A FAIR GO – A Transport Reality or Impossible Dream?

2004 AITPM National Conference
Adelaide 4–6 August 2004

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CONFERENCE: Thursday 5 – Friday 6 August 2004

conference papers
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

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Foreword

On behalf of the AITPM South Australian Branch Committee we welcome you to the 23rd AITPM National Conference to be held at the Adelaide Convention Centre between the 4-6 August 2004.

This year’s conference, A FAIR GO – a transport reality or impossible dream? is of relevance to all levels of government, traffic and transport practitioners, transport planners, engineers and researchers, policy makers, social and urban planners and elected members involved in traffic and planning decisions at a strategic and local level. Our conference theme has been designed to develop the concept of what is considered ‘a fair go’ and then examine the cost and consider the implications of trying to provide a fair go to all. We expect some positive and practical outcomes which will provide strategic direction for our delegates and improve traffic and transport related conditions for the community.

The Conference Program includes the presentation of papers (and discussion) on a wide range of topics from authors who have taken the time to develop and share their ideas with colleagues at the conference. The Conference Organising Committee were most impressed with the very strong response to the Call for Papers with some 40 papers received from across Australia and overseas. Although the Conference initially required much less than that number, it was decided to present concurrent sessions, a new innovation for AITPM conferences, to enable as many authors as possible to present their work. We thank all authors that took the time to respond to our call and trust that their work will be rewarded at our conference.

Austroads has also joined with AITPM to present a workshop to develop ideas for the next generation of the Guide to Traffic Management. We look forward to an on-going relationship with Austroads in the future to assist in the development of the new resource material for practitioners.

The Conference is preceded with a workshop sponsored by the City of Unley dealing with consultation titled, Consultation – Nightmares or Dreams. The workshop is designed to give practitioners some tools and techniques when engaging the community by incorporating some social inclusion principles.

There is also a trade display included with the Conference featuring some of Australia’s leading traffic and transport suppliers, consultants and other organisations are also represented.

We would like to thank all of our sponsors for their support, which greatly assists AITPM to present the conference for the delegates.

The South Australian Conference Committee has worked untiringly over the past two years and we thank them for their dedication, commitment and professionalism throughout.

We hope that this years National Conference will be a slightly controversial, motivating and thought provoking event which will be the highlight of this years traffic and transport calendar. The Adelaide Convention Centre will provide a perfect backdrop in Adelaide – a big city with small town charm.

Therefore, we invite you to take every opportunity at the conference to participate in the discussions, challenge the ideas, network with your fellow traffic and planning colleagues and most importantly enjoy yourselves.

Nick Meredith
CONFERENCE CONVENOR

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NATIONAL PRESIDENT
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About the Institute

Traffic planning and management is an integrated activity involving traffic engineering, land-use planning, social science, economics and environmental matters associated with generation of traffic for the safe and efficient movement of people and goods. The Institute is an association of people practising in these fields. From its beginnings as a small group of practitioners in Sydney, the Institute is now a truly national organization, with Branches in NSW, South Australia, Queensland, Victoria and Western Australia.

The Institute’s mission is to promote the positive and productive aspects of traffic and transport planning and management, and to influence decisions in these matters for the benefit of the community, by representing the expertise of practitioners and the interests of its members. The Institute aims to advance traffic planning and management, to increase the knowledge of its members by encouraging free discussion, exchange of ideas and research in this field, and to provide a central point of reference for practitioners.

For admission as a Member of the Institute, an applicant must:

• hold formal academic qualifications associated with traffic planning or traffic management gained from a recognised tertiary institution, and be practising in the field of traffic planning or traffic management; or

• have had appropriate experience for a period of at least three years in the field of transport planning or traffic management, including research, gained through a recognised organization.

The Institute has more than 550 members, representing practitioners in federal and state government agencies, local governments, private practice and academic institutions. It has also attracted an impressive range of Corporate members and sponsors for its activities. These include state road and traffic authorities, automobile associations, government departments and private industry. Over the years membership of the Institute has been seen by many employers as a prerequisite for employment in traffic planning and management. Enquiries about the Institute and its activities, including National Conference arrangements, may be directed to:

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Session 1

A Fair Go – at what price?
Keynote address – Thinking fair public spaces

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Thinking Fair Public Spaces

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ABSTRACT

This presentation examines the assumptions which underpin the production of public spaces in our cities. Drawing upon a range of audio-visual and written evidence, we argue that assumptions surrounding public space, mobility and automobile desire are primary reasons for the creation of unfair and unsustainable public spaces. Accordingly, these assumptions need to be re-thought in order to meet the gamut of sustainability objectives and to ensure a ‘fair go’ for all citizens in public spaces. The presentation concludes with a number of possibilities that arise when notions of public space, travel/mobility and automobile desire are re-thought in ways that prioritise respectful social relations, ecological sustainability and health.

Dr Jennifer Bonham & Dr Donna Ferretti currently teach urban & regional planning at the University of South Australia. Electronic copies of their keynote presentation will be available from the conference organisers.
A transport plan – what the punter is entitled to

MS SHARON HANLON

RAA
A transport plan – what the punter is entitled to

SHARON HANLON
General Manager Public Affairs
Royal Automobile Association (RAA) of South Australia Inc

In submitting an abstract for the consideration of the conference organizers, it was intended that this paper would explore the entitlements of roadusers, all roadusers, when setting out to develop a State-based strategic transport plan – and to assess the efforts of our transport planners and policy makers to develop a visionary and achievable plan for South Australia.

Unfortunately, the South Australian Government’s failure to publish anything beyond a draft transport plan, and this some fourteen months ago, means I have little to discuss in terms of the latter part of my topic. So I will focus on what the RAA believes roadusers can legitimately expect policy-makers to provide for on their behalf.

Some of you may be surprised to learn that I’m not about to rattle off a wish-list built around the dominance of the motor vehicle, but I will be calling on planners and policy-makers to undergo certain reality checks to ensure their decisions are made with their feet firmly planted on the ground and their heads out of … the clouds. To do otherwise would almost certainly result in a set of theory-based policies that ignore the fact that, in order for South Australia to thrive commercially and economically, a set of practical policies in tune with the significant demands placed on our transport system is needed.

Certainly, there is room to be innovative and to challenge traditional ways. Indeed, it is to be encouraged. But this must be tempered with reality.

What then is this reality? For a start, our State’s road network plays a pivotal role in the transportation of people and goods. So it makes profoundly good economic sense to maximize the efficiency of this network. Any strategic transport plan that ignores this reality in favour of solutions that cater primarily for alternative modes of transport would be flawed.

But even more fundamental is the reality that the motor vehicle is the preferred mode of choice for the majority of road users. This is not to say that the dominance of the motor vehicle should be allowed to grow unfettered. However, there must be a recognition of the legitimacy of this mode and policies must be developed around this perfectly natural form of travel demand.

Roadusers have every right to expect the road network to deliver a level of service that offers efficient, effective and safe travel. And often this is the case – good road networks are put in place to cater for existing and some level of projected travel demand, supplemented with alternative modes of transport performing vital supporting roles, and the system as a whole works quite well.
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But a failure to properly monitor the performance of the network and to make subtle changes as and when necessary to ensure satisfactory levels of service are maintained, results in a system incapable of being ‘patched up’ and, instead, requiring vast amounts of capital investment to once again provide a system capable of properly managing the transport task. And when this stage is reached, governments tend to put up the shutters saying they can’t afford the expenditure necessary to provide this infrastructure, and planners and policy-makers are forced to operate within these confines. Inevitably, the result is policies and plans that don’t address existing and projected travel demand, but that tend to focus on investments in alternative modes of transport – even though the modal switch encouraged by such investment is highly unlikely to be sufficient to significantly ease the burden on the overall road network.

Governments need to view investment in road infrastructure from the perspective that highly positive net returns will result. They need to have the courage to develop transport plans incorporating infrastructure investment that will pay off in the long term … even if the short term political impact is not all that palatable.

It’s also not acceptable for governments to hide behind the claim that communities are opposed to the construction of new roads and the widening of existing roads. This is an excuse trotted out all too often for keeping the chequebook closed and is just not acceptable. During the stakeholder consultation phase preceding the production of South Australia’s draft transport plan, the RAA and others greeted just such claims with scepticism, yet no evidence to support the claim was produced then or since.

Yet these claims are the basis for the government all but ignoring the need to address South Australia’s road network deficiencies, while advocating a two-fold increase in public transport patronage, cycling and walking. To suggest public transport as a panacea for metropolitan congestion is a fallacious argument. Eighty percent (80%) of public transport in Adelaide already operates on the road network and this figure must rise in order to realise the doubling of patronage that is mooted. Clearly, this will only contribute to an exacerbation of the road network’s deterioration and, as such, these claims cannot go unchallenged.

Almost 80% of trips in South Australia are by car, and the government admits that many of our arterial roads are already at or near capacity. Road users have every right to expect investment in measures that address demand on the network and deserve better than to be told by government that such investment is neither affordable nor acceptable to the community.

The results from the 2003 National Study of Motorists’ Priorities and Attitudes, conducted by ANOP on behalf of the RAA and its counterparts, paints a very clear picture as to South Australians’ views, thoughts and concerns when it comes to motoring issues.

9 out of 10 South Australians attach a very high degree of personal importance to their cars. 2 out of 3 South Australians using their car every day, with growth in car use primarily attributed to more frequent, shorter trips being undertaken by outer-urban parents with young children. Try telling these people we’d all be better off if only they would ride a bike or catch the bus or walk … particularly, when 5 out of 10 South Australian’s consider the standard of local roads and streets to be below par.
It’s not unreasonable for roadusers to expect governments to do something about a road network that has, quite simply, reached its use-by date. By the government’s own admission, this is exactly what has happened in South Australia. RAA travel-time surveys conducted on the metropolitan road network since 1987 clearly show the deteriorating and unacceptable level of service offered by the network.

For this very reason, the development of a Road System Management Strategy, as foreshadowed in the draft transport plan, is absolutely critical. The RAA considers this strategy should form the cornerstone of South Australia’s transport plan and should contain enough detail, including funding and implementation specifics, to demonstrate the ability to provide sufficient network capacity to efficiently manage travel demand. Everything else – improved public transport, cycling and walking facilities – is complementary, not pivotal. Yes, public transport must be efficient to allow and encourage people to make modal choices away from the private car where convenient and practical. And, yes, public transport must also be better integrated with urban development.

But, again, the RAA would argue that, in order to respond to rising congestion levels on the network, a balanced perspective must prevail. Very large investments in public transport and other non-car modes will not make a huge difference to congestion levels. The mathematics just doesn’t add up – not with nearly 80% of trips are by car and just 4.6% of trips by public transport.

So motorists are entitled to query this key objective of doubling public transport patronage.

Recent developments in Brisbane are worth reflecting on here, given this city has been held up on occasion as operating a public transport model worth emulating. Brisbane City Council’s newly-elected mayor ran on a campaign platform where he promised to remove bus only lanes and downgrade the full time tidal bus system that Brisbane has been operating because of the gross under-utilisation of these facilities.

The RAA considers it is far from unreasonable to demand policies that address existing network deficiencies in the first instance, because enhanced social inclusion, decreased congestion and improved environmental outcomes, will all follow.

It is also appropriate to query whether a modal shift to public transport is the most effective way to achieve desired environmental outcomes. Doubling Adelaide’s daily public transport trips from the current level of 200,000 per day to 400,000 trips per day does not mean there will be 100,000 less vehicles on Adelaide roads every day, so there are unlikely to be huge savings in congestion levels and air quality.

The RAA would argue that greater measurable environmental improvements can be achieved through strategies such as improved vehicle technology, fuel quality standards, random roadside motor vehicle inspections, harmonized traffic signal operations, and a more efficient road network.

Indeed, the national study I referred to earlier reports an overall lessening, right across Australia, in the community’s environmental consciousness, with 64% of respondents expressing concern about the impact of vehicles on the environment – down from 75% in 1999 and well down on the 81% reported in 1995.
When asked to identify realistic solutions for reducing the impact cars have on the environment, South Australians favour new technologies, new fuels and new types of cars, well above better public transport or encouraging people to drive less. Simply put, South Australians will accept different sorts of cars, driven by different technologies and fuels, but they will not accept being forced out of their cars.

The cost of providing public transport is high with only about 20% of the total cost of operating the Adelaide network recovered through fares.¹ While some level of subsidy is justified on the basis that public transport has lower environmental impacts, is safer, and it reduces pressure for road construction, the vast majority of public transport uses the road network, thereby increasing the road maintenance task. This must be avoided given South Australia’s current road maintenance backlog is already in excess of $160 million and was totally ignored by Treasury in this year’s State Budget.

This is also where RAA’s major concern lies in a rural sense – the overall safety of the network. There are many roads in our mid-North along with freight routes in the South-East that are simply not fit-for-purpose. They are too narrow, poorly aligned, have vegetation and other roadside hazards too close to the carriageway, offer insufficient overtaking lanes and lack sealed shoulders.

Governments are wrong to level the bulk of the blame for the degradation of the environment at motorists. Cars do contribute to environmental concerns and all reasonable means to limit this damage are warranted but, once again, a balanced response is required.

Industry is by far the greatest contributor to total emissions and, in terms of transport emissions, commercial vehicles are the most significant contributor – not passenger vehicles.

Passenger vehicles account for approximately 8% of total greenhouse gas emissions in South Australia while commercial and industrial transport accounts for another 10% and the remaining 72% comes from other sources, such as industry.

At present, light commercial vehicles perform just 2% of the freight task, yet account for 26% of freight’s greenhouse gas emissions. Given forecasts of a 50% increase in inter-city freight trips and a 50-100% increase in vehicle kilometres travelled by light commercial vehicles in major cities over the next 10-15 years, governments cannot focus on passenger vehicles alone if they are truly serious about reducing greenhouse gases and meeting environmental targets.

Similarly, drivers are justified in rejecting plans to levy tolls or other charging mechanisms to recoup costs imposed on government and the community. 7 out of 10 South Australians tell us they are opposed to toll roads because of the strongly held belief that they already pay sufficient taxes to build new major roads … and rightly so. South Australian drivers already more than pay their way – through registration and license fees, stamp duty, fuel excise … and, of course, GST.

The fact that the money collected from these taxes and charges is not directed to transport or road-related projects and programs, is not the fault of the road user.

¹ South Australia’s Draft Transport Plan (p.25)
That said, the RAA is not completely opposed to the concept of private investment in warranted projects, recouped through tolls, where financing by existing road funds would impact adversely on other priorities. We consider it vital, however, that, after allowing for the recovery of capital costs, any such asset should revert to public ownership and be free to users.

It’s true that South Australia’s infrastructure needs exceed the State’s available resources – but to exclude investment in road infrastructure in favour of investing in strategies like doubling public transport patronage, cycling and walking, is nothing less than fiscal mismanagement.

As highlighted by the SA Economic Development Board in its Framework for Economic Development document, adequate funds must be made available for infrastructure priorities, including transport, if South Australia is to prosper. Prudent borrowing, as a legitimate means of financing projects, must be a risk governments are prepared to take. The community – industry, businesses and individual citizens – are much more likely to regard this as responsible fiscal management than investment in the bit-roles played out by alternative transport modes.

One possible solution might be community-based financing arrangements, such as infrastructure bonds, to accelerate warranted road projects. Governments could commit to at least matching the funds raised by this method, and guarantee that these monies would be over and above normal funding levels, and be transparently administered.
To summarise …

Motorists have good reason to demand inclusion in any strategic transport plan an acknowledgement that the private car will continue to be the dominant mode of transport for the foreseeable future.

It is not acceptable for the architects of any transport plan to dismiss as ‘impracticable’, investment in road network infrastructure projects.

It is misleading to claim that the community is opposed to investment in new road projects and widening of existing roads to better manage travel demand.

Investment in public transport, cycling and walking, while warranted, has limitations and must not be sold as the panacea to solving problems on a congested road network, including environmental concerns.

Parts of Adelaide’s metropolitan road network have exceeded capacity or are very close to doing so. A transport plan that ignores this and, instead, favours investment in peripheral strategies is incomplete, unrealistic, and misleading – and its architects can rightly be accused of neglect.

South Australians deserve much better than what is currently on offer. They deserve a plan that is visionary, not one that has been constrained by government policy directing that serious investment in the road network is ‘off limits’.

South Australians expect responsible environmental management to be reflected in any transport plan, and would be accepting of policies aimed at maximizing efficiencies in alternative transport modes, particularly public transport … but they will not tolerate an approach that is not balanced with practical reality and constructed by bureaucrats intent on implementing solutions that fiddle around the edges and fail to address clear transport deficiencies.

Such is the current state of South Australia’s draft transport plan and one can only hope that commonsense and a splash of political bravery will prevail in the end in order that our State can stop floundering in a transport backwater, and reach the economic goals that will ensure a prosperous future for all.
Session 2

The price of a fair go?
Social Exclusion & Transport in SA – Moving Towards Sustainable Transport?

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KEYWORDS: SOCIAL EXCLUSION, TRANSPORT DISADVANTAGE, SUSTAINABLE TRANSPORT

ABSTRACT

The ‘vicious cycle’ of social disadvantage and poverty can lead to social exclusion, which is enhanced by -and itself enhances- transport disadvantage. There is wide international recognition that poor access to public and private transport can have a profound impact on people’s quality of life. This is especially the case for people from low socio-economic and remote areas as well as other groups in society that experience mobility constraints or some other form of disadvantage.

This paper attempts to shed light on the relationship between social exclusion and access to transport in South Australia. The first part defines relevant terms, draws on Australian Bureau of Statistics Data to outline current transportation trends and uses mapping of Socio-Economic Indexes for Areas to identify vulnerable groups and areas.

The next section explores measures, which support a move towards the vision of a sustainable transport system ensuring ‘a fair go’ for all South Australians. Finally, the paper highlights threats and opportunities for a socially, environmentally and economically sustainable transport future, thus identifying a range of policy options available to Government to achieve its social justice and transport objectives.

1 Introduction: Social Disadvantage – First Hand

“I go where I have to, not where I want to [because] petrol costs $1.22 a litre out here.” low-income person in rural area (SACOSS 2001).

“Occasionally I go to the pawnbrokers. I take my engagement ring and my dinner set, they give me $50 for them and then when I can I pay them $65 to get them back. I also pay them $11.50 per month to stop my things from getting sold.” low-income renter (Shelter SA survey 2003 quoted by SACOSS)

“It's pretty isolated [here]. Even services in [the next suburb] are fairly limited as well as far as shopping is concerned... There's no direct route and you have to get off at [the next suburb] to get anywhere else.” low income woman in metro region (SACOSS 2001)
“There’s no point in her being at school, it’s not like you can sit her down at night and read her books, with this stuff going on around us.” homeless family in a private hotel (SACOSS 2001)

2 Social Exclusion and Transport

Definitions of social inclusion or exclusion vary widely, most however include the concept of access to participation in life chances that are taken for granted by the majority of society (Murrey 1998; Kenyon, Lyons and Rafferty 2002).

Social exclusion refers to constraints that prevent people from participating (reasonably) in society, including education, employment, public services and (other) activities. Inadequate transport sometimes contributes to social exclusion, particularly for people who live in an automobile dependent community and are physically disabled, have low income or are unable to own and drive a personal automobile. (Litman 2003, p.1)

The concept of social exclusion in relation to transport is multi-dimensional; exclusion can be spatial (where distances can’t be overcome), temporal (where access is limited to certain time frames), fiscal (where access is too expensive) and personal (for people with specific mobility requirement such as the disabled) (Sinclair and Sinclair 2001).

Social exclusion can be regarded as a dynamic process, which varies in its extent with different stages of people’s life cycle, labour market conditions and societal attitudes towards marginalised groups. Acknowledging the constantly changing and multivariate nature of social exclusion is essential if it is to be tackled successfully.

Due to this interrelation of factors social exclusion can be a result of poor transport, as well as being reinforced by it (UK Cabinet Office, 2002). If a geographical area is lacking transport services (public or private), if communities suffer disproportionately from transport related pollution, noise, isolation or pedestrian deaths or if facilities are beyond people’s financial means, social exclusion results from inadequate transport. Reinforcement of social exclusion on the other hand occurs when an otherwise already deprived individual, group or community experiences additional difficulties in gaining a reasonable level of access and participation. Unavailable or inadequate transport can thus result in exclusion of certain groups from resources, services or social activities, which are considered to be a necessary requirement for social and economic wellbeing.

Inclusive transport systems on the other hand provide access for all groups to relevant products, services and activities, especially if they do so in a manner, which satisfies standards and expectations of users. It has thus been argued that socially inclusive transport has to be available, affordable, accessible and acceptable (Sinclair et al. 2001).

2.1 Social exclusion versus poverty

A socially inclusive society ideally provides all social groups with the means of maintaining a certain level of socio-economic wellbeing. The debate about how this minimum standard of living...
can be defined is not a new phenomenon and opinions vary greatly even when restricted to the field of social science. However, social exclusion is clearly a relational concept, which must be defined depending on the context of its social environment, relevant values and norms such as ideals of social justice. No single quantitative measure like income can be regarded as the fit-all solution for definition in different countries or even for different groups within the same country (Murrey 1998). The multi-faceted phenomenon of social exclusion can be experienced independently of poverty. While poverty is concerned with inadequate access to economic and material goods, social exclusion centres upon unequal access to participation in societal life. Poverty in general is about vertical distribution. People can move up or down. Poverty is about the disparities between rich and poor. Social Exclusion on the other hand is relational in terms of resource and power relationships. People are either in or out, are either part of societal life or lack access to participation. People thus can be socially, politically, economically or culturally excluded without being in poverty. Vice versa (even though it is the exception rather than the rule) people can be poor and still be socially included- they participate in general community life. This access to community participation, civic and political involvement is crucial for people to build up social capital – informal and formal social networks, resources and support structures that result in a sense of belonging, trust, reciprocity and tolerance of diversity (Office of Regional Development 2002; ABS 2000; Bullen 1999; Hine and Mitchell 2003).

3 Where are we at?

Australians in their vast majority rely on privately owned cars to get around. Statistics indicate that South Australians do so even more than their national counterparts (ABS 2003). We are among the highest per capita emitters of greenhouse gases in the world and have not yet been able to reduce emissions (Dept. of the Premier and Cabinet 2004). While the number of people using public transport in South Australia has increased by 6% between 2000 and 2002 after a decade of decline, private vehicle use and ownership are also steadily increasing (EPA 2003). Subsidies that encourage fossil fuel use in Australia amount to more than $5 billion annually (Riedy & Diesendorf 2003). To maintain our current lifestyle on a long-term basis we would need four planet earths (Rann 2004). This is clearly environmentally (and thus socially and economically) unsustainable (UNEP 2002).

According to the Australian Bureau of Statistics (2003) eighty-nine percent of South Australian households have a registered motor vehicle, which leaves 11% of households without a car. Seventy-Eight percent of South Australians travel to work or study by private motorized vehicle – 75% of them as driver and only 3% as passengers. 52% of South Australians stated that others did not require transport as the reason for not taking passengers. Ten percent of South Australians use public transport for travel to work and study, 83% never use public transport. The main reasons for taking public transport are cost (45%), parking problems (28%), not owning a motor vehicle (27%) and convenience/comfort/less stress (20%). Reasons for not taking public transport were with 68% related to inadequate service provision, while 34% gave reasons related to convenience and comfort of private vehicle use (ABS 2003).
The social costs of car-dependence in low-density settlements such as Adelaide are high. Air pollution causes respiratory problems such as asthma, lack of activity results in obesity and cardiovascular diseases, while the lack of mobility options leaves those without a private vehicle isolated, frustrated and disadvantaged (Girardet 2003).

3.1 Who is disadvantaged?

Accessibility to transport depends on its affordability, safety, availability, convenience and appropriateness. Lack of adequate access to transportation creates barriers to social, economic and civic engagement in activities, which are common to mainstream society. The socially excluded are subject to relative deprivation in comparison to other groups in society as they suffer inequality of access to social goods (Abercombe, Hill and Turner 1994). Thus the degree of social exclusion in a society can only emerge if a wider range of contributing factors is taken into consideration.

It is important to identify the diversity of people, who are affected by social exclusion. In terms of personal mobility and access to transport the children, youths and the aged, women, disabled people, ethnic minorities, non-English speaking people, single parents, home carers, the unemployed, the poor and those reliant on alternative transport modes are at risk of disadvantage (DETR 1999; England 1993; Hine et al. 2003; UK Social Exclusion Unit 2003). Financial problems can however have an equally restricting effect for car owners. In addition, single-car households may have unequal vehicle access for individual household members with women being particularly prone to have restricted mobility options when men need the car for commuting to work. Concerns about the safety of the public transport system at night, perceived unreliable service provision or the lack of knowledge about mobility options may also reduce mobility and hence access (Office for the Status of Women 2001).

Australians in the age group of 18-24 years and those aged 75+ are according to the Australian Bureau of Statistics ‘General Social Survey’ (2002) most likely to have difficulties gaining access to transport (children and teenagers are not represented in the survey). Especially prone to transport disadvantage are women, persons from jobless households, one-parent families and recent migrants (ABS 2004). It is important to acknowledge that statistics might underestimate the extent to which the very poor are disadvantaged; homeless people for example might not even make the records (ABS 2004). Problems are often inter-related causing multiple disadvantage. Many of the jobless households for example are also one-parent families. Single parent households also dominated the bottom quintile of the income distribution (for equalised gross household income) and are most likely to experience severe financial stress (ABS 2002).

Aboriginal and Torres Strait Islanders are among the most disadvantaged groups in contemporary Australia and thus deserve special consideration. 45.9% are in the lowest income quintile (Equalised Gross Household Income) compared with 22.4% of the non-Aboriginal population (Hugo 2003). The profile of disadvantage is multi-dimensional; road-death rates for Aboriginal people is for example estimated to be three times higher than for non-Aboriginal people (ATSB 2000). Life expectancies are nearly 20 years below that of the general Australian population. Infant mortality, which is a highly sensitive indicator of a population’s well-being, is despite strong declines over the last 50 years still twice that of the total population. These differences amount to
extreme inequality, which should be of major concern to all Australians and policy makers in particular. Low access to medical services is one of the main reasons for these disturbing statistics. Lack of facilities, cost of treatment and transport enhance the effects of poverty and inequality, leaving people discriminated against, helpless and powerless (Hugo 2003). Transport does not only play a significant role for the physical, but the cultural wellbeing of the Aboriginal population. The maintenance of extended kinship networks and connection to the homeland for ceremonial or spiritual activity are powerful aspects of Aboriginal culture (Pollack 2001). Policy makers need to understand the travel needs and patterns of disadvantaged groups; direct consultation at a local level is thus an integral part of working towards Social Inclusion.

3.2 Where is disadvantage concentrated?

3.2.1 Index for Relative Socio-Economic Disadvantage (ABS/SEIFA 2001)

The Index for Relative Socio-Economic Disadvantage, mapped in Figure 1, identifies areas with populations that have (among other attributes) high proportions of unemployment, low income, unskilled occupations, low educational attainment, no motor vehicle at dwelling, high proportions of Indigenous persons or single parent households (ABS 2003). While the index is too broad to justify specific purpose funding allocation, it should be used to ensure that funding is not systematically biased in its distribution against groups that are in particular need of services (ABS 2003). The quality of transport service provision should for example not be higher in socio-economically advantaged areas.

The process of spatial segregation of populations into social classes can be described as social polarisation (Badcock 1997). While the patterns of segregation are very distinct, one has to keep in mind that the indexes display an average of population characteristic. Socio-economically advantaged areas thus might well contain pockets of high disadvantage and vice versa.

The national average for the index is 1000. For Metropolitan Adelaide the index has the national average in the third quintile, which indicates that in general socio-economic conditions in Metropolitan Adelaide are similar to those of the whole nation. However, the national average for all South Australians is in the forth quintile, which reflects the comparative socio-economic disadvantage of South Australia as a whole (only Tasmania has a lower socio-economic profile (ABS 2001)) and regional, rural and remote areas in particular. The patterns of disadvantage are very clear and consistent across all four Socio-Economic Indexes (the other indexes reflect relative advantage, economic resources and educational and occupational attainment). The Statistical Local Areas of Whyalla (unincorporated), Peterborough and the Riverland (unincorporated) though sparsely populated are particularly disadvantaged as they are in the lowest quintile of several indexes. Poorer health outcomes and higher mortality rates in rural and remote areas further underline the vulnerability of regional populations (Strong, Trickett, Titulaer and Bhatia 1998).

In Central and South-Eastern areas of metropolitan Adelaide are clusters of high socio-economic advantage. Disadvantaged areas on the other hand are located distinctly separate in the North-West, West and outer North and South of Adelaide’s suburbs. This pattern of locational disadvantage has existed for quite some time and has been worsened in its experience for residents by relatively
poorer transport facilities, access to community services and employment (Sommerville 1996; Travers Morgan 1991).

![Maps showing socio-economic disadvantage in Adelaide](image)

**Figure 1: Index of Relative Socio-Economic Disadvantage (Adelaide Suburbs/ Statistical Local Areas)**

4 Where do we want to go?

4.1 Towards a sustainable transport system

The interdependence of ecological, economic and social dimensions is integral to the sustainability concept (Pepperdine 2000). Definitions however vary from a narrow focus on resource availability to the broad concept of social, economic and environmental sustainability, which can be defined as “societal well-being per unit of environmental impact” (Chambers 2002, p. 6).

Within a sustainable transport system the minimisation of negative impacts on the environment is as important an outcome as the facilitation of access for people and goods. The goal is to achieve this in an economically sensible way. Intra- and intergenerational equity are fundamental principles, which are currently being severely undermined (Rosenbaum 1992). A move towards sustainability thus requires substantial changes to the status quo and conventional ways of
conducting business (UNEP 2002). The measures listed below have long been acknowledged as necessary for the move towards sustainable transport (ITE 1986), but have been insufficiently implemented.

4.2 Making the right decisions

Sustainable transport means looking after the interests of future generations. Thus the real cost of car-dependency (which has not yet been passed on to drivers (Charles 2000)) must be considered using the underlying notion of value for money (efficiency) including the depletion of social and environmental resources. Decision making of government and the private sector in regards to transport investment must seriously consider all alternative options to road capacity extension (conventional and unconventional) and evaluate potential policies and projects vigorously using the triple bottom line (economic, social and environmental) for sustainability (Ecologically Sustainable Development Working Groups 1991).

Personal travel costs vary in their distribution according to different modes. Car use has higher user cost, lower provider cost and higher societal cost than public transport (AUSTROADS 1994). Social and environmental externalities are paid for by society, they affect quality of life and hit the poor the most. One could even extend this principle to the big picture: assuming the climate is changing as rapidly as professionals in the field of science suggest, marginalised groups will suffer disproportionately from the consequences as they have the least resources to adapt to changing conditions (WA Dept. of the Premier and Cabinet 2003). All increases in travel cost by car should be off-set by additional accessibility service provision targeted at those that inevitably will be affected most – the socio-economically disadvantaged (Santos and Rojey 2004).

4.3 Mobility Management

Travel Demand Management (TDM) or ‘Mobility Management’ (as it is now called in Europe) is the basis for future sustainable transport systems. Mobility Management refers to strategies that use carrots and sticks to increase transport system efficiency and provide real mobility options. Investment in and coordination of walking, cycling and public transport infrastructure, complemented by integrated land use and transport planning as well as initiatives targeted at changing travel behaviour (Perkins 2002), are tools that work most effectively when implemented as packages. Movement of people and goods is prioritised over movement of cars. Available transport space is integrated optimising mobility across all modes. There is a need for push and pull packages to be implemented, such as designating people movement corridors complemented by measures such as parking provision at the end/start of corridor and potentially road pricing for congested areas (Luk and Hepburn 1995; Transport for London 2004). Mobility Management recognises that reduction rather than expansion of road transport infrastructure can optimise transport system efficiency (Litman 2003).

Not only are Mobility Management strategies often the most cost effective solutions to transport challenges (when all externalities are accounted for), they can also have immense social and environmental benefits as they employ win-win solutions that increase quality of life outcomes. In
the context of transport disadvantage nearly all Mobility Management solutions aid the move towards a more inclusive transport system as mobility options increase for those reliant on alternative transport modes and regional solutions cater for particular local needs.

4.4 Intelligent Transport Systems (ITS)

Intelligent Transport Systems (ITS) use technological innovations to enhance access and mobility. Various human factors can be influenced by ITS, including safety and mobility of vulnerable or high crash risk transport users as well as ease of access to knowledge about relevant services (RACV 2001). ITS should specifically target disadvantaged groups using applications which enhance road user safety, ease of access to destinations and comfort. If information technology is used to deliver transport services, lack of access to the internet or limited computer literacy of certain groups has to be considered and offset by other means for services to be socially inclusive.

4.5 Public and Community Transport

Physical accessibility, availability and convenience are key aspects of sustainable public transport. Investment in high speed & capacity rail, tram or O-Bahn networks with a transit focus create the backbone to a reliable public transport system, while frequent and strategically located bus services provide for changing demand and flexibility (Newman, Kenworthy and Lyons 1989). This is not only true for urban centres - regional, rural and remote areas have an even greater need for increased mobility options due to the sheer distances that have to be overcome to get from A to B. Public transport routes that link regional centres are essential (NRMA/ACOSS 1995). The investment in and coordination of different forms of community transport into Integrated Passenger Networks is particularly valuable for basic access. Such Integrated Passenger Transport Systems make best use of existing community transport services and utilise the efforts of volunteers, which play a significant role in service provision, especially in regional areas.

Another important issue is the affordability of public transport services. Targeted concession for disadvantaged groups is crucial if the downward spirals of poverty and exclusion are to be broken. Strategies for fair access to public transport include integrated ticketing and temporary support schemes i.e. for job seekers or travel to educational facilities (Hodgson and Turner 2003).

4.6 Walking, Cycling and a reduced need for travel

The vast majority of people benefit from a walking and cycling friendly environment, particularly if it is designed to also accommodate people with mobility constraints. The ability to access crucial services and destinations without a personal car or public transport can make a significant difference as to how well people can participate in general community activity. While walking comes natural, it is not catered for to an extent that would reflect the status of a basic mobility option. Integration of land use and transport planning reduces the need to travel and thus breaks down barriers to walking and cycling while it prevents unnecessary increases in traffic volumes (Local Government and Planning Ministers Council 2003). Ease of regional and local access generates local business activity hence laying the foundation for sustainable local communities,
especially if access is based on people rather than vehicle movement (Westerman 2002). Safer streets and stations are critical for pedestrians and cyclists, measures such as street lighting, designated paths and crossing points as well as speed limit reductions help to increase real and perceived safety for vulnerable road users (Heart Foundation 1999). All new developments should strictly follow best practice guidelines for pedestrian infrastructure provision and design to create well connected, liveable neighbourhoods that encourage physical activity (Queensland Dept. of Transport 2000, WA Planning Commission 2000). Australia’s poorest people are also the most obese (ABS 2001), which highlights the need for investment in pedestrian and cycling provision for low socio-economic areas to increase recreational and incidental physical activity.

4.7 Consultation and Sense of Place

Community consultation is a vital process. To ensure local ownership of initiatives, bottom–up implementation should be considered as essential. Places and people have unique characteristics, which need to be catered for and reflected in flexible service provision, local amenity and public spaces in order to create a sense of place and community identity (WA Dept. of the Premier and Cabinet, 2003). Greater involvement of the public in decision-making is thus an essential step towards social sustainability (Newman, 2001). People need to be able to tell their story and find their own way forward. Socio-economic and cultural differences between stakeholders have to be considered to ensure their ability to participate in consultation processes (Transport SA, 1999). Respect for each other and the will to listen and learn from each other (across all spheres of community, business and government) is the key to innovative, holistic solutions that ensure a fair go for all.

5 Conclusion: Sustainability and the price of a fair go

The price of a fair go will be a change in our lifestyles and ways of solving problems to a more sustainable and efficient pattern, which results in maintaining, protecting and strengthening of the assets that will shape our future. Achieving these changes will not be easy. Sustainability is a big challenge - future generations might judge us on how we tackle it now. However, sustainability is not about the end of the world, it is about putting politics of hope on the agenda and consequently acting upon them. The clue is interventional investment in sustainable initiatives and win-win solutions –recognising the necessity of incremental change, making steps in the right direction, giving long-term outcomes priority over short-term gains, moving outside of our comfort zone, putting communal over individual interests and walking the talk in dollar terms.

In the transport context this means switching funding priorities from the automobile to greener modes, focusing on strategic outcomes through the integration of land use and transport on a regional and local level, excellent public transport services and best practice walking and cycling infrastructure to create an environment that encourages physical activity and community cohesion.

The goal should be an economically, socially and environmentaly supportive rather than dominating transport system (Westerman 2002), which gives all of us (and future generations) a fair go.
6 References


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TIS – A Statement of Fact or Fiction?

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ABSTRACT

A Traffic Impact Statement (TIS) documents the traffic impact on the surrounding transport infrastructure of a proposed development. It explores the number of car parking spaces required to support the development and predicts the impact of the traffic movements generated by the development and distributed onto the surrounding road network.

The prescribed parking demand and the traffic generation for a particular land use are evaluated using planning policies for the relevant authority, published guidelines or surveys of similar developments.

The planning policies are typically based on the published guidelines which are based on research undertaken in the 1980s and early 1990s. The question is: are these documents still relevant?

There have been some major changes in the last 10 to 25 years that have had a significant effect on actual car parking demand and traffic generation of developments including:

- Increasing trading hours
- Increasing car ownership
- Reducing public transport use
- Changes to seasonal variations
- Impact of Travel Demand Management

Do these changes effect the relevance of these technical guides for current and future developments? If we use these guides without making corrections for these and other changes will the resulting TIS be a sound technical document or a great piece of fiction?

This paper explores the potential changes on car parking demand and traffic generation from these and other changes that have occurred over the last 10 to 25 years and poses the question: what are we as traffic practitioners, who faithfully service the development industry, doing about it and is our response reasonable?
Introduction

This paper is concerned with Traffic Impact Statements for new developments or changes in use of a parcel of land rather than the impact of a new traffic control on the public road network.

This paper asks more questions than it answers. It’s purpose is to generate debate on the issue ultimately resulting in an improved understanding and the development of new resources.

The paper introduces the resources currently used in preparing Traffic Impact Statements and identifies problems with these resources. It also investigates some of the factors that may effect parking demand and traffic generation since the resources were developed. It concludes by proposing the framework for a model to update the current resources.

While the paper is targeted at practice in Australia, it is based on the South Australian experiences of the authors.

Traffic Impact Statements

A Traffic Impact Statement (TIS), analysis or study is an appraisal of the traffic and safety implications relating to a specific development. These statements typically address the following issues (RTA 1993):

- Existing proposed improvements on the adjacent road
- Impact on road safety
- Impact of traffic noise
- Traffic volumes on the surrounding road network, including growth trends
- Peak period traffic volumes and congestions levels at key affected or adjacent intersections
- Existing parking supply and demand in the vicinity of the development
- Existing public transport services
- Parking provisions appropriate to the proposed development
- Traffic generation and trip distribution of the proposed development
- Safety and efficiency of the internal road network
- Impact of the generated traffic on key adjacent intersections, streets and other nearby developments
- Safety and efficiency of access between the site and the adjacent road network
The planning and road authorities use the Traffic Impact Statement to determine if the proposed development is appropriate and its traffic impact can be accommodated within the existing road network.

Traffic Impact Statements are also prepared in support of new traffic control devices installed within the public road network, however this is not the focus of this paper.

This paper is concerned about determining the appropriate level of parking and forecasting the traffic generation for a particular development.

In South Australia, TIS’s are requested by planning authorities, when in their opinion the development is of a significant size, is likely to have a significant impact on the surrounding road network, or the parking provision is less than permitted in the Development Plan. The Development Plan is the expression of planning policy for each Council area used by the State and Local Government authority as the primary reference for making decisions on development applications.

Resources

To determine the amount of parking required to support a development, or the traffic generated by a development, there are a number of resources available to the Traffic Engineer. The following are the main documents used in South Australia:

- Guide to Traffic Generating Developments, Road Traffic Authority of New South Wales, 1994
- Land Use Traffic Generation Guidelines, Director General of Transports, South Australia, 1987
- Planning Bulletin: Parking provision for selected land uses (Suburban Metropolitan Adelaide), Planning SA, 2001
- Development Plans of various Councils.

The first thing that you will notice about the above list is that the first two documents are over 10 years old.

These guides and other resources available to a Traffic Engineer are explored further below.

Guide to Traffic Generating Development

This document is based on a number of individual reports for different land uses, 25 Data and Analysis reports to be exact. Each of these reports included detailed surveys of numerous locations in Regional Centres and Sub-Regional Centres of New South Wales. The results of the surveys were then statistically analysed and the strength of the model tested based on the resulting $R^2$ value for the regression coefficients that were derived.
The Data and Analysis reports that support this guide were undertaken between 1979 and 1993. Some of the most common land uses are among the oldest including:

- Offices, 1979
- Shopping Centres, 1980
- Fast Food, 1980

Therefore some of the guidelines that are relied on for many developments are based on data that is 25 years old.

**Land Use Traffic Generation Guidelines, Director General of Transport, South Australia**

The Director General of Transport commissioned a study in the mid 1980s to determine the traffic generation rates of different land uses in South Australia.

This guideline was based on a number of previous reports including a reasonable number of surveys undertaken in 1986, up to 12 per land use. In the words of the author even this number of surveys provided “so few points (that) a rigorous analysis was not possible”.

Although this report is dated before the release of the RTA guide it is more current because some of the surveys used are more recent. For example this guide is based on surveys in 1986 while the RTA guide uses some surveys that were undertaken in 1980, as discussed above.

It is interesting to note that this is the only guide that comments on the distribution of demand over the year.

**Planning Bulletin**

The Planning Bulletin: Parking provisions for selected land uses (Suburban Metropolitan Adelaide) is a resource prepared by Planning SA, South Australia’s State Government Planning Department. The research that this Planning Bulletin is based on includes:

- A review of literature
- A survey of South Australian Councils regarding the parking rates in their Development Plans and what type of parking rates they were approving
- A review of Traffic Impact Statements prepared in support of development applications whose car parking were below that detailed in the Development Plan, these typically included surveys of similar land uses
- A selected number of surveys were undertaken in 1999 of hotels/taverns with gaming facilities, medical centre/day surgery, consulting rooms and aged-care accommodation.
It is important to note that the limited number of surveys that were undertaken did not enable a statistically significant analysis to be undertaken.

**Surveys**

The Guidelines and controls in South Australia’s Development Plans are often considered by developers to be overly onerous and not inline with real market demand. To try and justify lower car parking rates or improve the understanding of the impact of a development these developers engage Traffic Engineers to prepare a Traffic Impact Statement that includes surveys of similar land uses.

Typically these surveys are undertaken at locations that are similar in nature to the proposed development. Unfortunately, there are rarely more than a few surveys undertaken and rarely for more than one or two days. While these rates are helpful in justifying reduced parking demand and quantifying current traffic generation rates they are rarely a statistically valid analysis.

**Influencing Factors**

So what are the factors that could effect the appropriateness of the resources discussed above? For this paper some of the more obvious factors that have easily accessible quantifiable information are discussed below.

**Changes to Business Hours**

The South Australian Department of Workplace Services have advised that:

- In 1980 general Metropolitan shopping hours were 9am to 5pm most weekdays, except Thursday which was till 9pm and open on Saturday between 9am and 12.30pm.
- In 1996 general Metropolitan shopping hours were 9am to 5pm most weekdays, except Thursday which was till 9pm and open on Saturday 9am to 5pm
- In 2004 general Metropolitan shopping hours are from 6am to 9pm most weekdays, and till 5pm Saturday and Sunday.

This clearly demonstrates that over the last 20 years there has be a huge change in retail business hours. So what is the likely impact? 20 years ago there were two opportunities for people that worked in an office to visit the shop, Thursday night and Saturday morning. Now this has increased to all day Saturday and Sunday as well as later into the night for many stores such as supermarkets. Given more choice, shoppers are less likely to shop during the busiest periods, therefore the peak demand for parking and traffic generated by particularly retail land uses is likely to have reduced significantly.

**Changes in Car Ownership**

In 1981 car ownership in South Australia was approximately 440 vehicles per 1,000 people. By
1991 this had increased to 490 vehicles per 1,000 people and 550 vehicles per 1,000 people by 2001 (Government of South Australia, 2003). This is an increase of about 25% over the last 20 years.

Increasing car ownership is a major factor in increasing the number of vehicle trips and therefore resulting in an increase in the traffic generated by land uses and parking demands for a land use.

**Public Transport Use**

In Adelaide, the number of public transport trips have gradually reduced, from approximately 110 boarding’s per capita in 1981, to 90 boarding’s per capita in 1991 and 60 boarding’s per capita in 2001 (Government of South Australia, 2003). This is a reduction of approximately 45%.

As discussed earlier this corresponds to an increase in car ownership, indicating that people are changing from using public transport to car based movements. Once again this leads to an increasing demand for parking and increasing traffic generated by particular land uses.

**Seasonality**

When reviewing the resource documents it is interesting to note that the Guide to Traffic Generating Development (RTA, 1993) has made adjustment for seasonal variations in demand for businesses. The Land Use Traffic Generation Guidelines (Director General of Transport, South Australia, 1987) recognises the potential effect of seasonal variations but does not make an adjustment for them. Do these changes in income/sales reflect a change to the parking demand and amount of traffic generated by a particular land use? This is difficult to answer as there is insufficient information however anecdotal evidence suggests that this income/sales fluctuations does reflect in the level of demand of parking and therefore traffic generation levels. Some of the changes in seasonal sales for a shopping centre include:

- A peak in December
- A trough in January equal to 52% of the December peak.

While there are clearly variations throughout the year, these are poorly identified and raise an important question: what level of car parking and traffic generation should a new land use need to consider? The Planning Bulletin: Parking provisions for selected land uses (Suburban Metropolitan Adelaide) (Planning SA, 2001) suggests that a new development should consider the 85th percentile occurrence, the level of activity that is not expected to be exceeded by more than 54 days in a year. In contrast, some traffic engineers have suggested a higher level, such as the supply of parking may be exceeded no more than 10 days in a year. Depending on what occurrence interval is used, there will be an impact on the level of parking required and the estimate of the traffic generated by a development. Again this does not appear to have been well documented or researched and therefore its impact is unknown. Although intuitively the higher the occurrence interval that must be accommodated, the higher the parking demand and amount of traffic generated by a development.
Travel Demand Management

State Government have programs aimed at reducing the demand for travel and particularly car based travel. In Western Australia and South Australia, these programs are known as TravelSmart and use a number of different tools including Travel Blending and IndiMark. In South Australia, the State Government has confirmed their desire to continue travel demand management through their Draft South Australian Transport Plan.

The tools arguably decrease the demand for car based travel by 10% (Roth, 2003). If this reduction is achieved it is likely that the demand for parking and the traffic generation from a land use will be reduced by a similar factor.

There is general agreement that demand will be induced by increasing the capacity of the transport network. If the capacity of the network is reduced there will be a reduction in demand as people choose other modes, other ways to undertake the desired activity or do not undertake an activity. Therefore by providing large amounts of car parking, the demand for parking will be increased which is contrary to the State Government’s policy to reduce the amount of car travel. This raises another question: should future research consider setting maximum limits as well as minimum limits of car parking provision?

Geographical Differences

Another issue is the application of guidelines developed in one City to another City. As discussed previously the two most widely used documents in South Australia were developed using data from New South Wales and Adelaide. Before a traffic engineer can use guidelines from another City they need to have an understanding of the impacts on the differences between the locations. These factors include:

- Demographics and socio-economic structure
- Business hours
- Car ownership
- Public transport systems
- Household size
- Household densities

Based on these differences, the question needs to be asked about whether there should be statistically relevant research into parking demand and traffic generation for each major City.

Other Influencing Factors

The factors discussed above are only a limited selection of the factors that may have an effect on parking demand and the traffic generation for different land uses. Some other factors that could be considered are:
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- The level of consumer spending: are people spending more on consumables and therefore making more trips related to shopping? Are people buying the same amount but in smaller quantities requiring more frequent trips?
- Reducing household size; has the number of trips reduced with the reduction in household sizes?

The Problem

So is there a problem? It is clear from the brief analysis of the general resources used that:

- Many of the surveys on which Traffic Impact Statements are based are over 10 years old, and some of the most commonly used are 25 years old.
- These guides are often not based on statistically rigorous processes, often relying on anecdotal evidence or a limited number of surveys.
- Only one guide makes any attempt to discuss variations over times of the year, one of the most critical considerations for adjusting one-off surveys.

So the guidelines are old and not based on statically rigorous analysis. Does this really matter? Are they not still considered by most planning Authorities, Traffic Engineers and Developers to be adequate? Perhaps the answer is best summed up by the Director General of Transport, South Australia in the preface of his guideline that “care should be taken in applying them (the traffic generation rates) after 1990” (Director General of Transport, South Australia, 1987).

The review of the changes in some socioeconomic and transport factors clearly demonstrates that there have been major changes over the last 10 to 25 years. The interaction between these factors is complex and it is therefore very difficult to make adjustments to 25 year old data to reflect these changes.

There is clearly a problem: the use of the existing data is highly questionable and in dire need of updating. Although the only option for current practitioners, there is a desperate need for more statistically significant research. But undertaking new research to provide updated guidelines now is not enough. Clearly over time there will be more changes in society that will continue to change the demand for parking and level of traffic generated by a land use requiring any new resource to be continually updated.

Key Stakeholders

The above analysis shows that the current resources used to support the parking demand and traffic generation need to be updated, but who should undertake this review? This next section of the paper focuses on who are the key stakeholders in developing reliable resources and what are their responsibilities with relation to providing this data?
State Government

Each State has its own Government Departments focused on providing Planning and Transport related infrastructure and policy frameworks. In South Australia it is the Department of Transport and Urban Planning and their agencies, Planning SA and Transport SA. In South Australia, these Government Departments provide policy frameworks and approve the Development Plans for each Local Government Authority (Council). These departments have also in the past funded the development of resources such as the Land Use Traffic Generation Guidelines, 1987 and the Planning Bulletin: Parking provisions for selected land uses (Suburban Metropolitan Adelaide) 2001.

Local Governments and Local Government Associations

Local Governments (Councils) are responsible for the approval of the majority of developments, either new buildings or changes in land uses. Therefore the Council and its officers rely heavily on resources available to ensure that orderly development occurs.

The Councils also fund the updating of their relevant development regulations, Development Plans in South Australia, which indicate the car parking requirements for different land uses. Therefore Councils are responsible for providing one of the guidelines on car parking demand that are relied on by traffic engineers, developers and Council officers.

If Councils inappropriately approve a development the impact is most likely to surface within the street network under their care and control. This includes increased demand for on-street parking or traffic congestion requiring the upgrading of roads or intersections. Given that Councils are the grass roots level of Government, they are under the most pressure to ensure that development does not unduly impact on local residents and business owners. Issues that impact on all Councils are often investigated by the Local Government Association.

Developers

Developers are the group of people that change land uses or build new developments. They are required to operate within the development controls/regulations of the Local and State Governments. If they would like to undertake a development that is not in accordance with these controls/regulations they must provide evidence that its impacts are not unreasonable or are balanced by other factors that exceed the requirement of the development controls/regulations.

Developers are market driven, while this means that they are interested in building the smallest amount of car parking possible and providing the least amount of transport infrastructure possible, they must also create a development that meets the demand of their market. Often developers are identifying that their market demand, particularly for car parking is lower than that presented in many of the resources previously discussed.

Being market driven a developer’s goals may also not be aligned with the local communities, which are represented by the local Council.
Universities

One of the major functions of Universities in Australia is as centres for research. Many of the Universities have departments or centres who specialise in research into transport related issues. In South Australia this includes the Transport System Centre of the University of South Australia.

Given that the Universities have a high concentration of academics from a broad spectrum of disciplines they are also well aligned to undertake detailed and statically relevant research.

However as academic groups, these Universities may not have any practical experience in assessing traffic generation or parking demand for selected land uses. This may be an advantage as they do not have any preconceived ideas or opinions that they must support, as well as a disadvantage as they are not aware of the complications associated with determining traffic generation rates and parking demand.

It has also been suggested that this type of research, into developing guidelines for existing practice, is not aligned with what is usually undertaken by Universities, research into emerging issues.

Universities rarely have the funds to independently undertake research, they therefore require external funding to undertake research into topics such as parking demand and traffic generation.

Professional Associations

Interested professional associations are many, however there are three most obvious for this topic, specifically the Australian Institute of Traffic Planning and Management (AITPM), Engineers Australia and the Planning Institute of Australia (PIA). These bodies represent the professionals involved in assessment of development applications including government departments, Councils, Traffic Engineers and Planners.

These professional associations have a significant role in providing resources for their members. These resources currently include conferences, newsletters, exchange of information and to a limited extent development and publication of guidelines.

Consultants

Consultants, particularly consulting Traffic Engineers recognise that the existing resources are inadequate and do their best within the financial controls of their clients to undertake as thorough an investigation as possible when preparing a Traffic Impact Statements.

Most traffic engineering consultancies are probably unable to fund research of this magnitude. However their skills and expertise for undertaking research are high, as evident by the Land Use Traffic Generation Guidelines, 1986 and the Planning Bulletin: Parking provisions for selected land uses (Suburban Metropolitan Adelaide), 2001 being undertaken by consultants.
Suggested Model

Following some discussion with colleagues, the following framework is proposed to ensure that up to date and statistically relevant resources are available now and are regularly updated. This is a suggested framework aimed at stimulating debate rather than the only way forward.

Funding

There are three key stakeholders who could potentially fund this research, they are:

- The State Government
- The Local Government Association
- Developer groups, such as the Property Council of Australia.

Rather than seeking funds from one of these key stakeholders it is suggested that they all fund the research in partnership.

It is important that any research project that affects such a broad range of stakeholders has guidance and input from all key stakeholders. It is therefore suggested that there would need to be input into the process from other stakeholder groups such as professional associations including AITPM and PIA.

Research Group

There are two schools of thought regarding how the research should be undertaken. The first is that Universities and Consultants should have to tender for the available funds. The Second is that the funding should be directly allocated to a University or Professional Association to undertake the research.

The authors of this paper are proposing that the research be undertaken by directly allocating the funds to a group, potentially the AITPM who would directly employ a person to undertake this research. If the AITPM were the authors of this research they are likely to monitor changes in society and ensuring that the research is updated when necessary.

Conclusion

This paper has put forward a strong case that the resources used to develop a Traffic Impact Statement for development or change in Land Use are unlikely to be reliable, although the best information currently at hand.

Specifically the resources that are used are 10 to 25 years old, and some are not based on a statistically rigorous methodology. Most do not consider fluctuations in the time of the year when research was undertaken.

The age of the resources generally available are compounded by the significant social and transport
changes that have occurred over the last 10 to 25 years including increased shopping hours and increased car ownership.

The key stakeholders who have an interest in ensuring that the resources used in developing Traffic Impact Statements are accurate include:

- State Governments;
- Local Governments and Local Government Associations;
- Developers; and
- Professional Associations such as AITPM and PIA.

Having identified the key stakeholders and that there is an issue with the accuracy of the existing resources, the following framework is proposed for discussion:

- Joint funding of the research by the State Government, Local Government Association and Developer Groups;
- A reference group that includes representatives from all the key stakeholder groups; and that the
- Research is undertaken by a professional association such as AITPM.

The most important requirement of this research is that the research is statistically rigorous which will require a large number of parking and traffic generation surveys and a review of how the parking demand and traffic generation changes throughout the year.

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Session 3A

The human element – making allowances
What traffic managers are missing from traditional engineering approaches to road safety

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What traffic managers are missing from traditional engineering approaches to road safety

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KEYWORDS: Accident, Crash, In-Depth Investigation, Research, Vision Zero

ABSTRACT

The Centre for Automotive Safety Research at the University of Adelaide has been conducting indepth crash investigation over three decades. The studies conducted over this period involve scrambling an investigation team to attend crashes when notified via the ambulance radio. Measurements are taken at the crash scene relating to the people, vehicles and site conditions involved. This data may then be used to create a reconstruction of the crash and to better inform agencies about the true causes of crashes.

Current engineering practices place much emphasis on the crash history of specific sites and the use of crash databases gathered by the police. However, such data often does not reveal much about an individual crash and is only useful when patterns of crashes emerge. The key perspective that is often missing in road safety management is that of the road user themselves.

This paper presents some cases from in-depth crash research performed in South Australia. The paper is written from an engineering perspective and highlights the way in which we have come to accept common road safety problems. The benefits of this type of research for State and Local Government Authorities are highlighted through the use of some poignant examples.

1 Introduction

As engineers and road managers we tend to think that we know a lot about how roads should be used. The reality is that people are being killed and injured on our roads due to predicable mistakes or common conditions. In the past, we have had a very strong culture of ‘victim blaming’ whereby somebody was considered at fault with a crash and the quality of the road ‘system’ was rarely challenged strongly. This is evident, for example, when we ‘blame’ people for inattention or failing to give way.
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

In actual fact, many of the mistakes that people make are predictable and so too is much of their erroneous and “irrational” behaviour. If we were to start out today to design a safe system for transportation, it is unlikely that we would end up with the type of vehicles or infrastructure that we have inherited today. We would design a system which took into account human fallacies; a parallel is often made to aviation where a safety ethic is uncompromising and ergonomics is immensely important. This seems to have been de-emphasised with road safety.

The Swedish came up with a concept called ‘Vision Zero’. Many people misinterpreted this to mean an approach to achieve zero deaths or injuries on the road. The concept actually represented a paradigm shift whereby authorities would move away from victim blaming and start modifying their infrastructure to take account of predictable human behaviour (Tingvall and Haworth, 1999).

This paper discusses the use of crash scene visits to conduct research into the causes of road crashes from the perspective of the road user - it is this perspective that is often lost when managing road systems.

2 Crash Investigation

The Centre for Automotive Safety Research and its former incarnation, the Road Accident Research Unit at the University of Adelaide, has been attending crash scenes and collecting valuable data for over three decades. Why do we do this? There is considerable data available for road safety research from the Police, the hospitals, insurance agencies and the road authorities but in many ways the data has significant deficiencies. By visiting the crash scene, valuable information can be gathered leading to more accurate conclusions on the likely causes of the crash. Such data can be much more meaningful than using police crash reports which are designed for a different purpose. Many more details are collected in relation to the crash and the contributing factors of the crash. A good example of this is the recording of where vehicle occupants were seated during impact or if the airbag in an airbag equipped car did not go off.

It should be noted that a similar study, called the Australian National Crash In-depth Study (ANCIS), has been conducted in New South Wales and Victoria since 2000 (Fildes et al 2003). The study is based on retrospective investigation of the crash but unlike the CASR investigations, the crash scene is not visited at the time of the crash. At the time of writing, ANCIS had 180 cases.

CASR has crash investigation teams made up of engineers, psychologists and sometimes doctors who scramble to a crash scene once hearing about the event on the emergency services radio. The sequence of events for any crash case is as follows:

1. Notification by the Ambulance Service Radio
2. Attend crash at scene
3. Photograph and map the scene
4. Photograph and measure vehicles
5. Obtain injury details from hospitals
6. Interview participants and witnesses
7. Investigate crash histories of drivers and locations

8. Reconstruct the crashes

Following the crash, an engineering survey is made of the site noting road geometry, the location of roadside furniture and any other relevant information such as the location roadside hazards. The final resting position of the crash involved vehicles is recorded as are any known impact points with other objects.

Personal interviews are conducted with those involved with the crash or those who witness the crash. These are extremely important for setting the context of the crash and obtaining a clearer picture of sequence of events leading to impact. Data sought during these interviews includes:

- Personal details
- Demographics
- Driving, offence and crash history
- Crash and vehicle details
- Trip details
- Possible distractions
- Usual and crash alcohol and drug use
- Emotional and fatigue factors
- Pre-existing medical and physical disabilities
- Perception of the crash and its causes
- Immediate injuries and resultant disabilities

A review is conducted of each case by a group of CASR experts where all the collected data is reviewed and the likely causes of the crash determined. Where data is sufficiently robust, the crash can be reconstructed using computer simulation.

Indepth crash investigation is a very costly and resource hungry exercise and approximately 100 cases are collected per year. The accumulated database can be used for numerous road safety studies with a level of detail otherwise unavailable. For example, CASR is leading international efforts in the development of a pedestrian crash computer simulation model with considerable input from in-depth crash data. CASR is also in the process of establishing working groups with the state road authority to discuss road safety issues which arise as a result of the research. It would be nice to think that such an exercise could be developed with Local Government Authorities into the future as well.

What follows is a discussion of cases to emphasise certain points about crashes. The many different contributing factors and different crash types makes a thorough discussion of the database impossible for a single conference paper but it is hoped that the following cases provide some perspective for practitioners who occasionally deal with road safety issues.
3 Example One – Filter Right Turns

The practice of filter right turns at signalised intersections is usually employed to ensure junction efficiency especially when through volumes are high. It is well known that right turn crashes in such circumstances feature strongly in crash databases. There have been attempts to make motorists aware of this danger by using flashing yellow arrows or LED signs (as provided for in the Australian Road Rules).

In the case presented here, a driver made a right filter turn into the path of an oncoming truck. The car was struck at right angles by the truck and shunted into a traffic signal pole with the car being completely destroyed in the process (See Figure 1). It was only by the good fortune of vehicle alignment that the traffic signal pole did not strike the car further back and the driver escaped with minor cuts and bruising. Consequent interviews with the driver revealed that some emotional stress fatigue may have been a major factor in the crash.

![Figure 1 - End result of a filter right turn crash](image)

From an engineering perspective, we have come to convince ourselves that there is nothing wrong with the junction. It conforms to all current standards, there are adequate signals in a suitable
configuration, slip lanes have been provided for turning vehicles and there is good vision to oncoming traffic. In this case, the driver is viewed as being at fault for not giving way to oncoming traffic and in any case was fatigued so the intersection was not at fault.

Systematically across the whole network, however, there are large numbers of drivers making similar mistakes at junctions which meet our engineering standards. The provision of a green turn arrow is known to significantly reduce right turn crashes by up to 80% (Bui, Cammeron and Foong, 1991), yet the filter right turn is still used extensively on the policy of network efficiency and the assumption that enough people act rationally most of the time.

A recent review of crashes at signalised intersections in Adelaide revealed (Kloeden et al 2004) that casualty crashes:

- average around 390 casualty crashes per year
- account for 5.2% of casualty crashes in South Australia
- account for 6.7% of casualty crashes in Adelaide
- account for 26.9% of casualty crashes at Adelaide signalised intersections
- are mostly judged by the Police to be due to the right turning vehicle failing to stand (91.3%)

These figures are not, by any stretch of the imagination, insubstantial. Large reductions in crashes would follow if dedicated right turn phases were used on a permanent basis at all intersections. This is backed up by others, such as Taylor (1991), who has concluded that the efficiency trade off should be towards greater safety:

“[At] off-peak the differences in mobility performance between alternative right turn control regimes are small, suggesting that the considerable safety benefits found for full control should be of primary concern. At peak periods, partial control may offer mobility advantages, but at all other times the gains from partial control instead of full control are not significant” (p. iii).

4 Example Two - Pedestrians

One thing is certain when we study the road system that we have inherited – pedestrians were never meant to interact with it. During 2002 in Australia, 249 pedestrians were killed on our road networks (see Table 1). In 2002 in South Australia, although 18 pedestrians were killed, a further 120 were admitted to hospital, 278 treated for their injuries and 117 had to visit their doctor.

<p>| Table 1 - National Pedestrian Fatalities by State for 2002 |
|-----------------|------|-----|---|---|---|---|---|---|---|</p>
<table>
<thead>
<tr>
<th>State</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>NT</th>
<th>ACT</th>
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<td>18</td>
<td>24</td>
<td>6</td>
<td>11</td>
<td>1</td>
<td>249</td>
</tr>
</tbody>
</table>
Recent moves to the 50 km/h speed limit will provide a significant benefit to vulnerable road users however this is not nearly enough to ensure a safe and equitable road system. McLean et al (1994) showed that the chances of a pedestrian being killed when struck by a vehicle increased dramatically for impact speeds above 40 km/h.

![Figure 2 - Relationship between likelihood of death for adult pedestrians and impact speed (McLean et al 1994)](image)

A pedestrian hit at an impact speed of 60 km/h faces almost certain death, at 50 km/h an 82% likelihood of death and at 40 km/h a 20% chance. Many may think that if travelling at a specific speed they will react, apply the brakes and the impact speed will be reduced significantly. In the many cases we see, the driver never had a chance to apply their brakes. Even if the brakes had been applied, vehicles slow down most in the final stages of braking (i.e., distance travelled) instead of the initial stages. We also see many cases in which the driver initially sees the pedestrian crossing the road but misinterprets their intentions and a collision results.

In the following case, a four year old child ran into the path of a vehicle and was initially thrown forward and then struck again and dragged under the vehicle. The crash occurred on a 50km/h residential street presumably with a low traffic volume and with good footpaths on both sides. The crash occurred in daylight in dry conditions. Again from an engineering perspective there would seem nothing wrong with the street.

Prior to the crash, a mother and her child were standing on a neighbour’s driveway. The mother was having an argument with the neighbour and the child became distressed and tried to run across the street to join his siblings. The child was not killed on site but suffered severe head injuries and was not given much chance of surviving the night in hospital.
In the next case, a teenage girl was crossing an arterial road to get to a bus stop. The road consisted of two lanes in each direction with a 2.5m median. There was a slight downhill gradient on a gentle right hand bend in a 60 km/h zone. There was good line of sight and the driver actually saw the pedestrian when approaching in the right hand lane. The driver assumed that the pedestrian would stop in the left lane to let him past. The pedestrian did not stop but looking in the other direction accelerated into the path of the oncoming vehicle which swerved to the left unable to avoid striking the pedestrian.
From an engineering perspective, there was good visibility to the driver and pedestrian and a central wide median should have made things easier for the pedestrian (albeit with a right turn slip lane on the opposite side of the road).

We protect road workers with 25 km/h speed limits; school areas with 25 km/h (in SA) and 40 km/h limits in other states. However we seem happy to allow pedestrians to interact with vehicles travelling at 60 km/h on our arterial roads (and in many cases roads with even higher speed limits). Where warranted, we erect pedestrian crossings and shelters in the middle of the road; these are not safer in absolute terms, however, and crash cushions would be more desirable (see Figure 5). These two crashes highlight the importance of vehicle travelling speeds in seemingly “safe” and predictable environments. Again we assume rational behaviour and our solutions to do not cater well for mistakes or misjudgements that people make. In addition, our many investigations have revealed the importance of placing bus stops and pedestrian facilities carefully. Cluttered footpaths not allowing pedestrian progress is also particularly undesirable yet exists.

5  Example Three – Roadside Hazards

We have become accustomed to passing objects at high speeds. Our rural roads allow us to pass at times within half a metre of trees at speeds of up to 110 km/h. In the urban environment, utility poles frequently touch the kerb on major and minor roads. When crossing the road, pedestrians
pass within centimetres of cars. In pure transfer of energy terms, Figure 6 is a good analogy of the environment that we are actually in (Tingvall pers comm.).

![Figure 6 - Analogy of our road environment in terms of energy transfer](image)

In the following case (see Figure 7), a mini-skip truck driver had to take evasive action when a vehicle pulled in front of him. He consequently swerved, braked heavily and ran into a large utility pole by the side of the road. The truck and its bull bar came off second best and the left passenger was trapped in the cabin by his legs. In many other cases, vehicles hit unprotected roadside objects as a result of deflection from an earlier collision.

Again from an engineering perspective, we have come to accept the presence of utility poles near the road. We claim that the cost of putting the services underground is too high and have become accustomed to the dangers which exist. Despite this, we see many crashes as a result of the mistakes of others such as changing lanes or misjudging gaps at uncontrolled junctions. Just in our own daily driving experience we always seem to get “that idiot” who does silly things – yet we have a road environment that does not protect us from these “inevitable” situations.
4 Example Four – Interface between residential and major roads

The bulk of crashes in local government areas occur at the interface between residential streets and arterial roads. Again we have come to tolerate these as from an engineering perspective there appears to be little wrong with the junctions, especially if treated with a give way or stop sign. Intuitively, we all know that certain junctions are difficult to turn right at and some of us may avoid specific junctions altogether. The crash diagram below shows a common situation whereby a vehicle turning out of a side street had its view obscured by a van and did not see traffic in the other lane. The road on which this occurred is known as a busy road and there was a stop sign at the particular junction.

Such junctions provide a huge challenge to Local Government and State Road Authorities to find workable solutions. Often the threat of right turn bans or junction closure is met with stiff resistance from shop owners and residents alike. However, unless we can achieve a high standard of road with medians, slip lanes and storage lanes we present many opportunities for a severe crash to the public. To highlight a specific point on speed, although 50 km/h has been reduced on local roads, this only represents approximately 15 per cent of all crashes (in South Australia). If travelling speeds were reduced on arterial roads, the reductions in crashes would be immense. Until we raise the standard of our infrastructure, surely this must be the most feasible short term solution.
5 Conclusions

In-depth crash investigation is a costly but necessary exercise to determine contributing factors in vehicle crashes. The data collected can provide valuable insights into crashes which the broader Government databases are not capable of supporting. Our traditional approach to managing the road network is one of victim blaming – we blame people for making predictable mistakes on our road system. However this paradigm seldom leads to a thorough criticism or review of the road infrastructure itself. In-depth crash investigation ensures that we take the the perspective of the “victim” into account when determining crash causation, and it is not assumed that the engineering solutions, even they meet current standards, are the best that can be found.
6 References


7 Acknowledgments

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Look and learn – Capitalising on individual responsibility in speed management

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Look and Learn – Capitalising on Individual Responsibility in Speed Management

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KEYWORDS: Speeding, Sign, Vehicle activated, Crash reduction, Speed reduction, Curves, Junctions, Intersections, Speed crash relationship.

ABSTRACT

Speed management is an issue subject to much professional and public debate, not least of which the success of programs focused on penalising non-compliant road users. Arguably, it could be hypothesised that the enforcement focus is placing responsibility on enforcement solutions to ‘catch us if you can’ rather than advancing behavioural change with education and encouragement.

This paper will present the Transport Research Laboratory’s (TRL) latest research findings and experience with speed management, in particular with non enforcement based technologies such as the interactive road sign.

This paper will discuss TRL’s findings that road users are responding positively to information advising of inappropriate speeds linked to specific reasoning, and outline the results of research examining speed behaviour in response to an interactive sign system that advises a change of behaviour and links it to specific and identifiable risks.

The interactive sign system will be shown to be effective in creating a willingness of road users to co-operate without the threat of enforcement and the related ongoing administrative requirements or loss of ‘customer’ goodwill. In doing so, the signs are capitalising on elements of individual responsibility among drivers.

The appearance of the signs without any further initiatives leading to a positive behaviour change is delivering a “look and learn” response from drivers, more aligned with experience based positive reinforcement than more punitive or control based road safety initiatives.

The approach is feasible and cost effective for a large range of road authorities, and gives motorists a sense of a ‘fair go.’
1 Introduction

Speeding – both in excess of the posted speed limit and inappropriate for the conditions – is a recognised road safety problem and Australia’s single biggest road safety issue.

In NSW, the Roads and Traffic Authority estimates speeding was a contributing factor in 40% of fatal road crashes from 1999 to 2003 inclusive. The figure is slightly higher at 43% for country areas [RTA, 2004].

Surveys of the community also show a general acknowledgement of speeding as a problem. Community concerns related to traffic and road safety are most commonly founded on speed concerns [McDonald, 1998] and NRMA surveys in NSW and the ACT over the last decade show the public perceive speeding to be the major contributing factor to crashes, often being the top of mind, first mentioned factor in survey work.

The public appear supportive of measures to counter speeding with an NRMA during 2000 showing 88% believe ‘face to face’ enforcement is an effective and appropriate response to speeding (decreasing to 75% for speed cameras).

However, there is also extensive evidence that many drivers continue to speed as evidenced by on road experience, speed surveys and attitude surveys.

In a 2002 survey for the Australian Transport Bureau, while most drivers stated they normally drove within the speed limit, six out of ten indicated they ‘sometimes’ drive at higher speeds [ATSB, 2002, p108]. A survey for the Roads and Traffic Authority of NSW in 2002 indicated that most drivers believe there is something called “safe speeding” with over 90% of 17-39 year old males confessing to “safe speeding” in urban areas [RTA, 2004].

Inappropriate speed is also shown in respondents’ answers to an RTA question regarding the safe speed around an 85 km/h signposted curve. Half (50%) stated speeds in excess of 85 km/h, with 3% stating more than 100 km/h.

Therefore, there is a need to synchronise on road behaviour with general attitudes towards speeding, whilst not jeopardising attitudes that have some limited control over speeding at present. Accordingly, we should consider both crash trends and psychological principles for reducing driving speeds.

2 The Speed – Crash Relationship

There are a number of studies that show a relationship between vehicle travel speeds and increased crash risk. And of course, conversely, decreasing travel speeds decreases crash risk.

One specific study of rural single carriageway roads across England showed that crash frequency increased rapidly with mean speed [Taylor et al. 2002]. Note: The study considers mean speed of all traffic, and not the speed of individual vehicles relative to mean traffic speed. The study was commissioned by the UK Government following a review of speed policy published in March 2002 that identified a need for greater understanding of the role of speeding in rural crashes.
A relationship was found whereby the relative crash increases to the power of 2.5 to the relative speed increase. That is, a 10% (110% of original) increase in the mean (average) speed would result in a 26% (110% to the power of 2.5) increase in crash frequency.

The effect of speed on fatal and serious crashes was noted to be greater than the effect for all crashes (although the relationship could not be proven to be statistically significant). For fatal and serious crashes, a 10% increase in mean speed would be expected to result in a 30% increase in crash frequency.

Of course, these are figures for a relationship on English roads, so arguably a different relationship may exist here due to differences in road environments. However, the Australian Transport Safety Bureau quotes that an increase in average vehicle speed from 100 km/h to 110 km/h (ie. 10%) on rural roads can be expected to increase serious injury crashes by about one third [ATSB 2004, p101].

The following headings relate to the study of crashes and speed on rural single carriageway roads in England, and are used to highlight road environment issues to highlight possible target areas related to speeding.

2.1 Speed and Curves

The frequency of crashes was also found to increase rapidly with the density of sharp curves (those marked with a chevron and/or curve warning sign). For each additional sharp curves per kilometre, the crash frequency increased by 13%. This relationship was particularly strong for single vehicle crashes with a relationship of 34% increase in crash frequency per sharp curve per kilometres.

2.1 Speed and Junctions

The relationship between mean speed and density of minor crossroad junctions (where priority is against the crossroads) was found to be even stronger. For every additional minor crossroad junction per kilometre, the all crash frequency was found to increase by 33%. The relationship was found to be roughly proportional to the 5th power of relative speed change, which suggests a substantial potential for crash reduction for strategies designed to reduce speeds at junctions.

3 Reducing driving speeds: Psychological principles

Understanding a number of psychological principles behind driver’s travel speeds are useful not only from a direct attitudinal and educational perspective, but also to understand how road environment measures might work to reduce travel speeds. A number of relevant theoretical approaches to reducing speed are briefly described below [Elliot et al, 2003]:

- **Increasing cognitive load**, involves increasing the amount of mental effort or information processing a person is required to perform. A number of studies have shown increased levels of cognitive load reduce driving speeds.
• **Utility:** Decreasing the perceived profit of an individual to speed, relates to an individual’s choice to perform a behaviour based on a rationalised weighing up of the associated positives and negatives. Potentially, to decrease the perceived benefit (‘profit’) for driving fast may reduce travel speeds.

• **Enhancing perceived danger/risk,** works with an individual’s risk tolerance. If the perceived risk associated with a particular travel speed exceeds a driver’s tolerance, the driver may slow down.

• **Retinal streaming,** involves the processing of visual clues for speed perception. As the amount of ‘activity’ in peripheral vision increases along with the perceived travel speed, so too may driver discomfort. A driver may compensate by simply slowing down.

• **Driver stress.** It has been suggested that increases in driver stress levels may result in reduced travel speeds. However, stress is a complex and multidimensional phenomenon and little is known about it’s full effects on driving performance.

• **Fear of enforcement,** is generally self explanatory. It is reliant upon the perceived likelihood and consequence of enforcement, and conscious thought at a given time.

• **Better knowledge of posted speed limits.** Survey respondents often state that they were unaware of the posted speed limit (or appropriate speed for a given condition) and therefore did not know what speed to travel at.

• **Better knowledge of own travelling speed,** relates substantially to driver’s awareness of their own travel speed within increasingly ‘coccooned’ motor vehicles.

It should be noted that although some of the above interventions may influence vehicle speeds positively, they may have adverse effects on other elements of safety performance. Examples may include ‘overloading’ the cognitive performance of a driver so that they can not safely perform the holistic task or similarly overstressing the driver, increasing risk tolerance in perceived circumstances to the detriment of real circumstances, or diluting the fear of enforcement by over-promotion.

### 4 Vehicle Activated Signs

Many road safety engineering measures have been developed in an attempt to influence driver behaviour and cut vehicle speeds when approaching and negotiating high-risk locations where the geometry of the road network is a factor or where a high incidence of vehicle interactions can reasonably be expected. One of the latest measures is Vehicle Activated Signs (VAS), whose development has been pioneered by the Safety Group of the UK’s Transport Research Laboratory (TRL), on behalf of the UK Department for Transport.

#### 4.1 What are VAS?

Speed that is ‘inappropriate for the conditions’ is often a factor in accidents. However, while speed limits are intended to bring speeds into line with the prevailing conditions, these limits are by their nature inflexible and many locations actually need drivers to travel at speeds well below this limit.
VAS technology displays a simple message relating to road condition, for example, indicating the presence of a curve, junction or speed requirements. The sign is illuminated only briefly, typically 4 seconds, and only to drivers exceeding a pre-programmed threshold speed for the location. The remainder of the time the sign remains blank.

**Figure 1 – Activation of a speed limit roundel sign with ‘slow’ advice in Nottingham, UK.**

The signs utilise fibre-optic technology or light emitting diodes to display the symbols and/or words required, so allowing different colours to be used for different parts of the message. At night, automatic dimming is used to reduce the intensity of the sign output. Activation of such signs is typically through the use of microwave detectors, although inductive loops cut into the road surface can also be used.

In the late 1990s a significant number of VAS units were installed in the UK, based upon the successful results of preliminary trials. In the latest study conducted by TRL, the effectiveness of more than 60 existing VAS installations was investigated [Winnett and Wheeler, 2002].

The sites investigated were predominantly rural single carriageway roads in 4 counties of the UK, and 4 distinct types of VAS were considered:

- speed limit roundel, placed just within the initial speed limit sign and predominantly on the approaches to small settlements;
- curve warnings;
- junction warnings; and
- safety camera ahead repeater signs.
4.2 VAS Achieving Results

The evaluation study discovered that the average traffic speed at the sites reduced by between 1 and 14 mph (between 2 and 22 km/h). At some of the sites investigated the effective speed limit was cut by 10 mph (16 km/h) at the time the VAS was installed and these sites secured the highest overall reductions in vehicle speed. At locations where no adjustment had been made to the speed limit, the reduction in average speed was in the range 1 to 7 mph (2 to 11 km/h), with a mean reduction of 4 mph (6.5 km/h).

At curve and junction warning sites where VAS had been adopted, average vehicle speeds reduced by up to 7 mph (11 km/h). An average reduction of 1 mph (2 km/h) was found at safety camera sites, with a 4 mph (6.5 km/h) reduction when the installation was associated with a change in speed limit.

These results are particularly worth noting given the speed – crash relationships noted at curves and junctions mentioned earlier in this paper.

<table>
<thead>
<tr>
<th>Sign Type</th>
<th>No. of speed measurement locations</th>
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</table>

The percentage of drivers exceeding the pertinent speed limit was reduced at all categories of site where VAS were utilised. A corresponding reduction in the incidence of personal injury crashes was also experienced.

For one of the English counties examined, at the 21 sites were VAS had been adopted, there were found to be one third less personal injury crashes compared to the number that would have been expected without the installation of the signage, based upon trends for ‘untreated’ sites. This result displays statistical significance. A small reduction in personal injury crashes was found to occur where VAS depicting a safety camera logo had been installed, compared to the situation with the safety cameras alone, before VAS installation.

In addition to the above statistics demonstrating road safety gains, feedback from drivers has also been positive. In separate studies in 2 English counties where VAS have been used, involving nearly 450 drivers in total, it was found that drivers overwhelmingly approved of the signage. The vast majority of drivers interviewed stated that they had made a connection between the speed at which they were traveling and the signs being triggered and believed that exceeding the speed limit was much more likely to trigger the speed limit roundel signs than any of the warning signs (ie. curve, junction, speed camera). Over 50% of the drivers interviewed believed that they would receive a fixed penalty notice for triggering a safety camera repeater sign.
Nearly all of the drivers interviewed thought that the junction warning sign VAS’ primary function was to slow traffic down or to warn of the hazard.

It was previously thought that drivers would associate the microwave detection equipment mounted above a VAS with speed enforcement cameras. However, the driver interviews conducted did not find evidence to support this assumption.

Table 2 – Summary of speed reductions at roundel signs

<table>
<thead>
<tr>
<th>Sign type</th>
<th>No. of speed measurement locations</th>
<th>Change in mean speed Maximum (km/h)</th>
<th>Minimum (km/h)</th>
<th>Average change (km/h)</th>
<th>Av. before speed Km/h (mph)</th>
<th>Av. after speed Km/h (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 mph roundel</td>
<td>17</td>
<td>-11.4</td>
<td>-4.2</td>
<td>-7.2</td>
<td>21.4 (34.5)</td>
<td>18.6 (30.0)</td>
</tr>
<tr>
<td>40 mph roundel</td>
<td>5</td>
<td>-7.1</td>
<td>-1.9</td>
<td>-5.0</td>
<td>23.7 (38.2)</td>
<td>21.8 (35.1)</td>
</tr>
<tr>
<td>30/20 mph change</td>
<td>6</td>
<td>-12.1</td>
<td>-7.1</td>
<td>-10.0</td>
<td>19.3 (31.1)</td>
<td>15.5 (24.9)</td>
</tr>
<tr>
<td>40/30 mph change</td>
<td>7</td>
<td>-22.2</td>
<td>-10.5</td>
<td>-14.3</td>
<td>24.7 (39.7)</td>
<td>19.1 (30.8)</td>
</tr>
<tr>
<td>50 mph roundel*</td>
<td>1</td>
<td>-7.4</td>
<td>-5.8</td>
<td>-6.6</td>
<td>32.3 (52)</td>
<td>29.7 (47.9)</td>
</tr>
</tbody>
</table>

* speed measured in two lanes

It is worthy of note that the attitudes, understanding and speed behaviour of drivers in the 2 counties where the driver interviews were conducted were found to be similar, which could suggest that no regional differences exist.

4.3 Why use VAS?

Vision is our most important sense when we drive. Typically those researching in the domain claim that 90% of the information we need to drive is visual.

However, it has been estimated that in the range of 69-80% of all intersection crashes in Australia are caused by one road user failing to ‘see’ another until it is too late to avert a collision (among other factors). That is, road users don’t cognitively process the risk of the other road user until it is too late, even though they may be a highly visible risk such as another vehicle. This is referred to as Looked But Failed to See error [Langham and McDonald, 2004].

In such an environment, it would not be surprising for drivers to ‘lose’ relevant warning sign information, while also not finding static warning signs particularly relevant to their driving experiences on either a familiar road, or road with features familiar to their driving experience. VASs work on the basis of providing concise and cognitively conspicuous and relevant information to specific drivers (ie. those travelling above a predetermined speed).

By specifically targeting drivers with relevant messages, the signs act on a number of the psychological principles described earlier, namely:

- Subtly increasing cognitive load, without going ‘too far’,
- Providing a danger/risk prompt to modify behaviour,
- And providing better knowledge of a driver’s own travelling speed in a specific context and set of circumstances.
In doing the above, the evaluation study concluded:

- drivers can be influenced to reduce speed when they are specifically targeted, with fixed signs alone likely to have less effect;
- VAS are effective at reducing average traffic speed;
- VAS can reduce the number of drivers who exceed the speed limit and who contribute disproportionately to crash risk;
- a substantial crash reduction was found in this study;
- VAS can be operated at thresholds well below normal Police enforcement levels; and
- there is no evidence to suggest that drivers become less responsive to such signs over time, (eg. this was found even after three years of introduction).

The major benefits of VAS appear to be that they are self-enforcing and produce high compliance levels.

Although a VAS installation currently costs in the order of 5000 pounds in the UK (approximately AUD$11,500), this is a low cost when compared to the costs associated with personal injury crashes. The on-going operating costs of VAS are also reported to be low.

It should be recognized, however, that VAS technology is not the answer to all questions and should not be seen as replacement for measures that already exist to reduce traffic speed on road networks. They are merely an addition to the road safety engineer’s toolkit. Solutions must be situation specific.

4.4 Where to Use VAS?

Appropriate speed traversing curves is a specific target for VAS given the current inability to enforce an appropriate speed, and given the community sentiment towards curve advisory speed signposting. Junctions are also a specific target given the ability to effect safety outcomes from speed changes, and the likely current community opinion towards speed approach to minor junctions where they are travelling with legal priority.

However, VAS will not be suitable for every location nor every circumstance. The local authority will need to make a range of decisions based on such issues as nature and extent of problem, and cost effectiveness of treatment.

Another issue that may be considered are the use of stereotypical risk models to identify below average crash and/or speed performance and the potential for speed modification benefits. The use of relationships between speed and crashes are particularly useful in the context of lower volume roads where crash history will be variable due to normal statistical variation.

In the English study of the crash – speed relationship [Taylor et al. 2002], relationships were developed for a range of different road types. These ranged from Group 1 roads (being ‘low quality’ hilly, high curve density and low traffic speed roads) through to Group 4 roads (being
‘high quality’ level, straight, with few accesses and junctions). These general relationships are shown in figure 2.

![Graph showing accident frequency vs mean speed for different groups]

**Figure 2 – English rural crash rate and average speed relationship by road type**

A model such as the above could be extended to incorporate junction and curve relationships to speed, and use a predictive approach to risk based on road environment attributes and speed surveys.

As a final thought, I would also suggest that the feasibility easily mobilised signs be considered given the spread of Australian road networks, possibly by the use of detachable or relocateable post mountings, or temporary/portable signs similar to the speed monitoring trailers in use a by a number of road and local government authorities across Australia. This may counter the drawback of limited resources over a broad number of road environment features with limited traffic. However, it should also be remembered that the provision of a sign at one feature may (ideally) have a carry over affect to other similar sites through the ‘training’ of road users for appropriate responses to similar circumstances.

One objective of all speed reduction measures is to raise driver awareness of the importance of appropriate speed choice and so, over time, to contribute to an improvement in driver behaviour. With respect to VAS technology, the main aim is to alert drivers to the need to adopt a lower speed due to a particular hazard ahead, or in preparation for a lower speed limit ahead and this dictates a sparing extent of use, ie. they are not a substitute for standard or fixed signs and should only be employed when signing, road markings and road conditions are fully compliant with pertinent standards. Before a VAS is installed, the undertaking of a detailed crash investigation and speed analysis is needed to confirm the use of a VAS as a most appropriate remedial measure. Traffic speeds and crash data must also be analysed following the introduction of a VAS.
6 Conclusion

This paper has discussed the problems of speed and crashes and the challenges of changing driver behaviour. Specific speed – crash relationships have been presented that identify particular opportunities to target rural curves and junctions for crash reduction from speed management.

In response to specific speed management opportunities at curves and junctions, and to a lesser extent, near speed cameras and through urban centres, experience within the United Kingdom with Vehicle Activated Signs (VAS) has been discussed from an evaluation by TRL Limited.

VAS display a message triggered by specific vehicle approach speed, the message being specifically relevant to speed behaviour such as the risk of a curve, junction or speed camera ahead or the need to slow to the speed limit.

Speed reductions and associated crash reductions are noted and found to be sustained over an extended period. Public response to the signs has been positive, and drivers are interpreting the intent of the signs correctly without the need for education campaigns.

The signs have the benefit of specific targeting of individuals and identifying appropriate speed behaviour with road environment risks. This targeting can be delivered below normal enforcement capabilities.

It is considered that vehicle activated signs are worthy of trial in appropriate circumstances within Australia. The incorporation of specific warning advice for circumstances such as curves and junctions is an extension of exiting field experience with forms of variable signs in Australia including such programs as on the F6 Motorway south of Sydney and more static (non targeted) flashing warning lights on school speed zones and special purpose signs.

The use of generic road type speed crash relationships is suggested as one technique for targeting the signs, as is the opportunity to consider more mobile installations than have been applied to the UK road environment.


7 References


Whilst every effort has been made to ensure that the material presented in this paper is relevant, accurate and up-to-date, the author cannot accept any liability for any error or omission. The views expressed in this paper are those of the author and are not necessarily the corporate views of TRL.

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Road Marking – A fair go for drivers (A road safety reality, or a road-maintenance impossible dream)

MR BOB CARNABY
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Road Marking - A Fair Go for Drivers
(A Road Safety reality or a road maintenance impossible dream?)

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KEYWORDS: Road marking, Retro-reflectivity, Road safety.

ABSTRACT
In recent times there has been great advancement in technology, with the introduction of glass beads for road marking that provide much-improved retroreflectivity, because of the optical properties (such as refractive index, optical transmission, colour and sphericity). This new technology builds on the wet-night-visible roadmarking technology of the last decade, to provide road markings of 2 to 3 times the measure of retroreflectance, that are visible during wet-night driving conditions.

The State of New South Wales’ Roads and Traffic Authority (RTA) has had a wet-night visibility requirement for painted road marking for quite some time. However, with the advent of this recently improved technology, the RTA has asked Potters Industries to partner with them in an extensive round of field testing, on various road surfaces, using a variety of roadmarking binder systems, to generate performance data. The RTA has a short term / long term plan to improve delineation. It is anticipated that current specifications for road marking will be adjusted to ‘raise the bar’ on performance.

This paper presents the data from these field trials, which suggests how it may be possible to make roadmarkings visible in almost all driving conditions, and increase the end-of-line detection distance, to reduce the drivers needs, reduce the drivers mistakes and make the driver less vulnerable, thus improving driver comfort and safety.

1 Road markings disappear on rainy nights.
We are able to see road-marking lines far ahead of our vehicles when we are driving at night because embedded into the painted lines are millions of tiny glass beads; each acting as tiny mirrors, reflecting our headlamp beams back to us.

Glass beads, having a diameter of 0.3 to 0.4mm have been used on painted markings, for this very purpose, in Australia since around 1952, and have proven very effective at providing clear road delineation at night time in dry conditions.
The problem is, however, that once it starts raining (right at the time that you need as much visual information as you can get about the roadway ahead), these lines become virtually invisible. The reason for this is that under wet conditions the tiny beads become covered in a film of water that effectively stops the light from being reflected back to us.

Reassuringly however, this problem can be easily overcome via the use of larger glass beads of around 1mm in diameter.

![Figure 1 - The traditional 0.3mm sized glass bead functions well, providing good night time visibility of the painted pavement markings until rain begins to fall. The larger 1mm diameter sized glass beads continue to send a visual message at night, in both dry and wet conditions.]

2 Retroreflectivity and Measurement

Painted pavement markings are the only continuous means of guidance for motorists in their travels. Pavement markings are visible at night because the light from the headlight is reflected back to the driver from the glass bead in the paint. The interaction of these three components, glass beads, paint and light defines how effective the overall system will be at guiding drivers at night. The popular definition of nighttime visibility of pavement markings is defined as the retroreflectivity of the markings. This is a measurement of the efficiency of the marking to return light in the general direction from which it came. It is simply a ratio of the light visible to the driver compared to the light entering the pavement marking.

Both portable and mobile retroreflectometer instruments are used to measure the retroreflectivity of the markings. These instruments measure the coefficient of Intense Luminance (CIL), and express the measures in millicandellas x lux x metres squared (mcd/lux/m²). The absolute minimum dry measure of retroreflectivity that appears to satisfy scientists throughout the world is *100mcd/lux/m². Wet retroreflectivity, or the measure of visibility of the markings during rainy night conditions is a different matter.

*NOTE: The 100mcd/lux/m² measure has been established, using reflectometer instrument set to an observation angle of 30metres. (Search for Luminance Contrast Thresholds for Pavement Markings - M. Bry and D. Krauze, LCPC, France).

3 Value Management Study

In November 1995, the NSW Roads and Traffic Authority, at the direction of the State Minister for Roads, commissioned the Department of Public Works and Services’ Production Evaluation Unit, to identify key problem areas, review current practices and examine potential improvement options, so that a strategy could be developed to ensure road delineation would provide all the necessary
functions. These functions included the requirement for visibility of road markings during both day and night conditions, particularly in wet weather. As a result of this study, 1mm wet-night-visible sized glass beads were introduced to the road-marking specification in NSW.

4 Line Visibility for All Ages
Recently the Australian Institute of Traffic Planning and Management (AITPM) produced a report titled “Line-marking Standards – Searching for Best Practice”. Based on their research they concluded that Australian motorists are being robbed of many safety benefits of good line-marking because of the patchwork of different standards in each State and a lack of strategic management practices.

Performance standards for line-marking and maintenance vary greatly between States yet the requirements of the driving population they serve are common.

These concerns are heightened with an aging population. As we get older our sensitivity to contrast decreases, our ability to resolve details decreases and our glare sensitivity increases.

The implications for line-marking standards are clear. If we wish to maintain the safety effectiveness of line-marking we should be looking to enhance the standards to adopt systems that compensate for the reduces visual capabilities of older drivers.

5 Research and Development of Safer Road Marking Systems
Potters Industries has initiated a series of road marking field trials, in a partnership with the NSW Roads and Traffic Authority’s Scientific Services Branch and the ACT’s Department of Urban Services. Many combinations of road markings have been applied to roads in the Canberra area, with the intention of developing safer road marking systems, using a variety of road marking materials and application methods. Performance data has been generated, to date, over the past three years. A Scientific team visits the site each 3 months and measures the line visibility and resistance to skid. This information is reported to industry on a regular basis.

These trials have proven that there are safer road marking systems to suit all road users, in almost all driving conditions, which are immediately available, and cost effective through the extended high performance and durability that is provided.

6 Proven Performance Data
Roadmarking field trials, initiated as far back as 1999, are still generating data. With some of the markings exposed to nearly five years of trafficking, and others with at least three years of trafficking, there are some conclusions that may be stated.

Most of the past field trials were applied to various road surfaces and road alignments. Most were applied where they will potentially be used, as longitudinal markings. In particular, we have more
recently focused on the performance of these longitudinal markings that have been applied as left-side edge-lines, on a left curved road alignment. This is considered ‘worst case’ testing. The RTA’s Scientific Services Branch partnered with Potters on all trials conducted on the Majura Road, Canberra. We call this type of roadmarking exposure, ‘testing in extreme conditions’. So if the marking lasts here, it should be able to last in most situations.

6.1 WET NIGHT VISIBLE MARKINGS
Large sizes glass beads (approx 1.0mm to 1.18mm), to Australian Standards AS/NZS2009-2002 ‘Class D wet-night visible glass beads’, have been in use to provide wet night visibility of markings, through parts of Australia for the past ten years. Road Authority Scientists have backed up the finds of the glass bead manufacturing industry in proving that glass beads need to be of at least 1mm in diameter to provide wet night visibility. Potters Industries, with the approval of the ACT’s Department of Urban Services, has established a 400 metre long demonstration site where parallel lines to various specifications can be viewed. The site is viewed during night conditions in a dry state, then a water truck is introduced to wet the pavement. Markings to various spec can be seen to perform quite differently to one another.

Figure 6.1 – The left side photo shows two lines, that both look quite similar when observed on a dry night. The far left line has the traditional small 0.3mm sized glass bead (AS/NZS2009-2002 Class B) surface applied, and measures 350mcd/lux/m² in dry conditions. The line next to it has a larger 1mm sized glass bead (AS/NZS2009-2002, Class D) surface applied, and measures 450mcd/lux/m². Both lines are of waterborne traffic paint.

The right side photo shows the performance of the same two lines during rainfall. (Demonstration site is located on Jerribombera Road, Canberra. Thanks to ACT Dept of Urban Services for the use of the section of road).
6.2 LONGER ROAD PREVIEW TIME
In more recent times, glass beads with optical improvements (including refractive index, colour, light transmission and sphericity) have been demonstrated as being capable of providing longer road preview time, or, if you prefer, longer end-of-line detection distances. The higher measures of retroreflectivity provided by this class of glass bead provides not only brighter and easier to follow roadmarkings at night, they also add to the life of the markings.

6.3 DURABILITY RESULTS ON CHIPSEAL
As only one example, a performance contract awarded to Totalcare Industries in Canberra, to maintain longitudinal markings on an eleven kilometre length of the Tuggeranong Parkway. The road surface is of mainly coarse chipseal of 14mm. It carries 40,000 vehicles each day. Waterborne paint and Class D wet-night visible glass beads were used. After two and a half years of trafficking, the markings had a mean measure of 250mcd/lux/m².

![Image of chipseal road surface]

**Figure 6.3** – Above – Retroreflectivity / time / road alignment.

Left – A macro photo of the waterborne paint and large glass bead marking, on a coarse chip-seal road surface, after 30 months of trafficking.

6.4 DURABILITY RESULTS ON ASPHALT
Totalcare also applied waterborne paint and Class D beads to a new asphalt surfaced section (no previous markings) of an eight kilometre length of the Barton highway, as edgelines. After nearly five years of trafficking, these markings measure a mean of above 200mcd/lux/m². Since then we have established that the results can be much better if there has been a previous marking applied. The improvement in retroreflectivity can be as great as 100mcd/lux/m², with the previous marking not allowing paint penetration into the road surface. This provides better glass bead embedment, which improves the durability.
6.5 ADHESIVE COATINGS FOR THERMOPLASTIC
In accelerated wear testing of edgelines on a curved road alignment, Class D beads with an adhesive coating treatment were trialled against the same beads, without any coating. The results are demonstrated in the graph plotted below.

![Graph showing durability comparison between coated and uncoated beads]

**Figure 6.5** - Demonstrates the benefit in durability of glass beads that have been treated with an adhesive coating, over glass beads without the coating. Both markings are of Thermoplastic.

6.6 ADHESIVE COATINGS FOR COLD APPLIED PLASTIC
In accelerated wear testing, in the same environment mentioned above, the results are demonstrated in the graph below.

![Graph showing durability comparison between coated and uncoated beads]

**Figure 6.6** - Demonstrates the durability benefits of adhesive coated glass beads on PMMA. The dotted line combinations are all of beads without the coating, while the continuous plotted lines all have the adhesive coating treatment on the glass beads.
6.7 DUAL PAINT GUN TECHNIQUE
Chipseal can be a difficult substrate for any roadmarking system. Because of the deep texture created by the aggregate formation, thin layer spray-able applications tend to blast the product into the voids and favor the application approach side of the stones. A dual opposing paint gun system has been developed that provides much improved results for no additional use of materials nor additional cost, apart from some small costs in initial purchase of equipment and some set-up time. Two paint guns are angled in towards one another at an opposing angle of around 60 degrees. The paint streams are tuned to meet at just above the pavement.

![Figure 6.7 - Demonstrates the angled dual paint gun technique. This system of road marking paint application has proven to provide much greater line performance in durability and glass bead retention, particularly on textured road surfaces, such as coarse chip-seals.](image)

6.8 ACCELERATED PAINT DRYING
Field trials, using a product developed by Rohm and Hass, has proven conclusively that Fastarck® waterborne paint drying time can be greatly accelerated, even in extremely cold conditions. The product, identified as Aquaset® QS-1, has been tested for its effect on the pavement marking’s durability, with no adverse effects noted. The accelerator was found to be best applied by sandwiching between two streams of paint (the method mentioned above), using a calibrate-able dispenser (Figure 6.7).

6.9 STATIC GLASS BEAD APPLICATION
Through much field testing, with the aim to improve the placement of glass beads at speed, it has been discovered that a ‘static environment’ can be created. This static drop technique virtually eliminates the bounce and roll of the larger Class D sized glass beads during application, thus optimizing their performance in retororeflectivity and durability. Technology has been developed that now allows the application speed to be increased to 28km/hr. This is known as the Speedbeader® system.

![Figure 6.9 - Glass beads are directed in a reverse direction and at similar velocity to the forward speed of the applicator. This provides a ‘static drop’ of the beads.](image)
6.10 IMPROVED SKID RESISTANCE WITH PAINT
Cycle and motorcycle lobby groups have pushed the cause for trials into trying to improve the coefficient of friction of horizontal pavement markings. Field trials, using waterborne paint and Class D glass beads have provided data on the usefulness of including angular surface applied particles. Accelerated wear testing, over three years to date, is demonstrated in the graph below. The line provides retroreflectivity performance over the period of exposure to accelerated wear trafficking, while the boxes contain the skid resistance measure at each period of testing.

![Graph of Accelerated wear testing of Fastrack 3427 (Bristol formulated) Waterborne Paint with Visibeads](image)

**Figure 6.10** - Waterborne paint in an accelerated wear test, using wet night visible sized glass beads and crushed quartz to improve the skid resistance.

6.11 IMPROVED SKID RESISTANCE WITH THERMOPLASTIC
Roll-over testing on transverse lines, both with and without angular surface applied particles, has demonstrated benefits in sustainable skid resistance values, while maintaining safe levels of retroreflectivity. This is demonstrated in the graph below.

![Graph of Transverse testing of Thermoplastic with Visibeads & Crushed quartz of 2.8 to 0.8mm at various ratios](image)

**Figure 6.11** - Demonstrates the high skid resistance and retroreflectivity that is achievable and sustainable, using large sized wet night visible glass beads.
6.12 IMPROVED SKID RESISTANCE WITH COLD PLASTIC
Once again, accelerated wear data has been generated by placement of left-side edgelines on a left curved road alignment. In this case there were three lengths of line with different angular particle treatments. Only the best performing combination has been included. See the graph below.

![Graph showing retroreflectivity and skid resistance of PMMA Two-Component Cold-Applied Plastic with adhesive coated Visibeads and 2 to 1mm Corundum.](image)

Figure 6.13 - Demonstrates the retroreflectivity and skid resistance of one of the better performing combinations, using PMMA.

6.13 APPLICATION ORDER FOR ANGULAR MATERIAL
Field testing has established that the best way to apply angular material to longitudinal roadmarkings is to apply it individually (not premixed with the glass beads). The angular material should be applied immediately after the roadmarking binder, through a calibrate-able dispenser, followed by the glass bead application.

6.14 SIZE OF ANGULAR PARTICLES
Generally the angular particles, be they of crushed quartz, corundum, or other, are supplied in a particles size range (eg 0.5mm to 1.0mm). It has been established that the angular particles are best to be marginally larger in size distribution than the size of the glass beads. So if Class D wet-night-visible sized glass beads were to be used, the main concentration of these beads is 1.00mm to 1.18mm. Therefore a crushed quartz of 1.6mm to 1.0mm would provide a better skid resistant result than if the smaller size, as mentioned earlier, were to be used. Be aware that the angular particles will cause shadowing of the reflective bead elements, so size, application rate and distribution are all important. Most of our successful field testing results used a ratio of either 1:1 of quartz : beads, or 1:2 of quartz : beads.

6.15 GLASS BEAD POPULATION - ROAD TEXTURE RELATED
It is not only the glass bead quality and embedment depth of the bead into the roadmarking binder that are important. The spread and population of the glass beads is also an important consideration,
that can have a great influence on the measured retroreflectivity. For instance, for glass beads to AS/NZS 2009-2002 ‘Class D wet-night visible glass beads’, it has been determined that 400g/m² will provide high measures of retroreflectivity on a smooth dense grade asphalt surface. To get the same results is retroreflectivity on say a 20mm chipseal requires closer to 700g/m². The aggregate creates its own shadows, and splits the view in travel direction, so the population needs increasing to provide similar quantities of mini reflectors viewable to the driver.

6.16 OPTIMUM RETROREFLECTIVITY  -  YOU MAY NEED TO WAIT

In many of our field trials we have noted that the initial measures of retroreflectivity (ie: measured soon after application), may not be as high as anticipated. This can be due to several reasons. A fine film of paint, enveloping the exposed glass beads, may need time to wear off. Thermoplastic waxes may wick over the exposed part of the glass bead. Or, maybe the marking just needs time to settle down. Initial measures may in fact be best collected around one week after application. In some cases, using quality beads and quality roadmaking binder systems, the markings have been observed to rise in retroreflectivity, quite significantly, over periods as great as a year or more. This is the exception more than the rule. But it does happen.

7  Scientific Experiments Prove the Worth of Enhanced Horizontal Painted Pavement Markings

A great deal of work has been done over the past twenty years to prove the worth of the humble painted pavement marking. A summary of some of the finding are presented in a brief form below, and not in any particular order:

- Centrelines and edgelines reduce all accidents by 20% (Miller, 1992).
- Centrelines and edgelines reduce single vehicle accidents by 34% (Moses 1986).
- Edgelines improve lateral control, which is linked to reduced accident rates (Godley, 1999).
- Higher visibility edgelines decreases lane keeping errors (McKnight & Tippets, 1998).
- The higher the initial CIL/m² (retroreflectivity) the longer the life of the line (Dr JE Kemp, 1998).
- The majority of traffic fatalities occur at night, (Boyce 1981).
- Traffic fatalities are 3 to 4 time higher at night, than day, (Boyce 1981).
- Improved night-time visibility for drivers can be a major factor in reducing accidents, (Boyce 1981).
- For roads with an AADT of 5,000, the minimum retroreflectivity required is 150mcd/lux/m² (30m geometry) (Dravitzski, Laing & Potter, 2004).
- End of line detection distances can be 55% higher for the younger driver than the older driver, (Zwahlen & Schnell, 1998).
- Retroreflectivity has more influence over end of line detection distances than head lamp illumination, (Zwahlen & Schnell, 1998).
- Larger (1mm) sized glass beads provide more effective wet night visibility, (Kalchbrenner, 1989).
- Large glass beads are used to add wet weather retroreflectivity to conventional markings. The beads need to be at least 1mm in size, (CIE International Commission on Illumination, 1999).
• For highway speeds above 80km/hr, a minimum RL value of 150mcd/lux/m² was recommended, (Migletz, Graham, Bauer & Harwood, 1998).
• For nighttime wet-pavement conditions, a minimum RL value of 180mcd/lux/m² was recommended, (Migletz, Graham, Bauer & Harwood, 1998).
• When comparing enhanced markings with conventional markings in adverse conditions, the enhanced markings provided,
  - Better lateral lane control
  - Better speed control
  - Better maintenance of target level performance
And were found to be,
  - Less mentally demanding
  - Less physically demanding
  - Less temporally demanding
  - Less effort was required
  - Less frustration resulted
  - Less difficult
  - Higher confidence in ability to drive safely
(Horberry, Anderson, Regan, 2003).

8 Conclusion
The benefits of enhanced horizontal painted pavement markings have been proven. The benefits in road safety have been proven. The durability benefits of enhanced pavement marking systems have been proven.

Basic safe road marking delineation for drivers in almost all driving conditions is immediately available, and cost effective through the extended high performance and durability that is provided. It’s a driver’s right – isn’t it?

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- New South Wales Roads and Traffic Authority
- A.C.T. Department of Urban Services
- Totalcare Industries
- Barloworld Coatings
- Traffic Control Products
- Rohm and Haas
- Crystalite Design

Figure 10 - Potters R&D application vehicle, the DART, and one of Potters off road test decks, where improved road marking methods and systems are developed.
Session 3B

New technology on old infrastructure
Different Forms of Detection – a TSA Perspective

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Different Forms of Detection – A South Australian Perspective

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KEYWORDS: Microwave detection, Video detection.

ABSTRACT

There are certain types of road users, such as pedestrians that are either difficult to detect or cannot be detected by conventional underground loop detectors. This paper outlines alternative methods used to detect road users and shows some of the successes and problems encountered along the way.

Transport SA is frequently asked to provide greater time for disabled and or elderly pedestrians at Pedestrian Actuated Crossings situated near Schools or retirement complexes whilst at the same time being asked to provide assistance to public transport, freight routes and general vehicular traffic along the same corridors. In order to accomplish this task, the use of microwave and video as ways of detecting these road users were investigated. Comparisons are made of the traffic volumes collected using video and loop technologies to detect vehicular traffic.

1 Introduction

As managers of the traffic network in metropolitan Adelaide, Transport SA is constantly trying to give all road users a fair go. Transport SA is frequently asked to provide more time for disabled and/or elderly pedestrians whilst at the same time enhancing the operations of heavy freight, public transport and improve general vehicle progression throughout the metropolitan road network. Given that there is a finite amount of time available to service all these demands, dividing up the cake so that everyone gets a fair go can be quite a difficult and sometimes frustrating task.

Under normal operation the walk and clearance times of a pedestrian actuated crossing consists of a walk time (where a green man is displayed to pedestrians), followed by a clearance time (where a flashing red man is displayed to pedestrians as they complete their crossing). As outlined in Austroads guidelines (Austroads, 2003), the times are normally 4 to 5 seconds of walk followed by a clearance calculated at a walking speed of 1.2 metres per second. The normal practice for assisting disabled or elderly pedestrians in the past has been to calculate the clearance time using a walking speed of 1 metre per second. Depending on the width of the crossing this can add five to ten seconds or more to the allocated pedestrian time. The disadvantage of this approach is that this
extra time becomes lost time when able-bodied pedestrians or young children use the crossing; it generally results in motorists facing red light on an empty crossing with the pedestrian having crossed the road quickly.

To enable the assistance of slower pedestrians whilst at the same time providing a benefit to motorists when faster pedestrians cross, ways in which to reliably detect pedestrians during their time on the crossing were investigated.

2 Microwave Detection

Trials were conducted in May of 1995 with the installation of an AGD microwave detector at a midblock pedestrian crossing on Hampstead Road at Clearview, South Australia, along with pedestrian wait pads buried in the footpath. The latter were intended to cancel a demand for the pedestrian movement if the pedestrian walked off, however these were abandoned after a trial period.

The microwave detectors however produced such impressive results that the decision was made to proceed with installations at several other midblock pedestrian actuated crossings in the Adelaide metropolitan area.

2.1 Configuration

AGD-220 microwave units are configured to have a 20 metre elliptical pattern that is projected across the carriageway from the unit. Figure 2.1 shows a typical mid-block pedestrian crossing with one microwave unit at point A. It is mounted just above the signal lanterns and aimed such that it detects the pedestrian from the kerb on side A to about one metre from the opposite kerb. This is to allow for the one second delay on the end of the microwave detection logic. This set up will reliably detect pedestrians walking in either direction and will terminate the pedestrian clearance after they step onto the footpath.

![Figure 2.1 – Typical configuration of microwave detector at pedestrian actuated crossing](image)
Microwave detection of pedestrians is also possible at signalised intersections using a pair of microwave detection units mounted on each side of the road, represented by points A and B in Figure 2.2. The pedestrian movements at intersections run as part of the parallel vehicle phase and continue to clear throughout the amber and red portion of the phase. Consequently the aiming of the units needs to take into account the interactions of the coincident pedestrian and vehicular phase sequences.

The units are aimed down such that they detect pedestrians from the kerb on the departure side to a point approximately five metres from the opposite kerb as shown in Figure 2.2. This actual distance is calculated as the Amber and Red time at a walking speed of 1 metre per second and allows the vehicle phase to terminate while the pedestrian covers the last few metres to the kerb. Care must also be taken to ensure that microwave units are not affected by unintended detection of adjacent vehicular traffic.

AGD-220 microwave detectors are not user configurable and any failures require the unit to be sent to England for adjustment or repair. After the initial purchase some eight or nine months elapsed before the decision was made to purchase more units. During the intervening time the manufacturer not only changed the units from analogue to digital but also changed the footprint of the microwave detection area from an ellipse pattern with a reach of 20 metres to a teardrop pattern which reached only 10 metres. The rational behind this was to use two microwaves overlapping from either side of the crossing in order to cover the entire area of typical English crossings with an average width of about 12 metres as shown in Figure 2.3.

This worked fine on narrow English roads but was unsuitable for use on 18 metre wide roads in Adelaide. The end result was that that all of the units purchased had to be returned to England to be reconfigured to the original elliptical pattern.

![Typical layout of microwave detectors at intersections](image)

**Figure 2.2 – Typical configuration of microwave detectors at intersections**
2.2 Reliability and Effectiveness

The AGD-220 units have proven to be very reliable with a failure rate of approximately 1% since installation commenced in 1995. Pedestrians are detected walking in either direction however the units do seem to be slightly more sensitive to approaching pedestrians.

Trials have been carried out showing the effectiveness of the microwave detector in returning unrequired pedestrian time back to vehicular traffic. Pedestrian crossing times at two separate midblock crossings were recorded using SCATS. The normal time settings for these crossings prior to the installation of microwave detectors are shown in Table 2.1.

<p>| Table 2.1 – Pedestrian Actuated Crossing signal timings prior to microwave detection |
|---------------------------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>CROSSING FEATURES</th>
<th>CROSSING 1</th>
<th>CROSSING 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (metres)</td>
<td>25.2</td>
<td>18.9</td>
</tr>
<tr>
<td>Min Walk time (seconds)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Min Clearance (seconds)</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Standard Clearance (seconds)</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>Maximum Clearance (seconds)</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

Data recorded over 500 actuations of the crossings is shown in the chart in Figure 2.4 and clearly shows a large benefit for vehicular traffic. The total amount of time that was returned to vehicular traffic for the test period of 500 actuations was 3237 seconds, or an average of 6.5 seconds per activation.
Figure 2.4 – Combined results for two pedestrian actuated crossings

Many schools and disability groups that request extended crossing times for large groups of children or disabled pedestrians during special outings or sporting functions can be assisted by this flexibility in operation. The time extensions are usually quite significant and are required on one or two days of the week for periods of about 15 minutes. In the past catering to these requests by extending fixed clearance times would have caused excessive delays when the crossing is activated outside these periods. Also the use of microwave detection obviates the need for the alternative approach of SCATS or controller program changes to switch the facility on and off again. Microwave detection now allows the allocation of large clearance times for these groups. The clearance time terminates once the group is no longer on the crossing and will not over-extend the clearance if a single pedestrian were to use the crossing.

3 Video Detection

Two types of video detectors have been trialed for the detection of pedestrians and vehicles at midblock pedestrian crossings and intersections, with varying results.

3.1 Autoscope

The Autoscope Solo was purchased from US company Image Sensing Systems Inc in May 2000. The Autoscope is a wide area video detection system with a Multi Vision Processor unit and camera housed in a single unit. Each unit is capable of detecting presence, speed, and wrong way, as well as a multitude of logical functions. It uses eight outputs and four inputs via a mini hub located in the controller cabinet. In general it has been found that the unit can be cost effective
against normal loop detectors if it is used for the whole site. This unit has been used for effective detection of pedestrians and vehicles at pedestrian actuated crossings located midblock and at a bus station on the O’Bahn guided busway. Figure 3.1 shows the configuration of video detection zones at a pedestrian crossing.

The bus station application was chosen because underground loops were not desirable due to the nature of the coloured and patterned asphalt pavement. The placement of the unit at the bus station did highlight some shortcomings with the initial unit. It had some intermittent difficulties in detecting buses on the far carriageway from the unit at night and was strongly affected by moving shadows from trees on windy days.

Figure 3.1 - Example of midblock pedestrian crossing with all detection covered by Autoscope.

Figure 3.1 shows two detection zones for vehicles in each carriageway and 14 detection zones to detect pedestrians while on the crossing. These are arranged in two rows of seven zones. The detection software has the ability to link detection zones together to provide an input into a virtual or logical detector. These are shown by the rectangles labelled “OR-0”.
In addition a contrast testing detector zone is located across the edge and including part of the stop line of the far carriageway in Figure 3.1. This detector tests for adverse light conditions or faults where the camera can not adequately distinguish contrast changes.

The use of multiple detection zones to detect pedestrians in conjunction with a logical detector to group their inputs, came about through finding that this method was significantly more reliable for consistently detecting the presence of pedestrians across the full width, than using single detection zones that each covered the full width of the road. This allowed the application of similar functionality to that enabled by microwave detection for varying the pedestrian clearance time according to the speed that pedestrians crossed.

The second unit purchased was an Autoscope Solo Pro. This unit has a zoom lens and an improved vision processing capability, with the latest software capable of increasing the camera gain during low light periods, making the unit better at detecting vehicles at night.

Tests were carried out to determine the accuracy of the Autoscope units by comparing the volume counts to the existing underground loop detectors at the above site shown in Figure 3.1. the result of one test is shown in Figure 3.2. Although the traffic volumes detected by the Autoscope unit followed a similar pattern, they were consistently slightly less than the loop detectors.

![Graph of Autoscope (dark colour) and loops (light colour) detectors at PC324](image)

**Figure 3.2 - Graph of Autoscope (dark colour) and loops (light colour) detectors at PC324**

The unit was subsequently moved to the bus station where tests were carried out using the citybound carriageway, which was closest to the unit. This carriageway has an underground loop detector situated at the entry to the station from the guideway track. As this bus station is isolated from the general road network, every bus must cross both the loop detector and continue through
the crossing where the Autoscope detection was set up. The results of this collection are shown in Figure 3.3. Once again the results of the collection showed volumes that were similar with some slight differences.

Four sources of bus volume counts were used in this assessment. They were as follows:

- Loop detection as an input into SCATS
- Detection of buses using a video detection zone near the loop. This video detection input was sourced via SCATS
- Video detection using the detection zone at the pedestrian crossing stop line. This input was taken directly from the Autoscope unit
- Using the same video detection zone at the stop line with the input being sourced via SCATS

![Graph](image)

**Figure 3.3 - Detector Count Comparison - Citybound Carriageway - Klemzig Bus Station**

Thirdly, tests were carried out at a T-Junction where the unit was mounted such that it could see all three approaches. A manual count of traffic was undertaken at the same time that SCATS was used to count the loop and video detectors. The results for the eastern leg are shown in Figure 3.4. Results for the trial were difficult to reconcile, as there were discrepancies between all three counts. Once again the trends were similar, except for the early morning, where sun glare appeared to affect some video detectors. Complications with the pole location selected for the placement of the Autoscope unit resulted in early termination of the trial and as a result no SCATS strategic approach comparisons were possible.
3.2 Traficam

The second system currently under investigation is the Traficam unit, which is manufactured in Belgium by Traficom Ltd and is distributed in Australia by Tyco Safety Products.

The Traficam unit is a small single approach unit with the processing software once again incorporated in the camera housing. The units are capable of detecting up to four vehicles lanes per approach. The unit gives simple detection of presence and can be made directional. Figure 3.5 shows two detection zones, one of which is directional. Although the units do not contain the more advanced features of the Autoscope, they have performed quite reliably during the trial period with SCATS strategic input and approach figures from the Traficam units matching very closely to the underground loop traffic volumes at the test site.

![Graph showing comparison between Traficam, Autoscope, and manual counts]

**Figure 3.4 - Comparison Autoscope video, loop & manual counts at TS470 Eastern Approach**
Figure 3.5 - Traficam unit with two detector zones, (outside lane directional, inside lane normal).

Figure 3.6 shows the Traficam units attached to a traffic signal pole. The extension pole shown is commonly used to mount closed circuit television cameras in Adelaide and are simple to install.
Figure 3.6 – Mounting of Traficam units on traffic signal poles

The Traficam system only processes the image data immediately behind the defined detectors, ignoring the rest of the field of view. Each unit can be set up using a laptop or hand held PDMA. It has been found during use that units can be affected by rapidly moving shadows but do not appear to be affected by the gradual creeping shadows caused by the normal movement of the sun across the sky as the day progresses. The image in Figure 3.5 shows the shadow of the traffic signal pole over detector 1 with no adverse affects.

Some layouts of video detection can be subject to small amounts of occlusion, but this has had only a minor effect at the trial site. The above configuration is such that a large truck could trigger detector 2, however this could also be true of loop detectors. If a truck is not correctly positioned within the nearside lane it could trigger the centre lane loop depending on sensitivity. Comparisons of traffic volumes between the existing underground loops and the Traficam detectors showed that overall the Traficam units generated similar results to the loops with minor exceptions. During early morning and late afternoon the video detectors were influenced by the long shadows generated by traffic in adjacent lanes and at night time headlights from traffic travelling in adjacent lanes sometimes triggered the video detectors, especially if the road surface was wet.

At the time of compiling this paper, the Traficam units are still under review, however some preliminary comparison figures are included. Figure 3.7 shows a comparison of the average
degrees of saturation between the video detector (light colour) and loop detector (dark colour) on a single approach over a twenty four hour period. Most days showed a similar trend with the only areas of concern being the periods from 6am – 7am and 6pm – 7pm where either sun glare or shadow have caused the video detectors to give exaggerated results.

Figure 3.7 - Average degrees of Saturation comparison, (loop detector (dark) video detector (light))
4 Conclusion

Microwave detection has proved invaluable in reducing delays to vehicular traffic while also enabling an increased level of service to pedestrians when they are not able to cross as quickly as most. Microwave detectors are now routinely used at pedestrian actuated crossings and intersections with wide road widths. The application of this technology enables the extension of the pedestrian clearance phase for larger groups of pedestrians such as school children, and for individual pedestrians who are slower due to infirmity or disability.

Video detection is improving in leaps and bounds. The trials show that video detection technology can be used to detect pedestrians as well as vehicles. In particular using the configuration technique of linking many smaller detection zones via a logical detector can be superior to single long detection zones for the detection of pedestrians.

Volume counts comparing vehicle detections simultaneously sourced from video and loop detectors show that video source data is reasonably consist with loop based data. The main source of variation appears to be caused by sun glare or long shadows.

Despite the apparent shadow and sun glare problems, trials of the video detection units point to their suitability for use at certain intersections on a permanent basis. Also due to the ease of installation, the units are also considered suitable for temporary installation at critical sites where underground loop detection has been damaged and can not be repaired for some time.
5 References

Austroads 2003, Guide to Traffic Engineering Practice Part 7 - Traffic Signals, Sydney

6 Acknowledgments

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7 Disclaimer

This paper does not represent any endorsement or otherwise by the South Australian Government of the products or their performance that are discussed in this paper.
New lamps for old – New technology on old infrastructure

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New Lamps for Old

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ABSTRACT
This paper presents a report on the adoption of Light Emitting Diode (LED) Traffic Signal Lanterns in South Australia. LED Lanterns represent third generation in Lantern Technology and are the most significant advance in Traffic Signal Lanterns to date.

Transport SA is the first Australian State to embark in widespread replacement of old traffic signal lanterns with LED lanterns.

Upgrading to LED lanterns will reduce power consumption and green house gas emissions, while offering extended service life and improved levels of safety for road users.

Where required, the associated traffic signal controller hardware and/or personality program has been upgraded to enable monitoring of LED lanterns.

1 Introduction

Transport SA installed its first signalised intersection in August 1947 at the intersection of South Road and Henley Beach Road, approximately 5 Km west of the Adelaide CBD. In November 1951 a second intersection was signalised some 450 Km away at Mount Gambier in the State’s South East.

From these humble beginnings, Transport SA now operates 683 traffic signal intersections and pedestrian crossings across South Australia,. Transport SA also manages the maintenance of several installations on Local Government Roads. All traffic signals within the City of Adelaide are owned and operated by the Adelaide City Council.

2 Distribution of Traffic Signals in South Australia

The majority of Transport SA’s 683 signalised installations are within the greater metropolitan area. Only 22 sites are located in regional areas. This distribution is indicated in Figure 2.1 below.
Figure 2.1 – Map of South Australia indicating relative distribution of Traffic Signals

Transport SA staff maintains all installations within the Metropolitan Area. Installations in Regional Areas are maintained under contract by local businesses.

This concentration of signals has assisted in achieving the rollout program in the short timeframe available.

3 Traffic Signal Lantern Details

Lanterns used by Transport SA fall into three categories:

- **Lanterns with 240 volt incandescent lamps**: These are first generation lantern technology and are high consumers of electricity (typically 63 and 94 watts)
- **Lanterns with 10 volt incandescent lamps**: These are second generation lantern technology and consume approximately 50% of the electricity of the above lanterns (typically 30 watts).
• **LED Lanterns:** These are third generation lantern technology and consume approximately 20% of the energy of the 240 volt lanterns (typically 13 watts).

The Australian Standard (AS/NZS 2144) defines two types of Traffic Signal Lantern:

**General Purpose:** designed for recognition from a distance of up to 100 m. These are used extensively at most intersections in South Australia.

**Extended Range:** designed for recognition from a distance of up to 240 m. These are used at intersections with speeds in excess of 80 kph. Transport SA has also used these at all pedestrian crossings and many intersections where arrow displays were installed.

Prior to 2002 the Australian Standard for Traffic Signal Lanterns dealt with the following requirements for lanterns using a lamp as their light source.

• **Colour:** This is to ensure recognition and also to optimise the colour to minimise the problem of red/green colour confusion.

• **Intensity:** This is to ensure recognition under all conditions of ambient light.

• **Sun Phantom:** To reduce the effect of reflected of sunlight in the face of the lantern which can cause a False “ON” Signal. An example of this is shown in figure 3.1 below.

• **Target Board:** This defines the size of an additional surround to the lantern to improve lantern visibility by providing isolation between the lantern aspects and the background, particularly the sky. An example of this is shown in figure 3.1 below.

![Image of Traffic Signal Lanterns](image)

**Figure 3.1 – Treatment of Lanterns. Target board for isolation from background sky.**
**Horizontal Louvres in left hand lantern to reduce effect of “sun phantom” as seen in the right hand lantern**
A revised Australian Standard for Traffic Signal Lanterns was published during 2002. A major part of the revision was to cater for LED lantern technology.

As a result the following additional requirements were included.

- **Veiling Reflections:** The LEDs used in Traffic Signal Lanterns are clear and can reflect white light which can cause the signal display to appear washed out, reducing the intensity of the colour signal.

- **Special electrical requirements for compatibility with Signal Controllers:** Modern Signal Controllers perform extensive monitoring of the lanterns connected. The electrical characteristics of each aspect need special consideration to ensure the integrity of the Controller/Lantern interface.

- **Special dimming requirements:** Most lanterns are dimmed at night to reduce night time glare. All Controllers achieve this by reducing the voltage to the lanterns. Lanterns using incandescent lamps respond well to this mode of dimming. LED Lanterns, being electronic required that the response to reduced voltage be well defined for a range of voltages.

- **Prescribed Failure Modes:** Failure of incandescent lamps is easily detected by Signal Controllers. LED lanterns are constructed using many individual LEDs. Progressive failure of individual LEDs is allowable up to a certain point at which the entire aspect must turn off to allow the Controller to detect the failure. Typical LED aspects are shown in Figure 3.3 below.

- **Higher Initial Intensity:** LED Lanterns are expected to exhibit long life (10 years). At this point, the light output is expected to be such that the lantern is still recognisable. As the intensity reduces with age, the initial intensity is in fact higher than that achieved from lanterns using lamps.

![Figure 3.3 – Lantern showing LEDs comprising each aspect (Figure obtained from aldridgetraffic.com.au).](image-url)
4 Why LEDs

Light Emitting Diodes are electronic devices, which emit light when electric current passes through them. The colour of the light is dependent on the type of chemicals making up the device. Their main application for years has been as indicators for items such as electrical goods, computers etc.

Recent developments have resulted in a variety of colours and considerable increase in intensity. LEDs are now finding their way into a vast range of devices as genuine sources of illumination.

LEDs offer a number of advantages over incandescent lamps, including:

- **Energy Efficient**: Most of the energy used by LEDs is converted to light, with only a small amount being generated as heat.

- **LEDs produce only one colour**: Almost all the energy required by the LED is usable as the intended colour without the need for filters.

This is depicted in Figure 4.1 below.

![Typical Radiation Output of an Incandescent Light Bulb](image)

**Figure 4.1 – Incandescent lamps heat the lamp filament to more than 2000 °C. This generates mainly heat, with the remaining energy (approx 15%) being available as light. For traffic signals, this is further filtered to produce the correct colour. (Figure obtained from SolarMarineLights.com).**

In simple terms it can be seen that a LED display, producing the same amount of light as an incandescent lamp, will consume approximately 15% of the energy.

The service life of LED’s is expected to be 10 years compared with around six months for 240 volt lamps.
5 The Need For Change

Traffic signals represent a significant electrical load for Transport SA and also incur significant maintenance costs, due to ongoing replacement of failed lamps. Lamps are replaced in bulk twice per year and also as they fail. Lamp faults impact significantly on the maintenance resources of Transport SA, with an average lamp failure rate of up to 30 per day. This behaviour is seasonally variable as seen in Figure 5.1 below.

![Lamp Faults Graph](image)

**Figure 5.1 – Graph showing the distribution of lamp faults over several years**

74% of Transport SA’s lanterns use 240-volt lamps. This contributes significantly to Transport SA’s energy burden. In addition, as these lanterns represent ageing technology, their pending obsolescence is highlighted by worldwide difficulties in sourcing replacement lamps.

Transport SA commissioned a report in 2000 “Traffic Signals and Road Lighting at Transport SA - Opportunities for Energy Efficiency” to look at traffic signal energy costs in terms of energy consumption and greenhouse gas emissions.

The report found that the upgrading to LED lanterns will vastly reduce power consumption and reduce Transport SA’s green house gas emissions by up to 8%, (equivalent to 230 hectares of revegetated land or annual emissions from 600 family cars).

As a result of this report Transport SA has targeted its population of lanterns using 240 volt lamps for replacement with LED lanterns. Maintenance activities will change from Bulk Replacement and Fault Replacement to Lantern Maintenance which is predominately lantern cleaning. The extent of this work is not yet realised, but it is expected the need to attend sites will reduce to annual visits.
Current costs and expected savings are detailed in Table 5.1 below.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>CURRENT COSTS</th>
<th>POTENTIAL SAVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Replacement</td>
<td>$300,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>Fault Replacement</td>
<td>$200,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>Energy</td>
<td>$1,150,000</td>
<td>$700,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,650,000</td>
<td>$1,000,000</td>
</tr>
</tbody>
</table>

The total value of the replacement program is $6,180,000 over 2 years, so in simple terms the repay period is approximately 6 years.

6 Project Opportunities

Transport SA, being the first State Authority to undertake a replacement program of such scale, found that there was limited market development in LED lanterns and so adopted a two-stage purchasing approach to maximise preparation and development by those parts of the market who needed further time to produce LED Lanterns compliant with the Australian Standards.

With the scale of this project, Transport SA has taken the opportunity to review many of its installation practices. The most significant of these have been the deployment of lanterns, the use of target boards and louvres and the treatment of signals at closely located intersections.

A major change has been the use of general purpose lanterns, replacing the extended range lanterns previously used at all pedestrian crossings. This action alone has resulted in a reduction of power of 340 watts per location., with an indicative cost saving per year of $120 per year.

Adjacent lanterns were previously installed each with an individual target board. An example of this can be seen in Figure 3.1 in a previous section. New lanterns are being installed with one target board surrounding both lanterns. This is in line with Australian Standards and Traffic Engineering guidelines. The resulting installation is much neater and occupies less width, reducing the possibility of lanterns being hit by passing traffic.

Transport SA has worked closely with a local manufacturer to develop a target board to meet Australian Standards and to address Occupational Health, Welfare and Safety issues (in particular manual handling) for use by Transport SA. The resulting product meets Transport SA requirements for all installation conditions and is backward compatible with existing lanterns.

The use of louvres has been reviewed, resulting in a vast reduction particularly in arrow displays.

The issue of reducing the conspicuity of downstream signals at closely located installations has for years been achieved by tilting the green aspect of the downstream lantern. This always presented difficulty in guaranteeing good vision of the display at close proximity to these lanterns. Also substantial on site rework was required if an existing installation was to be retrofitted with this
treatment. Significant assessment and trials has resulted in the use of a tilted visor with internal louvres. This has proven very effective, with a much better result than the previous method. Also applying this treatment to a site is a relatively simple process.

One of the great opportunities of converting sites to LED lanterns, due to the vast reduction in power, is the potential to equip major sites with a standby source of power (UPS). For example a major intersection in South Australia has five approaches and is located at Gepps Cross, north of the city. Prior to conversion to LED, this site consumed 3.3 kW. This has reduced to 500 W following the change to LEDs.

Transport SA is conducting trials using the test rack described in Section 7, and indications are that the above site could have its power maintained for up to 4 hours loss of electrical supply. The implications are that the effect of power outages, particularly during peak traffic periods can be overcome. Transport SA expects to commence field trials prior to October 2004. Without the conversion to LEDs, the above site could only be sustained for 30 to 40 minutes.

7 Compatibility with Existing Infrastructure

Retrofitting LED lanterns is no small task. Many factors have had to be taken into account.

- **Compatibility with Signal Controllers:** The entire stock of Tyco PSC Controllers requires changes to hardware and software to provide the correct monitoring for LED lanterns. Failure to do this may result in inability to monitor failed lamps and false detection of “last red out”, causing the signals to revert to flashing yellow.

- **Installation Restrictions:** To minimise the impact on road user safety, the work has been performed with the signals operating. To maintain traffic control and safety, no more than one lantern facing a given direction could be disconnected at any time. Removal and reinstatement of lanterns was organised to ensure that unsecured lanterns were not inadvertently oriented to give conflicting displays during the removal and replacement phase.

- **Disposal of Old Lanterns:** With up to 4000 lanterns being removed from service, Transport SA sought innovative methods of disposal/recycling as part of the Tender submission. Current practice is for Transport SA to retain any second generation technology lanterns for possible redeployment and for older first generation lanterns to be disposed of by various recycling methods.

One of the big challenges facing Transport SA was determining the compatibility between the lanterns, the signal controller and the existing field wiring. The project had very tight time constraints brought about by the time required to develop a specification, call tenders and award a contract. This left a period of 6 months for supply and installation.

The magnitude of this project left no time available for field trailing prior to full scale installation. It was determined that Transport SA would need to conduct its own tests to determine this compatibility.
Transport SA has a range of signal controllers currently in use including three representing the latest in signal controller technology. These controllers perform all signal switching by means of electronic switches. They also monitor lamp current and voltage to determine if any signal display conflicts are present and if any lamps have failed.

The new LED lanterns are significantly different to existing lantern as they are an electronic device and bear little resemblance to the traditional incandescent lamps.

The Australian standard pertaining to traffic signal lanterns (AS/NZS 2144) specifies the requirements of LED lanterns for compatibility with these new type signal controllers.

There are many different cabling arrangements used in South Australia reflecting a variety of installation methods that have prevailed over the past 28 years. Early experience gained in South Australia with LED lanterns indicated the field cabling could have a significant effect on the reliability of LED lanterns when used with these newer controllers.

An essential criterion for any new lantern was the compatibility with any of the newer controllers and the associated field wiring as used in South Australia. Transport SA considered it unreasonable for lantern manufacturers to have to equip themselves with three different controllers and perform the range of compatibility testing needed.

Transport SA developed and built its own test facility. This was a major undertaking, resulting in a facility capable of carrying up to three different brands of lantern and equipped with the three different controller types. Estimate cost of this facility is $100,000.

The facility allows ready connection of any controller to any brand of lantern or combination of lantern brands. The cabling is designed to simulate a range of cabling arrangements found in the field. The main feature of the test rack is to ensure that each controller is capable of operating the lanterns without any detected faults, and that the signal controller correctly detects all simulated lamp failures and is capable of determining last red out conditions.

The test rack is shown in Figure 7.1 overleaf.
This approach allowed Transport SA to perform a wide range of tests on behalf of lantern suppliers and provide feedback to both the lantern suppliers and the controller manufactures. Both parties have been able to make changes to their equipment as a result of these tests.

Other State Transport Authorities have expressed interest in the test results obtained and have expressed a desire to share these results.

It is possible Transport SA will make available the test facility to other State Authorities for any future testing they intend to perform.

8 Benefits of the Program

The LED lantern replacement program is one of the most ambitious undertaken by Transport SA in relation to its Traffic Signal Asset.

The program has been able to deliver a “Fair Go” in a wide range of areas as follows:

8.1 Reduced Energy and Greenhouse Gas Burden

The resulting reduction in power consumption and green house gas emissions has lessened Transport SA’s dependence on the electricity network. This is a major contributor towards energy sustainability and frees up available energy for use by others, particularly during summer months when the electricity supply is placed under its highest demand. Transport SA has also offered Local Governments the opportunity to participate in this program.
8.2 Reduced Maintenance Burden

The reduced maintenance and energy budget allows more public fund to be available for other purposes. The ever increasing demands on State Budgets are eased, if only slightly, by this venture. With the reduction in field attendances associated with lamp maintenance and faults, a safer environment is created for Transport SA’s workers and Contractors as their exposure to road traffic is significantly reduced. This in turn will reduce congestion at signalised sites due to maintenance works.

8.3 Consistency of Signal Displays

As a result of Transport SA reviewing many of its installation practices, a more consistent “look” to signal displays is now available across the board for all road users. All installations will be of similar appearance and the former variation of age has been addressed. With the expected long life of LED Lanterns, the number of lamp failures is expected to be extremely low and this will add to the relative safety and lack of confusion to all road users, which resulted previously when lamps had failed.

Its early days yet, but we are starting to receive feedback from users and it appears that persons who have difficulty distinguishing colours may benefit from the deployment of LED lanterns. A small section of the community has difficulty recognising the individual colours, but because of the physical separation of the aspects, they have been able to determine which is on. Recent feedback indicates that the actual colour can now be seen. This may be due to the nature of the light emitted from LEDs, which is monochromatic.

8.4 Lantern Manufacturer Development

The two-stage purchasing process has resulted in Transport SA achieving a lower lantern price. This will allow Transport SA to up grade more sites than was originally planned. These additional sites will be upgraded within the original allocated project budget of $6.18 million.

This two-stage procurement has also achieved significant market development by encouraging the LED Lantern industry to further invest in research and development of a stable reliable LED Lantern suitable for use in a traffic environment. The process has also resulted in two new manufacturers entering the market. In stage one there was only one viable supplier in Australia, the process of tendering in stages has allowed two other competitive suppliers to tender in stage two.

The LED Lantern industry has been stimulated and Australia now has three LED lantern manufacturers who have a greater capacity to demonstrate LED lantern compliance than would have been the case with a single stage process.

8.5 Controller manufacturers

There are three major Traffic Signal Controller Manufacturers in Australia. The compatibility testing performed by Transport SA has assisted these organisations in their development and adaptation of Signal Controllers to successfully control and monitor the new generation of Signal Lanterns.
8.6 Knowledge Transfer Between State Authorities

Shared results between States has reduced costs for State Authorities in terms of testing and research and has provided reduced costs of compatibility testing for lantern manufacturers resulting in lower product prices for end users.

9 Conclusion

Transport SA has set the pace in Australia in the widespread adoption of LED Traffic Signal Lanterns. This action has provided much needed impetus to the manufacturing market. Significant product development and enhancement has resulted.

Standardisation of traffic signal installations has been possible.

Transport SA’s signalised installations represent the highest possible standard, offering the users a consistent appearance in all applications.

Equipping signalised sites with UPS has the potential to provide signals with immunity to electricity power supply disruptions.

The energy savings obtained through this project have reduced the Greenhouse Gas burden due to Traffic Signals and have significantly reduced the load on the generation of electricity in South Australia. This benefits all South Australians as a result of the reduced dependence on energy supply, particularly during Summer Months.

The Program has delivered a “Fair Go” for all concerned.

7 References


8 Acknowledgments

I wish to acknowledge the tireless work of our Traffic Signal Maintenance Section for the effort they contributed towards the building of the test rack and the subsequent testing they performed. This section also provided the field surveillance during the installation works. Without their assistance the project could not have been achieved in the given timeframes.

In particular I thank Kingsley Noble, Tony McDonald and Dave Vinal.
Developing road-based ITS deployment guidelines for Queensland

MS KATH MARSCHKE
Queensland Department of Main Roads
Developing road-based Intelligent Transport System (ITS) deployment guidelines for Queensland

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KEYWORDS: deployment guidelines, Intelligent Transport System (ITS), strategic planning, objective warrants.

ABSTRACT

One of Main Roads' four outputs is "fair access and amenity". With increasing pressures on the road network, the department has had to make more compromises to achieve fairer mobility for Queenslanders. Intelligent Transport Systems (ITS) are deployed to improve the operations of the road network and can include devices, communications, software, policies, guidelines and processes. To ensure funding is directed to maximise the community benefits, the department needs to make funding decisions at both district and network system levels. To do this, a strategic planning tool for ITS, based on what is realistic and affordable in the short term (approximately 5 years), is needed.

This project involves developing ITS deployment guidelines for Main Roads. The deployment guidelines indicate a desired level of ITS to aid planning and indicate possible intervention levels. To determine the desired level of ITS, each road section is classified according to parameters such as AADT, percentage heavy vehicles and overloaded vehicles, crash cost, number of incidents, incident duration and percentage time volume-capacity ratio is greater than 0.85. The guidelines then indicate a desired level of ITS for each road type and classification. Once the desired level is determined, the department will be able to undertake a gap or deficiency analysis by measuring the existing ITS deployment and comparing it to the desired level of ITS deployment set out in the guidelines.

The deployment guidelines are still in a draft state and require validation. The version presented here is for consultation and to seek feedback, so if you have any comments or input, please do not hesitate to contact the author via email.
1 Introduction

The Queensland Department of Main Roads (herein called Main Roads) is placing increasing emphasis on optimising the operations of the road network. To help achieve this, the department undertook an internal project called Operations Plus assessing the existing network operation methods in Main Roads and making recommendations. As part of this project, a corporate policy audit was undertaken which identified a gap in strategic Intelligent Transport System (ITS) policy. The outcomes recommended that the department develop deployment guidelines to inform planning decisions and indicate when ITS interventions may be required.

1.1 Main Roads Outcomes

As prescribed in the Strategic Plan 2003-2008, Main Roads has four outcomes:

1. Efficient and effective transport to support industry competitiveness and growth;
2. Safer roads to support safer communities;
3. Fair access and amenity to support liveable communities; and
4. Environmental management to support environmental conservation.

These outcomes are linked to the Queensland Whole of Government outcomes and priorities. The ITS deployment guidelines align with Main Roads outcomes to ensure that ITS funding is appropriately directed towards implementing the department's strategic objectives.

1.2 Draft Strategic Framework for Road System Management

The draft Strategic Framework for Road System Management (see Figure 1.2) outlines the process the department follows to deliver services to the public, from developing strategic outcomes and outputs to delivering the program and reporting on performance. Performance reporting plays an important role in providing feedback for funding allocations.
Figure 1.2 – Draft Strategic Framework for Road System Management

These ITS deployment guidelines will provide the department with guidance on road system and road corridor ITS requirements, which fall into phases 2 and 3 in the above figure. The guidelines will enable the department to conduct ITS gap or deficiency analysis across the state (phase 2) and develop link strategies involving ITS (phase 3).

1.3 Strategic Plan

The Strategic Plan specifies the department priorities, which are split into products and services. One of these is "road operations" and the following activity set out in the 2003-2008 Strategic Plan relates to developing ITS deployment guidelines:

• RO4 – Improve traffic management and road safety systems and processes and more specifically, ensure appropriate 'intelligence' is built into major roads.

1.4 ITS Strategy

The draft Multi-modal ITS Strategy provides strategic guidance on the implementation of ITS in Queensland. As stated in the strategy, the Transport Portfolio's ITS visions is:

Contributing to government outcomes through consistent, coherent leadership in the development and management of innovative transport solutions in Queensland that connect people, goods and services.

The ITS deployment guidelines play a key role in achieving this vision. They provide a method to integrate ITS into transport planning processes (strategic direction PL1.1 in the document).

After a number of iterations, a draft framework has been developed and is presented here for the 2004 AITPM conference in Adelaide.
2 Objectives

2.1 ITS Objectives

The draft Multi-Modal ITS Strategy for Queensland defines ITS as:

The application of modern computer and communication technologies to transport systems to increase efficiency, reduce pollution and other environmental effects of transport and to increase the safety of the travelling public.

For these deployment guidelines, a broader definition of ITS has been adopted. ITS does not only include devices and communications, it can also include supporting policies and procedures. Since this is a guideline for Main Roads, recommendations have been limited to ITS that Main Roads can influence, that is, road-based systems.

The objective of the use of ITS on Queensland's roads is to maximise the potential benefits across all surface transport modes, to further whole-of-government priorities and the strategic priorities of the transport portfolio. The following table (Table 2.1) outlines the objectives of using ITS on different types of roads and the ITS services that could be applied.

<table>
<thead>
<tr>
<th>Road Types</th>
<th>Desired Output</th>
<th>ITS Services to be Provided</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| Limited access, grade separated (motorways / freeways) | • Maximise throughput  
• Reduce duration of incidents  
• Minimise secondary accidents | • Incident management  
• Traveller information  
• Safety  
• Traffic management  
• Heavy vehicle management | • Optimised traffic flow  
• Increased road safety  
• Enhanced motorist assistance |
| Limited access, at grade (highways)            | • Maximise throughput  
• Reduce duration of incidents  
• Minimise secondary accidents | • Incident management  
• Traveller information  
• Safety  
• Traffic management  
• Heavy vehicle management | • Optimised traffic flow  
• Increased road safety  
• Enhanced motorist assistance |
### Road Types

| Multi-lane and two-lane, two-way roads (arterials, sub-arterials, collector roads) |

<table>
<thead>
<tr>
<th>Desired Output</th>
<th>ITS Services to be Provided</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maximise throughput</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reduce duration of incidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Minimise delays and queues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Incident management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Traveller information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Traffic management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Optimised traffic flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Increased road safety</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2.2 Deployment Guidelines Objectives

The Operations Plus policy audit identified the need for a high-level planning tool that defined when ITS applications are warranted. The ITS deployment guidelines make recommendations that are based on what is realistic and affordable in the short term (approximately 5 years). The tool provides objective trigger levels for intervention and provides guidance so operational requirements can be included in the concept planning stage.

The deployment guidelines also provide a process for conducting an ITS gap analysis where actual ITS deployment is compared with the recommendations in the deployment guidelines. This can be done on a network level to identify where the network needs resources for ITS.

The guidelines will need to align with current Main Roads' ITS documentation, including:

- The **Traffic and Road Use Management (TRUM) Manual**, which gives the districts guidance on specific traffic management methods.
- The **Road Planning and Design Manual**, which provides the road planner and designer with specifications. The ITS section of this document is currently being developed.
- A new version of Chapter 5 of the **Asset Management Guidelines** is also being developed and will specify requirements for the ongoing maintenance of ITS devices.
- **Draft Road Network Performance Measurement** framework. The ITS deployment guideline criterion outlined in this document align with the performance indicators in the network performance framework.
3 Framework Methodology

The following section outlines the draft framework that has been developed to date. The framework has not been validated and requires further refining. The information presented in this document has been developed for consultation and to seek feedback, so if you have any input, please do not hesitate to contact the author via email.

3.1 Road Type

The framework for the ITS deployment guidelines consists of first classifying the road according to road type. Road type has two (2) tiers. The first being whether the road is urban or rural. Rural roads include roads in both regional and remote areas. The second is related to the access, grade and number of lanes. Table 3.1 below defines each road type.

<table>
<thead>
<tr>
<th>Road Types</th>
<th>Access</th>
<th>Carriageway</th>
<th>Number of Lanes</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Limited</td>
<td>Dual carriageway</td>
<td>Any</td>
<td>Motorways and freeways</td>
</tr>
<tr>
<td>Limited access, grade</td>
<td>Limited</td>
<td>Single carriageway</td>
<td>Any</td>
<td>Highways</td>
</tr>
<tr>
<td>separated, at grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-lane</td>
<td>Unlimited</td>
<td>Single carriageway</td>
<td>More than two (2)</td>
<td>Arterials, sub-arterials and collector roads</td>
</tr>
<tr>
<td>Two-lane, two-way roads</td>
<td>Unlimited</td>
<td>Single carriageway</td>
<td>Two (2)</td>
<td>Arterials, sub-arterials and collector roads</td>
</tr>
</tbody>
</table>

| Rural (Regional and Remote) | Limited    | Dual carriageway    | Any             | Freeways                                   |
| Limited access, grade       | Limited    | Single carriageway  | Any             | Highways                                   |
| separated, at grade         |            |                     |                 |                                            |
| Multi-lane                  | Unlimited  | Single carriageway  | More than two (2) | Arterials, sub-arterials and collector roads |
| Two-lane, two-way roads     | Unlimited  | Single carriageway  | Two (2)         | Arterials, sub-arterials and collector roads |
3.2 Road Classification

3.2.1 Criteria

To determine suitable ITS deployment, the road must be assessed according to its needs. To do this, each road is classified into heavy, moderate or light according to a number of criteria. The criterion is based on the desired objectives (see Table 2.1). Table 3.2.1 indicates the criterion and a proposed methodology for how the data is collected and analysed in Main Roads. ARMIS stands for A Road Management Information System and is an asset data management system used by Main Roads. STREAMS is Main Roads ITS platform that manages all aspects of traffic operations on surface streets and motorways.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
<th>Justification</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of traffic</td>
<td>Average annual daily traffic (AADT) in vehicles per day.</td>
<td>Indicates number of customers</td>
<td>• ARMIS database</td>
</tr>
<tr>
<td>Percentage of heavy vehicles</td>
<td>Percentage of heavy/commercial vehicles compared to all types of vehicles travelling on the road.</td>
<td>Indicates freight / economic importance</td>
<td>• ARMIS database</td>
</tr>
<tr>
<td>Crash cost per VKT</td>
<td>Total cost of crashes, based on the AUSTROADS costs by DCA code for the year divided by the vehicle kilometres travelled (VKT).</td>
<td>Indicates cost of crashes to the community</td>
<td>• ARMIS – Road Crash 2 database</td>
</tr>
<tr>
<td>Number of incidents per kilometre</td>
<td>Total number of incidents (planned or unplanned, including major and minor accidents, road-works, congestion, and so on) for the year, divided by the length of the road.</td>
<td>Indicates number of incidents across the network</td>
<td>• Traffic management centre databases</td>
</tr>
<tr>
<td>Criteria</td>
<td>Definition</td>
<td>Justification</td>
<td>Data Source</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Total incident duration</td>
<td>Incident duration is defined as the length of time between when the incident is detected or reported and when the traffic flow returns to normal. Total incident duration (in minutes) for all incidents is summated for the year.</td>
<td>Indicates road outage – mostly incidents on urban roads and flooding on rural roads</td>
<td>• Traffic management centre databases</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• STREAMS incident reporting</td>
</tr>
<tr>
<td>Percentage time volume-capacity ratio &gt; 0.85</td>
<td>Percentage of time where the volume-capacity ratio exceeds 0.85, indicating congested conditions. Calculated using at least a weeks worth of data.</td>
<td>Indicates level of congestion</td>
<td>• ARMIS – TARS database</td>
</tr>
<tr>
<td>Percentage of heavy vehicles overloaded</td>
<td>Percentage of illegally overloaded vehicles. compared with the total number of heavy vehicles.</td>
<td>Indicates stress level on roads</td>
<td>• Queensland Transport inspectors data</td>
</tr>
</tbody>
</table>

### 3.2.2 Classification

Table 3.2.2 indicates the classification, based on need, for each road type. The road has to fulfil at least four (4) of the criteria in that classification to qualify. Numbers are based on experience and engineering judgement.
Developing road-based ITS deployment guidelines for Queensland

Table 3.2.2 – Road Classification

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Classification</th>
<th>AADT</th>
<th>Heavy vehicles</th>
<th>Crash cost / VKT</th>
<th>No incidents / km</th>
<th>Total incident duration</th>
<th>% of time V/C &gt; 0.85</th>
<th>Overloaded heavy vehicles % of heavy vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>veh/day</td>
<td>%</td>
<td>$10^4 per 10^8 VKT</td>
<td>$10^3 per km</td>
<td>min</td>
<td>% of time</td>
<td>% of heavy vehicles</td>
</tr>
<tr>
<td>Urban</td>
<td>Limited access, grade separated</td>
<td>Heavy</td>
<td>&gt; 60,000</td>
<td>&gt; 10</td>
<td>&gt; 400</td>
<td>&gt; 2,000</td>
<td>&gt; 1,000</td>
<td>&gt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>20,000 – 60,000</td>
<td>5 – 10</td>
<td>200 – 400</td>
<td>500 – 2,000</td>
<td>100 – 1,000</td>
<td>0 – 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 20,000</td>
<td>&lt; 5</td>
<td>&lt; 200</td>
<td>&lt; 500</td>
<td>&lt; 100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy</td>
<td>&gt; 40,000</td>
<td>&gt; 10</td>
<td>&gt; 400</td>
<td>&gt; 2,000</td>
<td>&gt; 1,000</td>
<td>&gt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>20,000 – 40,000</td>
<td>5 – 10</td>
<td>200 – 400</td>
<td>500 – 2,000</td>
<td>100 – 1,000</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 20,000</td>
<td>&lt; 5</td>
<td>&lt; 200</td>
<td>&lt; 500</td>
<td>&lt; 100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy</td>
<td>&gt; 25,000</td>
<td>&gt; 3</td>
<td>&gt; 250</td>
<td>&gt; 1,000</td>
<td>&gt; 500</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>15,000 – 25,000</td>
<td>1 – 3</td>
<td>100 – 250</td>
<td>250 – 1,000</td>
<td>50 – 500</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 15,000</td>
<td>&lt; 1</td>
<td>&lt; 100</td>
<td>&lt; 250</td>
<td>&lt; 50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Limited access, at grade</td>
<td>Heavy</td>
<td>&gt; 25,000</td>
<td>&gt; 3</td>
<td>&gt; 250</td>
<td>&gt; 1,000</td>
<td>&gt; 500</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>15,000 – 25,000</td>
<td>1 – 3</td>
<td>100 – 250</td>
<td>250 – 1,000</td>
<td>50 – 500</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 15,000</td>
<td>&lt; 1</td>
<td>&lt; 100</td>
<td>&lt; 250</td>
<td>&lt; 50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Urban, two-way roads</td>
<td>Heavy</td>
<td>&gt; 10,000</td>
<td>&gt; 15</td>
<td>&gt; 400</td>
<td>&gt; 10</td>
<td>&gt; 5,000</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>5,000 – 10,000</td>
<td>5 – 15</td>
<td>200 – 400</td>
<td>5 – 10</td>
<td>500 – 5,000</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 5,000</td>
<td>&lt; 5</td>
<td>&lt; 200</td>
<td>&lt; 5</td>
<td>&lt; 500</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Limited access, at grade</td>
<td>Heavy</td>
<td>&gt; 10,000</td>
<td>&gt; 15</td>
<td>&gt; 400</td>
<td>&gt; 10</td>
<td>&gt; 5,000</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>5,000 – 10,000</td>
<td>5 – 15</td>
<td>200 – 400</td>
<td>5 – 10</td>
<td>500 – 5,000</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 5,000</td>
<td>&lt; 5</td>
<td>&lt; 200</td>
<td>&lt; 5</td>
<td>&lt; 500</td>
<td>0</td>
</tr>
<tr>
<td>Rural</td>
<td>Multi-lane</td>
<td>Heavy</td>
<td>&gt; 5,000</td>
<td>&gt; 5</td>
<td>&gt; 250</td>
<td>&gt; 5</td>
<td>&gt; 2,500</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>2,000 – 5,000</td>
<td>3 – 5</td>
<td>100 – 250</td>
<td>2 – 5</td>
<td>250 – 2,500</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 2,000</td>
<td>&lt; 3</td>
<td>&lt; 100</td>
<td>&lt; 2</td>
<td>&lt; 250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Urban, two-way roads</td>
<td>Heavy</td>
<td>&gt; 5,000</td>
<td>&gt; 5</td>
<td>&gt; 250</td>
<td>&gt; 5</td>
<td>&gt; 2,500</td>
<td>&gt; 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate</td>
<td>2,000 – 5,000</td>
<td>3 – 5</td>
<td>100 – 250</td>
<td>2 – 5</td>
<td>250 – 2,500</td>
<td>0 – 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light</td>
<td>&lt; 2,000</td>
<td>&lt; 3</td>
<td>&lt; 100</td>
<td>&lt; 2</td>
<td>&lt; 250</td>
<td>0</td>
</tr>
</tbody>
</table>
3.3 ITS Deployment Recommendations

3.3.1 ITS Services

As discussed in Section 2.1, the recommendations in this framework are road-based ITS which Main Roads has direct control over. This section describes the ITS used in Tables 3.3.2 and 3.3.3. ITS is broadly defined as devices, communications, software, policies, guidelines and procedures deployed to enhance road operations. Also, since this document is used for concept planning and ITS gap analysis, only systemic ITS issues are included.

Due to the broad definition of ITS, it has been suggested that the title of the guidelines change to "Guidelines for Road Operation Services and ITS Deployment". This will occur in the next version of the guidelines.

Incident Management Detection

- **Help phones** are deployed on all roads to enable road users to communicate directly with TMC staff.
- **Vehicle detectors** in this context are used to notify the TMC automatically of unplanned incidents and even congestion on the network.

Incident Management Verification

- **Closed Circuit Television (CCTV)** technology is deployed to verify reported incidents on the network. Other methods of verification include communications with police and emergency services.

Incident Management Response

- **Emergency Vehicle Priority (EVP)** has been deployed at specific intersections near hospitals to reduce the travel time of the emergency vehicle. Main Roads has also looked at EVP on a network level. The latter is more applicable in this context since it is a systemic ITS issue.
- **Route diversions** define alternate routes and clear implementation plans for unplanned incidents on the network.
- **Emergency vehicle cross-overs** enable vehicles to cross to the other carriageway at regular intervals along the roadway.
- **Incident Response Coordinators (IRC) / Traffic Response Units (TRU)** provide an important service at unplanned incidents. IRC and TRU staff are responsible for traffic management in the outer cordon at incidents, providing emergency services with support and acting as a communication conduit between the TMC staff and the incident. IRC are Main Roads employed staff, at this stage only employed in the South Coast Hinterland District and the TRU are contractors through Brisbane City Council, with support from Main Roads. Both services also provide minor breakdown services to motorists.
- **Contracted services – dedicated towing and incident clean-up** provides motorists with more efficient incident clearance times.
Traveller Information

- **Variable Message Signs (VMS)** are deployed along major routes advising motorists of conditions downstream of the sign, information on future planned events, actual incident management (including route diversions) and traveller information.

- **Changeable Message Signs (CMS)** are similar to VMS but with a limited number of message alternatives. They are a low-cost alternative to deploying a fully variable sign. An example is a tri-vision sign, which can mechanically change between three (3) static messages.

- **Web cameras** provide users with visual information of their route before they leave for the journey. At this stage, Main Roads has two (2) web cameras in Brisbane at www.mainroads.qld.gov.au.

- **Flood detection** is linked to the RACQ website (www.racq.com.au) where the real-time road condition for all roads in Queensland are displayed. The website indicates, through red, amber and green 'traffic lights', whether the road is open or closed to traffic. Obviously, flood detection is deployed at flood-prone sites, (that is, problem-specific), but is included in these guidelines for completeness.

- **Environmental monitoring** detects adverse environmental driving conditions such as fog detection and slippery roads. The monitoring needs to be linked to a VMS or CMS to communicate the warning to motorists. Again, environmental monitoring is deployed where there is a high proportion of incidents relating to the whether, but is included in these guidelines for completeness.

- **Passenger information** signs are deployed to advise public transport passengers of real-time bus information. Guidelines for these signs will be developed in the future.

Traffic Management

- **Variable Speed Limits (VSL)** provide the ability to alter the speed limit according to the traffic conditions thereby increasing the capacity of the road during congested periods and reducing the chance of secondary accidents during incident response. VSL is deployed in problem specific cases.

- **Ramp metering** controls the vehicle demand onto a motorway during peak periods thereby increasing the capacity on the motorway lanes.

- **Traffic signal coordination** produces green waves for motorists and reduces overall delays on major routes.

- **Bus queue jumps, bus signal priority and bus / High Occupancy Vehicle (HOV) lane guidelines** will be developed in the future. Main Roads is shifting its focus towards multi-modal approach to traffic management. Policies for these measures are currently being developed.

Heavy Vehicle Management

- **Weigh-In-Motion (WIM) site** location guidelines are specified in the state's WIM Strategy, but included here for completeness.

- **WIM image capture** is technology linking weight measurements with number plates. The technology cannot be used directly for enforcement due to the dynamic nature of the WIM sites,
but the technology is useful for deciphering WIM data and tracking freight company overloading trends. The technology is currently being trialled and will be included in these guidelines once further implementation is approved.

- *Data / classification sites* are used to collect data regarding the classification and volumes along the road. The data feeds into WIM planning and road maintenance processes.

- *Interception sites* are located throughout the state enforcing heavy vehicle overloading.

- *Heavy vehicle advisory systems* are deployed to advise heavy vehicles of downstream road conditions. For example, advising heavy vehicles of a steep grade. The system detects the heavy vehicle and changes the message accordingly. Again, advisory systems are deployed in problem-specific cases, but are included in the guidelines for completeness.

For more information on specific ITS in Queensland, refer to the Main Roads' website or TRUM Manual or contact the Network Operations and Performance Branch, Traffic and Road Use Management Division, Road System and Engineering Group on (07) 3834 9421.

### 3.3.2 ITS Deployment Recommendations

Based on the type and classification of the road, ITS deployment guidelines are assigned to urban roads according to Table 3.3.2. 'P' indicates that the ITS *shall* be provided, 'R' indicates that the ITS *should* be provided (that is, recommended), 'N' indicates that the ITS *may* be provided (that is, not required) and 'S' indicates that the ITS is to be deployed under problem-specific circumstances.

The guidelines are deliberately stringent to give districts in Main Roads specific guidelines to allocate resources. If ITS is specified in the guidelines, but common sense indicates its not required, then reasons why the ITS will not be implemented needs to be given (that is, 'if not, why not' rule).
## Table 3.3.2 – ITS Deployment for Urban Roads

<table>
<thead>
<tr>
<th>ITS</th>
<th>Road type and classification</th>
<th>Limited access, grade separated</th>
<th>Limited access, at grade</th>
<th>Multi-lane</th>
<th>Two-lane, two-way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident Management Detection</td>
<td>Help phones</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Vehicle detectors</td>
<td>P</td>
<td>R</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Incident Management Verification</td>
<td>Closed Circuit Television (CCTV)</td>
<td>P</td>
<td>R</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Incident Response</td>
<td>Incident Response Coordinator / Traffic Response Unit (TRU)</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Contracted service – dedicated towing</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Contracted service – incident clean-up</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Route diversions</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Emergency Vehicle Priority (EVP)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Emergency vehicle cross-overs</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>Variable and Changeable Message Signs (VMS / CMS)</td>
<td>P</td>
<td>R</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Web cameras</td>
<td>R</td>
<td>R</td>
<td>N</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Flood detection</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Environmental monitoring</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Passenger information</td>
<td>Future development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Management</td>
<td>Traffic signal coordination</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Ramp metering</td>
<td>R</td>
<td>R</td>
<td>N</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Variable Speed Limits (VSL)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Bus queue jumps</td>
<td>Future development</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Bus signal priority</td>
<td>Future development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bus / High Occupancy Vehicle (HOV) lanes</td>
<td>Future development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy Vehicle Management</td>
<td>Weigh-In-Motion (WIM) sites</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Data / classification sites</td>
<td>P</td>
<td>P</td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Interception sites</td>
<td>P</td>
<td>R</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>WIM image capture</td>
<td>Future development</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Heavy vehicle advisory system</td>
<td>S</td>
<td>S</td>
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<td>S</td>
</tr>
</tbody>
</table>
Table 3.3.2 – ITS Deployment for Urban Roads

<table>
<thead>
<tr>
<th>ITS</th>
<th>Road type and classification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limited access, grade separated</td>
</tr>
<tr>
<td>Incident Management Detection</td>
<td></td>
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<tr>
<td>Help phones</td>
<td>P</td>
</tr>
<tr>
<td>Vehicle detectors</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td>Incident Management Response</td>
<td></td>
</tr>
<tr>
<td>Incident Response Coordinator</td>
<td></td>
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<tr>
<td>Traffic Response Unit (TRU)</td>
<td>P</td>
</tr>
<tr>
<td>Contracted service – dedicated towing</td>
<td></td>
</tr>
<tr>
<td>Contracted service – incident clean-up</td>
<td></td>
</tr>
<tr>
<td>Route diversions</td>
<td>P</td>
</tr>
<tr>
<td>Emergency Vehicle Priority (EVP)</td>
<td></td>
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<tr>
<td>Emergency vehicle cross-overs</td>
<td></td>
</tr>
<tr>
<td>Traveller Information</td>
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<tr>
<td>Variable and Changeable Message Signs (VMS / CMS)</td>
<td></td>
</tr>
<tr>
<td>Web cameras</td>
<td>P</td>
</tr>
<tr>
<td>Flood detection</td>
<td>S</td>
</tr>
<tr>
<td>Environmental monitoring</td>
<td>S</td>
</tr>
<tr>
<td>Passenger information</td>
<td>P</td>
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<tr>
<td>Traffic Management</td>
<td></td>
</tr>
<tr>
<td>Traffic signal coordination</td>
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<tr>
<td>Ramp metering</td>
<td>R</td>
</tr>
<tr>
<td>Variable Speed Limit (VSL)</td>
<td>S</td>
</tr>
<tr>
<td>Bus queue jumps</td>
<td>S</td>
</tr>
<tr>
<td>Bus signal priority</td>
<td>Future development</td>
</tr>
<tr>
<td>Bus / High Occupancy Vehicle (HOV) lanes</td>
<td></td>
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<tr>
<td>Heavy Vehicle Management</td>
<td></td>
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<tr>
<td>Weigh-In-Motion (WIM) sites</td>
<td></td>
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<tr>
<td>Data / classification sites</td>
<td></td>
</tr>
<tr>
<td>Interception sites</td>
<td>P</td>
</tr>
<tr>
<td>WIM image capture</td>
<td>Future development</td>
</tr>
<tr>
<td>Heavy vehicle advisory system</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.3.3 below indicates the ITS deployment recommendations for rural roads. 'P' indicates that the ITS shall be provided, 'R' indicates that the ITS should be provided (that is, recommended), 'N' indicates that the ITS may be provided (that is, not required) and 'S' indicates that the ITS is to be deployed under problem-specific circumstances.
4 Future Steps

The author has started a "masters by research" at the Queensland University of Technology to validate the framework from first principles. Extensive consultation will be part of the process. Following this, the Traffic Alliance Group in Main Roads will most likely sign-off the framework.

A state-wide deficiency or gap analysis will completed as the first step in the validation process. Then, each district in Main Roads will apply the guidelines to their roads. The refinement of the guideline will be based on the results and feedback collected.

Additional ITS services such as passenger information, bus queue jumps, bus signal priority, bus / HOV lanes and WIM image capture will be added to the table as the next stage of work.

5 References


Department of Main Roads. 2003, Strategic Plan 2003-2008: Essential to connecting Queensland.

6 Acknowledgments

We wish to acknowledge all those involved in the working group, especially Dennis Walsh and Sanjay Ram who were responsible for initiating the idea for the framework.
7 Appendices

7.1 Definitions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Average Annual Daily Traffic</td>
</tr>
<tr>
<td>ARMIS</td>
<td>A Road Management Information System (asset data management system for Main Roads)</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>CMS</td>
<td>Changeable Message Sign</td>
</tr>
<tr>
<td>EVP</td>
<td>Emergency Vehicle Priority</td>
</tr>
<tr>
<td>HOV</td>
<td>High Occupancy Vehicle</td>
</tr>
<tr>
<td>IRC</td>
<td>Incident Response Coordinator</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
</tr>
<tr>
<td>STREAMS</td>
<td>Main Road's integrated ITS platform that manages all aspects of traffic operations on surface streets and motorways</td>
</tr>
<tr>
<td>TMC</td>
<td>Traffic Management Centre</td>
</tr>
<tr>
<td>TRU</td>
<td>Traffic Response Unit</td>
</tr>
<tr>
<td>TRUM</td>
<td>Traffic and Road Use Management</td>
</tr>
<tr>
<td>VKT</td>
<td>Vehicle Kilometres Travelled</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable Message Sign</td>
</tr>
<tr>
<td>VSL</td>
<td>Variable Speed Limit</td>
</tr>
<tr>
<td>WIM</td>
<td>Weigh-In-Motion</td>
</tr>
</tbody>
</table>
Session 4A

Integrated planning in transport – are we getting it right?
The Perception of Community Severance

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The Perception of Community Severance

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KEYWORDS: Severance, community perception, future assessment methods

ABSTRACT

Community severance is a concept that has existed for years in many countries’ transport appraisal systems but who can claim to know what it means?

Most severance assessment frameworks assess only part of the picture. A typical definition is that given in the UK Design Manual for Roads and Bridges:

*The separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows*

However, research has indicated that severance means many things to many people. For example, research carried out in the early 1990s by TRL (Clark et al, 1991) found that communities see severance as a mixture of:

- Pedestrian delay;
- Trip diversion / suppression;
- Pollution;
- Danger; and
- Overall unpleasantness.

This paper draws on a research project that TRL are currently undertaking for the Department for Transport in the UK and:

- Outlines practitioners’ and communities’ perception of severance; and
- Assesses how a broader picture of severance could be carried forward to practical and effective severance assessment methods.
1 Introduction

The UK Department for Transport (DfT) has identified the need to investigate the challenges and issues inherent in community severance assessment and mitigation\(^1\). Historically, there has been substantial research into community severance assessment in the UK leading to a methodology that is now included in the Design Manual for Roads and Bridges (DMRB) Volume 11. However, many challenges are faced by practitioners as the need for a more holistic approach to addressing social and equity issues emerges.

Such challenges include how to assess the psychological aspects of community severance, how to effectively assess and mitigate community severance caused by all modes of transport and how to link community severance into the social exclusion and accessibility agenda.

TRL Limited was commissioned in December 2003 to undertake research with the following aims:

- Search, identify, and review the international and domestic approaches to, and methodologies used in, measures of community severance;
- Review the existing evidence generated by such approaches and methodologies (including international approaches) and identify any potentially transferable lessons;
- Identify the range of mitigation measures used to reduce severance effects and summarise the existing evidence on the effectiveness of these measures;
- Identify any knowledge gaps in UK practice with regards to measures of severance and mitigation;
- Recommend how measures of severance can be developed to robustly capture a broad range of impacts on communities of transport schemes across a range of relevant modes; and
- Recommend how mitigation measures could be further developed, particularly where new aspects of severance have been identified.

Discussions with the DfT and Highways Agency (HA) Steering Group determined that the focus of the project should be on identifying key research questions shown in Box 1.

---

\(^1\) Issues related to mitigation will be more fully investigated as part of the next stage of the project. Therefore, this paper concentrates on issues related to assessment.
Box 1: Key research questions

**What is severance?**
- How do communities and practitioners perceive severance?
- Are all significant dimensions of severance identified, measured and, therefore, mitigated against in current methods of severance assessment?

**Severance assessment and mitigation measures**
- How is severance being identified?
- What aspects of severance are being measured and how?
- What mitigation measures are being used and what are their advantages and disadvantages?
- Are other countries assessing and mitigating severance effects in a more effective manner?

**What is practical?**
- Is it practical to measure all aspects of severance?
- What are the difficulties involved?

The project is a 16 month programme but is at a relatively early stage as the scoping review has just been produced. This paper will outline the conclusions of this stage of the research. A key early stage of the research has been the consideration of what severance is perceived to be by communities and practitioners. Without this insight it is impossible to consider how severance can be assessed and how it can be mitigated effectively. This paper will review how the project so far has assessed the perception of severance and how this could affect the design of severance assessment and mitigation methodologies.

## 2 Methodology

An assessment of the perception and definition of severance was undertaken through a literature review and a consultation with UK practitioners based in local highway authorities.

### 2.1 Literature Review

Information on severance assessment and mitigation can be found in a variety of literature from government guidance and government research, conference and journal papers and academic research to published and unpublished grey literature. A comprehensive literature search was carried out using the TRACS database. The TRACS database (Transport and Road Abstracting and Cataloguing system) contains bibliographic references and abstracts of English and foreign language articles from journals, books and research reports. It is the English language version of the world-wide ITRD (International Transport Research Documentation) database and therefore regularly receives material from the USA, Australia, Scandinavia, the Netherlands, Canada and
other countries, in addition to our own UK input. The database comprises some 300,000 abstracts. In addition to this a targeted web search was carried out and sources such as MORI (Market and Opinion Research International) were searched in order to identify if any public opinion surveys have been undertaken on people’s views of transport impacts. Figure 2.1 shows the types of literature that were reviewed.

Figure 2.1 - The types of literature reviewed

2.2. Consultation

Numerous practitioners in the UK have first hand experience of assessing and mitigating severance throughout the UK, particularly in the field of engineering and transport planning within Local Authorities. A short questionnaire was sent to 45 practitioners through the CSS (formerly the County Surveyors Society) Transport and Environment Committee. The CSS represents local authority chief officers with responsibility for Strategic Planning, Transportation, the Environment, Waste Management and Economic Development and as such has a close working relationship with Local Authorities across the UK 11 questionnaires were received. A range of opinions were gathered through the questionnaire and a discussion group (see below) on what factors constitute severance, how severance should be defined and how the assessment and mitigation of severance needs to be changed.

3 Definition and Perception of Severance

This section of the paper will review the work undertaken by the study to define how the term community severance is perceived. The study analysed the following:

- The changing nature of the definition of the term community severance;
• How practitioners and communities\(^2\) view the factors that make up severance; and
• The gap between what severance is perceived to be and the methods available to measure these effects.

### 3.1 The definition of community severance

The concept of community severance has been discussed in transport policy and appraisal documents many times over the last eighty years. However, in that time, the meaning of the concept has evolved. Table 3.1 shows some key aspects of this change.

<table>
<thead>
<tr>
<th>Originator</th>
<th>Year</th>
<th>Definition and meaning</th>
<th>Reference Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigou</td>
<td>1924</td>
<td>Severance is the divorce between residence and work place</td>
<td>Clark et al, 1992</td>
</tr>
<tr>
<td>Ministry of Transport To Traffic in Towns Report UK Urban Motorway Project Team OECD</td>
<td>1963</td>
<td>Reflected the idea that geographical areas could contain a local cohesiveness</td>
<td>Clark et al, 1992</td>
</tr>
<tr>
<td></td>
<td>1971</td>
<td>The sum of the divisive effects a major urban road has on the inhabitants either side of it</td>
<td>Clark et al, 1992</td>
</tr>
<tr>
<td></td>
<td>1973</td>
<td>Disturbance to established neighbourhoods, social patterns, life styles, shopping patterns etc that have cultural and psychological impacts</td>
<td>OECD Road Research Group, page 41</td>
</tr>
<tr>
<td></td>
<td>1983</td>
<td>The separation of residents from facilities and services they use within their community, from friends and relations and perhaps from place of work as a result of changes in road patterns and traffic levels</td>
<td>Ministry of Transport Manual of Environmental Appraisal, Part B, Section 4</td>
</tr>
<tr>
<td>Clark et al</td>
<td>1992</td>
<td>Community severance is the sum of the divisive effects a road has on those in the locality</td>
<td>Clark et al, 1992</td>
</tr>
<tr>
<td>Department for Transport</td>
<td>1993</td>
<td>The separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows</td>
<td>DMRB Volume 11, 1993</td>
</tr>
<tr>
<td>Chinn and Davies</td>
<td>1995</td>
<td>The range of community effects from small increases in journey lengths or times through to the situation where journeys are no longer made, or alternative facilities are visited because of the additional inconvenience, delay or danger caused by the barrier or because the</td>
<td>Chinn and Davies, 1995</td>
</tr>
</tbody>
</table>

\(^2\) It has not been possible to undertake primary research on communities views of the term severance. Secondary data sources have been used where possible. Consultation with communities will form a large part of the next phase of research.
### A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

<table>
<thead>
<tr>
<th>Originator</th>
<th>Year</th>
<th>Definition and meaning</th>
<th>Reference Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SACTRA</td>
<td>1999</td>
<td>barrier is perceived to be impassable Separation of adjacent areas by road or rail infrastructure or heavy traffic, causing negative impact on human beings or flora and fauna</td>
<td>SACTRA, 1999</td>
</tr>
<tr>
<td>Scottish Executive</td>
<td>2003</td>
<td>The positive or negative effects of a scheme on the ability to move around on foot bicycle or horseback. It reflects in particular the improvement in or deterioration of the ability of the community to cross major road or rail links and thereby reach local destinations</td>
<td>Scottish Executive, 2003. Scottish Transport Appraisal Guidance</td>
</tr>
</tbody>
</table>

(Source: Adapted from Guo, Black and Dunne, 2001)

In summary, the principal ways in which the definition of severance has changed are:

- In the 1920s and 1930s community severance was seen only as the separation of residence and work places;

- By the late 1960s the social dimension of severance was recognised by the Buchanan Report (Ministry of Transport, 1963) which documented the idea that identifiable geographical areas could contain a local cohesiveness. This recognition was developed by the newly established Urban Motorways Committee in their report in 1972 (Urban Motorways Committee, 1972). This Committee recognised that severance not only involved physical separation, but that it incorporated other undesirable impacts including noise, visual effects and disruption to neighbourhood lifestyle. This led to a more widely embracing definition of severance that recognised both physical and psychological elements.

- This theme continued until 1993 with the publication of the DMRB Volume 11 which included guidance on severance. The definition contained within DMRB Volume 11 limits the appraisal to consideration of the separation of residents from facilities and could be considered as a retrograde step. Since publication of the DMRB Volume 11 guidance consideration of severance within UK transport has been limited to appraisal of physical severance. This is possibly a reflection of the fact that psychological severance is perceived to be difficult to assess.

Evidence from the practitioner consultation and discussion group suggests that practitioners believe that a definition of community severance should include aspects of both physical and psychological severance. Definitions suggested for this project encompass concepts such as community division and psychological barriers. The respondents of the severance questionnaire were asked if they could add anything to the existing DMRB Volume 11 definition of severance. Table 3.2 shows the suggestions given and includes some issues that are not covered by the existing UK definition. These include the important of longitudinal severance, links to accessibility, effects on different groups of people and economic impacts of severance.
Table 3.2 - Definitions of severance suggested by consultees

<table>
<thead>
<tr>
<th>DMRB definition of community severance should include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The DMRB definition implies crossing the road, but walking along a road with no footway is also severance.</td>
</tr>
<tr>
<td>Severance definition should include all groups not just people who walk or cycle. The definition doesn’t take into consideration other traffic which prevents cars from moving. Some users may have no option but to use the car and severance caused to them should be considered.</td>
</tr>
<tr>
<td>As a general description the DMRB definition seems still to fit. Maybe the word ‘accessibility’ should be in it somewhere now, given the emphasis on accessibility planning.</td>
</tr>
<tr>
<td>Should include movement of pedestrians and cyclists within their communities</td>
</tr>
<tr>
<td>Economic and social impacts of severance. In extreme cases severance can lead to significant long-term decline of an area with the attendant social problems that result.</td>
</tr>
<tr>
<td>Since the arrival of the NATA and GOMMMS appraisal methods and the associated AST we seem to have lost any way of measuring business or commercial severance including farm severance – in DMRB there is a “land use” category which could accommodate these issues but there is now no obvious place to assess them. I agree that the community severance definition is fine and that business severance should not be assessed as part of this objective as, especially in the case of a by-pass, adverse farm severance and benefits to community severance are likely to cancel each other out, but somewhere is needed in the new appraisal methodology to assess business severance. Comments: it would be difficult to assess whether farm severance and community severance would cancel each other out.</td>
</tr>
<tr>
<td>Doesn’t include resident-resident separation and perceived severance</td>
</tr>
</tbody>
</table>

3.2 Factors that constitute severance

It can be seen from the definitions of severance listed above that severance is generally disaggregated into two mechanisms (Tate, 1997):

- Physical severance relating to the direct effect on trips including trip diversion and trip suppression; and
- Psychological severance that stems from feelings of being cut off from services or from social interaction from other members of your community and the amenity effects of traffic such as noise, pollution, visual intrusion and danger that can have a psychological and health effect.

Guo, Black and Dunne (2001) have further disaggregated physical severance into two mechanisms:

- Static severance which is caused by the road infrastructure itself; and
- Dynamic (or longitudinal) severance which is caused by vehicular traffic flowing along it.
This type of severance will vary according to the level and behaviour of traffic on a road. Therefore, severance can be classified into three separate mechanisms:

- Physical severance caused by a physical barrier which can be any type of transport infrastructure including underpasses or overbridges which may generate fear of use;
- Physical severance caused by the flow and behaviour of traffic using the infrastructure; and
- Psychological severance which is caused by either of the two factors (or a combination of both) and results in the feeling of being cut off or of the decision to forgo certain trips or routes.

There have been very few surveys on the perception of the factors of any type of community severance. However, those that have been undertaken reinforce the view that community severance is a complex phenomenon made up of many effects. For example, Clark et al (1991) found that severance is perceived by the public as a number of effects which ideally should be identifiable through an assessment method:

Pedestrian delay;
- Effects on trip diversion and suppression;
- Noise and pollution;
- Perceived danger; and
- Overall unpleasantness.

A literature search (including a search of recent MORI transport surveys) did not reveal any recent surveys on community perceptions of the effects of transport. This was confirmed by consultees who were not aware of any studies that looked specifically at community perception of severance.

Research in New Zealand has also confirmed that severance is governed by numerous factors. A review undertaken Tate (1997) showed the multifaceted nature of community severance with a diagram which is presented in Figure 3.1.
Figure 3.1 - The factors that constitute severance

It is clear from the above studies that psychological aspects of severance are considered as important as physical aspects of severance by communities. Past research has emphasised this issue stating it is important to consider the needs and attributes of communities when assessing the severity of severance. The first major study to examine the effect of severance on community cohesion was that undertaken by Appleyard and Lintell in San Francisco. This study found a direct correlation between lower traffic flows and speeds with increased levels of community cohesion. Community cohesion was measured by such factors as the number of local friends and acquaintances, the number of interactions between neighbours, amount of walking and the size of an area considered by people to be their home territory (Appleyard and Lintell, 1972).

Studies have shown that severance can affect community cohesion in a negative way. However, it has also been claimed that the level of community cohesion already present in a community can be identified as an underlying measure of the susceptibility of a community to further social severance (Kirby, 1981). Thus, it has been claimed that community cohesion can also affects severance. The Kyeemag – Chullora Road Inquiry in New South Wales (Kirby, 1981) was one of the first studies to consider this issue. The Inquiry found that highly mobile communities with less developed community cohesion were less likely to be affected by severance, although it is unclear whether this is because the community was already suffering some form of severance. This idea is one that has persisted in the literature on community severance but as far as the project team are aware this finding has never been validated in the UK.

4 Implications for Severance Assessment

The project has used the available evidence on perception of severance to build a model of what should be included in a severance assessment framework. This considers both the type of effect
that the assessment framework should consider and the assessment stages the framework should include. This is shown in Table 4.1.

**Table 4.1 - Factors to be included in a severance assessment framework**

<table>
<thead>
<tr>
<th>Types</th>
<th>Effect</th>
<th>Assessment Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical barrier</td>
<td>Pedestrian / cyclist delay</td>
<td>• Identification of problems or areas more sensitive to severance (scoping)</td>
</tr>
<tr>
<td>(infrastructure)</td>
<td>Pedestrian / cyclist diversion</td>
<td>• Impact identification</td>
</tr>
<tr>
<td>Traffic flow and behaviour</td>
<td>Trip suppression</td>
<td>• Impact forecasting</td>
</tr>
<tr>
<td>(traffic speed and volume, %</td>
<td>Motorised trip diversion</td>
<td>• Identification of mitigating measures</td>
</tr>
<tr>
<td>of HGV’s)</td>
<td>Journey amenity</td>
<td>• Impact significance</td>
</tr>
<tr>
<td>Psychological</td>
<td>Economic effects</td>
<td></td>
</tr>
<tr>
<td>Community cohesion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived danger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise, visual intrusion and pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall unpleasantness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disruption of lifestyle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A number of severance assessment methods have been reviewed as part of the project and compared against the severance assessment framework. The purpose of this is to see whether there are any severance effects that are not being assessed as part of severance assessment. The methods reviewed were divided into the categories shown in Table 4.2.

**Table 4.2 - Types of method found in the literature review**

<table>
<thead>
<tr>
<th>Assessment Stage</th>
<th>Identification of Problem Areas</th>
<th>Impact Identification and Forecasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility measures</td>
<td></td>
<td>Checklists</td>
</tr>
<tr>
<td>Indicators</td>
<td></td>
<td>Modelling techniques</td>
</tr>
<tr>
<td>Consultation based methods</td>
<td></td>
<td>Consultation based methods</td>
</tr>
<tr>
<td>Checklists</td>
<td></td>
<td>Accessibility / barrier measures</td>
</tr>
</tbody>
</table>

The methods found vary from the simple to the complex. Simple methods include checklists that identify problem areas and impacts. Consultation methods are also used to identify community concerns. The types of evidence produced by these methods are lists of impacts or concerns. The potential benefit of these methods is their simplicity in use and their use in assisting with impact identification. However, checklists and consultation methods cannot be used alone as they do not consider the significance of impacts.

The most complex methods are modelling techniques that attempt to define the relationships between key variables in order to identify where impacts may be experienced (impact identification) and their significance (impact forecasting and impact significance). Such modelling techniques vary from those which address one aspect of severance, for example, pedestrian delay, to those which attempt to capture several effects of severance into one figure (this is sometimes an
index and sometimes a single monetary value). Evidence produced by these methods is usually a single figure. The reliability of these figures can be questioned, however, as in many cases it is unclear what validation has been carried out on the relationships that underlie the methods. The main benefit of modelling methods is that they make it easier to compare the effects of two schemes. Where monetary values are used, the severance effect can also be compared against potential benefits of a scheme (as long as the benefits are also expressed as a monetary value). However, some practitioners dislike reducing environmental and social effects to a monetary value. This was a finding re-iterated by the discussion group for the project.

Indicators are used in impact assessment to simplify an assessment and may be used at a number of stages from scoping and impact identification through to monitoring. In this case, indicators have been found at only one stage of severance assessment – at the scoping stage in order to identify potential problem areas. Examples include indicators that assess the friendliness of the pedestrian environment or those that measure the social cohesion of a community. No indicators have been found that are designed to identify and predict impacts. The main benefit of indicators is that they reduce large amounts of information to a manageable size. They also present information in a way that is meaningful to the public.

The comparison of the methods reviewed against the severance assessment framework revealed a number of issues. The main lessons learnt in terms of severance assessment methods was:

- There are ways of measuring psychological aspects of community severance but none are routinely used in the UK;
- None of the methods identified cover the complete range of assessment stages. Methods are either useful as a scoping tool or useful as an impact identification and / or impact forecasting tool. No method has been found that is useful at both stages;
- None of methods identified suggest an effective and useful form of assessing significance including the significance of effects in relation to different groups of people;
- There are no methods identified that measure the economic effects of severance; and
- Very few of the methods take into account the effectiveness of mitigation.

However, a number of methods were identified that require further investigation. These are shown in Table 4.3.
Table 4.3 – Methods worthy of further investigation

<table>
<thead>
<tr>
<th>Method</th>
<th>Issues for Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical severance methods</strong></td>
<td></td>
</tr>
<tr>
<td>Models that can be used to model crossing behaviour and pedestrian delay. Examples include pedestrian delay models, crossing indexes and conflict indexes.</td>
<td>The cost effectiveness of modelling techniques needs to be considered as an important issue. The discussion group and the questionnaire indicated that some practitioners feel that a model which generates a single answer can never be applicable in all circumstances.</td>
</tr>
<tr>
<td>Broader modelling techniques that attempt to combine the different elements of severance into an equation. Examples include the Swedish (referenced in Tate, 1997) and Denmark (referenced in Tate, 1997) approaches.</td>
<td></td>
</tr>
<tr>
<td>Indicator based methods related to severity of existing severance. This might entail the adaptation of indicators that are used currently to address accessibility and walking and cycling permeability.</td>
<td>These may form part of a severance audit framework that could be used to augment the accessibility planning methodology.</td>
</tr>
<tr>
<td>Cost Benefit Analysis</td>
<td>This could be investigated as a way to monetise severance impacts.</td>
</tr>
<tr>
<td><strong>Psychological severance methods</strong></td>
<td></td>
</tr>
<tr>
<td>Community cohesion and stability indicators that can help define the level of community cohesion present in a community. Examples include indicators included as part of mobility management, indicators of key attributes of place, social feasibility and community interaction.</td>
<td>Investigation is needed of how this relates to severance. Is a community that is less stable, less susceptible to severance effects?</td>
</tr>
<tr>
<td>Consultation based assessment</td>
<td>The discussion group and the questionnaire indicated that some practitioners feel that severance assessment must involve the community in identifying impacts. A review of the specialist community consultation literature may help to define this element of the research.</td>
</tr>
<tr>
<td>Modelling techniques such as the perceived danger model and the risk perception technique</td>
<td>The cost effectiveness of modelling techniques needs to be considered as an important issue. The discussion group and the questionnaire indicated that some practitioners feel that a model which generates a single answer can never be applicable in all circumstances.</td>
</tr>
<tr>
<td>Checklist based methods that can assist in impact identification. Examples include the New Zealand severance assessment method Transit New Zealand (date unknown) and the Pakistan assessment Government of Pakistan (1997) frameworks</td>
<td>These add elements not covered in the UK but any investigation needs to focus on what links can be made to impact forecasting and significance.</td>
</tr>
</tbody>
</table>
The findings of the research so far confirm the earlier findings of Tate that:

- The phenomenon of severance is complex;
- No unique method of evaluation exists;
- A large number of proxy measures exist that, to a greater or lesser extent, may quantify one or more aspects of severance; and
- A range of possible combinations is available that, while not completing the picture, would account for a large proportion of the issue.

6 Conclusion

The research conducted so far has found that severance constitutes a range of effects both physical and psychological. This range of effects is much wider than that included in the UK definition of severance. A large number of severance assessment methodologies exist throughout the world and many of these merit further study. The main issues for consideration when developing new severance assessment methodologies are:

- Ways of measuring psychological severance need to be developed that are cost effective and useful to practitioners;
- No methods identified cover the whole range of severance effects. A toolkit of methods is needed that can address different severance effects in an effort to build a more complete inventory of effects;
- Methods are needed that can help to audit levels of existing severance;
- Ways are needed that can effectively assess significance including the significance of effects in relation to different groups of people;
- Methods are needed that can measure the economic effects of severance; and
- Methods are needed that can take into account the effectiveness of mitigation.

The next stages of the DfT research will concentrate on further reviewing and testing promising severance assessment and mitigation techniques.
7 References


8 Acknowledgments

We wish to acknowledge the UK Department for Transport, Highways Agency and the many other people who have assisted the team through these first stages of the research.
Integrated Planning – Sense or nonsense?

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Integrated Planning – Sense or Nonsense?

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KEYWORDS : Integrated Planning, Smart Growth, Smart Growth Lite, Really Smart Growth

ABSTRACT
Much is made today of the need for “integrated planning” of land use and transport. But have not land uses always integrated themselves with the access opportunities presented by transport modes, nodes, routes and networks? So what does “integrated planning” mean today, both in intent and in effects on the nature, form and efficiency of urban development? This paper seeks (i) to expand our perception of what integrated planning really is and means, (ii) to explore whether it can indefinitely sustain evolutionary forces and the inherent sacrifices required of personal freedom and democratic representation in the making of value-judgements and decision tradeoffs, and (iii) to outline some modifications that might enable evolutionary planning to offset a potential revolution in the planning and governance of urban development.

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   1.3 Integrated Planning’s Own Environment
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   2.2 Historical Roles of Transport Modes in Urban Development
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3 Integrated Planning and the “Smart Growth” Construct
   3.1 Origins and Development of “Smart Growth” Planning
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4 Smart Growth – Thesis and Antithesis
   4.1 Energy Supply and Demand
   4.2 Effects of Automobilisation
   4.3 Efficiency – of What, for Why?
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5 Ways Ahead
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6 Conclusion
7 References
Sustainable Transport in the Lower Hunter Region

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KEYWORDS: Local Government, Sustainable, Regional, Integrated, Transport Planning

ABSTRACT

Local Government in the Lower Hunter Region believes that integrated transport planning should be achieved at the regional level, and it is best if the planning is done now before the land development pressures close off the low-cost options.

In an Issues Paper presented to the five Lower Hunter Councils in 2003, there are 21 Action Strategies for Local Government to pursue in order to achieve sustainable transport systems in the future. They are based on the premise that it is local government that has to raise the priorities for transport planning in regional areas, and that this can be achieved through cooperation, coordination and integration of many of the disjoint programs that are currently managed by various local, state and federal agencies.

The Paper outlines the opportunities that exist in the Lower Hunter for achieving integrated transport systems and moving towards a target modal split of 20% for public transport. The strategies include regional transport plans, regional transport management, community advocacy, expansion of the regional rail system, intermodal interchanges, enhancement of bus networks, converting old rail corridors and crown road reserves into pathways and cycleways, kerbside lanes used for alternative transport modes instead of parking, and short term demonstration projects.

1 Introduction

The Hunter Region has a diverse and prosperous economy which is heavily dependant on efficient transport. The region’s complex infrastructure includes all of the conventional modes of transport, intertwined with urban, industrial and rural development. The region’s need for a comprehensive approach to the multi-modal transport task is high compared to other regions in Australia.

The Lower Hunter is a distinct area within the Hunter Region. It covers 4300 km², has a coastline of 95 km, and extends inland for about 60 km. It is centred on the regional capital at Newcastle, and embraces the local government areas of Cessnock, Lake Macquarie, Maitland, Newcastle and Port Stephens. Its population in August 2001 was 470,600 people, 88% of the entire Hunter Region. 91% of people in the Lower Hunter Region live in 13 discrete urban areas.
The Lower Hunter Region is experiencing unprecedented growth pressures, given its proximity to Sydney. Within the State Government’s metropolitan strategy, it is seen as a major development area that can ease the urban pressures in Sydney. Parts of Maitland, Port Stephens and Lake Macquarie are experiencing growth rates of around 2% per annum, while in the inner city area of Newcastle the annual population growth rate is over 13% as a result of urban renewal programs.

While each of the Councils has prepared its own Urban Strategy and Settlement Plans based on environmental, economic and social sustainability, they acknowledge that they cannot achieve integrated transport planning within their separate boundaries. Two other approaches are needed:

- a regional perspective that recognises movements across local government boundaries
- involvement of the State Government as the provider of transport infrastructure and services.

The priorities of the State Government do not necessarily reflect those of the Councils, and the management of the State’s transport assets and services has been focused more on economic efficiency than facilitating sustainable urban strategies. To achieve regional integration, the initiative had to come from local councils acting together with a regional focus.

The transport systems in the Lower Hunter are growing at an unsustainable rate, much the same as in many other regional areas. On an average weekday (1999), there are 1.9 million trips, at a rate of 4.1 per person. 81% of trips are made by car, 5% by train and bus, and 12% by walking.

2 Regional Approach

The latest regional plan for the Hunter dates back to 1989. Several attempts since then to prepare a Regional Plan have not been successful.

In 2001, the five Councils formed the Lower Hunter Public Transport Liaison Group (LHPTLG) to cooperatively pursue the improvement of public transport services in the region. The LHPTLG comprises Councillors and strategic and transport planners from each of the Councils.

The LHPTLG commissioned Transit Planners to prepare an Issues Paper, “Sustainable Transport in the Lower Hunter Region”, to examine the implications of adopting a sustainable approach to transport planning, to identify the future transport systems that might be feasible, and to suggest the strategic directions that the Councils should pursue. The 183-page Issues Paper is in two volumes.

- Volume 1: Action Strategies
  - Overview, Urban sustainability issues, Opportunities, and Sustainable transport projects
- Volume 2: Regional Context
  - Regional population and transport profiles, Transport initiatives already undertaken, Understanding passenger transport issues, and Sustainable transport in other regions.

In October 2003, the Issues Paper was presented as a vision statement to each of the Councils separately, but with the same set of recommendations. This was a bold move that broke new ground in local government. It encouraged councils to raise their profile in transport planning, traditionally a state government prerogative. It challenged the unrestrained growth of private car
transport and advocated action to change travel behaviour. It detailed the standards that need to be adopted across the region if alternative modes of transport are going to attract some people out of their cars. It placed a new perspective on funding programs and allocation of resources.

Each Council formally received the Issues Paper and adopted the Group’s recommendations without dissent. This would seem to indicate the depth of concern about managing the region’s transport issues and achieving integration of transport planning. What might have been thought of as an impossible dream started to become a transport reality.

The Councils’ decisions empowered the LHPTLG to disseminate the Issues Paper, to review and progress the issues raised, and to report back to the Councils. Individual Councils asked for officers’ reports on local projects that could be adopted within the regional framework.

Newcastle City Council went further. It placed the Issues Paper on public exhibition and held a public strategic meeting to canvas community opinion. It found there was general acceptance of the Paper’s strategic directions. It then adopted the Issues Paper in principle, agreed to incorporate its suggestions into future revisions of its policies and strategies, requested the State Government to facilitate a regional transport plan, and supported the target of a 20% modal split for public transport by 2020.

The Issues Paper has provided a sound regional perspective that all Councils and the community have been able to use as a reference point in their assessments and responses to several recent NSW Government reviews of transport services, including the Parry Inquiry on (economic) sustainability of transport services, the Unsworth Review of Bus Services, and the Lower Hunter Transport Working Group’s reports on the options for rail transport in the city centre in Newcastle.

These reviews tend to regard the Lower Hunter as part of the metropolitan area of Sydney, and apply to it the same reforms being considered for Sydney. The local response has emphasised that the Lower Hunter has its own travel dynamics which need to be understood and managed on a regional basis, not as an appendage to Sydney, and that an integrated regional transport plan is needed before any determination is made about components of the region’s transport system.

3 Sustainable Transport Visions

3.1 The Challenges

A clear vision needs to be set to develop the future of alternative and sustainable transport opportunities in the Lower Hunter. There are many small ways in which to make a start, particularly with walking, cycling and better use of the existing public transport. There would then be a gradual transition towards the achievement of the vision, with an emphasis on integration and consultation.

More efficient public transport services need to be provided and these need to be integrated with each travel mode, with urban development, and with ticketing and timetabling. The underlying factor is that public transport, to benefit the community, must become more attractive to a larger
proportion of the community for at least some of their trips. Attempts to do this so far with conventional transport have not been successful, partly because of the lack of a captive market. Something innovative and visionary is required to respond to the region’s needs.

With a population of around 500,000 people, the Lower Hunter is well placed to take on board a sustainable approach to transport planning. It is small enough to be able to modify and develop its transport infrastructure according to sustainable objectives, but it is large enough to have daily travel patterns that can support alternative transport systems. The Issues Paper presented several innovations for consideration.

3.2 TramTrain

![Light rail vehicles on the 56km S5 TramTrain route between Wörth and Mühlacker pass the Marktplatz in the centre of Karlsruhe (top) and stop in the main line train platform at Pforzheim (bottom).]
The Lower Hunter has developed around two main rail lines which are shared by local and intercity passenger trains, freight trains and coal trains. The rolling stock for the local trains is due for replacement, and there are debates in the community about the operation of heavy-rail trains close to the foreshore within the Newcastle City Centre.

TramTrains are a significant development in Europe, where light rail vehicles operate over heavy rail lines to serve the suburban areas of regional cities and the surrounding towns in the region.

For over 10 years, light rail vehicles have been running from the city centre in Karlsruhe in south-western Germany along old industrial rail lines through the suburbs and onto the main intercity rail lines for distances of up to 60km. They run on the same tracks as the heavy rail passenger and freight trains, and use the same main line station platforms. The frequency of all trains using the main lines is about every 10 minutes.

The success of the Karlsruhe system has been reflected in an enormous increase in the number of passengers and a positive change to the modal split.

The TramTrain concept is an option for the Newcastle - Maitland and Newcastle - Morisset rail lines. It can provide high-speed high-frequency links between urban areas and regional centres, and it allows rail vehicles to travel through pedestrian precincts such as the harbour foreshore in the Newcastle City Centre. The use of existing rail tracks and stations minimises infrastructure costs.

Keen interest has been demonstrated by both the Councils and the community in the TramTrain concept and they have put it forward as worthy of further evaluation.

3.3 Automated People Mover Systems

Automated People Movers (APM) are advanced transportation systems in which automated driverless vehicles operate on fixed guideways in exclusive rights of way.

Attractive features of APMs include the high frequency of their operations, and the low operating costs due to reduced staff levels. The deployment of vehicles is more flexible due to the removal of the requirement to comply with driver working conditions and award provisions.

APMs are especially suitable to situations where there are relatively small numbers of people moving throughout the day. Within their capacity restraints, they are far more effective per person moved in achieving sustainability targets than any system using vehicles with drivers.

The opportunity exists for APMs to be included in major residential developments, such as at Thornton and Glendale, where the infrastructure can be provided and funded as part of the project and linked to the adjoining railway stations. The APMs would replace bus services, thereby overcoming the problems of poor service levels in the early stages of development.

Other applications of this technology could be to assist movement around the campus of large university and TAFE colleges and regional hospitals.

There are two APM projects at an advanced stage of development which could be appropriate components of the future transport systems of the Lower Hunter Region.
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

The Austrans system, an Australian invention, uses a medium-sized vehicle running on a specially-designed rail guideway for the self-steering vehicle bogies. The vehicles are powered by electricity picked up from the rails.

The Urban Light Transport (ULTra) system has been developed by Bristol University. The vehicle is a 4-seat capsule which runs on rubber wheels. Guidance is provided by computer responses to magnetic implants in the 2m-wide guideway. Vehicles are battery powered.

While Austrans is designed to carry at least 9 people at one time, ULTra is designed to provide personalised transport for up to 4 people. Both designs include provision for disabled access and luggage.

Figure 3.2 - Austrans 9-person prototype at the Chullora test site, March 2004.  
Figure 3.3 - Prototype of the 4-person ULTra vehicle on the test track in Cardiff, Wales, October 2001.

3.4 Car Sharing

‘Car Sharing’ refers to schemes where people belong to a group that has access to a fleet of vehicles. The car is used by different people at different times.

Car sharing is a recent innovation that has proved to be very successful in Europe. In Germany, 200 000 people belong to organisations which arrange car sharing. An initial car sharing scheme started in Newtown (Sydney) late in 2002.

The car sharing schemes in Europe use smartcard technology. Members of the scheme book a car on the internet and use their smartcard to gain access to the vehicle at any time from a holding yard (often associated with a shopping centre). A smartcard embedded in the vehicle records the user and the usage details. The car can be returned to any holding yard, not necessarily the one it came from, and the smartcard locks the vehicle. Members are billed monthly.

Car sharing has the potential to reduce the need for one car in multi-car households. It also raises awareness of other alternative transport systems.

The success of car sharing is highly dependant on regional commitment, appropriate seed funding, and integration with the walking, cycling and public transport strategies.
4 Sustainable Transport Activities

4.1 Trip Patterns

The argument is often heard that a revival of public transport is not possible in the Lower Hunter because the other travel modes are too easy. In particular, it is stated that most people have access to a car, car parking is not difficult and is usually free, and that public transport takes too long.

These arguments run the risk of treating the whole population as being homogeneous. Surveys undertaken in the NRMA Clean Air 2000 program support the contention that about 40% of the population will never use public transport, 40% are prepared to consider using it for some of their trips, and 20% use it regularly. It is the modal split patterns of the 60% who are favourably disposed to use public transport that form the patronage potential. It is illogical to equate these people with the 40% who will not use public transport at all.

Table 4.1 shows how the modal split will change under a sustainable approach, based on the latest available trip data for the Lower Hunter (1999). 21% of current trips will transfer from car travel to either public transport, cycle or walk. The majority of trips, 60%, will still be made by car.

<table>
<thead>
<tr>
<th>TRIP MODE</th>
<th>MODAL SPILT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOW</td>
</tr>
<tr>
<td>Car</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>56%</td>
</tr>
<tr>
<td>Passenger</td>
<td>25%</td>
</tr>
<tr>
<td>Public Transport</td>
<td></td>
</tr>
<tr>
<td>Train</td>
<td>1%</td>
</tr>
<tr>
<td>Bus</td>
<td>4%</td>
</tr>
<tr>
<td>Cycle, Walk</td>
<td>14%</td>
</tr>
</tbody>
</table>

To achieve a modal split target of 20% by 2020, public transport modal split has to maintain parity with population growth and increase by at least 1% of the current number of trips each year. Put in this context, this does not appear to be an unreasonable target.

4.2 Sustainable Transport Plan

The most fundamental initial requirement is the preparation of a Sustainable Transport Plan for the Lower Hunter Region. This needs to be initiated and driven by local government within the context of state planning and development processes, and without the restriction of individual local government boundaries. Responsibility for managing the Sustainable Transport Plan would be vested with a Sustainable Transport Management Group, established jointly by local and state government agencies.
Both local and state government agencies devote resources to regional transport issues, but from their narrow individual perspective. The outputs are generally not very effective in achieving integrated regional transport management. The pooling of these resources, as has been done with TransLink in South East Queensland, will achieve much greater benefits without increasing costs.

The regional community has to have ownership of the regional transport plan. This will ensure greater acceptance, recognition of regional assets and aspirations, and more certainty of implementation.

4.3 Regional Transport Management

As far as can be assessed, public transport systems which have been successful in reversing the decline in patronage have generally been managed locally with a focus on responding to the regional opportunities, markets and strategies.

Transport management by a Regional Group would improve the utilisation of the region’s assets, increase patronage, reduce costs, and provide a standard of service that reflected the objectives of the Hunter Region. Hence, the government would not be encumbered with additional costs, but it would achieve greater benefits from the use of current funds. Priorities for allocating funds would be made within regional parameters across all modes, instead of by state parameters within each mode without regard to regional coordination and integration.

A formal process of Regional Transport Advocacy would enable the community and local government in the Lower Hunter to play an effective role in making submissions to the State and Federal Governments on transport policies, resources, and innovative projects. These submissions would be soundly based on the principles of sustainability as applied to transport, and would represent the views not only of the five Lower Hunter councils, but also of the regional community.

It is envisaged that the advocacy process would operate outside the local government management system so as to give it the freedom and flexibility to address issues quickly and comprehensively, to coalesce community opinion and present it to whichever level of government is relevant.

4.4 Lower Hunter Regional Transport System

Arising out of the Lower Hunter Sustainable Transport Plan, an integrated Lower Hunter Regional Sustainable Transport System would emerge. This would be the system, or combination of systems, by which a transport network would be developed to facilitate the achievement of sustainable transport targets associated with personal travel and the movement of freight.

The Sustainable Transport System would be determined after a comprehensive analysis of current and expected travel patterns, and how these need to be modified to achieve sustainability. It would include the appropriate transport mode to be used in each corridor, chosen from on-road bus priority, busway, light rail, tramtrain, heavy rail, or automated people mover, as well as the infrastructure for integration and access, and the regional management and funding regimes.
The current approach of setting service standards based on existing patronage levels is not sustainable. Standards need to be set so that services will attract the patronage levels which will reach the sustainable modal split targets. The most critical service standards are high frequencies and reliability. Achievement of modal split targets will produce sufficient revenue to cover the costs of high frequency services.

4.5 Transport and Land Use Planning

A significant number of reports have been written about what needs to be done in urban planning to facilitate the provision of sustainable transport systems and achieve increased use of public transport. The task now is to place the outputs from these reports into council approval processes so that all new developments and government works programs can be more supportive of sustainable transport.

In order to enable better decisions to be made about how many people might travel where and by what mode under a sustainable transport system, transport modelling and studies need to be done with parameters appropriate to the Lower Hunter Region.

In 2001, Planning NSW in collaboration with Transport NSW and the RTA prepared draft land use and transport planning policy documents which can be used to provide the appropriate context for local government to address issues related to land use and transport, especially when they arise in development applications and strategic policy decisions.

Freight logistics have to be studied to ensure that sustainable transport modes are not impeded by large freight vehicles in urban streets. Alternative methods of handling freight distribution within urban areas have to be identified and implemented.

A sustainable transport strategy would dictate that comprehensive employee access systems for major employment areas are as important as the environmental management programs for the site development. Access systems would aim to reduce on-site parking by providing public transport services from transport interchanges.

4.6 Transport Corridors

For the foreseeable future, roads will be the infrastructure used for most of the region’s transport. However, in a sustainable transport system, roads are not provided just for cars, trucks and parking. They are designed and built to accommodate several modes of transport, including transit systems, bus priority, cycleways and pathways.

Several former rail corridors are still substantially vacant and mostly in some form of public ownership. These can be developed as transit corridors to supplement the rail network. The mode of travel within the transit corridors can be determined later. The important issue at the moment is to preserve the corridors for use by the future regional public transport system.
The projected growth in the use of rail for passenger, freight and coal transport indicates that the current infrastructure will have insufficient capacity. This can best be resolved through an integrated approach, rather than each transport agency managing only their own interests.

Vacant corridors still exist to the west of the city and between the Port and future large industrial sites that would allow the separation of passenger and freight transport.

4.7 Rural Transport

In the Lower Hunter, 41 175 people (9% of the population) live outside designated urban areas in small towns, villages and rural areas. Their needs and reasons for travel are probably greater than people in urban areas because of the lower level of services available locally. They have the same rights to choose sustainable means of transport. The fact that it is more difficult to provide for rural transport than urban transport should not be an acceptable excuse for failing to provide it.

A significant opportunity for improving rural transport revolves around the full-time use of school buses that currently lie idle outside school start and finish times. With coordinated organisation, consultation and promotion, no additional funding would be needed, assuming that the users of the potential new services pay market fares to cover the marginal costs of additional services.

4.8 Parking

To accommodate alternative modes of transport, there needs to be a cultural change in the attitude to car parking on roads. This new approach will require a significant change of attitude not only within the community but also in the level of cooperation that is necessary between government agencies and transport operators.

It is difficult to change the current attitudes and policies towards provision of car parking prior to comprehensive improvements in public transport services. However, a start has to be made, and this can be done through some individual projects and through longer-term parking policies that apply consistently throughout the region.

4.9 Pathways

Footpaths and cycleways are extremely important as a means by which pedestrians and cyclists can gain direct access to the urban road network, bus routes, railway stations and activity destinations such as employment, shops and recreation areas.

Safety is a prime consideration with these modes. Pathways should be separate from the roadway. Most people would not regard a white line on a road denoting a cycleway as providing enough safety and protection from other vehicles. It is no longer acceptable that people walk along the edge of the road, especially outside built-up areas where vehicles speeds are much higher.

Elderly people and people with disabilities are now able to used motorised 3- and 4-wheel scooters to improve their mobility. For these people, footpaths are essential.
Crown land, unformed cadastral roads, stock routes, utility easements and former rail lines can all be used to develop a network of pathways throughout the region. The main work involved is defining the path, making sure that the path is trafficable, bridging waterways and signposting.

Demand for school transport could be eased by developing safe pathways for walking and cycling to local schools. Students could be encouraged to walk or ride to school rather than be driven by car or catch a school bus (which could be better utilised providing peak hour commuter transport).

Rural roads are able to attract roads funding to assist the councils in their maintenance, and these funds can be used to incorporate provision for additional travel modes, including pathways for safer walking and cycling.

4.10 Demonstration Projects

One of the most effective ways to start the process of change in attitudes to public transport usage is to initiate some demonstration projects with the proposed higher service standards. Projects have to be selected where the existing infrastructure is suitable or can be readily modified, and where there is a reasonable chance of a favourable patronage response.

The initial projects selected for consideration are:

- Bus priority for the region’s best patronised routes along the Pacific Highway between Swansea, Charlestown and Newcastle
- Integrated bus-train fares and timetables between Cessnock, Maitland and Newcastle
- Revised fare structures to make it attractive for large employers to consider packaging public transport travel into salary payments.

4.11 Information, Promotions and Marketing

As with any desirable cultural change, alternative transport options have to be extensively promoted and marketed. Recent research by UITP shows that between 5% and 25% of journeys are not made on public transport solely due to lack of adequate information.

The information needs to be an integrated package in several formats and standardised for all operators in the region. It has to be recognised that people have different information needs at different times, and all of these needs have to be catered for. The information needs to be kept up-to-date and accessible at all locations.

4.12 Alternative Fuels

The fuels used for transport are one of the major sources of harmful pollutants in the air. Action needs to be taken at a regional level to escalate the adoption of less polluting renewable fuels for use both by existing vehicles and in the design and purchase of new vehicles.
Leadership in this issue can be given by local government. Innovative projects may be eligible for research and development grants, as well as enhancing the region’s environmental benefits. Newcastle Council has recently begun running its refuse collection trucks on bio-diesel.

4.13 Funding Programs

Advocacy by local government for sustainable transport does not mean that it has to shoulder the funding burden. Rather, it will work in collaboration with state and federal government programs. A critical role for local government will be to identify regional issues that need action, and to lobby for the appropriate priorities to be allocated to these projects.

There are a number of plans and funding programs to support regional sustainable transport initiatives. They include:

- Auslink.
- Private Public Partnerships.
- Using roads funding to include separate pathways in the road reserve.
- Contributions from developers for alternative transport infrastructure in new developments.
- State and Federal funding under Public Transport Improvement Programs.
- The Australian Greenhouse Office programs for sustainable transport improvements that will reduce greenhouse gases.
- Research and development funding for innovative transport and alternative fuel projects.
- Land value capture, where funding for infrastructure is secured from the development opportunities that accrue from the new facilities.
- Transport research projects, Centre for Urban and Regional Studies, University of Newcastle.

5 Summary

Local Government in the Lower Hunter Region has started to turn what many thought was an impossible dream of integrated, sustainable transport planning into a transport reality that has been embraced by the regional community. The challenge now is to convince the State Government to recognise this vision by supporting the establishment of a regional group to prepare a sustainable transport plan that takes on board the issues and values advocated by the regional community.
6 References


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Session 5A

Do we really understand the users needs?
Blind Dreams

MR TONY STARKEY AND MRS MARGARET BROWN

Royal Society for the Blind of SA Inc
BLIND DREAMS

A paper detailing the independence issues for a person who is blind or vision impaired.

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KEYWORDS: Blind, Pedestrian, Universal Design, Disability Access

Form of Presentation: Lecture style, with PowerPoint Presentation.
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1 Introduction

A dream for a blind person would be to travel independently through the environment as quickly as other members of the community.

In the future, a person who is blind will be moved from A to B via an automated motorcar, simply by entering the GPS co-ordinates, and on arrival a wayfinding system will announce directions via a wireless mobile phone. As they walk along, signs will talk to their mobile phone and shops will advertise the same way.

Unfortunately, in reality a person who is blind does not go out independently and explore the world. Orientation & Mobility training has to be provided by a Mobility Instructor on proposed routes of travel. Issues encountered include:

• Public transport.
• Accessible footpaths.
• Road crossings.
• Information that must be memorised.

These are just a few of the considerations that have to be taken into account before a trip is undertaken.

2. Functional effects of Vision Loss

In order to understand the modifications and interventions that assist independent travel for people who are blind or vision impaired, it is first necessary to understand the functional impact of various conditions.

The functional effects can be divided into four main categories, namely:

• Central vision loss
• Peripheral vision loss
• Cloudy vision
• No functional vision
Central Vision Loss

Central vision is used to see detail and colour. People with eye conditions such as macular degeneration experience central vision loss. This type of vision loss causes:

- Difficulty performing detailed visual tasks eg: reading, watching television, recognising people’s faces, reading a watch, pouring a cup of tea.
- Decreased colour vision. Usually primary colours can still be seen but muted shades (eg fawns and greys) become more difficult to distinguish.
- Difficulty seeing objects that are of a poor colour contrast, eg steps, kerbs.
- Difficulty judging distances and speed, particularly with regard to traffic; and
- Problems seeing in areas with poor lighting.

They may, however, be able:

- To move around with little difficulty;
- Pick out items with their side vision eg a pin on the floor; and
- To use visually contrasting ground surfaces eg the difference between footpaths and road surfaces for moving about. People with this type of vision loss may not use a cane and so are not easily identified.
Peripheral Vision Loss

Peripheral vision is used for movement and night vision. It is the part of vision that helps us avoid obstacles and detect the movement of traffic. Eye disorders that impact on peripheral vision are glaucoma and retinitis pigmentosa. This type of vision loss causes difficulties with:

- Moving about, particularly detecting poles, door frames or low obstacles;
- Adapting to changing lighting conditions; and
- Night vision or where lighting is dim.

They may, however be able to:

- Read and see detail; and
- Recognise people’s faces.
Cloudy Vision

Cloudy vision combines the difficulty in seeing detail with mobility difficulties. Examples of eye disorders that cause cloudy vision are cataracts and diabetic retinopathy. Overall loss does not mean total blindness but rather a generalised clouding of vision.

No Functional Vision

Included under this category are those that have no vision, light perception, or have the ability to count fingers only. The strategies used to enhance mobility for these people are predominantly around vision substitution. This means they are completely reliant on senses other than vision.

Other Functional Effects

Almost all eye conditions cause an increase in glare sensitivity and this further decreases the ability to see clearly. In orientation and mobility training, glare glasses are a very important tool to enhance vision.

A person who is blind or vision impaired will be unable to visually scan their surroundings and will therefore have an incomplete picture of their environment. Signage is particularly difficult to locate and read.
3. **Common Myths**

There are many myths on how a blind person travels through the built environment, some of these are:

- All people who are blind cannot see anything
- All people who are blind need or use a Seeing Eye Dog
- All people who are blind have extra ordinary powers of perception

Unfortunately these myths are not reality and in actual fact a blind person generally only independently travels along a previously mapped out route. The physical environment is not yet consistent enough for a blind person to independently navigate and roam the city streets.

4. **Strategies for Independent Travel**

For people who are blind or vision impaired, the strategies to enable them to navigate independently in their environment incorporate the following:

- Vision enhancement techniques;
- Vision substitution techniques; or
- A combination of both vision enhancement and substitution techniques.

5. **Vision Enhancement**

The three principals for Vision Enhancement are:

- Bigger
- Brighter
- Bolder

Examples of these in the area of independent travel include:

- Bigger - Street Signage
- Brighter - Street Lighting
- Bolder - Contrasting Street Poles

6. **Vision Substitution**

The three principles for Vision Substitution are:

- Bumps
- Broadcasting
- Other Senses
Example of these principles in independent travel include:

Bumps - contrasting Tactile Ground Surface Indicators (TGSI’s). Different surfaces for footpaths.
Broadcasting (Audio) - Audio tactile lights
  - Talking bus stops
Other Senses - Smell, skin, muscle memory

7. **Universal Design Definition and Principles**

Universal design is a concept that requires all new products, environments and communication modes to be designed with consideration for the needs of all potential users. This concept also recognises the fact that good, inclusive design principles benefit the community as a whole.

There are seven principles of universal design:

1. Equitable use - The design does not disadvantage or stigmatise any group of users.
2. Flexibility in use - The design accommodates a wide range of individual preferences and abilities.
3. Simple, intuitive use - Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.
4. Perceptible information - The design communicates the necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.
5. Tolerance for error - The design minimises hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical effort - The design can be used efficiently and comfortably, and with a minimum of fatigue.
7. Size and space for approach and use - Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user’s body size, posture, or mobility.

8. **Equipment and Devices**

The following represent current aides and devices used to assist people who are blind or vision impaired in independent travel:

- Telescopes
- White Canes
- Seeing Eye Dogs
- Bus Number Flash Cards
- Audio-Tactile Lights
- Electronic Devices
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

- Tactile and Audio Maps
- Talking Bus Stops

Currently being developed is technology incorporating:
- Sonars
- GPS

9. **Orientation and Mobility Services**

Orientation and Mobility involves the training of people who are blind or vision impaired to travel independently. Quite often it involves training people in the use of the white cane.

Orientation refers to the ability to use all sensory information available to:
- Identify the traveller’s location in the environment.
- Mobility is the tool that is used to move about the environment. These tools may include a white cane, a seeing eye dog or an electronic device.

10. **The Urban Environment and Traffic Management**

For the purposes of this paper, we have identified three examples of potential hazards to independent travel and strategies, which may be adapted to navigate these hazards. These are not the only impediments to independent travel/

11. **Road Crossings**

When crossing roads, people who are blind or vision impaired are at significant risk. These days traffic volumes have increased, intersections are more complex and cars are significantly quieter.

For a person who is blind or vision impaired, the issues with Road Crossings are:
- Where to cross
- When to cross
- Crossing in a straight line

**Where to cross**

Wherever pedestrian crossings are available, people are taught to use these as the safest practice even if they have to walk further. The CBD of Adelaide is an excellent example of an environment that is easy to travel because of the number of controlled crossings. Busy four lane roads where roundabouts are the preferred method of controlling traffic can be inaccessible for many people. This can mean, for example, that people can catch a bus to their desired destination, return on the bus, but not be able to cross the road for the return trip home. Pedestrian refuges are sometimes
used to assist where crossings would impede the flow of traffic but they are of very limited assistance to people who are blind or vision impaired.

When to cross

The basic technique used by people who are blind or vision impaired is to listen to the sound of the traffic flow. What is listened for is the sound of the perpendicular traffic stopping and the sound of the parallel traffic moving off to know when to cross. However, intersections have become much more complex and difficult and at many, the only safe way to know when to cross is through the use of audio tactile light systems.

The introduction of left slip lanes has made even these crossings hazardous, as the left slip lanes may not be light controlled even though all the other legs of the intersection are. At these intersections, a traveller may cross the left slip lane to the main leg only to find that the only indication she is there is the TGSI’s.

Additionally, the buttons on the lights may have been installed without consideration about which way the arrow is pointing. Where there are a couple of audio tactile lights on adjacent poles, people are taught to put their hand on the button in order to discriminate which one is producing the sound. The arrow above the button should point the way the person is going and also help to discriminate which light is operating. An arrow pointing up in the air may make sense to sighted people but is of no help to people who are blind. It is not unusual for people to step out into moving traffic because the arrow has been installed incorrectly.

Crossing in a straight line

Walking in a straight line is one of the most difficult tasks for a person who is blind. Squaring off on a perpendicular surface is essential if a person is to cross a road without veering into the traffic. Modern crossing design has resulted in narrower crossings with little forgiveness for veering. The best tool for squaring off is the side of the pram ramp. While the position of these is currently being updated, many still point people into the middle of the intersection. Blended kerbs and blended ramps mean that there are no straight edges available to line up squarely.

Failing a straight edge on the ramp, it is possible to line up on the edge of hazard TGSI’s. This is not their purpose, as they are meant to warn people that they at a point of danger. However, there are many examples where these are not installed correctly and can be misleading such as when each individual tile is angled.

12. Footpaths

For a person who is blind or vision impaired the issues are:

• The existence of footpaths
• The maintenance of footpaths
• Obstacles on footpaths, eg, telephone boxes, A-frames
Many suburbs lack hard surface footpaths. Footpaths provide an excellent surface to follow with the cane. When they are not available, the person has to walk in the gutter or follow the edge of the road, putting them at greater risk from motorists. Where footpaths are not provided, and the nature strip acts as the footpath, many hazards are encountered such as extreme slopes which threaten balance, or sudden drop offs into driveways. Councils actively encourage householders to beautify the nature strip and many take this on enthusiastically, planting gardens all the way to the kerb. A blind pedestrian can suddenly find themselves tangled up with rose bushes and again have to get down onto the roadway to continue the journey.

Lack of maintenance of footpaths can turn a valuable resource for the blind pedestrian into a hazard. Tree roots lifting the surface, large cracks, broken edges can all make a route difficult. Even more commonly, when maintenance is being carried out, the repair work is not enclosed in a safe manner, with flags or witches hats being used. A cane will slide between or underneath these items and the blind person can easily find themselves in a dangerous position. Mesh or the Lego blocks are the only safe way to prevent this happening.

Obstacles on the footpath can also make footpaths difficult to move along. Too many poles are placed in the middle of the footpath which when cluttered with wheelie bins on rubbish collection day can make for a very hazardous trip. In shopping areas, racks of goods placed outdoors by retailers, A-frames, dining tables at cafes, fire hydrants all make travel very difficult for the person who is blind or vision impaired.

13. **Roundabouts**

Unfortunately people who are blind or vision impaired, do not find roundabouts a safe haven to cross a roadway. This is due to the fact that they are unable to determine the direction of the traffic on their right using visual clues such as a traffic indicator on a vehicle or their position in the lane of traffic. The RSB at this point in time train their clients to move away from the roundabout and then cross the road at least a hundred metres away from the roundabout.

14. **How to achieve the Dream**

It is fairly obvious that in the next twenty years my dream of being able to be independently drive whilst still a blind person will be unachievable. However, there are a number of ways in which the principles we have talked about today and the issues that effect people who are blind or vision impaired can be incorporated into future design of our transport and road networks.

I feel that this is not purely an issue relating to traffic engineers, urban planners or local government, but is the whole of the infrastructure creation team who must work together taking into account the needs of all in the Community. If we remember the three B’s (Bigger, Brighter, Bolder) this will not only help the vision impaired Community but will assist the whole of the Community to easily read signs and locate fixtures.

Similarly the use of vision substitution techniques will assist people travelling at night. These modifications can be incorporated with artistic flare, all items do not have to be safety yellow, they can be terracotta against sandstone, heritage green against a white background, but we should avoid
grey against charcoal, beige against white. For the delivery of information such as signs, directories, bus stops, these also should be in a contrasting, large font and should avoid italics and other artistic styles and should not be shades of colour upon colours.

It is also important that texture, logical paths of travel and audible information are incorporated as part of the design solution. On another note and to be able to fulfil my dream to independently drive, considerations should be given to installing GPS transmitters on all traffic signs, distance markers and that all future white paint used on the roads should be infused with data dots that are charged with GPS information and radar detecting responses (this will keep the car straight on the road). Although this is a wonderful dream, I am sure when it is fulfilled the excitement of driving will be totally removed, as it will require no human input. This will reduce me to being taken from A to B by someone or something else as I am today, when I have to be orientated to a place.

15. **Conclusion**

In a perfect world a person who is blind or vision impaired will independently move through the built environment with no hazards or frustration.

To achieve this the application of good design principles must be applied.

Today we have briefly discussed a number of these strategies and have hopefully convinced you of the fact that good design is “a fair go for all”.

We now throw the challenge to you to make this dream a reality.
Crossing the Road – Are we building what the mobility impaired really need?

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Crossing the road with a disability – Are we building what the mobility impaired really need?

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KEYWORDS: disability, pedestrians, pedestrian facilities, pedestrian crossings.

ABSTRACT

Crossing the road – this is not a simple task for some parts of the community, in particular those with a disability. As practitioners, it is important that crossing facilities that are provided to assist pedestrians also assist those with a disability. How do people cross the road, what is the process and what are the critical features that can assist a pedestrian with a disability? Are the critical features known and are they being implemented? We have a community that is aging and the proportion of mobility impaired pedestrians increasing. We want to maintain mobility but are we providing the correct support infrastructure?

According to the research undertaken as part of a Master’s thesis we are not. Results of focus group discussions with people with disabilities have been compared to the perceptions of local government practitioners responsible for the implementation of crossing facilities. Both groups were asked to rank the importance of 18 crossing facility characteristics. The results were then compared using a chi squared analysis to determine if there is a difference in perceptions.

The analysis found that there is a statistical dependence between the two samples for the majority of characteristics. That is, there is a difference in opinion between the two sample populations. Between the two groups there is general agreement on the need for various characteristics, with the difference being the relative importance each group places on the characteristic. The disabled community had a greater tendency to consider characteristics ‘critical’ to the crossing task whilst local government considered the same characteristic ‘important or desirable’. This raises further questions. If we do not adequately assist the mobility impaired in the simple task of crossing the road what else are we doing wrong and what impact does that have on maintaining a communities mobility.
1 Introduction

This paper has been prepared as part of a Master’s thesis and seeks to explore the differences in perception between the disabled community and local government in terms of ‘crossing the road’ as a pedestrian. The most common facilities implemented to assist pedestrians crossing the road include pedestrian activated signals, pedestrian refuges, zebra crossings and under/overpasses. These facilities are generally implemented where there is a demand for a facility measured either through recording pedestrian and vehicle volumes or through crash history. However, these facilities often don’t resolve the crossing task, particularly for the mobility impaired. For this part of the community crossing the road can be a very daunting experience and it is imperative that practitioners consider the elements and features of simple pedestrian infrastructure to ensure that the needs of the whole community are being met.

2 Background

According 1998 ABS data (2001 not available) 19% of the Australian population has a disability. In Western Australia\(^1\):

- 20% of the population, or 381,500 people have a disability;
- one in three people knows someone with a disability, whether as a family member, friend, or workmate; and
- 93% of people with disabilities live in the community, either independently or with family or friends.

Physical and sensory disabilities make up the largest population of the disabled community. As a group these are perhaps the easiest to understand in terms of mobility requirements and hence provision of facilities to assist these pedestrians should be easy to resolve? Or is it?

This paper takes the simple task of crossing the road and looks at how a person with a disability might cross a busy street. More importantly it compares the perceptions of local government engineers and planners in Victoria with a group of people with various disabilities.

The facilities considered as part of this study include:

- underpasses;
- overpasses;
- pedestrian operated signals;
- zebra crossings; and
- pedestrian refuges.

3 Crossing characteristics

A number of standards and guidelines are used to assist in the design of pedestrian crossing facilities for people with disabilities. These include:

- Australian Standards AS 1428, AS 3661, AS 2353 and AS 1742
- Austroads Guide to Traffic Engineering Part 13 Pedestrians
- Various state specific road authority guidelines

Each of these documents dedicate small sections to describe the types of characteristics that should be included in pedestrian crossing facilities.

In most cases these are the same characteristics that assist parents with prams or pedestrians in general.

As part of this study respondents for the disabled community and the authorities were asked to rank 18 different characteristics in terms of critical to have, important, desirable, not important and not desirable. The characteristics included:

- Delineation including the colour that the delineation should be. Colour was used rather than contrast to avoid any confusion with terms. Yellow and white are clearly the colours that have the greatest degree of contrast. The characteristics tested were:
  - Delineation across the road in any colour or form
  - Delineation that is yellow or white
  - Delineation that is not yellow or white
- Delineation leading towards the crossing facility
- Tactile pavement
- Width of pathway leading to the facility. A number of scenarios were tested in order to determine the optimal width ranging from 1.0m to 3.0m
- Height of pushbuttons including existing height and lower than existing height
- Width of the central island. This characteristic was included to gain an appreciation of how ‘protected’ pedestrians felt when storing in the central island. A number of scenarios were tested in order to determine the optimal width ranging from 1.8m to 3.6m.
- Audible cues
- Accessible ramps without nose bumps

4 Survey Methodology

The survey methodology was developed to meet the following aims:

- To determine how well the needs of the disabled are catered for in crossing the road and
- To understand where there are differences in ‘desirable’ characteristics of crossing facilities
The survey methodology was modified for the two target populations – the disabled community and the designers of pedestrian facilities. Face to face interviews were conducted with people with disabilities or disabled advocacy groups while a self completion questionnaire was distributed to the Engineering department of all Victorian local council’s and shires.

4.1 Disabled Community

Interviews were held with local council disability advocacy groups and individuals with disabilities. Four interviews were held with individuals while focus group sessions were held with:

- Frankston Disability Advisory Committee;
- Wyndham Disability Advocacy Group;
- Boroondara Disability Advisory Committee; and
- Glen Eira Disability Advisory Committee.

Each committee had a number of members with ranging levels of mobility as well as careers and other able people involved in disability services. The groups ranged in size from 7 to 12.

Councils throughout metropolitan Melbourne were called to determine which Councils had established advocacy groups that met at regular intervals. Four groups were then selected to represent inner and outer metropolitan regions and different socio-economic parts of the community.

The four individual interviews were held with various students of Monash University.

The interview method was chosen over other survey methodologies for a number of reasons. It was felt that a smaller sample would be more valuable to the study compared to a self-completion questionnaire. An interview survey permits the interviewer to further explore issues and concepts that might not be identified in a self-completion questionnaire. The method also provides opportunity to describe characteristics and clarify terminology depending on the level of knowledge of the respondents. This is particularly important in this survey since the level of knowledge of the target group was difficult to determine. Interviews are also less effort for the respondent. It was considered critical to minimise the efforts required of the respondent.

4.2 Local government

A self-completion questionnaire was distributed to the 72 local councils within Victoria. Essentially the questionnaire covered similar issues compared to the disabled questionnaire. A total of 35 responses were received equating to a response rate of 47%. This was considered a particularly good response rate for a self-completion questionnaire.

For the disabled community questionnaire the widths were converted into common objects such as width of one wheelchair to minimise interpretation errors.
5 Results

The following briefly describes key results for each of the 18 characteristics surveyed.

5.1 Delineation across the road

Of the 43 responses 42% felt that the characteristic was an important feature while 30% felt it was a critical feature. Only 5% felt that delineation was not important.

5.2 Delineation across the road in a contrasting colour

After first establishing if delineation across the road is important, respondents were then asked to comment on the effect of the delineation being in a contrasting colour. Yellow and white were quoted in the question as possible colours.

Of the total responses 51% felt that the characteristic was an important feature while 16% felt it was a critical feature. This compares to the disabled community where 67% felt it was a critical feature. Less respondents felt that the colour of delineation was critical compared to the provision of delineation however more respondents felt that colour was an important feature.

5.3 Delineation across the road in a colour other than white or yellow

As well as considering delineation in the contrasting colours yellow and white, respondents were asked to rank the usefulness of delineation in other colours.

There was a greater variation within the two samples compared to delineation or delineation as yellow or white. This suggests that there is some uncertainty to whether delineation is valuable if it is not yellow or white. Many of the disabled respondents during discussion stated that yellow or white is a preferable colour however having delineation in a different colour is better than having no delineation at all. Visually impaired respondents did indicate that unless the delineation was in a contrasting colour it provided little benefit.

5.4 Delineation leading towards the crossing facility

More respondents felt that delineation was an important/critical feature compared to not important/not desirable feature. Of the 35 respondents from local government 52% suggested the feature was desirable however a similar majority was not evident within the disabled community with a high variability within the sample. Over 60% of the disabled community did however suggest that the characteristic was critical or important.

5.5 Tactile pavers

The benefit of tactile pavers has generated extensive discussion in both the engineering and disabled community. The American legislation has removed the requirement for tactile pavers since
consensus amongst the disabled community cannot be achieved. While tactile pavers benefit the visually impaired they can be difficult to negotiate in a wheelchair.

During the focus groups the disabled community discussed their use extensively. One respondent perhaps best paraphrased the discussion by saying that ‘tactile pavers were less of a disbenefit to wheelchairs compared to the benefit they have for the visually impaired'.

Local government had a greater tendency to suggest that the characteristic was desirable (43%) while the disabled community felt that tactile pavers were critical (50%). Responses for important were not high in either sample.

5.6 Height of pushbutton at existing height

There is little published information regarding the height of the pushbutton at signals. While some people with disabilities suggest that the current height of 1.0m is possibly a little high the majority were fairly comfortable with the height. The main point made was consistency between sites. Some respondents during the focus groups did stress that the height should be measured from the ground level where a wheelchair would rest. At some locations dirt is mounded around the base of the pedestal and the height of 1.0m is measured from the mound and not the footpath level.

Respondents were asked to rank 'height of anything to push (eg push button at lights) is at the height where a person sitting down can reach forward and a person standing up reaches down.'

Of the total 43 respondents 42% suggested the existing height for the pushbutton of 1.0m is critical. The ‘critical’ response was not dependant on the sample it was chosen, indicating agreement between the disabled and local government. Removing the ‘desirable’ and ‘not important’ responses from the sample had the same statistical conclusion.

Respondents were also asked to rank 'Height of anything to push (eg push button at lights) is at the height where a person sitting down reaches up and a person standing up reaches forward’. The height of a button in this scenario would be lower than it currently is.

There was significant variation within the samples suggesting that respondents (disabled and authorities) were undecided if a person seated should reach up rather than reach forward.

5.7 Width of pathway leading to the facility

Respondents were asked to rank the characteristic width of pathway leading to the facility:

- wide enough for one person to stand comfortably (1.0m)
- wide enough for one wheelchair (1.5m)
- wide enough for one two people to stand comfortably (2.0m)
- wide enough for two wheelchairs side by side (3.0m)
- greater than two wheelchairs side by side (>3.0m)
The purpose of the questions was to determine the most appropriate width. Figure 1 compares the perception of the disabled community and authorities. The graph indicates that the authorities believe that the minimum width of a path should be at least 1.5m compared with the disabled community believing that it should be 2.0m. The disabled community appear clearer on the minimum width with the authorities less committed with more ‘important’ responses rather than ‘critical’.

![Comparison of width of pathway leading to a crossing facility](image)

Note (a) denotes authorities response while (d) denotes disabled responses.

**Figure 5.1: Comparison of width of pathway leading to a crossing facility**

The graph indicates a difference in opinion between the disabled and authorities and this is supported by the statistical analysis.

### 5.8 Central island width

The width of the central island is important regarding how protected pedestrians feel in the centre of the road. Respondents were asked to rank central island widths between 1.8 and 3.5m.

Specifically the questions described widths as:

- one wheelchair (1.8m)
- length of one wheelchair and a person standing behind (2.8m)
- length of two wheelchairs (3.6m)
- greater than the length of two wheelchairs (>3.6m)
The questions aimed to determine the most appropriate central island width.

![Central Island Width Comparison](image)

Note: (a) denotes authorities response while (d) denotes disabled responses.

**Figure 5.2: Comparison of central island width**

Figure 5.2 indicates a difference between perceptions of the disabled community and local government with regards to the central island width.

The figure suggests that the disabled community are very clear in the critical width being at least 2.8m, however local government appear more undecided. This could be related to how local government related the widths to personal experience. Typically the width of a central island is determined by road cross-section – the width that is left after the lane widths are removed rather than desirable minimum standards.

It is important however to recognise the trend in the diagram. The disabled community suggest that 2.8m is the critical width. Local government also place greater importance on 2.8m although this is considered ‘important’ rather than ‘critical’.

### 5.9 Audible cues

Audible cues were considered by the disabled community as one of the most fundamental requirements of a crossing facility. Some respondents comments on the type of sound however this was a relatively minor comment. Visually impaired respondents claimed that audio cues are imperative to the crossing task.

While the disabled community clearly suggested that audible cues were critical the authorities were divided between critical (40%) and desirable (29%). However the majority of the combined sample suggests that audible cues are critical.
5.10 Accessible ramps

As with audible cues for the visually impaired accessible ramps for wheelchairs were considered by the disabled community as one of the most fundamental requirements of a crossing facility.

The disabled community and authorities were in reasonable agreement that accessible ramps are a critical feature of a crossing facility.

While the disabled community clearly suggested that audible cues were critical the authorities were divided between critical (40%) and desirable (29%). However the majority of the combined sample suggests that audible cues are critical.

6. Statistical Analysis

Table 6.1 summarises the statistical analysis for the 18 crossing facility characteristics tested. The table highlights that there is a statistical dependence between the results and the population with the exception of the height of the push button. That is, depending on the sample (disabled community or local government) the results from the questions differ and that there is a difference in opinion between the two sample populations.

The ranking of the characteristic is also described where possible. The ranking shown in the table corresponds to the maximum number of responses for that particular ranking.

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>CHARACTERISTIC</th>
<th>CHI-SQUARED VALUE</th>
<th>DIFF RESPONSES</th>
<th>RANKING MAX</th>
<th>RANKING 99%ILE RESPONSE</th>
<th>RANKING MAX RESPONSE</th>
<th>RANKING MAX LOCAL GOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Delineation across the road</td>
<td>39.16</td>
<td>Yes</td>
<td>C</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Delineation - yellow or white</td>
<td>28.46</td>
<td>Yes</td>
<td>C</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Delineation - other colours</td>
<td>24.30</td>
<td>Yes</td>
<td>I</td>
<td>NI-ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Delineation leading towards the crossing facility</td>
<td>48.02</td>
<td>Yes</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Tactile pavement</td>
<td>44.83</td>
<td>Yes</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Width of pathway leading to the facility approximately 1.0m</td>
<td>18.32</td>
<td>Yes</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Width of pathway leading to the facility approximately 1.5m</td>
<td>20.24</td>
<td>Yes</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Width of pathway leading to the facility approximately 2.0m</td>
<td>41.75</td>
<td>Yes</td>
<td>C</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Width of pathway leading to the facility approximately 3.0m</td>
<td>18.42</td>
<td>Yes</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Value</th>
<th>Evaluation</th>
<th>Desirability</th>
<th>Critical</th>
<th>Desirable</th>
<th>Not Desirable</th>
<th>Important</th>
<th>Not Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Width of pathway leading to the facility greater than 3.0m</td>
<td>15.75</td>
<td>Yes</td>
<td>ND</td>
<td>NI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Height of anything to push as existing</td>
<td>6.13</td>
<td>No</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Height of anything to push lower than existing</td>
<td>13.90</td>
<td>Yes</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Central island width approx 1.8m</td>
<td>20.36</td>
<td>Yes</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Central island width approx 2.8m</td>
<td>17.93</td>
<td>Yes</td>
<td>C</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Central island width approx 3.6m</td>
<td>21.57</td>
<td>Yes</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Central island width greater than 3.6m</td>
<td>31.33</td>
<td>Yes</td>
<td>D</td>
<td>NI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Audible cues</td>
<td>28.72</td>
<td>Yes</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Accessible ramps without nose bumps</td>
<td>25.22</td>
<td>Yes</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:  
- C – Critical, D – Desirable, ND - Not desirable, I – Important, NI - Not important

Generally there was some agreement between the disabled and local government that the following characteristics should be included in all crossing facilities:

- Width of pathway leading to the facility wide enough for one person to stand comfortably;
- Width of pathway leading to the facility wide enough for one wheelchair;
- Height of anything to push (eg push button at lights) is at the height where a person sitting down can reach forward and a person standing up reaches down;
- In the middle of the road the island is the length of one wheelchair;
- Audible cues; and
- Accessible ramps without nose bumps.

Statistically however, the disabled and local government only agreed on the height of the push button. The difference in samples is influenced by the variability within the sample rather than the variable with the greatest frequency.

Although it can be concluded from the data that there is a difference between disabled and local government it should be noted that there are limits to the data. The chi-squared test is normally applicable to large samples where the expected value is greater than 5.0 in each cell.

Removing data from the sample did not change the statistical conclusions from the data however it did reduce the size of an already small data set.

The disabled community data set also had limitations. Whilst the focus groups had a large number of respondents the interviewer only recorded the consensus of the group to each question. The data was therefore aggregated prior to the chi-squared analysis.
The results indicate that the disabled community had a higher tendency to rank characteristics as critical while the authorities are more likely to rank the same characteristic as important or even desirable. This could be due to a number of factors including:

- Greater appreciation of funding constraints; and
- Reduced understanding of the difficulties in crossing the road.

Figure 6.1 demonstrates that when all responses are aggregated the disabled community had far more ‘critical’ characteristics while local government had greater ‘desirable’ characteristics.

**Figure 6.1: Difference between samples with respect to relative importance of characteristics**

![Bar chart showing the difference between authorities and disabled samples in terms of relative importance of characteristics]

7. Conclusion

Many important conclusions can be drawn from the research completed as part of this paper. Fundamentally, there is a need to provide a 'combination' of characteristics within each crossing facility. Pedestrian signals with their audible cues were most favoured amongst the disabled community. The treatment however is the most expensive and has the highest thresholds for both pedestrian and vehicle volumes within the guidelines. This is indicative of a risk/cost/benefit decision.

Generally there was some agreement between the disabled and local government that some characteristics should be included in all crossing facilities including minimum pathway widths, standard push button heights, audible cues and accessible ramps.

The results indicate that the disabled community had a higher tendency to rank characteristics as critical while the authorities are more likely to rank the same characteristic as important or even desirable.
The results were encouraging in that they highlighted that many local government engineers and planners are aware of the types of facilities that should be providing however it is over a longer period that various characteristics can be phased in.

Although it can be concluded from the data that there is a difference between disabled and local government it should be noted that there are limits to the data, particularly the sample size and the impact that this has on the chi squared test.

Overall it should be noted that provision for the disabled is a balance of needs. During the disabled focus group discussions respondents were asked to identify the most important characteristic to be provided if only one could be. This generated significant debate and in two cases the groups did not agree and ended up not responding to the question. This discussion is indicative of the issues faced by the disabled community. They are a non-homogeneous group with different often conflicting needs. One statement was made by many of the groups and is an appropriate final conclusion to this study:

‘having some facility with a few characteristics is better than having no facility at all’

8 References


Australian Bureau of Statistics, 2000, 4433.0 Disability and Disabling Conditions, Australian Bureau of Statistics, Canberra


Standards Australia, 1999, AS 12353 Pedestrian push button assemblies Standards Australia, Sydney

Standards Australia, 1992, AS 1428.2 Design for access and mobility Part 2; Enhanced and additional requirements - buildings and facilities, Standards Australia, Sydney


9 Acknowledgments

I wish to acknowledge my thesis supervisor Professor William Young at Monash University, Melbourne whose guidance and advice has been invaluable and much appreciated.
“On your bike!”
– A saving to you and your community?

MR JASON VAN PAASSEN
Parsons Brinckerhoff
“On your bike!” - A saving to you and your community?

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KEYWORDS: Cycling, Planning, Bicycles, Bike, Policy, Targets, Solutions, Active Transport

ABSTRACT

It is becoming common practice within both Australian and international transport planning communities for “cycling usage targets” to be defined as part of an overall transport strategy. In many cases these targets primarily relate to a significant increase in the proportion, or mode share for cycling within each community. As well, cycling is also usually combined with an increase in the walking and public transport mode share as part of a wider “Active Transport” philosophy.

A raft of reasons are known that justify or support increases in cycling mode share. For example, common reasons include cost savings for the individual and community; direct and indirect health benefits; reduced environmental and social impact compared to motorised vehicular traffic; increased social interaction and “sense of community” and simply to promote “active” transport.

This paper discusses these diverse benefits and then concludes by exploring whether cycling is really receiving a “fair go”. It also suggests broad solutions that may be adopted to ensure cycling receives a “fair go” into the future.

1 Introduction

The key purpose for this paper is to broadly see whether cycling could be seen as receiving a “fair go”. Certainly, cycling does represent one key component of planning for not only Australia’s future sustainable transport needs but also plays a key role in fostering a healthy and social society.

2 Cycling targets – a dream or reality?

2.1 What are they?

What are cycling targets? What purpose do they serve? Are they numbers that have been chosen based on strong evidence, background knowledge or research or are they simply a political statement? Are they numbers that exist merely for a political purpose, serving a political end in themselves? We all certainly hope not.
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

Having targets helps us as planners as it gives us something to strive for, some goal, an aim, a “target”. Targets give us direction.

Whatever the real driver behind targets there is one thing that is clear and that is that they are commonplace and form in many respects the back-bone and underlying direction for planning within our community on many fronts, not just transport planning, but also within other sectors of the community, e.g. health, education amongst others.

Targets are commonplace not only in Australia but also throughout the world. Usually targets relating to cycling are defined as part of an overall integrated transport strategy. In many cases these targets primarily relate to a significant increase in the proportion, or mode share for cycling within communities.

As part of a wider “Active Transport” (and sustainable) philosophy cycling targets are often combined with an increase in the walking and public transport mode share components. This is certainly commendable and should be applauded as it brings to the forefront the three modes of transport that by themselves can, and are otherwise often overwhelmed by the sheer volume of motorised private vehicle traffic in our communities. However, if these three modes are seen together as part of an “active transport” package it provides some “strength in numbers”. Maybe even a chance for a stronger “lobby group”?

To illustrate our collective commitment to the use of targets outlined below in Table 2.1 are guides of what are understood to be the representative cycling targets for Australia’s major capital cities into the not too distant future.

Some of the themes that may be drawn out from Table 2.1 are as follows:

- Targets seem to be better if they are “punchy”, that is, simple principles such as a “doubling” or maybe even a “quadrupling” over existing levels of use. Certainly, this is more politically palatable and media friendly, perfect for the quick “grab” on the TV News of Newspaper.

- Some of the changes that need to be achieved could be considered ambitious, for example, is a 10% pa ongoing change over 15 years realistic, as is the case for Brisbane (highest ranking in Table 2.1)? Certainly, if growth rates such as these were experienced in the Sharemarket the company of interest would be an “over-performing stock” a “dream stock”.

- As we have to have a shift in people’s behaviour would more moderate rates of growth be more realistic? That is, say a 4-5% pa change, as is the target for Adelaide. Naskila certainly recognises that “realistic” targets should be set, as is the experience in Finland, “The aim to increase cycling must be exact, hard but realistic. The exact aim must be kept during the whole process and it must be the same with all parties promoting cycling” (Naskila, 1995).

- Are the “punchy targets” supported with funding that equates to or surpasses the growth required to achieve the target? If this was the case you would be expecting a reasonable rate of growth in bicycle usage across the community as a fair return on the investment.
<table>
<thead>
<tr>
<th>City</th>
<th>“Existing” or “baseline” mode share</th>
<th>Proposed future mode share target</th>
<th>Comment</th>
<th>The simplified “vision” target rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelaide</td>
<td>1.2% (of total person trips for an average weekday, 2001)</td>
<td>2.4% (of person trips for an average weekday, 2018)</td>
<td>These targets are part of South Australia’s Transport Plan (draft) (Transport SA, 2003)</td>
<td>Doubling in 17 years or about a 4% pa increase</td>
</tr>
<tr>
<td>Brisbane</td>
<td>2.0% (of total person trips for an average weekday, 2001)</td>
<td>8.0% (of person trips for an average weekday, 2016)</td>
<td>These targets are part of Brisbane’s Transport Plan (Brisbane City Council, 2003)</td>
<td>Quadrupling in 15 years or about a 10% pa increase</td>
</tr>
<tr>
<td>Canberra</td>
<td>2.3% (for work trips, 2001)</td>
<td>5.0% (for work trips, 2011)</td>
<td>These targets are part of ACT’s Sustainable Transport Plan (ACTPLA, 2000)</td>
<td>Doubling+ in 10 years or about a 7% pa increase</td>
</tr>
<tr>
<td>Melbourne</td>
<td>1.0 – 2.0% (of total person trips for an average weekday, 2003)</td>
<td>10.0% (of total person trips for an average weekday, 2030)</td>
<td>Actual target not defined in Melbourne 2030 document (DoT, 2002) although value quoted here is Bicycle Victoria’s proposed target (Bicycle Victoria, 2004)</td>
<td>Five to Tenfold in 27 years or about a 6%-9% pa increase</td>
</tr>
<tr>
<td>Perth</td>
<td>5.7% (of total person trips for an average weekday, 1991)</td>
<td>11.5% (of total person trips for an average weekday, 2029)</td>
<td>These targets are part of Perth’s Metropolitan Transport Strategy (MTS) (DoT, 1995)</td>
<td>Doubling in 38 years or about 2% pa increase</td>
</tr>
<tr>
<td>Sydney</td>
<td>0.5% (of total person trips for an average weekday, 2000)</td>
<td>1.0% (of total person trips for an average weekday, 2010)</td>
<td>Actual target not defined in the Bikeplan 2010 document (RTA, 1999) although value quoted here is an estimate based on Bikeplan 2010’s commitment to the National Bicycle Strategy’s target to “double” cycling usage (AustRoads, 1999)</td>
<td>Doubling in 10 years or about a 7% pa increase</td>
</tr>
</tbody>
</table>

Note: The above values are broad indications only and some variation may exist if more recent information or other planning documents supersede those targets identified above.
The above illustrates that maybe as planners when we are “setting targets” we need to strike a more realistic balance in terms of growth expectations, that is, our estimated “hope” in the rate of change in travel behaviour. In this case what is in question is the rate of take-up of cycling within the community versus available funding and its likely future rate of growth. Certainly, if this connection is not made we may be in danger of raising expectations to an unrealistic level. This scenario may ultimately result in the non-attainment of targets with the corresponding “backlash” from interested sectors in the community calling for the rejection of what was actually a “very good idea”, that is, the strong pursuit of growth in cycling use within our communities. This was certainly the case in the UK when the targets were not met:

The promotion of cycling is at a crucial stage. Just a year away from the 2002 target of the National Cycling Strategy, by which cycle use should have doubled from 1996, cycle use is actually 7 per cent lower than in the base year. Now concern is mounting that the remaining target of quadrupling cycle use by 2010 may not just fail to be met, but fail spectacularly. The implications of this for continued political support for cycling cannot be overstated. So where have we gone wrong? Is it all Government’s fault, the actions of the road lobby or motorists, or could it be that at least part of the problem lies in the strategies pursued by cyclists? (CCN, 2001).

2.2 What are they doing now and how do we achieve them?

The burning questions that are always asked if you have a “target” are:

- “How are we going against our target?” or
- “Are we there yet?”

These questions are certainly the most critical as the answers allow us to gauge how we are performing and whether our actions or policies are resulting in the desired changes in the community’s travel behaviour. Unfortunately though for these, the most crucial planning questions, we as a community struggle to have the resources available to provide the necessary answers. We also need to provide these answers on a regular enough basis to be able to gauge change and then respond with appropriate policy settings so as to try and improve the outcomes.

Each of our major capital cities undertake either Household Travel Surveys (HTS) or other specific travel surveying programs (usually related to a specific project) to establish the types of travel behaviour within the community. The real question is whether we undertake these surveys often enough and do we then compile this information into a single data repository so that the most can be derived from each dataset to inform us about the travel behaviour of the community. Sydney provides a good example of this with the use of the Transport Data Centre (TDC). Brisbane is also moving along this path through Queensland Transport.

What is needed is a central location in each major Australia capital city charged with the role of maintaining a rolling program of surveys to understand travel behaviour change over time. This is one clear way to ensure we have the data to allow effective decisions to be made in relation to transport planning policy settings, including cycling targets, and how we are performing against these over time.
For each of us as planners to determine how we achieve the targets is dependant on what strategy we adopt. The strategy usually includes a mix of both policy settings and infrastructure improvements to allow us to achieve the pre-defined target. For this to be able to be done we need to know where we are now. Unfortunately, this is a question for which the answer is not forthcoming and may not be being asked regularly enough so as to give us time to respond with appropriate balanced actions.

2.3 What are the implications of having targets?

One of the implications of having cycling targets is that expectations are raised not only within the community but also within the political environment. Targets are a “double-edged sword” as they may provide an impetus at the start of a program and also something to aim for. But, equally if the targets are not achieved they also arm opponents of programs with ammunition to allow them to lobby against what are in all likelihood worthwhile programs. Some of the key implications, both positive and negative of having cycling targets are outlined below in Table 2.2.

<table>
<thead>
<tr>
<th><strong>“POSITIVE” IMPLICATIONS</strong></th>
<th><strong>“NEGATIVE” IMPLICATIONS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides a focus for energy and effort within the program.</td>
<td>Funding is required to match the requirements of the target.</td>
</tr>
<tr>
<td>Defines what changes need to be undertaken within the community over a specified period.</td>
<td>To effect change the program hinges on the political will to drive through the necessary changes within the community.</td>
</tr>
<tr>
<td>Gives planners a basis upon which funding or resources can be reasonably justified.</td>
<td>Once the targets are set the level of expectation has been raised to that level, therefore, achieving the targets is crucial.</td>
</tr>
<tr>
<td>Can build strength and direction for lobby groups to support the program.</td>
<td>Not achieving targets reduces the likely future strength of the program.</td>
</tr>
<tr>
<td>Champions of the program, political or otherwise, can justify their stance and garner support from the necessary community groups to effect change.</td>
<td>A lack of adequate support to the program will reduce the potential to achieve the targets.</td>
</tr>
<tr>
<td>Funding is likely forthcoming to support the program if there is a clear direction.</td>
<td>Ongoing progress reviews to “track” against the targets and justify continuation of the program.</td>
</tr>
</tbody>
</table>

2.4 Dream...reality?

Are the cycling targets a dream or reality? This question cannot be answered as it is too early on in the “life of the targets”. Some target timeframes have many more years to run, 10+ or more. That said, what can be established is that as planners we may be guilty of “setting targets” that do not strike a realistic balance in terms of growth expectations, that is, our estimated rate of change in travel behaviour over time within the community.
For example, Brisbane’s aim of quadrupling the amount of cycling usage by 2016 effectively means an annual increase in cycling usage of about 10% pa ongoing for the next 15 years (Brisbane City Council, 2003). Unfortunately, how we have tracked against these targets cannot be determined as the recent Household Travel Survey (HTS) for South East Queensland is not yet available. Certainly a review of this data to establish if a measurable change in cycling usage for Brisbane has indeed occurred would be of interest. What would be expected is that at least a 10% increase in cycling usage has occurred across Brisbane since 1991 (the previous HTS results). If the targets are achieved or surpassed then the program will be given an impetus to move forward but if it is not we may have run the risk of initially setting too high a target and consequently too high an expectation on any given program to increase cycling usage. This could be seen as an unnecessary burden.

As another example, interestingly, recent data for Sydney indicates that “Bicycle travel has shown a slight decrease on weekdays (Mon – Fri) from 1991 – 2000, but has experienced some growth on weekends” (RTA, 2003). Hopefully, this result will not be reflected in our other major capital cities.

3 Reasons for increasing cycling mode share and aiming for targets

A raft of reasons to support increases in cycling mode share are known. Broadly, the reasons include the following:

- cost savings for the individual and the community;
- direct and indirect health benefits;
- reduced environmental and social impact compared to motorised vehicular traffic;
- increased social interaction and “sense of community”; and
- promotion of “active” transport.

Provided below is a brief discussion in relation to the justification of each of the above reasons.

3.1 Cost savings for the individual and the community

For both individuals and the community replacing short car trips (< 5km, see Figure 3.1 below) with bicycle trips represents a clear benefit as these trips represent about 35% of the trips that are made each day within our major cities (see Figure 3.1 below summarising Adelaide data, note that Adelaide’s trip distribution is fairly representative of the trip length distributions experienced in Australia’s other major capital cities).
Figure 3.1 – Distance travelled to work/education by private vehicle, Adelaide data (AustRoads, 1999)

Recent estimates (Shayler, 1993) indicate that the cost savings to society resulting from using a bike rather than a private vehicle are high at about 60c/km. These cost savings are realised by the individual as reduced travel costs and by the government in areas such as savings in relation to health services. Other additional social cost savings are also realised that are not included in this saving including reduced environmental pollution and road congestion thereby leading to reduced operating and infrastructure costs. Reducing private vehicle reliance and using a bike as an alternative can also assist industry with a healthier workforce and reduced business transport costs (AustRoads, 1999).

The potential for an increase in cycling use in most major Australian cities is becoming more of a reality with the gradual increase in the development and take-up of more medium to high density living in urban areas and in particular, along public transport routes. Within this framework cycling as a transport mode is a realistic option and complements this lifestyle and in doing so provides benefits to both the individual and the community. To a degree this direction is evidenced in Sydney where workers living in Central Sydney are more likely to ride a bicycle than workers in outer areas of Sydney (Transport NSW, 2003).

It is more cost effective for the community to provide facilities for cyclists than for cars (Blumenauer, 1995). Cycling is a cost-efficient transport mode that can provide cost-effective transport for a large number of people within the community. For example, in Sydney there are 0.8 bicycles per household with 36% of household having at least one bicycle (Transport NSW, 2003). Bicycles are available they just need to be used more often by more people for short trips.
3.2 Direct and indirect health benefits

It is commonly highlighted in the media and other sources that there has been an upward trend in the body weight of the Australian population. Indeed, this is a recognised trend throughout the Western World. It has reached the point where “documentary movies” are highlighting these issues, for example, the recent US release of the movie “Super Size Me” (about McDonald’s Fast Food Restaurants in the US). It is also well documented that one of the contributing factors to the higher levels of obesity has been the lower level of physical activity by all sections within our community. This level of obesity has a direct cost to the individual and ultimately our communities,

The costs of obesity to the community are significant. The National Health and Medical Research Council indicate that “the costs of obesity...have been conservatively estimated at $840 million (in 1992-93 dollar terms) per year, in care, 63 per cent of which were direct costs within the health system.” [with] “...a further $500 million for weight control programs (NHMRC, 1997).

This level of obesity need not continue within our communities if we commit to an increase in physical activity and a healthy diet. Both sides of Federal politics have made recent commitments to increasing physical activity in schools. This is a good first step but this should also translate into a change in behaviour in relation to how children get to and from school. Physical activity can result in direct benefits to an individual’s health. It has been shown that “regular physical activity, that is, as little as 30 minutes of moderate intensity physical activity on most days of the week, can prevent coronary heart disease, some cancers, non insulin dependant diabetes mellitus, mental illness and injury” (AustRoads, 1999).

It is commonly accepted that those activities that are most likely to be started and continued throughout an individual’s life are those that are able to be incorporated into an individual’s daily lifestyle. Cycling and walking are both modes of transport (and recreation) that offer significant potential for increased physical activity within our communities. The British Medical Association have stated that “existing evidence would suggest that, even in the current hostile traffic environment, the benefits gained from regular cycling are likely to outweigh the loss of life through cycling accidents” (BMA, 1992).

3.3 Reduced environmental and social impact compared to motorised vehicular traffic

One of the major transport related threats or impacts, both environmental and social, upon the community results from the effects of motorised vehicle emissions. The emissions are both air quality and also noise pollution impacts.

The transfer of many short trips from cars to bicycles will assist in reducing these impacts into the future. This is particularly the case for “cold starts”. As indicated above, for much of the population, trips less than 5 km are likely easily undertaken by bicycle and for many so are those less than 10 km. Given that the majority of pollutants from a motor vehicle are emitted during the first 8-10 minutes of a journey local air quality will particularly benefit from this change in travel
behaviour (AustRoads, 1999). Similarly, noise emissions reductions would result over the length of a journey undertaken by a bicycle rather than a car. The impacts of motorised vehicles upon air quality and Australia’s contribution to greenhouse gases is clear,

Transport was responsible for 14.4 per cent of Australia’s net greenhouse gas emissions. Cars were the largest single contributor, being responsible for 51 per cent of domestic transport greenhouse gas emissions (Commonwealth Department of the Environment, 1998).

The environmental and social credentials of cycling are undeniable.

Cycling gives each of us as individuals a look at an application of sustainable behaviour and if we strive to achieve this ideal each of us will gain a sense of empowerment and accountability for our contribution to the environment.

### 3.4 Increased social interaction and “sense of community”

Cycling provides a level of social interaction that is not achieved through the use of the private motor vehicle. Cycling is an apolitical issue as everyone, regardless of political persuasion or ideology rides a bike (Blumcnauer, 1995).

In many respects private vehicles are effectively a “cocoon” from which the driver sees or surveys the world as they speed by. Each driver feeling safe within their own world. This is a world of air-conditioned (or heated) comfort with the music of their choice in the background. The senses of a driver are to some extent “numbed” due to the limited auditory or feeling inputs received from the outside world. In some respects motorists may drive along oblivious to the world around as it passes by. This could be thought of as “dialed-in-driving”, or maybe part of our current infatuation with living our lives “remote control”.

The life of the cyclist could not be more distant from that of the motorist. As a cyclist you have to interact closely with not only other cyclists but also very likely “lower speed” pedestrians. This results in a greater level of social interaction. Indeed, “people are required to see each other eye-to-eye on a bicycle” (Blumcnauer, 1995). This results in recognition of each other as a person not a vehicle. In the world of the cyclist (and pedestrian) one notices the changes in the local landscape and the environment day-to-day. This is a function of the lower speed and level of interaction achieved when cycling. You are more involved with your community when cycling, or for that matter walking. This is not achieved with the private vehicle. As a cyclist (or pedestrian) you “engage” with the local environment and your community rather than simply “pass through it” as you do as a driver of a vehicle.

Bicycles have, in many respects, a calming effect on a community, “bicycles allow people to move around more safely, creating a slower, safer environment for everyone” (Blumcnauer, 1995). This feature of cycling lends itself to the higher density urban areas and community precincts that are starting to develop in Australia’s major capital cities. With a bicycle you can stop and talk to someone you know. This is effectively impossible with a vehicle. Of course, you probably could if you really wanted but would you want to waken the “road rage” menace? The importance of cycling as a means of increasing social interaction and a sense of community has been recognised by the Federal Government,
Successful neighbourhoods require the creation of attractive living environments that promote social interaction, participation and a sense of community identity for all residents (Commonwealth Department of Housing and Regional Development, 1995).

Cycling is an equitable form of transport and is accessible by a large section with the community, indeed,

cycling provides access and transportation to segments of the Australian population that would otherwise not be able to travel, or travel as far, independently. Cycling extends the geographical range for trips usually made on foot and provides a low cost transport alternative for short to medium length trips usually made with motorised vehicles (AustRoads, 1999).

Shorter distance trips (< 5km) need not be the only trip type for cycling if suitable supporting policies and systems are in place within the wider public transport system. For example, in Brisbane, bikes are allowed on the CityTrain network outside of peak hour periods and trials are currently underway with the use of “bike racks” on the front of selected Brisbane Transport bus services across Brisbane. These systems are good for both commuters and recreational cyclists.

Cycling meets the needs of many aspects of life and groups within our community, including transport, recreation, health, economics, sport and social interaction. However, for these needs to be met “cycling needs to be given equal treatment as a transport choice” (AustRoads, 1999) within all of our communities.

3.5 Promotion of “active” transport

Cycling is one element of “active transport”. The other two elements being walking and public transport.

Cycling promotes active transport and a healthy lifestyle for our communities. The Federal Government, as well as the other two levels of Government, support initiatives that foster an active lifestyle within our communities,

The national initiative, Active Australia is aimed at encouraging and assisting Australians to become physically active and remain so throughout life. In “Developing an Active Australia: a framework for action for physical activity and health” the Federal Government advocates broad inter-sectoral linkages and environmental opportunities to improve health and social functioning through safe cycling (Commonwealth Department of Health and Family Services, 1998).

Cycling, in conjunction with public transport and walking, each need to continue to be promoted as a healthy alternative transport package for better healthier communities.

4 So….is cycling receiving a fair go?

Is cycling receiving a fair go? If we look at the targets you may conclude it must be as we are anticipating constant rates of growth in cycling mode share. But is this actually the case? Certainly based on the experience of Sydney (as identified above) with a reduction in weekday usage it does not seem too promising. But as recognised above it may still be too early to
confidently gauge whether there has or has not been an appreciable increase in keeping with the targets.

So, what should be done to give cycling a fair go so that as a result an increase in mode share is more likely? From experiences worldwide there exist a suite of “conditions” or measures that should be in place to varying degrees before cycling truly becomes attractive as an alternative mode. In many respects some of these conditions are “solutions” that will likely lead to improvements in mode share. Achieving these conditions (see Table 4.1 below) would certainly improve the accessibility of cycling to the broader community, not just for the “hardcore” cyclists. Also, in Table 4.1 a subjective “score-card” has been placed against each condition. The score-card results are intended to broadly establish how we in Australia are scoring in relation to each condition. These score-card results are subjective and likely open-to-debate but do provide a point of discussion. What would be of interest is the likely score-card result for a world-renowned cycling mecca such as the Netherlands?

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>“SCORE CARD”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Land Use</strong></td>
<td></td>
</tr>
<tr>
<td>Reduced urban sprawl - shorter travel distances, say 80-90% of trips within 10km or less</td>
<td>2</td>
</tr>
<tr>
<td>Increased focus on the development of regional centres</td>
<td>2</td>
</tr>
<tr>
<td>Higher density development for employment, education facilities and other social services</td>
<td>3</td>
</tr>
<tr>
<td><strong>2 Infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td>Road networks suitable for “vulnerable road users”</td>
<td>2</td>
</tr>
<tr>
<td>Public transport services supporting cycling access</td>
<td>2</td>
</tr>
<tr>
<td>Direct and safe cycling networks</td>
<td>2</td>
</tr>
<tr>
<td>End-of-journey facilities</td>
<td>2</td>
</tr>
<tr>
<td>“Way finding” – signage and maps</td>
<td>2</td>
</tr>
<tr>
<td><strong>3 Community response/attitude</strong></td>
<td></td>
</tr>
<tr>
<td>Positive attitude of motorised vehicular traffic – non “road rage” environment</td>
<td>2</td>
</tr>
<tr>
<td>Community understanding and acceptance of the need for cycling within the community</td>
<td>2</td>
</tr>
<tr>
<td><strong>4 Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Conducive climate</td>
<td>5</td>
</tr>
<tr>
<td>Relatively flat terrain, topography not too steep</td>
<td>4</td>
</tr>
<tr>
<td>Attractive and safe urban environment</td>
<td>3</td>
</tr>
<tr>
<td><strong>5 Supporting policies</strong></td>
<td></td>
</tr>
<tr>
<td>Policies &amp; incentives to support commuter, educational, shopping and recreational cycling.</td>
<td>2</td>
</tr>
<tr>
<td>Changes to existing tax arrangements for private vehicles, e.g. as part of salary packaging</td>
<td>2</td>
</tr>
<tr>
<td>Active (“green”) transport plans for workplaces, educational and education facilities</td>
<td>1</td>
</tr>
<tr>
<td>Policies that support a reduction in reliance on private vehicles.</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: The above “scores” are out of 5, where “5” is “the ideal”.

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Based on the results of the above table it could be concluded that cycling is not currently receiving a “fair go” within our communities. That said, there are strategies in place in each capital city that are designed to increase cycling’s mode share. Once these strategies are implemented they then need to be monitored as part of an ongoing program so that the benefits of a particular program are understood and if necessary improved or expanded. A monitoring program based on the broad “score card” approach identified above may be worthwhile.

With appropriate investment (see the Appendices for examples of “high quality facilities) and cycling policy development the actual score-card results for our cities should improve over time. Hopefully, slowly but surely, moving towards “the ideal”. Also, it would be logical to expect that as we move towards the ideal, in response cycling mode share increases.

The development of score-cards for each city would allow planners to monitor the degree of impact our cycling strategies and policies are having in our communities. In practice, more detailed score-cards would need to be developed and these would also need to tie-in to frequent measurement of performance against the cycling mode share targets.

5 Conclusions

Currently, cycling within our communities is not receiving a “fair go”. This is apparent with relatively skeletal cycling networks, a lack of strong supporting policies that aim to put “active transport” modes into the forefront of the minds of our communities and to demonstrate that cycling is a real and competitive alternative to the private motor vehicle.

The benefits of cycling are clear. There are benefits for the community as a whole, such as environmental, financial, health, social as well as for each individual.

A basic principle that we may need to consider to assist us in realising the goal of increasing cycling usage is the “subsidiarity principle” espoused by Saladin:

We should then, in traffic planning, exhaust the possibilities of transportation with the help of our muscles before we have recourse to any engine.

If we follow this principle, we permit our five senses to receive enough stimulation every day and help us to keep a brain functioning in good condition.

And we arrive at the 3 laws permitting a good integration of all systems of transportation:

1. Any point in the city stays reachable by car, if you really need it, even if not very agreeable.

2. Every transportation that can be done by a person and his muscles should be facilitated and made agreeable by all types of equipment.

3. From the application of the first two laws, we deduce the amount and type of public transport required by the city (Saladin, 1995).

This principle heavily relies on the ability for cycling (and walking) to be realistic alternatives. This will continue to be difficult in Australia until we have an urban form that primarily consists of
higher density living and shorter distance trips. Nevertheless, this philosophy is of interest and certainly thought provoking.

Bicycling represents a positive message. Do something good for yourself and your community (Blumenauer, 1995).

Should we, as planners consider a similar approach to the supply of transport resources (roadspace) as is currently being considered for Australia’s water supply? That is, price it to match the real resource cost and impose limitations on its use based on available resource capacity. Is this really the only way to inspire a change, to direct change, seek alternatives? What is clear is that a “business as usual” scenario will not result in clear change in our communities in the use of alternative transport choices. Will pricing measures result in a community that will adapt its behaviour to match the available resource, the available roadspace? This is a critical question and one that certainly needs to be further explored as part of the development of active transport options, including cycling policy.

Cycling is an important element in Australia’s development as a sustainable society. Are you hearing and responding to the old but worthwhile catch-cry of “choosing to be part of the solution and not part of the problem?”

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7 Appendices – Photos of High Quality Cycling Facilities, Brisbane

| Photo 1 – The Western Freeway bikeway near the Mt-
| Coota Road Roundabout, Toowong |
| Photo 2 – The underpass at Coronation Drive, Toowong |
| to separate cycling and pedestrian traffic from |
| motorised traffic. |
“On your bike!” – A saving to you and your community?

A FAIR GO
a transport reality or impossible dream?

Photo 3 – Underpass at Coronation Drive, Toowong on the riverside of the tunnel (Bicentennial Bikeway).

Photo 4 - Bicentennial Bikeway along the river at Toowong looking towards the City (in the background).

Photo 5 – The Bicentennial Bikeway (Coronation Drive) cycling and pedestrian bridge near the City.

Photo 6 - The cycling and pedestrian network underneath the Riverside Espressway in the City.

Photo 7 - The “Goodwill Bridge” a new cycling and pedestrian bridge or “Green Bridge”.

Photo 8 - The “RiverWalk”, on-river cycling and pedestrian walkway between the City and New Farm.
A FAIR GO
a transport reality
or impossible dream?

Session 5B
A fair go for all modes
“A fair go for all modes”: The Eastern Transport Corridor, Auckland

MR IAN CLARK
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The Eastern Transport Corridor:

“A fair go for all modes”

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ABSTRACT
This paper discusses the development of the concept of the Eastern Transport Corridor, a major, multi modal transport scheme proposed in Auckland, New Zealand. It sets out some of the transportation issues facing the Auckland region, which houses approximately 30% of the population of New Zealand and considers the extent to which the proposed scheme provides “a fair go for all modes”.
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

1. Introduction

This paper covers the recent study by Opus International Consultants Ltd, into the Eastern Transport Corridor.

The Eastern Transport Corridor is the largest and most controversial transport scheme currently under consideration in New Zealand. It relates to a proposal for a transport facility between Manukau City (south Auckland) and the Auckland CBD, a distance of 27 km. The cost is estimated as $2.8b to $3.2b (expected costs, with the range depending on the option selected), with 95th percentile costs of $3.3b to $3.9b. These costs are in New Zealand dollars.

Figure 1: Location of Eastern Transport Corridor
It is controversial due to:

- The cost;
- The political implications;
- The environmental implications of the scheme passing through sections of established urban areas and coastline.

2. Transport in Auckland

Before discussing the scheme itself, it is necessary to give some background into the situation in Auckland.

Auckland has a population of over 1.2m. As such it accommodates approximately 30% of the population of New Zealand.

The population of Auckland continues to grow, and the regional growth strategy anticipates a population of 1.5m by 2050. This offers several challenges, as every day there are:

- 50 more people;
- 20 more houses;
- 35 new cars,
- 1 hectare of additional land required.

The challenges of growth are compounded by the geography of Auckland, and by the historical development of the transport network.

Auckland is situated on a very narrow neck of New Zealand, between a number of harbours and rivers. In addition, there are a number of volcanic cones, which people wish to see retained. These features make Auckland a pleasant place to live, but are not conducive to the provision of a good transportation network.

Partly as a result of the above, but also a result of under funding in the past, Auckland is overly dependant on State Highway 1 – the Northern and Southern Motorway route, which passes right through the urban area. This route includes the Auckland Harbour Bridge, one of many links where a relatively minor incident can have a major impact on congestion over a wide area.

There have been proposals to develop the transportation networks for some forty years. These have been pursued with greater vigour in recent years, and Transit New Zealand is proposing the development of a series of links comprising what cumulatively is known as the “Western Ring Route”. Also, there are proposals to improve the rail system, and to provide rapid transit routes along a few key corridors in the region.
3. Eastern Transport Corridor

The eastern transport corridor is one of the links in the network that was identified in the 1960s studies. A strategy study was commissioned in 2002, and Opus was commissioned in 2003 to develop the concept to the “Scheme Assessment” stage.

The aim of the scheme has been defined as:

“To provide a high quality strategic regional transport link between Auckland City and Manukau City via their eastern suburbs, that will improve access and mobility for people, goods and services throughout the region and in the areas served by the corridor”.

As such, the aim has not been to give a “fair go for all modes”, but to determine the route and an appropriate mode mix. The proposal has been pursued as a multi modal transport corridor, and the recommended option included the following mix:

- **Rail**: much of the corridor follows the line of one of the few existing (heavy) rail lines in the Auckland Region;
- **Bus “rapid transit”**: dedicated bus lanes are proposed along the length of the corridor;
- **Road**: the route includes lengths of existing strategic roads, while a new strategic road is proposed along the section of the corridor that follows the existing rail line;
- **Pedestrians and cyclists**: the clients are keen to use the opportunity to provide good pedestrian and cycle connections, both along and across the route.

In recommending this mix, we have had to address questions as to the impact of the scheme on each mode, and consideration of alternatives. This debate is therefore relevant to the title of this conference.

The scheme has been developed with full cognisance of the emerging New Zealand Transport Strategy, which places greater emphasis on sustainability, and the need to provide for alternative modes to the private car. As a result, we have sought to develop packages of integrated transport solutions, rather than segregated road and passenger transport options.
4. Urban Form

Our study drew on research around the world that indicates that the efficiency of passenger transport systems is related to differing density of development, as follows:

<table>
<thead>
<tr>
<th>Residential density (dwellings/hectare)</th>
<th>Commercial density (employees/hectare)</th>
<th>Effective Transport Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 40</td>
<td>More than 450</td>
<td>Heavy and light rail</td>
</tr>
<tr>
<td>15-40</td>
<td>100-450</td>
<td>Bus</td>
</tr>
<tr>
<td>Less than 15</td>
<td>5-100</td>
<td>Private vehicles</td>
</tr>
</tbody>
</table>

Auckland has traditionally been a low density city, with vast urban sprawl. The areas currently with dense residential and industrial development are illustrated in the following diagrams.

The regional growth strategy seeks to change the pattern of development over time and a number of growth nodes are proposed, generally at locations well served by transport, and in particular passenger transport. Five of these are within the eastern transport corridor.

**Figure 2: Location of Proposed “Growth Nodes” along the Eastern Transport Corridor**
4.1 “A fair go for all modes”: rail

Auckland is poorly served by rail. There are only three lines, all heading into the Auckland CBD, and many of the stations serve industrial areas, with very poor amenity. However, rail will best serve the several “growth nodes” within the corridor, these being high density, mixed use areas, well suited to efficient use of rail. There is a growing view that a high quality rail system will support “transit oriented development”, i.e. giving effect to the growth strategy.

A draft rail business plan was published in 2003. This has no legal status, but it sets out the proposals, as envisaged by several of the bodies responsible for the provision of transport within the region. Stage 1 of the plan includes:

- Improvements to frequency;
- Increases in the capacity of trains;
- Electrification and signalling improvements;
- Station upgrades;
- Limited network improvements.

Subsequent phases refer to the possibility of further network improvements.

As a result, a particularly controversial element of the Eastern Transport Corridor has been the recommendation to provide dedicated bus lanes, parallel to the rail lines, between Panmure and the CBD. People have seen these bus lanes are being directly competing with the rail.

Our recommendations were driven by the maximum rail frequency currently envisaged by the draft rail business plan, at one train per direction every 10 minutes. This in turn is dictated by capacity issues in and around the new rail terminus at the Auckland CBD, called the “Britomart” station. We noted the perceived transfer penalties that will discourage people from using passenger transport, and the modelling backed up our view that to force people to transfer to rail at Panmure would lead to an increase in rail patronage, but overall it would decrease passenger transport numbers.

The project steering group, in May 2004, recommended that the option of providing bus lanes between Panmure and the CBD should be reconsidered, following investigations into further improving rail. As a result, it would appear that rail is being given a “fair go”.
4.2 “A fair go for all modes”: Bus

The passenger transport element of the eastern transport corridor is centred, for much of its length, on bus. This is primarily due to the issue of density of development, noted above, and it is recognised that buses can penetrate into suburban Auckland to a significant degree, much better than rail.

This has then led to the conundrum over what passenger transport facilities should be provided between Panmure and the Auckland CBD. It has been recognised that the bus network has to serve a number of very different functions. It needs to serve local trips, but for many users, once they are on the bus, they want to get to the destination as quick as possible. Also, the dispersed nature of Auckland, and the fact that the CBD provides a relatively low proportion of employment, complicates the bus network necessary to serve all needs.

The recommended option provided for dedicated bus facilities along the entire length of the route. These were not “lower order” bus priority lanes, but dedicated facilities, wherever possible. Along Ti Rakau Drive and Te Irirangi Drive, in Manukau City, they were to be kerbside lanes, to allow for regular stops by some vehicles, while between Panmure and the Auckland CBD they were central (median) facilities, with stations and also bus only ramps at key locations.

It should be noted that the resulting system had bus providing the rapid service between Panmure and the CBD, with rail serving several local stations. It was recognised that this ran contrary to the more normal hierarchy, in which rail would serve the longer distance trips. However, we were concerned that to replace existing rail stations with bus stations, to allow the modes to revert to the “normal” hierarchy would be viewed as being contrary to the rail business plan.

As a result, while the project team sought to give bus a “fair go”, the objective is an effective passenger transport system, and the needs of each mode need to be seen within the wider context. The key issue here is to ensure that the ability to provide the bus lanes between Panmure and the CBD should be protected until the further investment in rail is committed.

4.3 “A fair go for all modes”: General Traffic

There is a perception by some that all the eastern suburbs need is investment in passenger transport, combined with travel demand management. However, this ignores several key factors:

- As noted above, Auckland currently suffers from a limited and incomplete strategic road network. The slightest incident causes massive congestion. The “Western Ring Route” referred to earlier will improve the situation, but (to copy a phrase often used by the Auckland City Mayor, John Banks) “Auckland needs a triple bypass”.

- Many busy routes are totally unsuited to the heavy flows they are forced to take. Accident rates along many such routes are the highest in the region.
Furthermore it has been recognised that the greater density of development proposed within the growth nodes need good accessibility by more than just public transport. As a result, the project team is convinced that the Eastern Transport Corridor needs to include a roading element. This may be taken by some to mean that we are not giving passenger transport or travel demand management a “fair go”, and we accept that the general traffic lanes are likely to fill up sooner rather than later. However, we have emphasised to the project parties that the construction of a new road brings with it a “window of opportunity”. As soon as the road opens, this allows a variety of complementary transportation measures to be put in place.

This will facilitate various other transport initiatives and will enforce the predicted reductions in traffic flows on other routes, to ensure the scheme offers permanent rather than temporary benefits. These measures could include:

- Bus priority measures along routes that are currently heavily congested.
- Measures to improve safety – such as safer phasing of signals.
- Measures to improve the safety and convenience of pedestrians and cyclists.

In addition we note that buses depend on reliable travel times, and these can be enhanced by a road scheme which diverts general traffic off other routes. In fact, the modelling indicated that overall passenger transport patronage will increase, if a roading element is introduced to the scheme. The modelling also demonstrated that the severe traffic congestion predicted with the do minimum scenario would be unlikely to be sufficiently eased by a passenger transport only solution.

There has been a suggestion by some that we should be providing only a “roading” solution. This may achieve improvements in congestion and accessibility in the short term, but we have been mindful of the aim to get Aucklanders out of their cars, for a variety of reasons. To provide a solution which further emphasises the private car as the mode of choice for most people could be counter productive in the long term, even though it is quite possible that elements of a passenger transport solution may not be fully economic in the short term.

During the development of the scheme, we significantly altered the nature and location of traffic interchanges. They are now located away from the growth nodes, rather than within them. With hindsight, this may seem obvious, but it demonstrates that we have attempted to provide traffic accessibility within the eastern suburbs in a way that does not stifle the growth anticipated.

As a result, we have sought to give the needs of private vehicles a “fair go”, without compromising the expected benefits of the scheme for other modes.

4.4 “A fair go for all modes”: Walking and Cycling

In general the scheme includes dedicated pedestrian and cycle facilities along and across the route, and we have sought to integrate the scheme in with the existing and proposed local networks. However, the Eastern Transport Corridor will also assist the growth in walking and cycling as modes of transport in Auckland by the following means:
• By reducing the traffic flows along several busy arterials;
• By introducing pedestrian and cycle facilities along roads that are predicted to benefit from reductions in traffic, as a result of the scheme;
• By facilitating the growth strategy nodes, with core areas in which walking and cycling are the priority modes.

5. Travel Demand Management

Travel demand management is a relatively new phrase in the Auckland context and the implication has been made that you either pursue TDM OR the Eastern Transport Corridor. However, we have noted the following:

• Influencing where people live and work in a way that minimises the need to travel is one of the key strands of travel demand management. TDM will not happen just by building high rise apartments. As such, we believe that the Eastern Transport Corridor will facilitate the region’s growth strategy, by providing the required transport infrastructure for the growth nodes (that is, passenger and private transport, plus areas in which walking and cycling are the priority modes).
• The successful implementation of TDM measures requires the existence of good passenger transport facilities to provide the satisfactory alternative to the private car (i.e. “the carrot” as well as “the stick”).

6. Impacts on the economy

In passing, I note that a study by Business and Economic Research Ltd (BERL) has concluded that the scheme will have a substantial impact on the economy. This is in part a result of the predicted reduction in congestion, which will reducing the costs of freight distribution and provide general improvements in accessibility. Also, the economic benefits of the intensified development, including development over sections of the route which are to be built in a trench, have been assessed as being significant. This trench was conceived initially to reduce severance. However, the possibility of development over the scheme will ensure that the livable area of the growth nodes, within walking distance of the public transport hub, is not decimated by the eastern transport corridor.
7. Conclusion

The Eastern Transport Corridor has long been known as the “eastern highway” or “eastern motorway”, and these terms have been hard to shake. However, we have sought to promote the concept of a multi modal transport corridor, and we firmly believe that the eastern transport corridor offers much, to assist the transportation needs of a growing Auckland region.

While it has not necessarily been the aim of the Eastern Transport Corridor to provide a “fair go for all modes”, it has been the aim to improve accessibility, facilitate structured growth and enhance the economy of Auckland. This has been demonstrated to be best achieved by much needed improvements to the passenger transport, private transport and pedestrian and cycle networks.

I trust that this example has demonstrated some of the mode integration issues to be addressed in developing such a major transportation scheme, such that it is of use in an Australian context.
“All modes are not equal” How to provide priority for public transport but still account for others

MR ANDREW COLLINGS AND MS ANITA CURNOW

VicRoads
“ALL MODES ARE NOT EQUAL” – HOW TO PROVIDE PRIORITY FOR PUBLIC TRANSPORT BUT STILL ACCOUNT FOR OTHERS

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KEYWORDS: Public Transport Competing Demands

ABSTRACT
The Victorian Government is aiming to increase public transport usage to 20% of motorised trips by 2020. An increase in public transport priority on the road network has been initiated to contribute to this. This increase in priority has brought to the forefront the issue of competing demands for road space and time between different modes. In other words, it raises the question: “How do we provide priority for public transport, but still be accountable for other road users?” This paper focuses on how VicRoads is addressing the Victorian Government’s public transport agenda, and is tackling the issue of an increase in public transport priority that can adversely affects other modes. The frameworks that have been developed will continue to be refined. However, it is considered that they will be useful to other road authorities, or transport planners, to assist in evaluating competing demand issues between different modes.
1 Introduction

Road space can be viewed as a valuable and limited commodity. There are many possible uses for road space, and while some uses are harmonious, in many cases there is competition between modes and functions. This competition between modes has lead to issues regarding decisions about allocating road space and more importantly, who makes these decisions. In addition, the effects of reallocating road space also need consideration and discussion. This competition between modes is only going to increase in the future as the road network adjusts to increases in demand for capacity. As such, VicRoads is developing a system to help identify and manage competing demands.

This paper discusses the process that VicRoads is undertaking to manage competing demands on the Victorian road network - more specifically, the issue of how to provide priority for Public transport while still accounting for other modes is considered. The paper provides a background summary of how managing competing demands arose as an issue for VicRoads, discusses the process undertaken, including outcomes, and documents the lessons learnt along the way. Finally conclusions are made.

2 Background

Over recent years public transport has gained increasing importance in VicRoads’ work program. This change has arisen in response to greater attention to public transport in Government polices and strategies. These strategies focus on sustainability in Victoria’s future, namely:

- Melbourne 2030 – The Metropolitan land use/transport strategy (A short description of relevant Melbourne 2030 directions are detailed in Appendix A)
- Growing Victoria Together and its stated objective of achieving 20% of all motorised trips to be made by public transport by 2020.

As the arterial road manager, VicRoads has an integral role in delivering public transport improvements. To achieve this, VicRoads had focused on:

- Managing the arterial road system to provide travel time improvements for road based public transport, and
- Encouraging modal shift on congested corridors towards public transport.

In order to achieve these, VicRoads is defining network hierarchies, applying principles of public transport priority, freight access, better use of existing roads, and maintaining amenity. Priorities for network use will be established for some sections of arterial roads with differing functions. This will enable the overall arterial network to best meet the needs of all users. In particular, it will improve traffic flow in Melbourne’s inner and middle suburbs where there is limited road space available, and established patterns of abutting land use.

Victoria is developing a Metropolitan Travel Plan (MTP) which documents these VicRoads directions in more detail. In addition to these priorities, the Minister for Transport has established the Victorian Road Based Public Transport Advisory Council. The Advisory Council is chaired by
the VicRoads Chief Executive and brings representatives of state and local government, operators, and users together to advise on road management issues as they relate to buses, trams and taxis.

Both the MTP and the Advisory Council recognise the pivotal importance of management of competing demands for road space. This paper has focused on a process drafted by the Advisory Council that may be of interest to a more general audience.

3 The process undertaken

In response to the Advisory Council, VicRoads convened five case study groups to consider how to increase priority for public transport while still accounting for other modes. The case studies were used to test and improve an approach for managing competing demands, and resulted in ongoing enhancement of that approach. Key stakeholders were included to ensure effective decisions were made and that all modes were accounted for. Table 1 outlines the stages of development of the approach.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Done by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Case studies and objectives established</td>
<td>Advisory Council</td>
</tr>
<tr>
<td>2</td>
<td>Local priorities, issues &amp; treatments determined</td>
<td>5 Case Study Groups</td>
</tr>
<tr>
<td>3</td>
<td>Reviewed outcomes and refocused process</td>
<td>Advisory Council</td>
</tr>
<tr>
<td>4</td>
<td>Reviewed and expanded process</td>
<td>Sub-Group of Case Study Groups</td>
</tr>
<tr>
<td>5</td>
<td>Tested revised process</td>
<td>5 Case Study Groups</td>
</tr>
<tr>
<td>6</td>
<td>Finalisation and referral of process</td>
<td>Advisory Council</td>
</tr>
</tbody>
</table>

This course of action is provided in more detail below:

3.1 Establishment

The issue of Managing Competing Demands arose when the Advisory Council developed its priority action plan. It was proposed that five case study groups be set up to help analyse real life experience of competing demands. The case studies should form the development of a process suitable for options, in the light of transport issues and broader consultative issues that are known to Advisory Council members. A case study group made up of representatives for the Advisory Council and different transport modes was developed for each route. The routes selected were:

- **Burke Road** – Whitehorse Road to Malvern Road
- **Sydney Road** – Brunswick Road to Bell Street
- **Collins Street** – Spencer Street to Spring Street
• **Stud Road** – Monash Freeway to Clow Street

• **Moorabool Street** – McKillop Street to Barwon River

### 3.2 Case Study Issues & Treatments

The case study group meetings were undertaken as follows:

- **Scene setting** – It was stated that the process was a subjective exercise of assigning priorities and raising issues rather than detailed analytical work.

- **Description of the key stakeholders** – Each group identified what modes should be represented in analysis of the route, and what the key characteristics of that mode were.

- **Assessment of the importance of the particular route to each mode relative to other parts of the network** – This was done using a 1-5 scale ranging from low importance through to high importance. (Refer to Appendix B)

- **Assessment of the existing level of service for each mode on route** – The question to answer was how well served this mode was for the route. Again this was done using a 1-5 scale – low level of service through to high level of service (Refer to Appendix B)

- **The strategic importance question was considered again in the light of future possible/proposed changes** – Were there any known factors that would influence the strategic importance of the route to that mode.

- **Desired level of service for each mode** – The desired level of service was assumed to be equivalent to the future strategic importance assigned to that mode.

- **Possible treatments** – All groups discussed possible treatments that could be applied on the route, that would deliver the desired level of service for each mode.

The overall outcome of the meetings was a framework for determining the desired level of service for each mode on the route and then identifying methods of managing road space and time to match these levels of service.

A single report containing information on all of the case study groups was prepared and provided to the Advisory Council. This report also recommended a generic process that accounted for each of the case study groups’ experience.

### 3.3 Reviewing by Advisory Council

The Advisory Council then reviewed the generic process and sought to expand it to account for network effects. In particular, the following points were made:

- If a traffic route is downgraded, the proposal must also consider the impact this will have on adjacent routes;

- The lack of focus on network effects was due to needing to first develop a generic process on a route basis before considering network effects
The Advisory Council concluded that it was important for the Case Study Groups to consider the broader effects, both in terms of devising acceptable solutions, and also in making trade-offs between modes and user groups. As such, a broad level meeting involving representatives from all of the Case Study Groups was arranged.

3.4 Detailed Review of Process

The broad level meeting was held with representatives from across the case study groups to address the comments of the Advisory Council and to move the process forward. The following issues were discussed:

- **Issue 1:** Making the strategic importance of the route clear
- **Issue 2:** Making the process account for network effects and land use impacts.
- **Issue 3:** Making sure adequate attention is given to stakeholder consultation
- **Issue 4:** Making sure analytical processes are integrated, adequate and practical.

The result of the meeting was a restructure of the process to better reflect the above. The new process was planned to be tested during the second Case Study Group meetings. As part of this, reference material was developed to assist uniform specification of service levels, and to assist planning the necessary consultation and evaluation for each project.

3.5 Testing Revised Process by Case Study Groups

At the second set of individual case study group meetings, each group was asked to test the proposed process for the particular case study. The reference material – level of service definitions and the consultation and evaluation planner – were modified after testing (these are detailed in section 4 of this report). The consultation and evaluation planner was tested using the real-life treatments suggested by the case study groups.

3.6 Finalisation and Referral

With the benefit of real life examples, an updated process was reported to the Advisory Council with some minor further amendments. A final 8-step process was developed and is presented in Section 4. In addition, it was agreed that ideas for the case study groups would not be lost, but be handed over to the responsible authority (mostly VicRoads) for consideration in future programs.

4 The resulting approach

This section details the approach that the Advisory Council developed to analyse competing demands. The section first looks at an overview of the process and then provides a summary on each of the steps.
This approach can be applied wherever competing demands need to be assessed – in the context of setting network hierarchies of use, at the strategic level, or at the more detailed level, of assessing individual treatments.

The approach is summarised as an eight-step process in Table 2. It is considered that this process could be used and adapted by other jurisdictions addressing competing demand issues. Because every location has a different political, environmental and physical environment, some adaptation to suit relevant government policies and procedures would be required.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Question addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Context of the route</td>
<td>What is the land use/transport context in which the route operates?</td>
</tr>
<tr>
<td>Step 2</td>
<td>Establishing a vision</td>
<td>What is the vision for the route including its activities, and who will champion this vision?</td>
</tr>
<tr>
<td>Step 3</td>
<td>Road space pressure points</td>
<td>What pressure points arise from claims for road space?</td>
</tr>
<tr>
<td>Step 4</td>
<td>Revisiting route priorities</td>
<td>How can pressures be alleviated by reprioritisation of modes and network shifting?</td>
</tr>
<tr>
<td>Step 5</td>
<td>Gap analysis</td>
<td>What is the difference between the importance and the current level of service for modes?</td>
</tr>
<tr>
<td>Step 6</td>
<td>Development of treatments</td>
<td>What package of treatments best closes the “gap” between importance and level of service, accounting for cost and community concern?</td>
</tr>
<tr>
<td>Step 7</td>
<td>Implementation phase</td>
<td>What needs to be done to see the preferred treatments implemented?</td>
</tr>
<tr>
<td>Step 8</td>
<td>Evaluation and ongoing improvement</td>
<td>Have the treatments achieved their objectives and are impacts known?</td>
</tr>
</tbody>
</table>

4.1 Context of the route

The first step is to develop an understanding of the context of the route. In other words what is the land use / transport context in which the route operates. This is done via preparation of a map that shows the region or route under consideration and if a route, also including the network surrounding the route. The map should extend to parallel alternative routes, which may require 3-4km to be depicted either side of the route. On the map, the following items should be depicted:

- Whether it is a local or arterial road
- Road cross section, showing time of day differences if relevant (eg affected by parking)
- Nominated roles of the road that have been identified in prior strategies such as Melbourne 2030 or local strategies (eg Principal Public Transport Network, Principal or Municipal Bicycle Network, Principal Road Network, preferred traffic route or other relevant policies etc in other states).
- Abutting land uses and other attracting major activity centres
- Land use-transport interactions within the network

Figure 4.1 overleaf shows a fictitious map detailing relevant information
4.2 Establishment of a vision

The next step is to establish the vision for the route including its activities and who will champion the vision. This is done via identification of high-profile person or persons with a vision for the route that is consistent with Melbourne 2030, and who is (are) willing to champion this vision within the community. This vision should:

- Compare the anticipated future situation with the existing situation identified in Step 1
- Be documented and accessible
- (Where possible), be supported at the high-level by key stakeholders
- Be conveyed to the community

4.3 Road space pressure points

Step 3 in the process identifies what pressure points arise from claims for roads space. To achieve this, the following process is suggested:

- Use a worksheet such as that shown in Figure 4.3, modifying it to represent the main modes and number of routes sections, cross roads, and parallel routes that apply to the
route in question. If applicable, prepare two different versions—one for when parking is permitted and one for when it is not.

- Fill in the worksheet by nominating an importance rating for each mode, route section & time of day. This can be achieved via attached set of definitions for level of service for modes in Appendix B.
- Identify the pressure points by then considering the range of demands on each road section (or major intersection) along the route in question, and taking into account the road cross section and adjacent land uses, identify sections with an unmanageable range of pressures.
- Map these pressure points and in doing so, provide some indication of the range of pressures that apply to each section, and rank the sections in order of increasing pressure magnitude. Two maps should be used—one for peak and one for off-peak.

**Figure 4.3 Possible Table to use**

<table>
<thead>
<tr>
<th>Road location by parking regime</th>
<th>Mode or function</th>
<th>Through traffic modes</th>
<th>Local access modes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bus</td>
<td>Tram</td>
</tr>
<tr>
<td>When Parking is banned</td>
<td>Route section 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route section 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route section 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross road 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross road 2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Cross road 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross road 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternative route A sec 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternative route A sec 2</td>
<td></td>
<td></td>
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<td></td>
<td>Alternative route A sec 3</td>
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<tr>
<td></td>
<td>Alternative route B sec 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternative route B sec 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternative route B sec 3</td>
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</tr>
</tbody>
</table>
4.4 Revisiting route priorities

Once the pressure points on the route have been established, it is then possible to consider how pressures can be alleviated by reprioritisation of modes and network shifting. A review of the “pressure points” map is likely to reveal a number of route sections where it will not be possible for all modes to be catered for according to their strategic function. In order to give some certainty to the remainder of the process, and a framework for making decisions about suitable treatments, it will be important to see whether any trade-offs can be made at the network level. A suggested process is:

- Arrange a meeting of key stakeholders (road authorities, planning authorities, representatives of modal groups) and highlight the problem for each of the most critical pressure points.
- Consider the options for “making a call” on other ways to structure networks (for example, assigning an alternative route as a through route, implementing high-level strategies such as road closures, moving bicycle networks to off-road or local road alternatives, moving or downgrading the role of the public transport service)
- If network restructuring is not an option, or does not completely alleviate pressure points, it will be necessary for some modes to be downgraded in importance – an up-front recognition that not all modes will be able to be serviced. This should be done transparently and with the highest level of agreement between parties possible.
- Review the ratings of importance undertaken in Step 2 in the light of the outcomes of the key stakeholder meeting.

4.5 Gap analysis

The gap analysis step compares the difference between the strategic importance and the current level of service for modes. It is necessary to be able to define levels of service for each mode in a way that is comparable with the importance rating made in Step 2 (and revised in Step 3). The objective is to then use this assessment to determine the priorities for improvements, and to give an order of magnitude to the level of improvement required.

- Make a copy of the worksheet used in Step 2 and delete the importance assessments.
  Instead of importance, now enter for each mode along the various sections of the route under question the current level of service for that mode.
- The levels of service definitions provided in Figure 3 are to be used in nominating level of service. This should be done by time of day as well as section of route. Initial levels of service definitions are provided in Figure 3 and will ensure consistency in the application of
this step to different situations. It is recommended that a range of stakeholders have the opportunity to input to or review the nomination of level of service.

- Once levels of service are entered in, subtraction of level of service from revised (Step 3) importance will highlight “gaps” between the conditions experienced and the objective conditions for each mode. The greatest differences highlight the modes for focused consideration when treatments are developed for the route in Step 5.

Refer to Appendix A for further information on level of service for modes.

4.6 Development of treatments

Step 6 considers what package of treatments best closes the “gap” between importance and level of service, accounting for cost and community concern. Although trade-offs have already been made in Step 3 at the network level, there will be a need for further trade-offs to be made between modes as detailed treatments are developed. However, the fact that a call has been made regarding the importance of one mode over another, means that some context is available for those developing the treatments. At all times, treatments developed should optimise the usage of the road space, accounting for as many modes as practical.

The treatments should be developed with appropriate use of different evaluation techniques, and appropriate levels of consultation. In order to put a framework around decisions about consultation and evaluation, a planner has been developed, and is illustrated in Appendix C.

The intended use of the planner is as follows:

- Develop a list of potential treatments, and package these in a way that simplifies the procedure somewhat, including early identification of any mitigative measures (such as providing equivalent off street parking if on-street parking is to be restricted)
- Plot the proposed treatments on the Consultation and Evaluation Planner, in terms of the level of community concern about the treatment, and the combined cost and complexity of the treatment.
- Highlight the treatments that are considered to have the most potential for effectiveness (that is, they are most likely to contribute to objectives such as travel time reduction) by emphasising them on the Planner – for example, depict the more promising treatments with larger dots, while the less effective ones would be indicated by a small dot.
• Determine from the Planner the appropriate consultation and evaluation requirements of (mitigated) treatments.

• Assess whether it is justifiable to pursue the treatments with lower effectiveness (that is, those indicated by a small dot). Discard any that are not considered worth pursuing. An example of a treatment that might be discarded is provision of a bus flyover at a major intersection with relatively few buses. The level of community concern (about visual intrusion) and level of cost and complexity would both be very high, while the treatment may only provide moderate travel time gains to a small number of buses.

• For the remaining treatments, undertake the level of consultation and evaluation indicated.

• After this consultation and evaluation, identify the preferred package of treatments (Appendix C shows this consultation plan).

4.7 Implementation phase

This stage moves the process forward from a theoretical process to a consultation and implementation process. The essential purpose of this stage is to evaluate what needs to be done to see the preferred treatments implemented. During the implementation phase, the treatment packages will need further refinement, and bids for funding to implement the projects will be required. It is also important to note, that depending on the nature of the treatment, provision of information to the local community may also be necessary.

4.8 Evaluation and ongoing improvement

This final step is an evaluation to see if the treatments implemented have achieved their objectives and if any additional impacts have occurred.

After implementation, the package of treatments should be regularly monitored for effectiveness, and to identify any unexpected impacts. In some cases, minor adjustments to the treatments may be necessary to see them operating satisfactorily.

• Evaluate how well the impacts of the implemented treatment matches the anticipated impacts to each mode, and use as an input to refining the process

• Identify and undertake any necessary fine-tuning post implementation

• Identify any significant new improvements possible and progress them through the process
5 Key findings and lessons learned

The set of activities outlined in section 3 led to the definition of the approach in section 4. However, there were several iterations of the approach on the way to that presented in this paper. This section discusses the main learnings of the process outlined, to make the process as effective as possible in real life situations. Listed below are crucial learnings and findings that have been identified during the process. They include strategic thinking, effective consultation and consideration for all road users. These issues although specific to the Victorian environment can be utilised by other jurisdictions.

**Need to set a vision for the route:** The framework of using Strategic Importance of Route, Existing Level of Service, and Proposed Level of Service for each mode, proved to be an effective means of subjectively assessing where we are and where we want to be.

**Analytical assessments are needed:** The initial subjective assessments to balancing competing demand could be undertaken, but a reasonable degree of analytical assessment will be needed to more accurately state where we are and where we want to be.

**Route and network assessments are needed:** Competing demands need to be assessed on both a route and network basis. Which comes first, the network or the route. The route comes first and then impacts on the network should be considered.

**A range of engineering options to achieve a new balance:** Each working group identified a wide range of options that could be used to deliver varying changes to the balance between stakeholders. Determining what level of change is acceptable to the community and the method of achieving ultimate vision needs to be considered. One approach is multiple incremental changes all building towards the final vision (although there are usually a very limited number of increments). The other approach is the one off project to deliver the new balance.

**Stakeholder consultation:** Extensive stakeholder consultation is likely to be needed. The Advisory Council working groups were supportive of public transport, and hence the engineering options often favoured public transport. For the wide range of stakeholders to be supportive of public transport, a strong policy context from the Government is likely to be required.

**Adversely affecting other modes:** To achieve benefits for public transport, it is often necessary to downgrade the level of service for another mode or road user group. The process must allow for this to be undertaken at a strategic level.
6 Conclusion

Establishing a process to incorporate public transport and other modes on the Victorian road network is a journey for VicRoads. An iterative process was undertaken detailing different steps that could be undertaken to manage competing demands. When new information or new thinking came to light – the process was changed to become more efficient and effective. As such the methods undertaken to evaluate competing demands are by no means an end point and definitive. As a result the steps provided should be viewed as a theoretical framework from which to set a base for managing competing demands.

The next step is to exercise the approach developed to the network and individual routes. It is likely that ongoing adaptation and refinement of the process will be necessary as the network and individual routes are managed and decisions made about priority modes.

7 References

Victorian Road Based Public Transport Advisory Council, 2003, Discussion Paper on Managing Competing Demands, Papers for May 27, 2003 meeting

Victorian Road Based Public Transport Advisory Council, 2003, Discussion Paper on Managing Competing Demands, Papers for August 26, 2003 meeting

Victorian Road Based Public Transport Advisory Council, 2003, Competing Demands Case Study Groups, Papers for November 18, 2003 meeting

Victorian Road Based Public Transport Advisory Council, 2004, Managing Competing Demands Report, Papers for May 25, 2004 meeting

8 Acknowledgments

We wish to acknowledge the input of the Victorian Road Based Public Transport Advisory Council and the five case study groups to the development of the approach outlined in this paper.
9 Appendices

Appendix A

Melbourne 2030

*Melbourne 2030 – planning for sustainable growth,* is a 30-year plan to manage growth and change across metropolitan Melbourne and the surrounding region. The core of *Melbourne 2030* is nine ‘directions’, or desired results, whose achievement over time depends on putting into effect specific, carefully framed policies. Direction No 8 – “Better transport links” is the most relevant direction to VicRoads. The Direction outlines eight policies and a number of initiatives to manage the development of transport in Melbourne and the surrounding region. The initiatives related directly to public transport are:

- Upgrade and develop the Principal Public Transport Network and local public transport services to connect activity centres and link Melbourne to the region cities.
- Improving the operation of the existing public transport network with faster, more reliable and efficient – on road and rail public transport.
- Coordinate development of all transport modes to prove a comprehensive transport system
- Manage the road system to achieve integration, *Add more info*

**Victorian Road Based Public Transport Advisory Council**

The Advisory Council was set up by the Minister for Transport to provide a broadly based forum for obtaining views and advice from the transport sector on issues affecting the effective integration of the needs of road based public transport and the management of the road and traffic system in Victoria. The main role of the Advisory Council is to provide advice to VicRoads and the Minister for Transport on the needs of public transport in the development, planning, programming, regulation, management, operation and design of the road and traffic network in Victoria with particular reference to:

- State Government strategies for planning and transport;
- Road transport efficiency;
- Road safety;
- Community and environmental issues;
- Service performance standards for road based public transport; and
- International best practice for the management of roads and the public transport that users them.
Appendix B – Ranking Index and Spreadsheet

Figure 3: Level of service definitions (sample modes listed)

**Cars – Through Traffic**

1. Traffic is bumper to bumper and stop-start at intersections and mid-block
2. Traffic is heavy and often has to wait several cycles to get through intersections
3. Traffic is moderate and sometimes have to wait more than one cycle at intersections
4. Traffic moves freely and only occasionally have to wait more than one cycle at intersections
5. The traffic moves freely like in the middle of the night

**Pedestrians**

1. Long cycle times at signals with short crossing times, two-stage crossings, very few gaps in traffic mid-block, infrequent formal crossing points, footpaths inadequate
2. Long cycle times at signals, few gaps in traffic mid-block and few formal crossing points, footpaths may be inadequate
3. Moderate cycle times at intersections with moderate crossing times, sometimes has gaps in traffic mid block and some formal crossing points, footpaths may be inadequate
4. Short cycle times at intersections with moderate crossing times, often has gaps in traffic mid block or frequent formal crossing points, footpaths adequate
5. Zebra crossings and very light traffic mid-block or frequent formal crossing points, footpath widths adequate

**Cars – Local**

1. Traffic is bumper to bumper, car parking spaces are very difficult to access and delays are significant when turning into side streets.
2. Traffic is heavy, car parking spaces are difficult to access and significant delays when turning into side streets.
3. Traffic moderate, often hard to access, and moderate delays when turning into side streets
4. Traffic moves freely, occasionally car parking spaces are difficult to access and there are occasional delays when turning into side streets.
5. Traffic moves freely, large number of car spaces available and no delays when turning into side streets.

**Public Transport**

1. Traffic is bumper to bumper and stop-start at intersections and mid-block, causing consistently slow and late running PT operations
2. Traffic is heavy and PT often has friction mid-block, and often waits several cycles to get through intersections or to reach stops
3. Traffic is moderate and PT sometimes has friction mid-block, and sometimes waits several cycles to get through intersections or to reach stops
4. Traffic moves freely and PT has little mid-block friction and only occasionally has to wait more than one cycle at intersections
5. The traffic moves freely like in the middle of the night and PT stops only occasionally at lights

**Cyclists**

1. Bicycle operates mixed with other traffic
2. Bicycles operate in shared space (wide kerbside lanes)
3. Bicycles lanes exist but not continuous over route
4. Bicycle lane continuous over route, excluding some intersection
5. Bicycle lane continuous over route, including through intersections
<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>EXISTING</th>
<th>FUTURE GOAL</th>
<th>FUTURE LOS WITH IMPROVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strat Imp</td>
<td>LOS</td>
<td>Strategic Importance/ Desired LOS</td>
</tr>
<tr>
<td>Malop to Ryrie</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street parking</td>
<td>3</td>
<td>3</td>
<td>1- Significantly reduce importance and LOS</td>
</tr>
<tr>
<td>Access to off-street parking</td>
<td>3</td>
<td>3</td>
<td>2- Reduce importance and LOS</td>
</tr>
<tr>
<td>Through traffic</td>
<td>2</td>
<td>2</td>
<td>1- Reduce importance and LOS</td>
</tr>
<tr>
<td>Buses</td>
<td>3</td>
<td>2</td>
<td>5- Significantly increase importance, substantially increase LOS</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>5</td>
<td>4</td>
<td>5- Increase LOS</td>
</tr>
<tr>
<td>Taxis</td>
<td>3</td>
<td>3</td>
<td>3- Remains the same</td>
</tr>
<tr>
<td>Ryrie to McKillop</td>
<td></td>
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<tr>
<td>Street parking</td>
<td>5</td>
<td>5</td>
<td>3- Significantly reduce importance and LOS</td>
</tr>
<tr>
<td>Access to off-street parking</td>
<td>4</td>
<td>4</td>
<td>4- Remains the same</td>
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<tr>
<td>Through traffic</td>
<td>3</td>
<td>3</td>
<td>2- Reduce importance and LOS</td>
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<tr>
<td>Buses</td>
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<td>3</td>
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<td>Pedestrians</td>
<td>4</td>
<td>3</td>
<td>4- Increase LOS</td>
</tr>
<tr>
<td>Taxis</td>
<td>3</td>
<td>3</td>
<td>3- Remains the same</td>
</tr>
</tbody>
</table>

- Change the operation of the Little Malop St intersection by making it left turn only, and remove it from signal control (retain ped. operated signals).
- No right turn, buses excepted, Malop into Moorabool
- Move southbound bus bays back to N side of Little Malop Street, make daytime parking spaces into loading zone (still taxi rank at night) and use the additional roadspace in SE quadrant for additional through traffic capacity.
- Conversion of spaces to parallel parking as already flagged
- Longer parallel parking bays that allow faster parking/unparking when the bays are put in.
- Median, one lane northbound, two lanes southbound, as flagged by Council
<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>EXISTING</th>
<th>FUTURE GOAL</th>
<th>FUTURE LOS WITH IMPROVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strat Imp</td>
<td>LOS</td>
<td>Strategic Importance/ Desired LOS</td>
</tr>
<tr>
<td>McKillop to Barwon R</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Street parking
  - Strat Imp: 3
  - LOS: 5
  - Strategic Importance/ Desired LOS: 2- Reduce importance, substantially reduce LOS
  - FUTURE LOS WITH IMPROVEMENTS:
    - 2- Meets goal

- Access to off-street parking
  - Strat Imp: 2
  - LOS: 4
  - Strategic Importance/ Desired LOS: 2- Significantly reduce LOS
  - FUTURE LOS WITH IMPROVEMENTS:
    - 4- Does not move to goal

- Through traffic
  - Strat Imp: 4
  - LOS: 3
  - Strategic Importance/ Desired LOS: 4- Increase LOS
  - FUTURE LOS WITH IMPROVEMENTS:
    - 3- Does not move to goal

- Buses
  - Strat Imp: 4
  - LOS: 3
  - Strategic Importance/ Desired LOS: 5- Increase importance, significantly increase LOS
  - FUTURE LOS WITH IMPROVEMENTS:
    - 5- Meets goal

- Pedestrians
  - Strat Imp: 2
  - LOS: 2
  - Strategic Importance/ Desired LOS: 2- Remains the same
  - FUTURE LOS WITH IMPROVEMENTS:
    - 2- Remains OK

- Taxis
  - Strat Imp: 4
  - LOS: 3
  - Strategic Importance/ Desired LOS: 4- Reduce LOS
  - FUTURE LOS WITH IMPROVEMENTS:
    - 3- Does not move to goal

• Introduction of pm peak clearway, combined with a bus lane that terminates back from signalised intersections so that the intersections operate at maximum possible capacity.

• Mirror the pm peak bus lane arrangement in the northbound direction in the morning, to ensure that buses are not further delayed in the future as congestion levels grow.

“All modes are not equal.” How to provide priority for public transport but still account for others.
Appendix C

Levels of consultation

- **Involve**: Work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered.
- **Consult**: Obtain public feedback or analyze another decision's public comments, focus groups, surveys, public meetings.
- **Inform**: Provide the public with balanced and objective information to assist them in understanding the problems, alternatives, and solutions. Provide web, fact sheets, information displays.
- **None**: Controlled by ongoing agreements between stakeholders.

Levels of evaluation

- **Database**: Development and consideration of options, triple bottom line evaluation, use of models developed from past experience, in limited cases, use of microsimulation or network modeling. Use of detailed tools to refine the specifics of the treatment and minimize and mitigate its impacts.
- **Partial**: Use of similar past treatments as indicators of likely outcomes, undertake manual analysis of options, uncalibrated modeling, refine or add to design as a result of the evaluation.
- **Minimal**: Use of sketch evaluation techniques, rely on similar previous work, focus evaluation on the more sensitive or complex aspects as a design & mitigation aid.
Session 6A
Between the fences – using the space
South Australia's Transport Plan

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Transport Planning in South Australia

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KEYWORDS: Transport Planning, Sustainable Transport, Social Inclusion, Accessible Transport.

ABSTRACT
The State Government’s vision for transport is to achieve a sustainable transport system: one that is integrated, coordinated, affordable, efficient and safe, and meets the accessibility needs of all South Australians. The challenge for transport planning is to find the balance between economic, social and environmental needs while ensuring the efficient movement of people and goods.

The Government recognises that not all South Australian’s fare equally in terms of transport and planning, and some experience acute and disproportionate disadvantage. This is why social inclusion is a central theme.

The Draft Transport Plan is a key component of the transport planning process and seeks to provide the direction and framework for decision-making across all modes of transport. The incorporation of land use planning approaches and innovations on more traditional transport solutions aims to maximise access to infrastructure and services in order to widen transport choices in both rural and metropolitan areas. Emphasis is on fair access for pedestrians, cyclists and more sustainable transport modes generally. Public transport is given greater priority than in the past – at intersections, on the transport system and for Government expenditure – as is rail and shipping for the movement of freight.

The State Government will need community involvement and partnership with other Governments and the private sector to achieve the vision of a sustainable transport system for South Australia.
1 Introduction

Over the last two years the South Australian Government has embarked on the development of a comprehensive transport planning process. The key components in this process has been the release of a Draft Transport Plan and a major community engagement phase to seek the views of the whole community about direction for transport in South Australia.

2 Transport Policy Platform

The South Australian Government’s policy platform on transport (A Commitment to Transport 2002) provides the context for the development of a Draft Transport Plan. The platform for government document (Platform for Government 2000) also provided guiding policies, principles and commitments for a number of important transport elements. In these commitments the Government has outlined an aim to ensure a sustainable transport system for South Australia. Specifically, a Sustainable Transport System for the state that is integrated, coordinated, affordable, efficient and safe. In order to achieve this, the South Australian Government has identified a series of specific actions:

- develop a Draft Transport Plan in partnership with key stakeholders and the community for the delivery of infrastructure, regulation and system management strategies;
- work with all stakeholders, including rural and regional communities, to improve road safety;
- in conjunction with local government and communities review existing speed limits in rural and country areas in order to maximize road safety;
- initiate a Community Road Safety Fund with revenue raised from anti-speed devices;
- work with industry, union and Commonwealth government representatives to develop occupational health and safety strategies for the heavy vehicle industry;
- create the Office of Public Transport within the Department of Transport and Urban Planning to deliver accessible, efficient and affordable public transport services;
- create the Premier’s Taxi Council to identify and discuss key issues of strategic importance for to the industry;
- develop and encourage sustainable transport modes including cycling and walking in partnership with key stakeholders, local government and the private sector.

Since then, the State Government has progressed in the implementation of these policies, and has:

- established the Ministerial Road Safety Council and Advisory Council on Road Safety to provide a sharper focus and clearer lines of accountability for road safety policy;
- established the Community Road Safety Fund;
- released the South Australian Road Safety Strategy 2003 – 2010;
- established the Office of Public Transport and Premier’s Taxi Council.
3 Relationship to Other State Strategic Plans

The Draft Transport Plan is one of a number of strategic plans within the overarching framework provided by the South Australian State Strategic Plan (State Strategic Plan 2004), which was released by the South Australian Government in March 2004. The plan is a roadmap for South Australia’s future to strengthen the economy and strengthen the community. It is formulated around six interrelated objectives:

- growing prosperity
- improving wellbeing
- attaining sustainability
- fostering creativity
- building communities
- expanding opportunity.

The State Strategic Plan reinforces the need for an integrated and cooperative approach to face the challenges and work on the solutions. The Government’s actions, legislation and decisions will align themselves to the 79 targets in the plan. The targets will be reviewed every two year and published – which will allow the community to see where and how the state is progressing over time. Figure 3.1 illustrates the relationship between the Draft Transport Plan and other strategic plans.

![Figure 3.1 – Relationship between Commonwealth, State and Local Strategic Plans](image URL)
The Draft Transport Plan is directly linked to the State Strategic Plan, with two key targets out of the nine targets in the Draft Transport Plan being included in the State Strategic Plan.

- Reduce road fatalities by 40% by 2010, with an ongoing focus on reductions in fatalities and serious injuries across all modes.
- Double the use of public transport to 10% of weekday travel by 2018.

The Draft Transport Plan is also based on five key principles that are directly related to the objectives in the State Strategic Plan. Refer to Appendix 1 for these principles.

4 The Transport Challenges facing South Australia over the next 15 years

South Australia is at the crossroads in terms of being able to integrate the transport system much more closely with the land use planning for the State. South Australia is fortunate that its size and rate of growth has meant that it is not facing the same pressure of traffic problems as some other Australian cities. We have a window of opportunity to re-shape our urban development, environmental, economic and social policies to avoid the problems other cities already experience, and to take a more sustainable pathway for the future.

Some of the transport challenges that currently confront South Australia are:

- The poorest road safety record of any Australian State.
  (The South Australian Road Safety Strategy 2003-2010 (2003))
- Aging transport infrastructure and a backlog of asset maintenance on Commonwealth, State and Local Government roads.
- Rising private car use and commercial freight on metropolitan and regional roads.
- Social exclusion in regional South Australia and certain parts of the metropolitan area.
- Low usage of public transport despite high relative subsidies.
- Increasing demand for public transport services in regional areas.
- Low numbers of cycling and walking trips.
- Increasing levels of air pollution and greenhouse gas emissions.
- Environmental impacts of transport – such as, noise, amenity, and escalating fuel use.
- Some metropolitan arterial roads nearing capacity, with congestion on some major arterials during peak periods.
- More and larger freight vehicles on the roads, with continued growth in freight vehicle movement. (Freight between Australian Cities 1972-2001, BTRE 2003)
- Planning regulations which could be better used to support transport decisions.
- Balancing tight state dollars with increasing service level demand. The need to do more with less.
However, despite the looming challenges for transport, it is clear that more and bigger roads no longer provide the solution for congestion. Increased car dependence and its negative impacts invariably follows new infrastructure through ‘induced demand’. We need to address a series of difficult issues, ranging from the need to shift from private car use to public transport, and to shift road freight to rail and sea, the need to increase investment levels, reducing the in the road toll, and increase social inclusion.

5 The Community Response to the Draft Transport Plan

The Draft Transport Plan was released in May 2003 for a three and a half month community engagement phase.

The engagement phase was successful with:

- More than one thousand people attending the ten community forums held across the State.
- Twelve Stakeholder Forums with groups such as business, social, environmental and indigenous interests.
- Sixty comment sheets were received from the community forums.
- Over nine thousand hits were received on the Draft Transport Plan website.
- More than two hundred submissions were received from organisations and individuals.
- About two hundred emails were received as well as many phone calls to the Draft Transport Plan Info Line.

There was an overwhelming response to the Draft Transport Plan, with the engagement period being extended by a number of weeks. This level of interest illustrates the community’s breadth of awareness of transport. Soon after the community engagement period ended a comprehensive Community Engagement Report (Gould & Associates 2003) was published on the Department of Transport and Urban Planning web site at www.dtup.sa.gov.au.

5.1 Key Themes from the Community Engagement Phase

The key themes that emerged from the community engagement phase fall into five main areas.

- the engagement process was welcomed by the community;
- the strategic balance across the key areas of social inclusion, economic development and environmental sustainability was appropriate;
- greater specificity was sought about where, when, the cost and who would pay for specific projects and initiatives;
- there was debate about whether the plan should focus on short to medium term infrastructure spending or a long term transport vision;
- many people did not understand that the State Government is only one of a number of players in the transport system.
5.2 Summary of the Specific Transport Issues Emerging from the Community Forums

The primary issues for Regional South Australia and Metropolitan Adelaide are shown in Table 5.1.

<table>
<thead>
<tr>
<th>METROPOLITAN ADELAIDE</th>
<th>REGIONAL SOUTH AUSTRALIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Metropolitan passenger transport</td>
<td>1. Condition of the transport network (particularly roads)</td>
</tr>
<tr>
<td>2. Condition of the transport network (particularly roads)</td>
<td>2. Road safety</td>
</tr>
<tr>
<td>3. Road safety</td>
<td>3. Regional passenger transport</td>
</tr>
<tr>
<td>4. Freight</td>
<td>4. Freight</td>
</tr>
</tbody>
</table>

In metropolitan Adelaide the community believes that:

- more investment should be made in public transport infrastructure (trains, buses, trams, stations, stops and interchanges) and the reliability, frequency and coverage of services should be improved.
- more investment should be made in road maintenance for safety.
- road safety is the main priority, especially targeted initiatives such as the black spot program.
- the current volume of road freight traffic and the extent of the road freight network is a safety concern for most drivers, and freight noise and air pollution is affecting the amenity of residential areas.

In regional South Australia the community believes that:

- more investment should be made in road maintenance to keep pace with the residential and economic growth of particular regional areas.
- road safety is a high priority and investment in shoulder sealing, overtaking lanes and the back spot program needs to continue.
- community passenger networks in towns and between regions should be expanded to cater for people without access to a car, especially the disadvantaged.
- freight traffic on intra-regional roads and in towns is a safety concern and more should be done to improve road safety for all road users.
6 Transport Planning – A Fair Go for all South Australian’s

In response to the challenges outlined above, the State Government aims to:

- shift the focus to maintaining and maximising the use of existing urban and regional transport assets, rather than the construction of new infrastructure to address the maintenance backlog.
- provide new infrastructure that is better targeted, and determined within a four-tiered priority framework - safety first, followed by public transport, freight, then selected improvements to address capacity needs.
- recognise that efficient and cost competitive freight networks will play a key role in the economic prosperity of South Australia and encourage more freight to shift from road to rail.
- link regional, rural and remote South Australia to each other and global markets.
- make transport and land use planning more integrated and give greater consideration to the transport impacts of residential and commercial development decisions and vice versa.
- continue to make safety a high priority when making investment decisions.
- give greater priority for public transport at intersections and on the transport system to improve accessibility for all South Australians.
- widen the transport choices, especially for pedestrians, cyclists and the disadvantaged, and more sustainable transport modes generally.
- improve the environmental performance of transport by lowering emissions and energy use. Make public transport, walking and cycling more attractive, and programs that encourage ‘greener’ travel behaviour and reduce the dependency upon the private car.
- embrace new technology to reduce energy use and harmful emissions, improve public transport reliability, enhance safety and the efficient movement of people and goods.
- make better use of the existing transport system assets such as reconfiguring the road space to cater for potential changes in the role and function.
- explore innovative means for financing transport infrastructure and more closely link benefits to costs.

6.1 The Role of the Major Players in Transport

The Department of Transport and Urban Planning needs to work to raise awareness that the Draft Transport Plan is the State Governments response to South Australia’s transport challenges, and that the State Government alone is not in a position to provide all of the answers.

The State Government is just one of many players in the transport system, with the key to achieving a sustainable transport future being a collegiate approach toward a common vision - a Sustainable Transport Future. Ultimately, we need community involvement and partnership with other Governments and the private sector to make this vision a reality.
6.1.1 The Commonwealth Government

The Commonwealth Government plays an important role in:

- Funding investment and maintenance of the land transport system
- Funding important programs such as the Commonwealth Black Spot program, Roads to Recovery and the Special Local Roads Program.

The Commonwealth Government’s review of its land transport funding arrangements and the release of the Auslink proposal have the potential to significantly change the manner in which Commonwealth transport funding is allocated to South Australia. Under Auslink the past funding formula has been largely discarded and projects are expected to compete against each other on a national level. South Australia has traditionally received less than its fair share of funding based on lane–kilometres travelled and our population, but under Auslink this has been reduced further.

There is a danger that continued under-funding of the South Australian components of the national road and rail networks will detract from the level of economic activity in the State, and result in South Australia being by-passed. Australian funding distribution has generally recognized the need for positive discrimination in favour of regions where, due to large land areas and low population densities, the provision of services is more costly. Now the State Government has the challenge of obtaining a greater proportion of Commonwealth revenue for land transport infrastructure and its maintenance, to help underpin the ongoing economic development of the State.

6.1.2 Local Government

Local Government manages and invests a great deal of money in transport. It has similar transport challenges to those of the State Government - no more so than how to fund new transport infrastructure and the backlog in road maintenance across the State.

Local Government in South Australia has made major improvements in strategic local planning over the past few years with the development of Local Transport Plans by Local Government Associations. All of these have been in the regional areas of the state but the Metropolitan Local Government Group of eighteen councils is now in the process of developing a Local Government Metropolitan Transport Strategy.

Currently there are three separate but linked programs to assist Councils to fund strategic roads:

- The Special Local Roads Program (15% of Identified Local Roads component of the Commonwealth Financial Assistance Grants to Local Government).
- The special projects component of the Commonwealth Roads to Recovery Program (15% of the Roads to recovery grants)
- The State funded Regional Roads Program.

The distribution of scarce funds for the development and maintenance of transport assets is being done in an efficient and strategic way under the direction of the Local Roads Advisory Committee.
This committee provides advice to the Minister for Local Government on the allocation of funding under the Special Local Roads Program and to the Minister for Transport on matters relating to the reclassification of roads.

The State Government is seeking to expand the level of cooperation with Local Government to maximise the value to the State of Commonwealth funding from the recently announced extension to the Commonwealth Roads to Recovery program. This extension, will give Councils from 2005/06 an additional $100m a year for local land transport infrastructure projects of strategic regional importance.

This co-operation can be taken further with Local Government beginning to align their Local Transport Plans with each other and with the Draft South Australian Transport Plan. In other words, where possible for every strategy in the Draft Transport Plan there should be a corresponding link to a local government initiative.

6.1.3 The Private Sector

The private sector’s commitment to the State’s transport strategies is critical with regard to the rail network and ports in particular, which are largely privately owned and operated. To achieve the desired shift in freight from road to rail, the Draft Transport Plan includes strategies for the revitalisation of the State’s rail network through standardization of the metropolitan and some of the regional broad gauge rail networks, and the development of outer metropolitan and regional inter-modal freight terminals. The success of this revitalization will depend largely on private sector investment.

Another example is the deepening of the Outer Harbor channel to permit access to the Port of Adelaide container terminal and bulk berths by deeper draft Panamax and Post Panamax vessels. Commonwealth and State Governments are investing heavily in improving access to the port through a series of linked road and rail developments known as the Northern Adelaide Port Access project, and it is appropriate that the private sector invests in upgrading port facilities and contributes to the cost of channel deepening.

The Northern Adelaide Port Access project involves:

- Port River Expressway road and rail link to the LeFevre Peninsula;
- Widening of Port Wakefield Road up to the Sturt Highway Extension;
- Sturt Highway Extension as the new national land transport urban link corridor to Sydney;
- Upgrading the rail corridor between Dry Creek and Outer Harbor;
- Establishment of rail/road inter-modal facilities at locations such as Edinburgh Parks and the Barossa Valley.
7 Conclusion

Transport planning in South Australia needs to take an innovative, integrated and inclusive approach to delivering sustainable transport outcomes and provides direction and specific initiatives to address the transport challenges over the next fifteen years.

Initiatives such the Port River Expressway epitomise the Government’s approach to managing the growth in freight transport. By shifting heavy freight vehicles onto a more efficient route, away from residential areas, it allows the creation of local jobs, the revitalisation of the local community around the Inner Port of Adelaide and improved protection of the marine and land environment.

Transport planning will take a whole-of-system approach to managing the challenges, with fundamental links to other key State Government Plans under the framework of the State Strategic Plan.

The vision for change cannot be achieved by the State Government alone, and requires partnership with other Governments, the private sector and the community to make this vision a reality.

8 References

Australian Labor Party, South Australian Branch (2002) A Commitment to Transport


9 Acknowledgements

The author wishes to acknowledge the permission granted by the Chief Executive, Department of Transport & Urban Planning to present this paper at the 2004 AITPM National Conference.
10 Appendices

Appendix 1 - The Guiding Principles for the Draft Transport Plan

The Draft Transport Plan is based on five key principles that are directly related to the objectives in the State Strategic Plan and run through each chapter. The five principles are:

*Integrating transport and land use planning*

Understanding and coordinating land use and transport decisions allows positive connections to be exploited and fragmented outcomes to be avoided. By shaping the pattern of development and influencing the location, scale, density and mix of land uses, planning can help to facilitate an efficient transport-land use system.

*Recognising transport’s contribution to social inclusion*

Social exclusion can be the result when people or geographic communities suffer from a combination of problems such as unemployment, lack of education and skills, low incomes, poor housing, high crime rates, poor health and family breakdown. Recognising that social exclusion affects many people, particularly people with disabilities, older people, women and young people, is a central theme.

*Acknowledging transport’s role in economic development*

Transport plays an essential role in supporting the economy by enabling business to access raw materials, to move intermediate products between factories, and to export goods interstate and overseas. An efficient, integrated and responsive transport system is needed to enable business to respond to changes in community needs and to support growth in the economy.

*Minimising transport’s damaging effects on the environment*

Many of the serious environmental issues such as air pollution, noise, contaminated water from run-off from roads, visual impacts and community severance, are directly linked to the transport system. Transport decisions must have environmental issues at their core. The Government acknowledges its role in the wider national and global context to ensure a sustainable future and a liveable, attractive environment for current and future generations.
Managing Travel Demand: The Development of High Occupancy Vehicle Policy for Queensland

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MANAGING TRAVEL DEMAND

The development of high occupancy vehicle policy for Queensland

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KEYWORDS: High Occupancy Vehicle, HOV and Policy.

ABSTRACT

The Queensland Department of Main Roads Strategic Plan identifies High Occupancy Vehicle (HOV) arrangements as a deliverable. This is consistent with whole-of-government targets to increase vehicle occupancy and public transport modal share of trips, as outlined in various Queensland integrated regional transport plans and state-wide action plans.

There are several million dollars in HOV related projects in the Roads Implementation Plan (RIP) to be delivered in the next 2 years, yet there is currently no departmental or whole of government policy relating to the implementation, operation or support of HOV facilities.

Information contained in past studies and consultation with major stakeholders formed the basis for identifying HOV related issues and possible policy areas. The biggest issues with HOV arrangements are related to agency coordination, strategic direction, design and operation, compliance and enforcement, and performance monitoring.

The draft policy includes 12 separate policy areas arranged into three groups: planning and design, operations and other.

This paper outlines the HOV policy development process to date, and provides an overview of the draft policies developed for the planning, implementation, operation and support of HOV facilities.

1 Introduction

High occupancy vehicles (HOVs) are any motor vehicles carrying more than a specified minimum number of occupants. High occupancy vehicle facilities are measures that give priority to HOVs over single occupant vehicles. They encourage individuals to share vehicles (private or public) leading to reduced traffic volumes and increased efficiency of the road network. When
implemented correctly, HOV arrangements are an effective means of managing the existing road space and providing equity for all road users and transport modes.

The Main Roads Strategic Plan includes the strategy ‘Support demand management and intermodal transfer to increase the efficient transport of people and goods’. It identifies HOV arrangements as a deliverable of this strategy. This is consistent with whole-of-government targets to increase vehicle occupancy and public transport modal share of trips, as outlined in various integrated regional transport plans and state-wide action plans.

The Department of Main Roads is currently developing a HOV Policy Framework to address issues related to HOV arrangements in Queensland. This paper outlines the procedure and outcomes of the HOV policy development process carried out to date. That is, researching background information, outlining the current situation and issues to be addressed, developing draft policies and determining what future work is required.

2 Background

Main Roads has recognised the requirement for a high occupancy vehicle policy for some time. In late 2000, the department produced a draft HOV policy and facility implementation guidelines internally. These were reviewed by McCormick Rankin Cagney, who identified a number of deficiencies.

In response to this feedback, Main Roads commissioned McCormick Rankin Cagney to prepare a HOV facilities policy and operational guidelines. These consultants were chosen because of their expertise in HOV arrangements, which was demonstrated through their involvement in the Brisbane HOV Arterial Roads Study.

Operational design guidelines for HOV Facilities on Queensland Motorways and arterial roads were completed by McCormick Rankin Cagney, along with a preliminary policy framework.

In February 2004 the same company completed a review of current and proposed Travel Demand Management (TDM) Measures in South East Queensland.

3 Current situation

On-street bus priority measures such as bus lanes, bus queue jumps and bus signals have been used in South East Queensland for many years. More recently, transit lanes open to carpools and busways have been implemented in selected corridors.

The Brisbane HOV Arterial Roads Study lists the existing Brisbane HOV priority infrastructure inbound to Brisbane CBD (at December 2002). However, the department does not currently record or report on existing priority measures.

Various support programs have been trialled in recent years, including discount parking for carpools in the Brisbane CBD and a ride matching pilot project. Both of these programs were unsuccessful and have since been terminated.
4 Issues

There are several issues associated with the way HOV facilities are currently planned, implemented and operated in South East Queensland. A review of previous studies and discussions with major stakeholders indicated that the biggest issues are associated with: multi-agency coordination, strategic direction, design and operation, compliance and enforcement, and performance monitoring.

4.1 Agency coordination

McCormick Rankin Cagney’s TDM report found that the efforts of different agencies to implement HOV measures lack coordination and focus. More specifically:

- The role of different agencies is not clearly defined/understood.
- Policies are being developed by local government in isolation of the state.
- Integrating HOV measures with major transport infrastructure does not seem to be occurring.
- No incentives exist for the private sector to support travel change behaviour pilot programs.

The Brisbane HOV Arterial Roads Study also identified gaps and overlaps in what Main Roads, Queensland Transport and the Brisbane City Council are doing in regard to HOV priority.

4.2 Strategic direction

The strategic direction is not currently supported by a program or projects with definite aims and outcomes. Therefore, HOV facilities are often implemented without clear goals and objectives.

Main Roads’ districts have identified the need for strategic direction in relation to warrants or criteria for converting existing road space to HOV facilities.

A strategic decision is also required regarding whether a bus priority should be separated from general HOV policy.

4.3 Design and operation

A need was identified for Main Roads guidelines on pavement marking and signage of HOV facilities, as Brisbane City Council is currently leading the department in this area. Current signage and pavement marking should be enhanced and designed for greater impact.

HOV conflict at signalised intersections and non-HOVs turning from HOV lanes are considered to be issues by Main Roads, while Queensland Transport believes there is a blind spot in Main Roads’ approach to bus priority at traffic signals (as it is based on through car units). Active signal intervention measures should be implemented for behind schedule buses.
The suitability of the current Main Roads design standard for bus lanes for all situations was questioned. This issue is associated with fitness for purpose and may be addressed using extended design domain principles.

Delay to HOVs should be minimised by providing bus bays and provision for left turning non-HOVs so the flow of through traffic in HOV lanes is not impeded. Implementation of queue jumps should be reviewed to ensure length and signage is adequate to ensure effective operation.

4.4 Compliance and enforcement

The Queensland Police Service have not been involved in the planning and design of many of the current HOV facilities. Police involvement in the design and implementation of HOV facilities would address the problem of design not being suited to enforcement.

The lack of enforcement technology utilisation by Main Roads leads to a need for manual or physical enforcement techniques, which can result in congestion on busy roads. Other issues with enforcement include low penalties, difficulty observing vehicle occupancy, non-restrictive legislation for turning vehicles, and low levels of signage, marketing, education and public awareness.

4.5 Performance monitoring

There is little specific monitoring and evaluation of facility performance. Therefore, there is no way of determining or predicting the benefits of various HOV facilities. Information on the true benefits of different facilities is necessary for Main Roads to give priorities to the problems that need to be addressed and to determine the most appropriate solutions, also to set targets for HOV arrangements and get an indication of whether objectives are being met.

More specifically, various surveys such as before-and-after, car pool/transit lane user, violation and origin-destination surveys should be carried out to give an indication of what measures would influence modal shift, the evolution of the carpool market and the competition between different modes.

The small amount of performance data that is collected is not being actively collated or stored. A uniform approach to ongoing monitoring and evaluation of HOV measures is required.

4.6 Other

A number of other issues, which do not fall into the above categories, were also identified. Issues that require investigation include:

- A lack of support programs and public education aimed at inducing modal shift.
- Bicycle issues: the design of HOV facilities to meet the needs of cyclists, and the consequences for the cost and performance of HOV facilities.
• Involvement of bus operators is currently low. Their support, including service improvements, is necessary to maximize the gains of HOV facilities.
• STREAMS (Main Roads traffic signal coordination and traffic management system) development with respect to HOV.
• Effectiveness of passenger information systems.

5 Draft policy framework

The development of a policy framework, along with policy objectives and statements, began following the identification of issues, in order to ensure all HOV related issues were covered. A number of policy areas were recommended in both the Brisbane HOV Arterial Roads Study and in McCormick Rankin Cagney’s previous policy development work.

Elements of these recommended policies were combined, along with a number of new policy areas to produce the following draft policy framework.

5.1 Context

High Occupancy Vehicle Policy is required to ensure the following broader departmental and whole-of-government objectives are met, to:
• Enhance personal mobility through actions that encourage travellers to share rides.
• Promote and coordinate the development of HOV systems and related transportation system management activities (including public education and promotion of alternative modes).
• Develop a more sustainable transport system.
• Restrain growth of vehicle trips (or reduce volumes if possible).
• Restrain growth/reduce the number of single occupant vehicles.
• Increase average vehicle occupancy rates.
• Improve person-movement performance of roads.
• Improve efficiency and effectiveness of the existing network/system.
• Maintain environmental quality.

5.2 Group 1: Planning and design

5.2.1 HOV strategic/network planning

Policy objective

To ensure planning of HOV facilities is conducted at a network level and guided by strategic objectives contained in the strategic plan.
Policy statement

Main Roads districts will identify HOV implementation as part of the link strategy analysis for each road.

Consideration will be given to other government and departmental objectives such as economic development (including the movement of freight).

Consideration will be given to the need for connectivity and consistency with nearby or related HOV facilities and the impact of HOV facilities on the wider network performance.

5.2.2 HOV lane implementation

Policy objective

To ensure non-traditional urban transport solutions such as HOV facilities are included in Main Roads’ standard planning, design, construction and operation practices.

To outline when and where HOV alternatives may be suitable and to ensure that optimum use is made of limited transport infrastructure.

Policy statement

Main Roads will consider HOV alternatives in the planning stage for all projects. Alternatives will consider, at a minimum, space reallocation within the existing roadway, lane conversion and road widening options.

A continuous HOV lane should provide for equivalent or improved person-trip performance as the adjacent general-purpose lane/s. This does not apply to queue jumps or brief HOV segments/links.

HOV projects that do not add vehicular capacity should ensure that there is no net loss of person-movement performance or increase in person-trip delay in the affected corridor.

The upper threshold at which consideration will be given to operational or infrastructure changes to accommodate increased demand will ensure that the facility operates at a higher level of service (LOS) than the adjacent general-purpose lanes.

If a higher LOS cannot be maintained, or if bus operations are interfered with and design and operational improvements have been implemented without fully resolving the problem, vehicle or occupancy eligibility should be restricted (for example: convert ‘T3’ to ‘BUS ONLY’).

If the HOV facility is under-utilised, vehicle or occupancy eligibility should be expanded. For example convert a bus lane to a T3 lane.

The ability of an arterial priority lane to accommodate HOVs will be defined on the basis of the volume and operating demands of buses, taxis and bicycles first, 3+ car pools next, then 2+ carpools.
Consideration will be given to other demands for kerbside space, such as access, parking, service delivery, loading etc.

5.2.3 Non-HOV use of HOV Facilities

Policy objective
To address the issues related to the use by other vehicles of facilities intended for HOVs (including trucks, motorcycles, emergency vehicles etc).

Policy statement
Main Roads will consider the needs of cyclists (particularly safety) during planning, design and funding of HOV projects. Cycling agencies will be involved in the HOV lane development process.

Particular consideration will be given to bicycle facilities when HOV projects coincide with an identified bicycle corridor.

Consideration will be given to the use of HOV facilities by non-eligible vehicles (e.g. freight and service vehicles) on a case-by-case basis.

5.2.4 HOV use of available pavement

Policy objective
To define the department’s position on providing for HOVs outside of the normal flow of traffic.

Policy statement
Main Roads will consider new initiatives or proposed practices to allow HOV use of pavement outside of the running lanes (e.g. indents, shoulders etc.) on a case-by-case basis.

Main Roads will consider new initiatives or proposed practices to allow reversible or contraflow HOV lanes on a case-by-case basis.

5.3 Group 2: Operations

5.3.1 Hours of operation

Policy objective
To outline the basic hours of operation for HOV facilities.

Policy statement
Where possible, HOV facilities will be provided on a 24 hour basis.
A FAIR GO – A TRANSPORT REALITY OR IMPOSSIBLE DREAM

Hours of operation may be restricted (e.g. week day, peak period, peak direction) if necessary to provide for competing demands for kerbside space such as parking. Actual hours of operation for each facility will be determined on a case-by-case basis.

Busways operate 24 hours.

5.3.2 Speed and Reliability

Policy objective
To define the minimum level of service that maintains the desired speed and travel time reliability attributes for HOV priority in a HOV facility.

Policy statement
The speed limit of a HOV lane should be the same as adjacent general-purpose lanes, set in accordance with the speed management guidelines.

When traffic is congested, freeway HOV lanes must operate at a higher level of service than adjacent general-purpose lanes in order to encourage modal shift.

HOV lanes will provide a considerable reduction in journey time for buses and transit vehicles when compared to adjacent standard lanes (e.g. time savings of 5-7 minutes over a totally journey time of 40-60 minutes).

5.3.3 ITS for HOV Priority

Policy objective
To ensure that existing and emerging ITS technologies are applied to HOV facilities where appropriate.

Policy statement
ITS technologies will be continuously monitored to identify candidate technologies or systems that exhibit potential for supporting HOV goals (eg traffic signal priority, electronic enforcement, real-time traveller information).

Consideration will be given to signal priority measures and passenger/traveller information, vehicle location and other tagging systems for each HOV facility (e.g. Real-time and Passenger Information Display- RAPID).

5.3.4 HOV Facility Compliance and Enforcement

Policy objective
To ensure an adequate enforcement strategy is developed and applied to each HOV facility in the state, as a means of encouraging motorist compliance with HOV related traffic issues.
Policy statement

The Queensland Police Service will be consulted throughout the planning, design and operational phases of all HOV projects.

Enforcement provisions will be made in all HOV facilities. These will be developed in consultation with police.

HOV lanes will be monitored for misuse and facilities will be reviewed for signage, design and operational improvements as well as targeted for enforcement sweeps.

International developments in automated enforcement will be monitored, with demonstrated successful systems considered for implementation in Queensland.

5.3.5 Performance monitoring and evaluation

Policy objective

To ensure specific monitoring and evaluation of facility performance takes place to enable the benefits of various HOV facilities to be determined.

Policy statement

Main Roads will ensure that HOV facilities are planned and operated on the basis of a rational, comprehensive understanding of user needs, facility utilisation and effectiveness in support of the regional transport strategy.

Main Roads will assess the effectiveness of HOV facilities, identify learnings and recommend actions to improve design and operation.

A performance-monitoring program will be developed and applied.

The performance-monitoring program will, at a minimum, include surveys of usage, operations and motorist/public views, and will be consistent and comparable against different facilities.

5.4 Group 3: Other

5.4.1 Interagency coordination and responsibility

Policy objective

To ensure a multi-agency approach is taken to the provision and operation of HOV facilities and programs.

Policy statement

Main Roads will work with other agencies in the planning, design, implementation and operation of HOV facilities and programs on state corridors.
Main Roads will state its interest in participating at an appropriate level in any HOV facility or program undertaken or led by other agencies in Queensland.

Main Roads will be the lead agency in planning, designing, funding, constructing and operating HOV lanes and related provisions on state-controlled roads.

5.4.2 Public education and marketing

Policy objective

To ensure public education and marketing takes place to encourage changes in trip making habits by promoting HOV use.

Policy statement

Public engagement and education for HOV projects will be funded from the project budget.

Main Roads will support education and marketing initiatives undertaken by others (when consistent with and supporting of Main Roads HOV policy).

5.4.3 Support Programs

Policy objective

To ensure support programs are put in place to encourage changes in trip making habits by promoting HOV use and providing real-time traveller information.

Policy statement

Where the minimum usage criteria for a HOV facility cannot be met immediately upon opening, a short-term program will be put in place to boost lane usage to threshold levels. A regular performance review of the facility will be carried out.

The provision of real-time passenger/traveller information will be considered for each HOV facility.

5.5 Rationale

This policy does not define HOV vehicle eligibility or when non-HOV use of HOV facilities is permitted, as these are defined in legislation.

The policy statements indicate that a technical justification is required for the provision of HOV facilities. This is to ensure that the provision of HOV facilities will not reduce the capacity or performance of the existing roadway. However, there may be cases where it is appropriate to consider providing facilities that do not meet the minimum requirements. For example, when building capacity for the future or encouraging changes traveller behaviour.

Conversely, if HOV facility use is so high as to not provide significant reductions in travel time, ride-share, then positive modal shift outcomes are unlikely to emerge.
6 Conclusion

The development of departmental or whole of government policy relating to the implementation, operation and support of HOV facilities is a complex and challenging task. The main elements that need to be addressed in a comprehensive HOV policy to direct the implementation of sound HOV priority practices involves:

- Effective inter-agency coordination.
- Alignment with strategic directions.
- Incorporation of extended design domain requirements.
- Effective operation and management of HOV infrastructure.
- Sound compliance and enforcement techniques.
- Implementation of comprehensive performance monitoring.

Further work is necessary to capture relevant input from stakeholders and formulate a HOV policy to guide planning, implementation, operation and support of HOV facilities.

7 References


McCormick Rankin Cagney, 2001, Draft Queensland Department of Main Roads High Occupancy Vehicle Policy, McCormick Rankin Cagney: Consultants in Transportation, Brisbane.


8 Acknowledgments

I wish to acknowledge Adrian Derbyshire for his suggested comments and editorial changes to this paper.
Session 7

Achieving the ideal
Urban Sprawl – Can it be slowed?

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Urban sprawl - can it be slowed?

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KEYWORDS: Urban, Sprawl, Growth.

ABSTRACT

Urban sprawl is low and medium density residential development on the outer fringes of urban areas, where it will never be effectively or efficiently served by public transport. This leads to:

- Increased total transport costs,
- Increased reliance on private car transport,
- Excessive consumption of valuable land and other non-renewable resources.

Based on observations of the rapidly growing area of south-east Queensland, the mechanisms and drivers of urban sprawl are examined. Low density, fringe-urban population growth is shown to be encouraged and subsidised in several ways, as the by-product of the policies and practices of state and local government agencies.

The objectives of these government policies can be achieved without encouraging urban sprawl, particularly through the more effective integration of the planning of land use, transport and other urban infrastructure.

Residential location choices (where people choose to build houses and live) are strongly influenced by perceived household transport costs. The provision of transport infrastructure can and should be used to change perceived transport costs and influence urban development patterns to reduce urban sprawl. At present, government policies, particularly in respect of major road construction, are doing exactly the opposite, and encouraging urban sprawl.

One of the primary drivers of urban sprawl in south east Queensland is the construction by the Department of Main Roads, primarily with federal funding, of high-speed, fringe-urban rural freeway standard radial roads, developed with the worthwhile objectives of lowering inter-regional transport costs, encouraging tourism and industry, reducing accident costs, etc. However, these roads function primarily as high-speed intra-urban arterial roads, encouraging and subsidising low density fringe-urban residential development - urban sprawl.
1 Urban growth mechanisms

In 1969, Lyndsay Oxlad and Colin Beard completed their civil engineering undergraduate degree thesis, working under the supervision of Dr Ken Davidson - "The Relationship between Transport Facilities and Population Densities" (ref. 1) using ABS census collector district data for Brisbane between 1911 and 1966. That research demonstrated:

- Brisbane in 1911 had relatively high central densities - between 6000 and 9000 persons per square kilometre. During the fifty years to 1966, near-CBD densities progressively declined to between 4000 and 5000 persons per square kilometre.

- Between 1911 and 1947, the primary influence on suburban population growth was the development of the essentially radial tram routes. Along the tram routes, suburban densities were remarkably consistent, averaging approximately 3000 persons per square kilometre. In the corridors between the tram routes, residential densities remained much lower.

- After the second world war, everything changed as car ownership increased dramatically, and urban residential development was no longer constrained to the tram routes.

- There were no high speed urban roads at that time, so travel times were strongly related to total travel distances. However, virtually all of the Brisbane urban area was within a 25 minute drive of the CBD, so subdivisions occurred in whichever area offered the best overall amenity and value. Suburban population densities continued to stabilise at an average of approximately 3000 persons per square kilometre.

- Growth between 1911 and 1966 demonstrated that the development of transport infrastructure produced three basic urban growth mechanisms. These three basic growth types, shown in Figure 1.1, are all still occurring in different parts of the region, and can be described as:

  1. Densification - encouraged by the upgrading of existing transport infrastructure,
  2. Incremental growth - encouraged by the incremental development of transport infrastructure in parallel with urban development,
  3. Explosive growth - encouraged by construction of new transport infrastructure which substantially lowers perceived transport costs in the outer part of the transport corridor.

Figure 1.1 - Urban Growth Mechanisms
2 Population growth in south east Queensland

The south east Queensland region, centred on Brisbane, now extends as a near-continuous urban area from the New South Wales border in the south to Noosa in the north, as shown on Figure 2.

Figure 2 - Local Authorities in South East Queensland
The south east Queensland region is growing very rapidly. Table 2.1, derived from ABS data, sets out the population growth in the various local government areas which constitute the region, relative to growth in Queensland and Australia over the past several decades.

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In 1966, Queensland accommodated 14.4 percent of the Australian population, and in 2003 it accommodated 19.1 percent. Queensland is growing faster than Australia.

In 1966, the south east region accommodated 54.7 percent of the Queensland population, and in 2003, it accommodated 65.6 percent. The south east region is growing faster than Queensland.

The climate and the natural attractions of this area have obviously encouraged a high growth rate. However, the rapid in-migration has also been facilitated by the state government allowing urban development to occur without associated development of critical regional infrastructure - particularly transport, water supply, power and nature-based recreation. Consequently, the continuing population growth is steadily eroding the quality of life in the region.

Effectively, urban land in the region has been sold much too cheaply, with land developers being required to fund only a small part of the regional infrastructure necessitated by their developments. Further, the state government has not made up the shortfall through increased public expenditure (Queensland is a low tax state). This is particularly true in respect of transport infrastructure.
Property and land development employed 8.4 percent of the total Queensland workforce in 2003, second only to the manufacturing sector in respect of total contribution to the state's economy; and 80 percent of all development occurred in the south east region. Queensland's UDIA President, Peter Sherrie, was recently reported as saying "... the well-being of the state hinges on the development industry, and the well-being of our industry depends directly on the government policies and framework we must work under." Apparently, the state government agrees. Successive Premiers have measured the health of the economy (and their political futures) by counting the cranes on the skyline from their Brisbane offices.

Cheap land, low taxes and low unemployment are good politics. Future governments can worry about the future.

The state government has recently established the "Office of Urban Management" under a senior minister, and with quality staff, to deal with regional planning issues. However, it appears that this office does not initially plan to coordinate or prioritise infrastructure development. Its primary objective appears to be to identify areas in the region where urban development can and cannot occur. However, it is early days, and it is very encouraging that this office has finally been established. The region needs growth management; but it also needs effective regional planning, incorporating integrated control of key infrastructure expenditure.

With a high-growth background, the urbanised south east Queensland region is an ideal study area in respect of urban growth. Unfortunately, it is also an ideal study area in respect of urban sprawl.

Table 2.2, derived from Table 2.1, sets out where the growth has occurred in the south east region at different stages during the past 17 years.

<table>
<thead>
<tr>
<th>Sub region</th>
<th>Population Growth Rate (persons per annum)</th>
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<td>Outer Northern Sector</td>
<td>14529</td>
</tr>
<tr>
<td>Total South East Region</td>
<td>57418</td>
</tr>
</tbody>
</table>

During the past 37 years, the population of south east Queensland has been growing at an average rate of over 55000 persons per year. In the past few years, the rate of increase has been more than 66000 persons per year.

The population of Brisbane City is continuing to grow strongly through infill and densification, but it accounts for only approximately one quarter of the total growth in the region. Brisbane City went through a period of comparatively low growth during the 1960's and 1970's.

The population of the inner sector is continuing to grow, primarily through infill (densification) and incremental growth. These cities and shires started as relatively independent communities, but are now effectively absorbed into a continuous urban area. Growth will slow during the next few years as infill opportunities are exhausted, and these communities are not well designed to accommodate redevelopment at higher densities.
The population of the outer western sector is barely growing at all, despite the relative proximity of this sector to central Brisbane (see Figure 2). What growth there is would be best classified as incremental, being incremental growth of the independent rural centres in the region as well as incremental regional growth.

The populations of the outer southern and outer northern sectors are growing most rapidly, essentially as explosive growth, all over the Gold and Sunshine Coast regions. Population growth has been most rapid in these outer southern and outer northern regions partially because of the natural attractions of the areas. However, it has also been encouraged by the construction of radial urban motorways, particularly:

- The Pacific Motorway - 110 km/hour freeway from outer southern Brisbane to the Gold Coast,
- The Bruce Highway - 100 & 110 km/hour freeway from outer northern Brisbane to the Sunshine Coast.

Particularly in the northern and western parts of the Gold Coast, population growth has accelerated as a direct result of the announcement and construction of the eight lane Pacific Motorway from Logan City to the Gold Coast, following the earlier extension of the electrified suburban rail service. A substantial part of this growth would not have occurred (or would have occurred elsewhere in the region) if the high operating speeds on the motorway had not suddenly made commuting to Brisbane an attractive option.

The inner sections of both the Pacific Motorway and the Bruce Highway have been heavily congested during peak periods for many years, without any significant upgrading during that time, and with none planned in the future. However, the outer urban sections (beyond 20 kilometres from the CBD) have continued to be upgraded and widened so that they continue to function as 110 km/hour routes, even during weekday peak periods.

Traffic volumes on both motorways are growing much more rapidly than anticipated by the Department of Main Roads, primarily because the traffic projections made during the project planning phases substantially under-estimated the impact of the explosive population growth induced by the construction of the routes. Consequently, within a relatively short time, capacity will again be an issue on these routes.

Both of these motorways are part of National Route 1, and they are important inter-regional routes. However, the great majority of the traffic on these roads is intra-urban arterial traffic. That is, the commonwealth and state governments have been funding and building inter-regional rural freeway standard roads which function as urban arterial roads.

It may be appropriate for inter-regional roads to operate at 110 km/hour, but urban arterial roads should be operating at 60 or 70 km/hour (consistent with the recently stated objectives of the Federal Parliament's Standing Committee on Transport and Regional Services).
3 Ways in Which Urban Sprawl is Subsidised

In "Government Sponsorship of Urban Sprawl in South-east Queensland" (ref 2), Beard identified some of the ways in which the side-effects of often well-meaning government policies and practices currently subsidise low-density fringe-urban residential development. They include, in respect of roads:

- Higher design speeds and posted speed limits on outer-urban and fringe-urban roads;
- Greater tolerance of congestion on inner-urban roads, leading to greater differences in perceived costs of travel on outer-urban roads relative to costs of travel on inner-urban roads;
- Freeway ramp spacing and accessibility, and ramp metering, effectively providing priority and travel time savings to long distance commuters from fringe-urban areas;
- Arterial road access planning which introduces a consistent bias in favour of longer distance trips (shorter trips are forced onto lower speed local routes);
- Intersection design and management gives priority to through (longer distance) traffic.

By far, the biggest influence on perceived travel cost is travel time (or speed). Motorists on the Pacific Motorway can travel in comfort at 110 km/hour for 40 or 50 kilometres in the time that it takes inner-urban commuters to get through the queues generated by ramp metering, and thereby gain access to the same freeway. This is done with the objective of maximising transport efficiency, but the side effect is a subsidy to fringe-urban land developers.

The speed advantage for private car commuters is duplicated in urban passenger transport services, because these services are trying to compete (with limited success) with private car travel. Consequently, public transport agencies provide services which:

- Have much lower fares per kilometre for longer, outer-urban commuter trips;
- Provide express services which bypass inner-urban stops and provide travel time advantages for outer-urban commuters;
- On inbound, morning peak services, have all seats occupied before the services reach the inner suburbs; and
- Provide park-n-ride facilities, primarily for outer-urban commuters.

Although all of these measures are adopted to encourage public transport usage, they also subsidise fringe urban development, and the reality is that only a small proportion of the vehicle trips made by fringe-urban households which generate the public transport commuter trips will be made by public transport. That is, the public transport operators, in trying to compete with private car usage, are also encouraging low density, fringe-urban development which is the antithesis of an urban form which can ever properly be served by public transport.

The inevitable result has been that, in south east Queensland, the proportion of trips being made by public transport continues to decline.
4 What Can We do?

Politicians are not going to stop making politically expedient decisions which are attractive in the short term to a partially informed electorate. Long term problems will remain "someone else's problems."

People are not going to stop wanting their own slice of heaven near the beach or the bush, with only a quick trip to town on the freeway.

People are not going to start using public transport because it is better for the community or the environment.

However, with better coordinated planning, we should be able to encourage urban forms where a higher proportion of households can make a higher proportion of walking, cycle and public transport trips, and shorter private vehicle trips, than they are now.

It is quite feasible to progressively remove the subsidies to fringe-urban land development provided by high-speed outer-urban roads constructed at public expense which are distorting urban development patterns.

Things we can do include:

1. Put in place a regional planning agency which uses public infrastructure expenditure to encourage the urban form we need for the future;

2. Define and consistently work towards speed targets for major urban roads - 60 km/hour for undivided arterial and sub-arterial roads, 70 km/hour for divided, multi-lane arterial and sub-arterial roads, and 80 km/hour for grade-separated arterial roads. In particular, do not allow roads which will function as urban arterials to be built to inter-regional rural freeway standards with 120 km/hour design speeds.

3. Introduce variable speed limit signage systems on the urban freeways, initially with lower speed limits in adverse weather, during weekday morning and evening peak and other congested periods, and in emergency situations. This will allow overall speed regimes to be progressively reduced as circumstances allow. This alone would save lives and make incident management much safer and more effective.

4. As traffic volumes and congestion on the urban freeways increase, add extra lanes (traffic or transit lanes) at the expense of sealed left and right shoulder widths and lane widths, in conjunction with speed limit reductions.

5. Undertake infrastructure upgradings on the inner-urban arterial roads first, where congestion is the highest, to progressively reduce disparity between outer-urban road and inner-urban road operating speeds. This will be a tough one because local communities will continue to strongly resist land acquisitions for road or busway construction or widenings. However, lower design speeds will minimise land requirements. The feasibility of tunnels is currently being investigated as one way to resolve the land acquisition problem.
6. As the existing subsidies to outer-urban private vehicle commuters are progressively removed, progressively remove the subsidies to outer-urban public transport commuters, thereby making it relatively more attractive to be an inner urban resident who can and does make at least some trips by public transport.

South east Queensland has a perfect opportunity to test this approach in the near future. Largely with federal funds, the Ipswich Motorway will be upgraded and/or duplicated during the next few years by the state government. This is currently a heavily congested urban freeway, with comparatively low design standards, but which operates at 100 km/hour. Accidents are not uncommon, and when they occur, massive disruption occurs in the corridor.

Consistent with the objectives described above, the desirable upgrade steps could be:

- Introduce a variable speed limit signage system with lower speed limits in the peak direction of travel during peak periods, in adverse weather and in emergency situations. Progressively increase the length of periods with 80 km/hour speed limits. Immediately, this will reduce accident rates and severity, with very little real change in actual travel times. However, perceptions will change;

- Progressively undertake minor structural and other widening works (starting at the Brisbane end) to achieve three narrower traffic lanes in each direction, but with reduced break down facilities, and a consistent design speed of 80 km/hour;

- These first two measures will "buy some time" while a parallel route is planned and constructed, with in-built priority for freight and transit vehicles. The parallel road should be a grade-separated route, but with a consistent geometric design speed not exceeding 80 km/hour. Along this route, capacity should be matched to demand. That is, during peak periods, it should operate with similar congestion levels and operating speeds along its whole length - not 100 km/hour on the outer sections and 20 km/hour on the inner sections (as currently occurs on the existing Ipswich Motorway).

5 Conclusion

Transport infrastructure development directly changes perceived transport costs, particularly relative costs in different parts of the region.

Urban development trends are strongly influenced by perceived transport costs.

Consequently, transport infrastructure development should be used to encourage regional planning outcomes which minimise total community costs and which maximise future liveability in the region. Currently, in south east Queensland, transport infrastructure development is having precisely the opposite impact. This is not "A Fair Go" for existing or future residents.

"A Fair Go" in respect of urban transport and land development probably is an impossible dream, particularly if south east Queensland is the test case. However, "A Fairer Go" is a feasible transport reality, provided transport and urban planners are prepared to lead a more informed community debate.
The first requirement for change is coordinated planning. Urban infrastructure planning and development (without real coordination) cannot be allowed to remain under the sole control of individual state government agencies. For example, the Department of Main Roads currently makes decisions which substantially influence the direction and nature of regional development, but they have no responsibility for regional planning or the regional planning outcomes produced by their decisions.

These days, all professional urban and transport planners pay lip service to the need for less reliance on private vehicle travel. However, trip proportions by other than private vehicle continue to decline. Why? Because we tell the community we want them to make more walk, cycle and public transport trips, and then we provide massive subsidies to urban development forms which will never make more of those trips feasible; and while we are at it, we allow the quality of life in one of the most attractive parts of Australia to be continuously eroded.

Ensuring that low density fringe urban residential development has all houses within 400 metres of what one day might be a bus route with a few services per day does not constitute effective transport planning, and it is not "A Fair Go" for the growing community.

We will have "A Fairer Go" when we remove the distorting and counter-productive subsidies on fringe-urban land development, particularly those produced by road building projects which are wonderful political and professional monuments, but which encourage exactly the urban form we don't want and don't need if the region is to remain liveable.

6 References


Management of Network Operations
“The future for the best traffic engineers?”

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The Future For The Best Traffic Engineers?

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KEYWORDS: Roads, Traffic, Network, Operation, Management, Its

ABSTRACT
There is no doubt that a mind set change is taking place in road administrations. It is the acceptance that road and traffic authorities have two equally important roles:

- Management of Road Infrastructure Assets; and
- Management of Network Operations.

The first is well understood and managed. The second is newer and less well developed.

The World Road Association has created international technical committees (TC 4.1 and TC 1.4 respectively) to champion both issues. This paper will investigate the second of these - Management of Network Operations, using the strategic direction set by the World Road Association in late 2003.

The World Road Association has asked TC 1.4 to look at the role of Management of Network Operations from three viewpoints – with each viewpoint having three components. They are:

- New ideas for wide Network Operations
- Information Management and the Public Interest
- Appropriate Use of ITS for an Integrated Transport System

This paper will show that from a management and technical perspective the challenges for up and coming traffic engineers will be breathtaking. They will be working to optimise a system that extends well beyond roads, and has billions of stakeholders who often have very different objectives. It is the challenge that the best minds will grab with relish!
1 Introduction

The World Road Association – better known as PIARC, is a non-profit organisation founded in 1909 to promote international cooperation in issues related to roads and road transport. It has 108 member countries spread throughout the world. It achieves its objectives via a 4-year strategic plan that is implemented through 18 international committees. These committees usually meet twice a year in workshops, seminars and conferences to produce and exchange best practice information in their field of endeavour. The culmination is the World Road Congress, which is held every 4 years.

The current strategic plan (2004-2007) has four strategic themes:

ST1: Governance and Management of the Road System

ST2: Sustainable Mobility

ST3: Safety and Road Operations

ST4: Quality of Road Infrastructure

Committee T1.4 – Management of Network Operations – was established to address some of the issues identified in ST1. These are:

- New ideas for wide Network Operations
- Information Management and the Public Interest
- Appropriate Use of ITS for an Integrated Transport System

This paper will provide an overview of these topics, noting that at the time of writing this paper Committee T1.4 had only met once and had a long way to go to fully address the issues. As a consequence this paper will mainly focus on the findings of this committee’s predecessor C16 – Road Network Operations that was in place from 2000 to 2003. The work by this committee created the groundwork for much of the work to be undertaken by T1.4.

2 Technical Committee C16 - Road Network Operations

The members of C16 came from all over the world but without doubt their main focus was the operation of congested road networks, as found in major urban areas the world over, and in non urban areas in countries such as the United Kingdom, France, Holland and Japan. Major contributions to the work of the committee came from countries such as France, Belgium, USA, Britain, Japan, Canada and Germany. Countries such as Australia and South Africa contributed but more from the broader perspective. Most members of C16 had been members of the Intelligent Transport Systems (ITS) Committee from 1996 to 1999. During its term C16 focussed on transitioning from an ITS focus to the broader agenda of Road Network Operations.
2.1 C16 Conclusions

“Transportation comprises the movement of people and goods through space and time. In order to meet the expectations of road users and the demands of society needing to move rapidly and securely, the road network operator strives to provide a trafficable network, adequate capacity, a safe roadway, real-time accurate traveller information, a sustainable infrastructure and an environmentally friendly resource. “

“The road to development begins with development of the road.” The growing expectation for greater mobility is affecting all modes. Providing a good road infrastructure, managing it and operating it effectively is critical throughout the world. Issues of road safety and relief of transportation congestion are rising up the political agenda, because of their adverse effects on the economy and quality of life.

Recently the transportation community has been implementing new strategies to respond to these trends. With this new approach the attention shifts to a customer oriented focus. Under this network operations approach, the outputs and performance issues deal more directly with customer requirements. Consequently, policy leaders, transportation professionals and international organizations need to pay attention to network operation concepts as new influences on their thinking and actions.

2.2 C16 Advice for Policy Leaders

- A major transition needs to occur from a public works mentality to a mobility service mentality. A transition of this magnitude will require leadership and constituency building by governmental and private sector organizations. Policy makers must provide this leadership.

- Network Operations need to be defined and institutionalised in agencies’ policies, in their processes and in their programs. This will have a significant impact on budgets and human resources.

- The new focus will require a customer performance point of view rather then just a facilities performance point of view.

- Establishment of performance measures for multiple modes and for interdependent agencies will be required. This will require inter-agency collaboration and cooperation.

- Policy shifts towards road user charging open up new possibilities for demand and mobility management. Road user charging also brings new opportunities for funding transportation facilities.

- There is an urgent need to foster partnerships between the roads authorities, the automotive industry and other key players to exploit new technologies for the benefit of sustainable mobility.
2.3 C16 Advice for transportation professionals

- Transportation professionals will be the ones implementing the policies, operating the systems and actually measuring performance. Therefore, the organizations’ plans, programs and staffing will need to reflect network operations concepts.

- A continuous learning and training process will be required as the transition takes place from the traditional emphasis on public works towards new service-driven network operations.

- Professionals will need to develop and maintain awareness and knowledge of the new tools and technologies such as ITS.

- New technologies bring opportunities to achieve better network efficiency, and to enhance road safety. Therefore roads authorities will need to work in partnership with the automotive and other industries to realise the goal (of vehicle to infrastructure communications).

- Mechanisms to establish measurable customer expectations and to actually measure customer satisfaction will have to be developed and refined.

- Education and training institutions will be required to modify transportation curricula to include network operations concepts, practices, tools and techniques.

- There is an urgent and continuing need for network operators to participate in research and development activities (including demonstration applications).

2.4 C16 Advice for International Organisations

- There is a need to give more prominence to the concept of network operations.

- Information sharing on network operations concepts, best practices, benefits and funding sources should become a high priority.

- Introducing network operations modules into international roads and transportation conferences would be valuable in sharing the experiences of many countries.

- Publication of handbooks in several languages and in different media, including the Internet, could facilitate a better understanding of the concepts and the potential benefits of network operations.

- Workshops and routine publications should convey experiences and best practices, and identify locations where successful network operations actions are underway.

- International organizations can encourage international study visits, which are of great assistance for the transfer of know-how.
3 So What is Network Operations?

Understanding and appreciating this function is the crucial first step. Network Operations is a concept that can be explained in several ways. It is the next stage in the evolution of the science of managing road transportation networks:

- Thirty years ago there was Traffic Management
- Fifteen years there was Road Use Management
- Now there is Network Operations

Network Operations is more than Traffic Management: It is also more than Road Use Management. C16 provided a definition in their Road Network Operations Handbook (PIARC, 2003):

*Road network operations can be defined as all traffic management and user support activities intended to permit, improve, or facilitate the use of an existing network, whatever its conditions of use.*

C16 went on to say:

*Road network operations concerns all activities directly related to the concept of service to the user of a road network (person, freight transporters, and public transport operator) and to service improvement.*

*It therefore differs from:*

- *Improvement of the infrastructure, which consists in equipping it and adjusting its geometric and physical characteristics;*
- *Maintenance of the infrastructure, designed to ensure the preservation, quality of use and renewal of road assets;*
- *Traffic policing powers that concern general or local rules of road use, whether permanent or temporary.*

*Road network operations require defined levels of service and associated quality indicators to quantify user satisfaction and the efficiency of the whole road system when considered part of a global transport system. Road network operations require continuous consultation between all the partners concerned: police, call-out services, network operators, etc. In addition, operation-related concerns must be taken into account from the design and development stage of the infrastructure.*

The Network Operations Handbook produced by C16 is available from PIARC and is strongly recommended. It is without doubt the best guide to be had on how to operate congested road networks. PIARC can be contacted directly at www.piarc.org, through Austroads www.austroads.com or by contacting the author at bob.peters@mainroads.wa.gov.au.
4 Best Practice in Road Network Operations

C16 identified five main fields that the network operator needed to manage well in order to achieve best practice:

- Network monitoring;
- Maintaining road serviceability and safety;
- Traffic control;
- Travel aid and user information; and
- Demand management.

As an aside it is not surprising to note that these are very similar to those faced by operators of other networks such as water, electricity, telephone, gas and computer. There is a strong case to be made for operators of the various networks to get together and compare notes! The similarities in the roles and tools of operators of the various networks were identified in the paper presented on behalf of the author at the REAAA/ARRB Conference held in Cairns (Australia) in May 2003 (Peters, 2003).

C16 had the following to say about the five fields:

**Network Monitoring** - covers all measures, resources, and procedures that enable the operator to observe and find out the condition of the network and its use as quickly and completely as possible.

**Maintaining road serviceability and safety** - covers, in the event of a disturbance, all field operations designed to maintain or restore conditions of road use that are as close as possible to the normal situation.

**Traffic control** - covers all measures in respect to predetermined objectives, aimed at distributing and controlling traffic flows in time and space, in order to avoid the onset of disturbances or to reduce their impacts. Traffic control is carried out in coordination with, and under the control of, the authorities in charge of traffic policing.

**Travel aid and user information** - covers all measures to disseminate predictive or current information on traffic conditions and to improve general conditions of network use. Its general aim is safety and user comfort.

**Demand management** - covers all the operation measures that aim to limit the consequences of a decreasing level of service on a route. This is carried out through actions related to the mobility policy such as improving traffic distribution through time or inciting users to modal transfer.

The best practices network operator uses elements of each of these tools to get the most out of the road network. If there is one criticism to be made of these fields it is that of customer input. Excellent customer service is now a fundamental objective for transportation network providers. The above approach is clearly aimed at achieving this objective but there seems to an omission in the five-field approach in that it indicates that the road network operator always knows what is best. The new PIARC strategic plan makes it clear that customer input is also vital.
5 T1.4 Plan 2004-2007

As previously indicated the findings of C16 were considered and built on by PIARC in forming T1.4’s agenda for 2004-2007. It identified three issues it wanted considered and the strategies it wanted investigated for each. These are shown below but as previously indicated Committee T1.4 has not yet commenced addressing the issues.

5.1 Issue 1.4.1 - New ideas for wide Network Operations

Strategies

- Collect new ideas on methodology for wide network operation
  - determination of the service standards
  - actors in charge of implementation
  - coordination with stakeholders

- Identify strategies for setting road network development goals suited to the network’s stage of development and changes in social dynamics

- Investigate the contribution of Traffic Demand Management (TDM) to network operation

5.2 Issue 1.4.2 - Information Management and the Public Interest

Strategies

- Investigate measures to assess user needs (when, where and what), to provide services

- Identify and analyse information gathering and cost sharing methods among various transport operators

- Investigate the property rights of gathered information from the viewpoint of the public interest

5.3 Issue 1.4.3 - Appropriate Use of ITS for an Integrated Transport System

Strategies

- Study procedures and methods to evaluate the appropriateness and suitability for selecting specific ITS services at the project proposal stage

- Study economic evaluation methods and performance indicators for ITS services in mid- and post-term of the projects

- Identify and analyse ITS road network management strategies suitable for integrated transport system
6 ITS – Intelligent Transport Systems

The significance of ITS to the network operator is huge and growing. PIARC has long recognised this but wants to make sure there is as much thought given to network operators providing problems to the ITS industry for solution as there is energy applied by the ITS industry to producing systems looking for problems.

As previously indicated C16 was from 1996 to 1999 the ITS Committee. During this time it produced the highly acclaimed ITS Handbook – widely regarded as the best guide in the world to ITS for road network operators. A key reason for this is the fact that it was produced by people using ITS equipment who had no vested interest. By virtue of the rapidly evolving nature of ITS equipment C16 produced a second version of the handbook and this will be published in October 2004. Details on its availability will be available from PIARC or the author.

ITS is without doubt a very valuable aid to the network operator. C16 addressed the issue of ITS under seven headings:

- Network Monitoring
- Maintaining Road Serviceability and Safety
- Traffic Control
- Traveller Aid and User Information
- Demand Management
- Enforcement
- Integration

Details on how to get the most out of ITS in each of these areas are given in both handbooks.

7 Australian Practice

The Australian road and traffic authorities are embracing the changes needed for them to be more effective in the future. Austroads has endorsed a strategic plan that has five taskforces addressing the key themes:

- Network – Optimising utilisation of the network
- Freight
- Registration and Licensing
- Assets
- Safety
Main Roads Western Australia also has a new strategic plan with the Vision: “To be recognised for excellence in customer service and world class road access”. Its first listed priority for Strategic Focus is “Sustaining Network Operations”.

It is very much the case that the key road and traffic authority decision makers in Australia see network operations and its management as critical to their success.

8 The Future For The Best Traffic Engineers?

Many traffic engineers would argue that they have been the poor relations in road and traffic authorities. The glory work has been in building roads and bridges. Core business has been road construction and maintenance. But now there is no doubt that roads and transport systems in general are moving away from being traditional public services where commercial pressures could be largely ignored. There are two key movements in road administration that are putting the spotlight on operators of roads:

- The steady move to direct charging for road use with tolls; and
- The growing awareness in the educated world that road users have as much right to customer service as users of airlines or fast food outlets.

More and more road users see themselves as purchasers of a road access service and for that they demand respect and consideration – exceptional customer service. The network operator will need to respond appropriately to these expectations or become redundant. The evidence is widespread of what happens to public sector agencies that are seen to give the customers inadequate service – water authorities, electricity companies, hospitals, road and traffic authorities, etc. They are pilloried in the media and there are many Australian instances of CEOs being ‘sacked’ for failing to meet customer needs.

The best traffic engineers will need to become the network operators. Before they actually do any ‘traffic engineering’ they will however need to be strategic, proactive, plan, use best practice customer services, work with other transport service providers and then put in place solutions. The solutions will often be highly technical – making great use of ITS, pricing, psychology, media, and of course best practice traffic engineering.
9 Conclusion

Road and traffic authorities have traditionally focussed on building and maintaining road networks – asset management. For many reasons the focus is shifting to the dual role of asset management and network operation. Governments and communities have tired of simply providing more roads and bridges: They want these assets to be better used. Much of this responsibility falls to the network operator and for the network operator to succeed they will need to use tools and skills that are evolving, drawn from the commercial world or drawn from analogous industries. Two critical and emerging tools in particular are:

- Pricing to manage demand; and
- Customer service.

These tools and all other aspects of network operations are enormously exciting. They will be relished by the new breed of people entering the land transportation industry – particularly those with qualifications in engineering and business or commerce or marketing. The ambitious traffic engineer will have every opportunity to make an even bigger difference, but in order to do that they will need to broaden their outlook to that of a network operator.

10 References


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Why do we bother? Back to the first principles of managing traffic impacts in local areas

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Why do we bother? Back to the first principles of managing traffic impacts in local areas

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KEYWORDS: Local area, residential street, traffic impact, environmental capacity, safety-conscious planning, road function, network, connectivity, cul-de-sac.

ABSTRACT

Traffic professionals have been blamed for many aspects of residential areas that are currently considered to be undesirable. Practitioners, at least in Australia, do not deserve this criticism. In the context of a “fair go” in the transport system, we already have a body of literature and practice that gives us the tools we need to plan and design the local street system for those not in vehicles. This paper reviews some of this knowledge in order to emphasise the importance of safety, functionality and amenity in the local planning process. Key elements of safety-conscious planning (reducing vehicular travel, avoiding serious conflicts, compatible traffic in shared areas, and segregation where necessary) are noted, and some contradictions between safety-conscious planning and current planning practices are highlighted. A way to regard the hierarchy of movement spaces in a local area is recommended. The impacts of traffic on residential amenity are in greatest danger of being neglected in the current planning environment. Amenity calls up considerations of environmental capacity, and the influence of traffic flow on neighbourhood interaction and the householder’s sense of territory around their dwelling. The documented findings on these matters need to play a bigger part in decisions about traffic networks and flows, and there are strong indications that the appropriate traffic level for local streets serving family housing and for conventional housing fronting arterials is probably a good deal lower than many codes currently allow.
1 Introduction

If I had to name one central theme since my elementary understanding of traffic merged with my career path in urban planning nearly 40 years ago, it is this. Most of the impacts of motor traffic on humans and their environment (physical, social, emotional…) are negative, and dealing with those impacts requires our highest skill and diligence. In the words of the old truism, the car is a good servant but a bad master, and keeping it in its place is still a knowledge-based and skilful art. The Victorian era engineers had sewage, we’ve got traffic. Here was my mission in life (Brindle 1996).

I was not alone. For traffic planners, the 1960s (when I cut my planning teeth) were the “Buchanan Era”. We were being encouraged to think more about what traffic was doing to urban communities, and to be more concerned about moderating the demands of traffic rather than surrendering more and more of our city space to them. More of this shortly, but here it is necessary to explain why I think this is once again a matter of concern for practitioners. Simply, the ground rules and the reasons for them seem to have dropped out of collective awareness. Consequently, there may be things we need to say in the current planning dates, but we’ve forgotten them or maybe we lack the courage of our previous convictions.

Much ground has been covered in traffic management in the past few decades, and not only the techniques but also the values and understandings of the traffic professions have changed. The majority of practitioners today would take for granted the rightness of a “fair go” in the traffic and transport system—having due regard not only for all users, but also non-users of the road and transport system. In many areas, traffic practitioners pioneered policies and practices that involve moderation of traffic and reducing its impacts on households and communities. Traffic calming, for example, was developed and promoted by the engineers in local government, and their consultants. You will read about the early days of LATM in Australia, and about sensible design practices for local streets that reflect their multiple purposes, and about safety concerns due to excessive speeds, only in the various conferences and publications of the Australian Road Research Board and local government engineers. We paved the way, and made it possible and made it work. The planning profession’s literature was mostly silent about these matters until fairly recent times.

1.1 The fall and fall of the traffic specialist

Now, however, a career in traffic planning or engineering is about as esteemed in some circles as working for a tobacco company. Take this derogatory and highly inaccurate blast from a well-known planning academic:

“Part of the process of turning streets into traffic sewers has been the takeover of street design and operation by the traffic engineering profession. This profession does a good job at controlling road design standards for motorised traffic and optimising safety for motorised road users. However, they perform badly in wider thinking about the city and its social meaning and the important role that pedestrians play in keeping streets safe and turning neighbourhoods into genuine communities. The presumption that street design standards and the accompanying road hierarchies should be mainly shaped around motorised traffic has been an important factor in the creation of vast suburban areas
where the pedestrian is an anomaly. The endless (sic) cul-de-sacs, fenced distributor roads with no active frontages, controlled access highways and high-walled, pedestrian access rights-of-way, fondly known in the urban design profession as RPOs (rape and pillage opportunities), make walking for any real purpose almost an impossibility. Fortunately, the New Urbanism, with its requirement for urban design principles based upon the 'walkability' of urban development, is gradually changing the traffic engineering and town planning professions.” (Kenworthy 2002)

The “walking city” is dead, and apparently we killed it. Traffic practitioners are blamed for everything from heart disease and obesity to global warming. Revisionist history of neighbourhood planning now makes us responsible for having deviated from good old rectilinear grid subdivisions and forced tributary networks and the dreaded cul-de-sac upon longsuffering residents1. Only New Urbanism can save the world from traffic engineers, planning and design students are being told. Nowadays we see widely and long-accepted engineering guidelines for accommodating all users of the streetspace being quoted back at us as if we were ignorant of them, rather than being credited as the people who have been trying to make it happen for the past two decades.

How did this situation come about, I wondered. This paper results from reflecting on that question, and the thought that perhaps we have taken too much for granted, have been too timid in asserting the messages from past experience and research—and perhaps we have been negligent by not ensuring that this knowledge is adequately handed on to emerging professionals in traffic management, planning and development. Maybe a level of ignorance about the fundamentals of traffic planning in local areas has indeed crept in, and we do need to revive and proclaim the basics.

2 Back to basics

The fundamentals I am talking about are the things we have learned from a lot of experience (and a substantial body of empirical research) about local movement networks and coping with the negative impacts of vehicular traffic, particularly when it interacts with people where they live, work and carry out their daily business. Primarily, this means:

- **Safety**: maintaining a high level of safety and security in the movement system;
- **Functionality**: ensuring that the roads and other networks we put in place and manage are giving priority to the functions that we want them to serve; and
- **Amenity**: reducing the effects of traffic on the places where we live, work and interact.

There are, of course, many more objectives and criteria by which local area plans must be assessed, but these are the three that I see as being often at risk of dropping off the agenda in the current climate. They are sometimes neglected or relegated to secondary importance simply because they have traditionally been the responsibility of the engineering sector, whose influence on the workings of local government and the wider public sector has waned as the professional base engaged in planning and development has expanded.

Let’s look at them a little more closely.

2.1 Road Safety—Reduction of risk

It should not be necessary to lecture the AITPM community about the importance of road safety criteria in local planning, and not much will be said about it here. But how well prepared are we to argue the case in local planning and the hearings that sometimes follow?

In planning and development decisions, there is almost always a road safety element even on local streets. Since the late 1970s, we have been aware that up to a third of reported casualty crashes occur on the local street system. Lower speeds and traffic calming programs have improved that situation to some extent, but it remains true that a significant proportion of traffic-related injuries occurs on the road network, especially to the young and to cyclists and pedestrians. “Safety-Conscious Planning” (or “Planning for Safety”) is a fundamentally important process that aims to get things as right as we can in the first place, to minimise foreseeable traffic safety problems in our neighbourhoods the future (TRB 2001).

There is a reasonable body of literature and extensive experience to support Safety-Conscious Planning and the recommended practices to which it gives rise (Brindle 2001). Unfortunately, this experience is not commonly acknowledged in contemporary town planning. This is despite the fact that the first National Road Safety Strategy had “Road safety as a priority in the management of transport and land use” as one of its eight Objectives, and “land use planning and development decisions that minimise physical risk to road users” as one of three strategies towards that objective (FORS 1992). This is not a universally accepted priority:

“(M)ore typical in current town planning circles is the view that road safety considerations – along with other ‘engineering’ criteria – have unduly influenced planning ideas and controls. ‘Of course we’re in favour of road safety, but not at any price’, one former state government planner was heard to say. A clear conflict of purpose and beliefs has arisen.” (Brindle 2001)

Ominously, the 2001-2010 National Road Safety Strategy makes no reference to safety-conscious planning. What do you think about that?

2.1.1 Processes to plan for road safety

Traditionally, the four prongs of Safety-Conscious Planning have been:

- reducing the amount of vehicle travel, by arranging land uses and networks to encourage alternatives;
- creating street systems in which points of serious vehicle-vehicle and vehicle-pedestrian conflict are minimised;
- creating conditions (including lower speeds by design) conducive to the safe sharing of the street by vehicles, pedestrians and cyclists where appropriate; and
- segregating vulnerable road users from vehicles in other cases.

VicRoads has been interested in this subject in recent times and has released “Guidelines for Safer Urban Environments” (VicRoads 2004) which include some of the techniques and principles to further these four objectives.
Safety auditing, the formal process for reviewing the likely safety outcomes of proposed plans (either for a road or a development proposal), ought to be a central part of a truly comprehensive local government road safety strategy (Morgan 1995). Despite that, the report of the 2001 National Road Safety Audit Summit (Austroads 2001) wistfully noted “the apparent low take-up of road safety audit principles within Local Government”, and recommended that local government safety audit policies similar to that developed in West Australia (IPWEA 2001) should be encouraged.

Safety audits of planning proposals should apply the key understandings that have emerged from Safety-Conscious Planning. In most respects, the important elements of current housing area codes are compatible with improved local safety, especially where they encourage lower speeds and more intimate street environments. However, there may sometimes be points of divergence:

- We know that local crashes are a direct function of the number of unprotected cross intersections, especially between local distributors. “Permeability” should not come at the expense of creating many cross intersections. This is not “paranoia” (Higgs 1999), and frequent roundabouts are not a good design solution, especially on bus routes.

- We know that maximising the number of dwellings on local streets with zero or very low connectivity (culs-de-sac or loops) results in safer local environments. We have long experience and data on our side. So how do we meet the current desire for connective pedestrian networks while maintaining a “parking area” environment for traffic movement? This shouldn’t be too demanding a task. Figure 1 shows the sketch network in an area designed by AV Jennings in 1975, cul-de-sac based and apparently impermeable. But the pedestrian network in that area is highly connected, as Figure 2 shows. Culds-de-sac do not have to create indirectness for pedestrians.

- We know that the risk to pedestrians is directly related to the number of roads they have to cross, and the number of vehicle movements that intersect their path—especially straight-through movements. Crash rates are also known to be directly related to the frequency of driveways. We know that turning movements and parking associated with vehicle access to frontages can be detrimental to the safety of the road itself, especially for pedestrians and cyclists. These are the concerns of access management (Austroads 2000).

- We know that junctions between local streets and arterial roads are significant crash locations (Cairney 1986). While there can be too few connections between a locality and the surrounding traffic network, there are usually too many. Again, as Figures 1 and 2 show, pedestrian connections can be created without allowing traffic through those points.
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There are many more knowledge-based contributions that the safety-conscious planner can make in local planning, and in the development of planning guidelines and codes. We should not be timid about insisting that they, and the four “prongs” of safety-conscious planning, be given due consideration.

*Bottom line:* Think about the road safety consequences of planning decisions. Apply the four “prongs”. Make full use of the recorded research and experience about the safety performance of various local network and planning elements. Where there are gaps in the knowledge, clamour for more these to be filled! Insist on an independent safety audit of any substantial development plans.

### 2.2 Functionality—Fit for purpose

“Functionality” means that the road and other movement infrastructure you put (or require to be put) in place actually meets the objectives and purposes you have in mind for them. This hardly needs mentioning, so obvious is it. But not so long ago, local streets were in many places required to be excessively wide by today’s standards for obscure reasons that were only partly to do with traffic. Certainly, traffic could move freely and it was assumed that wide roads were safe roads. By 1980 we knew better.

Functionality does not mean that “all roads are for traffic” or that traffic needs will always dominate decision making. You won’t find too many traffic practitioners taking that position these days.

A functional approach to road planning and management means that we identify what legitimate functions we want to accommodate in the roadspace and in the land next to the road. This will include, in varying combinations, movement of vehicles (including buses), bicycle and pedestrian movement, casual use of the streetspace by local people, the coming and going of vehicles to sites along the road, a visual and physical separation between the buildings, and so on. A “functional
“road hierarchy” simply means one in which you have sorted out what emphases you are going to give to which of these uses of each road, and to what level of performance. But talk of a “road hierarchy” today attracts condemnation, even though there is no such thing as a “non-hierarchical network” in practice. How did this simple and accommodating concept acquire such a bad name among our co-professionals?

A useful way to present movement hierarchies in a way that more clearly explains what we are trying to do is shown in Figure 3 (Gunnarsson 1990). This is based on distinguishing between—

- the vehicle space (T)
- the traffic-calmed local environment (C)
- unencumbered pedestrian/cycle space (F)

—and their overlaps:

- moderated traffic routes with environmental priority (C/T)
- pedestrian dominated streets (F/C).

Figure 3 – A spatial approach for classification of the urban traffic network
(Source: Gunnarsson 1990)

Far from being a pro-car, anti-community concept, the idea of a hierarchy in the movement network is shown by Figure 3 to be a very useful tool to help us identify appropriate planning and
management policies for movement in our communities. The “spaces” are hierarchically distinguished in descending pedestrian freedom from left to right, and in traffic freedom from right to left. Within each “space”, or network element, there may be hierarchical distinctions in terms of continuity and level of service (e.g. there are roads of varying importance in the vehicle space; and there may be roads of differing suitability for buses in the local system).

An obvious example is the distinction between traffic routes (T) and “calmed” local streets (C) which has underpinned Australian road design and traffic management for at least 15 years. On local streets, vehicle speed and traffic service are not allowed to dominate decisions about the form and operation of the street. Rather, local streets are treated more like access ways in parking areas, which in a way they are, of course. This is the basis both of traffic calming and contemporary residential street design flowing from AMCORD\(^2\), and most of the design concepts envisaged in contemporary integrated local planning (“new urbanism”, “neo-traditional development”, etc.).

“Putting traffic in its place” does not mean having no roads at all that meet the reasonable needs of traffic; functionality of a local street (the C and C/T spaces) demands that legitimate circulation of vehicles be catered for. This includes manoeuvrability into and out of driveways and intersecting streets, and adequate provision for parking. Many recent neighbourhood projects have resulted in streets in which quite inadequate provision for legitimate traffic function has been made, at any speed. Reduced roadway widths are an important part of improved local street environments, but some skill is needed to make sure that the street does not become dysfunctional as a result.

Capacity is rarely a design issue in such streets, and (apart from safe sight lines) neither is design speed in the highway engineer’s sense. Claims that designing for the needs of the car has created traffic-dominated urban streets are therefore focussing on the wrong issue.

Another aspect of functionality concerns design for pedestrians and cyclists. Many new residential estates do not make adequate provision for pedestrian movement clear of motor traffic. Other than perhaps in very short courts, we should be cautious about allowing any street that does not have a footpath on at least one side of the street. There are several reasons for this which time does not allow me to expand on, but they are to do with functionality for pedestrians, and you can probably anticipate them for yourself. Even in the “shared zone” environment of the *woonerf*, it was found necessary to designate parts of the street surface for pedestrians only, not accessible to vehicles.

The insistence on connective (wrongly called “permeable”) networks for pedestrians has been mentioned in discussion of Figures 1 and 2. The evidence about the extent to which pedestrian networks are deterministic (i.e. “it’s only inadequate networks that have stopped people walking”, and “if we build it, they will come”) is not very substantial. While provision for convenient and pleasant walk trips is an essential component of local planning, the argument that one or other type of road network directly affects levels of walking is “not proven”. This seems to be a ripe area for post-graduate research.

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\(^2\) The Australian Model Code for Residential Development.
Cyclists often get a raw deal. If we are serious about making cycling an attractive alternative to the car, we would make sure not only that bike use has an obvious advantage in terms of travel route, but also would make sure that bike provisions are functional. This includes provisions for cyclists at LATM (traffic calming) devices. Note, by the way, that Figures 1 and 2 demonstrate the suggestion in Figure 3 that networks for walking and cycling do not have to be also available for use by vehicles.

Fundamentally, the needs of functionality do not necessarily mean that wider roads or more lanes are “better”, even for more important traffic routes. Capacity of urban traffic networks is determined by the capacity of its intersections, with supporting attention being given to adequate storage and turning lanes at intersections, and not by how many lanes the roads themselves have.

Local communities, especially in NSW, have found this to be so in their main streets (Westerman 1999). Reducing through movement to one lane allows space to be provided for widened footways, parking manoeuvres, bike provisions and perhaps a narrow median to assist random pedestrian crossing.

*Bottom line:* If a “good idea” ends up reducing the serviceability of the streetspace which you want for one or other type of road users on any given part of the network, then perhaps a different approach may be called for. Conversely, “functionality” may be satisfied by some surprisingly innovative planning ideas.

### 2.3 Amenity—Living with traffic

So far, we have looked at aspects of local planning which traffic practitioners are still generally confident with and knowledgeable about. The third fundamental concerns the effects of traffic on the use and enjoyment (or “amenity”) of a place or street. Past professional knowledge about this seems to have been largely lost, or at least is not called upon very often. Yet this was (and still is) the mainspring that drove improvements to the traffic environment in local areas, at least as far as residents were concerned.

Traffic can be detrimental to amenity in many familiar ways. Some are measurable and have an identifiable impact, like noise and vibration, local air quality, disruption to movements into and out of a site and so on. Others are more subtle and less measurable, but no less real for the people involved. These are more to do with a sense of disturbance, intrusion and unease created by exposure to traffic past the door. More recently, we have become aware of some of the health impacts of these physical and emotional disturbances, regardless of whether or not the residents seem to perceive and accept them. A “sewer”—whether it be carrying traffic or wastes—is not a suitable place for people to live alongside, any more than a railway is, and separation of such infrastructure from living spaces is logical.

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3 It was found in Melbourne that removing a discontinuous third lane on a freeway actually decreased interruptions to traffic flow.
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So how are we to respond to current planning thought that allows (even encourages and sometimes demands) residential and other sensitive land uses abutting roads carrying substantial traffic? And what is “substantial traffic”? We can call on three major contributions to our understanding of what makes communities respond adversely to traffic, and what their thresholds of acceptance might be. These three are:

- the concept of *environmental capacity*: limits to the amount of traffic a street or area can carry without creating environmental or social disturbance;
- the relationship between traffic flow and *neighbourhood interaction*, which demonstrates a breakdown in communication between neighbours as traffic volumes grow; and
- the concept of “*territory*” around a dwelling, which explains why and how people use the street and other spaces near their dwellings (or not) as a function of traffic intrusion.

Together with decades of experience of community reaction against traffic, these give us some useful rules of thumb for distinguishing between acceptable and unacceptable traffic environments in local areas. We need to insist that they be considered, to avoid repeating adverse traffic conditions that we are trying to deal with today.

2.3.1 Environmental capacity

*Environmental capacity* refers to the limits of traffic conditions that occupants of an urban street or locality find acceptable, or (it could now be added) at which health, social or other disturbance occurs. The word “environmental” is used in the sense of “amenity” rather than in the sense of natural systems, and thus relates to “grey” issues in the blue-green-grey categorisation of environmental considerations (see Box).

**Box**

The Rotterdam *Manual for Urban Planning and Environment* (Public Works Rotterdam 1994) described three clusters of environmental factors that planners must address in decision making about urban development. These are:

- the sustainability (or *blue*) cluster, which covers matters of relevance to future generations (resources, greenhouse etc);
- the *green* cluster which emphasises ecological quality and refers to the conservation of habitats and species—perhaps seen as the more ‘traditional’ environmental topics; and
- the *grey* cluster dealing with traditional urban amenity concerns such as noise, safety, local air quality and odour, intrusion, soil contamination and social factors—all important in relation to the quality of urban life, or ‘liveability’.

Environmental Capacity, in the present context, refers to the third of these.
The environmental capacity concept is the direct ancestor of the traffic limits for various types of road set out in AMCORD and the various housing codes that derive from it. We have a long research and experiential heritage to support standards that set limits for traffic conditions in streets on which people are expected to live and interact. It is—

- 40 years since we first heard of Buchanan’s (1963) concepts of environmental capacity and residential areas as the “rooms” of cities;
- 32 years since Russ Symons submitted his Master’s thesis on the subject;
- 30 years since the seminal paper by Clark and Lees at the ARRB Conference (1974);
- 25 years since Holdsworth and Singleton (1979, 1980) presented a paper on environmental capacity at the ATRF and another a year later at the ARRB Conference; and
- 15 years since my own summary of the subject (in Brindle 1989).

Have we consigned this work to the dustbin of time? Or could we still usefully apply the experience and knowledge we have accumulated? There is at least as strong an argument for using the concept to avoid unpleasant traffic environments in future living areas, and a much stronger empirical basis for it, as there is for most contemporary urban design requirements. Traffic practitioners know this, because we’ve been here before: the traffic does not go away, and we are expected to fix the problems it causes after the event. Far from being guilty of “turning streets into traffic sewers”, traffic specialists have been warning about these consequences for decades. It is proper to point out that a given street environment has limits to the traffic conditions it can accommodate without damage to the people and the neighbourhood, and I hope we continue to do so with confidence.

Given the way knowledge tends to drops off the end of the shelf, it might be useful to summarise some of the things we can say with confidence.

**Basis of “environmental capacity”**

The basis of environmental capacity is the realisation that increasing levels of traffic, and higher speeds of traffic, have detrimental effects on the amenity of adjacent housing and some other land uses. This relates to the topics of territory and neighbourhood interaction. Noble, Bennett and Jenks (1987) found in a survey of private housing developments in the UK that level of satisfaction with the residential environment decreased with increasing traffic and status of the road in the hierarchy, and there are many other reports of similar findings. There is a subjective negative response to “traffic disturbance” in general terms, but there are also measurable impacts such as:

- reduction of non-travel street activity,
- reduced interaction between neighbours,
- degraded quality of the space between dwelling and road,
- restrictions on the freedom of use of the site (concern about the vulnerability of children, pets, visitors’ parked cars, vehicles turning into and out of the site etc) constrain how the occupants live and use their private spaces, and so on.

There are also increasing signs of health impacts due to traffic noise and a sense of invasion of the “territory” of the dwelling.
Quantifying Environmental Capacity

To be useful, of course, environmental capacity needs quantitative measures. Buchanan (1963) concluded that the threshold of environmental acceptability was 3000 veh/d. The fact the subsequent Australian experience led to a similar approximation, based on streets on which LATM was demanded, eventually raised suspicions. While 3000 veh/d has survived as a pretty good rule of thumb for the limit any street in a living area should be asked to carry, there is more to it than a single magic number.

The following contributors to variability in the environmental capacity are relevant, and there are probably more:

1. Traffic speed as well as volume is an important factor.
2. Environmental capacity is not a “universal constant”:
   - Different physical environments (with different housing and household types, different cultural expectations, different dimensions, and in different parts of the metropolitan complex) will have different thresholds of acceptability.
   - Individuals will respond differently, and their responses may even be different at different times.
3. It is a “level of service” concept, reflecting degrees of dissatisfaction, rather than a “go-no go” threshold.

We’ll look at these a little more closely in the following.

- “Tolerability” relates to both speed and volume of traffic

It has been known for a long time that tolerability to traffic is not simply measured by the volume of traffic. Speed (and sometimes composition of the traffic stream) is also an important factor. Lower levels of traffic moving at higher speeds may be a greater perceived and actual problem than slow-moving higher traffic volumes. This characteristic has been exploited in recent times by dropping the speed limit to 50 km/h, for example, even on some important roads in the network through country towns. Clark and Lees (1974) pointed out that environmental quality would improve as either or both parameters decreases (see Figure 4), compared with levels of traffic service which improve as volumes decrease and speed increases.

This is why speed is an important tool in planning and traffic management, and local authorities can moderate road-land impacts by dealing with the speed environment. However, creating low-speed conditions up into the more heavily-trafficked parts of the network for the sole purpose of making future sensitive frontage development more compatible (or to make the traffic more tolerable to frontage development) is unlikely to be an optimal solution. Furthermore, the trade-off is not without limits; as Appleyard (1981) showed, heavier traffic flows create palpable barriers between people and activities along and across a road, even at low and congested speeds.

- The adopted Environmental Capacity is a percentile of a distribution rather than a constant
Sometimes people will “ tolerate” traffic conditions that, unknown to them, exceed levels that are desirable for their health and well-being. Conversely, some people will complain about traffic conditions which are quite acceptable to the majority of the population (e.g. Figure 5 shows that 20 per cent of respondents in a Melbourne survey thought that traffic above 300 vehicles in a 12 hour period was unacceptable). The values of “environmental capacity” will form a distribution, not stand as a single figure. In this distribution of responses at different levels of traffic, a representative threshold (such as the 85th percentile) has to be adopted in the knowledge that for some this will still be “unacceptable”. Conversely, there will always be a small percentage of households which are tolerant of extreme traffic conditions. (This does not necessarily mean that they are unaffected.) In Figure 5, 85 per cent of respondents thought that something less than 3,000 vehicles in 12 hours is unacceptably high.

![Figure 4 – Relationship of environmental quality to flow and speed](from Clark and Lees 1976)

These sorts of findings assume a “typical” street form and “normal” frontages. However, there is some evidence that manipulation of the physical form of the land-road system (part of the Space-Orientation-Design approach (Brindle 1989)) can render a given traffic stream more acceptable to residents, particularly if separation between the traffic and the domestic territory can be increased. Bosselman and Macdonald (1999), for example, show the benefits of increased setbacks and service roads (“boulevards”) in reducing perceptions of traffic impacts. Geometry cannot, however, overcome dislocation between neighbours (see section 2.3.2), and the space requirements for these treatments (including a road reserve width of the order of 40 m) are demanding.

Without such efforts, a road higher in the traffic hierarchy, or simply with a wider carriageway, does not have a higher environmental capacity, but it may have a lower level of environmental quality. This leads to the next observation: it is more to do with “quality” than “capacity”.

Why do we bother? Back to the first principles of managing traffic impacts in local areas  339
Figure 5 – Community perception measured against traffic flow, Melbourne 1975
Based on Soraghan (1981)

- “Environmental Capacity” is really a “level of quality” measure.

It is common to see different environmental “capacities” specified for different street categories in a hierarchical fashion. This is a distortion of the environmental capacity concept and has no theoretical or empirical basis. What such codes imply is that residents on higher-order streets are expected to suffer less amenable traffic conditions, not that their levels of tolerance are somehow higher – except by assuming some process of Darwinian selection which places more insensitive households on busier roads. In reality, those without choice tend to find themselves there.

It has been made clear so far that it is more realistic to talk about “levels of environmental quality” rather than a single capacity figure. The similarity to the “levels of service” concept of traffic capacity is evident. A “level of service” interpretation of environmental capacity, and the need to include traffic speed with volume, was the significant contribution of Clark and Lees (1974). Figure 6 is adapted from their work in Canberra, with the “levels of environmental quality” designated from Level of Environmental Quality (LEQ) A (highest quality, required for most resident environments) to F (the worst combinations of speed and volume from the point of view of a living environment). Clark and Lees describe the area below the dotted line as “infeasible” due to “intolerable traffic conditions”. Much of this area is indeed “infeasible”, but it now seems more comprehensive to include combinations of lower-speed travel and higher volumes.

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4 Figure 6 appears to be more helpful and consistent if the upper bound traffic volume for LEQ C is 2000 veh/d. Clark and Lees appear to have been constrained by the “universal” 3000 veh/d threshold.
The planning task is then not to try to justify higher traffic volumes so that particular theories about networks can be implemented, but rather to nominate the level of environmental quality that is aimed for and then contrive a pattern of activities and streets that achieves that combination of speeds and flows for as many dwellings as possible.

The criteria used in Figure 6 indicate that streets carrying 3-10,000 veh/d (as the “Neighbourhood Connectors” in the WA Liveable Streets code can do (WAPC 2000)) fall into Level D environmental quality, and may even drop into LEQ E or F if the speeds rise above 60 km/h, other things being equal. While we lack hard evidence on what this means in terms of specific impacts (and that would be a useful investigation), the accumulated evidence suggests that our sights could and should be a lot higher than this.

The relevance of that conclusion becomes clear when related to the matter of warrants for LATM devices, to which this interpretation of environmental capacity is closely related.

“Environmental Capacity” has parallels with LATM warrants

Some forms of warrants for traffic management devices in local streets make similar use of speed-volume combinations (O’Brien et al. 1997; Austroads forthcoming). Warrants are related to standards, which are performance targets (for traffic operation, safety outcomes, environmental quality and so on) for the system in question. Failure to meet the specified criterion level may be interpreted as a “warrant” for some sort of action. However, warrants for LATM can never be treated as absolute, because judgement about what are “desirable” levels of operation of local street and land systems is a matter of degree, just as is the assessment of environmental quality.
Combinations of speed and volume thresholds that indicate the transitions from “no problem” to “problem” to “action required” for local streets (Figure 7) and distributor roads (Figure 8), were developed from a review of Australian practice reported by O’Brien et al. (1997). The precise form of these graphs may not necessarily be valid for a given place or community, but they do illustrate the fact that the severity of a traffic-related problem may be eased if the speed of traffic can be significantly reduced, even if the volume remains the same. The charts hint at the same sorts of understandings of the degrees of environmental quality that emerge from an interpretation of environmental capacity. They also demonstrate that traffic calming action is triggered at conditions that are already well in excess of desirable environmental limits. Empirical refinements on this topic would have therefore have traffic management as well local planning use.

The charts also confirm that traffic calming action is triggered at conditions that are already well in excess of desirable environmental limits. This brief comparison suggests a possible description of the Levels of Environmental Quality (Table 1). Plans which anticipate traffic exceeding 3000 veh/d, for example, are in effect accepting LEQ D or worse for future residents.

**Figure 7 – Possible relationship between speed-volume warrants for LATM and thresholds of environmental quality (LEQ) for local access streets**
(Source: O’Brien et al. 1997)
Figure 8 – Possible relationship between speed-volume warrants for LATM and thresholds of environmental quality (LEQ) for distributor roads
(Source: O’Brien et al. 1997)

Table 1 – Indicated descriptions of environmental quality for given speed-flow combinations

<table>
<thead>
<tr>
<th>LEQ</th>
<th>Indicated upper limits (max.)a</th>
<th>Deduced description of environmental quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flow veh/d</td>
<td>Speed km/h</td>
</tr>
<tr>
<td>A</td>
<td>200</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>1000</td>
<td>55</td>
</tr>
<tr>
<td>C</td>
<td>30000⁰</td>
<td>Above 60</td>
</tr>
<tr>
<td>D</td>
<td>10,000</td>
<td>Above 60</td>
</tr>
<tr>
<td>E</td>
<td>20,000</td>
<td>Above 60</td>
</tr>
<tr>
<td>F</td>
<td>&gt;20,000</td>
<td>Above 60</td>
</tr>
</tbody>
</table>

Notes:
(a) Maxima in one parameter correspond to minima in the other
(b) Many sources state 2000 veh/d
2.3.2 Effects of traffic on Neighbourhood Interaction

The level of *neighbourhood interaction* as a function of traffic flow was first quantified in an American study (Appleyard 1981) which showed that the higher the traffic volume, the less interaction there was between householders on opposite sides of a road, and eventually even between next door neighbours. People on Appleyard’s ‘light street’ (2,000 veh/d) were found to have three times as many friends and twice as many acquaintances in the neighbourhood as those on the ‘heavy street’ (16,000 veh/d). The effects appeared to increase with traffic volume up to about 10,000 veh/d, at which point the rate of increase in dislocation tapered off.

This situation is diametrically opposed to the case of low-traffic culs-de-sac, in which high levels of interaction are observed between households and in the street space, unresearched propaganda to the contrary notwithstanding.

An indicator of the level of social interaction, especially in areas with high numbers of children, is the amount of children’s play in the common space of the street. This brings us to the matter of “territory”, the third contribution to an understanding of the effects of traffic on people where they live.

2.3.3 Traffic and personal territory

A sense of *territory* is central to understanding how people respond to traffic at their door. Appleyard (1981) found that people living with 2000 veh/d considered the whole street to be their home territory, while those on the street carrying 16,000 veh/d defined their home territory as an area tightly contained around their own building.

Jan Gehl (1977, 1980) usefully defines an “interface zone” between the public space of the street and the private space of the home. In quiet courts and streets, the sense of private territory may well extend out into the “public” space of the street.

This sense of common space when traffic conditions allow it was observed by Marcus (2001):

“Residents will tend to casually meet, recognize each other and identify with a group when that group has access to a portion of the physical environment that is walkable and safe, and for which the group feels some sense of responsibilities. These criteria are met when residences are clustered around some form of shared outdoor space, whether this be predominantly hard-surfaced (for example, a low-traffic street or cul-de-sac) or predominantly landscaped (for example, the green space in the center of some medium-density housing schemes).

“The key issue here is that neighbors have access to some completely shared outdoor space that is neither private (home and yard) nor completely public (through street, public park).”

The value of quiet, non-connective streets to this end is reinforced by UK studies. Millward (1999), for example, reported that there is three times as much play in the common ground of the street in estates with low-volume loops and culs de sac as in older urban streets with long straight roads and terrace houses.
These more recent findings confirm Appleyard’s conclusion that increasing traffic has a negative effect on the way and degree in which public space is used, and that by about 10,000 veh/d the traffic already almost totally suppresses non-traffic uses of the street space. Streets with intermediate levels of traffic were well on the way in that regard. As the traffic increases the household becomes more uneasy about the street space and the traffic it carries, and as a result—

“it will draw its perceived territory inwards. On busy roads it may even surrender the ‘private’ space between the dwelling and the front fence line if it becomes noisy, threatened or simply too ‘public’. Solid high front fences are symptomatic of an attempt to define the boundary between private and public space, to retrieve part of the interface zone.” (Brindle 1989)

In addition, householders begin to neglect their front gardens and front areas are converted to parking spaces. There is a shift from owner-occupied to tenant occupancy. Bylaws against high front fences and garage facades are in effect asking householders to sacrifice their (perhaps futile) sense of security and a degree of environmental protection. Are we confident about the real advantages to pedestrian passers-by and other travellers that justify this impost? I’m not sure that we actually know enough to come down so solidly in favour of the traveller over the householder, but in my view it would be better anyway to avoid this sort of problem altogether, by managing the levels of traffic on elements of the network.

3 So, how much is too much traffic?

In reality, despite the fact that these measures of amenity all derive from non-engineering origins, few outside the inner sanctum of traffic planning seem to be aware of them these days, which is a great pity. All three indicators—environmental capacity, neighbourhood interaction and sense of territory—point towards the need to avoid exposing conventional housing to substantial traffic, especially if that traffic is travelling above acceptable neighbourhood speeds.

The tolerance thresholds for major collector roads and arterials seem to be higher, and on that basis current urban design accepts residential development on roads carrying traffic in the 5-10,000 veh/d range5. But the unacknowledged health and social impacts are still substantial, and allowing households to be exposed to these levels of traffic as part of deliberate planning policy seems inequitable. Without deliberate and extensive physical countermeasures, including building form, larger building setbacks and attention to vehicular access, occupants of conventional dwellings fronting these traffic routes pay a big price, even if they appear to “tolerate” the traffic.

Whatever threshold is adopted, a clear distinction needs to be made between “planning standards” and “deficiency standards”. Deficiency standards flag critical conditions and indicate that action must be taken. In other words, they correspond to the upper end of the cumulative frequency distribution of traffic tolerance. On the other hand, a planning standard should correspond to a

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5 For example, WAPC (2000) allows traffic of the order of 7,000 veh/d on “Neighbourhood Connectors” providing frontages to conventional family dwellings. This is akin to Appleyard’s (1981) “Medium Street”. The impact of traffic conditions on dwellings abutting such roads seems likely to be worse, if anything, than on the former “difficult distributors” they aim to replace.
level at the lower end of the distribution of tolerable traffic. It should be satisfactory under most conditions and for most people, especially if it quoted as a “deemed to satisfy” condition.

The appropriate traffic level for local streets serving family housing and for conventional housing fronting arterials is probably a good deal lower than many codes currently allow. As we have seen, the indications are that traffic starts to interfere with many householders’ enjoyment and freedom of use of their homes in local access streets when volumes get above 1,000 veh/d, especially if the speeds are not low. Performance measures related to environmental acceptability (including tolerability) are likely to be met under most conditions if traffic volumes past direct frontages are below 1,500 veh/d. (Speeds will still need to be moderate). Between 2000 and 3000 veh/d some sort of threshold seems to be crossed, and this is the range set in many codes in the past few decades as an upper limit to traffic on streets serving family dwellings (Brindle 1989, Table 2). However, this seems closer to a deficiency standard than a reliable planning standard; Figure 5, for example, suggested that almost all people thought that flows in excess of 3,000 veh/d are unacceptable. Inevitably, local plans commonly contain roads whose estimated traffic volumes push the upper limits set in the codes – i.e. are knocking at the door of “action warrants” for traffic management.

The implication is that, if volumes above 2,000 veh/d are to be accommodated, at least the physical conditions have to be different. The designer should have to demonstrate how this is to be achieved. As the traffic volume increases, the conditions under which the performance measures can still be met become more demanding. It is conceivable that volumes well over 3,000 veh/d would be compatible with the performance measures, but only under highly prescribed conditions and perhaps with artificial control over the market (e.g. to regulate the kinds of household that will occupy adjacent properties).

Some may argue that attitudes to traffic past the front door have changed, based on an observed decrease in community support for traffic calming measures, and that this may invalidate the past work that established these thresholds. Reduced street life, runs this argument, has made us less sensitive to traffic disturbance and more tolerant of higher traffic flows. We lack any sort of time series data to test this, but whether it is true or not the response is obvious: If street life is revived as a result of “new urbanism”, then people will become more, not less, exposed to traffic and aware of its impacts. In addition, thresholds of “acceptable” traffic are not determined by public opinion alone—the health and environmental criteria are still important. This seems the very worst time to be contemplating lifting the maximum permitted levels of traffic in local streets.

Bottom line: We need to take the lead in sounding caution about letting “acceptable limits” to traffic creep up again. When a proposal exposes some householders to the impacts of excessive traffic, either ask how the needs of those householders will be protected, or find a different way to shape the proposal so that the conflict does not occur.

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6 I am grateful to Robert Morgan in Melbourne for pointing this out to me.
4 Conclusion

We need to be more assertive about designing to minimise impacts of traffic on the safety, amenity and functions of a local street. In the context of a “fair go” in the transport system, we already have a body of literature and practice that gives us the tools we need to plan and design the local street system for those not in vehicles. Traffic practitioners have nothing to be embarrassed about in their contributions to liveable neighbourhoods, but we are in danger of losing a lot of what we knew.

This paper has made the following points:

1. The fundamental requirements of safety, functionality and amenity need to be acknowledged in the local planning process.

2. The principles of safety-conscious planning (reducing vehicular travel, avoiding serious conflicts, compatible traffic in shared areas, and segregation where necessary) are well-documented. A number of planning factors contributing to increased safety appear to be contradicted and even prevented by current planning requirements.

3. The use of a safety audit process as plans develop can help to shift the focus from what can and can’t be done to the expected outcomes of the plan.

4. Functionality means primarily that the street serves all its uses and users. However, the basic needs of individual vehicle manoeuvrability have to be met. This does not mean that vehicles have to be able to go everywhere pedestrians and cyclists can go; the movement spaces for each do not coincide.

5. Amenity calls up considerations of environmental capacity, and the influence of traffic flow on neighbourhood interaction and the householder’s sense of territory around their dwelling. The documented findings on these matters need to play a bigger part in decisions about traffic networks and flows.

6. The appropriate traffic level for local streets serving family housing and for conventional housing fronting arterials is probably a good deal lower than many codes currently allow. The desire to create “active frontages” on higher-order roads has led to greater exposure of households to traffic impacts. The effects of this trend need to be monitored, and the physical conditions under which it is permitted deserve greater attention. Placing conventional housing on roads carrying more than 3,000 veh/d should be the exception, not the norm, at least until we have greater confidence about the effects on the people who have to live there.

Insisting on specific design and planning standards and models may not guarantee functionality, high levels of traffic safety or a pleasant living environment if a direct link between the standards or models and those desired outcomes is not confidently known. If we separate what we would like to achieve from how we think that will best happen, then we are able to focus on what each part of our movement infrastructure is required to do (the “ends”), and not get hung up on set standards or models of practice (the “means”). Focussing on the “ends” rather than the “means” is the key to
how we can hang on to the fundamentals in debates about local planning and design. It is also the
correct way for the practitioner to contribute in a team which is being pressed to follow “means”-
specific planning rules.

By attending to the three fundamentals we can give a fair go to all who use or are affected by roads
on that 80% or so of the network that is part of the living environment for most of the population.
The acid test for any traffic environment we contemplate in living areas, and especially on the new
generation “difficult distributors” that contemporary urban design encourages, is a simple question:

What will it be like to live there?

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