



Department of Transport
Public Transport Authority



Travel Demand Management Plan

Transport @ 3.5 Million

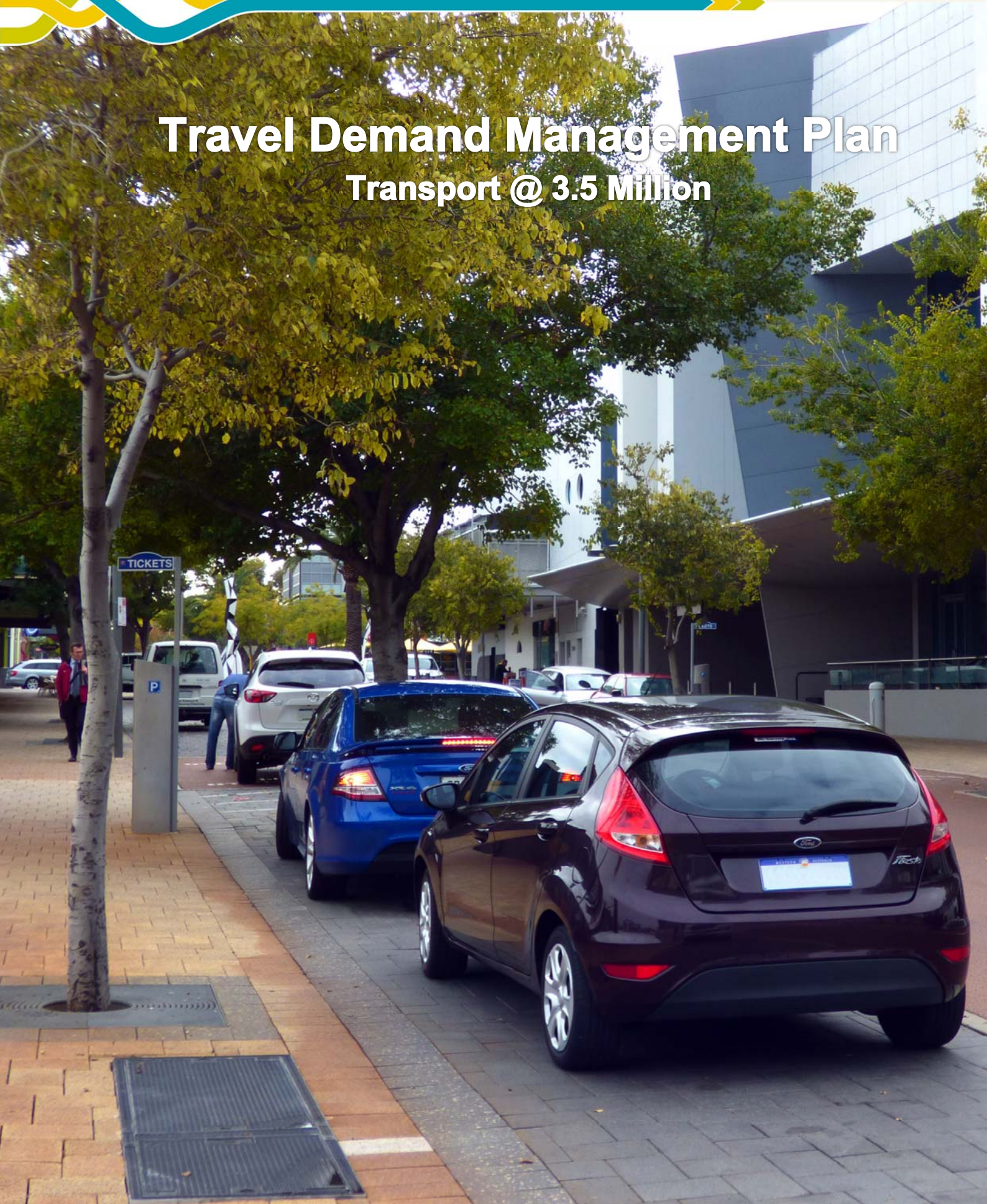


Table of Contents

EXECUTIVE SUMMARY	3
1 TRAVEL DEMAND MANAGEMENT IN PERTH AND PEEL	8
1.1 What is travel demand management?	8
1.2 Why manage travel demand?	8
1.3 Existing travel demand management in Perth	9
1.4 Relevant trends and external factors	10
1.5 Freight and TDM	12
2 METHODOLOGY	14
3 TRAVEL DEMAND MANAGEMENT MEASURES FOR PERTH @ 2.7M AND 3.5M	16
3.1 Travel plans required for new developments	16
3.2 Travel behaviour change programs	21
3.3 Walking and cycling infrastructure	27
3.4 Parking strategies	32
3.5 Public transport time of day pricing	38
3.6 Road user pricing reform	42
4 FURTHER WORK	48
4.1 Implementation of recommended measures	48
4.2 Other potential applications	48
4.3 Other enablers	52
APPENDIX A: ACRONYMS	54

Executive Summary

This plan has been produced as part of the *Transport @ 3.5 million* project. It identifies key travel demand management (TDM) measures and initiatives that will be effective in the Perth and Peel region as it heads towards a population of 3.5 million.

TDM includes initiatives that improve transport outcomes, such as congestion mitigation, more efficient use of infrastructure and a more reliable transport system, without the need to provide significant additional road or public transport infrastructure or services. TDM can delay or defer the need to provide costly infrastructure upgrades and extensions and offer solutions when there is limited capacity to expand existing networks.

Improvements to transport systems' efficiency and reliability can be achieved through managing supply or demand. Supply-side measures typically refer to delivery of road and public transport infrastructure, which often require large capital outlays. The role of TDM in a sustainable transport system is to deliver substantial social, economic and environmental benefits including:

- reduction of congestion cost and growth
- efficient use of existing transport infrastructure and services
- reduction or deferral of transport infrastructure investment
- improved accessibility for the transport disadvantaged
- increased physical activity and public health
- improved liveability and amenity
- road safety benefits including reduced personal trauma, injuries and other costs
- improved air quality and reduced emissions.

Following an extensive literature review and a workshop with local, national and international TDM experts, a number of measures were identified as the most likely to succeed in Perth in terms of transport, cost, economic and social effects. Further detailed appraisal of these measures included an independent assessment of likely transport outcomes as well as projected economic, social and environment benefits of specific applications in Perth.

The plan identifies six key TDM measures for implementation in Perth at a population of 2.7 million and 3.5 million. These measures and their future application in Perth are described below.

Travel demand management measures for Perth @ 2.7m and 3.5m

Travel plans for new developments

Travel plans are a package of actions to encourage safe, healthy and sustainable travel options for specific organisations or sites such as large medical centres, shopping centres, large residential developments and universities. Their purpose is to plan actions that are relevant, feasible and likely to be effective in changing transport choices. Establishing travel plans in new major commercial and residential developments in Perth could be achieved through building on existing processes that have proved successful in introducing travel plans for some specialised activity centres and large commercial developments in Perth.

Population	Recommendation
2.7 million	Travel plans implemented for new major commercial development and travel plans implemented for new major residential development associated with strategic activity centres in Perth and Peel.
3.5 million	Travel plans implemented for all new major commercial and all new major residential development in Perth and Peel.

Travel behaviour change programs

Travel behaviour change programs use education, information, incentives and other marketing-based approaches to persuade and assist people to decrease their need to travel, reduce dependence on private cars and increase physical activity by making voluntary changes in their travel habits and patterns. Such changes include reducing car use and increasing the share of trips by alternatives such as cycling, walking, public transport or car-pooling.

Travel behaviour change programs achieve these shifts in demand by changing perceptions or attitudes to alternative travel options. Travel behaviour change programs typically target households, workplaces and schools.

Population	Recommendation
Integrated travel change programs	
2.7 million	<p>Integrated travel behaviour change programs that target households, workplaces and schools expanded and delivered across targeted regions in Perth and Peel with an emphasis on optimising efficiency of the existing network and new infrastructure and services.</p> <p>Integrated travel behaviour change programs combined with significant public transport infrastructure projects and services and a proportion of associated capital budgets allocated for this purpose. Alternative sources of funding will be increasingly leveraged.</p>
3.5 million	Integrated travel behaviour change programs delivered across Perth and Peel every 10 years. Workplace programs delivered in major activity centres and transit oriented developments. School programs offered to all schools in the Perth and Peel region.

Workplace travel change programs	
Population	Recommendation
2.7 million	Workplace travel behaviour change programs delivered across Perth and Peel focusing on identified priority areas such as major activity centres and transit oriented developments. Travel plans mandated in the Government Office Accommodation Standards for workforce relocations, including appropriate parking levels and fleet management. Programs delivered as part of the integrated travel behaviour change approach described above.
3.5 million	Workplace travel behaviour change programs delivered in major activity centres and transit oriented developments in the Perth and Peel region.
School travel change programs	
Population	Recommendation
2.7 million	Large-scale school travel behaviour change programs delivered across Perth and Peel. Programs delivered as part of the integrated travel behaviour change approach described above.
3.5 million	School travel behaviour change programs offered to all schools in the Perth and Peel region.

Walking and cycling infrastructure

Walking and cycling infrastructure provides safe and enjoyable routes and facilities, which encourage people to walk or cycle. Appropriate infrastructure for walking and cycling can improve transport network efficiency and improve safety.¹ There are also positive and statistically significant relationships between bicycle paths and lanes and levels of cycling. The provision of a full range of bicycle end of trip facilities in particular increases the likelihood of bicycle commuting.²

Population	Recommendation
2.7 million	Perth's off-road cycling and walking network expanded from 172 km to 350 km to better connect all activity centres with an increasing emphasis on the separation of cyclists and pedestrians. End of trip facilities widely available in all major activity centres in Perth.
3.5 million	Further expansion of the PSP network to cater for long distance commuters and additional river crossings, resulting in 850 km of off-road cycleways.

Parking strategies

Efficient parking management includes various mechanisms that result in more efficient use of parking facilities. Measures include supply constraints, sharing, efficient pricing, improved user information, and incentives to use alternative modes where it is more cost effective than subsidising parking. Effective parking strategies

¹ Department of Infrastructure and Transport (2013) *Walking, Riding and Access to Public Transport: Supporting Active Travel in Australian Communities*. Ministerial Statement. Commonwealth of Australia.

² Wardman, M, Tight, M & Page, M (2007) 'Factors influencing the propensity to cycle to work', *Transp. Res. Part A* vol. 41, pp. 339–350.

generally combine the use of long and short term parking charges, levies and limits to parking supply (parking caps) to discourage private car journeys to specific sites or areas. Levies applied to parking facilities can increase parking prices as well as provide revenue for various planning objectives and increase use of alternative transport modes. Parking caps impose an upper limit on parking supply in particular districts or areas. Reducing parking supply can also make cities more liveable by reallocating surface car parking to public spaces and footpaths or new residential areas.

Public transport time of day pricing

Public transport time of day pricing includes the introduction (or increase) of public transport fare differentials between peak periods (higher) and non-peak periods (lower). Peak pricing schemes can be introduced as either a surcharge for travel in peak periods or discounted travel during off-peak periods, or a combination of both.

Introducing large fare differentials between peak and off-peak periods can shift public transport users' travel patterns. Perth's public transport fares currently have a differential pricing structure for distance (zone based) but are not time-based and do not distinguish between different modes or services. This is in contrast to most other major Australian cities that have introduced some form of public transport peak and off-peak pricing.

Population	Recommendation
2.7 million	Revenue neutral time of day pricing scheme implemented with peak fares 30 per cent higher than off-peak fares. Concession fares remain unaffected.
3.5 million	Pricing of public transport fares reviewed to assess the need to increase the fare differential between peak and non-peak periods. Concession fares remain unaffected.

Road use pricing reform

Pricing measures to manage road use demand include schemes that charge motorists a road use fee that varies by time, distance, location and vehicle. Fees might be higher under congested conditions or for larger and more polluting vehicles and lower on uncongested roadways or in off-peak times. Road use pricing reform aims to eliminate other road user taxes and charges such as vehicle registration fees and fuel excise while more directly charging motorists for their individual levels of road use. Cordon pricing, where motorists are charged a fee for driving in specific areas such as central business districts, is sometimes proposed as an urban congestion reduction strategy aimed at reducing local traffic impacts and discouraging unnecessary road use in busy areas. Successive Commonwealth Government tax, competition and productivity reviews, including the Henry Tax Review³, the recently released Harper Review⁴, have identified reforming the way road users are charged as a national priority and the key to a more productive, efficient and sustainable Australian transport

³ Australian Treasury (2010), *Australia's Future Tax System*, The Commonwealth Government of Australia

⁴ The Harper Review advised that Governments should introduce cost-reflective road pricing with the aid of new technologies, with pricing subject to independent oversight and revenues used for road construction, maintenance and safety

system. The 2016 Australian Infrastructure Plan also recommended road user charging reform as a way of reducing congestion and to help fund major projects.⁵

Any measures to use pricing to manage road use demand in Perth would need to be fair and equitable for all motorists and have scope to remove existing road user costs such as vehicle registration fees and fuel excise charges.

<i>Population</i>	<i>Recommendation</i>
2.7 million	Work with national reform agencies, other Australian jurisdictions and stakeholders to develop options to introduce cost reflective road pricing for all vehicles.
3.5 million	Well-designed road use pricing initiatives that mitigate congestion and meet overall social equity objectives considered for introduction in Perth and Peel.

Implementation

As part of the broader *Transport @ 3.5 Million* implementation program, the Department of Transport will develop a TDM Implementation Plan to address how recommended measures will be implemented in the short to medium term, identify further research and policy work to be undertaken and identify enablers that underpin the implementation of successful TDM strategy and policy in Perth.

Development of the TDM Implementation Plan will include consultation and engagement within the Transport Portfolio, across government and with other key stakeholders.

⁵ Infrastructure Australia (2016) *Australian Infrastructure Plan: Priorities and reforms for our nation's future*

1. Travel demand management in Perth and Peel

1.1 What is travel demand management?

Travel demand management (TDM) is a strategic approach to mitigate urban traffic congestion and defer or reduce the need for additional transport infrastructure investment.

TDM includes initiatives that improve transport outcomes, such as congestion mitigation, more efficient use of infrastructure and a more reliable transport system. Essentially, TDM results in more efficient travel as people change their mode or time of travel, or simply travel less. It can delay or defer the need to provide infrastructure upgrades and offer solutions when there is limited capacity to expand existing networks.

Travel patterns (or demand) are determined by the availability of transport infrastructure and services, the locations of places, and people's need to access goods and services. A variety of initiatives including policies, programs, services or products that address transport demand are grouped under the term 'Travel Demand Management'. By influencing whether, why, when, where and how people travel, TDM measures can contribute to the following changes in travel behaviour:

- modal shift – more people choosing to walk, cycle, use public transport, carpool, or use other means of access;
- trip reductions – more people choosing to telework, shop online or conduct personal business by telephone or internet;
- driving reductions – more drivers making fewer trips by car, particularly to closer destinations; and
- time and route shifting – more drivers changing the time or route of their driving trip to avoid traffic congestion.

In simple terms the effect of most TDM initiatives is to change users' modes of transport, time of travel or amount of travel.

1.2 Why manage travel demand?

Improvements to transport system efficiency and reliability can be achieved by changing either supply or demand. Supply-side measures typically refer to delivery of road and public transport infrastructure, which often requires large capital outlays. Demand-side measures typically refer to using instruments or programs that use incentives or disincentives to affect transport choices and often do not require large resource outlays to implement and manage.⁶

⁶ Noxon Associates, (2011), *Transportation Demand Management for Canadian Communities: A Guide to Understanding, Planning and Delivering TDM Programs*, Transport Canada.

TDM is an essential part of a sustainable transport system, delivering social, economic and environmental benefits including:

- reduction in congestion cost and growth;
- efficient use of existing transport infrastructure and services;
- reduction or deferral of transport infrastructure investment;
- better access and more transport choices for socially and economically disadvantaged people;
- increased physical activity and better public health;
- improved liveability and amenity;
- road safety benefits including reduced personal trauma, injuries and other costs; and
- improved air quality and reduced emissions.

Comparative advantages of TDM include⁷:

- *Flexibility* – TDM measures tend to be flexible in application and scope. They can be deployed with new infrastructure or to trouble spots to address specific issues and be responsive to changing circumstances. TDM measures can be customised for specific user groups, which is often more difficult with supply-side and land use measures. TDM can also address congestion where there is limited capacity to increase supply.
- *Synergies* – TDM complements infrastructure investment in walking and cycling networks and upgraded public transport services. TDM can make investments in networks and services more effective and maximise economic, social and environmental benefits.
- *Speed* – TDM measures can be planned and deployed in months, weeks or even days. Supply-side and land use measures can take many years, even decades.
- *Affordability* – TDM measures can be scoped and scaled to match available resources and can make effective and creative use of existing staff and budgets. In many cases it is more cost effective to manage demand than to continue expanding supply.

TDM will play a crucial role in achieving the Smart Transport campaign. This campaign aims to develop a collective sense of responsibility for Perth's transport system and provide people with information and tools that influence their travel choices. Research conducted to inform this initiative found that identifying small changes people could make to improve the transport system would highlight the personal and social benefits they could achieve and the difference that their behaviour could make to the efficiency of the transport system for the community. Many TDM measures, particularly behaviour change programs, can help people achieve these small changes and often have a local, personalised focus.

⁷ Noxon (2011)

1.3 Existing travel demand management in Perth

Many TDM initiatives already exist in Perth and have been in place for many years. Travel behaviour change programs that target households, workplaces and schools have been progressively rolled out in Perth and Peel since the first WA TravelSmart program was launched in 1997. Travel Plans have also been used to achieve a number of travel and other benefits in specific Perth and Peel activity centres, including the QEII Medical Centre, Fiona Stanley Hospital, Murdoch campus of Challenger Institute of Technology and some recent large shopping centre expansions.

Bus priority infrastructure, including full and part time bus lanes and dedicated busways, has been opportunistically implemented in Perth and there is an increasing focus on providing priority for bicycles and pedestrians with upgrades and trials in local areas.

Investment to improve Perth and Peel's cycling network has escalated in recent years in response to increasing numbers of people cycling and a growing recognition of cycling as a valuable and significant transport mode. Implementation of *Transport @ 3.5 Million* will see the off-road cycle network expand from 172 km to around 850 km by the time the population reaches 3.5 million people. Key actions include:

- expansion of pathways;
- better connectivity to stations and schools;
- development of an online trip planner; and
- increasing the number of end of trip facilities in the Perth central business district (CBD) and activity centres.

Enhancements in public transport service frequency and reliability have been effective in Perth and Peel to achieve strong public transport patronage over the last 10 years and reduce the number of car trips. More recently, WA transport agencies have made a number of moves to provide real time travel information to travellers to help reduce public transport waiting times and influence mode choice.

Parking levies and controls on the supply and location of non-residential parking in Perth's CBD and parking caps at key specialised and strategic activity centres have played a major role in helping shape travel demand in Perth.

TDM is not new or unfamiliar in Perth and many TDM instruments have been successfully applied in Perth and Peel. As Perth continues to grow however, specific and targeted TDM techniques that minimise congestion and increase transport network reliability and efficiency will need to become more prevalent.

1.4 Relevant trends and external factors

Demographic and economic trends and rapidly changing technology will create change in demand as well as opportunities for applying TDM. Trends that increase demand for non-vehicle modes can have significant synergistic effects that should be fostered.⁸

⁸ Litman, T (2015) The future isn't what it used to be: Changing trends and their implications for transport planning, Victoria Transport Policy Institute, viewed 5 November 2015, <http://www.vtpi.org/future.pdf>

1.4.1 Demographics and changing traveller preferences

Factors such as age, culture, income, place of residence and employment location all influence travel demand and travel behaviour.

The ageing population is a significant trend. Older people have different mobility needs, increasing the importance of providing travel options for non-drivers.⁹ From a TDM perspective, this trend will increase the importance of providing quality travel options for non-drivers.

Further deregulation of retail trading hours is likely to result in some peak spreading.¹⁰ It is also likely to reduce shopping activity and the high number of shopping trips undertaken between 9am and 5pm on Saturdays. Shopping activity patterns in Australian jurisdictions that have achieved full shopping hours deregulation indicate that weekend travel activity is more likely to follow the same profile as weekdays.¹¹

Community attitudes in Perth towards density, public transport and car-dependence have changed in recent years. Compared to three years ago, more people believe an efficient public transport system is highly important and fewer people value Perth's low-density lifestyle.¹² Over the past two decades fewer young people are obtaining driver's licences and public transport patronage has risen in Australian cities.¹³

These changes in consumer preferences will attract increasing public support for TDM initiatives as growing numbers of people prefer to live in communities where it is possible to walk and cycle safely and have access to quality public transport.

1.4.2 Trends in technology and industry

In 2014 the Productivity Commission estimated that since 2000 net revenue from fuel excise had fallen 30 per cent. In the same time period road use grew 25 per cent and the cost of road construction and maintenance grew by 40 per cent. Fuel excise returns are dropping partly because cars are becoming more fuel efficient. As revenue from fuel excise to fund transport infrastructure continues to decline and transport infrastructure costs increase, road pricing reform is likely to become an increasingly important priority for all governments.

The rise of the sharing economy, or collaborative consumption, has the potential to change the dynamic of Perth transport by changing the way products and services are produced, offered, purchased and used. Examples of collaborative consumption will include new mobility options that affect travel behaviour such as car sharing, bike sharing, ride sourcing, ride sharing and shared parking.¹⁴

Future transport policy innovation will need to harness the benefits of technology-enabled mobility. Technology can build links between demand management and transport system operations.

⁹ Victoria Transport Policy Institute (2015)

¹⁰ Wildermuth, H. (2015) Transport Modelling for 2041 and 2051. Technical Note 4: External Factors Likely to Affect Current Travel Patterns, draft prepared for Department of Transport

¹¹ Economic Regulation Authority WA (2014) *Inquiry into Microeconomic Reform in Western Australia*,

¹² Committee for Perth (2015) *Perth perception survey*, prepared by Ipsos, Perth

¹³ Newman, P., & Kenworthy, J. (2011). Peak car use: Understanding the demise of automobile dependence. *World Transport Policy and Practice*, 17(2), 31-42.

¹⁴ RAC (2015) *Exploring the role of car sharing in Perth*

TDM initiatives are also likely to be supported by governments increasingly embracing open data¹⁵ in order to boost efficiency, performance, transparency, trust and credibility. By embracing open data transport agencies can work with others in the community to help analyse and improve transport systems.¹⁶

1.5 Freight and TDM

The effective movement of freight across the state is crucial to Western Australia's economy and communities. Between 1971 and 2007 Australia's road freight task grew by approximately 5.4 per cent per annum to approximately 184 billion tonne kilometres (ABS, 2008). Over this period, increases in heavy vehicle size and capacity enabled more freight to be carried by fewer trucks.¹⁷ Careful management of roads and congestion is critical to ensure efficient freight movement and to minimise heavy vehicle impact.

There is a large spectrum of road freight vehicles operating within the transport industry, ranging from light commercial vehicles transporting urban freight, through to large vehicles transporting containerised freight from ports. Freight vehicles make up a lower portion of total urban-peak traffic but constitute a large portion of traffic on specific transport corridors, for example major arterial roads leading to ports and strategic industrial precincts. In this context, freight vehicles can be a major beneficiary of TDM strategies that reduce car trips on arterial and other major roads.

Some of the key benefits that can be achieved by reducing the amount of freight traffic include:

- *Reduced traffic congestion* – due to the vehicle size and slower acceleration rate, compared with light vehicles, heavy freight vehicles impose more congestion per unit of travel.
- *Reduction in road maintenance costs* – heavy freight vehicles cause higher levels of road wear and damage than light vehicles.
- *Reduction in pollution* – heavy freight vehicle emissions can be a major contributor to pollution along major industrial transportation corridors (ICB Consulting, 2001).
- *Improved community liveability* – freight traffic can degrade community amenity by imposing noise, dust, air pollution, traffic risk and traffic delay, particularly in neighbourhoods near major highways or intermodal terminals.
- *Improved pedestrian and cycling conditions* – heavy vehicle traffic is a deterrent to pedestrian and bicycle travel.¹⁸

There are a number of demand-side strategies that government and private industry can implement to improve freight transport efficiencies including:

- Improving scheduling and routing to reduce freight vehicle travel and empty container haulage by increased computerisation and greater coordination among distributors.

¹⁵ Merritt, K, (2015) The Next 5 Years in Open Data: 3 Key Trends to Watch, <http://www.govtech.com/opinion/The-Next-Five-Years-in-Open-Data-Three-Key-Trends-to-Watch.html>

¹⁶ Russell, A, (2015) Washington Post helps trumpet how open data improves our transit options. <http://mobilitylab.org/2015/10/27/wapo-open-data-techies/>

¹⁷ Australian Government Department of Infrastructure and Transport, Bureau of Infrastructure, Transport and Regional Economics, research report 123: road truck productivity sources, trends and future prospects, p. xiii

¹⁸ TDM Encyclopaedia, Victoria Transport Policy Institute, Freight Transport Management online: <http://www.vtpi.org/tdm/tdm16.htm>

- Adopting innovative technologies.
- Organising regional delivery systems so fewer vehicle trips are needed to distribute goods.
- Using smaller vehicles and active forms of transport (for example bicycle couriers) for urban distribution.
- Changing freight supply chain operating hours, including delivery times, to reduce congestion during peak-periods.
- Establishing pricing and taxation policies to encourage efficient freight transport.¹⁹

¹⁹ TDM Encyclopaedia, Victoria Transport Policy Institute, Freight Transport Management online: <http://www.vtpi.org/tdm/tdm16.htm>

2. Methodology

Research conducted by the Planning and Transport Research Centre (PATREC) in 2014 identified more than 70 measures or initiatives that could be used in Perth to help manage travel demand. The following methodology was applied to identify the most appropriate measures to be included in *Transport @ 3.5 Million*.

An extensive literature review and gap analysis was used to evaluate international and domestic experience of TDM as well as to capture measures not considered in the PATREC research. Measures that did not fit the TDM definition were also excluded.

A workshop was held on 25 July 2015 at which local, national and international experts provided input to the assessment of the TDM measures. Attendees used an evaluation framework to assess high-impact TDM measures' effectiveness and priority for Perth.

The high level assessment undertaken to shortlist all measures was based on the extent to which each TDM measure met the following criteria:

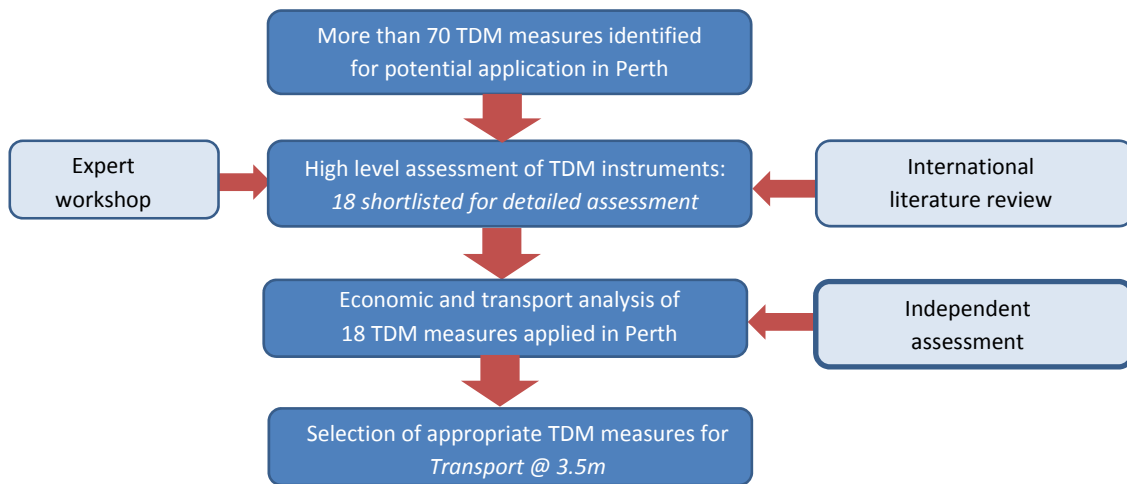
- effectiveness in managing travel demand, particularly during peak congestion periods;
- suitability for the Perth and Peel context; and
- demonstrated ability to achieve significant transport outcomes and associated economic, social and environmental benefits.

Likely risks and synergies associated with each measure were also identified as part of this process.

The high level assessment resulted in a preliminary report that described 25 TDM measures considered likely to be appropriate for the Perth context, represent good value for money and achieve significant transport outcomes such as mode shift, reduced vehicle kilometres travelled and reduced trips, particularly in peak periods. These transport effects translate to broad economic benefits including reduced congestion costs, lower vehicle emissions, fewer crashes, travel time savings, improved roadway performance reliability and lower operating costs.

Eighteen TDM measures were selected for further detailed appraisal by assessing the likely impact on travel behaviour and economic outcomes associated with effective implementation of each measure in Perth at a population of 3.5 million. This assessment was significantly informed by the work of independent transport economists, which included the development of a well-designed application of each measure and a detailed analysis of likely transport and economic benefits of each application.

Based on this detailed assessment, six measures have been recommended as appropriate for introduction or expansion in Perth as the population grows. For other measures, further investigation and monitoring is required to determine how the State Government might investigate, monitor or influence certain initiatives that work to mitigate traffic congestion as well as optimise existing transport infrastructure.



3. Travel demand management measures for Perth @ 2.7m and 3.5m

The following TDM measures are recommended for Perth at a population of 2.7 million and 3.5 million.

3.1 Travel plans for new developments

Travel plans are a package of actions to encourage safe, healthy and sustainable travel options for specific organisations or sites such as large medical centres, shopping centres, large residential developments or universities. Their purpose is to plan actions that are relevant, feasible and likely to be effective in changing transport choices. Establishing travel plans in new major commercial and residential developments in Perth could be achieved in a number of ways including building on existing planning processes that have proved successful in introducing travel plans for some specialised activity centres and large commercial developments in Perth to date. Plans can be tailored to specific organisations or sites drawing on a variety of tools such as site audits, transport facilities and policies, surveys of local transport system users and consultation with stakeholders.

3.1.1 Rationale

When travel plans are established in new developments they can help incorporate alternative modes in facility planning and design, such as well-designed pedestrian and bicycle facilities, convenient bicycle and rideshare vehicle parking, end of trip facilities, attractive and convenient bus stops and on-site car share vehicles. They can also reduce car travel to or around a specific site by limiting parking supply.

The application of travel plans allows local authorities to set transport targets for new developments and require operators to monitor ongoing performance and report findings.

3.1.2 Background

UK experience has shown that travel plans mandated through planning approval mechanisms and supported by legislation can reduce single occupant vehicle use by approximately 18 per cent when combined with effective parking management strategies.²⁰ Travel plans must be established for any new development that exceeds a prescribed threshold²¹ and in London all large-scale developments and applications must submit a full travel plan as part of the planning application process. This requirement applies to new developments and extensions of existing sites.

In Perth, the planning process has been used in certain cases to leverage the introduction of travel plans, usually through requirements in the development application process for universities, hospitals and shopping centres. The requirement for a travel plan was a condition of approval for a number of developments, including QEII Medical Centre, Fiona Stanley Hospital, Murdoch campus of Challenger Institute

²⁰ Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., & Goodwin, P., (2004) 'Smarter choices-changing the way we travel.' *Transport Reviews*, 28(5), 593-618.

²¹ Rye, T, Green, C, Young, E, & Ison, (2011)

of Technology and some recent large shopping centre expansions. This mechanism has sometimes been used to offset non-standard aspects of a proposal.

Transport assessments are currently undertaken in Perth and Peel and applied at the structure plan, subdivision and individual development level. These assessments are voluntary, although strongly encouraged. The assessments look at transport implications of land use development proposals including implications for roads, intersections, pedestrian and cycle networks, and public transport services. The Department of Planning has published guidelines to assist developers in conducting transport assessments. The guidelines are also used by the approving authority's planning officers to determine whether or not the appropriate level of transport assessment has been provided in support of the proposal.

Some Western Australian local authorities, including the Town of Victoria Park and the City of Geraldton, have proposed adapting their local planning policy to require new medium and large scale developments to prepare and maintain travel plans, although these changes have not yet been implemented.

The City of Sydney development plan requires a travel plan where estimated peak trip generation exceeds certain thresholds.²²

3.1.3 Assessment

Transport and economic

Assessment of a travel plan implemented at a specialised activity centre in Perth provides some empirical indication of potential travel benefits. Travel plans established for the QEII Medical Centre are estimated to have reduced private car travel to and from the site by 30 per cent over four years.²³ Based on the number of employees and visitors accessing the centre, this is estimated to represent a reduction of approximately 3,840 trips by employees in peak periods as well as an additional 3,000 trips generated by patients and visitors every day.²⁴

The potential benefits of introducing travel plans for new major commercial and residential developments in Perth and Peel were independently evaluated. The evaluation considered the application of two scenarios expected to achieve different rates of vehicle trip reduction.

The first scenario envisages travel plan initiatives being implemented at mainly low or no net cost to business, with light-touch monitoring and enforcement, while the second assumes substantial business investment and monitoring and enforcement to drive travel change.

Based on existing data on development applications and assuming a cumulative effect, the assessment estimates that a total of 1,940 sites in Perth and Peel would develop travel plans by 2050.

²² See 3.11.1 in <http://www.cityofsydney.nsw.gov.au/development/planning-controls/development-control-plans>

²³ Martin, J (2014) *Parking Supply Restriction and Mode Shift at QEII Medical Centre – A Case Study*, AITPM 2014 National Conference

²⁴ QEII tenants employ more than 8,000 people, with approximately 80 per cent working on any particular weekday. In addition, there are approximately 5,000 patients and visitors that attend every day. These calculations were based on a 30 per cent reduction of trips generated by these groups.

In the absence of information on current developments or the projected future mix of developments, an average of 100 peak hour vehicle trips per development is assumed.²⁵ Using this assumption, the 1,940 sites subject to travel plans in 2050 would be responsible for 194,000 peak hour vehicle trips. If total vehicle trips grow in proportion to population and if Perth mode shares remain constant, this figure would represent approximately 28 per cent of all peak hour vehicle trips in Perth and Peel in 2050.

If introducing travel plans for major new developments can reduce vehicle trips by an average of five per cent²⁶ there will be 9,700 fewer daily peak hour trips in 2050. If travel plans (when combined with parking management strategies) can reduce vehicle trips by 18 per cent²⁷ there will be approximately 35,000 fewer peak hour trips per day.

Table 1 shows these results along with corresponding reductions in daily trips and vehicle kilometres travelled.

Table 1: Vehicle traffic changes in 2050 with travel plans implemented for major new developments

	5% vehicle trip reduction	18% vehicle trip reduction
Peak hour		
Vehicle trips	- 9,700	- 34,900
Vehicle km	- 101,000	- 363,000
Daily		
Vehicle trips	- 126,000	- 453,000
Vehicle km	- 1,310,000	- 4,720,000

Calculations of indicative benefit/cost ratios for the introduction of travel plans are based on the method used by Marsden Jacob Associates in their 2011 evaluation of the TravelSmart Local Government and Workplace Programs²⁸ and a number of assumptions about likely travel effects (based on overseas and local estimates) and monitoring and enforcement costs.

Table 2 shows the results of the indicative economic analysis for travel plans for major new developments in 2050, assuming a population of 3.5 million, by which time it is estimated approximately 1,940 developments will have travel plans in place. Benefit/cost ratios will be lower in earlier years when there are fewer developments.

²⁵ This is one of the thresholds at which the Town of Victoria Park requires new developments to prepare a full travel plan

²⁶ Workplace travel plans have been found typically to reduce single occupant car use by 5 – 15 per cent

²⁷ UK experience has shown that mandatory travel plans can reduce single occupancy vehicle use by approximately 18 per cent when combined with parking management strategies

²⁸ The assessment identified a number of limitations with this methodology. However using this approach does provide indicative results that can be compared with the MJA BCR values for local government and workplace travel plans.

Table 2: Indicative benefit/cost ratios for travel plan scenarios in 2050

Scenario description	Scenario 1 5% vehicle trip reduction	Scenario 2 18% vehicle trip reduction
	Travel plan initiatives mainly low or no net cost to business, with light-touch monitoring and enforcement	Substantial business investment and monitoring and enforcement to drive travel change
Annual cost (\$M)		
Government	0.2	1.2
Private	3.9	38.8
Total annual cost	4.1	40.0
Annual benefits (\$M)*	26.1	94.1
Indicative BCR	6.4	2.4

* Calculation of benefits does not include likely reduced capital costs associated with avoided or deferred transport infrastructure for reduced peak period trips.

It is likely that the first scenario a five per cent reduction in vehicle trips could be achieved with a system relying mainly on implementation of travel plan initiatives chosen on the basis that they are effective but have minimal or no net cost to owners or tenants, for example employers paying subsidies for travel behaviour change that are offset by reduced costs to provide car parking. Only a low level of monitoring and enforcement would be necessary as the travel plan initiatives should be mostly self-sustaining.

For the second scenario, an 18 per cent reduction in vehicle trips would require more substantial investment by developers and subsequently by owners and tenants.

Social

Travel plans can ensure accessibility of new developments for the mobility disadvantaged. Wider social benefits can accrue from reduced travel times, health benefits associated with increased use of alternative modes of travel and increased amenity of activity centres through parking constraints.

Environmental

Travel plans can reduce the amount of land used for parking space and leave more for green space. Through reducing single occupant vehicle use, travel plans also result in lower transport energy use, fewer greenhouse gas emissions and less noise pollution.

3.1.4 Challenges for implementation

UK experience indicates that a regulatory approach risks poor engagement by applicants and the perception that travel plans are burdensome.²⁹ Likewise a lack of engagement or involvement might prompt local planning authorities to approach travel plan implementation with a lack of interest or commitment.

Monitoring and enforcement is a key consideration. In the UK there is little assessment of whether established travel plans are actually put into effect or outcomes achieved.

²⁹ Enoch, M & Zhang, L (2012) 'Travel plans,' in T Rye & S Ison (eds.), *The implementation and effectiveness of transport demand management measures: an international perspective*. Ashgate Publishing, Ltd.

Travel plans will only meet their intended objectives if appropriate regulatory or other mechanisms ensure plans are properly implemented.

Area travel plans have been suggested as being a more effective, holistic TDM measure than individual site-based plans, as they ensure that capacity released by an individual travel plan is not taken up by latent demand from elsewhere. This model could reduce applicant participation and accountability however, and remains untested in Australia.

Detailed investigation is needed to identify the best approach for implementing travel demand management plans in Perth. Successful implementation will require collaboration with key State and local governments as well as developers.

3.1.5 Synergies and enablers

Some elements of parking management, for example parking caps or maximum parking standards, significantly enhance the effectiveness of travel plans. Offsetting the impact of reduced car parking is a common reason for requiring a travel plan for a new development. Reducing car parking has clear benefits for developers through reduced costs, and acts as an important incentive to manage car use as part of a site's travel plan.³⁰

Other enablers could include:

- endorsement and push from higher levels of government to gain local government support;
- guidance documents from government agencies to provide advice, support and promotion of travel plans, recognition when good practice is demonstrated, and build industry skills to enable planning consultancies to effectively develop the plans; and
- facilitating ownership and engagement by involving occupants in developing travel plans, which is widely recognised as a key success factor.

Taking a staged approach to a travel plan policy will help manage risks and allow learning from early experience.

³⁰ De Gruyter, C., Rose, G., & Currie, G. (2014). Securing travel plans through the planning approvals process: A case study of practice from Victoria, Australia. *Cities*, 41 (A), 114-122.

3.1.6 Future application for Perth

Implementation of travel plans for new developments will require the Departments of Transport and Planning, as well as local government authorities, to work closely together to:

- establish widespread support across government for the use of travel plans for major developments;
- establish an agreed threshold at which a development is considered 'major';
- establish consistent policies and processes to promote the introduction of good practice travel plans in major developments;
- consult on an ongoing basis with developers, major property owners and occupants of new developments to facilitate ownership, engagement and support for site specific travel plans; and
- investigate how to support the establishment of public-private partnerships to help property owners implement trip reduction programs by providing transport and parking management services in particular areas such as commercial districts, medical centres and industrial parks.

Different kinds and levels of travel plans could be applied depending on the scale of development and location. Full travel plans could include a site assessment, travel surveys, objectives linked to the site's context, travel targets, provision for end of trip facilities, travel change programs and effective strategies that might limit or efficiently charge for car parking.

<i>Population</i>	<i>Recommendation</i>
2.7 million	Travel plans implemented for new major commercial development and travel plans implemented for new major residential development associated with strategic activity centres in Perth and Peel.
3.5 million	Travel plans implemented for all new major commercial and residential development in Perth and Peel.

3.2 Travel behaviour change programs

Travel behaviour change programs use education, information, incentives and other marketing-based approaches to persuade and assist people to reduce their need to travel, reduce dependence on private cars and increase physical activity by making voluntary changes in their travel habits and patterns. Such changes include reducing car use and increasing the share of trips by alternatives such as cycling, walking, public transport or car-pooling.

3.2.1 Rationale

Travel behaviour change programs use a packaged approach to shift people's travel demand preferences by providing information, incentives and support to try alternative travel modes. The programs seek to permanently influence participants into more efficient travel patterns.

3.2.2 Background

Western Australia is recognised as a world leader in its travel behaviour change programs, which target households, workplaces, schools and local governments. Extensive evaluation of program effectiveness has indicated that a 10 per cent reduction in vehicle kilometres travelled, 20 per cent increase in public transport use

and significant reductions in car use can be achieved and are sustained for years following.³¹

Travel behaviour change programs in Perth and Peel have been particularly successful in increasing uptake of new and existing public transport infrastructure and services. For example, public transport trips in the Mandurah area increased by nearly 60 per cent following the opening of the Mandurah train line. Following the implementation of a household travel behaviour change program, public transport trips increased by another 31.4 per cent. Major benefits can be gained by delivering targeted travel behaviour change programs to promote new and existing transport services and infrastructure.

Travel behaviour change programs similar to those in Western Australia have been introduced in Queensland and Victoria and in cities across the world including Bellingham, Cleveland, Durham, Sacramento and the state of Oregon in the US, Vancouver in Canada, and Peterborough and Worcester in the UK. In general, these programs have resulted in reductions in single occupant car use of between three and 13 per cent, 14 per cent increases in public transport use and increases in walking and cycling of between 12 and 36 per cent.³²

Travel behaviour change programs conducted at various schools, universities, hospitals and workplaces in Victoria resulted in the development of more than 150 travel plans across more than 38 funded projects. A 2012 review of 134 projects commissioned by Victoria's Department of Transport found that 85 per cent of participants reported a shift towards more sustainable travel options. Sixty-five per cent reported reduced car use, 35 per cent reported increased public transport use, and 49 per cent reported increased cycling.³³

Integrated travel behaviour change programs in Perth, such as the *Your Move* program in Cockburn and Wanneroo, have improved transport system efficiency by reducing travel demand and shifting travel times, thereby helping limit local congestion. These programs also improve public transport patronage and leverage cycling initiatives to improve infrastructure connections to destinations.

3.2.3 Assessment

Transport and economic

The potential benefits of expanding travel behaviour change programs in Perth were independently evaluated. The evaluation assessed the introduction of a region-wide integrated travel behaviour change program delivered across Perth and Peel on a 10 year rolling basis with emphasis on activity centres, transport infrastructure developments and congestion hotspots. The program would target workplaces, households and schools in partnership with local governments and include developing travel plans, promoting strategic asset management and using central online engagement.

³¹ Ashton Graham, C. and John, G. (2006) *Department of Transport Working Paper: TravelSmart Household program: Frequently Asked Questions in travel demand management and dialogue marketing*, Department of Transport

³² Rodwell, J. (2009) *Evaluative Results of Individualized Marketing Programs for "SmartTrips" Programs: Synthesis*, report prepared for WSDOT

³³ Victorian Auditor-General's Report (2013) *Managing Traffic Congestion*

Assumed low and standard diversion rates³⁴ are drawn from the draft Travel Behaviour Change volume of Australia's National Guidelines for Transport System Management, which provides default diversion rates for use in economic assessments of travel behaviour change projects based on an extensive review of the different types of programs.

The standard set of diversion rates is based on the average of all household/community projects reviewed. The low set is based on the average of the bottom half of diversion rates achieved and is applicable for projects that might not implement the full range of initiatives that have become standard in household based programs, or where public transport services or cycle/walking facilities are poor.

Table 3: Projected travel behaviour change for a region-wide integrated travel change program in Perth and Peel

Mode	Diversion rates		Percentage changes		Change in trips per day ('000) – Perth 2015 @ 2.01m		Change in trips per day ('000) – Perth 2050 @ 3.5m	
	Standard	Low	Standard	Low	Standard	Low	Standard	Low
Car driver	-3.1	-1	-6%	-2%	-304.7	-98.3	-530.6	-171.2
Car passenger	-0.5	-0.2	-2%	-1%	-49.2	-19.7	-85.6	-34.2
Public transport	1.4	0.5	33%	12%	137.6	49.2	239.6	85.6
Cycle	0.9	0.3	19%	6%	88.5	29.5	154.1	51.4
Walk	1.3	0.4	8%	3%	127.8	39.3	222.5	68.5
Measure					Perth 2015 @ 2.01m		Perth 2050 @ 3.5m	
					Standard	Low	Standard	Low
Change in car VKT per day (million)					-3.17	-1.02	-5.52	-1.78

Using benefit values developed for application to household travel behaviour change programs in Auckland New Zealand, and converting these to Australian dollars, it is possible to calculate the following indicative estimates of benefits.

Household travel behaviour change project benefits per capita per year:

Standard diversion rates: \$145

Low diversion rates: \$45

These benefit values apply to the total population of the target area, not just those that choose to participate in the program. Even if only the low diversion rates are achieved, the benefit/cost ratio of the program will be approximately seven (\$45/\$6.35), which is a very good return on investment.

An assessment was also undertaken of the transport and economic effects of development and implementation of a broad scale workplace travel program across the Perth and Peel region, commencing in the Perth CBD and other identified priority areas, such as major activity centres.

³⁴ Diversion rates refer to the proportion of additional public transport, cycling or walking trips that would otherwise be car driver trips.

Table 4: Workplace travel change program effects

	Car driver	Car passenger	Public transport	Cycle	Walk
Diversion rates (percentage points of mode share)	-5.0	1.3	1.3	0.6	1.8
Percentage changes	-9%	6%	30%	13%	11%
Change in AM peak period trips per day in year 2050	- 9,840	2,558	2,558	1,181	3,542
Change in AM peak period car VKT per day in year 2050	- 102,339				

This assessment indicated that likely effects include significant reductions in car trip from current mode share (nine per cent) and corresponding increases in public transport trips (30 per cent), cycling (13 per cent) and walking (11 per cent). An indicative benefit/cost ratio of workplace programs could be as high as 26 (\$36.4 million for \$1.4 million investment).³⁵

An assessment was also undertaken of the potential impact of an expanded a large-scale school travel behaviour change program.

Table 5 shows potential travel behaviour impacts in 2050 assuming that one third of schools participate in the school travel change program. An indicative benefit/cost ratio of 6.4 has been calculated for the program.

Table 5: School travel change program impacts in 2050

	Car driver	Car passenger	Public transport	Cycle	Walk
Number of schools participating	330				
Total roll of participating schools	193,300				
Diversion rates (percentage points of mode share)		-9.0	2.7	2.8	3.5
Change in AM peak period trips per school day in year 2050		- 17,400	5,220	5,410	6,770
Change in AM peak period car VKT per school day in year 2050*	- 157,000				

* Based on average trip lengths of the new modes x 2 for car driver return trip

Social

A range of social benefits are associated with travel behaviour change programs including:

- reduced car traffic and parking demand around schools during pick-up and drop-off times;
- increased levels of physical activity and associated health benefits;
- reduced transport costs to households;
- reduced exposure to vehicle pollutants;
- increased accessibility for people without cars and the mobility disadvantaged;

³⁵ The assessment noted that this might not be achieved due to diminishing returns when all high priority workplaces have implemented workplace travel plans and remaining workplaces are smaller

- increased community interaction and social well-being; and
- increased road safety outcomes³⁶.

Environmental

Local assessment of existing Perth travel behaviour change programs indicates that significant reductions in greenhouse gas emissions are likely to be achieved through reductions in car trips.³⁷ Through reducing single occupant vehicle use, travel behaviour change programs also result in lower transport energy use and less noise pollution.

3.2.4 Challenges for implementation

Decreasing use of landline telephones as more people move to mobile devices as their principal point of contact, increasing one-person households and an aging population³⁸ present significant challenges for the Department of Transport's current integrated travel behaviour change model.

Participants are also increasingly likely to access and benefit from personalised information on real time travel options, public transport and health benefits derived from program participation. Travel behaviour change programs will increasingly need to engage with individual customers online and adopt behavioural marketing techniques³⁹ to provide relevant, instant information.

Commuter trips to and from the Perth central sub-region will remain the greatest opportunity for workplace travel behaviour change programs. Digital delivery of services through online platforms and mobile devices will be a high priority for future travel behaviour change programs to target specific, high-need areas and individual customers.

3.2.5 Synergies and complementary strategies

Travel behaviour change programs are highly adaptable and can be deployed to complement other transport initiatives such as priority programs for specific transport modes and new and upgraded infrastructure. Over the long term, travel behaviour change programs could enhance the success of transit oriented developments and should be integrated into development of all new major public transport, active transport and appropriate road projects.

Travel behaviour change programs motivate people to adopt alternative transport options and can mitigate the perceived negative impact of 'push' measures, like parking supply and pricing measures, to shift travellers out of cars.

Revenue from local parking levy schemes modelled on the Perth Parking Policy can provide important sources of revenue for local governments to fund travel behaviour change programs. Other alternative funding sources include cross-government partnerships and private sector sponsorship.

³⁶ Fishman, E., Ker, I., Garrard, J., and T. Litman, (2011)

³⁷ Ashton Graham, C. and John, G. (2006) *Department of Transport Working Paper: TravelSmart Household program: Frequently Asked Questions in travel demand management and dialogue marketing*, Department of Transport 2006.

³⁸ Department of Planning and Western Australian Planning Commission, (2015) *Draft Perth and Peel@3.5million*, Department of Planning.

³⁹ Silverpop, 7 (2015) *Key Marketing Trends for 2015*, Silverpop - IBM, 2015.

3.2.6 Future application for Perth

Implementation of travel behaviour change programs will require the Department of Transport to:

- maintain and create new alliances with key agencies including the Department of Sport and Recreation, the Department of Education, local government authorities and schools;
- develop ongoing recruitment and engagement strategies with participants including online and digital service delivery; and
- collect survey information and other data to continually evaluate program effectiveness in transport impact as well as benefit/cost terms.

Population	Recommendation
Integrated travel change programs	
2.7 million	<p>Integrated travel behaviour change programs that target households, workplaces and schools expanded and delivered across targeted regions in Perth and Peel with an emphasis on optimising efficiency of the existing network and new infrastructure and services.</p> <p>Integrated travel behaviour change programs combined with significant public transport infrastructure projects and services and a proportion of associated capital budgets allocated for this purpose. Alternative sources of funding will be increasingly leveraged.</p>
3.5 million	Integrated travel behaviour change programs delivered across Perth and Peel every 10 years. Workplace programs delivered in major activity centres and transit oriented developments. School programs offered to all schools in the Perth and Peel region.
Workplace travel change programs	
Population	Recommendation
2.7 million	<p>Workplace travel behaviour change programs delivered across Perth and Peel focusing on identified priority areas such as major activity centres and transit oriented developments.</p> <p>Travel plans mandated in the Government Office Accommodation Standards for workforce relocations, including appropriate parking levels and fleet management.</p> <p>Programs delivered as part of the integrated travel behaviour change approach described above.</p>
3.5 million	Workplace travel behaviour change programs delivered in major activity centres and transit oriented developments in the Perth and Peel region.
School travel change programs	
Population	Recommendation
2.7 million	<p>Large-scale school travel behaviour change programs delivered across Perth and Peel.</p> <p>Programs delivered as part of the integrated travel behaviour change approach described above.</p>
3.5 million	School travel behaviour change programs offered to all schools in the Perth and Peel region.

3.3 Walking and cycling infrastructure

Walking and cycling infrastructure provides safe and enjoyable routes and facilities, which encourage people to walk or cycle. Improving walking and cycling infrastructure involves constructing and expanding pathways, partial segregation of traffic, increased separation of pedestrians and cyclists, bike boulevards, better lighting, bike routes that connect to public transport, public bike-sharing programs, early-start signals for cyclists and pedestrians and high quality end of trip (EOT) facilities for cyclists.

3.3.1 Rationale

High quality infrastructure effectively attracts users from other modes of transport for suitable trips. A shift to walking or cycling mitigates congestion by reducing private car use, particularly for commuter journeys during peak periods.

3.3.2 Background

Appropriate infrastructure for walking and cycling can improve transport network efficiency and improve safety,⁴⁰ and there are positive and statistically significant relationships between bicycle paths and lanes and levels of cycling. A cross-sectional study of 40 US cities found that each new mile of cycleway per square mile increased the share of workers commuting by bicycle by one per cent⁴¹ and several studies have also found links between infrastructure improvements that promote street connectivity and limit car parking and increased walking levels.⁴²

Electric bicycles (e-bikes) could significantly increase future cycling rates and currently represent one of the fastest growing transport market segments. In the last decade, more than 150 million e-bikes have been sold worldwide.⁴³ In Australia, the e-bike market is growing rapidly, faster than the growth in regular bike sales.⁴⁴ E-bike users appear to cycle more frequently and further. Research in China, North America, and Australia indicates that e-bikes have a greater capacity to replace car use than standard bicycles.⁴⁵

In recent Australian research, 60 per cent of respondents to an online survey cited replacing some car trips as a main motivation for e-bike purchase, followed by 49 per cent that said they were motivated by being able to cycle with less effort.⁴⁶

High quality walking and cycling infrastructure can significantly increase walking and cycling in cities by improving the quality of journeys and reducing safety concerns. Perceived and actual traffic hazards are a key constraint in low walking and cycling countries such as Australia, even among those that cycle regularly.⁴⁷

⁴⁰ Department of Infrastructure and Transport (2013) *Walking, Riding and Access to Public Transport: Supporting Active Travel in Australian Communities*. Ministerial Statement. Commonwealth of Australia.

⁴¹ Pucher, J, Dill, J & Handy, S (2010) 'Infrastructure programs and policies to increase bicycling: an international review', *Preventative Medicine* 50

⁴² Hooper P, Knuiman M, Bull F, Jones E and Giles-Corti B. (2015) *Are we developing walkable suburbs through urban planning policy? Identifying the mix of design requirements to optimise walking outcomes from the 'Liveable Neighbourhoods' planning policy in Perth, Western Australia*. International Journal of Behavioral Nutrition and Physical Activity, Vol 12.

⁴³ Fishman, E & Cherry, C 2015, 'E-bikes in the Mainstream: Reviewing a Decade of Research', *Transport Reviews*

⁴⁴ <https://rideonmagazine.com.au/new-and-electric-ebikes-explained/>

⁴⁵ Fishman, E & Cherry, C 2015; Johnson, M., & Rose, G. (2013). Electric Bikes – cycling in the New world city: An Investigation of Australian Electric Bicycle Owners and the Decision Making Process for Purchase. Paper presented at the Australasian Transport Research Forum, Brisbane.

⁴⁶ Johnson, M., & Rose, G. (2013), above n 82.

⁴⁷ Cycling Promotion Fund, 2008, *Cycling: Getting Australia Moving*, funded by the Australian Government Department of Health and Ageing

Measures that increase the number of people cycling reduce the risk of road injuries and fatalities. An in-depth study commissioned by Transport for London examined fatal and life threatening collisions involving cyclists over a two year period and found that the best way to achieve a safer environment and encourage more people to cycle was to invest in best practice cycling infrastructure. The 2014 report estimated that this could increase the number of cyclists four-fold by 2026.⁴⁸

Increasing rates of cycling participation in cities can in itself improve safety outcomes for cyclists. In Portland Oregon, cycling increased four-fold between 1991 and 2006, yet crashes fell by 69 per cent. Cycling in London increased by 83 per cent between 2002 and 2008, while the number of serious crashes declined by 28 per cent. Data indicates that countries with best practice cycling infrastructure and the highest levels of cycling, such as Denmark, have the lowest levels of cycling fatalities.⁴⁹

The provision of a full range of bicycle EOT facilities in particular increases the likelihood of bicycle commuting. Analysis of UK survey data estimates there are statistically significant impacts from providing bicycle parking and showers for cyclists.⁵⁰ There is also evidence that providing EOT facilities at workplaces that include bicycle parking, showers and lockers results in 4.86 times more people commuting by bicycle.⁵¹

There is immense scope for car trips to be converted to walking or cycling trips, particularly for the 40 per cent of Australians that commute less than 10 km to their place of work or study, or those that make short local trips. Up to 84 per cent of non-regular cyclists in Sydney indicate they would be willing to consider cycling or cycling more often if dedicated cycleways and off-road routes were available.⁵² Perth people indicate they are likely to walk more if there are good walking paths.⁵³ To increase the levels of walking in neighbourhoods with increased connectivity, it is essential to provide more route choices, more direct routes and closer proximity to core destinations. Perth residents that have an accessible network of bicycle or shared use paths are 77 per cent more likely to use cycling as a form of transport.⁵⁴ Use of cycle paths in Perth's inner areas can particularly reduce demand and congestion on peak period public transport services.

Each day Perth residents take more than 400,000 private car trips of less than a kilometre and equivalent to a 10 minute walk.⁵⁵ Perth's dry climate and flat terrain make walking and cycling ideal transport options. Pedestrians form the largest single road-user group⁵⁶ and WA's cycling rate is higher than the national average. The results of a 2006 survey indicated that for all trips on an average weekday in school terms, 11 per cent are 'walk all the way' trips. For distances up to one kilometre 48 per cent are walking trips and for distances up to three kilometres 26 per cent are walking

⁴⁸ Christie, N (2014) *Pedal Cyclist Fatalities in London: Analysis of Police Collision Files (2007-2011)*, Centre for Transport Studies, University College London 2014

⁴⁹ 'Power to the Pedals', 2010, *World Watch Magazine* Vol. 23, No 4

⁵⁰ Wardman, M, Tight, M & Page, M (2007) 'Factors influencing the propensity to cycle to work', *Transp. Res. Part A* vol. 41, pp. 339-350.

⁵¹ Buehler, R, (2012) 'Determinants of bicycle commuting in the Washington DC region', *Transport Research Part D*, vol. 17, pp. 525-531

⁵² City of Sydney Council, (2006) *Sydney Cycling Research: Internet Survey*, prepared by Environmetrics

⁵³ Department of Transport (2008) Walking Accessibility / Footpaths webpage (<http://www.transport.wa.gov.au/activetransport/24033.asp>)

⁵⁴ Living Liveable (2015) *The Impact of the Liveable Neighbourhoods Policy on the health and wellbeing of Perth residents. The University of Western Australia*. Perth, Western Australia

⁵⁵ Department of Transport. *Perth and Regions Travel Survey (PARTS) 2002-2006*. Perth. Western Australia: Western Australian Government.

⁵⁶ Department of Transport (2015) Walking Accessibility webpage (<http://www.transport.wa.gov.au/activetransport/24033.asp>)

trips.⁵⁷ Cycling has been on the rise in Perth for many years and the use of the off-road Principal Shared Paths by cyclists to access the Perth CBD has increased by 34 per cent since 2011.

Growth in Perth Bicycle Network use has consistently exceeded population growth and local experience indicates that cycle path extensions have a cumulative effect on level of use.⁵⁸ Government investment in cycling infrastructure has also grown sharply in recent years.

Perth residents have recently identified improvements in on-road and off-road infrastructure for cycling and walking, paths to major centres, and safe crossing points for pedestrians as very high priorities.⁵⁹ Safety concerns remain one of the main reasons that people in WA choose to not cycle more often.⁶⁰

3.3.3 Assessment

Transport and economic

In 2013, for a typical off-road path in an Australian inner urban area, the economic benefit per kilometre walked or cycled in terms of reduced motor vehicle congestion was estimated at 20.7 cents per kilometre, with vehicle operating cost savings of 35 cents per kilometre. The health benefit was up to \$1.68 per kilometre, the infrastructure savings for road maintenance was 6.8 cents per kilometre and environmental savings from reduced carbon emissions was 5.9 cents per kilometre. The aggregate economic benefits over a 30 year period is that for every 1,000 pedestrians per day, around \$7 million is generated per kilometre of walking path, and for every 1,000 cyclists per day around \$15 million is generated per kilometre of cycling path.⁶¹

The provision of quality EOT facilities by workplaces and other organisations has been shown to provide considerable cost savings in terms of vehicle kilometres travelled and to significantly increase returns on public investment in on-road and off-road bicycle facilities. Recent research has also cited demand for EOT facilities as one of the key drivers of demand in Australia's central business district property markets.⁶²

The potential benefits of expanded walking and cycling infrastructure in Perth were evaluated by assessing the overall planned expansion of Perth's bicycle network, implemented with supporting travel behaviour change programs. The principal document informing this evaluation is *A Business Case for Investment in Cycling in Western Australia*, prepared by Catalyst and PATREC. This economic appraisal concluded that, in socio-economic terms, investment in the Principal Shared Pathway network (over a 25 year evaluation period), that delivered a five per cent growth in bicycle travel in the metropolitan area and was implemented with support travel behaviour change programs, would result in benefits of at least 3.4 times the costs incurred. A summary of the potential benefits of applying the appraisal's benefit/cost

⁵⁷ Data Analysis Australia (2006) Perth and Regional Travel Survey. Department of Planning

⁵⁸ RAC (2012) *A Business Case for Investment in Cycling in Western Australia*, prepared by Catalyst and PATREC

⁵⁹ 2015 RAC cycling survey and Main Roads WA Community Perceptions Survey 2015

⁶⁰ 2015 RAC cycling community survey

⁶¹ Queensland Department of Transport and Main Roads 2011, *Benefits of inclusion of active transport in infrastructure projects*, prepared by SKM and PWC, table EX.1: benefits summary. NOTE: Based on per kilometre benefits for a typical inner urban project (where no location has been specified), in 2010 figures.

⁶² Colliers International (2015) *Who will rule our CBDs: Ownership changing the realm of office*. Research and Forecast report First half 2015 Australia & New Zealand.

ratios to the proposed additional 685 kilometres of off-road cycle paths is provided below, assuming a network-averaged capital cost of \$1.15 million per kilometre for path construction costs⁶³ and a 7 per cent discount rate.

Table 6 Summary of potential economic benefits of 685 km Principal Shared Pathway

	PV\$M	BCR
Costs	747	
Benefits:		
15 years – no induced travel	1278	1.71
25 years – no induced travel	2143	2.87
25 years induced travel + 5% pa growth	2539	3.40

It should be noted that the economic (benefit/cost ratio) performance of individual PSP schemes is likely to vary considerably from the overall program average because of substantial variations between schemes in both costs (per kilometre) and in usage (per route section) and benefits. This highlights the importance of assessing performance of individual schemes as well as for the total program.

Social

Health benefits from cycling and walking are usually included as part of economic assessments. Cycling and walking provide regular cardio-vascular activity, which reduces a large range of major health risks including heart disease, strokes, hypertension, obesity and Type 2 diabetes. For example each additional hour spent commuting in a motor vehicle increases the likelihood of obesity by six per cent.⁶⁴ Changing from motorised trips to walking or cycling can also improve health by reducing air pollution.

Walking and cycling offer low cost, accessible travel for a range of trips and ages and imposes minimal costs on household and public budgets. Pedestrians include people with disability, the elderly and the very young, and it is important to ensure they are safe and able to complete their journeys conveniently and comfortably. Access to cycling routes can also increase access opportunities for people that are currently mobility-poor. Comparison of low income households in Denmark and the UK suggests that cycling at Danish rates could increase the mobility of the UK's poorest families by up to one quarter.⁶⁵

Well-designed urban spaces that incorporate walking and cycling infrastructure encourage community interaction and social well-being. Walking provides affordable exercise and opportunities for improved quality of life.

Environmental impact

Infrastructure interventions that achieve significant shifts from motorised transport to cycling and walking trips have clear environmental benefits because, unlike motorised transport, cycling and walking produce no noise pollution or greenhouse gas

⁶³ While costs and benefits calculated in the Catalyst Business Case were based on investment in the Principal Shared Pathway network it is likely that similar costs and benefits would apply to other off-road pathways that comprise the WA Bicycle Network including

⁶⁴ Cycling Promotion Fund (2008), *Cycling: Getting Australia Moving*, funded by the Australian Government Department of Health and Ageing

⁶⁵ British Cycling (2014) *Benefits of Investing in Cycling*

emissions. Case studies indicate that cycling and walking save significant quantities of fuel and reduce carbon from vehicle emissions.⁶⁶

3.3.4 Challenges for implementation

Full benefits of cycling are only likely to be achieved by long term, network-wide strategic investment. Key risks to achieving increased cycling rates and associated benefits in Western Australia include delays to infrastructure delivery programs, increases in costs and external factors that make cycling less attractive.⁶⁷

The Office of the Auditor General's findings in a 2015 report reinforced this view.⁶⁸ Completion of cycle paths along major transport corridors and more clearly defined bicycle routes through local neighbourhoods was considered critical to cycling becoming a significant mode of transport.

Piecemeal approaches, where marginal additions are made to an existing fragmented cycling and walking network, will not achieve a significant mode share for cycling.⁶⁹ Well-designed networks, community engagement and staged approaches to delivery are key factors in overcoming this risk. By far the highest percentage increase in use has been on the Midland train line Principal Shared Path where new sections have resulted in a progressively longer, unbroken cycling link to the Perth CBD.

Increases in walking require similar considerations for safety and infrastructure that provides clear separation from cyclists and motorists.

Decision-makers often take walking for granted and assume that few interventions are required to boost walking rates.⁷⁰ Because it is possible to walk and cycle along roads that lack foot or cycle paths, walking and cycling facilities are often given low priority. Areas with poor or limited walking paths tend to have significantly less walking and more driving than more walkable areas.⁷¹

3.3.5 Synergies and complementary measures

Policies and initiatives to create robust urban cycling and walking infrastructure include investment in an extensive network of shared paths and cycle lanes, traffic calming, intersection modifications, bike parking, integration with public transport and complementary parking and land use policies.⁷² Research indicates that these initiatives must be taken together to achieve success.

Cross integration of relevant government agencies, programs to achieve a broad and connected network and integration with public transport facilities, such as train and bus stations, are also important.

Awareness and education campaigns to tackle issues of safety, cyclist and pedestrian behaviour and promote cycling and walking as the mode of choice for short journeys

⁶⁶ U.S. Department of Transportation (2000) *The Environmental Benefits Of Bicycling And Walking, National Bicycling And Walking Study*, Case Study No. 15

⁶⁷ RAC (2012)

⁶⁸ Office of the Auditor 2015, *General Safe and Viable Cycling in the Perth Metropolitan Area*, Perth

⁶⁹ Infrastructure Australia March (2009) *Cycling Infrastructure for Australian Cities* Background Paper

⁷⁰ Goodman, R. and R. Tolley (2003), *The Decline of Everyday Walking In The UK: Explanations And Policy Implications, Sustainable Transport: Planning for Walking and Cycling In Urban Environments* (Rodney Tolley Ed.), Woodhead Publishing (www.woodhead-publishing.com), pp. 70-83.

⁷¹ Litman, T. (2014) *Economic Value of Walkability*. Victoria Transport Policy Institute

⁷² Pucher, J (2012) *City Cycling* Ralph Buehler MIT Press

are an important complementary measure for infrastructure improvements. Initiatives that focus on reducing vehicle traffic, controlling vehicle speed and clear separation of cycling and pedestrian pathways can be important to realise benefits of infrastructure improvements.

Collaboration between stakeholder groups and State Government agencies and local governments remains essential to providing for and promoting cycling and walking effectively.

3.3.6 Future application for Perth

Implementation of improved cycling and walking infrastructure will require Transport portfolio agencies to work with other State Government agencies, local government authorities and peak cycling bodies to:

- Develop guidelines to support the introduction of EOT facilities into new developments and investigation of the feasibility of private EOT facilities in some areas.
- Improve cycling and walking safety through targeted infrastructure treatments.
- Improve collection of bicycle counter data and other technical information to measure growth in cycling participation as well as identify areas with growing demand for cycling and walking.
- Investigate capacity of future strategic transport models to estimate the transport impact of walking and cycling infrastructure.
- Target investment to address gaps within the Principal Shared Path (PSP) and Regional Shared Path (RSP) networks and expand the PSP network.
- Reduce congestion and improve safety around key destinations including the Perth CBD, strategic activity centres, and connections to stations and schools.
- Review the existing and future bicycle network to ensure all future PSPs are based on separation of cyclists and pedestrians where possible.
- Undertake a review of all PSPs and RSPs within the CBD and inner areas in partnership with the City of Perth and Road Safety Commission.
- Plan for provision for cycle-only lanes within road or rail reserves.

Population	Recommendation
2.7 million	Perth's off-road cycling and walking network expanded from 172 km to 350 km to better connect all activity centres with an increasing emphasis on the separation of cyclists and pedestrians. End of trip facilities widely available in all major activity centres in Perth.
3.5 million	Further expansion of the PSP network to cater for long distance commuters and additional river crossings, resulting in 850 km of off-road cycleways.

3.4 Parking strategies

Efficient parking management includes various mechanisms that result in more efficient use of parking facilities, including supply constraints, sharing, efficient pricing, improved user information, and incentives to use alternative modes where this is more cost effective than subsidising parking. Effective parking strategies generally combine the use of long and short term parking charges, levies and parking supply limits (parking caps) to discourage private car journeys to specific sites or areas. Levies applied to parking facilities can increase parking prices to provide revenue for various planning objectives and increase use of alternative transport modes. Parking caps

impose an upper limit on parking supply in particular areas and can make cities more liveable by reallocating surface car parking to public spaces and footpaths or new residential areas.

3.4.1 Rationale

Increasing or introducing parking costs through charges and levies or limiting parking supply makes other transport modes more attractive and reduces car trips.

Efficient parking management has mixed user impacts: parking fee increases are a negative incentive while parking cash out and unbundling provide positive incentives to reduce vehicle ownership and use.

3.4.2 Background

Parking management strategies, particularly efficient parking pricing, are among the most effective TDM strategies.⁷³ Charging motorists directly for using parking spaces, or cashing out free parking, typically reduces car travel by between 10 and 30 per cent.⁷⁴ Similarly, unbundling residential parking so motorists pay for each parking space they use tends to reduce vehicle ownership. Other parking management strategies, such as reduced and more flexible parking requirements, indirectly reduce vehicle travel by allowing more compact infill development and encouraging property owners to charge for parking.⁷⁵

In Australia, area-wide parking pricing schemes have operated in the business districts of Sydney, North Sydney and Perth since the 1990s and in other suburban business districts of Sydney since 2000. A parking levy was introduced in Melbourne in 2006. These have achieved typical parking elasticities for car travel demand ranging from 0.20 to -0.40. Although difficult to quantify, some research suggests parking prices can achieve a diversion rate to public transport of between 50 and 75 per cent.⁷⁶

Case studies have shown that parking policies introduced as part of an integrated transport and land use strategy have been effective in reducing growth of parking and traffic over a period of 10 to 15 years.⁷⁷

The introduction of the Perth Parking Policy in 1999 has had a significant impact on travel patterns in central Perth over the past 15 or so years. In the early 1990s, 50 per cent of commuters travelled to the Perth CBD as a car driver. This has now reduced to an estimated 35-38 per cent and travel by public transport, cycling or walking has almost doubled. Much of this reduction has been achieved by the direct and indirect effects of the Perth Parking Policy (PPP).⁷⁸

The joint City of Perth and State Government policy established strict maximum parking levels for new non-residential city developments, an annual non-residential parking licence fee that funds public transport, pedestrian and cycling improvements, and three parking zones on the city's edge.

⁷³ Tom Rye (2010), *Parking Management: A Contribution Towards Livable Cities*, Module 2C, *Sustainable Transportation: A Sourcebook for Policy-Makers in Developing Countries*, Sustainable

⁷⁴ J. Richard Kuzmyak, Rachel Weinberger, Richard H. Pratt and Herbert S. Levinson (2003), *Parking Management and Supply*, Chapter 18, Report 95, Transit Cooperative Research Program; Transportation Research Board (www.trb.org); at

⁷⁵ Richard Willson (2015), *Parking Management for Smart Growth*, Island Press

⁷⁶ Paul Hamer, Graham Currie, William Young (2009) *Exploring travel and parking impacts of the Melbourne CBD parking levy*

⁷⁷ Richardson, Emerson (2014) *The importance of Parking policy for sustain transport and land use city planning*. AITPM National Conference 2014

⁷⁸ Richardson, E (2014)

During a period in which employment in the city has grown by about 30 per cent, there has been a reduction in car trips to and from the city and public transport use has more than doubled. The major reasons for these travel pattern changes are direct and indirect effects of the PPP along with improved public transport capacity and services.⁷⁹ The PPP has also contributed to reallocation of parking spaces with a growing number of property owners converting car parking bays to bike parking areas.

These impacts vary depending on specific demographic and geographic conditions, and the types of travel affected. The impact of parking supply constraints on the QEII Medical Centre has been particularly effective with car driver mode share decreasing from 73 per cent to 43 per cent over four years. Although a number of other TDM measures were implemented to support the parking supply restrictions, parking caps were determined to be the driving factors for the observed mode shift.⁸⁰

3.4.3 Assessment

Transport and economic

The potential benefits of expanding parking strategies to other activity centres in the Perth region have been independently evaluated. The evaluation assessed a policy to limit parking supply for long-stay (worker) and short-stay (shopper) parking at major activity centres. The policy involves a supply component (i.e. constraints on the number of parking spaces provided) and a pricing component (i.e. parking charges more related to the costs of provision). A cash in lieu scheme and a parking levy are proposed as part of the policy with all revenue hypothecated to improvements to transport infrastructure for public transport, walking or cycling, or the provision of public parking within the city centre.

The evaluation is based on a review of previous work undertaken to develop a parking strategy for the City of Stirling city centre.

The economic analysis was designed to assess the economic costs and benefits of the proposed parking strategy relative to a 'business as usual' strategy, which would effectively continue the prior policy settings of unconstrained free parking. Demand assessment and analysis of costs and benefits was undertaken for three years (2010, 2021 and 2031), with the report noting that demand effects were based on scenario development rather than a formal modelling approach.

⁷⁹ Richardson, (2014)

⁸⁰ Martin, J (2014) *Parking Supply Restriction and Mode Shift at QEII Medical Centre – A Case Study*, AITPM 2014 National Conference

Table 7: Economic benefits and costs of parking strategy introduced at major Perth activity centre*

Item	Present value (\$M)	
	Discount rate 7% 2021	Discount rate 4% 2031
Costs		
PT operations (and capital) costs**	133.9	205.9
Net costs	-145.3	-163.9
Benefits		
Parking infrastructure capital costs	-257.1	-335.9
Parking facility O&M costs	-22.1	-33.9
Private vehicle operation (reduction)	122.8	192.2
Congestion (reduction)	92.6	148.0
Health and fitness (increase)	72.9	115.6
Road trauma (reduction)	16.0	24.2
Air pollution (reduction)	9.4	14.2
Noise pollution (reduction)	6.4	9.9
GHG/climate change (reduction)	5.2	78.7
Net benefits	325.3	512.8
NPV	470.6	675.6
BCR	4.5	3.5

* Economic evaluation was undertaken over a 20 year period starting from 2010, based on two discount rates (7% pa and 4% pa, real terms).

** It should be noted that the costs of public transport are almost certainly over-stated because there are opportunities to make use of existing spare capacity (mainly contra flow in peak periods) or double use of capacity on services.

The main benefit items included:

- savings in private vehicle operation and reductions in congestion on the road network resulting from the reduced traffic generation by the centre; and
- health and fitness, associated with people switching from largely car travel to walking or cycling to the centre.
- savings in the capital costs of parking facilities as a result of the reduced number of spaces provided in the strategy; and
- savings, although much smaller, in ongoing parking operations and management costs.

These two savings items are partly offset by the costs associated with the higher levels of public transport provision to and from the centre.

Overall, the assessment indicated cost savings of \$145 million and net benefits of \$325 million at a seven per cent discount rate, and cost savings of \$164 million and net benefits of \$512 million at a four per cent discount rate. In economic terms this indicates a very good scheme as it results in both cost savings to public and private developers and net benefits to the transport system and its users.⁸¹

⁸¹ The cost and benefit assessment was generally consistent with a conventional cost-benefit analysis approach. However, no term was included for travel time savings or losses for visitors to the centre which might impact on the validity of these estimates.

If similar analyses were to be undertaken for other major activity centres broadly similar results are likely to be obtained, suggesting that there would be a strong economic case for the adoption of parking constraint and levy strategies at other centres. It would be important that implemented strategies conform to a consistent set of guidelines applied throughout the region.

Social

Properly implemented parking policies provide multiple benefits; they can help reduce traffic congestion, encourage more compact development, support environmental objectives and raise revenue for public programs and infrastructure.

Social benefits of the PPP have included improved pedestrian amenity, which has helped encourage a 30 per cent increase in pedestrians in the CBD.⁸² Reductions in traffic volumes have enabled more bus priority and cycling infrastructure as well as wider footpaths.

3.4.4 Challenges for implementation

Pricing changes need to be coupled with other incentives and complemented with good alternative transport choices so that commuters and shoppers choose to not drive.

Unless road users appreciate the benefits they traditionally object to new charges and higher prices, particularly if parking has been free or significantly subsidised. While there were some initial concerns about the PPP's impact on the CBD economy due to restricted car access, the policy, combined with public transport and pedestrian environment improvements, has been very successful and is now widely accepted.

Levies might not achieve significant mode shifts in themselves when they are not passed directly on to motorists. Examination of the introduction of a levy on public and private car parking spaces in the Melbourne CBD, where the revenue raised by the levy is not hypothecated (unlike the Perth Parking Policy) concluded that it had only been moderately effective in reducing travel demand.⁸³

Parking demand that exceeds supply can result in more cars driving around a local area searching for limited parking, leading to more congestion and delay. Parking management that provides for short term parking is integral to TDM.

Imposing parking maximums are likely to have a reduced impact over time because the long-term strategic factors that they anticipate (for example improved public transport) will eventually influence parking provision through normal market forces. The congestion reduction benefits that they deliver however might persist longer.⁸⁴

Where parking caps are implemented, some flexibility will need to be retained for commercial and delivery vehicles (these are treated differently under the Perth Parking Policy).

3.4.5 Synergies and complementary strategies

Perth's success in achieving a consistent and stable parking policy in the city centre demonstrates the benefits of introducing a statutory policy that has been negotiated

⁸² Richardson, Emerson (2014) *The importance of Parking policy for sustain transport and land use city planning*. AITPM National Conference 2014

⁸³ Hamer, Currie and Young, (2011) 'Parking Price Policies – a review of the Melbourne congestion levy' *Australian Transport Research Forum 2*

⁸⁴ Auckland Council (2013) *The Economic Impacts of Parking Requirements in Auckland*

between the State and local governments. A key success factor was the fact that the policy was multifaceted and addressed parking capacity, caps, pricing and use of revenue to fund transport modes that provide alternatives to cars.

The price of parking linked to the number of available spaces influences travel behaviour in areas with high parking demand. For parking policy measures to be effective, good alternative transport must be in place before such policies are introduced.

Parking levies tend to provide the greatest benefit if they are:

- applied as broadly as possible to the widest geographic area and the most categories of parking facilities;
- implemented as part of parking management programs that encourage more efficient use of parking facilities;
- implemented as part of programs that encourage use of alternative transport modes; and
- used to fund local improvements.

Parking maximums are most effective in areas or commercial centres where parking is cheap and available, congestion is high and where attractive travel alternatives are readily available. Complementary policies such as on-street parking controls and parking levies are often necessary to form an efficient parking market.

A broad range of travel demand measures is essential to support the implementation of parking caps. Initiatives implemented at QEII Medical Centre to complement parking restrictions included:

- travel behaviour change programs;
- travel plans for new developments;
- increased frequency and hours of operation for bus services;
- provision of electric bicycles for on-site use;
- parking prioritisation;
- a centralised carpool management system with guaranteed parking for multi-occupancy vehicles; and
- introduction and expansion of on-site paid parking.

3.4.6 Future application for Perth

Implementation of new parking strategies or policies in Perth's activity centres will require the Department of Transport to work with the Department of Planning, local government authorities and the community to:

- identify activity centres where employment and density are rapidly growing and which centres are, or are expected to be, dominated by uses that generate commuter traffic;
- develop new parking policies and guidelines for access to and within strategic and specialised centres;
- develop new parking policies and guidelines for all activity centres that manage demand for parking and related congestion; and
- periodically review the Perth Parking Policy to assess potential for further mitigation of congestion in the CBD.

Population	Recommendation
2.7 million	Where good transport alternatives to car driving exist, parking strategies introduced in activity centres and industrial areas with high levels of density and employment. Levies used to fund alternate travel modes.
3.5 million	Parking strategies widely applied in appropriate locations across Perth and Peel.

3.5 Public transport time of day pricing

Public transport time of day pricing includes the introduction of public transport fare differentials between peak periods (higher) and non-peak periods (lower). Peak pricing schemes can be a surcharge for travel in peak periods, an offer of free or discounted travel during off-peaks, or a combination of both.

3.5.1 Rationale

Public transport time of day pricing makes off-peak travel more financially attractive for users who have flexible travelling times than during times of peak demand when transport costs are higher.

By encouraging passengers to reduce use of public transport during peak periods, public transport time of day pricing can optimise the use of existing public transport capacity and better achieve transport economic efficiency objectives.

3.5.2 Background

Introducing fare differentials between peak and off-peak periods can shift public transport users' travel patterns. In general, fare differentials of at least 30 per cent between peak and off-peak travel can substantially reduce peak period train overcrowding.⁸⁵

Peak public transport use declined by about eight per cent one year after the introduction of peak surcharges by several US public transport operators.⁸⁶ Evidence in other cities suggests that simultaneous peak pricing and off-peak discounts could be more effective than peak surcharge or off-peak discounts individually to spread peak and off-peak public transport demand, if properly managed and implemented.⁸⁷

A number of trials and schemes operate to provide discounted or free travel to passengers travelling outside peak periods. Melbourne's 'Free before 7' initiative provides free public transport for trips before 7:00am and is estimated to have reduced demand in the peak by between 1.2 and 1.5 per cent, which is equivalent to between 2.5 and five peak train loads⁸⁸. A number of US trials to provide free off-peak public

⁸⁵ Johnson, D.H. and Whelan, G.A. (2003) *Modelling the impact of alternative fare structures on train overcrowding*. In: European Transport Conference 2003

⁸⁶ Cervero, R. 1986. Time-of-day Transit Pricing: Comparative US and International Experiences. *Transport Reviews: A Transnational Transdisciplinary Journal*,

⁸⁷ Evan Gwee and Graham Currie (2013) Review of Time-Based Public Transport Fare Pricing, *Journeys*

⁸⁸ Graham Currie (2009) 'Exploring The Impact of the 'Free Before 7' Campaign on Reducing Overcrowding on Melbourne's Trains', 32nd Australasian Transport Research Forum

transport have achieved significant peak patronage share decreases. Substantially smaller impacts were found for discounted rather than free fares.⁸⁹

While time based pricing structures can increase off-peak patronage, there is limited evidence on the impact of peak pricing on overall patronage and possible mode shifts to other forms of transport. This reflects the complicated nature in which travellers make decisions about public transport. Service frequency and on-time performance are more likely to influence patronage than fare prices⁹⁰ and price elasticities for bus and train travel can differ.⁹¹

Peak contraflow fares were introduced on the London Underground in January 2011 in which passengers travelling out of central London during a weekday peak period were charged an off-peak fare instead of a peak fare. Despite an average fare decrease of 46 per cent, after two months there was negligible change in patronage.

Perth's public transport fares currently have a differential pricing structure for distance (zone based) but are not time-based and do not distinguish between different modes or services. This is in contrast to most other major Australian cities that have introduced some form of public transport peak and off-peak pricing.

Despite public transport in Australian cities being among the world's most affordable,⁹² according to the 2015 Perth Passenger Satisfaction Monitor approximately half of public transport users in Perth consider bus and train fares to be 'excellent' or 'good' value for money and satisfaction with fares has been in decline since 2005.

Analysis of train boardings indicates that Perth experiences a highly concentrated peak between 8:00am and 8:30am, falling sharply in the half hour before 9:00am. Travel during the morning peak is dominated by standard ticket holders. Tertiary students are a significant customer group, representing approximately 10 per cent of CBD passengers.

Perth's transport patronage has been growing over the long-term and adding new capacity to serve peak periods is difficult and costly due to existing platform lengths, signalling and train control system capacity and the cost of adding new railcars or lines.

3.5.3 Assessment

Transport and economic

The potential benefits of introducing time of day public transport pricing in Perth have been independently evaluated. The evaluation assessed a fare differential of 30 per cent in Perth public transport fares and considered economic benefits and financial costs and savings.

The key characteristics of the differential (time of day) fare options assessed are as follows.

⁸⁹ McCollom, B.E., & Pratt, R.H. (2004). 'Transit Pricing and Fares - Traveler Response to Transportation System Changes' *Transportation Cooperative Research Program (TCRP) Report 95: Chapter 12*, published by Transportation Research Board, Washington.

⁹⁰ Pratt. (2000, March). *Traveler response to transportation system changes, interim handbook (TCRP Web Document 12)*. Garrett Park, Maryland: Transit Cooperative Research Program.

⁹¹ Webster, F.V., Bly, P.H. & Pailley, N.J. (1988). *Urban land-use and transportation interaction: Policies and models*. Brookfield, Massachusetts: Avebury.

⁹² <http://www.smh.com.au/business/the-economy/public-transport-in-australian-cities-among-the-worlds-most-affordable-20150928-gjwkah.html>

- Revenue neutral (no change in total public transport fare revenue).
- Peak 'standard' fare increases of approximately nine per cent while off-peak fares reduce by approximately 16 per cent, with the result that peak fares would be 30 per cent higher than off-peak fares. Concession fares would not be affected.
- Patronage reduction of approximately four per cent in peak periods with an increase of approximately 12 per cent in off-peak periods, giving an overall increase of approximately three per cent.

The economic benefit components covered were (in descending order of magnitude):

- Health benefits – associated with changes in walking/cycling travel.
- Car operating (unperceived) cost adjustment.
- Road (de)congestion.
- Other – crash savings, fuel duty reduction.

The application also results in significant cost savings, estimated as follows:

- Potential Public Transport Authority expenditure for public transport system (rail and bus) service expansion over the next 20 years that might be attributed to increases in CBD peak period capacity averages \$244 million per annum (approximately \$4,900 million over 20 years).
- This would provide an increase of around 60 per cent in current CBD peak period capacity.
- The reduction in the projected business as usual CBD-oriented peak period demand as a result of the differential fares policy would be 3.2 per cent.

On this basis, the estimated annual cost savings of a time of day pricing initiative as described above is \$12.9 million per annum.⁹³

Overall findings are as follows.

- Differential fare policies, if implemented in a revenue-neutral manner, would result in net economic benefits estimated at \$7 million per annum, principally to public transport users.
- Such policies would also reduce the need for (or delay the timing of) costly increases in rail and bus system capacity in the central/inner areas. The indicative estimate is that this would result in a financial saving to government of around a further \$13 million per annum.
- The overall result is a net economic benefit of between \$19 million and \$20 million per annum (which as calculated would apply for 20 years and potentially in perpetuity).

Social

Peak pricing is likely to improve social equity by reducing the financial burden on low income passengers. In the absence of peak pricing, off-peak travellers, who tend to have lower incomes and travel shorter distances, effectively subsidise peak period commuters, who enjoy higher incomes and travel longer distances.⁹⁴

⁹³ This saving would be expected to apply throughout the 20 year period, and potentially in perpetuity.

⁹⁴ Smith (2009)

Peak-pricing schemes attract more commuters to public transport by reducing overcrowding during peak periods and offer wider community benefits through overall reductions in congestion.

Environmental

Environmental impacts of public transport peak pricing will depend on travel mode changes. Where public transport peak trips are converted to car trips, there is potential for negative environmental impact while a growth in off-peak patronage would have positive environmental benefits in terms of reduced emissions.

3.5.4 Challenges for implementation

Worldwide experiences show that any form of time-based public transport fare pricing programs would need time before they could have any perceptible effect on shifting peak ridership to off-peak periods.⁹⁵

There are a number of transport, social and other risks where price differentiation is introduced as fare increases or peak period surcharges. Fare increases are generally unpopular and there are strong pressures to keep fares low and subsidies high to achieve wider community objectives such as social inclusion and access to services.

Peak surcharges could have the unwanted effect of reducing overall passenger numbers and shift trips made by public transport to other modes, such as car travel. Some studies have estimated passenger losses of up to seven per cent due to increased fares.⁹⁶

While peak pricing has been considered in Perth no research to date has accurately determined whether passengers that shift from the peak move to shoulder services or leave the public transport system entirely for another mode. This impact is likely to vary from jurisdiction to jurisdiction depending on a range of other factors such as availability and price of parking, price of fuel, availability of cycling networks and end-of-trip facilities.

The existing smart ticketing system in Perth does not easily lend itself to peak pricing and consideration would need to be given to new business rules for ticketing and ensuring that a peak fare system did not encourage public transport users to purchase cash tickets.

3.5.5 Synergies and complementary strategies

Initiatives that promote flexible working, tertiary and school hours and increase the capacity of peak passengers to shift the timing of their trips will offer the greatest support to peak pricing schemes. Quality of service in peak and off-peak periods, particularly frequency and capacity, is also a critical success factor.

Success in shifting passengers out of peak periods requires pre-peak services with unused capacity, commuter willingness to re-time trips, flexible ticketing systems and gated exits, and regulatory/economic structures to realise benefits from reduced overloading.⁹⁷

⁹⁵ Evan Gwee and Graham Currie (2013) Review of Time-Based Public Transport Fare Pricing, *Journeys*

⁹⁶ Carlquist and Fearnley (2001)

⁹⁷ Currie G (2010) 'Enhancing Rail Capacity Using Free Fare Incentives To Shift Demand Peaks' *World Conference Transport Research Lisbon July 2010*.

Peak public transport pricing is also related to using pricing measures to manage demand on the urban road network by ensuring that users pay appropriate fees to use the road during peak periods.⁹⁸

3.5.6 Future application for Perth

Key government agencies including the Public Transport Authority, Department of Treasury and Department of Transport will need to work together to:

- undertake further detailed research, evaluation and discussion to agree on a differential pricing option for further assessment including modelling of various options;
- develop a robust business case to assess economic, financial, social and travel impacts of an agreed time of day pricing scheme;
- determine a timeframe and communications strategy for implementation; and
- scope and undertake changes to business processes and payment systems.

<i>Population</i>	<i>Recommendation</i>
2.7 million	Revenue neutral time of day pricing scheme implemented with peak fares 30 per cent higher than off-peak fares. Concession fares remain unaffected.
3.5 million	Pricing of public transport fares reviewed to assess the need to increase the fare differential between peak and non-peak periods. Concession fares remain unaffected.

3.6 Road use pricing reform

Pricing measures to manage road use demand include schemes that charge motorists a road use fee that varies by time, distance, location and vehicle. Fees might be higher under congested conditions or for larger and more polluting vehicles and lower on uncongested roadways or in off-peak times. Road use pricing reform aims to eliminate other road user taxes and charges such as vehicle registration fees and fuel excise while more directly charging motorists for their individual levels of road use. Cordon pricing, where motorists are charged a fee for driving in specific areas, such as central business districts, is sometimes proposed as an urban congestion reduction strategy aimed at reducing local traffic impacts and discouraging unnecessary road use in busy areas. The most well-known and best documented examples include schemes in Singapore, London and Stockholm.

3.6.1 Rationale

Pricing measures that manage road use demand reflect the real cost of travel during periods of high demand. Pricing schemes regulate traffic flows to efficient levels by directly charging car drivers for the use of congested roads or entry into specific areas at peak periods. Efficient pricing of roads encourages car drivers that drive frequently on heavily congested roads to make more efficient choices about what transport mode to take and/or which route to drive. Pricing measures can simultaneously generate revenue that can be used to improve an area's public transport and road networks.

⁹⁸ Smith (2009)

3.6.2 Background

Successive Commonwealth Government tax, competition and productivity reviews, including the Henry Tax Review⁹⁹ and the Harper Review¹⁰⁰ have identified reforming the way road users are charged as a national priority and the key to a more productive, efficient and sustainable Australian transport system. The 2016 Australian Infrastructure Plan also recommended road user charging reform as a way of reducing congestion and help fund major projects.¹⁰¹

Distance and time based charging

While direct road user charging for all motorists on the basis of distance and time is widely considered by economists to be the optimal form of charging for road use, no system of this type has been introduced in Australia or overseas for passenger vehicles. Mass-distance-location charging schemes have been established in a number of overseas countries for heavy vehicles, primarily to raise revenue to cover the cost of heavy vehicle roads and to improve efficiencies in the road transport sector. Singapore is currently planning to replace its existing electronic pricing system with a satellite-based charging mechanism by 2020.¹⁰² While this initiative is primarily to reduce operational costs of the current gantry system, it could also allow the Singapore Land Transport Authority to introduce a distance and time based charging mechanism for roads.

Any measures to use road pricing to manage demand in Perth would need to be fair and equitable for all motorists and have scope to remove existing road user costs, such as vehicle registration fees and fuel excise charges.

Distance, location and time based road pricing has been widely promoted as a way to reduce traffic congestion and achieve other TDM objectives. This has significant implementation costs, including equipment, vehicle tracking and billing. It requires motorists to pay for special tracking equipment to be installed in their vehicles to calculate the road user fee, which reduces its cost efficiency, raises privacy concerns and tends to generate political opposition.

These costs could be reduced if implemented nationally, with standardised tracking equipment installed in all new vehicles. Until this occurs it will be difficult for a single state or urban region to implement a distance and time based road pricing system.

Cordon charging

Cordon charging has been used in a number of overseas cities to manage road use demand with some success. The Singapore scheme, which was first implemented in 1975 as a simple area-licence scheme, is estimated to have resulted in a 44 per cent decline in traffic in the city centre. London's system is reported to have reduced traffic volumes by approximately 20 per cent, which increased average traffic speed by 37 per cent and reduced bus congestion delays by about 50 per cent. Bus ridership increased 14 per cent and subway ridership by about one per cent. Stockholm's congestion charge system also reduced traffic volumes by about 20 per cent.

⁹⁹ Australian Treasury (2010), *Australia's Future Tax System*, The Commonwealth Government of Australia

¹⁰⁰ The Harper Review advised that Governments should introduce cost-reflective road pricing with the aid of new technologies, with pricing subject to independent oversight and revenues used for road construction, maintenance and safety

¹⁰¹ Infrastructure Australia (2016) *Australian Infrastructure Plan: Priorities and reforms for our nation's future*

¹⁰² www.channelnewsasia.com/news/singapore/satellite-based-erp-to-be/2547700.html

In Milan, a cordon charge that differentiated between private and commercial vehicles reduced the number of vehicles entering the city centre by around one-third.¹⁰³ A pause in implementation due to legal action by car park operators provided clear evidence that the reduction in vehicle numbers was almost solely due to the congestion charge, as vehicle numbers reverted to pre-cordon charge levels.

Singapore currently has the most well developed electronic road pricing system. The Singapore scheme involves more than 50 charging points in a ring around the central business zone, on the main expressway and on several arterial streets. The charges vary by vehicle type, location and time of day/traffic conditions - with the aim of keeping speeds on the routes affected within a 'golden range' which ensures efficient traffic flow.

3.6.3 Assessment

Transport and economic

An assessment of road user pricing reform included consideration of distance and time based charging as well as cordon charging in the Perth central business district.

There are currently no examples of real-time, distance-based, time-of-day large area charging although a number of studies have tested how this kind of road-based charging might affect travel activity. One study¹⁰⁴ found small-scale travel adjustments by motorists could virtually eliminate traffic congestion. Other potential benefits included lower vehicle emissions, fewer crashes, travel time savings, improved roadway performance and reliability, and lower operating costs. A conservative analysis indicated that the present value of net economic benefits could exceed \$28 billion over a 30-year period.¹⁰⁵

Transport portfolio modelling of the impact of a moderate distance-based charge in Perth and Peel at 3.5 million showed a 5.1 per cent decrease in car driver trips (all day), a small increase in car passenger trips, a 4.1 per cent increase in PT trips and approximately 1 per cent increase in walking and cycling trips. Modelling also showed that average trip length for car drivers dropped significantly. The combination of fewer car driver trips and shorter car driver trips resulted in a decrease in both car driver vehicle kms and vehicle hours.

By reviewing the effects of cordon charges in Stockholm, Milan and in particular London, where extensive post-implementation analysis has been undertaken, some likely effects of an inner city cordon charge and its impact on road traffic in Perth have been estimated.¹⁰⁶

¹⁰³ EC (2013). *Milan: Lessons in congestion charging*. European Commission. http://ec.europa.eu/environment/ecoap/about-eco-innovation/good-practices/italy/20130708_milan-lessons-in-congestion-charging_en.htm

¹⁰⁴ *TheTraffic Choices Study* (www.psrc.org/transportation/traffic) tested a road pricing system on using 275 representative households in the Puget Sound, Washington region.

¹⁰⁵ Wallis, Ian (2016) *WA Department of Transport Assessment of Travel Demand Management Instruments*

¹⁰⁶ Wallis, Ian (2016) *WA Department of Transport Assessment of Travel Demand Management Instruments*

The key behavioural impacts of the application are expected to be:

- Reduction in traffic volumes within the cordon area and (to an extent) approaching the cordon, offset to some extent by an increase in traffic travelling on circumferential routes just outside the cordon.¹⁰⁷
- Reduction in the demand for parking within the cordon areas, particularly by employees.
- Increase in public transport patronage, particularly for work trips to and from the CBD.
- Reduction in peak period traffic congestion and associated externalities (crashes, vehicle emissions, etc).
- Increased travel costs for motorists that need to access the cordon area, translating into increased revenues to the cordon charging authority (but partly offset by scheme implementation and administration costs).
- Time savings due to reduced congestion for motorists that need to access the cordon area.

In summary the economic assessment indicated that:

- The benefits of a cordon charge scheme would significantly exceed the costs.
- There would be some benefits to road users from road decongestion and savings in vehicle operating costs; however, road users would also be disadvantaged, largely through having to pay the cordon fee.
- The cordon fee would result in some current car users switching to public transport, cycling or walking. There would be some consequent health and fitness benefits and a reduction in air pollution costs.
- Economic assessment of transport benefits forecast that the wider community would gain \$0.54 billion from reduced noise, pollution, greenhouse gas emissions, crashes and improved health from increased cycling and walking.
- Wider benefits are likely to accrue through the mitigation of the overall economic, social and environmental effects of traffic congestion, including financial and productivity costs. Monetised time savings are estimated to be higher than the operating costs of a congestion charging scheme by a wide margin.¹⁰⁸

Social

While cordon charges deliver substantial general social benefits through reduced congestion costs and travel time savings, cordon pricing is often criticised as unfair and regressive. Its overall equity impacts depend on the price structure, motorist demographics (whether economically disadvantaged people frequently drive on congested roads), the quality of alternatives to driving and how revenues are used. In many situations, road user fees are less regressive than other road financing options, and benefit disadvantaged people overall if a portion of revenue is invested in affordable transport options such as public transport service improvements.

Car drivers that drive minimal distances such as seniors and the economically disadvantaged benefit from a user pays system. Research in Melbourne however indicates that people who currently live in urban fringes without good public transport

¹⁰⁷ A component in the success of the London (and Stockholm) congestion charge schemes was the existence of a high capacity ring route just outside the cordon.

¹⁰⁸ E. Pike (2010), *Congestion Charging: Challenges and Opportunities*, International Council on Clean Transportation;

(and likely to be less wealthy than inner city residents) travel longer distances than those living in the metropolitan areas.¹⁰⁹

Environmental

Cordon charges deliver localised environmental benefits within the cordon charging area by reducing the number of vehicles accessing the zoned area, vehicle idle time and start-stop driving. The benefits of cordon charging schemes are not restricted to the immediate area of application and overall reductions in traffic volumes are likely to contribute to reduced local air pollution, noise and greenhouse gas emissions.

3.6.4 Challenges for implementation

The primary risks of introducing any congestion pricing initiative include community rejection, implementation costs, risk of failure (for example inaccurate charging levels to manage travel demand), social impacts and unintended consequences. Any measures to use pricing to manage road use demand in Perth would need to be fair and equitable for all motorists and have scope to remove existing road user costs such as vehicle registration fees and fuel excise charges.

One of the key hurdles to the introduction of broad scale road pricing is community acceptance. Opponents are concerned not only about the direct cost to users but also diversion of traffic into residential areas and a lack of alternative forms of transport, including public transport, being in place before the scheme is implemented.

Failure to manage expectations in advance was the primary reason for the overwhelming rejection of proposed cordon charging by 74 per cent of Edinburgh voters (BBC, 2005).¹¹⁰ Asking people in advance, with no benchmark to inform them and no demonstration of commitment to providing alternatives, appears to be a recipe for non-implementation. In addition, initial rejection has long-term consequences making reintroduction of price measures to manage road use demand even more difficult.¹¹¹

Any cordon-based price measure to manage road use demand would place added pressure on car parking in areas immediately outside the cordon. This can already be seen with high CBD parking charges leading to all-day parking pressure in parts of the City of Vincent and will require active and effective management, including enforcement.

For more comprehensive road use pricing initiatives, experience of heavy vehicle charging schemes across the world indicate costs of implementation can vary widely and therefore careful consideration of technology and functions of any scheme is essential to minimise capital and operating costs.

3.6.5 Synergies and complementary measures

Clear policy objectives and rationale for road use charging schemes has been an important element of successful heavy vehicle charging schemes across the world.

¹⁰⁹ Currie (2014) 'When the wheels come off: transport poverty and disadvantage'. *Insight Magazine*, Victorian Council of Social Service

¹¹⁰ BBC News, 22nd February, (2005) 'Edinburgh rejects congestion plan'. http://news.bbc.co.uk/2/hi/uk_news/scotland/4287145.stm (accessed 16th October, 2015)

¹¹¹ Edinburgh Evening News, (2014) - <http://www.edinburghnews.scotsman.com/news/transport/council-rule-out-new-city-congestion-charge-1-3482932>.

Road use charging schemes need to be supported by efficient operation with low costs to demonstrate a clear nexus between the policy and net contribution to the economy and the community. Appropriate capabilities to deliver policy, effective compliance and enforcement strategies along with public engagement activities and partnership with key decision makers has been vital to ensuring support for policy implementation.

Any comprehensive road use charging scheme must demonstrate that the benefits clearly exceed the disadvantages. Support for road pricing reform can be engendered through trial periods, express lanes, and advocacy through non-government groups.

Replacement of existing road user charges and taxes would be a key element to gain community acceptance of distance and time based charging as could hypothecation of revenue to fund transport solutions.

3.6.6 Future application for Perth

<i>Population</i>	<i>Recommendation</i>
2.7 million	Work with national reform agencies, other Australian jurisdictions and stakeholders to develop options to introduce cost reflective road pricing for all vehicles.
3.5 million	Well-designed road use pricing initiatives that mitigate congestion and meet overall social equity objectives considered for introduction in Perth and Peel.

4. Further work

The Department of Transport will develop a TDM Implementation Plan to address how recommended measures will be implemented in the short to medium term, identify further research and policy work to be undertaken and identify enablers that would underpin the implementation of successful TDM strategy and policy in Perth.

Development of the TDM Implementation Plan would include extensive consultation and engagement with Transport Portfolio partners, relevant State Government agencies and other key stakeholders.

The TDM Implementation Plan will reflect, where relevant, the objectives of the Smart Transport framework which promotes small step changes in travel behaviour, localised content and a collective sense of responsibility for Perth's transport system. It will include a focus on the campaign's key audience segments that include car users who are open to congestion minimisation strategies and public transport use, public transport users open to greater use and those who like to walk and cycle. It will also help to provide people in Perth with a sense of what is being achieved now and in the future.

4.1 Implementation of recommended measures

The TDM Implementation Plan for Perth will specify an implementation strategy for the recommended measures for the short, medium and long term. It will describe responsible agencies, timeframes, key activities to be undertaken, resourcing requirements and how measures will be designed. In some instances, the Implementation Plan will recommend the development of detailed business cases.

4.2 Other potential applications

A number of the TDM measures assessed in this report indicate potential for moderate to high impacts on travel behaviour at relatively low cost. The TDM Implementation Plan will describe additional work or activities to be undertaken in respect of the following initiatives or measures.

4.2.1 Flexible and staggered hours

Although the Department of Transport has no direct role in implementing flexible and staggered hours in workplaces, it will continue to provide guidance and information through its travel change workplace programs, which promote the potential benefits of reducing the need for employees to travel in peak periods. In partnership with transport agencies in other Australian jurisdictions and relevant organisations, it will also continue to research, explore, monitor and assess the effect of alternative work schedules, staggered hours and telecommuting on mitigating congestion.

Alternative work schedules

Alternative work schedules are variations to the typical 9am-5pm, Monday to Friday, working week in order to reduce peak period traffic and public transport demand. Alternative work schedules include flexible work hours ('flexitime'), compressed working week (employees working fewer but longer days) and staggered shifts that reduce the number of employees arriving and leaving a worksite at the same time.

Provision of alternative work schedules can have a strong effect on peak period traffic and public transport demand. The option of a flexible work schedule is the primary factor determining how employees schedule their travel.

Teleworking

Telework uses technology to replace the need for physical travel for work purposes. As technology costs reduce and service quality improves the feasibility of telework increases. Telework might occur from home or from a regional telework centre. Teleworking, also known as telecommuting reduces vehicle kilometres travelled, especially during peak times.

Staggered school hours

Staggering school hours refers to schools adopting different starting and finishing times and is aimed at reducing the number of students and staff arriving and leaving schools at the same time. For example, school shifts could be split between a 7am to 1pm shift, a 9am to 3pm shift, and a 12pm to 6pm shift.

Staggering school drop off and pick up times can considerably reduce congestion around schools.¹¹² spread out peak demand on roads and public transport, particularly on buses and trains that carry school students.¹¹³ and therefore optimise the use of existing infrastructure. It can also reduce extreme early morning peaks at particular departure points.¹¹⁴ Staggered school hours do not directly promote mode shift or reduce the need to travel.

4.2.2 Improved travel information and payment systems

Improving the provision of timetabling information online, at stops and stations and on board buses and trains increases the convenience, connectivity and ease of using public transport and encourages more people to use public transport services. High quality provision of real-time timetable information can also help change the perception that public transport is unreliable. Technology innovations such as advanced traveller information systems that enable networked and real-time information can have a significant peak spreading effect.

The Department of Transport in conjunction with the Public Transport Authority will monitor the impact of the increasing provision of real time passenger information in Perth and the development of personalised journey planners, and the effect of these initiatives on mode shift and travel times.

The Department of Transport in conjunction with Transport Portfolio partners will investigate the feasibility of establishing and developing standards and partnerships between service operators and commercial partners to promote data sharing and user involvement in public transport service development. Proposals will be developed as appropriate depending on available technology, adoption rates, costs and private user-provided services, and might be undertaken by the private sector.

¹¹² La Vigne, N. (2007). 'The Problem of Traffic Congestion Around Schools'. *Guide No. 50*. Centre for Problem Oriented Policing (http://www.popcenter.org/problems/school_traffic/print/)

¹¹³ Yellow School Bus Commission (2008) *Commission's Report and Recommendations*, London: Yellow School Bus Commission

¹¹⁴ Ljungberg A. and Jansson J. (2009). 'Staggered school hours to spread peak demand for public transport - benefits and costs. *International Journal of Transport Economics*, 36(1), pp141-160

4.2.3 Integrated land use and transport

Growth strategies include the establishment of transit oriented developments (TODs), corridor planning and smart growth. TODs increase residential density and mixed uses around public transport stations and can be used to manage transport demand. TODs can provide accessible alternatives to car use and reduce the need to travel by containing activities such as work, shopping, leisure and education within a higher density urban precinct. Corridor planning integrates land use and transport planning by providing frequent public transport services, linear transport networks and activity centres along high density corridors. Smart growth is a term used predominantly in North America and Europe for policies that integrate urban planning and transport decisions to concentrate growth in compact, walkable urban centres to avoid sprawl.

The land use system plays a crucial role in travel demand by determining people's transport needs and options. Changes to the land use system that increase employment, residential density and other activity, particularly around public transport hubs, while providing for effective corridor planning and promoting efficient employment distributions are vital to fundamentally change travel behaviour in Perth.

The land use scenarios depicted in the Western Australian Planning Commission's Perth and Peel @ 3.5 million are modelled in Transport @ 3.5 Million. The challenge is to improve employment self-sufficiencies by providing jobs near to where people live and so maximise the use of existing and proposed infrastructure.

The Department of Transport will develop cross-agency policies that support integrated land use, including a policy to facilitate the development of TODs. It will also investigate and address potential governance and other barriers to better integration of land use.

4.2.4 New mobility services

Car sharing

Car sharing schemes provide members with short term access to vehicles for personal and business use. Car sharing can provide the benefits of private car ownership without the operating costs and responsibilities and are effective in reducing overall vehicle kilometres travelled. Although car sharing has existed for many years around the world, it is currently undergoing a technology-driven revolution to offer advanced services such as open-ended bookings, instant access, one-way rentals, prepaid user cards, interoperability and personal vehicle sharing. The potential annual savings from car sharing in the US is estimated to be \$4.3 billion¹¹⁵ and include factors such as reduced vehicle maintenance costs, reduced congestion costs, annual deferred road construction costs, crash avoidance and carbon emissions reduction.

The greatest benefits of car sharing schemes are likely to be realised when implemented with 'unbundled parking'. Currently in Perth the cost of parking for residential and commercial units is often passed on to the occupants indirectly. Unbundling parking from rent or purchase prices by renting or selling parking spaces separately could reduce the total amount of parking available in buildings and influence choices about vehicle ownership. Facility managers and developers could unbundle

¹¹⁵ Viechnicki, K, Fishman & Eggers. S (2015)

parking in several ways when renting or selling building space and offer discounts to tenants or buyers that require fewer than average parking spaces.

Studies in a number of US cities suggest that car sharing schemes implemented with unbundled parking typically reduce vehicle ownership and parking demand by 10 to 20 per cent.¹¹⁶

The Department of Transport will undertake research and stakeholder engagement to assess the likely impact of introducing car sharing schemes in Perth and develop appropriate policies to optimise transport benefits. The Department of Transport will also undertake research to assess the likely impact of unbundled parking in Perth and identify implementation enablers and barriers.

Ride sharing

Ride service companies such as Uber and Lyft provide app-based, on-demand ride sharing services. Ride sourcing companies provide direct competition to traditional taxi services, however ride sourcing users tend to be younger, own fewer vehicles and more frequently travel with companions¹¹⁷ and can therefore reduce single or low occupancy car trips.

Higher vehicle occupancy will also likely be achieved by technology-enabled ride matching and changing attitudes towards car ownership. By accommodating different user origins and destinations and requirements for forward planning, dynamic ride sharing overcomes major barriers to traditional carpooling or vanpooling.

Ride splitting services are now offered by some ride service companies overseas and enable riders to share a ride and split the fare. Ride splitting is a significant trend and now represents approximately half of the ride sourcing market in the San Francisco Bay area.

The Department of Transport will work with transport agencies in other Australian jurisdictions to assess the impact of ride sharing on congestion and public transport patronage, and identify strategies to increase positive effects on travel behaviour. Proposals that might be undertaken by the private sector will be developed as appropriate depending on technology development and adoption rates, costs, private user-provided services and other factors.

Flexible transport solutions

Flexible transport services cover a range of mobility options including demand responsive transport, where services are flexible along one or more routes, vehicle allocation, vehicle operator, type of payment and passenger category. Flexible transport services are often operated with dedicated small buses, minibuses or maxi-taxis for general public use or for closed user groups such as special services for seniors or people with disabilities.¹¹⁸

Flexible transport services are increasingly used throughout the UK, Europe and USA as part of the public transport mix.¹¹⁹ The services are provided particularly in areas

¹¹⁶ Litman, Todd (2013) *Parking Management: Strategies, Evaluation and Planning*, Victoria Transport Policy Institute 2013

¹¹⁷ Rayle, L., Shaheen, S., Chan, N., Dai, D., & Cervero, R. (2014). *App-Based, On-Demand Ride Services: Comparing Taxi and Ride-sourcing Trips and User Characteristics in San Francisco* University of California Transportation Center (UCTC). UCTC-FR-2014-08.

¹¹⁸ Daniels, R., & Mulley, C. (2010). *Overcoming barriers to implementing flexible transport services in NSW*.

¹¹⁹ Nelson, J. D., & Mulley, C. (2013). 'The impact of the application of new technology on public transport service provision and the passenger experience: A focus on implementation in Australia' *Research in Transportation Economics*, 39(1), 300-308.

where demand is too low to support conventional scheduled public transport services. Flexible transport services are not widespread in Australia.

The Department of Transport will monitor national and international experience of flexible transport solutions to identify new opportunities for filling the public transport gaps as Perth and Peel populations grow. Proposals that might be undertaken by the private sector will be developed as appropriate depending on technology development and adoption rates, costs, private user-provided services and other factors.

4.3 Other enablers

4.3.1 Ongoing transport survey data

Good transport planning requires comprehensive data on who moves where, and how and why they do it. Historically data has been used from the Perth and Regions Travel Survey, a study of the day-to-day travel patterns of 10,947 households in the wider Perth metropolitan area between October 2002 and September 2006.

The Transport Data Survey project is a five-year initiative to collect data on household travel behaviour and commercial vehicle trips to update the State Government's strategic transport models for the Perth metropolitan region. Outputs from the updated transport models will better inform transport infrastructure investment decision making. The Department of Transport will continue to update transport survey data at appropriate intervals.

4.3.2 Tax and workplace reform

A major impediment to the success of workplace travel programs is the impact of concessional car fringe benefits. There have been many inquiries, studies and advocacy papers on this issue¹²⁰ and provision of these benefits is acknowledged by the Henry Tax Review as providing a strong incentive for employees to take a car as part of their remuneration package and skew consumption toward motor vehicle services.¹²¹ Similarly, cars and parking are commonly provided as employee benefits and this promotes commuting by car. The provision of free car parking substantially reduces incentives to cycle, walk or use public transport.¹²²

The Department of Transport will investigate the development of employer and employee incentives such as employer-funded SmartRiders and bicycles, end of trip facility grants, public transport incentives and initiatives that encourage employees to switch from car driving to active forms of transport.

The Department of Transport will continue to monitor developments in concessional car fringe benefit tax reform as well as other tax policies that combat the impact of employer-provided cars.

¹²⁰ These include:

<http://www.heartfoundation.org.au/SiteCollectionDocuments/Blueprint-for-an-active-Australia-Second-edition.pdf> (see p74)

¹²¹ Australia's Future Tax System Review Panel (Henry tax review) 2008 *Australia's Future Tax System Consultation Paper*, p90.

¹²² Shoup, DC (1997)

APPENDIX A: List of Acronyms

ATIS	Advanced traveller information systems
AUPS	Advanced user pays systems
BCR	Benefit/cost ratio
CAT	Central Area Transit
DoT	Department of Transport
EOT	End of trip
ERP	Electronic road pricing
FTS	Flexible transport services
HOT	High occupancy toll
HOV	High occupancy vehicle
ICT	Information communication technology
MRWA	Main Roads Western Australia
NPV	Net Present Value
PTA	Public Transport Authority (WA)
PV	Present value
RTPI	Real-time passenger information
TDM	Travel demand management
TOD	Transit oriented development
VKT	Vehicle kilometres travelled

