CHAPTER 26

THE ROLE OF PARKING IN LIMITING TRAFFIC GROWTH AND CONGESTION

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INTRODUCTION

In early 2016, the population of Perth and Peel (Perth) exceeded two million people (Western Australian Planning Commission (WAPC), 2015). Excluding commercial traffic, Perth drivers made an estimated four million trips each day. If the proportion of car drivers was to remain at its current level (about 57 per cent), car trips in Perth would increase by three million to seven million trips per day by the time Perth's population reaches 3.5 million by 2050. This substantial increase in traffic requires adequate planning measures to ensure a functional, efficient and sustainable transport system, but also a liveable city.

This chapter provides an overview of the effectiveness of parking policies and management strategies in Perth and connects these measures to a broader set of demand-management approaches aimed at mitigating traffic congestion and promoting more active travel and public transport alternatives.

The chapter opens with a review of the relevant literature on travel and parking, followed by a presentation of the local context and an outlook for current and potential future car travel in Perth to 2050. The next section analyses the transport policy framework and provides two case studies of parking within the CBD area. The chapter concludes with lessons for planning professionals in Perth and recommends parking policies that are applicable elsewhere.

WHAT INFLUENCES HOW PEOPLE TRAVEL?

A broad range of factors influence how people travel and, to a lesser extent, how often. The following factors are likely to have had some influence on the lower levels of car driving per person that we have witnessed since the turn of the twenty-first century.

Regulatory Framework

Government policy and transport strategies can have a significant influence on how people travel. During the mid to late 1990s and early 2000s, most cities in Australia developed strategic transport policies in response to community demands for the development of more balanced and integrated transport systems (e.g. Perth Metropolitan Transport Strategy, 1995; South East Queensland Integrated Transport Plan, 1997; Melbourne 2030, 2002). These plans all set targets for an increased mode share of public transport, walking and cycling and a reduced mode share by car drivers. They also included demand-management policies designed to encourage more people to use active and public transport.

Following the release of the Perth Metropolitan Transport Strategy (1995), the WA Department of Transport released a number of modal strategies and demand-management policies with a view to increasing the mode share of walking, cycling and public transport and decreasing the proportion of people driving for everyday travel. These included *Bike Ahead: Bicycling Strategies for the 21st Century* (1996); *Better Public Transport: 10 Year Plan for Transperth* (1998); and *TravelSmart 2010: A 10 Year Plan* (1999). In 1999 the City of Perth and the Western Australian Government agreed to the Perth Parking Policy. By the mid-2000s, the mode share of car driving had fallen from 63 per cent to 58 per cent (Perth and Area Travel Survey, 2003–2006).

Induced Demand from High Investment in Public Transport or Roads

Increasing road capacity results in increased or induced traffic, which is significant in congested urban areas (refer to SACTRA, 1994; Noland, 1999; Richardson, Chambers & James, 1999; Noland &

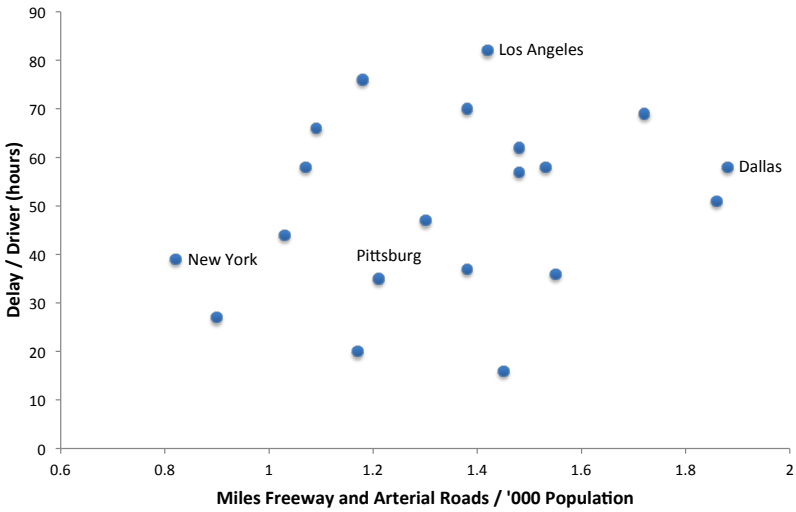

Figure 1: Measure of delay – America's twenty biggest cities (Urban Transportation Monitor, 1999; Data from Texas Transportation Institute).

Lem, 2001). At a system level, Noland (1999) and Noland and Lem (2001) estimated that about a quarter of vehicular traffic growth in American cities can be attributed to induced traffic.

Figure 1 shows a very weak correlation between major road construction per capita and driver delay per person for the twenty biggest US cities. It is very likely that induced traffic from road expansion will have resulted in increased delays on the network and reduced the anticipated benefits of the road expansion.

Cairns, Atkins and Goodwin (2002) have shown that the opposite also applies. When road space is reduced along a corridor or in an area (for example, due to pedestrianisation or a public transport priority), the level of traffic reduces. Richardson and Burgess (2005) demonstrated that the phenomenon of induced demand also applies when improvements are made to public transport and that the level of this induced demand is more substantial than for car traffic. They provided examples showing that the induced demand for public transport improvements resulted in less car driving. For example, 23 per cent of rail patrons on Perth's Joondalup Rail Line, after opening, previously travelled by car.

There is also evidence that induced demand applies to cycling. In the inner areas of Perth, where separate cycling paths are established, there has been a substantial rise in cycling. The mode share of cycling in these areas is four to eight times higher than in outer areas where the cycling-path network is disconnected and of poor quality, and where people who do cycle are compelled to share busy streets with cars (ABS, 2011; Journey to Work Travel and Western Australian Bicycle Network Plan 2014–2031).

Vuchic (1999) discusses the theory of incentives and disincentives to car and public transport in some depth in his book *Transportation for Liveable Cities*. He concludes that the benefits in terms of increased public transport use will be enhanced if introduced at the same time as car disincentives, but diluted if introduced at the same time as incentives to car use. This demonstrates that demand management of car travel can be effective in increasing travel by public transport, as well as reducing car driving.

Managing Demand for Car Travel

In the 1990s, strong support for a more broadly based definition of travel demand management (TDM) emerged (see chapter 25). In 1996, the Institution of Engineers published a position paper on TDM in which it was defined as follows:

> Travel demand management is intervention (excluding provision of major infrastructure) to modify travel decisions so that more desirable transport, social, economic and/or environmental objectives can be achieved and the adverse impacts of travel can be reduced.

The Austroads Travel Demand Resource Book (Austroads, 2002) partially endorsed this definition, but went on to say that TDM 'is a misnomer under all definitions in that it is not trying to reduce *all* demand for travel – only the demand for car travel, in order to reduce its negative effects'. (p.5).

By the 1990s, transport planners in most countries had recognised that simply increasing the supply of road space was not a sustainable way of eliminating congestion. In Australia, around the turn of the century, most large cities developed transport strategies that incorporated measures to manage transport demand as part of a broader suite of measures. For example, the Perth Metropolitan Transport Strategy (Department of Transport, 1995) set a target and proposed strategies to reduce the proportion of travel as a car driver from 63 per cent to 46 per cent by 2031.

Policy options such as TravelSmart (voluntary behaviour change management program) and Parking Policy have been effective in reducing car travel and improving the level of walking, cycling and public transport. These strategies, both implemented in Perth, are discussed in more detail later in the chapter.

Integrated Land-Use and Transport Planning

Cities that have low densities in terms of persons and jobs per hectare generally have higher car use in terms of car passenger kilometres per capita (Newman & Kenworthy, 2006). This is particularly relevant for Australian cities, which have amongst the lowest urban densities in the world (Newman & Kenworthy, 2011). As Newman and Kenworthy point out, low-density cities are highly car dependent because the density and form of development make walking, cycling and public transport unattractive for many people.

Cost of Driving and Parking

Research shows that higher petrol and diesel prices alongside higher parking costs are effective in reducing driving in various parts of the world (refer for example Barla, Lamonde, Miranda-Moreno & Boucher, 2009; Graham & Glaister, 2002; Lin & Zeng, 2013; and Wang, Zhou & Zhou, 2012). However, new cars are becoming more fuel efficient, which to some extent will mitigate the effect of higher fuel costs because the operating cost per kilometre is decreasing. For example, in Portugal, Matos and

Silva (2011) reported a rebound effect of 0.24 for freight transport and, in Hong Kong, Wang et al. (2012) observed a 0.35 rebound effect for passenger transport.

In Australia, since 2004 when car use started to decline, fuel prices have increased and then declined, but this has resulted in no perceptible change in the overall trend of less driving per person. This does not mean that fuel price has no impact on car driving. Rather it suggests that many other conditions may have contributed to less driving.

High parking charges in city centres can result in reduced levels of driving to these locations. In Perth, by 2016, hourly kerb-side parking charges had increased to more than $4 per hour and daily off-street parking in central Perth costs between $20 and $50 per day, depending on location (www.cityofperthparking.com.au/parking-fees; https://www.wilsonparking.com.au/find-a-park/WA/Perth%20CBD). These parking charges have contributed to a lower level of driving in central Perth, but the impact has been reduced on a metropolitan-wide basis because parking remains free at many locations across Perth. The increased cost of parking in central Perth has resulted in some drivers choosing to park at suburban park-and-ride areas at rail stations. The WA government's response to the high demand for park-and-ride at stations was to introduce a $2 per day charge for parking in 2014 (www.transperth.wa.gov.au/parking). Because of the low cost of this daily charge, there is little evidence that it has reduced the attractiveness of the park-and-ride option, as witnessed by the fact that most park-and-ride facilities are full by 8am.

Changes in Economic Circumstances

In the past, a major drop in economic activity has been shown to result in some reduction in the amount of travel, particularly business or work travel. However, the significant decline in car driving was evident well before the worldwide recession that occurred following the Global Financial Crisis (GFC) in 2008. Furthermore, there has been no recession in Perth, since before

1990, thus decreased car driving per person cannot be directly linked to the GFC. Internationally both Goodwin and Puentes, in the International Transport Forum (2013), noted some decoupling of the strong relationship between GDP and vehicle kilometres driven during the last decade.

Increasing Congestion

Congestion increases travel time and makes driving a less attractive option, particularly for those people who have a feasible alternative. Public transport and cycling can become a more attractive option where priority is provided for these modes. Increased congestion can also influence people to reduce their overall level of travel as some people may choose to work from home or stay connected through travel substitutes.

Staying Connected Through Travel Substitutes

There is increasing evidence that young people are choosing alternatives to driving to stay connected. In the latter part of the twentieth century, most young people chose to get a driving licence and gain access to a car to stay in touch with their friends (Dutzik & Davis, 2012; Dutzik & Baxandall, 2013). Nowadays, young people are choosing to stay connected through digital communication and most of them consider it more important to have a computer and a mobile phone than to have access to a car and often they are unable to afford both (Dutzik & Davis, 2012; Dutzik & Baxandall, 2013). It is also becoming more difficult and costly for young people to obtain a driver's licence and car insurance. Car sharing is also responsible for reduced levels of car driving in the young segments of the population.

The combined impact of these changing preferences and the additional costs of driving are resulting in a much larger proportion of young people choosing to not get a driving licence or to delay getting one. For example, studies by the RACV (2015) show that more than one-third of Victorians aged between eighteen and twenty-four did not hold a driving licence in 2014. This reduction

in driving licences is significant, considering that a decade before, in 2001, only 22 per cent of the young residents did not hold a driving licence.

Similar trends were found in European countries and the USA. For example, between 1983 and 2010 in the United States, the percentage of nineteen year olds holding a driving licence fell from 87 per cent to 70 per cent, whilst the proportion of seventeen year olds fell by a third from 69 per cent to 46 per cent (Sivak & Schoettle, 2012).

Summary – There is No Single Reason Responsible for the Change

Whilst it is clear that car driving per person has declined in Perth, in other Australian cities and in cities in other OCED countries, there is no single explanation for the change. The evidence appears to show that economic changes are not sufficient to explain the change in behaviour. Rather, a combination of factors appears to be responsible. These factors include increasing congestion on the road system; better quality public and active transport options; land-use changes designed to improve walking, cycling and public transport; changes in life styles and attitudes; and a desire on the part of young people in particular to favour connection through digital technology. Governments are able to influence some, but not all, of the reasons likely to be responsible for reduced driving.

PER CAPITA CAR TRAVEL IS DECLINING

There is a major difference in how people travel in cities around the world. Figure 2 shows that twenty years ago, American cities and, to a lesser extent, Australian and Canadian cities still had a much lower percentage of travel by public transport than European and Asian cities. Perth (thirteenth from the left on the chart), in 1995, showed lower public transport use and a higher level of car dependence than other Australian cities.

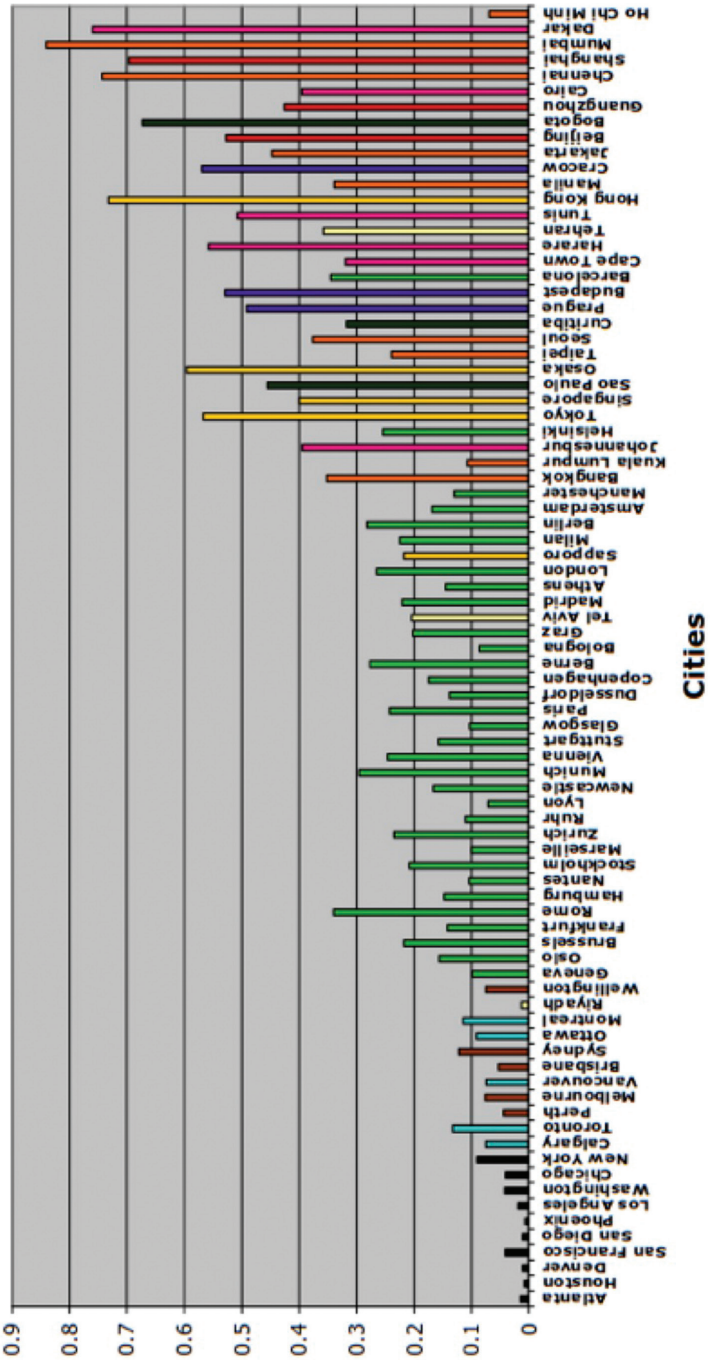

Figure 2: Proportion of motorised passenger kilometres on public transport in world cities, 1995 (Kenworthy & Laube (2001). The Millenium Database for Sustainable Transport International Union of Public Transport, Brussels, and Institute for Sustainability and Technology Policy, Perth).

In view of the fact that the total number of trips per person per day has not changed markedly over time, more car trips usually result in fewer trips by public transport and vice versa.

Litman (2004), in a study comparing America's fifty largest cities, has demonstrated that cities with a more extensive rail system have significantly lower levels of car travel and an improved level of road safety (Table 1).

Indicator	Increase/Decrease Compared to Bus Only System Cities		
	Large Rail System (7 Cities)	Small Rail System (16 Cities)	Bus Only System (27 Cities)
Public transport ridership (km per person)	+500%	+50%	0%
Car driver travel (km per person)	-20%	-10%	0%
Traffic safety (deaths per 100,000 persons)	-35%	-15%	0%

Table 1: Travel Characteristics in America's Fifty Largest Cities. (Litman (2004).

	Munich	Manchester	Glasgow
Metropolitan population	2.9m	2.6m	2.2m
Public transport mode share	25%	14%	12%
Car (driver plus passenger) mode share	41%	59%	55%

Table 2: Mode Share Comparisons – Munich, Manchester and Glasgow. (Atkins, 2001).

Atkins (2001), in a study carried out for the UK Commission on Integrated Transport, compared travel patterns in Munich (Germany) with Manchester and Glasgow (UK). Munich is of a similar size to the two UK cities and was established over a similar time period, but residents have significantly higher levels of public transport use and lower levels of car travel than those in the British cities. Munich has achieved the high use of public transport and lower car driving by investing a high proportion of its transport budget on public transport (65 per cent) compared to Manchester (18 per cent) and Glasgow (11 per cent) (Atkins, 2001).

The above two examples demonstrate that government investment in and improvement of the public transport system can significantly increase use of public transport and reduce car travel and vice versa.

Declining Car Travel in Australian Cities

The per capita car-kilometres travelled in Australian cities has decreased since around 2003/04, after more than half a century of growth (see chapter 8). Figure 3 shows that car travel per person levelled out in the mid-1990s and began to decline in 2004.

Some of the reasons for this trend are discussed by Richardson and Elaurant (2013) and further in this chapter. Richardson and Elaurant (2013) conclude that any reduction in the proportion of travel as a car driver is consistent with state government policies and strategies developed around the turn of the century and will assist in reducing congestion and increasing overall accessibility. They also conclude that, based on the evidence, the behaviour change and trends that have occurred are likely to be sustained.

Journey-to-work (JTW) statistics provide longitudinal records of car driver mode share and mode share by other modes. Using Australian census data, Mees, Sorupia and Stone (2007) showed that JTW by car started to decline after 1996 or 2001, except in Sydney, where it increased in 2006 after a drop between 1996 and 2001, before declining again in 2011 to below the 1996 level. In Perth, the JTW as a car driver peaked in 1996 and 2001, before dropping by 1.2 per cent by 2006 and by 5 per cent by 2011. The JTW car travel figure has reduced less than overall car travel. This is likely to reflect the longer distance for JTW and the limited suitable public and active transport options that exist in Australian cities. Whilst JTW normally accounts for only about 20 per cent of all travel, it accounts for a much higher proportion of travel in peak periods when congestion is more severe.

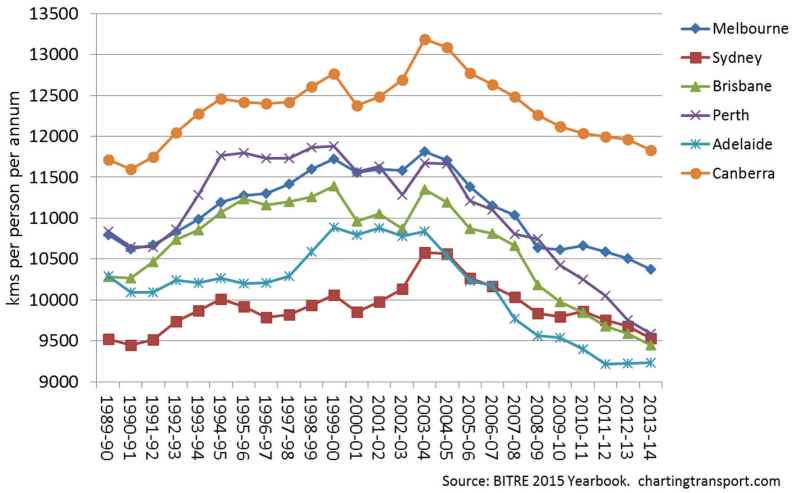

Figure 3: Estimated Car-km per Capita – Australian Cities (Loader, 2012 – Charting Transport using BITRE data).

In inner city areas, where public transport systems are more developed, residential densities are higher and more people live closer to where they work; the level of car driving is lower and dependency on cars for travel is lower.

Sample of Councils	Car Driver Mode Share	Change in Mode Share 2001–2011
Inner City (Vincent, Subiaco, South Perth, Victoria Park)	63.3%	-9%
Middle City (Stirling, Melville, Canning, Cockburn)	73.9%	-6%
Outer City (Kalamunda, Swan, Armadale, Wanneroo)	76.8%	-2%
Perth and Peel average	72.9%	-5%

Table 3: Car Driver Mode Share for Perth Councils.

As far back as 1997, the Victorian Area Travel Survey (VATS) showed that car travel per person in the inner areas of Melbourne was significantly lower (about half (Department of Infrastructure Victoria, 1997)) than in the outer areas (25 per cent versus 50 per cent). In Perth, the work census data (ABS, 2011) shows that inner municipalities have significantly lower mode shares for car driving and higher levels of mode share for walking, cycling and public transport. Furthermore, car driver mode share in inner areas is

reducing at a higher rate than for middle and outer areas (Table 3). The lower level of car driving in inner areas is associated with higher levels of accessibility and amenity, which enable a larger number of people to benefit from living in these areas. This supports the state government's policy of targeting increased urban infill and reducing urban sprawl.

The decline in car driving per capita is not isolated to Australia. Puentes (2013) notes that car driving per capita has declined in the USA since around 2004. Goodwin (2012) comments on a similar trend in the UK and observes that this decline is higher in cities where travellers have more alternatives to driving. The International Transport Forum has summarised the evidence in a number of OECD countries and found a trend exists to lower car driving per capita since just after the millennium (ITF, 2013).

Car Growth in Perth

Figure 4 graphs historical growth of daily car travel in Perth from 1976 to 2011. Car travel almost doubled between 1976 and 2001, but since then the rate of growth has declined. However, the high rate of population growth has ensured that the daily volume of traffic continues to grow.

Figure 4 also provides four scenarios for possible future growth of daily car travel in Perth through to 2050 when the population is projected to reach 3.5 million.

All scenarios are based on the total trips per person per day remaining at 3.5. However, there is the prospect that this may drop over the next thirty-five years due to some people choosing to stay connected through travel substitutes for certain activities or for other reasons. If this were to be the case, car travel by each scenario would be lower. The four scenarios are:

- Scenario 1: the estimated 2016 car driver mode share – 57 per cent;
- Scenario 2: 50 per cent car driver mode share;
- Scenario 3: 45 per cent car driver mode share; and
- Scenario 4: 40 per cent car driver mode share.

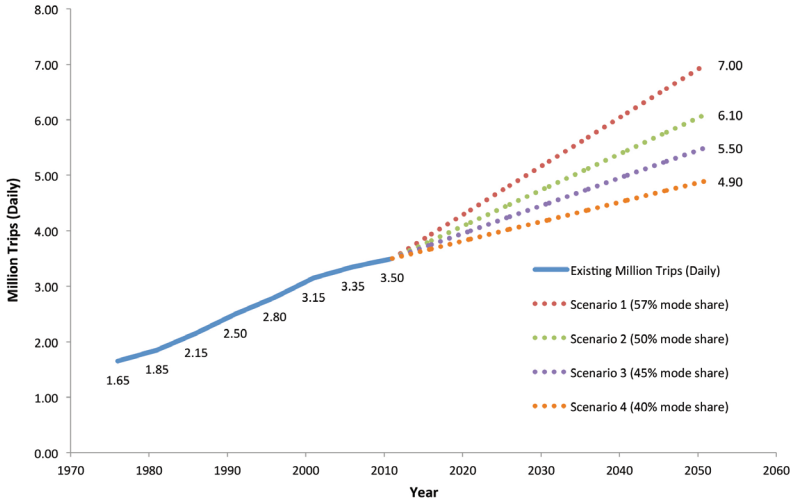

Figure 4: Growth of cars in Perth from 1976 to 2011 and projections to 2051.

These scenarios show that car driving will grow under all scenarios, driven by population growth, but by different amounts depending on the assumptions on mode share. If scenario 1 was to eventuate, car driving would double from 2011 to 2050, to seven million trips per day. On the other hand, if car driver mode share was to be reduced to 40 per cent, the amount of car driving on Perth's roads would be reduced by over two million trips per day. The draft *Perth Transport Plan for 3.5 Million* (Department of Transport, 2016) has set a mode share target for car driving of 50 per cent by 2050 (scenario 2). Given the current trends to lower levels of car driving and the significant investment proposed in the Perth Transport Plan for cycling and public transport, it is considered more likely that Perth's car driver mode share could drop lower, to about 45 per cent (scenario 3). This would be marginally below the 2012 car driver mode share of 46.9 per cent for Sydney (Bureau of Transport Statistics, 2013).

With careful management of travel demand, in conjunction with increased investment in public and active transport, a reduction of car driver mode share to 45 per cent is realistic and has the potential to limit car growth through population increase to below two million daily trips above the 2011 level of 3.5 million. This would represent a daily reduction in car travel of 1.5 million trips per day, when compared to daily car travel based on current mode share (57 per cent).

The actual future level of car driving will be influenced by a range of factors including current trends, government policy on demand management; improvements made to capacity and level of services of the walking, cycling, public transport and road networks, as well as ongoing changes to land use density and mix of uses.

MANAGING TRAVEL DEMAND, BEHAVIOUR CHANGE AND PARKING POLICY – EXAMPLES FROM PERTH

A continuation of growth in per person car driving, as occurred during the last half of the twentieth century, would not be sustainable for our cities. Similarly, in Perth, a doubling of car driving on the limited road and street infrastructure experienced since 1976, with the potential for a repeated doubling of traffic by the time Perth's population reaches 3.5 million around 2050, is not a desirable or realistic outcome. Physically, there is not enough space to accommodate this traffic on road networks without extensive land acquisition and segregation of neighbourhoods or alternatively building an underground network of roads that would be prohibitively expensive.

With the predicted high growth of population in Perth (the fastest growing city in Australia; Weller, 2009), there is an imperative to develop and implement transport policies designed to limit car travel even further by building on current trends. As suggested, this can be achieved by developing the walking, cycling and public transport network capacity and level of service

and introducing a comprehensive range of demand-management measures to limit the growth of car travel. The following sections provide an overview of TravelSmart (behaviour change management programs, also discussed in chapter 25) and parking policy and management programs that have been successfully introduced in Perth.

TravelSmart Behaviour Change Strategies

TravelSmart Individualised Marketing was first trialled in South Perth in 1997. It was the first time that individualised marketing had been targeted at increasing public transport, walking and cycling. When previously used in Europe, it was targeted only at increasing public transport (Brög, Erhard, Ker, Ryle & Wall, 2009).

Following the South Perth trial, a large-scale project involving 35,400 people was implemented in South Perth (Department of Transport, 1999). It resulted in a 14 per cent reduction in daily car trips and a 17 per cent reduction in car kilometres travelled. The estimated economic benefits from this intervention were:

- Personal savings from less car use – $2.8 million per year; and
- Increased public transport fare revenue – $600,000 per year (Department of Transport, 1999).

Perth's TravelSmart policies and strategies have been well documented (Ashton-Graham, 2003; Brög & Johns, 2001; James, 1998; James, 2002 and Ker, 2002). TravelSmart interventions have been shown to reduce car driver mode share by 10 per cent on average.

Perth Parking Policy – A Case Study in Demand Management

The Perth Parking Policy was introduced in 1999, following a joint agreement of the City of Perth and the state government. The supporting legislation, *Perth Parking Management Act 1999,* and regulations were passed unanimously by members of all five political parties (at the time) in the Western Australian Parliament

(Western Australian Government Gazette, 1999). The minister, in the second reading speech on the Perth Parking Management Bill (Hansard, 26 November 1998) stated:

> The principal objectives of the Perth Parking Management Bill and the Perth Parking Policy are to promote a balanced transport system to gain access to central Perth, and to limit the growth of transport congestion and deterioration of air quality in the central area.

The parking policy covers the entire City of Perth. The regulations of have been modified over time to reflect changed circumstances without straying from the underlying principles of the policy. The 2014 version of the policy is documented in the Western Australian Government Gazette (2014).

At the time the policy was introduced (1999), a major concern of some in the development industry was that limitations on parking supply would have a negative influence on development of the Perth City Centre. Furthermore, the Chamber of Commerce and Industry and the Property Council lobbied strongly against the parking policy, mainly because of its taxing powers that enabled the introduction of a parking licence fee (levy) on owners.

The transport planning context in which parking policy was debated and finally introduced in mid to late 1999 was one of alleviating traffic and congestion through limiting parking, following the practices in the previous two decades. Specifically, parking supply doubled between 1970 and 1990, congestion grew rapidly on the approach roads to the city and on city streets, public and active transport were declining and there was concern about air quality problems and reduced amenity on city centre streets.

Figure 5 shows how the parking supply grew rapidly until the time the policy was introduced and then decreased following its introduction. The supply of parking (2015) in the City of Perth is lower than it was when the policy was introduced in 1999.

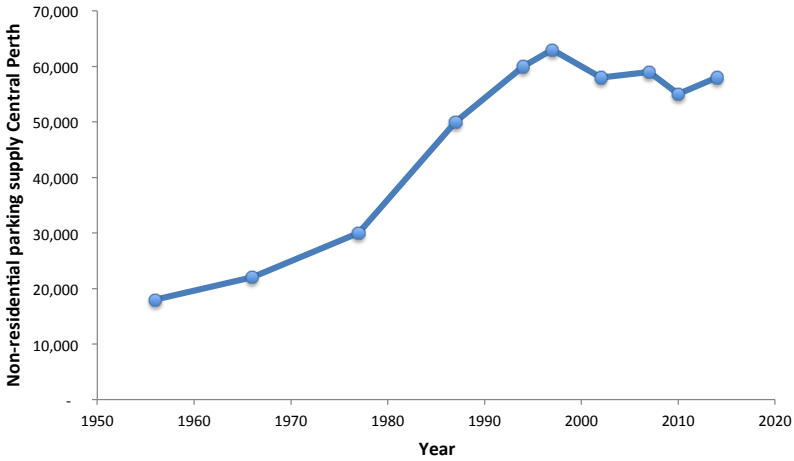

Figure 5: Central Perth Non-residential Parking Supply (WA Department of Transport Data).

The parking policy was introduced primarily as a demand-management measure. The key ingredients of the policy were:

- Maximum levels of private parking permitted are based on land area, regardless of development intensity. Prior to its introduction, parking supply for new developments was regulated by minimum rates of parking;
- Long-term public parking is restricted to peripheral areas;
- Public parking and tenant parking is not permitted with access from streets within the pedestrian priority zone (refer to Figure 6);
- All parking bays (other than residential) must be licensed; and
- Licence fees must be applied to off- and on-street bays with a few exceptions that are listed in the regulations.

Because the private parking associated with a development is based on the site area rather than the gross floor area, higher density development is permitted a lower rate of parking than lower density developments, when measured in terms of parking

Figure 6: Perth Parking Management Area showing Pedestrian Priority Zone (Western Australian Government Gazette, 2014).

bays per 100m^2 of net leasable area. These higher density developments are generally located in the CBD, with very good access by public transport.

A number of trends have become apparent since the parking policy was introduced.

- There has been an 8 per cent reduction in parking bays (1999 to 2012);
- Changes in mode share for access to the city have dropped from 50 per cent car driver in the mid-1990s to 35 per cent in 2010, and vice versa, an increase in public transport from 35 per cent to 50 per cent;
- A 40 per cent growth in city employment;
- CAT bus services (Central Area Transit free bus services) increased by 103 per cent and Free Transit Zone regular bus services increased by 146 per cent between 2000 and 2014.

These changes are expected to continue in the future, as shown in Figure 7.

The price of parking has increased significantly since 1999, which has contributed to the reduced level of car driving to/from the City of Perth. This was an indirect impact of the parking policy, as it was quite specific about not intervening in setting parking prices. However, the reduced supply of parking associated with continuing high demand resulted in price increases. Furthermore, parking station operators have chosen to increase parking fees each year, partly as a response to annual increases in the parking levies.

The reductions in car travel along with increasing numbers of people in the city have resulted in a number of benefits for the city centre, including:

- Car travel on some major shopping streets has halved since the mid-1990s;
- Footpaths have been widened and bus priority lanes introduced;

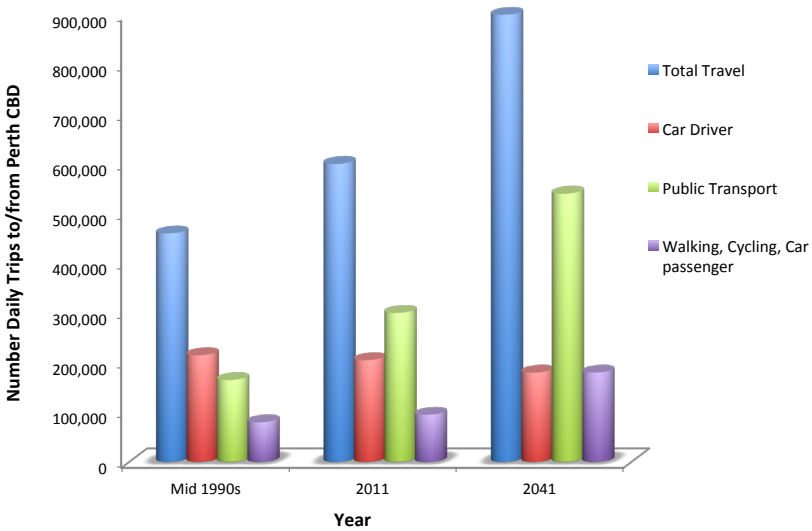

Figure 7: Travel to Perth City Centre by Mode, 1990s to 2041.

- Pedestrian movement is easier and safer;
- Evidence of improved amenity and less local pollution; and

- The city has seen vibrant, strong city centre growth.

Even those who were cautious or opposed to the parking policy in the late 1990s now accept that it has been a catalyst (along with improved public transport) for positive change that has enabled the city to grow strongly with less car traffic. This has brought about a major change in mindset at the Perth City Council, where the policy position has changed from 'Your Car is as Welcome as You Are' in the 1980s to 'People First, Public Transport Second and Cars Last' (City of Perth, 2010).

Key success factors of the policy have been:

- Hypothecation of the parking levy annual fees, currently over $30 million per annum. The fees, although collected by the Department of Finance, do not go into general revenue. These funds go into a trust account and are only for expenditure within the City of Perth on public transport, walking and cycling improvement projects. A large proportion of these funds have been used to subsidise free public transport travel within the City of Perth (Free Transit Zone) and operating the CAT routes.
- Setting maximum levels of parking bays for new development and redevelopment within the City of Perth. Non-residential parking capacity within the City of Perth is lower than it was in the mid-1990s.
- Restrictions on the level of parking based on site area rather than the area of the building.

Restricting the level of parking based on site area has proved successful as it provides greater restrictions on parking in the core of the city where it is most needed, as demonstrated in the following two case studies (Table 4).

In case study 1, a high-rise development in the heart of the city, the ratio of parking to employees suggests the limitation on parking limits the mode share of driving to less than 10 per cent. In case study 2, towards the periphery of the city (about 3

kilometres west), a mode share of driving of between 25 per cent and 30 per cent could be estimated. The accessibility profile has a significant contribution as well: whereas case 1 has high access by public transport and connections to freeways are not of prime importance, case 2 is located next to the freeways, which shapes the mobility profile of its employees and visitors, a link well documented by Van Wee and Van der Hoorn (2002).

Characteristic	**Case Study 1: 140 William Street**	**Case Study 2: 18–24 Parliament Place**
Location	CBD, adjacent to central railway station	West Perth (Periphery of CBD)
Type of development	20-storey office with ground floor retail	8-storey office
Site area (ha)	0.84 ha	0.21 ha
Maximum parking allowance (bays)	168	56
Floor area (GFA) (m^2)	Approximately 40,000m^2	Approximately 4280m^2
Parking bays/100m^2 GFA	0.42 bays/100m^2 GFA	1.3 bays/100m^2 GFA
Approximate number of employees	2000	200

Table 4: Features of Two Case Studies of Parking in Perth, CBD.

The policy has been important for what it has achieved, but it has arguably achieved an even greater benefit for our planners and decision-makers through the following key learnings:

- There is a clear nexus between parking supply and traffic generated in centres;
- Parking policies and strategies can increase use of public transport and active transport and are necessary for enabling urban centres to reach their full potential;
- The capacity and service of public transport must be sufficient to achieve less traffic in centres;
- Reducing the level of parking and increasing the price of parking does not result in the economic decline of centres with good public transport.

The experience with the parking policy has been instrumental in changing transport thinking in Perth and the City of Perth is

well advanced in the implementation of a major urban enhancement project designed to 'stitch' the city street grid back together and make streets more attractive for people to use and enjoy (City of Perth, 2010). The one-way street network, introduced in the 1970s to increase capacity for cars, is in the process of being redesigned, with most streets reverting to two-way traffic. The council has recognised that wider footpaths and improved access to the city by public transport is an essential component of its new street plan. It has engaged with state authorities including the Department of Transport and the Public Transport Authority with a view to building priority for public transport vehicles along key streets within the city. Other notable transport improvements include widened footpaths to accommodate more pedestrians, cycle paths into the city heart and introduction of super-high-frequency bus services.

Overall, Perth has shown leadership on how to use parking policy to limit vehicular traffic in the city centre. The joint state government/City of Perth Parking Policy is recognised around the world as best practice in travel-demand management. Further details on the parking policy can be found in Richardson (2010).

Policy Change for Parking at Activity Centres

Building on the success of the parking policy, the Western Australian Planning Commission (WAPC) has developed planning guidelines to support State Planning Policy 4.2 for the development of the Activity Centres for Perth and Peel. State Planning Policy 4.2 identifies nine policy objectives (refer to Table 5), with one of them (Movement) emphasising the importance of reducing car trips by maximising access to activity centres by alternative modes. This enables the activity centres to be larger with a more vibrant mix of uses and activities, without being negatively impacted by severe congestion.

As part of structure planning for a number of strategic metropolitan and secondary centres in Perth, the following parking principles are currently under consideration:

- **Parking Principle 1** – The amount and type of parking provided should support the city centre vision and broader transport and planning policies. The intention is that this policy principle would guide the development of a framework that establishes *maximum* levels of parking and *minimum levels of public parking* to meet the operational needs of the centre, without resulting in unacceptable levels of congestion.
- **Parking Principle 2** – The amount and location of parking should assist in improving *access in and around the centre* and in *reducing impacts on people* travelling to/from/within the centre. The intention is that this policy principle would assist in the development of guidelines and policies to determine the preferred location of car parks and identify streets where car park entrances should not be permitted due to safety issues, such as conflict with pedestrians and cyclists.
- **Parking Principle 3** – *Maximise resource efficiency and the value of parking.* The purpose of this principle is to assist in achieving the optimal amount of parking, bearing in mind that excessive levels of parking can detract from good design, can be costly to provide and have less value at the margin when over-supplied.
- **Parking Principle 4** – Allocate on-street space for car parking, based on *giving priority to the highest value users.* Provision for loading and servicing and for public transport stops and priority travel, as a rule, should be given the highest priority, followed by taxi stands, bicycle/scooter/motorcycle parking, short-term parking and finally long-term parking. There may be instances where the highest value use is to widen the footpath for al fresco dining or for other uses.
- **Parking Principle 5** – Visitors to the city centre should be provided with *clear directions* to available

parking and between car parks and major activities and landmarks. The intention of this principle is to ensure that the investment in parking is maximised by ensuring that the location of parking is well understood in relation to the location of important city destinations.

Activity Centre Hierarchy	1 Distribute activity centres to meet different levels of community need and enable employment, goods and services to be accessed efficiently and equitably by the community. 2 Apply the activity centre hierarchy as part of a long-term and integrated approach by public authorities and private stakeholders to the development of economic and social infrastructure. 3 Plan activity centres to support a wide range of retail and commercial premises and promote a competitive retail and commercial market.
Activity	4 Increase the range of employment in activity centres and contribute to the achievement of sub-regional employment self-sufficiency targets. 5 Increase the density and diversity of housing in and around activity centres[1] to improve land efficiency, housing variety and support centre facilities.
Movement	6 Ensure activity centres provide sufficient development intensity and land use mix to support high-frequency public transport. 7 Maximise access to activity centres by walking, cycling and public transport while reducing private car trips.
Urban Form	8 Plan activity centre development around a legible street network and quality public spaces.[2]
Out-of-centre development	9 Concentrate activities, particularly those that generate high numbers of trips, within activity centres

Table 5: Policy Objectives for Activity Centres in Perth and Peel. Notes: 1 Apart from Perth and Jandakot airports. 2 A street system designed to provide a sense of direction and connection, giving clear signals regarding the spatial layout and geography of an area (after West Leederville Planning and Urban Design Study - Town of Cambridge, 2009). (WA Government Gazette, 2010, p.4141)

The following case study examples demonstrate the current approach to parking in major activity centres.

CASE STUDY 1 – PARKING AT QEII MEDICAL CENTRE

The QEII Medical Centre (QEIIMC) in Perth is the largest hospital and medical complex in the southern hemisphere. It is located

adjacent to The University of Western Australia (UWA) and the two facilities are recognised as a specialist activity centre by the Western Australian Planning Commission (WAPC).

Parking at UWA has been capped for many years and over time there has been a steady increase in travel to UWA by public transport and by cycling. Prior to 2007, the state government approved a substantial increase in medical and hospital facilities at the QEII campus. Hospital beds were planned to increase from 600 to 1500 and plans were initiated to move the Perth Children's and Perth Women's Hospitals to the QEII campus. The Perth Children's Hospital is due to open in 2017.

Extensive traffic analysis was undertaken to support structure planning in 2007. As part of this planning, the WAPC determined that a cap on parking was necessary at QEIIMC as part of demand management for travel to and from QEII. A Travel Plan, first developed in 2007, has been updated regularly since. Its major objective was to reduce single-occupant car driver trips to the site from 85 per cent mode share in 2006 to 62 per cent in 2012. Whilst considered challenging at the time, the actual car driver mode share achieved in 2012 was 42 per cent, with an increase in public transport to 35 per cent compared to a forecast of 20 per cent and a mode share of walking and cycling to 17 per cent (compared to the forecasted 10 per cent; QEIIMC, 2016). The major reason for achieving such a large decrease in driving to QEII was the severe shortage of parking that was a result of construction of the Perth Children's Hospital and a multistorey car park on the previous at-grade car parks during the lead up to 2012. The multistorey car park, providing the majority of current car parking at QEII, was opened in 2012 and following the opening of the Perth Children's Hospital, there will be 5,185 parking bays at QEII (just below the cap of 5,350 bays), with 4,000 bays for staff. There is no 'as of right' access to a staff parking bay with priority given to specialist medical staff and shift workers. More details on parking supply resolutions and mode shift at QEIIMC can be found in Martin (2014).

CASE STUDY 2 – MAJOR SHOPPING CENTRE EXPANSIONS IN PERTH

Prior to 2010, restrictions were placed on the size of shopping centres in Perth. Following the removal of this cap, approval has been given for a number of major shopping centre expansion projects at strategic metropolitan and secondary centres in Perth. The approach taken during assessment and approval of these centre extension plans has been to negotiate a package of road improvements, public transport improvements and demand-management measures and include them as a condition of development approval. The demand-management measures mainly relate to parking management. The existing town planning schemes generally required a rate of parking of six bays per 100m^2 or more of net leasable area (NLA). However, lower levels of parking were negotiated between the developers, the local councils and state transport and planning agencies. It was recognised from surveys that there has been a reduction in parking requirements at large shopping centres, possibly due to internet shopping or internet 'window shopping' for some goods. Also, evidence was presented showing that vehicle trips per 100m^2 declines as the size of the centre increases. Transport agencies and local councils supported lower rates of parking as a demand-management tool, along with other means to reduce car driver demand, including charging for parking of over three hours at the centres and a range of measures to increase use of public transport (more frequent services and bus priority measures).

A number of shopping centres, with some mixed office and residential uses and a total land-use of around 100,000 m^2 of NLA, have been granted approval based on provision of between 3.7 and 4.3 parking bays per 100m^2 of NLA.

CONCLUSIONS

There are significant differences to how people travel in different cities and in different areas within cities. Travel by car is less in

denser cities and in cities with a greater mix of land-uses where people are able to live closer to work and other activities. This enables more people to walk, cycle or use public transport.

After more than fifty years of increasing car travel, car driving per person started to decline around or just after the turn of the century, in most OECD cities, including Australian cities. However, in fast growing cities such as Perth, traffic continues to grow despite per capita reductions in car travel.

In Perth, as in other cities, the road system in many areas is approaching capacity with very limited opportunities to expand without going underground, which is very expensive. There will be an ongoing need to increase travel by public and active transport to reduce the percentage of travel by cars. This offers the best opportunity to mitigate congestion on a sustainable basis, as expanding the road system is likely to induce more road travel, which can have the effect of increasing congestion at or near the end of the road expansion work.

The potential to have more people travelling by public or active transport will be greatly enhanced if demand-management measures are introduced in conjunction with increased investment in public and active transport.

Perth has had great success in developing TravelSmart initiatives that have, where implemented, reduced car travel by about 10 per cent. Furthermore, parking management has now been established in Perth as an effective way to reduce traffic in and around the Perth city centre and other strategic metropolitan centres.

The Perth Parking Policy introduced in 1999 has complemented public transport and cycling access improvements to central Perth. The combined impact has been a reduced level of driving into Perth from that which existed in the mid-1990s, despite an increase in employment of 40 per cent since that time. Car driving mode share to central Perth reduced from 50 per cent to 35 per cent between the mid-1990s and 2015. This has enabled the Perth City Council to widen footpaths, plant more trees and improve the ambience for people walking in the city centre.

Success in reducing car travel at centres outside of central Perth has also been achieved. Reduced car travel and increased public transport and active transport travel to the QEIIMC and UWA is a prominent example.

As Perth grows towards 3.5 million people, a reduced level of traffic growth, by accelerating the current trend, offers the best alternative to mitigating growing levels of congestion driven by population growth. Across metropolitan Perth, car driver daily mode share has reduced by 10 per cent over twenty years since the mid-1990s. If it could be reduced by a further 15 per cent over the next thirty-five years to around 45 per cent of total daily travel, the daily traffic on Perth's road system would be reduced by 1.5 million trips per day, when compared with retention of the current car driver mode share of 57 per cent.

The experience with demand-management measures in Perth, including TravelSmart behaviour change strategies and parking policies and strategies, indicates that demand management can make a significant contribution to reducing car dependence and use and assisting in mitigating congestion. One caveat that must be added to this finding is that continuous improvements will need to be made to the public and active transport networks to increase capacity and level of service. This is necessary to enable mode shift from car to public and active transport to take place.

Travel-demand-management measures work best when they are delivered as part of a package of measures that includes upgrades to the public transport, cycling and walking networks. Similarly, investment in the public transport, cycling and walking networks will deliver greater benefit when introduced as part of a package that includes demand management.

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