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Literature review of induced travel

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ABSTRACT: Induced travel is the increase in travel attributable to transportation projects that increase capacity. This paper reviews the causes and impacts of induced travel. It discusses some of the debates in the literature around the nature and extent of induced travel and reviews the scale and time frame of the effect. It includes a discussion of the possible impacts of clearways on induced travel in Melbourne, including possible impacts on on-road public transport.

KEY WORDS: ***Induced travel, clearways, elasticities***

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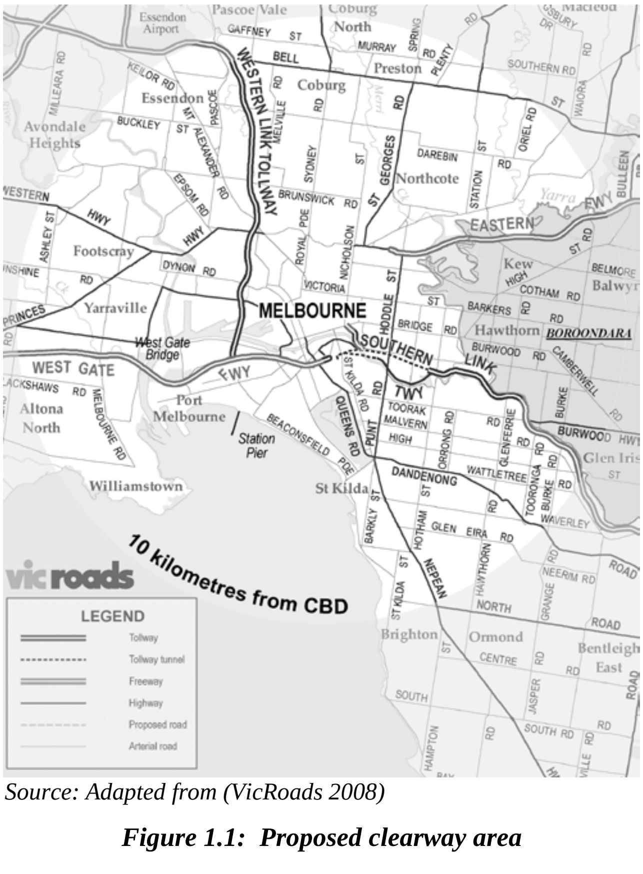
1. Introduction

This report presents the draft report of a research literature review concerning the subject of 'induced travel'. It is written by the Institute of Transport Studies, Monash University on behalf of the City of Boroondara.

1.1 Background

The City of Boroondara aims to protect and enhance the local economy and liveability of Boroondara. Much of the city's economic and community activities are centred around retail and commercial strips which lie on major traffic arterials. These roads also provide through access for tram routes as well as commuter and freight traffic.

The Victorian State Government through its agency VicRoads proposes to introduce standardised and extended clearway times on many of Boroondara's arterial roads to enhance tram and general traffic travel times. Clearways would operate from 6:30am to 10am and from 3pm to 7pm on all major arterial roads within 10km of the city. The majority of the Boroondara council area lies within this 10km radius (see Figure 1.1).



Source: Adapted from (VicRoads 2008)

Figure 1.1: Proposed clearway area

The City of Boroondara is concerned about how these plans will impact on the economic viability and liveability of its major shopping and retail strips. It has also questioned if these plans will be successful in reducing traffic congestion and in improving traffic and tram travel times. A range of overseas studies have suggested that measures to increase the road space available in congested traffic can act to increase the volume of traffic through a process called 'induced travel'. There is a need to understand this research to better inform this debate.

The City of Boroondara has therefore commissioned the Institute of Transport Studies to develop a literature review of research experience and evidence associated with 'induced travel'. Particular advice is required regarding:

- Circumstances associated with increasing road space
- Specific examples associated with measures such as the proposed clearways
- Evidence regarding the time frames where induced travel can occur
- The overall effects on traffic congestion, travel times and on associated public transport services (if available).

1.2 Literature review aims

This literature review examines published research evidence concerning the topic of 'induced travel'. It examines the following themes within this context:

- Definitions of induced travel
- Evidence regarding its causes and potential mitigating factors
- The evidence for and against its validity as a travel demand effect
- Evidence regarding the scale and time frame of effects
- Specific evidence of impacts associated with 'clearway' type measures
- Any evidence associating 'induced travel' impacts with on-road public transport impacts.

1.3 Report structure

This report is structured as follows:

Section 2: Definitions – reviews evidence regarding the definitions of 'induced travel'.

Section 3: Causes and Mitigating Factors – reviews factors which are associated with creating 'induced travel' and factors that act to influence the types of impacts which induced travel has.

Section 4: Critical Assessment – examines debate regarding the case for and against 'induced travel' as a phenomenon in urban transport.

Section 5: Scale and Time Frames – reviews evidence on the size of 'induced travel' impacts measured or forecast and the time scales over which these impacts have been seen to occur.

Section 6: Impact – reviews the impacts of 'induced travel' in both the short term and the long term

Section 7: Induced Travel and Clearways – focuses on evidence associated with 'induced travel' and the clearway type measures proposed in current VicRoads plans for inner Melbourne.

Section 8: Induced Travel and On-Road Public Transport – reviews evidence associating the phenomenon of 'induced travel' with impacts on bus and tram services.

Section 9: Conclusions for Boroondara – considers what implications of the research are for the situation in Boroondara.

2. Definitions

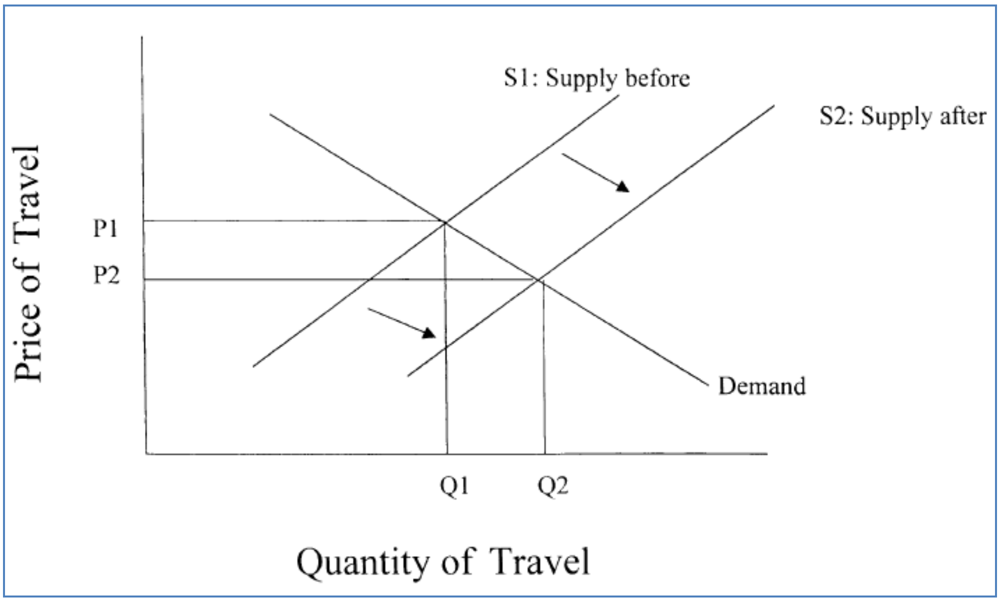
This section reviews evidence regarding the definitions of 'induced travel'. The simplest definition of **induced travel** and one widely accepted in the literature is:

"the increase in vehicle miles [kilometres] of travel attributable to any transportation infrastructure project that increases capacity" (Noland and Lem 2002).

Note that this definition is not constrained to traffic on the targeted route but includes travel to and from the targeted route ("downstream travel"). However it does not include travel that is shifted in time (from off-peak to on-peak) or place (unless the new route increases vehicle kilometres).

2.1 Underlying theory

The underlying theory behind induced travel is the economic principle of supply and demand. Travel has a cost in both a financial sense (through petrol prices or road tolls) but also in the amount of time it takes from other activities; this cost imposes limits on the amount of travel undertaken. Where increasing the capacity of roads (supply) reduces congestion, it thereby reduces the time-cost of travel. When travel is reduced in cost, the quantity demanded of that good increases. This increase in demand represents the induced travel effect (Noland and Lem 2002).



Source: (Noland and Lem 2002)

Figure 2.2: Induced travel as supply and demand

3. Causes and mitigating factors

3.1 Introduction

This section reviews factors which are associated with creating 'induced travel' and factors that influence the degree of induced travel.

3.2 Causes of induced travel

Litman (2001) provides a useful categorisation of factors that contribute to induced travel. These include new trips, mode shift, destination change and trip diversion.

Table 3.1: Types of induced travel

Types of induced travel	Example	Travel impact
New trips	Driving to shops rather than ordering online	Increase
Mode shift	Driving instead of walking or taking public transport	Increase driving
Choosing farther destinations	Driving to a large mall instead of a local shopping strip	Increase
Diverting trips in space	Changing routes to use the improved road	Depends on route
Diverting trips in time	Moving from off-peak to peak-hour use of the improved road	None

Source: adapted from Litman (2001)

Most of these factors result in an increase in car travel. Diverting trips does not generate new trips and where the new route is more direct it may even reduce vehicle kilometres (VKT). But trip diversion increases traffic levels on the roads where capacity is increased.

All of these factors are relatively immediate but a number of factors can increase demand over the long-term, for example through changing land use patterns. These factors will be discussed in greater depth in section 6.3.

3.3 Mitigating factors

It is the reduction in travel times, not capacity expansion itself, which generates induced travel. Therefore the most significant factor that mitigates the degree of induced traffic is the amount of travel time the project will save users. New transport projects will show greater induced traffic where there is high **latent demand** (the underlying demand for a particular route) (Mackie et al. 2003). For example a new river crossing where none existed before may have high latent demand, whereas a freeway connecting two distant suburbs may not.

Where projects improve capacity on existing routes, the amount of time users save is proportional to the amount of congestion that will be relieved (Litman 2001). This congestion is an expression of the latent demand for the existing route. Furthermore, because congestion is greatest in peak hour, peak periods see particularly high growth rates related to induced travel when extra capacity is provided (Goodwin 1996).

4. Critical assessment

4.1 Introduction

This section examines debate regarding the case for and against ‘induced travel’ as a phenomenon in urban transport.

4.2 Criticism of induced travel

The scope of research on induced travel is no longer concerned with *whether* increasing capacity increases travel, but *how much* increasing capacity increases travel (Cervero 2003). In the past, however, several criticisms of induced travel have been raised and addressed in academic literature.

There is some debate on the direction of causality between road capacity and traffic level. One might argue that road capacity was increased in response to, or in anticipation of, traffic increase (Hansen 1998). Yet many studies use observations before and after capacity increases to show that the road improvements are what encouraged traffic growth (Hansen 1998). One could still argue that highway planners were able to anticipate increased traffic growth, but repeated studies have shown that traffic increases usually surpass predictions (Goodwin 1996).

Other critics have argued that increased road capacity contributes little compared to exogenous variables such as population growth, incomes, and gasoline prices on traffic growth (Heanue 1998; Sen et al. 1998; Burt and Hoover 2006). Others conclude that increasing road capacity reduces congestion (Bayliss 2008) and that freeway expansion does not contribute to decentralization (Sen et al. 1998). These criticisms have been addressed directly and indirectly but as a whole those studies are regarded as outdated and in some cases methodologically unsound (Center for Neighborhood Technology 1999; Litman 2009).

A common argument is that increasing road capacity is justified for the sake of economic development. But research suggests that new transport projects do not have a major impact on economic growth where cities already have well-developed infrastructure (Boarnet 1996; UK Standing Advisory Committee for Trunk Road Investment 1997; Center for Neighborhood Technology 1999).

The debate is not just an academic one but has played out in the courtroom. Following America’s Clean Air Act Amendments of 1990, a number of highway expansion projects came under scrutiny for their potential to increase motor vehicle traffic and vehicle emissions (Transportation Research Board

1995). Capacity enhancements were originally thought to reduce emissions by reducing stop-and-go traffic and increasing travel speeds to a more fuel-efficient range. Environmentalists challenged these views by arguing that increasing capacity results in more traffic and emissions in the long run by making motor vehicle travel easier and encouraging dispersed, automobile-dependent urban development. A committee was convened to address this challenge but concluded that the analytical methods in use at the time were inadequate for addressing regulatory requirements (Transportation Research Board 1995). The court ruled in favour of allowing highway improvements to continue.

Over the last few decades much research has confirmed the effect of induced travel. Induced travel effects have been found using a range of different methods in both empirical analyses and regional modelling. Empirical studies directly observe the impact of road supply on traffic, land use and other variables using natural variation in road supply. Empirical studies usually measure traffic flows before and after major improvements and compare those increases to forecasts or to traffic flows on non-improve routes. Regional models do not directly observe impacts but instead simulate them using assumptions based on observed data; these variables can then be directly manipulated in ways that empirical studies cannot (Hansen et al. 1993).

While there is little substantive evidence against the concept of latent demand there is certainly concern over the accuracy of measurement associated with individual types of travel behaviour of which latent demand comprises. It is relatively easy to measure total travel volume at specific locations and hence to illustrate changes in total travel. It is more difficult to understand how much of total travel impacts are caused by trip diversion, trip generation, trip retiming or mode shift. Furthermore it is easy to attribute short term travel changes to traffic measures that increase road capacity. It is harder to attribute changes over the long term (5 – 10 years) to these measures since wider economic and social changes and/or other changes to travel will also impact these factors.

5. Scale and time frame

5.1 Introduction

This section reviews evidence on the size of 'induced travel' impacts measured or forecast and the time scales over which these impacts have been seen to occur.

5.2 Scale of the effect

The impact of induced traffic is usually measured in terms of elasticities. Elasticities are expressed as a decimal and express the strength of the relationship between two factors, specifically, the percent difference in one variable resulting from a 1% difference in another. For example an elasticity of .5 in lane kilometres means that increasing road capacity by 10% will increase VKT by 5%.

Studies that track induced traffic over time have shown that effects continue to accrue over time. Elasticities in the short-term (1-5 years) usually range from near zero to .4 whereas long-term (5-10 years) elasticities range from .5 to 1.0 (Schiffer et al. 2005). That is:

A 10% increase in lane capacity can cause up to a 4% increase in VKT in the short term and up to a 10% increase in VKT in the long term.

Table 5.1 shows the range of elasticities across a range of empirical studies.

Table 5.2: Review of induced travel elasticities

		Lane km elasticity		Travel time elasticity**		
Paper	**Data used**	**Short-term***	**Long-term***	**Short-term**	**Long-term**	**Improvement type**
Cervero, Hansen 2001	32 CA counties	.56	.78			Widening
Hansen, Huang 1997	CA counties	.3	.68			Not specified
Hansen, Huang 1997	CA metro level	.5	.94			Not specified
Marshall, 1996	TTI Congestion Study	-	.76 - .85			Not specified
Rodier, et al 2001	Sacramento regional	-	.8 - 1.1			New road and widening
Strathman, et al 2000	Nationwide NPTS data	-	.29			Not specified
Cervero, 2001	24 CA corridors	.29	.64			Widening
Fulton, et al 2000	MD, VA, NC, DC counties	.3 - .5	.47 - .89			Not specified
Hansen, et al 1993	CA highway	.2 - .3	.3 - .6			Widening
Mokhtarian, et al 2000	CA highway	.0	-			Widening
Noland 2001	State-level	.3 - .68	.7 – 1.0			New road and widening
Noland 2001	State -level	-	.5 - .8			New road and widening
Noland, Cowart 2000	Nationwide metro level	-	.81 – 1.0			Not specified
Noland, Cowart 2000	Nationwide metro level	.3	-			Not specified
Cervero 2002	24 CA corridors	.1	.39			Not specified
Hansen, et al 1993	California county	.46 - .5	-			Widening
Hansen, et al 1993	California metro level	.54 - .61	-			Widening
Goodwin 1996	Petrol price evaluation			-.5	-1.0	Not specified
Barr 2000	Nationwide NPTS data			-.3	-.4	Not specified

Overall	Range	.0 - .68	.29 – 1.1	-.3 – -.5	-.4– -1.0
	Average	.35	.69	-.4	-.7
Widening projects	Range	.0 - .58	.45 - .78		
	Average	.36	.62		

**Depending on the study, "short-term" is generally one to five years; "long-term" is generally five to ten years.*
***Travel time elasticities compare induced traffic to savings in travel time. An elasticity of -.5 means that a reduction in travel time of 10% will increase traffic volumes by 5%.*
Source: (Schiffer et al. 2005)

Table 5.1 shows that:

- The range of elasticities is quite broad across different studies. However when elasticities are measured using travel time savings instead of lane kilometres increases the range of average values narrows.
- Furthermore when one considers only those projects that widened roads (a situation most similar to clearway extension), the range of average elasticities are relatively narrow.
- Average short term lane km elasticities range from 0.0 to 0.68 with an average value of 0.35.
- Average long term lane km elasticities are higher with a range of 0.29 to 1.1 and an average value of 0.69.

Table 5.1 also includes the average elasticity for projects involving only road widening. These projects might be more readily associated with clearways since clearways effectively remove a parking lane acting to widen the road. For road widening projects Table 5.1 suggests that:

- Average short term lane mile elasticities range from 0.0 to 0.58 with an average value of 0.36.
- Average long term lane mile elasticities are higher with a range of 0.45 to 0.78 and an average value of 0.62.

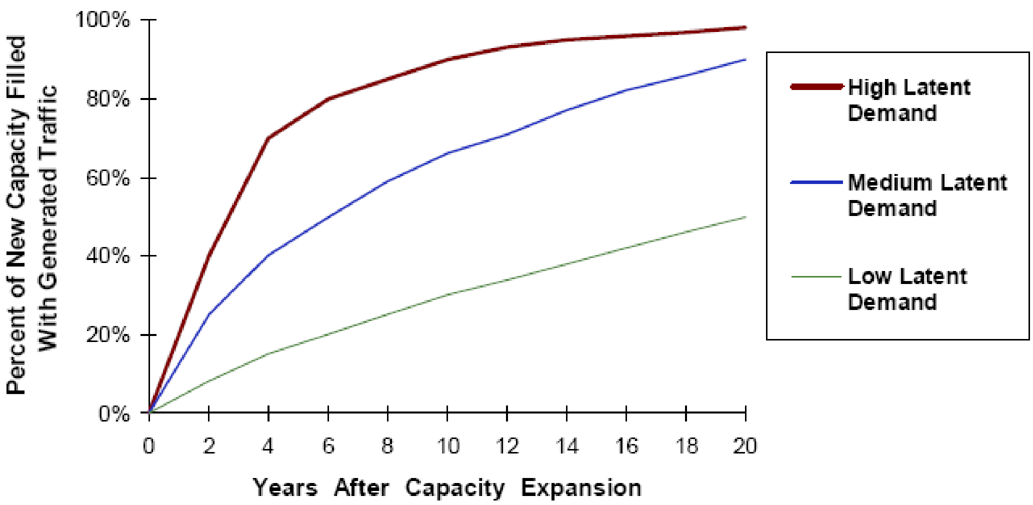
Elasticities near 1.0 are of particular significance as they indicate that all increased capacity may be filled with induced demand. Table 5.1 indicates that elasticities around 1.0 have only been computed in long term evidence (5-10 years). Three out of the 13 studies making long term estimates quoted values in this range, one with a value above 1. Hence long term values of 1.0 are known to have been reported in the literature but are represent a minority cases in the evidence.

Elasticities of 0.0 are also interesting since they suggest that induced travel doesn't occur. Only one study out of the 17 lane km based studies quoted found an elasticity of zero. This suggests that it is indeed very rare for studies to conclude that capacity expansion has no effect on demand.

The evidence shown in Table 5.1 is entirely from overseas sources. However the concept is widely acknowledged in local studies (e.g. ARRB Consulting and SJ Wright & Associates 2006; Booz Allen Hamilton 2006a; Booz Allen Hamilton 2006b; Competition and Regulation Working Group 2006; VCEC (Victorian Competition & Efficiency Commission) 2006). In each of these cases only international evidence is quoted. This is a lack of local evidence on the subject.

5.3 Time frame

The rate at which the additional capacity is absorbed is not linear. Studies suggest that there is a sharp increase in VKT in the first few years after a project is completed, after which the rate of increase slows (Hansen 1998; Litman 2001). There is also evidence that latent demand influences the initial rate at which increased capacity is absorbed. Figure 5.1 models the rate at which new capacity is filled depending on the degree of latent demand.



Source: (Litman 2001)

Figure 5.3: Rate of capacity uptake by latent demand

Figure 5.1 suggests that corridors with higher latent demand (and generally, greater congestion) absorb additional capacity through induced travel at a faster rate than routes with low latent demand. In general higher impacts result from induced travel when congestion is greater.

5.4 Aggregation effects

A further influence on the size of elasticities is the level of aggregation of data. When the effect on individual roads are measured, elasticities tend to be in the lower range; comparable studies that look at induced traffic at the metropolitan or region-wide level find higher elasticities (Luk and Chung 1997; Hansen 1998). This pattern suggests that much of the travel induced by road improvements happens away from the expanded road resulting in "downstream congestion". As section 6.2 suggests, downstream congestion is one consequence of induced travel that affects the adjoining road network.

5.5 Scale of capacity increase evidence

None of the evidence cases documented in Table 5.1 refer to clearway removal projects. Furthermore all of the evidence concerns large road development projects such as the construction of freeways. An unanswered issue of importance is the degree to which evidence of this type is applicable to smaller scale road capacity increases such as clearway removal. There is no guidance from the literaturte either way on this issue.

6. Impact of induced travel

6.1 Introduction

This section examines the impacts of 'induced travel' in the long and short term.

6.2 Short-term Impacts

Increasing roadway capacity has the immediate benefit of reducing the time-cost of travel, which is what creates induced traffic. However induced travel imposes a range of costs on the system and individual.

Litman (2009) summarises these costs by the type of trips generated (Table 6.1). Trips diverted from other routes can cause congestion in other parts of the network as more people attempt to access the improved route. Where people decide to take longer trips using the improved route, the increase in travel distance imposes costs on the road system, increases crash rates and pollution, increases petrol consumption and imposes a barrier effect on non-motorized travel. Generated trips (those that would not have occurred if the road had not been improved) impose all of the costs of longer trips plus the additional requirements of parking, reduction in public transport efficiency (where mode was shifted) and development of vehicle-dependent travel.

Table 6.3: Immediate impacts of roadway capacity expansion

Diverted trips	Longer trips	Induced trips
Downstream congestion	Downstream congestion	Downstream congestion
	Road facilities	Road facilities
	Traffic services	Traffic services
	Per-capita crash rates	Per-capita crash rates
	Pollution emissions	Pollution emissions
	Noise	Noise
	Petrol consumption	Petrol consumption
	Barrier effect	Barrier effect
		Parking facilities
		Transit efficiency

Source: (Litman 2009)

6.3 Long-term impacts

Immediate impacts of induced travel are relatively easy to identify and measure. Long-term impacts are difficult to isolate from other influences but can have significant impacts on cities. Two impacts that have received some attention are the impact of road improvements on development patterns (particularly urban sprawl) and reduction in public transport use.

It seems reasonable to associate increasing travel speeds through large-scale road projects with the stimulation of urban sprawl. After all why pay for expensive inner-city housing if one can purchase a cheaper house in a distant suburb with a quick commute into the city? But these effects are complex to measure and are usually confined to studying the impacts of new freeways or significant freeway widening. A number of studies have attempted to empirically demonstrate long-term land use changes as a response to roadway improvements with limited results (Luk and Chung 1997; Ewing and Lichtenstein 2002). However this effect is accepted to the extent that indirect effects such as land-use changes are now being cited in regulatory and compliance contexts (Transportation Research Board 1995; The Louis Berger Group Inc. 1998).

Another possible long-term impact is a shift from alternative transport modes to car travel both through immediate mode shift and under-investment in public transport as a result of car-dependent sprawl. Several studies in Australia have studied the impact of freeway improvements on heavy rail travel. Zeibots & Petocz (2005) found a statistically significant decline in rail journeys following the opening of Sydney's M4 Motorway. Mewton (2005) documented declines in rail journeys as a response to the opening of the Sydney Harbourt Tunnel and Gore Hill Expressway though bus patronage was unchanged. In Melbourne, Luk & Chung (1997) attempted to discover whether improvements to the Monash Freeway in the 1980s resulted in a decrease in patronage to parallel train services but their work was hindered by a lack of data on train patronage.

All of these studies are primarily limited to assessing the impact of large-scale road projects on heavy rail. The impact of road improvements on on-road public transport has not been empirically assessed but will be discussed in section 8.

7. Induced travel and clearways

7.1 Introduction

This section focuses on evidence associated with 'induced travel' and the clearway type measures proposed in current VicRoads plans for inner Melbourne.

7.2 Induced travel and clearways

To date no research has been conducted on the induced travel effects of clearways. Indeed all of the research evidence presented in Table 5.1 concerned much larger road development projects such as freeways.

Melbourne's system of clearways is virtually unique internationally and research into clearways as a whole is quite limited. When Sydney considered extending its clearways beyond peak periods in the 1970's and early 1980's, several reports assessed the possible impacts (Hallam and Dimitric 1978; Moore 1983). A report was commissioned by VicRoads in 2001 into a kerb lane management plan for Melbourne (Holdsworth 2001). The only city outside of Australia with a similar arrangement is London's "red routes" which are no-parking zones on major arterial roads; however unlike Melbourne these restrictions last throughout the day (Holdsworth 2001). Whilst these studies discuss the congestion-reduction impact of clearways, none of them address the contribution of induced travel.

It could be theorised that adding a clearway to a road is similar to adding new lanes to an existing road. In theory a clearway would increase lane capacity by 100% if the road had two lanes in one direction and one lane was used for parking. Indeed it might also be theorised that capacity may be increased more than 100% in this case. 'Parking friction' can reduce road capacity on roads with kerbside parking. A clearway would add a new lane of road for traffic use by removing parking but also removes 'parking friction' effects for traffic using lanes adjacent to parking lanes.

These comments are entirely theoretical since no evidence of clearway effects is available. However they are not implausible. If it is assumed that road capacity is increased by 100% as a result of clearway removal and the evidence shown in Table 5.1 is applied average short and long term elasticity values of 0.36 and 0.62 might be adopted. Applying these would suggest that 36% of increased capacity would be taken up by induced travel with 1-3 years. Over 5-10 years 62% might be expected to be taken up.

The research evidence also suggests that induced travel impacts will be higher in areas with higher base congestion and lower in less congested areas.

8. Induced travel and on-road public transport

8.1 Introduction

This section reviews evidence associating the phenomenon of 'induced travel' with impacts on bus and tram services.

8.2 Induced travel and public transport

Research into induced travel and public transport considers whether reducing the cost of car-based travel will entice travellers away from public transport. In the short-term people may gravitate away from public transport if car access is improved; in the long-term increased car dependence (through increased travel speeds or land use change) can reduce investment in public transport (Litman 2009). However empirical evidence of this effect is constrained to large-scale road projects and heavy rail-based public transport (Luk and Chung 1997; Mewton 2005; Zeibots and Petocz 2005).

The impact of road improvements on on-road public transport has rarely been studied. Presumably a reduction in congestion would increase the travel speeds of on-road public transport, counteracting the effects of mode-shifting within the improved route. Indeed Mewton (2005) found a decrease in rail patronage but no decrease in bus patronage after a major Sydney road project.

Congestion has a major impact on tram speeds in Melbourne because 67% of streetcar track is in mixed traffic (Currie and Shalaby 2006). Research suggests that tram speeds are more affected by congestion effects than by traffic per se, as tram speeds have declined faster than peak road traffic speeds (Currie and Shalaby 2006). This suggests that if tram speeds are increased by congestion relief then tram patronage may actually rise. Furthermore, traffic congestion reduces tram reliability which may further compound (and possibly exceed) this effect (Currie and Shalaby 2006).

8.3 Public transport elasticities

Public transport has its own measures of elasticity in response to travel time and reliability. Studies on the relationship between bus patronage and in-vehicle time are limited in Australia but international evidence suggests elasticities of -.1 to -.5 with a central estimate of -.3 (Booz Allen Hamilton 2003). That is, reducing in-vehicle travel time by 10% will increase patronage by approximately 3%.

Reliability is a complex factor to measure but is often defined as the standard deviation of arrival times (Bates et al. 2001). There is only limited research on the effects of reliability on patronage but where services are irregular, estimates of elasticity range from -.6 to -1.0 (Booz Allen Hamilton 2003). That is, reducing the standard deviation of arrival times by 10% may increase patronage by 6% to 10%.

However it is important to remember that induced traffic on the improved route will eventually act to increase congestion. This may in turn counteract initial increases in public transport patronage as services become slower and less reliable in the long term.

9. Conclusions for Boroondara

In Boroondara, **induced travel** would be any increase in vehicle kilometres travelled as a response to the extension of clearway times or clearway operations of any kind.

No specific evidence from previous research has been found relating induced travel to clearway conditions. This is because clearway operations are quite rare internationally. Most of the evidence concerning induced travel is from overseas sourced and concerns large road widening projects such as freeways. It is unclear if this evidence is applicable to smaller scale road traffic measures such as clearways.

Published evidence suggests that on average and with all other things being equal, a road with a 100% increase in lane capacity might be expected to generate an increase in traffic of 36% within 1-3 years and a 62% increase in 5-10 years. In practice the extent of induced travel will depend on how congested the roads were before changes to capacity are made. If roads are not currently congested it is unlikely that induced travel will be high.

Some of the evidence suggests the impacts of induced travel could remove all benefits of new road capacity in the long term. While evidence of this type is not the norm it has been demonstrated in 3 of the 13 long term studies identified. One research study suggested that induced travel will have zero impact. Evidence of this kind is rare and unusual. Many local studies into traffic congestion have noted that induced traffic impacts are valid however no local evidence on the scale of impacts has been produced.

It could be theorised that adding a clearway to a road is similar to adding new lanes to an existing road. In theory introducing a new clearway would increase lane capacity by 100% if the road had two lanes in one direction and one lane was used for parking. Indeed it might also be theorised that capacity may be increased more than 100% in this case. 'Parking friction' can reduce road capacity on roads with kerbside parking. A clearway would add a new lane of road for traffic use by removing parking but also removes 'parking friction' effects for traffic using lanes adjacent to parking lanes.

These comments are entirely theoretical since no evidence of clearway effects is available. However they are not implausible. If it is assumed that road capacity is increased by 100% as a result of clearway removal and that international evidence is applicable, then it can be suggested that 36% of increased capacity would be taken up by induced travel with 1-3 years. Over 5-10 years 62% might be expected to be taken up.

If clearway extensions act to improve the travel time and reliability of bus and tram services then patronage on these services may be expected to increase. Based on previous evidence, the amount of increase will be approximately 3% for every 10% reduction in total travel time plus an additional 6% to 10% for every 10% increase in reliability. It the travel time and reliability benefits of clearways are eroded by induced traffic, any increases in ridership would be counteracted by declines in ridership due to reduced reliability and lower travel speeds.

Induced travel research suggests that the benefits of clearways may not be as simple or as large as they may immediately appear. Increased road capacity from clearways is likely to improve traffic and public transport travel times in the short term; however road capacity benefits may not last into the long term.

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