

Time and space travel by Brisbanites during road space restrictions: Are people smarter than traffic models?

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Abstract

The Infrastructure Restriction Behaviour Impact Study (IRBIS) aimed to understand the travel behaviour impacts of the closure of a lane on Coronation Drive in Brisbane for 8 weeks for construction works from 1 November to 19 December 2009. The study quantified the impact of restricting lane capacity on a major arterial, and provides learnings and recommendations for future similar projects and for congestion management in major cities.

The lane restriction was expected to generate additional traffic congestion with delays of up to 50 minutes and long queues. However, the impacts were not nearly as severe as anticipated on Coronation Drive. This raised the fundamental question of “where did the traffic go?” Alternately, the question could be “why did the modelling get it so wrong?”

IRBIS represents the first time a Queensland road authority has been able to quantify the full travel behaviour change impacts of *planned* road works. Both survey data and traffic data were analysed. By comparison, the Riverside Expressway Transport Investigation and Network Analysis (RETINA) study quantified the impact of an unplanned closure in 2006.

Four in ten people surveyed in the study made some kind of change to their travel behaviour due to the lane restriction. The study concluded that people respond to capacity restrictions on major roads in fairly predictable ways - change travel route, time, mode, and cancel/postpone. If the congestion is likely to be severe due to capacity reductions, some trips “disappear” (onto other modes, are cancelled, and so on). The findings indicate that road works in areas where there are viable public transport and active transport facilities could be seen as an important “tool” or opportunity in achieving long term mode shift.

1. Introduction

The Infrastructure Restriction Behaviour Impact Study (IRBIS) (DTMR 2010a) aimed to understand the travel behaviour impacts of the closure of a lane on Coronation Drive in Brisbane for 8 weeks for construction works in November and December 2009. Based on the traffic modelling, the lane restriction was expected to generate additional traffic congestion with delays of up to 50 minutes and long queues. However, the impacts were not nearly as severe as anticipated. This raises a fundamental question of “where did the traffic go?”

Alternately the question could be “why did the models get it so wrong?” or more particularly, what could be done to better account for any shortfalls in the models used?

In asking either of these simple questions a more complex set of enquiries are prompted:

- Did drivers simply choose another route or did they make a more complex package of decisions involving mode, time and route choices?
- What prompted people to make those choices and did they continue with that choice
- Were their behaviour changes detectable in transport system data?
- What were peoples’ perceptions of their new travel choices?

The Queensland Department of Transport and Main Roads initiated IRBIS to quantify the impact of restricting lane capacity on a major arterial and to gain insight into these questions. The study represents one of the few attempts worldwide to quantify the impacts of *planned* capacity restrictions on travel behaviour. It is a companion piece to another study titled *Riverside Expressway Transport Investigation and Network Analysis (RETINA)* also conducted by the Department of Transport and Main Roads published in 2010. The RETINA report considers the impact of an unplanned capacity restriction on travel behaviour (DTMR 2010b).

This paper considers the data and findings of IRBIS and RETINA and discusses the important implications for future planned and unplanned events and for congestion management generally in major cities.

2. Background and project context

Coronation Drive is a major arterial leading from the western suburbs of Brisbane into the Brisbane Central Business District (CBD). It is approximately 3 kilometres long and runs from the western edge of the City to the suburb of Toowong, a major commercial centre. Running parallel to Coronation Drive and within 700 metres are a number of major transport routes such as Milton Road, another urban arterial, the Ipswich rail line and the Brisbane River.

Coronation Drive carries around 65,000 vehicles per day and 29 scheduled bus services which carry between 150,000 and 200,000 passengers per week (DTMR 2010a). It is generally busy most of the day in both directions as it forms the main road connection between the largest and second largest trip attractors in Brisbane – the CBD and University of Queensland respectively. It also provides direct access to major destinations such as the Wesley Hospital and Toowong Village Shopping Centre. This contrasts it with most other urban arterials leading into or through the Brisbane CBD, which generally have more pronounced inbound morning and outbound afternoon flows. This added to the complexity of managing the restriction by limiting management options such as tidal flow arrangements.

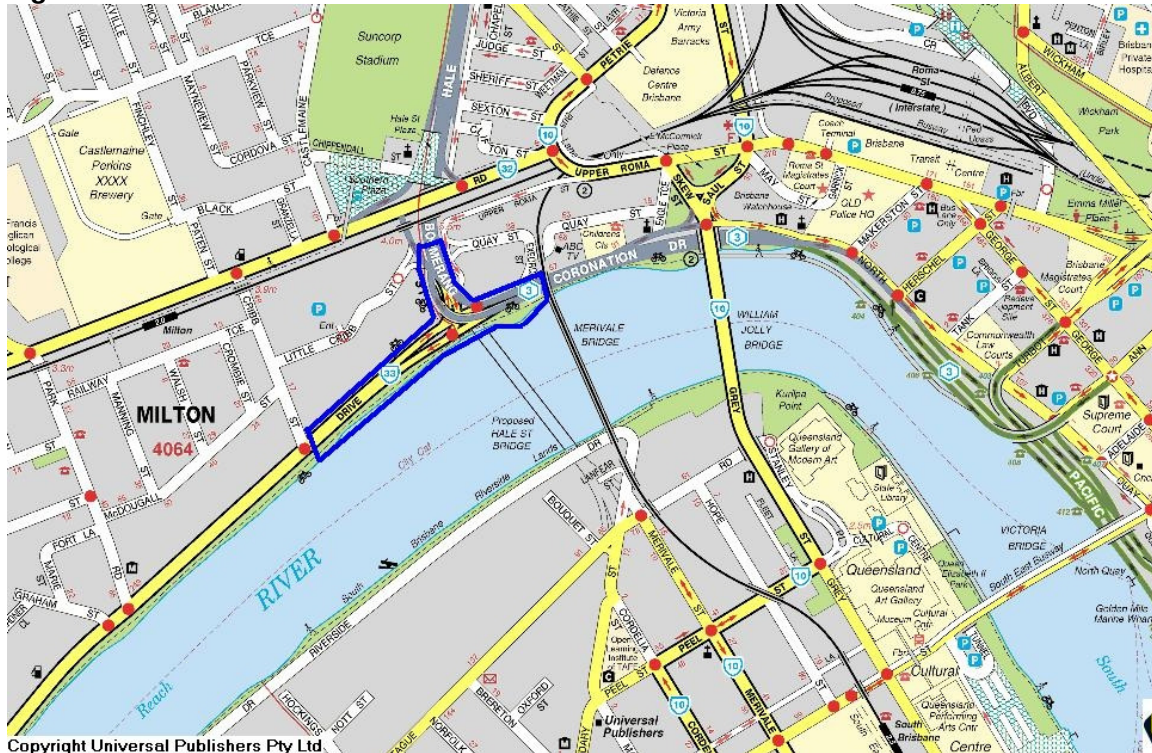
From Sunday 1 November 2009 to 28 February 2010, Brisbane City Council, the road owner, programmed major changes to traffic conditions on Coronation Drive.

The works were required to complete construction of the Coronation Drive overpass as part of the “Go Between” Bridge project, which was joint venture between Brisbane City Council

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and a construction consortium called Hale Street Link Alliance. The extent of the works is shown in Figures 1 and 2.

Figure 1: Coronation Drive – extent of works on northern side of river.



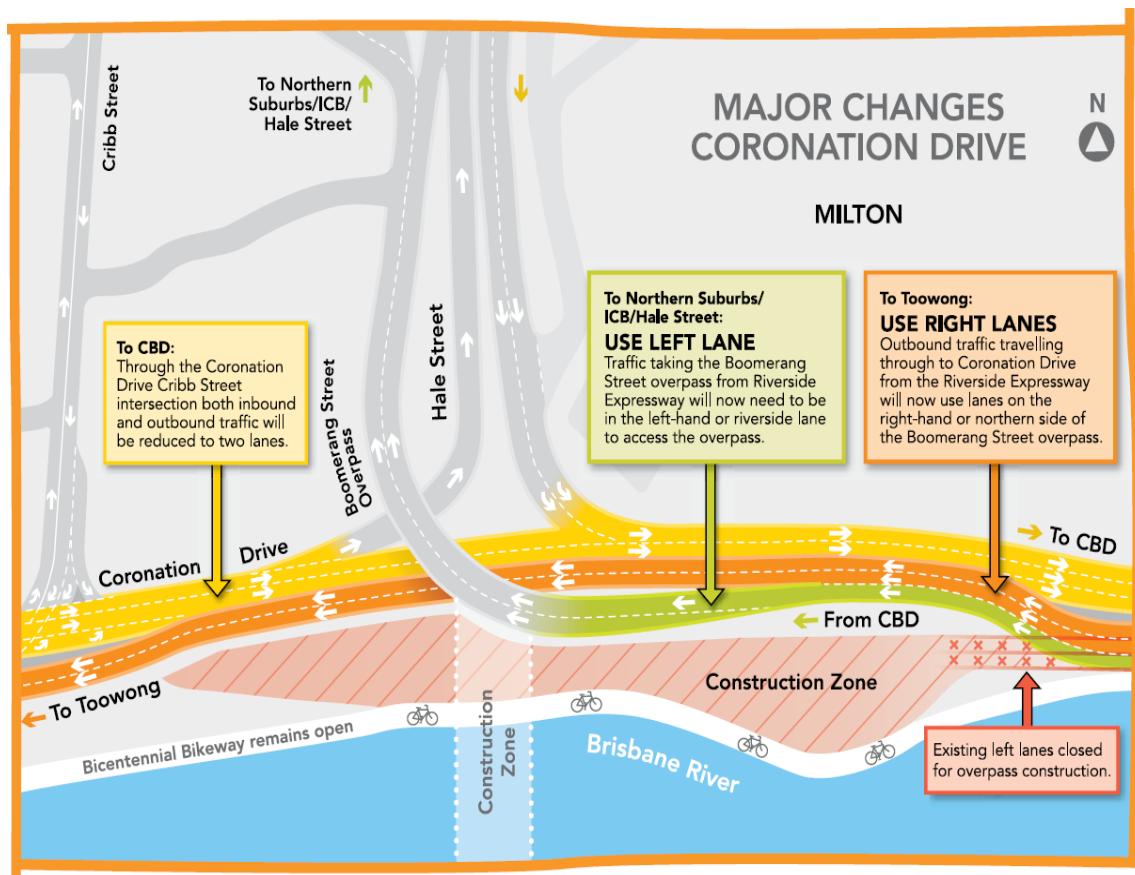
Source: Hale Street Link Alliance 2009a.

The restrictions were put in place for the construction of a viaduct to take westbound traffic on Coronation Drive over the new Go Between Bridge which was also under construction.

The restrictions occurred over a 500m section of the CBD end of Coronation Drive with the inbound lanes being reduced from three to two. The outbound lanes remained the same but traffic taking the Boomerang St Overpass had to use the left hand or river side lane rather than the inside lane. See Figure 2 below.

It is important to note that construction of the Go Between Bridge had been underway for over a year and that other construction related restrictions had been in place, most notably the removal of a right hand turn lane from Hale Street onto Coronation Drive westbound. The viaduct works were ultimately completed by 19 December 2009 – more than two months earlier than anticipated. The lane restrictions were then lifted.

Figure 2: Changes to Coronation Drive during overpass construction



Source: Brisbane City Council 2009a.

3. Predicted impacts and traffic management responses

The impacts of this stage of the works (based on SIDRA and Paramics modelling) were predicted to be quite significant on a number of the affected routes, such as Milton Road and Hale Street, a 6 lane distributor for the Inner City Bypass. The most notable predicted impacts made by the Hale Street Link Alliance (2008, pp. 35-36), were:

- 40 to 50 minutes on Coronation Drive eastbound in AM peak and 10 to 20 minutes in PM peak
- 5 to 15 minutes on Coronation Drive westbound in AM peak and 20 to 30 minutes in PM peak
- 20 to 40 minutes on Milton Road eastbound
- 10 to 20 minutes on Milton Road westbound
- 10 to 20mins on Hale Street southbound
- 10 to 20 minutes for right turn from Hale Street to Coronation Drive via Milton Road (compared to existing right turn via Hale Street/Coronation Drive intersection).

These same delays were also expected to apply to bus travel times. The traffic models were calibrated using 2007 traffic data which was collected prior to the tidal flow arrangement being removed from Coronation Drive but were adjusted to take this into account.

The models were run using the various traffic management schemes proposed by the Hale Street Link Alliance. However, the models used were based on the assumption that the traffic demand for trips in this area would not change with the construction impacts in place and hence did not account for delayed, postponed or removed trips or for trips diverted to alternative modes. The results cited above therefore represent the worst-case outcomes if no one changed their travel behaviour.

It is important to note that when a system is near capacity, and an additional traffic capacity constraint is added, doubling or tripling of delays output from traffic models is not unusual. This is because these models do not contemplate the range of alternative options available to travellers to collectively minimise the added inconvenience to their daily routines. This is a common shortcoming of conventional urban transport models being used for testing in at/near capacity environments.

The Hale Street Link Alliance and Brisbane City Council used multiple measures to reduce the impact of the traffic lane restriction on the travelling public including:

- Timing/scheduling of works during university and Christmas holidays, and restricting additional necessary lane closures to night time and weekends
- Active worksite management – using feedback from inspections, traffic data and users to monitor and adjust signals and manage traffic operations; presence of police around the works and pre positioning of breakdown vehicles on the route
- Managing the cumulative impact of multiple projects across Brisbane, and in particular, minimising the impact of the nearby North South Bypass Tunnel (now “Clem 7”) by maintaining peak period capacity on the Inner City Bypass
- Additional public transport including an extra morning and evening peak hour service on the Ipswich line which parallels Coronation Drive
- Media and communications to inform the community of the likely delays (Hale Street Link Alliance 2008).

4. International experience with capacity restrictions

Studies which quantify the actual changes people make to their travel behaviour in response to temporary or permanent traffic lane capacity reductions are relatively rare. The most extensive study of real world examples of traffic lane restrictions to date suggests that predictions of “traffic chaos” rarely eventuate. Rather, “the misleading expectations of ‘traffic chaos’ are produced by assumptions that the total amount of traffic is insensitive to changes in congestion” (Cairns et al 1998, p. 31).

Travel behaviour responses to lane capacity restrictions seem to vary depending on the level of disruption expected - “Typically people make minor changes if possible, and major ones if necessary” (Cairns et al 1998, p. 31). In some cases, such as with “road diets”, there is sufficient “spare capacity” in the road even after lane capacity reductions which absorb existing traffic without causing undue delay.

In some cases, there is spare capacity on alternative routes or at different times of the day. Changes to route and time of journey are the most universal response and generally account for the majority of changes people report in response to lane capacity reductions. If the congestion is likely to be severe due to capacity reductions, some trips “disappear” (onto other modes, are cancelled and so on) (Cairns et al 1998, p. 29). These patterns seem to be consistent across case studies internationally. However, the extent to which this can happen depends on the kinds of options available.

The Netherlands is applying mobility management approaches during works on major arterials to achieve very high levels of mode shift and other travel behaviour changes. This allows “short and fierce” works to be done, minimising delay and exposing a large number of people to public transport and other travel choices in the process. Mobility management options need to be customised for specific situations and targeted carefully. It is not sufficient to just “rent a bus” and expect people to use it (De Munck and Pauwel 2008).

There is a high degree of variability in day-to-day traffic in normal conditions which may make it difficult to accurately model the impact of changes to lane capacity. However, when capacity reductions are made, there is good evidence that traffic alters to take account of the new conditions after a “settling down period” (Cairns et al 1998, p. 36; Clegg 2007).

Another factor affecting the ability of current modelling approaches to more accurately predict traffic impacts relate to the techniques now employed to reduce delay at work sites. Numerous techniques are now implemented across all phases of projects from pre-project system planning, to project planning, design, construction and maintenance. There is an enormous menu of techniques, methods and processes that are used which are being packaged to achieve significant time, cost and delay savings at work zones (Transportation Research Board 2000). In addition, sophisticated modelling and “smart technologies” have allowed significant gains to be made in safety and efficiency of traffic flow at work sites (Bourne et al 2008; Carr 2000; Curtis 2008; Jackson 2009).

There is also a move internationally to introduce policies about minimising delay due to work sites across the transport network as a whole. This is driving new ways to coordinate and manage delay across multiple work zones (Curtis 2008; De Munck and Pauwel 2008).

Section 7 below discusses factors that need to be better accounted for in model calibrations.

5. Study methodology

IRBIS considered two major data sets to determine how people changed their travel behaviour in response to the lane restriction on Coronation Drive.

- reported household travel data derived from surveys; and
- actual road traffic counts.

Both the behaviour change and transport system data sets were considered from a multimodal perspective. The behaviour change component of the data set sought to understand the effects on people who use Coronation Drive and parallel roads and modes predominantly in the western corridor. The transport system data collection component focused on network effects closer to Coronation Drive. It also provided some ability to validate the results of the surveys.

5.1 Behaviour change assessment derived from surveys

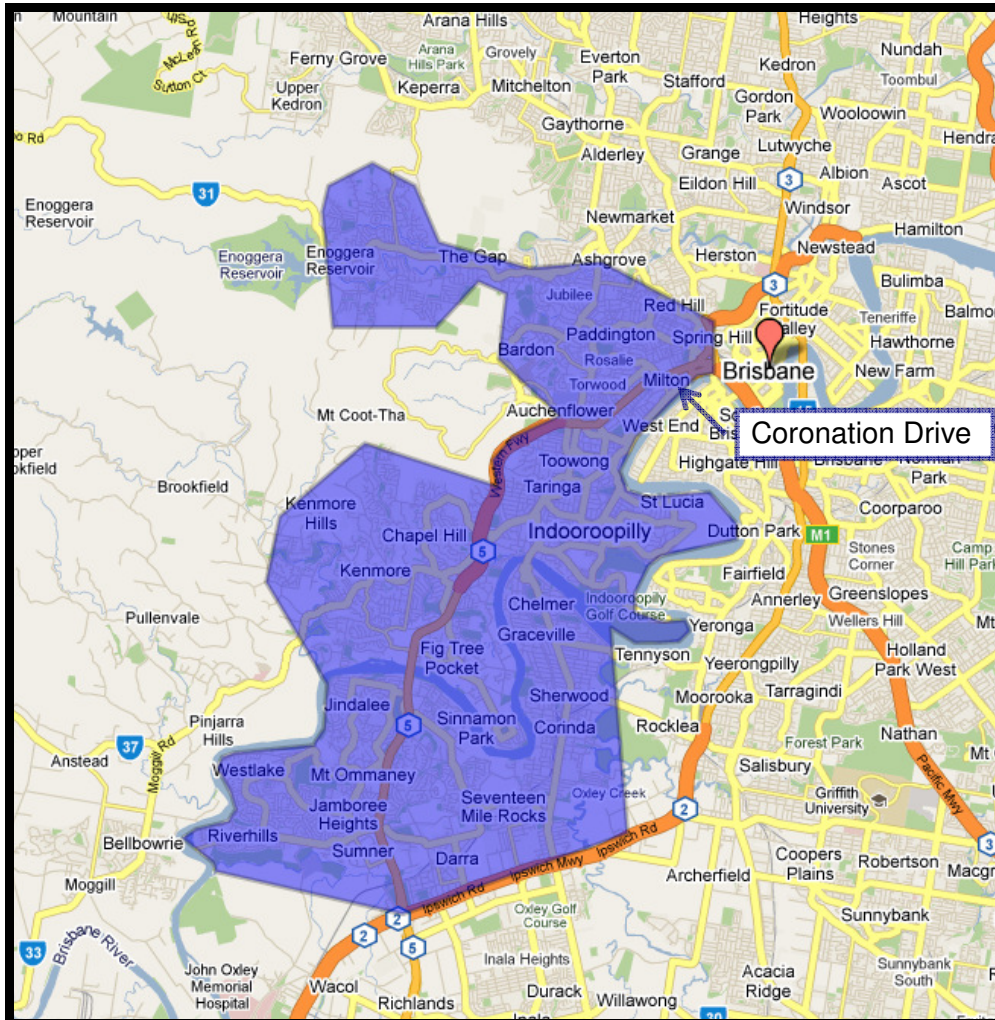
To provide a more complete understanding of total mode choice change 'Before and After' travel surveys, using telephone, of residents of households in Brisbane's western suburbs were undertaken. The first survey of 1,200 residents was undertaken in two survey periods either side of the Christmas holidays (17 to 21 December 2009 and 5 to 10 January 2010). Respondents were asked to remember their most usual trip prior to the restrictions and then during the restrictions. There were no statistically significant differences between results collected before and after the Christmas holidays.

The 'western suburbs' included in the study were done so based on the area most likely to be affected by the restrictions. Key factors considered included the most likely travel patterns of Brisbanites, natural boundaries such as Mt Coot-tha and the arterial road network that could

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provide reasonable alternate routes to Coronation Drive. Figure 3 below displays the area of western suburbs for the study.

Figure 3: 'Western Brisbane' IRBIS sampling area (blue shade)



Base map source: Google Maps 2010

A second survey was conducted from 1-15 March 2010, after traffic conditions returned to normal (i.e. return of university classes). This survey was directed only to those 224 out of the original 1,200 people who had agreed to provide their contact details for follow up after the first survey *and who had reported changing their travel behaviour in the first survey*.

The surveys therefore give us data on Western Brisbanites' travel behaviour for three periods in time.

- the weeks prior to the restriction coming into force on 1 November 2009
- during the restrictions in force from 1 November to 19 December 2010
- about ten weeks after the restrictions were lifted (early March 2010).

5.2 Transport system data collection and analysis

Two main types of analysis were conducted of traffic data – trips across a screen line, and weekday average traffic volumes by half hour intervals on Coronation Drive and other key routes around it. The aim was to determine whether the travel behaviour changes reported in

the phone survey could be detected in the transport system data. In addition, a small amount of travel speed data was analysed along with public transport patronage data and travel times, and bicycle and pedestrian counts.

6. What changed travel behaviour did Western Brisbanites make?

6.1 Changes everywhere - Route, Time, Mode and Frequency

6.1.1 Survey data

Four in ten respondents to the first telephone survey reported making some type of change to their travel behaviour due to the lane restriction on Coronation Drive. The remainder did not change – over half (51%) didn't even consider making a change. See Figure 4 below.

The results show:

- 29% of the total sample (45% of those who said they were “affected”) changed route
- 18% of the total sample (29% of those who said they were “affected”) changed time of day they travelled
- 5% of the total sample (8% of those who said they were “affected”) changed mode
- 6% of the total sample (9% of those who said they were “affected”) changed frequency (postponed between 1 and 3 trips and cancelled between 1 and 2 trips).

Figure 4: Changes made by Western Brisbanites while lane restriction where in force.

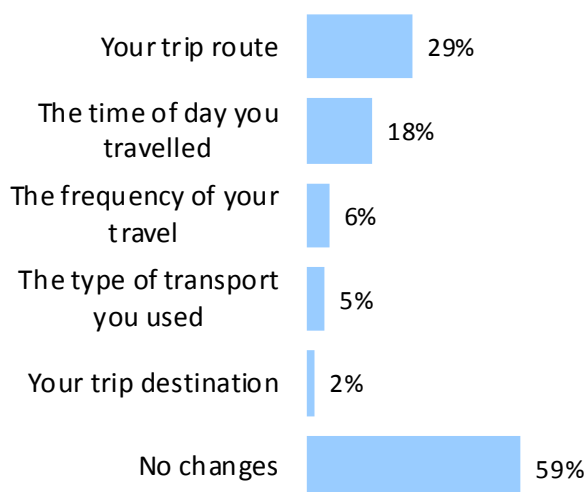


Figure 4 calculated by data generated from the 1,200 respondents in the first telephone survey carried out over 9 days between 17 December 2009 to 10 January 2010.

Respondents were asked to remember their most usual trip prior to and during the restrictions.

Source data: Enhance 2010a Survey results, unpublished technical report of the first survey to the Infrastructure Restriction Behaviour Impact Analysis: Coronation Drive.

6.1.2 Traffic count data

An analysis of inbound traffic volume changes on parallel and connecting arterial routes before and during the lane restriction on Coronation Drive supports the survey results.

The data indicates a shift of up to 20% of traffic off Coronation Drive and onto other routes. Parallel alternate routes, Milton and Musgrave Roads, had increases in average daily vehicles of 3% and 15% respectively. Hale Street (southbound), which is fed by northern arterials Musgrave and Kelvin Grove roads, had a 7% increase in average daily traffic, despite Kelvin Grove Road itself recording a significant drop (35%) in traffic volumes.

Consideration of the changes in the AM peak however shows the significant redistributive impact of the Coronation Drive restriction. Milton and Musgrave Roads, had increases in

average daily vehicles of 10% and 50% respectively. Hale Street (southbound) had a 30% increase, despite Kelvin Grove Road still recording a 30% drop.

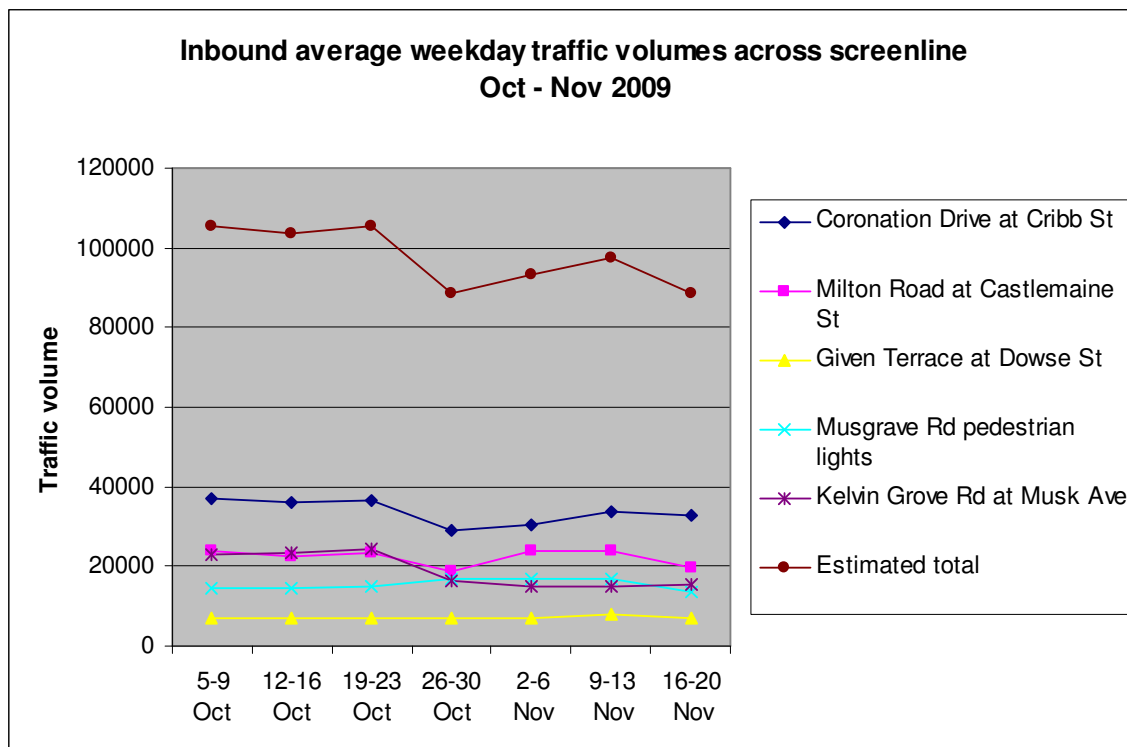
This unexpected drop in traffic on Kelvin Grove Road at Musk Ave and corresponding rise on Musgrave Road might be explained by drivers transferring off Kelvin Grove Road further upstream to Musgrave Road due to queues caused by additional traffic on Countess Street.

Milton Road at Park Road shows an unexpected slight drop in average vehicles per day during the lane restriction. This may be because of delays experienced on Milton Road due to traffic signal management measures.

Mode shift and postponement/cancellation of trips is not readily detectable in public and active transport data. However, traffic volume screen line data analysis shows a reduction in traffic of up to 10% on major arterials from the western suburbs into the CBD Frame in the first week after the lane restriction. This seems to validate the phone survey finding of mode shift and postponement/cancellation of trips.

Figure 5 below provides more detail on the weekly movements while Appendix 1a and b below show a map of the major arterials and a summary of the recorded traffic data.

Figure 5: Inbound average weekday traffic volumes across major Western CBD Frame screen lines Oct – Nov 2009



6.2 Settling in

Of those that made travel behaviour changes, 74% said they made these changes on either the first day or first week of the lane restriction and the vast majority maintained the changes for the entire lane restriction period.

However the dynamic nature of the collective decision making is highlighted by the fact that:

- Almost half (48%) of those who changed the time they travel also changed their route
- 21% of those that changed didn't do so for 2 weeks or more after restrictions commenced

- 15% of people tried two or more alternate trip choices before settling on their preferred trip. (Enhance 2010a, p. 28).

The fact that there appears to be a “settling down period” after which traffic reaches a new equilibrium is consistent with the international experience discussed in Section 4 above and underscores the additional factors that models need to account for.

Figure 5 also reveals that the drop in traffic commenced in two weeks prior to the actual restrictions coming in force on 1 November. There were no other system wide influences that could have caused this (for example school or university holidays, special events or other major new road blockages). Given this, the influence of the extensive information campaign and general media surrounding the restrictions seems to have been the major factor.

So people in Brisbane displayed similar dynamic settling in patterns to their international counterparts but, perhaps due to more extensive information, were proactive to the impending change as compared to being reactive after the restriction was in place.

6.3 Some changes to stick by

The follow-up phone survey of 224 of the respondents who had changed their travel behaviour indicated that almost three months after the lane restriction was lifted:

- Of those that had changed their mode, 72% had maintained this change for at least some trips
- Of those that had changed their trip route or time of travel, 60% maintained these changes
- Frequency of travel was the least maintained change with four in ten respondents doing so.

Figure 6 below provides more detail.

Figure 6: Changes maintained by Affected Western Brisbanites after lane restrictions are lifted

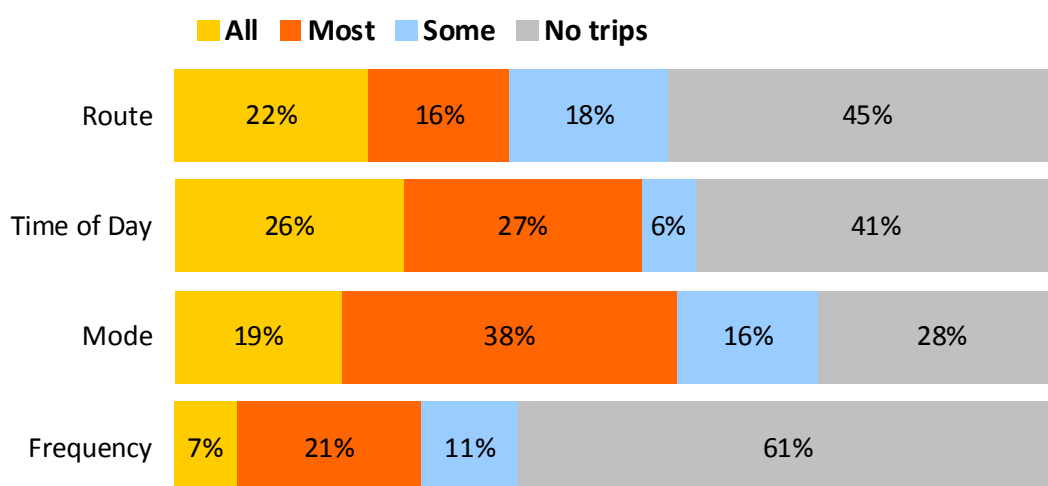


Figure 6 calculated by data generated from the 224 respondents in the second telephone survey carried out over 14 days between 1 and 15 March 2010. Source data: Enhance 2010b Survey results, unpublished technical report of the second survey to the Infrastructure Restriction Behaviour Impact Analysis: Coronation Drive.

For those whom made Route changes the major reasons stated by respondents for their continued changed behaviour was because they were still unconvinced that the congestion on affected roads/routes had eased (32%) or because their new route was easier/more convenient (24%)

For those whom made Time changes the major reasons stated by respondents for their continued changed behaviour was because their new time had less traffic (54%) or they had formed a new habit (14%). For those whom made Mode changes the major reasons stated by respondents for their continued changed were because it was quicker (35%) or cheaper (22%).

This data provides an interesting contrast between positive and negative reasons for change. Route changers are being influenced more by a negative perception of the old trip choice still not being better than their new choice while Time and Mode changers are attracted by positives of their new choice. Therefore, the prospect for long-term maintenance is greater for Time and Mode changes with Route changes being more fickle. Section 6.3 below considers respondents stated intentions to continue with their changes to test this concept.

6.4 Mode - a stickier little situation

In the second survey carried out in March 2010, respondents were also asked their intentions to continue with their changed travel behaviour. The higher commitment to change levels by those whom made Time and Mode changes during the lane restrictions was also reflected in their stated intentions to continue with the changes in the future. Figure 7 below provides more detail.

Figure 7: Intentions of Western Brisbanites to continue with their changes

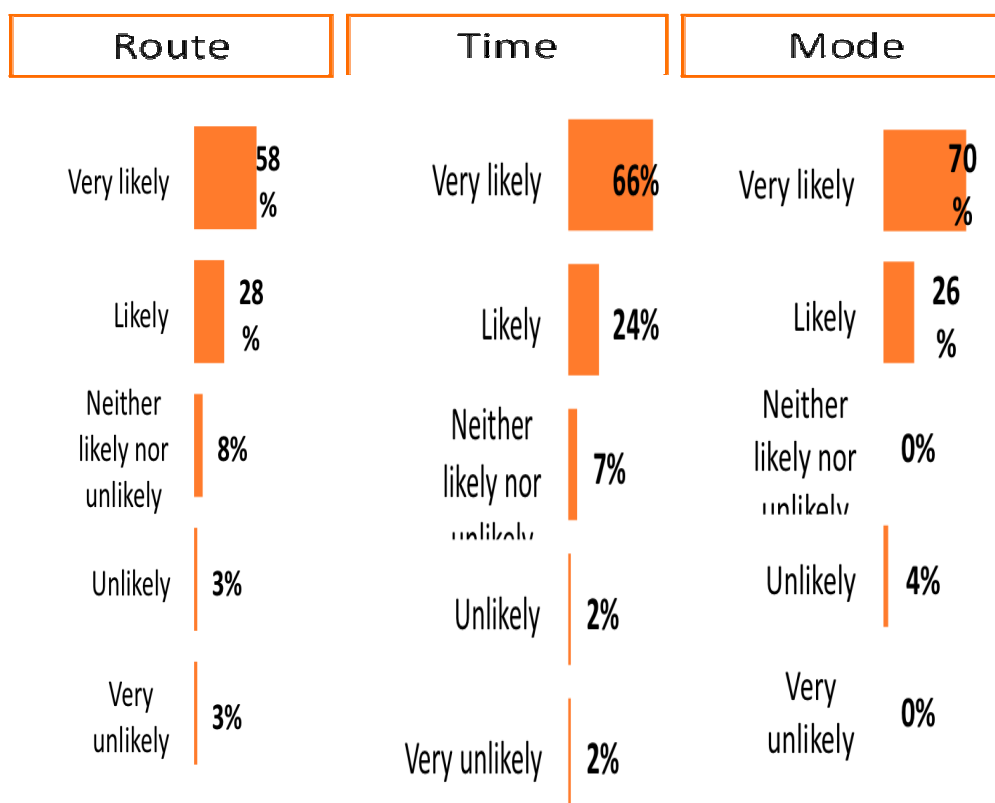


Figure 7 calculated by data generated from the 224 respondents in the telephone After survey carried out over 14 days between 1 and 15 March 2010. Source data: Enhance 2010b Survey results, unpublished technical report of the second survey to the Infrastructure Restriction Behaviour Impact Analysis: Coronation Drive.

Mode shift, although smallest seems to have slightly higher commitment levels. The benefits for this 'stickier' commitment level to Mode shifts will be to public transport.

Of the 5% of people whom changed mode 40% switched to train, 28% to bus and 12% to CityCat (ferry). Around half (47%) made this change for some trips with one in three (33%) changing for most and one in five (20%) changing for all.

About 54% of those who switched to a train switched from a single occupant vehicle and 65% of those who switched to a bus switched from a single occupant vehicle (Enhance 2010a, p. 39).

Continuation of mode changes is most likely due to the greater personal investment in making this change compared with time or route changes. Additionally, Mode changers view the characteristics of their alternative mode as the reason for maintenance. That is, they have found that using public transport or car pooling is a quicker, cheaper and easier option.

The 'stickier' commitment level to this new trip choice decision is higher than the commitment level found from Route changers which are often only maintained while the original route remains less competitive (Enhance 2010b, p. 4).

Time changers, although not as sticky as Mode changers, offer some good prospects for long-term maintenance, as is demonstrated in the popularity of flexible work place practices by many workers. Work by Marinelli et al (2010, p. 7) in comparing time shifts for workers participating in a flexible work place pilot in the Brisbane CBD Frame demonstrated that the most popular time shift was 'forward by up to 30 minutes'. This is the same pattern displayed by Time changers during both the Riverside Expressway closure and the Coronation Drive restriction.

It supports the view that Time changers are attracted more by positives than repelled by the negatives of their previous trip choices and will have higher commitment to it.

Therefore the opportunity that capacity constraints present to engender a long term redistribution of traffic in both time and mode, and aid in congestion management, should not be underestimated.

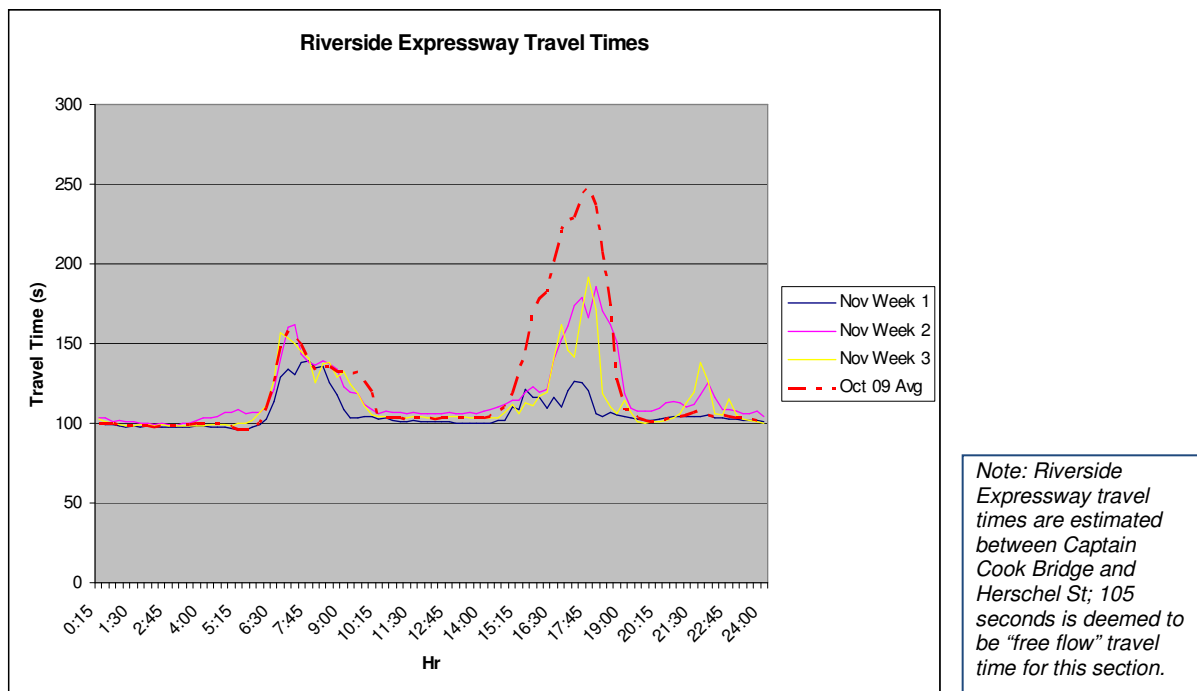
6.5 Travel delay - is perception reality?

The impacts of the lane restriction on travel delay are more difficult to ascertain. Half of the phone survey respondents in the first survey said their travel time was the same or better during the lane restriction. Travel time data was available for the South East Freeway which connects directly to Coronation Drive. Only travel times for the northbound (unrestricted) side were available.

As shown in Figure 8 below, these are well within normal range for this section of road. Without local road travel time data, no firm conclusions can be drawn but it appears that travel delays did not occur to the extent predicted in modelling on Coronation Drive. Other routes may have suffered a reduction in level of service but without travel time data, it is not possible to judge whether this was less than modelled delays.

This can be contrasted with the perceptions of those Affected Western Brisbanites of which 28% perceived that their travel time increased a lot and those 45% that perceived that their travel time increased a little. More importantly therefore may be the perceptions that people held of their time delays. If there was a perception that their original trip choice was now significantly degraded due to the restrictions, this may have been a major factor in people's decision to change.

Figure 8: Travel times northbound on Riverside Expressway



7. Discussion

Several measures in combination may have contributed to the less than expected effects of the traffic lane restriction and need to be better accounted for in model calibrations.

7.1 Better information

Effective communications was key – the phone survey found extremely high levels of awareness of the changes proposed for Coronation Drive prior to works commencing (79%), and even higher after the lane restriction was introduced (97%). This suggests the communications effort by the Hale Street Link Alliance and Brisbane City Council was very effective. Phone survey results suggested the vast majority of people were prompted to change their travel behaviour because of concerns about likely congestion. This raises a “Catch 22” situation. Had the traffic modelling been better able to predict the level of travel behaviour change that actually occurred, and if this had been used in the communication materials, it is unlikely travel behaviour would have changed to the extent it did.

7.2 Active worksite management

In addition, active worksite management and Intelligent Transport Systems (ITS) were also applied. For example, Brisbane City Council developed new real time traffic monitoring and modelling tools that may have broader and more permanent application in traffic operations and management. In addition, Hale Street Link Alliance and Brisbane City Council attempted to optimise capacity and traffic flow on major roads affected by the lane restriction with the assistance of the Brisbane Metropolitan Transport Management Centre (BMTMC), which was able to provide real time information on delays and alter traffic flows through controlled intersections in response to changing traffic levels (BMTMC Communications Manager, Pers Comm., 2009). However as noted in Section 6.1.2 above a number of roads suffered significant increases in traffic volumes, particularly in the AM peak.

7.3 Testing the overseas evidence with local data

As discussed in Section 4 numerous international studies suggest people respond to planned capacity restrictions on major roads in fairly predictable ways - they change Route, Time, Mode and Frequency (cancel/postpone). People respond to unplanned events in similar ways to planned events if the capacity restriction stays beyond a day or two. Having said that, the majority of people tend to stay in their private motor vehicles if at all possible. For this reason, changes to route and time of journey are the most universal response and generally account for the majority of changes people report in response to lane capacity reductions.

Cairns et al (1998) theorise on the effects in more detail and propose that traffic:

- first takes up spare capacity on existing road. If this is insufficient, traffic
- then takes up spare capacity on adjoining routes and at other times of the day. If this is insufficient, traffic
- then either shifts onto other modes or disappears through cancelled or postponed journeys.

In addition, when capacity reductions are made, there is good international evidence that traffic alters to take account of the new conditions after a “settling down period” (Cairns et al 1998, p. 36; Clegg 2007). Is there evidence of these same effects in Brisbane? This remainder of this section looks at each in turn.

7.3.1 Was there spare capacity on Coronation Drive?

Given the 33% reduction in inbound lane capacity it would seem that there was little or no spare capacity on Coronation Drive, particularly on the AM inbound peak. Somewhere between 15% and 25% of the traffic volume from Coronation Drive went elsewhere, especially in the morning peak.

7.3.2 Was there spare capacity on alternate routes and at other times of the day?

There was definitely some spare capacity on parallel/adjoining routes at other times of the day as evident in the peak spreading in the traffic data and as reported in the phone survey.

It is less clear whether there was spare capacity on these alternative routes during the peaks. As mentioned in Section 6.4 above, half to two thirds of the phone survey respondents reported some travel time increases on Coronation Drive, Milton Road and Hale Street. (It should be noted that about 7% of respondents felt that overall, travel time actually decreased during the lane restriction).

This suggests these roads were probably close to capacity in the peak already. Milton Road (4 lane arterial) in particular did manage to carry many of the morning peak trips re-routed off Coronation Drive. Given Terrace (a 4 lane arterial) also appears to have carried additional traffic as did local streets. In other words, the traffic spread across the whole network. Despite this, the level of delay expected seems to have been sufficient to induce mode change and trip postponement/cancellation.

7.3.3 Did trips “disappear” off the road network?

Based on the traffic screen line data and phone survey data on mode shift, it could be argued that up to 10% of trips “disappeared” off major arterials inbound to the CBD in the morning peak. How much of this might be attributable to the “holiday effect” (i.e. reduction of vehicle trips due to school and university holidays)? In the phone survey, very few people reported being on holidays during the closure.

In any one week, no more than 4% started holidays and the vast majority of these holidays were for two weeks or less. There is no significant seasonal change in traffic volumes on Coronation Drive between October and November in 2007 or 2008 which might explain trips disappearing. Therefore, most of the reduction in trips on the screen line probably could be attributed to mode shift and cancelled/postponed trips in response to predicted delays.

7.4 Testing some local evidence

If the actual traffic impacts of the project were so different to the modelled outcomes, was there a problem with the modelling? Well Yes and No!

7.4.1 Was the appropriate model used?

As discussed in Section 4, the modelling results represent the worst case outcomes if no one had changed their travel behaviour in response to expected congestion. In other words, the modelling probably represents the outcomes of an unplanned lane restriction.

The use of Paramics, which uses microsimulation modelling, assumes a finite amount of road space and doesn't reallocate trips. In the model, speeds drop as the cars can't fit into the available "space". For this reason, microsimulation can result in overestimation of congestion impacts. By contrast, the actual behaviour change displayed by Western Brisbanites showed a dynamic reallocation of trips in both time and space.

Use of a strategic model, such as the Brisbane Strategic Transport Model, that is able to reassign trips may have addressed this issue as other mode and route choices could be modelled. However, use of a strategic model alone may have underestimated congestion impacts. That is, if the number of cars can't fit into the space, this does not show up so clearly in a strategic model. Despite the increased resource requirements, a combination of strategic and SIDRA and Paramics microsimulation models working together in sequence may have given outputs that more closely aligned with the observed behaviour.

7.4.2 Influencing behaviour

Because the lane restriction on Coronation Drive was planned and very well publicised, those who were prepared to adjust their travel behaviour in some way did so. Therefore the impacts of planned events are very different to the impacts of unplanned events.

7.4.3 Understanding behaviour

There is local evidence on trip choice decisions by Brisbane transport users when confronted with a need to change their trip choice which would aid in calibrating models. The evidence is that, like their overseas counterparts, Brisbanites also prefer to change route first, followed by a time shift then a mode or frequency shift.

IRBIS has found that Brisbane drivers changed their travel behaviour in response to traffic lane restrictions in a way that is relatively consistent with similar situations both internationally and locally, for planned situations, and for unplanned situations after the disruption has been in for more than a day or two.

A strong body of evidence can be found from the surveys carried out of a random sample of 2,085 residents of the Greater Brisbane (the Brisbane Statistical Division) after the unplanned closure of the Riverside Expressway for three days in 2006. Those surveys revealed that 29% said they were affected in some way positively or negatively. The behaviour change of Greater Brisbanites was:

- 51% changed travel route
- 38% changed time of day they travelled
- 14% changed mode

- 7% changed frequency (trip postponed/cancelled)

Option choice was not exclusive, with some people combining route, time and mode changes. The behaviour changes made by the unaffected 71% of the population were not captured (Marinelli and Watson 2009, p. 6, Figure 6).

Analysis by sub region also showed that 36% those living in the Brisbane City Council area (that is, closer to the event) stated they were affected compared to the 29% average for Greater Brisbane. This seems logical given that about 70% of all trips by private car in Brisbane and Greater Brisbane are for 10kms or less (Socialdata Australia 2006, p. 7, Table 3; DTMR 2011) and that the average commute trip distance in Greater Brisbane for all modes is only 15kms (DTMR 2011). Behaviour change by sub region was not analysed for the RETINA however it is reasonable to assume that affected Brisbanites would have had have made trip choice changes in similar patters to Greater Brisbanites.

7.4.4 Modelling behaviour

Using the extreme assumption that not one of the unaffected Brisbanites decided to change a trip, then we could calculate a conservative population wide behaviour change. This estimate will in fact be very conservative as the survey results of Western Brisbanites for IRBIS showed that between 1% and 10% (depending of the behaviour change type) of those that said they were not affected in any way still made trip changes (Enhance 2010a, p. 27).

Bringing all these data sets together provides an opportunity to consider the likely range of behaviour change those living in and around Brisbane would make when confronted by similar capacity constraint events in the future. This information would be a valuable input to the assumptions to be made when calibrating future models of capacity constraint.

Figure 9 below compares this displayed behaviour change by Brisbanites to their normal trip choice when they were actually confronted by a capacity constriction due to the unplanned closure of the Riverside Expressway for three days in 2006 and the planned Coronation Drive lane restriction for two months in 2009.

It has allowed for that portion of the population that made no changes in the circumstances. It therefore represents the conservative range of behaviour change Brisbanites are likely to make in similar circumstances.

Figure 9 – Behaviour Change by Brisbanites During Road System Capacity Constraints

Behaviour Change	Riverside Expressway Closure Greater Brisbanites	Riverside Expressway Closure Brisbanites	Coronation Drive Lane Restriction Western Brisbanites
Changed route	15%	18%	29%
Changed time of travel	11%	14%	18%
Mode change	4%	5%	5%
Frequency (trip postponed/cancelled)	2%	3%	6%

Option choice was not exclusive, with some people combining route, time and mode changes.
Sources: Marinelli and Watson, 2009 p. 8, Figure 9 and Enhance 2010a, p. 27.

Riverside Expressway 'Affected Brisbanites' data was gathered from telephone surveys 16-26 November 2006 of 2,085 residents of the Brisbane Statistical Division. The Coronation Drive 'Affected Western Brisbanites' data was gathered from telephone surveys carried out for 9 days between 17 December 2009 to 10 January 2010 of 1,200 residents of selected western suburbs within the Brisbane City Council area.

This provides some strong local evidence of the likely range of changes that modellers could be confident in using to calibrate their capacity constraint models.

Depending on the function of the constrained road (Inter-urban; arterial); the alternates and the nature of the closure (planned; unplanned) modellers would have strong justification for calibrating models for planned events and longer term unplanned events to allow for:

- Route changes of between 15% and 29% of trips
- Time changes of between 11% and 18% of trips
- Mode changes of around 5% of trips
- Frequency changes of between 2% and 6% of trips.

The better the communication strategy deployed, the more confident modellers could be in these assumptions being replicated in a real life situation.

8. Conclusion: Applicability for broader implementation in Brisbane

Both the studies into the closure of the Riverside Expressway and the Coronation Drive restrictions confirm that Brisbane drivers changed their travel behaviour in response to traffic lane restrictions in a way that is relatively consistent with similar situations both internationally and locally, for both planned situations, and for unplanned situations after the disruption has been in for more than a day or two.

That is, people change their travel behaviour as much as they need to in response to the seriousness of the capacity restrictions and to the extent that alternative travel routes and options exist. People respond to capacity restrictions on major roads in fairly predictable ways – they change Route, Time, Mode, and Frequency.

Changes to route and time of journey are the most universal response and generally account for the majority of changes people report in response to lane capacity reductions.

If the congestion is likely to be severe due to capacity reductions, some trips “disappear” (onto other modes, are cancelled, and so on). These patterns seem to be consistent across international case studies where the effect has been quantified.

IRBIS findings also support the international study findings that there tends to be a “settling in” effect as a new equilibrium is reached in the transport network over time. However in the case of Brisbanites the “settling-in” effect commenced prior to the restrictions. It seems that the information campaign about expected delay was so “successful” that the traffic data shows evidence of an “early over reaction” to the lane restriction. Traffic volumes on Coronation Drive were exceptionally low. By the second and third weeks, some travellers appeared to shift back to their original route and time choices.

The lack of wide spread and deep data sets on travel behaviour change stemming from capacity constraints is a hindrance to calibrating models. However, those studies that do exist strongly support the Route, Time, Mode and Frequency logic followed by transport system users.

The evidence from the two large scale Brisbane studies (RETINA and IRBIS) is that modellers would have strong justification for calibrating models for planned events and longer term unplanned events to allow for Route, Time, Mode and Frequency changes that could move up to 30% of private car trips out of the area being modelled.

IRBIS has also found that while mode shift is the smallest change, it is also the “stickiest”. This means that customers won over to public or active travel as a result of lane capacity restrictions are more likely to stay with this choice than with mode or time changes.

It may also mean that road works in areas where there are viable public transport and active transport facilities could be seen as an important “tool” or opportunity in achieving long term mode shift. And it also suggests that road users could adapt to carefully planned and implemented High Occupancy Vehicle (HOV) lane projects or permanent lane capacity restrictions.

So are people smarter than traffic models and did the models get it so wrong?

People are smarter than the traffic models because people are making multiple dynamic trip choice decisions that traffic models currently cannot mimic. Models can however become less dumb by adopting into their assumptions some of the known travel behaviour changes that people display when a capacity constraint occurs.

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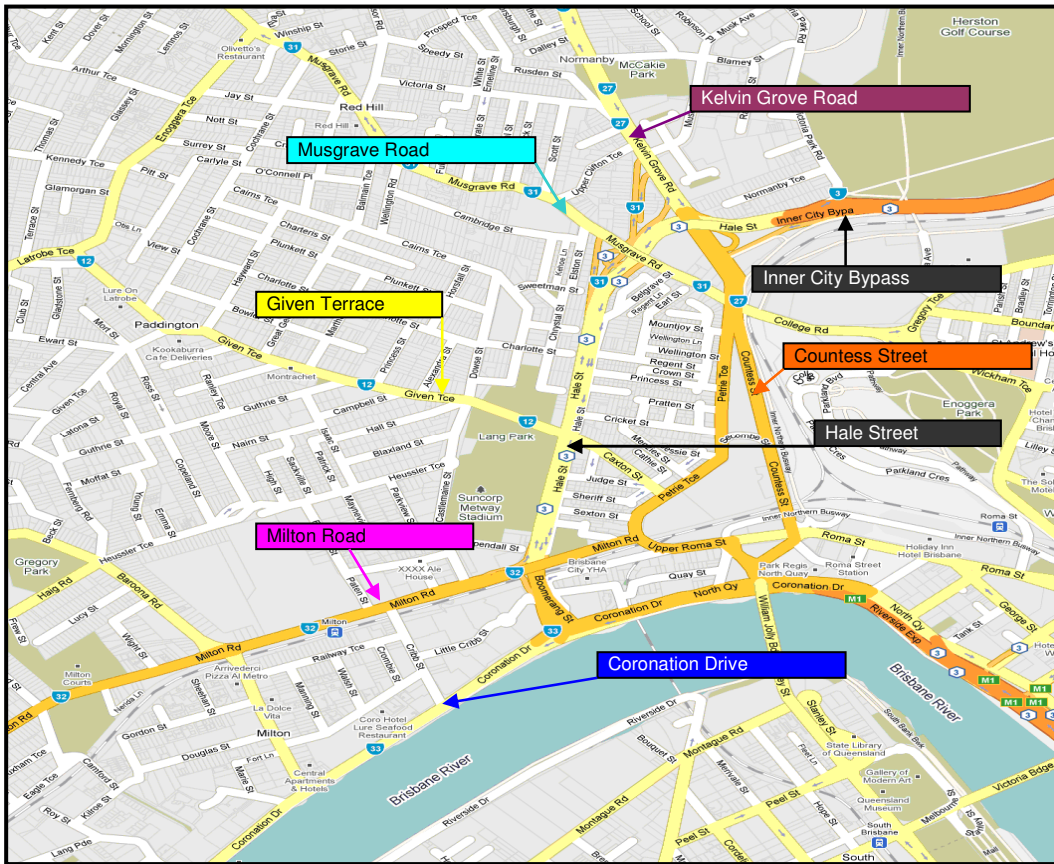
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Time and space travel by Brisbanites during road space restrictions: Are people smarter than traffic models?

Appendices

Appendix 1a: Map of major alternate and adjoining arterials near Coronation Drive



Base map source: Google Maps 2010

Appendix 1b: Summary of inbound average daily traffic volumes on major alternate and adjoining arterials near Coronation Drive

Route	October 2009 traffic volume	November 2009 traffic volume	Change	% Change	AM peak change Oct to Nov 2009	AM Peak shift Oct to Nov 2009
Coronation Drive at Park Rd	32,393	29,567	-2,826	-9%	20% less	45 mins earlier
Coronation Drive at Cribb St	36,040	33,663	-2,377	-7%	15-20% less	45 mins earlier
Milton Rd at Park Rd	24,105	23,002	-1,103	-5%	5% more	30 mins later
Milton Rd at Castlemaine St	23,231	24,009	778	3%	10% more	45 mins earlier
Musgrave Rd at pedestrian lights	14,668	16,888	2,220	15%	50% more	30 mins earlier
Kelvin Grove Rd at Musk Ave	23,298	15,151	-8,147	-35%	30% less	30 mins earlier
Hale St onramp (s'bound) at Caxton St	9,063	9,737	674	7%	30% more	-

Appendix 1b adapted from Table 8, p. 64 of the Infrastructure Restriction Behaviour Impact Analysis: Coronation Drive.
Source data: Brisbane City Council road traffic data