Response to Centre Street Bridge Closure: Where the “Disappearing” Travellers Went

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Abstract

An ongoing topic of interest in urban transportation engineering is the impact of changes in road network capacity upon the amount of vehicle travel made in the urban area. In many cases the debate focuses on the potential increases in vehicle travel occurring with increases in road capacity – the phenomenon of “induced demand”. Some studies have also looked at the effects of reductions in roadway capacity, and found that in many of these cases reductions in vehicle travel occur, generally confirming that a relationship exists between roadway capacity and vehicle travel.

This paper provides additional information on this subject, in a North American context.

The City of Calgary, in Alberta, Canada is a thriving major urban centre with a population of over 850,000, and a Downtown employment of over 100,000. Centre Street Bridge is a major road bridge across the Bow River connecting Downtown Calgary to the residential area in the north part of the City. The bridge carries over 34,000 vehicles per day, with heavy peak period flows. In August of 1999 the Centre Street Bridge was closed to car and truck traffic for a period of 14 months for major repairs.

A detailed study was undertaken of changes in weekday traffic, transit and pedestrian flows changes that took place in weekday travel patterns during the closure. This included both analysis of observed count data before and during the closure; and an interview survey with over 1,300 car users of the Centre Street Bridge and the other bridges serving the north side of the Downtown.

This paper summarizes the major findings of this study. Particular emphasis is placed on explaining what happened to the vehicle trips that used the Bridge before the closure.

1. Introduction

The City of Calgary, in Alberta, Canada is a thriving major urban centre with a population of over 850,000, and a Downtown employment of over 100,000. The city is experiencing a period of rapid growth, with population and employment increasing by over 2% annually. This growth is spread through all geographic sectors of the city.

Centre Street Bridge is a major road bridge across the Bow River connecting Downtown Calgary to the residential area in the north part of the City. The bridge carries over 34,000 vehicles per day, with heavy peak period flows. In August of 1999 the Bridge was closed to car and truck traffic for a period of 14 months for major repairs.

A detailed study was undertaken of changes in weekday traffic, transit and pedestrian flows and the changes that took place in weekday travel patterns during the closure. This included both analysis of observed count data before and during the closure; and an interview survey with over 1,300 car users of the Centre Street Bridge and the other bridges serving the north side of the Downtown.

This paper describes the overall access routes to Downtown Calgary and the bridge closure details; identifies potential changes in travel behaviour that might occur with capacity reductions, and findings from other similar situations; and summarizes the findings of the Calgary studies.

2. Access to Downtown Calgary

The Downtown area of Calgary is well defined by physical barriers; the Bow River to the north and heavy rail lines to the south. The Bow River is traversed by a total of six road bridges in the Downtown area, as shown in figure 1 below.

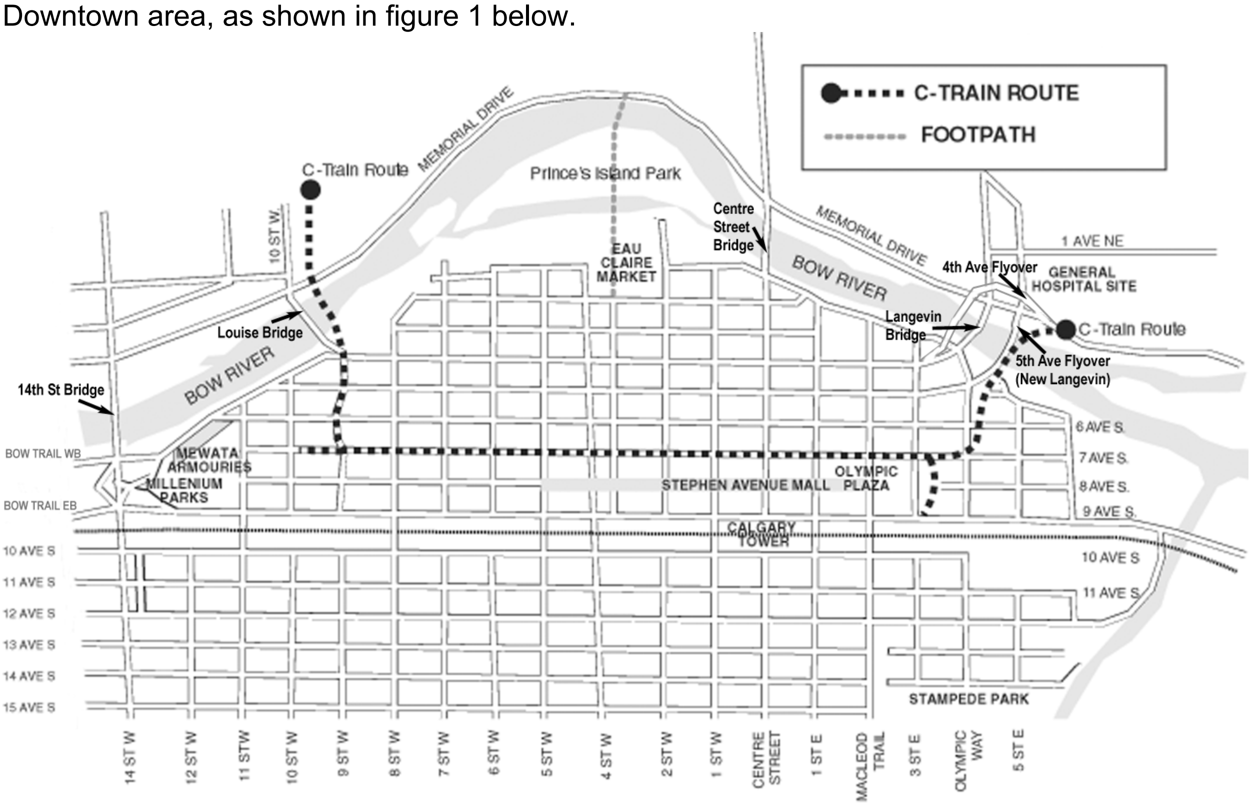

Figure 1: Calgary Downtown Access Routes.

Centre Street Bridge is a major 4-lane road bridge across the Bow River connecting Downtown Calgary to the residential area in the north part of the City, carrying around 34,000 vehicles per day, with heavy peak flows. To the west of the Centre Street Bridge are two 4-lane bridges: the 14th Street Bridge, and the Louise Bridge. To the east of the Centre Street Bridge are the 4th Ave Flyover, a two-lane inbound only facility; the Langevin bridge, an two-lane inbound facility; and the 5th Ave Flyover (New Langevin) bridge, a four-lane outbound facility**.**

There are two light-rail transit (LRT) “C-Train” lines serving the north side of Downtown via bridges, the Northwest LRT line (which also has a pedestrian deck on the LRT bridge); and the Northeast LRT line. Pedestrian-only bridges connect the Downtown to pathways on the north of the Bow via Prince’s Island and St. George’s Island.

On the west side of Downtown Bow Trail is a six-lane arterial road; and the east side of Downtown is accessed by 9th Avenue, a four-lane arterial road.

The Downtown area is also accessible by eight arterial roads that cross or run under the tracks to the south; and by the South LRT line.

3. Centre Street Bridge Closure

Centre Street Bridge is over 80 years old. In 1999 it was nearing the end of its useful life. A $6.7 million rehabilitation project was required to extend its operating life by another 40 years. It was necessary to close the bridge to general traffic for an extended 14-month period from August 1999 to September 2000, in order to allow the necessary repairs to be undertaken.

During construction work two lanes were kept operational at all times for the use of transit and emergency vehicles. One sidewalk was also operational at all times for pedestrians and cyclists. This was done to minimise the impact of the project for existing transit, pedestrian and cycle users; and to provide high quality alternatives for car users affected by the closure.

In addition to maintaining this level of access across the facility, a number of traffic management changes were made along potential alternate routes. The most significant of these were a lane reversal on Edmonton Trail, permitting three peak direction lanes, and changes of signal timings related to access to the Louise Bridge, and the Langevin/4th Ave Flyover/5th Ave Flyover bridge complex.

4. Travel Behaviour Changes with Roadway Capacity Reductions

This section discusses the range of travel behaviour changes that vehicle users can make when roadway capacity is reduced. It defines the context for analysis of the impact of the Centre Street Bridge closure, and draws on work by Goodwin et al (1998).

The following potential changes in individual car user travel behaviour can occur as a direct result of situations where roadway capacity has been reduced:

Changes in driving style that increase roadway capacity (travelling faster; following more closely; accepting shorter gaps)

- Changes in route
- Changes in time at which trips are made
- Changes in mode of travel
- Changes in trip origin or destination
- Consolidation of trips to serve several destinations on one journey (trip chaining)
- Trip elimination

In general, the responses people make to roadway capacity reductions will be determined by:

- The level of capacity reduction with respect to existing traffic flow;
- The level of flow affected directly;
- The amount of provision of extra roadway capacity in the immediate corridor;
- The relative attractiveness of alternative routes and their spare capacity;
- The type of trip affected;
- The availability and attractiveness of alternative modes;
- The relative attractiveness of alternative locations;
- The amount of information provided about the reduction / availability of alternatives.

The scale of behaviour change will depend upon the nature and extent of the roadway capacity reduction. It is also dependent upon the unique circumstances of each individual traveller. Each person has their own reasons and needs to make any particular trip, and has their own range of alternative choices that are feasible. For example, there may be less flexibility to change the trip travel time or destination for trips to work than for a trip to a restaurant. Car drivers who have to drop their children off at a day-care before continuing on to their work may have little real choice for their mode of travel.

4.1 Types of Roadway Capacity Reduction

The amount and type of travel behaviour change experienced with a roadway capacity reduction is heavily dependent upon the nature and extent of the reduction project. There are three basic situations where these can occur:

1. Planned permanent roadway capacity reductions.

2. Planned temporary roadway capacity reductions, usually to accommodate construction or repair work. The time period can range from hours to years.

3. Unplanned temporary roadway capacity reductions, arising from unforeseen circumstances such as accidents, or structural failures. The time period can range from minutes through to years.

In the planned cases it is possible to minimize the impact on traffic flow, by providing advance notice to users of the facility, and maximizing the availability and use of roadway alternatives through signage, changes in traffic control and management, and increases in transit service.

The extent to which the travel behaviour of road users of an affected facility will change is dependent upon the availability of alternatives that offer similar travel conditions to those that they currently enjoy.

1. In some situations, there is no real net roadway capacity reduction. Capacity increases are provided on or close to the affected route, through changes in traffic control and / or management, and these offset any direct reduction. Traffic re-routes to these alternatives if required.

2. In some situations there is a real net reduction in capacity on the affected corridor, but it is not a major issue because alternative routes are readily available, and generally have sufficient spare capacity to absorb any diverted traffic. Again, traffic re-routes to these alternatives as required, with some limited time of travel changes at peak times.

3. In some situations there is a significant reduction in roadway capacity in a corridor, and there is not sufficient spare capacity on readily alternative routes at the preferred time of travel to absorb the diverted traffic. Car users may have to make more significant travel behaviour changes other than changing routes and travel times, including changing travel mode, trip destination, or trip frequency.

The Centre Street Bridge closure created travel situations that fell into the second and third categories above. At peak travel times the alternative routes had insufficient capacity to cope with all the traffic normally using Centre Street. At other times of day, and on weekends, there was generally sufficient spare capacity on the other routes to be able to handle any traffic diverted from Centre Street without significantly increasing travel delays on those routes.

4.2 Changes in Travel Behaviour over Time

Studies of the effect of roadway capacity reductions on travel behaviour have shown that the following time-related reactions tend to take place:

1. Immediately following the capacity reduction there is a period of instability in traffic patterns, as drivers react to the change. Peak traffic congestion can increase significantly on alternative routes as drivers divert to them. There is a period of adjustment necessary, whilst all vehicle users in the affected areas make decisions as to their route and time of travel choice, or make even larger travel behaviour decisions such as to change mode or destination. However, after only a few days a new “equilibrium” travel pattern emerges where there is relative stability. In this new traffic pattern, travel times at peak times may be somewhat longer than before, but the overall system is in balance again.

2. In the medium term, up to a year or so of a capacity reduction, there is a settled period. Traffic has adapted to the new conditions, and traffic conditions are normal and predictable, subject to the usual daily and seasonal variations.

3. In the longer term, other impacts start to occur as a result of changes beyond the scope of the roadway capacity reduction. Underlying growth in traffic may cause traffic conditions to deteriorate. Transportation policies that affect travel demand in the area as a whole might cause conditions to improve.

4.3 Changes in Users of Facilities over Time

Individuals change their travel behaviour over time, as their circumstances change. They age; can change status e.g. from student to worker, marry, have children, change their job, buy a new home, buy a new car.. Each of these changes can significantly alter their travel patterns. There are two distinct traveller markets to be considered when looking at "before" and "after" travel patterns related to capacity reductions.

1. A stable set of individuals whose external circumstances have not changed. Changes in these individuals' behaviour captured in "before" and "after" surveys may be attributed directly to the capacity reduction itself.

2. A set of individuals whose external circumstances have changed. Their changes in travel behaviour may directly impact the amount of travel in the affected area, but cannot be attributed to the capacity reduction itself.

5. Observed Changes in Traffic Levels: Capacity Reductions

Goodwin summarized the empirical results from over 100 studies around the world documenting changes in traffic flows arising from roadway capacity reductions. These studies included planned permanent reductions; planned temporary reductions; and unplanned temporary reductions. In the majority of studies a reduction in traffic flow was observed. On average it was found that there was a net 15% decrease in daily traffic flows in the area occurring as a result of roadway capacity reductions.

Table 1 gives the results for temporary bridge closures or major capacity reductions.

Table 1: Changes in Traffic Flow: Temporary Bridge Closures / Reductions

Bridge	Date & Length Closure	Daily Traffic Flow	Change in Daily Traffic in Area	% Change in Daily Traffic in Area
Hobart, Australia [1]	1975, 14 months	44,000	-27,000	-61%
Tower Bridge, London [2]	1993, 1 month	44,000	-35,000	-24%
Kinnaird Bridge, Edmonton	1979, 3 weeks	1,300 peak hour	-550 peak hour	-16%
Hammersmith Bridge, London	1997, 1 month	31,000	-10,000	-8%
York, England	1978/9, 1 month	16,000	-3,000	-4%
Munich, Germany	1988	32,000	0	0%
Frankfurt, Germany	1989	29,500	500	+0.3%

1. The Hobart case involved a major bridge collapse with limited alternative capacity.
2. The Tower Bridge, London case only measured traffic flows on the four bridges leading to the City of London, and may not have captured all the traffic diversions to other routes that took place.

6. Data Collection / Measurement Issues

Goodwin noted that there were a wide variety of methods of collecting "before reduction" and "during reduction" data on observed changes in traffic flow arising from roadway capacity reductions. These included traffic counts, roadside interviews, personal travel surveys, and ongoing panel surveys.

Each of these survey methods contained some form of potential systematic bias, that could influence the results obtained. Four main types of potential survey bias were identified:

1. One-day traffic counts do not allow for the day to day or seasonal variability that occurs in practice in traffic flows. Comparisons made using one-day counts may contain these "natural" variations in flow, that would mask the true impact of the capacity reduction.

2. Journey detours may extend over a larger distance than that captured in screen-line or cordon counts. Survey results using this method may over-state the true net negative impact on traffic flows that result from a capacity reduction, as some diverted traffic is simply not counted.

3. Traffic growth may occur due to other factors such as population and employment growth, increased income and car ownership. In these cases survey results will under-state the true net negative impact on traffic flows that result from a capacity reduction, as this "natural" traffic growth is included in the "during" survey.

4. Survey may be confined exclusively to the users of the affected corridor prior to the reduction. In these cases people who may reduce their use will be covered, but offsetting former non-users who increase their use will not be surveyed, resulting in an over-estimate of the true reduction in travel that occurred.

7. Changes in Vehicle Flows during Centre Street Bridge Closure

24-hour vehicle traffic counts were made at the same points on all arterial roadways accessing Calgary Downtown on a May weekday in both 1999, three months before the Centre Street bridge closure; and in 2000, nine months into the closure. This comparison of traffic flows for the same roads for the same type of day, and at the same time of year, was made in order to eliminate seasonal variations. For ease of understanding results are presented here for the inbound direction into the Downtown only.

For analysis purposes three screen-lines were defined:

1. The 'north' screen-line included entrances to the Downtown from the north, running from the 14^{th} Street Bridge to the Langevin/4^{th} Ave Flyover/5^{th} Ave Flyover bridges complex. These north routes, which include the Centre Street Bridge as well as the nearby bridges, would show the most direct effects of the closure of the Centre Street Bridge.
2. The 'east/west' screen-line included Bow Trail on the west and 9^{th} Ave on the east Bridge. These east/west routes would be expected to show some effect from the Centre Street Bridge closure, as their connections to north-south arteries could lead into traffic from the north shifting onto them;.
3. The 'south' screen-line included entrances to the Downtown from the south. These routes are more isolated from the effects of the closure of Centre Street, and were expected to act as a "control" in the study, showing underlying trends in travel movements into the Downtown.

7.1 Changes in AM Peak Period Inbound Vehicle Flows During Bridge Closure

Figure 2 shows the net change in May weekday AM peak period (5.00 AM to 10.00 AM) inbound vehicles to Downtown Calgary between 1999 and 2000 (i.e. during the bridge closure, and defined as 2000 vehicle flow – 1999 vehicle flow) for the north, east/west and south routes. Data is shown for flow rates in 15-minute increments.

The major difference, as expected, was in the north, where the net change in AM peak inbound traffic between 1999 and 2000 steadily increased from 5.00 AM to a difference of almost 700 extra vehicles in the 7:00-7:15 AM period; then, over the next half an hour, switched to a reduction of over 700 vehicles for the 7:45-8:00 AM period. Net reductions on a smaller scale continued until 10.00 AM.

The east/west routes have small net changes in AM peak inbound traffic between 1999 and 2000, but they are all show increases in traffic. This increase was greatest during the traditional higher 7.00 AM – 9.00 AM traffic flow period..

The south route is shown to have very similar AM peak inbound traffic flows in 1999 and 2000, with net changes of nearly zero for all time periods.

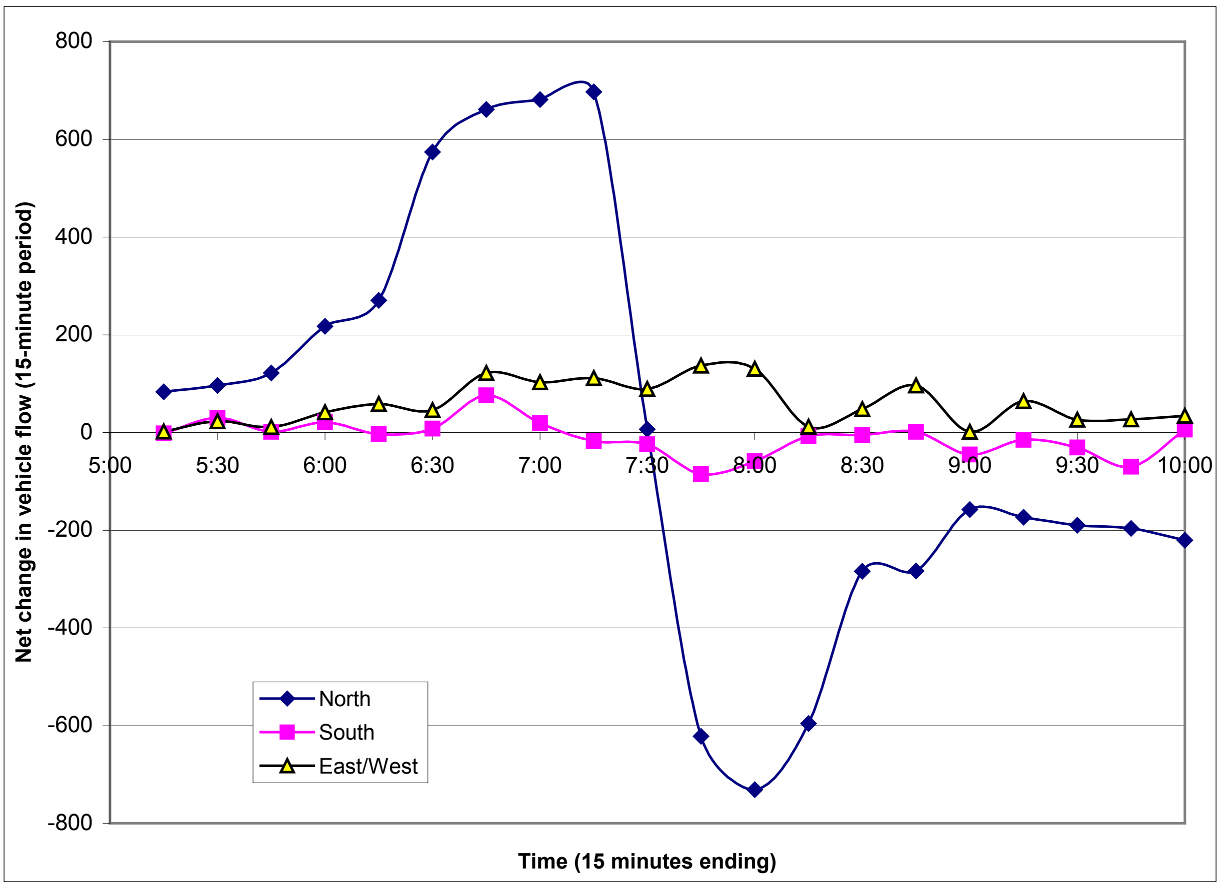

Figure 2: Net Changes in Downtown Inbound AM peak Vehicle Flows, 1999 - 2000

Figure 3 shows the cumulative net change in AM peak inbound flows.

The north routes show a cumulative increase of almost 3500 vehicles by 7:15 AM, between 1999 and 2000. This cumulative increase then diminishes to a very slight cumulative reduction by 10:00 AM.

On the east/west routes, the continual small net increases seen on Figure 2 accumulate, leading to a cumulative gain of over 1000 vehicles by 10.00 AM between 1999 and 2000.

The cumulative change on the south control routes are minimal, with a slight increase during the AM peak, but a small cumulative reduction by 10:00 AM.

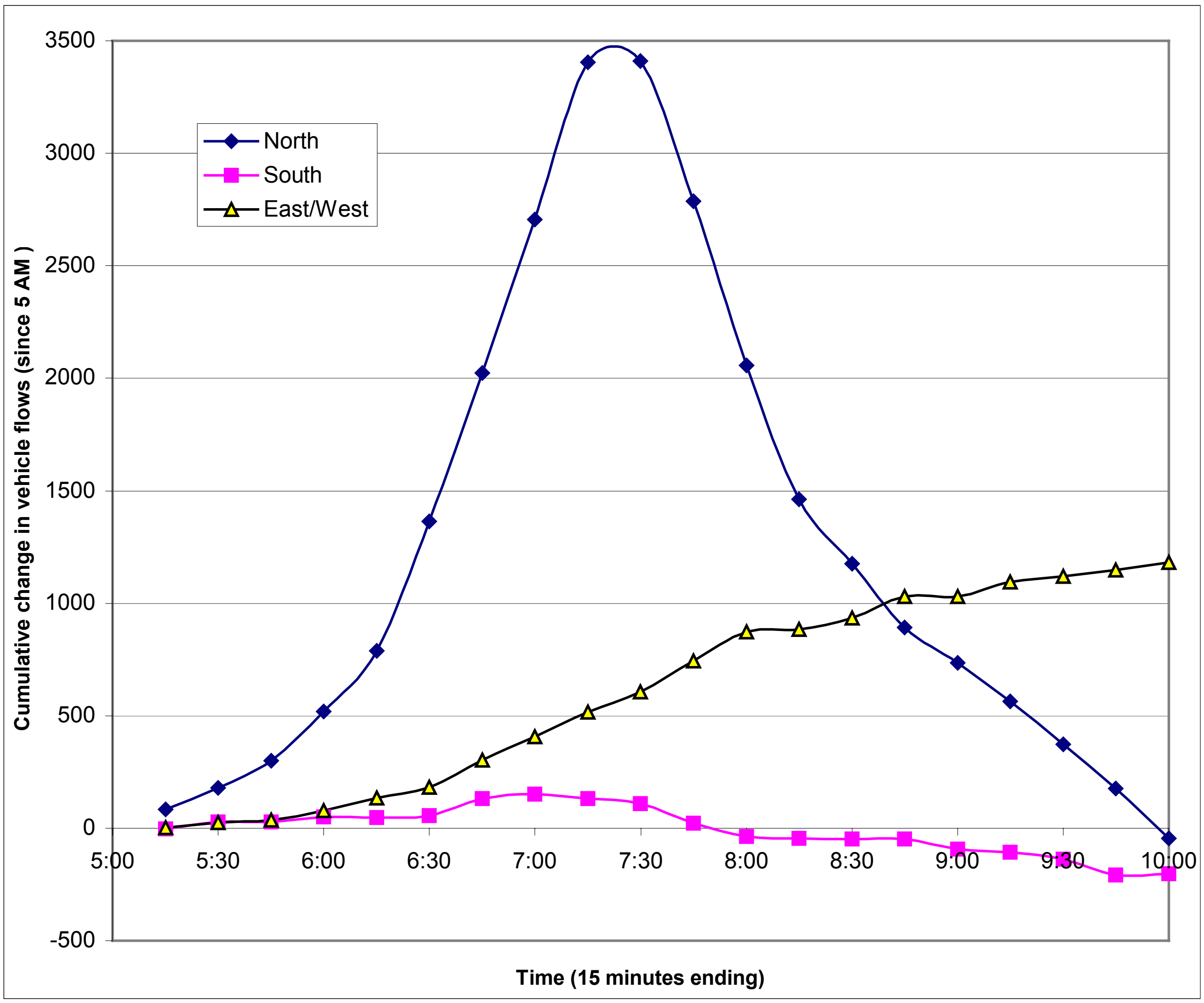

Figure 3: Cumulative Changes in Downtown Inbound AM Peak Vehicle Flows, 1999 - 2000

This cumulative Downtown inbound AM peak vehicle flow comparison before and during the bridge closure shows three major patterns:

1. A shift in inbound vehicle travel times towards earlier travel times on the north access roads, during the bridge closure. This is borne out by the fact that the median travel time for vehicles crossing the north screen-line during the studied 5.00 to 10.00 AM time period shifted from 08.01 AM in 1999 to 07.46 AM in 2000, a forward shift of fifteen minutes. It can be deduced that this shift took place to take advantage of spare capacity that existed on the available north routes at such times. In that way excessive congestion was avoided that would have occurred if all traffic left at their 1999 travel times, as traffic diverted from Centre Street competed for limited road capacity space with existing traffic on the other routes.

   There was virtually no cumulative net change in vehicle traffic on these north routes between 5.00 AM and 10.00 AM i.e. an inbound vehicle traffic flow equivalent to the 1999 traffic flow on Centre Street bridge was added to the other north routes, in the year 2000.

2. An increase in traffic flows on the alternative east / west routes to Downtown between 5.00 AM and 10.00 AM, totalling around 1,000 vehicles.

3. The “control” south routes into Downtown show a slight reduction in traffic, so this increase in east/west inbound traffic could be interpreted as a route diversion impact of the Centre Street closure.

It appears that the AM peak Centre Street bridge traffic has simply diverted to other available routes and / or shifted travel times to an earlier time.

7.2 Changes in 24-Hour Inbound Vehicle Flows During Bridge Closure

The traffic count data was also analysed for the entire 24-hour period. Results are given in Table 2.

Table 2: Downtown Inbound 24-Hour Vehicle Flows 1999 - 2000

Screen-line	1999 Vehicles	2000 Vehicles	2000 – 1999 Vehicles	2000 – 1999 Change (%)
North	83,750	75,200	-8,550	-10.2%
East/West	33,450	36,850	3,450	10.3%
North plus East/West	**117,200**	**112,050**	**-5,150**	**-4.4%**
South	53,150	50,450	-2,700	-5.1%

Over the 24-hour May weekday period, a significant 10% reduction is seen in inbound flows across the north screen-line, between 1999 and 2000 i.e. with the bridge closure. This reduction is offset to an extent by an increase of 10% in the east / west screen-line inbound flows. An overall reduction in vehicle flows of 4.4% is observed on the combined north and east / west screen-lines.

This 4.4 – 10.2% reduction in daily vehicle trips on roads in the vicinity of the Centre Street Bridge could be interpreted as a direct impact of the Centre Street bridge closure – vehicle trips have “disappeared”. The magnitude of change is in line with the middle to lower range of findings by Goodwin for similar closure situations.

However a similar 5.1% reduction in vehicle flows is observed on the "control" south screen-line. Some of the reduction on this screen-line may be "through" trips using Centre Street to travel from south to north through Downtown, who no longer make that trip as a result of the bridge closure. There may also be a trend of reduction in vehicle flows into the Downtown, perhaps due the increased attractiveness of alternative modes or destinations as the city and traffic pressures grow. It is difficult to isolate the effect of the bridge closure simply by looking at the 24-hour weekday traffic count data.

It noticeable that the full 24-hour Downtown inbound traffic volumes are seen to be declining, whilst the AM peak period (5.00 AM to 10.00 AM) volumes were stable or increasing slightly. This may be due to the fact that in the AM a majority of Downtown inbound trips are being made for a compulsory purpose (work, school), where there is little flexibility in destination. At other times of day more trips are being made for more discretionary reasons, where there is more ability to choose alternative destinations and routes, or to change travel patterns more radically.

8. Changes in Flows on Other Modes during Centre Street Bridge Closure

In addition to the automatic vehicle count surveys, peak period manual count surveys were conducted on May weekdays in 1999 and 2000 for flows in and out of the Downtown. Data was obtained on the number of transit passengers, auto passengers and non-motorized mode users.

8.1 Transit Passengers

Table 3 shows changes in AM peak transit passenger flows between 1999 and 2000, for screen-lines into the Downtown.

Table 3: Inbound AM Peak (7.00-9.00) Transit Passenger Flows 1999 - 2000

Screen-line	1999 Transit passengers	2000 Transit passengers	2000 – 1999 Transit passengers	2000 – 1999 Change (%)
North (including LRT)	16,350	17,800	1,450	9.0%
East/West	4,600	4,500	-100	-2.0%
North plus East/West	**20,950**	**22,350**	**1,400**	**6.6%**
South (including LRT)	9,650	10,850	1,200	12.6%

AM peak transit passengers crossing the north screen-line into Downtown increased by 9% between 1999 and 2000. These transit routes are the ones to which vehicle users of the north bridges might readily divert. They include the Northwest and Northeast LRT lines which are well served by Park and Ride and can be accessed by vehicle users. The data seems to indicate a mode shift occurring for trips from the north side of the City, because of the Centre Street bridge closure.

However an increase in transit ridership to Downtown Calgary on the high performance Light Rail Transit system could also be occurring. (AM peak transit usage of the east / west screen-line bus routes is showing a slight decline between 1999 and 2000). Transit passenger flows on the "control" south entry to Downtown, also served by LRT, increased by over 12% over the same period between 1999 and 2000. This again illustrates the difficulty of interpreting the underlying causes of observed changes in travel patterns when these are simply based on vehicle or passenger counts.

8.2 Auto Passengers

Table 4 shows changes in AM peak auto occupancies between 1999 and 2000, for screen-lines into the Downtown.

Table 4. Inbound AM Peak (7:00 AM – 9:00 AM) Auto Occupancy 1999 - 2000

Route	1999 Occupancy	2000 Occupancy	% Change
North	1.27	1.24	-2.0%
East/West routes	1.23	1.23	-0.2%
North plus East/West routes	**1.26**	**1.24**	**-1.5%**
South Routes	1.21	1.23	1.9%

The Centre Street Bridge closure might have resulted in some peak period drivers from the north shifting to auto passenger, as some travellers changed their normal behaviour in reaction to the diversion of additional traffic to already congested routes. However the data indicates no shift in that direction. In fact AM peak auto occupancy declined on the north routes. In contrast, on the south “control” routes, peak auto occupancy actually increased between 1999 and 2000.

8.3 Walking and Cycling Modes

Table 5 shows changes in AM peak walk and cycling flows between 1999 and 2000, for screen-lines into the Downtown.

Table 5: Inbound AM Peak (7.00-9.00) Walk and Cycling Flows 1999 - 2000

Screen-line	1999 Total	2000 Total	2000-1999	% Change
North	2,760	2,940	180	6.4%
East/West	650	690	40	6.0%
North plus East/West	**3,410**	**3,620**	**220**	**6.3%**
South Routes	3,710	3,640	-70	-1.9%

This data indicates a consistent increase in AM peak walk and cycling inbound trips across both the north and east / west screen-lines, between 1999 and 2000. The “control” south screen-line walk and cycling flows declined slightly during this period. This might indicate a mode shift occurring as a result of the Centre Street closure. The Bridge was kept open for pedestrian and cycle movements. For certain shorter distance trips from the residential areas immediately north of the Downtown the walk and cycle modes could become relatively attractive compared to the alternatives for car travellers. However the absolute magnitude of the change in walking and cycling trips is relatively small.

9. Telephone Interview Survey of Bridge Auto Users

The City of Calgary Transportation Department commissioned a survey of around 1,500 auto users of the north bridges into the Downtown. Prior to the Centre Street bridge closure, registrations of autos entering the Downtown on both Centre Street ***and*** the other bridges were recorded. In November / December 1999 (three months into the bridge survey) the registered owners were contacted by telephone. A survey instrument was developed that included data on:

- Personal data;
- Auto bridge crossing inbound trip details prior to the closure (auto mode, origin, destination, purpose, time);
- Whether a similar trip was still being made during the closure, and if not why not;
- Bridge crossing inbound trip details during the closure (including mode).

The interview survey data survey confirmed the overall patterns seen in the observed data.

1. 93% of the auto bridge flow prior to the closure continued to use auto during the bridge closure, to a similar destination.

2. By definition, the Centre Street bridge motorists who continued to use auto during closure travelled on other routes. Interestingly, 15-30% of auto users on other bridges prior to the closure also switched routes on closure. There was significant “cross-over” switching as drivers sought the “best” route in the new traffic conditions. For example, 5% of the 4th Ave Flyover users diverted to Langevin Bridge, whilst 17% of Langevin Bridge users diverted to the 4th Ave Flyover.

3. 39% of AM peak bridge auto users reported leaving home earlier, during the closure.

4. 3.6% of bridge auto users prior to the closure reported using transit for a similar trip after the closure, with two-thirds of those changing to transit being auto drivers. Centre Street bridge users were more likely to switch to transit than other bridge users. The reason for this mode change was not explicitly collected in the survey. It may have occurred as a result of “external” personal circumstances rather than as a direct consequence of the bridge closure. For comparison, 1.7% of auto users reported changes in personal circumstances between June and November 1999, which meant they no longer made the trip across the north bridges into Downtown.

5. A slight decline in auto passenger mode was reported during the closure

6. 0.8% of bridge auto users prior to the closure reported using walk or bicycle for a similar trip after the closure. Again, the reason for this mode change was not explicitly collected.

7. 2.7% of bridge auto users prior to the closure reported that they no longer made the trip to Downtown using one of the bridges. However only 0.2% of the users explicitly specified the impact of the closure as the reason for this change. 1.7% of users cited external circumstances such as a new job or maternity leave; and 0.8% gave no reason for the change. It was not established whether these persons made an alternative trip to another destination

10. Conclusions

The above analysis of vehicle count data, manual count data, and telephone interview survey data gives good evidence to explain what happened to the 34,000 weekday vehicle users of the Centre Street Bridge travelling to and from and through Downtown Calgary, whilst the bridge was closed for repair.

There are some difficulties in making a precise interpretation of all the survey results, because of the inherent survey methodology limitations identified by Goodwin and discussed in an above situation. However the evidence strongly suggests:

1. There was a small decline in vehicle trips as a direct result of the bridge closure.

   No net decline in vehicle trips was observed in the AM peak period, in the affected road sectors. There was a net reduction of 4.4% in daily vehicle trips on the north and east / west corridors into Downtown. A similar decline was observed in daily trips into the Downtown from the south. Some of this reduction is due to the bridge closure; some may be due to general trends.

   The telephone interview survey did indicate a similar magnitude of vehicle trip reduction from auto users of the bridges prior to the closure. 4.4% of auto users reported switching modes; and 2.7% no longer made that trip. The reasons behind the mode shift were not directly obtained. 1.8% of those no longer making the trip explicitly identified external personal circumstances as a reason for this shift. Only 0.2% of bridge auto users explicitly stated they no longer made the trip because of the bridge closure. Those not making the vehicle trip to the Downtown may simply have diverted to an alternative destination.

2. 93% of bridge auto users before the closure reported continuing to use auto after the closure. There was no positive change in auto occupancy. The main responses to the bridge closure were for vehicle drivers to find other routes to the same destination; and for a significant number of drivers on these routes to shift travel times in the peak demand times, to avoid excessive traffic congestion.

3. Flows on alternative modes – transit, walk and cycle - from the north into the Downtown were observed to increase during the closure.

   3.6% of auto bridge users before the closure reported using transit for the trip during the closure - two thirds of these were auto drivers. A general increase in transit ridership on the LRT corridors into Downtown was observed, so some of the shift to transit may have been due to factors other than the bridge closure.

   0.8% of auto bridge users before the closure reported walking or cycling for the trip during the closure.

References:

Goodwin P., Hass-Klau C., and Cairns S., Evidence on the Effects of Road Capacity Reductions on Traffic Levels. Traffic Engineering and Control, June 1998, Ps. 348-354.