

5th Avenue Connector Contra-flow Facility: From Concept to Completion

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Abstract

Lane reversals have been implemented in the City of Calgary on several approaches to the downtown core in order to maximize peak period capacity without costly and intrusive expansion of inner city roadway infrastructure. This paper describes the development and implementation of the most recent lane reversal project, the 5th Avenue Connector, a contra-flow facility operating in the morning peak period on one of the busiest approaches to downtown Calgary.

Heavy traffic volumes merge from Crowchild Trail (a north-south expressway) onto Bow Trail (an east-west expressway) on the west side of downtown Calgary. The inbound and outbound carriageways of Bow Trail are laterally separated by hundreds of metres throughout the approach to downtown. As a result, in order to create a contra-flow facility on Bow Trail, a unique approach was required.

The 5th Avenue Connector was implemented as a trial in September 2005. Today, on weekdays between 6 a.m. and 9 a.m., traffic destined for 5th Avenue has an additional route available via a contra-flow lane on Bow Trail. Motorists are able to avoid three traffic signals on their former route and bypass congestion due to heavy volume and weaving

The costs of the project were minimized during the trial period by relying on manual setup and takedown of traffic control devices. A permanent contra-flow facility is being developed in early 2006 that will minimize or eliminate the need for manual operation of the facility, while maintaining the same capacity throughout the lane reversal period. Remarkably, the period between concept/analysis and implementation took only four months. This process, including the analysis, design, stakeholder engagement, construction, and field crew training, is described in this paper.

The trial has been deemed a success on several fronts:

- Low cost and minimal disruption to other traffic, adjacent businesses, and non-road users;
- User benefits – the project was very well received by commuters who save time by using the facility. Approximately 750 vehicles use the facility in the peak hour;
- Spillover benefits – the project resulted in 2.5-4.5 minute decreases in travel time on Bow Trail adjacent to the 5th Avenue Connector. Standing queues that formerly spilled over onto Crowchild Trail were reduced.
- Rapid implementation – from concept to trial in four months.

The 5th Avenue Morning Connector is an excellent example of how existing infrastructure can be optimised to produce tangible benefits at low cost and with timely implementation.

Optimising the Transportation System

The value and need to intensify the focus on optimizing existing infrastructure has been identified recently by some of the major transportation organizations in North America. The City of Calgary is taking significant steps to ensure optimisation of the existing transportation system is recognized as part of the foundation for sustainable operations, as well as a measure to address efficiency in Transportation Systems Management (TSM).

The City of Calgary's Approach

In 2003, the City of Calgary Transportation Department reviewed its internal structure and identified changes to improve efficiencies and ensure long term sustainability. One of the key recommendations from this review was to create a new Division which could focus solely on finding new and innovative ways to manage Calgary's existing transportation system more efficiently. Ideally, this division would represent all components of the transportation system: all users - auto, transit, pedestrians, cyclists, goods movement, as well as all transportation divisions – traffic signals, traffic operations, design, community traffic, forecasting and transit. This group would be able to develop comprehensive, low-cost, high benefit transportation solutions that could be quickly implemented. This new group was created in September 2005 and is called the Transportation Optimisation Division. The mission of the group is: to strategically identify, evaluate and plan improvements that optimise the operation of the transportation system for all Calgarians by co-coordinating timely implementation, promoting innovation and monitoring effectiveness with a team of specialists working in a supportive work environment.

Transportation Optimisation established long-, medium- and short-term visions to meet this mission. The long-term (greater than 5 years) vision is: Calgary is a leader across the nation for having the most efficient Transportation System Operation. The medium term vision (1 to 5 years): proactive, systematic operational improvements are being made that: increase capacity, reliability and safety; and postpone the need for major infrastructure. The short term vision in 2005 was to successfully implement three to five projects which demonstrate the effectiveness of the Transportation Optimisation Division.

One of these projects is the 5th Avenue Morning Connector, a contra-flow facility located on the western gateway to downtown Calgary. The facility (referred to in the paper as "the Connector") operates between 6:00 a.m. and 9:00 a.m. on weekdays. Vehicles travel in the eastbound direction on one of the three existing westbound lanes on Bow Trail.

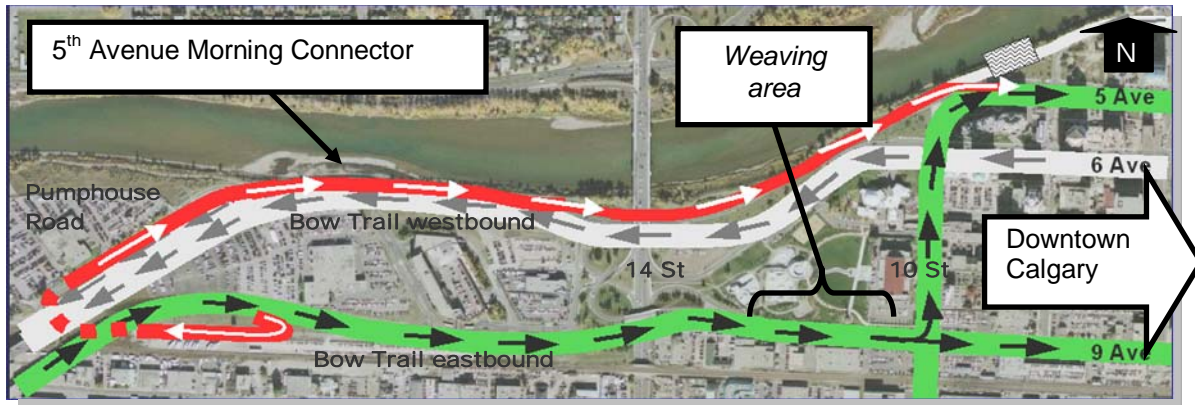


Figure 1. Location of the Connector

Localized Weaving Affecting System Performance

Inbound Bow Trail/9th Avenue at 11th Street SW carried 4,900 vehicles per hour (vph) in the a.m. peak period in 2004. Traffic entering 9th Avenue from 14th Street directly conflicted with approximately 1,200 vph trying to turn left at 11 Street. Most of the 1,200 vph turning left was destined for 5th Avenue, three blocks to the north. This conflict between movements on 9th Avenue created queuing that spilled back over 2 kilometres during the a.m. peak period. The queuing interfered with the operation of two expressways to the west: eastbound Bow Trail, and northbound and southbound Crowchild Trail.

Unique Solution: Contra-Flow Operation

A unique solution was developed that optimised the use of under-utilized existing infrastructure. Outbound (westbound) Bow Trail carried only 1,000 vph on three lanes. Often, where such an imbalance exists, there is opportunity to operate a lane reversal. This has been done in other locations entering downtown Calgary. However, the carriageways on Bow Trail are laterally separated by up to 300 metres with intervening development, making construction of a simple lane reversal impossible.

Low volume roads serving commercial properties in the area, Pumphouse Road and Pumphouse Avenue, offered an opportunity to funnel traffic onto the westbound carriageway of Bow Trail. Means of controlling the directional flow of traffic was necessary to facilitate contra-flow operation on Bow Trail and at the entry and exit to the facility. A temporary detour traffic control scheme was devised to operate the facility immediately. In the longer term, as soon as the concept could be validated, functional requirements and designs could be prepared and permanent installations would be used to operate the Connector.

Unique Approach and Building Support

The approach to having this unique operation in effect within four months and ultimately adopted as a permanent facility was a success. There were three key elements to the approach:

1. Senior Management and Technical Support (including practitioner buy-in, and the use of trial methodology);
2. Political and Community/Business Support; and
3. Before/After Study and Reporting Actual Results.

Senior Management and Technical Support

To field the unfamiliar concept, each operational group's technical leader was presented with the concept and the benefits of its operation. This included Roads (Traffic Engineering, Traffic Signals, Field Operations), Calgary Transit, and Transportation Planning. A clear and concise presentation was created with detailed graphics representing what the facility would look like in real life. These graphics became critical to help others visualize the new operation. The graphics also displayed the results of traffic analysis and modeling that supported the proposal. Further, it was imperative to explain that this would be a trial and that, for the most part, only temporary traffic control devices would be used. This gave practitioners a comfort level that even if the outcome was not as designed, the facility could be returned to its current operation relatively inexpensively. This aspect was more useful as a change management strategy rather than as a means of actually testing the operation of the facility.

Political and Community/Business Support

A clear and concise presentation with good graphics showing the existing and future operation was also critical to help political decision makers visualize the new operation. The area businesses, community representatives, including Alderman and Mayor were shown the project scope and impacts, including indication that it was a trial. Each group had various needs addressed and they were incorporated (within reason) to the design. This happened over a two month period while the final details of the operation were being worked through.

Before/After Study Results and Reporting Actual Results

This element turned out to be the most important. The media, politicians, practitioners were all very interested in the actual results of the operation. Visually, most would agree the project was a success based on the reduction in queues. Key project members were available to respond to media inquiries on the project operations during the first days of operation. Measurements of the travel times and queues before and after clearly identified the benefit of the permanent installation. These also helped to develop confidence and trust from stakeholders in future projects.

Design and Implementation of the Connector

Once support for the plan was confirmed, the process of design and implementation began. The multi-disciplinary approach is worth noting because Transportation Optimisation is based within Transportation Planning, a non operations business unit distinct from Roads the operations and maintenance area. Both are within the overall Transportation Department:

- Transportation Optimisation worked with Traffic Engineering and Traffic Field Operations, to determine the appropriate temporary traffic control setup;
- Subdivision Development staff designed and contracted the construction of alternate access to Pumhouse Road from Bow Trail;
- Transportation Optimisation and Traffic Signals prepared detailed controller timings and coordination for four upstream signals to complement the addition of the lane reversal;
- Communications staff from Roads and the General Manager's office assisted with media relations and internal communications; and
- Several other divisions contributed to the efficient operation of the facility and the conceptual design for permanent installation of the Connector, including Transportation Data, Roads Drafting, Construction Materials, and Roads Maintenance.

The benefits of the project were clearly illustrated through modeling. This was key to generating strong support for the project. In response to the potential benefits indicated in the traffic analysis, an aggressive schedule was set between conceptual design and implementation. It took approximately four months to proceed through design and implementation. The Connector was opened on September 16, 2005.

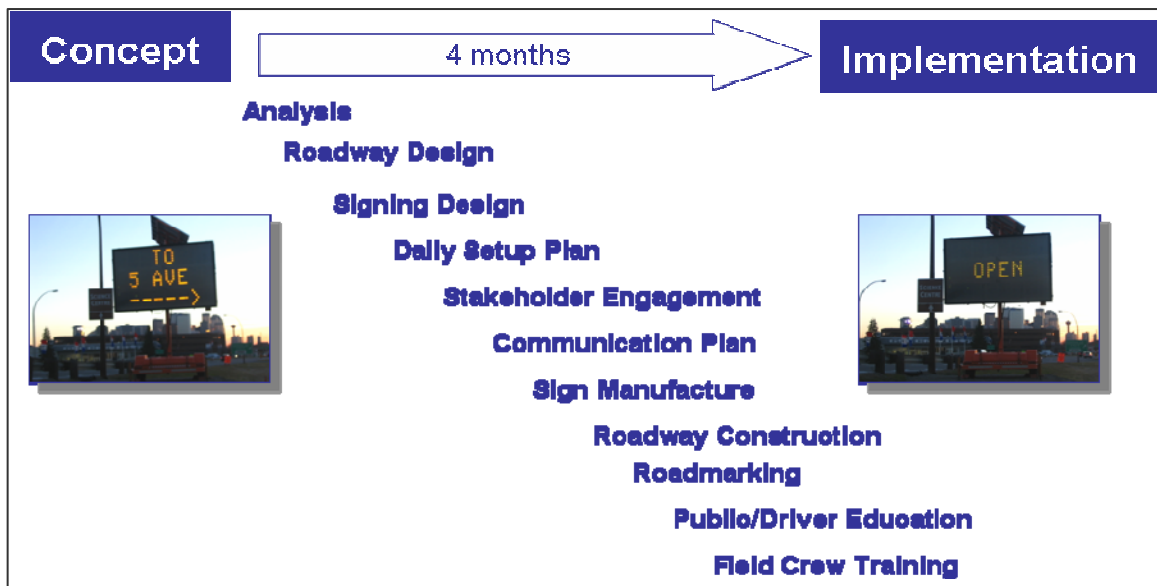


Figure 2. Steps in Design/Implementation Process

Operation

Opening Day

Operation of the facility began on Friday, September 16th, 2005. A practice setup was conducted on the Sunday prior in order to identify any issues in the field. Setup/takedown sequences were revised on the basis of the practice setup. The sequence was optimised in order to allow traffic to exit the contra-flow facility, prevent traffic from entering the wrong way, and at the same time reduce the amount of back-and-forth activity (driving time and effort) for the field crews during setup and takedown of traffic control devices.

During the week leading up to implementation, variable message signs and static signs were deployed in order to advertise the opening of the Connector. Media interest was generated through detailed press releases, and advertisements were purchased in Calgary's two major daily newspapers.

Opening day was a success. There was considerable media attention including two live onsite broadcasts. Motorist acceptance came quickly with significant volumes of traffic using the Connector on its first day, despite their unfamiliarity with the facility. A total of 961 vehicles used the Connector on opening day.

The figures below illustrate the progression of traffic through the Connector.

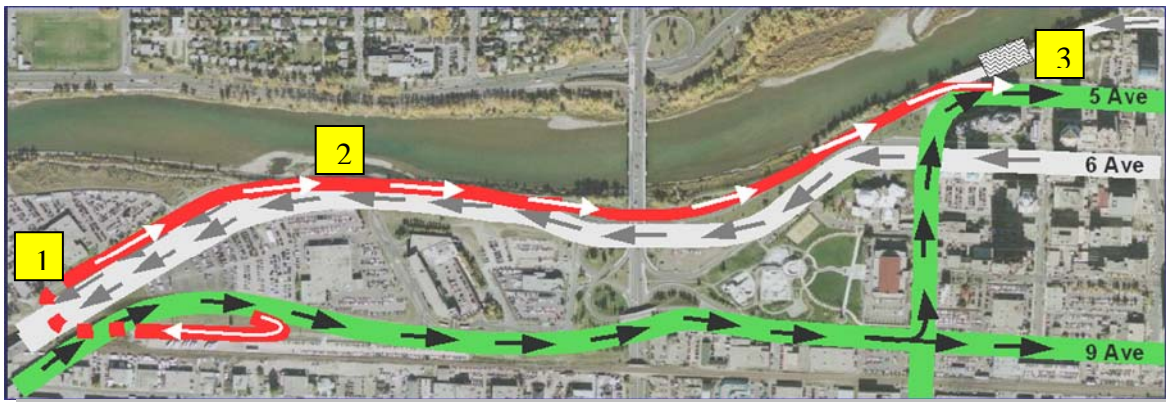


Figure 3. Map of Connector and Locations of Photos Shown Below

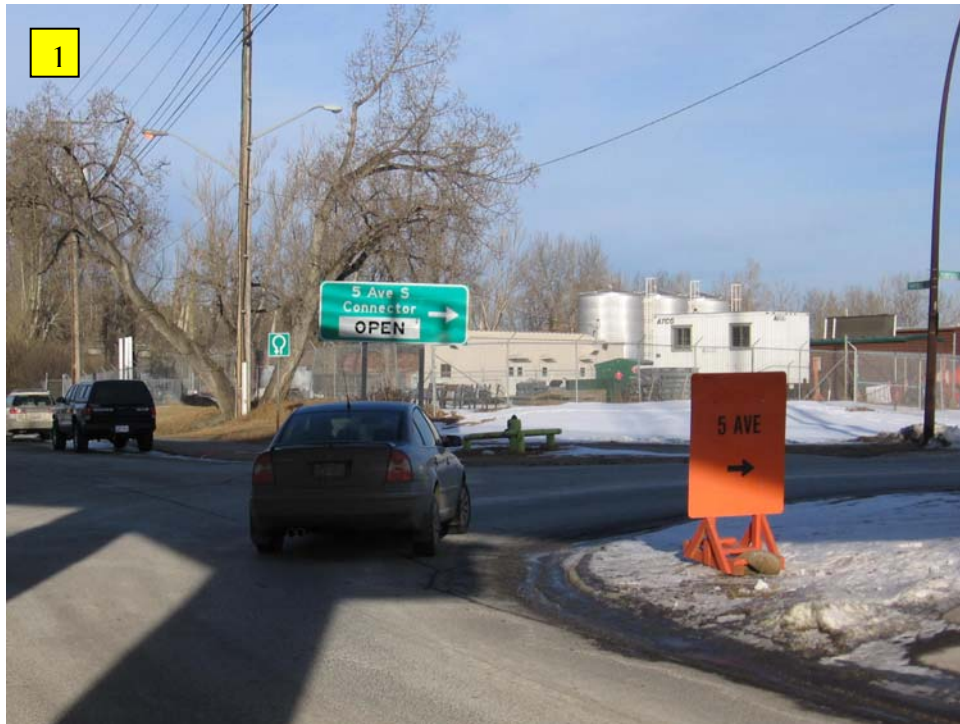


Figure 4. Traffic Enters Pumphouse Road from Pumphouse Avenue



Figure 5. Contra-Flow Lane on Bow Trail



Figure 6. Entering 5th Avenue SW from the Contra-Flow Lane on Bow Trail

Results of Operations

Before and after data was collected to evaluate the success of the Connector. Traffic counts were collected on the Connector at progressive dates of operation as shown below.

Table 1. Traffic Counts on the 5th Avenue Morning Connector

Date	Peak Hour Traffic (vph)	Total Traffic 6:00-9:00 a.m. (vehicles)
Opening Day, September 16, 2005 (Friday)	486	961
September 20, 2005 (Tuesday)	644	1,265
March 15, 2006 (Wednesday)	786	1,476

Travel time measurements were conducted before and after the implementation of the Connector. Travel time savings of between 2.5 and 4.5 minutes were measured on 9th Avenue between Crowchild Trail and 10th Street SW. This data is clear indication of the effectiveness of the Connector in relieving a bottleneck

due to weaving. Similar time savings were incurred by motorists using the Connector to travel between Crowchild Trail and 10th Street SW, despite the additional travel distance and circuitous route.

The Connector is thought to be at least partially responsible for improvements along the Bow Trail corridor to the west. Travel time savings were realized by motorists up to four kilometres west of the site based on observations before and after the implementation of the Connector.

Signal timing improvements were also made to complement the Connector. In some cases the Connector was implemented in advance of optimised timing plans. Data shown below illustrates that removal of the bottleneck was likely key to the effectiveness of the signal timing plans. The existence of downstream bottlenecks should be a consideration for the identification of corridor timing improvements in the future.

Before and after performance measures are shown in the table below. These results are derived from field data collected between September 7th and September 29th, 2005 in the eastbound direction on Bow Trail from Sarcee Trail to 26th Street SW. New signal timings were installed on September 15, 2005.

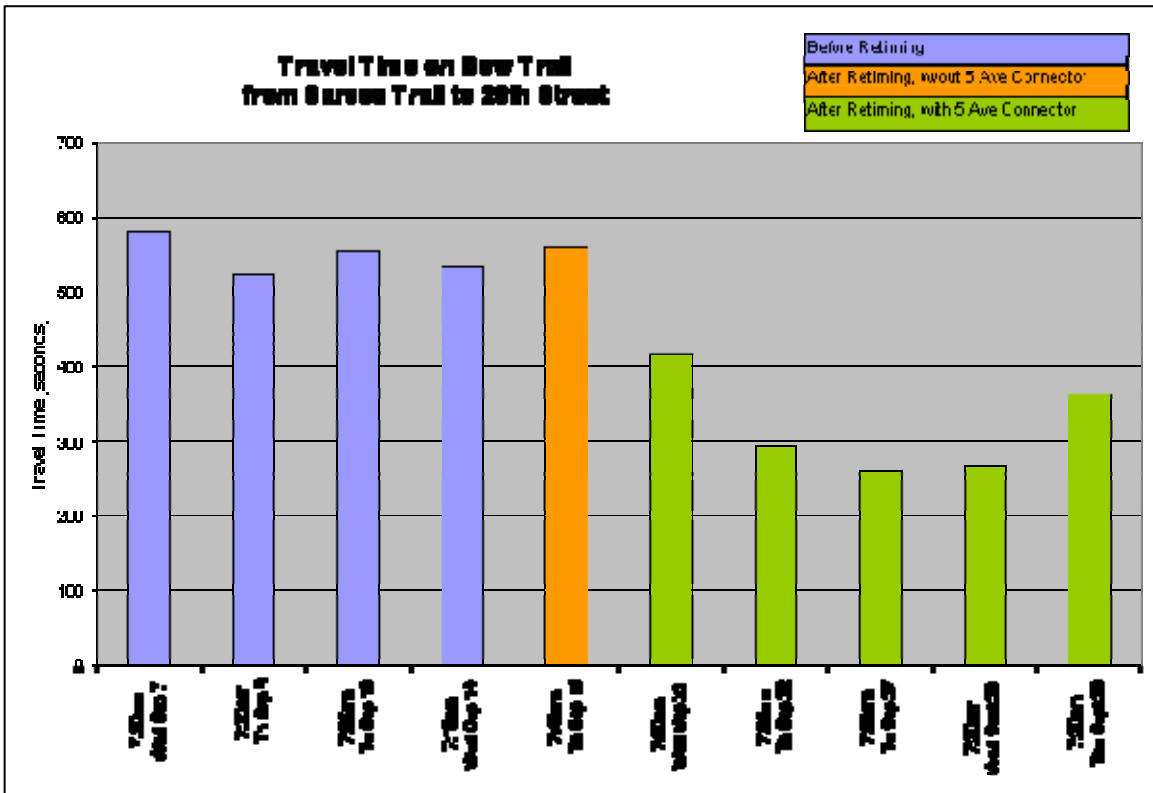


Figure 7. AM Peak Travel time on Bow Trail west of the Connector

Table 2. Performance Measures on Bow Trail West of the Connector between Sarcee Trail and 26th Street SW

(per vehicle)	Before (average of 4 runs)	After (average of 5 runs)	Difference	Improvement
Travel Time	9min 8sec	5min 20sec	3min 48sec	42%
Stops	7.25	3.00	4.3 stops	59%
Stopped Delay	3min 19sec	1min 1sec	2min 18sec	69%

Prior to the implementation of the Connector and the corridor retiming, the trip from Bow Trail & Sarcee Trail to 5th Avenue & 10th Street SW (via 9th Avenue and 11th Street) took an average of 19 minutes, 13 seconds. After, it has taken an average of 11 minutes, 41 seconds via the same route (time savings are even greater for those using the Connector). The total savings in travel time between Sarcee Trail and 10th Street SW (over 7 1/2 minutes) will be directly realized by the thousands of commuters that use Bow Trail to commute to downtown.

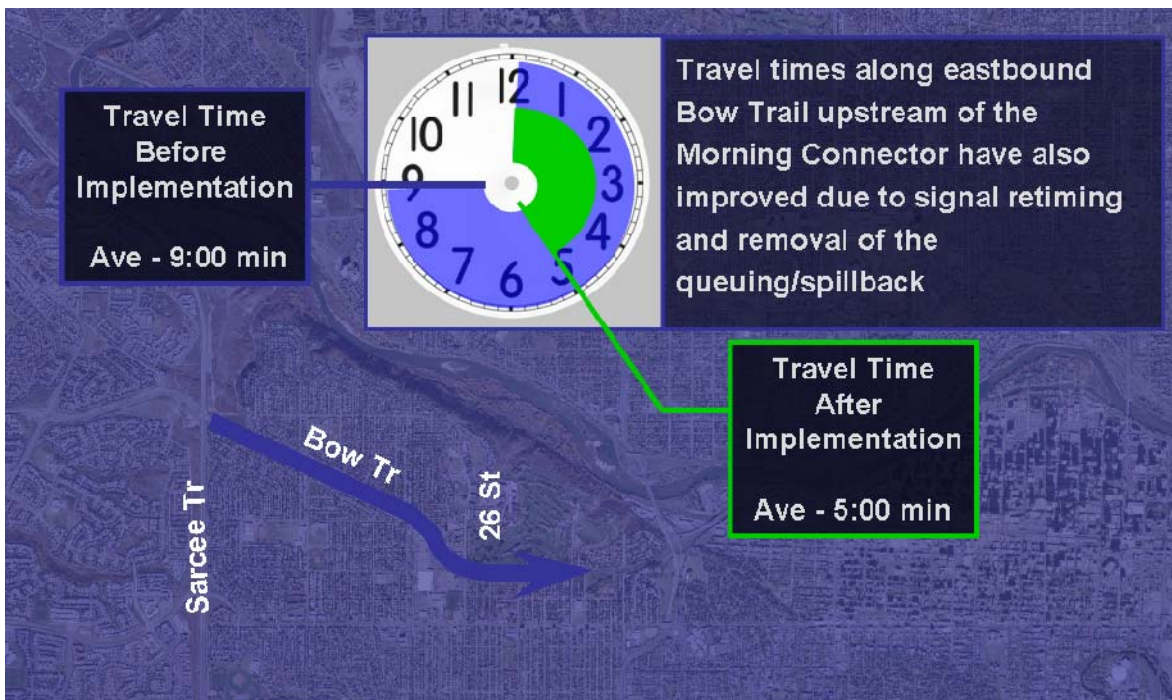


Figure 8. Illustration of Impacts of Removing Bottleneck on Bow Trail

It should be noted that upstream construction of dual left turn lanes at the intersection of Bow Trail and Sarcee Trail has impacted traffic operations on the Bow Trail corridor to an uncertain extent. Traffic counts that might reflect the

impact of this intersection are only available for two Fridays 'before' and a Thursday 'after'. These are shown in the table below.

Table 3. Traffic Counts on Bow Trail West of the Connector

AM Peak Hour Traffic Count Eastbound Bow Trail, East of 26 Street SW		
Before		After
(Fri Mar 19/04)	(Fri Mar 31/05)	(Thurs Sept 29/05)
2,756	2,603	2,776

Public Response

Benefits are reflected in the positive feedback received from nearly all Calgarians and City Council. To encourage feedback from users, signs were placed at the end of the lane reversal on opening day encouraging calls to Calgary's new 311 public contact system. Immediate overwhelming positive response was received to this new improved operation. Never before has the City received so many direct positive comments from the public on a transportation project.

Costs

This project used existing infrastructure with some relatively minor property access changes costing approximately \$150,000. If a separate road facility that provided the same service were constructed it could have cost many millions of dollars and taken years to implement in order to achieve the same benefit for the morning commute. There is a daily operational requirement of four staff for one hour to set-up and take down the temporary traffic control during the trial.

Lessons Learned

The following are just some of the key lessons learned by the City of Calgary that might be of benefit to others considering similar improvements:

- Soliciting comments from the public through static signage is effective in generating immediate feedback;
- Commuters' unfamiliarity with traffic control schemes is less of an obstacle than generally perceived when their alternative is putting up with delays and stops due to traffic congestion;
- The public and public officials favorably received daily setup and takedown by City staff using existing operating budgets;
- Effectiveness of signal coordination improvements depends on the relief of downstream bottlenecks; and
- Traffic analysis models were effective in evaluating and presenting the potential benefits of the project.

Conclusion

The 5th Avenue Morning Connector trial has been deemed a success, and a permanent contra-flow facility is being developed in early 2006 that will minimize or eliminate the need for manual operation of the facility. The trial project was low-cost and resulted in minimal disruption to other traffic, adjacent businesses, and non-road users. The benefits were significant: the project was very well received by commuters, whose travel time over the 1.5 kilometre problematic area was cut in half by using the Connector. Approximately 750 vehicles use the facility in the peak hour today. As well, there were significant spillover benefits – the project resulted in 2.5-4.5 minute decreases in travel time on Bow Trail for traffic that is not using the Connector. Standing queues that formerly spilled over onto an adjacent expressway were reduced, and benefits up to four kilometres to the west were realized once the downstream bottleneck was removed.

The 5th Avenue Morning Connector is an excellent example of how existing infrastructure can be optimised to produce tangible benefits with low cost and timely implementation. The project also demonstrated that cooperation of a small dedicated traffic optimisation team with the support of operational units can achieve results in a timely manner.

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