Mobility monitor

Transportation Data

Monitoring today,
for tomorrow.

This issue

Measuring Travel Time Reliability on Selected Goods Movement Corridors

The Municipal Development Plan (MDP) and the Calgary Transportation Plan (CTP) recognize the important economic role of goods movement. A safe, efficient and connected goods movement network contributes to a prosperous economy. Trucking is the primary mode for the movement of goods within Alberta. As a trucking hub, Calgary plays an important role in providing a safe, efficient and connected goods movement network.

The Monitoring and Reporting Program (The Program) provides a mechanism through which the goals, objectives and policies of the MDP and CTP are being assessed. The Program identifies several citywide indicators that are relevant for the implementation of these plans. The travel time reliability on the goods movement network is one of the citywide Supplementary Indicators monitored by The Program. By monitoring the travel time reliability on selected goods movement corridors over time, the effects of network improvements and the impacts of congestion and delay on commercial vehicle movement can be measured and mitigated as necessary.

To fulfil the mandate of The Program, The City has investigated opportunities to use new technologies, including Bluetooth travel time monitoring equipment. The objective was to develop a methodology that has the following characteristics:

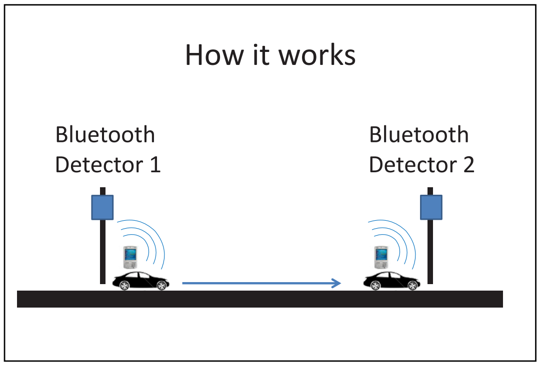
- Repeatable from year to year using available data
- Simple and easy to understand
- Cost-effective data collection
- Easily and reliably measured data

In addition, during the research, several questions came to mind:

- How do we determine which corridors are to be measured?
- What is the sample size needed to measure travel time reliability?
- How should travel time reliability be measured?

After the research, it was evident that the Bluetooth travel time methodology fulfils the above objective. This methodology provides many data points and the opportunity to measure the travel time.

It was determined that BluFax units will be used to measure travel time. BluFax units operate by monitoring Bluetooth signals at several points along a roadway. By tracking when individual signals reach various points along the route, travel time can be determined.



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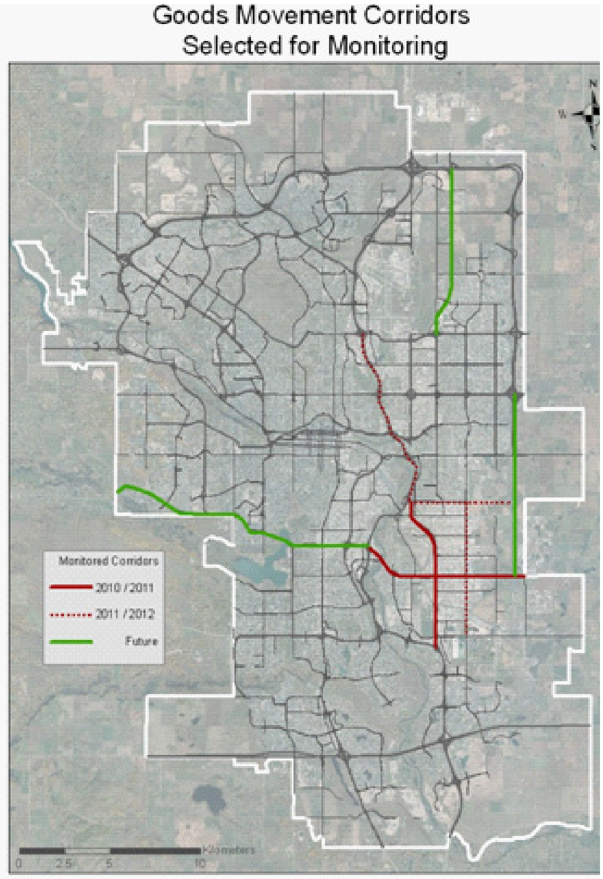
The important goods movement corridors (see below) were identified based on the Primary Goods Movement Network map (see page 4), the truck route map and the periodically produced map of Calgary showing the percentage of traffic consisting of commercial vehicles.



Based on the research on sample size for travel time estimation, it was concluded that the sample size should be 3% of the total vehicle volume within the monitored time period and that a minimum of 20 days of data collection is needed to determine travel time reliability. Furthermore, measuring the corridors three times a year would give us a seasonal variation and 60 days of data.

To better understand the total vehicle volume and BluFax sample size relationship, using automatic hoses or similar means to count the traffic volume is recommended at least once during the measurement period (three times during a 3-month period). It was decided to exclude all outliers due to extreme weather, holidays, major incidents and extensive stops from the sample.

What is travel time reliability?

Day-to-day travel time can be significantly different than the average travel time with unexpected delays due to weather, traffic congestion or traffic incidents, to name a few. To account for variability, drivers usually build a time buffer into their trip planning to avoid arriving late.

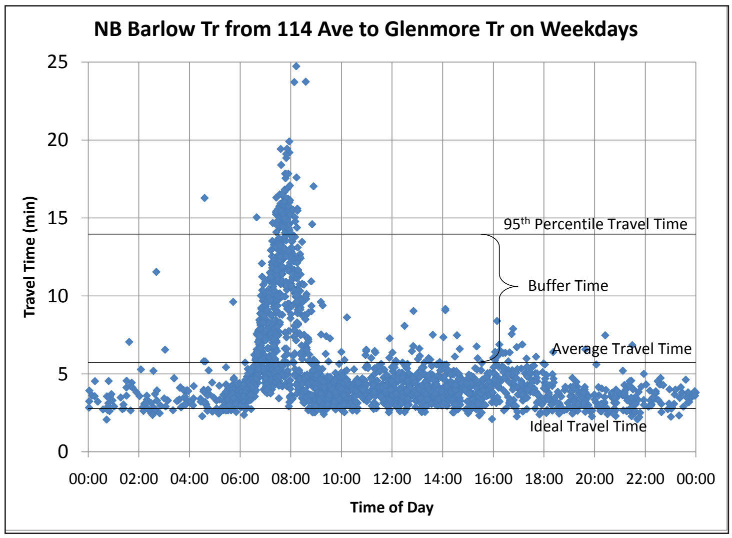
How do we measure travel time reliability?

One of the recommended travel time reliability measures is the travel time buffer index. This index represents the extra buffer time that most drivers add to their average travel time when planning trips to ensure on-time arrival. It is a measure of the expected variability in the time spent travelling a route.

The travel time buffer index is calculated as the difference between the 95th percentile travel time and average travel time, divided by the average travel time for a specific segment and time period.

$$\text{Travel Time Buffer Index (\%)} = \frac{\text{95th percentile travel time [minutes]} - \text{average travel time [minutes]}}{\text{average travel time [minutes]}}$$

The travel time buffer index increases as the travel time reliability worsens. The 95th percentile travel time indicates how bad delay is on the heaviest travel days.



This figure shows the difference between 95th percentile travel time, buffer time, average travel time and ideal (free-flow) travel time on weekdays over a 24-hour period.

As the selected corridors consist of several segments, the vehicle kilometres travelled are used as a weighting factor to calculate the average buffer index and planning time index values for the whole corridor.

$$\text{Average Index Value} = \frac{\sum_{i=1}^{n} \text{(index value n x VKT n) for each section and time period}}{\sum_{i=1}^{n} \text{(VKT n) for each section and time period}}$$

The City of Calgary calculates daily vehicle kilometres travelled (VKT) annually. The calculation is done in the GIS environment and the VKT value for each segment on the goods movement network is easily accessible.

KEY FINDINGS:
Drivers need to add 72% more time to their trip planning than they will need on average to be on time on the two studied corridors.

The corridors studied were

- Barlow Trail from Peigan Trail to 114 Avenue SE
- Glenmore Trail from Deerfoot Trail to 116 Street SE

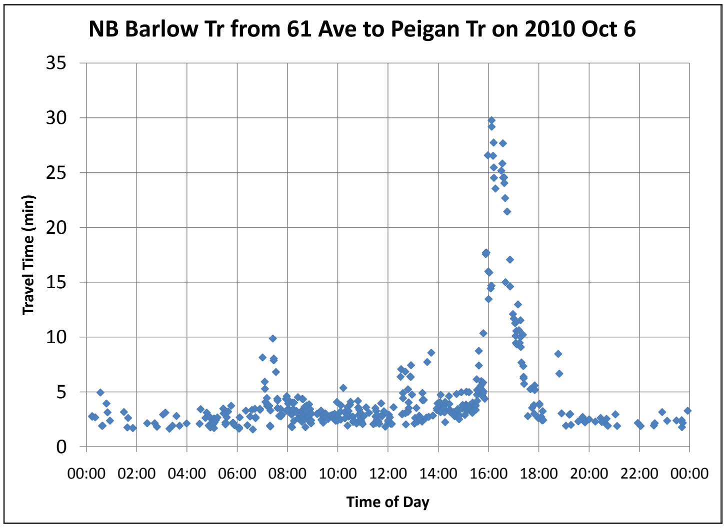
By applying the Average Index Value formula, it is possible to obtain one number representing the average state of the goods movement network. For the two corridors studied, the average buffer index is 72% for weekdays. This means on these corridors, drivers need to add 72% more time to their trip planning than they will need on average to be on time. There is greater volatility in the travel times on Barlow Trail as evidenced by the higher than average buffer index values for the Barlow Trail segments.

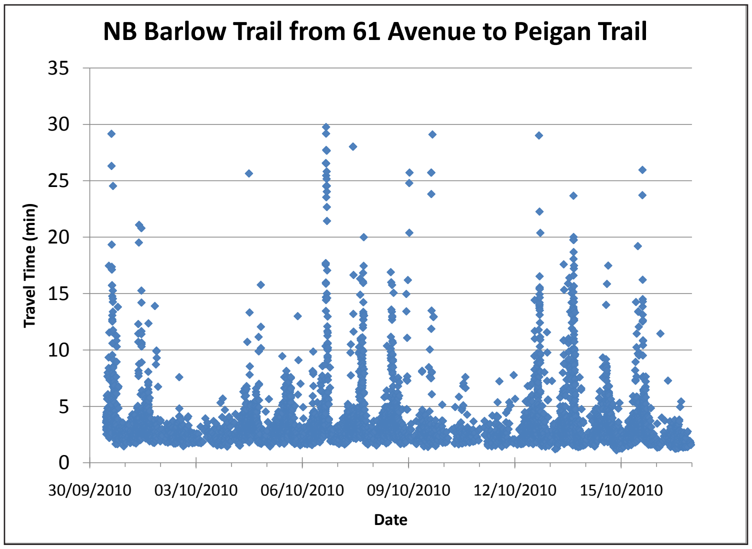
Barlow Trail SE Findings

The least reliable segments of Barlow Trail SE are northbound in the AM peak from 114 Avenue to Glenmore Trail and between 61 Avenue and Peigan Trail.

The peak direction in the AM is primarily northbound, particularly at the south end of Barlow Trail. The data indicate this segment is experiencing congestion during this peak period. On a scatter plot of the northbound segment of Barlow Trail from 114 Avenue to Glenmore Trail over a 24-hour period on weekdays (see previous page), the duration of congestion can be easily seen as the travel time has a very distinctive spike.

The congestion indicated on northbound Barlow Trail from 61 Avenue to Peigan Trail is due to an at-grade rail crossing frequently used for shunting trains in the adjacent rail yard. This type of delay can be just as severe as peak period congestion, but without the predictability of duration and when it will occur.





The scatter plots on this page show the same segment on northbound Barlow Trail with delays (spikes) observed on 2010 October 6 and observed over September 30 - October 17, 2010. The spikes show how common train crossings are at this location.

Glenmore Trail SE Findings

There is significant delay westbound on Glenmore Trail from 116 Street to 68 Street in the AM peak. The high index values for this segment and time period are an indicator of the variability of the travel time in the AM peak. The buffer index value of 195% for this segment indicates that drivers need to schedule their trips to allow three times the average travel time for the AM peak period (100% travel time plus 195% buffer time). This means that, on average, twice the actual time spent travelling is wasted in arriving early and cannot be used for other activities.

On the Glenmore Trail segment between Deerfoot Trail and 18 Street E the Graves Bridge over the Bow River was under construction. Surprisingly, this was not the greatest source of congestion and delay on this corridor. The worst segment on westbound Glenmore Trail is between 18 Street and 52 Street. There is an at-grade rail crossing on this segment. Further investigation into the causes of the delay on this segment is warranted to determine whether opportunities for mitigation exist.

Conclusions and Recommendations

It is evident that Bluetooth technology is an effective way to measure travel time and reliability. It fulfilled the objective originally set at the beginning of the project. Bluetooth detection technology is cost effective as it does not need additional infrastructure such as toll tag infrastructure.

The sample size of 3% of the total vehicle volume within the monitored time period is sufficient for good representation of travel time reliability. In addition, the chosen time period (60 days of data) is adequate for a statistical analysis if permanent data collection is not available.

The results of the travel time studies will be used to determine a baseline and a 10-year target for the goods movement indicators. The travel time reliability on selected goods movement corridors is included in the MDP/CTP Supplementary Indicators set. The travel time monitoring program has been developed on the goods movement corridors. During the research, it was determined that when reporting the travel time reliability indicator to the public, the buffer time or buffer travel time index concept is readily understood compared to reporting the standard deviation of the travel time.

Furthermore, the results of the travel time studies will help identify possible infrastructure improvement projects in the future (e.g., a corridor with an at-grade rail crossing). Travel time reliability is an excellent criterion to include in the evaluation of these projects.

Bluetooth technology can be used to monitor performance not only on the goods movement network, but also on other transportation networks such as commuter routes. There is an advantage to having BluFax units permanently installed along selected corridors, as the daily average travel time for goods movement and the peak period travel time for commuters may be reported. These multi-purpose results can be used for real-time travel information through The City's Traveller Information System map and roadside dynamic message signs, infrastructure projects prioritization and MDP/CTP reporting.

Sources of information

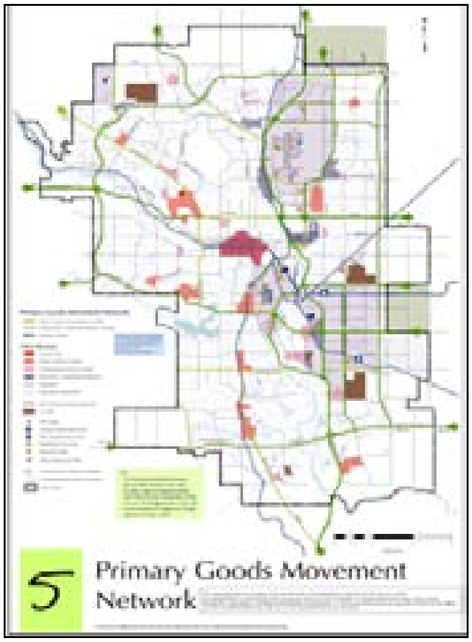
The Office of Operations of the U.S. Department of Transportation's Federal Highway Administration (FHWA) has developed a methodology for calculating travel time reliability.

All travel time data was collected as part of the Goods Movement Travel Time Reliability Study for the MDP/CTP Monitoring and Reporting Program.

Calgary Transportation Plan 2009

3.4 Goods Movement

Objective: To recognize the important economic role of goods movement by providing a safe, efficient and connective goods movement network that supports the Calgary International Airport, the Canadian National (CN) and Canadian Pacific (CP) intermodal facilities, transportation and distribution districts and goods movement routes, while also minimizing impacts on surrounding communities.



How accurate and reliable are these data?

How concerned should you be by the potential error in the data presented in The Mobility Monitor? Traffic on a road can vary by ten per cent or more from one day to the next. A change from one day to the next may be due to some random event, such as weather, accidents or simply, heavy rail crossing. At this time, the study is incomplete as data collection is still on-going.

It must be kept in mind that no one source of information can claim to be infallible. Consideration and appropriate weighting of other sources of information is to be encouraged before making decisions.

The Mobility Monitor

The Monitoring and Reporting Program has been established as part of the Calgary Transportation Plan (CTP) Implementation Framework. The purpose of the Mobility Monitor is to report on strategic trends and events that affect the implementation of the CTP. The Mobility Monitor is produced by the Transportation Data division of Transportation Planning.