

Presented To:	Operations Committee
Presented:	Monday, Jan 15, 2018
Report Date	Monday, Dec 18, 2017
Type:	Managers' Reports

Request for Decision

Leading Pedestrian Interval Policy

Resolution

THAT the City of Greater Sudbury approves the use of Leading Pedestrian Intervals at locations with a cumulative assessment score of 5 or more when using the Leading Pedestrian Interval Guidelines;

AND THAT The City of Greater Sudbury does not implement Leading Pedestrian Intervals at traffic signals that have a protected advanced left or right turn movement as outlined in the report entitled "Leading Pedestrian Interval Policy", from the General Manager of Growth and Infrastructure, presented at the Operations Committee meeting on January 15, 2018.

Relationship to the Strategic Plan / Health Impact Assessment

This report refers to "providing quality multimodal transportation alternatives for roads, transit, trails, paths, sidewalks and connecting neighborhoods and communities within Greater Sudbury" which is identified in the Strategic Plan under the key pillar of Sustainable Infrastructure.

Report Summary

This report introduces the concept of a Leading Pedestrian Interval (LPI) and provides an overview of the proposed LPI policy, including a warrant process and implementation guidelines. This report also seeks Committee approval to adopt the LPI policy to be implemented consistently throughout the City of Greater Sudbury.

Financial Implications

The cost to implement a Leading Pedestrian Interval ranges in cost from \$1,000 to \$18,000 per signalized intersection. Upgrades to existing intersections to introduce a Leading Pedestrian Interval will be funded from the approved Roads Capital Budget through the Traffic System Improvements budget.

Signed By

Manager Review

Joe Rocca
Traffic and Asset Management
Supervisor
Digitally Signed Dec 18, 17

Division Review

Stephen Holmes
Director of Infrastructure Capital
Planning
Digitally Signed Dec 18, 17

Financial Implications

Apryl Lukezic
Co-ordinator of Budgets
Digitally Signed Dec 20, 17

Recommended by the Department

Tony Cecutti
General Manager of Growth and
Infrastructure
Digitally Signed Dec 21, 17

Recommended by the C.A.O.

Ed Archer
Chief Administrative Officer
Digitally Signed Dec 21, 17

Leading Pedestrian Interval Policy

Background:

Pedestrian safety has been and remains a primary focus of the City's Traffic and Transportation Engineering Services Division. Although many pedestrian safety initiatives have been implemented over the years, staff remains committed to researching and implementing new safety initiatives as they are developed throughout the industry with the goal of providing the safest transportation network for all road users.

In 2016, City Council adopted the Transportation Master Plan (TMP) which emphasizes the need to provide safe accommodation for pedestrians and cyclists in Greater Sudbury. Section 10.11 Pedestrian Safety, puts forth guidance to enhance pedestrian safety and recommends Leading Pedestrian Intervals (LPI) as a means to achieve this.

Conventional signalized intersections provide for a pedestrian crossing concurrently with the adjacent vehicle through movement. Right or left turning vehicles are required to yield to pedestrians in the crosswalk; however, in practice, it has been observed that turning vehicles often impede the path of pedestrians. The LPI is a technique that can be used to improve pedestrian safety by reducing vehicle turn conflicts with pedestrians at signalized intersections. By giving pedestrians a head start, this allows pedestrians to establish the right-of-way, which increases the visibility of pedestrians to motorists, and thereby reduces potential conflicts with turning vehicles.

What is a Leading Pedestrian Interval?

A LPI is a pedestrian signal timing option in which the "walk" interval starts several seconds before the adjacent vehicle through movement phase thus providing a head start for pedestrians. Typically during this period, all traffic signals are red, while the pedestrian begins to cross. The purpose of an LPI is to provide pedestrians with the opportunity to begin crossing the street before adjacent through movement vehicles are permitted to proceed.

There are a number of advantages to providing LPIs at intersections with a known history of conflicts:

- LPIs enhance the visibility of pedestrians in the intersection and reinforce their right-of-way over turning vehicles.
- The LPI is particularly helpful for older pedestrians, as they may take longer to occupy the crosswalk following the start of a "walk" indication, making them less obvious to turning motorists.
- LPIs typically require adjustments to existing signal timing that are relatively low cost compared to other countermeasures.

- The LPI has also been recommended as a strategy for reducing pedestrian-vehicle collisions at signalized intersections. According to the Crash Modification Factor (CMF) Clearinghouse, maintained and administered by the U.S. Federal Highway Administration (FHWA), a LPI implementation can be expected to reduce the number of pedestrian-vehicle collisions at an intersection with traffic signals by up to 45%.

While implementing LPIs have obvious advantages for improving pedestrian safety, it is important to also acknowledge potential disadvantages with this countermeasure:

- LPIs may create safety problems for vision-impaired pedestrians, since the sound of parallel moving traffic is delayed. Signals equipped with a LPI may cause pedestrians with a vision impairment to start crossing too late, leaving them with inadequate time to finish crossing safely. To address this issue, all intersections with a LPI must be equipped with an Audible Pedestrian Signal (APS) and the APS for parallel crossings must be timed exactly the same at the intersection, even if the LPI is only being implemented at one of two parallel crossings.
- It may negatively impact emergency vehicle response times by delaying automobile traffic by the amount of time allotted to the pedestrian signal lead.
- Use of multiple LPI locations in a single corridor may increase congestion by lengthening vehicular travel times for commuters and other drivers.

Leading Pedestrian Interval Warrant:

With this report, staff are seeking to formalize the process for determining where to apply a LPI in Greater Sudbury through the creation of a warrant and implementation guidelines for LPIs. The Suitability Assessment Worksheet (warrant) presented in Exhibit A, is based on a review and adaptation of the Leading Pedestrian Interval Assessment and Implementation Guidelines from the City of Toronto. The purpose of the Guidelines is to assist staff in identifying suitable locations for LPIs using a checklist, and to further consider operational features that would maximize the positive safety effects and minimize any negative impacts on vehicular capacity. The Guidelines also provide a simple and easy to use tool for staff to assess the suitability of a location for application of an LPI without significant resource requirements.

The following list summarizes factors considered in the Suitability Assessment Worksheet (Exhibit A).

- Any intersection where drivers make left turns without the need to yield to oncoming traffic (i.e. T-intersections and intersections of two-way roads with one-way roads);

- Presence of sight line or visibility issues due to irregular intersection geometry, wide turning radius, crosswalk placement, obstructions such as buildings or the base of a bridge, and blinding sun angle when the sun is low on the horizon;
- High volume of pedestrians crossing;
- High rate of collisions between pedestrians and turning vehicles or observed non-yield or near-miss incidents during a conflict analysis;
- Close proximity to elementary schools;
- High level of activity by elderly residents;
- Impacts on vehicular traffic:
 - Increase in vehicular delay;
 - Negative impact on vehicular Level of Service; and
 - High vehicular traffic volume
- To address the above potential capacity issues, the City shall only consider LPI at locations with a cumulative assessment score of 5 or more obtained when using the Leading Pedestrian Interval Guidelines as outlined in Exhibit A.

Pilot Project Results:

In March 2017, the City of Greater Sudbury installed a Leading Pedestrian Interval at the intersection of Notre Dame Avenue and Kathleen Street as a pilot project. The goal of the pilot was to reduce the potential conflicts between pedestrians and turning vehicles at the intersection. In addition, staff sought to determine the impact of the LPI on pedestrian safety at the signalized intersection before determining whether implementation throughout the City would be an effective approach to increase pedestrian safety.

To evaluate the impact of the LPI, before and after vehicle–pedestrian conflict analysis was conducted at the intersection of Notre Dame Avenue and Kathleen Avenue using a video camera system to capture pedestrian and motorist conflicts at the crosswalks. Analysis presented within this report is based on observations and data collected from the intersection during the morning (AM), mid-day (MD) and evening (PM) peak hours. Table 1 below displays the number of pedestrians and vehicles observed during the before and after analysis.

Table 1. Volume of Pedestrians and Vehicles for Pedestrian-Vehicle Conflict Study

Time Period	Before			After		
	Pedestrian volume	Left turn volume	Right turn volume	Pedestrian volume	Left turn volume	Right turn volume
AM Peak	45	304	261	29	197	188
MD Peak	112	321	214	56	222	192
PM Peak	160	609	352	104	428	291

To measure the impact of the LPI, a pedestrian-vehicle conflict rate was used. Conflict rates are preferred over conflict frequencies because they account for changes in volume of pedestrians and vehicles during the study periods. The pedestrian-vehicle conflict rates represent the number of conflicts observed per 1,000 pedestrians per turning vehicle volume. Reductions in pedestrian-vehicle conflict rates are considered positive safety impacts. Table 2 shows the pedestrian-vehicle conflict rates for the before and after evaluation periods. The conflict rates were reduced by 25% to 41% after the LPI was installed relative to those observed prior to installation.

Table 2. Before and After Pedestrian-Vehicle Conflict Rates

Study Period	Pedestrian-Vehicle Conflict Rate (conflicts /1000 pedestrians / turning vehicle volume)		
	Before	After	Conflict Reduction (%)
AM Peak	0.17	0.10	-41
MD Peak	0.04	0.03	-25
PM Peak	0.04	0.03	-25

Proposed 2018 Leading Pedestrian Interval Locations:

Using the Suitability Assessment Worksheet presented in Exhibit A, staff have completed an evaluation of numerous signalized intersections throughout the community. While analysis indicates that seven (7) of the intersections qualified for an LPI, practically speaking, LPIs can only be implemented at the following four locations (Exhibit B):

- Brady Street at Minto Street
- Notre Dame Avenue at King Street
- Notre Dame Avenue at Ste. Anne Road/Louis Street
- Notre Dame Avenue at Wilma Street

LPIs cannot be implemented at three other locations, including Elm Street at Regent Street, Froot Road at College Street and Notre Dame Avenue at Elm Street, due to protected advanced left turn movement (Exhibit C) that is provided at these traffic signals.

Next Steps

While there is no one measure that could be implemented which could eliminate all pedestrian collisions, the City strives to use a variety of countermeasures to target specific issues. The City's goal is to provide the safest transportation network for all road users. As previously mentioned, Greater Sudbury has implemented many new pedestrian safety initiatives, such as pedestrian crossovers, pedestrian countdown signals, painted zebra crosswalks, pedestrian refuge island, etc. over the past number of years and is committed to researching and implementing new safety initiatives as they become available.

The addition of the Leading Pedestrian Interval to the municipal toolbox is one strategy for reducing pedestrian-vehicle crashes at signalized intersections. By adopting a consistent approach to implementation and continuing to expand the LPI program, pedestrian access and movement will continue to be prioritized which ultimately enhances pedestrian safety and enables a healthier lifestyle for Greater Sudbury residents.

Communication Plan

Prior to implementation the City will issue a Public Service Announcement and inform the public via social media of the changes and when they will occur. Staff will further update the City's website to provide information about how an LPI works to educate all road users on their proper use and where they are located.

Resources Cited:

Crash Modification Factors Clearinghouse, Access on line:
<http://www.cmfclearinghouse.org/results.cfm>

Leading Pedestrian Interval Assessment and Implementation Guidelines, Access online:
<http://docs.trb.org/prp/15-1579.pdf>

Ontario Traffic Manual, Book 12, Traffic Signals, Access online:
<https://www.library.mto.gov.on.ca/SydneyPLUS/Sydney/ViewRecord.aspx?template=Books&record=59cabe78-8aaf-4347-95ab-d6c066099015&lang=en-US>

EXHIBIT "A"

Leading Pedestrian Interval Suitability Assessment Worksheet

	Description	Values	Score	Score Allocation Guide	Justification	Notes
1	Is the pedestrian crossing at a T-intersection (crossing is parallel to a road that ends at the intersection) and/or Is the pedestrian crossing parallel to a one-way road?		0 to 2	Yes = 2 No = 0	High level of potential safety improvement with LPI at T-intersections compared to regular intersections because all vehicles approaching a T-intersection make a left/right turn and left turning vehicles do not need to wait for and yield to vehicles in the opposing direction. Similarly, left turning vehicles travelling on a one-way road do not need to wait for and yield to vehicles in the opposing direction.	
2	Are there issues such as safety concerns verified by staff or visibility issues due to features such as irregular intersection geometry, wide turning radius, crosswalk placement, obstructions such as buildings or base of a bridge, blinding sun angle?		0 to 2	Yes (4 or more issues) = 2 Yes (Between 1 to 3 of issues) = 1 No = 0	High level of potential safety improvement	
3	8-Hour volume of pedestrians crossing the leg being considered for LPI (p)		0 to 2	2 if P > 1000 1 if 200 < P ≤ 1000 0 if P ≤ 200	High level of benefit for the highest number of pedestrians	
4	What is the overall total impact on vehicles using the intersection? What is the increase in intersection total or average delay (%) (a) What is the through phase V/C ratio of the signal with LPI (b) What is the total 8-Hour vehicular volume at the intersection (c)		0 to -6	Overall impact = -1 x Min(A,B) x C , where A={ 0 if a < 10%, -1 if 10% < a ≤ 30% -2 if a > 30%} B={ 0 if b < 0.9 -1 if b ≥ 0.9} C={-1 if C < 16,000 -2 if c ≥ 16,000 and < 30,000 -3 if c ≥ 30,000 }	High level of negative impact on traffic operations for a large number of drivers	
5	What is the rate of annual collisions between pedestrians and left or right turning vehicles per 1000 8-hour pedestrian crossings at the specific crossing in the past 5 years?		0 to 2	None = 0 Between 0 and 3 = 1 Greater than 3 = 2	High level of potential safety improvement	
6	What is the rate of conflicts* [conflicts per 1000 8-hour observations] between pedestrians and left or right turning vehicles at the specific crossing during 8 hours of observation during area specific pedestrian peak and non peak periods?***		0 to 2	None = 0 Between 0 and 3 = 1 Greater than 3 = 2		
7	How far is the location from the nearest elementary school?		0 to 2	2 if e = 5 1 if 4 ≤ e < 5 0 if e < 4	High level of benefit to slower walking pedestrians: elderly	
8	TOTAL SCORE					

EXHIBIT "B"

Pedestrian Leading Interval Warrant

#	Intersection	Left turn mode	Intersection		Safety concerns		Pedestrian Volume		% increase total delay		Through phase		Total 8 hour vehicular		Ped/turning vehicle per 1000 - 8hr ped crossing in the last 5 year		Rate of conflict		Distance from the		Elderly activity		Total Score	Warrant	Notes	
			Type	Score	Safety concerns	Score		Score	%	Score	%	Score		Score	Ped collision / 5 years	score	score	score	score	Score						
1	Brady @ Minto	Perm	c	0	None	0	1412	2	2.3	0	0.1	0	12324	-1	4	5.64	2	5.65	2	No	0	yes	2	7	YES	Crossing Brady
2	Notre Dame @ King	Perm	c	0	V, CR, B, Bus location	2	588	1	1	0	1	0	19628	-2	5	2.94	1	2.94	1	No	0	yes	2	5	YES	Crossing Notre Dame
3	Notre Dame @ St Anne	Perm	c	0	O B	1	743	1	1.4		1.1	0	17079	-2	3	2.23	1	2.23	1	350	1	yes	2	5	YES	Crossing Notre Dame
4	Notre Dame @ Wilma	Perm	c	0	O	1	254	1	0		1	0	15996	-1	3	0.76	1	0.76	1	No	0	yes	2	5	YES	Crossing Notre Dame

- Visibility V
- Offset O
- Wide Turning Radius R
- Crosswalk Placement C
- Obstruction B
- Blind sun angle S

EXHIBIT "C"

Leading Pedestrian Interval Suitability Assessment Work Sheet

#	Intersection	Left turn mode	Intersection		Safety concerns		Pedestrian Volume		% increase total delay		Through phase		Total 8 hour vehicular		Ped/turning vehicle per 1000 -8hr ped crossing		Rate of conflict		Distance from the		Elderly activity		Total Score	Warrant	Notes	
			Type	Score	Safety concerns	Score		Score	%	Score	%	Score		Score	Ped collision / 5 years		score		score		score					Score
1	Lasalle @ Lansing	Perm	C	0	None	0	303	1	10.7	0	11.1	-1	14,610	-1	5	1.51	1	1.51	1	No	0	yes	2	3	NO	Crossing Lasalle
2	Barrydowe @ Westmount	Perm	C	0	None	0	101	0	0.5	0	21	-1	12,324	-1	3	0.3	1	0.3	1	270	1	yes	2	3	NO	Crossing Barry Downe
3	Falconbridge @ Penman	Perm	T	2	None	0	105	0	0	0	0	0	9,781	-1	3	0.32	1	0.32	1	500	1	med	1	3	NO	Crossing Falconbridge
4	Lasalle @ Auger	Perm	T	2	None	1	195	0	1.2	0	0	-1	19,113	-2	4	0.78	1	0.78	1	535	1	yes	2	3	NO	Crossing Lasalle
5	MR80 @ Main	Prot	C	0	O	1	127	0	3.2	0	0	-1	19,722	-2	3	0.38	1	0.38	1	280	1	yes	2	3	NO	Crossing MR80
6	Paris @ Brady	Prot & Perm	C	0	B	1	688	1	2	0	0	-1	26,319	-2	3	2.06	1	2.06	1	No	0	yes	2	3	NO	Crossing Paris
7	Paris @ Walford	Perm	C	0	C,R, O	0	50	0	0.3	0	1	-1	19,781	-2	3	0.150	1	0.15	1	400	1	yes	2	2	NO	Crossing Paris
8	Regent @ Long Lake	Prot	C	0	O, R	1	453	1	5	0	3.5	-1	28,169	-2	5	2.27	1	2.27	1	No	0	yes	2	3	NO	Crossing Regent
9	Elm @ Regent	Prot & Perm	C	0	V,O, B	1	246	1					9,914	-1	3	0.73	1	0.74	1	No	0	yes	2	5	NO	Crossing Elm
10	Frood @ College	Prot & Perm	C	0	V,O, B	1	667	1	10.3				7,285	-1	3	2	1	2	1	250	1	yes	2	6	NO	Crossing College
11	Notre Dame @ Elm	Prot & Perm	C	0	R O B	1	1783	2					22,738	-2	3	5.35	2	5.35	2	No	0	yes	2	7	NO	Crossing Notre Dame Crossing Elm

- Visibility V
- Offset O
- Wide Turning Radius R
- Crosswalk Placement C
- Obstruction B
- Blind sun angle S