

EXHIBIT C



HDR Corp
255 Adelaide Street West
Toronto, ON M5H 1X9
Tel: (416) 777-4900
Fax: (647) 777-4901
www.hdrinc.com

File: 2.0
Project # 6583

Memorandum

To: Dave Kivi – City of Greater Sudbury
Cc: Dave Shelsted – City of Greater Sudbury
From: Sasha Naylor – HDR
Chris Philp – CIMA
Date: September 27, 2013
Re: **Design Considerations for an IPS at Brady Street and
Shaughnessy Street**

1. BACKGROUND

This memo has been prepared in response to the request from the staff of the City of Greater Sudbury for design considerations for a new set of intersection pedestrian signals (IPS) at Brady Street and Shaughnessy Street.

In January of 2012, HDR developed a pedestrian crossing policy for the City and completed a review of three individual locations where the new policy was applied. One of the locations was at Brady Street and Shaughnessy Street. The resulting report concluded that a controlled crossing (i.e. a pedestrian signal) was not warranted according to the justification requirement of the Ontario Traffic Manual Book 12 and that signal spacing between Shaughnessy Street and the signals at Minto Street and Paris Street were of concern. As a result, a marked, uncontrolled crossing should be maintained. Specifically, the recommendations stated:

Considering the high pedestrian volumes that cross Brady Street throughout the day, and the strong pedestrian desire line between the numerous pedestrian generators along Shaughnessy Street and City Hall and the Police station, it is recommended that the existing unprotected mid-block crossing be maintained and enhanced to accommodate this desire line. Recommended crossing enhancements to the mid-block crossing include the application of Zebra style pavement markings similar to those used along Elm Street, as well as the addition of “Yield to Traffic” signs at both ends of the crossing.

In order to eliminate jay-walking at random locations across Brady Street, it is recommended that median enhancements be installed along Brady Street to discourage jay-walking and consolidate pedestrians to the enhanced pedestrian crossing. Median enhancements can include the installation of a fence and / or planters similar to the median enhancements applied along Elm Street at the Elm Street crossing.

To ensure pedestrians use the side of the intersection with the crosswalk, no markings should be shown on the east side of the Brady Street and Shaughnessy Street intersections. Further, Ra-9A signs requiring pedestrians to "Cross Other Side" should be posted across this leg of the intersection. It is also recommended that these "Cross Other Side" signs be regularly enforced.

This recommendation was presented to the City's Operations Committee during a meeting of April, 2012. After some debate, the Committee determined that staff should investigate a controlled (i.e. signalized) crossing at the Brady Street / Shaughnessy Street location. Given the concerns associated with signal spacing and insufficient justification of the warrant, signals at this location must be planned carefully. This memo provides some considerations and recommendations for the design of IPS's at this location.

2. EXISTING CONDITIONS

An unprotected pedestrian crossing is currently located on the west leg of the Brady Street / Shaughnessy Street intersection, at approximately 95 metres west of the Paris Street intersection and 90 metres east of Minto Street intersection. Brady Street is posted at 50 km/h and carries an AADT of approximately 15,900. There is a fire hall located on Shaughnessy Street, south of Van Horne Street.

The traffic signals at Minto and Paris Streets run coordinated using a 110 second cycle time throughout the day. The storage area for the eastbound left turn lane at Brady Street and Paris Street extends back to the Shaughnessy intersection. Queuing was observed in previous safety reviews to extend from Paris Street beyond Shaughnessy Street in the PM peak hour.

The volume of pedestrians crossing Brady Street at Shaughnessy Street was observed during a traffic count undertaken on November 13, 2012. The count shows that the peak period of the day is between 4:00 and 5:00 pm. During that peak period, 187 pedestrians crossed Brady Street on the west side and 72 crossed Brady Street on the east side for a total of 259 pedestrians per hour.

The November 13, 2012 count also shows that the volumes on Shaughnessy Street are insufficient to meet the thresholds required in the Ontario Traffic Manual for signalization. Furthermore, the spacing to the adjacent intersections violates the minimum spacing guidelines of 215 metres spacing between signals. The 215 metre guideline was selected to reduce the potential for driver confusion when approaching closely spaced signals. In this situation, drivers may focus on downstream signals rather than the signals at the impending intersection.

3. ALTERNATIVES

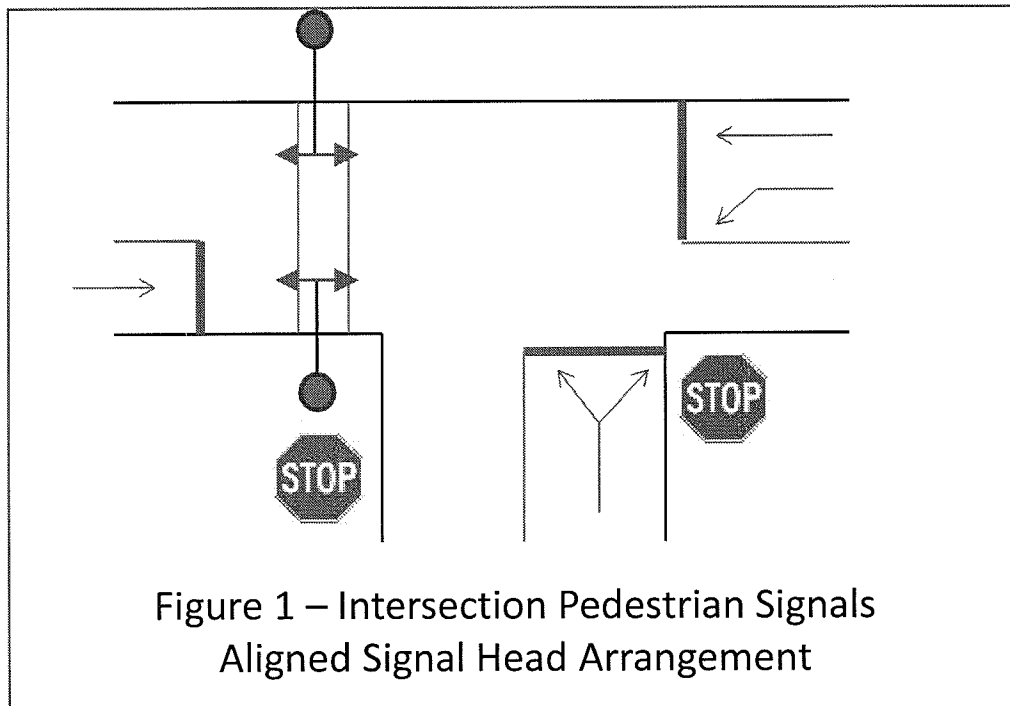
To address the potential for driver confusion, optically programmable signal indications (OPSI) are recommended. OPSI's allow the signal indication to be focussed on a specific footprint on the roadway. With this intended operation, drivers will not see the indication upstream of this footprint area and therefore will not confuse the indication at one intersection with another.

To address the request of the City's Operations Committee and in light of the tight spacing between the proposed IPS and the signals up and down stream, three options were considered for a protected crossing at the Brady Street and Shaughnessy Street intersection:

1. Intersection Pedestrian Signals with an aligned signal head arrangement
2. Intersection Pedestrian Signals with a conventional signal head arrangement
3. Full Traffic Control Signals with a conventional signal head arrangement

Option 1 - Intersection Pedestrian Signals with an Aligned Signal Head Arrangement

In this option, intersection pedestrian signals are installed on the west leg of the Brady Street and Shaughnessy Street intersection. The west leg is selected to avoid impeding on the westbound left turn storage area. A schematic of this option is shown in Figure 1.



Most agencies in Ontario run IPS's in an uncoordinated (or free) operation. This mode of operation minimizes the delays to pedestrians as they are generally serviced immediately. The alternative (coordinated mode of operation) has the potential to introduce a delay before servicing the pedestrian. The concern with this delay is that pedestrians may not wait and cross the road anyway before getting the right-of-way particularly since there are no other signal indications that would give the pedestrian the sense that the signals are actually cycling.

As a result, and for the purposes of this evaluation, it is assumed that the City would operate the signals shown in Figure 1 in free mode. There are both advantages and disadvantages of this option.

Advantages:

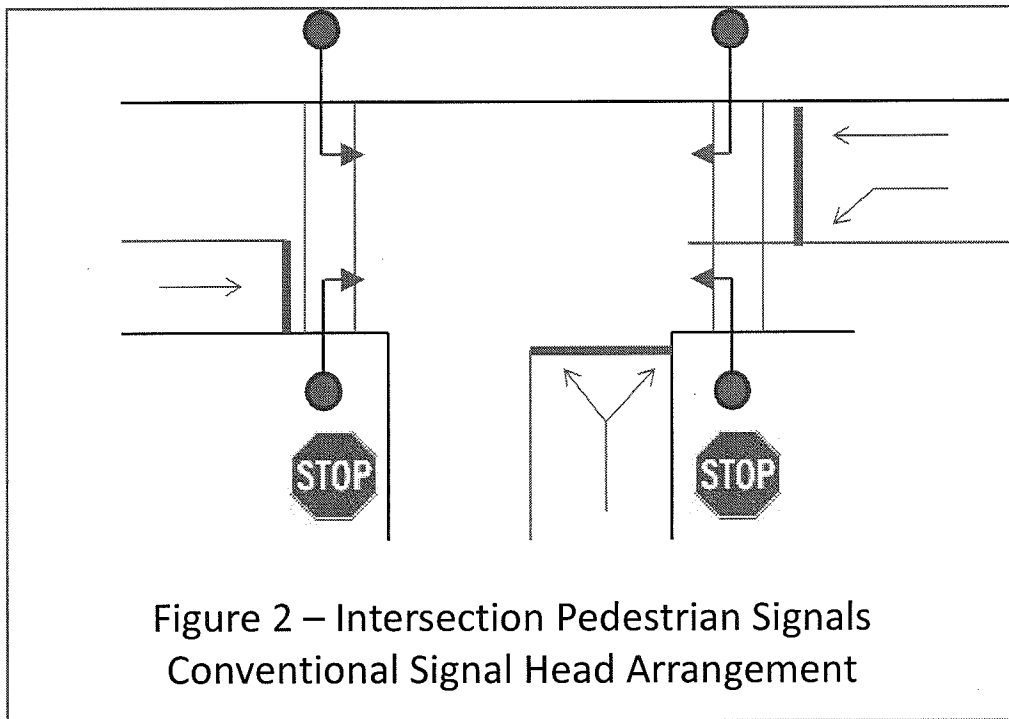
- Traditional design for intersection pedestrian signals
- Fewer poles required
- Lower cost than a full set of signals,
- Typically responds quickly to pedestrian demands by running free

Disadvantages:

- Free operation results in the potential to interrupt signal coordination along Brady Street
- OPSI's on Brady Street may confuse drivers (and pedestrians) on Shaughnessy Street since the heads will appear dark
- This orientation results in a repositioning of the stop bar for eastbound traffic some 15 meters further to the west, resulting in an even shorter signal spacing with signals at Minto Street

Option 2 - Intersection Pedestrian Signals with a Conventional Signal Head Arrangement

The second option considered an intersection pedestrian signal but using a four-pole, conventional signal head arrangement. This option is considered to allow the eastbound stop bar to be positioned closer to the Shaughnessy Street intersection than in Option 1. Additionally, to address the pedestrian demand crossing the east leg, this Option introduces a second cross-walk on Brady Street. It is schematically illustrated in Figure 2.



Again, there are advantages and disadvantages of this option.

Advantages:

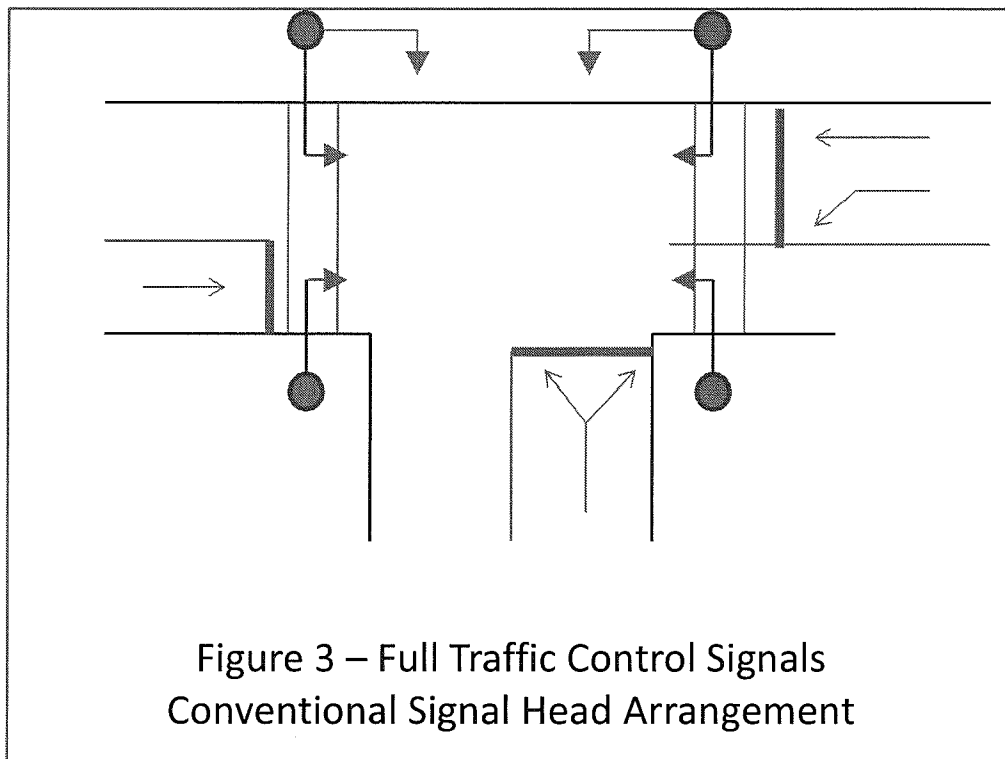
- Allows for optional second Brady Street crossing
- Compresses the intersection and maximizes spacing between stop bars
- Typically responds quickly to pedestrian demands by running in free

Disadvantages:

- Non-traditional design
- More costly than Option 1
- Free operation results in a potential loss of coordination on Brady Street
- May result in confusion for drivers (and pedestrians) on Shaughnessy Street particularly with OPSI's on Brady Street

Option 3 - Full Traffic Control Signals with a Conventional Signal Head Arrangement

Option 3 was identified as a means of reducing the confusion to drivers waiting on Shaughnessy Street and re-introducing progression along Brady Street. It consists of a full set of traffic signals. The schematic for this option is shown in Figure 3.



Once again, there are advantages and disadvantages of this option.

Advantages:

- This option uses a traditional design
- Minimizes driver confusion on Shaughnessy Street
- Coordination maintained along Brady Street
- Compresses the intersection and maximizes spacing between stop bars
- Safer operations during pre-emption

Disadvantages:

- Longer delay to pedestrians and traffic on Shaughnessy Street
- More costly than Option 1 and marginally more costly than Option 2
- May set a precedent of installing signals where they do not fully comply with the warrant

Median Enhancements

Enhancements to the existing median along Brady Street should be considered in an effort to limit the amount of “jay-walking” across the street and to force pedestrians crossing the street to use the signals at Shaughnessy Street. Median enhancements could include the addition of added landscaping / planting or a fence along the median to limit the potential for pedestrians to cross at various locations between Paris and Minto Streets.

Other Considerations

Consider pedestrian buttons that give audible and visual feedback that the call has been acknowledged.

4. RECOMMENDATIONS

While cost and mobility are important criteria for the City, pedestrian safety is paramount. HDR's original recommendation of maintaining a marked, uncontrolled crossing is still the preferred result. However, should the option of signalization be selected, Option 3 is recommended as it is expected to result in the highest compliance rate for pedestrians while servicing pedestrians on both the east and west legs. It also offers the advantages of signal progression on Brady Street and the ability to provide OPSI's with minimal confusion to motorists and pedestrians.

A median consisting of raised planters should be constructed to discourage pedestrians from crossing mid-block.