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MEMORANDUM

To: Caitlyn Prévost

From: Kalle Hakala

Date: 3 February 2020

Re: Cycling Safety Review of High-volume Intersections – Traffic Signal Review

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Review of Protected Right Turn Traffic Signals

PROBLEM STATEMENT

At large suburban protected intersections, there is a strong desire to see fully protected right turns due to:

- the operating speed of the roadways (typically 60km/h+ in suburban environments)
- the typically very large effective turning radius required (15m radius can result in high turning speeds)
- the high volume of right turning vehicles (NACTO recommends that fully protected right-turn movements be implemented at intersections with cycle track crossings when the conflicting right turn volume exceeds 150 vehicles during peak hours, which is typically exceeded at for most suburban intersections)
- the relative space-efficiency of a protected intersection corner compared to a smart channel that accommodates separated walking and cycling movements

This presents a new challenge to accommodate the required number of signals for all desired movements. This includes primary and secondary heads for left, thru, right, and bicycle movements, 8 signal heads total.

DESIGN GUIDANCE REVIEW

The constraints imposed from Book 12:

- primary signal head must be within cone of vision for the associated lane, extending 30 deg horizontally and 15 deg vertically (p84)
- for roadways with posted speeds less than 80km/h, secondary heads can be mounted at a height of 2.75m as long as it is not mounted over a lane (p87)
- primary signal head should be located between 12 and 55m longitudinally from the stop bar (p90)
- primary and secondary heads should be separated by min 5m, desirable max 15m, absolute max 22m (p92)
- 2.4m min between secondary thru signal head and a primary protected left signal head (p109)

The guidance from OTM Book 12A (p19):

- Does not specify minimum spacing between motor vehicle signal heads and bicycle signal heads, but states that "wherever possible, the bicycle signal head should be positioned lower and out of the typical line of sight of the motor vehicle driver while being placed in the line of sight of the cyclists" (p18)

- provides additional guidance for differentiating bicycle signals from motor vehicle signals including different signal head housing and using no backboard (p18)
- If a nearside auxiliary head is deployed, it may be smaller than 200 mm and could be mounted at a height less than 2.5 m, as determined by the road authority (p19)
- The City of Toronto's draft On-street Bikeway Design Guidelines recommend a pilot to test the efficacy of nearside bicycle signals at a height less than 2.5m

PEER CITY EXAMPLES

This challenge to separate all turning movements is a result of a continued push to improve the safety of cycling facilities across North America. It is an emerging design need and is expected to become more prominent in the near future. For example, the City of Toronto's Draft On-Street Bikeway Design Guidelines (expected publication 2020) requires consideration of fully protected right and left turn phasing based on the volume of turning vehicles, including heavy vehicles and buses.

The City of Vancouver has been an early leader in the implementation of large protected intersections. At the recently-constructed protected intersection of Cornwall and Burrard, a fully-protected right turn was implemented where vehicles cross a bidirectional cycle track crossing (image below). This was accomplished by placing the secondary right turn and bicycle signal heads on the nearside of the intersection.

Figure 1 - Nearside right turn signal installed at Cornwall and Burrard in Vancouver

LIMITATIONS

One potential limitation is the provision of signals at very large intersections, with cross sections of 9 lanes or more (three thru lanes each direction, two left-turn lanes, one right-turn lane). In these cases, it is unlikely that the recommended maximum longitudinal distance of the primary signal head from the approaching vehicle stop bar of 55 m can be met. In this case, other crossing treatment should be considered such as grade separations or smart channels, which accommodate a primary signal pole in a closer location longitudinally.

Another challenge is the implementation of a nearside signal head that is smaller than 200 mm and mounted below 2.5 metres. From a user-perspective, this is a highly effective method to provide signalization to cyclists without confusing motorists; however, a lower voltage is required when a signal is installed at a height lower than 2.5 metres. This is a challenge of the technical nature and should be investigated further due to the high potential value of this method, particularly at large intersections.

CONCLUSION

Based on this preliminary assessment, there is evidence from other Canadian jurisdictions that this signalization method is both desired and possible in the context of providing safe and separated cycling infrastructure. The current Book 12 and Book 12A framework should permit the installation of this treatment. User compliance can be improved by implementing one bicycle signal head on the near side of the intersection with a lens of 200 mm or smaller and at a height lower than 2.5m, and lowering the far-side bicycle signal head to the minimum 2.5m to provide vertical separation from the right-turn heads.

At the Ottawa example intersection of March and Herzberg (image below), it appears that the bicycle signals were installed at roughly the same height as the right-turn heads. With the proposed protected intersection designs, bicycle signal heads would not be in a position where they would have to clear vehicles beneath them, making the lower mounting height desirable.

Figure 2 - Protected right turn installation at March and Herzberg in Ottawa