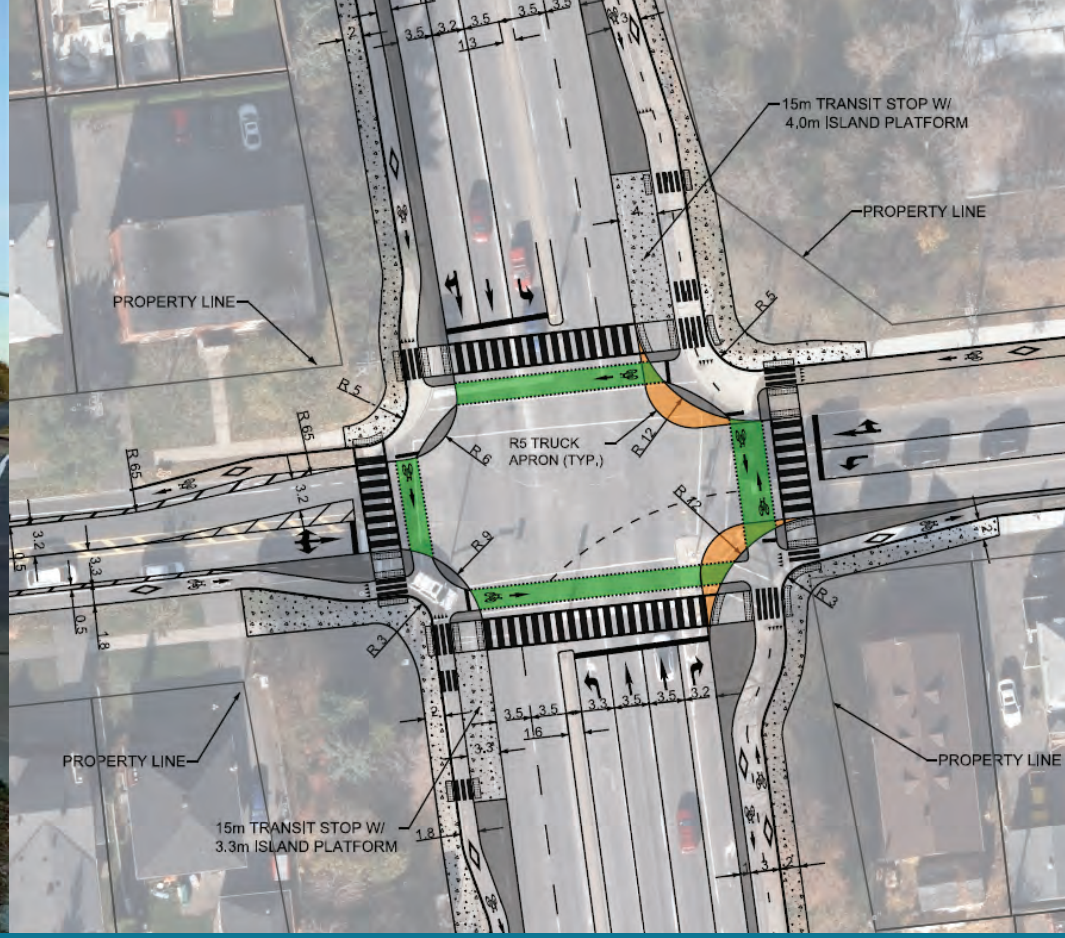


City of Ottawa

Cycling Safety Review of High-Volume Intersections

March 2020

Prepared by Alta Planning + Design

Contents

Introduction 1

Report Discussion 5

(1) Alta Vista Drive @ Industrial Avenue
(2) Bank Street @ Fifth Street
(3) Bank Street @ Riverside Drive
(4) Bank Street @ Wilton Crescent
(5) Bayswater Avenue @ Somerset Street
(6) Bayview Avenue @ Scott Street
(7) Cumberland Street @ Laurier Avenue
(8) Cummings Avenue @ Ogilvie Road
(9) Donald Street @ Vanier Parkway
(10) Gladstone Avenue @ Bank Street
(11) Gladstone Avenue @ Booth Street
(12) Gladstone Avenue @ Preston Street
(13) Hazeldean Road @ Eagleson Road
(14) Hazeldean Road @ Terry Fox Drive
(15) West Hunt Club Road @ Merivale Road
(16) West Hunt Club Road @ Prince of Wales Drive
(17) Island Park Drive @ Richmond Road
(18) King Edward Avenue @ Sussex Drive
(19) King Edward Avenue at St. Patrick Street
(20) Laurier Avenue @ King Edward Avenue
(21) Montreal Road @ Aviation Parkway
(22) Moodie Drive @ Robertson Road
(23) Nelson Street @ Rideau Street
(24) Preston Street @ Prince of Wales Drive / QE Driveway
(25) Preston Street @ Somerset Street
(26) Prince of Wales Drive at Fisher Avenue
(27) Prince of Wales Drive at Meadowlands Drive
(28) Smyth Road @ Riverside Hospital
(29) Somerset Street @ Bronson Avenue
(30) Somerset Street @ Kent Street
(31) St. Laurent Boulevard @ Ogilvie Road
(32) St. Patrick Street @ Sussex Drive
(33) Wellington Street @ Lyon Street
(34) Industrial Avenue @ Riverside Drive

Concept Designs 139

(1) Alta Vista Drive @ Industrial Avenue
(2) Bank Street @ Fifth Street
(5) Bayswater Avenue @ Somerset Street
(6) Bayview Avenue @ Scott Street
(7) Cumberland Street @ Laurier Avenue
(8) Cummings Avenue @ Ogilvie Road

(9) Donald Street @ Vanier Parkway
(10) Gladstone Avenue @ Bank Street
(11) Gladstone Avenue @ Booth Street
(12) Gladstone Avenue @ Preston Street
(13) Hazeldean Road @ Eagleson Road
(14) Hazeldean Road @ Terry Fox Drive
(15) West Hunt Club Road @ Merivale Road
(16) West Hunt Club Road @ Prince of Wales Drive
(17) Island Park Drive @ Richmond Road
(18) King Edward Avenue @ Sussex Drive
(19) King Edward Avenue at St. Patrick Street
(20) Laurier Avenue @ King Edward Avenue
(22) Moodie Drive @ Robertson Road
(23) Nelson Street @ Rideau Street
(24) Preston Street @ Prince of Wales Drive / QE Driveway
(25) Preston Street @ Somerset Street
(26) Prince of Wales Drive at Fisher Avenue
(27) Prince of Wales Drive at Meadowlands Drive
(28) Smyth Road @ Riverside Hospital
(29) Somerset Street @ Bronson Avenue
(30) Somerset Street @ Kent Street
(31) St. Laurent Boulevard @ Ogilvie Road
(34) Industrial Avenue @ Riverside Drive

Appendices

Appendix A Traffic Data Summary A1
Appendix B Countermeasure Menu B1
Appendix C Traffic Signal Review Memo C1
Appendix D Design Criteria D1
Appendix E Cost Estimates E1

Cycling Safety Review of High-Volume Intersections

Introduction

The Cycling Safety Review of High-Volume Intersections project is a study reviewing 34 intersections that were identified by the City of Ottawa as having the highest risk of potential vehicle/cyclist conflict. The project provides both interim countermeasure recommendations and an ultimate concept design that prioritizes cyclist safety, but also considers pedestrian, transit, and motor vehicle safety.

The City selected the intersections based on their characteristics, collision history, or consultation with the community. The characteristics considered were cycling volumes, vehicle volumes, speed limit, and road classification. The collision threshold for inclusion in the project was 4 or more collisions in 5 years or 3 or more collisions in 5 years that had the same trend.

The workflow towards developing the concept designs for the project is outlined below. Communication between the consultant team and the City project manager occurred throughout the process, but with particular attention during the review of deliverables. There was also some consultation with other groups in the City's Transportation Services Department.

Existing Conditions

Data was provided by the City for each intersection that included GIS layer files, traffic counts (either a full study or a 12-hour Miovision count), collision detail reports for the last 10-years, and any further information or other considerations, such as other City projects related to the intersection. The traffic volume data is detailed in Appendix A.

The data was used to complete existing condition reports for each of the 34 intersections. The reports also provide relevant information relating to each intersection for emergency, transit, and truck service, as well as classifications in the City's Transportation Master Plan and Cycling Plan.

Site visits were also completed at this stage to observe signal cycles, users, and to identify any other considerations that should be noted in the report.

The existing condition reports were submitted to the City for review and any requested changes were completed.

Countermeasures Menu

To assist in the development of designs and interventions, a menu of countermeasures was established, which differentiates between interim and ultimate measures. Interim measures are those which can be done at low-cost and/or involving temporary materials, generally not requiring roadway reconstruction (ex. speed humps, signage, pavement markings). Ultimate measures are to be considered when improvement opportunities arise through reconstruction (ex. signalization, protected intersection). The full countermeasures menu is detailed in Appendix B.

Potential Issues Identified

A list of potential issues was developed for each of the intersections before commencing the intersection countermeasure and design process. This list provides a succinct summary of the potential major issues at the intersection that impact the safety and comfort of cyclists using the intersection. They were developed by reviewing the existing conditions, which included the collision history.

Short-term Countermeasures

Based on the potential issues identified, short-term countermeasures were recommended for each intersection from the established countermeasures menu and illustrated on the basemaps of each intersection. The countermeasures are intended to be interim measures, focusing on paint, signage, and temporary physical elements, such as flexible delineator posts. The short-term countermeasure drawings for each intersection are included in a separate document.

Concept Designs

Concept designs for 29 intersections were developed to show a high-level ultimate design for each intersection. Five intersections were not carried forward to the concept design stage as those intersections will be addressed through other studies or have unique characteristics. The ultimate concept designs allow for consideration of full reconstruction of each intersection, including modifying curbs, lanes, signals, and drainage. The concept designs were created based on design criteria, which were developed based on published guidance from the City of Ottawa and other design guidelines. Each concept design drawing is accompanied by a written commentary on the design and a Class D cost estimate.

The most prevalent design features considered include:

- **Protected corner** – This is the most desired treatment as it provides in-boulevard queueing space for cyclists with forward stop bars and setback crossings, and allows cyclists to make right turns at any time. Pedestrians cross the cycle tracks (with cyclists yielding to pedestrians) and wait in a refuge area before crossing the roadway. Where the conflicting motor vehicle right turning volume is high, fully protected right turn movements are proposed to eliminate potential conflicts with cyclists and pedestrians
- **Smart channel** – This is proposed where either high vehicle right turning volumes or an acute intersection corner skew make a protected corner less desirable. Pedestrians and cyclists cross the channel in a yield-controlled, raised crossing and queue on the channel island. Smart channels also have lower signal infrastructure requirements and lead to shorter single-leg pedestrian and cyclist crossing distances compared to protected corners, although they generally consume more space overall. This design of smart channel is a new type of design for the City of Ottawa and further review will be required to ensure it is feasible within the City's design requirements and policies.
- **Adjacent crossing** – This is proposed where physical space constraints render a protected corner infeasible. Cyclists queue behind the crosswalk and motor vehicle stop bars are set back 2 m behind bicycle stop bars to provide higher visibility. Two-stage turning boxes are provided to facilitate cyclist left-turning movements, and truck aprons are proposed to reduce passenger vehicle turning speeds. Leading bicycle and pedestrian intervals are generally proposed as well to further improve visibility

Design Objectives, Assumptions, and Methodology

The primary objective of each intersection design is cyclist and pedestrian safety and comfort. Minimizing disruptions to motor vehicle and transit capacity and delay was considered a secondary objective.

During the project a variety of assumptions were made in coordination with City staff. These assumptions include:

- Direction on the type of cycling facility to be considered in each ultimate design was provided by Transportation Planning, and generally includes cycle tracks on all arterial and collector roadways
- Ultimate cycling facilities were added to streets generally by widening intersections while retaining the existing roadway lane configuration. Where physical constraints such as buildings or bridges limit widening options, motor vehicle, transit, and parking lanes are shown as removed as needed to accommodate the assumed cycling facility. Further discussion within the City is required to prioritize competing elements at each intersection (which include transit priority corridors, on-street parking, existing traffic capacity, and heavy vehicle movements). Further analysis will be required at functional design to confirm the impact on these other elements
- Intersection operational analysis (i.e. Synchro) was not conducted as part of this project. Instead, high-level assumptions relating to the capacity of a typical vehicle lane were used to determine the high-level feasibility of certain vehicle lane configurations. Suggested traffic operational measures accompany each design and include protected signal phasing and leading intervals, which are subject to further review

- Vehicle turning path analysis (i.e. Autoturn) was not conducted as part of this project. Instead, desired effective turning radii were selected and provided for all vehicle movements based on the established design criteria
- Private property acquisition was not considered a constraint when developing ultimate designs, but acquisition requirements are noted for further consideration
- Proposed cycling facility alignment generally does not consider physical impediments such as utility poles or grades. Instead, the costs for relocation of poles is considered in the cost estimate
- While intersection designs show facilities transitioning to midblock configurations leading away from the intersection, midblock cross sections are not the focus of the project and are subject to further refinement. This includes analysis of parking space removals
- Existing transit stops are accommodated in each design. While OC Transpo expressed a general preference for far-side stops, configurations were selected on the basis of accommodating the proposed cycling facilities and did not consider transit operational impacts or passenger volumes
- Truck aprons are proposed on many designs and are shown as conceptual only. In principle, truck aprons are intended to create a tighter turning radius for motor vehicles while still accommodating larger vehicles. In practice, this is achieved through a combination of measures. Truck aprons details should be considered at the functional design stage
- Fully protected right turn signalization is proposed at several locations. To support this recommendation, a memo was produced that reviews existing Ontario guidance for the placement of signals including bike signals, practices used by Toronto and Vancouver to signalize fully-protected right turns, and provides high-level recommendations for the implementation of signalized protected right turns combined with bike signals in Ottawa. The full memo is located in Appendix C. Note that fully protected right turn phasing may require more storage than currently provided on intersection approaches. The impact of protected right turns on operational performance were not studied as part of this project.
- Existing traffic patterns have been accommodated in the concept designs where possible. Where physical constraints exist, some changes have been proposed, such as prohibiting a particular turning movement and the removal of auxiliary and/or through lanes
- The designs attempt to minimize changes to roadway alignment, such as by retaining the existing curblines where possible

Design Criteria

Design criteria were developed for the project based on existing City of Ottawa guidance as well as other published guidance:

- Ottawa Traffic Calming Guidelines (2019)
- Ottawa Designing Neighbourhood Collector Streets Guidelines (2019)
- Ottawa Arterial Road Cross Sections (2017)
- *Draft* OTM Book 18 Update (2020)
- NACTO Don't Give Up at the Intersection (2019)
- NACTO Designing for All Ages and Abilities (2017)

One interpretation of significance is regarding the City's allowance for minimum roadway width between curbs. For continuous sections of roadway, a minimum of 8 metres between curbs is provided. For "pinch points" on two-way roadways, 7 metres is permitted, although the length of a "pinch point" is not defined. For the purpose of the project, "pinch points" are assumed to be no longer than 20 metres. It is also noted that minimum lane width requirements vary considerably between jurisdictions and are likely to change over time.

Existing sidewalk minimum widths have been retained, and widened to 2.0 metres (1.8 metres minimum) where possible.

The full design criteria are detailed in Appendix D.

Cost Estimates

Based on the concept designs, Class D cost estimates have been developed. Property requirements have also been noted, but are not included in the cost estimates as property costs fluctuate over time. The following items have been excluded from costing in lieu of a blanket contingency and should be reviewed in more detail at functional design: grading, street furniture, guard rails, retaining walls, tree removals, and bridge/overpass work. The findings are summarized in the discussion for each intersection, and detailed in Appendix E.

Municipal Class Environmental Assessment

Recommendations are provided on which level of Municipal Class Environmental Assessment (MCEA) is required (Schedule A, A+, B, or C). This is based on the Municipal Class Environmental Assessment Amendments (2015) which includes specific changes related to cycling facilities. In general, projects that add cycling facilities but do not remove existing road capacity are Schedule A+ projects, projects that change road capacity and have a cost of less than $2.4 million are Schedule B projects, and projects that change road capacity and have a cost over $2.4 million are Schedule C projects.

Future Work

The following elements will be reviewed as part of functional design development:

- Intersection modelling and network/corridor analysis
- Autoturn analysis
- Accommodating utilities
- Midblock cross-sections
- Parking analysis
- Landscaping and urban design
- Optimizing cycling and pedestrian facility alignment based on grading, poles, etc.
- Design details and extents of truck aprons
- Sightline analysis
- Cycling network review
- Bicycle and pedestrian storage requirements

It should also be noted that the City is currently developing protected intersection design guidelines.

(1) Alta Vista Drive and Industrial Avenue

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history. Alta Vista Drive and Industrial Avenue is a signalized intersection with split phases for N-S traffic, and a protected/permissive WBL. The SBR and EBR movements both have right turn channels. North of the intersection, Alta Vista Drive becomes Sanford Fleming Avenue. The west side of the intersection does not have a N-S pedestrian crosswalk. The surrounding area includes a mix of industrial, commercial, and residential uses. The Canada Post distribution centre is located at the northwest corner of the intersection. To the east of the intersection is the Trainyards commercial district. A public park is southwest of the intersection. Hurdman O-Train station is 600 m west of the intersection.

Overview of Existing Intersection Characteristics

Characteristic	Alta Vista Drive	Industrial Avenue
Road Classification	Major Collector south, Collector north (Sanford Fleming)	Arterial
Speed Limit	50 km/h	60 km/h
Truck Route	No	Yes
Transit	Route 44 (frequent) and 46. Near side NB and SB stops	None
Emergency Route	South of Industrial	Yes
Cycling Facilities	Bike lane south of Industrial, NB lane ends at Rolland, sharrows beyond	MUP on south side
Pedestrian Facilities	Sidewalks both sides	MUP on south side, sidewalk on north side
Configuration	NB double left, through SB left, through, right channel	EB left, two through, right turn channel WB left, two through lanes

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Alta Vista Drive	Industrial Avenue
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route south of Industrial, Sanford Fleming is Local Route	Spine Route
Cross-Town Bikeway	No	Yes, west of Alta Vista, then on pathway southeast to Coronation Ave. Route 4

Alta Vista Drive is a Transit Priority Corridor in the Official Plan.

This intersection has been previously identified as part of the City's Cycling Safety Improvement Program (CSIP). The previous improvement included adding dismount and walk signs on the MUP on the south side of Industrial Avenue approaching the intersection.

The 2018 CSIP design proposed installing green thermoplastic and chevron flex stakes to horizontally deflect cyclists approaching the intersection to slow them down or encourage a dismount and walk scenario. These measures have not been implemented at the time of this report.

Screen capture of proposed 2018 CSIP treatments

Collision History

There have been 155 reported collisions at this intersection from 2009 to 2018. Thirty-five collisions resulted in non-fatal injuries. One collision involved a pedestrian, while 7 collisions involved a person cycling. Two of the cyclist-involved collisions occurred during rainy, wet conditions, the rest were during clear, dry conditions. All the collision occurred during the day, with 5 occurring between 7-9 AM. Five resulted in non-fatal injuries. Five of the collisions involved cyclists using the south side crosswalk being hit by NBR vehicles.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in March 2016. No major physical changes have occurred at this intersection since.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	21-Nov-2017
Time Period	7AM-6PM
Vehicles	23614
% Trucks/Buses	6%
% Bicycles (on-road)	0%
Bicycles (on-road)	31
Pedestrians	517

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- High volume intersection for vehicles, vehicle volumes are higher E-W (64%), on-road cyclist volumes are higher N-S (61%)
- Largest light vehicle volumes EB, Majority of NB and SB vehicles turn right or left onto Industrial Avenue
- Heavy peak turns include SB right, WB left, NB right and left, and EB right and left. NB left and EB right are heaviest
- 2015 summer data for cyclists (including MUP traffic) suggest EB and WB dominant movements, 10 times higher bike traffic
- Very high heavy vehicle traffic as percentage of total, 19% of WB right, 29% of SB left, 22% WB right
- Two bus routes proceed NB/SB through, and one SB left
- Most pedestrians on east leg, low-moderate overall volumes

Site Visit Notes

A site visit was conducted at this intersection on October 21, 2019 at 4:20 PM. The following observations are noted:

- Observed cycle times total 140 seconds, P1: WBL, WBT (10s), P2: E-W (85s), P3: SB (15s), P4: NB (30s)
- WB protected/permissive LT arrow
- Right turn channels NW and SW corners
- SB painted bike lane, NB sharrows
- MUP on south side of Industrial, no crossride
- Bus stops: SB and NB (both near side, NB with shelter/bench)
- No hydro or other utility poles
- Heavy E-W and NBL vehicular volumes
- Some cyclists on MUP E-W through intersection and on Alta Vista Drive
- WBL (during permissive phase) near miss with cyclists crossing across S leg

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Cyclists on south leg are conflicting with vehicles according to collision data– especially NBR and WBL
- Potential for reduced visibility on MUP approach from SE
- Permissive WBL creates a potential conflict with cyclists using MUP
- Channels on SW and NW corners and wide turn radii allow for high vehicle speeds, which has the potential to create conflicts with pedestrians and cyclists
- Long cycle times are uncomfortable for pedestrians and cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on Alta Vista Drive, and a bidirectional cycle track on the south side of Industrial Avenue, with a multi-use trail (MUT) branching off to the SE of the intersection. There are no major physical constraints that affect the design. The proposed solution is a partially-protected intersection, with protected corners on the SW and SE corners, and an adjacent crossing on the NW corner with a fully protected SBR movement. A smart channel is provided on the SW corner to accommodate the high volume of EBR movements. The smart channel is intended to permit a higher volume of vehicle right turns while promoting slower turning speeds and requiring yielding to pedestrians and cyclists.

The existing transit stops are set back from the intersection and are not a factor of the proposed intersection design.

Changes to Configuration

The existing SBR turn channel is replaced with a dedicated and fully protected right turn lane, and the corresponding acceleration lane is removed. The existing SBL lane is removed, and the movement is prohibited. The inner NBL lane is converted to a through lane, to allow the NBR lane to be fully protected and to eliminate the split phasing. The existing EBR turn channel is converted to a smart channel and the corresponding acceleration lane is removed. A centre median on the north leg is proposed to improve vehicle alignment through the intersection. Sightlines will be reviewed at functional design.

Existing sidewalk alignments are maintained midblock on most legs. The south side MUP on Industrial Avenue is upgraded to a 3 m bidirectional cycle track adjacent to a 2 m sidewalk, setback from the roadway by a 1.5 m buffer. A crosswalk has been added to the west leg.

Turning Radii Accommodated

As an arterial-major collector intersection, the desired effective turning radius is 12 m, and this is provided for all movements in the design. Heavy vehicles make right turns at this intersection at moderate to high rates:

- 64-65 heavy vehicles per day for EBR and WBR movements (moderate)
- 26 heavy vehicles per day for NBR movement
- 341 heavy vehicles per day for SBR movement, although it is noted that the counts were taken on Nov 21, 2017 when the Stage 1 LRT was under construction and the temporary transitway alignment required a high volume of buses to made this movement

Suggested Traffic Changes

A four-phase signal operation is proposed:

- P1: EBL, WBL, NBR, SBR (no ped/bike crossings)
- P2: WBT, WBR (permissive), EBT (peds and bikes cross on N and S legs)
- P3: NBL, NBT (peds and bikes cross on E leg)
- P4: SBT, SBL (permissive), NBT, NBL (permissive) (peds and bikes cross on E and W leg)

This operation fully separates the heaviest vehicle turning movements from bicycle and pedestrian movements, significantly reducing conflict points. The collision data identified several conflicts between turning vehicles and the south MUP crossing; the proposed design eliminates the potential for these conflicts.

The SBL is proposed as prohibited for safety reasons, due to the turning path overlap with NBL vehicles. The SBL movement is also very low, carrying just 291 vehicles per day. An alternative route is available for this movement via Terminal Avenue. OC Transpo Route 46 currently makes this movement and consultations would be required to adjust the route, though the detour is expected to be feasible with minimal impacts to travel time.

The EBR movement is permitted at all times, but vehicles must yield to pedestrians in the crossing.

Fully prohibited right-on-red is recommended for the NBR, WBR, and SBR movements to reduce conflict points between vehicles and cyclists/pedestrians.

Additional Considerations

- The skew of the intersection may present a challenge for large trucks making turns at intersection, especially the NBR and SBR movements. Autoturn analysis is recommended to make adjustments to corner dimensions to accommodate these vehicles, as well as to verify the paths of NBL and SBL movements
- The removal of the SBR turn lane creates a significant amount of pedestrian space on the NW corner, and presents an opportunity for landscaping improvements
- Traffic counts for this intersection were taken when there were increased bus movements resulting from Stage 1 LRT construction. It is recommended that post-LRT construction traffic counts be obtained for review at functional design.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,340,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(2) Bank Street and Fifth Avenue

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Bank Street and Fifth Avenue is a signalized intersection with no protected phases. The surrounding area includes a mix of commercial and residential land uses, with commercial centred along Bank Street. Mutchmor Public School is one block west of the intersection on Fifth Avenue. Ottawa Fire Station No. 12 is east of the intersection at Fifth Avenue and O'Connor Street. The new Flora Footbridge over the Rideau Canal was completed in 2019 connecting Fifth Avenue to Clegg Street.

Overview of Existing Intersection Characteristics

Characteristic	Bank Street	Fifth Avenue
Road Classification	Arterial	Collector
Speed Limit	40 km/h	40 km/h
Truck Route	Yes	No
Transit	Route 6 and 7 (frequent). NB and SB nearside stop	None
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route	Suggested Route west of Bank, bike lanes (except WB west of Bank)
Pedestrian Facilities	Sidewalks both sides	Sidewalks on both sides
Configuration	NB and SB through, through/right	EB one lane, WB one lane

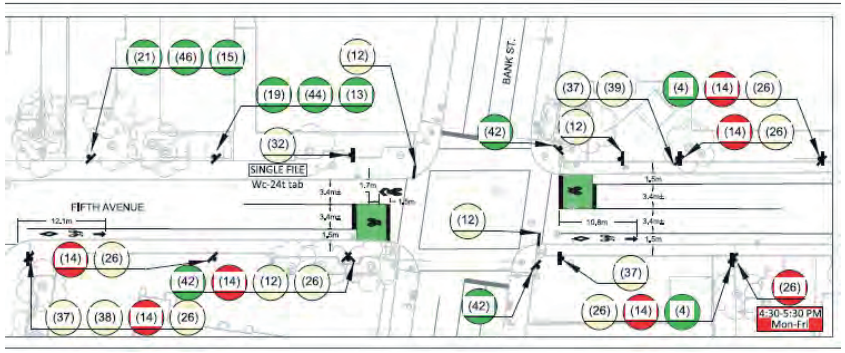
Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Bank Street	Fifth Avenue
Affordable Cycling Project List	Not listed	Listed as P1-6
Ultimate Cycling Network	Local Route	Local Route
Cross-Town Bikeway	No	Neighbourhood Bikeway

Bank Street is a Transit Priority Corridor and a Traditional Mainstreet in the Official Plan.

The City developed detailed designs for the cycling treatment of Fifth Avenue among other streets in the Glebe neighbourhood in the Glebe Neighbourhood Cycling Plan, issued for tender January 31, 2018. The designs include bike boxes on the WB and EB approaches on Fifth Avenue with bike lanes leading up to them, as well as additional signage. Based on the site visit, these improvements have now been implemented.



Detail of Bank and Fifth intersection in Glebe Neighbourhood Cycling Plan tender

Collision History

There have been 23 reported collisions at this intersection from 2009 to 2018. Only 2 collisions resulted in non-fatal injuries. One collision involved a pedestrian, and one collision involved a person cycling. The one cyclist involved collision occurred in the evening during clear, dry conditions. The cyclist was EB making a LT, and was hit by a WB car going through the intersection. The collision resulted in non-fatal injuries.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2017. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Jul-2017
Time Period	7AM-6PM
Vehicles	14246
% Trucks/Buses	5%
% Bicycles (on-road)	6%
Bicycles (on-road)	798
Pedestrians	4966

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Majority of E-W vehicles turn at intersection (68-74%), while majority of bicycles travel through
- No high-volume peak hour turning movements, only moderate movement is WBL during PM peak
- Motor vehicle volumes heavily skew N-S (82%), as do bicycle volumes (62%)
- On-road bicycles account for 6% of intersection volumes, and 25% of E-W through volumes
- Trucks/buses account for less than 5% of volumes in all movements Vast majority of truck volumes are N-S through, very low truck volumes E-W
- Very high volume of pedestrians, highest on E and W legs
- E-W total daily vehicle volume (2,317) is just over the NACTO All Ages & Abilities threshold for a street being appropriate for mixed-traffic cycling

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 5:20 PM. The following observations are noted:

- Observed cycle times total 75 seconds, N-S = 50s, E-W = 25s
- Bike boxes on EB and WB approaches (appear to be new)
- Off-peak parking in N-S curb lanes
- WB on Fifth is a fire route (fire truck observed making WBR)
- “Right-turning vehicles yield to bikes” signs displayed on EB and WB approaches
- Slow speeds north-south due to congestion (queues formed on north and south legs)
- Very low vehicle volumes and slow vehicle speeds east-west
- EB and WB motorists not using bike boxes correctly (stopping in them)
- Heavy pedestrian volumes, many crossing E-W
- Heavy bus traffic N-S

New bike box on WB side with cars stopped in it

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High demand for E-W through movement for cyclists, but current vehicle volumes on Fifth Avenue are just above what is acceptable for a neighbourhood bikeway according to TAC Geometric Design Guidelines
- E-W through cyclists have potential conflicts with turning vehicles
- Cyclist turning movements at intersection are currently not well-supported

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks running north-south on Bank Street, and mixed traffic on Fifth Avenue. Existing buildings are built to the property edge on all corners. As a result of the construction of the Flora Footbridge to the east of this intersection, Fifth Avenue is expected to play a much more significant role in Ottawa's cycling network as a connecting route and a neighbourhood cycling route in the Glebe Cycling Plan.

The proposed solution uses a number of traffic restrictions to remove turning potential conflicts on Bank Street, and reduce vehicle volumes on Fifth Avenue to be more appropriate for mixed traffic operation (NACTO recommends 1,500 vehicles per day for Bicycle Boulevards).

The design prohibits left and right turns for vehicles travelling on Bank Street, and prohibits through movements for vehicles on Fifth Avenue, while allowing bicycles to travel through the intersection and make all turning movements using bicycle turn boxes. The restrictions are reinforced through the installation of medians at the receiving legs, which are mountable to allow emergency vehicles to pass through unhindered. These restrictions closely resemble the existing traffic patterns: only 8% of vehicles on Bank Street make turns at Fifth Avenue, and only 30% of vehicles on Fifth Avenue continue straight through the intersection. Applying these restrictions would reduce volumes on Fifth Avenue to below 1,000 ADT on each side of the intersection, making it suitable for mixed traffic operation for cyclists of all ages and abilities.

East of the intersection, advisory bicycle lanes are proposed on Fifth Avenue, to provide an even more comfortable cycling environment while accommodating a lane of on-street parking.

The existing nearside transit stops on Bank Street are accommodated and have been configured with a 1.2 m landing zone between the cycle track and the roadway.

Changes to Configuration

Peak period travel lanes (and off-peak parking lanes) are removed on Bank Street to accommodate the proposed cycle tracks. Removal of lanes on Bank Street may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design. Vehicle approaches on Fifth Avenue are comprised of a single left-right lane. Traffic restrictions on Fifth Avenue will be reviewed in further detail at functional design.

Turning Radii Accommodated

This is a collector-arterial intersection, so the desired effective turning radii is 12 m. Heavy vehicles turn at this intersection at a low rate, with the highest being the southbound right (19 heavy vehicles per day). Due to the proposed turning restrictions, only the east and west left and right movements need to be accommodated. This is accomplished by tapering out the receiving curbs on the north and south legs.

Suggested Traffic Changes

As mentioned above, the proposed design fully restricts all turning movements on Bank Street, and all through movements on Fifth Avenue at this intersection. These prohibitions will be reviewed through a traffic network analysis at functional design. Fully prohibited right-on-red is required for the remaining turning movements on Fifth Avenue due to the presence of the two-stage turn boxes. In conjunction with the concept design, it is also recommended that the speed limit on Fifth Avenue east of Bank Street be reduced to 30 km/h to provide a safer and more comfortable operating environment for pedestrians and cyclists.

No changes are proposed to the existing fixed cycle operation of the intersection.

Additional Considerations

- Based on the traffic counts conducted on July 20, 2017, the proposed restrictions will lead to approximately 1,500 daily vehicle movements (including 250 during the PM peak) shifting to other locations in the network. The dense street grid can likely accommodate these detoured movements; however further modelling is required to fully understand the impacts**.**
- Emergency vehicles frequently use Fifth Avenue as a response route due to the fire station located just east of the intersection. The proposed medians are intended to be fully mountable by an emergency vehicle to facilitate easy movement through the intersection.
- The cycle tracks on Bank Street are not recommended in isolation of continuous cycling facilities on Bank Street.
- Emergency Services should be consulted due to the proximity of the Fire Station east on Fifth Avenue.

Cost Estimate

The concept design has an estimate cost (Class D) of $466,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(3) Bank Street and Riverside Drive North

3/13/2020

Context

This intersection was selected based on its characteristics and collision history. There is also a planned project impacting the intersection next year. Bank Street and Riverside Drive North is a signalized intersection with no protected phases. There is a LT restriction and a RTOR restriction for SB traffic, and a LT restriction for NB traffic on Bank Street. Riverside Drive North is one-way WB. North of the intersection is Billings Bridge which crosses the Rideau River, connecting to Old Ottawa South, which has a mix of residential and commercial land uses. South of the intersection is the Billing Bridge Shopping Centre, some commercial on Bank Street, and residential off of Bank Street. The NCC Rideau River Pathway is adjacent to Riverside Drive North, on the north side. An underpass for the pathway that runs under Bank Street was completed in 2019.

Overview of Existing Intersection Characteristics

Characteristic	Bank Street	Riverside North
Road Classification	Arterial	Arterial
Speed Limit	50 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 5 and 6. NB nearside stop	None
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route	MUP on north side
Pedestrian Facilities	Sidewalks both sides	Sidewalk south side, MUP north side
Configuration	Two NB through, SB through, through/right	One LT lane

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Bank Street	Riverside North
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Yes	No

Bank Street is a Transit Priority Corridor and Traditional Mainstreet in the Official Plan.

Collision History

There have been 185 reported collisions at this intersection in the past 10 years, and an additional 11 on the bridge north of the intersection. Forty-six resulted in non-fatal injuries, and one collision resulted in a fatality. Seven collisions involved pedestrians, and 9 collisions involved a person cycling. All the cyclist involved collisions occurred in clear, dry conditions during the day. Seven of the collisions were due to turning movements, where the cyclist was continuing through the intersection, 5 of these were cyclists that were headed SB, hit by a SBR vehicle. One of these collisions resulted in a fatality. The other cyclist-involved collisions all resulted in non-fatal injuries. Of the seven pedestrian collisions, three were westbound left turns colliding with a pedestrian in the south crosswalk. There were no other pedestrian collision trends.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2015. The E-W MUP underpass on the northside of the intersection was completed since this time.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	16-Jul-2015
Time Period	7AM-6PM
Vehicles	23522
% Trucks/Buses	3%
% Bicycles (on-road)	3%
Bicycles (on-road)	618
Pedestrians	581

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- High volume intersection, balanced between W and N-S
- SBR, WBR and WBL are all high-volume turning movements during peak hours
- Bicycles account for 3% of intersection volumes, and 5% of N-S through volumes
- Bicycle volumes skew N-S (73%), not including volumes on parallel NCC pathway.
- WBR is the only high-volume bicycle turning movement
- Trucks/buses account for less than 5% of volumes in all movements
- Fairly low volume of pedestrians
- Pedestrians mostly cross E and W legs

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 4:55 PM. The following observations are noted:

- Observed cycle times total 90 seconds, N-S = 40s, E-W = 50s
- Physically constrained on all corners
- Very narrow lanes on Bank, cyclists have no dedicated space on bridge
- High car volumes and long queues
- Many cyclists pass through using E-W underpass
- Lots of cyclists riding on sidewalks N-S
- Many cyclists continuing N-S on Bank Street through intersection

The intersection is physically tight and busy

Other Considerations

Bank Street south of the intersection is currently undergoing detailed design for road reconstruction. The design includes unidirectional cycle tracks to this intersection. Some recommendations for how to improve this intersection will be made as part of that design process, but options for improvements will be limited as the project extent does not include any alterations to the bridge.

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- N-S bike movements over bridge create potential conflicts with heavy SBR vehicle movement
- Connecting planned Bank Street (south) cycle tracks to E-W MUP with highly constrained corners on north side

Concept Design

A concept design was not completed for this intersection. The existing Bank Street bridge to the north poses a severe constraint on possible cycling and pedestrian improvements, and future bridge options are beyond the scope of this project.

(4) Bank Street and Wilton Crescent

Context

This intersection was selected based on the number of cyclist-involved collisions that have occurred in the past 10 years. The intersection is stop controlled on Wilton Crescent. No left turns are permitted from Wilton Crescent onto Bank Street. There is no crosswalk for pedestrians to cross Bank Street at Wilton. The surrounding land use varies, with residential to the west, the mixed-use Lansdowne development is on the east side of Bank Street, including TD Place stadium. Directly south of this intersection is one of the few crossings of the Rideau Canal. Pedestrians and Cyclists can cross underneath the Bank Street bridge south of Wilton Crescent, on the north side of Queen Elizabeth Driveway. The underpass and pathways leading to it are winter cleared.

Overview of Existing Intersection Characteristics

Characteristic	Bank Street	Wilton Crescent
Road Classification	Arterial	Local
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	No
Transit	Frequent routes 6 and 7, and special event routes.	None
Emergency Route	Yes	No
Cycling Facilities	Sharrows with green Thermoplast both sides, NB dashed bike lane, shared sidewalk on east side to Queen Elizabeth Driveway	Sharrows, MUP on Queen Elizabeth Place ends at Bank
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	Two through lanes both directions	One lane each direction, LT restriction

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Bank Street	Wilton Crescent
Affordable Cycling Project List	Not Listed	Not listed
Ultimate Cycling Network	Local Route	Local Route
Cross-Town Bikeway	Not listed	Not listed

Bank Street is a Transit Priority Corridor and Traditional Mainstreet in the Official Plan.

Collision History

There have been 40 reported collisions at this intersection in the past 10 years. Twelve resulted in non-fatal injuries, and the remainder resulted in only property damage, and one was not reportable. Two collisions involved pedestrians, and 9 collisions involved a person cycling. All cyclist-involved collisions occurred in clear, dry conditions during the day, with exception of one collision that occurred in wet conditions. Seven of the collisions led to non-fatal injuries. Five of the collisions involved a SB cyclist going through the intersection, hit by a NBL car.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2017. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Jul-2017
Time Period	7AM-6PM
Vehicles	16213
% Trucks/Buses	4%
% Bicycles (on-road)	6%
Bicycles (on-road)	919
Pedestrians	687

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- High-volume intersection, majority of traffic at intersection is N-S through
- EBR and NBL are high-volume turning movements during peak hours
- 22% of NB vehicle traffic turns left
- Bicycle turning patterns very similar to motor vehicle patterns, higher demand for EBR and NBL
- Cyclists have an alternative to making a NBL, by turning right onto MUP and heading south
- Trucks and buses account for relatively low percentage of overall traffic, and vast majority travel N-S through
- Moderate volume of pedestrians, most cross on west leg (as this is the only designated crossing point)

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 5:10 PM. The following observations are noted:

- No signal, W leg is stop-controlled
- EBL prohibited at all times
- Physically constrained on all corners
- Very narrow lanes on Bank Street, cyclists have no dedicated space on bridge
- NB on-street bike lane starts at this intersection and continues 250m
- Very high car volumes and long queues on Bank Street
- Many cyclists pass through E-W using Bank Street underpass
- Lots of cyclists riding on sidewalks N-S
- Many cyclists continuing N-S on Bank Street through intersection

NBL movements are common at this intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Potential conflicts for NBL bikes; directing NBL bikes to right to use underpass may reduce potential conflicts
- NBL and EBR vehicles conflict with bicycle movements as per the collision data
- The high posted speed limit on Bank Street could create safety issues for cyclists and pedestrians

Concept Design

A concept design was not completed for this intersection as designs will be developed as part of a future reconstruction project.

(5) Bayswater Avenue and Somerset Street

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Somerset Street and Bayswater Avenue is a signalized intersection with no protected phases. Somerset Street is a key east-west connection as it provides access over O-Train Line 2. The land use around the intersection is a medium density mix of commercial and residential, as well as nearby Devonshire Community Public School a block away on Breezehill Avenue North. To the north of the intersection at Bayview Station Road and Scott Street is Bayview O-Train Station.

Overview of Existing Intersection Characteristics

Characteristic	Somerset Street	Bayswater Avenue
Road Classification	Arterial	Collector
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	North of Somerset
Transit	Route 11 (Frequent). WB and EB nearside stops	None
Emergency Route	Yes	South of Somerset
Cycling Facilities	Wide shared lane	None existing
Pedestrian Facilities	Sidewalks	Sidewalks
Configuration	EB and WB right turn lanes	SB left turn lane

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Somerset Street	Bayswater Avenue
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Local Route
Cross-Town Bikeway	Not listed	Not listed

Somerset Street is a Transit Priority Corridor and a Traditional Mainstreet in the Official Plan.

Collision History

There have been 24 reported collisions at this intersection from 2009 to 2018. Sixteen resulted in only property damage, and 8 in non-fatal injuries. Six collisions involved pedestrians, and only one collision involved a person cycling. One collision also involved a transit bus. Rear end impacts were the most common collision type, with 7 instances. In the bicycle involved collision conditions were clear. A through EB bicycle movement hit a SB stopped pick-up truck. Only property damage occurred. For the pedestrian collisions, one occurred in the evening, while the remainder occurred during the day. Three of the collisions occurred in wet conditions, two in dry. All of the collisions resulted in non-fatal injuries. Two of the collision involved SBR vehicles, one involved a EBR vehicle. The other two collisions involved a WBL vehicle and a NBL vehicle.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in September 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	7-Sep-2016
Time Period	7AM-6PM
Vehicles	9336
% Trucks/Buses	3%
% Bicycles (on-road)	7%
Bicycles (on-road)	692
Pedestrians	1745

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Low vehicle volumes overall for signalized intersection
- NS and EW leg vehicle volumes are balanced
- SBL is a high-volume turning movement during AM and PM peaks (122, 102)
- WBR is a moderate volume turning movement during PM peak (125)
- Most bike traffic is EW thru (80%)
- Bikes make up 13-15% of all-day EW volumes
- Low volume of heavy vehicles (3%) at this intersection (E-W buses likely account for most heavy movements)
- Moderate volume of pedestrians, south leg is highest-used pedestrian crossing

Site Visit Notes

A site visit was conducted at this intersection on October 8, 2019 at 8:10AM. The following observations are noted:

- Observed cycle times total 70 seconds, N-S = 35s, E-W = 35s
- EB and WB cyclists have no dedicated space between through and RT lane
- Intersection performing well, only one instance where all traffic did not get through
- Generally low speeds, WB vehicles coming off bridge travelling faster
- Grade of Bayswater roadway north of intersection is significant

A lot of school-based traffic uses the intersection in the morning and afternoon

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- No priority and potential for reduced visibility for E-W cyclists
- Posted speed limit is higher than desired for mixed traffic operation, according to TAC Geometric Design Guidelines

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks in both directions on Somerset and on the north leg of Bayswater Avenue, with mixed traffic operation south of Somerset Street. This intersection has buildings to the property line on all corners, and slopes downward heading north on Bayswater Avenue.

The proposed solution is a protected intersection. South on Bayswater Avenue, cycle tracks transition to on-street bike lanes and then merge into mixed traffic operations. Pedestrian refuges are provided at most pedestrian crossings, but in two cases there is insufficient space to provide them.

The existing eastbound and westbound near-side transit stops are accommodated in the design. The westbound stop is an island platform stop, while the eastbound stop has a 1.2 m landing zone.

Changes to Configuration

To accommodate the proposed cycle tracks on Somerset Street, one lane of on-street parking is removed. Right turn lanes on Somerset Street are also removed. The removal of parking and right turn lanes may have impacts on traffic and parking supply and will need to be reviewed in more detail at functional design. The existing lane configurations on Bayswater Avenue are maintained, although the roadway width is narrowed north and south of the intersection.

Seven metre "pinch points" are created on the east, south, and west legs of the intersection on the approaches as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-collector-local intersection, the desired effective turning radius is 12 m on the NE and NW corners, and 9 m on the SE and SW corners. Heavy vehicles turn at this intersection at low rates:

- 1 heavy vehicle per day for NBR movement
- 3 heavy vehicles per day for EBR movement
- 14 heavy vehicles per day for SBR movement
- 26 heavy vehicles per day for WBR movement

In addition, OC Transpo intends to operate dead-head bus routes through the intersection in the near future, making WBR and SBL movements.

The desired effective turn radii are accommodated for all movements. Truck aprons are proposed on the NE and NW corners to encourage slower turning speeds for passenger vehicles, while still accommodating the low daily volume of turning heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation of the intersection be maintained. Fully prohibited right-on-red is recommended for all legs to reduce potential conflicts and improve safety for pedestrians and cyclists, which will be reviewed at functional design. In conjunction with the concept design, a lower posted speed limit of 40 km/h is recommended for Somerset Street, along with the necessary design changes to the corridor to accommodate this speed.

Eastbound and westbound left movements are low at this intersection, and turn restrictions are not recommended.

Additional Considerations

- The proposed design uses nearly all available space between existing buildings, and is therefore more sensitive to constraints such as utility poles and higher grades on the north leg. These should be reviewed in more detail to verify the feasibility of the design at the functional design stage.
- Autoturn analysis is required at the functional design stage to verify that OC Transpo vehicles can make the required WBR and SBL turns at the intersection.

- Horizontal offset for SB through movement will need to be reviewed at functional design to determine if it meets the TAC recommended upper limit of 1.5 m. However, given that Bayswater Avenue is a local street, the hazard is reduced and the offset will function as traffic calming

Cost Estimate

The concept design has an estimate cost (Class D) of $920,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix D.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(6) Bayview Station Road and Scott Street

Context

This intersection was selected based its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Bayview Station Road and Scott Street is a signalized intersection with no protected phases. Bayview O-Train Station is to the northeast of the intersection. The surrounding land use is a mix of residential and industrial. Tom Brown Arena is on the southeast corner of the intersection. A major development is planned east of the intersection at 900 Albert Street. The intersection plays a significant role for E-W bicycle traffic, with the MUP on the northwest side, and the MUP north of the LRT bridge on the east side of Bayview Station Road, which travels through Bayview O-Train Station and reconnects with Scott Street. People cycling EB can also use the buffered bike lane on the south side of Scott Street and connect to the MUP on the southeast side of the intersection to connect to the pathway through Bayview O-Train Station.

Overview of Existing Intersection Characteristics

Characteristic	Bayview Station Road	Scott Street
Road Classification	Collector	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	South of intersection	Yes
Transit	None	Routes 16, N57, N61, N75, N95. WB and EB stops far side
Emergency Route	No	Yes
Cycling Facilities	Wide shared lanes	MUP on northwest side, buffered bike lane on south side
Pedestrian Facilities	Sidewalks	Sidewalk east and southwest of intersection, MUP on northwest side
Configuration	NB LTL, through, right channel; SB LTL	EB two through, one bus only/right turn WB left, through, bus only/right

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Bayview Station Road	Scott Street
Affordable Cycling Project List	Not Listed	Bike lanes from Holland to Bronson listed as P1-31
Ultimate Cycling Network	Local Route	Spine Route
Cross-Town Bikeway	Not listed	Yes

Collision History

There have been 44 reported collisions at this intersection in the past 10 years. Thirteen resulted in non-fatal injuries, and the remainder resulted in only property damage. Two collisions involved pedestrians, and 4 collisions involved a person cycling. All collisions involving people cycling occurred in clear conditions during the day. Three led to non-fatal injuries. In three of the collisions, the person cycling was making a through SB movement. Of these three, two were hit by a NB left turning car movement.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in September 2016 which is before the E-W MUP was built.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	7-Sep-2016
Time Period	7AM-6PM
Vehicles	11916
% Trucks/Buses	14%
% Bicycles (on-road)	1%
Bicycles (on-road)	172
Pedestrians	901

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Major changes have occurred at this intersection since this count was taken - E-W bike path opened; LRT opened reducing buses on-road
- Vehicle traffic is higher E-W (70%)
- NBR and SBL are high volume movements, westbound left is moderate volume
- Bikes (on-road) more frequently travel N-S (75%) - but this is before major E-W MUP opened
- Heavy (mostly buses) make up 25% of E-W movements
- Moderate volume of pedestrians, W leg is highest volume

Site Visit Notes

A site visit was conducted at this intersection on October 8, 2019 at 8:30 AM. The following observations are noted:

- Observed cycle times total 140 seconds, N-S = 30s, E-W = 110s (note this may have been adjusted after bus detour ended)
- High pedestrian volumes
- N-S ped crossing is by actuation only
- High volume of SB trucks, and heavy SBL movement
- Cyclists skew through intersection to reach MUT at NE corner
- Cyclists mostly ride across crosswalks and sidewalks instead of using turning lanes
- Cyclists desire lines illustrated below

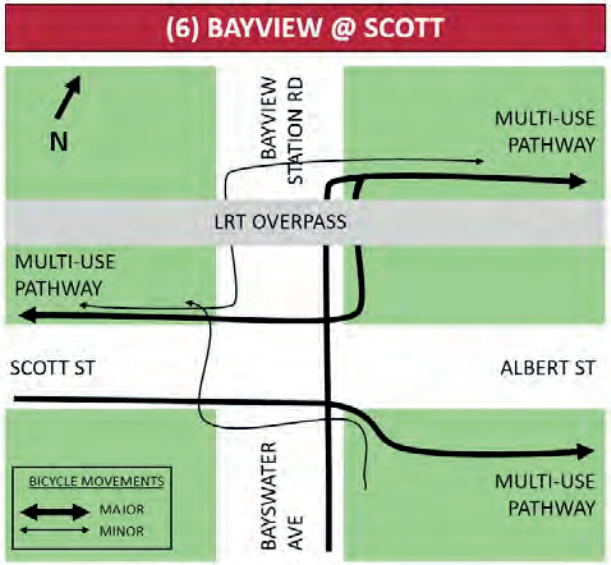


Illustration of observed cyclist movements during site visit

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Awkward jog from NW LRT MUP to Scott Street MUP, with no signage or any treatment to support this movement
- Potential for limited visibility for SB cyclists travelling under bridge approaching intersection leading to potential conflict with NBL vehicles.
- NBR turn channel can lead to potential conflicts, especially with new MUP on south side.

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Existing multi-use paths branching out to the NE, SE, and NW from the intersection are also accommodated in the proposed design. The LRT bridge across the north leg of the intersection imposes a width constraint. The intersection is also heavily skewed, presenting alignment challenges.

The proposed solution includes a combination of treatments. Protected corners are proposed on the NE and NW corners, an adjacent crossing is proposed on the SW corner, and a smart channel is proposed on the SE corner. The existing LRT MUP on the NW corner is shown as upgraded to separate walking and cycling facilities, both carried to the intersection and connecting to the MUP NE of the intersection, closing a significant gap for cyclists.

The existing westbound transit stop is accommodated in the proposed design as a far side island platform stop. The existing eastbound stop is removed from the design by request of OC Transpo as it will be relocated further east.

Changes to Configuration

The proposed design includes the removal of the transit lanes on Scott Street, which are redundant with the recent opening of the Confederation LRT line. The southbound left turn lane on Bayview is also removed to accommodate the bi-directional cycle track connecting to the LRT MUP. One lane of parking is also removed on Bayview north of the intersection to accommodate the proposed cycle tracks. Removal of parking and turn lanes may have impacts on traffic and parking supply and will need to be reviewed in more detail at functional design.

The existing NBR turn channel is replaced with a smart channel with raised crossing, a larger island and a tighter merge angle to reduce vehicle turn speeds and encourage yielding to pedestrians and cyclists.

Turning Radii Accommodated

As an arterial-collector intersection, the desired effective turning radius is 12 m, which is provided in the design. Heavy vehicles make right turns at this intersection at low to high rates:

- 15 heavy vehicles per day for NBR movement
- 9 heavy vehicles per day for EBR movement
- 17 heavy vehicles per day for SBR movement
- 31 heavy vehicles per day for WBR movement

The desired effective turn radii are accommodated for all movements. Truck aprons are proposed on the NE, SW, and SE corners to slow turning speeds for passenger vehicles while still accommodating the volume of heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation be maintained. Fully prohibited right-on-red is recommended for the EBR, WBR, and SBR movements to reduce potential for conflicts and improve safety for pedestrians and cyclists.

The SBL is low volume during most of the day, but peaks during the AM peak period. With the removal of the SBL lane, it is recommended that the SBL movement be restricted during the AM peak.

Additional Considerations

- If it is desired that the existing SBL lane be retained, the southbound cycle track on the north leg could be removed, and replaced with a midblock crossing north of the intersection for cyclists to join the bidirectional facility on the east side of the roadway
- The heavy skew of the intersection presents a unique challenge for turning vehicles at this intersection. Autoturn analysis is required at functional design stage to verify curb radii and stop bar placements.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,257,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(7) Cumberland Street and Laurier Avenue

Context

This intersection was selected based on the collision history of the intersection. Cumberland Street and Laurier Avenue is a signalized intersection with no protected phases. The area around the intersection is mixed use, and within the University of Ottawa campus area. Student residences, cafes, and university buildings immediately surround the intersection.

Overview of Existing Intersection Characteristics

Road Classification	Local	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	No	No
Transit	None	Routes 16, 19, N39, N45, N95, N97, N98. WB and EB stops are both nearside
Emergency Route	No	Yes
Cycling Facilities	Bike lanes north of Laurier, Suggested Route south, NB bike box	Bike lanes west of Cumberland, no existing facility east
Pedestrian Facilities	Sidewalks	Sidewalks
Configuration	NB general, parking SB general	EB two general, WB left, through/right

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Cumberland Street	
Affordable Cycling Project List	Not Listed	West of Cumberland is listed as project P1-30
Ultimate Cycling Network	Spine Route	West is Spine Route, east is Local Route
Cross-Town Bikeway	Yes, north of Laurier	Yes, west of Cumberland

Collision History

There have been 43 reported collisions at this intersection from 2009 to 2018. Eleven resulted in non-fatal injuries, one was non-reportable, and the remainder involved property damage. Four collisions involved pedestrians, and seven collisions involved a person cycling. All collisions involving people cycling occurred in clear conditions during the day. Five led to non-fatal injuries. There were no prevailing similarities between the collisions, with 3 EB, 2 SB, one NB and one WB, and various impact types.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in November 2018. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	28-Nov-2018
Time Period	7AM-6PM
Vehicles	7723
% Trucks/Buses	7%
% Bicycles (on-road)	8%
Bicycles (on-road)	642
Pedestrians	9983

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

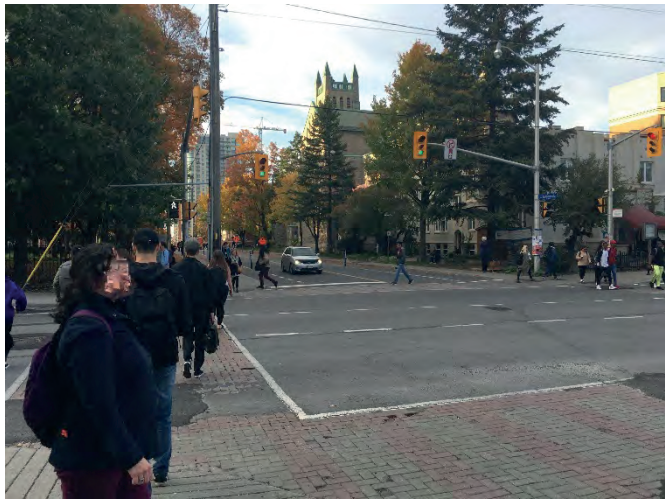
- Pedestrian crossings outnumber motor vehicles and cyclists at this intersection
- Most motor vehicle and bicycle traffic is E-W (79%), while pedestrian volumes are balanced across all legs
- Low vehicle volumes overall for signalized intersection

- Most peak-hour turn movements are low-volume, except EBL and NBL during PM peak
- On-road bicycles account for 8% of vehicles
- Majority of bicycle movements are E-W through
- Moderate volume of heavy vehicles travelling E-W, due to many bus routes operating on Laurier during LRT construction
- Very low heavy vehicle turning volumes
- Very high volume of pedestrians

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 5:10 PM. The following observations are noted:

- Observed cycle times total 60 seconds, N-S = 23s, E-W = 37s
- EB bike lane drops through intersection
- Heavy pedestrian crowding and congestion on NE and NW corners
- Very high pedestrian volumes
- High bicycle movements in all direction



Heavy pedestrian volumes in both directions

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Cyclist turning movements may conflict with motor vehicles
- Lack of physical separation for cyclists east of Cumberland Street
- Very high pedestrian volumes and crowding on corners – may create conflicts with cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Existing buildings are close to the intersection on the NE and SW corners but still set back.

The proposed design is a fully protected intersection with pedestrian refuges provided on all crossings. Large pedestrian corner storage areas are provided in the design to accommodate the very high pedestrian volume at the intersection (9,983 daily).

The existing eastbound near-side stop is accommodated in the same location as an island platform stop, and the existing westbound far-side transit stop is accommodated in the design as a landing-zone style stops with a 1.2 m landing zone.

Changes to Configuration

Laurier Avenue and Cumberland Street are reduced to minimum vehicle cross sections (one lane in each direction, no on-street parking) to accommodate the proposed cycle tracks. Removal of lanes may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design. Cumberland Street must be widened to the west on the north leg of the intersection to accommodate the cycle tracks.

Seven metre "pinch points" are created on all legs of the intersection on the approaches as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-local intersection, the desired effective turning radius is 9 m. Heavy vehicles turn at this intersection at low rates:

- 6 heavy vehicle per day for NBR movement
- 4 heavy vehicles per day for EBR movement
- 6 heavy vehicles per day for SBR movement
- 5 heavy vehicles per day for WBR movement

The desired effective turn radii are accommodated for all movements.

Suggested Traffic Changes

Fully prohibited right-on-red is recommended for all legs to reduce potential conflicts and improve safety for pedestrians and cyclists. It is proposed that EBL movements be prohibited during PM peak periods to maintain an acceptable performance of the intersection. All-day left turn restrictions may need to be considered, based on the results of a traffic analysis conducted at functional design.

No changes are suggested to the existing observed signal phasing, which operates on a basic two-phase cycle.

Additional Considerations

- While no buildings are impacted by the proposed design, more property is required, which will disrupt the existing fence on the NW corner and the gardens on the NE corner
- To further manage turning speeds of right-turning vehicles, truck aprons with a radius of 5 m may be considered on all corners
- In a full reconstruction, it may be possible to accommodate an on-street parking lane on the south side of Laurier Avenue by widening the roadway
- The operating volumes on Cumberland Street are sufficiently low that on-street painted bike lanes, or wider advisory bike lanes, may be suitable. This would avoid widening the roadway on the north leg, and may provide an opportunity to maintain the on-street parking on the south leg
- Consultation with emergency services is required due to proximity of fire station east on Laurier Avenue.

Cost Estimate

The concept design has an estimate cost (Class D) of $840,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(8) Cummings Avenue and Ogilvie Road

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history. Cummings Avenue and Ogilvie Road is a signalized intersection with EBL, SBL, and WBL protected/permissive phases. The NBR movement has a right turn channel. The surrounding area includes a mix of commercial, industrial, and residential land uses. A townhouse development is proposed on the southwest corner of the intersection.

Overview of Existing Intersection Characteristics

Characteristic	Cummings Avenue	Ogilvie Road
Road Classification	Major Collector north, Arterial south of Ogilvie	Arterial
Speed Limit	50 km/h	60 km/h
Truck Route	Yes	Yes
Transit	N39, far side SB stop	Route 24, far side stops
Emergency Route	Yes	Yes
Cycling Facilities	None	Bike Lane
Pedestrian Facilities	Sidewalks both sides north, east side south	Sidewalks on both sides
Configuration	NB left, through, right channel SB left, through/right lane	EB left, through, through/right WB left, through, through/right

Planning Considerations

Ogilvie Road is a Transit Priority Corridor, and the intersection is in an area designated Mixed Use Centre in the Official Plan.

Ottawa Cycling Plan (2013) Classifications

	Cummings Avenue	Ogilvie Road
Affordable Cycling Project List	North of Ogilvie listed as P1-39 Shared Use Lanes	Not listed
Ultimate Cycling Network	Local Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Collision History

There have been 111 reported collisions at intersection from 2009 to 2018. Twenty-eight collisions resulted in non-fatal injuries. Four collisions involved a pedestrian, while 8 collisions involved a person cycling. All of the cyclist involved collisions occurred during clear and dry conditions during the day. Six resulted in non-fatal injuries. Seven of the collisions involved a WB cyclist going through the intersection, with 5 of those collisions involving a WBR car.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in April 2018. No physical changes have occurred at this intersection since.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	11-Apr-2018
Time Period	7AM-6PM
Vehicles	20464
% Trucks/Buses	2%
% Bicycles (on-road)	0%
Bicycles (on-road)	94
Pedestrians	412

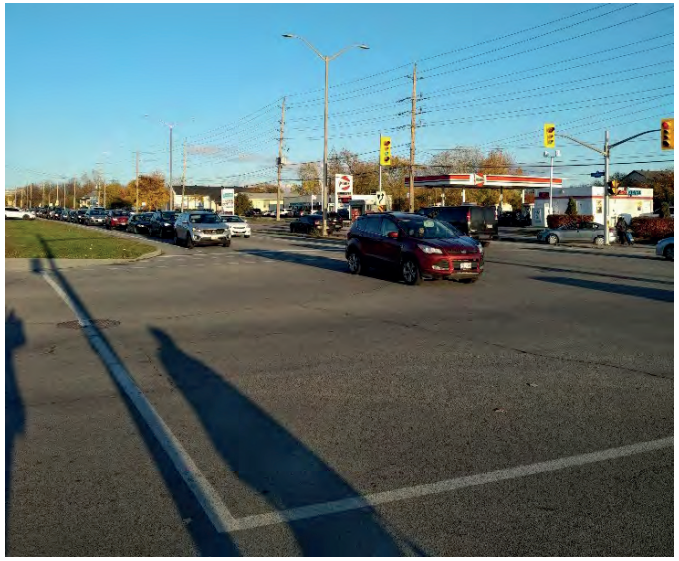
Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle (71%) and bicycle (78%) volumes are higher E-W
- Heavy peak hour turns SB left, WB right and left, NB right (PM), EB left (PM)
- Three times more cyclists (total) in July 2015 vs. April 2018
- Low truck percentage, up to 5% for NB and EB right, and 6% for WB left, others at 2-3%
- Bus route approximately 6 per hour per direction E-W through
- Low ped volumes, generally balanced on all legs but east and west dominate

Site Visit Notes

A site visit was conducted at this intersection on October 24, 2019 at 5:00 PM. The following observations are noted:

- Observed cycle times total 120 seconds, P1: EBL, WBL (15s), P2: E-W (60s), P3: SBL+T (15s when actuated), P4: N-S (45s with ped, 30s without)
- Painted bike lanes on Ogilvie with "bikes permitted" signage
- LT lanes all directions, 2 through lanes EW, 1 through lane NS
- Hydro poles on south side b/w sidewalk and curb (approx. 2m from curb)
- Fire hydrant NE corner
- EB, WB far side bus stops (with benches), SB far side stop
- Heavy EW volumes; Medium SB volumes
- Few cyclists, all going EW



High westbound vehicular traffic volumes

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- No separated cycling facilities on Ogilvie Road present potential safety and comfort issue for cyclists
- Conflicts between cyclists and turning vehicles, especially WBR according to collision data
- NBR turn channel and other corners have excessively wide curb radii, which can lead to excessive vehicle speeds
- Overly high volumes and posted speed limit for mixed traffic operation on Cummings Road, according to TAC Geometric Design Guidelines

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on all legs. There are no major physical constraints that affect the design. The proposed solution is a fully protected intersection. The existing NBR turn channel is converted to a dedicated right turn lane. WBR and NBR volumes are sufficiently high during peak hour that fully protected phases are recommended. The SBR and EBR movements operate permissively.

The existing transit stops on Ogilvie Road are accommodated in the design as island platform stops on the far sides of the intersection.

Changes to Configuration

The only proposed changes to the configuration are the removal of the NBR turn channel and the addition of a WBR turn lane. NBR turn lane queue length will be reviewed at functional design.

Generally, pedestrian crossing distances are maintained or reduced.

Turning Radii Accommodated

The east, west, and south legs of this intersection are arterial roadways, while the north is a collector. As such, the desired effective turning radius is 15 m on the SW and SE corners, and 12 m on the NW and NE corners. Heavy vehicles make right turns at this intersection at low to moderate rates:

- 15 heavy vehicles per day for SBR movement
- 23 heavy vehicles per day for WBR movement
- 52 heavy vehicles per day for NBR movement
- 6 heavy vehicles per day for EBR movement

Given the very low volume of EBR heavy vehicles, it is suggested that a lower effective turn radius be provided. EBR heavy vehicle turns can either be prohibited, or heavy vehicles can be expected to deviate from the approach lane in order to complete turns. All other desired effective turning radii are provided.

Suggested Traffic Changes

A four-phase operation is proposed:

- P1: EBL, WBL, NBR (no ped/bike crossings)
- P2: WBT, EBT, EBR (peds and bikes cross on N and S legs)
- P3: NBL, SBL, WBR (no ped/bike crossings)
- P4: NBT, SBT, SBR (peds and bikes cross on E and W legs)

The NBR, WBR, and all left turn movements are proposed as fully protected. Fully prohibited right-on-red is required as a condition of the fully protected turns, and is recommended on all corners to minimize potential conflicts between turning motor vehicles and pedestrians and cyclists.

Additional Considerations

- Truck aprons may be provided on the NW and SW corners to encourage slower vehicle turning speeds where permissive right turns are permitted
- Synchro analysis is required to verify the required storage length for all turn lanes

Cost Estimate

The concept design has an estimate cost (Class D) of $1,400,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(9) Donald Street and Vanier Parkway

Context

This intersection was selected based on the collision history. Donald Street and Vanier Parkway is a signalized intersection with a SBL protected/permissive phase. The NBR movement has a right turn lane and channel. The surrounding area consists of primarily residential land uses. Education Permanente High School is at the northeast corner of the intersection. There are a few places of worship along Donald Street east of the intersection. The Adawe bridge is three blocks west at the end of Donald Street.

Overview of Existing Intersection Characteristics

Characteristic	Donald Street	Vanier Parkway
Road Classification	Collector	Arterial
Speed Limit	50 km/h	60 km/h
Truck Route	No	No
Transit	None	Route 9 and 19, far side stops
Emergency Route	Yes	Yes
Cycling Facilities	Buffered Bike Lane west of Vanier	None
Pedestrian Facilities	Sidewalks on both sides	Sidewalks on both sides
Configuration	WB left, through/right	NB left, two through, right channel SB left, through, through/right lane

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

		Vanier Parkway
Affordable Cycling Project List	P1-39 Shared Use Lanes	Not listed
Ultimate Cycling Network	Local Route	Spine Route
Cross-Town Bikeway	No	No

Collision History

There have been 117 reported collisions at this intersection from 2009 to 2018. Thirty collisions resulted in non-fatal injuries. Three collisions involved a pedestrian. Seven collisions involved a person cycling. All of the cyclist involved collisions occurred during clear and dry conditions, except for one collision that occurred in wet conditions. One collision was in the early morning. Six resulted in non-fatal injuries. There was no prevailing common characteristics between the collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in April 2018. No physical changes have occurred at this intersection since.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	19-Apr-2018
Time Period	7AM-6PM
Vehicles	28997
% Trucks/Buses	2%
% Bicycles (on-road)	0%
Bicycles (on-road)	51
Pedestrians	314

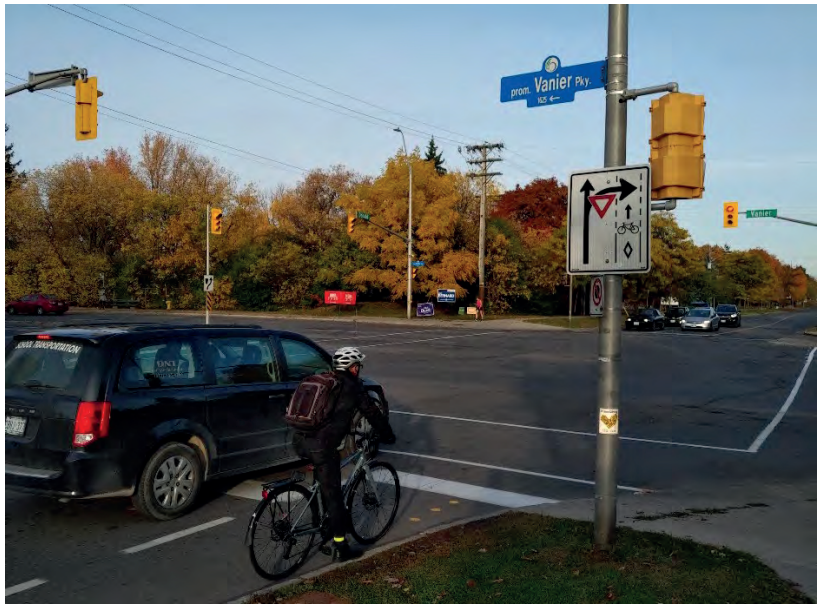
Based on the traffic volume data provided (and detailed in Appendix B), the following additional observations are observed:

- Heavy vehicle volumes, with higher N-S (90%), cyclist volumes higher E-W (86%)
- Over half WB and EB vehicles turns right or left (most EB vehicles turn right)
- Similar patterns for heavy vehicles but most heavy vehicles move SB and NB through
- Peak hour turns are very high for SB and WB left, significant volumes also for WB right (AM) and NB left (PM)
- Dominant cycling volumes EB (EB through 6% of total)
- Lower volumes of heavy vehicles as percentage of all vehicles (2%)
- Bus route N-S on Vanier every 20-30 minutes
- Low volume of pedestrians, consistent at all four legs with slight skew to south and north legs

Site Visit Notes

A site visit was conducted at this intersection on October 21, 2019 at 4:40 PM. The following observations are noted:

- Observed cycle times total 130 seconds, P1: SBL, SBT (10s), P2: N-S (90s), P3: E-W (30s)
- Bike lanes with flex posts both directions west of Vanier Pkwy on Donald
- NB far side bus stop with bench, SB far side bus stop with shelter
- Hydro pole on NE corner behind sidewalk
- Heavy NS volumes
- Medium bike volumes E-W



An eastbound cyclist waits in bike lane

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High volumes on Vanier Parkway are uncomfortable for cyclists
- Potential for turning conflicts between vehicles and cyclists/pedestrians on Donald Street and NB right from Vanier Parkway
- No cyclist space on Donald Street east of Vanier Parkway

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs, including a bidirectional cycle track on the east side of Vanier Parkway to improve access for cyclists given the limited number of crossing opportunities along the corridor. On the west leg of the intersection, a revised design of buffered bike lanes is proposed to match the existing condition, due to the very low volume of vehicles and presence of mature trees in the boulevard.

There are no physical constraints at the intersection. Both roadways have wide boulevards.

The proposed solution is a protected intersection.

Existing far-side transit stops are accommodated as island platform stops, which in conjunction with acceleration lane removal improves transit level of service by not requiring buses to merge in and out of travel lanes.

Changes to Configuration

The NBR turn channel is replaced with a dedicated right turn lane, which is not anticipated to cause performance issues (low-volume, 90 peak hour). The acceleration lanes on Vanier Parkway are also removed, as they are not required in conjunction with the proposed right-on-red restrictions. The curb lanes on Vanier Parkway are also reduced to 3.5 m.

Turning Radii Accommodated

As an arterial-collector intersection, the desired effective turning radius is 12 m. Heavy vehicles turn at this intersection at low rates:

- 18 heavy vehicles per day for NBR movement
- 12 heavy vehicles per day for EBR movement
- 0 heavy vehicles per day for SBR movement
- 16 heavy vehicles per day for WBR movement

The low vehicle volumes and very low heavy vehicle volumes on Donald Street to the west of the intersection are much more typical of a local roadway. As such, it is proposed that this section of road be designed for smaller effective turning radii. The SBR movement carries zero heavy vehicles and as such the NW corner is designed at a much smaller turning radius of 6 m. The desired effective turning radius of 12 m is accommodated for the NE and SE corners. Truck aprons are proposed on these corners to slow passenger vehicle turning speeds to improve safety for pedestrians and cyclists.

Suggested Traffic Changes

A three-phase operation is proposed, which includes fully protected NBL and SBL turns, which are a requirement given the bidirectional crossride on the east leg. Fully prohibited right-on-red is recommended for all right turn movements to reduce potential conflicts and improve safety for pedestrians and cyclists.

Additional Considerations

- The low traffic volume onto and off of Donald Street west of the intersection (~1,800 vehicles per day) is much more typical of a local street. It is suggested this roadway be reclassified as a local roadway to reflect these conditions.
- The addition of a MUP on the east side of Vanier Parkway as directed by City of Ottawa staff may have impacts on the existing vegetation.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,140,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(10) Gladstone Avenue and Bank Street

Context

This intersection was selected based on the characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) of the intersection. The intersection is signal controlled with no protected phases. There is a restriction on SBL from 7 – 9 AM. The surrounding land use is varied with high density mixed-use, and mid density commercial, and residential. There is a gas station on the southwest corner.

Overview of Existing Intersection Characteristics

Characteristic	Bank Street	Gladstone Avenue
Road Classification	Arterial	Major Collector
Speed Limit	50 km/h	50 km/h
Truck Route	South of Gladstone	Yes
Transit	Frequent routes 6 and 7. NB near side stop, SB far side stop	Frequent route 14 and route 114. EB and WB near side stops
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route	Suggested Route with bike route signage
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB left, general SB two general	EB two general WB one general

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Bank Street	Gladstone Avenue
Affordable Cycling Project List	Not Listed	Not listed
Ultimate Cycling Network	Local Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Bank Street and Gladstone Avenue are Transit Priority Corridors and Traditional Mainstreets in the Official Plan.

Collision History

There have been 72 reported collisions at this intersection from 2009 to 2018. Sixteen resulted in non-fatal injuries, and the remainder resulted in only property damage, and two were not reportable. Ten collisions involved pedestrians, and 4 collisions involved a person cycling. One collision occurred during rainy, wet conditions, while the others occurred in clear, dry conditions during the day. Three of the collisions led to non-fatal injuries. There were no prevailing commonalities between the collisions. There were no trends in pedestrian collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	27-Jul-2016
Time Period	7AM-6PM
Vehicles	13632
% Trucks/Buses	4%
% Bicycles (on-road)	6%
Bicycles (on-road)	798
Pedestrians	5875

Based on the traffic volume data provided (and detailed in the Appendix), the following additional observations are observed:

- Motor vehicle traffic higher N-S (63%), as do bicycle volumes (71%)
- High percentage of vehicle turns on E, W, and S legs; 46% of EB traffic turns left or right
- EBR and NBL are high-volume movements during peak periods, EBL is moderate during AM peak
- Bicycles account for 6% of on-road traffic
- Bicycle traffic turning patterns are very similar to motor vehicles at this intersection
- Truck/bus traffic is mostly through-bound, and accounts for 4% of overall volumes
- High volume of pedestrians, mostly crossing on E and W legs

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 4:55 PM. The following observations are noted:

- Observed cycle times total 75 seconds, N-S = 47s, E-W = 28s
- Very compact intersection, constrained on NW and NE corners
- Very narrow lanes on west, north, and south legs
- Parking lane on south side of east leg creates a pinch and congestion for EBT cyclists
- Congested on all legs
- Very slow speeds through intersection due to congestion
- Very high pedestrian volumes
- Several cyclists walking bikes, riding on sidewalks

A car stopped in the crosswalk during the site visit

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Clarifying space for cyclists at intersection – current lack of space
- Address the EBT pinch-point

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Existing buildings on the NE, NW, and SE corners are built to the property line and impose significant constraints on the intersection.

The proposed design is a dedicated intersection with adjacent crossings, as there is insufficient space for a fully protected intersection. Due to the high-volume EBR movement, a dedicated EBR lane is proposed, with a fully protected phase separated from the EBT bicycle movement.

Bicycle stop bars are placed 2 m ahead of vehicle stop bars (except on the eastbound approach), and left turning cyclists are accommodated with turn boxes on all corners.

Existing northbound and westbound transit stops are accommodated in the design in their present near-side locations with 1.2 m landing zones. To support the proposed design, it is proposed that the existing eastbound near-side stop be shifted to the far side of the intersection.

Changes to Configuration

On the south leg of Bank Street, one travel lane in each direction is removed in order to accommodate the proposed cycle tracks, resulting in the loss of the dedicated NBL lane. On the north leg, the second southbound lane is removed. On the west leg of Gladstone, the peak-travel (off-peak parking) westbound curb lane is removed, and on the east leg, the south on-street parking lane is removed. Removal of lanes may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design.

The very narrow cross-sectional width of Bank St to the north of the intersection requires a continuous roadway width of 7 m to fit in the cycle tracks without narrowing the existing sidewalks. A 7 m “pinch point” is provided on the east leg of the intersection on the approach as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-collector intersection, the desired effective turning radius is 12 m. Heavy vehicles turn at this intersection at low to moderate rates:

- 17 heavy vehicles per day for NBR movement
- 30 heavy vehicles per day for EBR movement
- 9 heavy vehicles per day for SBR movement
- 4 heavy vehicles per day for WBR movement

The desired 12 m effective radius is provided on all corners, while still providing tighter physical corners for pedestrians (shown in red on SW corner). Truck aprons are provided on all corners to encourage slower turning speeds for passenger vehicles, while still accommodating turning heavy vehicles. Further review of truck apron design is required at functional design.

Suggested Traffic Changes

The proposed operation is to add a third phase where the EBR movement is fully protected and separated from eastbound cyclists and pedestrians crossing the south leg.

- P1: N-S (peds and cyclists cross east and west legs)
- P2: EBT, EBL, WBT, WBL, WBR (peds and cyclists cross north and south legs)
- P3: EBT, EBL, EBR (peds and cyclists cross north leg only)

The EBR protected phase is proposed at the end of the E-W phase rather than the beginning to avoid conflicting with cyclists using the SW two-stage turn box and facilitate leading pedestrian and bicycle intervals, which are recommended on all legs to improve visibility of vulnerable road users. Peak-hour left turn restrictions may be required, especially for the NBL movement which reaches 115 vehicles during the PM peak.

Fully prohibited right-on-red is required for all right turn movements as a condition of the two-stage turn boxes.

Additional Considerations

- Cycle tracks on Bank Street are not recommended in isolation of extended cycling facilities on Bank Street.

Cost Estimate

The concept design has an estimate cost (Class D) of $787,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(11) Gladstone Avenue and Booth Street

Context

This intersection was selected based on the collision history of the intersection. The intersection is signal controlled with leading pedestrian intervals. On the east side there is a channel for EBR that is stop controlled. The surrounding land use is mixed, mid density. There is a church on the northwest and southeast corners. St. Anthony Catholic School and Dalhousie Parents' Day Care Centre are on the northeast corner. Piazza Dante Park is located on the southwest corner.

Overview of Existing Intersection Characteristics

Characteristic	Gladstone Avenue	Booth Street
Road Classification	Major Collector	Major Collector
Speed Limit	40 km/h	40 km/h
Truck Route	Yes	No
Transit	Route 14 (frequent) and 114. EB and WB near side stops	No
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route with bike route signage	Suggested Route
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB left, through, channel RT WB left, through lane	NB and SB wide general lane

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Gladstone Avenue	Booth Street
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Gladstone Avenue is a Transit Priority Corridor and a Traditional Mainstreet in the Official Plan.

Collision History

There have been 36 reported collisions at intersection from 2009 to 2018. Only five resulted in non-fatal injuries, and the remainder resulted in only property damage. There have been no collisions involving pedestrians. Five collisions involved a person cycling. One collision occurred during rainy, wet conditions, while the others occurred in clear, dry conditions during the day. Three of the collisions led to non-fatal injuries. All of the collisions occurred while the cyclist was making a through movement. Three of the collision were turning movement impacts, two of which were with SB cyclists hit by NBL turning cars.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	27-Jul-2016
Time Period	7AM-6PM
Vehicles	10958
% Trucks/Buses	2%
% Bicycles (on-road)	4%
Bicycles (on-road)	455
Pedestrians	861

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Slightly more vehicle volumes in E-W direction (55%), while bicycles are more heavy E-W (82%)
- Most peak-hour turn movements are low-volume, except WBL and NBL during PM peak
- Bicycles account for 7-8% of vehicle volumes travelling E-W through
- Bicycles turning movements are minimal
- Low truck/bus volumes, most heavy movements are likely buses travelling E-W (trucks are prohibited on Booth in both directions)
- Moderate pedestrian volumes, south crosswalk is most-used

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 4:40 PM. The following observations are noted:

- Observed cycle times total 80 seconds, N-S = 38s, E-W = 42s, LPIs for both directions, no RTOR restrictions
- EB cyclists are travelling slowly due to uphill
- N-S approaches are wide enough that vehicles can swerve around vehicles waiting to make left turns
- Uphill grade through intersection from west to east
- Generally slow vehicle speeds, minimal aggressive movements
- Lots of children
- WB traffic is backed up from Rochester to the west, long queues on WB approach

Long WB vehicle queue backed up from intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Through bound bikes have potential conflicts with turning vehicles
- Wide approach lanes on N and S legs could be ambiguous to users

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Buildings are present on all corners and are major constraints.

The proposed design is a dedicated intersection with adjacent crossings, as there is insufficient space for a fully protected intersection. Bicycle stop bars are placed 2 m ahead of vehicle stop bars, and left turning cyclists are accommodated with turn boxes on all corners. While the EBR turn channel is retained in the design, geometric improvements are made on the EB approach to reduce vehicle turn speeds and improve safety for cyclists and pedestrians crossing the EBR turn channel.

The existing transit stops are accommodated on the near sides of the intersection. The westbound stop includes an island platform and the eastbound stop includes a landing zone.

Changes to Configuration

The proposed design includes the removal of the EBL and WBL turn lanes, as well as one on-street parking lane on Gladstone west of the intersection. Removal of turn and parking lanes may have impacts on traffic, transit, and parking supply and will need to be reviewed in more detail at functional design. The NB and SB approach lanes are also narrowed to 4 m, which meets the minimum requirement of 8 m between curbs.

Turning Radii Accommodated

As a collector-collector intersection, the desired effective turning radius is 12 m. Heavy vehicles turn at this intersection at very low rates:

- 3 heavy vehicles per day for NBR movement
- 5 heavy vehicles per day for EBR movement
- 5 heavy vehicles per day for SBR movement
- 3 heavy vehicles per day for WBR movement

Trucks are prohibited on Booth Street, which accounts for the low turning volumes. Based on these restrictions and associated low volumes, it is proposed that a lower effective radius of 9 m be accommodated in the design. This will encourage slower vehicle turning speeds and create more corner storage space for pedestrians and cyclists. On the NE corner an effective radius of 9 m is provided with a physical radius of 5 m and a set back stop bar for southbound traffic.

Truck aprons are also proposed on the NW and SE corners to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation of the intersection be maintained. Leading bicycle and pedestrian intervals are recommended on all legs to improve visibility of vulnerable road users. Peak-hour left turn restrictions may be required, particularly for the NBL and WBL movements which are high during the PM peak. The WBR movement is proposed to be prohibited based on direction from City staff.

Fully prohibited right-on-red is recommended for all right turn movements to reduce potential conflicts and improve safety for pedestrians and cyclists.

Additional Considerations

- Autoturn analysis is required at functional design to verify that the desired control vehicles (emergency vehicles) can complete turns at the intersection without impacting bike boxes or curbs

Cost Estimate

The concept design has an estimate cost (Class D) of $792,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(12) Gladstone Avenue and Preston Street

Context

This intersection was selected based on the collision history of the intersection. The intersection is signal controlled and does not have any protected phases. The EB stop bar is set back approximately 8 m from the crosswalk. The NBL and WBL turn lanes are also set back 7 and 9 m from the intersection, respectively. The surrounding land use is mixed residential and commercial. The Adult High School is located on the southeast corner. Ottawa Fire Station No. 11 is located on Preston Street 4 blocks north of Gladstone. There is a PXO located 80 m north of the intersection on Preston Street.

Overview of Existing Intersection Characteristics

Characteristic	Gladstone Avenue	Preston Street
Road Classification	Major Collector	Arterial
Speed Limit	40 km/h	50 km/h
Truck Route	East of Preston	Yes
Transit	Route 14 (frequent) and 114. EB stop far side and WB stop near side	Route 85 (frequent), NB near side stop, SB far side stop
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route with bike route signage	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	WBL lane and through lane, One EB lane	NB and SB left turn lane and one through lane

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Gladstone Avenue	Preston Street
Affordable Cycling Project List	West of Preston listed as P1-28	Not listed
Ultimate Cycling Network	Spine Route	Local Route
Cross-Town Bikeway	Not listed	Not listed

Gladstone Avenue is a Transit Priority Corridor and a Traditional Mainstreet, and Preston Street is a Traditional Mainstreet in the Official Plan.

The future Gladstone O-Train station will be located 200 m west of the intersection. A large public housing development is proposed on the north side of Gladstone adjacent to the O-Train corridor.

Collision History

There have been 55 reported collisions at this intersection from 2009 to 2018. Nineteen resulted in non-fatal injuries, and the remainder resulted in only property damage or were not reportable. There have been six collisions involving pedestrians. Eight collisions involved a person cycling. All the collision occurred in clear, dry conditions during the day, except for one was at night. All 8 of the collisions led to non-fatal injuries. All of the collisions occurred while the cyclist was making a through movement, 6 EB, and 2 WB. Six of the collisions involved vehicle turning movements resulting in the collision with the through cyclist. Of these collisions, two were EBR, two were EBL, and two were WBL movements. There were no trends in pedestrian collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in June 2017. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Jun-2017
Time Period	7AM-6PM
Vehicles	12688
% Trucks/Buses	6%
% Bicycles (on-road)	4%
Bicycles (on-road)	470
Pedestrians	1596

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle traffic heavier N-S (59%), while bicycles heavier E-W (71%)
- Generally low-volume peak hour turning movements
- SBL is moderate during AM peak and WBL and NBL are moderate during PM peak
- Bicycles make up 4% of overall traffic and 7-11% of E-W through traffic
- Higher percentage of heavy vehicles, highest on N-S through movements
- Heavy vehicles account for 12% of WBR volumes and 14% of SBL volumes
- Moderate volume of pedestrians, fairly balanced across all leg

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 4:25 PM. The following observations are noted:

- Observed cycle times total 70 seconds, N-S = 35s, E-W = 35s
- Very constrained, poor sightlines on NW and SW corners
- EB and WB cyclists have no dedicated space at far side of intersection
- Cyclists making two-stage turns have very little space to queue
- EB and WB approaches are significant downhill grades
- Minimal sidewalk cycling
- Lots of trucks travelling N-S
- Frequent red-light running

Car stopped in crosswalk during site visit

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Potential for conflicts between E-W cyclists and turning vehicles given visual constraints at intersection, and while bikes are travelling downhill to/through intersection
- E-W posted speed limit and vehicles volumes are not suitable for mixed traffic operations, as per TAC Geometric Design Guidelines

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Existing buildings on the NW and SW corners are built to the property line and impose significant constraints on the intersection. Due to a significant roadway width restriction on the west leg, the design facilities are a westbound on-street bike lane, and mixed traffic operation eastbound. The westbound bicycle lane is prioritized over eastbound as westbound cyclists are travelling uphill and will experience a larger speed differential with vehicles.

The proposed design is a dedicated intersection with adjacent crossings, as there is insufficient space for a fully protected intersection. Bicycle stop bars are placed 2 m ahead of vehicle stop bars, and left turning cyclists are accommodated with turn boxes on all corners. On the eastbound approach, cyclists share the lane with vehicles.

Existing transit stops on all legs are accommodated in the design in their present near-side locations.

Changes to Configuration

Left turn lanes on the southbound, northbound, and westbound approaches are removed to provide space for cycle tracks. On-street parking lanes on Preston Street are also removed. Removal of lanes may have significant impacts on traffic, transit operations, emergency response operations, and parking supply and will need to be reviewed in more detail at functional design. Vehicle lanes on Gladstone Avenue on the west leg of the intersection are reduced to 3.5 m to accommodate the westbound bicycle lane within the existing curb-to-curb width.

Seven metre “pinch points” are created on the east, south, and north legs of the intersection on the approaches, as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-collector intersection, the desired effective turning radius is 12 m. Heavy vehicles turn at this intersection at varying rates:

- 27 heavy vehicles per day for NBR movement
- 12 heavy vehicles per day for EBR movement
- 8 heavy vehicles per day for SBR movement
- 78 heavy vehicles per day for WBR movement

Given that the NE and SE corners carry the majority of the heavy vehicle turns, the desired 12 m effective radius is provided on these corners, while still providing tighter physical corners for pedestrians. The effective turning radius for the SBR and EBR movements is increased over the existing design by offsetting the vehicle paths further from the curb, but the 12 m desired effective radius is not met due to physical constraints.

Truck aprons are proposed on all corners to encourage slower turning speeds for passenger vehicles, while still accommodating the daily volume of turning heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation of the intersection be maintained. Leading bicycle and pedestrian intervals are recommended on all legs to improve visibility of vulnerable road users. Peak-hour left turn restrictions may be required, although left turn volumes are low to moderate during peak periods (22-85 vehicles per hour).

Fully prohibited right-on-red is recommended for all right turn movements to reduce conflict potential and improve safety for pedestrians and cyclists.

Additional Considerations

- Autoturn analysis is required at the functional design stage to verify that the desired control vehicle (emergency vehicles) can complete turns at the intersection without impacting bike boxes or curbs

- Review of loading requirements for large vehicles on Gladstone Avenue west of the intersection will be required at functional design.

Cost Estimate

The concept design has an estimate cost (Class D) of $680,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(13) Hazeldean Road and Eagleson Road

Context

This intersection was selected based on consultation. Hazeldean Road and Eagleson Road is a signalized intersection with protected phases in all directions, including EB and WB double left. Hazeldean Road becomes Robertson Road east of the intersection. All right turn movements have right turn channels. The surrounding area includes low-density residential and commercial land uses, and the Greenbelt to the east. Hazeldean Mall is located on the southwest corner of the intersection, with access to the mall via Eagleson Road.

Overview of Existing Intersection Characteristics

Characteristic	Hazeldean Road	Eagleson Road
Road Classification	Arterial	Arterial
Speed Limit	60 km/h	60 km/h, 80 km/h north of intersection
Truck Route	Yes	Yes
Transit	Route 88 (frequent), no stops at intersection, turns onto Eagleson to stop at Hazeldean Mall	Route 164, 168, SB far side stop
Emergency Route	Yes	Yes
Cycling Facilities	None at intersection, intermittent facilities along Hazeldean	None
Pedestrian Facilities	Sidewalks both sides west of Eagleson, none east	On west side only
Configuration	NB left, two through, right channel SB left, two through, right channel	EB two left, three through, right turn channel WB two left, three through, right turn channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Hazeldean Road	Eagleson Road
Affordable Cycling Project List	P3-6 listed west of Eagleson – Segregated Bike Facility	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Hazeldean Road is a Transit Priority Corridor and an Arterial Mainstreet and Eagleson Road is a Transit Priority Corridor in the Official Plan

Collision History

There have been 158 reported collisions at this intersection from 2009 to 2018. Twenty-one collisions resulted in non-fatal injuries, with the remainder resulting in property damage only. One collision involved a pedestrian and one collision involved a person cycling. The collision occurred in the early morning in clear and dry conditions. The cyclist was heading through the intersection EB, and was hit by a NBR vehicle, resulting in a non-fatal injury.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in August 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	18-Aug-2016
Time Period	7AM-6PM
Vehicles	30170
% Trucks/Buses	2%
% Bicycles (on-road)	0%
Bicycles (on-road)	45
Pedestrians	65

Based on the traffic volume data provided, (and detailed in Appendix A), the following additional observations are observed:

- Consistent high vehicle volumes on all intersection legs, slightly higher N-S (58%), cyclist volumes higher E-W (73%)
- Heavy vehicles follow same pattern with double the volume for N-S vs. E-W
- High peak hour volume for all turns except WB right during AM
- Heavy vehicles about 2% of traffic at all movements, 3-4% at EB right and WB left
- Bus movement N-S along Eagleson every 30 minutes in each direction, more frequent E-W on Hazeldean
- Low overall volume of pedestrians, with most on west leg (80%)

Site Visit Notes

A site visit was conducted at this intersection on October 28, 2019 at 11:45 PM. The following observations are noted:

- Observed cycle times total 110 seconds, 4 phases with fully protected left movements. N-S = 54s, E-W = 20s. N-S pedestrian phase pretimed, E-W pedestrian phase fully actuated
- Right turn channels on every corner
- Red light camera on NW corner facing south
- Hydro pole on SW corner
- Paved shoulders on Robertson 350 m east of intersection
- High posted speed limit creates potential safety issue: Eagleson changes from 80km/h to 60km/h SB just north of intersection
- SBR channel has excessive turn radii, which allows drivers to proceed through channel at high speeds

Left: Cars queuing for a protected left movement

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High posted speed limit and high volumes of cars are not acceptable for mixed traffic cycling, according to TAC Geometric Design Guidelines
- Potential conflicts at right turn channels, especially free-flow SBR channel
- Transition from 80 km/h to 60 km/h on Eagleson Road north of intersection may lead to excessive speeds through the intersection

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on both Hazeldean Road and Eagleson Road. Due to the high posted speed limit and volumes, and generous boulevards, cycle tracks are proposed as 2.0 m wide, separated from the roadway by a 1.5 m buffer. The proposed solution is a fully-protected intersection.

As right turn volumes on all legs exceed 150 vehicles during peak hour, fully protected right turns are proposed on all legs, to fully separate all turning conflict points between vehicles and pedestrians. This involves the removal of all right turn channels and associated acceleration lanes. An alternative design is provided showing the footprint of smart channels, which improve the operational performance for right-turn movements, reduce signal infrastructure requirements, and shortened pedestrian and cyclist crossing distances. Smart channels require a larger amount of space to construct and require yield-controlled rather than fully-protected crossings for pedestrians and cyclists.

The existing far-side southbound transit stop is accommodated as a landing zone style bus stop. The remainder of the existing transit stops are set back from the intersection and are not a factor in the proposed intersection design.

Changes to Configuration

Existing through and turn lanes are maintained. Existing right turn channels are converted to adjacent turn lanes, and acceleration lanes are removed.

The proposed configuration increases the pedestrian crossing distances by approx. 3 m on the north and east legs.

Turning radii accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at moderate rates, with the highest being the EBR (79 heavy vehicles per day). A physical radius of 15 m is provided at all corners to easily facilitate heavy vehicle movements on all legs. Truck aprons are not necessary to reduce turning speeds, as right turning vehicles are signal-separated from cyclists and pedestrians.

Suggested Traffic Changes

The existing four-phase operation of the intersection can be maintained by operating the fully protected right turn movements in conjunction with dual left movements (e.g. WBR and EBR would operate in conjunction with NBL and SBL). Fully prohibited right-on-red is required as a condition of the fully protected turns. In conjunction with the concept design, it is also recommended that the speed limit on Eagleson Road be reduced to 60 km/h further in advance of this intersection to provide a potentially safer and more comfortable operating environment for all road users.

Additional Considerations

- Bidirectional cycling facilities may be considered appropriate for this context as a cost-savings measure, given the lack of driveways and large distances between intersections
- The design is well-suited for the placement of future bus stops on the far side of the intersection, as buses would not need to merge back into traffic from the right-turn lane. They would be designed as an extension of the existing pedestrian refuges
- Length of right turn lanes to accommodate queuing vehicles will be reviewed at functional design.
- Under the current guidance of OTM Book 12, the intersection as shown is too large to accommodate traffic signals within the recommended 55 m longitudinally of the opposite stop bar. To enable the design to be compliant with Book 12, two solutions are suggested:
    - Removal of one through lane in each direction (reduction from three to two)
    - Replacement of right turn lanes with smart channels, which provide opportunities for signals to be placed closer to the intersection. A second version of the intersection is provided showing the approximate footprints for smart channels.

- The smart channel option will move the crossings and stop bars closer to the centre of the intersection, modifying the paths of left turning vehicles at this intersection. Autoturn analysis required at the functional design stage to verify that left turn paths will not overlap.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,290,000 for the base option, and $1,520,000 for the option with smart channels. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule A+ will be required. For the smart channel option, it is expected that a MCEA Schedule B will be required.

(14) Hazeldean Road and Terry Fox Drive

Context

This intersection was selected based its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Hazeldean Road and Terry Fox Drive is a signalized intersection with protected double left turn phases in all directions. All right turn movements have right turn channels. The surrounding area includes low-density residential, industrial, and commercial land uses. There is a shopping plaza on the southeast corner, and a grocery store on the southwest, with residential subdivisions setback from the intersection. The Kanata Recreation Complex is on the northwest corner, and the Hazeldean Industrial Park on the northeast corner.

Overview of Existing Intersection Characteristics

Characteristic	Hazeldean Road	Terry Fox Drive
Road Classification	Arterial	Arterial
Speed Limit	60 km/h	70 km/h
Truck Route	Yes	Yes
Transit	Route 88 (frequent), 61 (rapid), stops set back from intersection.	Route 88 (frequent), 167, stops set back from intersection
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB two left, two through, right channel SB two left, two through, right channel	EB two left, two through, right turn channel WB two left, two through, right turn channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Hazeldean Road	Terry Fox Drive
Affordable Cycling Project List	P3-6 listed east of Terry Fox – Segregated Bike Facility	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Not listed	Yes – Route 8

Hazeldean Road is a Transit Priority Corridor and an Arterial Mainstreet and Terry Fox Drive is a Transit Priority Corridor in the Official Plan

Collision History

There have been 176 reported collisions at this intersection from 2009 to 2018. Forty collisions resulted in non-fatal injuries, with the remainder resulting in property damage only. One collision involved a pedestrian and three collisions involved a person cycling. Two of these collisions occurred in clear and dry conditions. All of the cyclist collisions were angle collisions. Two of the collisions resulted in non-fatal injuries, the other resulted in property damage. There were no other prevailing similarities between the collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in March 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	3-Mar-2016
Time Period	7AM-6PM
Vehicles	28736
% Trucks/Buses	4%
% Bicycles (on-road)	0%
Bicycles (on-road)	1
Pedestrians	102

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- N-S and E-W vehicle volumes are balanced; a similar pattern is seen for heavy vehicles
- Higher cyclist volumes seen in June 2014 data (136) with higher volumes on NB and EB movements
- Consistently high overall turn movements at all right and left turns. Highest SB right and EB left
- High volume peak turns for all movements excluding NB right
- Moderate-heavy vehicle volumes, high heavy vehicle percentages at SB left (7%) and WB right (8%)
- Bus traffic every 20 minutes N-S through and every 12 minutes E-W through
- Low pedestrian volumes, highest on the south leg. Triple the volume in June from March

Site Visit Notes

A site visit was conducted at this intersection on October 28, 2019 at 11:25 PM. The following observations are noted:

- Observed cycle times total 110 seconds, 4 phases, fully protected lefts. Pedestrian phases semi-actuated (N-S phase pretimed, E-W phase fully actuated)
- Right turn channels on every corner
- Floating bike lanes every approach
- N-S hydro line on west side
- Many heavy trucks present
- Frequent vehicles speeding up at end of each cycle
- Terry Fox posted 70 km/h
- Frequent bus turning movement: SBL and WBR

A truck making a right turn during the site visit. The hydro line on the north side can also be seen

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High posted speed limit and high volumes of cars are not acceptable for mixed-traffic cycling according to TAC Geometric Design Guidelines
- Potential conflicts between vehicles and pedestrians/cyclists at right turn channels

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on both Hazeldean Road and Terry Fox Drive. Due to the high posted speed limit and volumes, and generous boulevards, cycle tracks are shown are 2.0 m wide, separated from the roadway by a 1.5 m buffer. The proposed solution is a fully-protected intersection.

Right turn volumes on all legs exceed 150 vehicles during peak hour, so fully protected right turns are proposed on all legs, to fully separate all turning conflict points between vehicles and pedestrians. This involves the removal of all right turn channels and their associated acceleration lanes. An alternative design is provided showing the footprint of smart channels, which improve the operational performance for right-turn movements, reduce signal infrastructure requirements, and shorten pedestrian and cyclist crossing distances. Smart channels require a larger amount of space to construct and require yield-controlled rather than fully-protected crossings for pedestrians and cyclists.

The existing transit stops are set back from the intersection and are not a factor of the proposed intersection design.

Changes to configuration

Existing through and turn lanes are maintained. Existing right turn channels are converted to adjacent turn lanes, and acceleration lanes are removed.

Turning Radii Accommodated

This is an arterial-arterial intersection, so the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at a high rate, with the highest being the westbound right (134 heavy vehicles per day). A physical radius of 15 m is provided at all corners to easily facilitate heavy vehicle movements on all legs. Truck aprons are not necessary to reduce turning speeds since right turning vehicles are signal-separated from cyclists and pedestrians.

Suggested Traffic Changes

The existing four-phase operation of the intersection can be maintained by operating the fully protected right turn movements in conjunction with dual left movements (so WBR and EBR would operate in conjunction with NBL and SBL). Fully prohibited right-on-red is required as a condition of the fully protected turns. In conjunction with the concept design, it is also recommended that the speed limit on Terry Fox Drive be reduced to 60 km/h to provide a potentially safer and more comfortable operating environment for all road users, which may require design changes to the corridor to accommodate this speed.

Additional Considerations

- The design is well-suited for the placement of future bus stops on the far side of the intersection, as buses would not need merge back into traffic from the right-turn lane. They would be designed as an extension of the existing pedestrian refuges
- Due to the generally unconstrained context of this intersection, smart channels may be considered on all corners as an alternative design, which may improve performance of right turn movements. This should be considered at the functional design stage
- The smart channel option will move the crossings and stop bars closer to the centre of the intersection, modifying the paths of left turning vehicles. Autoturn analysis required at the functional design stage to verify that left turn paths will not overlap.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,170,000 for the base option, and $1,360,000 for the smart channel option. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(15) West Hunt Club Road and Merivale Road

Context

This intersection was selected based its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). West Hunt Club Road and Merivale Road is a signalized intersection with protected left turn phases for all directions. All right turn movements have right turn channels. The surrounding land use is low-density commercial and industrial uses.

Overview of Existing Intersection Characteristics

Road Classification	Arterial	Arterial
Speed Limit	80 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 96B, 199, stops setback from intersection	Route 80 (frequent), 186, stops setback from intersection
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB two left, two through, right channel WB left, three through, right channel	NB left, two through, right turn channel SB two left, two through, right turn channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

		Merivale Road
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	No	No

Merivale Road is a Transit Priority Corridor (continuous lanes) and an Arterial Mainstreet and West Hunt Club Road is a Transit Priority Corridor (isolated measures) in the Official Plan.

Collision History

There have been 253 reported collisions at this intersection from 2009 to 2018. Thirty-six collisions resulted in non-fatal injuries, and one resulted in a fatality, with the remainder resulting in property damage only. No reported collisions involved a pedestrian. One collision involved a person cycling, resulting in a fatal injury. It occurred during the day in clear, wet conditions. The cyclist was EB making an unknown movement and was hit by an EBR truck and trailer.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in April 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	26-Apr-2016
Time Period	7AM-6PM
Vehicles	37144
% Trucks/Buses	4%
% Bicycles (on-road)	0%
Bicycles (on-road)	24
Pedestrians	207

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle movements balanced in both directions
- 30-40% of vehicles at all legs make a turn at the intersection

- Similar patterns for heavy vehicles except higher volume of NB turns
- Peak hour turns high for all movements except EB right - highest for PM SB right and WB right
- Significantly higher bicycle volumes in June 2013 vs. April 2016
- Bicycle movements mainly N-S and E-W through, with highest volume of turns NB right (June)
- Up to 9% heavy vehicle traffic, particularly at NB and EB right, and WB and NB left
- Bus route N-S on Merivale every 15 minutes in both directions
- Low pedestrian volumes, balanced volumes at all legs

Site Visit Notes

A site visit was conducted at this intersection on October 16, 2019 at 12:30 PM. The following observations are noted:

- Observed cycle times total 130 seconds, P1: NBL, SBL (21s), P2: N-S (38s), P3: EBL, WBL (17s), P4: E-W (34s)
- Very small RT channels all legs
- Painted bike lane West Hunt Club Roadboth directions
- Bus stops on Merivale Road: NB far side, SB near side; none on West Hunt Club Road
- Very high volumes for both roads
- Very high posted speed limit on West Hunt Club (80km/h)
- Few pedestrians, very few cyclists

Pedestrians waiting on island to cross road

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Extremely long floating bike lane east of intersection which is uncomfortable for cyclists and has the potential to create conflicts between cyclists and vehicles
- High posted speed limit and high volumes on Merivale Road are not appropriate for mixed-traffic cycling, according to TAC Geometric Design Guidelines
- High heavy vehicle movements EBR, NBL, NBR according to traffic data, which may present conflicts for cyclists
- Potential conflicts between vehicles and pedestrians/cyclists at right turn channels

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on both West Hunt Club Road and Merivale Road. Due to the high speed limit and volumes, and generous boulevards, cycle tracks are shown are 2.0 m wide, separated from the roadway by a 1.5 m buffer. The proposed solution is a fully-protected intersection.

As right turn volumes on all legs exceed 150 vehicles during peak hour, fully protected right turns are proposed on all legs, to fully separate all turning conflict points between vehicles and pedestrians. This involves the removal of all right turn channels and their associated acceleration lanes. An alternative design is provided showing the footprint of smart channels, which improve the operational performance for right-turn movements, reduce signal infrastructure requirements, and shorten pedestrian and cyclist crossing distances. Smart channels require a larger amount of space to construct and require yield-controlled rather than fully-protected crossings for pedestrians and cyclists.

The existing transit stops are set back from the intersection and are not a factor of the proposed intersection design.

Changes to Configuration

Existing through and turn lanes are maintained. Existing right turn channels are converted to adjacent turn lanes, and acceleration lanes are removed.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at a moderate to high rate, with the highest being the northbound right (131 heavy vehicles per day). A physical radius of 15 m is provided at all corners to easily facilitate heavy vehicle movements on all legs. Truck aprons are not necessary to reduce turning speeds since right turning vehicles are signal-separated from cyclists and pedestrians.

Suggested Traffic Changes

The existing four-phase operation of the intersection can be maintained by operating the fully protected right turn movements in conjunction with dual left movements (so WBR and EBR would operate in conjunction with NBL and SBL). Fully prohibited right-on-red is required as a condition of the fully protected turns. In conjunction with the concept design, it is also recommended that the speed limit on West Hunt Club Road be reduced to 60 km/h to provide a potentially safer and more comfortable operating environment for all road users, which may require design changes to the corridor to accommodate this speed.

Additional Considerations

- The design is well-suited for the placement of future bus stops on the far side of the intersection, as buses would not need merge back into traffic from the right-turn lane. They would be designed as an extension of the existing pedestrian refuges
- Under the current guidance of OTM Book 12, the east-west cross section as shown is too large to accommodate traffic signals within the recommended 55 m longitudinally of the opposite stop bar. To enable the design to be compliant with Book 12, two solutions are suggested:
    - Removal of one through lane in each direction on West Hunt Club Road (reduction from three to two)
    - Replacement of right turn lanes with smart channels, which provide opportunities for signals to be placed closer to the intersection. Note that the existing building on the SW corner is in conflict with the footprint of a smart channel at that location. A second version of the intersection is provided showing the approximate footprints for smart channels.
- The smart channel option will move the crossings and stop bars closer to the centre of the intersection, modifying the paths of left turning vehicles at this intersection. Autoturn analysis required at the functional design stage to verify that left turn paths will not overlap.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,150,000 for the base option and $1,340,000 for the option with smart channels. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(16) West Hunt Club Road and Prince of Wales Drive

Context

This intersection was selected based its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). West Hunt Club Road and Prince of Wales Drive is a signalized intersection with protected left turn phases for all directions. All right turn movements have right turn channels. The surrounding land use is low-density commercial and industrial uses to the west of the intersection. To the east is the Rideau River. West Hunt Club Road is one of the few bridges that crosses the Rideau River in the southern part of the City. On the east side of the river is Ottawa International Airport and the airport business park.

Overview of Existing Intersection Characteristics

Characteristic	West Hunt Club Road	Prince of Wales Drive
Road Classification	Arterial	Arterial
Speed Limit	80 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 96, stops setback from intersection	None
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB two left, two through, right channel WB two left, two through, right channel	NB left, two through, right turn channel SB two left, two through, right turn channel; tapers to one through lane each direction north and south of intersection

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	West Hunt Club Road	Prince of Wales Drive
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Spine Route, Major Pathway on east side
Cross-Town Bikeway	No	Yes, Route 6

West Hunt Club Road is a Transit Priority Corridor in the Official Plan.

Collision History

There have been 309 reported collisions at this intersection from 2009 to 2018. Forty-eight collisions resulted in non-fatal injuries, with the remainder resulting in property damage only. No reported collisions involved a pedestrian. One collision involved a person cycling, resulting in property damage only. It occurred during the day in clear, dry conditions. The cyclist was WB making a through movement and was hit by a WBR car.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	10-Jul-2016
Time Period	7AM-6PM
Vehicles	47825
% Trucks/Buses	4%
% Bicycles (on-road)	0%
Bicycles (on-road)	220
Pedestrians	82

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Volumes for vehicles and cyclists balanced E-W and N-S, slightly higher E-W volumes for vehicles (58%)
- High NB right and WB left turns
- High peak hour turns at all movements except NB left and EB right
- Majority through movements for bicycles, but high turn movements at WB right and EB left
- Moderate percentage of trucks, higher percentage (5-6%) at WB right and EB right
- Low volumes of buses (every hour)
- Low pedestrian volumes. Preference for south and west legs (45 and 29% respectively)

Site Visit Notes

A site visit was conducted at this intersection on October 28, 2019 at 12:30 PM. The following observations are noted:

- Observed cycle times total 130 seconds, with 4 phases, including fully protected lefts
- Very large right turn channels on every corner and large islands
- Long pedestrian crossing distances
- Floating bike lanes east-west and north of intersection
- Recently implemented bicycle right-turn channel crossings on SE and SW legs
- Two-stage bicycle turn boxes on all corners
- Poor vehicle yield rates to pedestrians through channels
- High volume of trucks
- Many turning vehicles
- Heavy volumes all legs especially E-W

At left: Cyclists going through the intersection with a truck following

At left: Recently implemented cycling improvement from in-boulevard cycling facility, across right turn channel to on-road facility

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High speed right turn channel design can lead to poor yield compliance and potential conflicts at corners
- Floating bike lanes for long distances present potential for conflicts between vehicles and cyclists
- High speeds and volumes are not appropriate for mixed-traffic cycling, according to TAC Geometric Design Guidelines

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on both West Hunt Club Road and Prince of Wales Drive. Due to the high posted speed limit and volumes, and generous boulevards, cycle tracks are shown at 2.0 m wide and separated from the roadway by a 1.5 m buffer. Vehicle right turn volumes are exceptionally high at this intersection for the NBR (900+ vehicles peak hour) and the WBR movements. To accommodate these movements, smart channels are proposed on all legs, to manage vehicle turning speeds and support vehicles yielding to pedestrians and cyclists. Mixing smart channels with non-channelized corners can present geometric issues for crosswalks and crossrides, and thus smart channels are proposed on all legs.

The existing transit stops are set back from the intersection and are not a factor of the proposed intersection design.

Changes to Configuration

Existing through and turn lanes are maintained. Existing right turn channels are converted to smart channels, and acceleration lanes are removed.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at a high rate, with the highest being the northbound right (176 heavy vehicles per day). A truck apron radius of 7 m is provided at all smart channel corners to encourage slower turning speeds for passenger vehicles, while still accommodating the daily volume of turning heavy vehicles.

Suggested Traffic Changes

No changes are proposed to the existing four-phase operation of the intersection. In conjunction with the concept design, it is recommended that the speed limit on West Hunt Club be reduced to 60 km/h to provide a potentially safer and more comfortable operating environment for all road users, and to reduce potential for conflicts at the smart channel. A reduction in speed limit may require design changes to the corridor to accommodate this speed.

Additional Considerations

- This intersection carries the highest volume of traffic of all study intersections (47,825 ADT). Given the significant turning volumes at this intersection (especially WBR and NBR), underpasses or overpasses for cyclists and pedestrians may be an optimal solution from a safety and operations perspective (see image below for example)
- The truck apron geometry is subject to refinement based on Autoturn analysis to ensure that a WB-20 can complete a turn using the apron
- Protected corners with fully protected right turns were considered for the SBR and EBR movements due to lower turning volumes, however a mix of smart channels and protected corners would create significant skews for bicycle and pedestrian crossings, and thus this solution was not advanced in the design

Above: Intersection with MUP underpass on west side near Amsterdam, NL

Source:
https://www.google.ca/maps/@52.4266031,4.8280396,342a,35y,354h/data=!3m1!1e3

Cost Estimate

The concept design has an estimate cost (Class D) of $1,650,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule A+ will be required.

(17) Island Park Drive and Richmond Road

Context

This intersection was selected based on the collision history of the intersection. The intersection is signal controlled with no protected phases. The surrounding land use is mixed, medium-density, with proposed high-density developments along the Richmond Road/Wellington Street West corridor, including at the northeast corner of the intersection. Hilson Avenue Public School is one block west of the intersection.

Overview of Existing Intersection Characteristics

Characteristic	Richmond Road	Island Park Drive
Road Classification	Arterial	Federally Owned Road
Speed Limit	50 km/h	40 km/h
Truck Route	Yes	No
Transit	Frequent routes 11, 51, and route 153. EB near side, WB far side stops	No
Emergency Route	Yes	Yes
Cycling Facilities	None	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB and WB wide lanes accommodate two vehicles	NB left, general SB left, general

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Richmond Road/Wellington Street West is a Transit Priority Corridor and a Traditional Mainstreet in the Official Plan. As a federal roadway, Island Park Drive is under the jurisdiction of the National Capital Commission.

Collision History

There have been 91 reported collisions at this intersection from 2009 to 2018. Thirteen resulted in non-fatal injuries, one collision was not reportable, and the remainder resulted in only property damage. There has been one collision involving a pedestrian. Six collisions involved a person cycling. One collision occurred during rainy, wet conditions, while the others occurred in clear, dry conditions in the afternoon and evening times. Four of the collisions led to non-fatal injuries. All of the collisions occurred while the cyclist was making a through movement, with no prevailing pattern in the travel direction of the cyclists. Three of the collision were turning movement impacts, two of the impacts were sideswipe impacts.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	26-Jul-2016
Time Period	7AM-6PM
Vehicles	15692
% Trucks/Buses	2%
% Bicycles (on-road)	3%
Bicycles (on-road)	505
Pedestrians	712

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Trucks/buses account for 5-7% of vehicles in E-W direction
- No high-volume peak hour turning movements
- N-S direction carries more vehicles (59%)
- E-W direction carries more bicycles (56%)
- Pedestrians mostly cross N and S legs

Site Visit Notes

A site visit was conducted at this intersection on October 7, 2019 at 4:30 PM. The following observations are noted:

- Observed cycle times total 85 seconds, N-S = 45s, E-W = 40s
- LT vehicles frequently block one lane in E-W movement, leading to sharp lane changes as drivers go around
- Intersection performing well, no signal movement failures
- No left turn queueing area for bikes despite frequent left turns observed
- Cyclists frequently cross by riding through crosswalk

SB cyclist going through the intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Frequent vehicle lane changes E-W create could create a significant hazard for all road users, especially cyclists
- Potential for reduced visibility for cyclists at intersection
- Lack of separation for cyclists E-W, which is inappropriate for this type of road based on TAC Geometric Design Guidelines
- Lack of integration of trail/pathway on NE corner could create potential for conflicts

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. There are no physical building constraints at the intersection, though the north leg is significantly skewed.

The proposed solution is a protected intersection. The existing pedestrian path to the NE is proposed as upgraded to separated walking and cycling facilities, and is integrated into the design of the NE corner.

Existing eastbound and westbound near-side transit stops are accommodated in the design as far-side stops. The westbound stop has an island platform and the eastbound stop has a landing zone.

Changes to Configuration

To accommodate the proposed cycle tracks on Richmond Road, the peak period travel lanes (off-peak parking lanes) are removed. Dedicated left turn lanes are provided at the intersection. The removal of traffic and parking lanes may have impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design. The existing lane configurations on Island Park Drive are maintained, although the roadway width is narrowed north and south of the intersection.

Turning Radii Accommodated

As an arterial-federal intersection with trucks prohibited on Island Park Drive and no transit turning movements, the assumed effective turning radius is 9 m on all corners. Heavy vehicles turn at this intersection at very low rates, between 0 and 4 per day.

Suggested Traffic Changes (signals, operations)

It is proposed that the existing two-phase operation of the intersection be maintained. Fully prohibited right-on-red is recommended for all right turn movements to reduce conflict points and improve safety for pedestrians and cyclists. In conjunction with the concept design, a lower posted speed limit of 40 km/h is recommended for Richmond Road, which may require design changes to the corridor to accommodate this speed.

Additional Considerations

- The conversion from four lanes to three on Richmond Road could improve safety for all road users, including motorists. The current configuration is observed to encourage sudden lane changes as motorists change lanes to bypass left-turning queued vehicles. This contributes to side-swipe collisions involving motorists and cyclists.
- The bidirectional neighbourhood connection to the NE may create demand for southbound cyclists to cross on the east leg. However, this demand is expected to be very low, as SBL cyclists will likely choose to travel east through local streets rather than detouring west to reach this intersection. A demand study should be conducted at functional design
- Impacts to existing vegetation should be considered at functional design

Cost Estimate

The concept design has an estimate cost (Class D) of $1,010,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(18) King Edward Avenue and Sussex Drive

Context

This intersection was selected based its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). King Edward Avenue and Sussex Drive is a signalized intersection with protected/permissive left turn WB phase. There is a WBR restriction, NB through restriction and EBL restriction from Monday to Friday 3-6 PM. The surrounding land use is institutional and recreational. The north leg of the intersection is the driveway to the National Research Council Canada building. The Global Affairs Canada Pearson Building is southwest of the intersection and the Diefenbaker Building is southeast, on Green Island. The adjacent sites on the Ottawa and Rideau rivers are popular tourist destinations. There are many nearby embassies. King Edward Avenue SB has access to the Macdonald-Cartier Bridge to Quebec. There are multiple pathways near the intersection.

Overview of Existing Intersection Characteristics

Characteristic	King Edward Avenue	Sussex Drive
Road Classification	Arterial	Arterial
Speed Limit	40 km/h	60 km/h
Truck Route	Yes	West of King Edward
Transit	None	Route 9, WB near side, EB far side
Emergency Route	Yes	Yes
Cycling Facilities	MUP on east side	Bike Lane, floating lane approach EB
Pedestrian Facilities	Sidewalk on west side, MUP on east side	Sidewalks both sides
Configuration	NB left, through/right lane SB left, through/right lane	EB two through, right turn lane WB left, two through lanes

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	King Edward Avenue	Sussex Drive
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Major Pathway on east side	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Collision History

There have been 55 reported collisions at this intersection from 2009 to 2018. Nine collisions resulted in non-fatal injuries, with the remainder resulting in property damage. No reported collisions involved a pedestrian. Two collisions involved a person cycling, both resulting in non-fatal injuries. In both collisions, the cyclist was making an EB through movement, and was hit by a WB left turning car. Both collisions occurred during the day in clear, dry conditions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in May 2017. No major physical changes have occurred since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	18-May-2017
Time Period	7AM-6PM
Vehicles	18097
% Trucks/Buses	2%
% Bicycles (on-road)	4%
Bicycles (on-road)	647
Pedestrians	937

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Significantly higher vehicles (light and heavy) and cyclist volumes for E-W movements
- Majority of NB vehicles turn east or west (driveway ahead), significant volume of WB vehicles turn left and EB turn right
- High peak turns at WB left and EB right
- High bicycle volumes, 4% of total vehicles, but particularly >10% of WB and NB through and SB and NB left
- Most northbound and southbound bicyclists turn, with >90% of NB cyclists turning left
- Almost all EB and WB cyclists are moving through the intersection, with 5% EB turning right
- Overall low volume of trucks at 2%, higher percentage of heavy vehicles at NB through and NB right
- Bus volumes E-W every 30 minutes in each direction
- Moderate pedestrian volumes, majority at south leg (60%)

Site Visit Notes

A site visit was conducted at this intersection on October 31, 2019 at 7:20 AM. The following observations are noted:

- Observed cycle times total 80 seconds, P1: N-S [King Edward] (30s), P2: WBL, WBT (20s), P3: E-W [Sussex] (30s)
- Overly large intersection; large radius right turns
- Painted bike lanes with flex posts on Sussex
- Green painted “floating” lane EB on Sussex
- MUP on east side of King Edward but meets 25m SE of intersection
- North leg is NRC access
- WB near side bus stop on Sussex
- Construction at 125 Sussex is blocking full extent of EB right lane--normally this lane starts 150m further west with that additional length intended for busses only, with bike lane floating between bus lane and general purpose lanes
- Heavy E-W and EBR traffic; very light NB traffic
- Vehicles block floating bike lane while queuing for EBR onto King Edward
- No cyclists observed but weather very rainy

Looking SW at intersection. The EB floating bike lane on the W approach can be seen (Google Streetview)

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Vehicles blocking floating bike lane when turning EBR
- Many vehicles enter bus lane prior to start of right turn lane, creating potential for conflicts with cyclists and other vehicles
- Uncomfortable for cyclists in long floating bike lane
- E-W cyclists have potential for conflicts with WBLT
- NB bikes cannot turn left comfortably

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on Sussex Drive, and a bidirectional cycle track on the east side of King Edward Avenue, extending through the intersection. The existing bridge east of the intersection imposes a cross-sectional constraint on the east leg, but this is assumed to be beyond the scope of the intersection design.

The proposed design is a protected intersection, with a smart channel on the SW corner (note that Sussex is assumed to be the east-west roadway). Protected corners are proposed on the NE, SE, and NW corners. The smart channel on the SW corner is proposed in order to accommodate the very high EBR turn volume during peak hours (762 during PM peak)

The existing eastbound far-side transit stop is accommodated in the proposed design as an island platform stop.

Changes to Configuration

The existing lane configurations are maintained on the east, south, and west legs of the intersection. The southbound left turn lane from the driveway is removed. The eastbound right turn lane is replaced with a smart channel with a raised crossing to improve vehicle operation encouraging yielding to pedestrians and cyclists.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles make right turns at this intersection at low to high rates:

- 18 heavy vehicles per day for NBR movement
- 111 heavy vehicles per day for EBR movement
- 0 heavy vehicles per day for SBR movement
- 1 heavy vehicles per day for WBR movement

The high volume EBR movement for heavy vehicles is accommodated with the smart channel design. The minimum physical radius of 5 m is provided on the NE and NW corners in response to the very low volume of heavy turning vehicles here. A physical radius of 12 m is provided on the SE corner to create an effective radius of 15 m for the NBR movement.

A truck apron is proposed on the SW corner to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing signal phasing operation of the intersection be maintained. Fully prohibited right-on-red is recommended for the NBR and WBR movements to reduce conflict points and improve safety for pedestrians and cyclists.

The SBL is very low volume, carrying just 55 vehicles all day. It is proposed that this movement be fully prohibited, requiring SBL traffic to detour to the nearest signalized intersection 175 m to the west or use the roundabout at Union Street and King Edward Avenue. This mitigates the need for a fully protected movement, which would be required in conjunction with the bidirectional crossride on the east leg.

Additional Considerations

- While the SBL is proposed as prohibited at this intersection, it is possible to accommodate the movement by providing a fully protected phase for this movement, as required due to the presence of a conflicting bidirectional cycling facility crossing (a current requirement of the City of Ottawa). This would require an additional phase to the operation of the intersection, which would likely impact the intersection's capacity. This should be investigated at the functional design stage.
    - Alternatively, a permissive left may be acceptable; the *MassDOT Separated Bike Lane Planning & Design Guide (2015)* suggests a threshold for protecting a left turn across a bidirectional cycling facility and one lane of traffic of 50 vehicles during peak hour. For the SBL

movement, the peak hour turn volume is only 12 vehicles per hour, well below the threshold

Cost Estimate

The concept design has an estimate cost (Class D) of $1,130,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule A+ will be required.

(19) King Edward Avenue and St Patrick Street

Context

This intersection was selected based its collision history. King Edward Avenue and St Patrick Street is a signalized intersection with a protected WBR phase. St Patrick is one-way WB. The surrounding land use includes medium-density residential and commercial uses. The ByWard Market is to the southwest of the intersection. There are also many nearby hotels.

Overview of Existing Intersection Characteristics

Characteristic	King Edward Avenue	St Patrick Street
Road Classification	Arterial	Arterial
Speed Limit	40 km/h	50 km/h
Truck Route	Yes	West of King Edward
Transit	Route 56, stops near side set back from intersection	Route 6, no stops near intersection
Emergency Route	Yes	Yes
Cycling Facilities	Shared Lane	Bike Lane, floating lane approach
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB three through SB two queue for left, two through, reserved bus/bike lane (peak)	WB two through, two right turn lanes with channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	King Edward Avenue	St Patrick Street
Affordable Cycling Project List	Not listed	West of King Edward listed as P1-35
Ultimate Cycling Network	No	Spine Route
Cross-Town Bikeway	Not listed	Not listed

King Edward Avenue is a Transit Priority Corridor and Traditional Mainstreet and St. Patrick Street is a Transit Priority Corridor in the Official Plan.

Collision History

There have been 152 reported collisions at this intersection from 2009 to 2018. Twenty-two collisions resulted in non-fatal injuries, and one resulted in fatal injuries, with the remainder resulting in property damage. Three reported collisions involved a pedestrian. Five collisions involved a cyclist. All collisions occurred during the day in clear, dry conditions. Four of the collisions resulted in non-fatal injuries. In four of the collisions, the cyclist was WB, but the manoeuvre, other vehicle movement and impact type varied.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in May 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	9-May-2016
Time Period	7AM-6PM
Vehicles	24692
% Trucks/Buses	8%
% Bicycles (on-road)	0%
Bicycles (on-road)	86
Pedestrians	755

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Higher N-S vehicle volumes (63%), higher WB volumes for cyclists (76%)
- Dominant vehicle movements are SB and NB through as well as WB right
- Majority of WB vehicles turn (73%, largely right)
- High peak hour turns at WB right and left - all other turns except SB right are prohibited
- High percentage of heavy vehicles at N-S through movements
- WB buses every 15 minutes, N-S busses less frequent
- Low-moderate pedestrian volumes, west leg is dominant (45%)
- Note: Significant number of EB through cyclists even though St Patrick is one-way WB

Site Visit Notes

A site visit was conducted at this intersection on October 30, 2019 at 5:30 PM. The following observations are noted:

- Observed cycle times total 100 seconds, P1: WB (35s), P2: N-S (50s), P3: SB, WBR (15s)
- WB green painted floating bike lane b/w two right turn lanes and through lanes
- Three NB and three SB general purpose lanes on King Edward (one SB lane is bus/bike in peak hours)
- SB bus stop (STO) near side
- 40km/h speed limit on King Edward
- Very heavy NB and WBR traffic; medium SB and WB traffic
- Very few bikes (one observed SB), though rain present
- Several STO buses on King Edward and turning WB onto St. Patrick
- WB vehicles cross green floating bike lane when WBR signal is green; block green floating bike lane when WBR signal red

Left: View from WB bike lane across King Edward

Below: SB lanes, with two left turn, time reserved bus and bike lane signage

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Vehicles queueing where floating bike lane begins—potential conflict for WB cyclists
- SB vehicle right turns could conflict with through bike movements as this is a shared bike/bus lane
- Length of floating bike on St. Patrick presents higher conflict potential and low comfort level
- Uncomfortable for cyclists SB in bus/bike lane

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on King Edward, and a westbound unidirectional cycle track on the north side of St Patrick.

The proposed design includes a combination of design strategies. Protected corners are provided on the NW and SW, and SE corners. On the NE corner, cyclists cross the dual right turn lanes to the corner island at a signalized crossing with pedestrians, with space being provided on the island for pedestrian and cyclist movements.

The existing northbound nearside transit stop is accommodated in the proposed design as an island platform stop. The existing southbound transit stop is located north of the intersection and is considered beyond the scope of the intersection design.

Changes to Configuration

The proposed design maintains the same lane configuration westbound on St. Patrick, but moves the on-street bike lane into the boulevard as a cycle track, which eliminates the 150 m long "floating" bike lane between the through and right turning lanes. West of the intersection, one on-street parking lane is removed on St. Patrick to accommodate the proposed cycle track. On King Edward, the existing southbound peak bus/bike (off-peak parking) lane and one northbound general traffic lane are removed to accommodate the proposed cycle tracks. Removal of lanes may have impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles make right turns at this intersection at moderate to high rates:

- 250 heavy vehicles per day for SBR movement
- 69 heavy vehicles per day for WBR movement

The desired effective radius is provided for both movements. For the SBR movement, heavy vehicles are expected to turn into the outer westbound lane to achieve the 15 m effective radius.

A truck apron is proposed on the NW corner to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing operation of the intersection be maintained. It is proposed to prohibit right-on-red at all time periods for the SBR movement to reduce conflict points and improve safety for pedestrians and cyclists.

Additional Considerations

- The removal of the travel lanes on King Edward could significantly affect operational performance of the intersection for vehicles. A broader network analysis and strategy is required to support this intervention and should be considered in more detail at the functional design stage
- The proposed cycle track treatment on St. Patrick can still function as a standalone design intervention if cycle tracks on King Edward are determined to be infeasible.
- Bicycle storage on the island will be reviewed at functional design

Cost Estimate

The concept design has an estimate cost (Class D) of $1,120,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(20) Laurier Avenue and King Edward Avenue

Context

This intersection was selected based on the intersection characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Laurier Avenue and King Edward Avenue is a signalized intersection with a protected-permissive EBR phase. There is an EBL restriction implemented in early 2019. There is a WBL, SB RTOR and EB RTOR restriction from 7 AM – 7 PM. The land use around the intersection is mixed-use, and adjacent to the University of Ottawa campus. Fire Station No. 13 is located on the northwest corner of the intersection. The Angolan Embassy is located on the northeast corner.

Overview of Existing Intersection Characteristics

Characteristic	Laurier Avenue	King Edward Avenue
Road Classification	Arterial west of King Edward, major collector east of King Edward	Arterial
Speed Limit	50 km/h	40 km/h
Truck Route	No	No
Transit	Route 19, WB nearside stop	Route 56
Emergency Route	Yes	Yes
Cycling Facilities	None	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB through, right WB through lane	NB left, through SB left. through, right

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Laurier Avenue	King Edward Avenue
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Local Route	None
Cross-Town Bikeway	Not listed	Not listed

Collision History

There have been 134 reported collisions at this intersection from 2009 to 2018. Thirty-six resulted in non-fatal injuries, and the remainder only resulted in property damage.

Seven collisions involved a person cycling. One cyclist involved collision occurred during rain at night, and two others occurred early in the morning in dry conditions. The rest occurred in dry, clear conditions during the day. All collisions led to non-fatal injuries except for one which resulted in only property damage. Six of the 7 collisions occurred with cyclists making through movement and being hit by a turning vehicle, but there was no prevalent pattern with the cyclist direction of travel or the vehicle direction of travel.

Twelve collisions involved pedestrians, four of which occurred in wet conditions, while the remainder occurred during dry conditions. Three of the collisions occurred at night. One collision resulted in only property damage, while the remainder resulted in non-fatal injuries. The most common vehicle movements that resulted in collisions are EBL and SBL, which both had four collisions. There have been two collisions that involved two pedestrians, one from an EBL and one from a NBL. Four collisions involved NB vehicles with a split between movements. Only one collision involved a WB vehicle.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in August 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	3-Aug-2016
Time Period	7AM-6PM
Vehicles	14601
% Trucks/Buses	5%
% Bicycles (on-road)	7%
Bicycles (on-road)	981
Pedestrians	3862

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Motor vehicle traffic slightly higher N-S (61%), while bicycle traffic is almost exclusively E-W (94%)
- NBL and EBR are moderate-high volume turning movements
- Bicycles account for 7% of vehicle traffic
- Minimal bicycle turning movements, nearly all bicycle traffic is E-W through
- Buses/trucks account for 5% of vehicle volumes
- Highest bus/truck movements are EBR and NBL and account for 22-25% of all vehicles making these movements (a notable proportion of which are likely buses)
- High volume of pedestrians, mostly crossing N and S legs

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 5:30 PM. The following observations are noted:

- Observed cycle times total 80 seconds, P1: E-W = 31s, P2: NBT, NBL, EBR = 17s, P3: N-S = 31s
- High driver workload at intersection, lots of signals and signs
- NW and NE corners constrained
- Generally slow speeds
- Heavy pedestrian volumes
- N and S approaches backed up
- Minimal bicycle traffic

The intersection has high pedestrian and vehicle volumes

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- E-W bicycle through movements have the potential to conflict with turning vehicles, especially EBR heavy vehicles
- Painted buffer at curb on eastbound approach makes it attractive for cyclists to sneak up on right side, creating a potential hazard

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. Buildings are present on all corners but are not built to the property line.

The proposed design is a dedicated intersection with adjacent crossings, as there is insufficient space for a fully protected intersection. Bicycle stop bars are placed 2 m ahead of vehicle stop bars, and left turning cyclists are accommodated with turn boxes on all corners.

The existing westbound and northbound transit stops are accommodated on the near sides of the intersection, both with landing zones.

Changes to Configuration

The proposed design includes the removal of the SBR and EBR turn lanes due to limited space. Removal of lanes may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design. Seven metre "pinch points" are created on the east and west legs of the intersection on the approaches as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-arterial-collector intersection, the desired effective turning radius is 15 m for the NW and SW corners and 12 m for the NE and SE corners. Heavy vehicles turn at this intersection at low to high rates:

- 16 heavy vehicles per day for NBR movement
- 191 heavy vehicles per day for EBR movement
- 16 heavy vehicles per day for SBR movement
- 5 heavy vehicles per day for WBR movement

The counts analyzed were taken in August 2016. At that time, the EBR movement was part of the temporary OC Transpo Transitway during the Confederation LRT construction. As of Fall 2019, the volume of buses making this movement has significantly decreased to one bus (Route 16) every 30 minutes all-day, plus overnight bus routes, and occasional light rail replacement service.

Given the relatively low volume of heavy vehicles making the SBR movement, an effective radius of 12 m is proposed rather than 15 m. The desired effective turning radius is provided at the other corners.

Truck aprons are proposed on all corners to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

Suggested Traffic Changes

The proposed operation of the intersection is for three phases, including a lagging protected-permissive phase for NBL and SBL during peak periods. Leading bicycle and pedestrian intervals are recommended on all legs to improve visibility of vulnerable road users. The existing EBL restriction is proposed to be maintained. Fully prohibited right-on-red is recommended for all right turn movements to reduce conflict points and improve safety for pedestrians and cyclists.

Additional Considerations

- Consultation with emergency services is required at functional design due to the proximity to a fire station

Cost Estimate

The concept design has an estimate cost (Class D) of $671,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(21) Montréal Road and Aviation Parkway

Context

This intersection was selected based its characteristics. Montréal Road and Aviation Parkway is a signalized intersection with left turn protected phases for all directions. All right turn movements have a right turn channel. The surrounding land use varies with residential, commercial, and institutional uses. Montfort Hospital is located on the northeast corner of the intersection, with access from both Aviation Parkway and Montréal Road. The Canadian Mortgage and Housing Corporation offices are located on the southeast corner.

Overview of Existing Intersection Characteristics

Characteristic	Montréal Road	Aviation Parkway
Road Classification	Arterial	Federally Owned Road
Speed Limit	60 km/h	60 km/h
Truck Route	Yes	No
Transit	Route 12, 15, 20, stops near side set back from intersection	Route 25 (Occasional Service)
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane	MUP on west side
Pedestrian Facilities	Sidewalks both sides	MUP on west side only
Configuration	EB left, two through, right channel WB left, two through, right channel	NB left, through, right channel SB left, through, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Montréal Road	Aviation Parkway
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Major Pathway on west side
Cross-Town Bikeway	Not listed	Not listed

Montreal Road is a Transit Priority Corridor and Arterial Mainstreet in the Official Plan.

The City's Transportation Planning department is working on the Montréal -Blair Road Transit Priority Corridor EA that will result in a functional design for the corridor with ultimate design configurations.

Collision History

There have been 183 reported collisions at this intersection in the past 10 year. Fifty collisions resulted in non-fatal injuries, with the remainder resulting in property damage. Three reported collisions involved a pedestrian. One collision involved a person cycling. The collision occurred during the day in clear, dry conditions. The collision resulted in non-fatal injuries. The cyclist was heading SB making a left turn movement, and was hit by a NB vehicle going though the intersection.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in January 2018. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	25-Jan-2018
Time Period	7AM-6PM
Vehicles	24742
% Trucks/Buses	3%
% Bicycles (on-road)	0%
Bicycles (on-road)	4
Pedestrians	584

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle volumes higher E-W (73%)
- Significant volume of vehicles turning right WB, NB and EB
- High peak turn volumes at all turns except SB right and EB left
- July 2014 bicycle counts (without turn data) show WB, NB, and EB at about 100 cyclists each
- Low % of heavy vehicles (3%), higher at WB through (5%)
- Most SB heavy vehicles (90%) turn left
- E-W bus routes with frequent service
- Low-moderate ped volumes, majority at north (41%) and south (39%) legs

Site Visit Notes

A site visit was conducted at this intersection on October 29, 2019 at 5:30 PM. The following observations are noted:

- Observed cycle times total 95 seconds, P1: NBL, SBL (10s), P2: N-S (30s), P3: EBL, WBL (15s), P4: E-W (40s)
- Left turn lanes on all directions; Right turn channels all corners
- Hydro pole on northeast island
- No sidewalk on Aviation (MUP on west side)
- Painted bike lanes on Montréal
- Heavy EW traffic, especially eastbound (during afternoon peak)
- Medium-heavy NBL and SBLs
- Some bikes observed crossing intersection to access MUP

Vehicles queuing for NB left turn

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Long pedestrian crossings are not comfortable for pedestrians
- Floating bike lanes are not comfortable for cyclists
- Cyclists cannot ride through intersection from MUP, which is uncomfortable for cyclists
- Inappropriate volumes and posted speeds for mixed-traffic cycling, according to TAC Geometric Design Guidelines
- Right turning channels have wide radii, which could lead to excessive speeds and potential conflict points for cyclists and pedestrians

Concept Design

A concept design was not completed for this intersection as designs will be included in the Montreal Road Transit Priority Corridor Planning and Environmental Assessment study, which covers this intersection.

(22) Moodie Drive and Robertson Road

Context

This intersection was selected based on feedback from consultation. Moodie Drive and Robertson Road is a signalized intersection with left turn protected phases for all directions. The NB and SB have double left turn lanes. All right turn movements have a right turn channel. The surrounding land uses are a variety of residential and commercial uses. Commercial uses are primarily north on Moodie, and both directions on Robertson. Residential uses are set back south and east from the intersection. Bells Corners Public School is east of the intersection at Robertson Road and Old Richmond Road.

Overview of Existing Intersection Characteristics

		Robertson Road
Road Classification	Arterial	Arterial
Speed Limit	60 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 57, 58, 252, 256, stops set back from intersection	Route 88, 252, 256, stops set back from intersection
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB two left, two through, right channel SB two left, two through, right channel	EB left, two through, bus through, right channel WB left, two through, bus through, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

		Robertson Road
Affordable Cycling Project List	Not listed	East - listed as P2-4 – Segregated Bike Facility
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Not listed	Yes, Route 2

Robertson Road is a Transit Priority Corridor and an Arterial Mainstreet in the Official Plan.

Collision History

There have been 125 reported collisions at this intersection from 2009 to 2018. Twenty-five collisions resulted in non-fatal injuries, with the remainder resulting in property damage. Two reported collisions involved a pedestrian. No collisions involved a person cycling.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in March 2016. No major physical changes have occurred since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	8-Mar-2016
Time Period	7AM-6PM
Vehicles	26417
% Trucks/Buses	3%
% Bicycles (on-road)	0%
Bicycles (on-road)	3
Pedestrians	443

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Slightly higher E-W volumes (59%) for light vehicles, heavy vehicles balanced in all directions
- Over 60% of NB and SB vehicles turn. High overall volume of SB left turns and NB right and left turns
- High peak hour turns in PM peak at all movements
- Higher cyclist volumes in June 2014 (99) with higher volumes E-W
- E-W bus route (4/hr/direction)
- Low pedestrian volumes - balanced at all intersection legs

Site Visit Notes

A site visit was conducted at this intersection on October 28, 2019 at 12:00 PM. The following observations are noted:

- Observed cycle times total 130 seconds, 4 phases, fully protected lefts. E-W pedestrian phase pre-timed. N-S pedestrian phase fully actuated
- Right turn channels on every corner
- All right turn channels appear to be “smart channel” design
- All turn channel islands are quite small
- N-S hydro line running on east side
- Lots of trucks
- Lots of peds at lunch hour crossing intersection

Pedestrians crossing the intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- N/S floating bike lanes are very long - 130 m on north leg, 95 m which could be uncomfortable for cyclists
- Potential for turning conflicts as right turning vehicles must cross bike lane
- Inappropriate posted speed limit for on-street bike lanes, according to TAC Geometric Design Guidelines

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on both Moodie Drive and Robertson Road. Due to the high posted speed and volumes, and generous boulevards, cycle tracks are proposed as 2.0 m wide, separated from the roadway by a 1.5 m buffer. The proposed solution is a fully-protected intersection.

As right turn volumes on all legs exceed 150 vehicles during peak hour, fully protected right turns are proposed on all legs, to fully separate all turning conflict points between vehicles, cyclists and pedestrians. This includes the removal of all right turn channels and associated acceleration lanes. An alternative design is provided showing the footprint of smart channels, which improve the operational performance for right-turn movements, reduce signal infrastructure requirements, and shorten pedestrian and cyclist crossing distances. Smart channels require a larger amount of space to construct and require yield-controlled rather than fully-protected crossings for pedestrians and cyclists.

The existing far-side transit stops on Robertson Road are accommodated as island platform stops.

Changes to Configuration

Existing through and turn lanes are maintained. Existing right turn channels are converted to adjacent turn lanes, and acceleration lanes are removed.

The proposed configuration increases the pedestrian crossing distances by approx. 2 m on the south and north legs.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at moderate rates, between 35 and 43 heavy vehicles per day. A physical radius of 15 m is provided at all corners to easily facilitate heavy vehicle movements on all legs. Truck aprons are not necessary to reduce turning speeds, as right turning vehicles are signal-separated from cyclists and pedestrians.

Suggested Traffic Changes

The existing four-phase operation of the intersection can be maintained by operating the fully protected right turn movements in conjunction with dual left movements (e.g. WBR and EBR would operate in conjunction with NBL and SBL). Fully prohibited right-on-red is required as a condition of the fully protected turns.

Additional Considerations

- The northbound and southbound vehicle peak hour though volumes are relatively low (176-433 vehicles), and may not warrant the presence of two through lanes north-south
- The outer east-west through lanes operate as transit queue-jump lanes in the existing condition. In the proposed design, the outer through lanes could be repurposed as transit-only lanes

Cost Estimate

The concept design has an estimate cost (Class D) of $1,150,000 for the base option, and $1,330,000 for the option with smart channels. Property will be required to implement the smart channel concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule A+ will be required.

(23) Nelson Street and Rideau Street

Context

This intersection was selected based on its collision history. Nelson Street and Rideau Street is a signalized intersection with an EB left turn protected phase. Nelson Street is fully closed to through car traffic one block south of the intersection. The surrounding land use is medium- to high-density residential and commercial uses including a grocery store on the NE corner.

Overview of Existing Intersection Characteristics

Characteristic	Nelson Street	Rideau Street
Road Classification	Local	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	No	Yes
Transit	None	Route 7, 12, 14, 15, 17, 18, stops near side
Emergency Route	No	Yes
Cycling Facilities	None	Shared bike/bus lane during peak hours
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB through, SB through	EB left, through, bus/bike only/right WB left, through, bus/bike only/right turn

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Nelson Street	Rideau Street
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	No	No
Cross-Town Bikeway	Not listed	Not listed

Rideau Street is a Transit Priority Corridor and Traditional Mainstreet in the Official Plan.

Collision History

There have been 50 reported collisions at this intersection in the past 10 years. Seventeen collisions resulted in non-fatal injuries, with the remainder resulting in property damage. Ten reported collisions involved a pedestrian. Six collisions involved a person cycling. All of these collisions occurred in clear, dry conditions during the day, except for one which occurred at night. Five of the collisions resulted in non-fatal injuries. All cyclists were making through movements, but there is no prevailing trend in the direction of travel or with the other vehicle involved in the collision. Of the pedestrian collisions, four involved a westbound right-turning vehicle failing to yield right-of-way to a pedestrian and three occurred where a pedestrian was crossing without the right-of-way.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in December 2015. No physical changes have occurred since.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	1-Dec-2015
Time Period	7AM-6PM
Vehicles	8124
% Trucks/Buses	7%
% Bicycles (on-road)	1%
Bicycles (on-road)	48
Pedestrians	5900

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Significantly higher vehicle volumes E-W (87%), slightly higher E-W volumes of cyclists (60%)
- Almost all SB vehicles turn left or right, similarly, almost all NB vehicles turn (87%), note: no exit south on Nelson.
- Higher peak hour turns at EB left and SB left and WB right
- Significant bike volumes for December (48), high percentage of NB and SB through (20% and 38%). Higher volumes in June 2011 (157)
- Higher truck volumes at 7%, 9-10% of WB and EB through, high total volume of turns SB right and EB left
- E-W high frequency bus routes (15/hr each direction)
- Very high pedestrian volumes, with pedestrian crossings 70% of total volumes. High on all legs but most on north (39%)

Site Visit Notes

A site visit was conducted at this intersection on October 30, 2019 at 6:50 PM. The following observations are noted:

- Observed cycle times total 65 seconds, N-S = 20s, E-W = 45s
- Two general purpose lanes each direction, centre left turn lane on Rideau. Peak hour curb bus lanes on Rideau
- One general purpose lane each direction on Nelson
- Nelson is cul-de-sac south of Rideau
- Near side bus stops on Rideau (several frequent routes)
- High pedestrian volumes
- Common pedestrian and cyclists crossing N-S on red signal
- EBL vehicles start turn without looking for peds or bikes then stop midway through turn to let peds/bikes proceed
- Some trucks present, likely for loading at grocery store on NE corner (loading bay on Nelson)

EB bus stopped near side

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- E-W through bicycles conflicting with vehicle turning movements according to collision data, which possibly originates from cut-through traffic
- Uncomfortable for cyclists on Nelson Street and Rideau Street as there are no dedicated cycling facilities

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on Rideau Street and mixed traffic on Nelson Street. The intersection is located in a dense urban area and buildings are present on all corners, although parking lots on the NW and SW corners provide some opportunity for widening to accommodate the design.

The proposed design includes a combination of treatments.

- On the south leg, eastbound cyclists cross at an adjacent crossing, which is considered acceptable due to the physical space constraints on the SE corner as well as the very low volume of EBR vehicles conflicting with the through cycling movement (61 vehicles all day). EBL cyclists are accommodated with a two-stage turn box
- On the north leg, a five-metre set back crossing with pedestrian refuge is provided for the westbound cycle track, where the conflicting WBR vehicle volumes are higher (692 per day). Bicycle right-turn channels are also provided on the north leg, allowing WBR and SBR bicycles to turn without using the signal
- On the northbound approach, where existing lanes are narrow and vehicle volumes are very low (160 per day), cyclists are expected to approach and queue in mixed traffic
- On the southbound approach, minor widening to the property line is proposed to provide cyclists the opportunity to bypass vehicles

The proposed design improves upon the skew of the west leg crosswalk, but keeps the east crosswalk skew because any further offset from the SE corner would place pedestrians out of sight of NBR turning drivers. The proposed design also slightly improves the north-south horizontal offset of the intersection, although it is still present.

The eastbound near-side transit stop is relocated as a far-side stop, and has a 1.2 m landing zone due to physical constraints. The existing westbound near-side stop will remain in its present position as it serves the community well. It will have a 1.2 m landing zone due to physical constraints.

Changes to Configuration

The existing EB and WB turn lanes are removed due to low volumes and to accommodate the proposed cycle tracks at the intersection. The wide curb lanes, which function as transit lanes in the peak-hour and parking lanes during off peak, are narrowed to the 3.5 m minimum width, and the centre lanes are narrowed to the 3.25 m minimum width. The centre lanes will accommodate all through traffic during off-peak hours. However, since parked vehicles will not use the full width of the curb lane the remaining additional space will act as effective centre lane width.

Turning Radii Accommodated

As an arterial-local intersection, the desired effective turning radius is 9 m. Heavy vehicles turn at this intersection at low to moderate rates:

- 2 heavy vehicles per day for NBR movement
- 2 heavy vehicles per day for EBR movement
- 23 heavy vehicles per day for SBR movement
- 13 heavy vehicles per day for WBR movement

The desired effective radius is provided on all corners. For the NBR and SBR movements, it is assumed the effective radius is achieved by vehicles turning into the inner WB and EB lanes, allowing for lower corner physical radii to be used on the NW and SE corners.

Suggested Traffic Changes

It is proposed that the intersection operate in a basic two-phase operation. WBL and EBL movements are proposed as prohibited during AM and PM peak periods to improve intersection operation and prioritize vehicle and transit through movements. Fully prohibited right-on-red is recommended for all right turn movements to reduce conflict points and improve safety for pedestrians and cyclists, and is required for the NBR movement in conjunction with the proposed two-stage turn box.

Due to the skew of the intersection, it is recommended that the NB and SB through movements be prohibited, with bicycles excepted. These movements are very low-volume (10 and 21 vehicles per day, respectively), so operational impacts are expected to be minimal.

Additional Considerations

- The transit lanes have been designed to accommodate off-peak parking by providing a minimum of 0.7 m buffer between the cycle tracks and the roadway. If the transit lanes are intended to operate as transit-exclusive all-day, the buffer can be reduced to 0.5 m
- The proposed design has been developed for the intersection only, with mid-block cross-sections not considered. It is recommended that this design not be implemented in isolation of a continuous bicycle facility on Rideau Street.

Cost Estimate

The concept design has an estimate cost (Class D) of $621,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(24) Preston Street and Prince of Wales Drive

Context

This intersection was selected based on the characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history of the intersection. The intersection is signal controlled with an EBL/SBR protected-permissive phase. There is also a channel for WBR movements. The land to the northwest of the intersection is included in the plans for the new Ottawa Civic Hospital campus that is planned to open 2026. Commissioners Park on the northeast corner is a main site of the Tulip Festival. To the south of the intersection is HMCS Carleton, Dow's Lake Pavilion, Dow's Lake, and the Arboretum. The Rideau Canal Pathway runs along the south side of Queen Elizabeth Driveway, and south through the Arboretum. The Trillium Pathway adjacent to O-Train Line 2 terminates at the northwest corner of the intersection, but also has a crossing option west of the intersection onto the pathway off of Navy Private.

Overview of Existing Intersection Characteristics

Characteristic	Preston Street	Prince of Wales Drive	Queen Elizabeth Driveway
Road Classification	Arterial	Arterial	Federally Owned Roadway
Speed Limit	50 km/h	60 km/h	40 km/h
Truck Route	Yes	Yes	No
Transit	No	Route 88 – Occasional service	No
Emergency Route	Yes	Yes	Yes
Cycling Facilities	None	MUP on north side, Bike Lanes	MUP on south side
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides	MUP and boardwalk on south side
Configuration	SB left/through, right	EB left, general	WB left, general, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Preston Street	Prince of Wales Drive	Queen Elizabeth Driveway
Affordable Cycling Project List	Not listed	Not listed	Not listed
Ultimate Cycling Network	Local Route	Spine Route	Not listed
Cross-Town Bikeway	Trillium Pathway west of Preston is Cross-Town Bikeway 6	Yes, west from Trillium Pathway is part of Cross-Town Bikeway 6	Not listed

Queen Elizabeth Driveway is a Federal Roadway and thus is under the jurisdiction of the NCC.

Collision History

There have been 45 reported collisions at this intersection from 2009 to 2018. Twelve resulted in non-fatal injuries, 2 collisions were non-reportable, and the remainder resulted in only property damage. There has been one collision involving a pedestrian. Five collisions involved a person cycling. All collisions occurred in clear, dry conditions during the day. Two of the collisions led to non-fatal injuries. Four of the collisions occurred while the cyclist was making a through movement and were considered as angle impacts. Three of these collisions were with EB cyclists and SB vehicles making right turns or going through. Three of the collisions were in a crosswalk.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in January 2018 (*out-of-season for cyclists).

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	10-Jan-2018
Time Period	7AM-6PM
Vehicles	13768
% Trucks/Buses	2%
% Bicycles (on-road)	0%*
Bicycles (on-road)	12*
Pedestrians	1466

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

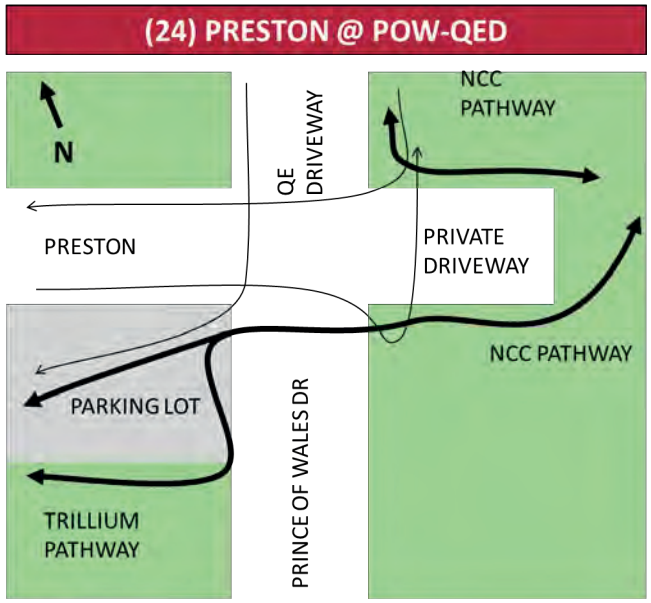
- Very high vehicle turning volumes on all legs except driveway on south leg (SBR, SBL, WBR, EBL)
- Low number of heavy vehicles using intersection (2%), despite Preston and POW being truck routes
- Majority of heavy vehicle movements are EBR and NBL
- All-day volumes are highest on SBR and EBL turning movements (turning between Preston and POW)
- Ped volumes highest on E, S, and W legs
- Very low volumes to and from driveway on south leg
- Three Miovision datasets were provided for this intersection. One set (Aug 6, 2018) is from a Saturday and limited to 5PM-midnight. The second set (Jul 22, 2015) is from 3PM to 11PM and misses the AM peak period. The third set (Jan 10, 2018) contains a full weekday of data but likely underrepresents cyclists due to seasonality. The third set is selected as it is the only one that captures a full weekday of traffic volumes. A site visit was used to confirm bicycle movement patterns at this intersection.
- Site visit confirmed that most bicycles are off-road at this intersection using trails, and crossing in the crosswalk, so bicycles are not accurately represented in on-road data
- Miovision data from Jul 22, 2015 shows that most on-road bicycle movements are to and from the west leg driveway, which provides access to the NCC trail

Site Visit Notes

A site visit was conducted at this intersection on October 9, 2019 at 4:10 PM. The following observations are noted:

- Observed cycle times total 130 seconds, P1: N-S = 50s, P2: EBL, EBT, SBR = 45s, P3: E-W = 35s
    - Preston Street is considered N-S
- Large amount of open space surrounding intersection
- Permissive SB right-on-red leads to potential conflicts between motorists and peds/bikes
- Heavy traffic volumes in all directions, very long queues
- Cyclists mostly cross using crosswalks, especially south crosswalk (due to off-road trail connections), lots of bike/ped/vehicle potential conflicts there
- Very long cycle time causes delays for cyclists and pedestrians
- Most cyclists travel between MUP leg on SE corner and Trillium path, but access to path is split between cutting through parking lot and taking off-road trail along QE driveway (which is approx. 100m longer)

Above, cyclists crossing intersection in crosswalk; below illustration showing cyclist movements



Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Long signal cycle time leads to long delays for pedestrians and cyclists (PLOS D on west leg using City's MMLOS guidelines), and could lead to midblock crossing at the foot of the Trillium Pathway
- Multiple pathways in different directions could be confusing for users or could create conflicts
- Potential for major conflict with SBR vehicle movement on west crossing leg, and corner radius is excessively wide
- Lack of defined space for pedestrians and cyclists at corners

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on Preston, a unidirectional eastbound cycle track on the south side of Prince of Wales, a bidirectional cycle track on the north side of Prince of Wales Drive, plus the existing south side MUP on Queen Elizabeth Driveway, and other trails branching off from the intersection.

The intersection is heavily skewed, which can lead to increased turning speeds and could limit sightlines. For the purposes of this design, the existing roadway alignment is maintained, though this should be reviewed at the functional design stage. There are no other physical constraints that affect the design.

The proposed design is a unique approach involving mixed corners. Pedestrians and cyclists are not separated, but coloured concrete on the inside of each corner is used to encourage cyclists to cross on the inside of the intersection. The proposed operation is a dedicated pedestrian-cyclist phase, timed to provide pedestrians enough time to cross one leg, enabling cyclists to cross up to two legs in a phase.

The mixed approach is a response to the significant number and mix of facility types (trails and cycle tracks) converging on the intersection. In the site visit, it was observed that few cyclists choose to travel through the intersection on-road, instead electing to cross using the pedestrian crosswalks. This design acknowledges and responds to this behaviour. Wide corner areas with minimal visual obstructions create an environment that is more conducive to pedestrians and cyclists mixing.

There are no existing transit stops at this intersection.

Changes to Configuration

The existing WBR turn channel is replaced with a smart channel with a raised crossing. The WBL turn lane is removed due to low volumes (25 vehicles per day), and to create more space for a buffer between the roadway and the south-side trail on QE Driveway. Removal of a turn lane may have impacts on traffic and will need to be reviewed in more detail at functional design.

Turning Radii Accommodated

As an arterial-arterial-federal intersection with a private driveway on the south leg, the desired effective turning radius varies by corner. Heavy vehicles are prohibited on QE Driveway. Heavy vehicles make right turns at this intersection at low to high rates:

- 2 heavy vehicle per day for NBR movement
- 0 heavy vehicles per day for EBR movement
- 96 heavy vehicles per day for SBR movement
- 9 heavy vehicles per day for WBR movement

The desired arterial-arterial effective turning radius of 15 m is provided on the NW corner for the high volume SBR movement. A 15 m effective radius is also provided for the WBR movement. Five metre physical radii are proposed for the driveway entrance due to the very low volumes.

Suggested Traffic Changes

The proposed operation is to maintain the existing vehicle phase configuration, and add a dedicated pedestrian-cyclist phase:

- P1: EBT, EBL, SBR (no ped-cyclist crossings permitted)
- P2: EBT, WBT, EBL (permissive) (no ped-cyclist crossings permitted)
- P3: SBR, SBT, SBL (no ped-cyclist crossings permitted)
- P4: SBR, SBT, NBT (no ped-cyclist crossings permitted)
- P5: Bike-ped only phase; pedestrians and cyclists cross all legs with no vehicle movements permitted

The ped-bike phase would be timed to provide pedestrians enough time to cross one leg, enabling cyclists to cross up to two legs in a phase. This operation addresses the high level of conflict identified in the collision data between high-volume turning movements and vulnerable road users, especially at the NW corner. The ped-bike phase would be subject to further traffic analysis.

Due to low volumes, the WBL lane is removed. WBL is proposed as prohibited, with buses excepted, as it is noted that tour buses access the driveway seasonally.

Fully prohibited right-on-red for the SBR, EBR, and NBR movements is a requirement for the proposed operation of the intersection.

Additional Considerations

- Pedestrian and cyclist delay can be reduced by implementing two bike-ped phases in the overall cycle, by adding another phase between P2 and P3. The impacts of this on the operation of the intersection should be studied at the functional design stage
- The design as proposed can function without the pedestrian-cyclist phase, but allowing turning movements permissively with cyclist and pedestrian crossings exposes vulnerable road users to potential conflicts, especially on the NW corner where the SBR movement is very high-volume.
- This intersection should be considered within the context of the new Civic Hospital campus planned on the adjacent sites. This redevelopment will increase travel volumes through the site but also create broader opportunities to improve pedestrian and cycling connectivity, through measures such as grade separated crossings and improved roadway alignments
- The desired design and control vehicle for the private driveway should be established at the functional design stage, with the SE and SW corner radii adjusted accordingly

Cost Estimate

The concept design has an estimate cost (Class D) of $1,230,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(25) Preston Street and Somerset Street

Context

This intersection was selected based on the characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history of the intersection. The intersection is signal controlled with leading pedestrian intervals for both directions. The surrounding land use is mixed residential and commercial. The Plant Recreation Centre is at the southwest corner of the intersection. Fire Station No. 11 is located south of the intersection at Preston Street and Eccles Street.

Overview of Existing Intersection Characteristics

Characteristic	Preston Street	Somerset Street
Road Classification	Arterial	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	Yes
Transit	Route 85 (frequent), NB and SB near side stops. Shelter at NB stop	Route 11 (frequent), WB far side stop, EB near side stop
Emergency Route	Yes	Yes
Cycling Facilities	None	Suggested Route with bike route signage
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB left, general SB left, general	EB left, general WB left, general

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Preston Street	Somerset Street
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Local Route	Spine Route
Cross-Town Bikeway	Not listed	Not listed

Somerset Street is a Transit Priority Corridor and Traditional Mainstreet and Preston Street is a Traditional Mainstreet in the Official Plan.

Collision History

There have been 46 reported collisions at this intersection from 2009 to 2018. Seventeen resulted in non-fatal injuries, and the remainder resulted in only property damage.

Nine collisions involved a person cycling. All the collision occurred in clear, dry conditions, and all were during the daytime except for 2 which were at night. All of the collisions occurred while the cyclist was making a through movement, 5 WB, and 3 EB, and one SB. Five of the collisions involved vehicle turning movements resulting in the collision with the through cyclist. Of these collisions, 3 involved vehicles making a WBR movement, one from a WBL, and one from a NBL.

There were 5 collisions involving pedestrians, all of which occurred during the day in clear, dry conditions. All of the collision resulted in non-fatal injuries. The vehicle movements of the collisions were split between all the directions, with two SB vehicles. Three of the collisions were right turn movements, and two were left turn movements.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in June 2017. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Jun-2017
Time Period	7AM-6PM
Vehicles	11530
% Trucks/Buses	6%
% Bicycles (on-road)	5%
Bicycles (on-road)	530
Pedestrians	1893

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle volumes balanced E-W and N-S
- Generally low turning volumes during peak periods, NBL is moderate during AM and PM peaks
- Majority of bicycle traffic is E-W through (80%), and bicycles make up 8-10% of vehicle volumes over this movement
- Higher percentage of trucks/buses, most of which travel N-S through
- Trucks/buses account for 9-10% of N-S through vehicles
- Moderate volume of pedestrians, evenly spread across all legs

Site Visit Notes

A site visit was conducted at this intersection on October 23, 2019 at 5:00PM. During the site visit the NW corner and WB lane were closed due to construction, with WB traffic diverted through the EBL lane. The following observations are noted:

- Observed cycle times total 70 seconds, N-S = 35s, E-W = 35s. RTOR restricted at all legs (7AM-7PM Monday-Friday). LPIs on all crossings. Signal exists to allow a protected-permissive NBL, but the phase is only active during firehall signal preemption.
- Only NW corner is constrained physically (building edge)
- EBL lane closed at time of visit due to construction on the west leg of intersection
- Lots of large trucks using intersection, especially Preston
- No vehicle backlogs, despite EBL lane being closed
- Bike movements observed in many directions, most dominant being NBT and SBT (which is contrary to traffic data)
- Most cyclists are not riding on sidewalk
- No speeding issues observed, speeds are fairly low
- Moderate hill directly to east and 150m west of intersection

During the site visit, high truck traffic on Preston was noted. Construction on NW corner can be seen on the left side of the photo

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High volume of through moving cyclists have potential to conflict with turning vehicles.
- Potential for low visibility for cyclists with buildings at street and increased cyclist speeds westbound due to downhill
- High volume of trucks, including turning trucks could create conflicts with pedestrians and cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. There is a building built to the property line on the NW corner, and the other three corners are unconstrained by buildings.

The proposed design includes a combination of treatments. Protected corners with two-stage pedestrian crossings are provided on the NE, SE, and SW corners, and an adjacent crossing is provided on the NW corner due to the existing building constraint. The southbound bicycle stop bar is placed 2 m ahead of the southbound vehicle stop bar, and westbound left turning cyclists are accommodated with a turn box on the NW corner.

The existing transit stops are accommodated in their existing locations. The northbound stop has an island platform, while the eastbound, westbound and southbound stops have 1.2 m landing zones.

Changes to Configuration

To accommodate the proposed cycle tracks on Somerset Street, one lane of on-street parking is removed. Left turn lanes on Somerset Street and Preston Street are also removed. Removal of lanes may have significant impacts on traffic, transit operations, emergency vehicle egress, and parking supply and will need to be reviewed in more detail at functional design.

Seven metre "pinch points" are created on all legs of the intersection on the approaches as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at low to moderate rates:

- 9 heavy vehicle per day for NBR movement
- 58 heavy vehicles per day for EBR movement
- 15 heavy vehicles per day for SBR movement
- 11 heavy vehicles per day for WBR movement

Due to the low volume of heavy vehicles making SBR, WBR, and NBR movements, reduced effective turning radii of 12 m are proposed on the NE, NW, and SE corners. The desired 15 m effective radius is provided on the SW corner to accommodate the higher volume of heavy vehicles making the EBR movement.

Truck aprons are proposed on all corners to encourage slower turning speeds for passenger vehicles, while still accommodating turning heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation of the intersection be maintained. It is recommended to prohibit right-on-red for all time periods for all legs to reduce conflict points and improve safety for pedestrians and cyclists. In conjunction with the concept design, a lower posted speed limit of 40 km/h is recommended for Somerset Street, along with the necessary design changes to the corridor to accommodate this speed.

Left turn movements are low to moderate at this intersection (18 to 84 vehicles peak hour), and therefore turn restrictions are not suggested. However, the impacts of the left turn lane removals should be assessed at the functional design stage.

Additional Considerations

- Due to the lack of constraints on the NE and SE corners, it may be possible to widen the intersection further to accommodate NBL and SBL vehicle turn lanes
- Time-based left turn restrictions may be desirable to maintain the peak period performance of the intersection; this should be assessed at the functional design stage

Cost Estimate

The concept design has an estimate cost (Class D) of $902,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(26) Prince of Wales Drive and Fisher Avenue

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Prince of Wales Drive and Fisher Avenue is a three-leg signalized intersection with a NB left turn protected phase. The SBR and EBR have right turn channels. The surrounding land use is mainly low-density residential, with some commercial. There are a few nearby places of worship.

Overview of Existing Intersection Characteristics

Road Classification	Arterial	Arterial
Speed Limit	60 km/h	50 km/h
Truck Route	South of Fisher	Yes
Transit	None	None
Emergency Route	Yes	Yes
Cycling Facilities	None	Paved Shoulder
Pedestrian Facilities	None	South side only at intersection
Configuration	NB left, through, SB through, right channel	EB left, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Prince of Wales Drive	
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route, Major Pathway on west side	Spine Route
Cross-Town Bikeway	Yes, Route 6	Not listed

Fisher Avenue is a Transit Priority Corridor in the Official Plan.

Collision History

There have been 61 reported collisions at this intersection from 2009 to 2018. Fourteen collisions resulted in non-fatal injuries. No reported collisions involved a pedestrian or a cyclist.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in April 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	6-Apr-2016
Time Period	7AM-6PM
Vehicles	18215
% Trucks/Buses	3%
% Bicycles (on-road)	0%
Bicycles (on-road)	14
Pedestrians	7

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- N-S higher vehicle volumes (78%) and cyclists (86%)
- All EB vehicles turn (t-intersection), with 98% majority turning right. Very high NB left turns.
- Very high peak hour movements for NB left and EB right
- Bicycle volumes predominantly in through movements
- Heavy vehicle volumes low, concentrated in through movement and NB left and EB right

- Paved shoulder on Prince of Wales Drive on both sides
- Pedestrian crossings majority on west leg. No pedestrian crossing on east leg (driveway)

Site Visit Notes

A site visit was conducted at this intersection on October 16, 2019 at 12:10 PM. The following observations are noted:

- Observed cycle times total 80 seconds, P1: EB (actuated), P2: NBT, NBL (actuated), P3: N-S (resting). Cycle time varies based on called movements (max = 80s). NB permissive LT arrow
- Large right turn channels for EBR and SBR movements
- Hydro poles on west side, but not too close to roadway
- No sidewalk on POW or Fisher north side
- SB bike lane through intersection only--cyclists forced to cross EBR acceleration lane
- SB to WB and EB to SB deceleration and acceleration lanes.
- Pedestrian crossing possible on all legs
- Rural cross-section east side POW
- No bus routes or stops
- High posted speeds on POW (60km/h, changes to 50km/h 100m north of intersection)

Pedestrian waiting to cross WB with actuated signal

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- SB cyclists must cross SBRT and EBRT turn channels, which could create conflicts
- NBL is over-capacity and the permissive phase could cause conflicts with SB cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. There are no physical building constraints at the intersection.

The proposed solution is a protected intersection with a smart channel on the SW corner.

There are no existing transit stops at this intersection.

Changes to Configuration

The proposed design includes the removal of the SBR turn channel due to very low volumes (117 all day). The large EBR turn channel is converted to a smart channel to maintain an acceptable capacity while reducing turning speeds and increasing yield rates to pedestrians and cyclists.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m on all corners. Heavy vehicles turn at this intersection at low to high rates:

- 191 heavy vehicles per day for EBR movement
- 5 heavy vehicles per day for SBR movement

The desired effective turn radius is accommodated for the EBR movement with the smart channel design. It is recommended that heavy vehicle turns be prohibited for the SBR movement, based on the low volumes. The proposed design provides a 9 m effective turn radius while directing passenger vehicles through a tighter 5 m turn radius using a truck apron.

Suggested Traffic Changes

It is proposed that the existing phasing of the intersection be maintained. Fully prohibited right-on-red is recommended for the SBR movement to reduce conflict points and improve safety for pedestrians and cyclists.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,000,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(27) Prince of Wales Drive and Meadowlands Drive

Context

This intersection was selected based on its collision history. Prince of Wales Drive and Meadowlands Drive is a signalized intersection with left turn protected phases for all directions. The EBR and WBR have right turn channels. East of the intersection, Meadowlands Drive becomes Hog's Back Road. The surrounding land use is a mix of low- to high-density residential, as well as commercial and recreational uses. Rideauview Mall is on the northwest corner, and Hog's Back Plaza is on the southwest corner. There is a gas station at the northwest corner. East of the intersection is Hog's Back Falls, the Rideau Canal, and Mooney's Bay Park and Beach which hosts many large festivals.

Overview of Existing Intersection Characteristics

Characteristic	Prince of Wales Drive	Meadowlands Drive
Road Classification	Arterial	Major Collector
Speed Limit	50 km/h south, 40 km/h north	50 km/h west, 60 km/h east
Truck Route	Yes	No
Transit	Route 111, stops set back north of intersection	Route 111, stops set back west of intersection
Emergency Route	Yes	Yes
Cycling Facilities	Bike Lane, NB floating lane	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB left, two through, right SB left, through, through/right	EB left, two through, right channel WB left, left/through, through, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Prince of Wales Drive	Meadowlands Drive
Affordable Cycling Project List	Not listed	East of intersection P1-21A MUP on south side
Ultimate Cycling Network	Spine Route, Major Pathway on east side	Spine Route, Major Pathway on south side
Cross-Town Bikeway	Yes, Route 6	No

Prince of Wales Drive and Meadowlands Drive are Transit Priority Corridors in the Official Plan. Hog's Back Road is a Federal Roadway and thus is under the jurisdiction of the NCC.

Collision History

There have been 155 reported collisions at this intersection from 2009 to 2018. Twenty-eight collisions resulted in non-fatal injuries, with the remainder resulting in property damage. No reported collisions involved a pedestrian. Eight collisions involved a cyclist. All of the collisions occurred in clear, dry conditions during the day. Seven of the collisions resulted in non-fatal injuries. Four of the collisions involved a NBR vehicle colliding with a cyclist and 2 involved a WB through cyclist.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in July 2016. No major physical changes have occurred since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Jul-2016
Time Period	7AM-6PM
Vehicles	22803
% Trucks/Buses	2%
% Bicycles (on-road)	2%
Bicycles (on-road)	358
Pedestrians	848

Based on the traffic volume data provided (and detailed in the Appendix), the following additional observations are observed:

- No significant higher vehicle volumes in a particular direction, higher E-W bicycle volumes (65%)
- Significant WB left and NB right turns for motor vehicles
- Peak hour turns high for SB and WB left, NB and WB right, and significant for EB left
- Dominant EB through for cyclists, nearly 80% of WB cyclists turn left and 40% of NB cyclists turn right
- Bicycles comprise 4% of EB through
- Generally low % of total heavy vehicles, 5-6% at SB right and EB left
- Bus route turning SB right and EB left (4-5/hr)
- Low-moderate pedestrian volumes, dominant leg is south with 40%

Site Visit Notes

A site visit was conducted at this intersection on October 16, 2019 at 11:50 AM. The following observations are noted:

- Observed cycle times total 140 seconds, P1: EB (actuated), P2: NBL, SBL (actuated), P3: N-S (resting), P4: WB (actuated). Cycle times vary based on called movements (max = 140s). NB permissive RT arrow. Meadowlands has alternating signal phases (i.e., all WB movements, then all EB movements)
- Right turn channels EBR and WBR
- No on-street parking
- No TWSIs
- Good sightlines
- Red light camera for north-south traffic
- Painted bike lanes on POW, but substandard width (1.0m approx.)
- Hydro pole on NW and SW corner directly behind sidewalk.
- Bus stops:
    - WB Meadowlands (far side 100m from intersection)
    - EB Meadowlands (near side 100m from intersection)
    - NB POW (far side 60m from intersection)
    - SB POW (near side 60m from intersection)
- Hog's Back bridge closed--temporary impacts on traffic for east leg

Cyclist EB on Meadowlands at intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Long floating bike lane NB could cause conflicts between vehicles and cyclists
- Potential for conflicts between cyclists and turning vehicles
- Cyclists cannot easily make WBLT from south side MUP
- Narrow bike lanes on SB direction

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on the north, west, and south legs, and a bidirectional cycle track on the south side of Hog's Back Road on the east leg. There are no significant building physical constraints.

The proposed design includes a combination of treatments. Protected corners with two-stage pedestrian crossings are provided on the NW, SW, and SE corners, and a smart channel is provided on the NE corner. The smart channel on the NE corner is proposed due to the acute angle skew of the corner, and reduces crossing pedestrian and cyclist crossing distances.

The existing transit stops are set back from the intersection and are not considered to be within the scope of this design.

Changes to Configuration

The proposed design includes a significant number of changes to the configuration of the intersection.

- One through lane is removed in the southbound, northbound, and eastbound directions
- A second northbound right lane is added
- The eastbound right turn channel is removed and that movement is prohibited
- The northbound left turn lane is removed and that movement is prohibited
- The westbound right turn channel is converted to a smart channel

Turning Radii Accommodated

As an arterial-collector intersection, the desired effective turning radius is 12 m. Heavy vehicles turn at this intersection at low to moderate rates:

- 47 heavy vehicle per day for NBR movement
- 9 heavy vehicles per day for EBR movement
- 32 heavy vehicles per day for SBR movement
- 8 heavy vehicles per day for WBR movement

A 12 m effective turning radius is provided on the NE, NW, and SE corners. On the NW corner, this is accomplished by the control vehicle turning into the inner westbound lane. On the SW corner, the effective radius is not provided as this movement is proposed as prohibited.

Suggested Traffic Changes

It is proposed that the existing split phase operation of the intersection be removed, with phasing as follows:

- P1: WBL, EBL, NBR
- P2: WBT, EBT (peds and cyclists cross north and south legs)
- P3: SBT, SBL (advance left turn)
- P4: SBT, SBL (permissive), NBT, NBL (permissive) (peds and cyclists cross east and west legs)

In order to meet AODA and City of Ottawa signal requirements, the audible pedestrian signals for the north and south legs will need to play different tones or have special messaging. It is preferred that the split phasing operation be maintained, as it caters to the high volume WBL, WBT and NBR vehicle movements (525, 657, and 581 vehicles per peak hour, respectively).

The NBL movement is proposed as prohibited due to low volumes (272 vehicles per day) and a lack of space for a dedicated turn lane. OC Transpo buses are to be excepted from this restriction, though safety and sightlines associated with this movement will need to be reviewed at functional design. The EBR movement is proposed as prohibited due to low volumes (246 vehicles per day) and the space requirements to accommodate a right turn with the desired effective radius of 12 m.

Fully prohibited right-on-red is required for the NBR movement, and is recommended the SBR movement to reduce conflict points and improve safety for pedestrians and cyclists.

Additional Considerations

- The design can be modified to remove the split phasing operation; however, this would involve the removal of the second WBL lane, which would likely impact the capacity of the intersection. This should be assessed further at the functional design stage.
- The design can be modified to provide a smart channel to accommodate the EBR movement, however this would require significant land acquisition on the SW corner to accommodate. Alternatively, passenger vehicles may be permitted to turn EBR, with heavy vehicles restricted. The current heavy vehicle turning demand is low; 9 vehicles per day.
- Sightlines for NB and SB left turning vehicles will be reviewed at functional design.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,360,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(28) Smyth Road and Riverside Hospital

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Smyth Road and the Riverside Hospital driveway is three-leg signalized intersection with a SB bicycle only signal. The intersection is near the on- and off-ramps for Riverside Drive. There is a pathway north of the intersection to Frobisher Lane. The surrounding land use is a mix of low- to high-density residential as well as some offices. Riverside Hospital is to the south of the intersection, and this intersection is one of two public road entrances to the site.

Overview of Existing Intersection Characteristics

Characteristic	Smyth Road	Riverside Hospital
Road Classification	Arterial	Not listed
Speed Limit	50 km/h	Not listed
Truck Route	Yes	No
Transit	Route 55, EB far side, WB near side stop	None
Emergency Route	Yes	No
Cycling Facilities	None at intersection, Bike Lane west of Riverside ramps	None, pathway on north leg of intersection
Pedestrian Facilities	Sidewalks both sides	Sidewalks on west side south of intersection, pathway north
Configuration	EB two through, through/right WB left, through, bus/right	NB left, through, right

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Smyth Road	Riverside Hospital
Affordable Cycling Project List	Not listed	P1-23A north of intersection and P1-23B south – MUP and Shared Lanes
Ultimate Cycling Network	Spine Route	Pathway Link north of intersection, Local Route south
Cross-Town Bikeway	No	No

There have been multiple complaints about the conditions for people cycling west of the intersection at the Riverside Drive on- and off-ramps where there is no cycling treatment and the bike lanes end west of the ramps.

Collision History

There have been 31 reported collisions at intersection from 2009 to 2018. Six collisions resulted in non-fatal injuries. No reported collisions involved a pedestrian or cyclist. At the western approach to the intersection there have been 4 EB/SB collisions involving bikes in the last 10 years, all classified as sideswipes.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in November 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	20-Nov-2016
Time Period	7AM-6PM
Vehicles	14726
% Trucks/Buses	3%
% Bicycles (on-road)	0%
Bicycles (on-road)	50
Pedestrians	158

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicle and cyclist volumes are higher E-W, 96% and 74% respectively
- Dominant intersection movements are E-W through, with all turns showing significant volumes
- Significant (but on the lower end of the NACTO threshold) peak volumes for WB left (AM) and NB left (PM)
- High bicycle turn movements NB left (3% of vehicles) and EB right (4% of vehicles)
- High percentage of trucks on NB right and WB left at 7% of all vehicles each
- Low E-W through bus volumes (2/hour each direction)
- Pedestrian use equal for west, south, and east legs (no crossing on north leg)

Site Visit Notes

A site visit was conducted at this intersection on October 21, 2019 at 4:00 PM. The following observations are noted:

- Observed cycle time total max 80 seconds, P1: E-W (40s actuated), P2: N-S (10s [vehicle actuated], 40s [pedestrian actuated])
- North leg (SB) is ped and bike only with dedicated bicycle signal
- NBLT, WBLT lanes
- Bus stops: EB far side, WB near side both with shelter
- TWSI on NW corner only
- Heavy E-W vehicular volume; Light NB volume
- Medium N-S bike volume; Low E-W bike volume, but bikes positioned between right and centre lane (both EB and WB)
- No hydro or utility poles

Southbound MUP approaching intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Cyclists have no dedicated facility on Smyth Road and may ride on narrow sidewalks on Transitway bridge, which may present safety issue with presence of low railings
- Potential conflicts for E-W through cyclist movements with turning vehicles
- Conflict points for cyclists and pedestrians on ramps to the west
- North leg multi-use path is not as wide as current City policy directs
- Potential for reduced visibility of MUP and cyclists using north leg of the intersection

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on Smyth Road, on-street buffered bike lanes on Riverside Hospital and a bidirectional cycle track and sidewalk connection on the north leg of the intersection connecting to Frobisher Lane. The existing Transitway bridge on the west leg of the intersection imposes a constraint on the available cross section width, including at the SW and NW corners of the intersection. Given their close proximity to the intersection, the access ramps to Riverside Drive just west of the intersection are also considered within the scope of the design.

The proposed design is a protected intersection. Where Smyth Road crosses the access ramps to Riverside Drive, tightened turning radii and set back bicycle and pedestrian crossings are proposed to improve sightlines and reduce vehicle turning speeds. The cycle tracks tie into the existing on-road protected bike lanes on Smyth Road to the west of the intersection.

The existing eastbound and westbound transit stops are accommodated in their existing locations as island platform stops. Where the curb lanes west of the intersection are repurposed as right turn lanes onto Riverside Drive, transit queue jump lanes are proposed allowing transit vehicles to continue straight.

Changes to Configuration

The existing acceleration / right turn lanes running east-west through the intersection are removed to create space for the proposed cycle tracks. On Riverside Hospital, the NBL lane is removed to create space for on-street buffered bike lanes.

At the Riverside Drive access ramps, the outer through lanes on Smyth are proposed as right-turn only lanes. The geometry of the ramps is also reconfigured to resemble that of smart channels, to encourage slower turning speeds and improved yielding to pedestrians and cyclists.

Turning Radii Accommodated

As an arterial-private intersection, the desired effective turning radius is unknown. Heavy vehicles make right turns at this intersection at low to moderate rates:

- 38 heavy vehicles per day for NBR movement
- 11 heavy vehicles per day for EBR movement

An effective turning radius of 12 metres is provided for the NBR movement, and an effective radius of 9 metres is provided for the low-volume EBR movement. Given the low volume of northbound vehicles (846 all day) and the lack of an overlapping vehicle southbound movement, it is assumed that heavy vehicles at this intersection can deviate from the typical path of travel to achieve a turn in the more constrained space. The northbound stop bar can be set back to provide more maneuvering space for the EBR movement. It is also noted that an additional hospital access point for heavy vehicles is available from Riverside Drive, 500 metres to the south, where larger radii are available.

Suggested Traffic Changes

It is proposed that the existing signal phasing operation of the intersection be maintained. Fully prohibited right-on-red is recommended for the NBR and EBR movements to reduce conflict points and improve safety for pedestrians and cyclists.

Additional Considerations

- Vehicle turning volumes at the Riverside Drive ramps were not considered as part of this design. Functional design should analyze the operational performance of the proposed configuration of the roadway west of the intersection.
- A fully-protected WBL should be considered at the functional design stage as a safety improvement, which would reduce the risk of collisions between WBLT vehicles and cyclists
- A sightline analysis is required at functional design

Cost Estimate

The concept design has an estimate cost (Class D) of $1,510,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(29) Somerset Street and Bronson Avenue

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history. Somerset Street and Bronson Avenue is a signalized intersection with leading pedestrian intervals and RTOR restrictions during the day. The surrounding land use is mixed, with medium- and high-density residential and street-level commercial uses. The Chinatown neighbourhood is centred along Somerset Street west of the intersection including the Royal Gateway just west of Bronson Avenue. The Primrose Family Medicine Centre is one block northwest of the intersection. Peace Tower Church is on Bronson Avenue one block south of the intersection.

Overview of Existing Intersection Characteristics

Characteristic	Somerset Street	Bronson Avenue
Road Classification	Arterial	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	Yes
Transit	Route 11 (frequent), EB far side stop, WB near side stop	Route 10 (frequent), NB and SB near side stops
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB left, general WB left, general	NB two general SB two general

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Somerset Street	Bronson Avenue
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Not listed
Cross-Town Bikeway	Not listed	Not listed

Somerset Street and Bronson Avenue are Transit Priority Corridors and Traditional Mainstreets in the Official Plan.

Collision History

There have been 109 reported collisions at this intersection from 2009 to 2018. Thirty-four resulted in non-fatal injuries while the remainder resulted in property damage only, or were not reportable.

Seven collisions involved a person cycling, 6 of which resulted in non-fatal injuries. Five of the collisions occurred in clear, dry conditions, 2 in wet, rainy conditions. Six of the collisions involved EB or WB cyclists. Four of the collisions were turning movement impacts.

There were 15 pedestrian-involved collisions. Most collisions were during the day in clear, dry conditions, except for three in wet and one in slushy conditions. Fourteen resulted in non-fatal injury and one in property damage. Seven of the collisions involved NB vehicles, two making left movements, two making right movements, and three making through movements. The other collisions are split evenly among the other directions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in August 2016. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	18-Aug-2016
Time Period	7AM-6PM
Vehicles	15750
% Trucks/Buses	4%
% Bicycles (on-road)	3%
Bicycles (on-road)	516
Pedestrians	2801

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Vehicles volumes largely balanced, very slightly higher N-S vs. E-W for light vehicles, smallest volume of vehicles EB
- Significant higher cyclist volumes E-W as opposed to N-S
- High WB left peak turn movements, significant right peak hour movements
- For cyclists, through movements predominate for both directions, with some SB right and EB left.
- Heavy vehicles significant volumes at all right turns, especially EB and NB right. Significant WB left.
- High ped volumes, with higher volumes on north and south legs

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 8:15AM. The following observations are noted:

- Observed cycle times total 95 seconds, N-S = 58s, E-W = 37s, LPIs in both directions, RTOR restrictions (7am-7pm Mon-Fri) all directions
- Pedestrian crowding at nearside southbound transit stop due to narrow sidewalk and waiting area
- EB and WB cyclists are forced to shift to left at far sides of intersection, which may create conflict point
- Heavy vehicle volumes north-south, but queues clear on each signal cycle
- Frequent vehicle lane changes and high posted speed limit N-S
- Most cyclists go through intersection on LPI

Cyclists using LPI to get ahead of traffic

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Potential for reduced visibility for cyclists at intersection given angled and constrained geometry
- Turning movements for vehicles may create conflicts with cyclists and pedestrians
- No dedicated space for E-W through cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks on all legs. The intersection is skewed, with a constrained right-of-way and there are buildings tight to the property line on the NW and SE corners.

The proposed design is a dedicated intersection with adjacent crossings, as there is insufficient space for a fully protected intersection. Bicycle stop bars are placed 2 m ahead of vehicle stop bars, and left turning cyclists are accommodated with turn boxes on all corners.

There are existing transit stops on each leg of the intersection. The northbound, southbound, and westbound stops are maintained as near-side stops, and designed with 1.2 m landing zones. The eastbound far-side stop is relocated to the near-side of the intersection due to space constraints on the far side, and designed with a 1.2 m landing zone.

Changes to Configuration

The proposed design includes the removal of the EBL and WBL turn lanes on Somerset Street in order to accommodate the proposed cycle tracks. On-street parking lanes on Somerset Street near the intersection are also removed to accommodate the cycle tracks. The peak-travel (off-peak parking) curb lanes on Bronson Avenue are removed to accommodate the cycle tracks, with a NBL turn lane added. Removal of lanes may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design.

Seven metre “pinch points” are created on the east and west legs of the intersection on the approaches as a strategy to reduce travel speeds and create space for the proposed design.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at low rates:

- 19 heavy vehicles per day for NBR movement
- 20 heavy vehicles per day for EBR movement
- 15 heavy vehicles per day for SBR movement,
- 13 heavy vehicles per day for WBR movement

Given the low volume of heavy vehicle turns, and due to the exceptional space constraints of this intersection, a smaller effective turning radius of 12 m is provided on all corners.

Truck aprons are provided on all corners to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

Suggested Traffic Changes

It is proposed that the existing two-phase operation of the intersection be maintained. Leading bicycle and pedestrian intervals are recommended on all legs to improve visibility of vulnerable road users. Fully prohibited right-on-red is recommended for all right turn movements to reduce conflict points and improve safety for pedestrians and cyclists.

One anticipated traffic challenge is the accommodation of the high volume of westbound left traffic during peak hours (234 vehicles during the PM peak hour). There is insufficient space to accommodate a westbound left lane in the proposed design, and as such, this movement may need to be restricted all-day or during peak periods. This should be explored further in the functional design stage.

Cost Estimate

The concept design has an estimate cost (Class D) of $844,000. No additional property is required. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(30) Somerset Street and Kent Street

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification). Somerset Street and Kent Street is a signalized intersection with no protected signal phase. Kent Street is one-way NB. The surrounding land use is mixed, with medium- and high-density residential and commercial uses.

Overview of Existing Intersection Characteristics

Road Classification	Arterial	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	Yes
Transit	Route 11 (frequent), EB near side stop, WB far side stop	None
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route	None
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB left, through; WB general	NB left, three through lanes

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Somerset Street	
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route	Not listed
Cross-Town Bikeway	Not listed	Not listed

Somerset Street is a Transit Priority Corridor and a Traditional Mainstreet in the Official Plan.

Collision History

There have been 48 reported collisions at this intersection from 2009 to 2018. Thirteen resulted in non-fatal injuries while the remainder resulted in property damage only. Seven collisions involved pedestrians. Two collisions involved a person cycling, in clear, dry conditions. Both of these collisions involved WBT cyclists and a WBR vehicle. Six of the seven pedestrian collisions involved a northbound left-turning vehicle. Five of these six collisions occurred in dark or dusk conditions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in September 2014. No major physical changes have occurred at this intersection since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	10-Sep-2014
Time Period	7AM-6PM
Vehicles	14061
% Trucks/Buses	3%
% Bicycles (on-road)	4%
Bicycles (on-road)	497
Pedestrians	4076

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- NB volumes higher for all vehicles except bicycles, which have higher E-W volumes
- PM peak EB left and NB left and right have high volumes
- Bicycle movements predominantly through EW but also significant NB through; highest turns NB and EB left

- High heavy vehicle turns for all turns
- Consistent pedestrian volumes at all intersection legs

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 8:35AM. The following observations are noted:

- Observed cycle times total 75 seconds, N-S = 48 s, E-W = 27 s
- NE corner is constrained
- Heavy vehicle volumes and congestion northbound on both sides of intersection
- EB vehicles backed up from Bank Street
- Lots of children present
- EB nearside bus stop was influencing capacity at the intersection and driver behaviours (people going around the stopped bus in the EB-LT lane)

Heavy NB vehicle congestion

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- High volume of E-W through cyclists, but not dedicated space for cyclists, despite wide intersection
- Potential for reduced visibility of E-W cyclists due to close buildings
- WBR turning movements may create conflicts with WBT cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are cycle tracks running east-west on Somerset Street, and cycle tracks northbound on Kent Street. Existing buildings are built to the property edge on all corners except for a parking lot on the NW corner. The proposed solution is a partially-protected intersection, with protected corners on the NE and NW corners, and an adjacent crossing for eastbound and northbound cyclists. Cyclists making an EBL movement are accommodated by a two-stage turn box.

The existing westbound far-side transit stop is shifted approximately 40 m to the west, and the existing eastbound near-side stop roughly 50 m east of the intersection. These shifts are made due to the constrained right-of-way at the intersection itself. Both stops have 1.2 m landing strips.

Changes to Configuration

On-street parking is removed on Somerset Street to accommodate the proposed cycle tracks. Kent Street is reconfigured to convert one peak-period through travel lane to a NB cycle track and a permanent on-street parking lane north of the intersection. The former NBL dedicated lane is also replaced with a bump-out to shorten the pedestrian crossing. Removal of traffic and parking lanes may have significant impacts on traffic, transit operations, and parking supply and will need to be reviewed in more detail at functional design.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles turn at this intersection at a low to moderate rate, between 19-27 times per day. It is expected that large vehicles will accomplish turns by deviating from the typical turn path. NBR and NBL heavy vehicles turn from the centre lane rather than the curb lane, and WBR heavy vehicles turn into the far receiving lane. The EBL stop bar is set back so that a NBL vehicle can turn from the centre lane onto Somerset Street.

Suggested Traffic Changes

Fully prohibited right-on-red is recommended for all turning movements to reduce conflict points, and is required for the NBR due to the two-stage turn box. In conjunction with the concept design, it is also recommended that the speed limits on Somerset Street and Kent Street both be reduced to 40 km/h to provide a safer and more comfortable operating environment for pedestrians and cyclists, which may require design changes to the corridors to accommodate this speed.

No changes are suggested to the existing signal phasing, which operates on a basic two-phase cycle. A leading bicycle and pedestrian interval is proposed for the northbound movement, to provide higher visibility for vulnerable road users and reduce turning conflicts.

Additional Considerations

- In a full reconstruction, it may be possible to accommodate on-street parking on one side of Somerset by narrowing the existing sidewalks and/or consolidating the buffer spaces (as shown, there is a 0.5m buffer between the sidewalk and the cycle track, and the cycle track and the roadway)
- To further manage turning speeds of WBR vehicles, a truck apron with a radius of 5 m may be considered on the NE corner
- The proposed design will lower the capacity of the intersection to accommodate NBT movements as only two NBT lanes are proposed. The existing three-lane NBT configuration could be accommodated by removing the curb extensions on the west side of the roadway and the proposed on-street parking lane

Cost Estimate

The concept design has an estimate cost (Class D) of $740,000. Property will be required to implement the concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(31) St. Laurent Boulevard and Ogilvie Road

Context

This intersection was selected based on its characteristics (cycling volumes, vehicle volumes, speed limit, and road classification) and collision history. St Laurent Boulevard and Ogilvie Road/Coventry Road is a signalized intersection with a protected left signal phase for all directions, including an EB and WB double left. There are right turn channels in all directions. The surrounding land use is primarily commercial with some low-density residential. The St. Laurent Shopping Centre is on the southwest corner of the intersection, with access on both St Laurent Boulevard and Coventry Road. St-Laurent O-Train Station is located south of the mall adjacent to Highway 417.

Overview of Existing Intersection Characteristics

Characteristic	St Laurent Boulevard	Ogilvie/Coventry Road
Road Classification	Arterial	Arterial
Speed Limit	60 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 7, 14, 19, 24, stops set back from intersection	Route 24 on Ogilvie, EB stop far side, WB stop set back from intersection
Emergency Route	Yes	Yes
Cycling Facilities	None	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	NB left, three through, right channel SB left, three through, right channel	EB two left, two through, right channel WB two left, two through, right channel

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	St Laurent Boulevard	Ogilvie/Coventry Road
Affordable Cycling Project List	Not listed	P1-2 – Bike Lanes west of intersection
Ultimate Cycling Network	Spine Route	Spine Route, Major Pathway west of intersection on north side
Cross-Town Bikeway	Not listed	Yes, Route 3

St. Laurent Boulevard and Oglivie Road are Transit Priority Corridors and designated as Mixed Use Centre in the Official Plan.

Collision History

There have been 262 reported collisions at this intersection from 2009 to 2018. Forty-seven collisions resulted in non-fatal injuries, with the remainder resulting in property damage. Three reported collisions involved a pedestrian. Five collisions involved a cyclist. All of these collisions occurred in clear conditions during the day, one occurred in wet conditions. Four of the collisions resulted in non-fatal injuries. There was no prevailing trend among the collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in June 2017. No major physical changes have occurred since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	1-Jun-2017
Time Period	7AM-6PM
Vehicles	32143
% Trucks/Buses	4%
% Bicycles (on-road)	1%
Bicycles (on-road)	257
Pedestrians	1483

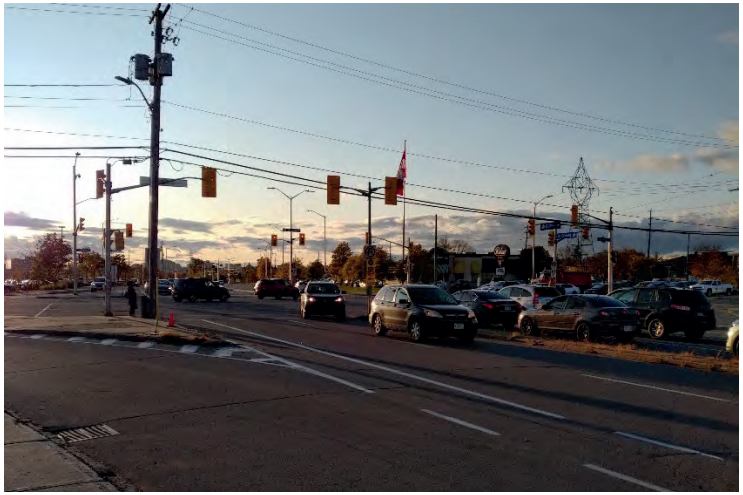
Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Slightly higher motor vehicle volumes N-S (59%)
- Significantly higher bicycle volumes E-W (90%), 4% of total vehicles
- High peak right turns for NB and SB right, and EB right (PM), high peak left (WB, NB and EB)
- Bicycle volumes focus on through movement, high % of total turns for NB/SB right (4%)
- Moderate heavy vehicle volumes, 5% for EB right and 7% for NB left; High heavy vehicle right turns at NB right;
- Moderate pedestrian volumes at all legs, dominant at west leg with 45% of total
- High frequency bus routes N-S through, lower frequency bus route turns NB left and WB left

Site Visit Notes

A site visit was conducted at this intersection on October 24, 2019 at 5:20 PM. The following observations are noted:

- Observed cycle times total 130 seconds, P1: EW (35s), P2: EWLT (20s), P3: NS (55s), P4: NSLT (20s). Actuated pedestrian signal EW
- Painted bike lanes on Ogilvie/Coventry with “bikes permitted” signage (green circle)
- Dual LT lanes E-W, single LT lanes N-S: all LTs fully protected
- Right turn channels on all corners
- NB near side bus stop with bench
- Hydro pole on SE right turn channel (directly at edge of roadway)
- Very heavy NS and WBL traffic
- Medium-heavy EBL, NBL and SBL traffic
- Few cyclists, those that are present on Coventry/Ogilvie (E-W)
- Many heavy trucks and buses



Floating EB bike lane and utility pole in island

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Free-flow right turn channels may create conflict points at turns
- Excessively large curb radii at corners may lead to high turning speeds
- Infrastructure design may lead to high vehicle speeds
- Floating bike lanes are uncomfortable for cyclists

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on all legs of the intersection. There are no major physical constraints that affect the design. The proposed solution includes a combination of design treatments. Protected corners are provided on the NE and SW corners, and smart channels are provided on the NW and SE corners due to higher turning volumes and acute intersection corner angles. An alternative option is provided that shows the footprint of a smart channel on the SW corner as well.

The existing northbound near-side transit stop is relocated to the far side with a 2.5 m landing zone.

Changes to Configuration

The proposed design involves the conversion of the NBR and SBR turn channels to smart channels, and the removal of the EBR and WBR channels. A dedicated right turn lane is provided for the EBR, while a shared through-right lane is provided for the WBR due to very low volumes. St. Laurent Boulevard is reduced to two through lanes in each direction to accommodate the proposed cycle tracks, which is suggested to be feasible for existing traffic volumes based on the traffic count data (759-850 peak hour through volumes for N-S), however, further analysis will need to occur at functional design. Existing left turn lanes are retained.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles make right turns at this intersection at low to high rates:

- 129 heavy vehicles per day for NBR movement
- 60 heavy vehicles per day for EBR movement
- 29 heavy vehicles per day for SBR movement
- 2 heavy vehicles per day for WBR movement

The desired effective radius is provided for all movements in the design, except for the WBR, which carries a very low volume of heavy vehicles. An effective radius of 12 m is proposed for this movement, with a physical radius of 8 m.

Suggested Traffic Changes

It is proposed that the existing four-phase operation of the intersection be maintained by operating the fully protected EBR turn movement in conjunction with the NBL and SBL protected left movements. Fully prohibited right-on-red is required for the fully-protected EBR movement and is recommended for the WBR movement to reduce conflict points and improve safety for pedestrians and cyclists.

Additional considerations

- The removal of two southbound lanes on St. Laurent create an opportunity for a landscaped boulevard on the south leg of the intersection
- The design is well-suited for the placement of bus stops on the far side of the intersection, designed as an extension of the existing pedestrian refuges

Cost Estimate

The concept design has an estimate cost (Class D) of $1,310,000 for conventional design, and $1,480,000 with a smart channel on the southwest corner. Property will be required to implement the smart channel concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule B will be required.

(32) St Patrick Street and Sussex Drive

Context

This intersection was selected based on its characteristics. St Patrick Street and Sussex Drive is a signalized intersection with a NB protected left signal phase and left turn on red restriction. St Patrick Street and Sussex Drive are one-way streets, WB and NB respectively, with Sussex transitioning to a two-way street to the north. The surrounding land use is a mix of mid-density residential as well as commercial, institutional, and tourism uses. The National Gallery is on the northwest corner and Notre-Dame Basilica is on the northeast corner. Southeast of the intersection is the ByWard Market. The US Embassy is southwest of the intersection. St Patrick Street west of the intersection becomes the Alexandra Bridge to Quebec. The Mackenzie Avenue and Murray Street intersection involves a multi-stage protected bicycle crossing to the Mackenzie Avenue bi-directional cycle track.

Overview of Existing Intersection Characteristics

Characteristic	St Patrick Street	Sussex Drive
Road Classification	Arterial	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	Yes	Yes
Transit	STO limited service	Route 9, no stops nearby
Cycling Facilities	Buffered Bike Lane	Bike Lane
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	WB one through, one through/right	NB left, two through

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	St Patrick Street	Sussex Drive
Affordable Cycling Project List	P1-35 east of Sussex Drive – Shared Use Lanes	No
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	To the west, Alexandra Bridge is Route 1	Not listed

The intersection is within the Central Area in the Official Plan.

Collision History

There have been 41 reported collisions at this intersection in the past 10 year. Seven collisions resulted in non-fatal injuries, with the remainder resulting in property damage. No reported collisions involved a pedestrian. Four collisions involved a cyclist. Two of these collisions occurred in rainy, wet conditions, and two in clear, dry conditions. All occurred during the day. Three resulted in non-fatal injuries. There were no prevailing commonalities between the collisions.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in May 2016. The buffered bike lane on St Patrick did not exist at this time.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	9-May-2016
Time Period	7AM-6PM
Vehicles	12703
% Trucks/Buses	5%
% Bicycles (on-road)	3%
Bicycles (on-road)	394
Pedestrians	2811

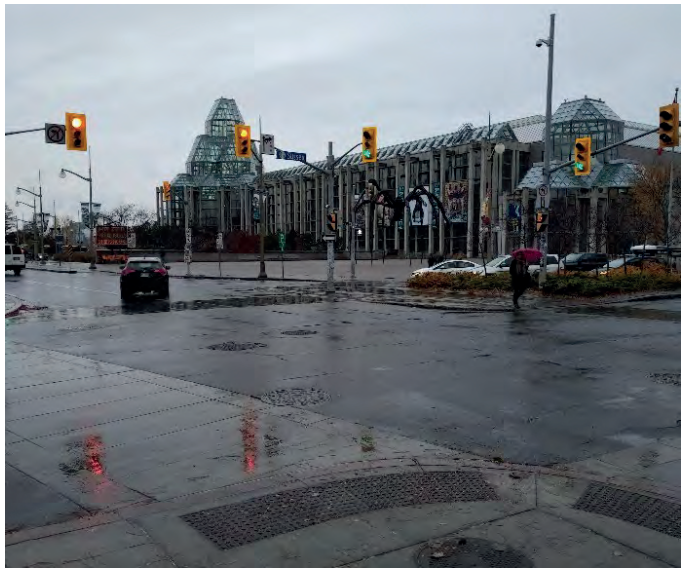
Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- N-S has higher volumes for vehicles (79%) and bicycles (76%)
- Data shows that all SB vehicles turn right to proceed through intersection (there is no distinction between traffic turning onto Alexandra Bridge)
- Highest movements are SB right and NB through, with significant WB through
- Peak hour turns high for SB right and NB left in PM peak
- Bikes high as percentage of total (4%) on WB through and NB through movements, 2% at SB right
- Similar patterns for heavy vehicles, but higher WB through than NB through and SB right
- High percentage of heavy vehicles for WB through (12%)
- Low frequency bus volumes N-S on Sussex
- High pedestrian volumes, dominant across east leg and north leg

Site Visit Notes

A site visit was conducted at this intersection on October 30, 2019 at 5:10 PM. The following observations are noted:

- Observed cycle times total 105 seconds, P1: N-S (30s), P2: NBL, NBT (45s), WB (30s)
- Buffered bike lane WB through intersection, and SB bike lane north of intersection
- Island between NB and SB and WB lanes
- High NB volumes, medium SB and WB volumes
- Many STO buses going WB.
- Some bikes NB and SB despite rainy weather
- Some WB bikes use separated lane to go SB, others use general purpose lane
- Many vehicles (inc. heavy vehicles) cut into SB bike lane at corner



Looking NW at intersection

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Large delay for cyclists to proceed SB via diverted route – they may still merge with traffic, which is where conflicts can occur
- SB vehicles observed to encroach on painted bike lane, which can cause conflict point

Concept Design

A concept design was not completed for this intersection as a functional design has already been completed as part of the Byward Market Public Realm Study.

(33) Wellington Street and Lyon Street

Context

This intersection was selected based on its characteristics. Wellington Street and Lyon Street is a signalized intersection with multiple protected signal phases. The SB and NB lanes of Lyon Street are separated by a wide 15m grass median. The Lyon NB lanes are restricted to bus traffic and traffic from the parking garage at Sparks Street. North of the intersection is federal parking lot access. The surrounding land use is high-density commercial and institutional uses, with many federal buildings surrounding the intersection. Lyon O-Train station is two blocks south at Queen Street.

Overview of Existing Intersection Characteristics

Characteristic	Wellington Street	Lyon Street
Road Classification	Arterial	Arterial
Speed Limit	50 km/h	50 km/h
Truck Route	East of Lyon	Yes
Transit	Routes 15, 17, and STO buses. Stops set back west of intersection	Routes 15, 17, no stops at intersection
Emergency Route	Yes	Yes
Cycling Facilities	Suggested Route with sharrows	Sharrows SB
Pedestrian Facilities	Sidewalks both sides	Sidewalks both sides
Configuration	EB right turn, RT, and through lane. WB left turn lane	2 NB and SB lanes

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Wellington Street	Lyon Street
Affordable Cycling Project List	Listed as P2-16	Not listed
Ultimate Cycling Network	Spine Route	Spine Route
Cross-Town Bikeway	Yes	Not listed

The intersection is located within the Central Area designation in the Official Plan.

Collision History

There have been 183 reported collisions at this intersection in the past 10 years. Twelve resulted in non-fatal injuries while the remainder resulted in property damage only, and 2 were not reportable. Two collisions involved pedestrians. Three collisions involved a person cycling, all of which resulted in non-fatal injuries. All 3 collisions occurred in clear, dry conditions during the day. All of the collisions involved EB cyclist, 2 making through movements, one making a RT. Two collisions involved an EBR vehicle, and one EB vehicle overtaking the cyclist.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in September 2019.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	4-Sep-2019
Time Period	7AM-6PM
Vehicles	16946
% Trucks/Buses	6%
% Bicycles (on-road)	4%
Bicycles (on-road)	637
Pedestrians	3442

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- Significantly higher volumes WB and EB movements, specifically WB through and left, and EB through and right (NB is a driveway and EB/WB is major street)
- Similar traffic patterns for cyclists, significant WB and EB through, as well as EB right
- Similar traffic patterns for trucks, high % of total, 8-9% of all WB movements, 10% of EB through (despite Wellington west of Lyon not being a truck route)
- High peak hour turns at WB left, EB right
- Majority of pedestrians on north and east leg, very few on west leg. Total volume moderate-high

Site Visit Notes

A site visit was conducted at this intersection on October 10, 2019 at 8:50AM. The following observations are noted:

- Observed cycle times total 145 seconds, P1: NBT, NBL, EBR = 30s P2: EBT, WBT = 27s P3: EBT, EBR, WBT = 55s P4: WBT, WBL = 30s P5 (actuated only): SB driveway, EB RTOR restricted
- EBR lanes are narrow and cyclists have no dedicated space
- Buses making EBR encroach into both RT lanes
- EB and SB direction is uphill
- Very heavy volumes and queues for EBR
- Heavy bicycle movements for EBR
- Awkward EBT movement for bicycles - either cross as pedestrians or cut across two lanes to use through lane
- EBT high volumes, lots of STO buses
- Moderate pedestrian volumes, high pedestrian delay
- Many cyclists make EBR movement on red

Heavy EBR vehicle movements

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Long cycle times lead to high pedestrian delay (PLOS F on east leg)
- Potential conflict for through cyclists and EBR vehicle movement as there is no separation of bikes mixed with a very high volume of vehicles
- Difficult for EBT bicycles to travel through intersection given lane configuration

Concept Design

A concept design was not completed for this intersection. The Bay Street cycling facilities (under construction) are expected to mitigate safety concerns for cyclists bound for destinations south of Wellington Street. Long-term plans will include an off-road bi-directional cycling facility on the north side of Wellington Street, which would mitigate safety concerns for eastbound bicycles.

(34) Industrial Avenue and Riverside Drive

Context

This intersection was selected based on consultation. Industrial Avenue and Riverside Drive is a signalized intersection with protected left turn phases in all directions, including SB and WB double left, and WB triple right protected phase. The NBR and WBR movements both have right turn channels. West of the intersection, Industrial Avenue becomes Terminal Avenue. The surrounding area includes a mix of industrial, commercial, and residential land uses. The Canada Post distribution centre is located at the northeast corner of the intersection. Cancer Survivors Park is on the southeast corner. To the east of the intersection is the Trainyards commercial district. Hurdman O-Train station is 400 m west of the intersection off of Terminal Avenue. The MUP on the south side of Industrial Avenue connects to the MUPs to Hurdman Station and to the NCC Rideau River Pathway.

Overview of Existing Intersection Characteristics

Characteristic	Industrial Avenue	Riverside Drive
Road Classification	Arterial east, Collector west of intersection (Terminal Ave)	Arterial
Speed Limit	60 km/h	60 km/h
Truck Route	Yes	Yes
Transit	Route 9 west on Terminal to Hurdman Station	Route 9 north on Riverside
Emergency Route	Yes	Yes
Cycling Facilities	MUP on south side	None
Pedestrian Facilities	MUP on south side, sidewalk on north side	Sidewalks both sides
Configuration	EB left, through, right WB two left, through, three right (inc. bus lane) and right channel	NB left, three through, right channel SB two left, two through, right

Planning Considerations

Ottawa Cycling Plan (2013) Classifications

	Industrial Avenue	Riverside Drive
Affordable Cycling Project List	Not listed	Not listed
Ultimate Cycling Network	Spine Route east, Major Pathway west	Spine Route
Cross-Town Bikeway	Yes, Route 4 both on road and MUP on south side to Hurdman Station	Not listed

The intersection is in an area designated Mixed Use Centre in the Official Plan.

Collision History

There have been 181 reported collisions at this intersection from 2009 to 2018. Twenty-eight collisions resulted in non-fatal injuries and one in fatal injuries. Two collisions involved a pedestrian, including the fatal injury inflicted by a southbound vehicle. Three collisions involved a person cycling. All of the cyclist-involved collisions were during clear, dry conditions during the day. They all resulted in non-fatal injuries. Two of the collisions were turning movement impacts, the other collision was an angle impact. All of the cycling collisions involved cars making turning movements.

Existing Traffic Volumes

Traffic data for this intersection was collected with Miovision sensors in November 2017. No major physical changes have occurred since then.

Existing Traffic Volume Summary

Summary Data	
Collection Method	Miovision
Date Collected	29-Nov-2017
Time Period	7AM-6PM
Vehicles	37308
% Trucks/Buses	6%
% Bicycles (on-road)	0%
Bicycles (on-road)	17
Pedestrians	365

Based on the traffic volume data provided (and detailed in Appendix A), the following additional observations are observed:

- N-S volumes higher for vehicles (70%)
- Nearly all WB vehicles turn (73% right), nearly all NB vehicles move through or turn right (24%)
- High peak hour turns for all turns except NB left, EB right and left
- Bikes high as percentage of total (5%) for EB through movement, highest volume of cyclists on SB right
- Similar patterns for heavy vehicles, higher percentage of turns (SB right and EB left)
- Note that WB leg (Terminal Ave) has diamond lane for transit
- Very high percentage of heavy vehicles for specific movements (likely due to buses): 41% of SB right, 24% of WB through, and 26% and 86% of EB through and left respectively
- Low volume of pedestrians, mainly on south leg (54%)

Site Visit Notes

A site visit was conducted at this intersection on October 28, 2019 at 5:30 PM. The following observations are noted:

- Observed cycle times total 120 seconds, P1: SBL, SBT, WBR (35s), P2: N-S (30s), P3: WBL, WBT (15s), P4: E-W (40s)
- WBR has three lanes (inc. 1 bus lane) and signal controlled
- RT channels on SE (very small) and NE (very large) sides
- MUP approaches intersection from SW and SE, but no crossride
- Very heavy traffic: SBL, WBR, N-S; Medium traffic: NBR, WBL; Light traffic: EW
- Some buses present, but most use Terminal Avenue overpass to avoid intersection to access Hurdman
- Very few bikes and peds, those that exist are all on south side MUP

Cyclists dismount sign where MUP crosses Riverside

Potential Issues Identified

Based on the review of the intersection context, the following potential issues were identified, which will be addressed by the concept design:

- Potential for conflict points between vehicles and pedestrians/cyclists at NBR channel
- Cyclists crossing both directions on south side of intersection despite lack of crossride
- High delays for cyclists and pedestrians crossing on the south side
- NBR channel island is small and cannot accommodate a cyclist comfortably

Concept Design

Design Approach

The assumed ultimate cycling facilities for this intersection are unidirectional cycle tracks on Riverside Drive, and a bidirectional cycle track on the south side of Industrial Avenue. There are no major physical constraints that affect the design.

The proposed design includes a combination of treatments. Protected corners are proposed on the SE and SW corners, a signalized channel crossing is provided on the NE corner, and an adjacent crossing is provided on the NW corner.

The existing transit stops are set back from the intersection and are not a factor of the proposed intersection design.

Changes to Configuration

The existing NBR turn channel is replaced with a dedicated right turn lane, and the corresponding acceleration lane is removed. The EBR turn lane is removed and the EBT lane is converted to a through-right lane. Other vehicle lane configurations are left as existing.

Turning Radii Accommodated

As an arterial-arterial intersection, the desired effective turning radius is 15 m. Heavy vehicles make right turns at this intersection at low to high rates:

- 113 heavy vehicle per day for NBR movement
- 4 heavy vehicles per day for EBR movement
- 742 heavy vehicles per day for SBR movement*
- 577 heavy vehicles per day for WBR movement*

The desired effective turning radius is provided on all corners. Truck aprons are provided on all corners to slow turning speeds for passenger vehicles while still accommodating the low volume of heavy vehicles.

**The counts provided to support the development of the concept design were taken on Nov 29, 2017 when the Stage 1 LRT was under construction and the temporary transitway alignment required a high volume of buses to make the SBR and WBR movements at this intersection. Heavy vehicles, the majority of which were likely buses, accounted for 40% of SBR vehicles at the time of the counts. With the Confederation LRT in service as of Fall 2019, the volume of heavy vehicles making these movements has likely declined significantly, changing the traffic patterns of the intersection.*

Suggested Traffic Changes

The NBR and SBR are high volume movements and are proposed as fully protected signalized right turns, to eliminate conflicts between motorists and vulnerable road users. An alternative option is provided showing the approximate footprint of smart channels to accommodate these movements.

The proposed signal operation of the intersection is the same as the existing four-phase operation, with the protected NBR and SBR phases operating at the same time as the EBL and WBL.

Fully prohibited right-on-red is a requirement for the NBR, WBR and SBR movements, and is recommended for the EBR movement to reduce conflict points and improve safety for pedestrians and cyclists.

Additional Considerations

- Given the change in traffic patterns experienced following the discontinuation of the temporary transitway detour, updated counts should be acquired for this intersection prior to traffic modeling at the functional design stage.
- If the updated traffic counts reveal that SBR volumes are significantly lower since the LRT opening, it may be permissible to provide a set back cycle track crossing for southbound cyclists on the NW corner, with a permissive SBR movement
- The importance of the east-west cycling route, combined with the very high volumes of this intersection, support the feasibility of a dedicated overpass or underpass for pedestrians and cyclists

crossing the south leg. This may be considered at the functional design stage.

Cost Estimate

The concept design has an estimate cost (Class D) of $1,390,000 for the base option and $1,550,000 with smart channels on the NW and SE corners. Property will be required to implement the smart channel concept design. A full breakdown of the cost estimate is included in Appendix E.

Municipal Class Environmental Assessment

Based on the concept design, it is expected that a MCEA Schedule A+ will be required for the base option and MCEA Schedule B for the smart channel option.