

Planning Memorandum: Re-designing Montreal's Bellechasse - Saint Laurent Blvd Intersection

To: The Head of Montreal's Department of Transportation

From: Bicycle Now Design

Date: November 4th, 2016

Subject: Re-designing Montreal's Bellechasse - Boulevard Saint Laurent Intersection

Bicycle Now Design is a bicycle advocacy group whose mandate it is to advocate for better and safer bicycle infrastructure in Montreal. Context appropriate bicycle infrastructure leads to higher levels of safety and comfort for all traffic participants - cyclists, pedestrians and motorists.

The Bellechasse - Boulevard Saint Laurent intersection is located on the border of Montreal's Mile End neighbourhood, just north of the Saint Laurent - CN Rail underpass. The suggestions presented in this planning memorandum are based on an analysis of the intersection's existing infrastructure as well as on observations of users' travel behaviour in the morning of October 31st, 2016. The intersection was recently re-designed in 2013, but still presents the following threats to pedestrians' and cyclists' safety.

- 1) A lack of visibility and signage results in collision potential between cyclists crossing Saint Laurent Boulevard from the CN Rail pathway and pedestrians heading north on Saint Laurent Boulevard's western sidewalk.
- 2) The median segregating cyclists from cars on Bellechasse forces cyclists to turn wide when turning left onto Saint Laurent Boulevard. This may lead to collisions with on-coming traffic.
- 3) The traffic lights do not account for cyclists making lefthand turns from Saint Laurent Boulevard onto the CN Rail cycle pathway.
- 4) Pedestrians and cyclists are not segregated appropriately when crossing Bellechasse, which results in a lack of clear prioritization and endangerment of pedestrians.
- 5) The traffic light indicating whether cyclists coming from Bellechasse can turn left is located in a position that feels counterintuitive and can be blocked by cars.

These threats mostly result from the intersection's function as a meeting point of three different types of bicycle infrastructure - bidirectional paths, uni-directional on-street paths as well as a separated pathway reserved exclusively for bicycles. The transition between the different types of infrastructure results in disorientation for all traffic participants and conflicting desire lines. Since the infrastructure leading up to the intersection is well-designed and is an example of Montreal's outstanding bikeability, the Bellechasse - Saint Laurent Boulevard intersection deserves to also reflect Montreal's standing as North America's most bikeable city and, more importantly, should be re-designed to better protect cyclists and pedestrians.

Analysis of Current Intersection Design

The current design of the Bellechasse - Saint Laurent Boulevard intersection leads to conflict zones that primarily endanger the safety of the two most vulnerable traffic participants - pedestrians and cyclists. An observation of the current infrastructure as well as traffic participants' behaviour while navigating the intersection allowed us to identify the intersection's most prevalent conflict zones, which are displayed in the graphic below.

Conflict Zone 1: A lack of visibility and signage results in collision potential between cyclists crossing Saint Laurent from the west on a green light and pedestrians heading north on Saint Laurent's western sidewalk.

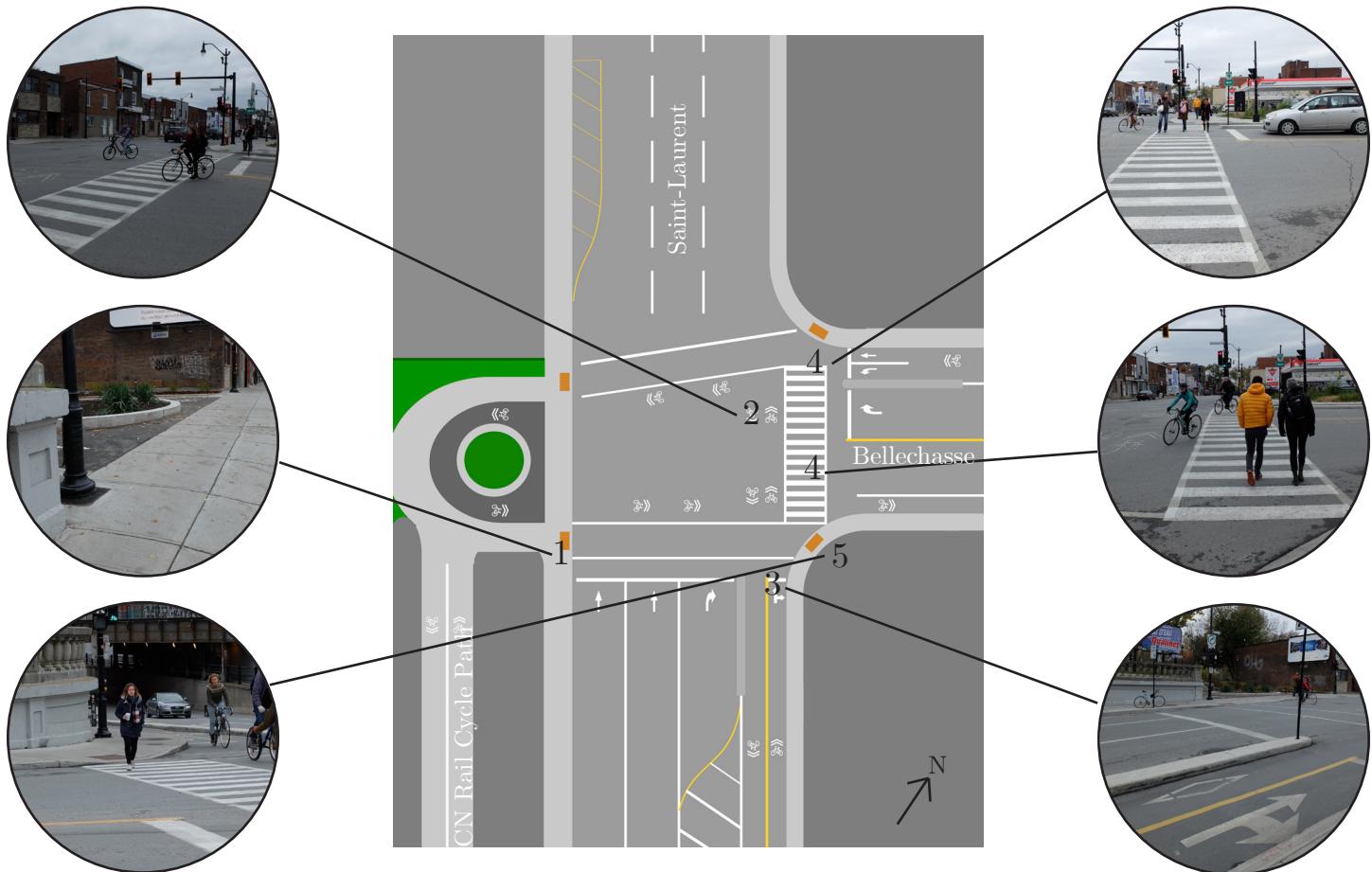
Conflict Zone 2: The median segregating cyclists from cars on Bellechasse forces cyclists to turn wide when turning left onto Saint Laurent. This exposes them to oncoming traffic on Saint Laurent, which may lead to accidents.

Conflict Zone 3: The traffic lights do not account for cyclists turning left from Saint Laurent onto the CN Rail cycle pathway. This leads to disorientation for cyclists taking this turn, which may result in them blocking the pedestrian path ways crossing Bellechasse and Saint Laurent or taking an illegal and dangerous turn to cross Saint Laurent.

Conflict Zone 4: Pedestrians and cyclists are not segregated appropriately when crossing Bellechasse, which results in a lack of clear prioritization and endangers pedestrians.

Conflict Zone 5: The traffic light indicating whether cyclists coming from Bellechasse can turn left is located in a position that feels counterintuitive and can be blocked by cars. Cyclists entering the intersection for the first time may feel disoriented and may cut into the intersection despite having a red light.

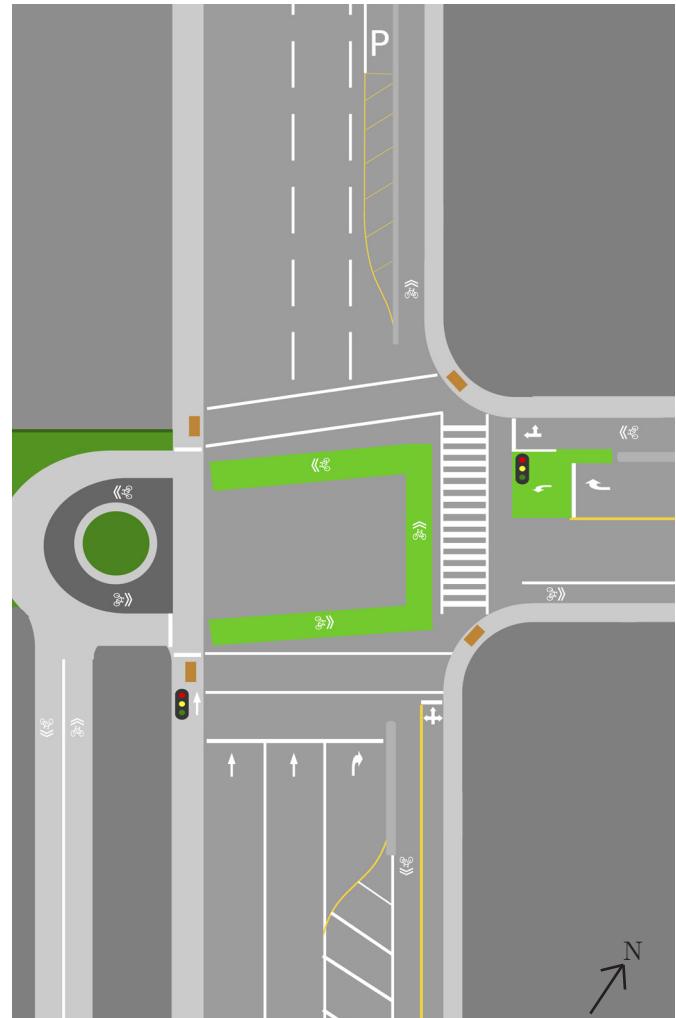
Further observations: The majority of cyclists heading north turn right onto Bellechasse and immediately turn left again onto Saint Dominique, which is a detour for cyclists and also causes conflict between cars, pedestrians and cyclists. Very few people continue cycling north on Saint Laurent, most likely due to the lack of cycling infrastructure.



Proposed Design Changes

Based on the analysis of the Bellechasse - Saint Laurent intersection, we propose the following changes to the intersection:

- 1) **The inclusion of a protected bike lane heading north on Saint Laurent**, ideally protected by a median, that runs between the side walk and parked cars to protect the cyclists from moving traffic. Saint Laurent is currently a street with onstreet parking on both sides and wide lanes and could accomodate this infrastructure.
- 2) **On street paint that guides cyclists through the intersection**. The paint reminds motorists of cyclists' presence and marks a clear separation between cycling and pedestrian space, therefore reducing the risk of conflict between the all three modes of transportation.
- 3) **The introduction of a cycling left turn from Saint Laurent onto the CN rail cycle path**. Please see Phase 3 below to see how the traffic light circuit would be affected.
- 4) **Set-backs for motorists on Saint Laurent and Bellechasse**. Cyclists are more visible from cars and are prioritized in traffic.
- 5) **New traffic lights on Bellechasse and Saint Laurent**. A new light on the south-western corner of the intersection stops pedestrians while cyclists cross Saint Laurent. The light indicating left turns to cyclists on Bellechase is moved to a location where it is easily visible, most preferably near the new bike box.
- 6) **A bike box on Bellechase for cyclists turning left onto Saint Laurent**. Cyclists who turn left wait there during a red light. A bike box at this location decreases the amount of conflict with pedestrians and other cyclists, especially in combination with an advanced left signal for cyclists.



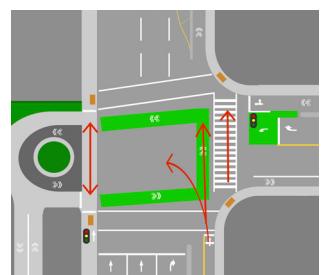
Conflict Minimizing Traffic Light Phasing



Phase 1:
Advanced left for cyclists



Phase 2:
Green for pedestrians, cars and cyclists crossing or turning onto Saint-Laurent Boulevard



Phase 3:
Advanced left for cyclists, green for pedestrians and cyclists heading north on Saint Laurent's eastern side



Phase 4:
Green for pedestrians, cars and cyclists (except left turns)

Conclusion

Cost and Priority

Although we urge the City of Montreal to fully implemented our proposed changes to increase the safety for pedestrians and cyclists at the Bellechasse - Saint Laurent Boulevard intersection, we recognize that the intersection was recently redesigned and substantial funds might not be allocated to the alteration of the intersection for the time being. We have therefore classified the proposed interventions by priority and cost as a guide for which interventions should be addressed first.

Intervention	Priority	Cost
Protected Bike Lane on Saint Laurent	Medium	High
Additional Traffic Lights	High	High
Bellechase Bike Box	High	Medium
On-Street Bike Paint in Intersection	High	Low
Introducing Car Set Backs	Medium	Low

Summary

The Bellechasse - Boulevard Saint Laurent intersection combines three different types of bicycle infrastructure, which makes transitions difficult and disorienting. The following issues have been observed:

- 1) Conflicts between pedestrians and cyclists when the light is green for both.
- 2) Lack of visibility when coming from the CN Rail pathway.
- 3) Risk of cyclist being hit by oncoming traffic due to forced wide turns when turning left from Bellechasse
- 4) Lack of space for the quantity of cyclists waiting at the intersection.

The solutions presented in this memorandum address all of these conflicts and enable a smoother transition between different intersection types while decreasing the amount of conflict potential in the intersection. The majority of the proposed changes are low or medium in cost and high in effect.

TO: Claude Carrette, Director, Infrastructure, Roads and Transportation Department, City of Montreal

FROM: Kyle Wiebe: Cognition Consulting Project Manager

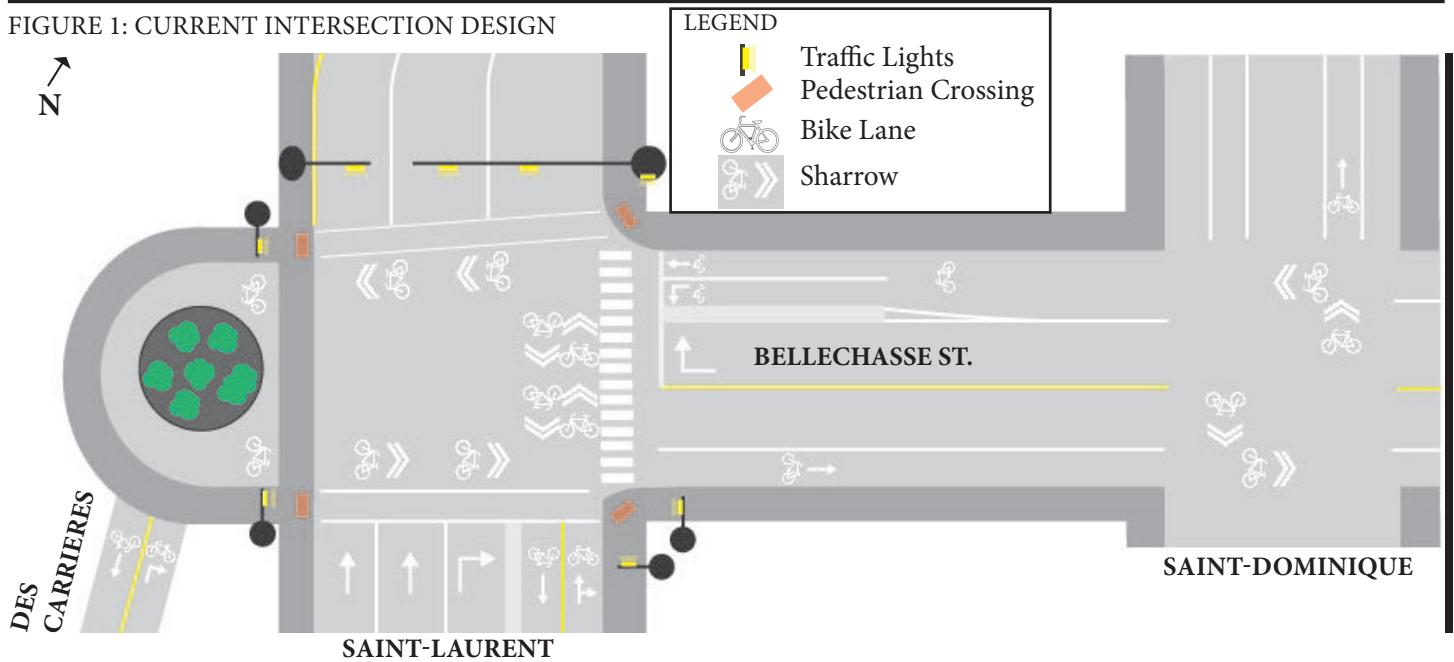
SUBJECT: **REDESIGNING BELLECHASSE ST. AND SAINT LAURENT BLVD INTERSECTION**

DATE: November 7, 2016

EXECUTIVE SUMMARY

The intersection of Bellechasse Street and Saint-Laurent Boulevard was re-designed three years ago to improve cycling and pedestrian connectivity. Despite improvements, the current design of the intersection creates conflicts between cyclists and pedestrians, and cyclists and vehicles. The design also creates confusion and long delays for a large number cyclists turning left from Bellechasse southbound on Saint-Laurent. To address the conflicts of the current design we recommend a new design for the intersection. This new design includes building a bike box that extends from Bellechasse Street into Saint-Laurent Boulevard. This bike box, along with other modest investments, improves the flow of traffic, and reduces conflicts between cyclists, pedestrians, and vehicles at the intersections.

FIGURE 1: CURRENT INTERSECTION DESIGN



CONTEXT AND IMPORTANCE OF THE PROBLEM

The intersection of Bellechasse St. and Saint-Laurent Blvd. is an important cycling, pedestrian and vehicular crossing. Saint-Laurent is an important north-south route as it is one of the few underpasses along the Canadian Pacific (CP) train tracks separating the Plateau and Rosemont Neighbourhoods. It is also an important cycling intersection as three major arteries of Montreal's cycling network converge on this area; North-South route along Saint-Laurent (via Clark St. and Saint-Dominique), the East West Route along Des Carrières, and the east West route along Bellechasse Street [Figure 1]

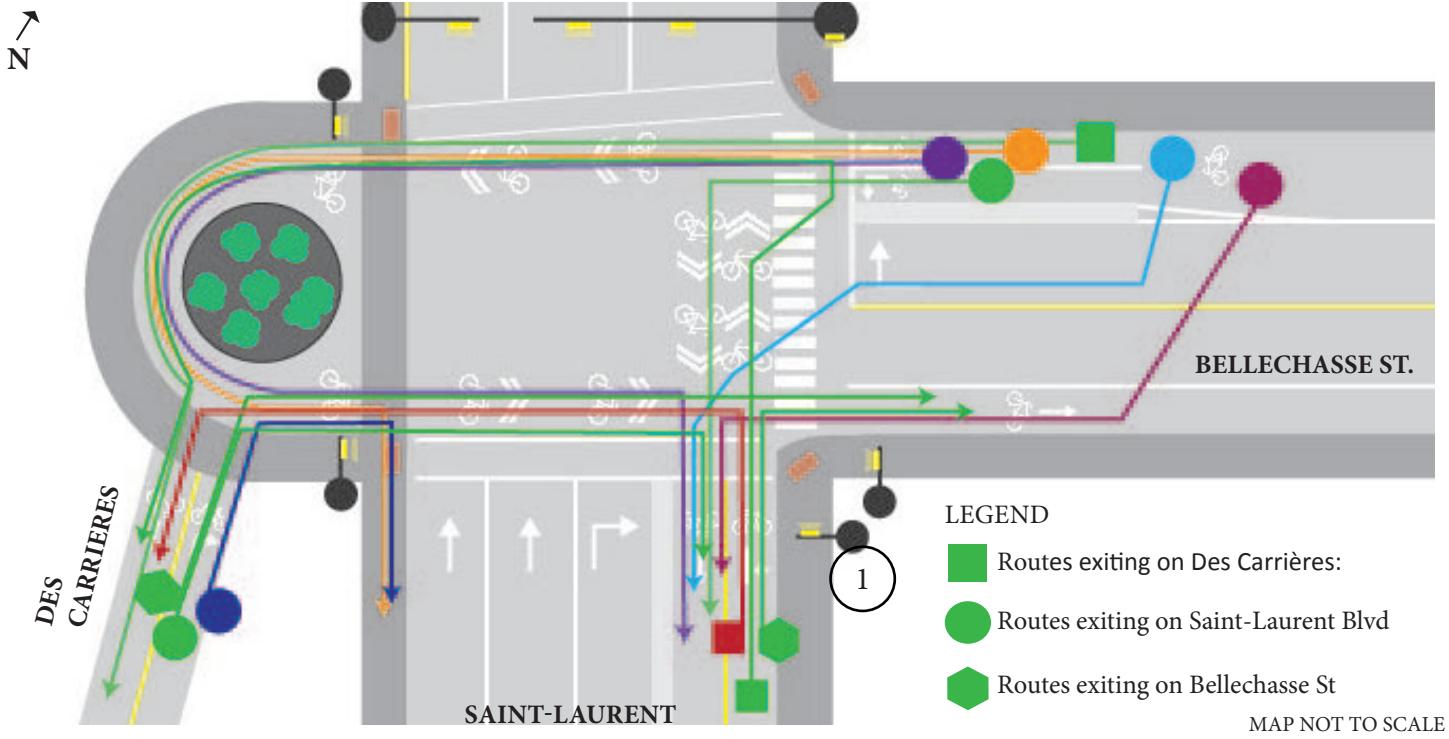
In 2013, the intersection was redesigned to improve the connections and safety of the cycling network. However, despite being an important and heavily used intersection by pedestrian, vehicles and cyclists, users have argued that the current design generates unsafe conflicts between cyclists and vehicles, and cyclists and pedestrians.

To assess the limitations of the current design, on-site observations were conducted for an hour during peak morning commute times on Monday, November 1st 2016. During the observations, movement patterns of cyclists, pedestrians, and vehicles were documented as well as conflicts between the different modes of transportation. These observations were used to identify sources of conflict generated from the current design, and document how cyclists were using the infrastructure in alternate ways.

DESIRE LINE ANALYSIS

Problems created by the current design were identified by observing how cyclists entered the intersection from each cycling route, and how these movements created conflicts between vehicles and pedestrians. These movements are referred to as desire lines. The following desire line analysis tracks the movements of cyclists through the intersection from each route and into each possible exit, and describes the potential problems. All routes in green represent movements taken as they were intended to be, while other colors represent alternative routes. This analysis will only assess those movements being done outside of the way the design intended.

FIGURE 2: DESIRE LINES OF CYCLISTS



BELLECHASSE ST. TO SAINT-LAURENT

The majority of conflicts associated with the intersection occur between vehicles turning right off Bellechasse St. and cyclists turning left headed southbound on Saint-Laurent. Cyclists are supposed to wait for a bike signal located in the south-east corner of the intersection (1), however, this light is infrequent and causes long waits. As a result, cyclists are making this maneuver in alternative ways.

Some cyclists are entering the intersection by using the vehicular lane and making a left hand turn into the Saint-Laurent cycle track southbound (blue) or by heading the wrong way on the eastbound Bellchasse cycle track (purple). Other cyclists are using the Des Carrières roundabout to head south bound, or using the roundabout and exiting on the west pedestrian underpass on Saint-Laurent (purple).

BELLCHASE ST. TO DES CARRIÈRES

Instead of waiting for a bike signal to cross the intersection, some cyclists heading southbound on Saint-Laurent from Des Carrières are using the west sidewalk on Saint-Laurent. This creates conflicts with pedestrians also using the underpass.

SAINT-LAURENT BOULEVARD TO DES CARRIÈRES

There is currently no safe way to cross from Saint-Laurent to Des Carrières. Instead cyclists are using the cross walk at the south end of the intersection to enter the Des Carrières roundabout the wrong way.

CRITIQUE OF CURRENT DESIGN: DEFINING CONFLICTS & INADEQUACIES (Figure 3.)

1. CYCLING INEFFICIENCY: Cyclists experience long delays turning left from Bellechasse St. onto Saint-Laurent Blvd., and when entering the Des Carrières roundabout. **INEFFICACY CAUSES CYCLISTS TO MAKE ILLEGAL MANEUVERS THAT GENERATE ADDITIONAL CONFLICTS.**

2. RICK HOOK COLLISION CAR - CYCLISTS CONFLICT: One significant conflict created by the current design is the potential for a 'right hook collision.' This conflict is caused by cars turning right off Bellechasse St. while cyclists are simultaneously turning left (illegally) onto Saint-Laurent (1). Cyclist and car conflicts also occur east of the intersection at Saint Dominique and Bellechasse St. where there is a lack of infrastructure and signage allowing cyclists to turn left from Bellechasse St. onto Saint-Dominique (2).

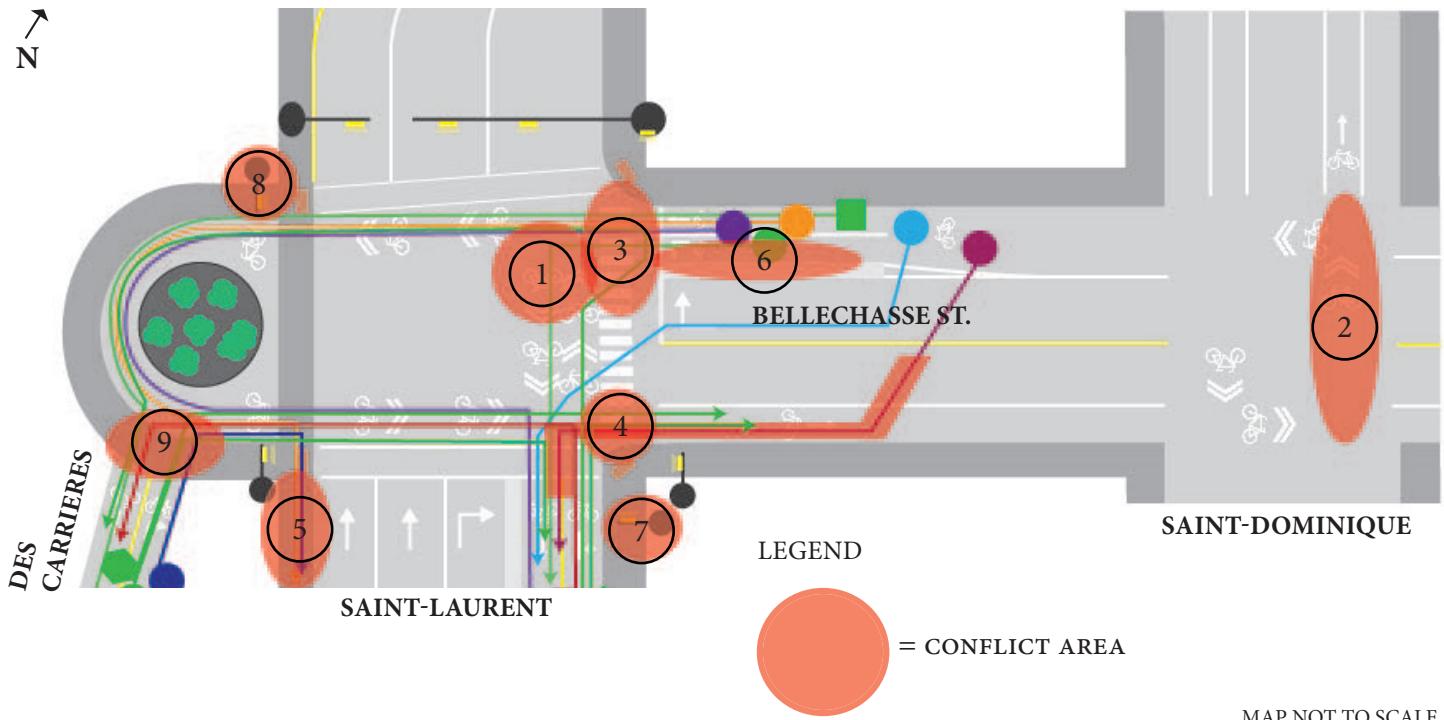
3. CROSSWALKS PEDESTRIAN - CYCLISTS CONFLICTS: The majority of conflicts generated between cyclists and pedestrians occur where cyclists are required to cross pedestrian paths before turning. This occurs primarily when exiting or entering Bellechasse St. (3, 4). Conflict also occurs where cyclists use the sidewalk (5).

4. LIMITED CAPACITY OF INFRASTRUCTURE: The current design does not accommodate the capacity of cyclists using the intersection. This results in long delays and back-ups along Bellechasse St. (5).

5. SIGNAL CLARITY: Depending on how cyclists approached the intersection, they may be directed by either a pedestrian crosswalk, traffic signal, or bike signal, and it is not always clear which direction cyclists need to look for their signal (6, 7) (Cyclists turning left at Bellechasse St. look for a signal at the south-east corner of the intersection (6)). Future design needs to be compressive and universal.

6. LACK OF VISIBILITY: Pedestrians lack visibility with cyclists at Des Carrières roundabout (8). This creates the potential for conflict between pedestrians and cyclists.

FIGURE 3: CURRENT CONFLICTS AT THE INTERSECTION



INTERSECTION RE-DESIGNS

To resolve the existing conflicts occurring at the Bellechasse St. and Saint-Laurent Blvd. intersection we are proposing two separate redesigns. These different designs differ in terms of cost and feasibility, the number of conflicts resolved, and the improved cycling flow. Each concept will be described briefly, before we make our final recommendation for one design, and address its benefits in more detail.

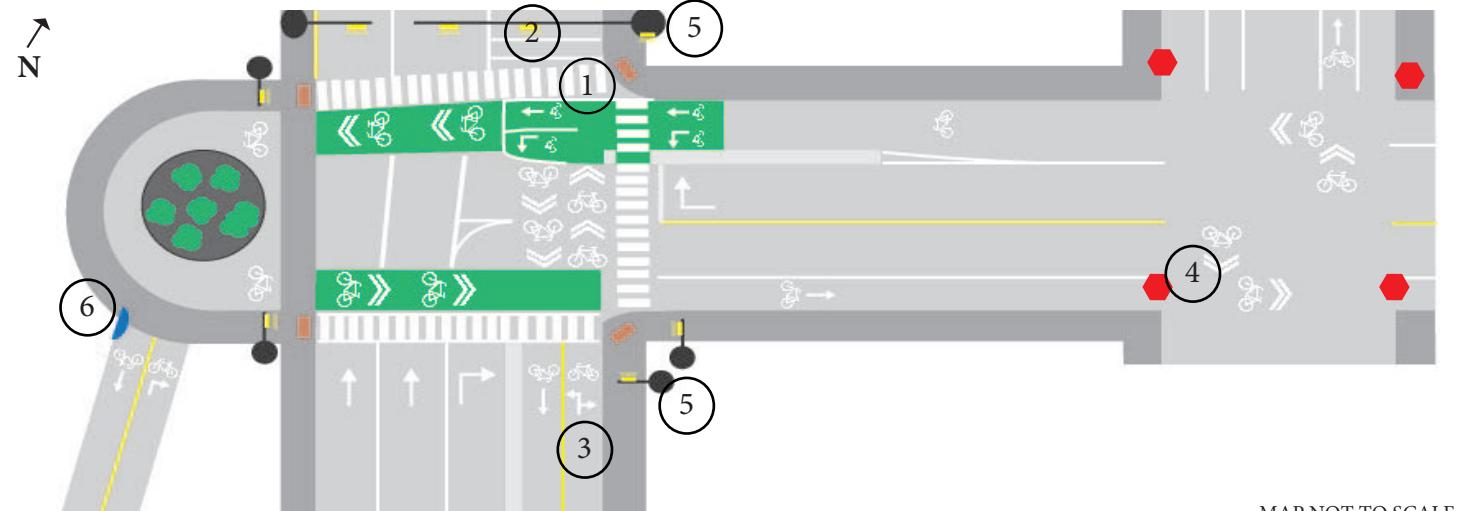
DESIGN 1: BIKE BOX AND PAINTED BIKE LANES

Most cyclist-pedestrian and cyclist-vehicle conflicts can be addressed with modest investments denoting more space to cyclists with paint. This design requires the current stop line for cyclists at Bellechasse St. to be moved into the Saint-Laurent intersection by the creating a modified 'bike box' (1) (space giving priority to cyclists over cars at intersections). To create the bike box the right lane north of the intersection must be converted into a no driving zone (2). This is not a concern as the right lane south of the intersection is required to turn right. Cyclists would, however, no longer be allowed to continue north on Saint-Laurent (3), and instead must make their way to Saint-Dominique, where a four way stop has been introduced (4). The bike box also provides space for cyclists coming from Saint-Laurent and heading to Des Carrières to wait and cross the intersection legally.

The addition of a bike box allows Saint-Laurent to be treated as two-way street, with south bound traffic being limited to cyclists. Cyclists enter the bike box unimpeded, and then head south or west as directed by the existing cycling signal (5). The zebra painted cross-walk for pedestrians gives them the right of way to cross when north south traffic is flowing, but cyclists could still enter the box by yielding to pedestrians. This solution increases cycling flows by eliminating conflicts with north bound Bellechasse traffic.

Sight-lines can also be improved in the area with the inclusion of convex mirrors at Des Carrières that allow pedestrians and cyclists to see around blind corners (6).

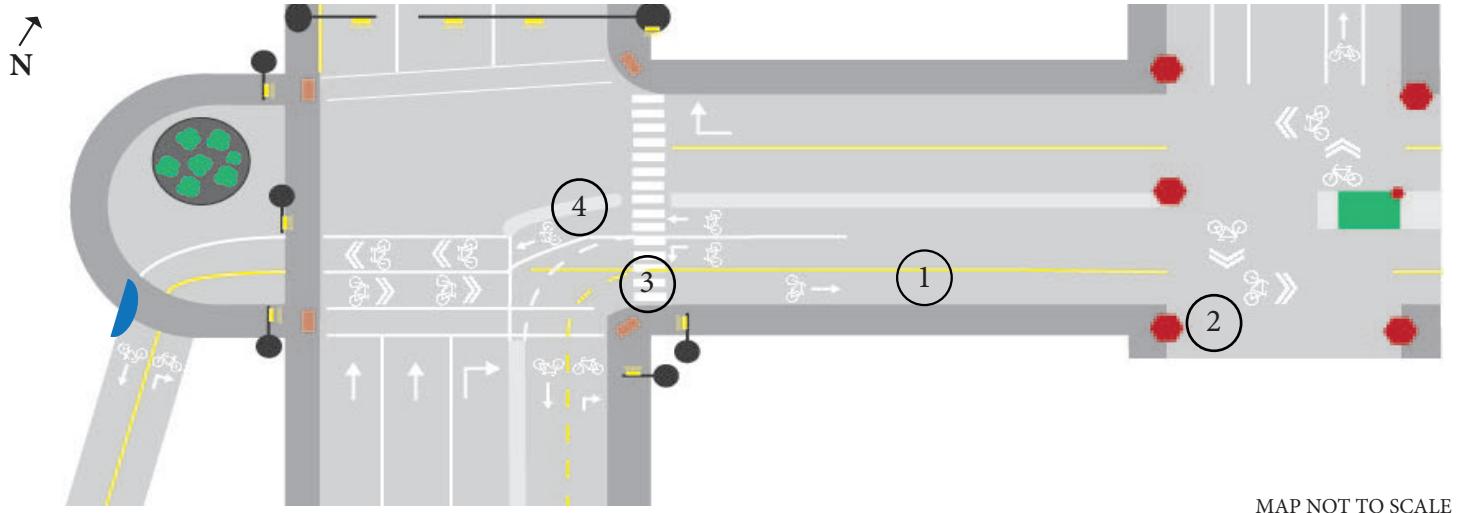
FIGURE 4: REDESIGN 1 - BIKE BOX AND PAINTED LANES



DESIGN 2: CYCLE TRACK INTERSECTION DESIGN.

Creating a new bi-direction cycle track along Bellechasse (1) eliminates all vehicle-cycling conflicts. Four-way stop signs at Bellechasse and Saint-Dominique also safely control south bound Cyclists entering the cycle track from Saint Dominique (2). Cyclists from the Bellechasse have unimpeded travel south along Saint Laurent, with the exception of the pedestrian crossing (3). Zebra strip crossing denotes that pedestrians have right of way when they have a crossing signal, but cyclists can still cross as long as they yield to pedestrians. The cycle track also has a space on the north side for cyclists continuing onto Des Carrières to wait without inturrupting other traffic flow (4). For continuity, the bi-directional cycle track should be extended along Bellechasse Street for the duration of the route.

FIGURE 5: REDESIGN 2 - BI-DIRECTIONAL CYCLE TRACK ON BELLECHASE



MAP NOT TO SCALE

FINAL RECOMMENDATION:

GIVEN THE COSTS AND FEASIBILITY OF EACH DESIGN, IT IS OUR RECOMMENDATION THAT DESIGN 1 BE IMPLEMENTED TO ADDRESS THE CURRENT CONFLICTS OCCURRING AT BELLECHASSE ST. AND SAINT-LAURENT.

DESIGN ONE REDUCES THE NUMBER OF CONFLICTS AND PROBLEMS CURRENTLY EXPERIENCED AT THE INTERSECTION BY;

- 1. IMPROVING CYCLING EFFICIENCY;** cyclists are allowed to travel south bound on Saint-Laurent as traffic is flowing north instead of waiting for their own signal
- 2. REDUCING THE CHANCES OF RIGHT HOOK COLLISIONS;** right hand vehicle turns at left hand cyclist turns at Bellechasse Street no longer occur at the same time.
- 3. INCREASING INFRASTRUCTURE CAPACITY;** cyclists are given a larger area to que in,
- 4. IMPROVING SIGNAL CLARITY;** cyclists are facing the traffic signals intended for them,

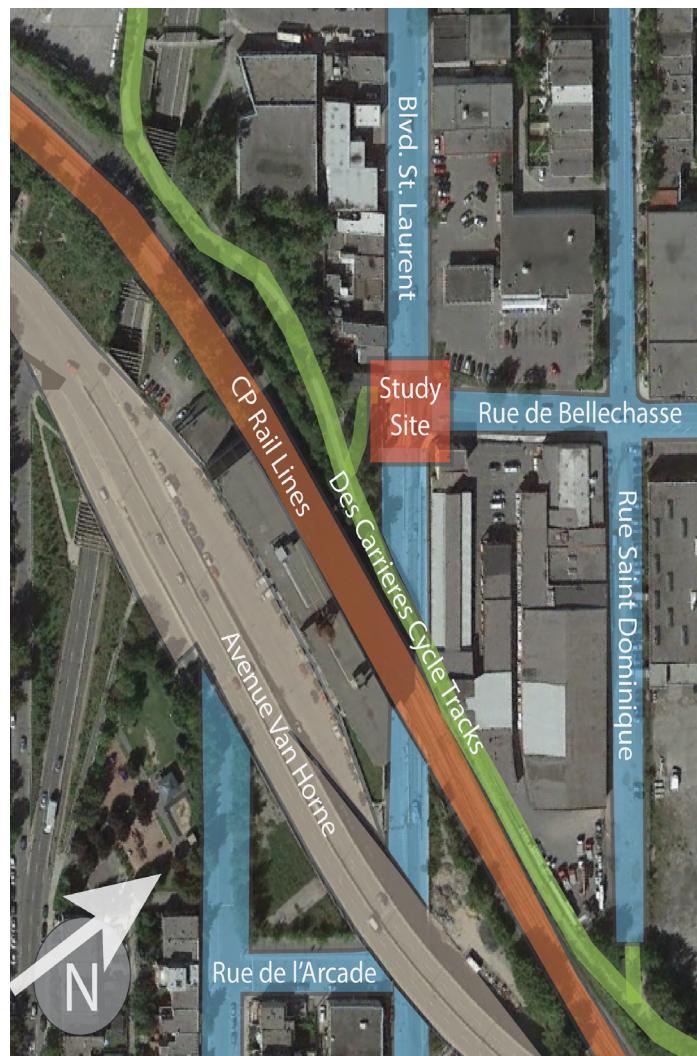
And **5. INCREASING THE INTERSECTIONS VISIBILITY;** convex mirrors at Des Carrières allow for better sight lines between cyclists and pedestrians

GIVEN THE BENEFITS AND RELATIVE COSTS OF DESIGN 1, WE BELIEVE ITS IMPLEMENTATION COULD REDUCE THE NUMBER OF CONFLICTS OCCURRING AT THE INTERSECTION CURRENTLY, AND DRASTICALLY IMPROVE CYCLING CONNECTIVITY.

Dear Mr. Marc Blanchet,

Montreal Cycling Advocacy Group (CAG) presents this planning memo on the design of the recently built intersection of Rue de Bellechasse and Boulevard St-Laurent (Figure 1).

Figure 1: Rue de Bellechasse/St. Laurent intersection and Surrounding area



I. Executive Summary

The intersection was redesigned 3 years ago to provide cyclists with a cycling link to cross the rail lines. However, complaints have been compiling from unsatisfied drivers, cyclists and pedestrians. The intersection lies just north of Avenue Van Horne, Canadian Pacific Rail Line and the Des Carriers cycle track overpasses. Due to the rail lines, the area suffers from many disconnected north-south streets resulting in low connectivity and a few traffic-burdened intersections. Therefore, it is important that the traffic needs of motorists, pedestrians and cyclists be efficient, yet safe.

This memo presents two design interventions (Scenario A, Scenario B) that will reduce conflicts between users of different travel modes. These recommendations are based on an on-site visit conducted on October 31, 2016 from 8:00 to 8:30am. This is a high volume period of traffic flow from the north and east towards downtown. It is assumed that heavier traffic flows in the opposite direction occur during the evening rush hour with lighter traffic throughout the day.

Figure 2: View approaching the intersection facing West on Rue de Bellechase (MTLville - Youtube)



II. Current Intersection Design

Motorists: The intersection of Rue de Bellechasse and Boulevard St. Laurent is a busy three-way intersection where motorists, cyclists and pedestrian meet. Blvd. St. Laurent is a one-way street running south-north. South of the intersection Boulevard St. Laurent underpasses the CP rail lines and the elevated Avenue Van Horne. Bellechasse is a bidirectional street that acts as an access point and an egress point for users of Rue de Bellechasse. A motorist heading west on Bellechasse only has the option to turn right on Boulevard St. Laurent. Motorists traveling north on St. Laurent have the option to turn right onto Bellechasse or continue North on St. Laurent.

Cyclists: The intersection plays an important role for cyclists using the city's biking network. North of the Bellechasse/St. Laurent intersection, cyclists are able to mix with one way traffic, but do not have shared street markings or cycle tracks that separates cyclists from motor traffic. South of the Bellechasse/St. Laurent intersection, cyclists can travel north and south on Saint Laurent via protected (cement buffer) bidirectional cycle tracks. On Rue de Belle-

chasse, cyclists are provided one-way cycling tracks that are delineated with a strip of white paint. These tracks continue east and intersect with bidirectional, but separated cycle lanes north on Rue Saint Dominique.

An important aspect of this intersection for cyclists, that separates it from most intersections, is in the bike round-a-bout on the west end of the intersection. This allows an access and egress point to the cycling street that runs along the CP railroad south of the intersection. However, there is also a less formal and less well known entrance at the dead-end on Rue Saint Dominique. Cyclists can also, if they so choose, go straight from Rue de Bellechasse, and perform a stylized U-turn using the round-a-bout to access the St. Laurent cycle track from the west.

Pedestrians: Pedestrians use the intersection, but with more obstacles than usual. Pedestrians traveling North and South on Boulevard South Laurent walk along the above street level sidewalks when crossing under the rail tracks and Avenue Van Horne.

This can be seen as an unfriendly environment for pedestrians since it is a narrow side walk with a cement wall on one side and a hip-level railing on the other protecting them from the drop off into traffic.

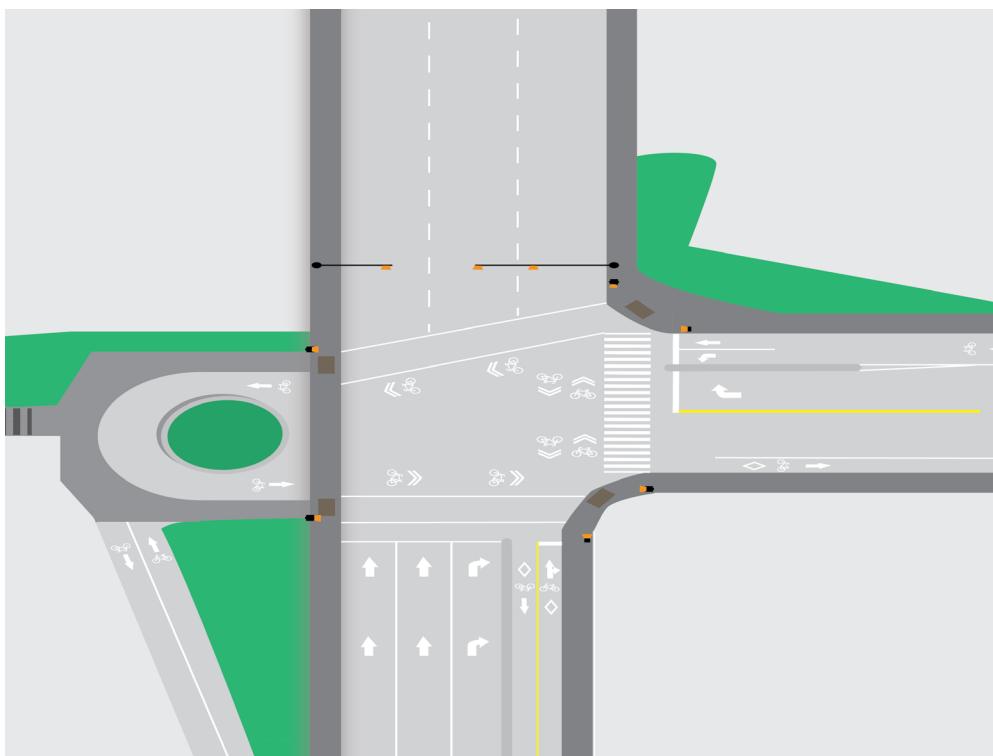
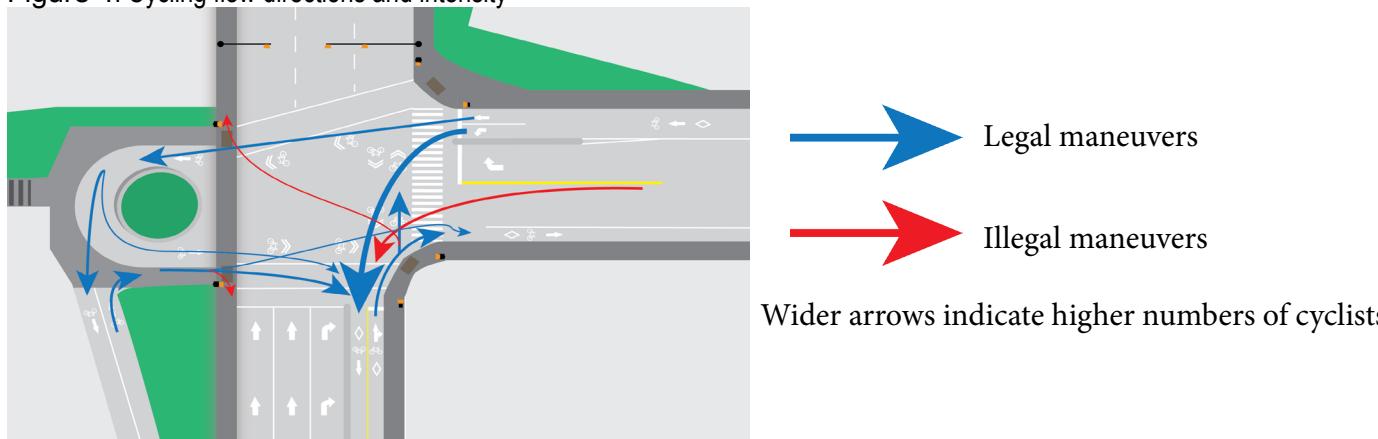


Figure 3: Current Rue de Bellechasse/St. Laurent intersection Design

III. Cycling Flows

Cycling flows were observed for a 15 minute period to have a better understanding of what proportions of traffic each direction and each cycling lane experienced. Figure 4 below displays the cyclists' flows. From this we can see that most cycling traffic comes from Bellechasse onto St. Laurent where in a ten minute time frame 95 cyclists took this route. All other directions experienced in total only a fraction of the Bellechasse to St. Laurent traffic. Again, flows were observed during the AM rush hour. Opposite flows are expected during the PM rush hour.

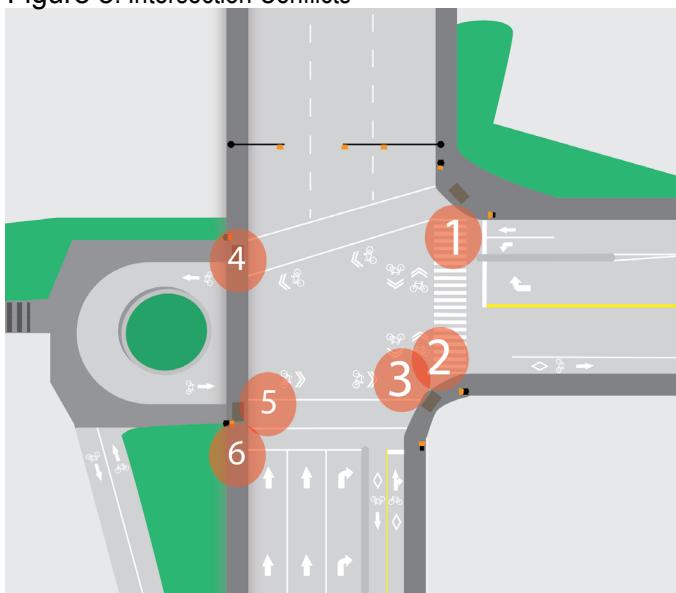
Figure 4: Cycling flow directions and intensity



IV. Conflicts

In terms of conflicts, the intersection is ridden with them. The most common and frequent conflict is between pedestrians and cyclists on the Northeast corner of the intersection. Cyclists and pedestrians follow the same traffic light signals; therefore, pedestrians (who have the right-of-way) must either stop or aggressively continue if a cyclist is taking off.

Figure 5: Intersection Conflicts



- 1 Pedestrians crossing Rue de Bellechasse are given the green light to cross at the same time. This causes the greatest proportion of conflicts in the intersections. Pedestrians have the right-of-way, but are often forced to let cyclists pass.
- 2 The conflict here is similar to the problem number one. However, cyclists are often moving at faster speeds which increases the chance of serious harm caused to both parties.
- 3 Here, cyclists were observed to have conflict with each other. This is principally caused by cyclists traveling west on Bellechasse who illegally bypass the designated cycle lane and travel in the opposite traffic lane. This is likely done to avoid waiting in line.
- 4 Cyclists who wish to access the bike round-a-bout from Bellechasse often encounter conflicts with pedestrians on the sidewalk.
- 5 Pedestrians and cyclists were seen to encounter problems here due to limited visibility of pedestrians who are travelling north on the sidewalk.
- 6 Regardless of ample cycle tracks, cyclists avoided crossing St. Laurent when coming from the Des Carriers cycle track and chose to take the side walk in the southern direction causing pedestrians to stop or move aside as cyclists passed.

V. Design Interventions

In order to improve the safety, function and efficiency of the intersection for pedestrians and cyclists the following two design interventions are recommended.

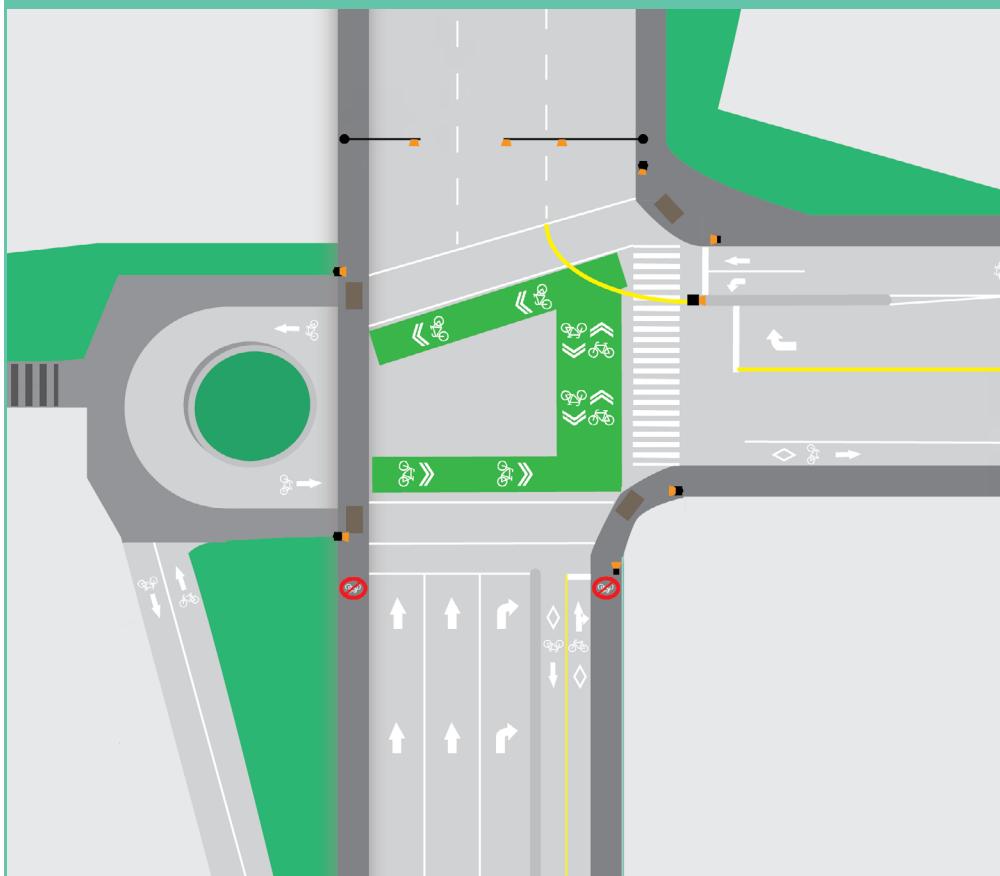
SCENARIO A: *Design Strategy A has the potential to be implemented immediately, causing few traffic interruptions and no structural changes. These changes should be implemented as soon as possible to avoid future pedestrian/cyclists conflicts that could arise. This strategy is principally designed to mitigate pedestrian/cyclist conflicts that were observed to be most prevalent and severe.*

Cost: Low

Time Frame: Short Term

IMPLEMENTATIONS:

- The bike lanes that empty cyclists from Rue de Bellechasse to Blvd. St. Laurent will be regulated by a cycling light.
- Light signalling will further separate cyclist and pedestrian start and end crossing times to avoid simultaneous crossings.
- Vehicles in the right-turn lane on Bellechasse will be limited to turn into the far two lanes on St. Laurent to maximize pedestrian and cyclists comfort. The stop position for these vehicles will also be pushed back to ensure better visibility for cyclists.



● Intersectional cycle lanes will be painted green to deter cyclists from veering off into pedestrian space or crossing diagonally.

● No bike signs will be posted along the underpass sidewalks to help deter cyclists from abusing pedestrian space.

Figure 6: Scenario A

SCENARIO B: *This design intervention has the potential to completely recreate the intersection and prioritize the safety of pedestrians and cyclists. It also has the potential implement readaptive use since it requires less overall space be given to the space of flows.*

Cost: High

Time Frame: Long Term

IMPLEMENTATIONS:

- The one-way cycle lanes presently on Rue de Bellechasse will be removed and consolidated to one bidirectional cycle track on the south side of Bellechasse. This lane would connect directly to the current protected cycle tracks on Blvd. St. Laurent.
- A pedestrian island will be constructed that consolidates pedestrian flows so that cyclists and pedestrians will only cross paths twice, as opposed to the previous eight path crossings. It will also serve to slow down traffic turning right onto Rue de Bellechasse.
- Access to the Des Carriers Cycle track will be removed and relocated to Saint-Dominique. There will; however, continue to be an egress point from Des Carriers.

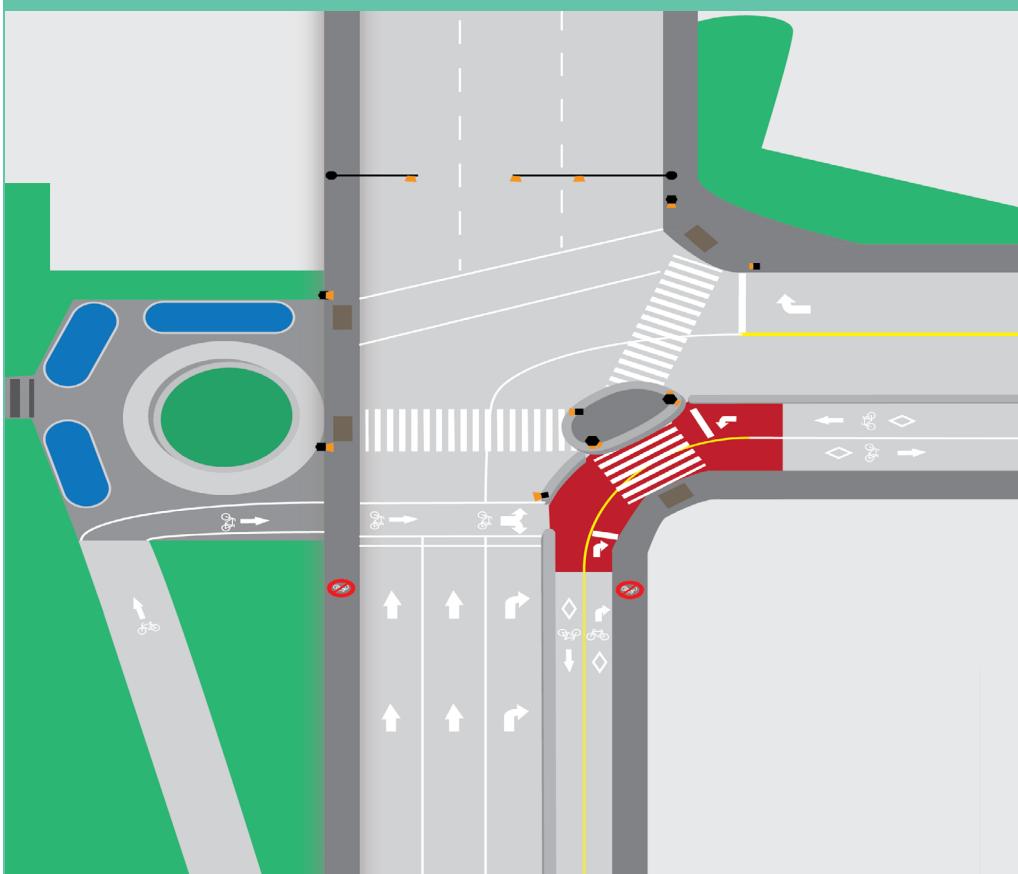


Figure 7: Scenario B

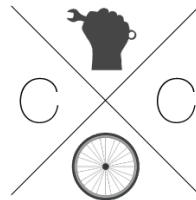
- The bike round-a-bout will be converted to a bike service station and outdoor fitness equipment center.

- Bikes coming from Des Carriers will be required to wait for a green light to cross St. Laurent and can go either direction on the protected cycle track.

- The Southeast corner of the intersection will be painted red to indicate a caution zone.

VI: Final Thought

The intersection at Rue de Bellechasse and Blvd. St. Laurent is a safety hazard and annoyance for pedestrians and cyclists. Cycling and walking are expected to garner a larger modal share in the coming years. If the Montreal TOD wants to improve the quality of life for pedestrians and cyclists at this intersection they should take into consideration these design interventions.



**Montreal Cycling Coalition
Memorandum**

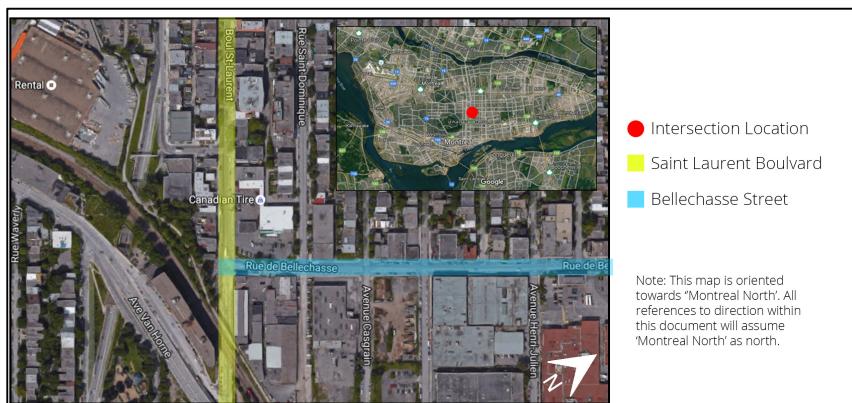
Date November 8th, 2016
To Claude Carrette, Director, Infrastructure, Roads and Transportation Department
From Montreal Cycling Coalition
Re: Bicycle Infrastructure at Saint Laurent-Bellechasse Intersection

Dear Claude Carrette,

Due to the popularity of the Saint Laurent bicycle railway crossing, the bicycle infrastructure at the intersection of Saint Laurent Boulevard and Bellechasse Street has exceeded its design capacity. This has caused significant increase in conflicts between cyclists, pedestrians and motorists that threaten safety and degrade efficiency. After an extensive review of the current issues, the Montreal Cycling Coalition (MCC) has identified three interventions to address this problem:

1. Implement 'bicycle box' for cyclists on Bellechasse Street
2. Extend bi-directional bicycle path along Saint Laurent Boulevard north to Saint Zotique Street
3. Upgrade intersection design including signal timing, signals and green painted cycling paths

MCC believes that these interventions will reduce the number of cyclists turning on Saint Laurent Boulevard and Bellechasse Street, increase space for cyclists and improve obscurities in the intersection.



Introduction

The Saint Laurent-Bellechasse intersection is situated immediately north of an important underpass that links Little Italy to the Plateau. Recently, this underpass was upgraded to include a high quality cycling path. As such, all bicycle traffic travelling downtown is funneled to this underpass through the Saint Laurent-Bellechasse intersection. However, this new infrastructure has become a victim of its own success. Originally designed for 2000 cyclists, this major crossing now accommodates significantly more than anticipated, resulting in cyclist congestion and increasing the number of conflicts between cyclists, pedestrians and automobiles.

Current Problems

The underlying issue at the intersection is that cyclists must navigate between different types of cycling infrastructure (from a bi-directional to a uni-directional). During the morning commute, the majority of cyclists approach the Saint Laurent-Bellechasse intersection from the east, along Bellechasse, imposing a left turn into the Saint Laurent bi-directional track. During the evening commute, cyclists approach from the south direction of Saint Laurent and must turn right onto Bellechasse. Users of the intersection have raised three key concerns related to the current design of the intersection:

1. Conflicts between pedestrians and cyclists when the light is green for both

2. Lack of space for the quantity of cyclists waiting at the intersection
3. Conflicts between cars and cyclists when cyclists turn left on Saint-Dominique Street from Bellechasse Street

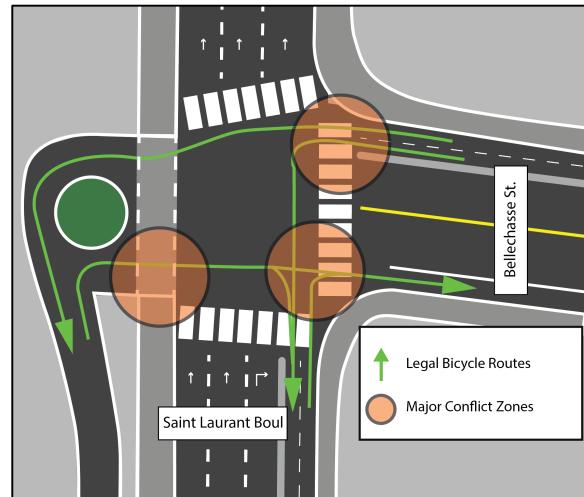


Figure 1 Bicycle Routes and Conflict Zones

Intervention Objectives

After a review of the intersection's current conditions and observed problems, MCC has developed four key objectives to guide our proposed intervention. These objectives are:

- To reduce the number of cyclists turning from Saint Laurent and Bellechasse
- To reduce the number of cyclists turning left from Bellechasse onto Saint Dominique
- To increase space of cyclists waiting to left from Bellechasse on Saint Laurent
- To increase clarity of signs and signals at the Saint Laurent-Bellechasse intersection

MCC does not believe the objectives stated here can be solved with minor adjustments to the intersection design. Although some design interventions are required, this intersection requires a holistic intervention-approach that considers the intersection as part of a wider network. Implementing more large-scale changes will improve the flow of traffic and ensure the safety of cyclists and pedestrians.

Proposed Interventions

1. Extend Bi-Directional on Saint Laurent

The key proposal of this memo is the extension of the bi-directional track on St. Laurent further north to Saint-Zotique Street. This will allow cyclists to navigate from Saint Dominique to Saint Laurent at two additional intersections (Beaubien Street and Saint-Zotique Street). With more opportunities to merge onto Saint Laurent within the network, cyclists will spread out and reduce congestion for the number of cyclists turning at the Saint Laurent-Bellechasse and the Saint Dominique-Bellechasse intersection. Further, cyclists travelling straight along Saint Laurent will be able to pass through the intersection much more quickly than those turning left, which in theory, will incentive this path for some cyclists. Some cyclists currently continue north along on Saint Laurent, so this addition will legitimize existing preferred behaviours of cyclists while also reducing conflicts.



Figure 2 Extension of Saint Laurent bi-directional path

2. Bike Box on Bellechasse

As mentioned earlier, pedestrian and cyclist conflicts are initiated when these two modes must cross paths at the same time. Although the extended bi-directional lane along Saint Laurent may reduce some of this conflict, cyclists, who are waiting, need more space. Therefore, we propose the development of a bike box on the west-facing lane on Bellechasse set in front of the pedestrian

crosswalk. Setting the crosswalk back will allow cyclists to cross the pedestrian crosswalk while it is not in use. It would also provide more room for cyclists turning right from Saint Laurent Boulevard onto Bellechasse Street. Further, it will create greater visibility of cyclists to the vehicles waiting at Bellechasse Street, and will enable more cyclists to turn left at the same time.



Figure 3 Proposed Bicycle Box

3. Intersection Design Changes

To facilitate the new bi-directional and bike box, major changes to the traffic signals will be required. These include changes to the timing of the lights, existing signage and signals as well as ground markings.

Timing

The new Saint Laurent-Bellechasse intersection will signal traffic in four phases. First, vehicle traffic on Saint Laurent Boulevard going north and turning right will be permitted to go. Second, the right turn signal will cease and cyclists and pedestrians traveling north-south will be allowed to proceed. This includes cyclists turning right onto

Bellechasse Street. Third, cyclists going straight and turning left from Bellechasse Street will go along with pedestrians crossing Saint Laurent on the north side. Finally, vehicles turning right from Bellechasse to Saint Laurent will turn right and pedestrians and cyclists crossing Saint Laurent on the south side will be signaled to go. Figure 5 illustrates the movement in each phase.

Signage

To avoid confusion we propose that bike specific signals at each corner be installed at each intersection. Similar signals exist at the bike median on the south side of Saint Laurent, while other corners simply suggest cyclists should follow the pedestrian lights. As this is not the normal procedure at most other intersections, such confusing directions should be avoided.

Currently, cyclists approaching the intersection from Des Carrières bicycle track from the west have limited visibility of pedestrians. We propose installing a mirror at the circular planter in order for cyclists and pedestrians to see who is approaching the corner.



Figure 4 Location of convex mirror

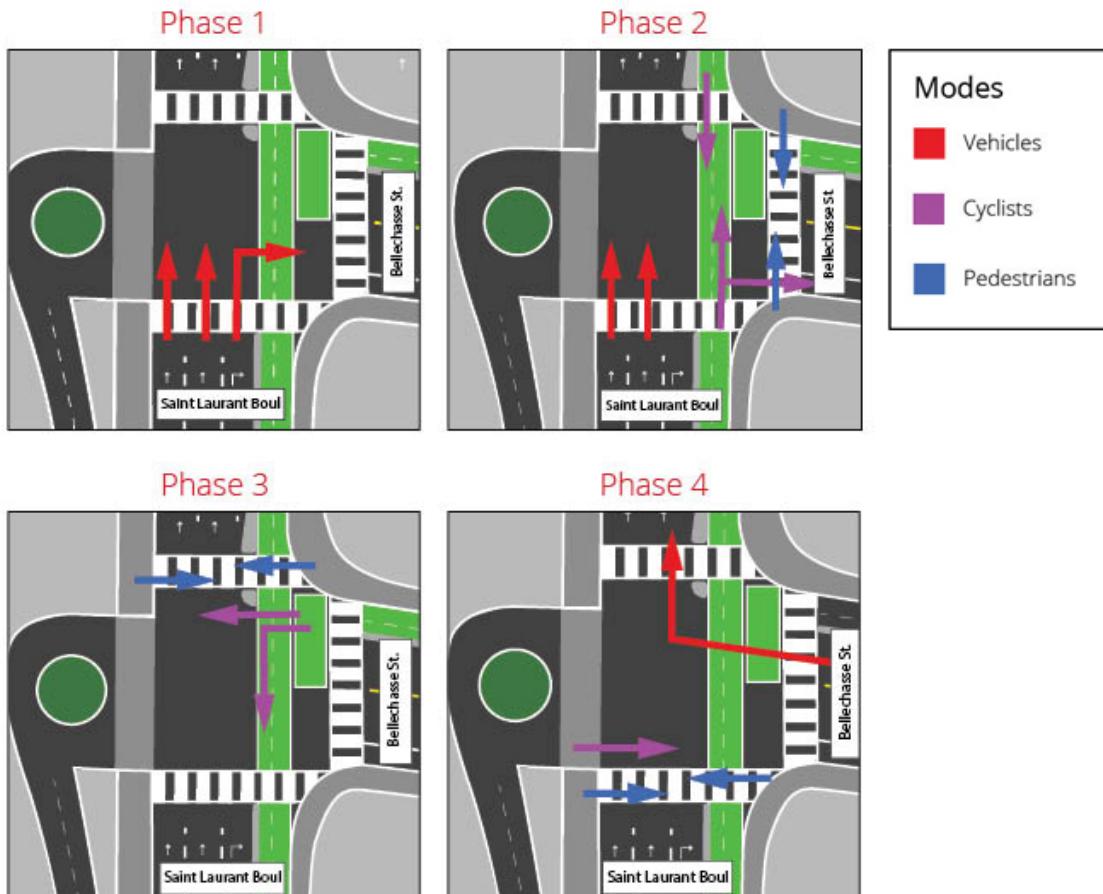


Figure 5 Signal phasing of new intersection

Ground Markings

Given the unique nature of this intersection, we suggest that the cycle paths be clearly marked with green paint for high volume crossings. This includes the north-south bi-directional on Saint Laurent Boulevard and the bike box on Bellechasse Street. Doing so ensures that all pedestrians, cyclists and motorists are aware of the path that cyclists will be moving along.

Conclusion

MCC believes that cycling in Montreal should be a safe and efficient means of transportation. The following memo outlines key strategies for addressing the current issues at the Saint Laurent and Bellechasse intersection. We hope you will prioritize the outlined interventions in the near future.



FORDWARD THINKING
BY LESLEY FORDHAM

PLANNING MEMO

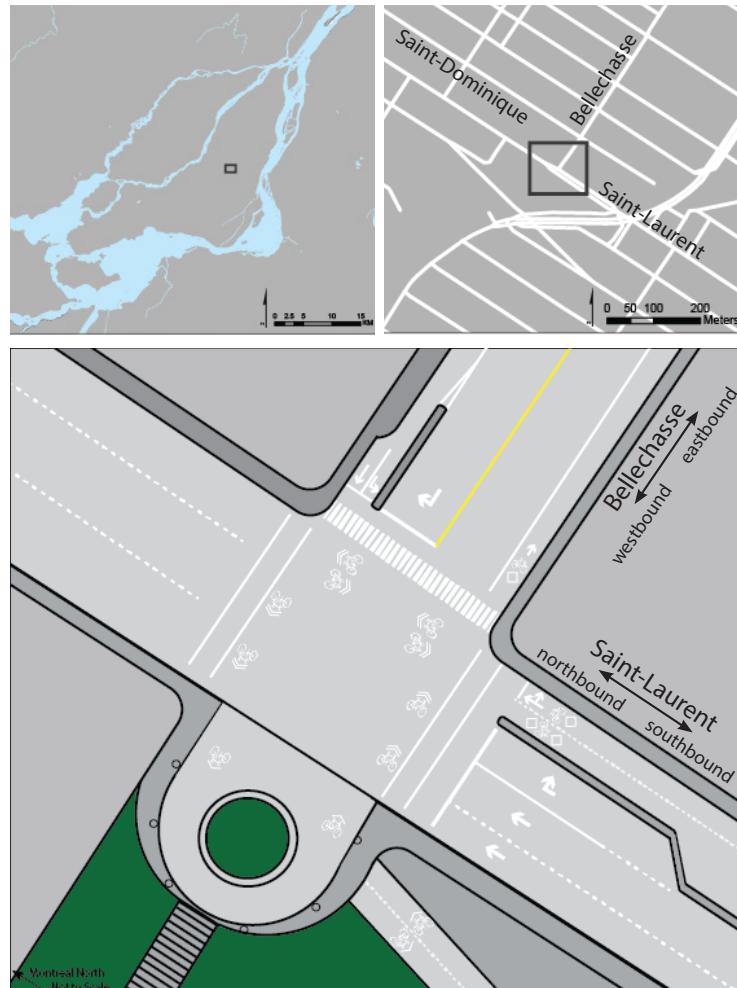
FOR: TRANSPORTATION DEPARTMENT, CITY OF MONTREAL
RE: REDESIGN OF SAINT-LAURENT BOULEVARD AND
BELLECHASSE STREET
FROM: FORWARD THINKING, LESLEY FORDHAM CYCLING
ADVOCACY GROUP

EXECUTIVE SUMMARY. The design of Saint-Laurent Boulevard and Bellechasse Street has resulted in cyclist crowding on the northeast and southeast corners of the intersection and conflictual zones. It is in need of additional interventions. This planning memo makes a recommendation for a street redesign that is low cost, politically feasible, and is well integrated with existing infrastructure.

CONTEXT. The intersection of Bellechasse Street and Saint-Laurent Boulevard was recently redesigned to improve the cyclist's experience of crossing the railway. This redesign featured a bidirectional protected bike track on Saint-Laurent and unidirectional cycle lanes eastbound and westbound on Bellechasse. Any additional interventions should carefully consider costs and the political feasibility of redesigning an intersection that was so recently under construction.

Figure 1 provides context and a conceptual illustration of the current state of the intersection. While all maps are oriented to true north, throughout this report directions are in reference to Montreal north, as indicated in the figures. This is done for ease of communication, consistency of maps, and to conform to Montreal colloquialisms.

Figure 1: Context



ANALYSIS

On Monday, October 31st, observations were made during the morning peak commute. This included recording how many cyclist were going in each direction and observing desire lines, which are formal or informal cyclists routes. It also involved examining where conflicts were taking place, who these conflicts were between, and the number and severity of conflicts.

DESIRE LINES

Desire lines are shown in Figure 2. This Figure shows that the most cyclist traffic occurs from westbound trips on Bellechasse that turn left to go southbound on Saint-Laurent, represented by Desire Line 1. This is followed by Desire Line 5, which represents cyclist going north on Saint-Laurent and turning right to go eastbound on Bellsechasse. This shows that cyclist traffic is highest on the southeast corner of this intersection. Two potentially problematic desire lines were observed. One was Desire Line 4, which featured cyclists outside of the separated bike lane on Bellechasse, and Desire Line 8, which featured cyclists taking a sharp right turn onto a pedestrian sidewalk. A desire line of note was Desire Line 3. To avoid waiting at a cyclist red light, cyclists would go straight on a pedestrian green light, go around the roundabout, and enter the Saint-Laurent protected bike track.

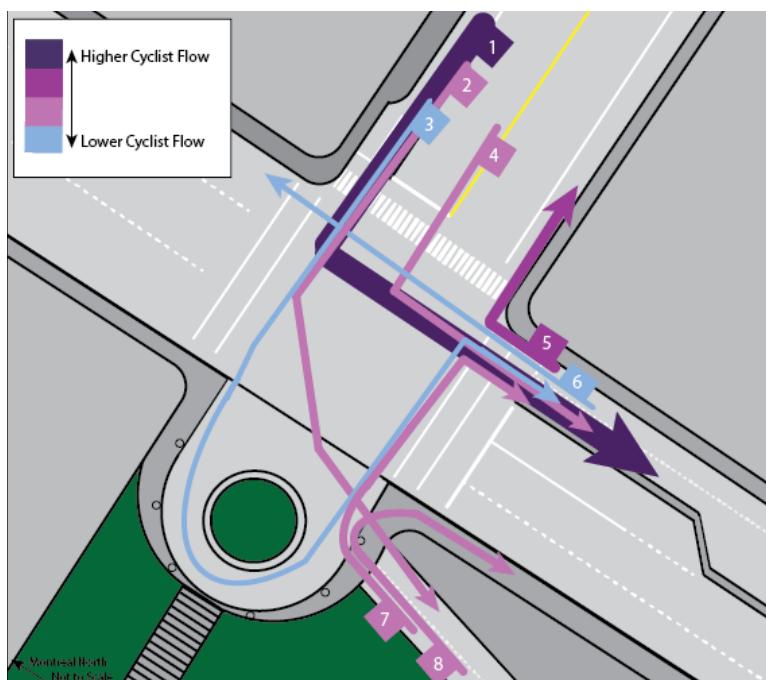
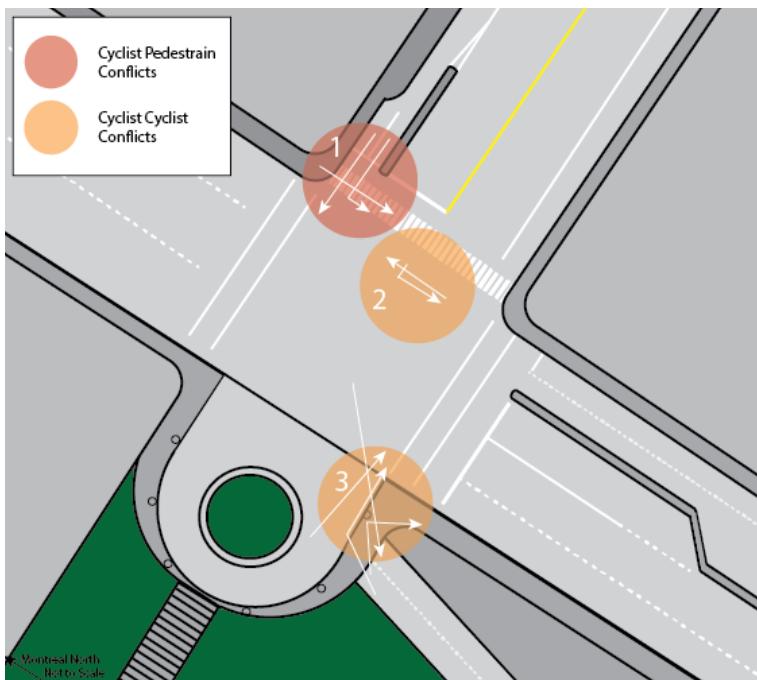


Figure 2: Desire Lines

CONFLICTS

Three Conflict Zones can be seen in Figure 3. Conflict Zone 1 represents conflicts between cyclist and pedestrians at the northeast corner of the intersection. Conflicts would occur when cyclists wanted to go straight or turn left and pedestrians were trying

Figure 3: Conflicts



to cross the street from the northeast to southeast corner of the intersection. In these instances, both pedestrians and cyclists had green lights. Conflict Zone 2 represents conflicts between cyclists at the southeast corner. Cyclists travelling northbound on Saint-Laurent would conflict with cyclists turning left from Bellechasse. Conflict Zone 3 also features conflicts between cyclists. The problem route in this zone is represented by Desire Line 2. These cyclist cut

across the street and interfered with cyclists from the bike path as well as cyclists using the roundabout. This is especially problematic as visibility is limited in this zone.

RESULTS

The redesign of Bellechasse and Saint-Laurent was an ambitious endeavour to improve cycling circulation. However, the redesign resulted in some problems. Three main issues were carefully considered when developing recommendations:

1. **Cyclist crowding** at the northeast and southwest corners of the intersection, where the most cyclist traffic was observed
2. **Conflicts** in these overcrowded areas
3. Cost and political **feasibility**

The above analysis gives rise to three redesign options, which are outlined below.

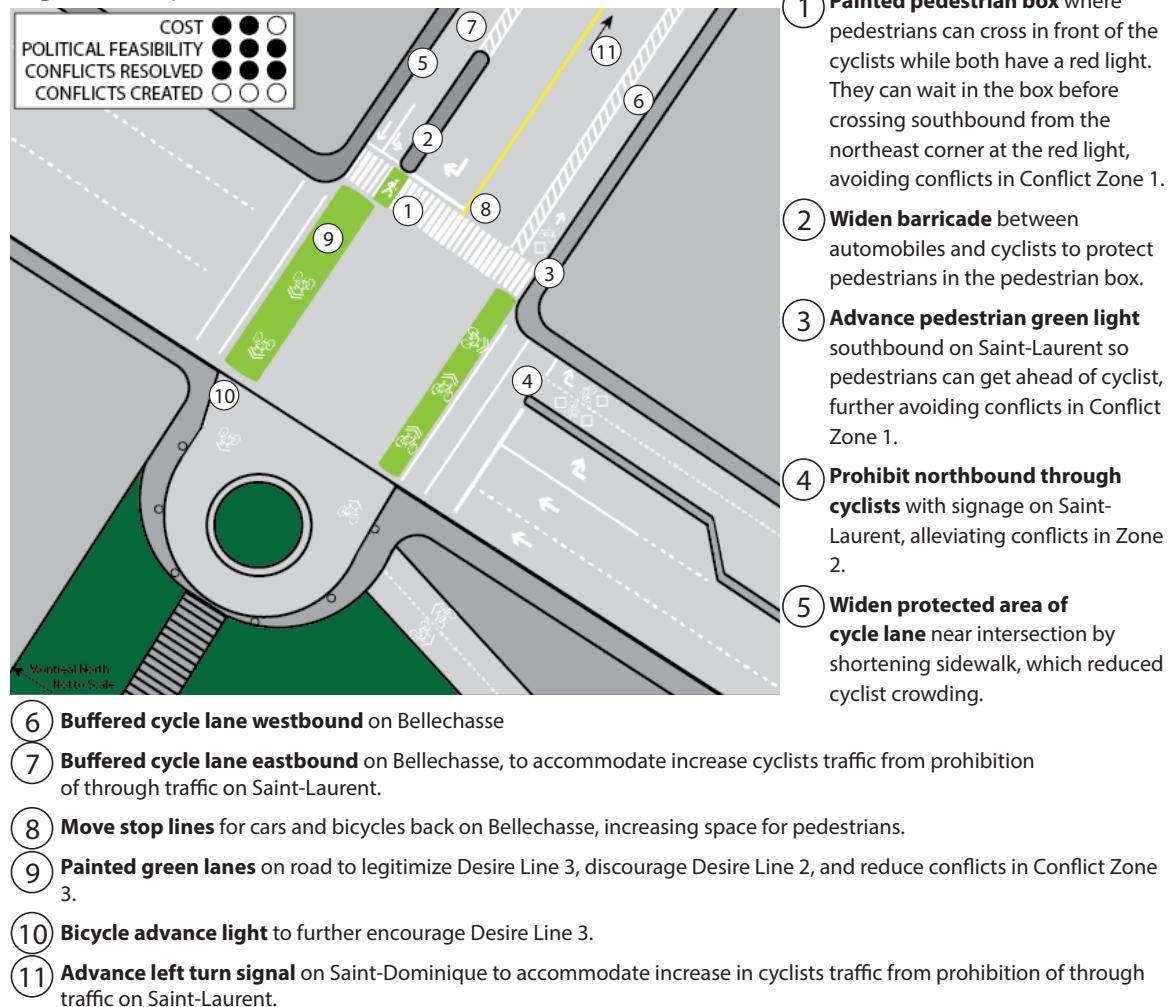
RECOMMENDATIONS

Three redesign options were considered. Option 1, which is the recommended option, is presented in detail. This is followed by a brief overview of Options 2 and 3.

OPTION 1: RECOMMENDED REDESIGN

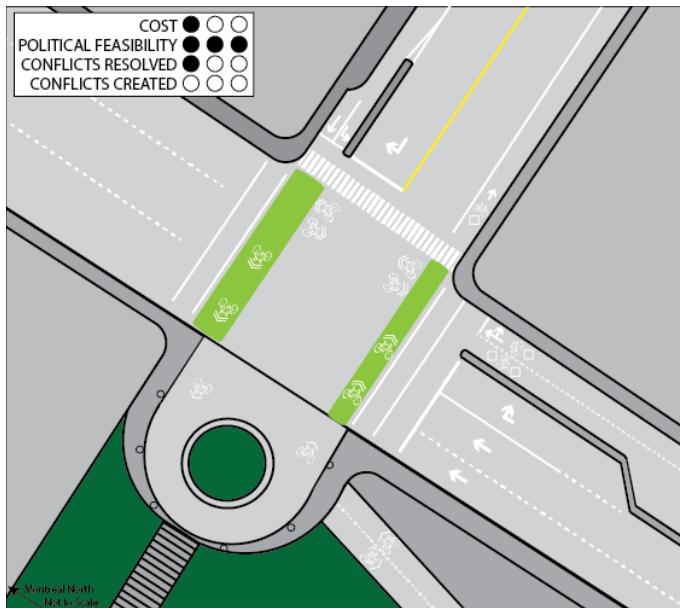
Option 1 is the recommended intersection redesign and can be seen in detail in Figure 4. In this option, attempts were made to utilize coloured paint, make minimal infrastructure adjustments, and integrate interventions with existing infrastructure. This redesign features a relatively low cost and high political feasibility.

Figure 4: Option 1



In this option, attempts were made to encourage Desire Line 3. This provides cyclists travelling westbound on Bellechasse with two opportunities to turn left. First, when they have a green light to go straight and, second, when they have a green light for left turns. The intention of this is to alleviate cyclists flow at the southeast corner of the intersection and reducing cyclist crowding at the northeast corner. Finally, prohibiting northbound through cyclists on Saint-Laurent is meant to divert cyclists to Saint-Dominique, where there is an existing contraflow cycle street for cyclists wishing to travel further north.

Figure 5: Option 2



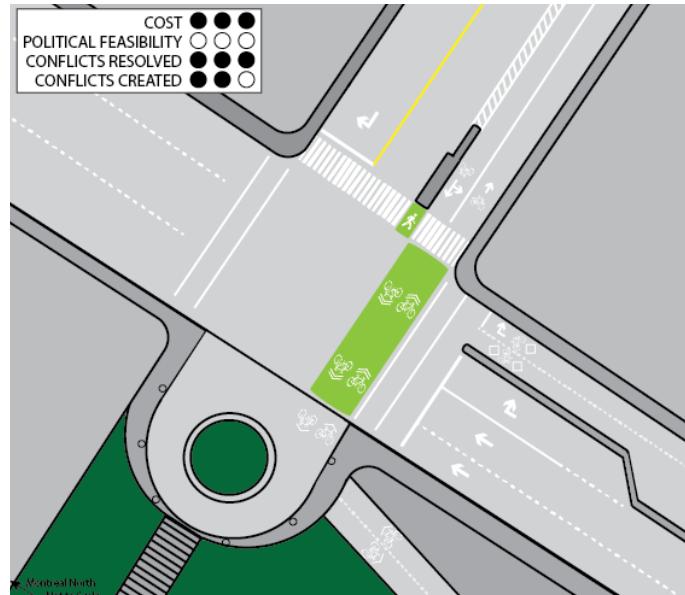
OPTION 2: LOW COST BUT LOW IMPACT

This alternative, shown in Figure 5, requires no infrastructure changes and, therefore, features very low costs and high political feasibility. However, it has a low impact on conflicts. The only conflict it potentially solves is the conflict in Zone 3 caused by Desire Line 2. This option is not recommended.

Figure 6: Option 3

OPTION 3: HIGH COST BUT POLITICALLY UNFEASIBLE

This high cost alternative, seen in Figure 6, features a bidirectional buffered cycle lane on the southside of Bellechasse. However, this could result in conflicts on Saint-Dominique, reduced space for westbound cyclist on Bellechasse, and crowding at the southeast corner of the intersection, which is where the most cyclist flow was observed. Furthermore, the number of driveways on the south side of Bellechasse makes increasing the number of cyclists on this side of the street undesirable. Importantly, this intersection was only recently redesigned. A high cost option resulting in further construction is politically unfeasible.



CONCLUSION. Option 1 is recommended due to its relatively lower costs, high political feasibility, and positive impact on existing conflicts. This option represents a second phase of interventions for this intersection that can be well integrated with existing infrastructure. An intersection design study should be completed at Bellechasse and Saint-Dominique to assess the impacts on this intersection and on the cycling network as a whole.

Boulevard St Laurent and Rue de Bellechasse Intersection Redesign Memo

Improving the Multimodal Experience Through Desire Line Analysis and Site Specific Opportunities

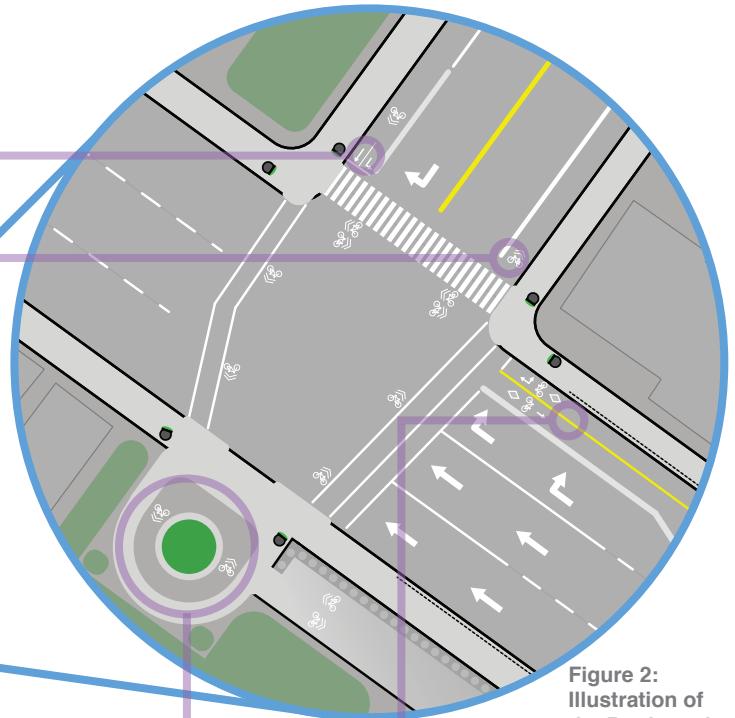
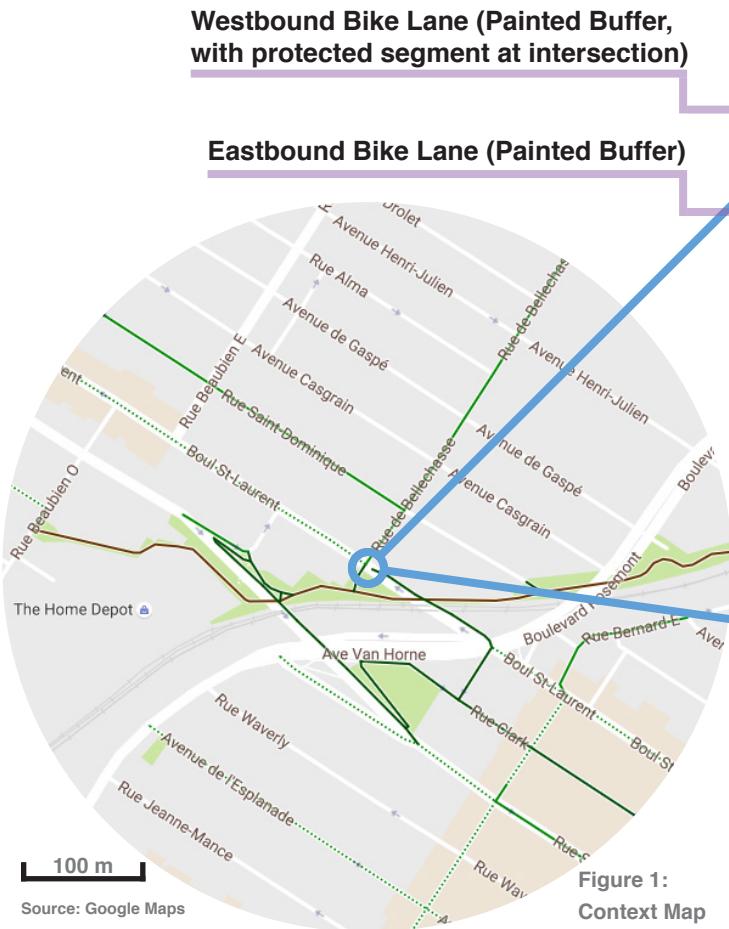
Intersection Description

The intersection of Boulevard St Laurent and Rue de Bellechasse has an atypical mix of multi-modal traffic dynamics. Parallel to St Laurent, north-south cycling routes exist on Rue Clark and Rue Saint Dominique. However, due to the barrier of the rail track in the area, cyclists are forced to travel under the track via the St Laurent or Rue Saint Urbain underpasses. This memo will focus on the intersection of Bellechasse and St Laurent.

St Laurent is major northbound multilane, one-way route for automobile traffic in the city. Currently, St Laurent has a short section of protected bidirectional cycle track along the length of the underpass, between Boulevard de l'Arcade and Bellechasse. Aside from the bidirectional cycle track along the underpass, St Laurent does not have continued cycling infrastructure in this area.

Bellechasse is a bidirectional east/west route for automobile traffic, and as a feeder to St Laurent, has moderate traffic density. Unprotected, unidirectional bike lanes exist on both sides of the street. Bellechasse reaches a dead end at St Laurent and all motorized traffic must turn right, heading north on St Laurent. However, crossing St Laurent as a pedestrian or cyclist leads to further cycling and pedestrian pathways along the rail lines, and an off-street area that facilitates U-turns by cyclists

Note: For the purposes of this report, North/South will be assumed to be in the direction of Boulevard St Laurent and East/West is assumed in the direction of Rue de Bellechasse.



Off-Street Cycling U-Turn Area
Bidirectional Protected Cycle Track

This T-intersection with a mix of bidirectional cycling infrastructure on one side of St Laurent with unidirectional bike lanes on both sides of Bellechasse creates a particularly high amount conflict zones between cyclists, pedestrian, and automobile traffic. Northbound cyclists transferring from Rue Clark or continuing along St Laurent are able to easily make a right onto Bellechasse, allowing them to continue east on Bellechasse with options to connect to the northbound bike lanes on Saint Dominique. However, southbound cyclists turning left on Bellechasse to St Laurent represent the greatest challenge to this intersection's design. The various ways in which cyclists make this left are explored in detail in the following section.



Figure 3: Pedestrians and cyclists using the cross walk at the intersection of Boulevard St Laurent and Rue de Bellechasse



Figure 4: Street markings for westbound cyclist's on Bellechasse

Desire Line Analysis

During rush hour on Monday, October 31st 2016, the intersection of St Laurent and Bellechasse was observed between 8:00 and 9:00 am. Though cycling traffic flows in many directions at the intersection, the problematic movement is southbound cyclists moving from the north side of Bellechasse to join the bidirectional cycle track on St Laurent's east side. This left off of Bellechasse to St Laurent was observed to have four main routes made by cyclists, two of which are illegal. These routes, including those unintended by the original designers, are known as desire lines. These desire lines are identified in figure 5. The routes, labelled from 1 to 4 are in order of popularity, with route 1 being the most frequently chosen path, and 4 the least common option. Additionally, the line weight approximately represents the relative frequencies of cyclists choosing the various routes.

1**Legal**

From the painted arrows in the bike lane and the bike specific lighting in line with St Laurent, this path is the most obvious solution to traversing this awaked intersection when cycling south on St Laurent, off of Bellechasse. The key problem is that cyclists cut across the pedestrian cross walk diagonally and are prompted to do so by the bike specific traffic lighting at the same time as pedestrians.

2**Illegal**

To avoid waiting for the cross walk signal and the disorganized congestion of pedestrians and cyclists along the cross walk, more confident (and unlawful) cyclists switch sides of the road and ride against automobile traffic.

Switching to the southern side of Bellechasse early in the block allows these cyclists to easily turn left, directly onto the bidirectional cycling infrastructure on St Laurent. These cyclists are rarely in the intersection at the same time as pedestrians, but are creating a dangerous situation while riding against automobiles turning right (albeit at low volumes) onto Bellechasse, off of St Laurent.

The signage for cyclists and pedestrians heading straight through the intersection to the U-turn-circle or the pathway system indicates that cyclists should follow the pedestrian cross walk signal. This lighting is phased, before the automobile traffic green light, helping to prevent right-hook scenarios when automobiles turn right onto St Laurent from Bellechasse. Routes 3 and 4 cross at this point, ahead of those choosing to wait for the southbound cross walk (Route 1 riders).

3**Illegal**

Jumping ahead of those waiting to perform the Route 1 path, cyclists following Route 3 legally cross earlier. However, rather than staying on cycling infrastructure, these cyclists ride along the western sidewalk of St Laurent, connecting them to Rue de l'Arcade and Clark. This is an enticing option as to continue south, cyclists will typically head west on Rue de l'Arcade before continuing on south on Clark; by staying in the western side of St Laurent, these cyclists avoid crossing St Laurent a second time.

4**Legal**

These cyclists legally jump the line by taking the pedestrian cross walk sign, which is also permitted for cyclist's movement. Creatively timing their path, shortly after these cyclists have the right of way to cross St Laurent, automobile traffic starts turning right off of Bellechasse, while these cyclists are in the U-turn-circle. As the cyclists complete their U-turn, they can cross St Laurent a second time, heading east on a green light. This maneuverer requires some confidence and is not an obvious way to use the provided infrastructure. Unfortunately, the temptation to stay on the western side of St Laurent seems to cause most cyclists to use the illegal Route 3, rather than the legal Route 4 option.

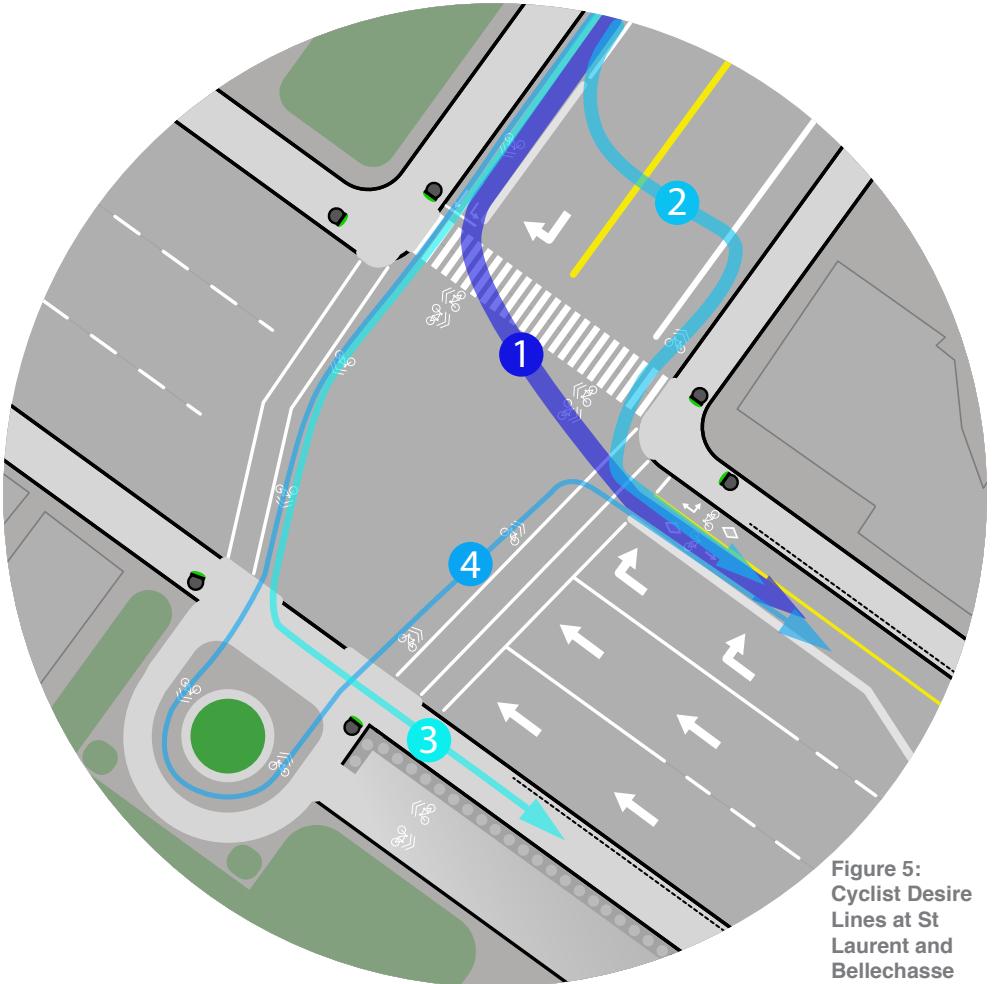


Figure 5:
Cyclist Desire
Lines at St
Laurent and
Bellechasse

Pedestrian Conflicts

The numerous ways cyclists navigate this intersection create excessive numbers of cyclist/pedestrian conflict zones, the most problematic being from the legal and most common cyclist Route 1. Pedestrians are often cut-off by cyclists travelling diagonally across the pedestrian crossing to get to the St Laurent bidirectional cycle track (Conflict Zone A). This is particularly troublesome when pedestrian are northbound, crossing Bellechasse on the eastern side of St Laurent; these pedestrians are often blocked by the slew of cyclists crossing their path and find themselves waiting in the middle of the road.

Though less common, cyclists choosing Route 2 are riding unpredictably and against traffic and cause Conflict Zone B.

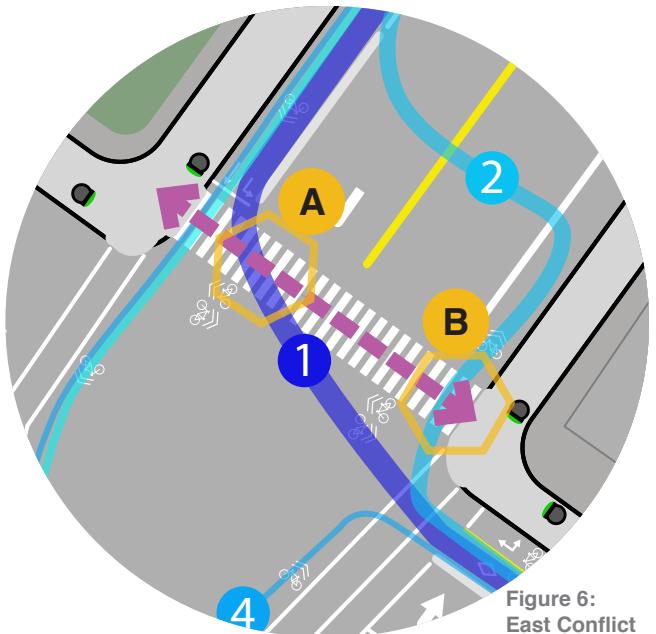


Figure 6:
East Conflict
Zones

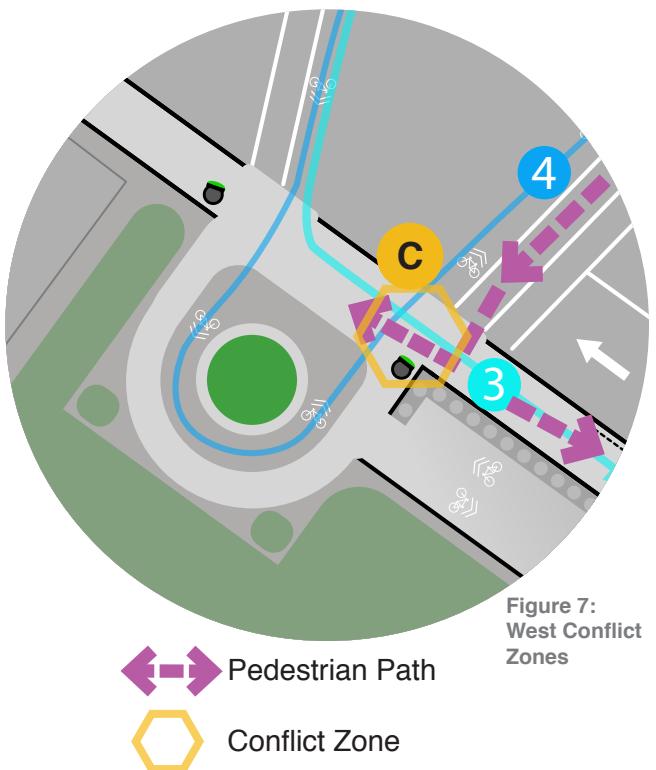


Figure 7:
West Conflict
Zones

With few cyclists using the U-turn-circle, pedestrian conflicts did not seem to be an issue there. However, if more cyclists were to become aware/comfortable with Route 4, there is potential for a blind corner scenario. Pedestrians walking north on the western side of St Laurent would be approaching the U-turn-circle with no sight lines into the U-turn-circle. Similarly the cyclists are blind to approaching pedestrians from the south (Conflict Zone C). During a site visit test ride of Route 4, this conflict zone resulted in a near miss. For this reason, adapting the intersection to promote further use of Route 4 is not recommended.



Figure 8:
Photo of
Conflict
Zone C

With the confusion caused by the four different cyclist routes going south on St Laurent and the inherent conflict zones of this intersection design, a careful rerouting of movement and redesign is called for. The following sections of this report will provide possible improvements to the cycling infrastructure and mixed-mode experience of the intersection of St Laurent and Bellechasse.

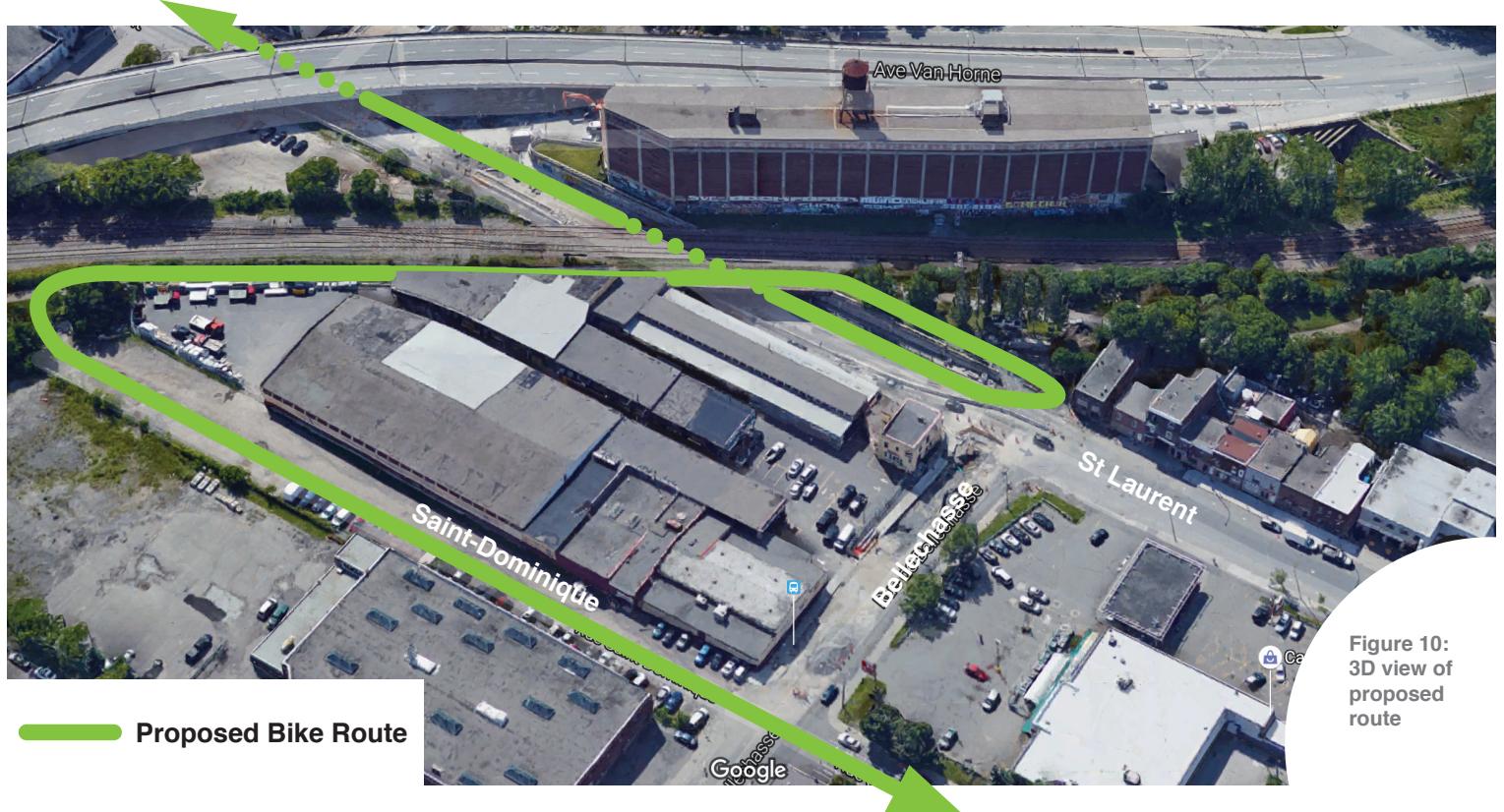
Proposed Alternate Route

The intersection of Bellechasse and St Laurent has a nearby asset to cycling connectivity less than 90 metres away: the rail bridge, which already has a mixed-use, gravel pathway (see figure 9). Cyclists and pedestrians can currently avoid this intersection all together with some added distance to the route. Unfortunately, the cycling infrastructure does not encourage the use of this bridge.



Figure 9: Photo overlooking intersection of Bellechasse and St Laurent from the rail bridge multiuse pathway

St Laurent's bidirectional bike lane on the eastern side is not conducive to cyclists traveling from either direction to incorporate the rail bridge as a part of their route. However, a bidirectional bike lane on the western side of St Laurent could promote the use of this bridge, allowing both north and southbound cyclists to easily join this section off-street bike path. After crossing St Laurent via the train bridge pathway, northbound cyclists can turn left onto Saint-Dominique. Southbound cyclist coming off of the bridge will head south on St Laurent, without the need to cross St Laurent at grade, with most taking their next right on Rue de l'Arcade to connect to Rue Clark's north/south cycling Infrastructure. The proposed route is shown in figure 10.



Turning off of St Laurent

As can be seen from figure 10, the proposed route never crosses St Laurent. However, the route requires specific adaptations to St Laurent and increased space to facilitate the sharp, 180-degree turn between St Laurent and the pathway system.

The infrastructure required to make this route possible is the relocation of St Laurent's bidirectional cycle track from the eastern to the western side (see figure 11). Ideally, the cycle track will be west of the pedestrian sidewalk; this will reduce cyclist-pedestrian conflicts with the high volume of turning bikes. What is currently a raised sidewalk along the underpass of St Laurent would become a cycle track, with a new extension providing replacement pedestrian space.

Around the current U-turn-circle, additional pavement space should be provided to create a wider turn-radius for cyclists making this 180-degree turn onto the pathway system (see figure 12). The concrete railing between the current sidewalk and the ramp leading to the pathway system should also be cut back to improve sight lines.

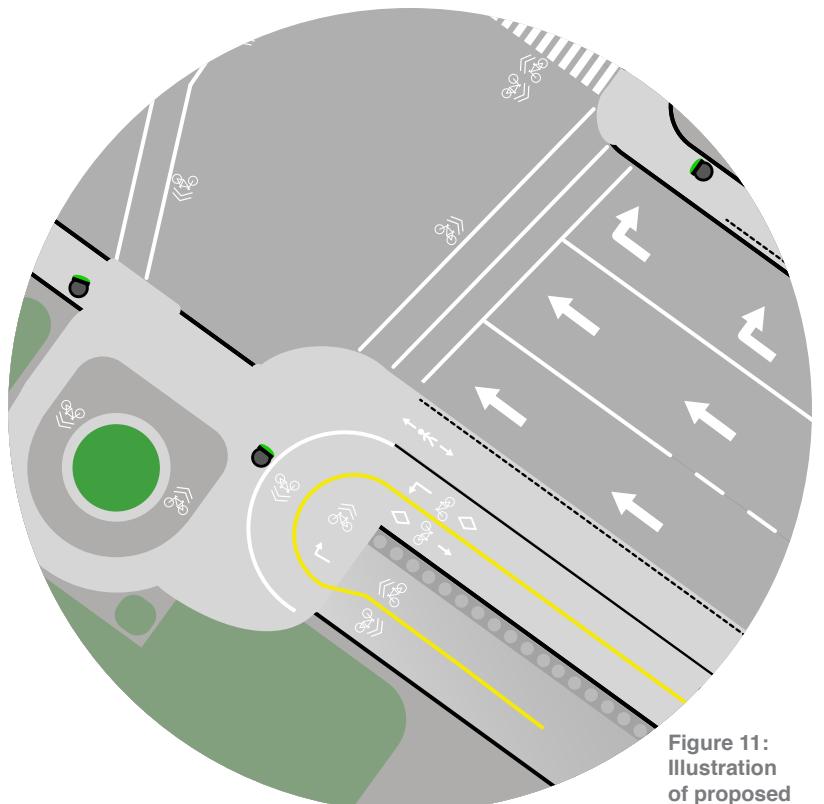


Figure 11:
Illustration
of proposed
update to
St Laurent's
cycling
infrastructure

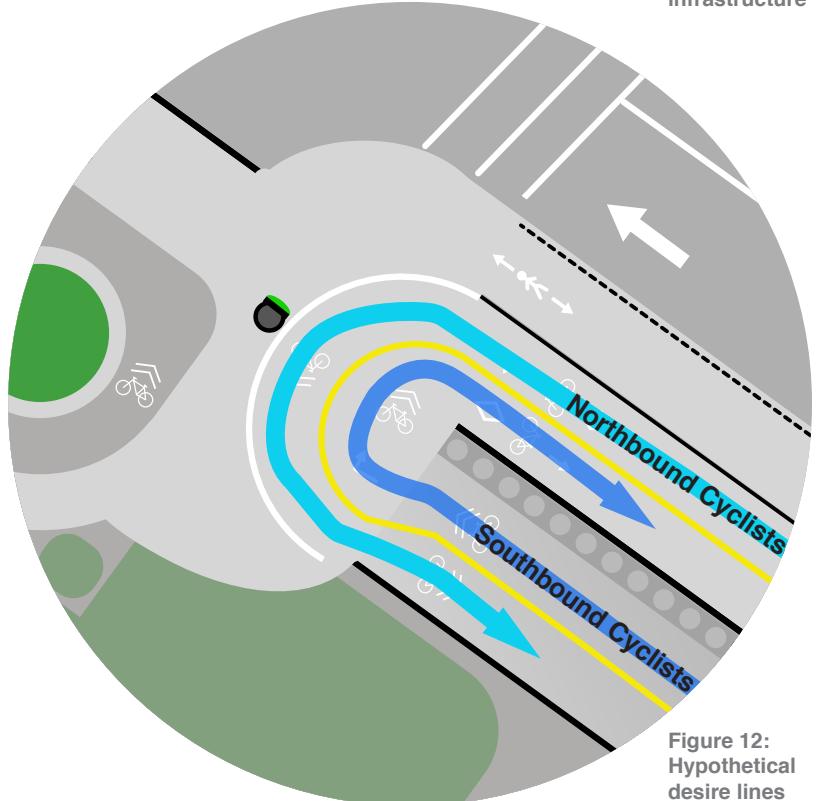


Figure 12:
Hypothetical
desire lines

Benefits

- Greatly reduced conflict zones
- Facilitates ability for north/southbound cyclists to transfer from bike infrastructure on Clark and Saint-Dominique without every crossing St Laurent at grade
- Allows cyclists to maintain constant motion, without any need to stop/accelerate
- Adds time spent on protected and off-street bike facilities
- Removes two St Laurent crossing points from the cycling route (at Bellechasse and l'Arcade)

Unfortunately, the proposed route does add distance to the cycling route. Following the path of the current cycling infrastructure, the cycling route between the intersections of Saint-Dominique/Bellechasse and St Laurent and d'Arcade is approximately 270 metres. The proposed route between the same intersections amounts to approximately 630 metres (a 360 m difference). At an attainable average speed of 20 kmh, the extra 360 metres should add roughly 1 minute in travel time for most cyclist (0.36 km/20kmh). However, the proposed route's absence of an intersection with traffic lights offers time savings. During a site visit, the time between bike specific lighting to cross Bellechasse was measured to be 59 seconds. Cyclists who just miss this light will have equivalent travel times on the proposed route, while cyclists who might have arrived at a green or with short wait times will pay a small time penalty for improved safety on the new route.

Additionally, by diverting cyclists to the western side of St Laurent, the proposed route also nullifies the second bike crossing further south on St Laurent and de l'Arcade; keeping cyclists west directly transfers them from Clark (west of St Laurent), without an at grade crossing. Combined with the utilization of the rail bridge, this approach removes not one, but two intersections from this cycling route. By staying in constant motion, without wait times at the two intersections on either side of the St Laurent underpass, the proposed route may actually be faster overall than the current route. Cyclists also benefit from not needing to stop and reaccelerate, causing less physical exertion and more time spent at cruising speeds. This again highlights further time cost reductions offered by the proposed route. Many travelers (cyclist or motorists) will add distance to their trips to use routes with timed lighting for example. The ability to skip two intersections altogether should greatly improve the experience of cyclists in this area.

Added Design Considerations and Conclusion

A drawback of the new design is that the intersection of Saint-Dominique and Bellechasse will unfortunately have increased cycling traffic. It is recommended that the Saint-Dominique/Bellechasse intersection have traffic lighting added to it. This lighting could have a sensor for bikes and only stop west/east automobile traffic on Bellechasse when cyclists appear at the intersection.

Some northbound cyclists may still choose to cross St Laurent at grade, to continue east on Bellechasse, before connecting to Saint-Dominique; this in mind, it is recommended that the bike lanes on Bellechasse remain as is.

By providing cycling infrastructure on the western side of St Laurent, the unlawful cyclists seeking time savings by biking along the western sidewalk (Route 3 identified in the desire line analysis) will have designated space. As described, the proposed route will increase the amount of cyclist's crossing at the intersection of Bellechasse and Saint-Dominique. However, the reduction of two cyclist crossings on St Laurent compared to the added traffic at the less busy Bellechasse/Saint-Dominique intersection is a clear net benefit to safety, and possibly cyclist travel times. If implemented, this redesign has the potential to save lives, attract further ridership in the area, and set a precedent for multimodal intersections design.



CASE BRIEF FOR INTERSECTION REDESIGN: BLVD ST LAURENT/ RUE DE BELLECHASSE

PREPARED FOR: M. MARC BLANCHET, ASSISTANT CITY MANAGER - DEVELOPMENT
PREPARED BY: NICOLE RATTI, SCHOOL OF URBAN PLANNING, MCGILL UNIVERSITY

THE ST LAURENT AND BELLECHASSE INTERSECTION IS A HOTSPOT FOR DANGEROUS INTERACTION BETWEEN CYCLISTS AND VEHICLES; MANY RESIDENTS HAVE CITED IT AS A COMPLETE SAFETY HAZARD (MONTREAL GAZETTE). THIS MEMO SERVES TO VOICE THE CONCERNS OF USERS, AND EXAMINE CURRENT AND POTENTIAL USAGE TO CREATE DIRECTED IMPROVEMENT STRATEGIES.

RELEVANT BACKGROUND:

The City of Montreal invested 5.6 million dollars into redeveloping and building cycling infrastructure along St Laurent, which included several major intersections. In 2013, the St Laurent/Bellechasse intersection underwent complete renovation of its infrastructure. Prior to this renovation, the intersection had no measurable infrastructure or dedicated space for cyclists or

pedestrians on either crossroad. This posed significant danger for cyclists attempting to navigate St. Laurent, or make dangerous left turns in an intersection crowded with vehicles.



Figure 1.0: St Laurent/Bellechasse (Before redevelopment)
(Google Maps)

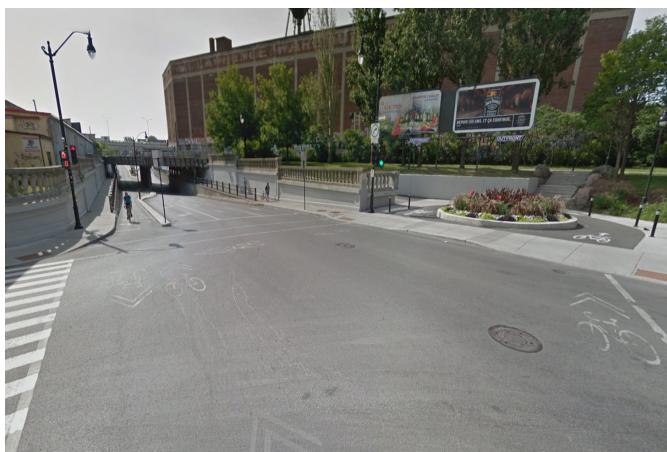


Figure 2.0: St Laurent/Bellechasse (After Redevelopment)
(Google Maps)

This renovation included the addition of the following components:

- Cycling-specific signals at all corners of the intersection
- A bi-directional buffered cycling track adjacent to the southbound lanes of St Laurent
- Painted cycling lanes running parallel to vehicular traffic flow along Bellechasse
- A separated left turn lane for cyclists turning from Bellechasse onto St Laurent, southbound.
- A bicycle-only roundabout on the west side of St Laurent

METHODS:

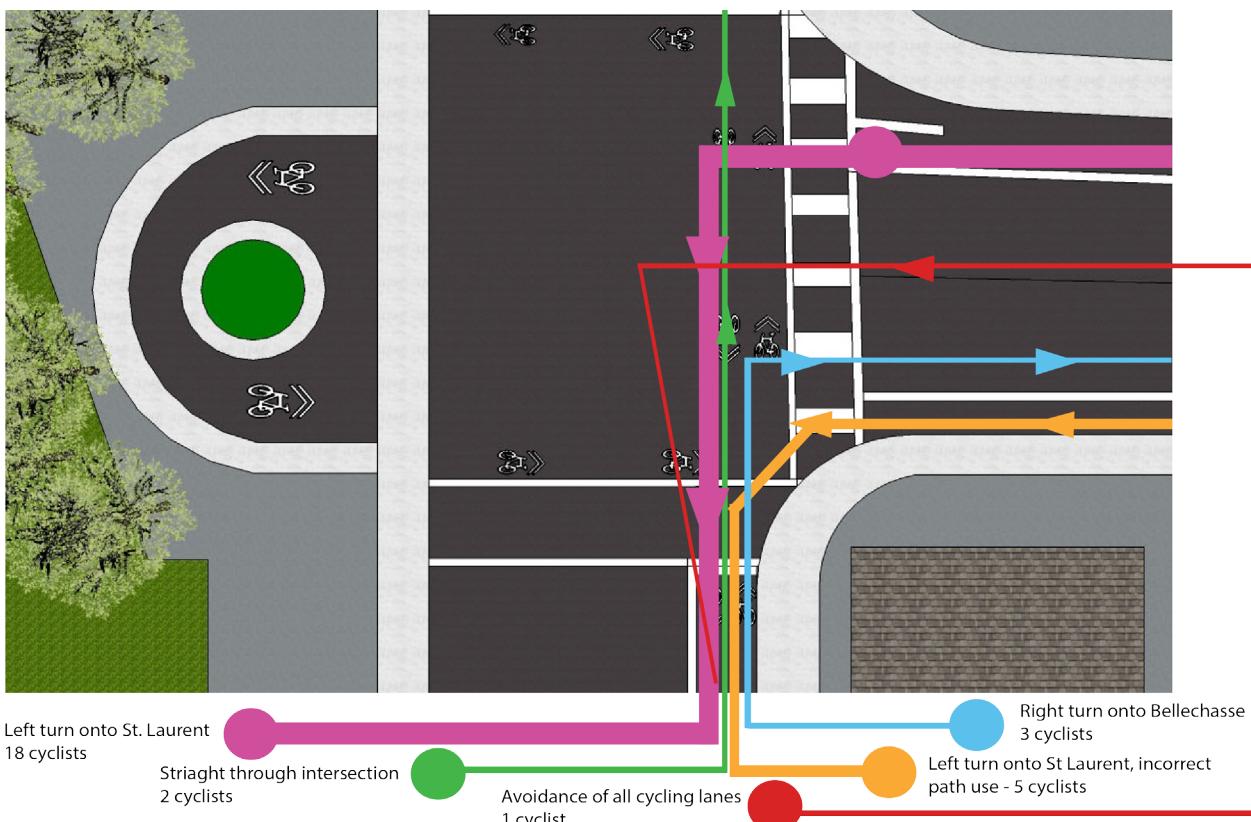
To best assess the performance of the infrastructure at the St Laurent/Bellechasse intersection, a desire lines analysis was performed. Desire lines involve physical observation at the study area, identifying the path taken by each cyclist through the intersection; noting any conflict areas, trends, or relevant characteristics. The thicker the line, the more frequently the path in question was used.

To obtain desire line data of this intersection, observations were taken for one hour, which included counts of all cyclists, and notation of close calls or conflicts between any travellers.

CURRENT USAGE:

As it stands currently, cyclists are not using the infrastructure of the St Laurent/Bellechasse intersection as intended, and several conflict zones between cyclists and vehicles are evident (figure 3.0). The results show:

- The majority of cyclists navigating this intersection are coming west along Bellechasse, and seek to make a left turn onto St Laurent (southbound)
- 10% of the cyclists avoided all cycling infrastructure completely, and rode between lanes of live traffic, or travelled the wrong way along bike lanes
- The roundabout, which was developed during the redevelopment, was completely unused during the observation period
- Two cyclists were forced to swerve out of the way of cars who pulled too far forward on Bellechasse
- All cyclists who made a right turn on onto Rue de Bellechasse did not use the correct lane, but instead took the turn very wide, cutting into lanes of traffic



Based on the observations made above, there is a significant concern with the safety of the left turns being made at this intersection. While the roundabout could be used to promote a 2-stage left turn across the intersection, by all accounts it appears to be serving little purpose. Additionally, the bi-directional lane on St Laurent puts cyclists very close to oncoming fellow cyclists, and causes them to cross over eachothers' lanes often.

RECOMMENDATIONS:

Based on the areas of conflict and frequency of use from the observations noted above, several strategic and targetted improvements for this intersection can improve its safety and utility for cyclists significantly. Figure 4.0 below shows a graphic representation of what an updated intersection may look like. The idea of this redevelopment is to create a protected intersection, where cyclists are separated from vehicles and other potential sources of injury as much as possible. Four key interventions are recommended in order to further advance the safety and utility of this intersection.



Figure 4.0: Proposed Improvements for the St Laurent/Bellechasse Intersection

1. COMPLETE CYCLING LANE NETWORK

It is imperative to build painted cycling lanes which move adjacent to the flow of traffic on St laurent north of this intersection so that cycling infrastructure does not end so abruptly. It is important that cyclists understand where to travel, and based on the lack of cyclists north of the intersection, the current “sharrow” system may not be clear enough in the face of so much traffic congestion. Currently, further up St Laurent there is mid-day commerical parking along the West side, however a lane adjacent to this parking, or in place of it where permissible would serve a great purpose (Boston Complete Streets, 2014).

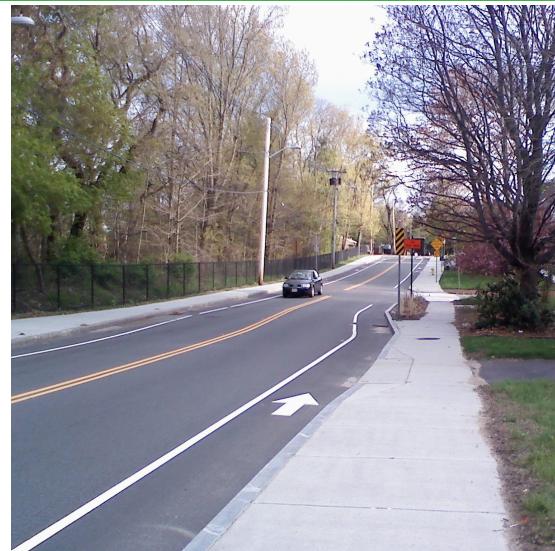


Figure 5.0: Bicycle lanes flowing with traffic
(Calm Streets Boston)

2. REMOVE BI-DIRECTIONALITY OF LANES

It is recommended that the bidirectional lane on the east side of St Laurent be split into two unidirectional lanes on either side of the road, which will follow the flow of traffic. There are several benefits to this model.

1. Bicycles will not be in conflict with one another by crossing into adjacent lanes
2. The intersection becomes more intuitive, and left turns do not involve dangerous cuts into the intersection, or crossing infront of vehicles, a simple L shaped turn suffices.



Figure 6.0: Proposed split bicycle lanes along St Laurent

3. BUMP OUTS AND PROTECTED TURNS

Building four concrete curbs, or small bumpouts, at each corner of the cycling intersection creates a physical divide between cars and cyclists when turning. Cyclists are able to wait for turns at their own crossing, vehicles are pushed back from the movement of cyclists, and pedestrians have their own crosswalk. This model supports cyclists moving freely in their own dedicated, and clearly marked space (Protected Intersections, 2014).

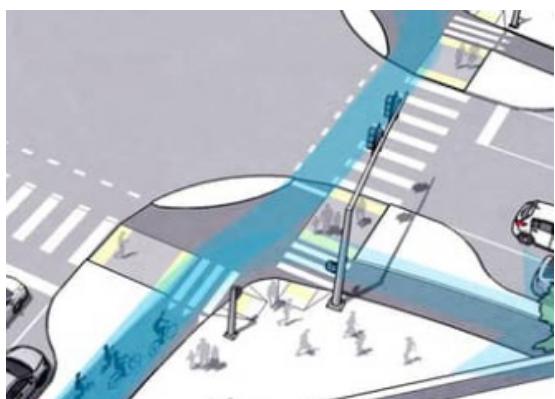


Figure 7.0: Protected Intersection Curbs
(<http://www.protectedintersection.com/>)

3. DEDICATED SIGNALS AND CLEAR SIGNS

There are two key components to clear signaling, which will ensure cyclists are using the intersection appropriately, and are given dedicated time to travel safely.

1. Cycling traffic signals

Separated traffic signals for cyclists, which are programmed to allow a period of time for cyclists to travel in all directions before any vehicles travel will ensure safety and minimize conflict in the intersection.

2. Clear marking of cycling zones

The use of bright coloured paint to denote the cyclist turning lanes of the intersection will provide a clearer signal for how the intersection is meant to be used. The use of sharrows and left turn symbols on the lane will also improve this clarity.

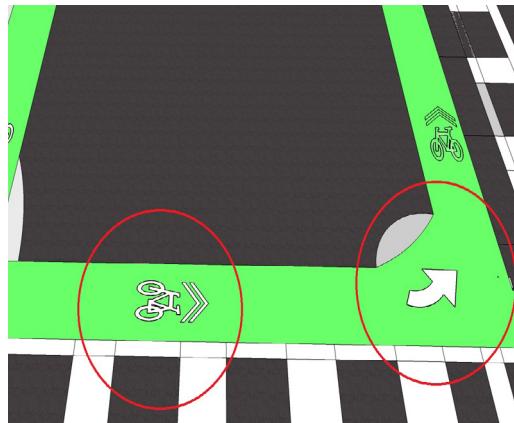


Figure 8.0: Proposed Signs and Symbols for Cycling Infrastructure

CONCLUDING REMARKS

As it stands, the intersection at St Laurent and Bellechasse is heavily used by cyclists, but lacks a cohesive, clear, or safe pattern of use. The results of a desire lines analysis suggest that the left turn onto St Laurent Southbound poses significant danger to all modes of transit, and infrastructure must be separated by transit mode. As well, the existing bike lanes and roundabout are being foregone altogether in place of disorganized route choices. It is recommended that this intersection be revisited by the City of Montreal Planning Department, and that additional modifications to infrastructure be made. The safety of pedestrians and cyclists can not be overlooked, and although the City performed an admirable renovation of this site in 2013, the results do not adhere to the needs of cyclists in the area. Building on this redevelopment using the interventions mentioned above is a step forward in responding to safety concerns for all travellers in Montreal.

SUPPORTING MATERIAL

Media Coverage of Intersection:

<http://montrealgazette.com/news/local-news/cyclists-say-city-has-much-work-to-do-to-improve-safety>
<http://www.cbc.ca/news/canada/montreal/bike-path-on-st-laurent-boulevard-causes-traffic-chaos-1.3080196>

Protected Intersections: <http://www.protectedintersection.com/>

Boston Complete Streets: <http://bostoncompletestreets.org/>