CITY OF VANCOUVER

REPORT

Report Date: September 19, 2023
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VanRIMS No.: 08-2000-20
Meeting Date: October 17, 2023
[Submit comments to Council]

TO: Vancouver City Council

FROM: General Manager of Engineering Services

SUBJECT: Piloting a Pedestrian Scramble Crossing in Vancouver

RECOMMENDATION

THAT Council direct staff to advance design, implementation and monitoring of a pedestrian scramble crossing at the intersection of Granville and Robson Streets, including stakeholder engagement to inform the detailed design, as generally outlined in this report.

REPORT SUMMARY

This report responds to a Council request to report back on piloting a pedestrian scramble in Vancouver. A pedestrian scramble has traffic signal phasing which gives pedestrians an exclusive phase to cross simultaneously in all directions at a signalized intersection, including diagonally, while vehicle movement in all directions is stopped.

COUNCIL AUTHORITY/PREVIOUS DECISIONS

The City of Vancouver's long-range transportation plan identifies walking and cycling as key priorities to support the growing number of people, jobs, and trips in the city, as well as health, climate and other key city goals. The plan set a target that at least two-thirds of all trips be by on foot, bike, or transit by 2040–which was advanced to 2030 through the Climate Emergency Action Plan. It also set a goal of zero traffic-related fatalities and serious injuries.

CITY MANAGER'S/GENERAL MANAGER'S COMMENTS

The City Manager recommends approval of the foregoing.

REPORT

Background/Context

A pedestrian scramble is a signalized intersection that provides an exclusive phase for pedestrians to cross the street in all directions. Typically this includes both direct and diagonal crossings. It is also known as a Pedestrian Priority Phase, Exclusive Pedestrian Phase or Barnes Dance. Vancouver was one of the first cities in the world to implement a pedestrian scramble at Granville and Hastings Streets where one was in operation from 1953 until 1970. More recently, in 2019 the City installed an "all-walk" phase at the intersection of Hornby Street and Robson Street to stop all vehicle traffic to let pedestrian cross in all directions simultaneously. However, this location does not include a diagonal crossing.

Pedestrian scrambles are typically used where pedestrian volumes are extremely high and/or when pedestrians crossing parallel to vehicle traffic is undesirable, such as when there are high vehicle turning volumes. During the pedestrian 'scramble' phase, red signals restrict vehicle movement in all directions, which eliminates potential conflicts between vehicles and people walking during that phase.

How a pedestrian scramble works

Implementing a pedestrian scramble requires the addition of a new phase to the signal cycle, as shown in Figure 1 below. There are two types of pedestrian scramble – type 1 only allows pedestrians to cross during the scramble phase while type 2 also allows pedestrians to cross when vehicles are moving. Allowing the pedestrian crossing when vehicles are moving reduces turning vehicle capacity and introduces potential conflicts if the turn is permitted. A more detailed overview of pedestrian scramble types and their applicability is described in *Appendix A*.

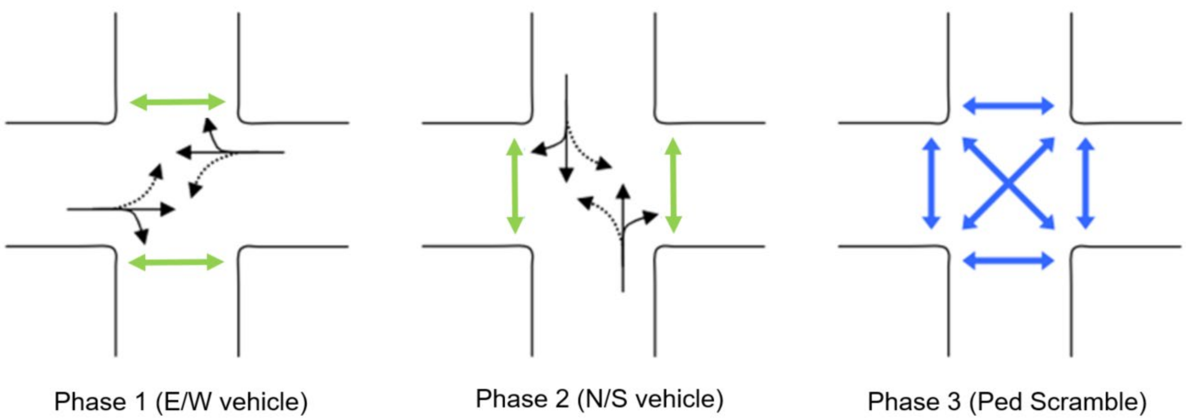

Figure 1. Example of signal phasing for a pedestrian scramble. Black lines indicate vehicle movement. Blue and green lines indicate permitted pedestrian crossings. Green lines are pedestrian crossings only permitted in a type 2 scramble.

The additional phase can increase delay for all users by reducing the share of time dedicated to each movement and/or increasing the overall signal cycle length, as shown in *Figure 2.*

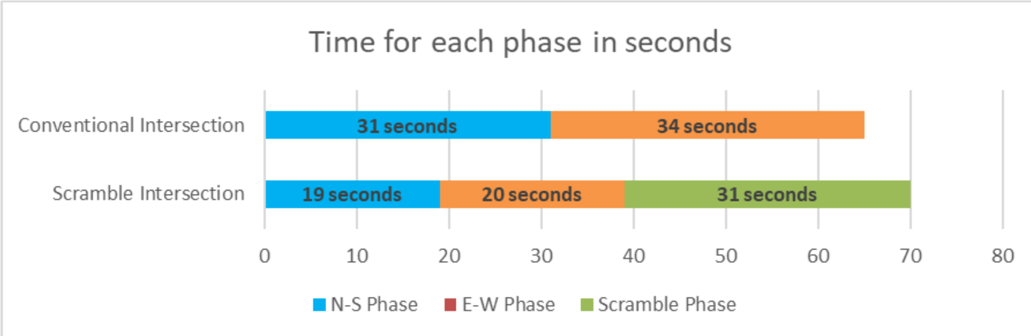

Figure 2. Example of a signal cycle distribution for conventional and pedestrian scramble intersections

Benefits and drawbacks of pedestrian scrambles

If implemented in the appropriate context, pedestrian scrambles can:

- Increase pedestrian priority and placemaking at the intersection
- Decrease crossing distance and time for pedestrians moving diagonally through the intersection, who would otherwise have to separately cross two legs of the street
- Eliminate conflicts between people walking and turning vehicles in a type 1 scramble
- Shorten pedestrian crossings when intersection geometry is skewed

Trade-offs of pedestrian scrambles can include:

- Longer waiting time for pedestrians, resulting in more crowded sidewalks and increased non-compliance (jaywalking)
- Increased vehicle and transit delays
- Accessibility challenges for visually-impaired people, due to the lack of vehicle movement parallel to the crosswalk during the walk phase, and the introduction of the diagonal crossing

An evaluation and comparison of pedestrian scramble types is described in *Appendix B*.

Pedestrian scrambles in other cities

Staff have reviewed implementation of pedestrian scrambles in other jurisdictions, including Toronto, New York City and Calgary (*Appendix C*). Results have been mixed, with some locations not being successful due to impacts to all road users and particularly concerns from persons with disabilities. The most successful examples have carefully considered the overall context of the intersection and transportation network.

Key elements of a successful candidate location

Based on peer city review and following recommendations from the 2012 City of Vancouver Pedestrian Safety Study, pedestrian scrambles would have the greatest overall benefit and chance for success at intersections with:

- Consistently high pedestrian volumes, particularly demand for diagonal crossings or high ratio of pedestrian volumes to vehicle volumes
- Low vehicle volumes, to manage vehicle delay associated with adding the scramble phase
- Short diagonal crossing length
- If a type 2 scramble is being considered, vehicle turn restrictions or low vehicle turning volumes

Strategic Analysis

Evaluations

Staff evaluated intersections that broadly fit the above criteria, with a focus on downtown intersections with high pedestrian volumes. A long list of candidates was evaluated to determine which locations would provide the greatest benefit while minimizing impacts. This included a review of traffic signal infrastructure, existing land use, pedestrian and vehicle volumes, intersection geometry and potential transit impacts.

This analysis resulted in a short list of the following four locations:

1. Granville St and Robson St
2. Granville St and Georgia St
3. Commercial Dr and 1st Ave
4. Denman St and Davie St

Detailed analysis of these four locations was conducted using Synchro and SimTraffic software to quantify the impacts of adding a pedestrian scramble phase to the existing signal timing. Results from the PM peak rush hour traffic modelling and analysis exercise are summarized in *Table 1.* Shortlist Vehicle Modelling Resultsbelow and more detailed results can be found in *Appendix D*. All four shortlisted intersections have high pedestrian volumes and have the potential to improve the experience for those on foot, although Type 1 scrambles may increase overall wait times for some walking trips. Therefore, the modelling and selection process focused on vehicles to understand how a scramble implementation would affect vehicles and particularly transit.

Table 1. Shortlist Vehicle Modelling Results

		Vehicular Intersection Delay (seconds/veh)	Vehicular Intersection Delay (% increase)	Level of Service
Granville & Robson	Existing	12.4	151%	B
	Scramble - Type 2	**31.1**		**C**
Granville & Georgia	Existing	12.7	196%	B
	Scramble - Type 1	**37.7**		**D**
Commercial & 1st	Existing	35.6	703%	D
	Scramble - Type 1	**286.0**		**F**
Denman & Davie	Existing	15	194%	B
	Scramble - Type 1	**44.2**		**D**

** Level of Service is a qualitative measure of traffic flow at an intersection where LOS D or lower indicates the intersection experiences substantial delays*

Based on these modelling results and additional considerations including cost, timelines, construction feasibility and coordination with adjacent/future projects, staff are recommending the intersection of Granville St and Robson St for the pedestrian scramble pilot.

Although the overall impact to vehicles is lowest at the Granville and Robson St intersection, it has potential to highly impact to transit riders with over 1,120 buses and 21,000 passengers each day. The delay to transit will result from the reduced green time for vehicles and will depend on when buses arrive at the intersection. This will primarily impact Granville St buses continuing north and south at the Granville and Robson St intersection. Staff have consulted with TransLink and they expressed concern with the additional delay to transit. Staff discussed adjusting the signal timing during the design phase and adjusting through the pilot phase to further to minimize transit delay. Additionally, staff will develop a robust monitoring plan to ensure all impacts are clearly understood during the pilot phase.

Public/Civic Agency Input

Staff plan to work with Council Committees, particularly the Persons with Disabilities Advisory Committee, on the detailed design should Council direct staff to proceed with a pilot.

Implications/Related Issues/Risk

Financial

Council has allocated $500k from Growing Community Fund to the pedestrian scramble pilot. Granville & Robson is anticipated to cost between $100 and $200k, which is lower than the original budget as this signal is relatively new and existing signal equipment wouldn't need an extensive upgrade. Please reference *Appendix E* for cost details. Any remaining funding will be reallocated to the Transportation Safety Program which provides funding for measures such as rapid flashing beacons, crosswalks, leading pedestrian intervals and curb bulges.

CONCLUSION

Based on traffic analysis and preliminary signal timing design, staff recommend a single pedestrian scramble pilot location at the intersection of Granville St and Robson St. This location is a strong candidate due to the consistently high pedestrian crossing volumes, restricted vehicle turning movements, presence of upgraded signal infrastructure, and it being a high profile nexus of pedestrian activity. It would be designed as a type 2 pedestrian scramble to also allow pedestrians to cross concurrently with vehicles during non-scramble phases. This would maximize priority for pedestrians and minimize non-compliance but would increase delay for bus passengers.

If directed to proceed by Council, staff will advance the pedestrian scramble pilot and begin detailed design incorporating feedback from key stakeholders, such as Council Advisory Committees, with a goal of implementing before summer 2024. Staff will coordinate with the Granville Street planning program to ensure that a pedestrian scramble pilot and the public space opportunities are complementary.

Following implementation, staff will monitor and evaluate the performance of the intersection to guide any short- or long-term modifications, as well as the potential to expand the pilot to other locations.

* * * * *

APPENDIX A: Overview of Pedestrian Scrambles

Scramble intersections introduce a new phase to the signal cycle

A simple, conventional intersection has two phases, allowing movement first in one direction, then in the other. Pedestrian scrambles introduce a third ‘scramble’ phase, which allows pedestrian movements in all directions, including diagonally. During this phase, motor vehicle movement is stopped on all approaches. Right turns on red are restricted on all approaches with a pedestrian scramble.

This new phase can increase delay for users by reducing the share of time dedicated to each movement and/or increasing the overall signal cycle length, as shown in Figure 3.

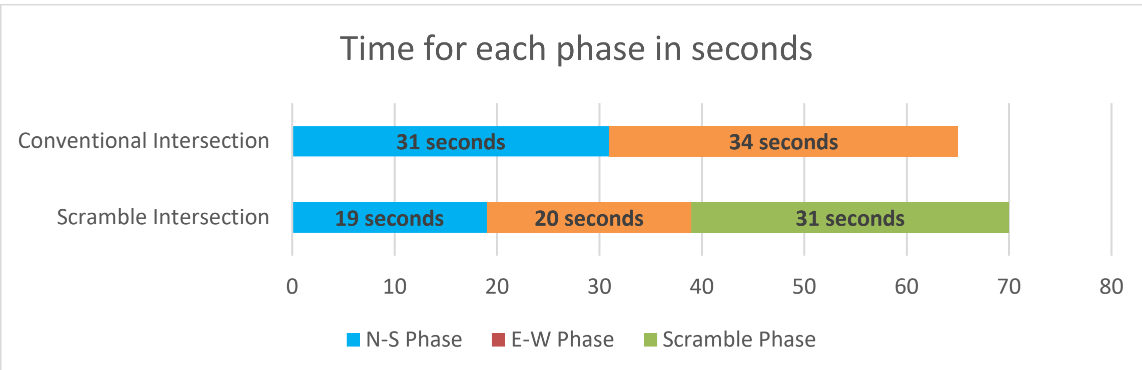

Figure 3. Example of a signal cycle distribution for conventional and pedestrian scramble intersections

Types of Pedestrian Scramble

There are two types of Pedestrian Scramble, as shown in *Figure 4* and *Figure 5*. Both types feature the scramble phase as described above: pedestrians can walk in all directions, including diagonally, while vehicles are completely stopped.

Where they differ is how pedestrians are treated during the other ‘vehicle movement’ phases:

- In Type 1, pedestrians are not allowed to cross concurrently in the direction of motor vehicle traffic movement.
- In Type 2, pedestrians are allowed to cross concurrently in the direction of motor vehicle movement.

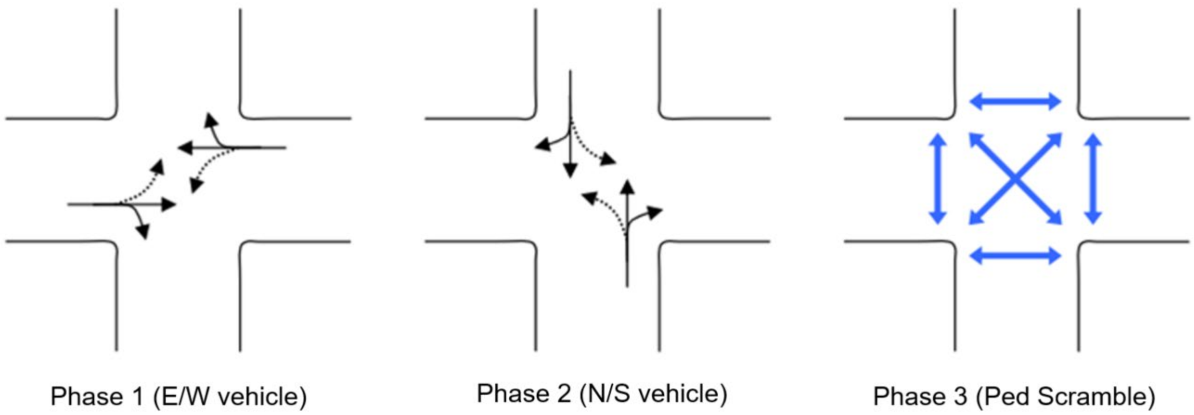

Figure 4. Type 1 pedestrian scramble. Black lines indicate vehicle movement. Blue lines indicate pedestrian movement. Pedestrians are not permitted to cross concurrently in the phases where traffic is flowing.

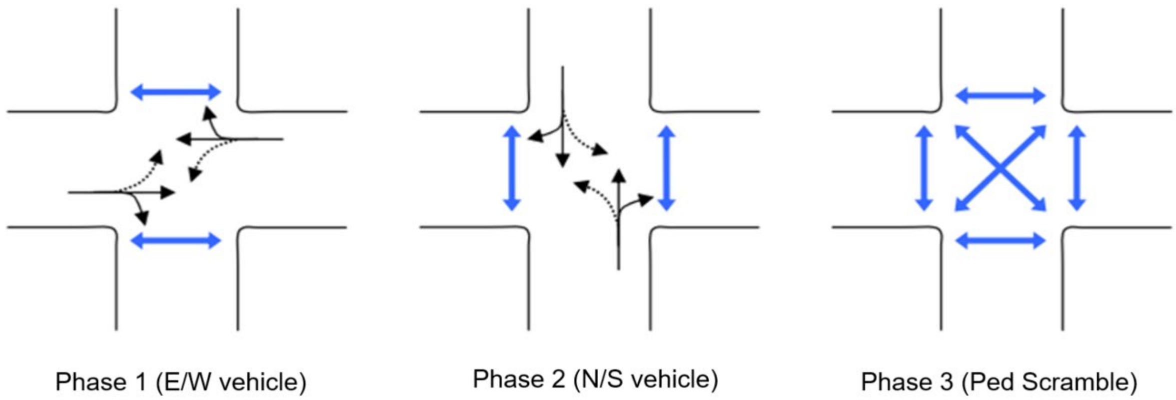

Figure 5. Type 2 pedestrian scramble. Black lines indicate vehicle movement. Blue lines indicate pedestrian movement. Pedestrians are permitted to cross concurrently with vehicles in Phase 1 or Phase 2.

Scramble types: typical applications

A comparison between the two types of scramble crossing is summarized below in *Table* 22.

Table 2. Benefits, trade-offs, and applicability of Type 1 and Type 2 scramble crossings

Type	Benefits	Trade-offs	Applicability
Type 1	- Eliminates conflicts between turning vehicles/transit and pedestrians crossing the street	- Reduced overall crossing times for pedestrians - Crowded sidewalks and increased jaywalking	- High turning volumes - Turn conflicts that delay transit movements - Sufficient sidewalk corner space - Acceptable increased delay for all users
Type 2	- Increased time for pedestrians to cross	- Reduced turn capacity for vehicles if not restricted - Potential conflicts between people walking and turning vehicles (during regular phases)	- High pedestrian volumes - Restricted or low vehicle turning volumes

Type 1 Pedestrian Scrambles allow for more turning vehicle capacity and eliminate conflicts between turning vehicles and pedestrians crossing the street. The trade-off is reduced overall crossing time for pedestrians, which requires pedestrians to wait longer and can cause sidewalks to get crowded.

It is more commonly used when there are high vehicle turning volumes and sufficient sidewalk corner space for pedestrians to stand, and where an increased delay for all users is acceptable, such as a narrow one-way street grid.

Type 2 Pedestrian Scrambles provide more crossing time overall for pedestrians, at the expense of restricting turn movement capacity for vehicles.

It is more commonly used when pedestrian volumes are high and vehicle turning volumes are restricted or very low. This also helps resolve accessibility concerns related to visually impaired pedestrians requiring parallel traffic present and reduces potential for jaywalking.

Appendix B – Pedestrian Scramble Signal Timing Evaluation and Comparison

Figure 6 below provides a chart of a typical signal cycle distribution for a conventional signal and one with a pedestrian scramble phase. The blue and orange portion of the chart illustrate the distribution of northbound/southbound and eastbound/westbound vehicle phases in seconds. The pedestrian scramble phase is shown in green. With the addition of the pedestrian scramble, the total signal cycle length increases while reducing vehicle phase length.

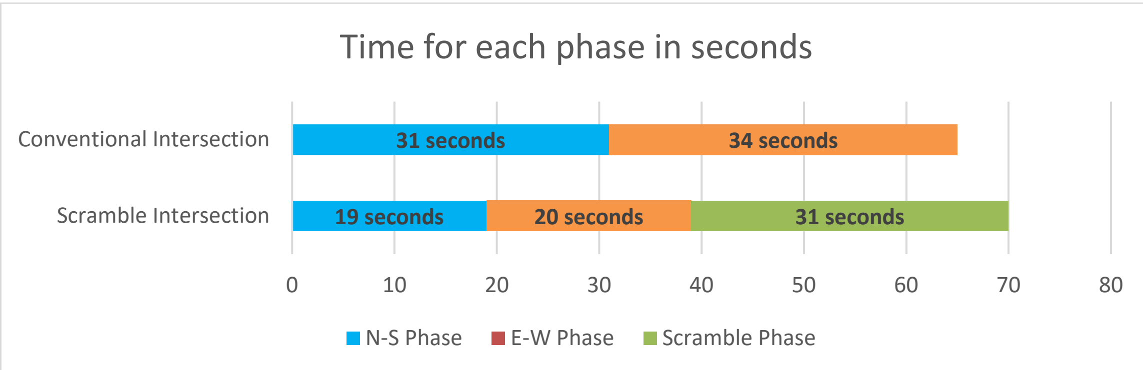

Figure 6. Example of a signal cycle distribution for conventional and pedestrian scramble intersections

Pedestrian Scramble Metrics

Refer to *Figures 7-10* below for comparisons between a conventional intersection and the 2 types of pedestrian scramble using an optimized signal cycle distribution as described above.

A conventional intersection provides 50% pedestrian crossing opportunity when it is equally split between each phase with a maximum wait time of 34 seconds.

A type 1 Pedestrian Scramble provides 44% pedestrian crossing opportunity and has a maximum of 44 second wait time to cross if they arrived at the end of the scramble phase. Compared with Type 1 pedestrian scramble, a conventional intersection provides more crossing opportunities and shorter wait time.

A type 2 pedestrian scramble will provide 74% crossing opportunity and has a maximum of 24 second wait time to cross if they arrived at the end of the scramble walk phase or concurrent vehicle green. Comparing with conventional intersection, a type 2 Pedestrian Scramble provides approximately 48% more crossing opportunities and 32% shorter wait time. This option significantly improves pedestrian crossing experience with minimal pedestrian delay and more crossing opportunities.

A vehicle or bus arriving to a red light at the intersection will have an average increase from 6.8s at a typical intersection phasing to 17.8s at a pedestrian scramble phasing using the above phasing assumptions.

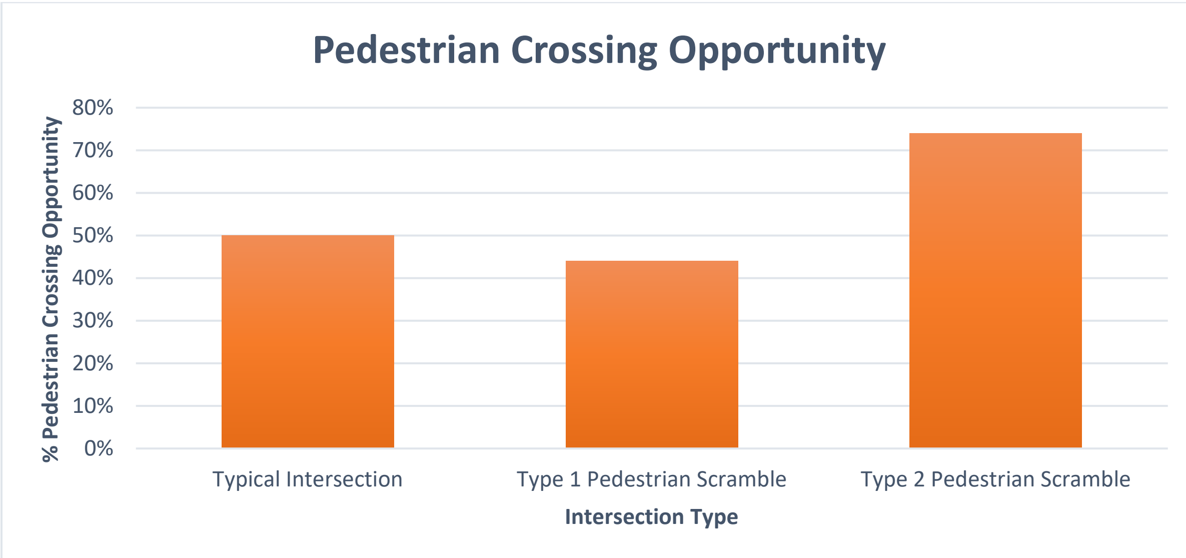

Figure 7. Pedestrian Crossing Opportunity at Intersection

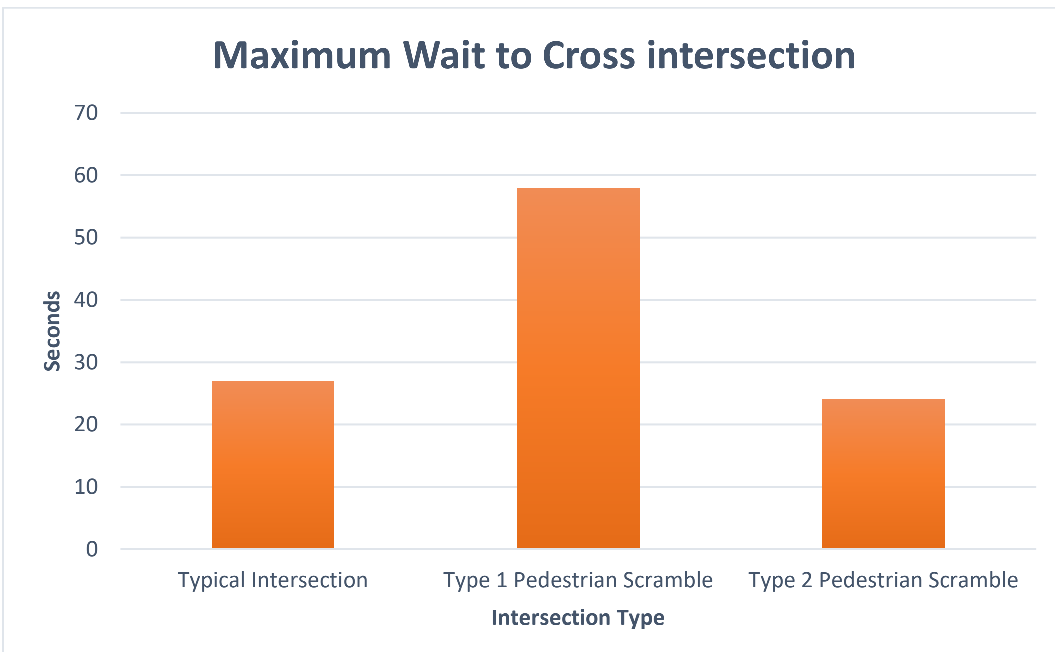

Figure 8. Maximum Wait Time for Pedestrian to Cross at Intersection

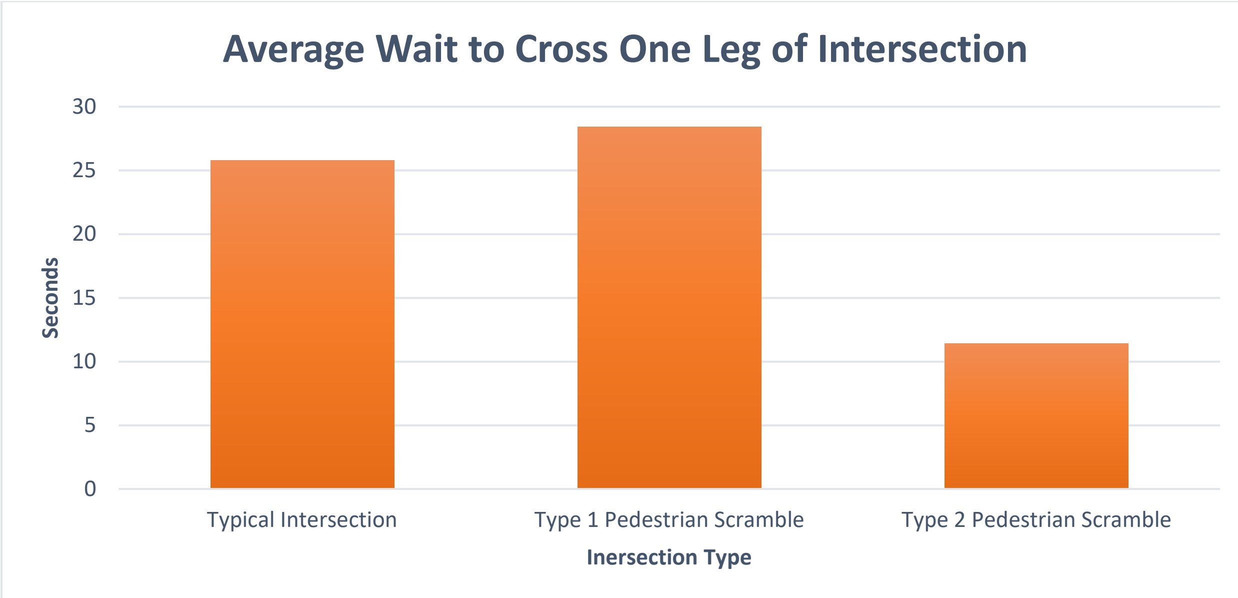

Figure 9. Average Wait Time for Pedestrian to Cross One Leg of Intersection

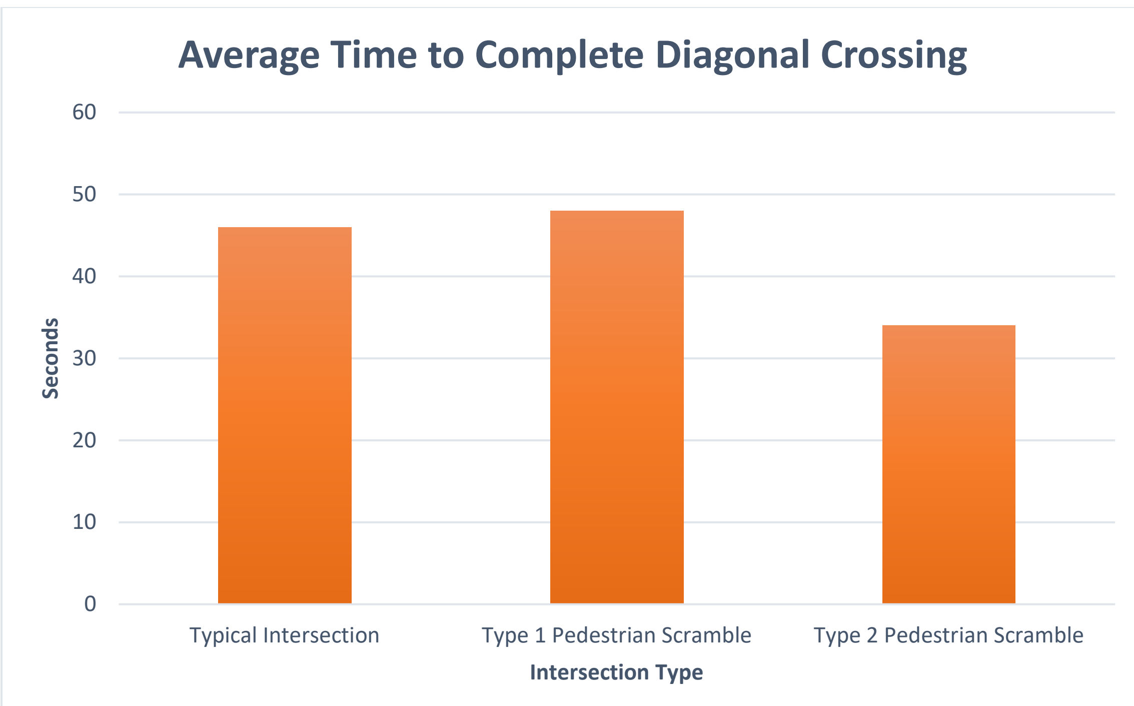

Figure 10. Average Time for Pedestrian to Cross at Intersection Diagonally

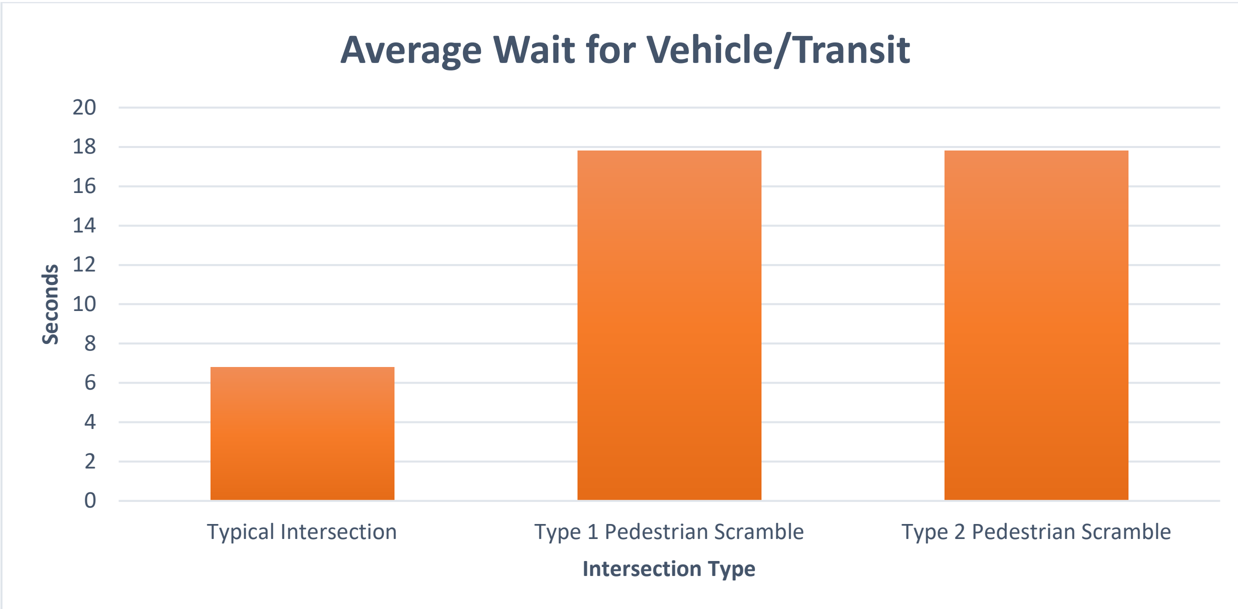

Figure 11. Average Time for Vehicle/Transit to wait for green light if arrived at red light

Appendix C: Research from other Cities

Research from Other Cities
Pedestrian scrambles have successfully been implemented in many other cities and towns. Some of the more prominent examples/studies in North America have come from Toronto, New York City and Calgary. Results have been most successful when municipalities consider the overall context of the intersection and transportation network but have not resulted in universal success to the high impact on operations for people walking, driving, cycling and taking transit as well as concerns from persons with disabilities.

Toronto prefers Type 2 scramble as it provides exclusive access to diagonal crossings when vehicle traffic is stopped, and it does not increase the amount of time pedestrians wait to cross and the subsequent increase in pedestrian jaywalking.

(*Traffic Signal Operations – Policies & Strategies. Transportation Services,* May 2015, https://www.toronto.ca/wp-content/uploads/2017/11/91d6-0_2015-11-13_Traffic-Signal-Operations-Policies-and-Strategies_Final-a.pdf)

Findings from New York City suggest that Pedestrian Scrambles can provide an overall positive outcome for all users when implemented in the appropriate intersection context and recommend that it be used in concert with other signal timing treatments that reduce vehicle-pedestrian conflicts with fewer negative impacts to operations

(*Walk This Way - Exclusive Pedestrian Signal Phase Treatments Study*, October 2017, https://www.nyc.gov/html/dot/downloads/pdf/barnes-dance-study-sept2017.pdf)

Research analysis from Calgary has shown that compliance and vehicle-pedestrian conflicts vary widely based on type of user. Weekday data has shown significant reduction in non-compliance and vehicle-pedestrian conflicts, while weekend data has shown increases in those measures. Annual analysis found that the number of collisions per year did not change significantly, which was not surprising as none of the recorded crashes involved pedestrians.

(*A Follow Up Study on Pedestrian Scramble Operations in Calgary*, TRB 2010, Retrieved at https://trid.trb.org/view/910118)

Based on the peer research, pedestrian scrambles show the greatest overall benefit when the subject intersection has the following characteristics:

- High pedestrian volumes, particularly demand for diagonal crossings or high ratio of pedestrian volumes to vehicle volumes
- Low vehicle volumes, due to the increase in vehicle delay associated with adding the scramble phase
- Vehicle turn restrictions or low vehicle turning volumes
- Short diagonal crossing length

However, research also suggests there can be variations on the benefits and drawbacks based on the unique nature of each intersection, requiring a detailed engineering review.

Appendix D – Location Review

Longlist:
Staff developed a long list of potential pedestrian scramble locations based on peer city recommended criteria, high pedestrian volumes, pedestrian placemaking opportunities, proximity to the downtown central business district, and the opportunity for intersection improvements to align with upcoming Capital Projects. The 9 intersections on the longlist for more detailed review were:

1. Granville & Georgia
2. Burrard & Georgia
3. Granville & Robson
4. Burrard & Robson
5. Thurlow & Robson
6. Commercial & 1st Ave
7. Commercial & Broadway
8. Davie & Denman
9. Seymour & Cordova

The qualitative and quantitative review of each intersection on the longlist was based on:
- Existing intersection layout and traffic signal infrastructure
- Vehicle, pedestrian, and transit data
- Intersection collision data
- Existing land use
- Future transportation planning opportunities

Below is a summary of each locations' feasibility for a Pedestrian Scramble:

1. Granville & Georgia

Benefits
- High pedestrian volumes and demand for diagonal crossings
- Located in the Downtown core.
- Could allow transit vehicles to turn without conflicting with pedestrians
- Majority of transit vehicles are going straight across intersection.
- Adequate sidewalk space to accommodate increasing pedestrians waiting to cross

Drawbacks
- Potential non-compliance of pedestrians during vehicle only phase
- Major impacts to network coordination for vehicles and transit

2. Burrard & Georgia

Benefits
- High pedestrian volumes and demand for diagonal crossings
- Located in the Downtown core.
- 2 pedestrian related collisions at intersection in 5 years.

Drawbacks

- Major impacts to transit and goods movement at the intersection with rapid transit route
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross
- Potential confusion for cyclist crossing
- Major impacts to network coordination for vehicles and transit

3. Granville & Robson

Benefits

- High pedestrian volumes and demand for diagonal crossings
- Located in the Downtown core. High profile location.
- Majority of transit vehicles are going straight across intersection
- Network coordination for vehicles not critical at this location
- Adequate sidewalk space to accommodate increasing pedestrians waiting to cross
- Upcoming Granville Street Downtown Project

Drawbacks

- Minor impacts to transit at the intersection due to turn restrictions
- Potential longer wait times for pedestrians
- Potential non-compliance of pedestrians during vehicle only phase
- Would not reduce vehicle and pedestrian conflicts as turns are restricted

4. Burrard & Robson

Benefits

- High pedestrian volumes and demand for diagonal crossings
- Located in the Downtown core. High profile location.
- 2 pedestrian related collisions at intersection in 5 years.

Drawbacks

- Major impacts to transit and goods movement at the intersection
- Major impacts to network coordination for vehicles
- Potential confusion for cyclist crossing
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross

5. Thurlow & Robson

Benefits

- High pedestrian volumes and demand for diagonal crossings
- Located in the Downtown core. High profile location.
- 1 pedestrian related collision at intersection in 5 years.
- Adjacent to Robson-Bute Plaza upgrade project

Drawbacks

- One-way coordination impacts on Thurlow Street
- Minor impact to transit along Robson
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross

6. Commercial Dr & 1st Ave

Benefits
- High pedestrian volumes in commercial area.
- 2 pedestrian related collisions at intersection in 5 years.

Drawbacks
- major impact to transit along Commercial Drive and traffic impact along 1st Ave
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross
- Loss of coordination during peak periods on 1st Ave which connects to Highway 1.
- Left turn phasing will further complicate coordination

7. Commercial & Broadway

Benefits
- High pedestrian volumes adjacent to Transit Hub

Drawbacks
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross
- Major impacts to transit and goods movement at the intersection
- Loss of coordination during peak periods
- Left turn phasing will further complicate coordination

8. Davie & Denman

Benefits
- High volume of pedestrians adjacent to English Bay.
- 1 pedestrian related collision at intersection in 5 years.

Drawbacks
- Insufficient sidewalk space to accommodate increasing pedestrians waiting to cross
- Potential confusion for cyclist crossing
- Major impacts to transit and goods movement at the intersection
- Loss of coordination during peak periods.
- Left turn phasing will further complicate coordination
- West End Waterfront Plan will provide direction on future of intersection – changes now might need to be removed based on plan direction

9. Seymour & Cordova

Benefits
- High pedestrian volumes adjacent to Waterfront Station/Transit Hub.
- Allows transit and other vehicles to turn without conflict with pedestrians. Currently, there is dual northbound right turns at the intersection.
- Adequate sidewalk space to accommodate increasing pedestrians waiting to cross
- 1 pedestrian related collision at intersection in 5 years

Drawbacks

- Potential longer wait times for pedestrians crossing at T-intersection.
- Major impacts to transit and goods movement at the intersection
- Base period and weekend pedestrian volumes may be low

Shortlist Traffic Modeling Analysis Results

	Time/Day	Scenario	Cycle Length	MOE	Approach												Intersection Overall
					EB			WB			NB			SB			
					EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Commercial & 1st	PM Peak	Existing	80	Volume	57	1342	88	71	1168	61	55	322	77	154	524	33	
				Delay (s/ veh)	55.7	49	-	80.8	28.4	-	31.9	39.1	8.5	17.7	16.1	-	35.6
				LOS	E	D	-	F	C	-	C	D	A	B	B	-	D
				V/C	0.66	1.01	-	0.82	0.87	-	0.36	0.74	0.27	0.46	0.4	-	
				95th %ile Queue (m)	78.4	152.7	157.4	85.2	159.5	163.3	36.1	75.6	21.4	41.8	60.8	46	
		Scramble	95	Volume	57	1342	88	71	1168	61	55	322	77	154	524	33	
				Delay (s/ veh)	100.5	442.3	-	140	330	-	56	120.1	50.8	77.6	34	-	286
				LOS	F	F	-	F	F	-	E	F	D	E	C	-	F
				V/C	0.82	1.92	-	0.99	1.66	-	0.54	1.1	0.55	0.91	0.64	-	
				95th %ile Queue (m)	78.4	138.4	139.8	80.9	139.9	186.5	53.6	112.5	100.8	50.2	86.4	67.1	
	Weekend Midday	Existing	70	Volume	68	1171	75	67	1136	66	77	391	74	113	371	39	
				Delay (s/ veh)	55.6	47	-	54.6	42.4	-	26.7	35.9	5.7	12.9	11.8	-	38.3
				LOS	E	D	-	D	D	-	C	D	A	B	B	-	D
				V/C	0.69	1	-	0.68	0.98	-	0.39	0.79	0.23	0.35	0.28	-	
				95th %ile Queue (m)	91.5	159.9	165.5	88.4	150.4	153.3	47.4	87.5	39.9	29.1	39.2	32.6	
		Scramble	95	Volume	68	1171	75	67	1136	66	77	391	74	113	371	39	
				Delay (s/ veh)	142	336.6	-	126.4	320.6	-	67.9	206.7	53.7	45.7	30.9	-	255.2
				LOS	F	F	-	F	F	-	E	F	D	D	C	-	F
				V/C	0.99	1.67	-	0.94	1.64	-	0.69	1.34	0.57	0.66	0.48	-	
				95th %ile Queue (m)	91.9	138.9	138.9	83.5	142.2	191.1	58.7	100.6	112.7	46.8	69.8	50.5	

	Time/Day	Scenario	Cycle Length	MOE	Approach												Intersection Overall
					EB			WB			NB			SB			
					EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Granville & Georgia	PM Peak	Existing	65	Volume	0	818	0	0	730	0	8	77	12	9	51	1	
				Delay (s/ veh)	-	12	-	-	13.3	-	-	14.1	-	-	13.4	-	12.7
				LOS	-	B	-	-	B	-	-	B	-	-	B	-	B
				V/C	-	0.37	-	-	0.48	-	-	0.17	-	-	0.1	-	
				95th %ile Queue (m)	62.5	44.5	16	58.8	42.5	-	-	23.3	-	-	18.5	-	
		Scramble	65	Volume	0	818	0	0	730	0	8	77	12	9	51	1	
				Delay (s/ veh)	-	27.9	-	-	50.4	-	-	31	-	-	27.3	-	37.7
				LOS	-	C	-	-	D	-	-	C	-	-	C	-	D
				V/C	-	0.75	-	-	0.96	-	-	0.43	-	-	0.26	-	
				95th %ile Queue (m)	101.4	79.1	45.4	102.4	82.7	-	-	29.3	-	-	24.9	-	
	Weekend Midday	Existing	65	Volume	0	854	0	0	686	0	3	71	11	3	52	3	
				Delay (s/ veh)	-	12.1	-	-	13	-	-	13.8	-	-	13.3	-	12.6
				LOS	-	B	-	-	B	-	-	B	-	-	B	-	B
				V/C	-	0.39	-	-	0.45	-	-	0.14	-	-	0.09	-	
				95th %ile Queue (m)	62.2	45.2	16.1	57.85	43.7	-	-	21.6	-	-	18.1	-	
		Scramble	65	Volume	0	854	0	0	686	0	3	71	11	3	52	3	
				Delay (s/ veh)	-	29.1	-	-	41.4	-	-	29.1	-	-	26.7	-	34
				LOS	-	C	-	-	D	-	-	C	-	-	C	-	C
				V/C	-	0.78	-	-	0.9	-	-	0.36	-	-	0.23	-	
				95th %ile Queue (m)	101.3	80	47.6	88.3	74.2	-	-	28	-	-	20.8	-	

Intersection	Time/Day	Scenario	Cycle Length	MOE	EB EBL	EB EBT	EB EBR	WB WBL	WB WBT	WB WBR	NB NBL	NB NBT	NB NBR	SB SBL	SB SBT	SB SBR	Intersection Overall
Granville & Robson	PM Peak	Existing	65	Volume	0	102	4	6	200	19	0	75	0	3	52	2	
				Delay (s/ veh)	-	11.3	-	-	12.7	-	-	12.8	-	-	12.7	-	12.4
				LOS	-	B	-	-	B	-	-	B	-	-	B	-	B
				V/C	-	0.14	-	-	0.13	-	-	0.11	-	-	0.09	-	
				95th %ile Queue (m)	-	26	-	-	42.7	-	-	23	-	-	17.6	-	
		Scramble	70	Volume	0	102	4	6	200	19	0	75	0	3	52	2	
				Delay (s/ veh)	-	25.6	-	-	37.2	-	-	25.3	-	-	24.9	-	31.1
				LOS	-	C	-	-	D	-	-	C	-	-	C	-	C
				V/C	-	0.3	-	-	0.69	-	-	0.22	-	-	0.18	-	
				95th %ile Queue (m)	-	30.2	-	-	85.9	-	-	23.4	-	-	20.9	-	
	Weekend Midday	Existing	65	Volume	3	96	3	16	210	18	0	75	0	0	50	3	
				Delay (s/ veh)	-	11.3	-	-	13.8	-	-	12.8	-	-	12.6	-	12.9
				LOS	-	B	-	-	B	-	-	B	-	-	B	-	B
				V/C	-	0.14	-	-	0.37	-	-	0.11	-	-	0.08	-	
				95th %ile Queue (m)	-	25.1	-	-	54.1	-	-	23.7	-	-	17.8	-	
		Scramble	70	Volume	0	102	4	6	200	19	0	75	0	3	52	2	
				Delay (s/ veh)	-	25.4	-	-	42.8	-	-	25.3	-	-	24.6	-	34.3
				LOS	-	C	-	-	D	-	-	C	-	-	C	-	C
				V/C	-	0.29	-	-	0.77	-	-	0.22	-	-	0.16	-	
				95th %ile Queue (m)	-	32	-	-	65.8	-	-	22.6	-	-	20.2	-	

Intersection	Time/Day	Scenario	Cycle Length	MOE	EB EBL	EB EBT	EB EBR	WB WBL	WB WBT	WB WBR	NB NBL	NB NBT	NB NBR	SB SBL	SB SBT	SB SBR	Intersection Overall
Denman & Davie	PM Peak	Existing	65	Volume	1	18	0	27	0	218	0	393	24	178	633	0	
				Delay (s/ veh)	-	18.4	-	21.3	-	15.4	-	22.9	0.5	8.4	12	-	15
				LOS	-	B	-	C	-	B	-	C	A	A	B	-	B
				V/C	-	0.04	-	0.16	-	0.5	-	0.64	0.08	0.39	0.63	-	
				95th %ile Queue (m)	-	8.6	-	13.4	-	35	-	25.4	12.4	26.4	34.6	-	
		Scramble	90	Volume	1	18	0	27	0	218	0	393	24	178	633	0	
				Delay (s/ veh)	-	32.4	-	41.3	-	57.1	-	54.7	28.2	49.7	27.4	-	44.2
				LOS	-	C	-	D	-	E	-	D	C	D	C	-	D
				V/C	-	0.07	-	0.29	-	0.9	-	0.89	0.14	0.83	0.64	-	
				95th %ile Queue (m)	-	16	-	19.3	-	44.7	-	24.9	9	40.7	35.9	-	
	Weekend Midday	Existing	65	Volume	1	18	0	31	0	211	0	417	40	142	638	0	
				Delay (s/ veh)	-	18.4	-	23.2	-	22.9	-	24.1	1.3	7.7	12.1	-	16.6
				LOS	-	B	-	C	-	C	-	C	A	A	B	-	B
				V/C	-	0.04	-	0.22	-	0.6	-	0.68	0.14	0.33	0.63	-	
				95th %ile Queue (m)	-	9.6	-	15.4	-	38.3	-	24.4	16.6	23.3	35.9	-	
		Scramble	90	Volume	1	18	0	31	0	211	0	417	40	142	638	0	
				Delay (s/ veh)	-	32.4	-	53.5	-	91.8	-	74.2	33.5	29.8	50.8	-	60.4
				LOS	-	C	-	D	-	F	-	E	C	C	D	-	E
				V/C	-	0.07	-	0.44	-	1.01	-	0.98	0.28	0.62	0.95	-	
				95th %ile Queue (m)	-	12.5	-	15	-	36.9	-	24.6	12.9	33.7	33.9	-	

Cyclist consideration

The BC Motor Vehicle Act considered bicycles as vehicles. A cyclist approaching an intersection with a pedestrian scramble on a bicycle needing to make a left turn has two options.

1. Move into the appropriate lane to safely cross the intersection and turn left as a vehicle in the flow of traffic.
2. Dismount and walk their bike across the crosswalk as a pedestrian.

Appendix E – Project Cost Estimates

a. General Cost

The cost of implementing a pedestrian scramble can vary widely depending on the intersection. It will generally require physical upgrades to the signal in order to support the signal timing changes with older signals being significantly more costly to modify. Also, modification to intersection layout may be required to provide diagonal crosswalks.

The intersection upgrade scope and cost may include the following:

- signal timing modifications to add the scramble phase
- moving signal poles/heads (ranging from $10,000 to $100,000 per pole)
- new signal heads to accommodate a diagonal crossing
- new traffic signal cabinet to accommodate the additional phase, Accessible Pedestrian Signal equipment, and traffic camera ($100,000)
- wiring upgrades ($50,000 per section)
- New curb ramp to align with diagonal crossing ($60,000)
- accessible pedestrian signal (APS) to ensure blind/low vision users can get the proper queues on when the have the right of way to cross ($40,000 for 4 crossing)
- Camera for intersection monitoring ($10,000 to $100,000 depending on communication conduit connection)
- Tactile warning strips
- Pavement markings ($40,000 for all crosswalk markings)

In the most expensive scenario, the cost would be approximately $500,000 based on average historical major signal rehabilitation project costs.

<u>Granville St & Robson St</u>
To install a Pedestrian Scramble at the Granville & Robson intersection, APS/audible tones and tactile warning strips will be required to help people with low vision navigate across the intersection. Granville Mall has unique curb ramp design which already accommodate diagonal crossings so would not need to be rebuilt. In addition, this provides flexibility for staff to adjust crosswalk widths with pavement marking to align with APS buttons mounted on existing signal poles. The intersections along Granville Mall have double the number of pedestrian signal heads for each crosswalk and so the duplicate pedestrian signal heads would be realigned for the diagonal crosswalk to minimize cost. In addition, the existing traffic signal controller is compatible with new scramble phase which further reduce upgrade cost. Based on a preliminary review, the cost of a Pedestrian Scramble is expected to be within the range of $100,000 - $200,000 depending on traffic control cost during construction and signal wiring connection scope.

Table 1 summarizes potential costs for each shortlisted location based on current site conditions. Further investigation will be required to determine detailed cost estimates. All shortlisted intersections are relatively new with traffic cameras and compatible traffic signal cabinets. However, Commercial St & 1st Ave requires more geometric upgrades as all curb ramps would need to be reconstructed to allow diagonal crossings.

Intersection	Estimated Cost
Granville & Georgia	$150,000
Granville & Robson	$150,000
Commercial Dr & 1st	$300,000
Davie & Denman	$250,000

Table 1. Cost Summary