2150 Lake Shore Boulevard West
Proposed Mixed-use Development
Toronto, Ontario

Urban Transportation Considerations
Official Plan Amendment, Zoning By-law Amendment, and Draft Plan of Subdivision Application Resubmission
Appendix J to Appendix K

Prepared For: FCR (Park Lawn) Corporation
2253213 Ontario Limited

February 2021

APPENDIX J:
Microsimulation Modelling and Assessment of Future Loop Road TTC Streetcar Operations

2150 LAKESHORE

Assessment of Future Loop Rd & Parklawn Station TTC Streetcar Operations

Vissim Microsimulation Modelling Exercise

Updated Technical Documentation, Results & Recommendations

Originally Submitted on October 22nd, 2020
Updated and Re-Submitted on January 18th, 2021

Overview

1) **Modelling Context & Background Information**

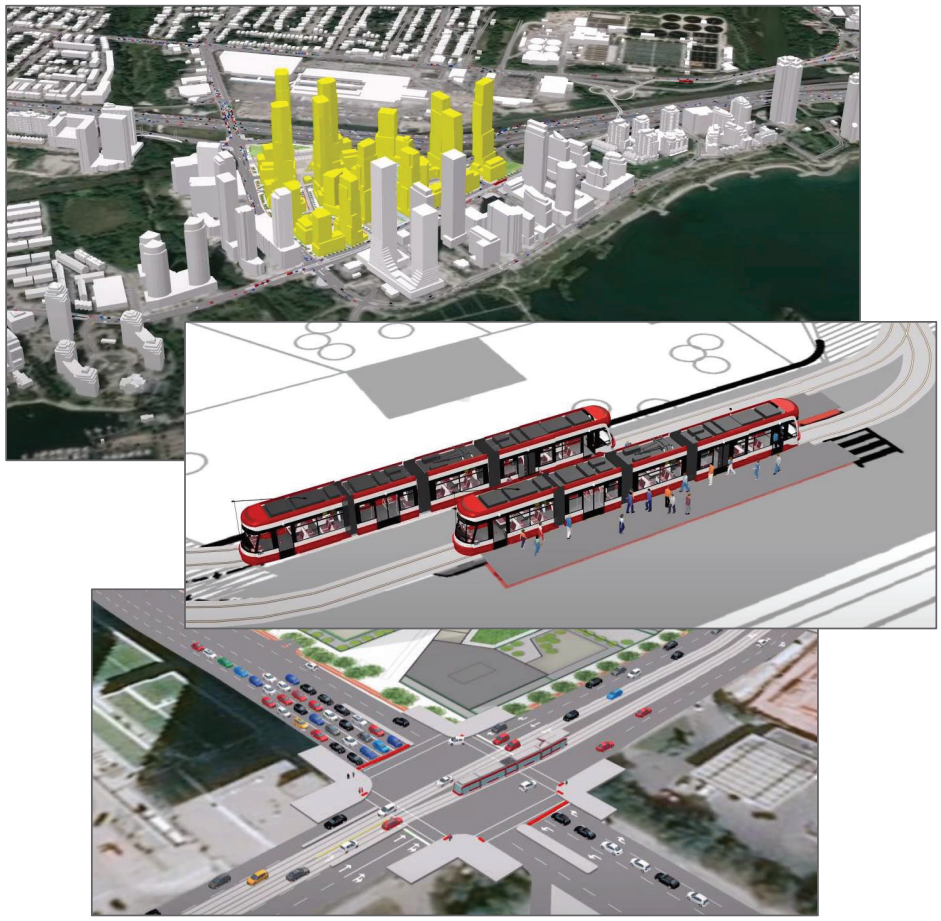
2) **Alternative Scenarios & Model Parameters**

3) **Transit Signal Timing & Priority Strategy – Basics**

4) **Analysis Results & Conclusions**

Appendix A: Transit Signal Timing & Priority Strategy – Details

Appendix B: Model Files & Detailed Simulation Results

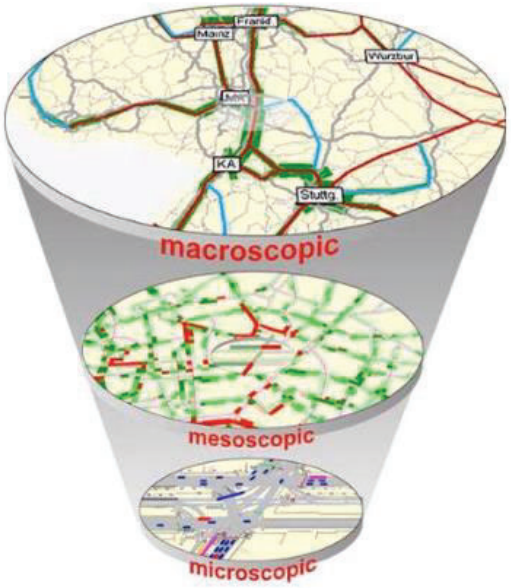


1) Modelling Context & Background Information

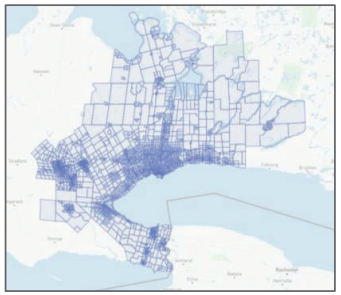
- Multi-Resolution (Macro/Meso/Micro) Modelling Process
- *Vissim* Model Used in BA Group Analysis

Modelling Process

- Multi-resolution (macro/meso/micro) modelling process conducted in conjunction with the City of Toronto, AECOM and BA Group
- Takes into account population/employment growth and planned infrastructure improvements (e.g. new GO train station) at both the regional and local levels

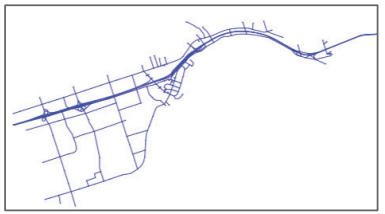


Macroscopic (Regional) *GTAModel v4.0 EMME* Model



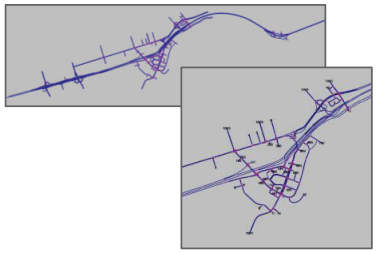
TORONTO

Mesoscopic *VISUM* Model



AECOM BA Group

Microscopic (Local) *VISSIM* Model



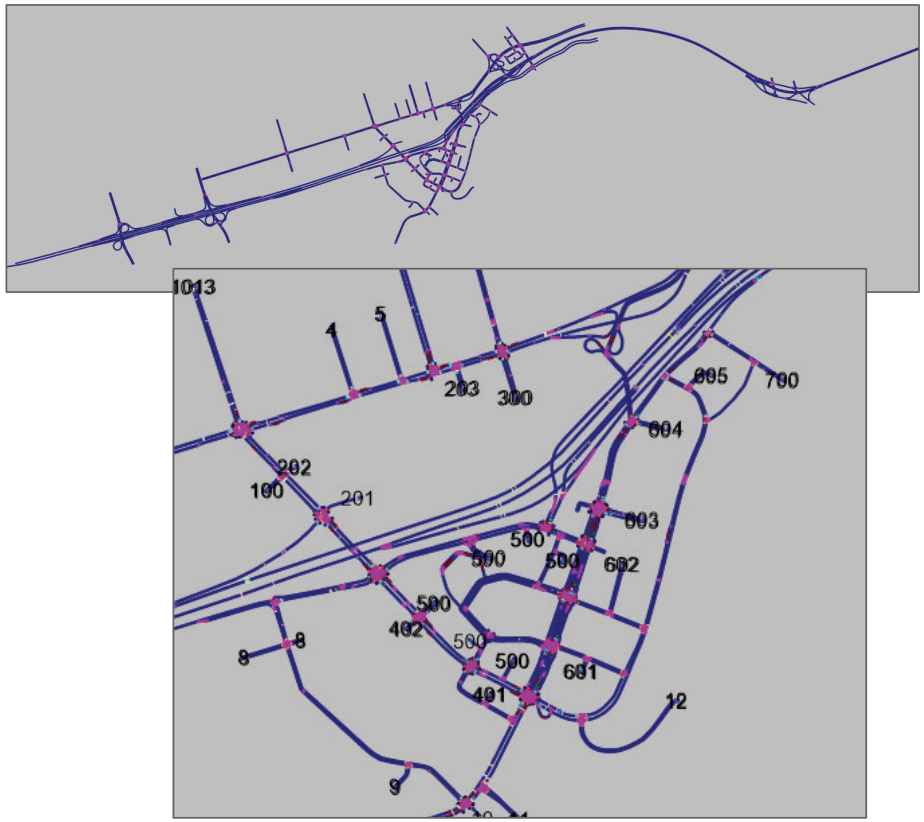
AECOM BA Group

Current Model

Model used by BA Group to evaluate streetcar operations and test different alternative scenarios is a *Vissim* microscopic (local) model derived from the ongoing multi-resolution (macro/meso/micro) modelling exercise conducted in collaboration with the City of Toronto and AECOM

Some model characteristics:

- Includes 2041 traffic projections (background traffic), from City's modelling, including new Parklawn GO station
- Includes 2041 Christie's site traffic
- Weekday morning (AM) peak period only



2) Alternative Scenarios & Model Parameters

- Alternative Scenarios & Location of Traffic Signals
- Transit Routes & Model Travel Time Segments
- Parklawn Station Platforms | Transit Vehicle Dwell Time
- Parklawn Station Platforms | Boarding & Alighting Operations
- Summary of Model Parameters

Alternative Scenarios & Location of Traffic Signals on Loop Rd

Scenario 1

Uni-Directional (ZBA plan)

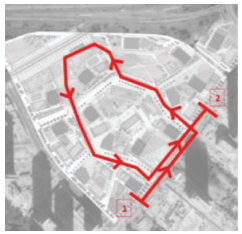
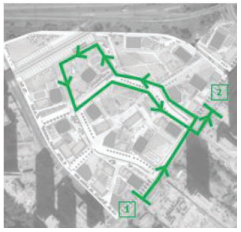
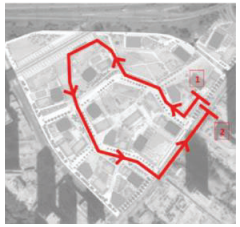
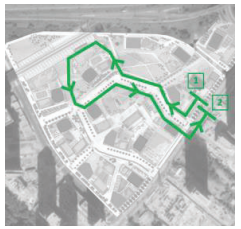
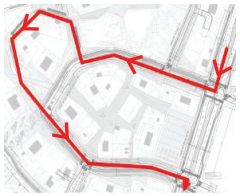
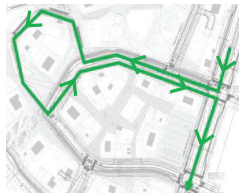
3 Signals along Loop Rd

Scenario 2

Bi-Directional East

2 Signals along Loop Rd

Transit Routes & Model Travel Time Segments

Weekday Morning (AM) Peak Hour	**Scenario 1** Uni-Directional	**Scenario 2** Bi-Directional East
501 Queen EB Long Branch to Church		
504 King Parklawn to Broadview		
501 Queen WB Church to Long Branch		

- Figures indicate the locations of start (1) and end (2) travel time markers, as coded in *Vissim* model
- All travel time segments begin upstream of first Lakeshore/Loop Rd intersection, include entirety of Loop Rd & Parklawn Station and end downstream of second Lakeshore/Loop Rd intersection
- Travel time start (1) and end (2) markers associated with specific transit routes share the same exact locations in all 3 model scenarios
- Travel time segments are broken down into delay due to a) Loop Rd & Parklawn Station and b) Lakeshore corridor & signalized intersections
- Vehicle travel speeds on Lakeshore Blvd far downstream/upstream of Loop Rd are equal in all scenarios (see page 21), said segments were therefore not included in transit vehicle operations travel times

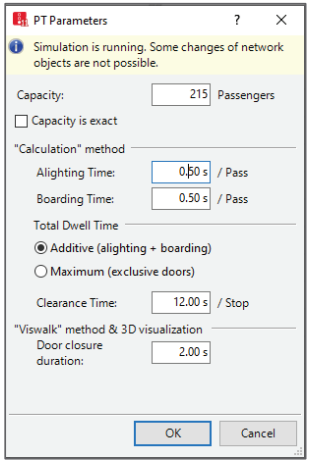
Typical Approach: Dwell Time Calculation

Transit vehicle dwell times at stops calculated based on:

- Hourly boarding volumes at stop
- Percentage of vehicle occupancy alighting at stop

Default calculation parameters:

- Alighting time: 0.5 secs/pass.
- Boarding time: 0.5 secs/pass.
- Door closure duration: 2 secs
- Clearance time: 12 secs

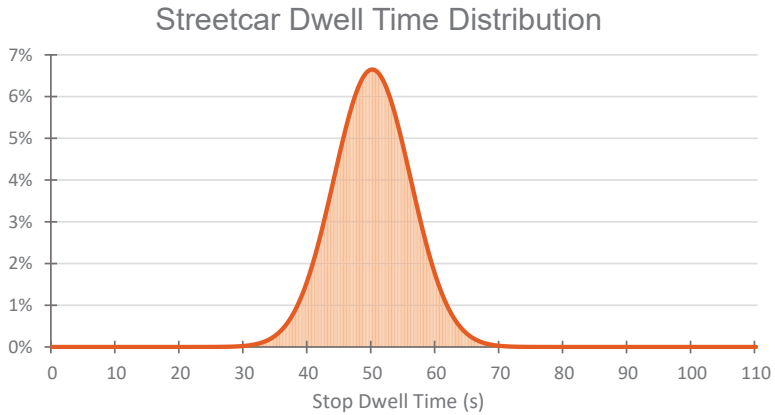


Limitations:

- Very little variability in resulting dwell times, majority of transit vehicle stop times fall within 1-2 secs of each other
- Approach leads to an unrealistic representation of transit vehicle stops at stations, much different from actual high variability conditions at existing stations (e.g. Dundas West, Bathurst, Broadview, Humber Loop, etc.)

Adopted Approach: Dwell Time Distributions

- Adopted approach incorporates higher dwell time variability and leads to a more realistic representation of transit vehicle stops at stations
- Based on normal dwell time distribution with a mean of 50 secs and a standard deviation of 6 secs.

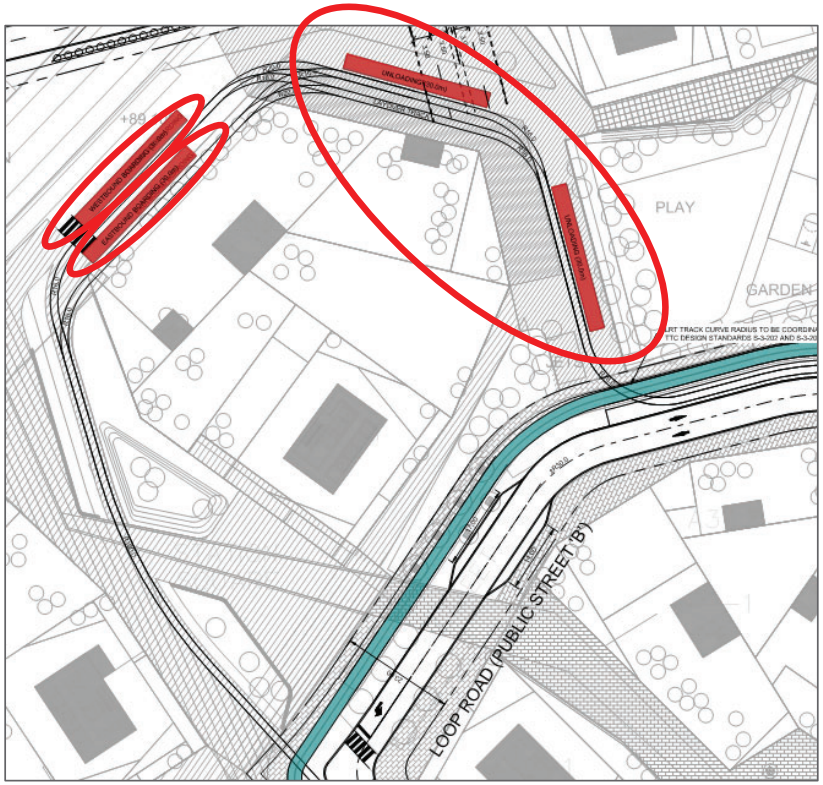


- **Same distribution used for all routes and platforms in all scenarios, distribution therefore does not impact relative differences in transit travel time results**

Parklawn Station Platforms | Boarding & Alighting Operations

Two Passenger Boarding Platforms

- North platform serves the 504 King (Parklawn to Broadview) transit route
- South platform serves the 501 Queen (Long Branch to Church) transit route



Two Passenger Alighting Platforms

- Both platforms serve all three transit routes indiscriminately
- Downstream platform always prioritized, unless already in use by streetcar alighting passengers
- Upstream platform only used if downstream platform already in use by another transit vehicle

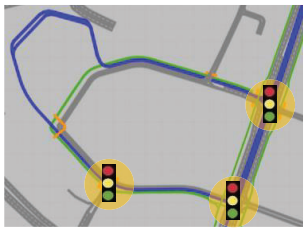
- *Parklawn station platforms passenger boarding and alighting operations are modelled in the exact same way in both scenarios (unidirectional vs bidirectional east), and therefore do not impact relative differences in streetcar travel time results*

Model Parameters – Summary

Traffic Volumes

Background Traffic	2041 area background traffic and site traffic derived from multi-resolution (macro/meso/micro) modelling process conducted with City of Toronto & AECOM	Accounts for proposed new Parklawn GO station & Relief Rd
Christie's Site Traffic		Based on latest development programme density and land use mix

Traffic Signals

Scenarios	**Scenario 1 – Uni-Directional**	**Scenario 2 – Bi-Directional East**
Location of Traffic Signals along Loop Rd		

Transit Parameters

Transit Route	**501 EB Long Branch to Church & 501 WB Church to Long Branch**	**504 Parklawn to Broadview**	**508 Lakeshore**
Transit Service Rates	Headway: One vehicle every 10 mins Frequency: 6 vehicles per hour	Headway: One vehicle every 5 mins Frequency: 12 vehicles per hour	Headway: One vehicle every 20 mins Frequency: 3 vehicles per hour
Parklawn Station Boarding & Alighting Operations	- Modelled using distribution due to unrealistically small variation of dwell times associated with default passenger-based method - Adopted dwell time distribution parameters: Mean: 50s, Standard Deviation: 6s, Upper Bound: 110s, Lower Bound: 0s		
Transit Signal Timing & Priority Strategy	- No transit signal priority coded in models at Lake Shore Blvd / Loop Rd intersections (VisVAP required) - Simple TSP coded with Vissim standard RBC at intersection of Loop Rd / Street C - Detailed information provided in Section 3) Transit Signal Timing & Priority – Basics as well as in Appendix A: TSP – Details		

3) Transit Signal Timing & Priority Strategy – Basics

- Two Types of Transit Signal Priority
- TSP Type 1 – Proxy Intersection & Signal Timing Strategy
- TSP Type 2 – Signal Timing Strategy

**** Appendix A: TSP Details should be read as a complement to this section ****

Transit Signal Priority Types

A this stage, no TSP included at the intersections of Lake Shore Blvd & Loop Rd (detailed *VisVAP* coding required)

Conservative, safe and standard signal timing plans coded at the two intersections of Lake Shore Blvd & Loop Rd. Simple TSP coded with *Vissim* RBC approach at Loop Rd / Street C.

Type 1 **Mid-Loop Rd Signals**

- No transit-only phase, main traffic phases extendable/callable early

Based on signal timing plans and transit priority strategies adopted at existing Toronto intersections

TSP Type 1 Signal Timing Strategy

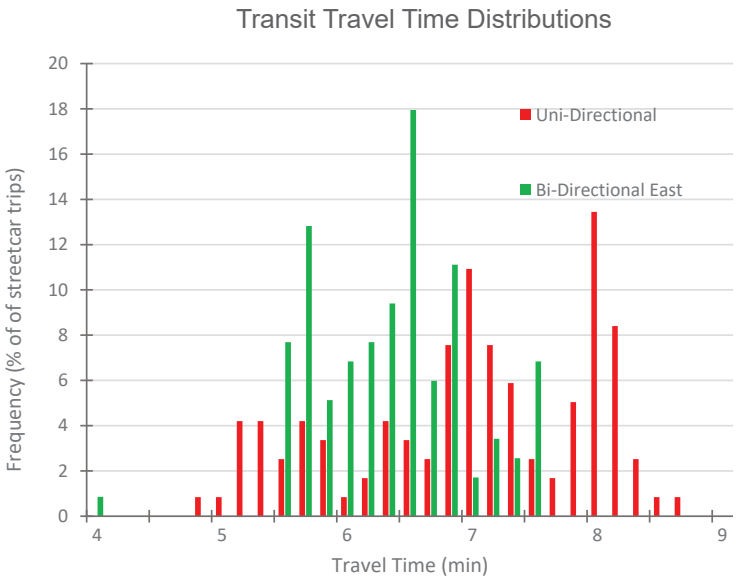
Signal at the intersection of Loop Rd and Street C

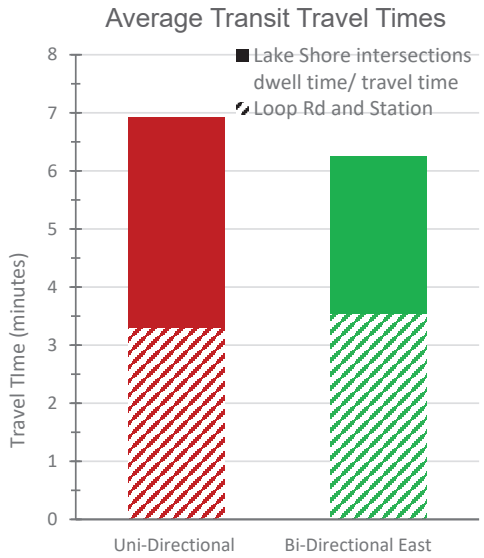
- “Typical” TSP, no transit-only phase
- Transit priority achieved with the extension/early-call of regular through-traffic phases on Loop Rd, actuation via check-in/check-out detectors
- Additional information provided in Appendix A

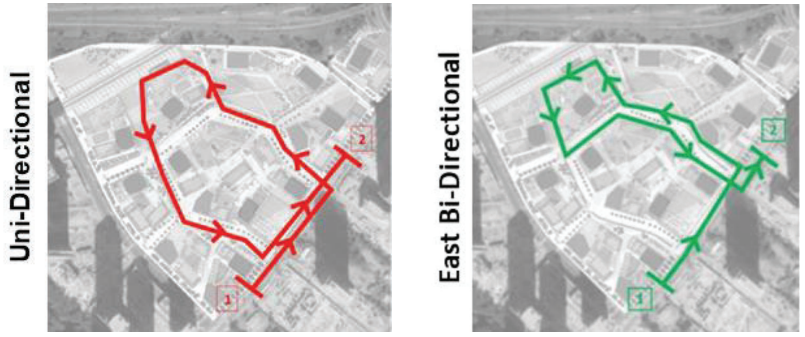
4) Analysis Results & Conclusions

- Transit Travel Times – 501 Queen EB (Long Branch to Church)
- Transit Travel Times – 504 King (Parklawn to Broadview)
- Transit Travel Times – 501 Queen WB (Church to Long Branch)
- Private Vehicle Operations
- Conclusions

501 QUEEN Long Branch to Church EB







Service Rate

Headway: One vehicle every 10m
Frequency: 6 vehicles per hour

Simulation Sample Size

Number of Simulation Runs: 20
Number of Peak Hour Transit Vehicles per Simulation Run: 6
Total Sample Size: 120 Transit Vehicle Runs

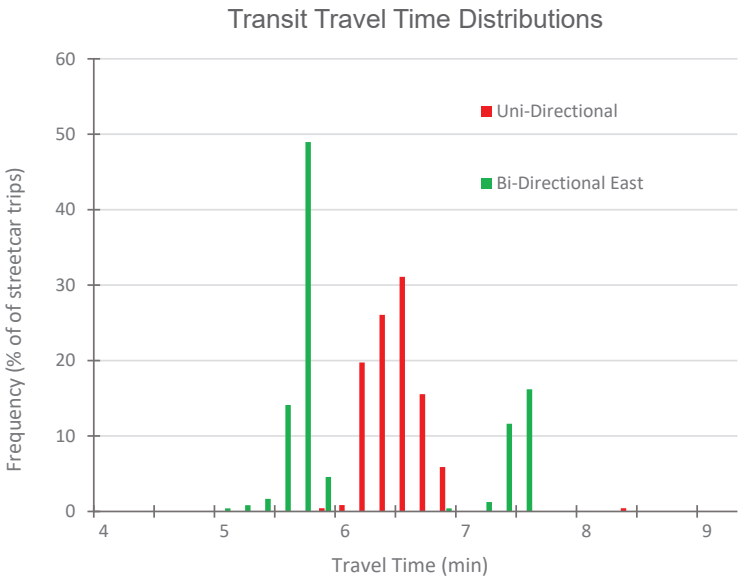
Average Travel Times

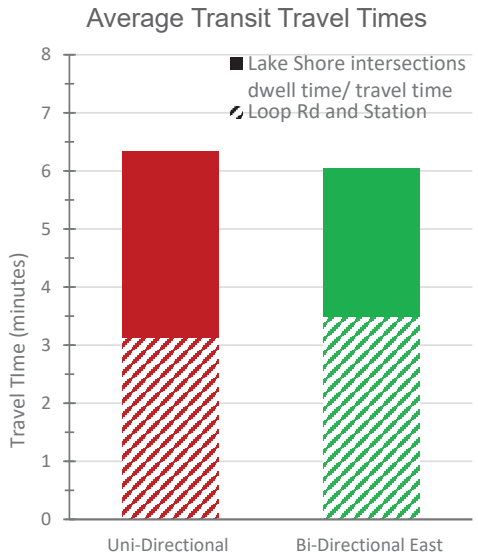
	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 17sec	3min 32sec
Lake Shore intersections dwell time/travel time	3min 37sec	2min 42sec
Total	**6min 54sec**	**6min 15sec**

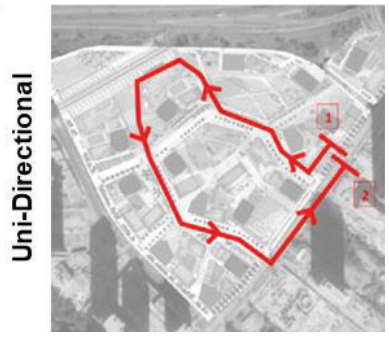
Additional Total Travel Time Distribution Metrics

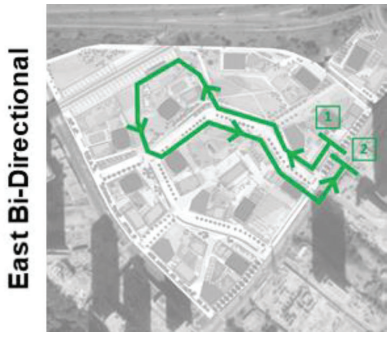
	Uni-Directional	Bi-Directional East
85th percentile	7min 58sec	6min 49sec
95th percentile	8min 5sec	7min 20sec
Standard deviation	0min 58sec	0min 35sec
Longest	8min 34sec	7min 22sec
Shortest	4min 45sec	3min 55sec

504 KING Park Lawn to Broadview









Service Rate

Headway: One vehicle every 5m
Frequency: 12 vehicles per hour

Simulation Sample Size

Number of Simulation Runs: 20
Number of Peak Hour Transit Vehicles per Simulation Run: 12
Total Sample Size: 240 Transit Vehicle Runs

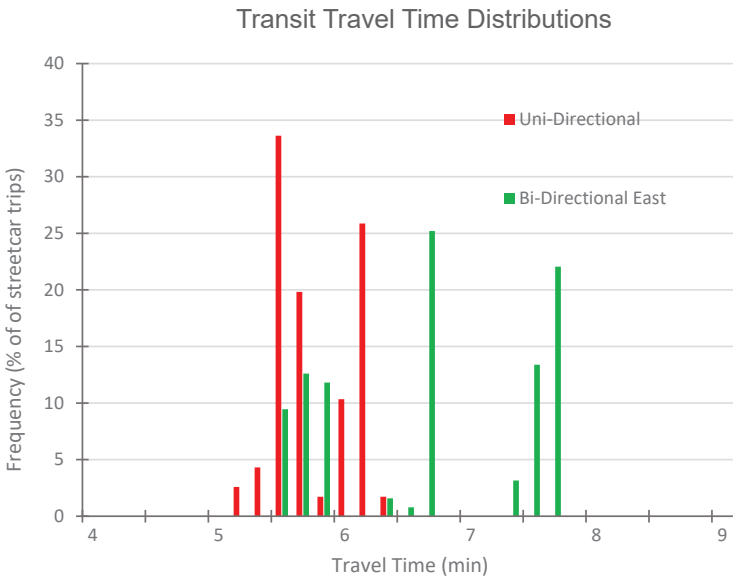
Average Travel Times

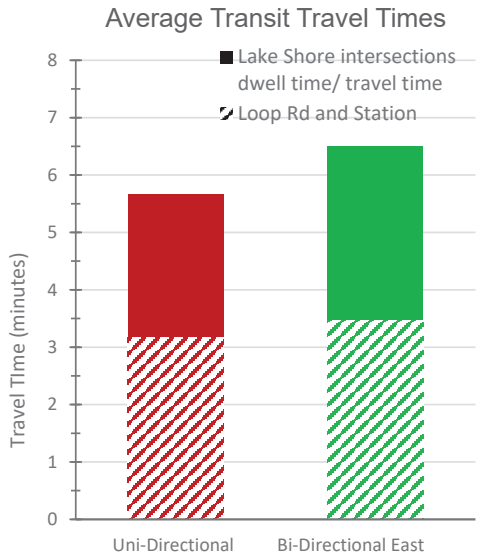
	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 7sec	3min 29sec
Lake Shore intersections dwell time/ travel time	3min 12sec	2min 33sec
Total	**6min 20sec**	**6min 2sec**

Additional Total Travel Time Distribution Metrics

	Uni-Directional	Bi-Directional East
85th percentile	6min 33sec	7min 20sec
95th percentile	6min 43sec	7min 22sec
Standard deviation	0min 13sec	0min 48sec
Longest	8min 13sec	7min 25sec
Shortest	5min 49sec	4min 59sec

501 QUEEN Church to Long Branch WB





Service Rate

Headway: One vehicle every 10m
Frequency: 6 vehicles per hour

Simulation Sample Size

Number of Simulation Runs: 20
Number of Peak Hour Transit Vehicles per Simulation Run: 6
Total Sample Size: 120 Transit Vehicle Runs

Average Travel Times

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 10sec	3min 29sec
Lake Shore intersections dwell time/travel time	2min 29sec	3min 1sec
Total	**5min 39sec**	**6min 30sec**

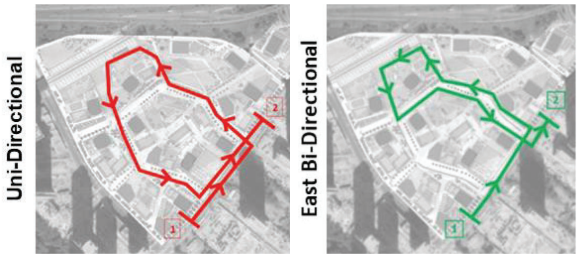
Additional Total Travel Time Distribution Metrics

	Uni-Directional	Bi-Directional East
85th percentile	6min 4sec	7min 31sec
95th percentile	6min 4sec	7min 32sec
Standard deviation	0min 18sec	0min 48sec
Longest	6min 11sec	7min 34sec
Shortest	5min 8sec	5min 21sec

Original VS Updated Results

- TTC comments have been addressed and models have been updated accordingly
- Negligible impacts on analysis results and conclusion

501 Queen EB (Long Branch to Church)



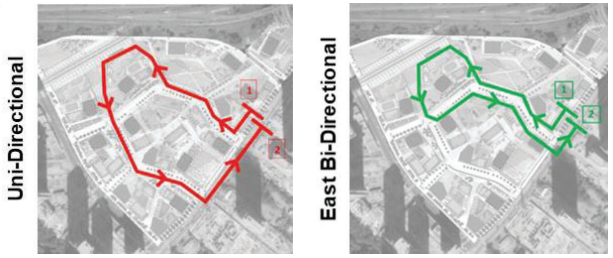
Original Submission

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 4sec	3min 30sec
Lake Shore intersections dwell time/travel time	2min 26sec	1min 24sec
Total	**5min 31sec**	**4min 54sec**
Difference (Bi-Directional E Benefit)	**- approx. 35 secs**	

Updated Results

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 17sec	3min 32sec
Lake Shore intersections dwell time/travel time	3min 37sec	2min 42sec
Total	**6min 54sec**	**6min 15sec**
Difference (Bi-Directional E Benefit)	**- approx. 40 secs**	

504 King (Park Lawn to Broadview)



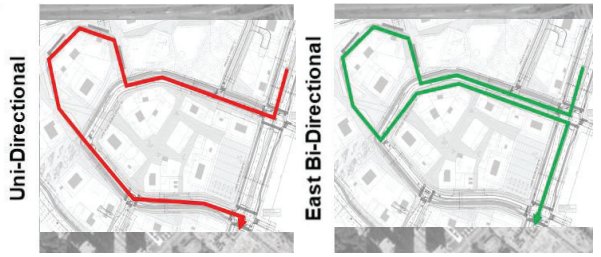
Original Submission

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 15sec	3min 34sec
Lake Shore intersections dwell time/ travel time	1min 57sec	1min 13sec
Total	**5min 12sec**	**4min 47sec**
Difference (Bi-Directional E Benefit)	**- approx. 25 secs**	

Updated Results

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 7sec	3min 29sec
Lake Shore intersections dwell time/ travel time	3min 12sec	2min 33sec
Total	**6min 20sec**	**6min 2sec**
Difference (Bi-Directional E Benefit)	**- approx. 20 secs**	

501 Queen WB (Church to Long Branch)



501 Queen WB was not analyzed in the original submission

Updated Results

	Uni-Directional	Bi-Directional East
Loop Rd and Station	3min 10sec	3min 29sec
Lake Shore intersections dwell time/travel time	2min 29sec	3min 1sec
Total	**5min 39sec**	**6min 30sec**
Difference (Bi-Directional E Benefit)	**+ approx. 50 secs**	

Private Vehicle Operations – Speed Plot

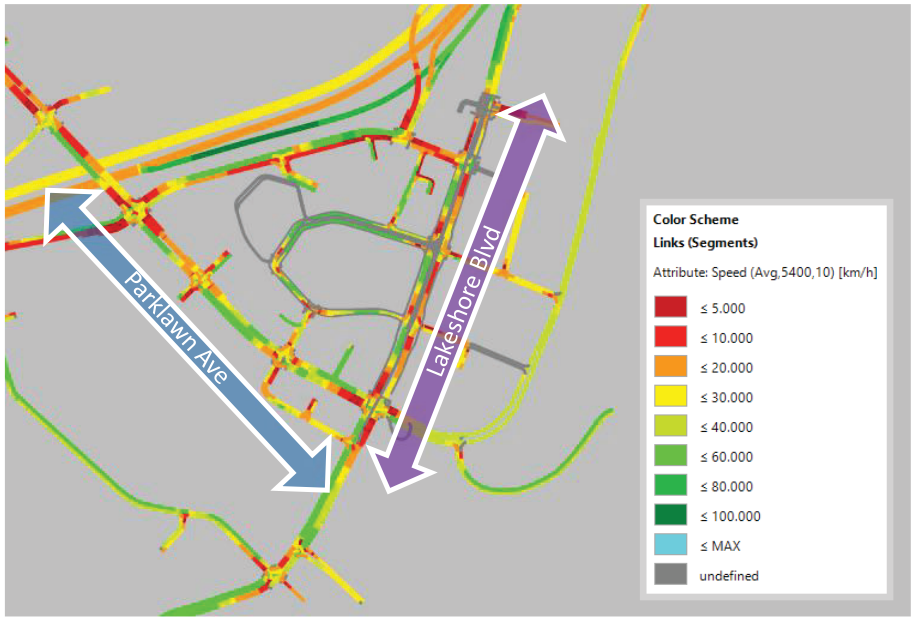
- Travel time markers were included in all *Vissim* models to evaluate the impact of potential transit track configurations on private vehicle average speeds along the Parklawn Rd and Lakeshore Blvd corridors in the vicinity of the Christie's site

Average Private Veh Travel Times & Speeds

			Uni-Directional	Bi-Directional East
Lake Shore	Travel Times	Eastbound	2min 30sec	2min 33sec
		Westbound	5min 16sec	5min 38sec
	Average Speed (km/h)	Eastbound	14.39	14.13
		Westbound	7.06	6.59

			Uni-Directional	Bi-Directional East
Park Lawn	Travel Times	Northbound	1min 49sec	1min 42sec
		Southbound	1min 19sec	1min 21sec
	Average Speed (km/h)	Northbound	16.00	17.10
		Southbound	23.04	22.71

Average Private Veh Speed Heat Map



Conclusions

Transit Vehicle Operations

- Streetcar travel times around Loop Rd are projected to take, on average, between 6 and 7 minutes, for all combinations of transit routes and potential track configurations.
- Unidirectional scenario transit travel times are marginally longer than Bidirectional East scenario transit travel times for the 501 Queen EB (Long Branch to Church) and the 504 King (Parklawn to Broadview) routes, by approximately 40 and 20 seconds, respectively.
- Bidirectional East scenario transit travel times are marginally longer than Unidirectional scenario transit travel times for the 501 Queen WB (Church to Long Branch) route, by approximately 50 seconds.
- Similar variability (30 to 60 seconds standard deviation) in travel time for different routes in both scenarios
- Overall, the transit track configuration is shown to have a limited influence on streetcar operations, as all modelled track configurations and transit route combinations perform well, with differences between each measured in seconds, rather than minutes.

Private Vehicle Operations

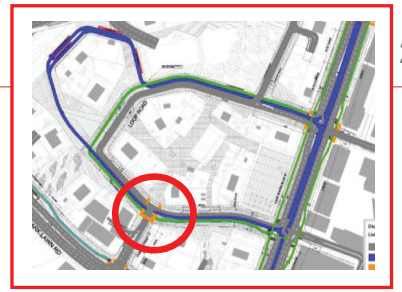
- Private vehicle travel times along segments of Lakeshore Blvd and Parklawn Rd adjacent to the site are very similar in both modelled scenarios.
- The choice of transit route configuration (unidirectional vs bidirectional east) is therefore projected to have little, if any, impact on private vehicle travel times along Lakeshore Blvd and Parklawn Rd.

Appendix A

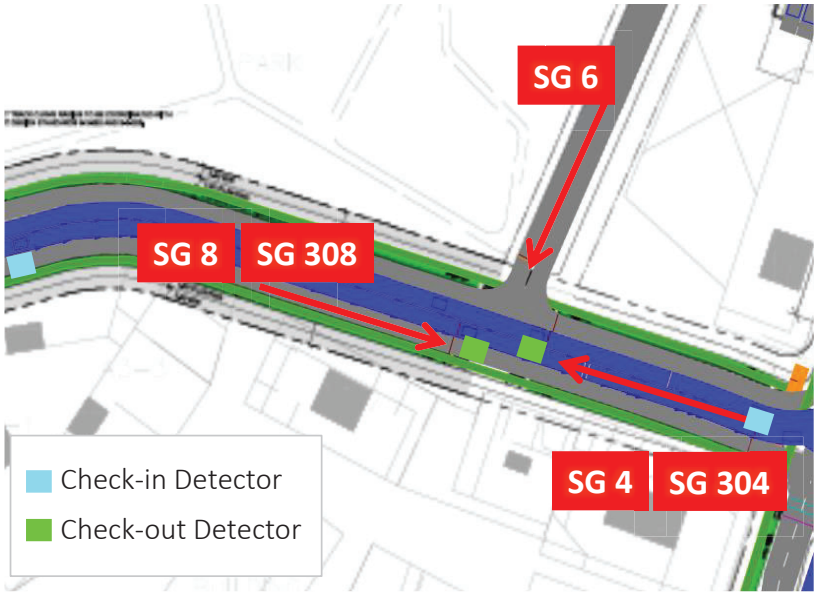
Transit Signal Timing & Priority Strategy – Details

1. **TSP Type 1 – Mid-Loop Rd Signals**

TSP Type 1 | Model Signal Parameters



Cycle length: **85 s**



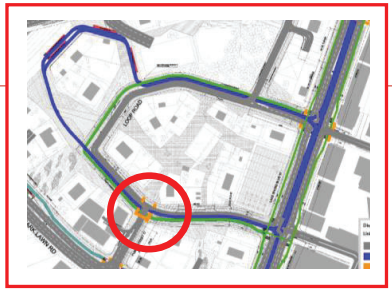
Basic

SG Number	4		6		8
SG Name	NBT		EB		SBT
Min Green	35		12		35
Veh Extension	3		3		3
Max 1	45		20		45
Yellow	3		3		3
Red Clearance	2		2		2
Ped SG Number	104		106		108
Walk	15		2		15
Ped Clear (FDW)	20		10		20
Start Up	☑	☐	☐	☐	☑
Min Recall	☑	☐	☐	☐	☑
Max Recall	☐	☐	☑	☐	☐
Ped Recall	☑	☐	☐	☐	☑

Pattern 1

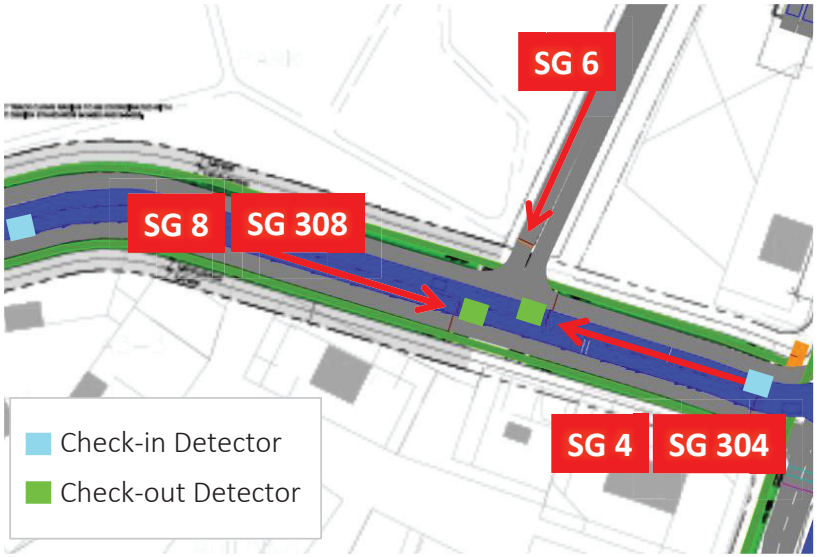
Signal Group:	4		6		8
Splits	60		25		60
Splits Extension					
Floating Green					
Perm Min Green					
Min Green					
Alternate Max					
Veh Extension					
Transition Min					
Transition Max	72		30		72
Force Off					
Permissive Start					
Permissive End					
Max 2	☐	☐	☐	☐	☐
Max 3	☐	☐	☐	☐	☐
Floating Force Off	☐	☐	☐	☐	☐
Coordinated	☑	☐	☐	☐	☑

TSP Type 1 | Model Signal Parameters (cont.)



Transit SGs

Transit SG	301	302	303	304	305	306	307	308
Use as Vissim SG	☐	☐	☐	☑	☐	☐	☐	☑
Parent SGs				4				8
No Call SGs								
Priority SGs								
Min Green				5				5
Yellow				3				3
Red Clearance								
Adv. Call Time								
Extension								
Call Mode	Non-Locked	Non-Locked	Non-Locked	Locked	Non-Locked	Non-Locked	Non-Locked	Locked
Priority				1				1



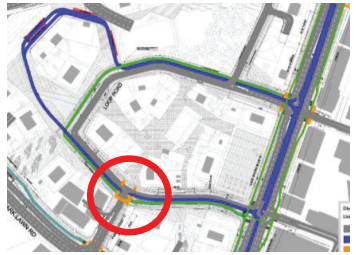
Coordination Priority

Transit SG:	301	302	303	304	305	306	307	308
Vehicle SG Omits								
Ped SG Omits								
Priority Mode	None	None	None	Early / Extend	None	None	None	Early / Extend
Extend Limit	1	1	1	15	1	1	1	15

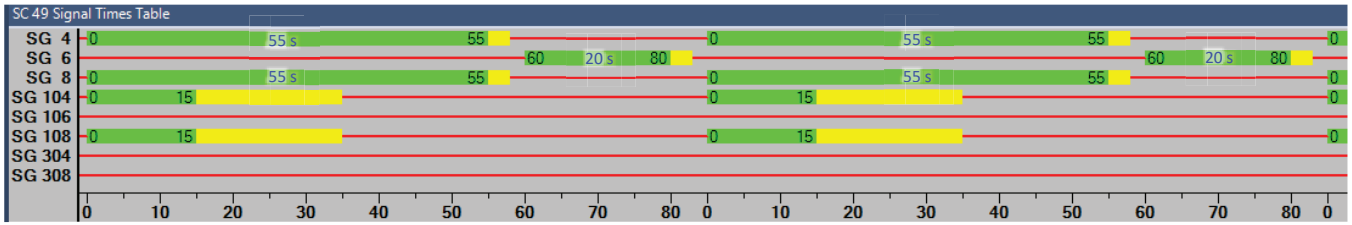
Transit Inputs

Inputs	4	5	6	7	8
Call					
Call Transit SGs	304				308
Checkout Detectors					
Delay Time					
Extend Time					
Travel Time	3				3
Travel Time Slack	4				4
Adjust Step					
Adjust Max					
Calling Pt. Detector	☐	☐	☐	☐	☐
Lateness	0	0	0	0	0
Check Out Limit					
Check Out Mode	Normal	Normal	Normal	Normal	Normal
Detector Type	Checkin / Checkout	Checkin / Checkout	Checkin / Checkout	Checkin / Checkout	Checkin / Checkout
Presence					
Check In	314	315	316	317	318
Check Out	324	325	326	327	328

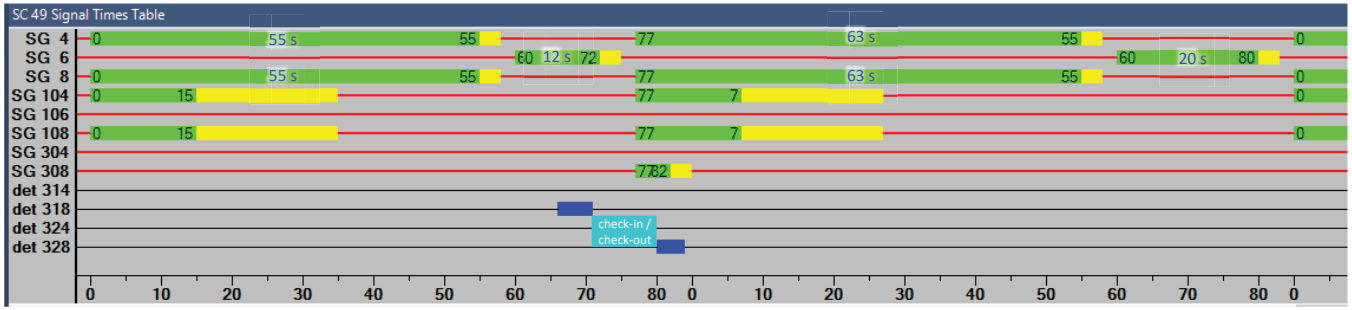
TSP Type 1 | Sample Actuation Cases & Cycle Responses



Base Case

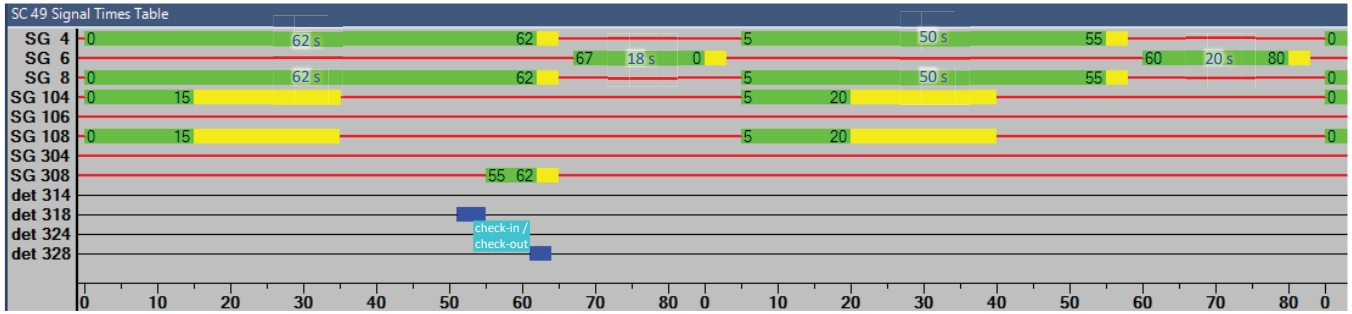


Early Call



Delay at intersection reduced by 8s due to early call of signal group.

Extension

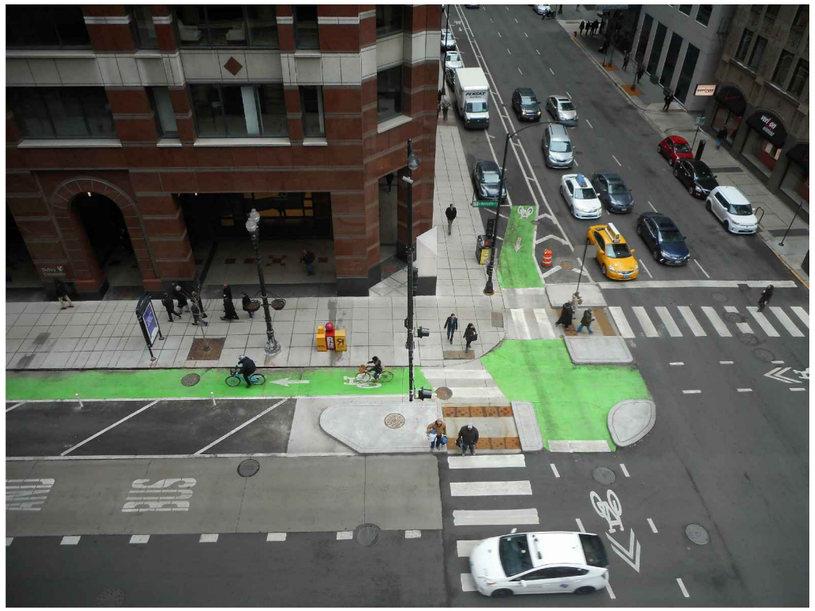


No delay due to green phase extension.

Vancouver, BC

Salt Lake City, Utah

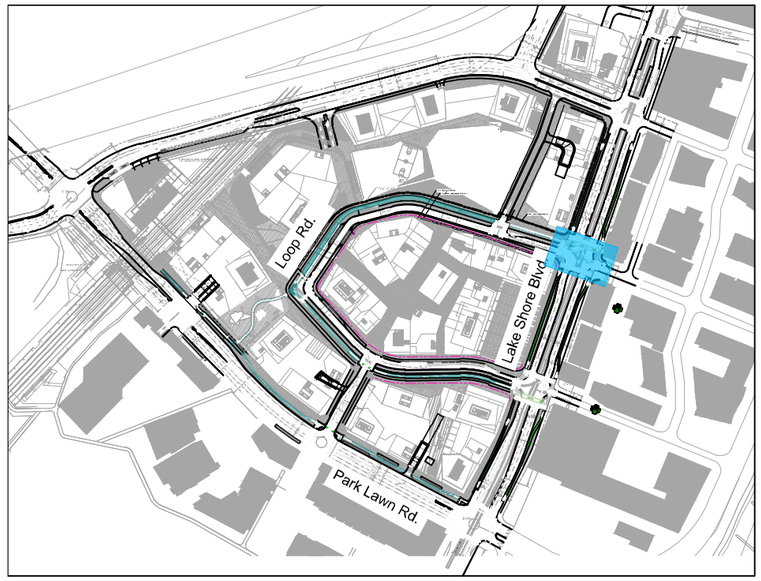
Davis, California



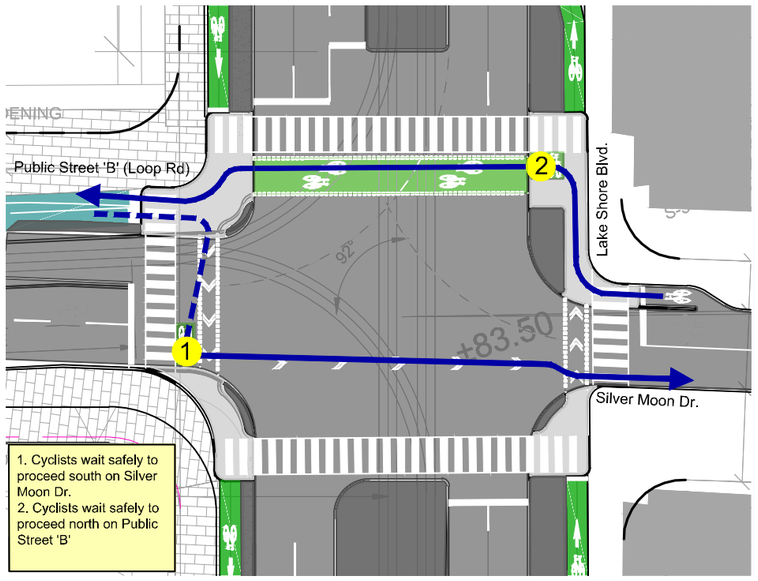
Chicago, Illinois

BA Group	2150 Lake Shore Boulevard West Protected Intersection Precedence North American Examples	Project: 2150 Lake Shore Blvd. Project No. 7036-10 Date: February 25, 2021 Revised: --	Scale Drawing No. SN-01

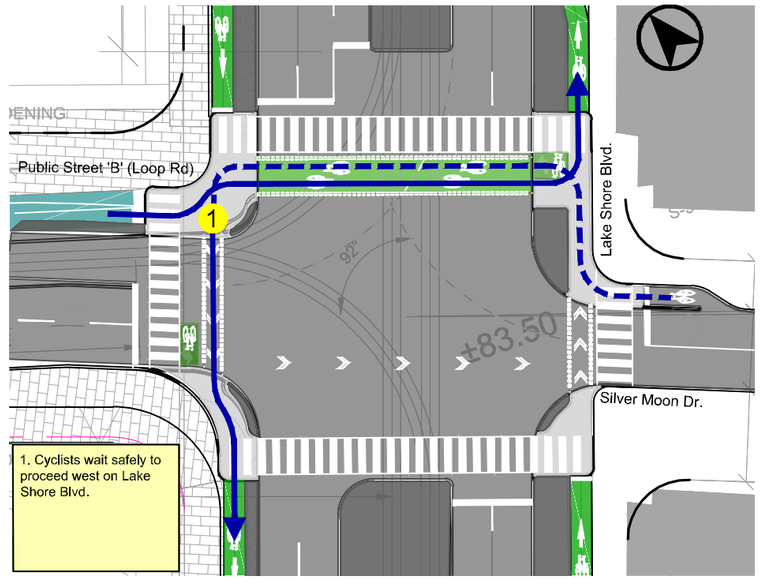
APPENDIX K:
Lake Shore Boulevard Intersections Cycling Crossing Diagrams



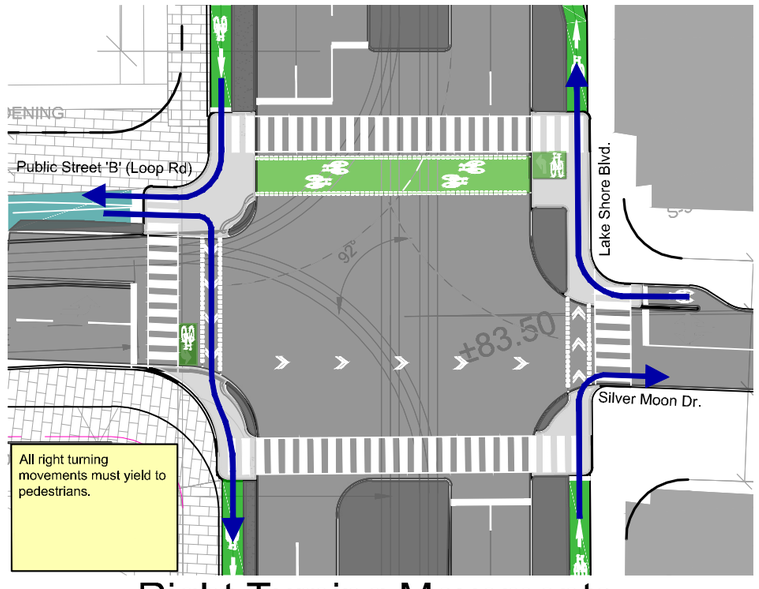
Key Map



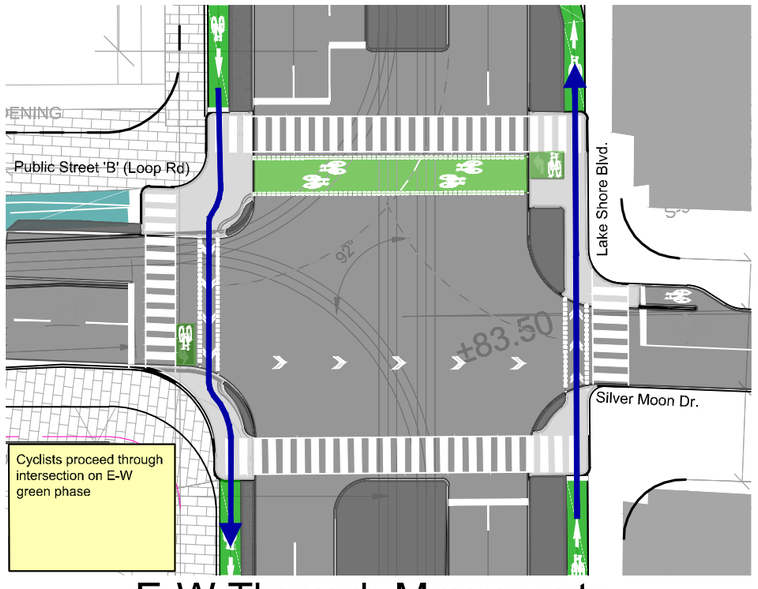
N-S Through Movements



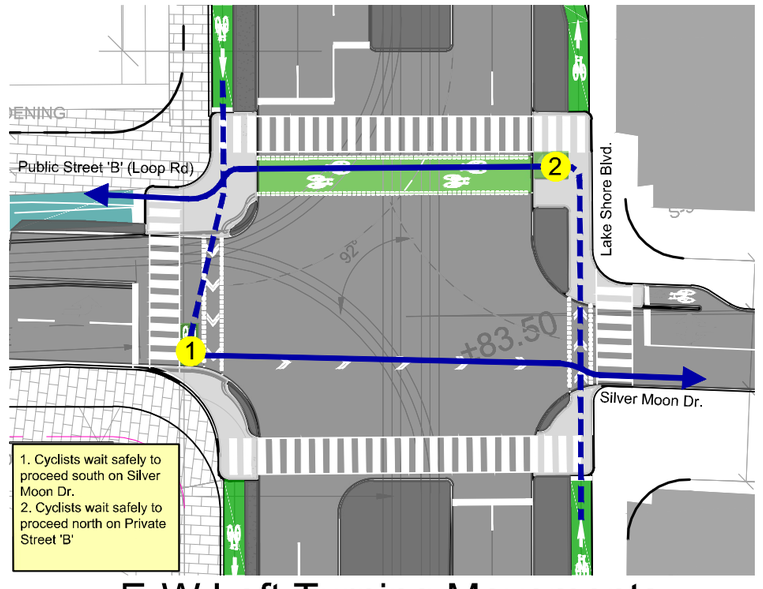
N-S Left Turning Movements



Right Turning Movements



E-W Through Movements



E-W Left Turning Movements

BA Group

2150 Lake Shore Boulevard West

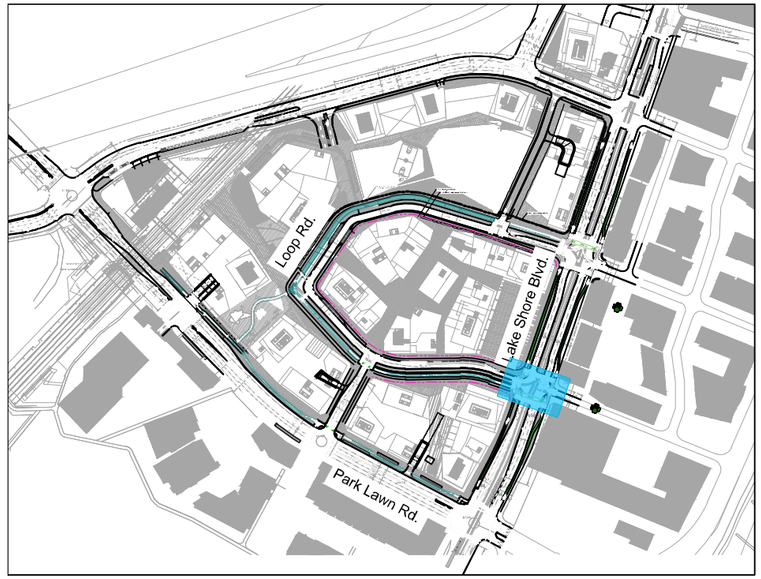
Cycling Path Diagram

North-East Intersection

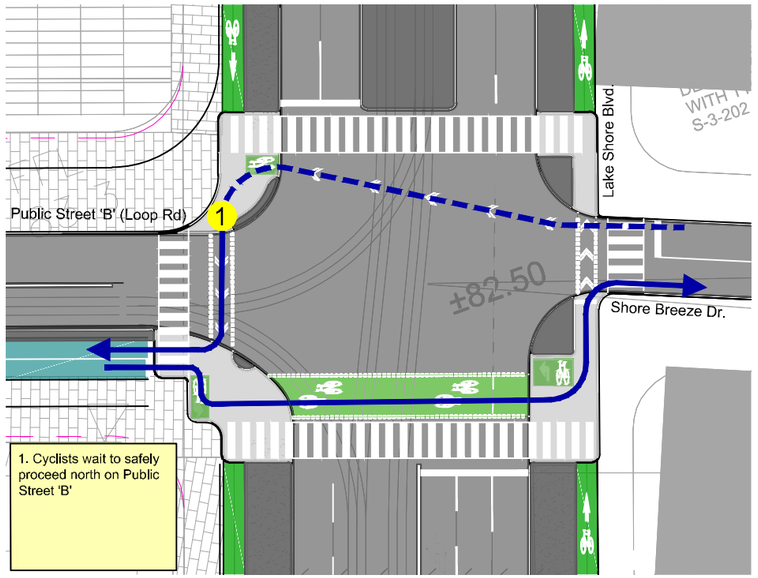
Project:	2150 Lake Shore Blvd.
Project No.	7036-10
Date:	February 25, 2021
Revised:	--

Scale 1:500 (0 5 10 15 20m)

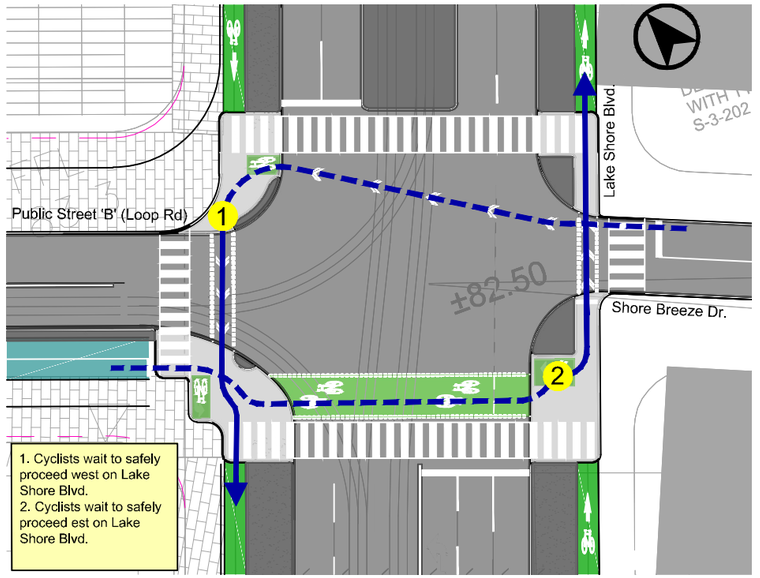
Drawing No. SN-02



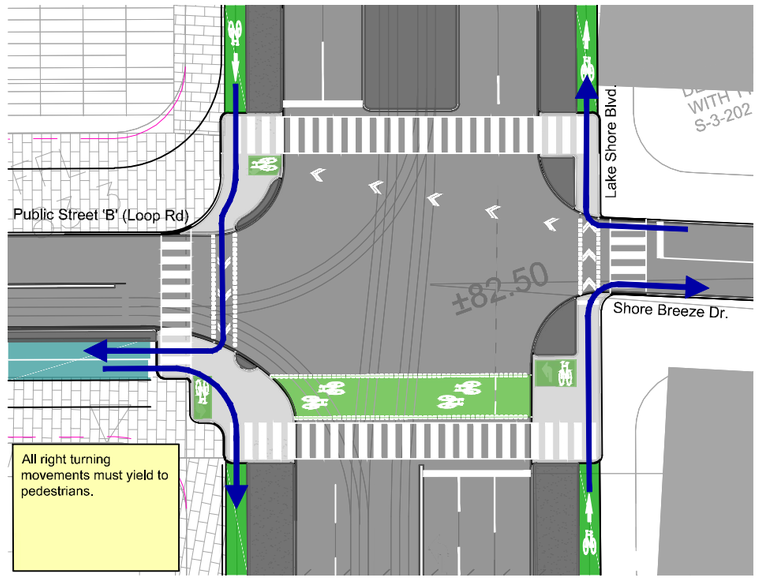
Key Map



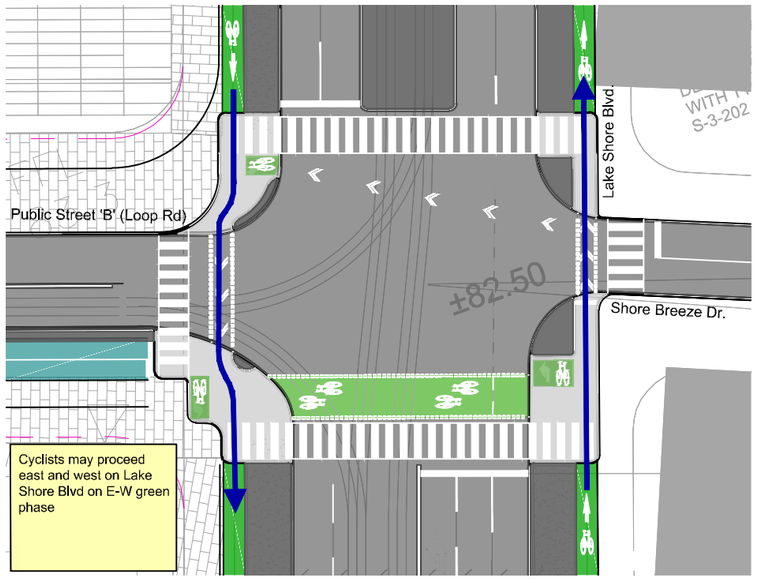
N-S Through Movements



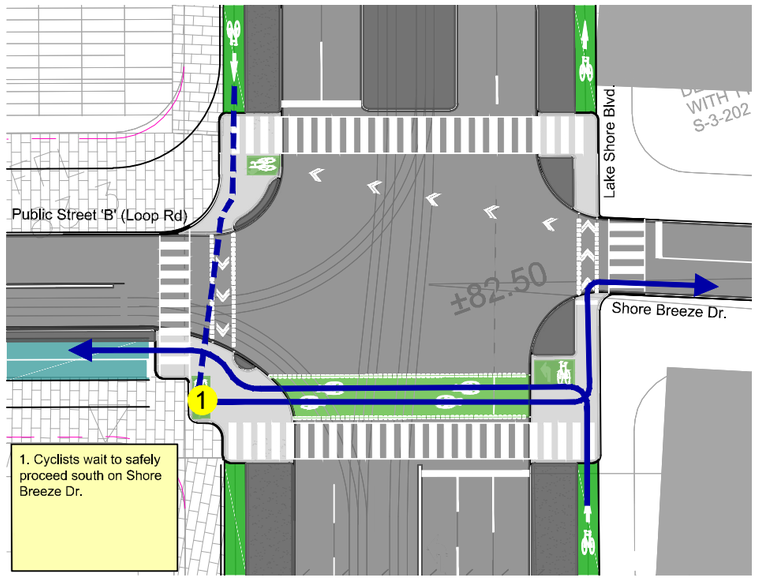
N-S Left Turning Movements



Right Turning Movements



E-W Through Movements



E-W Left Turning Movements

BA Group

2150 Lake Shore Boulevard West

Cycling Path Diagram

South-West Intersection

Project:	2150 Lake Shore Blvd.
Project No.	7036-10
Date:	February 25, 2021
Revised:	--

Scale 1:500 (0, 5, 10, 15, 20m)

Drawing No. SN-03