APPENDIX A

Terms of Reference

MEMO

DATE:	June 14, 2021
PROJECT NO:	04-21-0201
PROJECT:	**5360 12 Avenue, Delta**
SUBJECT:	**Transportation Impact Assessment (TIA) Terms of Reference**
TO:	Taras Dahl, City of Delta
PREPARED BY:	Stuart Thornley, EIT, Bunt & Associates
REVIEWED BY:	Peter Joyce, P.Eng., Bunt & Associates

The following document outlines Bunt's proposed Terms of Reference (ToR) for the proposed development at 5360 12 Avenue in Delta, BC. The proposed development includes approximately 30,000 square feet of office space, with driveway accesses to the site's 83 parking spaces taken from 12 Avenue (right-in, right-out), and 53A Avenue.

The study requirements provided herein reflect the City of Delta's "Terms of Reference for Traffic Impact Studies" guidelines.

Should you have any questions or comments, please do not hesitate to contact us.

Yours truly,

Bunt & Associates

Stuart Thornley, EIT
Transportation Analyst

Peter Joyce, P.Eng.
Principal

1. TERMS OF REFERENCE

1.1 Report

- Sealed and signed by a Professional Engineer registered in the Province of British Columbia.

  Note: The report will not be signed and sealed until the report has been finalized. This finalization of the report would occur once the City has provided all review comments on the draft report and the comments have been addressed by Bunt.

1.2 Study Contents

1.2.1 Proposed Development and Study Area

- Describe the land use(s) in the proposed development; and,
- Provide a map of the site plan and street network.

1.2.2 Existing Traffic Conditions

- Describe the nearby roadway/intersection classifications and traffic control types at study intersections;
- Summarize the existing multi-modal transportation network, including pedestrian, bicycle, and transit facilities in the nearby area;
- Collect traffic volume data (vehicles, bikes and pedestrians) for the weekday AM (7am-9am) and PM peak periods (3pm-6pm) at the study intersections.

  Note: given that the proposed development is comprised solely of office space, the weekday AM and PM peak hours are considered appropriate for this study, as office demand would typically be significantly lower during the weekend.

- Assess existing traffic operations at the study intersections listed below for the weekday AM and PM peak hour periods. The measures of effectiveness (MOEs) will include Level of Service (LOS) delay, V/C ratio, and 95th percentile queue lengths.
  1. 53A Street & 12 Avenue (signalized); and,
  2. 53A Street & 11A Avenue (unsignalized).

1.2.3 Future Traffic Conditions

Proposed Site Traffic

- Estimate the site-generated traffic volumes during the AM and PM peak hours using ITE Trip Generation Manual (10th Edition) trip rates; and,
  Provide figure(s) showing proposed AM and PM peak hour site-generated traffic, including the distribution and routing of the site trips to the adjacent study road network.

Note: given the low anticipated site trip generation, we feel that the number of study intersections is appropriate for this study. Bunt will provide discussion in the report about how the trip routing may impact operations at the study intersections and site accesses.

Future Traffic Operations Analysis

- Forecast future Background (without development) traffic volumes by applying a linear 1% per annum background growth rate;

  Note: the City of Delta has requested that the future Background traffic analysis take into account the site trips associated with several other nearby developments, including Southlands and Kinvillage. The City will provide Bunt with relevant information such as TIA reports.

- Assess future Background (without development) traffic operations at the study intersections for the Opening Day (2023) scenario for the AM and PM peak hour periods;
- Assess future Total (with development) traffic operations at the study intersections for the Opening Day (2023) scenario for the AM and PM peak hour periods;
- Identify what mitigation measures (if any) would be required at the study intersections in order to accommodate the addition of site traffic; and,
- Provide figure(s) showing the AM and PM peak hour Background (without development) and Total (with development) traffic volumes for the projected Opening Day (2023) horizon.

1.2.4 Parking Analysis

- Review the proposed parking supply and compare to the City's Zoning Bylaw requirement; and,
- If a variance is required, prepare a parking supply variance rationale that supports the proposed parking supply. The rationale will be based on Bunt's pre-existing parking demand data for similar type developments, information included in industry studies, an emphasis on the alternative transportation mode facilities available in the nearby area, and, if applicable, planned Transportation Demand Management (TDM) measures for the site.

APPENDIX B

Synchro Output Results

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	402	253	90	230	20	160
v/c Ratio	0.29	0.20	0.23	0.41	0.05	0.28
Control Delay	5.9	7.6	9.7	9.2	7.9	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.9	7.6	9.7	9.2	7.9	8.5
Queue Length 50th (m)	4.5	4.0	2.9	6.4	0.6	4.6
Queue Length 95th (m)	12.1	10.1	9.8	18.4	3.3	13.8
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2875	2795	855	1211	827	1268
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.09	0.11	0.19	0.02	0.13

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	199	129	44	164	20	81	130	77	18	113	31
Future Volume (vph)	34	199	129	44	164	20	81	130	77	18	113	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			1.00		0.99	1.00		1.00	1.00	
Frt		0.95			0.99		1.00	0.94		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3187			3379		1770	1692		1804	1787	
Flt Permitted		0.90			0.82		0.66	1.00		0.62	1.00	
Satd. Flow (perm)		2886			2800		1221	1692		1168	1787	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	38	221	143	49	182	22	90	144	86	20	126	34
RTOR Reduction (vph)	0	88	0	0	13	0	0	32	0	0	14	0
Lane Group Flow (vph)	0	314	0	0	240	0	90	198	0	20	146	0
Confl. Peds. (#/hr)	8		11	11		8	23		2	2		23
Confl. Bikes (#/hr)			4									2
Heavy Vehicles (%)	6%	4%	4%	10%	3%	0%	1%	1%	13%	0%	3%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		11.6			11.6		7.4	7.4		7.4	7.4	
Effective Green, g (s)		11.6			11.6		7.4	7.4		7.4	7.4	
Actuated g/C Ratio		0.39			0.39		0.25	0.25		0.25	0.25	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1115			1082		301	417		288	440	
v/s Ratio Prot								c0.12			0.08	
v/s Ratio Perm		c0.11			0.09		0.07			0.02		
v/c Ratio		0.28			0.22		0.30	0.48		0.07	0.33	
Uniform Delay, d1		6.3			6.2		9.2	9.6		8.7	9.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.2			0.1		0.7	1.0		0.1	0.5	
Delay (s)		6.5			6.3		9.9	10.7		8.8	9.8	
Level of Service		A			A		A	B		A	A	
Approach Delay (s)		6.5			6.3			10.4			9.7	
Approach LOS		A			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	8.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	30.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	9	9	3	277	273	11
Future Volume (Veh/h)	9	9	3	277	273	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79
Hourly flow rate (vph)	11	11	4	351	346	14
Pedestrians	21				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked						
vC, conflicting volume	734	374	381			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	734	374	381			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	100			
cM capacity (veh/h)	383	667	1171			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	22	355	360
Volume Left	11	4	0
Volume Right	11	0	14
cSH	486	1171	1700
Volume to Capacity	0.05	0.00	0.21
Queue Length 95th (m)	1.1	0.1	0.0
Control Delay (s)	12.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	12.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	462	497	67	176	37	151
v/c Ratio	0.29	0.37	0.21	0.35	0.11	0.30
Control Delay	5.7	7.4	11.5	8.4	10.5	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.7	7.4	11.5	8.4	10.5	10.4
Queue Length 50th (m)	6.0	8.3	2.5	3.7	1.4	4.8
Queue Length 95th (m)	13.8	18.1	9.7	14.9	6.2	15.8
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	3019	2626	785	1118	785	1174
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.19	0.09	0.16	0.05	0.13

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	282	104	99	286	58	60	75	82	33	101	34
Future Volume (vph)	25	282	104	99	286	58	60	75	82	33	101	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.98		1.00	0.92		1.00	0.96	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3331			3415		1765	1701		1803	1820	
Flt Permitted		0.91			0.76		0.66	1.00		0.65	1.00	
Satd. Flow (perm)		3028			2633		1228	1701		1227	1820	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	28	317	117	111	321	65	67	84	92	37	113	38
RTOR Reduction (vph)	0	59	0	0	21	0	0	61	0	0	19	0
Lane Group Flow (vph)	0	403	0	0	476	0	67	115	0	37	132	0
Confl. Peds. (#/hr)	11		14	14		11	5		2	2		5
Confl. Bikes (#/hr)						1			3			3
Heavy Vehicles (%)	4%	2%	1%	4%	1%	3%	2%	0%	4%	0%	0%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		14.8			14.8		6.8	6.8		6.8	6.8	
Effective Green, g (s)		14.8			14.8		6.8	6.8		6.8	6.8	
Actuated g/C Ratio		0.45			0.45		0.21	0.21		0.21	0.21	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1374			1195		256	354		255	379	
v/s Ratio Prot								0.07			c0.07	
v/s Ratio Perm		0.13			c0.18		0.05			0.03		
v/c Ratio		0.29			0.40		0.26	0.33		0.15	0.35	
Uniform Delay, d1		5.6			5.9		10.8	11.0		10.5	11.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.1			0.3		0.6	0.6		0.3	0.7	
Delay (s)		5.7			6.2		11.4	11.6		10.8	11.7	
Level of Service		A			A		B	B		B	B	
Approach Delay (s)		5.7			6.2			11.5			11.5	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	7.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	32.6	Sum of lost time (s)	11.0
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	13	6	4	204	283	20
Future Volume (Veh/h)	13	6	4	204	283	20
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	15	7	5	240	333	24
Pedestrians	12				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked						
vC, conflicting volume	608	357	369			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	608	357	369			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	100			
cM capacity (veh/h)	456	686	1191			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	22	245	357
Volume Left	15	5	0
Volume Right	7	0	24
cSH	511	1191	1700
Volume to Capacity	0.04	0.00	0.21
Queue Length 95th (m)	1.1	0.1	0.0
Control Delay (s)	12.4	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	12.4	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	26.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	482	318	102	244	21	173
v/c Ratio	0.34	0.24	0.26	0.42	0.06	0.29
Control Delay	6.2	7.9	10.7	10.0	8.6	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.2	7.9	10.7	10.0	8.6	9.2
Queue Length 50th (m)	5.9	5.5	3.6	7.3	0.7	5.4
Queue Length 95th (m)	15.4	13.4	12.6	22.5	3.9	17.0
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2881	2816	839	1206	811	1261
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.11	0.12	0.20	0.03	0.14

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	251	147	46	220	21	92	139	81	19	122	33
Future Volume (vph)	36	251	147	46	220	21	92	139	81	19	122	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			1.00		0.99	1.00		1.00	1.00	
Frt		0.95			0.99		1.00	0.94		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3201			3400		1770	1694		1804	1787	
Flt Permitted		0.90			0.82		0.65	1.00		0.61	1.00	
Satd. Flow (perm)		2893			2821		1207	1694		1153	1787	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	40	279	163	51	244	23	102	154	90	21	136	37
RTOR Reduction (vph)	0	98	0	0	11	0	0	31	0	0	14	0
Lane Group Flow (vph)	0	384	0	0	307	0	102	213	0	21	159	0
Confl. Peds. (#/hr)	8		11	11		8	23		2	2		23
Confl. Bikes (#/hr)			4									2
Heavy Vehicles (%)	6%	4%	4%	10%	3%	0%	1%	1%	13%	0%	3%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		12.2			12.2		7.6	7.6		7.6	7.6	
Effective Green, g (s)		12.2			12.2		7.6	7.6		7.6	7.6	
Actuated g/C Ratio		0.40			0.40		0.25	0.25		0.25	0.25	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1145			1117		297	418		284	440	
v/s Ratio Prot								c0.13			0.09	
v/s Ratio Perm		c0.13			0.11		0.08			0.02		
v/c Ratio		0.33			0.27		0.34	0.51		0.07	0.36	
Uniform Delay, d1		6.5			6.3		9.5	10.0		8.9	9.6	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.2			0.2		0.8	1.2		0.1	0.6	
Delay (s)		6.7			6.5		10.4	11.2		9.0	10.2	
Level of Service		A			A		B	B		A	B	
Approach Delay (s)		6.7			6.5			10.9			10.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	30.8	Sum of lost time (s)	11.0
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	9	10	3	302	303	11
Future Volume (Veh/h)	9	10	3	302	303	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79
Hourly flow rate (vph)	11	13	4	382	384	14
Pedestrians	21				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked						
vC, conflicting volume	803	412	419			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	803	412	419			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	100			
cM capacity (veh/h)	349	635	1134			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	24	386	398
Volume Left	11	4	0
Volume Right	13	0	14
cSH	461	1134	1700
Volume to Capacity	0.05	0.00	0.23
Queue Length 95th (m)	1.3	0.1	0.0
Control Delay (s)	13.2	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	13.2	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	28.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	672	604	113	198	39	171
v/c Ratio	0.39	0.43	0.35	0.39	0.12	0.34
Control Delay	6.8	8.4	15.4	10.7	12.5	12.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.8	8.4	15.4	10.7	12.5	12.5
Queue Length 50th (m)	11.3	12.6	5.4	6.0	1.8	7.0
Queue Length 95th (m)	24.6	27.2	18.0	21.1	7.7	21.8
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2942	2479	761	1108	760	1163
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.24	0.15	0.18	0.05	0.15

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	420	151	105	411	21	101	89	87	35	117	36
Future Volume (vph)	27	420	151	105	411	21	101	89	87	35	117	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.93		1.00	0.96	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3334			3488		1765	1711		1803	1825	
Flt Permitted		0.91			0.73		0.65	1.00		0.63	1.00	
Satd. Flow (perm)		3048			2564		1206	1711		1202	1825	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	30	472	170	118	462	24	113	100	98	39	131	40
RTOR Reduction (vph)	0	55	0	0	5	0	0	55	0	0	17	0
Lane Group Flow (vph)	0	617	0	0	599	0	113	143	0	39	154	0
Confl. Peds. (#/hr)	11		14	14		11	5		2	2		5
Confl. Bikes (#/hr)						1			3			3
Heavy Vehicles (%)	4%	2%	1%	4%	1%	3%	2%	0%	4%	0%	0%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		17.8			17.8		7.6	7.6		7.6	7.6	
Effective Green, g (s)		17.8			17.8		7.6	7.6		7.6	7.6	
Actuated g/C Ratio		0.49			0.49		0.21	0.21		0.21	0.21	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1490			1253		251	357		250	381	
v/s Ratio Prot								0.08			0.08	
v/s Ratio Perm		0.20			c0.23		c0.09			0.03		
v/c Ratio		0.41			0.48		0.45	0.40		0.16	0.40	
Uniform Delay, d1		6.0			6.2		12.6	12.4		11.8	12.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.2			0.3		1.5	0.9		0.3	0.8	
Delay (s)		6.2			6.5		14.1	13.3		12.1	13.3	
Level of Service		A			A		B	B		B	B	
Approach Delay (s)		6.2			6.5			13.6			13.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	8.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	36.4	Sum of lost time (s)	11.0
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	6	4	263	352	22
Future Volume (Veh/h)	14	6	4	263	352	22
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	16	7	5	309	414	26
Pedestrians	12				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked	0.99	0.99	0.99			
vC, conflicting volume	759	439	452			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	751	427	440			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	100			
cM capacity (veh/h)	372	620	1109			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	23	314	440
Volume Left	16	5	0
Volume Right	7	0	26
cSH	424	1109	1700
Volume to Capacity	0.05	0.00	0.26
Queue Length 95th (m)	1.4	0.1	0.0
Control Delay (s)	14.0	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	14.0	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	29.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	554	320	109	288	39	174
v/c Ratio	0.51	0.34	0.29	0.51	0.11	0.30
Control Delay	8.4	9.3	11.4	11.2	9.5	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.4	9.3	11.4	11.2	9.5	9.6
Queue Length 50th (m)	8.1	6.0	4.1	9.2	1.4	5.8
Queue Length 95th (m)	21.3	15.5	14.0	27.7	6.3	18.0
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2864	2671	737	1046	685	1111
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.12	0.15	0.28	0.06	0.16

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	313	149	48	220	21	98	142	117	35	123	33
Future Volume (vph)	36	313	149	48	220	21	98	142	117	35	123	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes		1.00			1.00		0.99	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.93		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3226			3398		1768	1655		1804	1787	
Flt Permitted		0.90			0.80		0.65	1.00		0.58	1.00	
Satd. Flow (perm)		2923			2726		1205	1655		1108	1787	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	40	348	166	53	244	23	109	158	130	39	137	37
RTOR Reduction (vph)	0	101	0	0	12	0	0	39	0	0	13	0
Lane Group Flow (vph)	0	453	0	0	308	0	109	249	0	39	161	0
Confl. Peds. (#/hr)	8		11	11		8	23		2	2		23
Confl. Bikes (#/hr)			4									2
Heavy Vehicles (%)	6%	4%	4%	10%	3%	0%	1%	1%	13%	0%	3%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		11.3			11.3		10.7	10.7		10.7	10.7	
Effective Green, g (s)		11.3			11.3		10.7	10.7		10.7	10.7	
Actuated g/C Ratio		0.34			0.34		0.32	0.32		0.32	0.32	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1000			933		390	536		359	579	
v/s Ratio Prot								c0.15			0.09	
v/s Ratio Perm		c0.16			0.11		0.09			0.04		
v/c Ratio		0.45			0.33		0.28	0.46		0.11	0.28	
Uniform Delay, d1		8.4			8.0		8.3	8.9		7.8	8.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4			0.2		0.5	0.8		0.2	0.3	
Delay (s)		8.8			8.3		8.8	9.6		8.0	8.6	
Level of Service		A			A		A	A		A	A	
Approach Delay (s)		8.8			8.3			9.4			8.5	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	33.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	9	10	3	346	307	11
Future Volume (Veh/h)	9	10	3	346	307	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79
Hourly flow rate (vph)	11	13	4	438	389	14
Pedestrians	21				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked						
vC, conflicting volume	864	417	424			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	864	417	424			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	100			
cM capacity (veh/h)	321	631	1129			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	24	442	403
Volume Left	11	4	0
Volume Right	13	0	14
cSH	437	1129	1700
Volume to Capacity	0.05	0.00	0.24
Queue Length 95th (m)	1.4	0.1	0.0
Control Delay (s)	13.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	13.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	30.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	697	611	116	220	51	175
v/c Ratio	0.51	0.57	0.37	0.44	0.17	0.35
Control Delay	8.0	10.4	16.2	11.1	13.3	13.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.0	10.4	16.2	11.1	13.3	13.0
Queue Length 50th (m)	12.1	13.1	5.8	6.7	2.4	7.5
Queue Length 95th (m)	26.4	28.6	18.9	23.1	9.6	22.9
Internal Link Dist (m)	65.7	1125.0		58.6		465.5
Turn Bay Length (m)			25.0		25.0	
Base Capacity (vph)	2923	2379	664	976	653	1022
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.26	0.17	0.23	0.08	0.17

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	438	156	111	411	21	103	90	106	45	120	36
Future Volume (vph)	27	438	156	111	411	21	103	90	106	45	120	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.92		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3335			3485		1765	1694		1803	1827	
Flt Permitted		0.91			0.70		0.65	1.00		0.62	1.00	
Satd. Flow (perm)		3044			2474		1202	1694		1178	1827	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	30	492	175	125	462	24	116	101	119	51	135	40
RTOR Reduction (vph)	0	60	0	0	5	0	0	61	0	0	15	0
Lane Group Flow (vph)	0	637	0	0	606	0	116	159	0	51	160	0
Confl. Peds. (#/hr)	11		14	14		11	5		2	2		5
Confl. Bikes (#/hr)						1			3			3
Heavy Vehicles (%)	4%	2%	1%	4%	1%	3%	2%	0%	4%	0%	0%	0%
Bus Blockages (#/hr)	0	6	0	0	0	0	0	0	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		16.1			16.1		9.8	9.8		9.8	9.8	
Effective Green, g (s)		16.1			16.1		9.8	9.8		9.8	9.8	
Actuated g/C Ratio		0.44			0.44		0.27	0.27		0.27	0.27	
Clearance Time (s)		5.6			5.6		5.4	5.4		5.4	5.4	
Vehicle Extension (s)		3.5			3.5		3.5	3.5		3.5	3.5	
Lane Grp Cap (vph)		1328			1079		319	449		312	485	
v/s Ratio Prot								0.09			0.09	
v/s Ratio Perm		0.21			c0.24		c0.10			0.04		
v/c Ratio		0.48			0.56		0.36	0.35		0.16	0.33	
Uniform Delay, d1		7.4			7.8		11.0	11.0		10.4	10.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			0.7		0.8	0.6		0.3	0.5	
Delay (s)		7.7			8.5		11.9	11.6		10.7	11.4	
Level of Service		A			A		B	B		B	B	
Approach Delay (s)		7.7			8.5			11.7			11.2	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	36.9	Sum of lost time (s)	11.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	6	4	285	365	22
Future Volume (Veh/h)	14	6	4	285	365	22
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	16	7	5	335	429	26
Pedestrians	12				1	
Lane Width (m)	3.0				3.0	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	1				0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					83	
pX, platoon unblocked	0.99	0.99	0.99			
vC, conflicting volume	800	454	467			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	794	445	458			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	99	100			
cM capacity (veh/h)	352	607	1095			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	23	340	455
Volume Left	16	5	0
Volume Right	7	0	26
cSH	404	1095	1700
Volume to Capacity	0.06	0.00	0.27
Queue Length 95th (m)	1.4	0.1	0.0
Control Delay (s)	14.5	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	14.5	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	30.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	362	73	31	289	0	93
Future Volume (Veh/h)	362	73	31	289	0	93
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	393	79	34	314	0	101
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	80					
pX, platoon unblocked						
vC, conflicting volume			472		658	236
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			472		658	236
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		100	87
cM capacity (veh/h)			1086		385	766

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	262	210	139	209	101
Volume Left	0	0	34	0	0
Volume Right	0	79	0	0	101
cSH	1700	1700	1086	1700	766
Volume to Capacity	0.15	0.12	0.03	0.12	0.13
Queue Length 95th (m)	0.0	0.0	0.8	0.0	3.6
Control Delay (s)	0.0	0.0	2.3	0.0	10.4
Lane LOS			A		B
Approach Delay (s)	0.0		0.9		10.4
Approach LOS					B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	549	24	16	544	0	45
Future Volume (Veh/h)	549	24	16	544	0	45
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	597	26	17	591	0	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	86					
pX, platoon unblocked			0.97		0.97	0.97
vC, conflicting volume			623		940	312
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			547		874	226
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		100	93
cM capacity (veh/h)			987		275	753

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	398	225	214	394	49
Volume Left	0	0	17	0	0
Volume Right	0	26	0	0	49
cSH	1700	1700	987	1700	753
Volume to Capacity	0.23	0.13	0.02	0.23	0.07
Queue Length 95th (m)	0.0	0.0	0.4	0.0	1.6
Control Delay (s)	0.0	0.0	0.8	0.0	10.1
Lane LOS			A		B
Approach Delay (s)	0.0		0.3		10.1
Approach LOS					B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	29.9%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX C

Swept Path Analysis

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2024/05/29 14:00, Plotted by Roxana Sorkhi

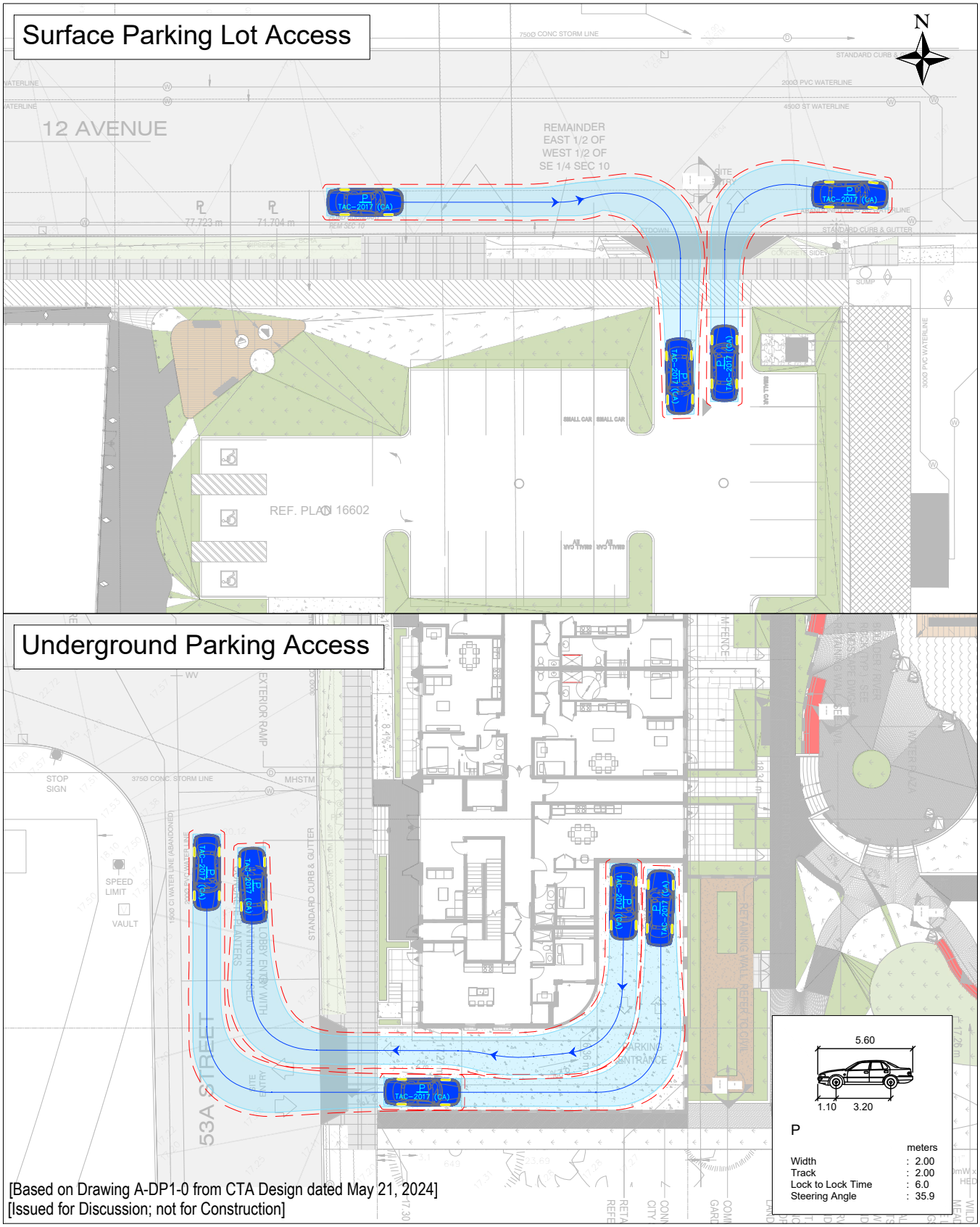


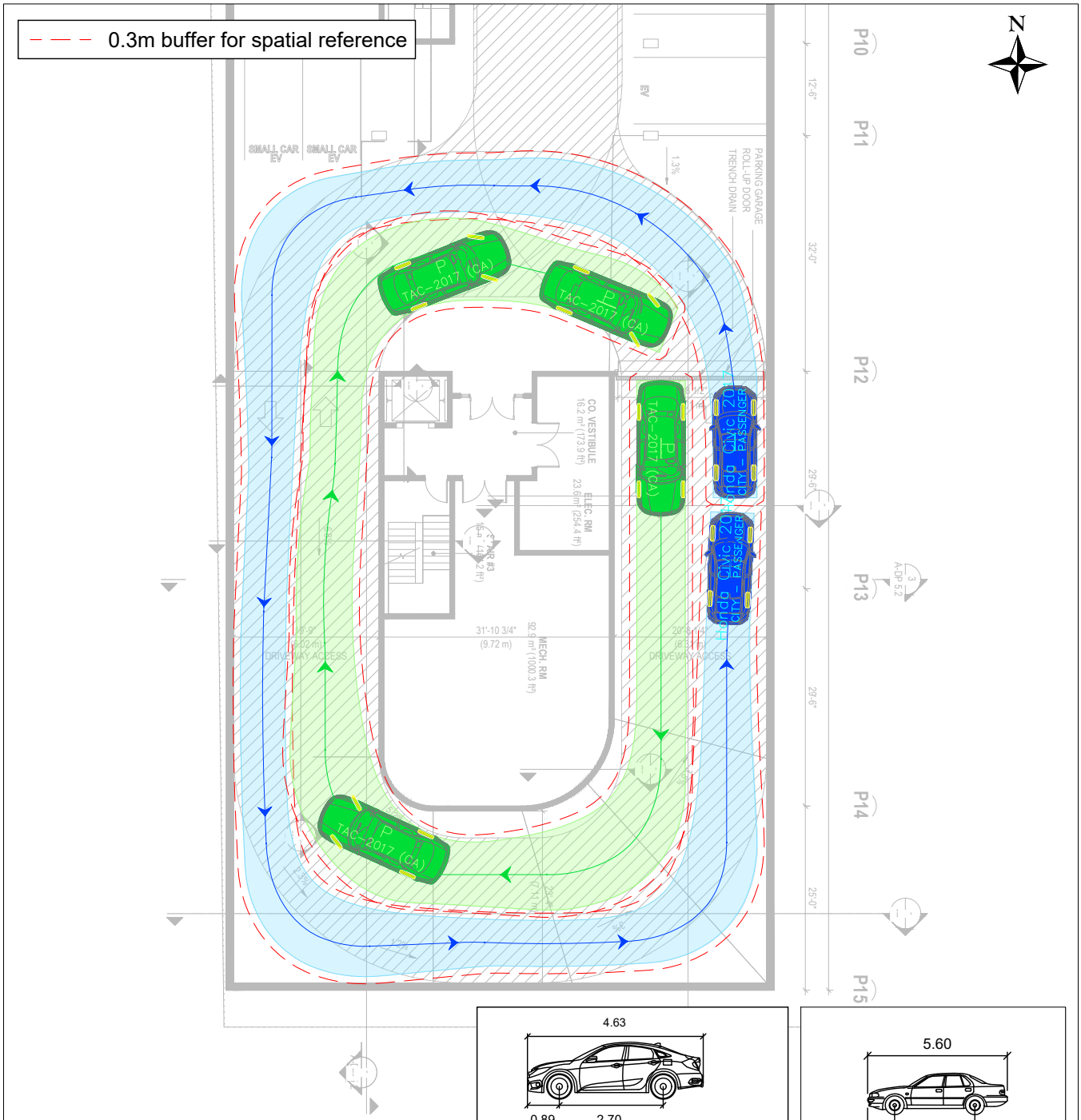
Exhibit C.1

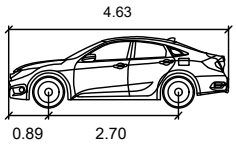
Passenger Vehicle Site Access

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:400 on Letter Prepared by RS

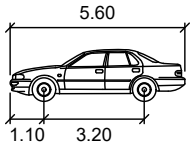
bunt & associates





Honda Civic 2017

	meters
Width	: 1.80
Track	: 1.78
Lock to Lock Time	: 6.0
Steering Angle	: 35.1



P

	meters
Width	: 2.00
Track	: 2.00
Lock to Lock Time	: 6.0
Steering Angle	: 35.9

[Based on Drawing A-DP2-1 from CTA Design dated April 8, 2024]
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2024/05/29 14:00, Plotted by Roxana Sorkhi

Exhibit C.2

P1 Parkade Ramp Circulation

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:250 on Letter Prepared by RS

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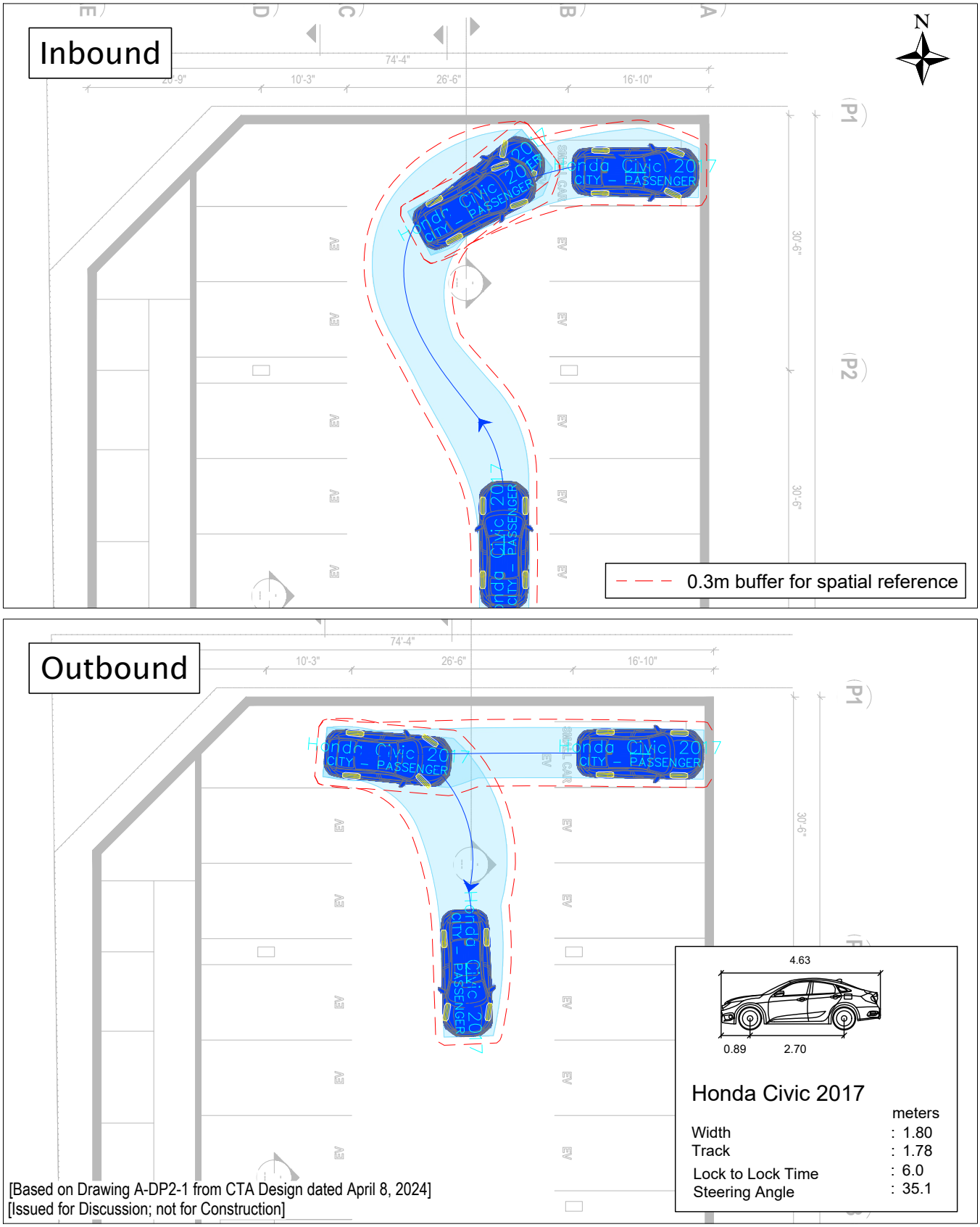

Exhibit C.3

P3 End Stall Parking Maneuvers

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:200 on Letter Prepared by RS

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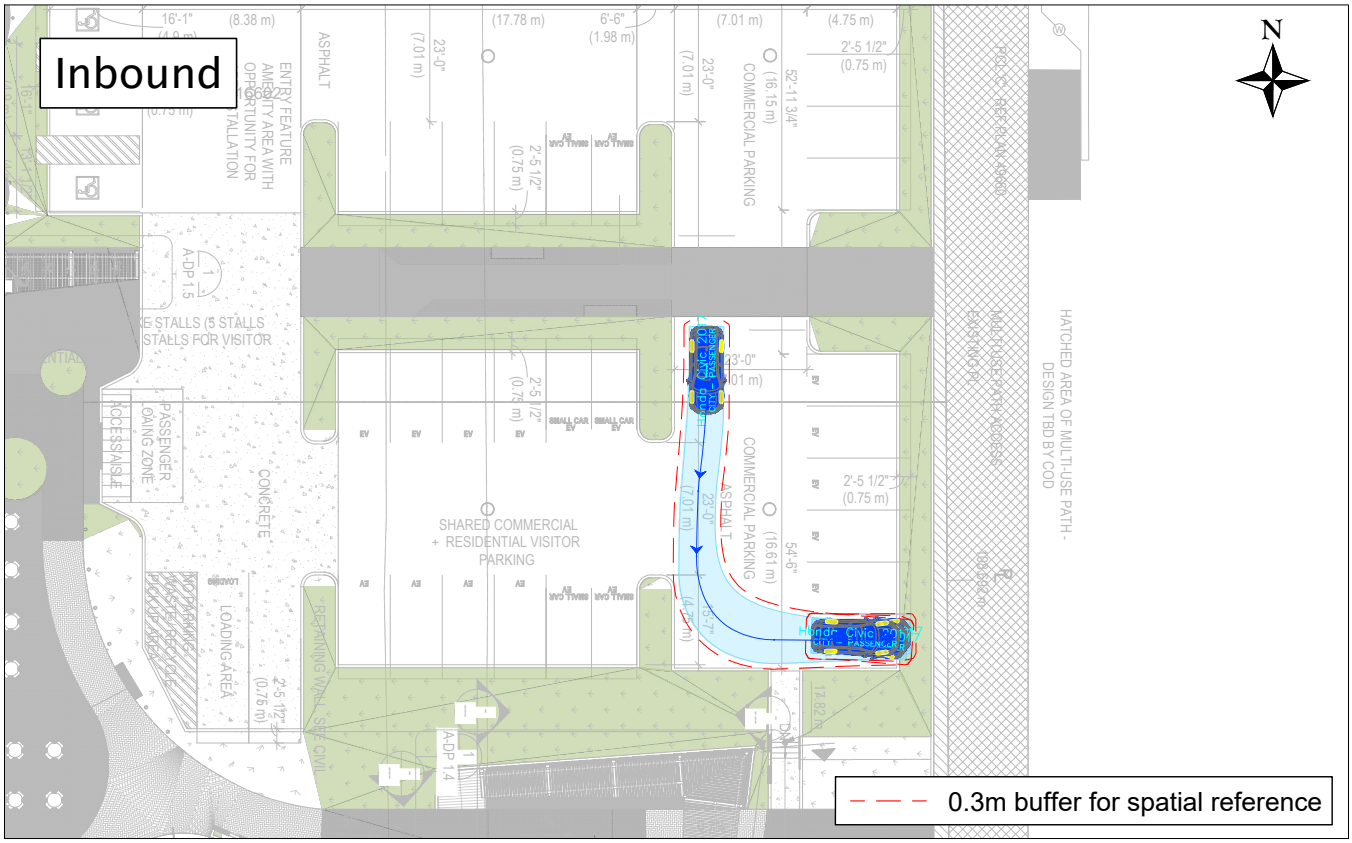

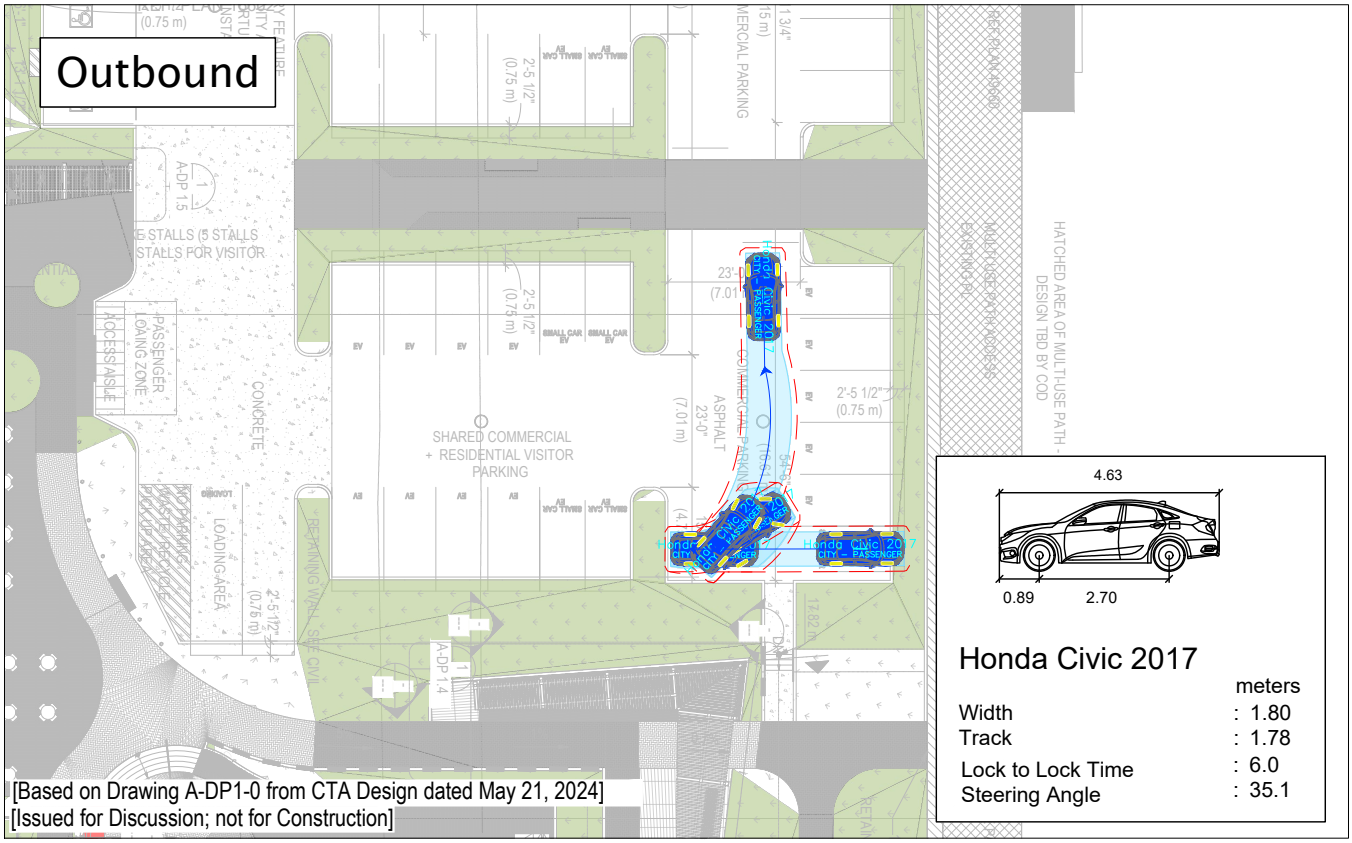

Exhibit C.4

Surface Parking End Stall Parking Maneuvers

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:400 on Letter Prepared by RS

bunt & associates

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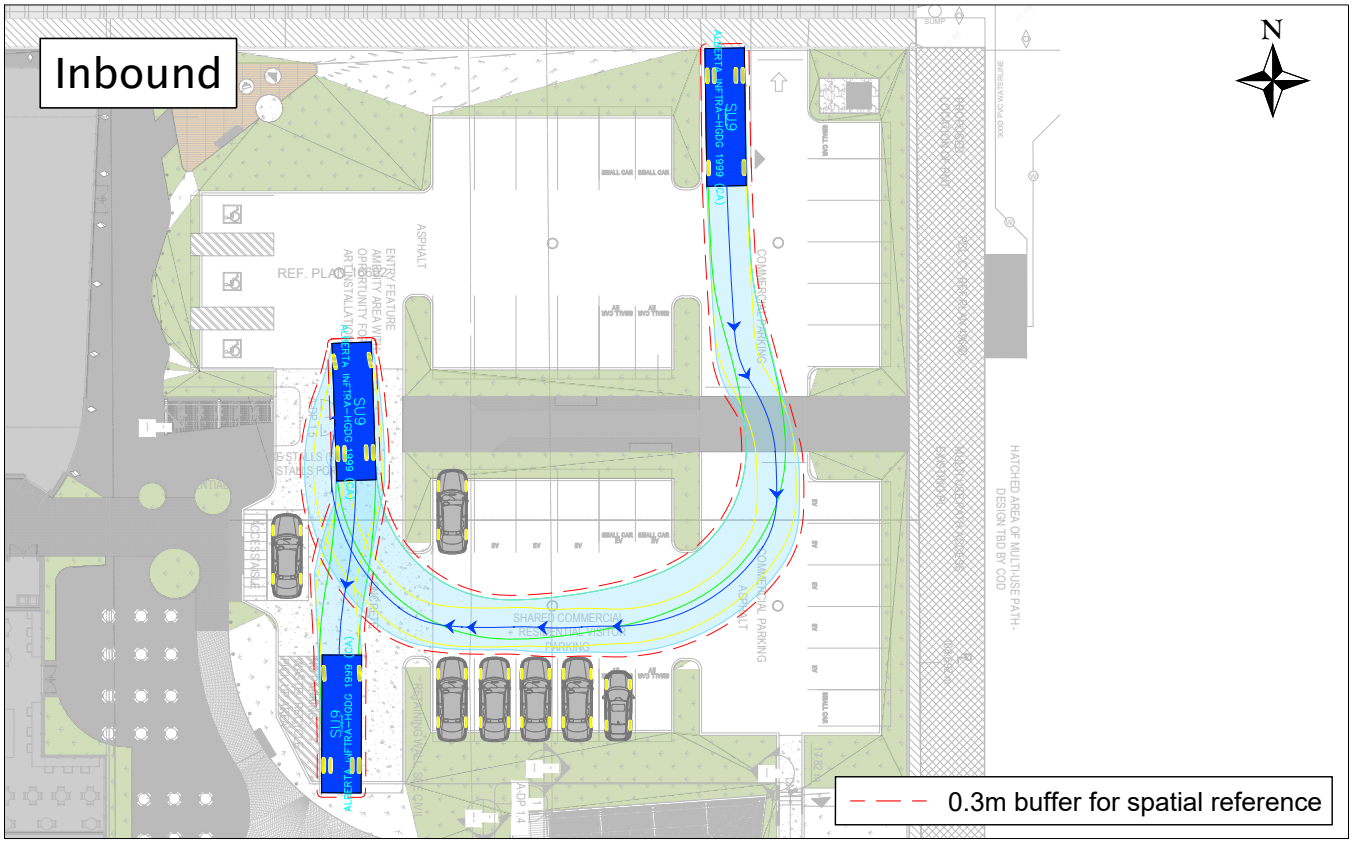
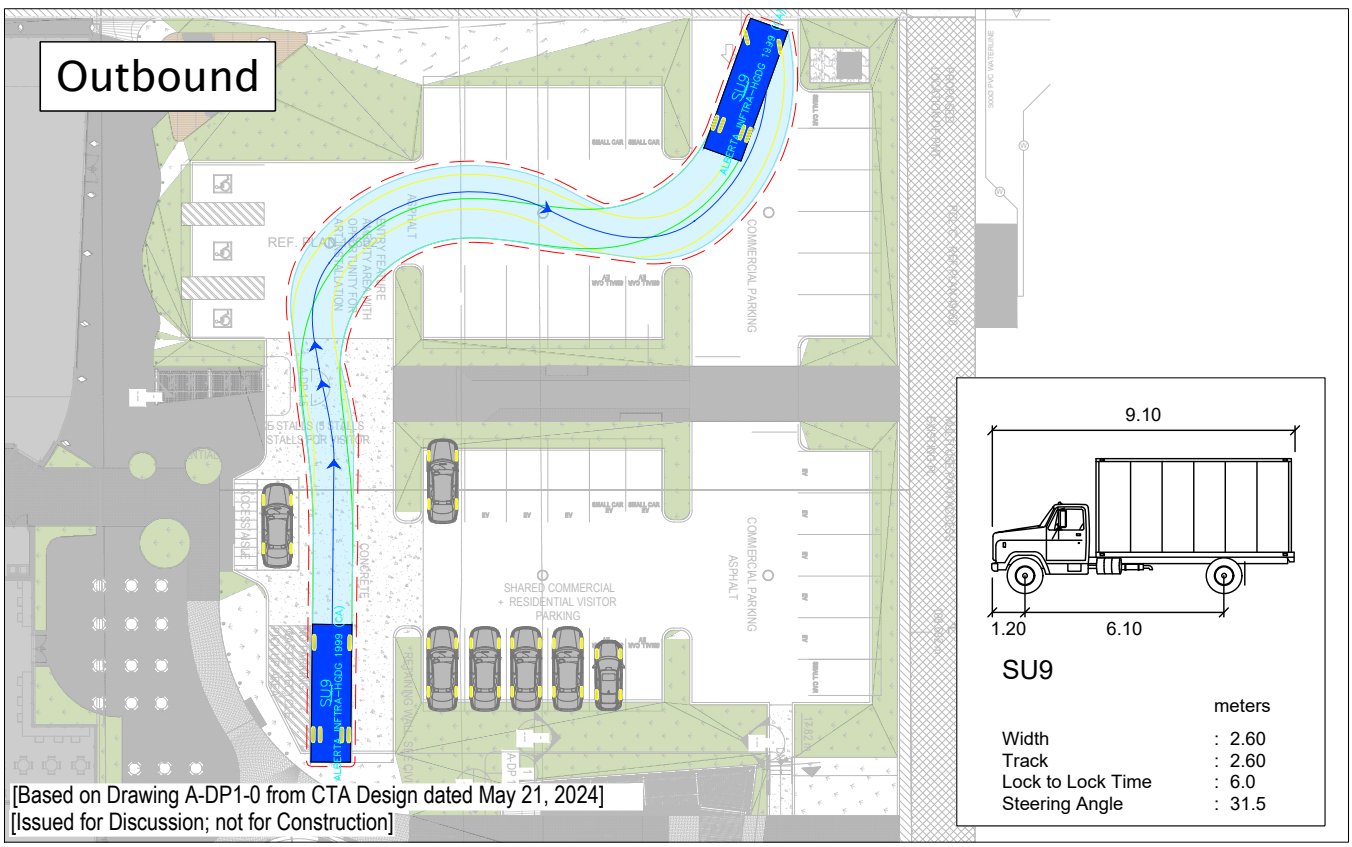




[Based on Drawing A-DP1-0 from CTA Design dated May 21, 2024]
[Issued for Discussion; not for Construction]

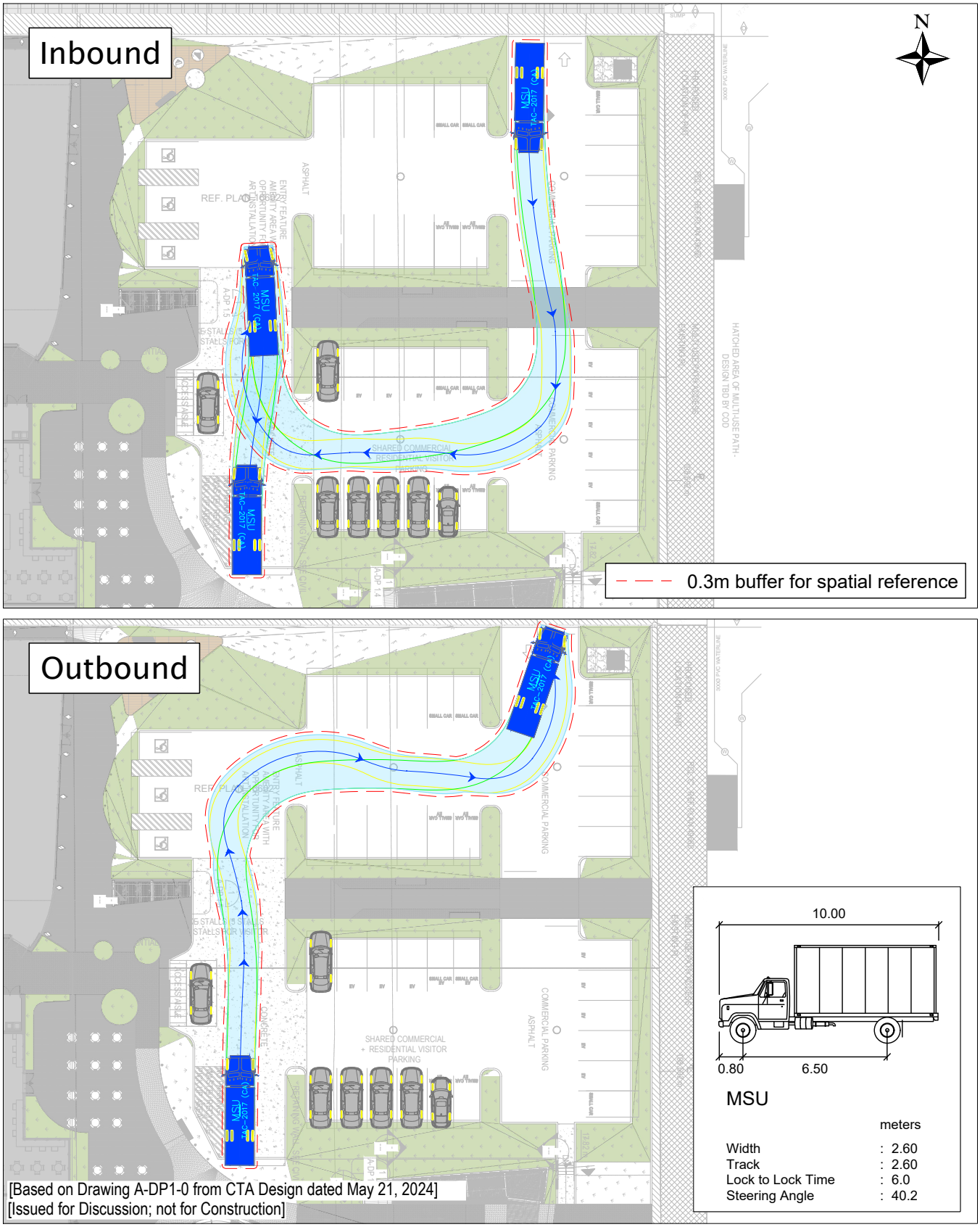
Exhibit C.5

SU9 Loading Truck AutoTURN Analysis

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:500 on Letter Prepared by RS

bunt & associates



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2024/05/29 14:00, Plotted by Roxana Sorkhi

Exhibit C.6

Waste Collection Truck (MSU) AutoTURN Analysis

5360 12 Ave Delta

04-21-0201 May 2024 Scale 1:500 on Letter Prepared by RS

bunt & associates