APPENDIX

D

TRAFFIC ANALYSIS MEMO

MEMO

TO: Valentino Tjia

FROM: Vincent Arcand-Landry, Mark Merlo

SUBJECT: **VFPA - Impact of changes on road network geometry [DRAFT]**

DATE: **October 6, 2020**

The WSP transportation planning team has been asked to analyze the changes to the traffic conditions and how it impacts the geometry of the proposed road realignment of the VFPA's Fraser Surrey Ports Land Transportation Improvement (FSPL TI) road network. This Memorandum presents the changes considered by the design team and their impacts on traffic condition.

CONTEXT

Recently, since July 1, 2020, DP World (DPW) has implemented a reservation system for its container terminal entry, as well as adding a second shift. The first shift runs from 8:00 a.m. to 4:30 p.m. and the second shift from 4:30 p.m. to 1:00 a.m. with breaks from 12:00 p.m. to 12:30 p.m. and 8:30 p.m. to 9:00 p.m. This system allows trucks entering the site to do so within a 16-hour period in a day. With the new reservation system, only a limited number of trucks will be allowed to arrive per 30-minute time window. This has reduced the time that trucks spend waiting, and reduced the number of queueing trucks waiting to enter the facility. The second shift spreads the demand over a longer period which in turn means fewer trucks arriving per hour, resulting in fewer delays and queues compared to the single shift system. DPW also stated that trucks arriving late will be required to book another appointment. Trucks without an appointment will be rejected.

METHODOLOGY

As part of the Brownsville Transportation Area Study, a detailed analysis of truck movements and their interactions with employee traffic and rail movements was completed. To conduct this analysis, an Aimsun micro-simulation model that was developed by Parsons for the Brownsville study area and surrounding traffic network was used. This 24-hour traffic operations micro-simulation model of the Brownsville area was developed to provide a basis for issues identification as well as the subsequent evaluation of mitigation options.

This model is used as the main data source to evaluate the traffic demand on the areas of interest of this analysis. The model includes the multimodal traffic demand for all vehicle classes and different dynamic assignment policies and strategies that are activated or not, depending on the traffic conditions. The traffic demand used for these analyses is "24 Hour - FGT + FSD Reservations" (FGT = Fraser Grain Terminal, FSD = Fraser Surrey Docks). This traffic demand considers the reservation system so the peak period demand has been spread compared to the original demand.

The following figures present the difference between the spread of truck arrival demand with both previous scenario (non-appointment system) and the current appointment system:

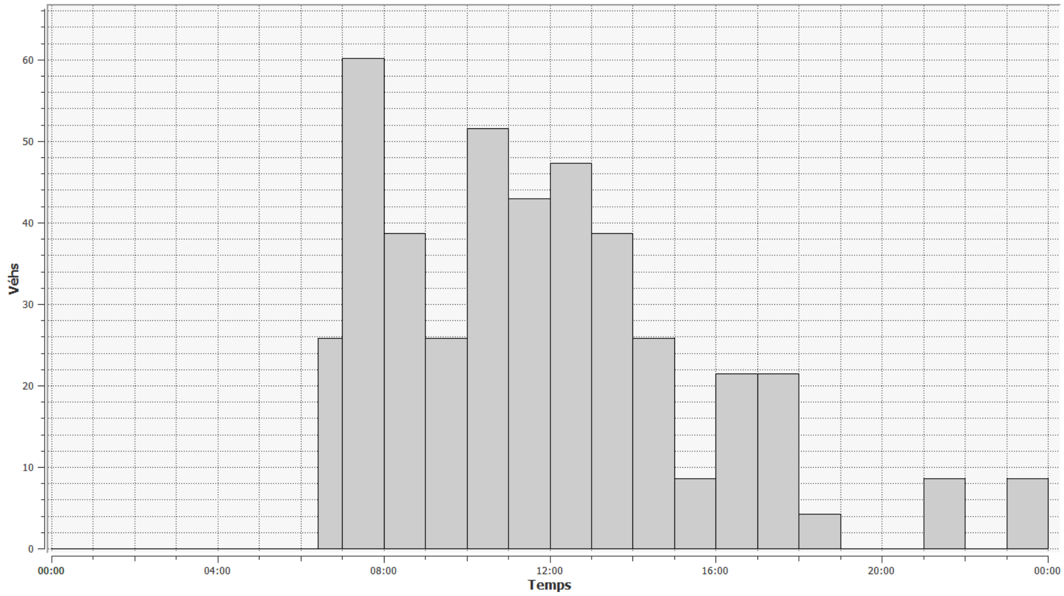

Figure 1 : FSD truck inbound demand without reservations

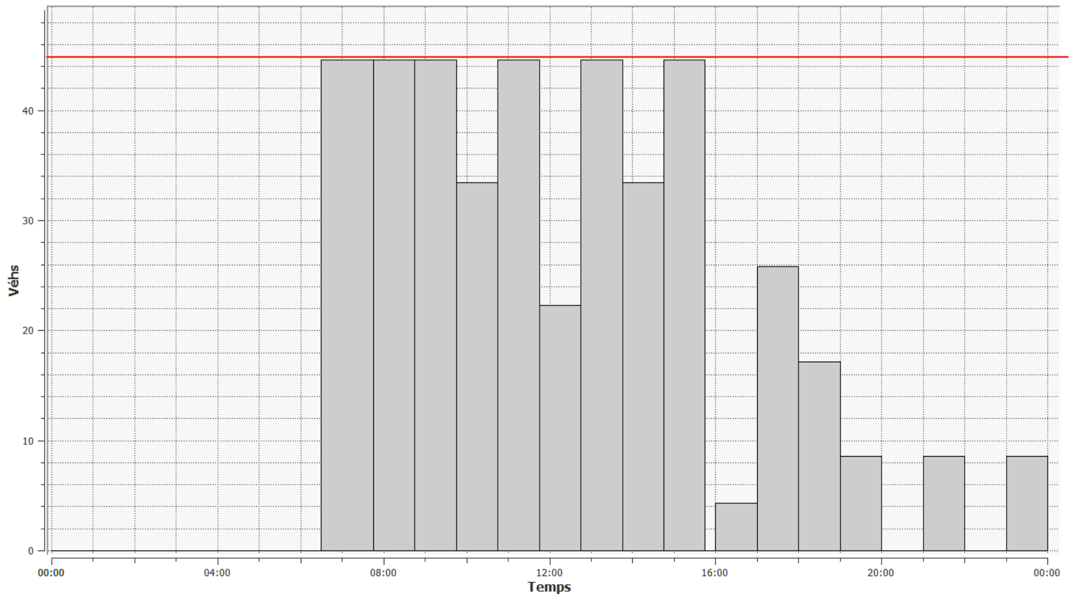

Figure 2 : FSD truck inbound demand with reservations

This analysis represents a demand of 430 trucks/day entering the container gate zone. As seen in the above figures, the peak demand drops from 60 trucks per hour to 45 trucks per hour with the reservation system. Figure 3 shows the daily volumes to the FSD gate.

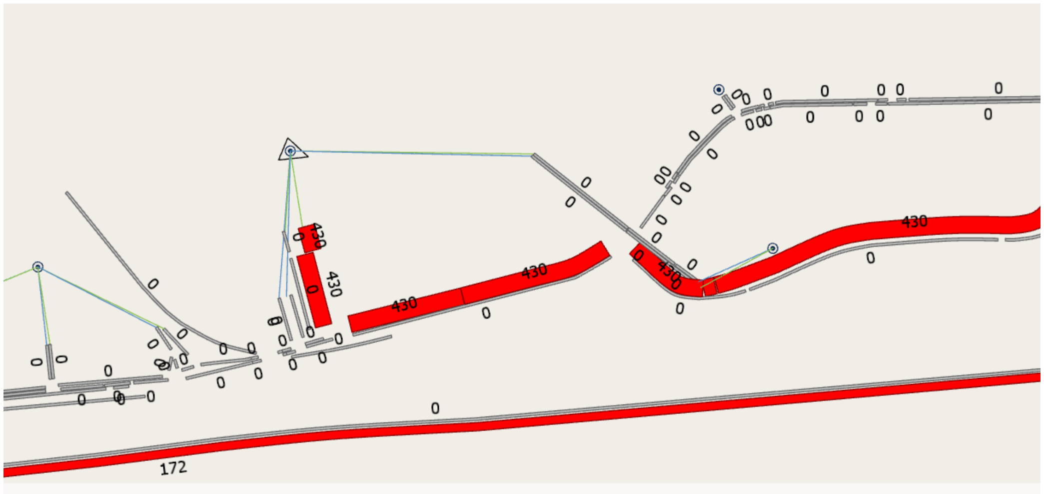

Figure 3 : Path of trucks entering containers gates zone

All assumptions used for this analysis are based on those used for the *Brownsville Transportation Options Study* reports by Parsons for the Port of Vancouver and the AIMSUN model provided by Parsons on July 15, 2020. The Parson's short to medium term information was used. The volumes in the Parsons report are understood to represent the short to medium term. This assumes that the FGT terminal includes additional trains, trucks and employee vehicle volumes. For the FSD no change in demand was made beyond the base conditions. An allowance was made for growth in other businesses' truck and employee volumes in the surrounding area. BHP (potash) traffic was not included at the time as it was still going through the approval process.

In the model, WSP made modifications to the DP world entry to more closely match the storage length available. We also modified the zone connectors to the Westran Intermodal yard to better assign traffic. Data from the recent BHP report was used for traffic volumes at the TMS access.

IMPACT OF PROPOSED MODIFICATIONS ON TRAFFIC

With the new analysis undertaken, there are three changes from the geometry concept developed by Parsons that were evaluated:

- Removal of four (4) truck staging lanes used to store inbound waiting truck and the gate system and reduce it to a single auxiliary storage lane;
- Removal of the northbound to westbound left turn lane from S. Timberland Rd to N. Timberland Rd (Timberland Wye Intersection); and
- Requirement for a new traffic signal at the Timberland Wye Intersection.
- Requirement for queue length for southbound right turn into N Timberland Rd at Timberland Wye Intersection.

Change 1: Removal of Four Truck Staging Lanes to a Single Auxiliary Lane

The original concept included four storage lanes to provide truck queueing in advance of the container gate until space was available at the entering container gate zone. This was due to the fact that Fraser Surrey Dock (FSD), the previous tenant of the site, did not have a reservation system and they had only 12-hour shift. The objective of the staging lane was to keep trucks in a safe waiting zone without blocking the road network. This system was operating with signals that can manage the arrival rate to the entering container zone. An exit lane was also designed to let rejected trucks from VACS Gates (check-in gates) exiting back to the S. Timberland Rd.

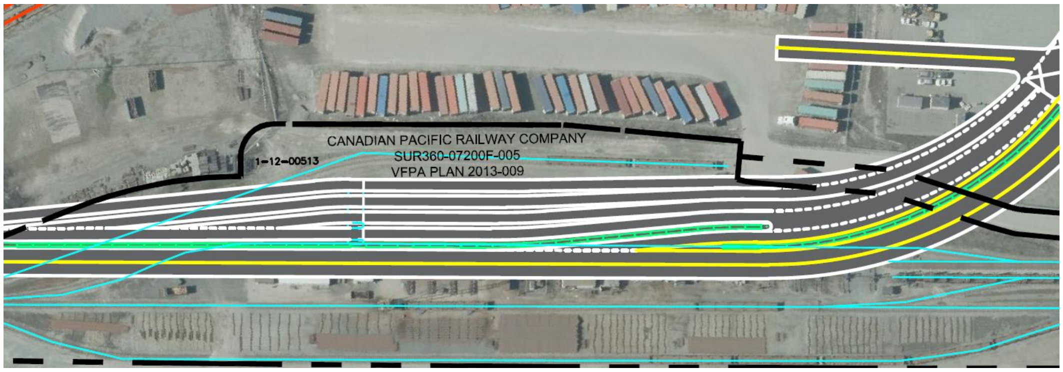

Figure 4 : Original Concept with Four storage lanes and Signals

The reservation system reduces the waiting time and the peak of the arrival of trucks so the need for these four storage truck lanes are no longer necessary and can be replaced with a singular auxiliary lane starting from the two VACS gates at the original point to the existing container gate. The two VACS gates at the start of auxiliary lane will remain in case one of the VACS gates breaks down.

Based on information provided to WSP in the model, the coded processing time at each gate is five minutes for the three eastern gates and six minutes for the two western gates, with a standard deviation of one minute.   This gives a total capacity of 56 tucks per hour in normal operation. The reservation system limits truck entry to a maximum of 22 trucks per 30 minutes except for three half our periods were 25 trucks are allowed (45 trucks/h capacity in the model). This information was provided by DP world on August 20, 2020. As a result, the capacity under normal operations is higher than the demand with five gates open. If more gates are open, then the capacity will be higher still. It is also necessary to consider that the normal operation starts at 7:30 a.m. and there are already trucks in the queue before the normal operation starts. There are also some breaks in operations during the day, so the service rate can be lower or zero during some part of the day, creating a queue that need to be managed. Since the service rate is in general higher than the arrival rate, the queues should be limited except for certain periods such as the early morning operations, arrival rate fluctuations or period with lower service rates. See **Appendix A** for the FSD Appointment Structure.

The Parsons' Aimsun model provided to WSP has been used to test this proposed geometry with the reservation system and traffic demand with the demand coded in the model.

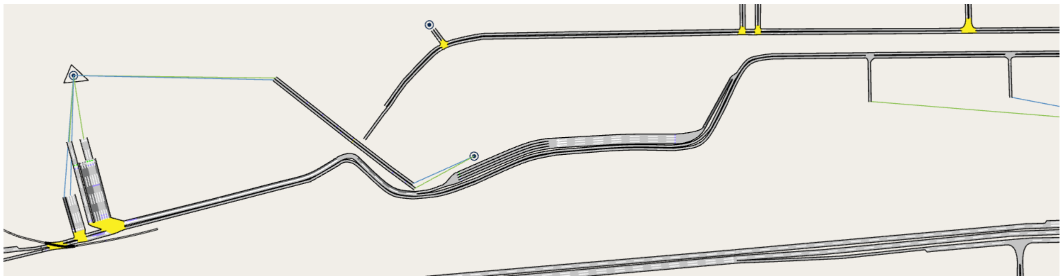
Figure 5 : Original Geometry with Four Truck Staging Lanes and Signals - Aimsun

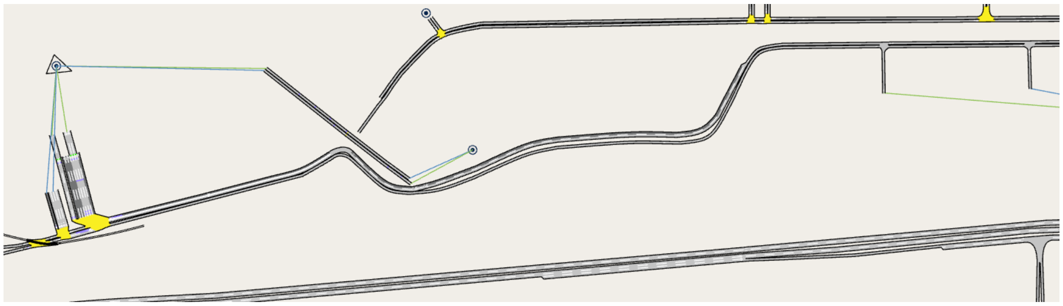

Figure 6 : Proposed Geometry with Only One Auxiliary Lane– Aimsun

The results show that the queue is relatively contained in the first section upstream of the gates S. Timberland Rd. In normal operations, without any unusual events, queueing fits in the first section of S. Timberland Road immediately upstream of the gates.

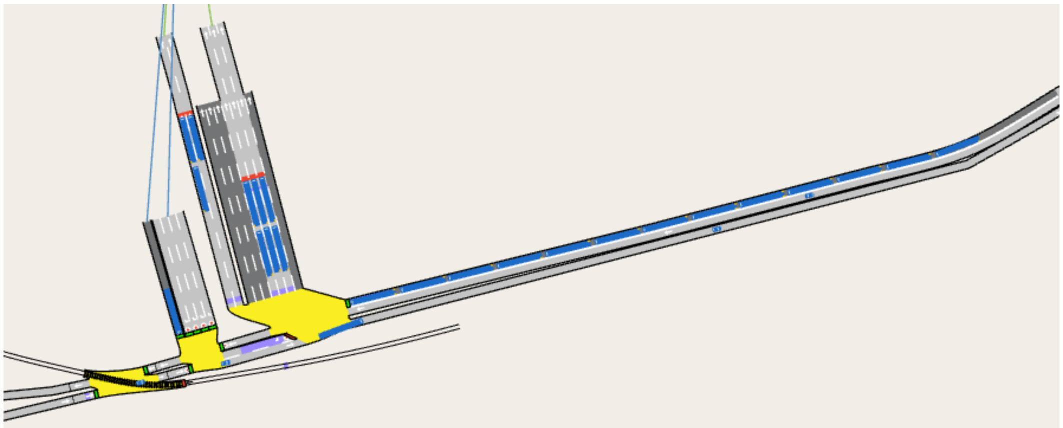

Figure 7 : Queue at 10:00 a.m.

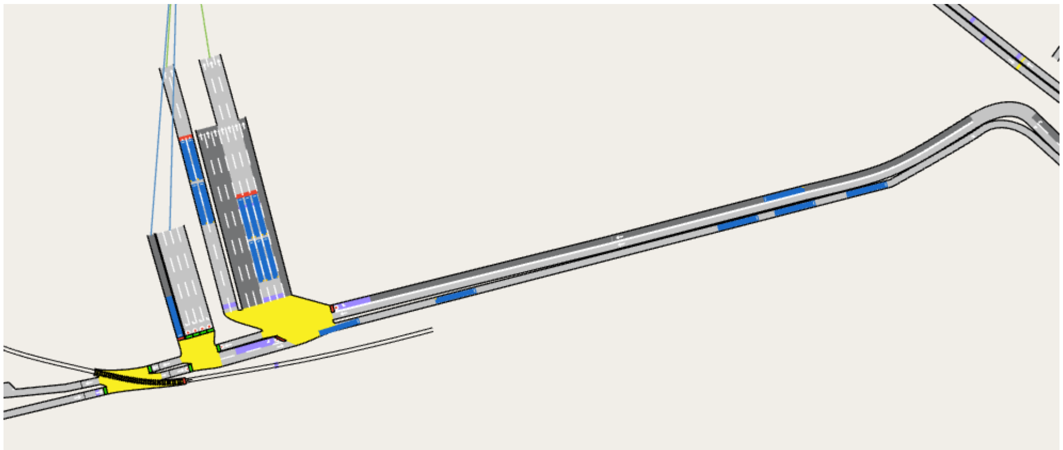

Figure 8 : Queue at 11:00 a.m.

The simulations show that there are lots of random elements that can occur and affect the queue and the behaviours. The queue can be longer in some circumstances, and it will be desirable to have the longest storage lane possible, to be able to manage some infrequent events without having any impact on the traffic conditions.

In conclusion, the analysis shown that removing the four (4) storage lanes in upstream S. Timberland Rd. will work adequately with minimal blocking of adjacent traffic. A formal auxiliary lane dedicated for the truck entrance, separated with traveling lane with barriers, should still be provided. WSP has proposed that a 3-metre wide shoulder be provided for trucks maneuvering in case there is a truck breaks down in this lane. It should be noted that these conclusions are based on the demands in the Parsons model that includes reservations. Should these key assumptions change, the reservation system be different than that in the model or the reservation system significantly change or be abandoned, then more queueing space may be needed. The single lane means that trucks will need to be able to be processed in their order in the queue as trucks will not be able to pass each other in the queue.

Change 2: Removal of the northbound to westbound left turn lane from S. Timberland Rd to N. Timberland Rd.

The second proposed modification is to analyze the removal of the norhtbound to westbound left turn lane from S. Timberland Rd to N. Timberland Rd. This lane is drawn in the original concept as shown in the figure below.

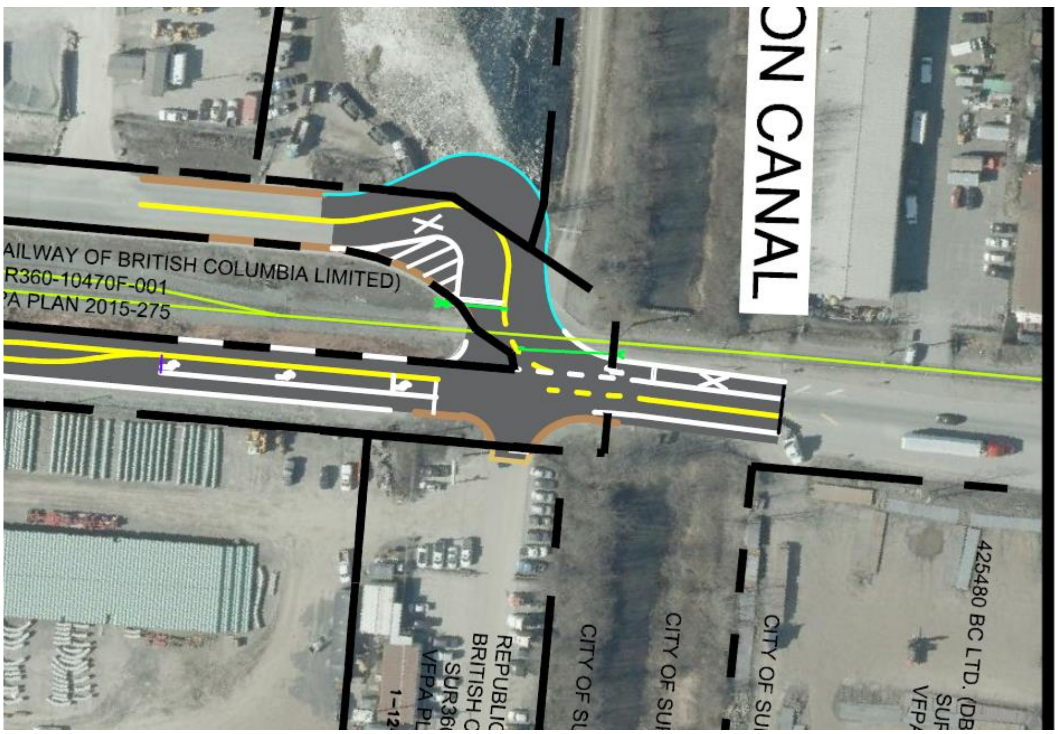

Figure 9 Railway Crossing at Timberland Wye Intersection

The Parsons AIMSUN model was used to analyze the demand for this specific intersection. The analysis of the assigned volume shows that there is very low demand anticipated for this left turn crossing over the railway. It is expected to have some low volume at this turning movement (lost vehicles, port employees, etc.) but this number is expected to be low since it is in effect a U-Turn movement from one large cul-de-sac to another. In this condition, it will be justified to remove the turning lane and add some shoulder widening so traffic travelling northbound could pass the occasional left turn vehicle. No significant impact on traffic condition is expected with removal of this left turn lane. It should be noted that when a train passes there will be the chance that a left turning vehicle will have to wait and through traffic will need to pass using the widened shoulder as planned. This is the time when this lane would be most beneficial: to store any left turns when a train is passing.

Change 3: Requirement for a new traffic signal at Timberland Wye Intersection.

A Synchro analysis of the Timberland Wye intersection showed that the intersection will function well as a two way stop controlled intersection in both the a.m. (7:00-8:00 am) peak hour and p.m. (3:00-4:00 pm) peak hours with a minimum level of service of at A or B on all approaches which represents low delays. We also confirmed that the 2005 Transportation Association of Canada Traffic Signal Warrant was not met based on projected volumes. The Synchro results are presented in **Appendix B** and the warrant results in **Appendix C**.

While Canada has no warrant for assessing the need for a signal at an intersection close to a railway crossing, the US Manual on Uniform Traffic Control Devices has a warrant for traffic signals adjacent to railway crossing, Warrant 9 (Intersection Near a Grade Crossing). Based on this warrant, for a rail crossing with 25 feet or less of an intersection, a volume of 25 vehicles per hour on the approach to the potential signal across a railway track triggers the warrant for a signal. This signal would help clear the stop-controlled approach of traffic when a train approaches including any vehicles that may be queued on the tracks waiting to turn. We have 108 vehicles per hour with a high percentage of trucks. With the truck adjustment factor taken into consideration, we have the equivalent of 451 vehicles per hour. As a result, a traffic signal is warranted at this location based on this Warrant 9. The key figure used in this warrant is given in **Appendix D**. Discussions should be held between the road authority and the railway to determine a mutually agreeable course of action.

It is also noted that WSP just recently completed a railway safety assessment and our railway team has recommended Flashing Lights Bells and Gates (FLBGs) at this crossing, not because of high cross product number of train and vehicular volumes but due to limited sight distance issue with the geometry. If a traffic signal is installed, the traffic signal design will need to consider railway signal pre-emption in conjunction with the FLBGs that are being proposed in this location.

Change 4. What is the desirable southbound right turn lane at the Timberland Wye intersection?

With the reconfiguration of the Timberland Wye intersection, a right turn lane is planned for traffic making the southbound right turn from Timberland Road to N. Timberland Road across the railway. In normal operations, queues are not expected to be long as there is no conflicting traffic; however, when a train is occupying the railway crossing, traffic in this right turn lane will begin to queue. Southern Rail has indicated that trains could occupy the crossing for between one to five minutes. If this blockage occurs during the busy a.m. peak hour when the demand is anticipated to be 135 vehicles per hour with more than 50% of these trucks then in a five-minute period it is anticipated that with would equate to on average 11 vehicles queueing, which equates to a queue of 175 metres. Given the short distance to Pine Road this distance could not be provided. It is recommended that as much storage as possible be provided, recognizing that the 175-metre queue length is only anticipated to occur when long duration trains coincide with peak traffic hours.

CONCLUSIONS

Based on our recent analysis, we conclude that:

- Removal of the four (4) truck staging lanes used to a single auxiliary lane is warranted as the reservation system minimises the peaks demands. The single auxiliary lane with a wide 3-metre shoulder should still be provided in case of special events or lower service rates than usual at gates.

- Removal of the northbound to westbound left turn lane from S. Timberland Rd to N. Timberland Rd. with provision of wider shoulder so traffic can pass the occasional left turning vehicles.
- A new traffic signal is warranted and should be considered at the Timberland Wye Intersection in conjunction with the additional of the flashing lights, bells and gates that is planned at this railway crossing. Discussions should be held between the road authority and the railway to determine a mutually agreeable course of action.
- Maximise the southbound right turn lane length on Timberland Road to N. Timberland Road to provide storage for vehicles when a train occupies the crossing.

APPENDICES

Appendix A: DP Surrey Dock Appointment Structure.

Appendix B: Synchro Output for a.m. and p.m. peak hour at Timberland Wy Intersection.

Appendix C: TAC Signalization Warrant

Appendix D: Warrant 4C.9 Figure

Appendix A: DP Surrey Dock Appointment Structure.

Gate Entry	Appt Start	Appt Close	Gate Reject	TTL Appts
7:30	8:00	8:30	9:00	15
8:00	8:30	9:00	9:30	15
8:30	9:00	9:30	10:00	22
9:00	9:30	10:00	10:30	22
9:30	10:00	10:30	11:00	22
10:00	10:30	11:00	11:30	22
10:30	11:00	11:30	12:00	22
11:00	11:30	12:00	12:30	15
11:30	13:00	13:30	14:00	25
13:00	13:30	14:00	14:30	25
13:30	14:00	14:30	15:00	25
14:00	14:30	15:00	15:30	20
14:30	16:30	17:00	17:30	0
16:30	17:00	17:30	18:00	12
17:00	17:30	18:00	18:30	12
17:30	18:00	18:30	19:00	12
18:00	18:30	19:00	19:30	12
18:30	19:00	19:30	20:00	12
19:00	19:30	20:00	20:30	12
19:30	20:00	20:30	21:00	12
20:00	21:30	22:00	22:30	12
21:30	22:00	22:30	23:00	12
22:00	22:30	23:00	23:30	12

Appendix B: Synchro Output for a.m. and p.m. peak hour at Timerland Wy Intersection.

Lanes, Volumes, Timings
3: Timberland N & Timberland Rd 10-01-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	148	10	38	198	135	5	0	11	28	0	0
Future Volume (vph)	5	148	10	38	198	135	5	0	11	28	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992				0.850		0.905				
Flt Protected		0.999			0.992			0.986			0.950	
Satd. Flow (prot)	0	1341	0	0	1442	1056	0	1130	0	0	1492	0
Flt Permitted		0.999			0.992			0.986			0.950	
Satd. Flow (perm)	0	1341	0	0	1442	1056	0	1130	0	0	1492	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		59.6			73.8			67.9			62.3	
Travel Time (s)		4.3			5.3			4.9			4.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	41%	50%	50%	27%	53%	50%	0%	50%	21%	0%	0%
Adj. Flow (vph)	5	161	11	41	215	147	5	0	12	30	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	177	0	0	256	147	0	17	0	0	30	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 35.3% ICU Level of Service A
Analysis Period (min) 15

Lanes, Volumes, Timings
3: Timberland Rd & Tinmberland N 10-01-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	219	5	9	108	52	5	0	15	108	0	0
Future Volume (vph)	2	219	5	9	108	52	5	0	15	108	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997				0.850		0.897				
Flt Protected					0.996			0.988			0.950	
Satd. Flow (prot)	0	1434	0	0	1269	1091	0	1123	0	0	1299	0
Flt Permitted					0.996			0.988			0.950	
Satd. Flow (perm)	0	1434	0	0	1269	1091	0	1123	0	0	1299	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		96.2			103.5			94.4			73.4	
Travel Time (s)		6.9			7.5			6.8			5.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	32%	50%	50%	49%	48%	50%	0%	50%	39%	0%	0%
Adj. Flow (vph)	2	238	5	10	117	57	5	0	16	117	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	245	0	0	127	57	0	21	0	0	117	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 32.7%	ICU Level of Service A
Analysis Period (min) 15	

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Appendix C: TAC Signalization Warrant

2005 Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Timberland Road New	Direction (EW or NS)	NS		Date:	Sep 30, 2020
Side Street (name)	Timberland Road Old	Direction (EW or NS)	EW		City:	Surrey, BC
Quadrant (if appl)						

Lane Configuration		Excl LT	Th & LT	Through or Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes	
Timberland Road New	NB			1				1	
Timberland Road New	SB		1			1	148	1	
Timberland Road Old	WB			1					
Timberland Road Old	EB			1					

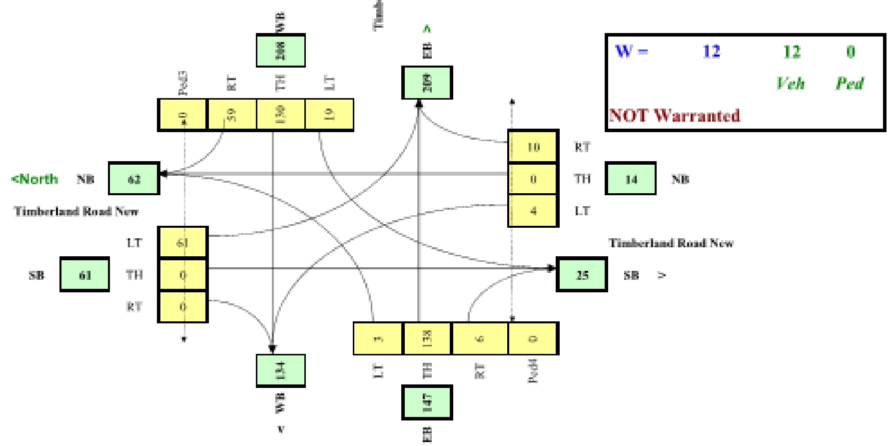
Demographics		
Elementary School	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	2500000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
Timberland Road New	NS	50	50.0%	n	n
Timberland Road Old	EW		50%	n	

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S side
7:00-8:00	5		11	28			38	198	135	5	148	10				
8:00-9:00	3		8	34			26	133	59	11	117	7				
12:00-13:00	4		9	78			30	132	41		151	8				
13:00-14:00	3		10	49			6	152	30	1	106	3				
15:00 - 16:00	5		15	108			9	108	52	2	219	5				
16:00 - 17:00	3		8	66			5	55	38		86	3				
Total (6-hour peak)	23	0	61	363	0	0	114	778	355	19	827	36	0	0	0	0
Average (6-hour peak)	4	0	10	61	0	0	19	130	59	3	138	6	0	0	0	0

Average 6-hour Peak Turning Movements

$W = [C_{bt}(X_{v-v}) / K_1 + (F\ (X_{v-p})\ L) / K_2] \times C_t$



Appendix D: Warrant 4C.9 Figure