



# LOST LAKE CORRIDOR REVIEW

## Traffic Impact Assessment

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## 1.0 INTRODUCTION

Watt Consulting Group was retained by Broadview Developments Inc to conduct a traffic assessment the potential rezoning of properties on Tanya Drive in Nanaimo, BC. There is also ongoing construction for two lots in close proximity that will have an impact on the traffic in the area: 5300 Rutherford Road and 5701 Vanderneuk Road. This report reviews existing traffic conditions and post rezoning/development conditions for the Tanya Drive developments, 5300 Rutherford Road, and 5701 Vanderneuk Road at a five year horizon.

### 1.1 STUDY AREA

The sites are located in the City of Nanaimo along Tanya Drive and Lost Lake Road. The study area for this development will include the following intersections: Lost Lake Road / Tanya Drive and Vanderneuk Road / Rutherford Road. All intersections in the study area are currently stop controlled. **Figure 1** shows the study are and site location.



**Figure 1: Study Area**

## 2.0 EXISTING CONDITIONS

### 2.1 ROAD NETWORK

Rutherford Road is designated as a major collector road north of Oliver Road in the City of Nanaimo's Official Community Plan. Within the study area, Rutherford Road is a two lane road with left turn lanes at key intersections. There is a sidewalk on the west side of Rutherford Road and a mixture of sidewalk and paved shoulder on the east side. Vanderneuk Road and Lost Lake Road are classified as a neighbourhood collector roads with a two-lane cross section. All intersections within the study area are unsignalized with stop signs on the side streets.

The City of Nanaimo has ultimate plans to provide a collector road between Turner Road and the Linley Valley area (see the City of Nanaimo's OCP *Map 2: Mobility*). This proposed road would be a minor collector road from Rutherford Road to the Linley Valley area known as Linley Valley Drive. Portions of Linley Valley Drive have been constructed between Lost Lake Drive and Rutherford Road.

### 2.2 LAND USE

The existing land use for the following properties is currently zoned as Urban Reserve (AR2): 5260, 5280, 5291, 5300, 5311 Tanya Drive. The existing land use for 5320 Tanya Drive, 5330 Tanya Drive, and 4905 Lost Lake Rd is Steep Slope Residential (R10). All the lots are currently vacant or with a single family house occupying the property. The surrounding land use is a mix of Steep Slope Residential (R10), Urban Reserve (AR2), and Parks, Recreation, and Culture One (PRC1).

### 2.3 TRAFFIC ANALYSIS

#### 2.3.1 TRAFFIC VOLUMES

Traffic counts were conducted at Rutherford Road / Vanderneuk Road and Lost Lake Road / Tanya Drive on Tuesday, October 18, 2016 during the PM peak hour of travel from 4:00pm – 5:00pm.

#### 2.3.2 TRAFFIC MODELLING – BACKGROUND INFORMATION

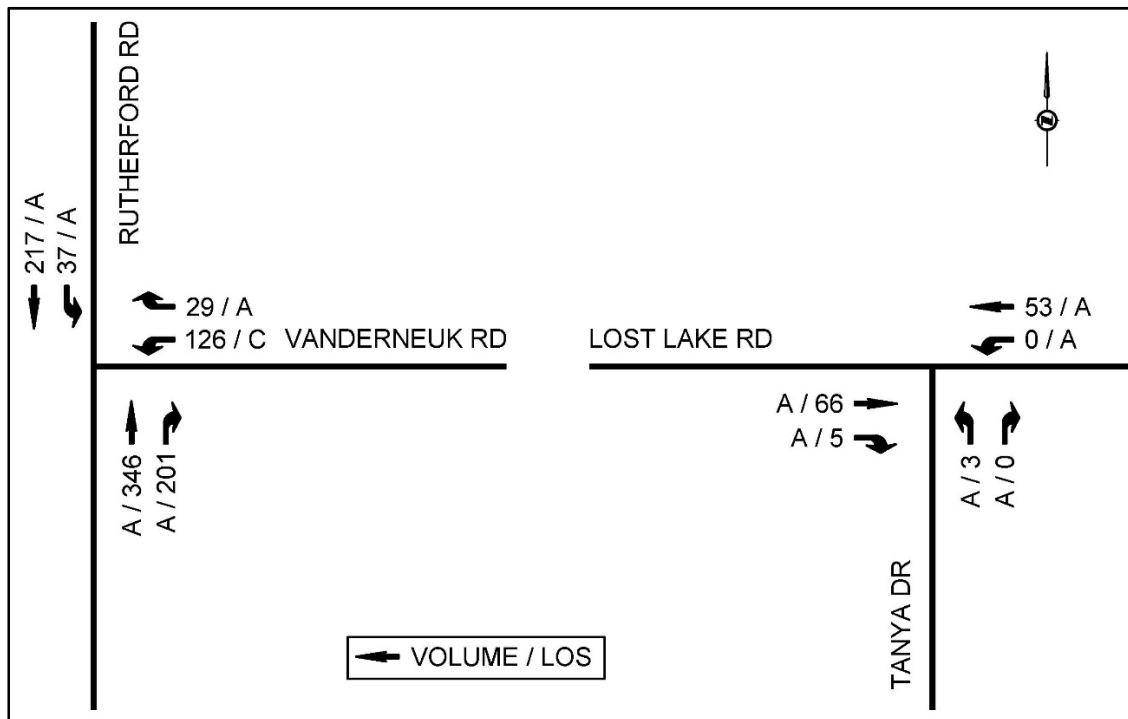
Analysis of the traffic conditions at the intersections within the study area were undertaken using Synchro software. The Synchro results were also reviewed using the microsimulation portion of the software (SimTraffic).

Synchro / SimTraffic is a two-part traffic modelling software that provides analysis of traffic conditions based on traffic control, geometry, volumes and traffic operations. Synchro software (Synchro 9) is used because of its ability to provide analysis using the Highway Capacity Manual (2010) methodology, while SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly "seeding" or positioning vehicles travelling throughout the network. Synchro uses measures of effectiveness to return the results of the analysis. These

measures of effectiveness include level of service (LOS), delay and 95<sup>th</sup> percentile queue length. The delays and type of traffic control are used to determine the level of service. The level of services are broken down into six letter grades with LOS A being excellent operations and LOS F being unstable/failure operations. Level of service D is generally considered to be an acceptable LOS by most municipalities.

### 2.3.3 TRAFFIC ANALYSIS RESULTS

The existing 2016 traffic volumes and lane geometrics were entered into Synchro to determine the existing traffic conditions during the PM peak hour of travel. At the Rutherford Road / Vanderneuk Road intersection all movements operate at a LOS A except for the westbound left which operates at LOS C. The Lost Lake Road / Tanya Drive intersection operates at LOS A. **Figure 2** shows the existing 2016 volumes and LOS.



**Figure 2: Existing 2016 Traffic Volumes and LOS**

## 3.0 POST DEVELOPMENT

### 3.1 LAND USE

For the purposes of this review all of the lots off Tanya Drive were reviewed with the Steep Slope Residential (R10) zoning. This zoning allows for a mixture of single family, cluster, townhouse and / or duplex housing. The number of units was estimated by dividing the lot area by 700m<sup>2</sup> as lot sizes can range from 325m<sup>2</sup> to 1200m<sup>2</sup>. The number of units was generated for each lot individually:

- 5260 Tanya Drive – 289;
- 5280 Tanya Drive – 72;
- 5291 Tanya Drive – 28;
- 5300 Tanya Drive – 57;
- 5311 Tanya Drive – 28;
- 5320 Tanya Drive – 33;
- 5330 Tanya Drive – 30;
- 3905 Lost Lake Road – 49.

The total number of single family lots estimated off Tanya Drive is 586 lots.

### 3.2 TRIP GENERATION

Trip generation for this land use is determined by using the industry standard Institute of Transportation Engineers' (ITE) *Trip Generation Manual (9<sup>th</sup> Edition)*. This manual provides trip generation characteristics for a variety of land uses based on actual observed data over the past 30 years.

Since there is limited transit service and amenities within walking distance the single family trip rate was utilized for all of the units even though a portion of the units are townhouses / duplexes and typically generate less traffic than single family housing.

The trips for adjacent housing projects at 5300 Rutherford Road and 5701 Vanderneuk Road were added in to the analysis to provide a better picture of the future conditions. The Rutherford / Vanderneuk data comes from a previous report by Boulevard Transportation Group: *5701 Vanderneuk Road Traffic Impact Assessment, September 17, 2013*. **Table 1** shows the trip generation for the proposed land use.

**TABLE 1: PAST LAND USE FOR TRIP GENERATION DURING PM PEAK HOUR**

ITE Code	Lot	Units	Trip Rate	Total Trips	Trips In	Trips Out
210	5260 Tanya Drive	289	1.00 trips / unit	289	182	107
210	5280 Tanya Drive	72	1.00 trips / unit	72	45	27
210	5291 Tanya Drive	28	1.00 trips / unit	28	18	10
210	5300 Tanya Drive	57	1.00 trips / unit	57	36	21
210	5311 Tanya Drive	28	1.00 trips / unit	28	18	10
210	5320 Tanya Drive	33	1.00 trips / unit	33	21	12
210	5330 Tanya Drive	30	1.00 trips / unit	30	19	11
210	3905 Lost Lake Road	49	1.00 trips / unit	49	31	18
<b>Total Trips for Tanya Development</b>				<b>586</b>	<b>370</b>	<b>216</b>
210	Rutherford / Vanderneuk Dev	558	1.00 trips / unit	558	351	207
<b>Total Trips for Rutherford / Vanderneuk Developments</b>				<b>586</b>	<b>351</b>	<b>207</b>

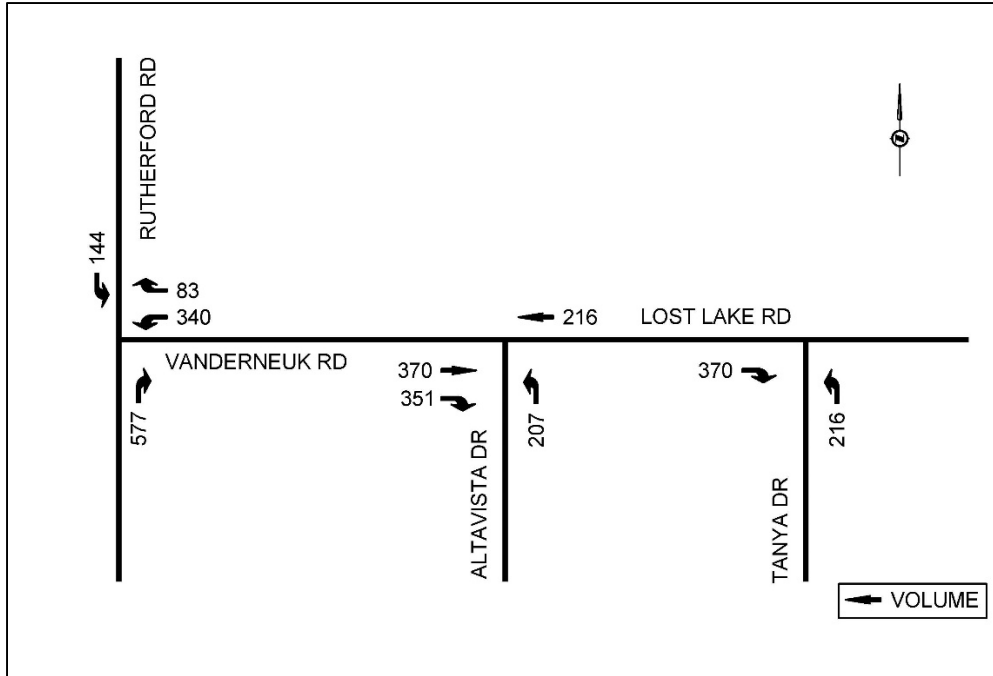
### 3.3 TRIP ASSIGNMENT

Trips were assigned based on the existing turn percentages at adjacent intersections (residential subdivisions). The trips were assigned with 80% of trips entering and exiting the development and travelling to / from the Oliver Road / Rutherford Road intersection and beyond while the remaining 20% will come from the north end of Rutherford Road. Three options were analyzed for the trips to access Rutherford Road depending on internal connection roads:

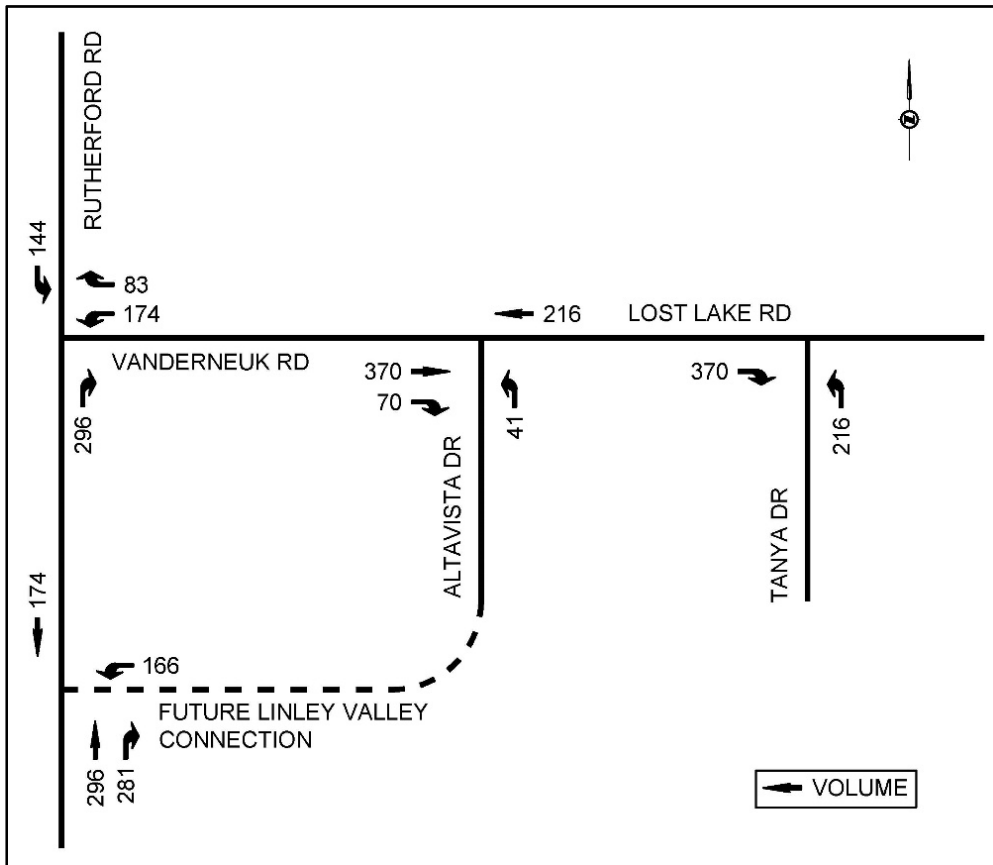
- Option 1 – All trips travel through the Vanderneuk Road / Rutherford Road intersection;
- Option 2 – The 5300 Rutherford Road and 5701 Vanderneuk Road developments would access a new southern connection to Rutherford Road if travelling south or continue to use the Vanderneuk Road route if travelling north. All the Tanya Drive lots would continue to use the Vanderneuk Road route;
- Option 3 – The 5300 Rutherford Rd and 5701 Vanderneuk Road developments would operate the same as Option 2 while the Tanya Drive lots would now be split 50 / 50 in using the Vanderneuk Road Route and using an internal connection to access the second southern connection to Rutherford Road.

**Figure 3, Figure 4, and Figure 5** show the trip assignments for the three options.

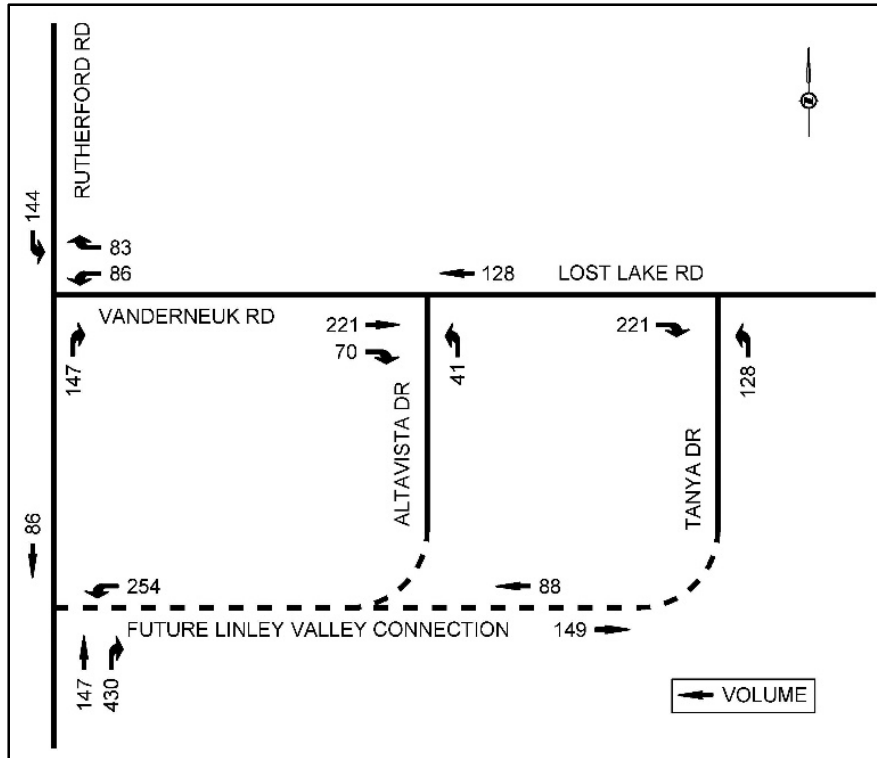




**Figure 3: Option 1 Trip Assignment**



**Figure 4: Option 2 Trip Assignment**



**Figure 5: Option 3 Trip Assignment**

### 3.4 SITE ACCESS

The specific site accesses have not been identified at this point. Further analysis will be required when individual properties develop.

### 3.5 TRAFFIC ANALYSIS

The weekday traffic volumes were analyzed with the proposed additional land use traffic during the PM peak hour for a five year horizon (2021). To remain consistent with the previous Rutherford / Vanderneuk report a 2.0% annual growth rate was applied to the measured existing 2016 traffic volumes to obtain the projected 2021 background traffic. The combined developments traffic volumes and the background traffic volumes were entered into Synchro to determine the post development traffic conditions for each of the trip assignment options.

The Rutherford Road / Vanderneuk Road intersection had multiple failing movement under the existing stop control conditions for all three trip assignment options. In order for the intersection to operate under acceptable LOS a traffic signal will need to be installed with a protected permitted southbound left turn phase. The intersection will also require a northbound right turn lane. The length for the right turn lane varies between options and is specified under each analysis. The Lost Lake Road / Tanya Drive continues to operate at good LOS with the existing northbound stop control.

### 3.5.1 OPTION 1 - POST DEVELOPMENT PM PEAK HOUR CONDITIONS (2021)

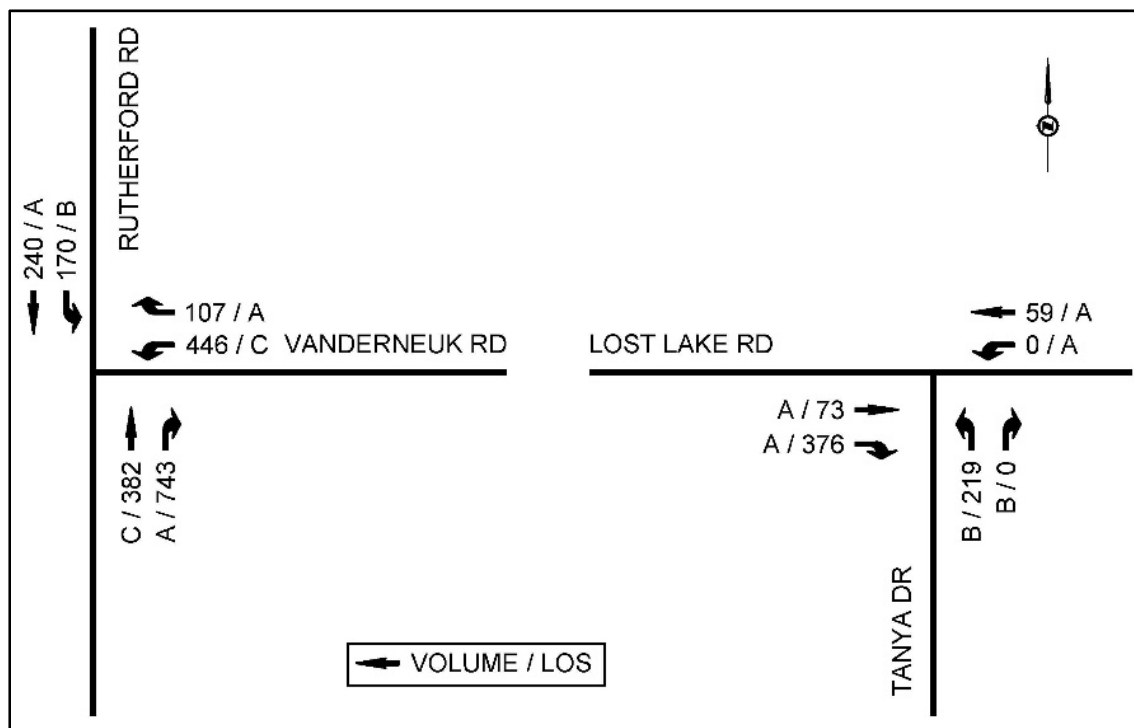
Option 1 assigns all trips through the Vanderneuk Road / Rutherford Road intersection. **Table 2** shows the post development PM peak hour traffic conditions for Option 1 in 2021.

**TABLE 2: OPTION 1 POST DEVELOPMENT PM PEAK HOUR TRAFFIC CONDITIONS**

Intersection	Movement	LOS	Delay (s)	95 <sup>th</sup> Queue (m)
Rutherford Road / Vanderneuk Road	WBL	C	27.7	128.7
	WBR	A	7.2	36.3
	NBT	C	21.8	327.2
	NBR	A	6.8	205.5
	SBL	B	13.3	33.7
	SBT	A	9.5	37.2
Lost Lake Road / Tanya Drive	EB T/R	A	0.0	0.0
	WB L/T	A	0.0	0.0
	NB L/R	B	13.7	23.1

The 95<sup>th</sup> percentile queue lengths were averaged from multiple SimTraffic simulations.

The Rutherford Road / Vanderneuk Road operates at an acceptable LOS for all movements; however, the northbound right turn lane will require a storage length over 200m. The Lost Lake Road / Tanya Drive intersection operates at a LOS B or better. **Figure 6** shows the 2021 post development volumes and LOS for Option 1.



**Figure 6: Option 1 Post Development 2021 Volumes and LOS**

In this option the volumes on Vanderneuk Road, near Rutherford Road will be over 14,000 vpd, which is in the range of an arterial road. On Lost Lake Drive, near Tanya Drive, daily traffic volumes are 8,300 vph, which is slightly above the expected volumes on a collector road.

### 3.5.2 OPTION 2 POST DEVELOPMENT PM PEAK HOUR CONDITIONS (2021)

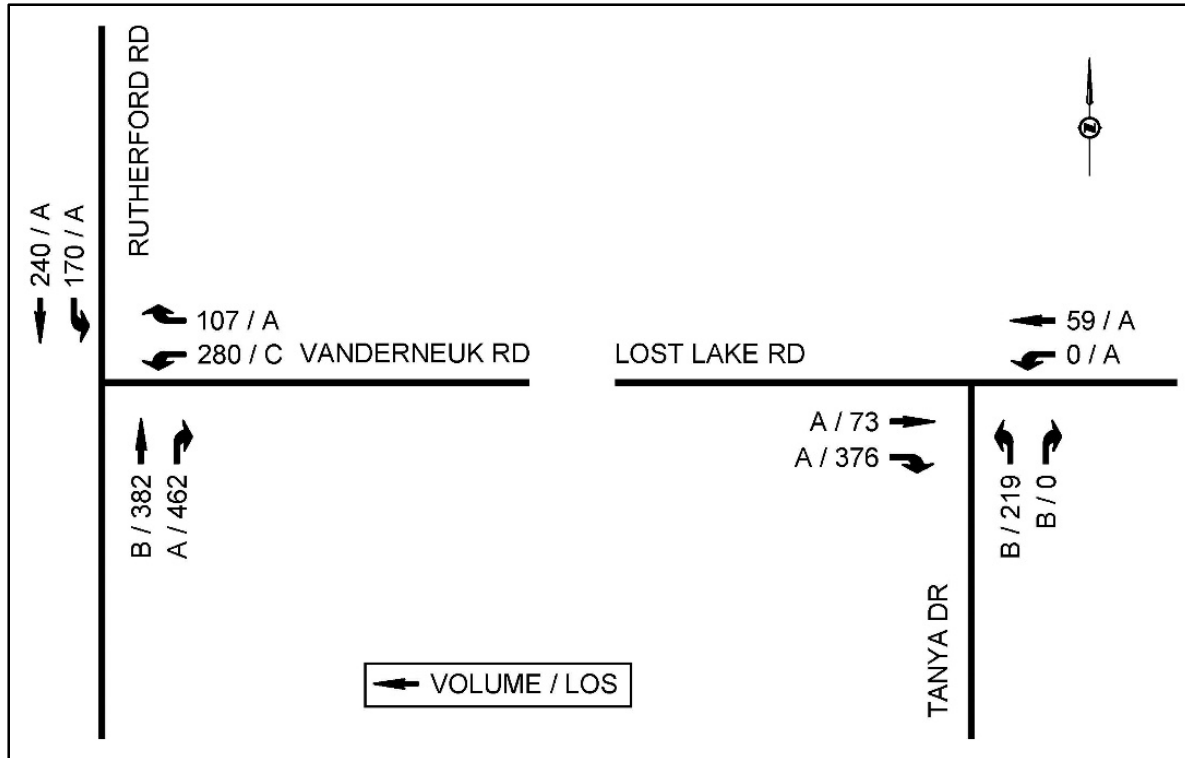
In Option 2 the Rutherford / Vanderneuk developments would access a new southern connection to Rutherford Road if travelling south or continue to use the Vanderneuk Road route if travelling north. All the Tanya Drive lots would continue to use the Rutherford / Vanderneuk Road intersection as it is unlikely Tanya Drive area motorists will travel along Alta Vista Drive to Cascara Drive to access Linley Valley/Rutherford Road compared to remaining on Lost Lake Road. **Table 3** shows the post development PM peak hour traffic conditions for Option 2 in 2021.

**TABLE 3: OPTION 2 POST DEVELOPMENT PM PEAK HOUR TRAFFIC CONDITIONS**

Intersection	Movement	LOS	Delay (s)	95 <sup>th</sup> Queue (m)
Rutherford Road / Vanderneuk Road	WBL	C	23.5	64.2
	WBR	A	5.2	32.0
	NBT	B	19.7	55.5
	NBR	A	4.5	52.5
	SBL	A	8.8	29.3
	SBT	A	7.3	30.3
Lost Lake Road / Tanya Drive	EB T/R	A	0.0	0.0
	WB L/T	A	0.0	0.0
	NB L/R	B	13.7	23.8

*The 95<sup>th</sup> percentile queue lengths were averaged from multiple SimTraffic simulations.*

The Rutherford Road / Vanderneuk Road intersection operates at LOS C or better for all movements similar to Option 1 conditions. However, the northbound right turn lane requires 55m storage and the northbound through improves from LOS C to LOS B. The northbound through and westbound left turn queues are significantly reduced in this option. Lost Lake Road / Tanya Drive operates a LOS B or better. **Figure 7** shows the 2021 post development volumes and LOS for Option 2.



**Figure 7: Option 2 Post Development 2021 Volumes and LOS**

In this option the daily volumes on Vanderneuk Road, near Rutherford Road will be approximately 10,000 vph, which is over the expected volume for a collector (8,000 vpd); however, closer than in Option 1. Volumes on Lost Lake Road are the same as Option 1.

### 3.5.3 OPTION 3 POST DEVELOPMENT PM PEAK HOUR CONDITIONS (2021)

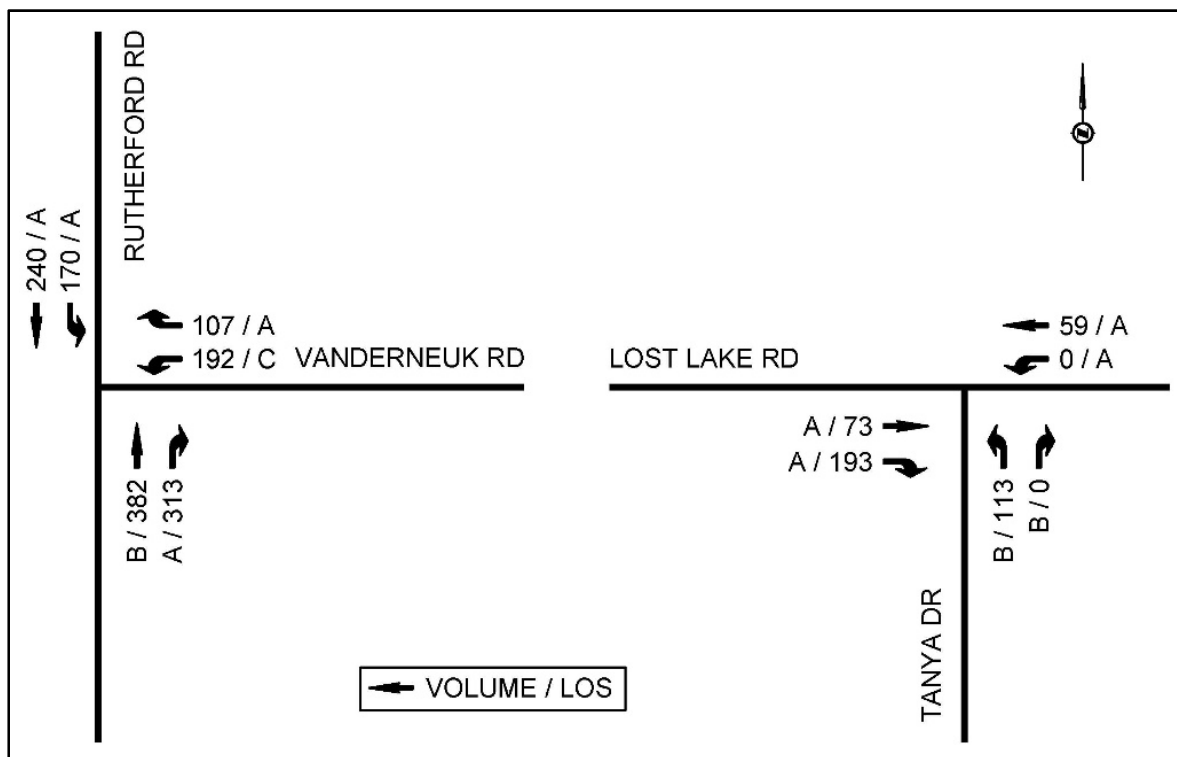
In Option 3 the 5300 Rutherford Rd and 5701 Vanderneuk Road developments would travel the same as Option 2 using both route to reach Rutherford Road. For the Tanya Developments the trips travelling to / from the north would continue to use the Rutherford Road / Vanderneuk Road intersection; however, the trips travelling to / from the south would now be split 50 / 50 in using the Vanderneuk Road Route and using an internal connection to access the through one of the Tanya Road properties to connect to Linley Valley Drive.

**TABLE 4: OPTION 3 POST DEVELOPMENT PM PEAK HOUR TRAFFIC CONDITIONS**

Intersection	Movement	LOS	Delay (s)	95 <sup>th</sup> Queue (m)
Rutherford Road / Vanderneuk Road	WBL	C	21.7	41.8
	WBR	A	5.7	27.3
	NBT	B	17.4	54.9
	NBR	A	3.6	33.7
	SBL	A	7.4	28.7
	SBT	A	6.2	27.8
Lost Lake Road / Tanya Drive	EB T/R	A	0.0	0.0
	WB L/T	A	0.0	0.0
	NB L/R	B	10.8	17.9

The 95<sup>th</sup> percentile queue lengths were averaged from multiple SimTraffic simulations.

The Rutherford Road / Vanderneuk Road intersection operates at LOS C or better for all movements with limited change in queues and delays compared to Option 2. The northbound right turn lane requires 35m storage. Lost Lake Road / Tanya Drive operates a LOS B or higher. **Figure 8** shows the 2021 post development volumes and LOS for Option 3.



**Figure 8: Option 3 Post Development 2021 Volumes and LOS**

In this option the expected daily volumes on Vanderneuk Road and Lost Lake Road are within the expected collector road range (4,000 vpd to 8,000 vpd).

## **4.0 OTHER MODES OF TRANSPORTATION**

### **4.1 PEDESTRIAN FACILITIES AND BICYCLE FACILITIES**

Sidewalks currently exist on the west side of Rutherford Rd and on the frontage of the Garnet Place subdivision. The remainder of the east side of Rutherford Road consists of an approximately 1.0m wide paved shoulder with exposed gravel behind it. Vanderneuk Road has sidewalks along its north side. Lost Lake Road has a mix of paved shoulder, gravel shoulder, and no shoulder on both sides of the road. Tanya Road has a mix of gravel and grass shoulders.

The City of Nanaimo's OCP *Map2* designates Rutherford Rd as a bicycle route. Neither Vanderneuk Road / Lost Lake Road nor Tanya Drive is designated bicycle routes in the OCP.

No further improvements to the sidewalks or bike lanes are required on Vanderneuk Rd and Rutherford Rd at this time. Sidewalk could be considered for Tanya Drive as the land is developed.

### **4.2 TRANSIT**

The Route 20 (Hammond Bay) bus is the closest to the Tanya Drive developments; however, there is no easy or direct route to access Hammond Bay Road. Following the road network would require a pedestrian to walk approximately 1.8km to access Hammond Bay Road. The Route 20 bus runs approximately 30 times a day.

## **5.0 CONCLUSIONS**

Overall Vanderneuk Road and Lost Lake Road can handle the expected volume of traffic if the properties on Tanya Drive are rezoned to R-10. With the potential future developments along Tanya Drive as well as the 5300 Rutherford Road and 5701 Vanderneuk Road developments the Rutherford Road / Vanderneuk Road intersection will be required to be signalized with a protected / permitted southbound left turn phase and a northbound right turn lane. The length of the northbound right turn lane will depend on the timing of the developments and the Linley Valley Drive connection to Rutherford Road and if it extends to Tanya Drive. Consideration should be given to extending Linley Valley Drive to Tanya Drive to provide dual access routes to the area for improved traffic operations as well as emergency service access.

This area has limited sidewalks and is not a recommended cycling route. Therefore consideration for sidewalks should be undertaken during develop of each property to determine the appropriate trail / sidewalk plan to connect the neighbourhood. Transit is also not accessible for these properties as transit is over 1.8km away.

## **APPENDIX A: SYNCHRO BACKGROUND**



## SYNCHRO MODELLING SOFTWARE DESCRIPTION

The traffic analysis was completed using Synchro and SimTraffic traffic modeling software. Results were measured in delay, level of service (LOS) and 95th percentile queue length. Synchro is based on the Highway Capacity Manual (HCM) methodology. SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly “seeding” or positioning vehicles travelling throughout the network. The simulation is run five times (five different random seedings of vehicle types, behaviours and arrivals) to obtain statistical significance of the results.

### Levels of Service

Traffic operations are typically described in terms of levels of service, which rates the amount of delay per vehicle for each movement and the entire intersection. Levels of service range from LOS A (representing best operations) to LOS E / F (LOS E being poor operations and LOS F being unpredictable / disruptive operations). LOS E / F are generally unacceptable levels of service under normal everyday conditions.

The hierarchy of criteria for grading an intersection or movement not only includes delay times, but also takes into account traffic control type (stop signs or traffic signal). For example, if a vehicle is delayed for 19 seconds at an unsignalized intersection, it is considered to have an average operation, and would therefore be graded as an LOS C. However, at a signalized intersection, a 19 second delay would be considered a good operation and therefore it would be given an LOS B. The table below indicates the range of delay for LOS for signalized and unsignalized intersections.

**Table A1: LOS Criteria, by Intersection Traffic Control**

Level of Service	Unsignalized Intersection Average Vehicle Delay (sec/veh)	Signalized Intersection Average Vehicle Delay (sec/veh)
A	Less than 10	Less than 10
B	10 to 15	11 to 20
C	16 to 25	21 to 35
D	26 to 35	36 to 55
E	36 to 50	56 to 80
F	More than 51	More than 81

## **APPENDIX B: 2016 EXISTING SYNCHRO**

**Intersection**

Int Delay, s/veh 3.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	126	29	346	201	37	217
Future Vol, veh/h	126	29	346	201	37	217
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	200	-	-	600	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	137	32	376	218	40	236

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	801	485	0	0	595	0
Stage 1	485	-	-	-	-	-
Stage 2	316	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	354	582	-	-	981	-
Stage 1	619	-	-	-	-	-
Stage 2	739	-	-	-	-	-
Platoon blocked, %			-	-		
Mov Cap-1 Maneuver	340	582	-	-	981	-
Mov Cap-2 Maneuver	340	-	-	-	-	-
Stage 1	619	-	-	-	-	-
Stage 2	709	-	-	-	-	-

Approach	WB		NB		SB
HCM Control Delay, s	20.5		0		1.3
HCM LOS	C				

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	340	582	981	-
HCM Lane V/C Ratio	-	-	0.403	0.054	0.041	-
HCM Control Delay (s)	-	-	22.6	11.5	8.8	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	1.9	0.2	0.1	-

**Intersection**

Int Delay, s/veh 0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	66	5	0	53	3	0
Future Vol, veh/h	66	5	0	53	3	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	72	5	0	58	3	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	77	132
Stage 1	-	-	74
Stage 2	-	-	58
Critical Hdwy	-	4.12	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	-	2.218	3.518
Pot Cap-1 Maneuver	-	1522	862
Stage 1	-	-	949
Stage 2	-	-	965
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1522	862
Mov Cap-2 Maneuver	-	-	862
Stage 1	-	-	949
Stage 2	-	-	965

Approach	EB	WB	NB
HCM Control Delay, s	0	0	9.2
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	862	-	-	1522	-
HCM Lane V/C Ratio	0.004	-	-	-	-
HCM Control Delay (s)	9.2	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

## **APPENDIX C: 2021 OPTION 1 CONDITIONS**

**Intersection**

Int Delay, s/veh 4.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Vol, veh/h	73	376	0	59	219	0
Future Vol, veh/h	73	376	0	59	219	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	79	409	0	64	238	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	488	348
Stage 1	-	-	284
Stage 2	-	-	64
Critical Hdwy	-	4.12	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	-	2.218	3.518
Pot Cap-1 Maneuver	-	1075	649
Stage 1	-	-	764
Stage 2	-	-	959
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1075	649
Mov Cap-2 Maneuver	-	-	649
Stage 1	-	-	764
Stage 2	-	-	959

Approach	EB	WB	NB
HCM Control Delay, s	0	0	13.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	649	-	-	1075	-
HCM Lane V/C Ratio	0.367	-	-	-	-
HCM Control Delay (s)	13.7	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	1.7	-	-	0	-

# Lanes, Volumes, Timings

## 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	446	107	382	743	170	240
Future Volume (vph)	446	107	382	743	170	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0	20.0		200.0	60.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	7.5				22.9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	1601	1883	1601	1789	1883
Flt Permitted	0.950				0.270	
Satd. Flow (perm)	1789	1601	1883	1601	509	1883
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		77		808		
Link Speed (k/h)	50		50			50
Link Distance (m)	739.5		727.3			791.7
Travel Time (s)	53.2		52.4			57.0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	485	116	415	808	185	261
Shared Lane Traffic (%)						
Lane Group Flow (vph)	485	116	415	808	185	261
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.7		3.7			3.7
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	4.8		4.8			14.6
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	26	14		14	26	
Number of Detectors	1	1	2	1	1	2
Detector Template	Left	Right	Thru	Right	Left	Thru
Leading Detector (m)	2.1	2.1	10.0	2.1	2.1	10.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.1	2.1	0.6	2.1	2.1	0.6
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)			9.4			9.4
Detector 2 Size(m)			0.6			0.6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	8	8		2	6	

# Lanes, Volumes, Timings

## 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016

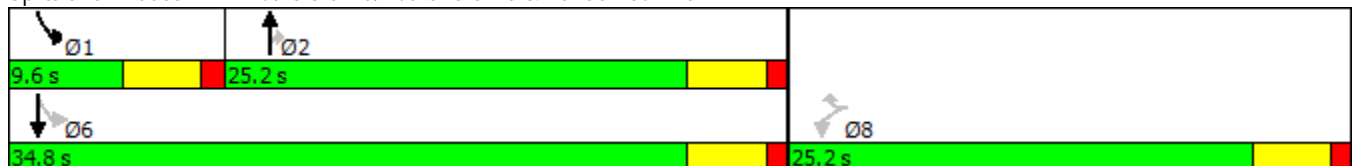


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Detector Phase	8	8	2	2	1	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	9.5	22.5
Total Split (s)	25.2	25.2	25.2	25.2	9.6	34.8
Total Split (%)	42.0%	42.0%	42.0%	42.0%	16.0%	58.0%
Maximum Green (s)	20.7	20.7	20.7	20.7	5.1	30.3
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag			Lag	Lag	Lead	
Lead-Lag Optimize?			Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	Min	Min	None	Min
Walk Time (s)	7.0	7.0	7.0	7.0		
Flash Dont Walk (s)	11.0	11.0	11.0	11.0		
Pedestrian Calls (#/hr)	0	0	0	0		
Act Effct Green (s)	18.4	18.4	17.7	17.7	24.7	24.7
Actuated g/C Ratio	0.35	0.35	0.34	0.34	0.47	0.47
v/c Ratio	0.78	0.19	0.66	0.75	0.50	0.30
Control Delay	27.7	7.2	21.8	6.8	13.3	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.7	7.2	21.8	6.8	13.3	9.5
LOS	C	A	C	A	B	A
Approach Delay	23.8		11.9			11.1
Approach LOS	C		B			B

### Intersection Summary

Area Type:	Other
Cycle Length:	60
Actuated Cycle Length:	52.6
Natural Cycle:	60
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.78
Intersection Signal Delay:	14.9
Intersection LOS:	B
Intersection Capacity Utilization:	65.5%
ICU Level of Service:	C
Analysis Period (min):	15

### Splits and Phases: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd





**Intersection: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd**

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	R	L	T
Maximum Queue (m)	151.9	27.5	258.1	175.0	39.5	46.8
Average Queue (m)	74.6	18.8	103.3	106.6	20.4	19.7
95th Queue (m)	128.7	36.3	327.2	205.5	33.7	37.2
Link Distance (m)	725.3		717.1			771.4
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)		20.0		200.0	60.0	
Storage Blk Time (%)	50	1	2	8		0
Queuing Penalty (veh)	53	4	17	30		0

**Intersection: 6: Tanya Dr & Lost Lake Rd**

Movement	NB
Directions Served	LR
Maximum Queue (m)	28.2
Average Queue (m)	14.9
95th Queue (m)	23.1
Link Distance (m)	663.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

**Network Summary**

Network wide Queuing Penalty: 104

## **APPENDIX D: 2021 OPTION 2 CONDITIONS**

**Intersection**

Int Delay, s/veh 4.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↶		↷		↶	
Traffic Vol, veh/h	73	376	0	59	219	0
Future Vol, veh/h	73	376	0	59	219	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	79	409	0	64	238	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	488	348
Stage 1	-	-	284
Stage 2	-	-	64
Critical Hdwy	-	4.12	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	-	2.218	3.518
Pot Cap-1 Maneuver	-	1075	649
Stage 1	-	-	764
Stage 2	-	-	959
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1075	649
Mov Cap-2 Maneuver	-	-	649
Stage 1	-	-	764
Stage 2	-	-	959

Approach	EB	WB	NB
HCM Control Delay, s	0	0	13.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	649	-	-	1075	-
HCM Lane V/C Ratio	0.367	-	-	-	-
HCM Control Delay (s)	13.7	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	1.7	-	-	0	-

# Lanes, Volumes, Timings

## 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	280	107	382	462	170	240
Future Volume (vph)	280	107	382	462	170	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0	20.0		200.0	60.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	7.5				22.9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	1601	1883	1601	1789	1883
Flt Permitted	0.950				0.292	
Satd. Flow (perm)	1789	1601	1883	1601	550	1883
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		116		502		
Link Speed (k/h)	50		50			50
Link Distance (m)	739.5		727.3			791.7
Travel Time (s)	53.2		52.4			57.0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	304	116	415	502	185	261
Shared Lane Traffic (%)						
Lane Group Flow (vph)	304	116	415	502	185	261
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.7		3.7			3.7
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	4.8		4.8			14.6
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	26	14		14	26	
Number of Detectors	1	1	2	1	1	2
Detector Template	Left	Right	Thru	Right	Left	Thru
Leading Detector (m)	2.1	2.1	10.0	2.1	2.1	10.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.1	2.1	0.6	2.1	2.1	0.6
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)			9.4			9.4
Detector 2 Size(m)			0.6			0.6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	8	8		2	6	

Lanes, Volumes, Timings

2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016

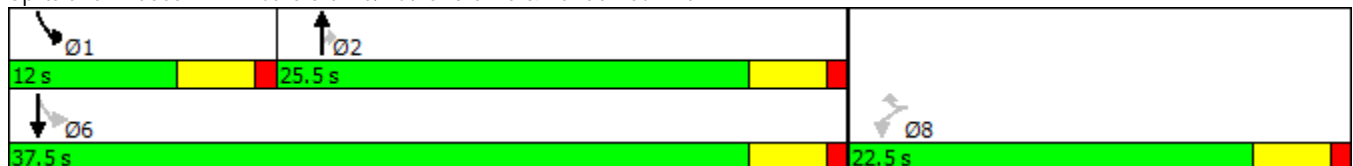


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Detector Phase	8	8	2	2	1	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	9.5	22.5
Total Split (s)	22.5	22.5	25.5	25.5	12.0	37.5
Total Split (%)	37.5%	37.5%	42.5%	42.5%	20.0%	62.5%
Maximum Green (s)	18.0	18.0	21.0	21.0	7.5	33.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag			Lag	Lag	Lead	
Lead-Lag Optimize?			Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	Min	Min	None	Min
Walk Time (s)	7.0	7.0	7.0	7.0		7.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0	0	0		0
Act Effect Green (s)	13.6	13.6	17.8	17.8	26.6	26.6
Actuated g/C Ratio	0.27	0.27	0.36	0.36	0.54	0.54
v/c Ratio	0.62	0.22	0.62	0.56	0.39	0.26
Control Delay	23.5	5.2	19.7	4.5	8.8	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	5.2	19.7	4.5	8.8	7.3
LOS	C	A	B	A	A	A
Approach Delay	18.4		11.4			7.9
Approach LOS	B		B			A

Intersection Summary

Area Type:	Other
Cycle Length:	60
Actuated Cycle Length:	49.7
Natural Cycle:	55
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.62
Intersection Signal Delay:	12.2
Intersection LOS:	B
Intersection Capacity Utilization:	56.3%
ICU Level of Service:	B
Analysis Period (min):	15

Splits and Phases: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd



**Intersection: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd**

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	R	L	T
Maximum Queue (m)	76.4	27.5	66.0	66.2	36.3	37.9
Average Queue (m)	35.4	15.2	33.0	30.0	17.8	15.0
95th Queue (m)	64.2	32.0	55.5	52.5	29.3	30.3
Link Distance (m)	725.3		717.1			771.4
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)		20.0		200.0	60.0	
Storage Blk Time (%)	23	1				
Queuing Penalty (veh)	25	2				

**Intersection: 6: Tanya Dr & Lost Lake Rd**

Movement	NB
Directions Served	LR
Maximum Queue (m)	27.2
Average Queue (m)	15.2
95th Queue (m)	23.8
Link Distance (m)	663.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

**Network Summary**

Network wide Queuing Penalty: 27

## **APPENDIX E: 2021 OPTION 3 CONDITIONS**

**Intersection**

Int Delay, s/veh 2.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	73	193	0	59	113	0
Future Vol, veh/h	73	193	0	59	113	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	79	210	0	64	123	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	289	248
Stage 1	-	-	184
Stage 2	-	-	64
Critical Hdwy	-	4.12	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	-	2.218	3.518
Pot Cap-1 Maneuver	-	1273	740
Stage 1	-	-	848
Stage 2	-	-	959
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1273	740
Mov Cap-2 Maneuver	-	-	740
Stage 1	-	-	848
Stage 2	-	-	959

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	740	-	-	1273	-
HCM Lane V/C Ratio	0.166	-	-	-	-
HCM Control Delay (s)	10.8	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.6	-	-	0	-



# Lanes, Volumes, Timings

## 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	192	107	382	313	170	240
Future Volume (vph)	192	107	382	313	170	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0	20.0		200.0	60.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	7.5				22.9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	1601	1883	1601	1789	1883
Flt Permitted	0.950				0.316	
Satd. Flow (perm)	1789	1601	1883	1601	595	1883
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		116		340		
Link Speed (k/h)	50		50			50
Link Distance (m)	739.5		727.3			791.7
Travel Time (s)	53.2		52.4			57.0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	209	116	415	340	185	261
Shared Lane Traffic (%)						
Lane Group Flow (vph)	209	116	415	340	185	261
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.7		3.7			3.7
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	4.8		4.8			14.6
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	26	14		14	26	
Number of Detectors	1	1	2	1	1	2
Detector Template	Left	Right	Thru	Right	Left	Thru
Leading Detector (m)	2.1	2.1	10.0	2.1	2.1	10.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.1	2.1	0.6	2.1	2.1	0.6
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)			9.4			9.4
Detector 2 Size(m)			0.6			0.6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Perm	Perm	NA	Perm	pm+pt	NA
Protected Phases			2		1	6
Permitted Phases	8	8		2	6	

# Lanes, Volumes, Timings

## 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd

10-27-2016

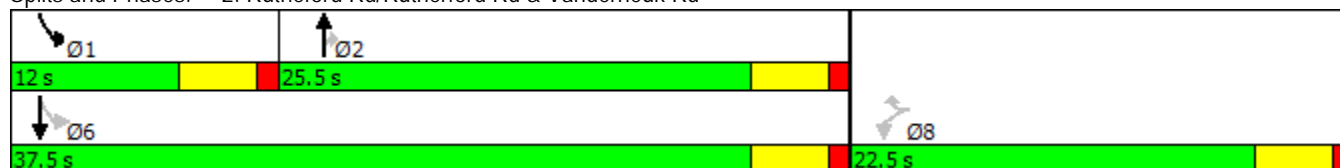


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Detector Phase	8	8	2	2	1	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	9.5	22.5
Total Split (s)	22.5	22.5	25.5	25.5	12.0	37.5
Total Split (%)	37.5%	37.5%	42.5%	42.5%	20.0%	62.5%
Maximum Green (s)	18.0	18.0	21.0	21.0	7.5	33.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag			Lag	Lag	Lead	
Lead-Lag Optimize?			Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	Min	Min	None	Min
Walk Time (s)	7.0	7.0	7.0	7.0		
Flash Dont Walk (s)	11.0	11.0	11.0	11.0		
Pedestrian Calls (#/hr)	0	0	0	0		
Act Effect Green (s)	11.0	11.0	18.5	18.5	27.6	27.6
Actuated g/C Ratio	0.23	0.23	0.39	0.39	0.58	0.58
v/c Ratio	0.51	0.25	0.57	0.41	0.36	0.24
Control Delay	21.7	5.7	17.4	3.6	7.4	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.7	5.7	17.4	3.6	7.4	6.2
LOS	C	A	B	A	A	A
Approach Delay	16.0		11.2			6.7
Approach LOS	B		B			A

### Intersection Summary

Area Type:	Other
Cycle Length:	60
Actuated Cycle Length:	47.9
Natural Cycle:	60
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.57
Intersection Signal Delay:	10.9
Intersection LOS:	B
Intersection Capacity Utilization:	51.4%
ICU Level of Service:	A
Analysis Period (min):	15

### Splits and Phases: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd



**Intersection: 2: Rutheford Rd/Rutherford Rd & Vanderneuk Rd**

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	R	L	T
Maximum Queue (m)	52.0	27.4	68.7	41.2	35.0	32.8
Average Queue (m)	23.9	12.7	31.4	20.0	17.1	14.0
95th Queue (m)	41.8	27.3	54.9	33.7	28.7	27.8
Link Distance (m)	725.3		717.1			771.4
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)		20.0		200.0	60.0	
Storage Blk Time (%)	11	0				
Queuing Penalty (veh)	12	1				

**Intersection: 6: Tanya Dr & Lost Lake Rd**

Movement	NB
Directions Served	LR
Maximum Queue (m)	21.6
Average Queue (m)	11.6
95th Queue (m)	17.9
Link Distance (m)	663.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

**Network Summary**

Network wide Queuing Penalty: 13