



801 Ryan Road:
Residential Development
**Transportation Impact
Assessment**
Draft

Prepared for
Seymour Pacific Developments

Date
July 15, 2020

Project No.
04-20-0120

July 15, 2020
04-20-0120

Rachel Ricard
Development Manager
Seymour Pacific Developments Ltd.
100 St Ann's Road
Campbell River, BC
V9W 4C4

Dear Rachel:

**Re: 801 Ryan Road Residential Development
Transportation Impact Assessment - Draft**

Please find attached our Transportation Impact Assessment draft report, for circulation to the City of Courtenay and the Ministry of Transportation and Infrastructure. We found that the development's modest vehicle trip generation is not anticipated to significantly effect the operations of nearby intersection. In addition, the proposed site plan includes multiple internal sidewalks to connect residents with Ryan Road and the adjacent properties. We also suggested opportunities to better manage vehicle flow from the shopping centre at 757 Ryan Road onto Ryan Road as this will be one of the development's vehicle access points.

Please let us know if we can be of any further assistance.

Yours truly,
Bunt & Associates

Simon Button, P.Eng., M.Eng.
Transportation Engineer

CORPORATE AUTHORIZATION

Prepared By: Simon Button, P.Eng.

Bunt & Associates Engineering Ltd.

530 – 645 Fort Street

Victoria, BC V8W 1G2

Canada

Reviewed By: Yulia Liem, P.Eng., PTOE
Senior Transportation Engineer

Telephone: +1 250 592 6122

Date: July 15, 2020

Project No. 04-20-0120

Status: Draft

This document was prepared by Bunt & Associates for the benefit of the Client to whom it is addressed. The copyright and ownership of the report rests with Bunt & Associates. The information and data in the report reflects Bunt & Associates' best professional judgment in light of the knowledge and information available to Bunt & Associates at the time of preparation. Except as required by law, this report and the information and data contained are to be treated as confidential and may be used and relied upon only by the client, its officers and employees. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Bunt & Associates accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	1
1.1 Study Purpose & Objectives	1
1.2 Study Scope & Area	1
1.3 Organization of Report	1
1.4 Proposed Development	1
2. EXISTING CONDITIONS	4
2.1 Existing Transportation Network	4
2.2 Municipal Plans	4
2.3 Crash History	4
2.4 Data Collection	5
2.4.1 Traffic Data Collection Program	5
2.4.2 Peak Hour Vehicle Volumes	5
2.5 Existing Vehicle Operations	9
2.5.1 Performance Thresholds	9
2.5.2 Existing Conditions Analysis Assumptions	10
2.5.3 Existing Operational Analysis Results	10
3. DEVELOPMENT PLAN REVIEW	12
3.1 Site Design	12
3.2 Private Off-site Design Modifications	12
3.3 Driveway Lengths	12
3.4 Bicycle Parking	13
3.5 Vehicle Parking	13
3.6 Safety Impacts	15
4. FUTURE VEHICLE CONDITIONS	18
4.1 Vehicle Forecasts	18
4.1.1 Background Vehicle Forecasts	18
4.1.2 Site Vehicle Trips	18
4.1.3 Total Vehicle Forecasts	19
4.2 Future Vehicle Operations	25
4.2.1 Future Conditions Analysis Assumptions	25
4.2.2 Future Background Vehicle Operations	25
4.2.3 Future Total Vehicle Operations	25

4.2.1	Right-Turn Lane Warrant.....	30
4.2.2	Tunner Drive Extension	30
4.2.1	Ryan Road & Sandwich Road Improvements	30
5.	SUMMARY & RECOMMENDATIONS	33
5.1	Summary	33
5.2	Recommendations	34
APPENDIX A Terms of Reference		
APPENDIX B Synchro Reports		

EXHIBITS

Exhibit 1.1: Study Area	2
Exhibit 1.2: Site Plan.....	3
Exhibit 2.1: Transportation Network	6
Exhibit 2.2: Crosswalks and Bus Stops on Ryan Road	7
Exhibit 2.3: Existing Peak Hour Vehicle Volumes	8
Exhibit 3.1: Site Access.....	16
Exhibit 3.2: Internal Intersection Conceptual Design	17
Exhibit 4.1: 2022 Background Vehicle Forecasts	20
Exhibit 4.2: 2032 Background Vehicle Forecasts	21
Exhibit 4.3: Site Vehicle Forecasts.....	22
Exhibit 4.4: 2022 Total Vehicle Forecasts.....	23
Exhibit 4.5: 2032 Total Vehicle Forecasts.....	24

TABLES

Table 2.1: Crash History 2014 to 2018	5
Table 2.2: Intersection Level of Service Thresholds.....	9
Table 2.3: Existing Vehicle Operations	11
Table 4.1: Peak Hour Vehicle Trip Generation.....	18
Table 4.2: Assumed Trip Distribution.....	19
Table 4.3: 2032 Net Change in Future Intersection Vehicle Volumes with New Site Trips.....	19
Table 4.5: 2022 Background Vehicle Operations	26
Table 4.6: 2032 Background Vehicle Operations	27
Table 4.7: 2022 Total Vehicle Operations	28
Table 4.8: 2032 Total Vehicle Operations	29
Table 4.9: 2022 Total Vehicle Operations - Weekday PM Peak Hour.....	32

EXECUTIVE SUMMARY

Seymour Pacific Developments is proposing a 251-unit residential development on Ryan Road in Courtenay, BC. A Transportation Impact Assessment (TIA) is required for the development application and given the site location, both the City of Courtenay and the Ministry of Transportation & Infrastructure (MoTI) need to approve the study.

The development includes pedestrian connections to three sides of the property (Ryan Road and two private properties) with the potential to connect to the future Tunner Drive extension. Vehicle connections are provided to the two adjacent private properties (through shared access agreements) and potentially to the future Tunner Drive extension as well, for which the development is providing a right-of-way. The City's Transportation Master Plan envisions Tunner Drive extending from Hunt Road to Highway 19A including a multi-use pathway which is anticipated to have a positive impact on local circulation.

We anticipate that most drivers will access the site through the Ryan Road & Sandwich Road intersection via the shopping centre at 757 Ryan Road. The developer is working with the shopping centre owner to improve their leg of this signalized intersection. In addition, the developer and MoTI should coordinate to update the shopping centre approach's laning and signal phasing to reduce vehicle queues.

The development will provide 1 secure bicycle parking space per unit and short-term bicycle spaces will be provided outside each of the three buildings. The development will provide 1.25 vehicle parking spaces per unit (1.13 spaces/unit for residents and 0.12 spaces/unit for visitors). This is an appropriate vehicle parking supply for the site location given the demand for parking at similar rental buildings and the City's desire to reduce the vehicle mode share.

The development is anticipated to generate approximately 100 vehicle trips per peak hour which is forecasted to increase the volume of vehicles using nearby intersections by 2% or less. The development's vehicle trip generation is not anticipated to cause any noticeable impacts to the intersection operations or safety.

There are only a few isolated vehicle movements which do not meet the City's performance thresholds, mostly at the Ryan Road & Highway 19A intersection. All vehicle movements which do not meet the City's performance thresholds occur in the future background conditions without the proposed development. No additional off-site transportation infrastructure is required to accommodate the proposed development.

1. INTRODUCTION

1.1 Study Purpose & Objectives

Seymour Pacific Developments is proposing a rental residential development on Ryan Road in Courtenay, BC, which will include three buildings with a total of 251 rental units. The site is currently vacant. A Transportation Impact Assessment (TIA) is required as part of the Rezoning application and both the City and Ministry of Transportation & Infrastructure (MOTI) will need to approve the study. The purpose of this study is to review the transportation implications of the proposed residential development and identify potential improvements.

1.2 Study Scope & Area

The study's Terms of Reference is provided in **Appendix A** which was approved by both road authorities. **Exhibit 1.1** illustrates the study area which includes Ryan Road from Highway 19A to Back Road.

1.3 Organization of Report

This report is organized as follows:

- Section 1.4 provides an overview of the proposed residential development;
- Section 2 reviews the existing conditions;
- Section 3 examines the proposed development site design;
- Section 4 assesses the future traffic conditions; and,
- Section 5 provides the study's conclusions and recommendations.

1.4 Proposed Development

Exhibit 1.2 illustrates the proposed site plan. The proposed development adds three residential buildings and associated surface parking. The site plan also includes a right-of-way through the south section of the property for the City's future Turner Drive Extension from Hunt Road to Highway 19A. The site includes up to three vehicle access points:

- Shared access agreement with the shopping centre to the west (757 Ryan Road) such that vehicles can use the full-movement Ryan Road & Sandwick Road signalized intersection or one of the two accesses on Highway 19A;
- Shared access agreement to use the existing right-in, right-out access on Ryan Road, immediately east of 801 Ryan Road; and,
- Potential access to the south for the future Turner Drive extension.

The multi-modal access arrangement as well as the Turner Drive extension are discussed further in Sections 3.1 and 2.2.

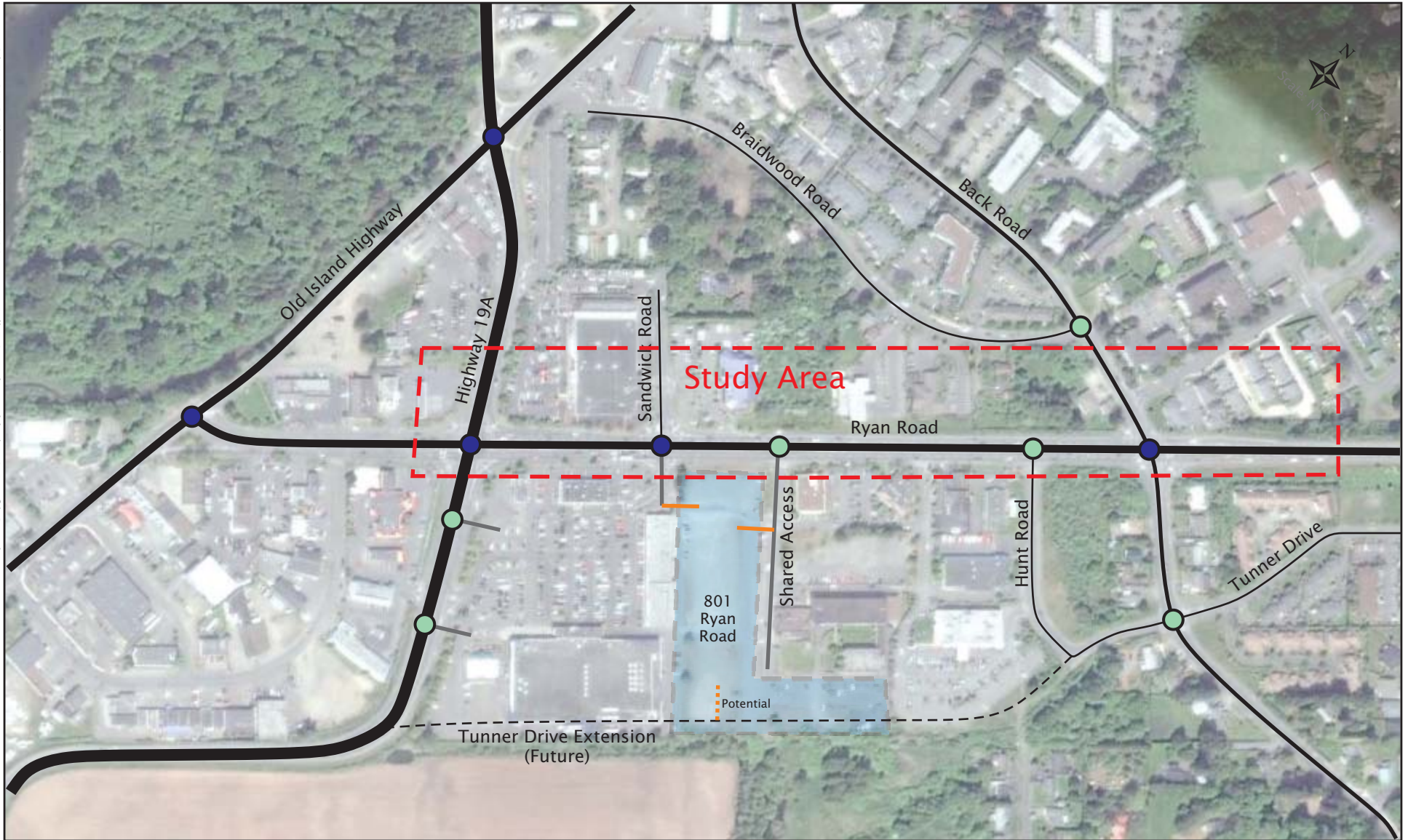


Exhibit 1.1 Study Area

801 Ryan Road TIA
July 2020

04-20-0120



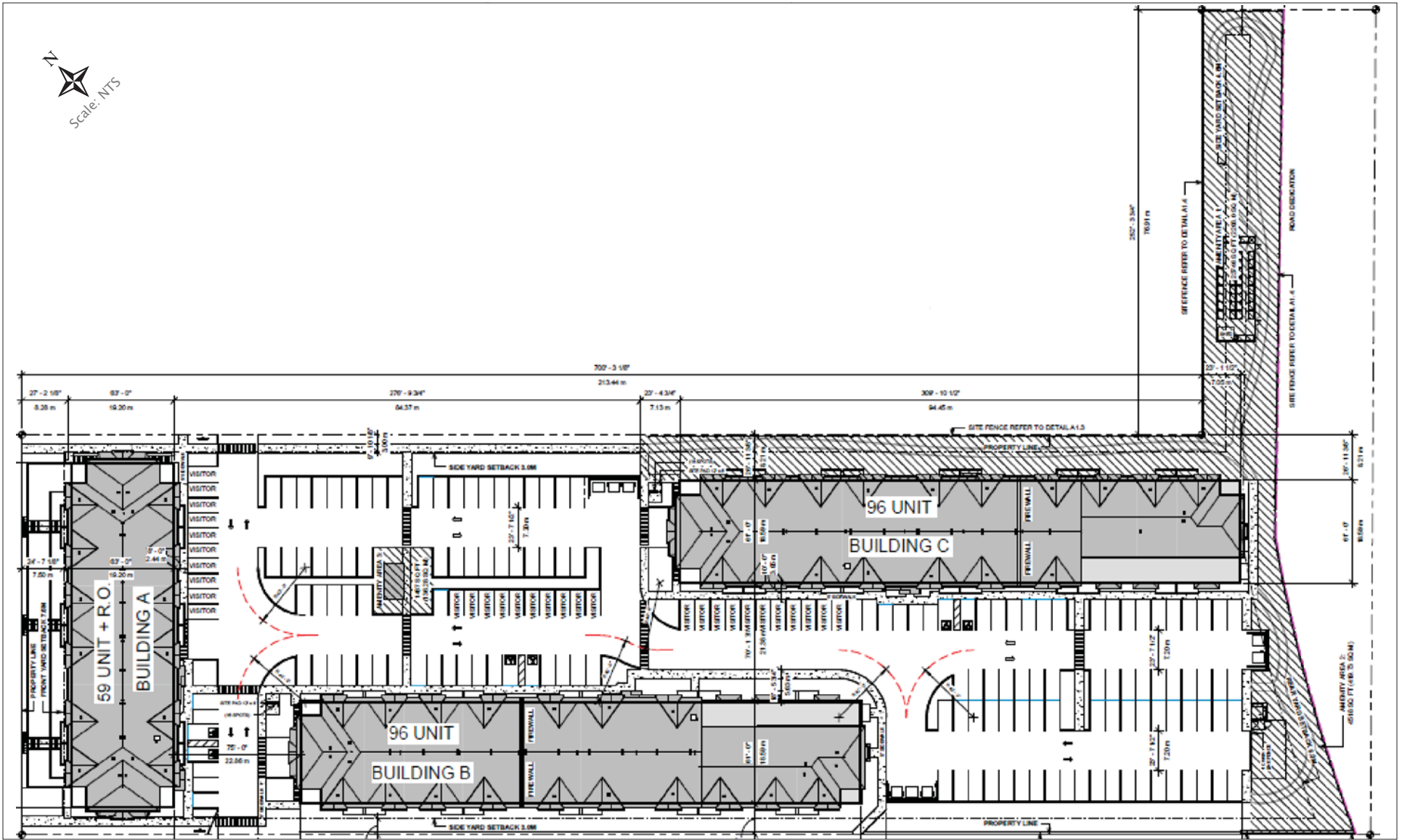


Exhibit 1.2 Site Plan

801 Ryan Road T1A
July 2020

04-20-0120



2. EXISTING CONDITIONS

2.1 Existing Transportation Network

Exhibit 2.1 illustrates the surrounding transportation network. Ryan Road and Highway 19A each has four travel lanes whereas the remainder of the streets typically have two travel lanes. Speed limit signs are generally not provided so the speed limit throughout the study area is assumed to be 50 km/h.

Ryan Road has sidewalks on both sides between Hwy 19A and Sandwick Road and on the south side of Ryan Road between Sandwick Road and Back Road. Sidewalk is also provided on limited sections of Hwy 19A.

Exhibit 2.2 presents the bus stops and pedestrian crossings on Ryan Road. There are six bus routes that provide service on Ryan Road (#4, 6, 11, 12, 34 and 99) with typical headways between 30 and 60 minutes.

Ryan Road east of Back Road, as well as Back Road south of Ryan Road, have shoulder bicycle lanes.

2.2 Municipal Plans

Courtenay's 2019 Transportation Master Plan sets the target of increasing the percentage of trips made by foot, bicycle, and transit from 15% to 30% over the next twenty years. The plan includes several infrastructure improvements in the study area including:

- Widening Back Road between Ryan Road and 10th Street East and improving cycling facilities;
- Limiting accesses on Ryan Road in the study area to right-turns only; and,
- Extending Tunner Drive from Back Road to Highway 19A (including a multi-use trail).

2.3 Crash History

Crash history was obtained from ICBC's crash map¹ from 2014 to 2018. The number of crashes at each study intersection during the five year period is shown in **Table 2.1**. The intersections which have higher vehicle volumes generally have a higher number of crashes. Detailed crash histories were not provided by the road authorities.

¹ ICBC Vancouver Island Crash Map <http://www.icbc.com/about-icbc/newsroom/Pages/Vancouver-Island.aspx>

Table 2.1: Crash History 2014 to 2018

INTERSECTION	PDO	CASUALTY	TOTAL
Ryan Road & Highway 19A	101	100	201
Ryan Road & Sandwick Road	29	19	48
Ryan Road & Shared Access	0	0	0
Ryan Road & Back Road	49	68	117

PDO = Crash causing property damage only, Casualty = Crash causing injury or death

2.4 Data Collection

2.4.1 Traffic Data Collection Program

Bunt previously conducted turning movement counts at all study intersections during the weekday PM peak period on Thursday, September 7, 2017, from 15:30 to 17:30, with 16:15 to 17:15 identified as the peak hour. There were no ferries arriving or departing Comox during the weekday PM traffic count.

Bunt collected the weekday AM peak period vehicle volumes on Thursday, May 28, 2020. This survey was conducted during the COVID-19 pandemic which impacted travel behaviours. The data was adjusted towards more typical values by comparing the vehicle volume during the AM peak hour before the pandemic. The 1025 Ryan Road Traffic Impact Assessment by Watt Consulting Group indicates that the two-way vehicle flow on Ryan Road, immediately east of the development site was approximately 2,000 vehicles per hour on November 13, 2019. The data collected by Bunt during the pandemic was 67% of the data collected in November 2019. Therefore, all AM peak hour data collected by bunt was increased by 49% (1 divided by 0.67) to match the November 2019 data which was assumed to reflect normal conditions.

2.4.2 Peak Hour Vehicle Volumes

Exhibit 2.3 illustrates the peak hour vehicle volumes for the two study periods (weekday AM and PM). The AM volumes reflect the adjusted volumes previously discussed to estimate the ‘normal’ vehicle volumes. The PM volumes were adjusted by 2% annually to estimate the 2020 volumes from the 2017 data.

The PM peak hour is modestly busier than the AM peak hour. There are currently approximately 2,400 vehicles on Ryan Road during the PM peak hour versus 2,000 during the AM peak hour. This equates to approximately 24,000 vehicles per day on Ryan Road.

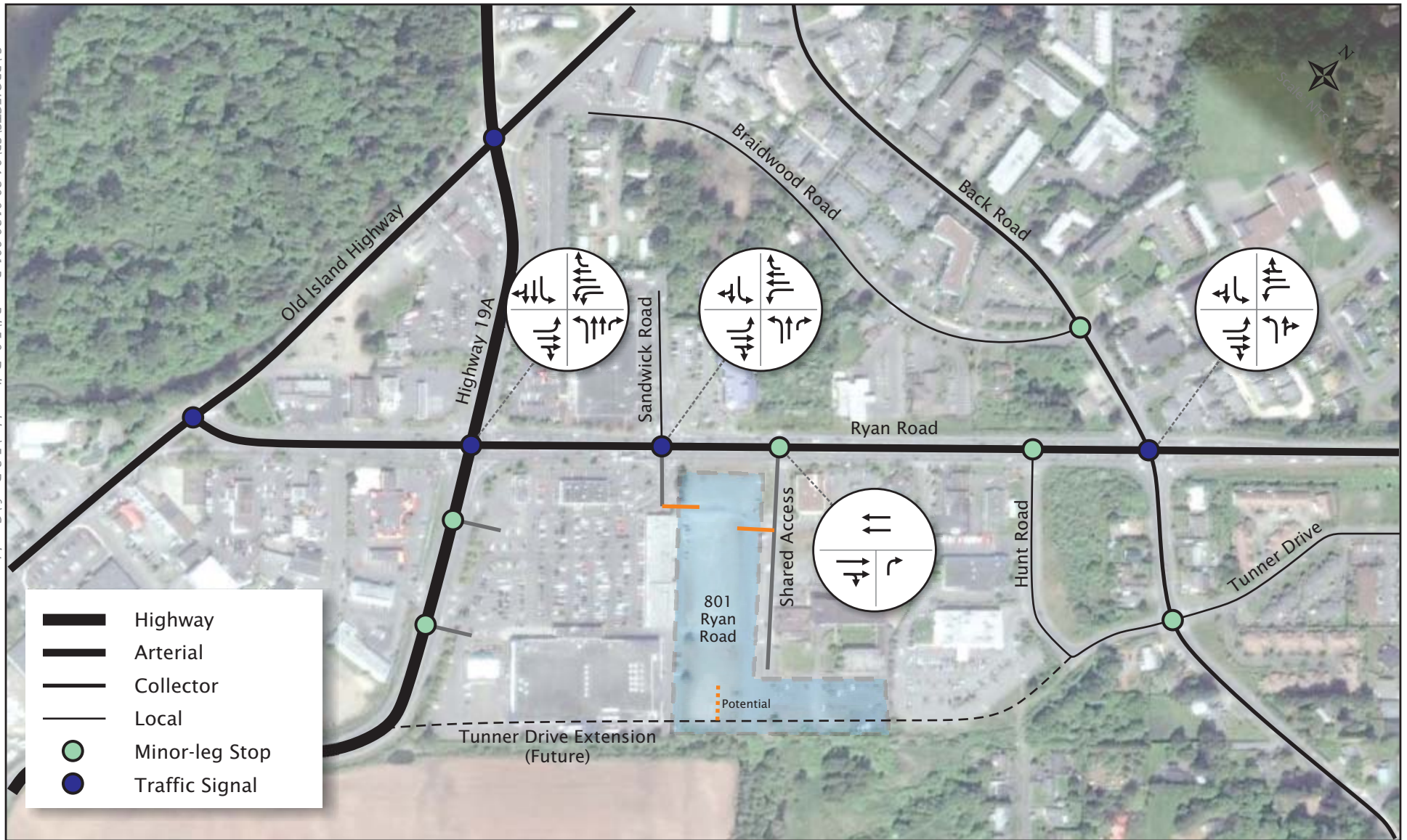


Exhibit 2.1 Transportation Network

801 Ryan Road TIA
July 2020

04-20-0120

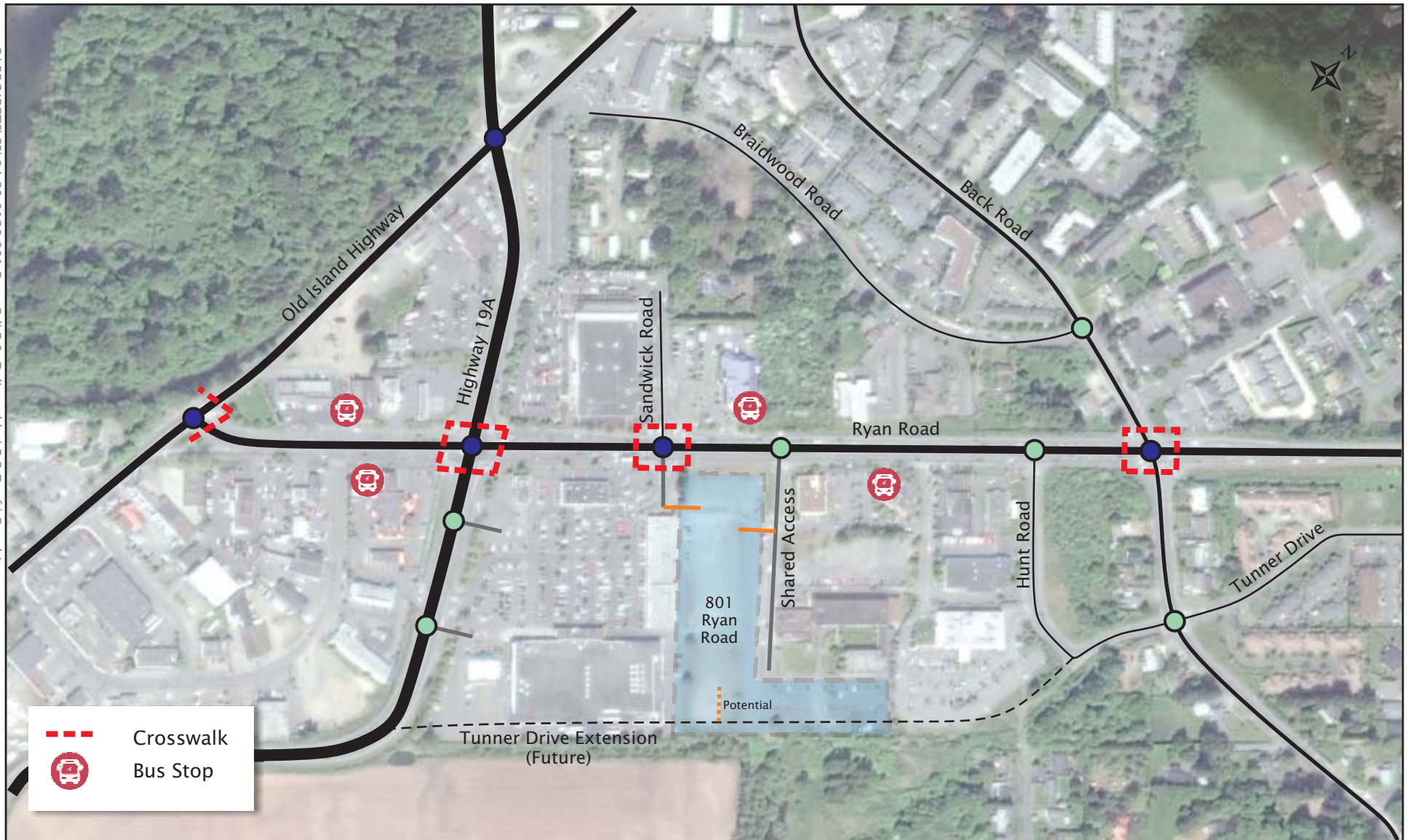


Exhibit 2.2 Bus Stops and Crosswalks on Ryan Road

801 Ryan Road TIA
July 2020

04-20-0120

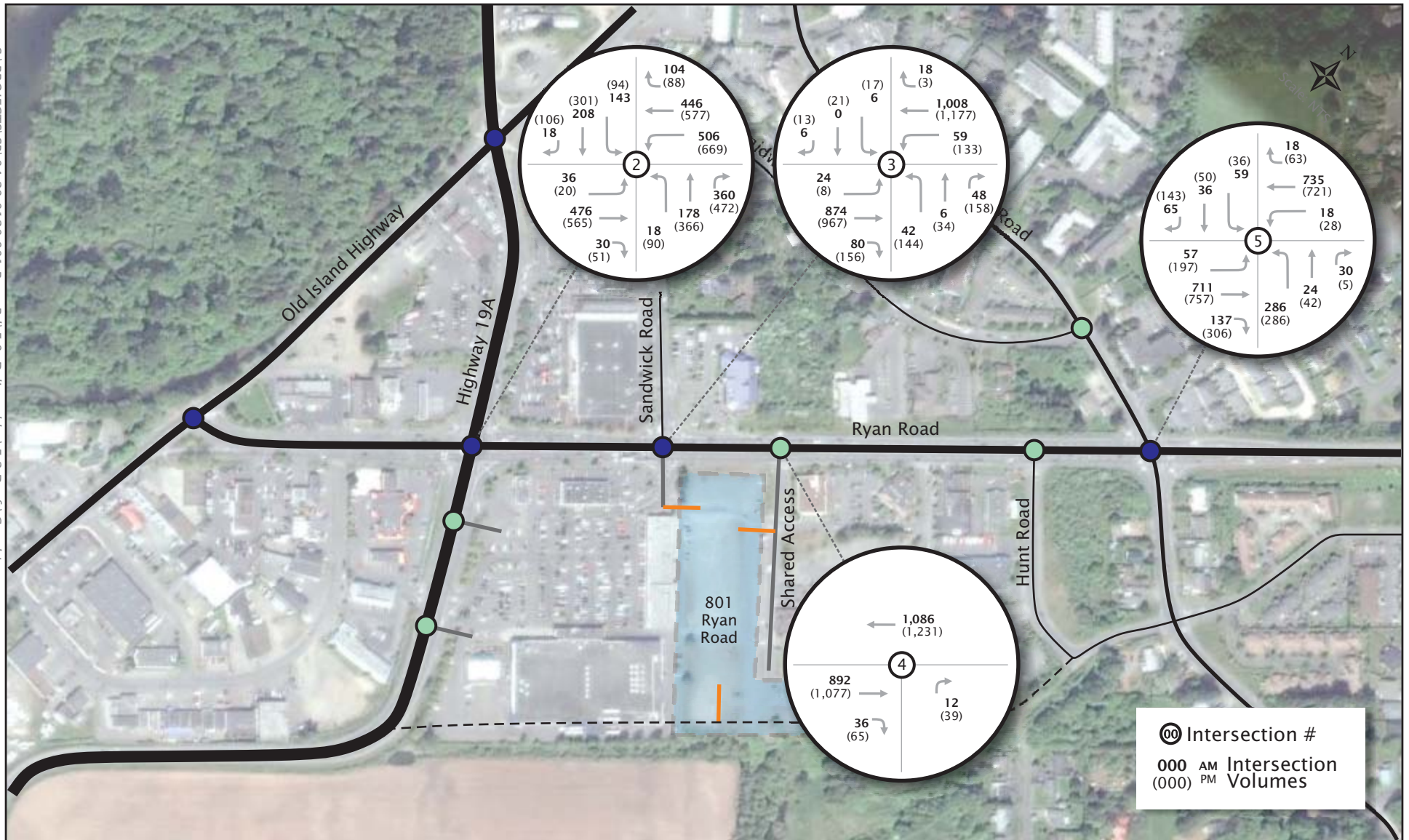


Exhibit 2.3 Existing Peak Hour Vehicle Volumes

801 Ryan Road TIA
June 2020

04-20-0120



2.5 Existing Vehicle Operations

2.5.1 Performance Thresholds

The existing operations of study area intersections and access points were assessed using the methods outlined in the 2000 Highway Capacity Manual (HCM), using the Synchro 9 analysis software. The traffic operations were assessed using the performance measures of Level of Service (LOS) and volume-to-capacity (V/C) ratio.

The LOS rating is based on average vehicle delay and ranges from “A” to “F” based on the quality of operation at the intersection. LOS “A” represents optimal, minimal delay conditions while a LOS “F” represents an over-capacity condition with considerable congestion and/or delay. Delay is calculated in seconds and is based on the average intersection delay per vehicle.

Table 2.2 below summarizes the LOS thresholds for the five Levels of Service, for both signalized and unsignalized intersections.

Table 2.2: Intersection Level of Service Thresholds

LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)	
	SIGNALIZED	UNSIGNALIZED
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Source: Highway Capacity Manual

The volume to capacity (V/C) ratio of an intersection represents the ratio between the demand volume and the available capacity. A V/C ratio of less than 0.85 indicates that there is sufficient capacity to accommodate demands and generally represents reasonable traffic conditions in suburban settings. A V/C value between 0.85 and 0.95 indicates an intersection is approaching practical capacity; a V/C ratio over 0.95 indicates that traffic demands are close to exceeding the available capacity, resulting in saturated conditions. A V/C ratio over 1.0 indicates a very congested intersection where drivers may have to wait through several signal cycles. In downtown and Town Centre contexts, during peak demand periods, V/C ratios over 0.90 and even 1.0 are common.

The City noted a desire to maintain V/C ratios for through and shared through/turning movements to 0.85 or less and 0.90 for exclusive turning movements as well as for queues to remain within their turn lane capacity. As noted in the Terms of Reference, the objective of the analysis is to ensure that no new “problem” movements are created by the development and that “problem” movements that exist are not worsened with the additional vehicle trips generated by the development.

In interpreting the analysis results, note that the HCM methodology reports performance differently for various types of intersection traffic control. In this report, the performance reporting convention is as follows:

- For signalized intersections: HCM 2000 output for overall LOS and V/C as well as individual movement LOS and V/C is reported. 95th Percentile Queues are reported as estimated by Synchro;
- For unsignalized two-way stop-controlled intersections: HCM 2000 LOS and V/C output is reported just for individual lanes as the HCM methodology does not report overall operations.

The performance reporting conventions noted above have been consistently applied throughout this document and the detailed outputs are provided in **Appendix C**.

2.5.2 Existing Conditions Analysis Assumptions

The existing signal timing plans for the signalized intersections were included in the analysis. The existing coordination between the Highway 19A and Sandwick Road intersections was also incorporated into the Synchro models.

During traffic data collection the number of heavy vehicles was recorded at select intersections, with on average 2% of all vehicles were considered heavy vehicles. As such a heavy vehicle percentage of 2% was assumed for all vehicle movements. The peak hour factor for each intersection was determined from the traffic data and was applied to all movements at the intersection.

2.5.3 Existing Operational Analysis Results

Table 2.3 summarizes the vehicle operational analysis results for the existing conditions. The movements which do not meet performance thresholds established by the City are highlighted in orange. Only two movements at the Ryan Road & Highway 19A intersection exceed the City's V/C ratio threshold during the PM peak hour only. All turning movements have a 95th percentile queue below their storage capacity except for the westbound left from Ryan Road to Highway 19A which just exceeds its storage length. The movement's 50th percentile queue is less than the available storage length.

The Ryan Road and Highway 19A intersection currently experiences moderate levels of delay, particularly in the eastbound and westbound directions. The remaining intersections operate within their capacity.

Table 2.3: Existing Vehicle Operations

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Highway 19A <i>Signalized</i>	OVERALL	F	0.54	-	E	0.65	-
	EBL	E	0.25	20	E	0.14	15
	EBT	D	0.65	85	E	0.86	115
	WBL	E	0.83	90	F	1.00	140
	WBT	D	0.57	80	D	0.80	90
	WBR	F	0.06	15	D	0.05	0
	NBL	D	0.08	10	D	0.42	40
	NBT	D	0.24	35	D	0.45	65
	NBR	D	0.22	30	D	0.29	30
	SBL	C	0.33	45	C	0.30	30
	SBT	C	0.18	30	C	0.32	50
Ryan Road & Sandwick Road <i>Signalized</i>	OVERALL	B	0.39	-	B	0.57	-
	EBL	A	0.07	5	A	0.04	0
	EBT/R	A	0.39	95	B	0.55	70
	WBL	A	0.15	10	B	0.42	20
	WBT	A	0.40	45	B	0.51	120
	WBR	A	0.01	0	A	0.00	0
	NBL	D	0.27	10	D	0.60	55
	NBT	D	0.03	0	D	0.10	20
	NBR	D	0.03	0	D	0.10	20
	SBL	E	0.17	0	E	0.26	10
	SBT/R	E	0.00	0	E	0.27	20
Ryan Road & Shared Access <i>Minor-leg Stop</i>	OVERALL	A	-	-	A	-	-
	EBT/R	A	0.38	0	A	0.46	0
	WBT	A	0.35	0	A	0.39	0
	NBR	B	0.02	0	A	0.06	0
Ryan Road & Back Road <i>Signalized</i>	OVERALL	C	0.64	-	C	0.72	-
	EBL	B	0.18	15	C	0.61	40
	EBT/R	B	0.48	75	B	0.60	110
	WBL	C	0.09	10	C	0.18	10
	WBT/R	C	0.62	90	C	0.66	100
	NBL	C	0.59	70	C	0.69	70
	NBT/R	B	0.06	10	B	0.06	15
	SBL	D	0.35	25	D	0.20	15
	SBT/R	D	0.21	25	D	0.47	40

3. DEVELOPMENT PLAN REVIEW

3.1 Site Design

Exhibit 3.1 illustrates the proposed site plan with the access routes highlighted. The site plan includes two sidewalk connections from the site to the Ryan Road sidewalk. Internal sidewalks are proposed connected to all three buildings, the surface parking area and Ryan Road. From Ryan Road, residents can access bus stops eastbound and westbound (by crossing Ryan Road at Sandwick Road). The development has approval from the neighbouring property owner to install a crosswalk connecting the site with the adjacent shopping centre.

The site includes up to three vehicle access points:

- Shared access agreement with the shopping centre to the west (757 Ryan Road) such that vehicles can use the full-movement Ryan Road & Sandwick Road signalized intersection or one of the two accesses on Highway 19A;
- Shared access agreement to use the existing right-in, right-out access on Ryan Road, immediately east of 801 Ryan Road; and,
- Potential access to the south for the future Tunner Drive extension.

3.2 Private Off-site Design Modifications

To better incorporate the future homes at 801 Ryan Road, the developer will improve the internal intersection at 757 Ryan Road, immediately south of the Ryan Road & Sandwick Road intersection. **Exhibit 3.2** illustrates a conceptual design of Bunt's proposed changes. The recommendations include:

- A reconfigured intersection to minimize the intersection's complexity;
- Increased queuing capacity for vehicles leaving the shopping centre by starting the second outbound lane sooner;
- Clear rules for vehicle priority including a hatched area to allow vehicles to turn left into and out of 801 Ryan Road; and,
- A crosswalk to connect the proposed development with the shopping centre.

The owner of the 757 Ryan Road shopping centre has agreed to these changes.

3.3 Driveway Lengths

The City requested that Bunt verify that the development's provided driveway lengths meet the minimum lengths suggested by the Transportation Association of Canada (TAC) Design Guide for Canadian Roads Section. 8.9.10. For a residential development with over 200 units, TAC suggest minimum clear throat length of 25 metres on a collector road and 40 metres on an arterial road. TAC does not provide any suggestions local roads.

The proposed development's driveways connect to private roadways which are considered a lower level road than collectors and arterials, requiring a shorter driveway length than those listed above. The proposed south driveway has 22 metres of queue storage between the first parking space and the internal intersection south of the Ryan Road & Sandwick Road intersection, providing queuing capacity for three vehicles. The north driveway approaching the shared access road is 12 metres long providing queuing capacity for two vehicles. Given these are private streets, we do not recommend that the TAC suggested driveway lengths for collectors (or arterials) need to be met. We do not anticipate any negative consequences of the proposed driveway designs.

3.4 Bicycle Parking

The development will provide one bicycle parking space for each residential unit. Short-term outdoor bicycle racks will also be conveniently located at the main entrance to each building.

3.5 Vehicle Parking

The development is right-sizing its vehicle parking supply by providing 1.25 vehicle parking spaces/unit which is less than the typical City requirement of 1.5 spaces/unit (1.35 spaces/unit for residents and 0.15 spaces/unit for visitors) for multi-family dwellings. Bunt supports the proposed parking supply for the following reasons:

1. The City has a target of reducing the vehicle mode share by 15% over the next 20 years. Right-sizing vehicle parking supply is a cost-efficient strategy to support a shift towards more walking, cycling, and transit.
2. There are a number of amenities nearby including shops, services, and employment opportunities. There is also direct access to bus service on Ryan Road which will allow residents to travel more often without a vehicle.
3. All homes will be rental units which typically always have in a lower parking demand than strata units. The Metro Metro Vancouver Apartment Parking Study found that the parking demand from rental units is 20% lower than strata units. The current Courtenay bylaw does not differentiate between strata and rental tenure.
4. Many municipalities have or intend to update their off-street parking requirements such that they align with municipal objectives to reduce vehicle use and/or such that they reflect actual current parking patterns. This generally results in municipalities lowering their parking requirements. Vehicle parking requirements for other Vancouver Island municipalities include:
 - a) The City of Victoria recently updated its off-street parking requirements to reflect the difference in vehicle ownership between strata and rental units as well as proximity to amenities. Rental units have a resident parking requirement of 0.5 to 1.3 spaces/unit based on location and unit size. The minimum visitor parking requirement is 0.1 spaces/unit for all scenarios.

- b) The City of Nanaimo recently updated its off-street parking requirements based on the proximity to amenities but did not stratify between strata and rental units. In a similar land use context to 801 Ryan Road, residential buildings have a parking requirement of 0.90 to 1.68 spaces/unit (inclusive of visitor parking) depending on the number of bedrooms.
 - c) The Town of Comox requires 1.0 residential space/unit and 0.25 visitor spaces/unit outside of downtown. This total parking requirement of 1.25 spaces/unit equals the proposed supply, however, the mix of resident versus visitor spaces is different.
5. The developer provided Bunt with the number of parking spaces rented by tenants in its existing rental buildings. The four buildings on Vancouver Island (Comox, Campbell River, Nanaimo, and North Cowichan) have an average parking space rental rate of 1.0 spaces/unit. Bunt validated this data by reviewing the parking demand late one evening. In addition, five buildings in Interior BC owned by the developer have an average rate of 1.1 spaces/unit. Therefore, the proposed building with a similar tenant mix is anticipated to have a similar parking demand from residents of approximately 1.0 spaces/unit.
 6. The supply of 0.12 visitor spaces/unit is higher than the anticipated demand. Bunt typically recommends between 0.05 and 0.10 visitor spaces/unit for locations across BC depending on the local context. This recommendation stems from the Metro Vancouver Residential Apartment Parking Study² which found that visitor parking demand never exceeded 0.06 vehicles per dwelling unit during the study period. These rates have been further substantiated by previous Bunt studies on Vancouver Island and in Greater Vancouver.

There are multiple reasons to support a parking supply of 1.25 spaces/unit from which 1.13 spaces/unit should be reserved for residents and 0.12 spaces/unit should be reserved for visitors. Many municipalities have or intend to update their vehicle parking requirements to either align them with their strategic plans to reduce the vehicle mode share and/or to reflect current parking patterns.

The the supply of 1.13 residential spaces/unit is not anticipated to cause any negative impacts since it is 13% above the developer's average parking space usage rate from similar buildings. The development is seeking a minor reduction in visitor parking of eight spaces from 0.15 spaces/unit to 0.12. This supply is still anticipated to accommodate peak visitor parking demands which rarely ever exceed 0.10 vehicles/unit.

² The visitor parking demand results from the Metro Vancouver Residential Parking Study was obtained from suburban sites in Burnaby, Port Coquitlam and Richmond which had varying levels of transit service. The visitor parking demand was not correlated with proximity to the Frequent Transit Network; in fact the site with the worst transit service had the lowest peak visitor parking demand of 0.02 visitor vehicles per dwelling. Therefore the results from the Metro Vancouver Residential Parking Study are seen as applicable to the proposed development.

3.6 Safety Impacts

The development is not changing any public roadways. Thus, any safety impacts that the development could cause would be the result of modest increases in vehicle traffic (discussed further in Section 4). Research has found that increasing vehicle traffic on arterials (such as Ryan Road and Highway 19A)³ decreases the crash rate (the number of crashes per vehicle). Therefore, the proposed development is not anticipated to have substantial safety impacts on the adjacent roadways.

³ The Relationship between Congestion Levels and Accidents, *Maryland State Highway Administration*, 2003

- Sidewalks and Crosswalks
- Vehicle Access Routes

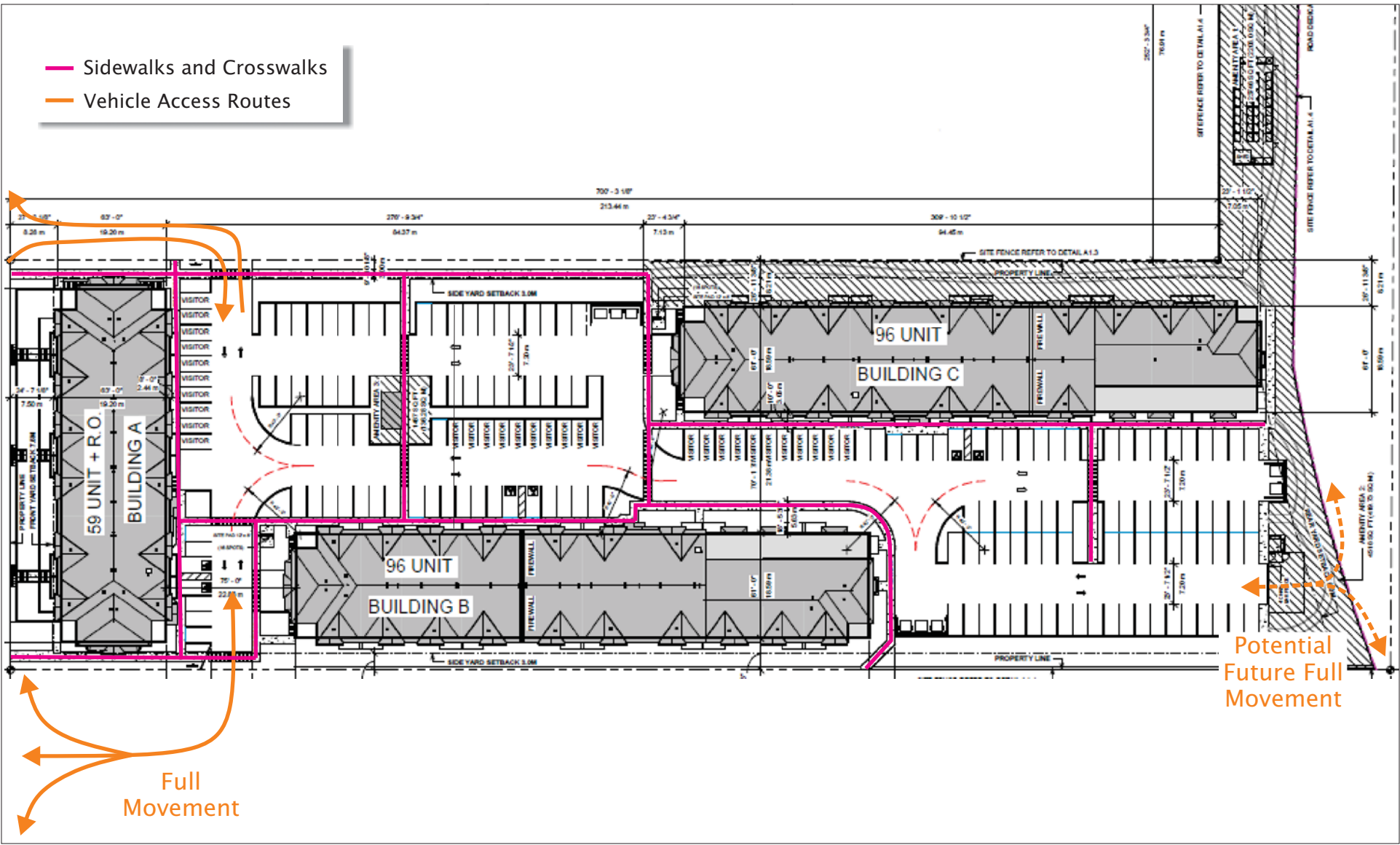


Exhibit 3.1 Site Access

801 Ryan Road T1A
July 2020

04-20-0120



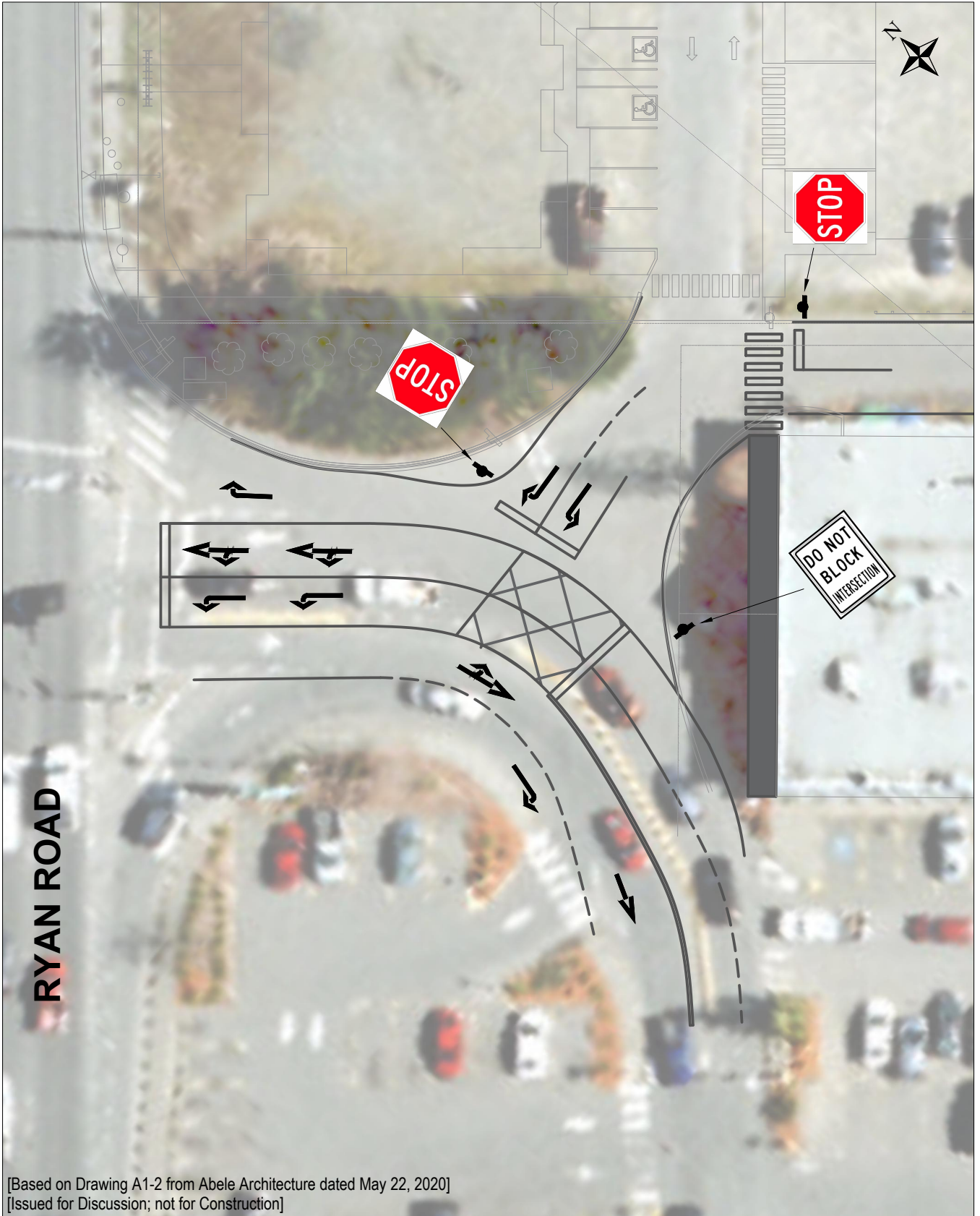


Exhibit 3.2 Internal Intersection Conceptual Design

4. FUTURE VEHICLE CONDITIONS

4.1 Vehicle Forecasts

4.1.1 Background Vehicle Forecasts

Background traffic is traffic that would be present on the road network if the Residential Development did not get built. Background traffic was estimated for the 2022 and 2032 horizon years which represent the target 'opening day' and 'opening day + 10 years'. **Exhibits 4.1 and 4.2** illustrate the background vehicle forecasts.

Background traffic was estimated by increasing existing vehicle volumes by 2% annually. This is a conservative (high) assumption since the critical intersection (Ryan Road & Highway 19A) is nearing capacity during peak hours and that the City's Transportation Master Plan sets a target of reducing the vehicle mode share from 85% to 70% over the next 20 years. The background vehicle forecasts also account for the nearby planned 118-unit residential development at 1025 Ryan Road. The vehicle trip assumptions for 1025 Ryan Road are similar to the assumptions for 801 Ryan Road which are described in Section 4.1.2.

4.1.2 Site Vehicle Trips

Trip Generation

The vehicle trip generation for the Residential Development was forecasted using the average vehicle trip rate for mid-rise residential buildings from the Institute of Transportation Engineers (ITE), 10th Edition. **Table 4.1** demonstrates the ITE trip rate and resulting vehicle trip generation for 251 residential units. The assumed trip rate results in 90 vehicle trips during the AM peak hour (1.5 vehicles per minute) and 110 vehicle trips during the PM peak hour (less than 2 vehicles per minute).

Table 4.1: Peak Hour Vehicle Trip Generation

LAND USE	UNITS	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		TOTAL	IN	OUT	TOTAL	IN	OUT
Trip Rate	Vehicles / Dwelling Units	0.36	26%	74%	0.44	61%	39%
Trip Generation	Vehicles	90	23	67	110	67	43

1: ITE Trip Generation Manual 10th Edition; Multifamily Housing, Mid-rise (221), General Urban/Suburban Location

Trip Distribution & Assignment

Table 4.2 summarizes the assumed trip distribution which was estimated by analyzing existing vehicle travel patterns through the study area.

Table 4.2: Assumed Trip Distribution

ORIGIN/DESTINATION	AM PEAK HOUR	PM PEAK HOUR
Ryan Road East	30%	25%
Old Island Highway (North and South)	20%	25%
Highway 19A North	15%	15%
Highway 19A South	30%	30%
Back Road North	5%	5%
TOTAL	100%	100%

Exhibit 4.3 illustrates the assumed vehicle trip generation assigned to the street network. It was assumed that a minority of drivers destined for 801 Ryan Road and more so for 1025 Ryan Road may choose to travel through the private lands west of Hunt Road through the casino as a more direct route if they are coming from the east.

Table 4.3 summarizes the increase in vehicle volume caused by the proposed development. As shown, the increases are in the range of 1 - 3% with the highest increase anticipated at Ryan Road & Sandwick Road intersection as the main access for the site.

Table 4.3: 2032 Net Change in Future Intersection Vehicle Volumes with New Site Trips

INTERSECTION	AM PEAK HOUR VOLUMES			PM PEAK HOUR VOLUMES		
	BACK-GROUND	SITE	% CHANGE	BACK-GROUND	SITE	% CHANGE
Ryan Road & Highway 19A	3,155	59	1%	4,204	77	2%
Ryan Road & Sandwick Road	2,721	65	2%	3,510	92	3%
Ryan Road & Back Road	2,711	32	1%	3,246	33	1%

4.1.3 Total Vehicle Forecasts

Exhibits 4.4 and 4.5 illustrate the total vehicle forecasts which are the sum of the background and site vehicle trip forecasts.

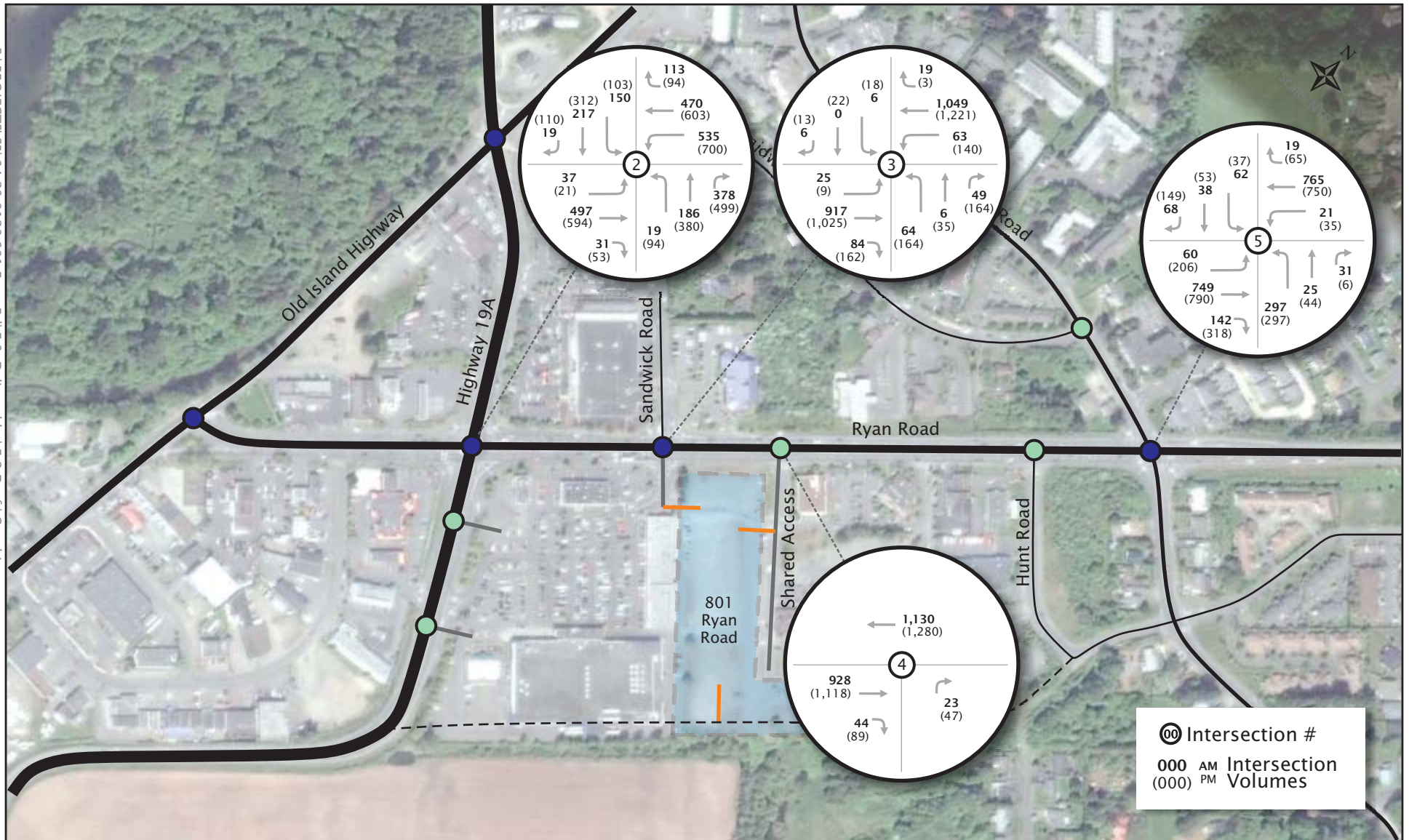


Exhibit 4.1
 2022 Background Vehicle Forecasts

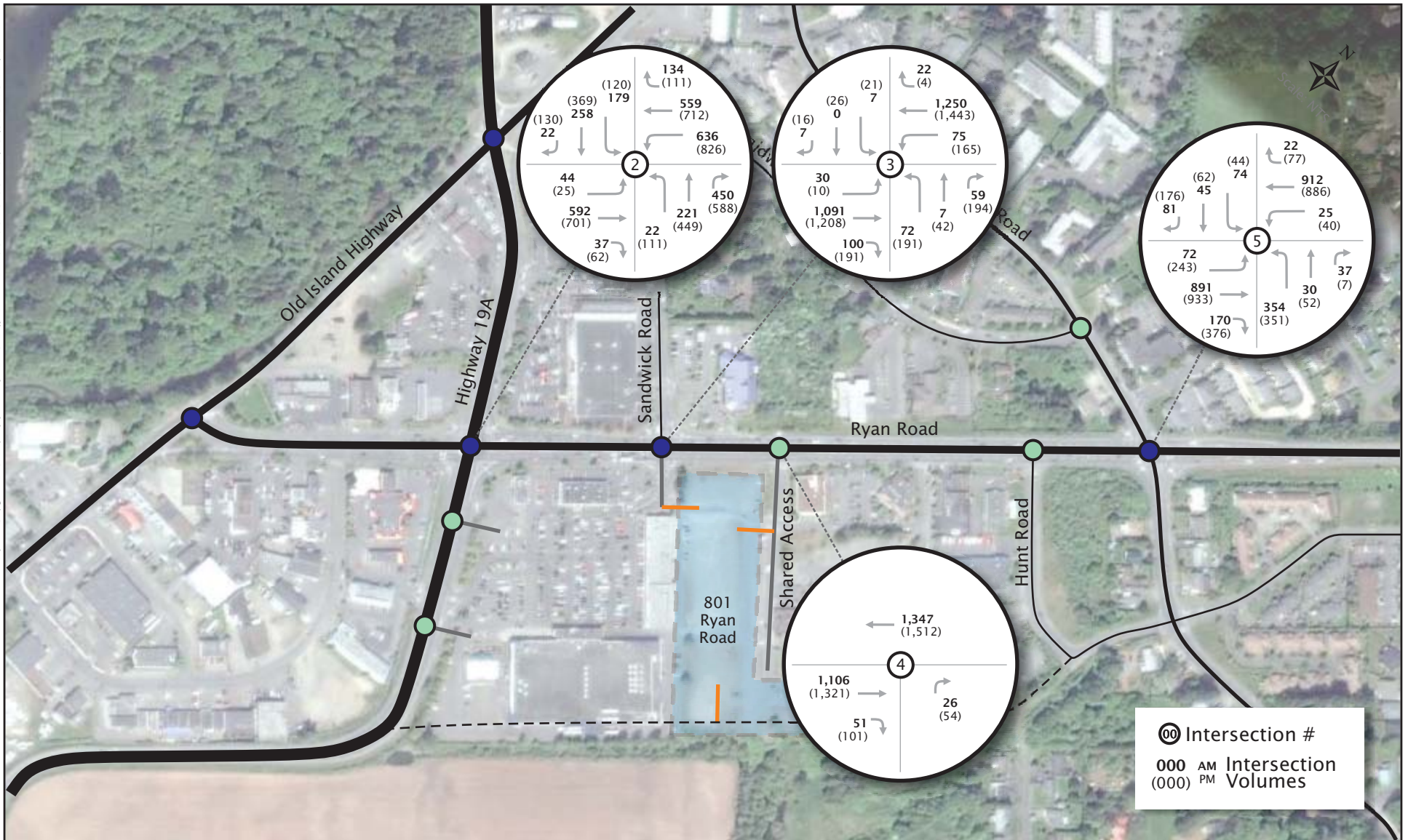


Exhibit 4.2 2032 Background Vehicle Forecasts

801 Ryan Road TIA
June 2020

04-20-0120



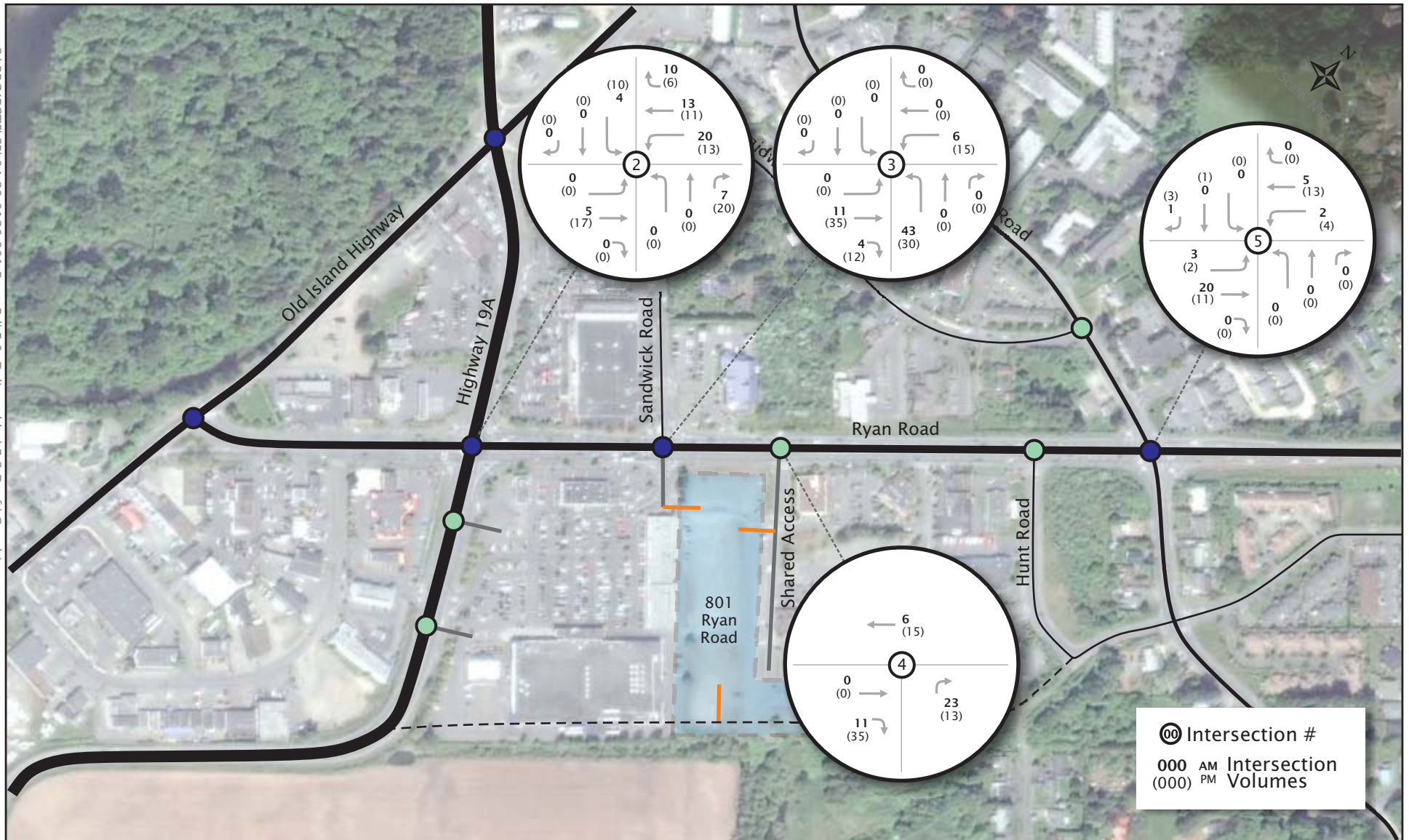


Exhibit 4.3 Site Vehicle Forecasts

801 Ryan Road TIA
June 2020

04-20-0120



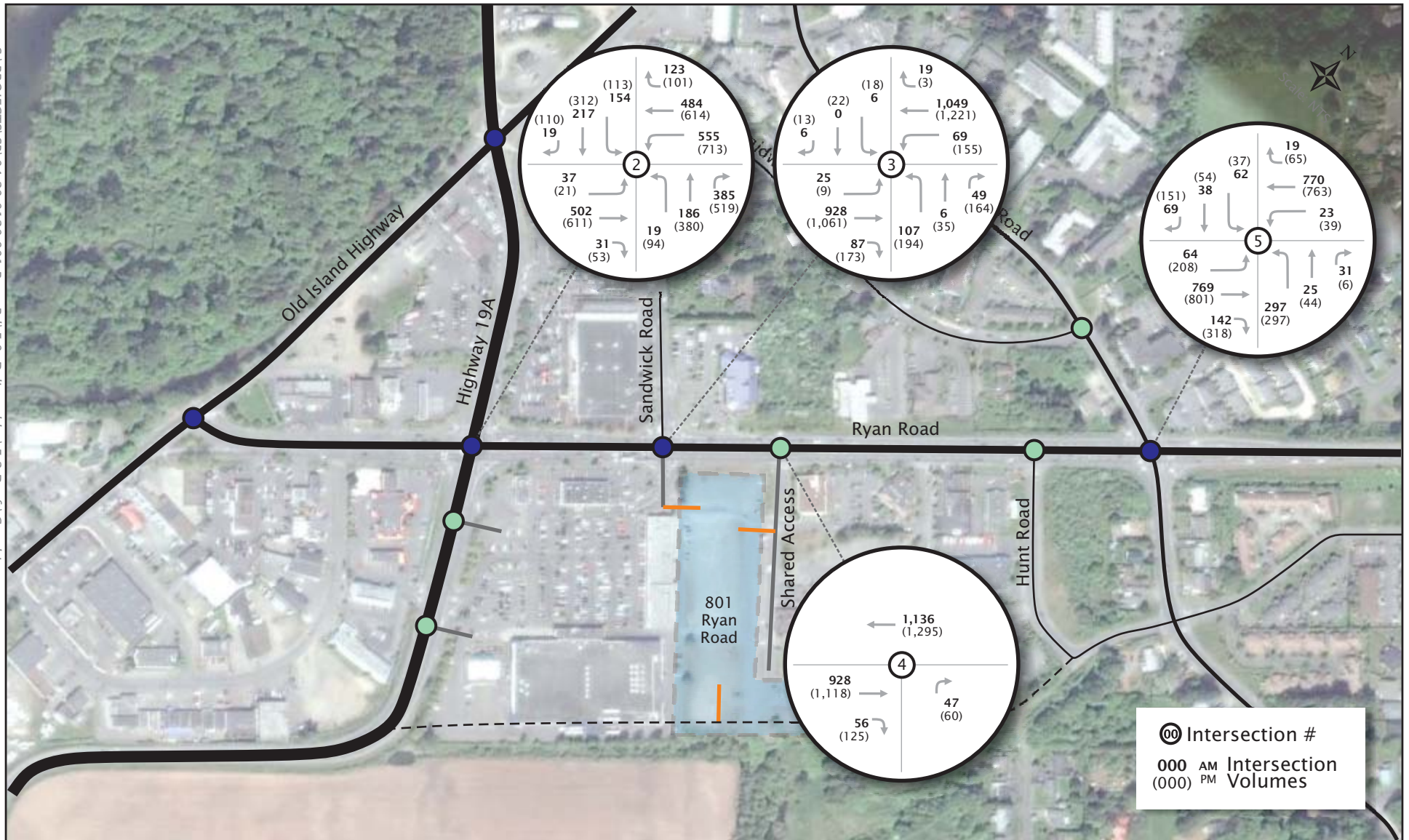


Exhibit 4.4 2022 Total Vehicle Forecasts

801 Ryan Road TIA
June 2020

04-20-0120



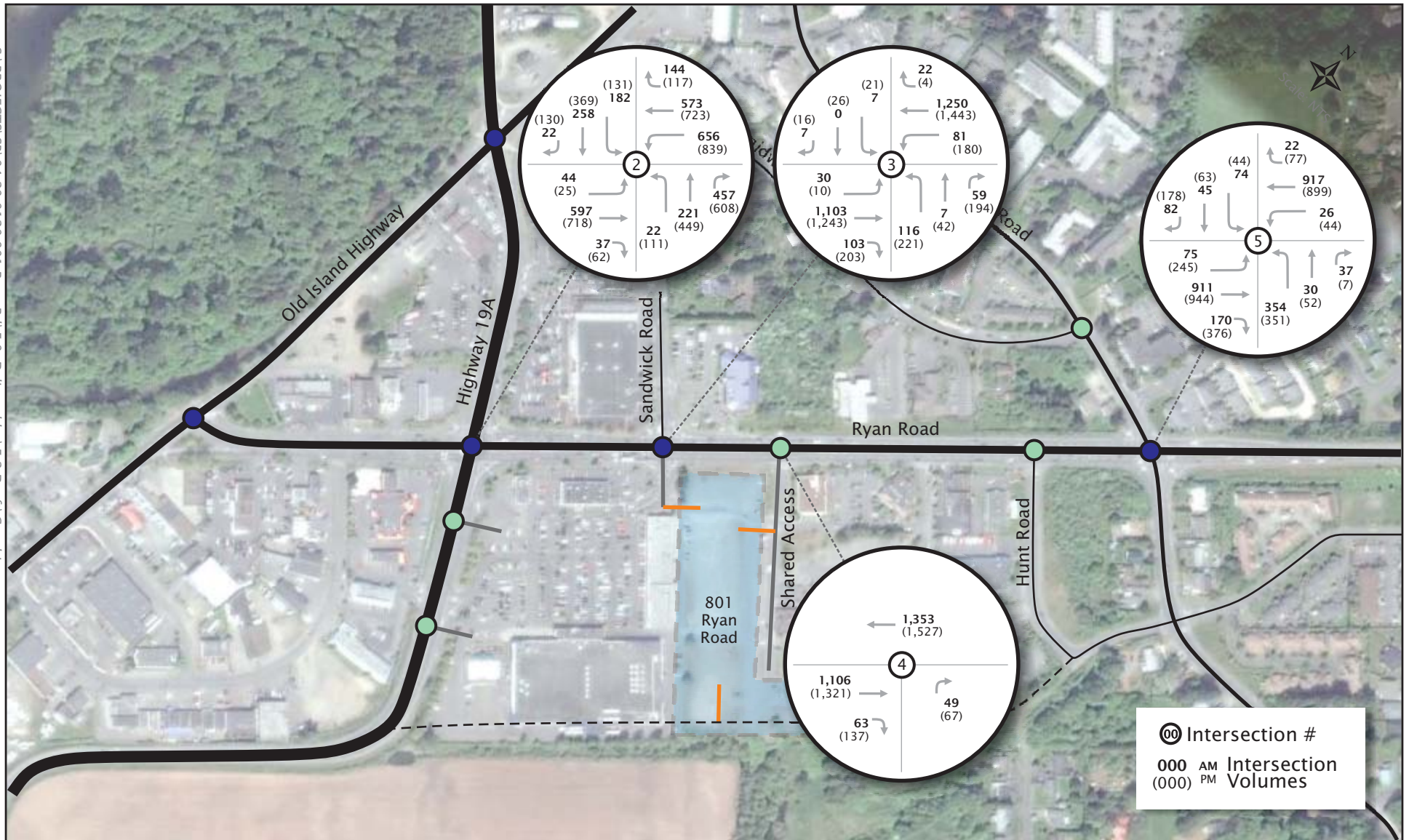


Exhibit 4.5 2032 Total Vehicle Forecasts

801 Ryan Road TIA
June 2020

04-20-0120



4.2 Future Vehicle Operations

4.2.1 Future Conditions Analysis Assumptions

For the future conditions analysis, the cycle length, split length and intersection offset was optimized for each signalized intersection to adapt to the traffic growth overtime. As with the existing conditions analysis, a heavy vehicle percentage of 2% was assumed. Peak hour factors were increased in order to match the increased congestion over time. For the 2022 horizon year, it was assumed that the peak hour factors would increase by 0.01 from the existing conditions. For the 2032 horizon year, it was assumed that the peak hour factors would increase by 0.03 from the existing conditions.

4.2.2 Future Background Vehicle Operations

Tables 4.5 and 4.6 summarize the background vehicle operational analysis results for horizon years 2022 and 2032, respectively. The results are largely similar to the existing conditions. Key findings include:

- The optimized signal timings at the Ryan Road & Highway 19A intersection improve the intersection's operations compared to the existing signal timings;
- The 95th percentile northbound left-turn queue from the shopping centre at 757 Ryan Road onto Ryan Road (at the Sandwick Road intersection) reaches its storage capacity during the PM peak hour. This queue is on private property which can be accommodated within the on-site parking lot; and,
- The northbound left turn from Back Road onto Ryan Road nears its theoretical capacity.

4.2.3 Future Total Vehicle Operations

Tables 4.7 and 4.8 summarize the total vehicle operations which are not noticeably different from the background conditions. The same congested movements exist within both sets of scenarios and the development does not significantly worsen any movements.

The critical vehicle movements for the background and total scenarios which only occur during the PM peak hour include:

- The eastbound through and westbound through/left-turn movements on Ryan Road at Highway 19A with v/c ratio nearing or at 1.0;
- The 95th percentile northbound left-turn queue from the shopping centre at 757 Ryan Road onto Ryan Road (at the Sandwick Road intersection) reaching its storage capacity during the PM peak hour; and,
- The northbound left turn from Back Road onto Ryan Road with v/c ratio nearing its theoretical capacity.

Table 4.5: 2022 Background Vehicle Operations

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Highway 19A <i>Signalized</i>	OVERALL	D	0.56	-	D	0.74	-
	EBL	E	0.25	20	E	0.27	10
	EBT	D	0.66	90	E	0.90	100
	WBL	E	0.82	90	D	0.90	100
	WBT	D	0.58	80	D	0.83	90
	WBR	D	0.07	0	C	0.06	0
	NBL	D	0.09	10	D	0.51	35
	NBT	D	0.27	35	D	0.55	50
	NBR	D	0.23	30	D	0.31	30
	SBL	C	0.37	45	C	0.41	30
	SBT	C	0.19	30	C	0.36	45
Ryan Road & Sandwick Road <i>Signalized</i>	OVERALL	D	0.42	-	B	0.60	-
	EBL	A	0.07	5	B	0.04	0
	EBT/R	A	0.41	95	B	0.57	145
	WBL	A	0.17	10	B	0.46	20
	WBT	A	0.42	95	B	0.51	125
	WBR	A	0.01	0	A	0.00	0
	NBL	E	0.37	30	E	0.67	65
	NBT	D	0.02	5	D	0.10	20
	NBR	D	0.03	0	D	0.11	20
	SBL	E	0.15	5	E	0.28	15
	SBT/R	E	0.0	0	E	0.28	20
Ryan Road & Shared Access <i>Minor-leg Stop</i>	OVERALL	A	-	-	A	-	-
	EBT/R	A	0.39	0	A	0.47	0
	WBT	A	0.36	0	A	0.40	0
	NBR	B	0.03	0	A	0.06	0
Ryan Road & Back Road <i>Signalized</i>	OVERALL	B	0.79	-	C	0.93	-
	EBL	B	0.23	10	B	0.68	40
	EBT/R	B	0.52	60	B	0.61	75
	WBL	B	0.12	10	B	0.24	10
	WBT/R	C	0.70	70	C	0.72	45
	NBL	C	0.73	55	E	0.97	70
	NBT/R	B	0.06	10	B	0.08	10
	SBL	C	0.30	20	C	0.18	10
SBT/R	C	0.19	15	C	0.29	20	

Table 4.6: 2032 Background Vehicle Operations

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Highway 19A <i>Signalized</i>	OVERALL	D	0.66	-	E	0.82	-
	EBL	E	0.29	25	E	0.26	15
	EBT	E	0.82	110	E	1.00	130
	WBL	E	0.89	110	E	0.98	135
	WBT	E	0.72	95	E	0.93	115
	WBR	D	0.08	10	D	0.07	0
	NBL	D	0.11	15	D	0.63	45
	NBT	D	0.33	40	D	0.63	65
	NBR	D	0.27	30	D	0.35	30
	SBL	C	0.44	55	C	0.55	35
	SBT	C	0.23	40	C	0.44	60
Ryan Road & Sandwick Road <i>Signalized</i>	OVERALL	B	0.49	-	C	0.71	-
	EBL	A	0.11	5	B	0.06	0
	EBT/R	B	0.50	120	C	0.68	195
	WBL	A	0.23	10	C	0.60	40
	WBT	A	0.50	120	B	0.61	160
	WBR	A	0.01	0	A	0.00	0
	NBL	E	0.36	30	E	0.73	70
	NBT	D	0.02	5	D	0.11	20
	NBR	D	0.04	0	D	0.12	20
	SBL	E	0.17	10	E	0.32	15
	SBT/R	E	0.00	0	E	0.31	20
Ryan Road & Shared Access <i>Minor-leg Stop</i>	OVERALL	A	-	-	A	-	-
	EBT/R	A	0.46	0	A	0.55	0
	WBT	A	0.42	0	A	0.47	0
	NBR	B	0.04	0	A	0.07	0
Ryan Road & Back Road <i>Signalized</i>	OVERALL	C	0.92	-	C	1.00	-
	EBL	B	0.27	10	C	0.81	65
	EBT/R	B	0.61	75	B	0.72	120
	WBL	B	0.16	10	C	0.41	20
	WBT/R	C	0.83	100	C	0.82	120
	NBL	D	0.85	70	E	1.00	90
	NBT/R	B	0.07	10	B	0.08	10
	SBL	C	0.34	20	C	0.21	15
SBT/R	C	0.21	20	C	0.44	35	

Table 4.7: 2022 Total Vehicle Operations

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Highway 19A <i>Signalized</i>	OVERALL	D	0.57	-	D	0.75	-
	EBL	E	0.25	20	E	0.27	10
	EBT	D	0.67	90	E	0.92	105
	WBL	E	0.84	95	E	0.91	105
	WBT	D	0.61	80	D	0.85	95
	WBR	D	0.08	5	C	0.06	0
	NBL	D	0.09	10	D	0.51	35
	NBT	D	0.27	35	D	0.55	50
	NBR	D	0.24	30	D	0.32	30
	SBL	C	0.38	50	C	0.45	30
	SBT	C	0.19	35	C	0.36	45
Ryan Road & Sandwick Road <i>Signalized</i>	OVERALL	B	0.45	-	C	0.66	-
	EBL	A	0.08	5	B	0.04	0
	EBT/R	B	0.44	105	B	0.61	160
	WBL	A	0.20	10	B	0.51	20
	WBT	A	0.44	100	B	0.52	125
	WBR	A	0.01	0	A	0.00	0
	NBL	D	0.47	45	E	0.78	80
	NBT	D	0.02	5	D	0.10	20
	NBR	D	0.03	0	D	0.11	20
	SBL	E	0.15	5	E	0.28	15
	SBT/R	E	0.00	0	E	0.28	20
Ryan Road & Shared Access <i>Minor-leg Stop</i>	OVERALL	A	-	-	A	-	-
	EBT/R	A	0.39	0	A	0.47	0
	WBT	A	0.36	0	A	0.41	0
	NBR	B	0.07	0	A	0.08	0
Ryan Road & Back Road <i>Signalized</i>	OVERALL	B	0.80	-	C	0.94	-
	EBL	B	0.24	10	C	0.69	45
	EBT/R	B	0.53	60	B	0.63	80
	WBL	B	0.13	10	B	0.27	15
	WBT/R	C	0.71	70	C	0.74	80
	NBL	C	0.73	55	E	0.98	70
	NBT/R	B	0.06	10	B	0.08	10
	SBL	C	0.30	20	C	0.18	10
SBT/R	C	0.19	20	C	0.53	20	

Table 4.8: 2032 Total Vehicle Operations

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Highway 19A <i>Signalized</i>	OVERALL	E	0.67	-	E	0.85	-
	EBL	E	0.29	25	E	0.26	15
	EBT	E	0.83	115	F	1.03	135
	WBL	E	0.91	115	E	1.00	140
	WBT	E	0.75	95	E	0.95	120
	WBR	D	0.09	10	D	0.07	0
	NBL	D	0.11	15	D	0.63	45
	NBT	D	0.33	40	D	0.63	65
	NBR	D	0.28	30	D	0.39	35
	SBL	C	0.45	55	D	0.60	35
	SBT	C	0.23	40	C	0.44	60
Ryan Road & Sandwick Road <i>Signalized</i>	OVERALL	E	0.52	-	C	0.76	-
	EBL	E	0.29	5	B	0.06	0
	EBT/R	E	0.83	135	C	0.72	210
	WBL	E	0.91	10	C	0.65	45
	WBT	E	0.75	130	B	0.61	160
	WBR	D	0.09	0	A	0.00	0
	NBL	D	0.11	45	E	0.84	90
	NBT	D	0.33	5	D	0.11	20
	NBR	D	0.28	3	D	0.13	20
	SBL	C	0.45	5	E	0.32	15
	SBT/R	C	0.23	0	E	0.31	20
Ryan Road & Shared Access <i>Minor-leg Stop</i>	OVERALL	A	-	-	A	-	-
	EBT/R	A	0.46	0	A	0.55	0
	WBT	A	0.42	0	A	0.47	0
	NBR	A	0.07	0	B	0.09	0
Ryan Road & Back Road <i>Signalized</i>	OVERALL	C	0.93	-	C	1.01	-
	EBL	B	0.28	15	C	0.82	70
	EBT/R	B	0.63	80	B	0.73	120
	WBL	B	0.17	10	C	0.46	20
	WBT/R	C	0.83	100	C	0.83	120
	NBL	D	0.85	70	E	1.01	90
	NBT/R	B	0.07	10	B	0.08	12
	SBL	C	0.34	20	C	0.20	15
SBT/R	C	0.21	20	C	0.45	35	

4.2.1 Right-Turn Lane Warrant

The City requested that Bunt conduct an auxiliary (also called continuous) right-turn lane warrant for the eastbound direction on Ryan Road. Ryan Road currently has three private accesses between Sandwich Road and Hunt Road which covers a 300-metre distance, equating to an average access spacing of 100 metres.

The Transportation Association of Canada Design Guide for Canadian Roads does not provide specific guidance regarding when auxiliary right-turn lanes should be provided, however, a variety of positive and negative impacts are noted. NCHRP notes a range of requirements for an intersection right-turn lane based on State Transportation Departments. The requirements range from 5 right-turning vehicles per hour to 120 vehicles per hour. The 2032 total vehicle forecast for the PM peak hour results in 80 vehicles turning right into the shared access.

Bunt does not recommend a right-turn auxiliary lane on Ryan Road as it does not appear to produce any significant benefits, i.e. considerable operation performance, in exchange for the space it would occupy. In addition, the City's Transportation Master Plan does not mention widening Ryan Road.

4.2.2 Tunner Drive Extension

The Tunner Drive Extension from Back Road to Highway 19A will likely have a positive transportation impact as it will alleviate traffic travelling on Ryan Road; however, its exact impact is out of the scope of this study as it is dependent on its future intersection configuration with Highway 19A (not known at this time) as well as the redevelopment plans for the private properties needed to make space for it (such as the neighbouring shopping centre at 757 Ryan Road).

The Tunner Drive Extension will provide additional east-west travel opportunities within the local network, which is much needed as multiple properties do not border a public street. Many properties (such as 801 Ryan Road) do not and will not have direct access to a public street. The City's Transportation Master Plan also notes a desire to limit private access points on Ryan Road to right-turns only. Thus, additional public streets south of Ryan Road will provide more travel opportunities and connections to make left-turns into and out of the neighbourhood without relying upon private shared access agreements. In addition, it will provide a new east-west active transportation connection important to the City's long-term bicycle network.

4.2.1 Ryan Road & Sandwich Road Improvements

Laning and Phasing

The proposed development at 801 Ryan Road is not anticipated to create any new congested vehicle movements or significantly worsen any existing movements. However, to improve the connection between the site and the neighbouring shopping centre at 757 Ryan Road, the development is proposing to convert the northbound through lane to a left/through lane at the Ryan Road & Sandwich Road intersection for additional left turn capacity. To accommodate this, the northbound and southbound movements would have to occur sequentially (i.e. split phasing). **Figure 4.1** illustrates the existing and proposed laning.

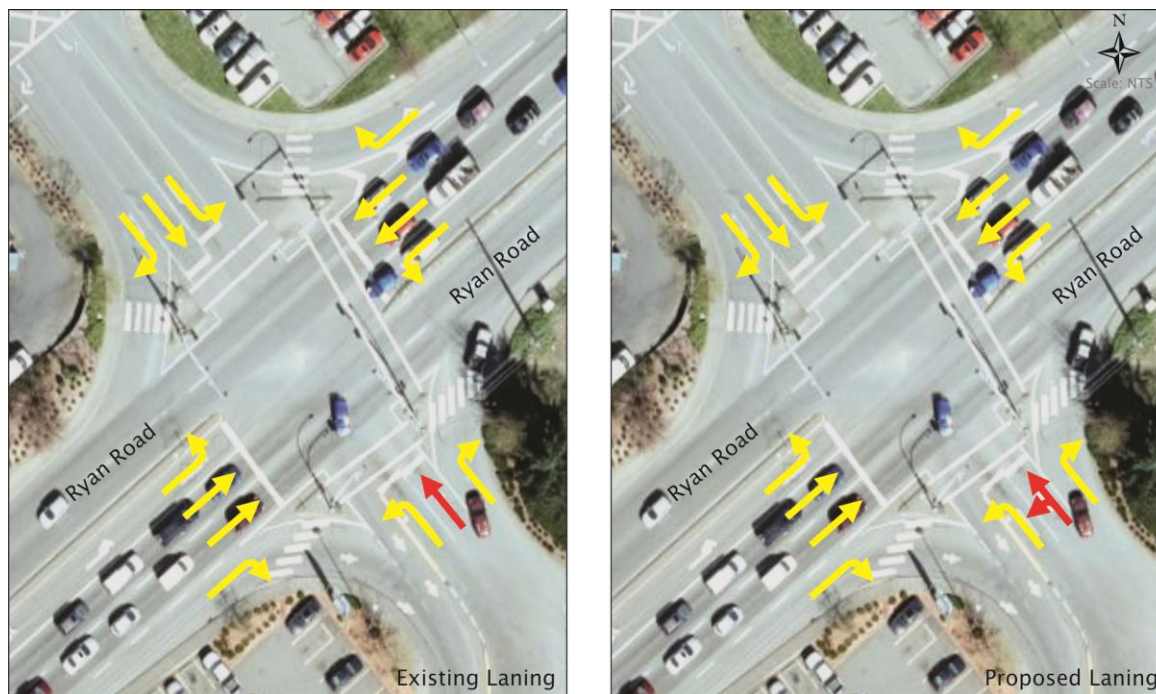


Figure 4.1: Existing and Proposed Laning

The existing signal timing plan provides a protected northbound left-turn phase followed by concurrent permissive phases for the northbound left/through and southbound left/through movements. In order to accommodate the additional left turn lane, split phasing is recommended on the north-south approaches: a protected northbound left/through phase followed by a protected southbound left/through phase. No changes to these east-west movements are recommended with the existing signal continuing to provide protected/permissive phasing for the eastbound left-turn movements.

Vehicle Operations

Table 4.9 summarizes the vehicle operations for the 2022 total vehicle PM peak hour scenario. The proposed improvement would change the 95th percentile northbound left queue from 80 to 60 metres – a 25% decrease.

Table 4.9: 2022 Total Vehicle Operations – Weekday PM Peak Hour

INTERSECTION/ TRAFFIC CONTROL	MOVEMENT	EXISTING LANING			PROPOSED LANING / TIMINGS		
		LOS	v/c	95th Q (m)	LOS	v/c	95th Q (m)
Ryan Road & Sandwick Road Signalized	OVERALL	C	0.66	-	C	-	
	EBL	B	0.04	0	B	0.04	0
	EBT/R	B	0.61	160	B	0.62	160
	WBL	B	0.51	20	B	0.51	30
	WBT	B	0.52	125	B	0.52	130
	WBR	A	0.00	0	A	0.00	0
	NBL	E	0.78	80	E	0.60	60
	NBT	D	0.10	20			
	NBR	D	0.11	20	D	0.11	20
	SBL	E	0.28	15	E	0.32	15
	SBT/R	E	0.28	20	E	0.30	20

Design Modifications

Subject to MoTI approval, the development is committed to implementing the following modifications to allow the proposed signal phasing:

1. Repaint the arrow marking on the south leg approach from a through arrow to a through/left arrow;
2. Add turn-lane signs for the northbound lanes to indicate lane designation;
3. Replace the two existing signal heads for the southbound approach (from Sandwick Road) to accommodate the protected southbound left-turn movement (details to be confirmed with the electrical consultant).
4. Erect signage on the shopping centre's property to ensure drivers use the appropriate lane to complete the northbound left-turn out of the site. Wayfinding should indicate that:
 - a. Drivers wishing to turn westbound left from Ryan Road to Highway 19A should use the left exit lane.
 - b. Drivers wanting to either turn right onto Highway 19A or continue on Ryan Road across Highway 19A should use the shared left/through exit lane.

These modifications are in addition to the proposed geometric design changes described in Section 3.2 to increase the amount of vehicle queuing capacity.

5. SUMMARY & RECOMMENDATIONS

5.1 Summary

1. The proposed development includes 251 rental residential units and no new access onto public streets is proposed. Access to the site will rely on neighbouring property accesses through shared agreement.
2. The development plan includes a series of internal sidewalks to connect the three buildings to Ryan Road, adjacent properties, and potentially to the future Tunner Drive extension for which the development is providing a right-of-way.
3. The development is working with the adjacent shopping centre (757 Ryan Road) to improve the private approach to the Ryan Road & Sandwick Road signalized intersection and increase on-site storage capacity for their heavy northbound left turn movement.
4. Bicycle parking will be provided at a rate of one secure bicycle parking space per unit. Short-term bicycle racks will also be provided outside each of the three buildings.
5. On-site vehicle parking will be provided at a rate of 1.25 vehicle parking spaces per unit (1.13 spaces/unit for residents and 0.12 spaces/unit for visitors) as opposed to the bylaw rate of 1.5 vehicles per unit. Bunt considers this rate to be appropriate for the proposed rental tenure and local context and is above the typical parking demand at the developer's existing rental buildings on Vancouver Island.
6. The development is anticipated to generate approximately 100 vehicle trips per peak hour which is forecasted to increase the volume of vehicles using nearby intersections by 3% or less. The development's vehicle trip generation is not anticipated to cause any noticeable impacts to intersection operations or safety.
7. The eastbound through, westbound through, and left turn movements at the Ryan Road & Highway 19A intersection will not meet the City's performance thresholds in the future background traffic conditions without the proposed development. They will operate slightly worse with the proposed development in place.
8. The development includes a right-of-way for the future Tunner Drive extension which is anticipated to have a positive impact on local circulation for all transport modes as it will provide a parallel route to Ryan Road and include a multi-use pathway.

5.2 Recommendations

9. Bunt recommends Seymour Pacific Developments work with MoTI to update the laning on the south side of Ryan Road & Sandwick Road intersection and update the signal timings to improve vehicle flow out of the shopping centre at 757 Ryan Road.
10. Updates on the signal timing plans should be done on a regular basis to improve vehicle operations (with or without the proposed development) to keep abreast of the traffic changes.
11. No off-site transportation infrastructure is required to accommodate the proposed development.

APPENDIX A

Terms of Reference

MEMO

DATE: May 22, 2020
PROJECT NO: 04-20-0120
PROJECT: **801 Ryan Road Residential Development**
SUBJECT: **Transportation Impact Study: Final Terms of Reference**

TO: Brendan Kelly, Ministry of Transportation and Infrastructure
Rich Feucht, City of Courtenay

PREPARED BY: Simon Button, P.Eng.

1. INTRODUCTION

This letter forms the Terms of Reference for a Transportation Impact Study for the proposed development at 801 Ryan Road in Courtenay, BC. The details of the existing site and the proposed development are presented, followed by the study terms for approval by both road authorities.

2. BACKGROUND

The proposed development is currently vacant and does not have any direct access to Ryan Road (or other public streets). The proposed development is currently planned to include 251 rental residential units across three buildings. Vehicle access will remain via shared access agreements with neighbouring property owners.

The attached site plan illustrates the additional details including the site's proximity to the Ryan Road & Sandwick Road intersection, immediately southwest of the development site. The site plan also illustrates the land dedication requested by the City for the future construction of Tunner Road which could potentially extend to Highway 19A.

3. STUDY SCOPE

3.1 Existing Conditions

1. Study intersections:
 - a. Ryan Road and Highway 19A
 - b. Ryan Road and Sandwick Road
 - i. Access easement to be verified

- c. Ryan Road and the site access to the east of the site (proposed shared access)
 - d. Ryan Road and Back Road
2. Present a map of the existing street network including traffic control, transit routes, and active transportation infrastructure.
3. Present traffic volumes and Level of Service, volume to capacity ratio and 95th percentile queues using Synchro 9/SimTraffic software for the weekday morning and afternoon peak hours due to the high amount of nearby commercial land uses which are anticipated to dictate the peak operational conditions.
4. Present traffic data collection details.
 - a. Afternoon traffic data was collected in the fall of 2017.
 - b. Morning traffic data will be collected in May 2020 and adjusted to reflect the COVID-19 pandemic.
5. Select peak hour based on overall highest hour of vehicle traffic.
6. Present existing plans and policies including the City's OCP Road Network Plan
7. Provide a review of relevant publicly available crash history

3.2 Development Details

1. Scale and type of development including size, floor areas, and number of units.
2. Road accesses
3. Trip generation forecasts (using ITE trip generation)
4. Trip assignment based on the most 'probably' travel patterns.
5. Clarify how residents will access the site by foot, bicycle, transit, and vehicle.
6. Impact of development on existing crash locations; identify mitigation as required
7. Site plan review (including walking/cycling/transit connections and site circulation)
8. Review the proposed parking supply (1.25 spaces/unit) for the local context and similar rental buildings.

3.3 Future Conditions

1. Analysis scenarios: development completion and development completion + 10 years
2. Background growth rate: 2%
3. Forecast background and total (with development) traffic volumes
4. Report Level of Service, volume to capacity ratio and 95th percentile queues using Synchro 9/SimTraffic software.
5. Qualitatively consider the impacts of Tunner Drive being extended to Highway 19A with regards to it improving or decreasing vehicle movement to the site and the overall neighbourhood.
6. The objective must be to ensure that no new "problem" movements are created by the development and that "problem" movements that exist are not worsened with the addition of site generated traffic. Supplementary surveys or analyses may be required to assess saturation flows, gap availability and projected queue lengths, etc.

7. Capacity analysis at signalized intersections where V/C ratios for overall intersections operations, through movements or shared through/turning movements increase to 0.85 or above, V/C ratios for exclusive movements increase to 0.90 or above; or queues for an individual movement are projected to exceed available turning lane storage.
8. Include an evaluation and identification of potential safety and/or operations issues associated with the following, as applicable:
 - a. Access conflicts;
 - b. Pedestrians;
 - c. Merging;
 - d. Sight distance; etc.
9. Provide recommendations to improve circulation on private property south of the Sandwich intersection. Provide recommendations regarding whether the T intersection will need to be reconfigured to minimize traffic impact to the Ryan Rd / Sandwich Rd intersection. If this private intersection is intended to be reconfigured in any way – provide confirmation that:
 - a. The adjacent land owner(s) agree to and will facilitate the reconfiguration in favor of 801 Ryan Road’s requirements.
 - b. The changes will not adversely impact the Ryan Rd / Sandwich Rd intersection
10. Provide recommendations related to verify that the new private approaches from the development meet minimum lengths as required in TAC Design Guidelines Section 8.9.10 Clear Throat Lengths. The minimum Clear Throat Lengths would be applicable to both the proposed private access at the Sandwich / Ryan Road intersections as well as the proposed private access to the access road east of the site.
11. Provide recommendations related to providing an auxiliary right turn lane to the eastern road access. Per TAC Design Guidelines Section 8.5.2.1 Warrants – a separate right-turn auxiliary lane may be warranted depending on the roadway’s single lane volume, the volume of right turn vehicles, the posted speed of the road and the history of rear end collisions.

* * * * *

APPENDIX B

Synchro Reports

Queues
2: Ryan Rd & Hwy 19A

Existing 2020 - AM Peak Hour































Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	37	522	522	460	107	19	184	371	147	233
v/c Ratio	0.25	0.65	0.83	0.57	0.22	0.08	0.24	0.58	0.33	0.18
Control Delay	62.9	53.1	59.0	45.9	8.7	46.6	46.8	8.6	33.9	30.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.9	53.1	59.0	45.9	8.7	46.6	46.8	8.6	33.9	30.5
Queue Length 50th (m)	9.3	67.0	69.2	58.9	3.0	4.1	21.5	0.0	27.5	21.8
Queue Length 95th (m)	20.7	87.2	87.6	77.5	15.8	11.5	33.5	27.6	44.1	31.6
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	801	692	805	494	245	769	638	463	1279
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.65	0.75	0.57	0.22	0.08	0.24	0.58	0.32	0.18

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Existing 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 		 	 			 		 	 	
Traffic Volume (vph)	36	476	30	506	446	104	18	178	360	143	208	18
Future Volume (vph)	36	476	30	506	446	104	18	178	360	143	208	18
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3692		3614	3725	1667	1863	3725	1667	1863	3680	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.61	1.00	1.00	0.53	1.00	
Satd. Flow (perm)	1863	3692		3614	3725	1667	1189	3725	1667	1041	3680	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	37	491	31	522	460	107	19	184	371	147	214	19
RTOR Reduction (vph)	0	3	0	0	0	84	0	0	294	0	5	0
Lane Group Flow (vph)	37	519	0	522	460	23	19	184	77	147	228	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	29.3		23.7	29.3	29.3	28.0	28.0	28.0	47.0	47.0	
Effective Green, g (s)	11.0	29.3		23.7	29.3	29.3	28.0	28.0	28.0	47.0	47.0	
Actuated g/C Ratio	0.08	0.22		0.17	0.22	0.22	0.21	0.21	0.21	0.35	0.35	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	797		631	804	359	245	768	343	439	1274	
v/s Ratio Prot	c0.02	c0.14		c0.14	0.12			0.05		c0.03	0.06	
v/s Ratio Perm						0.01	0.02		0.05	c0.08		
v/c Ratio	0.25	0.65		0.83	0.57	0.06	0.08	0.24	0.22	0.33	0.18	
Uniform Delay, d1	58.5	48.5		54.0	47.6	42.3	43.4	45.0	44.8	31.6	30.9	
Progression Factor	1.00	1.00		0.88	0.89	23.78	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.8	4.1		11.3	2.8	0.3	0.1	0.2	0.3	0.5	0.3	
Delay (s)	62.3	52.6		58.9	45.2	1006.4	43.6	45.1	45.1	32.1	31.2	
Level of Service	E	D		E	D	F	D	D	D	C	C	
Approach Delay (s)		53.3			146.2			45.1			31.5	
Approach LOS		D			F			D			C	
Intersection Summary												
HCM 2000 Control Delay			87.2			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			0.54									
Actuated Cycle Length (s)			135.7	Sum of lost time (s)					30.7			
Intersection Capacity Utilization			64.0%	ICU Level of Service			C					
Analysis Period (min)			15									
c Critical Lane Group												

Queues

Existing 2020 - AM Peak Hour

3: Sandwich Rd & Ryan Rd





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	26	1037	64	1096	20	46	7	52	7	7
v/c Ratio	0.06	0.37	0.14	0.37	0.01	0.28	0.03	0.19	0.07	0.02
Control Delay	6.7	10.0	4.3	7.3	0.0	56.0	48.3	1.5	62.5	0.2
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.7	10.3	4.3	7.3	0.0	56.0	48.3	1.5	62.5	0.2
Queue Length 50th (m)	1.1	35.9	2.0	43.9	0.0	11.8	1.8	0.0	1.8	0.0
Queue Length 95th (m)	m3.7	93.0	8.0	85.7	0.0	21.3	5.7	0.0	6.7	0.0
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	451	2818	577	2932	1335	230	628	605	332	524
Starvation Cap Reductn	0	955	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.56	0.11	0.37	0.01	0.20	0.01	0.09	0.02	0.01

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
3: Sandwick Rd & Ryan Rd

Existing 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 					 		
Traffic Volume (vph)	24	874	80	59	1008	18	42	6	48	6	0	6
Future Volume (vph)	24	874	80	59	1008	18	42	6	48	6	0	6
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3679		1863	3725	1667	1863	1961	1667	1863	1667	
Flt Permitted	0.23	1.00		0.24	1.00	1.00	0.48	1.00	1.00	1.00	1.00	
Satd. Flow (perm)	457	3679		472	3725	1667	934	1961	1667	1961	1667	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	26	950	87	64	1096	20	46	7	52	7	0	7
RTOR Reduction (vph)	0	3	0	0	0	5	0	0	46	0	7	0
Lane Group Flow (vph)	26	1034	0	64	1096	15	46	7	6	7	0	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	101.2	97.4		104.6	99.2	99.2	16.6	16.6	16.6	2.9	2.9	
Effective Green, g (s)	101.2	97.4		104.6	99.2	99.2	16.6	16.6	16.6	2.9	2.9	
Actuated g/C Ratio	0.75	0.72		0.77	0.73	0.73	0.12	0.12	0.12	0.02	0.02	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	380	2640		419	2723	1218	170	239	203	41	35	
v/s Ratio Prot	0.00	0.28		c0.01	c0.29		c0.02	0.00			0.00	
v/s Ratio Perm	0.05			0.11		0.01	c0.02		0.00	0.00		
v/c Ratio	0.07	0.39		0.15	0.40	0.01	0.27	0.03	0.03	0.17	0.00	
Uniform Delay, d1	4.9	7.5		4.4	7.0	5.0	53.7	52.5	52.5	65.2	65.0	
Progression Factor	1.62	1.27		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.4		0.2	0.4	0.0	1.2	0.0	0.1	2.0	0.0	
Delay (s)	8.0	9.9		4.5	7.4	5.0	54.8	52.5	52.5	67.2	65.0	
Level of Service	A	A		A	A	A	D	D	D	E	E	
Approach Delay (s)		9.9			7.2			53.5			66.1	
Approach LOS		A			A			D			E	
Intersection Summary												
HCM 2000 Control Delay			10.8			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.39									
Actuated Cycle Length (s)			135.7	Sum of lost time (s)					21.8			
Intersection Capacity Utilization			53.8%	ICU Level of Service			A					
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: Shared Access & Ryan Rd

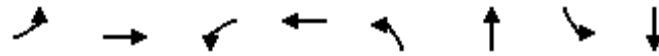
Existing 2020 - AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	892	36	0	1086	0	12
Future Volume (Veh/h)	892	36	0	1086	0	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.85
Hourly flow rate (vph)	970	39	0	1180	0	14
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked				0.89	0.88	0.89
vC, conflicting volume				1009	1580	504
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				763	828	197
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				100	100	98
cM capacity (veh/h)				752	273	722
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	647	362	590	590	14	
Volume Left	0	0	0	0	0	
Volume Right	0	39	0	0	14	
cSH	1700	1700	1700	1700	722	
Volume to Capacity	0.38	0.21	0.35	0.35	0.02	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.4	
Control Delay (s)	0.0	0.0	0.0	0.0	10.1	
Lane LOS						B
Approach Delay (s)	0.0		0.0		10.1	
Approach LOS						B
Intersection Summary						
Average Delay				0.1		
Intersection Capacity Utilization				34.5%	ICU Level of Service	A
Analysis Period (min)				15		

Queues
5: Back Rd & Ryan Rd

Existing 2020 - AM Peak Hour

























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	60	892	19	793	301	57	62	106
v/c Ratio	0.18	0.48	0.09	0.63	0.59	0.08	0.36	0.38
Control Delay	14.2	16.1	24.2	28.9	28.2	11.7	46.5	22.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	16.1	24.2	28.9	28.2	11.7	46.5	22.0
Queue Length 50th (m)	5.4	51.8	2.3	62.2	38.7	2.7	10.3	6.2
Queue Length 95th (m)	12.7	75.4	8.0	91.2	70.7	11.4	24.7	22.6
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	372	2282	271	1611	542	950	336	475
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.39	0.07	0.49	0.56	0.06	0.18	0.22

Intersection Summary

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Existing 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	57	711	137	18	735	18	286	24	30	59	36	65
Future Volume (vph)	57	711	137	18	735	18	286	24	30	59	36	65
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3635		1863	3712		1863	1796		1863	1772	
Flt Permitted	0.18	1.00		0.32	1.00		0.46	1.00		0.72	1.00	
Satd. Flow (perm)	348	3635		626	3712		892	1796		1411	1772	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	60	748	144	19	774	19	301	25	32	62	38	68
RTOR Reduction (vph)	0	13	0	0	1	0	0	20	0	0	60	0
Lane Group Flow (vph)	60	879	0	19	792	0	301	37	0	62	47	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	47.3	47.3		32.1	32.1		35.0	35.0		11.7	11.7	
Effective Green, g (s)	47.3	47.3		32.1	32.1		35.0	35.0		11.7	11.7	
Actuated g/C Ratio	0.51	0.51		0.34	0.34		0.37	0.37		0.12	0.12	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	331	1836		214	1273		513	671		176	221	
v/s Ratio Prot	0.02	c0.24			c0.21		c0.11	0.02			0.03	
v/s Ratio Perm	0.07			0.03			c0.11			0.04		
v/c Ratio	0.18	0.48		0.09	0.62		0.59	0.06		0.35	0.21	
Uniform Delay, d1	13.9	15.1		20.8	25.7		22.1	18.7		37.5	36.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.9		0.4	1.3		2.7	0.1		2.5	1.0	
Delay (s)	14.4	16.0		21.2	27.0		24.8	18.8		40.0	37.8	
Level of Service	B	B		C	C		C	B		D	D	
Approach Delay (s)		15.9			26.9			23.8			38.6	
Approach LOS		B			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			22.7	HCM 2000 Level of Service				C				
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			93.6	Sum of lost time (s)				22.9				
Intersection Capacity Utilization			66.9%	ICU Level of Service				C				
Analysis Period (min)			15									
c Critical Lane Group												

Queues
2: Ryan Rd & Hwy 19A

Background 2020 - AM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	38	539	546	480	115	19	190	386	153	240
v/c Ratio	0.25	0.66	0.82	0.58	0.23	0.09	0.27	0.62	0.37	0.20
Control Delay	63.1	52.8	64.1	51.2	2.2	48.6	49.1	9.4	35.9	32.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.1	52.8	64.1	51.2	2.2	48.6	49.1	9.4	35.9	32.0
Queue Length 50th (m)	9.6	68.8	71.9	60.6	0.0	4.2	22.8	0.0	29.4	23.1
Queue Length 95th (m)	20.9	90.3	89.8	80.4	3.0	11.7	35.1	28.6	46.8	33.3
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	821	745	825	502	223	703	627	440	1225
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.66	0.73	0.58	0.23	0.09	0.27	0.62	0.35	0.20

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Background 2020 - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	497	31	535	470	113	19	186	378	150	217	19
Future Volume (vph)	37	497	31	535	470	113	19	186	378	150	217	19
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3692		3614	3725	1667	1863	3725	1667	1863	3681	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.60	1.00	1.00	0.51	1.00	
Satd. Flow (perm)	1863	3692		3614	3725	1667	1181	3725	1667	1005	3681	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	38	507	32	546	480	115	19	190	386	153	221	19
RTOR Reduction (vph)	0	3	0	0	0	89	0	0	313	0	5	0
Lane Group Flow (vph)	38	536	0	546	480	26	19	190	73	153	235	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	30.1		24.9	30.1	30.1	25.6	25.6	25.6	45.0	45.0	
Effective Green, g (s)	11.0	30.1		24.9	30.1	30.1	25.6	25.6	25.6	45.0	45.0	
Actuated g/C Ratio	0.08	0.22		0.18	0.22	0.22	0.19	0.19	0.19	0.33	0.33	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	818		663	826	369	222	702	314	417	1220	
v/s Ratio Prot	c0.02	c0.15		c0.15	0.13			0.05		c0.04	0.06	
v/s Ratio Perm						0.02	0.02		0.04	c0.09		
v/c Ratio	0.25	0.66		0.82	0.58	0.07	0.09	0.27	0.23	0.37	0.19	
Uniform Delay, d1	58.5	48.1		53.3	47.2	41.7	45.4	47.1	46.7	33.2	32.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.0	4.1		11.1	3.0	0.4	0.2	0.2	0.4	0.5	0.4	
Delay (s)	62.5	52.1		64.4	50.1	42.1	45.6	47.3	47.1	33.7	32.7	
Level of Service	E	D		E	D	D	D	D	D	C	C	
Approach Delay (s)		52.8			56.2			47.1			33.1	
Approach LOS		D			E			D			C	

Intersection Summary

HCM 2000 Control Delay	50.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	135.7	Sum of lost time (s)	30.7
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues

Background 2020 - AM Peak Hour

3: Sandwich Rd & Ryan Rd




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	27	1076	68	1128	20	69	6	53	6	6
v/c Ratio	0.07	0.39	0.16	0.39	0.02	0.38	0.03	0.19	0.06	0.01
Control Delay	4.7	8.9	4.7	7.9	0.0	59.7	48.5	1.5	64.7	0.0
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.7	9.3	4.7	7.9	0.0	59.7	48.5	1.5	64.7	0.0
Queue Length 50th (m)	0.9	46.5	2.4	48.9	0.0	18.3	1.5	0.0	1.6	0.0
Queue Length 95th (m)	4.4	94.4	8.9	93.4	0.0	29.5	5.2	0.2	6.1	0.0
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	431	2792	548	2916	1327	368	787	730	322	579
Starvation Cap Reductn	0	1093	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.63	0.12	0.39	0.02	0.19	0.01	0.07	0.02	0.01

Intersection Summary

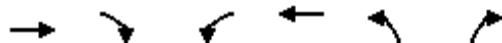
HCM Signalized Intersection Capacity Analysis
3: Sandwich Rd & Ryan Rd

Background 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	25	917	84	63	1049	19	64	6	49	6	0	6
Future Volume (vph)	25	917	84	63	1049	19	64	6	49	6	0	6
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3679		1863	3725	1667	1863	1961	1667	1863	1667	
Flt Permitted	0.22	1.00		0.23	1.00	1.00	0.48	1.00	1.00	1.00	1.00	
Satd. Flow (perm)	439	3679		444	3725	1667	934	1961	1667	1961	1667	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	27	986	90	68	1128	20	69	6	53	6	0	6
RTOR Reduction (vph)	0	2	0	0	0	5	0	0	46	0	6	0
Lane Group Flow (vph)	27	1074	0	68	1128	15	69	6	7	6	0	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	103.5	99.7		107.9	102.0	102.0	18.1	18.1	18.1	2.9	2.9	
Effective Green, g (s)	103.5	99.7		107.9	102.0	102.0	18.1	18.1	18.1	2.9	2.9	
Actuated g/C Ratio	0.74	0.71		0.77	0.73	0.73	0.13	0.13	0.13	0.02	0.02	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	363	2619		401	2713	1214	185	253	215	40	34	
v/s Ratio Prot	0.00	0.29		c0.01	c0.30		c0.03	0.00			0.00	
v/s Ratio Perm	0.05			0.12		0.01	c0.02		0.00	0.00		
v/c Ratio	0.07	0.41		0.17	0.42	0.01	0.37	0.02	0.03	0.15	0.00	
Uniform Delay, d1	5.3	8.2		4.8	7.4	5.2	55.2	53.2	53.3	67.3	67.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.5		0.2	0.5	0.0	1.7	0.0	0.1	1.7	0.0	
Delay (s)	5.4	8.7		5.0	7.9	5.2	56.9	53.3	53.4	69.1	67.2	
Level of Service	A	A		A	A	A	E	D	D	E	E	
Approach Delay (s)		8.6			7.7			55.3			68.1	
Approach LOS		A			A			E			E	
Intersection Summary												
HCM 2000 Control Delay			10.9	HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio			0.42									
Actuated Cycle Length (s)			140.0	Sum of lost time (s)				21.8				
Intersection Capacity Utilization			56.0%	ICU Level of Service				B				
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

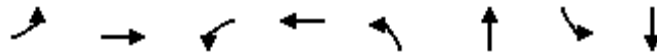
Background 2020 - AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	928	44	0	1130	0	23
Future Volume (Veh/h)	928	44	0	1130	0	23
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	998	47	0	1215	0	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.88	0.88	0.88	
vC, conflicting volume			1045	1629	522	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			783	834	190	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	97	
cM capacity (veh/h)			733	270	723	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	665	380	608	608	25	
Volume Left	0	0	0	0	0	
Volume Right	0	47	0	0	25	
cSH	1700	1700	1700	1700	723	
Volume to Capacity	0.39	0.22	0.36	0.36	0.03	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.8	
Control Delay (s)	0.0	0.0	0.0	0.0	10.2	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		10.2	
Approach LOS					B	
Intersection Summary						
Average Delay			0.1			
Intersection Capacity Utilization			35.7%	ICU Level of Service		A
Analysis Period (min)			15			

Queues
5: Back Rd & Ryan Rd

Background 2020 - AM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	63	928	22	817	309	58	65	111
v/c Ratio	0.23	0.53	0.12	0.70	0.74	0.09	0.30	0.34
Control Delay	12.4	13.6	20.0	25.1	30.2	8.7	29.7	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.4	13.6	20.0	25.1	30.2	8.7	29.7	14.6
Queue Length 50th (m)	4.1	38.8	2.0	47.2	29.9	2.1	7.5	4.5
Queue Length 95th (m)	10.5	59.3	7.2	70.0	#53.6	8.4	17.4	16.5
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	280	1764	188	1160	418	945	442	604
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.53	0.12	0.70	0.74	0.06	0.15	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

5: Back Rd & Ryan Rd

Background 2020 - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	749	142	21	765	19	297	25	31	62	38	68
Future Volume (vph)	60	749	142	21	765	19	297	25	31	62	38	68
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3636		1863	3712		1863	1799		1863	1773	
Flt Permitted	0.15	1.00		0.31	1.00		0.44	1.00		0.72	1.00	
Satd. Flow (perm)	301	3636		604	3712		855	1799		1410	1773	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	62	780	148	22	797	20	309	26	32	65	40	71
RTOR Reduction (vph)	0	17	0	0	2	0	0	21	0	0	60	0
Lane Group Flow (vph)	63	911	0	22	815	0	309	37	0	65	51	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	33.1	33.1		21.5	21.5		24.5	24.5		10.5	10.5	
Effective Green, g (s)	33.1	33.1		21.5	21.5		24.5	24.5		10.5	10.5	
Actuated g/C Ratio	0.48	0.48		0.31	0.31		0.36	0.36		0.15	0.15	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	280	1746		188	1158		421	639		214	270	
v/s Ratio Prot	0.02	c0.25			c0.22		c0.09	0.02			0.03	
v/s Ratio Perm	0.09			0.04			c0.18			0.05		
v/c Ratio	0.23	0.52		0.12	0.70		0.73	0.06		0.30	0.19	
Uniform Delay, d1	11.4	12.4		16.9	20.9		18.0	14.6		26.0	25.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.9	1.1		0.6	2.5		7.9	0.1		1.7	0.7	
Delay (s)	12.3	13.5		17.5	23.4		25.8	14.7		27.6	26.2	
Level of Service	B	B		B	C		C	B		C	C	
Approach Delay (s)		13.5			23.2			24.1			26.7	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	68.9	Sum of lost time (s)	22.9
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Background 2032 - AM Peak Hour

































Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	44	629	636	559	134	22	221	450	179	280
v/c Ratio	0.29	0.82	0.89	0.72	0.28	0.11	0.33	0.67	0.44	0.23
Control Delay	64.2	61.0	68.5	56.6	4.0	49.8	50.7	9.9	37.4	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.2	61.0	68.5	56.6	4.0	49.8	50.7	9.9	37.4	32.6
Queue Length 50th (m)	11.2	84.7	84.3	74.0	0.0	5.0	27.2	0.0	35.0	27.3
Queue Length 95th (m)	23.4	#111.7	#110.9	94.2	8.3	13.2	40.2	31.3	54.1	38.5
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	769	745	773	481	205	674	670	423	1225
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.82	0.85	0.72	0.28	0.11	0.33	0.67	0.42	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Ryan Rd & Hwy 19A

Background 2032 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 		 	 			 		 	 	 
Traffic Volume (vph)	44	592	37	636	559	134	22	221	450	179	258	22
Future Volume (vph)	44	592	37	636	559	134	22	221	450	179	258	22
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3693		3614	3725	1667	1863	3725	1667	1863	3682	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.58	1.00	1.00	0.47	1.00	
Satd. Flow (perm)	1863	3693		3614	3725	1667	1137	3725	1667	921	3682	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	44	592	37	636	559	134	22	221	450	179	258	22
RTOR Reduction (vph)	0	3	0	0	0	106	0	0	368	0	5	0
Lane Group Flow (vph)	44	626	0	636	559	28	22	221	82	179	275	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	28.2		26.8	28.2	28.2	24.6	24.6	24.6	45.0	45.0	
Effective Green, g (s)	11.0	28.2		26.8	28.2	28.2	24.6	24.6	24.6	45.0	45.0	
Actuated g/C Ratio	0.08	0.21		0.20	0.21	0.21	0.18	0.18	0.18	0.33	0.33	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	767		713	774	346	206	675	302	405	1221	
v/s Ratio Prot	c0.02	c0.17		c0.18	0.15			0.06		c0.05	0.07	
v/s Ratio Perm						0.02	0.02		0.05	c0.10		
v/c Ratio	0.29	0.82		0.89	0.72	0.08	0.11	0.33	0.27	0.44	0.23	
Uniform Delay, d1	58.7	51.3		53.0	50.1	43.3	46.4	48.3	47.8	33.8	32.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.8	9.3		15.7	5.8	0.5	0.2	0.3	0.5	0.8	0.4	
Delay (s)	63.5	60.6		68.8	55.9	43.8	46.6	48.6	48.3	34.5	33.2	
Level of Service	E	E		E	E	D	D	D	D	C	C	
Approach Delay (s)		60.8			60.8			48.4			33.7	
Approach LOS		E			E			D			C	
Intersection Summary												
HCM 2000 Control Delay			54.1	HCM 2000 Level of Service				D				
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			135.7	Sum of lost time (s)				30.7				
Intersection Capacity Utilization			71.9%	ICU Level of Service				C				
Analysis Period (min)			15									
c Critical Lane Group												

Queues

3: Sandwich Rd & Ryan Rd




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	32	1253	79	1316	23	76	7	62	7	7
v/c Ratio	0.10	0.48	0.23	0.47	0.02	0.40	0.03	0.21	0.07	0.02
Control Delay	5.2	11.1	5.6	9.2	0.0	59.9	48.0	3.3	64.7	0.1
Queue Delay	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.2	12.1	5.6	9.2	0.0	59.9	48.0	3.3	64.7	0.1
Queue Length 50th (m)	1.1	59.9	2.9	62.8	0.0	20.1	1.8	0.0	1.9	0.0
Queue Length 95th (m)	5.1	121.4	10.3	119.4	0.0	31.8	5.8	2.9	6.9	0.0
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	348	2608	464	2802	1280	369	787	730	322	566
Starvation Cap Reductn	0	995	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.78	0.17	0.47	0.02	0.21	0.01	0.08	0.02	0.01

Intersection Summary

HCM Signalized Intersection Capacity Analysis

3: Sandwick Rd & Ryan Rd

Background 2032 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	30	1091	100	75	1250	22	72	7	59	7	0	7
Future Volume (vph)	30	1091	100	75	1250	22	72	7	59	7	0	7
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3679		1863	3725	1667	1863	1961	1667	1863	1667	
Flt Permitted	0.17	1.00		0.17	1.00	1.00	0.48	1.00	1.00	1.00	1.00	
Satd. Flow (perm)	341	3679		332	3725	1667	934	1961	1667	1961	1667	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	32	1148	105	79	1316	23	76	7	62	7	0	7
RTOR Reduction (vph)	0	3	0	0	0	7	0	0	53	0	7	0
Lane Group Flow (vph)	32	1250	0	79	1316	16	76	7	9	7	0	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	99.8	95.9		107.6	99.9	99.9	20.1	20.1	20.1	2.9	2.9	
Effective Green, g (s)	99.8	95.9		107.6	99.9	99.9	20.1	20.1	20.1	2.9	2.9	
Actuated g/C Ratio	0.71	0.69		0.77	0.71	0.71	0.14	0.14	0.14	0.02	0.02	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	285	2520		339	2658	1189	211	281	239	40	34	
v/s Ratio Prot	0.00	0.34		c0.01	c0.35		c0.03	0.00			0.00	
v/s Ratio Perm	0.08			0.17		0.01	c0.02		0.01	0.00		
v/c Ratio	0.11	0.50		0.23	0.50	0.01	0.36	0.02	0.04	0.17	0.00	
Uniform Delay, d1	6.9	10.5		6.4	8.9	5.8	53.6	51.5	51.6	67.4	67.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.7		0.4	0.7	0.0	1.4	0.0	0.1	2.1	0.0	
Delay (s)	7.0	11.2		6.7	9.5	5.8	55.0	51.6	51.7	69.5	67.2	
Level of Service	A	B		A	A	A	E	D	D	E	E	
Approach Delay (s)		11.1			9.3			53.4			68.3	
Approach LOS		B			A			D			E	
Intersection Summary												
HCM 2000 Control Delay			12.7	HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio			0.49									
Actuated Cycle Length (s)			140.0	Sum of lost time (s)				21.8				
Intersection Capacity Utilization			61.7%	ICU Level of Service				B				
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

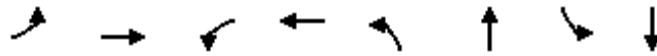
Background 2032 - AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	1106	51	0	1347	0	26
Future Volume (Veh/h)	1106	51	0	1347	0	26
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1164	54	0	1418	0	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.84		0.85	0.84
vC, conflicting volume			1218		1900	609
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			869		829	141
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	96
cM capacity (veh/h)			645		261	737
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	776	442	709	709	27	
Volume Left	0	0	0	0	0	
Volume Right	0	54	0	0	27	
cSH	1700	1700	1700	1700	737	
Volume to Capacity	0.46	0.26	0.42	0.42	0.04	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.9	
Control Delay (s)	0.0	0.0	0.0	0.0	10.1	
Lane LOS						B
Approach Delay (s)	0.0		0.0		10.1	
Approach LOS						B
Intersection Summary						
Average Delay			0.1			
Intersection Capacity Utilization			40.6%	ICU Level of Service	A	
Analysis Period (min)			15			

Queues
5: Back Rd & Ryan Rd

Background 2032 - AM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	73	1082	26	953	361	69	76	129
v/c Ratio	0.27	0.62	0.16	0.83	0.85	0.10	0.34	0.37
Control Delay	13.5	15.5	22.0	30.8	39.6	8.4	30.0	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.5	15.5	22.0	30.8	39.6	8.4	30.0	14.2
Queue Length 50th (m)	4.8	49.2	2.4	58.7	36.1	2.5	8.8	5.2
Queue Length 95th (m)	12.3	76.7	8.7	#98.3	#71.1	9.4	19.4	17.9
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	272	1748	160	1150	424	938	433	607
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.62	0.16	0.83	0.85	0.07	0.18	0.21






















Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

5: Back Rd & Ryan Rd

Background 2032 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	72	891	170	25	912	22	354	30	37	74	45	81
Future Volume (vph)	72	891	170	25	912	22	354	30	37	74	45	81
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3636		1863	3713		1863	1799		1863	1772	
Flt Permitted	0.15	1.00		0.26	1.00		0.44	1.00		0.71	1.00	
Satd. Flow (perm)	288	3636		518	3713		861	1799		1396	1772	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	73	909	173	26	931	22	361	31	38	76	46	83
RTOR Reduction (vph)	0	18	0	0	2	0	0	24	0	0	70	0
Lane Group Flow (vph)	73	1064	0	26	951	0	361	45	0	76	59	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	33.2	33.2		21.6	21.6		25.2	25.2		11.2	11.2	
Effective Green, g (s)	33.2	33.2		21.6	21.6		25.2	25.2		11.2	11.2	
Actuated g/C Ratio	0.48	0.48		0.31	0.31		0.36	0.36		0.16	0.16	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	272	1731		160	1150		426	650		224	284	
v/s Ratio Prot	0.02	c0.29			c0.26		c0.10	0.02			0.03	
v/s Ratio Perm	0.10			0.05			c0.21			0.05		
v/c Ratio	0.27	0.61		0.16	0.83		0.85	0.07		0.34	0.21	
Uniform Delay, d1	12.7	13.5		17.5	22.3		19.4	14.6		26.0	25.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.1	1.6		1.0	5.6		15.8	0.1		1.9	0.8	
Delay (s)	13.8	15.2		18.5	27.9		35.2	14.7		27.9	26.2	
Level of Service	B	B		B	C		D	B		C	C	
Approach Delay (s)		15.1			27.7			31.9			26.8	
Approach LOS		B			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			23.0			HCM 2000 Level of Service		C				
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			69.7			Sum of lost time (s)		22.9				
Intersection Capacity Utilization			81.3%			ICU Level of Service		D				
Analysis Period (min)			15									
c Critical Lane Group												

Queues
2: Ryan Rd & Hwy 19A

Total 2020 - AM Peak Hour


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	38	544	566	494	126	19	190	393	157	240
v/c Ratio	0.25	0.67	0.84	0.61	0.25	0.09	0.27	0.62	0.38	0.20
Control Delay	63.1	53.6	64.9	52.1	3.3	48.8	49.2	9.5	36.1	32.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.1	53.6	64.9	52.1	3.3	48.8	49.2	9.5	36.1	32.0
Queue Length 50th (m)	9.6	70.1	74.5	63.1	0.0	4.2	22.9	0.0	30.3	23.1
Queue Length 95th (m)	20.9	91.2	93.2	82.7	6.1	11.7	35.1	29.0	47.9	33.3
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	808	745	813	497	221	698	631	440	1225
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.67	0.76	0.61	0.25	0.09	0.27	0.62	0.36	0.20

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Total 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	502	31	555	484	123	19	186	385	154	217	19
Future Volume (vph)	37	502	31	555	484	123	19	186	385	154	217	19
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3693		3614	3725	1667	1863	3725	1667	1863	3681	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.60	1.00	1.00	0.51	1.00	
Satd. Flow (perm)	1863	3693		3614	3725	1667	1181	3725	1667	1004	3681	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	38	512	32	566	494	126	19	190	393	157	221	19
RTOR Reduction (vph)	0	3	0	0	0	99	0	0	319	0	5	0
Lane Group Flow (vph)	38	541	0	566	494	27	19	190	74	157	235	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	29.6		25.4	29.6	29.6	25.5	25.5	25.5	45.0	45.0	
Effective Green, g (s)	11.0	29.6		25.4	29.6	29.6	25.5	25.5	25.5	45.0	45.0	
Actuated g/C Ratio	0.08	0.22		0.19	0.22	0.22	0.19	0.19	0.19	0.33	0.33	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	805		676	812	363	221	699	313	418	1220	
v/s Ratio Prot	c0.02	c0.15		c0.16	0.13			0.05		c0.04	0.06	
v/s Ratio Perm						0.02	0.02		0.04	c0.09		
v/c Ratio	0.25	0.67		0.84	0.61	0.08	0.09	0.27	0.24	0.38	0.19	
Uniform Delay, d1	58.5	48.6		53.2	47.8	42.2	45.5	47.2	46.8	33.3	32.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.0	4.4		11.8	3.4	0.4	0.2	0.2	0.4	0.6	0.4	
Delay (s)	62.5	53.0		65.0	51.2	42.6	45.6	47.4	47.2	33.8	32.7	
Level of Service	E	D		E	D	D	D	D	D	C	C	
Approach Delay (s)		53.7			56.9			47.2			33.2	
Approach LOS		D			E			D			C	

Intersection Summary

HCM 2000 Control Delay	50.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	135.7	Sum of lost time (s)	30.7
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues

Total 2020 - AM Peak Hour

3: Sandwich Rd & Ryan Rd


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	27	1092	74	1128	20	115	6	53	6	6
v/c Ratio	0.07	0.42	0.19	0.41	0.02	0.51	0.02	0.17	0.06	0.02
Control Delay	5.7	11.0	5.9	9.6	0.0	60.9	45.2	1.1	64.7	0.0
Queue Delay	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.7	11.6	5.9	9.6	0.0	60.9	45.2	1.1	64.7	0.0
Queue Length 50th (m)	1.1	53.6	3.2	55.0	0.0	30.4	1.5	0.0	1.6	0.0
Queue Length 95th (m)	5.0	105.7	10.7	102.4	0.0	43.5	5.0	0.2	6.1	0.0
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	402	2603	513	2731	1250	374	787	730	322	542
Starvation Cap Reductn	0	1015	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.69	0.14	0.41	0.02	0.31	0.01	0.07	0.02	0.01

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: Sandwich Rd & Ryan Rd

Total 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	928	87	69	1049	19	107	6	49	6	0	6
Future Volume (vph)	25	928	87	69	1049	19	107	6	49	6	0	6
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3677		1863	3725	1667	1863	1961	1667	1863	1667	
Flt Permitted	0.22	1.00		0.21	1.00	1.00	0.48	1.00	1.00	1.00	1.00	
Satd. Flow (perm)	425	3677		417	3725	1667	934	1961	1667	1961	1667	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	27	998	94	74	1128	20	115	6	53	6	0	6
RTOR Reduction (vph)	0	3	0	0	0	6	0	0	44	0	6	0
Lane Group Flow (vph)	27	1089	0	74	1128	14	115	6	9	6	0	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	98.5	94.7		103.5	97.3	97.3	22.8	22.8	22.8	2.9	2.9	
Effective Green, g (s)	98.5	94.7		103.5	97.3	97.3	22.8	22.8	22.8	2.9	2.9	
Actuated g/C Ratio	0.70	0.68		0.74	0.69	0.69	0.16	0.16	0.16	0.02	0.02	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	338	2487		372	2588	1158	247	319	271	40	34	
v/s Ratio Prot	0.00	0.30		c0.01	c0.30		c0.05	0.00			0.00	
v/s Ratio Perm	0.05			0.14		0.01	c0.03		0.01	0.00		
v/c Ratio	0.08	0.44		0.20	0.44	0.01	0.47	0.02	0.03	0.15	0.00	
Uniform Delay, d1	6.9	10.4		6.3	9.3	6.6	52.4	49.2	49.3	67.3	67.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.6		0.3	0.5	0.0	1.9	0.0	0.0	1.7	0.0	
Delay (s)	7.0	11.0		6.6	9.9	6.6	54.2	49.2	49.4	69.1	67.2	
Level of Service	A	B		A	A	A	D	D	D	E	E	
Approach Delay (s)		10.9			9.6			52.6			68.1	
Approach LOS		B			A			D			E	










Intersection Summary

HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.8
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

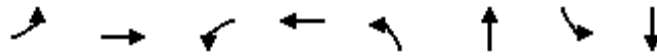
Total 2020 - AM Peak Hour

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	928	56	0	1136	0	47
Future Volume (Veh/h)	928	56	0	1136	0	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	998	60	0	1222	0	51
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.86	0.89	0.86	
vC, conflicting volume			1058	1639	529	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			752	772	140	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	93	
cM capacity (veh/h)			737	297	762	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	665	393	611	611	51	
Volume Left	0	0	0	0	0	
Volume Right	0	60	0	0	51	
cSH	1700	1700	1700	1700	762	
Volume to Capacity	0.39	0.23	0.36	0.36	0.07	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.6	
Control Delay (s)	0.0	0.0	0.0	0.0	10.1	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		10.1	
Approach LOS					B	
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			36.1%	ICU Level of Service		A
Analysis Period (min)	15					

Queues

Total 2020 - AM Peak Hour

5: Back Rd & Ryan Rd























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	67	949	24	822	309	58	65	112
v/c Ratio	0.24	0.54	0.13	0.71	0.74	0.09	0.30	0.34
Control Delay	12.6	13.8	20.3	25.2	30.2	8.7	29.7	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	13.8	20.3	25.2	30.2	8.7	29.7	14.6
Queue Length 50th (m)	4.3	40.1	2.2	47.6	29.9	2.1	7.5	4.5
Queue Length 95th (m)	11.0	61.0	7.8	70.5	#53.6	8.4	17.4	16.6
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	278	1766	184	1160	418	945	442	605
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.54	0.13	0.71	0.74	0.06	0.15	0.19

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Total 2020 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	64	769	142	23	770	19	297	25	31	62	38	69
Future Volume (vph)	64	769	142	23	770	19	297	25	31	62	38	69
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3638		1863	3712		1863	1799		1863	1772	
Flt Permitted	0.15	1.00		0.30	1.00		0.44	1.00		0.72	1.00	
Satd. Flow (perm)	297	3638		591	3712		855	1799		1410	1772	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	67	801	148	24	802	20	309	26	32	65	40	72
RTOR Reduction (vph)	0	17	0	0	2	0	0	21	0	0	61	0
Lane Group Flow (vph)	67	932	0	24	820	0	309	37	0	65	51	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	33.1	33.1		21.5	21.5		24.5	24.5		10.5	10.5	
Effective Green, g (s)	33.1	33.1		21.5	21.5		24.5	24.5		10.5	10.5	
Actuated g/C Ratio	0.48	0.48		0.31	0.31		0.36	0.36		0.15	0.15	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	279	1747		184	1158		421	639		214	270	
v/s Ratio Prot	0.02	c0.26			c0.22		c0.09	0.02			0.03	
v/s Ratio Perm	0.09			0.04			c0.18			0.05		
v/c Ratio	0.24	0.53		0.13	0.71		0.73	0.06		0.30	0.19	
Uniform Delay, d1	11.5	12.5		17.0	20.9		18.0	14.6		26.0	25.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.9	1.2		0.7	2.5		7.9	0.1		1.7	0.7	
Delay (s)	12.4	13.7		17.7	23.4		25.8	14.7		27.6	26.2	
Level of Service	B	B		B	C		C	B		C	C	
Approach Delay (s)		13.6			23.3			24.1			26.7	
Approach LOS		B			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			19.6			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			68.9			Sum of lost time (s)				22.9		
Intersection Capacity Utilization			69.1%			ICU Level of Service				C		
Analysis Period (min)			15									

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Total 2032 - AM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	44	634	656	573	144	22	221	457	182	280
v/c Ratio	0.29	0.84	0.91	0.75	0.30	0.11	0.33	0.68	0.45	0.23
Control Delay	64.2	62.4	70.1	58.0	5.2	49.9	50.8	10.0	37.6	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.2	62.4	70.1	58.0	5.2	49.9	50.8	10.0	37.6	32.6
Queue Length 50th (m)	11.2	85.6	87.5	76.2	0.0	5.0	27.3	0.0	35.6	27.3
Queue Length 95th (m)	23.4	#113.2	#116.9	96.6	11.0	13.2	40.2	31.4	54.8	38.5
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	759	745	763	477	205	671	675	423	1225
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.84	0.88	0.75	0.30	0.11	0.33	0.68	0.43	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Total 2032 - AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	44	597	37	656	573	144	22	221	457	182	258	22
Future Volume (vph)	44	597	37	656	573	144	22	221	457	182	258	22
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3693		3614	3725	1667	1863	3725	1667	1863	3682	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.58	1.00	1.00	0.47	1.00	
Satd. Flow (perm)	1863	3693		3614	3725	1667	1137	3725	1667	920	3682	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	44	597	37	656	573	144	22	221	457	182	258	22
RTOR Reduction (vph)	0	3	0	0	0	114	0	0	374	0	5	0
Lane Group Flow (vph)	44	631	0	656	573	30	22	221	83	182	275	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	27.8		27.2	27.8	27.8	24.5	24.5	24.5	45.0	45.0	
Effective Green, g (s)	11.0	27.8		27.2	27.8	27.8	24.5	24.5	24.5	45.0	45.0	
Actuated g/C Ratio	0.08	0.20		0.20	0.20	0.20	0.18	0.18	0.18	0.33	0.33	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	756		724	763	341	205	672	300	405	1221	
v/s Ratio Prot	c0.02	c0.17		c0.18	0.15			0.06		c0.05	0.07	
v/s Ratio Perm						0.02	0.02		0.05	c0.10		
v/c Ratio	0.29	0.83		0.91	0.75	0.09	0.11	0.33	0.28	0.45	0.23	
Uniform Delay, d1	58.7	51.7		53.0	50.7	43.7	46.5	48.4	47.9	33.8	32.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.8	10.5		17.1	6.7	0.5	0.2	0.3	0.5	0.8	0.4	
Delay (s)	63.5	62.3		70.1	57.4	44.2	46.7	48.7	48.4	34.6	33.2	
Level of Service	E	E		E	E	D	D	D	D	C	C	
Approach Delay (s)		62.3			62.1			48.5			33.8	
Approach LOS		E			E			D			C	
Intersection Summary												
HCM 2000 Control Delay	55.1			HCM 2000 Level of Service				E				
HCM 2000 Volume to Capacity ratio	0.67											
Actuated Cycle Length (s)	135.7			Sum of lost time (s)				30.7				
Intersection Capacity Utilization	72.7%			ICU Level of Service				C				
Analysis Period (min)	15											
c Critical Lane Group												

Queues

Total 2032 - AM Peak Hour

3: Sandwich Rd & Ryan Rd




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	32	1269	85	1316	23	122	7	62	7	7
v/c Ratio	0.10	0.50	0.26	0.48	0.02	0.53	0.03	0.19	0.07	0.02
Control Delay	6.2	13.2	6.9	10.9	0.0	60.9	44.9	2.8	64.7	0.1
Queue Delay	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.2	14.2	6.9	10.9	0.0	60.9	44.9	2.8	64.7	0.1
Queue Length 50th (m)	1.4	69.1	3.7	70.3	0.0	32.3	1.7	0.0	1.9	0.0
Queue Length 95th (m)	5.8	135.5	12.3	130.4	0.0	45.5	5.6	2.8	6.9	0.0
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	333	2515	442	2715	1243	376	787	730	322	530
Starvation Cap Reductn	0	920	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.80	0.19	0.48	0.02	0.32	0.01	0.08	0.02	0.01

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: Sandwich Rd & Ryan Rd

Total 2032 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	30	1103	103	81	1250	22	116	7	59	7	0	7
Future Volume (vph)	30	1103	103	81	1250	22	116	7	59	7	0	7
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3678		1863	3725	1667	1863	1961	1667	1863	1667	
Flt Permitted	0.17	1.00		0.16	1.00	1.00	0.48	1.00	1.00	1.00	1.00	
Satd. Flow (perm)	331	3678		311	3725	1667	934	1961	1667	1961	1667	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	32	1161	108	85	1316	23	122	7	62	7	0	7
RTOR Reduction (vph)	0	3	0	0	0	7	0	0	52	0	7	0
Lane Group Flow (vph)	32	1266	0	85	1316	16	122	7	10	7	0	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	96.3	92.4		104.7	96.7	96.7	23.3	23.3	23.3	2.9	2.9	
Effective Green, g (s)	96.3	92.4		104.7	96.7	96.7	23.3	23.3	23.3	2.9	2.9	
Actuated g/C Ratio	0.69	0.66		0.75	0.69	0.69	0.17	0.17	0.17	0.02	0.02	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	270	2427		321	2572	1151	254	326	277	40	34	
v/s Ratio Prot	0.00	0.34		c0.02	c0.35		c0.05	0.00			0.00	
v/s Ratio Perm	0.08			0.18		0.01	c0.03		0.01	0.00		
v/c Ratio	0.12	0.52		0.26	0.51	0.01	0.48	0.02	0.04	0.17	0.00	
Uniform Delay, d1	8.2	12.3		7.8	10.4	6.8	52.1	48.8	48.9	67.4	67.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.8		0.4	0.7	0.0	1.9	0.0	0.1	2.1	0.0	
Delay (s)	8.3	13.1		8.3	11.1	6.8	54.1	48.8	49.0	69.5	67.2	
Level of Service	A	B		A	B	A	D	D	D	E	E	
Approach Delay (s)		13.0			10.8			52.2			68.3	
Approach LOS		B			B			D			E	
Intersection Summary												
HCM 2000 Control Delay			14.8				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			140.0				Sum of lost time (s)				21.8	
Intersection Capacity Utilization			64.0%				ICU Level of Service				C	
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

Total 2032 - AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	1106	63	0	1353	0	49
Future Volume (Veh/h)	1106	63	0	1353	0	49
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1164	66	0	1424	0	52
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.82	0.85	0.82	
vC, conflicting volume			1230	1909	615	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			841	771	91	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	93	
cM capacity (veh/h)			648	287	778	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	776	454	712	712	52	
Volume Left	0	0	0	0	0	
Volume Right	0	66	0	0	52	
cSH	1700	1700	1700	1700	778	
Volume to Capacity	0.46	0.27	0.42	0.42	0.07	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.6	
Control Delay (s)	0.0	0.0	0.0	0.0	10.0	
Lane LOS						A
Approach Delay (s)	0.0		0.0		10.0	
Approach LOS						A
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			40.9%	ICU Level of Service	A	
Analysis Period (min)			15			

Queues

Total 2032 - AM Peak Hour

5: Back Rd & Ryan Rd























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	77	1103	27	958	361	69	76	130
v/c Ratio	0.28	0.63	0.18	0.83	0.85	0.10	0.34	0.37
Control Delay	13.7	15.7	22.4	31.0	39.6	8.4	30.0	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.7	15.7	22.4	31.0	39.6	8.4	30.0	14.1
Queue Length 50th (m)	5.1	50.7	2.5	59.0	36.1	2.5	8.8	5.2
Queue Length 95th (m)	12.9	78.8	9.0	#99.3	#71.1	9.4	19.4	18.1
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	272	1747	154	1150	424	938	433	607
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.63	0.18	0.83	0.85	0.07	0.18	0.21

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Total 2032 - AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	911	170	26	917	22	354	30	37	74	45	82
Future Volume (vph)	75	911	170	26	917	22	354	30	37	74	45	82
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3638		1863	3713		1863	1799		1863	1771	
Flt Permitted	0.15	1.00		0.26	1.00		0.44	1.00		0.71	1.00	
Satd. Flow (perm)	288	3638		501	3713		860	1799		1396	1771	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	77	930	173	27	936	22	361	31	38	76	46	84
RTOR Reduction (vph)	0	17	0	0	2	0	0	24	0	0	71	0
Lane Group Flow (vph)	77	1086	0	27	956	0	361	45	0	76	59	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	33.2	33.2		21.6	21.6		25.2	25.2		11.2	11.2	
Effective Green, g (s)	33.2	33.2		21.6	21.6		25.2	25.2		11.2	11.2	
Actuated g/C Ratio	0.48	0.48		0.31	0.31		0.36	0.36		0.16	0.16	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	272	1732		155	1150		426	650		224	284	
v/s Ratio Prot	0.02	c0.30			c0.26		c0.10	0.02			0.03	
v/s Ratio Perm	0.11			0.05			c0.21			0.05		
v/c Ratio	0.28	0.63		0.17	0.83		0.85	0.07		0.34	0.21	
Uniform Delay, d1	12.7	13.6		17.5	22.4		19.4	14.6		26.0	25.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	1.7		1.1	5.8		15.8	0.1		1.9	0.8	
Delay (s)	13.9	15.4		18.7	28.2		35.2	14.7		27.9	26.2	
Level of Service	B	B		B	C		D	B		C	C	
Approach Delay (s)		15.3			27.9			31.9			26.8	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	23.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	69.7	Sum of lost time (s)	22.9
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Existing 2020 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	21	635	690	595	91	93	377	487	97	419
v/c Ratio	0.14	0.86	1.00	0.80	0.19	0.42	0.45	0.65	0.30	0.33
Control Delay	60.4	65.0	91.9	53.6	1.5	52.7	47.8	8.3	33.3	30.4
Queue Delay	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.4	65.8	91.9	53.6	1.5	52.7	47.8	8.3	33.3	30.4
Queue Length 50th (m)	5.3	85.5	78.0	81.0	1.8	21.2	45.5	0.0	17.6	38.7
Queue Length 95th (m)	13.8	#113.7	#138.8	87.7	0.0	40.2	63.1	30.8	30.6	52.3
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	151	736	692	741	468	224	840	753	383	1265
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	16	0	0	0	0	0	2	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.88	1.00	0.80	0.19	0.42	0.45	0.65	0.25	0.33
























Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Existing 2020 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	565	51	669	577	88	90	366	472	94	301	106
Future Volume (vph)	20	565	51	669	577	88	90	366	472	94	301	106
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3679		3614	3725	1667	1863	3725	1667	1863	3580	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.51	1.00	1.00	0.35	1.00	
Satd. Flow (perm)	1863	3679		3614	3725	1667	994	3725	1667	681	3580	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	21	582	53	690	595	91	93	377	487	97	310	109
RTOR Reduction (vph)	0	5	0	0	0	73	0	0	377	0	25	0
Lane Group Flow (vph)	21	630	0	690	595	18	93	377	110	97	394	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	11.0	27.0		26.0	27.0	27.0	30.6	30.6	30.6	47.0	47.0	
Effective Green, g (s)	11.0	27.0		26.0	27.0	27.0	30.6	30.6	30.6	47.0	47.0	
Actuated g/C Ratio	0.08	0.20		0.19	0.20	0.20	0.23	0.23	0.23	0.35	0.35	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	151	732		692	741	331	224	839	375	326	1239	
v/s Ratio Prot	c0.01	c0.17		c0.19	0.16			c0.10		0.02	c0.11	
v/s Ratio Perm						0.01	0.09		0.07	0.08		
v/c Ratio	0.14	0.86		1.00	0.80	0.05	0.42	0.45	0.29	0.30	0.32	
Uniform Delay, d1	57.9	52.5		54.8	51.8	44.0	44.9	45.3	43.6	31.2	32.6	
Progression Factor	1.00	1.00		1.12	0.87	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.9	12.7		31.6	8.1	0.3	1.2	0.4	0.4	0.5	0.7	
Delay (s)	59.9	65.2		92.8	53.3	44.3	46.2	45.7	44.0	31.7	33.2	
Level of Service	E	E		F	D	D	D	D	D	C	C	
Approach Delay (s)		65.0			72.5			44.9			33.0	
Approach LOS		E			E			D			C	
Intersection Summary												
HCM 2000 Control Delay	57.7			HCM 2000 Level of Service				E				
HCM 2000 Volume to Capacity ratio	0.65											
Actuated Cycle Length (s)	135.7			Sum of lost time (s)				30.7				
Intersection Capacity Utilization	74.2%			ICU Level of Service				D				
Analysis Period (min)	15											
c Critical Lane Group												

Queues

Existing 2020 - PM Peak Hour

3: Sandwich Rd & Ryan Rd





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	9	1221	145	1279	3	157	37	172	18	37
v/c Ratio	0.03	0.54	0.42	0.48	0.00	0.61	0.10	0.38	0.22	0.31
Control Delay	5.6	10.7	9.7	10.1	0.0	58.5	43.7	8.6	66.6	49.2
Queue Delay	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.6	11.3	9.7	10.1	0.0	58.5	43.7	8.6	66.6	49.2
Queue Length 50th (m)	0.4	45.0	10.6	69.2	0.0	36.5	8.0	0.0	4.7	6.0
Queue Length 95th (m)	m1.1	70.8	18.5	118.1	0.0	56.2	17.2	18.1	12.7	17.1
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	337	2251	428	2678	1228	267	628	651	243	325
Starvation Cap Reductn	0	577	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.73	0.34	0.48	0.00	0.59	0.06	0.26	0.07	0.11

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.












HCM Signalized Intersection Capacity Analysis
3: Sandwich Rd & Ryan Rd

Existing 2020 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	8	967	156	133	1177	3	144	34	158	17	21	13
Future Volume (vph)	8	967	156	133	1177	3	144	34	158	17	21	13
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3648		1863	3725	1667	1863	1961	1667	1863	1849	
Flt Permitted	0.19	1.00		0.15	1.00	1.00	0.40	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	368	3648		300	3725	1667	778	1961	1667	1437	1849	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	1051	170	145	1279	3	157	37	172	18	23	14
RTOR Reduction (vph)	0	7	0	0	0	1	0	0	139	0	13	0
Lane Group Flow (vph)	9	1214	0	145	1279	2	157	37	33	18	24	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	83.6	82.4		98.7	92.2	92.2	26.2	26.2	26.2	6.5	6.5	
Effective Green, g (s)	83.6	82.4		98.7	92.2	92.2	26.2	26.2	26.2	6.5	6.5	
Actuated g/C Ratio	0.62	0.61		0.73	0.68	0.68	0.19	0.19	0.19	0.05	0.05	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	239	2215		342	2530	1132	263	378	321	68	88	
v/s Ratio Prot	0.00	c0.33		c0.03	c0.34		c0.06	0.02			0.01	
v/s Ratio Perm	0.02			0.27		0.00	c0.05		0.02	0.01		
v/c Ratio	0.04	0.55		0.42	0.51	0.00	0.60	0.10	0.10	0.26	0.27	
Uniform Delay, d1	10.5	15.7		10.2	10.6	7.0	48.4	45.0	45.1	62.3	62.3	
Progression Factor	0.82	0.61		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.7		0.8	0.7	0.0	4.2	0.1	0.1	2.1	1.6	
Delay (s)	8.7	10.3		11.0	11.3	7.0	52.6	45.1	45.2	64.4	64.0	
Level of Service	A	B		B	B	A	D	D	D	E	E	
Approach Delay (s)		10.3			11.3			48.4			64.1	
Approach LOS		B			B			D			E	
Intersection Summary												
HCM 2000 Control Delay			16.2	HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio			0.57									
Actuated Cycle Length (s)			135.7	Sum of lost time (s)				21.8				
Intersection Capacity Utilization			64.9%	ICU Level of Service				C				
Analysis Period (min)			15									
c Critical Lane Group												

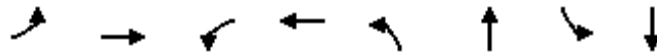
HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

Existing 2020 - PM Peak Hour

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	 			 		
Traffic Volume (veh/h)	1077	65	0	1231	0	39
Future Volume (Veh/h)	1077	65	0	1231	0	39
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.85
Hourly flow rate (vph)	1171	71	0	1338	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.81	0.89	0.81	
vC, conflicting volume			1242	1876	621	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			819	853	48	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	94	
cM capacity (veh/h)			649	267	814	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	781	461	669	669	46	
Volume Left	0	0	0	0	0	
Volume Right	0	71	0	0	46	
cSH	1700	1700	1700	1700	814	
Volume to Capacity	0.46	0.27	0.39	0.39	0.06	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.3	
Control Delay (s)	0.0	0.0	0.0	0.0	9.7	
Lane LOS						A
Approach Delay (s)	0.0		0.0		9.7	
Approach LOS						A
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			40.2%	ICU Level of Service	A	
Analysis Period (min)			15			

Queues
5: Back Rd & Ryan Rd

Existing 2020 - PM Peak Hour

























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	207	1119	29	825	301	49	38	204
v/c Ratio	0.61	0.60	0.18	0.67	0.69	0.07	0.20	0.62
Control Delay	22.8	18.4	28.9	31.8	33.0	19.5	42.9	29.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.8	18.4	28.9	31.8	33.0	19.5	42.9	29.2
Queue Length 50th (m)	21.6	73.5	4.0	71.5	43.2	5.4	6.8	17.6
Queue Length 95th (m)	40.4	109.4	12.1	102.5	69.8	13.4	16.8	41.6
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	347	2133	199	1512	470	951	320	476
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.52	0.15	0.55	0.64	0.05	0.12	0.43

Intersection Summary

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Existing 2020 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	197	757	306	28	721	63	286	42	5	36	50	143
Future Volume (vph)	197	757	306	28	721	63	286	42	5	36	50	143
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3565		1863	3681		1863	1931		1863	1743	
Flt Permitted	0.16	1.00		0.25	1.00		0.27	1.00		0.73	1.00	
Satd. Flow (perm)	308	3565		486	3681		531	1931		1422	1743	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	207	797	322	29	759	66	301	44	5	38	53	151
RTOR Reduction (vph)	0	36	0	0	5	0	0	3	0	0	93	0
Lane Group Flow (vph)	207	1083	0	29	820	0	301	46	0	38	111	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	50.8	50.8		33.5	33.5		37.4	37.4		13.6	13.6	
Effective Green, g (s)	50.8	50.8		33.5	33.5		37.4	37.4		13.6	13.6	
Actuated g/C Ratio	0.51	0.51		0.34	0.34		0.38	0.38		0.14	0.14	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	340	1820		163	1239		437	725		194	238	
v/s Ratio Prot	0.07	c0.30			c0.22		c0.12	0.02			0.06	
v/s Ratio Perm	0.24			0.06			c0.14			0.03		
v/c Ratio	0.61	0.60		0.18	0.66		0.69	0.06		0.20	0.47	
Uniform Delay, d1	16.6	17.1		23.3	28.2		23.9	19.9		38.1	39.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.5	1.4		1.1	1.8		5.7	0.1		1.0	3.0	
Delay (s)	21.1	18.6		24.4	29.9		29.7	19.9		39.1	42.6	
Level of Service	C	B		C	C		C	B		D	D	
Approach Delay (s)		19.0			29.7			28.3			42.0	
Approach LOS		B			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			25.5			HCM 2000 Level of Service		C				
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			99.5			Sum of lost time (s)		22.9				
Intersection Capacity Utilization			82.3%			ICU Level of Service		E				
Analysis Period (min)			15									

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Background 20202 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	21	660	714	615	96	96	388	509	105	430
v/c Ratio	0.27	0.90	0.90	0.83	0.19	0.51	0.55	0.70	0.41	0.38
Control Delay	57.5	57.1	55.5	51.7	0.8	49.1	41.7	9.2	32.2	26.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.5	57.1	55.5	51.7	0.8	49.1	41.7	9.2	32.2	26.5
Queue Length 50th (m)	4.2	68.4	72.0	63.5	0.0	17.5	37.5	0.0	15.6	31.5
Queue Length 95th (m)	12.0	#100.9	#101.5	#90.6	0.0	34.1	52.3	28.6	28.6	44.9
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	78	737	812	739	507	187	709	729	258	1124
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.90	0.88	0.83	0.19	0.51	0.55	0.70	0.41	0.38
























Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Background 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	594	53	700	603	94	94	380	499	103	312	110
Future Volume (vph)	21	594	53	700	603	94	94	380	499	103	312	110
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3680		3614	3725	1667	1863	3725	1667	1863	3580	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.50	1.00	1.00	0.31	1.00	
Satd. Flow (perm)	1863	3680		3614	3725	1667	984	3725	1667	616	3580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	606	54	714	615	96	96	388	509	105	318	112
RTOR Reduction (vph)	0	6	0	0	0	77	0	0	412	0	33	0
Lane Group Flow (vph)	21	654	0	714	615	19	96	388	97	105	397	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	4.4	20.8		23.1	20.8	20.8	20.0	20.0	20.0	32.0	32.0	
Effective Green, g (s)	4.4	20.8		23.1	20.8	20.8	20.0	20.0	20.0	32.0	32.0	
Actuated g/C Ratio	0.04	0.20		0.22	0.20	0.20	0.19	0.19	0.19	0.30	0.30	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	78	728		795	737	330	187	709	317	258	1091	
v/s Ratio Prot	c0.01	c0.18		c0.20	0.17			c0.10		0.02	c0.11	
v/s Ratio Perm						0.01	0.10		0.06	0.10		
v/c Ratio	0.27	0.90		0.90	0.83	0.06	0.51	0.55	0.31	0.41	0.36	
Uniform Delay, d1	48.7	41.1		39.8	40.4	34.2	38.1	38.4	36.5	27.5	28.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.3	16.1		15.0	10.8	0.3	2.4	0.9	0.5	1.0	0.9	
Delay (s)	57.0	57.2		54.8	51.2	34.5	40.5	39.3	37.1	28.5	29.5	
Level of Service	E	E		D	D	C	D	D	D	C	C	
Approach Delay (s)		57.1			51.9			38.3			29.3	
Approach LOS		E			D			D			C	
Intersection Summary												
HCM 2000 Control Delay			45.8								HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			105.0								Sum of lost time (s)	30.7
Intersection Capacity Utilization			76.3%								ICU Level of Service	D
Analysis Period (min)			15									
c Critical Lane Group												

Queues

3: Sandwich Rd & Ryan Rd





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	10	1276	151	1313	3	176	38	176	19	38
v/c Ratio	0.03	0.56	0.45	0.49	0.00	0.69	0.11	0.39	0.23	0.32
Control Delay	6.9	18.1	10.3	10.2	0.0	64.7	45.6	8.8	69.5	51.6
Queue Delay	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.9	19.3	10.3	10.2	0.0	64.7	45.6	8.8	69.5	51.6
Queue Length 50th (m)	0.7	105.1	11.2	72.7	0.0	43.0	8.6	0.0	5.1	6.4
Queue Length 95th (m)	2.4	146.2	19.4	123.1	0.0	64.4	17.9	18.6	13.4	17.7
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	324	2262	408	2693	1234	262	610	640	235	316
Starvation Cap Reductn	0	694	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.81	0.37	0.49	0.00	0.67	0.06	0.28	0.08	0.12

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: Sandwick Rd & Ryan Rd

Background 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 					 		
Traffic Volume (vph)	9	1025	162	140	1221	3	164	35	164	18	22	13
Future Volume (vph)	9	1025	162	140	1221	3	164	35	164	18	22	13
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3649		1863	3725	1667	1863	1961	1667	1863	1852	
Flt Permitted	0.18	1.00		0.14	1.00	1.00	0.40	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	354	3649		275	3725	1667	783	1961	1667	1436	1852	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	10	1102	174	151	1313	3	176	38	176	19	24	14
RTOR Reduction (vph)	0	6	0	0	0	1	0	0	142	0	13	0
Lane Group Flow (vph)	10	1270	0	151	1313	2	176	38	34	19	25	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	86.6	85.4		102.4	95.9	95.9	26.8	26.8	26.8	6.6	6.6	
Effective Green, g (s)	86.6	85.4		102.4	95.9	95.9	26.8	26.8	26.8	6.6	6.6	
Actuated g/C Ratio	0.62	0.61		0.73	0.69	0.69	0.19	0.19	0.19	0.05	0.05	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	231	2225		331	2551	1141	263	375	319	67	87	
v/s Ratio Prot	0.00	c0.35		c0.04	c0.35		c0.07	0.02			0.01	
v/s Ratio Perm	0.03			0.30		0.00	c0.06		0.02	0.01		
v/c Ratio	0.04	0.57		0.46	0.51	0.00	0.67	0.10	0.11	0.28	0.28	
Uniform Delay, d1	10.8	16.3		11.3	10.7	7.0	50.7	46.7	46.7	64.4	64.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.1		1.0	0.7	0.0	6.9	0.1	0.1	2.3	1.8	
Delay (s)	10.8	17.4		12.3	11.5	7.0	57.6	46.8	46.9	66.7	66.2	
Level of Service	B	B		B	B	A	E	D	D	E	E	
Approach Delay (s)		17.4			11.5			51.7			66.4	
Approach LOS		B			B			D			E	
Intersection Summary												
HCM 2000 Control Delay			19.7			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.60									
Actuated Cycle Length (s)			140.0	Sum of lost time (s)				21.8				
Intersection Capacity Utilization			68.1%	ICU Level of Service			C					
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: Shared Access & Ryan Rd

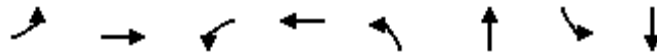
Background 20202 - PM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	1118	89	0	1280	0	47
Future Volume (Veh/h)	1118	89	0	1280	0	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	1202	96	0	1376	0	51
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked				0.79	0.88	0.79
vC, conflicting volume				1298	1938	649
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				854	902	36
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				100	100	94
cM capacity (veh/h)				619	244	816
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	801	497	688	688	51	
Volume Left	0	0	0	0	0	
Volume Right	0	96	0	0	51	
cSH	1700	1700	1700	1700	816	
Volume to Capacity	0.47	0.29	0.40	0.40	0.06	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.5	
Control Delay (s)	0.0	0.0	0.0	0.0	9.7	
Lane LOS						A
Approach Delay (s)	0.0		0.0		9.7	
Approach LOS						A
Intersection Summary						
Average Delay				0.2		
Intersection Capacity Utilization				42.1%	ICU Level of Service	A
Analysis Period (min)				15		

Queues
5: Back Rd & Ryan Rd

Background 20202 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	215	1154	36	849	309	52	39	210
v/c Ratio	0.68	0.62	0.24	0.72	0.98	0.08	0.18	0.53
Control Delay	24.4	13.4	23.7	25.4	69.5	14.4	26.7	13.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.4	13.4	23.7	25.4	69.5	14.4	26.7	13.6
Queue Length 50th (m)	13.7	45.2	3.2	47.5	31.0	3.9	4.4	6.2
Queue Length 95th (m)	#42.7	76.8	11.5	75.5	#72.0	10.3	11.7	22.2
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	314	1852	152	1173	316	959	455	664
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.62	0.24	0.72	0.98	0.05	0.09	0.32





















Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

5: Back Rd & Ryan Rd

Background 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	206	790	318	35	750	65	297	44	6	37	53	149
Future Volume (vph)	206	790	318	35	750	65	297	44	6	37	53	149
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3565		1863	3681		1863	1927		1863	1744	
Flt Permitted	0.15	1.00		0.25	1.00		0.33	1.00		0.72	1.00	
Satd. Flow (perm)	286	3565		482	3681		646	1927		1418	1744	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	215	823	331	36	781	68	309	46	6	39	55	155
RTOR Reduction (vph)	0	47	0	0	8	0	0	4	0	0	131	0
Lane Group Flow (vph)	215	1107	0	36	841	0	309	48	0	39	79	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	34.8	34.8		21.8	21.8		22.6	22.6		10.6	10.6	
Effective Green, g (s)	34.8	34.8		21.8	21.8		22.6	22.6		10.6	10.6	
Actuated g/C Ratio	0.51	0.51		0.32	0.32		0.33	0.33		0.15	0.15	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	314	1805		152	1168		318	633		218	269	
v/s Ratio Prot	0.07	c0.31			0.23		c0.08	0.02			0.05	
v/s Ratio Perm	c0.27			0.07			c0.23			0.03		
v/c Ratio	0.68	0.61		0.24	0.72		0.97	0.08		0.18	0.29	
Uniform Delay, d1	12.1	12.1		17.3	20.8		21.8	15.9		25.3	25.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.7	1.6		1.7	2.7		43.0	0.1		0.8	1.3	
Delay (s)	19.8	13.7		19.0	23.5		64.9	16.0		26.1	27.0	
Level of Service	B	B		B	C		E	B		C	C	
Approach Delay (s)		14.7			23.3			57.8			26.9	
Approach LOS		B			C			E			C	
Intersection Summary												
HCM 2000 Control Delay			23.8			HCM 2000 Level of Service		C				
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			68.7			Sum of lost time (s)		22.9				
Intersection Capacity Utilization			84.6%			ICU Level of Service		E				
Analysis Period (min)			15									
c Critical Lane Group												

Queues
2: Ryan Rd & Hwy 19A

Background 2032 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	25	763	826	712	111	111	449	588	120	499
v/c Ratio	0.26	1.00	0.98	0.93	0.22	0.63	0.63	0.74	0.55	0.46
Control Delay	59.2	79.1	71.9	65.0	1.0	60.2	47.3	9.8	41.4	31.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.2	79.1	71.9	65.0	1.0	60.2	47.3	9.8	41.4	31.6
Queue Length 50th (m)	5.4	~89.6	94.5	82.4	0.0	22.9	48.7	0.0	20.0	43.2
Queue Length 95th (m)	14.2	#130.1	#134.1	#116.8	0.0	#45.8	65.5	32.8	34.8	58.7
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	97	760	839	764	502	176	712	794	218	1088
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	1.00	0.98	0.93	0.22	0.63	0.63	0.74	0.55	0.46
























Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Background 2032 - PM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	25	701	62	826	712	111	111	449	588	120	369	130	
Future Volume (vph)	25	701	62	826	712	111	111	449	588	120	369	130	
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5		
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95		
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	1863	3680		3614	3725	1667	1863	3725	1667	1863	3580		
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.47	1.00	1.00	0.25	1.00		
Satd. Flow (perm)	1863	3680		3614	3725	1667	920	3725	1667	498	3580		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	25	701	62	826	712	111	111	449	588	120	369	130	
RTOR Reduction (vph)	0	6	0	0	0	88	0	0	476	0	30	0	
Lane Group Flow (vph)	25	757	0	826	712	23	111	449	112	120	469	0	
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA		
Protected Phases	9	4		3	4			2		1	6		
Permitted Phases						4	2		2	6			
Actuated Green, G (s)	6.0	23.6		26.7	23.6	23.6	22.0	22.0	22.0	34.0	34.0		
Effective Green, g (s)	6.0	23.6		26.7	23.6	23.6	22.0	22.0	22.0	34.0	34.0		
Actuated g/C Ratio	0.05	0.21		0.23	0.21	0.21	0.19	0.19	0.19	0.30	0.30		
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	97	755		839	764	342	176	712	318	218	1058		
v/s Ratio Prot	c0.01	c0.21		c0.23	0.19			0.12		0.03	c0.13		
v/s Ratio Perm						0.01	c0.12		0.07	0.13			
v/c Ratio	0.26	1.00		0.98	0.93	0.07	0.63	0.63	0.35	0.55	0.44		
Uniform Delay, d1	52.4	45.7		43.9	44.9	36.8	42.8	42.8	40.3	31.4	32.8		
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	6.3	33.5		27.5	19.7	0.4	7.2	1.8	0.7	3.0	1.3		
Delay (s)	58.7	79.2		71.5	64.6	37.2	49.9	44.6	41.0	34.4	34.2		
Level of Service	E	E		E	E	D	D	D	D	C	C		
Approach Delay (s)		78.6			66.2			43.3			34.2		
Approach LOS		E			E			D			C		
Intersection Summary													
HCM 2000 Control Delay	57.5			HCM 2000 Level of Service					E				
HCM 2000 Volume to Capacity ratio	0.82												
Actuated Cycle Length (s)	115.0			Sum of lost time (s)					30.7				
Intersection Capacity Utilization	84.9%			ICU Level of Service					E				
Analysis Period (min)	15												
c Critical Lane Group													

Queues

3: Sandwich Rd & Ryan Rd





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	11	1473	174	1519	4	201	44	204	22	44
v/c Ratio	0.05	0.68	0.59	0.58	0.00	0.75	0.12	0.42	0.27	0.35
Control Delay	7.8	22.8	21.6	13.4	0.0	68.2	45.1	8.4	70.2	50.8
Queue Delay	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	25.9	21.6	13.4	0.0	68.2	45.1	8.4	70.2	50.8
Queue Length 50th (m)	0.8	141.5	13.4	94.5	0.0	49.4	9.9	0.0	5.9	7.2
Queue Length 95th (m)	2.7	195.3	37.7	158.2	0.0	72.1	19.8	19.5	14.7	19.3
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	256	2178	350	2606	1197	272	619	665	234	317
Starvation Cap Reductn	0	581	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.92	0.50	0.58	0.00	0.74	0.07	0.31	0.09	0.14

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: Sandwick Rd & Ryan Rd

Background 2032 - PM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 						 		
Traffic Volume (vph)	10	1208	191	165	1443	4	191	42	194	21	26	16	
Future Volume (vph)	10	1208	191	165	1443	4	191	42	194	21	26	16	
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5		
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	1863	3649		1863	3725	1667	1863	1961	1667	1863	1847		
Flt Permitted	0.13	1.00		0.09	1.00	1.00	0.40	1.00	1.00	0.73	1.00		
Satd. Flow (perm)	251	3649		176	3725	1667	790	1961	1667	1428	1847		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	11	1272	201	174	1519	4	201	44	204	22	27	17	
RTOR Reduction (vph)	0	7	0	0	0	1	0	0	164	0	16	0	
Lane Group Flow (vph)	11	1466	0	174	1519	3	201	44	40	22	28	0	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA		
Protected Phases	5	2		1	6		3	8			4		
Permitted Phases	2			6		6	8		8	4			
Actuated Green, G (s)	84.7	82.3		101.5	93.8	93.8	27.7	27.7	27.7	6.8	6.8		
Effective Green, g (s)	84.7	82.3		101.5	93.8	93.8	27.7	27.7	27.7	6.8	6.8		
Actuated g/C Ratio	0.61	0.59		0.72	0.67	0.67	0.20	0.20	0.20	0.05	0.05		
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5		
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	179	2145		292	2495	1116	274	387	329	69	89		
v/s Ratio Prot	0.00	c0.40		c0.06	c0.41		c0.08	0.02			0.02		
v/s Ratio Perm	0.04			0.37		0.00	c0.06		0.02	0.02			
v/c Ratio	0.06	0.68		0.60	0.61	0.00	0.73	0.11	0.12	0.32	0.31		
Uniform Delay, d1	12.5	19.9		19.3	12.9	7.6	50.6	46.1	46.2	64.4	64.3		
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.1	1.8		3.3	1.1	0.0	10.4	0.1	0.2	2.7	2.0		
Delay (s)	12.7	21.7		22.5	14.0	7.6	61.0	46.2	46.3	67.0	66.4		
Level of Service	B	C		C	B	A	E	D	D	E	E		
Approach Delay (s)		21.6			14.9			52.9			66.6		
Approach LOS		C			B			D			E		
Intersection Summary													
HCM 2000 Control Delay			23.1									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.71										
Actuated Cycle Length (s)			140.0									Sum of lost time (s)	21.8
Intersection Capacity Utilization			76.5%									ICU Level of Service	D
Analysis Period (min)			15										

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: Shared Access & Ryan Rd

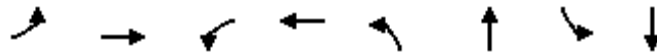
Background 2032 - PM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	1321	101	0	1512	0	54
Future Volume (Veh/h)	1321	101	0	1512	0	54
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1391	106	0	1592	0	57
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.72	0.84	0.72	
vC, conflicting volume			1497	2240	748	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			919	836	0	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	93	
cM capacity (veh/h)			533	257	783	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	927	570	796	796	57	
Volume Left	0	0	0	0	0	
Volume Right	0	106	0	0	57	
cSH	1700	1700	1700	1700	783	
Volume to Capacity	0.55	0.34	0.47	0.47	0.07	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.8	
Control Delay (s)	0.0	0.0	0.0	0.0	10.0	
Lane LOS						A
Approach Delay (s)	0.0		0.0		10.0	
Approach LOS						A
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			47.7%	ICU Level of Service	A	
Analysis Period (min)			15			

Queues
5: Back Rd & Ryan Rd

Background 2032 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	248	1336	41	983	358	60	45	243
v/c Ratio	0.81	0.73	0.41	0.82	1.01	0.09	0.21	0.62
Control Delay	39.3	18.5	38.5	33.6	74.5	15.7	32.1	20.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.3	18.5	38.5	33.6	74.5	15.7	32.1	20.5
Queue Length 50th (m)	21.1	74.3	4.9	71.7	~44.0	5.4	6.2	13.6
Queue Length 95th (m)	#67.3	118.0	#18.1	#118.2	#88.5	12.6	15.0	34.4
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	305	1840	101	1194	356	864	340	532
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.73	0.41	0.82	1.01	0.07	0.13	0.46

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

5: Back Rd & Ryan Rd

Background 2032 - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	243	933	376	40	886	77	351	52	7	44	62	176
Future Volume (vph)	243	933	376	40	886	77	351	52	7	44	62	176
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3565		1863	3681		1863	1926		1863	1743	
Flt Permitted	0.12	1.00		0.16	1.00		0.25	1.00		0.72	1.00	
Satd. Flow (perm)	242	3565		314	3681		486	1926		1408	1743	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	248	952	384	41	904	79	358	53	7	45	63	180
RTOR Reduction (vph)	0	45	0	0	7	0	0	4	0	0	124	0
Lane Group Flow (vph)	248	1291	0	41	976	0	358	56	0	45	119	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	41.8	41.8		26.8	26.8		29.8	29.8		12.8	12.8	
Effective Green, g (s)	41.8	41.8		26.8	26.8		29.8	29.8		12.8	12.8	
Actuated g/C Ratio	0.50	0.50		0.32	0.32		0.36	0.36		0.15	0.15	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	305	1797		101	1189		357	692		217	269	
v/s Ratio Prot	0.09	c0.36			0.27		c0.13	0.03			0.07	
v/s Ratio Perm	c0.32			0.13			c0.23			0.03		
v/c Ratio	0.81	0.72		0.41	0.82		1.00	0.08		0.21	0.44	
Uniform Delay, d1	16.7	16.0		21.8	25.8		23.4	17.5		30.6	31.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	16.9	2.5		5.5	5.2		48.3	0.1		1.0	2.4	
Delay (s)	33.6	18.5		27.3	31.1		71.8	17.6		31.6	34.2	
Level of Service	C	B		C	C		E	B		C	C	
Approach Delay (s)		20.9			30.9			64.0			33.8	
Approach LOS		C			C			E			C	

Intersection Summary

HCM 2000 Control Delay	30.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	82.9	Sum of lost time (s)	22.9
Intersection Capacity Utilization	94.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Total 20202 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	21	677	728	627	103	96	388	530	115	430
v/c Ratio	0.27	0.92	0.91	0.85	0.20	0.51	0.55	0.71	0.45	0.38
Control Delay	57.5	60.9	57.0	53.4	0.9	49.1	41.7	9.3	33.2	26.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.5	60.9	57.0	53.4	0.9	49.1	41.7	9.3	33.2	26.5
Queue Length 50th (m)	4.2	70.7	73.8	65.0	0.0	17.5	37.5	0.0	17.1	31.5
Queue Length 95th (m)	12.0	#105.2	#104.7	#93.2	0.0	34.1	52.3	29.6	30.6	44.9
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	78	733	812	735	506	187	709	746	258	1124
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.92	0.90	0.85	0.20	0.51	0.55	0.71	0.45	0.38
























Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Total 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	611	53	713	614	101	94	380	519	113	312	110
Future Volume (vph)	21	611	53	713	614	101	94	380	519	113	312	110
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3681		3614	3725	1667	1863	3725	1667	1863	3580	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.50	1.00	1.00	0.31	1.00	
Satd. Flow (perm)	1863	3681		3614	3725	1667	984	3725	1667	616	3580	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	623	54	728	627	103	96	388	530	115	318	112
RTOR Reduction (vph)	0	6	0	0	0	83	0	0	429	0	33	0
Lane Group Flow (vph)	21	671	0	728	627	20	96	388	101	115	397	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	4.4	20.7		23.2	20.7	20.7	20.0	20.0	20.0	32.0	32.0	
Effective Green, g (s)	4.4	20.7		23.2	20.7	20.7	20.0	20.0	20.0	32.0	32.0	
Actuated g/C Ratio	0.04	0.20		0.22	0.20	0.20	0.19	0.19	0.19	0.30	0.30	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	78	725		798	734	328	187	709	317	258	1091	
v/s Ratio Prot	c0.01	c0.18		c0.20	0.17			c0.10		0.03	c0.11	
v/s Ratio Perm						0.01	0.10		0.06	0.11		
v/c Ratio	0.27	0.92		0.91	0.85	0.06	0.51	0.55	0.32	0.45	0.36	
Uniform Delay, d1	48.7	41.4		39.9	40.7	34.3	38.1	38.4	36.6	27.6	28.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.3	19.4		16.5	12.1	0.4	2.4	0.9	0.6	1.2	0.9	
Delay (s)	57.0	60.8		56.4	52.8	34.6	40.5	39.3	37.2	28.9	29.5	
Level of Service	E	E		E	D	C	D	D	D	C	C	
Approach Delay (s)		60.7			53.3			38.3			29.3	
Approach LOS		E			D			D			C	
Intersection Summary												
HCM 2000 Control Delay			47.1								HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			105.0								Sum of lost time (s)	30.7
Intersection Capacity Utilization			77.1%								ICU Level of Service	D
Analysis Period (min)			15									
c Critical Lane Group												

Queues

Total 20202 - PM Peak Hour

3: Sandwich Rd & Ryan Rd






























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	10	1327	167	1313	3	209	38	176	19	38
v/c Ratio	0.03	0.60	0.50	0.49	0.00	0.80	0.10	0.39	0.23	0.32
Control Delay	7.2	20.0	12.0	10.3	0.0	74.1	45.6	8.7	69.5	51.6
Queue Delay	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.2	21.6	12.0	10.3	0.0	74.1	45.6	8.7	69.5	51.6
Queue Length 50th (m)	0.7	116.1	12.5	72.7	0.0	52.1	8.6	0.0	5.1	6.4
Queue Length 95th (m)	2.4	160.9	22.6	123.1	0.0	#78.7	17.9	18.6	13.4	17.7
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	324	2205	390	2684	1230	262	610	640	235	316
Starvation Cap Reductn	0	644	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.85	0.43	0.49	0.00	0.80	0.06	0.28	0.08	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: Sandwich Rd & Ryan Rd










Total 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 					 	 	
Traffic Volume (vph)	9	1061	173	155	1221	3	194	35	164	18	22	13
Future Volume (vph)	9	1061	173	155	1221	3	194	35	164	18	22	13
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3647		1863	3725	1667	1863	1961	1667	1863	1852	
Flt Permitted	0.18	1.00		0.12	1.00	1.00	0.40	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	360	3647		242	3725	1667	783	1961	1667	1436	1852	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	10	1141	186	167	1313	3	209	38	176	19	24	14
RTOR Reduction (vph)	0	7	0	0	0	1	0	0	142	0	13	0
Lane Group Flow (vph)	10	1320	0	167	1313	2	209	38	34	19	25	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	84.5	83.3		102.1	95.6	95.6	27.1	27.1	27.1	6.6	6.6	
Effective Green, g (s)	84.5	83.3		102.1	95.6	95.6	27.1	27.1	27.1	6.6	6.6	
Actuated g/C Ratio	0.60	0.59		0.73	0.68	0.68	0.19	0.19	0.19	0.05	0.05	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	230	2169		330	2543	1138	267	379	322	67	87	
v/s Ratio Prot	0.00	c0.36		c0.05	c0.35		c0.08	0.02			0.01	
v/s Ratio Perm	0.03			0.32		0.00	c0.07		0.02	0.01		
v/c Ratio	0.04	0.61		0.51	0.52	0.00	0.78	0.10	0.11	0.28	0.28	
Uniform Delay, d1	11.4	18.0		13.4	10.9	7.0	51.4	46.4	46.5	64.4	64.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.3		1.2	0.8	0.0	14.6	0.1	0.1	2.3	1.8	
Delay (s)	11.5	19.3		14.6	11.6	7.1	66.0	46.5	46.6	66.7	66.2	
Level of Service	B	B		B	B	A	E	D	D	E	E	
Approach Delay (s)		19.2			12.0			56.2			66.4	
Approach LOS		B			B			E			E	
Intersection Summary												
HCM 2000 Control Delay			21.5				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			140.0				Sum of lost time (s)			21.8		
Intersection Capacity Utilization			71.7%				ICU Level of Service			C		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

Total 20202 - PM Peak Hour

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1118	125	0	1295	0	60
Future Volume (Veh/h)	1118	125	0	1295	0	60
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	1202	134	0	1392	0	65
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked				0.77	0.86	0.77
vC, conflicting volume				1336	1965	668
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				842	854	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				100	100	92
cM capacity (veh/h)				609	256	836
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	801	535	696	696	65	
Volume Left	0	0	0	0	0	
Volume Right	0	134	0	0	65	
cSH	1700	1700	1700	1700	836	
Volume to Capacity	0.47	0.31	0.41	0.41	0.08	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.9	
Control Delay (s)	0.0	0.0	0.0	0.0	9.7	
Lane LOS						A
Approach Delay (s)	0.0		0.0		9.7	
Approach LOS						A
Intersection Summary						
Average Delay				0.2		
Intersection Capacity Utilization				43.3%	ICU Level of Service	A
Analysis Period (min)				15		

Queues

Total 20202 - PM Peak Hour

5: Back Rd & Ryan Rd

























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	217	1165	41	863	309	52	39	213
v/c Ratio	0.69	0.63	0.27	0.74	0.98	0.08	0.18	0.53
Control Delay	24.8	13.6	24.8	25.9	71.1	14.4	26.6	13.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	13.6	24.8	25.9	71.1	14.4	26.6	13.6
Queue Length 50th (m)	13.9	46.2	3.8	48.7	31.0	3.9	4.4	6.3
Queue Length 95th (m)	#43.4	78.4	12.8	77.0	#72.4	10.3	11.7	22.5
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	314	1850	150	1172	314	958	454	665
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.63	0.27	0.74	0.98	0.05	0.09	0.32

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Total 20202 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	208	801	318	39	763	65	297	44	6	37	54	151
Future Volume (vph)	208	801	318	39	763	65	297	44	6	37	54	151
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3567		1863	3681		1863	1927		1863	1744	
Flt Permitted	0.15	1.00		0.24	1.00		0.32	1.00		0.72	1.00	
Satd. Flow (perm)	286	3567		477	3681		635	1927		1418	1744	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	217	834	331	41	795	68	309	46	6	39	56	157
RTOR Reduction (vph)	0	46	0	0	8	0	0	4	0	0	133	0
Lane Group Flow (vph)	217	1119	0	41	855	0	309	48	0	39	80	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	34.8	34.8		21.8	21.8		22.6	22.6		10.6	10.6	
Effective Green, g (s)	34.8	34.8		21.8	21.8		22.6	22.6		10.6	10.6	
Actuated g/C Ratio	0.51	0.51		0.32	0.32		0.33	0.33		0.15	0.15	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	314	1806		151	1168		316	633		218	269	
v/s Ratio Prot	0.07	c0.31			0.23		c0.09	0.02			0.05	
v/s Ratio Perm	c0.27			0.09			c0.24			0.03		
v/c Ratio	0.69	0.62		0.27	0.73		0.98	0.08		0.18	0.30	
Uniform Delay, d1	12.2	12.2		17.5	20.9		21.9	15.9		25.3	25.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.1	1.6		2.0	2.9		44.6	0.1		0.8	1.3	
Delay (s)	20.3	13.8		19.5	23.8		66.5	16.0		26.1	27.1	
Level of Service	C	B		B	C		E	B		C	C	
Approach Delay (s)		14.8			23.6			59.2			26.9	
Approach LOS		B			C			E			C	
Intersection Summary												
HCM 2000 Control Delay			24.1			HCM 2000 Level of Service		C				
HCM 2000 Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			68.7			Sum of lost time (s)		22.9				
Intersection Capacity Utilization			85.0%			ICU Level of Service		E				
Analysis Period (min)			15									

c Critical Lane Group

Queues
2: Ryan Rd & Hwy 19A

Total 2032 - PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	25	780	839	723	117	111	449	608	131	499
v/c Ratio	0.26	1.03	1.00	0.95	0.23	0.63	0.63	0.76	0.60	0.46
Control Delay	59.2	84.3	75.6	67.3	1.1	60.2	47.3	10.5	44.0	31.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.2	84.3	75.6	67.3	1.1	60.2	47.3	10.5	44.0	31.6
Queue Length 50th (m)	5.4	~96.6	96.5	84.0	0.0	22.9	48.7	1.5	22.0	43.2
Queue Length 95th (m)	14.2	#134.5	#137.2	#119.5	0.0	#45.8	65.5	36.6	37.4	58.7
Internal Link Dist (m)		218.2		151.6			135.9			113.9
Turn Bay Length (m)			65.0		80.0	80.0		80.0	100.0	
Base Capacity (vph)	97	760	839	764	502	176	712	804	218	1088
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	1.03	1.00	0.95	0.23	0.63	0.63	0.76	0.60	0.46
























Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ryan Rd & Hwy 19A

Total 2032 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	718	62	839	723	117	111	449	608	131	369	130
Future Volume (vph)	25	718	62	839	723	117	111	449	608	131	369	130
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3681		3614	3725	1667	1863	3725	1667	1863	3580	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.47	1.00	1.00	0.25	1.00	
Satd. Flow (perm)	1863	3681		3614	3725	1667	920	3725	1667	498	3580	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	25	718	62	839	723	117	111	449	608	131	369	130
RTOR Reduction (vph)	0	6	0	0	0	93	0	0	485	0	30	0
Lane Group Flow (vph)	25	774	0	839	723	24	111	449	123	131	469	0
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA	Perm	pm+pt	NA	
Protected Phases	9	4		3	4			2		1	6	
Permitted Phases						4	2		2	6		
Actuated Green, G (s)	6.0	23.6		26.7	23.6	23.6	22.0	22.0	22.0	34.0	34.0	
Effective Green, g (s)	6.0	23.6		26.7	23.6	23.6	22.0	22.0	22.0	34.0	34.0	
Actuated g/C Ratio	0.05	0.21		0.23	0.21	0.21	0.19	0.19	0.19	0.30	0.30	
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.0	6.0	6.0	5.5	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	97	755		839	764	342	176	712	318	218	1058	
v/s Ratio Prot	c0.01	c0.21		c0.23	0.19			0.12		c0.03	0.13	
v/s Ratio Perm						0.01	0.12		0.07	c0.15		
v/c Ratio	0.26	1.03		1.00	0.95	0.07	0.63	0.63	0.39	0.60	0.44	
Uniform Delay, d1	52.4	45.7		44.1	45.1	36.9	42.8	42.8	40.6	31.8	32.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.3	39.5		31.1	21.8	0.4	7.2	1.8	0.8	4.6	1.3	
Delay (s)	58.7	85.2		75.2	66.9	37.2	49.9	44.6	41.4	36.4	34.2	
Level of Service	E	F		E	E	D	D	D	D	D	C	
Approach Delay (s)		84.3			69.0			43.4			34.6	
Approach LOS		F			E			D			C	
Intersection Summary												
HCM 2000 Control Delay	59.9			HCM 2000 Level of Service				E				
HCM 2000 Volume to Capacity ratio	0.85											
Actuated Cycle Length (s)	115.0			Sum of lost time (s)				30.7				
Intersection Capacity Utilization	85.7%			ICU Level of Service				E				
Analysis Period (min)	15											
c Critical Lane Group												

Queues

Total 2032 - PM Peak Hour

3: Sandwich Rd & Ryan Rd




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	11	1522	189	1519	4	233	44	204	22	44
v/c Ratio	0.05	0.71	0.65	0.58	0.00	0.86	0.12	0.42	0.27	0.35
Control Delay	8.0	24.5	30.1	13.5	0.0	79.7	45.1	8.7	70.2	50.8
Queue Delay	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.0	29.5	30.1	13.5	0.0	79.7	45.1	8.7	70.2	50.8
Queue Length 50th (m)	0.8	152.5	22.3	94.5	0.0	58.4	9.9	0.4	5.9	7.2
Queue Length 95th (m)	2.7	210.3	47.4	158.2	0.0	#91.3	19.8	20.0	14.7	19.3
Internal Link Dist (m)		151.6		67.8			58.5			112.4
Turn Bay Length (m)	50.0		50.0		50.0			35.0	35.0	
Base Capacity (vph)	254	2142	338	2599	1194	272	619	664	234	317
Starvation Cap Reductn	0	548	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.95	0.56	0.58	0.00	0.86	0.07	0.31	0.09	0.14

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3: Sandwick Rd & Ryan Rd

Total 2032 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	10	1243	203	180	1443	4	221	42	194	21	26	16
Future Volume (vph)	10	1243	203	180	1443	4	221	42	194	21	26	16
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3647		1863	3725	1667	1863	1961	1667	1863	1847	
Flt Permitted	0.13	1.00		0.08	1.00	1.00	0.40	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	253	3647		151	3725	1667	790	1961	1667	1428	1847	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	11	1308	214	189	1519	4	233	44	204	22	27	17
RTOR Reduction (vph)	0	7	0	0	0	1	0	0	162	0	16	0
Lane Group Flow (vph)	11	1515	0	189	1519	3	233	44	42	22	28	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	83.3	80.9		101.2	93.5	93.5	28.0	28.0	28.0	6.8	6.8	
Effective Green, g (s)	83.3	80.9		101.2	93.5	93.5	28.0	28.0	28.0	6.8	6.8	
Actuated g/C Ratio	0.59	0.58		0.72	0.67	0.67	0.20	0.20	0.20	0.05	0.05	
Clearance Time (s)	5.3	5.5		5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	5.0		3.0	5.0	5.0	4.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	178	2107		290	2487	1113	278	392	333	69	89	
v/s Ratio Prot	0.00	c0.42		c0.07	0.41		c0.09	0.02			0.02	
v/s Ratio Perm	0.04			0.40		0.00	c0.07		0.03	0.02		
v/c Ratio	0.06	0.72		0.65	0.61	0.00	0.84	0.11	0.13	0.32	0.31	
Uniform Delay, d1	12.9	21.3		28.5	13.0	7.7	51.4	45.8	46.0	64.4	64.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	2.1		5.2	1.1	0.0	20.0	0.1	0.2	2.7	2.0	
Delay (s)	13.1	23.5		33.7	14.2	7.7	71.5	46.0	46.1	67.0	66.4	
Level of Service	B	C		C	B	A	E	D	D	E	E	
Approach Delay (s)		23.4			16.3			58.4			66.6	
Approach LOS		C			B			E			E	
Intersection Summary												
HCM 2000 Control Delay			25.4									HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			140.0								21.8	Sum of lost time (s)
Intersection Capacity Utilization			80.1%									ICU Level of Service D
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Shared Access & Ryan Rd

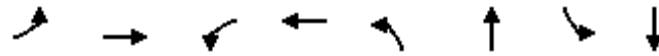
Total 2032 - PM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↗
Traffic Volume (veh/h)	1321	137	0	1527	0	67
Future Volume (Veh/h)	1321	137	0	1527	0	67
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1391	144	0	1607	0	71
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)	92			333		
pX, platoon unblocked			0.70	0.82	0.70	
vC, conflicting volume			1535	2266	768	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			902	780	0	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	91	
cM capacity (veh/h)			523	272	757	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	927	608	804	804	71	
Volume Left	0	0	0	0	0	
Volume Right	0	144	0	0	71	
cSH	1700	1700	1700	1700	757	
Volume to Capacity	0.55	0.36	0.47	0.47	0.09	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	2.3	
Control Delay (s)	0.0	0.0	0.0	0.0	10.2	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		10.2	
Approach LOS					B	
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			49.4%	ICU Level of Service		A
Analysis Period (min)			15			

Queues
5: Back Rd & Ryan Rd

Total 2032 - PM Peak Hour



























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	250	1347	45	996	358	60	45	246
v/c Ratio	0.82	0.73	0.46	0.84	1.01	0.09	0.21	0.62
Control Delay	40.2	18.8	43.1	34.4	75.1	15.7	32.0	20.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.2	18.8	43.1	34.4	75.1	15.7	32.0	20.9
Queue Length 50th (m)	21.6	75.8	5.5	73.4	~44.2	5.4	6.2	14.1
Queue Length 95th (m)	#68.0	119.7	#21.1	#120.9	#88.9	12.6	15.0	35.3
Internal Link Dist (m)		309.2		148.4		147.2		151.8
Turn Bay Length (m)	75.0		45.0		40.0		25.0	
Base Capacity (vph)	305	1837	97	1192	355	863	339	531
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.73	0.46	0.84	1.01	0.07	0.13	0.46

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Back Rd & Ryan Rd

Total 2032 - PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Traffic Volume (vph)	245	944	376	44	899	77	351	52	7	44	63	178
Future Volume (vph)	245	944	376	44	899	77	351	52	7	44	63	178
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.98		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3566		1863	3681		1863	1926		1863	1743	
Flt Permitted	0.12	1.00		0.15	1.00		0.25	1.00		0.72	1.00	
Satd. Flow (perm)	242	3566		303	3681		482	1926		1408	1743	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	250	963	384	45	917	79	358	53	7	45	64	182
RTOR Reduction (vph)	0	44	0	0	7	0	0	4	0	0	123	0
Lane Group Flow (vph)	250	1303	0	45	989	0	358	56	0	45	123	0
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	41.8	41.8		26.8	26.8		30.0	30.0		13.0	13.0	
Effective Green, g (s)	41.8	41.8		26.8	26.8		30.0	30.0		13.0	13.0	
Actuated g/C Ratio	0.50	0.50		0.32	0.32		0.36	0.36		0.16	0.16	
Clearance Time (s)	5.6	5.5		5.5	5.5		6.0	5.8		5.8	5.8	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	305	1793		97	1187		356	695		220	272	
v/s Ratio Prot	0.09	c0.37			0.27		c0.13	0.03			0.07	
v/s Ratio Perm	c0.32			0.15			c0.23			0.03		
v/c Ratio	0.82	0.73		0.46	0.83		1.01	0.08		0.20	0.45	
Uniform Delay, d1	17.0	16.2		22.4	26.1		23.4	17.5		30.5	31.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	17.5	2.6		7.2	5.7		49.1	0.1		1.0	2.5	
Delay (s)	34.5	18.8		29.6	31.8		72.5	17.6		31.5	34.3	
Level of Service	C	B		C	C		E	B		C	C	
Approach Delay (s)		21.3			31.7			64.6			33.9	
Approach LOS		C			C			E			C	

Intersection Summary

HCM 2000 Control Delay	31.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	83.1	Sum of lost time (s)	22.9
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group