TRANSPORTATION PLANNERS AND ENGINEERS

The Slopes
Transportation Impact Assessment

Final Report

Prepared for:	Longview Planning + Design
Date:	January 19, 2011
Prepared by:	Bunt & Associates Engineering (Alberta) Ltd.
Project No.:	1328-01
Permit No.:	P7694

January 19, 2011
1328-01

Kristi Beunder
Longview Planning + Design
#325, 259 Midpark Way SE
Calgary, AB T2X 1M2

Dear Kristi:

Re: The Slopes – Transportation Impact Assessment

Please find attached our Transportation Impact Assessment for the above noted project in Lacombe County. The analysis summarized in this report was undertaken in accordance with the County's requirements and our typical practices in organizing such studies. The conclusions and recommendations confirm the impacts of the development on the adjacent road network.

Pease call if you have any questions or wish to discuss any issue in further detail.

Yours truly,
Bunt & Associates

Ryan Martinson, P.Eng.
Transportation Engineer
RM/rm
Encl.

PROFESSIONAL ENGINEER ALBERTA
RYAN J. MARTINSON
JAN 19, 2011

PERMIT TO PRACTICE
Bunt & Associates Engineering (Alberta) Ltd.
Signature
Date JAN 19/11
PERMIT NUMBER: P 7694
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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1.0 EXECUTIVE SUMMARY

Longview Planning + Design is directing the development approval for *The Slopes* on behalf on Belterra Land Company. Bunt & Associates was retained to provide support in the way of necessary Transportation Planning and Traffic Engineering for the proposed development. As part of the application process, Lacombe County required the submission of a Transportation Impact Assessment (TIA) that addresses the impact on the existing transportation network and ascertains the traffic generation and cumulative impacts on the road network.

The proposed site is expected to generate 36 trips in the AM peak hour, 49 trips in the PM peak hour, and 460 trips daily.

1.1 Background Traffic Conditions

- It is recommended that the current intersection of Birchcliff Road and Range Road 1-4 be enhanced through signage. These signs include Reverse Curve Warning Signs (WA-5), Checkerboard Signs (WA-8), Concealed Road Signs (WA-13L and WA-13R), and Stop Ahead Sign (WB-1). These signs would replace the existing regulatory 20 km/h sign for the eastbound traffic, yet still highlight the important curve and intersection to the oncoming motorists.

- The intersection of Birchcliff Road and Range Road 1-4 is expected to operate within the acceptable capacity parameters in both background horizons.

- Range Road 1-4 is estimated to carry between 420-440 vpd in the background horizons and, as such, requires dust control surface treatment. The current surface treatment of Birchcliff Road, paved, is adequate for the background horizons.

- There is no significant collision trend at the intersection of Birchcliff Road and Range Road 1-4. As such, no improvements are required to address safety concerns due to background traffic growth.

- There is an existing sight distance issue at the intersection of Birchcliff Road and Range Road 1-4 intersection looking west. This condition is consistent in all background and post-development horizons. To address this inadequacy in sight distance a number of mitigation measures are suggested. They are move the existing stop bar, clear the vegetation, and/or realign the intersection. These mitigation measures should be considered in the order that they are presented, since each subsequent mitigation measure builds on the improvements implemented in the previous measure.

- At the Range Road 1-4 and Site Access intersection the decision and turning sight distances are not met. In order to meet the required sight distances at this location, it is recommended that the speed of Range Road 1-4 be reduced to 50 km/h from Birchcliff Road to north of the Site Access.

- The illumination warrant completed at the intersection of Birchcliff Road and Range Road 1-4 scored 73 points. Since a minimum of 120 points is required for the warrant to be met, illumination is not currently warranted at this location due to background traffic growth.

1.2 Post-Development Intersection Conditions

- All intersections are expected to continue to operate within acceptable capacity parameters in the Opening Day and 20-Year Post-Development horizons.
- The intersection of Range Road 1-4 and Site Access will require a Type II intersection at the Opening Day horizon as a result of site generated traffic.
- Based on the Opening Day and 20-Year Post-Development traffic volumes, the section of Range Road 1-4 between the Site Access and Birchcliff Road warrants a paved surface treatment as a result of site generated traffic. All other road links analyzed have adequate surface treatments.
- The illumination warrant completed at the intersection of Birchcliff Road and Range Road 1-4 scored 73 points and Range Road 1-4 and Site Access scored 28 points, for both horizons. Since a minimum of 120 points is required for the warrant to be met, illumination is not warranted at these locations due to site generated traffic.
- All roadways within the proposed development will be classified as local roads based on their function and the expected daily traffic volumes.

2.0 INTRODUCTION

2.1 Background

Longview Planning and Design is directing the development approval for *The Slopes*, a residential development on the north shore of Sylvan Lake. Bunt & Associates was retained to provide support in the way of necessary Transportation Planning and Traffic Engineering for the proposed development. As part of the application process, Lacombe County required the submission of a Transportation Impact Assessment (TIA) that addresses the impact of the proposed development on the existing transportation network.

2.2 Study Scope

This report was prepared to investigate the transportation impacts of the proposed development on the adjacent road network. Based on discussions with the County related to the site, the scope of work for the proposed development was as follows:

- Data collection and assessment of existing conditions.
- Development of Background (2010) and Future Background (2030) traffic volumes considering other approved developments in the area
- Assessment of expected traffic conditions under full build-out conditions. Analysis was completed for both study horizons and included the assessment of road functions, intersection geometric requirements, intersection capacity requirements, sight distance review, crash history review, and illumination requirements.

The two intersections that were considered in this study were the intersections of Range Road 1-4 and Birchcliff Road, and the intersection of Range Road 1-4 and the Site Access. The County[1] approved the scope and study locations for this study and the correspondence regarding the scope has been included in **Appendix A**.

The remainder of the report describes the methodologies and assumptions used in this study and provides recommendations regarding improvements required to accommodate the proposed development on the existing road infrastructure.

[1] See email correspondence with Allan Williams dated June 2, 2010

3.0 STUDY AREA

3.1 Subject Site

The proposed residential development site is located on the north side of Sylvan Lake, approximately 4 kilometres north of the Town of Sylvan Lake, adjacent to the Summer Village of Birchcliff in Lacombe County. The development will consist of 49 residential lots and have a single access off of Range Road 1-4. The subject study area and adjacent road network is illustrated in **Exhibit 3.1**. The analysis completed in this study specifically assesses the total build out of the 49 units at the post-development horizon.

3.2 Existing Transportation Network

Range Road 1-4 is classified as a Local Road Type A by Lacombe County and runs north-south parallel to the eastern boundary of the site. This roadway has an approximate 7.2 metre gravel top surface and will provide the only access to/from the site to Birchcliff Road to the south and Rainy Creek Road and Township Road 39-4 to the north. The posted speed limit is 80 km/h.

Birchcliff Road is classified as a Main Access Road by Lacombe County and runs east to Highway 20 from the Summer Village of Birchcliff. This roadway has an approximate 6.8 metre paved surface width[2] and is the southern boundary of the site. Range Road 1-4 connects with Birchcliff Road at a T-intersection with Birchcliff Road having free flow conditions. At the intersection of Birchcliff Road and Range Road 1-4, the eastbound speed limit is 20 km/h and the westbound speed limit is 50 km/h.

It is not typical practice to have varying speed limits for opposing directions of travel. As such, it was assumed (and confirmed in analysis) that the speed reduction currently in place was a result of sight distance issues. However, rather than implementing a regulated speed reduction at this intersection, it is instead recommended that a:

i. Reverse Curve Warning Sign (WA-5) be installed in advance of the S-curve on Birchcliff Road with a tab of 20 km/h[3],

ii. Checkerboard Signs (WA-8) be installed within the curve,

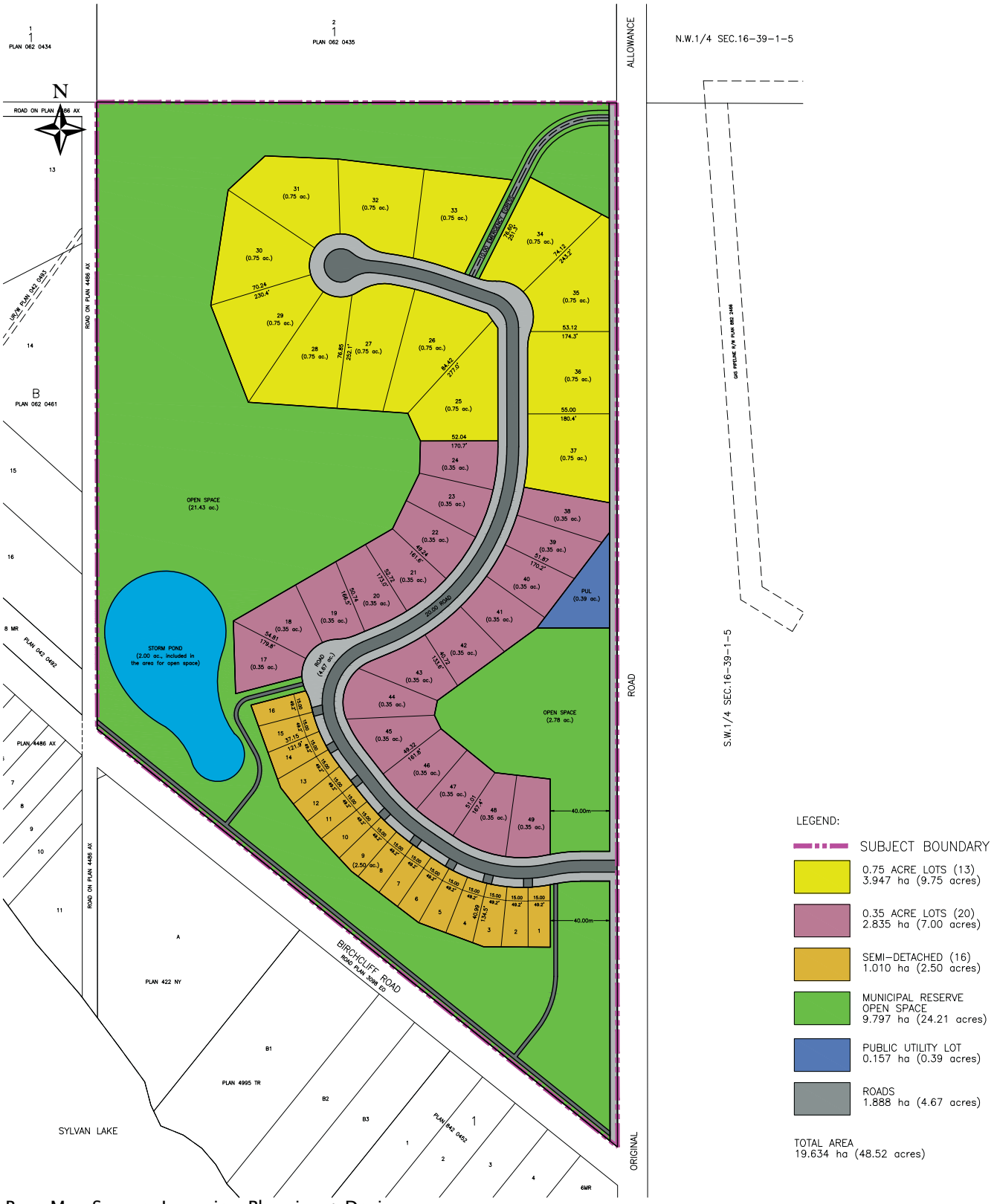
iii. Concealed Road Signs (WA-13L and WA-13R) be installed in advance of the intersection of Range Road 1-4, and

iv. Stop Ahead Sign (WB-1) be installed in advance of the southbound stop sign on Range Road 1-4.

[2] On-site measurements taken on July 16, 2010 confirm the roadway width to be approximately 6.8 metres near the intersection of Range Road 1-4 and approximately 9 metres near the intersection of Highway 20.
3 This 20 km/h was recommended based on the existing posted speed of 20 km/h for the eastbound movement. A ball-bank study should be completed to confirm the appropriateness of this speed recommendation.

These signs would replace the existing regulatory 20 km/h sign for the eastbound traffic, yet still highlight the important curve and intersection to the oncoming motorists.

Both roadways are under the jurisdiction of Lacombe County.



Base Map Source: Longview Planning + Design

Exhibit 3.1

Site Plan and Adjacent Road Network

The Slopes
January 2011 Scale NTS

4.0 BACKGROUND TRAFFIC AND GEOMETRIC CONDITIONS

To assess the impacts of the proposed development on the existing road infrastructure, it was first necessary to establish a baseline comparison without consideration of the site traffic volumes. For this study there were two study horizons, Opening Day and 20 years into the future (referred to in this report as "20-Year"). The methodologies and results of the analysis are described in the following sections.

4.1 Opening Day BAckground and 20-Year BAckground Traffic Volumes

On Thursday June 3, 2010, Bunt & Associates completed a turning movement count at the intersection of Range Road 1-4 and Birchcliff Road. This count was conducted during the weekday AM and PM Peak Hours (7:00-9:00am and 4:00-6:00pm) peak periods. In addition to the existing traffic volumes collected, Bunt & Associates was made aware of transportation study completed by ISL Engineering for a similar development to the north of the proposed site. The site traffic volumes for this site were superimposed onto the existing counts collected by Bunt & Associates to create the Opening Day Background Traffic Volumes.

As mentioned, the study scope also included a 20-year future horizon to be analyzed, which is referred to as the 20-Year Background. To estimate the traffic volumes at this horizon the traffic volumes collected by Bunt & Associates were increased by Alberta Transportation's standard growth rate of 2.5% per year (linear) to which the ISL Engineering site traffic volumes were then added.

The turning movement volumes are summarized in **Exhibit 4.1** for both the Background and the count data is provided in **Appendix B**.

4.2 Traffic Control

The roadway network in the vicinity of the site is rural and country residential in nature, with all intersections in the area either exhibiting uncontrolled or stop-controlled conditions. The intersection of Range Road 1-4 and Birchcliff Road is stop-controlled with Birchcliff Road exhibiting free-flow conditions. No signalized intersections are present in the area. The orientation of the stop controls and the laning at the study intersections are illustrated in **Exhibit 4.2**.

Traffic control was assumed to remain the same for both the Opening Day Background and 20-Year Background horizons.

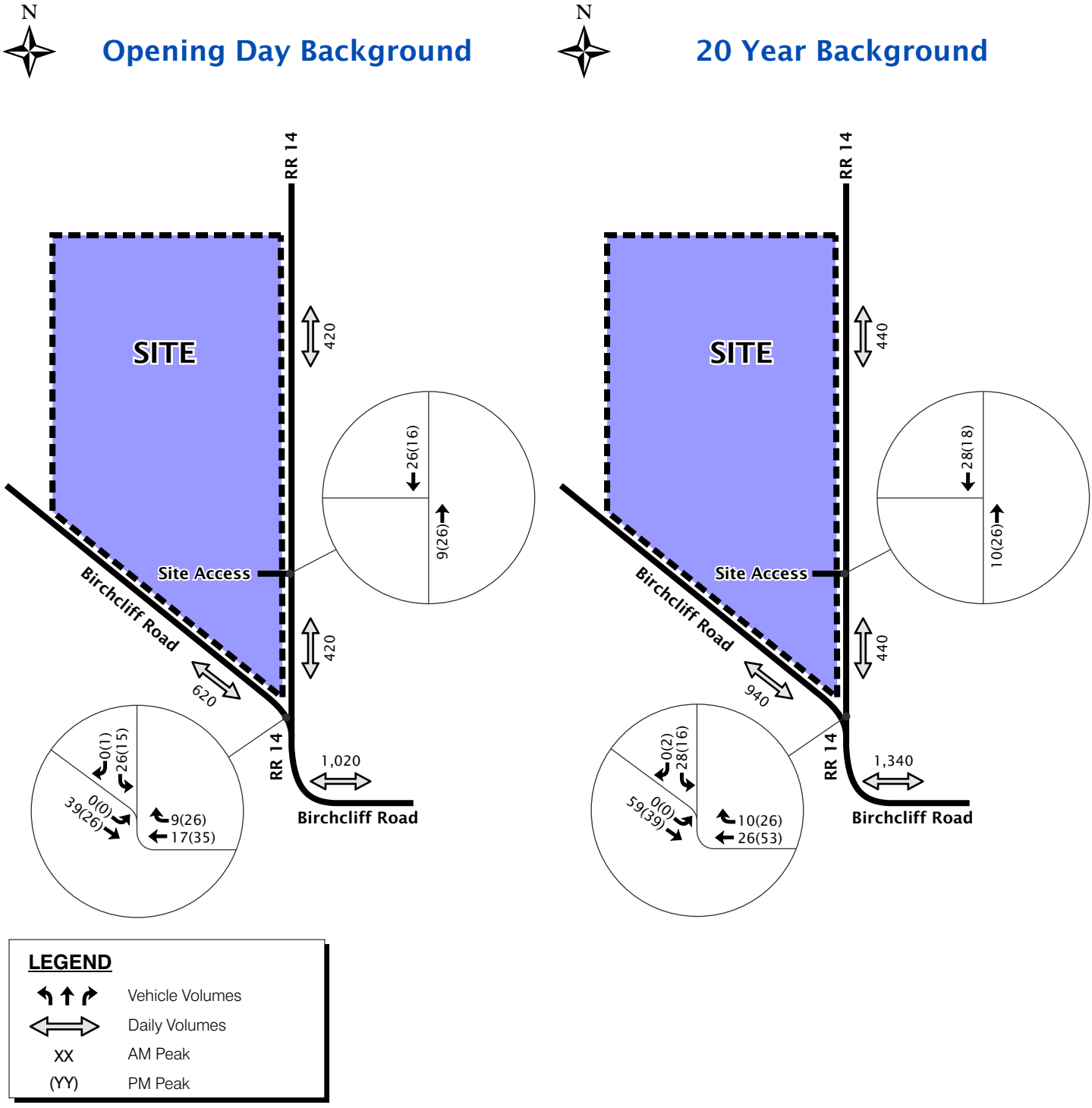


Exhibit 4.1

Opening Day Background and 20 Year Background Traffic Volumes

The Slopes
January 2011 Scale NTS

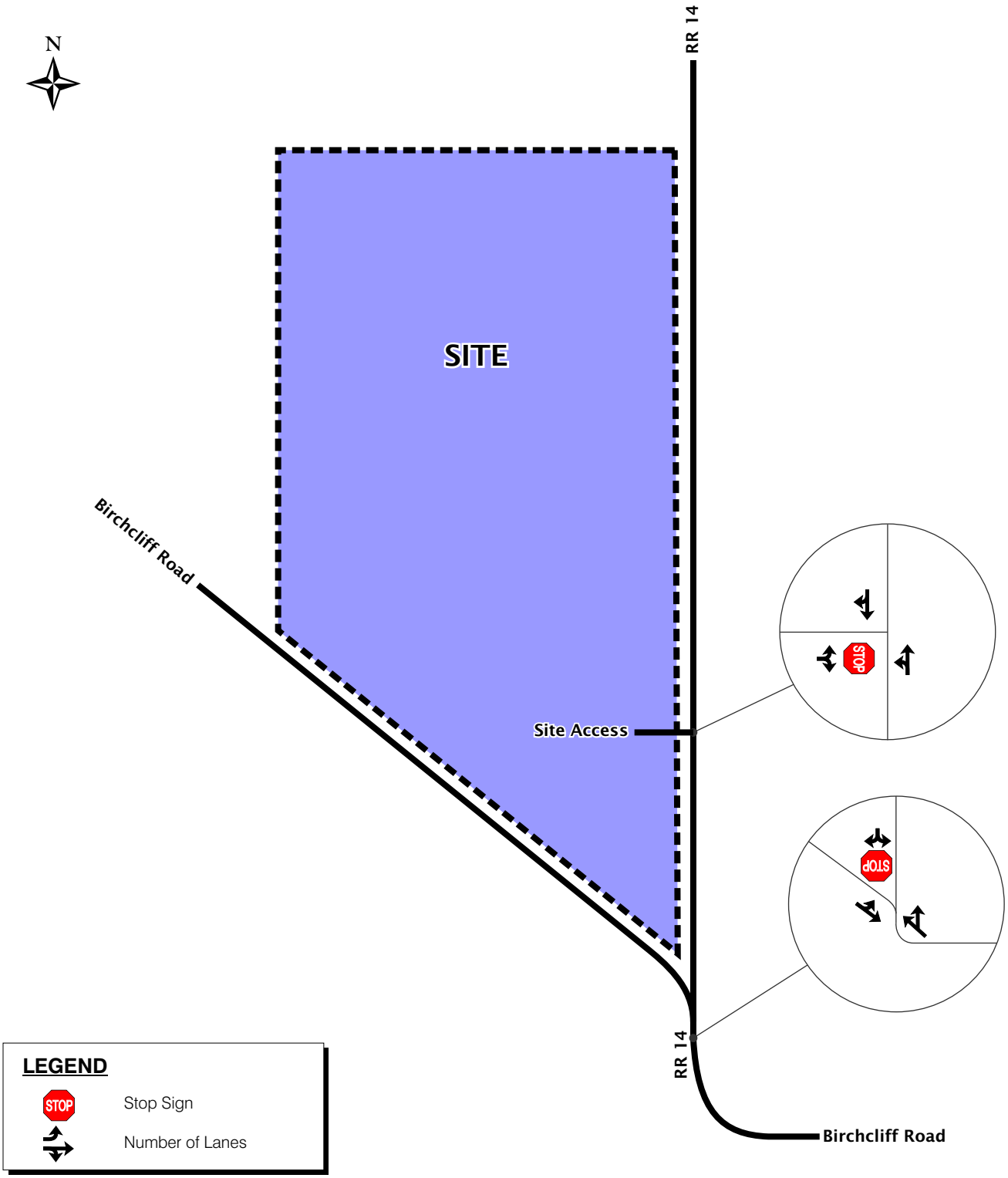


Exhibit 4.2

Existing Traffic Controls

The Slopes
January 2011 Scale NTS

4.3 Intersection Conditions

Two methods were used to assess the conditions at the study intersections; specifically intersection capacity analysis and Alberta Transportation (AT) Geometric Review. Intersection capacity analysis assesses the operation of the intersection with respect to the traffic volumes, intersection control, and lane configurations. The AT Geometric Review uses the turning movement volumes to determine whether specific geometric improvements are required with respect to highway design. The results of both analyses are described below.

4.3.1 Intersection Capacity Analysis

Intersection capacity analysis was undertaken for the study area intersections using Synchro 7.0, a traffic analysis software package based on the methods outlined in the Highway Capacity Manual.

The intersection capacity analysis was conducted based on the current and forecasted traffic volumes for the weekday AM and PM peak hours. Individual critical movements are assessed based on proportion of utilized capacity (a volume to capacity or v/c ratio) and on delay (the level of service or LOS). A level of Service of "A" represents ideal, free-flow conditions, and a LOS of "F" represents the failure of the critical movement. A LOS of "C" or "D" and a v/c of less than 0.90 is generally acceptable as a basis for rural design. If the volume-to-capacity ratios are greater than 0.9 and/or LOS values are D, E or F, then intersection/road improvements may be warranted.

The results of the Opening Day Background and 20-Year Background intersection capacity analysis were based on the each study horizon's traffic volumes, traffic control, and lane arrangement for the study intersection. It is noted that the saturation flow of 1550 vehicles per hour and peak hour factor of 0.95 were used in the analysis. These are consistent with the past studies conducted in rural Alberta. The existing intersection capacity analysis is summarized in **Table 4.1** and **Table 4.2**. All Synchro output is provided in **Appendix C**.

Table 4.1: Intersection Capacity Analysis – Opening Day Background

Intersection	Movement	AM			PM		
		v/c	LOS	95% Q(m)	v/c	LOS	95% Q(m)
Birchcliff Road & Range Road 1-4	EBL/T	<0.01	A	<1	<0.01	A	<1
	WBT/R	0.02	A	<1	0.04	A	<1
	SBL/R	0.03	A	1	0.02	A	1

Table 4.2: Intersection Capacity Analysis – 20-Year Background

Intersection	Movement	AM			PM		
		v/c	LOS	95% Q(m)	v/c	LOS	95% Q(m)
Birchcliff Road & Range Road 1-4	EBL/T	0.00	A	<1	0.00	A	<1
	WBT/R	0.02	A	<1	0.05	A	<1
	SBL/R	0.03	A	1	0.02	A	1

As summarized in the tables above, the intersection is expected to operate within the acceptable capacity parameters in both background horizons.

4.3.2 AT Geometric Review

Using the AT Geometric Design Guidelines, the treatment of the Site Access and Range Road 1-4 intersection was determined. Since the Site Access intersection does not exist in either of the Background horizons, the AT Geometric Review was not completed as part of the background traffic conditions assessment.

With respect to the Birchcliff Road and Range Road 1-4 intersection, because of the specific geometry and reduced speed at that intersection, the AT intersection treatment standards would not apply. As such, for that intersection the capacity analysis and sight distance requirements were used in confirming the geometric requirements.

4.4 Road Link Analysis

There are a number of factors that are considered in the classification of a roadway, such as adjacent land use, service function, traffic volume, flow characteristics, running speed, and vehicle type[4]. For the general identification of roadway classification, many municipalities use traffic volume as a guide, though this can and should be modified on a case-by-case basis after considering the other criteria as part of the overall recommendation. Lacombe County primarily uses roadway functions to determine the classification of their road system, but augments this with daily traffic volumes for some classifications[5]. For this study, the daily traffic volumes were used to determine the appropriate surface treatment type, rather than for classification purposes.

[4] Transportation Association of Canada (TAC) – Geometric Design Guide for Canadian Roads
[5] Lacombe County - Road Designations and Standards

The daily traffic volumes were determined using data collected by Bunt & Associates at the intersection of Birchcliff Road and Range Road 1-4. Applying the industry standard ratio of 10 daily trips to 1 peak hour trip, the daily traffic volumes for the subject roadway links were found. The daily traffic volumes for the Background and Future Background horizons are summarized in **Table 4.3**.

Table 4.3: Daily Traffic Volumes - Background

Roadway	Opening Day Background Daily Traffic Volume (vpd)	20-Year Background Daily Traffic Volume (vpd)	Existing Surface Treatment	Recommended Treatment
Birchcliff Road west of Range Road 1-4	620	940	Paved	Same as existing
Birchcliff Road east of Range Road 1-4	1020	1340	Paved	Same as existing
Range Road 1-4 north of Birchcliff Road	420	440	Gravel	Dust Control

The guidelines used by Alberta Transportation for the surface treatment of a road state that a road with a daily traffic volumes between 200 and 500 vehicles warrants dust control and a road with higher daily traffic should be considered for paving. Based on this guideline, Range Road 1-4 requires dust control and is approaching the paving threshold. The functions of both roadways remain consistent with the Lacombe County standards and, as such, no changes of the road classifications are recommended.

4.4.1 Collision Data

Bunt & Associates received collision data from Alberta Transportation for the intersection of Birchcliff Road and Range Road 1-4. The data is the most current available from the province and summarizes collisions reported between 2004-2008. Based on the information received from the Province, there were two collisions that took place at or near the intersection, both of which were a collision with a deer. The collisions resulted in property damage only (i.e. no injuries or fatalities). One collision occurred in July 2004 at approximately 6:30 PM and the other in February 2006 at approximately 5:15 PM. For both collisions the road conditions were not reported.

Based on the low frequency of collisions at this location, there is no significant collision trend that can be concluded. It is expected that the current safety characteristics of the roadway will remain and, as such, no improvements are required to address safety concerns.

4.4.2 Sight Distance Review

A sight distance assessment was undertaken at the intersection of Range Road 1-4 and Birchcliff Road and at the proposed site access on Range Road 1-4 to confirm the safety for turning movements and through movements. For this location, the intersection sight distance, decision sight distance and stopping sight distance are of primary concern and passing sight distance and non-striping sight distance is less of an issue since passing is generally not allowed[6].

The posted speed at the intersection of Birchcliff Road and Range Road 1-4 is 20 km/h for the eastbound traffic and 50 km/h for the westbound traffic. As already mentioned, it is recommended that both directions of travel have the same speed limit (50 km/h) at this intersection. As such, it was assumed that the enhanced warning signage would replace the speed reduction for the eastbound traffic. The posted speed at the Site Access and Range Road 1-4 intersection is 80 km/h. The sight distance requirements for these two intersections were based on an assumed design speed of 50 km/h on Birchcliff Road and 90 km/h (posted speed of 80 km/h plus 10 km/h) on Range Road 1-4.

Stopping sight distance is the distance a vehicles travels from the instant the driver sights/reacts to an object on the road, to the time the vehicles physically reaches a complete stop after applying the brake. In the case of Birchcliff Road and Range Road 1-4, the minimum stopping sight distance requirement would be 65 metres, and the desirable decision sight distance requirement would be in the order of 130-200 metres (the range accounts for a range of pre-manoeuvre times, i.e. detection and recognition, and decision response and initiation). In the case of Range Road 1-4 and Site Access intersection, the minimum stopping sight distance requirement would be 170 metres, and the desirable decision sight distance requirement would be in the order of 280-360 metres.

Based on TAC, the turning sight distance should account for the distance (or time) required for a vehicle to accelerate 85 percent of the mainline speed. In other words, a collision would be unavoidable without having the driver on the mainline (Birchcliff Road) reacting to the turning vehicle. In the case of the Birchcliff intersection the minimum requirement would be approximately 125 metres and for the Range Road 1-4 intersection the minimum requirement would be approximately 310 metres.

The existing sight distance from Range Road 1-4 to the west on Birchcliff Road is approximately 42 metres and to the east is approximately 107 metres. At the Site Access the sight distance to the north is greater than 500 metres and to the south is clear to the intersection at Birchcliff Road (210 metres). A summary of the sight distance requirements for the study intersections is shown in **Table 4.4** and **Table 4.5.**

6 Pg. U.B-3, Alberta Transportation. (2003). Highway Geometric Design Guide – Urban Supplement. Edmonton, AB.

Table 4.4: Sight Distance – Birchcliff Road and Range Road 1-4 Intersection (50km/h)

Sight Distance Type	Distance
Existing Sight Distance from Range Road 1-4 looking west	42 m
Existing Sight Distance from Range Road 1-4 looking east	107 m
Stopping Sight Distance	65 m
Decision Sight Distance	130-200 [a]
Turning Sight Distance	125 m

a – based on Figure 2.3.3.6 in TAC Geometric Design for Canadian Roads

Table 4.4: Sight Distance – Range Road 1-4 and Site Access Intersection (90km/h)

Sight Distance Type	Distance
Existing Sight Distance from Site Access looking north	>500 m
Existing Sight Distance from Site Access looking south	210 m
Stopping Sight Distance	170 m
Decision Sight Distance	280-360 m [a]
Turning Sight Distance	310 m

a – based on Figure 2.3.3.6 in TAC Geometric Design for Canadian Roads

As shown in the table, there are sight distance issues looking west at the intersection of Birchcliff Road and Range Road 1-4 intersection. This condition is consistent in all background and post-development horizons. To address this inadequacy in sight distance a number of mitigation measures are suggested. They are:

1. **Move existing stop bar** – The existing stop bar is situated in a position that does not allow for adequate sight distance. The Manual of Uniform Traffic Control Devices (MUTCD) states that a stop bar can be 1.2 metres from the travelled lane in a rural environment. Moving the stop bar to this position would improve the sight distance to the west. The exact sight distance should be confirmed in the field at the time of implementation.

2. **Clear vegetation** – Currently there are trees in the northwest portion of the intersection that block the sight distance. Clearing vegetation in the northwest portion of the intersection to the point where sight distances are met from the existing stop bar would eliminate any sight distance issues.

3. **Realign intersection** – As the area builds-out, consideration should be made to eliminate the s-curve in Birchcliff Road, which would subsequently reconfigure the intersection of Range Road 1-4 and improve sight distances.

Bunt & Associates recommends that the above mitigation measures be considered in the order that they are presented above, since each subsequent mitigation measure builds on the improvements implemented in the previous measure.

In addition, the decision and turning sight distances are not met at the Range Road 1-4 and Site Access intersection. In order to meet the required sight distances at this location, it is recommended that the speed of Range Road 1-4 be reduced to 50 km/h (design speed = 60 km/h) from Birchcliff Road to north of the Site Access. This speed reduction would result in a decision sight distance of 165-240 metres and turning sight distance of 160, which would be met[7], and would be consistent with the speed on Birchcliff Road and the nature of the area as it develops. It should be noted that the stopping sight distance is not violated at this intersection under the current posted speed of 80 km/h (design speed = 90 km/h).

4.5 Illumination Warrant

An illumination warrant calculation was completed for the existing study intersection, Birchcliff Road and Range Road 1-4, using the TAC Guide for the Design of Roadway Lighting[8]. This warrant procedure considers four subcategories, Geometric Factors, Operational Factors, Environmental Factors, and Collision History and, based on the total score given to the specific intersection, either full illumination (greater than 240 points), partial and/or delineation lighting (between 120 and 240 points), or no lighting may be warranted (less than 120 points). The intersection of Birchcliff Road and Range Road 1-4 scored 73 points based on the categories described in the warrant. Since a minimum of 120 points is required for the warrant to be met, illumination is not warranted at this location.

7 The lower figure, 165 metres, represents TAC's minimum decision sight distance, which would be met in this case.
8 Transportation Association of Canada. (2001). Illumination of Isolated Rural Intersections. Ottawa, ON.

5.0 SITE TRAFFIC DEVELOPMENT

5.1 Development Description

The proposed development is a 49 residential unit property located just east of Birchcliff, a Summer Village on the north shore of Sylvan Lake. To be conservative, the analysis has been completed as though the units were primary residences even though this development is intended to be primarily recreational property. Currently there is one homestead that is occupied on the property; however, when this property is developed, the homestead will not remain. As such, the analysis shows the 49 new units with the one homestead unit, assumed to generate the same amount of vehicle traffic, subtracted from the total.

5.2 Trip Generation

Bunt & Associates based the trip generation for the proposed site on the single family detached housing land use described in ITE Trip Generation[9]. As mentioned, to be conservative the study was treated as a single-family community rather than recreational property. This may overstate the total number of trips to and from the development since some units may be used as recreational property, but this was deemed to be an appropriate assumption given the relatively small size of proposed development. The trip generation rate that was used in the analysis for full build out is summarized in **Table 5.1**.

Table 5.1: Trip Generation Rates

Source	AM	PM	Daily
ITE – Single Family Detached Housing (ITE Land Use #210)	0.75 trips/unit (25% In/75% Out)	1.01 trips/unit (63% In/37% Out)	9.57 trips/unit (50% In/50% Out)

The trip generation rate described above was then applied to the proposed development. The results of the trip generation calculations are summarized in **Table 5.2**.

[9] Institute of Transportation Engineers. (2008). Trip Generation, 8th Edition. Washington, DC.

Table 5.2: Site Traffic Generation

Peak Period	Land Use	Rate	Proposed Number of Units	In	Out	Total
AM	Proposed Development	0.75 trips/unit (25% In/75% Out)	49	9	28	37
	Homestead	0.75 trips/unit (25% In/75% Out)	-1	0	-1	-1
	AM Total Site Traffic Generation			**9**	**27**	**36**
PM	Proposed Development	1.01 trips/unit (63% In/37% Out)	49	32	18	50
	Homestead	1.01 trips/unit (63% In/37% Out)	-1	-1	0	-1
	PM Total Site Traffic Generation			**31**	**18**	**49**
Daily	Proposed Development	9.57 trips/unit (50% In/50% Out)	49	235	234	469
	Homestead	9.57 trips/unit (50% In/50% Out)	-1	-5	-4	-9
	Daily Total Site Traffic Generation			**230**	**230**	**460**

As shown, the site is expected to generate 36 trips in the AM peak hour, 49 trips in the PM peak hour, and 460 trips daily.

5.3 Site Traffic Distribution and Assignment

The expected site traffic generation was assigned to the adjacent road network based on Statistics Canada Commuting Flow information. The Statistics Canada data describes the commuting flow for Sylvan Lake, which was used as a proxy for the proposed development since it was the only community in the area with a population that was significant enough to give an appropriate distribution.

The site-generated traffic was assigned to the road network based on the existing road network and associated travel times and distances. The proportion of the site traffic assigned to the road network is summarized in **Table 5.4**.

Table 5.4: Trip Assignment

Direction	Assignment
To/From the south on Range Road 1-4	95%
To/From the north on Range Road 1-4	5%

Based on the above assumptions, the majority of the vehicles, 95%, will be travelling to or from the south on Range Road 1-4 and a nominal amount, 5%, will travel to or from the north on Range Road 1-4. The site traffic volumes are illustrated in **Exhibit 5.1**.

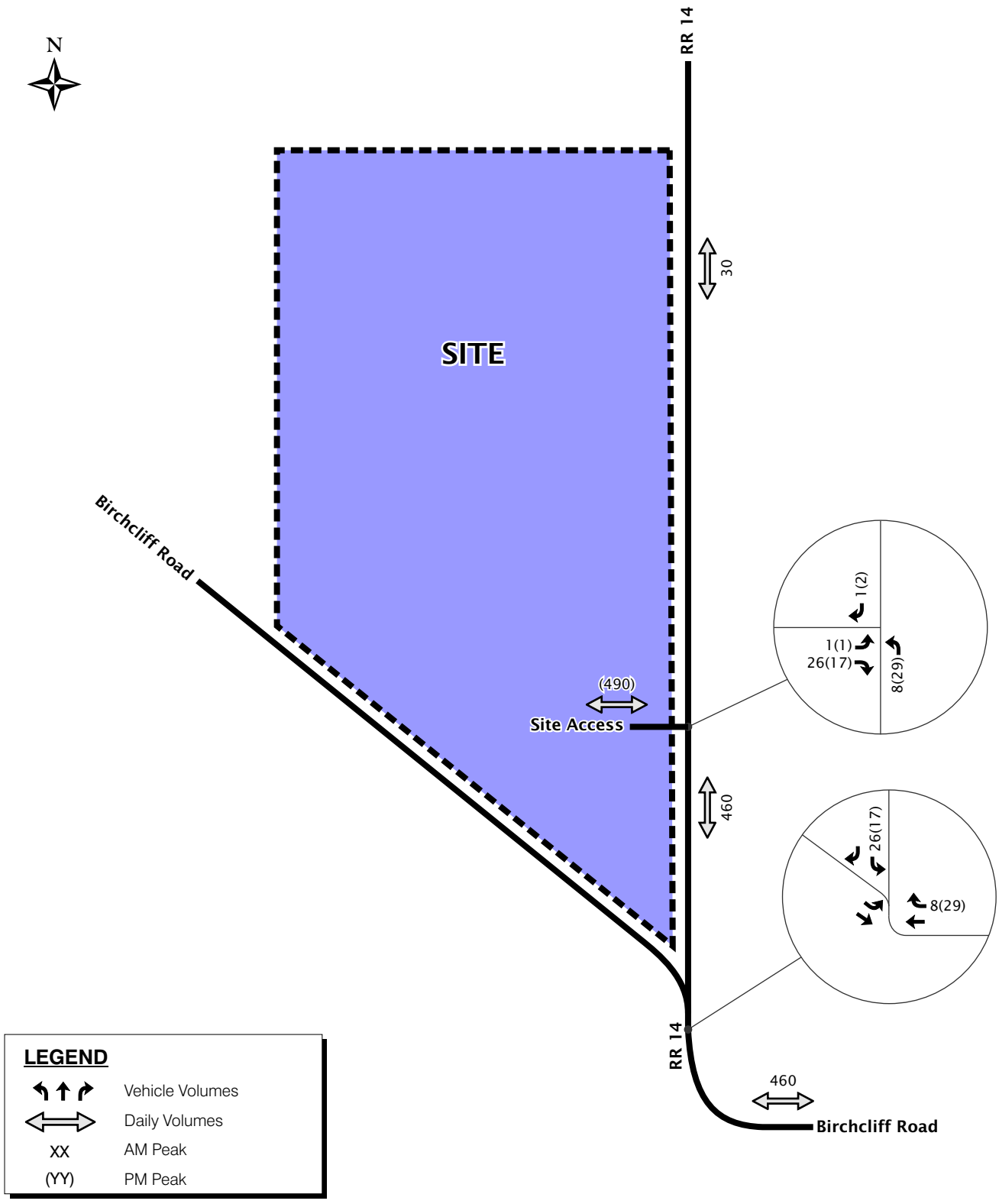


Exhibit 5.1

Site Traffic Volumes

The Slopes
January 2011 Scale NTS

6.0 POST-DEVELOPMENT TRAFFIC CONDITIONS

The site generated traffic volumes were superimposed onto the Opening Day Background and 20-Year Background traffic volumes to determine the Opening Day and 20-Year Post Development traffic volumes, respectively. The results of the analysis are described in the following sections.

6.1 Opening Day and 20-Year post-development Traffic Volumes

As mentioned, the post-development traffic volumes for both horizons were estimated by combining the background traffic volumes established in Section 4.1 with the expected site traffic volumes established in Section 5.4, for each intersection. The Opening Day and 20-Year Post-Development traffic volumes are illustrated in **Exhibit 6.1**.

6.1.1 Total Post-Development Intersection Capacity Analysis

The results of the total post-development intersection capacity analysis were based on full build-out traffic volumes, traffic control, and lane arrangement at the study intersections. The intersection control used in the post-development analysis is the same as those used in the background analysis. The results of the analysis are summarized in **Table 6.1**.

Table 6.1: Intersection Capacity Analysis – Opening Day

Intersection	Movement	AM			PM		
		v/c	LOS	95% Q(m)	v/c	LOS	95% Q(m)
Birchcliff Road & Range Road 1-4	EBL/T	<0.01	A	<1	<0.01	A	<1
	WBT/R	0.02	A	<1	0.06	A	<1
	SBL/R	0.06	A	2	0.04	A	1
Range Road 1-4 & Site Access	EBL/R	0.03	A	1	0.02	A	1
	NBL/T	0.01	A	1	0.02	A	1
	SBT/R	0.02	A	<1	0.01	A	<1

Table 6.2: Intersection Capacity Analysis – 20-Year Post-Development

Intersection	Movement	AM			PM		
		v/c	LOS	95% Q(m)	v/c	LOS	95% Q(m)
Birchcliff Road & Range Road 1-4	EBL/T	<0.01	A	<1	<0.01	A	<1
	WBT/R	0.03	A	<1	0.07	A	<1
	SBL/R	0.06	A	2	0.04	A	1
Range Road 1-4 & Site Access	EBL/R	0.03	A	1	0.02	A	1
	NBL/T	0.01	A	1	0.02	A	1
	SBT/R	0.02	A	<1	0.01	A	<1

As summarized in the table above, all intersections are expected to operate within the acceptable capacity parameters.

6.1.2 Total Post-Development AT Geometric Review

Using the AT Geometric Design Guidelines, a geometric review of the Site Access and Range Road 1-4 intersection was completed for the Opening Day and 20-Year Post-Development horizons. From this analysis it was found that the intersection of the Site Access and Range Road 1-4 requires a Type II intersection. This treatment type is shown in **Exhibit 6.2**.

As previously mentioned, because of the unique geometry and reduced speed at the Birchcliff Road and Range Road 1-4 intersection, the AT intersection treatment standards would not apply. As such, for that intersection the capacity analysis and sight distance requirements were used in confirming the geometric requirements.

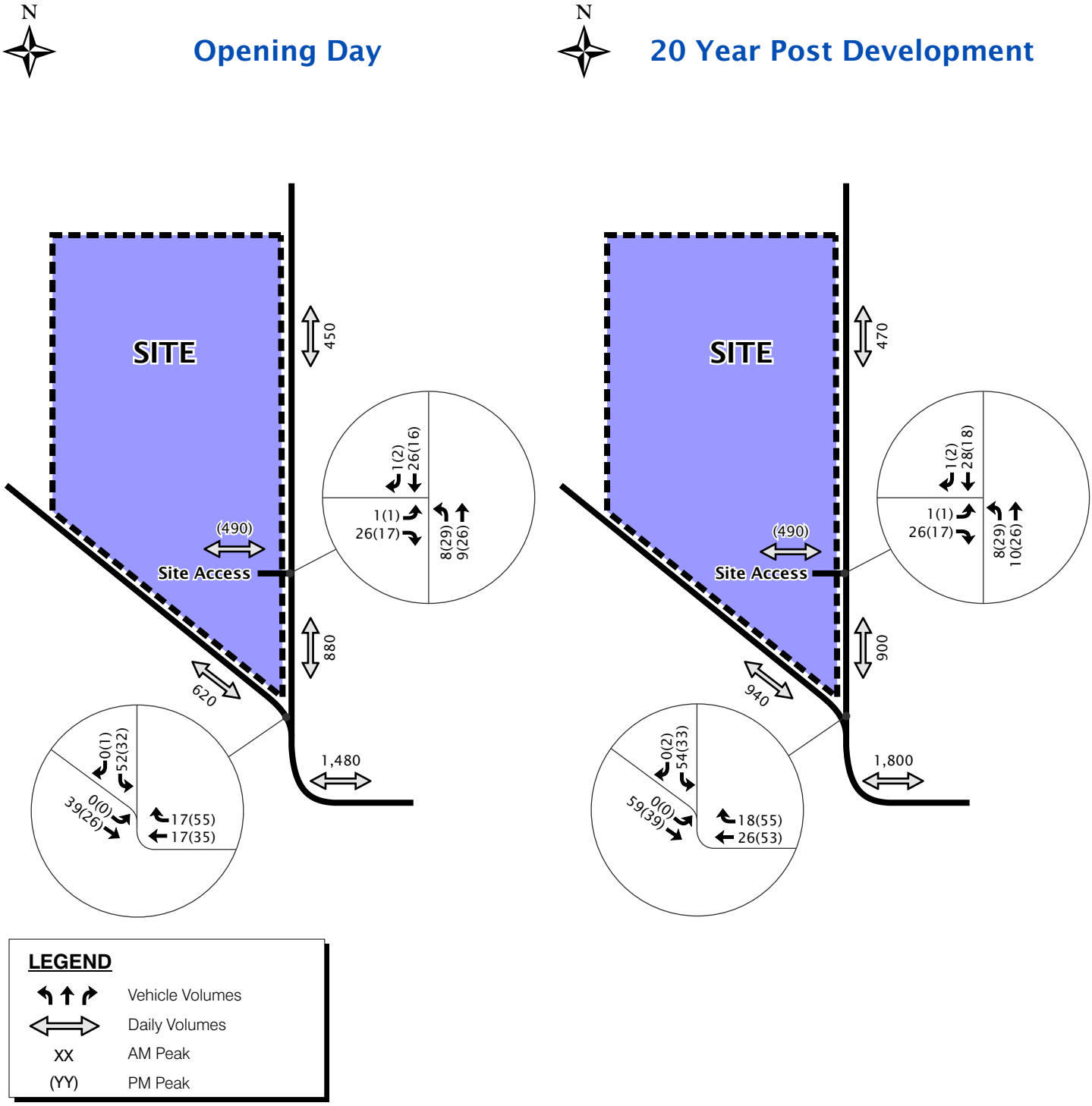


Exhibit 6.1

Opening Day and 20 Year Post Development Traffic Volumes

The Slopes
January 2011 Scale NTS

6.2 Total Post-Development Road Link Analysis

Using the Background daily traffic volumes and the site generated daily traffic volumes, Bunt & Associates calculated the Opening Day and 20-Year Post-Development daily traffic volumes for the subject roadways. The daily traffic volumes and the recommended surface treatments for the road links studied are summarized in **Table 6.2** and **6.3**, below.

Table 6.3: Daily Traffic Volumes – Opening Day

Roadway	Opening Day Background Daily Traffic Volume (vpd)	Recommended Opening Day Background Treatment	Opening Day Daily Traffic Volume (vpd)	Recommended Opening Day Treatment
Birchcliff Road west of Range Road 1-4	620	Same as existing (paved)	620	Same as existing
Birchcliff Road east of Range Road 1-4	1020	Same as existing (paved)	1480	Same as existing
Range Road 1-4 north of Birchcliff Road	420	Dust Control	880	Paved
Range Road 1-4 north of site access	420	Dust Control	450	Same as existing

Table 6.4: Daily Traffic Volumes – 20-Year Post-Development

Roadway	20-Year Background Daily Traffic Volume (vpd)	Recommended 20-year Background Treatment	20-year Post-Development Daily Traffic Volume (vpd)	Recommended 20-year Post-Development Treatment
Birchcliff Road west of Range Road 1-4	940	Same as existing (paved)	940	Same as existing
Birchcliff Road east of Range Road 1-4	1340	Same as existing (paved)	1800	Same as existing
Range Road 1-4 north of Birchcliff Road	440	Dust Control	900	Paved
Range Road 1-4 north of site access	440	Dust Control	470	Same as existing

Using the Alberta Transportation guidelines for the surface treatment of a road, all roadways have the appropriate surface treatment, with the exception of Range Road 1-4 that requires dust control. Paving is only necessary from the Site Access intersection to the Birchcliff Road; north of the site access on Range Road 1-4 does not require a paved surface. The functions of the roadways still remain consistent with the Lacombe County standards and, as such, no changes of the road classifications are recommended.

6.3 Illumination Warrant

An illumination warrant calculation was completed for the two study intersections using the Opening Day and 20-Year Post Development traffic volumes. The intersection of Birchcliff Road and Range Road 1-4 scored 73 points and Range Road 1-4 and Site Access scored 28 points, for both horizons. Since 120 points are required for the warrant to be met, illumination is technically not warranted at these locations.

6.4 Internal Road Classification

Determination of the internal road classification is required as part of Lacombe County's requirements for Transportation Impact Assessments. Bunt & Associates used the road classifications described by TAC[10] for the internal roadways of the development. The classification, function, and environmental capacity (vpd) are summarized in **Table 6.5**.

Table 6.5: TAC Road Classifications

Classification	Local
Traffic Service Function	Traffic movement secondary consideration
Land Service / Access	Land access primary function
Environmental Capacity (vpd) (typical)	<1000
Accommodation of Cyclists	No restrictions or special facilities
Accommodation of Pedestrians	Sidewalks normally on one or both sides
Right-of-way Width (m) (typical)	15-22

Based on the above standards, all roadways within the proposed development will be classified as local roads based on their function and expected daily traffic volumes

[10] Transportation Association of Canada. (1999). Geometric Design Guide for Canadian Roads. Ottawa, ON.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Longview Planning + Design is directing the development approval for *The Slopes* on behalf on Belterra Land Company. Bunt & Associates was retained to provide support in the way of necessary Transportation Planning and Traffic Engineering for the proposed development. As part of the application process, Lacombe County required the submission of a Transportation Impact Assessment (TIA) that addresses the impact on the existing transportation network and ascertains the traffic generation and cumulative impacts on the road network.

The proposed site is expected to generate 36 trips in the AM peak hour, 49 trips in the PM peak hour, and 460 trips daily.

7.1 Background Traffic Conditions

- It is recommended that the current intersection of Birchcliff Road and Range Road 1-4 be enhanced through signage. These signs include Reverse Curve Warning Signs (WA-5), Checkerboard Signs (WA-8), Concealed Road Signs (WA-13L and WA-13R), and Stop Ahead Sign (WB-1). These signs would replace the existing regulatory 20 km/h sign for the eastbound traffic, yet still highlight the important curve and intersection to the oncoming motorists.

- The intersection of Birchcliff Road and Range Road 1-4 is expected to operate within the acceptable capacity parameters in both background horizons.

- Range Road 1-4 is estimated to carry between 420-440 vpd in the background horizons and, as such, requires dust control surface treatment. The current surface treatment of Birchcliff Road, paved, is adequate for the background horizons.

- There is no significant collision trend at the intersection of Birchcliff Road and Range Road 1-4. As such, no improvements are required to address safety concerns due to background traffic growth.

- There is an existing sight distance issue at the intersection of Birchcliff Road and Range Road 1-4 intersection looking west. This condition is consistent in all background and post-development horizons. To address this inadequacy in sight distance a number of mitigation measures are suggested. They are move the existing stop bar, clear the vegetation, and/or realign the intersection. These mitigation measures should be considered in the order that they are presented, since each subsequent mitigation measure builds on the improvements implemented in the previous measure.

- At the Range Road 1-4 and Site Access intersection the decision and turning sight distances are not met. In order to meet the required sight distances at this location, it is recommended that the speed of Range Road 1-4 be reduced to 50 km/h from Birchcliff Road to north of the Site Access.

- The illumination warrant completed at the intersection of Birchcliff Road and Range Road 1-4 scored 73 points. Since a minimum of 120 points is required for the warrant to be met, illumination is not currently warranted at this location due to background traffic growth.

7.2 Post-Development Intersection Conditions

- All intersections are expected to continue to operate within acceptable capacity parameters in the Opening Day and 20-Year Post-Development horizons.
- The intersection of Range Road 1-4 and Site Access will require a Type II intersection at the Opening Day horizon as a result of site generated traffic.
- Based on the Opening Day and 20-Year Post-Development traffic volumes, the section of Range Road 1-4 between the Site Access and Birchcliff Road warrants a paved surface treatment as a result of site generated traffic. All other road links analyzed have adequate surface treatments.
- The illumination warrant completed at the intersection of Birchcliff Road and Range Road 1-4 scored 73 points and Range Road 1-4 and Site Access scored 28 points, for both horizons. Since a minimum of 120 points is required for the warrant to be met, illumination is not warranted at these locations due to site generated traffic.
- All roadways within the proposed development will be classified as local roads based on their function and the expected daily traffic volumes.

APPENDIX A

Correspondence

Subject: RE: The Slopes - TIA Scope
Date: Wednesday, June 2, 2010 10:39 AM
From: Allan Williams <awilliams@lacombecounty.com>
To: Ryan Martinson <rmartinson@bunteng.com>
Cc: Amanda-Brea Watson <awatson@lacombecounty.com>

Hi Ryan ...

I had our Manager of Operations take a look at the proposed scope of work for the TIA.

We believe that you have covered what needs to be done. We will be particularly interested to see what you have to say about the intersection at RR 1-4 and Birchcliff Road.

Allan Williams
Manager of Planning Services

From: Ryan Martinson [mailto:rmartinson@bunteng.com]
Sent: May 31, 2010 1:46 PM
To: Allan Williams
Cc: Amanda-Brea Watson; Leslie Radway
Subject: The Slopes - TIA Scope

Hi Allan,

Hope all is well.

Leslie Radway has asked me to email you with our proposed scope for *The Slopes* residential development at Sylvan Lake. The proposal is for a 37 unit residential development on a parcel of land in the northwest corner of the intersection of Range Road 14 and Birchcliff Road. The extent of the scope was based on previous studies completed for Lacombe County and on the study completed by ISL Engineering for Highland Park, just north of the proposed development.

The analysis would focus on the background (existing + ISL study), future background (20-year forecast) and post-development scenarios and be focused on following items:

- road function (e.g. daily traffic volume and road classification as per Lacombe County standards)
- intersection improvements (based on AT treatment type and capacity analysis),
- crash history,
- sight distance issues, and

- lighting warrants

We propose the study be limited to two intersections, namely the intersection of the Site Access & RR 14 and RR 14 & Birchcliff Road. The daily traffic impact of the development would be assessed on RR 14 and Birchcliff Road.

Could you please confirm that this scope is acceptable to the County or if any other issues need to be addressed as part of this development? We would like to schedule our data collection in the next week, so if you could confirm the study intersection(s) in the interim that would be greatly appreciated.

Thanks, Allan.

Ryan

Ryan Martinson, P.Eng.
Transportation Engineer

403-252-3343 (Ext. 104)
rmartinson@bunteng.com

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Suite 380, Southcentre Executive Tower
11012 Macleod Trail SE
Calgary, AB
Canada T2J 6A5

T 403. 252. 3343
F 403. 252. 3323
E info@bunteng.com
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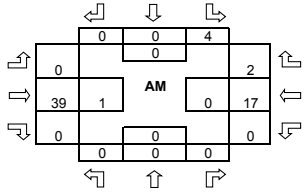
APPENDIX B

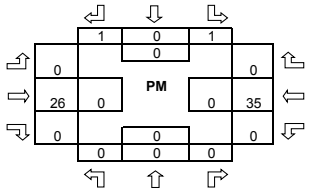
Intersection Turning Movement Counts

Intersection Turning Movement Counts
03-Jun-10 Thursday
Range Road 14 and Township Road 392/Birchcliff Road

	Eastbound										Westbound										Northbound										Southbound											
Time Ending	Left			Through			Right				Left			Through			Right				Left			Through			Right				Left			Through			Right				15 min	Hourly	
	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	total	Total	
7:00	0	0	0	2	0	1				0				1	0	0	0	0	0	0										0	0	0				0	0	0	0	4		
7:15	0	0	0	1	0	0				0				1	0	0	0	0	0	0										0	0	0				0	0	0	0	2		
7:30	0	0	0	4	0	0				0				0	0	0	0	0	0	0										0	0	0				0	0	0	0	4		
7:45	0	0	0	3	0	0				0				3	0	0	0	0	0	0										0	0	0				0	0	0	0	6	16	
8:00	0	0	0	6	1	0				0				4	0	0	0	0	0	0										0	0	0				0	0	0	0	11	23	
8:15	0	0	0	5	0	0				0				2	0	0	0	0	0	0										1	0	0				0	0	0	0	**8**	29	p
8:30	0	0	0	9	0	0				1				5	0	0	0	0	0	0										2	0	0				0	0	0	0	**16**	41	e
8:45	0	0	0	16	0	0				0				5	0	0	0	0	0	0										1	0	0				0	0	0	0	**22**	57	a
9:00	0	0	0	9	0	0				0				5	0	0	2	0	0	0										0	0	0				0	0	0	0	**16**	**62**	k
Total	0	0	0	55	1	1	0	0	0		0	0	0	26	0	0	2	0	0		0	0	0	0	0	0	0	0	0		4	0	0	0	0	0	0	0	0			
Total veh		0			57			0		1		0			26			2		0		0			0			0	0		4			0			0			0	89		
Pk Total	**0**	**0**	**0**	**39**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**17**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			
Pk Total veh		**0**			**39**			**0**				**0**			**17**			**2**				**0**			**0**			**0**			**4**			**0**			**0**				**62**	

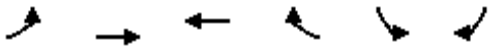
	Eastbound										Westbound										Northbound										Southbound											
Time Ending	Left			Through			Right				Left			Through			Right				Left			Through			Right				Left			Through			Right				15 min	Hourly	
	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	car	bus	truck	car	bus	truck	car	bus	truck	Peds	total	Total	
4:15	0	0	0	4	0	0				0				2	0	0	0	0	0	0										0	0	0				1	0	0	0	7		
4:30	1	0	0	7	0	0				0				2	0	0	0	0	0	0										0	0	0				0	0	0	0	10		
4:45	0	0	0	3	0	1				0				8	0	1	0	0	0	0										0	0	0				0	0	0	0	13		
5:00	0	0	0	2	0	0				0				8	0	1	0	0	0	0										0	0	0				0	0	0	0	**11**	41	p
5:15	0	0	0	2	0	1				0				8	0	0	0	0	0	0										1	0	0				0	0	0	0	**12**	46	e
5:30	0	0	0	7	0	0				0				11	0	0	0	0	0	0										0	0	0				1	0	0	0	**19**	55	a
5:45	0	0	0	14	0	0				0				7	0	0	0	0	0	0										0	0	0				0	0	0	0	**21**	**63**	k
6:00	0	0	0	5	0	0				2				4	0	0	0	0	0	0										0	0	0				0	0	0	2	9	61	
Total	1	0	0	44	0	2	0	0	0		0	0	0	50	0	2	0	0	0		0	0	0	0	0	0	0	0	0		1	0	0	0	0	0	2	0	0			
Total veh		1			46			0		2		0			52			0		0		0			0			0	0		1			0			2			2	102		
Pk Total	**0**	**0**	**0**	**25**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**34**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**			
Pk Total veh		**0**			**26**			**0**				**0**			**35**			**0**				**0**			**0**			**0**			**1**			**0**			**1**				**63**	





APPENDIX C

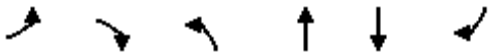
Synchro Analysis Outputs



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	39	17	9	26	0
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)	0	41	18	9	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	27				64	23
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	27				64	23
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	100
cM capacity (veh/h)	1586				942	1054

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	41	27	27
Volume Left	0	0	27
Volume Right	0	9	0
cSH	1586	1700	942
Volume to Capacity	0.00	0.02	0.03
Queue Length 95th (m)	0.0	0.0	0.7
Control Delay (s)	0.0	0.0	8.9
Lane LOS			A
Approach Delay (s)	0.0	0.0	8.9
Approach LOS			A

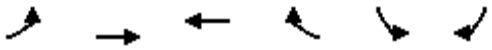
Intersection Summary			
Average Delay		2.6	
Intersection Capacity Utilization		13.3%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	9	26	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	9	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	37	27	27			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	37	27	27			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	976	1048	1586			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	9	27
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1586	1700
Volume to Capacity	0.00	0.00	0.02
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.0	0.0	0.0
Approach LOS	A		

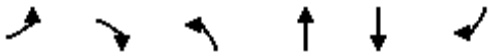
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	6.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	59	26	10	28	0
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)	0	62	27	11	29	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	38				95	33
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	38				95	33
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	100
cM capacity (veh/h)	1572				905	1041

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	62	38	29
Volume Left	0	0	29
Volume Right	0	11	0
cSH	1572	1700	905
Volume to Capacity	0.00	0.02	0.03
Queue Length 95th (m)	0.0	0.0	0.8
Control Delay (s)	0.0	0.0	9.1
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.1
Approach LOS			A

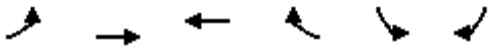
Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	10	28	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	11	29	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	40	29	29			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	40	29	29			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	972	1045	1584			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	11	29
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1584	1700
Volume to Capacity	0.00	0.00	0.02
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.0	0.0	0.0
Approach LOS	A		

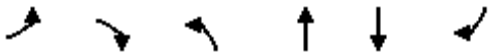
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	6.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	39	17	17	52	0
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)	0	41	18	18	55	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	36				68	27
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	36				68	27
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				94	100
cM capacity (veh/h)	1575				937	1049

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	41	36	55
Volume Left	0	0	55
Volume Right	0	18	0
cSH	1575	1700	937
Volume to Capacity	0.00	0.02	0.06
Queue Length 95th (m)	0.0	0.0	1.4
Control Delay (s)	0.0	0.0	9.1
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.1
Approach LOS			A

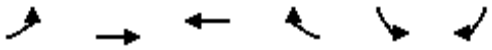
Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	13.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	1	26	8	9	26	1
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1	27	8	9	27	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	54	28	28			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	54	28	28			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	97	99			
cM capacity (veh/h)	949	1047	1585			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	28	18	28
Volume Left	1	8	0
Volume Right	27	0	1
cSH	1043	1585	1700
Volume to Capacity	0.03	0.01	0.02
Queue Length 95th (m)	0.6	0.1	0.0
Control Delay (s)	8.5	3.4	0.0
Lane LOS	A	A	
Approach Delay (s)	8.5	3.4	0.0
Approach LOS	A		

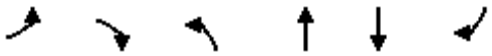
Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	17.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	59	26	18	54	0
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)	0	62	27	19	57	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	46				99	37
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	46				99	37
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				94	100
cM capacity (veh/h)	1561				900	1035

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	62	46	57
Volume Left	0	0	57
Volume Right	0	19	0
cSH	1561	1700	900
Volume to Capacity	0.00	0.03	0.06
Queue Length 95th (m)	0.0	0.0	1.5
Control Delay (s)	0.0	0.0	9.3
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.3
Approach LOS			A

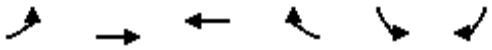
Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	14.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	1	26	8	10	28	1
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1	27	8	11	29	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	57	30	31			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	57	30	31			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	97	99			
cM capacity (veh/h)	945	1044	1582			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	28	19	31
Volume Left	1	8	0
Volume Right	27	0	1
cSH	1040	1582	1700
Volume to Capacity	0.03	0.01	0.02
Queue Length 95th (m)	0.6	0.1	0.0
Control Delay (s)	8.6	3.3	0.0
Lane LOS	A	A	
Approach Delay (s)	8.6	3.3	0.0
Approach LOS	A		

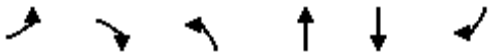
Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	26	35	26	15	1
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)	0	27	37	27	16	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	64				78	51
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	64				78	51
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1538				925	1018

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	27	64	17
Volume Left	0	0	16
Volume Right	0	27	1
cSH	1538	1700	930
Volume to Capacity	0.00	0.04	0.02
Queue Length 95th (m)	0.0	0.0	0.4
Control Delay (s)	0.0	0.0	8.9
Lane LOS			A
Approach Delay (s)	0.0	0.0	8.9
Approach LOS			A

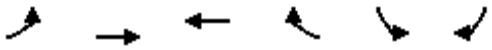
Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	14.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	26	16	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	27	17	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	44	17	17			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	44	17	17			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	966	1062	1600			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	27	17
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1600	1700
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.0	0.0	0.0
Approach LOS	A		

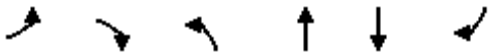
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	6.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	39	53	26	16	2
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)	0	41	56	27	17	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	83				111	69
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				111	69
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1514				886	993

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	41	83	19
Volume Left	0	0	17
Volume Right	0	27	2
cSH	1514	1700	897
Volume to Capacity	0.00	0.05	0.02
Queue Length 95th (m)	0.0	0.0	0.5
Control Delay (s)	0.0	0.0	9.1
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.1
Approach LOS			A

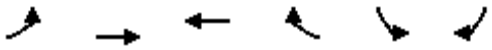
Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	15.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	26	18	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	0	27	19	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	46	19	19			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	46	19	19			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	964	1059	1598			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	27	19
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1598	1700
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.0	0.0	0.0
Approach LOS	A		

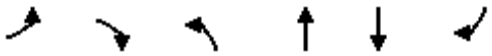
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	6.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	26	35	55	32	1
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)	0	27	37	58	34	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	95				93	66
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	95				93	66
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				96	100
cM capacity (veh/h)	1499				907	998

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	27	95	35
Volume Left	0	0	34
Volume Right	0	58	1
cSH	1499	1700	909
Volume to Capacity	0.00	0.06	0.04
Queue Length 95th (m)	0.0	0.0	0.9
Control Delay (s)	0.0	0.0	9.1
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.1
Approach LOS			A

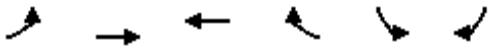
Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	16.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	1	17	29	26	16	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1	18	31	27	17	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	106	18	19			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	106	18	19			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	98	98			
cM capacity (veh/h)	874	1061	1598			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	19	58	19
Volume Left	1	31	0
Volume Right	18	0	2
cSH	1048	1598	1700
Volume to Capacity	0.02	0.02	0.01
Queue Length 95th (m)	0.4	0.4	0.0
Control Delay (s)	8.5	3.9	0.0
Lane LOS	A	A	
Approach Delay (s)	8.5	3.9	0.0
Approach LOS	A		

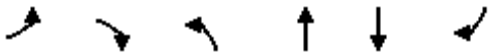
Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	20.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	39	53	55	33	2
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)	0	41	56	58	35	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	114				126	85
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	114				126	85
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				96	100
cM capacity (veh/h)	1476				869	974

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	41	114	37
Volume Left	0	0	35
Volume Right	0	58	2
cSH	1476	1700	874
Volume to Capacity	0.00	0.07	0.04
Queue Length 95th (m)	0.0	0.0	1.0
Control Delay (s)	0.0	0.0	9.3
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	17.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	1	17	29	26	18	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1	18	31	27	19	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	108	20	21			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	108	20	21			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	98	98			
cM capacity (veh/h)	872	1058	1595			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	19	58	21
Volume Left	1	31	0
Volume Right	18	0	2
cSH	1045	1595	1700
Volume to Capacity	0.02	0.02	0.01
Queue Length 95th (m)	0.4	0.4	0.0
Control Delay (s)	8.5	3.9	0.0
Lane LOS	A	A	
Approach Delay (s)	8.5	3.9	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	20.3%	ICU Level of Service	A
Analysis Period (min)	15		