BLACKFALDS CROSSING AREA STRUCTURE PLAN

NE 22-39-27-W4M
TOWN OF BLACKFALDS, AB

TRAFFIC IMPACT ASSESSMENT

Project No. 151-02471-00

Prepared for:
Elkay Developments Ltd.
Spire General Partner Ltd.

Date: November 28, 2016

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CORPORATE AUTHORIZATION

This report titled "**Blackfalds Crossing ASP Traffic Impact Assessment**" was prepared by WSP Canada Inc. for **Elkay Developments Ltd. and Spire General Partner Ltd.** The quality of information, conclusions and estimates contained herein is consistent with the level of effort provided by WSP Canada Inc. and are based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by **Elkay Developments Ltd. and Spire General Partner Ltd.** only, subject to the terms and conditions of its contract with WSP Canada Inc. Any other use of, or reliance on, this report by any third party is at that party's sole risk

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PERMIT TO PRACTICE
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REVISION HISTORY

VERSION	DATE	Description
1	October 8, 2015	Issued for Town of Blackfalds Review
2	November 25, 2015	Issued for Alberta Transportation Review
3	November 28, 2016	Revised with New Site Plan Issued for Alberta Transportation Approval

EXECUTIVE SUMMARY

WSP Canada Inc. was retained by Elkay Developments Ltd. and Spire General Partner Ltd. (Elkay / Spire) to complete a traffic impact assessment for the proposed Blackfalds Crossing Area Structure Plan (ASP) located within the southern limits of the Town of Blackfalds in NE 22-39-27-W4M.

The purpose of this study is to identify and assess the potential traffic impacts on the study intersections associated with the proposed development, and to suggest required mitigation measures (if any) to allow that the adjacent roadways safely accommodate the proposed development.

The proposed Blackfalds Crossing Area Structure Plan (ASP) is located west of Highway 2A and north of Highway 597 encompassing a total of approximately 40 hectares of land. The proposed ASP area is anticipated to be developed in four stages. According to the development concept plan (Appendix A), Stage 1 will include a food anchored shopping centre along Highway 2A. Stage 2 will include highway commercial development along Highway 597 and row housing and multi-family residential development. Stages 3 and 4 will include single family, row housing, and live/work mixed use housing residential development. A total of 602 units of residential housing are anticipated to be developed in the proposed ASP area. It is anticipated that Stages 1 and 2 will be completed within 3 years by 2018 and the entire development will be fully built out by 2025. The land at the northeast corner of the NE 22-39-27-W4M is anticipated to be developed by others and is included in this study.

Primary vehicular access to the development will be obtained via Highway 2A, Highway 597, Broadway Avenue, East Railway Street, a proposed North-South Collector Road onto Highway 597 (South Access), and a proposed East-West Collector Road onto Highway 2A (East Access). The following intersections were analyzed in this study:

- Highway 2A / Highway 597,
- Highway 2A / Proposed East-West Collector Road,
- Highway 597 / Proposed South Access, and
- South Street / East Railway Street.

The existing Highway 2A / 597 intersection is a four-legged intersection. A two-lane modern roundabout was recently constructed at this intersection. Highway 2A was widened to four lanes from Highway 597 to Broadway Avenue.

The existing Highway 2A / Broadway Avenue intersection is a three-legged intersection with two northbound through lanes. This intersection is currently controlled by a stop sign on Broadway Avenue with free flow conditions on Highway 2A. It is anticipated that Broadway Avenue will be realigned and intersect with the proposed east-west collector road when the proposed subdivision is developed.

The existing South Street / East Railway Street intersection is a three-legged intersection and is controlled by a stop sign on the east approach with free flow conditions in the north and west directions.

The following conclusions and recommendations were reached:

HIGHWAY 2A / HIGHWAY 597

- All traffic movements at the Highway 2A / Highway 597 intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 10 year horizon and LOS D or better at the 20 year horizon under the post-development traffic conditions. The roundabout at the

Highway 2A / Highway 597 intersection will be capable of accommodating the forecasted post-development traffic.

HIGHWAY 2A / BROADWAY AVENUE / EAST-WEST COLLECTOR

- The eastbound traffic movements on Broadway Avenue currently operate at LOS E during the AM peak hours at the existing Highway 2A / Broadway Avenue intersection.
- Traffic signals will be warranted at the proposed Highway 2A / East-West Collector Road intersection in 2016 when Stage 1 is fully built out.
- The following intersection lane configurations are recommended when traffic signals are installed at this intersection:
  - Eastbound: two left turn lanes and one right turn lane;
  - Northbound: one left turn lane and two through lanes, and
  - Southbound: two through lanes and one right turn lane.
- When the proposed Highway 2A / East-West Collector Road intersection is under signal control, all traffic movements will operate at an acceptable LOS C or better during both the AM and PM peak periods up to the 20 year horizon. The proposed intersection lane configurations will be capable of accommodating the forecasted post-development traffic.
- To improve the traffic operational performance at this intersection up to the 20-year horizon, traffic signals are proposed to be installed at the same time as the geometric improvements to an all-directional intersection. As the upgraded intersection nears capacity, the feasibility of a roundabout should be assessed at that time; however, the right of way for a future roundabout should be protected as the surrounding lands are developed.

HIGHWAY 597 / SOUTH ACCESS

- A Type IV left turn lane will be warranted for eastbound traffic under the 3 year horizon post-development traffic conditions. An additional 10 m storage length (total parallel deceleration lane length 65 m) will be required to accommodate the forecasted 20 year horizon traffic. The existing raised median on Highway 597 will need to be removed to provide room for the proposed eastbound left turn lane.
- It is recommended that two through lanes be provided for the westbound traffic on Highway 597 between the Highway 2A / 597 roundabout and the existing two lanes approximately 200 m west of the proposed South Access. One eastbound through lane is expected to be capable of accommodating the forecasted post-development traffic. The proposed South Access intersection is located east of and out of the eastbound two-lane to one-lane transition zone on Highway 597. The proposed intersection treatment concept plan is shown in Figure 11 and attached in Appendix C.
- Alberta Transportation is requiring that two eastbound through lanes be provided at the South Access intersection up to the existing two lanes west of the Highway 2A / 597 roundabout to provide better safety and operational performance for the eastbound traffic. Alberta Transportation's requested intersection improvement concept plan is shown in Figure 12 and attached in Appendix C. Construction cost sharing with Alberta Transportation is anticipated to be required regarding these upgraded intersection improvements.

- All traffic movements at the Highway 597 / South Access intersection will operate at an acceptable LOS D or better during both the AM and PM peak periods at the 10 and 20 year horizons under the post-development traffic conditions.
- The intersection sight distances along Highway 597 at the South Access intersection appear to be adequate.
- Signals will not be warranted at this intersection up to the 20 year horizon.
- Delineation lighting will be warranted at the Highway 597 / South Access intersection.

SOUTH STREET / EAST RAILWAY STREET

- This intersection will become a four-legged intersection with the proposed N-S Collector Road forming the south leg. It is recommended that an additional stop sign be installed on the west approach when the proposed N-S Collector Road is constructed. No auxiliary lane (i.e., left or right turn lane) is recommended for this intersection.
- All traffic movements at the South Street / East Railway Street intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 20 year horizon. The proposed intersection control type and lane configurations will be capable of accommodating the forecasted post-development traffic. South Street will operate at acceptable level of services with the existing two-lane cross section up to the 20 year horizon.

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1 INTRODUCTION

WSP Canada Inc. was retained by Elkay Developments Ltd. and Spire General Partner Ltd. (Elkay / Spire) to complete a traffic impact assessment for a proposed Blackfalds Crossing Area Structure Plan (ASP) located within the southern limits of the Town of Blackfalds in the NE 22-39-27-W4M. The subject site location is shown in Figure 1A.

1.1 STUDY PURPOSE

The purpose of this study is to identify and assess the potential traffic impacts on the study intersections associated with the proposed development, and to suggest required mitigation measures (if any) to allow that the adjacent roadways safely accommodate the proposed development.

1.2 SITE AND VICINITY DESCRIPTION

1.2.1 SITE DESCRIPTION

The proposed Blackfalds Crossing Area Structure Plan area is bounded by Highway 2A to the east, Highway 597 to the south, South Street to the north, and the Blackfalds RCMP and Fire Department to the immediate west. A Canadian Pacific railway line runs north-south across the north-west corner of the proposed ASP area.

The proposed Blackfalds Crossing ASP area is located west of Highway 2A and north of Highway 597 encompassing a total of approximately 40 hectares of land. The proposed development is anticipated to be developed in four stages. According to the development concept plan, Stage 1 will include a food anchored shopping centre along Highway 2A. Stage 2 will include highway commercial development along Highway 597 and row housing and multi-family residential development. Stages 3 and 4 will include single family, row housing, and live/work mixed use housing residential development. The proposed development in the Blackfalds Crossing ASP is summarized in Table 1A. A total of 602 units of residential housing are anticipated to be developed in the proposed ASP area. For the purpose of this study, it is assumed that the Blackfalds Crossing ASP will be fully built out by 2025. The proposed development concept plan is shown in Figure 1B and the proposed staging plan is illustrated in Figure 1C.

The triangular parcel (2.05 hectares) west of the CP rail line is expected to be developed by the Town of Blackfalds for use as a community dog park.

The land at the northeast corner of the NE 22-39-27-W4 is anticipated to be developed by others. The assumed land uses on this land are illustrated in Table 1B. To distinguish the development on this land from the Blackfalds Crossing ASP, hereinafter, the land at the northeast corner of the NE 22-39-27-W4 is called future development.

Table 1A. Proposed Development Summary

PROPOSED DEVELOPMENT		SIZE	ANTICIPATED BUILD OUT YEAR
Stage 1	Food Anchored Shopping Centre	11.80 Acres (Land Area)	2016
Stage 2	Highway Commercial	7.51 Acres (Land Area)	2018
	Row houses (R-2)	36 units	
	Multi-Family Housing (R-4)	140 units	
Stage 3	Single Family Housing (R-1S)	88 units	2023
Stage 4	Single Family Housing (R-1S)	80 units	2025
	Row houses (R-2)	25 units	
	Mixed Use Housing	233 units	
Blackfalds Crossing ASP Total Residential		**602** Units	2025

Table 1B. Future Development (Land at Northeast Corner of NE 22-39-27-W4)

PROPOSED DEVELOPMENT	SIZE	ANTICIPATED BUILD OUT YEAR
Single Family Housing (R-1S)	16 units	2025
Highway Commercial	7.25 Acres (Land Area)	

1.2.2 TRANSPORTATION NETWORK

Primary vehicular access to the development will be obtained via Highway 2A, Highway 597, Broadway Avenue, East Railway Street, a proposed north-south collector road onto Highway 597 (South Access), and a proposed east-west collector road onto Highway 2A (East Access). Therefore, the following intersections were analyzed in this study:

- Highway 2A / Highway 597;
- Highway 597 / Proposed South Access;
- Highway 2A / Proposed East Access, and
- South Street / East Railway Street / North-South Collector Road.

Highway 2A runs north-south parallel to the QE II Freeway and serves as the southern and northern gateway to the Town of Blackfalds. Highway 2A is a two-lane undivided provincial highway with a posted speed limit of 80 km/h in the vicinity of the proposed development. The current Average Annual Daily Traffic (AADT) and Average Summer Daily Traffic (ASDT) are estimated to be approximately 13,430 and 14,050 vehicles per day respectively, of which approximately 4% are trucks.

Highway 597 is a paved undivided provincial highway that connects the QEII and Highway 2A and provides access to the rural communities east of Blackfalds. The traffic volume on Highway 597 at the Highway 2A intersection is approximately 5,290 vehicles per day, of which approximately 11% are trucks. Highway 597 will eventually be twinned from Highway 2A to the CP rail bridge. However, the timing of Highway 597 twinning is unknown at present.

South Street is a two-lane local road with a posted speed limit of 50 km/h and is paved except for the segment between Broadway Avenue and East Railway Street which is graveled. South Street runs east-west and connects with Highway 597 to the west via Vista Trail.

The existing Highway 2A / 597 intersection is a four-legged intersection. A two-lane modern roundabout was recently constructed at this intersection. Highway 2A was widened to four lanes from Highway 597 to Broadway Avenue.

The existing Highway 2A / Broadway Avenue intersection is a three-legged intersection with two northbound through lanes. This intersection is currently controlled by a stop sign on Broadway Avenue with free flow conditions on Highway 2A. It is anticipated that Broadway Avenue will be realigned and intersect with the proposed east-west collector road when the proposed subdivision is developed.

The existing South Street / East Railway Street intersection is a three-legged intersection and is controlled by a stop sign on the east approach with free flow conditions in the north and west directions.

The Town of Blackfalds is planning to complete a Functional Design of Highway 2A from Highway 597 to South Street. It is unknown at present when the Town will commence the functional design.

1.3 ANALYSIS HORIZONS

Three analysis horizons were established in this study:

- 3 year short term horizon (2018);
- 10 year medium term horizon (2025), and
- 20 year long term horizon (2035).

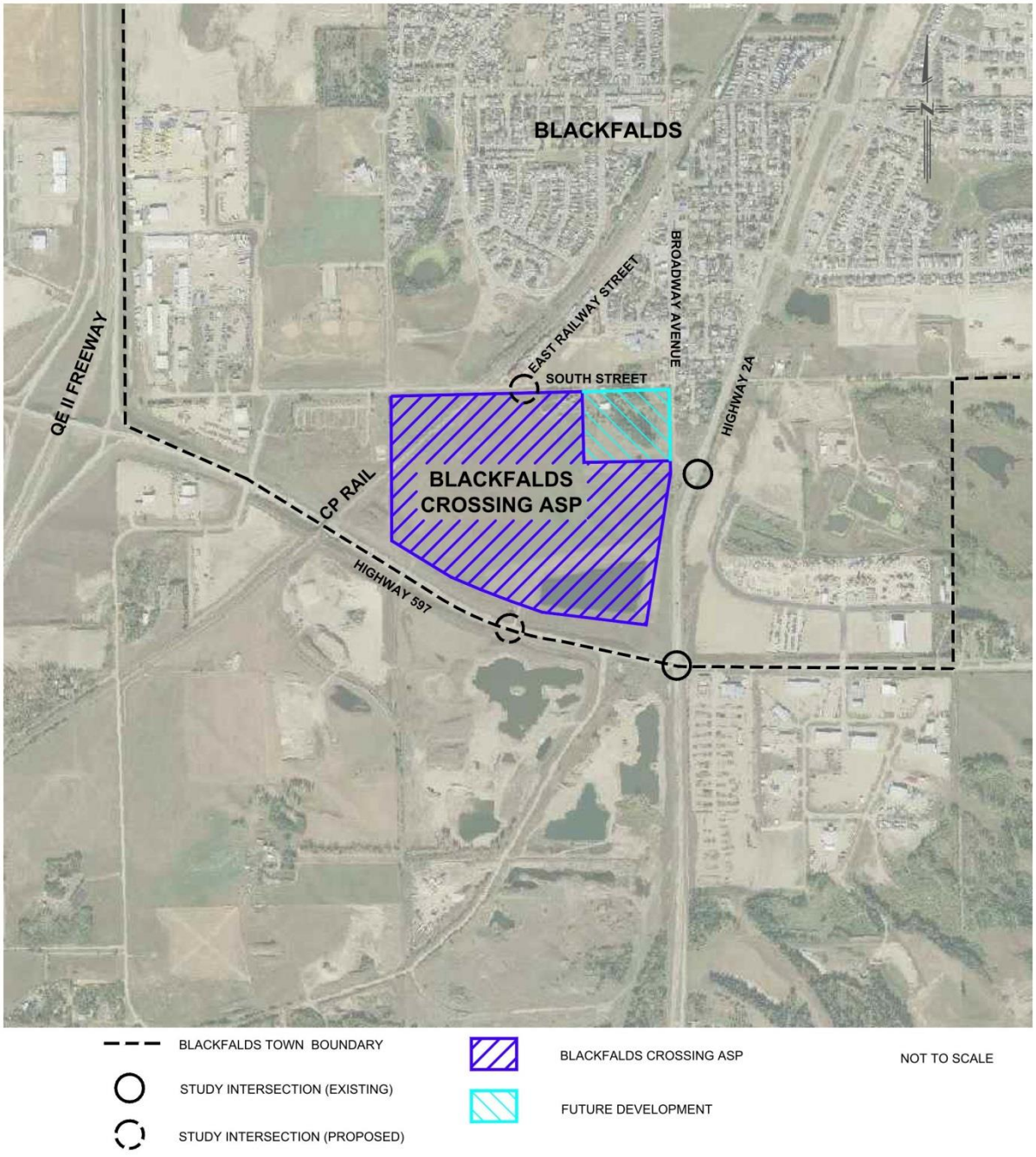

Figure 1A. Site Location

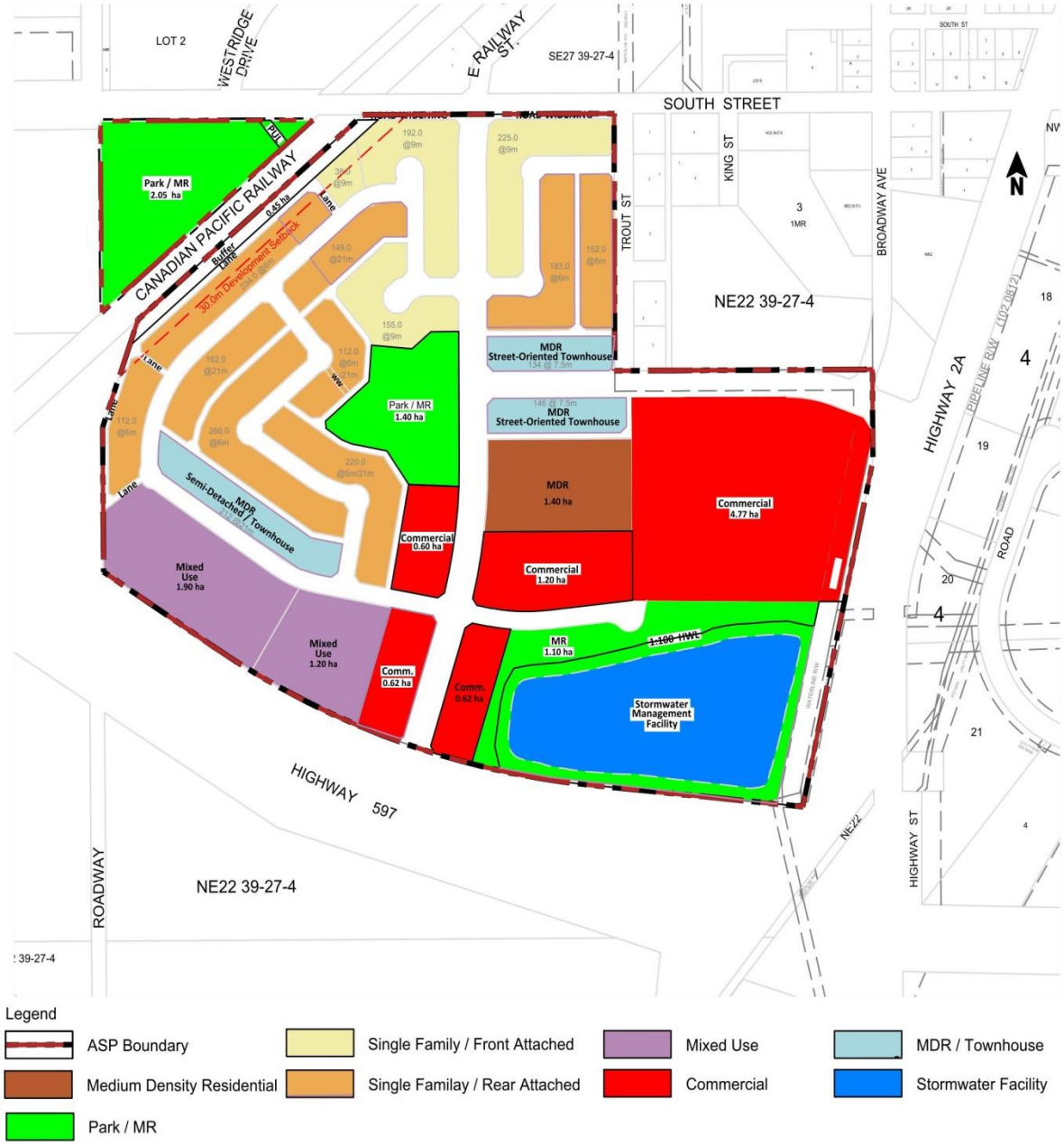

Figure 1B. Development Land Use

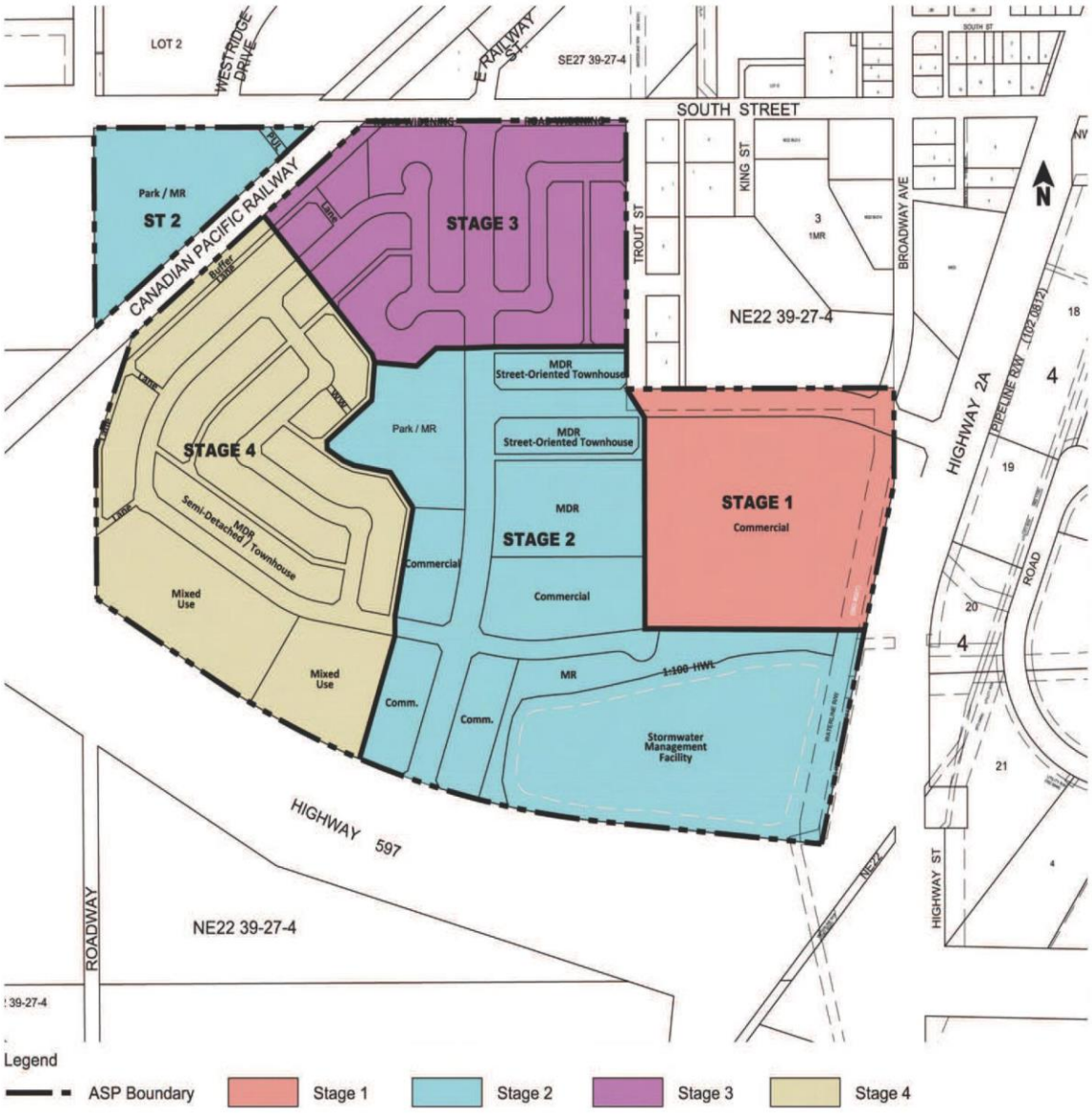

Figure 1C. Development Staging Plan

1.4 SCOPE OF WORK

The scope of this study includes the following:

- Determine current traffic operating conditions for the study intersections.
- Forecast background traffic volumes at the analysis horizons based on the average annual linear growth rate.
- Determine the number of new trips generated by the proposed development at each stage.
- Distribute the generated trips to different geographic areas (origins and destinations) that will be served by the development.
- Assign the generated trips to specific routes to and from the development.
- Forecast post development (combined) traffic volumes at the study intersections at the analysis horizons.
- Propose the appropriate lane configurations and traffic control (if needed) for the study intersections.
- Evaluate the traffic operating conditions at the study intersections at each analysis horizon.
- Conduct signal and illumination warrants based on Transportation Association of Canada (TAC) guidelines.
- Determine roadway, intersection, and access improvements required to provide acceptable levels of service (LOS) and safety.

1.5 METHODOLOGY

In order to meet the study objectives and accomplish the works stated above, the following methodology was used:

- Conduct AM and PM peak hour traffic counts at the Highway 2A / Broadway Avenue and South Street / East Railway Street intersections.
- Obtain traffic turning movement information at the Highway 2A / 597 intersection from Alberta Transportation (AT).
- Obtain historical traffic volumes on Highway 2A and Highway 597 adjacent to the study intersections from AT.
- Estimate current weekday AM and PM peak hour traffic volumes for each turning movement at the study intersections.
- Estimate the trips generated by the proposed development based on ITE's *Trip Generation Manual (9th Edition).*
- Conduct left and right tune lane warrant analyses based on the procedure provided in AT's *Highway Geometric Design Guide.*
- Analyze the delay, LOS and queue lengths of the study intersections at weekday AM and PM peak periods for the analysis horizon traffic using Synchro Studio 9 (Synchro) and SIDRA Intersection 6.1 (SIDRA) software.
- Identify any improvements necessary for the intersections to accommodate the forecasted traffic volumes.

2 TRAFFIC ANALYSIS

This section analyzes the existing (2015), 3 year horizon (2018), 10 year horizon (2025), and the 20 year horizon (2035) traffic conditions for the study intersections. The background traffic volumes at the analysis horizons were determined by applying a linear traffic growth rate to the existing traffic volumes.

2.1 EXISTING TRAFFIC

WSP conducted AM and PM peak hour traffic counts from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. on March 19 and July 9, 2015 at the Highway 2A / Broadway Avenue and South Street / East Railway Street intersections, respectively.

To estimate the existing (2015) traffic turning movements at the Highway 2A / 597 intersection, a 2.5% increase was applied to Alberta Transportation 2014 traffic volumes which are the latest available traffic data posted on their website at the time of this study.

Figure 3 shows the existing weekday AM and PM peak hour turning movement traffic volumes at the study intersections.

2.2 TRAFFIC GROWTH

The traffic growth history obtained from Alberta Transportation's website for Highway 2A and Highway 597 adjacent to the study intersections is summarized in Table 1. The complete file is attached in Appendix B**.**

Table 2. Historical Traffic Growth

YEAR	HIGHWAY 2A NORTH of HWY 597		HIGHWAY 597 WEST OF HWY 2A	
	AADT	GROWTH	AADT	GROWTH
2003	9,420	-	2,240	-
2004	9,910	5.2%	2,560	14.3%
2005	10,610	7.1%	2,720	6.3%
2006	11,250	6.0%	2,900	6.6%
2007	11,290	0.4%	2,940	1.4%
2008	11,070	-1.9%	2,940	0.0%
2009	10,800	-2.4%	3,660	24.5%
2010	10,990	1.8%	3,730	1.9%
2011	11,270	2.5%	3,730	0.0%
2012	12,620	12.0%	4,620	23.9%
2013	12,880	2.1%	5,060	9.5%
2014	13,100	1.7%	5,160	2.0%

Based on the historical traffic volumes on Highway 2A and Highway 597, Figure 2 illustrates the traffic growth trends including the linear AADT regression equations on the two highways in the vicinity of the study intersections. Using the regression equation, future traffic volumes on Highway 2A and Highway 597 were calculated and it was found that the future annual growth in traffic on Highway 2A is approximately 2.1% of the estimated 2015 volumes and the annual traffic growth on Highway 597 is approximately 5% of the 2015 traffic volumes.

In consulting with Alberta Transportation, the Ministry advised that the provincial average growth rate of 2.5% would be appropriate to estimate the future traffic for both Highway 2A and Highway 597. Therefore, in this study, a traffic growth rate of 2.5% was used to estimate the future traffic volumes on Highway 2A and Highway 597 at the 10 and 20 year horizons. A growth rate of 5% was used to estimate the 3 year horizon traffic volumes on Highway 597.

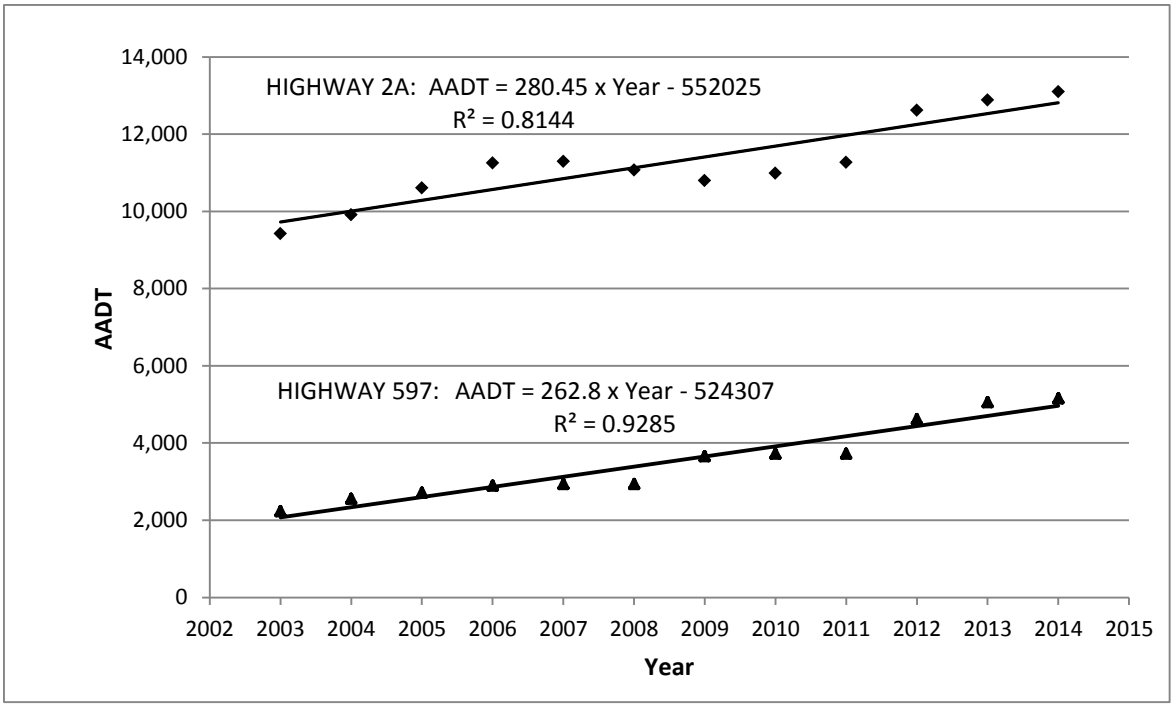

Figure 2. Traffic Growth Trends

2.3 BACKGROUND TRAFFIC

Background traffic (non-site traffic) is the traffic that exists without the addition of the trips generated by the proposed development.

Based on the anticipated traffic growth rates, the forecasted background traffic volumes in terms of weekday AM and PM peak hour traffic at the 3, 10 and 20 year horizons are presented in Figures 4 to 6.

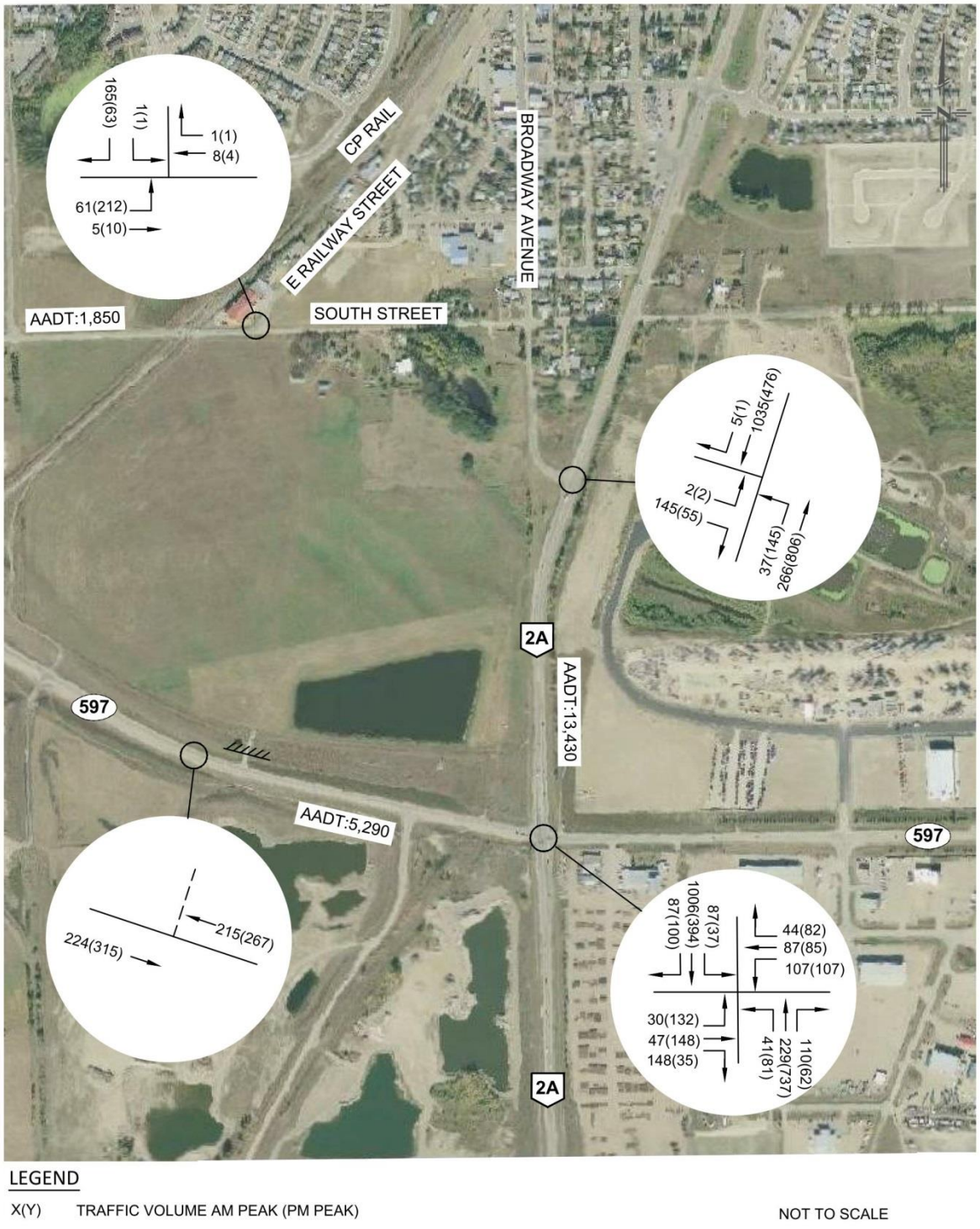

Figure 3. Existing (2015) Traffic

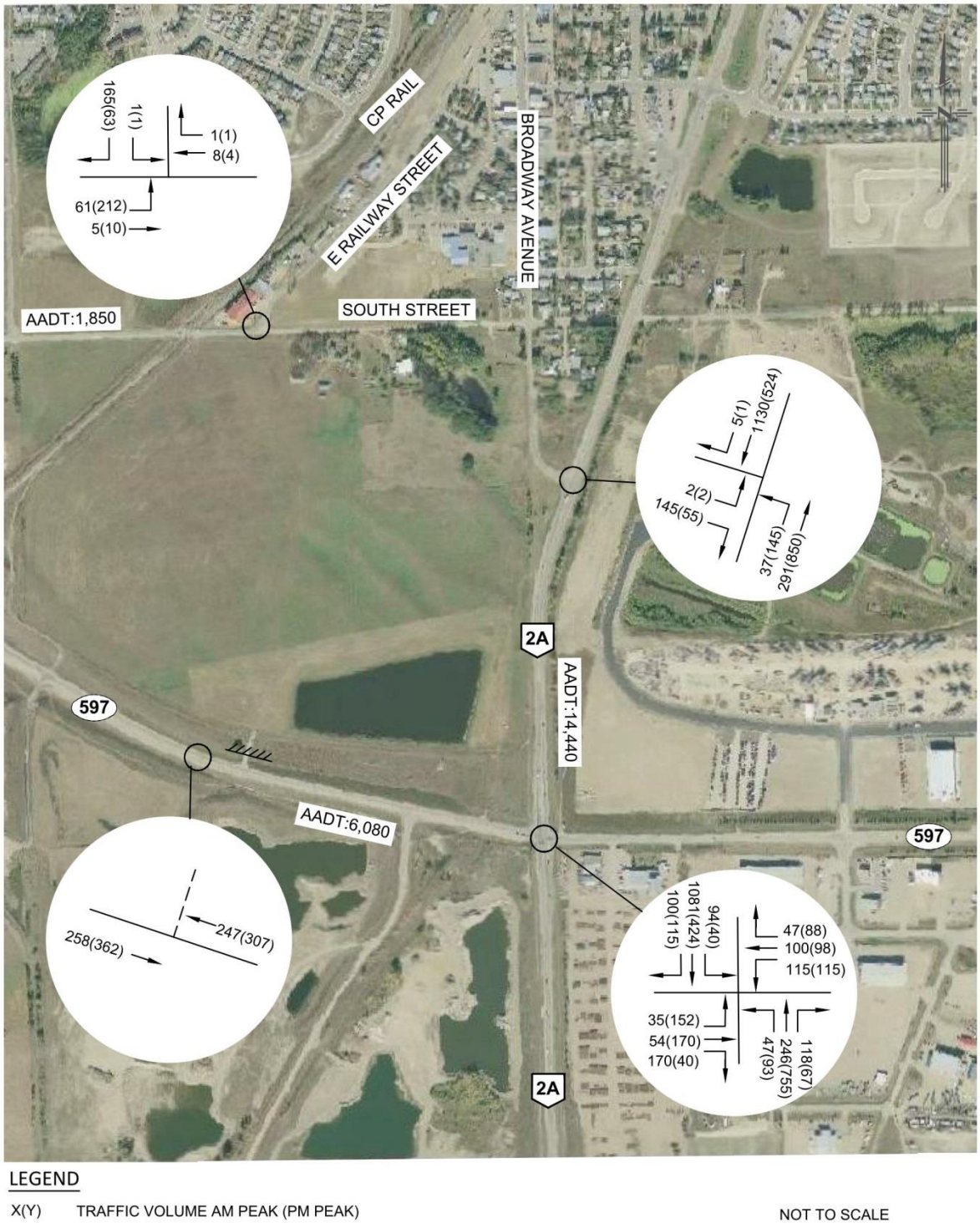

Figure 4. 3 Year Horizon (2018) Background Traffic

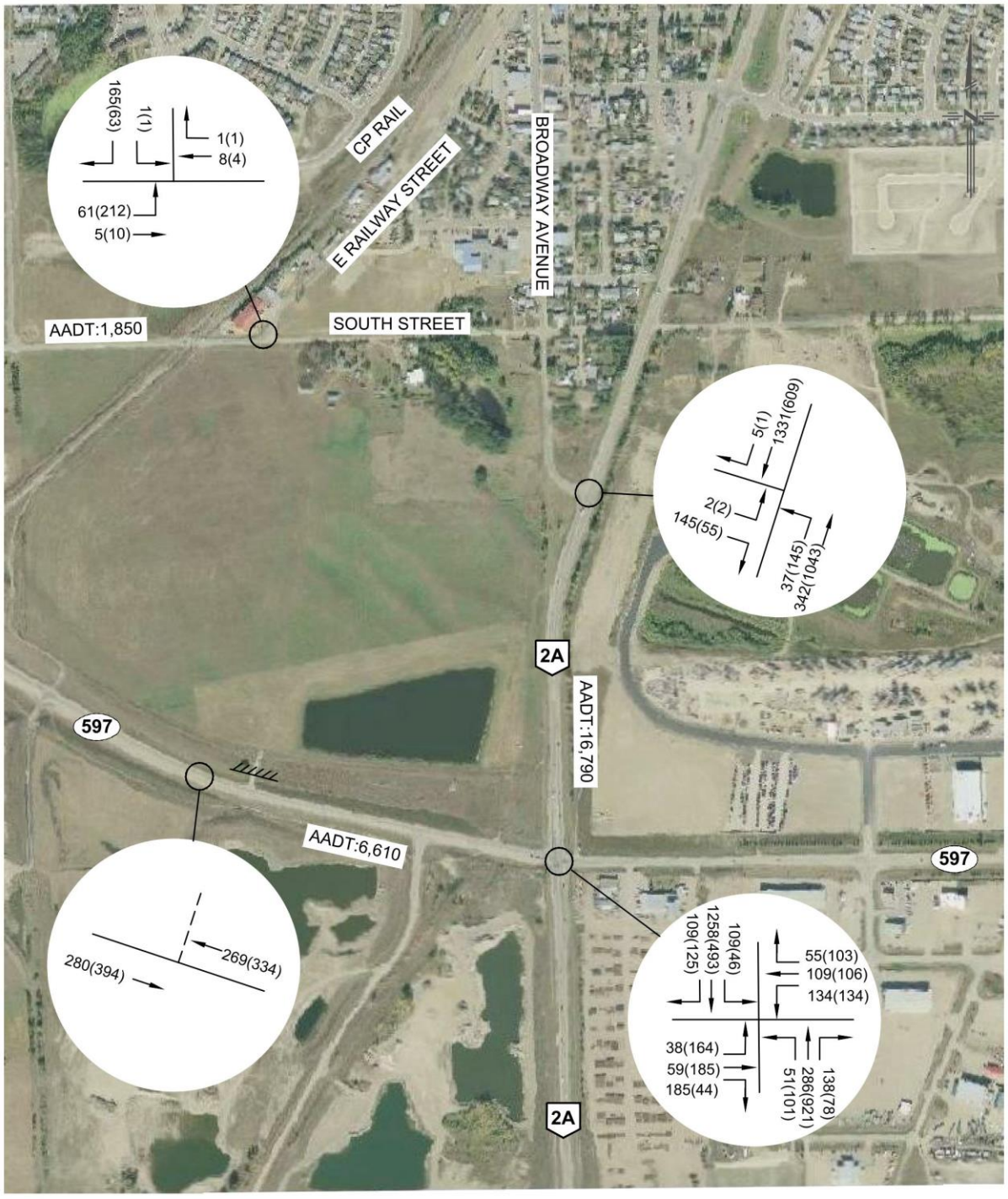

Figure 5. 10 Year Horizon (2025) Background Traffic

Figure 6. 20 Year Horizon (2035) Background Traffic

2.4 TRIP GENERATION

The Institute of Transportation Engineers (ITE) *Trip Generation Manual (9th Edition)* was used in this study to estimate the traffic generated by the proposed development.

The corresponding land uses in the ITE *Trip Generation Manual* that were used to estimate the traffic generated by the proposed developments are summarized in Table 3.

Table 3. Corresponding ITE Land Uses

PROPOSED DEVELOPMENT	ITE LAND USE (CODE)
Food Anchored Shopping Centre	Supermarket (850)
Highway Commercial	N/A
Single-Family Housing	Single-Family Detached Housing (210)
Row Housing	Residential Condominium / Townhouse (230)
Multi-Family Housing	Mid-Rise Apartment (223)
Mixed Use Housing	Mid-Rise Apartment (223)
	Shopping Center (820)

It should be noted that Highway Commercial is not a specific land use, and is better defined as a zoning category. In other words, Highway Commercial is defined as a mixed use site and includes a wide variety of land uses such as restaurants, gas bars, truck stops, and hotels. The ITE *Trip Generation Manual* does not provide trip generation rates for Highway Commercial land use.

Bunt & Associates Engineering Ltd. (Bunt) prepared a report for a C-TEP research project *"Trip and Parking Generation Rates for Land Uses in Small Towns in Alberta"* in 2005. In the report, Bunt recommended the AM and PM peak hour trip generation rates for Highway Commercial land use in Alberta. For the purpose of this study, the trip generation rates (AM: 2.56 / 1,000 ft^2, PM: 4.21 / 1,000 ft^2) recommended by Bunt were used to estimate the trips generated by the proposed highway commercial development. The trip directional distributions for Highway Commercial are based on the trip directional distribution rates for Shopping Center (Code: 820) in the ITE *Trip Generation Manual*.

The Mixed Use Live/Work housing land use combines living and working quarters for individuals who can live and work in the same building. The ground floor will be used for business purposes, such as office, retail, or service. For the purpose of this study, it was assumed that 60% of the ground area of the mixed use housing would be used for commercial. The trip generation rates for Shopping Center were used to estimate the traffic that would be generated by the mixed use housing commercial uses.

A Floor Area Ratio (FAR) of 0.20 was used to calculate the Gross Floor Area (GFA) of the proposed food anchored shopping centre and commercial development.

2.4.1 THREE YEAR HORIZON

In accordance with the developer, Stages 1 and 2 will be completed within three years by the year 2018. The estimated traffic volumes generated by the proposed developments in the two stages are illustrated in Tables 4A to 4D. It is anticipated that the proposed Stages 1 and 2 developments would generate a total of approximately 13,535 daily trips, 582 AM peak hour trips, and 1,151 PM peak hour trips

Table 4A. Trip Generation – Food Anchored Shopping Centre (Stage 1)

SUPERMARKET GFA: 102,800 ft^2	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	62%	38%	100%	51%	49%
Rate (Trips/1000 ft^2) / Regression Equation	102.24	34.08	34.08	3.40	2.11	1.29	Ln(T)=0.74Ln(X)+3.25		
Total Trips	10510	5255	5255	350	217	133	795	405	390

*T=Vehicle Trips; X = 1000 ft^2 GFA.

Table 4B. Trip Generation – Highway Commercial (Stage 2)

GFA: 65,400 ft^2	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	62%	38%	100%	48%	52%
Rate (Trips/1000 ft^2)	33.85	16.93	16.93	2.56	1.59	0.97	4.21	2.02	2.19
Total Trips	2214	1107	1107	167	104	64	275	132	143

Table 4C. Trip Generation – Row Housing (Stage 2)

UNITS: 36	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	17%	83%	100%	67%	33%
Regression Equations	Ln(T)=0.87Ln(X)+2.46			Ln(T)=0.80Ln(X)+0.26			Ln(T)=0.82Ln(X)+0.32		
Total Trips	264	132	132	23	4	19	26	17	9

Table 4D. Trip Generation – Multi-Family Housing (Stage 2)

UNITS: 140	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	31%	69%	100%	58%	42%
Rate (Trips / Unit)	3.90	1.95	1.95	0.30	0.09	0.21	0.39	0.23	0.16
Total Trips	546	273	273	42	13	29	55	32	23

2.4.2 FULL BUIDL OUT

The proposed Blackfalds Crossing ASP is anticipated to be fully built out by 2025. The estimated traffic volumes generated by the proposed development in stage 3 and 4 are illustrated in Tables 4E to 4I. It is assumed that the land at the northeast corner of the NE 22-39-27-W4 would be developed by 2025. The anticipated trips that would be generated by this land are summarized in Tables 4J and 4K.

Table 4E. Trip Generation – Single Family Housing (Stage 3)

UNITS: 88	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	25%	75%	100%	63%	37%
Regression Equations	Ln(T)=0.92Ln(X)+2.72			T=0.70(X)+9.74			Ln(T)=0.90Ln(X)+0.51		
Total Trips	934	467	467	71	18	54	94	59	35

*T=Vehicle Trips; X = Dwelling Units.

Table 4F. Trip Generation – Single Family Housing (Stage 4)

UNITS: 80	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	25%	75%	100%	63%	37%
Regression Equations	Ln(T)=0.92Ln(X)+2.72			T=0.70(X)+9.74			Ln(T)=0.90Ln(X)+0.51		
Total Trips	855	428	428	66	16	49	86	54	32

*T=Vehicle Trips; X = Dwelling Units.

Table 4G. Trip Generation – Row Housing (Stage 4)

UNITS: 25	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	17%	83%	100%	67%	33%
Regression Equations	Ln(T)=0.87Ln(X)+2.46			Ln(T)=0.80Ln(X)+0.26			Ln(T)=0.82Ln(X)+0.32		
Total Trips	193	96	96	17	3	14	19	13	6

Table 4H. Trip Generation – Mixed Use Housing Residential (Stage 4)

UNITS: 233	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	31%	69%	100%	58%	42%
Rate (Trips / Unit)	3.90	1.95	1.95	0.30	0.09	0.21	0.39	0.23	0.16
Total Trips	909	454	454	70	22	48	91	53	38

Table 4I. Trip Generation – Mixed Use Housing Commercial (Stage 4)

GFA: 40,000 ft^2	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	62%	38%	100%	48%	52%
Rate (Trips/1000 ft^2)	42.70	21.35	21.35	0.96	0.60	0.36	3.71	1.78	1.93
Total Trips	1708	854	854	38	24	15	148	71	77

Table 4J. Trip Generation – Single Family Housing (Future Development)

UNITS: 16	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	25%	75%	100%	63%	37%
Regression Equations	Ln(T)=0.92Ln(X)+2.72			T=0.70(X)+9.74			Ln(T)=0.90Ln(X)+0.51		
Total Trips	195	97	97	21	5	16	20	13	7

Table 4K. Trip Generation – Highway Commercial (Future Development)

GFA: 63,200 ft^2	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Directional Distribution	100%	50%	50%	100%	62%	38%	100%	48%	52%
Rate (Trips/1000 ft^2)	33.85	16.93	16.93	2.56	1.59	0.97	4.21	2.02	2.19
Total Trips	2139	1070	1070	162	100	61	266	128	138

It is estimated that the proposed development would generate a total of approximately 20,470 daily trips, 1,027 AM peak hour trips, and 1,875 PM peak hour trips when the whole development area is fully built out.

2.4.3 INTERNAL AND PASS-BY TRIPS

Internal trips should be considered for a multi-use development. According to the ITE *Trip Generation Handbook*, a multi-use development is typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system. The internal trips can be made either by walking or by vehicles using internal roadways. In this study, the proposed development is deemed to be a multi-use development (residential, shopping centre, and highway commercial), thus to estimate the trips made on the external streets, the internal trips that are not made on the major street system should be deducted from the total trips. To account for the internal trips, the following internal capture rates were used. It should be noted that vehicles travelling from / to the residential development may stop by the commercial development. These internal pass-by trips were considered as internal trips for commercial development.

- Residential: 20%
- Food Anchored Shopping Centre: 10%
- Highway Commercial: 10%
- Live/Work Housing Commercial development: 10%

According to the ITE *Trip Generation Handbook*, pass-by trips are defined as the trips that are made as intermediate stops on the way from an origin to a primary trip destination without a route diversion. Pass-by trips are attracted from traffic passing the site on an adjacent street or roadway that offers direct access to the generator. Pass-by trips will not add new traffic to the adjacent street system. In this study, the proposed shopper centre and highway commercial developments will attract pass-by trips. In accordance with the ITE *Trip Generation Handbook,* an average 36% of the trips generated by supermarket are pass-by trips. In this study, it is assumed that 35% of the total trips generated by the commercial development will be pass-by trips. Table 5 summarizes the estimated new trips that will be generated by the proposed development at full build out.

Table 5. Trip Generation Summary

DEVELOPMENT	WEEKDAY			AM PEAK HOUR			PM PEAK HOUR		
	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT
Residential (Blackfalds Crossing ASP)	3701	1850	1850	289	76	213	370	228	143
Commercial (Blackfalds Crossing ASP)	14432	7216	7216	555	344	211	1219	609	610
Total (Blackfalds Crossing ASP)	18133	9066	9066	844	420	424	1589	837	752
Residential (Future Development)	195	97	97	21	5	16	20	13	7
Commercial (Future Development)	2139	1070	1070	162	100	61	266	128	138
Total (Future Development)	2334	1167	1167	183	106	77	286	140	146
Total Trips	20467	10233	10233	1027	526	501	1875	977	898
Internal Trips	2436	1218	1218	134	61	73	227	122	105
External Trips	18030	9015	9015	893	465	428	1649	855	793
Pass-by Trips (35% of Commercial)	5220	2610	2610	226	140	86	468	232	236
Non-Pass-by Trips	12810	6405	6405	667	325	342	1181	623	558

2.5 TRIP DISTRIBUTION AND ASSIGNMENT

Trip distributions for the proposed development were estimated based on the traffic turning movement patterns at the existing intersections on Highway 2A and the road network in the vicinity of the proposed development.

Figures 7A and 7B illustrate the estimated site generated trips at the 3 year horizon (Stages 1 and 2) and full build out, respectively. The detailed trip distribution and assignment for each land use are attached in Appendix B.

2.6 COMBINED TRAFFIC

Combined traffic volumes (post-development traffic) include both background traffic and the traffic generated by the proposed development. Combined traffic volumes for the study intersections at the 3, 10 and 20 year horizons are shown in Figures 8 to 10.

2.7 SHORTCUTTING TRAFFIC

The proposed north-south collector road on site will provide a new connection between South Street and Highway 597. Some traffic travelling from the Town may use the proposed collector road as a shortcutting route to access onto Highway 597. However, based on the surrounding road network in the vicinity of the proposed development, it is anticipated that the volume of shortcutting traffic would be relatively small and would not significantly impact the Highway 597 / South Access intersection. Therefore, the shortcutting traffic was not included in this study.

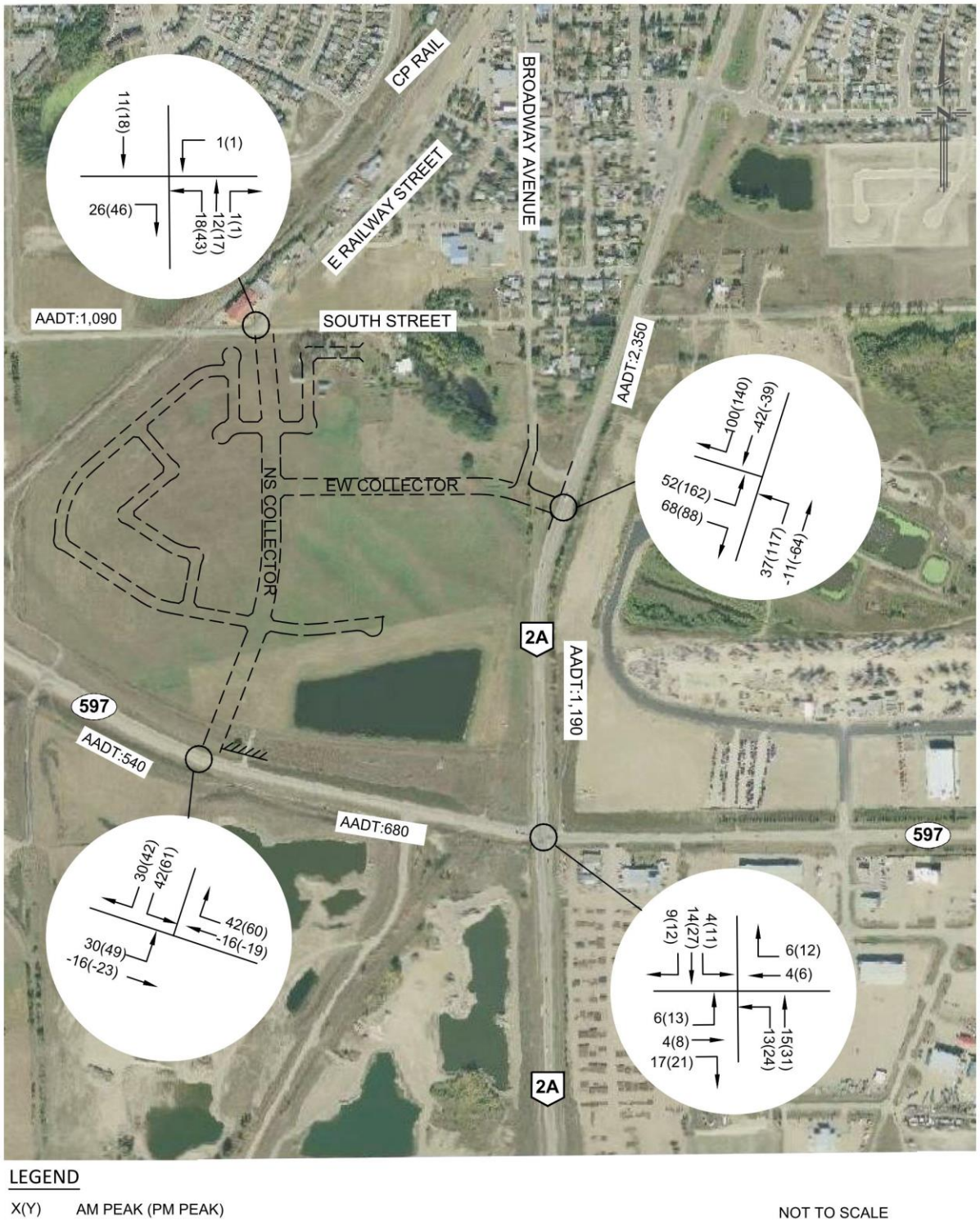

Figure 7A. Site Traffic – Stages 1 and 2

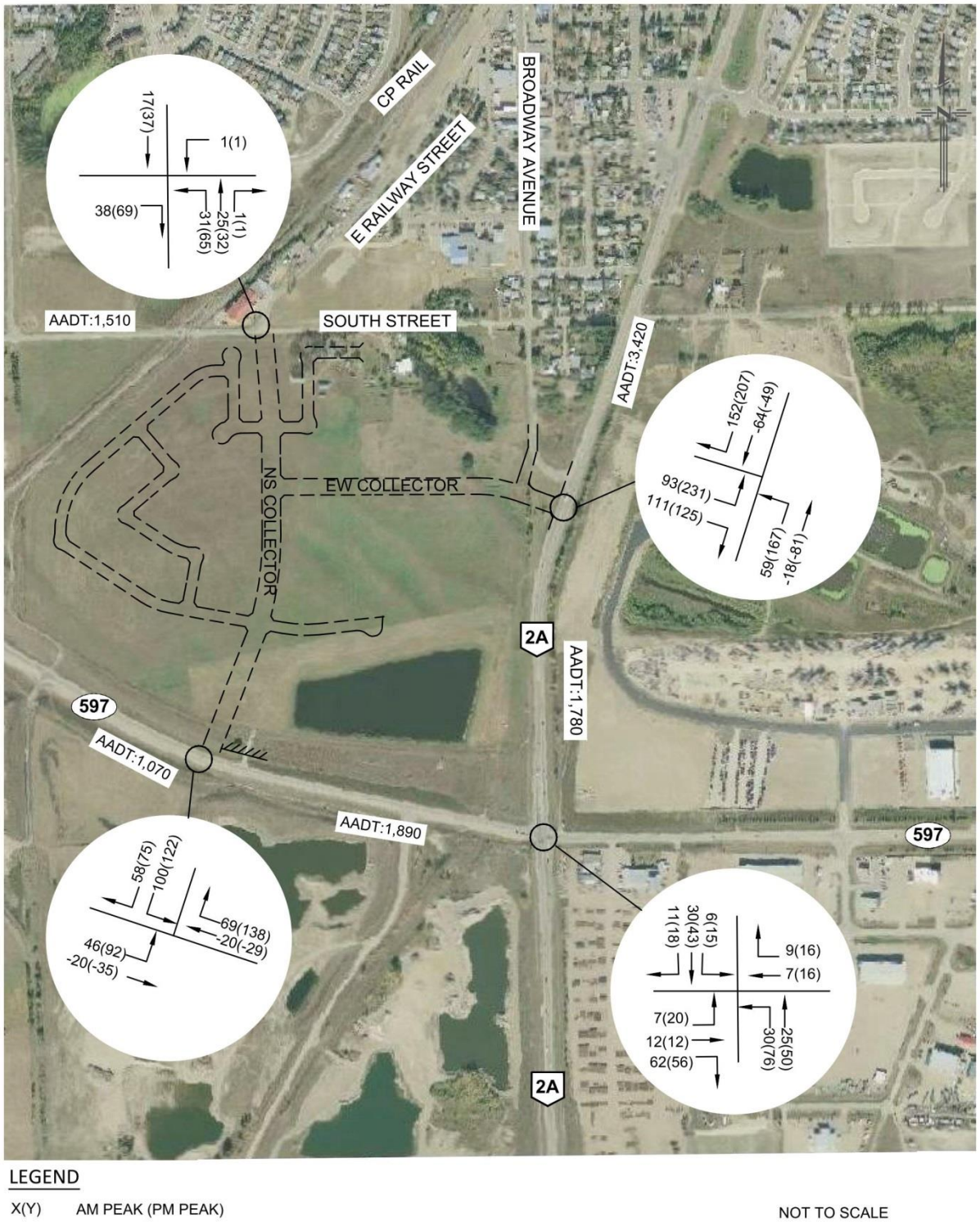

Figure 7B. Site Traffic – Full Build Out

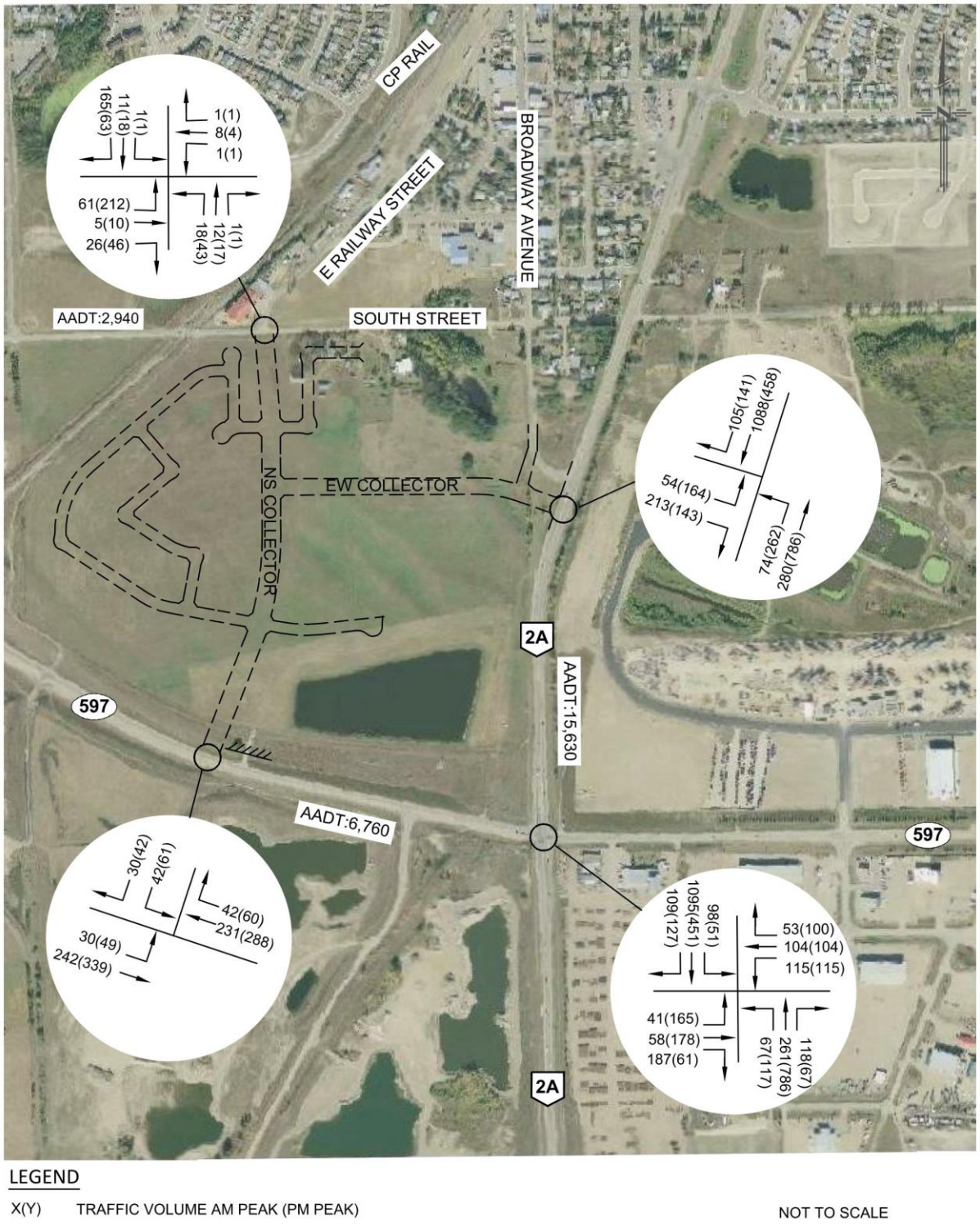

Figure 8. 3 Year Horizon (2018) Combined Traffic

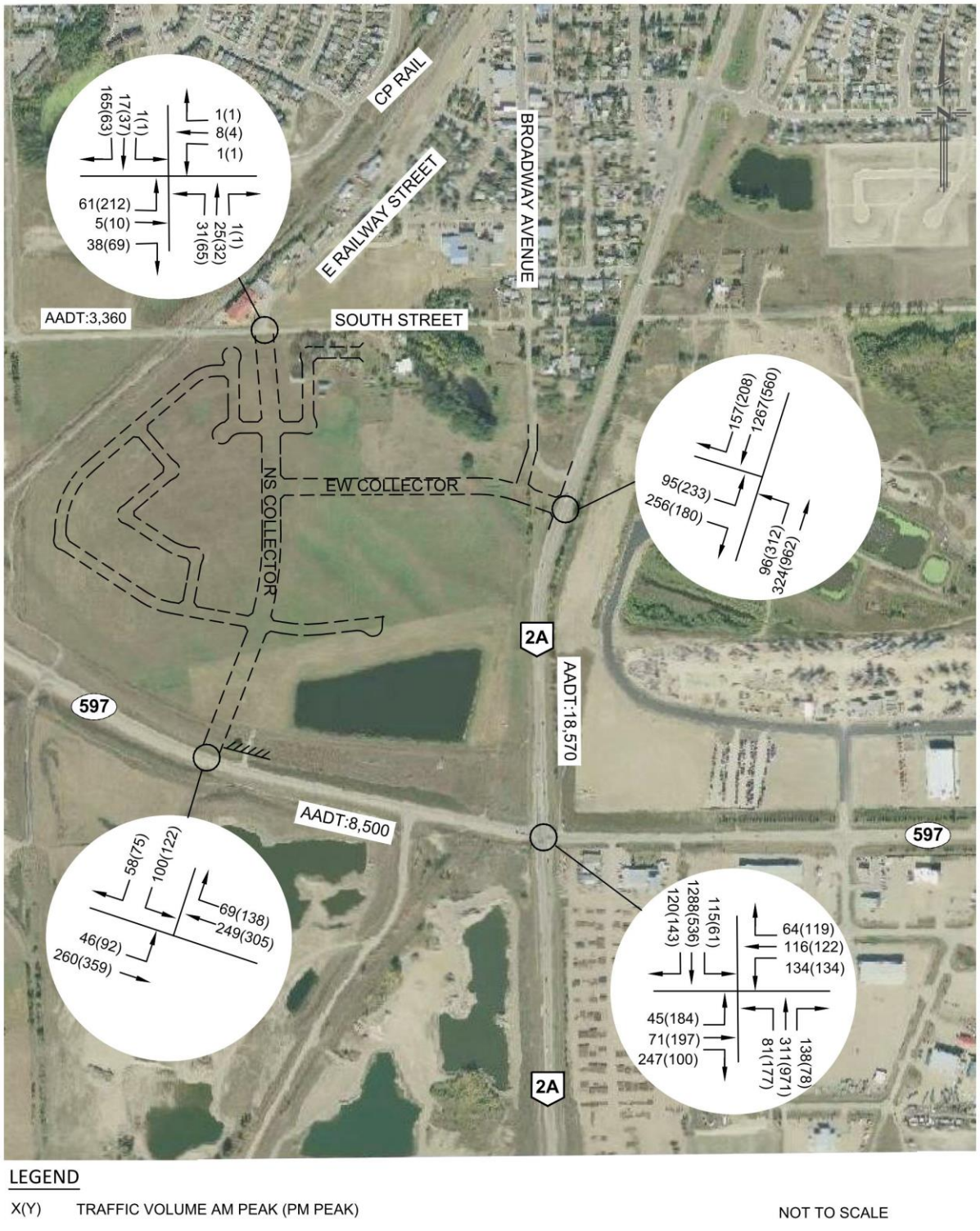

Figure 9. 10 Year Horizon (2025) Combined Traffic

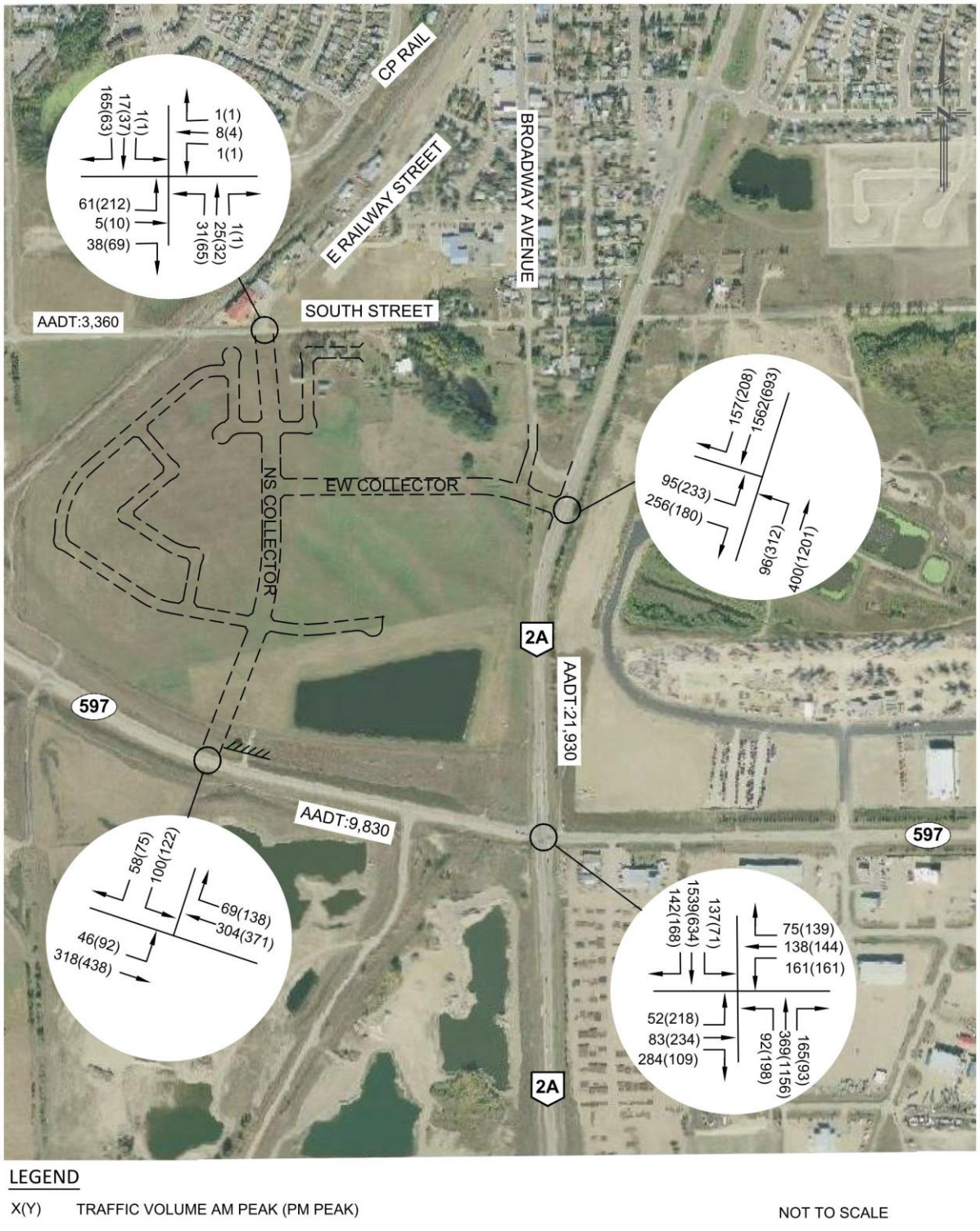

Figure 10. 20 Year Horizon (2035) Combined Traffic

3 SIGNAL WARRANT ANALYSIS

Signal warrant analyses were conducted for the proposed Highway 2A / East Access, Highway 597 / South Access, and South Street / East Railway Street intersections based on the forecasted traffic volumes.

The signal warrant analysis followed the procedure recommended in the *Traffic Signal Warrant Handbook (2014)* published by the Transportation Association of Canada (TAC). A value of 100 cumulative warrant points is considered the minimum value required to warrant a traffic signal. The warrant analysis files are attached in Appendix C, and the analysis results are outlined in Table 6.

Table 6. Signal Warrant Analysis

INTERSECTION	SCENARIO	WARRANT POINTS	SIGNALS?
Highway 2A / Broadway Avenue / East-West Collector Road	Existing (2015)	73	Not Warranted
	2018 Background	80	Not Warranted
	2025 Background	94	Nearly Warranted
	Stage 1 Combined	170	Warranted
	2018 Combined	200	Warranted
	2025 Combined	317	Warranted
Highway 597 / South Access	2018 Combined	21	Not Warranted
	2025 Combined	48	Not Warranted
	2035 Combined	58	Not Warranted
South Street / East Railway Street	2035 Combined	13	Not Warranted

Table 6 reveals that traffic signals will be warranted at the intersection of Highway 2A and the proposed East-West Collector Road under the 3 year horizon traffic conditions. It should be noted that traffic signals will be warranted in 2016 when Stage 1 is built out.

Traffic signals will not be warranted at the Highway 597 / South Access and South Street / East Railway Street intersection up to the 20 year horizon under the projected post-development traffic conditions.

It should be noted that Highway 2A is under Alberta Transportation's jurisdiction and in accordance with Design Bulletin #68/2010, Alberta Transportation may require that a roundabout feasibility assessment be conducted prior to installing traffic signals at the Highway 2A / East Access intersection.

The proposed East-West Collector Road intersection on Highway 2A will be located on a vertical sag curve with the gradient less than 4% in both northbound and southbound directions. In addition, there are no sight line constraints at this intersection. Therefore, a roundabout may be a feasible option for the proposed Highway 2A / East Access intersection. Based on the Technical Memo prepared by Stantec (Appendix A), traffic signals should be strongly considered as a more economical alternative

than a roundabout over the 20 year period and the Town of Blackfalds and Elkay / Spire wish to proceed with the construction of an upgraded signalized intersection.

Alberta Transportation indicated that they were prepared to consider the implementation of a signalized intersection at the Highway 2A / Broadway Avenue intersection on the condition that the Town of Blackfalds is responsible for constructing any future intersection improvements generated by developments, at the Town's cost and for addressing any operational concerns in a timely manner that may arise.

It is recommended that the right of way for a future roundabout at the Highway 2A / Broadway Avenue intersection should be protected as the surrounding lands are developed.

4 INTERSECTION ANALYSIS

This section presents the intersection analysis procedures that are specified in Alberta Transportation's *Highway Geometric Design Guide*, and covers the left and right turn lane criteria that were used in this study. The proposed Highway 597 / South Access intersection will not warrant traffic signals. Left and right turn lane warrant analyses were conducted for this intersection to determine if auxiliary lanes are required.

4.1 LEFT TURN LANE WARRANT ANALYSIS

Left turn warrants are based on the level of probability that a vehicle in the advancing traffic stream will not arrive at an intersection when another vehicle, traveling in the same direction, is stopped waiting to make a left turn. The interference caused by standing left turning vehicles in the through advancing traffic lane can reduce capacity and create a safety hazard. The amount of interference is dependent on opposing volumes, advancing volumes, and the number of left turning vehicles. The addition of a left turn lane with the required storage space will minimize this interference.

The analysis of left turn manoeuvres at the proposed Highway 597 / South Access intersection is based on the forecasted combined traffic volumes.

Table 7 summarizes the AM and PM peak hour turning information for the eastbound traffic on Highway 597 at the proposed South Access intersection under the 3, 10, and 20 year horizon combined traffic conditions. The left turn lane warrant analysis for the Highway 597 / South Access intersection was based on a design speed of 70 km/h.

Table 7. Left Turn Lane Warrant Analysis – Highway 597 / South Access

EB **AM** PEAK	ADVANCING	OPPOSING	LEFT TURNS	% LEFT TURN	TRUCKS IN LT	WARRANTED?
2018 Combined	272	273	30	11%	10%	Yes, Type III
2025 Combined	306	318	46	15%	10%	Yes, Type IV
2035 Combined	364	373	46	13%	10%	Yes, Type IV
EB **PM** PEAK	ADVANCING	OPPOSING	LEFT TURNS	% LEFT TURN	TRUCKS IN LT	WARRANTED?
2018 Combined	388	348	49	13%	10%	Yes, Type IV
2025 Combined	451	433	92	20%	10%	Yes, Type IV
2035 Combined	530	509	92	17%	10%	Yes, Type IV

Table 7 reveals that a Type IV left turn lane will be warranted at the Highway 597 / South Access intersection for the eastbound traffic under the 3 year horizon post-development traffic conditions. An additional 10 m storage length (total parallel deceleration lane length 65 m) will be required to accommodate the forecasted 20 year horizon traffic. The existing raised median on Highway 597 will need to be removed to provide room for the proposed eastbound left turn lane.

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4.2 RIGHT TURN LANE WARRANT ANALYSIS

According to Alberta Transportation's *Highway Geometric Design Guide*, the warrant for an exclusive right turn lane requires that all of the following conditions be met:

- Main (or through) road AADT ≥ 1800,
- Intersecting road AADT ≥ 900, and
- Right turn daily traffic volume ≥ 360 for the movement in question.

Based on the forecasted traffic volumes, a westbound right turn lane will be warranted at the proposed Highway 597 / South Access intersection under the 3 year horizon post-development traffic conditions.

Based on the Highway 2A / 597 roundabout plan, the proposed right turn lane taper at the Highway 597 / South Access intersection will overlap the westbound two lanes to one lane merging taper located approximately 80 m east of the South Access on Highway 597. It is recommended that two through lanes be provided for the westbound traffic on Highway 597 between the Highway 2A / 597 roundabout and the existing two lanes approximately 200 m west of the proposed South Access.

The proposed Highway 597 / South Access intersection improvement concept plan is shown in Figure 11 and attached in Appendix C. The South Access intersection is located east and out of the two-lane to one-lane transition zone on Highway 597.

Alberta Transportation is requiring that two eastbound through lanes be provided at the South Access intersection up to the existing two lanes west of the Highway 2A / 597 roundabout to provide better safety and operational performance for the eastbound traffic. Alberta Transportation prefers the intersection improvement concept plan shown in Figure 12 and attached in Appendix C. Discussion on construction cost sharing with Alberta Transportation is anticipated to be required on the upgraded intersection improvement.

Figure 11. Proposed Intersection Improvement Concept Plan (South Access)

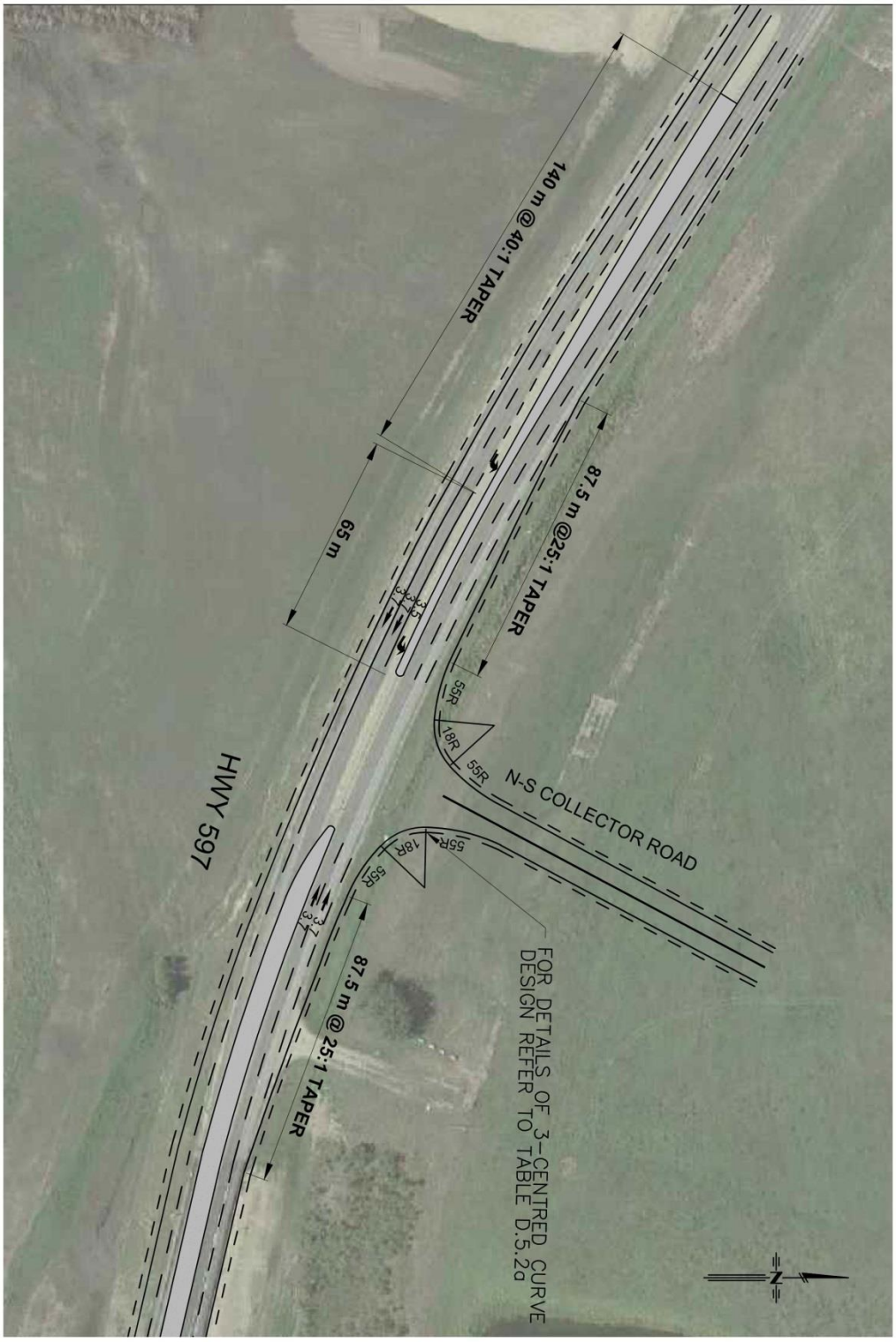


Figure 12. AT Preferred Intersection Improvement Concept Plan (South Access)

5 CAPACITY ANALYSIS

This section describes the method used for the capacity analysis and evaluates the operating level of service of the study intersections under the 3, 10, and 20 year horizon traffic conditions.

5.1 METHODOLOGY

To determine the operating conditions of an intersection or roadway, the concept of level of service (LOS) is generally used. The LOS of an intersection is a qualitative measure of capacity and operating conditions and is directly related to vehicle delay. LOS is given a letter designation from A to F, with LOS A representing very short delays and LOS F representing very long delays.

For this study, WSP developed Synchro Studio 9 (Synchro) intersection simulation models for signal and stop controlled intersections. Synchro 9 implements the methods of the *Highway Capacity Manual, 2010* (HCM 2010) and follows the LOS criteria that is listed in Table 8. For two-way stop controlled intersections, the delay is typically calculated for the movements at the minor approaches only, since the major roads are considered to be operating at free flow conditions.

To evaluate the traffic operational performance for a roundabout, SIDRA Intersection 6.1 (SIDRA) was used. SIDRA employs a combined geometry and gap-acceptance modelling approach in order to take into account the effect of roundabout geometry on driver behaviour directly through gap-acceptance modelling. The LOS criteria for unsignalized intersections in Table 8 were used for assessing the traffic operational performance for a roundabout.

Table 8. Level of Service Criteria for Intersections (HCM 2010)

SIGNALIZED CONTROL DELAY (s)	UNSIGNALIZED CONTROL DELAY (s)	LOS BY VOLUME-TO-CAPACITY RATIO	
		v/c ≤ 1.0	*v/c* > 1.0
≤ 10	≤ 10	A	F
> 10 and ≤ 20	> 10 and ≤ 15	B	F
> 20 and ≤ 35	> 15 and ≤ 25	C	F
> 35 and ≤ 55	> 25 and ≤ 35	D	F
> 55 and ≤ 80	> 35 and ≤ 50	E	F
> 80	> 50	F	F

5.2 CAPACITY ANALYSIS RESULTS

Traffic simulation models (Synchro and SIDRA) were created for the study intersections under the traffic conditions for each analysis horizon.

5.2.1 HIGHWAY 2A / HIGHWAY 597

The existing Highway 2A / 597 intersection is a four-legged intersection. A two-lane modern roundabout was recently constructed at this intersection.

Tables 9A to 9D summarize the anticipated traffic operational performance at the Highway 2A / 597 intersection under the analysis horizon traffic conditions when the two-lane modern roundabout is in operational. The detail SIDRA outputs are attached in Appendix D.

Table 9A. Capacity Analysis: Existing (2015) Traffic – Highway 2A / 597 (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	4.7	A	0.17	6.8	7.9	A	0.42	17.3
NBTR	4.2	A	0.17	6.7	7.2	A	0.42	17.8
WBLT	4.5	A	0.12	3.8	8.2	A	0.20	7.0
WBTR	3.9	A	0.12	3.7	6.5	A	0.20	7.5
SBLT	9.4	A	0.54	25.2	5.7	A	0.25	9.3
SBTR	8.6	A	0.54	25.9	5.3	A	0.25	9.6
EBLT	9.0	A	0.16	5.4	5.8	A	0.18	6.0
EBTR	7.7	A	0.23	8.8	5.3	A	0.18	6.5
INT Summary	7.5	A	0.54	-	6.6	A	0.42	-

Table 9B. Capacity Analysis: 2018 Combined Traffic – Highway 2A / 597 (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	5.2	A	0.21	8.7	9.6	A	0.49	22.5
NBTR	4.7	A	0.21	8.6	8.5	A	0.49	22.6
WBLT	5.0	A	0.14	4.6	9.9	A	0.26	9.4
WBTR	4.3	A	0.14	4.6	7.7	A	0.26	10.1
SBLT	11.5	B	0.62	35.2	6.6	A	0.31	12.0
SBTR	10.5	B	0.62	35.3	6.1	A	0.31	12.5
EBLT	11.2	B	0.23	8.1	6.9	A	0.25	8.7
EBTR	9.8	A	0.32	13.2	6.3	A	0.25	9.6
INT Summary	9.0	A	0.62	-	7.8	A	0.49	-

Table 9C. Capacity Analysis: 2025 Combined Traffic – Highway 2A / 597 (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	5.8	A	0.25	10.8	13.8	B	0.65	39.9
NBTR	5.2	A	0.25	10.7	12.1	B	0.65	40.6
WBLT	5.5	A	0.17	5.6	15.1	B	0.38	15.3
WBTR	4.7	A	0.17	5.5	11.2	B	0.38	16.9
SBLT	15.5	C	0.73	53.6	8.3	A	0.40	16.0
SBTR	14.0	B	0.73	54.4	7.5	A	0.40	16.8
EBLT	15.5	C	0.33	12.2	8.6	A	0.33	12.1
EBTR	15.3	C	0.49	24.3	7.9	A	0.33	13.8
INT Summary	11.9	B	0.73	-	10.8	B	0.65	-

Table 9D. Capacity Analysis: 2035 Combined Traffic – Highway 2A / 597 (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	6.7	A	0.31	14.1	23.5	C	0.82	70.2
NBTR	5.9	A	0.31	14.1	20.5	C	0.82	72.9
WBLT	6.3	A	0.21	7.3	27.8	D	0.58	26.8
WBTR	5.3	A	0.21	7.3	20.0	C	0.58	31.2
SBLT	27.8	D	0.88	102.8	10.5	B	0.50	23.6
SBTR	25.1	D	0.88	106.0	9.4	A	0.50	24.6
EBLT	28.3	D	0.52	22.1	11.4	B	0.43	17.9
EBTR	34.7	D	0.75	46.9	10.2	B	0.43	20.4
INT Summary	20.8	C	0.88	-	17.0	C	0.82	-

The capacity analysis results reveal that all traffic movements at the Highway 2A / 597 intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 10 year horizon and LOS D or better at the 20 year horizon under the post-development traffic conditions. The roundabout at the Highway 2A / 597 intersection will be capable of accommodating the forecasted post-development traffic.

5.2.2 HIGHWAY 2A / EAST-WEST COLLECTOR ROAD

Based on the signal warrant analysis results, the Highway 2A / East-west Collector Road intersection will warrant traffic signals at the 3 year horizon (2018) when Stage 1 and Stage 2 are fully built out.

Table 10A summarizes the current traffic operational performance at this intersection under the existing traffic conditions. Tables 10B to 10D summarize the traffic operational performance at the analysis horizons under the post-development traffic conditions when the intersection is under signal control. The detailed Synchro outputs are attached in Appendix D. The following intersection lane configurations are recommended when traffic signals are installed at this intersection:

- Eastbound: two left turn lanes and one right turn lane;
- Northbound: one left turn lane and two through lanes, and
- Southbound: two through lanes and one right turn lane.

Table 10A. Capacity Analysis: Existing Traffic – Highway 2A / Broadway Avenue (Stop Control)

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL	43.2	E	0.65	43.5	13.3	B	0.13	3.5
NBL	11.2	B	007	1.6	9.0	A	0.15	4.0
INT Summary	4.6	A	0.65	-	1.9	A	0.15	-

Table 10B. Capacity Analysis: 2018 Combined Traffic – Highway 2A / East-West Collector Road (Signal Control)

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL,L	20.8	C	0.13	6.6	17.4	B	0.29	13.5
EBR	9.5	A	0.56	14.9	7.1	A	0.38	11.3
NBL	5.8	A	0.24	6.8	7.0	A	0.47	18.4
NBT,T	4.3	A	0.15	10.2	5.8	A	0.38	28.0
SBT,T	15.2	B	0.69	91.7	15.1	B	0.53	27.8
SBR	3.3	A	0.14	7.4	4.5	A	0.29	8.9
INT Summary	12.0	B	0.69	-	9.1	A	0.53	-

Table 10C. Capacity Analysis: 2025 Combined Traffic – Highway 2A / East-West Collector Road (Signal Control)

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL,L	25.1	C	0.17	12.1	22.6	C	0.40	21.8
EBR	18.3	B	0.64	36.5	7.5	A	0.43	14.1
NBL	7.1	A	0.35	8.0	9.2	A	0.58	24.6
NBT,T	4.9	A	0.17	12.2	7.4	A	0.51	39.8
SBT,T	18.7	B	0.82	97.5	20.5	C	0.62	45.2
SBR	2.5	A	0.21	8.0	5.0	A	0.38	13.0
INT Summary	15.2	B	0.82	-	11.9	B	0.62	-

Table 10D. Capacity Analysis: 2035 Combined Traffic – Highway 2A / East-West Collector Road (Signal Control)

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL,L	32.6	C	0.21	14.3	23.4	C	0.41	22.3
EBR	27.0	C	0.74	51.2	7.8	A	0.44	14.4
NBL	7.9	A	0.35	10.7	12.8	B	0.66	32.4
NBT,T	4.0	A	0.19	13.0	8.5	A	0.63	52.1
SBT,T	20.9	C	0.88	138.3	20.9	C	0.70	52.8
SBR	2.0	A	0.19	7.4	4.3	A	0.36	12.0
INT Summary	17.6	B	0.88	-	12.9	B	0.70	-

The above capacity analysis results reveal that the existing eastbound traffic movements on Broadway Avenue currently operate at LOS E during the AM peak hours. When the proposed Highway 2A / East-West Collector Road intersection is under signal control, all traffic movements at this intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods up to the 20 year horizon. The proposed intersection lane configurations will be capable of accommodating the forecasted post-development traffic.

As previously stated in Section 3, Alberta Transportation requires that a roundabout feasibility assessment be conducted prior to installing traffic signals at an intersection on provincial highways. A two-lane roundabout concept plan was developed for illustrative purposes and attached in Appendix C.

Tables 10E to 10G summarize the anticipated traffic operational performance at the Highway 2A / East Access intersection under the analysis horizon traffic conditions when the proposed roundabout is constructed.

Table 10E. Capacity Analysis: 2018 Combined Traffic – Highway 2A / East-West Collector Road (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	3.8	A	0.14	5.6	7.7	A	0.46	23.2
NBT	3.6	A	0.14	5.8	7.2	A	0.46	24.0
SBT	7.1	A	0.46	22.1	6.1	A	0.29	11.9
SBTR	6.6	A	0.46	22.2	5.6	A	0.29	12.2
EBL	7.9	A	0.11	3.1	4.7	A	0.17	5.6
EBR	6.9	A	0.27	9.0	5.4	A	0.17	5.5
INT Summary	6.3	A	0.46	-	6.6	A	0.46	-

Table 10F. Capacity Analysis: 2025 Combined Traffic – Highway 2A / East-West Collector Road (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	4.3	A	0.18	7.2	10.9	B	0.60	36.1
NBT	4.1	A	0.18	7.5	10.1	B	0.60	36.8
SBT	8.9	A	0.56	31.8	7.7	A	0.39	18.3
SBTR	8.2	A	0.56	32.1	7.1	A	0.39	19.0
EBL	9.4	A	0.20	6.0	6.0	A	0.25	9.3
EBR	9.0	A	0.36	13.9	6.7	A	0.24	8.1
INT Summary	7.8	A	0.56	-	8.8	A	0.60	-

Table 10G. Capacity Analysis: 2035 Combined Traffic – Highway 2A / East-West Collector Road (Roundabout)

LANE	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
NBLT	4.6	A	0.21	9.0	14.2	B	0.71	57.8
NBT	4.3	A	0.21	9.3	13.1	B	0.71	58.3
SBT	11.4	B	0.67	46.8	8.9	A	0.46	23.5
SBTR	10.4	B	0.67	47.0	8.1	A	0.46	24.5
EBL	11.6	B	0.23	7.6	6.7	A	0.28	10.3
EBR	11.6	B	0.43	18.3	7.7	A	0.26	9.1
INT Summary	9.7	A	0.67	-	11.0	B	0.71	-

The roundabout capacity analysis results reveal that all traffic movements will operate at an acceptable LOS B or better during both the AM and PM peak periods up to the 20 year horizon if a roundabout is constructed at the Highway 2A / East-West Collector Road intersection.The proposed roundabout will be capable of accommodating the forecasted post-development traffic.

5.2.3 HIGHWAY 597 / SOUTH ACCESS

Tables 11A to 11C summarize the traffic operational performance at this intersection under the analysis horizon traffic conditions. The detailed Synchro outputs are attached in Appendix D.

Table 11A. Capacity Analysis: 2018 Combined Traffic – Highway 597 / South Access

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL	7.9	A	0.03	0.6	8.1	A	0.04	1.1
SBLR	11.6	B	0.20	3.3	13.9	B	0.22	6.2
INT Summary	1.8	A	0.20	-	2.2	A	0.22	-

Table 11B. Capacity Analysis: 2025 Combined Traffic – Highway 597 / South Access

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL	8.0	A	0.04	1.0	8.3	A	0.08	2.4
SBLR	14.2	B	0.31	9.8	21.9	C	0.51	21.7
INT Summary	3.3	A	0.31	-	4.7	A	0.51	-

Table 11C. Capacity Analysis: 2035 Combined Traffic – Highway 597 / South Access

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBL	8.1	A	0.04	1.1	8.5	A	0.09	2.5
SBLR	15.9	C	0.34	11.5	28.2	D	0.59	28.3
INT Summary	3.2	A	0.34	-	5.1	A	0.59	-

The capacity analysis results reveal that all traffic movements at the Highway 597 / South Access intersection will operate at an acceptable LOS D or better during both the AM and PM peak periods at the 10 and 20 year horizons under the post-development traffic conditions. The proposed intersection treatment is expected to be capable of accommodating the forecasted future traffic volumes.

5.2.4 SOUTH STREET / EAST RAILWAY STREET

The existing South Street / East Railway Street intersection is a three-legged intersection and is controlled by one stop sign on the east approach with free flow conditions in the north and west directions. This intersection is proposed to become a four-legged intersection with the proposed N-S Collector Road forming the south leg. It is recommended that an additional stop sign be installed on the west approach when the proposed N-S Collector Road is constructed. No auxiliary lane (i.e., left or right turn lane) is recommended for this intersection.

Tables 12A to 12C summarize the traffic operational performance at this intersection under the analysis horizon traffic conditions with the proposed intersection control type. The detailed Synchro outputs are attached in Appendix D.

Table 12A. Capacity Analysis: 2018 Combined Traffic – South Street / East Railway Street

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBLTR	10.1	B	0.12	3.1	12.1	B	0.37	12.7
WBLTR	10.4	B	0.02	0.4	10.1	B	0.01	0.2
NBL	7.6	A	0.01	0.3	7.5	A	0.03	0.7
SBL	7.2	A	0.00	0.0	7.3	A	0.00	0.0
INT Summary	3.7	A	0.12	-	8.7	A	0.37	-

Table 12B. Capacity Analysis: 2025 Combined Traffic – South Street / East Railway Street

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBLTR	10.3	B	0.14	3.8	13.9	C	0.44	17.1
WBLTR	10.8	B	0.02	0.4	10.7	B	0.01	0.2
NBL	7.7	A	0.03	0.6	7.5	A	0.05	1.1
SBL	7.3	A	0.00	0.0	7.3	A	0.00	0.0
INT Summary	4.0	A	0.14	-	9.3	A	0.44	-

Table 12C. Capacity Analysis: 2035 Combined Traffic – South Street / East Railway Street

TRAFFIC MOVEMENTS	AM PEAK HOUR				PM PEAK HOUR			
	Delay (s)	LOS	*V/C*	95th Queue Length (m)	Delay (s)	LOS	*V/C*	95th Queue Length (m)
EBLTR	10.3	B	0.14	3.8	13.9	C	0.44	17.1
WBLTR	10.8	B	0.02	0.4	10.7	B	0.01	0.2
NBL	7.7	A	0.03	0.6	7.5	A	0.05	1.1
SBL	7.3	A	0.00	0.0	7.3	A	0.00	0.0
INT Summary	4.0	A	0.14	-	9.3	A	0.44	-

The above capacity analysis results reveal that all traffic movements at the South Street / East Railway Street intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 20 year horizon. The proposed intersection control type and lane configurations will be capable of accommodating the forecasted post-development traffic. South Street will operate at acceptable level of services with the existing two-lane cross section up to the 20 year horizon.

6 ADDITIONAL CONSIDERATIONS

This section is intended as a general overview of a number of site aspects. Some additional issues have been identified for consideration.

6.1 SIGHT DISTANCE

The intersection sight distances along Highway 2A and Highway 597 at the study intersections were checked utilizing Alberta Transportation's TIMS based on the sight distance requirements in Alberta Transportation's *Geometric Design Guide*. The sight distances are adequate at the study intersections.

6.2 OPERATIOANL ANALYSIS

The proposed realigned Broadway Avenue intersection on the East-West Collector Road will be located approximate 100 m (center line to center line) west of Highway 2A. The stacking distance between the Broadway Avenue / East-West Collector Road and Highway 2A / East-West Collector intersection is more than 50 m which is adequate to accommodate two 25 m long WB-23 vehicles.

The East-West Collector Road and Broadway Avenue intersection will be controlled by one stop sign on Broadway Avenue with free flow conditions on the East-West Collector Road. Therefore, no vehicle queue is expected to occur for the westbound traffic on the East-West Collector Road at the Broadway Avenue / East-West Collector Road intersection. As such, westbound traffic on the East-West Collector Road will not spill onto Highway 2A.

6.3 PEDESTRIANS AND ILLUMINATION

Currently there are no pedestrian facilities (e.g., sidewalks or trails) provided along Highway 2A or in the vicinity of the Broadway Avenue intersection. If the Town wants to provide pedestrian facilities in the future, pedestrian traffic will be accommodated by providing marked crosswalks and pedestrian signals at the proposed signalized intersection.

Lighting is currently provided at the Highway 2A / Highway 597, Highway 2A / Broadway Avenue, and South Street / East Railway Street intersections. The Highway 597 / South Access intersection was evaluated for illumination requirements based on the latest revision of the Transportation Association of Canada's (TAC) *Guide for the Design of Roadway Lighting.* The following factors were evaluated:

- Geometric – geometric features of the intersection and associated roadways.
- Operational – present and proposed AADT, roadway classification and operating speeds on all connecting legs.
- Environmental – proximity to other lighted developments within the area.
- Collision – night-time highway collision history in the area that may be attributed to lack of illumination.

Based on the TAC requirements, delineation lighting will be warranted at the Highway 597 / South Access intersection. The illumination warrant analysis can be found in Appendix C.

7 CONCLUSIONS AND RECOMMENDATIONS

This study has examined the traffic impacts associated with the proposed residential and commercial development located within the southern limits of the Town of Blackfalds. The conclusions and recommendations are summarized below:

HIGHWAY 2A / HIGHWAY 597

- All traffic movements at the Highway 2A / Highway 597 intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 10 year horizon and LOS D or better at the 20 year horizon under the post-development traffic conditions. The roundabout at the Highway 2A / Highway 597 intersection will be capable of accommodating the forecasted post-development traffic.

HIGHWAY 2A / BROADWAY AVENUE / EAST-WEST COLLECTOR ROAD

- The eastbound traffic movements on Broadway Avenue currently operate at LOS E during the AM peak hours at the existing Highway 2A / Broadway Avenue intersection.
- Traffic signals will be warranted at the proposed Highway 2A / East-West Collector Road intersection in 2016 when Stage 1 is built out.
- The following intersection lane configurations are recommended when traffic signals are installed at this intersection:
  - Eastbound: two left turn lanes and one right turn lane;
  - Northbound: one left turn lane and two through lanes, and
  - Southbound: two through lanes and one right turn lane.
- When the proposed Highway 2A / East-West Collector Road intersection is under signal control, all traffic movements will operate at an acceptable LOS C or better during both the AM and PM peak periods up to the 20 year horizon. The proposed intersection lane configurations will be capable of accommodating the forecasted post-development traffic.
- To improve the traffic operational performance at this intersection up to the 20-year horizon, traffic signals are proposed to be installed at the same time as the geometric improvements to an all-directional intersection. As the upgraded intersection nears capacity, the feasibility of a roundabout should be assessed at that time; however, the right of way for a future roundabout should be protected as the surrounding lands are developed. A roundabout concept plan was developed for this intersection and attached in Appendix C.

HIGHWAY 597 / SOUTH ACCESS

- A Type IV left turn lane will be warranted for eastbound traffic under the 3 year horizon post-development traffic conditions. An additional 10 m storage length (total parallel deceleration lane length 65 m) will be required to accommodate the forecasted 20 year horizon traffic. The existing raised median on Highway 597 will need to be removed to provide room for the proposed eastbound left turn lane.
- It is recommended that two through lanes be provided for the westbound traffic on Highway 597 between the Highway 2A / 597 roundabout and the existing two lanes approximately 200 m west of the proposed South Access. One eastbound through lane is expected to be capable of accommodating the forecasted post-development traffic. The proposed South

Access intersection is located east of and out of the eastbound two-lane to one-lane transition zone on Highway 597.

- Alberta Transportation is requiring that two eastbound through lanes be provided at the South Access intersection up to the existing two lanes west of the Highway 2A / 597 roundabout to provide better safety and operational performance for the eastbound traffic. Alberta Transportation's requested intersection improvement concept plan is shown in Figure 12 and attached in Appendix C. Construction cost sharing with Alberta Transportation is anticipated to be required regarding these upgraded intersection improvements.
- All traffic movements at the Highway 597 / South Access intersection will operate at an acceptable LOS D or better during both the AM and PM peak periods at the 10 and 20 year horizons under the post-development traffic conditions.
- The intersection sight distances along Highway 597 at the South Access intersection appear to be adequate.
- Signals will not be warranted at this intersection up to the 20 year horizon.
- Delineation lighting will be warranted at the Highway 597 / South Access intersection.

SOUTH STREET / EAST RAILWAY STREET

- This intersection will become a four-legged intersection with the proposed N-S Collector Road forming the south leg. It is recommended that an additional stop sign be installed on the west approach when the proposed North-South Collector Road is constructed. No auxiliary lane (i.e., left or right turn lane) is recommended for this intersection.
- All traffic movements at the South Street / East Railway Street intersection will operate at an acceptable LOS C or better during both the AM and PM peak periods at the 20 year horizon. The proposed intersection control type and lane configurations will be capable of accommodating the forecasted post-development traffic. South Street will operate at acceptable level of services with the existing two-lane cross section up to the 20 year horizon.

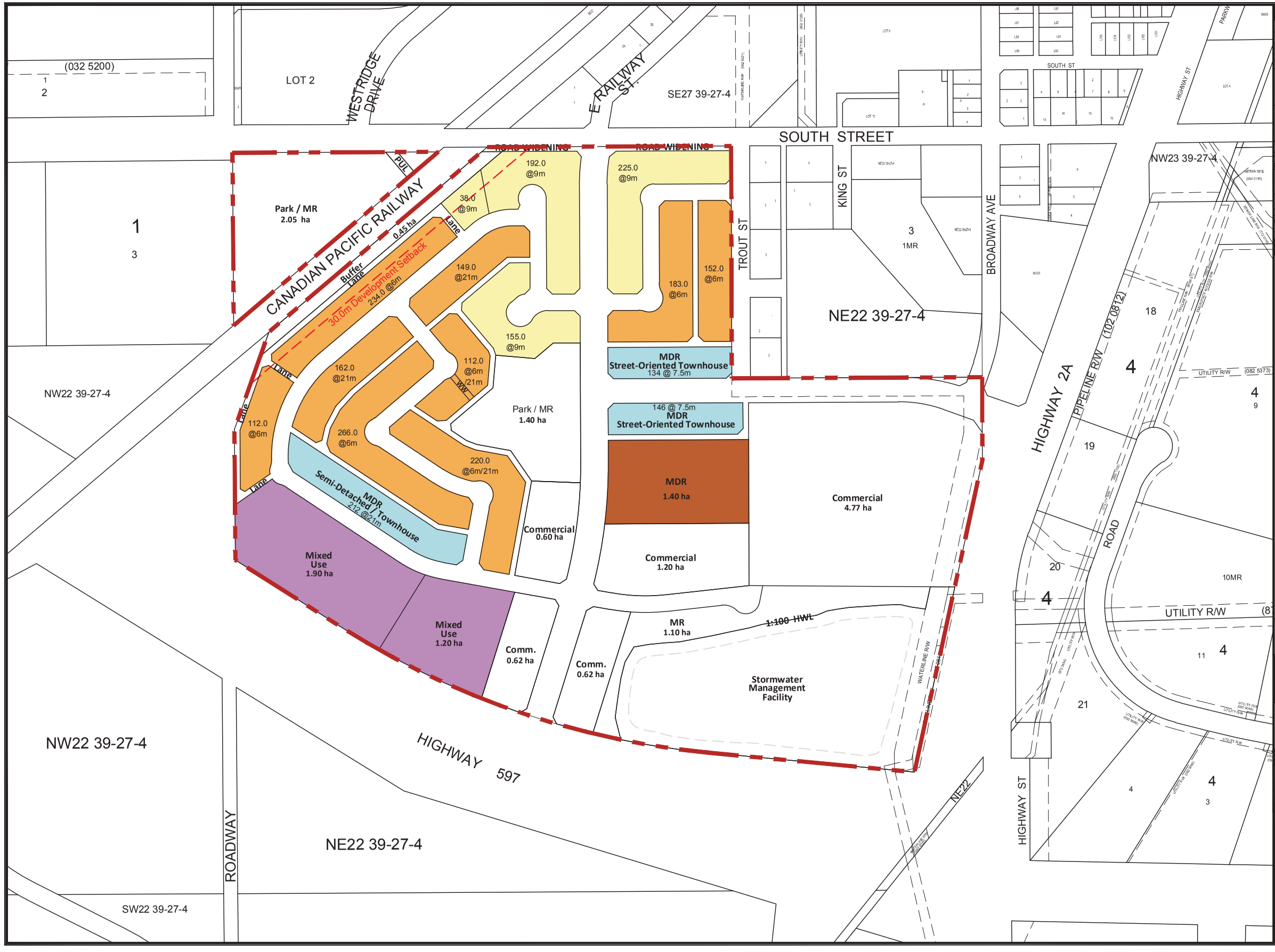
8 CLOSURE

This report has been prepared by WSP based on the best information available at the time for the exclusive use of Elkay Developments Ltd. and Spire General Partner Ltd. Use by third parties, without the express written permission of WSP Canada Inc., is not permitted.

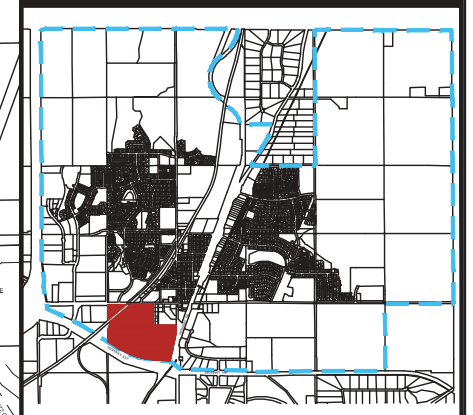
Appendix A

PROJECT INFORMATION

- **Proposed Site Plan**
- **Highway 2A / 597 Roundabout Plan**
- **AT's Comments**
- **Stantec Roundabout & Traffic Signals Life Cost Analysis**



KEY PLAN



LEGEND

- Area Structure Plan Boundary
- Single Family / Front Attached
- Single Family / Rear Detached
- MDR / Townhouse
- Medium Density Residential
- Mixed Use

LOT SUMMARY:

Unit Type	Frontage or Site Area	Average Lot Width	Units / ha	No. of Units
Single Family	2200 m	13.1m		168
MDR/Townhouse	492 m	8.0m		61
Medium Density	1.40 ha		100 upha	140
Mixed Use	3.10 ha		75 upha	233
TOTAL UNITS				602

NOTES:
Average lot widths and units per hectare are based on general information and may not reflect market demands at time of development.

SOURCES:

- Property lines are from parcel mapping corrected to 3TM Ground.
- Aerial photo is from FocusView corrected to 3TM Ground.

Designer: _____
Planner: Chuck McNutt

VERSION
7.0

BLACKFALDS CROSSING
BLACKFALDS, ALBERTA

DEVELOPMENT CONCEPT

JUNE 14, 2016 151-02471-00-CP-V7

SCALE NORTH

60 40 20 0 100 m
1 : 4,000

WSP
SUITE 300, 9925 - 109 STREET
EDMONTON, ALBERTA T5K 2J8
PHONE: 780 466-6555 - FAX: 780-463-0177 - WWW.WSPGROUP.COM

FILE: N:\151-02471-00 BLACKFALDS SUBDIVISION TIA\PLANNING\151-02471-00_AREA STRUCTURE PLAN\DRAWINGS\151-02471-00-CP-V7.DWG Sheet:Frontage Plan

102+600
102+400
102+200
102+000
101+900
101+800
101+700
101+600
101+500
101+400
101+300
NORTH N.W.P. ACCESS ROAD
SOUTH N.W.P. ACCESS ROAD
300+120
300+080
300+040
300+000
6+900
6+800
6+700
6+600
6+500
6+300
6+200
6+100
6+000
7+000
HWY 2A MEDIAN
BLACKFALDS
SE 22-39-27-4
HER MAJESTY THE QUEEN
IN RIGHT OF ALBERTA
EDMONTON, AB
HER MAJESTY THE QUEEN
IN RIGHT OF ALBERTA
EDMONTON, AB
NE 22-39-27-4
CROWN
6+450
6+400
6+350
101+850

Alberta Transportation

Office of the Operations Manager
Central Region

#401, 4920 - 51 Street
Red Deer, Alberta

Telephone 403/340-5166
Fax 403/340-4876

September 27th, 2016

File: Blackfalds (ASP)

Town of Blackfalds
Box 220, 5018 Waghorn St
Blackfalds, AB T0M 0J0
Sent via email to: MThompson@blackfalds.com

Attention: Myron Thompson, Chief Administrative Officer

RE: STANTEC TECHNICAL MEMO – REVIEW OF ROUNDABOUT & TRAFFIC SIGNALS
NE 22-39-27-W4 (ELKAY DEVELOPMENTS)
HIGHWAY 2A & BROADWAY AVENUE, BLACKFALDS CROSSING

Thank you for the technical memo and updated Life Cycle Cost Analysis (LCCA) comparing signalized intersection and roundabout treatment options at the Highway 2A & Broadway Avenue intersection.

We have reviewed the technical memo and in deciding between traditional traffic signals and a roundabout, we have considered the site-specific characteristics of this intersection, and given the life cycle costs of both are comparable, we prefer the roundabout option that offers lower collision costs, lower greenhouse gas cost, and better passenger and truck reliability (reduction in delays and improvements in traffic flow).

The LCCA clearly demonstrates the lower initial capital costs of traditional signals are offset by higher future collision costs. Within the context of similar overall life cycle costs, although our preference is to select the solution with the lower collision costs, we recognize the importance of the development to the Town of Blackfalds and we are prepared to consider the implementation of a signalized intersection at Highway 2A & Broadway Avenue on the condition that the Town of Blackfalds is responsible for constructing any future intersection improvements generated by developments, at the Town's cost and for addressing any operational concerns in a timely manner that may arise.

If the Town is amenable to accepting responsibility for all future Highway 2A and Broadway Avenue intersection improvements (which may include future twinning of Highway 2A to ensure adjacent intersections do not conflict) and operational issues, WSP is to incorporate the recommendation contained in Stantec's Technical Memo into a revised Traffic Impact Assessment for Alberta Transportation's acceptance.

If you have any questions, please contact me or Sandy Choi at 403-340-5166.

Sincerely,

Mike Baik
Operations Manager

SC/sc

cc: Stantec – Brad.VanderHeyden@stantec.com
Preston Weran – pweran@blackfalds.com
Russ Watts – Russell.Watts@gov.ab.ca

Alberta Transportation

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Red Deer, Alberta

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Stuart Richardson – Stuart.Richardson@gov.ab.ca

Stantec

Technical Memorandum

To:	Stuart Richardson Alberta Transportation	From:	Brad Vander Heyden Stantec Consulting Ltd.
File:	113928147-346	Date:	September 21, 2016

Reference: Proposed Broadway Avenue Intersection Upgrades - Life Cycle Cost Analysis Review of Roundabout & Traffic Signals

1.0 INTRODUCTION AND BACKGROUND

On June 15, 2016, Elkay Developments, the Town of Blackfalds, WSP, and Stantec met with Alberta Transportation to discuss the options of upgrading the Highway 2A and Broadway Avenue intersection as two potential improvements - a signalized intersection as well as a roundabout. At that meeting, a preliminary copy of the Life Cycle Cost Analysis (LCCA) was provided for discussion purposes. At the conclusion of the meeting, Alberta Transportation was understanding of the subjectivity of the comparison and open-minded to resubmitting the LCCA with supporting information for their decision making process.

On behalf of the Town of Blackfalds and Elkay Developments, Stantec and WSP have collaborated on the preparation of this updated LCCA to serve our respective clients in a united manner and we are pleased to submit it to you accordingly. The LCCA, was developed using the National Cooperative Highway Research Program (NCHRP) Life Cycle Cost Estimation Tool. The NCHRP tool compares the long term costs of constructing an upgraded signalized intersection to the costs of a roundabout intersection.

In general, roundabouts have historically been demonstrated to typically function safer and more efficiently than traffic signals, but in most cases, roundabouts cost considerably more for this type of highway project. In completing our review, we have made effort to remain technically-neutral to the pros and cons of each alternative to ensure that a design alternative solution is chosen to meet the satisfactory requirements of all stakeholders involved.

The LCCA was completed to compare the 20 year life cycle costs of the two alternatives (traffic signals and roundabout improvements), to each other as well as the base alternative scenario of "do nothing". In addition to the costs of construction, the LCCA also factors in the costs of passenger time, truck time, and safety (i.e. cost of collisions). It should be noted that these costs are very subjective and as such, they should be well supported with supplementary information

The benefit-cost ratio, shown on the summary sheet, is relative to the base case only (no development and no improvements) and in our opinion, should not be taken into consideration in comparing the signals and the roundabout alternatives. The formulas that calculate the benefit-cost ratio also seems to be significantly skewed and don't compare the life cycle costs of the signals and the roundabout directly to each other.

2.0 LIFE CYCLE COST ANALYSIS – CRITERIA INPUT

The following items were reviewed in chronological order with WSP's draft document and updated in the spreadsheet for comparative discussion:

2.1 Cost Parameters

The Alberta Transportation Project Benefit Cost Model User Guide (April 8, 2015) has identified the following collision costs.

Table 3.1 – Accident Costs, by Type

Accident Type	Stantec
Fatality	$9,464,015
Injury	$66,744
Property Damage Only	$5,851

It should be noted that Greenhouse Gas costs have not been included. Example case studies provided by the NCHRP that have included them have generally shown that the associated costs are very small relative to the overall cost and are not typically relevant in comparison.

Alberta Transportation uses as discount rate of 4%.

The demand and travel delays were based on the numbers provided by WSP are consistent with numbers used in the Alberta Transportation Project Benefit Cost Model User Guide (April 8, 2015).

2.2 Demand Parameters

The traffic demand parameters are based off of the Traffic Impact Assessment completed by WSP. As shown in the TIA, the signalized intersection will operate at an acceptable level of service beyond the standard 20 year design horizon.

2.3 Cost Base Inputs (Base Case, Alternative 1 – Signals, and Alternative 2 – Roundabout)

The Base Case is be a "do nothing" scenario, which is not an option to the Town and the Developer. Inherently, no development would mean no new upfront construction and design costs.

Table 3.2 – Costs of Construction and Professional Services

Direct Costs	Base Case	Alt 1 - Signals	Alt 2 - Roundabout
Planning and Design	$0	$200,000	$300,000
Construction (Total)	$0	$1,600,000	$4,000,000

2.4 Collision Projections

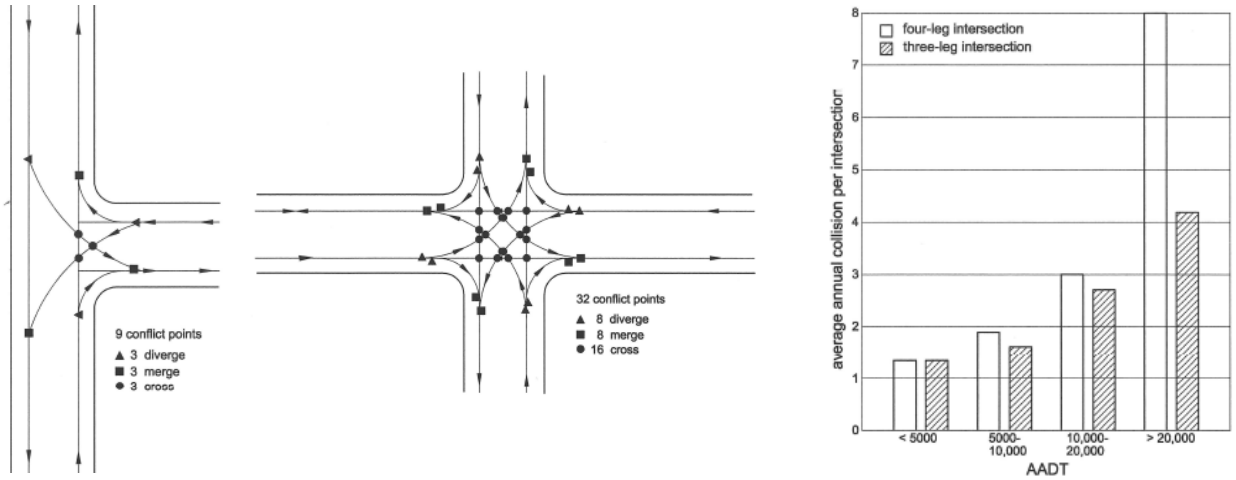
Perhaps the most challenging and subjective component of the analysis is the Safety costs, which are based on the number of fatal, injury only, and property damage only (PDO) collision types in the model. These are difficult to predict and they can vary substantially between model methodologies, Average Annual Daily Traffic (AADT) intersection types, posted speed limits, climate conditions, and unique site considerations. Rather than basing the estimated future collisions on models, we have taken a conservative approach of reviewing past collision history along the Highway 597 and Highway 2A corridors and inflating them quite conservatively to reflect future traffic growth. The data, which is discussed further below, was provided by the RCMP to the Town for information purposes. The projected collisions for the roundabout alternative were developed by WSP using the Collision Prediction Models for British Columbia in conjunction with the traffic volumes as per the TIA.

Table 3.3 – Projected Annual Collision Rates in Stantec Model

Collision Type	Base Case	Alt 1 - Signals	Alt 2 - Roundabout
Fatality	**0.04**	**0.04**	**0.0**
Injury	**0.67**	**0.109**	**0.26**
PDO	**2.7**	**11**	**2.43**

As shown in Table 3.4 below, there were 13 non-fatal collisions over a weighted 5 year period at the 5 intersections on Highways 2A and 597 in the Town limits, which averages 0.104 non-fatal collisions per year. Four of the five intersections used in the historical assessment are four legged intersections. The Broadway Avenue intersection is a tee intersection, which has less conflict points and lower collision rates than four legged intersections as illustrated in the TAC images below.

Figure 3.0 – Conflict Points and Collision Rates of Three and Four-Leg Intersections



* Image from Transportation of Canada Design Guide for Canadian Roads

The current AADT for Highway 2A north of Highway 597 is approximately 12,910. At an annual increase of 2.5%, it will reach approximately 21,150 in 2035. On average over the 20 year timespan, it is reasonable to increase the collision rate by a factor of 1.5 for the traffic volume increase and multiply the collision rate per year by a factor of 0.70 for a three legged intersection. Stantec has modeled the collision rate as follows:

Collision rate = (0.104 collisions/year) x (0.70) x 1.5 = 0.109

Over the 6 year period (weighted to 5 years), there was one fatality among the five signalized intersections, which results in an average of 0.04 fatalities per year. The fatality was at the signalized intersection of Highway 2A and Highway 597, which at the time, had a posted speed limit of 80km/hr. The posted speed limit at the proposed signalized intersection locations would only be 60km/hr, which would have a much lower rate of fatality. For conservation reasons, the LCCA has maintained the 0.04 fatalities per intersection per year and has not reduced it for the reduction in conflict points of a tee intersection in comparison to a four-legged intersection.

Table 3.4 –Fatal & Non-Fatal Collision History at Signalized Intersections Since 2010

Signalized Intersections	Year					
	2010	2011	2012	2013	2014	2015
Highway 597 and Vista Trail			1			
Highway 597 and Highway 2A	1		2	2	2[a]	4[b]
Highway 2A and Park Street		1				1
Highway 2A and Panorama Drive / Gregg Street		1		1	2	
Highway 2A and Cottonwood Drive	Not signalized until 2013					

a) One of the two collisions in 2014 at the Highway 2A and Highway 597 intersection resulted in a fatality.
b) 2015 was the first full year that the roundabout was open

As shown in Table 3.5 below, there were zero fatal collisions and 4 non-fatal collisions among the 6 unsignalized intersections over the 6 year period. Two of them were at Broadway Avenue, and as such Stantec is proposing to use a collision rate of 0.67 (2 collisions / 6 years x 2.0 Conservation Factor) for the unsignalized intersection.

Table 3.5 – Collision History at Unsignalized Intersections (No fatalities)

Unsignalized Intersections	Year					
	2010	2011	2012	2013	2014	2015
Highway 2A and Broadway Avenue		1				1
Highway 2A and South Street					1	
Highway 2A and Indiana Street (RIRO)						
Highway 2A and Cottonwood Drive					Signalized in 2013	
Highway 2A and TWP Rd 40-0		1				

The property damage only (PDO) projection developed by Stantec was based on the 2015 PDO data provided by the RCMP to the Town. To be conservative in the modeling, the rate was multiplied by a Factor of 2 based on the charts in the TAC collision rates and the projected AADT. The rate was developed as follows:

PDO Collision Rate = [(8 collisions) / (0.5 years) / 3 Intersections] x 2 = 10.6 (Rounded up to 11)

3.0 CONCLUSION AND OTHER ECONOMIC CONSIDERATIONS

Using the information entered above, which is highly conservative in the professional judgment of Stantec and WSP, the signalized intersections and the roundabout alternatives have 20 year life cycle costs of approximately $6.0 Million and $6.1Million, respectively. Therefore, the traffic signals option should be strongly considered as a more economical alternative than a roundabout over the 20 year period. **The additional $2.5M construction value of the roundabout alternative over the signals is not considered economically viable to the Development, which is only approximately 90 acres in size, and development cannot proceed at this time if a roundabout will be required.**

In addition, we would like Alberta Transportation to consider the additional economic benefits that will be realized by society if the development is able to proceed:

1. The construction of the servicing works for the first phase will provide jobs, income and additional tax revenue to the community and the province (approximately $3.5 million for construction of the servicing works for phase 1).
2. The construction of commercial buildings for the first phase will provide jobs, income and additional tax revenue to the community and the province (approximately $15 million for construction of approximately 80,000 sq. ft. of commercial/retail space).
3. Upon buildout the first phase commercial development will generate approximately $180,000 to $200,000 in tax revenue.

Reference: Proposed Broadway Avenue Intersection Upgrades

4. The completion of the first phase will be the catalyst to future phases (approximately 320 residential units and 10 additional acres of commercial land plus acres of Municipal Reserve).
5. Blackfalds requires additional retail services and conveniences which Blackfalds Crossing will provide.

It should also be noted that the "Do Nothing" scenario of no improvements to the Broadway Avenue intersection is the least favorable for public safety costs.

In summary, the Town of Blackfalds and Elkay Developments wish to proceed with the construction of an upgraded signalized intersection. We trust that this technical memo will meet your requirements, but if you have any questions or comments, we welcome the opportunity to discuss further to assist in moving this exciting project forward.

Sincerely,

STANTEC CONSULTING LTD.

Brad Vander Heyden, P.Eng.
Associate
Phone: 403-341-3320
Fax: 403-342-0969
brad.vanderheyden@stantec.com

Attachment: Model Summary

c. Town of Blackfalds, Elkay Developments, WSP

LIMITATIONS

The recommendations provided in this document are based strictly on the historical data that was provided to Stantec as well as the criteria shown in Alberta Transportation's Project Benefit Cost Model User Guide (April 8, 2015). The projected costs for safety are highly subjective and vary depending on the modeling techniques and other considerations that would need to be taken into account at the detailed design level.

Outputs

This sheet compiles the data from summary tables in individual alternatives sheets.

Analysis Summary

Cost Categories	Net Present Value of Costs									
	Alternative 0 - Base Case	Alternative 1 - Signal	Alternative 2 - Multilane Roundabout							
Planning & Construction Costs	$ -	$ 1,800,000	$ 4,300,000							
Post-Opening Costs	$ -	$ -	$ -							
Auto Passenger Time	$ 211,360	$ 1,572,767	$ 1,027,413							
Auto Passenger Reliability	--	--	--							
Truck Time	$ 17,471	$ 130,004	$ 84,925							
Truck Reliability	--	--	--							
Transit Passenger Time	--	--	--							
Transit Passenger Reliability	--	--	--							
Bicyclist Time	--	--	--							
Pedestrian Time	--	--	--							
Safety	$ 3,951,717	$ 2,498,629	$ 718,739							
Greenhouse Gases	--	--	--							
Criteria Pollutants	--	--	--							
Total cost	**$4,180,548**	**$6,001,400**	**$6,131,078**							

Benefit Categories	Net Present Value of Benefits Relative to Base Case									
		Alternative 1 - Signal	Alternative 2 - Multilane Roundabout							
Auto Passenger Time		$ (1,361,407)	$ (816,053)							
Auto Passenger Reliability										
Truck Time		$ (112,533)	$ (67,454)							
Truck Reliability										
Transit Passenger Time										
Transit Passenger Reliability										
Bicyclist Time										
Pedestrian Time										
Safety		$ 1,453,088	$ 3,232,978							
Greenhouse Gases										
Criteria Pollutants										
Net Present Value of Benefits		**$ (20,852)**	**$ 2,349,470**							
Net Present Value of Costs		**$ 1,800,000**	**$ 4,300,000**							
Present Value of Net Benefits		**$ (1,820,852)**	**$ (1,950,530)**							
Benefit-Cost Ratio		**-0.01**	**0.55**							

To exclude cost categories from the comparison clear all values in the row. Selecting the "Compile Analysis Summary" button will repopulate all values from the alternatives sheets.

THIS ASSESSMENT WAS COMPLETED WITH THE INTENT OF COMPARING THE SIGNALS AND ROUNDABOUT ALTERNATIVES TO EACHOTHER AND THEREFORE, A COMPARISON TO THE BASE CASE (NO DEVELOPMENT) SHOULD NOT BE CONSIDERED

Alberta Transportation

Office of the Operations Manager
Central Region

#401, 4920 - 51 Street
Red Deer, Alberta

Telephone 403/340-5166
Fax 403/340-4876

March 16th, 2016

File: Blackfalds (ASP)

Town of Blackfalds
Box 220
5018 Waghorn St
Blackfalds, AB T0M 0J0
Sent via email to: PWeran@blackfalds.com

Attention: Preston Weran, Director of Infrastructure and Property Services

RE: PROPOSED BLACKFALDS CROSSING TRAFFIC IMPACT ASSESSMENT (TIA)
NE 22-39-27-W4 (ELKAY DEVELOPMENTS)
HIGHWAYS 2A & 597, BLACKFALDS CROSSING

Our department has reviewed the information that was provided in the TIA and notes the following:

- Page 3: The Town may wish to ensure that this TIA does not conflict with the Town's future Functional Design of Highway 2A from Highway 587 to the South Street. Please also ensure that the Functional Design is in accordance with Alberta Transportation's Highway 597 Functional Plan.
- Research for C-TEP by Bunt & Associates were used as trip generation for Highway Commercial. Please provide us with the background information on how the numbers were attained.
- For the other trip generation categories, the ITE 9th Edition were used as per Alberta Transportation TIA guidelines, however, during our review, we noticed inconsistencies between our numbers and the TIA. Appendix 1 contains a sample of numbers we derived from our review for comparison purposes.
- Page 20 and 21: Figure 7A and 7B site traffic show negative traffic. Clarification is required as to what negative traffic means.
- Page 27: Based on the left turn lane warrant analysis, a Type IV intersection is recommended. Please confirm the specific intersection treatment type recommended (i.e. Type IVa)
- Page 29: The geometry of this intersection's eastbound lanes needs to be looked at again as it does not appear to match any of Alberta Transportation's Type IV standards.
- We are unable to accommodate the proposed right-in and right-out (RI/RO) on Highway 2A. There does not appear to be a demonstrated need for the addition of a new RI/RI as southbound right turns from 2A operate at LOS A and eastbound rights out of the development at LOS C according to the analysis at the 2035 signalized horizon. Furthermore, the proposed RI/RO introduces a potential weaving issue for traffic originating from the highway commercial lot turning right onto Highway 2A requiring a quick transition for those needing to get into the left lane of the roundabout. Also, the RI/RO contributes to additional conflict points from non-conforming northbound Highway 2A left turns into the RI/RO. The proposed location of the RI/RO approximately 150 metres south of the realigned Broadway Avenue intersection would also not meet our access spacing requirements.
- We also require an operational analysis (showing design vehicle turning left into the development, left out of the development) at this intersection to determine if there will be any stacking distance issues between the first access from Highway 2A and the realigned Broadway Avenue, as well as a drawing that shows storage lengths.

Alberta Transportation

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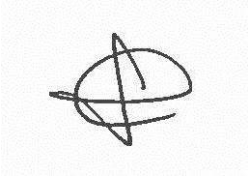
- There does not appear to developments east or south of the development where pedestrians require access, and accordingly, pedestrian warrants are not needed. Please confirm pedestrian requirements with the Town.
- In addition to the roundabout analysis, we also require a cost/benefit analysis (as per design bulletin #68/2010) since the TIA finds that a roundabout works at this location.
- The Town of Blackfalds is responsible for to submit a Roadside Development Application and a Traffic Accommodation Strategy (TAS) for the proposed Broadway Avenue realignment, and the new intersection on Highway 597.
- The Town of Blackfalds/Developer is responsible for arranging all the required intersectional improvements to accommodate the proposed development.

We look forward to receiving a revised copy with these amendments incorporated in the TIA for review prior to final endorsement. If you have any questions please contact me at 403-340-7179.

Sincerely,



Sandy Choi
Development & Planning

SC/sc

cc. WSP (Craig Suchy – Craig.Suchy@wspgroup.com)
Stuart Richardson, Alberta Transportation

Alberta Transportation

Office of the Operations Manager
Central Region

#401, 4920 - 51 Street
Red Deer, Alberta

Telephone 403/340-5166
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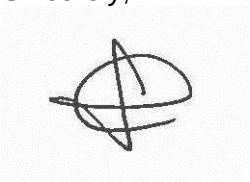
This link includes access to the associated report and also a newly developed "Life-Cycle Cost Estimation Tool" that can be used to compare intersection designs such as roundabouts vs signals.

Prior to Alberta Transportation accepting the TIA, please provide the additional information requested. Should you have any questions regarding any of the points above or wish to schedule a meeting, please contact me at 403-340-7179.

Sincerely,



Sandy Choi
Development & Planning

SC/sc

cc: WSP (Craig Suchy – Craig.Suchy@wspgroup.com)
Town of Blackfalds (Prestan Weran – PWeran@blackfalds.com)
Town of Blackfalds (Terry Topolnitsky – Terry@blackfalds.com)

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Appendix 1

			Total Generated Trips			Total Distribution of Generated Trips					
			Daily	AM Hour	PM Hour	AM In	AM Out	Pass-By	PM In	PM Out	Pass-By
Supermarket 850	KSF²	102.8	10,510	350	975	139	85	126	318	306	351
Single Family Homes 210	DU	40.0	381	30	40	8	23	0	25	15	0
Resd. Condo/Townhouse 230	DU	62.0	360	27	32	5	23	0	22	11	0

Alberta Transportation

Office of the Operations Manager
Central Region

#401, 4920 - 51 Street
Red Deer, Alberta

Telephone 403/340-5166
Fax 403/340-4876

May 11th, 2016

File: Blackfalds (ASP)

Town of Blackfalds
c/o WSP
300, 9925 – 109 Street
Edmonton, AB T5K 2J8
Sent via email to: James.Sun@wspgroup.com

Attention: James Sun, Transportation Engineer

RE: PROPOSED BLACKFALDS CROSSING TRAFFIC IMPACT ASSESSMENT (TIA)
NE 22-39-27-W4 (ELKAY DEVELOPMENTS)
HIGHWAYS 2A & 597, BLACKFALDS CROSSING

Thank you for addressing our comments on the Blackfalds Crossing TIA. Alberta Transportation's (AT) response to your comments is below:

1. **AT's Original Comment**: Research for C-TEP by Bunt & Associates were used as trip generation for Highway Commercial. Please provide us with the background information on how the numbers were attained.
   WSP's Response: We will provide a copy of C-TEP's report for the Department review.
   AT's Response*: We have received a copy of C-TEP's report and advise if we have any feedback.*

2. **AT's Original Comment**: For the other trip generation categories, the ITE 9th Edition were used as per Alberta Transportation TIA guidelines, however, during our review, we noticed inconsistencies between our numbers and the TIA. Appendix 1 contains a sample of number we derived from our review for comparison purposes.
   WSP's Response: WSP also used the ITE 9th Edition Trip Generation Manual in the process of trip generation estimate. ITEP Trip General Manual provides Average Trip Generation Rates and Fitted Curve Equations for most land uses in the manual. The process for selecting Average Rate or Equation for the proposed development followed the step-by-step procedure recommended in the ITP Trip Generation Handbook, Third Edition. In this study, when the equations were selected to estimate the trips generated by the development. The estimated trips will be different from that were estimated based on the average rates (AT used in the sample).
   AT's Response*: Acknowledged.*

3. **AT's Original Comment**: Page 20 & 21: Figure 7A and 7B site traffic show negative traffic. Clarification is required as to what negative traffic means.
   WSP's Response: The negative traffic numbers are pass-by trips for commercial development. Pass-by trips are drawn from the passing traffic stream and do not add new traffic to the adjacent road system. The detailed pass-by trip analysis for each commercial development is attached in Appendix B in the TIA report.
   AT's Response*: Acknowledged.*

4. **AT's Original Response**: Page 27: Based on the left turn lane warrant analysis, a Type IV intersection is recommended. Please confirm the specific intersection treatment type recommended (i.e. Type IVa).
   WSP's Response: The left turn lane warrant analysis indicated that a Type IV left turn lane (exclusive left turn lane) will be warranted for the eastbound traffic at the intersection. Highway

597 is not an Alberta Transportation's standard two-land highway (Raised median and four-lane cross-section to the west). It's hard and not necessary to apply a standard Type IV intersection treatment to this intersection. Since this is a three-legged intersection, Type IVa may be appropriate if we need to specify the intersection treatment type.

***AT's Response**:*

a. Eastbound Hwy 597

The proposed intersection is located in a transition zone between a divided and undivided roadway. Merging of lanes at the intersection are potential operational and safety issues. It is undesirable to have a proposed intersection located within a transition zone. Issues include not meeting driver expectations, increase driver workload, high potential for confusion, sideswipe and rear end type collisions with the proposed two eastbound lane transitioning into a single lane through the intersection.

***The warranted left turn lane EB to NB should be provided along with either a painted island or a preferred small raised island (1.5m minimum curb face to curb face width should be provided for hazard sign /keep right assembly) on the east leg. However, to reduce the potential operational/safety concerns, the two eastbound through lanes should be maintain past the proposed intersection. The two through lanes transition (or tie in) to the existing single lane should occur further east of the proposed intersection location or if possible, continue the two lanes east to the existing two lane (west of the roundabout)**.*

b. Westbound Hwy 597

The right side eastbound lane (shown as through/right arrow pavement markings) has not accommodated for slower vehicles (WB to NB) to decelerate and turn right from the eastbound through lane. ***Deceleration and acceleration tapers should be provided east and west of the proposed intersection treatment respectively**.*

c. ***What is the radius of the horizontal curve and superelevation rate on Hwy 597?*** *Intersections on horizontal curves are considered undesirable. As indicated in the AT HGDG (page B-29), Table B3.6a, for design speeds from 40km/h to 90 km/h, intersections are only permitted if e is less than or equal to 0.038. Highway 597 is posted at 50 km/h (design typical 60 km/h).*

d. *The existing north intersection immediately east of proposed intersection should be closed*.

5. **AT's Original Comment**: Page 29: The geometry of this intersection's eastbound lanes needs to be looked at again as it does not appear to match any of Alberta Transportation's Type IV standards).

WSP's Response: Similar reason as above, the proposed intersection treatment is not a standard Type IV intersection. The eastbound left turn lane will be provided by removing the raised median on the west leg. The eastbound through lane alignment will not change. An AT's Standard Type IV left turn lane on a two-lane highway is provided by shifting through lane to shoulder side by 3.5 m. A approaching tape and a departure taper (recovery taper) are required to accommodate the through traffic movement shifting. In our case, the eastbound through movement will not need to shift to the shoulder side and will stay in the existing through lane since the left turn lane will be provided by removing the raised median. As such, no tapers for the EB through lane will be required. That's why the proposed intersection treatment does not match AT's Type IV standard.

***AT's Response**: See AT's response to Section #4*.

6. **AT's Original Comment**: We are unable to accommodate the proposed right-in and right-out (RI/RO) on Highway 2A. There does not appear to be a demonstrated need for the addition of a new RI/RO as the southbound right turns from 2A operate at LOS A and eastbound rights out of the development at LOS C according to the analysis at the 2035 signalized horizon.
   WSP's Response: The right-in/right-out access was determined to be removed from the proposed site plan.
   AT's response*: Thank you and acknowledged*.

7. **AT's Original Comment**: We also require an operational analysis (showing design vehicle turning left into the development, left out of the development) At this intersection to determine if there will be any stacking distance issues between the first access from Highway 2A and the realigned Broadway Avenue, as well as a drawing that shows storage lengths.
   WSP's Response: The proposed realigned Broadway Avenue intersection on the East-West Collector Road will be located approximately 100m (center line to center line) west of Highway 2A. The stacking distance is adequate for two 25 m long WB-23 vehicles. The capacity analysis results show that the eastbound vehicle queue at the Highway 2A intersection will not reach the Broadway Avenue intersection. The design vehicle operational analysis will be conducted in preliminary and detail design stages.
   AT's Response: *The capacity analysis results showing eastbound vehicle queue at the Highway 2A intersection will not reach the Broadway Avenue intersection addresses local road concerns. We would like to see the design vehicle operational analysis done at the TIA stage to look at whether traffic spills onto Highway 2A and reaffirm the appropriate location of the local road intersection from Highway 2A.*

8. **AT's Original Comment**: There does not appear to be developments east or south of the development where pedestrians require access, and accordingly, pedestrian warrants are not needed. Please confirm pedestrian requirements with the Town.
   WSP's Response: Pedestrians are not anticipated crossing Highway 2A and Highway 597.
   AT's response*: How do you envision the potential for pedestrian traffic wanting to access the commercial destination at Blackfalds Crossing from the east side of Highway 2A?*

9. **AT's Original Comment**: In addition to the roundabout analysis, we also require a cost/benefit analysis (as per design bulletin #68/2010) since the TIA finds that a roundabout works at this location.
   WSP's Response: The purpose of the roundabout analysis in the TIA is to preliminarily identify if a roundabout is physically feasible for the geometrics of the roadway location and if a roundabout is able to accommodate the forecasted future traffic volumes. A cost/benefit analysis should be conducted in a detailed Roundabout Feasibility Study which is out of the scope of work of the TIA.
   AT's Response*: Section 1.0 Economic Analysis of the design bulletin requires that "an economic analysis shall be undertaken to assist in evaluating the preferred type of intersection control as per the current version of the Department's Benefit Cost Guide, that accounts for all cost and benefits over the design period". Alberta Transportation has consulted with the Town of Blackfalds and we would like to see an economic analysis as part of this TIA to establish the feasibility of a roundabout at this location.*

   Here is a link to a Transportation Research Board project on "Estimating the Life-Cycle Cost of Intersection Designs." *http://www.trb.org/Main/Blurbs/173928.aspx*

Alberta Transportation

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Red Deer, Alberta

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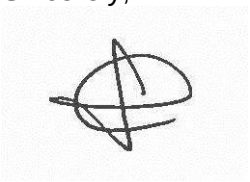
This link includes access to the associated report and also a newly developed "Life-Cycle Cost Estimation Tool" that can be used to compare intersection designs such as roundabouts vs signals.

Prior to Alberta Transportation accepting the TIA, please provide the additional information requested. Should you have any questions regarding any of the points above or wish to schedule a meeting, please contact me at 403-340-7179.

Sincerely,



Sandy Choi
Development & Planning

SC/sc

cc: WSP (Craig Suchy – Craig.Suchy@wspgroup.com)
Town of Blackfalds (Prestan Weran – PWeran@blackfalds.com)
Town of Blackfalds (Terry Topolnitsky – Terry@blackfalds.com)

May 30, 2016

Alberta Transportation - Central Region
#401, 4920 – 51 Street
Red Deer, AB T4N 6K8

Attention: Sandy Choi, Development and Planning Technologist

Re: PROPOSED BLACKFALDS CROSSING TRAFFIC IMPACT ASSESSMENT (TIA)
NE 22-39-27-W4 (ELKAY DEVELOPMENTS)
HIGHWAYS 2A & 597, BLACKFALDS CROSSING

O/Ref: 151-02471-00

Thank you for your comments on the Blackfalds Crossing TIA Report. The following details our responses to your comments dated May 11, 2016:

1. **(Comment #4)** Page 27: Based on the left turn lane warrant analysis, a Type IV intersection is recommended. Please confirm the specific intersection treatment type recommended (i.e. Type IVa).

   a. Eastbound Hwy 597

   The proposed intersection (Highway 597 / South Access) is located in a transition zone between a divided and undivided roadway. Merging of lanes at the intersection are potential operational and safety issues. It is undesirable to have a proposed intersection located within a transition zone. Issues include not meeting driver expectations, increase driver workload, high potential for confusion, sideswipe and rear end type collisions with the proposed two eastbound lane transitioning into a single lane through the intersection.

   Response: *We have developed a new concept plan and the proposed two eastbound through lanes continue to the existing two through lanes to the east.*

   b. Westbound Hwy 597

   The right side eastbound lane (shown as through/right arrow pavement markings) has not accommodated for slower vehicles (WB to NB) to decelerate and turn right from the eastbound through lane. Deceleration and acceleration tapers should be provided east and west of the proposed intersection treatment respectively.

   Response: *We have developed a new concept plan with the proposed deceleration and acceleration tapers for the westbound traffic.*

   c. What is the radius of the horizontal curve and superelevation rate on Hwy 597? Intersections on horizontal curves are considered undesirable. As indicated in the AT HGDG (page B-29), Table B3.6a, for design speeds from 40km/h to 90 km/h, intersections are only permitted if e is less than or equal to 0.038. Highway 597 is posted at 50 km/h (design typical 60 km/h).

   Response: *The radius of the horizontal curve is approximately 840 m and the super-elevation is approximately 0.046. The superelevation will be adjusted to*

meet the department requirements during the detail design stage. The existing horizon curve radius (840 m) is capable of accommodating a design speed of 80 km/h with a superelevation of 0.035.

d. *The existing north intersection immediately east of proposed intersection should be closed*.

Response: *Yes, the existing access will be closed.*

2. **(Comment #7)** We also require an operational analysis (showing design vehicle turning left into the development, left out of the development) at this intersection to determine if there will be any stacking distance issues between the first access from Highway 2A and the realigned Broadway Avenue, as well as a drawing that shows storage lengths.

   The capacity analysis results showing eastbound vehicle queue at the Highway 2A intersection will not reach the Broadway Avenue intersection addresses local road concerns. We would like to see the design vehicle operational analysis done at the TIA stage to look at whether traffic spills onto Highway 2A and reaffirm the appropriate location of the local road intersection from Highway 2A.

   Response: *The East-West Collector Road and Broadway Avenue intersection will be controlled by one stop sign on Broadway Avenue with free flow conditions on the Collector Road. Therefore, no vehicle queue will occur for the westbound traffic on the Collector Road at the Broadway Avenue intersection. As such, traffic will not spill onto Highway 2A.*

3. **(Comment #8)** There does not appear to be developments east or south of the development where pedestrians require access, and accordingly, pedestrian warrants are not needed. Please confirm pedestrian requirements with the Town.

   How do you envision the potential for pedestrian traffic wanting to access the commercial destination at Blackfalds Crossing from the east side of Highway 2A?

   Response: *Currently there are no pedestrian facilities (e.g., sidewalks or trails) provided along Highway 2A or in the vicinity of the Broadway Avenue intersection. If the Town wants to provide pedestrian facilities in the future, pedestrian traffic will be accommodated by providing marked crosswalks and pedestrian signals at the signalized intersection; or marked pedestrian crosswalks with associated signing, with the crossings safely located in accordance with NCHRP 672 - Roundabouts: An Information Guide if a roundabout is constructed.*

4. **(Comment #9)** In addition to the roundabout analysis, we also require a cost/benefit analysis (as per design bulletin #68/2010) since the TIA finds that a roundabout works at this location.

   Section 1.0 Economic Analysis of the design bulletin requires that “an economic analysis shall be undertaken to assist in evaluating the preferred type of intersection control as per the current version of the Department’s Benefit Cost Guide, that accounts for all cost and benefits over the design period”. Alberta

Transportation has consulted with the Town of Blackfalds and we would like to see an economic analysis as part of this TIA to establish the feasibility of a roundabout at this location.

Response: *WSP performed an economic analysis based on TRB's "Estimating the Life-Cycle Cost of Intersection Designs". The results reveal that the roundabout option will have a lower life-cycle cost than signals. However, the initial construction costs of the roundabout are much higher than the proposed signalized intersection. The stacking distance between Highway 2A and Broadway Avenue for the roundabout will be shorter than that for signals since a roundabout will occupy more land area than a signalized intersection. WSP recommends installing traffic signals and protecting the right-of-way for a potential future roundabout.*

Thank you for your comments. Should you have any questions, please do not hesitate to contact me at james.sun@wspgroup.com or 780.233.0757.

Yours truly,

WSP Canada Inc.

James Sun, MSc., P. Eng.
Transportation Engineer

Cc: Craig Suchy, P. Eng., Branch Manager – Red Deer
Janis Fong, P. Eng., Urban Transportation Manager – Northern Alberta

Alberta Transportation

Office of the Operations Manager
Central Region

#401, 4920 - 51 Street
Red Deer, Alberta

Telephone 403/340-5166
Fax 403/340-4876

June 9th, 2016

File: Blackfalds (ASP)
WSP File: O/Ref 151-02471-00

WSP
300, 9925 – 109 Street
Edmonton, AB T5K 2J8
Sent via email to: James.Sun@wspgroup.com

Attention: James Sun, Transportation Engineer

RE: PROPOSED BLACKFALDS CROSSING TRAFFIC IMPACT ASSESSMENT (TIA)
NE 22-39-27-W4 (ELKAY DEVELOPMENTS), HIGHWAYS 2A & 597

Thank you for the opportunity to provide input on the Blackfalds Crossing TIA review. I would advise that Alberta Transportation has reviewed your comments provided on May 30th, 2016 and offer the following comments:

1. As you are aware, Design Bulletin #68/2010 is a new policy requiring TIAs to review and assess roundabout as the first option for improvements to existing intersections or when constructing new intersections on the provincial highway network. Since the cost benefit analysis clearly demonstrates the economic, social and environmental benefits of a roundabout compared to a conventional signalized intersection at this location, a roundabout option is to be implemented at the Developer's/Town's cost.

2. Please revise the TIA to reflect the implementation of a roundabout at Highway 2A and the realigned Broadway Avenue intersection.

3. The Area Structure Plan (ASP) may need to be revised as well, and the roundabout is to be protected for at the subdivision stage.

4. I would confirm that the Town of Blackfalds would be responsible for arranging all required intersectional improvements to accommodate the proposed development. A Roadside Development Permit Application is required for Highway 2A & Broadway Avenue and Highway 597 & the North-South Collector Access.

We look forward to receiving a revised copy with these amendments incorporated in the TIA and if required, the ASP, for review prior to final endorsement.

Should you wish to schedule a meeting to clarify or discuss any of these points, please contact me at 403-340-5166.

Sincerely,

Sandy Choi
Development & Planning

SC/sc

cc: Preston Weran - PWeran@blackfalds.com
Terry Topolnitsky – Terry@blackfalds.com
Stuart Richardson, Infrastructure

Appendix B

TRAFFIC ANALYSIS

- **Traffic Turning Movements**
- **Traffic Volume History on Highway 2A and Highway 597**
- **Trip Distribution and Assignment for Each Land Use**
- **C-TEP Trip Generation Rates for Highway Commercial**

Turning Movement Summary Diagram

Reference No.: 89330

Intersection of:
2A & 597 S OF BLACKFALDS

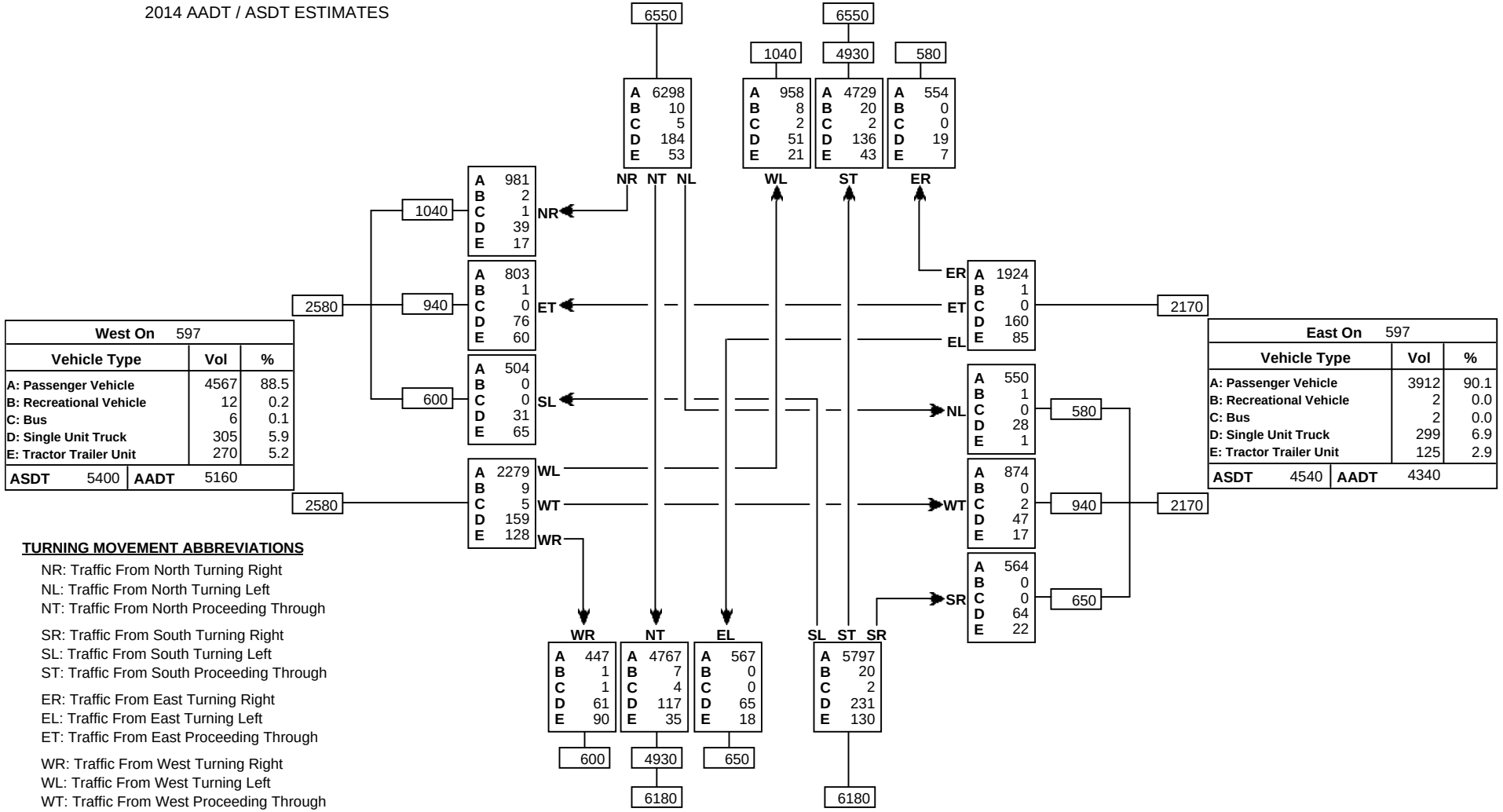
2014 AADT / ASDT ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	12539	95.7
B: Recreational Vehicle	38	0.3
C: Bus	9	0.1
D: Single Unit Truck	390	3.0
E: Tractor Trailer Unit	124	0.9
ASDT 13710	**AADT** 13100	

West On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	4567	88.5
B: Recreational Vehicle	12	0.2
C: Bus	6	0.1
D: Single Unit Truck	305	5.9
E: Tractor Trailer Unit	270	5.2
ASDT 5400	**AADT** 5160	

East On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	3912	90.1
B: Recreational Vehicle	2	0.0
C: Bus	2	0.0
D: Single Unit Truck	299	6.9
E: Tractor Trailer Unit	125	2.9
ASDT 4540	**AADT** 4340	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	11578	93.7
B: Recreational Vehicle	28	0.2
C: Bus	7	0.1
D: Single Unit Truck	474	3.8
E: Tractor Trailer Unit	273	2.2
ASDT 12930	**AADT** 12360	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
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TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 89330

Intersection of:
2A & 597 S OF BLACKFALDS

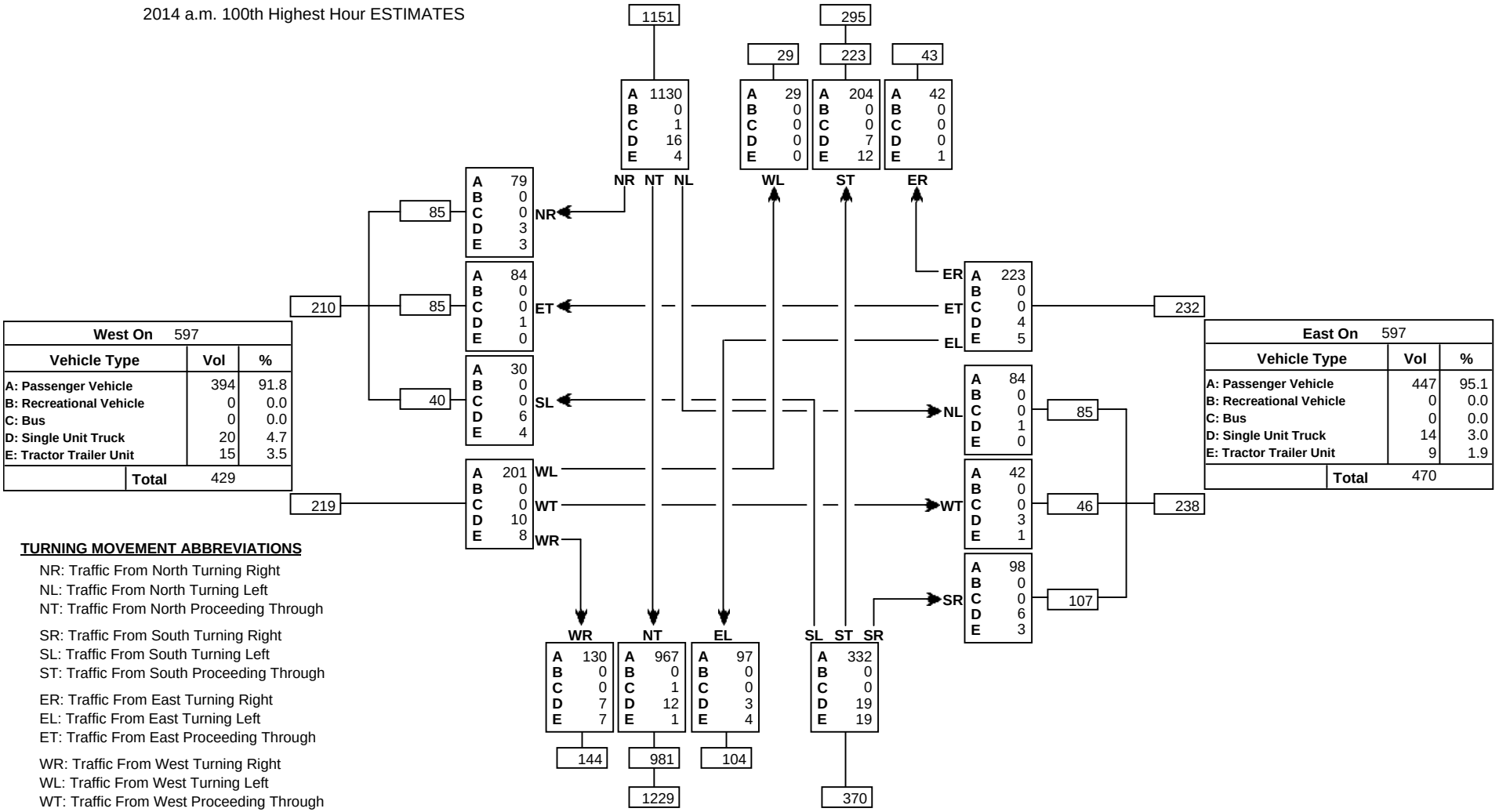
2014 a.m. 100th Highest Hour ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1405	97.2
B: Recreational Vehicle	0	0.0
C: Bus	1	0.1
D: Single Unit Truck	23	1.6
E: Tractor Trailer Unit	17	1.2
Total	1446	

West On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	394	91.8
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	20	4.7
E: Tractor Trailer Unit	15	3.5
Total	429	

East On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	447	95.1
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	14	3.0
E: Tractor Trailer Unit	9	1.9
Total	470	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1526	95.4
B: Recreational Vehicle	0	0.0
C: Bus	1	0.1
D: Single Unit Truck	41	2.6
E: Tractor Trailer Unit	31	1.9
Total	1599	



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Turning Movement Summary Diagram

Reference No.: 89330

Intersection of:
2A & 597 S OF BLACKFALDS

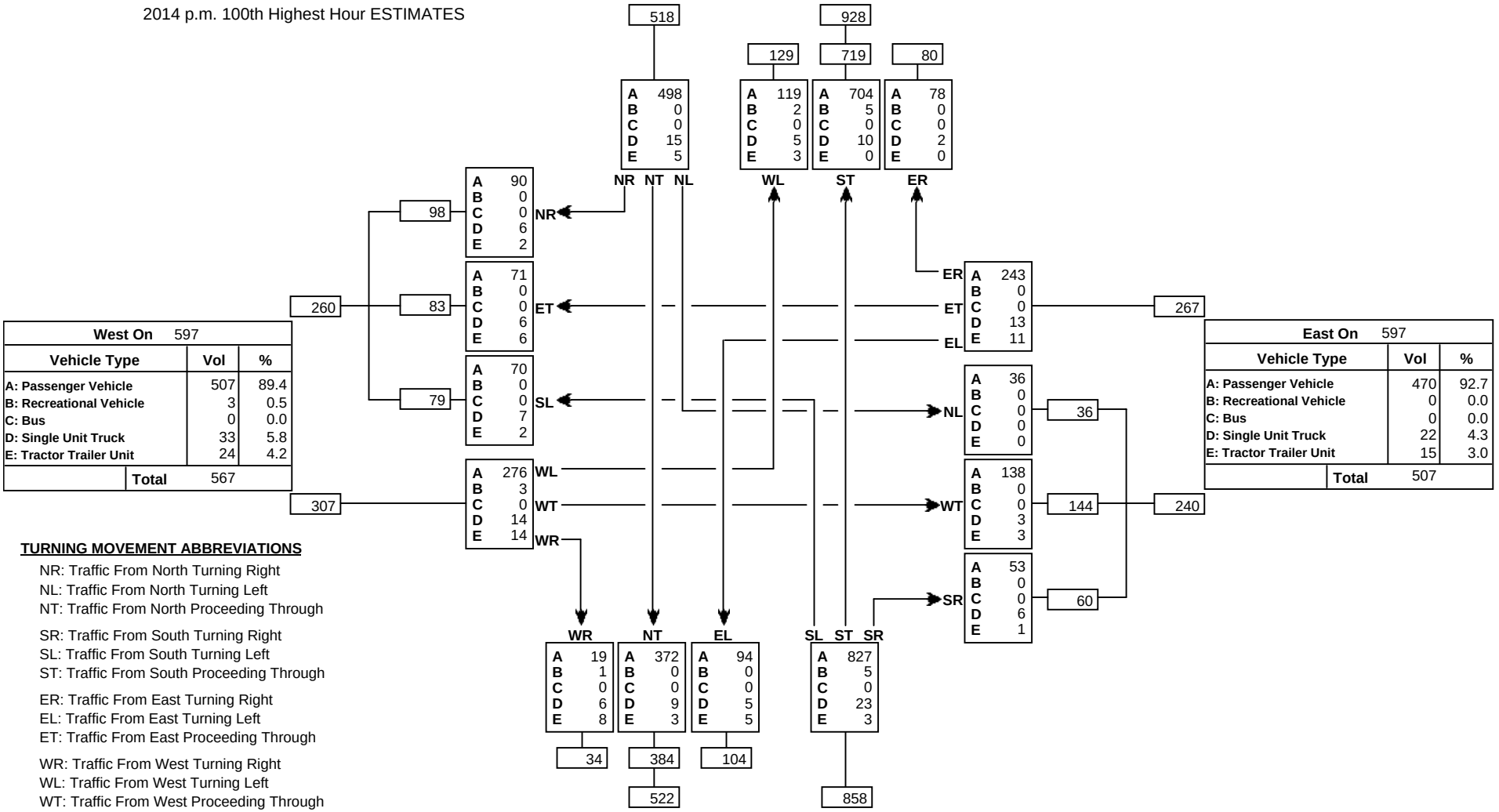
2014 p.m. 100th Highest Hour ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1399	96.7
B: Recreational Vehicle	7	0.5
C: Bus	0	0.0
D: Single Unit Truck	32	2.2
E: Tractor Trailer Unit	8	0.6
Total	1446	

West On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	507	89.4
B: Recreational Vehicle	3	0.5
C: Bus	0	0.0
D: Single Unit Truck	33	5.8
E: Tractor Trailer Unit	24	4.2
Total	567	

East On 597		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	470	92.7
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	22	4.3
E: Tractor Trailer Unit	15	3.0
Total	507	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1312	95.1
B: Recreational Vehicle	6	0.4
C: Bus	0	0.0
D: Single Unit Truck	43	3.1
E: Tractor Trailer Unit	19	1.4
Total	1380	



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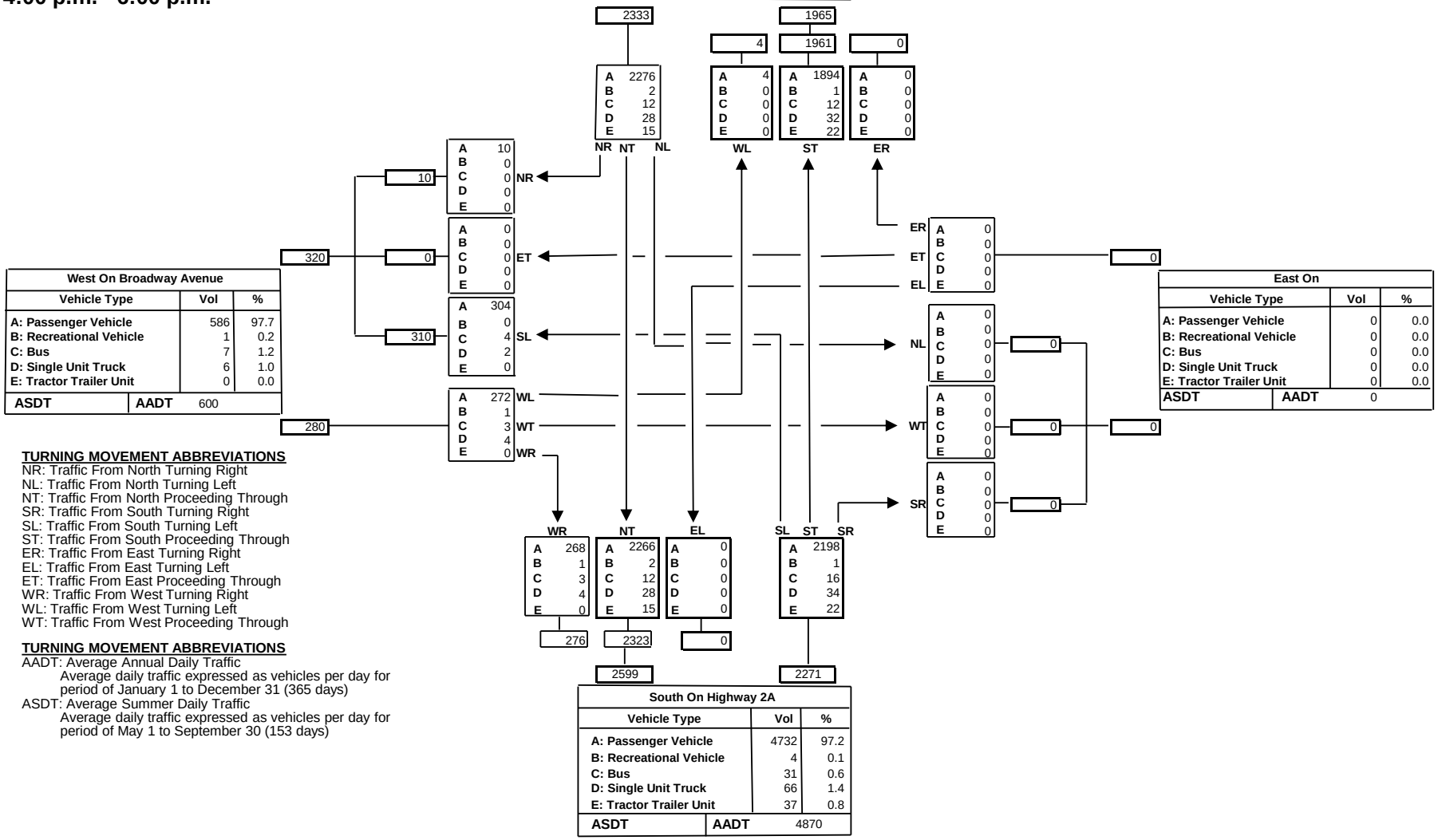
Intersection of:
Highway 2A / Broadway Avenue
Town of Blackfalds, AB

2015 AM and PM Traffic Count
7:00 a.m. - 9:00 a.m.
4:00 p.m. - 6:00 p.m.

Turning Movement Summary Diagram



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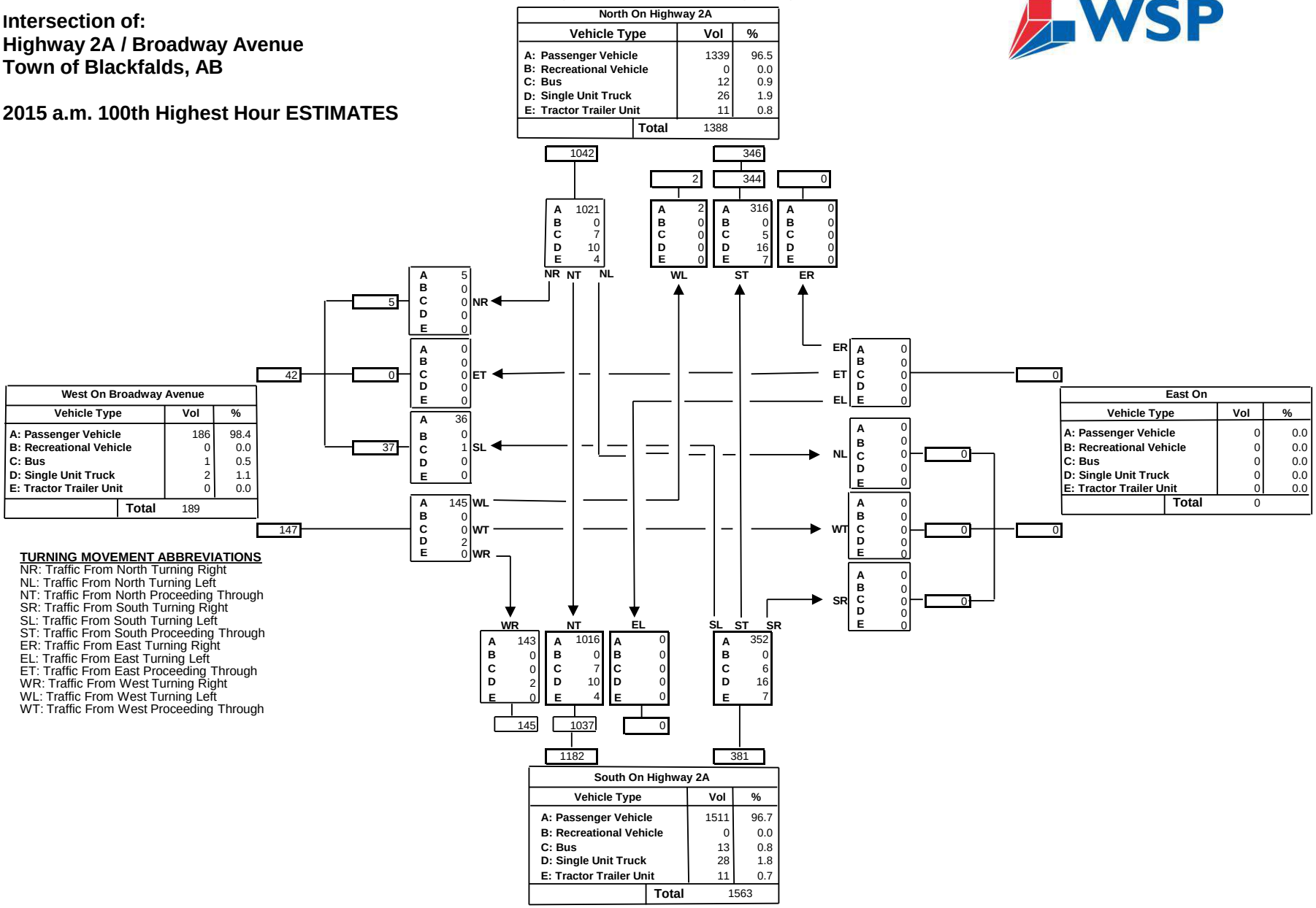
Intersection of:
Highway 2A / Broadway Avenue
Town of Blackfalds, AB

2015 a.m. 100th Highest Hour ESTIMATES

Turning Movement Summary Diagram



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Intersection of:
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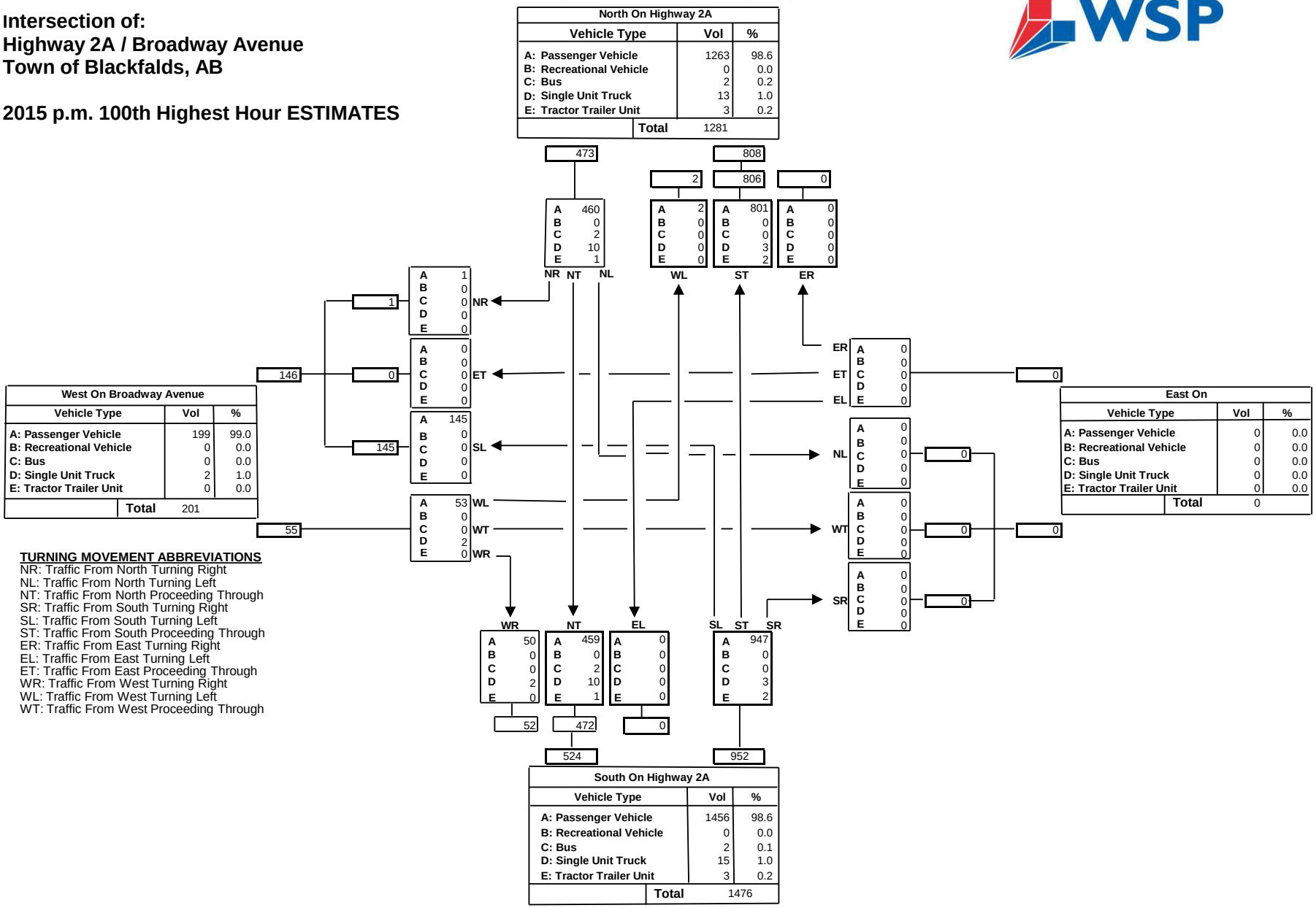
Town of Blackfalds, AB

2015 p.m. 100th Highest Hour ESTIMATES

Turning Movement Summary Diagram



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Intersection of:
South Street / East Railway Street
Town of Blackfalds, AB

2015 AM and PM Traffic Count
7:00 a.m. - 9:00 a.m.
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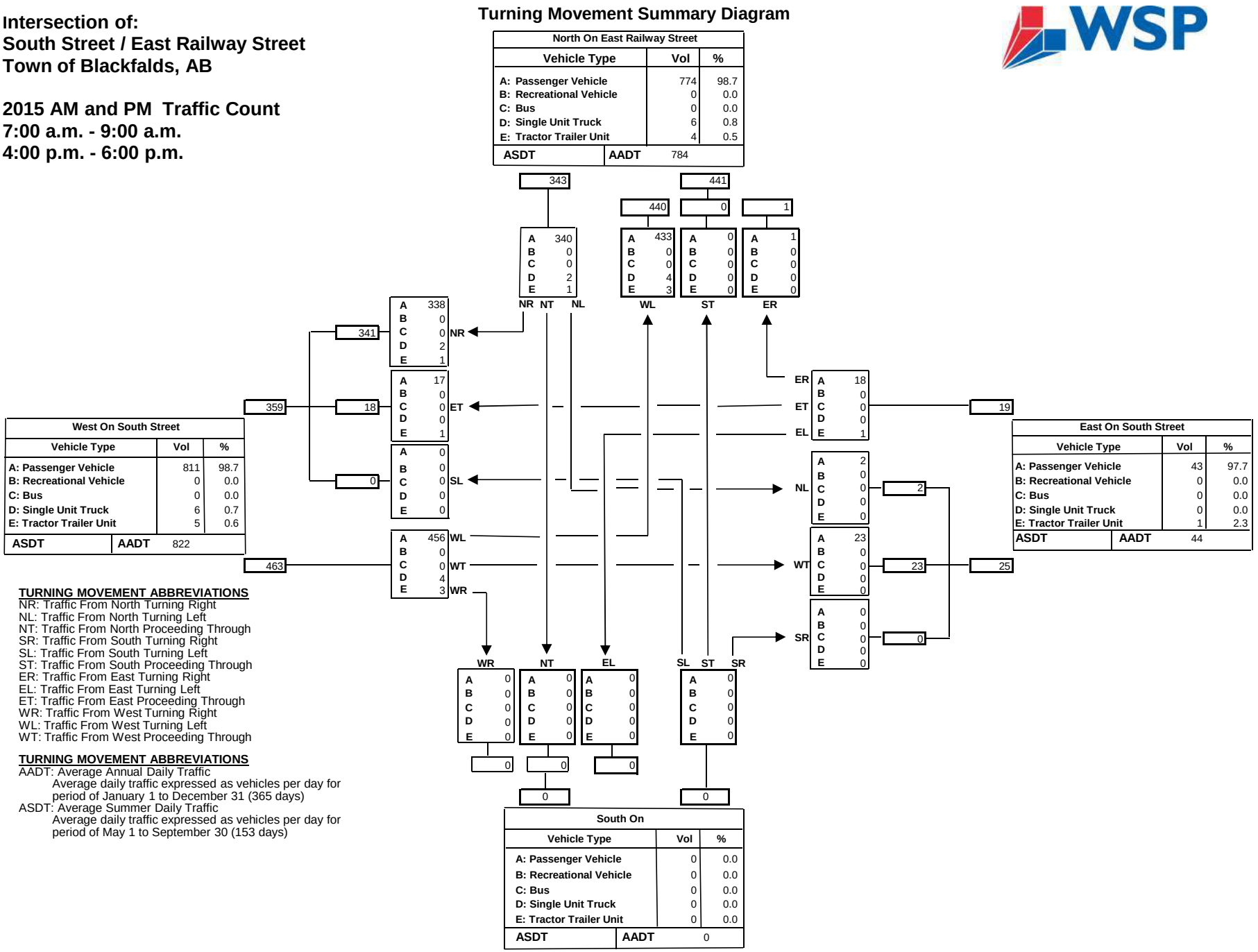

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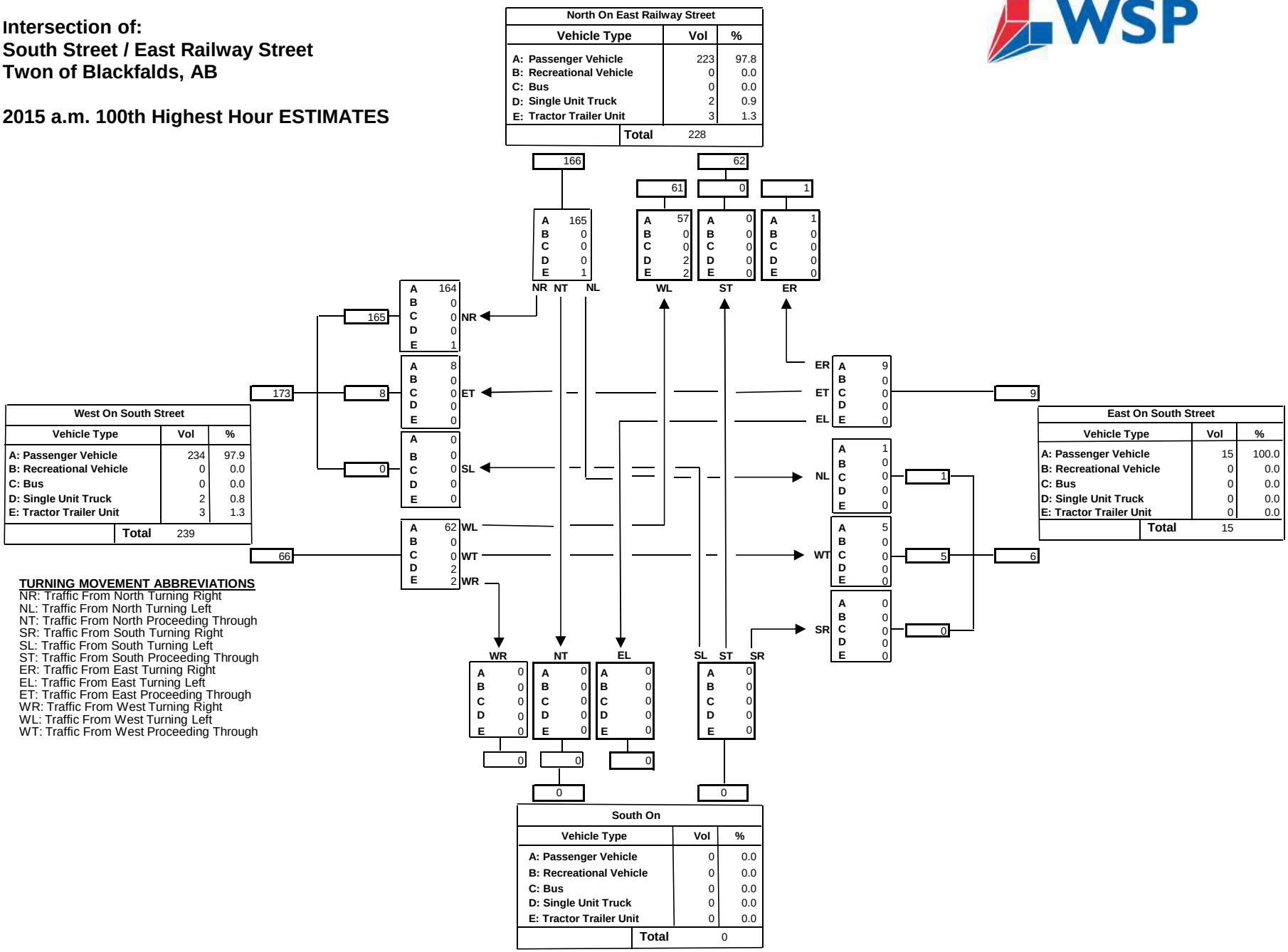
Turning Movement Summary Diagram

Intersection of:
South Street / East Railway Street
Twon of Blackfalds, AB

2015 a.m. 100th Highest Hour ESTIMATES



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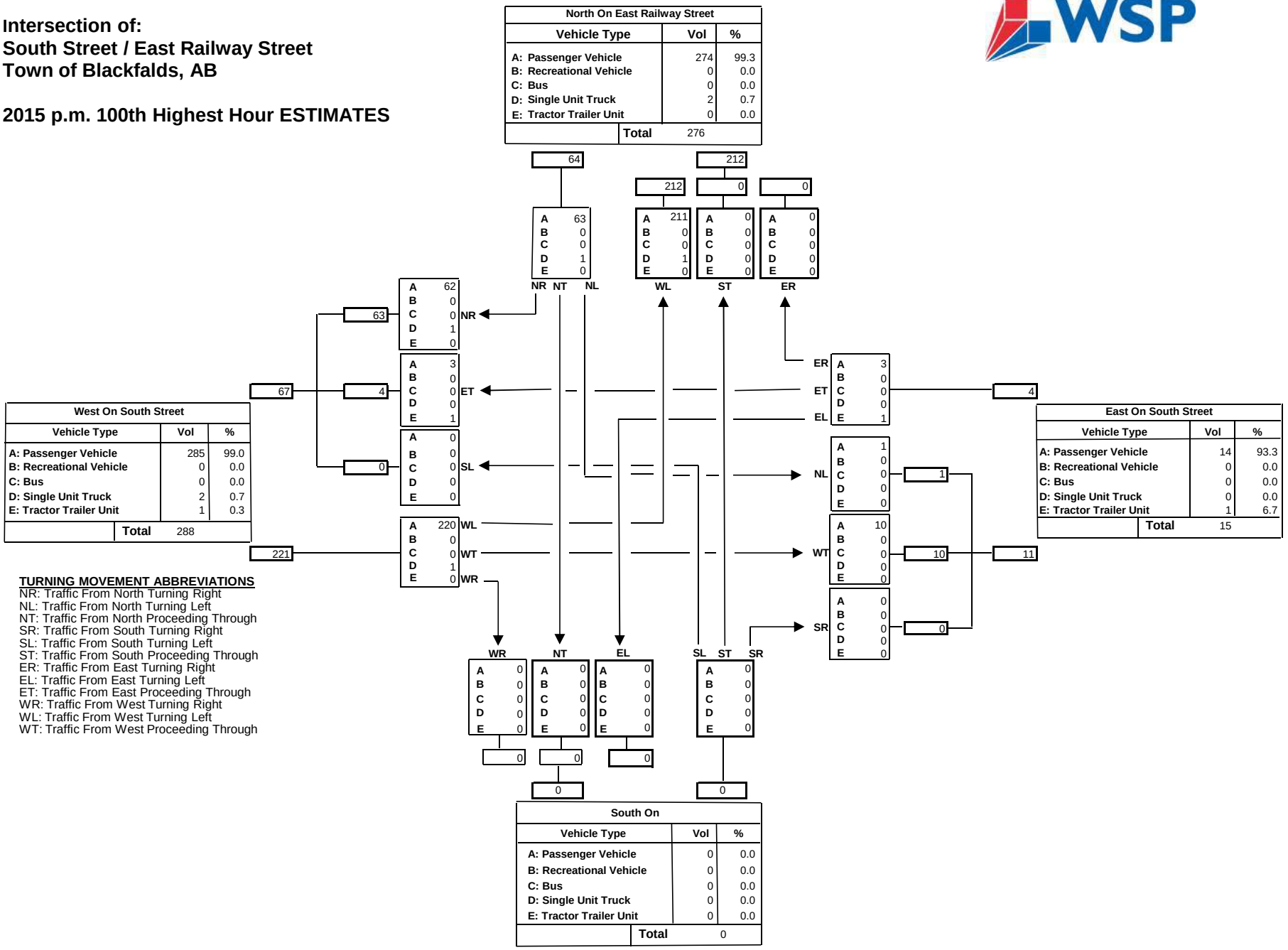
Turning Movement Summary Diagram

Intersection of:
South Street / East Railway Street
Town of Blackfalds, AB

2015 p.m. 100th Highest Hour ESTIMATES



ALBERTA HIGHWAYS 1 TO 986
TRAFFIC VOLUME HISTORY 2005 - 2014

Alberta Transportation
Modeling and Analysis

Produced: 18-Feb-2015 By CornerStone Solutions Inc.

Hwy	CS	TCS	Muni	Location Description	2005 AADT	2006 AADT	2007 AADT	2008 AADT	2009 AADT	2010 AADT	2011 AADT	2012 AADT	2013 AADT	2014 AADT
2 A	16	08	RdDr	N OF BOUNDRY ST, PENHOLD 25-36-28-410200000							2920	3100	3280	3360
2 A	16	08	RdDr	S OF 42 & 592 N OF PENHOLD	3960	4140	4580	4130	5320	5440	5580	5970	6330	6600
2 A	16	08	RdDr	0.8 KM N OF 2A & 42 PENHOLD	4690	5000	5400	4800	5940	6100	6170	6570	6950	7200
2 A	16	12	RdDr	N OF 42 & 592 N OF PENHOLD	4580	4760	5260	4660	5710	5830	6140	6550	6930	7140
2 A	16	12	RdDr	S OF TWP RD 372 12-37-28-402000000	4450					6070	6140	6550	6930	7140
2 A	16	12	RdDr	N OF TWP RD 372 12-37-28-402000000	5320					8100	7990	8520	9040	9510
2 A	16	12	RdDr	S OF MCKENZIE RD 19-37-27-406500000	5960	6200	6840	6780	7940	8100	7990	8520	9040	9510
2 A	16	12	RdDr	N OF MCKENZIE RD 19-37-27-406500000	6740	7010	7730	6250	7320	7480	7010	7480	7900	8290
2 A	16	12	RdDr	S OF LANTERN ST, RED DEER 32-37-27-415501560				6250	7320	7480	7010	7480	7900	8290
2 A	16	12	RdDr	N OF LANTERN ST, RED DEER 32-37-27-415501560				10650	11810	11560	11900	12700	13360	14050
2 A	16	99	CoRD	W OF 2 & TAYLOR DR IN RED DEER	8000	8450	9610	10650	11810	12070	13020	13890	14610	15350
2 A	18	16	RdDr	N OF 11A AT RED DEER	13920	14900	15020	14140	13870	14130	14530	14850	15170	15420
2 A	18	16	RdDr	S OF CENTRAL PARK RD 3-39-27-406000000	13490	14440	14560	13710	12990	13230	13550	14500	14800	15050
2 A	18	16	RdDr	N OF CENTRAL PARK RD 3-39-27-406000000	12880	13790	13910	13600	12900	13140	13470	14130	14430	14680
2 A	18	16	RdDr	1.6 KM N OF 2A & 11A RED DEER	12880	13940	13830	13640	12810	13220	13510	14110	14450	14770
2 A	18	16	RdDr	S OF NORTHLAND IND ACC 14-39-27-414251400	11450	12250	12350	12070	11440	11210	11490	11830	12090	12310
2 A	18	16	RdDr	N OF NORTHLAND IND ACC 14-39-27-414251400	11610	12430	12550	12270	11640	11300	11580	11920	12180	12400
2 A	18	16	Laco	S OF 597 S OF BLACKFALDS	11050	11860	11960	11700	11020	11220	11500	11900	12160	12360
2 A	18	20	Laco	N OF 597 S OF BLACKFALDS	10610	11250	11290	11070	10800	10990	11270	12620	12880	13100
2 A	18	20	Laco	S OF INDIANA ST IN BLACKFALDS 26-39-27-413401350	10440	11080	11120	10900	10140	10340	10600	11560	11800	12660
2 A	18	20	Laco	N OF INDIANA ST IN BLACKFALDS 26-39-27-413401350	8680	9220	9240	9060	9080	9260	9500	10360	10580	11600
2 A	18	20	Laco	S OF PARK ST IN BLACKFALDS 26-39-27-413101230	8680	9220	9240	9060	9080	9260	9500	10360	10580	11600
2 A	18	20	Laco	N OF PARK ST IN BLACKFALDS 26-39-27-413101230	7130	7570	7350	7210	7240	7370	7550	7520	7660	8260
2 A	18	20	Laco	S OF GREGG ST IN BLACKFALDS 26-39-27-411750805	7130	7570	7350	7210	7240	7370	7550	7520	7660	8260
2 A	18	20	Laco	N OF GREGG ST IN BLACKFALDS 26-39-27-411750805	7310	7770	7720	7600	7640	7790	7990	7010	7150	7590
2 A	18	20	Laco	S OF C&E TRAIL 26-39-27-409500325 SJ	7320	7780	7730	7610	7650	7800	8000	7010	7150	7590
2 A	18	20	Laco	N OF C&E TRAIL 26-39-27-409500325 SJ	6680	7100	7050	6810	6870	7000	7180	6250	6370	6750
2 A	18	20	Laco	S OF TWP RD 400 35-39-27-408050000	6680	7100	7050	6810	6870	7000	7180	6250	6370	6750
2 A	18	20	Laco	N OF TWP RD 400 35-39-27-408050000	6800	7220	7200	7020	7170	7300	7480	6590	6630	7040
2 A	18	20	Laco	S OF C & E TRAIL S OF LACOMBE 13-40-27-404000030 NJ	6930	7350	7350	7240	7310	7450	7400	6520	6560	6980
2 A	18	20	Laco	N OF C & E TRAIL S OF LACOMBE 13-40-27-404000030 NJ	5730	6070	6070	6100	6070	6190	5900	5220	5260	5600
2 A	20	04	Laco	S OF LACOMBE AIRPORT ACC 32-40-26-402000000	5300	5500	5760	5980	5940	6060	6000	5660	6480	6890
2 A	20	04	Laco	N OF LACOMBE AIRPORT ACC 32-40-26-402000000	4360	4520	4740	4500	4480	4560	4520	4430	5080	5410
2 A	20	04	Laco	4.9 KM N OF 2A & 12 LACOMBE	4030	4200	4370	4440	4390	4530	4460	4450	5090	5470
2 A	20	04	Laco	S OF C&E TRAIL 4-41-26-408050000	4030	4180	4370	4440	4410	4500	4460	4430	5080	5410
2 A	20	04	Laco	N OF C&E TRAIL 4-41-26-408050000	4310	4480	4650	4720	4690	4780	4770	4970	5710	6080
2 A	20	04	Laco	S OF MILTON RD 9-41-26-407501300	4310	4480	4650	4720	4690	4780	4770	4970	5710	6080
2 A	20	04	Laco	N OF MILTON RD 9-41-26-407501300	3510	3640	4030	4080	4050	4120	4210	4380	5030	5360
2 A	22	04	Laco	E OF 2 SW OF MORNINGSIDE	4160	4360	4400	4390	4300	4440	4360	4400	4800	5100
2 A	22	04	Pnka	S OF 604 N OF MORNINGSIDE	4170	4370	4400	4390	4300	4440	4600	4640	4850	5150

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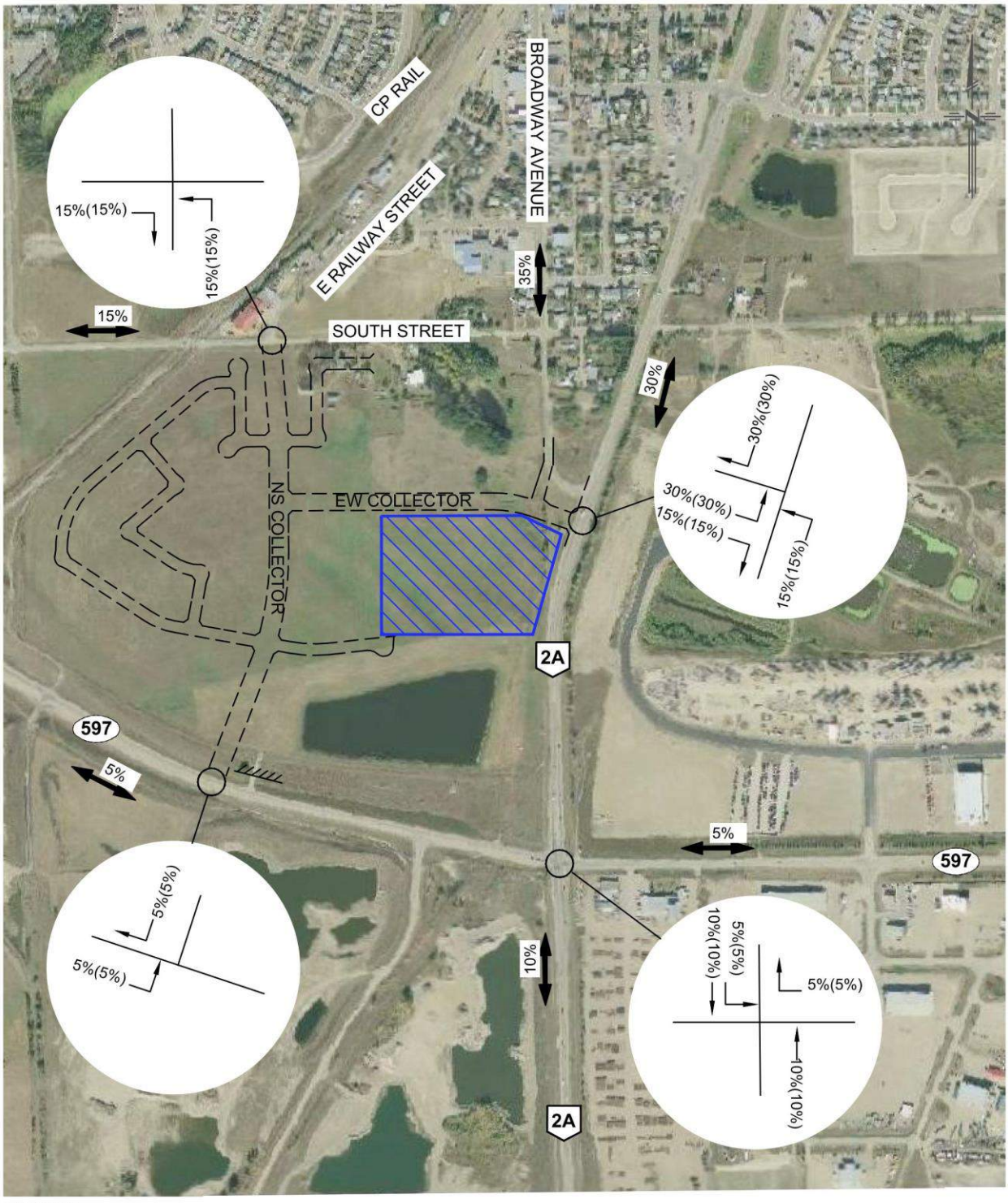
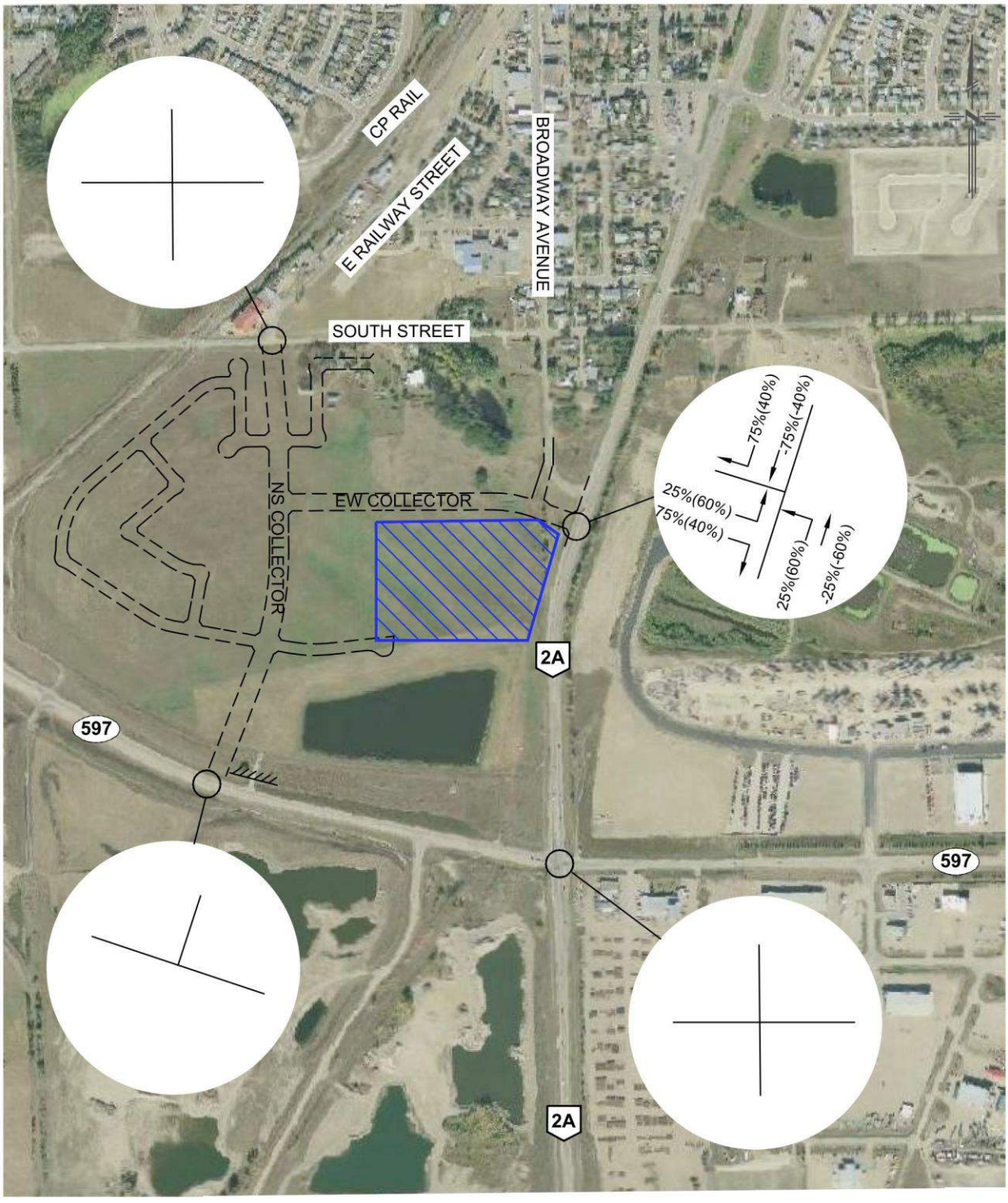
590	02	16	RdDr	W OF 21 S OF DELBURNE	600	910	880	880	880	880	880	870	870	870
590	04	04	RdDr	E OF 21 S OF DELBURNE	530	940	870	870	850	850	850	940	940	940
590	04	04	Stet	W OF RGE RD 212 22-35-21-400000000	460	550		780	760	760	760	760	660	660
590	04	04	Stet	E OF RGE RD 212 22-35-21-400000000	460	550		780	760	760	760	760	660	660
590	04	04	Stet	W OF 835 W OF BIG VALLEY	620	630	630	770	760	760	760	760	660	660
590	04	08	Stet	E OF 835 W OF BIG VALLEY	600	610	610	760	760	760	760	760	650	650
590	04	08	Stet	W OF 56 NE OF BIG VALLEY	460	550	540	540	540	540	540	520	520	520
591	02	04	Clrw	E OF 734 SW OF RICINUS	80	80	80	80	80	80	80	80	120	120
591	02	04	Clrw	W OF SWAN LAKE ACC 25-35-9-503501550	80	80	80	80	80	80	80	80	160	160
591	02	06	Clrw	E OF SWAN ALKE ACC 25-35-9-503501550	180	180	180	160	160	160	160	160	220	220
591	02	06	Clrw	W OF 22 & 54 W OF CAROLINE WJ	800	820	820	820	800	820	930	930	930	930
592	02	08	RdDr	E OF 781 NW OF PENHOLD	1040	1060	1060	1100	1170	1170	1170	1170	1260	1260
592	02	08	RdDr	W OF RGE RD 10 36-36-1-500000000	1090	1120		1230	1300	1300	1300	1300	1290	1290
592	02	08	RdDr	E OF RGE RD 10 36-36-1-500000000	1310	1340		1430	1500	1500	1500	1500	1540	1540
592	02	08	RdDr	W OF C & E TRAIL 283A 33-36-28-401000000	1550	1580	1650	1620	1780	1780	1780	1780	1780	1800
592	02	08	RdDr	E OF C & E TRAIL 283A 33-36-28-401000000	1370	1420	1470	1440	1540	1540	1540	1540	1540	1630
592	02	08	RdDr	W OF 2A & 42 N OF PENHOLD	1700	1780	1850	1820	1870	1870	1880	1920	1940	2430
593	02	04	Stet	E OF 850 E OF FENN	140	140	140	140	200	200	200	200	200	120
593	02	04	Stet	W OF 853 N OF BYEMOOR	60	60	60	60	100	100	100	100	100	60
594	02	04	Stet	E OF 835 SW OF ERSKINE	80	80	80	80	80	80	80	80	80	80
594	02	04	Stet	W OF 56 S OF WARDEN	110	180	180	180	180	180	140	140	140	140
595	02	04	RdDr	W OF 808 SE OF RED DEER	2600	2620	2420	2920	3200	3080	3080	3140	3280	3780
595	02	08	RdDr	E OF 808 SE OF RED DEER	2490	2510	2310	2810	2760	2640	2640	2680	2800	2880
595	02	08	RdDr	W OF 816 NW OF PINE LAKE	2440	2460	2260	2760	2620	2530	2520	2560	2660	2730
595	02	12	RdDr	E OF 816 NW OF PINE LAKE	1780	1800	1660	2030	2060	1980	1970	2010	2090	2190
595	02	12	RdDr	4.8 KM E OF 595 & 816 NW DELBURNE	1700	1590	1610	1940	1980	1930	1890	1930	2000	2100
595	02	12	RdDr	W OF 21 NW OF DELBURNE	1520	1540	1430	1610	1700	1650	1650	1680	1730	1780
597	02	04	Laco	E OF 2 W OF BLACKFALDS	4100	4390	4480	4480	6700	6780	6780	7280	9720	9890
597	02	04	Laco	W OF RGE RD 273 BLACKFALDS 22-39-27-412400245								7280	9720	9890
597	02	04	Laco	E OF RGE RD 273 BLACKFALDS 22-39-27-412400245								4820	5420	5500
597	02	04	Laco	W OF 2A S OF BLACKFALDS	2720	2900	2940	2940	3660	3730	3730	4620	5060	5160
597	02	08	Laco	E OF 2A S OF BLACKFALDS	3440	3590	3610	3610	2680	2720	2720	4020	4260	4340
597	02	08	Laco	W OF PRENTISS RD (RGE RD 260) 12-39-26-400000000	860	1140	1140	1140	1140	1270	1270	1270	1270	1270
597	02	08	Laco	E OF PRENTISS RD (RGE RD 260) 12-39-26-400000000	870	1180	1180	1180	1180	1220	1220	1220	1220	1220
597	02	08	Laco	W OF 815 N OF JOFFRE	720	810	810	810	810	810	810	810	810	720
598	02	04	Clrw	E OF 11 & 11A ROCKY MOUNTAIN HOUSE	7640	7890	7890	6150	5850	5970	6280	6410	6640	6710
598	02	04	Clrw	S OF RGE RD 71 SJ 26-39-7-500000940				2790	2650	2710	3050	3110	3140	3180
598	02	04	Clrw	E OF RGE RD 71 SJ 26-39-7-500000940				2710	2570	2630	2970	3030	3080	3120
598	02	04	Clrw	W OF RGE RD 71 EJ 25-39-7-514900815				2710	2570	2630	2970	3030	3080	3120
598	02	04	Clrw	E OF RGE RD 71 EJ 25-39-7-514900815				2720	2580	2640	2980	3040	3080	3120



Trip Distribution (Shopping Center - Stage 1) - Non-Pass-By Trips



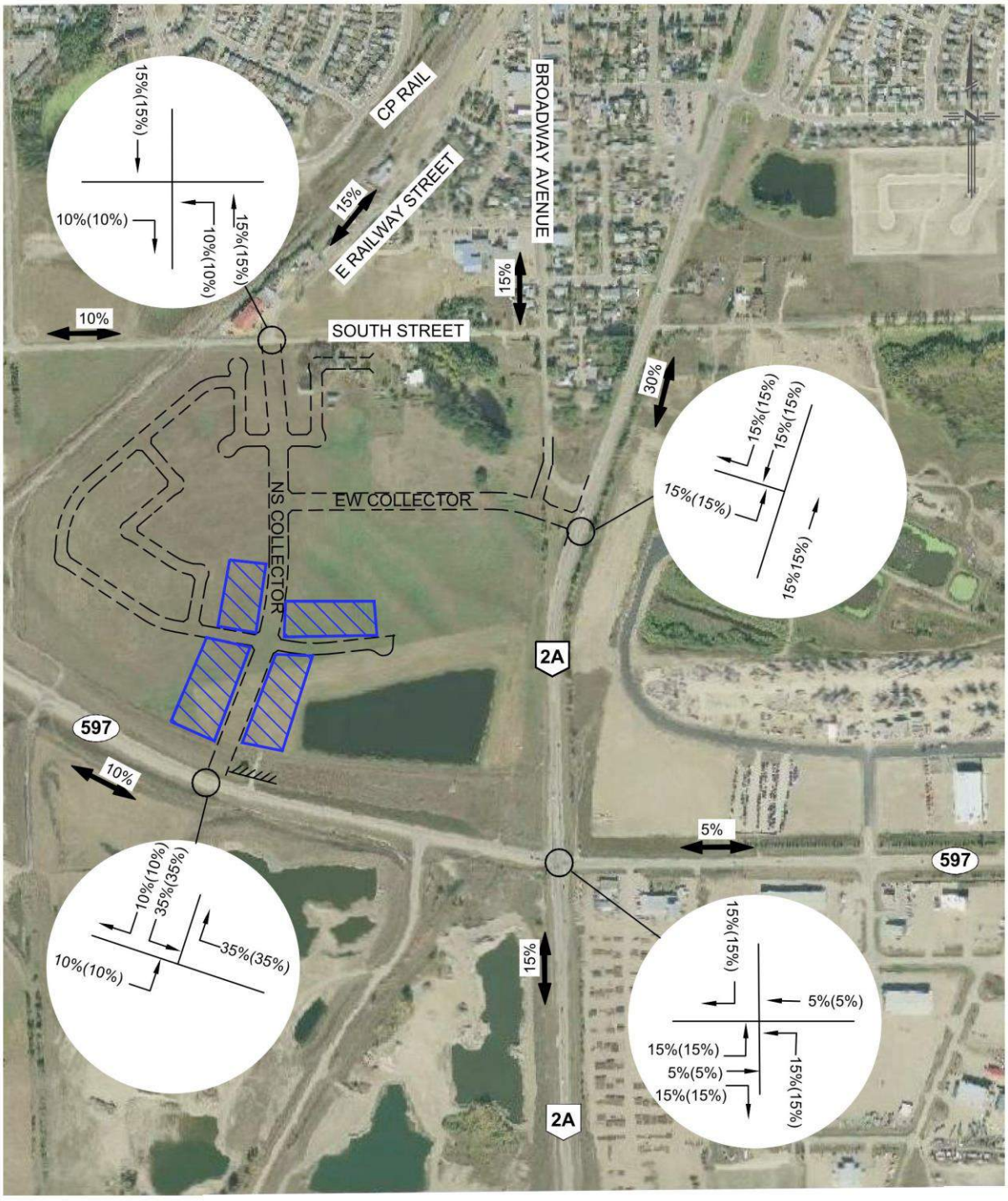
LEGEND

X(Y) AM PEAK (PM PEAK)

PROPOSED COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Distribution (Shopping Center – Stage 1) - Pass-By Trips



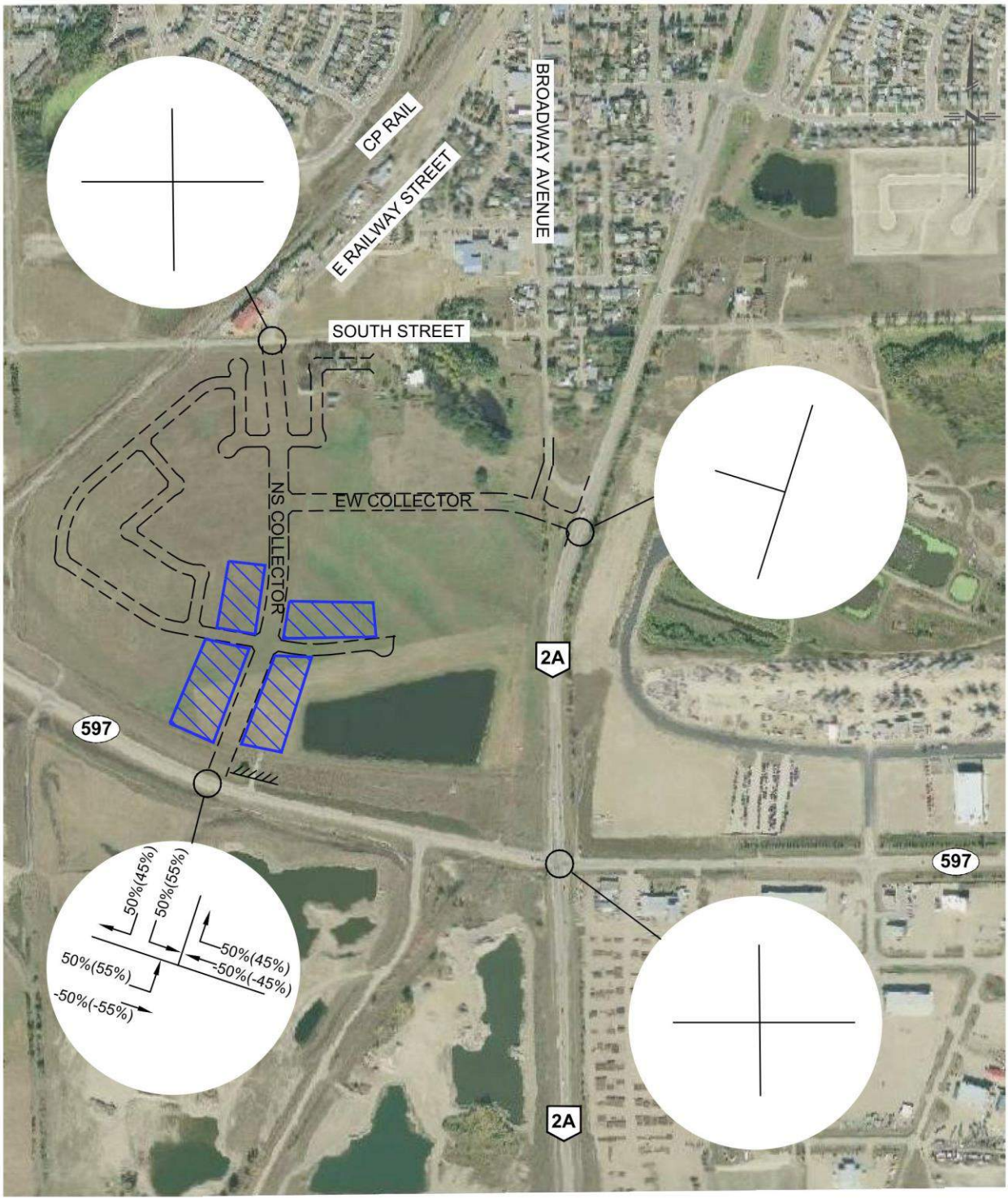
LEGEND

X(Y) AM PEAK (PM PEAK)

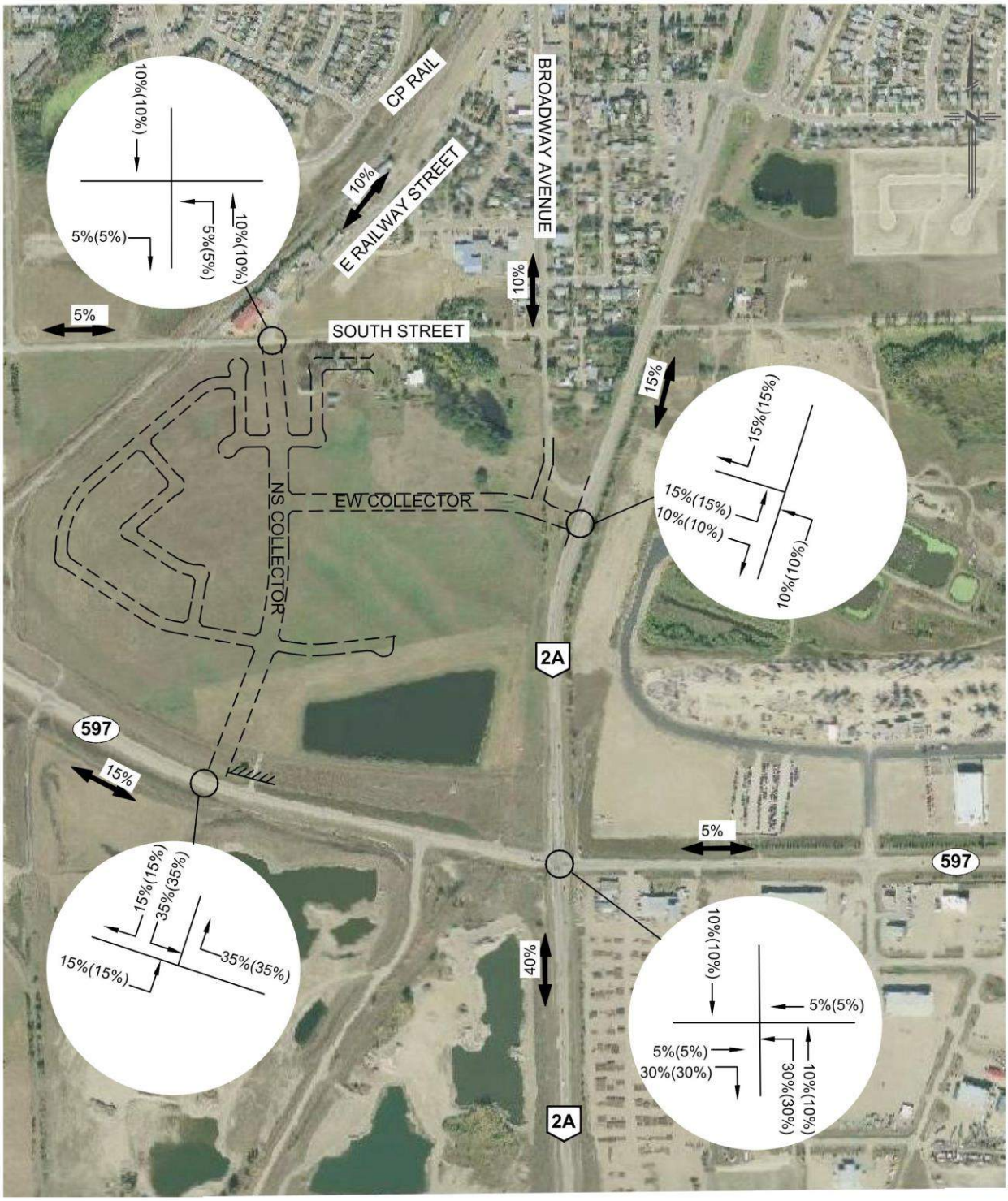
PROPOSED COMMERCIAL DEVELOPMENT

NOT TO SCALE

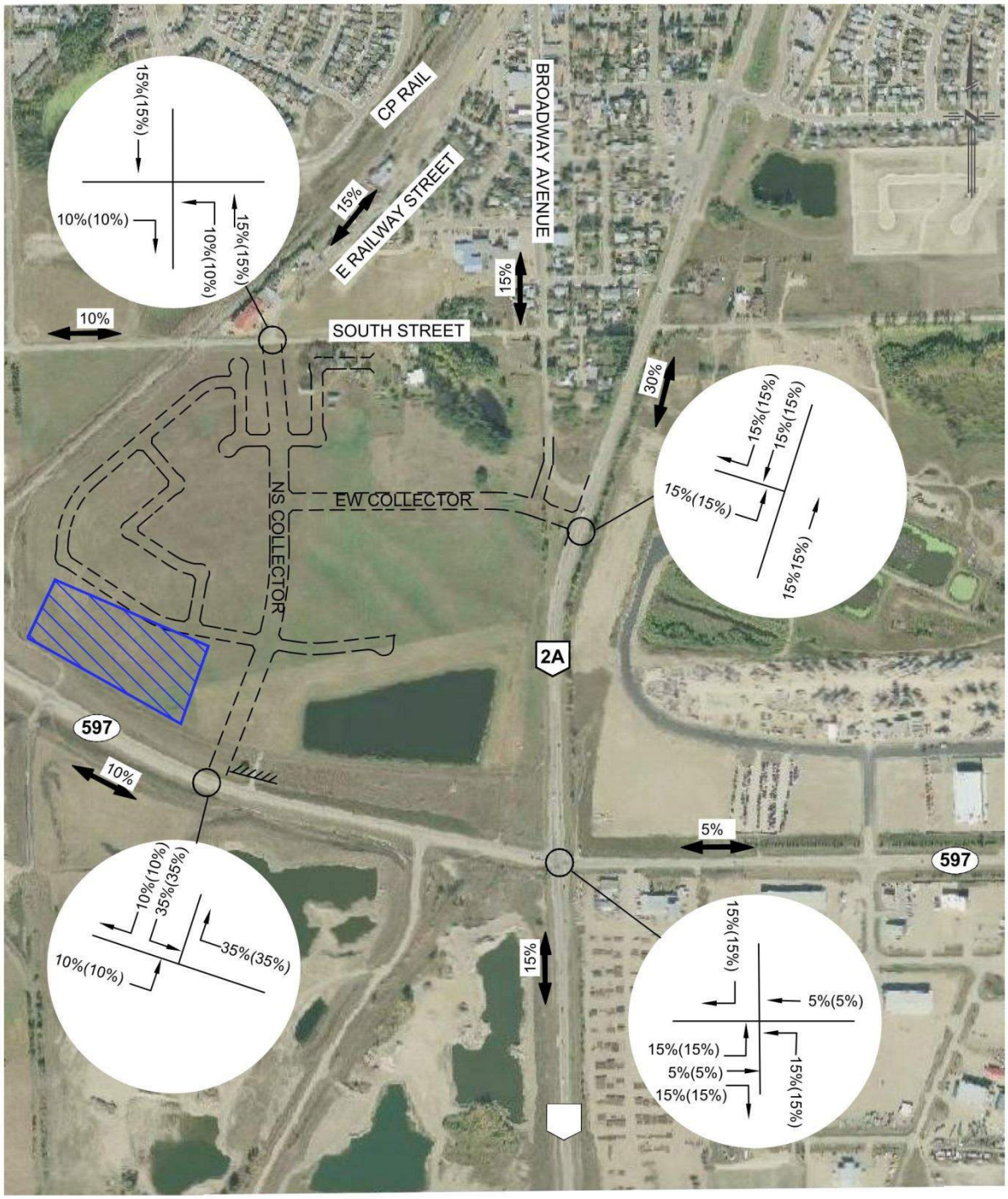
Trip Distribution (Highway Commercial – Stage 2) – Non-Pass-By Trips



Trip Distribution (Highway Commercial – Phase 2) - Pass-By Trips



Trip Distribution (Residential)



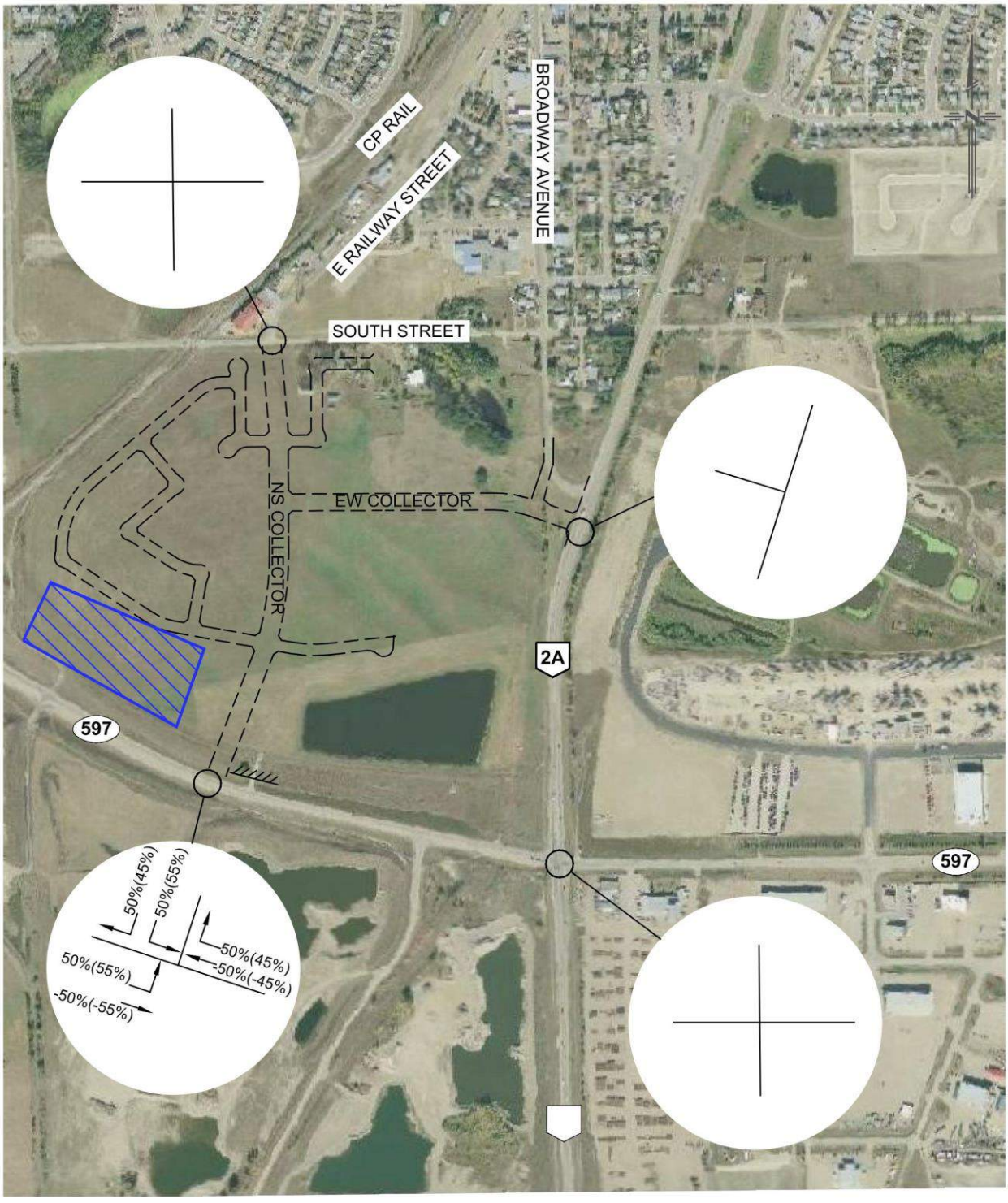
LEGEND

X(Y) AM PEAK (PM PEAK)

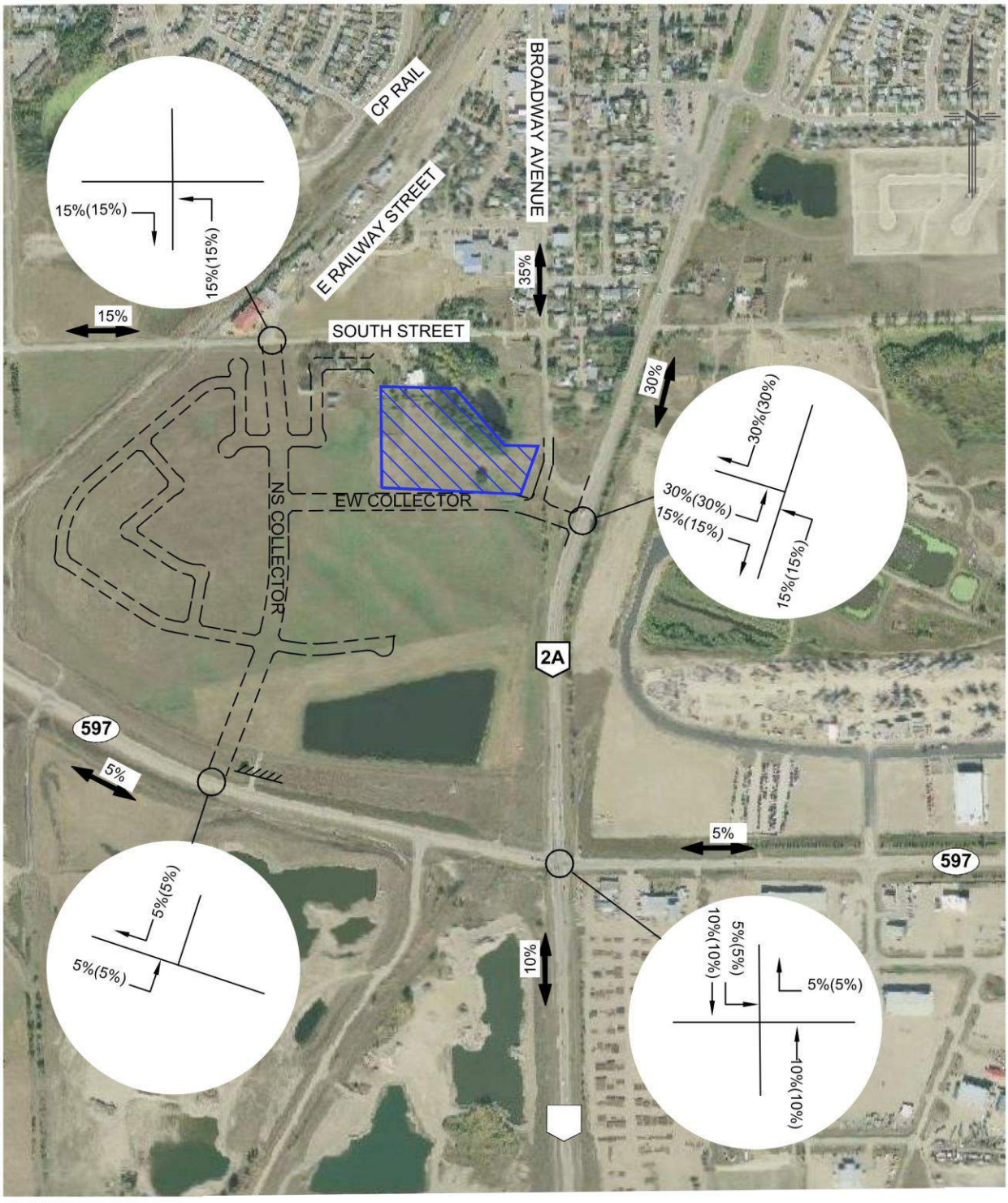
PROPOSED MIXED USE COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Distribution (Mixed Use Housing - Commercial) – Non-Pass-by Trips



Trip Distribution (Mixed Use Housing - Commercial) – Pass-by Trips



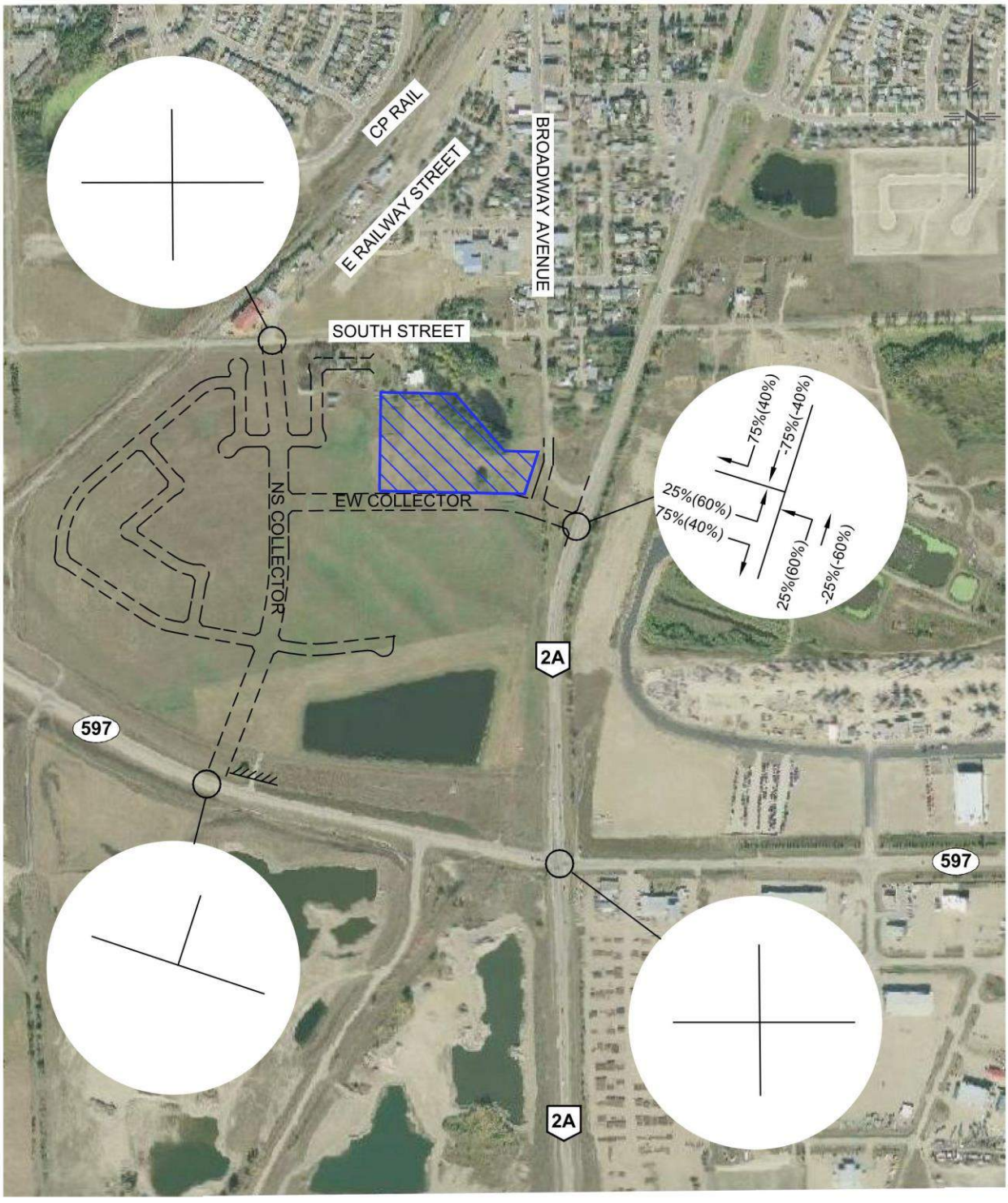
LEGEND

X(Y) AM PEAK (PM PEAK)

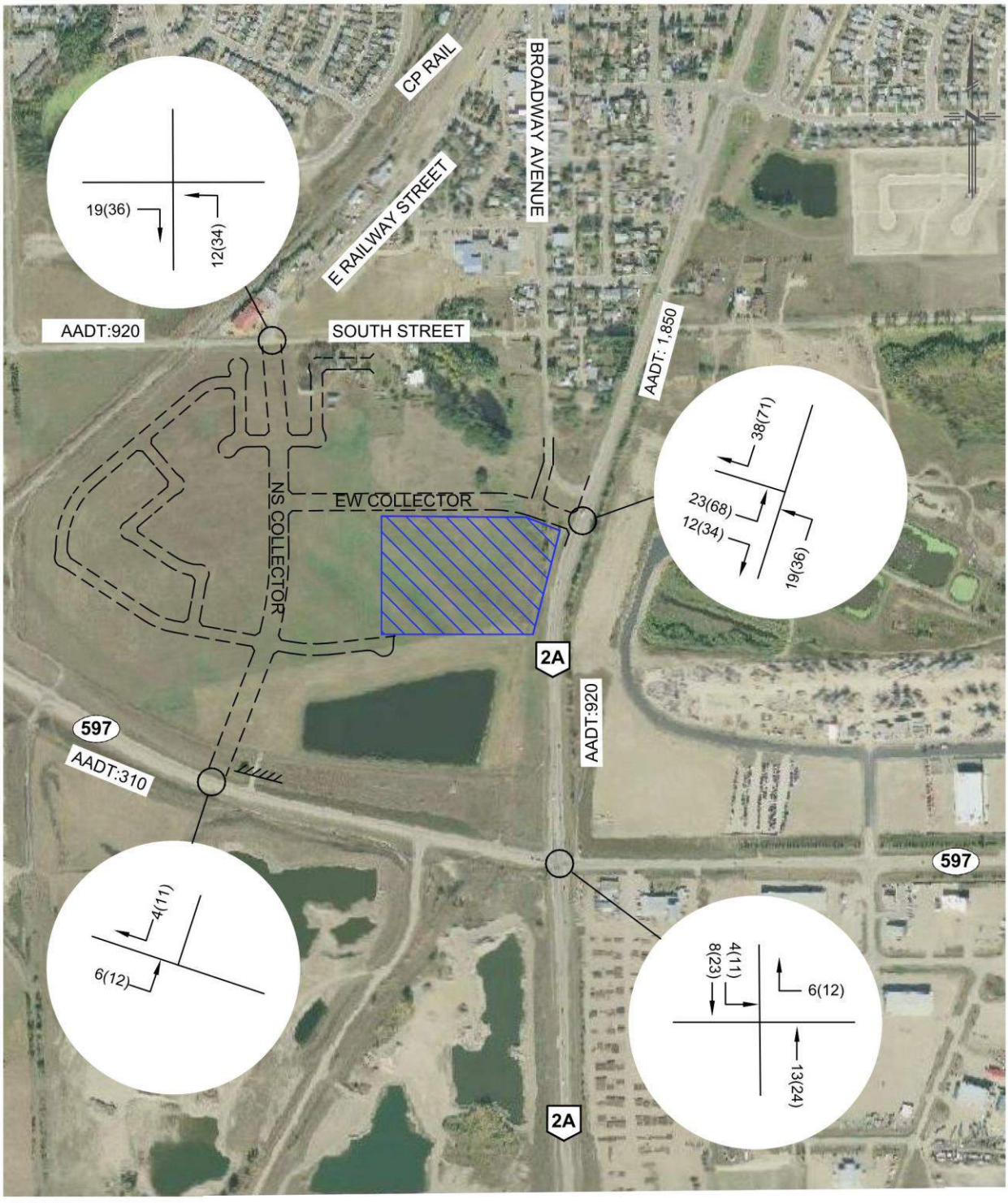
PROPOSED COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Distribution (Highway Commercial – Future Development) – Non-Pass-By Trips



Trip Distribution (Highway Commercial – Future Development) – Pass-By Trips



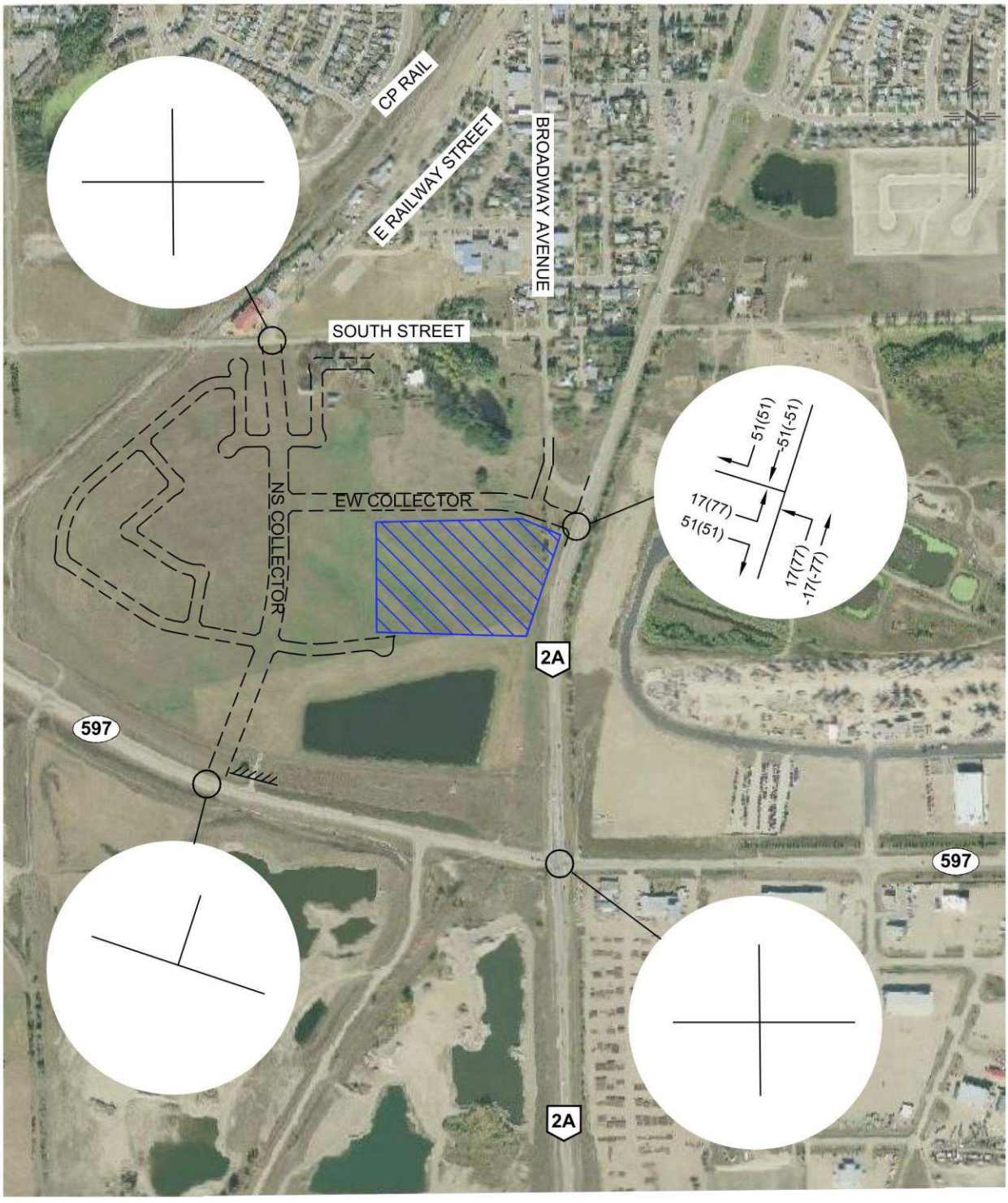
LEGEND

X(Y) TRAFFIC VOLUME AM PEAK (PM PEAK)

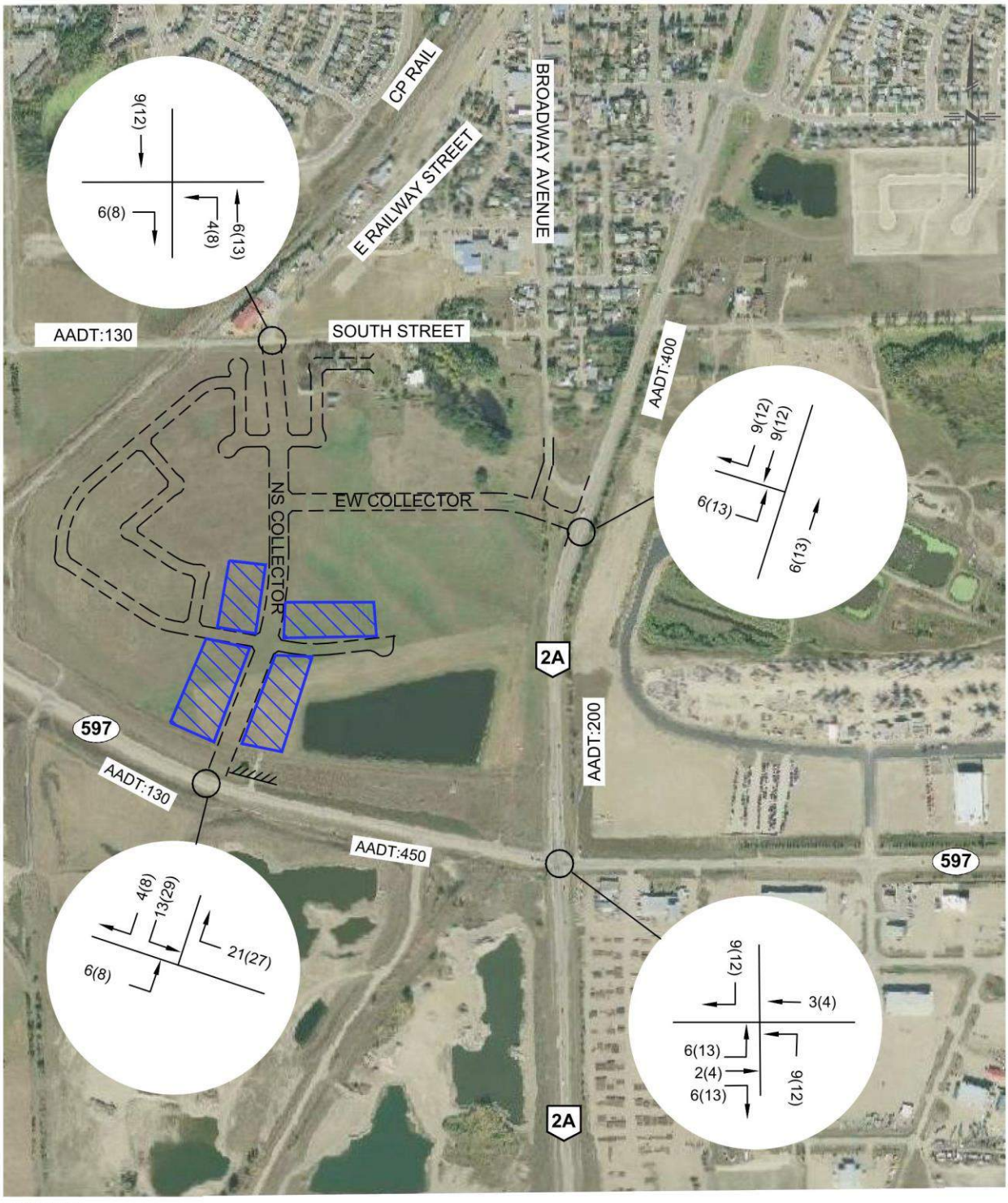
PROPOSED COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Assignment (Shopping Center) – Non-Pass-By Trips



Trip Assignment (Shopping Center) – Pass-By Trips



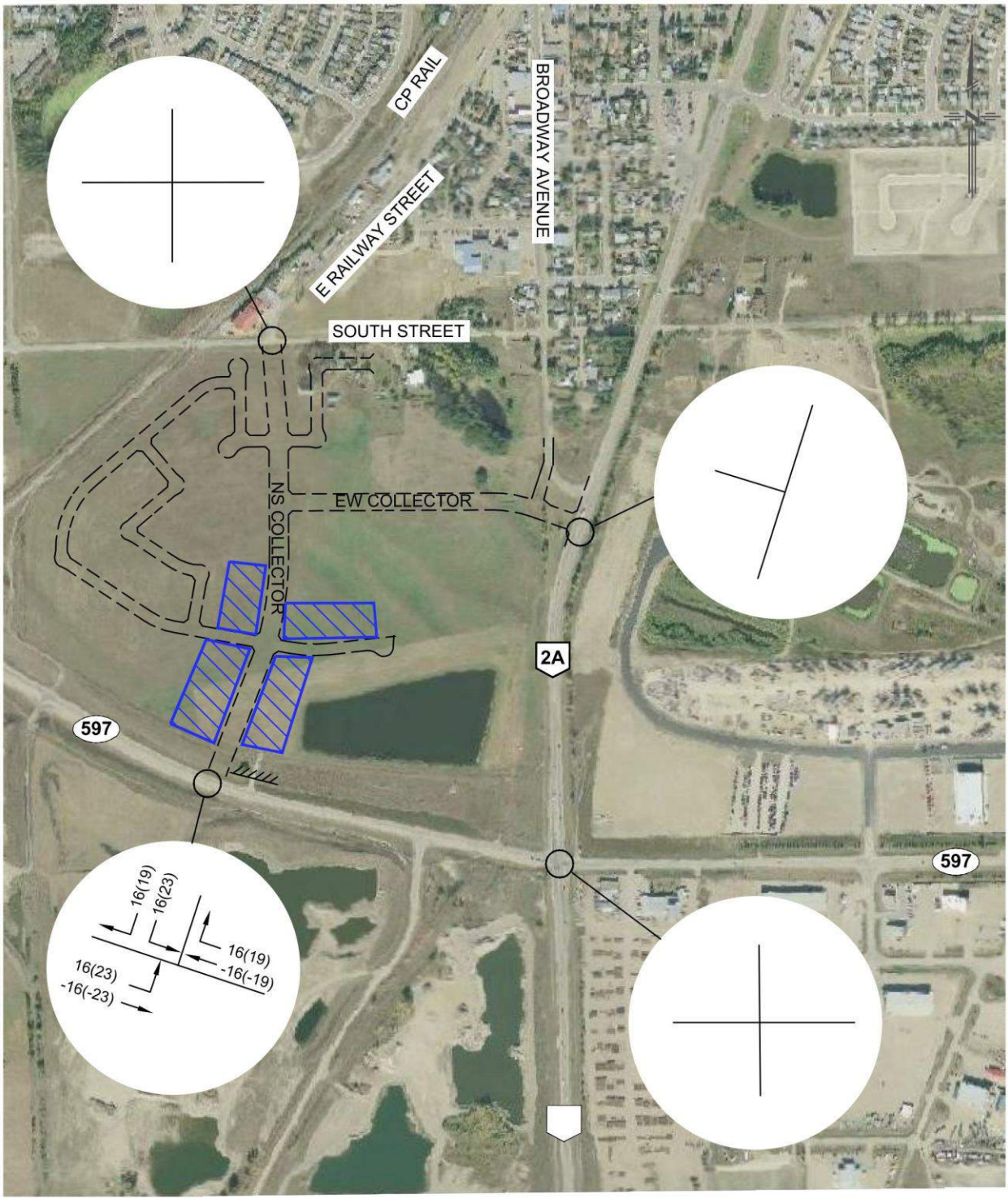
LEGEND

X(Y) AM PEAK (PM PEAK)

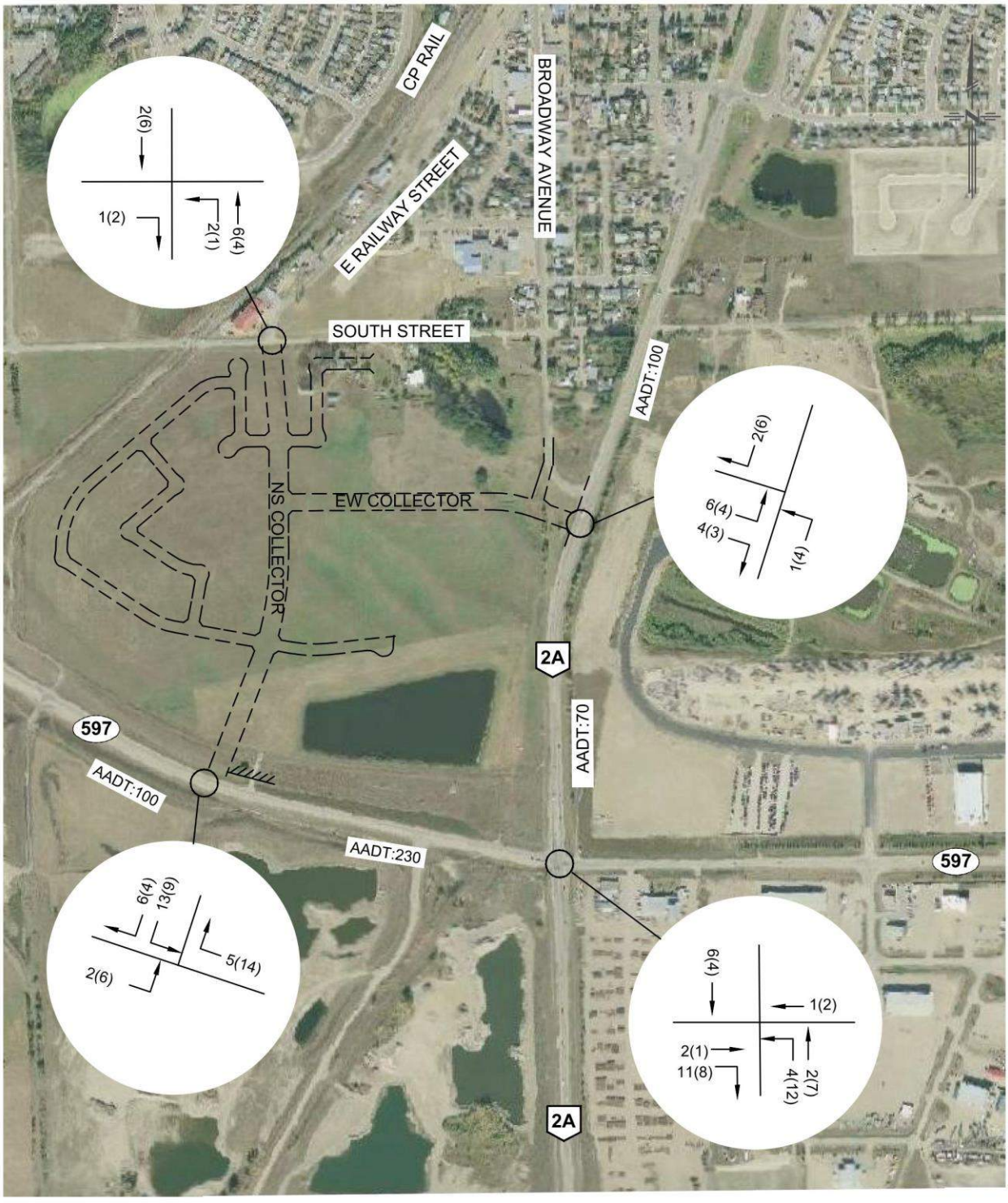
PROPOSED COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Assignment (Highway Commercial – Stage 2) – Non-Pass-By Trips



Trip Assignment (Highway Commercial – Stage 2) – Pass-By Trips

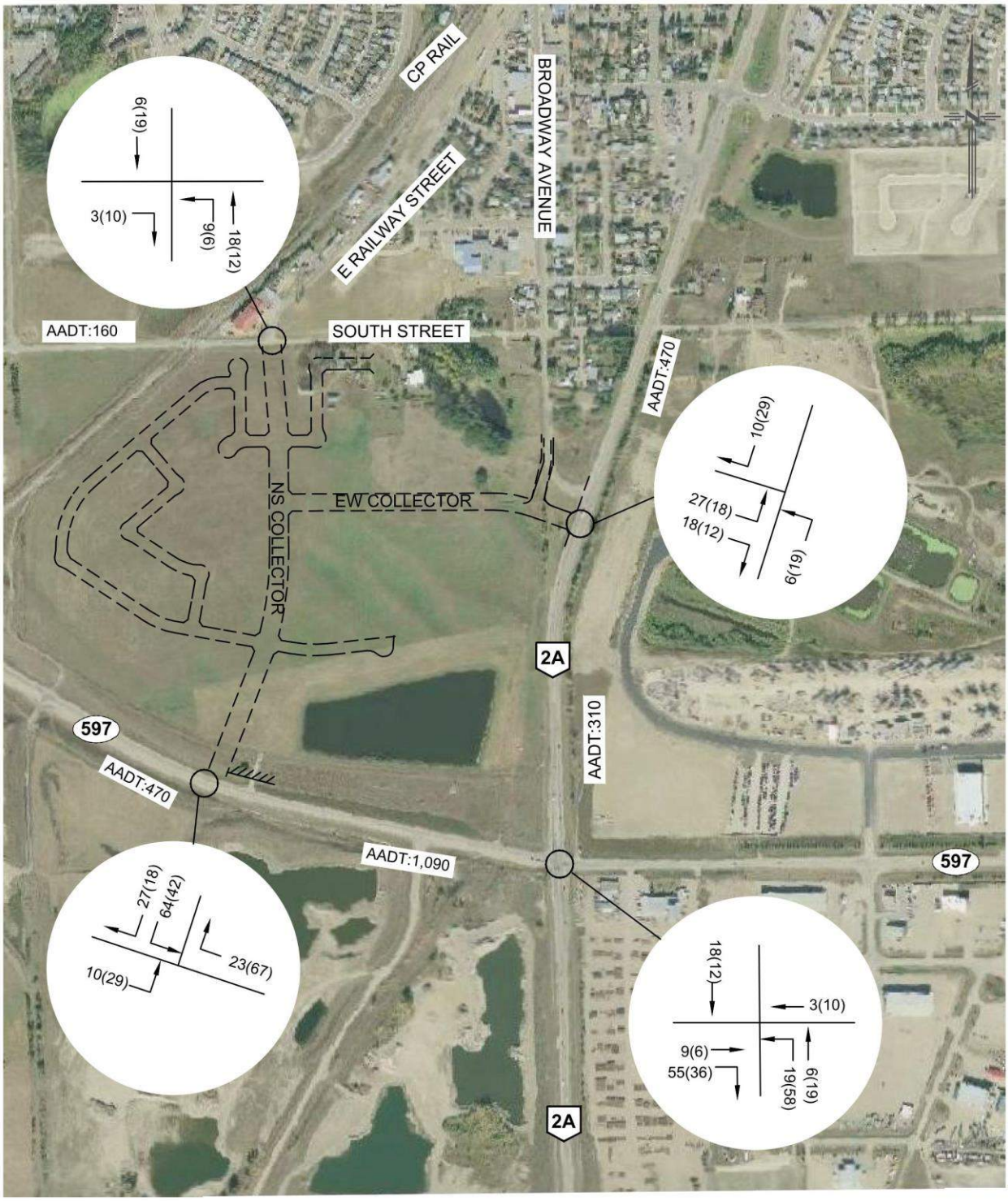


LEGEND

X(Y) AM PEAK (PM PEAK)

NOT TO SCALE

Trip Assignment (Residential – 3 Year Horizon)

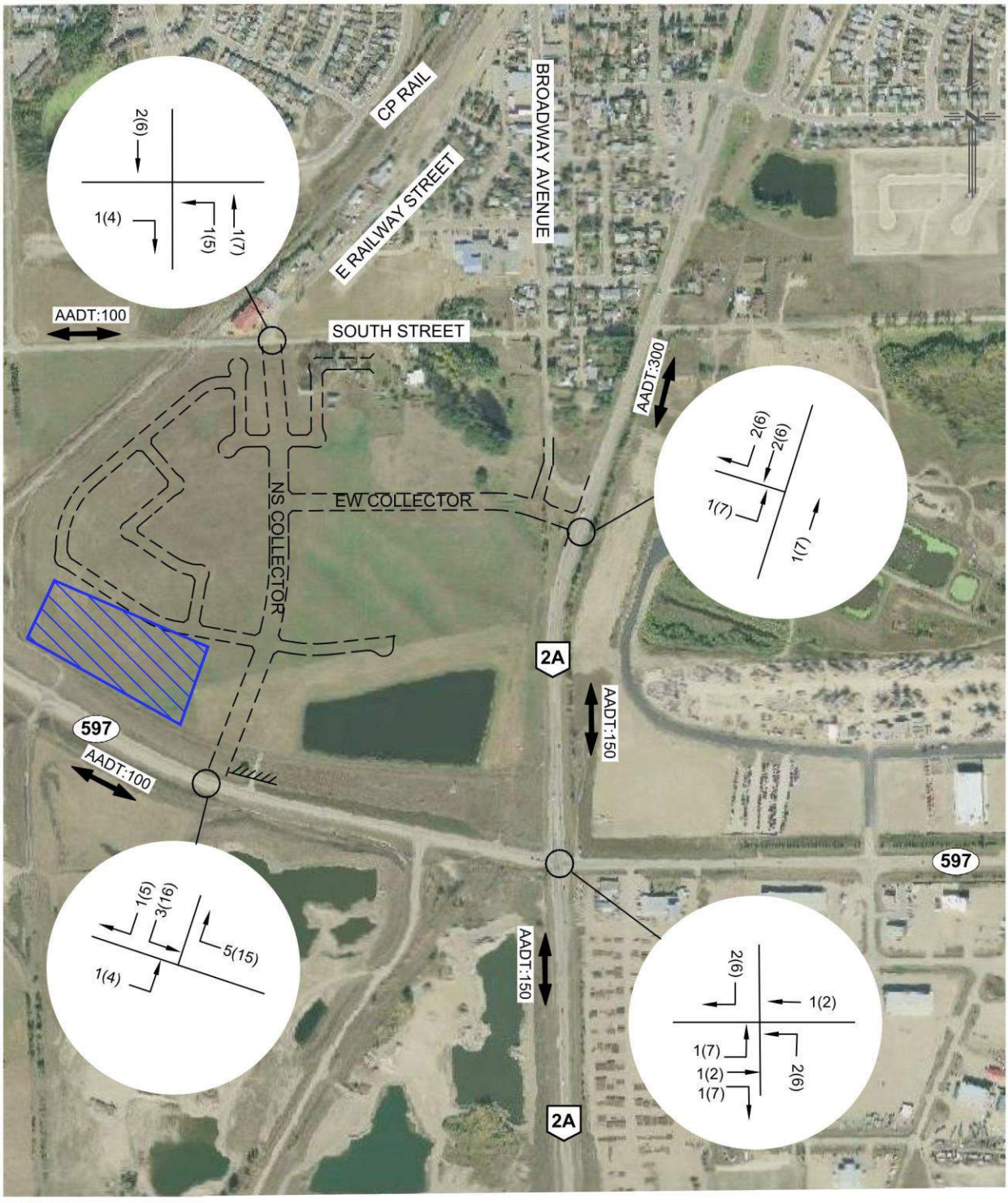


LEGEND

X(Y) AM PEAK (PM PEAK)

NOT TO SCALE

Trip Assignment (Residential Full Build Out)



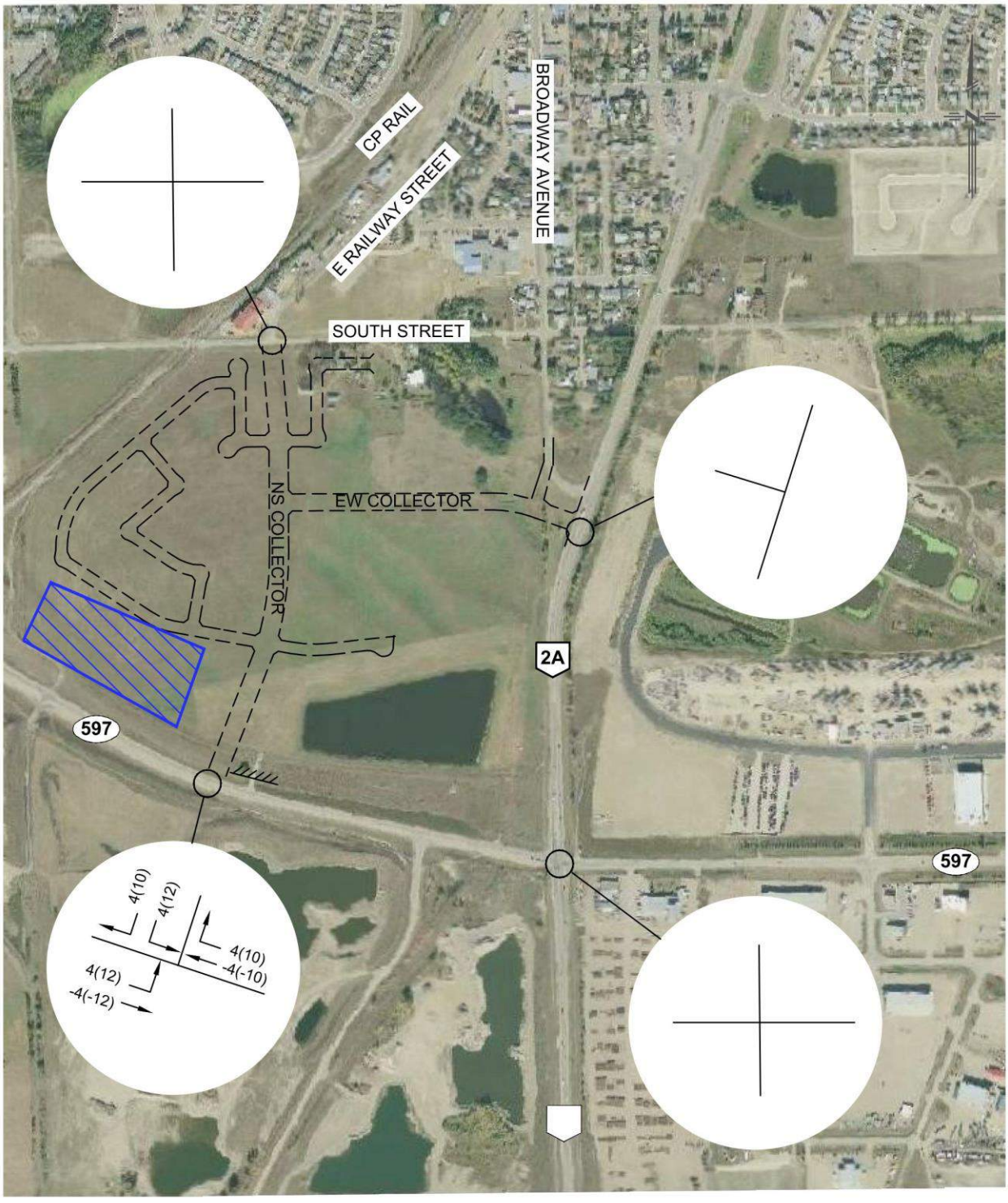
LEGEND

X(Y) AM PEAK (PM PEAK)

PROPOSED MIXED USE COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Assignment (Mixed Use Housing Commercial) – Non-Pass-by Trips



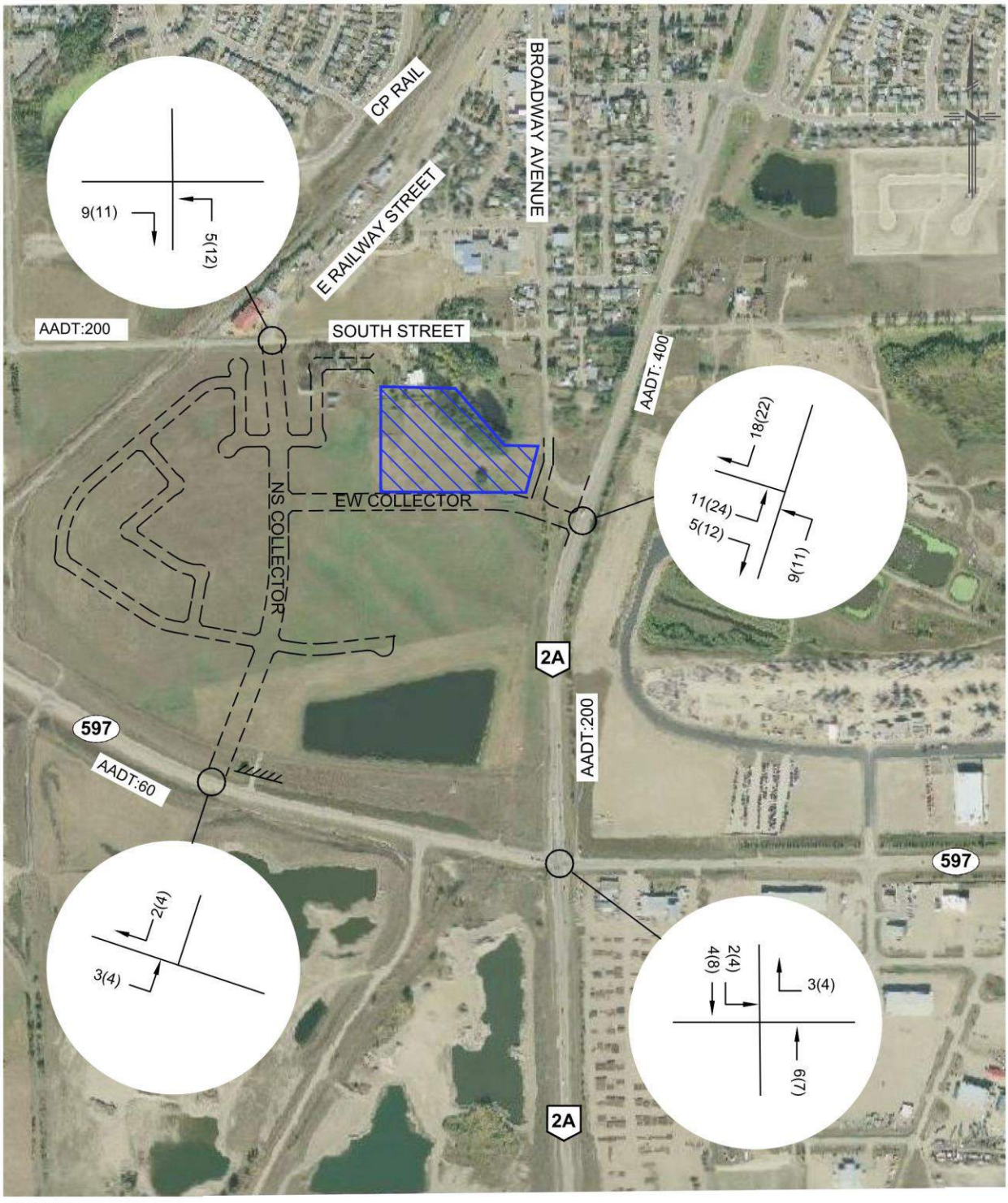
LEGEND

X(Y) AM PEAK (PM PEAK)

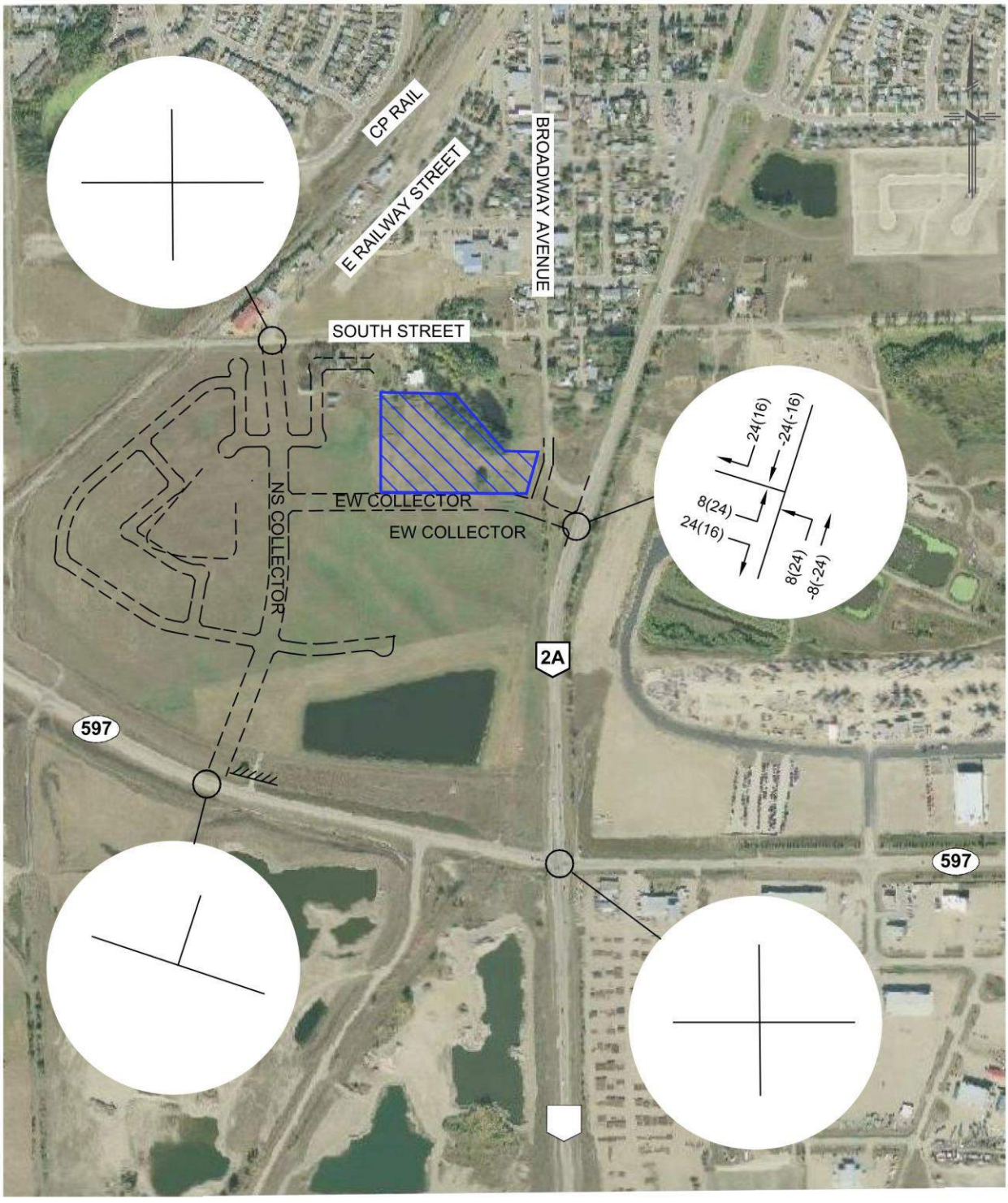
PROPOSED MIXED USE COMMERCIAL DEVELOPMENT

NOT TO SCALE

Trip Assignment (Mixed Use Housing Commercial) – Pass-by Trips



Trip Assignment (Highway Commercial – Future Development) – Non-Pass-By Trips



Trip Assignment (Highway Commercial – Future Development) – Pass-By Trips

Table 1.2: Recommended Site Traffic Generation Rate

Land Use	Recommendation	Time Period	Industry (ITE)	Empirical Average
Hotel	Use ITE Further study	AM	0.56/room 0.69/emp	0.36/room 2.64/emp
	Further study Further study	PM	0.59/room 0.80/emp	0.33/room 2.61/emp
Residential Dwellings	Use ITE	AM	0.78/unit	0.62/unit
	Use ITE	PM	1.01/unit	0.76/unit
High School	Use ITE Use local data	AM	0.41/stu 4.63/emp	0.45/stu 5.75/emp
	Further study Use local data	PM	0.41/stu 1.55/emp	0.26/stu 3.43/emp
Highway Commercial	Use local data	AM	N/A	2.56/93 m^2 GFA
	Use local data	PM	N/A	4.21/93 m^2 GFA
Multi-Family Dwellings	Use ITE	AM	0.30-0.67 per unit	0.34/unit
	Use ITE	PM	0.8-0.78 per unit	0.51/unit
General Office	Use ITE Use ITE	AM	1.55/93 m2 GFA 0.48/emp	1.82/93 m^2 GFA 0.86/emp
	Use ITE Further study	PM	1.49/93 m2 GFA 0.46/emp	2.23/ 93 m^2 GFA 1.01/emp
Medical/Dental Office	Further study Further study	AM	2.48/93 m2 GFA 0.53/emp	9.19/93 m^2 GFA 2.87/emp
	Use local data	PM	3.72/93 m2 GFA 1.06/emp	8.42/93 m^2 GFA 2.64/emp
Strip Mall	Further study	AM	1.03/93 m2 GLA	2.83/93 m^2 GFA
	Further study Use ITE	PM	3.76 per 93 m2 GLA	4.03/93 m^2 GFA
Big Box Shopping	Use local dada	AM	N/A	1.99/93 m^2 GFA
	Use local data	PM	N/A	2.52/93 m^2 GFA
Sit-Down Restaurant	Use ITE Use ITE	AM	0.47/seat 11.52/93 m2 GFA	0.30/seat 7.36/93 m^2 GFA
	Further study Use local data	PM	0.41/ seat 10.92/ 93 m2 GFA	0.25/seat 5.63/93 m^2 GFA
Fast Food Restaurant	Further study Further Study	AM	1.32/seat 53.11/93 m2 GFA	0.93/seat 26.58/93m^2 GFA
	Use ITE Further Study	PM	0.94/seat 34.64/93 m2 GFA	0.83/seat 21.15/93m^2 GFA
Elementary School	Use ITE Use ITE	AM	0.42/stu 5.19/emp	0.42/stu 4.74/emp
	Use ITE Further Study	PM	0.28/stu 3.45/emp	0.25/stu 2.75/emp

Appendix C

INTERSECTION ANALYSIS

- **Signal Warrant Analysis**
- **Left Turn Lane Warrant Analysis**
- **Illumination Warrant Analysis**
- **Proposed Intersection Improvement Concept plan for Highway 597 / South Access**

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS	Road Authority:	Alberta Transportation
Side Street (name)	Broadway Avenue	Direction (EW or NS)	EW	City:	Town of Blackfalds
Quadrant / Int #	3	Comments	Existing Traffic (2015)	Analysis Date:	2015 Apr 23, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2015 Mar 19, Thu
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB		1	1				600	2
Highway 2A	SB			1			1	3,000	1
Broadway Avenue	WB								
Broadway Avenue	EB				1		1		
							n		

Are the Broadway Avenue EB right turns significantly impeded by through movements? (y/n) n

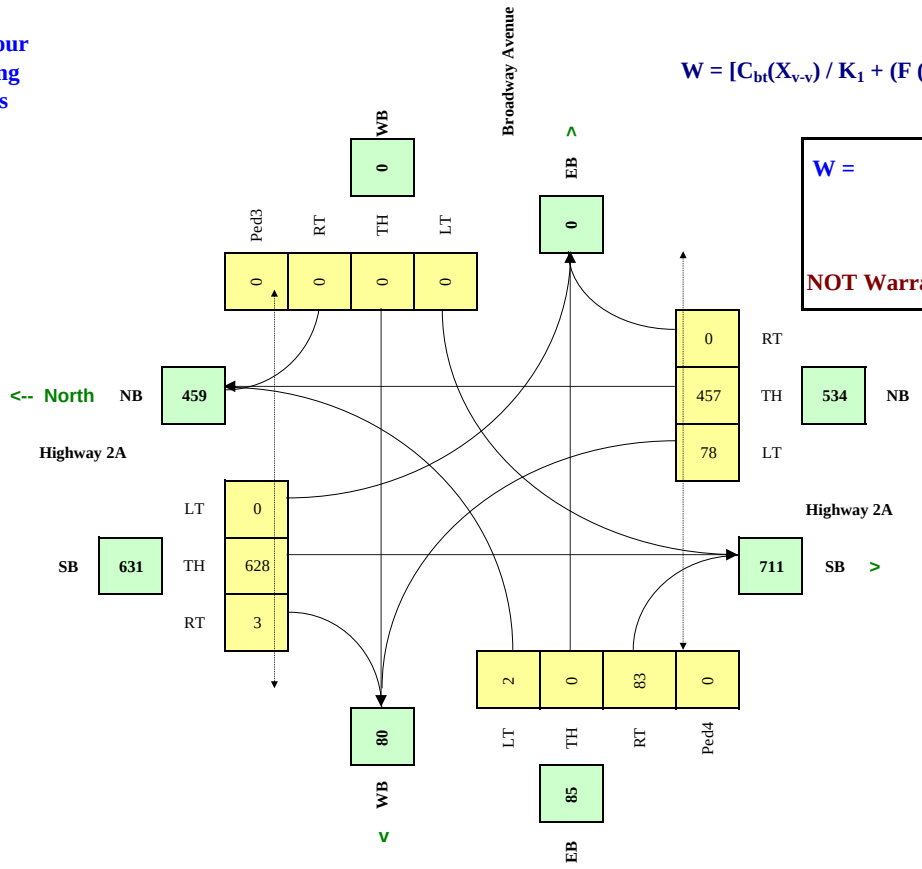
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	80	5.0%	n	
Broadway Avenue	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	37	266			1035	5				2		145				
8:00 - 9:00	28	200	0	0	776	4	0	0	0	2	0	109				
11:00 - 12:00	73	429	0	0	604	2	0	0	0	2	0	80				
12:00 - 13:00	60	354	0	0	472	2	0	0	0	2	0	62				
16:00 - 17:00	145	806			476	1				2		55				
17:00 - 18:00	123	685	0	0	405	1	0	0	0	2	0	47				
Total (6-hour peak)	**466**	**2,740**	**0**	**0**	**3,768**	**15**	**0**	**0**	**0**	**12**	**0**	**498**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**78**	**457**	**0**	**0**	**628**	**3**	**0**	**0**	**0**	**2**	**0**	**83**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



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

W =	72	72	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS	Road Authority:	Alberta Transportation
Side Street (name)	Broadway Avenue	Direction (EW or NS)	EW	City:	Town of Blackfalds
Quadrant / Int #	3	Comments	10 Year Horizon Background Traffic (2025)	Analysis Date:	2015 Apr 23, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2015 Mar 19, Thu
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB		1	1				3,000	2
Highway 2A	SB			1			1	730	1
Broadway Avenue	WB								
Broadway Avenue	EB	1					1		
							n		
							n		

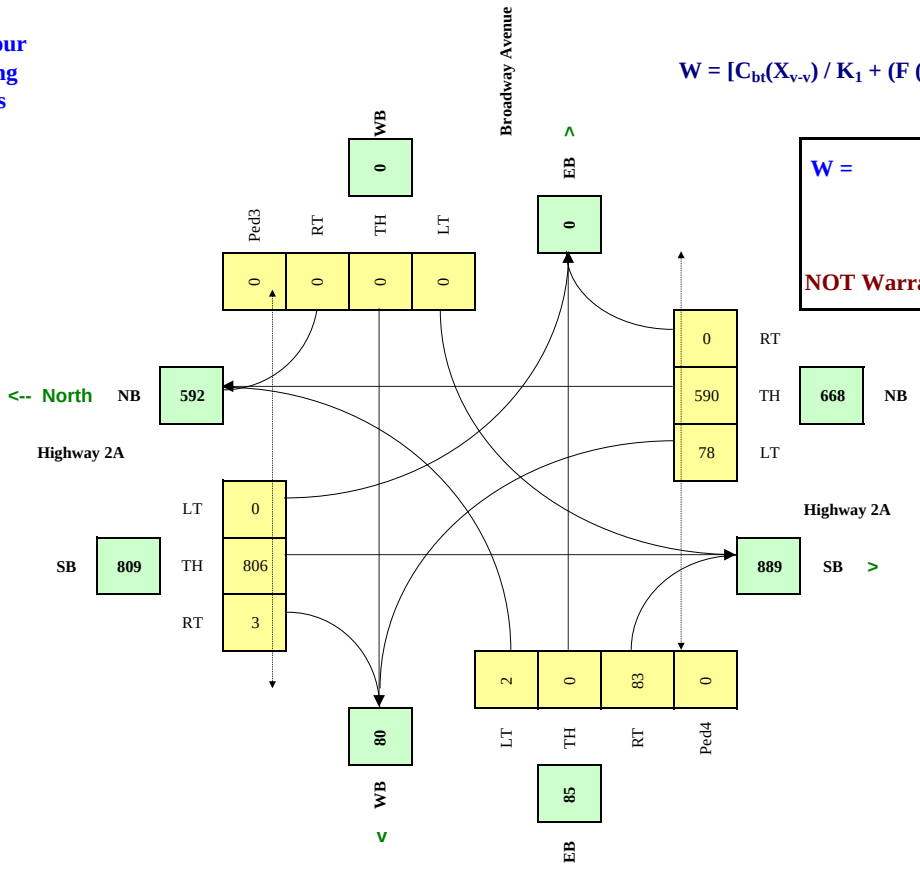
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	80	5.0%	n	
Broadway Avenue	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	37	342			1331	5				2		145				
8:00 - 9:00	28	257	0	0	998	4	0	0	0	2	0	109				
11:00 - 12:00	73	554	0	0	776	2	0	0	0	2	0	80				
12:00 - 13:00	60	458	0	0	606	2	0	0	0	2	0	62				
16:00 - 17:00	145	1043			609	1				2		55				
17:00 - 18:00	123	887	0	0	518	1	0	0	0	2	0	47				
Total (6-hour peak)	**466**	**3,541**	**0**	**0**	**4,838**	**15**	**0**	**0**	**0**	**12**	**0**	**498**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**78**	**590**	**0**	**0**	**806**	**3**	**0**	**0**	**0**	**2**	**0**	**83**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



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

W =	94	94	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS
Side Street (name)	Broadway Avenue	Direction (EW or NS)	EW
Quadrant / Int #	3	Comments	Phase 1 Post-Development Traffic
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	Alberta Transportation
City:	Town of Blackfalds
Analysis Date:	2015 Apr 23, Thu
Count Date:	2015 Mar 19, Thu
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB	1		2				3,000	2
Highway 2A	SB			2			1	730	2
Broadway Avenue	WB								
Broadway Avenue	EB				1		1		
							n		

Are the Broadway Avenue EB right turns significantly impeded by through movements? (y/n) n

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

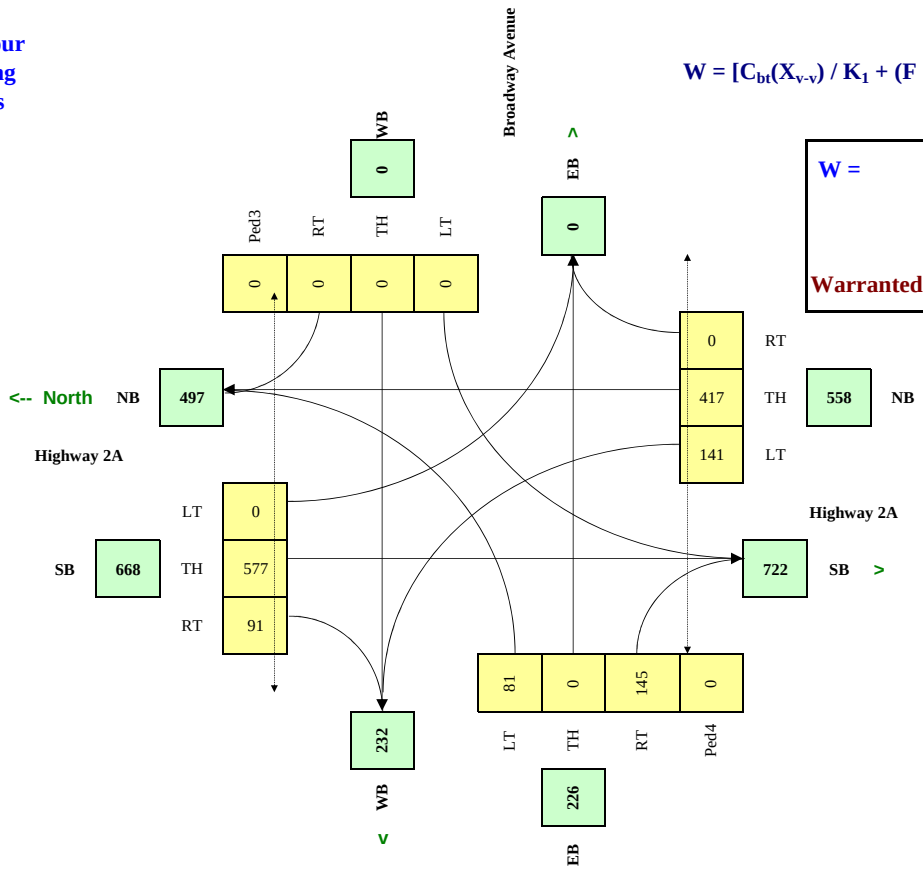
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	80	5.0%	n	
Broadway Avenue	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	73	249			984	94				42		208				
8:00 - 9:00	55	187	0	0	738	71	0	0	0	32	0	156				
11:00 - 12:00	132	391	0	0	556	86	0	0	0	76	0	139				
12:00 - 13:00	110	323	0	0	433	70	0	0	0	63	0	110				
16:00 - 17:00	258	729			405	122				147		140				
17:00 - 18:00	219	620	0	0	344	104	0	0	0	125	0	119				
Total (6-hour peak)	**847**	**2,499**	**0**	**0**	**3,460**	**547**	**0**	**0**	**0**	**485**	**0**	**872**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**141**	**417**	**0**	**0**	**577**	**91**	**0**	**0**	**0**	**81**	**0**	**145**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

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



W =	170	170	0
		Veh	*Ped*

Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS
Side Street (name)	Broadway Avenue	Direction (EW or NS)	EW
Quadrant / Int #	3	Comments	3 Year Horizon Combined Traffic (2018)
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	Alberta Transportation
City:	Town of Blackfalds
Analysis Date:	2015 Aug 23, Sun
Count Date:	2015 Mar 19, Thu
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB	1		2				3,000	2
Highway 2A	SB			2			1	730	2
Broadway Avenue	WB								
Broadway Avenue	EB	1					1		
							n		
							n		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

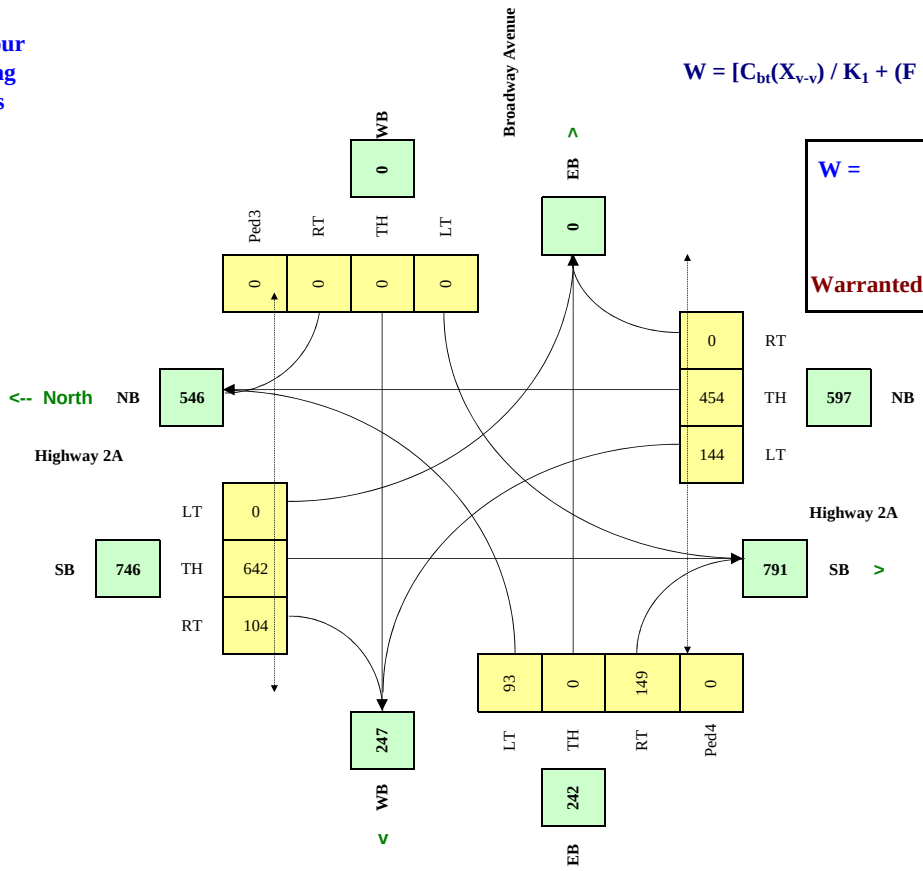
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	80	5.0%	n	
Broadway Avenue	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	74	280			1088	105				54		213				
8:00 - 9:00	56	210	0	0	816	79	0	0	0	41	0	160				
11:00 - 12:00	134	426	0	0	618	98	0	0	0	87	0	142				
12:00 - 13:00	112	351	0	0	482	80	0	0	0	72	0	113				
16:00 - 17:00	262	786			458	141				164		143				
17:00 - 18:00	223	668	0	0	389	120	0	0	0	139	0	122				
Total (6-hour peak)	**861**	**2,721**	**0**	**0**	**3,851**	**623**	**0**	**0**	**0**	**557**	**0**	**893**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**144**	**454**	**0**	**0**	**642**	**104**	**0**	**0**	**0**	**93**	**0**	**149**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

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



W =	200	200	0
		Veh	*Ped*

Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS
Side Street (name)	Broadway Avenue	Direction (EW or NS)	EW
Quadrant / Int #	3	Comments	10 Year Horizon Combined Traffic (2025)

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	Alberta Transportation
City:	Town of Blackfalds
Analysis Date:	2015 Apr 23, Thu
Count Date:	2015 Mar 19, Thu
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB	1		2				3,000	2
Highway 2A	SB			2			1	730	2
Broadway Avenue	WB								
Broadway Avenue	EB	1					1		
							n		
							n		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

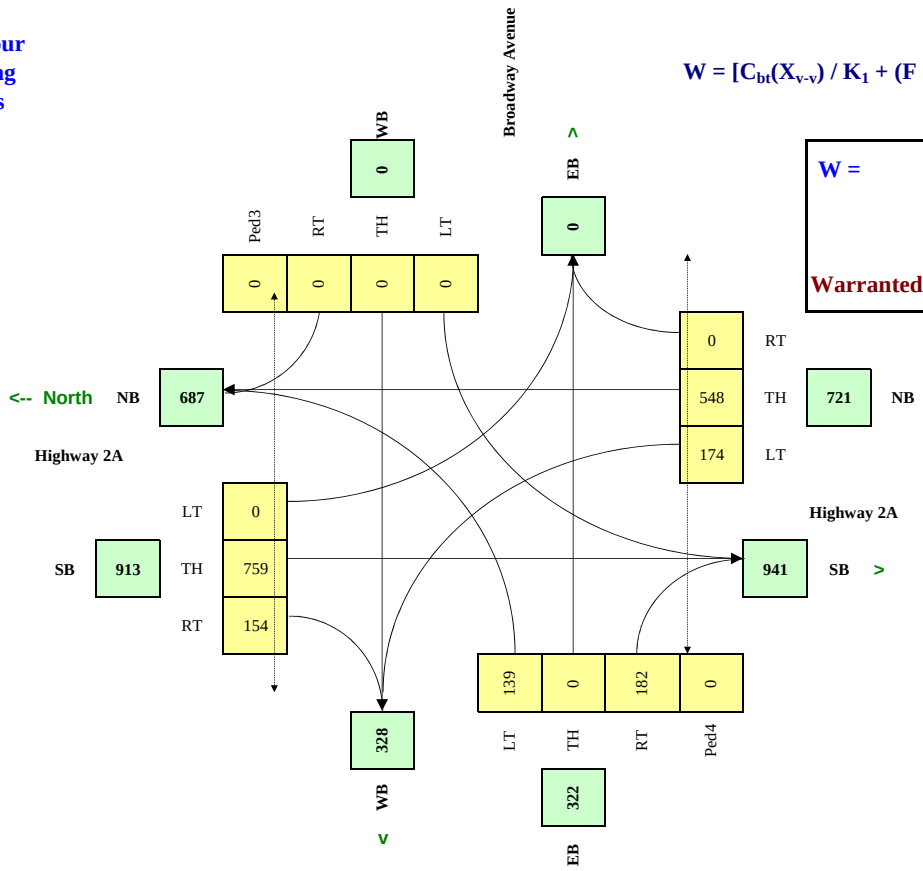
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	80	5.0%	n	
Broadway Avenue	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	96	324			1267	157				95		256				
8:00 - 9:00	72	243	0	0	950	118	0	0	0	71	0	192				
11:00 - 12:00	163	514	0	0	731	146	0	0	0	131	0	174				
12:00 - 13:00	135	424	0	0	570	118	0	0	0	108	0	138				
16:00 - 17:00	312	962			560	208				233		180				
17:00 - 18:00	265	818	0	0	476	177	0	0	0	198	0	153				
Total (6-hour peak)	**1,043**	**3,285**	**0**	**0**	**4,554**	**924**	**0**	**0**	**0**	**836**	**0**	**1,093**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**174**	**548**	**0**	**0**	**759**	**154**	**0**	**0**	**0**	**139**	**0**	**182**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

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



W =	317	317	0
		Veh	*Ped*

Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 597	Direction (EW or NS)	EW
Side Street (name)	South Access	Direction (EW or NS)	NS
Quadrant / Int #	3	Comments	3 Year Horizon Combined Traffic (2018)
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	Alberta Transportation
City:	Town of Blackfalds
Analysis Date:	2015 Apr 23, Thu
Count Date:	2015 Mar 19, Thu
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 597	WB			1		1		3,000	2
Highway 597	EB	1		2				800	2
South Access	NB								
South Access	SB				1				
							n		

Are the South Access SB right turns significantly impeded by through movements? (y/n) n

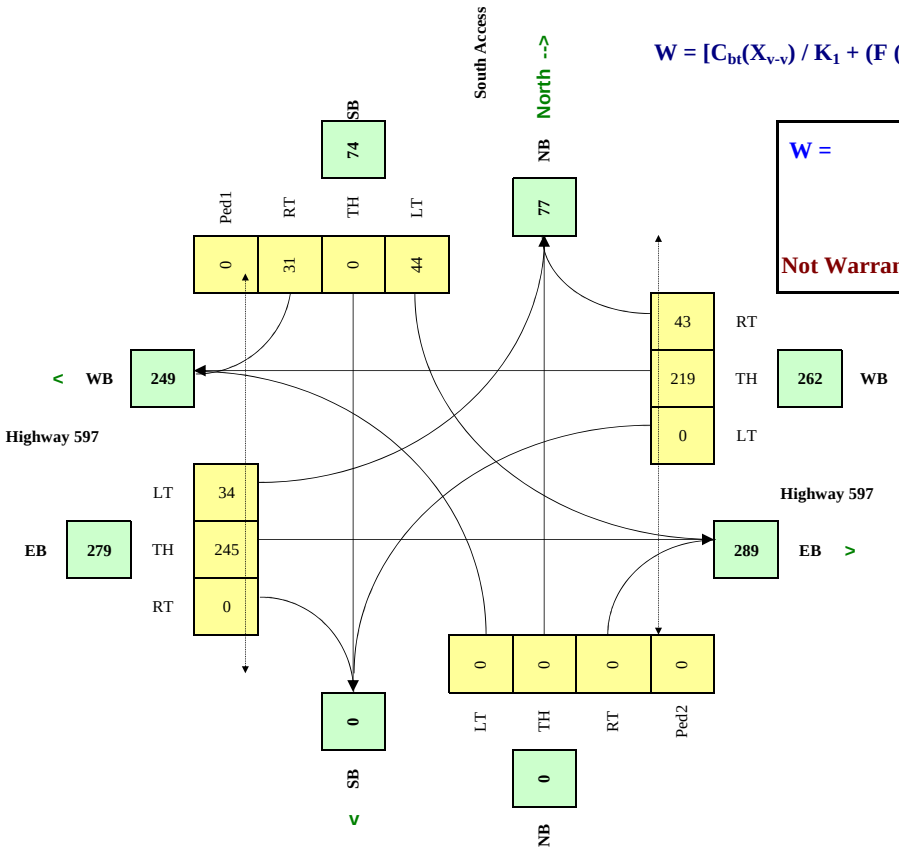
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 597	EW	80	11.0%	n	
South Access	NS		5.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0		42	0	30		231	42	30	242	0				
8:00 - 9:00	0	0	0	32	0	23	0	173	32	23	182	0				
11:00 - 12:00	0	0	0	41	0	29	0	208	41	32	232	0				
12:00 - 13:00	0	0	0	34	0	24	0	167	33	26	188	0				
16:00 - 17:00	0	0		61	0	42		288	60	49	339	0				
17:00 - 18:00	0	0	0	52	0	36	0	245	51	42	288	0				
Total (6-hour peak)	**0**	**0**	**0**	**262**	**0**	**184**	**0**	**1,312**	**259**	**202**	**1,471**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**44**	**0**	**31**	**0**	**219**	**43**	**34**	**245**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



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

W =	21	21	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 597**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**Alberta Transportation**
Side Street (name)	**South Access**	**Direction (EW or NS)**	**NS**	**City:**	**Town of Blackfalds**
Quadrant / Int #	**3**	**Comments**	**10 Year Horizon Combined Traffic (2025)**	**Analysis Date:**	**2015 Apr 23, Thu**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Count Date:**	**2015 Mar 19, Thu**
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 597	WB			1		1		3,000	2
Highway 597	EB	1		2				800	2
South Access	NB								
South Access	SB				1				
							n		

Are the South Access SB right turns significantly impeded by through movements? (y/n) n

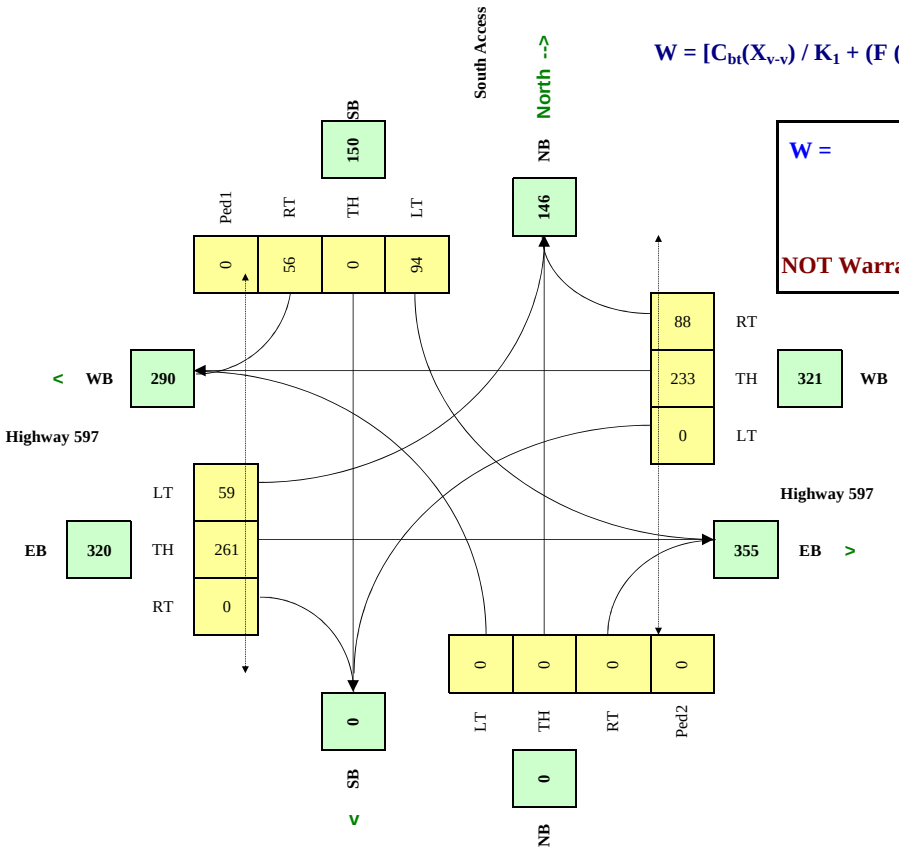
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 597	EW	80	11.0%	n	
South Access	NS		5.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1**	**Ped2**	**Ped3**	**Ped4**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**NS**	**NS**	**EW**	**EW**
													W Side	**E Side**	**N Side**	**S Side**
7:00 - 8:00	0	0		100	0	58		249	69	46	260	0				
8:00 - 9:00	0	0	0	75	0	44	0	187	52	35	195	0				
11:00 - 12:00	0	0	0	89	0	53	0	222	83	55	248	0				
12:00 - 13:00	0	0	0	72	0	43	0	178	68	45	200	0				
16:00 - 17:00	0	0		122	0	75		305	138	92	359	0				
17:00 - 18:00	0	0	0	104	0	64	0	259	117	78	305	0				
Total (6-hour peak)	**0**	**0**	**0**	**562**	**0**	**337**	**0**	**1,400**	**527**	**351**	**1,567**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**94**	**0**	**56**	**0**	**233**	**88**	**59**	**261**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



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

W =	**48**	**48**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 597	Direction (EW or NS)	EW	Road Authority:	Alberta Transportation
Side Street (name)	South Access	Direction (EW or NS)	NS	City:	Town of Blackfalds
Quadrant / Int #	3	Comments	20 Year Horizon Combined Traffic (2035)	Analysis Date:	2015 Aug 23, Sun
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2015 Mar 19, Thu
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 597	WB			1		1		3,000	2
Highway 597	EB	1		2				800	2
South Access	NB								
South Access	SB				1				
							n		

Are the South Access SB right turns significantly impeded by through movements? (y/n) n

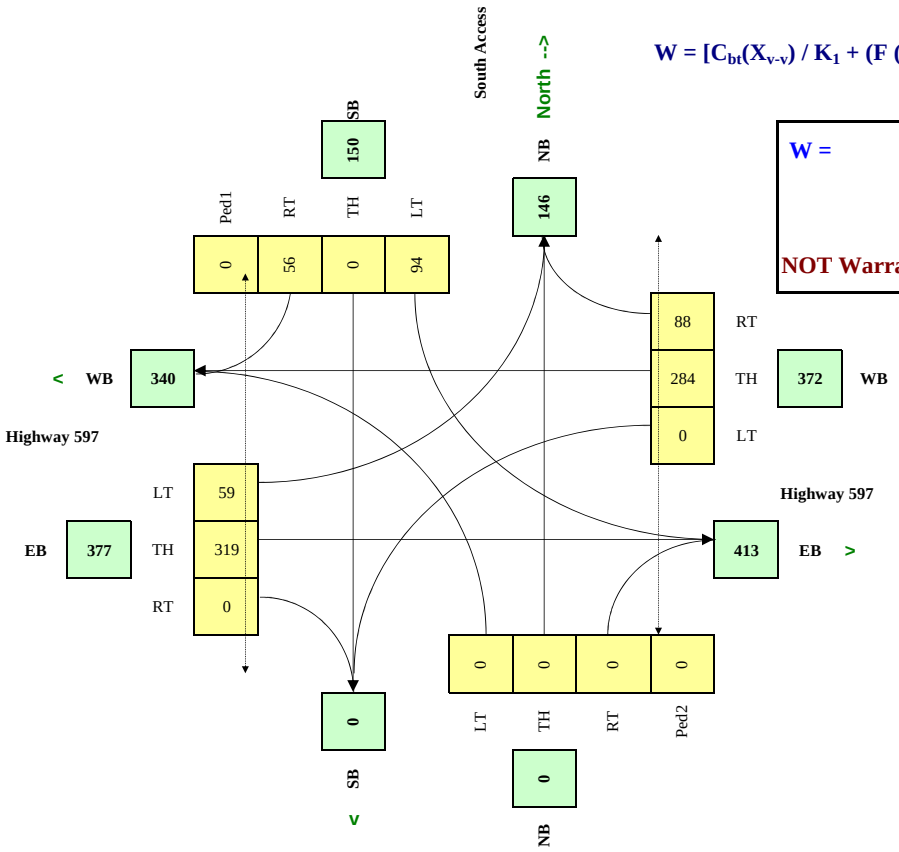
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	8,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 597	EW	80	11.0%	n	
South Access	NS		5.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0		100	0	58		304	69	46	318	0				
8:00 - 9:00	0	0	0	75	0	44	0	228	52	35	239	0				
11:00 - 12:00	0	0	0	89	0	53	0	270	83	55	302	0				
12:00 - 13:00	0	0	0	72	0	43	0	217	68	45	244	0				
16:00 - 17:00	0	0		122	0	75		371	138	92	438	0				
17:00 - 18:00	0	0	0	104	0	64	0	315	117	78	372	0				
Total (6-hour peak)	**0**	**0**	**0**	**562**	**0**	**337**	**0**	**1,705**	**527**	**351**	**1,913**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**94**	**0**	**56**	**0**	**284**	**88**	**59**	**319**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



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

W =	58	58	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Road Name	**Highway 597 / South Access**
From	**To**
Warrant Undertaken by	**James Sun**
Company Name	**WSP Canada Inc.**
Date	**22-Jun-15**

Warrant for Intersection Lighting (See Note 2)

Item No.	Classification Factor	Rating Factor 'R' 0	1	2	3	4	Weight Subcategory (if Applicable)	Weight 'W'	Enter 'R' Here	Score 'R' x 'W'	
Geometric Factors (G)											
1	Channelization	None	Right and/or Left Turn Lanes on Minor Approaches Only	Right Turn Lane(s) Only on Major Leg(s)	Left Turn Lane(s) on Major Leg(s)	Left and Right Turn Lanes on All Legs	Raised and Operating Speed Less than 70 km/h on at Least One Channelized Approach or	15			Only ONE 'R' Value is To Be Entered for These Three Rows!
							Raised and Operating Speed 70 km/h or More on at Least One Channelized Approach or	20			
							Painted Only	5	0	0	
2	Approach Sight Distances on the Most Constrained Approach (Relative to Recommended Minimum Intersection Sight Distance)	100% or More	75% to 99%	50% to 74%	25% to 49%	<25%		10	0	0	
3	Horizontal Curvatures (Radius) at or Immediately Before Intersection on Any Leg for Posted Speed Limit of:										
	110 km/hr:	Tangent	>1800 m	1150 to 1800 m	750 to 1150 m	<750 m		5	1	5	
	90 or 100 km/h:	Tangent	>1400 m	950 to 1400 m	600 to 950 m	<600 m					
	70 or 80 km/h:	Tangent	>950 m	550 to 950 m	340 to 550 m	<340 m					
	60 km/h:	Tangent	>575 m	320 to 575 m	190 to 320 m	<190 m					
4	Angle of Intersection or Offset Intersection	90 Degree Angle	80 or 100 Degree Angle	-	70 or 110 Degree Angle	<70 or >110 Degree or Offset Intersection		5	0	0	
5	Downhill Approach Grades at or Immdediately Before Intersection on Any Leg	<3.0%	3.1 to 3.9% and Meets Design Guidelines for Type and Speed of Road	4.0 to 4.9% and Meets Design Guidelines for Type and Speed of Road	5.0 to 7.0% and Meets Design Guidelines for Type and Speed of Road	>7.0% OR Exceeds Maximum Gradient for Type and Speed of Road		3	0	0	
6	Number of Legs	-	3	4	5	6 or More		3	1	3	
									Subtotal Geometric Factors	8	G
Operational Factors (O)											
If the Intersection is signalized, Illumination is Warranted If the Intersection is NOT Signalized, Points should be Calculated on the Basis of EITHER the AADT Factor or the Signalization Warrant Factor.											
7	Either AADT (2-Way) (See Note 1): On Major Road and On Minor Road or Signalization Warrant (See Note 1)	<1000 <500 Intersection Not Signalized and Volume-Based Signal Warrant is Less than 20% Satisfied	1000 to 2000 500 to 1000 Intersection Not Signalized and Volume-Based Warrant is 20% to 40% Satisfied	2000 to 3000 1000 to 1500 Intersection Not Signalized and Volume-Based Warrant is 40% to 60% Satisfied	3000 to 5000 1500 to 2000 Intersection is Not Signalized and Volume-Based Warrant is Over 80% Satisfied	>5000 >2000		10 20 30	4 4	40 80	
8	Regular Nighttime Hourly Pedestrian Volume (See Note 2)	No Pedestrians	Up to 10	10 to 30	30 to 50	Over 50		10	0	0	
9	Intersection Roadway Classifications	No Primary Road Involved	Primary/Rural Major, Primary Rural Minor, or Primary/Designated Community Access	Primary/Secondary	Primary/Primary	Intersection Includes Divided Highway		5	1	5	
10	Operating Speed or Posted Speed Limit on Major Road (See Note 3)	50 km/h or Less	60 km/h	70 km/h	80 km/h	90 km/h or Over		5	1	5	
11	Operating Speed or Posted Speed Limit on Minor Road (See Note 3)	50 km/h or Less	60 km/h	70 km/h	80 km/h	91 km/h or Over		5	0	0	
									Subtotal Operational Factors	130	O
Environmental Factors (E)											
12	Lighted Development Within 150 m Radius of Intersection	-	In One Quadrant	In Two Quadrants	In Three Quadrants	In Four Quadrants		5	2	10	
									Subtotal Environmental Factors	10	E
Collision Factors (A)											
13	Average Annual Nighttime Collision Frequency (See Note 4) or Rate of Last Three Year (Only Collisions Potentially Attributable to Inadequate Lighting)	0 Collisions per Year	1 Collision per Year	-	3 or More Colisions Per Year OR At Least 1.5 Collisions per Million Entering Vehicles per Year and an Average Ratio of All Night-to-Day Collisions of at Least 1.5		1 or 2 Collisions per Year	15	0	0	Only ONE 'R' Value is To Be Entered for These Two Rows!
							3 or More Collisions per Year or Rate ≥1.5 Collisions/MEV	30			
									Subtotal Collision Factors	0	A
									G+O+E+A = Total Warranting Points	148	
									Warranting Condition	120	
									Difference ±	28	D

Notes:

1 If the intersecition is not signalized, the user should choose EITHER the AADT OR the signalization factor. The points from either factor, but not both factors, may be used for the warrant point calculations.
2 The number of certain types of vulnerable pedestrians should be factored to reflect their increased need for visibility.
The number of child pedestrians (ages 12 and under) should be multiplied by two, and the number of senior pedestrians (age 65 and over) should be multiplied by 1.5.
3 85th percentile nightime speed should be used, if available. Otherwise the posted speed may be used.
4 Reported collisions, rounded to the nearest whole number.

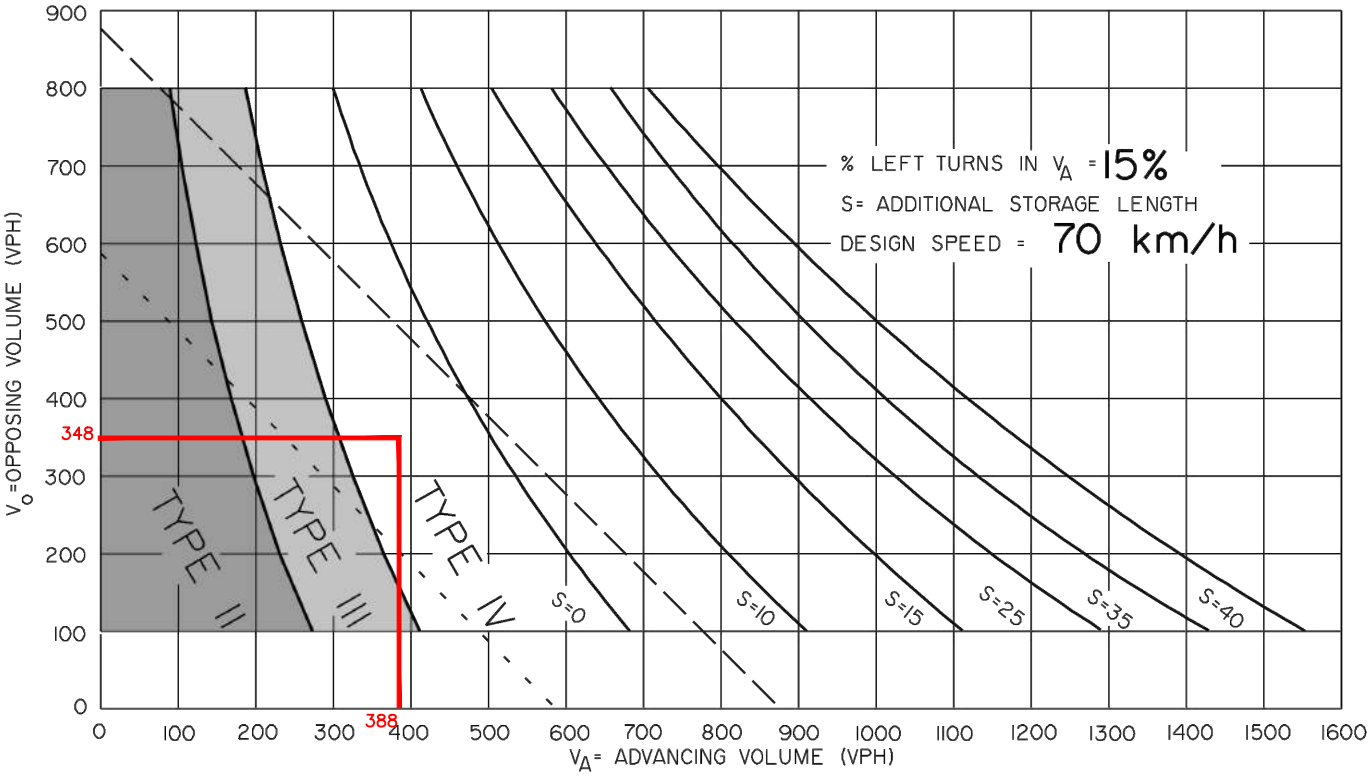
Alberta Transportation
Intersection Left Turn Lane Warrant Analysis
For Two-Lane Highways

Project Number:	**151-02471-00**
Project Name:	**Blackfalds Crossing ASP TIA**
Intersection:	**Highway 597 / South Accesws**
Roadway:	**Highway 597**
Direction:	**EB**
Time Period:	**PM Peak Hour**
Scenario:	**2018 Combined Traffic**
Design Speed:	**70 km/h**

Traffic Information:

a. Number of Left Turning Vehicles per Hour	**Vℓ = 49 vph**
b. Advancing Volume:	**Va =388 vph**
c. Proportion of Left Turns in Va	**L = Vℓ / Va =49 / 388 =13%**
d. Opposing Volume	**Vo = 348 vph**

∴ **A Left Turn Lane is Warranted (Type IV)**



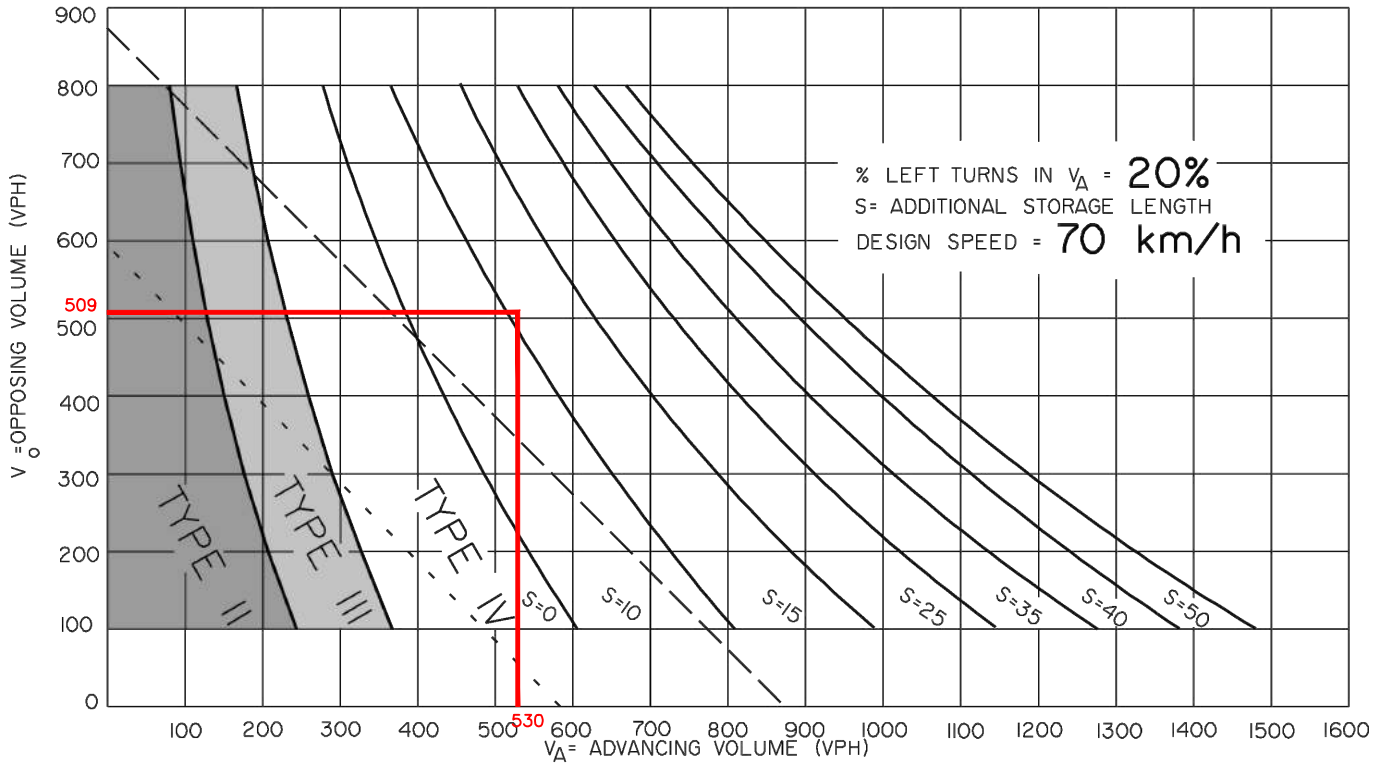
Alberta Transportation
Intersection Left Turn Lane Warrant Analysis
For Two-Lane Highways

Project Number:	**151-02471-00**
Project Name:	**Blackfalds Crossing ASP TIA**
Intersection:	**Highway 597 / South Accesws**
Roadway:	**Highway 597**
Direction:	**EB**
Time Period:	**PM Peak Hour**
Scenario:	**2035 Combined Traffic**
Design Speed:	**70 km/h**

Traffic Information:

a. Number of Left Turning Vehicles per Hour	**Vℓ = 92 vph**
b. Advancing Volume:	**Va =530 vph**
c. Proportion of Left Turns in Va	**L = Vℓ / Va =92 / 530 =17%**
d. Opposing Volume	**Vo =509 vph**

∴ **A Left Turn Lane is Warranted (Type IV)**



WSP
300, 9925 109 STREET,
EDMONTON, ALBERTA CANADA, T5K 2J8
PHONE: 780 466-6555 - FAX: 780 463-0177 - WWW.WSPGROUP.COM

CLIENT: ELKAY DEVELOPMENTS LTD.

PROJECT: BLACKFALDS DEVELOPMENT TIA

ISSUED FOR – REVISION:

IS	RE	DATE	DESCRIPTION

DISCIPLINE: CIVIL

TITLE: HWY 597 / SOUTH ACCESS PROPOSED INTERSECTION IMPROVEMENT CONCEPT PLAN

PROJECT NO: 151-02471-00

DESIGNED BY: J.SUN

DRAWN BY: J.SUN

CHECKED BY: --

SCALE: 1:1500

DATE: --

IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.

25mm

SHEET NUMBER: 151-02471-00-SO

SHEET #: SO OF --

ISSUE: REVIEW

DATE OF: JUNE 10, 2015

REV # 0

N:\151-02471-00 Blackfalds Subdivision TIA\Transportation\Roundabout Concept\151-02471-00 -1.dwg SOUTH ACCESS Nov. 23, 2016 2:41 PM - Sun, James

11" x 17" (Tabloid) Last Saved: Nov. 23, 2016 2:14 PM By: james.sun

WSP
300, 9925 109 STREET,
EDMONTON, ALBERTA CANADA, T5K 2J8
PHONE: 780 466-6555 - FAX: 780 463-0177 - WWW.WSPGROUP.COM

CLIENT: ELKAY DEVELOPMENTS LTD.

PROJECT: BLACKFALDS DEVELOPMENT TIA

ISSUED FOR – REVISION:

IS	RE	DATE	DESCRIPTION

DISCIPLINE: CIVIL

TITLE: HWY 597 / SOUTH ACCESS AT REQUESTED INTERSECTION IMPROVEMENT CONCEPT PLAN

PROJECT NO: 151-02471-00

DESIGNED BY: J.SUN

DRAWN BY: J.SUN

CHECKED BY: --

SCALE: 1:1500

DATE: --

IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.

25mm

SHEET NUMBER: 151-02471-00-SO

SHEET #: SO OF --

ISSUE: REVIEW

DATE OF: MAY 16, 2016

REV # 0

N:\151-02471-00 Blackfalds Subdivision TIA\Transportation\Roundabout Concept\151-02471-00 -2.dwg SOUTH ACCESS (3) Nov. 23, 2016 2:44 PM - Sun, James

11" x 17" (Tabloid) Last Saved: Nov. 23, 2016 2:44 PM By: james.sun

Appendix D

CAPACITY ANALYSIS

- **Synchro Outputs**
- **SIDRA Outputs**

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	2	145	37	266	1035	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	500
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	6	2	2
Mvmt Flow	2	158	40	289	1125	5

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1350	1125	1125	0	-	0
Stage 1	1125	-	-	-	-	-
Stage 2	225	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	153	249	621	-	-	-
Stage 1	309	-	-	-	-	-
Stage 2	792	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	141	249	621	-	-	-
Mov Cap-2 Maneuver	141	-	-	-	-	-
Stage 1	309	-	-	-	-	-
Stage 2	731	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	43.2	1.6	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	621	-	246	-	-
HCM Lane V/C Ratio	0.065	-	0.65	-	-
HCM Control Delay (s)	11.2	0.3	43.2	-	-
HCM Lane LOS	B	A	E	-	-
HCM 95th %tile Q(veh)	0.2	-	4	-	-

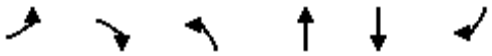
Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	2	55	145	806	476	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	500
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	3	2
Mvmt Flow	2	60	158	876	517	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1270	517	517	0	-	0
Stage 1	517	-	-	-	-	-
Stage 2	753	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	172	557	1049	-	-	-
Stage 1	598	-	-	-	-	-
Stage 2	427	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	122	557	1049	-	-	-
Mov Cap-2 Maneuver	122	-	-	-	-	-
Stage 1	598	-	-	-	-	-
Stage 2	302	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.3	2.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1049	-	495	-	-
HCM Lane V/C Ratio	0.15	-	0.125	-	-
HCM Control Delay (s)	9	1	13.3	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.5	-	0.4	-	-



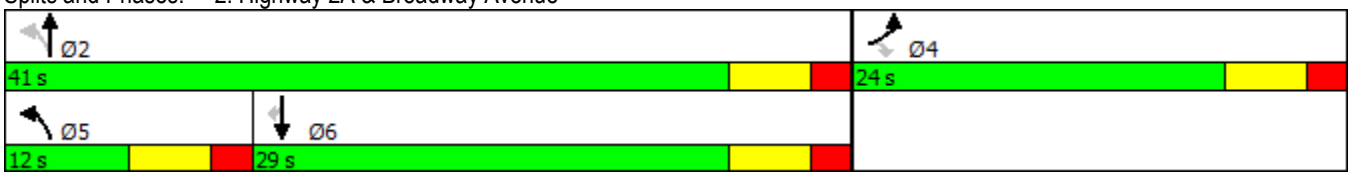
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	54	213	74	280	1088	105
Future Volume (vph)	54	213	74	280	1088	105
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	0.0	60.0			60.0
Storage Lanes	2	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3322	3484	1525
Flt Permitted	0.950		0.129			
Satd. Flow (perm)	3380	1559	237	3322	3484	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		232				114
Link Speed (k/h)	50			60	60	
Link Distance (m)	336.5			588.3	280.9	
Travel Time (s)	24.2			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	7%	2%	2%
Adj. Flow (vph)	59	232	80	304	1183	114
Shared Lane Traffic (%)						
Lane Group Flow (vph)	59	232	80	304	1183	114
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0
Minimum Split (s)	24.0	24.0	12.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	12.0	41.0	29.0	29.0
Total Split (%)	36.9%	36.9%	18.5%	63.1%	44.6%	44.6%
Maximum Green (s)	18.0	18.0	6.0	35.0	23.0	23.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Walk Time (s)	7.0	7.0		7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0
Act Effct Green (s)	7.0	7.0	31.7	31.7	25.0	25.0
Actuated g/C Ratio	0.14	0.14	0.62	0.62	0.49	0.49
v/c Ratio	0.13	0.56	0.24	0.15	0.69	0.14
Control Delay	20.8	9.5	5.8	4.3	15.2	3.3

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.8	9.5	5.8	4.3	15.2	3.3
LOS	C	A	A	A	B	A
Approach Delay	11.8			4.6	14.2	
Approach LOS	B			A	B	
Queue Length 50th (m)	2.6	0.0	2.1	4.4	47.8	0.0
Queue Length 95th (m)	6.6	14.9	6.8	10.2	#91.7	7.4
Internal Link Dist (m)	312.5			564.3	256.9	
Turn Bay Length (m)	50.0		60.0			60.0
Base Capacity (vph)	1212	707	327	2414	1710	806
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.33	0.24	0.13	0.69	0.14

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 50.9
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 12.0 Intersection LOS: B
Intersection Capacity Utilization 55.9% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 2A & Broadway Avenue



Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	242	231	42	42	30
Future Vol, veh/h	30	242	231	42	42	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	650	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	8	8	5	5	5
Mvmt Flow	33	263	251	46	46	33

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	251	0	-	0	448	126
Stage 1	-	-	-	-	251	-
Stage 2	-	-	-	-	197	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1290	-	-	-	532	891
Stage 1	-	-	-	-	759	-
Stage 2	-	-	-	-	808	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1290	-	-	-	518	891
Mov Cap-2 Maneuver	-	-	-	-	518	-
Stage 1	-	-	-	-	759	-
Stage 2	-	-	-	-	787	-

Approach	EB	WB	SB
HCM Control Delay, s	0.9	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1290	-	-	-	627
HCM Lane V/C Ratio	0.025	-	-	-	0.125
HCM Control Delay (s)	7.9	-	-	-	11.6
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

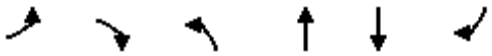
Intersection	
Int Delay, s/veh	3.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	61	5	26	1	8	1	18	12	1	1	11	165
Future Vol, veh/h	61	5	26	1	8	1	18	12	1	1	11	165
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	66	5	28	1	9	1	20	13	1	1	12	179

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	162	157	102	174	246	14	191	0	0	14	0	0
Stage 1	104	104	-	53	53	-	-	-	-	-	-	-
Stage 2	58	53	-	121	193	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	803	735	953	789	656	1066	1383	-	-	1604	-	-
Stage 1	902	809	-	960	851	-	-	-	-	-	-	-
Stage 2	954	851	-	883	741	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	784	723	953	752	646	1066	1383	-	-	1604	-	-
Mov Cap-2 Maneuver	784	723	-	752	646	-	-	-	-	-	-	-
Stage 1	888	808	-	946	838	-	-	-	-	-	-	-
Stage 2	929	838	-	850	740	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10	10.4	4.4	0
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1383	-	-	821	683	1604	-	-
HCM Lane V/C Ratio	0.014	-	-	0.122	0.016	0.001	-	-
HCM Control Delay (s)	7.6	0	-	10	10.4	7.2	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.4	0	0	-	-

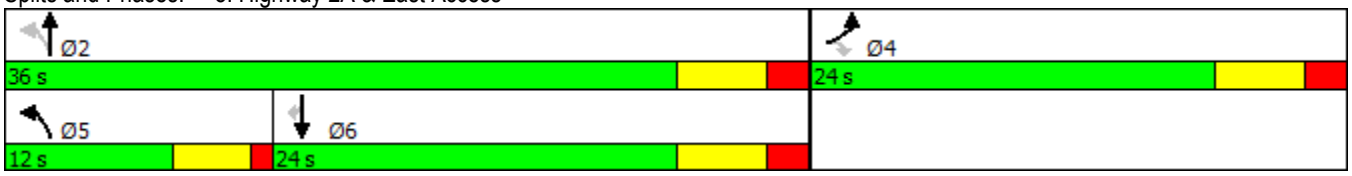


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	164	143	262	786	458	141
Future Volume (vph)	164	143	262	786	458	141
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	0.0	60.0			60.0
Storage Lanes	2	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3484	3417	1525
Flt Permitted	0.950		0.335			
Satd. Flow (perm)	3380	1559	614	3484	3417	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		155				153
Link Speed (k/h)	50			60	60	
Link Distance (m)	336.5			588.3	280.9	
Travel Time (s)	24.2			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	4%	2%
Adj. Flow (vph)	178	155	285	854	498	153
Shared Lane Traffic (%)						
Lane Group Flow (vph)	178	155	285	854	498	153
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0
Minimum Split (s)	24.0	24.0	12.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	12.0	36.0	24.0	24.0
Total Split (%)	40.0%	40.0%	20.0%	60.0%	40.0%	40.0%
Maximum Green (s)	18.0	18.0	7.5	30.0	18.0	18.0
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Walk Time (s)	7.0	7.0		7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0
Act Effct Green (s)	7.2	7.2	24.9	25.2	10.9	10.9
Actuated g/C Ratio	0.18	0.18	0.63	0.64	0.28	0.28
v/c Ratio	0.29	0.38	0.47	0.38	0.53	0.29
Control Delay	17.4	7.1	7.0	5.8	15.1	4.5

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	7.1	7.0	5.8	15.1	4.5
LOS	B	A	A	A	B	A
Approach Delay	12.6			6.1	12.6	
Approach LOS	B			A	B	
Queue Length 50th (m)	5.7	0.0	8.0	15.8	15.9	0.0
Queue Length 95th (m)	13.5	11.3	18.4	28.0	27.8	8.9
Internal Link Dist (m)	312.5			564.3	256.9	
Turn Bay Length (m)	50.0		60.0			60.0
Base Capacity (vph)	1641	836	616	2650	1660	819
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.19	0.46	0.32	0.30	0.19

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 39.3			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.53			
Intersection Signal Delay: 9.1		Intersection LOS: A	
Intersection Capacity Utilization 46.7%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 8: Highway 2A & East Access



Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	49	339	288	60	61	42
Future Vol, veh/h	49	339	288	60	61	42
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	650	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	9	11	5	5	5
Mvmt Flow	53	368	313	65	66	46

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	313	0	-	0	604	157
Stage 1	-	-	-	-	313	-
Stage 2	-	-	-	-	291	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1223	-	-	-	423	851
Stage 1	-	-	-	-	706	-
Stage 2	-	-	-	-	724	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1223	-	-	-	405	851
Mov Cap-2 Maneuver	-	-	-	-	405	-
Stage 1	-	-	-	-	706	-
Stage 2	-	-	-	-	693	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	13.9
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1223	-	-	-	515
HCM Lane V/C Ratio	0.044	-	-	-	0.217
HCM Control Delay (s)	8.1	-	-	-	13.9
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.8

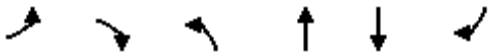
Intersection	
Int Delay, s/veh	8.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	212	10	46	1	4	1	43	17	1	1	18	63
Future Vol, veh/h	212	10	46	1	4	1	43	17	1	1	18	63
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	230	11	50	1	4	1	47	18	1	1	20	68

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	171	169	54	199	203	19	88	0	0	20	0	0
Stage 1	56	56	-	113	113	-	-	-	-	-	-	-
Stage 2	115	113	-	86	90	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	792	724	1013	760	693	1059	1508	-	-	1596	-	-
Stage 1	956	848	-	892	802	-	-	-	-	-	-	-
Stage 2	890	802	-	922	820	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	767	700	1013	696	670	1059	1508	-	-	1596	-	-
Mov Cap-2 Maneuver	767	700	-	696	670	-	-	-	-	-	-	-
Stage 1	925	847	-	863	776	-	-	-	-	-	-	-
Stage 2	856	776	-	864	819	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	12.1	10.1	5.3	0.1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1508	-	-	797	718	1596	-	-
HCM Lane V/C Ratio	0.031	-	-	0.366	0.009	0.001	-	-
HCM Control Delay (s)	7.5	0	-	12.1	10.1	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.7	0	0	-	-



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	95	256	96	324	1267	157
Future Volume (vph)	95	256	96	324	1267	157
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	0.0	60.0			60.0
Storage Lanes	2	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3322	3484	1525
Flt Permitted	0.950		0.119			
Satd. Flow (perm)	3380	1559	218	3322	3484	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		181				171
Link Speed (k/h)	50			60	60	
Link Distance (m)	336.5			588.3	280.9	
Travel Time (s)	24.2			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	7%	2%	2%
Adj. Flow (vph)	103	278	104	352	1377	171
Shared Lane Traffic (%)						
Lane Group Flow (vph)	103	278	104	352	1377	171
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	6.0	15.0	15.0	15.0
Minimum Split (s)	16.0	16.0	10.5	21.0	21.0	21.0
Total Split (s)	18.0	18.0	10.5	52.0	41.5	41.5
Total Split (%)	25.7%	25.7%	15.0%	74.3%	59.3%	59.3%
Maximum Green (s)	12.0	12.0	6.0	46.0	35.5	35.5
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Act Effct Green (s)	11.2	11.2	38.6	37.0	29.3	29.3
Actuated g/C Ratio	0.18	0.18	0.63	0.61	0.48	0.48
v/c Ratio	0.17	0.64	0.35	0.17	0.82	0.21
Control Delay	25.1	18.3	7.1	4.9	18.7	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.1	18.3	7.1	4.9	18.7	2.5
LOS	C	B	A	A	B	A

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Approach Delay	20.2			5.4	16.9	
Approach LOS	C			A	B	
Queue Length 50th (m)	5.6	10.7	3.4	7.0	67.1	0.0
Queue Length 95th (m)	12.1	#36.5	8.0	12.2	97.5	8.0
Internal Link Dist (m)	312.5			564.3	256.9	
Turn Bay Length (m)	50.0		60.0			60.0
Base Capacity (vph)	700	466	296	2517	2136	1001
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.60	0.35	0.14	0.64	0.17

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 60.8
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 15.2 Intersection LOS: B
Intersection Capacity Utilization 63.5% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 2A & Broadway Avenue

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	260	249	69	100	58
Future Vol, veh/h	46	260	249	69	100	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	650	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	8	8	5	5	5
Mvmt Flow	50	283	271	75	109	63

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	271	0	-	0	512	135
Stage 1	-	-	-	-	271	-
Stage 2	-	-	-	-	241	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1268	-	-	-	484	880
Stage 1	-	-	-	-	741	-
Stage 2	-	-	-	-	768	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1268	-	-	-	465	880
Mov Cap-2 Maneuver	-	-	-	-	465	-
Stage 1	-	-	-	-	741	-
Stage 2	-	-	-	-	738	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	14.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1268	-	-	-	562
HCM Lane V/C Ratio	0.039	-	-	-	0.306
HCM Control Delay (s)	8	-	-	-	14.2
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	1.3

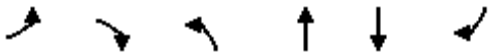
Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	61	5	38	1	8	1	31	25	1	1	17	165
Future Vol, veh/h	61	5	38	1	8	1	31	25	1	1	17	165
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	66	5	41	1	9	1	34	27	1	1	18	179

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	210	206	108	229	295	28	198	0	0	28	0	0
Stage 1	110	110	-	95	95	-	-	-	-	-	-	-
Stage 2	100	96	-	134	200	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	747	691	946	726	616	1047	1375	-	-	1585	-	-
Stage 1	895	804	-	912	816	-	-	-	-	-	-	-
Stage 2	906	815	-	869	736	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	723	673	946	676	600	1047	1375	-	-	1585	-	-
Mov Cap-2 Maneuver	723	673	-	676	600	-	-	-	-	-	-	-
Stage 1	873	803	-	889	796	-	-	-	-	-	-	-
Stage 2	873	795	-	825	735	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.3	10.8	4.2	0
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1375	-	-	788	634	1585	-	-
HCM Lane V/C Ratio	0.025	-	-	0.143	0.017	0.001	-	-
HCM Control Delay (s)	7.7	0	-	10.3	10.8	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.5	0.1	0	-	-



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	233	180	312	962	560	208
Future Volume (vph)	233	180	312	962	560	208
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	0.0	60.0			60.0
Storage Lanes	2	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3484	3417	1525
Flt Permitted	0.950		0.278			
Satd. Flow (perm)	3380	1559	510	3484	3417	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		196				226
Link Speed (k/h)	50			60	60	
Link Distance (m)	336.5			588.3	280.9	
Travel Time (s)	24.2			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	4%	2%
Adj. Flow (vph)	253	196	339	1046	609	226
Shared Lane Traffic (%)						
Lane Group Flow (vph)	253	196	339	1046	609	226
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	6.0	15.0	15.0	15.0
Minimum Split (s)	16.0	16.0	10.5	21.0	21.0	21.0
Total Split (s)	17.0	17.0	20.0	43.0	23.0	23.0
Total Split (%)	28.3%	28.3%	33.3%	71.7%	38.3%	38.3%
Maximum Green (s)	11.0	11.0	15.5	37.0	17.0	17.0
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Act Effct Green (s)	10.2	10.2	33.8	32.3	15.8	15.8
Actuated g/C Ratio	0.19	0.19	0.62	0.59	0.29	0.29
v/c Ratio	0.40	0.43	0.58	0.51	0.62	0.38
Control Delay	22.6	7.5	9.2	7.4	20.5	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.6	7.5	9.2	7.4	20.5	5.0
LOS	C	A	A	A	C	A

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Approach Delay	16.0			7.9	16.3	
Approach LOS	B			A	B	
Queue Length 50th (m)	11.2	0.0	12.9	26.6	27.1	0.0
Queue Length 95th (m)	21.8	14.1	24.6	39.8	45.2	13.0
Internal Link Dist (m)	312.5			564.3	256.9	
Turn Bay Length (m)	50.0		60.0			60.0
Base Capacity (vph)	684	471	667	2372	1069	632
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.42	0.51	0.44	0.57	0.36

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 54.6			
Natural Cycle: 55			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.62			
Intersection Signal Delay: 11.9		Intersection LOS: B	
Intersection Capacity Utilization 55.7%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 2: Highway 2A & East Access

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	92	359	305	138	122	75
Future Vol, veh/h	92	359	305	138	122	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	600	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	9	11	5	5	5
Mvmt Flow	100	390	332	150	133	82

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	332	0	-	0	727	166
Stage 1	-	-	-	-	332	-
Stage 2	-	-	-	-	395	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1203	-	-	-	353	840
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	641	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1203	-	-	-	324	840
Mov Cap-2 Maneuver	-	-	-	-	324	-
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	588	-

Approach	EB	WB	SB
HCM Control Delay, s	1.7	0	21.9
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1203	-	-	-	423
HCM Lane V/C Ratio	0.083	-	-	-	0.506
HCM Control Delay (s)	8.3	-	-	-	21.9
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.3	-	-	-	2.8

Intersection	
Int Delay, s/veh	9.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	212	10	69	1	4	1	65	32	1	1	37	63
Future Vol, veh/h	212	10	69	1	4	1	65	32	1	1	37	63
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	230	11	75	1	4	1	71	35	1	1	40	68

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	256	254	74	297	288	35	109	0	0	36	0	0
Stage 1	77	77	-	177	177	-	-	-	-	-	-	-
Stage 2	179	177	-	120	111	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	697	650	988	655	622	1038	1481	-	-	1575	-	-
Stage 1	932	831	-	825	753	-	-	-	-	-	-	-
Stage 2	823	753	-	884	804	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	666	618	988	574	591	1038	1481	-	-	1575	-	-
Mov Cap-2 Maneuver	666	618	-	574	591	-	-	-	-	-	-	-
Stage 1	886	830	-	785	716	-	-	-	-	-	-	-
Stage 2	777	716	-	805	803	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	10.7	5	0.1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1481	-	-	720	633	1575	-	-
HCM Lane V/C Ratio	0.048	-	-	0.439	0.01	0.001	-	-
HCM Control Delay (s)	7.6	0	-	13.9	10.7	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	2.2	0	0	-	-

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	95	256	96	400	1562	157
Future Volume (vph)	95	256	96	400	1562	157
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	40.0	60.0			60.0
Storage Lanes	0	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3322	3484	1525
Flt Permitted	0.950		0.089			
Satd. Flow (perm)	3380	1559	163	3322	3484	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		179				171
Link Speed (k/h)	50			60	60	
Link Distance (m)	64.5			588.3	280.9	
Travel Time (s)	4.6			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	7%	2%	2%
Adj. Flow (vph)	103	278	104	435	1698	171
Shared Lane Traffic (%)						
Lane Group Flow (vph)	103	278	104	435	1698	171
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	8.0	15.0	15.0	15.0
Minimum Split (s)	16.0	16.0	12.5	21.0	21.0	21.0
Total Split (s)	16.0	16.0	12.5	64.0	51.5	51.5
Total Split (%)	20.0%	20.0%	15.6%	80.0%	64.4%	64.4%
Maximum Green (s)	10.0	10.0	8.0	58.0	45.5	45.5
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Act Effct Green (s)	10.5	10.5	50.9	49.4	40.2	40.2
Actuated g/C Ratio	0.15	0.15	0.70	0.68	0.56	0.56
v/c Ratio	0.21	0.74	0.35	0.19	0.88	0.19
Control Delay	32.6	27.0	7.9	4.0	20.9	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.6	27.0	7.9	4.0	20.9	2.0
LOS	C	C	A	A	C	A

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Approach Delay	28.5			4.7	19.1	
Approach LOS	C			A	B	
Queue Length 50th (m)	7.4	14.3	3.4	8.9	105.1	0.0
Queue Length 95th (m)	14.3	#51.2	10.7	13.0	138.3	7.4
Internal Link Dist (m)	40.5			564.3	256.9	
Turn Bay Length (m)	50.0	40.0	60.0			60.0
Base Capacity (vph)	488	378	297	2620	2291	1061
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.74	0.35	0.17	0.74	0.16

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 72.4
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 17.6 Intersection LOS: B
Intersection Capacity Utilization 73.1% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 2A & E-W Collector Road

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	318	304	69	100	58
Future Vol, veh/h	46	318	304	69	100	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	650	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	8	8	5	5	5
Mvmt Flow	50	346	330	75	109	63

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	330	0	-	0	603	165
Stage 1	-	-	-	-	330	-
Stage 2	-	-	-	-	273	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1205	-	-	-	424	841
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	739	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1205	-	-	-	406	841
Mov Cap-2 Maneuver	-	-	-	-	406	-
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	708	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	15.9
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1205	-	-	-	501
HCM Lane V/C Ratio	0.041	-	-	-	0.343
HCM Control Delay (s)	8.1	-	-	-	15.9
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	1.5

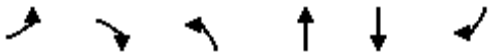
Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	61	5	38	1	8	1	31	25	1	1	17	165
Future Vol, veh/h	61	5	38	1	8	1	31	25	1	1	17	165
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	66	5	41	1	9	1	34	27	1	1	18	179

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	210	206	108	229	295	28	198	0	0	28	0	0
Stage 1	110	110	-	95	95	-	-	-	-	-	-	-
Stage 2	100	96	-	134	200	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	747	691	946	726	616	1047	1375	-	-	1585	-	-
Stage 1	895	804	-	912	816	-	-	-	-	-	-	-
Stage 2	906	815	-	869	736	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	723	673	946	676	600	1047	1375	-	-	1585	-	-
Mov Cap-2 Maneuver	723	673	-	676	600	-	-	-	-	-	-	-
Stage 1	873	803	-	889	796	-	-	-	-	-	-	-
Stage 2	873	795	-	825	735	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.3	10.8	4.2	0
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1375	-	-	788	634	1585	-	-
HCM Lane V/C Ratio	0.025	-	-	0.143	0.017	0.001	-	-
HCM Control Delay (s)	7.7	0	-	10.3	10.8	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.5	0.1	0	-	-



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	233	180	312	1201	693	208
Future Volume (vph)	233	180	312	1201	693	208
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.5
Storage Length (m)	50.0	30.0	60.0			60.0
Storage Lanes	0	1	1			1
Taper Length (m)	30.0		30.0			
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	3380	1559	1742	3484	3417	1525
Flt Permitted	0.950		0.213			
Satd. Flow (perm)	3380	1559	391	3484	3417	1525
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		196				226
Link Speed (k/h)	50			60	60	
Link Distance (m)	71.0			588.3	280.9	
Travel Time (s)	5.1			35.3	16.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	4%	2%
Adj. Flow (vph)	253	196	339	1305	753	226
Shared Lane Traffic (%)						
Lane Group Flow (vph)	253	196	339	1305	753	226
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	8.0	15.0	15.0	15.0
Minimum Split (s)	16.0	16.0	12.5	21.0	21.0	21.0
Total Split (s)	16.0	16.0	18.0	44.0	26.0	26.0
Total Split (%)	26.7%	26.7%	30.0%	73.3%	43.3%	43.3%
Maximum Green (s)	10.0	10.0	13.5	38.0	20.0	20.0
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	Min	Min	Min
Act Effct Green (s)	10.1	10.1	34.6	33.1	17.4	17.4
Actuated g/C Ratio	0.18	0.18	0.63	0.60	0.32	0.32
v/c Ratio	0.41	0.44	0.66	0.63	0.70	0.36
Control Delay	23.4	7.8	12.8	8.5	20.9	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	7.8	12.8	8.5	20.9	4.3
LOS	C	A	B	A	C	A

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Approach Delay	16.6			9.4	17.1	
Approach LOS	B			A	B	
Queue Length 50th (m)	11.7	0.0	12.9	37.2	34.5	0.0
Queue Length 95th (m)	22.3	14.4	32.4	52.1	52.8	12.0
Internal Link Dist (m)	47.0			564.3	256.9	
Turn Bay Length (m)	50.0	30.0	60.0			60.0
Base Capacity (vph)	616	444	577	2412	1245	699
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.44	0.59	0.54	0.60	0.32

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 55.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 12.9 Intersection LOS: B
Intersection Capacity Utilization 59.5% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Highway 2A & E-W Collector Road

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	92	438	371	138	122	75
Future Vol, veh/h	92	438	371	138	122	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	650	-	-	300	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	5	9	11	5	5	5
Mvmt Flow	100	476	403	150	133	82

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	403	0	-	0	841	202
Stage 1	-	-	-	-	403	-
Stage 2	-	-	-	-	438	-
Critical Hdwy	4.2	-	-	-	6.9	7
Critical Hdwy Stg 1	-	-	-	-	5.9	-
Critical Hdwy Stg 2	-	-	-	-	5.9	-
Follow-up Hdwy	2.25	-	-	-	3.55	3.35
Pot Cap-1 Maneuver	1131	-	-	-	298	796
Stage 1	-	-	-	-	635	-
Stage 2	-	-	-	-	609	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1131	-	-	-	272	796
Mov Cap-2 Maneuver	-	-	-	-	272	-
Stage 1	-	-	-	-	635	-
Stage 2	-	-	-	-	555	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	28.2
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1131	-	-	-	363
HCM Lane V/C Ratio	0.088	-	-	-	0.59
HCM Control Delay (s)	8.5	-	-	-	28.2
HCM Lane LOS	A	-	-	-	D
HCM 95th %tile Q(veh)	0.3	-	-	-	3.6

Intersection	
Int Delay, s/veh	9.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	212	10	69	1	4	1	65	32	1	1	37	63
Future Vol, veh/h	212	10	69	1	4	1	65	32	1	1	37	63
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	230	11	75	1	4	1	71	35	1	1	40	68

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	256	254	74	297	288	35	109	0	0	36	0	0
Stage 1	77	77	-	177	177	-	-	-	-	-	-	-
Stage 2	179	177	-	120	111	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	697	650	988	655	622	1038	1481	-	-	1575	-	-
Stage 1	932	831	-	825	753	-	-	-	-	-	-	-
Stage 2	823	753	-	884	804	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	666	618	988	574	591	1038	1481	-	-	1575	-	-
Mov Cap-2 Maneuver	666	618	-	574	591	-	-	-	-	-	-	-
Stage 1	886	830	-	785	716	-	-	-	-	-	-	-
Stage 2	777	716	-	805	803	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	10.7	5	0.1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1481	-	-	720	633	1575	-	-
HCM Lane V/C Ratio	0.048	-	-	0.439	0.01	0.001	-	-
HCM Control Delay (s)	7.6	0	-	13.9	10.7	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	2.2	0	0	-	-

LANE SUMMARY

Site: Highway 2A / 597 (2018 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	230	14.2	1091	0.211	100	5.2	LOS A	1.1	8.7	Full	500	0.0	0.0
Lane 2 (TR)[d]	266	9.0	1260	0.211	100	4.7	LOS A	1.1	8.6	Full	500	0.0	0.0
Approach	496	11.4		0.211		4.9	LOS A	1.1	8.7				
East: WB Highway 597													
Lane 1 (LT)	138	6.6	981	0.141	100	5.0	LOS A	0.6	4.6	Full	500	0.0	0.0
Lane 2 (TR)[d]	164	2.0	1164	0.141	100	4.3	LOS A	0.6	4.6	Full	500	0.0	0.0
Approach	302	4.1		0.141		4.6	LOS A	0.6	4.6				
North: SB Highway 2A													
Lane 1 (LT)	677	2.0	1097	0.617	100	11.5	LOS B	4.9	35.2	Full	500	0.0	0.0
Lane 2 (TR)[d]	770	2.8	1248	0.617	100	10.5	LOS B	4.9	35.3	Full	500	0.0	0.0
Approach	1447	2.4		0.617		11.0	LOS B	4.9	35.3				
West: EB Highway 597													
Lane 1 (LT)	110	6.1	469	0.234	73[5]	11.2	LOS B	1.1	8.1	Full	500	0.0	0.0
Lane 2 (TR)[d]	208	10.0	647	0.321	100	9.8	LOS A	1.7	13.2	Full	500	0.0	0.0
Approach	318	8.7		0.321		10.3	LOS B	1.7	13.2				
Intersection	2562	5.1		0.617		9.0	LOS A	4.9	35.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / 597 (2018 Combined Traffic PM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	486	4.1	989	0.492	100	9.6	LOS A	3.1	22.5	Full	500	0.0	0.0
Lane 2 (TR)[d]	568	3.3	1156	0.492	100	8.5	LOS A	3.1	22.6	Full	500	0.0	0.0
Approach	1054	3.7		0.492		9.0	LOS A	3.1	22.6				
East: WB Highway 597													
Lane 1 (LT)	148	10.8	564	0.262	100	9.9	LOS A	1.2	9.4	Full	500	0.0	0.0
Lane 2 (TR)[d]	199	8.4	759	0.262	100	7.7	LOS A	1.3	10.1	Full	500	0.0	0.0
Approach	347	9.4		0.262		8.7	LOS A	1.3	10.1				
North: SB Highway 2A													
Lane 1 (LT)	323	2.8	1030	0.313	100	6.6	LOS A	1.7	12.0	Full	500	0.0	0.0
Lane 2 (TR)[d]	361	4.9	1152	0.313	100	6.1	LOS A	1.7	12.5	Full	500	0.0	0.0
Approach	684	3.9		0.313		6.4	LOS A	1.7	12.5				
West: EB Highway 597													
Lane 1 (LT)	207	5.7	838	0.247	100	6.9	LOS A	1.2	8.7	Full	500	0.0	0.0
Lane 2 (TR)[d]	232	14.6	938	0.247	100	6.3	LOS A	1.2	9.6	Full	500	0.0	0.0
Approach	439	10.4		0.247		6.6	LOS A	1.2	9.6				
Intersection	2524	5.7		0.492		7.8	LOS A	3.1	22.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / 597 (2025 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	266	14.3	1057	0.252	100	5.8	LOS A	1.4	10.8	Full	500	0.0	0.0
Lane 2 (TR)[d]	310	9.0	1230	0.252	100	5.2	LOS A	1.4	10.7	Full	500	0.0	0.0
Approach	576	11.4		0.252		5.5	LOS A	1.4	10.8				
East: WB Highway 597													
Lane 1 (LT)	155	6.7	932	0.166	100	5.5	LOS A	0.8	5.6	Full	500	0.0	0.0
Lane 2 (TR)[d]	186	2.0	1121	0.166	100	4.7	LOS A	0.8	5.6	Full	500	0.0	0.0
Approach	341	4.1		0.166		5.0	LOS A	0.8	5.6				
North: SB Highway 2A													
Lane 1 (LT)	771	2.0	1061	0.727	100	15.5	LOS C	7.5	53.6	Full	500	0.0	0.0
Lane 2 (TR)[d]	884	2.7	1216	0.727	100	14.0	LOS B	7.6	54.4	Full	500	0.0	0.0
Approach	1655	2.4		0.727		14.7	LOS B	7.6	54.4				
West: EB Highway 597													
Lane 1 (LT)	126	6.3	385	0.327	66[5]	15.5	LOS C	1.7	12.2	Full	500	0.0	0.0
Lane 2 (TR)[d]	268	10.0	544	0.493	100	15.3	LOS C	3.2	24.3	Full	500	0.0	0.0
Approach	395	8.8		0.493		15.4	LOS C	3.2	24.3				
Intersection	2967	5.2		0.727		11.9	LOS B	7.6	54.4				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / 597 (2025 Combined Traffic PM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	609	4.5	942	0.647	100	13.8	LOS B	5.5	39.9	Full	500	0.0	0.0
Lane 2 (TR)[d]	724	3.2	1119	0.647	100	12.1	LOS B	5.6	40.6	Full	500	0.0	0.0
Approach	1333	3.8		0.647		12.9	LOS B	5.6	40.6				
East: WB Highway 597													
Lane 1 (LT)	169	10.7	440	0.384	100	15.1	LOS C	2.0	15.3	Full	500	0.0	0.0
Lane 2 (TR)[d]	239	8.5	623	0.384	100	11.2	LOS B	2.3	16.9	Full	500	0.0	0.0
Approach	408	9.4		0.384		12.8	LOS B	2.3	16.9				
North: SB Highway 2A													
Lane 1 (LT)	376	2.8	948	0.396	100	8.3	LOS A	2.2	16.0	Full	500	0.0	0.0
Lane 2 (TR)[d]	429	4.8	1082	0.396	100	7.5	LOS A	2.3	16.8	Full	500	0.0	0.0
Approach	804	3.9		0.396		7.8	LOS A	2.3	16.8				
West: EB Highway 597													
Lane 1 (LT)	248	5.6	761	0.326	100	8.6	LOS A	1.6	12.1	Full	500	0.0	0.0
Lane 2 (TR)[d]	275	18.6	843	0.326	100	7.9	LOS A	1.7	13.8	Full	500	0.0	0.0
Approach	523	12.5		0.326		8.3	LOS A	1.7	13.8				
Intersection	3067	6.0		0.647		10.8	LOS B	5.6	40.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / 597 (2035 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	313	14.1	1015	0.309	100	6.7	LOS A	1.8	14.1	Full	500	0.0	0.0
Lane 2 (TR)[d]	367	9.0	1189	0.309	100	5.9	LOS A	1.9	14.1	Full	500	0.0	0.0
Approach	680	11.4		0.309		6.3	LOS A	1.9	14.1				
East: WB Highway 597													
Lane 1 (LT)	183	6.8	871	0.210	100	6.3	LOS A	1.0	7.3	Full	500	0.0	0.0
Lane 2 (TR)[d]	224	2.0	1067	0.210	100	5.3	LOS A	1.0	7.3	Full	500	0.0	0.0
Approach	407	4.2		0.210		5.7	LOS A	1.0	7.3				
North: SB Highway 2A													
Lane 1 (LT)	891	2.0	1007	0.885	100	27.8	LOS D	14.4	102.8	Full	500	0.0	0.0
Lane 2 (TR)[d]	1032	2.7	1167	0.885	100	25.1	LOS D	14.8	106.0	Full	500	0.0	0.0
Approach	1923	2.4		0.885		26.4	LOS D	14.8	106.0				
West: EB Highway 597													
Lane 1 (LT)	145	6.3	281	0.516	69[5]	28.3	LOS D	3.0	22.1	Full	500	0.0	0.0
Lane 2 (TR)[d]	302	10.0	404	0.747	100	34.7	LOS D	6.2	46.9	Full	500	0.0	0.0
Approach	447	8.8		0.747		32.6	LOS D	6.2	46.9				
Intersection	3457	5.2		0.885		20.8	LOS C	14.8	106.0				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / 597 (2035 Combined Traffic PM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	713	4.4	875	0.815	100	23.5	LOS C	9.7	70.2	Full	500	0.0	0.0
Lane 2 (TR)[d]	860	3.2	1055	0.815	100	20.5	LOS C	10.1	72.9	Full	500	0.0	0.0
Approach	1573	3.7		0.815		21.8	LOS C	10.1	72.9				
East: WB Highway 597													
Lane 1 (LT)	195	10.5	334	0.584	100	27.8	LOS D	3.5	26.8	Full	500	0.0	0.0
Lane 2 (TR)[d]	288	8.7	493	0.584	100	20.0	LOS C	4.1	31.2	Full	500	0.0	0.0
Approach	483	9.4		0.584		23.1	LOS C	4.1	31.2				
North: SB Highway 2A													
Lane 1 (LT)	440	2.8	885	0.497	100	10.5	LOS B	3.3	23.6	Full	500	0.0	0.0
Lane 2 (TR)[d]	509	4.8	1025	0.497	100	9.4	LOS A	3.4	24.6	Full	500	0.0	0.0
Approach	949	3.9		0.497		9.9	LOS A	3.4	24.6				
West: EB Highway 597													
Lane 1 (LT)	284	5.7	669	0.425	100	11.4	LOS B	2.4	17.9	Full	500	0.0	0.0
Lane 2 (TR)[d]	326	17.5	768	0.425	100	10.2	LOS B	2.5	20.4	Full	500	0.0	0.0
Approach	610	12.0		0.425		10.8	LOS B	2.5	20.4				
Intersection	3614	5.9		0.815		17.0	LOS C	10.1	72.9				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2018 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	188	4.8	1339	0.141	100	3.8	LOS A	0.8	5.6	Full	500	0.0	0.0
Lane 2 (T)[d]	205	7.0	1456	0.141	100	3.6	LOS A	0.8	5.8	Full	500	0.0	0.0
Approach	393	6.0		0.141		3.7	LOS A	0.8	5.8				
North: SB Highway 2A													
Lane 1 (T)	623	2.0	1364	0.457	100	7.1	LOS A	3.1	22.1	Full	500	0.0	0.0
Lane 2 (TR)[d]	702	2.0	1538	0.457	100	6.6	LOS A	3.1	22.2	Full	500	0.0	0.0
Approach	1326	2.0		0.457		6.8	LOS A	3.1	22.2				
West: EB East Access													
Lane 1 (L)	60	2.0	551	0.109	100	7.9	LOS A	0.4	3.1	Full	50	0.0	0.0
Lane 2 (R)[d]	237	2.0	881	0.269	100	6.9	LOS A	1.3	9.0	Full	50	0.0	0.0
Approach	297	2.0		0.269		7.1	LOS A	1.3	9.0				
Intersection	2016	2.8		0.457		6.3	LOS A	3.1	22.2				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2018 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	552	3.4	1208	0.457	100	7.7	LOS A	3.2	23.2	Full	500	0.0	0.0
Lane 2 (T)[d]	613	5.0	1341	0.457	100	7.2	LOS A	3.3	24.0	Full	500	0.0	0.0
Approach	1164	4.3		0.457		7.5	LOS A	3.3	24.0				
North: SB Highway 2A													
Lane 1 (T)	315	2.0	1092	0.288	100	6.1	LOS A	1.7	11.9	Full	500	0.0	0.0
Lane 2 (TR)[d]	351	2.0	1216	0.288	100	5.6	LOS A	1.7	12.2	Full	500	0.0	0.0
Approach	666	2.0		0.288		5.8	LOS A	1.7	12.2				
West: EB East Access													
Lane 1 (L)[d]	182	2.0	1100	0.166	100	4.7	LOS A	0.8	5.6	Full	50	0.0	0.0
Lane 2 (R)	159	2.0	951	0.167	100	5.4	LOS A	0.8	5.5	Full	50	0.0	0.0
Approach	341	2.0		0.167		5.0	LOS A	0.8	5.6				
Intersection	2171	3.2		0.457		6.6	LOS A	3.3	24.0				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2025 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	224	4.6	1270	0.176	100	4.3	LOS A	1.0	7.2	Full	500	0.0	0.0
Lane 2 (T)[d]	243	7.0	1376	0.176	100	4.1	LOS A	1.0	7.5	Full	500	0.0	0.0
Approach	467	5.9		0.176		4.2	LOS A	1.0	7.5				
North: SB Highway 2A													
Lane 1 (T)	743	2.0	1329	0.559	100	8.9	LOS A	4.5	31.8	Full	500	0.0	0.0
Lane 2 (TR)[d]	839	2.0	1502	0.559	100	8.2	LOS A	4.5	32.1	Full	500	0.0	0.0
Approach	1582	2.0		0.559		8.5	LOS A	4.5	32.1				
West: EB East Access													
Lane 1 (L)	106	2.0	534	0.198	100	9.4	LOS A	0.9	6.1	Full	50	0.0	0.0
Lane 2 (R)[d]	284	2.0	782	0.364	100	9.0	LOS A	2.0	13.9	Full	50	0.0	0.0
Approach	390	2.0		0.364		9.1	LOS A	2.0	13.9				
Intersection	2439	2.7		0.559		7.8	LOS A	4.5	32.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2025 Combined Traffic PM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	668	3.4	1119	0.597	100	10.9	LOS B	5.0	36.1	Full	500	0.0	0.0
Lane 2 (T)[d]	748	5.0	1252	0.597	100	10.0	LOS B	5.0	36.8	Full	500	0.0	0.0
Approach	1416	4.3		0.597		10.4	LOS B	5.0	36.8				
North: SB Highway 2A													
Lane 1 (T)	401	2.0	1023	0.392	100	7.7	LOS A	2.6	18.3	Full	500	0.0	0.0
Lane 2 (TR)[d]	452	2.0	1152	0.392	100	7.1	LOS A	2.7	19.0	Full	500	0.0	0.0
Approach	853	2.0		0.392		7.4	LOS A	2.7	19.0				
West: EB East Access													
Lane 1 (L)[d]	259	2.0	1021	0.253	100	6.0	LOS A	1.3	9.3	Full	50	0.0	0.0
Lane 2 (R)	200	2.0	851	0.235	100	6.7	LOS A	1.1	8.1	Full	50	0.0	0.0
Approach	459	2.0		0.253		6.3	LOS A	1.3	9.3				
Intersection	2728	3.2		0.597		8.8	LOS A	5.0	36.8				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2035 Combined Traffic AM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	264	5.0	1268	0.208	100	4.6	LOS A	1.2	9.0	Full	500	0.0	0.0
Lane 2 (T)[d]	287	7.0	1382	0.208	100	4.3	LOS A	1.3	9.3	Full	500	0.0	0.0
Approach	551	6.0		0.208		4.5	LOS A	1.3	9.3				
North: SB Highway 2A													
Lane 1 (T)	895	2.0	1333	0.671	100	11.4	LOS B	6.6	46.8	Full	500	0.0	0.0
Lane 2 (TR)[d]	1015	2.0	1513	0.671	100	10.4	LOS B	6.6	47.0	Full	500	0.0	0.0
Approach	1910	2.0		0.671		10.9	LOS B	6.6	47.0				
West: EB East Access													
Lane 1 (L)	106	2.0	455	0.232	100	11.4	LOS B	1.1	7.6	Full	50	0.0	0.0
Lane 2 (R)[d]	284	2.0	664	0.428	100	11.6	LOS B	2.6	18.3	Full	50	0.0	0.0
Approach	390	2.0		0.428		11.5	LOS B	2.6	18.3				
Intersection	2851	2.8		0.671		9.7	LOS A	6.6	47.0				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Highway 2A / East Access (2035 Combined Traffic PM Peak)

EF: 1.1
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NB Highway 2A													
Lane 1 (LT)	791	3.7	1115	0.709	100	14.2	LOS B	8.0	57.8	Full	500	0.0	0.0
Lane 2 (T)[d]	890	5.0	1255	0.709	100	13.1	LOS B	8.0	58.3	Full	500	0.0	0.0
Approach	1681	4.4		0.709		13.6	LOS B	8.0	58.3				
North: SB Highway 2A													
Lane 1 (T)	470	2.0	1014	0.463	100	8.9	LOS A	3.3	23.5	Full	500	0.0	0.0
Lane 2 (TR)[d]	531	2.0	1146	0.463	100	8.1	LOS A	3.4	24.5	Full	500	0.0	0.0
Approach	1001	2.0		0.463		8.5	LOS A	3.4	24.5				
West: EB East Access													
Lane 1 (L)[d]	259	2.0	940	0.275	100	6.7	LOS A	1.4	10.3	Full	50	0.0	0.0
Lane 2 (R)	200	2.0	765	0.261	100	7.7	LOS A	1.3	9.1	Full	50	0.0	0.0
Approach	459	2.0		0.275		7.1	LOS A	1.4	10.3				
Intersection	3141	3.3		0.709		11.0	LOS B	8.0	58.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach