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From: Nick Ryan, Parsons

Date: April 25, 2017 – v3
March 14, 2017 – v2
February 27, 2017 – v1

Project #: 602534

RE: Short-Term Option Recommendation

Glenmore Trail East Study – Junction of 100 St SE and Glenmore Trail

1.0 INTRODUCTION

This technical memorandum is intended to provide a brief description of the basis of design, traffic modelling, and estimate for the short-term solution at the intersection of Glenmore Trail and 100 St SE. Parsons brief was for the development of a cost effective, short-term solution with a design life of ten years, through to 2028.

It is important to note, the design was only developed to a Functional Plan standard. Additional detail was only developed to provide the project team with cost and design assurity, and allow an informed decision to progress to a preliminary design phase. Preliminary design is outside of Parsons scope of services for this project.

2.0 STUDY AREA

The study area is located on Highway 560 (Glenmore Trail), southeast of Calgary, Alberta about 15km west of the hamlet of Langdon. The study area consists of the Glenmore Trail and 100 St SE intersection, outlined in Figure 2-1.

Figure 2-1 - Study Area



3.0 SHORT-TERM DESIGN DEVELOPMENT

The philosophy used to develop a cost-effective solution was to create an at-grade intersection, through utilizing existing infrastructure (pavement and medians) while minimizing impacts to utilities and property acquisitions.

The initial concepts were tested for performance through traffic simulation for the horizon year 2028 and iteratively optimized, as detailed hereafter.

3.1 GEOMETRIC DESIGN

3.1.1 DESIGN CRITERIA

Design criteria for the ultimate functional design was prepared and approved for use in the form of a technical memorandum, refer to Attachment 1 -Design Criteria (Revision 1), October 5, 2016. Although the purpose of this technical memorandum was for ultimate build out, where possible the document formed the basis of development for the short-term solution.

Where standards became impractical for the road environment, the following sources of information were used to develop a lower speed short-term solution:

- City of Calgary - Design Guidelines for Subdivision Servicing, (2012)
- Transportation Association of Canada (TAC) Geometric Design Guide, (1999)
- Alberta Transportation: Highway Geometric Design Guide, (1999)

The following criteria were agreed to be used as the basis for the development the short-term solution:

- Design Speed – Glenmore 90km/hr and 100 St. 60 km/hr.
- Design Vehicle - WB-36 - used to check all turning movements with the exception of dual left turns: WB-36 inside and SU9 on the outside movement.

3.1.2 DEVELOPMENT OF SHORT TERM SOLUTION

An intersection plan and typical cross sections showing the recommended short-term solution can be found in Attachment 2, and summarized below.

Intersection Improvements

Northbound

- Additional left turn lane added for a total of two left turn lanes, protected by a raised central median. Development of dual left turn lanes delineated by line marking to utilize existing pavement, limits the extents of central median construction, and provide overflow left turn storage;

Eastbound

- No change to existing left turn lane. Maintain existing curb line to avoid construction to the central median;
- Additional through lane;
- Improved right turn slip-lane, with increased deceleration and diverge taper;
- Increased taper (longer acceleration length) for merging traffic from northbound 100 St.;

Southbound

- Added dedicated protected left turn lane;
- Added protected right turn slip-lane;

Westbound

- No change to existing left turn lane. Maintain existing curb line to avoid construction to the central median
- Additional through lane;
- Improved right turn with increased deceleration and diverge taper. The design purposely does not provide a protected right turn to avoid having to acquire land; and
- Increased acceleration lane for merging traffic from southbound 100 St.

Horizontal / Vertical Alignment, Crossfall and Drainage

No changes to the horizontal alignment, with the exception of development of traffic lanes designed in accordance with previously listed standards.

It was assumed the existing pavement was of good condition and could meet the specified design life of ten years. All pavement widenings assumed an extension of the existing crossfall and was checked against standards listed in the design criteria. Therefore, no changes to the vertical alignment were required.

The proposed short-term solution has no overall impacts to the existing drainage system. In the locations of pavement widenings, longitudinal drainage was maintained.

3.2 TRAFFIC MODELING

Various operational models were developed in Synchro/SimTraffic simulation software to analyze existing conditions and develop options for future.

3.2.1 BACKGROUND DATA

Vehicle turning movement counts and truck survey were carried out on Tuesday 30 August, 2016 by the City of Calgary during the hours of 07:00 to 09:00 and 16:00 to 18:00. The observed peak hours for AM and PM were 07:00 to 08:00 and 16:00 to 17:00 respectively. Figure 3-1 and Figure 3-2 show the existing traffic volumes and truck percentages for AM and PM hours.

Figure 3-1 - All vehicle volumes - August 2016

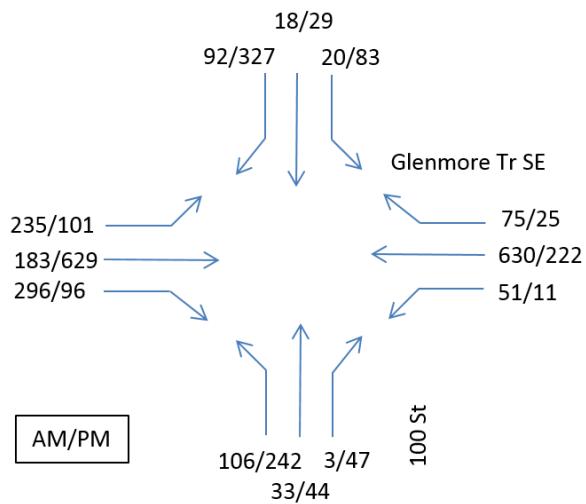
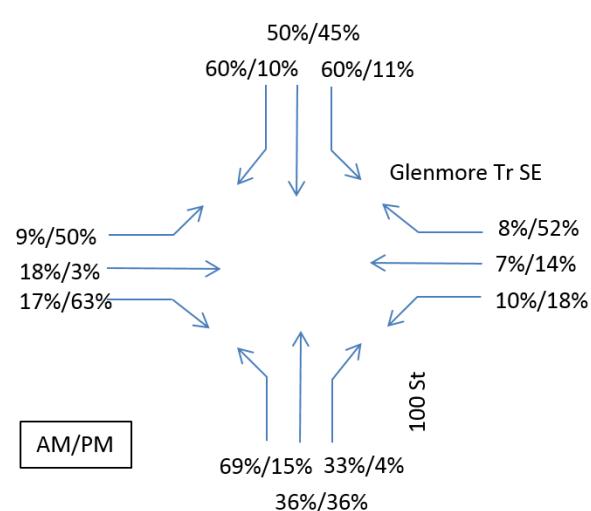


Figure 3-2 - Heavy Vehicle Percentages – August 2016



In order to identify potential improvements that will continue to address needs into future, traffic volumes were forecasted to the 2028 horizon year. The City of Calgary model forecasts for 2015 and 2028 were used to derive 2028 horizon year volumes. The difference between these volumes (2015 and 2028) were added to the August 2016 observed volumes. A sensitivity analysis was also carried out by increasing the forecasted volumes by 20%. The 2028 forecast volumes and 2028 sensitivity analysis volumes are shown in Figure 3-4 and Figure 3-3 respectively.

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Figure 3-4 - All Vehicle Volumes – 2028 Forecast

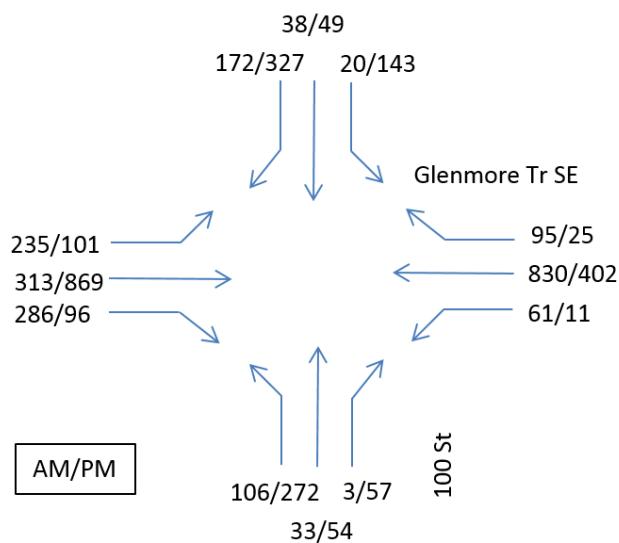
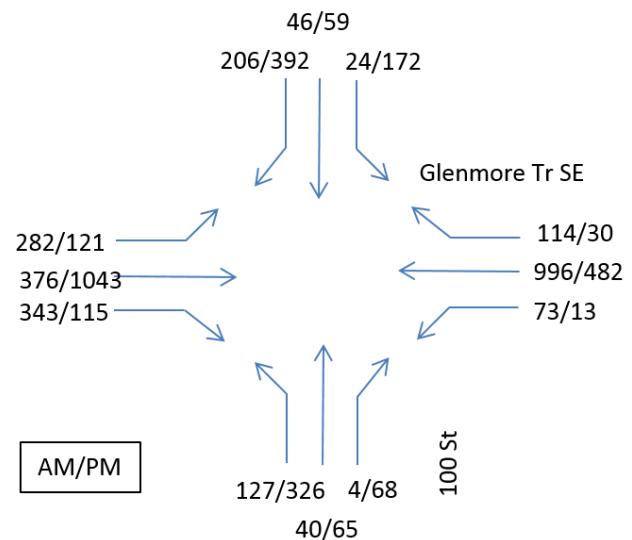


Figure 3-3 - All Vehicle Volumes – 2028 Sensitivity Assessment, Volumes+20%



3.2.2 DEVELOPMENT OF THE TRAFFIC OPERATIONS MODEL AND RESULTS

Synchro (version 8.0) capacity analysis software was used to create operational models to estimate the delay per vehicle, level of service (LoS), and volume to capacity (v/c) ratios. These calculations were generated for the existing 2016 condition, forecasted 2028 and 2028 sensitivity traffic volumes. Queuing at signalized intersections was assessed using SimTraffic with a 10-minute seeding interval, 60-minute recording interval, and three runs for statistical randomness.

An operational model was developed for determining impacts of existing geometric conditions in existing conditions year and in the future horizon year 2028. The signal timings were optimized to include operational changes that could be made to improve efficiency. Table 3.2.2-1 and Table 3.2.2-2 shows the analysis results for AM and PM from this operation model for existing year (August 2016) and horizon year (2028).

Table 3.2.2-1 - Synchro Analysis Summary, Existing (August 2016) AM and PM Peak Hours – Existing Geometry Conditions

AM					PM				
MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS	MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS
EBL	65	72	0.91	E	EBL	15	38	0.33	B
EBT	13	36	0.22	B	EBT	32	104	0.84	C
EBR	3	30	0.35	A	EBR	2	22	0.20	A
WBL	10	108	0.10	B	WBL	12	10	0.06	B
WBT	54	393	0.95	D	WBT	28	62	0.54	C
WBR	54	393	0.95	D	WBR	28	63	0.54	C
NBL	84	75	0.82	F	NBL	25	63	0.60	C
NBT	35	20	0.10	C	NBT	16	19	0.08	B
NBR	0	8	0.10	A	NBR	0	13	0.07	A
SBL	61	61	0.40	E	SBL	36	102	0.49	D
SBT	61	61	0.40	E	SBT	36	102	0.49	D
SBR	5	33	0.37	A	SBR	9	31	0.61	A
Intersection	40		0.95	D	Intersection	23		0.84	C

Table 3.2.2-2 - Synchro Analysis Summary, 2028 AM and PM Peak Hours – Existing Geometry Conditions

AM					PM				
MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS	MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS
EBL	105	113	1.01	F	EBL	16	185	0.38	B
EBT	12	57	0.32	B	EBT	51	494	0.97	D
EBR	2	28	0.30	A	EBR	4	189	0.18	A
WBL	9	168	0.12	A	WBL	12	9	0.09	B
WBT	71	1281	1.04	E	WBT	29	101	0.64	C
WBR	71	1281	1.04	E	WBR	29	101	0.64	C
NBL	171	108	1.10	F	NBL	73	95	0.94	E
NBT	49	96	0.13	D	NBT	28	40	0.12	C

NBR	0	5	0.01	A	NBR	7	23	0.11	A
SBL	117	507	0.77	F	SBL	96	713	0.95	F
SBT	117	507	0.77	F	SBT	96	713	0.95	F
SBR	23	35	0.70	C	SBR	30	31	0.78	C
Intersection	57		1.10	F	Intersection	45		0.97	D

As shown in the Table 3.2.2-1 and Table 3.2.2-2, the intersection is failing for both, existing (August 2016) and 2028 conditions. In EB and WB directions, v/c ratios and LoS are over acceptable conditions in existing AM and 2028 AM and PM peak hours. Even SB left and through is failing in existing AM and 2028 AM and PM peak hours. Improving capacity should solve most problems. EB and WB volumes are under 1,000 and one lane is enough for free flow. However, at controlled intersection, either additional green time should be provided or an additional lane should be provided to process more vehicles. Since, vehicle volumes are higher in both directions during both peak hours; it is advisable to add an additional lane for EB through and WB through direction. EB left volumes and NB left volumes are very high which can be addressed by providing an exclusive LT bay with protected phasing. Two (2) NB left turning lanes are required to process these volumes with lesser availability of green time. There is only one shared lane in the SB direction for through and left turning vehicles. This can be solved by providing a left turn bay with protected phasing.

Another operational model was created for an at-grade intersection with above-mentioned geometric and signal timing/phasing changes so that the intersection would operate at acceptable LoS, v/c, delays and queues. Table 3.2.2-3 to 5 shows the analysis results for AM and PM from this operation model.

Table 3.2.2-3: Synchro Analysis Summary (Existing AM and PM Peak Hours) – With Option

MOVEMENT	DELAY (S)	AM			MOVEMENT	DELAY (S)	PM		
		QUEUE (95TH) (M)	V/C	LOS			QUEUE (95TH) (M)	V/C	LOS
EBL	19	46	0.62	B	EBL	14	34	0.30	B
EBT	15	22	0.13	B	EBT	16	37	0.45	B
EBR	4	17	0.38	A	EBR	2	5	0.20	A
WBL	8	14	0.10	A	WBL	11	11	0.04	B
WBT	20	50	0.57	B	WBT	21	24	0.25	C
WBR	0	19	0.12	A	WBR	0	16	0.06	A
NBL	48	36	0.63	D	NBL	37	36	0.62	D
NBT	20	22	0.09	B	NBT	27	27	0.15	C
NBR	0	22	0.01	A	NBR	0	27	0.10	A
SBL	17	21	0.10	B	SBL	17	25	0.23	B
SBT	24	17	0.09	C	SBT	28	23	0.15	C
SBR	2	17	0.29	A	SBR	10	23	0.66	B
Intersection	16		0.63	B	Intersection	17		0.66	B

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Table 3.2.2-4: Synchro Analysis Summary (2028 Forecasted AM and PM Peak Hours) – With Option

AM					PM				
MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS	MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS
EBL	33	47	0.76	C	EBL	15	37	0.37	B
EBT	15	25	0.22	B	EBT	18	50	0.63	B
EBR	4	15	0.37	A	EBR	1	4	0.19	A
WBL	9	19	0.13	A	WBL	10	10	0.05	A
WBT	25	64	0.75	C	WBT	19	35	0.42	B
WBR	1	20	0.15	A	WBR	0	16	0.05	A
NBL	49	40	0.64	D	NBL	42	38	0.75	D
NBT	20	23	0.09	C	NBT	25	32	0.19	C
NBR	0	23	0.01	A	NBR	1	32	0.12	A
SBL	17	25	0.10	B	SBL	19	39	0.41	B
SBT	26	24	0.18	C	SBT	27	27	0.25	C
SBR	9	24	0.52	A	SBR	15	27	0.71	B
Intersection	20		0.76	B	Intersection	19		0.75	B

Table 3.2.2-5: Synchro Analysis Summary (2028 20% Sensitivity AM and PM Peak Hours) – With Option

AM					PM				
MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS	MOVEMENT	DELAY (S)	QUEUE (95TH) (M)	V/C	LOS
EBL	51	66	0.90	D	EBL	19	42	0.47	B
EBT	16	36	0.29	B	EBT	24	61	0.77	C
EBR	4	29	0.44	A	EBR	3	8	0.24	A
WBL	10	21	0.18	B	WBL	13	10	0.08	B
WBT	38	89	0.90	D	WBT	26	47	0.57	C
WBR	1	22	0.18	A	WBR	0	18	0.08	A
NBL	54	43	0.66	D	NBL	52	47	0.83	D
NBT	29	26	0.13	C	NBT	28	33	0.20	C
NBR	0	26	0.01	A	NBR	1	33	0.14	A
SBL	25	26	0.15	C	SBL	20	51	0.42	B
SBT	39	30	0.31	D	SBT	29	33	0.25	C
SBR	16	30	0.68	B	SBR	40	33	0.90	D
Intersection	28		0.90	C	Intersection	28		0.90	C

As shown in the previous three tables, the improved configuration will operate at an acceptable LoS, v/c, delays and queues, for both 2016 and 2028 horizon year. For the 2028 sensitivity analysis, LoS, delays and queues will be acceptable and the v/c ratios for the WBT in AM and EBT in PM movements will be not greater than 0.9.

3.3 PROPERTY REQUIREMENTS

The design attempted to avoid property acquisitions while maintaining an acceptable traffic functionality for the 2028 design year. A combination of traffic volumes and a high percentage of turning vehicles resulted in the addition of through and turning traffic lanes. The resulting increase in road surface area, in particular heavy vehicle turning movements, pushed the right-of-way requirements in to adjoining properties. As shown in Attachment 3 – Property Requirements Plan, small partial acquisitions are required in each quadrant surrounding the intersection.

For the purposes of determining the required extents of the right-of-way, a typical section of 5m wide was applied to the outside the limits of pavement. The cross section assumed desirable widths and crossfalls to accommodate future drainage and utility designs. Further design detail may allow for refinement and avoid the property acquisitions as listed below.

Northwest Quadrant - NW

The addition of the right turn slip lane requires property from the electrical utility right-of-way. It is unlikely further design will totally eliminate property requirements.

Future consideration must be given to the edge of pavement and proximity to the utility structure. Physical protection may be required.

Northeast Quadrant - NE

The protection of the left turn lane has required the northbound departure lane to moved to the east to accommodate a raised central median. It is likely the acquisition could be avoided by reducing the median and/or a design exception to design to minimum criteria.

An alignment shift of both north and southbound lanes to either the east or west could limit the acquisition to one side of the road i.e. either impacting the utility right-of-way or the Heatherglen Golf Course.

Southeast Quadrant - SE

With the addition of a compliant right turn taper, the right-of-way requirement encroaches the adjacent property by 2.1m. Either the removal of the right turn taper or an design exception should avoid the need for this acquisition.

Southwest Quadrant - SW

Similar to the northeast quadrant, the land acquisition could be avoided with either a reduction in the median or a design exception to allow minimum elements.

The short-term solution was developed in the need to address an immediate need. Although separate from the ultimate functional plan, the land requirements of the short-term option fall well within the ultimate land requirements. Before adoption of the suggestions listed above, consideration should be given to adopting the ultimate plan right-of-way boundaries. This would avoid the need for two land purchases and having to accept a less than desirable design.

3.4 COST ESTIMATE

3.4.1 SCOPE OF ESTIMATE

The high level cost estimate considers the pavement on existing travel lanes to be utilized. The pavement will be widened on both edges of roadway maintaining the existing crossfall. It assumes mill and inlay for the

surfacing course on the existing travel lanes and removal / reconstruction of the existing pavement on the shoulders. Pavement will be extending outward as required for the road widening.

On Glenmore Trail the existing concrete median will be utilized with some modifications at the intersection while new concrete medians will be installed on the 100 St SE. The existing concrete islands in the intersection will be removed and reconstructed as per the design.

3.4.2 EXCLUSIONS FROM ESTIMATE

The cost of the following was not included in the estimate:

- Site restoration beyond the works defined in the applicable cross sections;
- Landscaping in addition to restoration of the identifiable works;
- Road maintenance; and
- Utility investigation has not been completed and assumes no impact due to this project.

3.4.3 METHODOLOGY

The high level cost estimate was developed using the following basis:

- The costs for the major items of the project such as asphalt pavement, base, sub base, earthworks and concrete works are estimated on unit costs method;
- The quantities are estimated based on the functional level design that include an intersection plan and typical cross-sections;
- Lump sum cost are assigned for several other items such as traffic signal, landscaping works, erosion and sediment control, pavement marking, signage, traffic control etc.;
- Unit costs used are based on Parsons database of recent construction projects within the Calgary area;
- Cost per item in the estimate has been multiplied by each quantity to obtain the total cost of the item;
- The quantity estimate calculations were built in Excel software program;
- A contingency of 30% consistent to the level of the design; and
- 10% has been allowed for mobilization.

4.0 RECOMMENDATIONS

The proposed short-term solution meets the functional requirements for a 10-year design life. It is recommended any future design should be developed to a preliminary design standard and address the following items:

- Geotechnical investigation to determine condition and life existing pavement;
- Detail topographic survey to determine accurate levels, drainage paths and utility locations including traffic signalling equipment;
- Detailed 3D design to confirm crossfall extensions and drainage impacts; and
- Investigation the feasibility of design exceptions to avoid property acquisitions or adopting the ultimate right-of-way boundary.

5.0 ATTACHMENTS

Attachment 1 - Design Criteria

Attachment 2 - Intersection Plan and Typical Cross Sections

Attachment 3 - Property Requirements

Attachment 4 - Cost Estimate

Attachment 5 – Synchro Outputs

Attachment 6 – Vehicle Turning Diagrams

To: Lei Ma, City of Calgary – TP
Jerry Lau, Alberta Transportation
Gurbir Nijjar, Rocky View County

Copy: Stephen Power, Parsons
Chris Delanoy, ISL
Cory Wilson, McElhanney

From: Nick Ryan, Parsons
David Breu, ISL

Date: March 14, 2017

Project #: 602534

RE: Design Criteria (Revision 2)

Glenmore Trail East Study – 100 St SE to Conrich Road

1.0 BACKGROUND

1.1 GLENMORE TRAIL SE (GLENMORE TR)

Alberta Transportation (AT) ultimately designates Glenmore Tr as a six lane divided freeway. This type of road provides free flow movement of vehicular traffic at high operating speeds over long distances. Facilities for walking and cycling are not recommended within the Right-of-Way (ROW) of this type of road.

The following references were used to develop the Design Criteria for Glenmore Trail:

- Alberta Transportation – Highway Geometric Design Guide (HGDG) – 1999
- Alberta Transportation & City of Calgary – Ring Road and Highway Penetrators Agreement (RRHPA) – October 30, 1991

1.2 100 STREET SE (100 ST) AND CONRICH ROAD (CONRICH RD)

100 St and Conrich Rd will be 4-lane divided Arterial Streets and cross between The City of Calgary (The City) and Rocky View County (RVC). This type of road is one of the most common urban roads and provides a reasonably direct connection between major destinations. Pedestrian and Cyclist facilities are recommended to be integrated into the overall design.

The following references were used to develop the Design Criteria for 100 Street:

- Shepard Area Structure Plan
- Janet Area Structure Plan
- AT - HGDG Urban Supplement (DRAFT) – 2003
- RVC - County Servicing Standards – 2013
- The City - Complete Streets Policy – 2014
- - Design Guidelines for Subdivision Servicing (DGSS) – Section II – 2015

For the south side of Glenmore Tr, the Shepard Industrial Park – Functional Planning Study, 2009 (Shepard FPS) was used to determine the classification of these roadways and the base for determining the cross

sectional elements. It is recommended for both of these roadways to have a design speed of 60 km/h and a posted speed of 60 km/h

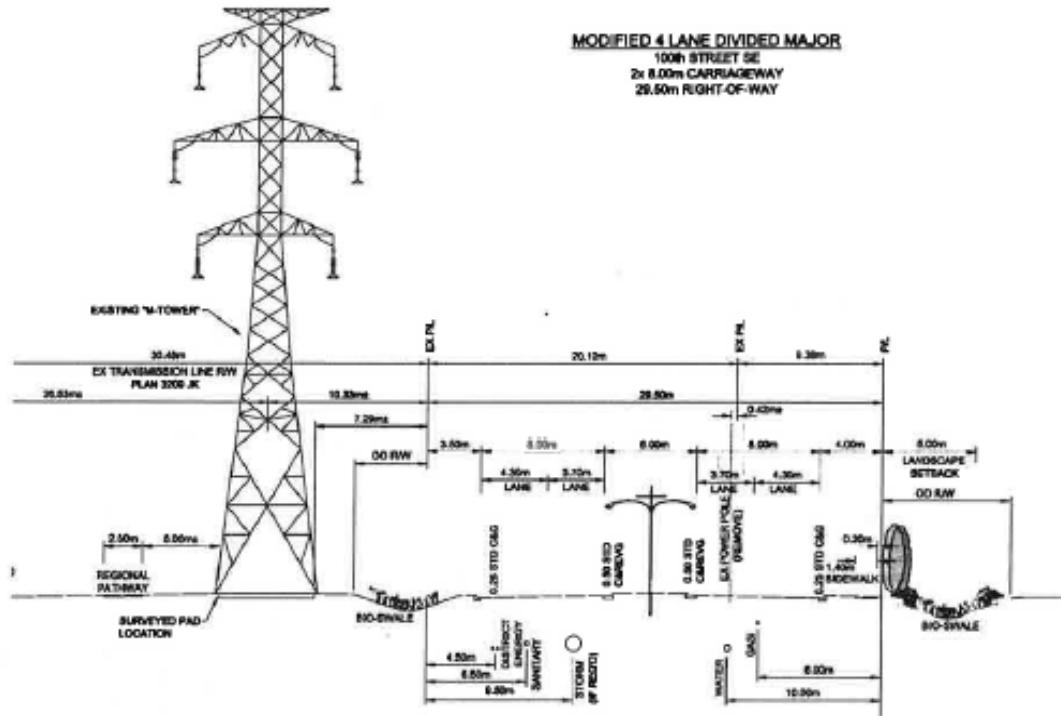


Figure 1 – 100 St Cross Section from Shepard FPS

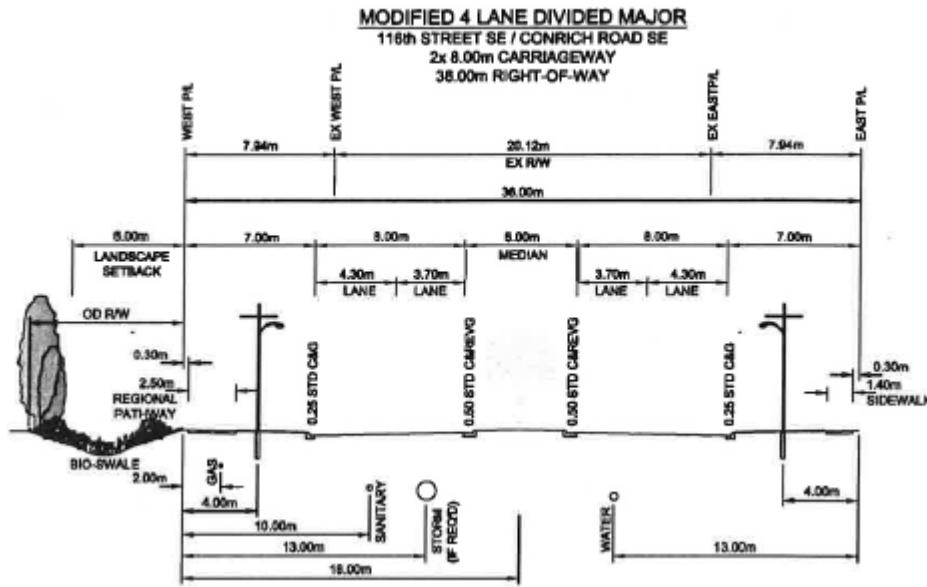


Figure 2 – Conrich Rd Cross Section from Shepard FPS

For the north side of Glenmore Tr, the Southeast Industrial Corridor Growth Area Plan – Transportation Study (Southeast CTS) was used to determine the classification of these roadways and the base for developing the cross sections.

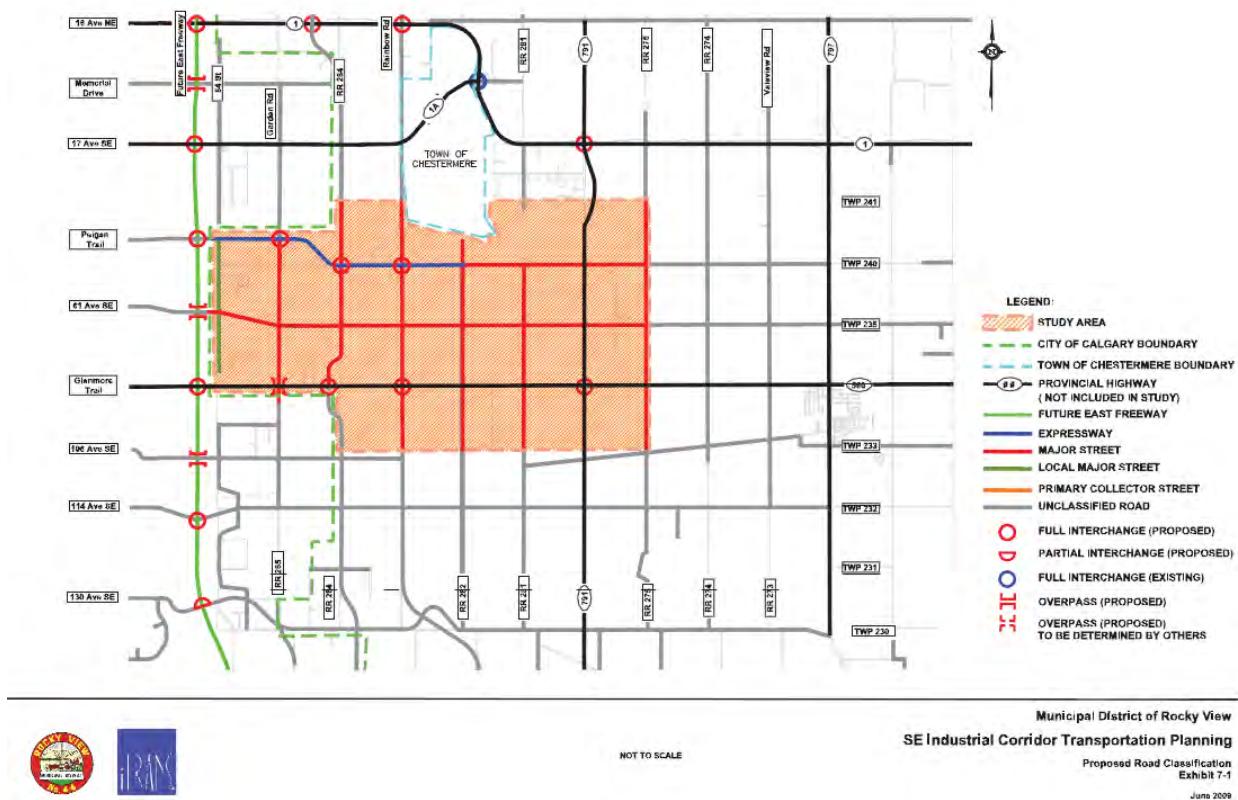


Figure 3 – Southeast CTS Roadway Classification Map

As per the above figure, both 100 St and Conrich Rd are recommended to be Divided Streets within RVC. Therefore, it is recommended that consistent design criteria be used for each road, both north and south of Glenmore Tr, within the project limits.

2.0 DESIGN VEHICLES

Glenmore Tr and 100 St are designated as provincial high load corridors. The required vertical clearance for a high load corridor is 9.14 m. All interchange options must accommodate oversized loads such as a Heavy Hauler, Platform Trailer, and Reactor Transporter.

Conrich Rd is designated locally as a High Load Corridor as well. However, the City of Calgary classification for High Load Corridors requires only 5.44 m vertical clearance.

All interchange options must accommodate oversized loads such as a Heavy Hauler, Platform Trailer, and Reactor Transporter. Exemption of any of these vehicles will require a design exception.

The development areas serviced by the interchanges at 100 St and Conrich Rd are planned to be mainly industrial business parks. Thus, a large design vehicle is recommended for these interchanges and associated ramp intersection junctions. It is recommended to use a modified WB-36 design vehicle, as this is consistent with the AT's HGDG Urban Supplement for all interchange ramp terminals (Table U.D.5.1 in Appendix A).

Intersection turning movements, especially left turn movements for all single left turn movements, opposing left turns will be required to accommodate a modified WB-36; dual left turns will be required to accommodate a modified WB-36 alongside a passenger car.

3.0 INTERSECTIONS & INTERCHANGE SPACING

Intersection spacing defined in the City of Calgary DGSS for an Arterial Street is 300m minimum. However, as per AT's HGDG, at service interchanges the first intersection centreline along the Arterial street shall be a minimum of 400m from the interchange ramp terminal.

The 100 St, Conrich Rd and Rainbow Rd Interchanges along Glenmore Tr are all considered service level interchanges. The spacing of these interchanges will be as such that sufficient weaving can be provided between the merge/diverge ramps. As per RRHPA, the minimum weaving distance of 600 m is allowable if confirmed sufficient through detailed weave analysis and modeling.

The Stoney Trail interchange along Glenmore Tr is ultimately considered a systems level interchange. As per RRHPA, the minimum desireable weaving distance between a systems level (Stoney Trail) and a service level (100 St) interchange is 800 m if confirmed sufficient through detailed weaving analysis and modelling.

4.0 RIGHT TURN TREATMENTS

Channelization is often used for interchange junctions and when designed appropriately it can increase both safety and capacity of an intersection. Where appropriate the following right turn design principles from the City's Complete Streets policy will be considered as part of the design:

- Safely accommodate all modes of transportation, including cyclists and pedestrians.
- Compact designs that accommodate the design vehicle are more favourable.
- Crossing roadways at 90° or as close as possible are desired.
- Sightlines are a critical considerations for crosswalks on free-flowing movements
- Yield condition shall be the preferred right turn treatment. However, in high volume areas, free flowing movements may be required.

Yield Condition

The City of Edmonton Right Turn Standard - Yield Condition is attached for reference. The yield condition right turn treatments will be finalized after the selection of the preferred interchange alternative. The following design elements from the City's complete streets policy and this project's design vehicle will help with the creation of a unique smart right turn design for this project:

- An entry angle of at least 60° shall be used.
- The cross walk shall be placed about one car length back from where drivers must yield.
- The separation island must be roughly twice as long as it is wide.
- Corner radius will be larger (45-90 m) at the beginning of the island and smaller (6-15 m) where it merges with the cross street. Note: Other radii will be required to accommodate modified WB-36.
- When creating this design it is necessary to allow for large trucks turning into multiple receiving lanes.
- The crosswalk is desired to be a minimum of one car length back from the crossroad.

Free-Flow Condition

Free-flow right turns accommodate larger right turning volumes more safely than the yield condition previously discussed. However, free flow right turns can be inhibiting to pedestrian traffic. In order to maximize safety and efficiency for free flow right turn ramps the following principles shall be considered:

- The controlling curve for free-flow right turns shall be in the range of 15-20m to help keep speeds lower at pedestrian crossings.
- Pedestrian crossings shall be located in the initial third of the right turn island to ensure maximum visibility
- The merge treatment shown DGSS Figure 52, but use a controlling curve in line with a 90 degree intersection as shown in Table D.5.2a from Alberta Transportation's HGDG.

5.0 DESIGN CRITERIA

The design criteria elements for each roadway are summarized in the following table and the typical cross sections are attached to this memorandum.

ITEM	GLENMORE TR SE (AKA HIGHWAY 560)	100 ST SE (AKA GARDEN ROAD)	CONRICH RD (AKA 116 STREET SE)	RAMPS
General				
Design Classification	RFD-616.6-110	Arterial Street	Arterial Street	N/A
Design Speed (km/h)	110	60	60	90km/h (Gore) 50km/h (Junction)
Posted Speed (km/h)	100	60	60	N/A
Intersection Spacing	N/A	400 m To Ramps 300 m (Min)	400 m To Ramps 300 m (Min)	N/A
Active Modes	Grade Separated	At-Grade	At-Grade	At-Grade
Bus Route	Limited	Yes	Yes	Limited
Truck Route	Yes (Prov Highload)	Yes (Prov Highload)	Yes (City Highload)	Yes (Highload)
On Street Parking	No	No	No	N/A
Sound Attenuation	N/A	Yes	Yes	N/A
Horizontal Geometry				
Min Radius (m)	600	130	130	Loops 70
Max Superelevation (m/m)	0.06	0.06	0.06	0.06
Exit/Entrance Treatments	Exit 25:1 ratio Entrance 50-55:1 ratio	TBD by Traffic Analysis	TBD by Traffic Analysis	N/A
Min Weaving (m)	600	N/A	N/A	N/A

Vertical Geometry				
Max Grade (%)	3 (des), 5 (max)	6	6	4 (Des), 7 (Max)
Min Grade (%)	0.6 (min), 0.8 (Des)	0.6 (min), 0.8 (Des)	0.6 (min), 0.8 (Des)	0.6 (min), 0.8 (Des)
Max Grade Intersections	N/A	4%	4%	4%
Min Stopping Sight Distance (m)	235	170	170	HGDG Figure B.4.4.2a or B.4.4.3
Min Crest Curve (SSD) (m)	K = 100	K = 55, L = 70	K = 55, L = 70	90km/h K = 55 50km/h K = 10
Min Sag Curve (SSD) (m)	K = 60	K = 15, L = 70	K = 15, L = 70	90km/h K = 40 50km/h K = 12
Vertical Clearance (m)	9.14	9.14	5.5	9.14
Cross Sectional Elements (Widths)				
Basic ROW Width (m)	100	36	36	N/A
Through Lane (m)	3.7	3.5 (inside) 3.7 (outside)	3.5 (inside) 3.7 (outside)	4.8 (single) 3.7 (dual)
Left Turn Lane (m)	N/A	3.5	3.5	N/A
Inside Shoulder (m)	2.5 with median ditch	N/A	N/A	1 (single), 2 (dual)
Outside Shoulder (m)	3.0 with roadside ditches	N/A	N/A	2.5 (single), 3 (dual)
Ditch (m)	4.0 (rounded)	N/A	N/A	4.0 (Rounded)
Median (m)	30.6 (4 or 6 lanes) 23.2 (8 lanes)	6.0 (Single Left Turn) 9.5 (Dual Left Turn)	6.0 (Single Left Turn) 9.5 (Dual Left Turn)	N/A
Sideslope Ratio	6:1 (Des) 4:1 (Max) 3:1 (over 6.5 m)	N/A	N/A	6:1 (Des) 4:1 (Max) 3:1 (over 6.5 m)
Backslope Ratio	5:1 (Normal) 3:1 (Maximum)	N/A	N/A	5:1 (Normal) 3:1 (Maximum)
Active Modes (m)	Not allowed on facilities directly adjacent to freeways/highways	2m sidewalk on east side and 3m pathway on west	2m sidewalk on east side and 3m pathway on west	N/A

6.0 DIVERGING DIAMOND INTERCHANGE (DDI) DESIGN CRITERIA

Both the City and AT requested that a DDI be investigated as potential solution for both 100 St and Conrich Rd interchange locations. The following table summarizes key design criteria described in The Federal Highway Administration (FHWA) August 2014 - Diverging Diamond Interchange Informational Guide. A diagram of the crossover roadways can be found in Appendix F that visually demonstrates some of the noted design elements.

DESIGN ELEMENT	DESIGN VALUE	REFERENCE
DDI Intersecting Roadway (Crossover) Design		
Crossover Alignment Design	<p>Lots of options available</p> <p>Note: current concept is a symmetrical design, but a design that shifts the cross overs west may be advantageous at Garden Rd</p>	FHWA(DDI) – Exhibit 7-8
Crossover Alignment Design and Posted Speed	<p>Through lanes = 50 km/h</p> <p>Note: This is a 10km/h reduction of design and posted speed along 100 St & Garden</p>	
Curvature Design Low-Speed Urban Street Design [Speed (km/h), R(m), e(%)]	<p>S = 50 km/h, R = 110 m, e = - 2%</p> <p>Note: Current Approach/Departure Radii = 190 m Current Bridge Adjacent Radii = 190 m</p>	Appendix F - Note 1 FHWA(DDI) Exhibit 7-14 TAC Figure 2.1.2.4
Super-elevation / Cross - Slope Development	<p>Approaches: -2% (Normal Crown)</p> <p>Crossovers: 0%</p> <p>Bridge Structure: -2% (Normal Crown)</p>	
Through Design Vehicles	<p>Simultaneous: WB-21</p> <p>Single: Modified WB-36</p>	
Lane Widths	<p>4.3 m Through Lanes</p> <p>Note: current concept lane width is based on Autoturn with WB-21 at 30 km/h with 1 m separation between vehicles</p>	Appendix F - Note 2
Crossover Angle (Desired Range)	<p>30-50 degrees</p> <p>Note: Current Concept Design is 35 degrees</p>	Appendix F - Note 3 FHWA(DDI) Page 128 Crossover Design
Tangent Length Between Crossovers	<p>This value varies to achieve tangents on the bridge when the DDI is above the Freeway</p> <p>Note: Current Design Concept is 75 m for a 60 m clearance requirement</p>	Appendix F - Note 4 FHWA(DDI) Exhibit 7-9
Crossover Tangent Length Extensions	<p>Desired = Width of lanes plus (6m before the crossover), and (4.5m after the crossover)</p> <p>Note: Current Concept achieves more than 2 times the required.</p>	Appendix F - Note 5 FHWA(DDI) Exhibit 7-16
Distance Between Crossovers	<p>Width driven by many factors such as: cross over angle, number of lanes, width of lanes, and crossover tangent length extensions</p> <p>Note: Current Concept is 250m</p>	Appendix F - Note 6
Width Between Crossover Centrelines	<p>Width driven by many factors such as: cross over angle, number of lanes, width of lanes and length extensions</p> <p>Note: Current design is 36.6m</p>	Appendix F - Note 7

DDI Turning Movement Channelization Design		
Left / Right Turn Design Vehicles	Single: Modified WB&36 Double: WB-21 on Outside and car on inside	
Right Turn Treatments	TBD – Yield, Free-Flow, Signal	
Left Turn Treatment Types	Free-Flow	
Active Modes Accommodation		
Pathways	We recommend pathways to be placed in between the bridges	FHWA(DDI) Exhibit 3-7

7.0 CONCLUSION

The above-described Design Criteria will be applied and utilized throughout the Options Generations and Evaluation Stages of this project. If any exceptions to the design criteria arise, they will be well analyzed, documented and communicated with The City, Alberta Transportaion and Rocky View County.

Attachments: Appendix A – AT References

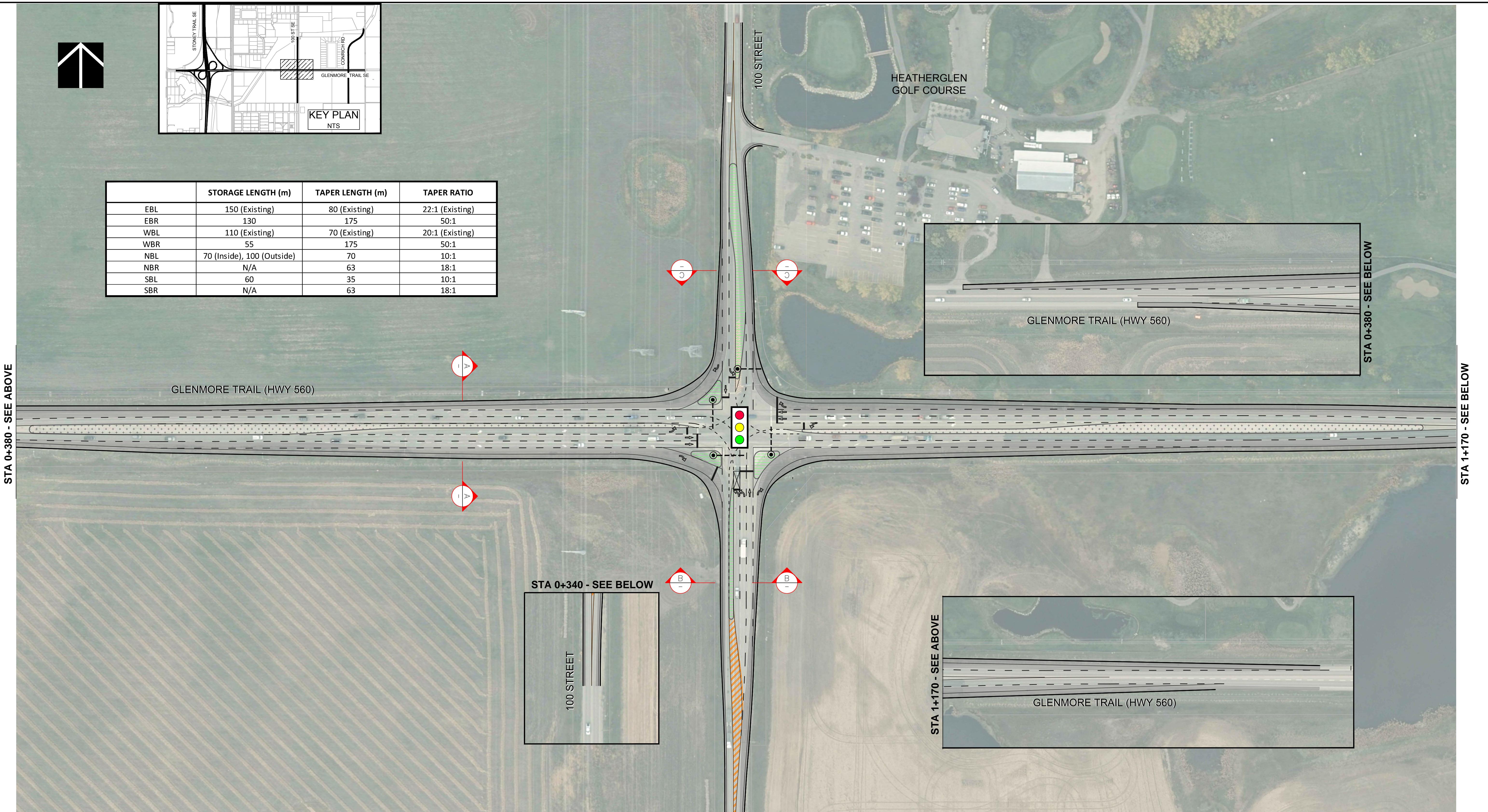
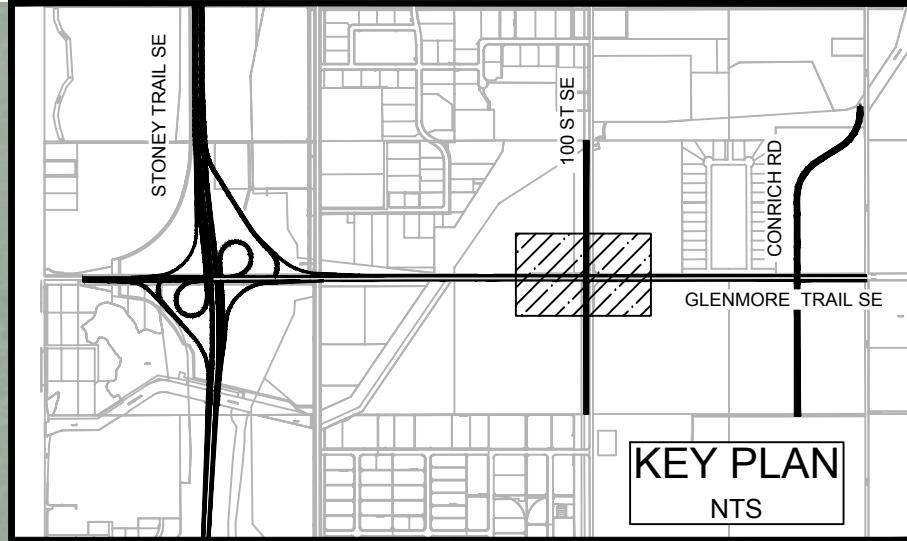
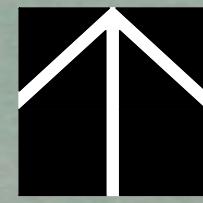
Appendix B – RVC References

Appendix C – City of Calgary References

Appendix D – Previous Study References

Appendix E – Intersection Details

Appendix F – DDI Geometric Details



NOTE: ALL DRAWINGS ARE PRINTED AT HALF SCALE WHEN IN 11" x 17" FORMAT

PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

LEGEND:

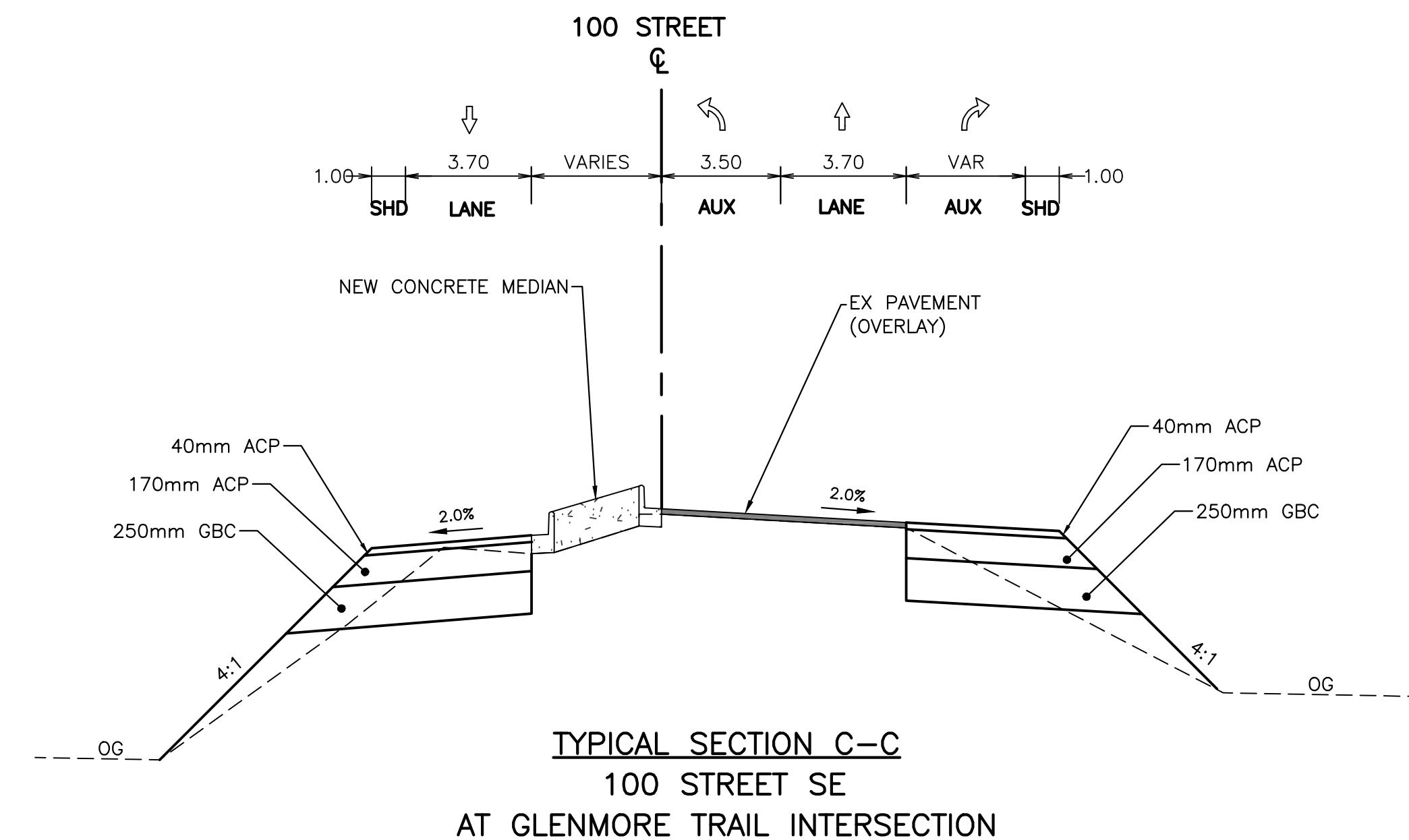
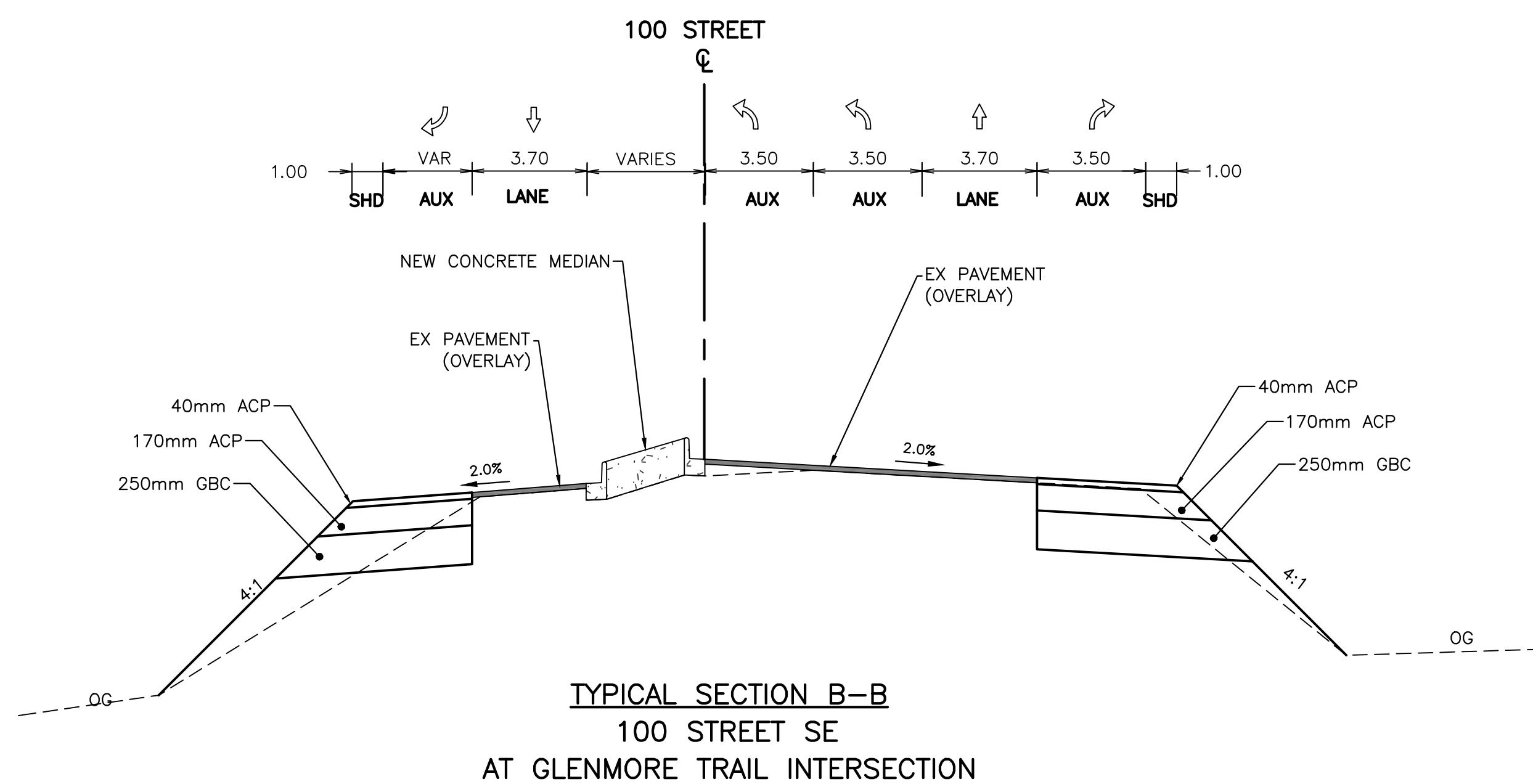
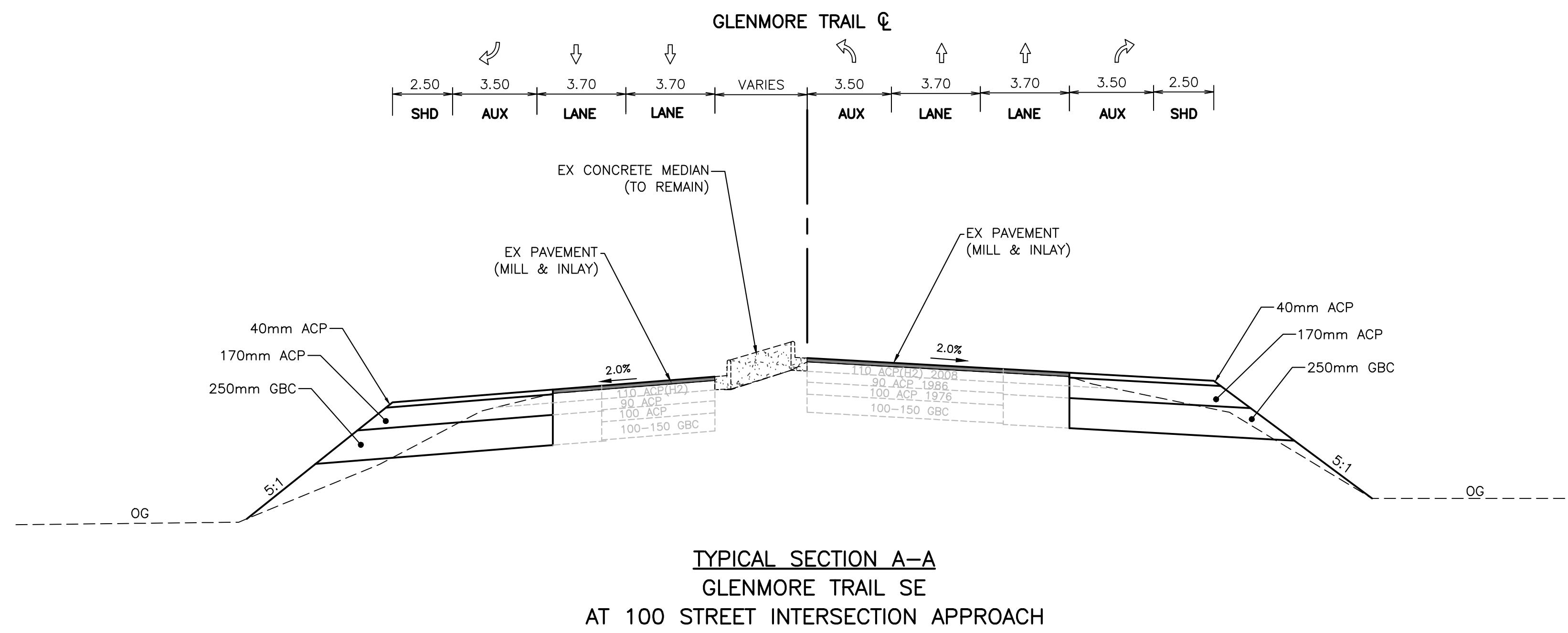
- EDGE OF PAVEMENT
- PAVEMENT MARKINGS
- - - LANE LINES
- ↔ ↔ LANE DIRECTION
- TRAFFIC SIGNAL POST

- [Hatched box] EX. CONCRETE MEDIAN
- [Dashed box] NEW CONCRETE MEDIAN
- [Grey box] NEW PAVEMENT STRUCTURE

1:1000 0 20 60m

GLENMORE TRAIL EAST SHORT-TERM IMPROVEMENTS SIGNALIZED INTERSECTION PLAN GLENMORE TRAIL & 100 ST INTERSECTION

Sheet 1 of 2



PARSONS

ISL Engineering and Land Services

NOTE: ALL DRAWINGS ARE
PRINTED AT HALF SCALE WHEN
IN 11" x 17" FORMAT

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SCALE: 1:150

**GLENMORE TRAIL EAST STUDY
SHORT-TERM IMPROVEMENTS
TYPICAL SECTIONS
GLENMORE TRAIL & 100 ST INTERSECTION**
Sheet 2 of 2

APRIL 2017



PARSONS

ISL Engineering and Land Services

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LEGEND:

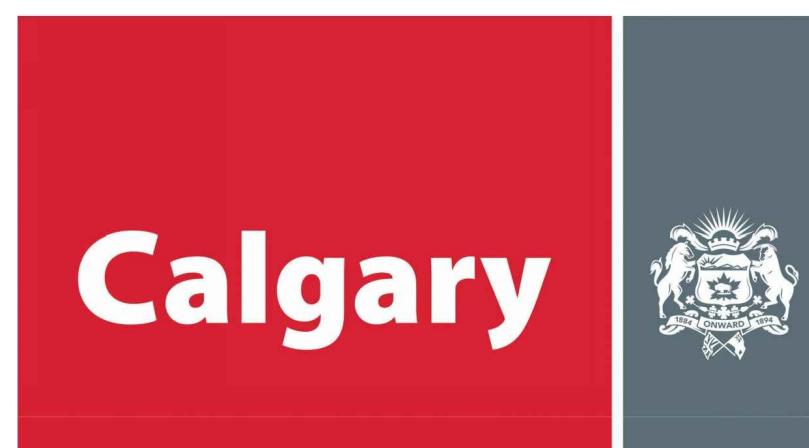
- EDGE OF PAVEMENT
- PAVEMENT MARKINGS
- - - LANE LINES
- ↔ ↔ LANE DIRECTION

- [Ex. Concrete Median] EX. CONCRETE MEDIAN
- [New Concrete Median] NEW CONCRETE MEDIAN
- [New Pavement Structure] NEW PAVEMENT STRUCTURE
- [Row Area] ROW AREA

1:1000 0 20 60m

**Glenmore Trail East Study
SHORT-TERM IMPROVEMENTS
PROPERTY REQUIREMENTS PLAN
Glenmore and 100 Street Intersection**

February 2017



PARSONS

ISL Engineering
and Land Services

NOTE: ALL DRAWINGS ARE
PRINTED AT HALF SCALE WHEN
IN 11" x 17" FORMAT

PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

LEGEND:

- EDGE OF PAVEMENT
- PAVEMENT MARKINGS
- - - LANE LINES
- ↔ ↔ LANE DIRECTION

- [Ex. Concrete Median] EX. CONCRETE MEDIAN
- [New Concrete Median] NEW CONCRETE MEDIAN
- [New Pavement Structure] NEW PAVEMENT STRUCTURE
- [Row Area] ROW AREA

1:1000 0 20 60m

**Glenmore Trail East Study
Short-Term Solution**

**PROPERTY REQUIREMENTS PLAN
Glenmore and 100 Street Intersection**

February 2017

							PARSONS	Calgary
Item No.	Description of Items	Unit	Unit Price	Estimated Quantity	Cost	Notes		
1	Breakout & Removals							\$ 187,082.00
1.1	Saw Cut Asphalt	m	\$ 11.00	3,410	\$ 37,510			
1.2	Breakout, Removal & Disposal of Asphalt	m2	\$ 12.60	8,220	\$ 103,572			
1.3	Road Planing (Mill Only) - 40mm (For Existing Lanes)	m2	\$ 3.00	13,600	\$ 40,800			
1.4	Breakout, Removal & Disposal of Existing Concrete Island, Median and Foundations of Street Lighting	m2	\$ 20.00	260	\$ 5,200			
2	Earthwork							\$ 419,850.00
2.1	Excavation	m3	\$ 7.00	3,800	\$ 26,600			
2.2	Common Fill	m3	\$ 20.00	13,100	\$ 262,000			
2.3	Top Soil Stripping (300mm)	m3	\$ 20.00	4,000	\$ 80,000			
2.4	Subgrade Preparation	m2	\$ 2.50	20,500	\$ 51,250			
3	Pavement							\$ 1,694,000.00
3.1	Granular Base Course (250mm)	t	\$ 40.00	13,000	\$ 520,000			
3.2	Asphalt Concrete Pavement - 170 mm	t	\$ 110.00	7,400	\$ 814,000			
3.3	Asphalt Concrete Pavement - 40mm	t	\$ 120.00	3,000	\$ 360,000			
4	Structures							\$ 147,600.00
4.1	Concrete Median and Island Infill	m2	\$ 90.00	1,200	\$ 108,000			
4.2	500 Standard Concrete Curb & Gutter	m	\$ 90.00	440	\$ 39,600			
5	Miscellaneous							\$ 581,000.00
5.1	Street Lighting & Electrical works	LS	\$ 50,000.00	1	\$ 50,000			
5.2	Traffic Signal	LS	\$ 361,000.00	1	\$ 361,000			
5.3	Landscaping Works	LS	\$ 100,000.00	1	\$ 100,000			
5.4	Erosion & Sediment Control	LS	\$ 20,000.00	1	\$ 20,000			
5.5	Miscellaneous - Pavement markings and Signage	LS	\$ 50,000.00	1	\$ 50,000			
Sub-Total (Direct Cost)							\$ 3,029,532	
	<u>Contingency (30%)</u>							\$ 908,860
	<u>Engineering fee/testing fee (15%)</u>							\$ 454,430
	<u>Mobilization (10%)</u>							\$ 302,953
Total Construction Cost (CAD \$)							\$ 4,695,775	

Existing Condition

AM Peak

2016



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	235	183	296	51	630	75	106	33	3	20	18	92
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	160.0		160.0	150.0		0.0	100.0		100.0	0.0		20.0
Storage Lanes	1		1	1		0	1		1	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Satd. Flow (prot)	1612	1568	1344	1598	1700	0	1040	1360	1182	0	1161	983
Flt Permitted	0.076			0.635			0.439				0.817	
Satd. Flow (perm)	129	1568	1344	1068	1700	0	481	1360	1182	0	974	983
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			315		6				109			155
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		1089.5			1177.9			896.2			812.0	
Travel Time (s)		49.0			53.0			64.5			58.5	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	9%	18%	17%	10%	7%	8%	69%	36%	33%	60%	50%	60%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	250	195	315	54	750	0	113	35	3	0	40	98
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8		8	4			6		6	2		2
Detector Phase	3	8	8	7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	7.0	15.0	15.0	7.0	15.0		7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	12.0	22.0	22.0	12.0	22.0		12.0	22.5	22.5	22.5	22.5	22.5
Total Split (s)	24.0	70.0	70.0	12.0	58.0		14.0	38.0	38.0	24.0	24.0	24.0
Total Split (%)	20.0%	58.3%	58.3%	10.0%	48.3%		11.7%	31.7%	31.7%	20.0%	20.0%	20.0%
Maximum Green (s)	19.0	65.0	65.0	7.0	53.0		9.0	33.0	33.0	19.0	19.0	19.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	0.0	0.0	3.0	0.0		3.0	0.0	0.0		3.0	0.0
Total Lost Time (s)	8.0	5.0	5.0	8.0	5.0		8.0	5.0	5.0		8.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min		None	None	None	None	None	None
Act Effct Green (s)	73.0	66.5	66.5	54.0	53.0		26.0	29.0	29.0		12.0	15.0
Actuated g/C Ratio	0.63	0.58	0.58	0.47	0.46		0.23	0.25	0.25		0.10	0.13
v/c Ratio	0.91	0.22	0.35	0.10	0.95		0.82	0.10	0.01		0.40	0.37
Control Delay	65.1	13.2	2.5	10.2	53.5		83.5	34.6	0.0		61.0	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Total Delay	65.1	13.2	2.5	10.2	53.5		83.5	34.6	0.0		61.0	5.3
LOS	E	B	A	B	D		F	C	A		E	A
Approach Delay		25.8			50.6			70.5			21.4	
Approach LOS		C			D			E			C	

Intersection Summary

Area Type: Other

Cycle Length: 120

Existing Condition

AM Peak

2016

Actuated Cycle Length: 115

Natural Cycle: 100

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 39.9

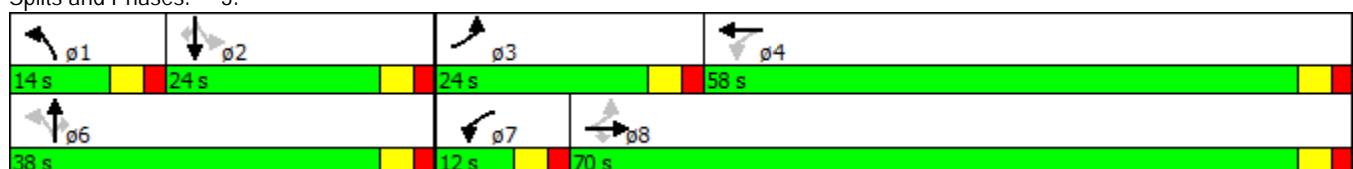
Intersection LOS: D

Intersection Capacity Utilization 79.6%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2016 AM - Base

4/20/2017

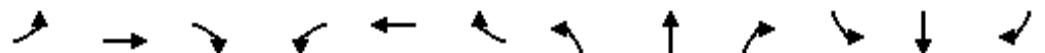
Intersection: 3:

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	LT	R
Maximum Queue (m)	79.9	46.0	34.2	123.5	383.0	90.1	25.8	16.3	67.1	27.5
Average Queue (m)	40.6	15.5	14.0	25.6	184.3	38.5	6.7	1.3	26.9	21.1
95th Queue (m)	69.4	35.7	26.6	108.1	393.2	75.8	20.1	7.9	60.5	34.1
Link Distance (m)				1163.8		882.2			801.8	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	160.0		160.0	150.0		100.0		100.0		20.0
Storage Blk Time (%)				0	20	0			12	13
Queuing Penalty (veh)				0	10	0			11	5

Existing Condition

PM Peak

2016



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	101	629	96	11	222	25	242	44	47	83	29	327
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	160.0		160.0	150.0		0.0	100.0		100.0	0.0		20.0
Storage Lanes	1		1	1		0	1		1	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Satd. Flow (prot)	1172	1796	965	1489	1547	0	1528	1360	1512	0	1487	1430
Flt Permitted	0.428			0.174			0.519			0.753		
Satd. Flow (perm)	528	1796	965	273	1547	0	835	1360	1512	0	1162	1430
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			145		6				145			344
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		1089.5			1177.9			896.2			812.0	
Travel Time (s)		49.0			53.0			64.5			58.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	50%	3%	63%	18%	14%	52%	15%	36%	4%	11%	45%	10%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	106	662	101	12	260	0	255	46	49	0	118	344
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8		8	4			6		6	2		2
Detector Phase	3	8	8	7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	7.0	15.0	15.0	7.0	15.0		7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	12.0	22.0	22.0	12.0	22.0		12.0	22.5	22.5	22.5	22.5	22.5
Total Split (s)	18.0	39.0	39.0	12.0	33.0		15.0	39.0	39.0	24.0	24.0	24.0
Total Split (%)	20.0%	43.3%	43.3%	13.3%	36.7%		16.7%	43.3%	43.3%	26.7%	26.7%	26.7%
Maximum Green (s)	13.0	34.0	34.0	7.0	28.0		10.0	34.0	34.0	19.0	19.0	19.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		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	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min		None	None	None	None	None	None
Act Effct Green (s)	35.8	33.7	33.7	29.3	23.8		30.9	30.9	30.9		15.9	15.9
Actuated g/C Ratio	0.47	0.44	0.44	0.38	0.31		0.40	0.40	0.40		0.21	0.21
v/c Ratio	0.33	0.84	0.20	0.06	0.54		0.60	0.08	0.07		0.49	0.61
Control Delay	14.8	32.0	2.3	12.1	28.1		24.8	16.4	0.2		36.3	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Total Delay	14.8	32.0	2.3	12.1	28.1		24.8	16.4	0.2		36.3	8.6
LOS	B	C	A	B	C		C	B	A	D	A	
Approach Delay		26.4			27.4			20.3			15.7	
Approach LOS		C			C			C			B	

Intersection Summary

Area Type: Other

Cycle Length: 90

Existing Condition

PM Peak

2016

Actuated Cycle Length: 76.7

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 22.9

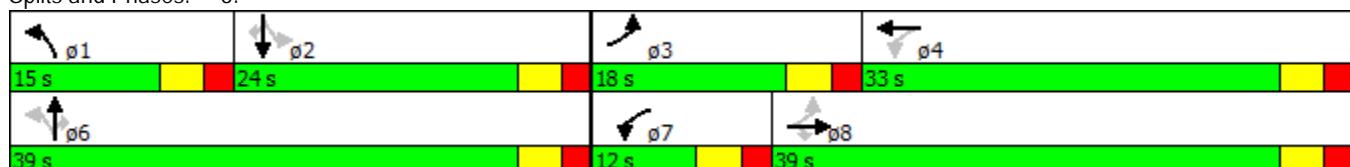
Intersection LOS: C

Intersection Capacity Utilization 72.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 3:



Queueing and Blocking Report

2016 PM - Base

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	LT	R
Maximum Queue (m)	49.7	122.2	28.8	15.3	77.0	75.3	27.3	21.1	128.0	27.5
Average Queue (m)	19.5	64.7	10.0	2.7	33.2	36.0	7.2	4.8	47.9	25.9
95th Queue (m)	38.1	103.9	21.6	10.4	62.0	63.4	19.5	13.1	102.6	30.6
Link Distance (m)				1163.8		882.2		801.8		
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	160.0		160.0	150.0		100.0		100.0		20.0
Storage Blk Time (%)									15	23
Queuing Penalty (veh)									49	26

Existing Condition

AM Peak

2028



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	235	313	286	61	830	95	106	33	3	20	38	172
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	160.0		160.0	150.0		0.0	100.0		100.0	0.0		20.0
Storage Lanes	1		1	1		0	1		1	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Satd. Flow (prot)	1612	1568	1344	1598	1701	0	1040	1360	1182	0	1185	983
Flt Permitted	0.046			0.560			0.414			0.872		
Satd. Flow (perm)	78	1568	1344	942	1701	0	453	1360	1182	0	1051	983
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			304			6			87			183
Link Speed (k/h)			80			80			50			50
Link Distance (m)			1089.5			1177.9			896.2			812.0
Travel Time (s)			49.0			53.0			64.5			58.5
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	9%	18%	17%	10%	7%	8%	69%	36%	33%	60%	50%	60%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	250	333	304	65	984	0	113	35	3	0	61	183
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8		8	4			6		6	2		2
Detector Phase	3	8	8	7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0		5.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	12.0	25.0	25.0	12.0	25.0		12.0	22.5	22.5	22.5	22.5	22.5
Total Split (s)	26.0	99.0	99.0	12.0	85.0		14.0	39.0	39.0	25.0	25.0	25.0
Total Split (%)	17.3%	66.0%	66.0%	8.0%	56.7%		9.3%	26.0%	26.0%	16.7%	16.7%	16.7%
Maximum Green (s)	21.0	94.0	94.0	7.0	80.0		9.0	34.0	34.0	20.0	20.0	20.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	0.0	0.0	3.0	0.0		3.0	0.0	0.0		3.0	0.0
Total Lost Time (s)	8.0	5.0	5.0	8.0	5.0		8.0	5.0	5.0		8.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min		None	None	None	None	None	None
Act Effct Green (s)	103.1	96.6	96.6	80.7	80.0		24.9	27.9	27.9		10.9	13.9
Actuated g/C Ratio	0.72	0.67	0.67	0.56	0.56		0.17	0.19	0.19		0.08	0.10
v/c Ratio	1.01	0.32	0.30	0.12	1.04		1.10	0.13	0.01		0.77	0.70
Control Delay	105.0	11.9	1.9	9.0	71.3		170.7	48.8	0.0		116.6	23.0
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Total Delay	105.0	11.9	1.9	9.0	71.3		170.7	48.8	0.0		116.6	23.0
LOS	F	B	A	A	E		F	D	A		F	C
Approach Delay		34.7			67.4			139.1			46.4	
Approach LOS		C			E			F			D	

Intersection Summary

Area Type: Other

Cycle Length: 150

Existing Condition

AM Peak

2028

Actuated Cycle Length: 144

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.10

Intersection Signal Delay: 57.4

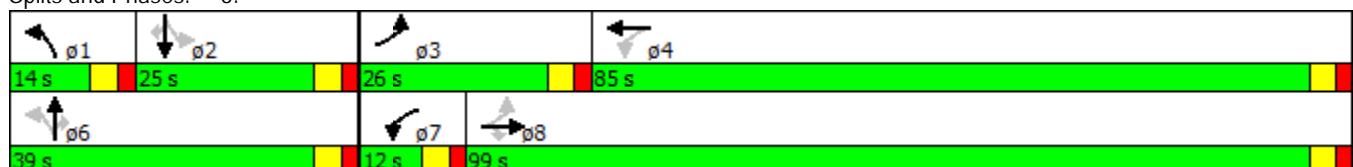
Intersection LOS: E

Intersection Capacity Utilization 91.9%

ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2028 AM - Base

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	LT	R
Maximum Queue (m)	121.0	66.6	37.9	157.4	1167.0	107.2	152.4	12.0	379.7	27.5
Average Queue (m)	63.8	29.0	13.4	56.4	749.9	61.5	22.7	0.7	243.3	25.8
95th Queue (m)	113.1	56.7	28.0	168.1	1281.0	108.3	96.3	5.0	507.3	35.0
Link Distance (m)				1163.8		882.2			801.8	
Upstream Blk Time (%)					17					
Queuing Penalty (veh)					0					
Storage Bay Dist (m)	160.0	160.0	150.0		100.0		100.0		20.0	
Storage Blk Time (%)	0			0	47	8	1		55	35
Queuing Penalty (veh)	1			0	29	3	1		94	20

Existing Condition

PM Peak

2028



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	101	869	96	11	402	25	272	54	57	143	49	327
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	160.0		160.0	150.0		0.0	100.0		100.0	0.0		20.0
Storage Lanes	1		1	1		0	1		1	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Satd. Flow (prot)	1172	1796	965	1489	1578	0	1528	1360	1512	0	1490	1430
Flt Permitted	0.323			0.075			0.340			0.744		
Satd. Flow (perm)	398	1796	965	118	1578	0	547	1360	1512	0	1150	1430
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			109		4				64			216
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		1089.5			1177.9			896.2			812.0	
Travel Time (s)		49.0			53.0			64.5			58.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	50%	3%	63%	18%	14%	52%	15%	36%	4%	11%	45%	10%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	106	915	101	12	449	0	286	57	60	0	203	344
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases	3	8		7	4		1	6			2	
Permitted Phases	8		8	4			6		6	2		2
Detector Phase	3	8	8	7	4		1	6	6	2	2	2
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0		5.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	12.0	25.0	25.0	12.0	25.0		12.0	22.5	22.5	22.5	22.5	22.5
Total Split (s)	14.0	64.0	64.0	12.0	62.0		18.0	44.0	44.0	26.0	26.0	26.0
Total Split (%)	11.7%	53.3%	53.3%	10.0%	51.7%		15.0%	36.7%	36.7%	21.7%	21.7%	21.7%
Maximum Green (s)	9.0	59.0	59.0	7.0	57.0		13.0	39.0	39.0	21.0	21.0	21.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		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	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min		None	None	None	None	None	None
Act Effct Green (s)	62.5	59.1	59.1	56.0	50.0		39.1	39.1	39.1		21.0	21.0
Actuated g/C Ratio	0.56	0.52	0.52	0.50	0.44		0.35	0.35	0.35		0.19	0.19
v/c Ratio	0.38	0.97	0.18	0.09	0.64		0.94	0.12	0.11		0.95	0.78
Control Delay	15.7	50.5	3.5	12.1	28.9		73.4	27.7	6.8		96.0	29.9
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Total Delay	15.7	50.5	3.5	12.1	28.9		73.4	27.7	6.8		96.0	29.9
LOS	B	D	A	B	C		E	C	A	F	C	
Approach Delay		42.9			28.5			57.0			54.4	
Approach LOS		D			C			E			D	

Intersection Summary

Area Type: Other

Cycle Length: 120

Existing Condition

PM Peak

2028

Actuated Cycle Length: 112.6

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.97

Intersection Signal Delay: 45.0

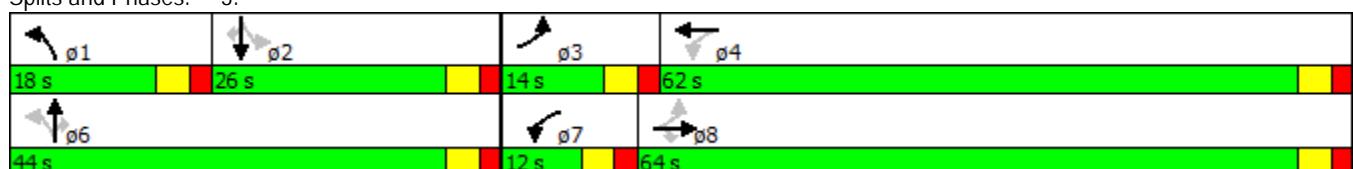
Intersection LOS: D

Intersection Capacity Utilization 85.8%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 3:



Queueing and Blocking Report

2028 PM - Base

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	T	R	LT	R
Maximum Queue (m)	167.4	478.9	167.5	13.4	112.7	102.8	55.2	32.9	657.4	27.5
Average Queue (m)	71.7	277.3	67.2	2.7	60.6	59.5	13.0	9.4	412.4	27.0
95th Queue (m)	185.1	493.5	188.6	9.4	100.9	95.1	40.3	23.1	712.5	31.4
Link Distance (m)				1163.8		882.2			801.8	
Upstream Blk Time (%)									2	
Queuing Penalty (veh)									0	
Storage Bay Dist (m)	160.0		160.0	150.0		100.0		100.0		20.0
Storage Blk Time (%)	0	25	0			1			55	41
Queuing Penalty (veh)	1	48	3			1			180	79

|

Short Term Option
AM Peak

2016



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑↑	↑	↑	↑↑	↑
Volume (vph)	235	183	296	51	630	75	106	33	3	20	18	92
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1612	2979	1344	1598	3285	1456	2017	1360	1182	1098	1233	983
Flt Permitted	0.270			0.629			0.950			0.734		
Satd. Flow (perm)	458	2979	1344	1058	3285	1456	2017	1360	1182	849	1233	983
Right Turn on Red				Yes			Yes			Yes		Yes
Satd. Flow (RTOR)				315			195			203		203
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			258.5			896.2			812.0	
Travel Time (s)		12.3			11.6			64.5			58.5	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	9%	18%	17%	10%	7%	8%	69%	36%	33%	60%	50%	60%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	250	195	315	54	670	80	113	35	3	21	19	98
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	13.0	25.5	25.5	13.0	25.5	25.5	10.0	21.0	21.0	10.0	21.0	21.0
Total Split (s)	13.0	25.5	25.5	13.0	25.5	25.5	10.0	21.5	21.5	10.0	21.5	21.5
Total Split (%)	18.6%	36.4%	36.4%	18.6%	36.4%	36.4%	14.3%	30.7%	30.7%	14.3%	30.7%	30.7%
Maximum Green (s)	7.5	20.0	20.0	7.5	20.0	20.0	5.0	16.5	16.5	5.0	16.5	16.5
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None											
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	31.6	29.1	29.1	27.4	20.8	20.8	5.2	15.9	15.9	12.6	10.4	10.4
Actuated g/C Ratio	0.54	0.50	0.50	0.47	0.36	0.36	0.09	0.27	0.27	0.22	0.18	0.18
v/c Ratio	0.62	0.13	0.38	0.10	0.57	0.12	0.63	0.09	0.01	0.10	0.09	0.29
Control Delay	19.2	14.6	4.0	8.4	19.9	0.4	47.9	20.0	0.0	16.8	24.2	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.2	14.6	4.0	8.4	19.9	0.4	47.9	20.0	0.0	16.8	24.2	2.1
LOS	B	B	A	A	B	A	D	B	A	B	C	A
Approach Delay			11.7			17.2			40.5			7.4
Approach LOS			B			B			D			A

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 58.5

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 16.1

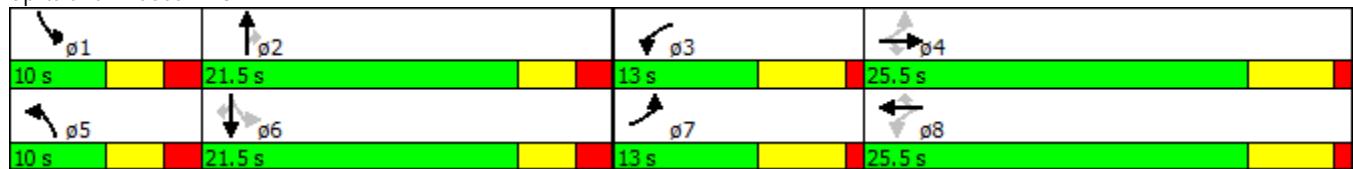
Intersection LOS: B

Intersection Capacity Utilization 54.4%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2016 AM - Option

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	56.9	30.6	29.9	27.3	17.4	49.1	57.7	24.6	31.3	40.1	31.5	30.7
Average Queue (m)	25.4	9.7	8.6	3.6	6.0	26.9	31.0	8.6	9.5	21.8	8.3	6.6
95th Queue (m)	45.9	22.0	21.9	16.8	14.3	43.1	49.6	18.9	25.0	36.2	22.4	21.2
Link Distance (m)		253.1	253.1			238.1	238.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0				130.0	110.0			55.0	85.0	85.0	60.0
Storage Blk Time (%)								0			6	
Queuing Penalty (veh)								0			6	

Intersection: 3:

Movement	SB
Directions Served	T
Maximum Queue (m)	22.4
Average Queue (m)	6.0
95th Queue (m)	17.3
Link Distance (m)	794.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	4
Queuing Penalty (veh)	5

Network Summary

Network wide Queuing Penalty: 11

Short Term Option
PM Peak

2016

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑↑	↑	↑	↑↑	↑
Volume (vph)	101	629	96	11	222	25	242	44	47	83	29	327
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1172	3413	965	1489	3083	1035	2965	1360	1512	1583	1276	1430
Flt Permitted	0.491			0.400			0.950			0.727		
Satd. Flow (perm)	606	3413	965	627	3083	1035	2965	1360	1512	1212	1276	1430
Right Turn on Red				Yes			Yes			Yes		Yes
Satd. Flow (RTOR)				170			170			177		344
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			262.5			896.2			812.0	
Travel Time (s)		12.3			11.8			64.5			58.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	50%	3%	63%	18%	14%	52%	15%	36%	4%	11%	45%	10%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	106	662	101	12	234	26	255	46	49	87	31	344
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	15.5	25.5	25.5	15.5	25.5	25.5	15.0	21.0	21.0	15.0	21.0	21.0
Total Split (s)	15.5	26.0	26.0	15.5	26.0	26.0	15.0	23.5	23.5	15.0	23.5	23.5
Total Split (%)	19.4%	32.5%	32.5%	19.4%	32.5%	32.5%	18.8%	29.4%	29.4%	18.8%	29.4%	29.4%
Maximum Green (s)	10.0	20.5	20.5	10.0	20.5	20.5	10.0	18.5	18.5	10.0	18.5	18.5
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min	Min	None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	31.4	29.7	29.7	24.8	20.3	20.3	9.5	15.7	15.7	19.0	11.3	11.3
Actuated g/C Ratio	0.46	0.43	0.43	0.36	0.30	0.30	0.14	0.23	0.23	0.28	0.17	0.17
v/c Ratio	0.30	0.45	0.20	0.04	0.25	0.06	0.62	0.15	0.10	0.23	0.15	0.66
Control Delay	13.5	16.0	1.6	11.2	21.2	0.3	36.7	26.9	0.4	17.3	27.8	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.5	16.0	1.6	11.2	21.2	0.3	36.7	26.9	0.4	17.3	27.8	10.2
LOS	B	B	A	B	C	A	D	C	A	B	C	B
Approach Delay		14.0			18.7			30.3			12.7	
Approach LOS		B			B			C			B	

Short Term Option

PM Peak

2016

Intersection Summary

Area Type: Other

Cycle Length: 80

Actuated Cycle Length: 68.3

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.66

Intersection Signal Delay: 17.3

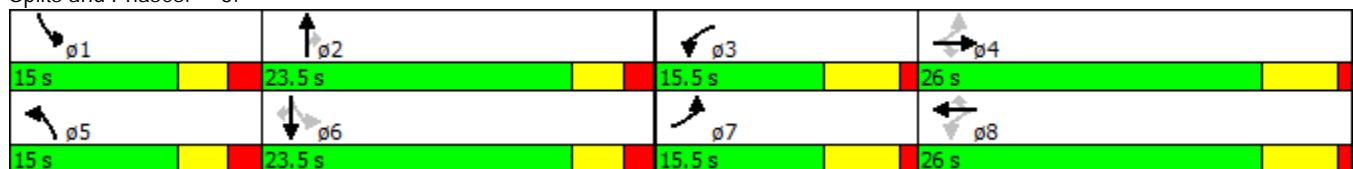
Intersection LOS: B

Intersection Capacity Utilization 57.5%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2016 PM - Option

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	43.2	40.0	42.0	5.6	17.2	27.2	28.4	20.4	35.0	43.1	29.6	30.4
Average Queue (m)	17.4	17.2	22.7	0.3	2.6	12.6	12.0	4.9	14.5	22.6	13.0	12.0
95th Queue (m)	33.6	32.1	37.1	4.5	10.9	24.1	24.1	15.8	29.6	36.2	27.2	24.8
Link Distance (m)		253.1	253.1			242.1	242.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0			130.0	110.0			55.0	85.0	85.0		60.0
Storage Blk Time (%)											11	
Queuing Penalty (veh)											32	

Intersection: 3:

Movement	SB
Directions Served	T
Maximum Queue (m)	27.7
Average Queue (m)	8.2
95th Queue (m)	22.5
Link Distance (m)	794.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	5
Queuing Penalty (veh)	21

Network Summary

Network wide Queuing Penalty: 53

Short Term Option
AM Peak

2028



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑↑	↑	↑	↑↑	↑
Volume (vph)	235	313	286	61	830	95	106	33	3	20	38	172
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1612	2979	1344	1598	3285	1456	2017	1360	1182	1098	1233	983
Flt Permitted	0.168			0.551			0.950			0.734		
Satd. Flow (perm)	285	2979	1344	927	3285	1456	2017	1360	1182	849	1233	983
Right Turn on Red				Yes			Yes			Yes		Yes
Satd. Flow (RTOR)				304			210			218		218
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			258.5			896.2			812.0	
Travel Time (s)		12.3			11.6			64.5			58.5	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	9%	18%	17%	10%	7%	8%	69%	36%	33%	60%	50%	60%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	250	333	304	65	883	101	113	35	3	21	40	183
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	13.0	25.5	25.5	13.0	25.5	25.5	10.0	15.0	15.0	10.0	15.0	15.0
Total Split (s)	13.0	26.0	26.0	13.0	26.0	26.0	10.0	16.0	16.0	10.0	16.0	16.0
Total Split (%)	20.0%	40.0%	40.0%	20.0%	40.0%	40.0%	15.4%	24.6%	24.6%	15.4%	24.6%	24.6%
Maximum Green (s)	7.5	20.5	20.5	7.5	20.5	20.5	5.0	11.0	11.0	5.0	11.0	11.0
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min	Min	None	None	None	None	None	None
Act Effct Green (s)	32.0	29.5	29.5	27.9	21.2	21.2	5.2	16.2	16.2	12.8	10.6	10.6
Actuated g/C Ratio	0.54	0.50	0.50	0.47	0.36	0.36	0.09	0.27	0.27	0.22	0.18	0.18
v/c Ratio	0.76	0.22	0.37	0.13	0.75	0.15	0.64	0.09	0.01	0.10	0.18	0.52
Control Delay	32.7	14.9	4.0	8.7	24.5	0.5	48.8	20.0	0.0	16.9	25.8	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.7	14.9	4.0	8.7	24.5	0.5	48.8	20.0	0.0	16.9	25.8	8.5
LOS	C	B	A	A	C	A	D	C	A	B	C	A
Approach Delay		16.2			21.2			41.1			12.1	
Approach LOS		B			C			D			B	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 59.1

Natural Cycle: 65

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 19.7

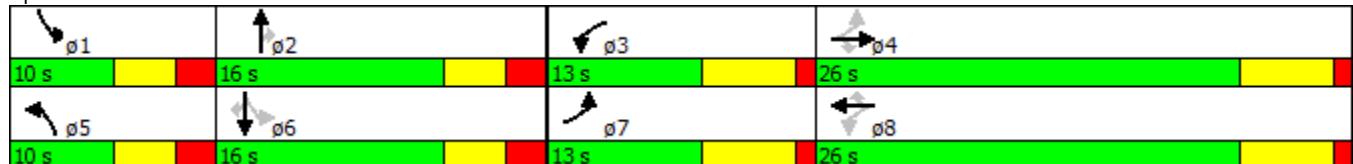
Intersection LOS: B

Intersection Capacity Utilization 60.0%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2028 AM - Option

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	56.9	29.8	27.9	23.3	21.8	65.4	68.8	26.7	39.9	43.6	33.0	32.5
Average Queue (m)	26.7	12.0	12.0	3.1	8.2	36.4	40.4	9.2	11.8	22.9	8.7	8.8
95th Queue (m)	47.3	23.8	25.4	15.0	18.5	59.2	63.9	19.8	30.4	39.9	22.8	25.2
Link Distance (m)		253.1	253.1			238.1	238.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0				130.0	110.0			55.0	85.0	85.0	60.0
Storage Blk Time (%)								2			6	
Queuing Penalty (veh)								2			7	

Intersection: 3:

Movement	SB
Directions Served	T
Maximum Queue (m)	29.3
Average Queue (m)	10.3
95th Queue (m)	24.3
Link Distance (m)	794.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	7
Queuing Penalty (veh)	13

Short Term Option
AM Peak

2028 Sensitivity

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑↑	↑	↑	↑↑	↑
Volume (vph)	282	376	343	73	996	114	127	40	4	24	46	206
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1612	2979	1344	1598	3285	1456	2017	1360	1182	1098	1233	983
Flt Permitted	0.108			0.516			0.950			0.729		
Satd. Flow (perm)	183	2979	1344	868	3285	1456	2017	1360	1182	843	1233	983
Right Turn on Red			Yes			Yes			Yes		Yes	
Satd. Flow (RTOR)			365			218			224			224
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			258.5			896.2			812.0	
Travel Time (s)		12.3			11.6			64.5			58.5	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	9%	18%	17%	10%	7%	8%	69%	36%	33%	60%	50%	60%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	300	400	365	78	1060	121	135	43	4	26	49	219
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	13.0	25.5	25.5	13.0	25.5	25.5	10.0	15.0	15.0	10.0	15.0	15.0
Total Split (s)	19.0	43.0	43.0	13.0	37.0	37.0	14.0	24.0	24.0	10.0	20.0	20.0
Total Split (%)	21.1%	47.8%	47.8%	14.4%	41.1%	41.1%	15.6%	26.7%	26.7%	11.1%	22.2%	22.2%
Maximum Green (s)	13.5	37.5	37.5	7.5	31.5	31.5	9.0	19.0	19.0	5.0	15.0	15.0
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min	Min	None	None	None	None	None	None
Act Effct Green (s)	49.5	39.6	39.6	37.2	30.4	30.4	8.6	20.7	20.7	16.0	11.0	11.0
Actuated g/C Ratio	0.59	0.47	0.47	0.44	0.36	0.36	0.10	0.24	0.24	0.19	0.13	0.13
v/c Ratio	0.90	0.29	0.44	0.18	0.90	0.18	0.66	0.13	0.01	0.15	0.31	0.68
Control Delay	51.1	15.8	3.8	10.0	37.6	0.6	54.0	29.0	0.0	24.6	39.4	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	15.8	3.8	10.0	37.6	0.6	54.0	29.0	0.0	24.6	39.4	16.4
LOS	D	B	A	B	D	A	D	C	A	C	D	B
Approach Delay		21.7			32.3			46.9			21.0	
Approach LOS		C			C			D			C	

Intersection Summary

Area Type: Other

Cycle Length: 90

Short Term Option

AM Peak

2028 Sensitivity

Actuated Cycle Length: 84.6

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.90

Intersection Signal Delay: 28.0

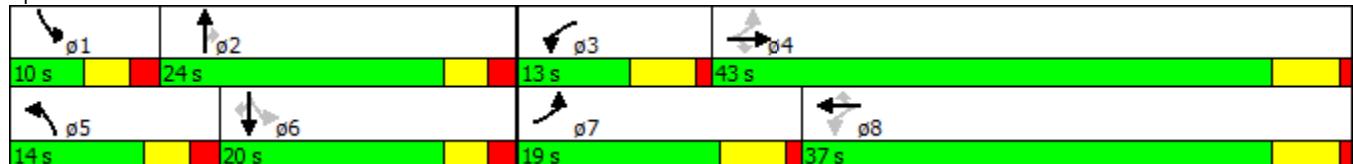
Intersection LOS: C

Intersection Capacity Utilization 68.0%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report
2028 AM - Option Sensitivity

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	86.9	39.3	45.3	49.7	25.6	93.1	106.0	30.2	48.5	48.7	37.8	36.4
Average Queue (m)	35.9	15.4	18.4	7.4	11.0	52.9	58.7	10.5	16.0	24.8	10.3	9.4
95th Queue (m)	66.4	32.6	36.4	29.1	21.3	81.7	89.1	22.1	36.9	42.7	26.4	25.8
Link Distance (m)		253.1	253.1			238.1	238.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0				130.0	110.0			55.0	85.0	85.0	60.0
Storage Blk Time (%)								0	12			10
Queuing Penalty (veh)								0	13			13

Intersection: 3:

Movement	SB
Directions Served Maximum	T
Queue (m) Average Queue (m)	35.6
95th Queue (m)	12.8
Link Distance (m) Upstream	794.5
Blk Time (%) Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	10

Short Term Option
PM Peak

2028



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑↑	↑	↑	↑↑	↑
Volume (vph)	101	869	96	11	402	25	272	54	57	143	49	327
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1172	3413	965	1489	3083	1035	2965	1360	1512	1583	1276	1430
Flt Permitted	0.435			0.222			0.950			0.720		
Satd. Flow (perm)	536	3413	965	348	3083	1035	2965	1360	1512	1200	1276	1430
Right Turn on Red				Yes			Yes			Yes		Yes
Satd. Flow (RTOR)				210			210			218		297
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			262.5			896.2			812.0	
Travel Time (s)		12.3			11.8			64.5			58.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	50%	3%	63%	18%	14%	52%	15%	36%	4%	11%	45%	10%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	106	915	101	12	423	26	286	57	60	151	52	344
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	10.5	25.5	25.5	10.5	25.5	25.5	10.0	15.0	15.0	10.0	15.0	15.0
Total Split (s)	10.5	26.0	26.0	10.5	26.0	26.0	13.0	16.5	16.5	12.0	15.5	15.5
Total Split (%)	16.2%	40.0%	40.0%	16.2%	40.0%	40.0%	20.0%	25.4%	25.4%	18.5%	23.8%	23.8%
Maximum Green (s)	5.0	20.5	20.5	5.0	20.5	20.5	8.0	11.5	11.5	7.0	10.5	10.5
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min	Min	None	None	None	None	None	None
Act Effct Green (s)	27.3	26.3	26.3	24.1	20.2	20.2	8.0	14.0	14.0	17.0	10.3	10.3
Actuated g/C Ratio	0.44	0.42	0.42	0.39	0.32	0.32	0.13	0.23	0.23	0.27	0.17	0.17
v/c Ratio	0.37	0.63	0.19	0.05	0.42	0.05	0.75	0.19	0.12	0.41	0.25	0.71
Control Delay	14.7	18.1	0.8	9.8	18.7	0.2	41.6	24.9	0.5	18.9	27.3	15.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.7	18.1	0.8	9.8	18.7	0.2	41.6	24.9	0.5	18.9	27.3	15.4
LOS	B	B	A	A	B	A	D	C	A	B	C	B
Approach Delay		16.2			17.5			33.1			17.5	
Approach LOS		B			B			C			B	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 62.2

Natural Cycle: 65

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 19.4

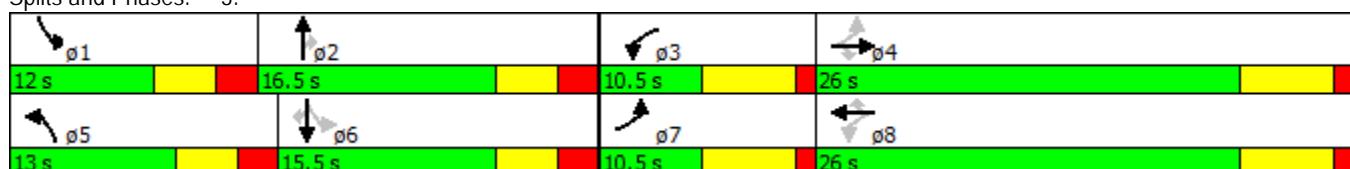
Intersection LOS: B

Intersection Capacity Utilization 58.3%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2028 PM - Option

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	45.9	55.2	58.2	5.6	16.7	37.9	41.7	24.6	39.2	46.4	39.8	43.0
Average Queue (m)	18.8	27.0	32.1	0.2	2.4	18.7	20.5	4.6	18.0	24.5	15.1	21.0
95th Queue (m)	36.8	45.7	50.2	3.6	10.3	31.0	35.2	15.9	32.8	38.3	31.5	39.0
Link Distance (m)		253.1	253.1			242.1	242.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0			130.0	110.0			55.0	85.0	85.0		60.0
Storage Blk Time (%)											15	
Queuing Penalty (veh)											49	

Intersection: 3:

Movement	SB
Directions Served	T
Maximum Queue (m)	36.5
Average Queue (m)	11.3
95th Queue (m)	26.6
Link Distance (m)	794.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	9
Queuing Penalty (veh)	41

Network Summary

Network wide Queuing Penalty: 90

Short Term Option
PM Peak

2028 Sensitivity

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group												
Lane Configurations	↑	↑↑	↑	↑	↑↑	↑	↑↑	↑	↑	↑	↑↑	↑
Volume (vph)	121	1043	115	13	482	30	326	65	68	172	59	392
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	150.0		130.0	110.0		55.0	85.0		15.0	60.0		15.0
Storage Lanes	1		1	1		1	2		1	1		1
Taper Length (m)	80.0			70.0			70.0			35.0		
Satd. Flow (prot)	1172	3413	965	1489	3083	1035	2965	1360	1512	1583	1276	1430
Flt Permitted	0.318			0.165			0.950			0.713		
Satd. Flow (perm)	392	3413	965	259	3083	1035	2965	1360	1512	1188	1276	1430
Right Turn on Red			Yes			Yes			Yes		Yes	
Satd. Flow (RTOR)			170			170			177			218
Link Speed (k/h)		80			80			50			50	
Link Distance (m)		273.5			262.5			896.2			812.0	
Travel Time (s)		12.3			11.8			64.5			58.5	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	50%	3%	63%	18%	14%	52%	15%	36%	4%	11%	45%	10%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	127	1098	121	14	507	32	343	68	72	181	62	413
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	10.5	25.5	25.5	10.5	25.5	25.5	10.0	15.0	15.0	10.0	15.0	15.0
Total Split (s)	15.0	34.0	34.0	10.5	29.5	29.5	15.0	20.5	20.5	15.0	20.5	20.5
Total Split (%)	18.8%	42.5%	42.5%	13.1%	36.9%	36.9%	18.8%	25.6%	25.6%	18.8%	25.6%	25.6%
Maximum Green (s)	9.5	28.5	28.5	5.0	24.0	24.0	10.0	15.5	15.5	10.0	15.5	15.5
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	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	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag									
Lead-Lag Optimize?	Yes											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min	Min	None	None	None	None	None	None
Act Effct Green (s)	32.2	30.5	30.5	24.9	21.1	21.1	10.2	18.5	18.5	23.7	14.5	14.5
Actuated g/C Ratio	0.44	0.42	0.42	0.34	0.29	0.29	0.14	0.25	0.25	0.33	0.20	0.20
v/c Ratio	0.47	0.77	0.24	0.08	0.57	0.08	0.83	0.20	0.14	0.42	0.25	0.90
Control Delay	18.6	23.6	2.5	12.7	26.2	0.4	51.6	28.1	0.6	19.6	29.2	39.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.6	23.6	2.5	12.7	26.2	0.4	51.6	28.1	0.6	19.6	29.2	39.8
LOS	B	C	A	B	C	A	D	C	A	B	C	D
Approach Delay		21.2			24.3			40.7			33.2	
Approach LOS		C			C			D			C	

Intersection Summary

Area Type: Other

Cycle Length: 80

Short Term Option

PM Peak

2028 Sensitivity

Actuated Cycle Length: 72.8

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.90

Intersection Signal Delay: 27.5

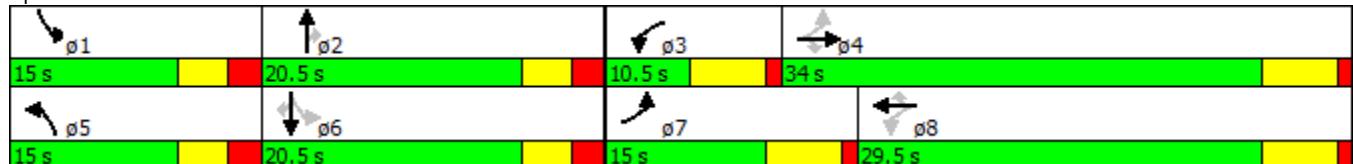
Intersection LOS: C

Intersection Capacity Utilization 64.1%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 3:



Queuing and Blocking Report

2028 PM - Option Sensitivity

4/20/2017

Intersection: 3:

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	L	T	L
Maximum Queue (m)	48.3	60.8	67.5	14.0	13.4	53.6	57.7	23.2	59.0	56.4	40.8	63.3
Average Queue (m)	23.3	35.4	40.7	0.7	2.9	26.3	29.2	5.9	23.9	29.9	16.8	28.1
95th Queue (m)	42.1	55.3	60.5	7.6	10.4	43.1	47.1	18.0	44.4	47.0	32.9	51.0
Link Distance (m)		253.1	253.1			242.1	242.1				882.4	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	150.0			130.0	110.0			55.0	85.0	85.0		60.0
Storage Blk Time (%)								0			18	1
Queuing Penalty (veh)								0			72	3

Intersection: 3:

Movement	SB
Directions Served	T
Maximum Queue (m)	38.5
Average Queue (m)	16.4
95th Queue (m)	32.7
Link Distance (m)	794.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	13
Queuing Penalty (veh)	75

Network Summary

Network wide Queuing Penalty: 149

