

February 10, 2023

Edgemont East Estates Ltd.
217 Sturgeon Place
Saskatoon, SK S7K 4C5

Attention: Mr. Darren Hagen
President

Re: Edgemont East Estates Traffic Impact Assessment

Dear Mr. Hagen:

KGS Group is pleased to submit this letter report summarizing the analysis, findings, and recommendations for the Edgemont East Estates Traffic Impact Assessment (TIA). The TIA identifies the traffic volumes generated by the proposed development on the adjacent road network and addresses potential mitigation measures to accommodate the development.

1.0 BACKGROUND

Edgemont East Estates, a 130-single family unit development, will be located in the lands immediately south of Grasswood Road between Clarence Avenue South (Range Road 3053) and Range Road 3052 within the R.M. of Corman Park. The development will include two accesses to Grasswood Road, with the east access approximately 130m west of Range Road 3052 and the west access approximately 1 km west of the east access and approximately 500m east of Clarence Avenue South.

The site context for the Edgemont East Estates development in proximity to other developments is illustrated in Figure 1.

Edgemont Park Estates and Ravenswood Estates are approved developments along Clarence Avenue South to the south of Edgemont East Estates. A recently completed (2017) Traffic Impact Assessment for Edgemont Park Estates developed a full-build-out traffic volume model (Total Forecast Traffic Volumes) for the area. It was determined that the Edgemont Park Estates Traffic Impact Assessment would serve as a base model for the Edgemont East Estates TIA, upon which Edgemont East Estates site-generated traffic would be applied. The rationale for this approach was a combination of the extent of local area development included in the Edgemont Park Estates study and recent completion date, in conjunction with on-going traffic volume fluctuations as a result of COVID-19 restrictions. This approach was confirmed through discussion with the R.M. of Corman Park.



FIGURE 1 SITE CONTEXT

2.0 EXISTING CONDITIONS

Clarence Avenue South is a two-lane undivided paved roadway where the posted speeds are 60 km/h north of Grasswood Road and 80 km/h to the south. Grasswood Road is posted at 80 km/h.

The Clarence Avenue South and Grasswood Road intersection is a four-way stop-controlled intersection with one lane on each approach.

3.0 TRAFFIC FORECAST

A traffic forecast, including an estimate of background traffic and site-generated traffic, was conducted to estimate the future traffic volumes for the opening date of the proposed Edgemont East Estates residential development.

Background Traffic Growth

Background traffic growth refers to the amount by which traffic volumes in the area would increase even if the proposed site development did not proceed. The Edgemont Estates Traffic Impact Assessment (titled at the time as *Prairie Lane Estate Traffic Impact Assessment*), completed by WSP Canada Inc. on September 14, 2017, developed a traffic forecast for the area based on surrounding development. To determine the background traffic forecast, a 1% per year linear growth was applied to the total traffic forecast from the Edgemont Estates TIA, for an overall 5% growth on both Clarence Avenue South and Grasswood Road.

The morning and afternoon peak hour background traffic volumes are illustrated in Figure 2 and Figure 3, respectively.

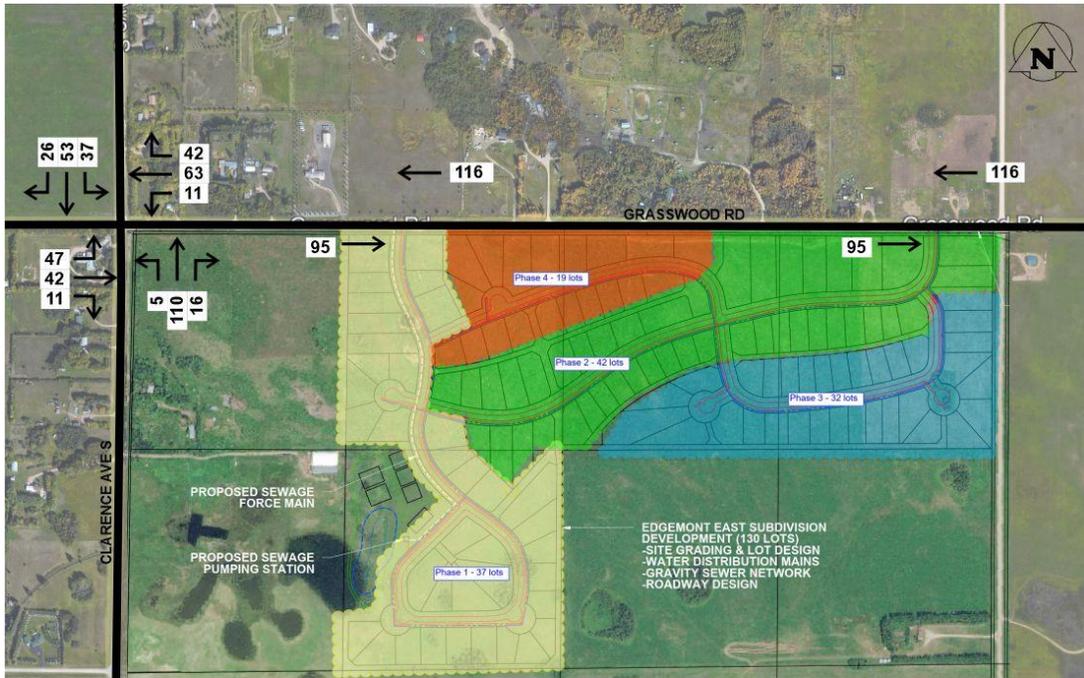


FIGURE 2 BACKGROUND TRAFFIC FORECAST – AM PEAK HOUR

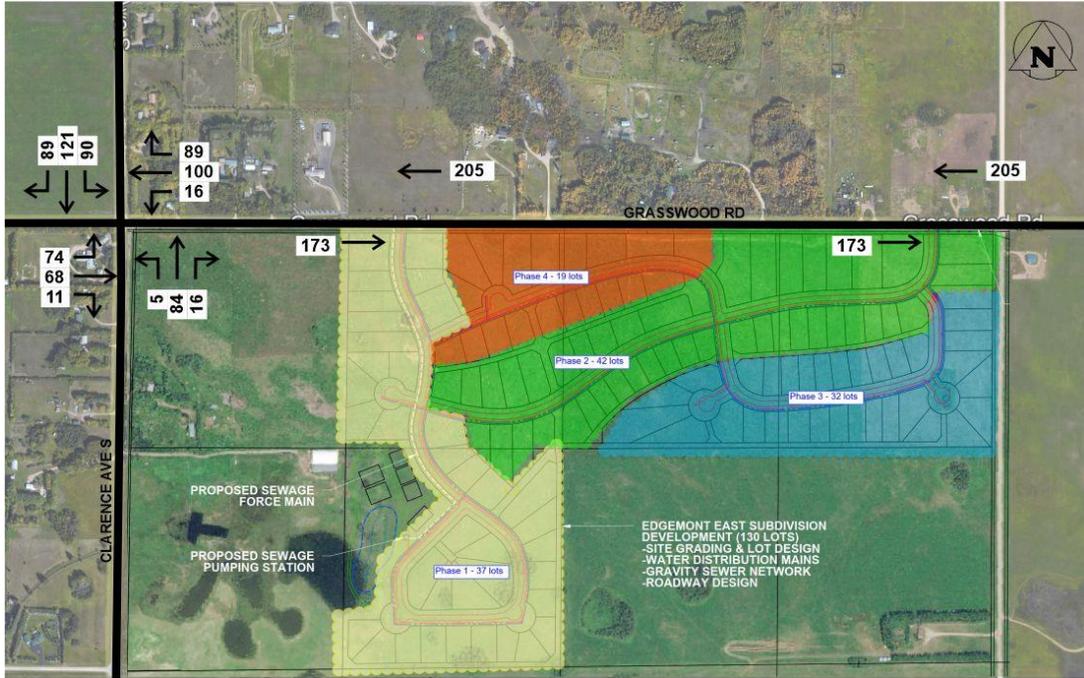


FIGURE 3 BACKGROUND TRAFFIC FORECAST – PM PEAK HOUR

Total Traffic Forecast

The proposed Edgemont East Estates residential development includes 130 units at full build-out. The Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition, was used to estimate the trips generated by the proposed development during the morning and afternoon peak hours. The ITE Land Use Single-Family Detached Housing (ITE Code 210) was selected to represent the proposed site.

Table 1 summarizes the land use code, trip rate, and directional distribution for the weekday peak hours.

Table 1 Proposed Trip Generation Rate

Land Use	ITE Code	Peak Hour	Trip Generation Equation	Directional Distribution	
				Enter	Exit
Residential	210	AM PK	$T = 0.71(X) + 4.80$	25%	75%
		PM PK	$\ln(T) = 0.96 \ln(X) + 0.20$	63%	37%

T = Number of Trips X = Number of Dwelling Units

The proposed Edgemont East Estates development is not anticipated to generate pass-by trips nor have site synergy due to being a single use development.

The proposed Edgemont East Estates development is anticipated to generate the following traffic volumes during peak hours:

- Morning Peak Hour – a total of 97 trips with 24 vehicles entering and 73 vehicles exiting the site
- Afternoon Peak Hour – a total of 131 trips with 82 vehicles entering and 49 vehicles exiting the site

Trip Distribution and Assignment

The traffic forecast was completed by distributing the site-related traffic volumes and assigning them to the road network based on an assessment of how people will access and egress the site. Trip distribution refers to the origins and destinations of the site-generated trips while trip assignment assesses the actual route that the vehicles will take between their origin and destination. The assignment process assumes that motorists will use the most efficient route.

The trip distribution was estimated based on the traffic patterns surrounding the proposed site. Due to the proximity of Saskatoon, the following distribution was assumed:

- 70% of the traffic will travel to / from the north using Clarence Avenue South
- 5% of the traffic will travel to / from the south using Clarence Avenue South
- 20% of the traffic will travel to / from the east using Grasswood Road
- 5% of the traffic will travel to / from the west using Grasswood Road

The site-generated trips were then assigned to the adjacent intersections based on existing traffic patterns and where the proposed site accesses are located. Trips generated by the proposed Edgemont East Estates residential development are presented in Figures 4 and 5.

The site generated trips were added to the background traffic forecast to obtain the opening day traffic volumes. The total morning peak hour traffic forecast is illustrated in Figure 6 and the afternoon peak hour traffic forecast is illustrated in Figure 7.

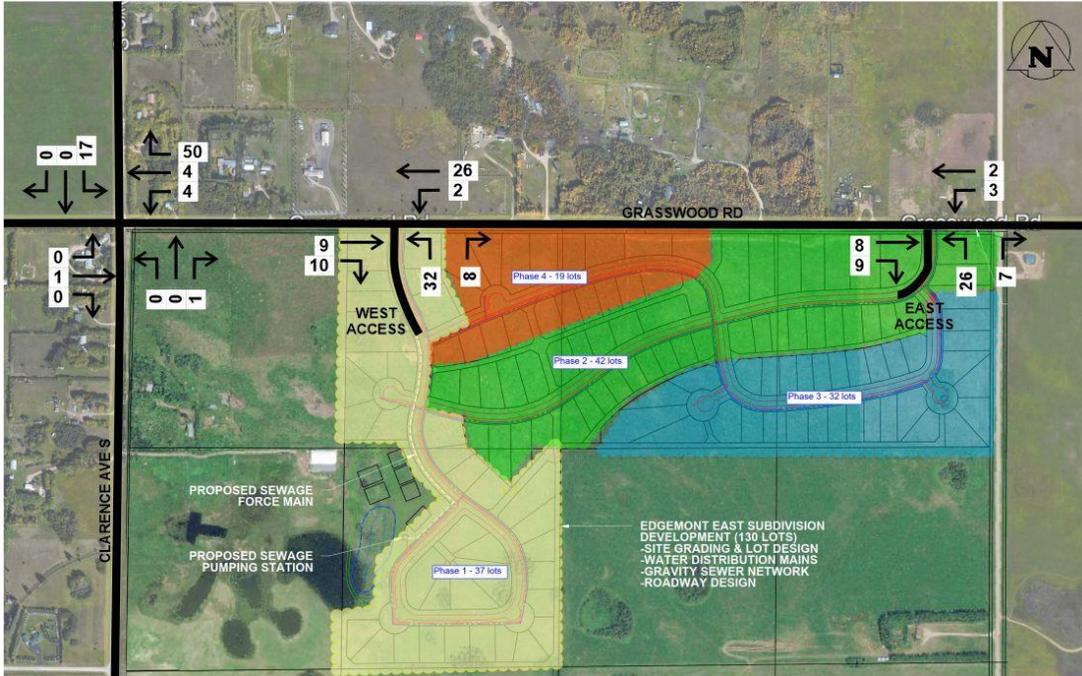


FIGURE 4 SITE-GENERATED TRIPS - AM PEAK HOUR

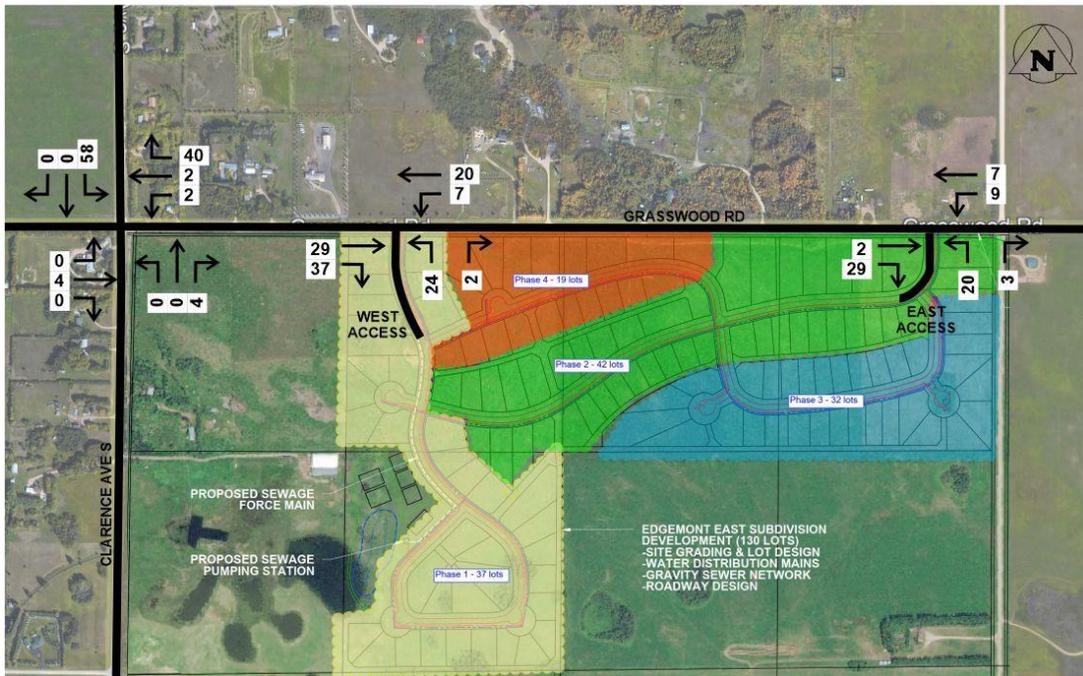


FIGURE 5 SITE-GENERATED TRIPS - PM PEAK HOUR

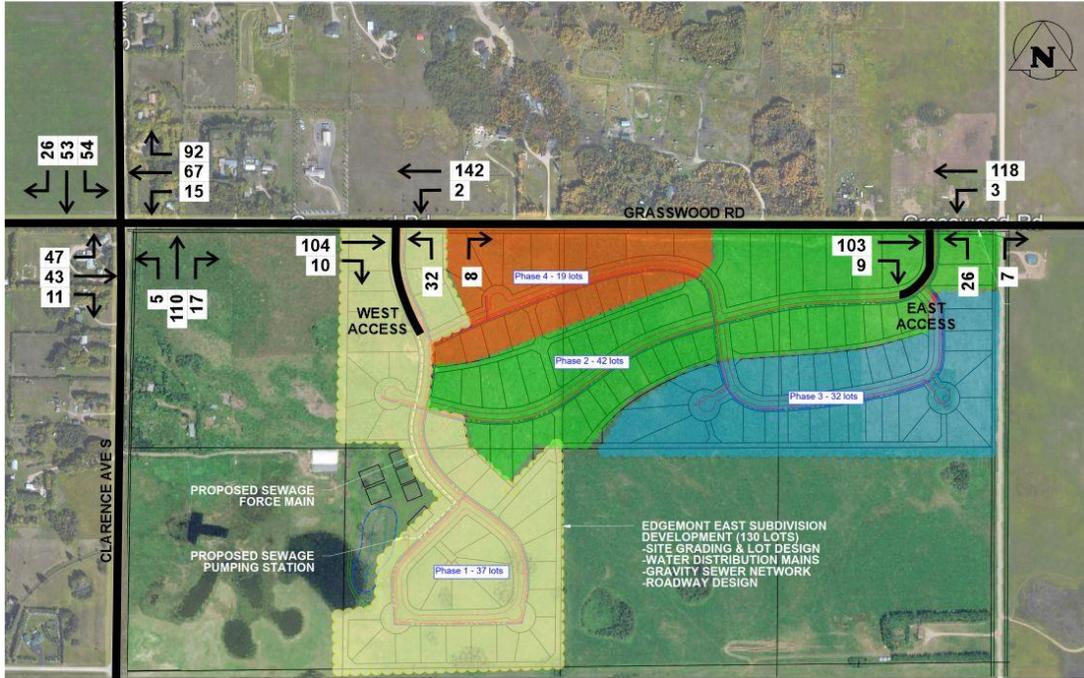


FIGURE 6 TOTAL TRAFFIC FORECAST – AM PEAK HOUR

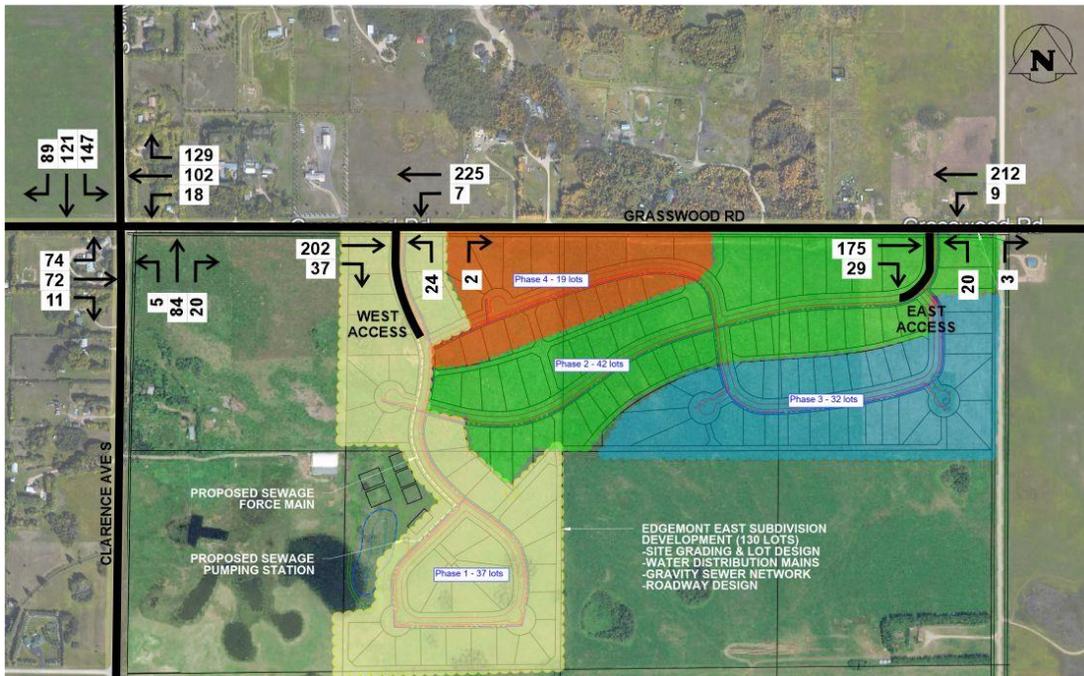


FIGURE 7 TOTAL TRAFFIC FORECAST – PM PEAK HOUR

4.0 TRAFFIC OPERATIONS

Background and total forecast volumes have been assessed using Synchro 11.0 (industry-standard traffic analysis software). The intersections were assessed during the morning and afternoon peak hours with no additional turning lanes or changes applied.

Level of service (LOS) analysis assesses the effectiveness of a transportation system alphabetically from A to F, with LOS A equating to the best operating conditions and LOS F representing the failure of a movement or intersection. LOS D is typically considered the limit of acceptable operation for a rural environment and excessive delays tend to occur beyond this threshold.

The volume-to-capacity (v/c) ratio is representative of congestion and available capacity and may be used to identify a movement’s ability to accommodate fluctuations in traffic flow. V/C values of 0.80 or greater typically indicate a system that has reached its limit of operational effectiveness. The 95th percentile queue length, determined using SimTraffic, represents the maximum length of a queue a movement may experience with 95th percentile traffic volumes.

Tables 2 presents the analysis results for the Clarence Avenue South and Grasswood Road intersection for the morning and afternoon peak hour background traffic forecast. Table 3 and Table 4 present the analysis results for all study intersections for the morning and afternoon peak hour total traffic forecast.

TABLE 2 BACKGROUND FORECAST INTERSECTION OPERATIONS FOR CLARENCE AVENUE SOUTH & GRASSWOOD RD INTERSECTION

Intersection	Parameter	Eastbound			Westbound			Northbound			Southbound			Overall LOS (Delay)
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Morning Peak Hour	LOS	A			A			A			A			A (8.5 s)
	Delay (s)	8.6			8.4			8.6			8.5			
	v/c ratio	0.14			0.16			0.18			0.16			
	Queue (m)	13.9			15.5			15.3			16.9			
Afternoon Peak Hour	LOS	B			B			A			B			B (10.8 s)
	Delay (s)	10.2			10.3			9.4			11.9			
	v/c ratio	0.24			0.31			0.17			0.44			
	Queue (m)	15.7			21.7			15.8			24.5			

**TABLE 3 TOTAL FORECAST INTERSECTION OPERATIONS
MORNING PEAK HOUR**

Intersection	Parameter	Eastbound			Westbound			Northbound			Southbound			Overall LOS (Delay)
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM Peak Hour														
Grasswood Rd & Clarence Ave S	LOS	A			A			A			A			A (8.9 s)
	Delay (s)	8.8			8.9			8.9			9.0			
	v/c ratio	0.15			0.24			0.19			0.19			
	Queue (m)	13.3			26.9			15.6			17.5			
Grasswood Rd & West Access	LOS	-			A			B						A (1.4 s)
	Delay (s)	-			7.5			10.1						
	v/c ratio	-			0.01			0.06						
	Queue (m)	-			1.3			14.9						
Grasswood Rd & East Access	LOS	-			A			A						A (1.3 s)
	Delay (s)	-			7.5			9.9						
	v/c ratio	-			0.01			0.05						
	Queue (m)	-			1.5			14.5						

**TABLE 4 TOTAL FORECAST INTERSECTION OPERATIONS
AFTERNOON PEAK HOUR**

Intersection	Parameter	Eastbound			Westbound			Northbound			Southbound			Overall LOS (Delay)
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM Peak Hour														
Grasswood Rd & Clarence Ave S	LOS	B			B			A			B			B (12.4 s)
	Delay (s)	10.9			11.6			9.9			14.5			
	v/c ratio	0.27			0.39			0.18			0.55			
	Queue (m)	15.1			23.0			16.3			28.5			
Grasswood Rd & West Access	LOS	-			A			B						A (0.7 s)
	Delay (s)	-			7.8			11.8						
	v/c ratio	-			0.01			0.05						
	Queue (m)	-			2.9			13.1						
Grasswood Rd & East Access	LOS	-			A			B						A (0.7 s)
	Delay (s)	-			7.7			11.3						
	v/c ratio	-			0.01			0.04						
	Queue (m)	-			2.9			12.6						

The capacity analysis results indicate:

- **Clarence Avenue South and Grasswood Road Intersection** | is expected to continue to operate acceptably during the morning and afternoon peak hours (LOS A/B) with the proposed development traffic. There is minimal queueing anticipated, with approximately 2-4 vehicles queued on each approach during peak commute times. The traffic generated by the Edgemont East Estates is expected to have a minimal impact to the intersection operations at the Clarence Avenue South and Grasswood Road intersection.
- **Grasswood Road and West Access Intersection** | is anticipated to operate well during both peak hours (LOS A) at full build-out. Negligible delay is anticipated for traffic traveling in the eastbound direction, and a minor delay (8 s) is anticipated in the westbound direction. Traffic exiting the proposed Edgemont East Estates development via the west access is anticipated to be delayed approximately 10 - 12 s with approximately a 2-vehicle queue during peak commute times.
- **Grasswood Road and East Access Intersection** | is anticipated to operate well during both peak hours (LOS A) at full build-out. Negligible delay is anticipated for traffic traveling in the eastbound direction, and a minor delay (8 s) is anticipated in the westbound direction. Traffic exiting the proposed Edgemont East

Estates development is anticipated to be delayed approximately 10 – 12 s with approximately a 2-vehicle queue during peak commute times.

5.0 WARRANTS

Illumination Warrant Assessment

Intersection illumination warrants were conducted using the Ministry of Highways and Infrastructure (MHI) design manual guidelines to improve the traffic safety along Grasswood Road at the west access and east access intersections for the full build-out phase using the total forecast volumes, existing configuration and alignment. It should be noted that the MHI warrants were developed for highways with a higher posted speed than Grasswood Road but were used in the analysis as an indication of potential appropriateness of lights to improve visibility at night.

As per MHI DM 2621-2 for intersection area lighting warrant, the study intersections do not meet the warrant requirement for area lighting.

As per MHI DM 2621-1 for intersection delineation lighting systems, all rural and urban intersections with provincial highways qualify for delineation lighting where the traffic volumes for the intersecting roadways exceed 150 vehicles-per-day (vpd). Delineation lighting would be warranted at both the east and west access to the proposed Edgemont residential development if Grasswood Road was a provincial highway. A streetlight at each access point would improve visibility for drivers at the intersection during evenings.

6.0 SIGHT DISTANCE

The two proposed accesses into the proposed development will be stop-controlled on the minor approach to Grasswood Road and are anticipated to have sight distance above the minimum requirement based on the Transportation Association of Canada's Geometric Design Guide for Canadian Roads. Grasswood Road is very flat with little vertical change through the study area.

The development should ensure that sufficient sight distance is accommodated through the sight triangles at the site accesses by avoiding planting new vegetation or constructing buildings or other infrastructure that will restrict driver's sight lines. The detailed design of accesses will need to ensure power poles do not obstruct a driver's view from the stop bar at the accesses, as well as driver's view approaching the access along Grasswood Road.

7.0 CONCLUSION AND RECOMMENDATIONS

The TIA analysis and findings identify that the 130 units proposed as part of the Edgemont East Estates development will have a negligible impact on operations along Grasswood Road and at the study intersections. No additional turning lanes or other geometric modifications will be necessary to accommodate the proposed development.

A streetlight at each of the access intersections would improve visibility at night and would be warranted if Grasswood Road were a provincial highway. Consideration for implementing a streetlight is recommended but it is acknowledged that other similar intersections within the R.M. are not currently illuminated.

We trust that this letter will assist in obtaining approval for the Edgemont East Estates development application. Do not hesitate to contact either Destiny or Nathan should you require further clarification.

Prepared By:

Approved By:

Destiny Piper, P.Eng.
Transportation Engineer

Nathan Gray, P.Eng., PTOE, PMP
Senior Transportation Engineer

DP

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for Edgemont East Estates Ltd. in accordance with the agreement between KGS Group and Edgemont East Estates Ltd. (the “Agreement”). This report represents KGS Group’s professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by Edgemont East Estates Ltd. Unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group’s work.

Third Party Use of Report

Any use a third party makes of this report or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

APPENDIX A

Synchro Reports

Intersection	
Intersection Delay, s/veh	8.5
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	47	42	11	11	63	42	5	110	16	37	53	26
Future Vol, veh/h	47	42	11	11	63	42	5	110	16	37	53	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	51	46	12	12	68	46	5	120	17	40	58	28
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.6	8.4	8.6	8.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	47%	9%	32%
Vol Thru, %	84%	42%	54%	46%
Vol Right, %	12%	11%	36%	22%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	131	100	116	116
LT Vol	5	47	11	37
Through Vol	110	42	63	53
RT Vol	16	11	42	26
Lane Flow Rate	142	109	126	126
Geometry Grp	1	1	1	1
Degree of Util (X)	0.181	0.143	0.157	0.16
Departure Headway (Hd)	4.567	4.735	4.494	4.58
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	785	757	797	782
Service Time	2.598	2.769	2.527	2.614
HCM Lane V/C Ratio	0.181	0.144	0.158	0.161
HCM Control Delay	8.6	8.6	8.4	8.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.7	0.5	0.6	0.6

Intersection	
Intersection Delay, s/veh	10.8
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	74	68	11	16	100	89	5	84	16	90	121	89
Future Vol, veh/h	74	68	11	16	100	89	5	84	16	90	121	89
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, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	72	12	17	105	94	5	88	17	95	127	94
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.2	10.3	9.4	11.9
HCM LOS	B	B	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	5%	48%	8%	30%
Vol Thru, %	80%	44%	49%	40%
Vol Right, %	15%	7%	43%	30%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	105	153	205	300
LT Vol	5	74	16	90
Through Vol	84	68	100	121
RT Vol	16	11	89	89
Lane Flow Rate	111	161	216	316
Geometry Grp	1	1	1	1
Degree of Util (X)	0.164	0.243	0.304	0.441
Departure Headway (Hd)	5.341	5.442	5.07	5.023
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	671	659	708	720
Service Time	3.376	3.479	3.106	3.023
HCM Lane V/C Ratio	0.165	0.244	0.305	0.439
HCM Control Delay	9.4	10.2	10.3	11.9
HCM Lane LOS	A	B	B	B
HCM 95th-tile Q	0.6	0.9	1.3	2.3

Intersection

Int Delay, s/veh 1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	104	10	2	142	32	8
Future Vol, veh/h	104	10	2	142	32	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	113	11	2	154	35	9

Major/Minor

	Major1	Major2	Minor1		
Conflicting Flow All	0	0	124	0	277
Stage 1	-	-	-	-	119
Stage 2	-	-	-	-	158
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1463	-	713
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	871
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1463	-	712
Mov Cap-2 Maneuver	-	-	-	-	712
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	870

Approach

	EB	WB	NB
HCM Control Delay, s	0	0.1	10.1
HCM LOS			B

Minor Lane/Major Mvmt

	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	747	-	-	1463	-
HCM Lane V/C Ratio	0.058	-	-	0.001	-
HCM Control Delay (s)	10.1	-	-	7.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection						
Int Delay, s/veh	1.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	103	9	3	118	26	7
Future Vol, veh/h	103	9	3	118	26	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	112	10	3	128	28	8

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	122	0	251
Stage 1	-	-	-	-	117
Stage 2	-	-	-	-	134
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1465	-	738
Stage 1	-	-	-	-	908
Stage 2	-	-	-	-	892
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1465	-	737
Mov Cap-2 Maneuver	-	-	-	-	737
Stage 1	-	-	-	-	908
Stage 2	-	-	-	-	890

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	9.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	772	-	-	1465	-
HCM Lane V/C Ratio	0.046	-	-	0.002	-
HCM Control Delay (s)	9.9	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Intersection Delay, s/veh	8.9
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	47	43	11	15	67	92	5	110	17	54	53	26
Future Vol, veh/h	47	43	11	15	67	92	5	110	17	54	53	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	51	47	12	16	73	100	5	120	18	59	58	28
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.8	8.9	8.9	9
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	47%	9%	41%
Vol Thru, %	83%	43%	39%	40%
Vol Right, %	13%	11%	53%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	132	101	174	133
LT Vol	5	47	15	54
Through Vol	110	43	67	53
RT Vol	17	11	92	26
Lane Flow Rate	143	110	189	145
Geometry Grp	1	1	1	1
Degree of Util (X)	0.189	0.149	0.234	0.192
Departure Headway (Hd)	4.74	4.874	4.461	4.771
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	753	732	802	749
Service Time	2.789	2.926	2.508	2.82
HCM Lane V/C Ratio	0.19	0.15	0.236	0.194
HCM Control Delay	8.9	8.8	8.9	9
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.7	0.5	0.9	0.7

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	202	37	7	225	24	2
Future Vol, veh/h	202	37	7	225	24	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	213	39	7	237	25	2

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	252	0	484
Stage 1	-	-	-	-	233
Stage 2	-	-	-	-	251
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1313	-	542
Stage 1	-	-	-	-	806
Stage 2	-	-	-	-	791
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1313	-	539
Mov Cap-2 Maneuver	-	-	-	-	539
Stage 1	-	-	-	-	806
Stage 2	-	-	-	-	786

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	553	-	-	1313	-
HCM Lane V/C Ratio	0.049	-	-	0.006	-
HCM Control Delay (s)	11.8	-	-	7.8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	175	29	9	212	20	3
Future Vol, veh/h	175	29	9	212	20	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	184	31	9	223	21	3

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	215	0	441
Stage 1	-	-	-	-	200
Stage 2	-	-	-	-	241
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1355	-	574
Stage 1	-	-	-	-	834
Stage 2	-	-	-	-	799
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1355	-	569
Mov Cap-2 Maneuver	-	-	-	-	569
Stage 1	-	-	-	-	834
Stage 2	-	-	-	-	793

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	11.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	594	-	-	1355	-
HCM Lane V/C Ratio	0.041	-	-	0.007	-
HCM Control Delay (s)	11.3	-	-	7.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	74	72	11	18	102	129	5	84	20	147	121	89
Future Vol, veh/h	74	72	11	18	102	129	5	84	20	147	121	89
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, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	76	12	19	107	136	5	88	21	155	127	94
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.9	11.6	9.9	14.5
HCM LOS	B	B	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	5%	47%	7%	41%
Vol Thru, %	77%	46%	41%	34%
Vol Right, %	18%	7%	52%	25%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	109	157	249	357
LT Vol	5	74	18	147
Through Vol	84	72	102	121
RT Vol	20	11	129	89
Lane Flow Rate	115	165	262	376
Geometry Grp	1	1	1	1
Degree of Util (X)	0.18	0.265	0.384	0.547
Departure Headway (Hd)	5.64	5.768	5.271	5.244
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	633	621	681	688
Service Time	3.697	3.823	3.32	3.287
HCM Lane V/C Ratio	0.182	0.266	0.385	0.547
HCM Control Delay	9.9	10.9	11.6	14.5
HCM Lane LOS	A	B	B	B
HCM 95th-tile Q	0.7	1.1	1.8	3.3



Design Manual

Section:

PARTIAL OR AREA LIGHTING

Subject:

Intersection Delineation

DEFINITIONS

Partial lighting is the illumination of key decision areas that demand full driver care and alertness by the placement of a limited number of luminaires.

Intersection delineation lighting consists of the installation of high pressure sodium (HPS) luminaire(s) over the intersecting roadway or median connector of divided highways for the purpose of illuminating vehicles entering or crossing the through highway route.

The luminaires provide the secondary benefit of visibly marking the location of the intersecting roadway on the provincial highway system.

POLICY

Partial roadway lighting, in the form of intersection delineation lighting, shall be provided at provincial highway intersections in accordance with the candidate and design criteria as noted herein and within Standard Plans 2621-1-1, 2621-1-2 and 2621-1-3.

CANDIDATE CRITERIA

All provincial highway to highway intersections qualify for intersection delineation lighting.

All intersections of the designated community access road with the provincial highway system qualify for intersection delineation lighting.

All rural and urban public highway intersections with a provincial highway with an intersecting roadway traffic volume greater than 150 AADT or 250 SADT for seasonal recreational roads qualify for intersection delineation lighting.

Assumed PM Volumes = 10% ADT

**West Access Intersecting AADT = 700 > 150 = warranted
East Access Intersecting AADT = 610 > 150 = warranted**

Section:

**PARTIAL OR AREA
LIGHTING**

Subject:

Intersection Delineation

COMMUNITY ACCESS ROADS

All intersections of the designated community access road with the provincial highway system qualify for intersection delineation lighting. Community access roads are assigned the 40 highway subsection identifier.

Intersection delineation lights for alternate access routes are subject to satisfying the minimum traffic volume criteria and priority ranking with all other provincial candidates.

PRIORITY RANKING

First priority should be given to any outstanding or new provincial highway to highway intersections where the availability of power permits an economical installation.

Next priority should be given to outstanding designated community access road intersections with a provincial highway where the availability of power permits an economical installation.

Other intersecting roadways that satisfy the 150 AADT or greater traffic criteria should be ranked on the basis of priority points. The candidate priority points are determined by use of Figure 2621-1-1 Intersection Delineation Lighting Priority Points.

A guideline for an acceptable price premium to bring power to the site is \$1,000 to \$2,000 per 100 AADT on the intersecting roadway.

Section:

PARTIAL OR AREA LIGHTING

Subject:

INTERSECTION DELINEATION

FIGURE 2621-1-1

DELINEATION LIGHTING PRIORITY RANKING POINTS

The purpose of this rating is to priority rank intersections for intersection delineation lighting. Points are assigned as follows:

	<u>Points</u>	<u>Maximum Points</u>
1. Highway Classification		
Arterial (major or minor)	5	
Collector	3	
Local	1	
2. AADT on Through Highway		
Points = $0.01 * AADT$		25
(Through highway intersection leg with highest AADT)		
3. AADT on Intersecting Roadway		
Points = $0.05 * AADT$		
(AADT on intersecting leg to be lit)		
4. Average Annual Number of Accidents		
Average annual number of night accidents last 3 years * 10		30

Section:

PARTIAL OR AREA LIGHTING

Subject:

INTERSECTION DELINEATION

FIGURE 2621-1-1
Continued

	<u>Points</u>	<u>Maximum Points</u>
5. Geometric Features		
5.1 Through Highway		
5.1.1 Channelized intersection treatment	5	
5.1.2 Divided Highway	5	
5.1.3 Intersection on horizontal curve	2	
5.1.4 Intersection off curve but within 100 m of curve (ST or TS)	1	
5.1.5 Intersection road surface visible:		
i) less than 180 m	2	
ii) less than 370 m	1	
5.1.6 Obstructed Sight Triangle in advance of intersection:		
i) one sight triangle obstructed	2	
ii) both sight triangles obstructed	3	
5.1.7 Intersection angle less than 70 or more than 110 degrees	2	
5.2 Intersecting Roadway		
5.2.1 Intersection road surface visible from less than 180 m	2	
5.2.2 Horizontal curve ending less than 60 m from the intersection	1	
5.2.3 Channelized intersection or divided roadway	5	
5.2.4 Signed Hospital access route	5	

Section:

PARTIAL OR AREA LIGHTING

Subject:

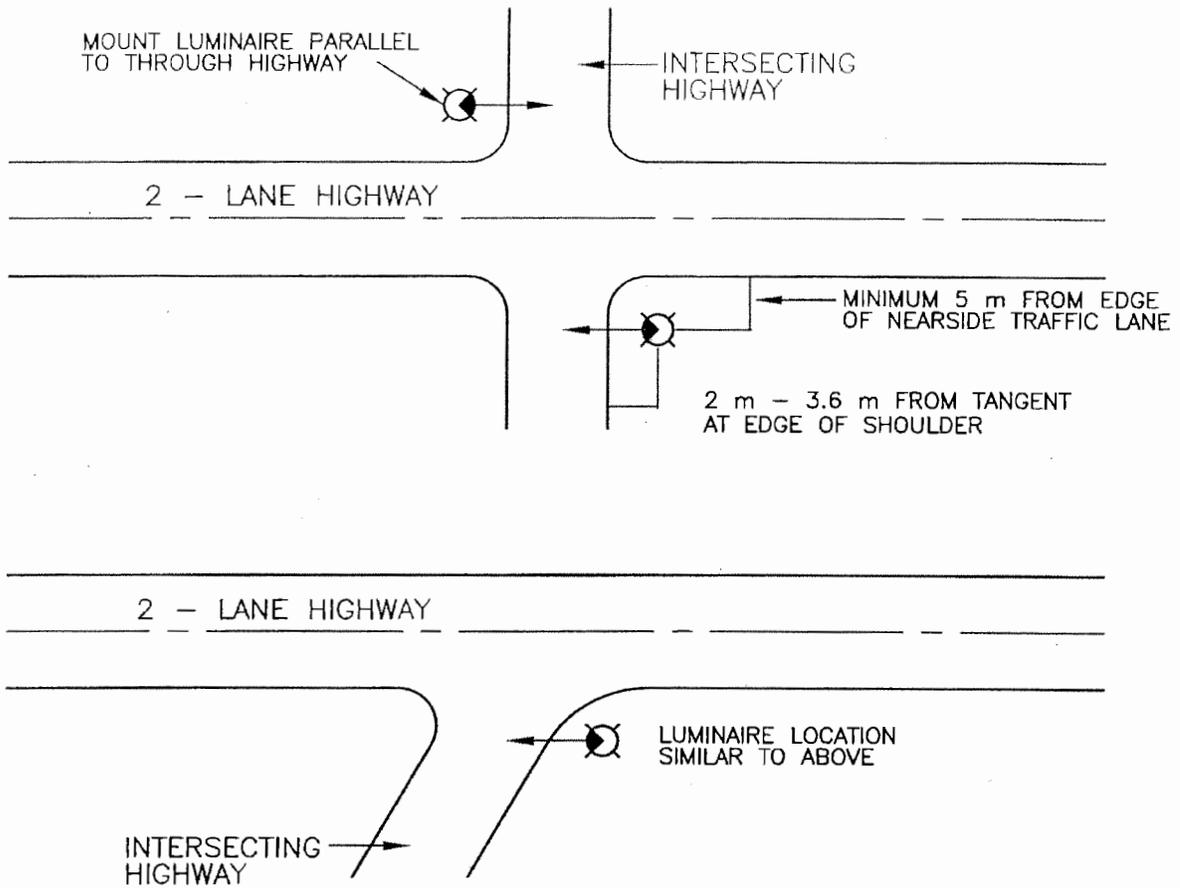
INTERSECTION DELINEATION

FIGURE 2621-1-1
Continued

	<u>Points</u>	<u>Maximum Points</u>
6. Environmental Factors		
Either		
6.1 Rural development with lighting : (within 150 m of intersecting leg)		
i) in four quadrants	8	
ii) in three quadrants	6	
iii) in two quadrants	4	
iv) in one quadrant	1	
or		
6.2 Urban built up area:		
i) highway commercial	8	
ii) residential	4	
iii) industrial with lighting	3	

NOTES:

1. Delineation lighting is not provided if there is already an equivalent urban street light within 25 m of the intersection.
2. High speed exit/entrance roadways partial lighting should be given higher priority than at grade intersections with 60 points or less.
3. To qualify for intersection delineation lighting candidates, other than provincial highways or designated community access roads, shall incur an intersecting roadway traffic volume \geq 150 AADT or 250 SADT for seasonal recreational roads.
4. Height of eye for road surface visibility should be 1.15 m.



Notes:

1. High Pressure Sodium Vapour Luminaire, photocell switch (150 HPS or equivalent).
2. 10.7 m high, 2.4 m davit steel pole, M.H. (road surface to luminaire) not less than 9.0 m.
3. Use approved type slip-joint or frangible base.
4. Underground wiring from nearest line pole to base of light pole.
5. Flange of slip-joint must not protrude more than 10 cm above ground.
6. Check traffic sign(s) and relocate if necessary to suit lighting.
7. At 4-leg intersections where one leg of the intersection is not a highway, a light should be installed where the road AADT is 150 or higher.



Saskatchewan Highways and Transportation

DELINEATION LIGHTING AT RURAL HIGHWAY INTERSECTIONS 2 LANE HIGHWAY

RECOMMENDED BY:	<i>[Signature]</i>	SENIOR DESIGN ENGINEER ENGINEERING SERVICES BR.	DATE	02-05-21	STANDARD PLAN NO	2621-1-1
APPROVED BY:	<i>[Signature]</i>	EXECUTIVE DIRECTOR ENGINEERING SERVICES BR.	DATE	02-06-05	SHEET	1 of 1

MOUNT LUMINAIRE PARALLEL TO DIVIDED HIGHWAY

INTERSECTING HIGHWAY

4 - LANE DIVIDED HIGHWAY

MINIMUM 5 m FROM EDGE OF NEAR SIDE TRAFFIC LANE

2 m - 3.6 m FROM TANGENT AT EDGE OF SHOULDER

SEE NOTE 7

4 - LANE DIVIDED HIGHWAY

SEE NOTE 7

INTERSECTING HIGHWAY

LUMINAIRE LOCATION SIMILAR TO ABOVE

Notes:

1. High Pressure Sodium Vapour Luminaire, photocell switch (150W HPS or equivalent).
2. 10.7 m high, 2.4 m davit steel pole, M.H. (road surface to luminaire) not less than 9.0 m.
3. Use approved type slip-joint or frangible base.
4. Underground wiring from nearest line pole to base of light pole.
5. Flange of slip-joint must not protrude more than 10 cm above ground.
6. Check traffic sign(s) and relocate if necessary to suit lighting.
7. a) At 4-leg intersections where one leg of the intersection is not a highway, a light shall be installed where the road AADT is 150 or higher.
b) When the light is not required on the intersection leg, it shall be installed in the median.

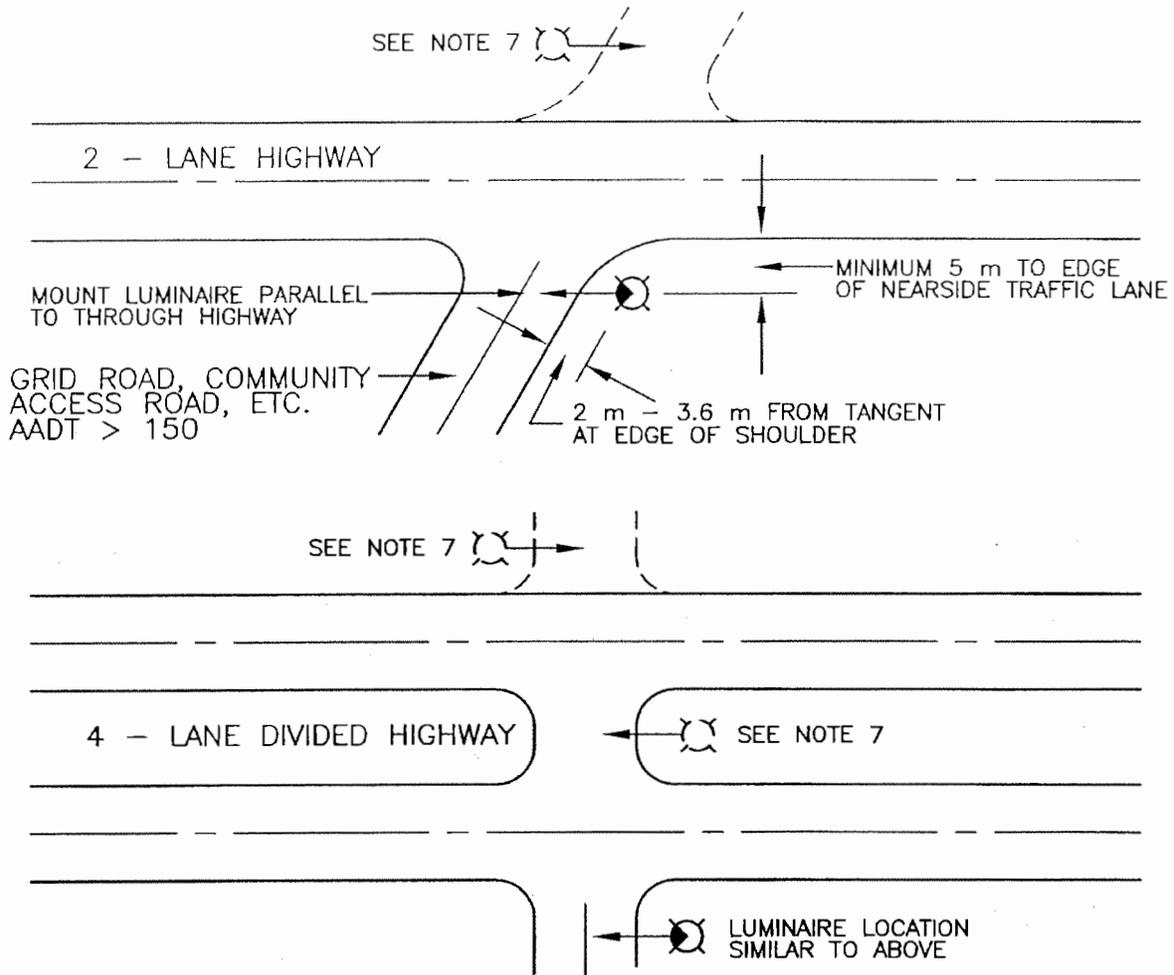


Saskatchewan Highways and Transportation

DELINEATION LIGHTING AT RURAL HIGHWAY INTERSECTIONS DIVIDED HIGHWAY

RECOMMENDED BY:	<i>[Signature]</i>	SENIOR DESIGN ENGINEER ENGINEERING SERVICES BR.	DATE	02-05-21	STANDARD PLAN NO	2621-1-2
APPROVED BY:	<i>[Signature]</i>	EXECUTIVE DIRECTOR ENGINEERING SERVICES BR.	DATE	02-06-05	SHEET	1 of 1

ACAD DWG: 2621-1-2.DWG LAST REV DATE: 01/11/20



Notes:

1. High Pressure Sodium Vapour Luminaire, photocell switch (150W HPS or equivalent).
2. 10.7 m high, 2.4 m davit steel pole, M.H. (road surface to luminaire) not less than 9.0 m.
3. Use approved type slip-joint or frangible base.
4. Underground wiring from nearest line pole to base of light pole.
5. Flange of slip-joint must not protrude more than 10 cm above ground.
6. Check traffic sign(s) and relocate if necessary to suit lighting.
7. a) At 4-leg intersections a light should be installed on the fourth leg where the road AADT is 150 or higher.
 b) When the light is not required on the intersection leg the second light may be installed in the median.



Saskatchewan Highways and Transportation

DELINEATION LIGHTING AT OTHER RURAL INTERSECTIONS

RECOMMENDED BY:		SENIOR DESIGN ENGINEER ENGINEERING SERVICES BR.	DATE	02-05-21	STANDARD PLAN NO	2621-1-3
APPROVED BY:		EXECUTIVE DIRECTOR ENGINEERING SERVICES BR.	DATE	02-06-05	SHEET	1 of 1

ACAD DWG: 2621-1-3.DWG LAST REV DATE: 01/11/20



Design Manual

Section:

PARTIAL OR AREA LIGHTING

Subject:

INTERSECTION AREA LIGHTING

DEFINITION

Intersection area lighting is the illumination of the intersection area and the adjacent through and auxiliary lanes of the through highway to a specified lighting criteria.

Glare, or veiling luminance (L_v) is the vertical illuminance at the observer's eye due to each luminaire. Visual performance reduced as a result of glare can be compared to the effect of shining a light directly at a viewing screen onto which an image is being projected. The screen acts as the retina, the light as a luminaire, and the image on the screen represents the observer's field of view. In both cases the retinal image is veiled by the light from the lamp thereby giving rise to the term 'veiling luminance' for glare.

POLICY

Partial roadway lighting, such as intersection area lighting, shall be provided at provincial highway intersections in accordance with the following warrant and lighting design criteria.

WARRANTS

The warrants for intersection area lighting are outlined in Figure 2621-2-1. To qualify, one of the three warrant criteria shall be met.

Intersection area lighting should not be considered as a solution to traffic operational problems caused by poor geometric layout. Geometric deficiencies that are contributing to operational problems should be considered for corrective action first.

DESIGN CRITERIA

Intersection area lighting is to be designed to the following criteria:

Average Illuminance	7 - 9 lux
Uniformity Ratios	
Average/Minimum	3.5 : 1
Maximum/Minimum	8 : 1
Glare - Average L_v Maximum	0.18 cd/m ²

The criteria should be applied to the intersection area defined by the through highway lanes, vehicle turning paths and auxiliary turning lanes within the length of influence. For other than raised curbing, the length of influence shall be limited to the provision of three lights upstream of the intersection for each travel direction plus conversion of intersection delineation light(s).

Section:
PARTIAL OR AREA LIGHTING

Subject:
INTERSECTION AREA LIGHTING

For the case of divided highways, the length of influence downstream shall be two poles. A single luminaire shall be provided over each intersecting roadway leg. In the case of a divided highway, an additional pole shall be provided for the median crossover where required to satisfy the lighting criteria.

The luminaire type shall be standard SaskPower 150 or 250 type II or III high pressure sodium vapour (HPS). The luminaire is to be mounted on pole heights of 12.1 or 13.7 m.

PRIORITY RANKING

Approved projects under categories 2 Raised Channelization/Median Curbing or 3 Traffic Accident Rate are to be given priority over 1 Traffic Volume candidates. Ranking of these candidates is based on engineering judgment with consideration of traffic volumes, roadway functional classification, accident rate, cost and any other applicable factors.

Candidates under category 1 Traffic volume warrants are ranked with highest priority assigned to the highest ranking index.

$$\text{Ranking Index} = \frac{X1 * X2 * FCC}{10,000}$$

where,

X1 = as determined in Section 1.1

X2 = as determined in Section 1.2

FCC = functional classification factor, 1.25 for arterial, 1.10 for collector, 1.00 for local.

Section:
PARTIAL OR AREA LIGHTING

Subject:
INTERSECTION AREA LIGHTING

Assumed PM Volumes
= 10% ADT

FIGURE 2621-2-1

WARRANTS FOR INTERSECTION AREA LIGHTING

1. Traffic Volume Warrant

West Access AADT = 2355 > 1500
East Access AADT = 2125 > 1500

1.1 Through Highway

West Access - not warranted
East Access - not warranted

$$\frac{\text{Leg 1 AADT} + \text{Leg 2 AADT}}{2} = X1 \geq 1500 \text{ AADT,}, \text{ and}$$

1.2 Intersecting Roadway

$$\text{Leg 1 AADT} + \text{Leg 2 AADT} = X2 \geq 1000 \text{ AADT}$$

West Access AADT = 700 < 1000
East Access AADT = 610 < 1000

Note: For T intersections leg 1 or leg 2 = 0 AADT

2. Raised Channelization/Median Curbing Warrant

2.1 Traffic Speed

Posted speed limit or actual 85th percentile speed ≥ 60 km/h, and

2.2 Traffic Engineering Assessment

Traffic engineering assessment supports retention of the raised islands/median and the provision of area lighting.

Note: The limits of the area lighting for raised islands should extend to the limits of the raised islands/media.

3. Traffic Accident Rate Warrant

3.1 Traffic Volume

Through highway traffic volume ≥ 1000 AADT, and

3.2 Accident Rate

The intersection accident rate is ≥ 1.5 accidents/million entering vehicles/year. The ratio of the last three year average night to day accident rate is > 1.5 . A traffic engineering study supports area lighting as an acceptable expenditure.