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Memo

To:	Brad Zurevinski Dream Asset Management Corp. 112-2100 8th Street East Saskatoon, SK S7H 0V1	From:	Crystal Phillips, A.Sc.T. Erin Medforth, P.Eng. 400-1820 Hamilton Street Regina, SK S4P 2B8
File:	111000399	Date:	June 10, 2021

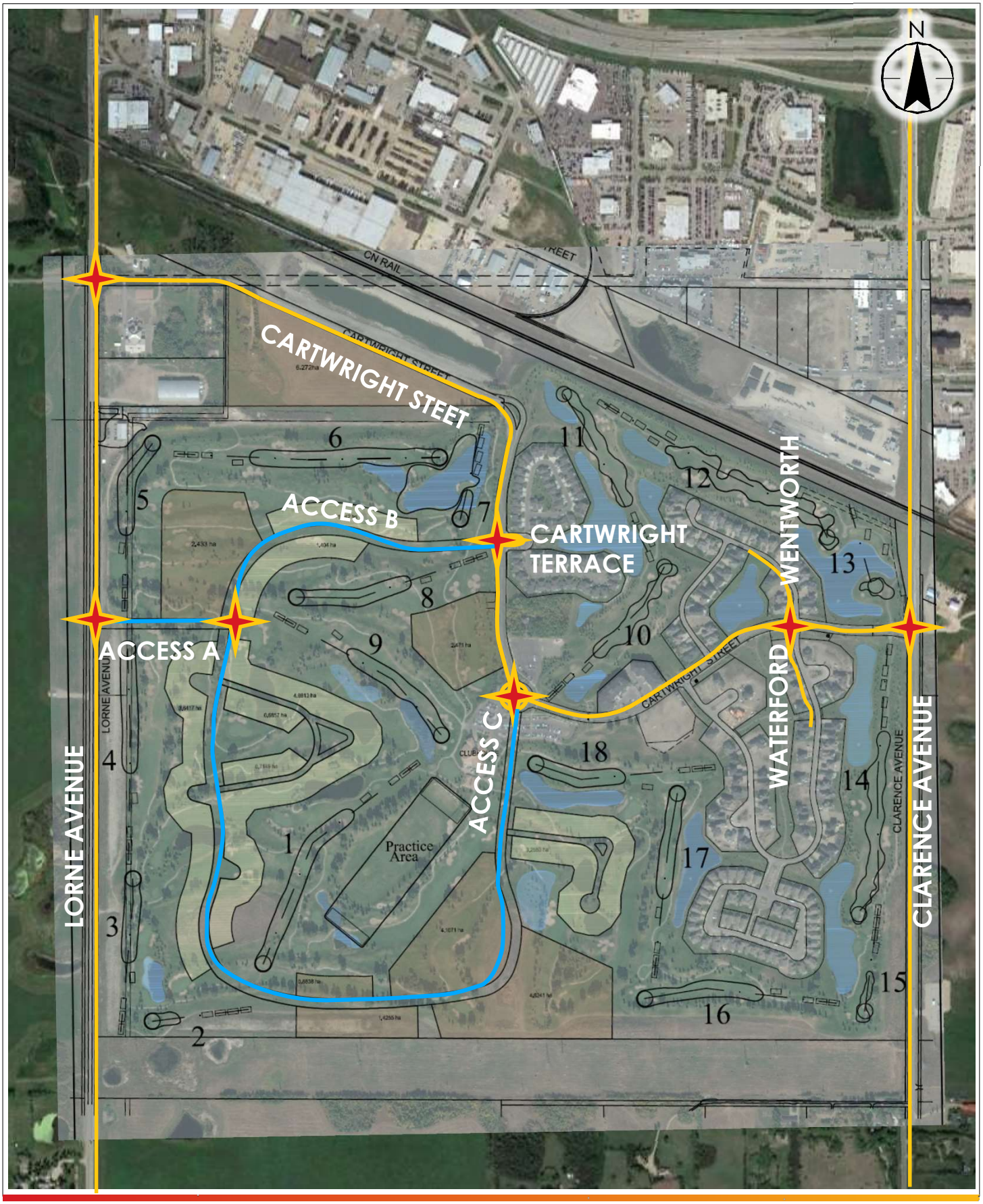
Reference: The Willows Traffic Impact Assessment Update

Dream Asset Management Corporation (Dream) has retained Stantec to complete updates to the 2017 Willows TIA, due to the proposed changes to the development roadway geometry and onsite land uses. These changes could impact recommendations provided in a Traffic Impact Assessment (TIA) prepared for Dream. This memo discuses the changes and any implications to recommendations made in the 2017 Willows TIA.

BACKGROUND

A mixed-use development is proposed for south and west of Cartwright Street within the current Willows development. The new development will include removal of 18-holes of the existing 36-hole golf course, located on the same land intended for the new development. In August 2017, the proposed development included single family and multifamily residential, a hotel and retail shopping. Access to the proposed development was to be provided at three locations: Cartwright Street (and subsequently Clarence Avenue and Lorne Avenue) and Access A. **Figure 1** shows the road network layout for the proposed development, as was submitted in the August 2017 TIA. The recommendations as part of the TIA included:

- Traffic signals be installed at the intersections of Clarence Avenue & Cartwright Street, and Lorne Avenue & Cartwright Street at or prior to full build-out.
- Highway 219 & Access A be constructed as a right-in/right-out access;
    - With raised concrete island to discourage left-turning movements; and
    - Incorporating slight flaring (taper only) on northbound approach and departure legs to ease turning movements.
- Highway 219:
    - Speed limit be reduced to 80 km/h where the Willows golf course abuts Highway 219;
    - Speed limit be reduced to 60 km/h commencing immediately south of Access A to the end of the proposed development; and
    - Partial intersection lighting be provided at Access A & Highway 219, in accordance with DM 2621-1.
    - **Figure 2** shows the recommended speed limit changes with the updated concept plan.
- Install walkway-to-walkway curb extensions at locations identified in the TIA.



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LEGEND

- STUDY INTERSECTION
- STUDY ROADWAY
- NEW ROADWAY

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FIGURE No. **1**

PREVIOUS ROAD LAYOUT AND SITE PLAN

EXISTING

PROPOSED

N

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LEGEND

- 100 KM/H
- 80 KM/H
- 60 KM/H

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FIGURE No. **2**

RECOMMENDED SPEED LIMITS

Reference: **The Willows Traffic Impact Assessment Update**

2021 UPDATES

Recently, the developer has slightly modified the quantities for each land use and revised the turning movements at Access A to allow a southbound left-turn movement to access the proposed development.

Previously, Access A only permitted a right-out movement from Access A onto Lorne Avenue. The developer requested that the revised network include a southbound left-turn movement, adding an additional way to access the proposed development. This addition required revising some distribution of traffic from the intersection of Lorne Avenue with Cartwright Street to Lorne Avenue with Access A. **Figure 3** shows the proposed road network which will service the revised development.

The following is a summary of the changes in lot layouts and quantities for each land use.

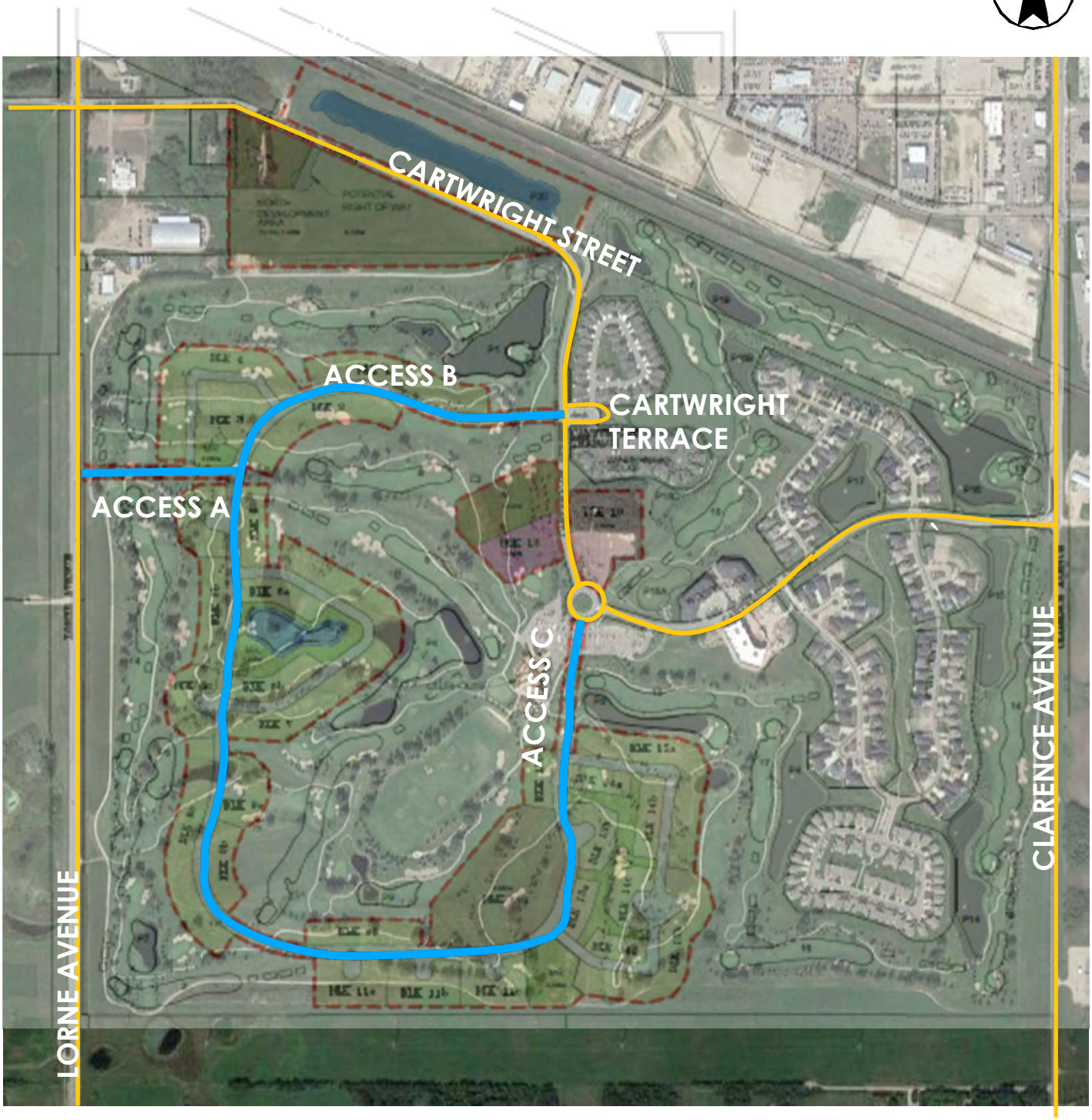
- Single Family Housing – switch from acre to unit measurement, change in quantity.
- Multi-Family Housing – switch from people to unit measurement, change in quantity.
- Multi-Family Housing (Low Density) – addition of category.
- Hotel – increase from 80 to 120 rooms, change from Hotel to Resort Hotel land use.
- Commercial / Retail – reduced square footage from 43,000 square feet to 11,000 square feet of general retail and 4,000 square feet for a medical clinic within a mixed land use.

The 18-hole golf course traffic which was calculated in the original TIA will remain the same. This traffic was added to account for the golf off-season count which was performed in October and November of 2016. The golf course traffic is included in the analysis, however, is not included in the trip generation comparison because it is unchanged.

OLD AND NEW SITE TRIP GENERATION COMPARISON

The updated concept plan for the development results in a change in the number of trips generated by the development. To determine the difference in trips generated, the same assumptions were used in the current analysis as were used in the original TIA, which included internal trip reductions of 50% for the commercial land use. Additionally, the same horizon year, 2036, was used for analysis and comparison.

Lastly, the ITE Trip Generation Manual 10th edition will be used for the updated analysis whereas the 8th edition was used for the TIA. **Table 1** shows the old and new concept plan with expected trip generation. Due to rounding, some totals may not appear to add correctly, however sums were completed considering the fractions of trips calculated from entering and exiting.



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LEGEND

STUDY ROADWAY
NEW ROADWAY

THE WILLOWS
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FIGURE No. **3**

NEW SITE PLAN

Reference: **The Willows Traffic Impact Assessment Update**

Table 1: Old and New Trip Generation

			2017 Concept Plan						2021 Concept Plan					
	ITE Code		Morning Peak Hour			Afternoon Peak Hour			Morning Peak Hour			Afternoon Peak Hour		
Land Use Description	**Old**	**New**	**In**	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Single Family	210	210	25	55	80	70	36	106	55	165	220	186	109	294
Multi-Family (Mid Rise)	Not Used	221	-	-	-	-	-	-	25	72	97	76	49	125
Multi-Family (Low Rise)	230	220	59	288	347	275	135	410	19	64	83	65	38	104
Hotel	320	330	13	23	36	20	17	37	28	11	38	21	28	49
Commercial Space	820	820	13	9	22	40	41	81	3	2	5	10	11	21
Medical Clinic /	Not Used	630	-	-	-	-	-	-	12	3	15	6	14	19
Total Trips			**110**	**375**	**485**	**405**	**229**	**634**	**142**	**317**	**459**	**364**	**249**	**613**

A summary of the total trip differences from the 2017 and current trip generation is provided in Table 2.

Table 2: Old and New Trip Generation Comparison

Land Use	Morning Total Trips Difference	Afternoon Total Trips Difference
Single Family / 210	+140	+188
Multi Family / 230 + 220 +221	-167	-182
Commercial / 820+630+936	-2	-41
Hotel / 320 +330	+2	+ 12
Overall Difference	-26	-21

The largest increase in trip generation comes from the Single Family land use. However, once it is balanced with the Multi Family land use reduction, the difference in trips is almost negligible. Overall, these changes will not be noticeable spread over the proposed road network.

The new trip generation and 2036 background traffic were added together on the proposed road network for analysis. Trip distribution followed what was outlined in the TIA, however assignment was updated to reflect the inclusion of the southbound left-turn at Lorne Avenue and Access A. **Figure 4** shows the combined 2036 traffic upon which the following analysis is based.

When reviewing the trips generated by the updated concept plan, it is also useful to compare the trips generated by the proposed development to the current trips generated by the 36-hole golf course it will be replacing. Table 3 compares the trips generated by the 36-hole golf course, to the proposed 18-hole golf course taking its place. There will be a reduction of 40 and 50 trips in the AM and PM peak hours, respectively. These trips could be subtracted from the overall development generation so that the impact to the existing network could be considered less severe.

Table 3: Pre-Development Trip Generation Comparison

Trips Generated	36 Hole Golf Course	18 Hole Golf Course	Difference
AM Peak Hour	80	40	-40
PM Peak Hour	100	50	-50

Reference: **The Willows Traffic Impact Assessment Update**

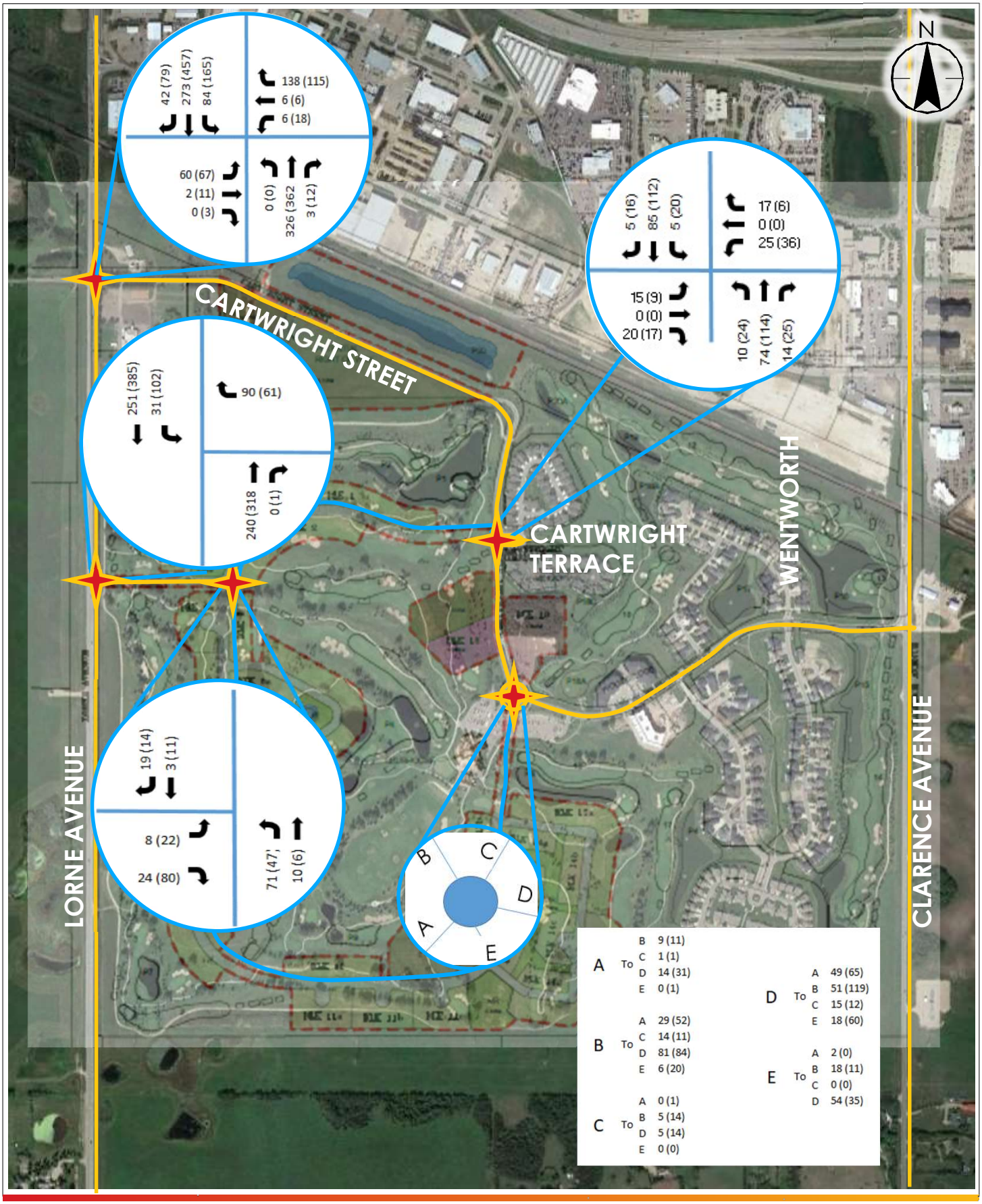
ANALYSIS COMPARISON

Provided there was a net reduction in trips generated, only the intersections impacted by the rerouting of traffic as a result of the addition of the southbound left-turn onto Access A required analysis to be updated from that completed in the original TIA. These intersections are:

- Lorne Avenue with Cartwright Street;
- Lorne Avenue with Access A;
- Cartwright Street with Cartwright Terrace;
- Access A with Access B / C; and
- the roundabout at Cartwright Terrace and Access C.

The remaining intersections servicing the development are expected to show very little change from the original TIA analysis given the small reduction in trips generated, and therefore were not reanalyzed.

Synchro capacity analysis and SimTraffic queuing analysis were completed to determine the concept plan changes' impact on the traffic delays, capacity and queuing. It should be noted that intersection configurations followed the proposed configurations without signalization in the TIA. Table 4 shows analysis results for the old and new concept plans.



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LEGEND

## (##)	AM PEAK (PM PEAK)
A	CLUBHOUSE
B	CARTWRIGHT STREET
C	HOTEL ACCESS
D	CARTWRIGHT STREET

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FIGURE No. **4**

COMBINED 2036 TRAFFIC

Reference: **The Willows Traffic Impact Assessment Update**

Table 4: 2017 TIA and Current Intersection Capacity Analysis Results – Combined Traffic 2036 Horizon

Intersection	Analysis Scenario	Control	Peak	Measure	Eastbound			Westbound			Northbound			Southbound			Overall Intersection LOS
					L	T	R	L	T	R	L	T	R	L	T	R	
Lorne Avenue & Cartwright Street	2017 TIA	EB / WB Stop	AM	Level of Service	F			C			A			A			B
				Delay (s)	168.4			18.1			0.3			4.3			
				V/C Ratio	1.02			0.45			0.01			0.12			
				Queue (95%) (m)	18.3			24.8			4.8			15.4			
			PM	Level of Service	F			F			A			A			B
				Delay (s)	>300			286.4			0.6			6.6			
				V/C Ratio	4.01			1.37			0.02			0.29			
				Queue (95%) (m)	39			28.2			9.7			32.5			
	Current Analysis	EB / WB Stop	AM	Level of Service	F			C			A			A			C
				Delay (s)	154.6			18.4			0.2			0.2			
				V/C Ratio	0.984			0.447			0.009			0.109			
				Queue (95%) (m)	17.6			18.4			3			16			
			PM	Level of Service	F			F			A			A			F
				Delay (s)	>300			181.5			0.2			3			
				V/C Ratio	3.89			1.19			0.011			0.225			
				Queue (95%) (m)	20.4			30			14.6			23.4			
Cartwright Terrace/ Access B & Cartwright Street	2017 TIA	WB Stop	AM	Level of Service	A			B			A			A			A
				Delay (s)	9.9			10.4			0.5			0.5			
				V/C Ratio	0.03			0.07			0.01			0.01			
				Queue (95%) (m)	11			9.9			2.3			3.2			
			PM	Level of Service	B			B			A			A			A
				Delay (s)	11.1			12			0.3			0.7			
				V/C Ratio	0.03			0.1			0.02			0.02			
				Queue (95%) (m)	10.8			10.7			4.3			3.7			
	Current Analysis	WB Stop	AM	Level of Service	A			B			A			A			A
				Delay (s)	9.7			10			0.8			0.4			
				V/C Ratio	0.055			0.067			0.007			0.004			
				Queue (95%) (m)	12.5			9			0			3			
			PM	Level of Service	B			B			A			A			A
				Delay (s)	10.4			11.8			1.1			1			
				V/C Ratio	0.049			0.09			0.018			0.016			
				Queue (95%) (m)	12.4			11.2			3			2.9			
Lorne Avenue & Access A	2017 TIA	WB Stop	AM	Level of Service				B				A		A			A
				Delay (s)				10.1				0		0			
				V/C Ratio				0.08				0.16		0.16			
				Queue (95%) (m)				14.7				0		0			
			PM	Level of Service				B				A		A			A
				Delay (s)				10.5				0		0			
				V/C Ratio				0.05				0.21		0.25			
				Queue (95%) (m)				12.9				0		0			
	Current Analysis	WB Stop	AM	Level of Service						B		A		A	A		A
				Delay (s)						10.4		0		7.9	0		
				V/C Ratio						0.13		0		0.027	0		
				Queue (95%) (m)						17.5		0		7.7	0		
			PM	Level of Service						B		A		A	A		A
				Delay (s)						10.8		0		1.7	0		
				V/C Ratio						0.098		0		0.094	0		
				Queue (95%) (m)						14.4		0		12.9	0		
Access A & Access B & Access C	2017 TIA	EB Stop	AM	Level of Service	A						A				A		A
				Delay (s)	8.9						7.4				0		
				V/C Ratio	0.01						0.03				0.02		
				Queue (95%) (m)	6.1						4.2				0		
			PM	Level of Service	A						A				A		A
				Delay (s)	8.7						7.3				0		
				V/C Ratio	0.01						0.02				0		
				Queue (95%) (m)	6.2						2.4				0		
	Current Analysis	EB Stop	AM	Level of Service	A						A				A		A
				Delay (s)	8.8						7.4				0		
				V/C Ratio	0.036						0.05				0		
				Queue (95%) (m)	8.6						6.3				0		
			PM	Level of Service	A						A				A		A
				Delay (s)	9						7.3				0		
				V/C Ratio	0.112						0.033				0		
				Queue (95%) (m)	6.8						4.4				0		

Reference: **The Willows Traffic Impact Assessment Update**

Table 4 Cont'd: 2017 TIA and Current Intersection Capacity Analysis Results – Combined Traffic 2036 Horizon

Intersection	Analysis Scenario	Control	Peak	Measure	Clubhouse Approach	Cartwright Street Westbound Approach	Cartwright Street Southbound Approach	The Red Barn Approach	Access C Approach	Overall Intersection LOS
Roundabout	Current Analysis	Yield on Entry	AM	Level of Service	A	A	A	A	A	A
				Approach Delay (s)	4	4.6	4.8	4	4.5	
				V/C Ratio	0.036	0.135	0.135	0.022	0.094	
				Queue Length (95%) (m)	7.5	7.3	11.4	3	8.1	
			PM	Level of Service	A	A	A	A	A	A
				Approach Delay (s)	4.5	5.9	5.6	4.7	4.4	
				V/C Ratio	0.061	0.258	0.188	0.049	0.066	
				Queue Length (95%) (m)	11.5	10	15.8	10.4	9.8	

Intersection	Analysis Scenario	Control	Peak	Measure	Clubhouse Approach	Cartwright Street Westbound Approach	Cartwright Street Southbound	The Red Barn Approach	Access C Approach	Overall Intersection LOS
Roundabout	2017 TIA	Yield on Entry	AM	Level of Service	A	A	A	A	A	A
				Approach Delay (s)	4.3	4.5	4.9	4	4.9	
				V/C Ratio	0.07	0.13	0.15	0.02	0.15	
				Queue Length (95%) (m)	8.2	7.1	10.8	4.4	9.9	
			PM	Level of Service	A	A	A	A	A	A
				Approach Delay (s)	5.1	6.5	6.1	4.9	6.1	
				V/C Ratio	0.13	0.31	0.21	0.03	0.21	
				Queue Length (95%) (m)	12.8	13.4	14.7	7.3	7.9	

Analysis with updated traffic volumes showed minimal changes to the network traffic performance overall. The failures which were present in the 2017 analysis were also present in the current analysis. No new failures, on an intersection level, were noted. The intersection of Cartwright Street with Lorne Avenue show the side streets being delayed more than 37 seconds, resulting in LOS F. According to the City of Saskatoon Traffic Impact Study Guidelines, mitigation is required to improve the LOS to D or better.

The addition of a southbound left-turn movement at the intersection of Lorne Avenue with Access A performed acceptably with LOS B or better, V/C of 0.16 or better and short queues.

SIGNAL WARRANT ANALYSIS

Transportation Association of Canada (TAC) Traffic Signal and Pedestrian Signal Head Warrant Handbook describes the accepted procedure for determining whether vehicle traffic volumes are sufficient to warrant installation of a traffic signal. This analysis considers proximity to schools, presence of bus routes, heavy vehicle traffic, and both vehicular and pedestrian traffic volume over six hours to calculate risk exposure at a given intersection. The procedure assigns warrant points to the intersection based on a number of parameters. A score of 100 basis points or more suggests that a traffic signal is warranted at the intersection based on the users' exposure to risk.

The TIA recommended that traffic signals be installed for Cartwright Street and its intersection with Lorne Avenue. This recommendation was based on signal warrant analysis completed in the TIA using the 20-year combined traffic horizon. The original TAC signal warrant score was 130 for the Lorne Avenue with Cartwright Street intersection.

The signal warrants for the intersection of Lorne Avenue and Cartwright Street were recalculated for the same horizon to include the new trip generation and southbound left-turn option. The points for the updated signal

warrant analysis on Cartwright Street and its intersection with Lorne Avenue was 136. This values suggest that signals are still warranted at Cartwright Street and Lorne Avenue intersection.

For completeness, warrants were completed for the intersections of Lorne Avenue with Access A. The intersection of Lorne Avenue and Access A scored 35 points. Therefore, traffic signals are not warranted for this intersection, according to the warrant points.

OPTIMIZED SCENARIO

An optimized scenario was created which analyzed traffic signals at the intersection of Cartwright Street with Lorne Avenue. The results are shown in **Table 5.**

Table 5: Optimized Scenario Traffic Analysis Results

Intersection	Control	Peak	Measure	Eastbound			Westbound			Northbound			Southbound			Overall Intersection LOS
				L	T	R	L	T	R	L	T	R	L	T	R	
Lorne Avenue & Cartwright Street	EB / WB Stop	AM	Level of Service		A			B			B			B		B
			Delay (s)		8.8			10.3			12.2			10.6		
			V/C Ratio		0.16			0.32			0.55			0.41		
			Queue (95%) (m)		16.5			21.9			38.6			39.6		
		PM	Level of Service		B			C			A			B		B
			Delay (s)		18.5			20.9			9.6			12.3		
			V/C Ratio		0.29			0.46			0.49			0.61		
			Queue (95%) (m)		17			24			41.4			60.4		

The analysis shows that the installation of traffic signals may result in the overall improvement of traffic flow at the intersection of Cartwright Street with Lorne Avenue.

INTERSECTION WARRANT ANALYSIS

Saskatchewan Ministry of Highways (MoH) intersection treatment warrants are provided as a guideline for assisting in the determination of an appropriate geometry for intersections with Saskatchewan's highway network. The intersection of Lorne Avenue with Access A will be located within MoH right-of-way. The intersection was analyzed for various warrants. MoH seasonal correction factors were not available from the Ministry at the time of completing the warrants and therefore could not be incorporated. Passenger car equivalent factors for heavy vehicles have been applied. A brief sensitivity analysis was completed for each. The completed warrants are attached to this memo. A summary of those warrants are provided below.

- Warrants for Left Turn Lanes (SP 20610) is not applicable to this location because of the undivided nature of Lorne Avenue.
- Warrants for Channelized Intersections (SP 20611) was found to be met. This warrant would continue to be met as long as the volume advancing on Lorne Avenue remains above 150 and the volume opposing remains above 240. Currently, the volumes are 388 and 320 for volume advancing and volume opposing, respectively. Therefore, even with the correction factors being applied, it is a high likelihood that the warrant for channelization would still be met. Although channelization warrant criteria is met for the intersection, a bypass lane may be more appropriate at this location due to upstream intersection spacing. A bypass intersection treatment is approximately 150 m shorter than a channelization intersection treatment and will reduce conflicts with the upstream intersections.

- Warrants for Right Turn Lanes (SP 20614) was found to be inconclusive. The low right-turn volume resulted in an R value of 0.003 and a volume advancing of 320. These two values are not included within the limits of the warrant graph and therefore a definitive conclusion cannot be drawn. However, given the expected low right-turn volume (1 vehicle), it is anticipated that the addition of a right-turn lane would not provide substantial benefit for one vehicle per hour and is therefore not recommended. Should the correction factors decrease the volume advancing, the warrant will not be met. Should the correction factors increase the volume advancing, the warrant is still inconclusive.

CONCLUSIONS & RECOMMENDATIONS

Overall, there was very little change to the operation of traffic between the proposed site in 2017 and the current site. The analysis suggests that traffic signals will still be required at Cartwright Street and its intersection with Lorne Avenue.

Also, from a traffic perspective, allowing a southbound left-turn movement at the intersection of Lorne Avenue and Access A does not alter traffic flow on the road network enough to change the outcome of the recommendation to install traffic signals on Cartwright Street and Lorne Avenue. The addition of the movement also does not increase congestion anywhere on the network. Ultimately, the presence of the access and allowable movements will be dictated by the Saskatchewan Ministry of Highways because Access A accesses part of their existing network.

Based on the conclusions and analysis contained within this memo, the following recommendations can be made:

- Traffic signals be installed for the intersection of Cartwright Street with Lorne Avenue upon construction of the proposed development;
- Should a southbound left-turn be constructed at Lorne Avenue with Access A, a channelized left-turn bay is warranted. However, due to access spacing to Cartwright Street, a bypass lane is recommended. This could be accomplished by extending the existing southbound lane past Access A and installing the downstream taper as per MoH Standard Plan 20620;
- Speed reductions, as shown in Figure 2, be applied to Highway 219; and
- The recommendations from the original TIA be used for the intersections of Cartwright Street and Clarence Avenue and Cartwright Street and Wentworth/Waterford.

Reference: **The Willows Traffic Impact Assessment Update**

If there are any questions about the analysis contained within this memo, please do not hesitate to contact the undersigned.

Sincerely,

Stantec Consulting Ltd.

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Transportation Engineer

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Attachment: Signal Warrant Analysis – Cartwright Rd & Lorne Avenue
Signal Warrant Analysis – Lorne Avenue & Access A
Intersection Treatment Warrants

c. Jordan Parisien

Canadian Traffic Signal Warrant Analysis

Main Street	**Lorne Ave**	**Date:** June 9, 2021
Side Street	**Cartwright Rd**	**City:** Saskatoon

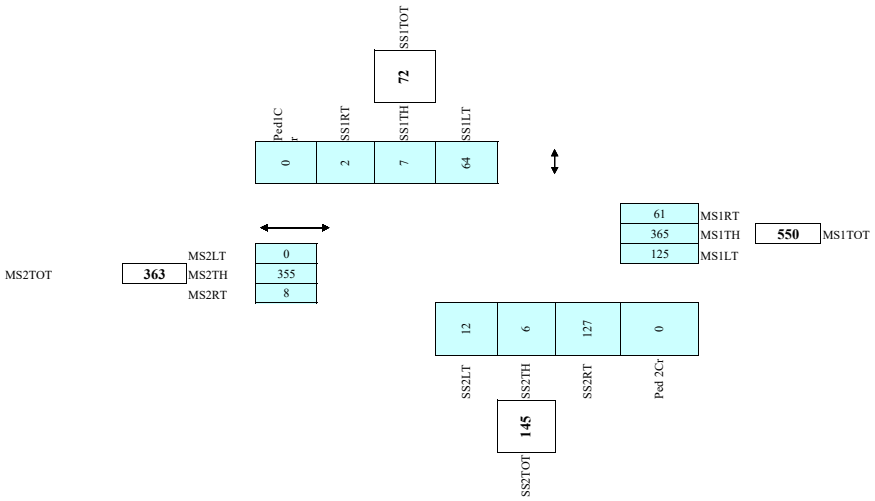
MainStreet1Lanes	(#)	1	Distance to next signal	(m)	750
MainStreet2Lanes	(#)	1	Elementary School	(y/n)	n
MainStreet LT Lanes	(#)	0	Senior's Complex	(y/n)	n
SideStreet1Lanes	(#)	1	Pathway to School	(y/n)	n
SideStreet2Lanes	(#)	1	Metro Area Population	(#)	325,000
MainStreetSpeedLimit	(km/h)	80	Side Street Bus Route	(y/n)	n
MainStreetTrucks/Buses	(%)	2.0%	Side Street Trucks	(%)	1.0%
Refuge Width on Median	(m)	0.0	T or 1-Way Intersection	(y/n)	n
			Central Business District	(y/n)	n

Vm =	**913**	(MainSt Vol Total)	Cs =	**1.028**	(Int SpacingFactor)
Vs =	**145**	(SideSt Vol Highest)	Cmt =	**1.000**	(MainStTruckFactor)
Pc =	**0**	Peds Crossing Main	Cv =	**1.100**	(SpeedFactor)
K1 =	**1,100**	veh/veh const	Cp =	**1.000**	(PopDemoFactor)
K2 =	**2,000**	veh/ped const	Csb =	**1.000**	(SideStBusFactor)
L =	**2.0**	TotalMainStLanes	Cst =	**1.000**	(SideStTruckFactor)
F =	**1.000**	(PedDemoFactor)	Vmx =	**550**	(MainStHighest)
Vm1 =	**913**	(MainStVeh-Veh#)	Vm2 =	**913**	(MainStVeh-Ped#)
Cvp =	**1.130**	(product of Cs,Cmt,Cv,Cp)	Cbt =	**1.000**	(maximum of Csb,Cst)
Ct1 =	**1.000**	T Int / one way Factor			

	MS1LT	MS1TH	MS1RT	MS2LT	MS2TH	MS2RT	SS1LT	SS1TH	SS1RT	SS2LT	SS2TH	SS2RT	PedC1	PedC2
7:00 - 8:00	84	273	42	0	328	3	60	2	0	6	6	138	0	0
8:00 - 9:00	84	273	42	0	328	3	60	2	0	6	6	138	0	0
11:00 - 12:00	124.5	365	60.5	0	355	7.5	63.5	6.5	1.5	12	6	126.5	0	0
12:00 - 13:00	124.5	365	60.5	0	355	7.5	63.5	6.5	1.5	12	6	126.5	0	0
16:00 - 17:00	165	457	79	0	382	12	67	11	3	18	6	115	0	0
17:00 - 18:00	165	457	79	0	382	12	67	11	3	18	6	115	0	0
Average	125	365	61	0	355	8	64	7	2	12	6	127	0	0

***** Enter the hourly turning movement counts averaged over the peak six hours of a typical week day**

***** Enter the peak pedestrian volume crossing the main street averaged over the same hours**



W = [Ct1xCbt(Vm1 x Vs)/K1 + (F(Vm2 x Pc)L)/K2] x Cvp

W =	**136**	**136**	**0**
	Warranted	***Veh***	***Ped***

Roadway, Vehicle and Pedestrian Factors			**Range**			
			Min	**@**	**Max**	**@**
Cs =	(Int SpacingFactor)		0.90	<200 m	1.10	isolated
Cmt =	(MainStTruckFactor)		1.00	<5%	1.15	>20%
Cv =	(SpeedFactor)		1.00	<60 km/h	1.10	>80 km/h
Cp =	(PopDemoFactor)		1.00	>250,000	1.20	<10,000
Csb =	(SideStBusFactor)		1.00	no	1.05	yes
Cst =	(SideStTruckFactor)		1.00	<10%	1.05	>10%
F =	(Ped DemoFactor)					
	(max of)	Elementary School	1.20			
		Seniors Complex	1.10			
		Path to School	1.10			

Explanation of Factors:

Cbt = 1.05 if the side street either is a bus route, or has more than 10% trucks, otherwise = 1.00.
(it is assumed that these two factors only affect the side street vehicles trying to cross the main street, not the pedestrians)

Ci = the product of the other 4 geographic factors
(Cs = intersection spacing, Cmt = main street truck, Cv = Speed, Cp = Population)

Vm1 = the main street volume - either the total of the two approaches or the highest single approach
(if the median is >=10.0 metres) (averaged over 6 peak hours)

Vm2 = the main street volume - either the total of the two approaches or the highest single approach
(if the median is >=6.0 metres) (averaged over 6 peak hours)

Vs = the highest side street approach volume (averaged over 6 peak hours)
*** note: it has been determined that Vs must be > 75 for signals to be considered ***

F = Pedestrian demographic factor - the maximum of the 3 individual pedestrian demographic factors

Pc = the total pedestrian volume crossing the mainstreet
(averaged over 6 peak hours)

L = number of lanes that the pedestrians have to cross
(only half the street if the median is >=5.0 metres)

Kv = Vehicle - Vehicle denominator constant
(Kv = 1,100 if L<=3, Kv = 1,400 if L >3)

Kp = Vehicle - Pedestrian denominator constant
(Kp = 2,000 if L<=3, Kp = 5,000 if L >3)

Canadian Traffic Signal Warrant Analysis

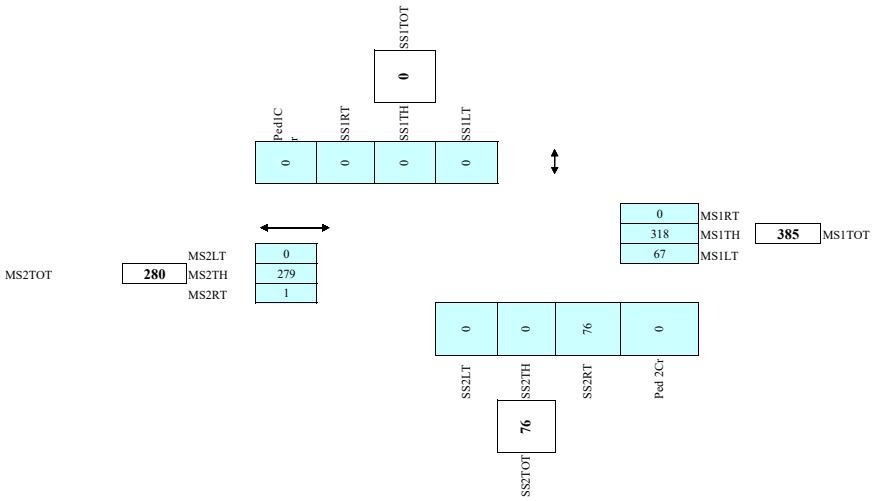
Main Street	**Lorne Ave**	**Date:** June 9, 2021
Side Street	**Access A**	**City:** Saskatoon

MainStreet1Lanes	(#)	1	Distance to next signal	(m)	1,500	Vm =	**664** (MainSt Vol Total)	Cs =	**1.048** (Int SpacingFactor)
MainStreet2Lanes	(#)	1	Elementary School	(y/n)	n	Vs =	**76** (SideSt Vol Highest)	Cmt =	**1.000** (MainStTruckFactor)
MainStreet LT Lanes	(#)	0	Senior's Complex	(y/n)	n	Pc =	**0** Peds Crossing Main	Cv =	**1.100** (SpeedFactor)
SideStreet1Lanes	(#)	1	Pathway to School	(y/n)	n	K1 =	**1,100** veh/veh const	Cp =	**1.000** (PopDemoFactor)
SideStreet2Lanes	(#)	1	Metro Area Population	(#)	325,000	K2 =	**2,000** veh/ped const	Csb =	**1.000** (SideStBusFactor)
MainStreetSpeedLimit	(km/h)	80	Side Street Bus Route	(y/n)	n	L =	**2.0** TotalMainStLanes	Cst =	**1.000** (SideStTruckFactor)
MainStreetTrucks/Buses	(%)	2.0%	Side Street Trucks	(%)	1.0%	F =	**1.000** (PedDemoFactor)	Vmx =	**385** (MainStHighest)
Refuge Width on Median	(m)	0.0	T or 1-Way Intersection	(y/n)	y	Vm1 =	**664** (MainStVeh-Veh#)	Vm2 =	**664** (MainStVeh-Ped#)
			Central Business District	(y/n)	n	Cvp =	**1.153** (product of Cs,Cmt,Cv,Cp)	Cbt =	**1.000** (maximum of Csb,Cst)
						Ct1 =	**0.667** T Int / one way Factor		

	MS1LT	MS1TH	MS1RT	MS2LT	MS2TH	MS2RT	SS1LT	SS1TH	SS1RT	SS2LT	SS2TH	SS2RT	PedC1	PedC2
7:00 - 8:00	31	251	0	0	240	0	0	0	0	0	0	90	0	0
8:00 - 9:00	31	251	0	0	240	0	0	0	0	0	0	90	0	0
11:00 - 12:00	66.5	318	0	0	279	0.5	0	0	0	0	0	75.5	0	0
12:00 - 13:00	66.5	318	0	0	279	0.5	0	0	0	0	0	75.5	0	0
16:00 - 17:00	102	385	0	0	318	1	0	0	0	0	0	61	0	0
17:00 - 18:00	102	385	0	0	318	1	0	0	0	0	0	61	0	0
Average	67	318	0	0	279	1	0	0	0	0	0	76	0	0

***** Enter the hourly turning movement counts averaged over the peak six hours of a typical week day**

***** Enter the peak pedestrian volume crossing the main street averaged over the same hours**



W = [Ct1xCbt(Vm1 x Vs)/K1 + (F(Vm2 x Pc)L)/K2] x Cvp

W = **35** **35** **0**

NOT Warranted ***Veh*** ***Ped***

Roadway, Vehicle and Pedestrian Factors			**Range**			
			Min	**@**	**Max**	**@**
Cs =	(Int SpacingFactor)		0.90	<200 m	1.10	isolated
Cmt =	(MainStTruckFactor)		1.00	<5%	1.15	>20%
Cv =	(SpeedFactor)		1.00	<60 km/h	1.10	>80 km/h
Cp =	(PopDemoFactor)		1.00	>250,000	1.20	<10,000
Csb =	(SideStBusFactor)		1.00	no	1.05	yes
Cst =	(SideStTruckFactor)		1.00	<10%	1.05	>10%
F =	(Ped DemoFactor)					
	(max of)	Elementary School	1.20			
		Seniors Complex	1.10			
		Path to School	1.10			

Explanation of Factors:

Cbt = 1.05 if the side street either is a bus route, or has more than 10% trucks, otherwise = 1.00.
(it is assumed that these two factors only affect the side street vehicles trying to cross the main street, not the pedestrians)

Ci = the product of the other 4 geographic factors
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(if the median is >=10.0 metres) (averaged over 6 peak hours)

Vm2 = the main street volume - either the total of the two approaches or the highest single approach
(if the median is >=6.0 metres) (averaged over 6 peak hours)

Vs = the highest side street approach volume (averaged over 6 peak hours)
*** note: it has been determined that Vs must be > 75 for signals to be considered ***

F = Pedestrian demographic factor - the maximum of the 3 individual pedestrian demographic factors

Pc = the total pedestrian volume crossing the mainstreet
(averaged over 6 peak hours)

L = number of lanes that the pedestrians have to cross
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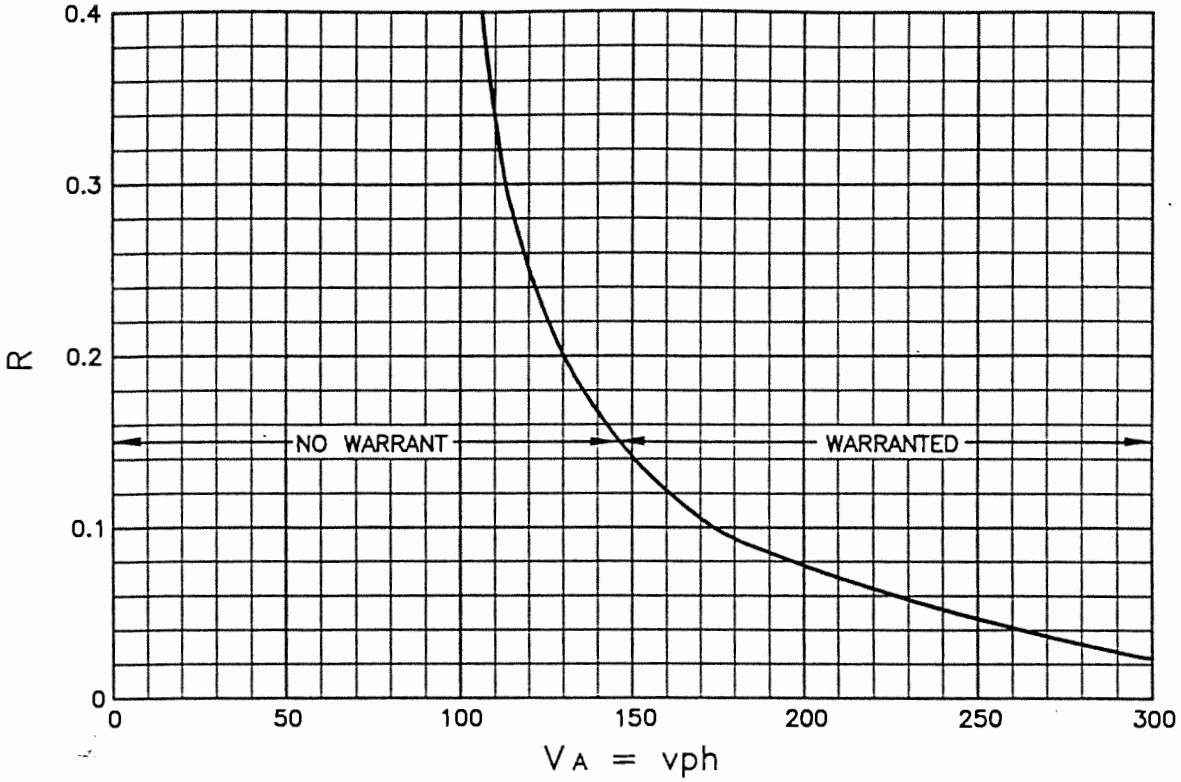


Warrants are based on Design Hourly Volumes

V_A = Advancing Volume, includes Volume Right and Volume Left unless exclusive left turn lane.

V_R = Right Turn Volume, vph.

$R = V^R/V^A$

Warrants: NON FLARED INTERSECTION – Provide 3.7 m turning lane.

FLARED INTERSECTION – Lengthen deceleration lane to meet the right turn lane standard.

Saskatchewan Highways and Transportation

WARRANTS FOR RIGHT TURN LANES
RURAL HIGHWAYS

RECOMMENDED BY:		DIRECTOR TECH. STDS. & POLICIES	DATE	95.02.24	STANDARD PLAN NO	20614
APPROVED BY:		ASSIST. DEPUTY MINISTER OPERATIONS DIVISION	DATE	95-02-28	SHEET	1 of 2

LAST REV DATE: FEB.14,1995

ACAD DWG: 20614-1

NOTES:

1. Right turn lanes are warranted at the following locations:
   - intersections with other Provincial Highways.
   - Industrial Access Roads.
   - Provincial Campgrounds and Picnic Sites.

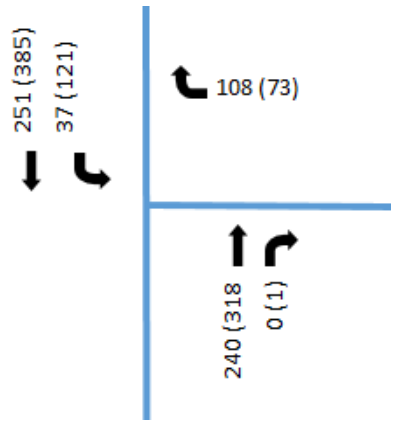
2. Use corrected peak hourly volumes (vph) projected to the 10th year after the proposed construction date. Refer to correction factors under DM 502–3 for further information.

3. Normally 0.6 m shoulder will be provided on turning lane.

4. 1.5 m shoulder may be provided on divided highways and at intersections where truck volumes are higher than normal, for example, at scale sites and access to industrial sites generating heavy truck volumes.

5. Length of the turning lane will be related to highway design speed and turning speed. See Standard Plan No. 20618.

6. For 4 lane highways, the advancing volume should be based on 50% of the total directional volume (vph) or 25% of the total volume (where directional split is not a factor), with no further reduction for left turn vehicles.



Vr = 1
Va=320 (318 without PCE)

R=1/320
R =0.003

Warrant Inconclusive

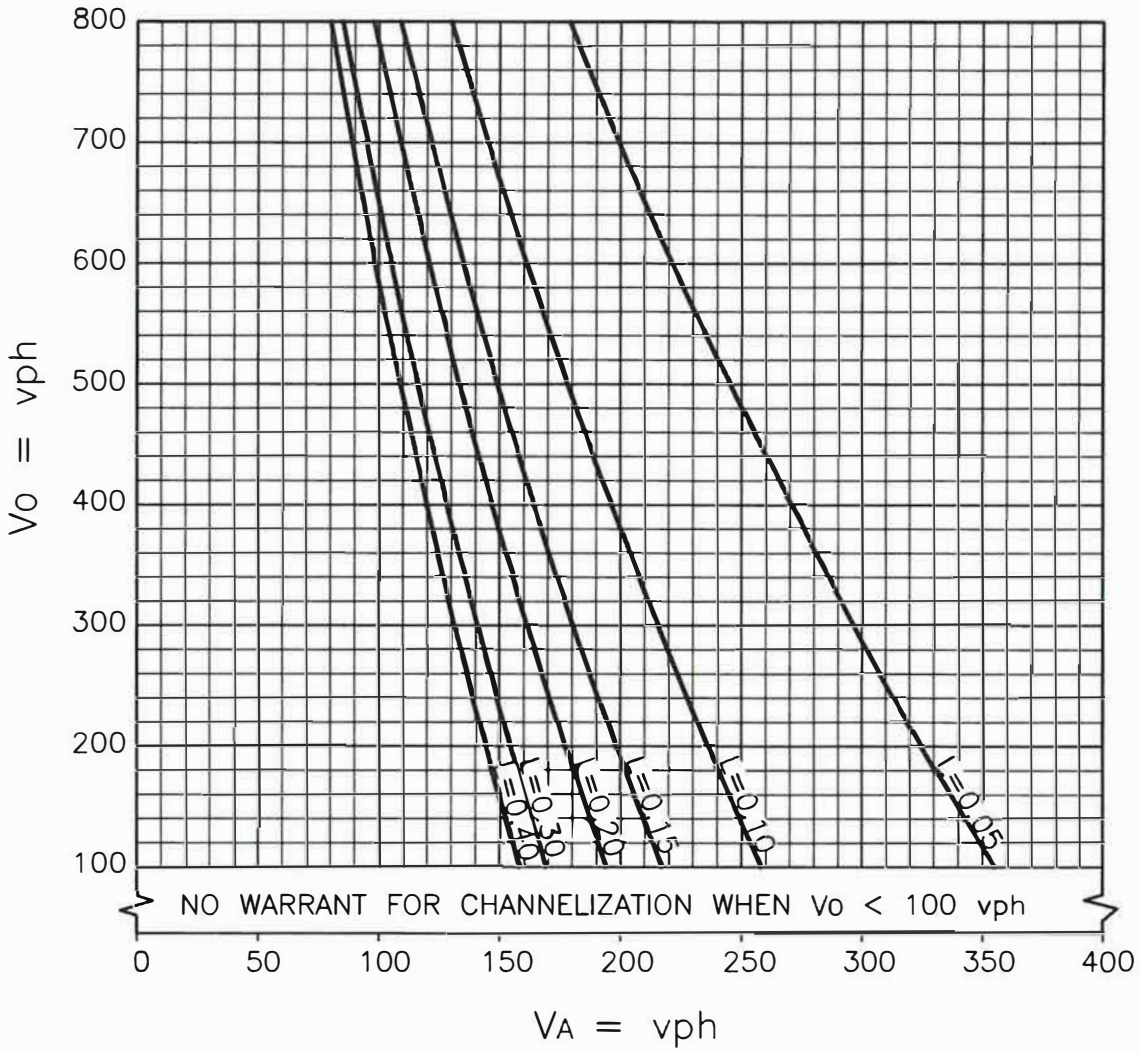
Saskatchewan Highways and Transportation

WARRANTS FOR RIGHT TURN LANES
RURAL HIGHWAYS

RECOMMENDED BY:		DIRECTOR TECH. STDS. & POLICIES	DATE	95-02-24	STANDARD PLAN NO	20614	
APPROVED BY:		ASSIST. DEPUTY MINISTER OPERATIONS DIVISION	DATE	95-02-28	SHEET	2 of 2	

LAST REV DATE: FEB.14,1995

ACAD DW



V_A = Advancing volume, includes volume left and volume right unless exclusive right turn lane.

V_0 = Opposing volume, includes volume left, and volume right unless separated right turning roadway (ramp).

V_L = Left turn volume.

$L = V_L/V_A$

NOTES:

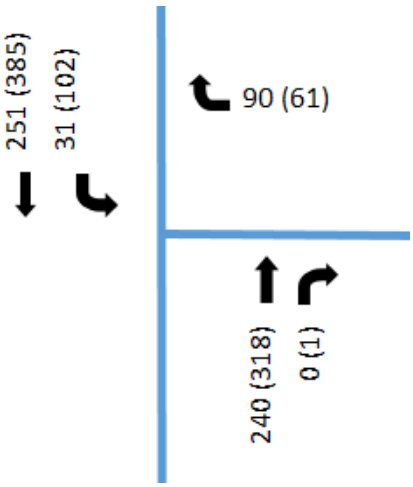
1. Use corrected peak hourly volumes (vph) projected to the 10th year after the proposed construction date. Refer to correction factors under SKS 2.3.1–C for further information.
2. No warrant for channelization if plotted point falls to left of applicable "L" line, or if L < 0.05.
3. If channelization is not warranted, check bypass lane treatment, Standard Plan 20612.
4. Check right turn lane warrants, Standard Plan 20614.
5. For additional information please refer to SKS 2.2.2–B, SKS 2.3.1–F, SKS 2.3.5–C & SKS 2.3.8–C.

Government of Saskatchewan
Ministry of Highways & Infrastructure

WARRANTS FOR
CHANNELIZED INTERSECTIONS
2 LANE RURAL HIGHWAYS

RECOMMENDED BY		DIRECTOR DESIGN & TRAFFIC ENG	DATE	2016-03-21	STANDARD PLAN NO	20611	
APPROVED BY		EXECUTIVE DIRECTOR TECHNICAL STANDARDS BRANCH	DATE	May 5/16	SHEET	1 OF 1	

ACAD DWG: SKS20611
LAST REV DATE: 16/01/27



1% Heavy Vehicles in Count

PCE for Va= 385-(0.01x385)+(0.01x385x1.7)=388
PCE for Vo=318-(0.01x318)+(0.01x318x1.7)=320

Assuming 0% Heavy Vehicles for development traffic
Vl=102

L=102/385
L=0.26

Warrant met