



Real People. Real Solutions.

12224 Nicollet Avenue
Burnsville, MN 55337-1649

Ph: (952) 890-0509
Fax: (952) 890-8065
Bolton-Menk.com

Intersection Control Evaluation

for

TH 5 at CSAH 11 North

in

City of Victoria, Carver County, Minnesota

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Ross B. Tillman, P.E.

51692

License. No.

05/16/2022

Date

REVIEWED BY:

Carver County Engineer

05/17/2022

Date

Victoria City Engineer

05.20.2022

Date

APPROVED BY:

For

MnDOT Metro District State Aid Engineer

5/23/2022

Date

Lars Impola

Digitally signed by Lars Impola
Date: 2022.05.24 12:31:10 -05'00'

MnDOT Metro District Traffic Engineer

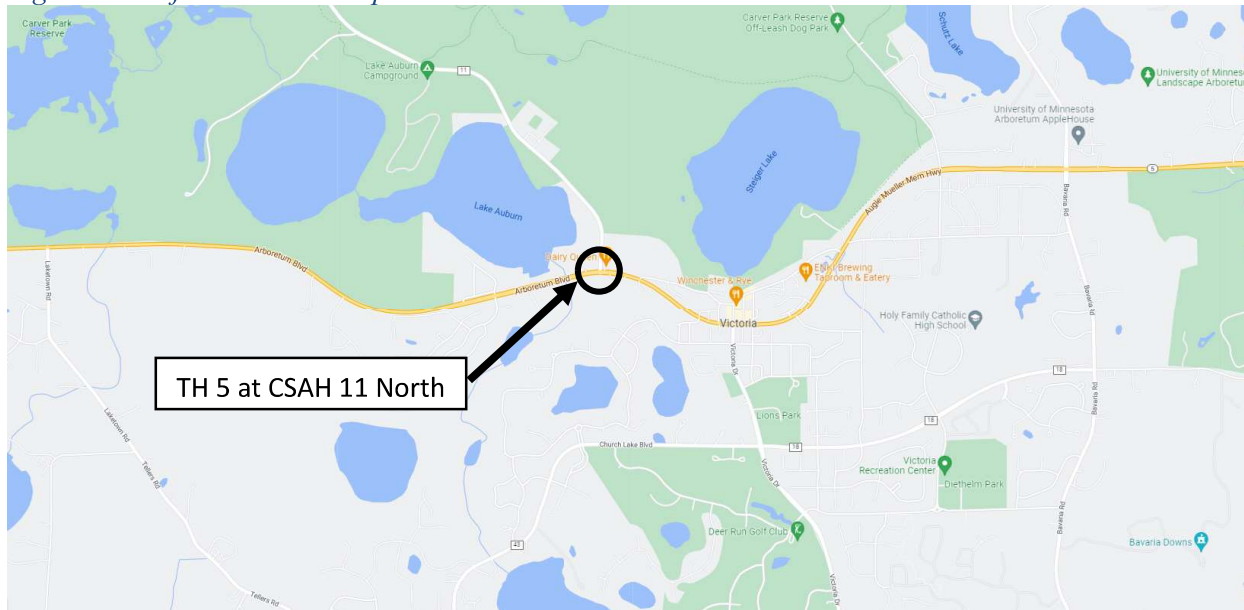
Date



Introduction

An Intersection Control Evaluation (ICE) is being performed for the intersection of TH 5 at CSAH 11 North (Victoria Dr). This ICE report will analyze the existing conditions, future conditions, and the analysis of alternatives at the intersection. The TH 5 at CSAH 11 North intersection is located in the City of New Victoria, MN in Carver County. See **Figure A** for the project location map.

Figure A: Project Location Map



Background

Carver County, in partnership with MnDOT and the surrounding cities (including the City of Victoria) completed the Arboretum Area Transportation Plan (AATP) in early 2020. The AATP study analyzed many roadways in the area including TH 5 from TH 41 through the CSAH 11 North intersection in Victoria. Prior analysis indicated that a single lane roundabout would improve traffic operations and safety. The previous study also showed that the single lane roundabout would be a short-term solution with expansion to a multi-lane implemented with an expansion of TH 5 to four-lanes. The study concluded that future development would influence TH 5 access locations and intersection control in the area and that future analysis is needed to confirm access locations when development plans are known.

Existing Conditions

The intersection of TH 5 at CSAH 11 North has the following characteristics:

- Side street stop-controlled T-intersection
- The speed limit along both roadways is 50 MPH
- Both TH 5 and CSAH 11 North are undivided 2 lane roadways with a channelized left and right turn lanes at the intersection
- TH 5 is classified as a Minor Arterial

- CSAH 11 North is classified as a Major Collector
- The Victoria Veterinary Hospital is located in the northwest quadrant of the intersection, Dairy Queen is located in the northeast quadrant of the intersection, and Waterfront Specialties Inc is located southeast of the intersection.
- Accesses to the Victoria Veterinary Hospital and Dairy Queen are approximately 100 ft to the north of the intersection.
- The Dairy Queen also has access off TH 5 within 25 ft of the intersection.
- Waterfront Specialties Inc has access off TH 5 approximately 100 ft east of the intersection.
- Residential homes are located along both TH 5 and CSAH 11 North within 300 feet of the intersection.
- There are no pedestrian or bicyclist facilities at the existing intersection

Data Collection

Traffic counts were completed in March of 2019 as part of the prior AATP work. A 48-hour count was collected at the intersection starting at 11:00 AM on Tuesday, March 19. The AM and PM peak hours varied by 15 minutes comparing the two days of data, but volumes only differed by at most 20 vehicles. The higher of the peak hours were analyzed. The AM peak hour was found to be from 7:15 AM to 8:15 AM and the PM peak hour was found to be from 4:30 PM to 5:30 PM. The full 48-hour count is included in the **Appendix** along with the peak hour turning movement counts, which are shown in **Figure 1** of the **Appendix**.

Crash Analysis

A crash review was completed for the intersection analyzing the last five years (2017-2021). Crash data from MnCMAT2 was analyzed. Over the past five years, five crashes were recorded. A summary of the crash type and severity is included in **Table 1**.

Table 1. Crash Type and Severity at TH 5 & CSAH 11 N

Crash Type	Serious Injury	Possible Injury	Property Damage
Right Angle	1	1	1
Sideswipe Opposing	-	-	1
Rear End	-	-	1

Table 2 shows that right angle crashes were the most common type of crash. Additionally, just north of the intersection there was a right angle crash involving a vehicle along southbound CSAH 11 N and a vehicle making a westbound left turn from the Dairy Queen access off of CSAH 11 N. This was not included in the crash review for the intersection but was noted since the existing access is only about 100 feet from the intersection.

A comparison of the crash rate and the critical rate was completed to determine if there is a safety issue at an intersection. The crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside of the expected, normal range. The critical index reports the magnitude of this difference and a critical index of less than one indicates that the intersection is operating within the normal range. The latest available statewide average crash rates are from 2020 and were used for comparison purposes. **Table 2** below provides a summary of the crash analysis.

Table 2. Intersection Crash Summary

Crash Analysis	Total Crash Rate				Fatal & Serious Injury Crash Rate			
	Observed Crash Rate	Statewide Average	Critical Rate	Critical Index	Observed Crash Rate	Statewide Average	Critical Rate	Critical Index
5 Year (2017-2021)	0.233	0.128	0.33	0.71	3.875	0.311	3.66	1.06

The total observed crash rate was found to be 0.233 which is nearly two times higher than the average for similar intersections statewide. The total crash critical index shows that with five crashes in the last five years the intersection overall is operating within the normal range compared to similar intersections, however, with a fatal and serious injury critical index of 1.06 the intersection is operating outside the normal range for fatal and serious injury crashes. The intersection crash rate worksheet and a crash diagram are included in the **Appendix**.

Warrant Analysis

Traffic signal warrants have been developed as national guidelines to promote conformity of traffic control devices to ensure that traffic signals are installed at intersections that would benefit from their use. On Trunk Highways, Warrant 1: Eight-Hour Vehicular Volume is the primary factor in installing a traffic signal.

There are additional warrants the MnMUTCD states shall be included in a traffic signal study, listed below:

- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network
- Warrant 9: Intersection Near a Grade Crossing

A traffic signal should not be installed unless one or more of the warrants can be met. Furthermore, a signal should not be installed unless an engineering study indicates that the signal will improve the overall safety and operation of the intersection. The following assumptions were made when analyzing Warrant 1:

- The 70% volume thresholds were analyzed since the speed limit exceeds 40 MPH
- Right turn lane volumes along CSAH 11 North were omitted
- Right turn lanes were omitted in the approach lane count
- Left turn volumes and lanes were included along CSAH 11 North
- Left turn lanes were omitted in the approach lane count along TH 5

The warrant analysis shows that Warrants 1B, 2, and 3 are met for the intersection with existing traffic volumes. The results of the signal warrant analysis are documented in the **Appendix**.

Operational Analysis

The traffic operation analysis for the intersection included an evaluation of existing intersection delay and Level of Service (LOS). LOS results are described using letters ranging from A to F. These letters serve to describe a range of operating conditions for different types of facilities. Levels of Service are

calculated based on the Highway Capacity Manual (HCM) 6th Edition, which defines the LOS, based on control delay. Control delay is the delay experienced by vehicles slowing down as they are approaching the intersection, the wait time at the intersection, and the time for the vehicle to speed up through the intersection and enter into the traffic stream. The average intersection control delay is a volume weighted average of delay experienced by all motorists entering the intersection on all intersection approaches. The control delay is modeled within the analysis software, Trafficware Synchro and SimTraffic. LOS D is commonly taken as an acceptable design year LOS.

The existing peak hours turning movement counts were analyzed in SimTraffic. The results are included in **Table 3**.

Table 3. Existing (2019) Traffic Operations Analysis – Side Street Stop Control

		Traffic Delay (sec/veh)				Traffic Queuing (feet)								
		AM Peak												
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	2 - A	4 - A	-	4 - A	29 - D	300	25	50	200	-	-	-	-	-
WB	-	2 - A	0 - A	2 - A		-	-	-	125	-	-	255	0	25
SB	110 - F	-	30 - D	108 - F		125	300	600	-	-	-	125	50	275
		PM Peak												
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	7 - A	2 - A	-	3 - A	5 - A	300	25	50	200	-	-	-	-	-
WB	-	3 - A	2 - A	3 - A		-	-	-	125	0	25	255	25	25
SB	25 - D	-	7 - A	22 - C		125	75	175	-	-	-	125	25	50

Table 3 shows that the southbound left turning movement operates with LOS F during the AM peak hour. The intersection overall operates with LOS D during the AM peak hour and LOS A during the PM peak hour. The eastbound and westbound movements operate with LOS A during both peak hours. Traffic queuing along the southbound approach blocks several driveway accesses along CSAH 11 North during AM peak hour.

Future Conditions

Traffic Forecasting

Future traffic volumes for 2040 were developed based on the Carver County Travel Demand Model (TDM) as a part of the Arboretum Area Transportation Plan project. The Carver County TDM was built from the Metropolitan Council’s Regional Activity Based Travel Demand Model and assumes regional socioeconomic development consistent with the MSP Thrive 2040 plan. Two different forecasts were developed in the project area. The first assumes TH 5 is expanded from a two-lane to a four-lane from TH 41 through Rolling Acres Road and the second assumes the expansion extends through Downtown Victoria. The forecast with the two-lane to a four-lane expansion through Downtown Victoria was assumed for the 2040 analysis in this report. **Figure 3** in the **Appendix** shows the 2040 peak hour volumes.

Operational Analysis

The forecasted 2040 turning movement counts were analyzed with the existing roadway geometry and traffic control. **Table 4** shows the operational results.

Table 4 – 2040 No Build Traffic Operations Analysis – Side Street Stop Control

Traffic Delay (sec/veh)					Traffic Queuing (feet)									
AM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	8 - A	5 - A	-	6 - A	248 - F	300	25	50	200	-	-	-	-	-
WB	-	3 - A	2 - A	3 - A		-	-	-	125	0	25	255	25	50
SB	2021 - F	-	1968 - F	2020 - F		125	3475	4175	-	-	-	125	25	250
PM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	23 - C	3 - A	-	4 - A	173 - F	300	25	75	200	-	-	-	-	-
WB	-	6 - A	5 - A	6 - A		-	-	-	125	-	-	255	25	50
SB	1466 - F	-	1337 - F	1452 - F		125	2725	4150	-	-	-	125	50	325

Table 4 shows that the overall intersection and southbound movements operates with LOS F during peak hours. All other movements operate with LOS A. The average southbound queue extends over half a mile during both peak hours. All other queues are acceptable.

Analysis of Alternatives

Both signal and roundabout alternatives were evaluated for the TH 5 and CSAH 11 North intersection. The alternatives were evaluated based on traffic operations, safety, and a benefit-cost ratio.

Operational Analysis

The existing and forecasted 2040 peak hour turning movement counts were analyzed with the proposed intersection alternatives. The signalized alternative was analyzed in SimTraffic and the roundabout alternative was analyzed in both Synchro and Arcady.

Signalized Intersection

The operational results for the signal alternative are shown in Tables 5 and 6 with the existing and 2040 volumes. The existing roadway lane configuration was assumed.

Table 5 – Signalized Intersection Traffic Operations Analysis (Existing – 2019 Volumes)

Traffic Delay (sec/veh)					Traffic Queuing (feet)									
AM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	9 - A	12 - B	-	12 - B	12 - B	300	25	50	200	125	200	-	-	-
WB	-	9 - A	2 - A	7 - A		-	-	-	125	50	100	255	25	75
SB	18 - B	-	4 - A	18 - B		125	100	225	-	-	-	130	25	25
PM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	11 - B	4 - A	-	5 - A	8 - A	300	25	50	200	50	100	-	-	-
WB	-	7 - A	4 - A	6 - A		-	-	-	125	75	200	255	50	75
SB	27 - C	-	8 - A	24 - C		125	75	175	-	-	-	130	25	50

Table 5 shows that the overall intersection operates with LOS A or B and all movements operate with LOS C or better during both peak hours. The maximum southbound left queue extends beyond nearby accesses during both peak hours. The maximum westbound through queue extends beyond nearby accesses during the PM peak hour.

Table 6 – Signalized Intersection Traffic Operations Analysis (2040 Volumes)

		Traffic Delay (sec/veh)				Traffic Queuing (feet)								
AM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	84 - F	104 - F	-	104 - F	94 - F	300	75	500	200	1150	1900	-	-	-
WB	-	15 - B	5 - A	12 - B		-	-	-	125	150	300	255	50	100
SB	197 - F	-	148 - F	196 - F		125	875	1200	-	-	-	125	50	325
PM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	26 - C	9 - A	-	10 - B	21 - C	300	25	75	200	100	225	-	-	-
WB	-	19 - B	12 - B	17 - B		-	-	-	125	200	400	255	75	275
SB	64 - E	-	26 - C	60 - E		125	225	450	-	-	-	125	50	325

Table 6 shows that the overall intersection and all eastbound and southbound movements operate with LOS F during the AM peak hour. The intersection overall operates with LOS C during the PM peak hour and the southbound left delay operates with LOS E. Problematic queues are seen along each approach during both peak hours.

An analysis was also completed assuming the four-lane expansion is constructed along TH 5. The traffic operations for the signalized option with two through lanes along each TH 5 approach is shown below in **Table 7**.

Table 7 – Signalized Intersection Traffic Operations Analysis (2040 Volumes – 4 Lane Roadway)

		Traffic Delay (sec/veh)				Traffic Queuing (feet)								
AM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	13 - B	11 - B	-	12 - B	14 - B	300	25	75	200	100	200	-	-	-
WB	-	9 - A	5 - A	8 - A		-	-	-	125	75	125	255	50	100
SB	29 - C	-	8 - A	29 - C		125	200	425	-	-	-	125	25	150
PM Peak														
Approach	Movement (Delay - LOS)			Approach (Delay - LOS)	Intersection (Delay - LOS)	Left Turn			Through			Right Turn		
	L	T	R			Storage	Avg	Max	Next Access	Avg	Max	Storage	Avg	Max
EB	19 - B	6 - A	-	7 - A	10 - B	300	25	75	200	75	125	-	-	-
WB	-	10 - B	8 - A	10 - B		-	-	-	125	100	150	255	75	150
SB	24 - C	-	7 - A	23 - C		125	125	225	-	-	-	125	25	50

Table 7 shows how with TH 5 modeled as a four-lane roadway the overall intersection delay is reduced to LOS B during both peak hours and all movements operate with LOS C or better. There are still a few problematic queues with the four-lane roadway due to the proximity of other accesses near the intersection, but most queues are acceptable.

Single Lane Roundabout

The roundabout alternative was analyzed in both Synchro based on Highway Capacity Methodology (6th Edition) and in Arcady (based on geometric simulation). The operational results for the roundabout alternative are shown in **Tables 8** through **13** with the existing, 2030, and 2040 volumes in both programs. The 2030 volumes were determined assuming straight-line growth between the existing (2019) and 2040 volumes. **Figure 2** in the **Appendix** shows the 2030 peak hour volumes. A single lane roundabout was analyzed.

Table 8. Single Lane Roundabout Traffic Operations Analysis (Existing – 2019 Volumes) – Synchro

Traffic Delay (sec/veh)		Traffic Queuing (feet)		Traffic Delay (sec/veh)		Traffic Queuing (feet)		
AM Peak				PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length	
			Storage	Max			Storage	Max
EB	18 - C	12 - B	200	175	6 - A	12 - B	200	25
WB	5 - A		125	25	15 - C		125	200
SB	7 - A		125	25	9 - A		125	25

Table 9. Single Lane Roundabout Traffic Operations Analysis (Existing – 2019 Volumes) – Arcady

Traffic Delay (sec/veh)		Traffic Queuing (feet)			Traffic Delay (sec/veh)		Traffic Queuing (feet)			
AM Peak					PM Peak					
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		
			Storage	Avg	Max			Storage	Avg	Max
EB	9 - A	7 - A	200	50	200	5 - A	10 - B	200	25	50
WB	5 - A		125	25	50	12 - B		125	100	300
SB	5 - A		125	25	50	5 - A		125	25	50

Comparing **Tables 8** and **9** you can see that the operational results are very similar between the two programs. Both analysis methods show how a single lane roundabout is anticipated to operate well with existing volumes as the intersection overall operates with LOS A or B during both peak hours. All movements operate with LOS C or better. The maximum westbound through queue extends beyond nearby accesses during the PM peak hour in both programs.

Table 10. Single Lane Roundabout Traffic Operations Analysis (2030 Volumes) – Synchro

Traffic Delay (sec/veh)		Traffic Queuing (feet)		Traffic Delay (sec/veh)		Traffic Queuing (feet)		
AM Peak				PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length	
			Storage	Max			Storage	Max
EB	134 - F	68 - F	200	850	11 - B	36 - E	200	100
WB	8 - A		125	75	51 - F		125	625
SB	13 - B		125	100	17 - C		125	75

Table 11. Single Lane Roundabout Traffic Operations Analysis (2030 Volumes) – Arcady

		Traffic Delay (sec/veh)	Traffic Queuing (feet)			Traffic Delay (sec/veh)	Traffic Queuing (feet)				
		AM Peak					PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			
			Storage	Avg	Max			Storage	Avg	Max	
EB	42 - E	23 - C	200	300	850	7 - A	66 - F	200	50	100	
WB	7 - A		125	50	100	104 - F		125	950	2375	
SB	7 - A		125	25	75	7 - A		125	25	75	

Comparing **Tables 10** and **11** the operational results are slightly different in the two programs. **Table 10** shows the intersection overall operating with LOS E or F during the peak hours, but **Table 11** shows the intersection overall operating with LOS C or F during the peak hours. Additionally, **Table 10** shows how in Synchro the eastbound approach is anticipated to operate with failing LOS during the AM peak hour, however, **Table 11** shows this approach operating with LOS E during the AM peak hour. Both programs show the westbound approach operating with LOS F during the PM peak hour, however, Arcady shows nearly double the delay as Synchro. Traffic queuing is very similar between the two programs during the AM peak hour with the maximum eastbound approach queue extending 850 ft. During the PM peak hour, traffic queues in Arcady are much longer than what is shown in Synchro.

Table 12. Single Lane Roundabout Traffic Operations Analysis (2040 Volumes) – Synchro

		Traffic Delay (sec/veh)	Traffic Queuing (feet)		Traffic Delay (sec/veh)	Traffic Queuing (feet)			
		AM Peak				PM Peak			
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		
			Storage	Max			Storage	Max	
EB	374 - F	181 - F	200	1900	21 - C	96 - F	200	225	
WB	13 - B		125	150	142 - F		125	1375	
SB	34 - D		125	275	42 - E		125	200	

Table 13. Single Lane Roundabout Traffic Operations Analysis (2040 Volumes) – Arcady

		Traffic Delay (sec/veh)	Traffic Queuing (feet)			Traffic Delay (sec/veh)	Traffic Queuing (feet)				
		AM Peak					PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			
			Storage	Avg	Max			Storage	Avg	Max	
EB	591 - F	276 - F	200	4575	6375	12 - B	379 - F	200	75	225	
WB	13 - B		125	100	275	634 - F		125	6675	8625	
SB	12 - B		125	75	175	8 - A		125	25	100	

Tables 12 and **13** show that in both Synchro and Arcady the intersection overall operates with failing LOS during both peak hours. Both programs also show the eastbound approach operating with LOS F during the AM peak hour and the westbound approach operating with LOS F during the PM peak hour. **Table 12** shows how in the Synchro the southbound approach is anticipated to operate with LOS D or E during the peak hours, however, **Table 13** shows this approach operating with LOS A or B during the peak hours. Problematic queues are seen along each approach during both peak hours in both programs.

Single Lane Roundabout with Westbound Right Turn Lane

An analysis was also completed with a dedicated westbound right turn lane added at the roundabout. The roundabout would remain a single lane roundabout and the westbound right turning vehicles would yield to circulating traffic at the roundabout, but capacity would be increased for westbound traffic with this configuration allowing two vehicles to enter the roundabout for each gap. 2030 and 2040 forecasted traffic volumes were analyzed. The results are shown in **Tables 14** through **17** below.

Table 14. Single Lane Roundabout with WBR Traffic Operations Analysis (2030 Volumes) – Synchron

Traffic Delay (sec/veh)		Traffic Queuing (feet)		Traffic Delay (sec/veh)		Traffic Queuing (feet)		
AM Peak				PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length	
			Storage	Max			Storage	Max
EB	134 - F	67 - F	200	850	11 - B	11 - B	200	100
WB	5 - A		125	25	9 - A		125	125
SB	13 - B		125	100	17 - C		125	75

Table 15. Single Lane Roundabout with WBR Traffic Operations Analysis (2030 Volumes) – Arcady

Traffic Delay (sec/veh)		Traffic Queuing (feet)		Traffic Delay (sec/veh)		Traffic Queuing (feet)				
AM Peak				PM Peak						
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		
			Storage	Avg	Max			Storage	Avg	Max
EB	40 - E	22 - C	200	275	825	7 - A	18 - C	200	50	100
WB	7 - A		125	50	100	25 - C		125	300	750
SB	7 - A		125	25	100	7 - A		125	25	75

Tables 14 and **15** show how adding a designated westbound right turn lane is anticipated to significantly improve operations in the PM peak hour when westbound volumes are higher. The maximum westbound queue during the PM peak in Arcady is reduced from 2,375 ft with the single lane roundabout to 750 ft with the right turn lane added. The approach delay improves from LOS F to LOS C in Arcady and LOS A in Synchron. The intersection delay improves from LOS E to LOS B in Synchron and LOS F to LOS C in Arcady. Traffic operations remain about the same during the AM peak hour which is to be expected since eastbound traffic is the dominant movement during the AM peak and no changes were made to the eastbound approach.

Table 16. Single Lane Roundabout with WBR Traffic Operations Analysis (2040 Volumes) – Synchron

Traffic Delay (sec/veh)		Traffic Queuing (feet)		Traffic Delay (sec/veh)		Traffic Queuing (feet)		
AM Peak				PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length	
			Storage	Max			Storage	Max
EB	374 - F	179 - F	200	1900	21 - C	19 - C	200	225
WB	6 - A		125	50	13 - B		125	225
SB	34 - D		125	275	42 - E		125	200

Table 17. Single Lane Roundabout with WBR Traffic Operations Analysis (2040 Volumes) – Arcady

		Traffic Delay (sec/veh)	Traffic Queuing (feet)			Traffic Delay (sec/veh)	Traffic Queuing (feet)				
		AM Peak					PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			
			Storage	Avg	Max			Storage	Avg	Max	
EB	556 - F	258 - F	200	4300	6200	12 - B	84 - F	200	75	200	
WB	10 - B		125	75	175	133 - F		125	1500	2950	
SB	12 - B		125	75	200	11 - B		125	50	100	

Tables 16 and 17 show how adding a designated westbound right turn lane is anticipated to improve operations in the PM peak hour when westbound volumes are higher, however, the westbound approach and intersection overall is still anticipated to operate with LOS F during the PM peak hour according to the Arcady results. The Synchro results show the approach delay improving from LOS F to LOS B and the intersection delay improving from LOS F to LOS C.

2x1 Roundabout

Additionally, an analysis was also completed with the roundabouts expanded to 2x1 roundabouts with two through lanes along each TH 5 approach. 2030 and 2040 forecasted traffic volumes were analyzed. The results are shown in Tables 18 through 21 below.

Table 18. 2x1 Roundabout Traffic Operations Analysis (2030 Volumes) – Synchro

		Traffic Delay (sec/veh)	Traffic Queuing (feet)		Traffic Delay (sec/veh)	Traffic Queuing (feet)			
		AM Peak				PM Peak			
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		
			Storage	Max			Storage	Max	
EB	13 - B	9 - A	200	100	6 - A	8 - A	200	25	
WB	5 - A		125	25	8 - A		125	75	
SB	11 - B		125	75	12 - B		125	50	

Table 19. 2x1 Roundabout Traffic Operations Analysis (2030 Volumes) – Arcady

		Traffic Delay (sec/veh)	Traffic Queuing (feet)			Traffic Delay (sec/veh)	Traffic Queuing (feet)				
		AM Peak					PM Peak				
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			
			Storage	Avg	Max			Storage	Avg	Max	
EB	7 - A	6 - A	200	50	150	5 - A	7 - A	200	25	75	
WB	5 - A		125	25	75	8 - A		125	75	200	
SB	7 - A		125	50	125	7 - A		125	25	75	

Comparing Tables 18 and 19, the operational results are very similar between the two programs. Both tables show how a 2x1 roundabout is anticipated to operate well with 2030 volumes as the intersection overall operates with LOS A during both peak hours. All movements operate with LOS B or better. The maximum westbound through queue extends beyond nearby accesses during the PM peak hour in Arcady. All other queues are acceptable.

Table 20. 2x1 Roundabout Traffic Operations Analysis (2040 Volumes) – Synchro

		Traffic Delay (sec/veh)	Traffic Queuing (feet)	Traffic Delay (sec/veh)	Traffic Queuing (feet)			
		AM Peak			PM Peak			
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length	
			Storage	Max			Storage	Max
EB	26 - D	18 - C	200	250	8 - A	11 - B	200	50
WB	6 - A		125	50	10 - B		125	125
SB	21 - C		125	175	23 - C		125	125

Table 21. 2x1 Roundabout Traffic Operations Analysis (2040 Volumes) – Arcady

		Traffic Delay (sec/veh)	Traffic Queuing (feet)	Traffic Delay (sec/veh)	Traffic Queuing (feet)					
		AM Peak			PM Peak					
Approach	Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length			Approach (Delay - LOS)	Intersection (Delay - LOS)	Approach Queue Length		
			Storage	Avg	Max			Storage	Avg	Max
EB	13 - B	10 - B	200	125	300	6 - A	11 - B	200	50	100
WB	6 - A		125	50	125	14 - B		125	150	375
SB	13 - B		125	75	200	11 - B		125	50	125

Tables 20 and 21 show that in both Synchro and Arcady the intersection overall operates with LOS C or better during both peak hours. Table 20 shows how in the Synchro the eastbound approach is anticipated to operate with LOS D during the AM peak hour, however, Table 21 shows this approach operating with LOS B during the AM peak hour. The maximum eastbound and southbound queue extends beyond nearby accesses during the AM peak hour in both programs. The average westbound queue extends beyond nearby accesses during the PM peak hour in Arcady.

Single Lane Roundabout – 2030 Hourly Analysis

An hourly analysis of the single lane roundabout (without the westbound right turn lane) was analyzed with 2030 volumes in Arcady. The overall intersection delay and eastbound/westbound approach delay by hour are shown in Table 22. The hourly queue length results for the eastbound and westbound approaches are shown in Table 23. The eastbound and westbound approach delay is also shown graphically in Figure B.

Table 22. 2030 Hourly Single Lane Roundabout Traffic Operations Analysis – Arcady

Hour	Eastbound Approach		Westbound Approach		Southbound Approach		Intersection Overall	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
6:00 AM	30	D	4	A	5	A	18	C
7:00 AM	30	D	7	A	7	A	18	C
8:00 AM	23	C	5	A	7	A	13	B
9:00 AM	6	A	5	A	4	A	5	A
10:00 AM	5	A	4	A	4	A	5	A
11:00 AM	6	A	5	A	4	A	5	A
12:00 PM	5	A	5	A	4	A	5	A
1:00 PM	5	A	6	A	5	A	5	A
2:00 PM	5	A	10	B	5	A	8	A
3:00 PM	5	A	21	C	6	A	14	B
4:00 PM	7	A	59	F	8	A	38	E
5:00 PM	7	A	69	F	8	A	42	E
6:00 PM	6	A	12	B	5	A	9	A

Note that while PM peak hour operational analysis using Arcady presented earlier in this report indicated LOS F, the hourly analysis displayed in **Table 22** resulted in LOS E based on the different time periods analyzed (4-5PM versus 4:30-5:30PM).

Table 22 shows how the eastbound approach operates with LOS D for the 6:00 AM and 7:00 AM hours and LOS A or C for the other hours of the day. **Table 22** also shows how the westbound approach operates with failing LOS for the 4:00 PM and 5:00 PM hours and LOS C or better for all other hours of the day. The southbound approach operates with LOS A for all hours of the day.

Figure B. Approach Delay – Arcady

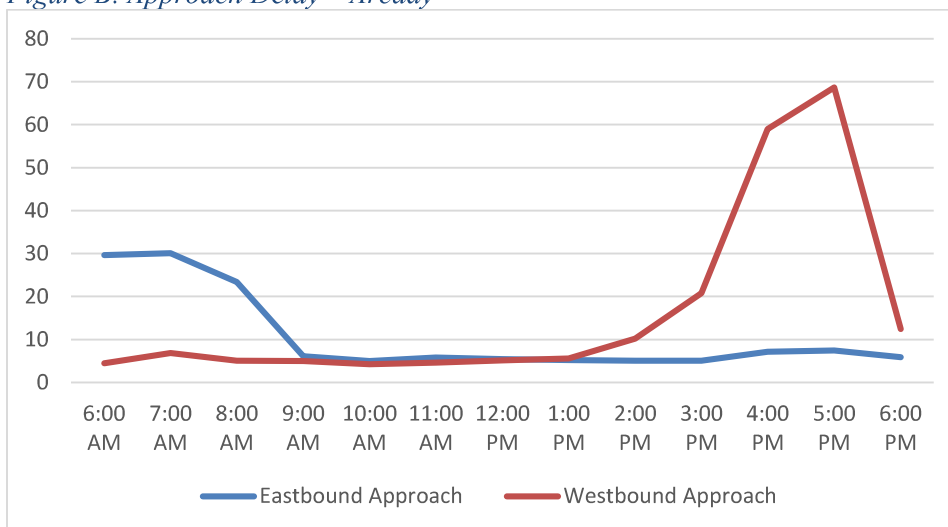


Figure B shows how the eastbound approach delay is highest from 6:00 AM to 9:00 AM and then delay remains minimal throughout the rest of the day. **Figure B** also illustrates how the westbound approach delay is minimal up until 1:00 PM. Then the delay increases from 1:00 PM through 5:00 PM.

Table 23. 2030 Hourly Single Lane Roundabout Traffic Queuing – Arcady

Hour	Queue Length (ft)								
	Eastbound Approach			Westbound Approach			Southbound Approach		
	Storage	Avg	Max	Storage	Avg	Max	Storage	Avg	Max
6:00 AM	200	225	725	125	25	50	125	25	75
7:00 AM	200	200	600	125	50	125	125	50	125
8:00 AM	200	200	575	125	25	75	125	25	100
9:00 AM	200	25	100	125	25	75	125	25	50
10:00 AM	200	25	100	125	25	50	125	25	50
11:00 AM	200	50	125	125	25	75	125	25	25
12:00 PM	200	25	75	125	25	100	125	25	50
1:00 PM	200	25	75	125	25	100	125	25	50
2:00 PM	200	25	75	125	75	225	125	25	25
3:00 PM	200	25	75	125	175	525	125	25	50
4:00 PM	200	50	100	125	675	1600	125	25	75
5:00 PM	200	50	125	125	750	1625	125	25	100
6:00 PM	200	50	125	125	100	300	125	25	50

Table 23 shows how traffic queues on the eastbound approach block driveways from 6:00 – 9:00 AM and how traffic queues along the westbound approach block driveways from 2:00 – 7:00 PM. All other hours operate with minimal traffic queuing.

Summary of Roundabout Operations

The use of two modeling tools was intended to provide an increased level of confidence in the projected results. While the results are different, there are similarities between both sets when comparing intersection delay/LOS by lane configuration and analysis year. **Table 24** shows a summary of the results at an intersection level, looking only at the overall intersection delay. 2025 peak hour operations were also analyzed to determine when the single lane roundabout would start to fail.

Table 24. Summary of Synchro and Arcady Modeling Results (Intersection Delay)

Option	2019		2025		2030		2040	
	Synchro	Arcady	Synchro	Arcady	Synchro	Arcady	Synchro	Arcady
Single Lane	12/12	7/10	29/20	11/19	68/36	23/66	181/96	276/379
Single Lane with WBR	-	-	-	-	67/11	22/18	179/19	258/84
2x1	-	-	-	-	9/8	6/7	18/11	10/11

Table 24 indicates that the single lane roundabout would operate well with 2019 and 2025 volumes, however, failing operations are anticipated by 2030. With a right turn lane added along the westbound approach the operations are acceptable with 2030 volumes in Arcady, however, the AM peak hour fails in Synchro. In 2040 the operational results from both programs indicate that a 2x1 roundabout is needed.

Benefit Cost Analysis

A benefit cost analysis was completed to compare the signal and roundabout alternatives considered at the intersection of TH 5 and CSAH 11 North. Since both the single lane roundabout and signalized intersection with the existing 2-lane are anticipated to operate with excessive delay in 2040 the benefit cost analysis assumed a 2x1 roundabout or 4-lane roadway with the signal were built in 2035.

Safety Benefit

The anticipated crash reduction was determined by analyzing the statewide average crash rates for each alternative considered and comparing the anticipated crash cost to the no build condition. The statewide averages for the roundabout and signal alternatives are shown below in **Table 25**. The existing entering volume at the intersection is 14,125 and the anticipated 2040 entering volume is 25,900. Therefore, a signal at the intersection would fall into the low volume category with existing volumes, but with 2040 volumes it would fall into the high volume category.

Table 25. Statewide Average Crash Rates

	Crash Rates			
	Single Lane Roundabout ¹	2x1 Roundabout ¹	Signal, Low Volume (<=20k) ²	Signal, High Volume (>20k) ²
Total Crash Rate	0.32	0.76	0.51	0.59
Fatal & Serious Injury Crash Rate	0.31	0.15	0.69	0.82

1. Data from "A Study of Traffic Safety at Roundabouts in Minnesota" (MnDOT)

2. Data from the StateAid Intersections Toolkit – Averages based on 2016-2020 Crashes

Table 25 shows that a single lane roundabout has the lowest total crash rate and a 2x1 roundabout has the lowest fatal & serious injury crash rate. The number of crashes anticipated per year for each option was determined using the crash rates shown in **Table 25**, the daily entering volume at the intersection, and the breakdown of crashes by severity statewide. The breakdown of crashes by severity statewide is shown in the Annual Minnesota Motor Vehicle Crash Facts Reports on the Minnesota Department of Public Safety webpage. Data from the previous three years available (2018-2020) was averaged for this analysis.

The number of crashes per year for the build scenarios were compared to the no build scenario. The 2040 no build crashes were estimated based on the existing crash breakdown and the assumption that crashes would increase at the same rate traffic volumes increase. The number of crashes per year was converted to a crash cost based on the cost per crash as outlined in the MnDOT HSIP Benefit Cost Worksheet. The build crash cost with each alternative was compared to the no build crash cost to determine the safety benefit. The existing year was assumed to be 2021. The reduction in crash cost per year was determined by interpolating between the existing year and 2040. The existing, 2040, and total 20-year safety benefits are shown in **Table 26** below.

Table 26. Summary of Safety Benefits

Alternative	Safety Benefit		
	Existing Year	2040	Total
Roundabout	\$219,408	\$238,876	\$4,582,837
Signal	\$161,150	\$252,933	\$4,140,838

The detailed calculation can be found in the **Appendix**. The safety analysis indicates that the roundabout alternative would have the greatest reduction in crashes.

Delay Benefit

The delay benefit was determined by modeling the existing and forecasted turning movement counts in Synchro/SimTraffic with the no build and build concepts. To estimate daily delay, hourly volumes for the highest 13-hours of the day were compared to the AM and PM peak hours as a percentage. Hours between 6am and 12pm were compared to the AM peak while hours between 12pm and 7pm were compared to the PM peak. The hourly volume percentage breakdown is shown in **Table 27**. The exact percent breakdown was rounded to 50% or 100% of the AM/PM peak volume. New Synchro models were created to analyze delay with 50% of the peak hour volumes.

Table 27. Hourly Volume Percentage Breakdown

Hour	Intersection Total	Exact Percentage of Peak Hour	Assumed Percentage of Peak Hour for Analysis
6AM	742	60% of AM	50% of AM
7AM	1220	98% of AM	100% of AM
8AM	913	74% of AM	100% of AM
9AM	728	59% of AM	50% of AM
10AM	581	47% of AM	50% of AM
11AM	646	52% of AM	50% of AM
12PM	717	50% of PM	50% of PM
1PM	724	51% of PM	50% of PM
2PM	867	61% of PM	50% of PM
3PM	1130	80% of PM	100% of PM
4PM	1360	96% of PM	100% of PM
5PM	1347	95% of PM	100% of PM
6PM	904	64% of PM	50% of PM

The turning movement count was also used to determine what percentage of the total volume was occurring during the highest volume time period (6am to 7pm). This data showed that 85% of the daily traffic was occurring during this period. Therefore, the following equation was used to calculate the total daily delay accounting for the remaining 15% of daily traffic. This equation references the number of hours from **Table 27** are associated with 50% or 100% of the AM/PM peak hours.

$$\begin{aligned}
 & \textbf{Total Daily Delay} = \\
 & \frac{4*(50\% \textbf{ AM Delay})+2*(100\% \textbf{ AM Delay})+4*(50\% \textbf{ PM Delay})+3*(100\% \textbf{ PM Delay})}{0.85}
 \end{aligned}$$

Text within parenthesis represents the total network delay in hours as determined for each concept in Synchro/SimTraffic. Auto delay and truck delay values were computed using the truck percentage (3.3%) collected from the turning movement counts.

Benefits from the reduction of delay were computed for the alternatives by comparing the total delay values for the improvement alternative to the no build alternative. The total benefit over the 20-year

analysis period was determined using the existing and 2040 benefits. Assuming the delay benefits increased over the analysis period with a discount rate of 0.7%, the following formula was used to convert to a present value total delay benefit:

$$\text{Total Delay Benefit} = (\text{Existing Benefit}) + 18.6 * (\text{Existing Benefit}) + 172.4 * \frac{(\text{2040 Benefit} - \text{Existing Benefit})}{20}$$

The formula was developed by assuming a uniform series of the benefit over the 20-year analysis period with the addition of a uniform gradient benefit (the additional benefit gained every year until the full 2040 benefit is reached). See **Table 28** for existing year, 2040, and total delay benefits for each alternative. Values in parenthesis indicate a negative delay benefit (increase in delay).

Table 28. Summary of Delay Benefits

Alternative	Existing Year Benefit	2040 Benefit	Total Delay Benefit
Roundabout	\$ 26,591	\$7,708,926	\$66,742,917
Signal	\$ 3,799	\$7,908,994	\$68,217,236

Table 28 shows how in the existing year the roundabout has a much higher delay benefit, however in 2040 the signal has a slightly higher delay benefit. This makes the overall delay benefit slightly higher for the signal than the roundabout.

Benefit-Cost Ratio

The 20-year safety and delay benefits were combined and compared to the total cost to construct each alternative to determine the benefit cost ratios. A ratio greater than one indicates the project cost is less than the anticipated benefit from the investment. A ratio lower than one, or a negative ratio, indicates the anticipated benefit does not offset the cost. The results are shown in **Table 29** below.

The initial construction of the single lane roundabout or signal with existing roadway geometry was assumed to be in 2026. The single lane roundabout cost assumed the roundabout would initially be built to the full inscribed diameter needed for the 2x1 roundabout, but the center median would be larger such that there is only room for one circulating lane upon initial construction. This would result in a higher upfront cost when the roundabout was initially constructed but would make for an easier conversion to a 2x1 roundabout in the future. The signalized intersection only includes the cost to add a signal system at the intersection in the existing year (no roadway work). The expansion to the 2x1 roundabout and 4-lane roadway with the signal was assumed for 2035. The total cost shown in **Table 29** is the present value cost and includes both the cost of the initial construction and future year expansion.

Table 29 – Benefit-Cost Analysis Summary

Alternative	Safety Benefit	Delay Benefit	Total Cost	B/C Ratio
Roundabout	\$4,582,837	\$66,742,917	\$5,324,000	13.40
Signal	\$4,140,838	\$68,217,236	\$3,291,000	21.99

Notes: Total cost does not include any applicable engineering fee.

Table 29 shows that both options have benefit to cost ratios much greater than one.

Other Considerations

Terrain/Sight Lines:

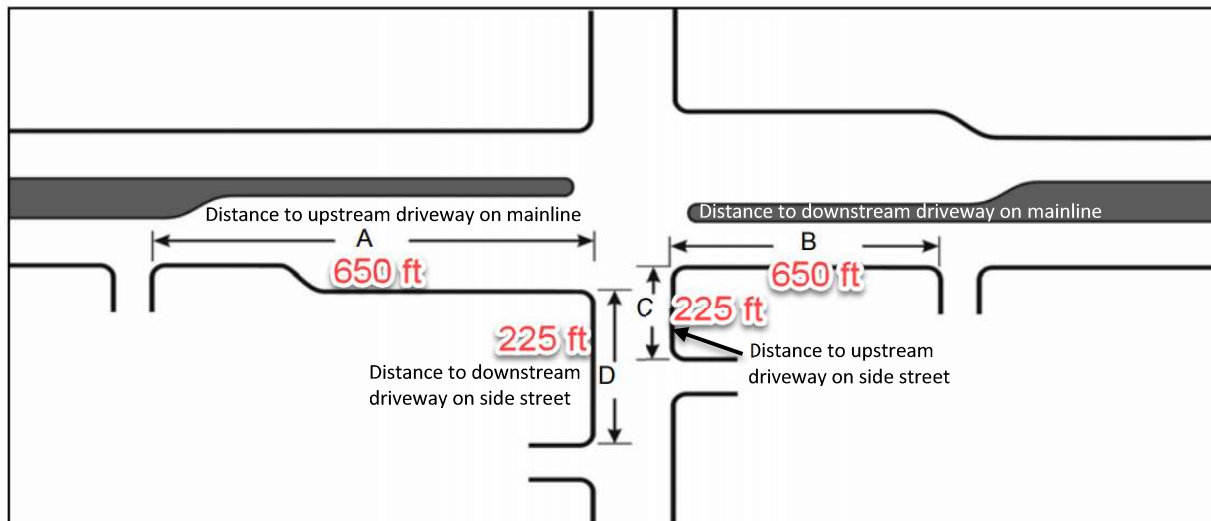
There are no terrain or sight line issues at this intersection.

Access:

There are several accesses located within 300 feet of the intersection. These are listed below:

- Accesses to the Victoria Veterinary Hospital and Dairy Queen are approximately 100 ft to the north of the intersection.
- The Dairy Queen also has access off TH 5 within 25 ft of the intersection.
- Waterfront Specialties Inc has access off TH 5 approximately 100 ft east of the intersection.
- Residential homes are located along both TH 5 and CSAH 11 North within 300 feet of the intersection.

Chapter 3 of the MnDOT Access Management Manual recommends the following distances between accesses along TH 5 and CSAH 11 North. These distances are referred to as the corner clearance.



There are accesses within all four corner clearances shown, however, the manual states that in cases where no alternative access is available, an access will have to be provided. Since several of the adjacent lots are small moving the access is not always possible therefore many if not all of the existing accesses must remain.

Since both TH 5 and CSAH 11 N are high speed roadways, MnDOT recommends 250 ft splitter islands with the roundabout alternative, although through the layout development process variations and practical design solutions may be implemented. The splitter islands will convert the accesses to right-in/right-out however most movements will still be easily accommodated as vehicles can make a U-turn at the roundabout.

Access considerations for the signal alternative are complex. Without median separation, full accesses would remain immediately adjacent to the intersection itself, within the average and max queuing anticipated at the signal. The safety concerns stemming from this configuration can be partially remedied by implementing medians along the approaches, however the signal alternative does not provide an efficient U-turn movement which could cause issues with certain vehicle types utilizing the intersection.

Pedestrian and Bicycle Accommodations:

There are plans to include pedestrian and bicycle facilities in the project area. The concepts analyzed can also accommodate these facilities at the intersection.

Traffic Growth:

An analysis of traffic volumes in StreetLight Insight indicates that 2021 volumes are about equal to 2019 volumes. Therefore, while the operational analyses indicate year 2030 or 2040 the actual year these higher volumes occur may be different (later).

Recommendation

A roundabout is the recommended alternative for this location. Both the signal and roundabout alternatives operate acceptably and have strong benefit cost ratios; however, the roundabout is anticipated to provide a greater safety benefit. Both a single lane and 2x1 roundabout have significantly lower fatal and serious injury crash rates than a signalized intersection according to the statewide averages. Also, the roundabout alternative better accommodates the driveway accesses compared to a signal.

The concept drawing of this alternative in the build year as a single lane roundabout is shown in **Figure C** below.

Figure C. Preferred Alternative



This alternative operates well with existing and 2025 volumes. The operational analysis indicates that a westbound right turn lane could be needed in 10 years to reduce westbound traffic queueing and delay

Name: TH 5 at CSAH 11 North Intersection Control Evaluation

Date: May 16, 2022

Page: 19

during the PM peak. Additionally, a 2x1 roundabout is likely needed in the 20-year horizon if traffic volumes reach what is anticipated with the 2040 forecasting.

Even though these capacity improvements are likely needed in the future, an expandable single lane is recommended for initial construction. Safety concerns are a major factor when determining the recommended lane configuration at a roundabout and single lane roundabouts have been proven to be easier to navigate compared to larger designs. As drivers become increasingly capable and familiar with driving roundabouts, the capacity of roundabouts can also increase. Therefore, it is not certain that such excessive queues and delays would be seen in the 20-year horizon so planning for them but not building the ultimate footprint now is recommended.

Appendix

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190319
 Site Code :
 Start Date : 3/19/2019
 Page No : 1

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
11:00 AM	1	0	18	0	0	15	60	0	0	0	0	0	0	0	0	0	64	3	0	0	161
11:15 AM	1	0	15	0	0	21	64	0	0	0	0	0	0	0	0	0	63	2	0	0	166
11:30 AM	2	0	13	0	0	29	70	0	0	0	0	0	0	0	0	0	56	1	0	0	171
11:45 AM	1	0	23	0	0	21	71	0	0	0	0	0	0	0	0	0	63	0	0	0	179
Total	5	0	69	0	0	86	265	0	0	0	0	0	0	0	0	0	246	6	0	0	677
12:00 PM	2	0	21	0	0	21	54	0	0	0	0	0	0	0	0	0	67	1	0	0	166
12:15 PM	4	0	23	0	0	24	74	0	0	0	0	0	0	0	0	0	76	0	0	0	201
12:30 PM	1	0	24	0	0	27	43	0	0	0	0	0	0	0	0	0	70	2	0	0	167
12:45 PM	1	0	24	0	0	19	67	0	0	0	0	0	0	0	0	0	62	1	0	0	174
Total	8	0	92	0	0	91	238	0	0	0	0	0	0	0	0	0	275	4	0	0	708
01:00 PM	3	0	21	0	0	28	63	0	0	0	0	0	0	0	0	0	50	2	0	0	167
01:15 PM	0	0	17	0	0	24	65	0	0	0	0	0	0	0	0	0	59	3	0	0	168
01:30 PM	4	0	19	0	0	23	66	0	0	0	0	0	0	0	0	0	55	3	0	0	170
01:45 PM	4	0	18	0	0	20	53	0	0	0	0	0	0	0	0	0	58	1	0	0	154
Total	11	0	75	0	0	95	247	0	0	0	0	0	0	0	0	0	222	9	0	0	659
02:00 PM	2	0	19	0	0	21	71	0	0	0	0	0	0	0	0	0	62	1	0	0	176
02:15 PM	5	0	16	0	0	28	88	0	0	0	0	0	0	0	0	0	85	1	0	0	223
02:30 PM	0	0	28	0	0	45	103	0	0	0	0	0	0	0	0	0	65	0	0	0	241
02:45 PM	4	0	31	0	0	33	100	0	0	0	0	0	0	0	0	0	58	3	0	0	229
Total	11	0	94	0	0	127	362	0	0	0	0	0	0	0	0	0	270	5	0	0	869
03:00 PM	1	0	21	0	0	57	83	0	0	0	0	0	0	0	0	0	53	1	0	0	216
03:15 PM	2	0	24	0	0	39	114	0	0	0	0	0	0	0	0	0	62	1	0	0	242
03:30 PM	2	0	36	0	0	35	126	0	0	0	0	0	0	0	0	0	75	1	0	0	275
03:45 PM	5	0	28	0	0	74	129	0	0	0	0	0	0	0	0	0	83	4	0	0	323
Total	10	0	109	0	0	205	452	0	0	0	0	0	0	0	0	0	273	7	0	0	1056
04:00 PM	1	0	20	0	0	62	143	0	0	0	0	0	0	0	0	0	76	0	0	0	302
04:15 PM	1	0	30	0	0	71	152	0	0	0	0	0	0	0	0	0	87	1	0	0	342
04:30 PM	7	0	37	0	0	65	171	0	0	0	0	0	0	0	0	0	77	4	0	0	361
04:45 PM	7	0	33	0	0	76	154	0	0	0	0	0	0	0	0	0	78	4	0	0	352
Total	16	0	120	0	0	274	620	0	0	0	0	0	0	0	0	0	318	9	0	0	1357

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190319
 Site Code :
 Start Date : 3/19/2019
 Page No : 2

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
05:00 PM	9	0	37	0	0	75	158	0	0	0	0	0	0	0	0	0	77	3	0	0	359
05:15 PM	6	0	38	0	0	81	130	0	0	0	0	0	0	0	0	0	88	5	0	0	348
05:30 PM	11	0	41	0	0	68	145	0	0	0	0	0	0	0	0	0	66	4	0	0	335
05:45 PM	10	0	38	0	0	46	124	0	0	0	0	0	0	0	0	0	64	1	0	0	283
Total	36	0	154	0	0	270	557	0	0	0	0	0	0	0	0	0	295	13	0	0	1325
06:00 PM	4	0	29	0	0	43	117	0	0	0	0	0	0	0	0	0	67	0	0	0	260
06:15 PM	1	0	31	0	0	43	95	0	0	0	0	0	0	0	0	0	56	0	0	0	226
06:30 PM	3	0	18	0	0	39	93	0	0	0	0	0	0	0	0	0	56	2	0	0	211
06:45 PM	1	0	13	0	0	17	70	0	0	0	0	0	0	0	0	0	43	0	1	0	145
Total	9	0	91	0	0	142	375	0	0	0	0	0	0	0	0	0	222	2	1	0	842
07:00 PM	1	0	10	0	0	25	59	0	0	0	0	0	0	0	0	0	34	1	0	0	130
07:15 PM	2	0	13	0	0	17	57	0	0	0	0	0	0	0	0	0	35	1	0	0	125
07:30 PM	2	0	13	0	0	23	63	0	0	0	0	0	0	0	0	0	33	0	0	0	134
07:45 PM	1	0	9	0	0	26	58	0	0	0	0	0	0	0	0	0	30	0	0	0	124
Total	6	0	45	0	0	91	237	0	0	0	0	0	0	0	0	0	132	2	0	0	513
08:00 PM	1	0	12	0	0	19	47	0	1	0	0	0	0	0	0	0	26	0	0	0	106
08:15 PM	1	0	9	0	0	10	41	0	0	0	0	0	0	0	0	0	21	1	0	0	83
08:30 PM	0	0	11	0	0	11	38	0	0	0	0	0	0	0	0	0	17	0	0	0	77
08:45 PM	0	0	3	0	0	12	36	0	0	0	0	0	0	0	0	0	26	0	0	0	77
Total	2	0	35	0	0	52	162	0	1	0	0	0	0	0	0	0	90	1	0	0	343
09:00 PM	0	0	3	0	0	10	37	0	0	0	0	0	0	0	0	0	14	0	0	0	64
09:15 PM	2	0	6	0	0	11	36	0	0	0	0	0	0	0	0	0	22	1	0	0	78
09:30 PM	0	0	7	0	0	12	34	0	0	0	0	0	0	0	0	0	11	0	0	0	64
09:45 PM	1	0	5	0	0	4	23	0	0	0	0	0	0	0	0	0	10	0	0	0	43
Total	3	0	21	0	0	37	130	0	0	0	0	0	0	0	0	0	57	1	0	0	249
10:00 PM	0	0	1	0	0	6	17	0	0	0	0	0	0	0	0	0	9	0	0	0	33
10:15 PM	0	0	2	0	0	2	19	0	0	0	0	0	0	0	0	0	5	0	0	0	28
10:30 PM	1	0	2	0	0	7	21	0	0	0	0	0	0	0	0	0	7	1	0	0	39
10:45 PM	0	0	2	0	0	5	20	0	0	0	0	0	0	0	0	0	4	0	0	0	31
Total	1	0	7	0	0	20	77	0	0	0	0	0	0	0	0	0	25	1	0	0	131

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190319
 Site Code :
 Start Date : 3/19/2019
 Page No : 3

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total	
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds		
11:00 PM	0	0	3	0	0	5	9	0	0	0	0	0	0	0	0	0	5	1	0	0	0	23
11:15 PM	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	12
11:30 PM	0	0	0	0	0	2	7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10
11:45 PM	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	6
Total	0	0	4	0	0	8	30	0	0	0	0	0	0	0	0	0	8	1	0	0	0	51
Grand Total	118	0	916	0	0	1498	3752	0	1	0	0	0	0	0	0	0	2433	61	1	0	0	8780
Apprch %	11.4	0	88.6	0	0	28.5	71.5	0	0	0	0	0	0	0	0	0	97.5	2.4	0	0	0	
Total %	1.3	0	10.4	0	0	17.1	42.7	0	0	0	0	0	0	0	0	0	27.7	0.7	0	0	0	
Cars	115	0	877	0	0	1450	3665	0	1	0	0	0	0	0	0	0	2362	57	1	0	0	8528
% Cars	97.5	0	95.7	0	0	96.8	97.7	0	100	0	0	0	0	0	0	0	97.1	93.4	100	0	0	97.1
Trucks	3	0	39	0	0	48	87	0	0	0	0	0	0	0	0	0	71	4	0	0	0	252
% Trucks	2.5	0	4.3	0	0	3.2	2.3	0	0	0	0	0	0	0	0	0	2.9	6.6	0	0	0	2.9

Start Time	CSAH 11 North (Victoria Dr) Southbound						TH 5 Westbound						TH 5 Northbound						TH 5 Eastbound						Int. Total
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	
Peak Hour Analysis From 11:00 AM to 11:45 PM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 04:30 PM																									
04:30 PM	7	0	37	0	0	44	65	171	0	0	0	236	0	0	0	0	0	0	0	77	4	0	0	81	361
04:45 PM	7	0	33	0	0	40	76	154	0	0	0	230	0	0	0	0	0	0	0	78	4	0	0	82	352
05:00 PM	9	0	37	0	0	46	75	158	0	0	0	233	0	0	0	0	0	0	0	77	3	0	0	80	359
05:15 PM	6	0	38	0	0	44	81	130	0	0	0	211	0	0	0	0	0	0	0	88	5	0	0	93	348
Total Volume	29	0	145	0	0	174	297	613	0	0	0	910	0	0	0	0	0	0	0	320	16	0	0	336	1420
% App. Total	.806	.000	.954	.000	.000	.946	.917	.896	.000	.000	.000	.964	.000	.000	.000	.000	.000	.000	.000	.909	.800	.000	.000	.903	.983

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
 Site Code :
 Start Date : 3/20/2019
 Page No : 1

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
12:00 AM	0	0	1	0	0	0	8	0	0	0	0	0	0	0	0	0	2	0	0	0	11
12:15 AM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	4
12:30 AM	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	3	0	0	0	7
12:45 AM	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	6
Total	0	0	3	0	0	3	14	0	0	0	0	0	0	0	0	0	8	0	0	0	28
01:00 AM	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	5
01:15 AM	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5
01:30 AM	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	1	0	0	0	6
01:45 AM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	0	4	0	0	3	10	0	0	0	0	0	0	0	0	0	1	0	0	0	18
02:00 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
02:15 AM	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	5	0	0	0	11
02:30 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	3
02:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
Total	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	11	0	0	0	19
03:00 AM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3	0	0	0	5
03:15 AM	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	3	0	0	0	6
03:30 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	5
03:45 AM	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	7
Total	0	0	2	0	0	2	6	0	0	0	0	0	0	0	0	0	13	0	0	0	23
04:00 AM	0	0	3	0	0	2	2	0	0	0	0	0	0	0	0	0	10	0	0	0	17
04:15 AM	0	0	5	0	0	5	2	0	0	0	0	0	0	0	0	0	9	0	0	0	21
04:30 AM	1	0	3	0	0	3	4	0	0	0	0	0	0	0	0	0	14	1	0	0	26
04:45 AM	0	0	2	0	0	4	3	0	0	0	0	0	0	0	0	0	15	0	0	0	24
Total	1	0	13	0	0	14	11	0	0	0	0	0	0	0	0	0	48	1	0	0	88
05:00 AM	0	0	8	0	0	5	2	0	0	0	0	0	0	0	0	0	29	0	0	0	44
05:15 AM	0	0	16	0	0	3	5	0	0	0	0	0	0	0	0	0	49	0	0	0	73
05:30 AM	0	0	11	0	0	5	12	0	0	0	0	0	0	0	0	0	61	1	0	0	90
05:45 AM	1	0	23	0	0	7	13	0	0	0	0	0	0	0	0	0	44	0	0	0	88
Total	1	0	58	0	0	20	32	0	0	0	0	0	0	0	0	0	183	1	0	0	295

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
 Site Code :
 Start Date : 3/20/2019
 Page No : 2

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
06:00 AM	0	0	25	0	0	5	15	0	0	0	0	0	0	0	0	0	65	1	0	0	111
06:15 AM	0	0	20	0	0	9	21	0	0	0	0	0	0	0	0	0	77	0	0	0	127
06:30 AM	0	0	44	0	0	17	38	0	0	0	0	0	0	0	0	0	135	2	0	0	236
06:45 AM	0	0	42	0	0	29	43	0	0	0	0	0	0	0	0	0	150	4	0	0	268
Total	0	0	131	0	0	60	117	0	0	0	0	0	0	0	0	0	427	7	0	0	742
07:00 AM	3	0	52	0	0	31	41	0	0	0	0	0	0	0	0	0	130	3	0	0	260
07:15 AM	2	0	88	0	0	33	60	0	0	0	0	0	0	0	0	0	143	6	0	0	332
07:30 AM	2	0	63	0	0	26	58	0	0	0	0	0	0	0	0	0	162	2	0	0	313
07:45 AM	1	0	80	0	0	34	44	0	0	0	0	0	0	0	0	0	146	10	0	0	315
Total	8	0	283	0	0	124	203	0	0	0	0	0	0	0	0	0	581	21	0	0	1220
08:00 AM	3	0	61	0	0	26	53	0	0	0	0	0	0	0	0	0	133	6	0	0	282
08:15 AM	1	0	47	0	0	30	53	0	0	0	0	0	0	0	0	0	82	4	0	0	217
08:30 AM	2	0	38	0	0	20	54	0	0	0	0	0	0	0	0	0	91	2	0	0	207
08:45 AM	1	0	32	0	0	18	54	0	0	0	0	0	0	0	0	0	101	1	0	0	207
Total	7	0	178	0	0	94	214	0	0	0	0	0	0	0	0	0	407	13	0	0	913
09:00 AM	1	0	35	0	0	27	32	0	0	0	0	0	0	0	0	0	81	2	0	0	178
09:15 AM	1	0	30	0	0	16	67	0	0	0	0	0	0	0	0	0	78	2	0	0	194
09:30 AM	1	0	26	0	0	17	58	0	0	0	0	0	0	0	0	0	67	2	0	0	171
09:45 AM	3	0	21	0	0	21	70	0	0	0	0	0	0	0	0	0	70	0	0	0	185
Total	6	0	112	0	0	81	227	0	0	0	0	0	0	0	0	0	296	6	0	0	728
10:00 AM	2	0	19	0	0	10	39	0	0	0	0	0	0	0	0	0	67	2	0	0	139
10:15 AM	2	0	20	0	0	26	35	0	0	0	0	0	0	0	0	0	65	2	0	0	150
10:30 AM	2	0	15	0	0	8	53	0	0	0	0	0	0	0	0	0	55	2	0	0	135
10:45 AM	1	0	18	0	0	14	57	0	0	0	0	0	0	0	0	0	65	2	0	0	157
Total	7	0	72	0	0	58	184	0	0	0	0	0	0	0	0	0	252	8	0	0	581
11:00 AM	2	0	14	0	0	15	50	0	0	1	0	0	0	0	0	0	60	2	0	0	144
11:15 AM	2	0	19	0	0	21	44	0	0	1	0	0	0	0	0	0	88	3	0	0	178
11:30 AM	2	0	16	0	0	19	46	0	0	0	0	0	0	0	0	0	67	3	0	0	153
11:45 AM	1	0	21	0	0	22	59	0	0	0	0	0	0	0	0	0	69	1	0	0	173
Total	7	0	70	0	0	77	199	0	0	2	0	0	0	0	0	0	284	9	0	0	648

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
 Site Code :
 Start Date : 3/20/2019
 Page No : 3

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
12:00 PM	3	0	19	0	0	19	57	0	0	0	0	0	0	0	0	0	58	1	0	0	157
12:15 PM	1	0	23	0	0	20	67	0	0	0	0	0	0	0	0	0	73	2	0	0	186
12:30 PM	2	0	19	0	0	21	71	0	0	0	0	0	0	0	0	0	78	1	0	0	192
12:45 PM	5	0	24	0	0	24	72	0	0	0	0	0	0	0	0	0	55	2	0	0	182
Total	11	0	85	0	0	84	267	0	0	0	0	0	0	0	0	0	264	6	0	0	717
01:00 PM	3	0	23	0	0	28	79	0	0	0	0	0	0	0	0	0	64	1	0	0	198
01:15 PM	2	0	16	0	0	23	79	0	0	0	0	0	0	0	0	0	39	1	0	0	160
01:30 PM	1	0	17	0	0	23	68	0	0	0	0	0	0	0	0	0	71	3	0	0	183
01:45 PM	3	0	24	0	0	25	78	0	0	0	0	0	0	0	0	0	50	3	0	0	183
Total	9	0	80	0	0	99	304	0	0	0	0	0	0	0	0	0	224	8	0	0	724
02:00 PM	0	0	17	0	0	17	79	0	0	0	0	0	0	0	0	0	59	1	0	0	173
02:15 PM	2	0	27	0	0	22	92	0	0	0	0	0	0	0	0	0	65	2	0	0	210
02:30 PM	3	0	22	0	0	45	98	0	0	0	0	0	0	0	0	0	59	2	0	0	229
02:45 PM	1	0	26	0	0	40	123	0	0	0	0	0	0	0	0	0	64	1	0	0	255
Total	6	0	92	0	0	124	392	0	0	0	0	0	0	0	0	0	247	6	0	0	867
03:00 PM	0	0	21	0	0	42	110	0	0	0	0	0	0	0	0	0	70	2	0	0	245
03:15 PM	2	0	32	0	0	49	93	0	0	0	0	0	0	0	0	0	83	6	0	0	265
03:30 PM	5	0	26	0	0	56	127	0	0	0	0	0	0	0	0	0	94	4	0	0	312
03:45 PM	6	0	30	0	0	67	122	0	0	0	0	0	0	0	0	0	78	5	0	0	308
Total	13	0	109	0	0	214	452	0	0	0	0	0	0	0	0	0	325	17	0	0	1130
04:00 PM	5	0	25	0	0	77	127	0	0	0	0	0	0	0	0	0	67	4	0	0	305
04:15 PM	6	0	39	0	0	82	150	0	0	0	0	0	0	0	0	0	77	2	0	0	356
04:30 PM	8	0	35	0	0	60	142	0	0	0	0	0	0	0	0	0	74	5	0	0	324
04:45 PM	8	0	40	0	0	77	155	0	0	0	0	0	0	0	0	0	91	4	0	0	375
Total	27	0	139	0	0	296	574	0	0	0	0	0	0	0	0	0	309	15	0	0	1360
05:00 PM	6	0	23	0	0	85	153	0	0	0	0	0	0	0	0	0	84	4	0	0	355
05:15 PM	9	0	29	0	0	70	136	0	0	0	0	0	0	0	0	0	97	5	0	0	346
05:30 PM	11	0	42	0	0	69	136	0	0	0	0	0	0	0	0	0	75	5	0	0	338
05:45 PM	5	0	27	0	0	56	111	0	0	0	0	0	0	0	0	0	107	2	0	0	308
Total	31	0	121	0	0	280	536	0	0	0	0	0	0	0	0	0	363	16	0	0	1347

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
 Site Code :
 Start Date : 3/20/2019
 Page No : 4

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
06:00 PM	4	0	16	0	0	52	121	0	0	0	0	0	0	0	0	0	89	3	0	0	285
06:15 PM	2	0	22	0	0	31	112	0	0	0	0	0	0	0	0	0	70	2	0	0	239
06:30 PM	5	0	23	0	0	26	102	0	0	0	0	0	0	0	0	0	50	3	0	0	209
06:45 PM	2	0	17	0	0	18	86	0	0	0	0	0	0	0	0	0	47	1	0	0	171
Total	13	0	78	0	0	127	421	0	0	0	0	0	0	0	0	0	256	9	0	0	904
07:00 PM	1	0	15	0	0	29	63	0	0	0	0	0	0	0	0	0	47	5	0	0	160
07:15 PM	4	0	12	0	0	17	85	0	0	0	0	0	0	0	0	0	34	1	0	0	153
07:30 PM	3	0	15	0	0	12	61	0	0	0	0	0	0	0	0	0	26	2	0	0	119
07:45 PM	2	0	20	0	0	22	71	0	0	0	0	0	0	0	0	0	33	0	0	0	148
Total	10	0	62	0	0	80	280	0	0	0	0	0	0	0	0	0	140	8	0	0	580
08:00 PM	1	0	9	0	0	17	57	0	0	0	0	0	0	0	0	0	38	1	0	0	123
08:15 PM	1	0	8	0	0	9	53	0	0	0	0	0	0	0	0	0	25	0	0	0	96
08:30 PM	1	0	9	0	0	14	49	0	0	0	0	0	0	0	0	0	24	1	0	0	98
08:45 PM	1	0	10	0	0	11	43	0	0	0	0	0	0	0	0	0	19	1	0	0	85
Total	4	0	36	0	0	51	202	0	0	0	0	0	0	0	0	0	106	3	0	0	402
09:00 PM	2	0	10	0	0	16	56	0	0	0	0	0	0	0	0	0	13	0	0	0	97
09:15 PM	0	0	8	0	0	13	33	0	0	0	0	0	0	0	0	0	14	0	0	0	68
09:30 PM	0	0	2	0	0	11	36	0	0	0	0	0	0	0	0	0	13	1	0	0	63
09:45 PM	0	0	3	0	0	12	28	0	0	0	0	0	0	0	0	0	15	0	0	0	58
Total	2	0	23	0	0	52	153	0	0	0	0	0	0	0	0	0	55	1	0	0	286
10:00 PM	0	0	4	0	0	2	27	0	0	0	0	0	0	0	0	0	13	1	0	0	47
10:15 PM	0	0	4	0	0	9	16	0	0	0	0	0	0	0	0	0	10	1	0	0	40
10:30 PM	0	0	3	0	0	6	17	0	0	0	0	0	0	0	0	0	11	0	0	0	37
10:45 PM	1	0	0	0	0	3	8	0	0	0	0	0	0	0	0	0	5	0	0	0	17
Total	1	0	11	0	0	20	68	0	0	0	0	0	0	0	0	0	39	2	0	0	141
11:00 PM	0	0	1	0	0	2	11	0	0	0	0	0	0	0	0	0	6	0	0	0	20
11:15 PM	0	0	2	0	0	2	9	0	0	0	0	0	0	0	0	0	5	0	0	0	18
11:30 PM	0	0	1	0	0	4	8	0	0	0	0	0	0	0	0	0	10	0	0	0	23
11:45 PM	0	0	0	0	0	1	6	0	0	0	0	0	0	0	0	0	2	0	0	0	9
Total	0	0	4	0	0	9	34	0	0	0	0	0	0	0	0	0	23	0	0	0	70

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
Data Prepared By: ACS
TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
Site Code :
Start Date : 3/20/2019
Page No : 5

Groups Printed- Cars - Trucks

	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
Grand Total	164	0	1769	0	0	1972	4905	0	0	2	0	0	0	0	0	0	4862	157	0	0	13831
Apprch %	8.5	0	91.5	0	0	28.7	71.3	0	0	0	0	0	0	0	0	0	96.9	3.1	0	0	
Total %	1.2	0	12.8	0	0	14.3	35.5	0	0	0	0	0	0	0	0	0	35.2	1.1	0	0	
Cars	155	0	1696	0	0	1885	4759	0	0	2	0	0	0	0	0	0	4730	147	0	0	13374
% Cars	94.5	0	95.9	0	0	95.6	97	0	0	100	0	0	0	0	0	0	97.3	93.6	0	0	96.7
Trucks	9	0	73	0	0	87	146	0	0	0	0	0	0	0	0	0	132	10	0	0	457
% Trucks	5.5	0	4.1	0	0	4.4	3	0	0	0	0	0	0	0	0	0	2.7	6.4	0	0	3.3

Start Time	CSAH 11 North (Victoria Dr) Southbound						TH 5 Westbound						Northbound						TH 5 Eastbound						Int. Total
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	
Peak Hour Analysis From 12:00 AM to 11:45 AM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 07:15 AM																									
07:15 AM	2	0	88	0	0	90	33	60	0	0	0	93	0	0	0	0	0	0	0	143	6	0	0	149	332
07:30 AM	2	0	63	0	0	65	26	58	0	0	0	84	0	0	0	0	0	0	0	162	2	0	0	164	313
07:45 AM	1	0	80	0	0	81	34	44	0	0	0	78	0	0	0	0	0	0	0	146	10	0	0	156	315
08:00 AM	3	0	61	0	0	64	26	53	0	0	0	79	0	0	0	0	0	0	0	133	6	0	0	139	282
Total Volume	8	0	292	0	0	300	119	215	0	0	0	334	0	0	0	0	0	0	0	584	24	0	0	608	1242
% App. Total	.667	.000	.830	.000	.000	.833	.875	.896	.000	.000	.000	.898	.000	.000	.000	.000	.000	.000	.000	.901	.600	.000	.000	.927	.935

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190320
 Site Code :
 Start Date : 3/20/2019
 Page No : 6

Start Time	CSAH 11 North (Victoria Dr) Southbound						TH 5 Westbound						Northbound						TH 5 Eastbound						Int. Total	
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total		
Peak Hour Analysis From 12:00 PM to 11:45 PM - Peak 1 of 1																										
Peak Hour for Entire Intersection Begins at 04:45 PM																										
04:45 PM	8	0	40	0	0	48	77	155	0	0	0	232	0	0	0	0	0	0	0	91	4	0	0	95	375	
05:00 PM	6	0	23	0	0	29	85	153	0	0	0	238	0	0	0	0	0	0	0	84	4	0	0	88	355	
05:15 PM	9	0	29	0	0	38	70	136	0	0	0	206	0	0	0	0	0	0	0	97	5	0	0	102	346	
05:30 PM	11	0	42	0	0	53	69	136	0	0	0	205	0	0	0	0	0	0	0	75	5	0	0	80	338	
Total Volume	34	0	134	0	0	168	301	580	0	0	0	881	0	0	0	0	0	0	0	347	18	0	0	365	1414	
% App. Total	PHF	.773	.000	.798	.000	.000	.792	.885	.935	.000	.000	.925	.000	.000	.000	.000	.000	.000	.000	.000	.894	.900	.000	.000	.895	.943

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190321
 Site Code :
 Start Date : 3/21/2019
 Page No : 1

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
12:00 AM	0	0	2	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	10
12:15 AM	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	1	0	0	0	8
12:30 AM	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	3	0	0	0	8
12:45 AM	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4
Total	0	0	2	0	0	7	15	0	0	0	0	0	0	0	0	0	6	0	0	0	30
01:00 AM	0	0	1	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	7
01:15 AM	0	0	1	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	6
01:30 AM	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	1	0	0	0	6
01:45 AM	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	0	4
Total	0	0	2	0	0	6	13	0	0	0	0	0	0	0	0	0	2	0	0	0	23
02:00 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
02:15 AM	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	5
02:30 AM	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	5
02:45 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	3
Total	0	0	3	0	0	1	7	0	0	0	0	0	0	0	0	0	4	0	0	0	15
03:00 AM	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	5
03:15 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	7
03:30 AM	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	4	0	0	0	9
03:45 AM	0	0	1	0	0	1	5	0	0	0	0	0	0	0	0	0	6	0	0	0	13
Total	0	0	3	0	0	4	8	0	0	0	0	0	0	0	0	0	19	0	0	0	34
04:00 AM	0	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	11	0	0	0	16
04:15 AM	0	0	8	0	0	4	1	0	0	0	0	0	0	0	0	0	11	0	0	0	24
04:30 AM	0	0	6	0	0	2	7	0	0	0	0	0	0	0	0	0	18	1	0	0	34
04:45 AM	0	0	2	0	0	3	4	0	0	0	0	0	0	0	0	0	12	0	0	0	21
Total	0	0	18	0	0	10	14	0	0	0	0	0	0	0	0	0	52	1	0	0	95
05:00 AM	0	0	10	0	0	4	8	0	0	0	0	0	0	0	0	0	31	0	0	0	53
05:15 AM	0	0	16	0	0	4	4	0	0	0	0	0	0	0	0	0	44	1	0	0	69
05:30 AM	0	0	14	0	0	5	10	0	0	0	0	0	0	0	0	0	52	0	0	0	81
05:45 AM	0	0	19	0	0	5	13	0	0	0	0	0	0	0	0	0	54	0	0	0	91
Total	0	0	59	0	0	18	35	0	0	0	0	0	0	0	0	0	181	1	0	0	294

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190321
 Site Code :
 Start Date : 3/21/2019
 Page No : 2

Groups Printed- Cars - Trucks

Start Time	CSAH 11 North (Victoria Dr) Southbound					TH 5 Westbound					TH 5 Northbound					TH 5 Eastbound					Int. Total
	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	Right	Thru	Left	U-Turn	Peds	
06:00 AM	0	0	16	0	0	9	20	0	0	0	0	0	0	0	0	0	56	2	0	0	103
06:15 AM	0	0	24	0	0	9	20	0	0	0	0	0	0	0	0	0	68	1	0	0	122
06:30 AM	0	0	39	0	0	10	37	0	0	0	0	0	0	0	0	0	119	3	0	0	208
06:45 AM	0	0	43	0	0	30	41	0	0	0	0	0	0	0	0	0	153	4	0	0	271
Total	0	0	122	0	0	58	118	0	0	0	0	0	0	0	0	0	396	10	0	0	704
07:00 AM	2	0	64	0	0	36	49	0	0	0	0	0	0	0	0	0	134	6	0	0	291
07:15 AM	4	0	74	0	0	43	62	0	0	0	0	0	0	0	0	0	139	8	0	0	330
07:30 AM	3	0	71	0	0	31	61	0	0	0	0	0	0	0	0	0	125	9	0	0	300
07:45 AM	3	0	67	0	0	31	43	0	0	0	0	0	0	0	0	0	155	2	0	0	301
Total	12	0	276	0	0	141	215	0	0	0	0	0	0	0	0	0	553	25	0	0	1222
08:00 AM	3	0	43	0	0	31	44	0	0	0	0	0	0	0	0	0	132	3	0	0	256
08:15 AM	0	0	50	0	0	11	58	0	0	0	0	0	0	0	0	0	106	2	0	0	227
08:30 AM	2	0	34	0	0	17	41	0	0	0	0	0	0	0	0	0	99	2	0	0	195
08:45 AM	2	0	38	0	0	18	49	0	0	0	0	0	0	0	0	0	86	1	0	0	194
Total	7	0	165	0	0	77	192	0	0	0	0	0	0	0	0	0	423	8	0	0	872
09:00 AM	2	0	32	0	0	22	50	0	0	0	0	0	0	0	0	0	81	1	0	0	188
09:15 AM	1	0	16	0	0	15	51	0	0	0	0	0	0	0	0	0	80	2	0	0	165
09:30 AM	1	0	26	0	0	13	53	0	0	0	0	0	0	0	0	0	66	2	0	0	161
09:45 AM	0	0	27	0	0	17	52	0	0	0	0	0	0	0	0	0	76	1	0	0	173
Total	4	0	101	0	0	67	206	0	0	0	0	0	0	0	0	0	303	6	0	0	687
10:00 AM	0	0	16	0	0	15	55	0	0	0	0	0	0	0	0	0	69	0	0	0	155
10:15 AM	0	0	21	0	0	23	47	0	0	0	0	0	0	0	0	0	57	1	0	0	149
10:30 AM	1	0	20	0	0	22	48	0	0	0	0	0	0	0	0	0	78	1	0	0	170
10:45 AM	0	0	15	0	0	9	51	0	0	0	0	0	0	0	0	0	70	1	0	0	146
Total	1	0	72	0	0	69	201	0	0	0	0	0	0	0	0	0	274	3	0	0	620
Grand Total	24	0	823	0	0	458	1024	0	0	0	0	0	0	0	0	0	2213	54	0	0	4596
Apprch %	2.8	0	97.2	0	0	30.9	69.1	0	0	0	0	0	0	0	0	0	97.6	2.4	0	0	
Total %	0.5	0	17.9	0	0	10	22.3	0	0	0	0	0	0	0	0	0	48.2	1.2	0	0	
Cars	21	0	802	0	0	428	955	0	0	0	0	0	0	0	0	0	2152	51	0	0	4409
% Cars	87.5	0	97.4	0	0	93.4	93.3	0	0	0	0	0	0	0	0	0	97.2	94.4	0	0	95.9
Trucks	3	0	21	0	0	30	69	0	0	0	0	0	0	0	0	0	61	3	0	0	187
% Trucks	12.5	0	2.6	0	0	6.6	6.7	0	0	0	0	0	0	0	0	0	2.8	5.6	0	0	4.1

Bolton & Menk, Inc.

Turning Movement Counts

Bolton & Menk, Inc.

Turning Movement Counts

TH 5 and Victoria Dr (North)
 Data Prepared By: ACS
 TURNING MOVEMENT COUNT

File Name : TH 5 & Victoria Dr (North)_20190321
 Site Code :
 Start Date : 3/21/2019
 Page No : 4

Start Time	CSAH 11 North (Victoria Dr) Southbound						TH 5 Westbound						TH 5 Northbound						TH 5 Eastbound						Int. Total	
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total		
Peak Hour Analysis From 12:00 AM to 10:45 AM - Peak 1 of 1																										
Peak Hour for Entire Intersection Begins at 07:00 AM																										
07:00 AM	2	0	64	0	0	66	36	49	0	0	0	85	0	0	0	0	0	0	0	0	134	6	0	0	140	291
07:15 AM	4	0	74	0	0	78	43	62	0	0	0	105	0	0	0	0	0	0	0	0	139	8	0	0	147	330
07:30 AM	3	0	71	0	0	74	31	61	0	0	0	92	0	0	0	0	0	0	0	0	125	9	0	0	134	300
07:45 AM	3	0	67	0	0	70	31	43	0	0	0	74	0	0	0	0	0	0	0	0	155	2	0	0	157	301
Total Volume	12	0	276	0	0	288	141	215	0	0	0	356	0	0	0	0	0	0	0	0	553	25	0	0	578	1222
% App. Total																										
PHF	.750	.000	.932	.000	.000	.923	.820	.867	.000	.000	.000	.848	.000	.000	.000	.000	.000	.000	.000	.000	.892	.694	.000	.000	.920	.926

Figure 1



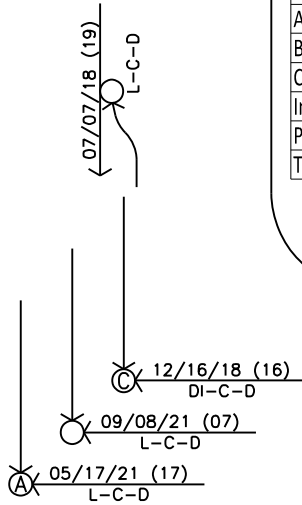
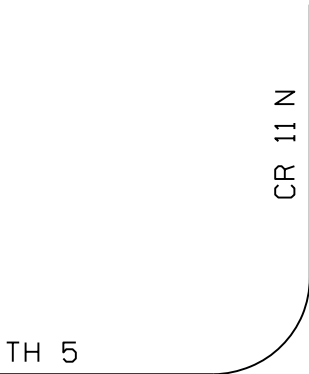
Map Document: \\arcserver1\GIS\CAC\014126275\ESRI\Maps\126275_Existing_TMC_8x11P.mxd | Date Saved: 4/5/2022 11:05:58 AM



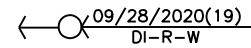
COLLISION DIAGRAM

BOLTON & MENK, INC.

LOCATION: CR 11 N (VICTORIA DR) AND TH 5 (ARBORETUM BLVD)
 TIME PERIOD: 01/01/17 - 12/31/2021 DATE: 04/04/2022
 PREPARED BY: K. ELLIS



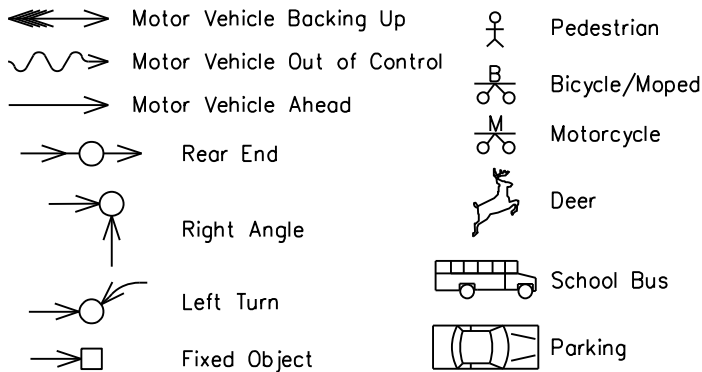
No. of Accidents	17	18	19	20	21
Fatal =	0	0	0	0	0
A Injury =	0	0	0	0	1
B Injury =	0	0	0	0	0
C Injury =	0	1	0	0	0
Injury Total =	0	1	0	0	1
Property Damage =	0	1	0	1	1
Total Accidents =	0	2	0	1	2



SEVERITY IDENTIFIERS

- Fatal Acc.
- ⒶⒷⒸ Personal Injury
- Property Damage Acc.

KEY



NOTES

[1] ADT = 14,125

[2] CR = 0.194 CI = 0.59

[3] SR = 3.875

Light: L= Daylight (1) DN= Dawn (2) R= Rain (3) DU= Dusk (3) DI= Dark, Lighted (4) Do= Dark, Lights Off (5) D= Dark, Unlighted (6) X= Unknown (99)	Weather: C= Clear or Cloudy (1 or 2) W= Wet (2) S= Snow or Sleet (4 or 5) F= Fog, Smog, Smoke (6) B= Blowing Sand/Dust (7) W= Severe Crosswinds (8) X= Other or Unknown (99)	Surface: D= Dry (1) W= Wet (2) S= Snow or Ice (3 or 4) M= Muddy (5) DB= Debris (6) O= Oily (7) X= Other or Unknown (99)
---	--	---

Other Vehicle [Date]-[Time (hrs)]-[Light-Weather-Surface]

Intersection Safety Screening

Intersection: CR 11 N (Victoria Dr) and TH 5 (Arboretum Blvd)

Statewide Averages based on 2016-2020 crashes

Crashes by Crash Severity	
Fatal (K)	0
Serious Injury (A)	1
Minor Injury (B)	0
Possible Injury (C)	1
Property Damage (PDO)	3
Total Crashes	5

Intersection Characteristics	
Entering Volume	14,125
Environment	Urban
Lighting	Lit
Traffic Control	Thru-Stop

Annual crash cost = \$181,800

Statewide comparison = Urban, Thru/STOP

Total Crash Rate	
Observed	0.194
Statewide Average	0.128
Critical Rate	0.330
Critical Index	0.59

Fatal & Serious Injury Crash Rate	
Observed	3.875
Statewide Average	0.311
Critical Rate	3.660
Critical Index	1.06

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference (i.e. observed crash rate ÷ critical crash rate).

The observed total crash rate for this period is 0.19 per MEV; this is 41% below the critical rate. Based on similar statewide intersections, an additional 4 crashes over the five years would indicate this intersection operates outside the normal range.

The observed fatal and serious injury crash rate for this period is 3.88 per 100 MEV; this is 1.1 times the critical rate. This site may be a sustained severe crash location.



SIGNAL WARRANTS ANALYSIS FOR

**TH 5 at CSAH 11 North
Victoria, Minnesota**

70% Volume Threshold
Existing Volumes

LOCATION: TH 5 at CSAH 11 North
COUNTY: Carver

DATE: 3/20/2019

OPERATOR: KR

Speed	Approach Description	Lanes
50	Major App1: Eastbound - TH 5	1
50	Major App3: Westbound - TH 5	1
50	Minor App2: Southbound - CSAH 11 North	1
	Minor App4:	

0.70 FACTOR USED?

YES

POPULATION < 10,000?

No

N/A

No

THRESHOLDS 1A/1B:

70%

350/525

105/52

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 (MET SAME 1A/1B
0:00 - 1:00	8	17	25	/	3	/			/
1:00 - 2:00	1	13	14	/	4	/			/
2:00 - 3:00	11	5	16	/	3	/			/
3:00 - 4:00	13	8	21	/	2	/			/
4:00 - 5:00	49	25	74	/	13	/			/
5:00 - 6:00	184	52	236	/	58	/X			/
6:00 - 7:00	434	177	611	X/X	131	X/X			X/X
7:00 - 8:00	602	327	929	X/X	283	X/X			X/X
8:00 - 9:00	420	308	728	X/X	178	X/X			X/X
9:00 - 10:00	302	308	610	X/X	112	X/X			X/X
10:00 - 11:00	260	242	502	X/	72	/X			/
11:00 - 12:00	293	276	569	X/X	70	/X			/X
12:00 - 13:00	270	351	621	X/X	85	/X			/X
13:00 - 14:00	232	403	635	X/X	80	/X			/X
14:00 - 15:00	253	516	769	X/X	92	/X			/X
15:00 - 16:00	342	666	1008	X/X	109	X/X			X/X
16:00 - 17:00	324	870	1194	X/X	139	X/X			X/X
17:00 - 18:00	379	816	1195	X/X	121	X/X			X/X
18:00 - 19:00	265	548	813	X/X	78	/X			/X
19:00 - 20:00	148	360	508	X/	62	/X			/
20:00 - 21:00	109	253	362	X/	36	/			/
21:00 - 22:00	56	205	261	/	23	/			/
22:00 - 23:00	41	88	129	/	11	/			/
23:00 - 24:00	23	43	66	/	4	/			/

Met (Hr) Required (Hr)

Warrant 1A	7	8	Not satisfied
Warrant 1B	12	8	Satisfied
Warrant 2	9	4	Satisfied
Warrant 3	5	1	Satisfied
Warrant 7	14	8	Satisfied, check accident record

LOCATION: TH 5 at CSAH 11 North
 COUNTY: Carver

REF. POINT:	Speed	Approach Description	Lanes
DATE: 3/20/2019	50	Major App1: Eastbound - TH 5	1
	50	Major App3: Westbound - TH 5	1
OPERATOR: KR	50	Minor App2: Southbound - CSAH 11 North	1
		Minor App4:	

0.70 FACTOR USED? YES
 POPULATION < 10,000? No
 EXISTING SIGNAL ? No

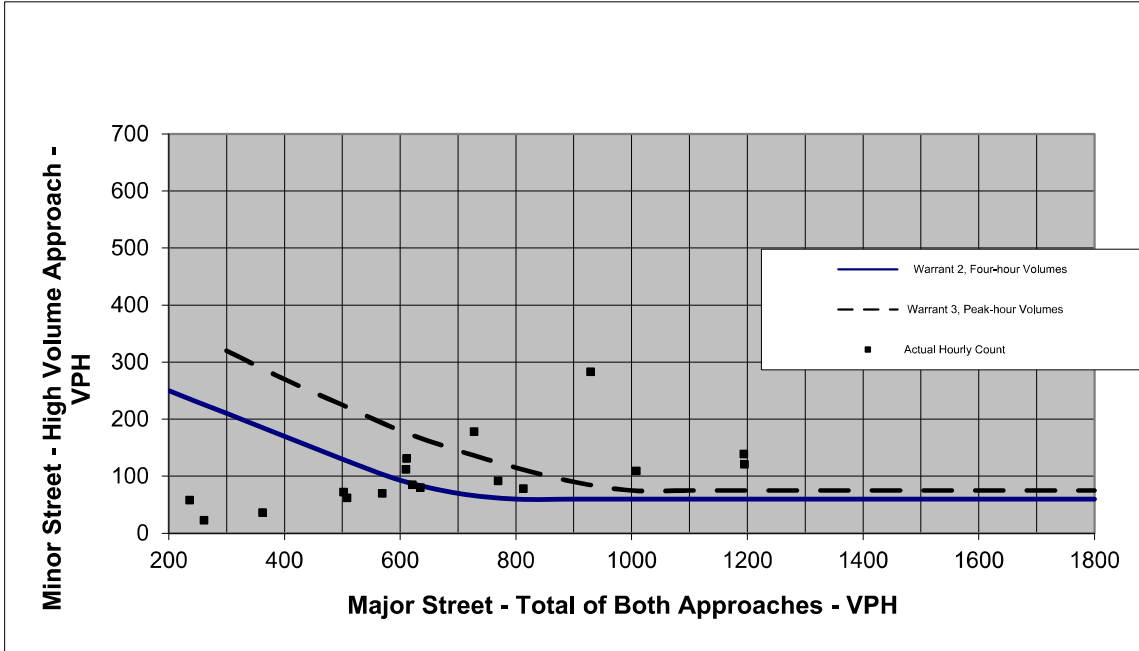


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Major	Warrant Criteria		Actual Hourly Count	
	Warrant 2, Warrant 3, Pe	Warrant 3, Pe	Major	Actual Hourly Count
200	250		25	3
300	210	320	14	4
400	170	270	16	3
500	130	225	21	2
600	93	180	74	13
700	70	145	236	58
800	60	115	611	131
900	60	90	929	283
1000	60	75	728	178
1100	60	75	610	112
1200	60	75	502	72
1300	60	75	569	70
1400	60	75	621	85
1500	60	75	635	80
1600	60	75	769	92
1700	60	75	1008	109
1800	60	75	1194	139
			1195	121
			813	78
			508	62
			362	36
			261	23
			129	11
			66	4



Map Document: \\arcsrvr1\GIS\CAC\014126275\ESRI\Maps\126275_2030_TMC_8x11P.mxd | Date Saved: 4/7/2022 9:59:50 AM



Map Document: \\carserver1\GIS\CAC\014126275\ESRI\Maps\126275_2040_TMC_8x11P.mxd | Date Saved: 4/5/2022 11:06:42 AM

Existing Year Safety Benefit Calculations

Crash Severity	Existing /No Build	Total Crashes (3 Year)	
		Single Lane Roundabout	Signal (Low Volume)
K crashes	0	0.01	0.02
A crashes	1	0.04	0.09
B crashes	0	0.37	0.58
C crashes	1	0.61	0.96
PDO crashes	3	3.93	6.24
Total	5	4.949	7.888

Crash Severity	Existing/No Build	Total Crashes (Per Year)	
		Single Lane Roundabout	Signal (Low Volume)
K crashes	0.00	0.00	0.01
A crashes	0.33	0.01	0.03
B crashes	0.00	0.12	0.19
C crashes	0.33	0.20	0.32
PDO crashes	1.00	1.31	2.08

Single Lane Roundabout	
Total CR	0.32
F & SI CR	0.31

Signal, Low Volume (<=20k)	
Total CR	0.51
F & SI CR	0.69

Single Lane Roundabout

$$\text{Total CR} = \frac{\text{Number of Crashes} \times 1,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years	3
Entering Vehicles per Day	14125

$$0.32 = \frac{1,000,000x}{15466875}$$

4.949 Crashes

$$\text{F \& SI CR} = \frac{\text{Number of Crashes} \times 100,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years	3
Entering Vehicles per Day	14125

$$0.31 = \frac{100,000,000x}{15466875}$$

0.048 K + A Crashes

Signal, Low Volume (<=20k)

$$\text{Total CR} = \frac{\text{Number of Crashes} \times 1,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years	3
Entering Vehicles per D	14125

$$0.51 = \frac{1,000,000x}{15466875}$$

7.888 Crashes

$$\text{F \& SI CR} = \frac{\text{Number of Crashes} \times 100,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years	3
Entering Vehicles per D	14125

$$0.69 = \frac{100,000,000x}{15466875}$$

0.107 K + A Crashes

2040 Safety Benefit Calculations

Crash Severity	Total Crashes (3 Year)			Signal (High Volume)	Total Crashes (Per Year)			Signal (High Volume)
	Existing/No Build	2x1 Roundabout	Signal (High Volume)		Existing/No Build	2x1 Roundabout	Signal (High Volume)	
K crashes	0	0.01	0.05	K crashes	0.00	0.00	0.02	
A crashes	1.83	0.03	0.19	A crashes	0.61	0.01	0.06	
B crashes	0	1.60	1.23	B crashes	0.00	0.53	0.41	
C crashes	1.83	2.66	2.04	C crashes	0.61	0.89	0.68	
PDO crashes	5.50	17.25	13.23	PDO crashes	1.83	5.75	4.41	
Total	9.168	21.554	16.733					

2x1 Roundabout

Total CR	0.76
F & SI CR	0.15

Signal, High Volume (>20k)

Total CR	0.59
F & SI CR	0.82

2x1 Roundabout

Total CR =
$$\frac{\text{Number of Crashes} \times 1,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Signal, High Volume (>20k)

Total CR =
$$\frac{\text{Number of Crashes} \times 1,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years: 3
 Entering Vehicles per Day: 25900

Number of Years: 3
 Entering Vehicles per Day: 25900

0.76 =
$$\frac{1,000,000 \times 21.554}{28360500}$$

0.59 =
$$\frac{1,000,000 \times 16.733}{28360500}$$

21.554 Crashes

16.733 Crashes

F & SI CR =
$$\frac{\text{Number of Crashes} \times 100,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

F & SI CR =
$$\frac{\text{Number of Crashes} \times 100,000,000}{\text{Entering Vehicles per Day} \times 365 \times \text{Number of Years}}$$

Number of Years: 3
 Entering Vehicles per Day: 25900

Number of Years: 3
 Entering Vehicles per Day: 25900

0.15 =
$$\frac{100,000,000 \times 0.043}{28360500}$$

0.82 =
$$\frac{100,000,000 \times 0.233}{28360500}$$

0.043 K + A Crashes

0.233 K + A Crashes

Total Crashes (Per Year - Existing Year)				Total Crashes (Per Year - 2040)				Safety Benefit		
								Roundabout	Signal	
Crash Severity	Existing/No Build	Crash Cost	Cost Per Year	Crash Severity	Existing/No Build	Crash Cost	Cost Per Year	2021	\$219,408.02	\$161,150.41
K crashes	0.000	\$1,500,000	\$0.00	K crashes	0.00	\$1,500,000	\$0.00	2040	\$238,875.68	\$252,933.34
A crashes	0.333	\$750,000	\$250,000.00	A crashes	0.61	\$750,000	\$458,407.08			
B crashes	0.000	\$230,000	\$0.00	B crashes	0.00	\$230,000	\$0.00			
C crashes	0.333	\$120,000	\$40,000.00	C crashes	0.61	\$120,000	\$73,345.13	2021	219,408	161,150
PDO crashes	1.000	\$13,000	\$13,000.00	PDO crashes	1.83	\$13,000	\$23,837.17	2022	220,433	165,981
			\$303,000.00				\$555,589.38	2023	221,457	170,812
								2024	222,482	175,642
Crash Severity	Single Lane Roundabout	Crash Cost	Cost Per Year	Crash Severity	2x1 Roundabout	Crash Cost	Cost Per Year	2025	223,506	180,473
K crashes	0.003	\$1,500,000	\$4,673.00	K crashes	0.00	\$1,500,000	\$4,146.07	2026	224,531	185,304
A crashes	0.013	\$750,000	\$9,650.33	A crashes	0.01	\$750,000	\$8,562.15	2027	225,556	190,134
B crashes	0.122	\$230,000	\$28,001.17	B crashes	0.53	\$230,000	\$122,891.23	2028	226,580	194,965
C crashes	0.202	\$120,000	\$24,236.11	C crashes	0.89	\$120,000	\$106,367.15	2029	227,605	199,796
PDO crashes	1.310	\$13,000	\$17,031.38	PDO crashes	5.75	\$13,000	\$74,747.10	2030	228,630	204,627
			\$83,591.98				\$316,713.70	2031	229,654	209,457
								2032	230,679	214,288
Crash Severity	Signal (High Volume)	Crash Cost	Cost Per Year	Crash Severity	Signal (High Volume)	Crash Cost	Cost Per Year	2033	231,703	219,119
K crashes	0.007	\$1,500,000	\$10,401.18	K crashes	0.02	\$1,500,000	\$22,665.16	2034	232,728	223,949
A crashes	0.029	\$750,000	\$21,479.77	A crashes	0.06	\$750,000	\$46,806.44	2035	233,753	228,780
B crashes	0.193	\$230,000	\$44,453.74	B crashes	0.41	\$230,000	\$94,262.52	2036	234,777	233,611
C crashes	0.321	\$120,000	\$38,476.44	C crashes	0.68	\$120,000	\$81,587.88	2037	235,802	238,441
PDO crashes	2.080	\$13,000	\$27,038.45	PDO crashes	4.41	\$13,000	\$57,334.03	2038	236,826	243,272
			\$141,849.59				\$302,656.04	2039	237,851	248,103
								2040	238,876	252,933
								Total	\$4,582,836.95	\$4,140,837.57