Spack CONSULTING
THE TRAFFIC STUDY COMPANY

Intersection Traffic Control Feasibility Study

Dakota COUNTY

Dakota County CP 8-20
CSAH 73 & CSAH 8 in West St. Paul

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.

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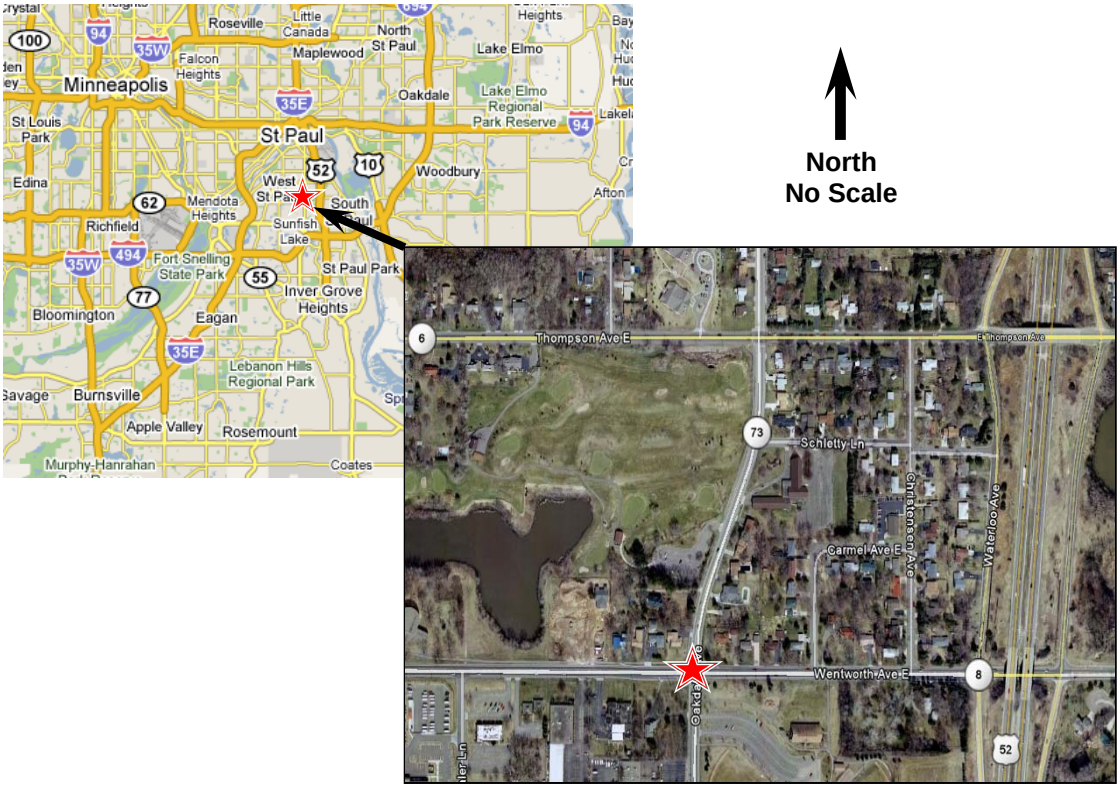
1. Purpose and Need

The intersection of Dakota County State Aid Highway 73 (Oakdale Avenue) and Dakota County State Aid Highway 8 (Wentworth Avenue), called CSAH 73/CSAH 8 hereafter, in West St. Paul, MN is one of the busiest intersections under Dakota County's jurisdiction controlled with all-way stop signs. The purpose of this *Feasibility Study* is twofold: (1) to determine the most appropriate long term level of traffic control for the intersection and (2) if a change in traffic control is needed, to determine in what year that change should occur. The traffic control alternatives are analyzed in the existing, near term (Year 2010), and long term horizons (Year 2030).

2. Description of Location

The City of West St. Paul is located south of St. Paul and is situated in the northern portion of Dakota County. Figure 2.1 shows the location of the study intersection as well as its proximity to major intersections. According to the US Census Bureau, the 2000 population of West St. Paul was estimated to be 19,405.

Figure 2.1 – CSAH 73/CSAH 8 Location Map



3. Existing Conditions

a. Intersection Geometry

CSAH 73

CSAH 73 is a two lane, undivided roadway (plus turn lanes) with a 30 mph posted speed limit north of CSAH 8 and 35 mph posted speed limit south of CSAH 8. It is designated as a collector roadway by Dakota County. The 2007 Average Annual Daily Traffic volume on CSAH 73 is 7,600 vehicles per day north of CSAH 8 and 9,900 vehicles per day south of CSAH 8. The stop sign controlled northbound and southbound approaches currently each have one exclusive left turn lane, one shared through/right lane and one parking lane. During congested periods motorists use the parking lanes as right turn lanes.

CSAH 8

CSAH 8 is a two lane, undivided roadway (plus turn lanes) with a 35 mph posted speed limit at the intersection with CSAH 73. It is designated as a B-Minor Arterial by Dakota County. The 2007 Average Annual Daily Traffic volume on CSAH 8 is 9,600 vehicles per day west of CSAH 73 and 10,000 vehicles per day east of CSAH 73. The stop sign controlled westbound and eastbound approaches currently each have one exclusive left turn lane, one through lane, and one exclusive right turn lane. There are Metro Transit bus stops on CSAH 73 both north and south of CSAH 8 approximately thirty feet upstream from the intersection.

The Trunk Highway 52/CSAH 8 interchange, approximately 1,200 feet east of the CSAH 73/CSAH 8 intersection, will be improved in 2009 through a Mn/DOT project. The intersections at the interchange will have roundabout control. The interchange is far enough away from the CSAH 73/CSAH 8 intersection that platoons of vehicles going along the CSAH 8 corridor will not adversely impact the operation of the intersections at CSAAH 73 or the Highway 52 interchange.

b. Traffic Data

Hourly traffic volumes for the existing northbound, southbound, eastbound, and westbound approaches of the existing CSAH 73/ CSAH 8 intersection are contained in Appendix A in Table A-1. The existing turning movement volumes for the intersection are shown in Table 3.1.

Table 3.1 – 2008 Turning Movement Peak Hour Volumes

	SB CSAH 73			WB CSAH 8			NB CSAH 73			EB CSAH 8		
	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt
AM	42	129	64	58	240	72	36	118	38	31	122	15
PM	75	231	79	76	317	105	56	205	94	85	382	74

Source: Dakota County

c. Crash Data

There were twelve State reported crashes at the intersection from January 1, 2005 to December 31, 2007 (six right angle crashes, three rear end crashes, two left turn crashes, and one head on crash). A crash diagram is included in Appendix B and a summary is shown in Figure 3.1. Eight of the twelve crashes occurred in 2007. Because 2/3 of the crashes at the intersection from 2005 through 2007 occurred in 2007, the intersection should be monitored by Dakota County Transportation staff in 2008 and in future years to determine if the high number of crashes in 2007 is an anomaly or the beginning of a trend.

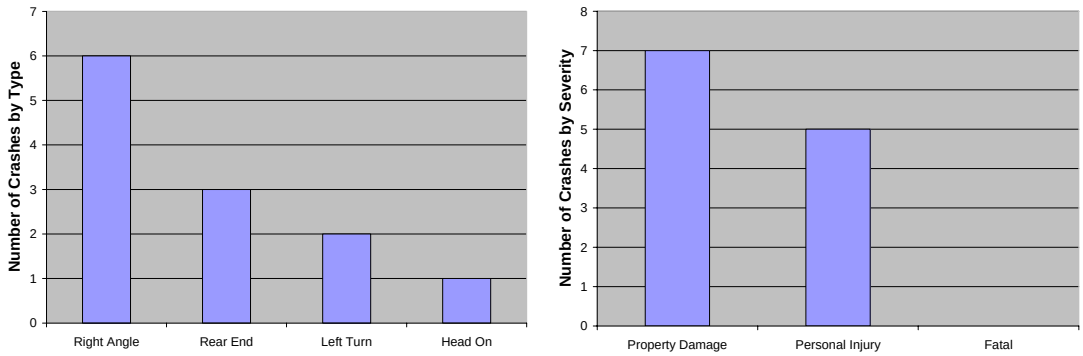


Figure 3.1 – 2005 through 2007 Crash Summary

Based on the 2008 average daily entering volumes, the intersection had 0.41 crashes per million entering vehicles on average from 2005 through 2007. However, the intersection had 0.99 crashes per million entering vehicles in 2007. Based on Mn/DOT's *2008 Traffic Safety Fundamentals Handbook*, it is expected all way stop sign controlled intersections have 0.60 crashes per million entering vehicles on average and signal controlled intersections have 0.70 crashes per million entering vehicles on average. Because signalized intersections have higher average crash rates than intersections with all way stop sign control, traffic signal installation is not considered a safety improvement. The CSAH 73/CSAH 8 intersection had a lower crash rate than the average all way stop sign controlled intersection from 2005 through 2007, however the 2007 crash rate was higher than average.

d. Intersection Observations

The existing CSAH 73/CSAH 8 intersection is controlled with all-way stop signs. The intersection was observed for an hour during the morning, midday, and evening peak periods. The eastbound queue built to 16 vehicles and the southbound queue built to 11 vehicles at about 5:15 p.m., but dissipated by 5:20 p.m. Queues quickly dissipated in the morning and midday hours, but were steady during the evening rush hour. Semi-trucks took wide turns at the intersection. The parking lot on the southeast quadrant of the intersection is used as a park and ride lot. The morning bus stops did not impact the operation of the intersection, however the evening bus stops did. At 5:25 and 5:52 p.m. buses stopped and dropped off approximately 20 passengers. This platoon of pedestrians took control of the intersection as they used the crosswalks to go from the northeast quadrant of the intersection to the southeast quadrant of the intersection. A detailed report of the observations is included in Appendix C.

e. Warrant Analyses

A traffic signal warrant analysis was conducted for the existing intersection per the *Minnesota Manual on Uniform Traffic Control Devices*. Mn/DOT has developed a procedure for reducing the right turn volumes used in a warrant analysis based on the amount of traffic that conflicts with the right turn movement. If there is little conflicting volume for a right turn movement, the right turn movement does not benefit from installation of traffic signal control. Dakota County uses the right turn reduction procedure developed by Mn/DOT. Following the procedure resulted in 100% of the right turn volumes being removed from the minor street approach volumes in the warrant analysis. The full warrant analyses are contained in Appendix D. Warrant 1 a & c (Eight Hour Vehicular Volumes) and Warrant 2 (Four Hour Volumes) are currently met.

f. Capacity Analyses

The *Highway Capacity Manual* documents procedures for determining the performance of different traffic control measures at intersections. Intersections are assigned a “Level of Service” letter grade for the peak hour of traffic based on the number of lanes at the intersection, traffic volumes, and traffic control. Level of Service A (LOS A) represents light traffic flow (free flow conditions) while Level of Service F (LOS F) represents heavy traffic flow (over capacity conditions). LOS D is considered acceptable in urban conditions.

In conjunction with City and County staff, it was determined to use micro-simulation to evaluate the stop sign controlled intersection because it will give the most accurate assessment of operations.

The existing conditions and traffic volumes were entered into the model SimTraffic™. The simulation software was seeded with a random number seed of 0, a seeding duration of 1 minute, and a recording duration of 60 minutes. Then the simulation software was run and recorded five times with random number seeds of 1, 2, 3, 4, and 5; using a seeding duration of 1 minute and a recording duration of 60 minutes. The model predicts there is 9.1 seconds of delay per vehicle (LOS A) in the a.m. peak hour and 22.1 seconds of delay per vehicle (LOS C) in the p.m. peak hour. The detailed SimTraffic™ reports are included in Appendix E.

4. Future Conditions

a. Traffic Forecasts

Dakota County provided Average Annual Daily traffic volumes for the years 2007 and 2030 (forecasts) as shown in Table 4.1. Based on these daily traffic volumes, the annual compounded growth rates shown in Table 4.1 were developed for each leg of the intersection.

Table 4.1 – Compounded Growth Rates

Intersection Leg	Existing AADT	2030 AADT	Compound Growth Rate
CSAH 8 -West	9,600	14,100	1.685%
CSAH 8 -East	10,000	12,300	0.904%
CSAH 73 - South	9,900	13,300	1.292%
CSAH 73 - North	7,600	10,200	1.288%

The turning movement peak hour volumes from Table 3.1 were factored by approach leg with the compounded growth rates in Table 4.1 to develop the turning movement volume forecasts shown in Table 4.2. Likewise, the daily approach volumes in Table A-1 were factored to develop the 2010 and 2030 approach volumes in Appendix A Tables A-2 and A-3.

Table 4.2 – Future Turning Movement Peak Hour Volumes

	SB CSAH 73			WB CSAH 8			NB CSAH 73			EB CSAH 8		
	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt	Lt	Thru	Rt
2010 AM	50	130	80	60	240	70	40	120	40	40	120	20
2030 AM	60	180	90	70	280	100	50	150	50	50	170	20
2010 PM	80	230	80	80	320	110	60	220	100	90	400	90
2030 PM	110	300	120	90	390	130	70	280	120	120	550	110

b. Future Intersection Configuration Alternatives

Based on discussions with City and County staff, the following lane configurations are to be studied in conjunction with each traffic control strategy.

All Way Stop Sign Control

The current all way stop intersection already has turn lanes on every approach. It was determined a roadway widening project without traffic control upgrades would not be adequate.

Roundabout Control

- Northbound CSAH 73: single entry
- Southbound CSAH 73: single entry
- Westbound CSAH 8: single entry
- Eastbound CSAH 8: single entry
- The roundabout will be a single lane roundabout

- or -

Traffic Signal Control (with existing lane configurations)

- Northbound CSAH 73: one left turn lane and one shared through/right turn lane
- Southbound CSAH 73: one left turn lane and one shared through/right turn lane
- Westbound CSAH 8: one left turn lane, one through lane, and one right turn lane
- Eastbound CSAH 8: one left turn lane, one through lane, and one right turn lane
- Protected/Permitted (left turns allowed on the green arrow or green circle indications) phasing will be assumed for all left turn movements. The County will determine left turn phasing with implementation of an improvement project.

5. Analysis of Alternatives

a. All Way Stop

The existing conditions, as described in Section 3a along with the turning movement volume forecasts from Table 4.2 were also entered into the SimTraffic™ model. The model was seeded with a random number seed of 0, a seeding duration of 1 minute, and a recording duration of 60 minutes. Then the simulation software was run and recorded five times with random number seeds of 1, 2, 3, 4, and 5; using a seeding duration of 1 minute and a recording duration

of 60 minutes. The overall intersection delay is shown in Table 5.1 and detailed SimTraffic™ reports are included in Appendix E.

The existing conditions, as described in Section 3a along with the turning movement volume forecasts from Table 4.2 were entered into the SimTraffic™ model. There will be 9.3 seconds of delay per vehicle (LOS A) in the 2010 a.m. peak hour and 23.2 seconds of delay per vehicle (LOS C) in the 2010 p.m. peak hour. There will be 11.5 seconds of delay per vehicle (LOS B) in the 2030 a.m. peak hour and 269.2 seconds of delay per vehicle (LOS F) in the 2030 p.m. peak hour. Table 5.1 also shows the forecasted delay the existing intersection configuration will experience with the future volumes compared with the delay results from other traffic control alternatives. The detailed SimTraffic™ reports are included in Appendix E.

The intersection will need to be improved as traffic volumes continue to grow at the intersection. Based on an iterative SimTraffic™ analysis, it is forecast the existing intersection will operate unacceptably at the Level of Service D/E boundary (35 seconds per vehicle of overall intersection delay) in 2014.

b. Traffic Control Signal

Warrant Analysis

A traffic signal warrant analysis was conducted for the intersection per the *Minnesota Manual on Uniform Traffic Control Devices*. The warrant analysis is based on the following assumptions:

- The approach volumes shown in Tables A-2 and A-3 were factored to remove the right turning volumes on the minor street approaches.
- All legs have 2+ legs.
- The Mn/DOT procedure for right turn reduction was used as the County uses this practice. Following the procedure resulted in 100% of the right turn volumes being removed from the minor street approach volumes in the warrant analysis.

The full warrant analyses are contained in Appendix D. Warrant 1 a & c (Eight Hour Vehicular Volumes), Warrant 2 (Four Hour Volumes), and Warrant 3 b (Peak Hour Volumes) will be met in 2010. Warrant 1 a, b, & c (Eight Hour Vehicular Volumes), Warrant 2 (Four Hour Volumes), and Warrant 3 b (Peak Hour Volumes) will be met in 2030.

Capacity Analyses

An intersection capacity analysis was conducted for the intersection as a traffic signal controlled intersection per the *Highway Capacity Manual*. The analysis was performed using Synchro™ software.

The lane configuration noted for the traffic signal control scenario in Section 4b was used along with the peak hour volumes from Table 4.2 to determine the overall delay. There will be 14.4 seconds of delay per vehicle (LOS B) in the 2010 a.m. peak hour and 20.9 seconds of delay per vehicle (LOS C) in the 2010 p.m. peak hour. There will be 17.5 seconds of delay per vehicle (LOS B) in the 2030 a.m. peak hour and 30.1 seconds of delay per vehicle (LOS C) in the 2030 p.m. peak hour. Table 5.1 also shows the forecasted delay this configuration will experience with the future volumes compared with the delay results from other traffic control alternatives. The full results are contained in Appendix F.

c. Roundabout

An intersection capacity analysis was conducted for the intersection as a roundabout controlled intersection using Rodel™ software. The lane configuration noted for the roundabout control scenario in Section 4b was used along with the peak hour volumes from Table 4.2 to determine the overall delay. There will be 8.8 seconds of delay per vehicle (LOS A) in the 2010 a.m. peak hour and 22.6 seconds of delay per vehicle (LOS C) in the 2010 p.m. peak hour. There will be 12.0 seconds of delay per vehicle (LOS B) in the 2030 a.m. peak hour and 120.0 seconds of delay per vehicle (LOS F) in the 2030 p.m. peak hour. Table 5.1 also shows the forecasted delay this configuration will experience with the future volumes compared with the delay results from other traffic control alternatives. The full results are contained in Appendix G.

The single lane roundabout experiences LOS F in the 2030 p.m. peak hour, so an alternative analysis was done for a double lane roundabout. The results from the 2030 p.m. peak hour, double lane roundabout scenario are contained in Appendix G and a summary of the results are shown in Table 5.1. The double lane roundabout will operate acceptably in the 2030 p.m. peak hour with 32.2 seconds of delay per vehicle (LOS D).

The Insurance Institute for Highway Safety found in their March 2000 report titled “Crash Reductions Following Installation of Roundabouts in the United States” that less crashes occur at intersections controlled with roundabouts versus traffic signals. This is likely due to the lower speed of the vehicles going through the intersection, the requirement for approaching vehicles to yield to vehicles within the intersection, and the lower likelihood of right angle or head on collisions. There were a significant amount of crashes at the intersection in 2007, however it isn’t clear if this is an anomaly or a trend.

d. Non-Traditional Intersection

The additional right-of-way required for the different non-traditional intersections is not justified at the CSAH 73/CSAH 8 intersection. The traditional all-way stop, roundabout, or traffic signal will provide adequate capacity.

e. Access Management Treatments

Access management treatments are not feasible at the study intersection.

f. Grade Separation

The forecasted traffic volumes at the study intersection do not warrant the expense of an interchange.

Table 5.1 – 2010 & 2030 Capacity Analyses

Scenario	All Way Stop (existing)	Single Lane Roundabout	Double Lane Roundabout	Signal
2010 AM	9.3	8.8	-	14.4
2030 AM	11.5	12.0	-	17.5
2010 PM	23.2	22.6	-	20.9
2030 PM	269.2	120.0	32.2	30.1

Notes: All way stop delay from SimTraffic, Roundabout delay from Rodel, Signal delay from Synchro HCM. Delay is measured in seconds per vehicle.

6. Preliminary Design

A preliminary design has been prepared for the double lane roundabout and the traffic signal alternatives. They are included in Appendix H. Included in Appendix I is a detailed, preliminary cost break down for each alternative. These cost estimates are for comparison purposes and don't contain costs for final design items such as right-of-way acquisition, storm sewer, utility relocation, signing, temporary easements, or contingencies. They do not It is anticipated the traffic signal alternative will cost approximately $260,000 and the double lane roundabout will cost approximately $970,000. For reference, single lane roundabouts typically cost approximately $750,000.

7. Recommended Alternative

It is recommended the CSAH 73/CSAH 8 intersection be controlled with a traffic control signal for the following reasons:

- The intersection will operate acceptably at Level of Service C through 2030 with traffic signal control.
- The traffic signal is approximately one fourth the price of the double lane roundabout.

- Delays to motorists caused by construction will be minimal because no roadway widening is needed for the traffic signal.

It is recommended the traffic control signal project be implemented by approximately 2014 when the existing intersection is predicted to operate unacceptably at Level of Service E.

There was one State reported crash at the intersection in 2005, three crashes in 2006, and eight crashes in 2007. The State reported crash history should continue to be monitored. If the high State reported crashes experienced in 2007 is an anomaly, the traffic signal is appropriate. If the intersection experiences high crashes in the future, the traffic control decision should be revisited. Roundabouts are proven to provide significantly safer traffic control than traffic signals and the added expense of roundabout control may be determined to be justified.

8. Appendix

A. Approach Volumes

B. 2005 to 2007 Crash Diagram

C. Intersection Observations

D. Traffic Signal Warrant Analyses

E. Level of Service for All-Way Stop (SimTraffic)

F. Level of Service for Traffic Control Signal (Synchro)

G. Level of Service for Roundabout (Rodel)

H. Preliminary Layouts

I. Preliminary Cost

Appendix A - Approach Volumes

Table A-1: 2007 Approach Volumes

	DAILY AVERAGES			
	CSAH 73 south of CSAH 8	CSAH 73 north of CSAH 8	CSAH 8 west of CSAH 73	CSAH 8 east of CSAH 73
Interval Begin	**NB**	**SB**	**EB**	**WB**
12:00 AM	23	17	36	29
1:00 AM	15	16	22	16
2:00 AM	15	12	21	15
3:00 AM	6	4	8	15
4:00 AM	14	11	14	19
5:00 AM	41	63	38	65
6:00 AM	126	145	122	191
7:00 AM	202	229	190	356
8:00 AM	180	209	230	354
9:00 AM	248	238	330	327
10:00 AM	283	264	378	346
11:00 AM	323	327	497	403
12:00 PM	381	332	545	406
1:00 PM	327	330	471	341
2:00 PM	326	334	468	362
3:00 PM	369	355	529	400
4:00 PM	408	401	597	432
5:00 PM	445	375	576	441
6:00 PM	346	295	483	392
7:00 PM	269	251	401	298
8:00 PM	222	203	366	254
9:00 PM	162	135	255	156
10:00 PM	77	69	153	100
11:00 PM	52	40	75	49
Totals	**4,860**	**4,655**	**6,805**	**5,767**

Appendix A - Approach Volumes

Table A-2: 2010 Approach Volumes

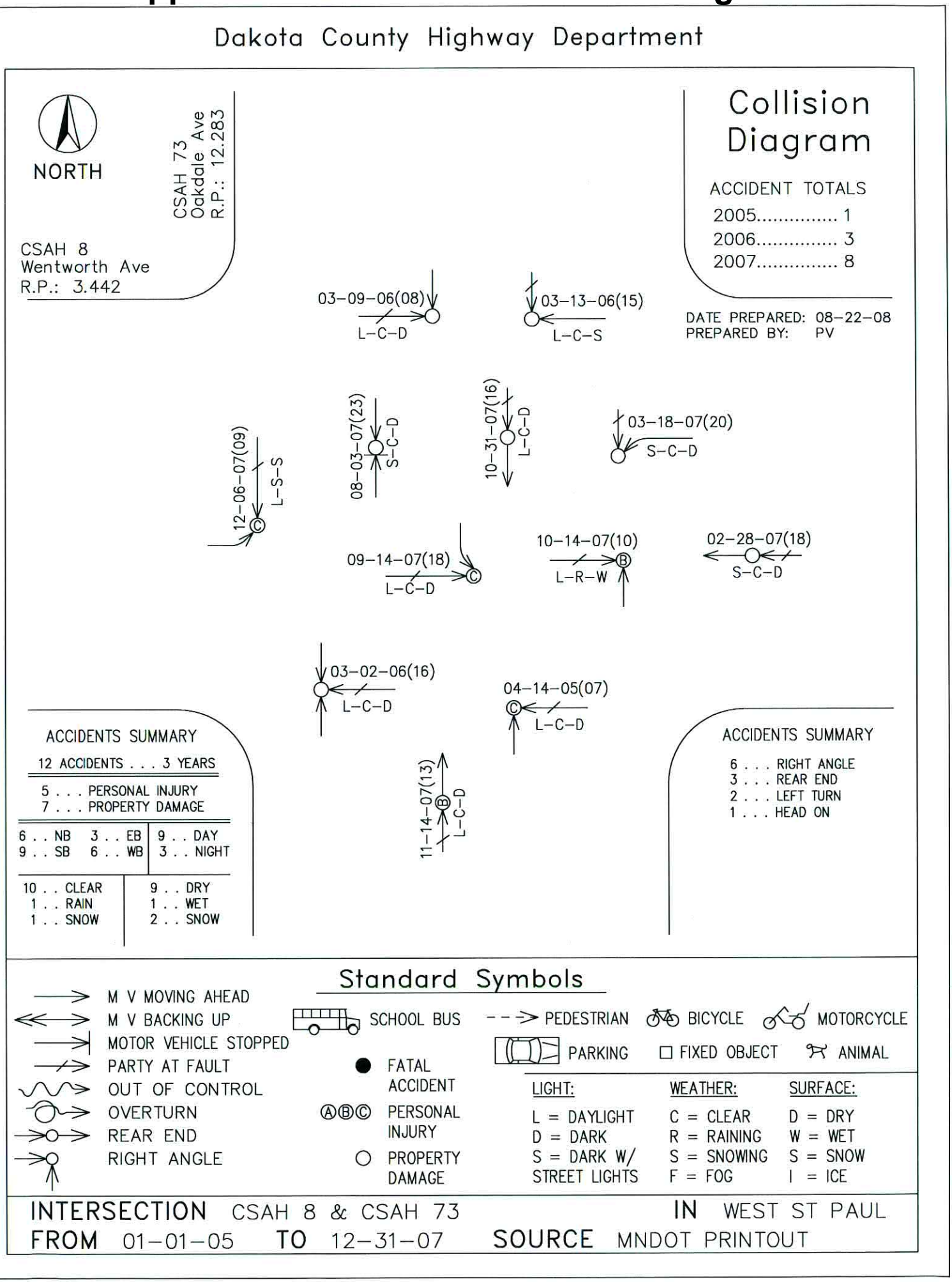
	DAILY AVERAGES			
	CSAH 73 south of CSAH 8	CSAH 73 north of CSAH 8	CSAH 8 west of CSAH 73	CSAH 8 east of CSAH 73
Interval Begin	**NB**	**SB**	**EB**	**WB**
12:00 AM	20	20	40	30
1:00 AM	20	20	20	20
2:00 AM	20	10	20	20
3:00 AM	10	0	10	20
4:00 AM	10	10	10	20
5:00 AM	40	70	40	70
6:00 AM	130	150	130	200
7:00 AM	210	240	200	370
8:00 AM	190	220	240	360
9:00 AM	260	250	350	340
10:00 AM	290	270	400	360
11:00 AM	340	340	520	410
12:00 PM	400	340	570	420
1:00 PM	340	340	500	350
2:00 PM	340	350	490	370
3:00 PM	380	370	560	410
4:00 PM	420	420	630	440
5:00 PM	460	390	610	450
6:00 PM	360	310	510	400
7:00 PM	280	260	420	310
8:00 PM	230	210	380	260
9:00 PM	170	140	270	160
10:00 PM	80	70	160	100
11:00 PM	50	40	80	50
Totals	**5,050**	**4,840**	**7,160**	**5,940**

Appendix A - Approach Volumes

Table A-3: 2030 Approach Volumes

	DAILY AVERAGES			
	CSAH 73 south of CSAH 8	CSAH 73 north of CSAH 8	CSAH 8 west of CSAH 73	CSAH 8 east of CSAH 73
Interval Begin	**NB**	**SB**	**EB**	**WB**
12:00 AM	30	20	50	40
1:00 AM	20	20	30	20
2:00 AM	20	20	30	20
3:00 AM	10	10	10	20
4:00 AM	20	10	20	20
5:00 AM	60	80	60	80
6:00 AM	170	190	180	230
7:00 AM	270	310	280	440
8:00 AM	240	280	340	440
9:00 AM	330	320	480	400
10:00 AM	380	350	560	430
11:00 AM	430	440	730	500
12:00 PM	510	450	800	500
1:00 PM	440	440	690	420
2:00 PM	440	450	690	450
3:00 PM	500	480	780	490
4:00 PM	550	540	880	530
5:00 PM	600	500	850	540
6:00 PM	460	400	710	480
7:00 PM	360	340	590	370
8:00 PM	300	270	540	310
9:00 PM	220	180	370	190
10:00 PM	100	90	220	120
11:00 PM	70	50	110	60
Totals	**6,530**	**6,240**	**10,000**	**7,100**

Appendix B - 2005 to 2007 Crash Diagram



Appendix C - Intersection Observations

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INTERSECTION OBSERVATION BY MIKE SPACK, PE

CSAH 73 (Oakdale Ave) & CSAH 8 (Wentworth Ave)
West St. Paul, Dakota County, MN
Tuesday, July 29, 2008, from 8:00 a.m. to 9:00 a.m.
Weather – Clear with daily high between 85 and 90 degrees

General Observations

1. Intersection operated at approximately LOS A (little overall delay)
2. Queues dissipated quickly
3. Little pedestrian or bicycle traffic
4. Semi-trucks took wide turns because of small radii

Maximum Queues (vehicles per lane):

NB = 4 vehicles, WB = 3 vehicles, SB = 3 vehicles, and EB = 3 vehicles

Time Log of Observations:

8:03 SB pedestrian
8:15 52 vehicles in park and ride lot on SE quadrant (capacity is approximately 150 vehicles)
8:22 SB bicycle
8:29 WB to NB bicycle
8:30 SB pedestrian on eastside of CSAH 73
8:31 NB to EB right turn using parking lane
8:37 SB to WB roller blader
8:38 WB to NB pedestrian
8:44 EB to SB pedestrian
8:49 SB bicycle
8:54 SB to WB wheelchair on street
8:56 two vehicle queue using parking lane as right turn lane

Appendix C - Intersection Observations

Spack CONSULTING THE TRAFFIC STUDY COMPANY

INTERSECTION OBSERVATION BY MIKE SPACK, PE

CSAH 73 (Oakdale Ave) & CSAH 8 (Wentworth Ave)
West St. Paul, Dakota County, MN
Tuesday, July 29, 2008, from 12:00 p.m. to 1:00 p.m.
Weather – Clear with daily high between 85 and 90 degrees

General Observations

1. Intersection operated at approximately LOS A or B
2. Queues dissipated quickly
3. Little pedestrian or bicycle traffic

Maximum Queues (vehicles per lane):

NB = 5 vehicles, WB = 4 vehicles, SB = 6 vehicles, and EB = 5 vehicles

Time Log of Observations:

12:00 NB 4 bicycles
12:10 SB to WB right using parking lane
12:11 NB pedestrian on west side
12:20 EB to NB bike on sidewalk
12:21 SB to WB right using parking lane
12:22 SB pedestrian on west side
12:28 NB to EB right using parking lane + 7 mph roll-through
12:44 NB to EB right using parking lane
12:53 NB 4 pedestrians on west side

Appendix C - Intersection Observations

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INTERSECTION OBSERVATION BY MIKE SPACK, PE

CSAH 73 (Oakdale Ave) & CSAH 8 (Wentworth Ave)
West St. Paul, Dakota County, MN
Tuesday, July 29, 2008, from 5:00 p.m. to 6:00 p.m.
Weather – Clear with daily high between 85 and 90 degrees

General Observations

1. Intersection operated at approximately LOS C
2. Approximately five minute period with large EB queue at 5:15 Vehicles making
3. Soutbound bus stopping at intersection causes queuing and then the 15-25 pedestrians cause queuing walking through intersection
4. NB and SB right turns used parking lanes almost exclusively (didn't keep track in time log)

Maximum Queues (vehicles per lane):

NB = 6 vehicles, WB = 7 vehicles, SB = 11 vehicles, and EB = 16 vehicles

Time Log of Observations:

5:05 EB Bicycle
5:06 SB Ambulance and EB to SB Fire Engine
5:15 EB pedestrian
5:19 SB pedestrian
5:19 WB to SB bicycle
5:20 EB bicycle
5:21 No queues
5:23 SB bicycle
5:25 SB bus (24 pedestrians NW to SE quadrant, caused SB queue of 11 – maximum 6 otherwise)
5:32 EB pedestrian
5:37 WB to NB pedestrian
5:40 SB to WB pedestrian
5:41 WB pedestrians (2)
5:49 NB pedestrian
5:50 EB to SB bicycle
5:52 SB bus (18 pedestrians NW to SW quadrant)
5:54 EB to NB bicycles (2)
5:54 NB to EB bicycle

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2007 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary

Major Street Approaches

Eastbound: **CSAH 8**
Number of Lanes: **2**
Approach Speed: **0**
Total Approach Volume: **6,805**

Westbound: **CSAH 8**
Number of Lanes: **2**
Approach Speed: **0**
Total Approach Volume: **5,767**

Minor Street Approaches

Northbound: **CSAH 73**
Number of Lanes: **2**
Total Approach Volume: **3,694**

Southbound: **CSAH 73**
Number of Lanes: **2**
Total Approach Volume: **3,583**

Warrant Summary **(Urban values apply.)**

Warrant 1 - Eight Hour Vehicular Volumes ..... **Satisfied**

Warrant 1A - Minimum Vehicular Volume ..... **Satisfied**
Required volumes reached for 10 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic ..... **Not Satisfied**
Required volumes reached for 5 hours, 8 are needed

Warrant 1 A&B - Combination of Warrants ..... **Satisfied**
Required volumes reached for 9 hours, 8 are needed

Warrant 2 - Four Hour Volumes ..... **Satisfied**
Number of hours (6) volumes exceed minimum >= minimum required (4).

Warrant 3 - Peak Hour ..... **Not Satisfied**

Warrant 3A - Peak Hour Delay ..... **Not Satisfied**
Total approach volumes and delays on minor street do not exceed minimums for any hour.

Warrant 3B - Peak Hour Volumes ..... **Not Satisfied**
Volumes do not exceed minimums for any hour.

Warrant 4 - Pedestrian Volumes ..... **Not Satisfied**
Required 4 Hr pedestrian volume reached for 0 hour(s) and the single hour volume for 0 hour(s)

Warrant 5 - School Crossing ..... **Not Satisfied**
Number of gaps > .0 seconds (0) exceeds the number of minutes in the crossing period (0).

Warrant 6 - Coordinated Signal System ..... **Not Satisfied**
No adjacent coordinated signals are present

Warrant 7 - Crash Experience ..... **Not Satisfied**
Number of accidents (-1) is less than minimum (5). Volume minimums are met.

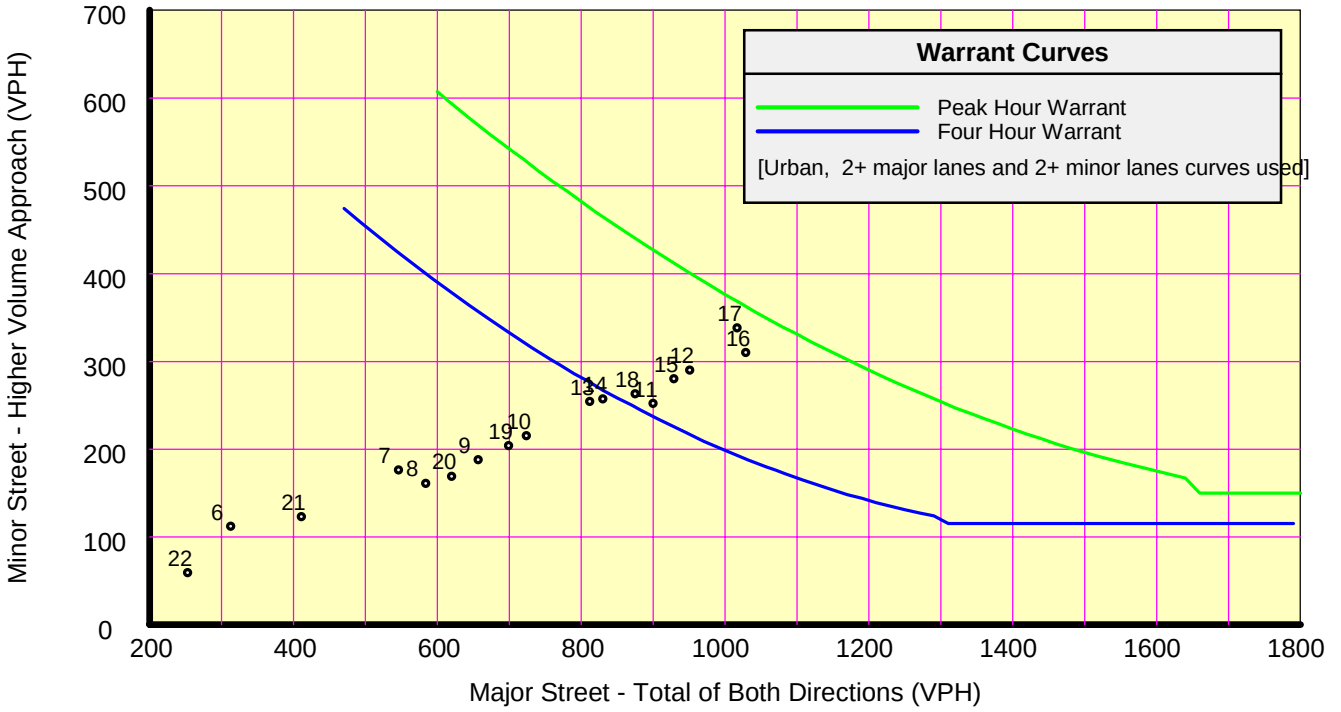
Warrant 8 - Roadway Network ..... **Not Satisfied**
Major Route conditions not met. One or more volume requirement met.

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2007 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary



Analysis of 8-Hour Volume Warrants:

Hour	Major	Higher Minor		War-1A			War-1B			War-1A&B		
Begin	Total	Vol	Dir	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	65	17	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
01:00	38	12	SB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
02:00	36	11	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
03:00	23	5	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
04:00	33	11	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
05:00	103	49	SB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
06:00	313	112	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-No	---
07:00	546	176	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-Yes	Minor
08:00	584	161	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-Yes	Minor
09:00	657	188	NB	600-Yes	200-No	Major	900-No	100-Yes	Minor	720-No	160-Yes	Minor
10:00	724	215	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
11:00	900	252	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
12:00	951	290	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
13:00	812	254	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
14:00	830	257	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
15:00	929	280	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
16:00	1,029	310	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
17:00	1,017	338	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
18:00	875	263	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
19:00	699	204	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-No	160-Yes	Minor
20:00	620	169	NB	600-Yes	200-No	Major	900-No	100-Yes	Minor	720-No	160-Yes	Minor
21:00	411	123	NB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-No	---
22:00	253	59	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
23:00	124	40	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2010 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary

Major Street Approaches

Eastbound: **CSAH 8**
Number of Lanes: 2
Approach Speed: 0
Total Approach Volume: 7,160

Westbound: CSAH 8
Number of Lanes: 2
Approach Speed: 0
Total Approach Volume: 5,940

Minor Street Approaches

Northbound: CSAH 73
Number of Lanes: 2

Total Approach Volume: 3,838

Southbound: CSAH 73
Number of Lanes: 2

Total Approach Volume: 3,726

Warrant Summary (Urban values apply.)

Warrant 1 - Eight Hour Vehicular Volumes ..... Satisfied

Warrant 1A - Minimum Vehicular Volume ..... **Satisfied**
Required volumes reached for 10 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic ..... **Not Satisfied**
Required volumes reached for 6 hours, 8 are needed

Warrant 1 A&B - Combination of Warrants ..... **Satisfied**
Required volumes reached for 10 hours, 8 are needed

Warrant 2 - Four Hour Volumes ..... Satisfied
Number of hours (8) volumes exceed minimum >= minimum required (4).

Warrant 3 - Peak Hour ..... Satisfied

Warrant 3A - Peak Hour Delay ..... **Not Satisfied**
Total approach volumes and delays on minor street do not exceed minimums for any hour.

Warrant 3B - Peak Hour Volumes ..... **Satisfied**
Volumes exceed minimums for at least one hour.

Warrant 4 - Pedestrian Volumes ..... Not Satisfied
Required 4 Hr pedestrian volume reached for 0 hour(s) and the single hour volume for 0 hour(s)

Warrant 5 - School Crossing ..... Not Satisfied
Number of gaps > .0 seconds (0) exceeds the number of minutes in the crossing period (0).

Warrant 6 - Coordinated Signal System ..... Not Satisfied
No adjacent coordinated signals are present

Warrant 7 - Crash Experience ..... Not Satisfied
Number of accidents (-1) is less than minimum (5). Volume minimums are met.

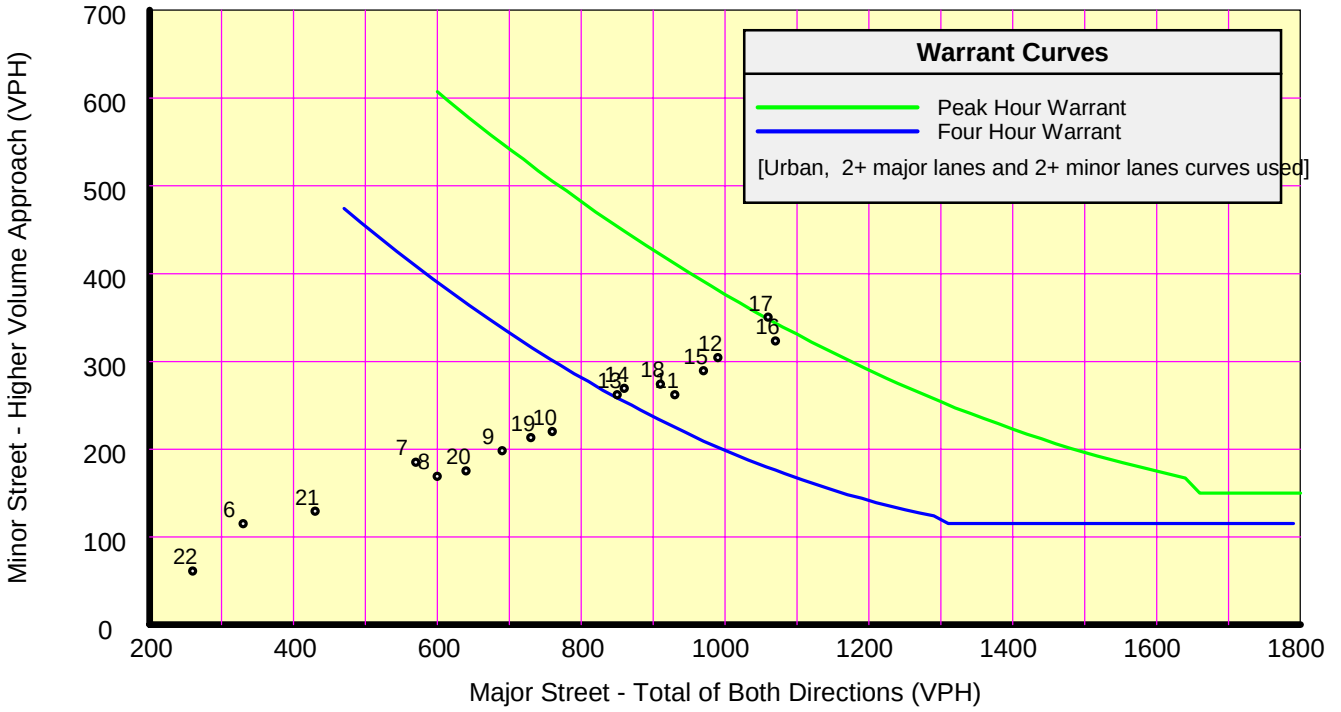
Warrant 8 - Roadway Network ..... Not Satisfied
Major Route conditions not met. One or more volume requirement met.

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2010 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary



Analysis of 8-Hour Volume Warrants:

Hour	Major	Higher Minor		War-1A			War-1B			War-1A&B		
Begin	Total	Vol	Dir	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	70	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
01:00	40	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
02:00	40	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
03:00	30	8	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
04:00	30	8	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
05:00	110	54	SB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
06:00	330	115	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-No	---
07:00	570	185	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-Yes	Minor
08:00	600	169	SB	600-Yes	200-No	Major	900-No	100-Yes	Minor	720-No	160-Yes	Minor
09:00	690	198	NB	600-Yes	200-No	Major	900-No	100-Yes	Minor	720-No	160-Yes	Minor
10:00	760	220	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
11:00	930	262	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
12:00	990	304	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
13:00	850	262	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
14:00	860	269	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
15:00	970	289	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
16:00	1,070	323	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
17:00	1,060	350	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
18:00	910	274	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
19:00	730	213	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
20:00	640	175	NB	600-Yes	200-No	Major	900-No	100-Yes	Minor	720-No	160-Yes	Minor
21:00	430	129	NB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-No	---
22:00	260	61	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
23:00	130	38	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2030 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary

Major Street Approaches

Eastbound: **CSAH 8**
Number of Lanes: **2**
Approach Speed: **0**
Total Approach Volume: **10,000**

Westbound: **CSAH 8**
Number of Lanes: **2**
Approach Speed: **0**
Total Approach Volume: **7,100**

Minor Street Approaches

Northbound: **CSAH 73**
Number of Lanes: **2**
Total Approach Volume: **4,963**

Southbound: **CSAH 73**
Number of Lanes: **2**
Total Approach Volume: **4,804**

Warrant Summary **(Urban values apply.)**

Warrant 1 - Eight Hour Vehicular Volumes ..... **Satisfied**

Warrant 1A - Minimum Vehicular Volume ..... **Satisfied**
Required volumes reached for 14 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic ..... **Satisfied**
Required volumes reached for 10 hours, 8 are needed

Warrant 1 A&B - Combination of Warrants ..... **Satisfied**
Required volumes reached for 14 hours, 8 are needed

Warrant 2 - Four Hour Volumes ..... **Satisfied**
Number of hours (11) volumes exceed minimum >= minimum required (4).

Warrant 3 - Peak Hour ..... **Satisfied**

Warrant 3A - Peak Hour Delay ..... **Not Satisfied**
Total approach volumes and delays on minor street do not exceed minimums for any hour.

Warrant 3B - Peak Hour Volumes ..... **Satisfied**
Volumes exceed minimums for at least one hour.

Warrant 4 - Pedestrian Volumes ..... **Not Satisfied**
Required 4 Hr pedestrian volume reached for 0 hour(s) and the single hour volume for 0 hour(s)

Warrant 5 - School Crossing ..... **Not Satisfied**
Number of gaps > .0 seconds (0) exceeds the number of minutes in the crossing period (0).

Warrant 6 - Coordinated Signal System ..... **Not Satisfied**
No adjacent coordinated signals are present

Warrant 7 - Crash Experience ..... **Not Satisfied**
Number of accidents (-1) is less than minimum (5). Volume minimums are met.

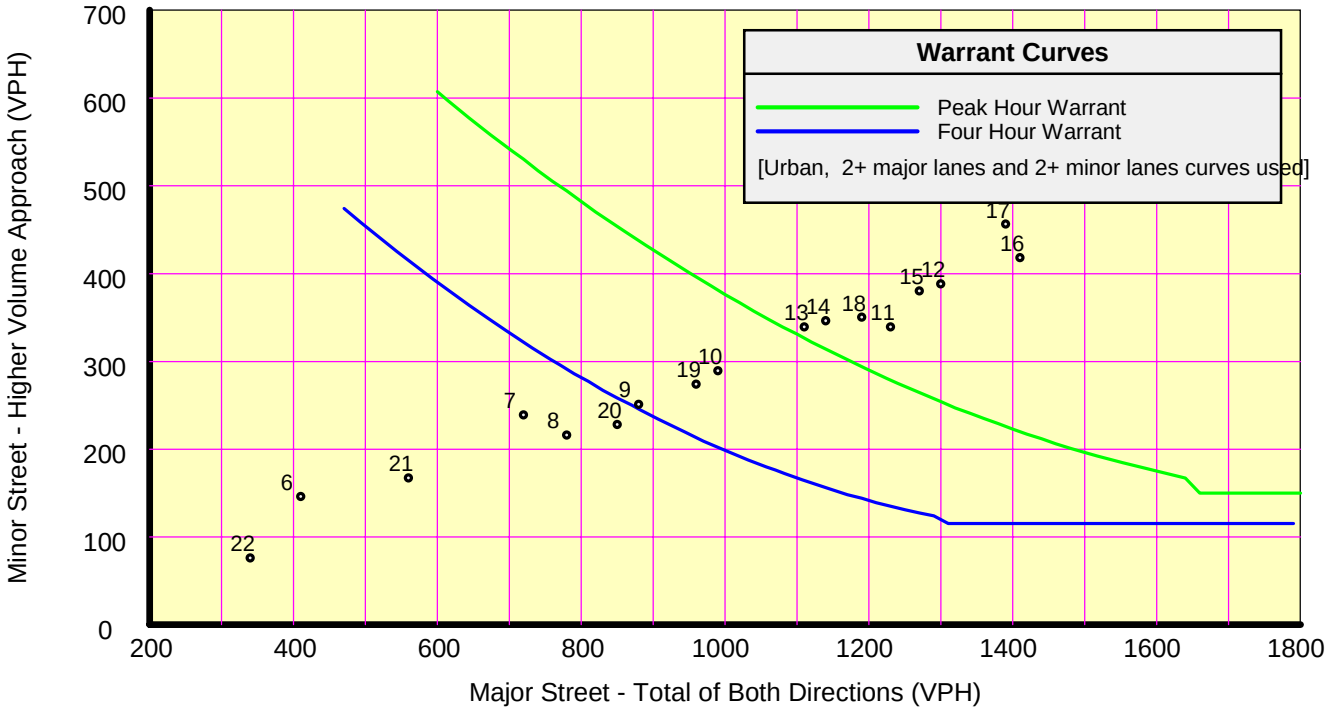
Warrant 8 - Roadway Network ..... **Not Satisfied**
Major Route conditions not met. One or more volume requirement met.

Appendix D - Signal Warrant Analyses

CSAH 73 & CSAH 8

2030 Signal Warrant Analysis
Right Turns Removed from Minor Leg
City of West St. Paul, Dakota County, MN

Signal Warrants - Summary



Analysis of 8-Hour Volume Warrants:

Hour	Major	Higher Minor		War-1A			War-1B			War-1A&B		
Begin	Total	Vol	Dir	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	90	23	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
01:00	50	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
02:00	50	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
03:00	30	8	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
04:00	40	15	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
05:00	140	62	SB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
06:00	410	146	SB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-No	---
07:00	720	239	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
08:00	780	216	SB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
09:00	880	251	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
10:00	990	289	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
11:00	1,230	339	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
12:00	1,300	388	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
13:00	1,110	339	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
14:00	1,140	346	SB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
15:00	1,270	380	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
16:00	1,410	418	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
17:00	1,390	456	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
18:00	1,190	350	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
19:00	960	274	NB	600-Yes	200-Yes	Both	900-Yes	100-Yes	Both	720-Yes	160-Yes	Both
20:00	850	228	NB	600-Yes	200-Yes	Both	900-No	100-Yes	Minor	720-Yes	160-Yes	Both
21:00	560	167	NB	600-No	200-No	---	900-No	100-Yes	Minor	720-No	160-Yes	Minor
22:00	340	76	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---
23:00	170	53	NB	600-No	200-No	---	900-No	100-No	---	720-No	160-No	---

Appendix E - LOS for All-Way Stop

2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.1	0.3	0.0	0.1	0.8	0.2	0.1	0.3	0.0	0.1	0.4	0.1
Delay / Veh (s)	7.2	9.3	6.2	7.6	11.4	7.6	6.2	8.5	4.0	8.7	10.9	7.3
Total Stops	29	132	17	57	239	74	36	113	40	40	131	64
Travel Time (hr)	0.8	3.6	0.5	1.4	5.8	1.8	0.4	1.4	0.5	0.4	1.5	0.7
Avg Speed (mph)	27	26	27	26	25	26	25	24	24	21	21	21
Vehicles Entered	30	134	17	58	241	75	35	114	40	40	132	64
Vehicles Exited	29	132	17	57	239	73	36	113	40	40	131	64
Hourly Exit Rate	29	132	17	57	239	73	36	113	40	40	131	64
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	2.5
Delay / Veh (s)	9.1
Total Stops	972
Travel Time (hr)	18.7
Avg Speed (mph)	25
Vehicles Entered	980
Vehicles Exited	971
Hourly Exit Rate	971
Denied Entry Before	0
Denied Entry After	0

Appendix E - LOS for All-Way Stop

2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.3	4.3	0.5	0.2	2.0	0.4	0.2	1.1	0.4	0.3	1.3	0.3
Delay / Veh (s)	13.5	39.8	22.0	11.8	23.0	13.6	9.8	20.4	16.0	13.0	16.0	14.9
Total Stops	90	401	107	74	311	119	58	201	100	71	227	76
Travel Time (hr)	2.6	13.8	2.5	1.8	8.5	2.8	0.8	3.2	1.5	0.9	3.5	1.0
Avg Speed (mph)	25	20	23	25	22	24	22	19	19	19	18	18
Vehicles Entered	91	391	80	74	311	108	58	202	100	71	288	78
Vehicles Exited	89	385	80	73	308	108	58	201	100	70	285	76
Hourly Exit Rate	89	385	80	73	308	108	58	201	100	70	285	76
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	11.3
Delay / Veh (s)	22.1
Total Stops	1835
Travel Time (hr)	43.0
Avg Speed (mph)	21
Vehicles Entered	1852
Vehicles Exited	1833
Hourly Exit Rate	1833
Denied Entry Before	0
Denied Entry After	0

Appendix E - LOS for All-Way Stop

1: CR 6 & CSAH 73 Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	All
Total Delay (hr)	0.4	0.1	0.4	1.5	0.2	0.1	0.2	0.1	0.1	0.3	3.5
Delay / Veh (s)	12.6	8.2	19.7	23.3	19.2	7.5	6.3	5.6	8.0	9.4	14.0
Total Stops	128	42	79	230	46	49	86	39	37	98	834
Travel Time (hr)	3.1	1.0	3.1	9.2	1.8	0.5	1.2	0.4	0.7	1.9	23.1
Avg Speed (mph)	29	29	29	28	28	22	22	22	25	25	28
Vehicles Entered	128	43	81	232	46	49	140	39	38	97	893
Vehicles Exited	128	42	79	230	46	49	141	39	37	98	889
Hourly Exit Rate	128	42	79	230	46	49	141	39	37	98	889
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.1	0.3	0.0	0.1	0.8	0.2	0.1	0.3	0.1	0.1	0.4	0.2
Delay / Veh (s)	7.9	9.3	4.6	7.1	11.9	8.3	6.5	8.8	4.5	9.7	10.7	7.3
Total Stops	41	116	9	62	239	72	40	116	40	51	138	81
Travel Time (hr)	1.1	3.2	0.2	1.4	5.8	1.7	0.5	1.5	0.5	0.6	1.5	0.9
Avg Speed (mph)	26	26	27	26	25	26	24	24	24	21	20	21
Vehicles Entered	41	119	10	62	241	72	40	116	41	52	140	82
Vehicles Exited	41	116	9	62	239	72	40	116	40	51	138	81
Hourly Exit Rate	41	116	9	62	239	72	40	116	40	51	138	81
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	2.6
Delay / Veh (s)	9.3
Total Stops	1005
Travel Time (hr)	18.9
Avg Speed (mph)	25
Vehicles Entered	1016
Vehicles Exited	1005
Hourly Exit Rate	1005
Denied Entry Before	0
Denied Entry After	0

Appendix E - LOS for All-Way Stop

1: CR 6 & CSAH 73 Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Total Delay (hr)	3.6	1.4	0.7	2.1	0.5	0.2	1.2	0.6	0.2	1.1	0.1	11.7
Delay / Veh (s)	42.8	38.4	24.7	30.6	27.0	11.5	19.0	16.3	12.5	16.7	13.8	26.5
Total Stops	304	130	100	250	66	62	236	134	56	228	23	1589
Travel Time (hr)	9.8	4.1	4.1	10.5	2.7	0.7	3.2	1.8	1.2	4.9	0.5	43.7
Avg Speed (mph)	21	22	28	27	27	20	17	17	24	23	23	23
Vehicles Entered	305	127	103	254	65	60	236	135	56	228	24	1593
Vehicles Exited	300	128	100	249	65	60	235	133	56	227	23	1576
Hourly Exit Rate	300	128	100	249	65	60	235	133	56	227	23	1576
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.3	4.2	0.6	0.2	1.9	0.4	0.1	1.7	0.6	0.3	1.3	0.4
Delay / Veh (s)	13.7	40.2	21.8	11.5	22.5	12.9	9.9	27.1	22.7	13.0	16.4	15.4
Total Stops	87	386	129	70	302	125	51	222	93	78	232	83
Travel Time (hr)	2.5	13.4	3.0	1.7	8.2	2.9	0.7	3.9	1.6	1.0	3.6	1.1
Avg Speed (mph)	25	20	23	25	23	24	22	17	17	19	18	18
Vehicles Entered	89	381	97	70	305	115	51	223	93	77	294	84
Vehicles Exited	87	375	95	70	300	114	50	221	92	77	289	83
Hourly Exit Rate	87	375	95	70	300	114	50	221	92	77	289	83
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	12.0
Delay / Veh (s)	23.2
Total Stops	1858
Travel Time (hr)	43.7
Avg Speed (mph)	21
Vehicles Entered	1879
Vehicles Exited	1853
Hourly Exit Rate	1853
Denied Entry Before	0
Denied Entry After	0

Appendix E - LOS for All-Way Stop

1: CR 6 & CSAH 73 Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Total Delay (hr)	0.6	0.1	0.7	2.5	0.3	0.1	0.4	0.1	0.1	0.4	0.0	5.5
Delay / Veh (s)	14.5	10.7	24.2	29.4	27.3	8.5	7.4	7.3	9.0	11.5	7.3	17.0
Total Stops	160	48	99	303	46	54	139	49	51	133	9	1091
Travel Time (hr)	3.9	1.2	4.1	12.8	1.9	0.6	2.0	0.6	1.0	2.7	0.2	30.8
Avg Speed (mph)	28	28	28	27	27	21	22	21	25	25	25	27
Vehicles Entered	159	48	102	313	47	54	212	50	51	133	9	1178
Vehicles Exited	160	48	99	302	46	54	212	49	51	133	9	1163
Hourly Exit Rate	160	48	99	302	46	54	212	49	51	133	9	1163
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.1	0.6	0.0	0.2	1.2	0.3	0.1	0.5	0.1	0.2	0.7	0.2
Delay / Veh (s)	8.9	12.1	6.7	9.2	14.5	10.6	7.3	10.7	6.5	10.7	13.1	9.2
Total Stops	52	169	10	75	292	108	51	155	53	57	181	80
Travel Time (hr)	1.4	4.7	0.3	1.8	7.4	2.7	0.6	2.0	0.7	0.7	2.1	0.9
Avg Speed (mph)	26	26	26	25	24	25	24	23	23	20	19	20
Vehicles Entered	52	170	10	75	294	110	52	155	53	58	182	82
Vehicles Exited	52	169	10	75	291	108	51	155	53	57	181	80
Hourly Exit Rate	52	169	10	75	291	108	51	155	53	57	181	80
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	4.1
Delay / Veh (s)	11.5
Total Stops	1283
Travel Time (hr)	25.4
Avg Speed (mph)	24
Vehicles Entered	1293
Vehicles Exited	1282
Hourly Exit Rate	1282
Denied Entry Before	0
Denied Entry After	0

Appendix E - LOS for All-Way Stop

1: CR 6 & CSAH 73 Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Total Delay (hr)	24.5	9.4	1.5	4.0	0.9	0.3	2.0	1.1	0.3	2.4	0.2	46.7
Delay / Veh (s)	268.0	265.1	36.4	47.4	41.9	15.1	30.5	26.7	15.9	30.4	24.1	91.1
Total Stops	480	188	164	305	77	88	241	145	72	288	33	2081
Travel Time (hr)	31.4	12.3	6.7	14.0	3.5	1.1	4.1	2.4	1.5	7.2	0.8	84.9
Avg Speed (mph)	7	7	26	24	25	18	14	14	23	20	20	14
Vehicles Entered	352	138	154	306	76	83	245	147	68	288	34	1891
Vehicles Exited	305	119	150	297	74	82	241	144	68	287	33	1800
Hourly Exit Rate	305	119	150	297	74	82	241	144	68	287	33	1800
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

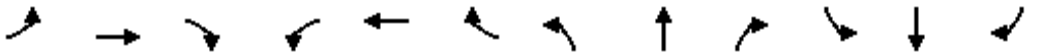
2: CSAH 8 & CSAH 73 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	9.4	85.2	24.7	0.5	14.0	4.6	0.4	13.2	5.6	1.3	6.3	2.4
Delay / Veh (s)	322.0	665.5	1056.6	21.1	134.5	131.5	21.1	178.5	167.4	46.9	67.4	77.9
Total Stops	544	2084	357	113	504	272	92	308	138	167	301	122
Travel Time (hr)	12.0	96.5	26.8	2.4	22.1	7.4	1.1	16.0	6.9	2.2	9.0	3.4
Avg Speed (mph)	6	3	2	22	11	11	18	5	5	11	8	8
Vehicles Entered	118	539	107	89	387	128	66	278	126	102	341	113
Vehicles Exited	93	383	61	88	365	123	65	256	116	99	332	109
Hourly Exit Rate	93	383	61	88	365	123	65	256	116	99	332	109
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	1	9	2	0	0	0	0	0	0	0	0	0

2: CSAH 8 & CSAH 73 Performance by movement

Movement	All
Total Delay (hr)	167.6
Delay / Veh (s)	269.2
Total Stops	5002
Travel Time (hr)	205.8
Avg Speed (mph)	5
Vehicles Entered	2394
Vehicles Exited	2090
Hourly Exit Rate	2090
Denied Entry Before	0
Denied Entry After	12

Appendix F - LOS for Signal



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1793		1770	1756	
Flt Permitted	0.55	1.00	1.00	0.64	1.00	1.00	0.54	1.00		0.65	1.00	
Satd. Flow (perm)	1027	1863	1583	1184	1863	1583	1009	1793		1207	1756	
Volume (vph)	40	120	10	60	240	70	40	120	40	50	130	80
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	130	11	65	261	76	43	130	43	54	141	87
RTOR Reduction (vph)	0	0	8	0	0	51	0	20	0	0	37	0
Lane Group Flow (vph)	43	130	3	65	261	25	43	153	0	54	191	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	18.0	16.0	16.0	20.0	17.0	17.0	17.0	15.0		17.0	15.0	
Effective Green, g (s)	19.6	16.8	16.8	21.6	17.8	17.8	18.6	15.8		18.2	15.6	
Actuated g/C Ratio	0.36	0.31	0.31	0.39	0.32	0.32	0.34	0.29		0.33	0.28	
Clearance Time (s)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8		4.6	4.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	404	569	484	505	603	512	380	515		426	498	
v/s Ratio Prot	0.01	0.07		c0.01	c0.14		0.01	0.09		c0.01	c0.11	
v/s Ratio Perm	0.03		0.00	0.04		0.02	0.03			0.04		
v/c Ratio	0.11	0.23	0.01	0.13	0.43	0.05	0.11	0.30		0.13	0.38	
Uniform Delay, d1	11.7	14.3	13.3	10.5	14.6	12.8	12.4	15.3		12.7	15.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		0.75	0.82	
Incremental Delay, d2	0.1	0.2	0.0	0.1	0.5	0.0	0.1	1.5		0.1	2.2	
Delay (s)	11.8	14.5	13.3	10.7	15.1	12.8	12.5	16.7		9.7	15.3	
Level of Service	B	B	B	B	B	B	B	B		A	B	
Approach Delay (s)		13.8			14.0			15.9			14.2	
Approach LOS		B			B			B			B	

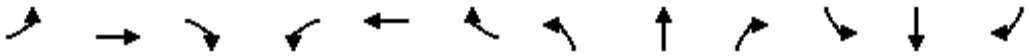
Intersection Summary			
HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Appendix F - LOS for Signal

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1775		1770	1791	
Flt Permitted	0.35	1.00	1.00	0.28	1.00	1.00	0.40	1.00		0.32	1.00	
Satd. Flow (perm)	647	1863	1583	525	1863	1583	741	1775		596	1791	
Volume (vph)	80	400	90	70	310	110	50	220	100	80	230	80
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	435	98	76	337	120	54	239	109	87	250	87
RTOR Reduction (vph)	0	0	67	0	0	85	0	27	0	0	20	0
Lane Group Flow (vph)	87	435	31	76	337	35	54	321	0	87	317	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	22.3	18.0	18.0	19.7	16.7	16.7	18.8	15.8		21.2	17.0	
Effective Green, g (s)	23.9	18.8	18.8	21.3	17.5	17.5	20.4	16.6		22.4	17.6	
Actuated g/C Ratio	0.40	0.31	0.31	0.36	0.29	0.29	0.34	0.28		0.37	0.29	
Clearance Time (s)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8		4.6	4.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	353	584	496	265	543	462	317	491		316	525	
v/s Ratio Prot	c0.02	c0.23		0.02	0.18		0.01	c0.18		c0.02	0.18	
v/s Ratio Perm	0.08		0.02	0.08		0.02	0.05			0.08		
v/c Ratio	0.25	0.74	0.06	0.29	0.62	0.08	0.17	0.65		0.28	0.60	
Uniform Delay, d1	11.9	18.5	14.4	13.6	18.4	15.4	13.7	19.2		12.9	18.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	5.1	0.1	0.6	2.2	0.1	0.3	6.7		0.5	5.1	
Delay (s)	12.2	23.6	14.5	14.2	20.6	15.5	13.9	25.8		13.4	23.3	
Level of Service	B	C	B	B	C	B	B	C		B	C	
Approach Delay (s)		20.6			18.5			24.2			21.3	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Appendix F - LOS for Signal



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1793		1770	1777	
Flt Permitted	0.40	1.00	1.00	0.60	1.00	1.00	0.48	1.00		0.58	1.00	
Satd. Flow (perm)	750	1863	1583	1120	1863	1583	888	1793		1083	1777	
Volume (vph)	50	170	10	70	280	100	50	150	50	60	180	80
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	185	11	76	304	109	54	163	54	65	196	87
RTOR Reduction (vph)	0	0	8	0	0	79	0	18	0	0	24	0
Lane Group Flow (vph)	54	185	3	76	304	30	54	199	0	65	259	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	18.7	15.5	15.5	18.7	15.5	15.5	22.3	19.1		22.3	19.1	
Effective Green, g (s)	20.3	16.3	16.3	20.3	16.3	16.3	23.9	19.9		23.5	19.7	
Actuated g/C Ratio	0.34	0.27	0.27	0.34	0.27	0.27	0.40	0.33		0.39	0.33	
Clearance Time (s)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8		4.6	4.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	322	506	430	422	506	430	413	595		468	583	
v/s Ratio Prot	0.01	0.10		c0.01	c0.16		0.01	0.11		c0.01	c0.15	
v/s Ratio Perm	0.05		0.00	0.05		0.02	0.04			0.05		
v/c Ratio	0.17	0.37	0.01	0.18	0.60	0.07	0.13	0.33		0.14	0.44	
Uniform Delay, d1	13.8	17.7	15.9	13.7	19.0	16.2	11.3	15.1		11.5	15.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		0.95	1.04	
Incremental Delay, d2	0.2	0.5	0.0	0.2	2.0	0.1	0.1	1.5		0.1	2.4	
Delay (s)	14.0	18.1	16.0	13.9	21.0	16.3	11.5	16.6		11.1	18.8	
Level of Service	B	B	B	B	C	B	B	B		B	B	
Approach Delay (s)		17.1			18.9			15.6			17.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

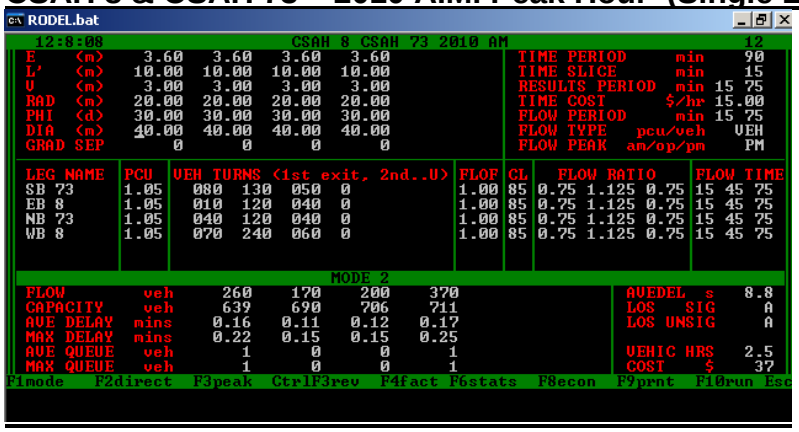
Appendix F - LOS for Signal

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1779		1770	1783	
Flt Permitted	0.29	1.00	1.00	0.14	1.00	1.00	0.23	1.00		0.26	1.00	
Satd. Flow (perm)	547	1863	1583	266	1863	1583	428	1779		491	1783	
Volume (vph)	120	550	110	90	390	130	70	280	120	110	300	120
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	130	598	120	98	424	141	76	304	130	120	326	130
RTOR Reduction (vph)	0	0	60	0	0	92	0	18	0	0	17	0
Lane Group Flow (vph)	130	598	60	98	424	49	76	416	0	120	439	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	31.2	27.2	27.2	31.2	27.2	27.2	29.8	25.8		29.8	25.8	
Effective Green, g (s)	32.8	28.0	28.0	32.8	28.0	28.0	31.4	26.6		31.0	26.4	
Actuated g/C Ratio	0.41	0.35	0.35	0.41	0.35	0.35	0.39	0.33		0.39	0.33	
Clearance Time (s)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8		4.6	4.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	298	652	554	199	652	554	249	592		264	588	
v/s Ratio Prot	0.03	c0.32		c0.03	0.23		0.02	0.23		c0.03	c0.25	
v/s Ratio Perm	0.15		0.04	0.17		0.03	0.10			0.15		
v/c Ratio	0.44	0.92	0.11	0.49	0.65	0.09	0.31	0.70		0.45	0.75	
Uniform Delay, d1	16.1	24.9	17.6	18.0	21.9	17.4	16.8	23.3		17.3	23.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.29	1.24	
Incremental Delay, d2	1.0	17.7	0.1	1.9	2.3	0.1	0.7	6.8		0.9	6.4	
Delay (s)	17.1	42.6	17.6	19.9	24.2	17.5	17.5	30.1		23.2	36.0	
Level of Service	B	D	B	B	C	B	B	C		C	D	
Approach Delay (s)		35.2			22.1			28.2			33.4	
Approach LOS		D			C			C			C	

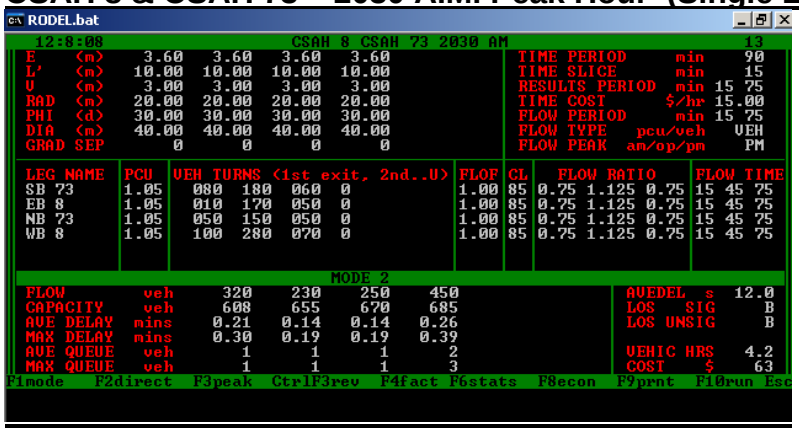
Intersection Summary			
HCM Average Control Delay	30.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix G - LOS for Roundabout

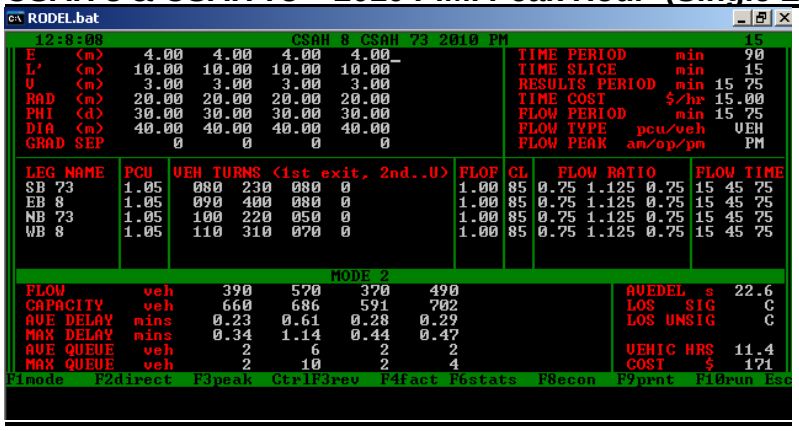
CSAH 8 & CSAH 73 – 2010 A.M. Peak Hour (Single Lane)



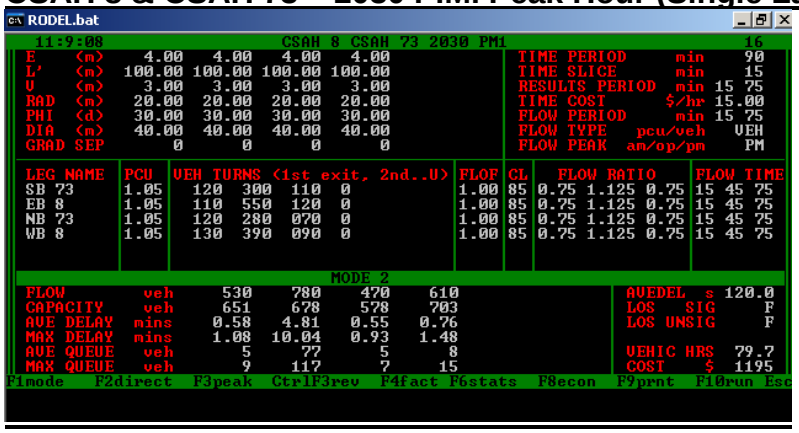
CSAH 8 & CSAH 73 – 2030 A.M. Peak Hour (Single Lane)



CSAH 8 & CSAH 73 – 2010 P.M. Peak Hour (Single Lane)

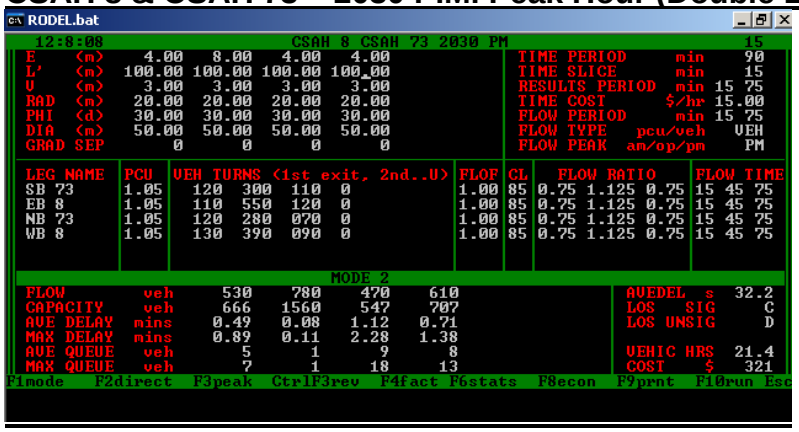


CSAH 8 & CSAH 73 – 2030 P.M. Peak Hour (Single Lane)



Appendix G - LOS for Roundabout

CSAH 8 & CSAH 73 – 2030 P.M. Peak Hour (Double Lane)



Appendix H - Prelliminary Layouts

THOMPSON OAKS
GOLF COURSE

CSAH 73

CHRISTENSEN AVE

MEADOW LN

WENTWORTH AVE

CSAH 8

WEST ST. PAUL
SPORTS COMPLEX

OAKDALE AVE

N

LEGEND

- INPLACE RIGHT OF WAY
- PROPOSED ROADWAY
- RAISED MEDIAN & CURB
- SHOULDER
- SIDEWALKS

REV. NO.	DATE	BY	CHK	DESCRIPTION

NOT TO SCALE

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR 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.

NAME _____ LIC. NO. _____ DATE 9/16/2008

DESIGNED
DRAWN
CHECKED

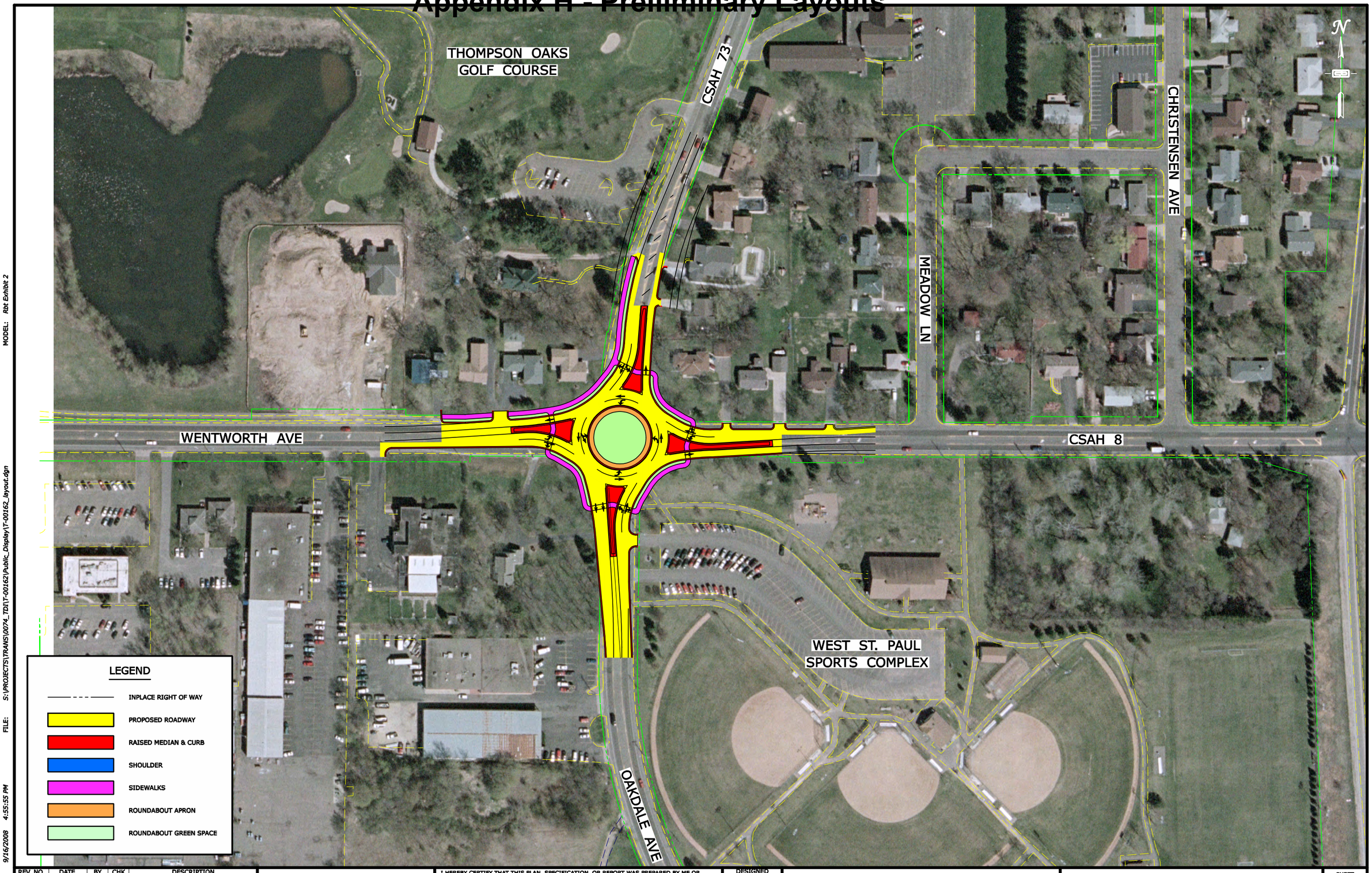
STONEBROOKE ENGINEERING
305 Stonebrooke Court Shakopee, MN 55379

CSAH 73/OAKDALE AVE & CSAH 8/WENTWORTH AVE
SIGNALIZED INTERSECTION
DAKOTA COUNTY TRAFFIC STUDY

SHEET
OF

PLOT DRIVER: pdf_HP1055.plt
PEN TABLE: stonebrooke.tbl
USER: ivandrasek
FILE: S:\PROJECTS\TRANS\0074_TDA\T-00162\Public_Display\T-00162_layout.dgn
PLOT DATE: 9/16/2008 4:53:17 PM
MODEL: Signal Exhibit 2

Appendix H - Prelliminary Layouts



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MODEL: Rbt Exhibit 2
PLOT DATE: 9/16/2008 4:55:55 PM

REV. NO.	DATE	BY	CHK	DESCRIPTION

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I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR 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.

NAME _____ LIC. NO. _____ DATE 9/16/2008

DESIGNED
DRAWN
CHECKED

STONEBROOKE ENGINEERING
305 Stonebrooke Court Shakopee, MN 55379

CSAH 73/OAKDALE AVE & CSAH 8/WENTWORTH AVE
ROUNDABOUT INTERSECTION
DAKOTA COUNTY TRAFFIC STUDY

SHEET
OF

Appendix I - Prelliminary Costs

STREET CONSTRUCTION COST ESTIMATE--CSAH 73 AND CSAH 8						
	Roundabout	Signalized Intersection			Roundabout	Signalized Intersection
Item	Quantity		Unit	Unit Price	Amount	
COMMON EXCAVATION (CV)	8702	0	CY	$11.00	$96,000.00	$0.00
REMOVE BITUMINOUS	52344	0	SY	$2.08	$110,000.00	$0.00
REMOVE CURB AND GUTTER	2313	0	LF	$2.05	$4,800.00	$0.00
REMOVE BITUMINOUS WALK	4904	0	SF	$0.57	$2,800.00	$0.00
SAWCUT BITUMINOUS	1184	0	LF	$3.00	$3,600.00	$0.00
3" WEAR COURSE TYPE SP 12.5 (4, F)	844	0	TON	$52.00	$44,000.00	$0.00
3" NON WEAR COURSE TYPE SP 12.5 (3, B)	844	0	TON	$45.00	$38,000.00	$0.00
BITUMINOUS MATERIAL FOR TACK COAT	361	0	GAL	$2.50	$910.00	$0.00
9" AGGREGATE BASE (CV) CLASS 5	2008	0	CY	$20.00	$41,000.00	$0.00
24" SELECT GRANULAR BORROW (CV)	5355	0	CY	$14.00	$75,000.00	$0.00
8" CONCRETE APRON	2463	0	SY	$45.85	$120,000.00	$0.00
RAISED MEDIAN CONCRETE	11885	0	SF	$6.00	$72,000.00	$0.00
4" CONCRETE WALK	518	0	SF	$2.77	$1,500.00	$0.00
3" BITUMINOUS WALK	7242	0	SF	$1.56	$12,000.00	$0.00
CONCRETE CURB AND GUTTER-B624	4097	0	LF	$10.80	$45,000.00	$0.00
4" BROKEN LINE WHITE-PAINT	164	266	LF	$0.16	$27.00	$43.00
4" SOLID LINE WHITE-PAINT	1426	3175	LF	$0.09	$130.00	$290.00
8" SOLID LINE WHITE-EPOXY	0	268	LF	$0.56	$0.00	$160.00
24" STOP LINE WHITE-EPOXY	0	140	LF	$9.14	$0.00	$1,300.00
4" DOUBLE SOLID LINE YELLOW-PAINT	460	1777	LF	$0.22	$110.00	$400.00
24" SOLID LINE YELLOW-PAINT	0	53	LF	$3.68	$0.00	$200.00
PAVEMENT MESSAGE (RT ARROW) EPOXY	0	3	EACH	$108.00	$0.00	$330.00
PAVEMENT MESSAGE (RT-THRU ARROW) EPOXY	4	3	EACH	$195.00	$780.00	$590.00
PAVEMENT MESSAGE (THRU) EPOXY	9	3	EACH	$125.00	$1,200.00	$380.00
PAVEMENT MESSAGE (LT ARROW) EPOXY	7	13	EACH	$125.00	$880.00	$1,700.00
PAVEMENT MESSAGE (LT-THRU ARROW) PAINT	1	0	EACH	$195.00	$200.00	$0.00
TRAFFIC CONTROL SIGNAL SYSTEM	0	1	SIGS	$250,000.00	$0.00	$250,000.00
Lighting	20	0	Each	$15,000.00	$300,000.00	$0.00
TOTAL					**$970,000.00**	**$260,000.00**

TOTAL AREA OF NEW ROADWAY		
	Roundabout	Signalized Intersection
Item	Area (SF)	
BITUMINOUS PAVEMENT	46060	0

TOTAL AREA OF RIGHT OF WAY		
	Roundabout	Signalized Intersection
	SF	
RIGHT OF WAY NEEDED	22786	2200

Estimate does not include costs for

Storm Sewer

Utility Relocation

Signing

Contingencies