APPENDIX C

TRAFFIC OPERATIONS ANALYSIS

SRF No. 0065712

MEMORANDUM

TO: Rick Brown, P.E., Vice President
Nancy Frick, AICP, Senior Associate

FROM: John Hagen, P.E., PTOE, Senior Associate
Jordan Mancl, Engineer

DATE: October 18, 2007

SUBJECT: TH 55 Environmental Assessment and Preliminary Layout
Traffic Operations Analysis

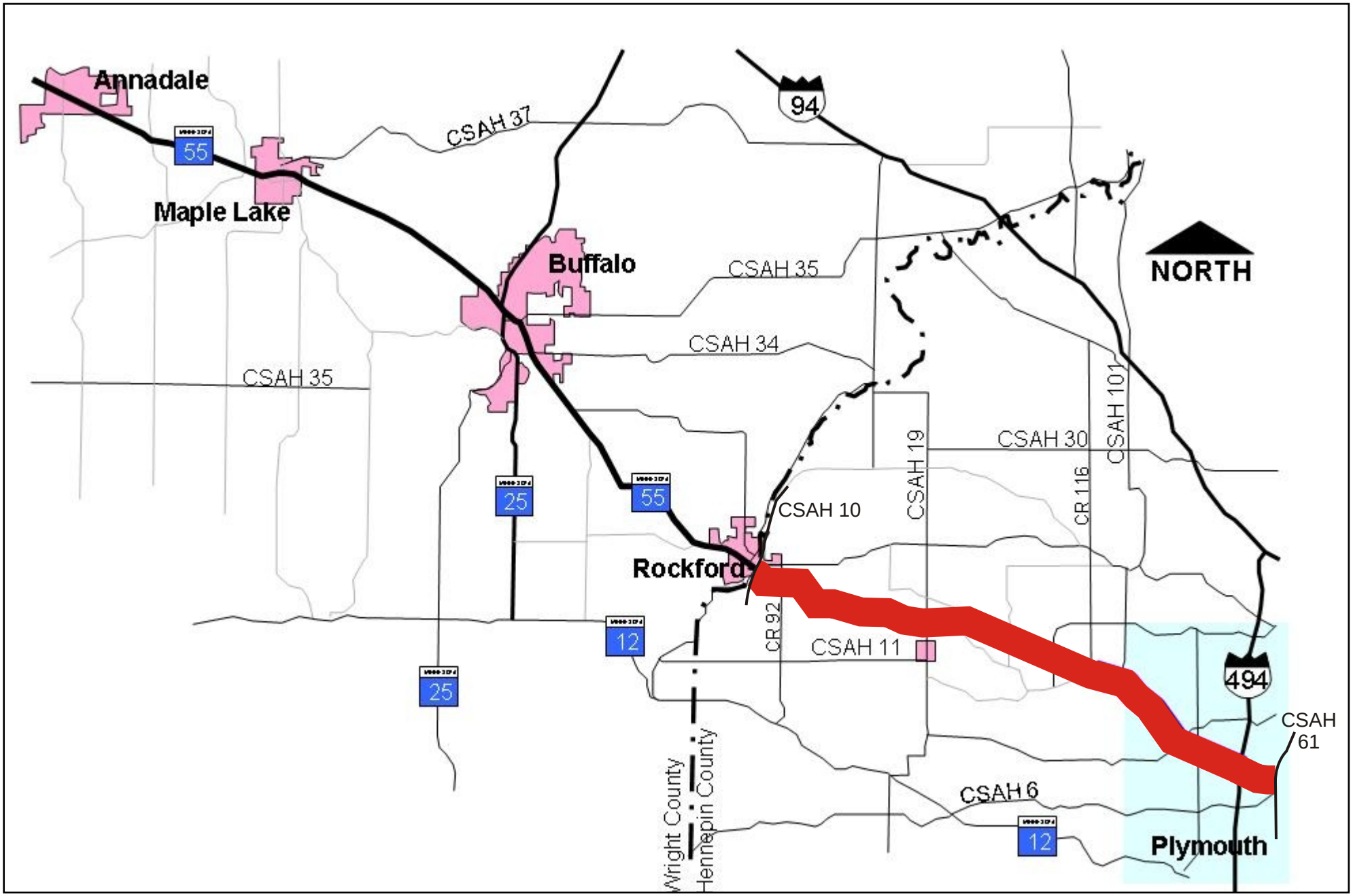
INTRODUCTION

As part of the TH 55 Environmental Assessment and Preliminary Layout, we have completed a traffic operations analysis of the existing and proposed roadway alternatives along TH 55 from CSAH 61 in Plymouth to CSAH 50/CSAH 10 in Rockford. The purpose of this traffic operations study is to identify, describe, and quantify the existing and forecast year traffic operations within the project study segment (see Figure 1). The existing, year 2030 No Build, and year 2030 Build traffic operations were analyzed for both a.m. and p.m. peak hour.

It should be noted that in April 2005, SRF Consulting Group, Inc. performed a TH 55 Future Traffic Demand Study from CSAH 61 in Plymouth to Willow Drive in Medina. The objective of that study was to assist Mn/DOT and the TH 55 Corridor Coalition in fully understanding traffic impacts associated with future improvements and expansion of TH 55. The results of the study were used to assist Mn/DOT and the TH 55 Corridor Coalition in future studies such as this environmental assessment and preliminary layout. Traffic forecasts from this previous study were used to develop turning movements for existing, year 2030 no build, and year 2030 build conditions on TH 55 from CSAH 61 to Willow Drive.

Study Segment

As shown in Figure 1, the study segment along TH 55 extends from CSAH 61 in Plymouth west to CSAH 50/CSAH 10 in Rockford. TH 55 is currently a four-lane facility from CSAH 61 to just west of Arrowhead Drive and is a two-lane facility from just west of Arrowhead Drive to just east of CSAH 50/CSAH 10. TH 55 then becomes a four-lane facility just east of CSAH 50/CSAH 10 through into Rockford.



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PROJECT SEGMENT

TH 55 EA & PRELIMINARY LAYOUT
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Figure 1

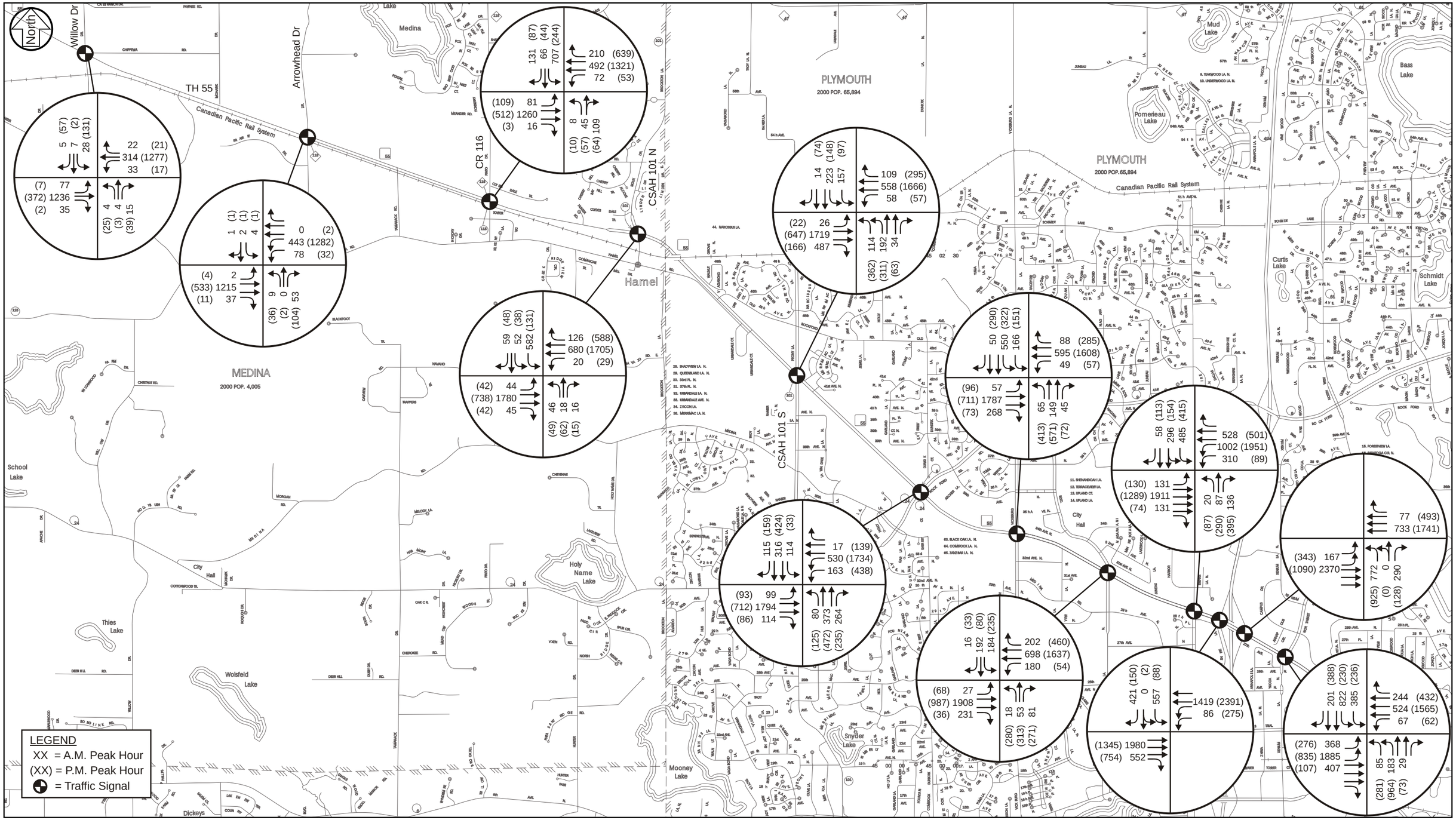
The key intersections that will be analyzed as part of this study include:

- TH 55 and CSAH 61
- TH 55 and I-494 East Ramp
- TH 55 and I-494 West Ramp
- TH 55 and Fernbrook Lane
- TH 55 and Plymouth Boulevard
- TH 55 and Vicksburg Lane
- TH 55 and CSAH 21/CSAH 9
- TH 55 and CSAH 101 (S)
- TH 55 and CSAH 101 (N)
- TH 55 and CR 116
- TH 55 and Arrowhead Drive
- TH 55 and Willow Drive
- TH 55 and Town Line Road
- TH 55 and Town Hall Drive
- TH 55 and Lake Sarah Heights Drive
- TH 55 and Vernon Street
- TH 55 and CSAH 19
- TH 55 and Greenfield Road
- TH 55 and CSAH 92
- TH 55 and CSAH 50/CSAH 10

EXISTING CONDITIONS

A traffic operations analysis was performed for a.m. and p.m. peak hour existing conditions to compare what the impacts that future traffic growth will have on the existing network. Current traffic controls include signalization at all key intersections, except TH 55/Townline Road, TH 55/Town Hall Drive, TH 55/Lake Sarah Heights Drive, TH 55/Vernon Street, and TH 55/Greenfield Road which are controlled by a side-street stop. SRF Consulting Group, Inc. collected a.m. and p.m. peak hour turning movement counts at each of the intersections stated above. Existing geometrics, traffic controls, as well as a.m. and p.m. peak hour traffic volumes for all key intersections are shown in Figures 2 and 3.

An operations analysis was conducted for the a.m. and p.m. peak hours at each of the respective peak hour key intersections to determine how traffic currently operates along the project segment. All signalized intersections were analyzed using the Synchro/SimTraffic software and unsignalized intersections were analyzed using the Highway Capacity Software. Capacity analysis results identify a Level of Service (LOS), which indicates how well an intersection is operating. The LOS results are based on average delay per vehicle. Intersections are given a ranking from LOS A through LOS F. LOS A indicates the best traffic operation and LOS F indicates an intersection where demand exceeds capacity. LOS A through D is generally considered acceptable by drivers.



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EXISTING CONDITIONS (1 of 2)

TH 55 CORRIDOR STUDY
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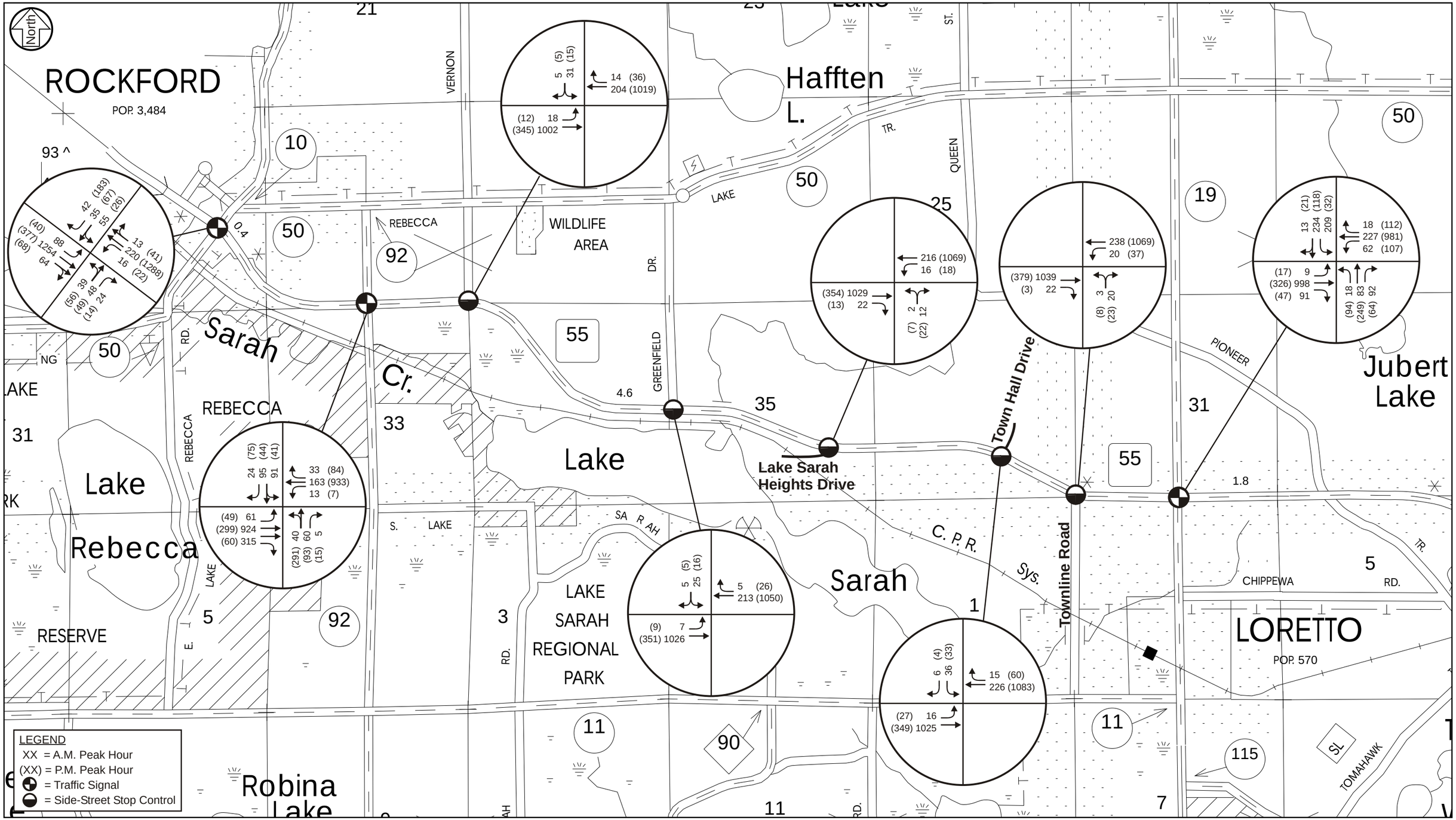
Figure 2



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EXISTING CONDITIONS (2 of 2)

TH 55 CORRIDOR STUDY
Minnesota Department of Transportation

Figure 3

For the analysis of side-street stop controlled intersections, the operations can be described in two ways. First, the overall intersection level of service is documented, which provides the average delay per vehicle for all approaches. However, at an intersection with side-street stop control, the mainline does not stop. Therefore, the majority of delay is experienced by vehicles on the side street. In addition to providing an average delay for all approaches, it is important to indicate the level of service on the side-street approach. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during the peak periods.

Results of the analysis shown in Table 1 indicate that several intersections operate at a LOS E or worse in the a.m. and p.m. peak period. The intersections that operated at a LOS E or worse in the a.m. peak hour include TH 55/CSAH 19, TH 55/CR 116, and TH 55/I-494 East Ramp. The intersections that operated at a LOS E or worse in the p.m. peak hour include TH 55/CSAH 50/CSAH 10, TH 55/CSAH 92, TH 55/Vernon Street, TH 55/Vicksburg Lane, TH 55/Fernbrook Lane, TH 55/I-494 East Ramp, and TH 55/CSAH 61.

Table 1
Existing Intersection Capacity
A.M. and P.M. Peak Hour Intersection Level of Service[1]

Location	Existing Conditions (2004)			
	AM		PM	
	LOS	Delay (sec)	LOS	Delay (sec)
CSAH 50/CSAH 10	C	25	**F**	130
CSAH 92	C	30	**F**	>180
Greenfield Road[2]	A/C	5	A/C	5
CSAH 19	**E**	65	C	35
Vernon Street[2]	A/C	10	**F/F**	115
Lake Sarah Heights Drive[2]	A/B	10	A/C	10
Town Hall Drive[2]	A/C	5	A/D	10
Town Line Road[2]	A/B	10	A/C	10
Willow Drive	C	25	C	25
Arrowhead Drive	B	10	B	20
CR 116	**F**	100	C	25
CSAH 101 (N)	C	30	C	25
CSAH 101 (S)	D	45	D	45
CSAH 21/CSAH 9	D	55	D	50
Vicksburg Lane	D	45	**F**	95
Plymouth Blvd.	D	45	D	45
Fernbrook Lane	D	45	**F**	175
I-494 West Ramp	C	35	B	20
I-494 East Ramp	**F**	115	**F**	>180
CSAH 61	D	50	**F**	105

[1]LOS is a measure of congestion. Mn/DOT defines acceptable LOS to be LOS D or better.
[2]Indicates an unsignalized intersection. The overall LOS is followed by the worst approach LOS.

YEAR 2030 NO-BUILD CONDITIONS

Traffic forecasts were developed for year 2030 no-build conditions. No-build volumes from CSAH 61 to Willow Drive were taken from the previous TH 55 Future Traffic Demand Study. The no-build numbers for the remainder of the intersections were developed using the same model that produced the forecasts contained in the earlier study. No-build conditions assume that the geometrics on the roadway will not change in the future while land use will develop around the corridor. Signal timing optimizations are also made in the no-build scenario. Figures 4 and 5 display the background traffic estimates for year 2030 no-build conditions.

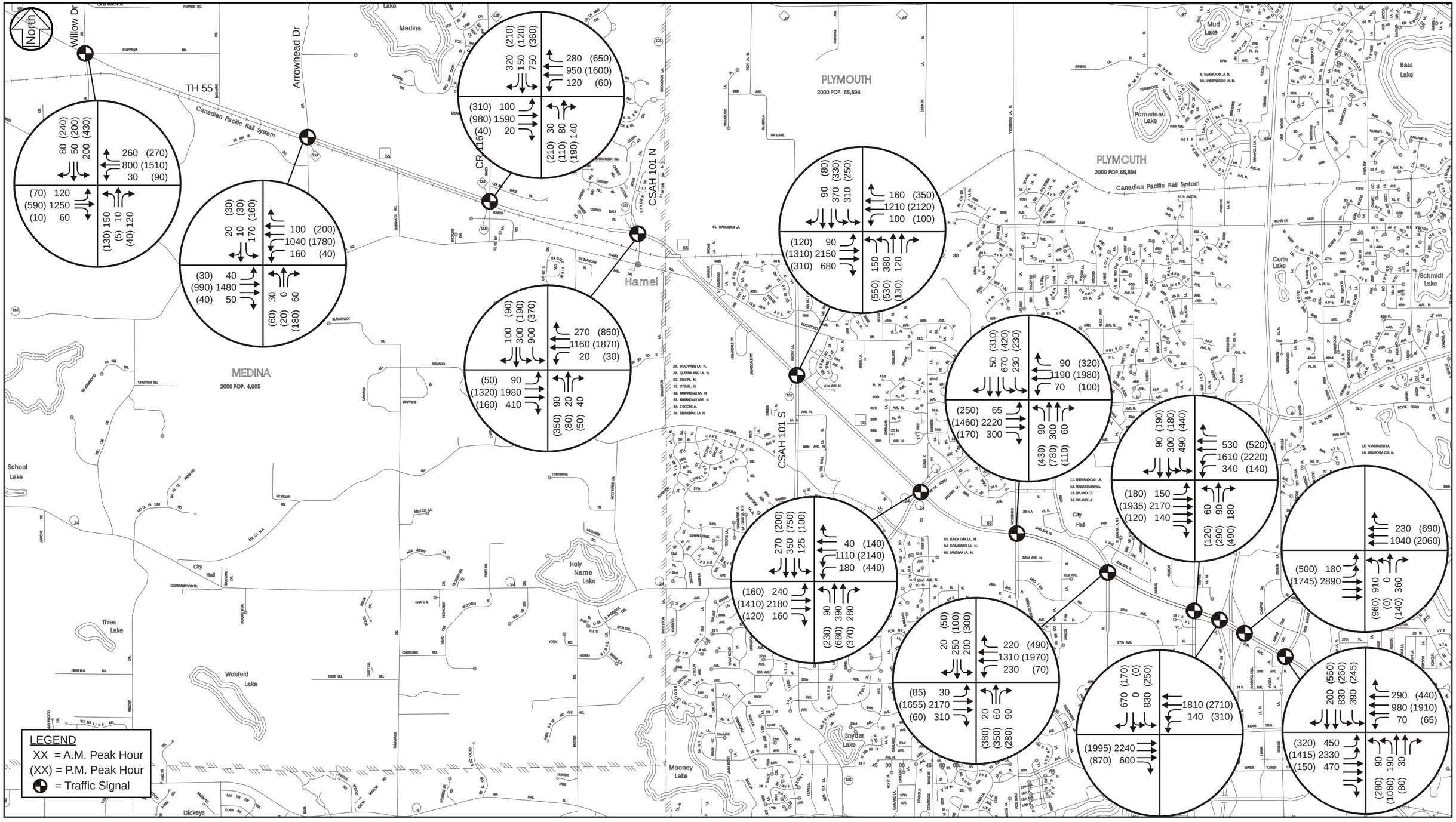
An a.m. and p.m. peak hour operations analysis was conducted for year 2030 no-build conditions. The analysis results shown in Table 2 indicate that most intersections operate at an unacceptable LOS E or worse. The poor LOS results are primarily due to the lack of lane capacity on mainline TH 55.

Table 2
Year 2030 No-Build Intersection Capacity
A.M. and P.M. Peak Hour Intersection Level of Service[1]

Location	Future No-Build Conditions (2030)			
	AM		PM	
	LOS	Delay (sec)	LOS	Delay (sec)
CSAH 50/CSAH 10	**F**	>180	**F**	>180
CSAH 92	**F**	>180	**F**	>180
Greenfield Road[2]	A/C	5	**E/F**	40
CSAH 19	**F**	>180	**F**	>180
Vernon Street[2]	A/C	10	**F/F**	>180
Lake Sarah Heights Drive[2]	A/C	10	B/D	15
Town Hall Drive[2]	A/C	5	A/**F**	10
Town Line Road[2]	**E/F**	40	B/D	15
Willow Drive	**F**	115	**F**	>180
Arrowhead Drive	C	35	**E**	80
CR 116[3]	**F**	>180	**F**	150
CSAH 101 (N)[3]	**F**	>180	**F**	105
CSAH 101 (S)[3]	**E**	75	**E**	75
CSAH 21/CSAH 9[4]	**E**	60	**F**	140
Vicksburg Lane[4]	**E**	80	**F**	>180
Plymouth Blvd.[3]	**E**	65	**F**	160
Fernbrook Lane	D	55	**F**	180
I-494 West Ramp	**F**	160	D	40
I-494 East Ramp	**F**	>180	**F**	>180
CSAH 61	D	45	**F**	>180

[1]LOS is a measure of congestion. Mn/DOT defines acceptable LOS to be LOS D or better.

[2]Indicates an unsignalized intersection. The overall LOS is followed by the worst approach LOS.



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YEAR 2030 NO BUILD CONDITIONS (1 of 2)

TH 55 CORRIDOR STUDY
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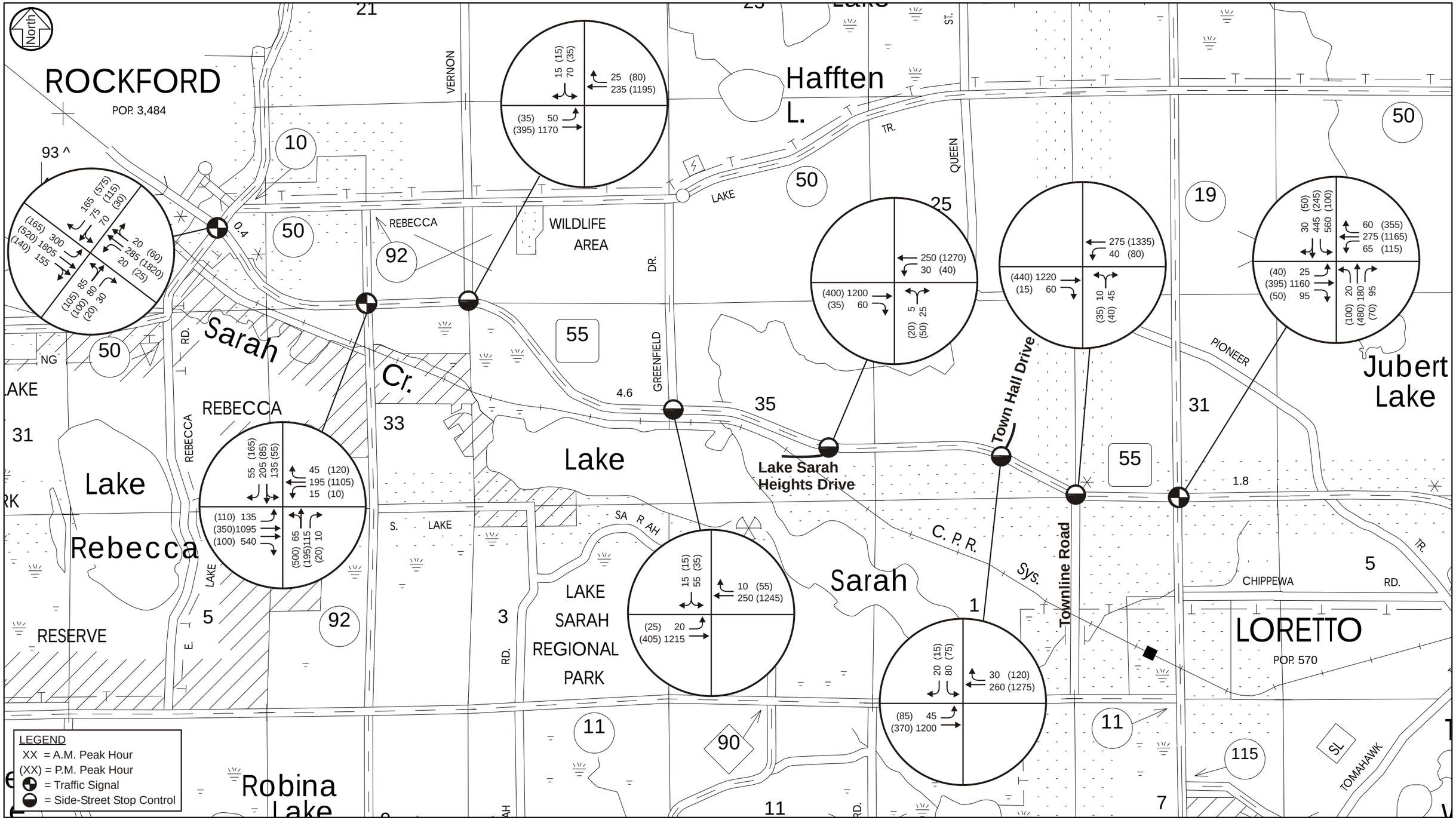
Figure 4



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YEAR 2030 NO BUILD CONDITIONS (2 of 2)

TH 55 CORRIDOR STUDY
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Figure 5

YEAR 2030 BUILD CONDITIONS

To analyze the 2030 build conditions, traffic forecasts were produced based on the build improvements made to the TH 55 corridor. The TH 55 corridor will be improved to a freeway section from I-494 through CR 116, and then from CR 116 to CSAH 50/CSAH 10, TH 55 will be improved to a four-lane divided highway. The intersection control improvements assumed at the key intersections along the TH 55 study segment under year 2030 Build conditions are as follows:

- TH 55/Fernbrook Lane: Intersection will become with button hook configurations on the north and south side.
- TH 55/Vicksburg Lane: Intersection will become a half Single-point Urban Interchange (SPUI) and half tight diamond interchange controlled by one traffic signal.
- TH 55/Rockford Road: Intersection will become a half SPUI and half tight diamond interchange controlled by one traffic signal.
- TH 55/CSAH 101 (S): Intersection will become an interchange with a standard tight diamond configuration.
- TH 55/CSAH 101 (N): Intersection will become an interchange with a standard tight diamond configuration.
- TH 55/CR 116: Intersection will become an interchange with a standard tight diamond configuration.
- TH 55/Townline Road and Town Hall Drive: Town Hall Drive will be realigned to tie in with the current location of Townline Road and the traffic control at this intersection will be upgraded to a traffic signal.
- TH 55/Lake Sarah Heights Drive: The intersection will become a right-in/right-out intersection.

Under 2030 build conditions, several turn bays will be added or lengthened to various intersections along TH 55. Figures 6 and 7 indicate all build geometric improvements as well as the build turning movement volumes. The 2005 study helped in producing the build turning movement volumes from CSAH 61 to Willow Drive, while the other intersection's volumes were produced from the forecast model.

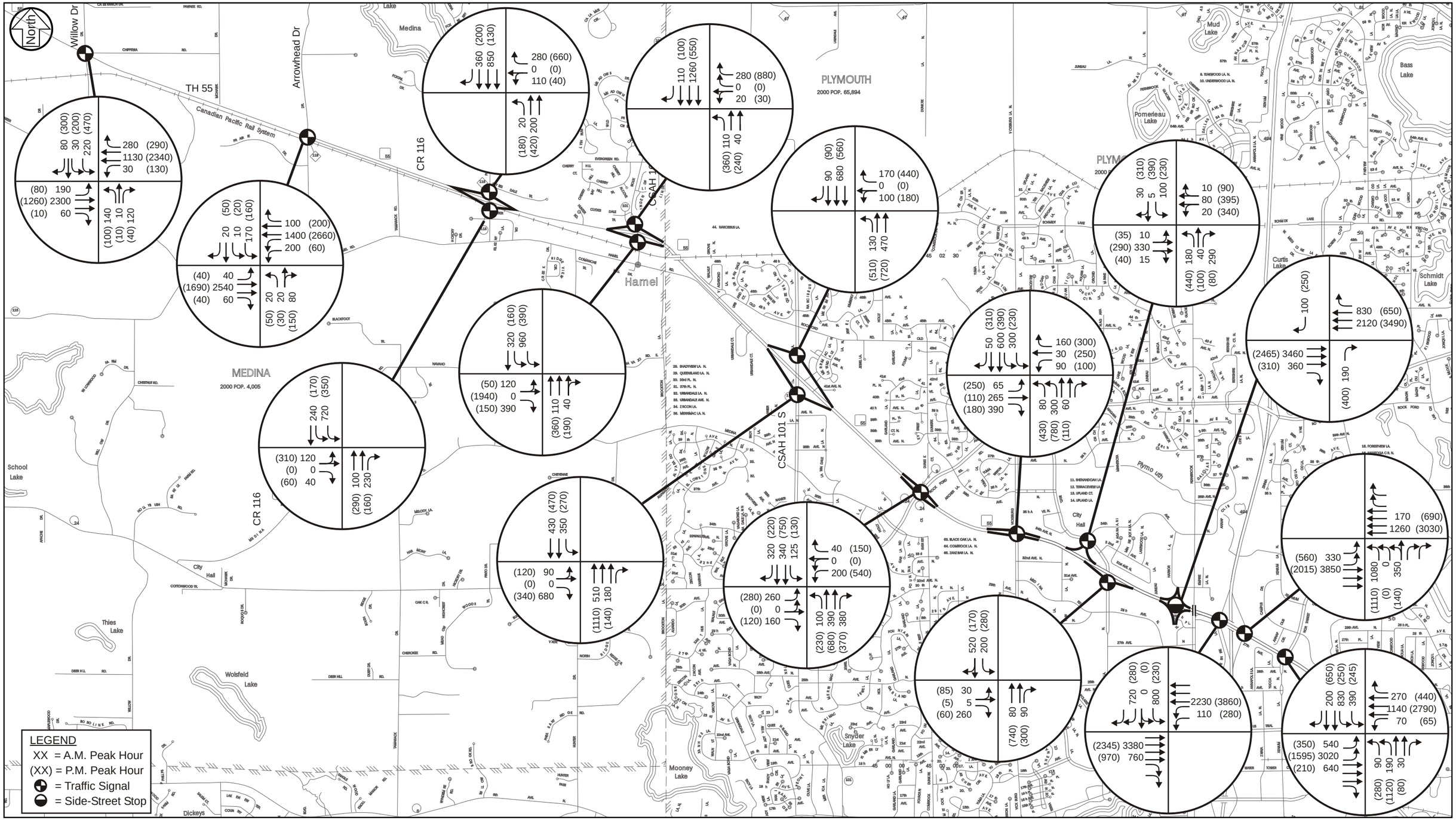
An operations analysis was completed for year 2030 build conditions during the a.m. and p.m. peak hours at each of the key intersections to determine how well the new build geometrics can accommodate the forecasted 2030 numbers. The analysis results shown in Table 3 indicate that most intersections operate at a LOS D or better under year 2030 build conditions during the a.m. and p.m. peak period assuming the recommended improvements shown in Figures 6 and 7. The only intersections do not operate at acceptable LOS D or better under year 2030 build conditions are the TH 55 intersections with Willow and Arrowhead Drives, and the intersections in the vicinity of the TH 55/I-494 interchange.

Table 3
Year 2030 Build Intersection Capacity
A.M. and P.M. Peak Hour Intersection Level of Service[1]

Location	Build Conditions (2030)			
	AM		PM	
	LOS	Delay (sec)	LOS	Delay (sec)
CSAH 50/CSAH 10	D	55	D	50
CSAH 92	C	30	D	45
Greenfield Road[2]	A/C	5	A/**E**	5
CSAH 19	D	45	D	40
Vernon Street[2]	A/D	5	A/D	5
Lake Sarah Heights Drive[2]	A/B	5	A/A	5
Town Hall Drive/Town Line Road	B	15	C	20
Willow Drive	**E**	65	**F**	110
Arrowhead Drive	**F**	90	**F**	90
CR 116 North Ramps	B	15	B	15
CR 116 South Ramps	A	5	B	15
CSAH 101 North Ramps	B	15	B	20
CSAH 101 South Ramps	B	10	C	30
CSAH 101 North Ramps	B	15	C	30
CSAH 101 South Ramps	C	25	D	40
CSAH 21/CSAH 9	C	30	D	50
Vicksburg Lane	D	40	D	50
Plymouth Blvd. North Ramps	B	15	C	20
Plymouth Blvd. South Ramps	C	25	C	25
Fernbrook Lane	N/A	N/A	N/A	N/A
I-494 West Ramp	**F**	>180	**F**	>180
I-494 East Ramp	**E**	65	**E**	75
CSAH 61	**F**	90	**F**	>180

[1]LOS is a measure of congestion. Mn/DOT defines acceptable LOS to be LOS D or better.

[2]Indicates an unsignalized intersection. The overall LOS is followed by the worst approach LOS.



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YEAR 2030 BUILD VOLUMES (1 of 2)

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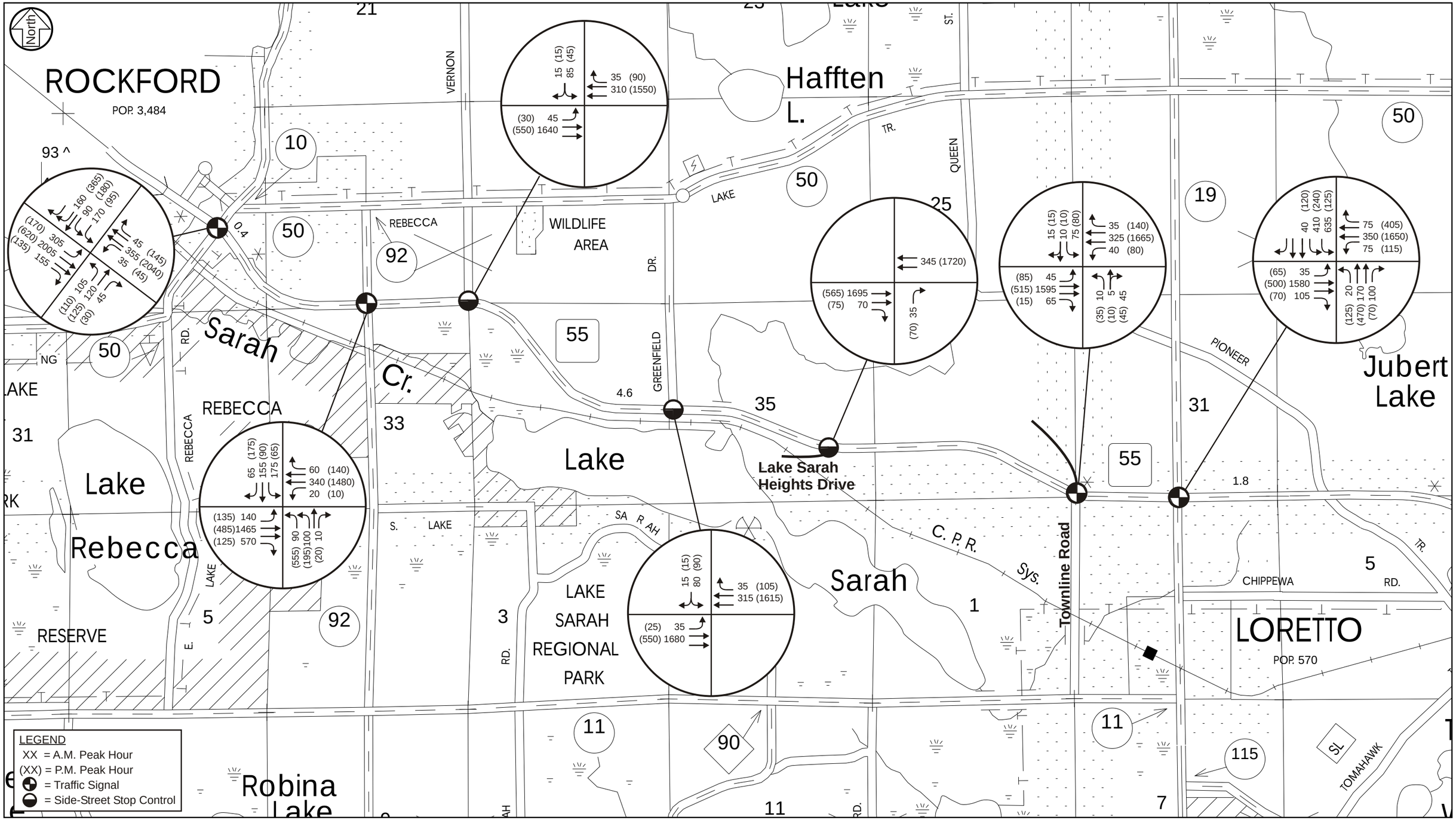
Figure 6



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YEAR 2030 BUILD CONDITIONS (2 of 2)

TH 55 CORRIDOR STUDY
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Figure 7

TH 55 at Willow Drive and Arrowhead Drive

Under current 2030 build forecasts, which assume improvements on TH 55 from I-494 to Annandale and no improvements to I-94 West of Fish Lake, the TH 55 intersections with Willow and Arrowhead Drives will not function at LOS D or better (See Table 4 below).

Table 4
Year 2030 Peak Hour Capacity Analysis
Level of Service Results

Intersection	A.M. Peak			P.M. Peak		
	LOS	Delay (seconds)	95th Percentile Queues (feet)	LOS	Delay (seconds)	95th Percentile Queues (feet)
TH 55 / Willow Drive	**E**	**65**	1,450 EB	**F**	**> 180**	2,710 WB
TH 55 / Arrowhead Drive	**F**	**90**	**2,920 EB**	**F**	**120**	**4,490 WB**

Note: The 95th-percentile queues represent the longest queue in the peak direction of travel.

The improvements to TH 55 are currently unfunded (similar to the improvements to I-94); however, I-94 West of Rogers was placed in the Governor's bonding package and growth and overall system importance (High Priority IRC plus interstate route) would suggest that capacity improvements are likely to occur on I-94 before TH 55. If this were assumed, we would expect approximately a 700 vehicle/hour reduction in TH 55 traffic. Under this assumption, we reanalyzed the problem intersections and found that they operated near or better than the LOS D/E threshold with significantly lower 95th percentile queues (See Table 5 below).

Table 5
Year 2030 Peak Hour Capacity Analysis: With Improvements to I-94/I-494 & TH 55
Level of Service Results

Intersection	A.M. Peak			P.M. Peak		
	LOS	Delay (seconds)	95th Percentile Queues (feet)	LOS	Delay (seconds)	95th Percentile Queues (feet)
TH 55 / Willow Drive	D	35	580 EB	**E**	**65**	1,010 WB
TH 55 / Arrowhead Drive	**D/E**	**55**	**1,770 EB**	D	35	**1,090 WB**

Note: The 95th-percentile queues represent the longest queue in the peak direction of travel.

The traffic operations at the next downstream intersection (CR 116) assumed the same 700 vehicle per hour reduction in TH 55 traffic. Based on a critical lane volume analysis, a six-lane at-grade facility would operate at the LOS D/E threshold; however, we feel strongly that this is the proper place to transition to a grade-separated facility given the key north-south role that CR 116 plays in western Hennepin County, and the tight intersection spacing which limits side street queues which can develop as a result of the heavy movements to and from TH 55 at this location.

Given, 1) the above regional demand modeling uncertainties that were tested, 2) the fact that a transition from freeway to expressway needs to occur somewhere along the corridor, and 3) the addition of more through lanes on TH 55 west of CR116 would significantly add to costs and impacts, yet only affect a very small portion of the daily traffic (peak of the peak), it is suggested that the four-lane expressway design that has been presented is an appropriate and fiscally responsible solution.

Weave Area between Fernbrook Lane and I-494

The proposed TH 55 "interim" improvements, in the area of Fernbrook Lane and I-494, replace the existing signal at Fernbrook Lane with a buttonhook interchange. The proposed interchange configuration will combine the heavy southbound left-turn and northbound right-turn from the existing intersection to a proposed eastbound buttonhook on-ramp. There is a concern that this combined heavy movement, while it is proposed to enter eastbound TH 55 as an add lane condition; will have limited weaving distance (approximately 1,350 feet) until the I-494 West Ramps. This is cause for some operational and safety concerns.

To further examine this concern, the proposed TH 55 interim improvement layout was analyzed using existing a.m. and p.m. peak hour traffic volumes (year 2005). The volumes were adjusted to reflect ramp volumes collected in 2007. This analysis specifically examines the weave section on eastbound TH 55 between the proposed buttonhook interchange and the I-494 West Ramp intersection. The on-ramp from the buttonhook interchange enters TH 55 as a free movement onto an add lane. Based on the modeling results, queues are expected do develop on the northbound to eastbound ramp at the buttonhook interchange during both peak hours. In addition, eastbound mainline traffic is expected to experience reduced speeds near the beginning of the weave segment during both peak hours. Based on current operations of similar roadway designs in the area, vehicles will tend to slow or possibly stop and wait for an acceptable gap on the mainline, even though this is intended as a free flow weave condition.

To address this issue, the possibility of installing a simple two-phase traffic signal on eastbound TH 55 at the proposed button hook location was analyzed. Based on the analysis, the following conclusions are offered for the TH 55 weave area between Fernbrook Lane and I-494:

- The progression of mainline traffic could be maintained by coordinating the signal with the signals at the I-494 ramps.
- The 95th-percentile queue in the eastbound direction is less than 600 feet during the a.m. peak and less than 400 feet during the p.m. peak hour.
- The on-ramp from the buttonhook will require a second right-turn lane with at least 300 feet of storage.
- This signal will address potential safety and operational issues caused by weave movements and should be shown for all alternatives that do not reconfigure the I-494/TH 55 interchange to a system interchange.

TH 55/I-494 Interchange Area

The proposed TH 55 "interim" improvements in the vicinity of the TH 494 interchange and CSAH 61 include the following:

- TH 55/I-494 West Ramp
  - Additional southbound right-turn lane
  - Additional eastbound right-turn lane
  - Additional eastbound through lane
  - Additional westbound through lane

- TH 55/I-494 East Ramp
  - Additional northbound right-turn lane
  - Additional westbound right-turn lane
  - Additional northbound left-turn lane
  - Additional westbound through lane

As shown previously in Table 3, these interim improvements in the TH 55/I-494 interchange area will not result in acceptable levels of service under year 2030 build conditions. Additional concepts have been developed for the TH 55/I-494 interchange area, and planning-level analyses have been conducted. However, since the TH 55/I-494 interchange will be ultimately be reconstructed as part of the future I-494 improvement project, the detailed analysis for these TH 55/I-494 interchange concepts will be performed as part of the future I-494 project.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis, the following conclusions and recommendations are offered for your consideration:

- TH 55 should be improved to a four-lane expressway facility from just west of Arrowhead Drive to CSAH 50/CSAH 10 in Rockford.
- TH 55 should be improved to a four-lane grade-separated "freeway" section from just west of CR 116 to I-494.
- Interchange lane configurations and traffic control along the TH 55 four-lane freeway section should be implemented as indicated in Figure 6.
- Side-street lane configurations along the TH 55 four-lane expressway segment should be implemented as indicated in Figure 7.
- Additional alternatives need to be developed to mitigate the impacts that the year 2030 traffic volumes have on the TH 55/I-494 interchange area. A detailed analysis of these alternatives should be conducted as part of a future I-494 improvement project.