



ENGINEERING, REIMAGINED

VISSIM URBAN ANALYSIS REPORT

Trunk Highway 22 Corridor Study

Mankato, Minnesota

October 2018

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Introduction and Study Area

As part of the *Trunk Highway (TH) 22 Corridor Study*, a VISSIM analysis was conducted along the urban corridor of TH 22 in Mankato from CSAH 26 (227th Street) to Hoffman Road including the US 14 interchange. The objective of the VISSIM analysis was to perform a detailed study of how the corridor would operate with signals, roundabouts, or other alternative intersections and how those intersections interacted with each other. VISSIM was chosen to properly calibrate roundabout conditions and to analyze the closely spaced US 14 intersections.

Study Intersections

This study analyzed the following intersections:

- » TH 22 and Blue Earth CSAH 26
- » TH 22 and Augusta Drive
- » TH 22 and CSAH 3 (N Victory Drive)
- » TH 22 and North US 14 Ramps
- » TH 22 and South US 14 Ramps
- » TH 22 and Adams Street
- » TH 22 and CSAH 17 (Madison Avenue)
- » TH 22 and Bassett Drive
- » TH 22 and Hoffman Road
- » Haefner Drive and Adams Street
- » Haefner Drive and Madison Avenue



Figure 1 – Study Intersections

Model Development

PTV VISSIM was chosen for the TH 22 corridor based on its flexibility with alternative intersections and interchanges and ability to calibrate roundabout operations to current conditions at Adams Street and Madison Avenue. These models also allowed us to model 24-hour operations, safety conflicts on an intersection and corridor level, and to provide a network delay comparison between scenarios.

Approach

AM and PM peak hour modeling were first conducted along the corridor for existing and future conditions and showed a sizable discrepancy in operations compared between AM and PM peak hours. With the corridor consisting of retail, commercial, and office land uses it was identified that existing daily volume profiles had a very high PM peak hour and several other midday hours that were much greater than the AM peak hour volumes. It was quickly determined that 24-hour modeling would be necessary to identify how many hours of the day would have operational deficiencies. Existing 24-hour volume profiles for the study intersections can be seen in **Attachment A**.

2045 forecasts developed for the project were developed assuming the highest expected traffic from the 2045 projected land use assumptions. 2030 conditions were also modeled to provide a mid-growth comparison between alternatives that considered infrastructure capacities on TH 22 and other collector roadways. Without major improvements to roadway capacity along collector and arterial roadways, TH 22 will likely see the mid-growth scenario out to 2045 however the 2045 results do show a worst-case scenario for the TH 22 mainline if major improvements are made to the study area.

When comparing roundabout and signalized alternatives, Level of Service (LOS) results do not accurately compare the operations at the study intersections due to the differences in LOS grades compared to intersection delay. Unsignalized intersections are considered unacceptable (LOS E/F) for delays over 35 seconds/vehicle whereas signals are considered unacceptable (LOS E/F) for delays over 55 seconds/vehicle. For this study, both delay and LOS were used to better compare each intersection type.

Travel times and safety were also compared between alternatives. Travel times were used to compare mainline TH 22 regional trips. Safety was compared between alternatives by utilizing the Safety Surrogate Assessment Model (SSAM) using VISSIM trajectory outputs to quantify the crossing, lane change, and rear end conflicts between alternatives. Network outputs were used to compare the total corridor operations.

Scenarios

As stated before preliminary modeling was performed using AM and PM peak hour volumes and used to identify scenarios that provided benefits and were brought onto 24-hour modeling. Interchange modeling was also performed separate to limit the effect of no build queueing from Adams Street. Below is a list of each scenario that was modeled as part of the urban corridor analysis.

INTERCHANGE MODELS

No Build
Roundabouts
Diverging Diamond

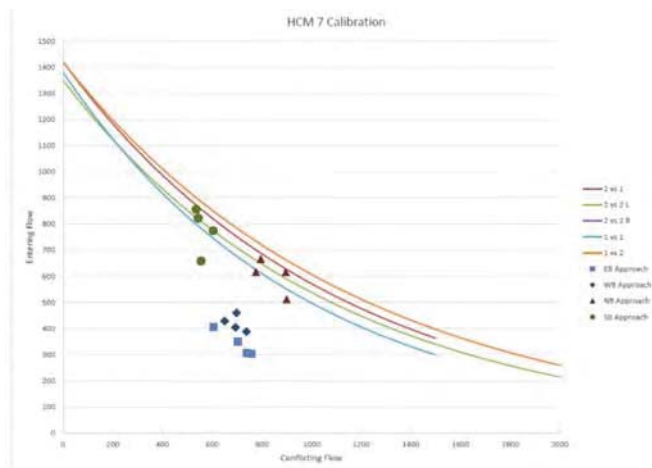
AM/PM Peak Hour Models

No Build
Roundabouts (w/wo meters)
Traffic Signals
Signalized RCUT and DDI
Hybrid Corridor

24-hour Daily Models

No Build
Roundabouts
Metered Roundabouts
Traffic Signals

Figure 2 – VISSIM Calibration to HCM 7 Capacities



Calibration and Validation

VISSIM allows for better calibration of the multilane roundabouts that are existing and proposed for the TH 22 corridor. Roundabout calibration consisted of editing link and driver behaviors to match HCM 7 roundabout capacities and to match existing delay and queueing that was witnessed from TH 22 and Adams Street video files. This calibration set EB and WB inputs to over capacity volumes to test that capacity maximums were not exceeded (see Figure 2). Final validation of the existing model included reviewing results with MnDOT staff to finalize model parameters for all roundabout modeling.

Interchange Development and Comparison

Initial 2045 PM No Build results showed that several movements were at capacity (LOS E) while still having 100-200 vehicles of latent demand from other intersections. This prompted that interchange modeling be conducted separate of overall corridor modeling to identify existing deficiencies and quantify improvements in operations. No Build modeling identified that northbound-left queues extended beyond existing storage distances and that the westbound on-ramp merging showed friction decreasing from three lanes to one.

Alternatives

Each of the three alternatives; Standard Diamond, Diverging Diamond (DDI), and Roundabouts were modeled with 2045 volumes to identify which interchange concept provided the most operational capacity during future conditions. The signals alternative assumed existing lane usage and optimized signal timing, the DDI assumed three lanes in each direction under US 14 with unsignalized movements

Figure 3 – Existing Interchange Queues



onto the freeway, and the roundabouts interchange assumed three-lane roundabouts with one lane onto the freeway, one lane through, and one shared lane with the option of both directions. Each alternative's design can be seen in Figure 4.

Figure 4 – Interchange Concepts



Analysis Results

Analysis results for the interchange concepts showed that the existing standard diamond provided the best 2045 operations. With the majority of traffic going north-south and south-north through the interchange the standard diamond provided the best operations for the through movements. However, if these travel patterns change in the future, the diverging diamond would provide better mainline to ramp movements including the northbound-left and provide better merging operations on the westbound on-ramp. This however causes the south ramp intersection to increase from LOS B to LOS C.

Table 1 – Interchange 2045 PM Peak Results Comparison

Interchange Option	Delay / Vehicle	Worst Approach	Peak Safety Conflicts
Standard Diamond	21 s/veh (LOS B/C)	54 s/veh (LOS D)	4,600
Diverging Diamond	37 s/veh (LOS C/C)	41 s/veh (LOS D)	9,900 (+115%)
Roundabouts	140 s/veh (LOS A/F)	770 s/veh (LOS F)	7,400 (+61%)

Corridor Alternative Development and Comparison

No Build

Existing, 2030 No Build, and 2045 No Build operations and safety analysis identified many corridor deficiencies. The existing safety analysis identified Augusta Drive, Adams Street, Madison Avenue, and Bassett Drive as intersections all over the critical crash rate, while N Victory Drive and Hoffman Road are also above the average rate. Most of the crashes were either rear-end or right-angle crashes that are associated with congested signalized corridors. Both Adams and Madison roundabouts saw a three time increase in total crashes in the two years after the roundabouts were opened compared to the signal before, but the number of severe crashes did decrease. Since crash data was limited, the crash rate at these roundabouts should be monitored to confirm a future decreasing crash rate.

No build modeling showed a high amount of latent demand in the PM peak hour where volume was not able to enter the network because of minor approach queueing. This queueing was noted at both the existing roundabout and existing side street stop intersections for 2045 modeling. No build modeling showed that several corridor improvements needed to be made for all future alternatives to achieve acceptable conditions. No Build operations and safety analysis are summarized in **Figure 5**.

Alternatives

No Build modeling identified that the following improvements would be needed to address latent demand regardless of intersection improvements:

- » Three northbound lanes between Adams Street and US 14
- » Adams Street westbound right becomes a free movement into the 3rd lane that drops at US 14.
- » Haefner Drive/Adams Street and Haefner Drive/Madison Avenue will be constructed as 2x1 roundabouts because the two-way stops became unacceptable in future modeling
- » Upgrading the two-way stop at Augusta Drive to a Signal or 2x1 roundabout
- » Keep the existing US 14 interchange configuration

After the initial improvements were made, four alternatives were created that would test the corridor under complete corridor visions. These alternatives included a signalized corridor, a roundabout corridor, a signalized RCI and diverging diamond corridor, and a hybrid corridor with roundabouts, signals, and signalized RCIs. Through the initial peak hour vetting process (results and concepts in **Attachment B**), it was shown that the signalized RCI and DDI and hybrid corridor alternatives did not provide an operational benefit or a reduction in safety conflicts compared to the signalized and roundabout corridors. The mix matched corridors also did not provide a consistent corridor design and were expected to provide lower safety and operational performance. The signalized and roundabout corridors with and without meters were advanced to 24-hour modeling as the peak hour modeling was inconclusive on a preferred corridor.

Analysis Results

Year 2030 and 2045 Daily Intersection Delay Results

The signalized and roundabout corridors were carried through to 24-hour modeling to compare the operational benefits based on an entire day of 2030 and 2045 volumes. These results were consistent with peak hour results where signalized intersections had better operations at North Victory Drive, Adams Street, and Madison Avenue but for most of the day roundabout and roundabout with meters corridor alternatives provided much lower delays. **Figures 6-12** show the results at each intersection for 24-hour modeling showing roundabout LOS tiers.

One important characteristic that the modeling did identify was the differences between the Adams Street and Madison Avenue volume splits. Minor approach volumes at Adams Street had a high percentage of left-turning traffic which limited the effectiveness of future metering. However, Madison Avenue had a higher percentage of minor through traffic which had a high benefit when metering was implemented. Volume trends should be monitored and reanalyzed in the future before metering is implemented across the corridor.

Figure 5 – No Build Traffic Operations and Safety Results

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	20 (C)	17 (B)
2045	21 (C)	20 (B)

Augusta Drive

Year	AM	PM
2030	33 (F)	74 (F)
2045	55 (F)	67 (F)

N Victory Drive

Year	AM	PM
2030	27 (C)	36 (D)
2045	29 (C)	39 (D)

US 14 Westbound

Year	AM	PM
2030	16 (B)	21 (C)
2045	17 (B)	23 (C)

US 14 Eastbound

Year	AM	PM
2030	13 (B)	8 (A)
2045	13 (B)	9 (A)

Adams Street

Year	AM	PM
2030	4 (A)	52 (F)
2045	6 (A)	58 (F)

Madison Avenue

Year	AM	PM
2030	6 (A)	36 (E)
2045	9 (A)	49 (E)

Bassett Drive

Year	AM	PM
2030	29 (C)	29 (C)
2045	25 (C)	40 (D)

Hoffman Road

Year	AM	PM
2030	27 (C)	21 (C)
2045	28 (C)	32 (C)

Roundabout

Signal

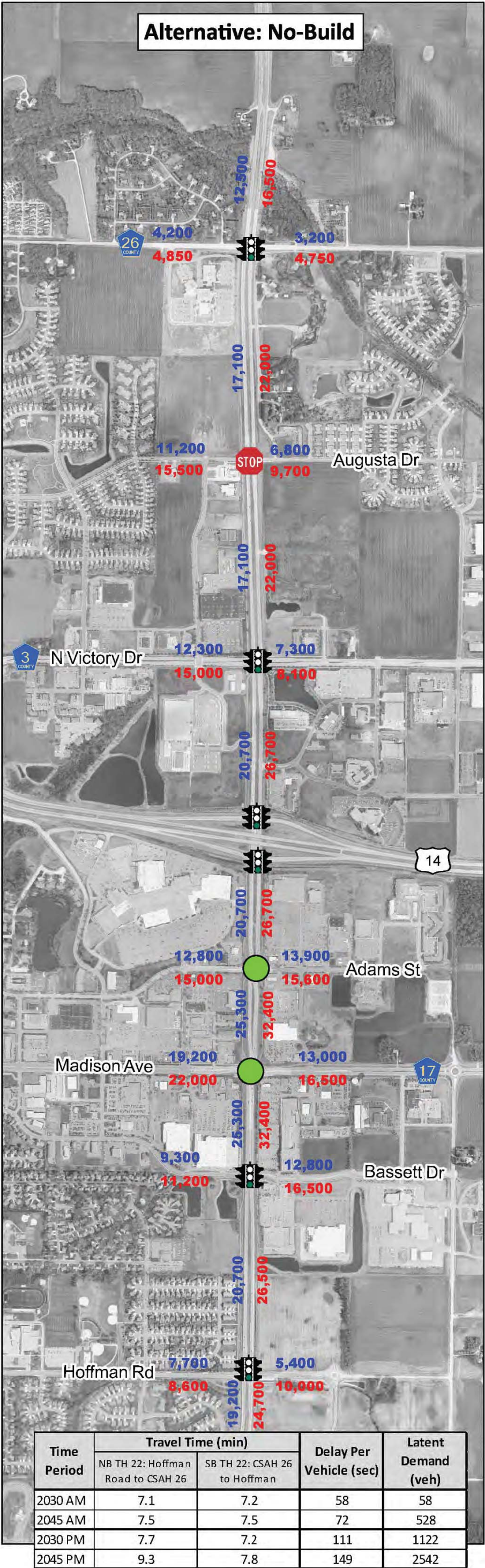
Two-Way Stop Control

10,000

2030 ADT

12,000

2045 ADT



Crash History (2011-2015)

CSAH 26

-Crash rate is below state average

Augusta Drive

-Crash rate is equal to critical crash rate
-15 total crashes
-11 right angle crashes

N Victory Drive

-Crash rate is above state average
-27 total crashes
-11 rear-end, 7 right-angle

US 14 Westbound

-Crash rate is below state average

US 14 Eastbound

-Crash rate is below state average

Adams Street

-3 times the number of crashes after roundabout implementation
-Only one injury crash with roundabout

Madison Avenue

-3 times the number of crashes after roundabout implementation
-8 injury crashes (no serious injuries)

Bassett Drive

-Crash rate is above critical crash rate
-46 total crashes
-21 rear-end, 9 right-angle

Hoffman Road

-Crash rate is above state average
-26 total crashes
-12 rear-end, 5 sideswipe

Figure 6 – CSAH 26 Daily Results

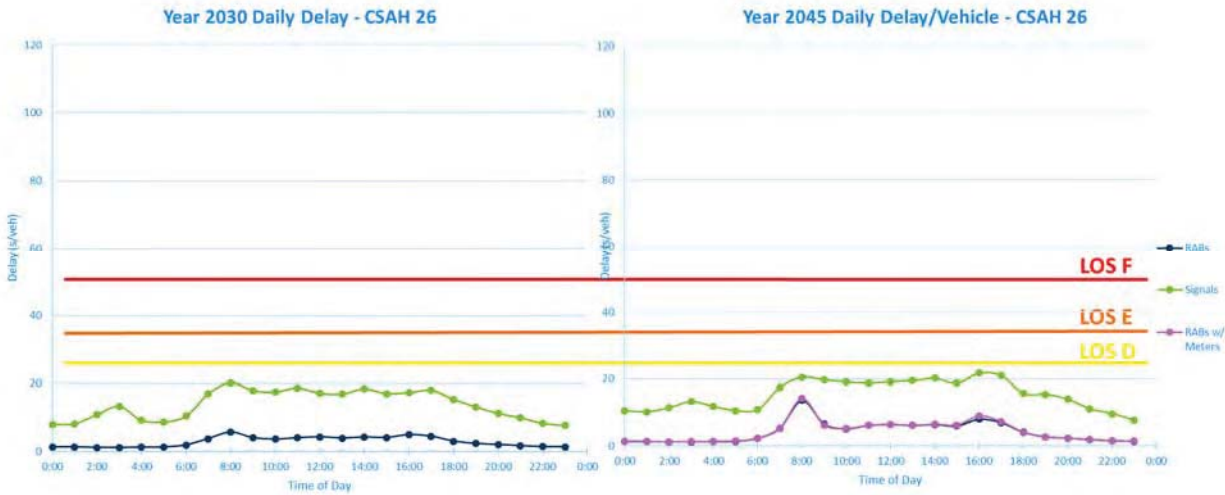


Figure 7 – Augusta Drive Daily Results

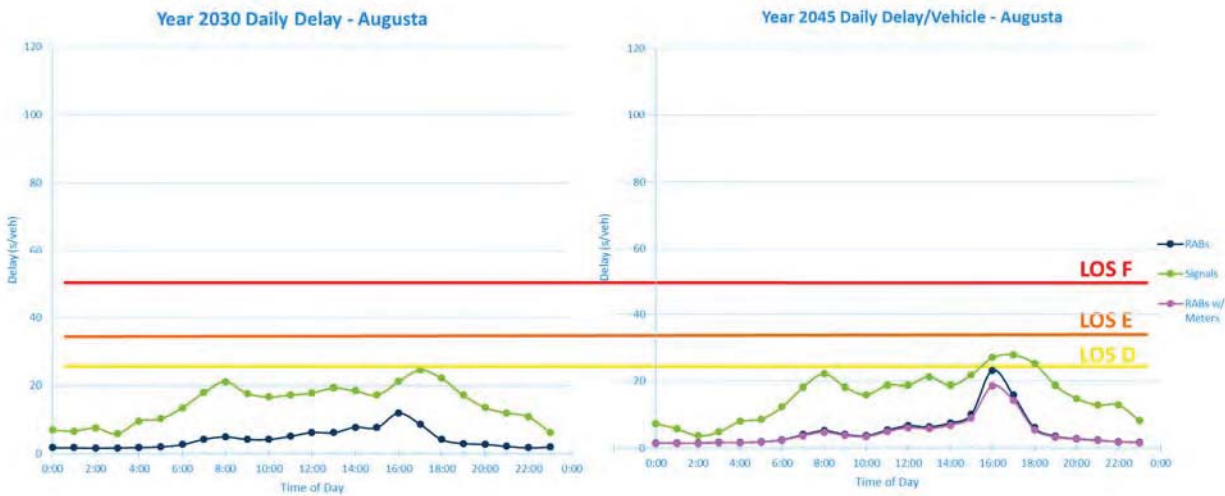


Figure 8 – North Victory Drive Daily Results



Figure 9 – Adams Street Daily Results



Figure 10 – Madison Avenue Daily Results

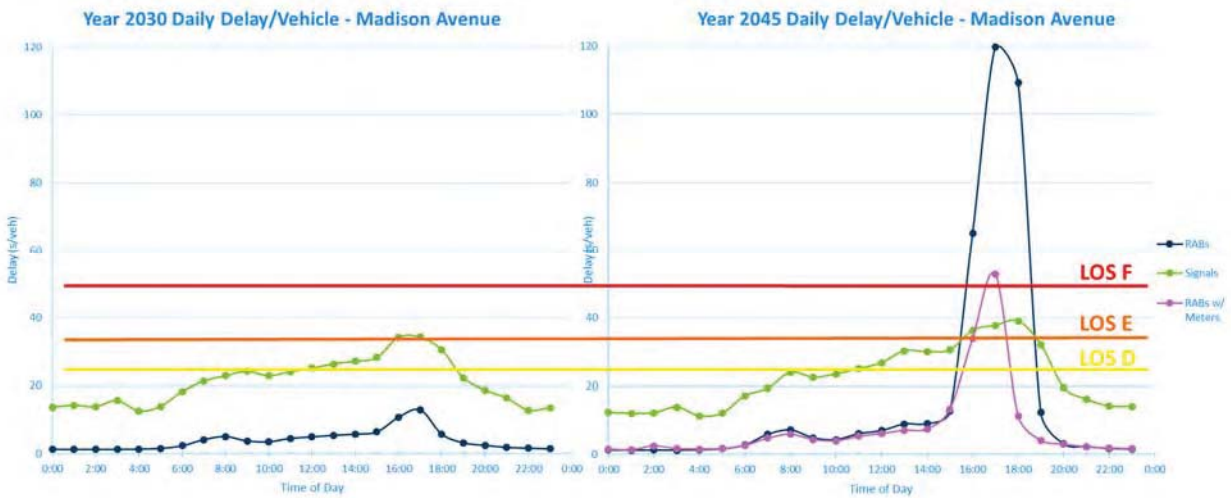
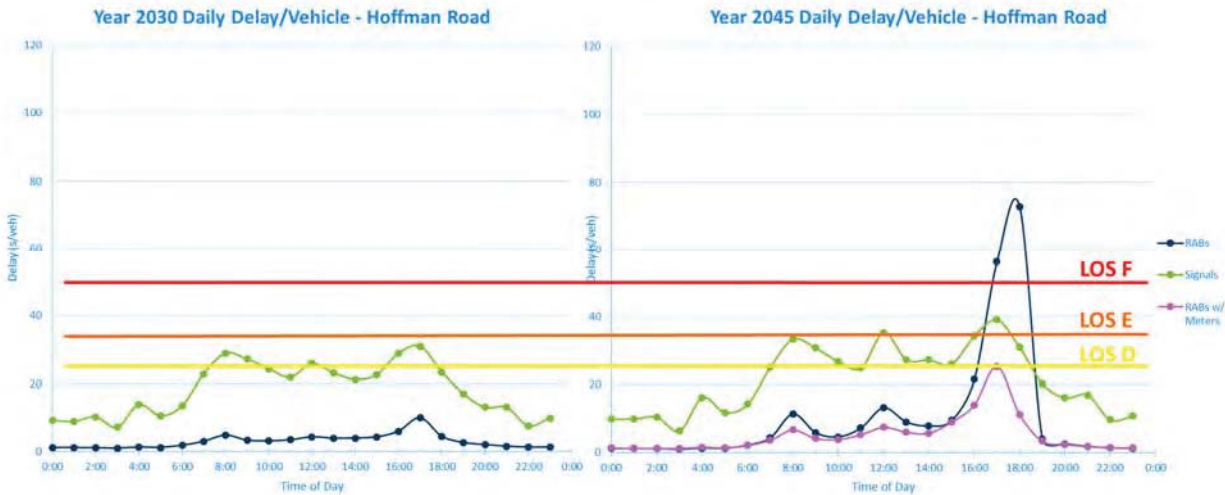


Figure 11 – Bassett Drive Daily Results



Figure 12 – Hoffman Road Daily Results



Year 2030 Daily Network Results

The Year 2030 daily network delay for the entire TH 22 corridor was compiled to compare delays including corridor delay before and after roundabouts and signals. The network results in **Figure 13** and **Table 2** show that the roundabout corridor had almost a 50 percent benefit in delay per vehicle throughout the day compared to the signalized alternative. Because of the nine roundabouts mainline travel times increased by two to five percent which equates to only 10 to 15 seconds.

Figure 13 – 2030 Network Delay Comparison

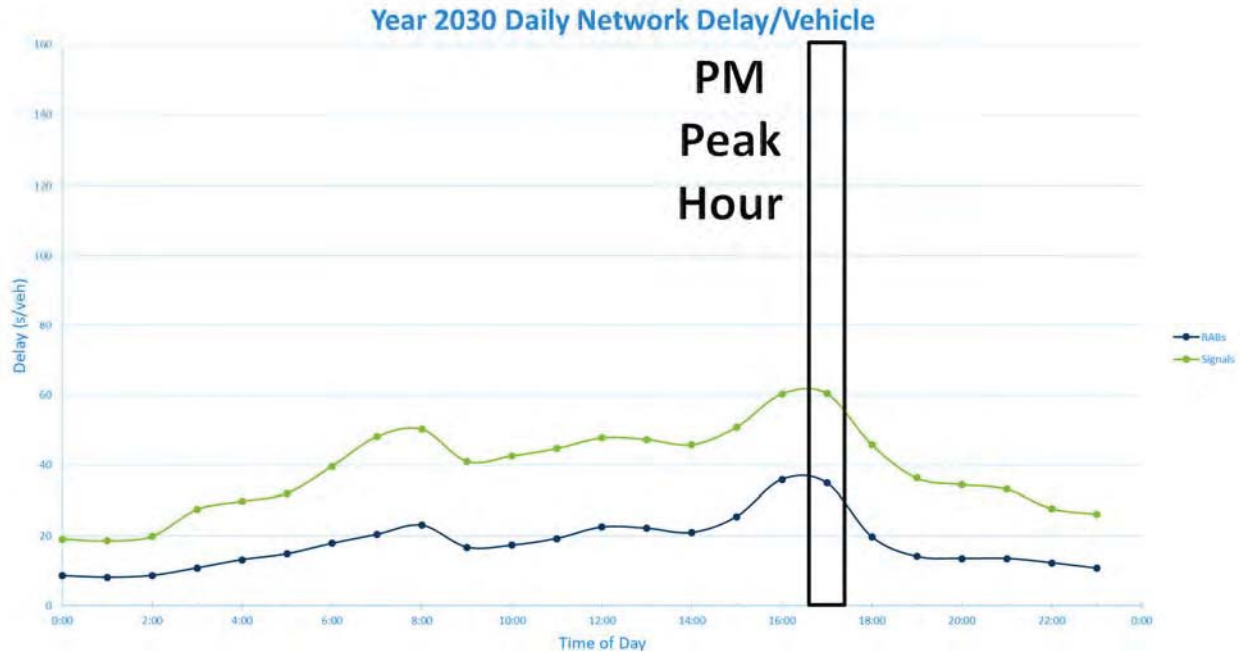


Table 2 - Year 2030 Network and Travel Time Comparison

Comparison	Signals	Roundabout Corridor
Avg Delay	47.1 s/veh	22.6 s/veh (-52%)
Avg NB Travel Time	6.4 m/veh	6.7 m/veh (+5%)
Avg SB Travel Time	6.7 m/veh	6.8 m/veh (+2%)

Year 2045 Daily Network Results

The Year 2045 daily network delay (Figure 14) showed that the roundabout corridor concept had three hours of increased delay around the pm peak hour and was over twice the delay of the signalized option. However when metering was implemented along the corridor, network delays were only slightly over the signalized corridor for the peak hour and showed a 35 percent improvement in daily vehicle delay per vehicle. Even with metering implemented at the roundabouts, mainline travel times increased by less than 50 seconds compared to the signalized alternative while the daily delay benefit for the metered roundabouts was 35 percent.

Figure 14 - 2045 Network Delay Comparison

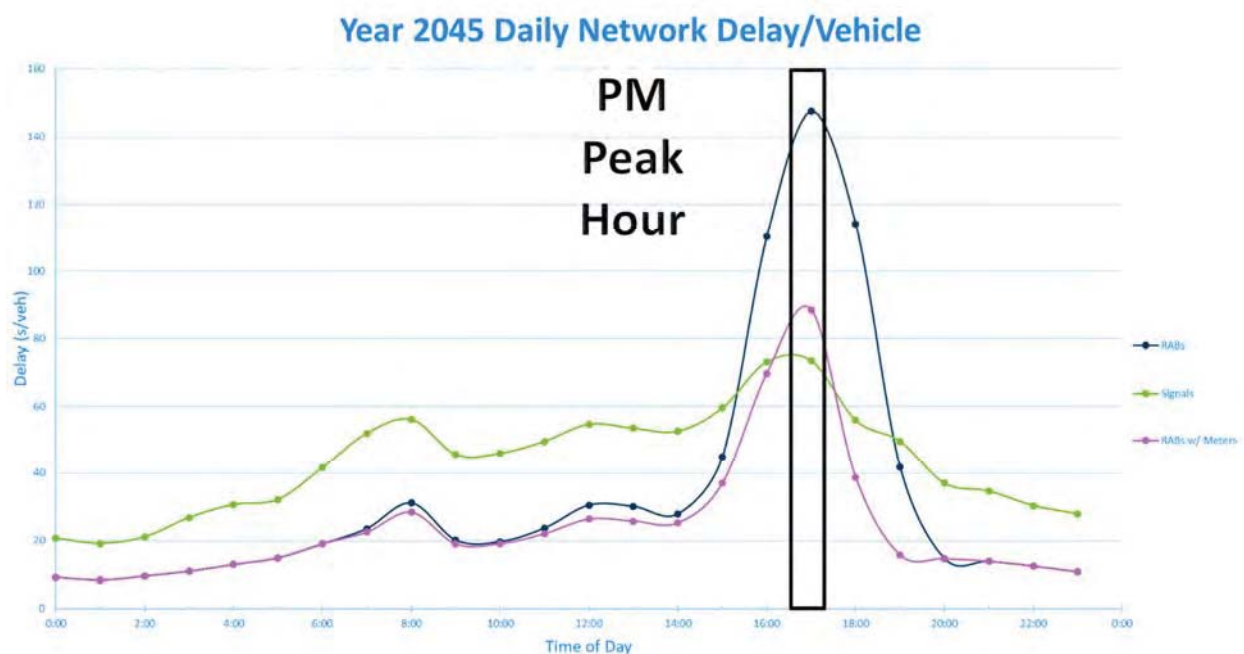


Table 3 - Year 2045 Network and Travel Time Comparison

Comparison	Signals	Roundabout Corridor	RAB with Meters
Avg Vehicle Delay	54.4 s/veh	53.1 s/veh (-2%)	35.1 s/veh (-35%)
Avg NB Travel Time	6.6 m/veh	7.0 m/veh (+6%)	7.4 m/veh (+12%)
Avg SB Travel Time	7.1 m/veh	7.1 m/veh (+0%)	7.4 m/veh (+4%)

Year 2045 Conflict Analysis

A daily conflict analysis was also completed for the Year 2045 daily alternatives to compare future safety. The traffic signals alternative was used as the comparison versus the No Build model that had high latent demand. The roundabout corridors show higher crash rates than the signalized corridor but showed a large decrease in crossing conflicts which are generally severe crashes. Implementing the mainline metering is expected to raise the rear end conflicts along TH 22 so metering should only be implemented when congestion and delay necessitate it to minimize these future conflicts.

Table 4 – 2045 SSAM Conflict Analysis Results

Comparison	Traffic Signal Corridor	Roundabout Corridor	RAB with Meters
Daily Total Conflicts	-	(+11%)	(+39%)
Daily Crossing Conflicts	-	(-33%)	(-53%)
Daily Rear End Conflicts	-	(+12%)	(+109%)
Daily Lane Change Conflicts	-	(+89%)	(+84%)

These results were weighted heavily because of the peak hour congestion, and it is expected that the roundabout corridor will provide less conflicts than the traffic signal corridor throughout the rest of the day. This safety advantage for the roundabout corridor is also expected for the 2030 results as well.

Year 2045 Travel Time Reliability Analysis

Travel time reliability was also analyzed to see if each alternative improved the reliability of travel along the TH 22 corridor. Travel time reliability compares the 80th and 50th percentiles of travel times to assess if travel times are consistent throughout the four-hour peak periods. If the ratio is over 1.5 the corridor is unacceptable for reliability. 2045 results (Table 5) showed that the No Build alternative was unacceptable and all three future alternatives provided an acceptable travel time reliability.

Table 5 – Level of Travel Time Reliability Results

No Build		Traffic Signals		Roundabouts		RAB w/ Meters	
NB	SB	NB	SB	NB	SB	NB	SB
1.74 (PM)	1.55 (AM)	1.13 (PM)	1.22 (PM)	1.18 (PM)	1.18 (PM)	1.23 (PM)	1.24 (PM)

Summary

Based on the results of the TH 22 urban corridor analysis a roundabout corridor (except for the US 14 interchange) is recommended for the future vision of the TH 22 corridor. This alternative provides the daily benefit of lower delays per vehicle and provides a safety benefit by limiting the amount of crossing conflicts by 33 to 53 percent along the corridor. The roundabout corridor operates better than the signalized corridor for 24/24 hours in 2030 and 21/24 hours in 2045 minimizing both intersection and network delay along the TH 22 corridor.

The roundabout corridor will operate acceptably with the existing US 14 interchange configuration. In 2045 the interchange was identified as having queuing concerns, but the left turns can be mitigated with signal phasing changes. If the westbound on-ramp continues to show merging issues an Interchange Justification Report (IJR) should be completed to analyze a lengthened merge area or two-lane entrance to US 14. The existing interchange should remain signalized for the foreseeable future until issues arise with queuing that could prompt the diverging diamond to be considered again.

If metering is implemented in 2045 the operational benefit to the corridor would increase to 23/24 hours. While 2045 forecasts appear aggressive and the roundabout alternative shows peak hour failure, the metering provides a viable solution to retrofit the corridor if 2045 volumes are achieved. MnDOT should continue recommending roundabout options along the corridor that are designed for 2x1 opening day design (if applicable) but flexibility to be expanded to full 2x2 roundabouts in the future when development volumes necessitate the improvement.

Table 6 – Final Intersection Recommendations

Intersection	Existing Traffic Control	2030 Traffic Control	2045 Traffic Control
TH 22 and Blue Earth CSAH 26	Traffic Signal	Hybrid 2x1 RAB	Hybrid 2x1 RAB
TH 22 and Augusta Drive	Two-way Stop	Hybrid 2x1 RAB	Multilane RAB
TH 22 and N Victory Drive	Traffic Signal	Multilane RAB	Multilane RAB*
TH 22 and North US 14 Ramps	Traffic Signal	Traffic Signal	Traffic Signal
TH 22 and South US 14 Ramps	Traffic Signal	Traffic Signal	Traffic Signal
TH 22 and Adams Street	Multilane RAB	Multilane RAB	Multilane RAB*
TH 22 and Madison Avenue	Multilane RAB	Multilane RAB	Multilane RAB*
TH 22 and Bassett Drive	Traffic Signal	Multilane RAB	Multilane RAB
TH 22 and Hoffman Road	Traffic Signal	Multilane RAB	Multilane RAB*
Haefner Drive and Adams Street	Two-way Stop	Hybrid 2x1 RAB	Hybrid 2x1 RAB
Haefner Drive and Madison Avenue	Two-way Stop	Hybrid 2x1 RAB	Hybrid 2x1 RAB

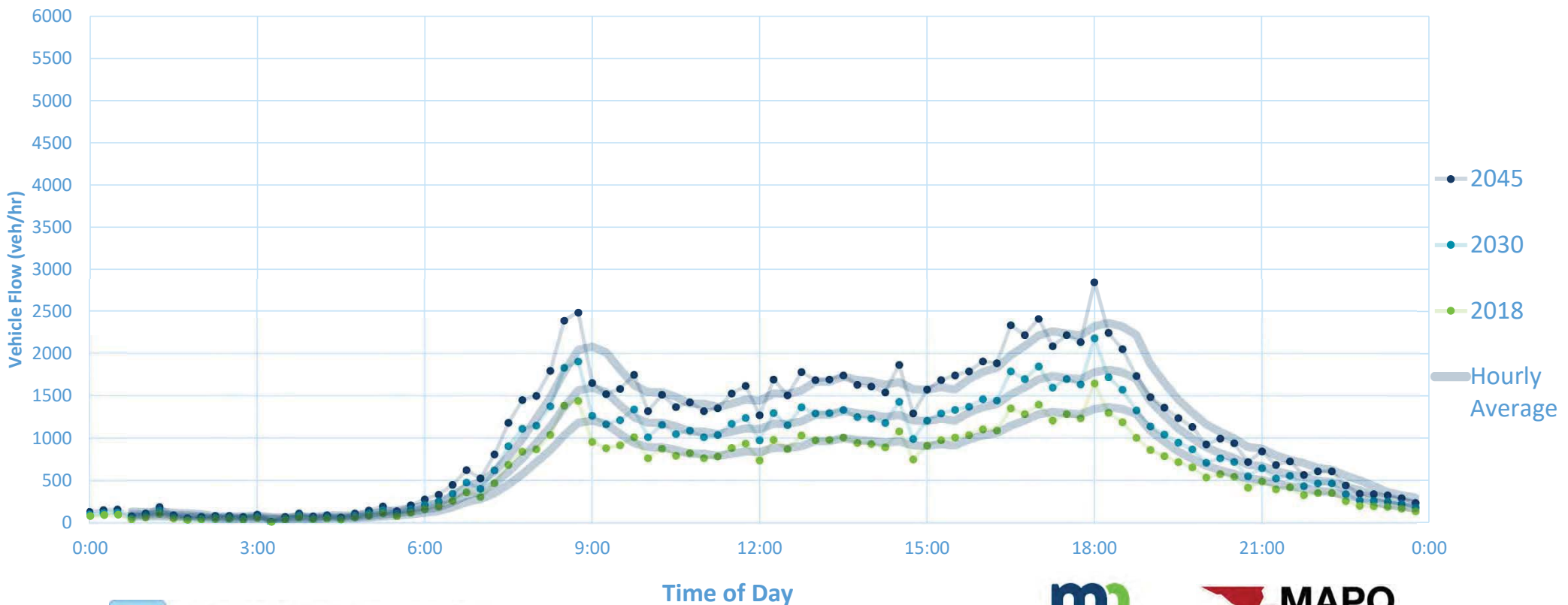
*Note: Metering can be implemented to address minor roadway queuing and delay.

ATTACHMENT A

DAILY VOLUME PROFILES

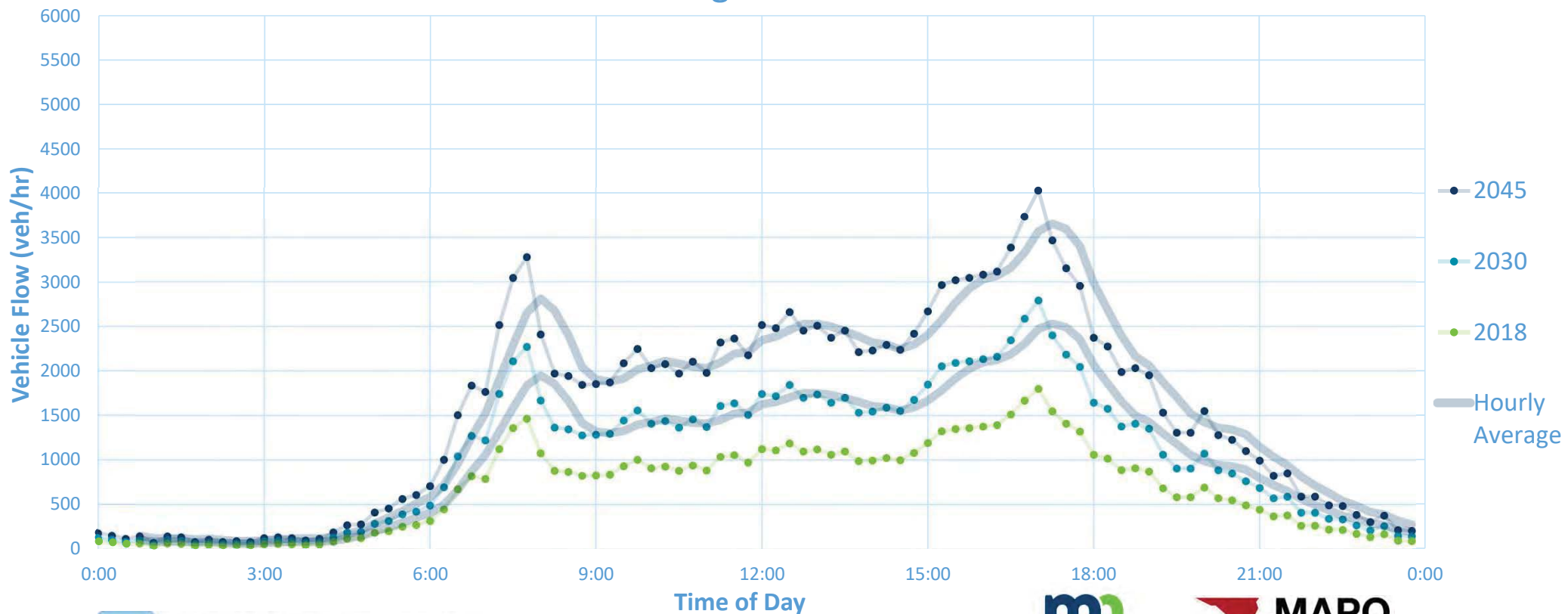
Intersection Volume Comparison

CSAH 26



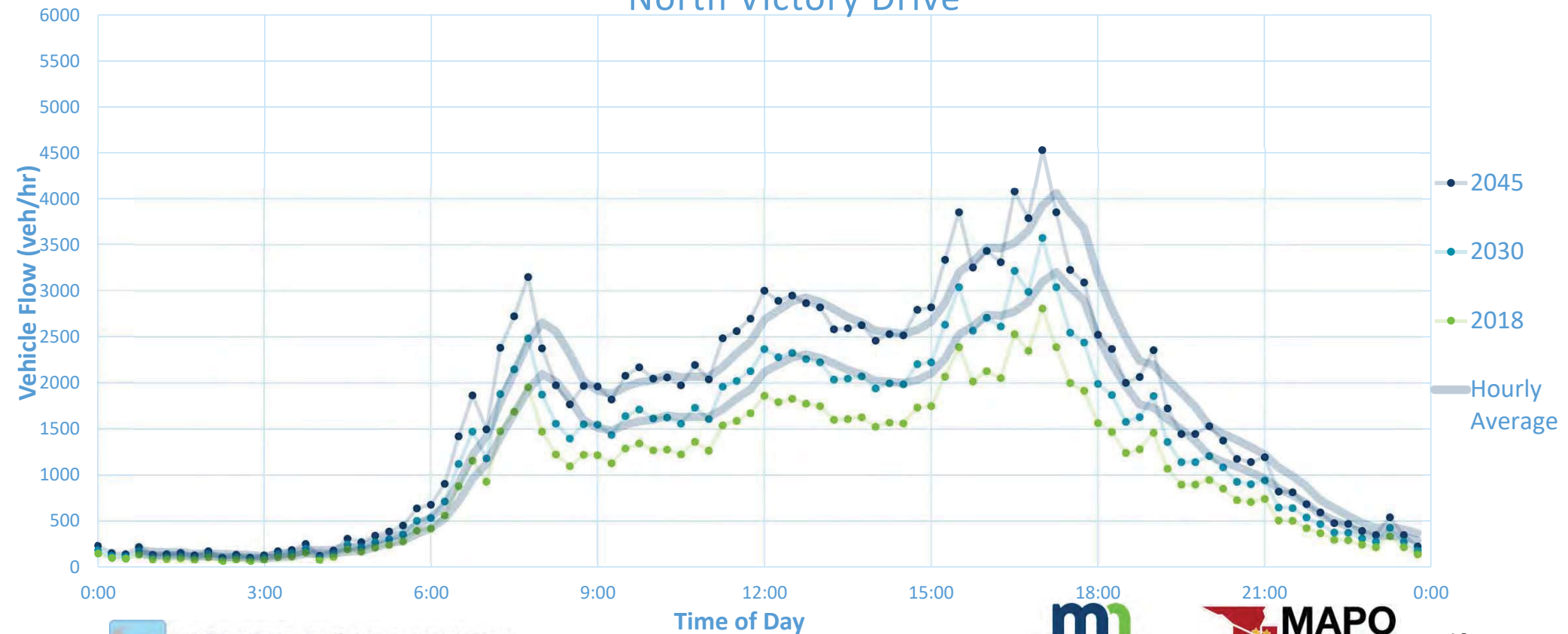
Intersection Volume Comparison

Augusta Drive



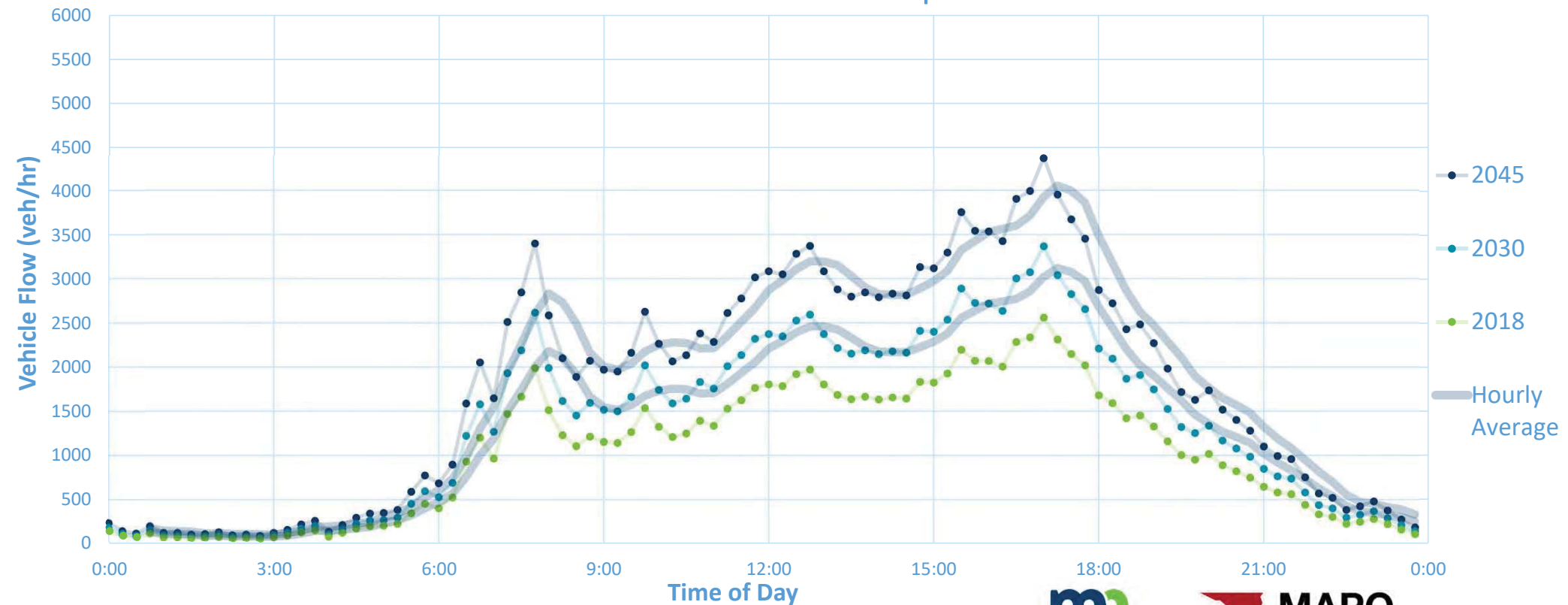
Intersection Volume Comparison

North Victory Drive



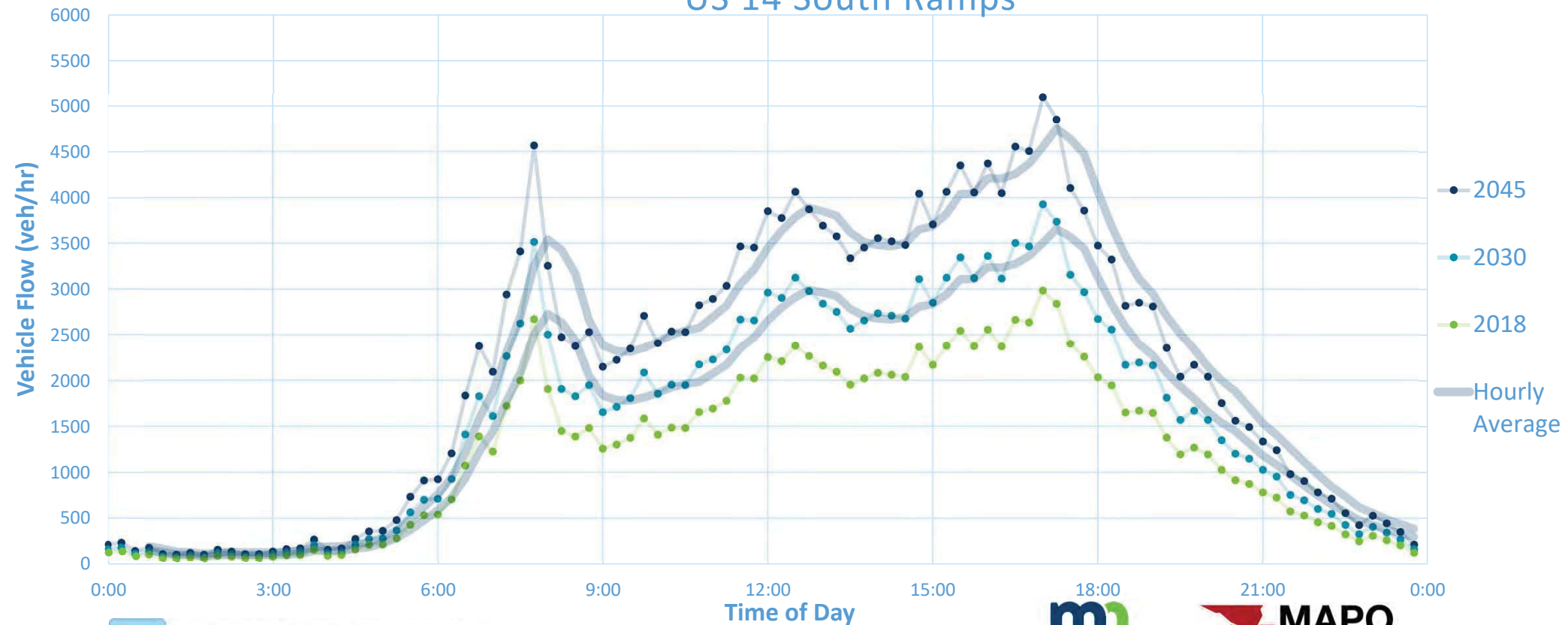
Intersection Volume Comparison

US 14 North Ramps



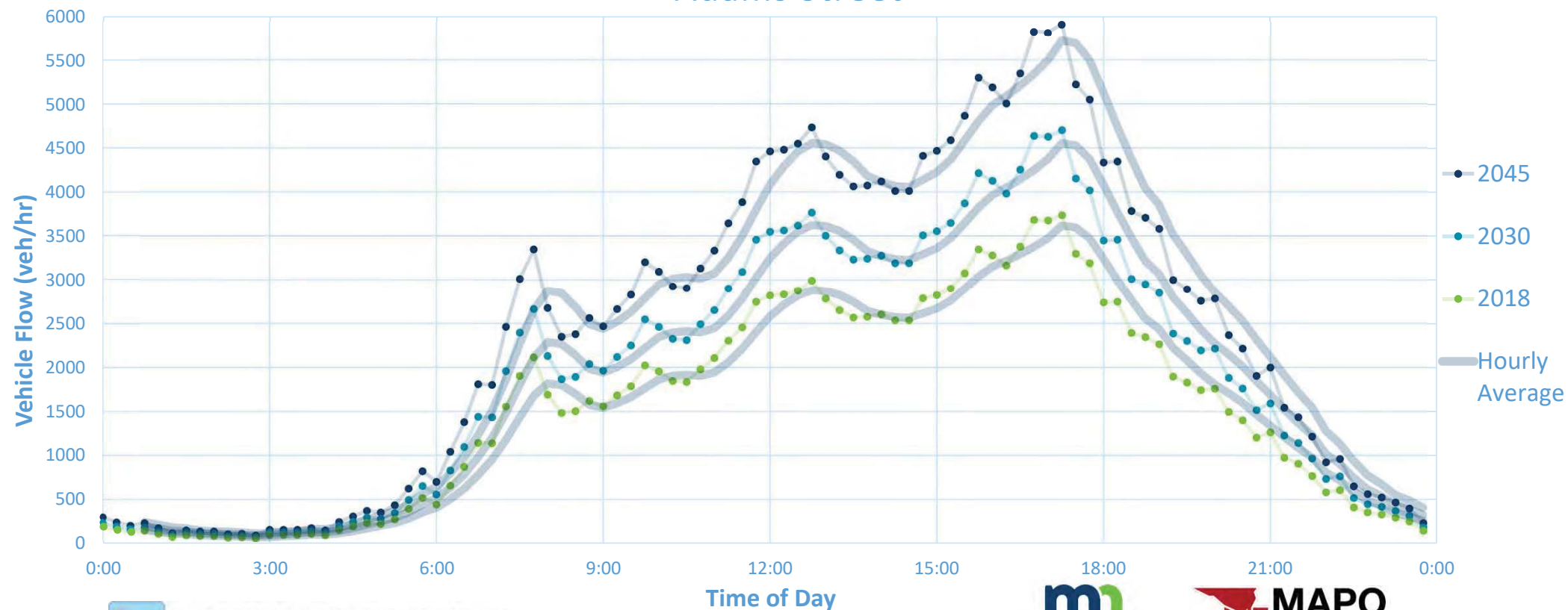
Intersection Volume Comparison

US 14 South Ramps



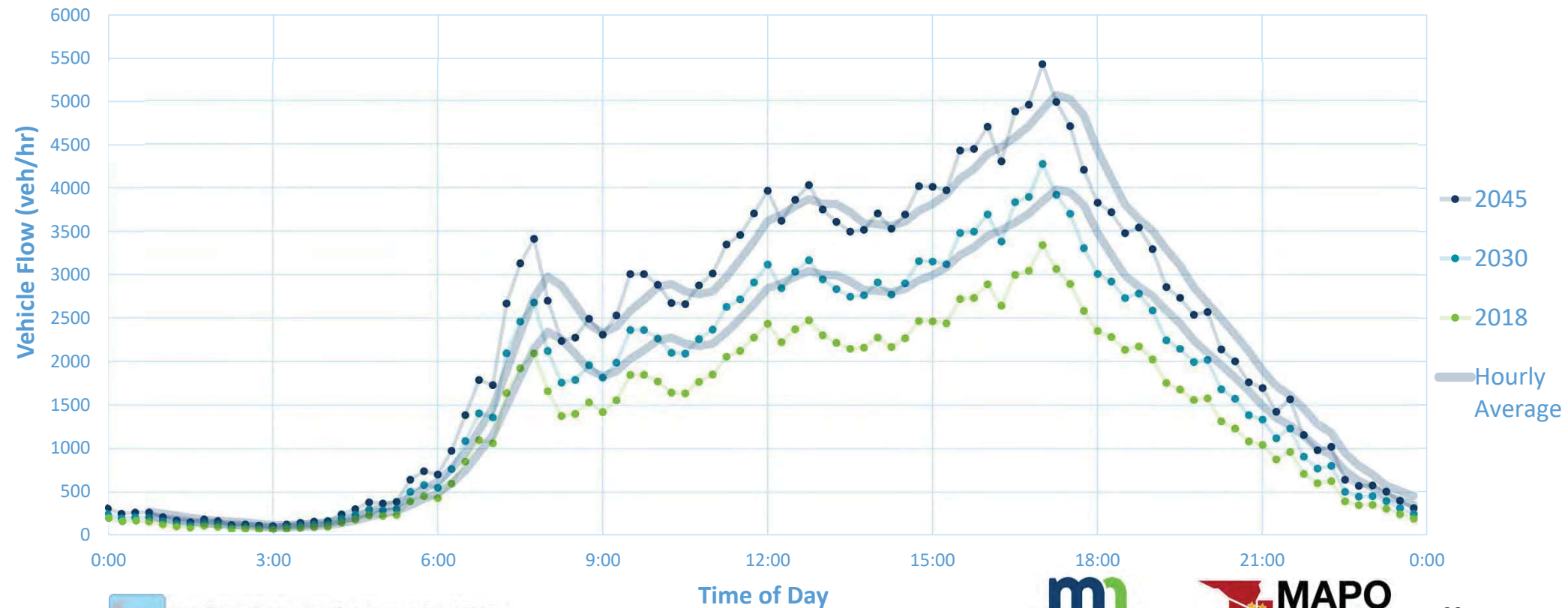
Intersection Volume Comparison

Adams Street



Intersection Volume Comparison

Madison Avenue



HIGHWAY 22 | CORRIDOR STUDY

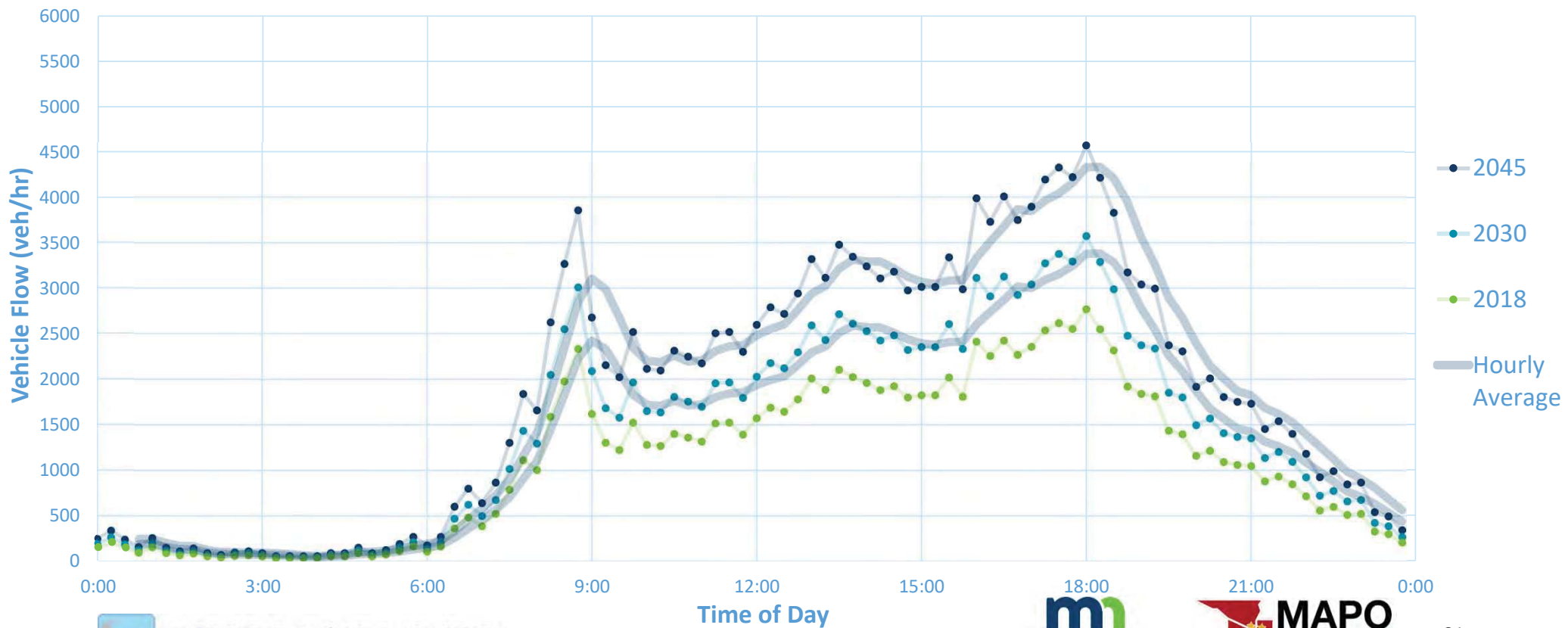
8/27/2018

Time of Day



Intersection Volume Comparison

Bassett Drive



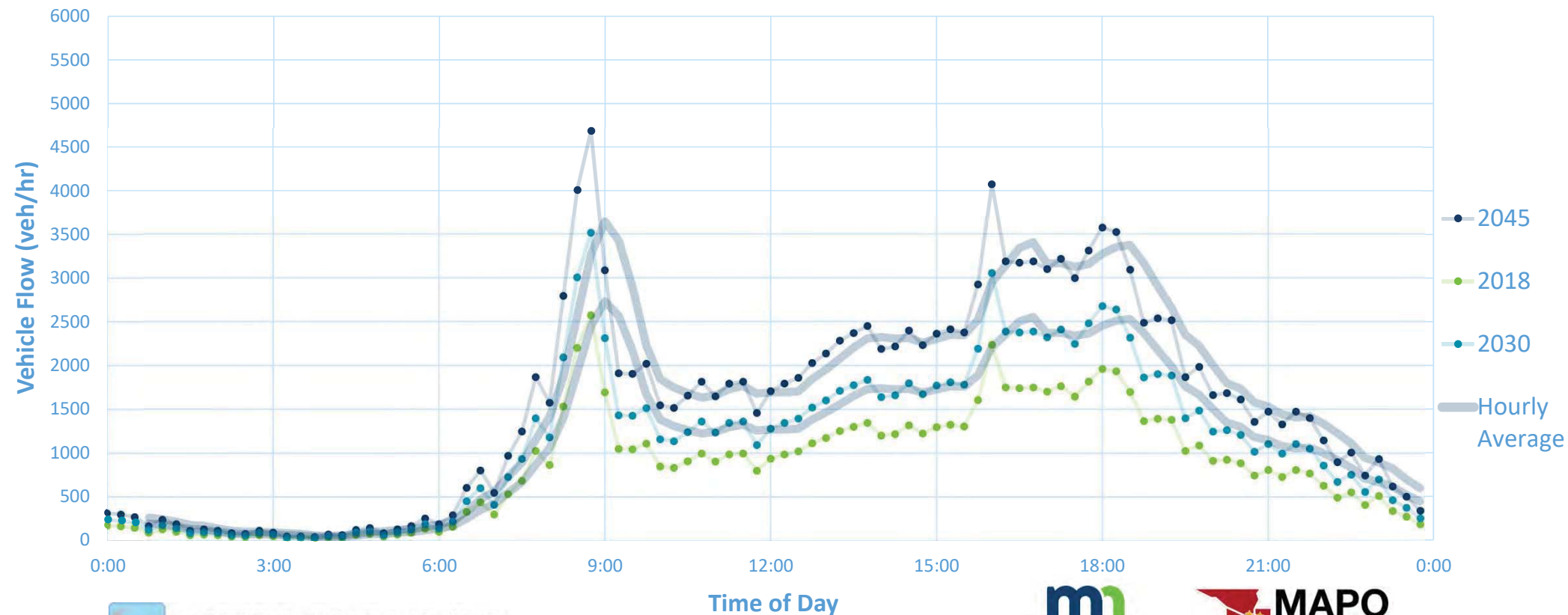
HIGHWAY 22 | CORRIDOR STUDY

8/27/2018



Intersection Volume Comparison

Hoffman Road



ATTACHMENT B

PEAK HOUR RESULTS

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	20 (C)	17 (B)
2045	21 (C)	20 (B)

Augusta Drive

Year	AM	PM
2030	33 (F)	74 (F)
2045	55 (F)	67 (F)

N Victory Drive

Year	AM	PM
2030	27 (C)	36 (D)
2045	29 (C)	39 (D)

US 14 Westbound

Year	AM	PM
2030	16 (B)	21 (C)
2045	17 (B)	23 (C)

US 14 Eastbound

Year	AM	PM
2030	13 (B)	8 (A)
2045	13 (B)	9 (A)

Adams Street

Year	AM	PM
2030	4 (A)	52 (F)
2045	6 (A)	58 (F)

Madison Avenue

Year	AM	PM
2030	6 (A)	36 (E)
2045	9 (A)	49 (E)

Bassett Drive

Year	AM	PM
2030	29 (C)	29 (C)
2045	25 (C)	40 (D)

Hoffman Road

Year	AM	PM
2030	27 (C)	21 (C)
2045	28 (C)	32 (C)

Roundabout

Signal

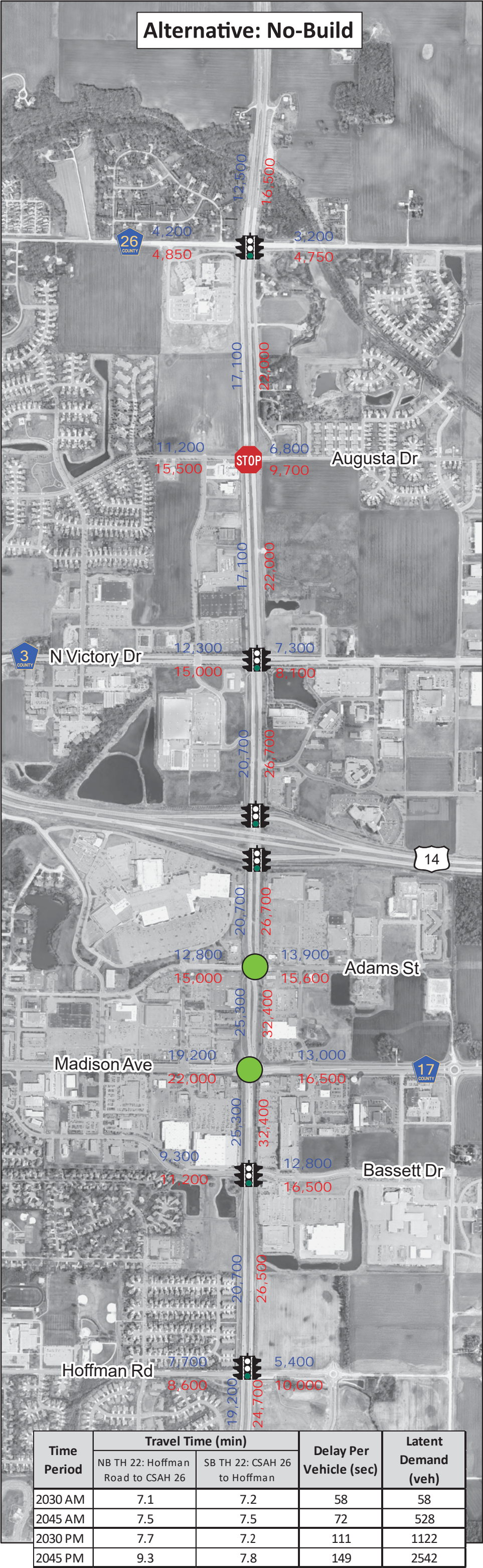
Two-Way Stop Control

10,000

2030 ADT

12,000

2045 ADT



Crash History (2011-2015)

CSAH 26

-Crash rate is below state average

Augusta Drive

-Crash rate is equal to critical crash rate
-15 total crashes
-11 right angle crashes

N Victory Drive

-Crash rate is above state average
-27 total crashes
-11 rear-end, 7 right-angle

US 14 Westbound

-Crash rate is below state average

US 14 Eastbound

-Crash rate is below state average

Adams Street

-3 times the number of crashes after roundabout implementation
-Only one injury crash with roundabout

Madison Avenue

-3 times the number of crashes after roundabout implementation
-8 injury crashes (no serious injuries)

Bassett Drive

-Crash rate is above critical crash rate
-46 total crashes
-21 rear-end, 9 right-angle

Hoffman Road

-Crash rate is above state average
-26 total crashes
-12 rear-end, 5 sideswipe

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	21 (C)	18 (B)
2045	23 (C)	20 (B)

Augusta Drive

Year	AM	PM
2030	14 (B)	20 (B)
2045	18 (C)	31 (C)

N Victory Drive

Year	AM	PM
2030	26 (C)	35 (C)
2045	28 (C)	36 (D)

US 14 Westbound

Year	AM	PM
2030	18 (B)	21 (C)
2045	20 (B)	22 (C)

US 14 Eastbound

Year	AM	PM
2030	13 (B)	8 (A)
2045	14 (B)	10 (A)

Adams Street

Year	AM	PM
2030	15 (B)	29 (C)
2045	15 (B)	33 (C)

Madison Avenue

Year	AM	PM
2030	26 (C)	35 (D)
2045	28 (C)	43 (D)

Bassett Drive

Year	AM	PM
2030	21 (C)	32 (D)
2045	24 (C)	41 (D)

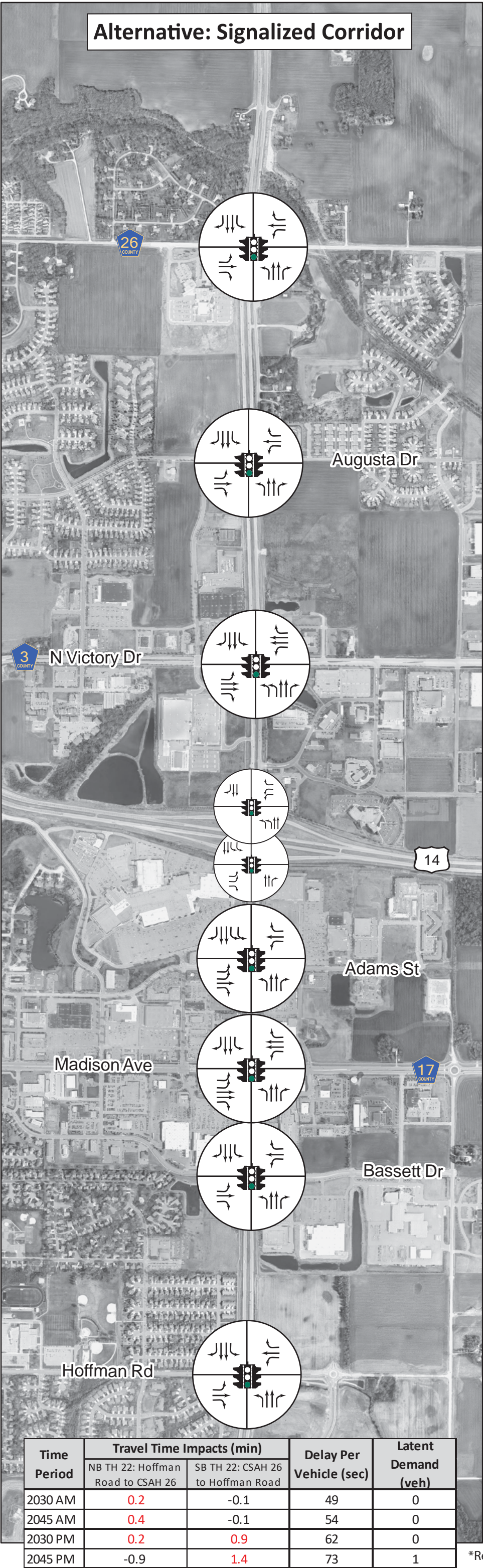
Hoffman Road

Year	AM	PM
2030	26 (C)	25 (C)
2045	29 (C)	33 (C)



Signal

Alternative: Signalized Corridor



Time Period	Travel Time Impacts (min)		Delay Per Vehicle (sec)	Latent Demand (veh)
	NB TH 22: Hoffman Road to CSAH 26	SB TH 22: CSAH 26 to Hoffman Road		
2030 AM	0.2	-0.1	49	0
2045 AM	0.4	-0.1	54	0
2030 PM	0.2	0.9	62	0
2045 PM	-0.9	1.4	73	1

*Red text indicates travel time increase

Change in Vehicle Conflicts

Signal Corridor Was Used to Establish Baseline for Vehicle Conflicts Analysis

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	5 (A)	4 (A)
2045	12 (B)	6 (A)

Augusta Drive

Year	AM	PM
2030	5 (A)	8 (A)
2045	8 (A)	20 (C)

N Victory Drive

Year	AM	PM
2030	5 (A)	79 (F)
2045	7 (A)	233 (F)

US 14 Westbound

Year	AM	PM
2030	9 (A)	45 (E)
2045	25 (D)	92 (F)

US 14 Eastbound

Year	AM	PM
2030	4 (A)	3 (A)
2045	4 (A)	4 (A)

Adams Street

Year	AM	PM
2030	3 (A)	14 (B)
2045	4 (A)	49 (E)

Madison Avenue




Year	AM	PM
2030	4 (A)	13 (C)
2045	6 (A)	62 (F)

Bassett Drive

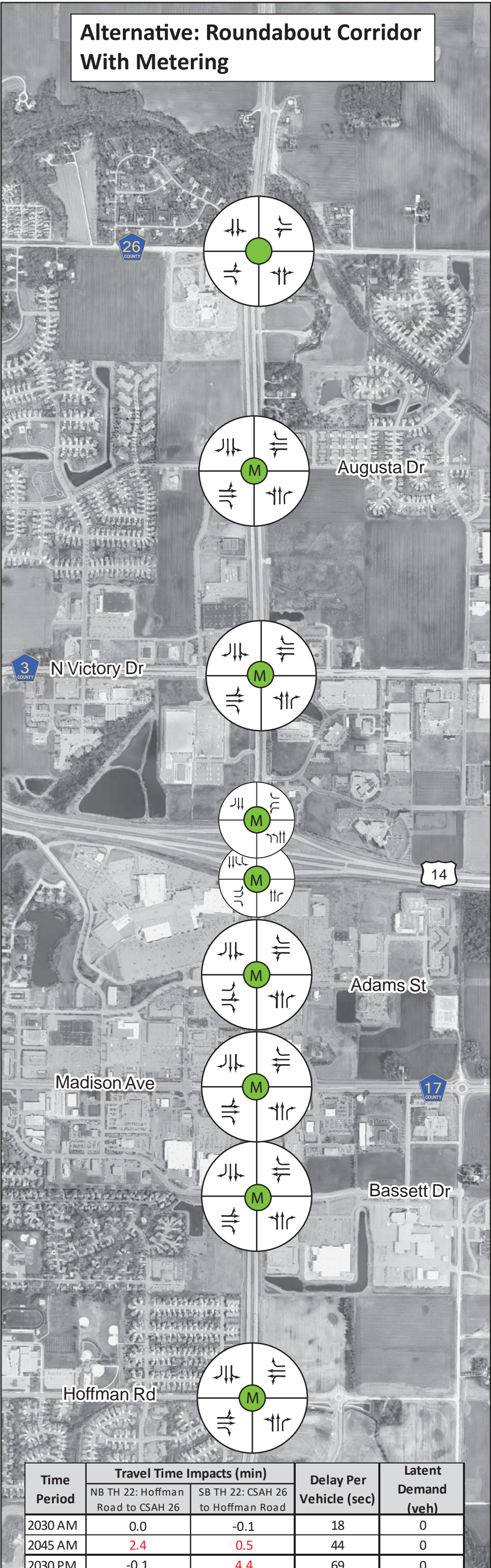
Year	AM	PM
2030	5 (A)	23 (C)
2045	8 (A)	58 (F)

Hoffman Road

Year	AM	PM
2030	7 (A)	13 (B)
2045	67 (F)	58 (F)

-  Roundabout
-  Roundabout
(Metered in PM Peak)
-  Signal

Alternative: Roundabout Corridor
With Metering



Time Period	Travel Time Impacts (min)		Delay Per Vehicle (sec)	Latent Demand (veh)
	NB TH 22: Hoffman Road to CSAH 26	SB TH 22: CSAH 26 to Hoffman Road		
2030 AM	0.0	-0.1	18	0
2045 AM	2.4	0.5	44	0
2030 PM	-0.1	4.4	69	0
2045 PM	1.8	12.4	179	348

Change in
Vehicle Conflicts

CSAH 26

Year	AM	PM
2030	-60%	-22%
2045	-49%	-31%

Augusta Drive

Year	AM	PM
2030	-35%	-22%
2045	-29%	-2%

N Victory Drive

Year	AM	PM
2030	-42%	+37%
2045	-40%	+61%

US 14 Westbound

Year	AM	PM
2030	-37%	+6%
2045	-24%	+1%

US 14 Eastbound

Year	AM	PM
2030	-29%	+4%
2045	-25%	-13%

Adams Street

Year	AM	PM
2030	-10%	+74%
2045	+1%	+92%

Madison Avenue

Year	AM	PM
2030	-37%	+51%
2045	-33%	+152%

Bassett Drive

Year	AM	PM
2030	-36%	+20%
2045	-31%	+50%

Hoffman Road

Year	AM	PM
2030	-46%	+10%
2045	+7%	+42%

Legend:
Conflicts:
-34% - Reduction in Total Conflicts Compared to Signal Corridor
+22% - Increase in Total Conflicts Compared to Signal Corridor

*Red text indicates travel time increase

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	5 (A)	4 (A)
2045	12 (B)	6 (A)

Augusta Drive

Year	AM	PM
2030	5 (A)	8 (A)
2045	8 (A)	21 (C)

N Victory Drive

Year	AM	PM
2030	5 (A)	79 (F)
2045	7 (A)	225 (F)

US 14 Westbound

Year	AM	PM
2030	9 (A)	45 (E)
2045	25 (D)	96 (F)

US 14 Eastbound

Year	AM	PM
2030	4 (A)	3 (A)
2045	4 (A)	3 (A)

Adams Street

Year	AM	PM
2030	3 (A)	14 (B)
2045	4 (A)	50 (F)

Madison Avenue

Year	AM	PM
2030	4 (A)	13 (C)
2045	6 (A)	67 (F)

Bassett Drive

Year	AM	PM
2030	5 (A)	23 (C)
2045	8 (A)	92 (F)

Hoffman Road

Year	AM	PM
2030	7 (A)	13 (B)
2045	67 (F)	113 (F)

-  Roundabout
-  Signal

Change in
Vehicle Conflicts

CSAH 26

Year	AM	PM
2030	-47%	-15%
2045	-31%	-26%

Augusta Drive

Year	AM	PM
2030	-14%	-22%
2045	-7%	-5%

N Victory Drive

Year	AM	PM
2030	-25%	+30%
2045	-19%	+62%

US 14 Westbound

Year	AM	PM
2030	-21%	+10%
2045	-19%	+5%

US 14 Eastbound

Year	AM	PM
2030	-11%	+8%
2045	-3%	-17%

Adams Street

Year	AM	PM
2030	+31%	+76%
2045	+49%	+44%

Madison Avenue

Year	AM	PM
2030	+10%	+67%
2045	+13%	+82%

Bassett Drive

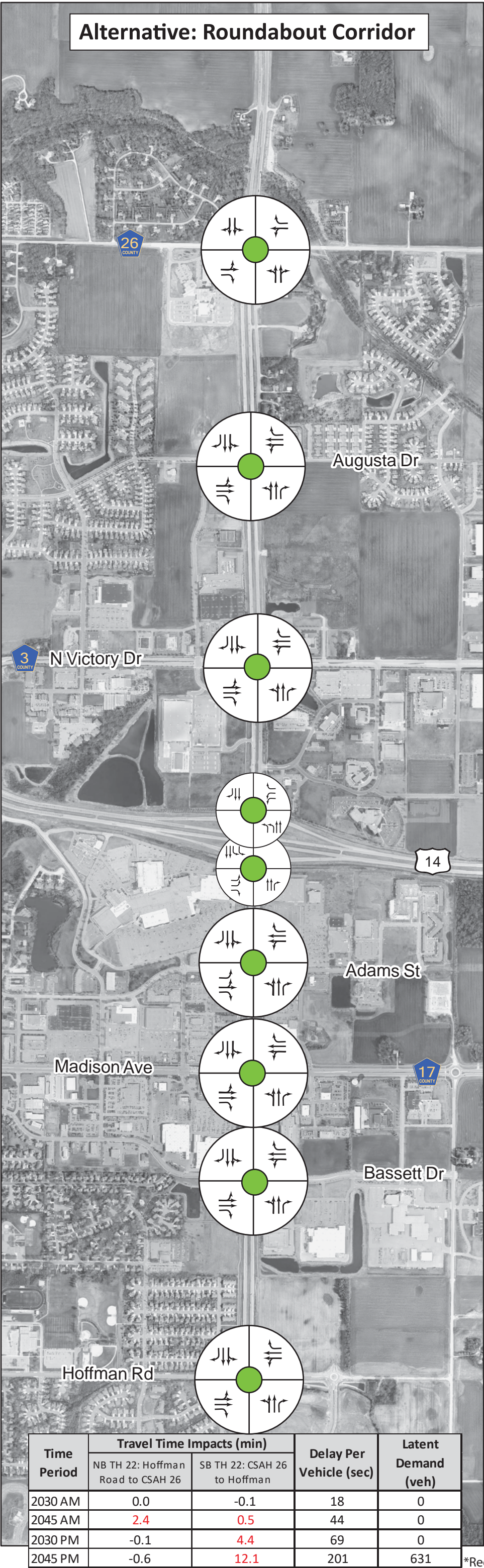
Year	AM	PM
2030	-19%	+18%
2045	-11%	+49%

Hoffman Road

Year	AM	PM
2030	-31%	+11%
2045	+31%	+42%

Legend:
Conflicts:
-34% - Reduction in Total Conflicts Compared to Signal Corridor
+22% - Increase in Total Conflicts Compared to Signal Corridor

*Red text indicates travel time increase



Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	20 (C)	18 (B)
2045	23 (C)	20 (C)

Augusta Drive

Year	AM	PM
2030	22 (C)	27 (C)
2045	28 (C)	38 (D)

N Victory Drive

Year	AM	PM
2030	20 (C)	33 (C)
2045	22 (C)	35 (D)

US 14 Westbound

Year	AM	PM
2030	26 (C)	28 (C)
2045	27 (C)	30 (C)

US 14 Eastbound

Year	AM	PM
2030	19 (B)	32 (C)
2045	21 (C)	49 (D)

Adams Street

Year	AM	PM
2030	8 (A)	48 (E)
2045	8 (A)	115 (F)

Madison Avenue

Year	AM	PM
2030	9 (A)	21 (C)
2045	11 (A)	114 (F)

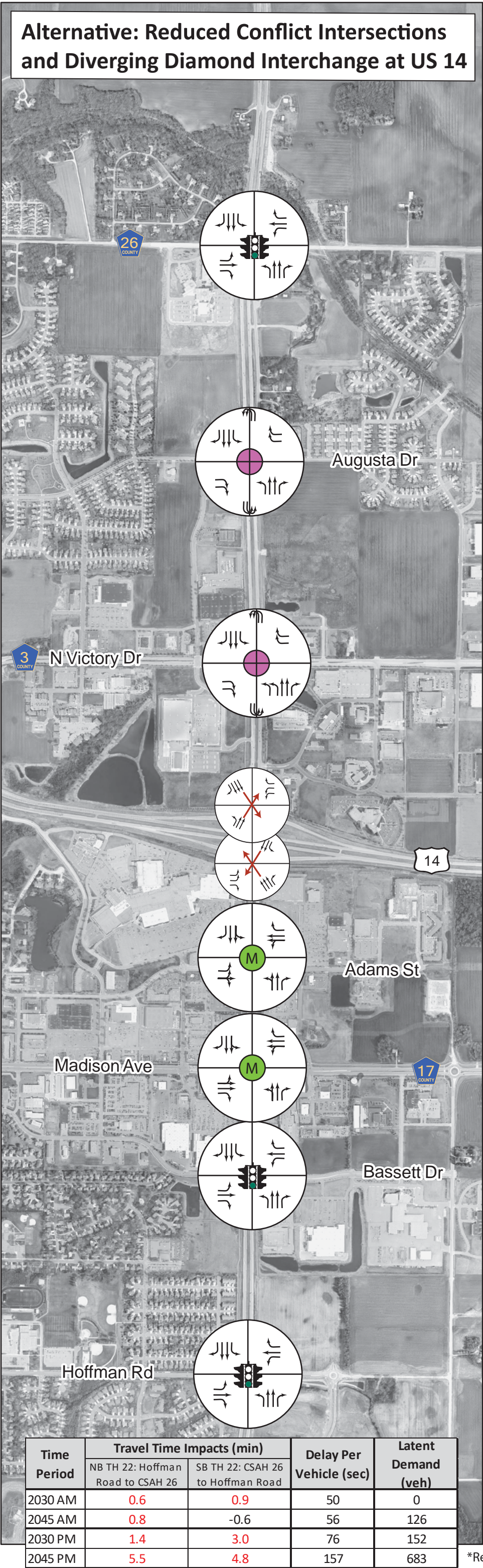
Bassett Drive

Year	AM	PM
2030	31 (C)	30 (C)
2045	25 (C)	60 (E)

Hoffman Road

Year	AM	PM
2030	25 (C)	22 (C)
2045	28 (C)	39 (D)

Alternative: Reduced Conflict Intersections and Diverging Diamond Interchange at US 14



Change in Vehicle Conflicts

CSAH 26

Year	AM	PM
2030	+2%	-2%
2045	+2%	-8%

Augusta Drive

Year	AM	PM
2030	+32%	+33%
2045	+35%	+19%

N Victory Drive

Year	AM	PM
2030	+41%	+41%
2045	+33%	+26%

US 14 Westbound

Year	AM	PM
2030	+83%	+89%
2045	+54%	+105%

US 14 Eastbound

Year	AM	PM
2030	+113%	+243%
2045	+120%	+225%

Adams Street

Year	AM	PM
2030	+206%	+120%
2045	+215%	+113%

Madison Avenue

Year	AM	PM
2030	+103%	+73%
2045	+112%	+142%

Bassett Drive

Year	AM	PM
2030	+13%	-2%
2045	-3%	+25%

Hoffman Road

Year	AM	PM
2030	+3%	-5%
2045	-1%	+8%

Legend:
Conflicts:
-34% - Reduction in Total Conflicts Compared to Signal Corridor
+22% - Increase in Total Conflicts Compared to Signal Corridor
*Red text indicates travel time increase

- Signal
- Roundabout (Metered in PM Peak)
- Signalized RCI
- Diverging Diamond Interchange

Traffic Operations

Legend:
Traffic Operations:
6 (A) - Seconds of Delay per Vehicle (LOS)

CSAH 26

Year	AM	PM
2030	21 (C)	17 (B)
2045	22 (C)	20 (B)

Augusta Drive

Year	AM	PM
2030	22 (C)	33 (C)
2045	27 (C)	36 (D)

N Victory Drive

Year	AM	PM
2030	21 (C)	34 (C)
2045	22 (C)	36 (D)

US 14 Westbound

Year	AM	PM
2030	16 (B)	21 (C)
2045	18 (B)	22 (C)

US 14 Eastbound

Year	AM	PM
2030	12 (B)	8 (A)
2045	13 (B)	15 (B)

Adams Street

Year	AM	PM
2030	4 (A)	33 (D)
2045	6 (A)	54 (F)

Madison Avenue




Year	AM	PM
2030	5 (A)	16 (C)
2045	8 (A)	45 (E)

Bassett Drive

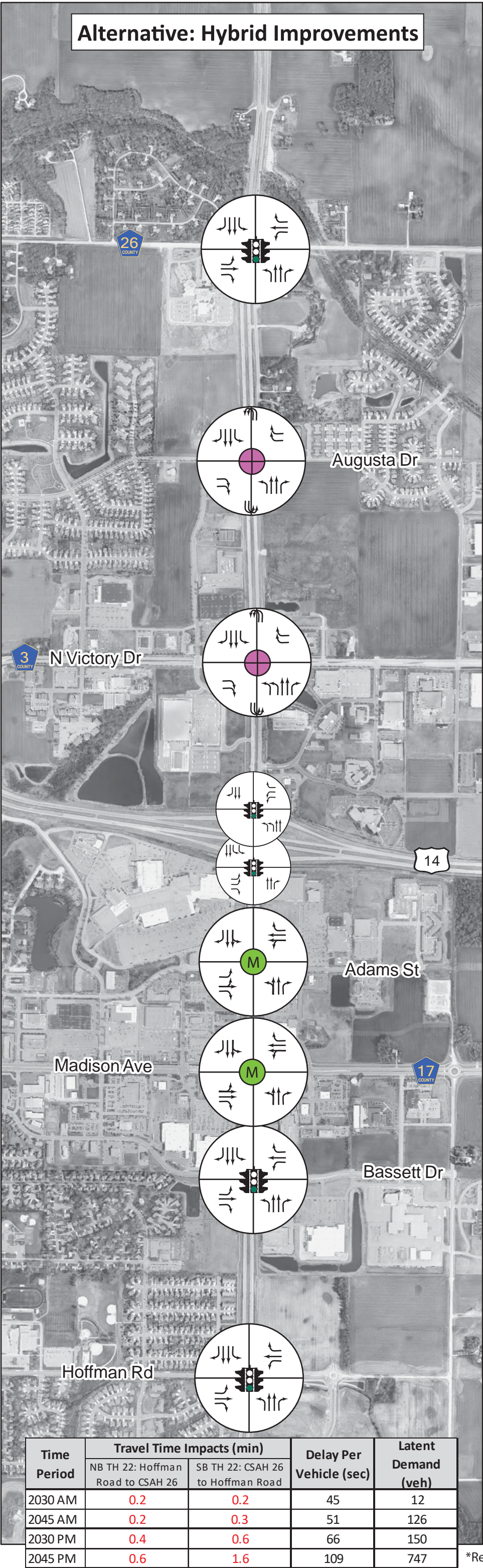
Year	AM	PM
2030	29 (C)	29 (C)
2045	25 (C)	43 (D)

Hoffman Road

Year	AM	PM
2030	26 (C)	22 (C)
2045	28 (C)	29 (C)

-  Signal
-  Roundabout
(Metered in PM Peak)
-  Signalized RCI

Alternative: Hybrid Improvements



Change in Vehicle Conflicts

CSAH 26

Year	AM	PM
2030	+2%	+2%
2045	+3%	-8%

Augusta Drive

Year	AM	PM
2030	+35%	+30%
2045	+30%	+21%

N Victory Drive

Year	AM	PM
2030	+36%	+37%
2045	+27%	+21%

US 14 Westbound

Year	AM	PM
2030	-13%	+6%
2045	-15%	+1%

US 14 Eastbound

Year	AM	PM
2030	-14%	-8%
2045	-10%	+33%

Adams Street

Year	AM	PM
2030	+86%	+78%
2045	+103%	+86%

Madison Avenue

Year	AM	PM
2030	+44%	+52%
2045	+54%	+75%

Bassett Drive

Year	AM	PM
2030	+7%	-3%
2045	-5%	-8%

Hoffman Road

Year	AM	PM
2030	-3%	-7%
2045	-2%	-9%

Legend:
Conflicts:
-34% - Reduction in Total Conflicts Compared to Signal Corridor
+22% - Increase in Total Conflicts Compared to Signal Corridor

*Red text indicates travel time increase