Strand Associates, Inc.®
910 West Wingra Drive
Madison, WI 53715
(P) 608-251-4843
(F) 608-251-8655

TECHNICAL MEMORANDUM

To: Tony Kemnitz, P.E., PTOE
Wisconsin Department of Transportation-North Central Region Traffic Safety Engineer

From: Joe Urban, P.E., Strand Associates, Inc.®

Date: March 29, 2018

Re: WisDOT Project ID 0656-43-04
STH 29 Safety Study
STH 49, CTH J, CTH D, CTH U, CTH MMM, and CTH F
Marathon and Shawano County
Roadway Safety Review Report

Dear Tony,

Enclosed for your review is the Roadway Safety Review Report for the STH 29 Safety Study in Marathon and Shawano Counties. This report summarizes the methodology and results of five Phase I: Scoping Level Intersection Control Evaluation (ICE) Reports in addition to a review of the STH 29 and STH 49/Willow Drive intersection and its segment from STH 49 to CTH OO.

Section 1: Background

Strand Associates, Inc.® (Strand) completed an analysis of the six study locations that included intersections and/or roadway segments along STH 29. The project location map for the STH 29 Safety Study is shown in Figure 1.

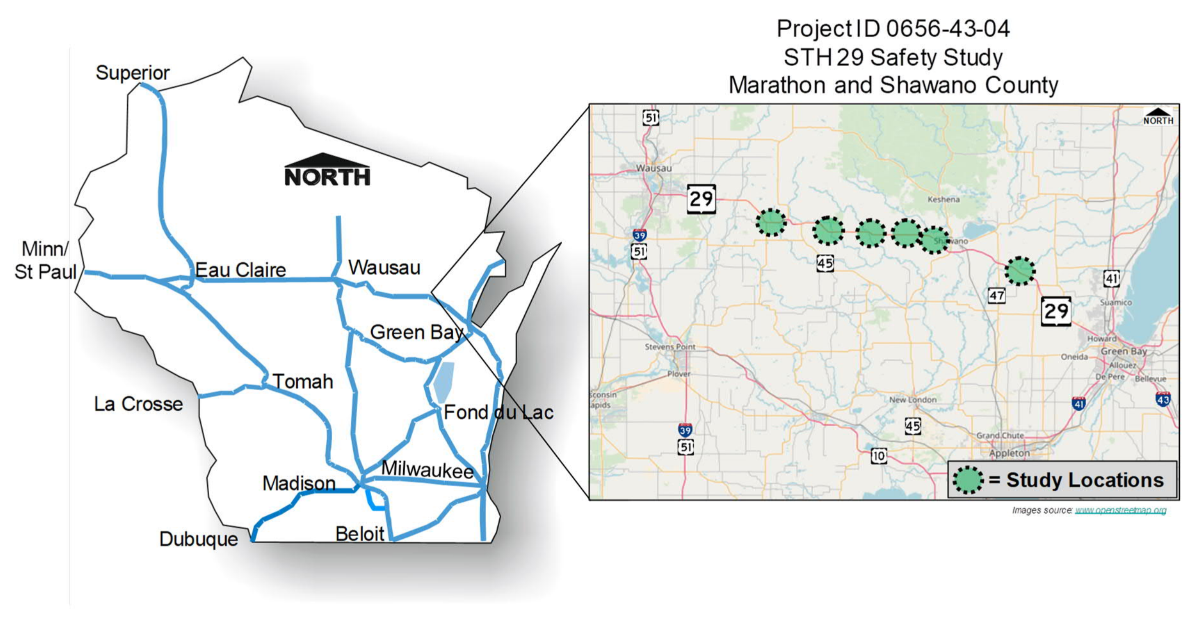


Figure 1 Project Location Map–STH 29 Safety Study

Following is a list of the study intersections and segments studied, which are shown in Figure 2:

1. STH 29 and STH 49/Willow Drive (referred to as STH 49) in Marathon County and its segment from STH 49 to CTH OO.
2. STH 29 and CTH J in Shawano County and its segment from CTH J to Fink Road.
3. STH 29 and CTH D/Rock Road (referred to as CTH D) in Shawano County.
4. STH 29 and CTH U in Shawano County and its segment from CTH U to Kroenke Creek Road.
5. STH 29 and CTH MMM/Clark Drive (referred to as CTH MMM) in Shawano County and its segment from CTH MMM to CTH M.
6. STH 29 and CTH F in Shawano County.

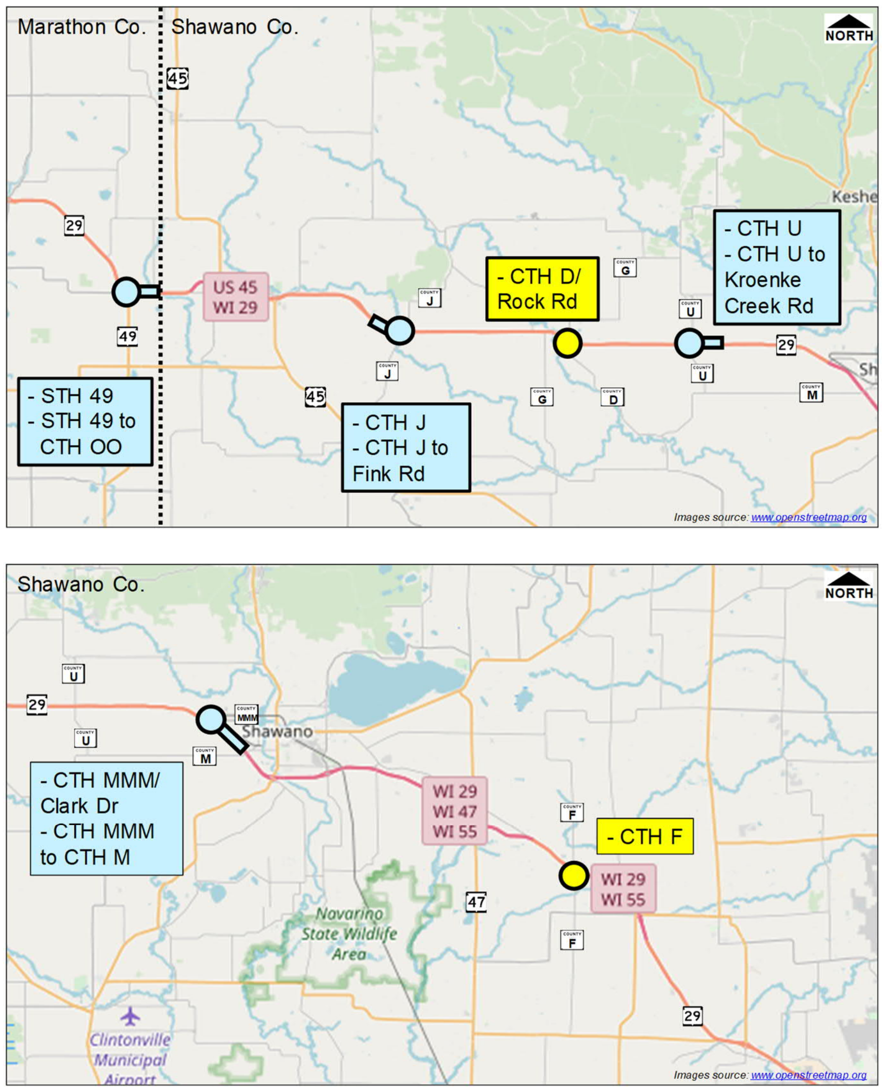


Figure 2 STH 29 Study Intersections and Segments

STH 29 is currently a four-lane divided expressway with a posted speed limit of 65 miles per hour (mph) at each of the study locations. Each of the crossroads are typically two-lane rural roadways with two-way-stop control at their junction with STH 29. STH 29 is part of the National Highway System (NHS)[1] and provides an NHS east-west link between Green Bay (to the east) and Wausau and Eau Claire (to the west). STH 29 is also a state-designated truck route and is identified in the *Corridors 2030 State Highway Plan* as a Backbone Route serving the Wisconsin Heartland Corridor[2].

In 2010, an Environmental Assessment (EA) was completed by the Wisconsin Department of Transportation (WisDOT) for STH 29 in Shawano County from US 45 North to the Shawano/Brown County line. The EA was an exercise in right-of-way mapping. The preferred alternative from the EA included right-of-way mapping for diamond interchanges at four of the five study intersections (CTH J, CTH U, CTH MMM, and CTH F) in Shawano County. It also included right-of-way mapping for an overpass at the CTH D intersection with a diamond interchange at CTH G, located just west of CTH D. At STH 49 in Marathon County, a Road Safety Audit (RSA) was completed in 2013 by Opus International Consultants (Opus) that evaluated short-, medium-, and long-term alternatives for the STH 49 intersection.

The STH 29 Safety Study was initiated to focus on short- to medium-term alternatives that address safety needs at the six study locations. While interchanges may be identified as feasible alternatives in the ICE Reports, they are generally considered long-term alternatives because of the higher costs and impacts anticipated with constructing an interchange. The types of alternatives this study primarily focuses on include access control, offset right-turn lanes, slotted left-turn lanes, J-Turns, and Median U-Turns. The alternatives considered and evaluated are discussed in further detail in this report and within each individual ICE Report. The ICE Reports include discussions on all alternatives considered and identify the most feasible alternatives of those identified by WisDOT NC Region and the study team.

Section 2: Analysis Methodology

The following subsections discuss the analysis methodology used at each of the study intersections. While an ICE Report was not part of the study's scope for the STH 49 intersection and its segment from STH 49 to CTH OO, the analysis methodology was similar to that of the ICE Report analysis.

A. Traffic Counts and Forecasts

Turning movement counts were collected for six hours (three hours in both the AM and PM peak periods) at the six study intersections between June 20 and June 22, 2017. Sketches of the intersection and observations from the field counts are included in each ICE Report.

Traffic volume forecasts were completed by the WisDOT Central Office Traffic Forecasting Section (TFS) on July 13, 2017, for the six study intersections. Peak-hour turning movement forecasts were provided for each study intersection for 2020, 2030, and 2040 horizon year volumes. WisDOT TFS also provided mainline average annual daily traffic (AADT) traffic forecasts for the STH 29 corridor. The Northeast Region Travel Demand Model and the Marathon County Travel Demand

[1] Wisconsin NHS Map: https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/wisconsin/wi_Wisconsin.pdf. Accessed 1/18/2018.

[2] Connections 2030 Plan: http://wisconsindot.gov/Documents/projects/multimodal/conn2030/maps/heartland.pdf. Accessed 1/18/2018.

Model were used in developing the traffic forecasts. Two considerations relating to the magnitude of the intersection traffic volumes follow.

1. The study team found that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study does applies a 9 percent seasonal adjustment; however, the slightly higher unadjusted base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and alternatives. For this reason, a sensitivity analysis using WisDOT forecast volumes was performed for the No-Build alternative to better understand the operational need at each intersection.

2. At CTH J, construction activities were occurring during the June 2017 traffic counts; however, the study team believes that this did not have a major impact on turning movement volumes because there are few nearby parallel routes for traffic to divert to during construction. The intersection remained open with full access for all movements at the time of the traffic counts, and high mobility along STH 29 was maintained during the peak hours (e.g., minimal delays). From mid-July to mid-October 2017, CTH J was closed north of STH 29 for reconstruction.

Table 1 provides a summary of the projected 2020 construction year and 2040 design year daily traffic volumes at each intersection.

STH 29 Intersection	Year	Average Annual Daily Traffic Volume (vehicles per day)			
		East Leg	West Leg	North Leg	South Leg
STH 49/ Willow Drive	2020	12,100	10,100	70	2,200
	2040	14,600	12,400	80	2,500
CTH J	2020	8,600	7,900	260	840
	2040	12,000	11,100	340	1,100
CTH D/ Rock Rd	2020	9,800	8,700	---	330
	2040	12,700	11,700	---	430
CTH U	2020	11,400	9,800	1,900	500
	2040	14,800	12,700	2,700	700
CTH MMM/ Clark Drive	2020	8,800	---	5,400	350
	2040	11,700	---	6,500	380
CTH F	2020	13,100	13,200	560	---
	2040	16,300	16,900	640	---

Note: Volumes reported from WisDOT Traffic Forecast Report prepared July 13, 2017.

Table 1 STH 29 Study Intersections and Segments

WisDOT traffic forecasts and summary tables describing the growth during the AM and PM peak hours at each of the study intersections are included in Appendix A

B. Traffic Operations Analysis

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT *Facilities Development Manual* (FDM) guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 to use HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers will experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through-movements that receive zero delay are factored into the average.

For alternative intersections, such as the J-Turn or Median U-Turn, LOS is based on the average Experienced Travel Time (ETT) for each movement as it travels through the intersection. The ETT takes into account the extra distance travel time required to travel to and from a U-Turn. The LOS thresholds for alternative intersections are identical to those for conventional signalized intersections. The HCM6 recommends reporting operations for alternative intersections by intersection approach ETT, as well as with an overall weighted average ETT.

For the scope of this study, LOS C was considered to be the limit of acceptable delay for the overall intersection, and for all turning movements or intersection approaches in the case of alternative intersections.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. Traffic volumes were input directly from WisDOT traffic forecasts with no seasonal adjustment or traffic volume balancing performed. For the alternatives, design year 2040 AM and PM peak hour conditions were analyzed and forecasted traffic volumes were redistributed as necessary.

C. Geometric Deficiencies

Strand performed a review of the geometric deficiencies at the intersection based on as-built plans provided by WisDOT; a site visit performed in July 27, 2017; and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Appendix B contains a summary table of each intersection's geometric deficiencies.

During the site visit, intersection site distance was also determined at each intersection using video recordings. A camera was placed at a driver's eye height (3.5 feet) above the ground to record a sample size of approximately 20 vehicles traveling along STH 29. Assuming an average travel speed of 70 mph and the average travel time of observed vehicles to enter and exit the view frame, an intersection sight distance was determined. The ICE Reports of each intersection highlight locations of poor intersection sight distance.

Photographs from the site visit performed in July 2017 are included in each ICE Report.

D. Crash Analysis

Strand performed a crash analysis using the most recent five years of crash data available (2012 to 2016). Strand obtained crash data and reviewed police reports provided by the University of Wisconsin-Madison Traffic Operations and Safety Laboratory to determine intersection crash rates at the six study intersections and four study segments. Total crash rates and severe injury/fatal (KAB) crash rates were determined at each location. Intersection crash diagrams and segment crash diagrams were prepared at each location.

The segment crash rates were calculated as the number of crashes per hundred million vehicle miles traveled (HMVMT). The 65 mph expressway peer group was used for the statewide average crash rates and upper control limit (UCL) calculations. The segment crash rates were compared to the 2012 to 2016 statewide crash rates, which were published on November 14, 2017.

Based on coordination with WisDOT NC Region in January 2018, year 2017 crash data was added to the CTH U intersection analysis to replace the 2012 crash data. At each of the study intersections, 2008 to 2011 and 2017 KAB intersection crashes were reviewed and are noted in the ICE Reports. This additional review provides an indication of the trends at each of the study intersections outside of the individual intersection's five-year analysis period.

In addition to the standard total crash rate and KAB crash rate calculations, WisDOT North Central (NC) Region provided information on the NC Region's Tier 1 Prime List and the statewide Location of Interest Report (LOIR) for each of the study locations.

WisDOT NC Region also has a tiered ranking system to identify crash hot spots. "Tier 1" crash spots are those that have a crash rate over one standard deviation of the mean for a given travel safety class. To further identify priority locations, the NC Region develops a "Tier 1 prime list", which uses a standard deviation of two or greater above the mean. The Tier 1 prime list typically includes 40 to 50 crash spots within the region that have been identified as a top site of concern. The LOIR is a statewide report that identifies top crash sites annually. Locations on the LOIR require a Performance Evaluation Factor of 0.5 instead of the standard 1.0. In other words, locations have a greater chance of qualifying for Highway Safety Improvement Program (HSIP) funds if they are included on the LOIR. Table 2 shows the study locations that have recently appeared on the Tier 1 Prime List or LOIR. It should be noted that the 2012 to 2016 LOIR was not available at the time of this study.

STH 29 Intersection	Crash List	Intersection or Segment	Five-Year Average Period on List
STH 49/ Willow Drive	Tier 1 Prime List	---	---
	LOIR	Segment	2010-2014
CTH J	Tier 1 Prime List	Intersection	2010-2014, 2011-2015, 2012-2016
	LOIR	Intersection, Segment	2011-2015 2009-2013, 2010-2014, 2011-2015
CTH D/ Rock Road	Tier 1 Prime List	Intersection	2010-2014, 2012-2016
	LOIR	Intersection	2011-2015
CTH U	Tier 1 Prime List	Intersection	2010-2014, 2011-2015, 2012-2016
	LOIR	Intersection	2010-2014, 2011-2015
CTH MMM/ Clark Drive	Tier 1 Prime List	Intersection	2010-2014, 2011-2015, 2012-2016
	LOIR	Intersection	2010-2014
CTH F	Tier 1 Prime List	Intersection	2010-2014, 2012-2016
	LOIR	Intersection	2008-2012

Note: The LOIR for 2012 to 2016 was not available during the time of this study.

Table 2 STH 29 Tier 1 Prime List and LOIR Locations

Crash Modification Factors (CMF) were applied to the crash totals to provide a quantitative analysis for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin. The CMF Clearinghouse website is a larger database of CMFs that was also used in the alternatives analysis. The ICE Reports contain more detail on the CMFs used in the analysis and how they were applied.

E. <u>Range of Alternatives Considered</u>

As discussed in Section 1, this study's focus is on short- to medium-term improvements. The goal of Phase I: Scoping Level ICE Reports is to identify the most feasible alternative, or alternatives, to carry forward into Phase II: Alternative Selection ICE Report or into preliminary design. Because this study includes Phase I: Scoping Level ICE Reports, a wide range of alternatives was considered in each report. These alternatives include:

1. Access Control: Restricting one or more turning movements.
2. Closed Median: Converting to right-in/right-out.
3. Turn Lane Improvements: Providing slotted left-turns, offset rights, and/or extending storage distances.
4. Intersection Control: Providing traffic signal, roundabout, or all-way-stop control.
5. Through Roadway Activated Warning System (TRAWS): System used to alert mainline traffic of vehicles approaching from a stop-controlled sideroad.
6. J-Turn: Reroutes sideroad through and left-turn traffic to new mainline U-turn locations. Typically allows direct mainline left-turn access at the primary intersection.

7. Median U-Turn: Reroutes sideroad through and left-turn traffic and mainline left-turn traffic to new mainline U-turn locations. Typically has a smaller footprint than the J-Turn.

8. Diamond Interchanges: Geometrics based on concepts shown in the 2010 EA.

Intersection control was not analyzed in detail for the study intersections to maintain free flow conditions along STH 29. There are no signal, roundabout, or all-way-stop-controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in Wausau and I-41 in Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

The TRAWS was not evaluated as a standalone alternative for this study because the system would not fully address geometric deficiencies. However, the TRAWS could be considered in combination with other alternatives.

Diamond interchanges or grade separations were considered among the least viable alternatives at four of the six study intersections. The diamond interchange alternative was considered a more viable alternative at the CTH U intersection and the CTH F intersection. Other interchange types were not considered at this time to be consistent with the concepts shown with the preferred alternative in the 2010 EA.

For STH 49, the alternatives considered generally reflect those that were identified in the 2013 RSA. The study team modified the alternatives slightly and brought each up to current WisDOT design standards. The range of alternatives was narrowed down at STH 49 because the current crash history (2012 to 2016) was not as severe as it had been in the past when the segment was identified on the 2010 to 2014 LOIR. More detail on the STH 49 alternatives evaluated is included in Section 3.C of this report.

F. Preliminary Designs and Cost Estimates

A conceptual layout of each of the most feasible alternatives was completed following current WisDOT FDM design standards. Turn-bay lengths are designed to accommodate projected 2040 horizon year 95th percentile queues. Design decisions for the J-Turn and Median U-Turn layouts were largely based on similar projects and discussions with WisDOT NC region staff. An initial draft of the conceptual layouts was provided to the region on October 26, 2017. The Region then performed a site visit to review deficiencies and the proposed U-turn locations from the initial conceptual layouts, and it provided comments on November 20, 2017.

An opinion of probable construction cost (OPCC) was prepared for each of the most feasible alternatives. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process.

The following is a summary of the assumptions included in the preliminary OPCC for the most feasible alternatives:

1. Quantities are based conceptual horizontal layout and are in 2017 dollars. No vertical design was completed.

2. An allowance of 20 to 25 percent was added to the earthwork, removal, and paving items to account for unmeasured or unknown items.

3. Unit costs were taken from Estimator when available. BidX was used to determine unit costs not available from Estimator.

4. Asphalt unit prices were determined using the asphalt spreadsheet available in the estimating resources page of the WisDOT extranet and from available data in Estimator and BidX.

5. Costs of known unmeasured items were established based on an analysis of similar projects listed following and adjusted based on engineering judgement.

    a) Constructed J-Turns in Wisconsin:
        (1) STH 29 at CTH U, Brown County, Project ID 9200-05-71
        (2) STH 54 at CTH U, Portage/Wood County, Project ID 1520-02-71
        (3) STH 29 at CTH C, Door County, Project ID 1009-10-71

    b) Rural interchange under construction in Wisconsin:
        (1) USH 18 and CTH ID, Iowa County, Project ID 1204-02-76

6. Earthwork was estimated by assuming an excavation depth of 15 inches for concrete pavement, 12 inches for asphalt pavement, and 12 inches for sideroads.

7. Existing concrete mainline travel lanes are assumed to remain. New mainline turn-bay pavement is assumed to consist of 9 inches of concrete over 6 inches of base. New sideroad pavement is assumed to consist of 4 inches of asphalt over 8 inches of base. Twelve inches of select crushed material was assumed over 5 percent of the new pavement area to account for excavation below subgrade.

8. Several assumptions listed below were made to determine earthwork quantities for the CTH U interchange.

    a) Limited vertical assumptions were performed to determine simple triangular and rectangular prism shapes based on the conceptual layout and slope intercepts from the 2010 EA.

    b) The existing ground was assumed flat. A height of 24 feet was assumed at the bridge abutments, and 3 percent grades were used to match into the existing ground.

c) New roadway pavement structures were assumed to be built above the existing ground and ditches excavated 1.3 feet into the ground with a combination of 4:1 foreslopes and 6:1 backslopes.

d) Twenty-five percent of all excavated common material was assumed to be waste material.

e) An expansion factor of 1.25 was used for all fill material.

f) A 25 percent contingency to the total borrow quantity was added to accommodate uncertainty of the measured quantities.

9. Real estate costs are not included. These costs will be determined by WisDOT NC Region.

G. Public Feedback

In April 2017, several agencies expressed their support for the STH 29 Safety Study. These agencies included the Shawano County Highway Committee, the Shawano County Highway Safety Commission, and Shawano Ambulance. Excerpts from the letters of support are below:

1. *"A combination of vertical profile issues as well as some of these roadways meeting at a skew on a curve provide less than desirable conditions. Current crash trends show this pattern continuing. This issue is of great concern for the Shawano County Highway Committee and we request that this work be completed as soon as practical."*

   - Tom Kautza, Chairman of the Shawano County Highway Committee and Grant Bystol, Shawano County Highway Commissioner

2. *Due to multiple accidents including fatalities this Commission would like to express their concern for public safety regarding Highway 29. The Highway Commission is in support of improvements on the Highway 29 corridor to reduce the number and severity of crashes in these areas. The main complaints in these areas are the increased traffic flow due to the expansion of area businesses, which includes the North Star Casino, and limited visibility.*

   - Steve Gueths, Chairman, Shawano County Highway Safety Commission

3. *I am writing to express my support and urge than any possible improvements which can be made are pursued.*

   These are very busy interior corridors, and the volume of traffic makes it inevitable to avoid further injuries and loss of life without design improvements.

   We generally "float" an extra one or two ambulances in that direction (in addition to the responding ambulances) due to the fact that our experience has shown that the potential for serious injuries at these locations (referring to County U, County MMM, and County F) is extremely high. Just recently, we responded to County U and 29 for a report of two people *injured, only to find 6 injured and one DOA. When we receive calls to these intersections, we automatically prepare for the worst.*

- Patrick A. Trinko, Director of Operations, Shawano Ambulance

The letters of support for the STH 29 Safety Study are located in Appendix C.

Section 3: Analysis Results

Following is a brief summary of the crash analysis and traffic operations analysis performed for the study. Additional information is detailed in each study intersection's respective ICE Report. The body of each ICE Report is included in Appendix D and the STH 49 analysis is included in Appendix E.

A. Crash Analysis

Table 3 summarizes the total number and severity of crashes at each of the six study intersections, along with the total crash rates and KAB crash rates over each intersection's five-year analysis period.

STH 29 Intersection	Number of Crashes (Five Year Total*)							Volume Entering Intersection (AADT)	Total Crash Rate	KAB Crash Rate
	Fatal	A Injury	B Injury	C Injury	*KAB*	PDO	TOTAL			
STH 49/Willow Drive	0	0	0	1	*0*	7	**8**	11,370	**0.39**	**0.00**
CTH J	1	2	0	1	*3*	5	**9**	7,940	**0.69**	**0.23**
CTH D/Rock Road	1	1	4	0	*6*	3	**9**	8,680	**0.57**	**0.38**
CTH U	3	3	2	1	*8*	6	**15**	9,800	**0.84**	**0.45**
CTH MMM/Clark Drive	0	1	3	0	*4*	6	**10**	9,780	**0.56**	**0.22**
CTH F	0	1	3	3	*4*	3	**10**	12,950	**0.42**	**0.17**
Totals	***5***	***8***	***12***	***6***	***25***	***30***	***61***			

Notes:
*5-year analysis period for CTH U = 2013 to 2017. All other locations use a 2012 to 2016 analysis period.
Intersections are organized top down from west to east.
Intersection crash rates are expressed in crashes per million entering vehicles.
Deer crashes and other animal crashes are not included in the calculations.
CTH J construction crashes in 2016 are excluded and the crash rate is calculated over a 4.5 year period.

Table 3 STH 29 Study Intersection Crash Summary

Table 4 summarizes the total number and severity of crashes for each of the four analysis segments, along with the total crash rates, KAB crash rates, and comparison to 2012 to 2016 statewide average and UCL values for the 65 mph Expressway Meta-Manager peer group.

STH 49 to CTH OO	Crash Severity	Total # of Crashes (2012-2016)	STH 29 Crash Rate (2012-2016)	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	14	149.2	47.6	3.13	70.2	2.13
1.0 miles 5,140 AADT	KAB Injury	1	10.7	8.7	1.23	18.3	0.58
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	4	42.6	47.6	0.90	70.2	0.61
1.0 miles 5,140 AADT	KAB Injury	1	10.7	8.7	1.23	18.3	0.58

CTH J to Fink Road	Crash Severity	Total # of Crashes (2012-2016)	STH 29 Crash Rate (2012-2016)	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	8	107.7	47.6	2.26	71.6	1.50
1.2 miles 3,770 AADT	KAB Injury	2	26.9	8.7	3.11	18.9	1.43
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	14	188.4	47.6	3.96	71.6	2.63
1.2 miles 3,770 AADT	KAB Injury	1	13.5	8.7	1.56	18.9	0.71

CTH U to Kroenke Creek Road	Crash Severity	Total # of Crashes (2013-2017)	STH 29 Crash Rate (2013-2017)	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	4	49.1	47.6	1.03	71.8	0.68
1.0 miles 4,465 AADT	KAB Injury	2	24.5	8.7	2.84	19.0	1.29
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	14	171.8	47.6	3.61	71.8	2.39
1.0 miles 4,465 AADT	KAB Injury	6	73.6	8.7	8.51	19.0	3.88

CTH MMM to CTH M	Crash Severity	Total # of Crashes (2012-2016)	STH 29 Crash Rate (2012-2016)	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	7	43.9	47.6	0.92	64.9	0.68
2.0 miles 8,740 AADT	KAB Injury	3	18.8	8.7	2.17	16.0	1.17
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total	11	69.0	47.6	1.45	64.9	1.06
2.0 miles 8,740 AADT	KAB Injury	3	18.8	8.7	2.17	16.0	1.17

Legend

1.00 - 1.99	*Ratio vs. Statewide Average or UCL*
2.00 - 2.99	*Ratio vs. Statewide Average or UCL*
3.00+	*Ratio vs. Statewide Average or UCL*

Table 4 STH 29 Study Segment Crash Summaries

As previously discussed, year 2017 crash data was added to the CTH U intersection analysis to replace the 2012 crash data. At each of the study intersections, 2008 to 2011 and 2017 KAB intersection crashes were reviewed and are noted in the ICE Reports. At the STH 29 and CTH U intersection, two fatal crash and two property damage crashes occurred in 2017. At this time, all crashes that occurred in 2017 at the other five study intersections have not been reviewed by the study team.

B. Traffic Operations Analysis

Traffic operations for the 2040 No-Build condition showed that all movements operate at LOS C or better at each study intersection with 95th percentile queue lengths of approximately of two vehicles (or 50 feet). Table 5 shows a summary of the delay, alphabetic LOS, and numeric LOS for the worst turning movement at each of the study intersections during the 2040 AM and PM peak hours.

	Intersection	AM			PM		
		Delay (s)	LOS	LOS Scale	Delay (s)	LOS	LOS Scale
2040 Conditions	STH 29 / STH 49 & Willow Dr	16.2	C	3.13	19.1	C	3.42
	STH 29 / CTH J	11.1	B	2.23	15.5	C	3.06
	STH 29 / CTH D & Rock Rd	13.7	B	2.75	14.8	B	2.97
	STH 29 / CTH U	16.2	C	3.13	19.2	C	3.43
	STH 29 / CTH MMM & Clark Dr	11.9	B	2.39	15.3	C	3.04
	STH 29 / CTH F	18.8	C	3.39	23.0	C	3.81

Note: Delay and LOS reported are reported for the worst movement (typical for two-way stop-controlled intersections).

Table 5 2040 No-Build Intersection Traffic Operations Summary

As discussed in Section 2.C, the traffic volumes used in the analysis are 9 percent lower in comparison to the June 2017 traffic volumes. A sensitivity analysis was performed with the 2040 No-Build conditions to understand how traffic operations in June may vary from the seasonally adjusted traffic operations. The sensitivity analysis showed that five of the intersections still operate at LOS C or better for all movements during the 2040 AM and PM peak hours. The CTH F intersection falls to LOS D during the 2040 PM peak hour, just over the LOS C/D threshold for unsignalized intersections, when using the unadjusted WisDOT forecast volumes.

These traffic operations results during the 2040 AM and PM peak hours further reinforce that traffic operations are not the primary need at the study intersections.

C. STH 49 Analysis

At the STH 49 intersection, based upon recent crash trends and severity, it is not anticipated to be able to secure HSIP funding for an improvement at this location. However, there is a possibility that the alternatives considered could be included in upcoming pavement improvement projects scheduled for STH 29. The following is a summary of the study team's findings at the STH 49 intersection and the segment of STH 29 from STH 49 to CTH OO.

The westbound left-turn movement from STH 29 to STH 49 and the northbound right-turn movement from STH 49 to STH 29 are the primary movements at this intersection, each of which accommodates approximately 10 to 15 trucks during the AM and PM peak hours. The westbound left-turn bay is a slotted turn and provides 130 feet of vehicle storage, which is deficient when compared to current FDM standards and may present issues if multiple trucks form a queue.

The segment of STH 29 between STH 49 and CTH OO had one Type A rear-end injury crash over the past five years (in 2012). This crash occurred along STH 29 eastbound and involved a truck slowing down in the rightmost mainline lane to turn right at a driveway, and the following vehicle struck the truck. A similar type of crash occurred in 2010 along STH 29, which was outside the study period.

Geometric deficiencies at this intersection include each turn bay providing less than the minimum deceleration and storage lengths, as well as being just at the minimum required intersection skew. Figure 3 shows a summary of the geometric deficiencies found at this intersection, and Appendix D contains a summary table.

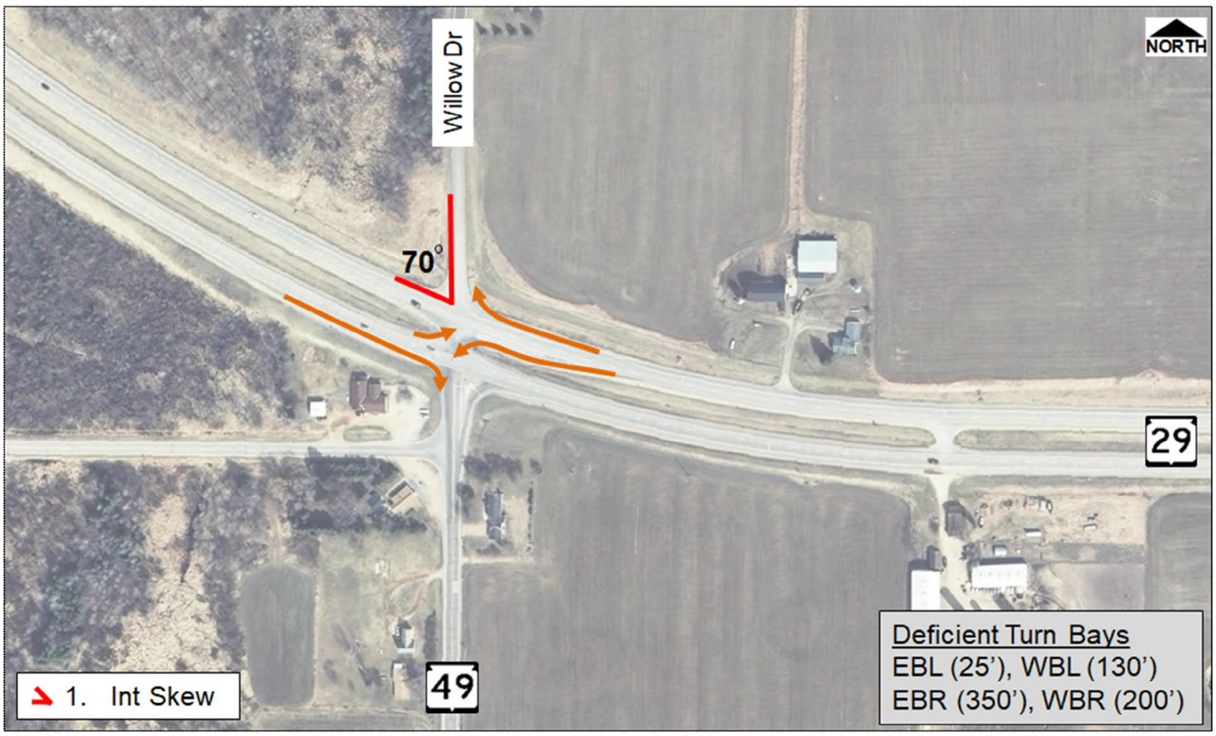


Figure 3 Summary of Geometric Deficiencies

Two alternatives were evaluated for the STH 49 intersection, each of which included a subalternative. The first alternative includes realigning the intersection to a 90-degree skew, adding a slotted eastbound left-turn lane, an extension of the westbound left-turn lane, and eastbound and westbound offset right-turn lanes. Additional subalternatives include an option for an eastbound acceleration lane and the closure of Willow Drive with a cul-de-sac. Alternative 1 is shown in Figure 4. More detail on these concepts and the subalternatives can be found in Appendix E.

Figure 4 Turn Lane Extension Alternative with Optional Eastbound Acceleration Lane

The second alternative was a reevaluation of the half J-Turn alternative recommended in the RSA prepared by Opus. In November 2017, WisDOT provided comments on the study team's conceptual layouts and recommended to include offset right-turn lanes for the eastbound and westbound intersection approaches and to break out the cul-de-sac of Willow Drive as an optional item in this alternative. The original alternative from RSA with the study team's suggested revisions is shown in Figure 5. This concept is shown in more detail in Appendix E.

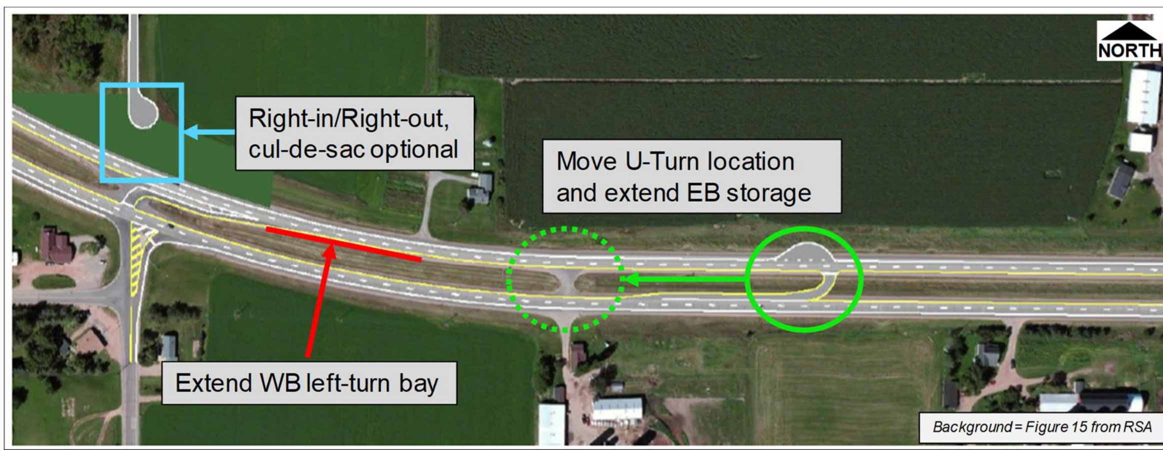


Figure 5 Reevaluation of Road Safety Audit J-Turn Concept

Section 4: Conclusions

Strand and WisDOT NC Region staff coordinated over the course of the study to identify the most feasible alternatives at each study intersection. A summary of the most feasible alternatives at each intersection is shown in Table 6.

STH 29 Intersection	Alternative	Preliminary Opinion of Probable Construction Cost (2017 dollars)[1]
STH 49/ Willow Drive	Alt 1, 1A, and 1B: Turn Lane Extensions with Acceleration Lane and access option	Alt 1: $1.3 to $1.7M Alt 1A–w/o Accel Lane: $0.9 to $1.2M Alt 1B–Cul-de-sac w/ Accel Lane $1.0 to $1.3M
	Alt 2 and 2A: Eastbound to Westbound J-Turn with Willow Drive access option	Willow Drive Open: $0.9 to $1.1M Willow Drive Closed: $0.8 - $1.1M
CTH J	Alt 1: Access Control (Right-in/Right-out/Left-in)	$1.0 to $1.3M
	Alt 2: J-Turn	$1.3 to $1.7M
	Alt 3: Median U-Turn	$1.0 to $1.3M
CTH D/ Rock Road	Alt 1 and 1A: Closed Median (Right-in/Right-out)	Alt 1–Both Legs: $0.4 to $0.5M Alt 1A–Rock Road Closed: $0.35 to $0.4M
	Alt 2: Closed Rock Road with Slotted Westbound Left	$0.5 to $0.7M
CTH U	Alt 1: J-Turn	$1.2 to $1.6M
	Alt 2: Median U-Turn	$0.9 to $1.2M
	Alt 3: Diamond Interchange	$10.4 to $11.7M
	Alt 4: TRAWS with Mainline Reconstruction[2]	*Evaluate in Phase II: Alternative Selection ICE*
CTH MMM/ Clark Drive	Alt 1 and 1A: Access Control (Right-in/Right-out/Left-in)	Alt 1–Both Legs: $1.0 to $1.3M Alt 1A–Clark Drive Closed: $0.6 to $0.8M
	Alt 2: J-Turn	$1.3 to $1.8M
	Alt 3: Median U-Turn	$0.8 to $1.1M
CTH F	Alt 1: J-Turn	$1.1 to $1.5M
	Alt 2: Median U-Turn	$0.8 to $1.0M
	Alt 3: Diamond Interchange	> $12 to 13M[2]

[1] The OPCC provided are preliminary. Strand strongly recommends the costs be reevaluated during the design process. See Section 2.F of this report for more information on the methodology. More detail on the preliminary OPCC for each alternative is located in each ICE Report and in Appendix E of this report for the STH 49 intersection.
[2] The TRAWS with Mainline Reconstruction alternative was added as a feasible alternative following WisDOT BTO's review of the Phase I: ICE Reports. This alternative will be evaluated further in the Phase II: Alternative Selection ICE, where more detailed vertical design will be necessary.
[3] A separate preliminary OPCC was not prepared for the CTH F diamond interchange. At this stage of design, the preliminary OPCC is assumed to be higher than the CTH U interchange preliminary OPCC because of the grade differences between CTH F and CTH U. See the ICE Reports for more detail on the diamond interchange analysis.

Table 6 Summary of Most Feasible Intersection Alternatives

More details on the operations and safety considerations for the most feasible alternatives and the preliminary OPCC prepared for each alternative are included in the ICE Reports and in Appendix E for the STH 49 intersection. The alternatives section of each ICE Report provides more detail and discussions of the pros and cons associated with each alternative. WisDOT BTO reviewed the ICE Reports and provided comments on March 1, 2018. The ICE Report review comments and concurrence received from WisDOT BTO for the most feasible alternatives at each intersection is included in Appendix F.

Please call me if you have any questions regarding the contents of this report.

Sincerely,

STRAND ASSOCIATES, INC.®

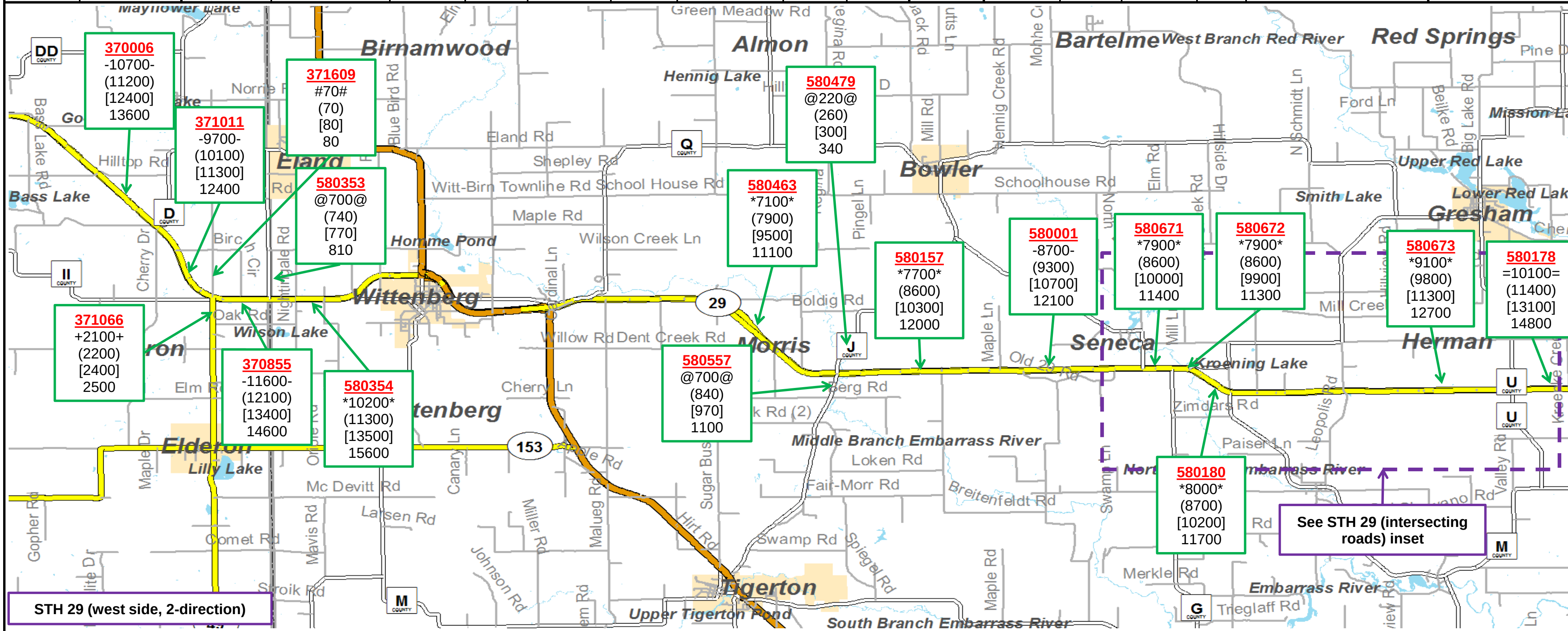
Joseph M. Urban, P.E.

Appendices: A–WisDOT Traffic Forecasts
B–Geometric Deficiency Summary Tables
C–Letters of Support for STH 29 Safety Study
D–Five ICE Reports (*body only, ICE appendices included in separate submittal*)
E–STH 49 Crash Analysis and Conceptual Layouts
F–WisDOT BTO ICE Report Reviews

APPENDIX A
WISDOT TRAFFIC FORECASTS

WisDOT TRAFFIC FORECAST REPORT	Region/COUNTY(IES): NC / Marathon & Shawano	Developed by: Jacci Ziebert
PROJECT ID(S): 0656-43-04	LOCATION: STH 49 - CTH F	Phone: (608) 266-9646
ROUTE(S): STH 29	COMPLETED: 7/13/2017	FAX #: (608) 267-0294
Traffic Forecasting Section; Bureau of Planning and Economic Development; Division of Transportation Investment Management		E-Mail: jaclyn.ziebert@dot.wi.gov

Design Values (%)											Truck Classification						
Site(s)	Route(s)	Volume(s)	Site Growth %	K250	K100	K30	P	D(Dsgn. Hr.)	T(DHV)	T(PHV)	AADTT	2D	3AX	2S1+2S2	3-S2	DBL-BTM	Total %
370006	STH 29	13570	1.10%	9.8	11.1	12.0	14.6	60/40	14.0	7.5	1790	4.0	1.3	1.2	9.8	0.3	16.7%
580001	STH 29	12130	1.66%	9.9	11.1	12.1	14.7	60/40	16.2	8.7	1680	3.5	1.1	2.6	12.0	0.2	19.3%
586101	STH 29	16630	1.46%	9.7	11.0	11.8	14.4	60/40	24.5	13.1	3340	17.3	2.1	9.1	0.6	0.1	29.2%



Full Vehicle Classification														
Site(s)	Route(s)	MC	CARS	SU2-4	BUSES	SU2-6	SU3	SU4+	ST4-	ST5	ST6+	MU5-	MU6	MU7+
370006	STH 29	0.0	60.7	19.1	0.2	3.8	1.2	0.1	1.2	9.5	0.3	0.2	0.0	0.1
580001	STH 29	0.3	62.0	18.3	0.9	2.6	0.7	0.3	2.6	11.3	0.7	0.1	0.1	0.0
586101	STH 29	1.1	47.4	22.2	7.5	9.8	1.8	0.3	9.1	0.6	0.0	0.1	0.0	0.0

N ↑

SITE ID = Colored, **bolded**, and underlined

Symbol	Count	Symbol	Forecast
-000-	2016 Count	(000)	2020 AADT
000	2015 Count	[000]	2030 AADT
+000+	2013 Count	000	2040 AADT
=000=	2012 Count		
%000%	2010 Count		
@000@	2009 Count		
#000#	2006 Count		

NOTES ON THE FORECAST:

1. This projection assumes that no major new traffic generators will be added to the development already included in the travel demand model.

2. Truck classification percentages were taken from annual 2005 & 2015 Wisconsin Vehicle Classification Data (Site # 370006 & 580001, respectively) and from 2015 Wisconsin Vehicle Classification Data (Site # 586101).

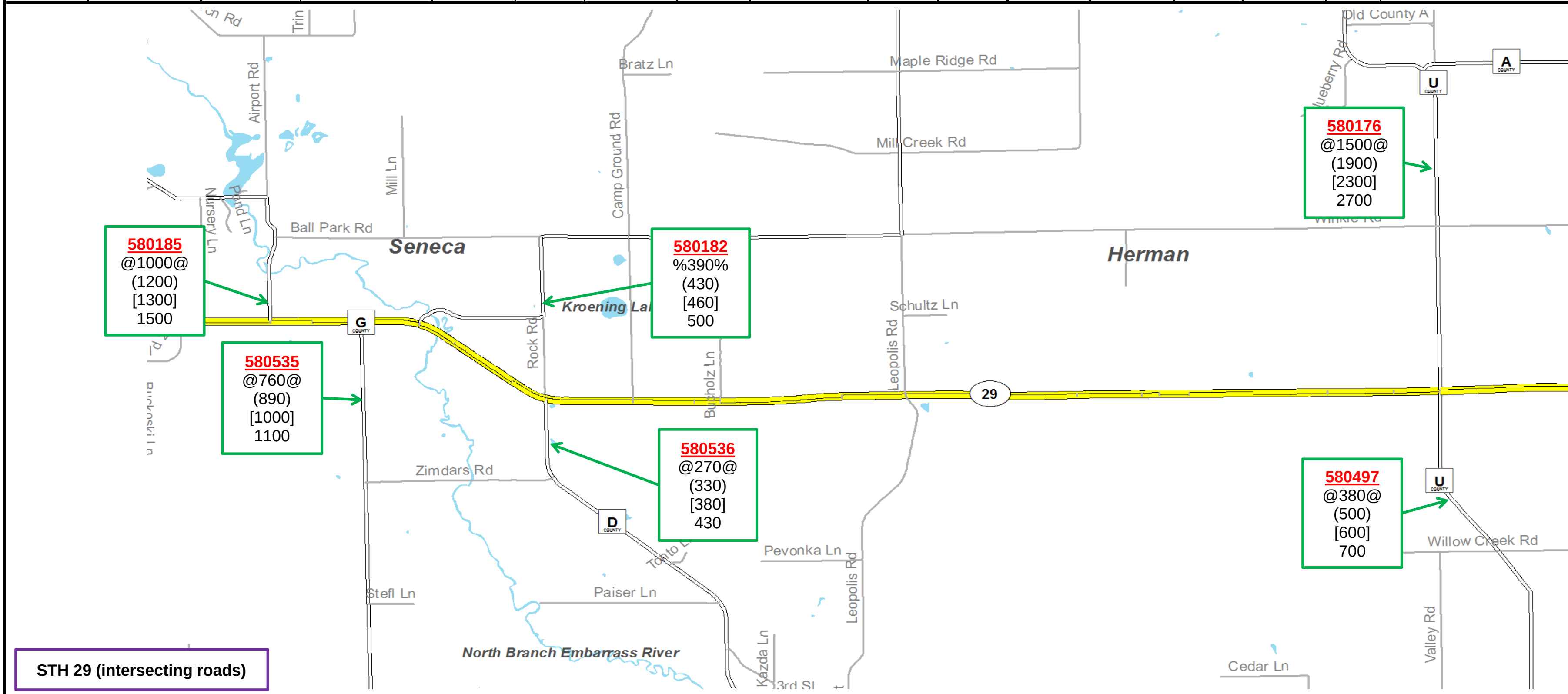
3. STH 29 is a Factor Group IV (Rural-Other) highway indicating low to moderate fluctuation in traffic from a seasonal perspective. It is functionally classified as a Rural Principal Arterial (2) for count purposes.

4. The 2010/2045 Northeast Region Travel Demand Model and the 2010/2050 Marathon County Travel Demand Model was used to complete this forecast. The Traffic Analysis Forecasting Information System output was used as a comparison tool to check against the model output. Adjustments were made as needed.

5. STH 29 forecasted directional volumes were calculated by analyzing directional volume data from 2002-2016 for each mainline site along STH 29. Average of directional volume ratio of each site was multiplied to each respective forecasted volume for the stated location.

WisDOT TRAFFIC FORECAST REPORT	Region/COUNTY(IES): NC / Marathon & Shawano	Developed by: Jacci Ziebert
PROJECT ID(S): 0656-43-04	LOCATION: STH 49 - CTH F	Phone: (608) 266-9646
ROUTE(S): STH 29	COMPLETED: 7/13/2017	FAX #: (608) 267-0294
Traffic Forecasting Section; Bureau of Planning and Economic Development; Division of Transportation Investment Management		E-Mail: jaclyn.ziebert@dot.wi.gov

Design Values (%)											Truck Classification						
Site(s)	Route(s)	Volume(s)	Site Growth %	K250	K100	K30	P	D(Dsgn. Hr.)	T(DHV)	T(PHV)	AADTT	2D	3AX	2S1+2S2	3-S2	DBL-BTM	Total %
370006	STH 29	13570	1.10%	9.8	11.1	12.0	14.6	60/40	14.0	7.5	1790	4.0	1.3	1.2	9.8	0.3	16.7%
580001	STH 29	12130	1.66%	9.9	11.1	12.1	14.7	60/40	16.2	8.7	1680	3.5	1.1	2.6	12.0	0.2	19.3%
586101	STH 29	16630	1.46%	9.7	11.0	11.8	14.4	60/40	24.5	13.1	3340	17.3	2.1	9.1	0.6	0.1	29.2%



Full Vehicle Classification														
Site(s)	Route(s)	MC	CARS	SU2-4	BUSES	SU2-6	SU3	SU4+	ST4-	ST5	ST6+	MU5-	MU6	MU7+
370006	STH 29	0.0	60.7	19.1	0.2	3.8	1.2	0.1	1.2	9.5	0.3	0.2	0.0	0.1
580001	STH 29	0.3	62.0	18.3	0.9	2.6	0.7	0.3	2.6	11.3	0.7	0.1	0.1	0.0
586101	STH 29	1.1	47.4	22.2	7.5	9.8	1.8	0.3	9.1	0.6	0.0	0.1	0.0	0.0

SITE ID = Colored, **bolded**, and underlined

Symbol	Count	Symbol	Forecast
-000-	2016 Count	(000)	2020 AADT
000	2015 Count	[000]	2030 AADT
+000+	2013 Count	000	2040 AADT
=000=	2012 Count		
%000%	2010 Count		
@000@	2009 Count		
#000#	2006 Count		

NOTES ON THE FORECAST:

1. This projection assumes that no major new traffic generators will be added to the development already included in the travel demand model.

2. Truck classification percentages were taken from annual 2005 & 2015 Wisconsin Vehicle Classification Data (Site # 370006 & 580001, respectively) and from 2015 Wisconsin Vehicle Classification Data (Site # 586101).

3. STH 29 is a Factor Group IV (Rural-Other) highway indicating low to moderate fluctuation in traffic from a seasonal perspective. It is functionally classified as a Rural Principal Arterial (2) for count purposes.

4. The 2010/2045 Northeast Region Travel Demand Model and the 2010/2050 Marathon County Travel Demand Model was used to complete this forecast. The Traffic Analysis Forecasting Information System output was used as a comparison tool to check against the model output. Adjustments were made as needed.

5. STH 29 forecasted directional volumes were calculated by analyzing directional volume data from 2002-2016 for each mainline site along STH 29. Average of directional volume ratio of each site was multiplied to each respective forecasted volume for the stated location.

WisDOT TRAFFIC FORECAST REPORT

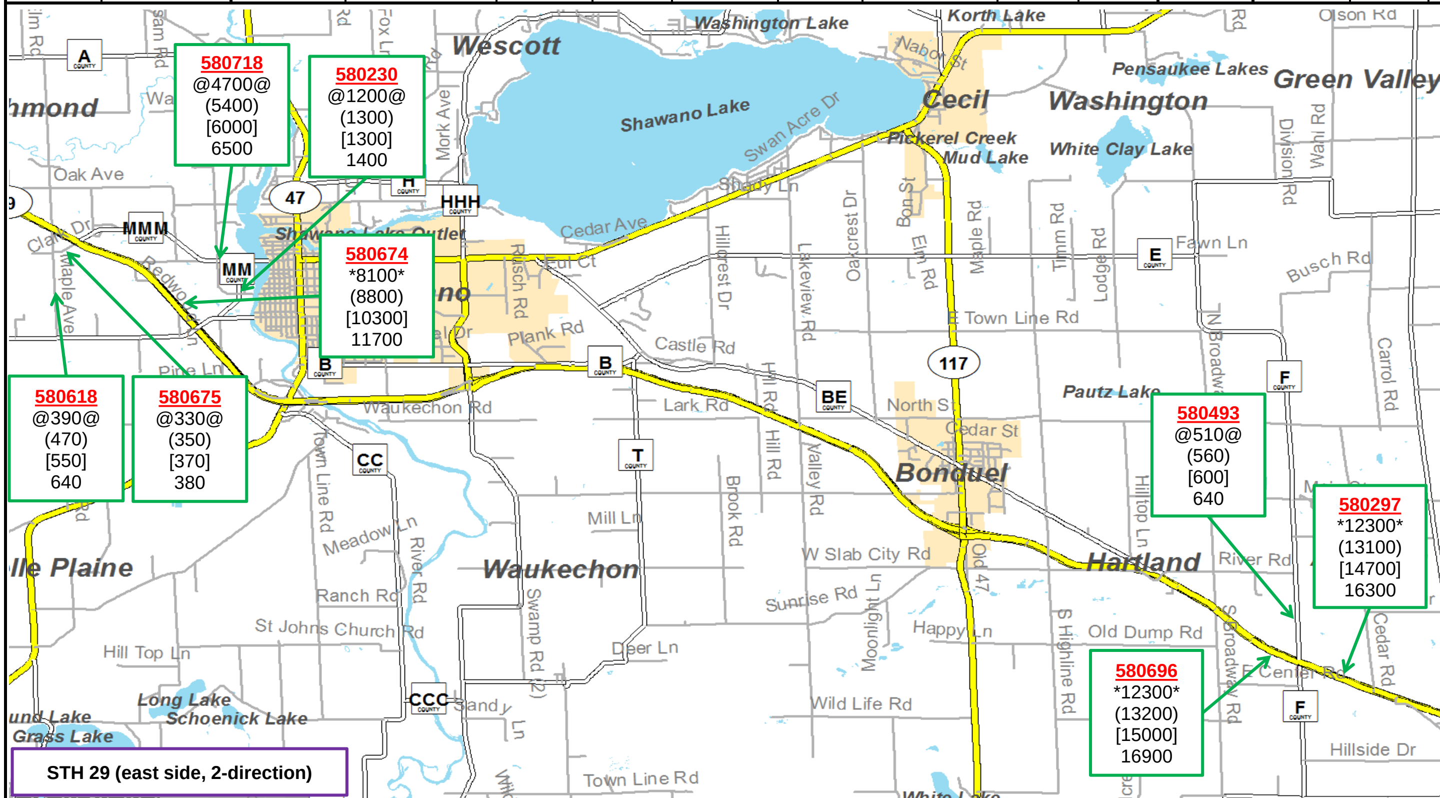
PROJECT ID(S): 0656-43-04
ROUTE(S): STH 29

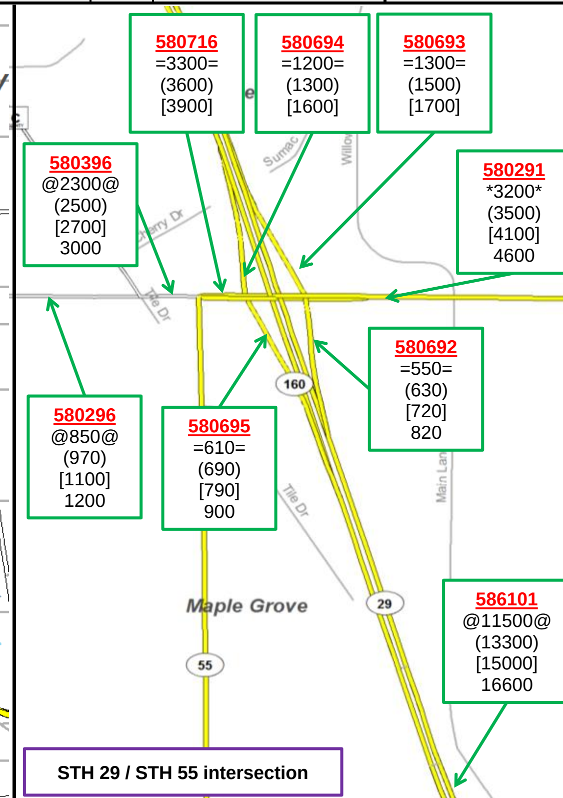
Region/COUNTY(IES): NC / Marathon & Shawano
LOCATION: STH 49 - CTH F
COMPLETED: 7/13/2017

Developed by: Jacci Ziebert
Phone: (608) 266-9646
FAX #: (608) 267-0294
E-Mail: jaclyn.ziebert@dot.wi.gov

Traffic Forecasting Section; Bureau of Planning and Economic Development; Division of Transportation Investment Management

Design Values (%)											Truck Classification						
Site(s)	Route(s)	Volume(s)	Site Growth %	K250	K100	K30	P	D(Dsgn. Hr.)	T(DHV)	T(PHV)	AADTT	2D	3AX	2S1+2S2	3-S2	DBL-BTM	Total %
370006	STH 29	13570	1.10%	9.8	11.1	12.0	14.6	60/40	14.0	7.5	1790	4.0	1.3	1.2	9.8	0.3	16.7%
580001	STH 29	12130	1.66%	9.9	11.1	12.1	14.7	60/40	16.2	8.7	1680	3.5	1.1	2.6	12.0	0.2	19.3%
586101	STH 29	16630	1.46%	9.7	11.0	11.8	14.4	60/40	24.5	13.1	3340	17.3	2.1	9.1	0.6	0.1	29.2%





Full Vehicle Classification

Site(s)	Route(s)	MC	CARS	SU2-4	BUSES	SU2-6	SU3	SU4+	ST4-	ST5	ST6+	MU5-	MU6	MU7+
370006	STH 29	0.0	60.7	19.1	0.2	3.8	1.2	0.1	1.2	9.5	0.3	0.2	0.0	0.1
580001	STH 29	0.3	62.0	18.3	0.9	2.6	0.7	0.3	2.6	11.3	0.7	0.1	0.1	0.0
586101	STH 29	1.1	47.4	22.2	7.5	9.8	1.8	0.3	9.1	0.6	0.0	0.1	0.0	0.0

SITE ID = Colored, **bolded**, and underlined

Symbol	Count	Symbol	Forecast
-000-	2016 Count	(000)	2020 AADT
000	2015 Count	[000]	2030 AADT
+000+	2013 Count	000	2040 AADT
=000=	2012 Count		
%000%	2010 Count		
@000@	2009 Count		
#000#	2006 Count		

NOTES ON THE FORECAST:

1. This projection assumes that no major new traffic generators will be added to the development already included in the travel demand model.

2. Truck classification percentages were taken from annual 2005 & 2015 Wisconsin Vehicle Classification Data (Site # 370006 & 580001, respectively) and from 2015 Wisconsin Vehicle Classification Data (Site # 586101).

3. STH 29 is a Factor Group IV (Rural-Other) highway indicating low to moderate fluctuation in traffic from a seasonal perspective. It is functionally classified as a Rural Principal Arterial (2) for count purposes.

4. The 2010/2045 Northeast Region Travel Demand Model and the 2010/2050 Marathon County Travel Demand Model was used to complete this forecast. The Traffic Analysis Forecasting Information System output was used as a comparison tool to check against the model output. Adjustments were made as needed.

5. STH 29 forecasted directional volumes were calculated by analyzing directional volume data from 2002-2016 for each mainline site along STH 29. Average of directional volume ratio of each site was multiplied to each respective forecasted volume for the stated location.

WisDOT TRAFFIC FORECAST REPORT

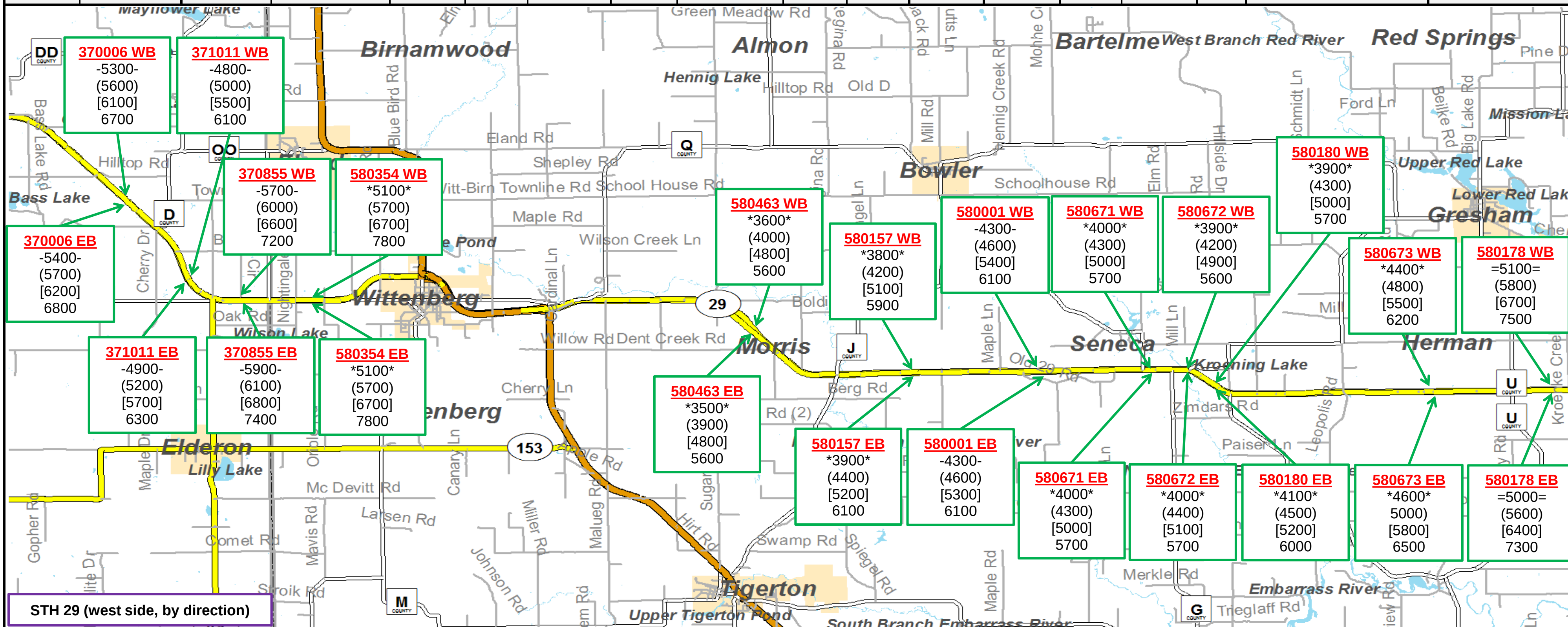
PROJECT ID(S): 0656-43-04
ROUTE(S): STH 29

Region/COUNTY(IES): NC / Marathon & Shawano
LOCATION: STH 49 - CTH F
COMPLETED: 7/13/2017

Developed by: Jacci Ziebert
Phone: (608) 266-9646
FAX #: (608) 267-0294
E-Mail: jaclyn.ziebert@dot.wi.gov

Traffic Forecasting Section; Bureau of Planning and Economic Development; Division of Transportation Investment Management

Design Values (%)											Truck Classification						
Site(s)	Route(s)	Volume(s)	Site Growth %	K250	K100	K30	P	D(Dsgn. Hr.)	T(DHV)	T(PHV)	AADTT	2D	3AX	2S1+2S2	3-S2	DBL-BTM	Total %
370006	**STH 29**	13570	1.10%	9.8	11.1	12.0	14.6	60/40	14.0	7.5	1790	4.0	1.3	1.2	9.8	0.3	16.7%
580001	**STH 29**	12130	1.66%	9.9	11.1	12.1	14.7	60/40	16.2	8.7	1680	3.5	1.1	2.6	12.0	0.2	19.3%
586101	**STH 29**	16630	1.46%	9.7	11.0	11.8	14.4	60/40	24.5	13.1	3340	17.3	2.1	9.1	0.6	0.1	29.2%



Full Vehicle Classification														
Site(s)	Route(s)	MC	CARS	SU2-4	BUSES	SU2-6	SU3	SU4+	ST4-	ST5	ST6+	MU5-	MU6	MU7+
370006	**STH 29**	0.0	60.7	19.1	0.2	3.8	1.2	0.1	1.2	9.5	0.3	0.2	0.0	0.1
580001	**STH 29**	0.3	62.0	18.3	0.9	2.6	0.7	0.3	2.6	11.3	0.7	0.1	0.1	0.0
586101	**STH 29**	1.1	47.4	22.2	7.5	9.8	1.8	0.3	9.1	0.6	0.0	0.1	0.0	0.0

SITE ID = Colored, **bolded**, and underlined

Symbol	Count	Symbol	Forecast
-000-	2016 Count	(000)	2020 AADT
000	2015 Count	[000]	2030 AADT
+000+	2013 Count	000	2040 AADT
=000=	2012 Count		
%000%	2010 Count		
@000@	2009 Count		
#000#	2006 Count		

NOTES ON THE FORECAST:

1. This projection assumes that no major new traffic generators will be added to the development already included in the travel demand model.

2. Truck classification percentages were taken from annual 2005 & 2015 Wisconsin Vehicle Classification Data (Site # 370006 & 580001, respectively) and from 2015 Wisconsin Vehicle Classification Data (Site # 586101).

3. STH 29 is a Factor Group IV (Rural-Other) highway indicating low to moderate fluctuation in traffic from a seasonal perspective. It is functionally classified as a Rural Principal Arterial (2) for count purposes.

4. The 2010/2045 Northeast Region Travel Demand Model and the 2010/2050 Marathon County Travel Demand Model was used to complete this forecast. The Traffic Analysis Forecasting Information System output was used as a comparison tool to check against the model output. Adjustments were made as needed.

5. STH 29 forecasted directional volumes were calculated by analyzing directional volume data from 2002-2016 for each mainline site along STH 29. Average of directional volume ratio of each site was multiplied to each respective forecasted volume for the stated location.

WisDOT TRAFFIC FORECAST REPORT

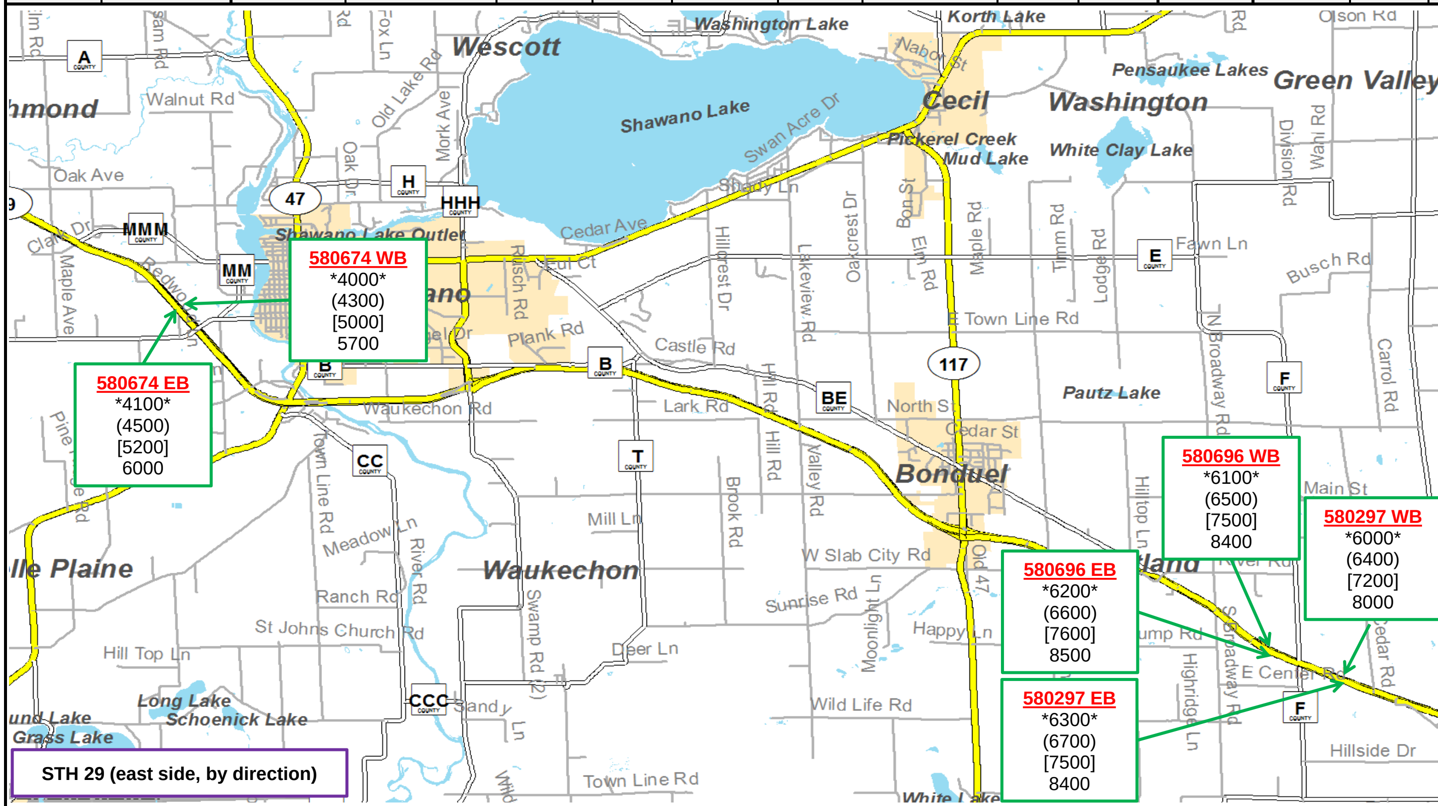
PROJECT ID(S): 0656-43-04
ROUTE(S): STH 29

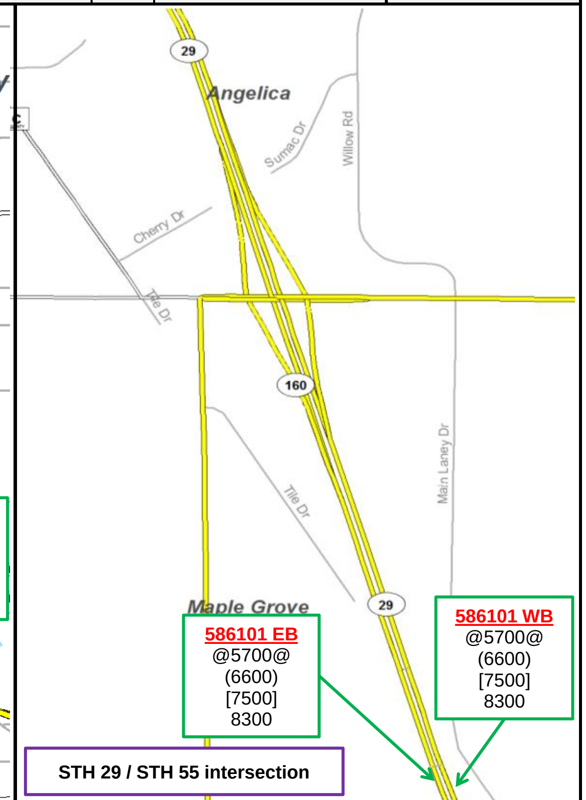
Region/COUNTY(IES): NC / Marathon & Shawano
LOCATION: STH 49 - CTH F
COMPLETED: 7/13/2017

Developed by: Jacci Ziebert
Phone: (608) 266-9646
FAX #: (608) 267-0294
E-Mail: jaclyn.ziebert@dot.wi.gov

Traffic Forecasting Section; Bureau of Planning and Economic Development; Division of Transportation Investment Management

Design Values (%)												Truck Classification						
Site(s)	Route(s)	Volume(s)	Site Growth %	K250	K100	K30	P	D(Dsgn. Hr.)	T(DHV)	T(PHV)	AADTT	2D	3AX	2S1+2S2	3-S2	DBL-BTM	Total %
370006	STH 29	13570	1.10%	9.8	11.1	12.0	14.6	60/40	14.0	7.5	1790	4.0	1.3	1.2	9.8	0.3	16.7%
580001	STH 29	12130	1.66%	9.9	11.1	12.1	14.7	60/40	16.2	8.7	1680	3.5	1.1	2.6	12.0	0.2	19.3%
586101	STH 29	16630	1.46%	9.7	11.0	11.8	14.4	60/40	24.5	13.1	3340	17.3	2.1	9.1	0.6	0.1	29.2%





Full Vehicle Classification

Site(s)	Route(s)	MC	CARS	SU2-4	BUSES	SU2-6	SU3	SU4+	ST4-	ST5	ST6+	MU5-	MU6	MU7+
370006	STH 29	0.0	60.7	19.1	0.2	3.8	1.2	0.1	1.2	9.5	0.3	0.2	0.0	0.1
580001	STH 29	0.3	62.0	18.3	0.9	2.6	0.7	0.3	2.6	11.3	0.7	0.1	0.1	0.0
586101	STH 29	1.1	47.4	22.2	7.5	9.8	1.8	0.3	9.1	0.6	0.0	0.1	0.0	0.0

SITE ID = Colored, **bolded**, and underlined

Symbol	Count	Symbol	Forecast
-000-	2016 Count	(000)	2020 AADT
000	2015 Count	[000]	2030 AADT
+000+	2013 Count	000	2040 AADT
=000=	2012 Count		
%000%	2010 Count		
@000@	2009 Count		
#000#	2006 Count		

NOTES ON THE FORECAST:

1. This projection assumes that no major new traffic generators will be added to the development already included in the travel demand model.

2. Truck classification percentages were taken from annual 2005 & 2015 Wisconsin Vehicle Classification Data (Site # 370006 & 580001, respectively) and from 2015 Wisconsin Vehicle Classification Data (Site # 586101).

3. STH 29 is a Factor Group IV (Rural-Other) highway indicating low to moderate fluctuation in traffic from a seasonal perspective. It is functionally classified as a Rural Principal Arterial (2) for count purposes.

4. The 2010/2045 Northeast Region Travel Demand Model and the 2010/2050 Marathon County Travel Demand Model was used to complete this forecast. The Traffic Analysis Forecasting Information System output was used as a comparison tool to check against the model output. Adjustments were made as needed.

5. STH 29 forecasted directional volumes were calculated by analyzing directional volume data from 2002-2016 for each mainline site along STH 29. Average of directional volume ratio of each site was multiplied to each respective forecasted volume for the stated location.

Wisconsin Department of Transportation

Annual % Class Distribution for 2005

Site Names: 370006, 374, NC
County: Marathon
Funct. Class: R Principal Arterial - Other
Location: STH 29 - W OF CTH D - HATLEY

	Roadway	Neg DIR	Pos DIR	Neg1	Neg2	Pos2	Pos1
MC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAR	60.7	62.4	59.1	60.0	74.3	69.4	57.0
PU	19.1	17.3	21.0	17.9	14.2	21.0	21.0
BUS	0.2	0.2	0.2	0.3	0.1	0.1	0.2
2D	3.8	4.1	3.6	4.3	2.7	2.5	3.9
SU 3	1.2	1.0	1.4	1.1	0.5	0.7	1.6
SU 4+	0.1	0.1	0.1	0.1	0.0	0.0	0.1
ST 4-	1.2	1.3	1.0	1.4	0.8	0.3	1.1
ST 5	9.6	8.8	10.3	9.8	3.8	4.9	11.4
ST 6+	0.3	0.3	0.2	0.4	0.1	0.1	0.2
MT 5-	0.2	0.2	0.2	0.3	0.1	0.1	0.3
MT 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT 7+	0.1	0.1	0.0	0.2	0.0	0.0	0.1
OFFSCALE	0.2	0.2	0.2	0.2	0.1	0.1	0.2
UNCLS	3.3	3.9	2.7	4.1	3.1	0.9	3.0
Trucks	16.7	16.2	17.1	17.8	8.3	8.6	18.7
Combo Trucks	11.3	10.8	11.8	12.0	4.9	5.3	13.1
Classified	96.5	95.9	97.2	95.7	96.8	98.9	96.8
Num Days	151	151	151	151	151	151	151
Total	9,341	4,740	4,601	3,959	782	754	3,847

Wisconsin Department of Transportation

Annual % Class Distribution for 2015

Site Names: 580001, 4060, NC
County: Shawano
Funct. Class: R Principal Arterial - Other
Location: STH 29 - 1.8 MI E OF CTH J - WITTENBERG

	Roadway	Neg DIR	Pos DIR	Neg1	Neg2	Pos2	Pos1
MC	0.3	0.3	0.3	0.3	0.4	0.3	0.3
CAR	62.0	58.9	65.2	55.3	73.4	77.2	62.7
PU	18.3	20.9	15.8	21.5	18.5	16.6	15.7
BUS	0.9	0.9	0.9	1.1	0.4	0.3	1.0
2D	2.6	3.6	1.6	3.8	2.6	1.0	1.7
SU 3	0.7	0.6	0.9	0.7	0.1	0.4	1.0
SU 4+	0.3	0.5	0.2	0.6	0.1	0.0	0.2
ST 4-	2.6	2.8	2.4	3.1	1.6	1.3	2.6
ST 5	11.3	10.7	12.0	12.8	2.6	2.9	13.9
ST 6+	0.7	0.8	0.6	0.9	0.3	0.1	0.7
MT 5-	0.1	0.1	0.1	0.1	0.0	0.0	0.1
MT 6	0.1	0.1	0.1	0.1	0.0	0.0	0.1
MT 7+	0.1	0.0	0.1	0.0	0.0	0.0	0.1
Trucks	19.3	20.0	18.7	23.0	7.8	5.9	21.4
Combo Trucks	14.8	14.4	15.2	16.9	4.5	4.3	17.5
Classified	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Num Days	293	293	293	293	293	293	293
Total	8,008	4,021	3,987	3,212	809	693	3,293

Wisconsin Department of Transportation

Daily % Class Distribution for 06/08/2015 through 06/10/2015 (48 hours)

Site Names:	586101, 7030, NC	Seasonal Factor Group:	4
County:	Shawano	Daily Factor Group:	4
Funct. Class:	R Principal Arterial - Other	Axle Factor Group:	1
Location:	STH 29 - NORTHWEST OF STH 156	Growth Factor Group:	1

	Roadway	Neg DIR	Pos DIR
MC	1.13	1.34	0.89
CAR	47.45	49.94	44.60
PU	22.22	21.84	22.65
BUS	7.54	7.19	7.93
2D	9.76	7.40	12.44
SU 3	1.78	1.88	1.67
SU 4+	0.27	0.13	0.42
ST 4-	9.13	9.24	9.01
ST 5	0.62	0.87	0.33
ST 6+	0.03	0.01	0.06
MT 5-	0.08	0.14	0.01
MT 6	0.00	0.00	0.00
MT 7+	0.01	0.01	0.00
Trucks	29.21	26.88	31.87
Combo Trucks	9.87	10.27	9.40
Classified	100.00	100.00	100.00
Volume	18,337	9,767	8,570

WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

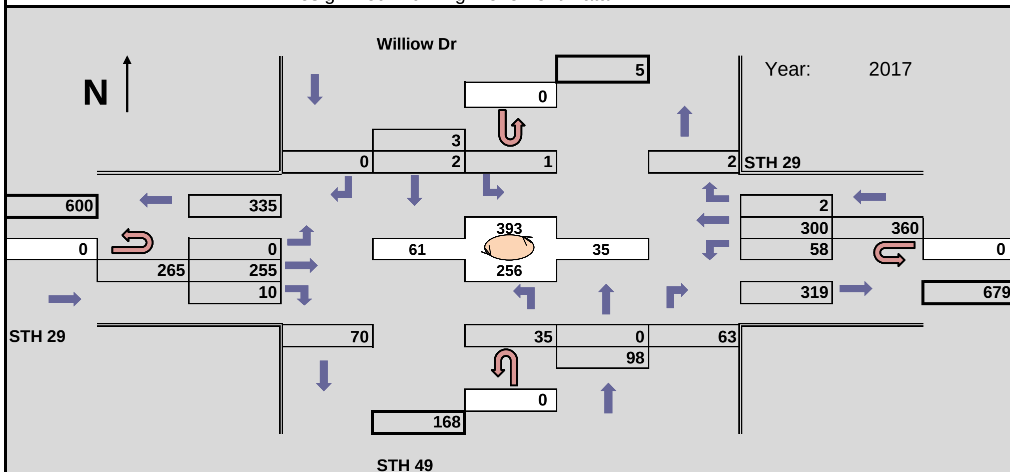
Design Hour: 7:15-8:15am

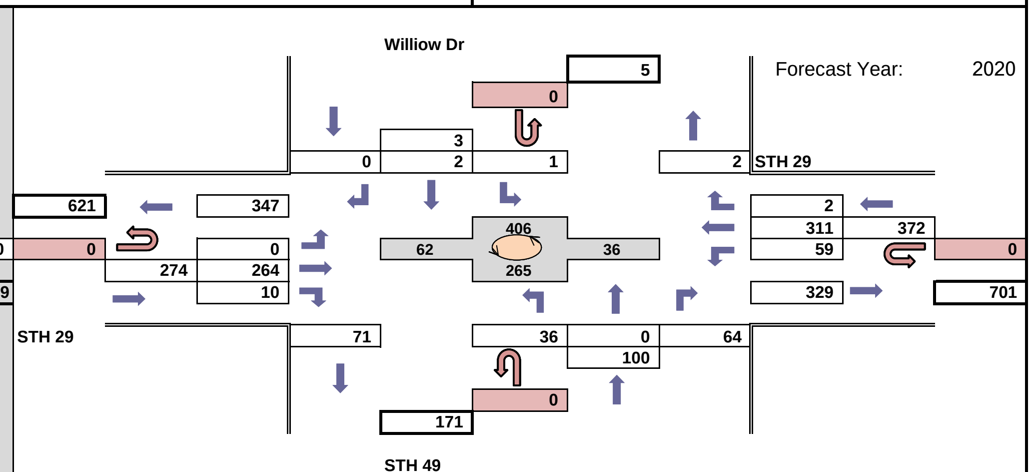
Forecast Completed: 7/13/2017

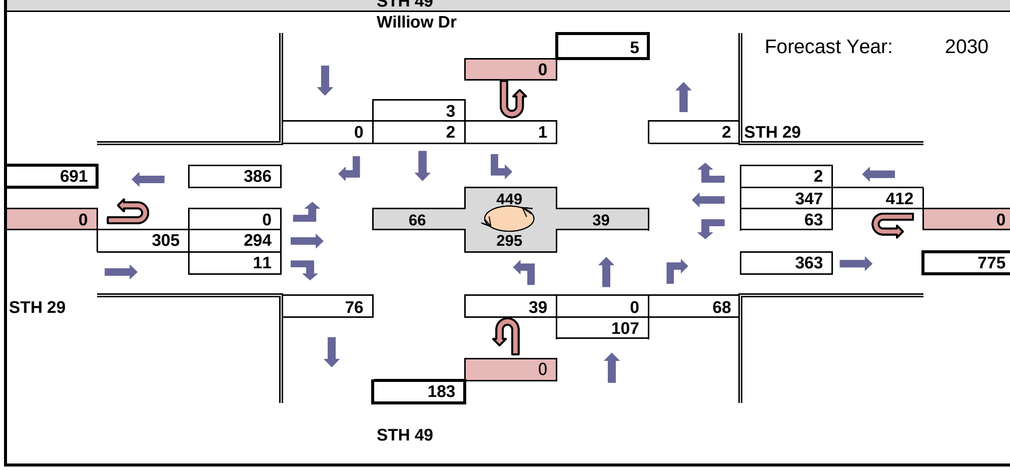
Project Description

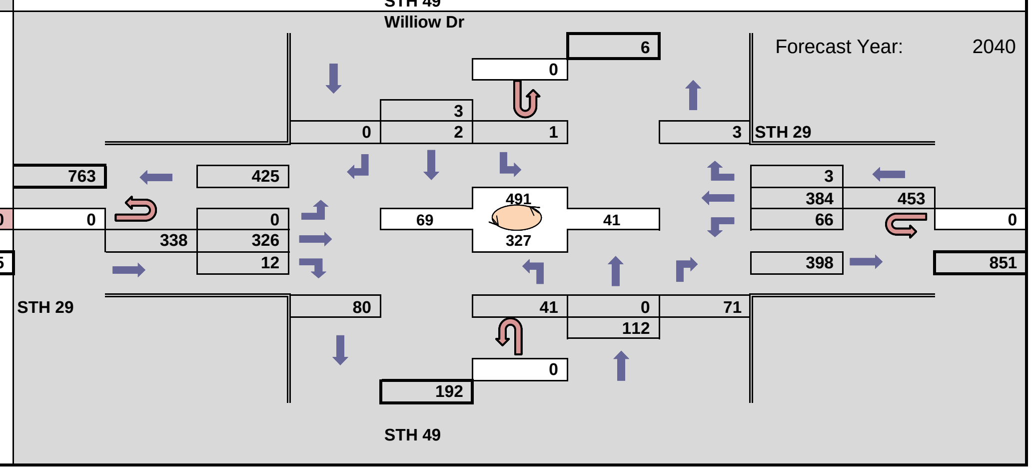
Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F

Design Hour Turning Movement Data



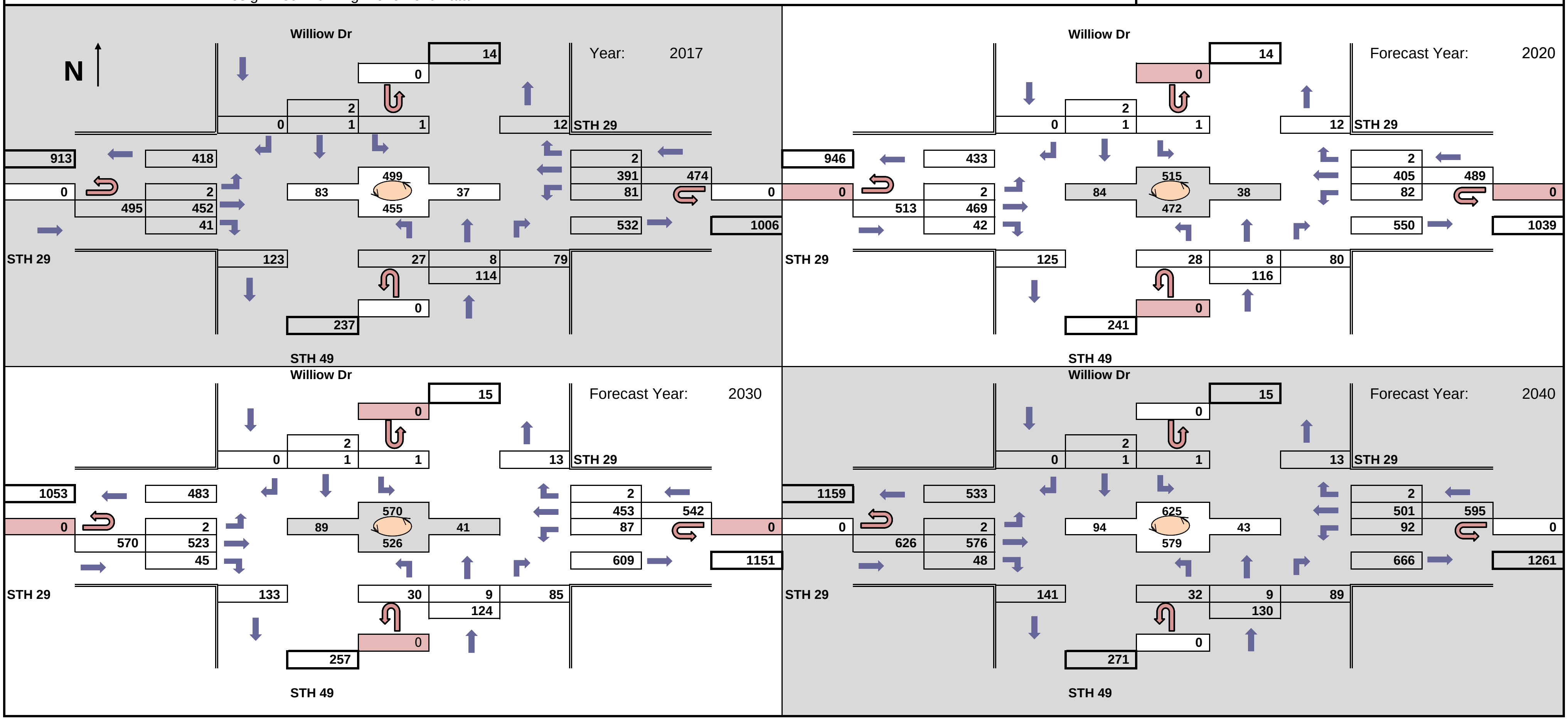






WisDot Bureau of Planning	**Projected PM Design Hour Traffic Volumes**	**Project Description**
Traffic Forecasting Section		**Project ID(s): 0656-43-04**
Forecast by: Jacci Ziebert	Indicates roundabout; Design Hour: 4:15-5:15pm	**Route(s): STH 29**
Phone: 608-266-9646		**Region/COUNTY(IES): NC / Marathon & Shawano**
Email: jacci.ziebert@dot.wi.gov	Forecast Completed: 7/13/2017	**Location: STH 49 - CTH F**

Design Hour Turning Movement Data



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

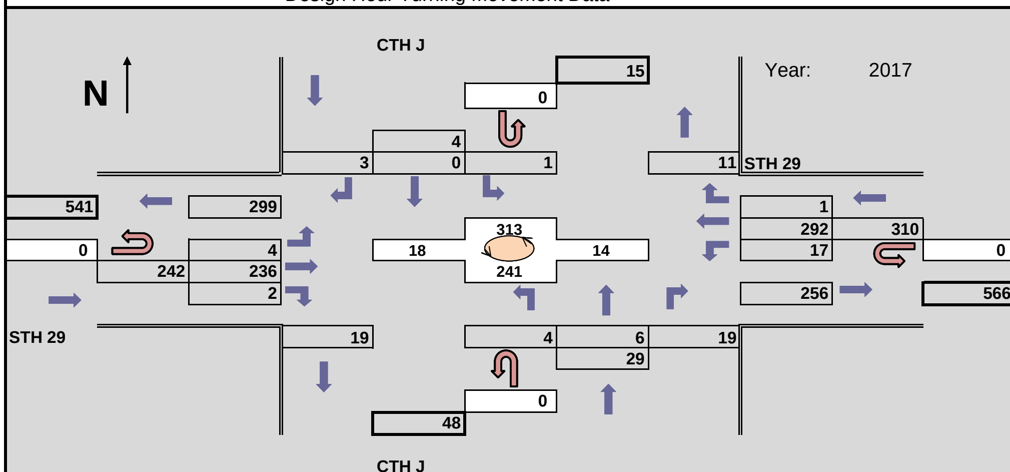
Design Hour: 7:15-8:15am

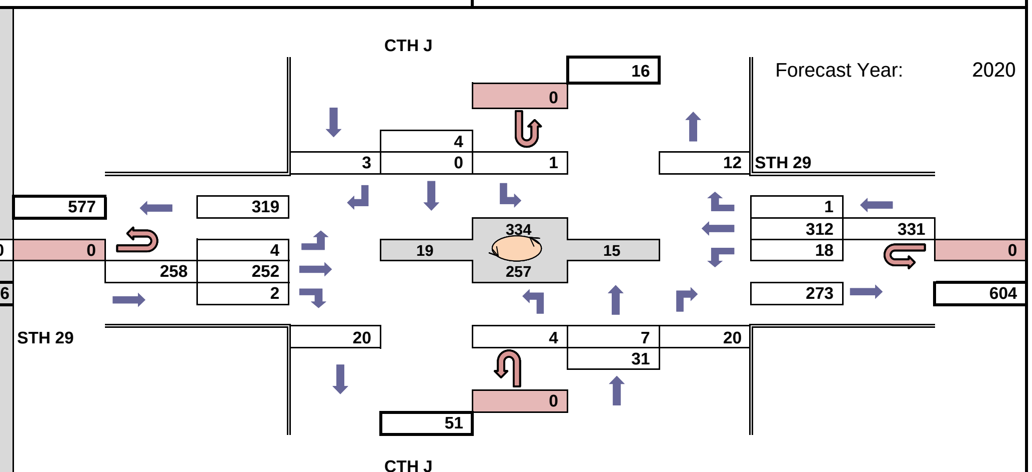
Forecast Completed: 7/13/2017

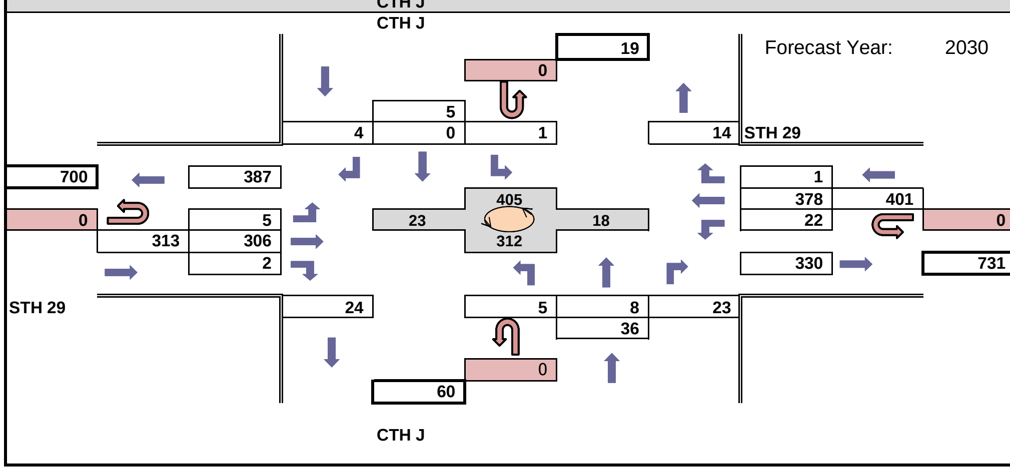
Design Hour Turning Movement Data

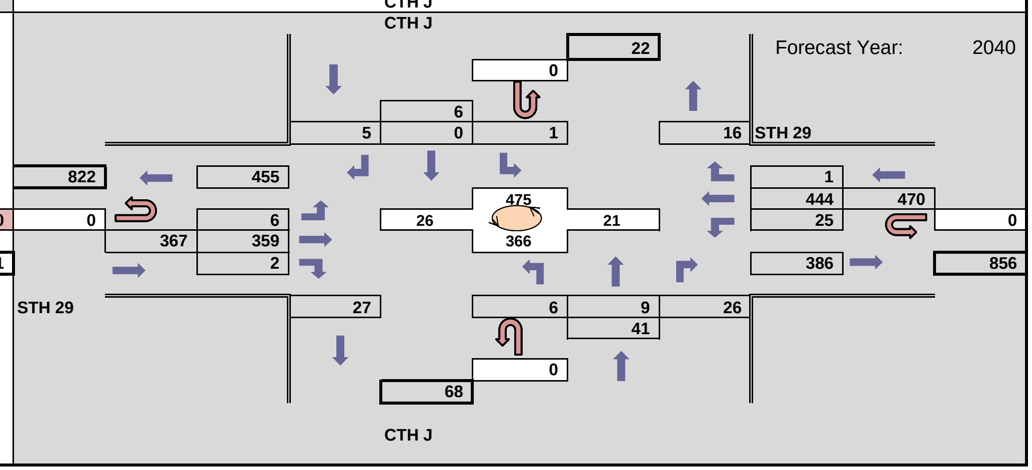
Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F









WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected PM Design Hour Traffic Volumes

Indicates roundabout

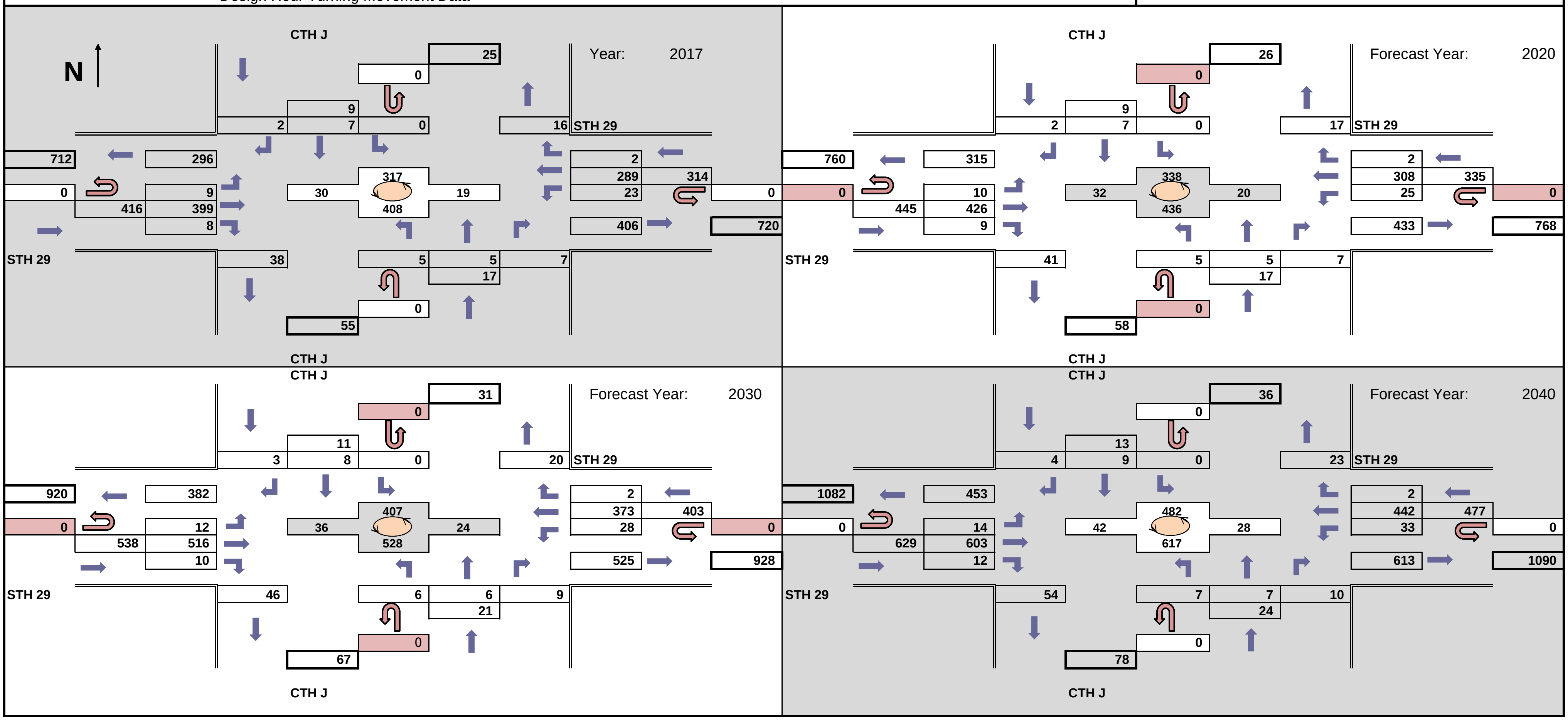
Design Hour: 4:00-5:00pm

Forecast Completed: 7/13/2017

Project Description

Project ID(s):	**0656-43-04**
Route(s):	**STH 29**
Region/COUNTY(IES):	**NC / Marathon & Shawano**
Location:	**STH 49 - CTH F**

Design Hour Turning Movement Data



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

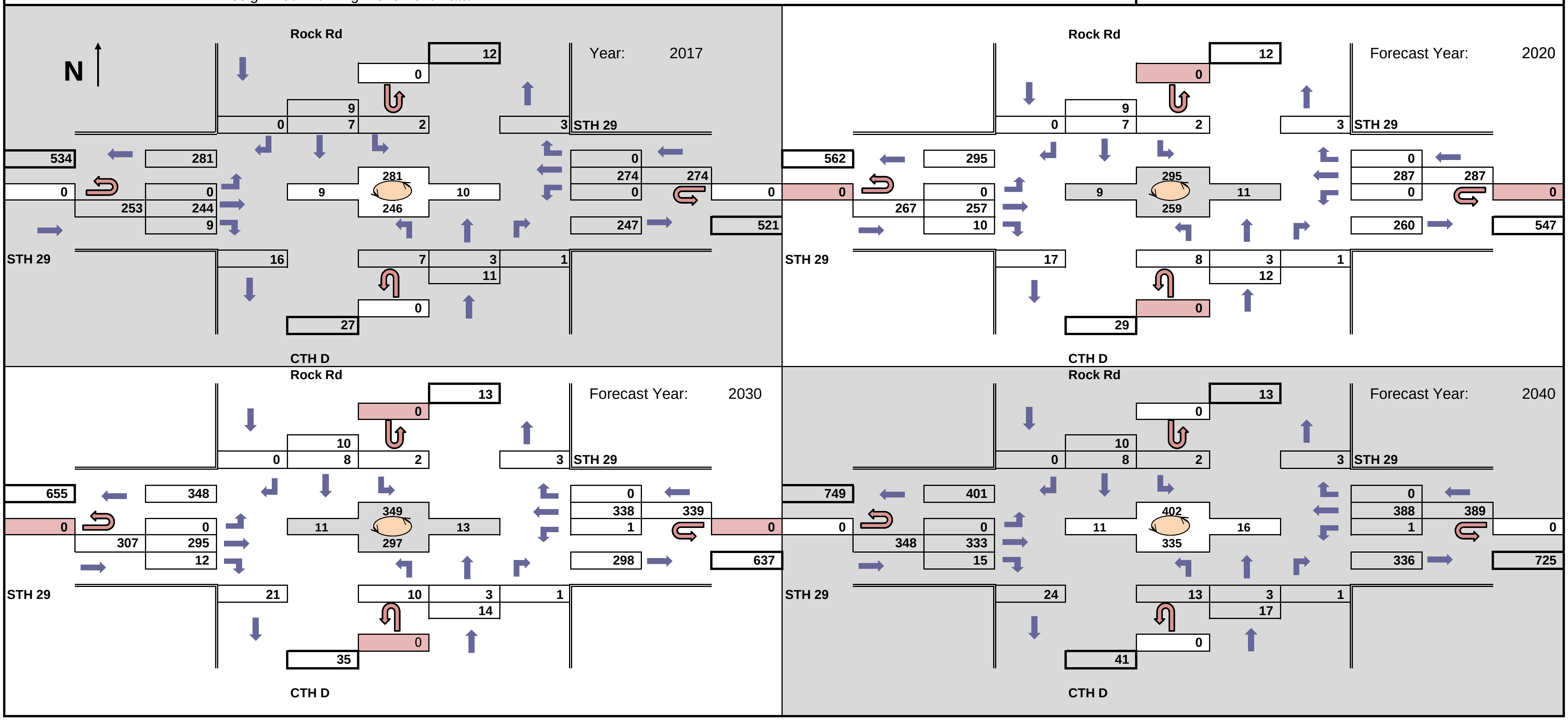
Design Hour: 7:15-8:15am

Forecast Completed: 7/13/2017

Design Hour Turning Movement Data

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected PM Design Hour Traffic Volumes

Indicates roundabout

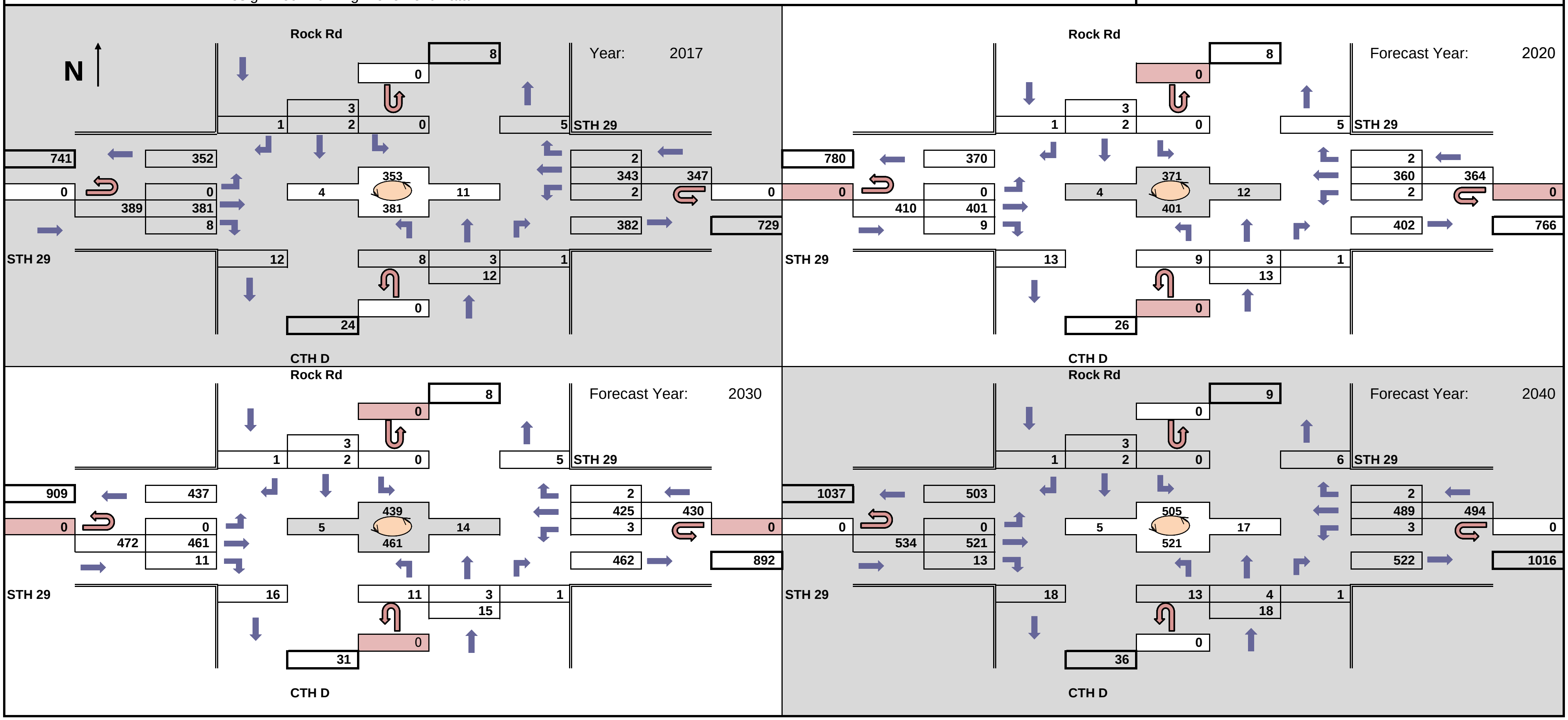
Design Hour: 4:00-5:00pm

Forecast Completed: 7/13/2017

Design Hour Turning Movement Data

Project Description

Project ID(s):	0656-43-04
Route(s):	STH 29
Region/COUNTY(IES):	NC / Marathon & Shawano
Location:	STH 49 - CTH F



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

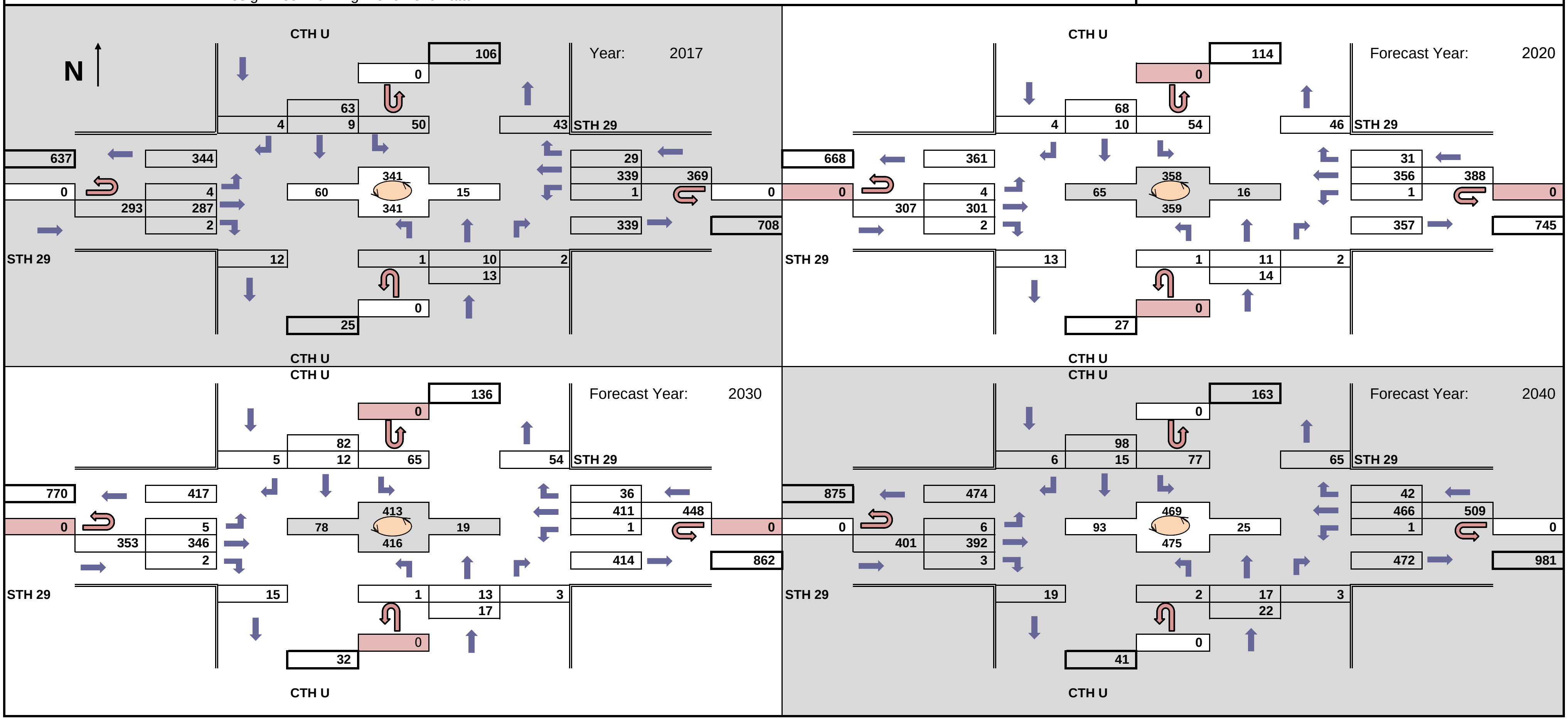
Design Hour: 7:30-8:30am

Forecast Completed: 7/13/2017

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F

Design Hour Turning Movement Data



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected PM Design Hour Traffic Volumes

Indicates roundabout

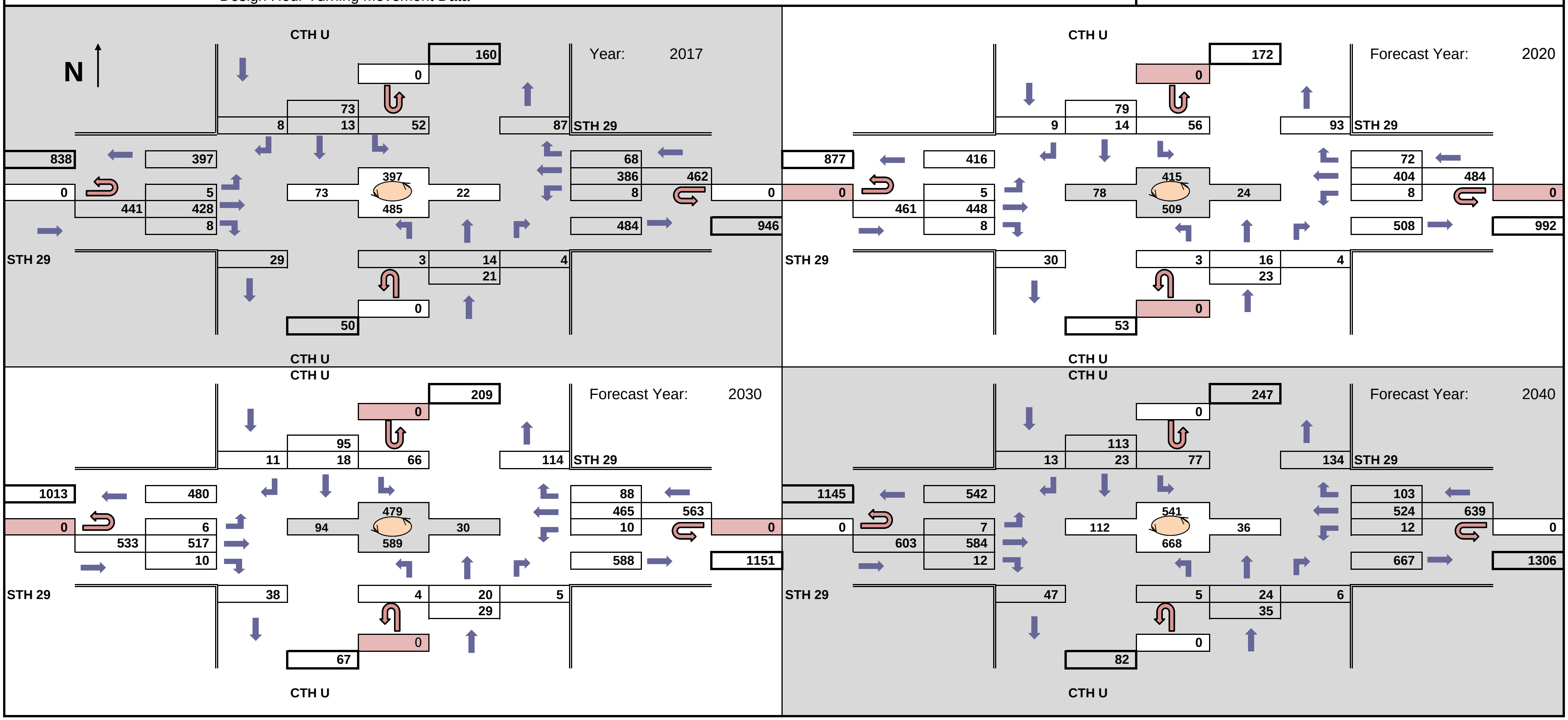
Design Hour: 4:00-5:00pm

Forecast Completed: 7/13/2017

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F

Design Hour Turning Movement Data



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

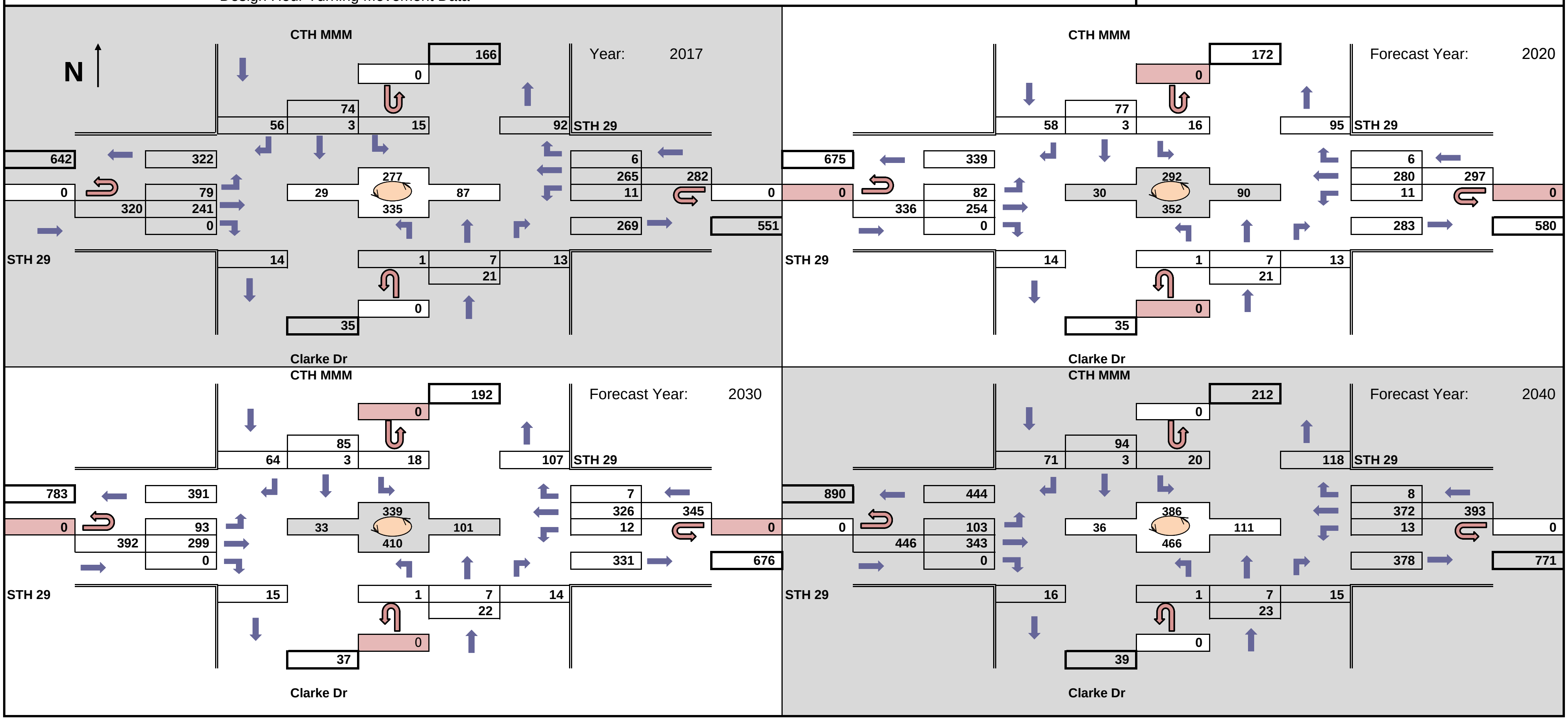
Design Hour: 7:15-8:15am

Forecast Completed: 7/13/2017

Design Hour Turning Movement Data

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected PM Design Hour Traffic Volumes

Indicates roundabout

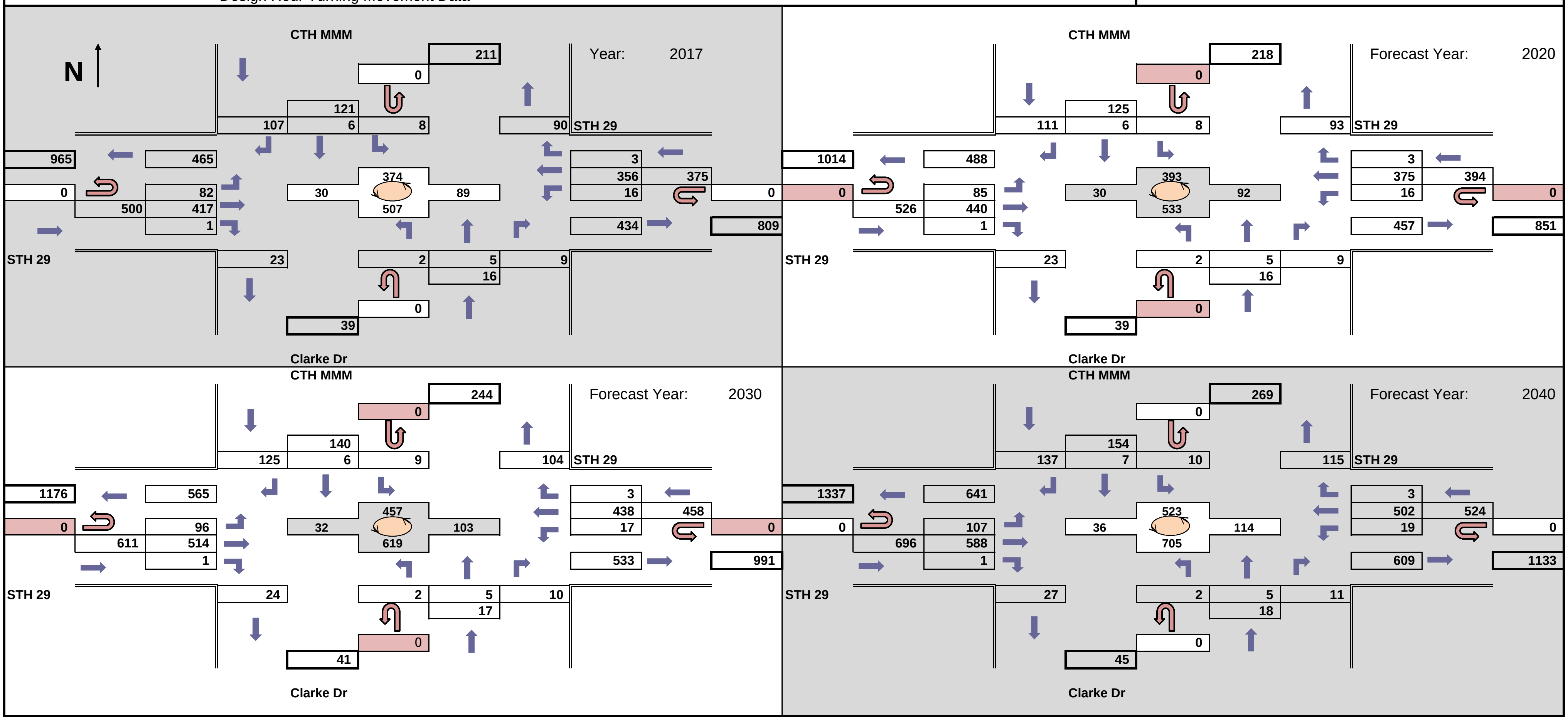
Design Hour: 4:00-5:00pm

Forecast Completed: 7/13/2017

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F

Design Hour Turning Movement Data



WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected AM Design Hour Traffic Volumes

Indicates roundabout

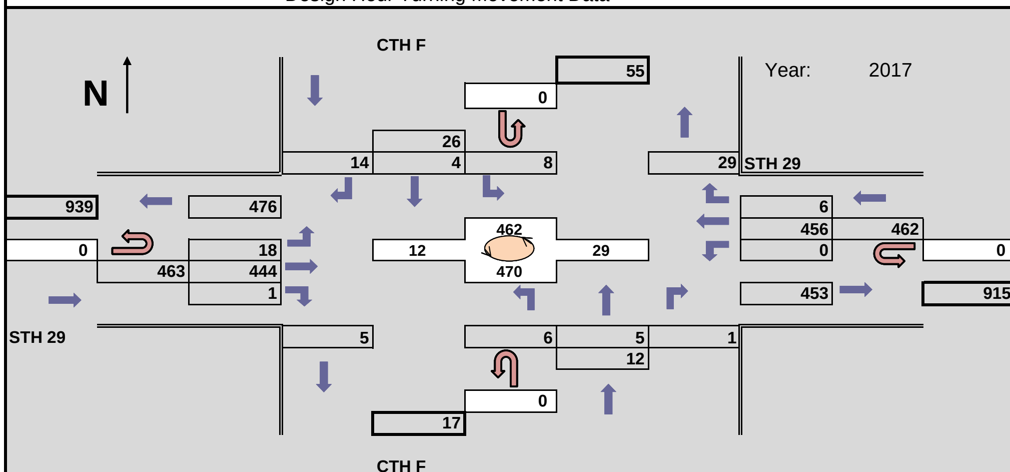
Design Hour: 7:15-8:15am

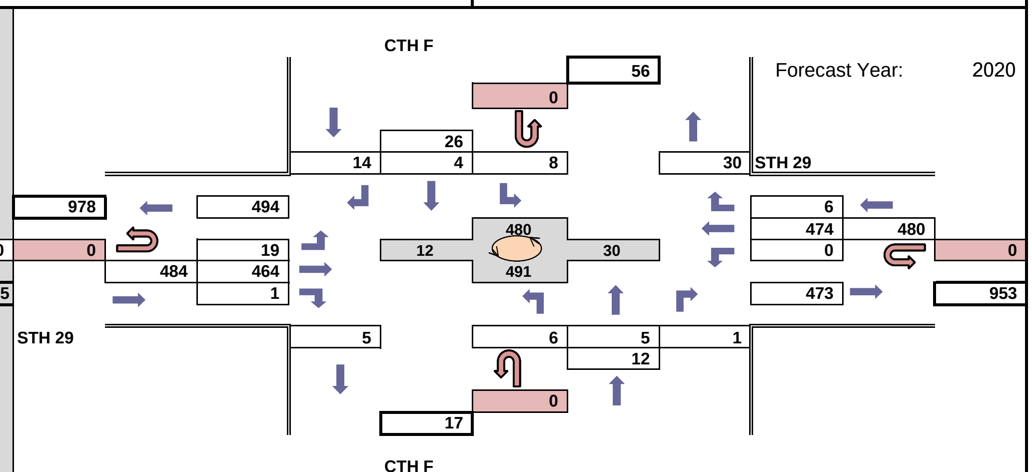
Forecast Completed: 7/13/2017

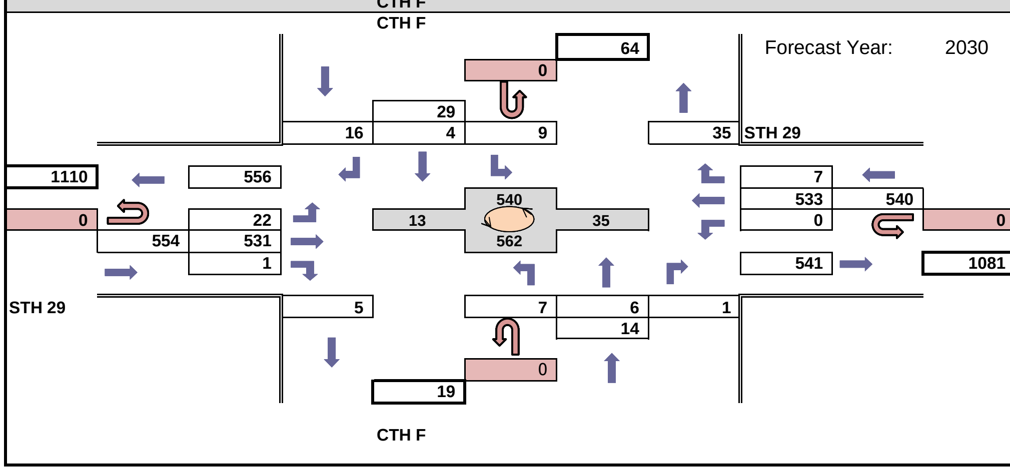
Design Hour Turning Movement Data

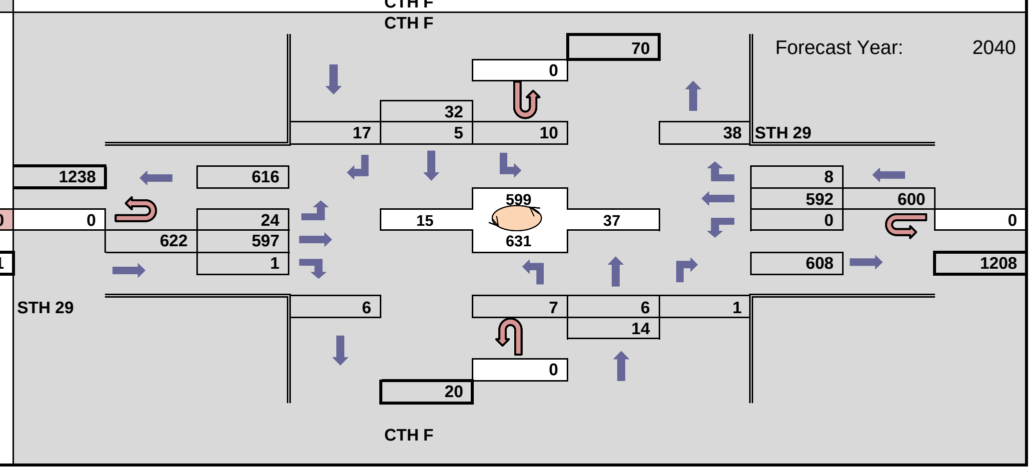
Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F









WisDot Bureau of Planning
Traffic Forecasting Section
Forecast by: Jacci Ziebert
Phone: 608-266-9646
Email: jacci.ziebert@dot.wi.gov

Projected PM Design Hour Traffic Volumes

Indicates roundabout

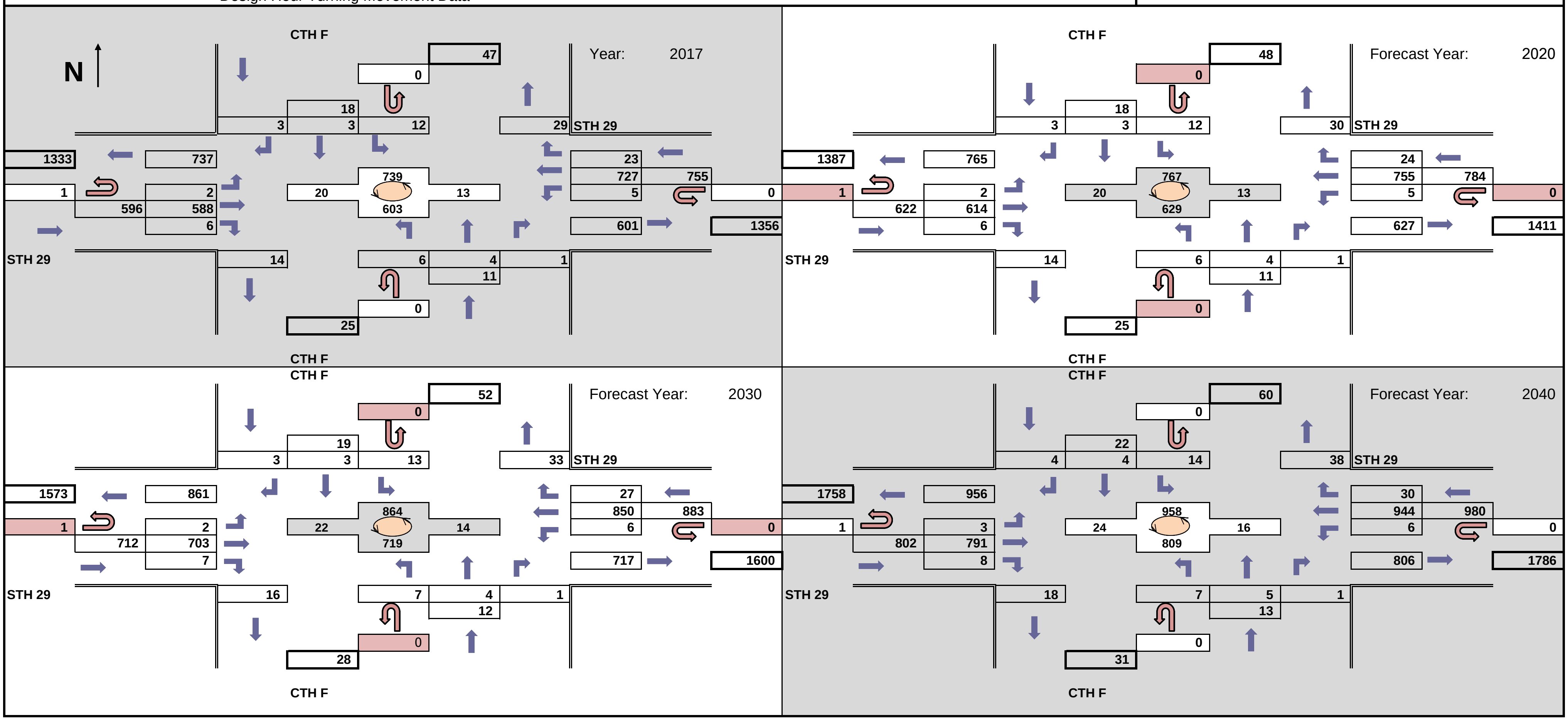
Design Hour: 4:15-5:15pm

Forecast Completed: 7/13/2017

Design Hour Turning Movement Data

Project Description

Project ID(s): 0656-43-04
Route(s): STH 29
Region/COUNTY(IES): NC / Marathon & Shawano
Location: STH 49 - CTH F



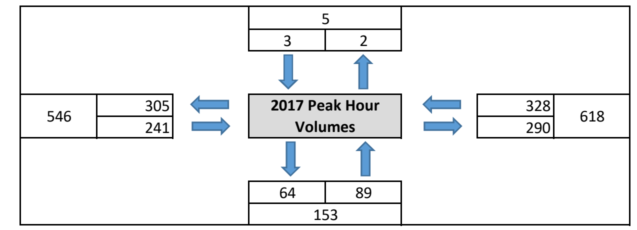
STH 29 Traffic Forecast Volumes: Growth Summary

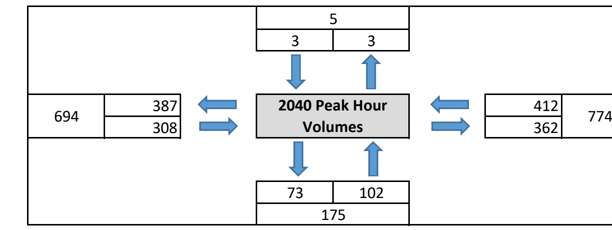
August 21, 2017 *Prepared by Strand Associates, Inc.*

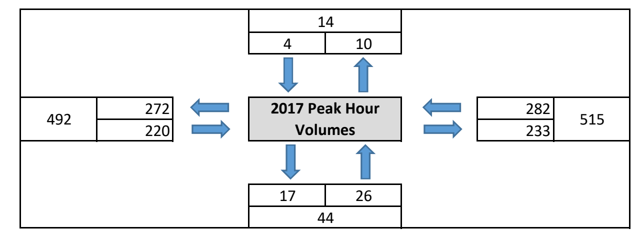
AM PEAK

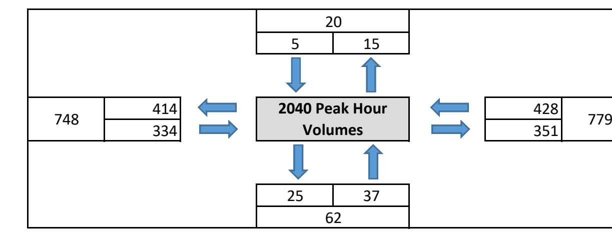
Location and Turning Movement	2017 Volumes (June, Count)	2040 Volumes (Forecast)	2017 Volumes (Annual Avg*)	2040 Volumes (Annual Avg*)	Absolute Growth	Percent Growth	Annual Growth
STH 29 and STH 49/Willow Drive	*726*	*906*	***661***	***824***	***164***	***24.8%***	***1.0%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*679*	*851*	***618***	***774***	***157***	***25.3%***	***1.0%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*600*	*763*	***546***	***694***	***148***	***27.2%***	***1.1%***
Two-Way Hourly Volumes (Willow Drive - North Leg)	*5*	*6*	***5***	***5***	***1***	***20.0%***	***0.8%***
Two-Way Hourly Volumes (STH 49 - South Leg)	*168*	*192*	***153***	***175***	***22***	***14.3%***	***0.6%***
EB Left	0	0	0	0	0	---	---
EB Thru	255	326	232	297	65	27.8%	1.1%
EB Right	10	12	9	11	2	20.0%	0.8%
NB Left	35	41	32	37	5	17.1%	0.7%
NB Thru	0	0	0	0	0	---	---
NB Right	63	71	57	65	7	12.7%	0.5%
WB Left	58	66	53	60	7	13.8%	0.6%
WB Thru	300	384	273	349	76	28.0%	1.1%
WB Right	2	3	2	3	1	50.0%	1.8%
SB Left	1	1	1	1	0	0.0%	0.0%
SB Thru	2	2	2	2	0	0.0%	0.0%
SB Right	0	0	0	0	0	---	---
STH 29 and CTH J	*585*	*884*	***532***	***804***	***272***	***51.1%***	***1.8%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*566*	*856*	***515***	***779***	***264***	***51.2%***	***1.8%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*541*	*822*	***492***	***748***	***256***	***51.9%***	***1.8%***
Two-Way Hourly Volumes (CTH J - North Leg)	*15*	*22*	***14***	***20***	***6***	***46.7%***	***1.7%***
Two-Way Hourly Volumes (CTH J - South Leg)	*48*	*68*	***44***	***62***	***18***	***41.7%***	***1.5%***
EB Left	4	6	4	5	2	50.0%	1.8%
EB Thru	236	359	215	327	112	52.1%	1.8%
EB Right	2	2	2	2	0	0.0%	0.0%
NB Left	4	6	4	5	2	50.0%	1.8%
NB Thru	6	9	5	8	3	50.0%	1.8%
NB Right	19	26	17	24	6	36.8%	1.4%
WB Left	17	25	15	23	7	47.1%	1.7%
WB Thru	292	444	266	404	138	52.1%	1.8%
WB Right	1	1	1	1	0	0.0%	0.0%
SB Left	1	1	1	1	0	0.0%	0.0%
SB Thru	0	0	0	0	0	---	---
SB Right	3	5	3	5	2	66.7%	2.2%
STH 29 and CTH D/Rock Road	*547*	*764*	***498***	***695***	***197***	***39.7%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*521*	*725*	***474***	***660***	***186***	***39.2%***	***1.4%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*534*	*749*	***486***	***682***	***196***	***40.3%***	***1.5%***
Two-Way Hourly Volumes (Rock Road - North Leg)	*12*	*13*	***11***	***12***	***1***	***8.3%***	***0.3%***
Two-Way Hourly Volumes (CTH D - South Leg)	*27*	*41*	***25***	***37***	***13***	***51.9%***	***1.8%***
EB Left	0	0	0	0	0	---	---
EB Thru	244	333	222	303	81	36.5%	1.4%
EB Right	9	15	8	14	5	66.7%	2.2%
NB Left	7	13	6	12	5	85.7%	2.7%
NB Thru	3	3	3	3	0	0.0%	0.0%
NB Right	1	1	1	1	0	0.0%	0.0%
WB Left	0	1	0	1	1	---	---
WB Thru	274	388	249	353	104	41.6%	1.5%
WB Right	0	0	0	0	0	---	---
SB Left	2	2	2	2	0	0.0%	0.0%
SB Thru	7	8	6	7	1	14.3%	0.6%
SB Right	0	0	0	0	0	---	---

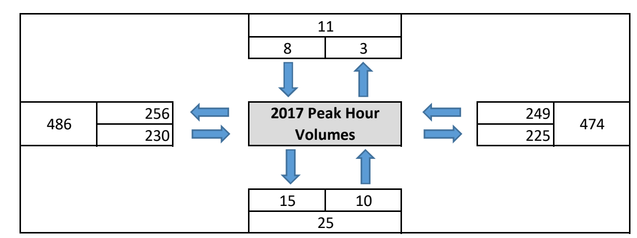
**The traffic counts performed in June 2017 were found to be 8 to 10 percent lower than the annual average counts along STH 29 based on analysis of the available historic traffic data (2010 to 2013) at ATR 580001 (1.8 miles east of CTH J). For this reason, the base year and design year intersection volumes used in the intersection traffic analysis were reduced by 9 percent.*

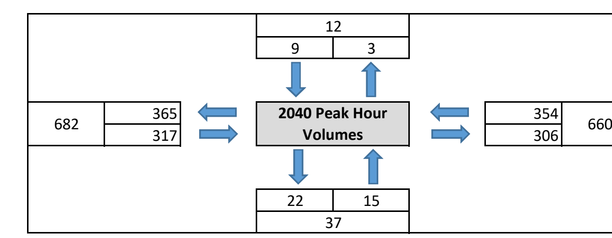












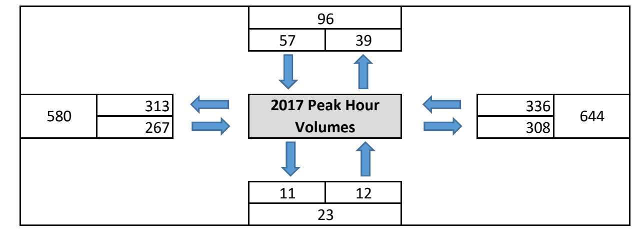
STH 29 Traffic Forecast Volumes: Growth Summary

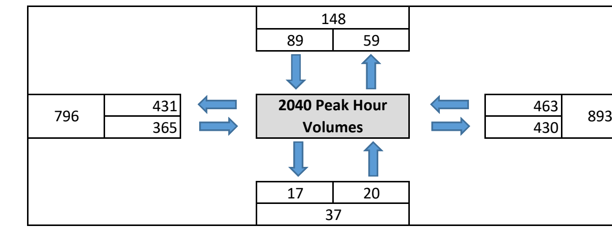
August 21, 2017 *Prepared by Strand Associates, Inc.*

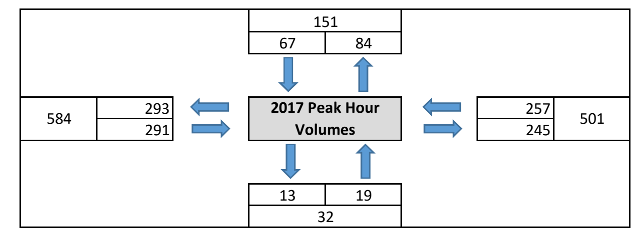
AM PEAK

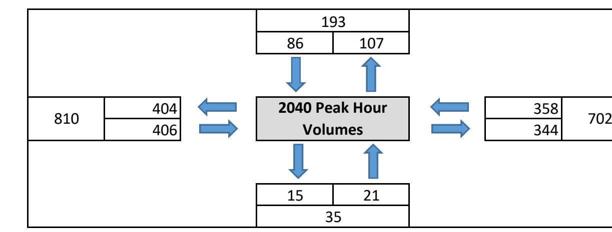
Location and Turning Movement	2017 Volumes (June, Count)	2040 Volumes (Forecast)	2017 Volumes (Annual Avg*)	2040 Volumes (Annual Avg*)	Absolute Growth	Percent Growth	Annual Growth
STH 29 and CTH U	*738*	*1,030*	***672***	***937***	***266***	***39.6%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*708*	*981*	***644***	***893***	***248***	***38.6%***	***1.4%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*637*	*875*	***580***	***796***	***217***	***37.4%***	***1.4%***
Two-Way Hourly Volumes (CTH U - North Leg)	*106*	*163*	***96***	***148***	***52***	***53.8%***	***1.9%***
Two-Way Hourly Volumes (CTH U - South Leg)	*25*	*41*	***23***	***37***	***15***	***64.0%***	***2.2%***
EB Left	4	6	4	5	2	50.0%	1.8%
EB Thru	287	392	261	357	96	36.6%	1.4%
EB Right	2	3	2	3	1	50.0%	1.8%
NB Left	1	2	1	2	1	100.0%	3.1%
NB Thru	10	17	9	15	6	70.0%	2.3%
NB Right	2	3	2	3	1	50.0%	1.8%
WB Left	1	1	1	1	0	0.0%	0.0%
WB Thru	339	466	308	424	116	37.5%	1.4%
WB Right	29	42	26	38	12	44.8%	1.6%
SB Left	50	77	46	70	25	54.0%	1.9%
SB Thru	9	15	8	14	5	66.7%	2.2%
SB Right	4	6	4	5	2	50.0%	1.8%
STH 29 and CTH MMM/Clark Drive	*697*	*956*	***634***	***870***	***236***	***37.2%***	***1.4%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*551*	*771*	***501***	***702***	***200***	***39.9%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*642*	*890*	***584***	***810***	***226***	***38.6%***	***1.4%***
Two-Way Hourly Volumes (CTH MMM - North Leg)	*166*	*212*	***151***	***193***	***42***	***27.7%***	***1.1%***
Two-Way Hourly Volumes (Clark Drive - South Leg)	*35*	*39*	***32***	***35***	***4***	***11.4%***	***0.5%***
EB Left	79	103	72	94	22	30.4%	1.2%
EB Thru	241	343	219	312	93	42.3%	1.5%
EB Right	0	0	0	0	0	---	---
NB Left	1	1	1	1	0	0.0%	0.0%
NB Thru	7	7	6	6	0	0.0%	0.0%
NB Right	13	15	12	14	2	15.4%	0.6%
WB Left	11	13	10	12	2	18.2%	0.7%
WB Thru	265	372	241	339	97	40.4%	1.5%
WB Right	6	8	5	7	2	33.3%	1.3%
SB Left	15	20	14	18	5	33.3%	1.3%
SB Thru	3	3	3	3	0	0.0%	0.0%
SB Right	56	71	51	65	14	26.8%	1.0%
STH 29 and CTH F	*963*	*1,268*	***876***	***1,154***	***278***	***31.7%***	***1.2%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*915*	*1,208*	***833***	***1,099***	***267***	***32.0%***	***1.2%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*939*	*1,238*	***854***	***1,127***	***272***	***31.8%***	***1.2%***
Two-Way Hourly Volumes (CTH F - North Leg)	*55*	*70*	***50***	***64***	***14***	***27.3%***	***1.1%***
Two-Way Hourly Volumes (CTH F - South Leg)	*17*	*20*	***15***	***18***	***3***	***17.6%***	***0.7%***
EB U-Turn	0	0	0	0	0	---	---
EB Left	18	24	16	22	5	33.3%	1.3%
EB Thru	444	597	404	543	139	34.5%	1.3%
EB Right	1	1	1	1	0	0.0%	0.0%
NB Left	6	7	5	6	1	16.7%	0.7%
NB Thru	5	6	5	5	1	20.0%	0.8%
NB Right	1	1	1	1	0	0.0%	0.0%
WB Left	0	0	0	0	0	---	---
WB Thru	456	592	415	539	124	29.8%	1.1%
WB Right	6	8	5	7	2	33.3%	1.3%
SB Left	8	10	7	9	2	25.0%	1.0%
SB Thru	4	5	4	5	1	25.0%	1.0%
SB Right	14	17	13	15	3	21.4%	0.8%

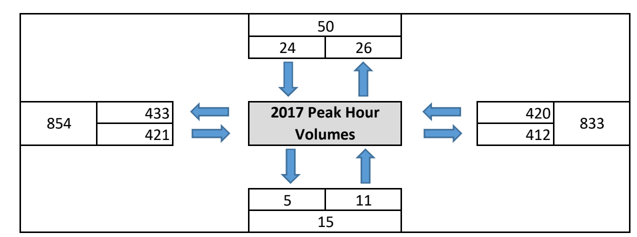
**The traffic counts performed in June 2017 were found to be 8 to 10 percent lower than the annual average counts along STH 29 based on analysis of the available historic traffic data (2010 to 2013) at ATR 580001 (1.8 miles east of CTH J). For this reason, the base year and design year intersection volumes used in the intersection traffic analysis were reduced by 9 percent.*

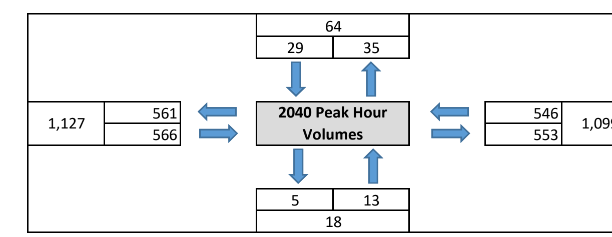












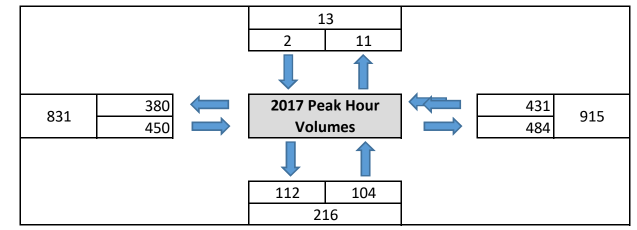
STH 29 Traffic Forecast Volumes: Growth Summary

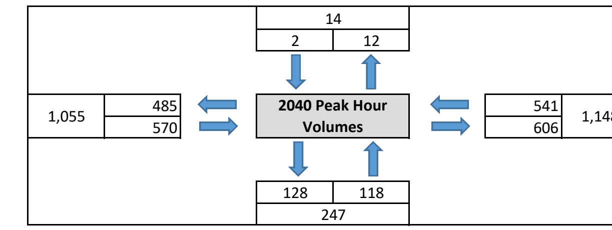
August 21, 2017 *Prepared by Strand Associates, Inc.*

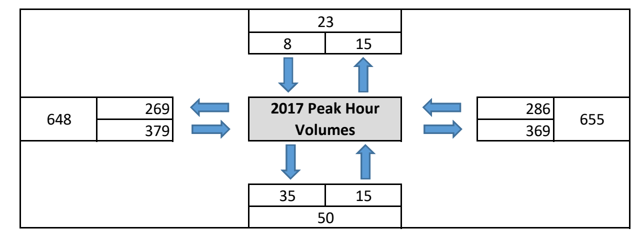
PM PEAK

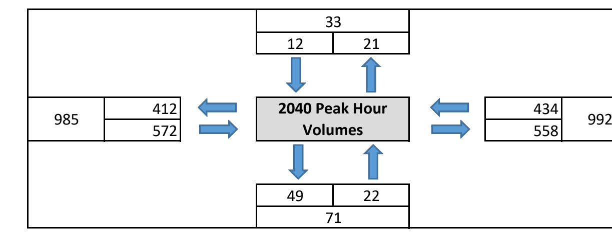
Location and Turning Movement	2017 Volumes (June, Count)	2040 Volumes (Forecast)	2017 Volumes (Annual Avg*)	2040 Volumes (Annual Avg*)	Absolute Growth	Percent Growth	Annual Growth
STH 29 and STH 49/Willow Drive	*1,085*	*1,353*	***987***	***1,231***	***244***	***24.7%***	***1.0%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*1,006*	*1,261*	***915***	***1,148***	***232***	***25.3%***	***1.0%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*913*	*1,159*	***831***	***1,055***	***224***	***26.9%***	***1.0%***
Two-Way Hourly Volumes (Willow Drive - North Leg)	*14*	*15*	***13***	***14***	***1***	***7.1%***	***0.3%***
Two-Way Hourly Volumes (STH 49 - South Leg)	*237*	*271*	***216***	***247***	***31***	***14.3%***	***0.6%***
EB Left	2	2	2	2	0	0.0%	0.0%
EB Thru	452	576	411	524	113	27.4%	1.1%
EB Right	41	48	37	44	6	17.1%	0.7%
NB Left	27	32	25	29	5	18.5%	0.7%
NB Thru	8	9	7	8	1	12.5%	0.5%
NB Right	79	89	72	81	9	12.7%	0.5%
WB Left	81	92	74	84	10	13.6%	0.6%
WB Thru	391	501	356	456	100	28.1%	1.1%
WB Right	2	2	2	2	0	0.0%	0.0%
SB Left	1	1	1	1	0	0.0%	0.0%
SB Thru	1	1	1	1	0	0.0%	0.0%
SB Right	0	0	0	0	0	---	---
STH 29 and CTH J	*756*	*1,143*	***688***	***1,040***	***352***	***51.2%***	***1.8%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*720*	*1,090*	***655***	***992***	***337***	***51.4%***	***1.8%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*712*	*1,082*	***648***	***985***	***337***	***52.0%***	***1.8%***
Two-Way Hourly Volumes (CTH J - North Leg)	*25*	*36*	***23***	***33***	***10***	***44.0%***	***1.6%***
Two-Way Hourly Volumes (CTH J - South Leg)	*55*	*78*	***50***	***71***	***21***	***41.8%***	***1.5%***
EB Left	9	14	8	13	5	55.6%	1.9%
EB Thru	399	603	363	549	186	51.1%	1.8%
EB Right	8	12	7	11	4	50.0%	1.8%
NB Left	5	7	5	6	2	40.0%	1.5%
NB Thru	5	7	5	6	2	40.0%	1.5%
NB Right	7	10	6	9	3	42.9%	1.6%
WB Left	23	33	21	30	9	43.5%	1.6%
WB Thru	289	442	263	402	139	52.9%	1.9%
WB Right	2	2	2	2	0	0.0%	0.0%
SB Left	0	0	0	0	0	---	---
SB Thru	7	9	6	8	2	28.6%	1.1%
SB Right	2	4	2	4	2	100.0%	3.1%
STH 29 and CTH D/Rock Road	*751*	*1,049*	***683***	***955***	***271***	***39.7%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*729*	*1,016*	***663***	***925***	***261***	***39.4%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*741*	*1,037*	***674***	***944***	***269***	***39.9%***	***1.5%***
Two-Way Hourly Volumes (Rock Road - North Leg)	*8*	*9*	***7***	***8***	***1***	***12.5%***	***0.5%***
Two-Way Hourly Volumes (CTH D - South Leg)	*24*	*36*	***22***	***33***	***11***	***50.0%***	***1.8%***
EB Left	0	0	0	0	0	---	---
EB Thru	381	521	347	474	127	36.7%	1.4%
EB Right	8	13	7	12	5	62.5%	2.1%
NB Left	8	13	7	12	5	62.5%	2.1%
NB Thru	3	4	3	4	1	33.3%	1.3%
NB Right	1	1	1	1	0	0.0%	0.0%
WB Left	2	3	2	3	1	50.0%	1.8%
WB Thru	343	489	312	445	133	42.6%	1.6%
WB Right	2	2	2	2	0	0.0%	0.0%
SB Left	0	0	0	0	0	---	---
SB Thru	2	2	2	2	0	0.0%	0.0%
SB Right	1	1	1	1	0	0.0%	0.0%

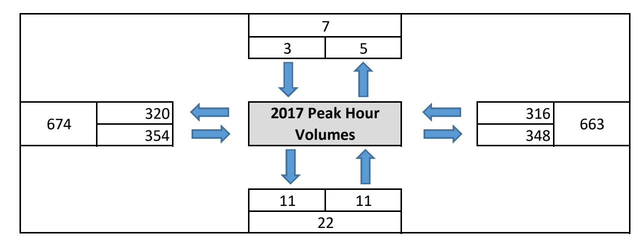
**The traffic counts performed in June 2017 were found to be 8 to 10 percent lower than the annual average counts along STH 29 based on analysis of the available historic traffic data (2010 to 2013) at ATR 580001 (1.8 miles east of CTH J). For this reason, the base year and design year intersection volumes used in the intersection traffic analysis were reduced by 9 percent.*

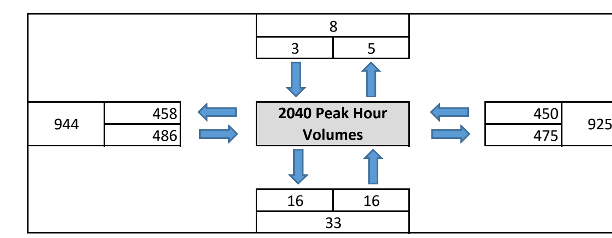












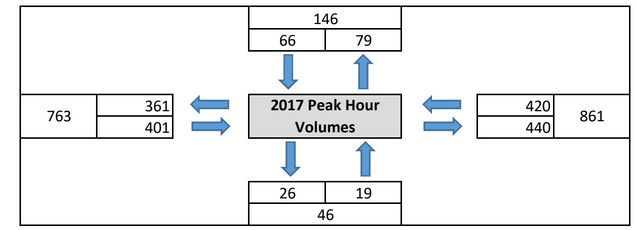
STH 29 Traffic Forecast Volumes: Growth Summary

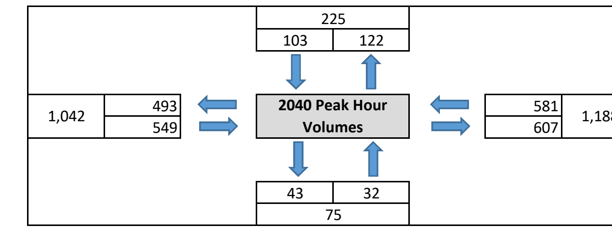
August 21, 2017 *Prepared by Strand Associates, Inc.*

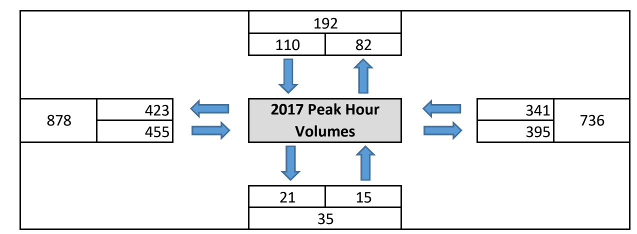
PM PEAK

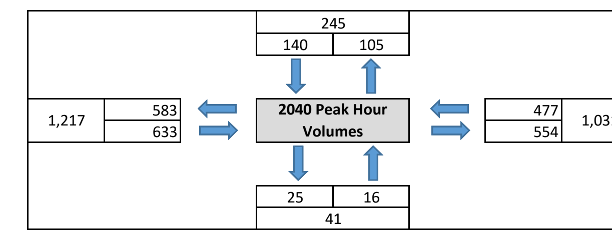
Location and Turning Movement	2017 Volumes (June, Count)	2040 Volumes (Forecast)	2017 Volumes (Annual Avg*)	2040 Volumes (Annual Avg*)	Absolute Growth	Percent Growth	Annual Growth
STH 29 and CTH U	*997*	*1,390*	***907***	***1,265***	***358***	***39.4%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*946*	*1,306*	***861***	***1,188***	***328***	***38.1%***	***1.4%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*838*	*1,145*	***763***	***1,042***	***279***	***36.6%***	***1.4%***
Two-Way Hourly Volumes (CTH U - North Leg)	*160*	*247*	***146***	***225***	***79***	***54.4%***	***1.9%***
Two-Way Hourly Volumes (CTH U - South Leg)	*50*	*82*	***46***	***75***	***29***	***64.0%***	***2.2%***
EB Left	5	7	5	6	2	40.0%	1.5%
EB Thru	428	584	389	531	142	36.4%	1.4%
EB Right	8	12	7	11	4	50.0%	1.8%
NB Left	3	5	3	5	2	66.7%	2.2%
NB Thru	14	24	13	22	9	71.4%	2.4%
NB Right	4	6	4	5	2	50.0%	1.8%
WB Left	8	12	7	11	4	50.0%	1.8%
WB Thru	386	524	351	477	126	35.8%	1.3%
WB Right	68	103	62	94	32	51.5%	1.8%
SB Left	52	77	47	70	23	48.1%	1.7%
SB Thru	13	23	12	21	9	76.9%	2.5%
SB Right	8	13	7	12	5	62.5%	2.1%
STH 29 and CTH MMM/Clark Drive	*1,012*	*1,392*	***921***	***1,267***	***346***	***37.5%***	***1.4%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*809*	*1,133*	***736***	***1,031***	***295***	***40.0%***	***1.5%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*965*	*1,337*	***878***	***1,217***	***339***	***38.5%***	***1.4%***
Two-Way Hourly Volumes (CTH MMM - North Leg)	*211*	*269*	***192***	***245***	***53***	***27.5%***	***1.1%***
Two-Way Hourly Volumes (Clark Drive - South Leg)	*39*	*45*	***35***	***41***	***5***	***15.4%***	***0.6%***
EB Left	82	107	75	97	23	30.5%	1.2%
EB Thru	417	588	379	535	156	41.0%	1.5%
EB Right	1	1	1	1	0	0.0%	0.0%
NB Left	2	2	2	2	0	0.0%	0.0%
NB Thru	5	5	5	5	0	0.0%	0.0%
NB Right	9	11	8	10	2	22.2%	0.9%
WB Left	16	19	15	17	3	18.8%	0.7%
WB Thru	356	502	324	457	133	41.0%	1.5%
WB Right	3	3	3	3	0	0.0%	0.0%
SB Left	8	10	7	9	2	25.0%	1.0%
SB Thru	6	7	5	6	1	16.7%	0.7%
SB Right	107	137	97	125	27	28.0%	1.1%
STH 29 and CTH F	*1,381*	*1,818*	***1,257***	***1,654***	***398***	***31.6%***	***1.2%***
Two-Way Hourly Volumes (STH 29 - East Leg)	*1,356*	*1,786*	***1,234***	***1,625***	***391***	***31.7%***	***1.2%***
Two-Way Hourly Volumes (STH 29 - West Leg)	*1,333*	*1,758*	***1,213***	***1,600***	***387***	***31.9%***	***1.2%***
Two-Way Hourly Volumes (CTH F - North Leg)	*47*	*60*	***43***	***55***	***12***	***27.7%***	***1.1%***
Two-Way Hourly Volumes (CTH F - South Leg)	*25*	*31*	***23***	***28***	***5***	***24.0%***	***0.9%***
EB U-Turn	1	1	1	1	0	0.0%	0.0%
EB Left	2	3	2	3	1	50.0%	1.8%
EB Thru	588	791	535	720	185	34.5%	1.3%
EB Right	6	8	5	7	2	33.3%	1.3%
NB Left	6	7	5	6	1	16.7%	0.7%
NB Thru	4	5	4	5	1	25.0%	1.0%
NB Right	1	1	1	1	0	0.0%	0.0%
WB Left	5	6	5	5	1	20.0%	0.8%
WB Thru	727	944	662	859	197	29.8%	1.1%
WB Right	23	30	21	27	6	30.4%	1.2%
SB Left	12	14	11	13	2	16.7%	0.7%
SB Thru	3	4	3	4	1	33.3%	1.3%
SB Right	3	4	3	4	1	33.3%	1.3%

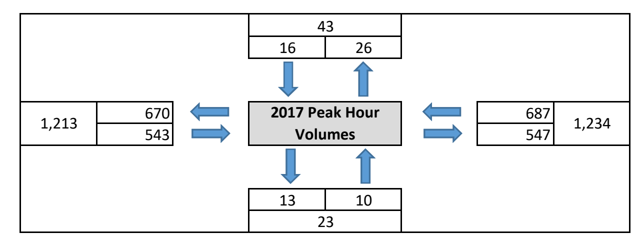
**The traffic counts performed in June 2017 were found to be 8 to 10 percent lower than the annual average counts along STH 29 based on analysis of the available historic traffic data (2010 to 2013) at ATR 580001 (1.8 miles east of CTH J). For this reason, the base year and design year intersection volumes used in the intersection traffic analysis were reduced by 9 percent.*

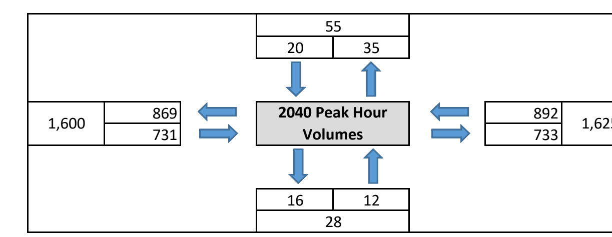












APPENDIX B
GEOMETRIC DEFICIENCY SUMMARY TABLES

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and STH 49/Willow Drive Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	69.9 or 110.1 Degrees
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	2,800' using 5.5% super	2,040' using 6% max super	4,584 FT
Curve Radius (through intersection and east)	2,800' using 5.5% super	2,040' using 6% max super	2,865 FT
Superelevation	---	---	5.50%
Vertical Curve K Values (Crest)	566	247	666 east of intersection and 1,171 west of intersection
Vertical Curve K Values (Sag)	287	210	1,707
Vertical Profile Tangent Grades	---	---	0.52% max.
EB Turn Bay Length (Left Turn Lane)	400'	300'	~25'
WB Turn Bay Length (Left Turn Lane)	550'	450'	~130'
EB Turn Bay Length (Right Turn Lane)	450'	450'	350'
WB Turn Bay Length (Right Turn Lane)	300'	300'	No turn bay storage per as-builts. Google shows ~200' turn bay.

Does not meet current FDM standards

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and CTH J Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	93.2 degrees north leg 103.8 degrees south leg
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	2,310' using 5.9% super	2,040' using 6% max super	2,291 FT
Curve Radius (east of intersection)	2,310' using 5.9% super	2,040' using 6% max super	11,460 FT
Superelevation	---	---	5.9% west of intersection 2.0% east of intersection
Vertical Curve K Values (Crest)	566	247	262 west of intersection 564 east of intersection
Vertical Curve K Values (Sag)	287	210	150 min east of intersection
Vertical Profile Tangent Grades	---	---	3.63% max.
EB Turn Bay Length (Left Turn Lane)	400'	300'	~420'
WB Turn Bay Length (Left Turn Lane)	550'	450'	450' reconstructed with WB Bridge replacement
EB Turn Bay Length (Right Turn Lane)	450'	450'	~350'
WB Turn Bay Length (Right Turn Lane)	300'	300'	350' reconstructed with WB Bridge replacement

Does not meet current FDM standards
Meets min, but not desirable FDM standards

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and CTH D/Rock Road Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	73.4 or 106.6 Degrees
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	2,310' using 5.93% super	2,040' using 6% max super	2,083 FT
Curve Radius (east of intersection)	2,310' using 5.93% super	2,040' using 6% max super	2,083 FT
Superelevation	---	---	5.93%
Vertical Curve K Values (Crest)	566	247	291 west of intersection 840 east of intersection
Vertical Curve K Values (Sag)	287	210	210 min east of intersection
Vertical Profile Tangent Grades	---	---	3.63% max.
EB Turn Bay Length (Left Turn Lane)	400'	300'	No turn bay storage per as-builts. Google shows ~60' turn bay.
WB Turn Bay Length (Left Turn Lane)	400'	300'	~405'
EB Turn Bay Length (Right Turn Lane)	300'	300'	~345'
WB Turn Bay Length (Right Turn Lane)	300'	300'	No turn bay storage per as-builts. Google shows ~170' turn bay.

Does not meet current FDM standards

Meets min, but not desirable FDM standards

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and CTH U Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	88.7 or 91.3 Degrees
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	10,300' using RC super	2,040' using 6% max super	11,460 FT
Curve Radius (east of intersection)	10,300' using RC super	2,040' using 6% max super	11,460 FT
Superelevation	---	---	2.00%
Vertical Curve K Values (Crest)	566	247	340 west of intersection 335 east of intersection
Vertical Curve K Values (Sag)	287	210	165 west of intersection 540 east of intersection
Vertical Profile Tangent Grades	---	---	3.52% max.
EB Turn Bay Length (Left Turn Lane)	550'	450'	~350'
WB Turn Bay Length (Left Turn Lane)	550'	300'	~350'
EB Turn Bay Length (Right Turn Lane)	450'	300'	~350'
WB Turn Bay Length (Right Turn Lane)	450'	450'	~350'

Does not meet current FDM standards

Meets min, but not desirable FDM standards

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and CTH MMM (BUS 29) Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	63.2 or 116.8 Degrees
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	3,220' using 5.1% super	2,040' using 6% max super	N/A
Curve Radius (east of intersection)	3,220' using 5.1% super	2,040' using 6% max super	3,275 FT
Superelevation	---	---	5.10%
Vertical Curve K Values (Crest)	566	247	945 west of intersection 1,800 east of intersection
Vertical Curve K Values (Sag)	287	210	1,360 west of intersection 1,800 east of intersection
Vertical Profile Tangent Grades	---	---	0.50% max.
EB Turn Bay Length (Left Turn Lane)	550'	450'	~350'
WB Turn Bay Length (Left Turn Lane)	400'	300'	~350'
EB Turn Bay Length (Right Turn Lane)	300'	300'	~25'
WB Turn Bay Length (Right Turn Lane)	450'	450'	~350'

Does not meet current FDM standards

Geometric Deficiencies Summary

Date: 07/27/2017

STH 29 and CTH F Intersection			
STH 29 Existing Conditions			
Criteria	**Desirable**	**Min**	**Provided**
Lane Width	12'	---	12'
Shoulder Width (Left)	6'	---	6' (3' paved 3' aggregate)
Shoulder Width (Right)	10'	---	10' (8' paved 2' aggregate)
Median Width	60'	---	60'
Bridge Width	N/A	N/A	N/A
Intersection Skew	between 75 and 105 degrees	between 70 and 110 degrees	64.3 or 115.7 Degrees
Cross Slope (Lanes)	2%	---	2%
Cross Slope (Shoulders)	4%	---	4%
Curve Radius (west of intersection)	10,300' using RC super	2,040' using 6% max super	11,460 FT
Curve Radius (east of intersection)	10,300' using RC super	2,040' using 6% max super	11,460 FT
Superelevation	---	---	2.00%
Vertical Curve K Values (Crest)	566	247	400 through intersection 150 east of intersection
Vertical Curve K Values (Sag)	287	210	412 west of intersection 308 east of intersection
Vertical Profile Tangent Grades	---	---	3.56% max.
EB Turn Bay Length (Left Turn Lane)	550'	450'	No turn bay storage per as-builts. Google shows ~230' turn bay.
WB Turn Bay Length (Left Turn Lane)	400'	300'	No turn bay storage per as-builts. Google shows ~205' turn bay.
EB Turn Bay Length (Right Turn Lane)	300'	300'	No turn bay storage per as-builts. Google shows ~205' turn bay.
WB Turn Bay Length (Right Turn Lane)	450'	450'	No turn bay storage per as-builts. Google shows ~135' turn bay.

Does not meet current FDM standards

Meets min, but not desirable FDM standards

APPENDIX C
LETTERS OF SUPPORT FOR STH 29 SAFETY STUDY

Honoring Tradition • Discovering Tomorrow
Since 1853
SHAWANO COUNTY
Wisconsin

Shawano County Highway Dept.

Grant Bystol / Highway Commissioner

3035 E. Richmond, Shawano, WI 54166 * 715-526-9182 * Fax (715)524-4162 * www.co.shawano.wi.us

April 17, 2017

Tony Kemnitz, P.E. – Traffic Safety Engineer
Wisconsin Department of Transportation
1681 2nd Avenue, South
Wisconsin Rapids, WI 54495

Dear Mr. Kemnitz,

Please accept this letter on behalf of Shawano County Highway Committee as support for the WisDOT North Central Region's application to request highway safety funding to facilitate the review and reconstruction of the STH 29 at grade intersections with CTH F, CTH MMM, CTH U, CTH D/Rock Road, and CTH J, within Shawano County. These intersections have been the site of multiple crashes over the last 5-10 years.

A combination of vertical profile issues as well as some of these roadways meeting at a skew or on a curve provide less than desirable conditions. Current crash trends show this pattern continuing. This issue is of great concern for the Shawano County Highway Committee and we request that this work be completed as soon as practical. Please contact me if there is any additional information the County can provide to assist in moving this safety initiative forward.

Sincerely,

Tom Kautza
Chairman
Shawano County Highway Committee

Grant Bystol
Highway Commissioner
Shawano County

CC: Senator Robert Cowles
Senator Thomas Tiffany
Representative Gary Tauchen
Representative Jeffrey Mursau

Enc:

SHAWANO COUNTY SHERIFF'S OFFICE

Sheriff Adam C. Bieber

George Lenzner
Chief Deputy

Greg Trinko
Jail Administrator

April 25, 2017

Tony Kemnitz, P.E. – Traffic Safety Engineer
Wisconsin Department of Transportation
1681 2nd Avenue, South
Wisconsin Rapids, Wisconsin 54495

Dear Mr. Kemnitz

The Shawano County Highway Safety Commission has discussed recently the safety issues at multiple intersections on State Highway 29 located in Shawano County. The intersections in question are located at Highway 29/County U, Highway 29/County MMM, Highway 29/County F and Highway 29/County J. Due to multiple accidents including fatalities this Commission would like to express their concern for public safety regarding Highway 29. The Highway Commission is in support of improvements on the Highway 29 corridor to reduce the number and severity of crashes in these areas.

The main complaints in these areas are the increased traffic flow due to the expansion of area businesses, which includes the North Star Casino, and limited visibility. In total, there have been five fatalities in these areas in the last five years in Shawano County. Two of these fatalities have occurred within the last 6 months. Additional, there were 15 reported personal injury accidents in these intersections from 2012 to the present. It is anticipated that these numbers will continue to follow this uphill movement in the years to come.

Please accept this letter on behalf of the Shawano County Highway Safety Commission to request the Wisconsin Department of Transportation to investigate possible safety improvements on WIS 29 at the intersections of CTH U, CTH MMM, CTH F and CTH J, along with possible HSIP funding to develop an improvement project to mitigate the ongoing traffic accidents. Please contact me if there is any additional information the County can provide to assist in moving this safety initiative forward. Your efforts in this matter are appreciated.

Sincerely,

Steve Gueths
Chairman
Shawano County Highway Safety Commission

25 April 2017

Tony Kemnitz, P.E. – Traffic Safety Engineer
Wisconsin Department of Transportation
1681 2nd Avenue, South
Wisconsin Rapids, WI 54495

Mr. Kemnitz,

Having been a part of the discussion relating to the at-grade intersections on State Highway 29 at today's Shawano County Highway Safety Committee meeting, I am writing to express my support and urge that any possible improvements which can be made are pursued. I personally have responded to fatal crashes at each of the County U, County MMM, and County F intersections, as well as countless personal injury crashes at each. These are very busy interior corridors, and the volume of traffic makes it inevitable to avoid further injuries and loss of life without design improvements.

When Shawano Ambulance receives a report of a crash at one of these intersections, regardless of the information our dispatch center provides, we generally "float" an *extra* one or two ambulances in that direction (in addition to the responding ambulances) due to the fact that our experience has shown that the potential for serious injuries at these locations is extremely high. Just recently, we responded to County U and 29 for a report of two people injured, only to find 6 injured and one DOA. When we receive calls to these intersections, we automatically prepare for the worst.

Our paramedics see firsthand the tragedies originating from these known problem areas. On behalf of Shawano Ambulance Service, please accept this letter to underscore the need for improvements at (or replacement of) these dangerous at-grade intersections.

Sincerely,

Patrick A. Trinko
Director of Operations

cc: Senator Robert Cowles
Senator Thomas Tiffany
Representative Gary Tauchen
Representative Jeffrey Mursau

APPENDIX D
INTERSECTION CONTROL EVALUATION REPORTS (BODY)

To: Tony Kemnitz, P.E., PTOE
From: Joseph Urban, P.E., Strand Associates, Inc.®
Adam Walter, Strand Associates, Inc.®
Brenden Johnson, Strand Associates, Inc.®
Date: 3/29/2018
RE: 0656-43-04
STH 29 and CTH J
Town of Morris, Shawano County
Highway Safety Improvement Program (HSIP)

Section 1: Project Description

The Wisconsin Department of Transportation (WisDOT) is currently investigating the intersection of STH 29 and CTH J, located in the town of Morris in Shawano County, as a candidate for HSIP funding. The purpose of this Intersection Control Evaluation (ICE) is to identify the most viable alternatives to improve intersection safety at STH 29 and CTH J. The study limits extend approximately 1.2 miles from Fink Road/River Road to CTH J as shown in Figure 1, which includes the functional area of the CTH J intersection. See Attachment A for a complete map of the surrounding street network.

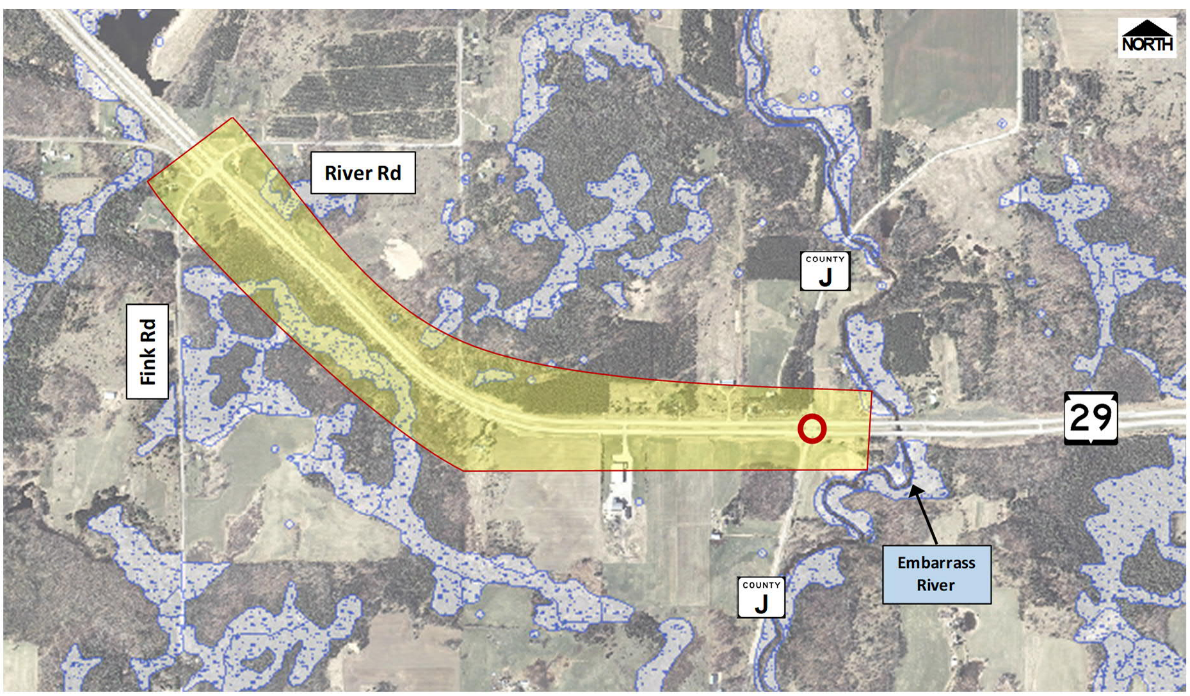


Figure 1–STH 29 and CTH J Intersection

Section 2: Existing Conditions

STH 29 is a 4-lane divided rural highway with a 60-foot median and a posted speed limit of 65 miles per hour (mph). CTH J is a 2-lane undivided rural highway with a posted speed limit of 55 mph. The northbound (NB) and southbound (SB) approaches of CTH J are stop controlled. The CTH J NB and SB approach tapers provide space for through/left and right turning vehicles to stack next to each other at the stop bar. The Embarrass River crosses STH 29 approximately 800 feet to the east of the intersection. The westbound (WB) STH 29 bridge over the Embarrass River was replaced in 2016.

Strand Associates, Inc.® performed a review of the geometric deficiencies at the intersection based upon As-Built plans provided by WisDOT, a site visit performed in July 27, 2017, and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Figure 2 shows a summary of the geometric deficiencies found at this intersection.

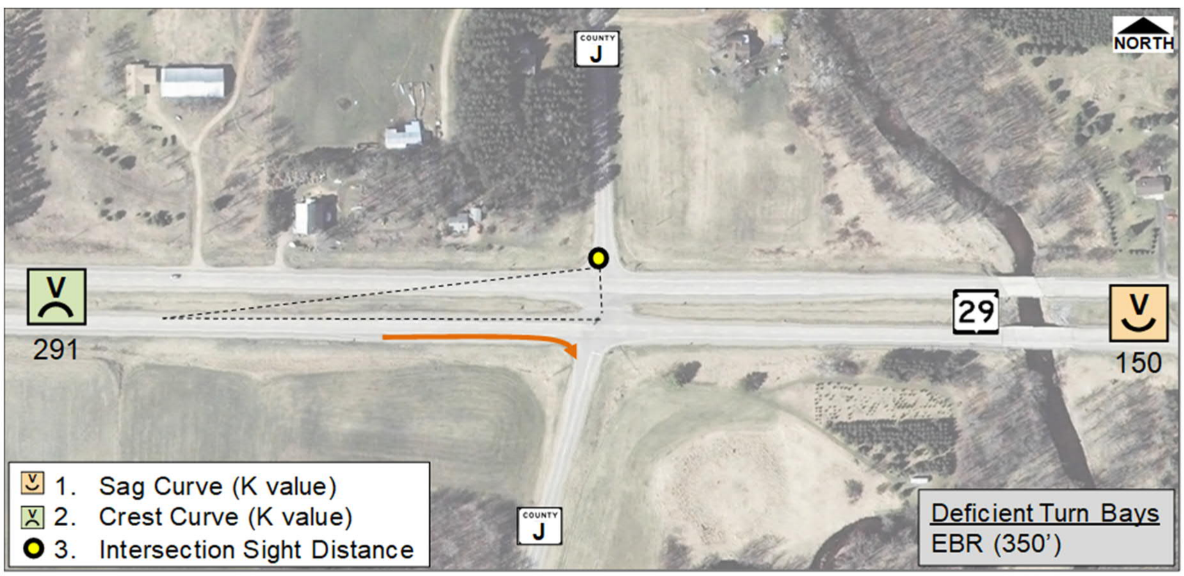


Figure 2–Summary of Geometric Deficiencies

The vertical curve to the west contributes to poor intersection sight distance. The horizontal curve radius to the west of the intersection and vertical curve K values do not meet current Facilities Development Manual (FDM) standards. See Figure 3 for intersection sight distance deficiencies.

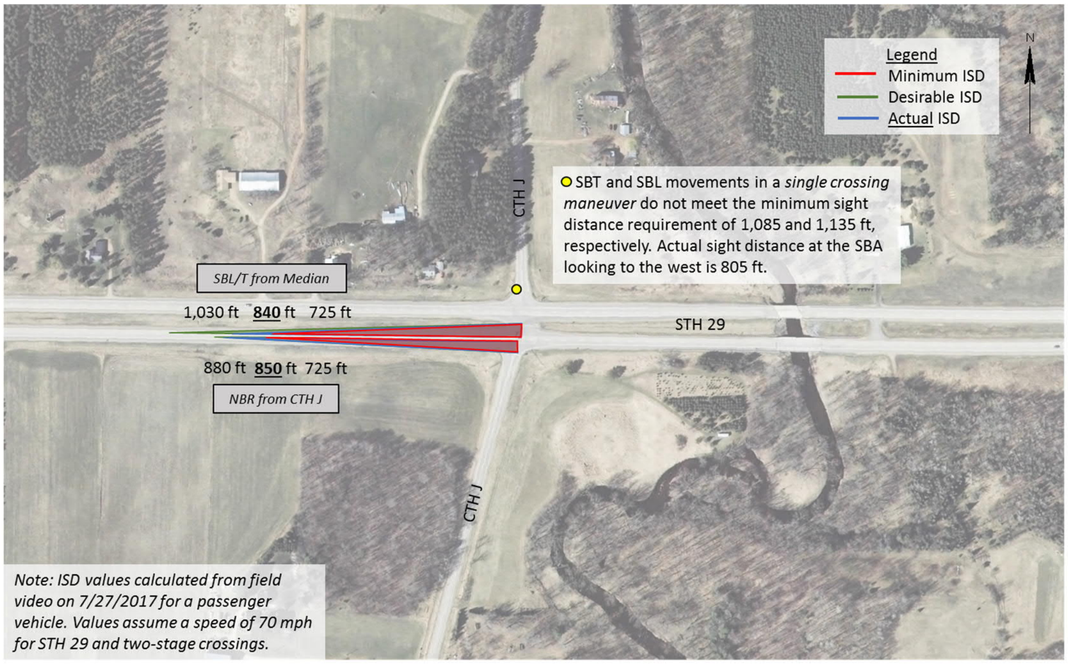


Figure 3–Intersection Sight Distance Deficiencies

The eastbound (EB) left and right-turn bays are 420 and 350 feet, respectively. The WB left and right-turn lanes are 450 feet and 350 feet, respectively. The EB right-turn lane does not meet current FDM standards for a Type A1 intersection. A summary of the turn bay storage length deficiencies is shown in Table 1.

Table 1: Turn Bay Storage Length Summary

Intersection Turn	Existing Storage Length (ft)	Intersection Type	Desirable Storage Required (ft)	Minimum Storage Required (ft)	Meets FDM Standards?
Eastbound Left	420	B1	400	300	Yes
Westbound Left	450	A1	550	450	Yes
Eastbound Right	350	A1	450	450	No
Westbound Right	350	B1	300	300	Yes

Five access points are located within the functional area of the STH 29 and CTH J intersection. There are two driveways/field entrances along CTH J north of STH 29 within 500 feet, one field entrance along CTH J south of STH 29 within 350 feet, and two driveways along STH 29 west of CTH J within 750 feet of the intersection. The remaining land use includes farm fields and woodland areas. Figure 4 shows the access points near the STH 29 and CTH J intersection.

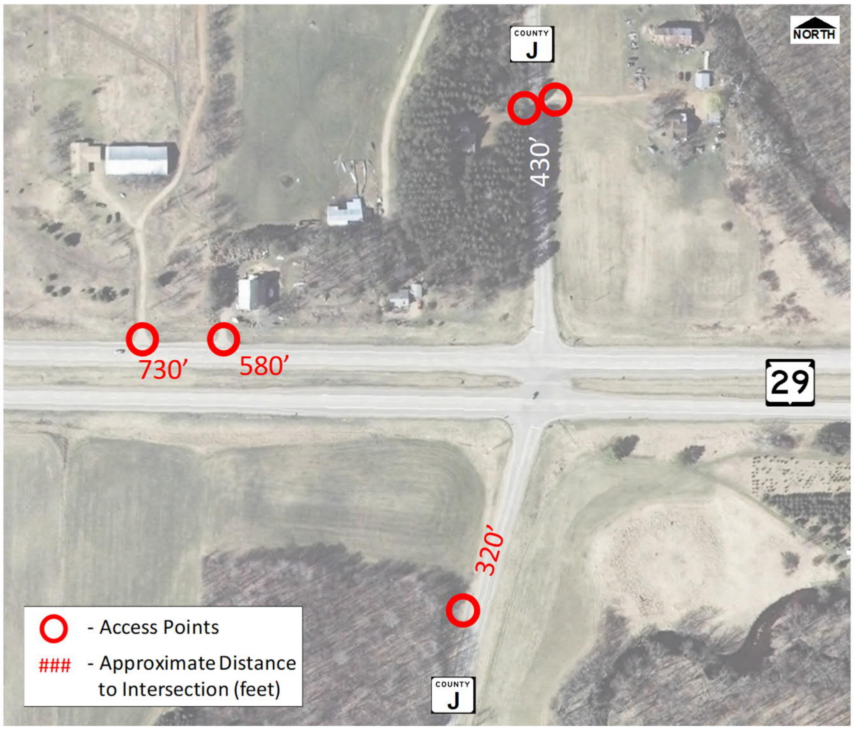


Figure 4–STH 29 and CTH J: Nearby Access Points

Photographs from the site visit performed in July 2017 are included in Attachment A.

Crash Analysis:

Crashes at the STH 29 and CTH J intersection were evaluated for the 5-year period from 2012 to 2016. During that time, nine crashes occurred, four of which were injury crashes including one fatal crash. The total intersection crash rate is 0.69 crashes per million entering vehicles (MEV) over the analysis period.

The fatal crash involved a vehicle traveling NB with an older driver on CTH J failing to yield to a vehicle traveling EB on STH 29. The non-fatal injury collisions included two involving Type A (incapacitating) injuries and one involving Type C (possible) injuries. Vertical curvature was flagged as a possible contributing factor in six of the nine crashes (67 percent).

See Attachment B for the STH 29 and CTH J intersection crash diagram. Tables 2, 3, and 4 summarize the intersection crash type and crash severity trends at this intersection.

Table 2–Intersection Crash Type

Crash Type	2012	2013	2014	2015	2016	Total
Angle	2	1	1	2	0	6
Rear End	0	0	0	1	0	1
Sideswipe-Same Direction	0	0	0	0	0	0
Sideswipe-Opposite Direction	0	0	0	0	0	0
Single Vehicle	1	1	0	0	0	2
Total	3	2	1	3	0	9

Table 3–Intersection Crash Severity

Crash Severity	2012	2013	2014	2015	2016	Total
Fatal	0	1	0	0	0	1
A Injury	0	0	1	1	0	2
B Injury	0	0	0	0	0	0
C Injury	1	0	0	0	0	1
Property Damage Only	2	1	0	2	0	5
Total	3	2	1	3	0	9

Table 4–Intersection Crash Type and Severity

Crash Type	Severity					Total
	K	A	B	C	PDO	
Angle	1	2	0	1	2	6
Rear End	0	0	0	0	1	1
Sideswipe-Same Direction	0	0	0	0	0	0
Sideswipe-Opposite Direction	0	0	0	0	0	0
Single Vehicle	0	0	0	0	2	2
Total	1	2	0	1	5	9

The segment crash rates were calculated as the number of crashes per hundred million vehicle miles traveled (HMVMT). Peer Group 210 with 65 mph expressways was used for the statewide average crash rates and upper control limit (UCL) calculations. The segment crash rates were compared to the 2012 to 2016 statewide crash rates, which were published on November 14, 2017.

Segment crashes on STH 29 from CTH J to Fink Road/River Road were evaluated for the 5-year period from 2012 to 2016. The segments EB and WB total and KAB crashes are above the statewide average. During the study period there were 14 WB crashes that resulted in a crash rate nearly 4 times the statewide average; 12 of the 22 crashes (55 percent) were single vehicle crashes; 11 of the 22 crashes (50 percent) flagged road conditions as a possible contributing factor. Three KAB (1 K, 2 A) severity crashes occurred on this segment, each of which occurred at the CTH J intersection.

A Type A (incapacitating) injury crash occurred along STH 29 near Fink Road in 2012 that involved a police chase where the driver hit a spike strip, crossed the median, and eventually hit a tree. This crash was excluded from the crash statistics because it was a unique situation that was not directly caused by the physical characteristics of the roadway.

See Attachment B for the STH 29 segment crash diagram from CTH J to Fink Road/River Road. Figure 5 shows the segment crash analysis summary.

CTH J to Fink Road	Severity	2012	2013	2014	2015	2016	Total	Average Annual Crash Rate	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	3	2	1	1	1	**8**	107.7	*47.62*	**2.26**	*71.6*	1.50
1.2 miles 3,770 AADT	KAB Injury	0	1	1	0	0	**2**	26.9	*8.65*	**3.11**	*18.9*	1.43
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	3	3	4	4	0	**14**	188.4	*47.62*	**3.96**	*71.6*	**2.63**
1.2 miles 3,770 AADT	KAB Injury	0	0	0	1	0	**1**	13.5	*8.65*	1.56	*18.9*	0.71

1.00 - 1.99	*Ratio vs. Statewide Average or UCL*
2.00 - 2.99	*Ratio vs. Statewide Average or UCL*
3.00+	*Ratio vs. Statewide Average or UCL*

Figure 5–STH 29 Segment Crash Summary from CTH J to Fink Road/River Road

Intersection and Segment KAB crashes that occurred between 2008 through 2011 and in 2017, outside of the 2012 to 2016 analysis period, are shown in Table 5 for the STH 29 and CTH J intersection and the CTH J to Fink Road segment to provide further background of this area's severe injury crash history. The Type B rear-end crash in 2011 occurred at the maintenance crossover for the Shawano County Maintenance building (west of the CTH J intersection).

Table 5–KAB Crashes Outside of Analysis Period

Crash Type	2008	2009	2010	2011	2017	Total
CTH J Intersection–Angle	1 (B)	1 (B)	0	0	0	2
Segment–Single Vehicle	1 (B)	1 (A)	0	0	0	2
Segment–Rear End	0	0	0	1 (B)	0	1
Total	2	2	0	1	0	5

Traffic Operations Analysis:

Turning movement counts for STH 29 and CTH J were collected on Wednesday, June 21, 2017. The AM peak hour was determined to be 7:15 to 8:15 AM and the PM peak hour was determined to be 4 to 5 P.M. See Attachment D for the 2017 turning movement counts. Construction activities were occurring during the June 2017 traffic counts; however, the study team believes that this did not have a major impact on turning movement volumes because there are few nearby parallel routes for traffic to divert to during construction. The intersection remained at full access at the time of the traffic count and high mobility along STH 29 was maintained during the peak hours (i.e. minimal delays). From mid-July to mid-October 2017, CTH J was closed north of STH 29 for reconstruction.

The WisDOT Traffic Forecasting Section provided turning movement counts for the existing 2017 traffic volumes and the forecasted 2020, 2030, and 2040 year volumes for the STH 29 and CTH J intersection. WisDOT also provided mainline average annual daily traffic (AADT) forecasts for the STH 29 corridor. See Attachment E for the forecasted turning movement counts and mainline AADT forecast.

It should be noted that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study assumes a 9 percent seasonal reduction; however, the slightly lower base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and potential alternatives. See Attachment E for the seasonally adjusted turning movement volumes.

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT FDM guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 on using HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers will experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through movements that receive zero delay are factored into the average.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. For the scope of this project, LOS C was considered to be the limit of acceptable delay.

Table 6 summarizes the existing and design year no-build traffic operations for the STH 29 and CTH J intersection.

Table 6–Existing and Future No Build Traffic Operations Summary

Intersection	Analysis Year	AM Peak			PM Peak		
		Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH J	2017	10.0	B	--	13.0	B	--
	2020	10.2	B	--	13.4	B	--
	2030	10.6	B	--	14.3	B	--
	2040	11.1	B	--	15.5	C	--

The existing and future no build turning movements operate at LOS B or better during the AM peak hour and at LOS C or better during the PM peak hour using the seasonally adjusted traffic volumes. Using the unadjusted 2040 traffic volumes, the future no build turning movements continue to operate at LOS B or better during the 2040 AM peak hour and at LOS C or better during the 2040 PM peak hour. See Attachment G for the results of the existing and future no build operations analysis.

Section 3: Alternatives

The purpose of this study is to identify the most viable alternatives to address existing safety needs. The following describes the alternatives considered, the feasibility of each alternative, and a more detailed evaluation of the most feasible alternatives.

Alternatives Considered:

Factors that went into the initial screening in order to identify the most viable alternatives included Crash Modification Factor (CMF) analyses, indirection (i.e. traffic volumes rerouted due to alternative), relative costs and impacts, and corridor continuity.

The following alternatives were considered for the STH 29 and CTH J intersection:

- Closed Median (Right-in/Right-out)
- Access Control (Right-in/Right-out/Left-in)
- Intersection Control
- Through Route Activated Warning System (TRAWS)
- Slotted Lefts
- J-Turn
- Median U-Turn
- Diamond Interchange

Feasibility of Alternatives:

The study team coordinated with WisDOT North Central Region staff through conference calls and an in-person meeting to identify the most viable alternatives for this intersection. The study team also used the Phase 1: ICE Brainstorming Guide to supplement the alternatives evaluation. See Attachment C for the Phase 1: ICE Brainstorming Guide. Information from an Environmental Assessment (EA) that was conducted in 2010 for the STH 29 corridor to map out a long-term plan for the conversion of STH 29 from expressway to freeway was used in this study's alternatives analysis as well.

CMFs were applied to the crash totals to provide a quantitative crash reduction for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin, the J-Turn and TRAWS alternative CMFs were used from that table. The Median U-Turn and Slotted Left (also referred to as Positive Offset Left-Turn Bays) CMFs were taken from the CMF Clearinghouse website. The CMF Clearinghouse is a larger database of CMFs that more appropriately matched the alternatives.

The Right-in/Right-out/Left-in and Right-in/Right-out alternative did not have a close match in the CMF Clearinghouse website so the J-Turn CMF from the WisDOT table was applied to the Right-in/Right-out/Left-in alternative and the Median U-Turn from the CMF Clearinghouse website was applied for the Right-in/Right-out alternative. The study team coordinated with and received approval from WisDOT BTO staff for this concept related to the J-Turn and Right-in/Right-out/Left-in alternative.

The J-Turn alternative and Right-in/Right-out/Left-in alternative are similar in how that they redirect minor road vehicles from crossing the intersection. However, the J-Turn and Right-in/Right-out/Left-in alternatives have different movements with different conflict points. The J-Turn alternative has vehicles merging off and merging into traffic, which is different from the left-turn movement where vehicles are crossing oncoming traffic. The difference in movements/conflict points may cause different accident types and totals. Therefore, the J-Turn and Right-in/Right-out/Left-in alternatives will appear to reduce crashes equally in Table 7, but may have different results than shown in the table. Additionally, the Right-in/Right-out/Left-in and Right-in/Right-out alternatives each redirect traffic to adjacent intersections, which is not captured by the CMF analysis but may have a negative effect on safety and operations for other intersections, driveways, or median crossovers.

Table 7 summarize the CMF applications showing the total crashes and estimated crash reduction for each alternative. See Attachment F for the CMF analysis of the STH 29 and CTH J intersection.

Table 7–Crash Reduction Summary for STH 29 and CTH J

Alternative	Total Crashes		Fatal Crashes		Serious Injury Crashes (A, B)	
	Total	Reduction	Total	Reduction	Total	Reduction
J-Turn	9	4.16	1	0.63	2	1.25
Median U-Turn		4.59		--		1.24
Right-in/Right-out/Left-in		4.16*		0.63*		1.25*
Right-in/Right-out		4.59*		--		1.24*
Positive Offset Left-Turn Bays		3.04		0.36		0.71
TRAWS		2.30		0.27		0.53

*See discussion preceding table on comparison of access control alternatives to J-Turn and Median U-Turn alternatives.

The following describes alternatives that were considered the least viable at this intersection.

1. Closed Median (Right-in/Right-out)
   Closing the median and providing a right-in/right-out treatment for CTH J intersection would be a highly effective safety treatment to eliminate all 24 crossing conflicts at the intersection. However, this alternative would result in a high amount of indirection for the mainline left-turn movements and the sideroad through and left-turn movements. These movements could either reroute to local roads to access STH 29 or perform U-turns at the next closest access points along STH 29. Along STH 29 to the west of CTH J, the Fink Road/River Road intersection (approximately 1.2 miles away) has a WB left-turn bay that may be favorable to U-turns. To the east, the closest median opening with an EB left-turn bay is approximately 3 miles away at Maple Road. Within 1 mile east and west of CTH J, there are two median openings in each direction that do not have mainline left-turn bays, which would not be favorable to U-turns.

   The movements affected by the right-in/right-out treatment are more substantial on the south leg compared to the north leg. The north leg would have approximately 25 total vehicles rerouted during the AM and PM peak hours combined. The south leg would have approximately 65 vehicles rerouted during the AM and PM peak hours combined. There would likely be a negative impact on other local roads, driveways, or median opening locations if this traffic were to be rerouted.

   Additionally, stakeholders involved in the EA identified CTH J as an important north/south route for commuters and emergency vehicles.

   For these reasons, the Closed Median alternative was not identified as one of the most feasible alternatives.

2. Intersection Control (Signals, Roundabouts, or All-way-stop)
   Traffic signal control, roundabout control, and all-way-stop control were not analyzed for the STH 29 and CTH J intersection in order to maintain free flow conditions along STH 29. There are no controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in the city of Wausau and I-41 near the city of Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

3. TRAWS
   The TRAWS is not being evaluated as a stand-alone alternative because it does not improve the geometric deficiencies or fully address the 24 crossing conflicts at the existing intersection. This could be considered in combination with another alternative; however, the most feasible alternatives for this intersection restrict through movements and left-turn movements from the sideroad. The TRAWS system may not be as effective of a safety measure when only activated for right-turns from the sideroad as opposed to through movements or left-turns from the sideroad.

4. Slotted Lefts
   This concept was considered less feasible than other alternatives because geometric deficiencies and factors contributing to the crash history are not fully addressed. Mainly, the number of crossing conflicts would not be reduced with this alternative.

5. Diamond Interchange
   The EA completed in 2010 identified the STH 29 and CTH J intersection as a possible location for an interchange. This alternative is a long-term solution that would remove all crossing conflicts between STH 29 mainline traffic and CTH J traffic, effectively addressing the existing safety needs at the intersection. This is not a viable alternative at this time due to the higher anticipated cost and real estate impacts relative to the other alternatives being considered for HSIP funding.

Evaluation of Alternatives:
The following alternatives were identified by WisDOT North Central Region and the study team and as the most feasible for this intersection within the goals of the study:

- Alternative 1: Access Control (Right-in/Right-out/Left-in) with Slotted Lefts
- Alternative 2: J-Turn
- Alternative 3: Median U-Turn

For each of these alternatives a preliminary opinion of probable construction cost (OPCC) was prepared. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on three similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process. The OPCC for the conceptual layouts were developed in 2017 dollars and are based on similar projects in Wisconsin. The OPCC excludes any real estate costs. Attachment J includes a detailed list of assumptions and breakdown of quantities and unit prices used in the OPCC.

As part of the improvements to the CTH J intersection, EB right-turn and WB left-turn lanes are added to the maintenance crossover for the Shawano County Maintenance building in each alternative. These two turn lanes remove decelerating maintenance trucks from the mainline when turning into the driveway. The 2012 to 2016 crash history did not show issues at this location; however, a WB rear-end collision involving a truck turning left occurred here in 2011, resulting in a Type B injury.

The study team evaluated traffic operations for Alternatives 1, 2, and 3 under the 2040 design year conditions. For alternative intersections, like the J-Turn and Median U-Turn, the LOS is based on the average Experienced Travel Time (ETT) for each movement as it travels through the intersection. The ETT takes into account the Extra Distance Travel Time (EDTT) required to travel to and from a U-Turn.

The LOS threshold for alternative intersections are identical to those for conventional signalized intersections. See Attachment H for the results of the future build operations analysis.

<u>Alternative 1: Access Control (Right-in/Right-out/Left-in) with Slotted Lefts</u>

Alternative 1 restricts access to right-in/right-out/left-in for movements at CTH J. Islands on the approaches of CTH J direct vehicles away from the slotted left-turn lanes to reduce wrong way maneuvers. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the intersection. A conceptual layout of Alternative 1 is provided in Attachment I.

The preliminary OPCC for Alternative 1 is between $1.0 and $1.3 million.

This alternative would reroute low amounts of traffic to local roads or median crossover locations and is not ideal for emergency vehicles or north/south commuters, which were identified as important considerations by stakeholders in the EA.

This alternative eliminates 20 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that this access control treatment would address seven of the nine crashes, six of which were right-angle crashes and one where a WB mainline vehicle swerved to avoid a NB through vehicle. While crossing conflicts remain with the access control alternative between the mainline left-turns versus mainline through vehicles, the crash history does not include any collisions between these movements. Restricting the NB and SB through and left-turn movements in this treatment is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 1, all turning movements operate at LOS B or better during the 2040 AM and PM peak hours. Table 8 summarizes the Alternative 1 traffic operations for the STH 29 and CTH J intersection, which are reported for the worst turning movement.

Table 8–2040 Alternative 1 Traffic Operations

Intersection	AM Peak			PM Peak		
	Int. Delay (s)	Int. LOS	LOS E or F Movements	Int. Delay (s)	Int. LOS	LOS E or F Movements
STH 29 and CTH J	9.9	A	--	10.3	B	--

<u>Alternative 2: J-Turn</u>

The J-Turn alternative provides full access at the CTH J intersection, while redirecting the CTH J through and left-turn movements to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two additional U-turn openings in the median with the WB turn lane extending to CTH J. To avoid impacts to the Embarrass River Bridge, the EB to WB U-turn turn lane begins downstream of the bridge, introducing weaving along the STH 29 mainline. The EB to WB U-turn location results in the removal of a maintenance crossover that provides direct access to properties on either side of STH 29. Islands on the approaches of CTH J reduce wrong way maneuvers and directs SB through and left-turning movements into the U-turn turn lane to remove mainline weaving. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the CTH J intersection.

The preliminary OPCC for Alternative 2 is between $1.3 and $1.7 million.

This alternative eliminates 20 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the J-Turn treatment would address seven of the nine crashes, six of which were right-angle crashes and one where a WB mainline vehicle swerved to avoid a NB through vehicle. While crossing conflicts remain with the J-Turn alternative between the mainline left-turns versus mainline through vehicles at the primary intersection, the crash history does not include any collisions between these movements. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 2, the LOS D operations for the NB approach during the 2040 PM peak hour can be mainly attributed to the distance from the primary intersection to the U-turn crossovers. In order to avoid impacting the newly constructed WB Embarrass River bridge (approximately 800 feet to the east of the intersection), the U-turn crossovers were located approximately 1,200 feet east of the bridge (or nearly 2,000 feet east of the intersection). Because of this distance, the travel time for the NB lane and NB through movements to use the crossover is estimated to be 41 seconds, which places these movements in the LOS D range for alternative intersections. When factoring in a control delay of 18 to 19 seconds, the LOS for the NB lane and NB through movements drop to LOS E. For the NB intersection approach as a whole, this results in LOS C during the 2040 AM peak hour and LOS D during the 2040 PM peak hour, which would not meet the LOS goals of the study.

Table 9 summarizes the Alternative 2 traffic operations for the STH 29 and CTH J intersection by intersection approach.

Table 9–2040 Alternative 2 Traffic Operations

J-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH J	EB STH 29	0.1	A	0.2	A
	WB STH 29	0.4	A	0.6	A
	NB CTH J	26.6	C	38.9	D
	SB CTH J	13.9	B	27.7	C
	Overall	1.8	A	1.7	A

Alternative 3: Median U-Turn

The Median U-Turn alternative provides full access at the CTH J intersection, while redirecting the CTH J through and left-turn movements and the STH 29 left-turns to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two U-turn openings in the median with turn lanes extending through the CTH J intersection. Islands on the approaches of CTH J direct through and left-turning movements into the J-turn turn lane and improves sight distance when combined with offset right-turn lanes on STH 29. To avoid impacts to the Embarrass River Bridge and meet intersection sight distance at the U-turn locations the Median U-Turn locations are shifted to the west, slightly increasing indirection for WB to EB movements and decreasing indirection for EB to WB movements. A conceptual layout of Alternative 2 is provided in Attachment I.

The preliminary OPCC for Alternative 3 is between $1.0 and $1.3 million.

This alternative eliminates all 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the Median U-Turn treatment would address eight of the nine crashes, six of which were right-angle crashes. The additional two crashes that may be mitigated include a WB vehicle swerving to avoid a NB through vehicle and a WB through vehicle rear-ending a vehicle that had just completed an EB to WB U-turn at the intersection. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 3, each intersection approach operates at LOS C or better during both the 2040 AM and PM peak hours. The difference in the NB and SB approach operations between Alternative 3 (Median U-Turn) and Alternative 2 (J-Turn) is that the EDTT is about 35 seconds less for the NB lane and NB through movements and about 4 seconds less for the SB lane and SB through movements in Alternative 3 compared to Alternative 2. In other words, the U-Turn locations are tighter to the primary intersection in the Median U-Turn versus the J-Turn, leading to a difference in the experienced travel time for the driver.

Table 10 summarizes the Alternative 3 traffic operations for the STH 29 and CTH J intersection by intersection approach.

Table 10–2040 Alternative 3 Traffic Operations

Median U-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH J	EB STH 29	0.2	A	0.3	A
	WB STH 29	1.3	A	1.7	A
	NB CTH J	14.9	B	19.3	B
	SB CTH J	13.5	B	26.0	C
	Overall	1.5	A	1.6	A

Table 11 lists pros and cons for each of the most feasible alternatives.

Table 11–Alternatives Evaluation

Alternatives Evaluation		
Alternative	Pros	Cons
1 Access Control (Right-in/ Right-out/ Left-in) with Slotted Lefts	• Removes 20 of the 24 crossing conflicts at existing intersection • Highly Effective CMF • Minimal volume affected (<10 vehicles per hour Right-in/Right-out/Left-in for north leg) • Lowest cost of these 3 alternatives (tied)	• Rerouted vehicles, strain on local roads, potential safety concerns with other STH 29 intersections/driveways • Approximately 3 miles indirection for SB lane/through • Approximately 2 miles indirection for NB lane • County Road access change
2 J-Turn	• Removes 20 of the 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • No indirection for mainline left-turns	• More travel time than Median U-Turn, particularly for NB lane and NB through movements • Highest cost/impacts versus other alternatives
3 Median U-Turn	• Removes all 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • Less travel time than J-Turn • Lowest cost of these 3 alternatives (tied)	• Creates indirection for mainline left-turn movements

Section 4: Conclusion

The Access Control (Right-in/Right-out/Left-in) with Slotted Lefts, J-Turn, and Median U-Turn were identified as the most viable alternatives to consider for HSIP funding. These alternatives each address intersection sight distance deficiencies and reduce crossing conflicts. Mainline turn lanes are added to the maintenance crossover for the Shawano County Maintenance building in each alternative.

The costs prepared for this study are to be considered preliminary and are presented as a range. It is at the discretion of WisDOT to select the appropriate OPCC from the range presented, or otherwise, to be used in the HSIP application.

Attachments:

Attachment A–Project Location Map
Attachment B–Crash Diagrams
Attachment C–ICE Brainstorming Guide
Attachment D–Traffic Counts
Attachment E–Traffic Forecasts
Attachment F–Crash Modification Factors
Attachment G–Existing and Future No Build Traffic Modeling Results
Attachment H–Build Conditions Traffic Modeling Results
Attachment I–Preliminary Design
Attachment J–Opinion of Probable Construction Cost

To: Tony Kemnitz, P.E., PTOE
From: Joseph Urban, P.E., Strand Associates, Inc.®
Adam Walter, Strand Associates, Inc.®
Brenden Johnson, Strand Associates, Inc.®
Date: 3/29/2018
RE: 0656-43-04
STH 29 and CTH D/Rock Road
Town of Seneca, Shawano County
Highway Safety Improvement Program (HSIP)

Section 1: Project Description

The Wisconsin Department of Transportation (WisDOT) is currently investigating the intersection of STH 29 and CTH D/Rock Road, located in the town of Seneca in Shawano County, as a candidate for HSIP funding. The purpose of this Intersection Control Evaluation (ICE) is to identify the most viable alternatives to improve intersection safety at STH 29 and CTH D/Rock Road. The study limits are the physical and functional area of the intersection, as shown in Figure 1. See Attachment A for a complete map of the surrounding street network.

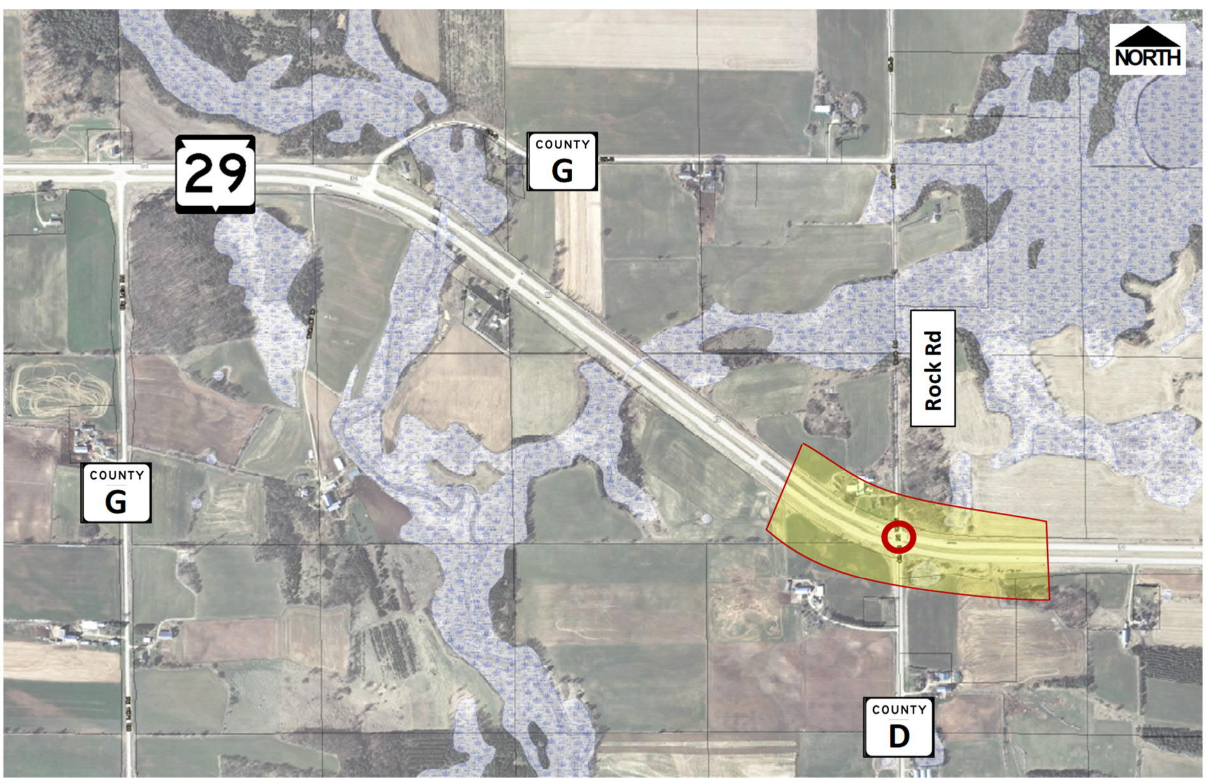


Figure 1–STH 29 and CTH D/Rock Road Intersection

Section 2: Existing Conditions

STH 29 is a 4-lane divided rural highway with a 60-foot median and a posted speed limit of 65 miles per hour (mph). CTH D is the south approach of the intersection and is a 2-lane undivided rural highway with a posted speed limit of 55 mph. Rock Road is the north approach of the intersection and is a 2-lane undivided rural road with a posted speed limit of 45 mph. The northbound (NB) and southbound (SB) approaches are stop controlled. The CTH D NB approach tapers provide space for through/left and right turning vehicles to stack next to each other at the stop bar. The Rock Road SB approach provides space for a right/through/left movement.

STH 29 intersects CTH D/Rock Road in a horizontal curve and in a crest vertical curve. Strand Associates, Inc.® performed a review of the geometric deficiencies at the intersection based upon As-Built plans provided by WisDOT, a site visit performed in July 27, 2017, and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Figure 2 shows a summary of the geometric deficiencies found at this intersection.

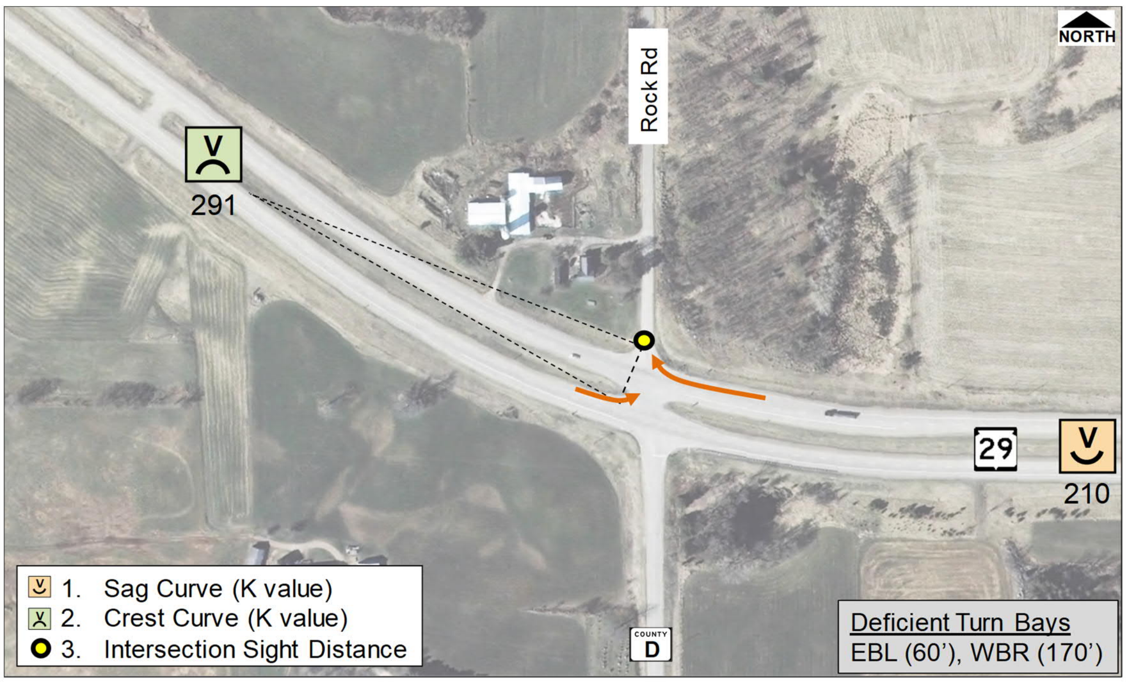


Figure 2–Summary of Geometric Deficiencies

The horizontal curve radius, intersection skew, and vertical curve K values do not meet current Facilities Development Manual (FDM) standards. The vertical curve to the west contributes to poor intersection sight distance. See Figure 3 for intersection sight distance deficiencies.

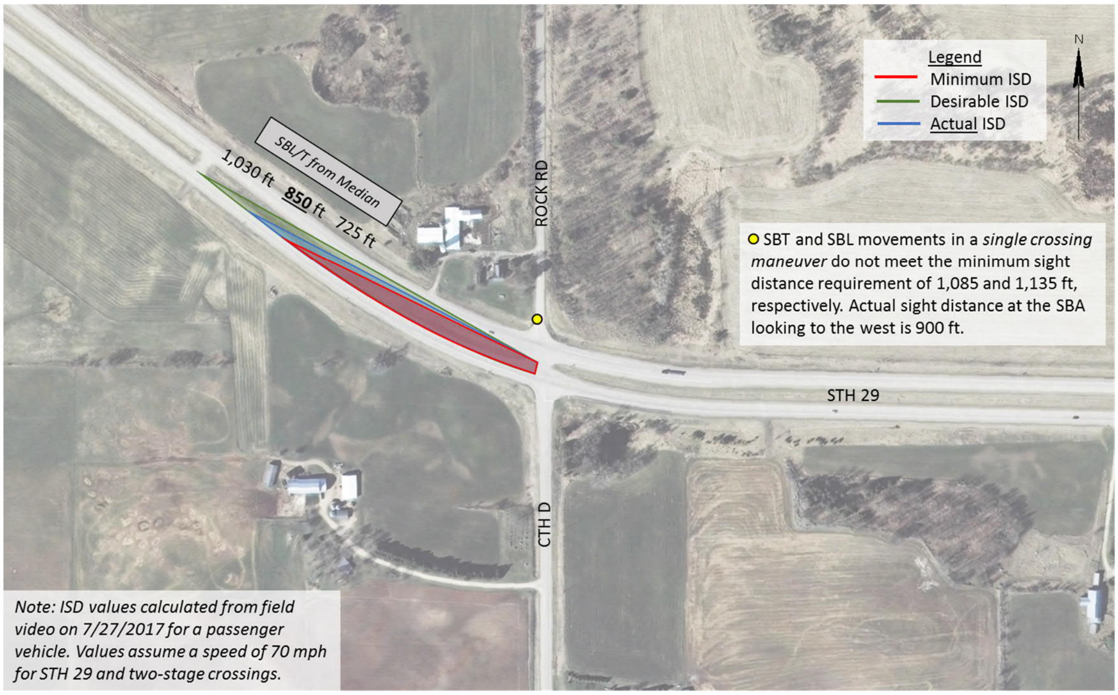


Figure 3–Intersection Sight Distance Deficiencies

The eastbound (EB) and westbound (WB) approaches along STH 29 at CTH D/Rock Road provide left- and right-turn bays. The EB left and right-turn bays are 60 and 345 feet, respectively. The WB left- and right-turn bays are 405 feet and 170 feet, respectively. The EB left-turn lane and WB right-turn lane do not meet current minimum FDM standards for Type B1 intersections. A summary of the turn bay storage length deficiencies is shown in Table 1.

Table 1–Turn Bay Storage Length Summary

Intersection Turn	Existing Storage Length (ft)	Intersection Type	Desirable Storage Required (ft)	Minimum Storage Required (ft)	Meets FDM Standards?
Eastbound Left	60	B1	400	300	No
Westbound Left	405	B1	400	300	Yes
Eastbound Right	345	B1	300	300	Yes
Westbound Right	170	B1	300	300	No

Three access points are located within the functional area of the STH 29 and CTH D/Rock Road intersection. The residence in the northwest quadrant has two driveways within approximately 300 feet of the intersection (one along STH 29 and one along Rock Road) and there is one driveway approximately 500 feet south of the intersection. The remaining land use includes farm fields and woodland areas. Figure 4 shows the access points near the STH 29 and CTH D/Rock Road intersection.

Figure 4–STH 29 and CTH D/Rock Road: Nearby Access Points

Photographs from the site visit performed in July 2017 are included in Attachment A.

Crash Analysis:

Crashes at the STH 29 and CTH D/Rock Road intersection were evaluated for the 5-year period from 2012 to 2016. During that time, nine crashes occurred, five of which were injury crashes including one fatal crash. The total intersection crash rate is 0.57 crashes per million entering vehicles (MEV) over the analysis period.

The collisions with severe injuries (KAB) included one involving a Type A (incapacitating) injury and four involving Type B (non-incapacitating) injuries. The fatal crash involved a vehicle heading SB that was stopped in the median and did not see a vehicle traveling EB. Difficulty seeing EB through vehicles on STH 29 was noted in four of the five multiple-vehicle crashes. Horizontal curvature was flagged as a possible contributing factor in six of the nine crashes (67 percent), although it could be more based on the police report descriptions. Horizontal and vertical curve deficiencies are likely contributing factors to these crashes.

See Attachment B for the STH 29 and CTH D/Rock Road intersection crash diagram. Tables 2, 3, and 4 summarize the intersection crash type and crash severity trends at this intersection.

Table 2–Intersection Crash Type

Crash Type	2012	2013	2014	2015	2016	Total
Angle	0	1	2	1	0	4
Rear End	0	0	0	0	0	0
Sideswipe–Same Direction	0	0	1	0	0	1
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	1	1	2	0	0	4
Total	1	2	5	1	0	9

Table 3–Intersection Crash Severity

Crash Severity	2012	2013	2014	2015	2016	Total
Fatal	0	0	0	1	0	1
A Injury	0	1	0	0	0	1
B Injury	0	0	4	0	0	4
C Injury	0	0	0	0	0	0
Property Damage Only	1	1	1	0	0	3
Total	1	2	5	1	0	9

Table 4–Intersection Crash Type and Severity

Crash Type	Severity					Total
	K	A	B	C	PDO	
Angle	1	1	2	0	0	4
Rear End	0	0	0	0	0	0
Sideswipe–Same Direction	0	0	0	0	1	1
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	0	0	2	0	2	4
Total	1	1	4	0	3	9

Intersection KAB crashes that occurred between 2008 through 2011 and in 2017, outside of the 2012 to 2016 analysis period, are shown in Table 5 for the STH 29 and CTH D/Rock Road intersection to provide further background of the severe injury crash history. The fatal angle collision occurred in 2008 at the STH 29 and CTH D/Rock Road intersection involving a SB and an EB vehicle (similar to the more recent severe injury crashes).

Table 5–KAB Crashes Outside of Analysis Period

Crash Type	2008	2009	2010	2011	2017	Total
Angle	1 (K)	0	0	1 (B)	0	2
Single Vehicle	0	1 (B)	0	1 (B)	0	2
Total	1	1	0	2	0	4

Traffic Operations Analysis:
Turning movement counts for STH 29 and CTH D/Rock Road were collected on Thursday, June 20, 2017. The AM peak hour was determined to be 7:15 to 8:15 A.M. and the PM peak hour was determined to be 4 to 5 P.M. See Attachment D for the 2017 turning movement counts.

The WisDOT Traffic Forecasting Section provided turning movement counts for the existing 2017 traffic volumes and the forecasted 2020, 2030, and 2040 year volumes for the STH 29 and CTH D/Rock Road intersection. WisDOT also provided mainline annual average daily traffic (AADT) forecasts for the STH 29 corridor. See Attachment E for the forecasted turning movement counts and mainline AADT forecast.

It should be noted that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study assumes a 9 percent seasonal reduction; however, the slightly lower base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and potential alternatives. See Attachment E for the seasonally adjusted turning movement volumes.

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT FDM guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 on using HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through movements that receive zero delay are factored into the average.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. For the scope of this project, LOS C was considered to be the limit of acceptable delay.

Table 6 summarizes the existing and design year no-build traffic operations for this intersection.

Table 6–Existing and Future No Build Traffic Operations Summary

Intersection	Analysis Year	AM Peak			PM Peak		
		Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH D/Rock Road	2017	12.2	B	--	12.8	B	--
	2020	12.3	B	--	13.0	B	--
	2030	13.0	B	--	13.9	B	--
	2040	13.7	B	--	14.8	B	--

The existing and future no build turning movements operate at LOS B or better during both the AM and PM peak hours using the seasonally adjusted traffic volumes. Using the unadjusted 2040 traffic volumes, the future no build turning movements operate at LOS B or better during the 2040 AM peak hour and at LOS C or better during the 2040 PM peak hour. See Attachment G for the results of the existing and future no build operations analysis.

Section 3: Alternatives

The purpose of this study is to identify the most viable alternatives to address existing safety needs. The following describes the alternatives considered, the feasibility of each alternative, and a more detailed evaluation of the most feasible alternatives.

Alternatives Considered:

Factors that went into the initial screening in order to identify the most viable alternatives included Crash Modification Factor (CMF) analyses, indirection (i.e. traffic volumes rerouted because of alternative), relative costs and impacts, and corridor continuity.

The following alternatives were considered for the STH 29 and CTH D/Rock Road intersection:

- Closed Median (Right-in/Right-out)
- Access Control (Right-in/Right-out/Left-in)
- Intersection Control
- Through Route Activated Warning System (TRAWS)
- Slotted Lefts
- J-Turn
- Median U-Turn
- Overpass

Feasibility of Alternatives:

The study team coordinated with WisDOT North Central Region staff through conference calls and an in-person meeting to identify the most viable alternatives for this intersection. The study team also used the Phase 1: ICE Brainstorming Guide to supplement the alternatives evaluation. See Attachment C for the Phase 1: ICE Brainstorming Guide. Information from an Environmental Assessment (EA) that was conducted in 2010 for the STH 29 corridor to map out a long-term plan for the conversion of STH 29 from expressway to freeway was used in this study's alternatives analysis as well.

CMFs were applied to the crash totals to provide a quantitative crash reduction for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin, the J-Turn and TRAWS alternative CMFs were used from that table. The Median U-Turn and Slotted Left (also referred to as Positive Offset Left-Turn Bays) CMFs were taken from the CMF Clearinghouse website. The CMF Clearinghouse is a larger database of CMFs that more appropriately matched the alternatives.

The Right-in/Right-out/Left-in and Right-in/Right-out alternative did not have a close match in the CMF Clearinghouse website so the J-Turn CMF from the WisDOT table was applied to the Right-in/Right-out/Left-in alternative and the Median U-Turn from the CMF Clearinghouse website was applied for the Right-in/Right-out alternative. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff for this concept related to the J-Turn and Right-in/Right-out/Left-in alternative.

The J-Turn alternative and Right-in/Right-out/Left-in alternative are similar in how that they redirect minor road vehicles from crossing the intersection. However, the J-Turn and Right-in/Right-out/Left-in alternatives have different movements with different conflict points. The J-Turn alternative has vehicles merging off and merging into traffic, which is different from the left-turn movement where vehicles are crossing oncoming traffic. The difference in movements and conflict points may cause different accident types and totals. Therefore, the J-Turn and Right-in/Right-out/Left-in alternatives will appear to reduce crashes equally in Table 7, but may have different results than shown in the table. Additionally, the Right-in/Right-out/Left-in and Right-in/Right-out alternatives each redirect traffic to adjacent intersections, which is not captured by the CMF analysis but may have a negative effect on safety and operations for other intersections, driveways, or median crossovers.

Table 7 summarizes the CMF applications showing the total crashes and crash reduction for each alternative. See Attachment F for the CMF analysis of the STH 29 and CTH D/Rock Road intersection.

Table 7–Crash Reduction Summary for STH 29 and CTH D/Rock Road

Alternative	Total Crashes		Fatal Crashes		Serious Injury Crashes (A, B)	
	Total	Reduction	Total	Reduction	Total	Reduction
J-Turn	10	4.62	--	--	--	--
Median U-Turn		5.10		--		--
Right-in/Right-out/Left-in		4.62*		--		--
Right-in/Right-out		5.10*		--		--
Positive Offset Left-Turn Bays		3.38		--		--
TRAWS		2.55		--		--

*See discussion preceding table on comparison of access control alternatives to J-Turn and Median U-Turn alternatives.

The following describes alternatives that were considered the <u>least</u> viable at this intersection.

1. Intersection Control (Signals, Roundabouts, or All-way-stop)
   Traffic signal control, roundabout control, and all-way-stop control were not analyzed for the STH 29 and CTH D/Rock Road intersection in order to maintain free flow conditions along STH 29. There are no controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in the city of Wausau and I-41 near the city of Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

2. TRAWS
   The TRAWS is not being evaluated as a stand-alone alternative because it does not improve the geometric deficiencies, notably intersection sight distance, or fully address the 24 crossing conflicts at the existing intersection. This could be considered in combination with another alternative; however, the most feasible alternatives for this intersection restrict through movements and left-turn movements from the sideroad. The TRAWS system may not be as effective of a safety measure when only activated for right-turns from the sideroad as opposed to through movements or left-turns from the sideroad.

3. Slotted Lefts
   This concept was considered less feasible than other alternatives because geometric deficiencies and factors contributing to the crash history are not fully addressed. Mainly, the number of crossing conflicts would not be reduced with this alternative.

4. J-Turn and Median U-Turn
   The J-Turn and Median U-Turn alternatives would remove 20 to 24, respectively, of the 24 crossing conflicts at the primary intersection; however, lower-build (and lower cost) access-control alternatives are anticipated to provide similar crash reduction benefits.

   Additionally, the traffic volumes on both Rock Road and CTH D are low, with less than 15 vehicles per hour (two-way) in each peak hour on Rock Road and less than 40 vehicles per hour (two-way) in each peak hour on CTH D. A higher build, such as a J-Turn or Median U-Turn, may not be needed for adjacent intersections, such as CTH G, to handle this traffic with the access control alternatives.

5. Overpass
   The EA completed in 2010 identified the STH 29 and CTH D/Rock Road intersection as a possible location for an overpass, with an interchange being proposed to the west at the CTH G intersection. This alternative is a long-term solution that would remove all crossing conflicts between STH 29 mainline traffic and CTH D/Rock Road traffic, effectively addressing the existing safety needs at the intersection. The town of Seneca supported the proposed interchange location, noting that there were large farm operations and future land use concerns in the area.

This is not a viable alternative at this time due to the higher anticipated construction cost and real estate impacts relative to the other alternatives considered.

Evaluation of Alternatives:

The following alternatives were identified by WisDOT North Central Region and the study team and as the most feasible for this intersection within the goals of the study:

- Alternative 1: Closed Median (Right-in/Right-out)
- Alternative 2: Closed Rock Road, Slotted WB Left

For each of these alternatives a preliminary opinion of probable construction cost (OPCC) was prepared. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on three similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process. The OPCC for the conceptual layouts were developed in 2017 dollars and are based on similar projects in Wisconsin. The OPCC excludes any real estate costs. Attachment J includes a detailed list of assumptions and breakdown of quantities and unit prices used in the OPCC.

The study team evaluated traffic operations for Alternatives 1 and 2 under the 2040 design year conditions. See Attachment H for the results of the future build operations analysis.

Alternative 1: Closed Median (Right-in/Right-out)

The median closure for Alternative 1 restricts access to right-in/right-out movements from CTH D/Rock Road with additional offset right-turn lanes on STH 29. Islands on the north and south legs improve intersection skew and sight distance when combined with the offset right-turn lanes. However, the horizontal and vertical curve to the west of CTH D will continue to influence the NB intersection sight distance negatively. An additional sub-alternative (Alternative 1A) includes removing access to the north leg of the intersection by placing a cul-de-sac at Rock Road. A conceptual layout of Alternative 1 and 1A is provided in Attachment I.

The OPCC for Alternative 1 is between $400,000 and $500,000 and the preliminary OPCC for Alternative 1A is between $350,000 and $400,000.

Alternatives 1 and 1A each eliminate all 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that these alternatives would each address four of the nine crashes, three of which were right-angle crashes on the EB side of the roadway and one involving a WB mainline left-turn vehicle and an EB mainline through vehicle. Closing the median to restrict the NB and SB through and left-turn movements in these alternatives is anticipated to address the issues related to severe injuries identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

In Alternative 1, the turning movements operate at LOS B or better during both the 2040 AM and PM peak hours. Table 8 summarizes the Alternative 1 traffic operations for the STH 29 and CTH D/Rock Road intersection. Additional operational analysis was not performed for Alternative 1A; however, similar operations are expected to Alternative 1 for the NB approach.

Table 8–2040 Alternative 1 Traffic Operations

Closed Median (Right-in/Right-out)						
Intersection	AM Peak			PM Peak		
	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH D/Rock Road	9.7	A	--	10.4	B	--

<u>Alternative 2: Closed Rock Road, Slotted WB Left</u>

Alternative 2 restricts access to right-in/right-out/left-in for movements at CTH D and closes Rock Road with a cul-de-sac. An island at the south leg of CTH D directs vehicles away from the WB slotted left-turn lane to reduce wrong way maneuvers and improves intersection skew. Sight distance is also improved with an EB offset right-turn lane; however, the horizontal and vertical curve to the west of CTH D will continue to influence the NB intersection sight distance negatively. A conceptual layout of Alternative 2 is provided in Attachment I.

The OPCC for the Alternative 2 is between $500,000 and $700,000.

Alternative 2 eliminates 22 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that this alternative would address three of the nine crashes, each of which were right-angle crashes involving severe injuries on the EB side of the roadway. This alternative may not fully address the WB mainline left-turn versus EB mainline through collision that occurred in 2014 and resulted in a Type B injury. Closing Rock Road and restricting NB access in this alternative is anticipated to address most of the issues related to severe injuries identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

In Alternative 2, the turning movements operate at LOS B or better during both the 2040 AM and PM peak hours. Table 9 summarizes the Alternative 2 traffic operations for the STH 29 and CTH D/Rock Road intersection.

Table 9–2040 Alternative 2 Traffic Operations

Closed Rock Road, Slotted WB Left						
Intersection	AM Peak			PM Peak		
	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH D/Rock Road	9.7	A	--	10.4	B	--

Table 10 lists pros and cons for the most feasible alternatives.

Table 10: Alternatives Evaluation

Alternatives Evaluation		
Alternative	Pros	Cons
1 and 1A Closed Median (Right-in/ Right-out)	• Removes all 24 crossing conflicts • Highly Effective CMF • Rock Road and mainline left-turns are very low volume (less than 10 vehicles per hour) • Addresses SB ISD deficiencies	• CTH D: Reroutes NB lane to CTH G • County Road access change • Reroutes WB lane to Leopolis Road
2 Closed Rock Road, Slotted WB Left	• Removes 22 of the 24 crossing conflicts • Highly Effective CMF • Rock Road very low volume (less than 10 vehicles per day) • Addresses SB ISD deficiencies	• CTH D: Reroutes NB lane to CTH G • County Road access change • Slightly higher cost than Closed Median alternative

Section 4: Conclusion

The Closed Median (right-in/right-out) and the Closed Rock Road with Slotted WB Left alternatives were identified as the most viable alternatives to consider for HSIP funding. These alternatives will address intersection sight distance deficiencies by removing or reducing crossing conflicts related to EB STH 29 mainline traffic, which is the direction of travel in which the majority of severe injury crashes occurred. The costs prepared for this study are to be considered preliminary and are presented as a range. It is at the discretion of WisDOT to select the appropriate OPCC from the range presented, or otherwise, to be used in the HSIP application.

Attachments:

Attachment A–Project Location Map
Attachment B–Crash Diagrams
Attachment C–ICE Brainstorming Guide
Attachment D–Traffic Counts
Attachment E–Traffic Forecasts
Attachment F–Crash Modification Factors
Attachment G–Existing and Future No Build Traffic Modeling Results
Attachment H–Build Conditions Traffic Modeling Results
Attachment I–Preliminary Design
Attachment J–Opinion of Probable Construction Cost

To: Tony Kemnitz, P.E., PTOE
From: Joseph Urban, P.E., Strand Associates, Inc.®
Adam Walter, Strand Associates, Inc.®
Brenden Johnson, Strand Associates, Inc.®
Date: 3/29/2018
RE: 0656-43-04
STH 29 and CTH U
Town of Herman, Shawano County
Highway Safety Improvement Program (HSIP)

Section 1: Project Description

The Wisconsin Department of Transportation (WisDOT) is currently investigating the intersection of STH 29 and CTH U, located in the Town of Herman in Shawano County, as a candidate for HSIP funding. The purpose of this Intersection Control Evaluation (ICE) is to identify the most viable alternatives to improve intersection safety at STH 29 and CTH U. The limits of the intersection investigation extend approximately one mile from CTH U to Kroenke Creek Road as shown in Figure 1, which includes the functional area of the CTH U intersection. See Attachment A for a complete map of the surrounding street network.

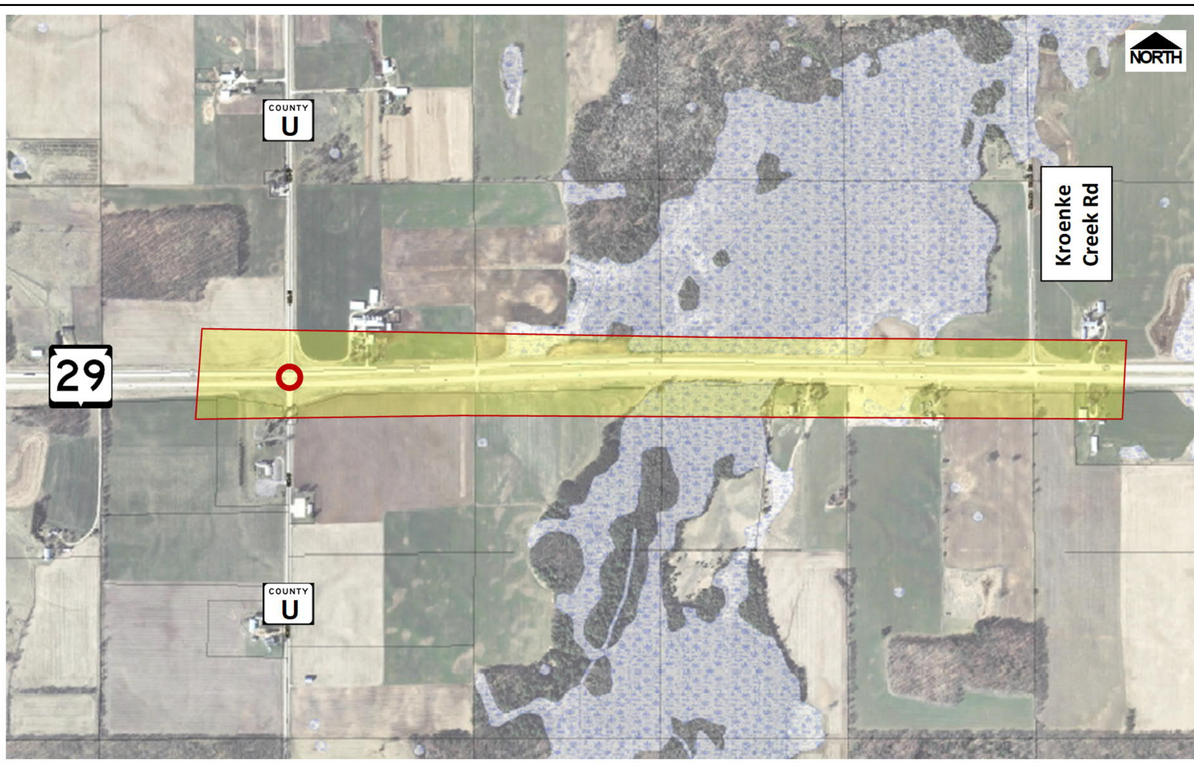


Figure 1–STH 29 and CTH U Intersection

Section 2: Existing Conditions

STH 29 is a 4-lane divided rural highway with a 60-foot median and a posted speed limit of 65 miles per hour (mph). CTH U is a two-lane undivided rural highway with a posted speed limit of 55 mph. The northbound (NB) and southbound (SB) approaches of CTH U are stop controlled. The CTH U NB and SB approach tapers provide space for through/left and right turning vehicles to stack next to each other at the stop bar.

Strand Associates, Inc. (Strand) performed a review of the geometric deficiencies at the intersection based upon As-Built plans provided by WisDOT, a site visit performed in July 27, 2017, and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Figure 2 shows a summary of the geometric deficiencies found at this intersection.

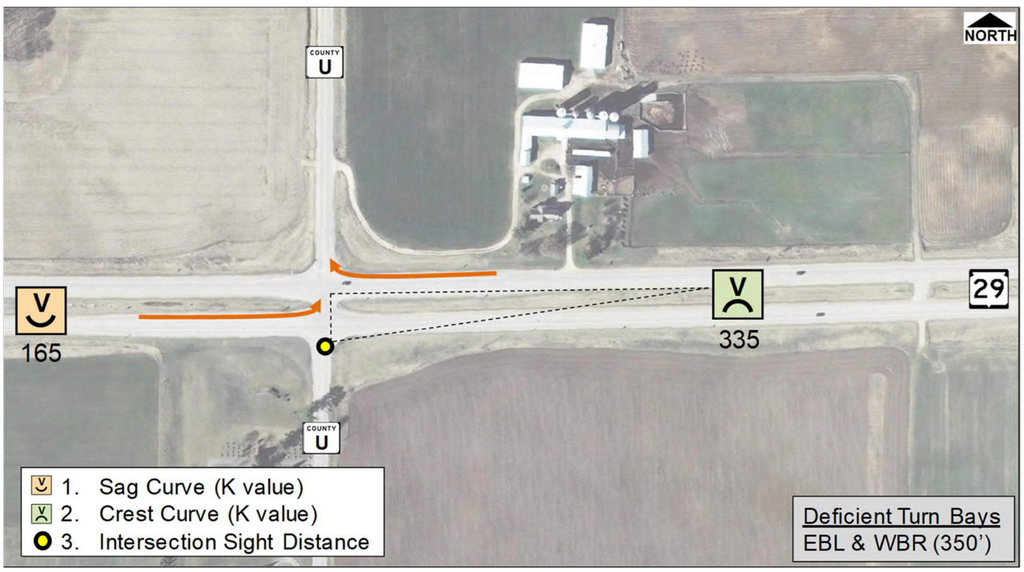


Figure 2–Summary of Geometric Deficiencies

CTH U intersects STH 29 between two vertical curves, a sag curve to the west and a crest curve to the east. The vertical curve K values do not meet current Facilities Development Manual (FDM) standards. The vertical curve to the east contributes to poor intersection sight distance. See Figure 3 for intersection sight distance deficiencies.

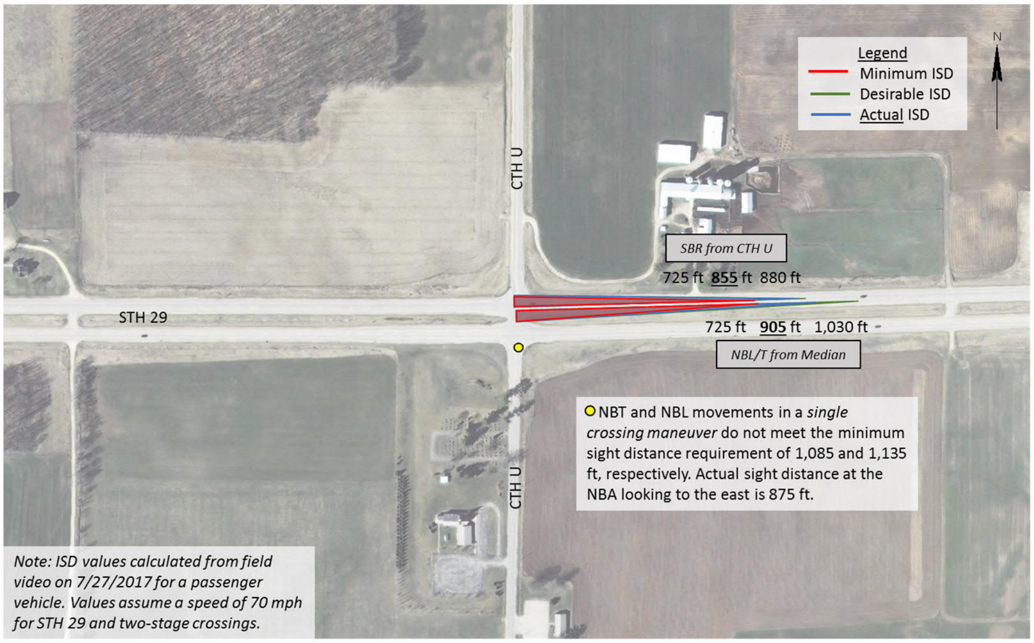


Figure 3–Intersection Sight Distance Deficiencies

The eastbound (EB) and westbound (WB) approaches along STH 29 at CTH U provide left- and right-turn bays ranging in lengths between 325 feet to 375 feet. The EB left-turn lane and WB right-turn lane lengths do not meet current FDM standards for Type A1 intersections. A summary of the turn bay storage length deficiencies is shown in Table 1.

Table 1–Turn Bay Storage Length Summary

Intersection Turn	Existing Storage Length (ft)	Intersection Type	Desirable Storage Required (ft)	Minimum Storage Required (ft)	Meets Standards?
EB Left	350	A1	550	450	No
WB Left	350	B1	400	300	Yes
EB Right	350	B1	300	300	Yes
WB Right	350	A1	450	450	No

Along STH 29, numerous access points are present for individual driveways and field access points. Within the intersection limits, six access points are located along STH 29, one of which occurs at the WB right-turn bay taper to provide access to the farm in the northeast quadrant. St. John's Lutheran Church and cemetery are located in the southwest quadrant and approximately 300 feet south of CTH U intersection. The remaining land use includes farm fields and woodened, wetland areas. Figure 4 shows the access locations near the STH 29 and CTH U intersection.

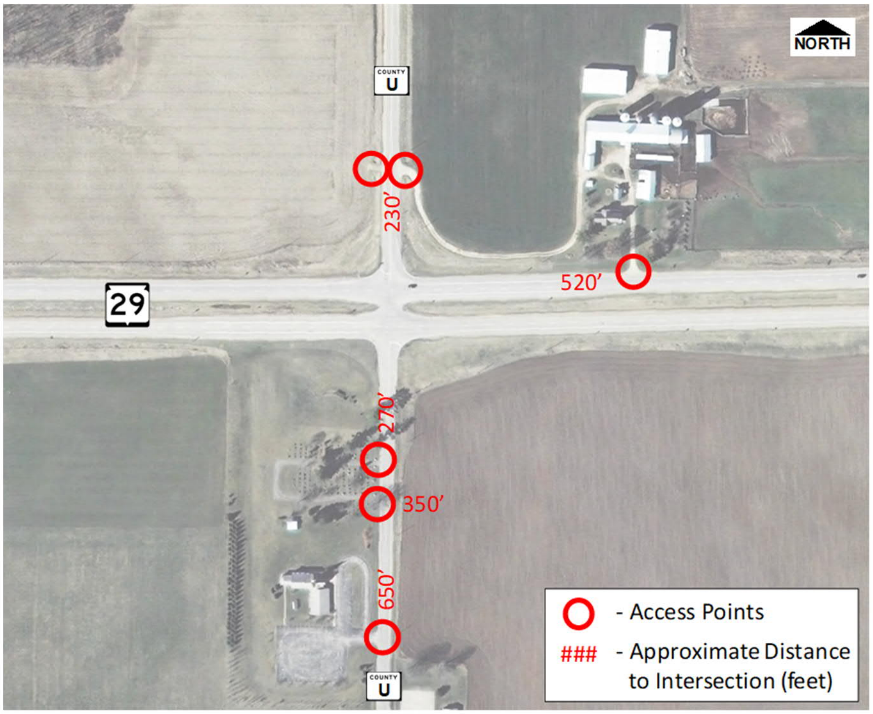


Figure 4–STH 29 and CTH U: Nearby Access Points

Recent improvements at the CTH U intersection in response to two fatal angle crashes in fall 2017 include the following:

- Rumble pads were reground. The three rumble strip locations are approximately 400, 625 to 650, and 975 to 1,000 feet away from the stop bars on the sideroad approaches, respectively.
- Left side "stop-ahead" signs with metal orange flags were added to the CTH U mainline and provided to Shawano County by WisDOT to place on the "stop-ahead" signs.
- Flashing red beacons on top of the CTH U stop signs will be installed in 2018.
- Double-marked intersection warning signs were installed with 55 mph advisory speeds along STH 29, east of CTH U.

WisDOT collected travel speed data along the STH 29 WB mainline in July 2017. The results showed that the average speed was 66 mph and the 85th percentile speed was 71 mph.

Photographs from the site visit performed in July 2017, before the improvements listed above were implemented, are included in Attachment A.

Crash Analysis:

Crashes at the STH 29 and CTH U intersection were evaluated for the 5-year period from 2013 to 2017. During that time, 15 crashes occurred, 9 of which were injury crashes including 3 fatal crashes. The other injury crashes included 3 involving a Type A (incapacitating) injury, 2 involving Type B (non-incapacitating) injuries, and 1 involving a Type C (possible) injuries. The total intersection crash rate is 0.84 crashes per million entering vehicles (MEV) over the analysis period.

Two of the fatal crashes involved a collision between a vehicle traveling WB on STH 29 and a crossing NB vehicle on CTH U. The third fatal crash was a right-angle crash between an EB through vehicle and a SB through vehicle. Angle crashes account for 67 percent of the crashes during the analysis period. The angle crashes may be due to the poor sight distance of oncoming vehicles and may lead to drivers misjudging the speeds of approaching vehicles.

See Attachment B for the STH 29 and CTH U intersection crash diagram. Tables 2, 3, and 4 summarize the intersection crash type and crash severity trends at this intersection.

Table 2–Intersection Crash Type

Crash Type	2013	2014	2015	2016	2017	Total
Angle	0	2	1	3	4	10
Rear End	0	0	0	1	0	1
Sideswipe–Same Direction	0	1	1	0	0	2
Sideswipe–Opposite Direction	1	0	0	0	0	1
Single Vehicle	0	0	0	1	0	1
Total	1	3	2	5	4	15

Table 3–Intersection Crash Severity

Crash Severity	2013	2014	2015	2016	2017	Total
Fatal	0	0	0	1	2	3
A Injury	0	1	1	1	0	3
B Injury	0	0	0	2	0	2
C Injury	0	1	0	0	0	1
PDO	1	1	1	1	2	6
Total	1	3	2	5	4	15

Table 4–Intersection Crash Type and Severity

Crash Type	Severity					Total
	K	A	B	C	PDO	
Angle	3	3	1	1	2	10
Rear End	0	0	1	0	0	1
Sideswipe–Same Direction	0	0	0	0	2	2
Sideswipe–Opposite Direction	0	0	0	0	1	1
Single Vehicle	0	0	0	0	1	1
Total	3	3	2	1	6	15

Intersection KAB crashes that occurred between 2008 through 2012, outside of the 2013 to 2017 analysis period, are shown in Table 5 for the STH 29 and CTH U intersection to provide further background of the crash history.

Table 5–KAB Crashes Outside of Analysis Period

Crash Type	2008	2009	2010	2011	2012	Total
Angle	1 (K)	0	0	1 (A)	2 (B)	4
Sideswipe–Same Direction	0	0	0	1 (B)	0	1
Total	1	0	0	2	2	5

The segment crash rates were calculated as the number of crashes per hundred million vehicle miles traveled (HMVMT). Peer Group 210 with 65 mph expressways was used for the statewide average crash rates and upper control limit (UCL) calculations. The segment crash rates were compared to the 2012 to 2016 statewide crash rates, which were published on November 14, 2017.

Segment crashes on STH 29 from CTH U to Kroenke Creek Road were evaluated for the 5-year period from 2013 to 2017. In this segment, 14 of the 18 crashes occurred in the WB direction of travel; of those 14 crashes, 6 resulted in a KAB injury, which is approximately 8.5 times the statewide average. In this segment, 15 of the 18 crashes (83 percent) occurred at the STH 29 and CTH U intersection. The 3 non-intersection crashes were rear-end collisions, all east of CTH U. On this segment, eight of the crashes were KAB severity, which occurred at the CTH U intersection. Figure 5 shows the segment crash analysis summary. See Attachment B for the STH 29 segment crash diagram from CTH U to Kroenke Creek Road.

CTH U to Kroenke Creek Road	Severity	2013	2014	2015	2016	2017	Total	Average Annual Crash Rate (2013-2017)	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	0	0	1	2	1	**4**	49.1	*47.62*	1.03	*71.8*	0.68
1.0 miles 4,465 AADT	KAB Injury	0	0	0	1	1	**2**	24.5	*8.65*	**2.84**	*19.0*	1.29
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	1	3	2	5	3	**14**	171.8	*47.62*	**3.61**	*71.8*	**2.39**
1.0 miles 4,465 AADT	KAB Injury	0	1	1	3	1	**6**	73.6	*8.65*	**8.51**	*19.0*	**3.88**

1.00 - 1.99	*Ratio vs. Statewide Average or UCL*
2.00 - 2.99	*Ratio vs. Statewide Average or UCL*
3.00+	*Ratio vs. Statewide Average or UCL*

Figure 5–STH 29 Segment Crash Summary from CTH U to Kroenke Creek Road

Traffic Operations Analysis:

Turning movement counts for STH 29 and CTH U were collected on Wednesday, June 21, 2017. The AM peak hour was determined to be 7:30 to 8:30 A.M. and the PM peak hour was determined to be 4 to 5 P.M. See Attachment D for the 2017 turning movement counts.

The WisDOT Traffic Forecasting Section provided turning movement counts for the existing 2017 traffic volumes and the forecasted 2020, 2030, and 2040 year volumes for the STH 29 and CTH U intersection. WisDOT also provided mainline average annual daily traffic (AADT) forecasts for the STH 29 corridor. See Attachment E for the forecasted turning movement counts and mainline AADT forecast.

It should be noted that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study assumes a 9 percent seasonal reduction; however, the slightly lower base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and potential alternatives. See Attachment E for the seasonally adjusted turning movement volumes.

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT FDM guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 on using HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers will experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through movements that receive zero delay are factored into the average.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. For the scope of this project, LOS C was considered to be the limit of acceptable delay. Table 6 summarizes the existing and design year no-build traffic operations for the STH 29 and CTH U intersection.

Table 6–Existing and Future No Build Traffic Operations Summary

Intersection	Analysis Year	AM Peak			PM Peak		
		Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH U	2017	13.0	B	--	14.3	B	--
	2020	13.3	B	--	14.8	B	--
	2030	14.6	B	--	16.6	C	--
	2040	16.2	C	--	19.2	C	--

The existing and future no build turning movements operate at LOS C or better during both the AM and PM peak hours using the seasonally adjusted traffic volumes. Using the unadjusted 2040 traffic volumes, the future no build turning movements continue to operate at LOS C or better during both the 2040 AM and PM peak hours. See Attachment G for the results of the existing and future no build operations analysis.

Section 3: Alternatives

The purpose of this study is to identify the most viable alternatives to address existing safety needs. The following describes the alternatives considered, the feasibility of each alternative, and a more detailed evaluation of the most feasible alternatives.

Alternatives Considered:

Factors that went into the initial screening in order to identify the most viable alternatives included Crash Modification Factor (CMF) analyses, indirection (i.e., traffic volumes rerouted because of alternative), relative costs and impacts, and corridor continuity.

The following alternatives were considered for the STH 29 and CTH U intersection:

- Closed Median (Right-in/Right-out)
- Access Control (Right-in/Right-out/Left-in)
- Intersection Control
- Through Route Activated Warning System (TRAWS)
- Slotted Lefts
- J-Turn
- Median U-Turn
- Diamond Interchange

Feasibility of Alternatives:

The study team coordinated with WisDOT North Central Region staff through conference calls and an in-person meeting to identify the most viable alternatives for this intersection. The study team also used the Phase 1: ICE Brainstorming Guide to supplement the alternatives evaluation. See Attachment C for the Phase 1: ICE Brainstorming Guide. Information from an Environmental Assessment (EA) that was conducted in 2010 for the STH 29 corridor to map out a long-term plan for the conversion of STH 29 from expressway to freeway was used in this study's alternatives analysis as well.

CMFs were applied to the crash totals to provide a quantitative crash reduction for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin, the J-Turn and TRAWS alternative CMFs were used from that table. The Median U-Turn and Slotted Left (also referred to as Positive Offset Left-Turn Bays) CMFs were taken from the CMF Clearinghouse website. The CMF Clearinghouse is a larger database of CMFs that more appropriately matched the alternatives.

The Right-in/Right-out/Left-in and Right-in/Right-out alternative did not have a close match in the CMF Clearinghouse website so the J-Turn CMF from the WisDOT table was applied to the Right-in/Right-out/Left-in alternative and the Median U-Turn from the CMF Clearinghouse website was applied for the Right-in/Right-out alternative. The study team coordinated with and received approval from WisDOT BTO staff for this concept related to the J-Turn and Right-in/Right-out/Left-in alternative.

The J-Turn alternative and Right-in/Right-out/Left-in alternative are similar in how that they redirect minor road vehicles from crossing the intersection. However, the J-Turn and Right-in/Right-out/Left-in alternatives have different movements with different conflict points. The J-Turn alternative has vehicles merging off and merging into traffic, which is different from the left-turn movement where vehicles are crossing oncoming traffic. The difference in movements and conflict points may cause different accident types and totals. Therefore, the J-Turn and Right-in/Right-out/Left-in alternatives will appear to reduce crashes equally in Table 7, but may have different results than shown in the table. Additionally, the Right-in/Right-out/Left-in and Right-in/Right-out alternatives each redirect traffic to adjacent intersections, which is not captured by the CMF analysis but may have a negative effect on safety and operations for other intersections, driveways, or median crossovers.

Table 7 summarizes the CMF applications showing the total crashes and estimated crash reduction for each alternative. See Attachment F for the CMF analysis of the STH 29 and CTH U intersection.

Table 7–CMF Analysis Summary for STH 29 and CTH U

Alternative	Total Crashes		Fatal Crashes		Serious Injury Crashes (A, B)	
	Total	Reduction	Total	Reduction	Total	Reduction
J-Turn	15	6.93	3	1.88	5	3.14
Median U-Turn		7.65		--		3.10
Right-in/Right-out/Left-in		6.93		1.88		3.14
Right-in/Right-out		7.65		--		3.10
Positive Offset Left-Turn Bays		5.07		1.07		1.78
TRAWS		3.83		0.80		1.33

The following describes alternatives that were considered the least viable at this intersection.

1. Closed Median or Access Control
   Closing the median or restricting access for certain movements would be a highly effective safety treatment to either eliminate or reduce the crossing conflicts at the intersection. However, this alternative would result in a high amount of indirection for the mainline left-turn movements and the sideroad thru and left-turn movements. These movements could either reroute to local roads to access STH 29 or perform U-turns at the next closest access points along STH 29.

Along STH 29 to the west of CTH U, there are four median openings within a mile of CTH U without mainline left-turn bays, the closest being 0.25 miles away. These openings would not be favorable to account for U-turn traffic. To the east, there is one median opening approximately 0.25 miles away without a mainline left-turn bay and the Kroenke Creek Road intersection, approximately 1 mile away, has a mainline left-turn bay that would be favorable to U-turns.

The amount of traffic volume rerouted with the closed median or access control alternatives would be undesirable on the north leg of the intersection, with 85 to nearly 100 vehicles being rerouted during the peak hours with either a Right-in/Right-out or Right-in/Right-out/Left-in concept. On the south side, less than 40 vehicles would be rerouted during the peak hours; however, the indirection to nearby local roads would be greater (over 3 miles).

Additionally, stakeholders involved in the EA identified CTH U as an important north/south route for Village of Gresham commuters, emergency vehicle operations, and tourist destinations north of STH 29. In 2017, a letter from the Shawano Highway Safety Commission noted that the main complaints in this area is the increased traffic flow because of the expansion of area business, which includes the North Star Casino (north of STH 29).

For these reasons, the Closed Median and Access Control alternatives were not identified as one of the most feasible alternatives.

2. Intersection Control (Signals, Roundabouts, or All-way-stop)
   Traffic signal control, roundabout control, and all-way-stop control were not analyzed for the STH 29 and CTH U intersection in order to maintain free flow conditions along STH 29. There are no controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in the city of Wausau and I-41 near the city of Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

3. TRAWS
   The TRAWS is not being evaluated as a stand-alone alternative because it does not improve the geometric deficiencies or fully address the 24 crossing conflicts at the existing intersection. The TRAWS is being considered as a supplement to one alternative that would reconstruct the STH 29 WB mainline to address the crest vertical curve east of the intersection. This alternative is discussed further in the Evaluation of Alternatives section of this report. The TRAWS system may not be as effective of a safety measure when only activated for right-turns from the sideroad as opposed to thru movements or left-turns from the sideroad.

4. Slotted Lefts
   This concept was considered less feasible than other alternatives because geometric deficiencies and factors contributing to the crash history are not fully addressed. Mainly, the number of crossing conflicts would not be reduced with this alternative.

Evaluation of Alternatives:

The following alternatives were identified by WisDOT NC Region, WisDOT BTO, and the study team as the most feasible for this intersection within the goals of the study:

- Alternative 1: J-Turn
- Alternative 2: Median U-Turn
- Alternative 3: Diamond Interchange
- Alternative 4: TRAWS with Mainline Reconstruction

A preliminary opinion of probable construction cost (OPCC) was prepared for Alternatives 1, 2, and 3. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on three similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process. The OPCC for the conceptual layouts were developed in 2017 dollars and are based on similar projects in Wisconsin. For Alternatives 1 and 2, similar projects included three recently constructed J-turns. For Alternative 3, the OPCC was based on a combination of information from the USH 18/CTH ID interchange in Iowa County (Project ID 1204-02-76), the previously prepared design from the EA, and vertical design assumptions by the study team. The OPCC excludes any real estate or impact costs for each alternative. Attachment J includes a detailed list of assumptions and breakdown of quantities and unit prices used in the OPCC. For Alternative 4, a more detailed vertical design would be required to develop an accurate OPCC. While this alternative is still considered viable as it may help address safety concerns, impacts and costs will need to be evaluated further in the Phase II: Alternative Selection ICE Report.

The study team evaluated traffic operations for Alternatives 1 and 2 under the 2040 design year conditions. For alternative intersections, like the J-Turn and Median U-Turn, the LOS is based on the average Experienced Travel Time (ETT) for each movement as it travels through the intersection. The ETT takes into account the Extra Distance Travel Time (EDTT) required to travel to and from a U-Turn. The LOS thresholds for alternative intersections are identical to those for conventional signalized intersections. See Attachment H for the results of the future build operations analysis.

Alternative 1: J-Turn

The J-Turn alternative provides full access at the CTH U intersection, while redirecting CTH U through and left-turn movements to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two additional U-turn openings in the median with turn lanes extending to CTH U. Islands on the approaches of CTH U direct through and left-turning movements into the U-turn turn lane to remove mainline weaving and reduce wrong way maneuvers. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the CTH U intersection. A conceptual layout of Alternative 1 is provided in Attachment I.

The preliminary OPCC for Alternative 1 is between $1.2 and $1.6 million.

This alternative eliminates 20 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2013 to 2017 crash history, it is anticipated that the J-Turn treatment would address 11 of the 15 crashes, ten of which were right-angle crashes. While crossing conflicts remain with the J-Turn alternative between the mainline left-turns versus mainline through vehicles at the primary intersection, the crash history does not include any collisions between these movements. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 1, the EB and WB intersection approaches operate at LOS A and the NB intersection approach operates at LOS C during the 2040 AM and PM peak hours. The SB intersection approach operates at LOS D during the 2040 AM peak hour and at LOS C during the 2040 PM peak hour. The LOS D for the SB sideroad approach is largely due to the EDTT for the through and left-turn movements and not the control delay for the driver. Table 8 summarizes the Alternative 1 traffic operations for the STH 29 and CTH U intersection by intersection approach.

Table 8–2040 Alternative 1 Traffic Operations

J-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH U	EB STH 29	0.1	A	0.1	A
	WB STH 29	0.0	A	0.2	A
	NB CTH U	32.8	C	34.6	C
	SB CTH U	35.8	D	35.0	C
	Overall	4.1	A	3.8	A

Alternative 2: Median U-Turn

The Median U-Turn alternative provides full access at the CTH U intersection, while redirecting the CTH U through and left-turn movements and the STH 29 left-turns to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two U-turn openings in the median with turn lanes extending through the CTH U intersection. Islands on the approaches of CTH U direct through and left-turning movements into the U-turn turn lane and improves sight distance when combined with offset right-turn lanes on STH 29. A conceptual layout of Alternative 2 is provided in Attachment I.

The preliminary OPCC for Alternative 2 is between 0.9 and 1.2 million dollars.

This alternative eliminates all 24 crossing conflicts experienced at the existing intersection. Based on the 2013 to 2017 crash history, it is anticipated that the Median U-Turn treatment would address 11 of the 15 crashes, 10 of which were right-angle crashes. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 2, each intersection approach operates at LOS C or better during both the 2040 AM and PM peak hours. The difference in the SB approach operations between Alternative 2 (Median U-Turn) and Alternative 1 (J-Turn) is that the EDTT is about 6 seconds less for the SBL and SBT movements in Alternative 2 compared to Alternative 1. In other words, the U-turn locations are tighter to the primary intersection in the Median U-Turn versus the J-Turn, leading to a difference in the experienced travel time for the driver. Table 9 summarizes the Alternative 2 traffic operations for the STH 29 and CTH U intersection by intersection approach.

Table 9: 2040 Alternative 2 Traffic Operations

Median U-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. EDT (s)	App. LOS	App. EDT (s)	App. LOS
STH 29 and CTH U	EB STH 29	0.3	A	0.2	A
	WB STH 29	0.0	A	0.4	A
	NB CTH U	28.9	C	30.8	C
	SB CTH U	30.0	C	29.7	C
	Overall	3.6	A	3.5	A

<u>Alternative 3: Diamond Interchange</u>

The EA completed in 2010 identified the STH 29 and CTH U intersection as a possible location for an interchange. While this alternative is anticipated to cost substantially more and have higher real estate impacts relative to the J-Turn and Median U-turn alternatives, it would also remove all at-grade intersection crossing conflicts with STH 29 mainline traffic and fully addresses the current intersection sight distance deficiencies. Ten total crossing conflicts are presented at the two stop-controlled ramp terminal intersections; however, these would be at a much lesser volume and would occur at lesser speeds than the current crossing conflicts. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

Additionally, according to the FDM (11-30-1), as "…a general 'rule of thumb' interchanges warrant consideration when the design year mainline and side road combined AADT > 12,000 and the side road traffic AADT > 2,000." Based on the WisDOT traffic forecasts, these conditions would be met by the 2040 design year on the STH 29 mainline and on the north leg of CTH U.

Traffic operations were not evaluated for the diamond interchange alternative; however, it is anticipated that the ramp terminal intersections will operate acceptably in the 2040 design year because in the 2040 No-Build operations all movements operate at LOS C or better during the AM and PM peak hours for the current at-grade, full access intersection.

The EA indicated that there would be a total of 0.27 acres of wetland impacts in the northeast quadrant of the interchange, two relocations, and agricultural impacts. As discussed previously, these costs are not included in the preliminary OPCC. In addition, the vertical design and cost estimate should be reviewed in further detail during the design phase as vertical design information was not readily available from the EA for use in this study.

The preliminary OPCC for Alternative 3 is between $10.4 and $11.7 million. This cost is similar to the let for the USH 18/151 and CTH ID interchange in Iowa County (Project ID 1204-02-76), which is currently under construction, at $9.75 million without engineering and contingency costs. The USH 18/151 and CTH ID design is shown in Attachment K for reference. The preliminary OPCC for the CTH U interchange without engineering and contingency ranges from $9.07 to $10.2 million. Given the limited information available to complete the preliminary OPCC, the study team suggests erring on the high side of the range for budgeting purposes.

The study team identified three options to reduce costs of the 10.4 to 11.7 million preliminary OPCC if the interchange is built as a stand-alone project. The options are described below and are shown schematically in Attachment K. The reduction in costs and impacts has not been evaluated for these options, but should be considered further in the design phase.

- North Reduction Option 1: Viewed as a stand-alone alternative, there may not be a need for the frontage road at all in the northwest quadrant if the relocation indicated in the EA occurs. If this frontage road is not built, the driveway and field entrance to the west of the WB on-ramp would be just over and below, respectively, the desirable distance for access points near an interchange.
- North Reduction Option 2: Shortening the frontage road could be considered if the residence in the northwest quadrant is not considered a relocation. A reevaluation of slope-intercepts and right of way impacts would be needed in the design phase.
- South Reduction Option: The frontage road could be shortened an additional 2,000 feet compared to the currently design, which is modified from the EA. However, construction the frontage roads as shown in the current design would remove additional access points along STH 29 near the interchange.

Alternative 4: TRAWS with Mainline Reconstruction

The TRAWS with Mainline Reconstruction alternative would maintain full access at the CTH U intersection and reconstruct the STH 29 mainline east of the intersection to reasonably flatten the crest curve in order to provide better intersection sight distance. A conceptual layout was not prepared for this alternative as detailed vertical design was not included as part of the Phase I: Scoping Level ICE effort for this study.

This alternative would not eliminate any of the 24 crossing conflicts experienced at the existing intersection; however, the TRAWS treatment may help to mitigate crashes involving crossing vehicles and could supplement the recent safety improvements implemented at this intersection. Reducing the crest curve east of the intersection would improve sight distance for all SB movements, NB through and left-turn movements, and EB left-turn movements.

Based on the 2013 to 2017 crash history, it is difficult to determine if any crashes would be fully addressed because no crossing conflicts are eliminated with this treatment. Even so, improving sight distance and implementing the TRAWS may help to mitigate the 10 right-angle crashes that occurred at this intersection.

For Alternative 4, the intersection would be expected to operate similarly to the No-Build condition, where each movement operates at LOS C or better during both the 2040 AM and PM peak hours.

Table 10 lists pros and cons for each of the most feasible alternatives.

Table 10: Alternatives Evaluation

Alternatives Evaluation		
Alternative	Pros	Cons
1 J-Turn	• Removes 20 of the 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • No indirection for mainline left-turns	• Driveway between eastern U-turn and main intersection • Slightly more travel time than Median U-Turn • Higher cost than Median U-Turn
2 Median U-Turn	• Removes all 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • Less travel time than J-Turn • Lower cost than J-Turn	• Creates indirection for mainline left-turn movements
3 Diamond Interchange	• Removes 24 STH 29 mainline and CTH U crossing conflicts. Crossing conflicts that occur (10) are at low volume along CTH U • Anticipated to operate acceptably • Long-term solution for safety needs	• Highest anticipated construction cost versus other alternatives • Impacts include approximately 0.27 acres of wetland along with two relocations and agricultural impacts
4 TRAWS with Mainline Reconstruction	• Mainline reconstruction improves sight distance for 6 of 12 intersection movements • TRAWS would supplement recent safety improvements for the current full access intersection	• Does not geometrically address crossing conflicts at the intersection • Unknowns with costs and impacts of reconstruction the STH 29 mainline

Section 4: Conclusion

The J-Turn, Median U-Turn, Diamond Interchange, and TRAWS with Mainline Reconstruction were identified as the most viable alternatives to consider for HSIP funding. These alternatives will each address intersection sight distance deficiencies and three of the four alternatives remove or reduce crossing conflicts at the primary intersection.

The costs prepared for this study are to be considered preliminary and are presented as a range. It is at the discretion of WisDOT to select the appropriate OPCC from the range presented, or otherwise, to be used in the HSIP application.

Attachments:

Attachment A–Project Location Map
Attachment B–Crash Diagrams
Attachment C–ICE Brainstorming Guide
Attachment D–Traffic Counts
Attachment E–Traffic Forecasts
Attachment F–Crash Modification Factors
Attachment G–Existing and Future No Build Traffic Modeling Results
Attachment H–Build Conditions Traffic Modeling Results
Attachment I–Preliminary Design
Attachment J–Opinion of Probable Construction Cost
Attachment K–CTH U Interchange Considerations

To: Tony Kemnitz, P.E., PTOE
From: Joseph Urban, P.E., Strand Associates, Inc.®
Adam Walter, Strand Associates, Inc.®
Brenden Johnson, Strand Associates, Inc.®
Date: 3/29/2018
RE: 0656-43-04
STH 29 and CTH MMM/Clark Drive
Town of Morris, Shawano County
Highway Safety Improvement Program (HSIP)

Section 1: Project Description

The Wisconsin Department of Transportation (WisDOT) is currently investigating the intersection of STH 29 and CTH MMM/Clark Drive, located in the town of Richmond in Shawano County, as a candidate for Highway Safety Improvement Program (HSIP) funding. The purpose of this Intersection Control Evaluation (ICE) is to identify the most viable alternatives to improve intersection safety at STH 29 and CTH MMM/Clark Drive. The study limit extends approximately 1.2 miles from CTH MMM/Clark Drive to CTH M as shown in Figure 1, which includes the functional area of the CTH MMM/Clark Drive intersection. See Attachment A for a complete map of the surrounding street network.

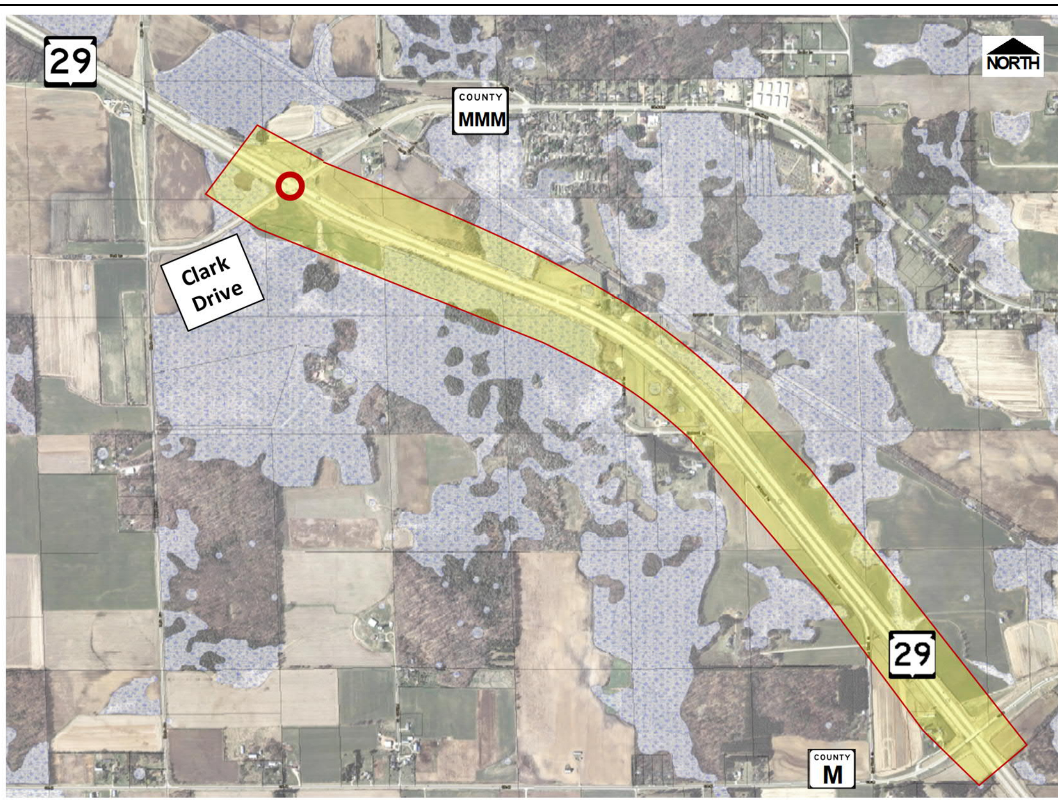


Figure 1–STH 29 and CTH MMM/Clark Drive Intersection

Section 2: Existing Conditions

STH 29 is a 4-lane divided rural highway with a 60-foot median and a posted speed limit of 65 miles per hour (mph). CTH MMM is the north approach of the intersection and is a 2-lane undivided rural highway with a posted speed limit of 55 mph. Clark Drive is the south approach of the intersection and is a 2-lane undivided rural road with a posted speed limit of 45 mph. The northbound (NB) and southbound (SB) approaches are stop controlled. The CTH MMM SB approach tapers provide space for through/left and right turning vehicles to stack next to each other at the stop bar. The Clark Drive NB approach only provides space for a right/through/left movement.

Strand Associates, Inc. (Strand)performed a review of the geometric deficiencies at the intersection based upon As-Built plans provided by WisDOT, a site visit performed in July 27, 2017, and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Figure 2 shows a summary of the geometric deficiencies found at this intersection.

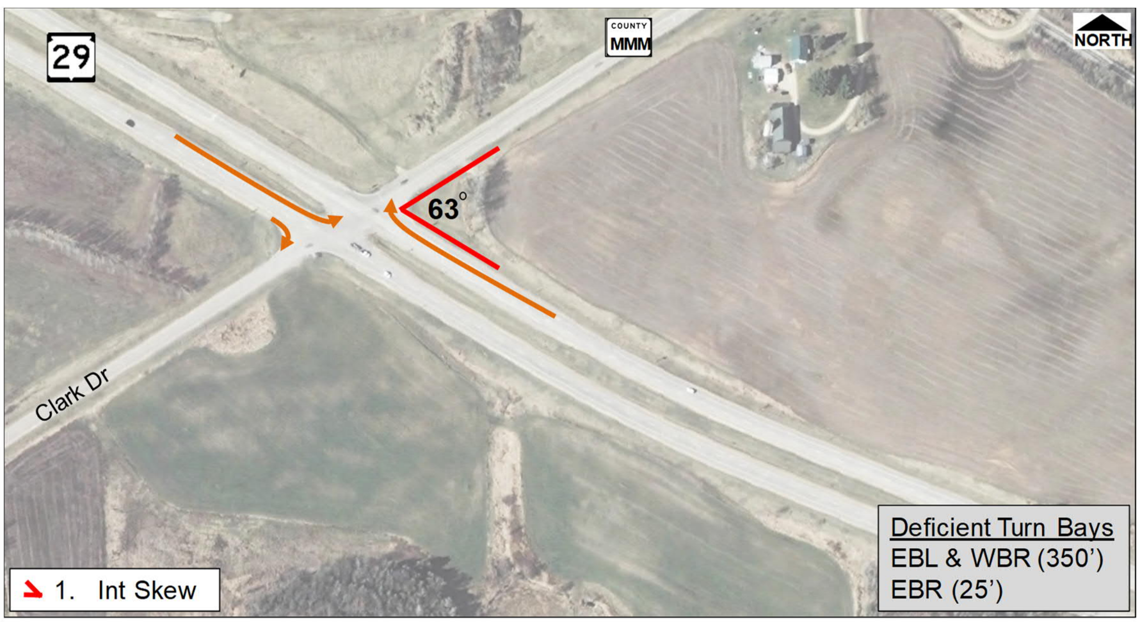


Figure 2–Summary of Geometric Deficiencies

The STH 29 and CTH MMM/Clark Drive intersection is skewed 63 degrees, which does not meet current minimum Facilities Development Manual (FDM) standards. The eastbound (EB) and westbound (WB) approaches along STH 29 at CTH MMM/Clark Drive provide left- and right-turn bays. The EB left- and right-turn bays are 350 and 25 feet, respectively. The WB left- and right-turn bays are both 350 feet. The EB left- and right-turn lanes and WB right-turn lane do not meet current minimum FDM standards for Type A1 or Type B1 intersections. A summary of the turn bay storage length deficiencies is shown in Table 1.

Table 1: Turn Bay Storage Length Summary

Intersection Turn	Existing Storage Length (ft)	Intersection Type	Desirable Storage Required (ft)	Minimum Storage Required (ft)	Meets FDM Standards?
EB Left	350	A1	550	450	No
WB Left	350	B1	400	300	Yes
EB Right	25	B1	300	300	No
WB Right	350	A1	450	450	No

There are no driveways or access points within the functional area of the STH 29 and CTH MMM/Clark Drive intersection; however, there is a snowmobile trail crossing within 100 feet of the intersection along CTH MMM. The nearest access along STH 29 to the east of the CTH MMM/Clark Drive intersection is the STH 22 interchange, approximately 3.5 miles away, and to the west is the Oak Road intersection, approximately 2 miles away. The STH 22 interchange is located on the south side of the City of Shawano and has stop-controlled ramp terminal intersections. Oak Road is a full access at-grade intersection.

Photographs from the site visit taken in July 2017 are included in Attachment A.

Crash Analysis:

Crashes at the STH 29 and CTH MMM/Clark Drive intersection were evaluated for the 5-year period from 2012 to 2016. During that time, ten crashes occurred, four of which were injury crashes. The total intersection crash rate is 0.56 crashes per million entering vehicles (MEV) over the analysis period.

The collisions with severe injuries (KAB) included one involving a Type A (incapacitating) injury and three involving Type B (non-incapacitating) injuries. High severity collisions typically occurred from motorist trying to cross STH 29, with five of the ten crashes being angle collisions. The deficient intersection skew may contribute to drivers on CTH MMM not clearly seeing WB STH 29 vehicles as failure to yield was noted in several crashes.

See Attachment B for the STH 29 and CTH MMM/Clark Drive intersection crash diagram. Tables 2, 3, and 4 summarize the intersection crash type and crash severity trends at this intersection.

Table 2–Intersection Crash Type

Crash Type	2012	2013	2014	2015	2016	Total
Angle	0	0	2	2	1	5
Rear End	1	0	0	0	1	2
Sideswipe–Same Direction	0	1	0	1	0	2
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	1	0	0	0	0	1
Total	2	1	2	3	2	10

Table 3–Intersection Crash Severity

Crash Severity	2012	2013	2014	2015	2016	Total
Fatal	0	0	0	0	0	0
A Injury	0	0	1	0	0	1
B Injury	0	0	1	1	1	3
C Injury	0	0	0	0	0	0
Property Damage Only	2	1	0	2	1	6
Total	2	1	2	3	2	10

Table 4–Intersection Crash Type and Severity

Crash Type	Severity					Total
	K	A	B	C	PDO	
Angle	0	1	3	0	1	5
Rear End	0	0	0	0	2	2
Sideswipe–Same Direction	0	0	0	0	2	2
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	0	0	0	0	1	1
Total	0	1	3	0	6	10

The segment crash rates were calculated as the number of crashes per hundred million vehicle miles traveled (HMVMT). Peer Group 210 with 65 mph expressways was used for the statewide average crash rates and upper control limit (UCL) calculations. The segment crash rates were compared to the 2012 to 2016 statewide crash rates, which were published on November 14, 2017.

Segment crashes on STH 29 from CTH MMM to CTH M were evaluated for the 5-year period from 2012 to 2016 for each direction of travel, following WisDOT's statewide average crash rate guidance for divided roadways. The total crash rate for EB STH 29 is below the statewide average and UCL, while WB STH 29 is nearly 50 percent over the statewide average and about 5 percent over the UCL for this segment. During the study period there were six KAB crashes, which results in a KAB crash rate over double the statewide average and about 15 percent over the UCL. On this segment, seven of the eight non-intersection crashes were single vehicle crashes. All six of the KAB (two Type A and four Type B) severity crashes within this segment occurred at the STH 29/CTH MMM intersection.

A fatal single-vehicle overturn crash occurred west of the CTH MMM intersection in 2014 where two of the occupants were fatalities; however, this crash was excluded from the crash statistics as it was outside of the study limits.

See Attachment B for the STH 29 segment crash diagram from CTH MMM to CTH M. Figure 3 shows the segment crash analysis summary.

CTH MMM to CTH M	Severity	2012	2013	2014	2015	2016	Total	Average Annual Crash Rate	Statewide Average (2012-2016)	Corridor vs Statewide Average	Upper Control Limit (UCL) (2012-2016)	Corridor vs UCL
EASTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	0	1	2	2	2	**7**	43.9	*47.62*	0.92	*64.9*	0.68
2.0 miles 8,740 AADT	KAB Injury	0	0	1	1	1	**3**	18.8	*8.65*	**2.17**	*16.0*	1.17
WESTBOUND *Meta-manager Peer Group 210: 65 mph Expressways*	Total Crashes	5	1	2	2	1	**11**	69.0	*47.62*	1.45	*64.9*	1.06
2.0 miles 8,740 AADT	KAB Injury	0	1	2	0	0	**3**	18.8	*8.65*	**2.17**	*16.0*	1.17

1.00 - 1.99	*Ratio vs. Statewide Average or UCL*
2.00 - 2.99	*Ratio vs. Statewide Average or UCL*
3.00+	*Ratio vs. Statewide Average or UCL*

Figure 3–STH 29 Segment Crash Summary from CTH MMM to CTH M

Intersection and Segment KAB crashes that occurred between 2008 through 2011 and in 2017, outside of the 2012 to 2016 analysis period, are shown in Table 5 for the STH 29 and CTH MMM/Clark Drive intersection. The CTH MMM to CTH M segment is also shown in Table 5 to provide further background of this area's severe injury crash history.

Table 5–KAB Crashes Outside of Analysis Period

Crash Type	2008	2009	2010	2011	2017	Total
CTH MMM Int–Angle	0	0	1 (A)	0	0	1
CTH MMM Int–Rear End	0	1 (B)	0	0	0	1
Segment–Single Vehicle	0	1 (A)	1 (B)	0	1 (B)	3
Total	0	2	2	0	1	5

<u>Traffic Operations Analysis:</u>

Turning movement counts for STH 29 and CTH MMM/Clark Drive were collected on Thursday, June 22, 2017. The AM peak hour was determined to be 7:15 to 8:15 A.M. and the PM peak hour was determined to be 4 to 5 P.M. based on the side road volumes. See Attachment D for the 2017 turning movement counts.

The WisDOT Traffic Forecasting Section provided turning movement counts for the existing 2017 traffic volumes and the forecasted 2020, 2030, and 2040 year volumes for the STH 29 and CTH MMM/Clark Drive intersection. WisDOT also provided mainline average annual daily traffic (AADT) forecasts for the STH 29 corridor. See Attachment E for the forecasted turning movement counts and mainline AADT forecast.

It should be noted that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study assumes a 9 percent seasonal reduction; however, the slightly lower base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and potential alternatives. See Attachment E for the seasonally adjusted turning movement volumes.

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT FDM guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 on using HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers will experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through movements that receive zero delay are factored into the average.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. For the scope of this project, LOS C was considered to be the limit of acceptable delay.

Table 6 summarizes the existing and design year no-build traffic operations for the STH 29 and CTH MMM/Clark Drive intersection.

Table 6–Existing and Future No Build Traffic Operations Summary

Intersection	Analysis Year	AM Peak			PM Peak		
		Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH MMM/Clark Drive	2017	10.9	B	--	13.0	B	--
	2020	11.0	B	--	13.3	B	--
	2030	11.4	B	--	14.2	B	--
	2040	11.9	B	--	15.3	C	--

The existing and future no build turning movements operate at LOS B or better during the AM peak hour and at LOS C or better during the PM peak hour using the seasonally adjusted traffic volumes. Using the unadjusted 2040 traffic volumes, the future no build turning movements continue to operate at LOS B or better during the 2040 AM peak hour and at LOS C or better during the 2040 PM peak hour. See Attachment G for the results of the existing and future no build operations analysis.

Section 3: Alternatives

The purpose of this study is to identify the most viable alternatives to address existing safety needs. The following describes the alternatives considered, the feasibility of each alternative, and a more detailed evaluation of the most feasible alternatives.

Alternatives Considered:

Factors that went into the initial screening in order to identify the most viable alternatives included Crash Modification Factor (CMF) analyses, indirection (i.e., traffic volumes rerouted because of alternative), relative costs and impacts, and corridor continuity.

The following alternatives were considered for the STH 29 and CTH MMM/Clark Drive intersection:

- Closed Median (Right-in/Right-out)
- Access Control (Right-in/Right-out/Left-in)
- Intersection Control
- Through Roadway Activated Warning System (TRAWS)
- Slotted Lefts
- J-Turn
- Median U-Turn
- Diamond Interchange

Feasibility of Alternatives:

The study team coordinated with WisDOT North Central Region staff through conference calls and an in-person meeting to identify the most viable alternatives for this intersection. The study team also used the Phase 1: ICE Brainstorming Guide to supplement the alternatives evaluation. See Attachment C for the Phase 1: ICE Brainstorming Guide. Information from an Environmental Assessment (EA) that was conducted in 2010 for the STH 29 corridor to map out a long-term plan for the conversion of STH 29 from expressway to freeway was used in this study's alternatives analysis as well.

CMFs were applied to the crash totals to provide a quantitative crash reduction for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin, the J-Turn and Through Route Activated Warning System (TRAWS) alternative CMF's were used from that table. The Median U-Turn and Slotted Left (also referred to as Positive Offset Left-Turn Bays) CMFs were taken from the CMF Clearinghouse website. The CMF Clearinghouse is a larger database of CMFs that more appropriately matched the alternatives.

The Right-in/Right-out/Left-in and Right-in/Right-out alternative did not have a close match in the CMF Clearinghouse website so the J-Turn CMF from the WisDOT table was applied to the Right-in/Right-out/Left-in alternative and the Median U-Turn from the CMF Clearinghouse website was applied for the Right-in/Right-out alternative. The study team coordinated with and received approval from WisDOT BTO staff for this concept related to the J-Turn and Right-in/Right-out/Left-in alternative.

The J-Turn alternative and Right-in/Right-out/Left-in alternative are similar in how that they redirect minor road vehicles from crossing the intersection. However, the J-Turn and Right-in/Right-out/Left-in alternatives have different movements with different conflict points. The J-Turn alternative has vehicles merging off and merging into traffic, which is different from the left-turn movement where vehicles are crossing oncoming traffic. The difference in movements/conflict points may cause different accident types and totals. Therefore, the J-Turn and Right-in/Right-out/Left-in alternatives will appear to reduce crashes equally in Table 7, but may have different results than shown in the table. Additionally, the Right-in/Right-out/Left-in and Right-in/Right-out alternatives each redirect traffic to adjacent intersections, which is not captured by the CMF analysis but may have a negative effect on safety and operations for other intersections, driveways, or median crossovers.

Table 7 summarizes the CMF applications showing the total crashes and estimated crash reduction for each alternative. See Attachment F for the CMF analysis of the STH 29 and CTH MMM/Clark Drive intersection.

Table 7–CMF Analysis Summary for STH 29 and CTH MMM/Clark Drive

Alternative	Total Crashes		Fatal Crashes		Serious Injury Crashes (A, B)	
	Total	Reduction	Total	Reduction	Total	Reduction
J-Turn	10	4.62	--	--	4	2.51
Median U-Turn		5.10		--		2.48
Right-in/Right-out/Left-in		4.62*		--		2.51*
Right-in/Right-out		5.10*		--		2.48*
Positive Offset Left-Turn Bays		3.38		--		1.42
TRAWS		2.55		--		1.06

*See discussion preceding table on comparison of access control alternatives to J-Turn and MUT alternatives.

The following describes alternatives that were considered the least viable at this intersection.

1. Closed Median (Right-in/Right-out)
   Closing the median and providing a right-in/right-out treatment for CTH MMM and Clark Drive would be a highly effective safety treatment to eliminate all 24 crossing conflicts at the intersection. However, this alternative would result in a high amount of indirection for the mainline left-turn movements and the sideroad through and left-turn movements. The next closest access points to this intersection along STH 29 are the STH 22 interchange on the south side of the City of Shawano approximately 3.5 miles to the east and the STH 29/Oak Road intersection approximately 2 miles to the west.

   While movements to and from Clark Drive are generally lower volume (less than 45 vehicles per hour 2-way, the EB left-turn to CTH MMM is currently approximately 75 vehicles in the AM and PM peak hours and is projected to be approximately 95 vehicles in the 2040 AM and PM peak hours. Rerouting and additional 75 to 95 left-turn vehicles to the STH 22 interchange may put unnecessary strain on the operations for the stop-controlled STH 22 EB off-ramp.

Additionally, stakeholders involved in the EA identified access for emergency vehicles to and from Shawano Medical Center as an important consideration for the analysis. For these reasons, the Close Median alternative was not identified as one of the most feasible alternatives.

2. Intersection Control (Signals, Roundabouts, or All-way-stop)
   Traffic signal control, roundabout control, and all-way-stop control were not analyzed for the STH 29 and CTH MMM/Clark Drive intersection in order to maintain free flow conditions along STH 29. There are no controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in Wausau and I-41 in Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

3. TRAWS
   The TRAWS is not being evaluated as a stand-alone alternative because it does not improve the geometric deficiencies, notably intersection skew, or fully address the 24 crossing conflicts at the existing intersection. This could be considered in combination with another alternative; however, the most feasible alternatives for this intersection restrict through movements and left-turn movements from the sideroad. The TRAWS system may not be as effective of a safety measure when only activated for right-turns from the sideroad as opposed to thru movements or left-turns from the sideroad.

4. Slotted Lefts or Turn Lane Improvements
   The study team prepared a conceptual layout of turn lane improvements that included slotted left-turn lanes and an EB offset right-turn lane, but no changes in access. Upon further review and discussions, this concept was considered less feasible than other alternatives because geometric deficiencies and factors contributing to the crash history were not fully addressed. Mainly, the number of crossing conflicts would not be reduced with this alternative.

5. Diamond Interchange
   The EA completed in 2010 identified the STH 29 and CTH MMM/Clark Drive intersection as a possible location for an interchange. This alternative is a long-term solution that would remove all crossing conflicts between STH 29 mainline traffic and CTH MMM traffic, effectively addressing the existing safety needs at the intersection. This is not a viable alternative at this time because of the higher anticipated construction cost relative to the other alternatives being considered for HSIP funding.

<u>Evaluation of Alternatives:</u>

The following alternatives were identified by WisDOT North Central (NC) Region and the study team and as the most feasible for this intersection within the goals of the study:

- Alternative 1: Access Control (Right-in/Right-out/Left-in)
- Alternative 2: J-Turn
- Alternative 3: Median U-Turn

For each of these alternatives, a preliminary opinion of probable construction cost (OPCC) was prepared. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on three similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process. The OPCC for the conceptual layouts were developed in 2017 dollars and are based on similar projects in Wisconsin. The OPCC excludes any real estate costs. Attachment J includes a detailed list of assumptions and breakdown of quantities and unit prices used in the OPCC.

The study team evaluated traffic operations for Alternatives 1, 2, and 3 under the 2040 design year conditions. For alternative intersections, like the J-Turn and Median U-Turn, the LOS is based on the average Experienced Travel Time (ETT) for each movement as it travels through the intersection. The ETT takes into account the Extra Distance Travel Time (EDTT) required to travel to and from a U-Turn. The LOS threshold for alternative intersections are identical to those for conventional signalized intersections. See Attachment H for the results of the future build operations analysis.

Alternative 1: Access Control (Right-in/Right-out/Left-in)

Alternative 1 restricts access to right-in/right-out/left-in for movements at CTH MMM/Clark Drive and addresses intersection skew by realigning the CTH MMM approach. Islands on the approaches of CTH MMM/Clark Drive direct vehicles away from the slotted left-turn lanes to reduce wrong way maneuvers. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the CTH MMM/Clark Drive intersection. An additional sub-alternative (Alternative 1A) includes removing access to the south leg of the intersection by placing a cul-de-sac at Clark Drive. A conceptual layout of Alternative 1 and 1A is provided in Attachment I.

The preliminary OPCC for Alternative 1 is between $1.0 and $1.3 million, while the preliminary OPCC for Alternative 1A is between $600,000 and $800,000.

Alternatives 1 and 1A would both have an effect on emergency vehicles traveling to and from the Shawano Medical Center. Stakeholders in the EA identified maintaining access for all movements as an important consideration at the CTH MMM/Clark Drive intersection.

Alternative 1 eliminates 20 of the 24 crossing conflicts experienced at the existing intersection and Alternative 1A eliminates 22 of the 24 crossing conflicts. Based on the 2012 to 2016 crash history, it is anticipated Alternative 1 (both legs with access control) would address four of the ten crashes, each of which were right-angle crashes. Alternative 1A (cul-de-sac to Clark Drive) would address one additional angle crash that involved a WB mainline left-turn vehicle and an EB mainline through vehicle. Restricting the NB and SB through and left-turn movements in this treatment is anticipated to address most of the issues related to severe injuries identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 1 (Access Control), all turning movements operate at LOS B or better during the 2040 AM and PM peak hours. Table 8 summarizes the Alternative 1 traffic operations for the STH 29 and CTH MMM/Clark Drive intersection.

Table 8–2040 Alternative 1 Traffic Operations

Access Control (Right-in/Right-out/Left-in)						
Intersection	AM Peak			PM Peak		
	Int. Delay (s)	Int. LOS	LOS E or F Movements	Int. Delay (s)	Int. LOS	LOS E or F Movements
STH 29 and CTH MMM/Clark Drive	10.1	B	--	11.0	B	--

<u>Alternative 2: J-Turn</u>

The J-Turn alternative provides full access at the CTH MMM/Clark Drive intersection, while redirecting the CTH MMM/Clark Drive through and left-turn movements to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two additional U-turn openings in the median with turn lanes extending to CTH MMM/Clark Drive. Islands on the approaches of CTH MMM/Clark Drive direct through and left-turning movements into the U-turn turn lane to remove mainline weaving and reduce wrong way maneuvers. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the CTH MMM/Clark Drive intersection. This alternative also addresses intersection skew by realigning the CTH MMM approach. A conceptual layout of Alternative 2 is provided in Attachment I.

The preliminary OPCC for Alternative 2 is between $1.3 and $1.8 million.

This alternative eliminates 20 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the J-Turn treatment would address four of the ten crashes, each of which were right-angle crashes. The J-Turn alternative may not fully address the WB mainline left-turn versus EB mainline through collision that occurred in 2016 and resulted in a Type B injury. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address most of the issues related to severe injuries identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

The J-Turn alternative provides direct EB STH 29 left-turn access from the mainline to CTH MMM, which does not have an apparent crash issue based on the crash history. This may be considered a benefit for emergency vehicle access in comparison to the Median U-Turn, which was a concern noted in the EA.

For Alternative 2 (J-Turn), each approach operates at LOS C or better during the 2040 AM and PM peak hours. Table 9 summarizes the Alternative 2 traffic operations for the STH 29 and CTH MMM/Clark Drive intersection.

Table 9–2040 Alternative 2 Traffic Operations

J-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH MMM /Clark Drive	EB STH 29	1.9	A	1.3	A
	WB STH 29	0.3	A	0.3	A
	NB Clark Drive	18.0	B	21.0	C
	SB CTH MMM	16.4	B	14.0	B
	Overall	3.0	A	2.6	A

Alternative 3: Median U-Turn

The Median U-Turn alternative provides full access at the CTH MMM/Clark Drive intersection, while redirecting the CTH MMM/Clark Drive through and left-turn movements and the STH 29 left-turns to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two U-turn openings in the median with turn lanes extending through the CTH MMM/Clark Drive intersection. Islands on the approaches of CTH MMM/Clark Drive direct through and left-turning movements into the U-turn turn lane and improves sight distance when combined with offset right-turn lanes on STH 29. This alternative also addresses intersection skew by realigning the CTH MMM approach. A conceptual layout of Alternative 3 is provided in Attachment I.

The preliminary OPCC for Alternative 3 is between $0.8 and $1.1 million.

This alternative eliminates all 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the Median U-Turn treatment would address five of the ten crashes, four of which were right-angle crashes and one that involved a WB mainline left-turn vehicle versus an EB mainline through vehicle. Restricting the NB and SB through and all of the left-turn movements at the primary intersection along with improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

With Alternative 3 (Median U-Turn), each approach operates at LOS B or better during the 2040 AM and PM peak hours. The difference in the NB and SB approach operations between Alternative 3 (Median U-Turn) and Alternative 2 (J-Turn) is that the EDTT is about 7 to 8 seconds less for the NB lane, NB through, SB lane, and SB through in Alternative 3 compared to Alternative 2. In other words, the U-turn locations are tighter to the primary intersection in the Median U-Turn versus the J-Turn, leading to a slight difference in the experienced travel time for the driver. Table 10 summarizes the Alternative 3 traffic operations for the STH 29 and CTH MMM/Clark Drive intersection by intersection approach.

Table 10–2040 Alternative 3 Traffic Operations

Median U-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH MMM /Clark Drive	EB STH 29	4.6	A	3.3	A
	WB STH 29	0.7	A	0.8	A
	NB Clark Drive	16	B	18.7	B
	SB CTH MMM	14.7	B	13.3	B
	Overall	4.3	A	3.6	A

Table 11 lists pros and cons for each of the most feasible alternatives.

Table 11–Alternatives Evaluation

Alternative Evaluation		
Alternative	Pros	Cons
1 or 1A Access Control (Right-in/ Right-out/ Left-in)	• Removes 20 to 22 of the 24 crossing conflicts at existing intersection • Addresses intersection skew deficiency • Highly Effective CMF • Clark Drive and CTH MMM: minimal/moderate volume affected • Lowest cost of the feasible alternatives	• Long distances to reroute traffic (likely to STH 22 interchange or local roads) • Not ideal for emergency vehicle access to/from the Shawano Medical Center • County Road access change
2 J-Turn	• Removes 20 of the 24 crossing conflicts at existing intersection • Addresses intersection skew deficiency • Highly Effective CMF for total crashes and severity • Maintains direct EB left-turn access	• Highest cost/impacts versus other alternatives • Slightly higher travel time for sideroad movements than Median U-Turn
3 Median U-Turn	• Removes all 24 crossing conflicts at existing intersection • Addresses intersection skew deficiency • Highly Effective CMF for total crashes and severity • Lower cost than J-Turn	• Creates indirection for mainline left-turn movements in comparison to J-Turn, may be a disadvantage for emergency vehicles. • Higher cost than Access Control alternative

Section 4: Conclusion

The Access Control (Right-in/Right-out/Left-in), J-Turn, and Median U-Turn alternatives were identified as the most viable alternatives to consider for HSIP funding. Each alternative improves the intersection skew for the CTH MMM approach and removes a majority of the crossing conflicts at the primary intersection.

The costs prepared for this study are to be considered preliminary and are presented as a range. It is at the discretion of WisDOT to select the appropriate OPCC from the range presented, or otherwise, to be used in the HSIP application.

Attachments:

Attachment A–Project Location Map
Attachment B–Crash Diagrams
Attachment C–ICE Brainstorming Guide
Attachment D–Traffic Counts
Attachment E–Traffic Forecasts
Attachment F–Crash Modification Factors
Attachment G–Existing and Future No Build Traffic Modeling Results
Attachment H–Build Conditions Traffic Modeling Results
Attachment I–Preliminary Design
Attachment J–Opinion of Probable Construction Cost

To: Tony Kemnitz, P.E., PTOE
From: Joseph Urban, P.E., Strand Associates, Inc.®
Adam Walter, Strand Associates, Inc.®
Brenden Johnson, Strand Associates, Inc.®
Date: 3/29/2018
RE: 0656-43-04
STH 29 and CTH F
Town of Bonduel, Shawano County
Highway Safety Improvement Program (HSIP)

Section 1: Project Description

The Wisconsin Department of Transportation (WisDOT) is currently investigating the intersection of STH 29 and CTH F, located in the town of Bonduel in Shawano County, as a candidate for HSIP funding. The study limits are the physical and functional area of the intersection, as shown in Figure 1. The purpose of this Intersection Control Evaluation (ICE) is to identify the most viable alternatives to improve intersection safety at STH 29 and CTH F. See Attachment A for a complete map of the surrounding street network.

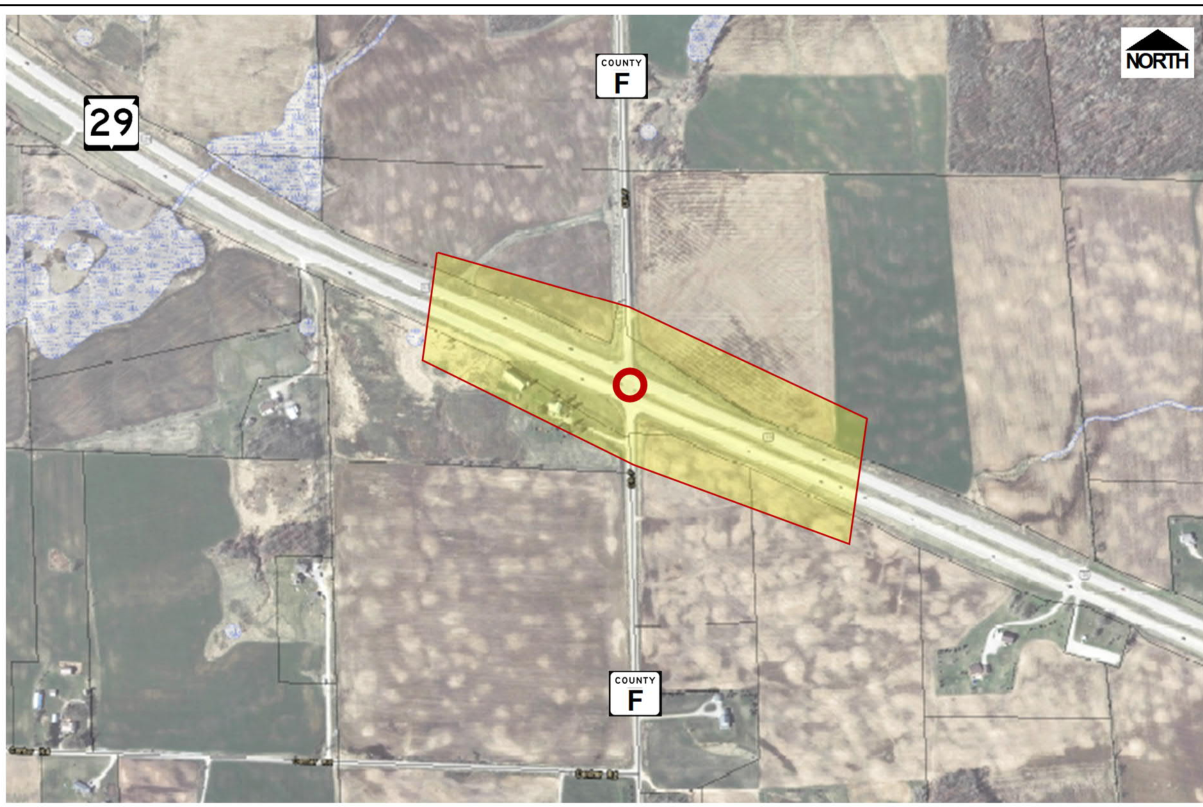


Figure 1–STH 29 and CTH F Intersection

Section 2: Existing Conditions

STH 29 is a 4-lane divided rural highway with a 60-foot median and a posted speed limit of 65 miles per hour (mph). CTH F is a 2-lane undivided rural highway with a posted speed limit of 55 mph. The northbound (NB) and southbound (SB) approaches of CTH F are stop controlled. The CTH F NB and SB approach tapers provide space for through/left and right turning vehicles to stack next to each other at the stop bar.

Strand Associates, Inc.® performed a review of the geometric deficiencies at the intersection based upon As-Built plans provided by WisDOT, a site visit performed in July 27, 2017, and available internet mapping resources such as Google Maps. Items reviewed included lane width, shoulder width, median width, intersection skew, cross slope, curve radius, superelevation, vertical curve K values, vertical curve tangent grades, and turn bay lengths. Figure 2 shows a summary of the geometric deficiencies found at this intersection.

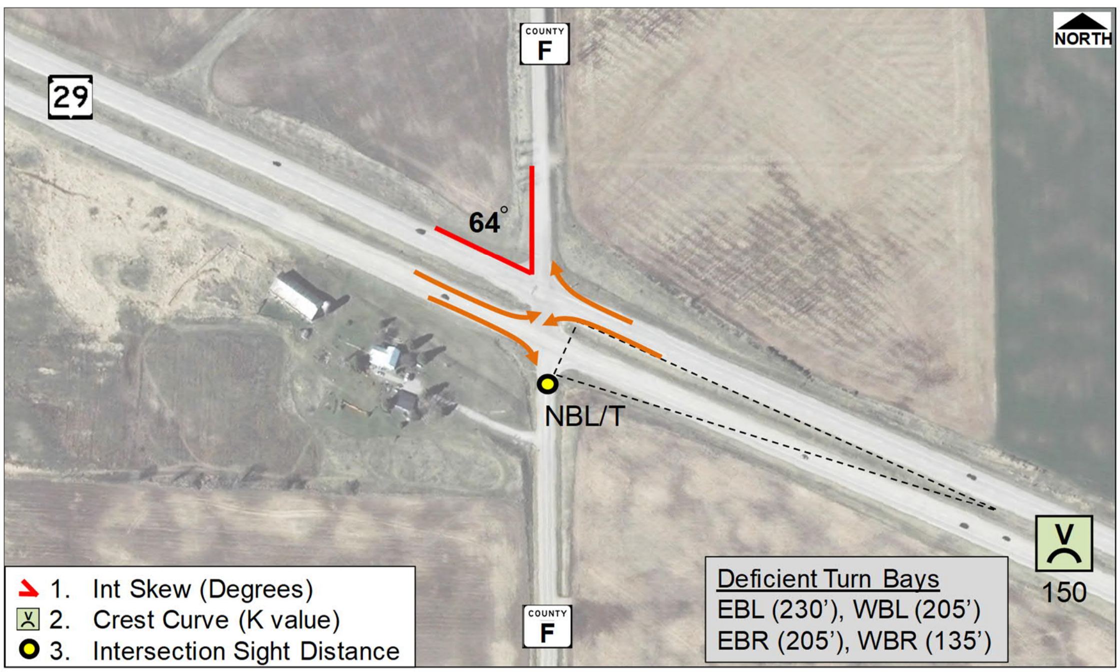


Figure 2–Summary of Geometric Deficiencies

CTH F intersects STH 29 in a crest vertical curve, which contributes to poor intersection sight distance. The intersection skew and vertical curve K values do not meet current Facilities Development Manual (FDM) standards. See Figure 3 for intersection sight distance deficiencies on the NB approach.

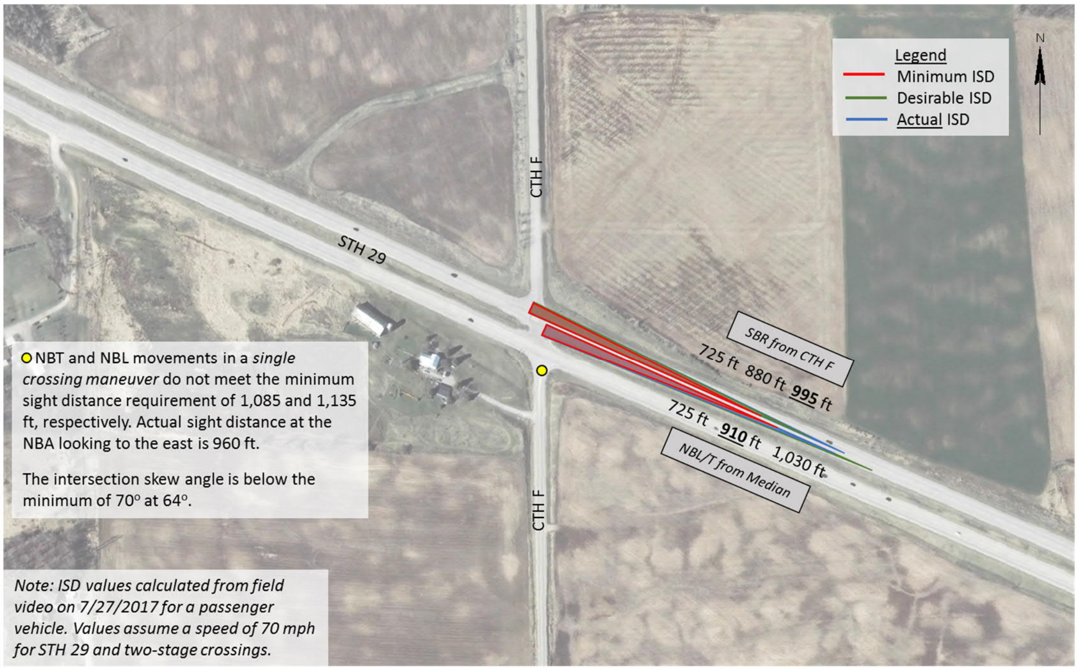


Figure 3–Intersection Sight Distance Deficiencies

The eastbound (EB) left and right-turn bays are 230 and 205 feet, respectively. The westbound (WB) left and right-turn bays are 205 feet and 135 feet, respectively. None of the turn bay storage lengths meet current minimum FDM standards for Type A1 or Type B1 intersections. A summary of the turn bay storage length deficiencies is shown in Table 1.

Table 1–Turn Bay Storage Length Summary

Intersection Turn	Existing Storage Length (ft)	Intersection Type	Desirable Storage Required (ft)	Minimum Storage Required (ft)	Meets FDM Standards?
Eastbound Left	230	A1	550	450	No
Westbound Left	205	B1	400	300	No
Eastbound Right	205	B1	300	300	No
Westbound Right	135	A1	450	450	No

Two access points are located within the functional area of the STH 29 and CTH F intersection. There is a field entrance nearly 200 feet north of the intersection in the northeast quadrant. To the south, there is a residential driveway just over 100 feet south of STH 29 in the southwest quadrant of the intersection. The remaining land use includes farm fields and woodland areas. Figure 4 shows the access locations near the STH 29 and CTH F intersection.

Figure 4–STH 29 and CTH F: Nearby Access Points

Photographs from the site visit performed in July 2017 are included in Attachment A.

Crash Analysis:

Crashes at the STH 29 and CTH F intersection were evaluated for the 5-year period from 2012 to 2016. During that time, ten crashes occurred, seven of which were injury crashes. The total intersection crash rate is 0.42 crashes per million entering vehicles (MEV) over the analysis period. The injury crashes included one involving a Type A (incapacitating) injury, three involving Type B (non-incapacitating) injuries, and three involving Type C (possible) injuries.

Of the ten crashes, seven (70 percent) were angle crashes. Of the seven angle crashes, four were included severe injury (KAB) collisions (1 Type A, 3 Type B). Vertical curvature was flagged as a possible contributing factor in eight of the ten crashed (80 percent). Further supporting the vertical curve deficiency, two of the angle crashes involved drivers on the NB approach who said that they could not see the WB mainline vehicle.

See Attachment B for the STH 29 and CTH F intersection crash diagram. Tables 2, 3, and 4 summarize the intersection crash type and crash severity trends at this intersection.

Table 2–Intersection Crash Type

Crash Type	2012	2013	2014	2015	2016	Total
Angle	2	1	1	0	2	6
Rear End	0	0	0	0	1	1
Sideswipe–Same Direction	0	0	0	0	0	0
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	0	1	1	0	1	3
Total	2	2	2	0	4	10

Table 3–Intersection Crash Severity

Crash Severity	2012	2013	2014	2015	2016	Total
Fatal	0	0	0	0	0	0
A Injury	1	0	0	0	0	1
B Injury	1	1	1	0	0	3
C Injury	0	1	0	0	2	3
Property Damage Only	0	0	1	0	2	3
Total	2	2	2	0	4	10

Table 4–Intersection Crash Type and Severity.

Crash Type	Severity					Total
	K	A	B	C	PDO	
Angle	0	1	3	1	1	6
Rear End	0	0	0	1	0	1
Sideswipe–Same Direction	0	0	0	0	0	0
Sideswipe–Opposite Direction	0	0	0	0	0	0
Single Vehicle	0	0	0	1	2	3
Total	0	1	3	3	3	10

Intersection KAB crashes that occurred between 2008 through 2011 and in 2017, outside of the 2012 to 2016 analysis period, are shown in Table 5 for the STH 29 and CTH F intersection to provide further background of the severe injury crash history.

Table 5–KAB Crashes Outside of Analysis Period

Crash Type	2008	2009	2010	2011	2017	Total
Angle	1 (A)	1 (B)	0	0	0	2
Total	1	1	0	0	0	2

<u>Traffic Operations Analysis:</u>

Turning movement counts for STH 29 and CTH F were collected on Thursday, June 22, 2017. The AM peak hour was determined to be 7:15 to 8:15 A.M. and the PM peak hour was determined to be 4:15 to 5:15 P.M. based on the peak of the mainline left-turning movements and sideroad. See Attachment D for the 2017 intersection turning movement count data.

The WisDOT Traffic Forecasting Section provided turning movement counts for the existing 2017 traffic volumes and the forecasted 2020, 2030, and 2040 year volumes for the STH 29 and CTH F intersection. WisDOT also provided mainline annual average daily traffic (AADT) forecasts for the STH 29 corridor. See Attachment E for the forecasted turning movement counts and mainline AADT forecast.

It should be noted that, historically, June traffic counts were found to be 8 to 10 percent greater than the annual average daily traffic along the corridor based on an evaluation of traffic data from an Automatic Traffic Recorder along STH 29 east of CTH J in Shawano County. The operations analysis performed for this study assumes a 9 percent seasonal reduction; however, the slightly lower base year (and therefore future year) traffic volumes were a consideration when evaluating intersection needs and potential alternatives. See Attachment E for the seasonally adjusted turning movement volumes.

Highway Capacity Software (HCS) Version 7 was used to analyze motor vehicle operations because it includes updated modules to implement the latest analysis procedures from the Highway Capacity Manual 6th Edition (HCM6). The WisDOT FDM guidance as of November 2017 (FDM 11-5-3) lists HCM 2010 tools being supported by WisDOT for use in traffic analysis. The study team coordinated with and received approval from WisDOT Bureau of Traffic Operations (BTO) staff in June 2017 on using HCS Version 7 throughout the course of the study. WisDOT BTO advised that an update will be made to the FDM guidance to approve the use of HCM6 analysis methodologies (including the use of HCS Version 7) for traffic analysis in the near future.

Traffic operations for this study have been evaluated based on conditions at the intersections. An intersection's Level of Service (LOS) is based on average delay in seconds per vehicle for traffic entering the intersection. LOS A indicates travelers will experience minimal average delay at an intersection (less than 10 seconds). LOS F indicates the average delay is high (more than 50 seconds at an unsignalized intersection). For unsignalized intersections, the highest delay for any yielding movement is used to report the overall intersection operations because the average delay tends to be skewed to lower delays as the through movements that receive zero delay are factored into the average.

Traffic modeling was completed for the existing year (2017) and three horizon years (2020, 2030, and 2040) for the no-build condition during the AM and PM peak hours. For the scope of this project, LOS C was considered to be the limit of acceptable delay. Table 6 summarizes the existing and design year no-build traffic operations for STH 29 and CTH F.

Table 6–Existing and Future No Build Traffic Operations Summary

Intersection	Design Year	AM Peak			PM Peak		
		Int. Delay (s)	Int. LOS	LOS D, E, or F Movements	Int. Delay (s)	Int. LOS	LOS D, E, or F Movements
STH 29 and CTH F	2017	15.3	C	--	17.6	C	--
	2020	15.6	C	--	18.1	C	--
	2030	17.2	C	--	20.4	C	--
	2040	18.8	C	--	23.0	C	--

The existing and future no build turning movements operate at LOS C or better during both the AM and PM peak hours using the seasonally adjusted traffic volumes. Using the unadjusted 2040 traffic volumes, the future no build turning movements operate at LOS C or better during the 2040 AM peak hour and at LOS D or better during the 2040 PM peak hour. During the 2040 PM peak hour, the unadjusted traffic volumes show delays on the NB and SB approaches that are within 1.2 seconds of the LOS C/D threshold of 25 seconds. See Attachment G for the results of the existing and future no build analysis.

Section 3: Alternatives

The purpose of this study is to identify the most viable alternatives to address existing safety needs. The following describes the alternatives considered, the feasibility of each alternative, and a more detailed evaluation of the most feasible alternatives.

Alternatives Considered:

Factors that went into the initial screening in order to identify the most viable alternatives included Crash Modification Factor (CMF) analyses, indirection (i.e. traffic volumes rerouted due to alternative), relative costs and impacts, and corridor continuity.

The following alternatives were considered for the STH 29 and CTH F:

- Closed Median (Right-in/Right-out)
- Access Control (Right-in/Right-out/Left-in)
- Intersection Control
- Through Route Activated Warning System (TRAWS)
- Slotted Lefts
- J-Turn
- Median U-Turn
- Diamond Interchange

Feasibility of Alternatives:

The study team coordinated with WisDOT North Central Region staff through conference calls and an in-person meeting to identify the most viable alternatives for this intersection. The study team also used the Phase 1: ICE Brainstorming Guide to supplement the alternatives evaluation. See Attachment C for the Phase 1: ICE Brainstorming Guide. Information from an Environmental Assessment (EA) that was conducted in 2010 for the STH 29 corridor to map out a long-term plan for the conversion of STH 29 from expressway to freeway was used in this study's alternatives analysis as well.

CMFs were applied to the crash totals to provide a quantitative crash reduction for each alternative. A CMF is an estimate of the change in expected average crash frequency as a result of a particular treatment or design element. The WisDOT Traffic Engineering, Operations and Safety Manual has a CMF table with commonly used treatment for Wisconsin, the J-Turn and TRAWS alternative CMFs were used from that table. The Median U-Turn and Slotted Left (also referred to as Positive Offset Left-Turn Bays)

CMFs were taken from the CMF Clearinghouse website. The CMF Clearinghouse is a larger database of CMFs that more appropriately matched the alternatives.

The Right-in/Right-out/Left-in and Right-in/Right-out alternative did not have a close match in the CMF Clearinghouse website so the J-Turn CMF from the WisDOT table was applied to the Right-in/Right-out/Left-in alternative and the Median U-Turn from the CMF Clearinghouse website was applied for the Right-in/Right-out alternative. The study team coordinated with and received approval from WisDOT BTO staff for this concept related to the J-Turn and Right-in/Right-out/Left-in alternative.

The J-Turn alternative and Right-in/Right-out/Left-in alternative are similar in how that they redirect minor road vehicles from crossing the intersection. However, the J-Turn and Right-in/Right-out/Left-in alternatives have different movements with different conflict points. The J-Turn alternative has vehicles merging off and merging into traffic, which is different from the left-turn movement where vehicles are crossing oncoming traffic. The difference in movements/conflict points may cause different accident types and totals. Therefore, the J-Turn and Right-in/Right-out/Left-in alternatives will appear to reduce crashes equally in Table 7, but may have different results than shown in the table. Additionally, the Right-in/Right-out/Left-in and Right-in/Right-out alternatives each redirect traffic to adjacent intersections, which is not captured by the CMF analysis but may have a negative effect on safety and operations for other intersections, driveways, or median crossovers.

Table 7 summarizes the CMF applications showing the total crashes and estimated crash reduction for each alternative. See Attachment F for the CMF analysis of the STH 29 and CTH F intersection.

Table 7–CMF Analysis Summary for STH 29 and CTH F

Alternative	Total Crashes		Fatal Crashes		Serious Injury Crashes (A, B)	
	Total	Reduction	Total	Reduction	Total	Reduction
J-Turn	10	4.62	--	--	4	2.51
Median U-Turn		5.10		--		2.48
Right-in/Right-out/Left-in		4.62*		--		2.51*
Right-in/Right-out		5.10*		--		2.48*
Positive Offset Left-Turn Bays		3.38		--		1.42
TRAWS		2.55		--		1.06

*See discussion preceding table on comparison of access control alternatives to J-Turn and Median U-Turn alternatives.

The following describes alternatives that were considered the least viable at this intersection.

1. Closed Median (Right-in/Right-out)
   Closing the median and providing a right-in/right-out treatment for the CTH F intersection would be a highly effective safety treatment to eliminate all 24 crossing conflicts at the intersection. However, this alternative would result in a high amount of indirection for the mainline left-turn movements and the sideroad through and left-turn movements. These movements could either reroute to local roads to access STH 29 or perform U-turns at the next closest access points

along STH 29. Along STH 29 to the west of CTH F, the Doc's Harley Davidson driveway (approximately 0.6 miles away) has a WB left-turn bay that may be favorable to U-turns. To the east, there are three median openings within 1 mile that do not have mainline left-turn bays (two driveways and the STH 29/Cedar Road intersection), which would not be favorable to U-turns.

The movements to and from CTH F are generally lower volume, with less than 40 vehicles per hour rerouted in each of the 2040 AM and PM peak hours. Even though the volumes rerouted would be low, there would likely be a negative impact on other local roads or driveways.

Additionally, stakeholders involved in the EA identified access to future development southeast of Bonduel and to the Graf Creamery north of STH 29 as reasons to maintain or improve the access at the STH 29 and CTH F intersection.

For these reasons, the Closed Median alternative was not identified as one of the most feasible alternatives.

2. Access Control (Right-in/Right-out/Left-in)
   Similar to the Closed Median (Right-in/Right-out) alternative, restricting access for the CTH F intersection would be a highly effective safety treatment to reduce the number of crossing conflicts at the intersection. Four crossing conflicts would remain with this alternative and the right-angle crash history (6 of the 10 crashes) would be addressed.

   Less indirection would occur as compared to the closed median alternative, with less than 30 vehicles rerouted within each peak hour (north and south legs combined). Even though the volumes rerouted would be low, there would likely be a negative impact on other local roads or driveways.

   Additionally, stakeholders involved in the EA identified access to future development southeast of Bonduel and to the Graf Creamery north of STH 29 as reasons to maintain or improve the access at the STH 29 and CTH F intersection.

   For these reasons, the Access Control (Right-in/Right-out/Left-in) alternative was not identified as one of the most feasible alternatives.

3. Intersection Control (Signals, Roundabouts, or All-way-stop)
   Traffic signal control, roundabout control, and all-way-stop control were not analyzed for the STH 29 and CTH F intersection in order to maintain free flow conditions along STH 29. There are no controlled intersections along the approximately 86-mile stretch of STH 29 between I-39 in the city of Wausau and I-41 near the city of Green Bay. Introducing intersection control would be against driver expectation for this high-speed and mostly rural corridor.

4. TRAWS
   The TRAWS is not being evaluated as a stand-alone alternative because it does not improve the geometric deficiencies or fully address the 24 crossing conflicts at the existing intersection. This could be considered in combination with another alternative; however, the most feasible alternatives for this intersection restrict through movements and left-turn movements from the sideroad. The TRAWS system may not be as effective of a safety measure when only activated for right-turns from the sideroad as opposed to thru movements or left-turns from the sideroad.

5. Slotted Lefts
   This concept was considered less feasible than other alternatives because geometric deficiencies and factors contributing to the crash history are not fully addressed. Mainly, the number of crossing conflicts would not be reduced with this alternative.

Evaluation of Alternatives:

The following alternatives were identified by WisDOT North Central Region and the study team as the most feasible for this intersection within the goals of the study:

- Alternative 1: J-Turn
- Alternative 2: Median U-Turn
- Alternative 3: Diamond Interchange

For Alternatives 1 and 2 a preliminary opinion of probable construction cost (OPCC) was prepared. Each OPCC is presented as a range. The range includes costs for drainage, storm sewer, traffic control, erosion control, finishing, lighting, signing, pavement marking, roadway incidentals, and allowances for unmeasured items based on three similar projects completed in the state over the last several years. The OPCC estimates developed for the ICE analysis are preliminary. Strand strongly recommends the costs be reevaluated during the design process.

The OPCC for the conceptual layouts were developed in 2017 dollars and are based on similar projects in Wisconsin. For Alternatives 1 and 2, similar projects included three recently constructed J-turns. For Alternative 3, the OPCC was based on a combination of information from the USH 18/CTH ID interchange in Iowa County (Project ID 1204-02-76), the previously prepared design from the EA, and this study's preliminary OPCC prepared for the STH 29 and CTH U diamond interchange alternative. The OPCC excludes any real estate or impact costs for each alternative. Attachment J includes a detailed list of assumptions and breakdown of quantities and unit prices used in the OPCC.

The study team evaluated traffic operations for Alternatives 1 and 2 under the 2040 design year conditions. For alternative intersections, like the J-Turn and Median U-Turn, the LOS is based on the average Experienced Travel Time (ETT) for each movement as it travels through the intersection. The ETT takes into account the Extra Distance Travel Time (EDTT) required to travel to and from a U-Turn. The LOS threshold for alternative intersections are identical to those for conventional signalized intersections. See Attachment H for the results of the future build operations analysis.

Alternative 1: J-Turn

The J-Turn alternative provides full access at the CTH F intersection, while redirecting the CTH F through and left-turn movements to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two additional U-turn openings in the median with turn lanes extending to CTH F. Islands on the approaches of CTH F direct through and left-turning movements into the U-turn turn lane to remove mainline weaving and reduce wrong way maneuvers. The STH 29 mainline left- and right-turns are slotted to provide improved sight distance at the CTH F intersection. A conceptual layout of Alternative 1 is provided in Attachment I.

The preliminary OPCC for Alternative 1 is between $1.1 and $1.5 million.

This alternative eliminates 20 of the 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the J-Turn treatment would address six of the ten crashes, each of which were right-angle crashes. While crossing conflicts remain with the J-Turn alternative between the mainline left-turns versus mainline through vehicles at the primary intersection, the crash history does not include any collisions between these movements. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 1, the EB and WB intersection approaches operate at LOS A and the NB and SB intersection approaches operate at LOS D during the 2040 AM and PM peak hours. The LOS D for each sideroad approach is largely due to the EDTT for the through and left-turn movements, and not the control delay. Table 8 summarizes the Alternative 1 traffic operations for the STH 29 and CTH F intersection by intersection approach.

Table 8–2040 Alternative 1 Traffic Operations

J-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH F	EB STH 29	0.4	A	0.0	A
	WB STH 29	0.0	A	0.1	A
	NB CTH F	35.9	D	38.6	D
	SB CTH F	25.4	C	35.3	D
	Overall	1.2	A	0.8	A

Alternative 2: Median U-Turn

The Median U-Turn alternative provides full access at the CTH F intersection, while redirecting the CTH F through and left-turn movements and the STH 29 left-turns to a designated U-turn opening on either side of the intersection. Reconfiguring the existing intersection creates two U-turn openings in the median with turn lanes extending through the CTH F intersection. Islands on the approaches of CTH F direct through and left-turning movements into the U-turn turn lane and improves sight distance when combined with offset right-turn lanes on STH 29. A conceptual layout of Alternative 2 is provided in Attachment I.

The preliminary OPCC for Alternative 2 is between $0.8 and $1.0 million.

This alternative eliminates all 24 crossing conflicts experienced at the existing intersection. Based on the 2012 to 2016 crash history, it is anticipated that the Median U-Turn treatment would address six of the ten crashes, each of which were right-angle crashes. Restricting the NB and SB through movements in this treatment and improving sight distance by implementing the U-turn crossovers is anticipated to address the issues identified from the crash history. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

For Alternative 2, each intersection approach operates at LOS C or better during both the 2040 AM and PM peak hours. The difference in the NB and SB approach operations between Alternative 2 (Median U-Turn) and Alternative 1 (J-Turn) is that the EDTT is about 5 seconds less for the NB lane, NB through, SB lane, and SB through movements in Alternative 2 compared to Alternative 1. In other words, the U-turn locations are tighter to the primary intersection in the Median U-Turn versus the J-Turn, leading to a slight difference in the experienced travel time for the driver. Table 9 summarizes the Alternative 2 traffic operations for the STH 29 and CTH F intersection by intersection approach.

Table 9–2040 Alternative 2 Traffic Operations

Median U-Turn					
Intersection	Approach	AM Peak		PM Peak	
		App. ETT (s)	App. LOS	App. ETT (s)	App. LOS
STH 29 and CTH F	EB STH 29	0.9	A	0.1	A
	WB STH 29	0.0	A	0.1	A
	NB CTH F	32.6	C	33.4	C
	SB CTH F	23.2	C	31.2	C
	Overall	1.4	A	0.7	A

Alternative 3: Diamond Interchange

The EA completed in 2010 identified the STH 29 and CTH F intersection as a possible location for an interchange. While this alternative is anticipated to cost substantially more and have higher real estate impacts relative to the J-Turn and Median U-turn alternatives, it would also remove all at-grade intersection crossing conflicts with STH 29 mainline traffic and fully address the current intersection sight distance deficiencies. A total of ten crossing conflicts are presented at the two stop-controlled ramp terminal intersections; however, these would be at a much lesser volume and would occur at lesser speeds than the current crossing conflicts. See Attachment F for a breakdown of the crash types and severities likely to be addressed.

Traffic operations were not evaluated for the diamond interchange alternative; however, it is anticipated that the ramp terminal intersections will operate acceptably in the 2040 design year because in the 2040 No-Build operations all movements that operate at LOS C or better during the AM and PM peak hours for this at-grade, full access intersection.

A diamond interchange would provide corridor continuity east of the city of Bonduel, with the STH 47/STH 117 interchange located approximately 4.5 miles to the west of CTH F and the STH 160/STH 55 interchange located approximately 3.5 miles to the east of CTH F.

The EA indicated that there would be a total of 1.11 acres of wetland impacts near CTH F north of STH 29 and 0.57 acres of wetland impacts near STH 29 west of CTH F, for a total of 1.68 acres of wetland impacts. In addition, the EA indicates one relocation and agricultural impacts. The vertical design and cost estimate should be reviewed in further detail during the design phase as vertical design information was not readily available from the EA for use in this study.

A preliminary OPCC for Alternative 3 was not prepared by the study team; however, it is anticipated to be either on the high end of, or higher than, the preliminary OPCC prepared for the CTH U diamond interchange as part of this study, which was between$ 10.4 and $11.7 million. The CTH U diamond interchange preliminary OPCC is similar to the let for the USH 18/151 and CTH ID interchange in Iowa County (Project ID 1204-02-76), which is currently under construction, at$ 9.75 million without engineering and contingency costs. The preliminary OPCC for the CTH U interchange without engineering and contingency costs range from $9.07 to $10.2 million. See the STH 29 and CTH U Phase 1 ICE Report for more details. Additionally, several options to reduce frontage roads (and therefore construction costs) are shown in Attachment K if this alternative is carried forward into design as a stand-alone alternative.

An increase in construction costs for the CTH F interchange compared to the CTH U interchange is anticipated due to the increased grades at CTH F. The northwest and northeast quadrants of the CTH F intersection would likely require large amounts of fill. For these reasons, the CTH F interchange preliminary OPCC is assumed to be $12 to $13 million at this stage of design, where the low end reflects the high end of the CTH U preliminary OPCC.

Table 10 lists pros and cons for each of the most feasible alternatives.

Table 10–Alternatives Evaluation

Alternatives Evaluation		
Alternative	Pros	Cons
1 J-Turn	• Removes 20 of the 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • No indirection for mainline left-turns	• Slightly more travel time than Median U-Turn • Higher cost than Median U-Turn
2 Median U-Turn	• Removes all 24 crossing conflicts at existing intersection • Highly Effective CMF for total crashes and severity • Less travel time than J-Turn	• Creates indirection for mainline left-turn movements
3 Diamond Interchange	• Removes 24 STH 29 mainline and CTH F crossing conflicts. Crossing conflicts that occur (10) are at low volume along CTH F. • Anticipated to operate acceptably • Long-term solution for safety needs	• Highest anticipated construction cost versus other alternatives • Impacts include approximately 1.68 acres of wetland along with one relocation and agricultural impacts

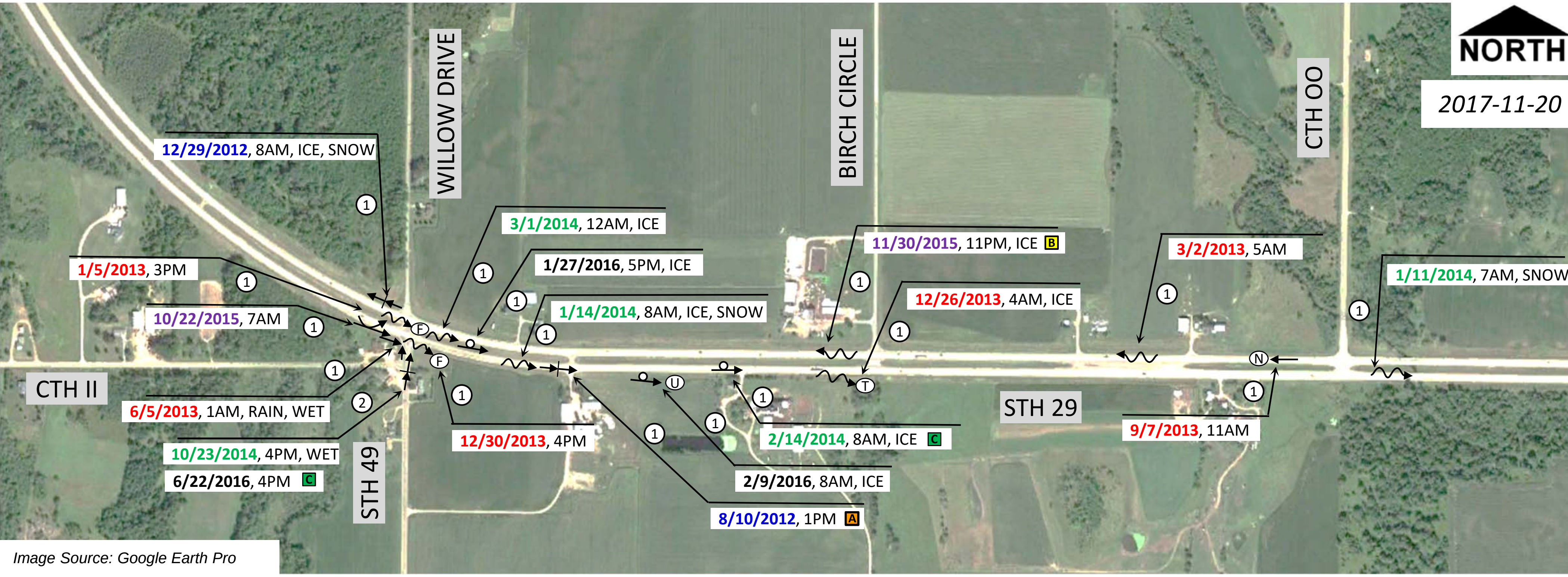
Section 4: Conclusion

The J-Turn, Median U-Turn, and Diamond Interchange were identified as the most viable alternatives to consider for HSIP funding. These alternatives will address intersection sight distance deficiencies and remove or reduce crossing conflicts at the primary intersection. The costs prepared for this study are to be considered preliminary and are presented as a range. It is at the discretion of WisDOT to select the appropriate OPCC from the range presented, or otherwise, to be used in the HSIP application.

Attachments:

Attachment A–Project Location Map
Attachment B–Crash Diagrams
Attachment C–ICE Brainstorming Guide
Attachment D–Traffic Counts
Attachment E–Traffic Forecasts
Attachment F–Crash Modification Factors
Attachment G–Existing and Future No Build Traffic Modeling Results
Attachment H–Build Conditions Traffic Modeling Results
Attachment I–Preliminary Design
Attachment J–Opinion of Probable Construction Cost
Attachment K–CTH F Interchange Considerations

APPENDIX E
STH 49 CRASH ANALYSIS AND CONCEPTUAL LAYOUTS



LEGEND

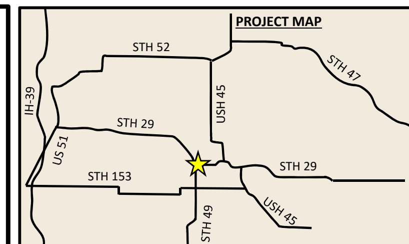
Moving Vehicle	Stop/Yield Sign	Angle (Right Angle)	Head-On
Backing Vehicle	Ⓣ Tree	Angle (Left-Turn)	Rear-End
Pedestrian	Ⓤ Utility Pole	Angle (Right-Turn)	Out of Control
Bicyclist	Ⓕ Fixed Object	Sideswipe-Same	Overtake
Parked Vehicle	Ⓝ Non-Fixed Object	Sideswipe-Opposite	Overturn

(#) = CRASH FREQUENCY

"LETTER" = USED FOR REFERENCING CRASHES IN REPORT AS NEEDED
DATE OF CRASH
HOUR
SEVERITY (SEE SEVERITY DEFINITIONS)
ROAD CONDITIONS (DRY IF BLANK)
LIGHT CONDITIONS (DAYTIME IF BLANK)
ALCOHOL/DRUG INVOLVEMENT (AL/DG)

CRASH SEVERITY DEFINITIONS
- K = Fatal Crash
- A = Incapacitating Injury Crash
- B = Non-Incapacitating Injury Crash
- C = Possible Injury Crash
- = Property Damage Only Crash

YEAR
2012 BLUE
2013 RED
2014 GREEN
2015 PURPLE
2016 BLACK



CRASH FREQUENCY/SEVERITY

18 Crashes

- 0 Fatal Crash (K)
- 1 Incapacitating (A-Level)
- 1 Non-Incapacitating (B-Level)
- 2 Possible (C-Level)
- 14 Property Damage Only

CRASH RATE
Two-Way : 95.9
Eastbound: 149.2
Westbound : 42.6
Crashes Per 100 Million Vehicle Miles Traveled

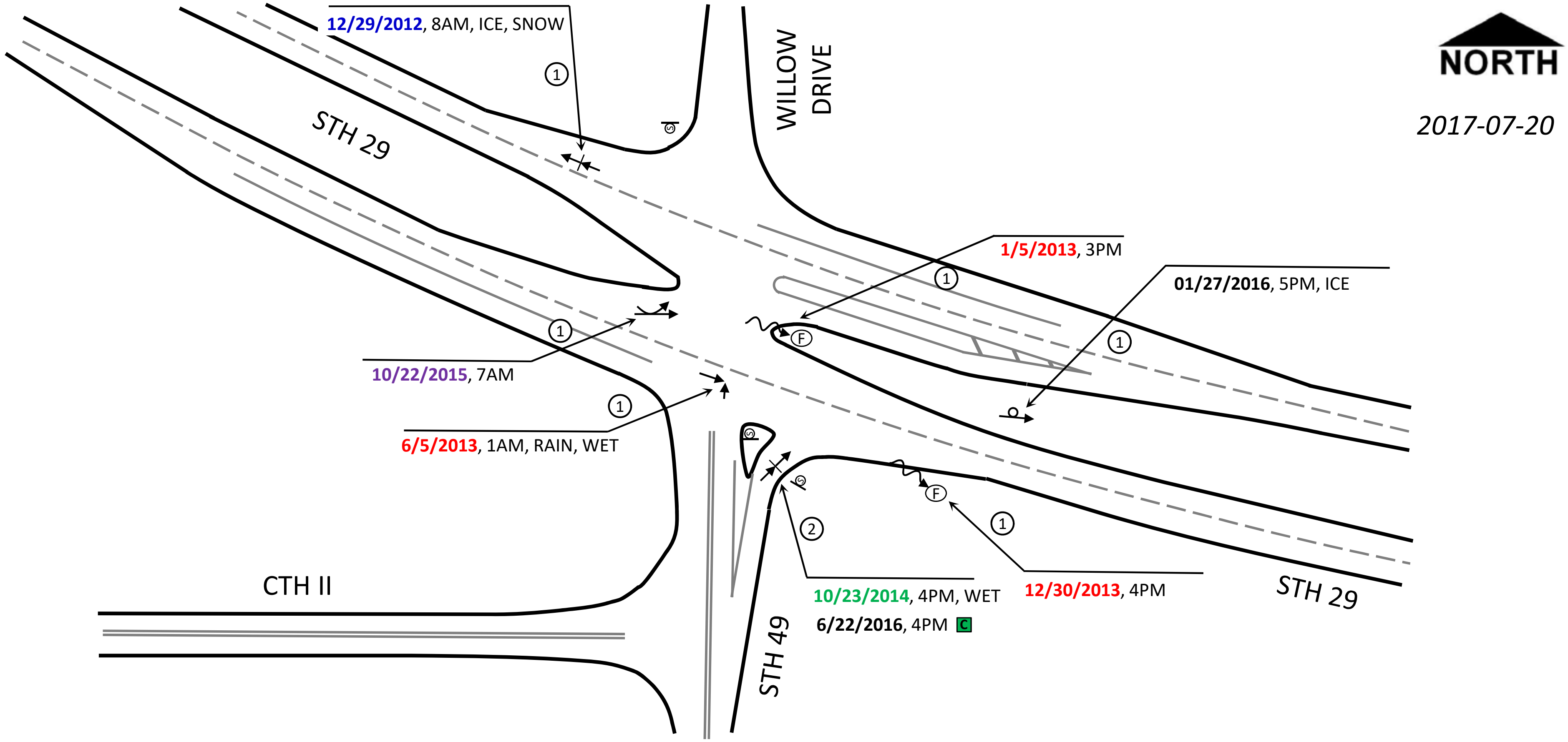
Corridor vs Statewide Average:
Two-Way: 2.01
Eastbound: 3.13
Westbound: 0.90

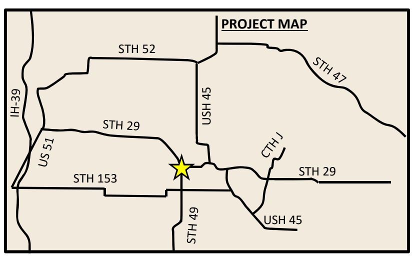
KAB CRASH RATE
Two-Way: 10.7
Eastbound: 10.7
Westbound : 10.7
Crashes Per 100 Million Vehicle Miles Traveled

Corridor vs Statewide Average:
Two-Way: 1.23
Eastbound: 1.23
Westbound: 1.23

2012-2016 AADT
10,280 vpd

SEGMENT COLLISION DIAGRAM
STH 29, STH 49 TO CTH OO
MARATHON COUNTY, WISCONSIN





YEAR

2012 BLUE
2013 RED
2014 GREEN
2015 PURPLE
2016 BLACK

CRASH RATE

0.39 Crashes
Per Million
Entering Vehicles

Entering Vehicles: 11,370/day

CRASH FREQUENCY/SEVERITY

8 Crashes

0	Fatal Crash (K)
0	Incapacitating (A-Level)
0	Non-Incapacitating (B-Level)
1	Possible (C-Level)
7	Property Damage Only

LEGEND

Moving Vehicle
Backing Vehicle
Pedestrian
Bicyclist
Parked Vehicle

Stop/Yield Sign
Tree
Utility Pole
Fixed Object
Non-Fixed Object

Angle (Right Angle)
Angle (Left-Turn)
Angle (Right-Turn)
Sideswipe-Same
Sideswipe-Opposite

Head-On
Rear-End
Out of Control
Overtake
Overturn

(#) = CRASH FREQUENCY

"LETTER" = USED FOR REFERENCING CRASHES IN REPORT AS NEEDED
DATE OF CRASH
HOUR
SEVERITY (SEE SEVERITY DEFINITIONS)
ROAD CONDITIONS (DRY IF BLANK)
LIGHT CONDITIONS (DAYTIME IF BLANK)
ALCOHOL/DRUG INVOLVEMENT AL/DG

CRASH SEVERITY DEFINITIONS

K = Fatal Crash
A = Incapacitating Injury Crash
B = Non-Incapacitating Injury Crash
C = Possible Injury Crash
= Property Damage Only Crash

STRAND ASSOCIATES

INTERSECTION COLLISION DIAGRAM

STH 29 & STH 49/WILLOW DRIVE – MARATHON COUNTY, WISCONSIN

GENERAL INFORMATION

INTERSECTION:	STH 29 & STH 49/WILLOW DRIVE			*DURATION*	
MUNICIPALITY:	ELDERON	*CRASHES FROM:*	1/1/2012	5 YEARS	
COUNTY:	MARATHON	*TO:*	12/31/2016	0 MONTHS	
STATE:	WI				
PROJECT ID:	0656-43-04	*PREPARED BY:*	AJW	*DATE:*	7/20/2017

INTERSECTION CHARACTERISTICS

TRAFFIC CONTROL:	TWO WAY STOP CONTROL ON STH 49/WILLOW DRIVE	*POSTED SPEED (MAJOR):*	65
INTERSECTION AADT: Year (2012-2016):	11,370	*DEER CRASHES INCLUDED:*	NO
NUMBER OF LEGS:	4	*AREA TYPE:*	RURAL

CRASH STATISTICS

CRASH FREQUENCY & SEVERITY

YEAR	PD	C-LEVEL	B-LEVEL	A-LEVEL	FATAL	TOTAL
2012	*1*	*0*	*0*	*0*	*0*	1
2013	*3*	*0*	*0*	*0*	*0*	3
2014	*1*	*0*	*0*	*0*	*0*	1
2015	*1*	*0*	*0*	*0*	*0*	1
2016	*1*	*1*	*0*	*0*	*0*	2
TOTAL	*7*	*1*	*0*	*0*	*0*	*8*
PERCENT	*87.5%*	*12.5%*	*0.0%*	*0.0%*	*0.0%*	*100.0%*
YEAR AVG.	*1.4*	*0.2*	*0.0*	*0.0*	*0.0*	*1.6*

ROAD CONDITIONS		PERCENT
DRY	4	50.0%
WET	2	25.0%
SNOW	0	0.0%
ICE	2	25.0%
MUD	0	0.0%
OTHER/UNKN	0	0.0%
TOTAL	*8*	*100.0%*

CRASH TYPE		PERCENT
ANGLE	1	12.5%
REAR-END	3	37.5%
HEAD-ON	0	0.0%
SS-SAME	1	12.5%
SS-OPPOSITE	0	0.0%
PEDESTRIAN	0	0.0%
BICYCLE	0	0.0%
OBJECT	2	25.0%
NO COLLISION	0	0.0%
OVERTURN	1	12.5%
OTHER/UNKN	0	0.0%
TOTAL	*8*	*100.0%*

CRASH RATES	per MEV
CRASH RATE	0.39
KAB CRASH RATE	0.00

TOTAL OCCUPANT INJURIES	
FATAL	0
A-LEVEL	0

LIGHT CONDITIONS		PERCENT
DAY	4	50.0%
DARK	4	50.0%
TOTAL	*8*	*100.0%*

Note: Dawn, dusk or street lighted conditions included in dark total.

VEHICLE TYPES		PERCENT
CAR	8	57.1%
TRUCK	6	42.9%
OTHER/UNKN	0	0.0%
TOTAL	*14*	*100.0%*

Note: Statistics based on first and second vehicles in crashes.

DAY AND TIME - BOTH DIRECTIONS

DAY OF WEEK	*EARLY MORNING* 2:00 AM TO 5:59 AM	*AM PEAK* 6:00 AM TO 9:59 AM	*MIDDAY* 10:00 AM TO 1:59 PM	*PM PEAK* 2:00 PM TO 5:59 PM	*EVENING* 6:00 PM TO 9:59 PM	*LATE EVENING* 10:00 PM TO 1:59 AM	*UNKNOWN*	*TOTAL*	
MONDAY	0	0	0	1	0	0	0	1	Weekday
TUESDAY	0	0	0	0	0	0	0	0	
WEDNESDAY	0	0	0	2	0	1	0	3	
THURSDAY	0	1	1	0	0	0	0	2	
FRIDAY	0	0	0	0	0	0	0	0	
SATURDAY	0	1	0	1	0	0	0	2	Weekend
SUNDAY	0	0	0	0	0	0	0	0	
TOTAL	*0*	*2*	*1*	*4*	*0*	*1*	*0*	*8*	

DRIVER AGES		PERCENT
<25	4	28.6%
25-34	2	14.3%
35-44	2	14.3%
45-54	0	0.0%
55-64	1	7.1%
65-74	1	7.1%
75-84	2	14.3%
85+	0	0.0%
UNKNOWN	2	14.3%
TOTAL	*14*	*100.0%*

Note: Statistics based on first and second vehicles in crashes.

VEHICLE DAMAGE		PERCENT
OTHER/UNKN	0	0.0%
NONE	2	14.3%
VERY MINOR	1	7.1%
MINOR	3	21.4%
MODERATE	5	35.7%
SEVERE	2	14.3%
VERY SEVERE	1	7.1%
TOTAL	*14*	*100.0%*

Note: Statistics based on first and second vehicles in crashes.

AVERAGE NUMBER OF VEHICLES PER CRASH	*1.8*

Note: Statistics based on all vehicles in crashes.

CURVATURE		PERCENT
HORIZONTAL	7	87.5%
VERTICAL	0	0.0%

ALCOHOL RELATED CRASHES	
TOTAL	0
PERCENTAGE OF TOTAL	0.0%

INTERSECTION CRASH STATISTICS
STH 29 & STH 49/WILLOW DRIVE
MARATHON COUNTY, WISCONSIN

2

DESIGN CONSIDERATIONS

- ADD EB ACCELERATION LANE (1620 FT PLUS 50:1 TAPER)
- REALIGNS NB/SB APPROACHES TO 90 DEG
- OFFSET RIGHT TURN LANES 12 FFET
- NB APPROACH CONSIDERED 'A1' INTERSECTION
  -EXTEND SLOTTED WBL AND EBR TO 'A1' LENGTH
- SB APPROACH CONSIDERED 'B1' INTERSECTION
  -ADD EBL AND EXTEND WBR TO 'B1' LENGTH

TURN LANES:

- TURN LANES: (D4+D3+TAPER; D4=STORAGE D3=MANEUVER DIST)
  -RIGHT TURNS USE 'B1'/'A1' INTERSECTION DESIGN WITH 300'/450' PLUS TAPER = 450 FT/600 FT (EB/WB)
  FOR REFERENCE@ 70 MPH --> D4=0 + D3=575/425 (DES/MIN) + 150 = 725/575' (DES/MIN)
  -MAINLINE LEFT TURNS USE 'A1/B1' INTERSECTION DESIGN 450/300 PLUS STORAGE AND TAPER = 700/550 FT
  FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)

2

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 1: REALIGNED - EXTENDED WBL & ADDED EBL WITH ACCELERATION LANE (1 OF 2)	SHEET	E

FILE NAME : S:\MAD\1000--1099\1089\867\ACAD\CIVIL 3D\DESIGN\EDGELINES\STH 29 & STH 49_ALT 1 REALIGNEXTEND WBL_ADD EBL W ACCEL LANE.DWG
LAYOUT NAME - Plan 1 IN 100 FT (1)
PLOT DATE : 1/18/2018 2:32 PM
PLOT BY : JOHNSON, BRENDEN
PLOT NAME :
PLOT SCALE : 1 IN:100 FT
WISDOT/CADDS SHEET 42

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 1: REALIGNED - EXTENDED WBL & ADDED EBL WITH ACCELERATION LANE (2 OF 2)	SHEET	E

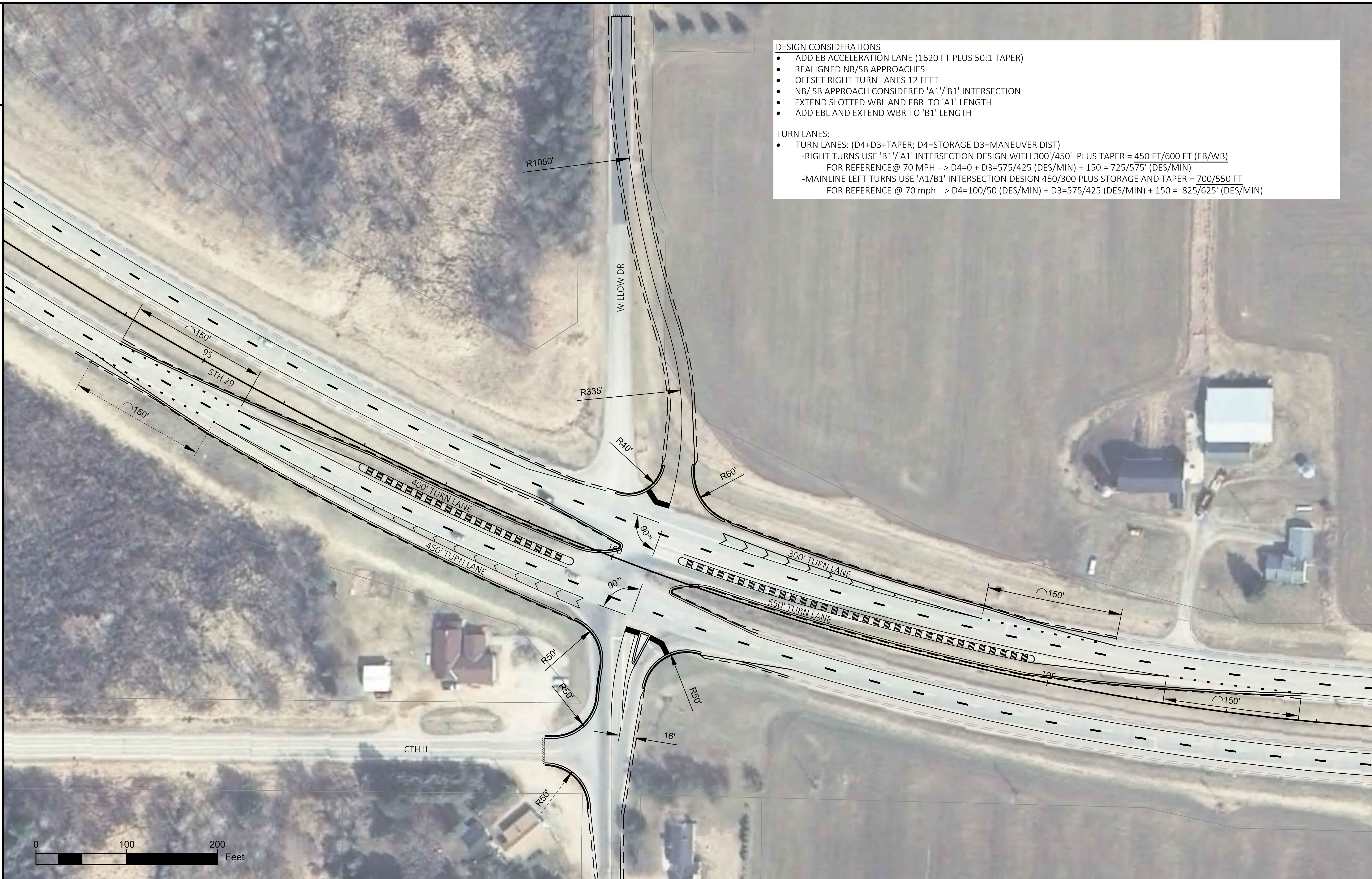
FILE NAME : S:\MAD\1000--1099\1089\867\ACAD\CIVIL 3D\DESIGN\EDGELINES\STH 29 & STH 49_ALT 1 REALIGNEXTEND WBL_ADD EBL W ACCEL LANE.DWG
LAYOUT NAME - Plan 1 IN 100 FT (2)
PLOT DATE : 1/18/2018 2:32 PM PLOT BY : JOHNSON, BRENDEN PLOT NAME : PLOT SCALE : 1 IN:100 FT WISDOT/CADDS SHEET 42

DESIGN CONSIDERATIONS

- ADD EB ACCELERATION LANE (1620 FT PLUS 50:1 TAPER)
- REALIGNED NB/SB APPROACHES
- OFFSET RIGHT TURN LANES 12 FEET
- NB/ SB APPROACH CONSIDERED 'A1'/'B1' INTERSECTION
- EXTEND SLOTTED WBL AND EBR TO 'A1' LENGTH
- ADD EBL AND EXTEND WBR TO 'B1' LENGTH

TURN LANES:

- TURN LANES: (D4+D3+TAPER; D4=STORAGE D3=MANEUVER DIST)
  - -RIGHT TURNS USE 'B1'/'A1' INTERSECTION DESIGN WITH 300'/450' PLUS TAPER = 450 FT/600 FT (EB/WB)
    - FOR REFERENCE@ 70 MPH --> D4=0 + D3=575/425 (DES/MIN) + 150 = 725/575' (DES/MIN)
  - -MAINLINE LEFT TURNS USE 'A1/B1' INTERSECTION DESIGN 450/300 PLUS STORAGE AND TAPER = 700/550 FT
    - FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)



PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 1A: REALIGNED - EXTENDED SLOTTED WBL & ADDED EBL	SHEET	E

DESIGN CONSIDERATIONS
- ADD EB ACCELERATION LANE (1620 FT PLUS 50:1 TAPER)
- MAINTAIN NB APPROACH WITH ADDITIONAL CHANNELIZED NBR INTO THE ACCELERATION LANE; CONSIDERED 'A1' INTERSECTION
- CUL-DE-SAC RADIUS 45 FT TO ACCOMMODATE SU
- EXTEND SLOTTED WBL AND EBR TO 'A1' LENGTH
- OFFSET RIGHT TURN LANE 12 FEET

TURN LANES:
- TURN LANES: (D4+D3+TAPER; D4=STORAGE D3=MANEUVER DIST)
  - -RIGHT TURNS USE 'A1' INTERSECTION DESIGN WITH 450' PLUS TAPER = 600 FT (EB/WB)
    - FOR REFERENCE@ 70 MPH --> D4=0 + D3=575/425 (DES/MIN) + 150 = 725/575' (DES/MIN)
  - -MAINLINE LEFT TURNS USE 'A1/B1' INTERSECTION DESIGN 450/300 PLUS STORAGE AND TAPER = 700/550 FT
    - FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 1B: EXTENDED WBL WITH ACCELERATION LANE-WILLOW DR CLOSURE (1 OF 2)	SHEET	E

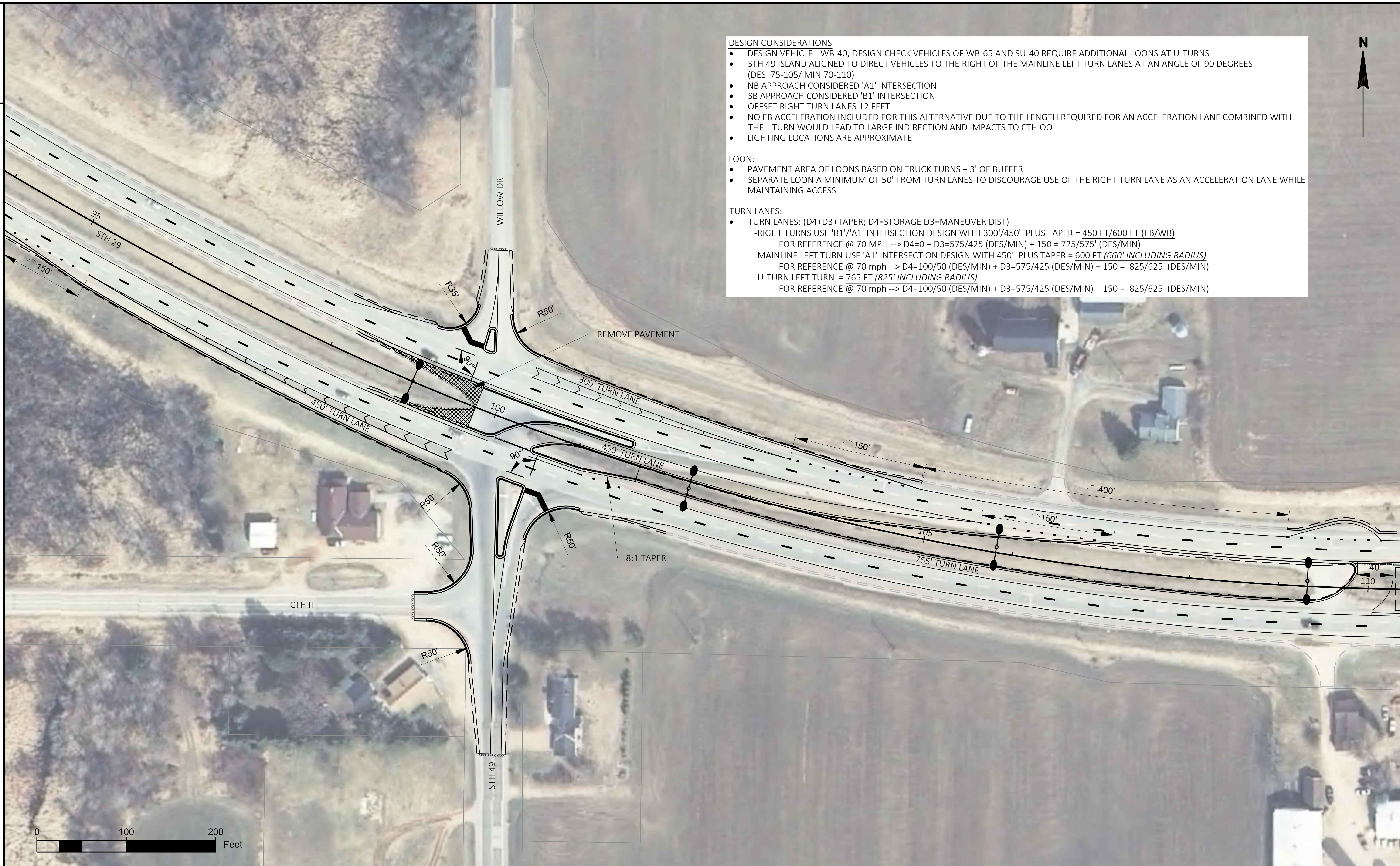
FILE NAME : S:\MAD\1000--1099\1089\867\ACAD\CIVIL 3D\DESIGN\EDGELINES\STH 29 & STH 49_ALT 1B EXTEND WBL_W ACCEL_WILLOW CLOSE.DWG
LAYOUT NAME - Plan 1 IN 100 FT (1)
PLOT DATE : 1/18/2018 2:29 PM PLOT BY : JOHNSON, BRENDEN PLOT NAME : PLOT SCALE : 1 IN:100 FT
WISDOT/CADDS SHEET 42

2

2

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 1B: EXTENDED WBL WITH ACCELERATION LANE-WILLOW DR CLOSURE (2 OF 2)	SHEET	E

FILE NAME : S:\MAD\1000--1099\1089\867\ACAD\CIVIL 3D\DESIGN\EDGELINES\STH 29 & STH 49_ALT 1B EXTEND WBL_W ACCEL_WILLOW CLOSE.DWG
LAYOUT NAME - Plan 1 IN 100 FT (2)
PLOT DATE : 1/18/2018 2:29 PM
PLOT BY : JOHNSON, BRENDEN
PLOT NAME :
PLOT SCALE : 1 IN:100 FT
WISDOT/CADDS SHEET 42



DESIGN CONSIDERATIONS

- DESIGN VEHICLE - WB-40, DESIGN CHECK VEHICLES OF WB-65 AND SU-40 REQUIRE ADDITIONAL LOONS AT U-TURNS
- STH 49 ISLAND ALIGNED TO DIRECT VEHICLES TO THE RIGHT OF THE MAINLINE LEFT TURN LANES AT AN ANGLE OF 90 DEGREES (DES 75-105/ MIN 70-110)
- NB APPROACH CONSIDERED 'A1' INTERSECTION
- SB APPROACH CONSIDERED 'B1' INTERSECTION
- OFFSET RIGHT TURN LANES 12 FEET
- NO EB ACCELERATION INCLUDED FOR THIS ALTERNATIVE DUE TO THE LENGTH REQUIRED FOR AN ACCELERATION LANE COMBINED WITH THE J-TURN WOULD LEAD TO LARGE INDIRECTION AND IMPACTS TO CTH OO
- LIGHTING LOCATIONS ARE APPROXIMATE

LOON:

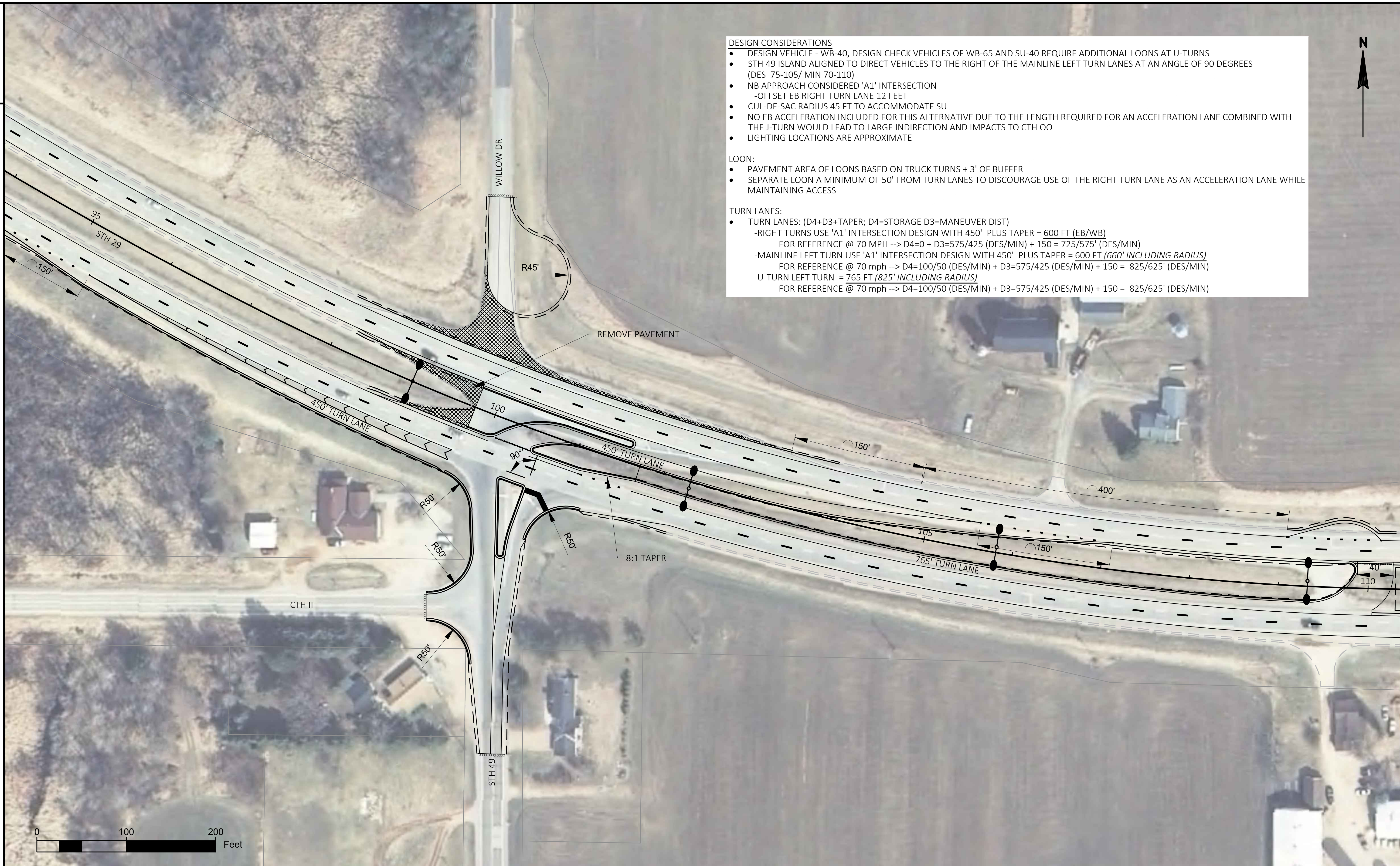
- PAVEMENT AREA OF LOONS BASED ON TRUCK TURNS + 3' OF BUFFER
- SEPARATE LOON A MINIMUM OF 50' FROM TURN LANES TO DISCOURAGE USE OF THE RIGHT TURN LANE AS AN ACCELERATION LANE WHILE MAINTAINING ACCESS

TURN LANES:

- TURN LANES: (D4+D3+TAPER; D4=STORAGE D3=MANEUVER DIST)
  - -RIGHT TURNS USE 'B1'/'A1' INTERSECTION DESIGN WITH 300'/450' PLUS TAPER = 450 FT/600 FT (EB/WB)
    - FOR REFERENCE @ 70 MPH --> D4=0 + D3=575/425 (DES/MIN) + 150 = 725/575' (DES/MIN)
  - -MAINLINE LEFT TURN USE 'A1' INTERSECTION DESIGN WITH 450' PLUS TAPER = 600 FT *(660' INCLUDING RADIUS)*
    - FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)
  - -U-TURN LEFT TURN = 765 FT *(825' INCLUDING RADIUS)*
    - FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 2: EB TO WB J-TURN	SHEET	E

FILE NAME : S:\MAD\1000--1099\1089\867\ACAD\CIVIL 3D\DESIGN\EDGELINES\STH 29 & STH 49_ALT 2 EB TO WB J-TURN.DWG
LAYOUT NAME - Plan 1 IN 100 FT
PLOT DATE : 1/4/2018 3:53 PM PLOT BY : JOHNSON, BRENDEN PLOT NAME : PLOT SCALE : 1 IN:100 FT



DESIGN CONSIDERATIONS

- DESIGN VEHICLE - WB-40, DESIGN CHECK VEHICLES OF WB-65 AND SU-40 REQUIRE ADDITIONAL LOONS AT U-TURNS
- STH 49 ISLAND ALIGNED TO DIRECT VEHICLES TO THE RIGHT OF THE MAINLINE LEFT TURN LANES AT AN ANGLE OF 90 DEGREES (DES 75-105/ MIN 70-110)
- NB APPROACH CONSIDERED 'A1' INTERSECTION
  -OFFSET EB RIGHT TURN LANE 12 FEET
- CUL-DE-SAC RADIUS 45 FT TO ACCOMMODATE SU
- NO EB ACCELERATION INCLUDED FOR THIS ALTERNATIVE DUE TO THE LENGTH REQUIRED FOR AN ACCELERATION LANE COMBINED WITH THE J-TURN WOULD LEAD TO LARGE INDIRECTION AND IMPACTS TO CTH OO
- LIGHTING LOCATIONS ARE APPROXIMATE

LOON:

- PAVEMENT AREA OF LOONS BASED ON TRUCK TURNS + 3' OF BUFFER
- SEPARATE LOON A MINIMUM OF 50' FROM TURN LANES TO DISCOURAGE USE OF THE RIGHT TURN LANE AS AN ACCELERATION LANE WHILE MAINTAINING ACCESS

TURN LANES:

- TURN LANES: (D4+D3+TAPER; D4=STORAGE D3=MANEUVER DIST)
  -RIGHT TURNS USE 'A1' INTERSECTION DESIGN WITH 450' PLUS TAPER = 600 FT (EB/WB)
  FOR REFERENCE @ 70 MPH --> D4=0 + D3=575/425 (DES/MIN) + 150 = 725/575' (DES/MIN)
  -MAINLINE LEFT TURN USE 'A1' INTERSECTION DESIGN WITH 450' PLUS TAPER = 600 FT *(660' INCLUDING RADIUS)*
  FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)
  -U-TURN LEFT TURN = 765 FT *(825' INCLUDING RADIUS)*
  FOR REFERENCE @ 70 mph --> D4=100/50 (DES/MIN) + D3=575/425 (DES/MIN) + 150 = 825/625' (DES/MIN)

2

PROJECT NO: 0697-30-69	HWY: STH 29 & STH 49	COUNTY: MARATHON	ALT 2A: EB TO WB J-TURN - WILLOW DRIVE CLOSURE	SHEET	E

STH 29 ICE OPINION OF PROBABLE COST ASSUMPTIONS AND NOTES

0656-43-04
STH 29 Safety Study
STH 49 - CTH F
STH 29, Marathon and Shawano Counties
January 2, 2018

	Assumptions/Notes
1.	Quantities are based on conceptual horizontal layout and are in 2017 dollars. No vertical design has been completed.
2.	An allowance of 20 to 25 percent was added to the earthwork, removal, and paving items to account for unmeasured/unknown items.
3.	Unit costs were taken from Estimator when available. BidX was used to determine unit costs not available from Estimator.
4.	Asphalt unit prices were determined using the asphalt spreadsheet available in the estimating resources page of the WisDOT extranet and available data in Estimator and BidX.
5.	The range of percentages for known unmeasured items shown on lines 7 through 15 in the opinion of probable costs were established based on an analysis of similar projects listed below. Percentages were adjusted based on engineering judgement. The following projects were used as a comparison: *Constructed J-turns in Wisconsin (ID# | Hwy | County)* 9200-05-71 | STH 29 at County U | Brown County | Final Construction Cost (w/o E&C) = $1,179,000 1520-02-71 | STH 54 at County U | Portage/Wood County | Final Construction Cost (w/o E&C) = $1,506,000 1009-32-74 | STH 29 at County C | Door County | Final Construction Cost (w/o E&C) = $1,158,000 *Rural Interchange under construction in Wisconsin (ID# | Hwy | County)* 1204-02-76 | USH 18 and County ID | Iowa County | Awarded Contract Amount (w/o E&C) = $9,750,000
6.	Earthwork was estimated by assuming an excavation depth of 15-inches for concrete pavement and 12-inches for asphalt pavement and 12-inches for the sideroads.
7.	Existing concrete mainline travel lanes are assummed to remain. New mainline turn bay pavement assummed to consist of 9 inches of concrete over 6 inches of base. New side road pavement assummed to consist of 4 inches of asphalt over 8 inches of base. Twelve inches of select crushed material was assumed over 5 percent of the new pavement area to account for excavation below subgrade.
8.	Below is a list of the following earthwork assumptions used for the CTH U interchange. Limited vertical assumptions were performed. 1. Simple triangular/rectangular prism shapes were used to calculate earthwork quanities based on the conceptual layout and slope intercepts from the 2010 EA. 2. The existing ground was assummed flat. A height of 24-feet was assumed at the bridge abutments, and 3 percent grades were used to match into the existing ground. 3. New roadway pavement structures were assumed to be built above the existing ground and ditches excavated 1.3-feet into the ground with a combination of 4:1 foreslopes and 6:1 backslopes. 4. 25 percent of all excavated common material was assummed to be waste material. 5. An expansion factor of 1.25 was used for all fill material. 6. A 25 percent contingency to the total borrow quantity was added due to uncertainty of the measured quantities.
9.	Real estate costs are not included.

STH 29/STH 49 Intersection
Opinion of Probable Construction Costs
Alternative 1 - Realigned - Extended WBL & Added EBL with Acceleration Lane
Date: 01/02/2018

	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	REMOVALS				
	Pavement	SY	110	$4.25	$ -
	Curb & Gutter	LF	580	$5.00	$ 3,000
1				**Removals Subtotal Cost**	$ 3,000
	EARTHWORK				
	Excavation Common	CY	7,000	$12.00	$ 84,000
2				**Earthwork Subtotal Cost**	$ 84,000
	PAVING ITEMS				
	Select Crushed Material	TON	470	$19.00	$ 9,000
	Base Aggregate Dense 1 1/4-Inch	TON	6,250	$13.50	$ 84,000
	Base Aggregate Dense 3/4-Inch	TON	310	$25.50	$ 8,000
	HMA Pavement	TON	900	$75.00	$ 68,000
	Concrete Pavement 9-Inch	SY	9,300	$38.00	$ 353,000
	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF	730	$17.00	$ 12,000
3				**Paving Items Subtotal Cost**	$ 534,000
4				**Major Roadway Items Subtotal Cost (Lines 1 - 3)**	$ 621,000
5	**ALLOWANCE FOR UNMEASURED ITEMS**	LS	20 to 25 % of Line 4	N/A	$ 124,000 to $ 155,000
6				**Roadway Items Subtotal Cost Range (Lines 4 - 5)**	$ 745,000 to $ 776,000
	OTHER ITEMS				
7	**CULVERT PIPE**	LS	3 to 6 % of Line 6	N/A	$ 22,400 to $ 46,600
8	**ROADSIDE BARRIER**	LS	to % of Line 6	N/A	$ - to $ -
9	**EROSION CONTROL/FINISHING**	LS	3 to 6 % of Line 6	N/A	$ 22,400 to $ 46,600
10	**DRAINAGE/STORM SEWER**	LS	3 to 7 % of Line 6	N/A	$ 22,400 to $ 54,300
11	**SIGNING**	LS	3 to 5 % of Line 6	N/A	$ 22,400 to $ 38,800
12	**MISCELLANEOUS ITEMS**	LS	10 to 18 % of Line 6	N/A	$ 74,500 to $ 139,700
13	**TRAFFIC CONTROL**	LS	7 to 13 % of Line 6	N/A	$ 52,200 to $ 100,900
14	**PAVEMENT MARKING**	LS	4 to 10 % of Line 6	N/A	$ 29,800 to $ 77,600
15	**LIGHTING AND ITS**	LS	8 to 14 % of Line 6	N/A	$ 59,600 to $ 108,600
16	**TRAFFIC SIGNALS**	EA		N/A	$ -
17				**Roadway Subtotal Cost Range (Lines 6 - 16)**	$ 1,051,000 to $ 1,389,000
	STRUCTURES				
	Structure Removal	EACH			$ -
	Bridges	SF			$ -
	Sign Bridges	EA			$ -
	Retaining Walls	SF			$ -
	Noise Walls	SF			$ -
	Box Culverts	LF			$ -
18				**Structures Subtotal Cost**	$ -
19				**Roadway & Structures Total Let Cost Range (Lines 17 - 18)**	**$ 1,051,000 to $ 1,389,000**
20	**COMPENSABLE UTILITIES**	LS	1 % of Line 21	N/A	$ 11,000 to $ 14,000
21	**PROPERTY ACQUISITION**	ACRES			$ -
22	**RESIDENTIAL RELOCATION**	LS			$ -
23	**COMMERCIAL RELOCATION**	LS			$ -
24				**Utilities & Real Estate Total Cost Range (Lines 20 - 23)**	**$ 11,000 to $ 14,000**
25	**ENGINEERING AND CONTINGENCY**	LS	15 % of Line 21	N/A	$ 158,000 to $ 208,000
26				**Engineering and Contingency Total Cost Range (Line 25)**	**$ 158,000 to $ 208,000**
	OPINION OF PROBABLE CONSTRUCTION COST RANGE (Lines 19, 24, 26)		**$ 1,300,000**	**to**	**$ 1,700,000**

STH 29/STH 49 Intersection
Opinion of Probable Construction Costs
Alternative 1A - Realigned - Extended Slotted WBL & Added EBL
Date: 01/02/2018

	ITEM DESCRIPTION	UNIT	QUANTITY				UNIT PRICE	TOTAL				
	REMOVALS											
	Pavement	SY				110	$4.25	$				-
	Curb & Gutter	LF				580	$5.00	$				3,000
1							**Removals Subtotal Cost**	$				3,000
	EARTHWORK											
	Excavation Common	CY				5,100	$12.00	$				61,000
2							**Earthwork Subtotal Cost**	$				61,000
	PAVING ITEMS											
	Select Crushed Material	TON				340	$19.00	$				6,000
	Base Aggregate Dense 1 1/4-Inch	TON				4,400	$13.50	$				59,000
	Base Aggregate Dense 3/4-Inch	TON				150	$25.50	$				4,000
	HMA Pavement	TON				730	$75.00	$				55,000
	Concrete Pavement 9-Inch	SY				6,500	$38.00	$				247,000
	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF				585	$17.00	$				10,000
3							**Paving Items Subtotal Cost**	$				381,000
4	**Major Roadway Items Subtotal Cost (Lines 1 - 3)**							$				445,000
5	**ALLOWANCE FOR UNMEASURED ITEMS**	LS	20	to	25	% of Line 4	N/A	$	89,000	to	$	111,000
6	**Roadway Items Subtotal Cost Range (Lines 4 - 5)**							$	534,000	to	$	556,000
	OTHER ITEMS											
7	**CULVERT PIPE**	LS	3	to	6	% of Line 6	N/A	$	16,000	to	$	33,400
8	**ROADSIDE BARRIER**	LS		to		% of Line 6	N/A	$	-	to	$	-
9	**EROSION CONTROL/FINISHING**	LS	3	to	6	% of Line 6	N/A	$	16,000	to	$	33,400
10	**DRAINAGE/STORM SEWER**	LS	3	to	7	% of Line 6	N/A	$	16,000	to	$	38,900
11	**SIGNING**	LS	3	to	5	% of Line 6	N/A	$	16,000	to	$	27,800
12	**MISCELLANEOUS ITEMS**	LS	10	to	18	% of Line 6	N/A	$	53,400	to	$	100,100
13	**TRAFFIC CONTROL**	LS	7	to	13	% of Line 6	N/A	$	37,400	to	$	72,300
14	**PAVEMENT MARKING**	LS	4	to	10	% of Line 6	N/A	$	21,400	to	$	55,600
15	**LIGHTING AND ITS**	LS	8	to	14	% of Line 6	N/A	$	42,700	to	$	77,800
16	**TRAFFIC SIGNALS**	EA					N/A	$				-
17	**Roadway Subtotal Cost Range (Lines 6 - 16)**							$	753,000	to	$	995,000
	STRUCTURES											
	Structure Removal	EACH						$				-
	Bridges	SF						$				-
	Sign Bridges	EA						$				-
	Retaining Walls	SF						$				-
	Noise Walls	SF						$				-
	Box Culverts	LF						$				-
18							**Structures Subtotal Cost**	$				-
19	**Roadway & Structures Total Let Cost Range (Lines 17 - 18)**							**$**	**753,000**	**to**	**$**	**995,000**
20	**COMPENSABLE UTILITIES**	LS		1		% of Line 21	N/A	$	8,000	to	$	10,000
21	**PROPERTY ACQUISITION**	ACRES						$				-
22	**RESIDENTIAL RELOCATION**	LS						$				-
23	**COMMERCIAL RELOCATION**	LS						$				-
24	**Utilities & Real Estate Total Cost Range (Lines 20 - 23)**							**$**	**8,000**	**to**	**$**	**10,000**
25	**ENGINEERING AND CONTINGENCY**	LS		15		% of Line 21	N/A	$	113,000	to	$	149,000
26	**Engineering and Contingency Total Cost Range (Line 25)**							**$**	**113,000**	**to**	**$**	**149,000**
	OPINION OF PROBABLE CONSTRUCTION COST RANGE (Lines 19, 24, 26)		**$**			**900,000**	**to**	**$**				**1,200,000**

STH 29/STH 49 Intersection
Opinion of Probable Construction Costs
Alternative 1B - Extended WBL & Added EBR with Accel. Lane - Willow Dr Closure
Date: 01/02/2018

	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	REMOVALS				
	Pavement	SY	110	$4.25	$ -
	Curb & Gutter	LF	580	$5.00	$ 3,000
1				**Removals Subtotal Cost**	$ 3,000
	EARTHWORK				
	Excavation Common	CY	5,400	$12.00	$ 65,000
2				**Earthwork Subtotal Cost**	$ 65,000
	PAVING ITEMS				
	Select Crushed Material	TON	370	$19.00	$ 7,000
	Base Aggregate Dense 1 1/4-Inch	TON	5,150	$13.50	$ 70,000
	Base Aggregate Dense 3/4-Inch	TON	270	$25.50	$ 7,000
	HMA Pavement	TON	860	$75.00	$ 65,000
	Concrete Pavement 9-Inch	SY	6,800	$38.00	$ 258,000
	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF	580	$17.00	$ 10,000
3				**Paving Items Subtotal Cost**	$ 417,000
4				**Major Roadway Items Subtotal Cost (Lines 1 - 3)**	$ 485,000
5	**ALLOWANCE FOR UNMEASURED ITEMS**	LS	20 to 25 % of Line 4	N/A	$ 97,000 to $ 121,000
6				**Roadway Items Subtotal Cost Range (Lines 4 - 5)**	$ 582,000 to $ 606,000
	OTHER ITEMS				
7	**CULVERT PIPE**	LS	3 to 6 % of Line 6	N/A	$ 17,500 to $ 36,400
8	**ROADSIDE BARRIER**	LS	to % of Line 6	N/A	$ - to $ -
9	**EROSION CONTROL/FINISHING**	LS	3 to 6 % of Line 6	N/A	$ 17,500 to $ 36,400
10	**DRAINAGE/STORM SEWER**	LS	3 to 7 % of Line 6	N/A	$ 17,500 to $ 42,400
11	**SIGNING**	LS	3 to 5 % of Line 6	N/A	$ 17,500 to $ 30,300
12	**MISCELLANEOUS ITEMS**	LS	10 to 18 % of Line 6	N/A	$ 58,200 to $ 109,100
13	**TRAFFIC CONTROL**	LS	7 to 13 % of Line 6	N/A	$ 40,700 to $ 78,800
14	**PAVEMENT MARKING**	LS	4 to 10 % of Line 6	N/A	$ 23,300 to $ 60,600
15	**LIGHTING AND ITS**	LS	8 to 14 % of Line 6	N/A	$ 46,600 to $ 84,800
16	**TRAFFIC SIGNALS**	EA		N/A	$ -
17				**Roadway Subtotal Cost Range (Lines 6 - 16)**	$ 821,000 to $ 1,085,000
	STRUCTURES				
	Structure Removal	EACH			$ -
	Bridges	SF			$ -
	Sign Bridges	EA			$ -
	Retaining Walls	SF			$ -
	Noise Walls	SF			$ -
	Box Culverts	LF			$ -
18				**Structures Subtotal Cost**	$ -
19				**Roadway & Structures Total Let Cost Range (Lines 17 - 18)**	**$ 821,000 to $ 1,085,000**
20	**COMPENSABLE UTILITIES**	LS	1 % of Line 21	N/A	$ 8,000 to $ 11,000
21	**PROPERTY ACQUISITION**	ACRES			$ -
22	**RESIDENTIAL RELOCATION**	LS			$ -
23	**COMMERCIAL RELOCATION**	LS			$ -
24				**Utilities & Real Estate Total Cost Range (Lines 20 - 23)**	**$ 8,000 to $ 11,000**
25	**ENGINEERING AND CONTINGENCY**	LS	15 % of Line 21	N/A	$ 123,000 to $ 163,000
26				**Engineering and Contingency Total Cost Range (Line 25)**	**$ 123,000 to $ 163,000**
	OPINION OF PROBABLE CONSTRUCTION COST RANGE (Lines 19, 24, 26)		**$ 1,000,000**	**to**	**$ 1,300,000**

STH 29/STH 49 Intersection
Opinion of Probable Construction Costs
Alternative 2 - EB to WB J-Turn
Date: 01/02/2018

	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	REMOVALS				
	Pavement	SY	110	$4.25	$ -
	Curb & Gutter	LF	590	$5.00	$ 3,000
1				**Removals Subtotal Cost**	$ 3,000
	EARTHWORK				
	Excavation Common	CY	4,600	$12.00	$ 55,000
2				**Earthwork Subtotal Cost**	$ 55,000
	PAVING ITEMS				
	Select Crushed Material	TON	300	$19.00	$ 6,000
	Base Aggregate Dense 1 1/4-Inch	TON	4,200	$13.50	$ 57,000
	Base Aggregate Dense 3/4-Inch	TON	150	$25.50	$ 4,000
	HMA Pavement	TON	560	$75.00	$ 42,000
	Concrete Pavement 9-Inch	SY	6,100	$38.00	$ 232,000
	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF	1,400	$17.00	$ 24,000
3				**Paving Items Subtotal Cost**	$ 365,000
4	**Major Roadway Items Subtotal Cost (Lines 1 - 3)**				$ 423,000
5	**ALLOWANCE FOR UNMEASURED ITEMS**	LS	20 to 25 % of Line 4	N/A	$ 85,000 to $ 106,000
6	**Roadway Items Subtotal Cost Range (Lines 4 - 5)**				$ 508,000 to $ 529,000
	OTHER ITEMS				
7	**CULVERT PIPE**	LS	3 to 6 % of Line 6	N/A	$ 15,200 to $ 31,700
8	**ROADSIDE BARRIER**	LS	to % of Line 6	N/A	$ - to $ -
9	**EROSION CONTROL/FINISHING**	LS	3 to 6 % of Line 6	N/A	$ 15,200 to $ 31,700
10	**DRAINAGE/STORM SEWER**	LS	3 to 7 % of Line 6	N/A	$ 15,200 to $ 37,000
11	**SIGNING**	LS	3 to 5 % of Line 6	N/A	$ 15,200 to $ 26,500
12	**MISCELLANEOUS ITEMS**	LS	10 to 18 % of Line 6	N/A	$ 50,800 to $ 95,200
13	**TRAFFIC CONTROL**	LS	7 to 13 % of Line 6	N/A	$ 35,600 to $ 68,800
14	**PAVEMENT MARKING**	LS	4 to 10 % of Line 6	N/A	$ 20,300 to $ 52,900
15	**LIGHTING AND ITS**	LS	8 to 14 % of Line 6	N/A	$ 40,600 to $ 74,100
16	**TRAFFIC SIGNALS**	EA		N/A	$ -
17	**Roadway Subtotal Cost Range (Lines 6 - 16)**				$ 716,000 to $ 947,000
	STRUCTURES				
	Structure Removal	EACH			$ -
	Bridges	SF			$ -
	Sign Bridges	EA			$ -
	Retaining Walls	SF			$ -
	Noise Walls	SF			$ -
	Box Culverts	LF			$ -
18				**Structures Subtotal Cost**	$ -
19	**Roadway & Structures Total Let Cost Range (Lines 17 - 18)**				**$ 716,000 to $ 947,000**
20	**COMPENSABLE UTILITIES**	LS	1 % of Line 21	N/A	$ 7,000 to $ 9,000
21	**PROPERTY ACQUISITION**	ACRES			$ -
22	**RESIDENTIAL RELOCATION**	LS			$ -
23	**COMMERCIAL RELOCATION**	LS			$ -
24	**Utilities & Real Estate Total Cost Range (Lines 20 - 23)**				**$ 7,000 to $ 9,000**
25	**ENGINEERING AND CONTINGENCY**	LS	15 % of Line 21	N/A	$ 107,000 to $ 142,000
26	**Engineering and Contingency Total Cost Range (Line 25)**				**$ 107,000 to $ 142,000**
	OPINION OF PROBABLE CONSTRUCTION COST RANGE (Lines 19, 24, 26)				**$ 900,000 to $ 1,100,000**

STH 29/STH 49 Intersection

Opinion of Probable Construction Costs

Alternative 2A - EB to WB J-Turn - Willow Drive Closure

Date: 01/02/2018

	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	REMOVALS				
	Pavement	SY	110	$4.25	$ -
	Curb & Gutter	LF	590	$5.00	$ 3,000
1				**Removals Subtotal Cost**	$ 3,000
	EARTHWORK				
	Excavation Common	CY	4,500	$12.00	$ 54,000
2				**Earthwork Subtotal Cost**	$ 54,000
	PAVING ITEMS				
	Select Crushed Material	TON	290	$19.00	$ 6,000
	Base Aggregate Dense 1 1/4-Inch	TON	4,300	$13.50	$ 58,000
	Base Aggregate Dense 3/4-Inch	TON	170	$25.50	$ 4,000
	HMA Pavement	TON	780	$75.00	$ 59,000
	Concrete Pavement 9-Inch	SY	4,900	$38.00	$ 186,000
	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF	1,200	$17.00	$ 20,000
3				**Paving Items Subtotal Cost**	$ 333,000
4	**Major Roadway Items Subtotal Cost (Lines 1 - 3)**				$ 390,000
5	**ALLOWANCE FOR UNMEASURED ITEMS**	LS	20 to 25 % of Line 4	N/A	$ 78,000 to $ 98,000
6	**Roadway Items Subtotal Cost Range (Lines 4 - 5)**				$ 468,000 to $ 488,000
	OTHER ITEMS				
7	**CULVERT PIPE**	LS	3 to 6 % of Line 6	N/A	$ 14,000 to $ 29,300
8	**ROADSIDE BARRIER**	LS	to % of Line 6	N/A	$ - to $ -
9	**EROSION CONTROL/FINISHING**	LS	3 to 6 % of Line 6	N/A	$ 14,000 to $ 29,300
10	**DRAINAGE/STORM SEWER**	LS	3 to 7 % of Line 6	N/A	$ 14,000 to $ 34,200
11	**SIGNING**	LS	3 to 5 % of Line 6	N/A	$ 14,000 to $ 24,400
12	**MISCELLANEOUS ITEMS**	LS	10 to 18 % of Line 6	N/A	$ 46,800 to $ 87,800
13	**TRAFFIC CONTROL**	LS	7 to 13 % of Line 6	N/A	$ 32,800 to $ 63,400
14	**PAVEMENT MARKING**	LS	4 to 10 % of Line 6	N/A	$ 18,700 to $ 48,800
15	**LIGHTING AND ITS**	LS	8 to 14 % of Line 6	N/A	$ 37,400 to $ 68,300
16	**TRAFFIC SIGNALS**	EA		N/A	$ -
17	**Roadway Subtotal Cost Range (Lines 6 - 16)**				$ 660,000 to $ 874,000
	STRUCTURES				
	Structure Removal	EACH			$ -
	Bridges	SF			$ -
	Sign Bridges	EA			$ -
	Retaining Walls	SF			$ -
	Noise Walls	SF			$ -
	Box Culverts	LF			$ -
18				**Structures Subtotal Cost**	$ -
19	**Roadway & Structures Total Let Cost Range (Lines 17 - 18)**				**$ 660,000 to $ 874,000**
20	**COMPENSABLE UTILITIES**	LS	1 % of Line 21	N/A	$ 7,000 to $ 9,000
21	**PROPERTY ACQUISITION**	ACRES			$ -
22	**RESIDENTIAL RELOCATION**	LS			$ -
23	**COMMERCIAL RELOCATION**	LS			$ -
24	**Utilities & Real Estate Total Cost Range (Lines 20 - 23)**				**$ 7,000 to $ 9,000**
25	**ENGINEERING AND CONTINGENCY**	LS	15 % of Line 21	N/A	$ 99,000 to $ 131,000
26	**Engineering and Contingency Total Cost Range (Line 25)**				**$ 99,000 to $ 131,000**
	OPINION OF PROBABLE CONSTRUCTION COST RANGE (Lines 19, 24, 26)	**$**	**800,000**	**to**	**$ 1,100,000**

APPENDIX F
WISDOT BTO ICE REPORT REVIEWS

Intersection Control Evaluation Comments

ICE Type: Scoping ICE
Project ID: 0656-43-04
Intersection: STH 29 & CTH J
Reviewed by: Vicki Haskell, Ben Rouleau, Kevin M. Scopoline
Date: 3/1/2018

Alternatives Considered

Existing:	• Two-Way Stop Control on Minor Road
Alternative 1:	• J-Turn
Alternative 2:	• Median U-Turn
Alternative 3:	• Access Control (Right-In/Right-Out/Left-In)
Alternative 4:	• Others

ICE Report Comments

- The preliminary design for the Median U-Turn alternative shows the EB U-Turn placed very close to the intersection. It does not appear that drivers would be able to enter the RT lane without having to cross solid white lines.
- The added RT lane for the Shawano County maintenance building seems like it should be added to all alternatives or none, since the RT lane is independent of the intersection.
- Do not need the segment crash information for the reviewing intersection control alternatives.

Conclusions & Recommendation

- BTO concurs with the suggested alternatives, proceed to a Phase II: Alternative Selection ICE Report.

ICE Type: Scoping ICE
Project ID: 0656-43-04
Intersection: STH 29 & CTH D/Rock Road
Reviewed by: Vicki Haskell, Ben Rouleau, Kevin M. Scopoline
Date: 3/1/2018

Alternatives Considered

Existing:	• Two-Way Stop Control on Minor Road
Alternative 1:	• Through Route Activated Warning System (TRAWS)
Alternative 2:	• Closed Median
Alternative 3:	• Closed Rock Road and Upgrade to Slotted WB Left Turn Lane
Alternative 4:	• Others

ICE Report Comments

- The existing conditions do not meet current sight distance standards.

Conclusions & Recommendation

- BTO concurs with the suggested alternatives, proceed to a Phase II: Alternative Selection ICE Report.

Intersection Control Evaluation Comments

ICE Type: Scoping ICE
Project ID: 0656-43-04
Intersection: STH 29 & CTH U
Reviewed by: Vicki Haskell, Ben Rouleau, Kevin M. Scopoline
Date: 3/1/2018

Alternatives Considered

Existing:	• Two-Way Stop Control on Minor Road
Alternative 1:	• J-Turn
Alternative 2:	• Median U-Turn
Alternative 3:	• Diamond Interchange
Alternative 4:	• Others

ICE Report Comments

- There have been recent improvements to the intersection to assist with safety. More improvements are planned for 2018.
- Was the TRAWS alternative considered along with reducing the crest curve to the east to improve sight distance? The crash diagram suggests a trend of WB vehicles not being seen so poor decisions are made.
- Used a different range of crash data (2013-2017) than the other intersections also being evaluated (2012-2016).
- Do not need the segment crash information for the reviewing intersection control alternatives.

Conclusions & Recommendation

- BTO concurs with the suggested alternatives, but would also like to see and alternative with a TRAWS in conjunction with reducing the profile of the crest curve to the east. Proceed to a Phase II: Alternative Selection ICE Report.

Intersection Control Evaluation Comments

ICE Type: Scoping ICE
Project ID: 0656-43-04
Intersection: STH 29 & CTH MMM
Reviewed by: Vicki Haskell, Ben Rouleau, Kevin M. Scopoline
Date: 3/1/2018

Alternatives Considered

Existing:	• Two-Way Stop Control on Minor Road
Alternative 1:	• J-Turn
Alternative 2:	• Median U-Turn
Alternative 3:	• Access Control (Right-In/Right-Out/Left-In)
Alternative 4:	• Others

ICE Report Comments

- There was no discussion of reconfiguring the intersection to improve the skew angle, even though this was mentioned as sub-standard. Some of the conceptual drawings show an improved skew angle.
- Do not need the segment crash information for the reviewing intersection control alternatives.
- Would the TRAWS system be viable along with improving the skew angle?

Conclusions & Recommendation

- BTO concurs with the suggested alternatives, but would also like to see and alternative with a TRAWS in conjunction with improving the intersection skew. Proceed to a Phase II: Alternative Selection ICE Report.

Intersection Control Evaluation Comments

ICE Type: Scoping ICE
Project ID: 0656-43-04
Intersection: STH 29 & CTH F
Reviewed by: Vicki Haskell, Ben Rouleau, Kevin M. Scopoline
Date: 3/1/2018

Alternatives Considered

Existing:	• Two-Way Stop Control on Minor Road
Alternative 1:	• J-Turn
Alternative 2:	• Median U-Turn
Alternative 3:	• Diamond Interchange
Alternative 4:	• Others

ICE Report Comments

- Are there any sight distance concerns with the U-turns?

Conclusions & Recommendation

- BTO concurs with the suggested alternatives, proceed to a Phase II: Alternative Selection ICE Report.

STH 29 Safety Study: Phase I Scoping ICE Comment Summary

March 22, 2018

On March 1, 2018 the Wisconsin Department of Transportation (WisDOT) Bureau of Traffic Operations (BTO) provided comments on the Scoping - Phase I Intersection Control Evaluation (ICE) Report completed by Strand Associates, Inc.®

This document summarizes the STH 29 Safety Study project team's responses (shown in red) to the ICE Report comments and notes changes made to the ICE Report. The responses below are organized by intersection, west to east, and are numbered in the order received.

STH 29 and CTH J

1. The preliminary design for the Median U-Turn alternative shows the EB U-Turn placed very close to the intersection. It does not appear that drivers would be able to enter the RT lane without having to cross solid white lines. Agreed. This is a drawback of the Median U-Turn alternative with the current conceptual layout. The EB to WB U-turn must either be within close proximity of the primary intersection or much further east in order to avoid impacts to the Embarrass River bridge. Further evaluation of shifting the U-turn location to the east of the Embarrass River bridge (similar to the J-Turn alternative) could occur in the Phase II ICE, if desired. It is anticipated that the OPCC for the Median U-Turn alternative would be similar to the J-Turn alternative if the U-turn is shifted further east.

2. The added RT lane for the Shawano County maintenance building seems like it should be added to all alternatives or none, since the RT lane is independent of the intersection. The eastbound right-turn lane and westbound left-turn lanes have been added to the Median U-Turn and Access Control Alternatives. The report and attachments have been updated to reflect these changes.

3. Do not need the segment crash information for the reviewing intersection control alternatives. No response required, the segment data will remain in document as background information for the region.

Concurrence was given on the suggested alternatives and to proceed to a Phase II: Alternative Selection ICE Report (Right-in/Right-out/Left-in, J-Turn, MUT).

STH 29 and CTH D/Rock Road

1. The existing conditions do not meet current sight distance standards. No response required.

Concurrence was given on the suggested alternatives and to proceed to a Phase II: Alternative Selection ICE Report (Closed Median, Close Rock Road with slotted WB left).

STH 29 and CTH U

1. There have been recent improvements to the intersection to assist with safety. More improvements are planned for 2018. No response required.

2. Was the TRAWS alternative considered along with reducing the crest curve to the east to improve sight distance? The crash diagram suggests a trend of WB vehicles not being seen so poor decisions are made. This alternative has not been considered to-date. The TRAWS with mainline reconstruction alternative has been added to the Phase I ICE report as one of the most viable alternatives along with some discussion. This alternative would not eliminate crossing conflicts, but would likely greatly improve sight distance issues associated with WB traffic. This alternative would need to be evaluated further in the Phase II ICE, where vertical design will likely be evaluated in more detail for all alternatives.

3. Used a different range of crash data (2013-2017) than the other intersections also being evaluated (2012-2016). No response required, updates to 2013-2017 range of crash data for other intersections will likely be made prior to the next HSIP submittal.

4. Do not need the segment crash information for the reviewing intersection control alternatives. No response required, the segment data will remain in document as background information for the region.

Concurrence was given on the suggested alternatives and to proceed to a Phase II: Alternative Selection ICE Report (J-Turn, MUT, Diamond Interchange, and TRAWS with mainline reconstruction).

STH 29 and CTH MMM/Clark Drive

1. There was no discussion of reconfiguring the intersection to improve the skew angle, even though this was mentioned as sub-standard. Some of the conceptual drawings show an improved skew angle. Discussion has been added in the "Evaluation of Alternatives" section of the report for each of the most viable alternatives.

2. Do not need the segment crash information for the reviewing intersection control alternatives. No response required, the segment data will remain in document as background information for the region.

3. Would the TRAWS system be viable along with improving the skew angle? It could be if desired to include a lower cost treatment as an option. However, through coordination with the region similar alternatives (such as the turn lane improvement alternative) were considered less viable because they do not geometrically address the crossing conflicts at the intersection. The TRAWS with an improved skew angle may help mitigate some crashes but should be also considered less viable would not geometrically remove crossing movements from the intersection, as the access control, J-Turn, and MUT alternatives do. The study team proposes no changes to the three alternatives currently identified as the most viable.

Concurrence was given on the suggested alternatives and to proceed to a Phase II: Alternative Selection ICE Report (Access Control, J-Turn, and MUT).

STH 29 and CTH F

1. Are there any sight distance concerns with the U-turns? WisDOT NC Region staff performed a field visit in November 2017 to review the draft conceptual layouts of the study alternatives, with a focus on sight distance related to each alternative. At CTH F, sight distance appeared to be acceptable based on the region's review of the proposed U-turn locations for the J-Turn and MUT alternatives. No adjustments were made to the U-turn locations after the region's November review.

Concurrence was given on the suggested alternatives and to proceed to a Phase II: Alternative Selection ICE Report (J-Turn, MUT, and Diamond Interchange).

From:	DOT ICE Review
To:	Kemnitz, Tony - DOT; DOT ICE Review; Brugman, Daniel J - DOT
Cc:	Johnson, Brenden; Urban, Joseph M.
Subject:	RE: STH 29 Ice Reports (0656-43-04)
Date:	Tuesday, April 3, 2018 12:51:22 PM

Tony

Ben, Kevin and I took a look at Strand's responses and the updated ICE reports and have no further comments. You are safe to proceed with the Phase II ICE reports.

Please let us know if you want us to formally update our previous comments to reflect such.

Thanks

Vicki

Vicki S. Haskell, P.E.
WisDOT Bureau of Traffic Operations
Office: (608) 266-8442

Email: vicki.haskell@dot.wi.gov

From: Kemnitz, Tony - DOT
Sent: Tuesday, March 27, 2018 4:21 PM
To: DOT ICE Review <DOTICEReview@dot.wi.gov>; Brugman, Daniel J - DOT <Daniel.Brugman@dot.wi.gov>
Cc: Johnson, Brenden <Brenden.Johnson@strand.com>; Urban, Joseph M. <Joseph.Urban@strand.com>
Subject: RE: STH 29 Ice Reports (0656-43-04)

We missed the HSIP Deadline so we would have time to accommodate a normal review and close out.
T

From: DOT ICE Review
Sent: Tuesday, March 27, 2018 4:16 PM
To: DOT ICE Review <DOTICEReview@dot.wi.gov>; Kemnitz, Tony - DOT <Tony.Kemnitz@dot.wi.gov>; Brugman, Daniel J - DOT <Daniel.Brugman@dot.wi.gov>
Cc: Johnson, Brenden <Brenden.Johnson@strand.com>; Urban, Joseph M. <Joseph.Urban@strand.com>
Subject: RE: STH 29 Ice Reports (0656-43-04)

Tony/Dan

BTO has received the updated ICE reports submitted by Strand. Kevin is out of the office until

Thursday, and on Thursday he will be tied up with HSIP reviews. Ben and I will both be out of the office on Friday. So we won't be able to look at these updated reports as a group until next week at the earliest. Please let us know if you need us to expedite our review of these revised reports.

Thanks

Vicki

Vicki S. Haskell, P.E.
WisDOT Bureau of Traffic Operations
Office: (608) 266-8442

Email: vicki.haskell@dot.wi.gov

From: Urban, Joseph M. [mailto:Joseph.Urban@strand.com]
Sent: Tuesday, March 27, 2018 3:44 PM
To: DOT ICE Review <DOTICEReview@dot.wi.gov>
Cc: Kemnitz, Tony - DOT <Tony.Kemnitz@dot.wi.gov>; Brugman, Daniel J - DOT <Daniel.Brugman@dot.wi.gov>; Scopoline, Kevin M - DOT (BTO) <KevinM.Scopoline@dot.wi.gov>; Johnson, Brenden <Brenden.Johnson@strand.com>
Subject: RE: STH 29 Ice Reports (0656-43-04)

Hello,

Strand and the NC region have reviewed the STH 29 Phase I ICE Report comments and have revised the documents as needed. Please see attached a response to the comments and the body of three of the revised ICE reports (with changes highlighted). A brief summary of the revisions is below:

- **CTH J:** Exhibits and OPCCs were revised to include the EB right and WB left-turn lanes to the maintenance building in each of the most feasible alternatives.
- **CTH D/Rock Road:** No changes required.
- **CTH U:** TRAWS with Mainline Reconstruction (i.e. flattening out the crest curve) has been added as a viable alternative based on BTO's recommendation. This alternative would need to be considered further in the Phase II ICE with more detailed vertical design.
- **CTH MMM:** TRAWS with fixing the skew angle was not added as a viable alternative. This was considered less feasible because it does not address right-angle crashes as well as the most viable alternatives that are currently identified. The same argument could potentially be made for the not including the CTH U TRAWS with Mainline Reconstruction as a viable alternative, but the deficiencies are considerably different between the two intersections. See the comment response for some more detail.
- **CTH F:** No changes required.

Let us know if you have any questions or further comments, otherwise we'll go ahead and finalize the reports.

Thanks,

Joe

From: Kemnitz, Tony - DOT <Tony.Kemnitz@dot.wi.gov>
Sent: Monday, March 12, 2018 8:08 AM
To: Urban, Joseph M. <Joseph.Urban@strand.com>
Subject: FW: STH 29 Ice Reports (0656-43-04)

Joe

Here are the comments. I will call to go over each of these and what your next steps are to finalize.

Tony

From: DOT ICE Review
Sent: Thursday, March 01, 2018 9:37 AM
To: Brugman, Daniel J - DOT <Daniel.Brugman@dot.wi.gov>
Cc: Kemnitz, Tony - DOT <Tony.Kemnitz@dot.wi.gov>; DOT ICE Review <DOTICEReview@dot.wi.gov>; Rouleau, Benjamin M - DOT <Benjamin.Rouleau@dot.wi.gov>
Subject: RE: STH 29 Ice Reports (0656-43-04)

Hi Dan,

I have attached BTO's comments for the STH 29 ICE reports. The general comment for all the intersections is since the alternatives could not be narrowed down to just one feasible option, a Phase II ICE should be completed to select the most appropriate intersection control. Please let us know if you have any questions or concerns.

Thanks,

Kevin M. Scopoline

Traffic Operations and Analysis Engineer
Wisconsin Department of Transportation
Bureau of Traffic Operations

phone: 608-266-1273
email: kevinm.scopoline@dot.wi.gov

From: Daniel.Brugman@dot.wi.gov [mailto:Daniel.Brugman@dot.wi.gov]

Sent: Tuesday, January 30, 2018 3:59 PM
To: DOT ICE Review <DOTICEReview@dot.wi.gov>
Cc: Brugman, Daniel J - DOT <Daniel.Brugman@dot.wi.gov>; Kemnitz, Tony - DOT <Tony.Kemnitz@dot.wi.gov>
Subject: STH 29 Ice Reports (0656-43-04)

BRUGMAN JR, DANIEL J has sent you the following file(s). To download the file(s) please click on the respective link(s) below.

Your password is: c\?eLlwF

Hi, We have five ICE reports for your review involving intersections in Shawano County. In addition, there is a supplemental report that includes the methodology used within the analysis. These intersections were reviewed within the NC Region due to safety concerns and are being pursued for HSIP funding. The following intersections were reviewed: STH 29 at CTH D-Rock Road STH 29 at CTH J STH 29 at CTH U STH 29 at CTH MMM-Clark Drive STH 29 at CTH F Please let us know if you have any questions relating to this. You can contact myself or Tony Kemnitz. Thanks, Dan

Name: CTH F_ICE Report (Final Draft 2018-01-29).pdf
Size: 12.7 MB
Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=1a6a09dabaa848679bcb2a2183faf11d-53cc12466d4f4b83975d6df457d74063

Name: CTH D-Rock Rd_ICE Report (Final Draft 2018-01-29).pdf
Size: 8.5 MB
Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=bd732a1ee7da450b810327fd35ca694a-53cc12466d4f4b83975d6df457d74063

Name: CTH J_ICE Report (Final Draft 2018-01-29).pdf
Size: 9.4 MB
Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=99f2e198b6cb4875b688e041b527bccd-53cc12466d4f4b83975d6df457d74063

Name: CTH U_ICE Report (Final Draft 2018-01-29).pdf
Size: 12.9 MB
Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=5fc219a1f25d430a82776788253a87af-53cc12466d4f4b83975d6df457d74063

Name: CTH MMM-Clark Dr_ICE Report (Final Draft 2018-01-29).pdf
Size: 13.6 MB

Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=282f08de2c0c461abb35b8bfe5ee83a0-53cc12466d4f4b83975d6df457d74063

Name: 2018-01-29 STH 29 Roadway Safety Review Report (Final).pdf
Size: 12.6 MB
Expires: March 01, 2018
Download: https://ftp.dot.wi.gov/download?domain=LAN&id=52cb1a2defb64272a02d248d58f3fcb1-53cc12466d4f4b83975d6df457d74063