

Prepared using  
winter 2007-2008  
traffic data and  
2002-2006 crash data.

## OPERATIONAL NEEDS ASSESSMENT

US 41 (CTH JJ/WIS 114  
to CTH S) and WIS 441

## FINAL REPORT

NOVEMBER 2011

PREPARED FOR

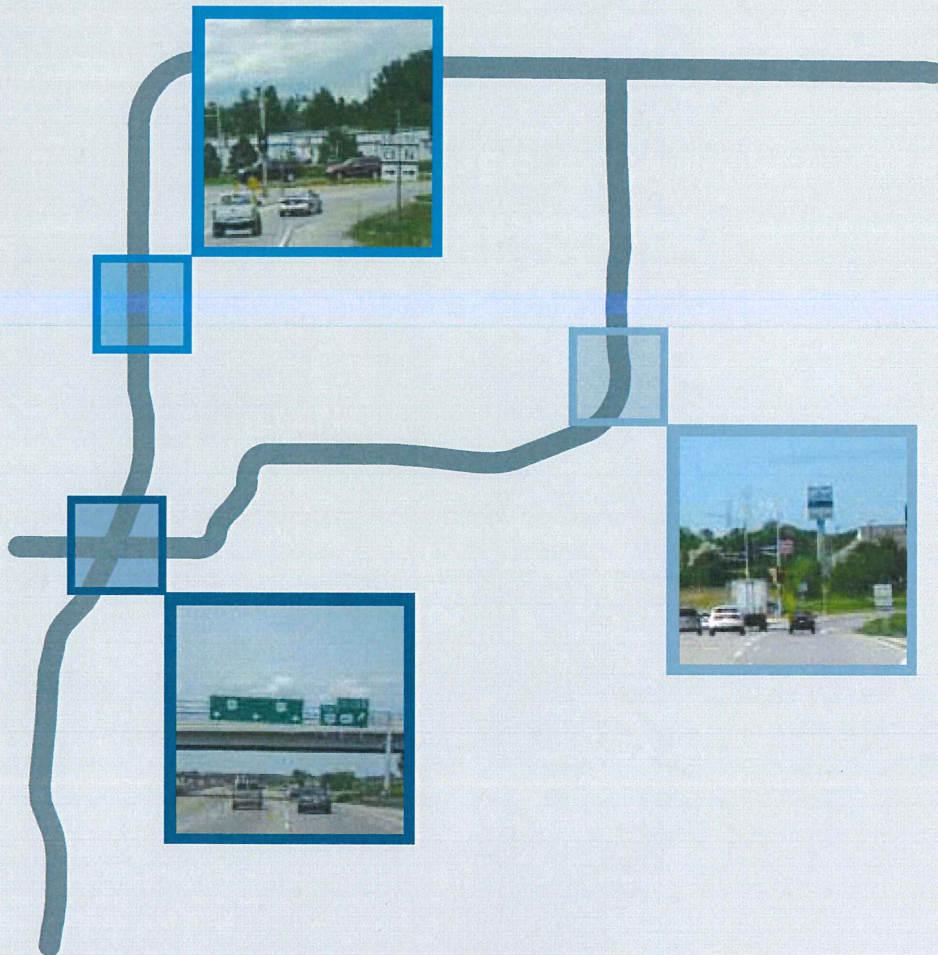
**Wisconsin Department of  
Transportation**  
944 Vanderperren Way  
Green Bay, WI 54324

PREPARED BY

**HNTB Corporation**  
10 W. Mifflin Street  
Suite 300  
Madison, WI 53703

Contact:

Jerry Shadewald  
(608) 294-5009  
jshadewald@hntb.com



**HNTB**

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## Executive Summary



# US 41/WIS 441 CORRIDOR FINAL REPORT

## US 41 and WIS 441

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November 2011

Winnebago, Outagamie, Calumet, and Brown Counties

WisDOT Project I.D. 1130-31-00

**Submitted to:**

Wisconsin Department of Transportation  
Northeast Region  
944 Vanderperren Way  
Green Bay, Wisconsin 54324

**Submitted by:**

HNTB Corporation  
10 West Mifflin Street  
Suite 300  
Madison, Wisconsin 53703

**Contact:**

Jerry K. Shadewald  
608-294-5009  
jshadewald@hntb.com



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# INTRODUCTION

## Study Location

This report describes the short term improvements developed for selected interchanges along the US Highway 41 (US 41) and Wisconsin State Highway 441 (WIS 441) corridors. The subject interchanges are managed by the Wisconsin Department of Transportation's Northeast Region. The study area included Winnebago, Outagamie, Brown, and Calumet Counties. The interchanges for which short term improvements were developed impact the following communities listed below and seen on Exhibit 1:

### Winnebago County

- City of Appleton
- City of Menasha
- City of Neenah
- Town of Clayton
- Town of Menasha

### Brown County

- Town of Lawrence
- Town of Wrightstown
- Village of Wrightstown

### Calumet County

- City of Appleton
- Town of Harrison

### Outagamie County

- City of Appleton
- City of Kaukauna
- Town of Buchanan
- Town of Grand Chute
- Town of Greenville
- Town of Kaukauna
- Town of Vandenbroek
- Town of Wrightstown
- Village of Kimberly
- Village of Little Chute
- Village of Wrightstown

## Study Purpose

The purpose of this study is to:

- Analyze how traffic moves through the study area. Collect traffic movement volumes and review signal timings. This information was used to develop design alternatives to improve traffic operations.
- Determine where crashes are prevalent. Analyze crash histories at all ramp terminals, interchanges, and roadway geometric features. This information was then used to prioritize the problematic crash areas and create design alternatives to improve safety for motorists.
- Define geometric deficiencies of existing highway characteristics such as physical conditions, alignment, bridge clearance, structural conditions, and ramp design.
- Evaluate environmental constraints throughout the corridor. A qualitative environmental impact screening can be found in the Operational Needs Assessment Report Appendix A. In this study the environmental screening details interchange specific concerns.

- Determine when demand will exceed capacity. Forecast future traffic volumes and evaluate using HCS, Synchro, Rodel, and Paramics. This information was taken into account to recommend future traffic operations. This is important in fixing key issues before the roadway faces congestion issues.
- Develop roadway solutions to address current and predicted problems. The improvement options and recommendations for short-term improvements have been tested by Paramics traffic simulation software to ensure proper function of the proposed design.

## **Study Interchanges**

US 41 and WIS 441 are primary routes serving the Fox Cities area in northeastern Wisconsin. Both of these facilities are experiencing growing traffic volumes and increasing safety concerns. Within the study area both of these facilities are access-controlled freeways with no at-grade access. Exhibit 1 shows the study area includes eighteen interchanges:

### **US 41 Corridor**

- CTH JJ/WIS 114 (Winneconne Road)
- Oakridge Road/Main Avenue
- CTH II/Winchester Road
- CTH BB/Prospect Avenue
- WIS 125/CTH CA (College Avenue)
- WIS 96/Wisconsin Avenue
- WIS 15/Northland Avenue
- WIS 47/Richmond Street
- CTH E/Ballard Road
- WIS 441 System Interchange
- CTH N/Freedom Road

- STH 55/Delenglade Street
- CTH J/Lawe Street
- CTH U/County Line Road
- CTH S/Freedom Road

### **WIS 441 Corridor**

- CTH KK (Calumet Street)
- CTH CE (College Avenue)
- CTH OO (Northland Avenue)





## FORMULATION OF ALTERNATIVES

### Short Term Improvement Alternatives

The main focus of short term improvements on these selected interchanges is to improve current and forecasted traffic operations and to address any major geometric deficiencies without the need for additional right-of-way or environmental studies. Many of these geometric deficiencies are contributing to safety problems for motorists utilizing the US 41 and WIS 441 corridors. These possible selected alternatives will improve operations and potentially decrease crash occurrences and severity. Design improvements were generally broken into alternatives:

**Alternative 1 (Signalized):** Any improvement that will impact the highway mainline safety or traffic operations.

**Alternative 2 (Signalized):** Any improvement that will impact the safety or traffic operations at the ramps as well as the ramp terminal intersections.

**Alternative 3 (Signalized):** Any improvement that will impact the safety or traffic operations at adjacent intersections on the interchange cross street.

**Alternative 4 (Roundabout):** Roundabout design evaluated for 2020 operational analysis.

**Alternative 5 (Roundabout):** Roundabout design evaluated for 2035 operational analysis.

### Safety Considerations

The influence area for the safety analysis included the ramps, ramp terminal intersections, and the cross road including the intersections adjacent to the interchange. If a geometric deficiency was minor in nature and was not contributing to any safety or other operational problems generally no improvement was planned. For the geometric deficiencies that were contributing to safety issues, a redesign has been developed to correct the issue and increase the safety ratings in the impacted area.

### Geometric Criteria

Table 1 below specifies the approach used to determine a numerical geometric rating for the interchanges studied within the US 41 and WIS 441 corridors. The purpose of the rating is to score existing interchange geometric deficiencies based on a series of criteria developed from technical standards. The eight criteria specified below were deemed to be most representative for interchange functionality. Each interchange is given a roadway score and a bridge score with maximum scores of 10 and 5, respectively, representing no current geometric deficiencies. The procedure used is identical to that found within the Backbone Interchange Needs Improvement Study<sup>1</sup> dated July, 2007.

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<sup>1</sup> WisDOT I.D. No. 1111-11-99

**Table 1 - Deficiency Scoring Sheet**

Criteria	Acceptable (0 pt)	Poor (-1 pt)	Severe (-2 pt)	Score
1. Ramp Design Speed and Horizontal Alignment	✓			0
2. Ramp Merge / Diverge	✓			0
3. Stopping Sight Distance	✓			0
4. Intersection Skew / Intersection Sight Distance	✓			0
5. Access Control	✓			0
<b>Roadway Score (Maximum of 10 Points)</b>				<b>10</b>

1. Bridge Width	✓			0
2. Vertical Clearance	✓			0
3. Lateral Clearance Under Structures	✓			0
<b>Bridge Score (Maximum of 5 Points)</b>				<b>5</b>



## **Traffic Operations**

Traffic operations were analyzed at the ramp terminal intersections, adjacent intersections to each side of the interchange area, and the merge and diverge areas of each interchange. The analysis was performed using peak hour traffic movements based on forecasts from the Northeast Travel Demand Model (NE TDM) for years 2020 & 2035. Synchro and Rodel were used to develop initial concepts with all alternatives then tested in Paramics with a 2020 and 2035 model for both a.m. and p.m. peak hours. The goal was for the system to operate efficiently through 2020 and then evaluate the useful life thereafter. To evaluate this, a Paramics model was tested at years 2023, 2025, 2028, 2030, and 2033 to evaluate when a system would fail.

## **Complete Streets**

The "Complete Streets" State Statute 84.01(35) was approved in June 2009 as Act 28. Trans 75, in effect as of January 1, 2011, is the administrative rule used to further clarify and enforce the statute 84.01(35). The US 41/ WIS 441 Traffic Operation Analysis considered bicycle and pedestrian accommodations. Recommended improvements should incorporate accommodations depending on each specific interchange. Example: When adding a turn lane and moving a curb line, look to add recommended bike and pedestrian accommodations. Always work with the municipality where the interchange is located in for their concurrence and acceptance of maintenance of the accommodation.

### **Complete Streets (Trans 75) Application**

The following roadway work has conditions that must be met:

- Resurface or recondition
  - Must adhere to FHWA policy on pedestrian bicycle accommodations
  - Retaining structural integrity or maintaining existing pavement structure (<4" = functional overlay)
  - Incorporate Trans 75 to the extent possible
- Pavement replacement, reconstruction, or new construction
  - Must incorporate Trans 75 unless a specific exception is made
  - If any of the following:
    - Moving curb lines
    - Purchasing right-of-way
    - Removing or replacing the pavement structural integrity (>4" = structural overlay)

## INTERCHANGE REPORTS

For each interchange studied, a set of reports has been developed to compile the information evaluated to help develop alternatives. Below are the respective documents in each interchange report.

### Green Sheet

The green sheet is a summary of the basic information for each interchange. It includes:

- 2008, 2020 and 2035 vehicle queue lengths
- 2008, 2020 and 2035 no-build levels of service
- Summary of the crash rates (2002-2006)
- Description of improvements in each alternative
- Levels of service per design alternative
- Predicted vehicle queue lengths for the 2020 and 2035 design alternatives
- Summary of the crash benefits
- Alternative cost summary
- Preliminary environmental screening of interchange area
- Roadway and deficiency ratings of existing condition
- Detailed crash types

### Interchange Summary

The interchange summary encompasses all of the information that is relative to the deficiencies as well as the proposed short term improvements. All of the alternatives are described in detail and explanations are given for how the proposed designs address the current issue(s) at that specific location. A short comparison of the alternatives is also given to help make informed decisions on how to allocate resources to the different individual projects within the interchange area. There is a section on possible environmental factors and cost contained in this part of the report.

### Interchange Traffic Operations Summary

The interchange traffic operations summary exhibit shows a general overview of where the traffic operations issues are predicted at 2020 and predicted at 2035. These exhibits show the recommended turn lane additions as well as lane additions that will be required to keep traffic flowing safely and with a reasonable level of service (LOS). This information supported the alternative to improve traffic operations.

### **Preliminary Cost Estimate Analysis**

A cost estimate was calculated for short term improvement alternatives. These cost estimate sheets break down each alternative by item, description, and subtotal. A summary sheet is given showing each respective alternative's estimate.

In the analysis, the cost is broken down by roadway, structure, construction, right-of-way, and construction management cost. An incremental total is listed for each alternative and an accumulated total of the alternative as well as any other improvements from other alternatives (i.e. Alternative 2 has alternative 1 improvements incorporated in its design. If the cost of alternative 1 is \$500,000 and the additional cost of alternative 2 is \$1,000,000, with the cumulative cost of \$1,500,000.)

In the green sheets, costs shown are by alternative while showing structure and right-of-way costs. Listed is the cumulative cost to show what each respective alternative would cost if selected.

### **Crash Benefit Analysis**

A crash benefit was analyzed for each design alternative. These crash benefit sheets show the predicted reduction in crashes with the addition of the proposed short term improvements. The reduction data was taken from the information compiled for the WisDOT Backbone Study. The outputs are a predicted reduction in the number of crashes based on previous studies and data.

### **Geometric and Safety Deficiency Map**

For each interchange a geometric and safety deficiency map was created. The map identifies geometric and structural deficiencies within the interchange area as well as the areas with numbers of high crashes or high crash severity rates. The existing roadways as well as existing right of way lines are shown on these exhibits as well.

### **Design Alternative Sheets**

The design alternative sheets are the visual exhibit showing the locations and details of short term improvements proposed at any given interchange. Most of the interchanges contain three signalized design alternatives; however, some of the interchanges have only one or two signalized options. All interchanges have roundabout designs for 2020 and/ or 2035. The proposed line work on these exhibits is strictly for representational purposes and is not to be used in any construction documents. The improvements are also briefly described on these exhibits but are more formally described in the interchange report.



















## SUMMARY OF POSSIBLE INTERCHANGE SELECTIONS

The following interchanges have been evaluated based on existing safety and operational needs. Short-term improvement alternatives were developed and evaluated based on their cost effectiveness in improving the existing deficiencies identified in the Operational Needs Assessment Preliminary Report dated August 2008. A summary of the possible alternatives is presented in Table 2. Exhibit 2 is the implementation map depicting the interchange by interchange proposed year of implementation, useful life, and cost estimate.

Following Table 2 are the detailed interchange reports. Each section provides a green sheet, an interchange report, interchange traffic operations summary, preliminary cost estimate analysis, crash benefit analysis, geometric and safety deficiency map, and the design alternative sheets.

The designs and alternatives proposed are conceptual and should not be considered final. WisDOT will continue to monitor and evaluate the corridor in the future.

Table 2 - Interchange Alternatives

Interchange	Deficiencies <sup>2</sup>	Proposed Alternative	Cost Estimate	Suggested Year of Implementation	Useful Life	Notes
US 41 & STH 114 / Winneconne Ave	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>2020 RAB improvements at NB and SB ramps</li> <li>Tie into existing RAB @ Green Bay Rd</li> </ul>	\$3,386,000	2015 - 2017	2035+	<ul style="list-style-type: none"> <li>Green Bay Rd has an existing RAB</li> <li>There is currently committed work to realign the NB ramp intersection</li> <li>Operates acceptably beyond 2035</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & Oakridge Rd / Main St	Geometry 	Alternative 1 <ul style="list-style-type: none"> <li>Increase NB off ramp right turn bay storage length</li> <li>Increase SB off ramp left turn bay storage length as well as reconstruct the horizontal curves</li> </ul>	\$157,000	2015 - 2017	2035+	<ul style="list-style-type: none"> <li>No on ramp access at this interchange</li> <li>Without any further improvements, the ramps will have LOS A through 2035</li> <li>Operates acceptably beyond 2035</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & CTH II / Winchester Rd	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>Add second SBL at SB ramp terminal</li> <li>Add continuous WBR from Green Bay Rd to NB ramp; second on ramp lane</li> <li>Lane additions and extensions at Green Bay Rd</li> </ul>	\$514,000 + \$139,000 (Local Share)	2015 - 2017	2035 +	<ul style="list-style-type: none"> <li>A committed auxiliary lane from CTH II to US 10 system interchange is currently under construction</li> <li>Alternative 2 would address local roadway operations at an additional local cost of \$139,000</li> <li>Access issues remain with Alternative 2</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & CTH BB / Prospect Ave	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>Extend NB and SB merge lengths to 1200'</li> <li>Add EB and WB look ahead left turn for both ramps</li> <li>Coordinate with local municipalities concerning American Dr and Northern Rd</li> </ul>	\$486,000 + Local Share	2015 - 2017	2028	<ul style="list-style-type: none"> <li>NB ramp terminal is offset</li> <li>"Band aid" option that alleviates strain in the short term but issues remain at NB ramp terminal and American Dr</li> <li>Heavy traffic flow on mainline causes issues with NB merge</li> <li>Local improvements at American Dr and Northern Rd are required prior to 2028<sup>3</sup></li> </ul>
	Access 					
	Safety 					
	Operations 					

 = Good     = Fair     = Poor

<sup>2</sup> Deficiencies are of existing conditions.

















<sup>3</sup> Local improvements for American Dr and Northern Rd are necessary but not listed as part of this alternative. American Dr and Northern Rd will affect the ramp terminals.

Interchange	Deficiencies <sup>2</sup>	Proposed Alternative	Cost Estimate	Suggested Year of Implementation	Useful Life	Notes
US 41 & WIS 125 / CTH CA <sup>4</sup>	Geometry ●	Alternative 1 <ul style="list-style-type: none"> <li>Auxiliary lanes SB and NB to and from WIS 96</li> <li>Multiple improvements to both the SB and NB ramp terminals</li> </ul>	\$2,470,000	2011	2020	<ul style="list-style-type: none"> <li>Project ID is 1130-35-71</li> <li>Backbone interchange that needs to be tied to WIS 96</li> <li>Improves ramps short term but does not address adjacent intersections</li> <li>Access/ spacing issues remain at Nicolet Rd/ Mall Dr</li> </ul>
	Access ●					
	Safety ●					
	Operations ●					
US 41 & WIS 96 / Wisconsin Ave <sup>4</sup>	Geometry ●	Alternative 1 <ul style="list-style-type: none"> <li>Auxiliary lanes SB and NB to and from WIS 125</li> <li>Improve traffic signal phasing at SB and NB ramps</li> </ul>	\$2,100,000	2011	2025	<ul style="list-style-type: none"> <li>Project ID is 1130-35-71</li> <li>Backbone interchange that needs to be tied to WIS 125</li> <li>Improves ramps short term but does not address adjacent intersection issues: NBL @ Westhill Blvd and SBL @ Greenville Dr</li> </ul>
	Access ●					
	Safety ●					
	Operations ●					
US 41 & STH 15 / Northland Ave	Geometry ●	Alternative 1 <ul style="list-style-type: none"> <li>Lane modifications to NB and SB off ramps</li> <li>Extend NB merge to 1000'</li> </ul>	\$302,000	2012 - 2014	2025	<ul style="list-style-type: none"> <li>"Band aid" option that addresses 2020 operational ramp issues and alleviates SB ramp crash issue</li> <li>More significant improvements are necessary at this interchange but should be reviewed with the NW quadrant of Appleton and US 41 capacity needs in mind</li> </ul>
	Access ●					
	Safety ●					
	Operations ●					
US 41 & WIS 47 / Richmond St <sup>4</sup>	Geometry ●	Alternative 2 <ul style="list-style-type: none"> <li>Extend NB and SB diverge and merge lanes</li> <li>Bridge raised, redeck and expanded 6'</li> </ul>	\$7,900,000	2013	2033	<ul style="list-style-type: none"> <li>Project ID is 1130-33-00</li> <li>Does not provide room under bridges for 6 lanes on US 41 to outside (mainline US 41 lanes could currently be added inside if deemed necessary)</li> </ul>
	Access ●					
	Safety ●					
	Operations ●					
US 41 & CTH E / Ballard Rd	Geometry ●	Alternative 2 <ul style="list-style-type: none"> <li>Extend NB diverge lane and SB merge lane</li> <li>Additional turn lanes at NB and SB ramps</li> <li>Look ahead left at each ramp terminal</li> </ul>	\$661,000	2012 - 2014	2025	<ul style="list-style-type: none"> <li>Constructed auxiliary lanes between CTH E and WIS 441 and NB right turn lane at Evergreen Dr</li> <li>Improvements greatly improve the NB diverge</li> <li>Both ramps continue to have operational issues (LOS D or worse)</li> </ul>
	Access ●					
	Safety ●					
	Operations ●					

● = Good    ● = Fair    ● = Poor

















<sup>4</sup> WIS 125, WIS 96, and WIS 47 interchange information per 2007 Earth Tech report via WisDOT



Interchange	Deficiencies <sup>2</sup>	Proposed Alternative	Cost Estimate	Suggested Year of Implementation	Useful Life	Notes
US 41 & WIS 441 System Interchange	Geometry 	No alternative necessary	N/A	N/A		<ul style="list-style-type: none"> <li>Substandard curves are very close to current standards</li> <li>No short term benefit anticipated for cost</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & CTH N / Freedom Rd	Geometry 	Alternative 1 <ul style="list-style-type: none"> <li>Extend NB and SB merge</li> </ul>	\$658,000	2012 - 2014	2035 +	<ul style="list-style-type: none"> <li>Access control issues remain at adjacent intersections</li> <li>No major crash or operational issues other than the on ramps that are addressed in alternative 1</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & STH 55 / Delanglade St <sup>5</sup>		RAB Alternative <ul style="list-style-type: none"> <li>RAB at both ramps and Maloney Rd</li> </ul>	\$5,900,000 (Cost includes entire reconstruction)	2014	2035 +	<ul style="list-style-type: none"> <li>Per Chuck Karow: We're in the negotiating phase with a consultant on the project for a tentative construction year 2014.</li> <li>Project ID is 4650-08-71</li> </ul>
US 41 & CTH J / Lawe St		RAB already implemented	N/A		2035 +	
US 41 & CTH U / County Line Rd	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>Weigh in Motion south of interchange at existing weigh station</li> </ul>	\$286,000 + Operating Cost	2018 - 2020	2035 +	<ul style="list-style-type: none"> <li>Cost includes initial cost and maintenance for over 12 year cycle but does not include operating cost</li> <li>No major crash or operational issues other than the possible weaving issue with trucks entering the highway after the weigh station</li> </ul>
	Access 					
	Safety 					
	Operations 					
US 41 & CTH S / Freedom Rd	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>Lengthen right turn bay storage for NB and SB ramps</li> <li>Signalize both ramp terminals when warranted</li> </ul>	\$665,000	After 2025	2035 +	<ul style="list-style-type: none"> <li>Ramp terminals may warrant traffic signals by 2035</li> <li>Access control issues remain at adjacent intersections</li> </ul>
	Access 					
	Safety 					
	Operations 					

 = Good    
  = Fair    
  = Poor

<sup>5</sup> STH 55 interchange information per OMNNI Associates and Chuck Karow, WisDOT

Interchange	Deficiencies <sup>2</sup>	Proposed Alternative	Cost Estimate	Suggested Year of Implementation	Useful Life	Notes
WIS 441 & CTH KK / Calumet St <sup>6</sup>	N/A	Committed HSIP project <ul style="list-style-type: none"> <li>Extend NB and SB merge</li> <li>Additional NB ramp terminal left and right turn lanes</li> </ul>	\$1,200,000	2013	2023	<ul style="list-style-type: none"> <li>Project ID is 4685-12-71</li> </ul>
WIS 441 & CTH CE / College Ave Phase 1	Geometry 	Alternative 1 <ul style="list-style-type: none"> <li>Extend NB and SB merge</li> <li>Multiple additions and extensions at both ramp terminals</li> </ul>	\$1,071,000	2012 - 2014	2025	<ul style="list-style-type: none"> <li>NB ramp terminal addition in 2012 (Project ID 4685-26-71) should be evaluated with respect to the selected alternative as there may be repetitive improvements</li> <li>Operational issues persist but there is improvement</li> <li>Crash benefit per improvements is significant</li> </ul>
	Access 					
	Safety 					
	Operations 					
WIS 441 & CTH CE / College Ave Phase 2	Geometry 	Alternative 2 <ul style="list-style-type: none"> <li>Additional turn lanes added at SB on and off ramp</li> <li>Realign roadway WB from Eisenhower Dr to NB ramp due to additional LT in each direction at ramp terminals</li> </ul>	\$1,487,000	2021 - 2023	2035 +	<ul style="list-style-type: none"> <li>SB ramp queue length reduces from 1277' to 265' in PM</li> <li>Bridge to stay intact but soil nailed wall is required for lane additions</li> </ul>
	Access 					
	Safety 					
	Operations 					
WIS 441 & CTH OO / Northland Ave Phase 1	Geometry 	Alternative 1 <ul style="list-style-type: none"> <li>Extend SB merge to 800' and additional SB ramp improvements</li> <li>Add right turn lane at NB and SB ramp terminals</li> </ul>	\$568,000	2012 - 2014	2020	<ul style="list-style-type: none"> <li>French Rd intersection starves the ramps therefore future improvements to French Rd are necessary</li> </ul>
	Access 					
	Safety 					
	Operations 					
WIS 441 & CTH OO / Northland Ave Phase 2	Geometry 	Alternative 3 <ul style="list-style-type: none"> <li>Move French Rd access 800' to the east</li> <li>SB on ramp, off ramp and ramp terminal improvements</li> </ul>	\$3,845,000	2018 - 2020	2035+	<ul style="list-style-type: none"> <li>Built after useful life of interchange improvements fail for phase 1</li> </ul>
	Access 					
	Safety 					
	Operations 					

 = Good    
 = Fair    
 = Poor

<sup>6</sup> CTH KK will be studied separately including multiple intersections throughout the southeast quadrant of the WIS 441 and CTH KK corridor therefore CTH KK was not evaluated farther here



Exhibit 2 - Implementation Schedule Map

