

### **Part III – Strategies and Recommendations/Access Management Plan**

This part of the report provides short and long term strategies and recommendations for the US 14 corridor within the study area. The discussion is organized according to the following areas:

- Mainline improvement strategies
- Intersection-related strategies
- Long-term access management plan
- Other strategies for consideration (outside corridor preservation scope)

The focus of this portion of the report is to identify strategies and recommendations that, if implemented, would extend the useful life of the existing facility for as long as possible. In addition, the strategies are complementary: implementation of one does not preclude the implementation of the others, and once ultimately implemented would function as an integrated system.

The traffic analysis and forecasts reveal that portions of the corridor currently or are anticipated to exceed thresholds for capacity expansion between now and 2038. The strategies and recommendations were conceived with the assumption that capacity expansion or bypass options would not be implemented prior to 2038 due to competition with higher priority projects or funding limitations. The focus of this portion of the report is thus on corridor preservation.

At the time this report was completed, other agencies and groups were also focused on the future vision for the US 14 corridor. The tasks of these groups included identifying bypass corridors, enhancing transit to the outlying communities, and researching multi-modal considerations, among others.

Bypass corridors and capacity expansion are outside the scope of this study. At the time this study was initiated, WisDOT was not granted authority by the Wisconsin state legislature to study these types of improvements. Regardless of any possible enabling legislation, it is anticipated that even if WisDOT was tasked to consider a bypass or capacity expansion project for US 14, the effort would take several years to study, follow the necessary NEPA requirements, coordinate with other agencies, conduct preliminary and final design, acquire real estate, mitigate effects, and construct. It is likely that traffic volumes would reach problematic levels before such an undertaking could be completed, validating the need for this study and its strategies for preserving the long-term function of the existing corridor.

A separate sub-study was completed as part of this study with the objective of evaluating sites for a multimodal transit center in Middleton that would include a park-and-ride facility, bus transfer point, and commuter rail station. Bike and pedestrian connectivity and circulation would also be important elements for the facility. The findings of the sub-study were recorded in *Middleton Transit Center Site Options Report*, which can be found in appendix G, *Compiled Data*.

Though not specifically identified in this section of the report, it is assumed that multi-modal and transit considerations would be evaluated prior to implementation of any concept as part of WisDOT's ongoing efforts to reduce vehicle use where another mode

can be provided. Due to the unique characteristics of the corridor and the large number of constraints immediately adjacent to the existing right of way (i.e., Black Earth Creek, the freight rail corridor, conservation and recreation lands, etc.), the construction of a multi-use trail located adjacent to US 14 is likely to have the same implementation challenges as a capacity expansion project. The study supports providing direct connectivity between the communities and interconnectivity between existing trail systems whenever possible, but leaves the details of these efforts to the communities and other groups that have secured funding to take on these challenges.

## **I. Improvement Strategies**

### **1.0 US 14 Mainline**

The vast majority of the existing corridor is recommended to be maintained as a two-lane facility. Improvements are recommended only where the function and safety of the roadway are currently deficient or projected to decline in the near future. Recommended mainline improvements include new or extended medians, new protected left-turn lanes, and realignment strategies to improve curves. Protected left-turn lanes with medians are recommended at several unsignalized intersections, and are detailed in the next section.

Between the villages of Mazomanie and Black Earth, three strategies were developed to address safety issues. Each strategy is a package of detailed access recommendations at locations along this stretch of US 14. Strategy A maintains US 14 on its existing route and is considered the “no-build” option. Strategies B and C, illustrated in exhibit 14 on the following page, propose realignment of US 14 to improve safety and operations in relation to the existing curves, improve safety for bus and school traffic at existing school entrances, and provide greater separation between US 14 and the existing railroad and Black Earth Creek. Under strategies B and C, a segment of the current US 14 corridor would be converted to a local road, providing access to private properties in place. Strategy B proposes to eliminate the deficient curves near Wisconsin Heights High School and the intersection at WIS 78 and provide safer access to the high school via a redesigned intersection at Miller Farm Road. Strategy C proposes to use more of the existing alignment than strategy B but still improves the existing curves considerably and provides safer access to the high school.

One curve located at the Sunnyside Seed Farm, between Cleveland and Twin Valley roads, is recommended for improvement. It is proposed that the roadway be shifted slightly north, reducing the severity of the curve and improving sightlines at this location.

The Middleton area is the only part of the corridor that currently has a median dividing the lanes of travel. The existing median extends from just west of Pleasant View Road to the US 12 ramps. Extending the median to just west of Wayside Road is recommended in order to improve safety at Wayside Road, Schwartz Road, Capitol Court, and Pinehurst Drive.

# Strategy B



# Strategy C

## **2.0 Intersections**

The US 14 corridor within the study boundaries contains seven signalized and 39 unsignalized intersections in both rural and urban settings. The existing and anticipated safety and operations conditions vary greatly depending on the context of the intersection. For purposes of analysis, signalized and unsignalized intersections were evaluated separately using Synchro SimTraffic software and a review of crash data. *Conceptual-level strategies were developed for the intersections to address deficiencies and to enhance operations. Further design would be needed prior to implementation.* If an intersection is not listed in the following sections, it currently operates adequately and is anticipated to operate adequately into the future. Tables 44 and 45 detail the levels of service (LOS), delay, and queue lengths for intersections in Cross Plains under existing conditions and with improvement alternatives.

### ***Signalized Intersections***

#### **WIS 78 (east)/Mills Street**

US 14 intersects WIS 78 (east)/Mills Street in the village of Black Earth, an urbanized segment of the highway. The intersection has a protected left-turn lane for westbound US 14 traffic turning south onto WIS 78. The protected left-turn lane is developed with a painted chevron that guides westbound through traffic to the outside. The approaches from northbound WIS 78 and eastbound US 14 each have two lanes, one for each movement.

Based on traffic analysis, the intersection currently functions well. However, two nearby driveways on US 14 — at the nursing home on the north side of US 14 and the parking lot in the southeast quadrant — are located within the intersection’s functional area and may negatively affect intersection operations and safety. Access to these properties should be redirected to nearby local roads. Village of Black Earth officials were receptive to providing internal circulation among properties on the north side of US 14, with access routed to local streets. If future development patterns intensify or change, the intersection should be reanalyzed.

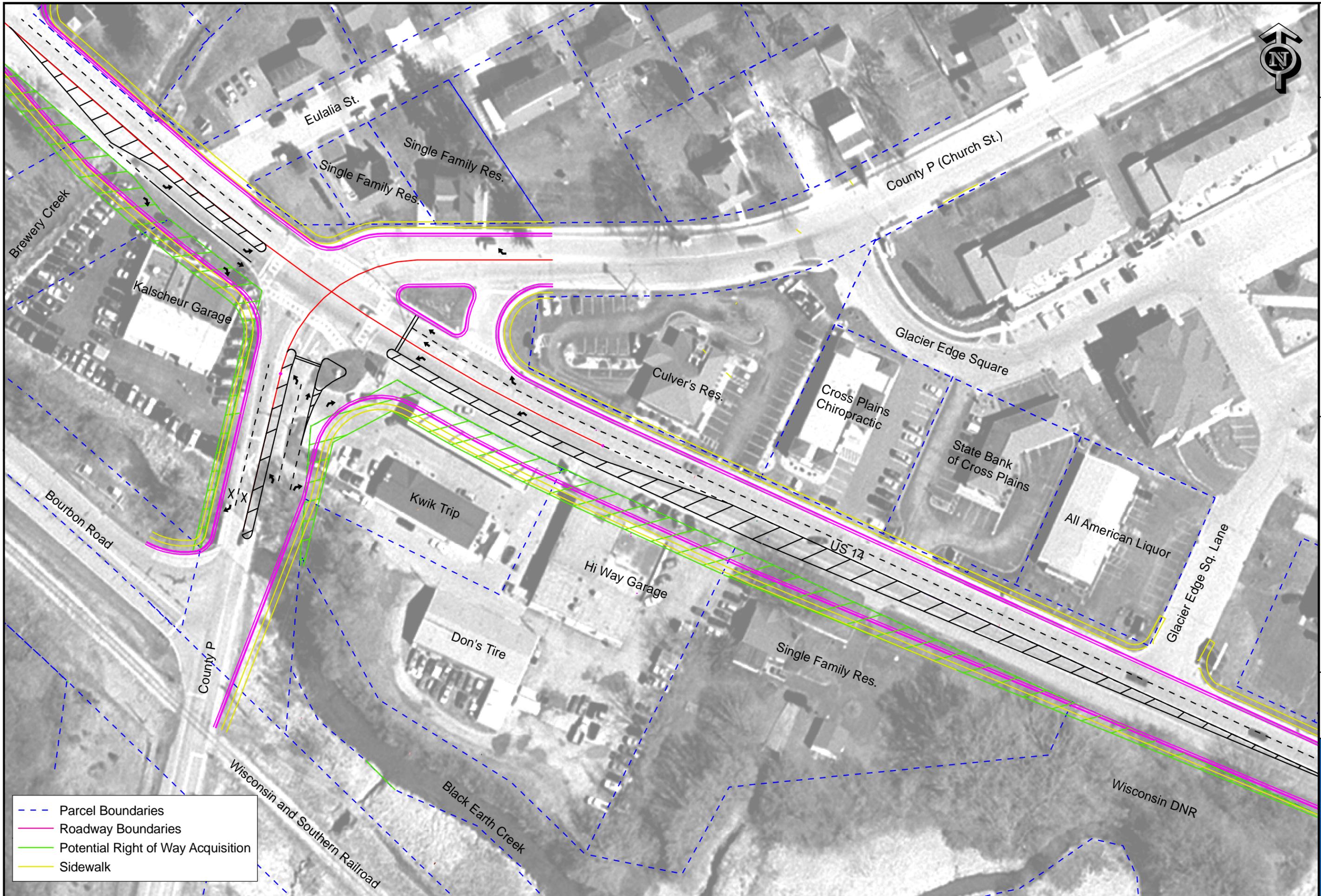
#### **County P**

County P is an important north–south major collector within the village of Cross Plains connecting residential areas and schools to US 14. In its greater regional context, County P connects US 18/151 just east of Mount Horeb to US 12 acting as a bypass of west Madison.

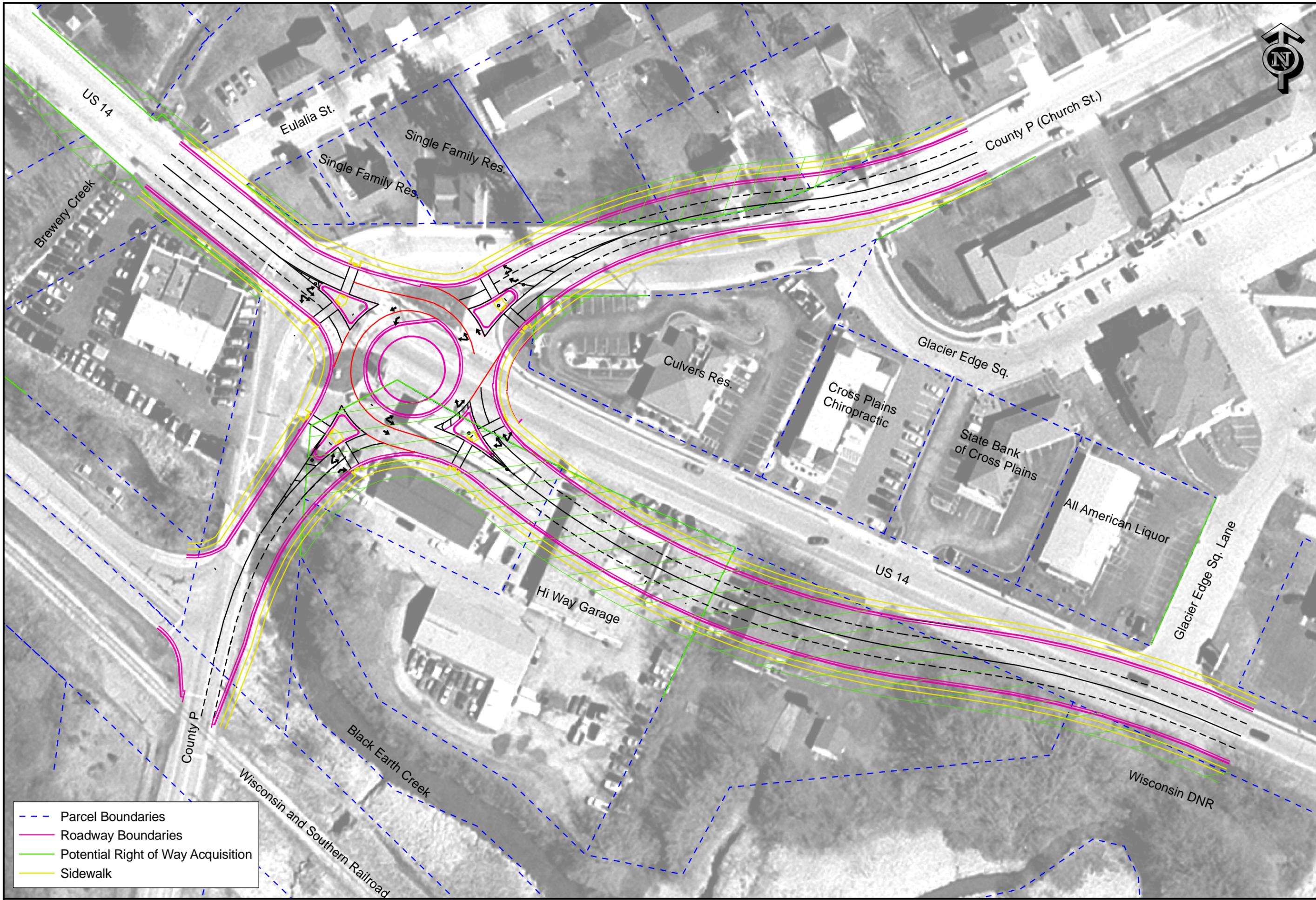
Because of its location in the center of the US 14 study area corridor, the operation and capacity of this intersection is important to maintaining regional mobility. Due to the many commercial properties surrounding it, the confluence of a US highway and a county highway, and the non-standard angle of approach on County P, this intersection experiences hazards, delays, and queues even during non-peak times.

Strategies identified for the intersection include a complete overhaul of the intersection to improve its capacity and operation. Two concepts were ultimately brought forward including an expanded signalized intersection and a roundabout as shown in exhibits 15 and 16. Both alternatives add additional lanes to the

intersection approaches and assume four lanes on US 14. Private driveways surrounding the intersection were not shown in detail on the exhibits and would need to be further evaluated for each concept. Pedestrian and bicycle accommodations would be provided if the intersection is reconstructed.



- - - Parcel Boundaries
- Roadway Boundaries
- Potential Right of Way Acquisition
- Sidewalk



- Parcel Boundaries
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Concept 1, shown in exhibit 15, is an expanded signalized intersection. With the added lanes, there would be three approach lanes from each direction: a left turn lane, through lane, and through/right lane for eastbound and westbound US 14 traffic, and left-turn, through, and right-turn-only lanes for northbound and southbound County P traffic. As shown in tables 44 and 45, the resulting levels of service for the intersection would be LOS C or better for morning and afternoon peak hours through the year 2038.

Concept 2, the roundabout, would have two approach lanes from each direction (see exhibit 15). Implementation of both concepts would require additional right of way and access modifications in the immediate vicinity of the intersection. Additional issues include the long-term viability of land use in the southeast quadrant of the intersection, the proximity of Black Earth Creek and stormwater issues, and Dane County plans for the County P crossing of Black Earth Creek. Queues vary slightly between concepts but would be significantly reduced in either case, while safety would be improved over existing conditions.

Signalized intersections and roundabouts each have advantages and drawbacks. However, roundabouts appear to offer wide-ranging safety and operational benefits over many signalized intersection configurations. Recent research indicates that replacing signalized intersections with roundabouts can have profound safety benefits. In one study of 23 intersections, installing roundabouts provided a 90 percent reduction in fatal crashes, an 80 percent reduction in injury crashes, and a 40 percent reduction in all crash types.<sup>1</sup> Although conversions to roundabouts seem to have benefits for all location types, safety improvements appear to be most pronounced for rural intersections. Compared to signalized intersections, roundabouts typically:

- Cost more to install when retrofitting
- Cost about the same when building new
- Require more right of way
- Are not common in the United States, and could necessitate public education
- Experience fewer crashes, injury crashes, and fatal crashes
- Experience fewer pedestrian and bicycle crashes
- Result in reduced average delays and queuing
- Have lower maintenance costs
- Reduce fuel consumption
- Reduce pollution
- Can be more aesthetically pleasing (due to additional landscaping opportunities and reduced utility poles and signage)<sup>2</sup>

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<sup>1</sup> Persaud, B N, et al. 2001. "Safety Effect of Roundabout Conversions in the United States: Empirical Bayes Observational Before-After Study," *Journal of the Transportation Research Board*, vol. 1751.

<sup>2</sup> Federal Highway Administration. 2000. *Roundabouts: an informational guide*. Report no. RD-00-067. Washington, DC: US Department of Transportation.

Furthermore, a roundabout at County P (Concept 2) would provide improved local access and circulation over a signalized intersection because the roundabout could be used to allow changing direction to access driveways on both sides of US 14 as right-in/right-out, even though queuing could potentially be slightly longer than with a signal. In both concepts, treatments at Brewery Road, such as the possibility of a signal, would need to be considered so that both intersections would function as a system.

Table 44 Intersections in Cross Plains: Weekday AM peak-hour level of service, average delay, and queue lengths

Intersection	Baseline 2008			Baseline 2018			Baseline 2028			Baseline 2038			Concept 1 <sup>3</sup> - 2038			Concept 2 <sup>4</sup> - 2038		
	LOS <sup>5</sup>	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue
Market St.	A	8 sec	300 ft	B	15 sec	746 ft	C	29 sec	1092 ft	D	51 sec	1876 ft	B	11 sec	256 ft	B	11 sec	256 ft
CTH P	D	40 sec	759 ft	F	108 sec	1417 ft	F	214 sec	2040 ft	F	337 sec	2314 ft	C	28 sec	452 ft	D	52 sec	1602 ft
Brewery Rd. <sup>6</sup>	F	67 sec	125 ft	F	283 sec	325 ft	F	757 sec	625 ft	F	1475 sec	925 ft	F	1475 sec	925 ft	F	1475 sec	925 ft
Brewery Rd. Signalized <sup>7</sup>													B	13 sec	236 ft	B	13 sec	236 ft

Table 45 Intersections in Cross Plains: Weekday PM peak-hour level of service, average delay, and queue lengths

Intersection	Baseline 2008			Baseline 2018			Baseline 2028			Baseline 2038			Concept 1 - 2038			Concept 2 - 2038		
	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue
Market St.	A	8 sec	241 ft	B	11 sec	420 ft	B	16 sec	632 ft	C	23 sec	960 ft	A	9 sec	179 ft	A	9 sec	179 ft
CTH P	B	19 sec	430 ft	C	29 sec	632 ft	E	62 sec	959 ft	F	102 sec	1138 ft	C	25 sec	306 ft	C	63 sec	372 ft
Brewery Rd.	D	30 sec	25 ft	F	51 sec	75 ft	F	120 sec	150 ft	F	312 sec	250 ft	F	312 sec	250 ft	F	312 sec	250 ft
Brewery Rd. Signalized													A	7 sec	140 ft	A	7 sec	140 ft

<sup>3</sup> Concept 1: keeping the County P intersection signalized, adding lanes so that there are three approach lanes in each direction.

<sup>4</sup> Concept 2: making the County P intersection a 2-lane roundabout.

<sup>5</sup> LOS: Level of Service. For signalized intersections, overall intersection LOS is displayed. A<or = 10 sec, F>80 sec delays.

<sup>6</sup> Unsignalized Intersection – only southbound left movement (worst movement) for Brewery Road. is displayed. Eastbound thru and Westbound thru and right movements are free flow. Eastbound left is LOS A-B. Southbound right is LOS A or B in the AM and C in the PM.

<sup>7</sup> Signalized Brewery Road results also include adding lanes to make 2 thru lanes for eastbound and westbound traffic.

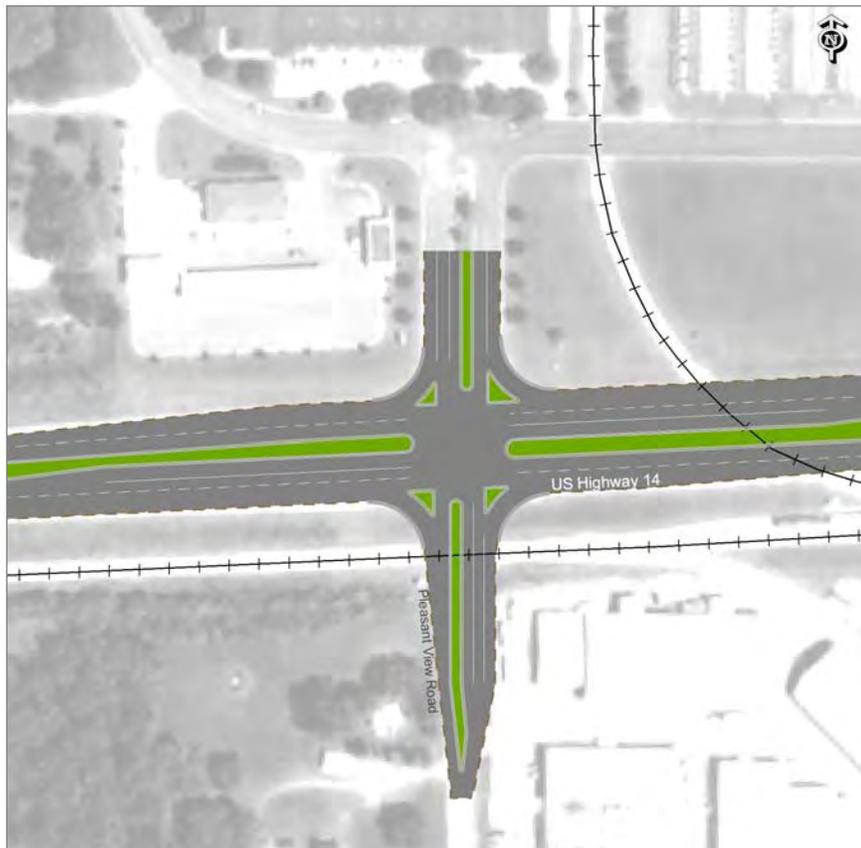
### Pleasant View Road

According to the Madison Metropolitan Area *Regional Transportation Plan 2030*, Pleasant View Road is classified as a minor arterial south of US 14 and an urban collector north of it. Pleasant View Road serves nearby commercial and industrial land uses, as well as residential uses further south.

Analysis indicates that the intersection's current peak-hour level of service in both the AM and PM is acceptable, at LOS C. However, it is expected to worsen to LOS D in the PM peak hour by 2018 if no improvements are made. Synchro analysis indicated that the addition of dedicated 200-foot northbound right and left-turn lanes, which are minimum improvements, would maintain LOS D in the AM and PM peak hours through 2038.

Figure 16 below shows recommended improvements to the intersection at Pleasant View Road. These improvements reflect the use of WisDOT standards, such as 350-foot minimum turn-lane lengths, and would accommodate anticipated traffic through 2038. Longer-term strategies could include realigning the Pleasant View Road corridor to the west, as is noted in the City of Middleton's *2005 Southwest Quadrant Plan Update*. Because the intersection in its current location would satisfy anticipated traffic, realignment would be beyond the scope of this study. Potential future locations and configurations for Pleasant View Road could be further explored as a separate study.

Figure 16 Recommended improvements at Pleasant View Road



### Deming Way

Deming Way is classified as an urban collector in the *Middleton 2005 Traffic Management Report*. The areas served by Deming Way are currently in mixed commercial use and are expected to intensify, remaining primarily commercial retail and office use, and generating several hundred trips per day. Balancing WisDOT's regional mobility goals with local access needs is a significant challenge for this intersection and the surrounding US 14 corridor.

An independent analysis of the intersection using recent count data collected by TranSmart Technologies in 2009 reveals that this intersection is expected to perform at LOS C or D during the AM peak hour through 2038. During the PM peak hour, however, the level of service is currently LOS E and drops to LOS F by 2018. Current field observations in the PM peak hour reveal that southbound left-turn movements and associated queues are already problematic at the intersection, primarily due to a lack of gaps created by continuous northbound right-turns. In addition, the current left-turn offset on Deming Way makes it difficult for a driver waiting to turn left to see past opposing left-turning vehicles.

Strategies to improve the operations of the intersection include adding a northbound right-turn lane and a second southbound left-turn lane with protected turn arrows by 2018. These improvements are anticipated to maintain the intersection's level of service at LOS D in the AM and PM peak hours through 2038. It is also recommended that the alignment of Deming Way be improved in order to reduce the current offset between opposing left turns on Deming Way. All right-turn lanes at Deming Way should be channelized and lengthened to WisDOT standards. Exhibit 17 shows the area between Deming Way and US 12/14 with recommended improvements.

### US 12/14 Beltline Eastbound Ramps

The US 12/14 corridor is classified as a principal arterial connecting the commercial/office areas on the west side of the city of Middleton to southwest Madison and points east. In its regional context, US 12 connects Interstate 39/90 on the southeast side of the city of Madison to I-90/94 in Wisconsin Dells via the south and southwest side of Madison, Middleton, Sauk City, and Baraboo. US 12 and US 14 share a 9.5-mile corridor on the Beltline highway from Park Street in Madison to University Avenue in Middleton. The US 12/14/University Avenue interchange is the eastern terminus of the study corridor including the eastbound ramps.

The intersection at the eastbound ramps (west side of the Beltline) is currently operating at LOS C in the AM and PM peak hours. However, by 2028, the level of service is anticipated to drop to LOS E in the AM peak hour, primarily due to the heavy US 14 eastbound traffic turning left onto US 12/14 (530 vehicles during the AM peak hour). Adding another eastbound left-turn lane by 2028 is recommended; the eastbound US 12/14 entry ramp should also be widened to two lanes at this time. Dual eastbound left-turn lanes will maintain LOS C in the PM and LOS D in the AM through 2038. A sketch of the improvement is shown in exhibit 17.

**Proposed Improvements at Deming Way**

- Add northbound right turn lane
- Add an additional southbound left turn lane
- Improve alignment as shown to reduce offset between opposing left turns
- Channelize all right turn lanes and lengthen to WisDOT standards



**Proposed Improvements at US 12/14 Eastbound Ramps**

- Add an additional eastbound left-turn lane
- Widen eastbound US 12/14 on ramp to two lanes



Not to Scale

## ***Unsignalized Intersections***

There are numerous intersections with public roads along US 14 located between the villages of Mazomanie and Middleton, many of which are addressed in this section. Most rural intersections are examined, but only a few intersections within the urbanized areas are included here. Intersections that are candidates for signalization are addressed first. This is followed by a discussion of design concerns for other unsignalized public road intersections in the study corridor. Finally, design recommendations for some selected intersections are presented.

### ***Intersections that are candidates for signalization***

Installing traffic signals is one possible solution to provide adequate time to turn onto US 14 from the side road. Because of the effect that signals have on traffic flow along a highway, there are a number of factors that must be evaluated to determine if they are candidates.

The WisDOT FDM Procedure 11-50-50 cites some minimum threshold values to consider in the initial screening of intersections for signal potential. Of the intersections evaluated according to the criteria, only three unsignalized intersections will meet the minimum screening criteria for signals prior to 2038:

- WIS 19/78 (west)
- Brewery Road
- Pinehurst Drive

Meeting the minimum criteria established in the FDM does not automatically approve an intersection for signals. It does, however, identify signals as one possible solution to address low levels of service. A detailed signal warrant analysis would ultimately need to be completed to determine if an intersection is a candidate for a future signal.

### **WIS 19/78 (west)**

WIS 19/78 is classified as a minor arterial in the *Village of Mazomanie Comprehensive Plan*. WIS 78 is a restricted truck route between Mount Horeb and Black Earth, and is a designated long truck route between US 14 and Sauk City. As such, it is a widely used north–south route for truck traffic travelling between US 18/151 (Mount Horeb and points west) and US 12 in Sauk City. The route takes travelers through the village of Black Earth, follows US 14 west for a short distance, then proceeds northward just east of the village of Mazomanie.

This intersection could benefit from signals in the future coupled with a potential reduction of the existing 55 mph posted speed. It meets the minimum screening criteria for signals and is an intersection of two state highways.

In 2008, 108 vehicles were turning left from WIS 78 onto US 14 during the AM peak hour. This number is expected to grow to 146 vehicles by the year 2038. With heavy US 14 eastbound traffic in the AM, these left-turning drivers will have difficulty finding sufficient gaps in traffic to make their maneuver. Table 46 compares intersection LOS with and without signals.

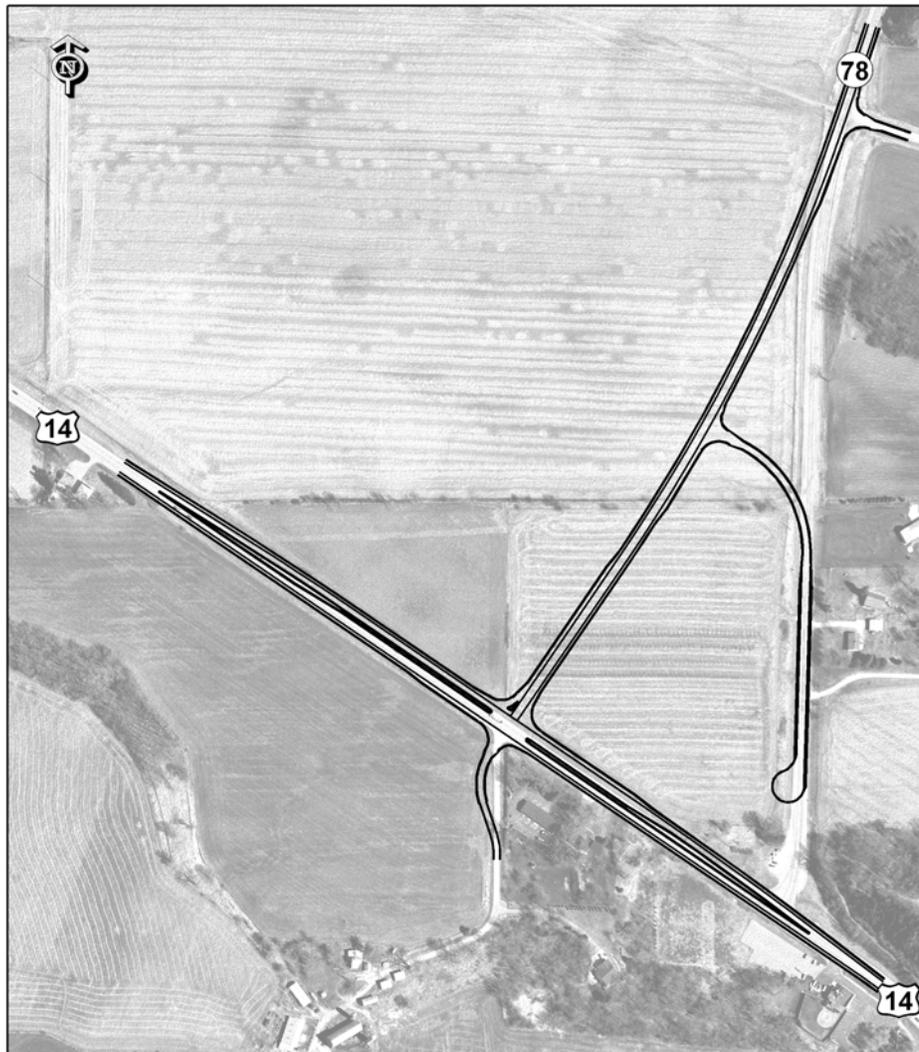
Table 46 WIS 78 intersection LOS, delay, and queue lengths, with and without signals

	2008			2018			2028			2038		
	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue
<b>AM, no signal*</b>	A/D	32 sec	50 ft	A/F	76 sec	125 ft	A/F	214 sec	225 ft	A/F	500 sec	350 ft
<b>AM, with signal#</b>	---	---	---	A	9 sec	318 ft	B	11 sec	592 ft	B	16 sec	844 ft
<b>PM, no signal*</b>	A/C	24 sec	25 ft	A/E	44 sec	75 ft	A/F	98 sec	125 ft	A/F	249 sec	200 ft
<b>PM, with signal+</b>	---	---	---	A	7 sec	217 ft	A	8 sec	322 ft	B	12 sec	597 ft

A/F: overall intersection LOS/worst movement for intersection displayed. \*Worst movement LOS & queue (displayed) is southbound left. #Longest queue (displayed) is for eastbound thru traffic. +Longest queue (displayed) is for westbound thru traffic.

In 2009, the US 14/WIS 78 intersection was reconstructed on a new alignment further west of the previous location. The new alignment improved sight distances at the intersection and revised its approach angle to 90 degrees. As part of the project, a median with channelized left-turn lanes was added on US 14 to remove turning vehicles from mainline traffic on US 14. In addition, driveways near the intersection on the south side of US 14 were relocated, and a cul-de-sac of the old WIS 78 roadway was created to provide access to properties. A new park-and-ride lot was also constructed northwest of the intersection. Figure 17 shows the improvements that were made. Even though the improvements are anticipated to address future traffic needs for some time, recommendations for a future signal are still applicable when safety/operations warrant.

Figure 17 WisDOT improvements at the US 14/WIS 78 intersection in 2009



### Brewery Road

Brewery Road is a local road that provides a short-cut between US 14 and the five-point intersection of County P/Church Street/Military Road to the north. It is used to access the commercial area along the north side of US 14 between Church Street (County P) and Brewery Road. In addition, it serves as a link to residential neighborhoods on the north side of the village.

The US 14/Brewery Road intersection is a T-type intersection located on the north side of US 14 and within the influence of the US 14/County P/Church Street intersection located further west. Proposed improvements at that intersection will likely influence potential improvement scenarios at the US 14/Brewery Road intersection as well. In addition, the County P/Church Street/Brewery Road/Military Road intersection to the north is a five-point intersection near the village hall, residential areas, and a school. It has been identified as a future location for improvements in the village comprehensive plan. This intersection

would also likely need to be considered with proposed improvements at the US 14/Brewery Road intersection.

The US 14/Brewery Road intersection could benefit from signals in the future. It meets the minimum screening criteria for signals and has a high number of southbound vehicles turning left in the AM peak hour (129 in 2008, expected to grow to 336 by 2038). Without traffic signals, these vehicles will have difficulty finding gaps in heavy US 14 eastbound AM peak-hour traffic. An average delay of almost five minutes and a queue of over 300 feet on Brewery Road are expected by 2018.

Pinehurst Drive

Pinehurst Drive is a local street that serves several light industrial and commercial businesses on the north side of US 14. It connects to Pleasant View Road (a north-south connector between US 14 and Airport Road) via Montclair Drive.

Pinehurst Drive has only a small number of vehicles turning left onto US 14 in the AM peak hour (16 in 2008, 22 expected in 2038), but during the PM peak hour there are many more (73 in 2008, 103 expected in 2038). These vehicles will have difficulty finding gaps in heavy westbound US 14 traffic during the PM peak hour. Without signals, these drivers would experience average delays of nearly five minutes by 2028 and nine minutes by 2038. Table 47 compares levels of service with and without signals.

Table 47 Pinehurst Drive intersection LOS, delays, and queue lengths, with and without signals

	2008			2018			2028			2038		
	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue	LOS	Delay	Queue
<b>AM, no signal*</b>	A/E	44 sec	25 ft	A/F	68 sec	25 ft	A/F	112 sec	50 ft	A/F	197 sec	75 ft
<b>AM, with signal#</b>	---	---	---	B	12 sec	864 ft	B	15 sec	1214 ft	C	21 sec	1840 ft
<b>PM, no signal*</b>	A/F	57 sec	75 ft	A/F	124 sec	150 ft	A/F	282 sec	225 ft	A/F	548 sec	300 ft
<b>PM, with signal+</b>	---	---	---	B	13 sec	558 ft	B	15 sec	774 ft	B	18 sec	987 ft

A/F: overall intersection LOS/worst movement for intersection displayed. \*Worst movement LOS & queue (displayed) is southbound left. #Longest queue (displayed) is for eastbound thru traffic. +Longest queue (displayed) is for westbound thru traffic.

Other considerations for the intersection include the proximity of other roads such as Pleasant View Road, Capitol Court, and Schwartz Road in addition to the location of the four- to two-lane taper of US 14. Improvements to other intersections in the vicinity of Pinehurst Drive could influence the appropriate treatment at the intersection. Strategies from a long-term system perspective are addressed in the Access Management Plan (section II).

*Intersections that are not candidates for signalization*

This section reviews the numerous local road intersections that will likely not meet criteria for signals within the study plan horizon of 2038. The majority of these intersections are located along the rural portions of US 14. These intersections were evaluated for both existing and anticipated levels of service, as well as for

existing deficiencies that can be addressed through minor design changes or other enhancements.

### *Design deficiencies at rural intersections*

Several intersections in the corridor do not meet WisDOT design standards. This section is intended to catalogue the design deficiencies of the unsignalized intersections. Deficiencies found include skew angles, curves, pavement cross-slope rollover, gradients, needed turn-lanes and passing lanes, spacing from railroads, and right of way. Each particular design deficiency is described, followed by a list of intersections that suffer from that deficiency. Corrective measures at the intersections could improve intersection safety and operations or delay costly mitigation measures at these locations.

#### Intersection on tangent segments

Intersections located on tangent segments of US 14, or on the outside of a horizontal curve may be a concern if the skew angle is sharper than 75 degrees. Rural public crossroads that do not meet this criteria are (skew angles are approximate): County F (60 degrees), Kahl Road-south (30 degrees), Kahl Road-north (50 degrees), Schultz Road (55 degrees), South Valley Road (65 degrees), Scherbel Road-south (68 degrees), and Cleveland Road (74 degrees).

Intersections located on the inside of a horizontal curve of US 14 may be a concern if the skew angle is sharper than:

- 75 degrees where the radius along US 14 exceeds 6,000 feet.
- 80 degrees where the radius along US 14 is between 4,000 and 6,000 feet.
- 85 degrees where the radius on US 14 is less than 4,000 feet.

The one rural public crossroad which does not meet this criterion is the north leg of Scherbel Road (approximately 73 degree skew at a radius of 5,730 feet).

#### Intersections on horizontal curve

Intersections located on a horizontal curve are undesirable because it is difficult for stopped traffic to correctly judge the speed of approaching vehicles. Areas of concern along the US 14 corridor include: Olson Road (1,432-foot radius on US 14), County F (1,910-foot radius), Scherbel Road (5,730-foot radius), and Westview Court (955-foot radius).

#### Pavement cross-slope rollover

Some intersections have a pavement cross-slope rollover that exceeds the desirable maximum of five percent. This is a concern at (rollovers are approximate): Olson Road (9%), Schultz Road (10%), Scherbel Road-south (13%), and Westview Court (7%).

#### Pavement gradient

Pavement gradient in areas where vehicles are required to stop at intersections should not exceed three percent. Rural public crossroads where pavement gradient is a concern are (gradients are approximate): Olson Road (4%), Schultz Road (8%), Scherbel Road-north (9.9%), Scherbel Road-south (15.4%), and Cleveland Road (9%).

### Right-turn lanes

Right-turn lanes from a mainline onto a crossroad are warranted for intersections where the crossroad has an ADT of at least 100, and may also be advisable for some locations not meeting the 100 ADT criteria. Most intersections along US 14 do not have right-turn lanes. Intersections now lacking a right-turn lane where it may be desirable to add one include:

- eastbound at Olson Road
- eastbound at Kahl Road
- eastbound and westbound at South Valley Road
- westbound at County KP (north) (a westbound right-turn lane would likely require improvement of a nearby bridge over Black Earth Creek)
- westbound at Westview Court
- east and westbound at Stagecoach Road
- westbound at Rocky Dell Road
- eastbound at Cleveland Road

### Spacing between roadway and railroad

The current standard of roadway and railroad spacing of at least 200 feet is not met in all areas where US 14 borders the railroad corridor (see FDM Procedure 17-60-1, page 1). At crossroads, close proximity of a railroad paralleling the roadway results in gradients far steeper than the desirable maximum of three percent wherever the profiles of the railroad and US 14 significantly differ, such as at Scherbel Road and Cleveland Road. In addition, at all crossroads, the spacing between successive at-grade crossings of the railroad and US 14 is undesirably small.

### Skew angle at railroad

The skew angle is undesirably sharp (exceeds 75 degrees) at the following railroad crossings (skew angles are approximate): Olson Road (70 degrees), Kahl Road (30 degrees), South Valley Road (65 degrees), Scherbel Road (68 degrees), and Cleveland Road (74 degrees). The skew angle concern is high at Olson Road and at Kahl Road where the roadway parallels the south side of the tracks from 50 to 60 feet away; it then curves sharply to cross the railroad tracks and intersect US 14.

### Curb and gutter at turning radii

Curb and gutter at turning radii are often desired by the maintaining authority. Most of the major crossroads already have curb and gutter at the turning radii where they intersect with US 14. There are some intersections, however, where it may be desirable to add curb and gutter. These intersections potentially include: Schultz Road, South Valley Road, County KP-north (northeast radius only), Rocky Dell Road-north, Twin Valley Road, Wayside Road-west, and Wayside Road-east.

### Right of way

At almost all of the existing intersections, the right of way is inadequate per current standards for intersection sight distance and vision triangles at US 14, or sight triangles at the railroad. (The summary of the areas enveloped by these three standards is hereafter referred to as “window.”) Two locations that may have adequate right of way for the window include WIS 78 (west), and the north leg of

the US 14/Stagecoach Road intersection. This assessment assumes that the intersections remain stop-controlled, and depend upon the speed of the crossroad. Even though existing right of way may not cover the window at a particular location, where the crossing includes fairly high fill, vegetation may be low enough to not encroach into the sight distance within the window, such as at County F. However, where fill is minimal, or there is cut, vegetation and/or embankments restrict the vision within the window. Also, in some locations, there are other restrictions within the window to block sight, such as buildings or utilities.

#### Passing lanes

A passing lane at a rural crossroad is warranted if the ADT of the crossroad exceeds 1,000 and the intersection has only three legs (T-intersection). All T-intersections having crossroad traffic meeting this warrant already have a bypass lane. However, a passing lane may also be advisable at T-intersection crossroads not meeting the 1,000 ADT criteria. Such locations on US 14 where it may be desirable to add a bypass lane include the westbound direction at Rookie's Restaurant, just east of WIS 78 (west), and the eastbound direction at County KP (north). At County KP, an eastbound passing lane would likely require improvements to a nearby bridge over Black Earth Creek.

#### Medians with a protected left-turn lane

It may be desirable to add raised medians with a protected left-turn lane on US 14 at the following locations:

- Wisconsin Heights High School
- County F
- Westbound US 14 at Kahl Road
- Scherbel Road
- County KP (north)
- Stagecoach Road

At both County F and County KP (north), placing a median on US 14 would require improvements to a nearby bridge over Black Earth Creek. The tight spacing between US 14 and the railroad complicates the potential addition of a median at Kahl Road, Scherbel Road, and Stagecoach Road. At Kahl Road, the sharp skew would probably make it difficult to line up the opposing legs of the crossroad if US 14 was widened to add a median. At Scherbel Road, the steep crossroad profile immediately north and south of US 14 presents an obstacle to the widening of the mainline for a median.

The County KP (north) intersection abuts the west end of a bridge over Black Earth Creek, resulting in an undesirable radius of the existing beam guard. Moving County KP (north) away from the bridge would allow for a standard beam guard transition, and would facilitate the potential intersection improvements that are noted above.

## *Recommended design improvements at selected rural intersections*

### County F

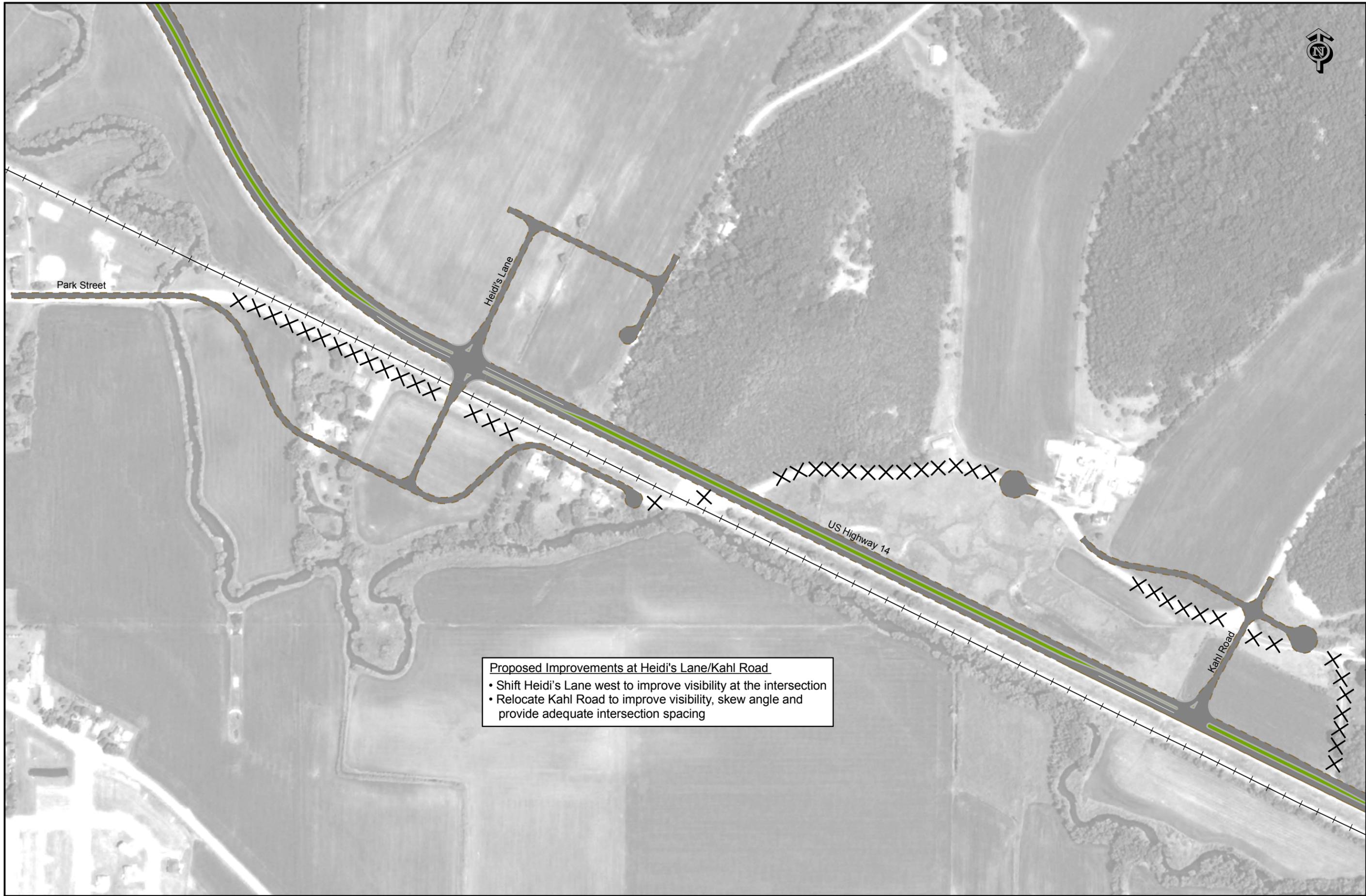
The existing intersection at County F is located on the outer tangent of a curve, and has a skew angle of 60 degrees. The proposed intersection at County F is intended to improve its safety by increasing the skew angle to nearly 90 degrees, and adding a protected left-turn lane and a channelized right-turn lane. Figure 18 shows proposed improvements at the US 14/County F intersection.

Figure 18 Proposed intersection improvements at County F



### Heidi's Lane/Kahl Road/Schultz Road

The existing intersections at Heidi's Lane, Kahl Road, and Schultz Road have numerous design deficiencies — such as acute skew angles, steep gradients, and insufficient spacing — that pose safety and operational challenges. Two new intersections having improved approaches and sightlines are recommended to replace them. Exhibit 18, on the following page, shows how these new intersections would provide more direct and safer connections to Kahl Road and nearby properties.



**Proposed Improvements at Heidi's Lane/Kahl Road**

- Shift Heidi's Lane west to improve visibility at the intersection
- Relocate Kahl Road to improve visibility, skew angle and provide adequate intersection spacing

### South Valley Road

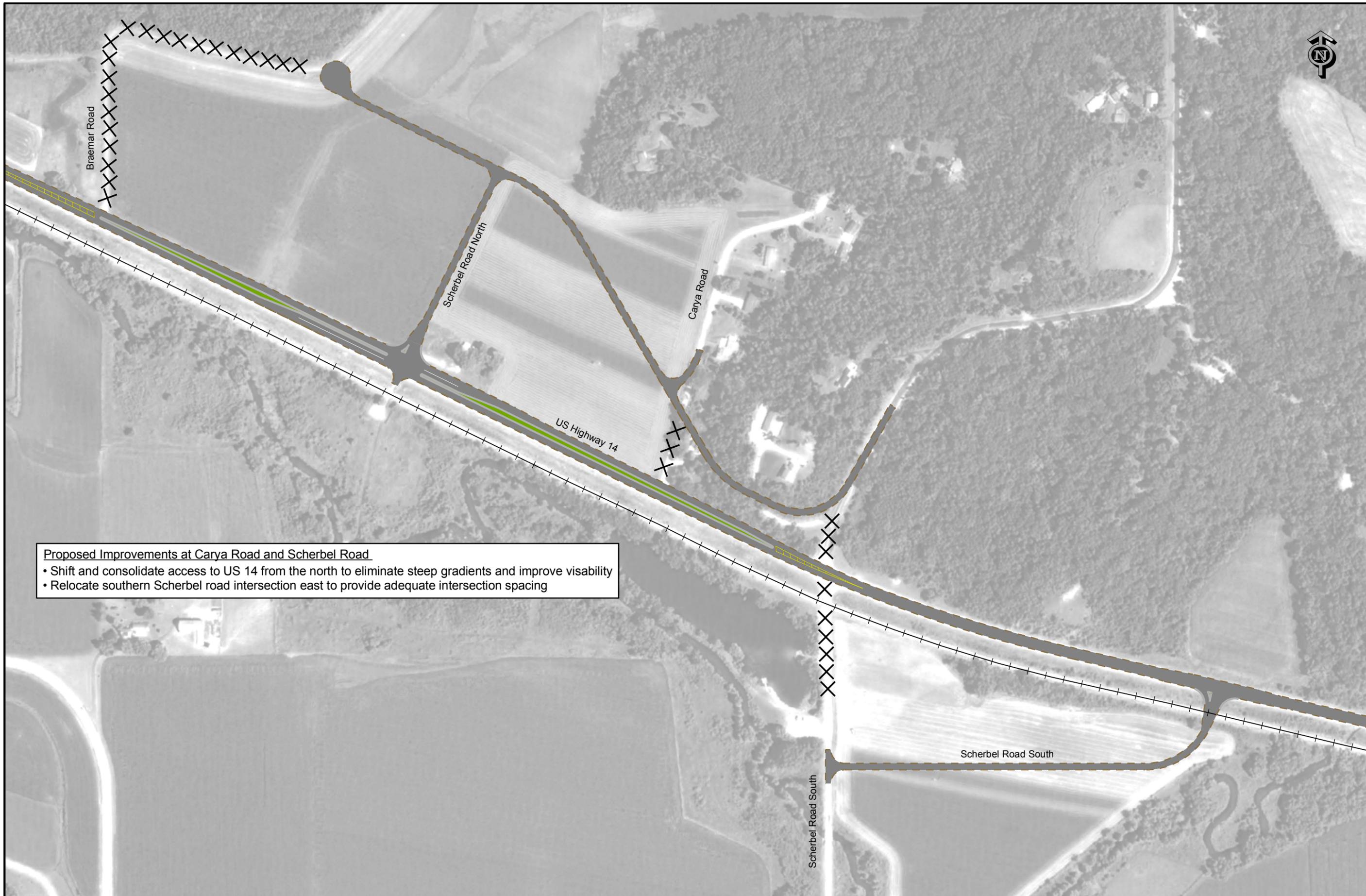
A complete reconstruction of the intersection at South Valley Road is recommended because of the acute skew angle (about 65 percent) from both the north and south approaches to US 14. As can be seen in figure 19 below, the recommended improvement would provide protected left-turn lanes on US 14 and a 90-degree approach angle and channelized right-turn lanes on South Valley Road.

Figure 19 Proposed improvements at South Valley Road



### Carya Road and Scherbel Road

It is recommended that Scherbel Road be relocated due to several design deficiencies at the existing intersection with US 14. The north approach currently has a steep gradient and visibility challenges, while the south approach has a steep gradient and acute skew angle (about 68 degrees). Nearby Carya Road has inadequate visibility. Exhibit 19 on the next page shows concepts for Carya Road and Scherbel Road.



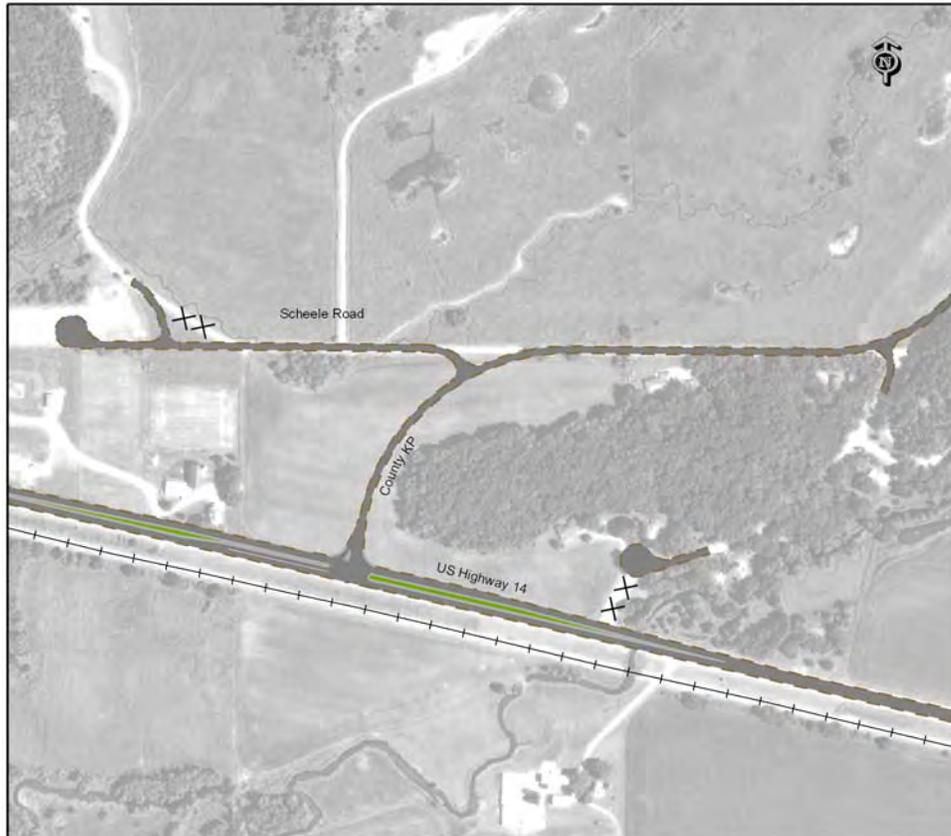
**Proposed Improvements at Carya Road and Scherbel Road**

- Shift and consolidate access to US 14 from the north to eliminate steep gradients and improve visibility
- Relocate southern Scherbel road intersection east to provide adequate intersection spacing

### County KP

It is recommended that the County KP intersection be shifted west of its current location. The existing intersection lacks needed turn lanes. However, due to the presence of the bridge over Black Earth Creek, there is insufficient right of way to make improvements at the intersection's current location. Figure 20 below shows recommended improvements at County KP.

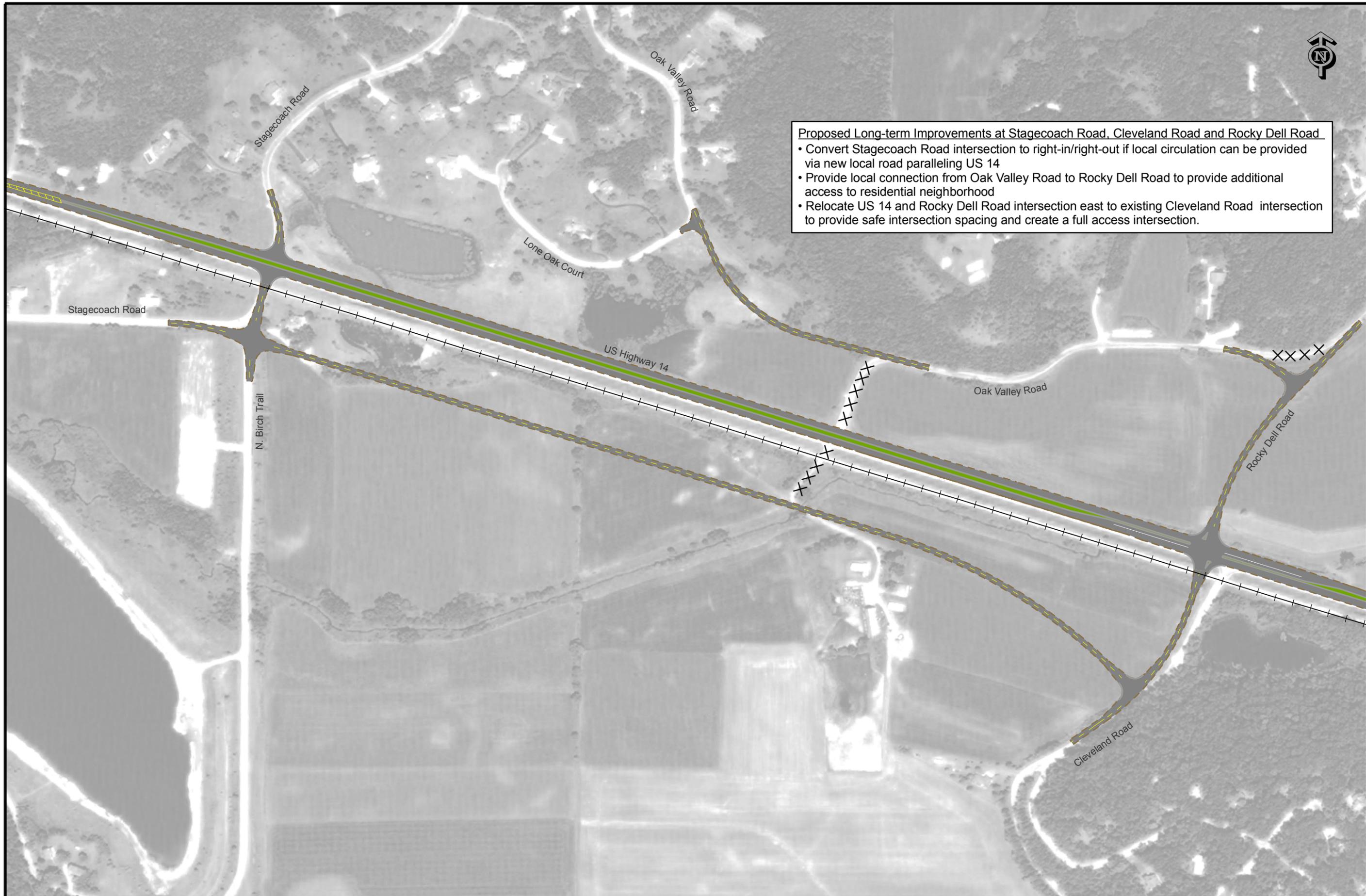
Figure 20 Proposed improvements at County KP



### Stagecoach Road

Stagecoach Road is an east–west connector between County P and US 14, crossing US 14 just east of a large active quarry. On the north side of US 14, the road serves a small residential neighborhood. The intersection with US 14 is currently the only access to properties in the neighborhood.

This intersection has special circumstances which cause delays and hazards. Quarry trucks that exit northbound Stagecoach Road onto eastbound US 14 take considerable time to accelerate to highway speed and cause slowdowns in traffic. This same movement is used by vehicles bypassing the village of Cross Plains that do not wish to negotiate the existing US 14/County P intersection.



**Proposed Long-term Improvements at Stagecoach Road, Cleveland Road and Rocky Dell Road**

- Convert Stagecoach Road intersection to right-in/right-out if local circulation can be provided via new local road paralleling US 14
- Provide local connection from Oak Valley Road to Rocky Dell Road to provide additional access to residential neighborhood
- Relocate US 14 and Rocky Dell Road intersection east to existing Cleveland Road intersection to provide safe intersection spacing and create a full access intersection.

In the 2008 AM peak hour, 74 vehicles turned right from northbound Stagecoach Road to eastbound US 14. This number is expected to climb to 111 by 2038. These vehicles could have a difficult time finding sufficient gaps in the eastbound US 14 traffic. The southbound Stagecoach Road vehicles turning left onto US 14 (27 in 2008, 43 expected in 2038) will experience delays for the same reason. Many of the gaps that could be used for the left-turns would likely be used by right-turning vehicles further limiting access to US 14 from the north.

This intersection is not expected to meet the minimum screening criteria for signals (1,700 ADT on Stagecoach Road) prior to 2038. For this reason, it is recommended that, at a minimum, an acceleration lane is added for eastbound US 14 east of Stagecoach Road to accommodate slow moving vehicles. Due to crashes at this intersection, the addition of a bypass lane is also recommended. Long-term considerations include identifying local connections to Rocky Dell Road to provide alternative access to the neighborhood, adding a raised median, and improving intersection spacing. These long-term concepts are shown in exhibit 20 and are also included in Section II, Access Management Plan.

### **3.0 Projected Benefits of Corridor-wide Implementation: Functionality, Travel Times, and Safety**

The strategies recommended in this report are intended to enhance roadway function and safety throughout the corridor. Adding turn lanes and bypass lanes at several unsignalized intersections could reduce crashes. Improving the most congested signalized intersections in the corridor would likely reap large benefits for both safety and functionality. Adding turn lanes at Pleasant View Road, Deming Way, and the US 12 ramps, and the complete reconstruction of the County P intersection should provide adequate level of service out to the year 2038, as well as reduce the number of crashes and crash severity at these locations.

#### **Level of service improvements**

Level of service improvements are expected to occur primarily at the corridor’s signalized intersections. Table 48 details the projected LOS, delays, and queues for signalized intersections along US 14 in 2038, with and without improvements. The LOS shown is for the overall intersection; the queue data shown is for the movement that had the worst queue.

Table 48 Peak-hour LOS ratings at selected signalized intersections in 2038, with and without proposed improvements (AM/PM)

Intersections	With improvements			Without improvements		
	LOS	Delay (seconds)	Queue (feet)	LOS	Delay (seconds)	Queue (feet)
County P, Cross Plains	C/C	28/25	452/306	F/F	337/102	2,314/1,138
Pleasant View Road, Middleton	D/C	47/35	788/401	E/F	72/95	1006/877
Deming Way, Middleton	D/D	48/50	686/516	D/F	52/212	738/1084
US 12 eastbound ramps	D/C	48/30	700/631	F/E	83/77	794/1098

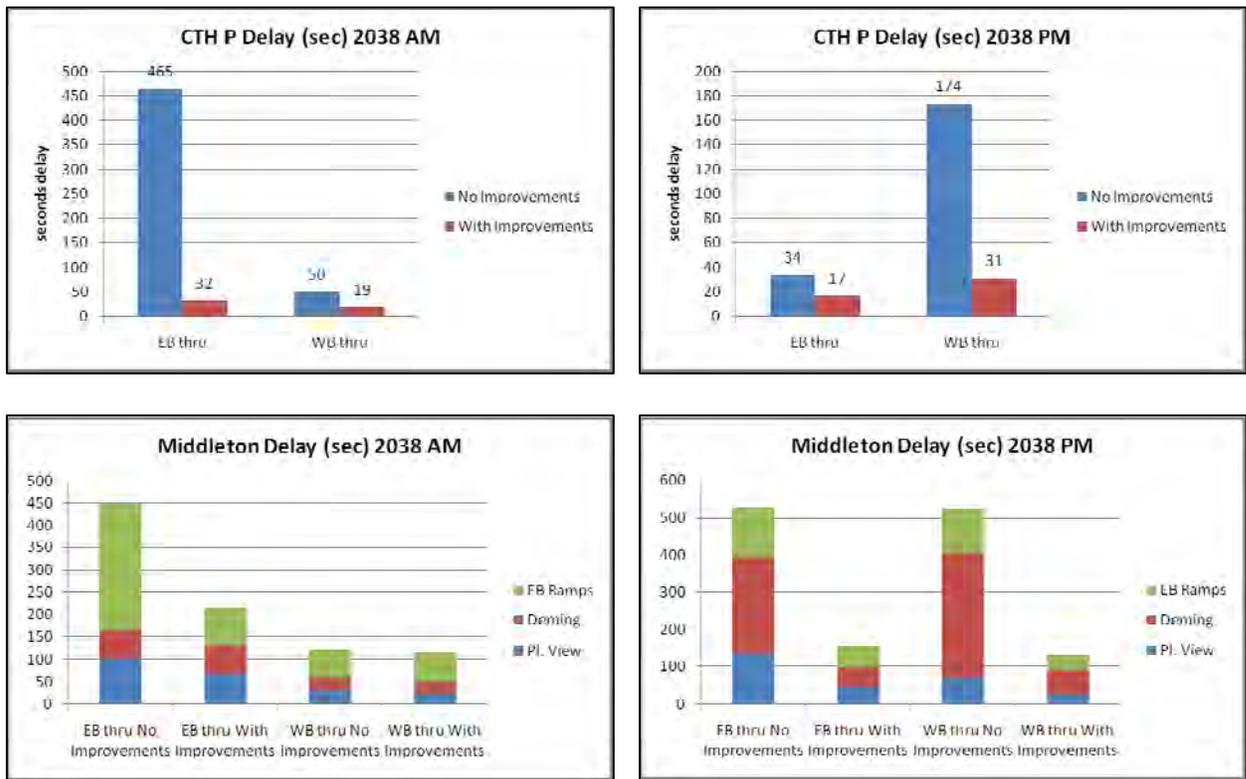
Note: Longest queue in AM is eastbound through and longest in PM is westbound through.

### Travel time improvements

Analysis was conducted to determine the effects of proposed improvements on US 14 corridor travel time. It is anticipated that, in the absence of capacity expansion, virtually any improvement in total corridor travel time and level of service would be due to improvements at County P and the signalized intersections in the city of Middleton. Improvements at unsignalized intersections and driveways within the corridor, while improving safety, are not expected to have a noticeable impact on corridor travel time.

The bar graphs below in figure 21 illustrate the extent that travel through key signalized intersections at County P and in Middleton could be improved by 2038 compared to a 2038 no-build scenario during AM and PM peak hours. Travel time improvements are measured in seconds in each of the graphs.

Figure 21 Estimated delay at County P and Middleton intersections with and without improvements



As the graphs show, improvements would have significant impact for eastbound traffic in the morning and westbound traffic in the afternoon. During the AM peak hour in 2038, the recommended improvements at County P could reduce delay by up to 433 seconds (a 93% reduction in delay) for the eastbound through movement and 31 seconds (62% reduction) for the westbound through movement. During the PM peak hour in 2038, improvements could reduce delay by 17 seconds (50% reduction) for the eastbound through movement and 143 seconds (82% reduction) for the westbound through movement.

Implementation of the recommended improvements at Pleasant View Road, Deming Way, and the eastbound ramps at US 12 would likely have greater positive impact for PM peak-hour travel. During the AM peak hour in 2038, improvements could reduce total delay by 233 seconds (52%) for the eastbound through movement and 5 seconds (4%) for the westbound through movement. During the PM peak hour in 2038, improvements could reduce delay by 371 seconds (70%) for the eastbound through movement and 391 seconds (75%) for the westbound through movement.

Table 49 below summarizes the effects that improvements could have on corridor travel time by 2038. Total corridor eastbound morning peak-hour travel time could be reduced by 666 seconds, or about 11 minutes; total corridor eastbound PM peak-hour travel time could be reduced by about six and a half minutes. Traveling westbound, total corridor travel time could be reduced by about half a minute in the morning peak hour, and about nine minutes during the PM peak hour.

Table 49 Possible travel time savings due to improvements (seconds)

Location	Eastbound		Westbound	
	A.M.	P.M.	A.M.	P.M.
County P	433	17	31	143
Middleton	233	371	5	391
Total savings	666	388	36	534

### **Safety improvements**

Improvements to the US 14 mainline and its intersections would likely result in reductions to the number and severity of crashes. FHWA has developed a resource to help estimate the reduction in crashes, entitled *Desktop Reference for Crash Reduction Factors*. This reference guide is a compilation of the results of various studies that examined the impacts of the implementation of geometric and operational safety countermeasures on mainline highways and intersections. The results are not to be interpreted as a guarantee of the success of a potential improvement. Rather, the results provide generic estimates that may be used to guide the selection of specific countermeasures that reduce crashes and improve safety.

The reference provides Crash Reduction Factors (CRFs) for each countermeasure or improvement. As defined in the reference, the CRF is “the percentage crash reduction that might be expected after implementing a given countermeasure.” While one CRF may be displayed, there are standard errors and ranges to consider, so it may be more appropriate to consider a CRF of 15 percent as a point in the middle of a range, for example, between 10 and 20 percent.

Most of the CRFs are shown for specific, individual improvements, such as adding a right-turn lane at an intersection. It is important to understand that potential projects at a given location could include a number of individual improvements, such as adding turn lanes, improving alignments and sight distances, adding traffic signals, installing medians, etc. The expected result of all of the improvements is not necessarily cumulative. Nevertheless, combinations of improvements may have

some measure of complementary benefit. Two or more improvements in combination may be expected to produce a better result than any of them individually, but less than the sum of their CRF values.

The following sections of the report provide Crash Reduction Factor estimates for the proposed improvements throughout the portion of the US 14 corridor covered by this study. The results are divided into three sections: mainline, signalized intersections, and unsignalized intersections.

#### Mainline US 14

Mainline improvements have been proposed along the corridor to bring the road to WisDOT standards, primarily straightening horizontal curves and adding medians. The realignment proposals for the segment of US 14 located between Mazomanie and Black Earth include changes to the mainline highway and individual intersections.

Deficient horizontal curves in the corridor are most prominent near Wisconsin Heights High School, near WIS 78 (west), and between Cleveland Road and Twin Valley Road. Depending on the amount of curve straightening, proposed improvements could reduce several crash types and yield the following CRFs:

- Rear-end: 24 to 73%
- Vehicle overturning: 24 to 73%
- Head-on: 64 to 67%
- Fixed-object: 68 to 87%
- Run-off-road: 79 to 90%
- Fatal / injury: up to 87%

An additional proposed countermeasure would extend the existing median that currently stretches from Pleasant View Road to US 12 in Middleton. Extending the raised median westward through the intersections of US 14 with Pinehurst Drive, Capitol Court, Schwartz Road, and Wayside Road would be expected to reduce all crash types along this segment 20 to 25 percent, and reduce head-on crashes by about 75 percent.

#### Signalized Intersections

There are currently seven signalized intersections in the corridor. As previously mentioned, improvements are proposed at four of these intersections. At a fifth, WIS 78 (east)/Mills Street in Black Earth, changes to driveway access in the vicinity of the intersection are recommended, but specific CRFs are not yet available for this type of improvement.

The four signalized intersections recommended for improvements include the intersections of US 14 with County P, Pleasant View Road, Deming Way, and the US 12 eastbound ramps. Additional turn lanes are recommended for all of these intersections. Channelization and approach realignments are recommended at County P, Pleasant View Road, and Deming Way. At County P, additional through lanes are recommended, while the intersection itself is a candidate for possible conversion to a roundabout. The expected reductions in crashes for these improvements are as follows:

- Addition of left-turn lane
  - All crash types: 10%
  - Involving left-turning vehicles: 13%
- Addition of right-turn lane: 4%
- Addition of channelized right-turn lane: 35% reduction in fatal/injury crashes
- Dual left-turn lanes
  - Fatal/injury crashes involving left-turning vehicles: 47%
  - Property-damage-only crashes involving left-turning vehicles: 71%
- Conversion to roundabout
  - All crash types: 35 to 67%
  - Fatal/injury crashes: 32 to 80%

### Unsignalized Intersections

Discussion of unsignalized intersections falls into two categories: those that have been identified as candidates for signalization, and those that are not candidates for signalization. Intersections were evaluated only at a preliminary level to identify candidates; *a full evaluation of intersections according to FHWA guidelines would be necessary to reach a final conclusion.* See the signal risk assessment in the Traffic Operations Analysis section for more details of the intersection evaluation.

The three intersections on the corridor that have been identified as candidates for potential signalization include the intersections of US 14 with WIS 19/78 (west) in Mazomanie, Brewery Road in Cross Plains, and Pinehurst Drive in Middleton. Detailed studies and design of the intersections would be required before the installation of signals was undertaken; these studies would identify additional specific geometric and/or operational improvements that would be needed. In general, however, the expected reduction in crashes that would result from the conversion of an intersection from stop-controlled to signal-controlled would be as follows:

- All crash types: 28 to 36%
- Fatal/injury crashes: 43 to 53%
- Right-angle crashes: 74%

As discussed in previous sections, there are a number of unsignalized intersections in the corridor that have one or more geometric, operational, and/or safety deficiencies, but that are not candidates for signalization within the timeframe of this study. However, there are a number of other improvements that have been recommended to mitigate the deficiencies, such as addition of turn lanes, medians, and curb-and-gutter; flattening of curves and gradients; and improvements to approach angles and sightlines.

These types of improvements have been recommended at the intersections of US 14 with County F, Heidi's Lane, Kahl Road, Schultz Road, South Valley Road, Carya Road, Scherbel Road, County KP, and Stagecoach Road. Specific recommendations at each intersection were discussed in detail in the previous section. Multiple recommendations have been crafted for some of the intersections. The expected CRFs for each type of improvement are detailed as follows:

- Correction of intersection skew (improve approach angles to, or closer to, 90 degrees): 7 to 25% reduction
- Improve sight distance by relocating intersection or removing obstructions
  - All crashes: 5 to 17%
  - Fatal/injury crashes: 36 to 57%
- Addition of right-turn lane
  - All crashes: 14 to 26%
  - Fatal/injury crashes: 23 to 40%
  - Crashes involving right-turning vehicles: 50 to 56%
  - Rear-end crashes: 65%
- Addition of turn and bypass lane
  - All crashes: 5%
  - Injury crashes: 18 to 36%
- Addition of left-turn lane
  - All crashes: 28 to 48%
  - Fatal/injury crashes: 35 to 58%
  - Crashes involving left-turning vehicles: 37 to 68%
- Addition of median
  - All crashes: 25 to 27%
  - Fatal/injury crashes: 25%
- Addition of acceleration lane
  - All crashes: 10 to 26%
  - Rear-end crashes: 75%

Specific improvements could reduce the number and severity of crashes at certain unsignalized intersections in the US 14 corridor. In the 2002 to 2006 study period, Rocky Dell Road and Stagecoach Road had the highest crash rates amongst the unsignalized intersections in the corridor. Both of these intersections are located in rural locations where the speed limit is 55 miles per hour. Because higher crash speeds generally result in a greater likelihood of crashes and severe injury or fatality in the event of crashes, undertaking specific improvement strategies, detailed previously in this report, could yield large crash rate reductions at these locations.

In the five-year study period, the intersection at Rocky Dell Road experienced five non-deer crashes, of which four involved eastbound vehicles on US 14 waiting to turn left onto Rocky Dell Road. Injuries resulted in each of these four crashes. Adding a protected left-turn lane could reduce both the crash rate and crash severity rate at this intersection.

The intersection at Stagecoach Road experienced four non-deer crashes, three of which involved a westbound vehicle waiting to turn left. Of these three, one crash led to a fatality and two non-fatal injuries and another crash resulted in injury. Based on information in the crash reports, a protected left-turn lane could reduce the number of crashes involving westbound left-turning vehicles. Therefore, adding a protected left-turn lane could reduce the intersection's crash rate and possibly the crash severity rate at this location.