EAST RAPID CITY TRAFFIC AND CORRIDOR ANALYSIS STUDY

Draft Report

April 2019

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STUDY BACKGROUND

The *East Rapid City Corridor Analysis* study has been prepared to identify potential transportation improvements to mitigate traffic operations and safety issues in northeast Rapid City, South Dakota. Major study area corridors that were a primary focus for improvements are East North Street, Cambell Street, and Omaha Street/South Dakota Highway 44.

East North Street, Cambell Street, and Omaha Street/Highway 44, form the backbone of Rapid City's existing east side arterial road network. Their ability to carry high levels of traffic is vitally important to the city for reasons of safety, mobility, development potential, and quality of life. Recent and continued growth in Rapid City has brought new development to northeast Rapid City, bringing challenges and opportunities for this portion of the city's transportation network. Increased development has resulted in localized growth, and with it increased traffic, leading to congestion, safety issues, and bicycle, pedestrian, and transit (multimodal) needs along these corridors.

We see these needs as evident whenever we drive these corridors, especially during the traffic peaks. Many of the turn lanes are over capacity, and yet some can be difficult to get to when through lane queues block their access. The reverse is also true, as some turn lane queues have been seen to block through travel lanes. This often leads to a lane use disparity, as people avoid getting stuck behind the overflow from a turn lane.

We've seen pedestrians and bicyclists traveling along these corridors. In some places sidewalk or bicycle facilities are non-existent, and walking paths sometimes operate like an obstacle course. There is significant opportunity to improve functionality for these users, both short and long-term. Corrective measures exist, but they must be balanced against development potential, impacts on existing properties, and environmental and cost constraints.

Increased development and new traffic has resulted in overburdened intersections throughout the study area, especially at the SD 44/Omaha Street and Cambell Street intersection and the East North Street and Cambell Street intersection. It is not uncommon for traffic to have to wait through multiple signal cycles and for long queues to develop at these locations. This results in further long delays for side street and private approach traffic waiting to get onto these arterial roadways. As new development continues in the study area, the congestion will only build.

Planned extensions to Anamosa Street, Valley Drive, Mickelson Drive, and Creek Drive will facilitate new development growth and these roads will carry some of the existing and future traffic in this area of the city. This study examines the impact of these planned roadways and their ability to relieve traffic on existing arterial roads.

Study Process

Methods and Assumptions

The methods and assumptions used for technical analysis and recommendations were vetted through the Study Advisory Team (SAT), with the full *Methods and Assumptions* document available in Appendix A. The Study Advisory Team consisted of representatives from the City of Rapid City, the Rapid City Area Metropolitan Planning Organization (MPO), the Federal Highway Administration (FHWA), and the South Dakota Department of Transportation (SDDOT).

Study Milestones

This study was structured to have several milestones where the Study Advisory Team was given an opportunity to review technical reports that documented study findings. Major milestones for this study included:

- Existing Conditions Report
- Future Conditions Report
- Environmental Scan Report
- Alternatives Development and Assessment

The SAT met six times throughout the study to review analysis findings and to provide guidance for subsequent phases of the study. Detailed summaries from each SAT meeting can be found in Appendix B.

Public Engagement

The study team met with the public three times throughout the study. All public meetings were advertised twice in the Rapid City Journal and in the Native Sun News. Invitations were also sent to landowners along the major corridors.

All public meetings were also advertised on the project website, http://eastrapidstudy.com/. Links to the project website were available on the city and SDDOT websites. The website provided information regarding the study purpose, news and articles, background and schedule, interim project reports, responses to frequently asked questions, and places for comments to be made. Twitter and Facebook ads were also used to direct people to the website and to highlight upcoming public meetings.

The first meeting on September 13th, 2018 was held to inform the public about the purpose of the study, to share results from preliminary analyses, and to better understand residents' transportation concerns and visions for the study area. The second meeting on February 28th, 2019 was held to show improvement alternatives to the public and to obtain feedback related to these alternatives.

A third meeting has been scheduled for April 10, 2019 to present the draft Report and receive comments on the draft Report and its recommendations. The results of that meeting will be incorporated into the final Report.

Stakeholder meetings were held in conjunction with the public meetings. MPO and Consultant staff also met and/or communicated with landowners who requested additional input opportunities. Detailed information about the public engagement process can be found in Appendix C.

CHAPTER 1: EXISTING CONDITIONS ANALYSIS

Existing study area characteristics, traffic operations, and safety conditions were evaluated to identify existing issues in the study area. These findings served as a foundation for subsequent analysis and the development of potential roadway improvements.

Study Area Characteristics

This study primarily focuses on the following roadway segments.

- **Cambell Street** –Saint Patrick Street to East North Street
- **Omaha Street/South Dakota Highway 44 (SD 44)** –LaCrosse Street to Valley Drive
- **East North Street** –LaCrosse Street to Eglin Street
- **Anamosa Street** –East North Street to future extension of Valley Drive
- **Valley Drive Extension** –SD 44 to East North Street

The roadway segments listed above will be referred to as *Primary Study Roadways* throughout this report. The study area, including major intersections, roadway speed limits, and roadway functional classifications can be seen in **Figure 1.2**.

Roadway Jurisdiction

Of the primary study roadways, the only route under SDDOT jurisdiction is Omaha Street/SD 44, with the remainder of roadways under City of Rapid City jurisdiction.

Existing Land Use

Along the primary study roadways, land uses are currently predominantly commercial (See **Figure 1.1**), with some industrial uses present, especially along Omaha Street/SD 44. The primary study roadways also provide connectivity to residential areas located along local roadways behind the commercial and industrial land uses in the study area. The existing study area land uses can be seen in **Figure 1.3**.

Figure 1.1 – Commercial Properties Near Cambell Street and East North Street

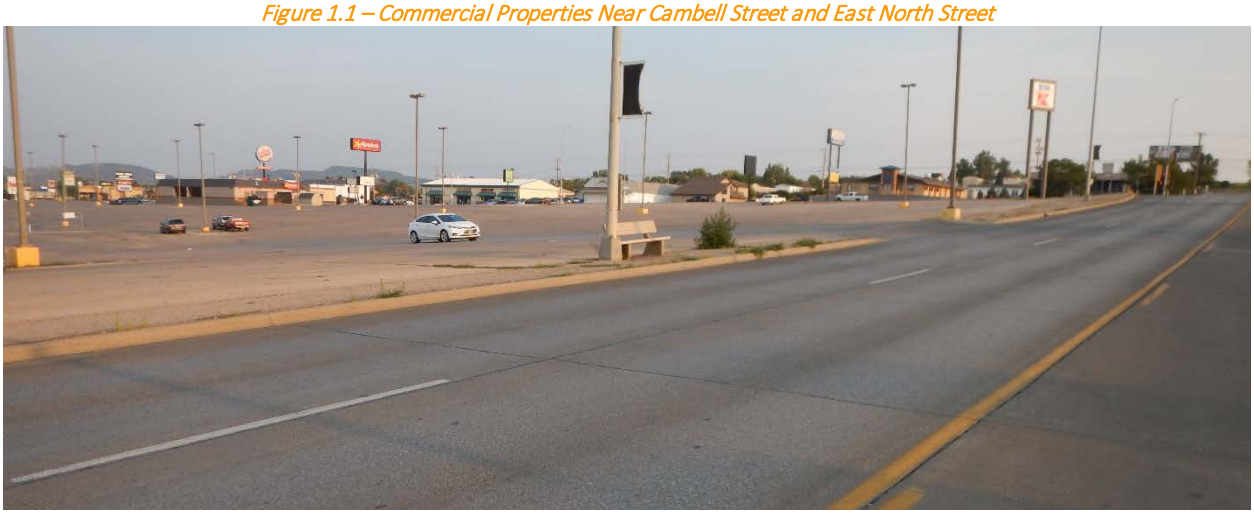


Figure 1.2 – Study Area

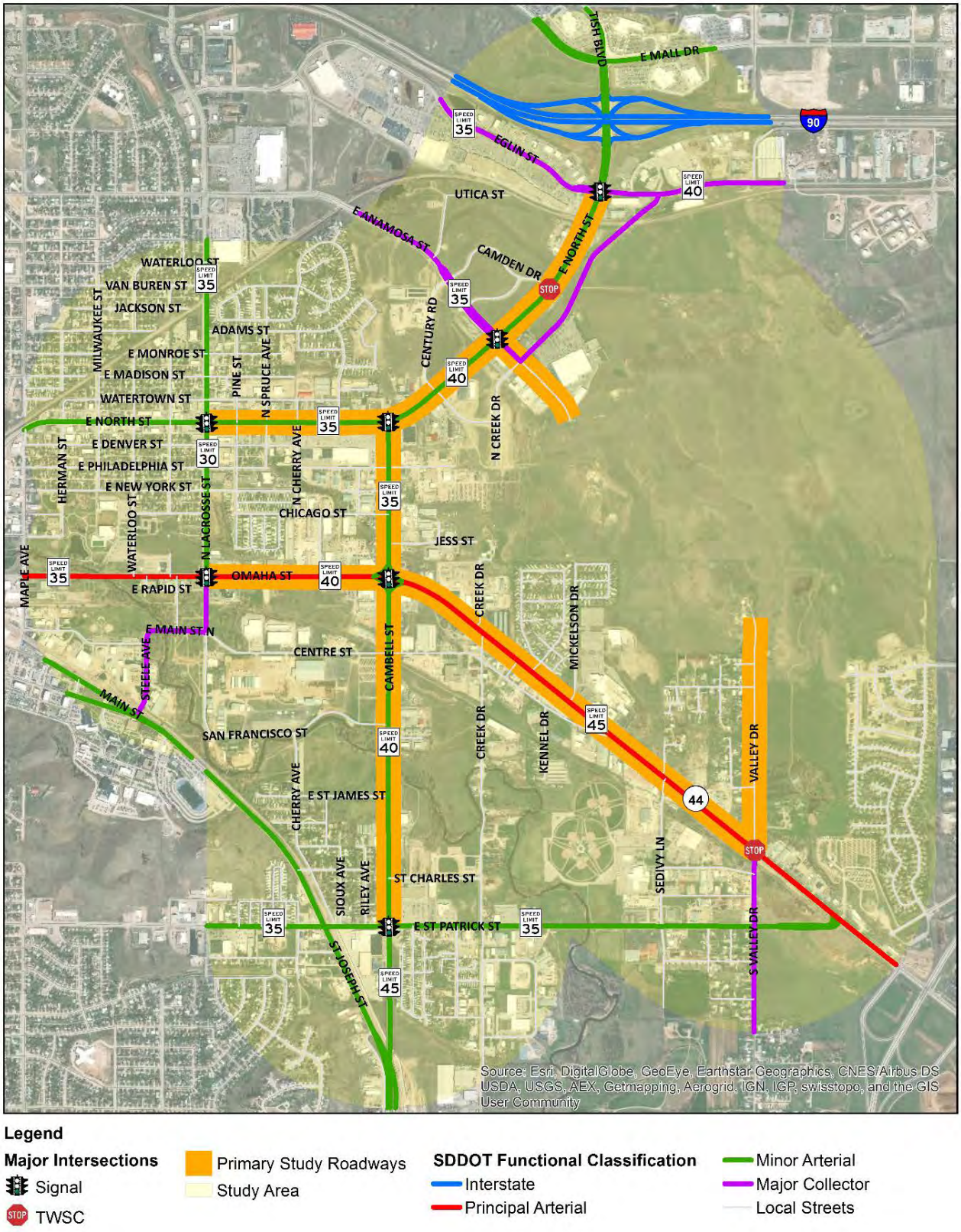
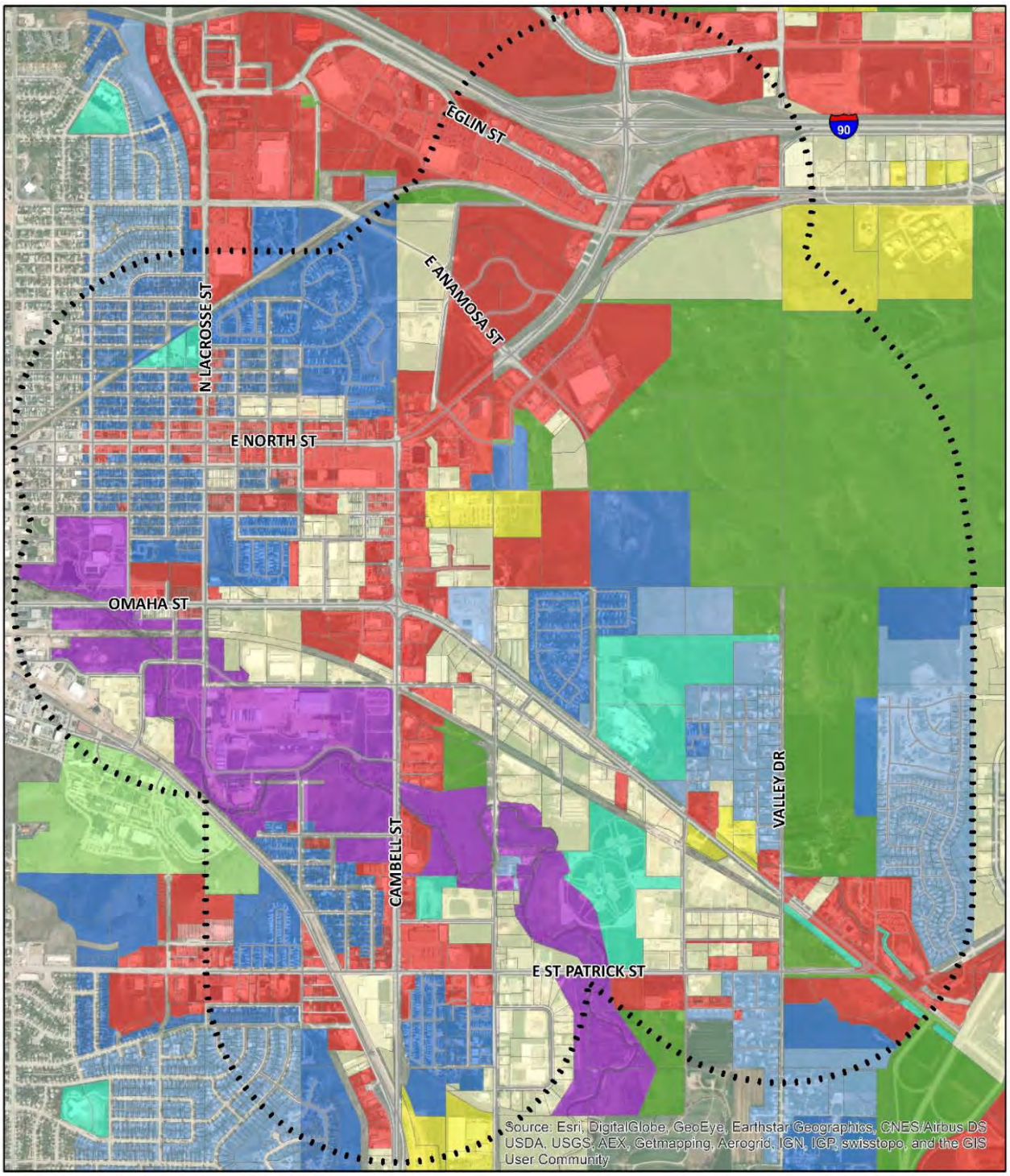


Figure 1.3 – Existing Zoning/Land Uses



Pavement Conditions

Existing pavement condition indices (PCI) were evaluated for major study area roadways. The PCI is a value between 0 and 100, with 0 reflecting very poor pavement conditions that will likely require full reconstruction and a score of 100 reflecting new pavement with no existing maintenance requirements. The table below shows descriptions, expected pavement life, and typical rehabilitation treatments for pavements in various PCI ranges:

Table 1.1 – Pavement Condition Index (PCI) Descriptions

PCI Range	Description	Typical Rehabilitation Actions
85 to 100	Excellent	Like new condition - little to no maintenance required when new; routine maintenance such as crack and joint re-sealing
70 to 85	Very Good	Routine maintenance like patching and crack sealing such as seal coats or slurries
60 to 70	Good	Heavier surface treatments and thin overlays. Localized joint rehabilitation and slight panel replacements
40 to 60	Fair to Marginal	Heavy surface-based inlays or overlays with localized repairs. Moderate to extensive panel replacements and joint rehab
25 to 40	Poor	Sections will require very thick overlays, surface replacement, base reconstruction, and possible subgrade stabilization
0 to 25	Very Poor	High percentage of full reconstruction

CAMBELL, EAST NORTH, AND LACROSSE STREETS

Most of Cambell Street, East North Street, and LaCrosse Street are in very good condition with PCI values above 70. These roadways can be rehabilitated with treatments such as joint repairs or crack sealing.

Figure 1.4 – Pavement on Cambell Street

Some small segments on study roadways have slightly poorer pavement conditions with PCI values between 60 and 70. These segments are Cambell Street between Centre Street and Omaha Street and East North Street between Cambell Street and Century Road. These road segments still have good pavement conditions that can be rehabilitated.

OMAHA STREET

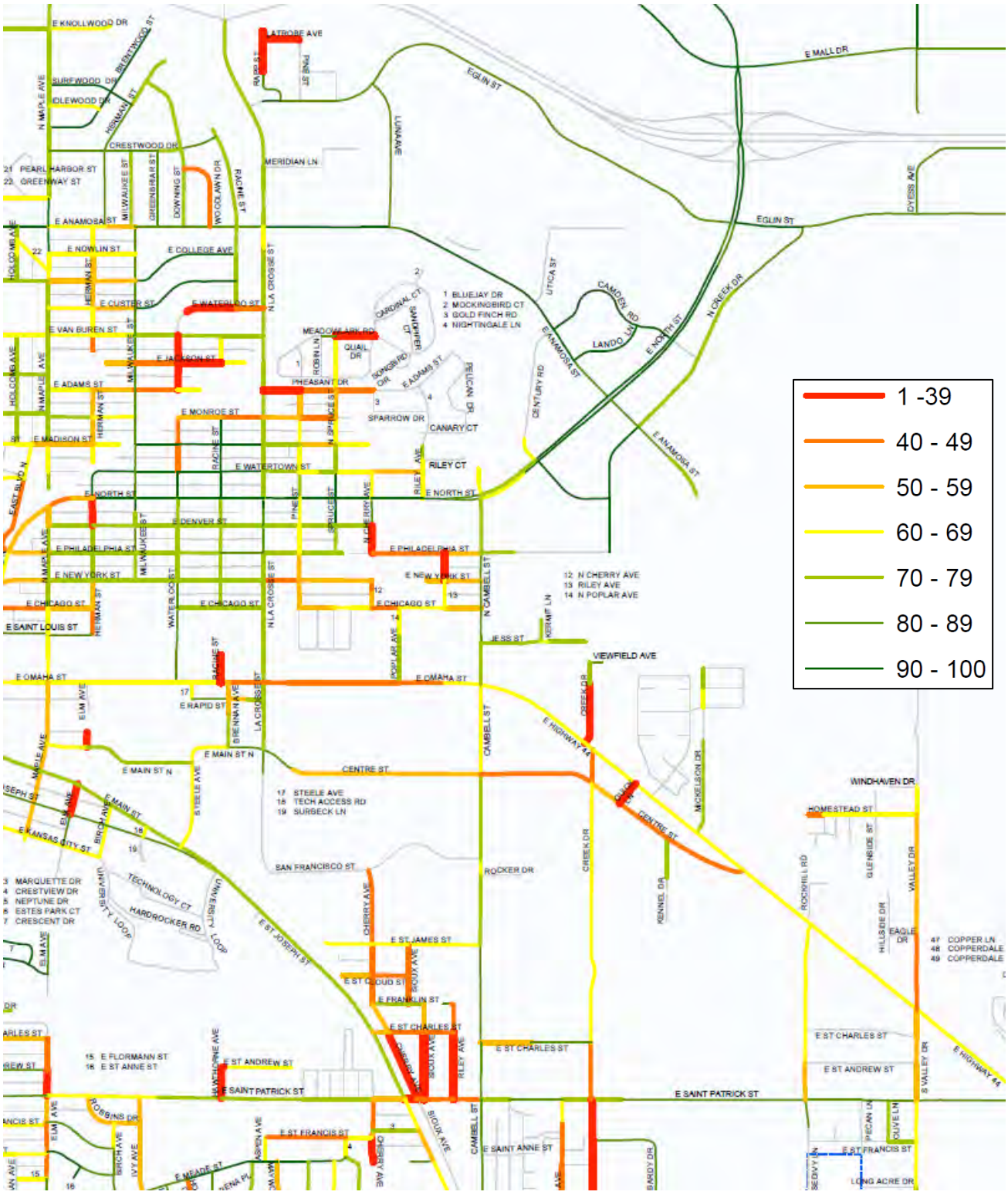
Compared to the other primary study roadways, Omaha Street PCIs are lower, ranging between 40 and 70. The lowest PCI is between LaCrosse Street and Cambell Street, with a PCI rating between 40 and 49. Locations with lower PCI values may require more extensive rehabilitation than other parts of the study area, but may or may not require full reconstruction.

CREEK DRIVE AND VALLEY DRIVE

Given that extensions are planned along these roads, it is worth noting that some existing segments are in poor or very poor condition. Pavements were probably not designed to handle the increased volumes that will occur.

Existing PCI information for the study area can be seen in **Figure 1.5**.

Figure 1.5 – Existing Pavement Condition Indices (PCI)



Source: City of Rapid City

Roadway Lighting

Existing roadway lighting was evaluated on the primary study roadways. Lighting analysis was intended to document where lighting is present (or absent) for safety purposes, but whether or not existing lighting meets illuminance standards was not evaluated. The following lighting conditions are present in the study area:

- Cambell Street
  - Corridor Lighting
    - Light poles are present on the west side of the corridor between Saint Patrick Street and East North Street
  - Intersection Lighting
    - Saint Patrick Street: Lights are on signal stands in all quadrants except the northeast quadrant (overhead utilities in northeast quadrant)
    - Omaha Street: Lights are on signal standards in all quadrants
    - East North Street: Lights are on signal standards in all quadrants except the southwest quadrant

Corridor lighting along the west side of Cambell Street is shown in **Figure 1.6**.

Figure 1.6 – Cambell Street Lighting

Photo taken facing southbound

- Omaha Street
  - Corridor Lighting
    - Light poles are present on both sides of the corridor between LaCrosse Street and Cambell Street
  - Intersection Lighting
    - Cambell Street: Lights are on signal standards in all quadrants
    - LaCrosse Street: Lights are on signal standards in the northeast and northwest quadrants

Corridor lighting along Omaha Street is shown in **Figure 1.7**.

Figure 1.7 – Omaha Street Lighting

- East North Street
  - Corridor Lighting
    - Light poles are present on both sides of the corridor
  - Intersection Lighting
    - LaCrosse Street: Lights are on signal standards in all quadrants except the southwest quadrant (overhead utilities in southwest quadrant)
    - Cambell Street: Lights are on signal standards in all quadrants except the southwest quadrant
    - Anamosa Street: Lights are on signal standards in all quadrants
    - Eglin Street: Lights are on signal standards in all quadrants

Access Spacing

Proper access spacing along roadways promotes better traffic flow and results in lower potential for vehicle collisions. Research documented in NCHRP Report #420 found that on average, each access along a corridor increases crash potential by four percent and decreases corridor travel speeds by 0.25 miles per hour.

In developed urban areas where mobility and access must be balanced, common access spacing goals are 330 feet to 660 feet between accesses. This access spacing translates to 8 to 16 accesses per mile being desirable.

The only primary study roadway with 16 or fewer accesses per mile is East North Street, east of Cambell Street. The segments with the highest access density are East North Street between LaCrosse Street and Cambell Street (56 accesses per mile (see **Figure 1.8**) and Cambell Street between Omaha Street and East North Street (32 accesses per mile).

Access density along all primary study roadways can be seen in **Figure 1.9**.

Figure 1.8 – Dense Access Spacing on East North Street (West of Cambell Street)

Source: Google Earth

SIGNAL SPACING

Research in NCHRP Report #420 has found that traffic signals should be spaced at least a quarter-mile from each other to optimize traffic flow, which is congruent with the City of Rapid City's standard of 1,200 feet between signals. The only signals in the study area that are spaced less than 1,200 feet are the East North Street signals at LaCrosse Street and Spruce Street, which are 890 feet from one another.

Figure 1.9 – Access Density

Existing Daily Traffic Volumes

KLJ obtained 2017 annual average daily traffic volumes (AADT) in the study area from the Rapid City Area Metropolitan Planning Organization (MPO) 2017 Traffic Volume Counts Report, then factored this data to 2018 conditions using information from the 2040 regional travel demand model. Adjusted 2018 AADT's can be seen in Figure 1.10.

Most primary study roadways carry over 15,000 AADT, with Cambell Street and portions of Omaha Street and East North Street carrying over 20,000 AADT. The highest volume segments in the study area are Cambell Street between Omaha and East North Streets (25,000 AADT) and East North Street between Cambell and Anamosa Streets (23,400 AADT).

TRUCK TRAFFIC AND VEHICLE SPEEDS

KLJ deployed radar detectors on the following roadway segments to collect both truck data and vehicle speed data. Speed data was collected for the average speed and the 85th percentile speed. The 85th percentile speed is typically used in evaluating whether posted speed limits are appropriate. Based on a review of prevailing traffic speeds, it appears that existing posted speed limits are appropriate through most of the study area.

Table 1.2 – Truck Traffic and Vehicle Speeds

Segment	Truck Percentage	Average Speed	85th Percentile Speed	Speed Limit
Cambell Street - Saint Patrick Street to Omaha Street/SD 44	8.0%	39 mph	43.4 mph	40 mph
Cambell Street - Omaha Street/SD 44 to East North	6.9%	34.3 mph	38.8 mph	35 mph
Omaha Street - LaCrosse Street to Cambell Street	5.2%	39.6 mh	43.8 mph	40 mph
SD 44 - Cambell Street to Valley Street	4.5%	43 mph	47.2 mph	45 mph
East North Street - Cambell Street to Anamosa Street	6.2%	35.8 mph	40 mph	40 mph
East North Street - Anamosa Street to Eglin Street	6.5%	38.5 mph	43.4 mph	35-40 mph

Existing Roadway Sections

The primary study roadways have two through lanes in each travel direction except for Valley Drive and a short segment of Anamosa Street. Existing roadway sections can be seen in **Figure 1.10.**

TWO-WAY LEFT TURN LANES

Beyond the two travel lanes in each direction that most study roadways have, most of the study roadways also have a two-way left turn lane. Two-way left turn lanes are present on:

- Cambell Street – From Saint Patrick Street to East North Street
- Omaha Street/SD 44 – Throughout the study area
- East North Street – Intermittently throughout the study area

Existing intersection lane assignments are presented in a later section of this chapter.

RAISED MEDIANS

Most roadways in the study area do not have existing raised medians, however there are short raised median segments on Anamosa Street on each side of East North Street and there is a raised median on East North Street through the I-90 interchange.

Existing raised medians and two-way left turn lane locations in the study area can be seen in **Figure 1.11.**

Figure 1.10 – 2018 Daily Traffic Volumes and Typical Roadway Sections

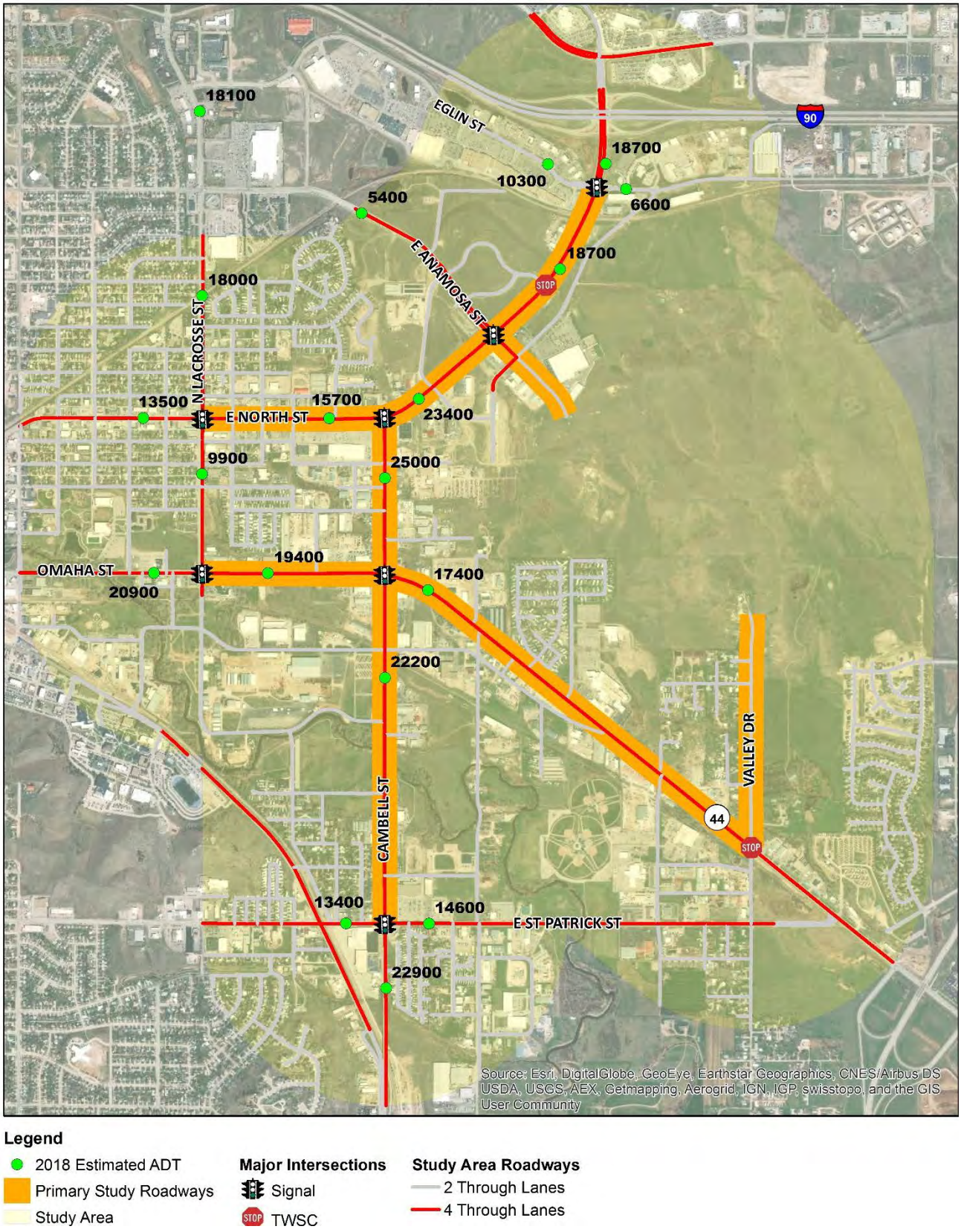
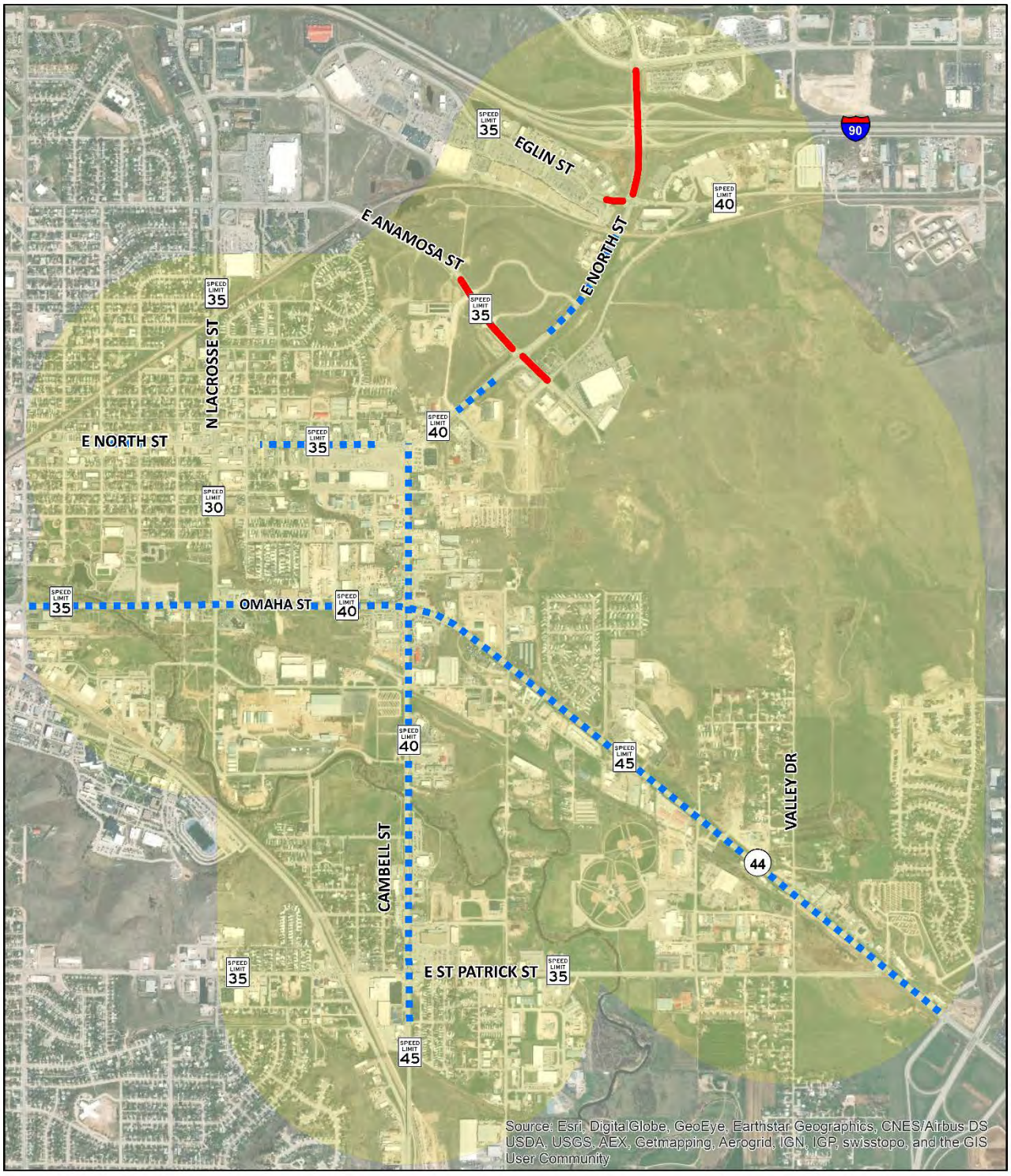


Figure 1.11 – Existing Study Area Two-Way Left Turn Lanes and Raised Medians



Multimodal Facilities

For the purposes of this study, multimodal facilities include transportation infrastructure for pedestrians, bicyclists, and transit users. The existing multimodal network currently has little consistency, with many gaps in some areas of the sidewalk network, and a complete absence of facilities in other areas. The sidewalk network along the primary study roadways can be seen in Figure 1.14.

Land use within the study area includes mostly heavy commercial uses, though a mixture of residential, industrial, and developing vacant land exists. Most of the primary study roadways are within a quarter mile of existing residential property, so non-motorized access to various places to shop, eat, or work is very important.

PEDESTRIAN FACILITIES

Cambell Street

Cambell Street has some dedicated sidewalks, but there are many gaps in the network. The dedicated sidewalks vary in width (5 to 10 feet wide) and are directly adjacent to the curb line. While many gaps in the sidewalk still have surfaces on which pedestrians can travel without being in the roadway (see Figure 1.12), these non-official paths typically do not comply with ADA design standards and can be barriers to travelers with disabilities. Other barriers are also present, such as signs, light poles, parked vehicles, and irregular surfaces.

Omaha Street/SD 44

There are no sidewalks along Omaha Street/SD 44 in the study area, however there is some pedestrian demand as is evident from worn down turf on the side of the road (see Figure 1.13).

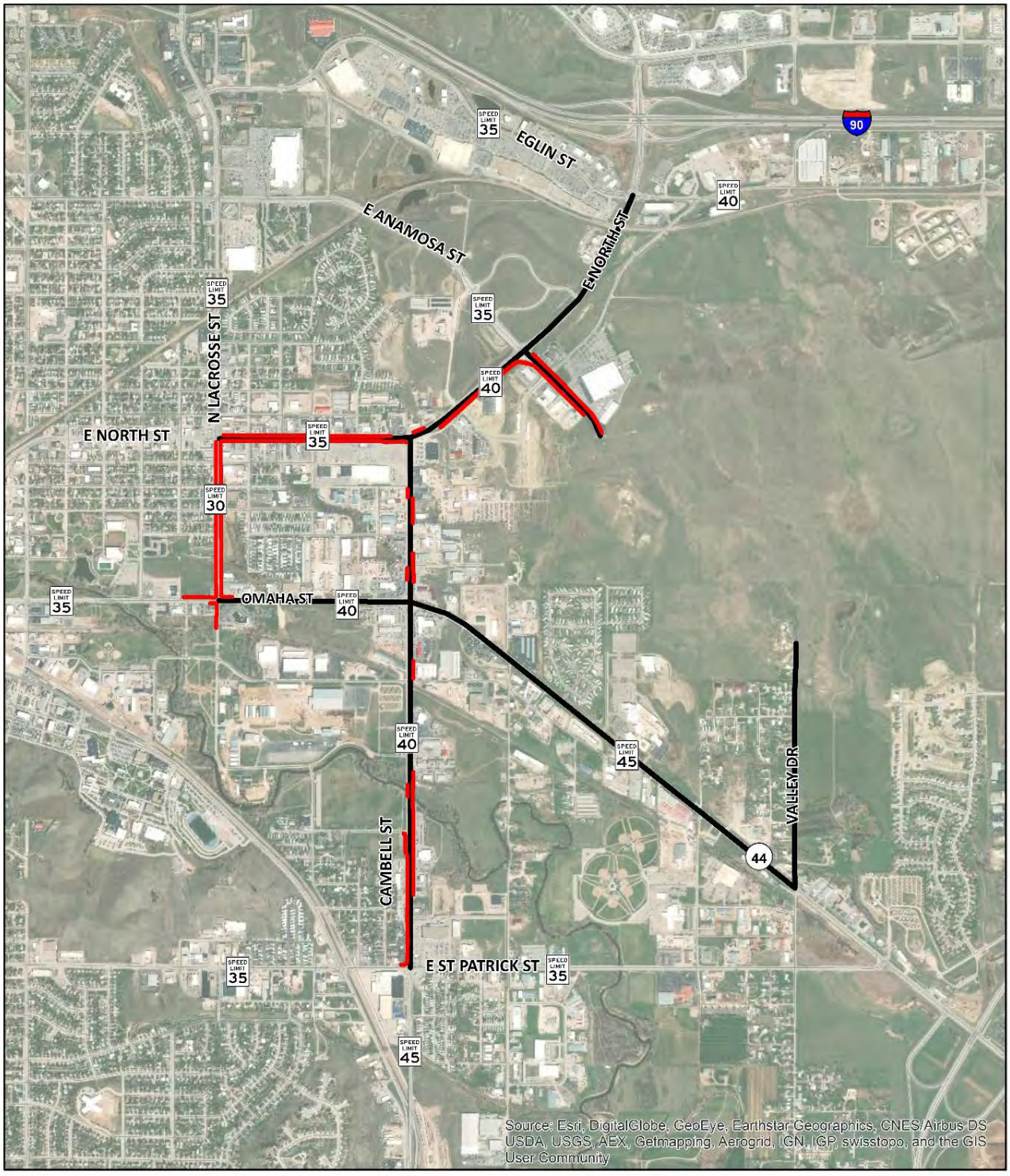
Figure 1.12 – Unofficial Walking Route on Cambell Street

Figure 1.13 – Pedestrian Trail on SD 44

East North Street

Between LaCrosse Street and Cambell Street, there are 5 foot wide sidewalks with 4.5 foot stamped concrete buffers on each side of the roadway. A 5 foot sidewalk was recently installed on the southeast side of East North Street between Century Road and Anamosa Street, however there remains a gap in the sidewalk network between Cambell Street and Century Road.

Figure 1.14 – Sidewalks Along Primary Study Roadways



Legend

Sidewalks

Study Roadways

BICYCLE FACILITIES

The only dedicated bicycle facilities in the study area are a shared-use path along Anamosa Street and the eastern portion of the Leonard “Swanny” Swanson Memorial Pathway. The Leonard “Swanny” Swanson Memorial Pathway crosses under both Cambell Street and Omaha Street, which then provides connectivity to many locations in northern Rapid City. Sidewalks on both Cambell and Omaha Streets connect to the bike path, however there are no dedicated bicycle facilities along these roadways.

Other than the facilities discussed above, there are no other dedicated bicycle facilities within the study area, and since most sidewalks in the area are 5 feet wide, these sidewalks do not serve as shared-use facilities for bicycles and pedestrians.

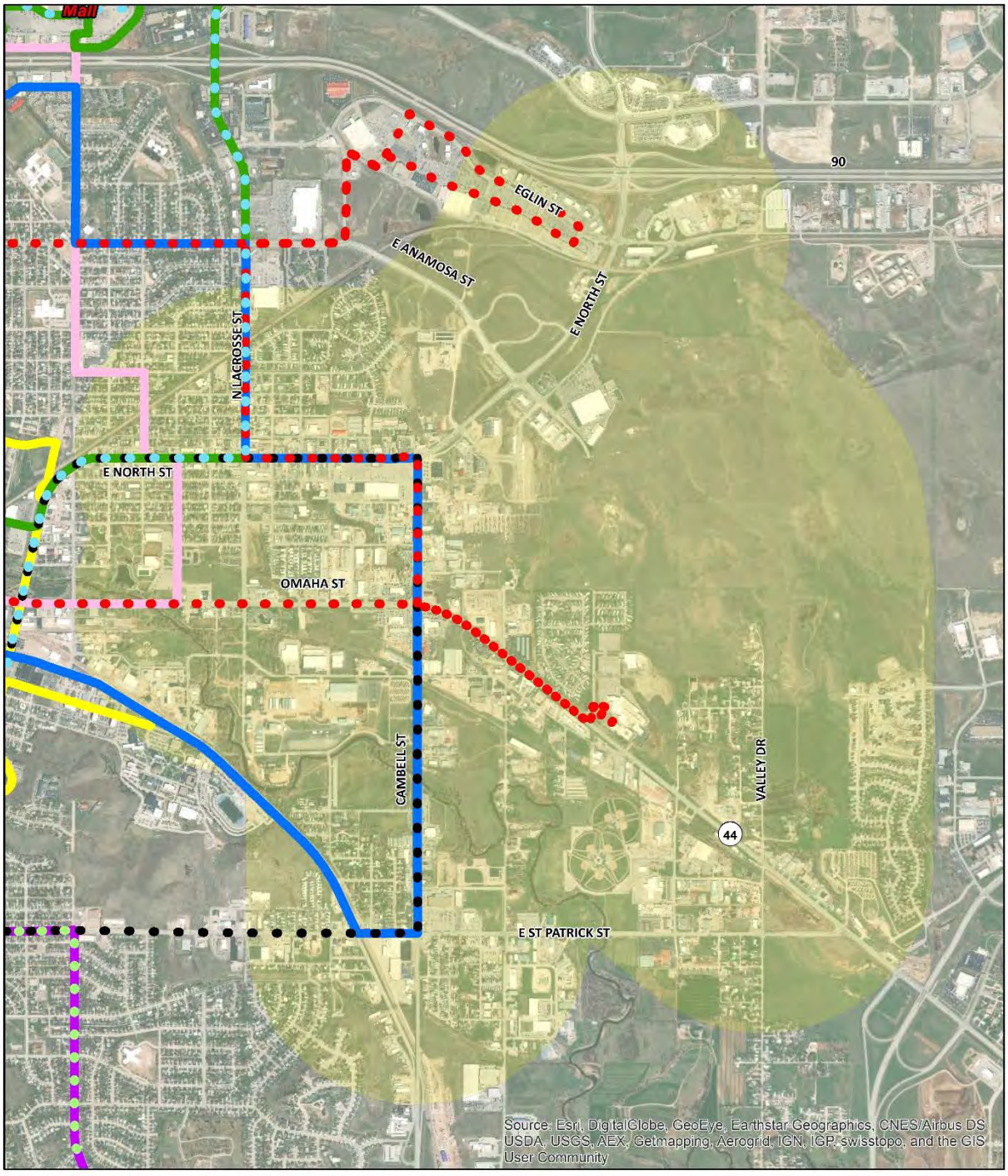
Study area speed limits on Cambell Street and Omaha Street are 35-45 miles per hour, and 35-40 miles per hour on East North Street. Since daily volumes are above 15,000 AADT through most of the study areas, the combination of prevailing traffic volumes and vehicle speeds can be uncomfortable and discourage usage for many on-street cyclists.

TRANSIT FACILITIES

RapidRide Hours of operation are Monday through Friday from 6:20 a.m. to 5:50 p.m., and on Saturday from 9:50 a.m. to 4:40 p.m. Existing transit routes within the study area extend along Eglin Street west of East North Street, along East North Street west of Cambell Street, and along Cambell Street between East North Street and East Saint Patrick Street. A route also extends along LaCrosse Street north of Omaha Street (See **Figure 1.15**).

Existing transit conditions were discussed with RapidRide Transit staff. They stated that the biggest issue reported by their bus drivers was the presence of long queues for northbound traffic on Cambell Street at the SD 44 intersection. There are no current plans to further extend routes within the study area.

Figure 1.15 – Study Area Transit Routes



Existing Levels of Service

Existing levels of service (LOS) for automobiles, bicyclists, and pedestrians were evaluated using the HCS 7 software, which implements the level of service analysis methodology described in the *Highway Capacity Manual*. Level of service is a letter grade assigned to transportation infrastructure to indicate the quality of service for each travel mode, with LOS "A" indicating high quality facilities that are efficient and comfortable for roadway users, and LOS "F" indicating high delays or high degrees of discomfort.

Automobile Level of Service

Automobile levels of service were evaluated at the following signalized study area intersections:

- SD 44/East Omaha Street and LaCrosse Street
- SD 44/East Omaha Street and Cambell Street
- Cambell Street and East Saint Patrick Street
- Cambell Street and East North Street
- East North Street and LaCrosse Street
- East North Street and East Anamosa Street
- East North Street and Eglin Street

Automobile level of service is assigned to an intersection based on the amount of delay experienced by each vehicle at the intersection. At signalized intersections, the following delay thresholds apply to each level of service:

- LOS A – Less than 10 seconds of delay per vehicle
- LOS B – 10 to 20 seconds of delay per vehicle
- LOS C – 20 to 35 seconds of delay per vehicle
- LOS D – 35 to 55 seconds of delay per vehicle
- LOS E – 55 to 80 seconds of delay per vehicle
- LOS F – More than 80 seconds of delay per vehicle

Intersection level of service at signalized intersections is a function of prevailing peak hour traffic volumes, traffic composition (i.e. percent trucks), roadway configurations (number of lanes, including turn lanes), and signal timing/phasing.

For this analysis, overall intersection LOS "C" or better is considered acceptable. This is consistent with the level of service goal that SDDOT has established for urban roadways. Subsequent alternatives analysis that is discussed later in this Report will strive to identify and recommend improvements that provide operations at LOS "C" or better.

Note that all traffic operations analysis in this study was performed for typical weekday traffic conditions. It is understood that some days throughout the year may have atypically high traffic volumes, such as days with events at the fairgrounds, however this analysis does not consider these unusually high-volume scenarios.

EXISTING PEAK HOUR TRAFFIC VOLUMES

KLJ collected 12 hours of turning movement data at the study intersections listed above to identify both the AM and PM peak hours. For peak hour intersection capacity analysis, the peak hour at each individual location was evaluated to ensure that the maximum traffic time period was being evaluated (i.e. peaks may begin at 4:00 pm at one location, 4:15 at another, etc).

Existing AM and PM peak hour turning movements and existing intersection lane configurations (including channelized movements) can be seen in **Figure 1.16**. Detailed turning movement count data can be found in **Appendix D**.

SIGNAL TIMING ASSUMPTIONS

Existing traffic operations analysis was performed using signal timing information provided by the City of Rapid City.

LANE UTILIZATION

Lane use imbalance can impact intersection operations, especially impacting queue lengths. As such, lane utilization information was collected for the following movements in the study area:

- East North Street and Anamosa Street
  - Southbound (Anamosa Street) through movements
  - Westbound (East North Street) through movements
- Cambell Street and Omaha Street
  - Northbound through movements
- East North Street and Cambell Street
  - Northbound left turn movements

Lane utilization information listed in **Tables 1.3, 1.4, 1.5, and 1.6** was incorporated into HCS capacity analysis models.

East North Street and Anamosa Street

The southbound through movement on Anamosa Street has a high imbalance of traffic using the right through lane, with 82 percent of traffic using this lane in the 12-hour observation period. AM and PM peak conditions follow this trend, with 90 percent of AM peak vehicles and 76 percent of PM peak vehicles selecting the right southbound lane.

The westbound through movement on East North Street also has a high imbalance of traffic, with 69 percent of all observed vehicles using the left through lane, with AM and PM peak hours closely following this trend.

Table 1.3 - Southbound Through Movement Lane Utilization on Anamosa Street at East North Street

Time-Period	Left Lane Usage	Right Lane Usage
12-Hour Average	18%	82%
AM Peak	10%	90%
PM Peak	24%	76%

Table 1.4 - Westbound Through Movement Lane Utilization on East North Street at Anamosa Street

Time-Period	Left Lane Usage	Right Lane Usage
12-Hour Average	69%	31%
AM Peak	72%	28%
PM Peak	67%	33%

Cambell Street and Omaha Street

The northbound through lane utilization on Cambell Street at Omaha Street is imbalanced, with higher utilization of the right lane throughout the day. 61 percent of all observed vehicles used the right lane, with this increasing to 67 percent in the AM peak hour.

Table 1.5 - Northbound Through Movement Lane Utilization on Cambell Street at Omaha Street

Time-Period	Left Lane Usage	Right Lane Usage
12-Hour Average	39%	61%
AM Peak	33%	67%
PM Peak	45%	55%

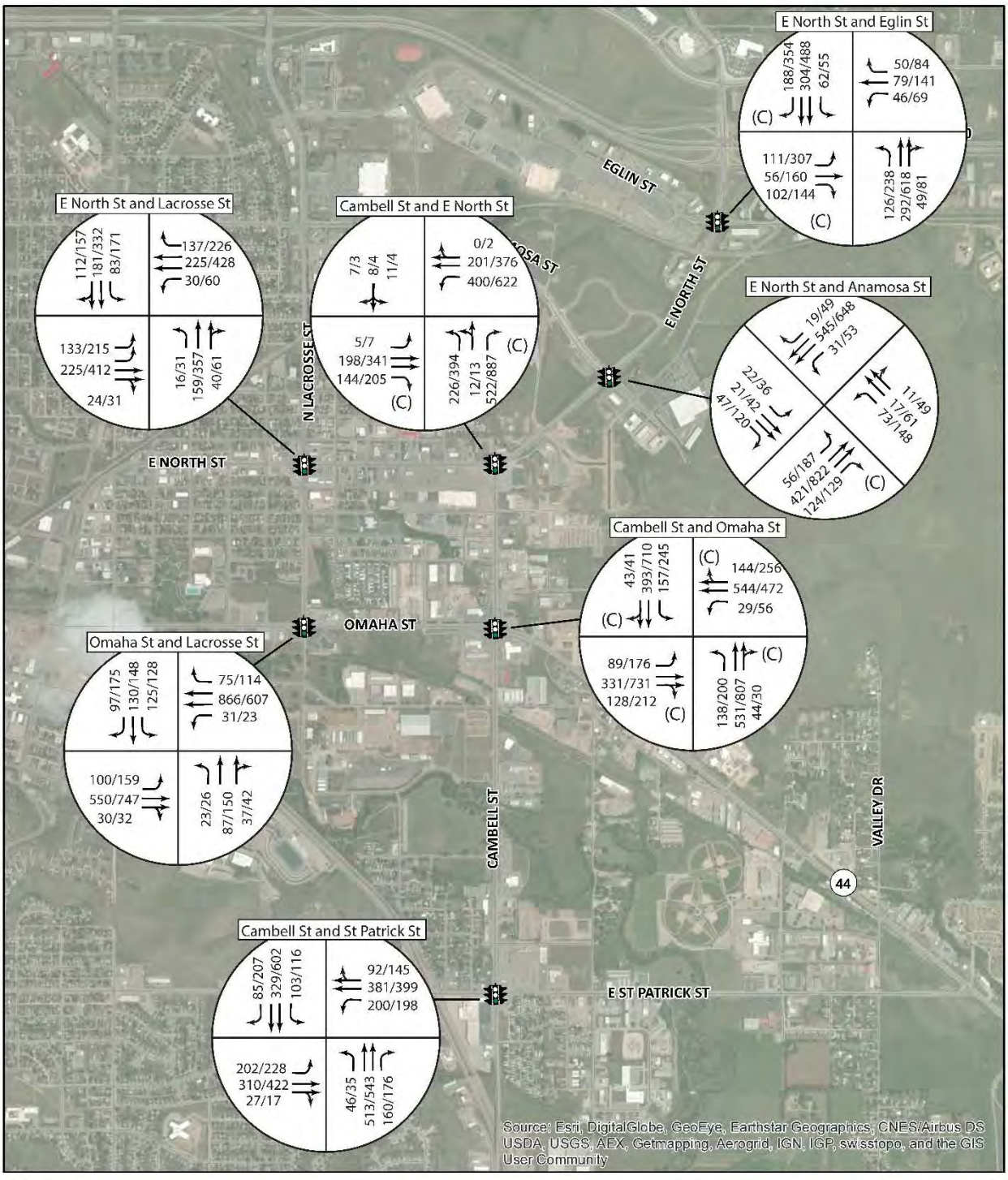
East North Street and Cambell Street

The two lanes that can be used for northbound left turns from Cambell Street to East North Street are utilized approximately evenly. Slightly more vehicles use the right lane (the shared through/left turn lane) throughout the day, but an even split was observed in the AM peak hour, and a slight imbalance toward the left lane was observed in the PM peak hour.

Table 1.6 - Northbound Left Turn Movement Lane Utilization on Cambell Street at East North Street

Time-Period	Left Lane Usage	Right Lane Usage
12-Hour Average	47%	53%
AM Peak	50%	50%
PM Peak	52%	48%

Figure 1.16 – Existing AM and PM Peak Hour Turning Movements



AUTOMOBILE LEVEL OF SERVICE ANALYSIS RESULTS

Overall intersection operations are at LOS "C" or better throughout the study area, except the intersection of Cambell Street and East North Street, where overall intersection LOS "D" is experienced in the PM peak hour.

The most significant delays at individual study intersection approaches include:

- Cambell Street and Omaha Street
  - Eastbound approach LOS "D" in PM peak hour
- Cambell Street and East North Street
  - Westbound approach LOS "E" in PM peak hour
  - Southbound approach LOS "D" and LOS "E" in AM and PM peak hours, respectively
- East North Street and LaCrosse Street
  - Southbound approach LOS "D" in AM peak hour
  - Northbound approach LOS "D" in AM and PM peak hours
- East North Street and Eglin Street
  - Westbound approach LOS "D" in AM and PM peak hours
  - Eastbound approach LOS "E" in PM peak hour

Level of service analysis results at all study intersections can be seen in tabular form in **Table 1.7** and graphically in **Figure 1.17**. Detailed level of service results can be found in **Appendix E**.

Table 1.7 – Intersection Level of Service Summary

Intersection	NB/SB Roadway	EB Delay/LOS				WB Delay/LOS				NB Delay/LOS				SB Delay/LOS				Overall Delay/LOS			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
Cambell and St. Patrick	Cambell	22.1	C	25.0	C	23.9	C	27.1	C	31.3	C	31.7	C	25.7	C	28.3*	C*	**26.2**	C	**28.1***	C*
Cambell and Omaha	Cambell	25.8*	C*	39.6*	D*	24.7*	C*	30*	C*	28.4*	C*	31.2*	C*	23.4*	C*	28.6*	C*	**25.8***	C*	**32***	C*
Cambell and North	Cambell	16.2	B	25.9	C	30.2	C	56.8*	E*	8.6	A	26.8	C	48.4	D	62.8	E	**18.0**	B	**36.5***	D*
Omaha and Lacrosse	Lacrosse	9.6	A	12.6	B	7.9	A	19.9*	B*	31.5	C	29.2	C	34.7	C	32.7	C	**17.2**	B	**20.3***	C*
North and Lacrosse	Lacrosse	20.3	C	25.4	C	14.6	B	22.4*	C*	40.4	D	37.2*	D*	36.8	D	30.3	C	**25.0**	C	**27.5***	C*
North and Anamosa	Anamosa	7.7	A	12.2	B	11.1	B	20.1	C	33.5	C	32.5	C	23.6	C	34.2	C	**11.8**	B	**19.7**	B
North and Eglin	North	19.9*	B*	57.6*	E*	40.9	D	43.9	D	16.1	B	20.6	C	17.8	B	26.4*	C*	**20.3***	C*	**34.1***	C*

Note: Delay presented in seconds of delay per vehicle *Queue spillback may increase delays over presented values

Corridor Level of Service

Corridor levels of service were also determined using the HCS 7 software. The corridor level of service also considers access density between signalized intersections and the associated impacts on travel speeds. Corridor level of service is established based on the difference between prevailing travel speeds and free-flow travel speeds. Corridor level of service thresholds are:

- LOS A: Travel speeds are 80 percent or more of free-flow speed
- LOS B: Travel speeds are between 67 and 80 percent of free-flow speed
- LOS C: Travel speeds are between 50 and 67 percent of free-flow speed
- LOS D: Travel speeds are between 40 and 50 percent of free-flow speed
- LOS E: Travel speeds are between 30 and 40 percent of free-flow speed
- LOS F: Travel speeds are less than 30 percent of free-flow speed

In the AM peak hour, corridor LOS "C" or better is experienced throughout the study area. More delays are present in the PM peak hour, with corridor LOS "D" being experienced on Omaha Street, on East North Street between LaCrosse Street and Cambell Street, and on Cambell Street between Omaha Street and East North Street.

Queuing Issues

Existing queues were evaluated to determine if turn lane storage is exceeded (queue storage ratio is greater than 1.0) or if through queues block access to turn lanes or block major accesses. No queues were found to extend back to upstream public intersections under existing traffic volumes.

Queueing analysis considered both 50th percentile queues (assumed to approximate average queues) and 95th percentile queues. Some queue spillback issues were found at all study intersections except for East North Street and Anamosa Street.

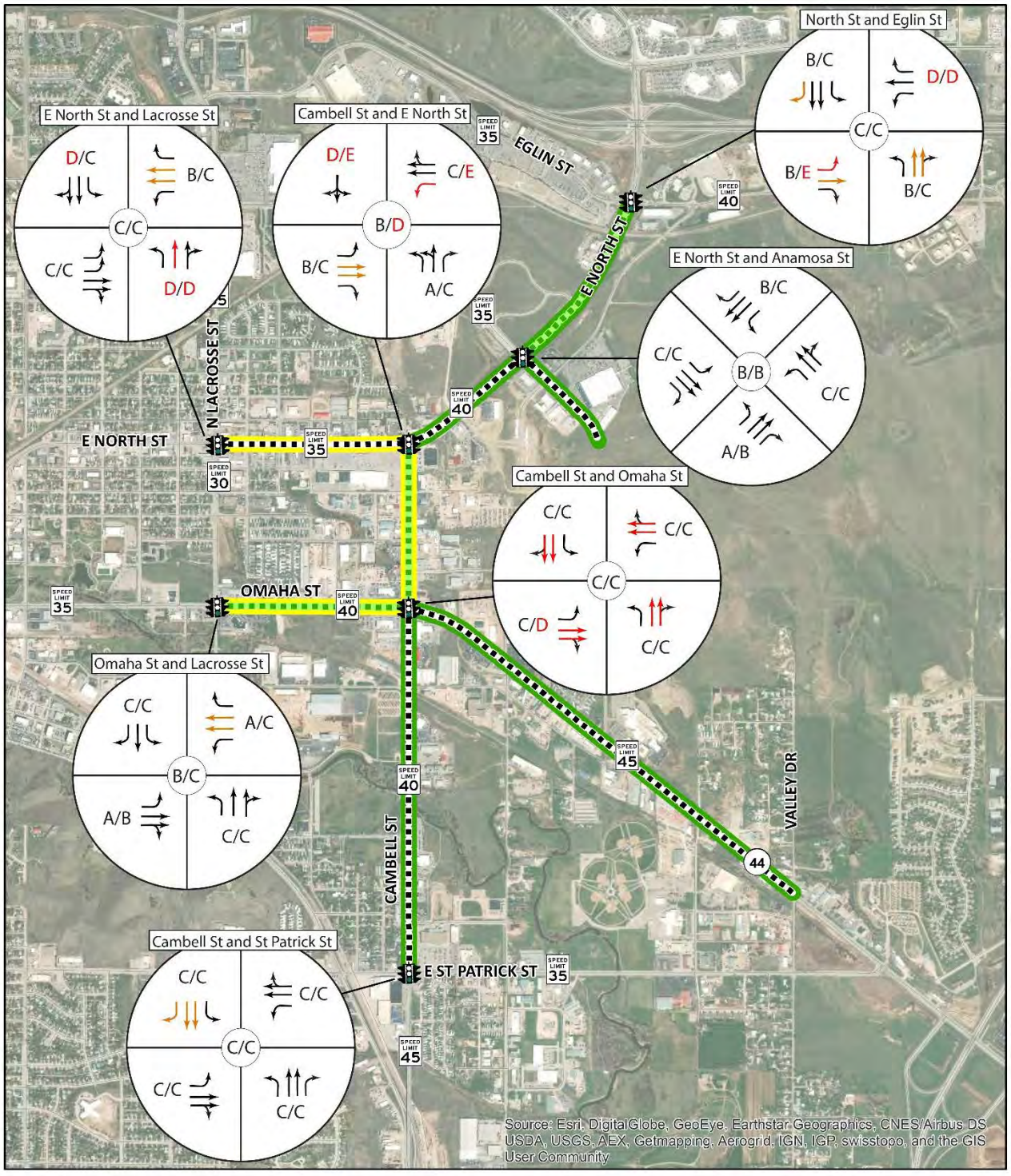
Note that queue spillback issues can result in additional delays beyond those calculated using the Highway Capacity Manual methodology.

Specific issues include:

- Cambell Street and Saint Patrick Street
  - Southbound 95th percentile through queues block channelized right-turn turn lane access during PM peak hour
  - Southbound 95th percentile right turn queue exceeds storage in PM peak hour*
- Cambell Street and Omaha Street/SD 44
  - 50th percentile through queues block access to channelized right turns on all approaches in PM peak hour
- Omaha Street and LaCrosse Street
  - Westbound 95th percentile through queue blocks access to right turn lane in PM peak hour
- East North Street and LaCrosse Street
  - Northbound 95th percentile through queue blocks access to left turn lane in PM peak hour
  - Westbound 95th percentile through queue blocks access to right turn lane in PM peak hour
  - Westbound 95th percentile right turn queue exceeds storage in PM peak hour*
- Cambell Street and East North Street
  - Westbound 50th percentile left turn queue exceeds storage in PM peak hour*
  - Eastbound 50th percentile through queues block left turn lane access in AM and PM peak hours (only 70 foot left turn lane length)
- East North Street and Eglin Street
  - Eastbound 50th percentile left turn queue exceeds storage in PM peak hour*
  - Eastbound 95th percentile through queue blocks turn lane access in PM peak hour
  - Southbound 95th percentile right turn queue exceeds storage in PM peak hour*

** Turn lane has queue storage ratio above 1.0*

Figure 1.17 – Existing Automobile Level of Service



Pedestrian and Bicycle Levels of Service

Pedestrian and bicycle level of service was evaluated using the HCS 7 software. Key inputs to this analysis are the presence of pedestrian or bicycle facilities, roadway widths, buffer spaces between moving traffic and sidewalks, vehicle speeds, and traffic signal spacing.

Given the lack of bicycle facilities and the sporadic presence of sidewalks on study roadways, pedestrian and bicycle levels of service are poorer than vehicle levels of service.

Existing pedestrian and bicycle levels of service can be seen in Figure 1.18.

PEDESTRIAN LEVEL OF SERVICE

Pedestrian LOS "F" is experienced on the following segments:

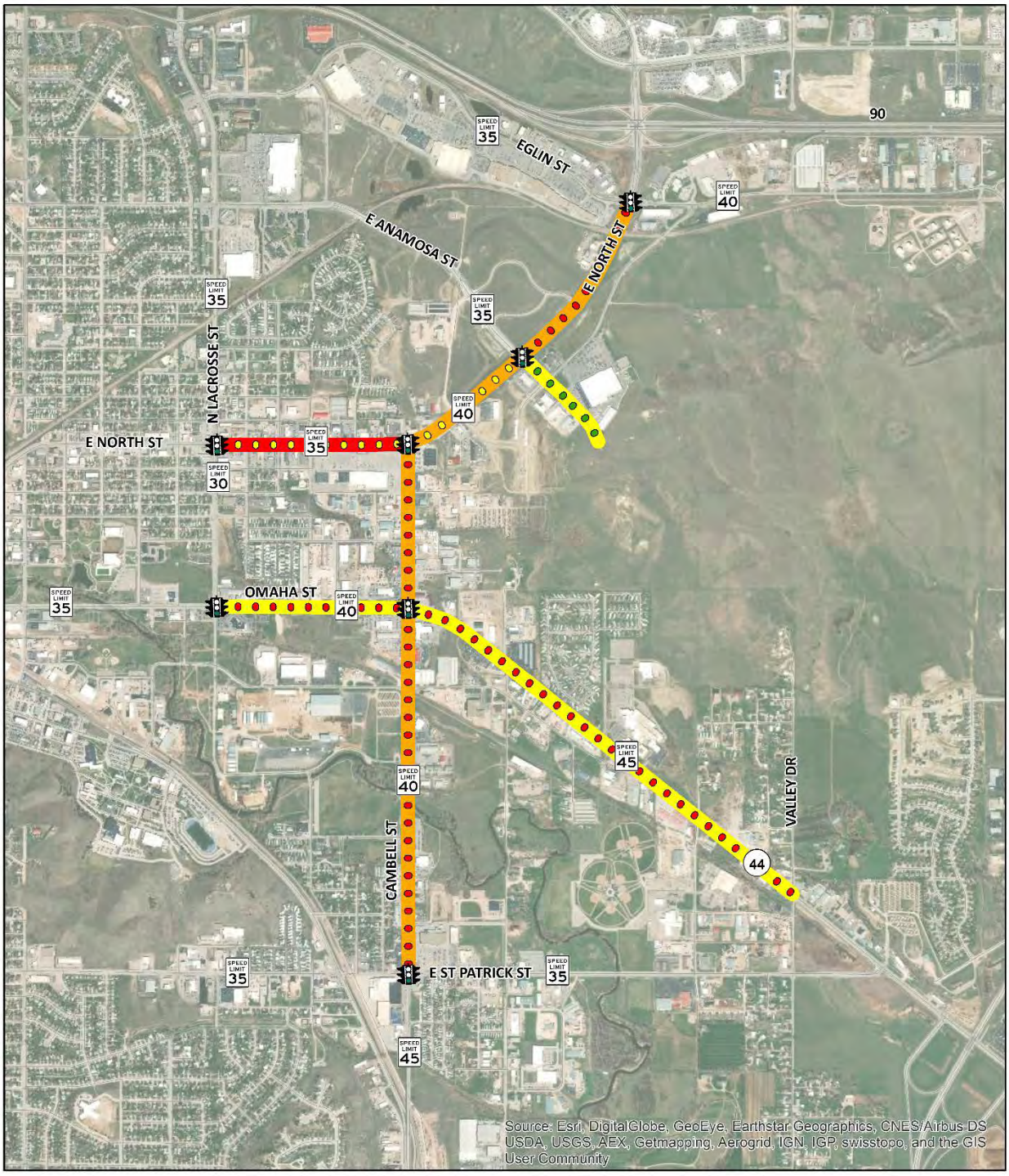
- Omaha Street/SD 44 throughout the project area
  - No sidewalks
- Cambell Street throughout the project area
  - Many gaps in sidewalk
- East North Street from Anamosa Street to Eglin Street
  - No sidewalks

Other than the short segment of Anamosa Street southwest of East North Street, the remainder of the pedestrian experiences LOS "D" or LOS "E", still indicating some uncomfortable walking conditions in the study area.

BICYCLE LEVEL OF SERVICE

Bike LOS "D" or worse is also experienced in the project area, with LOS "F" experienced on East North Street between LaCrosse Street and Cambell Street. Bike LOS "E" is experienced on both Cambell Street and on East North Street east of Cambell Street. The best bicycle level of service in the area is LOS "D" on Omaha Street.

Figure 1.18 – Pedestrian and Bicycle Levels of Service



Crash Analysis

Study area crash data was evaluated for the 2013 to 2017 time period. The crash analysis evaluated:

- **Intersection crashes**: Intersection-related crashes at locations where turning movement counts were obtained
- **Segment crashes**: Non-junction related crashes and intersection crashes at minor intersections along segments between primary study intersections

The obtained crash data identifies crashes as one of the following crash types: angle, head-on, rear-end, sideswipe (same direction and opposite direction), and non-collision with motor vehicle. Furthermore, crash severity is reported as: no injury, possible injury, non-incapacitating injury, incapacitating injury, or fatal.

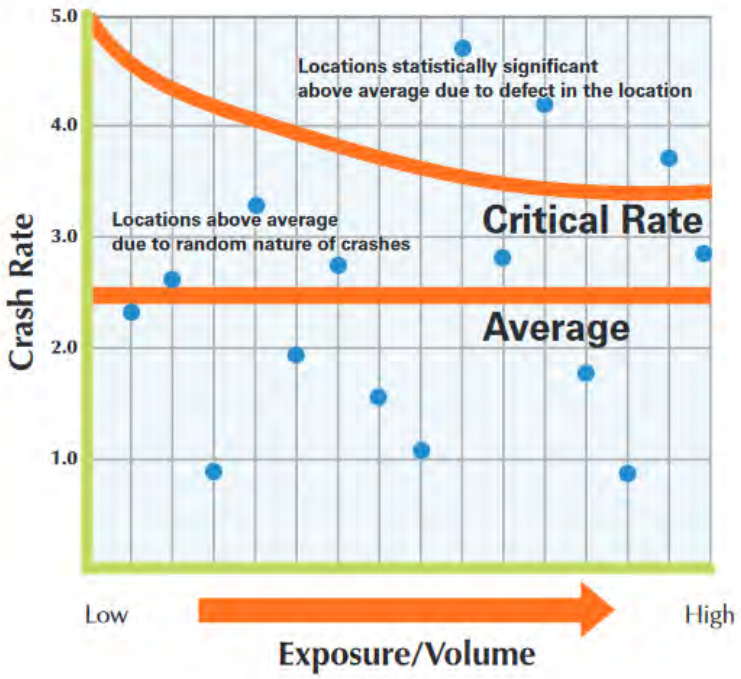
A tabular summary of crash data at intersections and along roadway segments can be seen in **Table 1.8**, and a graphical summary can be seen in **Figure 1.25** at the end of this section.

CRASH RATE COMPARISON

Intersection and segment crash rates were compared to average crash rates on similar facilities. The data used for this comparison was published by the Minnesota Department of Transportation (MnDOT). The comparison data used by MnDOT parses crash data out by traffic control, speed limit, traffic volume, and typical roadway cross-section. This applies well to conditions evaluated within the Rapid City study area.

To determine whether crash rates are above average crash rates simply due to the random nature of crashes or if elevated crash rates are attributable to roadway design or traffic control, the *critical crash analysis* methodology was used. The critical crash analysis method uses statistical analysis to determine if differences between observed crash rates and average crash rate are statistically significant, typically at a 99 percent confidence interval. Improvements to reduce crashes will be considered in alternatives analysis at locations with crash rates above the critical crash rate.

Figure 1.19 – Critical Crash Rate Concept



Source: MnDOT

Table 1.8 – Summary of Crash Data

Intersection	MEV	Total Crashes	Crash Severity					Observed CR	Critical CR	Crash Type					
			K	A	B	C	PD			Rear End	Sideswipe	Angle	Head On	Single Vehicle	Other
Omaha Street and Lacrosse Street	47.8	43	0	0	11	7	25	**0.90**	0.79	6	0	37	0	0	0
Omaha Street and Cambell Street	74.3	93	0	1	14	19	59	**1.25**	0.74	56	1	31	1	4	0
St Patrick Street and Cambell Street	66.6	39	0	3	5	8	23	0.59	0.75	14	1	23	1	0	0
North Street and Cambell Street	55.8	78	0	0	9	12	57	**1.40**	0.77	31	0	45	0	2	0
North Street and Lacrosse Street	50.0	37	0	0	6	9	22	0.74	0.79	13	0	22	0	2	0
North Street and Anamosa Street	43.5	23	0	3	2	3	15	0.53	0.81	10	1	11	1	0	0
North Street and Eglin Street	45.7	40	0	3	5	9	23	**0.88**	0.8	20	3	17	0	0	0

Segment	Million VMT	Total Crashes	Crash Severity					Observed CR	Critical CR	Crash Type					
			K	A	B	C	PD			Rear End	Sideswipe	Angle	Head On	Single Vehicle	Other
Omaha Street: Lacrosse Street to Cambell Street	16.7	28	0	1	4	3	20	1.68	3.63	14	2	8	0	4	0
Omaha Street: Cambell Street to Valley Drive	38.8	74	0	4	10	19	41	1.91	3.27	18	3	38	1	14	0
Cambell Street: St Patrick Street to Omaha Street	40.0	100	0	1	15	19	65	2.50	3.26	46	7	36	1	10	0
Cambell Street: Omaha Street to North Street	17.7	61	0	0	7	9	45	3.45	3.6	37	5	18	0	1	0
North Street: Cambell Street to Anamosa Street	16.1	24	0	0	1	5	18	1.49	3.65	9	2	12	0	1	0
North Street: Anamosa Street to Eglin Street	15.1	20	0	1	2	4	13	1.33	3.69	10	2	7	0	1	0
North Street: Lacrosse Street to Cambell Street	13.2	71	2	2	13	14	40	**5.36**	3.77	20	4	42	0	5	0
Anamosa St: SE of North Street	2.8	5	0	0	2	2	1	1.80	5.51	1	0	1	0	3	0
Valley St: North of SD 44	0.7	2	0	0	0	0	2	2.74	10.36	0	0	1	0	1	0

Crash Severity: K = Fatal; A = Incapacitating Injury ; B = Non-incapacitating Injury ; C = Possible Injury ; PD = Property Damage Only
MEV = Million entering Vehicles
Million VMT = Million Vehicle Miles Traveled

INTERSECTION CRASHES

Four intersections have crash rates above the critical crash rate.

Above Intersection Critical Crash Rate

The following intersections have observed five-year crash rates above the critical crash rate:

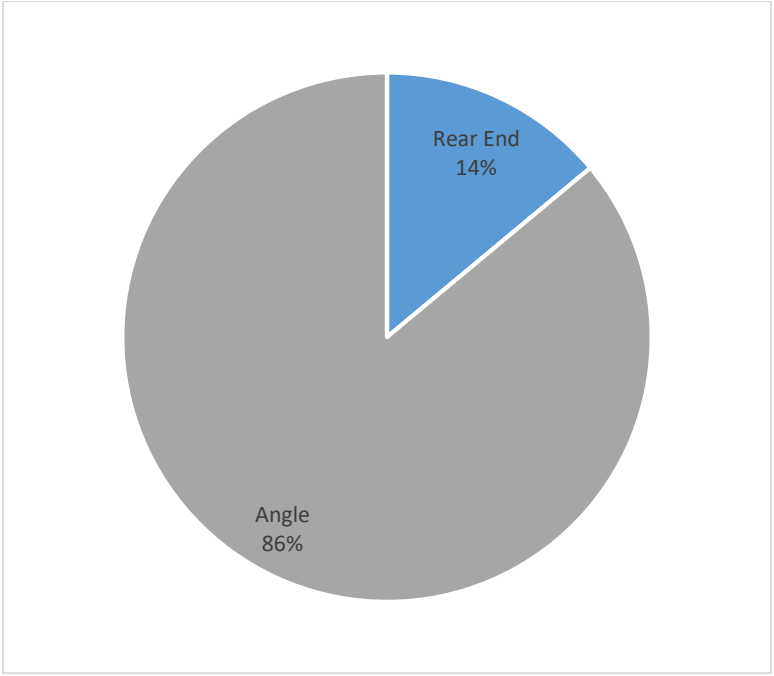
- Omaha Street and LaCrosse Street
- Omaha Street and Cambell Street
- East North Street and Cambell Street
- East North Street and Eglin Street

Omaha Street and LaCrosse Street

This intersection had 43 crashes in the five-year period, resulting in a crash rate of 0.90 crashes per million entering vehicles (MEV), compared to the critical crash rate of 0.79 per MEV. Of the 43 crashes, 18 crashes resulted in possible injuries or non-incapacitating injuries (42 percent). No incapacitating injuries or fatalities were reported.

Angle crashes were the most common crash type (37 crashes, or 86 percent of crashes). Angle crashes were not overrepresented on any of the approaches. The remaining six crashes were rear-end crashes. 21 angle crashes involved left turning vehicles, with all left turns operating under permitted left turn phasing (northbound/southbound) or protected-permissive left turn phasing (eastbound/westbound).

Figure 1.20 – Intersection Crash Distribution at Omaha Street and LaCrosse Street

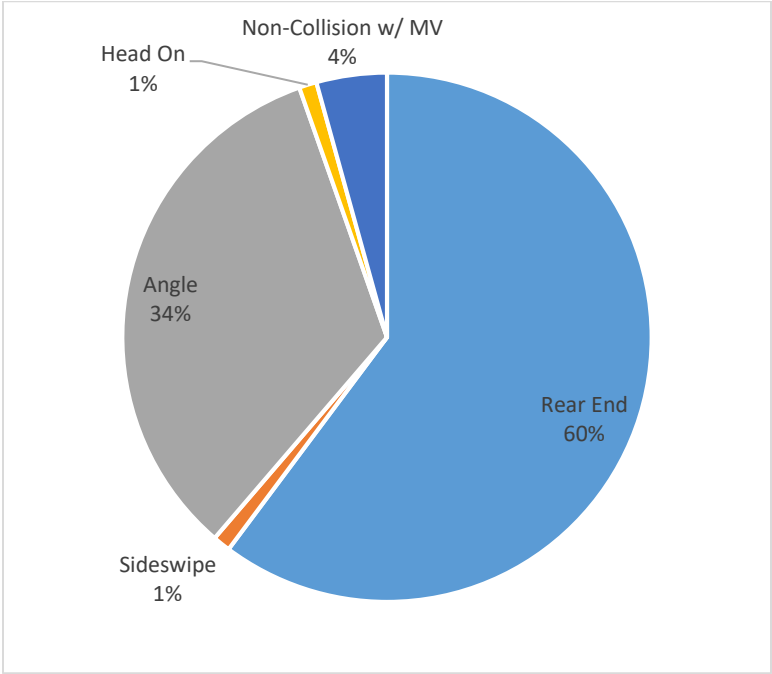


Omaha Street and Cambell Street

This intersection had 93 crashes in the five-year period, resulting in a crash rate of 1.25 crashes per MEV (0.74 per MEV is the critical rate). 33 crashes (35%) resulted in possible or non-incapacitating injuries, with one crash resulting in an incapacitating injury. No fatalities were reported.

Rear-end crashes are the most common crash type with 56 crashes (60 percent). This could be attributable to long queues on all approaches during peak periods, especially the PM peak period. Rear end crashes were most prevalent on the northbound approach (19 crashes), with the eastbound and southbound approaches experiencing 16 and 13 crashes, respectively. 20 of 56 rear-end crashes occurred at channelized right turns, with the channelized westbound right turn having 10 crashes. The second most prevalent crash type is angle crashes with 31 crashes (33 percent). 24 angle crashes were left-turn related, with all left turns operating under protected-permissive phasing. There was a roughly even split between angle crashes on the northbound/southbound and eastbound/westbound approaches.

Figure 1.21 – Intersection Crash Distribution at Omaha Street and Cambell Street

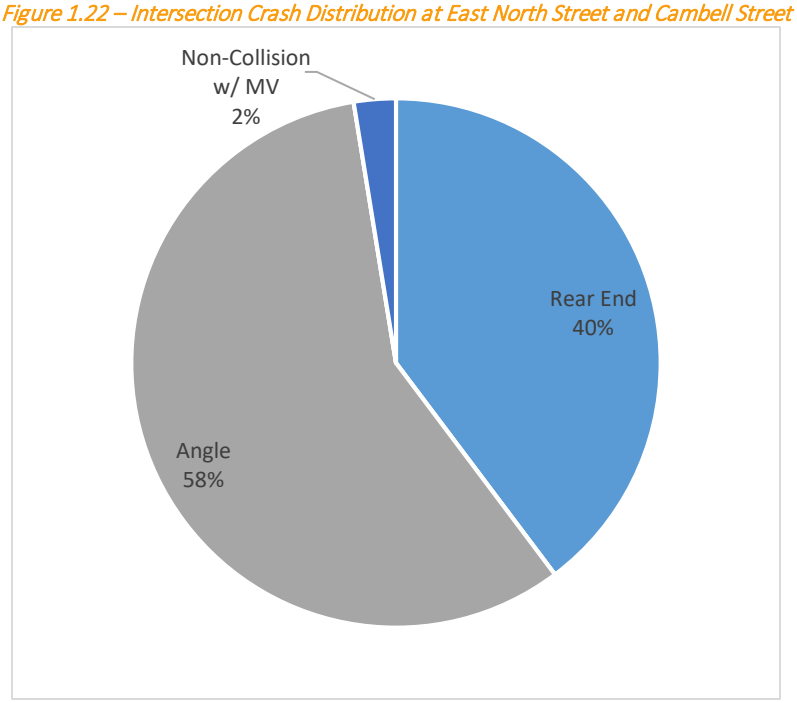


East North Street and Cambell Street

78 crashes were reported in the five-year period, resulting in a crash rate of 1.4 crashes per MEV (0.77 per MEV is the critical rate). 21 crashes (27 percent) resulted in possible injuries or non-incapacitating injuries. No crashes resulted in incapacitating injuries or fatalities.

45 crashes (58 percent) of crashes were angle crashes, with all but one angle crash being related to left-turning movements. All but two of these crashes involved westbound vehicles. Left-turns operate under permitted-only phasing beside the westbound left turn which operates under protected-permitted phasing. 31 crashes were rear-end crashes which could be attributable to queue spillback on each approach except the southbound approach. The northbound approach experienced 14 rear-end crashes, with the eastbound and westbound approaches experiencing 9 crashes and 8 crashes, respectively.

Figure 1.22 – Intersection Crash Distribution at East North Street and Cambell Street



Flashing-Yellow Arrow Implementation

The westbound left-turn at East North Street and Cambell Street was converted to flashing-yellow arrow operations on August 19th, 2015. Converting crash totals occurring before and after flashing-yellow arrow implementation, the following trends were observed:

- Total crashes per year before flashing-yellow arrow implementation: 14.1 crashes per year
  - Angle crashes per year before: 10.3 angle crashes per year
- Total crashes per year after flashing-yellow arrow implementation: 17.3 crashes per year
  - Angle crashes per year after: 7.59 angle crashes per year

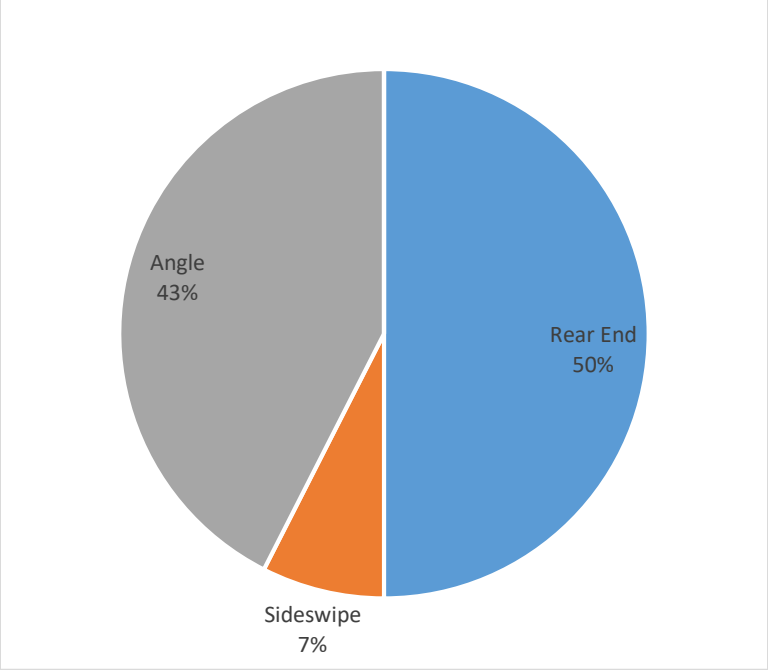
Based on this sample, the total number of crashes per year has increased by 23 percent with flashing-yellow arrow operations, but angle crashes have decreased by 26 percent. Given the small sample size (fewer than three years of data under each configuration) crash rates should continue to be monitored to further evaluate crash rate changes associated with the implementation of the flashing-yellow arrow.

East North Street and Eglin Street

40 crashes were reported in the five-year period, resulting in a crash rate of 0.88 crashes per MEV (0.80 per MEV is the critical rate). 14 crashes resulted in possible or non-incapacitating injuries, and 3 crashes resulted in incapacitating injuries.

Rear end crashes were the most common crash type, with 20 rear-end crashes reported. Eastbound and northbound rear-end crashes were the most prevalent, which could be attributable to queue spillback issues on these approaches. There were 17 reported angle crashes, with 13 of these crashes involving left-turning vehicles. 10 left-turn crashes were between northbound and southbound vehicles.

Figure 1.23 – Intersection Crash Distribution at East North Street and Eglin Street



Other Intersections

The following crash patterns were observed at the other study intersections:

- Cambell Street and Saint Patrick Street
  - 39 crashes (13 possible or non-incapacitating injury crashes, 3 incapacitating injury crashes)
  - 23 angle crashes
  - 14 rear end crashes
- North Street and LaCrosse Street
  - 37 crashes (15 possible or non-incapacitating injury crashes)
  - 22 angle crashes
  - 13 rear end crashes
- North Street and Anamosa Street
  - 23 crashes (5 possible or non-incapacitating injury crashes, 3 incapacitating injury crashes)
  - 11 angle crashes
  - 10 rear end crashes

SEGMENT CRASHES

All segments have crash rates below the critical crash rate except for the segment of East North Street from LaCrosse Street to Cambell Street.

Above Segment Critical Crash Rate

East North Street from LaCrosse Street to Cambell Street

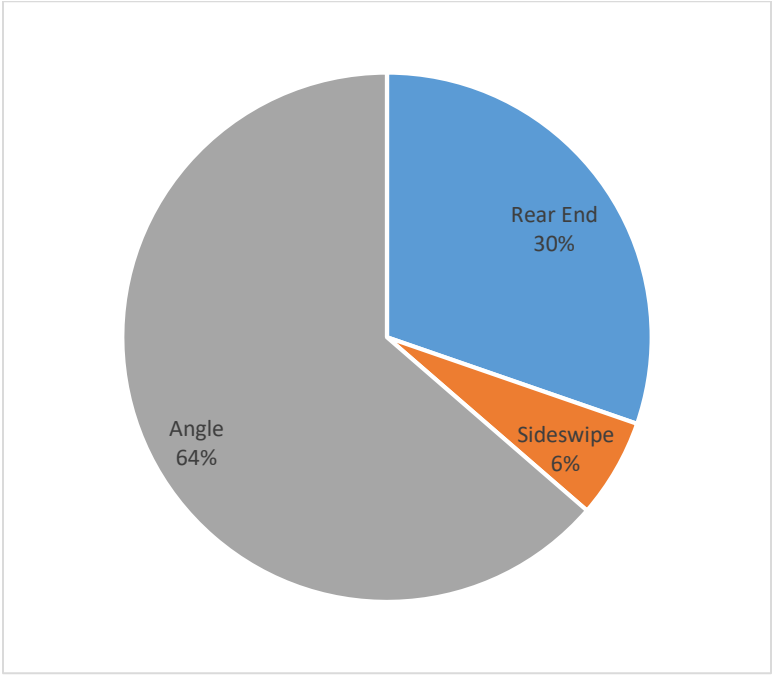
This segment has a crash rate above the critical crash rate, with 71 crashes being reported in five years. The observed crash rate of 5.36 crashes per million vehicle miles traveled (MVMT) is well above the critical crash rate of 3.77 crashes per MVMT.

The most prevalent crash types are angle crashes (42 crashes) and rear-end crashes (20 crashes). Peak hour congestion and access density (26 accesses, 52 accesses per mile) likely contribute to these types of crashes.

31 crashes resulted in injuries or possible injuries, with two of these crashes resulting in fatalities. Both fatal crashes occurred near Spruce Street, with one fatal angle crash involving an intoxicated driver fleeing the police and the other crash involving a pedestrian crossing East North Street, where alcohol was also involved.

If intersection-related crashes at Spruce Street are omitted from this analysis (8 crashes, all rear-end), the crash rate would lower to 4.76 crashes per MVMT, but would still be above the critical crash rate.

Figure 1.24 – Segment Crash Distribution on East North Street (LaCrosse Street to Cambell Street)



Other Segments

The following crash patterns were observed on other study segments:

- Omaha Street: LaCrosse Street to Cambell Street
  - 28 crashes (7 possible or non-incapacitating injury crashes, 1 incapacitating injury crash)
  - 14 rear end crashes
  - 8 angle crashes
- Omaha Street: Cambell Street to Valley Drive
  - 74 crashes (29 possible or non-incapacitating injury crashes, 4 incapacitating injury crashes)
  - 38 angle crashes, 18 rear end crashes
  - Longest segment studied (1.25 miles)
- Cambell Street: Saint Patrick Street to Omaha Street
  - 100 crashes (34 possible or non-incapacitating injury crashes, 1 incapacitating injury crash)
  - 46 rear end crashes
  - 36 angle crashes
  - Second-longest segment studied (1 mile)
- Cambell Street: Omaha Street to North Street
  - 61 crashes (16 possible or non-incapacitating injury crashes)
  - 37 rear end crashes
  - 18 angle crashes
- North Street: Cambell Street to Anamosa Street
  - 24 crashes (6 possible or non-incapacitating injury crashes)
  - 12 angle crashes
  - 9 rear end crashes
- North Street: Anamosa Street to Eglin Street
  - 20 crashes (6 possible or non-incapacitating injury crashes, 1 incapacitating injury crash)
  - 10 rear end crashes
  - 7 angle crashes
- Anamosa Street: Southeast of East North Street
  - 5 crashes (4 possible or non-incapacitating injury crashes)
  - 3 single vehicle crashes
- Valley Drive: North of SD Highway 44
  - 2 crashes (no injuries)
  - 1 rear end crash
  - 1 angle crash

PEDESTRIAN AND BICYCLE CRASHES

Within the study period, there were four crashes involving bicyclists and six crashes involving pedestrians.

Bicycle Crashes

Of the four total bicycle crashes, two occurred on Cambell Street between Saint Patrick Street and Omaha Street/SD 44, one resulting in a non-capacitating injury and the other resulting in a possible injury.

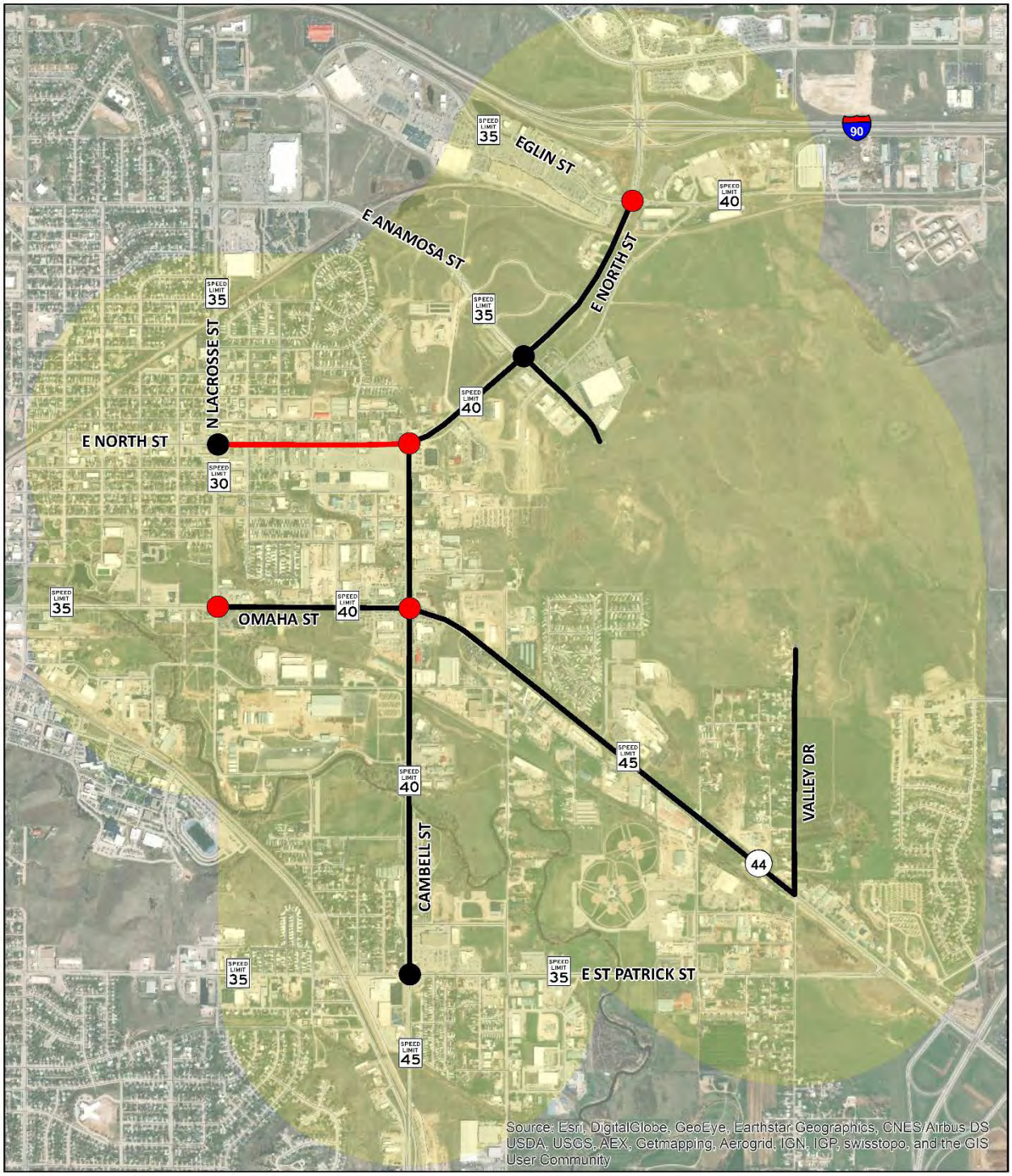
One bicycle crash resulting in an incapacitating injury occurred on SD 44, and another bicycle crash with a possible injury occurred at the intersection of North Street and LaCrosse Street.

Pedestrian Crashes

Of the six pedestrian crashes, four occurred on East North Street between LaCrosse Street and Cambell Street. On this segment, there was one pedestrian fatality when a pedestrian was struck near Spruce Street, with all other pedestrian crashes resulting in non-incapactiating or possible injuries. Three of the four pedestrian crashes on this segment of East North Street involved intoxicated pedestrians.

Two pedestrian crashes occurred on Cambell Street between Charles Street and Saint James Street, with one of these pedestrian crashes involving an intoxicated pedestrian who sustained a non-incapacitating injury. The other crash resulted in a possible pedestrian injury.

Figure 1.25 – Crash Analysis Summary



Summary of Existing Transportation Issues

Results from existing conditions analysis will be used later in this Report to develop a set of improvement strategies to mitigate various transportation issues that were discussed in this chapter. Some key issues that will be considered include:

- Lack of multimodal facilities:
  - **Sidewalks:** The sidewalk network is inconsistent, with many facility gaps that can discourage pedestrian activity and present challenges to individuals with disabilities. These conditions result in poor pedestrian levels of service, with LOS "E" or LOS "F" experienced in many locations in the area. There is also a pedestrian crash history in the study area, with six reported pedestrian crashes (four occurring on East North Street, with one fatality).
  - **Bicycle Facilities**: A lack of bicycle facilities along the high-traffic primary study roadways can discourage bicycle activity, with LOS "D", LOS "E", or LOS "F" experienced throughout the study area. There is also a lack of quality bicycle connections to facilities like the Leonard "Swanny" Swanson Memorial Pathway and the shared-use path on Anamosa Street. Four bicycle crashes have also been reported in the area.
- Elevated Crash Rates:
  - Observed crash rates are elevated at the intersections of Cambell Street/Omaha Street, Omaha Street/LaCrosse Street, Cambell Street/East North Street, and East North Street/Eglin Street. A high segment crash rate was also observed on East North Street between LaCrosse Street and Cambell Street.
- High Access Density:
  - Given the predominantly commercial land uses adjacent to primary study roadways, there are many private accesses in the study area, especially along Cambell Street and the portion of East North Street west of Cambell Street. High access density can reduce travel speeds and increases crash potential, which is consistent with higher crash rates and PM peak hour corridor LOS "D" on the higher density segments of Cambell and East North Street.
- Poor Automobile Level of Service:
  - Using LOS "C" as the mobility goal for the study area, some operational deficiencies exist today
    - Intersection LOS "D" is experienced at the intersection of Cambell Street and East North Street in the PM peak hour
    - Corridor LOS "D" is experienced on the more densely developed segments of Cambell Street, Omaha Street, and East North Street in the PM peak hour
- Queue Spillback:
  - While overall intersection operations are at LOS "C" or better throughout most of the study area (except East North Street and Cambell Street, which operates at LOS "D" in the PM peak hour), some queueing issues are present. Intersections where the average (50th percentile) peak hour queue length exceeds available storage are:
    - **Cambell Street and Omaha Street**: Through queues block channelized turn access on all approaches in the PM peak
    - **East North Street and Cambell Street**: Westbound left-turn queues exceed storage in PM peak
    - **East North Street and Eglin Street**: Eastbound left turn queue exceeds available storage in PM peak

CHAPTER 2: PROJECTED FUTURE CONDITIONS

This chapter provides an analysis of projected future conditions that will occur if no physical improvements are made. Traffic projections are commonly developed and used to examine traffic conditions at least 20 years into the future. Traffic conditions through the year 2045 were estimated to identify potential issues that may not exist today but could arise from future growth in the study area.

Traffic Projections

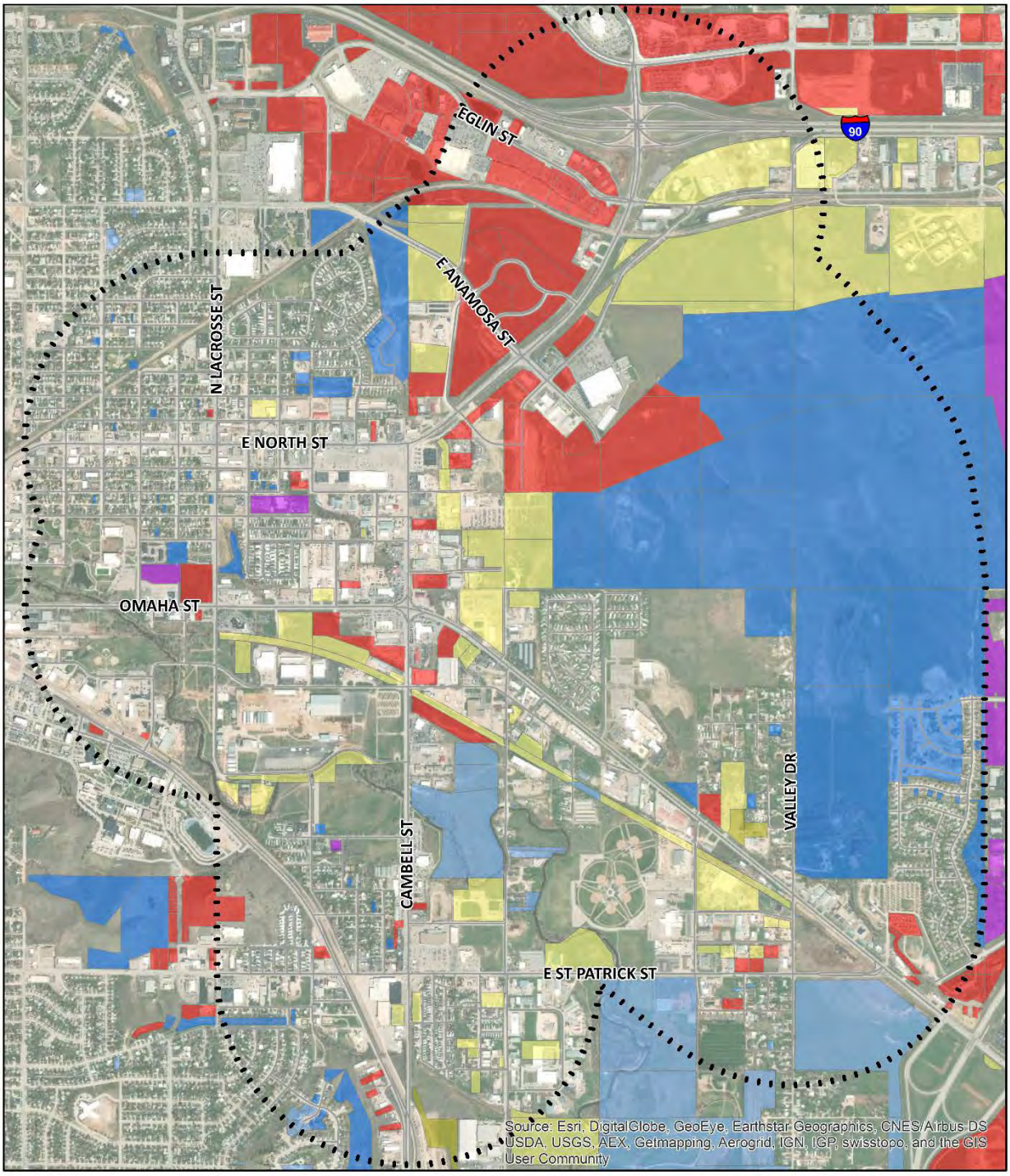
Study area traffic projections were developed for 2025 and 2045. These projections are based on 2040 Rapid City regional travel demand model results that were provided by the Rapid City Area Metropolitan Planning Organization (MPO). Travel demand models are used to estimate changes in traffic volumes that result from demographic changes, particularly changes in the number of households and jobs in an area. Planned changes in the roadway network are also incorporated into the model to better understand the impact from future roadway investments.

FUTURE LAND USE

Future land use information was provided by the City of Rapid City, which can be seen in **Figure 2.1**. Note that this land use map only shows projected land uses for areas that have an existing classification of "Not Developed". Some development has taken place since this data was developed, so this map is intended to provide an illustrative view of general land use changes.

Land use projections indicate that the areas near the intersection of East North Street and Anamosa Street will continue to experience commercial development, as well as the areas between Eglin Street and Anamosa Street (northwest of East North Street) and north of Interstate 90. Other major development plans include industrial uses along Eglin Street (east of East North Street) and a large area of residential development in the east portion of the study area.

Figure 2.1 – Future Changes in Land Use



Note: This map only shows the future land use for areas that are currently classified as "Not Developed"

FUTURE ROADWAY NETWORK EXPANSION

Through 2045, expansion of the study area roadway network is planned to support expected growth. Based on the approved Rapid City Major Street Plan and on feedback from the Study Advisory Team, this study assumes the following will be built by 2045:

- Creek Drive is fully connected between SD 44 and Anamosa Street
- Anamosa Street is extended southeast to Valley Drive
- Valley Drive is extended north/northwest to East North Street
- Mickelson Drive is extended to the future Anamosa Street extension

The assumed future roadways are shown in **Figure 2.2**. These changes were incorporated into traffic modelling of 2045 conditions, but not for 2025 conditions.

DAILY TRAFFIC PROJECTIONS

Travel demand models are mathematical models that sometimes result in inconsistencies between modelled volumes and actual field-collected volumes. For example, 2013 modelled volumes on Omaha Street were over 40 percent higher than 2018 field collected volumes.

To mitigate this issue, 2040 model results were adjusted by applying the difference between raw modelled 2040 and 2013 daily traffic volumes to existing 2018 daily volumes. 2025 and 2045 traffic conditions were then estimated using linear interpolation/extrapolation between 2018 and 2045 conditions. Daily traffic projections for 2025 and 2045 conditions can be seen in **Figure 2.2**. Some expected traffic growth trends include:

- **Growth through 2025**: By 2025, the average traffic increase on study area roadways is expected to be around 15 percent, with the highest increases seen on Anamosa Street, where increases around 30 percent are expected.
- **Growth through 2045**: By 2045, area-wide traffic is expected to increase by over 50 percent, with traffic on Anamosa Street more than doubling.

Traffic on Future Roadways and Relation to Overall Network Traffic

Analysis of travel demand model results shows that around 75 percent of traffic on future roadways is expected to be generated by new developments served by these routes. Traffic reductions on primary study roadways due to future roadways were found to be insignificant, indicating that new routes are not anticipated to relieve congestion on routes like East North Street, Cambell Street, and Omaha Street/SD 44.

TURNING MOVEMENT PROJECTIONS

To perform future conditions capacity analysis, AM and PM peak hour turning movement projections were estimated using the National Cooperative Highway Research Board (NCHRP) 765 method. The NCHRP 765 method estimates future intersection turning movements based on existing turning movement data and estimated growth factors on each intersection approach.

The assumed growth factors were established based on projected daily volume growth. This method is commonly used since it is responsive to volume changes on each approach, meaning that if high growth is expected on only two approaches, turning movement projections will reflect this.

Year 2025 and 2045 peak hour turning movement projections can be seen in **Figure 2.3** and **Figure 2.4**, respectively. It was observed that for the turning movements at most intersections, the PM peak hour has a higher traffic volume than the AM peak hour for most traffic movements. This is typical for most urban areas.

Figure 2.2 – Daily Traffic Projections

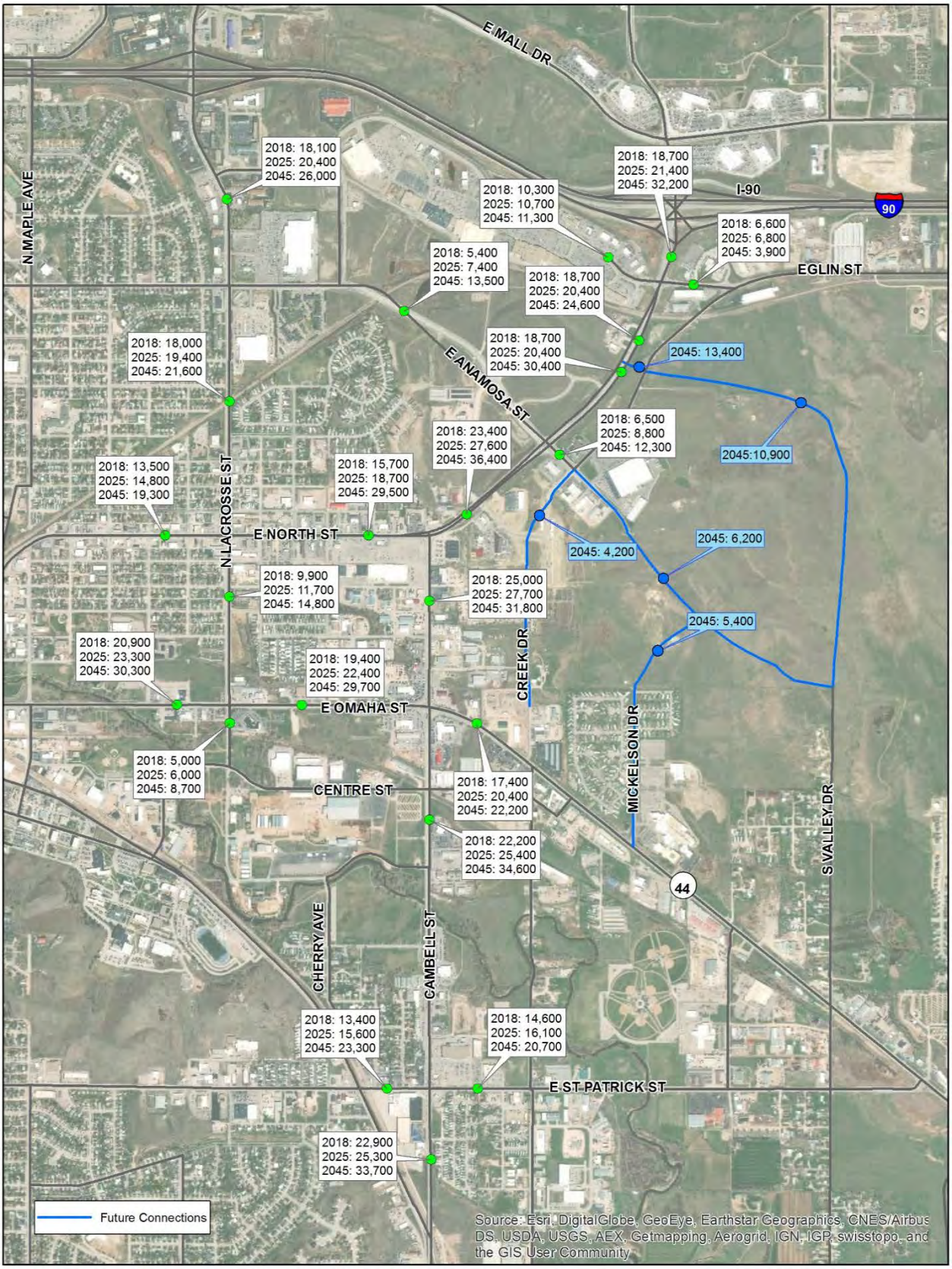


Figure 2.3 – 2025 Peak Hour Turning Movement Projections

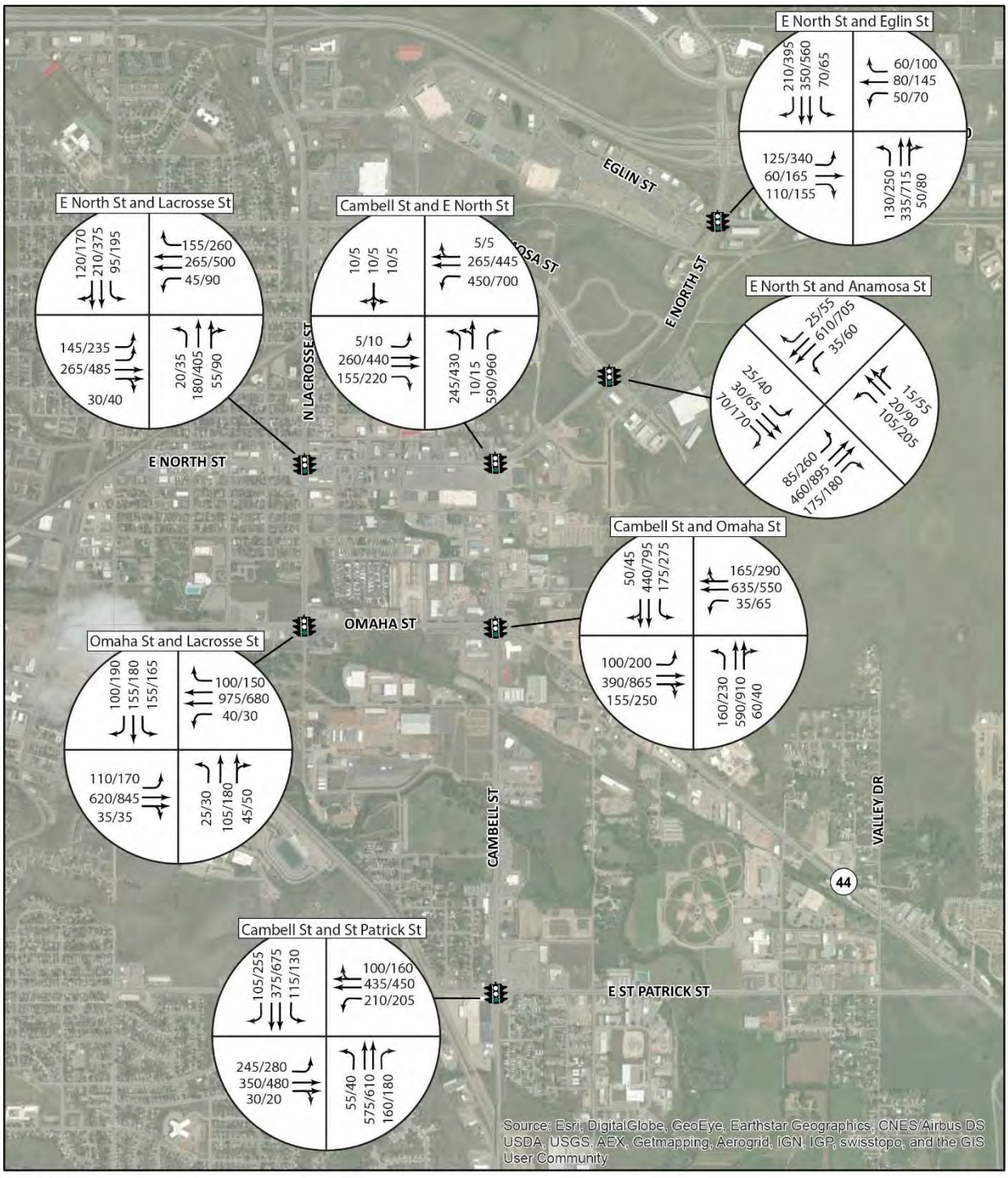
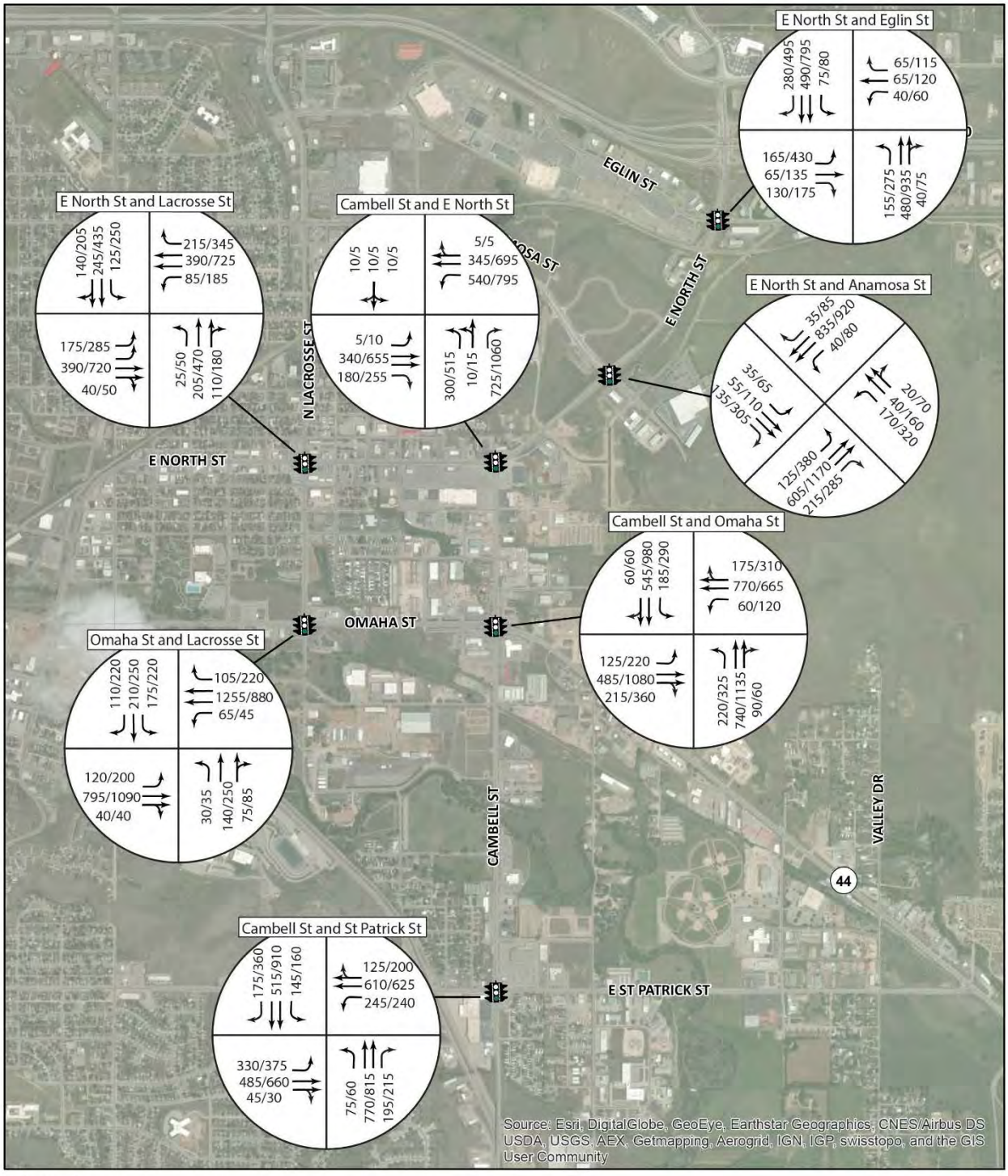


Figure 2.4 – 2045 Peak Hour Turning Movement Projections



Legend

Lane Configuration

(C) Channelized Movement

544/472 2045 Turning Movements: AM Peak/PM Peak

Study Intersections

Signal

Traffic Operations Analysis

Future conditions capacity analysis was performed using the HCS 7 software that implements the *Highway Capacity Manual* analysis methodology. More information related to the methodology can be found in the *Existing Needs Assessment* report. As in existing conditions analysis, LOS "C" is the mobility goal, so LOS "D" or worse will be considered deficient.

Future intersection level of service analysis results can be seen in **Table 2.1**. Existing conditions level of service is also shown for comparison purposes. Associated queue lengths for 2018, 2025, and 2045 conditions can be seen in **Tables 2.2, 2.3, and 2.4**, respectively. Details related to the capacity analysis methodology can be found in the *Existing Needs Assessment* report.

ASSUMPTIONS

For future conditions analysis, signal timings were optimized, however, parameters such as left-turn phasing type, yellow times, all-red times, and minimum green times were maintained. Modifications to these parameters and the associated operations impact from such changes were considered in the alternatives analysis phase of this study, which is discussed in the next chapter.

Existing intersection configurations were assumed at all study intersections except the intersection of Cambell Street and Omaha Street. It is assumed that project NH 0044(00)46 in 2021 will remove channelized right turns at this intersection and will construct 500 foot long eastbound and westbound right turn lanes.

Traffic analysis was performed assuming the following roads will be built by 2045 (but not built by 2025):

- Creek Drive is fully connected between SD 44 and Anamosa Street
- Anamosa Street is extended southeast to Valley Drive
- Valley Drive is extended north/northwest to East North Street
- Mickelson Drive is extended to the future Anamosa Street extension

2025 TRAFFIC OPERATIONS

By 2025, the Cambell Street/Omaha Street intersection is expected to drop to overall PM peak intersection LOS "D", with no other new intersection-level deficiencies expected to be triggered. The Cambell Street/East North Street intersection is expected to remain at PM peak intersection LOS "D" through 2025. PM peak intersection delay is however expected to increase by nearly 20 seconds per vehicle at this intersection by 2025, with PM peak westbound approach LOS "F" expected.

2025 Queues

Significant 2025 queuing is expected at Cambell and East North Street, with average PM peak westbound left turning queues spilling back to Century Road and 95th percentile PM peak northbound left turning queues spilling back beyond Philadelphia Street.

Some queue spillback is also expected at the Cambell Street intersections with Saint Patrick Street and Omaha Street, and at the East North Street intersections with LaCrosse Street and Eglin Street. Most queuing issues are related to through queues blocking turn lanes, however specific issues are highlighted in **Table 2.3**.

Note that queue spillback issues are not considered in the HCS 7 delay calculation methodology, so such issues could result in real-world delays in excess of what is calculated and presented in this analysis.

2045 TRAFFIC OPERATIONS

With projected 2045 traffic volumes, AM and PM peak hour operations are expected to deteriorate significantly. Overall PM peak intersection LOS "D" or worse is expected throughout the study area, except for the intersections of Omaha Street/LaCrosse Street and East North Street/Anamosa Street, which are expected to operate at LOS "C".

The Cambell Street/East North Street intersection is expected to operate at LOS "F" in the PM peak, with approach LOS "F" expected on all approaches. High PM peak turning volumes are expected, with 1165 northbound right turns, 520 northbound left turns, and 875 westbound left turns projected.

The Cambell Street/Omaha Street intersection is expected to operate at LOS "E" in the PM peak hour. This intersection will have both high through volumes and turning volumes since this is the junction of two primary roadways in Rapid City.

2045 Queues

Queue spillback issues are projected to become widespread by 2045. Most study intersections will have 95th percentile queues extending back to upstream public roadway intersections, with through queues blocking turn lanes and turn lane storage being exceeded being a common issue. The Cambell Street/Saint Patrick Street, Cambell Street/East North Street, and East North Street/LaCrosse Street intersections all are expected to have average queues spilling back to adjacent intersections.

The most significant queuing issues are again expected at East North Street and Cambell Street, with average PM peak hour northbound and westbound left turning queues exceeding 1,000 feet in length. Detailed 2045 queueing information can be seen in Table 2.4.

Table 2.1 – Existing and Future Intersection Level of Service

2018 Traffic Operations																				
Intersection	NB/SB Roadway	EB Delay/LOS				WB Delay/LOS				NB Delay/LOS				SB Delay/LOS				Overall Delay/LOS			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
Cambell and St. Patrick	Cambell	22.1	C	25.0	C	23.9	C	27.1	C	31.3	C	31.7	C	25.7	C	28.3*	C*	**26.2**	C	**28.1***	C*
Cambell and Omaha	Cambell	25.8*	C*	39.6*	D*	24.7*	C*	30*	C*	28.4*	C*	31.2*	C*	23.4*	C*	28.6*	C*	**25.8***	C*	**32***	C*
Cambell and North	Cambell	16.2	B	25.9	C	30.2	C	56.8*	E*	8.6	A	26.8	C	48.4	D	62.8	E	**18.0**	B	**36.5***	D*
Omaha and Lacrosse	Lacrosse	9.6	A	12.6	B	7.9	A	19.9*	B*	31.5	C	29.2	C	34.7	C	32.7	C	**17.2**	B	**20.3***	C*
North and Lacrosse	Lacrosse	20.3	C	25.4	C	14.6	B	22.4*	C*	40.4	D	37.2*	D*	36.8	D	30.3	C	**25.0**	C	**27.5***	C*
North and Anamosa	Anamosa	7.7	A	12.2	B	11.1	B	20.1	C	33.5	C	32.5	C	23.6	C	34.2	C	**11.8**	B	**19.7**	B
North and Eglin	North	19.9*	B*	57.6*	E*	40.9	D	43.9	D	16.1	B	20.6	C	17.8	B	26.4*	C*	**20.3***	C*	**34.1***	C*
Note: Delay presented in seconds of delay per vehicle										*Queue spillback may increase delays over presented values											

2025 Traffic Operations																				
Intersection	NB/SB Roadway	EB Delay/LOS				WB Delay/LOS				NB Delay/LOS				SB Delay/LOS				Overall Delay/LOS			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
Cambell and St. Patrick	Cambell	24.2	C	29.3	C	26.5	C	31.4	C	32.9	C	34.6	C	26.6	C	30.9*	C*	**27.9**	**C**	**31.6***	**C***
Cambell and Omaha	Cambell	34.8	C	52.2	D	31.5	C	50.3*	D*	32.5	C	34.3	C	27.9	C	30.2	C	**31.7**	**C**	**40.1***	**D***
Cambell and North	Cambell	18.3*	B*	31*	C*	51.1*	D	80.1*	F*	8.5	A	46.9*	D*	48.3*	D*	75.7	E	**25.7***	**C***	**54.3***	**D***
Omaha and Lacrosse	Lacrosse	11.1	B	16.1	B	9.5	A	9.0	A	30.0	C	26.4	C	33.7	C	30.1	C	**17.9**	**B**	**18.3**	**B**
North and Lacrosse	Lacrosse	20.7	C	30*	C*	15.9	B	26.5*	C*	40.2*	D*	35.4	D	35.8	D	27.5*	C*	**25.4***	**C***	**29.4***	**C***
North and Anamosa	Anamosa	8.1	A	17.0	B	12.5	B	24.2	C	26.3	C	32.1	C	27.8	C	38.0	D	**12.8**	**B**	**24.0**	**C**
North and Eglin	North	16.3	B	33.4*	C*	27.4	C	38.3	D	16.4	B	31.8	C	17.5	B	27.1*	C*	**17.9**	**B**	**31.3***	**C***
Note: Delay presented in seconds of delay per vehicle										*Queue spillback may increase delays over presented values											

2045 Traffic Operations																				
Intersection	NB/SB Roadway	EB Delay/LOS				WB Delay/LOS				NB Delay/LOS				SB Delay/LOS				Overall Delay/LOS			
		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
Cambell and St. Patrick	Cambell	29.3*	C*	73.6*	E*	42.5*	D*	38.2*	D*	36.3*	D*	34.5*	C*	36.8*	D*	49*	D*	**36.1***	**D***	**49***	**D***
Cambell and Omaha	Cambell	40.1*	D*	112.9*	F*	33.6*	C*	89*	F*	29.7*	C*	49.8*	D*	29.2*	C*	41.8*	D*	**33***	**C***	**69.1***	**E***
Cambell and North	Cambell	24.9*	C*	69.9*	E*	22.2*	C*	123*	F*	23.1*	C*	96.9*	F*	83.5	F	109.4	F	**24.1***	**C***	**96.7***	**F***
Omaha and Lacrosse	Lacrosse	15.4	B	28.4*	C*	12.0	B	13.1	B	28.0	C	22.9	C	32.7	C	28.5	C	**19.9**	**B**	**23.9***	**C***
North and Lacrosse	Lacrosse	21.9	C	40.1*	D*	20*	C*	28.7*	C*	38.5*	D*	36.9*	D*	32.1	C	67*	E*	**25.8***	**C***	**42.7***	**D***
North and Anamosa	Anamosa	10.4	B	19.1	B	16.4	B	26.8	C	16.6	B	25.3	C	24.7	C	27.1	C	**14.5**	**B**	**23.5**	**C**
North and Eglin	North	23.3	C	45*	D*	34.3	C	60.4	E	17.8	B	66.5*	E*	18.3	B	41.3*	D*	**20.7**	**C**	**52***	**D***
Note: Delay presented in seconds of delay per vehicle										*Queue spillback may increase delays over presented values											

Table 2.2 – Existing Peak Hour Queues

Intersection	Time Period	Approach	Distance to Upstream Street (ft)	Storage and Queues							
				Storage (ft)		Average Queue (ft)			95th % Queue (ft)		
				LT	RT	LT	TH	RT	LT	TH	RT
Cambell Street and Saint Patrick Street	2018 AM	EB	250	250	250	83	79	76	150	141	138
		WB	270	270	270	63	88	89	114	158	160
		NB	600	600	330	20	147	83	36	248	150
		SB	620	620	190	47	86	39	85	156	71
	2018 PM	EB	250	250	250	94	108	105	169	193	189
		WB	270	270	270	75	133	124	135	217	206
		NB	600	600	330	16	150	91	28	251	164
		SB	620	620	190	51	158	101	91	262	182
Cambell Street and Omaha Street	2018 AM	EB	900	900	120	46	126		83	214	
		WB	1350	270	120	8	90		15	161	
		NB	1000	1000	180	65	173		117	283	
		SB	430	430	160	70	108		125	195	
	2018 PM	EB	900	900	120	74	220		133	335	
		WB	1350	270	120	37	177		67	271	
		NB	1000	1000	180	93	283		167	423	
		SB	430	430	160	122	228		213	353	
Cambell Street and East North Street	2018 AM	EB	650	70	320	4	85		8	152	
		WB	730	380	730	138	23	0	232	42	0
		NB	630	630	280	116	5		204	9	
		SB	80	80	80		21			38	
	2018 PM	EB	650	70	320	6	171		10	270	
		WB	730	380	730	426	49	1	569	88	1
		NB	630	630	280	390	6		560	11	
		SB	80	80	80		10			18	
Omaha Street and LaCrosse Street	2018 AM	EB	350	350	350	21	85	80	38	154	143
		WB	1600	200	200	3	31	7	5	56	13
		NB	725	725	725	16	35	33	29	63	60
		SB	825	825	825	81	76	59	146	137	106
	2018 PM	EB	350	350	350	36	125	122	64	216	212
		WB	1600	1600	200	4	121	40	6	209	72
		NB	725	725	725	14	49	47	25	88	85
		SB	825	825	825	75	77	97	134	139	174
East North Street and LaCrosse Street	2018 AM	EB	440	300	440	86	50	51	154	90	92
		WB	360	190	130	9	37	49	16	67	89
		NB	250	130	250	9	62	59	16	111	106
		SB	230	230	230	43	89	82	78	160	148
	2018 PM	EB	440	300	440	98	111	109	175	193	190
		WB	360	190	130	21	92	105	38	159	177
		NB	250	130	250	14	115	110	25	203	196
		SB	230	230	230	74	127	114	132	220	202
East North Street and Anamosa Street	2018 AM	EB	1050	1050	560	8	40		14	56	
		WB	925	925	320	3	27	34	5	49	62
		NB	375	260	375	33	2	3	60	4	6
		SB	510	200	310	7	3	17	13	5	30
	2018 PM	EB	1050	1050	560	26	78		39	102	
		WB	925	925	320	11	107	101	21	178	204
		NB	375	260	375	74	9	16	137	18	29
		SB	510	200	310	16	7	58	29	14	108
East North Street and Eglin Street	2018 AM	EB	480	180	180	128	62		216	112	
		WB	700	700	330	28	50	37	50	90	67
		NB	1500	390	390	40	72	66	72	129	119
		SB	650	220	220	23	63	78	41	113	140
	2018 PM	EB	480	180	180	217	116		337	198	
		WB	700	700	330	43	100	57	78	181	103
		NB	1500	390	390	87	173	169	157	282	278
		SB	650	220	220	24	125	206	42	217	323

Legend:

Queue Spills Back to Upstream Public Roadway

Through Queue Blocks Turn Lane Access

Turning Queue Exceeds Available Turn Lane Storage

Table 2.3 – 2025 Peak Hour Queues

Intersection	Time Period	Approach	Distance to Upstream Street (ft)	Storage and Queues							
				Storage (ft)		Average Queue (ft)			95th % Queue (ft)		
				LT	RT	LT	TH	RT	LT	TH	RT
Cambell Street and Saint Patrick Street	2025 AM	EB	250	250	250	106	90	88	191	162	158
		WB	270	270	270	74	114	115	134	197	200
		NB	600	600	330	24	167	81	43	274	146
		SB	620	620	190	52	98	49	94	177	87
	2025 PM	EB	250	250	250	134	135	131	229	231	225
		WB	270	270	270	87	174	162	149	261	247
		NB	600	600	330	19	183	99	34	296	177
		SB	620	620	190	59	192	139	107	307	236
Cambell Street and Omaha Street	2025 AM	EB	900	900	500	46	131	137	83	221	232
		WB	1350	270	500	10	108	53	18	190	96
		NB	1000	1000	1000	72	199	230	130	317	360
		SB	430	430	430	77	139	141	139	237	242
	2025 PM	EB	900	900	500	82	238	149	147	354	241
		WB	1350	270	500	39	195	221	71	287	320
		NB	1000	1000	1000	101	352	362	182	507	522
		SB	430	430	430	124	281	276	215	420	412
Cambell Street and East North Street	2025 AM	EB	650	70	320	3	88		6	158	
		WB	730	380	730	356	34	1	527	61	2
		NB	630	630	280	114	4		202	7	
		SB	80	80	80		22			39	
	2025 PM	EB	650	70	320	8	221		15	314	
		WB	730	380	730	***822***	78	77	***1173***	140	139
		NB	630	630	280	592	10		***867***	18	
		SB	80	80	80		16			29	
Omaha Street and LaCrosse Street	2025 AM	EB	350	350	350	24	101	94	44	182	170
		WB	1600	200	200	3	41	11	6	73	19
		NB	725	725	725	16	39	37	30	70	67
		SB	825	825	825	95	84	55	171	151	99
	2025 PM	EB	350	350	350	43	167	163	77	273	268
		WB	1600	1600	200	7	54	8	12	97	15
		NB	725	725	725	15	54	52	27	97	94
		SB	825	825	825	93	87	96	168	157	173
East North Street and LaCrosse Street	2025 AM	EB	440	300	440	89	61	62	161	110	112
		WB	360	190	130	13	45	58	24	82	104
		NB	250	130	250	11	74	70	20	133	127
		SB	230	230	230	49	100	92	88	180	166
	2025 PM	EB	440	300	440	72	207	199	130	316	305
		WB	360	190	130	31	105	119	56	171	188
		NB	250	130	250	16	143	136	28	242	231
		SB	230	230	230	84	144	129	151	***244***	222
East North Street and Anamosa Street	2025 AM	EB	1050	1050	560	12	43		21	60	
		WB	925	925	320	3	35	41	6	64	73
		NB	375	260	375	39	3	4	70	5	8
		SB	510	200	310	9	4	29	16	8	52
	2025 PM	EB	1050	1050	560	56	122		75	149	
		WB	925	925	320	18	150	168	32	232	253
		NB	375	260	375	115	17	21	204	31	38
		SB	510	200	310	23	14	99	42	26	178
East North Street and Eglin Street	2025 AM	EB	480	180	180	89	40		160	72	
		WB	700	700	330	19	32	29	33	57	52
		NB	1500	390	390	31	66	61	55	118	109
		SB	650	220	220	19	56	70	34	100	125
	2025 PM	EB	480	180	180	113	96		193	170	
		WB	700	700	330	38	89	60	68	160	108
		NB	1500	390	390	114	222	219	201	346	342
		SB	650	220	220	26	135	223	47	231	345

Legend:

Queue Spills Back to Upstream Public Roadway

Through Queue Blocks Turn Lane Access

Turning Queue Exceeds Available Turn Lane Storage

Table 2.4 – 2045 Peak Hour Queues

Intersection	Time Period	Approach	Distance to Upstream Street (ft)	Storage and Queues							
				Storage (ft)		Average Queue (ft)			95th % Queue (ft)		
				LT	RT	LT	TH	RT	LT	TH	RT
Cambell Street and Saint Patrick Street	2045 AM	EB	250	250	250	194	150	145	***310***	***250***	243
		WB	270	270	270	79	226	226	141	***328***	331
		NB	600	600	330	37	276	116	67	415	205
		SB	620	620	190	82	173	103	148	285	185
	2045 PM	EB	250	250	250	***440***	220	213	***667***	***343***	333
		WB	270	270	270	120	***279***	258	148	***322***	300
		NB	600	600	330	30	270	123	55	406	215
		SB	620	620	190	126	346	259	220	499	392
Cambell Street and Omaha Street	2045 AM	EB	900	900	120	33	174	169	60	274	270
		WB	1350	270	120	19	146	60	34	239	108
		NB	1000	1000	180	99	229	236	178	356	367
		SB	430	430	160	95	158	160	171	262	267
	2045 PM	EB	900	900	120	137	435	225	224	610	326
		WB	1350	270	120	95	337	309	149	446	402
		NB	1000	1000	180	183	566	583	295	764	786
		SB	430	430	160	260	427	418	393	***598***	586
Cambell Street and East North Street	2045 AM	EB	650	70	320	6	226		11	339	
		WB	730	380	730	277	51	1	403	93	2
		NB	630	630	280	340	7		491	13	
		SB	80	80	80		37			66	
	2045 PM	EB	650	70	320	13	***683***		24	***810***	
		WB	730	380	730	***1357***	156	2	***1901***	231	3
		NB	630	630	280	***1051***	15		***1586***	27	
		SB	80	80	80		24			42	
Omaha Street and LaCrosse Street	2045 AM	EB	350	350	350	30	164	152	55	271	254
		WB	1600	200	200	6	64	7	12	116	12
		NB	725	725	725	20	54	51	35	97	91
		SB	825	825	825	112	111	57	199	199	103
	2045 PM	EB	350	350	350	63	310	305	114	***454***	448
		WB	1600	1600	200	11	82	19	20	146	33
		NB	725	725	725	17	73	69	30	132	125
		SB	825	825	825	136	113	101	231	201	182
East North Street and LaCrosse Street	2045 AM	EB	440	300	440	73	152	140	132	244	229
		WB	360	190	130	26	69	83	46	124	149
		NB	250	130	250	13	99	91	24	178	164
		SB	230	230	230	60	111	101	109	198	182
	2045 PM	EB	440	300	440	92	328	316	152	440	426
		WB	360	190	130	56	142	144	97	207	209
		NB	250	130	250	21	201	184	37	***318***	296
		SB	230	230	230	***254***	187	166	***409***	***300***	272
East North Street and Anamosa Street	2045 AM	EB	1050	1050	560	19	64		30	85	
		WB	925	925	320	4	55	4	8	100	7
		NB	375	260	375	43	7	8	77	13	14
		SB	510	200	310	12	7	49	22	12	89
	2045 PM	EB	1050	1050	560	85	162		108	193	
		WB	925	925	320	21	167	24	37	224	43
		NB	375	260	375	109	42	42	195	76	75
		SB	510	200	310	20	19	144	35	34	243
East North Street and Eglin Street	2045 AM	EB	480	180	180	69	55		125	98	
		WB	700	700	330	20	33	41	36	60	74
		NB	1500	390	390	46	108	101	82	195	181
		SB	650	220	220	24	96	111	43	172	199
	2045 PM	EB	480	180	180	421	143		***672***	175	
		WB	700	700	330	69	160	145	90	197	197
		NB	1500	390	390	440	522	514	495	610	607
		SB	650	220	220	63	313	456	88	448	618

Legend:

Queue Spills Back to Upstream Public Roadway

Through Queue Blocks Turn Lane Access

Turning Queue Exceeds Available Turn Lane Storage

CORRIDOR LEVELS OF SERVICE

On a corridor level, 2025 traffic volumes are expected to decrease the AM peak corridor level of service on Omaha Street to LOS "D" between LaCrosse Street and Cambell Street, with no additional deficiencies triggered.

2045 conditions are however expected to trigger PM peak corridor LOS "F" on Cambell Street between Omaha and East North Street, with AM peak corridor LOS "E" expected for this same segment. Corridor LOS "D" is also expected to be triggered on Omaha Street between LaCrosse Street and Cambell Street, East North Street between LaCrosse Street and Cambell Street, and East North Street between Cambell Street and Anamosa Street.

Table 2.5 – Future Corridor Levels of Service

Roadway	Between	Year and Time Period					
		2018		2025		2045	
		AM	PM	AM	PM	AM	PM
Cambell St	St Patrick St and Omaha St	B	C	B	C	C	C
Cambell St	Omaha St and E North St	C	D	C	D	E	F
Omaha St	LaCrosse St and Cambell St	C	D	D	D	D	D
Omaha St	Cambell St and Valley Dr	B	C	B	C	C	C
E North St	LaCrosse St and Cambell St	B	D	C	D	D	D
E North St	Cambell St and Anamosa St	B	C	B	C	C	D
E North St	Anamosa St and Eglin St	C	C	C	C	C	C

PEDESTRIAN AND BICYCLE LEVELS OF SERVICE

Future bicycle and pedestrian level of service was also evaluated, with analysis results shown in **Table 2.6.**

This analysis assumed two programmed projects in the study area are completed by 2025 (see **Figure 2.5**):

- **Omaha Street**: 2021 construction of shared use path on north side of the corridor between LaCrosse Street and Covington Street
  - Project NH 0044(00)46
- **Cambell Street:** 2021 construction of shared use path on east side of the corridor between Rocker Drive and Omaha Street
  - Project P TAPU(09)
  - With this configuration, a gap remains between the south terminus of the new shared use path and Saint Patrick Street unless pedestrians cross to the west side of Cambell Street

Figure 2.5 – Programmed Sidewalk/Shared Use Paths

Legend

- Programmed Sidewalks/Shared Use Paths
- Existing Sidewalks

The programmed projects will improve pedestrian and bicycle conditions on both Omaha and Cambell Streets, however the study area bicycle and pedestrian levels of service elsewhere are expected to be at LOS "D" or worse by 2045 if no further improvements are made.

The lack of sidewalks on segments of Cambell Street and North Street makes walking conditions difficult (LOS "F") into the future, and bicycle conditions will remain challenging on East North Street and some segments of Cambell Street without a further expansion of bicycle facilities, especially as traffic volumes increase in the area through 2045.

Table 2.6 – Future Pedestrian and Bicycle Levels of Service

Roadway	Between	Year and Travel Mode					
		2018		2025		2045	
		Ped	Bike	Ped	Bike	Ped	Bike
Cambell St	St Patrick St and Omaha St	F	E	C	D	D	D
Cambell St	Omaha St and E North St	F	E	F	E	F	E
Omaha St	LaCrosse St and Cambell St	F	D	C	C	C	C
Omaha St	Cambell St and Valley Dr	F	D	C	C	C	C
E North St	LaCrosse St and Cambell St	D	F	D	F	D	F
E North St	Cambell St and Anamosa St	D	E	D	E	D	E
E North St	Anamosa St and Eglin St	F	E	F	E	F	E

Summary of Expected Future Transportation Issues

AUTOMOBILE DELAYS AND QUEUEING

By 2045, existing intersection capacity is expected to result in major delays at the intersection of Cambell Street and East North Street (2045 PM LOS "F") and also some significant delays at Cambell Street and Omaha Street (2045 PM LOS "E"). Future traffic volumes are also expected to increase delays at other study area intersections, with PM peak hour intersection LOS "D" expected at East North Street/LaCrosse Street and East North Street/Eglin Street. Without improvements, queue spillback is expected to become a major issue, likely creating delays beyond those presented in this analysis.

Assuming a linear growth between existing conditions and 2045 conditions, 2025 traffic operations are generally within acceptable limits on an overall intersection level, however the Cambell Street/Omaha Street intersection is expected to drop to intersection LOS "D" in the PM peak hour and there will be some approach delays beyond what is experienced today. Long queues and LOS "F" projected for 2025 traffic at the WB approach at Cambell and East North Street indicate that improvements will be needed by 2025 to resolve issues at that intersection.

MULTIMODAL FACILITIES

Increased traffic volumes in the study area will make walking and biking more challenging, especially since many study roadways have either a total absence of facilities or significant gaps in facilities.

CHAPTER 3: ALTERNATIVES DEVELOPMENT AND ASSESSMENT

Based on issues identified through existing and future conditions analysis, transportation improvement options were developed for the study area. Conceptual solutions included intersection improvements, cross-section modifications, and the addition of pedestrian and bicycle facilities. Build alternatives are those solutions that were advanced as viable or preferred for consideration by the SAT and the public.

Intersection Concepts and Build Alternatives

The following intersection concepts were evaluated. These were compared to select viable build alternatives. All delay and level of service discussion pertains to the 2045 PM peak hour, unless otherwise noted. Note that all no-build conditions assume the removal of channelized right turns where they currently exist, based on SAT input.

Concept drawings and typical cross sections for the build alternatives can be found in Appendix F.

Cambell Street and Saint Patrick Street

The intersection is expected to operate at LOS D by 2045 under the existing configuration. The following improvement concepts were considered:

1. Add a second eastbound left turn lane and a westbound right turn lane. This assumes a southbound right turn overlap with the eastbound protected left turn phase.

    - Rationale: 375 eastbound left turns in 2045 PM peak hour (330 in AM peak hour); 200 westbound right turns in 2045 PM peak hour (105 in AM peak hour).
    - Impact: Intersection level of service is not improved from LOS D, but overall intersection delay is reduced from 49.0 seconds/vehicle to 36.7 seconds per vehicle
        - If lead/lag left turn phasing is required on the eastbound/westbound approaches, overall intersection delay would operate with 45.7 of delay/vehicle, still operating at LOS D.

2. Same turn lanes as above and widen Cambell Street to six lanes.

    - Rationale: 34,000 to 37,000 ADT estimated by 2045 on Cambell Street
    - Impact: Intersection remains at LOS D with 40.5 seconds/vehicle delay, which is higher than the option above. Given the 40 mph speed limit on Cambell Street, it is assumed that southbound and northbound left turns will operate with protected-only left turn phasing when crossing three lanes of opposing through traffic. At City discretion, this could be operated with protected/permitted left turn phasing.
        - If lead/lag left turn phasing is required on the northbound/southbound approaches, overall intersection delay would increase by 2.4 seconds per vehicle.

Table 3.1 – Performance of Cambell Street and Saint Patrick Street Intersection Concepts

Improvements	EB Delay/LOS 2045 PM		WB Delay/LOS 2045 PM		NB Delay/LOS 2045 PM		SB Delay/LOS 2045 PM		Overall Delay/LOS 2045 PM	
No Build	73.6	E	38.2	D	34.5	C	49.0	D	49.0	D
Add 2nd EB Left Turn Lane and Add WB Right Turn Lane	45.0	D	36.9	D	32.0	C	33.9	D	36.7	D
Turn Lane Improvements (Lead-Lag Left EB/WB Turn Phasing)	57.2	E	45.4	D	32.9	C	47.1	D	45.7	D
Turn Lane Improvements + 6 Lanes on Cambell	45.8	D	34.9	C	50.7	D	33.1	C	40.5	D
Turn Lane Improvements + 6 Lanes on Cambell (Lead-Lag Left EB/WB Turn Phasing)	45.2	D	39.4	D	39.1	D	46.7	D	42.9	D

BUILD ALTERNATIVES TO CARRY FORWARD

- Add second eastbound left turn lane and westbound right turn lane
- Turn lane improvements with six-lane expansion on Cambell Street

*Whether or not lead-lag phasing is desired may be decided later, based on potential for ROW impacts and associated costs.

Cambell Street and Omaha Street

The intersection is expected to operate at LOS E under the no-build configuration. The following improvements were considered:

1. Add second northbound and southbound left turn lanes, and convert right turns from channelized rights to dedicated right turn lanes on all approaches (with no channelization).

   - **Rationale:** By 2045, 325 and 290 PM peak hour left turns are projected on the northbound and southbound approaches, respectively (220 and 185 AM peak hour left turns, respectively).
   - **Impact:** Intersection level of service is improved from LOS E to LOS D (31 percent delay reduction).
     - Assumes modifications to allow northbound and southbound left turn phases to be run concurrently
     - Assumes right turn overlaps with compatible left turn phases on all intersection approaches

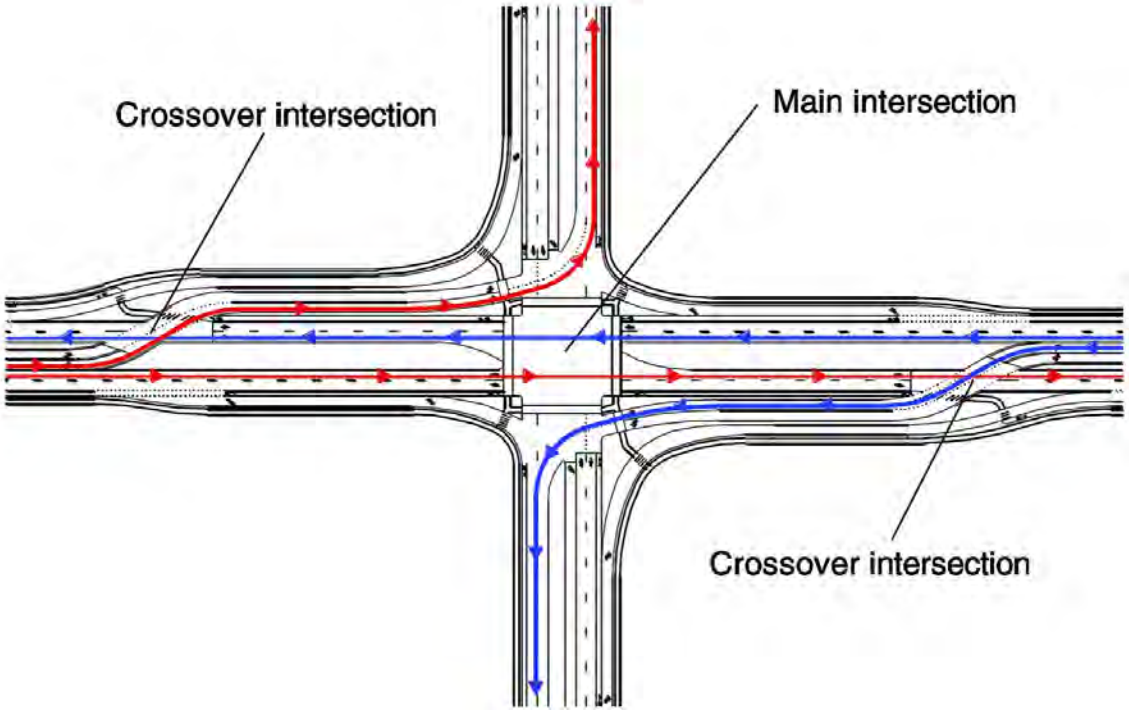
2. Add second northbound and southbound left turn lanes, and widen Cambell Street to six lanes.

   - **Rationale**: 34,000 to 37,000 ADT estimated by 2045 on Cambell Street
   - **Impact:** Intersection level of services is improved from LOS E to LOS D (41 percent delay reduction).
     - Assumes modifications to allow northbound and southbound left turn phases to be run concurrently
     - Assumes right turn overlaps with compatible left turn phases on eastbound and westbound approaches
     - Assumes shared through/right turn lanes on northbound and southbound approaches to reduce property impacts

3. Construct displaced left turns intersection (displace northbound and southbound left turn lanes)

   - **Rationale:** High northbound and southbound left turning movements and poor no-build level of service
   - **Impact:** This configuration enables running northbound and southbound left turns concurrently with northbound and southbound through movements. This configuration is expected to result in intersection LOS D at the main intersection, with LOS B at each of the left turn crossover intersections.
     - This assumes no through lanes are added on Cambell Street (i.e. no six lane section). Some minor roadway widening would however be required to accommodate the left turn crossovers.

Figure 3.1 – Left Turning Movements at a Displaced Left Turns Intersection (Example)



Source: FHWA

Table 3.2 – Performance of Cambell Street and Omaha Street Intersection Concepts (Standard Configurations)

Improvements	EB Delay/LOS		WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM		2045 PM	
No Build (Remove Channelizing Islands)	112.9	F	89.0	F	49.8	D	41.8	D	69.1	E
Add 2nd NB and SB Left Turn Lanes + Convert Channelized Right Turns to Dedicated Right Turn Lanes	63.5	E	44.6	D	44.5	D	42.4	D	47.9	D
Add 2nd NB and SB Left Turn Lanes + 6 Lanes on Cambell	44.1	D	36.5	D	43.7	D	37.8	D	40.6	D

Table 3.3 – Performance of Cambell Street and Omaha Street Intersection Concepts (Displaced Left Turns Configuration)

Intersection	EB Delay/LOS		WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM		2045 PM	
NB Crossover	-	-	-	-	11.3	B	8.7	A	10.0	B
Main Intersection	32.9	C	29.4	C	76.0	E	66.4	E	49.4	D
SB Crossover	-	-	-	-	8.7	A	11.8	B	10.1	B

BUILD ALTERNATIVES TO CARRY FORWARD

- Add second northbound and southbound left turn lanes
- Turn lane improvements with six-lane expansion on Cambell Street
- Displaced left turns intersection

Cambell Street and East North Street

The intersection is expected to operate at PM peak LOS F by 2045 under the no-build configuration.

The following improvements were considered:

1. Add second westbound left turn lane
   - **Rationale:** 795 PM peak hour westbound left turns projected by 2045 (540 in AM peak hour)
   - **Impact:** Intersection level of service is not improved from LOS F, however delays are reduced by 29 percent.

2. Add second westbound left turn lane and second northbound right turn lane
   - **Rationale:** 1060 PM peak hour northbound right turns projected by 2045 (725 in AM peak hour)
   - **Impact:** Intersection level of service is improved from LOS F to LOS E, with delays reduced by 59 percent

3. Add second westbound left turn lane and second northbound right turn lane, and widen East North Street to six lanes
   - **Rationale**: Over 36,000 ADT projected on East North Street by 2045 between Cambell Street and Anamosa Street
   - **Impact:** Intersection level of service is improved from LOS F to LOS D, reducing intersection delay by 64 percent.

4. Construct displaced left turns intersection (displace westbound left turn lanes)
   - **Rationale:** High westbound left turning movements and poor no-build level of service
   - **Impact:** This configuration would enable running westbound left turns concurrently with westbound through movements. This configuration is expected to result in intersection LOS B at the main intersection and LOS B at the westbound crossover.
     - This assumes no through lanes are added on East North Street (i.e. no six lane section). Some minor roadway widening would however be required to accommodate the left turn crossovers.

Technical analysis results and SAT feedback resulted in the discarding of the six-lane East North Street alternative from further consideration. Improved operations can be achieved with a displaced left turns intersection, and the expansion to six lanes is not expected to offer benefits elsewhere on the corridor (operations at other intersections). Adding a second westbound left turn lane (but no added second northbound right turn lane) was also discarded due to poor operations. As such, each of these alternatives are not recommended to be carried into future National Environmental Policy Act (NEPA) environmental documentation.

Table 3.4 – Performance of Cambell Street and East North Street Intersection Concepts (Standard Configurations)

Improvements	EB Delay/LOS 2045 PM		WB Delay/LOS 2045 PM		NB Delay/LOS 2045 PM		SB Delay/LOS 2045 PM		Overall Delay/LOS 2045 PM	
Remove Channelizing Islands	186.4	F	66.5	E	177.8	F	114.8	F	138.1	F
Add 2nd WB Left Turn Lane	84.5	F	34.9	C	166.2	F	81.9	F	98.4	F
Add 2nd WB Left Turn Lane and 2nd NB Right Turn Lane	70.0	E	42.0	D	61.9	E	78.0	E	56.4	E
Turn Lane Improvements + 6 Lanes on North	67.6	E	37.9	D	51.3	D	66.9	E	50.0	D

Table 3.5 – Performance of Cambell Street and East North Street Intersection Concepts (Displaced Left Turns Configuration)

Intersection	EB Delay/LOS 2045 PM		WB Delay/LOS 2045 PM		NB Delay/LOS 2045 PM		SB Delay/LOS 2045 PM		Overall Delay/LOS 2045 PM	
Main Intersection	15.2	B	21.9	C	10.5	B	55.3	E	14.5	B
WB Crossover	16.9	B	14.6	B	-	-	-	-	15.7	B

BUILD ALTERNATIVES TO CARRY FORWARD

- Add second westbound left turn lane and second northbound right turn lane
- Construct displaced left turns intersection

Discarded Concepts

- Add second westbound left turn lane (but no second northbound right turn lane)
- Widen East North Street to six lanes

Omaha Street and LaCrosse Street

The intersection is expected to operate at LOS C under the existing intersection configuration. As such, no improvements were considered.

Table 3.6 – Performance of Omaha Street and LaCrosse Street Intersection

Improvements	EB Delay/LOS 2045 PM		WB Delay/LOS 2045 PM		NB Delay/LOS 2045 PM		SB Delay/LOS 2045 PM		Overall Delay/LOS 2045 PM	
No Build	28.4	C	13.1	B	22.9	C	28.5	C	23.9	C

East North Street and LaCrosse Street

The intersection is expected to operate at LOS D under the existing configuration. Adding northbound and southbound right turn lanes is expected to improve operations to LOS C.

Table 3.7 – Performance of East North Street and LaCrosse Street Intersection Concepts

Improvements	EB Delay/LOS		WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM		2045 PM	
No Build	40.1	D	28.7	C	36.9	D	67.0	E	42.7	D
Add NB and SB Right Turn Lanes	36.3	D	28.6	C	33.6	C	37.5	D	34.1	C

BUILD ALTERNATIVES TO CARRY FORWARD

- Add northbound and southbound right turn lanes

East North Street and Anamosa Street

The intersection is expected to operate at LOS C under the existing configuration. Expanding East North Street to 6 lanes is expected to add 6.5 seconds/vehicle of delay due to running eastbound/westbound left turns as protected-only due to the 40 mph speed limit. LOS C is however still expected even with the modest delay increase.

The six-lane East North Street alternative was discarded from further consideration since no operational improvements are expected with this revision. As such, this alternative is not recommended to be carried into future NEPA environmental documentation.

Discarded Concepts

- Expand East North Street to six lanes

Table 3.8 – Performance of East North Street and Anamosa Street Intersection Concepts

NB/SB Roadway	EB Delay/LOS		WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM		2045 PM	
No Build	19.1	B	26.8	C	25.3	C	27.1	C	23.5	C
6 Lanes on North	21.3	C	39.3	D	33.7	C	33.8	C	30.0	C

East North Street and Eglin Street

The intersection is expected to operate at LOS D under the existing intersection configuration. The following improvements were considered:

1. Add second eastbound left turn lane. This assumes a southbound right turn overlap with the protected eastbound left turn phase.

   - **Rationale**: 430 PM peak hour eastbound left turns projected by 2045 (165 in AM peak hour)
   - **Impact:** The intersection is still expected to operate at LOS D, but intersection delay is expected to be reduced from 52.0 seconds/vehicle of delay to 36.4 seconds/vehicle of delay.
     - Similar operations are expected if lead/lag left turn phasing is required on the eastbound/westbound approaches. Analysis actually indicates intersection LOS C, however this is only a 1.9 seconds/vehicle delay improvement.

2. Same as above, but widen East North Street to six lanes.

   - **Rationale:** Over 30,000 ADT projected on East North Street between Anamosa Street and Interstate 90 by 2045.
   - **Impact**: Improves intersection from LOS D to LOS C.
     - Similar operations are expected even if eastbound/westbound split phasing is required.

The six-lane East North Street alternative was discarded from further consideration since operations are only slightly improved at this intersection (5.4 seconds/vehicle improvement), with the project cost exceeding its expected benefits. As such, this alternative is not recommended to be carried into future NEPA environmental documentation.

Table 3.9 – Performance of East North Street and Eglin Street Intersection Concepts

Improvements	EB Delay/LOS		WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM		2045 PM	
No Build	45.0	D	60.4	E	66.5	E	41.3	D	52.0	D
Add 2nd EB Left Turn Lane	38.0	D	65.4	E	33.3	D	32.0	C	36.4	D
Turn Lane Improvements (Lead-Lag EB/WB Left Turn Phasing)	46.5	D	49.8	D	32.2	C	27.0	C	34.5	C
Turn Lane Improvements + 6 Lanes on North	30.9	C	53.5	D	36.2	D	21.3	C	31.0	C
Turn Lane Improvements + 6 Lanes on North (Lead-Lag EB/WB Left Turn Phasing)	42.8	D	50.6	D	23.9	C	22.7	C	29.3	C

BUILD ALTERNATIVES TO CARRY FORWARD

- Add second eastbound left turn lane

Discarded Concepts

- Expand East North Street to six lanes

Corridor Concepts and Build Alternatives

Corridor cross-section concepts and build alternatives were also developed. Intersection analysis described previously helped support the analysis described below. Any reported crash history below is over the five-year time period from January 2013 to December 2017.

Cambell Street

All considered concepts and build alternatives assume a sidewalk on the west side of the corridor and a shared use path on the east side of the corridor. Additionally, each concept below has been developed with and without boulevards to provide flexibility in right-of-way requirements, especially on the segment north of Omaha Street/SD 44 where right-of-way availability is more constrained.

1. Five-Lane Section with Two-Way Left Turn Lane

   - This layout is close to the existing configuration, but with improved pedestrian and bicycle facilities
   - With standard turn lane improvements, intersection LOS D is expected at the Cambell Street/Omaha Street intersection in the 2045 PM peak hour with the existing Cambell Street section. Intersection LOS D is also expected with displaced northbound and southbound left turns.

2. Four-Lane Median Divided Section

   - Does not mitigate operational deficiencies at Cambell Street/Omaha Street intersection in 2045 PM peak hour
   - Provides access management benefits, with a slightly narrower typical roadway section compared to a five-lane section. Section widths will however be wider at locations where turn lanes are implemented.
     - Saint Patrick Street to Omaha Street: 100 segment-type crashes (35 injury crashes) reported on the one-mile long segment– 36 were angle crashes
       - Moderately dense access spacing – 30 accesses per mile existing
     - Omaha to North: 61 crashes (16 injury crashes) reported on the 0.4 mile long segment – 18 were angle crashes
       - Moderately dense access spacing – 32 accesses per mile existing
   - A median would be required to accommodate a displaced left turns configuration at the Cambell/Omaha intersection.

3. Six-Lane Median Divided Section

   - Increased section capacity, however right-of-way availability between Omaha Street and East North Street is limited
     - Six-lane section on Cambell Street improves intersection operations at Cambell Street/Omaha Street intersection from LOS E to LOS D in 2045 PM peak hour
       - Assumes northbound and southbound double left turn lanes
   - A median would serve as a pedestrian refuge, balancing out the increased crossing distance from a wider section. The median would be made of sufficient width to allow northbound and southbound left turns from Cambell Street to occur at key locations where access is essential.

The four-lane median divided section was discarded from further consideration since segment-type crash history does not reveal a significant safety issue that would be mitigated by medians. Crash rates are below the critical crash rate for these segments. As such, this alternative is not recommended to be carried into future NEPA environmental documentation. A median is however recommended for safety reasons if the roadway is widened to six lanes.

BUILD ALTERNATIVES TO CARRY FORWARD

- Five-lane section with two-way left turn lane
- Six-lane median divided section

Discarded Concepts

- Four-lane median divided section

Omaha Street/SD 44:

Both options currently assume a shared use path on the north side of the corridor, which is already programmed along some segments as a future improvement for 2021 construction. An eight-foot boulevard between the travel lanes and the shared use path was also assumed given the available right-of-way.

1. Five-Lane Section with Two-Way Left Turn Lane
   - Close to the existing configuration but with improved multimodal facilities

2. Four-Lane Median Divided Section
   - Provides access management benefits
     - LaCrosse to Cambell: 28 crashes (8 injury crashes) reported on the 0.5 mile long segment – 8 angle crashes
       - Moderately dense access spacing – 26 accesses per mile existing
     - Cambell to Valley: 74 crashes (33 injury crashes) reported on the 1.25 mile long segment – 38 angle crashes
       - Fairly good access spacing – 19 accesses per mile existing

The four-lane median divided section was discarded from further consideration since segment-type crash history does not reveal a significant safety issue that would be mitigated by medians. Crash rates are below the critical crash rate for these segments. As such, this alternative is not recommended to be carried into future NEPA environmental documentation.

BUILD ALTERNATIVES TO CARRY FORWARD

- Five-lane section with two-way left turn lane
  - The existing condition, but with programmed 2021 shared use path

Discarded Concepts

- Four-lane median divided section

East North Street: LaCrosse to Cambell

This section was recently reconstructed, so corridor reconfiguration was not considered.

East North Street: Cambell to Eglin

Given the significant right-of-way availability, all three options for this segment assume a sidewalk on northwest side, a shared use path on southeast side, and eight-foot boulevards separating travel lanes from multimodal facilities.

1. Five-Lane Section with Two-Way Left Turn Lane
   - Close to the existing configuration with improved multimodal facilities
     - 2045 PM intersection LOS C or better is possible at all intersections along the corridor if the displaced left turns alternative is selected at the Cambell Street/East North Street intersection.

2. Four-Lane Median-Divided Section

   - Provides access management benefits, with a slightly narrower typical roadway section compared to a five-lane section. Section widths will however be wider at locations where turn lanes are implemented.
     - Cambell to Anamosa: 24 crashes (6 injury crashes) reported on the 0.4 mile segment – 12 angle crashes
       - Good access spacing – 15 accesses per mile existing
     - Anamosa to Eglin: 20 crashes (7 injury crashes) reported on the 0.5 mile segment – 7 angle crashes
       - Good access spacing – 12 accesses per mile existing

   - A median would be required to accommodate a displaced left turns intersection at the East North Street/Cambell Street intersection. This configuration operates with significant improvements, with modelling showing LOS B at the main intersection in the 2045 PM peak.

3. Six-Lane Median-Divided Section

   - Increased section capacity
     - Six-lane section on East North Street improves intersection operations at East North/Omaha to LOS D in 2045 PM peak hour
       - Assumes double westbound left turn lane
       - Assumes westbound lane drop at Cambell Street
       - 2045 PM LOS F in no-build condition
       - 2045 PM LOS E with only adding westbound double left turn lane

The four-lane median divided section was discarded since segment-type crash history does not reveal a significant safety issue that would be mitigated by medians and existing access spacing is generally good.

The six-lane median divided section was also discarded since benefits are not substantial at the Eglin Street intersection and a delay increase is expected at the Anamosa Street Intersection. As such, this alternative is not recommended to be carried into future NEPA environmental documentation. If a displaced left turn lanes configuration is implemented at the East North Street/Cambell Street intersection, similar operations are expected with a four-lane section.

BUILD ALTERNATIVES TO CARRY FORWARD

- Five-lane section with two-way left turn lane

Discarded Concepts

- Four-lane median divided section
- Six-lane median divided section

Future Roadways

Per feedback from the SAT, this study assumes the following roadways will be extended or added by 2045:

- Creek Drive is fully connected between SD 44 and Anamosa Street
- Anamosa Street is extended southeast to Valley Drive
- Valley Drive is extended north/northwest to East North Street
- Mickelson Drive is extended to the future Anamosa Street extension

Future roadways were based on identified alignments in the city-approved Major Street Plan, and no changes to these alignments were considered as part of this study. It is recognized that some existing roadways that are part of a planned expanded network in the study area may require improvements to accommodate increased traffic volumes.

TYPICAL CROSS SECTIONS FOR FUTURE ROADWAYS

Based on 2045 traffic projections, it is expected that the future roadways discussed above should not require more than one travel lane in each direction. Turn lanes should be considered at major intersections and be in accordance with local design standards, and it is also recommended pedestrian and bicycle facilities are included to best integrate with other multimodal improvements that are being recommended as part of this study.

Typical cross-sections for future roadways can be found in Appendix F

Major Future Intersections

2045 traffic conditions were estimated for the future intersections at East North Street/Valley Drive and Anamosa Street/Valley Drive. This analysis indicates:

- East North Street and Valley Drive
  - Assumed to be a T-intersection
  - A traffic signal is expected to be warranted, and the intersection is expected to operate at LOS “C” with signal control in the 2038 PM peak hour.
  - This assumes a dedicated southbound left turn lane on East North Street, a dedicated northbound right turn lane on East North Street, and dedicated left and right turn lanes on westbound Valley Drive.
  - Assumes two through lanes in each direction on East North Street

Table 3.10 – 2045 HCM Analysis Results for East North Street and Valley Drive Intersection

Configuration	WB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM	
T-Intersection With Signal Control	42.0	D	31.5	C	15.0	B	28.0	C

E. North Street is the assumed NB/SB roadway
Assumes two through lanes in each direction on E. North Street
Assumes one through lane in each direction on Valley Street
Assumes dedicated turn lanes on all approaches

- Anamosa Street and Valley Drive
  - Assumed to be a T-intersection
  - Under eastbound stop control on Anamosa Street, the stop-controlled approach is expected to operate at LOS "B" through 2038.
  - This assumes one through lane in each direction on both Anamosa Street and Valley Drive, and assumes dedicated turn lanes for all turning movements.

Table 3.11 – 2045 HCM Analysis Results for Anamosa Street and Valley Drive

Configuration	EB Delay/LOS		NB Delay/LOS		SB Delay/LOS		Overall Delay/LOS	
	2045 PM		2045 PM		2045 PM		2045 PM	
T-Intersection With Stop Control on Anamosa Street	12.6	B	4.4	A	0.0	A	*	*

*HCM does not calculate overall delay/LOS for two-way stop controlled intersections
Valley Drive is the assumed NB/SB roadway
Assumes one through lane in each direction on all approaches
Assumes dedicated turn lanes on all approaches

Alternatives Assessment Summary

Numerous concepts were developed and evaluated to resolve identified intersection and corridor deficiencies along primary study corridors within the study area. Some concepts were discarded, and those that remain have been advanced as build alternatives to be considered as part of a future National Environmental Policy Act (NEPA) effort.

A summary of the intersection improvement build alternatives that were advanced, as well as concepts that were discarded can be seen in Table 3.12. A summary of the corridor improvement build alternatives that were advanced for a future NEPA effort, as well as concepts that were discarded can be seen in Table 3.13.

Build Alternative Layouts and Typical Cross Sections

Layouts and typical cross-sections for each build alternative can be found in Appendix F. Recommendations for which build alternatives should be implemented are provided in the next chapter of this report.

Environmental Scan

An environmental scan was completed for Cambell Street, Omaha Street, East North Street, and future roadways to determine if future projects would impact environmental resources in the study area. The environmental scan evaluated:

- Environmental Justice
- Wetlands, Waterways, and Water Quality
- Bicyclists, Pedestrians, and Recreational Resources
- Economic Resources
- Floodplains

The environmental scan indicated that future projects would not likely impact environmental resources for the items listed above. Note that additional analysis will need to be completed to evaluate impacts related to cultural resources, Section 4(f) and 6(f) resources, and for noise impacts.

More detailed information related to the Environmental Scan can be found in the Environmental Scan Memorandum in **Appendix G.**

Table 3.12 – Summary of Intersection Build Alternatives Assessment

Intersection	Alternative	Notes	Key Assumptions	Carry Forward to NEPA
Cambell Street and Saint Patrick Street	No build	**Issues:** Poor operations without improvements (LOS D in 2045)		✓
	Add second EB left turn lane and a WB right turn lane	**Rationale**: High EB left turning volumes, intersection LOS D by 2045. **Impact**: Reduces intersection delay by 25% if EB and WB left turns can be run conccurently. Delay improvement is only 7% if lead/lag left turn phasing is required.		✓
	Expand Cambell Street to six lanes, include turn lane improvements above	**Rationale**: 34,000 to 37,000 ADT estimated by 2045 on Cambell Street. **Impact**: Reduces intersection delay by 12% to 17%, depending on signal phasing.		✓
Cambell Street and Omaha Street	No build	**Issues**: Poor operations without improvements (LOS E in 2045)		✓
	Add second NB and SB left turn lanes + Convert all right turns to dedicted right turn lanes	**Rationale**: High NB and SB left turning volumes, intersection LOS E by 2045. **Impact**: Improves intersection to LOS D, reducing intersection delay by 31%.		✓
	Displace NB and SB left turns	**Rationale**: Intersection LOS D in 2045 even with a six-lane Cambell Street cross section. **Impact**: Reduces intersection delay by 28% (improves to LOS D) at the main intersection, with LOS B at each crossover intersection.	Assumes a 5-lane typical roadway section on Cambell Street	✓
	Expand Cambell Street to six lanes, add 2nd NB and SB left turn lanes	**Rationale**: High NB and SB left turning volumes, intersection LOS E by 2045. **Impact**: Improves intersection to LOS D, reducing intersection delay by 41%. **Issues**: Significant property impacts		
Cambell Street and East North Street	No build	**Issues**: Poor operations without improvements (LOS F in 2045)		✓
	Add second WB left turn lane and second NB right turn lane	**Rationale**: High NB right turning volumes, intersection LOS F remains even with second WB left turn lane. **Impact**: Reduces intersection delay by 64% (improves to 2045 LOS E)		✓
	Displace WB left turns	**Rationale**: Turn lane improvements above still operate poorly at LOS E **Impact**: The main intersection is expected to operate at LOS B in 2045, with LOS A and B at the crossover intersections	Assumes a 5-lane typical roadway section on East North Street	✓
	Add second WB left turn lane	**Issues:** Poor operations remain (LOS F in 2045)		
	Expand East North Street to six lanes	**Issues**: Limited operational benefits elsewhere on the East North Street corridor		
Omaha Street and LaCrosse Street	None	**Rationale**: Acceptable operations (LOS C) expected through 2045 with existing configuration		✓
North Street and LaCrosse Street	No Build	**Rationale**: The intersection is expected to operate at LOS D through 2045. This is however deficient per the assumptions established in this study.		✓
	Add NB and SB right turn lanes	**Impact**: Reduces intersection delay by 20%, improving operations to LOS C.		✓
North Street and Anamosa Street	None	**Rationale**: Acceptable operations (LOS C) expected through 2045 with existing configuration		✓
North Street and Eglin Street	No build	**Issues**: Poor operations without improvements (LOS D in 2045)		✓
	Add second EB left turn lane	**Rationale:** High EB left turns, intersection LOS D by 2045 **Impact:** 30% to 33% reduction in intersection delay, depending on the EB/EB left turn phasing used		✓
	Expand East North Street to six lanes	**Issues**: Minimal improvement compared to adding turn lanes without cross-section expansion		

Table 3.13 – Summary of Corridor Build Alternatives Assessment

Corridor Segment	Alternative	Notes	Carry Forward to NEPA
Cambell Street: St. Patrick Street to East North Street	No build	**Issues:** Offers no improvements to limited multimodal facilities	✓
	Five-lane section with two-way left turn lane + sidewalk and shared use path	**Rationale**: No existing bicycle facility and many gaps in existing sidewalk network. **Impact**: Shared use path and sidewalk improve cycling and walking conditions on the corridor.	✓
	Six-lane median divided section + pedestrian and bicycle facilities	**Rationale**: No existing multimodal facilities, adds roadway capacity **Impact**: Shared use path and sidewalk improve multimodal network, added capacity can improve intersection operations at Omaha Street	✓
	Four-lane median divided section + sidewalk and shared use path	**Issues**: Crash history does not indicate significant issues related to access control	
Omaha Street/SD 44: LaCrosse Street to St. Patrick Street	No build	**Issues:** Offers no improvements to limited multimodal facilities	✓
	Five-lane section with two-way left turn lane + shared use path	**Rationale**: No existing bicycle facility and many gaps in existing sidewalk network. **Impact**: Improves cycling and walking conditions on the corridor.	✓
	Four-lane median divided section + shared use path	**Issues**: Crash history does not indicate significant issues related to access control	
East North Street: LaCrosse Street to Cambell Street	No build	**Rationale**: Corridor was recently reconstructed, so no improvements were considered.	✓
East North Street: Cambell Street to Eglin Street	No build	**Issues:** Offers no improvements to limited multimodal facilities	✓
	Five-lane section with two-way left turn lane + sidewalk and shared use path	**Rationale**: No existing pedestrian or bicycle facilities **Impact**: Shared use path and sidewalk improve cycling and walking conditions on the corridor.	✓
	Four-lane median divided section + sidewalk and shared use path	**Issues**: Crash history does not indicate significant issues related to access control	
	Six-lane median divided section + sidewalk and shared use path	**Issues:** Limited traffic operations benefit from expanded cross section	

CHAPTER 4: RECOMMENDATIONS AND IMPLEMENTATION

To guide the planning, programming, and implementation of study area improvements, matrices were developed to summarize the benefits and consequences of build alternatives that were carried forward after alternatives analysis. Matrices were developed for both corridor-type improvements and intersection-type improvements.

For various criteria related to traffic operations, safety, and impacts, each alternative was given a rating. The possible ratings are:

- Good – The build alternative is most favorable and addresses the criteria well. It provides an improvement, or the existing condition does not have any issues
- Moderate – The build alternative is somewhat effective in addressing the criteria. It does not provide the desired level of improvement, or has some impacts that should be acknowledged
- Poor – The build alternative is least effective in addressing the criteria and may make a condition worse, or has more considerable impacts

Application of the rating criteria is somewhat subjective. The ratings are intended to be used as a tool to assist in understanding key benefits and consequences, and how the build alternatives compare. The corridor build alternatives matrix can be seen in Table 4.1 and the intersection build alternatives matrix can be seen in Table 4.2.

Table 4.1 – Corridor Build Alternatives Matrix

		Cambell Street: St. Patrick Street to East North Street		Omaha Street/SD 44: LaCrosse Street St. Patrick Street	East North Street: LaCrosse Street to Cambell Street	East North Street: Cambell Street to Eglin Street
		Five-lane section with added bicycle and pedestrian facilities	**Six-lane median divided section with added bicycle and pedestrian facilities**	**Five-lane section with added shared use path**		**Five-lane section with added bicycle and pedestrian facilities**
Traffic Operations and Safety	**Traffic Flow**	**Moderate** -Intersection operations can be improved with spot improvements	**Good** -Median reduces midblock conflicts	**Moderate** -Intersection operations can be improved with spot improvements		**Moderate** -Intersection operations can be improved with spot improvements
	Crash Potential	**Good** -Reduces multimodal crash potential -No reduction in vehicle crash potential	**Good** -Reduces multimodal crash potential -Median reduces midblock access-related crash potential	**Good** -Reduces multimodal crash potential -No reduction in vehicle crash potential		**Good** -Reduces multimodal crash potential -No reduction in vehicle crash potential
	Multimodal Accomodations	**Good** -Adds bicycle and pedestrian facilities	**Good** -Adds bicycle and pedestrian facilities -Median serves as refuge island	**Good** -Adds shared bicycle and pedestrian facility	**No Improvements Considered**	**Good** -Adds bicycle and pedestrian facilities
Cost and Impacts	**Project Cost**	**Moderate** $3.1 million	**Poor** $26.2 million	**Good** $600,000		**Good** $1.25 million
	Access Impacts	**Good** -No impact	**Poor** -Converts 30 to 40 accesses to right-in/right-out accesses	**Good** -No impact		**Good** -Minimal impact -Closes one redundant private access
	Property Impacts	**Moderate** -Some impacts to off-street parking	**Poor** -Signficant impacts to off-street parking	**Good** -Minimal impacts		**Good** -Minimal impacts

*All Level of Service (LOS) results shown in this table refer to 2045 PM peak traffic operations

**Cost estimates are for year 2024 (construction costs only, does not include right-of-way costs)

Table 4.2 – Intersection Build Alternatives Matrix

		Cambell Street and Saint Patrick Street	Cambell Street and Omaha Street			Cambell Street and East North Street		Omaha Street and LaCrosse Street	North Street and LaCrosse Street		North Street and Anamosa Street	North Street and Eglin Street
		Add second EB left turn lane and a WB right turn lane	**Add second NB and SB left turn lanes + Convert all channelized right turns to dedicated right turn lanes**	**Expand Cambell Street to six lanes + Add second NB and SB left turn lanes**	**Displace NB and SB left turns**	**Add second WB left turn lane and convert NB channelized right turn into a double right turn lane**	**Displace WB left turns**		**No Build**	**Add NB and SB right turn lanes**		**Add second EB left turn lane**
Traffic Operations and Safety	**Traffic Flow***	**Moderate** -25 precent intersection delay reduction -Remains at intersection LOS D (LOS D in no-build condition)	**Moderate** -31 percent intersection delay reduction -Improves intersection from LOS E to LOS D	**Moderate** -41 percent intersection delay reduction -Improves intersection from LOS E to LOS D	**Moderate** -Improves main intersection from LOS E to LOS D -Crossover intersections operate at LOS B	**Poor** -64 percent intersection delay reduction -Improves intersection from LOS F to LOS E	**Good** -Main intersection operates at LOS B -Crossover intersection operates at LOS B	**No Improvements Considered**	**Moderate** -Operates at intersection LOS D	**Good** -20 percent intersection delay reduction -Improves intersection from LOS D to LOS C	**No Improvements Considered**	**Moderate** -30 percent intersection delay reduction -Remains at intersection LOS D (LOS D in no-build condition)
	Crash Potential	**Good** -Rear end crash reduction from delay reduction -Angle crash reduction from protected-only left turn phasing on EB approach	**Good** -Rear end crash reduction from delay reduction -Angle crash reduction from protected-only left turn phasing on NB and SB approaches	**Good** -Rear end crash reduction from delay reduction -Angle crash reduction from protected-only left turn phasing on NB and SB approaches	**Good** -Limited safety data since this is a newer intersection configuration -Reduced delay will reduce rear end crash potential. -NB and SB left turns will not cross opposing through traffic at the main intersection	**Good** -Rear end crash reduction from delay reduction -Angle crash reduction from protected-only left turn phasing on WB approach	**Good** -Limited safety data since this is a newer intersection configuration -Reduced delay will reduce rear end crash potential. -WB left turns will not cross opposing through traffic at the main intersection		**Good** -No improvement, but no existing crash issue	**Good** -Reduced delay reduces rear end crash potential		**Good** -Rear end crash reduction from delay reduction -Angle crash reduction from protected-only left turn phasing on EB approach
	Truck Movements	**Good** -Proper intersection design can accommodate truck movements on proposed EB double left turn lane	**Good** -Proper intersection design can accommodate truck movements on proposed double left turn lanes	**Good** -Proper intersection design can accommodate truck movements on proposed double left turn lanes	**Good** -Proper intersection design can accommodate truck movements at displaced left turns	**Good** -Proper intersection design can accommodate truck movements on proposed double left turn lanes	**Good** -Proper intersection design can accommodate truck movements on proposed double left turn lanes		**Good** -No changes to existing truck maneuverability	**Good** -No changes to existing truck maneuverability		**Good** -Proper intersection design can accommodate truck movements on proposed EB double left turn lane
	Driver Familiarity	**Good** -Common intersection configuration	**Good** -Common intersection configuration	**Good** -Common intersection configuration	**Poor** -No similar intersections currently in South Dakota	**Good** -Common intersection configuration	**Poor** -No similar intersections currently in South Dakota		**Good** -Common intersection configuration	**Good** -Common intersection configuration		**Good** -Common intersection configuration
	Multimodal Accomodations	**Good** -Existing pedestrian signal heads -Crossing distance on west approach increases	**Good** -Existing pedestrian signal heads -Removing channelizing islands reduces pedestrian/bicycle crash potential	**Good** -Existing pedestrian signal heads -Median serves as pedestrian refuge -Removing channelizing islands reduces pedestrian/bicycle crash potential	**Moderate** -Medians at intersection could serve as pedestrian refuge -No vehicle conflicts for NB and SB right turning vehicles could increase turning speeds and pedestrian conflict potential	**Moderate** -Existing pedestrian signal heads -Crossing distances increase on both east and south intersection approaches	**Moderate** -Medians at intersection could serve as pedestrian refuge -No vehicle conflicts for NB right turning vehicles could increase turning speeds and pedestrian conflict potential		**Good** -Existing pedestrian signal heads	**Moderate** -Existing pedestrian signal heads, but crossing distance on north and south approaches		**Good** -Existing pedestrian signal heads, but crossing distance on west approach increases
Cost and Impacts	**Project Cost****	**Good** $1.8 million	**Moderate** $6.5 million	**Poor** $7.2 million	**Poor** $7.4 million	**Moderate** $4.2 million	**Moderate** $5.4 million		**Good** No cost	**Good** $565,000		**Good** $1.3 million
	Snow Maintenance	**Good** -No medians to impact snow removal	**Good** -Removing channelizing islands simplifies snow removal	**Moderate** -Medians can impact snow removal	**Poor** -Median-channelized turn lanes can create difficulties in snow removal	**Good** -Removing channelizing islands simplifies snow removal	**Poor** -Median-channelized turn lanes can create difficulties in snow removal		**Good** -No medians to impact snow removal	**Good** -No medians to impact snow removal		**Good** -Removing median to accommodate second EB left turn lane simplifies snow removal
	Property Impacts	**Moderate** -Some impacts to to private parking on NW and NE intersection corners -Potential impacts to four private accesses	**Moderate** -Some impacts to to private parking on corners of intersection -Potential impacts to two private accesses	**Poor** -Greater impacts to private parking on corners of intersection -Potential impacts to two private accesses	**Poor** -Greater impacts to private parking on corners of intersection -Potential impacts to five private accesses	**Poor** -Impacts to intersection corners, especially SE corner	**Poor** -Impacts to intersection corners, especially SE corner -Converts one private access to right-in/right-out -Converts Century Road to right-in/right-out at E. North Street		**Good** -No impacts	**Moderate** -Some impacts to NW and SE intersection corners		**Good** -No significant impacts

*All Level of Service (LOS) results shown in this table refer to 2045 PM peak traffic operations

**Cost estimates are for year 2024 (construction costs only, does not include right-of-way costs)

Recommended Improvements

Based on the ratings for all considered criteria, the following improvements are recommended:

Corridor-Type Improvements

- Cambell Street – from Saint Patrick Street to East North Street
  - Add sidewalk and shared use path to existing five-lane roadway section
    - Improves multimodal accessibility and safety
  - Traffic operations with the existing roadway section can be improved with intersection improvements at Omaha Street/SD 44, East North Street, and Saint Patrick Street
    - Expansion to six-lanes would have greater impacts to adjacent properties, with a much higher project cost

- Omaha Street/SD 44 – from LaCrosse Street to Saint Patrick Street
  - Add shared use path to existing five-lane roadway section
    - Improves multimodal accessibility and safety
  - Traffic operations with the existing roadway section can be improved with intersection improvements at Cambell Street

- East North Street – from Cambell Street to Eglin Street
  - Add sidewalk and shared use path to existing five-lane roadway section
    - Improves multimodal accessibility and safety
  - Traffic operations with the existing roadway section can be improved with intersection improvements at Cambell Street and Eglin Street

Intersection Improvements

- Cambell Street and Saint Patrick Street
  - Add second eastbound left turn lane and add westbound right turn lane

- Cambell Street and Omaha Street/SD 44
  - Add second left turn lane on northbound and southbound approaches and convert channelized right turns to dedicated right turn lanes on all approaches. Include widening to allow north-south left turns to run concurrently
    - Provides similar operations to a the considered displaced left turns configuration, but has fewer impacts and lower cost
  - See **Figure 4.1** for a conceptual layout of this build alternative

- Cambell Street and East North Street
  - Construct an intersection with displaced left turns on the westbound approach
    - This is the only configuration that provides acceptable traffic flow (expected to operate at LOS B through 2045)
    - Cost and impacts are comparable to other options
  - See **Figure 4.2** for a conceptual layout of this build alternative

- East North Street and LaCrosse Street
  - Add northbound and southbound right turn lanes
    - Provides a significant traffic flow benefit

- East North Street and Eglin Street
  - Add a second eastbound left turn lane
    - Provides a significant traffic flow benefit

Future Roadways

Based on 2045 traffic projections, it is expected that the future extensions of Creek Drive, Anamosa Street, Valley Drive, and Mickelson will not require more than one through lane in each direction. Turn lanes should be considered at major intersections and be in accordance with local design standards, and it is also recommended pedestrian and bicycle facilities are included to best integrate with other multimodal improvements that are being recommended as part of this study.

Since most traffic on these future routes is expected to be generated by adjacent development and not re-routed traffic from existing roadways, public funding of these future routes is not required.

Phasing of Improvements

Specific construction years for recommended projects have not been identified. However, a general time-frame for improvements based on the expected onset of issues has been identified (i.e. short-term projects, mid-term projects, long-term projects).

Since the need for future routes is based on the timing of new development in the study area, these projects were not included in project phasing.

SHORT-TERM PROJECTS

Short-term projects should be constructed within ten years. These projects should be integrated into the Transportation Improvement Program as soon as funds are available. These improvements have either been already identified as part of previous planning efforts or mitigate existing issues.

- Intersection Improvements at Cambell Street and East North Street
  - Construct an intersection with displaced left turns on the westbound approach
    - It is recommended that intersection improvements at this location are prioritized since peak hour traffic operations are currently deficient (LOS D in the PM peak hour), and peak hour delays are expected to increase by nearly 50 percent by 2025.

- Multimodal improvements along Omaha Street/SD 44 – from LaCrosse Street to Saint Patrick Street
  - Add shared use path to existing five-lane roadway section
    - A north side shared use path is already programmed as a 2021 project for the segment between LaCrosse Street to Covington Street. Note that Covington Street is southeast of Saint Patrick Street and is beyond the east side of the study area.

MID-TERM PROJECTS

Mid-term projects should be constructed in the next 11 to 20 years and should be considered in subsequent planning efforts and incorporated into the next Long-Range Transportation Plan. These projects can however can be programmed and implemented after the Cambell Street/East North Street intersection improvements.

- Intersection Improvements at Cambell Street and Omaha Street/SD 44
  - Add second left turn lane on northbound and southbound approaches and convert channelized right turns to dedicated right turn lanes on all approaches. Include widening to allow north-south left turns to run concurrently.
    - A slight deterioration in operations is expected by 2025, with PM peak hour LOS D expected, however more major delays are not expected until later into the future (2045 PM peak LOS E, and AM LOS D).

- East North Street and Eglin Street
  - Add a second eastbound left turn lane
    - The existing PM peak hour traffic operates at LOS E. This project is not currently in the Transportation Improvement Program, indicating that implementation any sooner may not be realistic.

- Multimodal improvements along Cambell Street – from Saint Patrick Street to East North Street
  - Add sidewalk and shared use path to existing five-lane roadway section
    - These facilities can connect with short-term multimodal improvements on Omaha Street/SD 44

- Multimodal improvements along East North Street – from Cambell Street to Eglin Street
  - Add sidewalk and shared use path to existing five-lane roadway section
    - These facilities can be built as development fills in along East North Street in the future

LONG-TERM PROJECTS

The following projects can be considered long-term improvements (20 years or more into the future), since acceptable operations (no worse than LOS C) are expected through at least 2025. These improvements can be carried into future planning documents, and/or also incorporated into larger overall corridor projects.

- Cambell Street and Saint Patrick Street
  - Add second eastbound left turn lane and add westbound right turn lane

- East North Street and LaCrosse Street
  - Add northbound and southbound right turn lanes

Figure 4.1 – Intersection of Cambell Street and Omaha Street: Standard Turn Lane Improvements

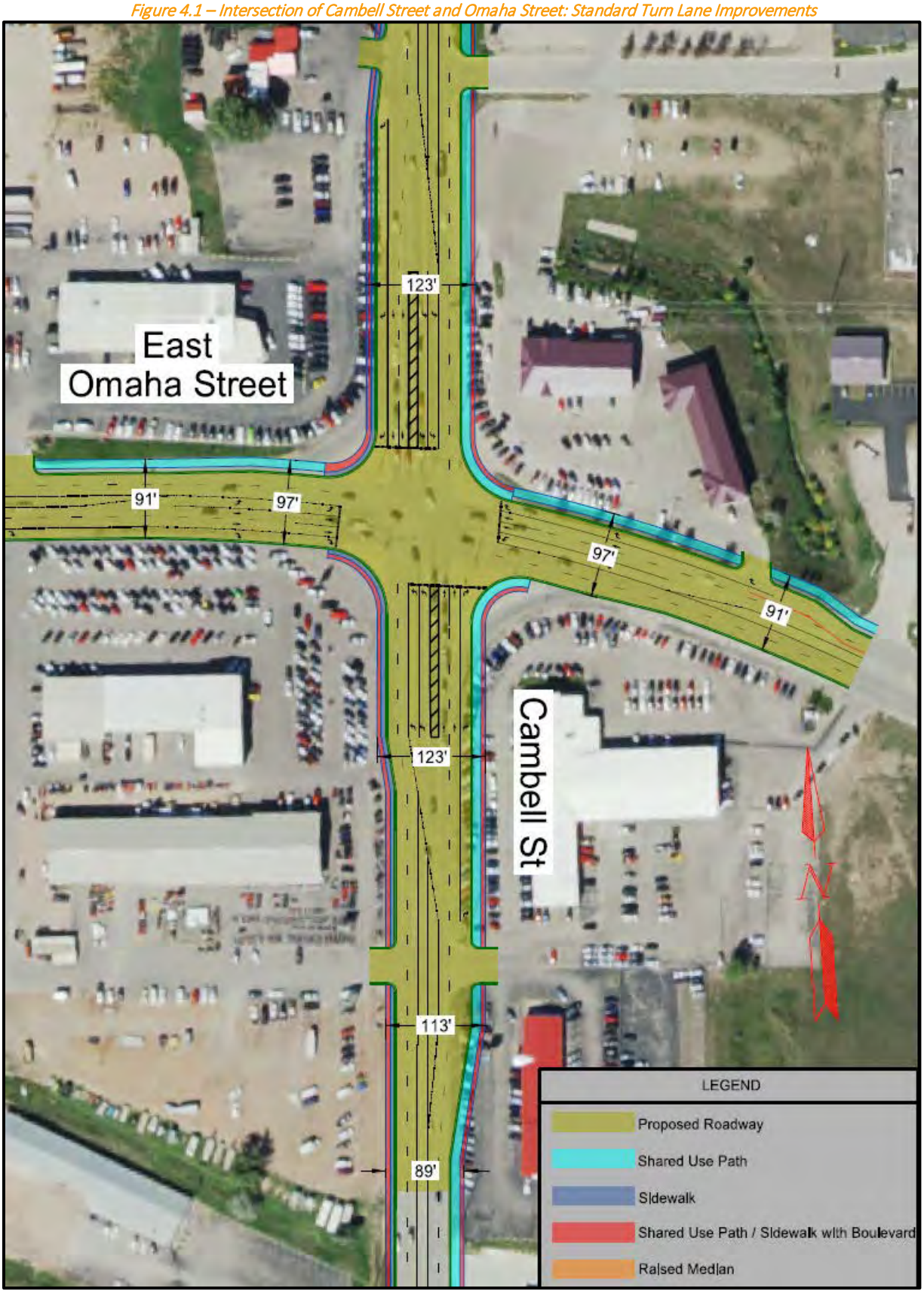


Figure 4.2 – Intersection of Cambell Street East North Street: Displaced Left Turns Configuration