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## **Existing Traffic Characteristics Memorandum**

**To:** *Darren Laesch, PE, MnDOT District 2*

**From:** *Jack Corkle, PTP, AICP, WSB & Associates, Inc.*  
*Sean Delmore, PE, PTOE, WSB & Associates, Inc.*

**Date:** *July 23, 2015*

**Re:** *TH 11 Existing Traffic Characteristics*  
*WSB Project No. 03063-000*

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The purpose of this memo is to document the existing traffic characteristics and operations on TH 11 between Greenbush and Roosevelt in Roseau County that are a part of the TH 11 Corridor Study. The memo is divided into five sections that describe existing traffic characteristics and operations. The first section provides general information on TH 11 and the area in which the study is occurring. The second section provides information on the roadway's characteristics related to traffic – such as traffic volumes, commercial traffic volumes, traffic control, etc. Some of the information in this section includes summaries from the Roadway Characteristics Memo from July 3, 2015. Section three documents existing roadway capacity constraints and “hot spots” that emerge during some time periods during the day. The fourth section provides information about existing operations at four intersections along the corridor. Section five includes information on corridor safety. General corridor trends are documented as well as problem segments and intersections. Understanding how the corridor operates and performs today will enable the team to identify problems that are likely to emerge in the future or need to be addressed as part of the alternatives development process.

## 1. Study Background Information

TH 11 is the primary east-west route for communities located near the Canadian border including, Greenbush, Badger, Roseau, Warroad and Roosevelt (**Figure 1**). It serves an important connection to international border crossings with Canada – including one that is open year-round, 24 hours a day. The corridor is home to two major employers, Polaris and Marvin Windows, as well as the Seven Clans Casino, which is also a larger employer for the area. In addition, Lake of the Woods borders the corridor in Warroad. Much of the area between the communities along the corridor is largely undeveloped, with a smattering of manufactured home communities, contractor yards, agricultural uses, isolated businesses, residential development and the Roseau Airport.

The corridor study area covers the approximately 60 miles of TH 11 between Greenbush and Roosevelt. As part of the study, existing and future conditions will be evaluated and recommendations for improvements along the corridor will be identified for implementation over the next 20 years. A number of items will be studied including congestion hot spots, safety problem areas, roadway design consistency, infrastructure condition, future growth and development, and American with Disabilities Act requirements.

## 2. Traffic Characteristics

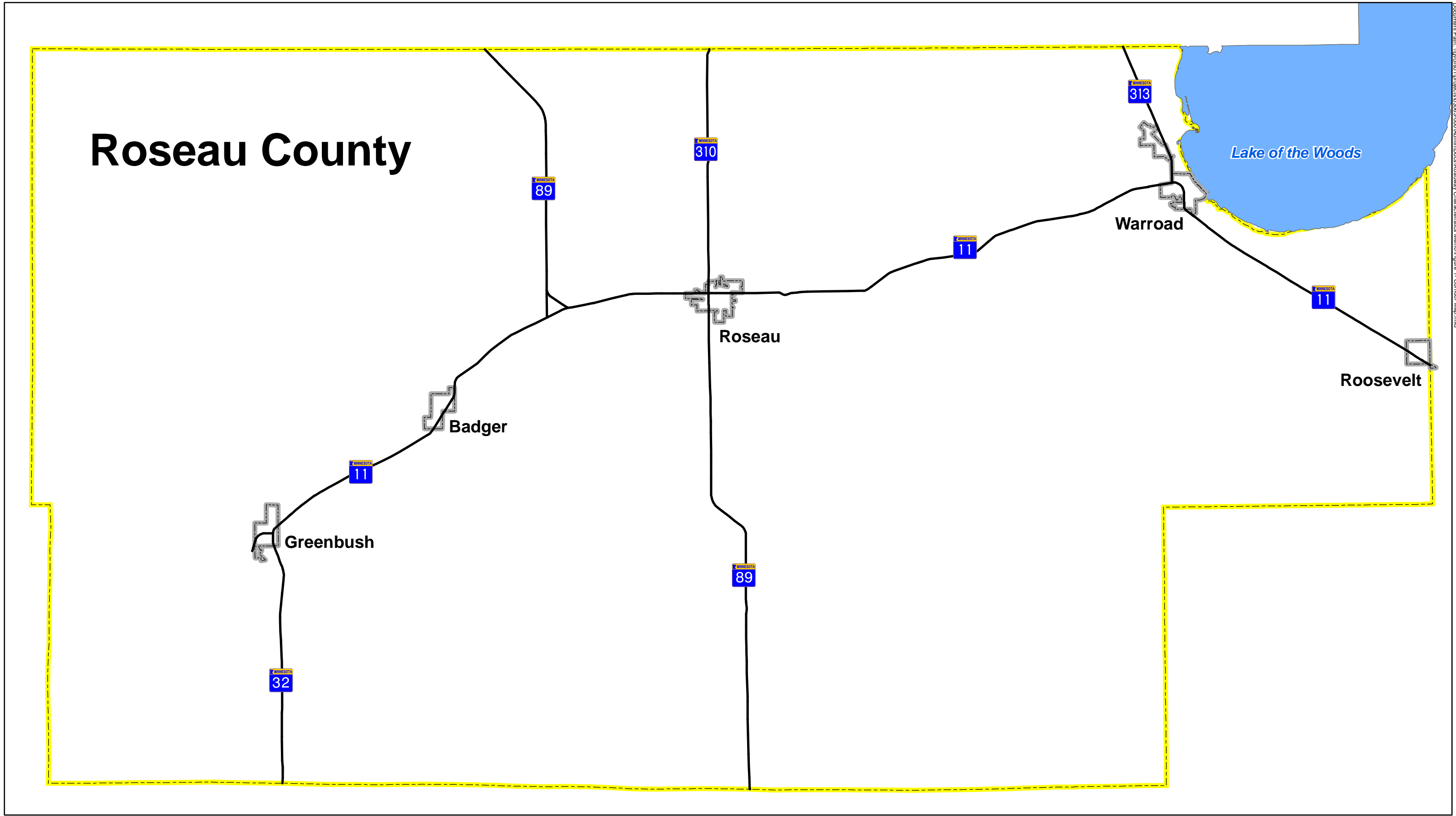
This section of the memo identifies and describes characteristics associated with traffic on the corridor. Information on the following is described on the following pages: Number of travel lanes, posted and proposed speeds, traffic volumes, heavy commercial volumes and traffic control.

### Travel Lanes

TH 11 is a two-lane roadway with 12-foot wide travel lanes for a majority of the corridor. Two sections of roadway through the Cities of Roseau and Warroad are three-lane sections. In these areas there is one travel lane in each direction and a 14-foot wide center left-turn lane to access driveways and public streets. In some locations within the three-lane segment there are also right-turn lanes. **Table 1** identifies the beginning and ending points of the different roadway configurations. **Figures 2** and **3** show the existing three-lane segments of the corridor.

**Table 1 – Number of Travel Lanes**

| General Area              | Segment Description  | Number of Lanes |
|---------------------------|--|-----------------|
| Greenbush/ Badger/ Roseau | From CR 104 (200th Street) to east of 15th Avenue NW in Roseau                   | 2               |
| Roseau                    | From east of 15th Avenue NW to 11th Avenue NE                                    | 3               |
| Roseau/Salol /Warroad     | From 11th Avenue NE in Roseau to west of TH 313 in Warroad                       | 2               |
| Warroad                   | From west of TH 313 to north of the Warroad River crossing                       | 3               |
| Swift/Roosevelt           | From north of the Warroad River crossing to the Lake of the Woods County border. | 2               |



# Roseau County

Lake of the Woods

Warroad

Roseau

Roosevelt

Badger

Greenbush

Figure 1- Corridor Study Area

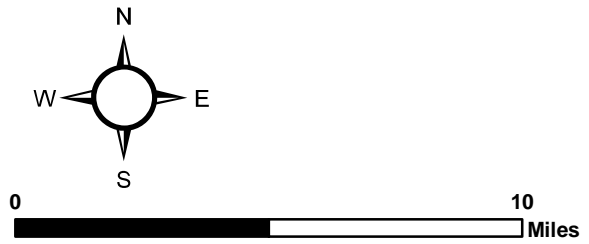


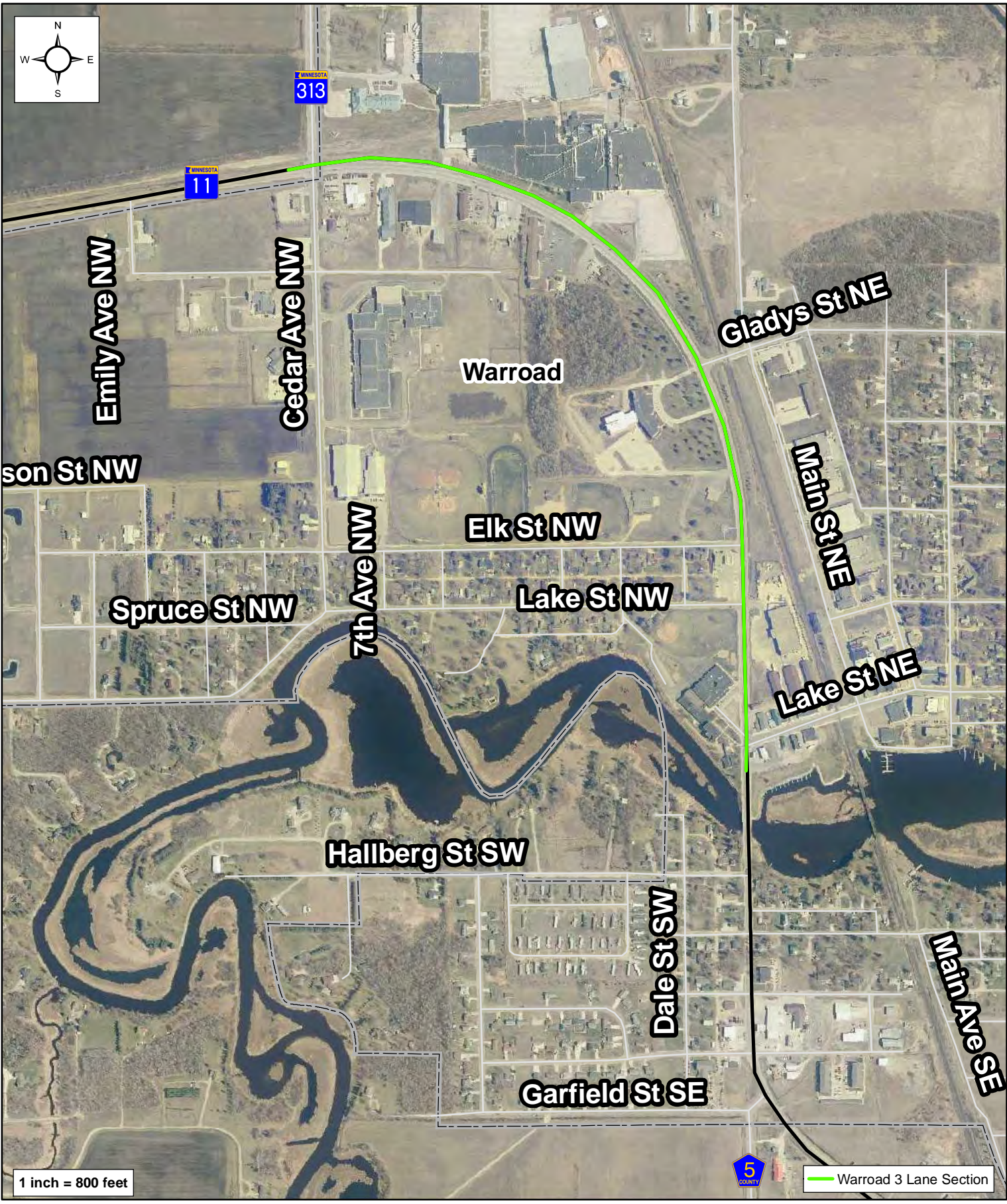




Figure 2 - Roseau 3 Lane Section







1 inch = 800 feet



Warroad 3 Lane Section

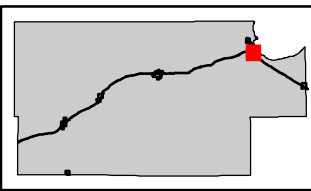


Figure 3 - Warroad 3 Lane Section



## Posted Speeds and Proposed Speed Change

### Posted Speeds

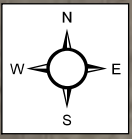
The posted speed on TH 11 is primarily 55 miles per hour, with speed zones of 30, 40, 45 and 50 miles per hour in more urbanized locations. Within the communities, speeds tend to drop due to the number of access locations, development along the corridor and a mix of users (e.g., pedestrians in downtown areas). In general, speeds are 30 miles per hour in locations where there is more residential density, schools and in the older/more mature part of the community. Speeds of 40 miles per hour or 45 miles per hour generally buffer the 30 mile per hour locations. Locations with speeds between 40 and 45 miles per hour tend to have more commercial uses or are transitioning back to more rural areas.

**Table 2** shows posted speeds along the corridor. **Figures 4 – 7** show locations where the speed limit is less than 55 miles per hour.

**Table 2 – Posted Speeds on TH 11**

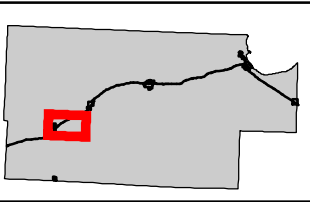
| Community            | TH 11 Segment Description   | Posted Speed      |
|----------------------|---|-------------------|
| Greenbush            | From CR 104 to just east of Oakview Drive   | 55 miles per hour |
| Greenbush            | From just east of Oakview Drive to intersection of TH 11 and TH 32  | 30 miles per hour |
| Greenbush            | From intersection of TH 11 and TH 32 to a point approximately 0.2 miles north/east  | 40 miles per hour |
| Greenbush, Badger    | From approximately 0.2 miles north/east of the TH 11 and TH 32 intersection to a point just south/west of CSAH 2 in Badger                                    | 55 miles per hour |
| Badger               | From just south/west of the intersection with CSAH 2 to just north of the railroad tracks and the Swedish Cemetery (south of the northern junction of CSAH 3) | 50 miles per hour |
| Badger to Roseau     | From CSAH 3 north of Badger to a point approximately 0.2 miles east of 380th/18th Avenues (just west of 15th Ave NW) in Roseau                                | 55 miles per hour |
| Roseau               | From just west of 15th Avenue NW to just west of 7th Avenue NW  | 45 miles per hour |
| Roseau               | From just west of 7th Avenue NW to just east of 11th Avenue NE  | 30 miles per hour |
| Roseau to Warroad    | From 11th Avenue NE in Roseau to just west of TH 313/Cedar Avenue NW in Warroad   | 55 miles per hour |
| Warroad              | From just west of TH 313/Cedar Avenue NW to between Gladys and Elk Streets  | 40 miles per hour |
| Warroad              | From between Gladys and Elk Streets to Warroad City Limits just south of the intersection with CSAH 5   | 30 miles per hour |
| Warroad to Roosevelt | From Warroad City Limits just south of the intersection with CSAH 5 to the Roseau-Lake of the Woods County Line in Roosevelt                                  | 55 miles per hour |





1 inch = 1,000 feet

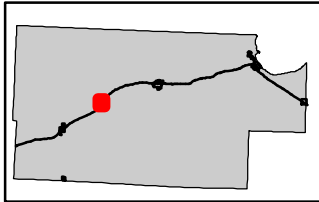
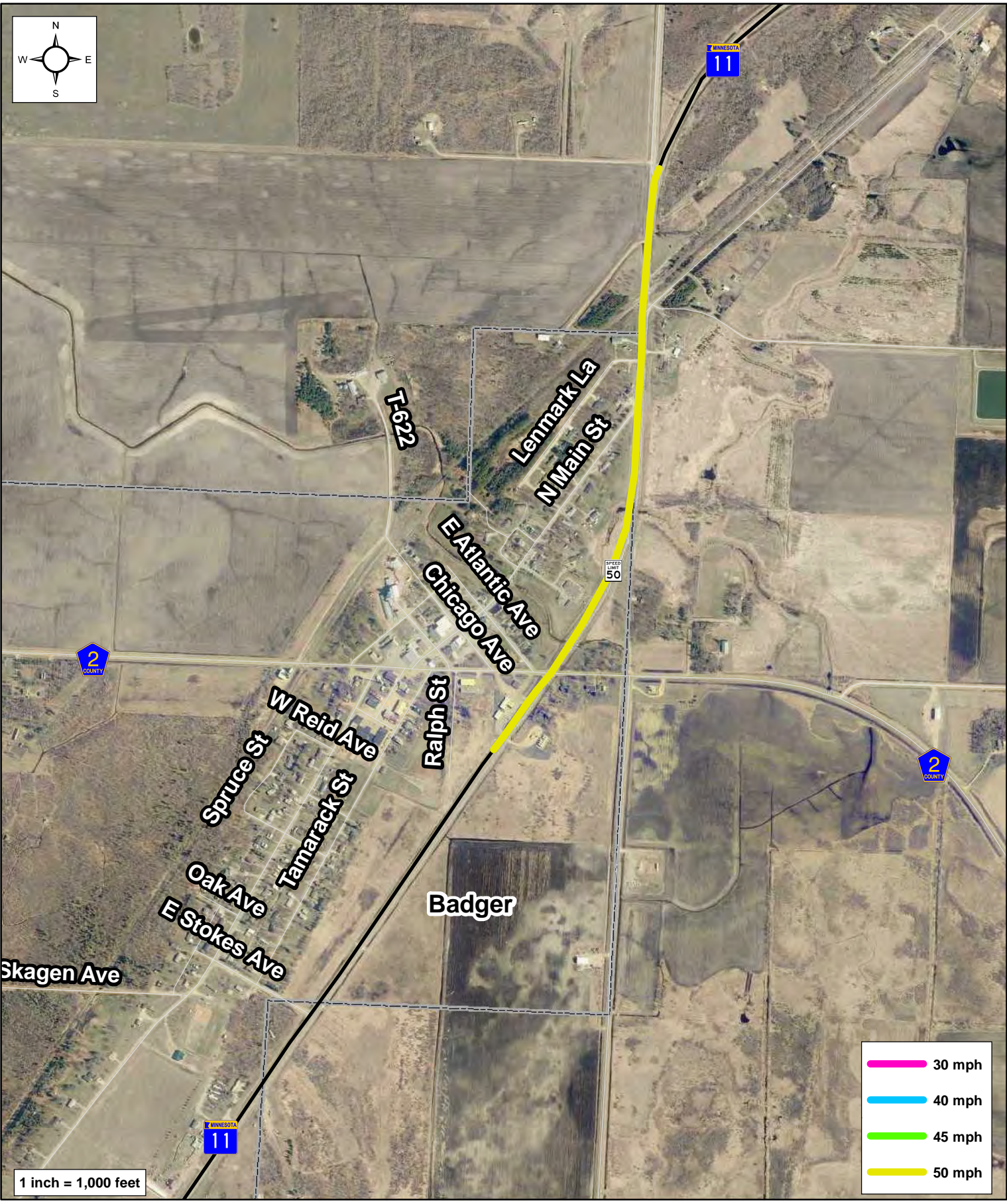
- 30 mph
- 40 mph
- 45 mph
- 50 mph



**Figure 4**  
**Speed Limits Less Than 55 mph**  
**Greenbush**



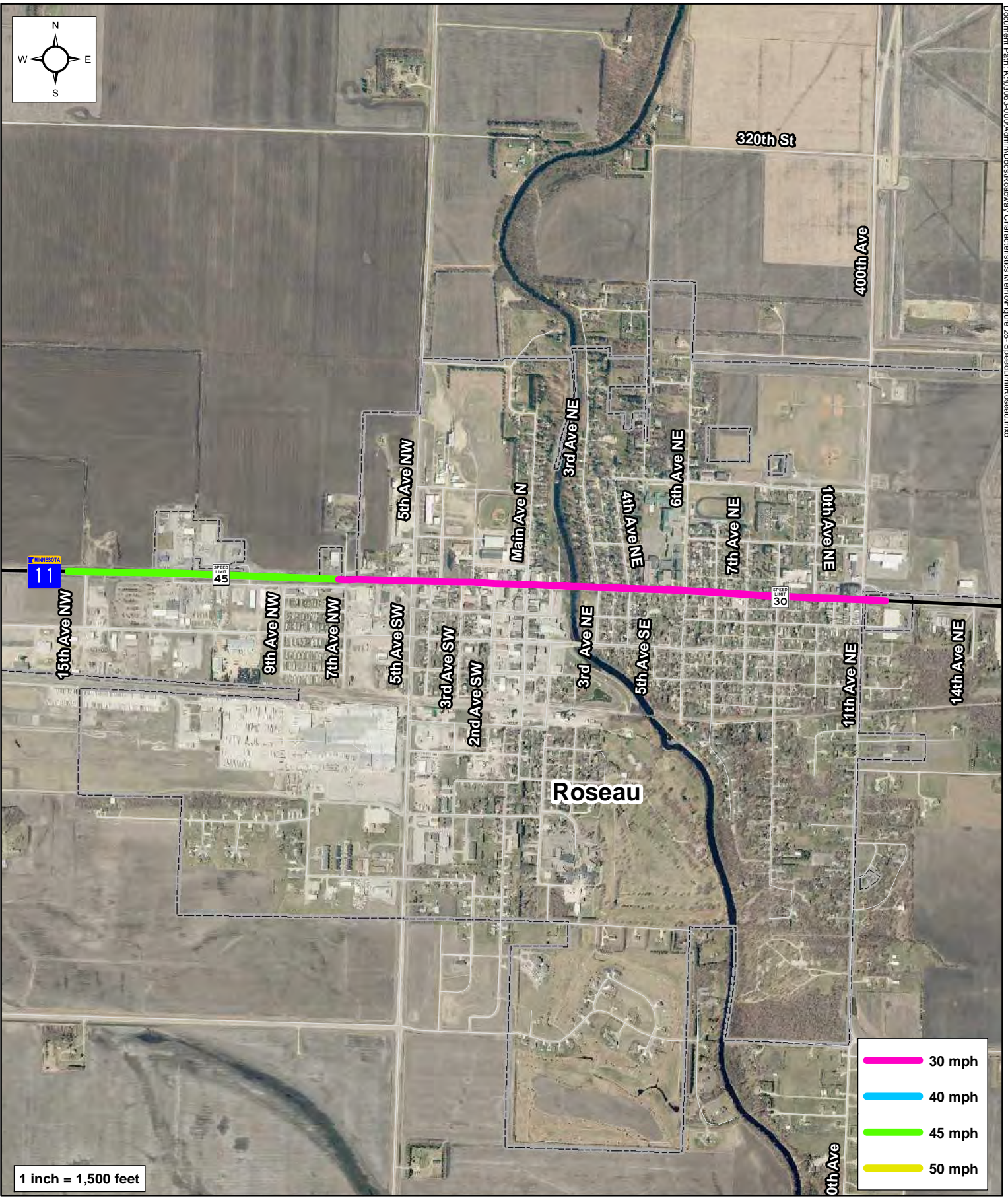
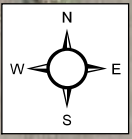




**Figure 5**  
**Speed Limits Less Than 55 mph**  
**Badger**

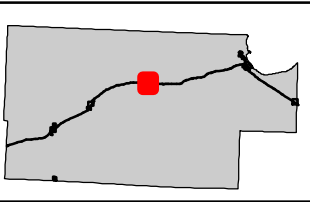






1 inch = 1,500 feet

- 30 mph
- 40 mph
- 45 mph
- 50 mph



**Figure 6**  
**Speed Limits Less Than 55 mph**  
**Roseau**

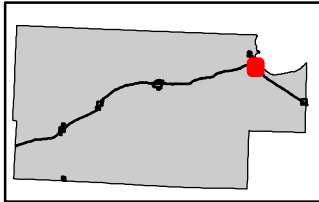






1 inch = 1,000 feet

- 30 mph
- 40 mph
- 45 mph
- 50 mph



**Figure 7**  
**Speed Limits Less Than 55 mph**  
**Warroad**





## TH 11 Existing Traffic Characteristics

In addition to the posted speed limits, there is also an advisory speed of 45 miles per hour posted along the curve south of the Roseau Municipal Airport (in both westbound and eastbound travel directions).

### **Proposed Speed Changes**

It is anticipated that in areas where current speeds are 55 miles per hour, speed limits will be raised as part of a statewide program to 60 miles per hour. This is likely to take effect sometime in 2015. An exact date has yet to be determined. It should be noted that the 60 mile per hour speed is consistent with the travel speeds that were collected/observed as part of the travel time runs documented in this memo.

### **Traffic Volumes**

MnDOT regularly counts the number of vehicles that use its roadways. This data is useful in understanding where congestion may be occurring, what changes in travel patterns happen over time, what destinations people are going to, how used a roadway is relative to other roadways in the network, what types of improvements might be needed, and how serious a crash location may be. Traffic data is recorded as annual, average daily traffic (AADT) and heavy commercial average daily traffic (HCADT). These two types of traffic are described on the following pages.

#### **AADT**

Annual, average daily traffic (AADT) is the amount of traffic that is likely to be on the roadway during a typical weekday. AADT is calculated based off of traffic counts taken by MnDOT. The data is collected using a few different means including, road tubes and automatic traffic recorders. Road tubes require the agency to go out and place counting tubes at locations on the corridor where they want to record data. Automatic traffic recorders are a system of data recorders that the state installs and leaves in place, on a year-round basis. They record vehicles passing by them 24 hours a day, seven days a week. Tube counts are generally only collected for a couple of days. The data collected is then factored by the time of year (fewer trips in the winter and more trips in the summer) to provide a daily estimate. AADT includes all motorized vehicles on the roadway.

The following highlights basic traffic facts about the TH 11 corridor:

- Traffic volumes are slightly less than 3,000 cars a day west of TH 308 (outside of Badger)
- At the TH 308, TH 11 and TH 89 triangle (outside of Badger) traffic volumes increase to approximately 3,600
- At the western junction of the City of Roseau, traffic volumes increase to approximately 9,000 (three-lane section)
- Traffic volumes drop slightly to 8,000 east of the TH 310/TH 89 intersection in Roseau (three-lane section)
- Traffic volumes drop to approximately 6,000 at 11th Avenue in Roseau (three-lane section)
- Traffic volumes drop to approximately 4,000 east of 11th Avenue in Roseau
- Traffic volumes increase to approximately 4,500 near 560th Avenue/350th Street outside of Warroad to TH 313 in Warroad
- Traffic volumes range between 7,000 and 8,000 between TH 313 and County Road 5 in Warroad (portions of the segment are a three-lane section)
- East/south of County Road 5 volumes are approximately 3,600 until County Road 12
- East of County Road 12 volumes are approximately 1,700

## TH 11 Existing Traffic Characteristics

**Table 3** lists traffic volumes by segment. **Figures 8 – 12** show 2014 traffic volumes on TH 11.

### HCADT

In addition to counting all of the vehicles that use a particular route, MnDOT also regularly counts the number of larger vehicles (semitrailers) that use the roadway. This information is useful in identifying freight patterns on the corridor and for identifying important freight origins and destinations that may be nearby. The truck traffic on the corridor is called Heavy Commercial Daily Traffic (HCADT). It is also useful in helping to prioritize the types of investments and safety improvements that should be considered.

The amount and percent of truck traffic varies widely from corridor to corridor. Where traffic volumes are lower, it is possible that a high percent of the traffic is truck traffic and where traffic volumes are really high, it takes a lot of trucks to get over 3 to 5 percent of the total traffic.

With large manufacturers (i.e., major freight generators at Polaris and Marvin) in and near the corridor, along with connections to international border crossings, TH 11 does have a lot of truck traffic. Many of the segments have more than 5 percent of truck traffic. It should be noted that TH 11 was identified as a Tier 2 on the state's truck network (MnDOT Western Minnesota Freight Study – 2009). Being designated as a Tier 2 corridor indicates that somewhere between 301 and 650 trucks use the corridor on any given day. Tier 1 and Tier 2 corridors were identified as having the highest priority for future investment.

The following highlights basic facts about truck traffic on TH 11:

- Truck traffic in Greenbush to CSAH 2 (University Avenue) in Badger is between 5 and 6.4 percent of all traffic
- Between CSAH 2 (University Avenue) in Badger and TH 308 truck traffic is over 9 percent of total traffic
- Between TH 308 and the western junction of the City of Roseau truck traffic is 3.9 to 4.4 percent of total traffic
- At the western junction of the City of Roseau, the percent of trucks decreases to 4.1 percent (traffic volumes increase to approximately 9,000 in this area)
- East of the TH 310/TH 89 intersection to 11th Avenue in Roseau, the percent of trucks is 7.4 percent. The number of trucks is a bit higher through portions of this area and traffic volumes are starting to reduce.
- East of 11th Avenue in Roseau to 560th Avenue/350th Street outside of Warroad, truck traffic comprises 6.8 percent of the total traffic
- From 560th Avenue/350th Street outside of Warroad to TH 313 the percent of truck traffic increases to 7.6 percent
- Between TH 313 and Lake Street (south junction) in Warroad truck traffic is 6.8 percent
- Between Lake Street (south junction) and CSAH 12 truck traffic is 10.4 percent
- East of CSAH 12 truck traffic is 13.9 percent

**Table 4** lists truck traffic volumes by segment. **Figures 13 – 17** show truck volumes on TH 11 in the study area.

**Table 3 – Traffic Volumes by Segment (AADT)**

| Segment | From   | To   | 1994  | 1996  | 1998  | 2000   | 2002   | 2004   | 2006  | 2008  | 2010  | 2012  | 2014  |
|---------|--|--|-------|-------|-------|--------|--------|--------|-------|-------|-------|-------|-------|
| 1       | Western Limit of Greenbush                   | Junction with TH 32 in Greenbush             | 2,150 | 2,550 | 2,600 | 2,400  | 2,650  | 2,850  | 2,800 | 2,700 | 2,550 | 2,450 | 2,450 |
| 2       | Junction with TH 32 in Greenbush             | CSAH 2/University Avenue in Badger           | 2,400 | 2,300 | 2,450 | 2,450  | 2,500  | 2,700  | 2,550 | 2,400 | 2,450 | 2,750 | 2,500 |
| 3       | CSAH 2/University Avenue in Badger           | TH 308                                       | 2,400 | 2,300 | 2,450 | 2,450  | 2,500  | 2,700  | 2,550 | 2,400 | 2,450 | 2,750 | 2,750 |
| 4       | TH 308                                       | Western Junction with TH 89                  | 3,400 | 2,100 | 2,950 | 3,400  | 3,200  | 3,300  | 2,950 | 3,200 | 2,950 | 2,850 | 2,800 |
| 5       | Western Junction with TH 89                  | CR 120/380th Avenue                          | 3,750 | 2,500 | 4,050 | 4,250  | 4,250  | 4,400  | 4,000 | 4,200 | 3,900 | 3,400 | 3,600 |
| 6       | CR 120/380th Avenue                          | Junction with TH 310/89/5th Avenue in Roseau | 6,700 | 8,000 | 9,000 | 8,700  | 9,300  | 10,100 | 8,100 | 8,700 | 8,300 | 7,700 | 8,700 |
| 7       | Junction with TH 310/89/5th Avenue in Roseau | Main Avenue North in Roseau                  | 8,300 | 6,500 | 9,100 | 8,700  | 9,800  | 10,200 | 8,600 | 8,400 | 8,000 | 7,800 | 7,800 |
| 8       | Main Avenue North in Roseau                  | 3rd Avenue Northeast in Roseau               | 6,800 | 7,600 | 8,500 | 7,700  | 8,800  | 9,500  | 8,700 | 8,000 | 6,600 | 6,800 | 6,300 |
| 9       | 3rd Avenue Northeast in Roseau               | CSAH 24/11th Avenue in Roseau                | 6,300 | 6,200 | 6,600 | 6,000  | 8,900  | 7,200  | 6,100 | 6,300 | 6,100 | 5,900 | 5,700 |
| 10      | CSAH 24/11th Avenue in Roseau                | CSAH 46                                      | 3,250 | 2,800 | 2,700 | 2,400  | 2,600  | 3,400  | 3,000 | 3,150 | 3,400 | 3,700 | 3,900 |
| 11      | CSAH 46                                      | TH 313 in Warroad                            | 4,500 | 3,900 | 4,050 | 4,000  | 4,350  | 4,750  | 4,300 | 4,250 | 4,500 | 4,500 | 4,400 |
| 12      | TH 313 in Warroad                            | Lake Street NW in Warroad                    | 5,900 | 6,400 | 6,100 | 7,900  | 6,500  | 6,400  | 6,800 | 6,500 | 6,500 | 6,200 | 6,800 |
| 13      | Lake Street Northwest in Warroad             | CSAH 74/Lake Street Northeast in Warroad     | 8,300 | 7,100 | 8,800 | 11,100 | 9,500  | 9,300  | 8,400 | 8,100 | 7,800 | 7,700 | 7,600 |
| 14      | CSAH 74/Lake Street Northeast in Warroad     | Hallberg Street Southwest in Warroad         | 8,000 | 8,000 | 8,800 | 9,200  | 9,600  | 9,100  | 8,700 | 8,000 | 8,100 | 7,700 | 7,500 |
| 15      | Hallberg Street Southwest in Warroad         | Garfield Street Southeast in Warroad         | 6,500 | 7,000 | 7,100 | 8,000  | 10,200 | 6,900  | 6,500 | 6,300 | 6,400 | 6,800 | 6,300 |
| 16      | Garfield Street Southeast in Warroad         | CSAH 12                                      | 3,450 | 3,100 | 4,000 | 4,950  | 4,950  | 4,300  | 3,550 | 3,400 | 3,550 | 3,400 | 3,550 |
| 17      | CSAH 12                                      | Roseau–Lake of the Woods County Line         | 1,800 | 1,800 | 1,800 | 2,250  | 1,700  | 1,750  | 1,650 | 1,650 | 1,800 | 1,650 | 1,550 |

**Table 4 – Truck Traffic Volumes by Segment (HCA DT)**

| Segment | From   | To   | 1998 | 2000 | 2002 | 2004 | 2006 | 2008    | 2010    | 2012 |
|---------|--|--|------|------|------|------|------|---------|---------|------|
| 1       | Western Limit of Greenbush                   | Junction with TH 32 in Greenbush             | 145  | 150  | 240  | 250  | 250  | 155     | 145     | 140  |
| 2       | Junction with TH 32 in Greenbush             | CSAH 2/University Avenue in Badger           | 170  | 180  | 320  | 350  | 330  | No Data | No Data | 160  |
| 3       | CSAH 2/University Avenue in Badger           | TH 308                                       | 170  | 180  | 320  | 350  | 330  | 230     | 235     | 265  |
| 4       | TH 308                                       | Western Junction with TH 89                  | 180  | 190  | 280  | 250  | 230  | 105     | 100     | 110  |
| 5       | Western Junction with TH 89                  | CR 120/380th Avenue                          | 210  | 220  | 340  | 350  | 320  | 195     | 180     | 160  |
| 6       | CR 120/380th Avenue                          | Junction with TH 310/89/5th Avenue in Roseau | 310  | 320  | 640  | 860  | 680  | 405     | 390     | 360  |
| 7       | Junction with TH 310/89/5th Avenue in Roseau | Main Avenue North in Roseau                  | 290  | 300  | 790  | 850  | 710  | 590     | 570     | 560  |
| 8       | Main Avenue North in Roseau                  | 3rd Avenue Northeast in Roseau               | 280  | 290  | 740  | 780  | 720  | 560     | 470     | 485  |
| 9       | 3rd Avenue Northeast in Roseau               | CSAH 24/11th Avenue in Roseau                | 250  | 260  | 740  | 580  | 490  | 445     | 435     | 420  |
| 10      | CSAH 24/11th Avenue in Roseau                | CSAH 46                                      | 165  | 170  | 370  | 240  | 210  | 220     | 245     | 265  |
| 11      | CSAH 46                                      | TH 313 in Warroad                            | 200  | 210  | 470  | 360  | 330  | 320     | 340     | 335  |
| 12      | TH 313 in Warroad                            | Lake Street NW in Warroad                    | 300  | 310  | 500  | 640  | 680  | 650     | 650     | 460  |
| 13      | Lake Street Northwest in Warroad             | CSAH 74/Lake Street Northeast in Warroad     | 330  | 340  | 680  | 900  | 820  | 790     | 770     | 570  |
| 14      | CSAH 74/Lake Street Northeast in Warroad     | Hallberg Street Southwest in Warroad         | 330  | 340  | 690  | 880  | 850  | 780     | 800     | 570  |
| 15      | Hallberg Street Southwest in Warroad         | Garfield Street Southeast in Warroad         | 300  | 310  | 720  | 690  | 650  | 630     | 650     | 500  |
| 16      | Garfield Street Southeast in Warroad         | CSAH 12                                      | 240  | 250  | 410  | 460  | 390  | 370     | 390     | 370  |
| 17      | CSAH 12                                      | Roseau–Lake of the Woods County Line         | 170  | 180  | 220  | 230  | 220  | 215     | 235     | 215  |





**Figure 8 – Existing AADT  
Greenbush - Badger**



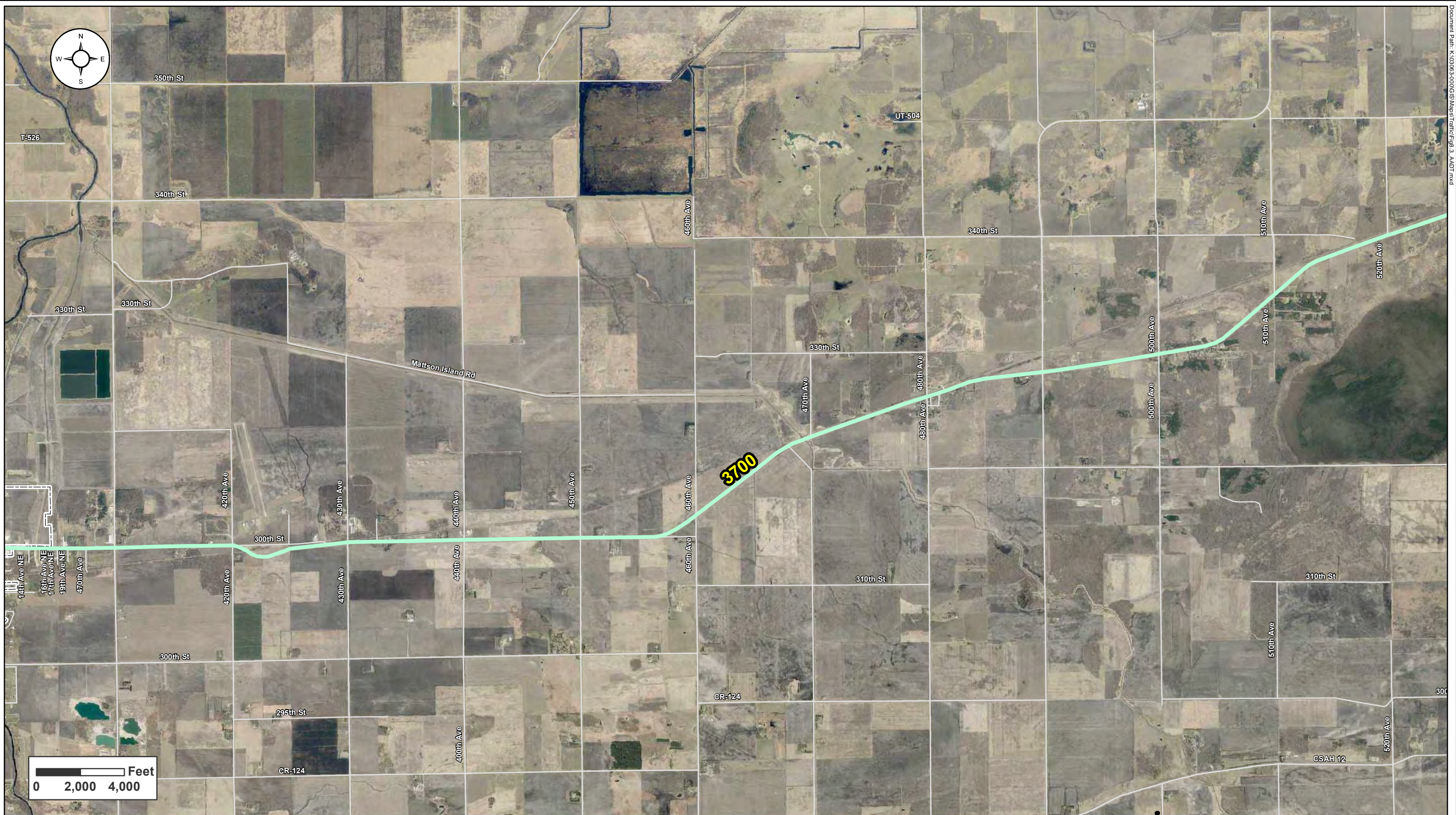




**Figure 9 – Existing AADT  
Badger - Roseau**







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**Figure 10 – Existing AADT  
Roseau to 520th Avenue**





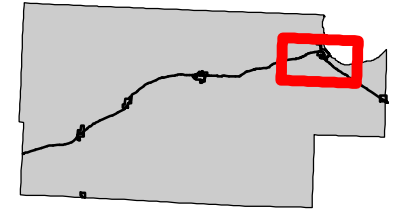
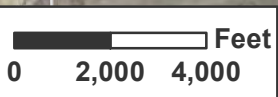


Figure 11 – Existing AADT  
Warroad







Figure 12 – Existing AADT  
Roosevelt







**Figure 13 – Existing HCADT (Truck Traffic)  
Greenbush to Badger**





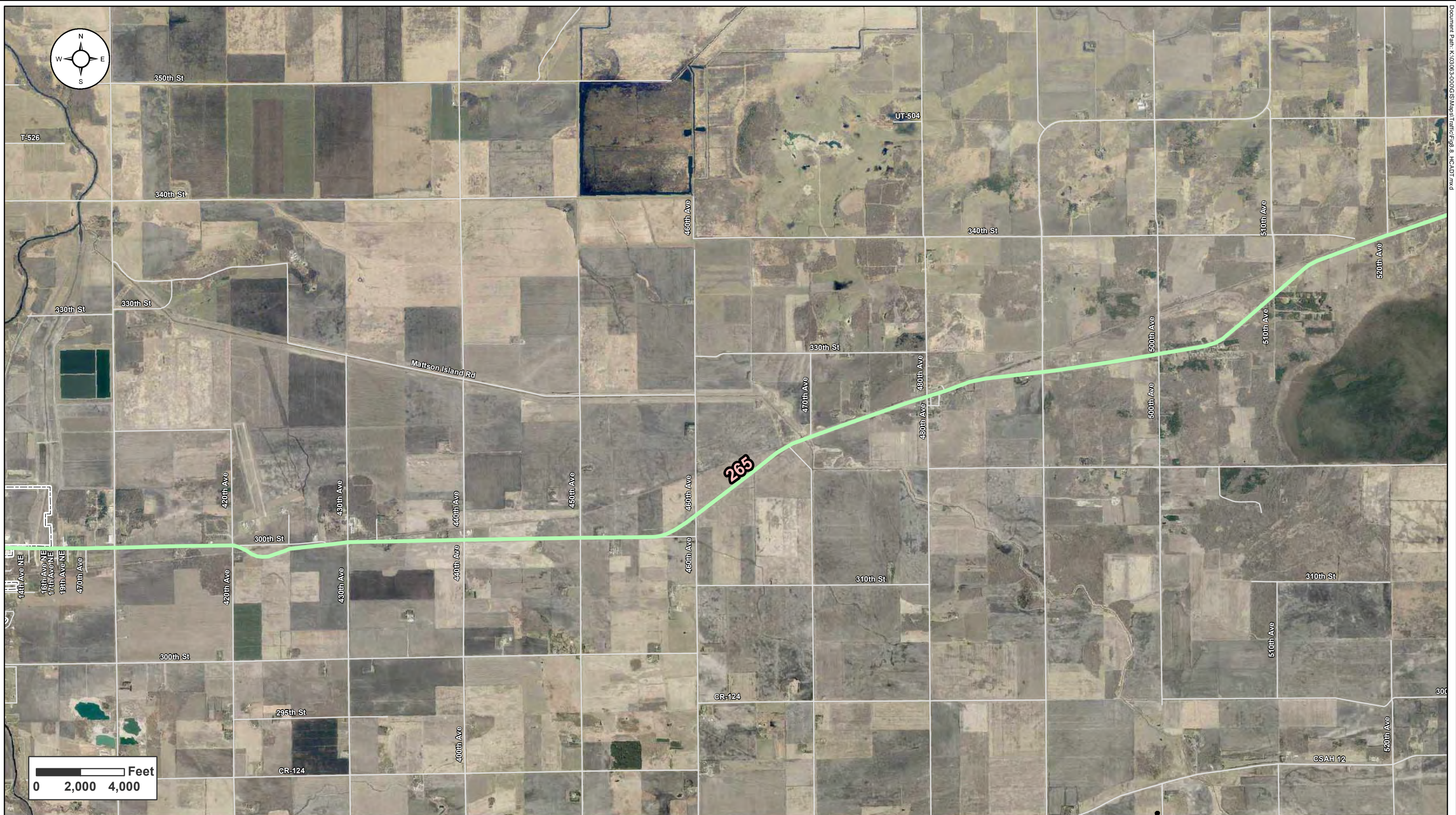


**Figure 14 – Existing HCADT (Truck Traffic)  
Badger to Roseau**

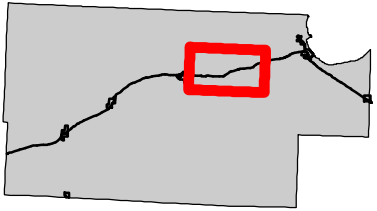


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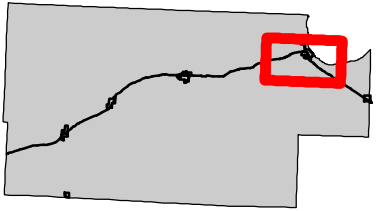
**Figure 15 – Existing HCADT (Truck Traffic)  
Roseau to 520th Avenue**







**Figure 16 – Existing HCADT (Truck Traffic)**  
**Warroad**





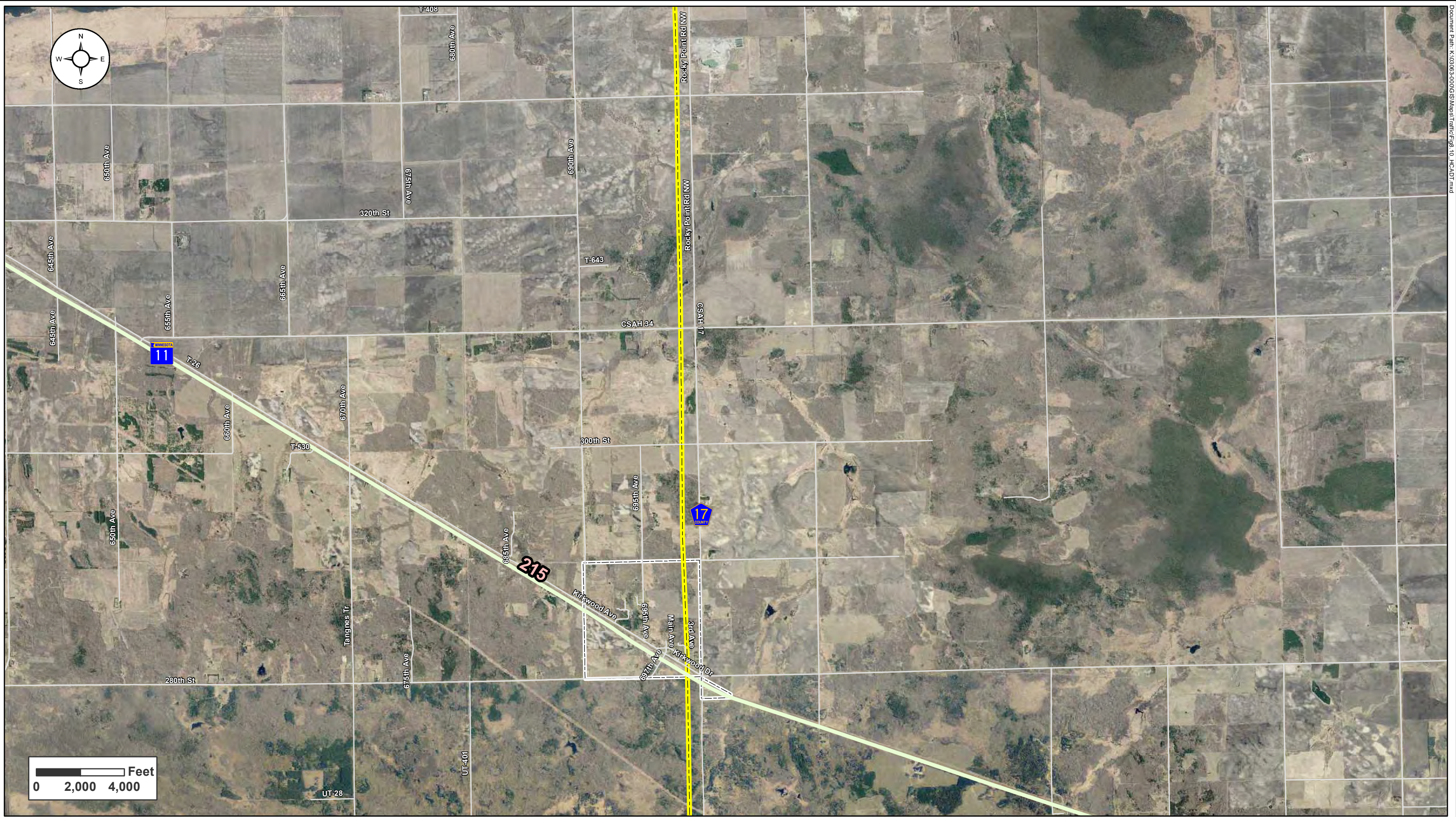


Figure 17 – Existing HCADT (Truck Traffic)  
Roosevelt





## TH 11 Existing Traffic Characteristics

### Traffic Control

Traffic control on TH 11 is limited. There are currently four traffic signals and one stop sign on the corridor.

The traffic signals are at the following intersections:

- TH 310 and TH 89 in Roseau
- Main Avenue North in Roseau
- TH 313 and Cedar Avenue Northwest in Warroad
- County Road 74/Lake Street NE in Warroad

The one stop sign on the corridor is located at the intersection with TH 32 in Greenbush. At this location, TH 32 and TH 11 have similar traffic volumes and truck traffic. TH 11 is required to stop based upon the roadway geometrics. TH 32 is the more through movement at this intersection as it continues north/south. TH 11 “T”s into the TH 32/TH 11 route. As such, it is required to stop.

**Figures 18 – 20** show the locations of traffic signals and the stop sign on TH 11.

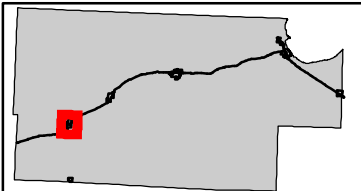
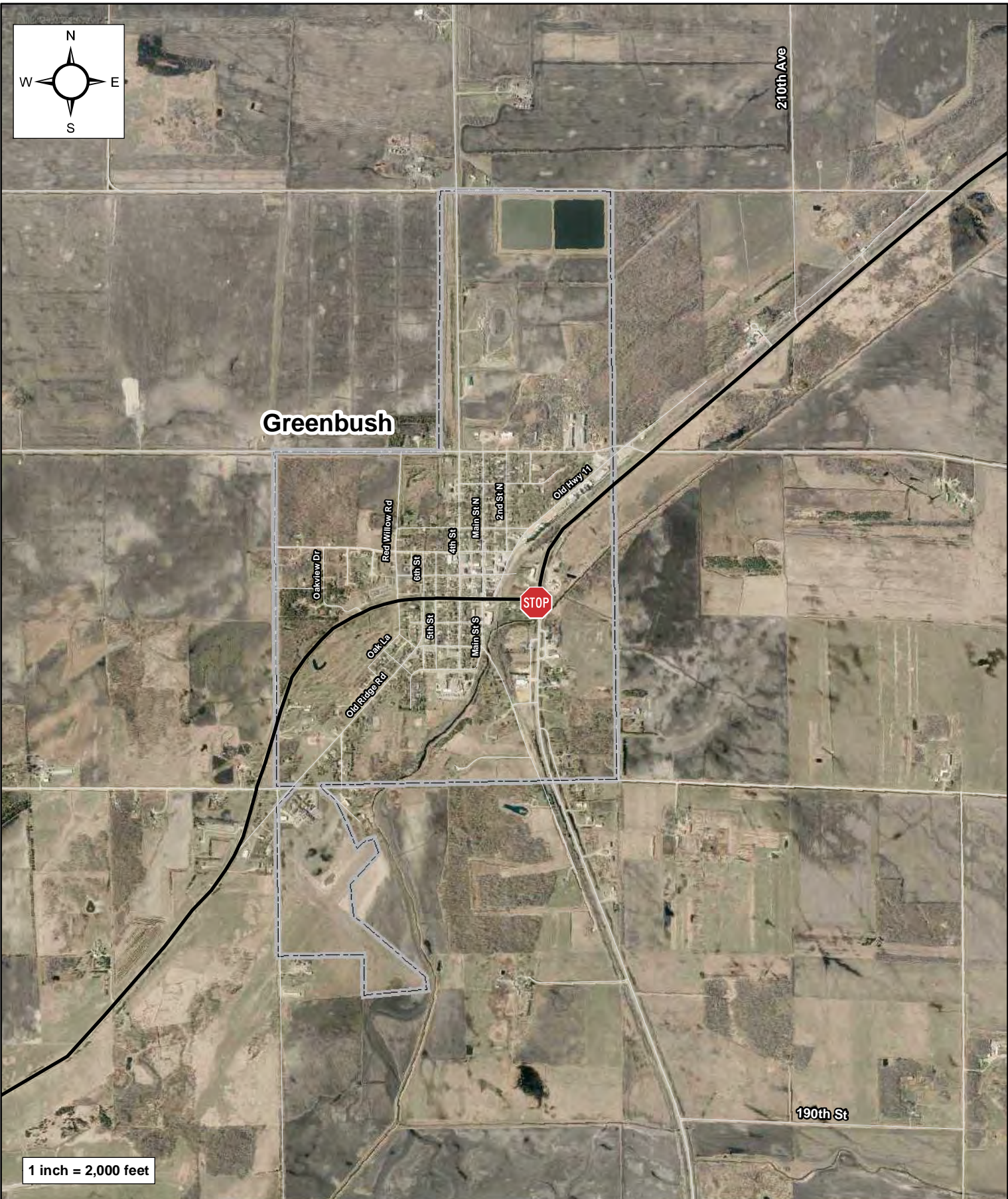
The limited number of traffic control devices on TH 11 helps to keep mobility on the corridor itself, but may reduce mobility on local (city and county) routes connecting to the corridor which require traffic to stop before it enters TH 11.

### Passing Zones

As documented in the roadway characteristics memo dated July 3, 2015, passing is permitted on much of TH 11 due to its generally flat terrain and gentle curves that enable drivers to see oncoming traffic. There are a total of 33 “No Passing Zones” within the corridor. While on the surface this may seem like a lot of zones, a majority of the zones are 700 feet in length or less. On an approximately 60-mile corridor, much of the route remains available for passing.

Seven of the 33 “No Passing Zones” apply to traffic in both directions (**Table 5**), 11 of the zones apply just to traffic travelling eastbound (**Table 6**) and 15 apply just to traffic travelling westbound (**Table 7**). **Figures 21 – 26** show “No Passing Zones” on the TH 11 corridor.

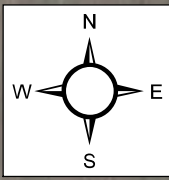




**Figure 18 Traffic Control  
Greenbush**



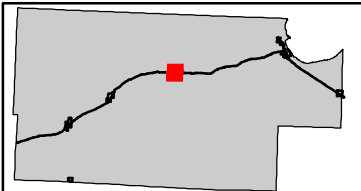




1 inch = 850 feet

Date of Turn On

 Traffic Signal



### Figure 19 Traffic Control Roseau







Figure 20 Traffic Control Warroad





TH 11 Existing Traffic Characteristics

**Table 5 – No Passing Zones for Traffic in Both Directions**

| General Area | Intersection/Location From            | Intersection/Location To  | Distance   |
|--------------|---------------------------------------|---|------------|
| Greenbush    | Approximately 700 feet north of CR 76 | 250 feet east/ north of Oakview Drive                                       | 1,590 feet |
| Greenbush    | Main Street                           | TH 32/TH 11 intersection  | 800 feet   |
| Badger       | North side of railroad crossing       | 980 feet north of the CSAH 3 north junction split                           | 1,710 feet |
| Roseau       | 890 feet west of 380th/18th Avenues   | 15th Avenue NW  | 2,250 feet |
| Roseau       | 15th Avenue NW                        | 500 feet west of 14th Avenue NE (three-lane section)                        | 1.9 miles  |
| Warroad      | 560th Avenue                          | 350th Street  | 150 feet   |
| Warroad      | 330 feet east of Emily Avenue NW      | 280 feet south of CR74/Lake Street NE (south junction) (three-lane section) | 1.22 miles |

**Table 6 – No Passing Zones for Traffic Travelling Eastbound**

| General Area | Intersection/Location From   | Intersection/Location To   | Distance   |
|--------------|--|--|------------|
| Greenbush    | Approximately 275 feet south of CR 76  | Approximately 700 feet north of CR 76 (northbound in this location)            | 975 feet   |
| Badger       | Approximately 690 feet south of CSAH 2   | CSAH 2   | 690 feet   |
| Badger       | Approximately 240 feet south of Lenmark Lane                                   | South side of railroad tracks (northbound in this location)                    | 740 feet   |
| Roseau       | 1,445 feet west of 380th/18th Avenues  | 900 feet west of 380th/18th Avenues  | 545 feet   |
| Roseau       | 520 feet west of 420th Avenue  | 730 feet east of 420th Avenue (former railroad crossing)                       | 1,250 feet |
| Warroad      | 550 feet west of 550th Avenue  | 550th Avenue   | 550 feet   |
| Warroad      | 450 feet west of 560th Avenue  | 560th Avenue   | 450 feet   |
| Warroad      | 460 feet east of Lakewood Circle   | 980 feet east of Lakewood Circle   | 520 feet   |
| Warroad      | 640 feet west of 570th Avenue  | 570th Avenue   | 640 feet   |
| Warroad      | 530 feet west of CSAH 35/580th Avenue  | CSAH 35/580th Avenue   | 530 feet   |
| Roosevelt    | 700 feet west of Roseau County Border (CR 17/Rocky Point Rd NW/Krull Trail NW) | 100 feet west of Roseau County Border (CR 17/Rocky Point Rd NW/Krull Trail NW) | 600 feet   |

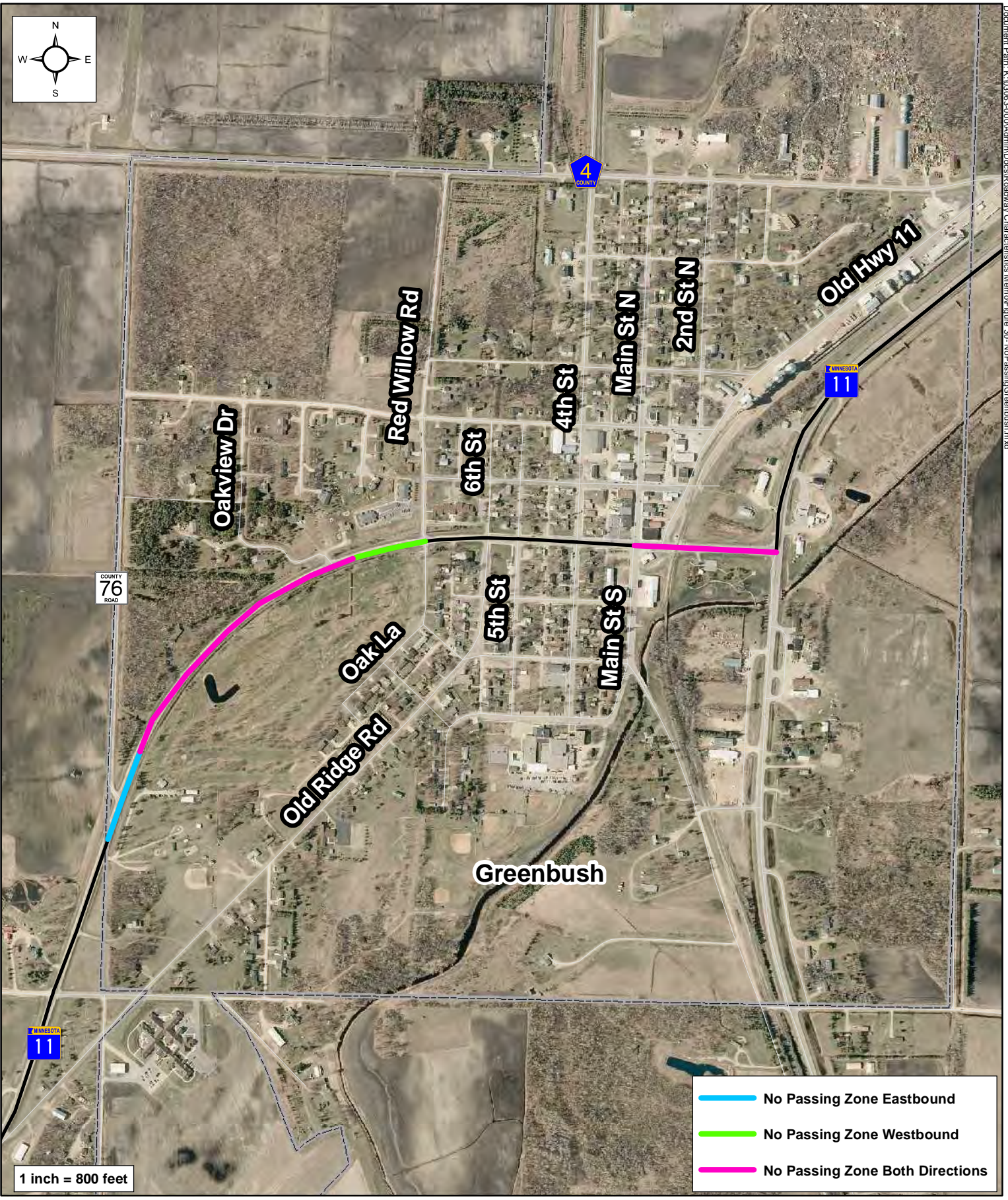
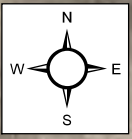


## TH 11 Existing Traffic Characteristics

**Table 7 – No Passing Zones for Traffic Travelling Westbound**

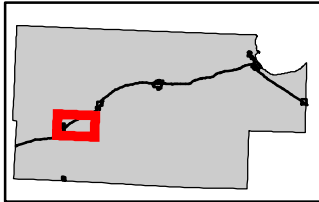
| General Area | Intersection/Location From   | Intersection/Location To   | Distance   |
|--------------|--|--|------------|
| Greenbush    | 75 feet west of Stephen Avenue West  | 250 feet east/north of Oakview Drive   | 680 feet   |
| Badger       | Approximately 830 feet to east/north of CSAH 2   | CSAH 2   | 830 feet   |
| Badger       | Approximately 1,580 feet north of the CSAH 3 north junction split                                  | 980 feet northeast of the CSAH 3 north junction split (north/eastbound in this location) | 600 feet   |
| Roseau       | 120 feet west of 14th Avenue NE  | 450 feet of 14th Avenue NE   | 330 feet   |
| Roseau       | 730 feet west of 420th Avenue (former railroad crossing)   | 910 feet to the east (910 feet east of the former railroad crossing)                     | 910 feet   |
| Salol        | 560 feet east/north of CSAH 9  | CSAH 9   | 560 feet   |
| Salol        | 560 feet east/north of Main Street   | Main Street  | 560 feet   |
| Salol        | 400 feet east/north of the eastern entrance into the Timberline mobile home park                   | Middle entrance of the Timberline mobile home park                                       | 1,350 feet |
| Salol        | 530 feet east/north of 510th Avenue  | 510th Avenue   | 530 feet   |
| Salol        | 390 feet east/north of the entrance to the Woodland Trailer Park (1,180 feet east of 520th Avenue) | Entrance to the Woodland Trailer Park (790 feet east of 520th Avenue)                    | 390 feet   |
| Warroad      | 520 feet east of 550th Avenue  | 550th Avenue   | 520 feet   |
| Warroad      | 460 feet east of 350th Street  | 350th Street   | 460 feet   |
| Warroad      | 1,780 feet east of Lakewood Circle   | 1,110 feet east of Lakewood Circle   | 670 feet   |
| Warroad      | 570th Avenue   | 700 feet east of 570th Avenue  | 700 feet   |
| Warroad      | 500 feet east of CSAH 35/580th Avenue  | CSAH 35/580th Avenue   | 500 feet   |





- No Passing Zone Eastbound
- No Passing Zone Westbound
- No Passing Zone Both Directions

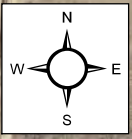
1 inch = 800 feet



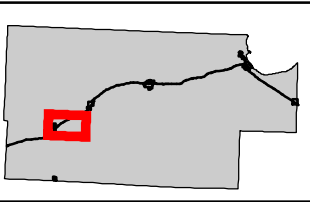
### Figure 21 No Passing Zones







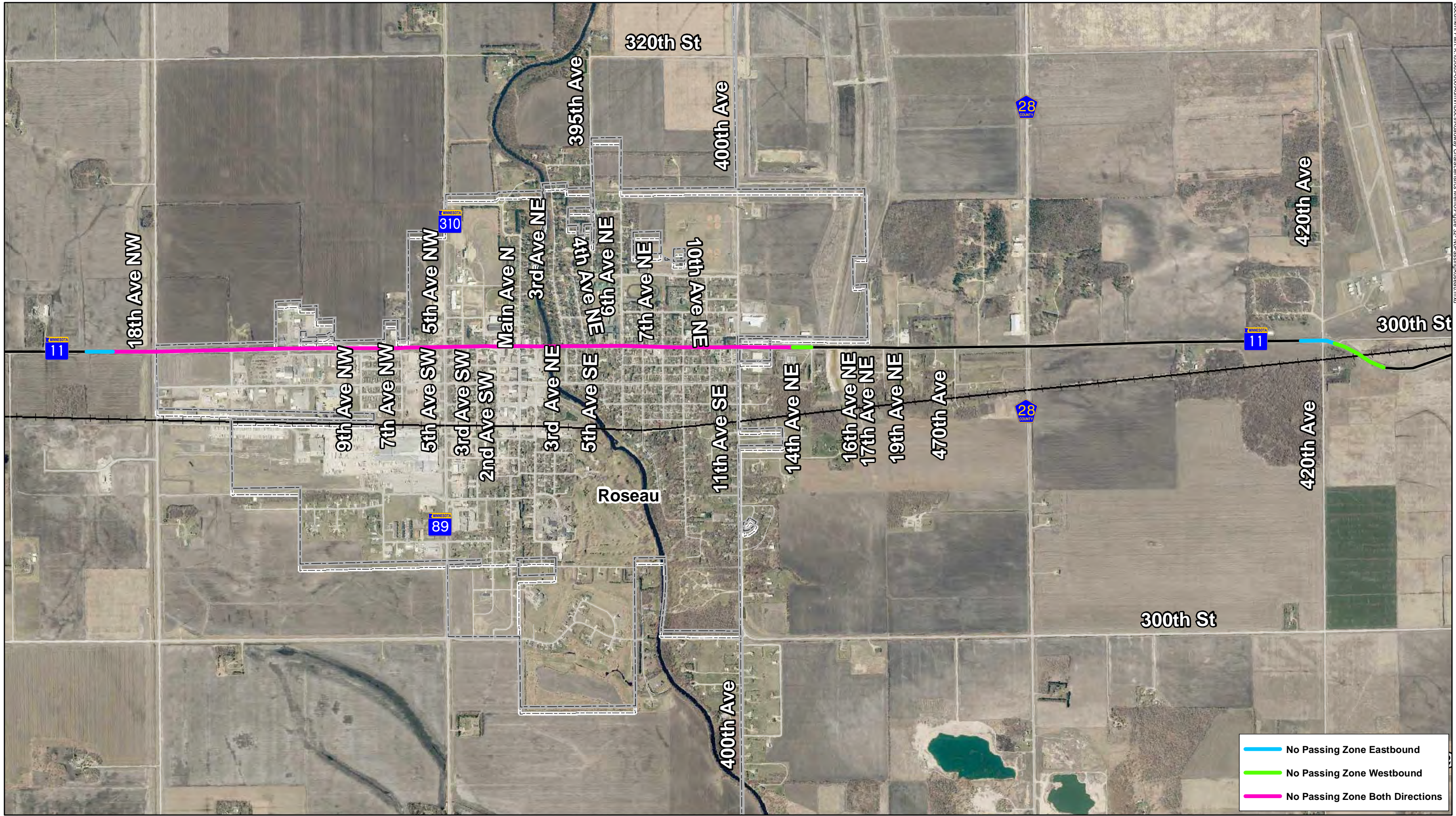
1 inch = 1,000 feet



### Figure 22 No Passing Zones

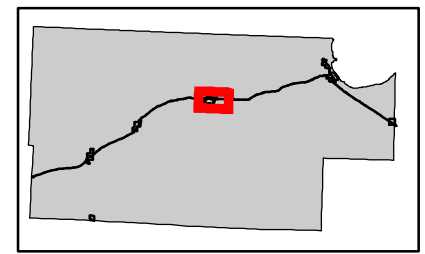
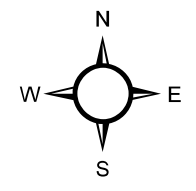






- No Passing Zone Eastbound
- No Passing Zone Westbound
- No Passing Zone Both Directions

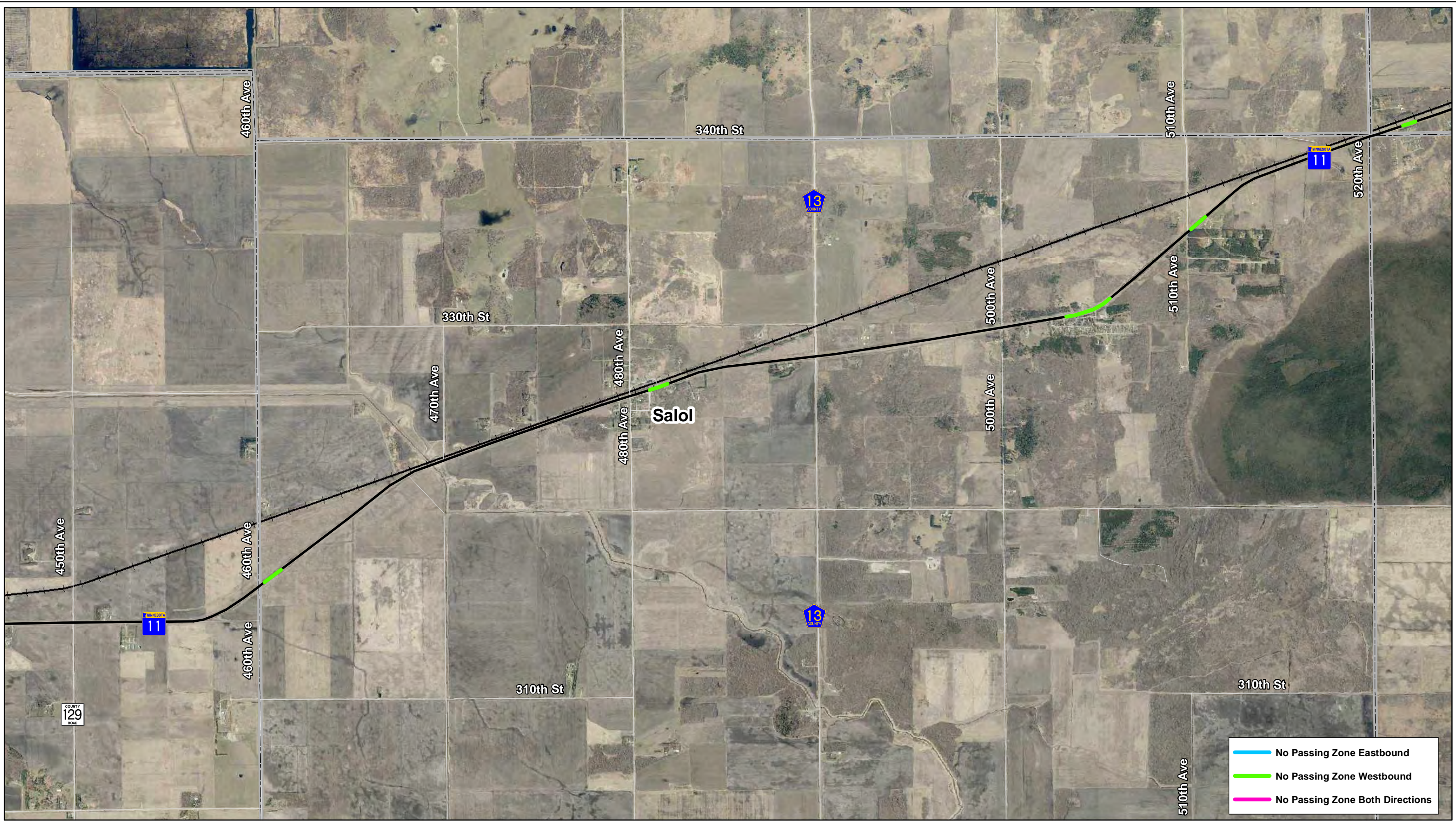
1 inch = 1,600 feet



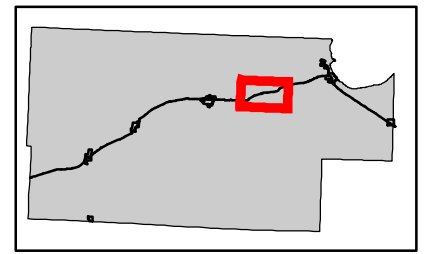
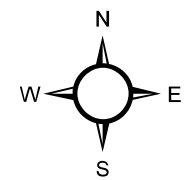
**Figure 23**  
**No Passing Zones**







1 inch = 2,500 feet



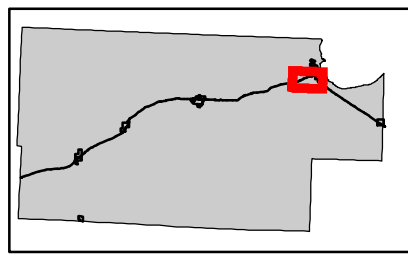
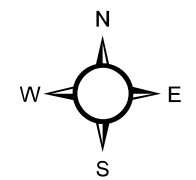
**Figure 24**  
**No Passing Zones**







1 inch = 1,600 feet



**Figure 25**  
**No Passing Zones**





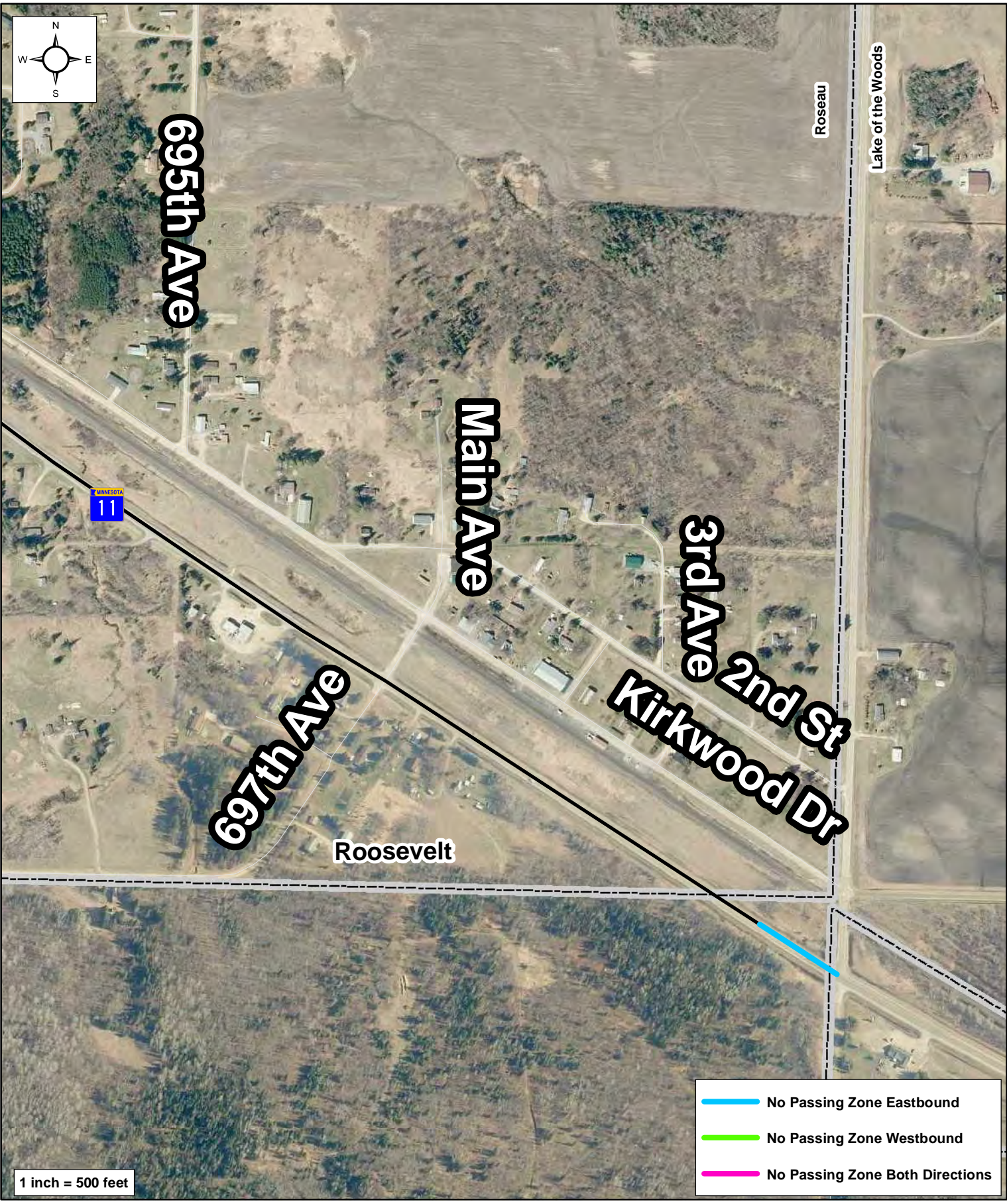


Figure 26  
No Passing Zones





### 3. Roadway Capacity and Operations

This section of the memo addresses capacity and operations on the different roadway segments of TH 11. Section 4 addresses capacity and operations at key intersections.

#### Capacity

A roadway’s capacity indicates how many vehicles may use a roadway before it experiences congestion. Capacity is dependent upon the number of lanes on a corridor as a starting point. Roadways with three travel lanes generally can accommodate more traffic than those with two lanes, and those with four lanes of traffic can accommodate more traffic than those with two or three lanes. Freeways can accommodate more traffic than non-freeway routes. Additional variation (more or less capacity) on an individual segment is influenced by a number of factors including: amount of access, type of access, peak hour percent of traffic, directional split of traffic, truck percent, opportunities to pass, and amount of turning traffic and availability of dedicated turn lanes. **Table 8** below lists planning-level thresholds that indicate a roadway’s capacity.

**Table 8 – Planning-level Roadway Capacity**

| Roadway Type                | Maximum Daily Traffic (two-way) |
|-----------------------------|---------------------------------|
| Two-lane, undivided – urban | 8,000 – 10,000 vehicles         |
| Two-lane, undivided – rural | 14,000 – 15,000 vehicles        |
| Three-lane – urban          | 14,000 – 17,000 vehicles        |
| Four-lane undivided – urban | 18,000 – 22,000 vehicles        |
| Four-lane divided – urban   | 28,000 – 32,000 vehicles        |
| Four-lane divided – rural   | 32,000 – 36,000 vehicles        |

As noted above, actual capacity may vary based upon individual corridor characteristics.

TH 11 is primarily a two-lane, undivided, rural roadway with three-lane segments in Roseau and Warroad. As shown in Table 8, its maximum capacity in the rural area is 14,000 – 15,000 vehicles a day. As noted in Section 2 – actual traffic volumes in the more rural areas range from approximately 1,700 between Warroad and Roosevelt to 4,500 just west of Warroad. In the three-lane sections of TH 11 traffic volumes range from 7,000 – 9,000.

#### Operations/Congestion

A planning-level review of the existing roadway capacity was completed in order to identify potential capacity deficiencies along TH 11. Congestion along a roadway is judged to exist when the ratio of traffic volume to roadway capacity (v/c ratio) approaches or exceeds 1.0. The ratio of volume to capacity provides a measure of congestion along a roadway segment and can help identify where roadway improvements may be needed. However, it does not provide information on intersection operations (those are discussed in Section 4). At a planning-level, if a v/c ratio is 1.0 or higher, the roadway is considered over capacity and will likely experience routine congestion. A v/c ratio between 0.86 and 0.99 is considered near congested and a v/c ration 0.85 or less is considered near congested.

A comparative look at the planning-level capacity thresholds shown in Table 8 versus the existing AADT volumes along TH 11 provide a good indication whether the roadway is currently over, near or under



## TH 11 Existing Traffic Characteristics

capacity. **Table 9** shows existing AADTs (2012 – 2014 depending upon location – verified with data collected as part of this study) as well as the v/c ratios for the corridor.

**Table 9 – Segment Congestion**

| Community / General Area             | Segment <sup>1</sup> | 2014 AADT | Design Capacity | Volume to Capacity Ratio <sup>2</sup> |
|--------------------------------------|----------------------|-----------|-----------------|---------------------------------------|
| Greenbush                            | 1                    | 2,450     | 14,000 – 15,000 | 0.16                                  |
| Greenbush                            | 2                    | 2,450     | 8,000 – 10,000  | 0.25                                  |
| Greenbush                            | 3                    | 2,450     | 14,000 – 15,000 | 0.16                                  |
| Greenbush/Badger                     | 4                    | 2,500     | 14,000 – 15,000 | 0.17                                  |
| North of Badger                      | 5                    | 2,750     | 14,000 – 15,000 | 0.18                                  |
| West of Roseau                       | 6                    | 2,800     | 14,000 – 15,000 | 0.19                                  |
| West of Roseau                       | 7                    | 3,600     | 14,000 – 15,000 | 0.24                                  |
| Western Roseau                       | 8                    | 8,700     | 14,000 – 17,000 | 0.51                                  |
| Central Roseau                       | 9                    | 7,800     | 14,000 – 17,000 | 0.46                                  |
| Central Roseau                       | 10                   | 6,300     | 14,000 – 17,000 | 0.37                                  |
| Central Roseau                       | 11                   | 5,700     | 14,000 – 17,000 | 0.34                                  |
| East of Roseau/Salol/West of Warroad | 12                   | 3,900     | 14,000 – 15,000 | 0.26                                  |
| Northeast Warroad                    | 13                   | 4,400     | 14,000 – 15,000 | 0.29                                  |
| Central Warroad                      | 14                   | 6,800     | 14,000 – 17,000 | 0.40                                  |
| Central Warroad                      | 15                   | 7,600     | 14,000 – 17,000 | 0.45                                  |
| Central Warroad                      | 16                   | 7,500     | 8,000 – 10,000  | 0.75                                  |
| Southern Warroad                     | 17                   | 6,300     | 8,000 – 10,000  | 0.63                                  |
| South of Warroad                     | 18                   | 3,550     | 14,000 – 15,000 | 0.24                                  |
| Swift/Roosevelt                      | 19                   | 1,550     | 14,000 – 15,000 | 0.10                                  |

<sup>1</sup> Segment 1 from Tables 3 and 4 has been split into three individual segments in this table due to the transitions between rural and urban roadway designs (and the associated design capacities). The remaining segments have been renumbered accordingly.

<sup>2</sup> Volume to capacity ratio calculated using the maximum design capacity for each segment (e.g., for Segment 1:  $v/c = 2,450/15,000 = 0.16$ ).

The numbers for both the rural and urban areas are well below the capacity of TH 11, even with the amount of access and the lack of turn lanes on the corridor. Based on a planning-level analysis, the roadway should generally be functioning well and should not have a significant amount of congestion.

### Travel Time Runs

Comments from stakeholders and members of the Technical Advisory Committee indicate that people believe the corridor has some congestion and operational problems. To better understand conditions beyond the planning-level numbers, extra efforts were undertaken to review traffic along the corridor. This was accomplished by completing travel time runs on the corridor. Through this exercise, a few trends emerged that provide insight into traveler expectations and conditions along the corridor. The sections below explain the travel runs and the trends influencing corridor operations.

Travel time runs are performed by recording the amount of time it takes a driver to go from one point to another along a given route. Travel time runs were conducted for TH 11 on June 9<sup>th</sup> and 10<sup>th</sup>, 2015. Six travel time runs were performed in each direction of travel for three different time intervals: AM peak,



## TH 11 Existing Traffic Characteristics

midday peak, and PM peak. The six travel runs were chosen in accordance with recommendations in the ITE Engineering Handbook for obtaining a statistically valid sample. The method used in this study was to manually drive the project limits and record the time when reaching key points. While driving the corridor, data was collected on the speed of travel, as well as any variance experienced and its cause. During data collection, the driver was to maintain steady flow with traffic, including situations where traffic exceeded the posted speed limit. During the midday travel time runs, only five runs were performed and the western limit used was the west edge of Badger instead of the western project limit due to the relatively low volumes on that stretch.

Data collected during the travel time runs show no major issues with traffic flow or mobility. Travel times were consistent across all the travel periods. Within city limits with lower speeds, traffic flows followed posted speed limits consistently. In rural areas traffic was free flowing at posted speeds roughly 60 percent of the time. The other 40 percent of the time traffic flows exceeded posted speed limits, with traffic travelling in the high 50 mph and low 60 mph range. **Tables 10** and **11** show the average travel speeds by direction during the AM Peak, midday peak and PM Peak.

During the travel runs, there were a few occasions where incidents or unusual traffic was observed and did create short disruptions in traffic flow. These incidents included a slow moving truck towing a trailer through Warroad, a car just east of Warroad traveling at 45 mph, a slow truck with trailer east of Warroad, and a tractor using the highway just east of Greenbush. Because there are opportunities to pass along TH 11, these incidents had a small impact on the overall traffic flow. However, they do create a situation where traffic wants to, and does pass.

During data collection, attention was also paid to delays caused by turning vehicles exiting TH 11 due to the lack of turn lanes but none were observed. Since it is an infrequent occurrence (volumes on most connecting roadways outside of the urban area are fairly low), driver expectations may not actively anticipate decelerating vehicles in free flowing conditions.

**Attachment A** includes the individual travel time run data and driver notes.

**Table 10 – Eastbound Travel Speeds**

| Eastbound                         | Average  |          |          | Segment Average |
|-----------------------------------|----------|----------|----------|-----------------|
|                                   | AM       | Midday   | PM       |                 |
| Greenbush Western Limits to TH 32 | (1)      | n/a      | (1)      | (1)             |
| Greenbush to Badger               | 56.7 mph | n/a      | 55.8 mph | 56.3 mph        |
| Badger city limits                | (1)      | (1)      | (1)      | (1)             |
| Badger to Roseau                  | 56.2 mph | 57.6 mph | 55 mph   | 56.3 mph        |
| Roseau city limits                | (1)      | (1)      | (1)      | (1)             |
| Roseau to Salol                   | 57.2 mph | 56 mph   | 55.5 mph | 56.2 mph        |
| Salol city limits                 | (1)      | (1)      | (1)      | (1)             |
| Salol to Warroad                  | 58.2 mph | 57 mph   | 56.7 mph | 57.3 mph        |
| Warroad city limits               | (1)      | (1)      | (1)      | (1)             |
| Warroad to Roosevelt              | 55 mph   | 59 mph   | 57.5 mph | 57.2 mph        |
| Roosevelt city limits             | (1)      | (1)      | (1)      | (1)             |

(1) Traffic traveling posted city speed limits



## TH 11 Existing Traffic Characteristics

**Table 11 – Westbound Travel Speeds**

| Westbound                              | Average  |          |          | Segment Average |
|--|----------|----------|----------|-----------------|
|  | AM       | Midday   | PM       |                 |
| Roosevelt city limits                  | (1)      | (1)      | (1)      | (1)             |
| Roosevelt to Warroad                   | 57.2 mph | 58 mph   | 56.7 mph | 57.3 mph        |
| Warroad city limits                    | 28.3 mph | (1)      | (1)      | 29.4 mph        |
| Warroad to Salol                       | 57 mph   | 57.6 mph | 57.5 mph | 57.4 mph        |
| Salol city limits                      | (1)      | (1)      | (1)      | (1)             |
| Salol to Roseau                        | 56.3 mph | 56.6 mph | 56.7 mph | 56.5 mph        |
| Roseau city limits                     | (1)      | 28 mph   | (1)      | 29.3 mph        |
| Roseau to Badger                       | 57.2 mph | 57.6 mph | 58.7 mph | 57.8 mph        |
| Badger city limits                     | (1)      | (1)      | (1)      | (1)             |
| Badger to Greenbush                    | 59 mph   | n/a      | 55.8 mph | 57.4 mph        |
| Greenbush TH 32 to Western City Limits | (1)      | n/a      | (1)      | (1)             |

(1) Traffic traveling posted city speed limits

During the travel runs, there were a few occasions where incidents or unusual traffic was observed and did create short disruptions in traffic flow. These incidents included a slow moving truck towing a trailer through Warroad, a car just east of Warroad traveling at 45 mph, a slow truck with trailer east of Warroad, and a tractor using the highway just east of Greenbush. Because there are opportunities to pass along TH 11, these incidents had a small impact on the overall traffic flow. However, they do create a situation where traffic wants to, and does pass.

During data collection, attention was also paid to delays caused by turning vehicles exiting TH 11 due to the lack of turn lanes but none were observed. Since it is an infrequent occurrence (volumes on most connecting roadways outside of the urban area are fairly low), driver expectations may not actively anticipate decelerating vehicles in free flowing conditions.

**Attachment A** includes the individual travel time run data and driver notes.

### ***Driver Expectations***

Based on the data collected and the feedback from those conducting the travel time runs, one clear trend on the corridor emerged – most drivers wanted to drive somewhere between 60 and 64 miles per hour. Most drivers were not content to drive 55 miles per hour and would start to pass other vehicles if they were not able to drive faster than 55 miles per hour. This desire is consistent with drivers on many other corridors and was documented as part of statewide studies conducted by MnDOT in 1999 (Interregional Corridor Study). Because MnDOT roadways are generally well designed and are usually in good condition, drivers feel comfortable driving 60 miles per hour or slightly higher.

With the current studies underway to evaluate speeds on corridors throughout the state, TH 11 is anticipated to have its speed limit raised to 60 miles per hour (in locations with posted speeds of 55 miles per hour) sometime this year.



## TH 11 Existing Traffic Characteristics

### ***Hot Spots***

As noted above, there were no locations that consistently had significant congestion or mobility delays that were observed during the travel time runs. Delays at the signalized intersections were typical for signalized intersections, with no excessive delays or significant queuing.

### ***Influence of Freight and Recreational Traffic***

There are factors in terms of vehicle mix that can influence a driver's experience in terms of feeling like the corridor is congested. [This experience was noted above in the discussion about disruptions in traffic flow.] When a driver gets behind a string of cars following a large truck or recreational vehicle (vehicle towing a boat/trailer) it may take a while for that driver to get an opportunity to pass the slower traffic, and the corridor will feel like it is congested even if speeds are at or very near the posted speed limit. This is true because many commercial vehicle operators are limited in terms of the speed that they are allowed to drive. If they are not able to drive above the posted limit or drive faster than five miles per hour over the posted limit, it will influence the speeds of other traffic on the corridor and can create a sense of congestion. Additionally, recreational vehicle drivers also tend to drive slower than typical passenger cars because they are towing something. Like the commercial drivers, this can slow adjacent traffic.

As noted earlier, TH 11 does have a lot of truck traffic and when lines form behind these vehicles it can make the corridor feel like it is congested. As a result, drivers will look for opportunities to pass when they feel comfortable to do so. If there is a more cautious driver immediately behind a truck or recreational vehicle, and that driver is unwilling to pass, a longer queue can form and pockets of congestion can occur.

### ***Influence of Turn Lanes***

Another factor influencing the sense of congestion and safety (discussed in Section 5) on a roadway corridor is the presence of turn lanes. Turn lanes provide motorists wishing to turn off the main travel way an opportunity to get safely out of the vehicle flow to make their maneuver and still allow through traffic to continue on its way without having to stop. When turn lanes are not present, motorists exiting the mainline remain in the travel lane in order to make their left- or right-turns. This in turn, requires traffic on the mainline to slow along with the turning traffic and in some instances come to a stop and wait while the motorist makes their turn (happens for left-turn when waiting for oncoming traffic). Motorists making right turns when turn lanes are absent will often use the roadway shoulder, but that is not predictable – not all motorists do this. Thus, vehicles making turns without the benefit of dedicated left- and right- turn lanes not only impact traffic flow, but also have the potential to impact the safety of the corridor.

Corridors without turn lanes can feel more congested because vehicles may be slowing down or stopping due to turning traffic. Because TH 11 has numerous access points (approximately 600 – including driveways and field accesses), and because a majority of them do not have dedicated turn lanes, some of the corridor capacity is reduced. Although not observed to have a significant impact during the travel time runs, lack of dedicated turn lanes is a factor that can reduce both mobility and safety on the corridor over the long-term.



#### **4. Key Intersection Operations**

The counterpart to roadway segment capacity is intersection capacity. On TH 11 there are approximately 600 intersections along the corridor (including driveways and field access locations). In terms of public streets, there are approximately 125 intersections. Given the scope of the TH 11 corridor study, it is not possible to evaluate every intersection along the corridor to determine how it operates, nor is it necessary. Most of the impacts in terms of delay or congestion are going to be experienced by those attempting to enter the TH 11 corridor. Unless the cross street/driveway access has heavier traffic volumes, the impacts are expected to be minimal for most users. For example, any given field entrance or private residential driveway is going to have a limited number of users stacked up and waiting to enter the TH 11 traffic stream. As a result, the overall delay (when TH 11 traffic is also considered) is going to be minimal.

Although every intersection is not being evaluated some general conclusions can be made about how intersections along the corridor operate:

- Most field entrances and private driveway entrances experience little delay because the number of vehicles using them at any one time is low.
- In areas outside of the communities of Greenbush, Badger, Roseau and Warroad, there is usually a gap between vehicles on TH 11 sufficient enough that vehicles on cross streets do not have to wait too long to access the TH 11 corridor. This situation is aided by the fact that traffic volumes on roadways in areas outside of Greenbush, Badger, Roseau and Warroad are generally below 400 vehicles a day (there are some exceptions).
- On the fringes of the communities of Warroad and Roseau, users trying to access the TH 11 corridor will experience more delay because traffic volumes on both TH 11 and the intersecting roadways are higher. Overall intersection operations are still good, but the cross streets will experience some delay.
- Within the communities of Roseau and Warroad delay will be higher on local cross streets than in the Cities of Greenbush and Badger due to the amount of traffic on TH 11. Overall operations are still good, but cross streets will experience some delay.

In addition to the general conclusions, MnDOT also asked that five intersections be evaluated to investigate existing operations. MnDOT recognizes that there are locations where some of the interesting roadways may be experiencing more delay and locations where existing signals are in place that may not be working as efficiently as they could be. The five intersections to be evaluated include:

- TH 11 & TH 32 (Greenbush)
- TH 11 & 18th Ave NW (Roseau)
- TH 11 & TH 89/TH 310 (Roseau)
- TH 11 & TH 313 (Warroad)
- TH 11 & Lake St NE (Warroad)



### Existing Volumes

Turning movement volumes for the five intersections are from counts taken between June 30 and July 2, 2015. Counts were documented for the AM and PM peaks as well as an off-peak period in which traffic volumes were heavier. Due to the Fourth of July holiday, it is expected that volumes are a little higher than normal. **Figures 27 – 29** show turning movements that were collected for the five intersections.

### Operations Modeling Methodology

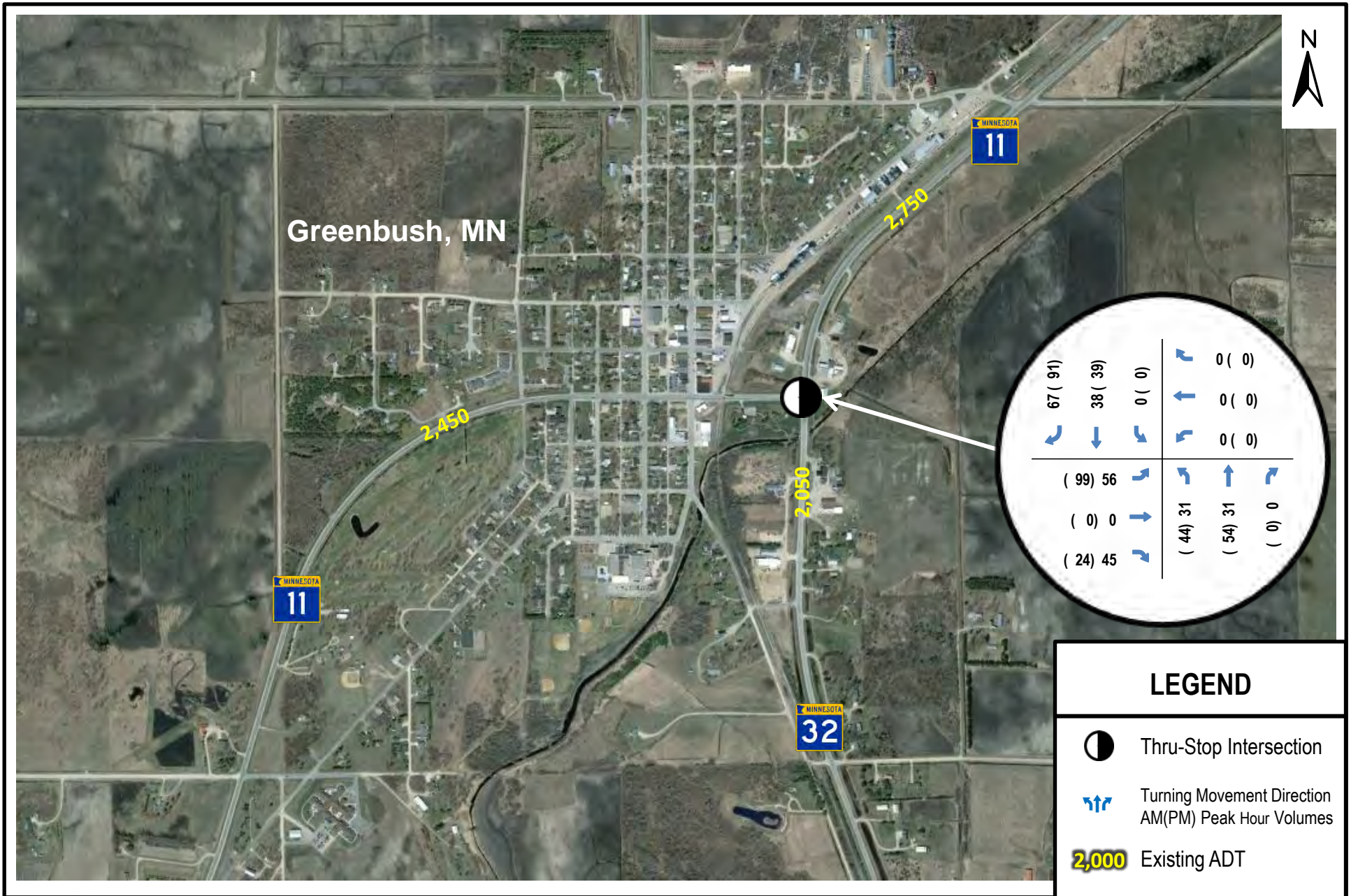
The capacity/operations analysis of the key intersections was conducted using Synchro/SimTraffic software. The Synchro software is based on the methodologies documented in the Highway Capacity Manual (HCM) 2010. The software was used to evaluate the characteristics of the roadway network including lane geometrics, turning movement volumes, traffic control, and signal timing (where applicable). The Synchro information was then transferred to SimTraffic, a traffic simulation model, to estimate average vehicle delays and queues. The results of the SimTraffic modeling were used to check the adequacy of the traffic control, signal timing, and geometric layout of each intersection.

### Level of Service Analysis Thresholds

A level of service (LOS) analysis was conducted for the five intersections previously identified. LOS indicates the quality of traffic flow through an intersection. The LOS results are based on the average delay per vehicle that goes through the intersection. Intersections are given a ranking of LOS A through LOS F. The level of service system is set up similar to a report card with “A” representing the highest quality operations and “F” representing the poorest operations. At LOS A, motorists experience very little delay or interference. On a roadway or intersection with LOS F conditions, motorists would experience severe congestion and extreme delay, i.e., gridlock. Although LOS A conditions represent the best possible level of traffic flow, the cost to construct intersections to such a high standard exceeds the benefit to the user. Within an urbanized or urbanizing area, it is generally regarded that LOS D provides an acceptable level of service.

For intersections, level of service is primarily a function of delay which is dependent on volumes, intersection lane configuration, and traffic control. The intersection analysis was completed using average control delay as defined by the HCM. The threshold delay values for each level of service for unsignalized intersections are slightly less than for signalized intersections because motorists’ expectations of the intersection differ with the type of traffic control. The level of service analysis criteria for signalized and unsignalized intersections are explained in **Table 12** and shown on **Graph 1**.

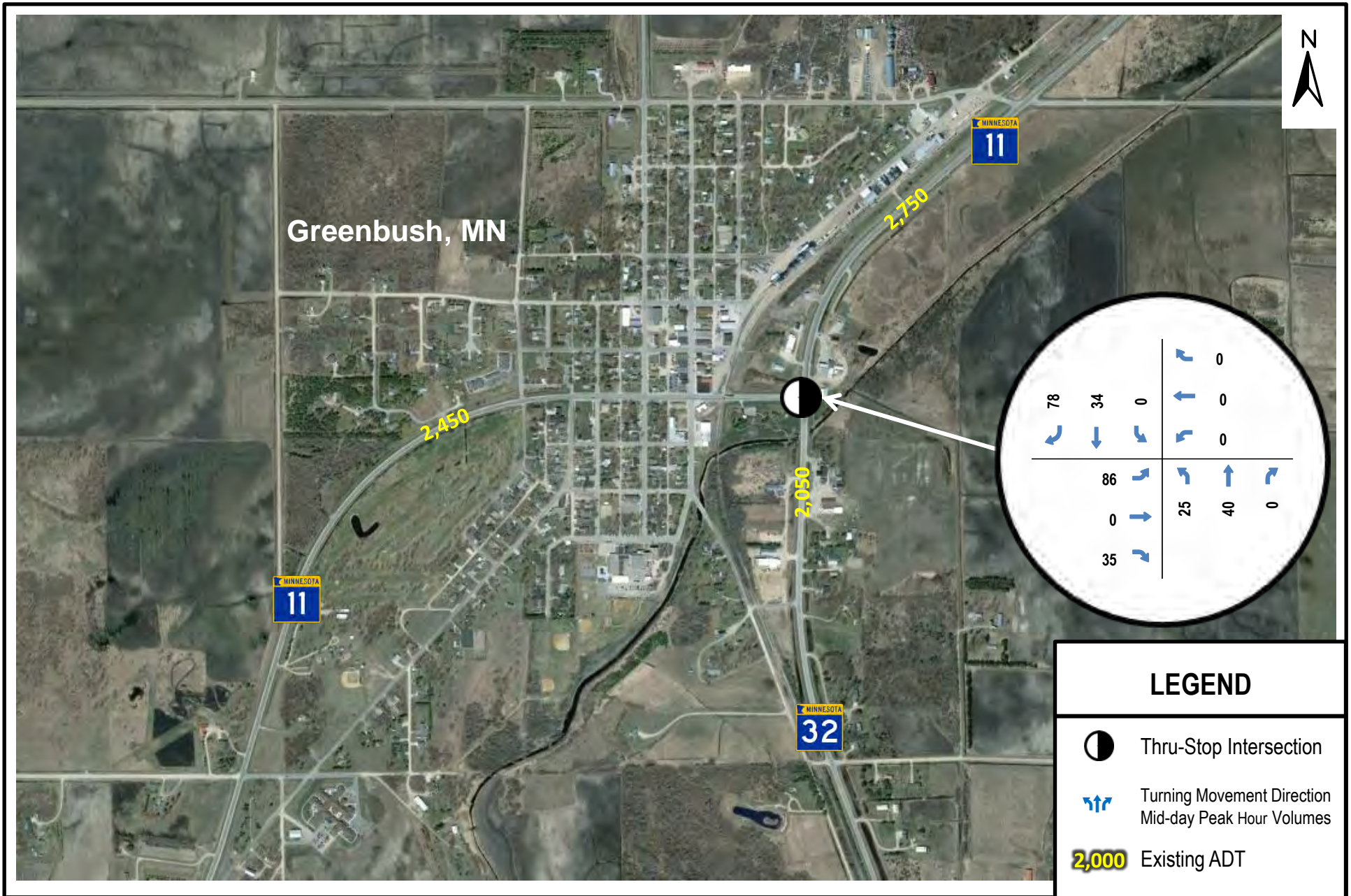




**TH 11 Corridor Improvements**  
 Intersection of TH 11 & TH 32  
 Minnesota Department of Transportation

**Figure 27-a**  
**Existing Volumes – AM & PM Peak Period**





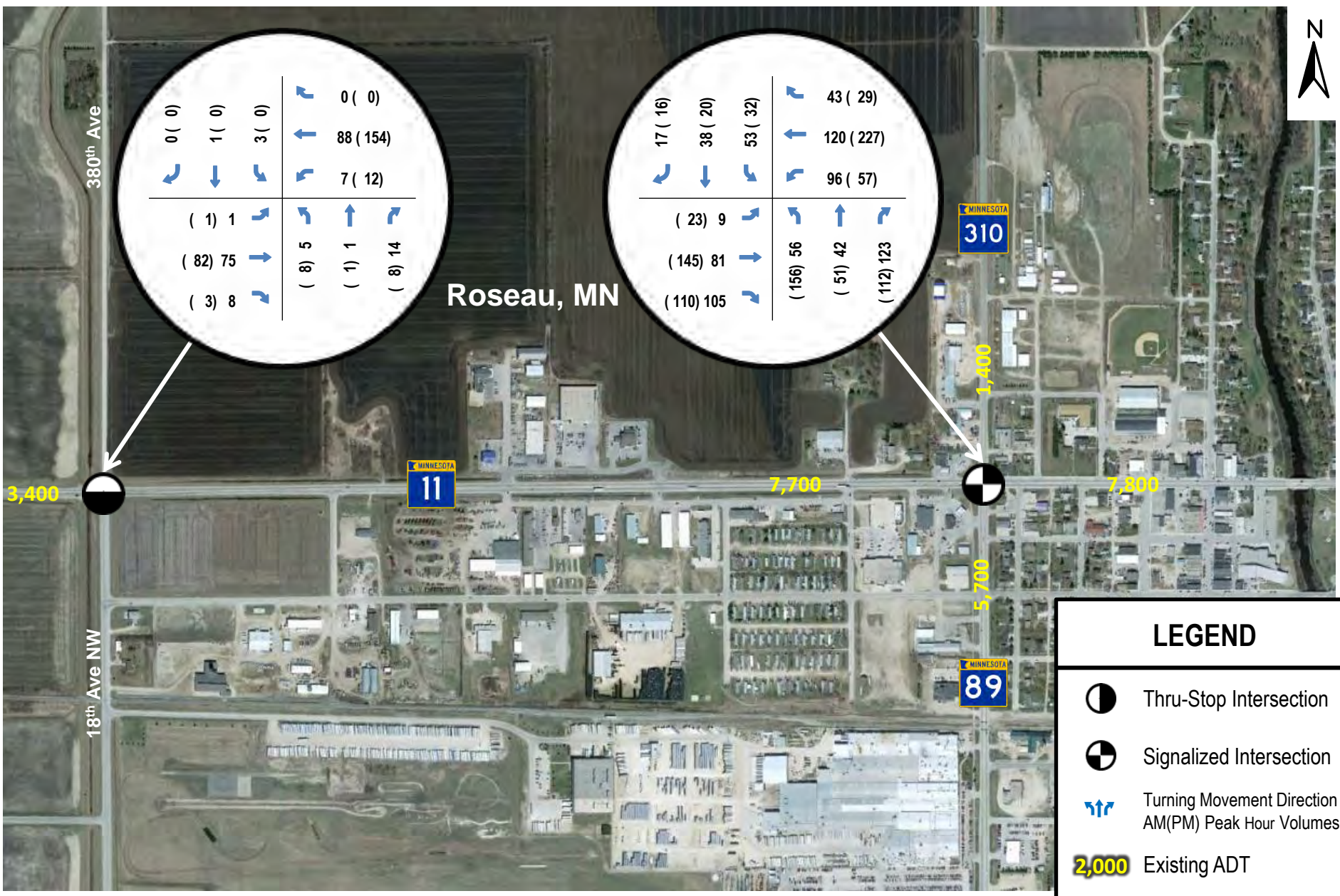
**TH 11 Corridor Improvements**

Intersection of TH 11 & TH 32

Minnesota Department of Transportation

**Figure 27-b**  
**Existing Volumes – Mid-day Peak Period**

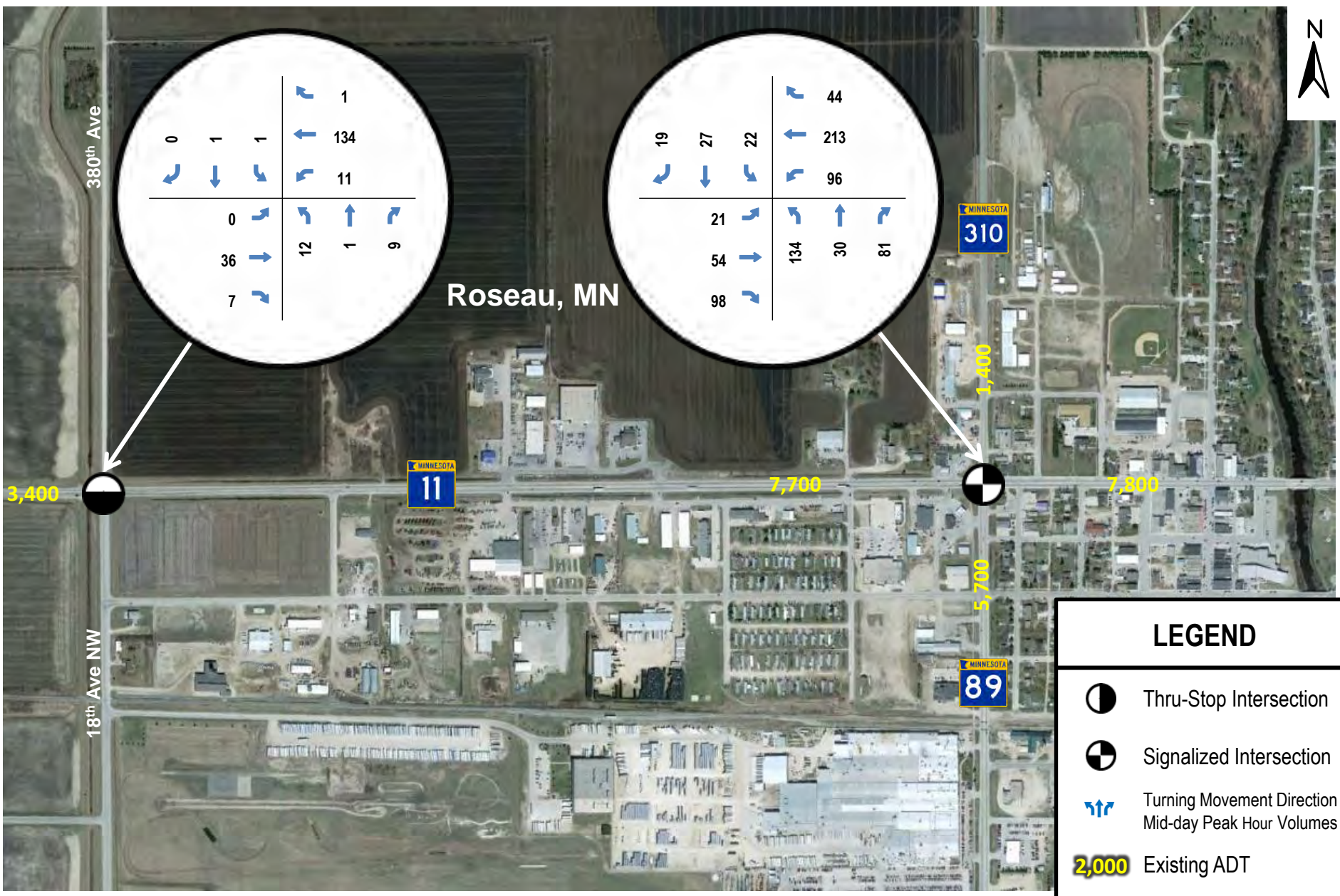




**TH 11 Corridor Improvements**  
 Intersections of TH 11 & 18<sup>th</sup> Ave NW, TH 11 & TH 89-310  
 Minnesota Department of Transportation

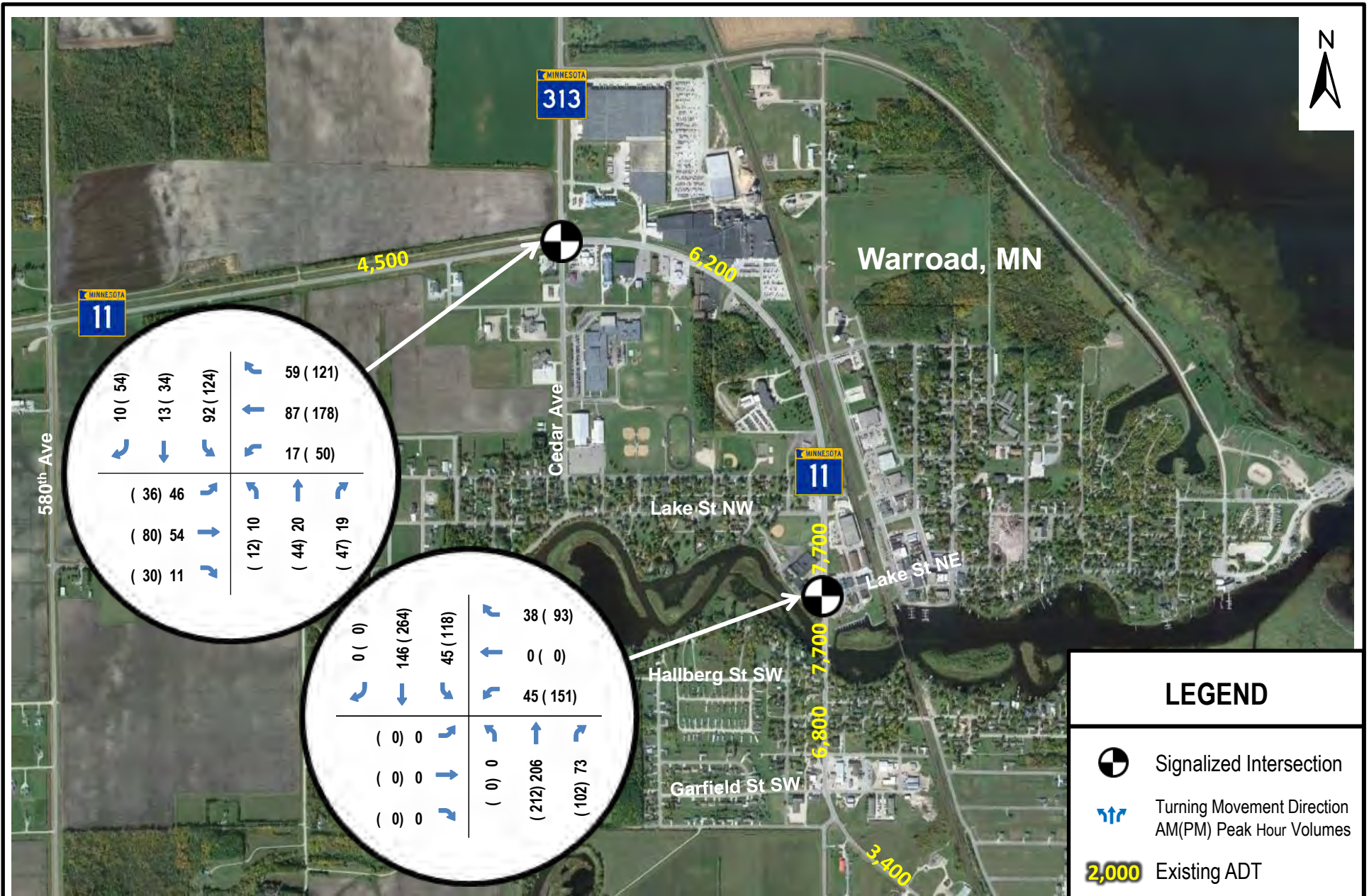
**Figure 28-a**  
**Existing Volumes – AM & PM Peak Period**





**Figure 28-b**  
**Existing Volumes – Mid-day Peak Period**





|          |          |          |          |
|----------|----------|----------|----------|
| 10 ( 54) | 13 ( 34) | 92 (124) | 59 (121) |
| ( 36) 46 | ( 80) 54 | ( 12) 10 | ( 44) 20 |
| ( 30) 11 | ( 12) 10 | ( 44) 20 | ( 47) 19 |

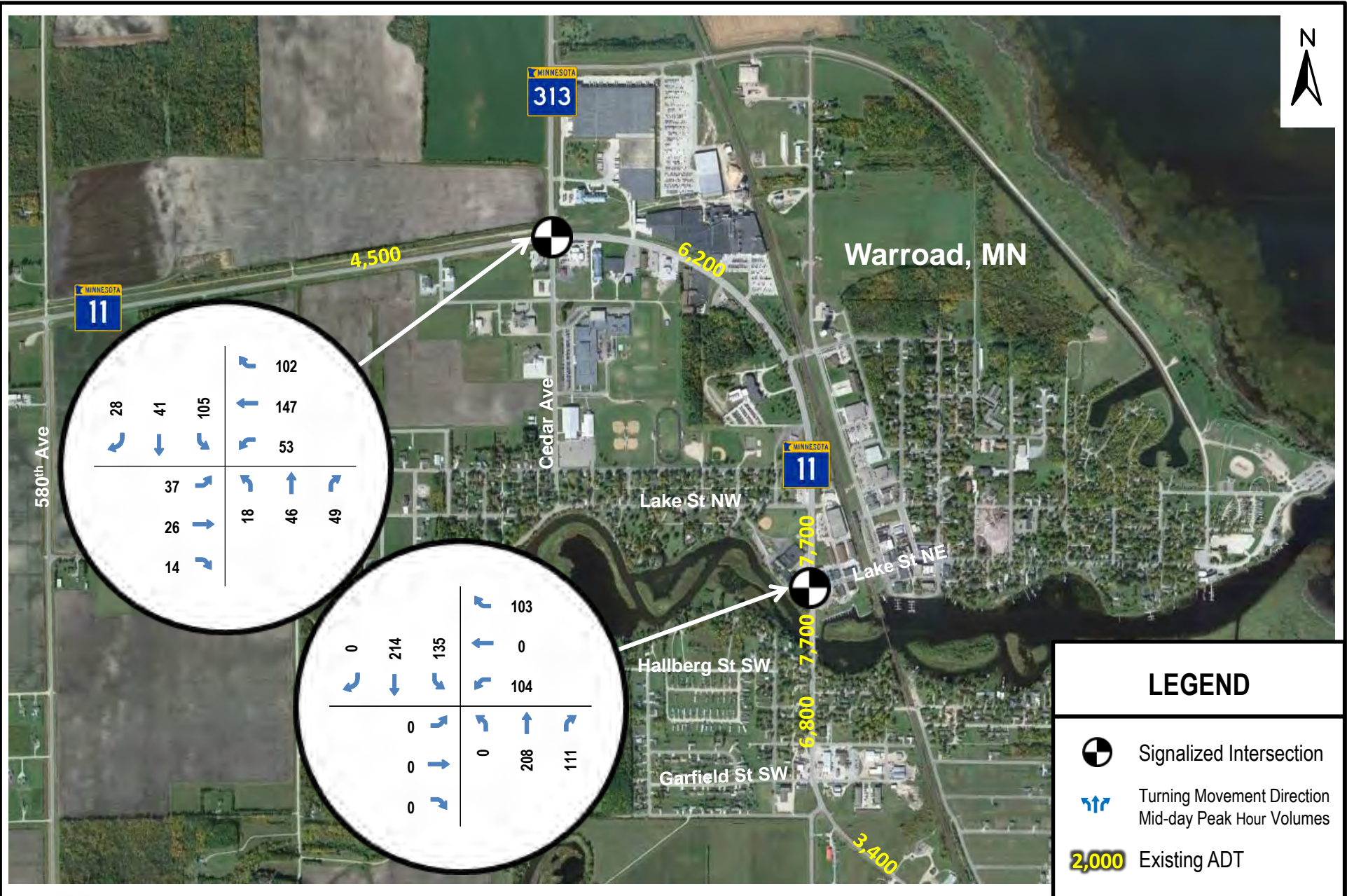
|        |           |          |            |
|--------|-----------|----------|------------|
| 0 ( 0) | 146 (264) | 45 (118) | 38 ( 93)   |
| ( 0) 0 | ( 0) 0    | ( 0) 0   | ( 212) 206 |
| ( 0) 0 | ( 0) 0    | ( 0) 0   | (102) 73   |



**TH 11 Corridor Improvements**  
 Intersections of TH 11 & TH 313, TH 11 & Lake St NE  
 Minnesota Department of Transportation

**Figure 29-a**  
**Existing Volumes – AM & PM Peak Period**





**TH 11 Corridor Improvements**  
 Intersections of TH 11 & TH 313, TH 11 & Lake St NE  
 Minnesota Department of Transportation

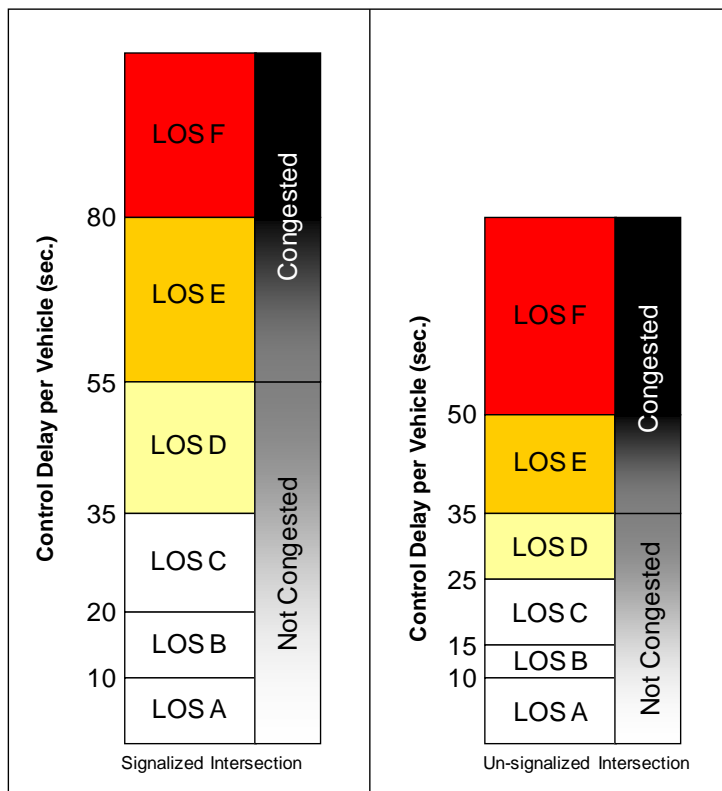
**Figure 29-b**  
**Existing Volumes – Mid-day Peak Period**



**Table 12 – Level of Service (LOS) Thresholds for Signalized and Unsignalized Intersections**

| LOS | Signalized Intersection Average Delay/Vehicle (seconds) | Unsignalized Intersection Average Delay/Vehicle (seconds) | Description of Intersection Conditions  |
|-----|---|---|---|
| A   | <10   | <10   | Stable flow – low delays; at traffic signals most vehicles do not stop; acceptable LOS  |
| B   | 10 to 20  | 10 to 15  | Stable flow – low delays; at traffic signals some vehicles must stop; acceptable LOS  |
| C   | 20 to 35  | 15 to 25  | Stable flow – moderate delays; at traffic signals some cycle failures; many vehicles must stop; acceptable LOS  |
| D   | 35 to 55  | 25 to 35  | Approaching unstable flow – moderate delays; at traffic signals cycle failures become noticeable; many more vehicles must stop; limit of acceptable LOS |
| E   | 55 to 80  | 35 to 50  | Unstable flow – significant delays; at traffic signals cycle failures are frequent; most vehicles required to stop; unacceptable LOS                    |
| F   | >80   | >50   | Forced flow/failure – significant delays; at traffic signals many cycle failures occur; most or all vehicles must stop; unacceptable LOS                |

**Graph 1 – Level of Service (LOS) Thresholds for Signalized and Unsignalized Intersections**



SOURCE: Level of Service thresholds from the Highway Capacity Manual.  
 K:\Traffic\Level of Service (LOS)\LOS Delay Graphic.ppt



### **Intersection Analysis – Existing Operations at the Five Intersections**

As previously discussed, the intersection traffic operations analysis utilized Synchro/SimTraffic software. The traffic signal timing used was developed by assigning green time to phases based on a critical lane analysis and not the actual timing of the traffic signal. The delay and level of service for each intersection for the existing condition are summarized in **Table 13**, and detailed modeling results for each studied intersection are provided in **Attachment B**.

The results of the operational analysis show there are no significant delay or queuing issues present at any of the intersections studied. The level of service is at A, B or C for all intersections during all three periods.



TH 11 Existing Roadway Conditions

Table 13 – Existing LOS AM, Midday and PM Periods

| Intersection |                      |          | AM Peak               |         |       |                           | Mid-day               |         |        |                           | PM Peak               |         |        |                           |
|--------------|----------------------|----------|-----------------------|---------|-------|---------------------------|-----------------------|---------|--------|---------------------------|-----------------------|---------|--------|---------------------------|
| Control      | Location             | Approach | Movement Delay* (LOS) |         |       | Intersection Delay* (LOS) | Movement Delay* (LOS) |         |        | Intersection Delay* (LOS) | Movement Delay* (LOS) |         |        | Intersection Delay* (LOS) |
|              |                      |          | Left                  | Through | Right |                           | Left                  | Through | Right  |                           | Left                  | Through | Right  |                           |
| Thru-Stop    | TH 11 & TH 32        | NB       | 2 (A)                 | 1 (A)   | 0 (A) | 2 (A)                     | 2 (A)                 | 1 (A)   | 0 (A)  | 3 (A)                     | 2 (A)                 | 1 (A)   | 0 (A)  | 2 (A)                     |
|              |                      | WB       | 0 (A)                 | 0 (A)   | 0 (A) |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           | 0 (A)                 |         |        |                           |
|              |                      | SB       | 0 (A)                 | 1 (A)   | 1 (A) |                           | 0 (A)                 | 1 (A)   | 1 (A)  |                           | 0 (A)                 | 1 (A)   | 1 (A)  |                           |
|              |                      | EB       | 5 (A)                 | 0 (A)   | 3 (A) |                           | 6 (A)                 | 0 (A)   | 2 (A)  |                           | 6 (A)                 | 0 (A)   | 2 (A)  |                           |
| Thru-Stop    | TH 11 & 18th Ave NW  | NB       | 5 (A)                 | 6 (A)   | 2 (A) | 1 (A)                     | 5 (A)                 | 5 (A)   | 2 (A)  | 1 (A)                     | 5 (A)                 | 8 (A)   | 3 (A)  | 1 (A)                     |
|              |                      | WB       | 1 (A)                 | 1 (A)   | 0 (A) |                           | 1 (A)                 | 2 (A)   | 1 (A)  |                           | 1 (A)                 | 2 (A)   | 0 (A)  |                           |
|              |                      | SB       | 5 (A)                 | 6 (A)   | 0 (A) |                           | 0 (A)                 | 8 (A)   | 0 (A)  |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           |
|              |                      | EB       | 0 (A)                 | 0 (A)   | 0 (A) |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           |
| Signalized   | TH 11 & TH 89/TH 310 | NB       | 9 (A)                 | 10 (B)  | 4 (A) | 9 (A)                     | 10 (B)                | 7 (A)   | 4 (A)  | 10 (B)                    | 11 (B)                | 9 (A)   | 5 (A)  | 10 (B)                    |
|              |                      | WB       | 12 (B)                | 11 (B)  | 4 (A) |                           | 12 (B)                | 13 (B)  | 5 (A)  |                           | 13 (B)                | 14 (B)  | 4 (A)  |                           |
|              |                      | SB       | 10 (B)                | 9 (A)   | 3 (A) |                           | 10 (B)                | 10 (B)  | 3 (A)  |                           | 9 (A)                 | 11 (B)  | 4 (A)  |                           |
|              |                      | EB       | 16 (B)                | 16 (B)  | 4 (A) |                           | 14 (B)                | 14 (B)  | 4 (A)  |                           | 13 (B)                | 14 (B)  | 3 (A)  |                           |
| Signalized   | TH 11 & TH 313       | NB       | 6 (A)                 | 4 (A)   | 2 (A) | 9 (A)                     | 6 (A)                 | 5 (A)   | 3 (A)  | 9 (A)                     | 6 (A)                 | 7 (A)   | 3 (A)  | 12 (B)                    |
|              |                      | WB       | 17 (B)                | 10 (B)  | 7 (A) |                           | 17 (B)                | 15 (B)  | 9 (A)  |                           | 21 (C)                | 19 (B)  | 9 (A)  |                           |
|              |                      | SB       | 4 (A)                 | 4 (A)   | 1 (A) |                           | 7 (A)                 | 7 (A)   | 3 (A)  |                           | 8 (A)                 | 8 (A)   | 3 (A)  |                           |
|              |                      | EB       | 19 (B)                | 14 (B)  | 3 (A) |                           | 16 (B)                | 9 (A)   | 2 (A)  |                           | 21 (C)                | 13 (B)  | 3 (A)  |                           |
| Signalized   | TH 11 & Lake St      | NB       | 0 (A)                 | 4 (A)   | 3 (A) | 6 (A)                     | 0 (A)                 | 9 (A)   | 6 (A)  | 10 (B)                    | 0 (A)                 | 9 (A)   | 5 (A)  | 12 (B)                    |
|              |                      | WB       | 17 (B)                | 0 (A)   | 7 (A) |                           | 22 (C)                | 0 (A)   | 11 (B) |                           | 24 (C)                | 0 (A)   | 15 (B) |                           |
|              |                      | SB       | 9 (A)                 | 6 (A)   | 0 (A) |                           | 10 (B)                | 7 (A)   | 0 (A)  |                           | 12 (B)                | 9 (A)   | 0 (A)  |                           |
|              |                      | EB       | 0 (A)                 | 0 (A)   | 0 (A) |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           | 0 (A)                 | 0 (A)   | 0 (A)  |                           |

\* Delay measured in seconds per vehicle



## 5. Safety

Safety is always a primary concern for MnDOT. Safety on TH 11 is a concern because of the speeds, the number and skew of at-grade intersections, and the mix of large and small vehicles. Understanding current conditions, crash patterns and trends as they exist today and how they may change as growth occurs is an important part of identifying and prioritizing improvements that could impact safety.

The safety data that was analyzed for this report was obtained from MnDOT's crash database for the past 10 years. This data was further subdivided into 3-year and 5-year time periods to get a sense of current conditions and recent historic trends. The crashes were analyzed in a few different ways to understand the corridor as a whole as well as to understand particular locations on the corridor. Results are summarized in the following sections.

### Overall Corridor

Data from 10 years, five years and three years was analyzed to identify basic crash trends along the corridor over the long-term, recent history and currently. In general, the number of crashes per year has been reduced; however, some of the more serious crashes are more recent events.

### Long-Term (10-Year)

Between January 1, 2005 and December 31, 2014, there were a total of 459 crashes, which averages approximately 50 crashes a year on the corridor. Fatal crashes represented approximately 1 percent of the crashes on the corridor. Type A crashes, the most severe crashes, which result in an incapacitating injury accounted for less than 1 percent of crashes on the corridor. Other injury crashes or potential injury crashes accounted for approximately 36 percent of the crashes and property damages made up the remaining crashes on the corridor (approximately 62 percent). **Figures 30 – 36** show where crashes have occurred over the past 10 years.

### Recent History (Five-Year)

The five-year history on the corridor between January 1, 2010 and December 31, 2014 shows that crashes on TH 11 were generally decreasing. During this five-year period, the total number of crashes was 209, which is an average of approximately 42 crashes a year. During this time period fatal crashes represented 1.4 percent of the crashes and Type A injury crashes were less than one percent. Other injury crashes were similar to the 10-year history with approximately 36 percent falling into that category. Property damage only crashes represented approximately 61 percent of the crashes.

The five-year trend saw a slight increase in injury crashes over property damage crashes.

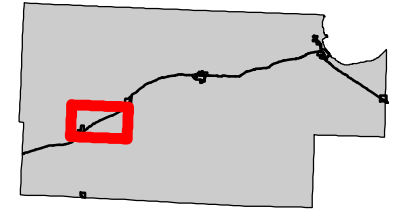
### Current Trends (Three-Year)

Current crash trends on the corridor are similar to the five-year history. Approximately 42 crashes a year occurred on the corridor with a higher percent of fatal (2.4 percent) and Type A (1.6 percent) crashes. Other injury crashes accounted for approximately 35 percent of the corridor crashes and property damage crashes accounted for 61 percent of the crashes. Three of the five fatal crashes on TH 11 occurred in 2014, which is why the percent for the recent history is higher than the 10-year and five-year trends. As a result of the three crashes, five people died. All three crashes occurred outside the incorporated cities. **Figures 37 – 43** show where crashes have occurred over the past three years.





**Figure 30 – Ten-Year Crash History  
Greenbush**





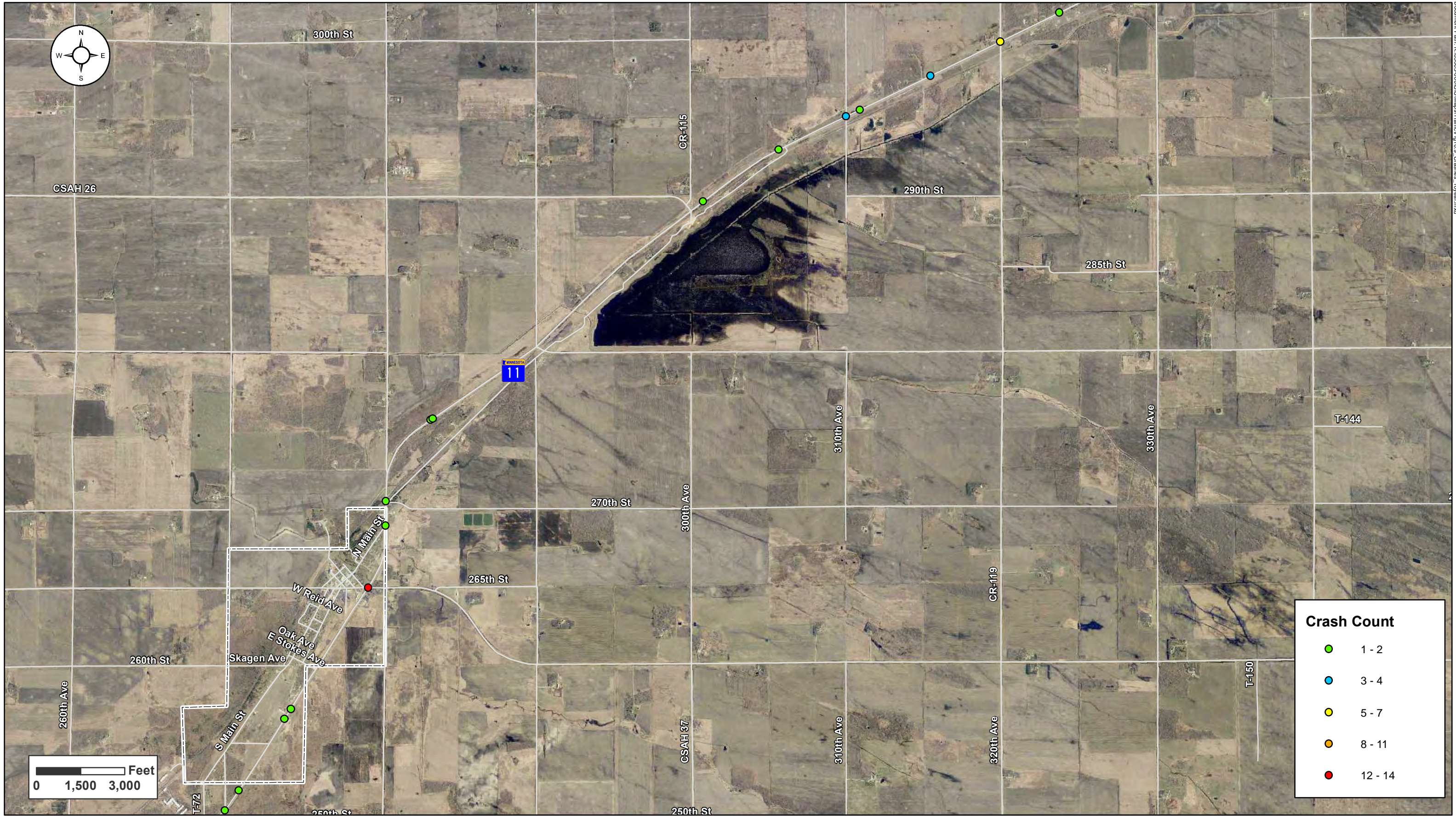


Figure 31 – Ten-Year Crash History  
Badger





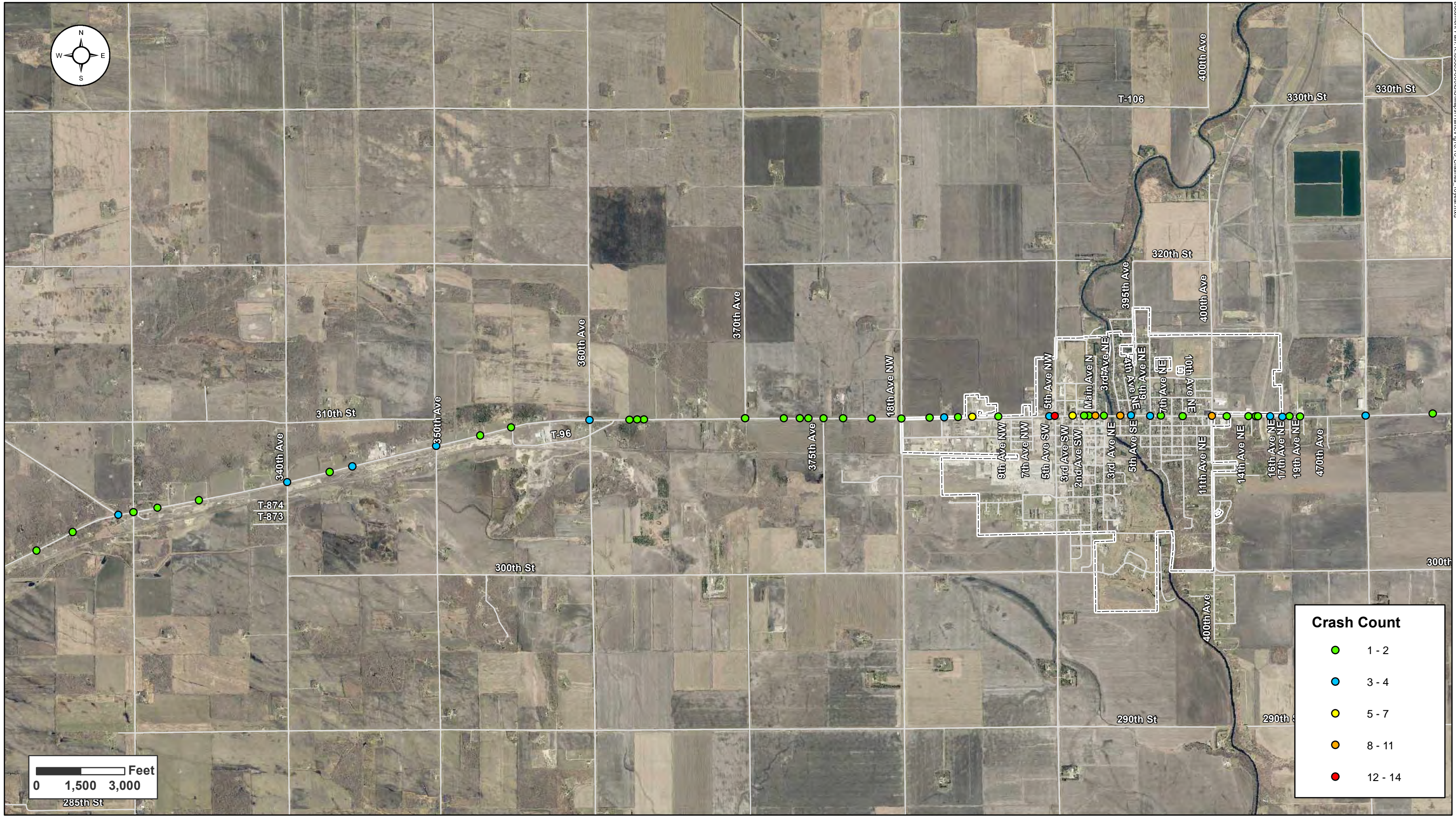
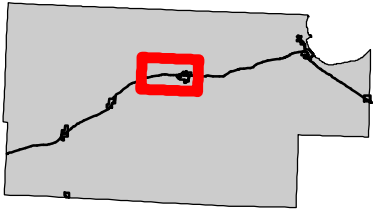
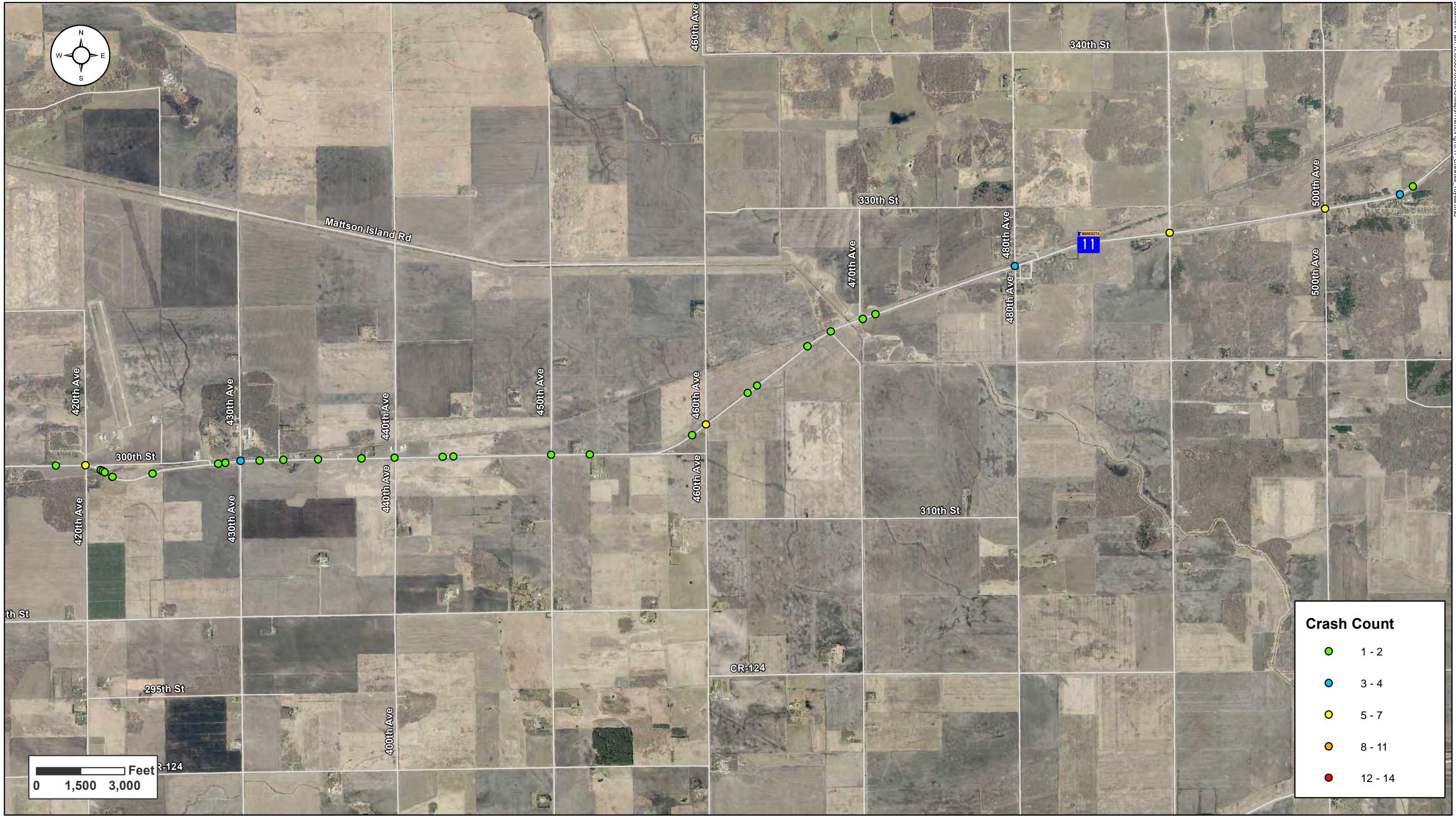


Figure 32 – Ten-Year Crash History  
Roseau







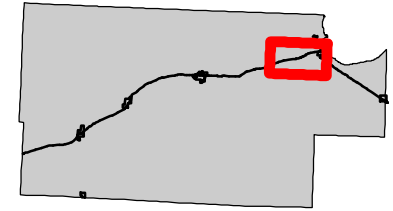
**Figure 33 – Ten-Year Crash History**  
**Salol**



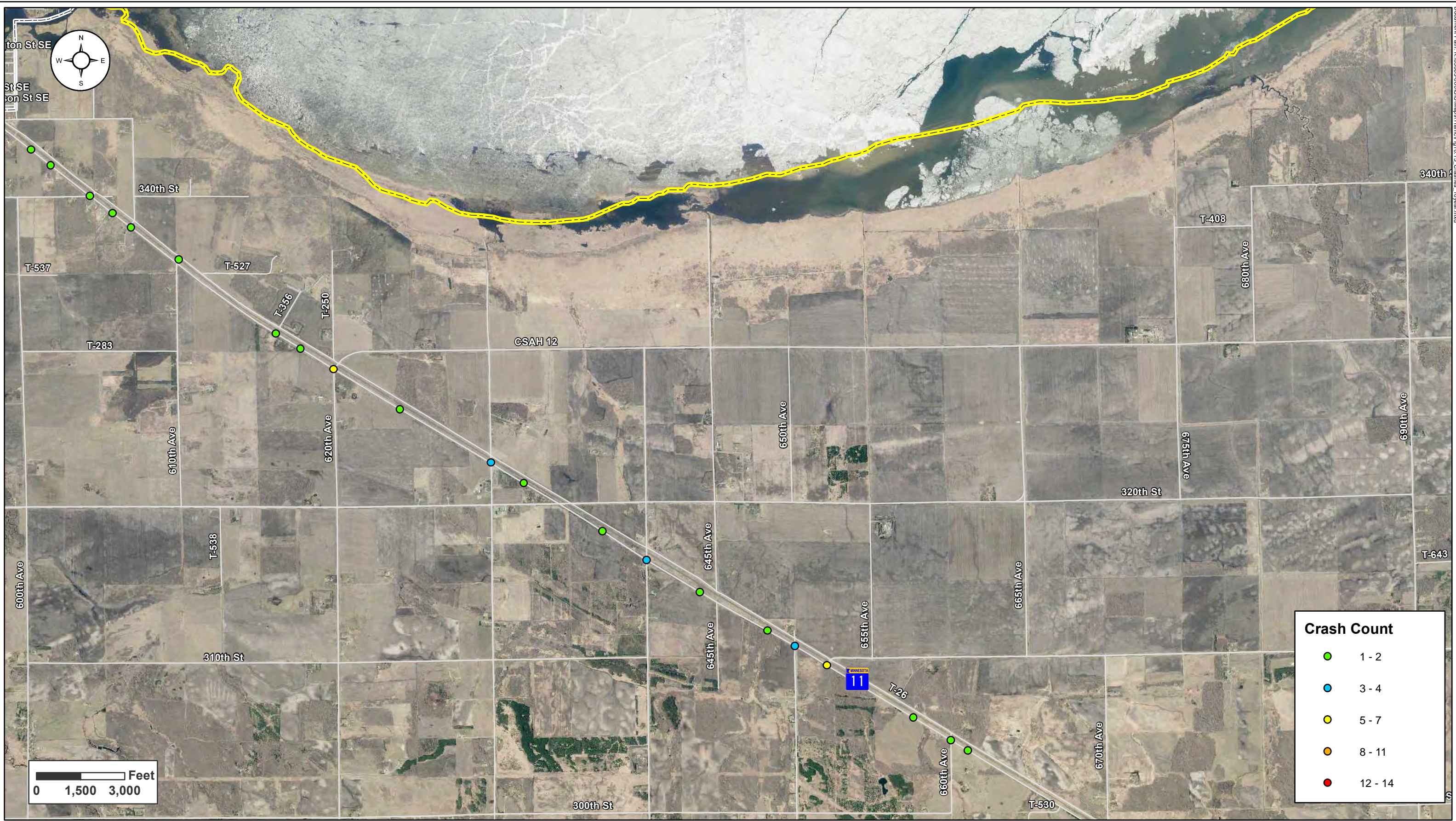




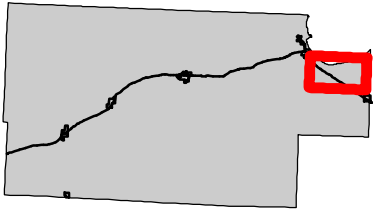
**Figure 34 – Ten-Year Crash History  
Salol to Warroad**







**Figure 35 – Ten-Year Crash History  
East of Warroad**





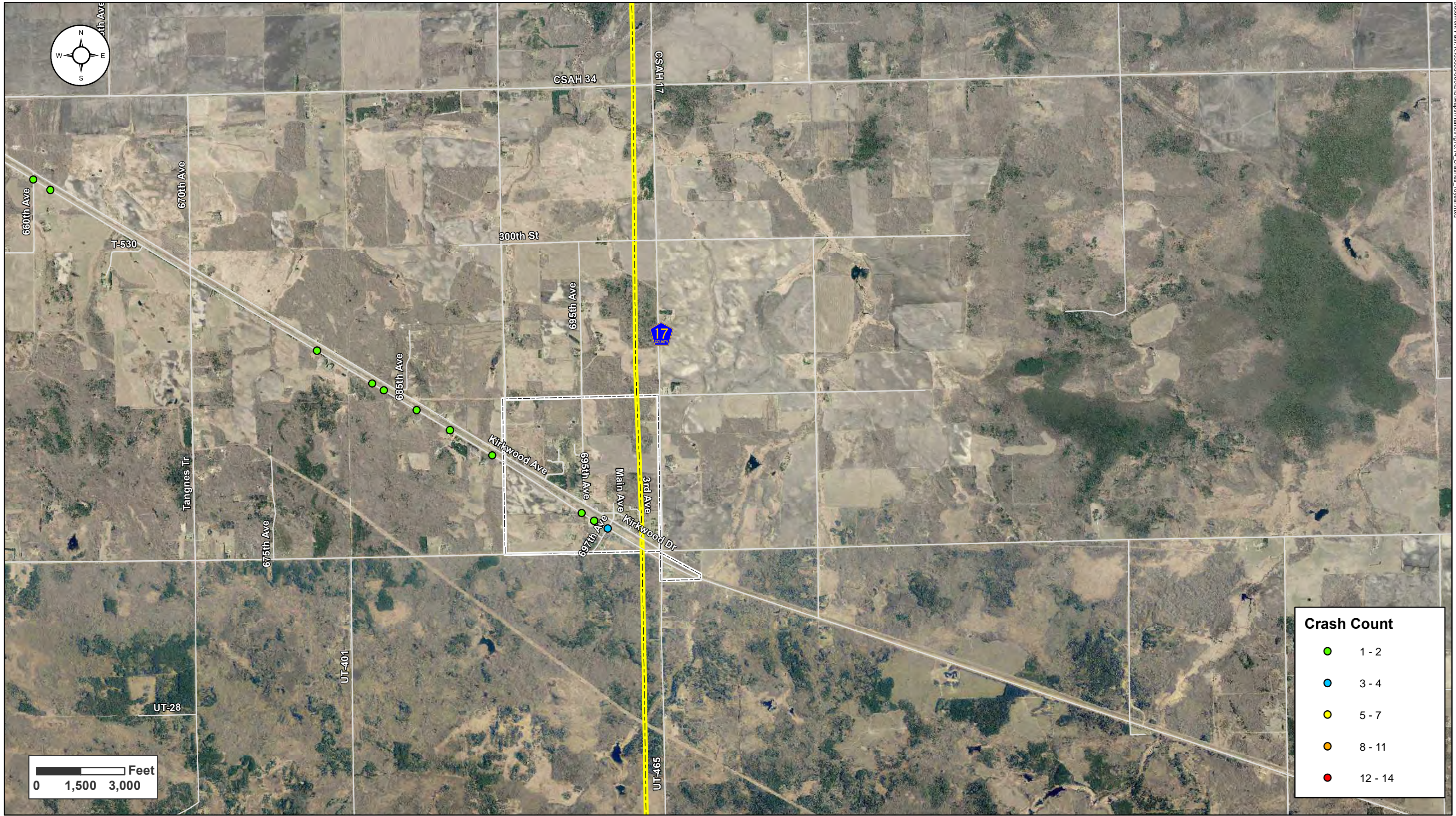
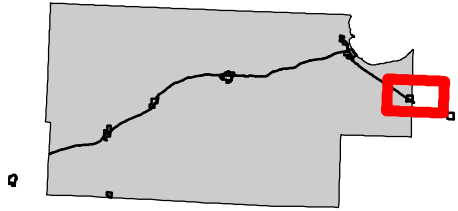


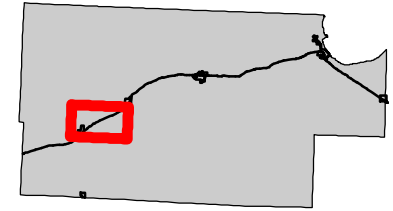
Figure 36 – Ten-Year Crash History  
Roosevelt







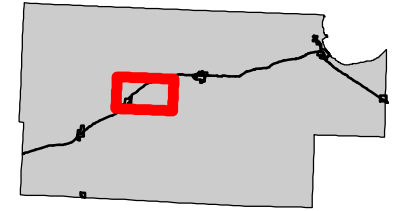
**Figure 37 – Three-Year Crash History**  
**Greenbush**



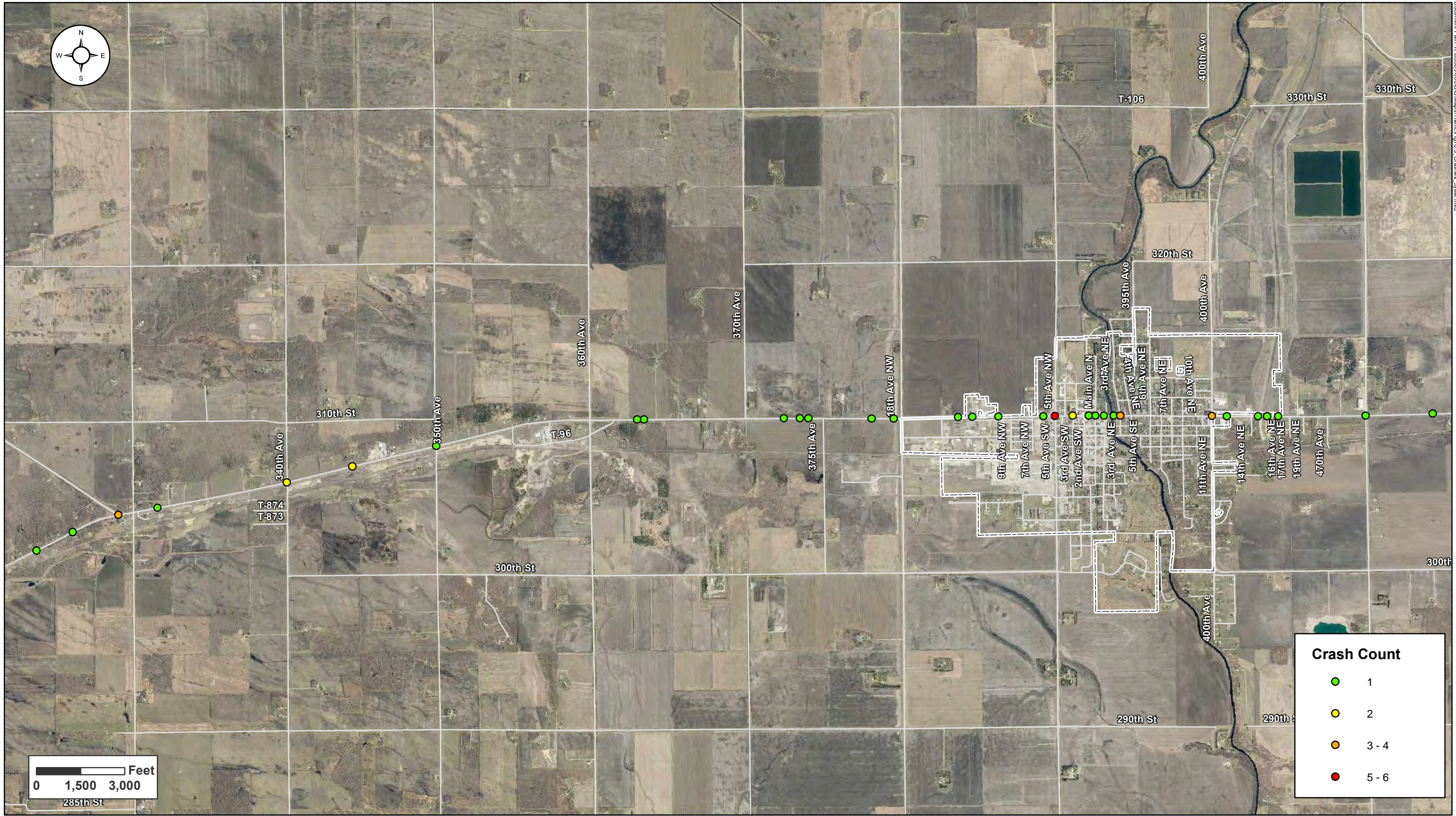




**Figure 38 – Three-Year Crash History**  
**Badger**







**Figure 39 – Three-Year Crash History**  
**Roseau**





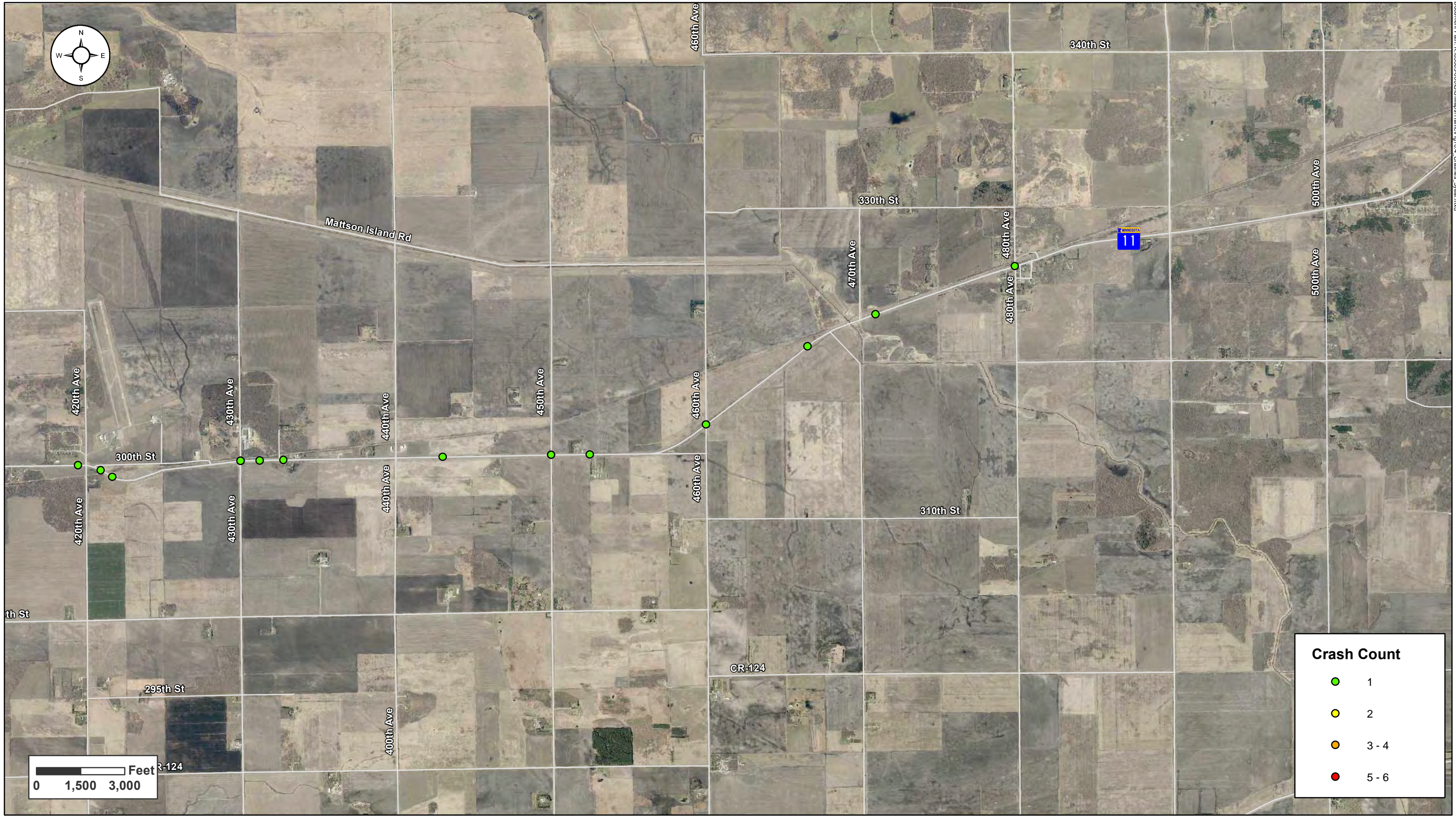
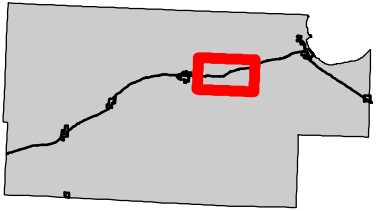


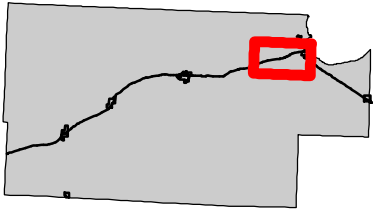
Figure 40 – Three-Year Crash History  
Salol



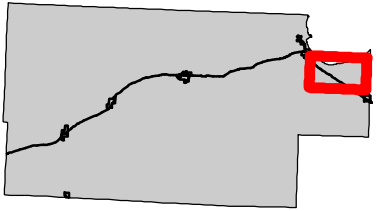
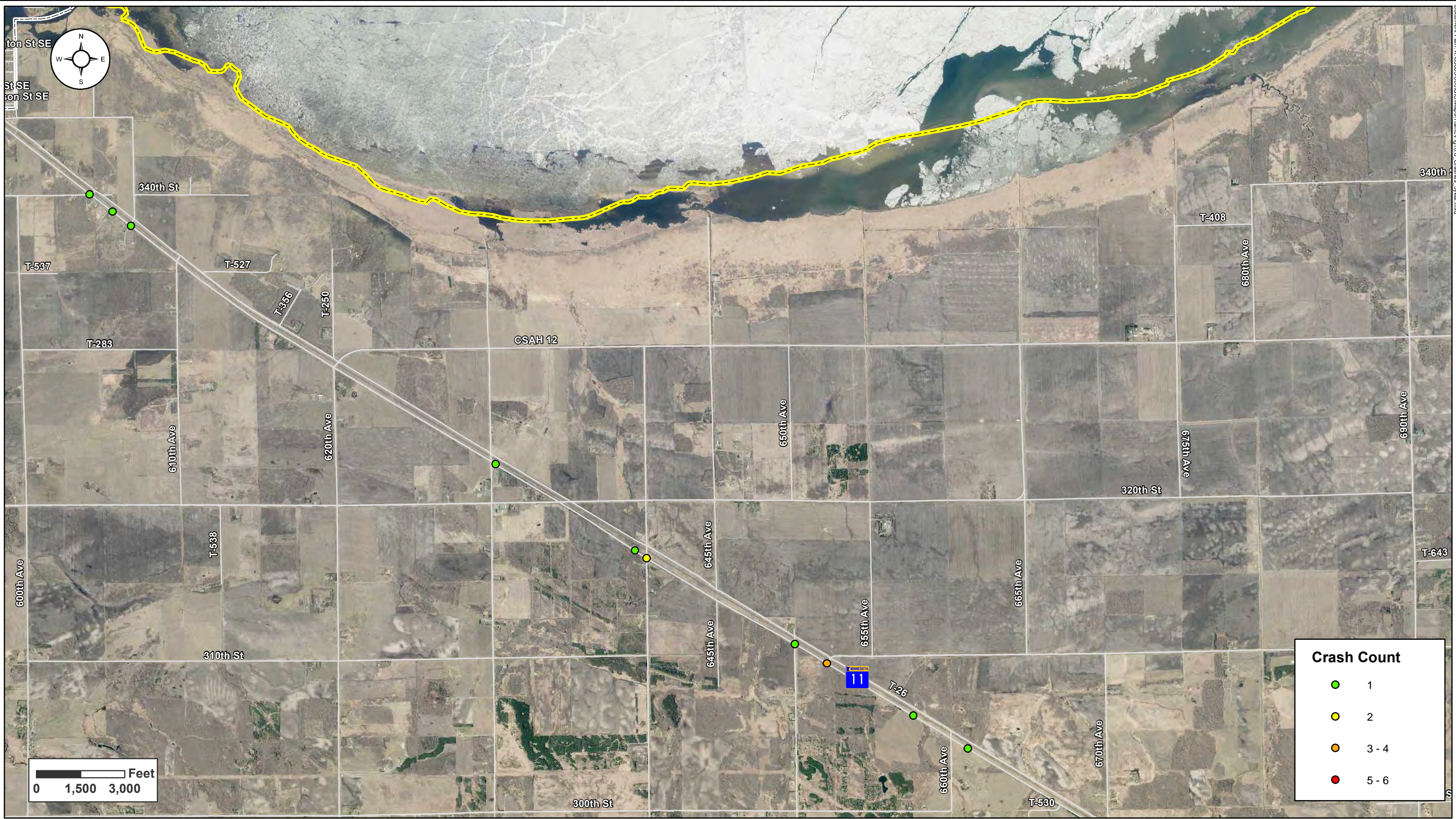




**Figure 41 – Three-Year Crash History  
Salol to Warroad**







**Figure 42 – Three-Year Crash History  
East of Warroad**

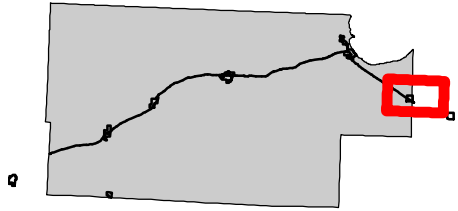






| Crash Count                           |       |
|---------------------------------------|-------|
| <span style="color: green;">●</span>  | 1     |
| <span style="color: yellow;">●</span> | 2     |
| <span style="color: orange;">●</span> | 3 - 4 |
| <span style="color: red;">●</span>    | 5 - 6 |

**Figure 43 – Three-Year Crash History  
Roosevelt**





### Corridor Sub-Areas Safety Analysis

In addition to identifying the number and severity of crashes occurring along the corridor, the crash analysis also looked at the percent of crashes compared to the vehicle miles traveled for five subareas of the corridor. By looking at the vehicle miles traveled in comparison to the number of crashes, areas of higher crash rates can be identified more clearly.

The five subareas were based on the number of lanes on the corridor. This grouping has the advantage of pulling out the more urbanized area as well as separating out a three-lane facility from a two-lane facility. These types of roadways can have different crash rates (in general) and it is more appropriate to keep these segments separated from one another. The five subareas included:

1. Western Segment: Western study limits to the three-lane in Roseau
2. Central Urban: Start of the three-lane in Roseau to the end of the three-lane in Roseau
3. Central Rural: Beginning of two-lane section in Roseau to the three-lane in Warroad
4. Eastern Urban: Start of the three-lane in Warroad to the end of the three-lane in Warroad
5. Eastern Rural: Start of the two-lane in Warroad to end of corridor in Roosevelt

Tables 14 and 15 show crash distribution by segment for a five-year history and a three-year history.

**Table 14 – Crash Distribution by Segment – Five-Year History**

| Corridor      | Total Crashes | Segment Length [mi] | Percent Crashes | Percent VMT | Crash Rate <sup>(2)</sup> | Statewide Average <sup>(3)</sup> | Comparison to Statewide Average |
|---------------|---------------|---------------------|-----------------|-------------|---------------------------|----------------------------------|---------------------------------|
| Western Rural | 59            | 22.8                | 28.2            | 32.8        | 0.51                      | 0.55                             | 7 percent lower                 |
| Central Urban | 42            | 1.9                 | 20.1            | 7.8         | 1.53                      | 2.00                             | 23 percent lower                |
| Central Rural | 64            | 19.8                | 30.6            | 41.0        | 0.44                      | 0.55                             | 20 percent lower                |
| Eastern Urban | 14            | 1.1                 | 6.7             | 3.6         | 1.10                      | 2.00                             | 45 percent lower                |
| Eastern Rural | 30            | 12.9                | 14.4            | 14.8        | 0.58                      | 0.55*                            | 5 percent higher                |
| <b>Totals</b> | <b>209</b>    | <b>58.4</b>         | <b>100</b>      | <b>100</b>  | <b>0.83</b>               | <b>1.28</b>                      | <b>18 percent lower</b>         |

<sup>(1)</sup> Based on crash records from January 2010 to December 2014

<sup>(2)</sup> Crashes per million vehicle miles (MVM)

<sup>(3)</sup> 5-year statewide averages for rural 2-lane roads and 3-lane undivided roads based on MnDOT 2013 Green Sheets

\* A segment of the corridor less than 1/4 of a mile has an AADT greater than 5000 vpd which has a 5-year statewide crash rate average of 0.61

**Table 15 – Crash Distribution by Segment – Three-Year History**

| Corridor      | Total Crashes | Segment Length [mi] | Percent Crashes | Percent VMT | Crash Rate <sup>(2)</sup> | Statewide Average <sup>(3)</sup> | Comparison to Statewide Average |
|---------------|---------------|---------------------|-----------------|-------------|---------------------------|----------------------------------|---------------------------------|
| Western Rural | 38            | 22.8                | 30.2            | 32.8        | 0.55                      | 0.55                             | Same as                         |
| Central Urban | 24            | 1.9                 | 19.0            | 7.8         | 1.46                      | 2.01                             | 27 percent lower                |
| Central Rural | 38            | 19.8                | 30.2            | 41.0        | 0.44                      | 0.55                             | 21 percent lower                |
| Eastern Urban | 5             | 1.1                 | 4.0             | 3.6         | 0.65                      | 2.01                             | 68 percent lower                |
| Eastern Rural | 21            | 12.9                | 16.7            | 14.8        | 0.67                      | 0.55*                            | 22 percent higher               |
| <b>Totals</b> | <b>126</b>    | <b>58.4</b>         | <b>100</b>      | <b>100</b>  | <b>0.75</b>               | <b>1.28</b>                      | <b>19 percent lower</b>         |

<sup>(1)</sup> Based on crash records from January 2012 to December 2014.

<sup>(2)</sup> Crashes per million vehicle miles (MVM)

<sup>(3)</sup> 3-year statewide averages for rural 2-lane roads and 3-lane undivided roads based on MnDOT 2013 Green Sheets

\* A segment of the corridor less than 1/4 of a mile has an AADT greater than 5000 vpd which has a 3-year statewide crash rate average of 0.60



## TH 11 Existing Traffic Characteristics

In general, crashes along TH 11 are lower than statewide averages with the exception of the most eastern segment, which has a crash rate that is higher than the statewide average. It also has a crash severity rate that is above the statewide average.

### Crash Type and Severity Analysis

Another way to better understand safety on TH 11 is to look at the types of crashes that are occurring and where those crashes are occurring. Certain types of crashes can indicate a higher severity rate (more likely to be an injury crash) or suggest the types of improvements that may need to be made either along segments of the corridor or at intersections. Data from 10-years and the most recent three-year history were reviewed to determine what types of crashes have historically and currently are occurring on the corridor.

Cashes that occur along the corridor are put into one of nine categories when they are reported. These categories include: rear-end, side swipe same direction, side swipe opposite direction, left turn, run off the road same direction, run off the road opposite direction, right angle, right turn and head on. In general, run off the road, head on and right angle crashes are usually the most severe crashes that occur. Rear-end crashes can be added to that category when they occur in areas with higher speed limits. In urban areas, when they occur at traffic signals or in congested locations, they tend to be less severe.

**Table 16** identifies the types and severity of crashes that have occurred over the past 10 years. **Table 17** does the same for the most recent three years.

**Table 16 – Crashes by Type and Severity – 10-Year History**

| Crash Type    | Number of Crashes | Crash Severity |                       |            |                 |
|---------------|-------------------|----------------|-----------------------|------------|-----------------|
|               |                   | Fatal          | Incapacitating Injury | Injury     | Property Damage |
| Rear-End      | 87                | 1              | 0                     | 38         | 48              |
| Side Swipe    | 43                | 0              | 0                     | 8          | 35              |
| Left Turn     | 14                | 0              | 0                     | 4          | 10              |
| Right Turn    | 7                 | 0              | 0                     | 0          | 7               |
| Right Angle   | 74                | 2              | 0                     | 29         | 43              |
| Run Off Road  | 130               | 1              | 1                     | 52         | 76              |
| Head On       | 39                | 1              | 2                     | 14         | 22              |
| <b>Totals</b> | <b>394</b>        | <b>5</b>       | <b>3</b>              | <b>145</b> | <b>241</b>      |

Please note – the total number of crashes does not match the 459 identified in the 10-year history. This is due to the fact that some crashes did not have their crash type coded.



**Table 17 – Crashes by Type and Severity – Three-Year History**

| Crash Type    | Number of Crashes | Crash Severity |                       |           |                 |
|---------------|-------------------|----------------|-----------------------|-----------|-----------------|
|               |                   | Fatal          | Incapacitating Injury | Injury    | Property Damage |
| Rear-End      | 18                | 0              | 0                     | 9         | 9               |
| Side Swipe    | 9                 | 0              | 0                     | 2         | 7               |
| Left Turn     | 4                 | 0              | 0                     | 1         | 3               |
| Right Turn    | 2                 | 0              | 0                     | 0         | 2               |
| Right Angle   | 22                | 2              | 0                     | 11        | 9               |
| Run Off Road  | 43                | 0              | 1                     | 10        | 32              |
| Head On       | 15                | 1              | 1                     | 6         | 7               |
| <b>Totals</b> | <b>113</b>        | <b>3</b>       | <b>2</b>              | <b>39</b> | <b>69</b>       |

Please note – the total number of crashes does not match the 126 identified in the three-year history. This is due to the fact that some crashes did not have their crash type coded.

**Figures 44 –57** show crashes by severity. **Figures 58 – 71** show crashes by type. Three-year and 10-year maps are provided for both the crashes by severity and crashes by type. [Please note – the summary of trends and intersection information are provided before the figures for ease of reading]

A closer look at the data in the various categories reveals some interesting trends on the corridor.

- As expected, the head on, run off the road and right angle crashes included the most severe crashes, along with a rear-end crash in a high-speed area. This is true for both the 10-year and three-year timeframes.
- A high number of the run off the road crashes are associated with illegal or unsafe speeds, driver inattention and weather conditions (60 percent over 10 years, 67 percent over last three years). Illegal or unsafe speed was the most frequently documented reason. This is true for both the 10-year and three-year timeframes.

Run off the road crashes have some locations where they are clustered. Areas that seem to experience these types of crashes include:

- Near 330th Avenue between Badger and Roseau
- Between 370th Avenue and 18th Avenue NW near Roseau
- Between 11th and 17th Avenues in Roseau
- From east of the airport in Roseau to 470th Avenue
- Between 560th and Emily Avenues outside of Warroad
- Between 650th and 660th Avenues east of Warroad

The 10-year data indicates a few additional locations that appear to be less problematic currently. These areas included a segment west of the Roseau airport, between 510th and 530th Avenues west of Warroad, and between 620th and 640th Avenues east of Warroad.

In terms of severity, the 10-year data indicates that there were more serious run off the road crashes occurring over the longer time frame versus current history. However, it should be



## TH 11 Existing Traffic Characteristics

noted that one of the fatal crashes was in the segment between the Roseau airport and 470th Avenue. That crash occurred within the past three years.

- About half of the rear end crashes occurred in areas with posted speeds of 40 miles per hour or less (more urbanized areas). Driver inattention was the most frequently documented reason for the crash occurring followed by no clear reason. This is true for both the 10-year and three-year timeframes.

As shown in the figures, about half of the crashes that are rear end crashes outside of the urban areas are at intersections. This is true for both the 10-year and three-year timeframes.

In terms of severity, during the three-year timeframe, the crashes were fairly balanced between property damage and non-incapacitating injury both inside and outside of the urban areas.

The number of rear end crashes per year has dropped quite a bit. During the 10-year timeframe, there were 87 rear end crashes reported, which averages to 8.7 per year. During the most recent three-year period there were only 18 crashes or 6 rear end crashes per year.

- Approximately 40 percent of the right angle crashes occurred in areas with posted speed limits of 40 miles per hour or less (urban areas) with the majority of the right angle crashes occurring outside the urbanized areas. The most frequently cited factor for these types of crashes was failure to yield the right of way (basically someone pulled out in front of someone else from a side street or driveway).

Most of the right angle crashes occur at public street locations; however, there are still a number that result from private driveway or field access locations. This is especially true during the 10-year history.

- A majority of the head on crashes in the past three years resulted in an injury or fatality.
- A majority of the head on crashes had no clear factor or reason for the occurrence. This was true for both the 10-year and three-year timeframes.

In the three-year time period, there were no distinct clusters of head on crashes except for in the City of Roseau. Between 3rd Avenue NW and 2nd Avenue NE there were three head-on crashes in the three-lane segment of the corridor. Additionally, just west of town there were two head-on crashes. One of the crashes occurred near 18th Avenue NW and one near 375th Avenue.

In the 10-year period, there was an additional cluster of head on crashes between 520th Avenue (west of Warroad) and 550th Avenue



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- In terms of smaller segments (not the ones previously identified) there are some additional areas where crashes appear to be denser. For the most recent three-years these include:
  - 320th to 330th Avenues west of Roseau
  - 370th to 18th Avenues just outside of Roseau
  - 420th to 460th Avenues near the airport
  - 560th to 570th Avenues outside of Warroad
  - 650th to 660th Avenues east of Warroad
  - Roosevelt near the county border

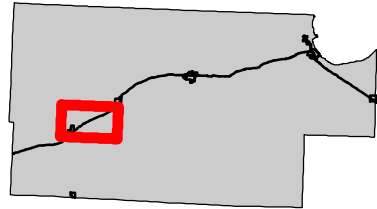
When the 10-year timeframe is considered, a few more segments emerge. These include:

- Downtown Greenbush
- 460th to 470th Avenues near the airport
- 510th to 550th Avenues outside of Warroad
- 600th to 640th Avenues east of Warroad





**Figure 44 – Three-Year Severity  
Greenbush**







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**Figure 45 – Three-Year Severity  
Badger**







### Figure 46 – Three-Year Severity Roseau

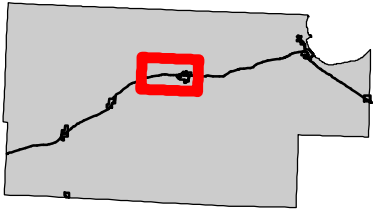






Figure 47 – Three-Year Severity  
Salol



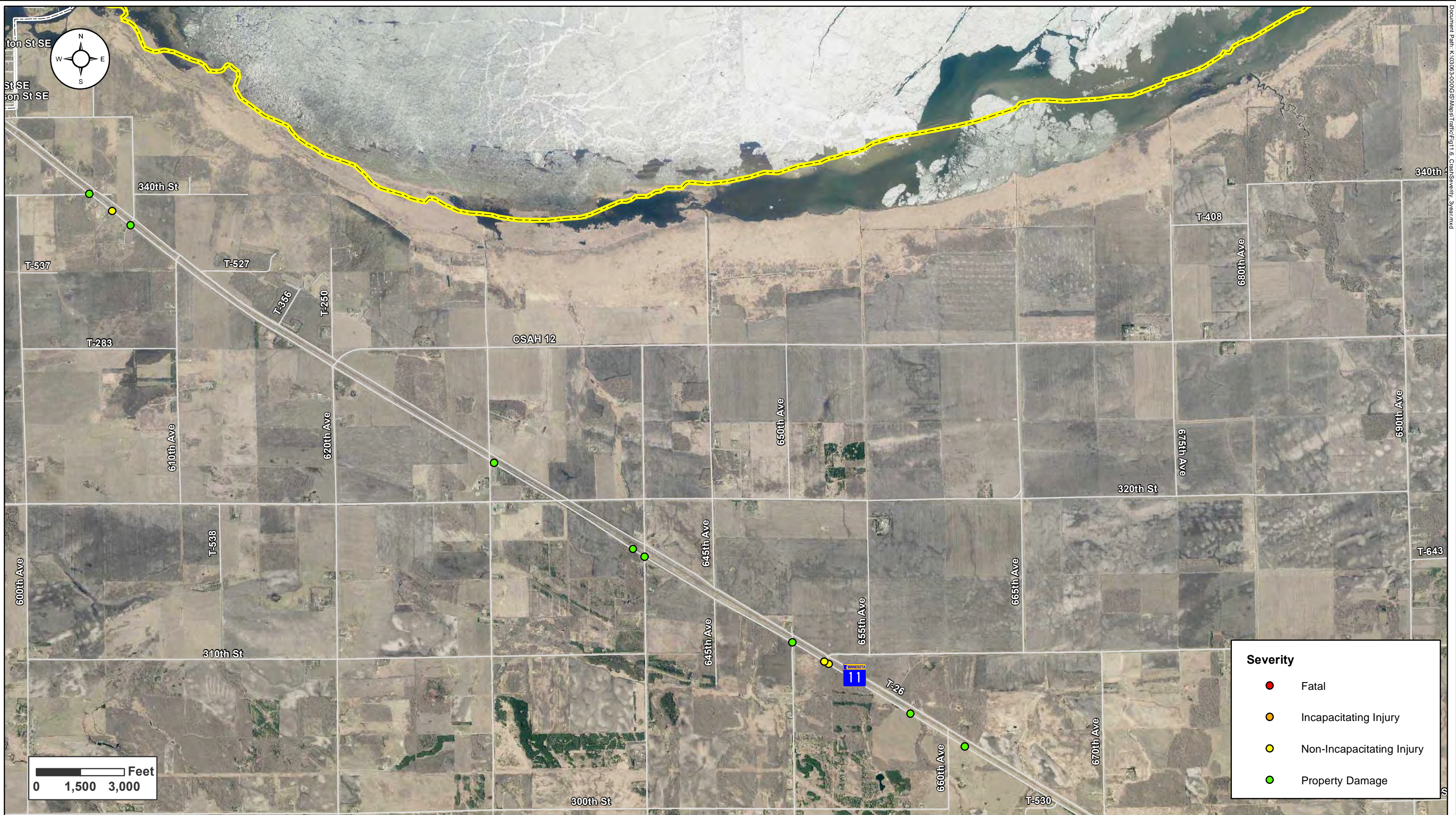




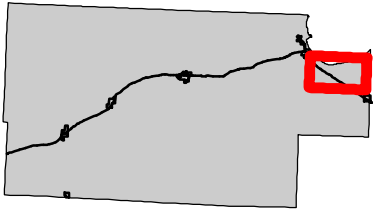
**Figure 48 – Three-Year Severity  
Salol to Warroad**







**Figure 49 – Three-Year Severity  
East of Warroad**



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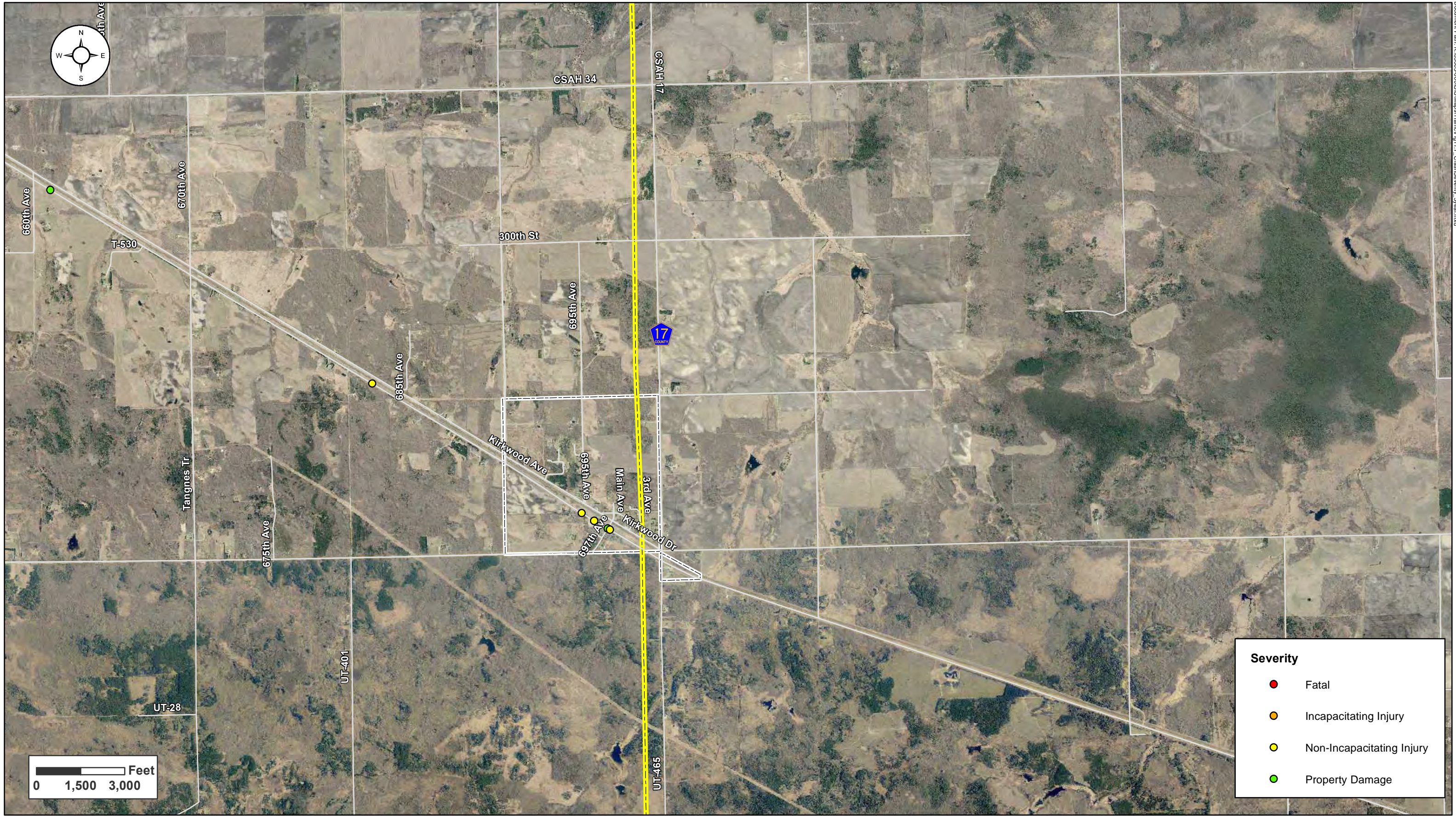


Figure 50 – Three-Year Severity  
Roosevelt







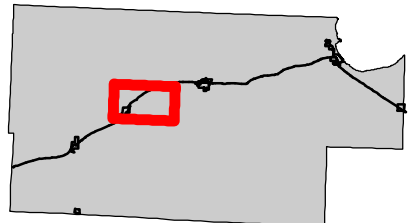
Figure 51 – Ten-Year Severity  
Greenbush







Figure 52 – Ten-Year Severity  
Badger





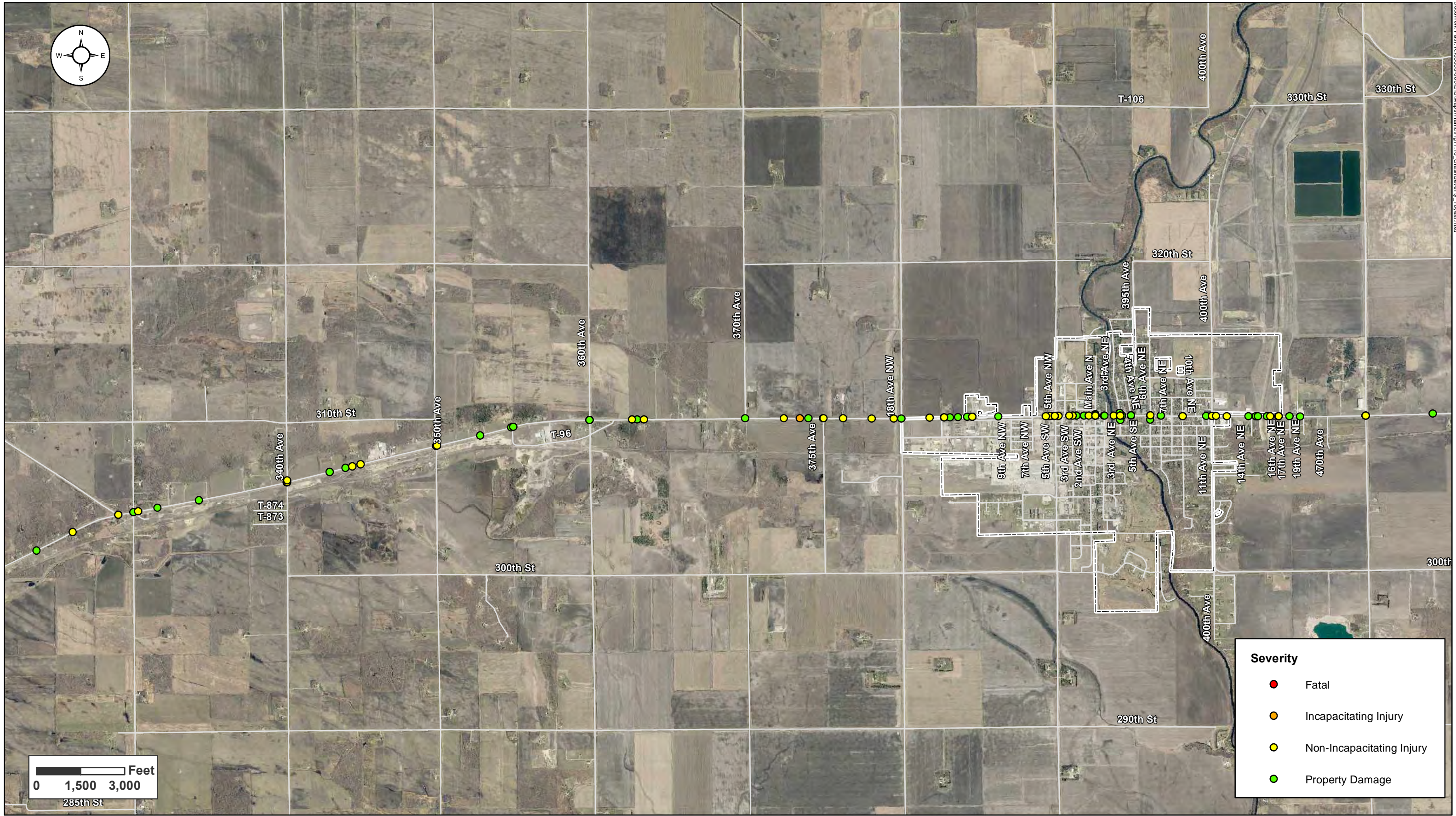


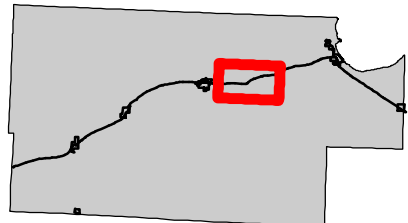
Figure 53 – Ten-Year Severity  
Roseau







**Figure 54 – Ten-Year Severity  
Salol**



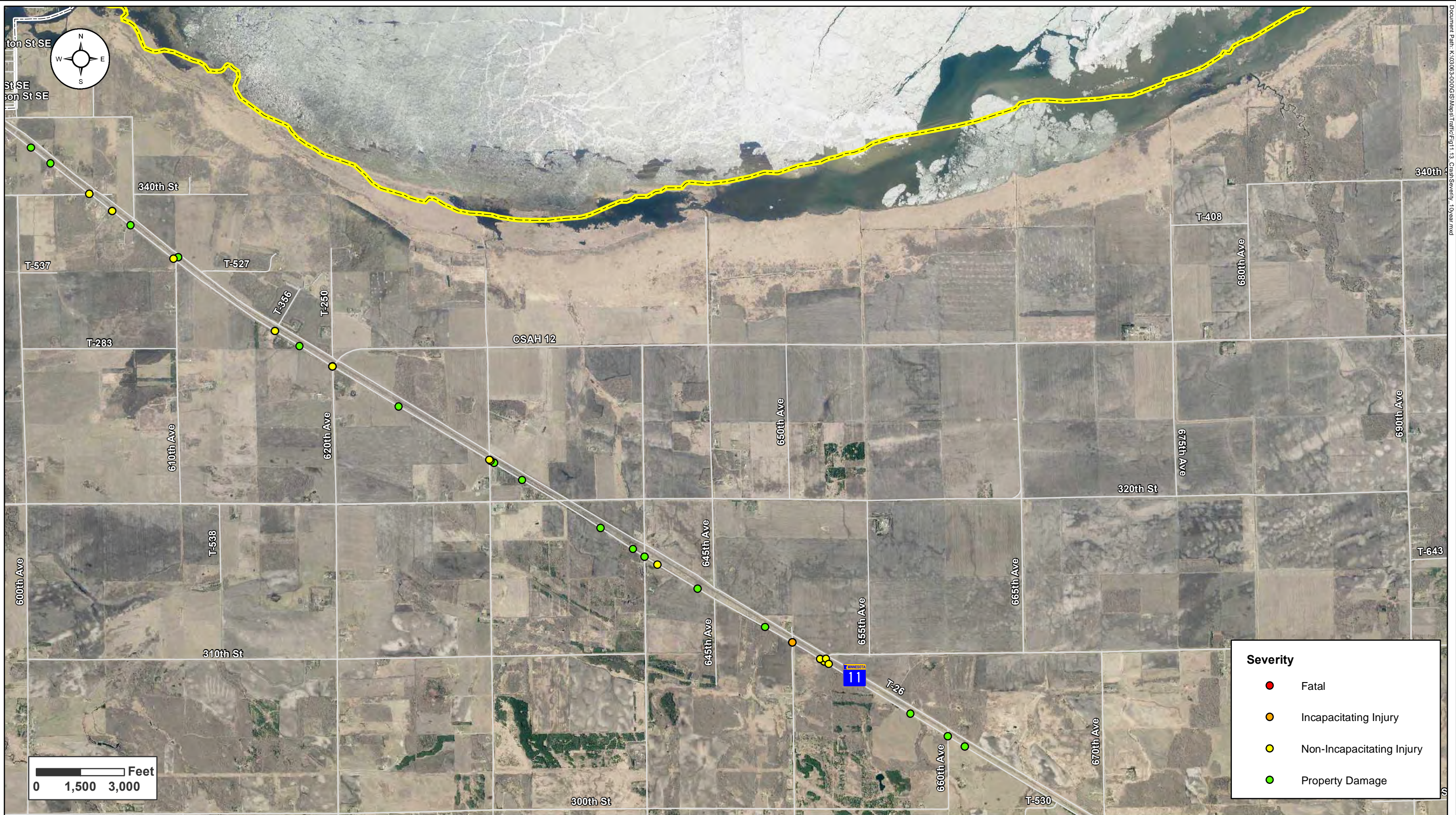




**Figure 55 – Ten-Year Severity  
Salol to Warroad**



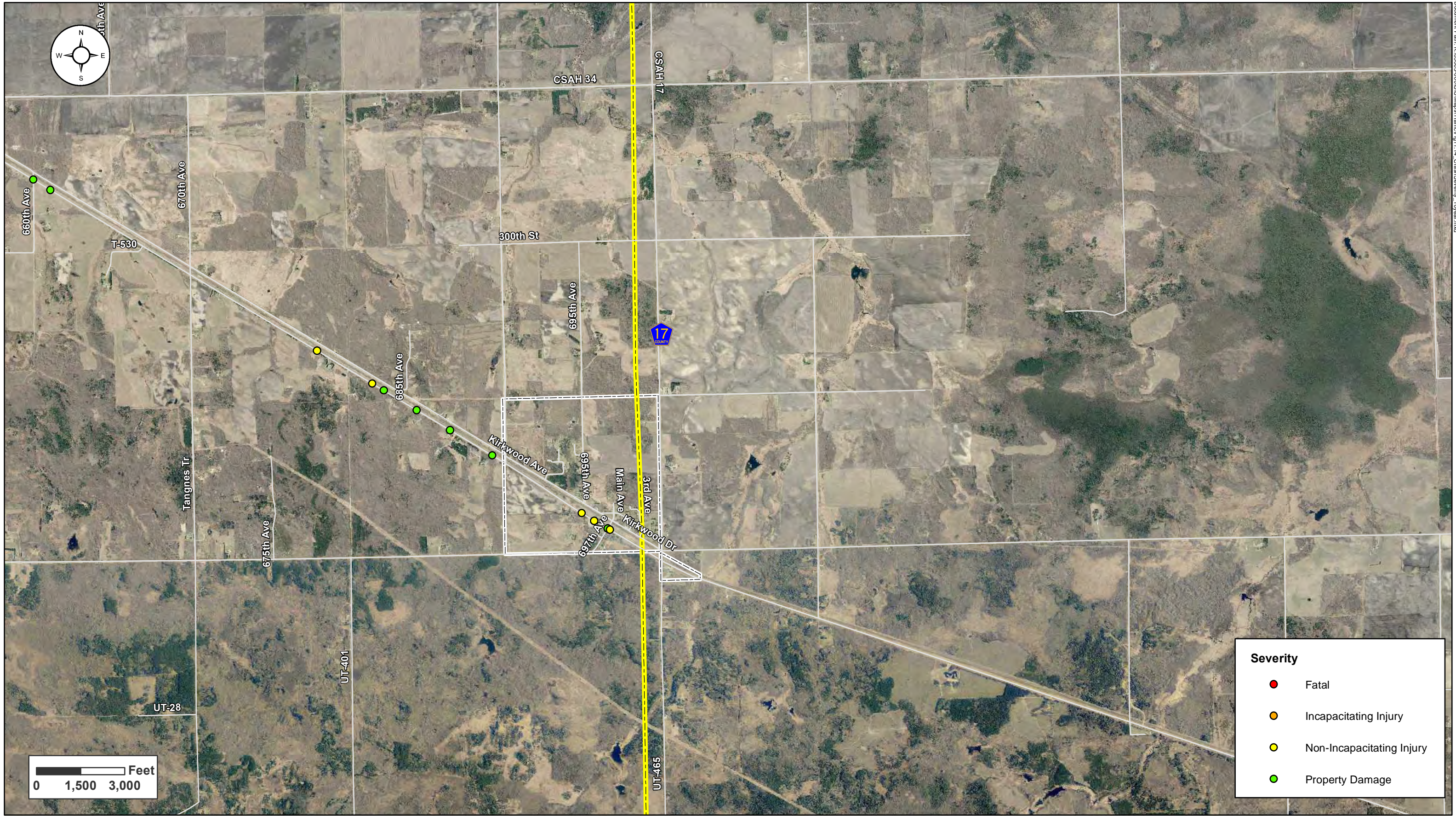




**Figure 56 – Ten-Year Severity  
East of Warroad**







**Figure 57 – Ten-Year Severity  
Roosevelt**







Figure 58 – Three-Year Type Greenbush







Figure 59 – Three-Year Type  
Badger





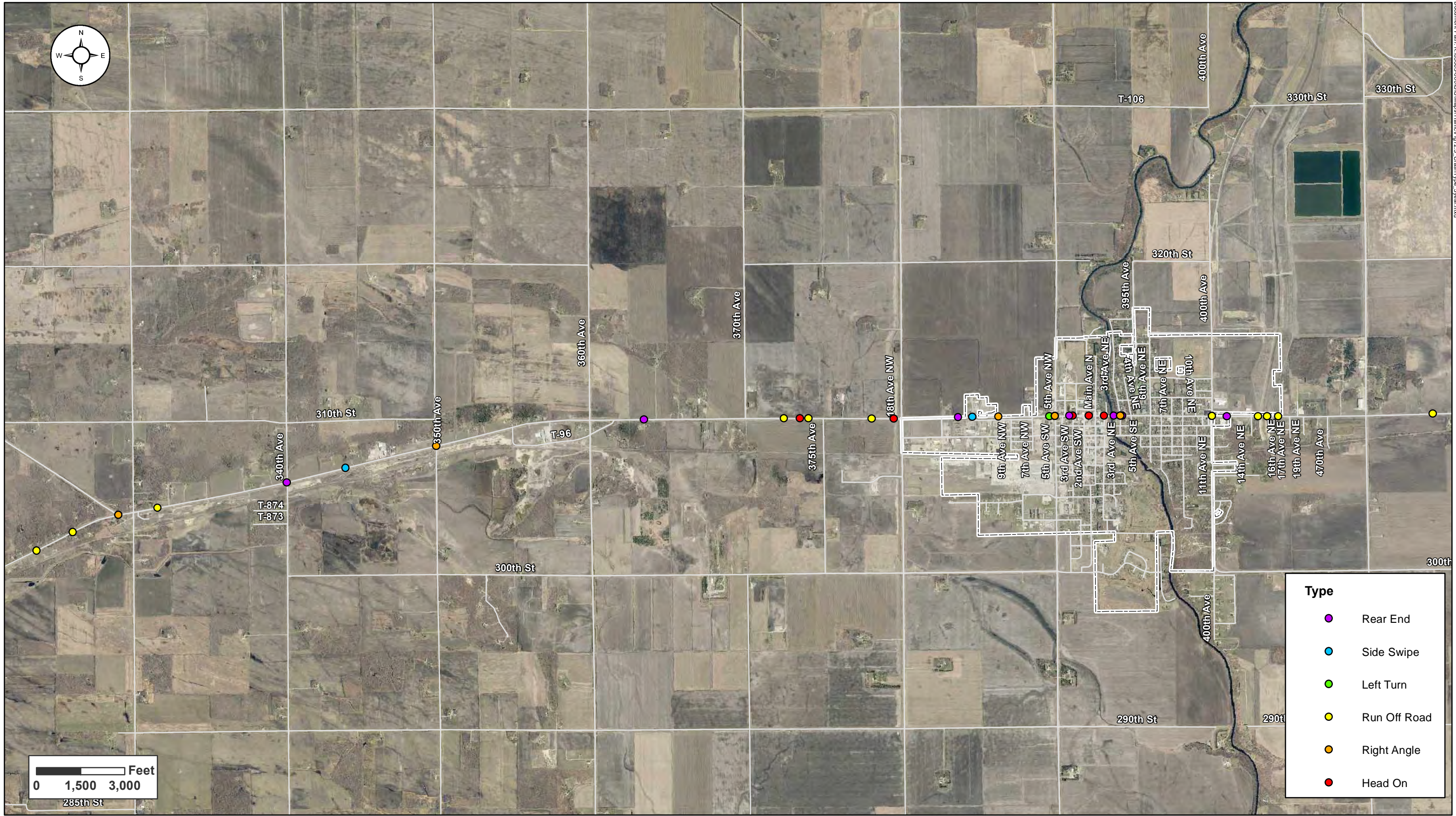


Figure 60 – Three-Year Type  
Roseau





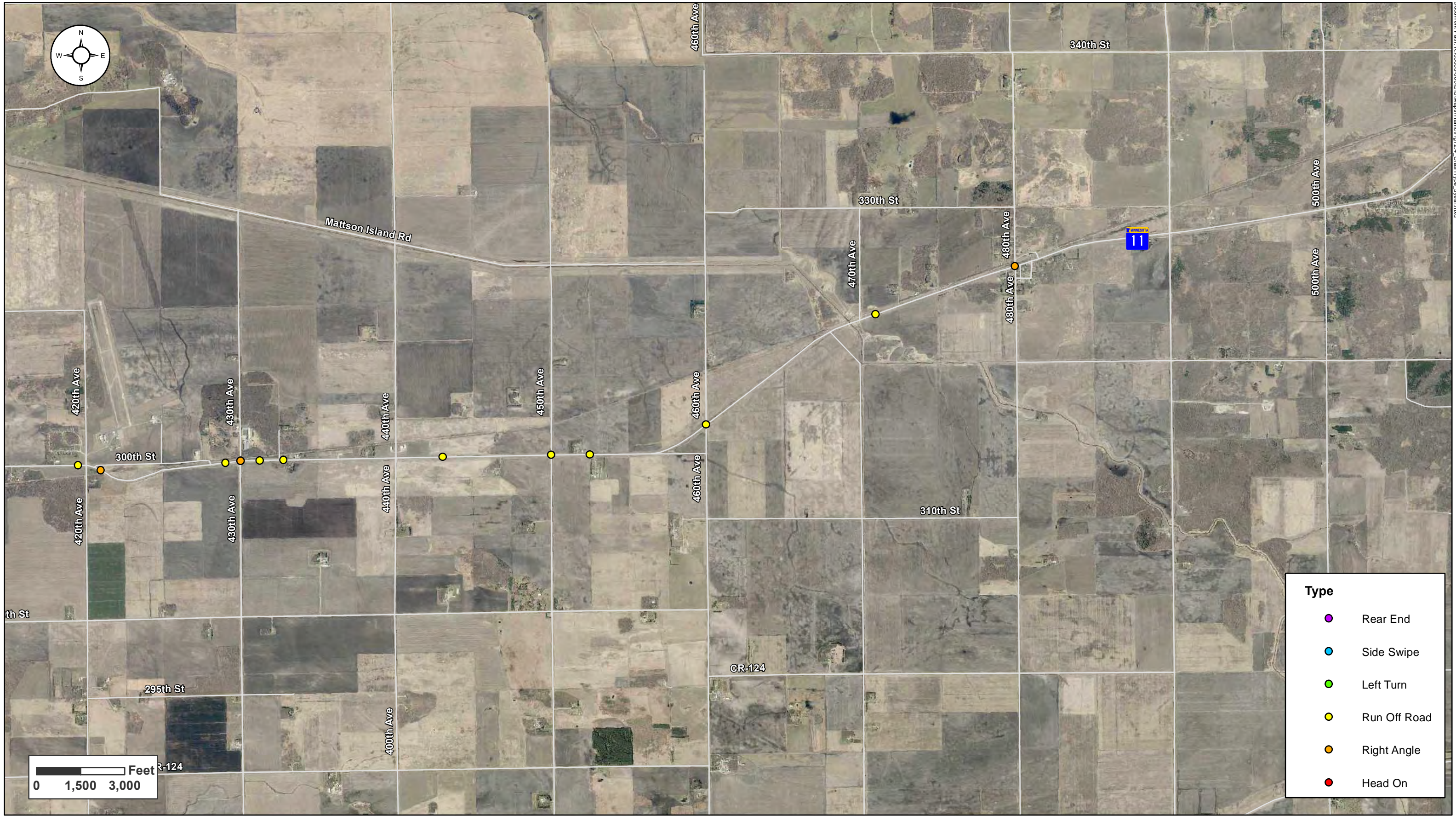


Figure 61 – Three-Year Type Salol

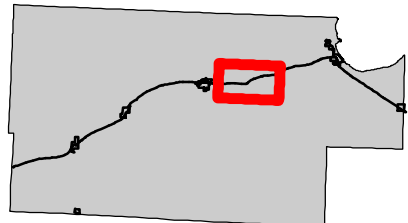






Figure 62 – Three-Year Type  
Salol to Warroad





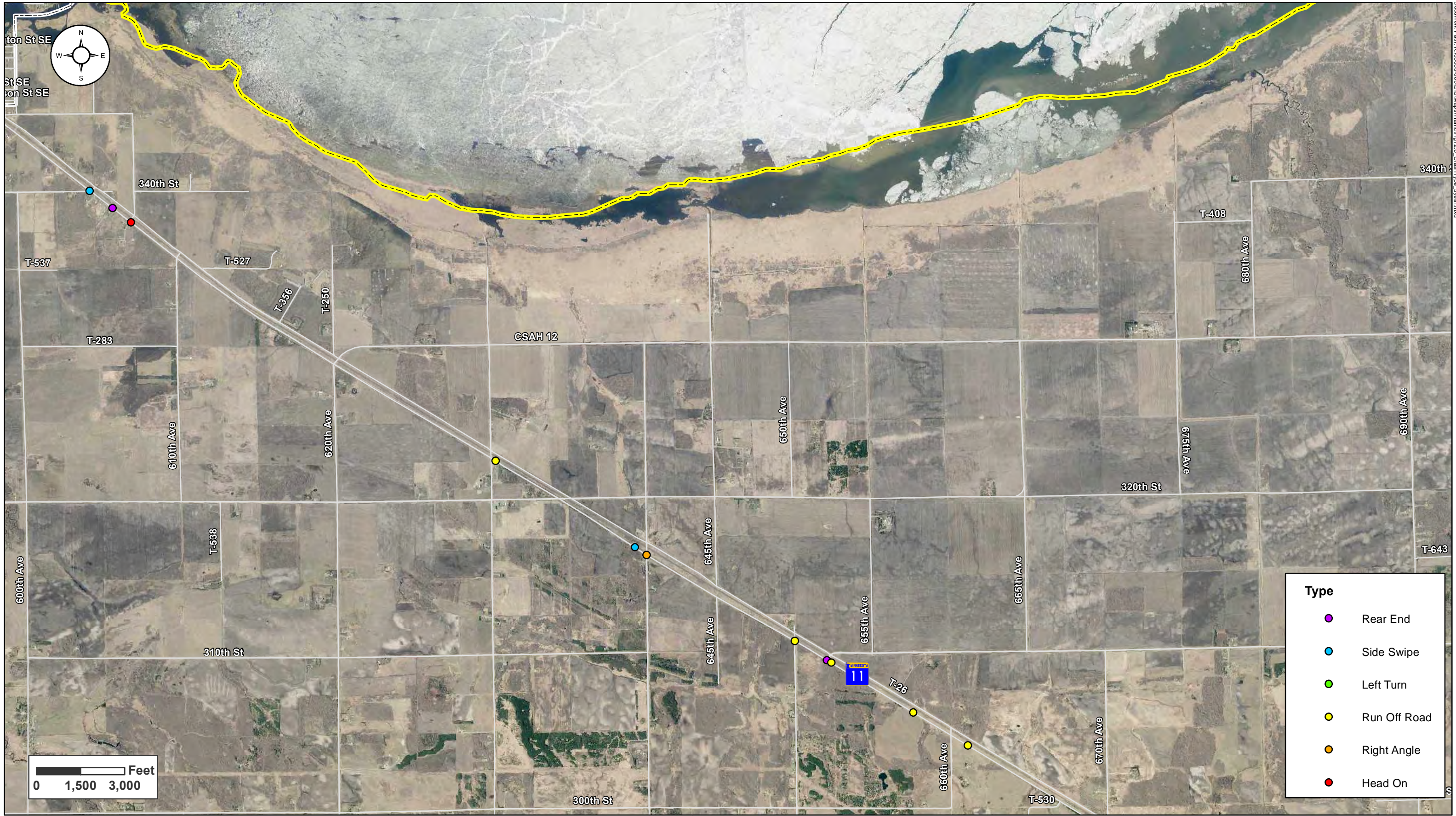


Figure 63 – Three-Year Type  
East of Warroad





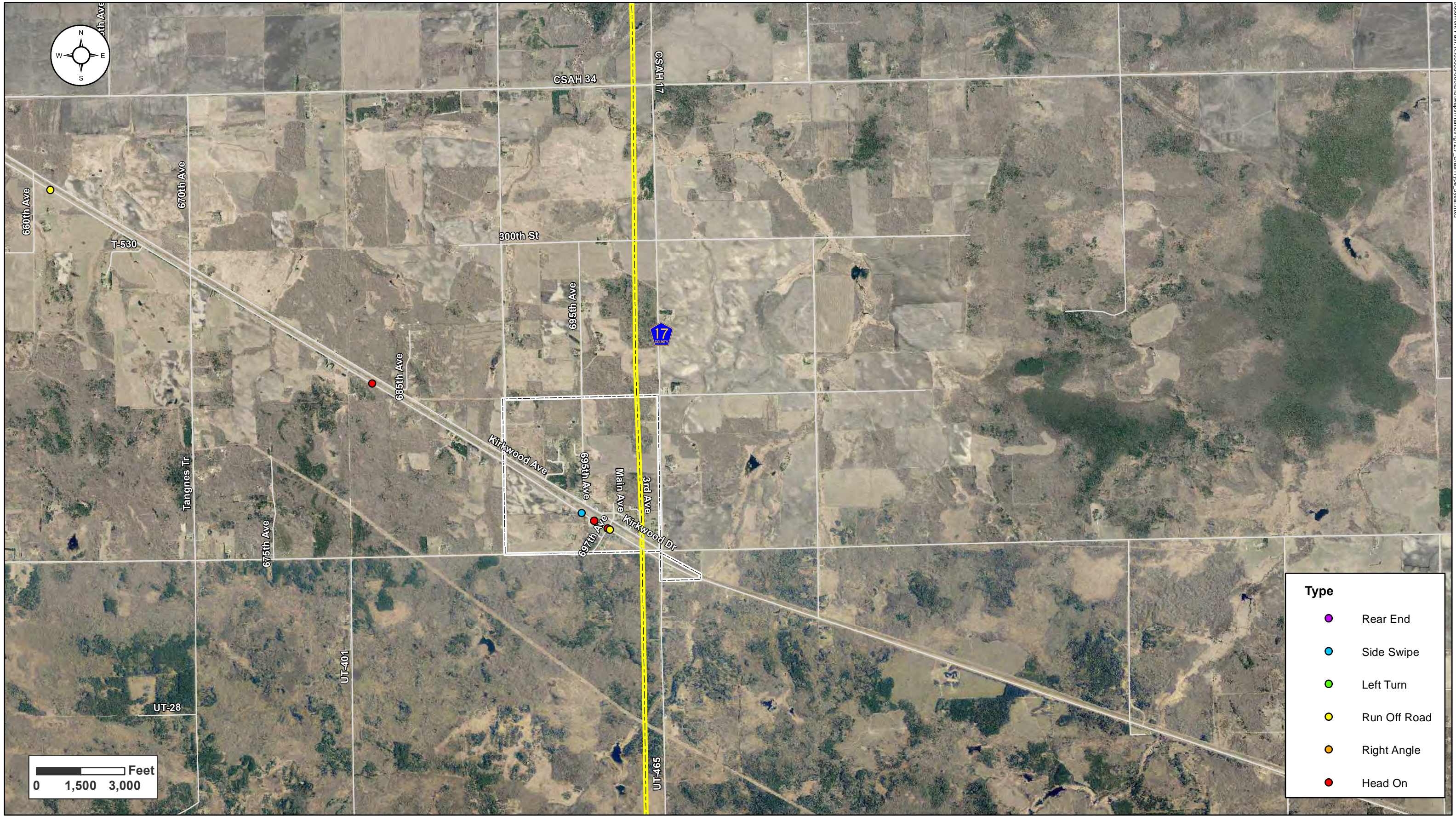


Figure 64 – Three-Year Type  
Roosevelt







Figure 65 – Ten-Year Type  
Greenbush







Figure 66 – Ten-Year Type  
Badger





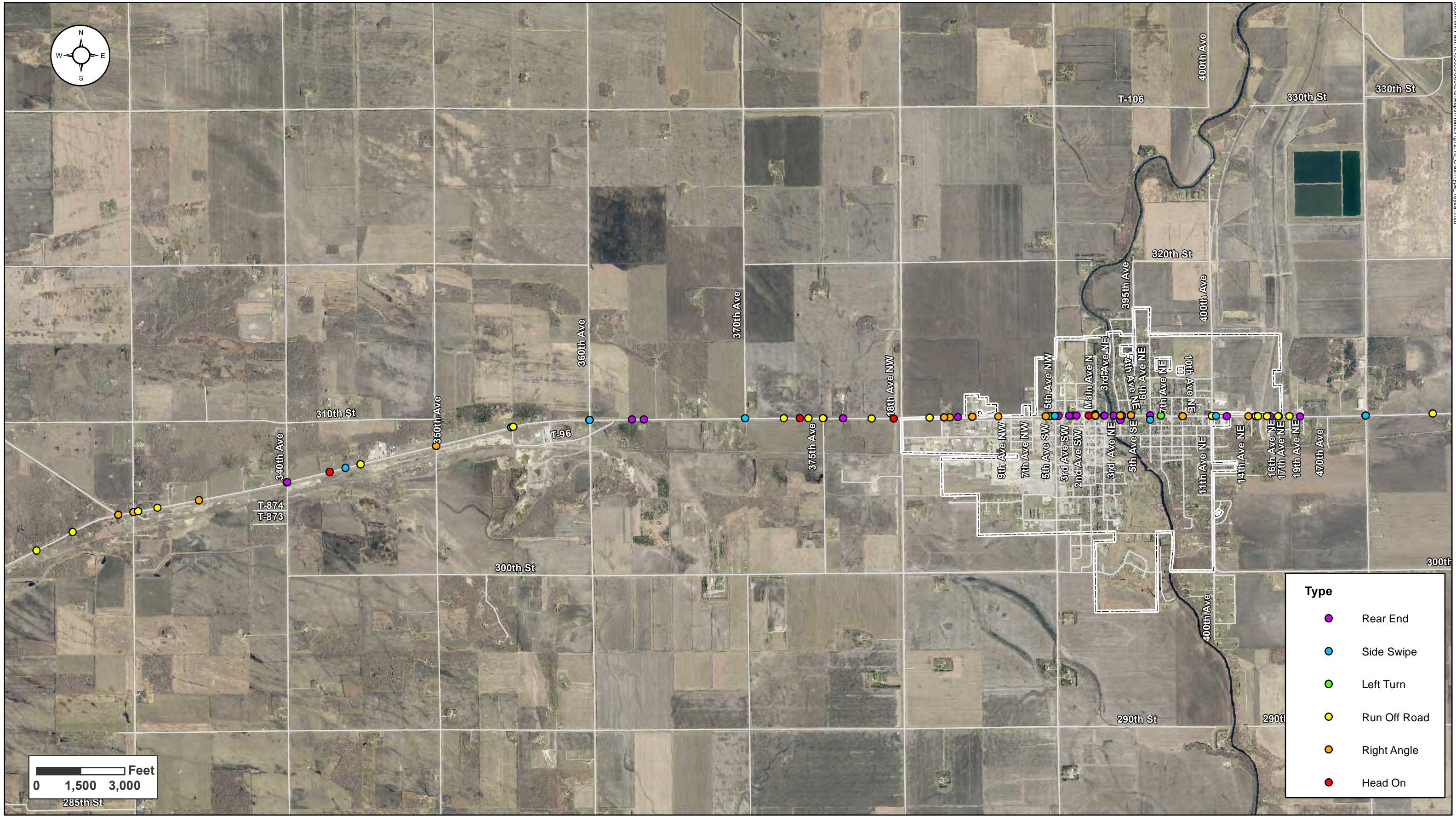
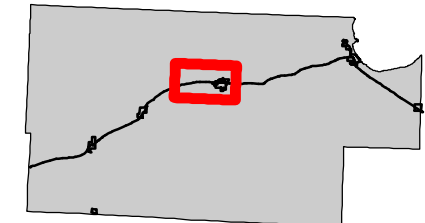


Figure 67 – Ten-Year Type  
Roseau





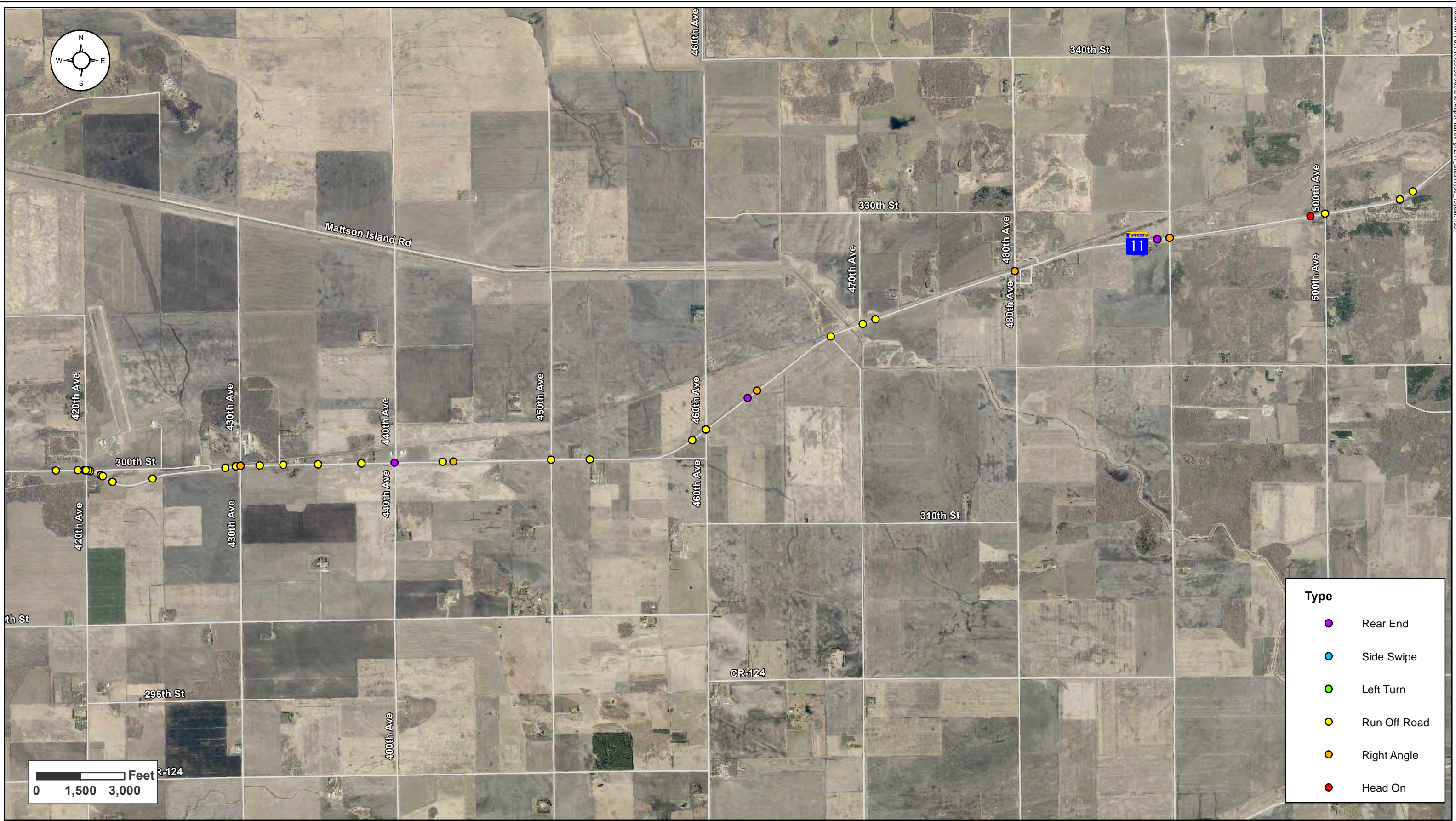


Figure 68 – Ten-Year Type  
Salol

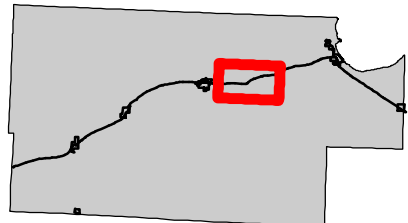






Figure 69 – Ten-Year Type  
Salol to Warroad





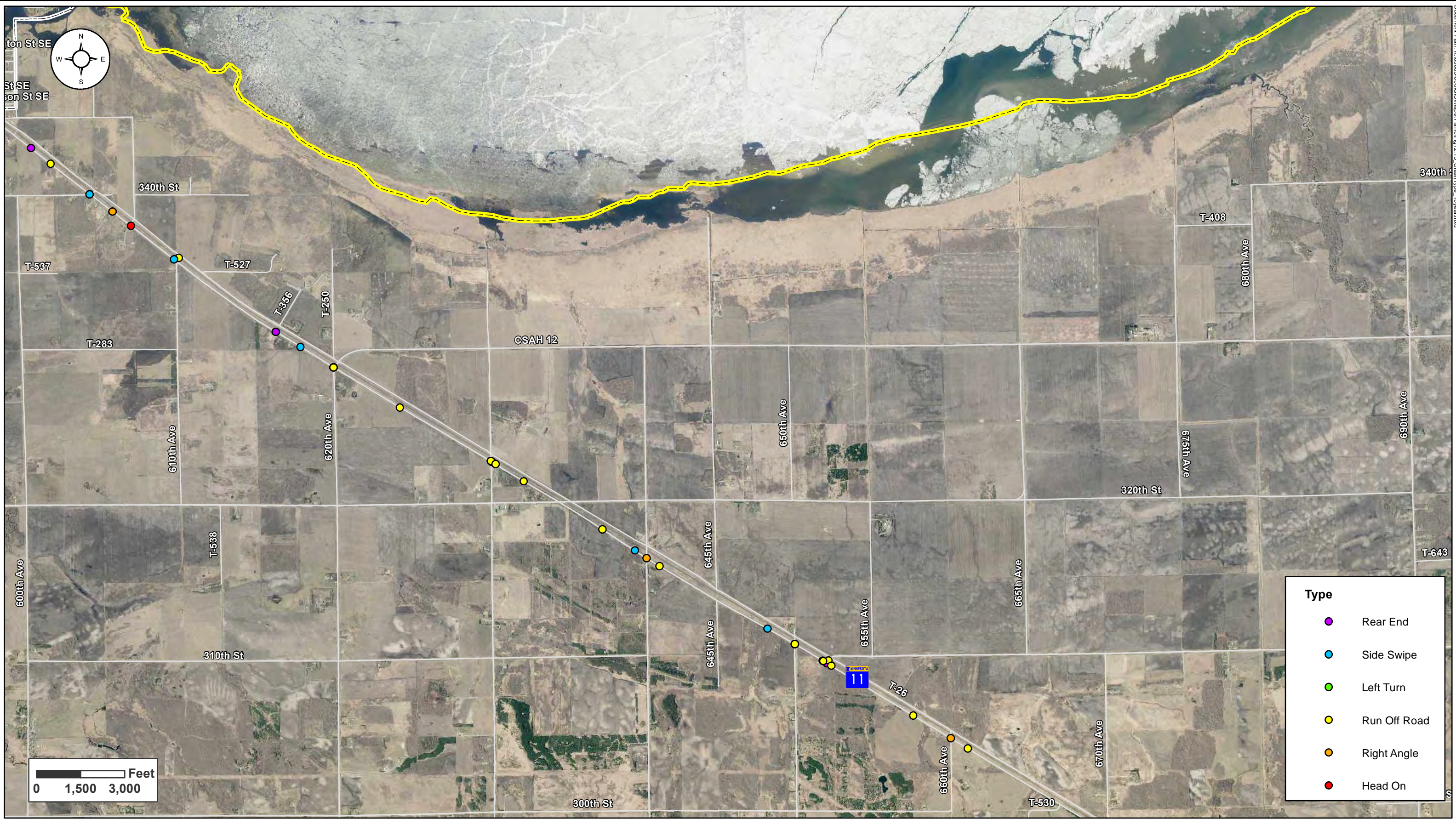
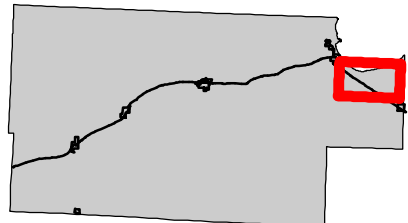


Figure 70 – Ten-Year Type  
East of Warroad





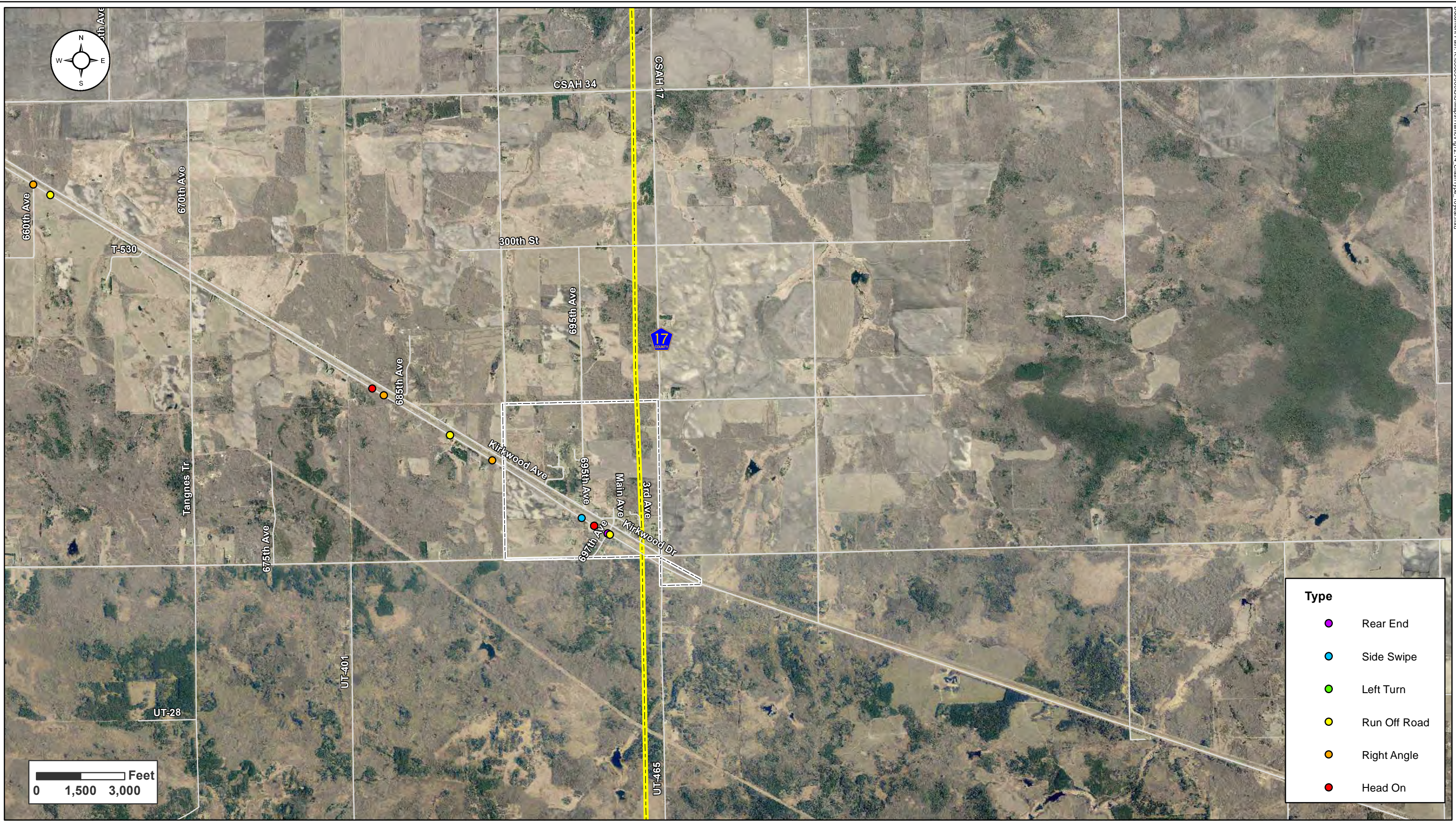


Figure 71 – Ten-Year Type  
Roosevelt





## Intersection Safety Analysis

Safety at intersections is an important consideration for MnDOT. The types of crashes that are occurring can suggest the need for changes to traffic control, geometrics and capacity depending upon the types of crashes that occur.

Crashes were analyzed at intersections along the TH 11 project limits using 10-year and 3-year crash data. These crashes included were only the crashes that can be attributed to the operations of the intersection. Due to the large number of intersections along the corridor, attention was paid to intersections with 3 or more crashes over a 10-year period (22 intersections), then reevaluated for intersections with 2 or more crashes over the last 3-year period (7 intersections) to give more focus on recent crash history. The majority of the intersections along the corridor are rural and urban through/stop intersections, with four low-speed, high-volume signalized intersections. The number and severity of each crash for the intersections analyzed on TH 11 are provided in **Table 18** for 10-year data and **Table 19** for 3-year data.

To better understand why crashes may be occurring or why a particular intersection may have more crashes than other similar locations, the types of crashes were also analyzed. **Tables 18 and 19** list the types of crashes that occurred. As expected, crash types varied depending on the character of the intersection (facility type, traffic control, speed, sight distance, etc.).

As shown in the tables, there were two intersections with over 10 crashes during the 10-year period between January 1, 2005 and December 31, 2014. Those intersections included TH 11 and CSAH 2 (University Avenue) and TH 11 and TH 89/TH 310. The TH 89/TH 310 intersection had the most crashes with 13 and the CSAH 2 intersection had 12. Other intersections that experienced a number of crashes included Main Avenue (8 crashes), TH 313 (7 crashes), Lake Street NE (6 crashes) and CSAH 12 (5 crashes).

For the most recent three-year data, two intersections (CSAH 2 and TH 89/TH 31) had five crashes each, with the intersection at TH 89 having three crashes.

None of the intersections with multiple crashes (single crash locations were not included in the tables) resulted in a fatality or a Type A (incapacitating) injury.

also important to understand what the relative number of crashes at any intersection means. Generally, intersections with one crash over a three-year or ten-year period are considered relatively safe intersections – a single crash can be more of a fluke rather than a pattern or trend.

To get at how the intersection compares to other intersections, average crash and severity rates were calculated for intersections with two or more crashes for the most recent three years and for three or more crashes for the 10-year period. The average crash and severity rates shown in **Tables 20 and 21** were calculated using the crash data in **Tables 18 and 19**, and were used to determine how adequately an intersection was performing relative to other similar intersections at a statewide level.



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**Table 18 – Intersection Crashes by Type and Severity – Ten-Year History**

| Location   | Number of Crashes | Crash Severity Distribution <sup>(1)</sup> |   |   |   |   | Crash Type Distribution |            |           |              |             |            |         |       |
|--|-------------------|--|---|---|---|---|-------------------------|------------|-----------|--------------|-------------|------------|---------|-------|
|  |                   | K  | A | B | C | N | Rear End                | Side Swipe | Left Turn | Ran Off Road | Right Angle | Right Turn | Head On | Other |
| TH 11 and TH 32  | 4                 |  |   |   | 1 | 3 | 1                       | 1          |           |              | 1           |            | 1       |       |
| TH 11 and CSAH 2/University Ave                                | 12                |  |   |   | 3 | 9 |                         | 2          |           |              | 9           |            |         | 1     |
| TH 11 and TH 89  | 3                 |  |   |   | 1 | 2 |                         | 1          |           |              | 1           |            |         | 1     |
| TH 11 and 340th Ave  | 3                 |  |   | 1 | 2 |   | 3                       |            |           |              |             |            |         |       |
| TH 11 and 360th Ave  | 3                 |  |   |   |   | 3 | 1                       | 2          |           |              |             |            |         |       |
| TH 11 and 15th Ave   | 3                 |  |   | 1 |   | 2 |                         |            |           |              | 3           |            |         |       |
| TH 11 and Frontage Road West Access between 7th Ave & 15th Ave | 3                 |  |   |   | 1 | 2 |                         | 1          |           |              | 2           |            |         |       |
| TH 11 and TH 89/TH 310   | 13                |  |   | 1 | 3 | 9 |                         | 3          | 3         |              | 5           | 1          |         | 1     |
| TH 11 and Main Ave   | 8                 |  |   |   | 2 | 6 | 3                       |            | 1         |              | 3           | 1          |         |       |
| TH 11 and 3rd Ave  | 4                 |  |   |   | 2 | 2 |                         |            |           |              | 4           |            |         |       |
| TH 11 and 4th Ave  | 3                 |  |   |   |   | 3 | 1                       |            | 1         |              | 1           |            |         |       |
| TH 11 and 11th Ave   | 3                 |  |   |   |   | 3 |                         |            |           |              | 3           |            |         |       |
| TH 11 and CSAH 28  | 3                 |  |   | 1 | 1 | 1 | 2                       | 1          |           |              |             |            |         |       |
| TH 11 and CSAH 9   | 4                 |  |   | 1 |   | 3 |                         | 2          |           |              | 1           | 1          |         |       |
| TH 11 and CSAH 13  | 3                 |  |   |   | 1 | 2 | 1                       |            |           |              | 1           |            | 1       |       |
| TH 11 and Timberline Manufactured Home Park East Entrance      | 3                 |  |   | 2 |   | 1 | 1                       | 1          |           | 1            |             |            |         |       |
| TH 11 and TH 313   | 7                 |  |   | 2 | 2 | 3 | 1                       | 1          | 1         |              | 1           |            | 2       | 1     |
| TH 11 and Gladys St  | 3                 |  |   |   | 2 | 1 |                         |            | 1         |              |             |            |         | 2     |
| TH 11 and Lake St NW   | 4                 |  |   |   | 2 | 2 | 2                       |            | 2         |              |             |            |         |       |
| TH 11 and CSAH 74/Lake St NE                                   | 6                 |  |   |   | 1 | 5 | 4                       | 1          |           |              | 1           |            |         |       |
| TH 11 and CSAH 12  | 5                 |  |   | 1 | 3 | 1 |                         |            |           | 2            | 2           |            | 1       |       |
| TH 11 and CSAH 34  | 3                 |  |   | 2 |   | 1 | 1                       |            |           | 1            |             |            |         | 1     |

(1) K = Fatality; A = Incapacitating injury; B = Non-incapacitating injury; C = Possible injury; N = Property damage (no apparent injury).

**Table 19 – Intersection Crashes by Type and Severity – Three-Year History**

| Location                        | Number of Crashes | Crash Severity Distribution <sup>(1)</sup> |   |   |   |   | Crash Type Distribution |            |           |              |             |            |         |       |
|---------------------------------|-------------------|--|---|---|---|---|-------------------------|------------|-----------|--------------|-------------|------------|---------|-------|
|                                 |                   | K  | A | B | C | N | Rear End                | Side Swipe | Left Turn | Ran Off Road | Right Angle | Right Turn | Head On | Other |
| TH 11 and CSAH 2/University Ave | 5                 |  |   |   | 2 | 3 |                         |            |           |              | 5           |            |         |       |
| TH 11 and TH 89                 | 3                 |  |   |   | 1 | 2 |                         | 1          |           |              | 1           |            |         | 1     |
| TH 11 and TH 89/TH 310          | 5                 |  |   | 1 | 1 | 3 |                         |            | 1         |              | 2           | 1          |         | 1     |
| TH 11 and 3rd Ave               | 2                 |  |   |   | 1 | 1 |                         |            |           |              | 2           |            |         |       |
| TH 11 and 11th Ave              | 2                 |  |   |   |   | 2 |                         |            |           |              | 2           |            |         |       |
| TH 11 and CSAH 13               | 2                 |  |   |   |   | 2 |                         |            | 1         |              |             |            | 1       |       |
| TH 11 and CSAH 34               | 2                 |  |   | 1 |   | 1 | 1                       |            |           |              |             |            |         | 1     |

(1) K = Fatality; A = Incapacitating injury; B = Non-incapacitating injury; C = Possible injury; N = Property damage (no apparent injury).



## TH 11 Existing Traffic Characteristics

**Table 20 – Intersection Crash and Severity Rate Comparison – Ten-Year History**

| Location   | Number of Crashes | Daily Entering Vehicles | Crash Rate <sup>(1)</sup> |         |                         | Severity Rate |         | Notes   |
|--|-------------------|-------------------------|---------------------------|---------|-------------------------|---------------|---------|---------|
|  |                   |                         | Calculated                | Average | Critical <sup>(2)</sup> | Calculated    | Average |         |
| TH 11 and TH 32  | 4                 | 3,575                   | 0.31                      | 0.28    | 0.56                    | 0.38          | 0.47    | (3)     |
| TH 11 and CSAH 2/University Ave                                | 12                | 3,505                   | 0.94                      | 0.28    | 0.57                    | 1.17          | 0.47    | (3)     |
| TH 11 and TH 89  | 3                 | 3,288                   | 0.25                      | 0.28    | 0.58                    | 0.33          | 0.47    | (3)     |
| TH 11 and 340th Ave  | 3                 | 3,775                   | 0.22                      | 0.28    | 0.56                    | 0.51          | 0.47    | (3) (6) |
| TH 11 and 360th Ave  | 3                 | 3,863                   | 0.21                      | 0.28    | 0.55                    | 0.21          | 0.47    | (3) (6) |
| TH 11 and 15th Ave   | 3                 | 8,850                   | 0.09                      | 0.28    | 0.45                    | 0.15          | 0.47    | (3) (6) |
| TH 11 and Frontage Road West Access between 7th Ave & 15th Ave | 3                 | 9,100                   | 0.09                      | 0.28    | 0.45                    | 0.12          | 0.47    | (3) (6) |
| TH 11 and TH 89/TH 310   | 13                | 12,075                  | 0.29                      | 0.48    | 0.67                    | 0.41          | 0.70    | (4)     |
| TH 11 and Main Ave   | 8                 | 9,085                   | 0.24                      | 0.48    | 0.70                    | 0.30          | 0.70    | (4) (6) |
| TH 11 and 3rd Ave  | 4                 | 6,800                   | 0.16                      | 0.20    | 0.37                    | 0.24          | 0.30    | (5) (6) |
| TH 11 and 4th Ave  | 3                 | 7,050                   | 0.12                      | 0.20    | 0.37                    | 0.12          | 0.30    | (5) (6) |
| TH 11 and 11th Ave   | 3                 | 6,000                   | 0.14                      | 0.20    | 0.38                    | 0.14          | 0.30    | (5) (6) |
| TH 11 and CSAH 28  | 3                 | 4,520                   | 0.18                      | 0.28    | 0.53                    | 0.36          | 0.47    | (3)     |
| TH 11 and CSAH 9   | 4                 | 4,230                   | 0.26                      | 0.28    | 0.54                    | 0.39          | 0.47    | (3) (6) |
| TH 11 and CSAH 13  | 3                 | 4,068                   | 0.20                      | 0.28    | 0.54                    | 0.27          | 0.47    | (3)     |
| TH 11 and Timberline Manufactured Home Park East Entrance      | 3                 | 4,025                   | 0.20                      | 0.28    | 0.55                    | 0.48          | 0.47    | (3) (6) |
| TH 11 and TH 313   | 7                 | 8,450                   | 0.23                      | 0.48    | 0.71                    | 0.42          | 0.70    | (4)     |
| TH 11 and Gladys St  | 3                 | 7,300                   | 0.11                      | 0.20    | 0.37                    | 0.19          | 0.30    | (5) (6) |
| TH 11 and Lake St NW   | 4                 | 7,500                   | 0.15                      | 0.20    | 0.36                    | 0.22          | 0.30    | (5) (6) |
| TH 11 and CSAH 74/Lake St NE                                   | 6                 | 10,300                  | 0.16                      | 0.48    | 0.68                    | 0.19          | 0.70    | (4)     |
| TH 11 and CSAH 12  | 5                 | 2,970                   | 0.46                      | 0.28    | 0.60                    | 0.92          | 0.47    | (3)     |
| TH 11 and CSAH 34  | 3                 | 1,660                   | 0.50                      | 0.28    | 0.72                    | 1.16          | 0.47    | (3)     |

(1) Intersection crash rates are expressed in crashes per million entering vehicles.

(2) Critical crash rates are expressed in crashes per million entering vehicles with 0.95 confidence level.

(3) Average crash and severity rates are from MnDOT 2013 green sheets for rural through-stop intersections.

(4) Average crash and severity rates are from MnDOT 2013 green sheets for high-volume, low-speed signalized intersections using.

(5) Average crash and severity rates are from MnDOT 2013 green sheets for urban through-stop intersections.

(6) AADT used to determine daily entering vehicles estimated using engineering judgement for one or both minor approaches when no MnDOT AADT available.

**Table 21 – Intersection Crash and Severity Rate Comparison – Three-Year History**

| Location                        | Number of Crashes | Daily Entering Vehicles | Crash Rate <sup>(1)</sup> |         |                         | Severity Rate |         | Notes   |
|---------------------------------|-------------------|-------------------------|---------------------------|---------|-------------------------|---------------|---------|---------|
|                                 |                   |                         | Calculated                | Average | Critical <sup>(2)</sup> | Calculated    | Average |         |
| TH 11 and CSAH 2/University Ave | 5                 | 3,505                   | 1.30                      | 0.25    | 0.80                    | 1.82          | 0.41    | (3)     |
| TH 11 and TH 89                 | 3                 | 3,288                   | 0.83                      | 0.25    | 0.82                    | 1.11          | 0.41    | (3)     |
| TH 11 and TH 89/TH 310          | 5                 | 12,075                  | 0.38                      | 0.69    | 1.10                    | 0.61          | 0.96    | (4)     |
| TH 11 and 3rd Ave               | 2                 | 6,800                   | 0.27                      | 0.18    | 0.50                    | 0.40          | 0.26    | (5) (6) |
| TH 11 and 11th Ave              | 2                 | 6,000                   | 0.30                      | 0.18    | 0.53                    | 0.30          | 0.26    | (5) (6) |
| TH 11 and TH 313                | 2                 | 8,450                   | 0.22                      | 0.69    | 1.19                    | 0.22          | 0.96    | (4)     |
| TH 11 and CSAH 34               | 2                 | 1,660                   | 1.10                      | 0.25    | 1.13                    | 2.20          | 0.41    | (3)     |

(1) Intersection crash rates are expressed in crashes per million entering vehicles.

(2) Critical crash rates are expressed in crashes per million entering vehicles with 0.95 confidence level.

(3) Average crash and severity rates are from MnDOT 2013 green sheets for rural through-stop intersections.

(4) Average crash and severity rates are from MnDOT 2013 green sheets for high-volume, low-speed signalized intersections using.

(5) Average crash and severity rates are from MnDOT 2013 green sheets for urban through-stop intersections.

(6) AADT used to determine daily entering vehicles estimated using engineering judgement for one or both minor approaches when no MnDOT AADT available.



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The average crash rates for each intersection were used to calculate the critical crash rate for each intersection. The critical crash rate for an intersection is derived from a formula which incorporates the average daily traffic and average crash rate for similar intersections statewide. The critical crash rate is a statistical analysis to determine whether crashes are random or if there is a statistically significant reason for crashes to be occurring at a particular location. If the intersection's crash rate is higher than the critical crash rate, the intersection is statistically proven to have a safety problem.

**Tables 20 and 21** provide a comparison between the calculated crash and severity rates and the corresponding average and critical rates. Values highlighted in yellow indicate that the crash or severity rate is higher than statewide average, and values highlighted in red indicate that the crash rate is higher than the calculated critical crash rate.

As included in the tables, two intersections for the most recent three-year period (CSAH 2 and TH 89 – west of Roseau) have calculated crash rates above the critical crash rate. Over the 10-year period, CSAH 2 remains as an intersection with a safety problem. Other intersections that had crash rates over the statewide average, but below critical crash rate thresholds (these intersections should continue to be monitored for additional crashes and potential improvements) included:

- TH 32 (10-year period)
- CSAH 12 (10-year period)
- CSAH 34 (10-year and three-year period)
- 3rd Avenue (three-year period)
- 11th Avenue (three-year period)

It should be noted that all of these intersections (with the exception of TH 32) also had severity rates above the statewide average.

Two intersections did not have crash rates above the statewide average, but did have severity rates above the statewide average. These intersections included 340th Avenue and the entrance to the Timberline manufactured home community.

More detail on the intersections identified above is provided in the following sections.

### **CSAH 2 (Badger) and TH 89 (West of Roseau) Intersections**

The intersections of most concern with regard to crash rates and severity include CSAH 2 and TH 89. CSAH 2 is located in the northern third of the City of Badger. This intersection is slightly off-set, meaning that the CSAH 2 approaches at TH 11 do not line up with one another – they are slightly off from one another. In addition, there are a number of driveways and local roadway connections that tie into CSAH 2 near its intersection with TH 11. This results in a lot of activity near the main intersection. Contributing to the severity rate is that a number of the crashes are right angle crashes, which tend to be more severe, especially in areas with posted speeds above 40 miles per hour.

At TH 89 (non-signalized intersection near TH 308 and 330th Avenue) the higher rate is likely attributed to lower traffic volumes on TH 89 and the offset nature of the intersection between TH 89 and the local roadway on the south side of the corridor. Intersections with lower traffic volumes tend to have a higher crash rate if multiple crashes occur at that specific location. Like the CSAH 2 intersection, there was a



## TH 11 Existing Traffic Characteristics

right angle crash at this location, which resulted in injuries. This increases the severity rate at the intersection as well. Weather was likely a factor in one of the crashes and failure to yield the right of way was a factor in another crash.

### **TH 32 (Greenbush)**

The intersection with TH 32 shows up as a problem in the 10-year history, but not in the most recent three-years. There were four crashes at the intersection, with three of them occurring before 2008. One of the crashes occurred in 2012. This intersection has good visibility, is relatively flat, and has a bypass lane for through traffic on TH 32. A review of the crashes indicates that weather was a factor in one of the crashes and that failure to yield the right of way was a factor in another. The remaining two crashes had no contributing factors.

### **CSAH 12 (Between Warroad and Roosevelt)**

Five crashes occurred at this intersection between 2007 and 2010. Two of the crashes included running off the road, two included right angle and one was a head on collision. Four of the five crashes resulted in an injury. The types of crashes that have occurred here, along with the injuries sustained, are factors that contribute to the severity rate at this intersection. It is almost double the statewide average.

This intersection is very skewed, with the intersecting legs of CSAH 12 not lining up with one another very well. The skew of the intersection is likely a contributing factor to the problems at this location.

### **CSAH 34 (Roosevelt)**

CSAH 34 is a problem intersection under both the ten-year and three-year timeframes. This intersection is at the eastern end of the corridor, close to Roosevelt. Three crashes have occurred at this location since 2008, with two of them in 2013. Two of the three crashes resulted in an injury, thus the elevated severity rate for the corridor. While the intersection is not above the critical crash rate for either period, it is almost at the critical crash rate for the past three-year period. Additionally, because the severity rate is over five times the state average, this intersection is considered to have a safety problem.

### **3rd Avenue (Roseau)**

There were four crashes at this intersection between 2010 and 2012, which has resulted in crash rates higher than the statewide average for both the three-year and 10-year timeframe. All of the crashes at this intersection were right angle crashes, with half the crashes resulting in an injury. This intersection is slightly skewed, which, along with large trees at the corner of 3rd Avenue on the south approach may impair a driver's ability to see oncoming traffic.

### **11th Avenue (Roseau)**

11th Avenue is at the edge of the urbanized area of Roseau on the eastern end of the community. Three crashes have occurred at this intersection, with two of them occurring in the past three years. All three crashes were right angle crashes. Because the speed is lower at this location, none of the crashes resulted in an injury. Areas on the fringe of a community can have higher crashes due to the transitional nature of speed limits, amount of development, driver expectations in terms of oncoming traffic and ability of drivers on side streets to perceive/identify speeds of oncoming traffic.



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### **340th Avenue (West of Roseau)**

340th Avenue does not have a high crash rate; three crashes have occurred at this location since 2007. However, all three crashes resulted in an injury. This is likely due to the fact that all three crashes were rear-end crashes at a high-speed location.

### **Timberline Manufactured Home Community (East of Salol)**

The entrance to Timberline had three crashes between 2009 and 2010. Like the intersection at 340th Avenue, this intersection does not have a high crash rate, but it does have a higher severity rate. Its severity rate is just above the statewide average. All three crashes that occurred at this location were of a different type, so there is no pattern or trend that was occurring other than that the crashes were more severe. The intersection is located on a curve which is likely influencing the crashes that occur in this location.