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# US 2 & ND 8 Signal Warrant Analysis

**Final Report** 

April 2010

Prepared for: North Dakota Department of Transportation

Prepared by: Advanced Traffic Analysis Center Upper Great Plains Transportation Institute North Dakota State University Fargo, North Dakota

# ENGINEERING CERTIFICATION

This document was originally issued and sealed by Jason P. Baker, Registration Number PE-6524, on 4/15/2010 and the original document is stored at the Advanced Traffic Analysis Center

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered Professional Engineer under the laws of the State of North Dakota.

Jason P. Baker, PE

April 15, 2010 Date

Name

### Background

The northwestern area of North Dakota has seen a significant increase in oil exploration and drilling activity over the past several years. Stanley, ND, is located in an area of heavy oil activity and is experiencing increased traffic volumes, especially truck volume. Concerns have been raised regarding the safety and operational efficiency of the intersection of US 2 & ND 8, which is located on the southeast side of Stanley, ND.

US Highway 2 is a four-lane divided highway which traverses the northern part of North Dakota. This highway is classified as a principal arterial and has a speed limit of 45 mph at the location of the intersection (Figure 1). The east and west approaches of the intersection have two through-lanes, and a right and left-turn lane. Traffic on US 2 is advised of the intersection by a yellow flashing beacon.



Figure 1. US 2 & ND 8 Intersection Geometry and Traffic Control

ND Highway 8 is a north-south two-lane minor arterial which intersects US 2. The approaches on ND-8 are controlled by a flashing beacon (two-way stop). The speed limit on the south side of the intersection is 55 mph, while on the north side it is posted at 35 mph. It should be noted that there are no turning lanes at either the north or south approaches of the intersection.

Although this intersection was examined by the North Dakota Department of Transportation (NDDOT) in 2008, a request was made to the Advanced Traffic Analysis Center (ATAC) to conduct a signal warrant analysis due to the current conditions. The signal warrant analysis consisted of collecting three days (12 hours each day) of traffic volumes at the intersection, and

applying the nine warrants specified in the 2009 Manual on Uniform Traffic Control Design (MUTCD). Other data were collected such as crash history, and projected traffic growth. In addition, ATAC staff met with city, county, and NDDOT staff about the intersection to obtain local perspectives and data related to the future growth based on oil activity.

#### Site Visit/Data Collection

Traffic data collection took place at the intersection on February 2 - 4, 2010 (Tuesday – Thursday). The traffic data collection involved the use of ATACs Traffic Data Collection System (TDCS), which consists of a 6 ft by 10 ft cargo trailer. The trailer houses a video processing unit, which controls two pan-tilt-zoom video cameras that can be mounted on the top of a 42ft pneumatic mast (also enclosed inside the trailer). The intersection was recorded by the TDCS, and manual counts were done at the intersection to expedite the post-processing of the video data. It should be noted that due to the environmental conditions (cold weather), the mast of the TDCS could not be extended. In addition, the cold weather caused some of the equipment to malfunction for a couple of hours on the first morning. Therefore manual data collection was conducted during that period until the equipment warmed up to an adequate operating temperature.

The three days of traffic data collected at the intersection were post-processed at the ATAC lab using Jamar counting boards (15-min. intervals) and the Petra software program. The 3, 12-hour traffic counts were averaged together to capture realistic traffic volumes and eliminate any unusual traffic patterns. The averaged volumes were entered into Petra for analysis. In addition to the traffic counts, crash data were received by the NDDOT, as well as a copy of the report from the study done in 2008.

A few truck-traffic generators are in the vicinity of the intersection of US 2 and ND 8. Two of the truck-traffic generators are located in the southeast quadrant of the intersection (Figure 2). The first is an oil storage and pipeline facility (truck terminal) owned by Hawthorn Oil, which pumps oil to a rail station approximately two miles northeast of Stanley. The second generator is also a truck terminal/oil storage and pumping facility which is owned by Enbridge. A third traffic generator is located approximately ¼ mile to the west of the intersection, and is a water pumping station which is used by trucks hauling water to the drilling rigs. Another oil pipeline pumping station and truck terminal owned by EOG is located approximately ½ mile to the south of the rail facility (northeast of Stanley), which is as close as oil trucks can get to the rail station. Therefore, all of the approaches of the intersection of US 2 and ND 8 experience a high amount of truck traffic.



Figure 2. Truck Traffic Generators in the Vicinity of US 2 & ND 8

During the site visit, a few individuals (Mountrail County Planner, Stanley City Coordinator, and the Mayor of Stanley) were contacted to discuss the intersection operations and the projected traffic growth in the area for the next several years. There are plans for development to the south of Stanley (in the vicinity of the intersection) in the near future, which include industrial developments and a proposed temporary housing development for oil field workers. The County Planner, Donald Longmuir, referenced a presentation given by Lynn Helms, who is the Director of the North Dakota Department of Mineral Resources (DMR). The presentation gives statistics for projected oil development at various areas in western North Dakota. The presentation showed that the Stanley-Ray-Tioga area is expected to see 430 to 540 new oil wells per year for the next 11 to 14 years. Data obtained from the DMR database shows that the same approximate area has seen an average increase of about 75 wells drilled per year over the past five years. In addition, the estimated number of truck trips required to develop a well is approximately 1,000 to 1,200. This data shows that there will be a significant increase in truck traffic in the coming years.

#### **Traffic Data**

Historical traffic data is available from the NDDOT website, and was analyzed to observe traffic growth trends for the intersection of US 2 & ND 8. Table 1 illustrates the intersection traffic volumes from 2004 to 2008. Although the counts for 2009 are not yet available, a spike in the volumes can be seen for the 2008 data.

|      | near train |          |        |          |        |          |
|------|------------|----------|--------|----------|--------|----------|
|      | A          | ADT      | Т      | rucks    | C      | Cars     |
| Year | Volume     | % Growth | Volume | % Growth | Volume | % Growth |
| 2004 | 3,300      | -4%      | 400    | -23%     | 2,900  | 0%       |
| 2005 | 3,295      | 0%       | 470    | -18%     | 2,825  | -3%      |
| 2006 | 3,295      | 0%       | 470    | 0%       | 2,825  | 0%       |
| 2007 | 3,240      | -2%      | 410    | -13%     | 2,830  | 0%       |
| 2008 | 6,805      | 110%     | 1,225  | 199%     | 5,580  | 97%      |

Table 1. Historical Traffic Volumes for the Intersection of US 2 & ND 8

Note: The AADT is based on the combined counts from the south and east sides of the intersection.

The traffic data collected by ATAC at the intersection of US 2 and ND 8 were similar to the 2008 traffic volume. The total traffic volume recorded at the intersection during the 2008 12-hour count was 5,443 vehicles. This value is approximately 6% higher than the 12-hour count from 2010 (5,094), which illustrates that the traffic volumes at the intersection have remained relatively stable since the previous study. Table 2 shows a summary of the 2010 traffic data collected by ATAC (note Appendix A for details).

Table 2. 2010 Average 12-Hour Intersection Turning-Movement Volumes

| 0                  | <u> </u> |         |
|--------------------|----------|---------|
| Vehicle Group      | Volume   | Percent |
| Passenger Cars     | 3,690    | 72%     |
| Single-Unit Trucks | 459      | 9%      |
| Semi-Trailers      | 945      | 19%     |
| Truck Totals       | 1,404    | 28%     |
| Total Volume       | 5,094    | -       |

Note: Passenger cars included cars and pickups (including service pickups with dualwheels).

The traffic volume data showed a significant amount of truck volumes for the intersection. The distribution of the truck traffic is illustrated in Figure 3. Although it was difficult to determine the cargo of the trucks, a majority of the trucks were tankers, which appeared to be involved in oilfield activity.



Figure 3. Truck percentages at the intersection of US 2 & ND 8

### **Signal Warrant Criteria**

Intersection traffic control is determined by considering a number of factors, such as traffic volume, vehicle crashes, pedestrian activity, etc. It is a popular misconception that the installation of a traffic signal will always improve the operation of an intersection. The most common arguments for the placement of a traffic signal are safety and delay. Traffic signals can reduce the number of right-angle and left-turn crashes, but in many cases the number of rear-end crashes increase. In addition, an un-warranted signal may actually increase the overall delay at an intersection.

The MUTCD, which is developed by the Federal Highway Administration (FHWA), serves as the standard for justifying the installation of traffic signals. The MUTCD specifies that an engineering study of the traffic conditions, pedestrian movements, and physical characteristics of an intersection be performed based on nine factors pertaining to the existing operation and safety of an intersection. These nine factors (warrants) are listed as follows:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network
- Warrant 9: Intersection Near a Grade Crossing

At least one warrant needs to be satisfied to justify installing a traffic signal, but there is a caveat in the MUTCD guidelines which states that the satisfaction of a traffic signal warrant or warrants

shall not in itself require the installation of a traffic control signal. The MUTCD does not present the warrant criteria as absolutes. Many sections of the MUTCD refer to engineering judgment and how the traffic and intersection data are interpreted. As a result, along with the warrants, the MUTCD provides additional guidance on traffic signal installations, such as:

- 1) Traffic control signals should not be installed unless one or more of the warrants are met,
- Traffic control signals should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection, and
- 3) Traffic control signals should not be installed if they will seriously disrupt progressive traffic flow.

### Crash Data Summary

Crash data collected from the intersection were obtained from the NDDOT (Appendix B). The crash data for this intersection illustrates that a majority of the documented crashes are right-angle crashes resulting from northbound and southbound vehicles crossing US 2. A summary of the applicable crash data for the past three years can be seen in Table 3. It should be noted that there were a total of five reported crashes at the intersection in 2009, but two of them were unrelated to the intersection control (non-collision crashes).

| Date       | Direction of instigating vehicle | Туре        |
|------------|----------------------------------|-------------|
| 3/16/2009  | Northbound                       | Right Angle |
| 5/22/2009  | Southbound                       | Right Angle |
| 12/16/2009 | Southbound                       | Right Angle |
| 3/3/2008   | Southbound                       | Right Angle |
| 3/20/2008* | Northbound                       | Right Angle |
| 8/21/2008  | Southbound                       | Right Angle |
| 9/10/2008  | Northbound                       | Right Angle |
| 9/24/2008  | Northbound                       | Right Angle |
| 10/24/2007 | Northbound                       | Right Angle |
| 11/8/2007  | Northbound                       | Right Angle |
| 12/21/2007 | Southbound                       | Right Angle |

Table 3. Relevant Crash Data for the Intersection of US 2 & ND 8

\*Fatal Crash

### **Signal Warrant Analysis**

The traffic signal warrant analysis was conducted as specified in Chapter 4C of the 2009 MUTCD. As mentioned previously, nine warrants are considered when evaluating the placement of a traffic signal at an intersection. However, of the nine warrants, only four were applicable for this intersection (Warrant 1, Warrant 2, Warrant 7, and Warrant 8).

Due to the lack of pedestrian movements at this intersection, Warrants 4 and 5 were not applicable for this evaluation. In addition, Warrants 6 and 9 were not applicable due to the isolated nature of this intersection. Warrant 3, which deals with peak-hour traffic, was not applicable for this intersection. This warrant can only be applied in certain situations where large amounts of traffic are attracted or discharged over a short time period. Typically this type

of traffic behavior is seen at office complexes, commercial facilities, and industrial developments.

Based on the 2010 traffic data, none of the signal warrants were met for the intersection of US 2 & ND 8 (see Appendix C for details). The following sections will discuss the requirements and results of the applicable warrants.

#### Warrant 1- Eight-Hour Vehicular Volume

Warrant 1 is intended for locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal, or where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. There are two conditions regarding Warrant 1 in the MUTCD which are outlined as follows (only one of them needs to be satisfied):

- A. At least 420 vehicles per hour (vph) on the major street (total of both approaches) for any 8 hours of an average day, and at least 105 vph on the highest-volume minor approach (for the same 8 hours).
- B. At least 630 vph on the major street (total of both approaches) for any 8 hours on an average day, and at least 53 vph on the highest-volume minor approach (for the same 8 hours).

For Condition A, the highest hourly volume for the major street (total of both approaches) was 274 vehicles, which is significantly lower than the minimum required volume of 420. The highest-volume minor-street approach volume was recorded as 131 vehicles. However, only 4 of the 8 highest-volume hours met the minimum required volume of 105 vph for the minor-street.

Although the minimum required minor-street volumes were met for Condition B, the major street volumes were significantly lower than the required volumes of 630. It should be noted that if neither Condition A nor Condition B are satisfied, a combination of both can be used. However, the minimum required major-street volume is 504 vph and the minimum required volume for the highest-volume minor street approach is 84 vph. Therefore, Warrant 1 is not satisfied under the current traffic volumes.

#### Warrant 2 – Four-Hour Vehicular Volume

Warrant 2 evaluates the 4-hour vehicle volume, and is intended to be applied at locations where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. This warrant requires plotting the points representing the vph on the major street (total of both approaches) and the corresponding vph on the highest-volume minor-street approach. All four points must fall above the applicable curve in Figure 4C-1 in the 2009 MUTCD for the warrant to be satisfied. Again due to the current traffic volumes, Warrant 2 is not satisfied.

#### Warrant 7 – Crash Experience

Warrant 7 pertains to crash data and was the closest warrant to being met during this analysis. Warrant 7 requires that three criteria be fulfilled in order to be met. Two of the criteria, (number of crashes in a 12-month time-period, and an adequate trial of remedial measures to reduce crashes e.g., flashing beacon), are met. The third, which relates to intersection volume, is not met. The minimum volume required on the major-street (US 2, total of both approaches) is 336 vph, however the highest recorded hourly volume was 268 vph. It should be noted that the minimum required volume for the highest-volume minor-street approach is 84 vph, which is satisfied by the current volumes (the 8 highest-hour minor-street approach volumes are equal-to or higher-than 84 vph).

#### Warrant 8 – Roadway Network

Warrant 8, which deals with the roadway network, has several criteria which must be met. Among these criteria are the following:

- A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or
- B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).

The current entering volume during the peak hour is 433 vehicles, which is significantly lower than the requirement of 1,000 vehicles per hour. Although traffic counts were not obtained for the weekend, it is reasonable to assume that the volumes do not increase by 600 vph for at least five hours of the day.

A difficult task for this study relates to estimating future traffic due to potential oil activity. Reasons for this occurrence includes the following:

- 1. It is difficult to accurately determine how the drilling rigs are moved from one location to the next, because it depends on several factors such as lease agreements, lease expiration dates, the competition among various drilling companies, etc.
- 2. The oil activity is heavily dependent on oil prices, which can fluctuate over time. If oil prices were to increase, the drilling activity would become more aggressive, and vice versa. This can potentially have a significant impact on the intersection operations.
- 3. Although the number of trips by oil tanker trucks will continue to grow cumulatively (as the number of producing oil wells increase), there will be spikes in the truck traffic due to the drilling activity. However, it is difficult to determine where the trucks are coming from and going to, specifically in reference to the truck terminals in the vicinity of the intersection of US 2 & ND 8. If the future oil well projections are correct, there could be an increase of 481% (74 to 430).

To evaluate the near-term traffic (2-5) years, the truck traffic was increased by 200% (which is 3 times the current traffic), and passenger cars were increased by 20%. This increased traffic volume data was used in Warrant 8 to determine if it would be met. Even with the increased traffic, a traffic signal warrant is not met. The projected traffic volumes were entered into Warrants 1, 2, and 3 as specified. Using the projected volumes, Warrant 1 was not met (only 6 of the 8 hours met the minimum required traffic volumes). Warrant 2 was not met with the projected volumes, having only 1 of the 4 highest-volume hours meeting the minimum required traffic volumes. Warrant 3 was not applicable for this intersection and was not evaluated for future traffic volumes.

#### Summary/Recommendations

A signal warrant analysis for the intersection of US 2 & ND 8 was conducted based on current (February 2010) traffic counts and crash data. The current conditions at this intersection do not warrant a traffic signal. However, the crash data and traffic volume should be monitored, especially if oil activity grows as projected.

Although the combination of crash history and traffic volume do not meet signal warrants, the number and type of crashes recorded at the intersection is cause for concern. It should be emphasized that although a signal is not currently warranted, several intersection control alternatives could be considered to improve traffic safety and operations. The intersection

analysis conducted by the NDDOT listed several alternatives to a traffic signal which have the potential to improve the safety of the intersection such as modifying the geometry of the intersection and implementing a J-turn intersection. Another alternative which may be considered for this intersection is the implementation of an all-way stop control.

As mentioned previously, accurately projecting traffic growth at this intersection is difficult due to the number of different variables which must be considered. A signal may be warranted at this intersection in the near future if traffic volumes increase at a significant rate. However, due to the similar traffic volumes between the 2008 and 2010 counts, it appears that the growth has slowed in the past couple years.

Appendix A: 2010 Traffic Count Data

North Dakota State University

US-2 & ND-8 Intersection Counts Stanley, ND 3-Day Average (2/2/10 - 2/4/10) Fargo, ND

|            |       |      |        |      | Gro        | oups Pi | rinted- | Passe  | nger ( | Cars - Ti  | ailers | - Sing | le Uni  | t Truc | ks         |       |      |        |      |            | 1          |
|------------|-------|------|--------|------|------------|---------|---------|--------|--------|------------|--------|--------|---------|--------|------------|-------|------|--------|------|------------|------------|
|            |       |      | ND8    |      |            |         | US2     |        |        |            |        | ND8    |         |        |            |       | US2  |        |      |            |            |
|            |       | So   | uthbou | ınd  |            |         | W       | estbou | nd     |            |        | No     | orthbou | und    |            |       | E    | astbou | nd   |            |            |
| Start Time | Right | Thru | Left   | Peds | App. Total | Right   | Thru    | Left   | Peds   | App. Total | Right  | Thru   | Left    | Peds   | App. Total | Right | Thru | Left   | Peds | App. Total | Int. Total |
| Factor     | 1.0   | 1.0  | 1.0    | 1.0  |            | 1.0     | 1.0     | 1.0    | 1.0    |            | 1.0    | 1.0    | 1.0     | 1.0    |            | 1.0   | 1.0  | 1.0    | 1.0  |            |            |
| 07:00 AM   | 3     | 9    | 4      | 0    | 16         | 13      | 16      | 4      | 0      | 33         | 1      | 7      | 4       | 0      | 12         | 15    | 11   | 8      | 0    | 34         | 95         |
| 07:15 AM   | 6     | 9    | 3      | 0    | 18         | 13      | 19      | 9      | 0      | 41         | 1      | 5      | 5       | 0      | 11         | 15    | 6    | 7      | 0    | 28         | 98         |
| 07:30 AM   | 7     | 7    | 4      | 0    | 18         | 9       | 23      | 5      | 0      | 37         | 0      | 9      | 3       | 0      | 12         | 11    | 10   | 6      | 0    | 27         | 94         |
| 07:45 AM   | 11    | 11   | 6      | 0    | 28         | 19      | 21      | 6      | 0      | 46         | 1      | 12     | 8       | 0      | 21         | 8     | 7    | 6      | 0    | 21         | 116        |
| Total      | 27    | 36   | 17     | 0    | 80         | 54      | 79      | 24     | 0      | 157        | 3      | 33     | 20      | 0      | 56         | 49    | 34   | 27     | 0    | 110        | 403        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 08:00 AM   | 8     | 10   | 5      | 0    | 23         | 12      | 23      | 8      | 0      | 43         | 1      | 8      | 4       | 0      | 13         | 6     | 9    | 10     | 0    | 25         | 104        |
| 08:15 AM   | 8     | 12   | 6      | 0    | 26         | 12      | 20      | 4      | 0      | 36         | 2      | 12     | 6       | 0      | 20         | 7     | 13   | 9      | 0    | 29         | 111        |
| 08:30 AM   | 7     | 8    | 6      | 0    | 21         | 10      | 17      | 4      | 0      | 31         | 1      | 11     | 3       | 0      | 15         | 15    | 12   | 9      | 0    | 36         | 103        |
| 08:45 AM   | 5     | 9    | 6      | 0    | 20         | 11      | 18      | 6      | 0      | 35         | 3      | 10     | 4       | 0      | 17         | 7     | 19   | 11     | 0    | 37         | 109        |
| Total      | 28    | 39   | 23     | 0    | 90         | 45      | 78      | 22     | 0      | 145        | 7      | 41     | 17      | 0      | 65         | 35    | 53   | 39     | 0    | 127        | 427        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 09:00 AM   | 5     | 7    | 6      | 0    | 18         | 6       | 20      | 3      | 0      | 29         | 3      | 9      | 3       | 0      | 15         | 7     | 18   | 9      | 0    | 34         | 96         |
| 09:15 AM   | 4     | 8    | 5      | 0    | 17         | 9       | 19      | 3      | 0      | 31         | 1      | 8      | 4       | 0      | 13         | 5     | 17   | 10     | 0    | 32         | 93         |
| 09:30 AM   | 8     | 11   | 5      | 0    | 24         | 0       | 18      | 2      | 0      | 20         | 2      | 11     | 6       | 0      | 19         | 6     | 15   | 7      | 0    | 28         | 91         |
| 09:45 AM   | 9     | 7    | 5      | 0    | 21         | 6       | 19      | 2      | 0      | 27         | 2      | 7      | 4       | 0      | 13         | 9     | 20   | 8      | 0    | 37         | 98         |
| Total      | 26    | 33   | 21     | 0    | 80         | 21      | 76      | 10     | 0      | 107        | 8      | 35     | 17      | 0      | 60         | 27    | 70   | 34     | 0    | 131        | 378        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 10:00 AM   | 5     | 12   | 5      | 0    | 22         | 4       | 15      | 3      | 0      | 22         | 4      | 9      | 4       | 0      | 17         | 8     | 19   | 12     | 0    | 39         | 100        |
| 10:15 AM   | 8     | 6    | 7      | 0    | 21         | 9       | 18      | 6      | 0      | 33         | 3      | 6      | 6       | 0      | 15         | 4     | 13   | 10     | 0    | 27         | 96         |
| 10:30 AM   | 8     | 8    | 4      | 0    | 20         | 5       | 10      | 7      | 0      | 22         | 3      | 7      | 5       | 0      | 15         | 6     | 19   | 11     | 0    | 36         | 93         |
| 10:45 AM   | 9     | 11   | 9      | 0    | 29         | 6       | 10      | 4      | 0      | 20         | 3      | 10     | 4       | 0      | 17         | 7     | 16   | 11     | 0    | 34         | 100        |
| Total      | 30    | 37   | 25     | 0    | 92         | 24      | 53      | 20     | 0      | 97         | 13     | 32     | 19      | 0      | 64         | 25    | 67   | 44     | 0    | 136        | 389        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 11:00 AM   | 4     | 9    | 10     | 0    | 23         | 5       | 16      | 4      | 0      | 25         | 3      | 11     | 5       | 0      | 19         | 7     | 19   | 7      | 0    | 33         | 100        |
| 11:15 AM   | 9     | 7    | 6      | 0    | 22         | 9       | 15      | 3      | 0      | 27         | 4      | 8      | 7       | 0      | 19         | 6     | 19   | 7      | 0    | 32         | 100        |
| 11:30 AM   | 10    | 7    | 9      | 0    | 26         | 4       | 13      | 4      | 0      | 21         | 3      | 8      | 5       | 0      | 16         | 9     | 24   | 8      | 0    | 41         | 104        |
| 11:45 AM   | 13    | 5    | 8      | 0    | 26         | 7       | 14      | 2      | 0      | 23         | 4      | 10     | 6       | 0      | 20         | 8     | 19   | 8      | 0    | 35         | 104        |
| Total      | 36    | 28   | 33     | 0    | 97         | 25      | 58      | 13     | 0      | 96         | 14     | 37     | 23      | 0      | 74         | 30    | 81   | 30     | 0    | 141        | 408        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 12:00 PM   | 9     | 12   | 6      | 0    | 27         | 3       | 9       | 0      | 0      | 12         | 2      | 15     | 8       | 0      | 25         | 5     | 17   | 8      | 0    | 30         | 94         |
| 12:15 PM   | 10    | 10   | 7      | 0    | 27         | 6       | 14      | 2      | 0      | 22         | 3      | 12     | 5       | 0      | 20         | 9     | 12   | 7      | 0    | 28         | 97         |
| 12:30 PM   | 11    | 12   | 5      | 0    | 28         | 7       | 10      | 2      | 0      | 19         | 4      | 16     | 9       | 0      | 29         | 7     | 17   | 11     | 0    | 35         | 111        |
| 12:45 PM   | 8     | 11   | 8      | 0    | 27         | 6       | 10      | 2      | 0      | 18         | 4      | 8      | 4       | 0      | 16         | 9     | 16   | 7      | 0    | 32         | 93         |
| Total      | 38    | 45   | 26     | 0    | 109        | 22      | 43      | 6      | 0      | 71         | 13     | 51     | 26      | 0      | 90         | 30    | 62   | 33     | 0    | 125        | 395        |
|            |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 01:00 PM   | 13    | 11   | 6      | 0    | 30         | 6       | 16      | 5      | 0      | 27         | 2      | 12     | 10      | 0      | 24         | 8     | 15   | 8      | 0    | 31         | 112        |
| 01:15 PM   | 6     | 14   | 7      | 0    | 27         | 4       | 15      | 3      | 0      | 22         | 3      | 8      | 6       | 0      | 17         | 6     | 15   | 6      | 0    | 27         | 93         |
| 01:30 PM   | 8     | 10   | 6      | 0    | 24         | 5       | 20      | 2      | 0      | 27         | 6      | 7      | 6       | 0      | 19         | 8     | 21   | 6      | 0    | 35         | 105        |
| 01:45 PM   | 10    | 13   | 6      | 0    | 29         | 5       | 16      | 2      | 0      | 23         | 5      | 10     | 11      | 0      | 26         | 9     | 13   | 6      | 0    | 28         | 106        |
| Total      | 37    | 48   | 25     | 0    | 110        | 20      | 67      | 12     | 0      | 99         | 16     | 37     | 33      | 0      | 86         | 31    | 64   | 26     | 0    | 121        | 416        |

North Dakota State University

Fargo, ND

|                      |       |      |        |      | Gro        | oups Pr | rinted- | Passe  | nger ( | Cars - Ti  | ailers | - Sing | le Uni  | t Truc | ks         |       |      |        |      |            | -          |
|----------------------|-------|------|--------|------|------------|---------|---------|--------|--------|------------|--------|--------|---------|--------|------------|-------|------|--------|------|------------|------------|
|                      |       |      | ND8    |      |            |         | US2     |        |        |            |        | ND8    |         |        |            |       | US2  |        |      |            |            |
|                      |       | So   | uthbou | ınd  |            |         | W       | estbou | nd     |            |        | No     | orthbou | ınd    |            |       | Ea   | istbou | nd   |            |            |
| Start Time           | Right | Thru | Left   | Peds | App. Total | Right   | Thru    | Left   | Peds   | App. Total | Right  | Thru   | Left    | Peds   | App. Total | Right | Thru | Left   | Peds | App. Total | Int. Total |
| Factor               | 1.0   | 1.0  | 1.0    | 1.0  |            | 1.0     | 1.0     | 1.0    | 1.0    |            | 1.0    | 1.0    | 1.0     | 1.0    |            | 1.0   | 1.0  | 1.0    | 1.0  |            |            |
| 02:00 PM             | 11    | 10   | 9      | 0    | 30         | 5       | 18      | 3      | 0      | 26         | 4      | 8      | 11      | 0      | 23         | 8     | 18   | 7      | 0    | 33         | 112        |
| 02:15 PM             | 8     | 8    | 6      | 0    | 22         | 6       | 14      | 3      | 0      | 23         | 2      | 9      | 8       | 0      | 19         | 9     | 15   | 7      | 0    | 31         | 95         |
| 02:30 PM             | 8     | 8    | 7      | 0    | 23         | 4       | 17      | 4      | 0      | 25         | 2      | 11     | 6       | 0      | 19         | 7     | 20   | 7      | 0    | 34         | 101        |
| 02:45 PM             | 9     | 9    | 8      | 0    | 26         | 6       | 16      | 2      | 0      | 24         | 4      | 9      | 5       | 0      | 18         | 6     | 22   | 5      | 0    | 33         | 101        |
| Total                | 36    | 35   | 30     | 0    | 101        | 21      | 65      | 12     | 0      | 98         | 12     | 37     | 30      | 0      | 79         | 30    | 75   | 26     | 0    | 131        | 409        |
|                      |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 03:00 PM             | 8     | 7    | 11     | 0    | 26         | 10      | 18      | 2      | 0      | 30         | 2      | 9      | 7       | 0      | 18         | 8     | 24   | 7      | 0    | 39         | 113        |
| 03:15 PM             | 13    | 12   | 11     | 0    | 36         | 5       | 16      | 3      | 0      | 24         | 3      | 10     | 7       | 0      | 20         | 8     | 22   | 6      | 0    | 36         | 116        |
| 03:30 PM             | 7     | 7    | 10     | 0    | 24         | 7       | 13      | 2      | 0      | 22         | 3      | 11     | 7       | 0      | 21         | 9     | 25   | 6      | 0    | 40         | 107        |
| 03:45 PM             | 7     | 12   | 13     | 0    | 32         | 7       | 16      | 2      | 0      | 25         | 5      | 10     | 6       | 0      | 21         | 8     | 22   | 8      | 0    | 38         | 116        |
| Total                | 35    | 38   | 45     | 0    | 118        | 29      | 63      | 9      | 0      | 101        | 13     | 40     | 27      | 0      | 80         | 33    | 93   | 27     | 0    | 153        | 452        |
|                      |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 04:00 PM             | 10    | 14   | 10     | 0    | 34         | 8       | 15      | 4      | 0      | 27         | 4      | 14     | 9       | 0      | 27         | 7     | 28   | 7      | 0    | 42         | 130        |
| 04:15 PM             | 11    | 10   | 11     | 0    | 32         | 4       | 17      | 3      | 0      | 24         | 3      | 8      | 9       | 0      | 20         | 6     | 25   | 7      | 0    | 38         | 114        |
| 04:30 PM             | 13    | 13   | 14     | 0    | 40         | 6       | 20      | 2      | 0      | 28         | 4      | 13     | 7       | 0      | 24         | 8     | 26   | 7      | 0    | 41         | 133        |
| 04:45 PM             | 8     | 9    | 9      | 0    | 26         | 5       | 24      | 2      | 0      | 31         | 4      | 11     | 7       | 0      | 22         | 6     | 25   | 7      | 0    | 38         | 117        |
| Total                | 42    | 46   | 44     | 0    | 132        | 23      | 76      | 11     | 0      | 110        | 15     | 46     | 32      | 0      | 93         | 27    | 104  | 28     | 0    | 159        | 494        |
|                      |       |      |        |      |            | ı       |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| 05:00 PM             | 8     | 9    | 14     | 0    | 31         | 9       | 18      | 4      | 0      | 31         | 9      | 17     | 11      | 0      | 37         | 7     | 25   | 5      | 0    | 37         | 136        |
| 05:15 PM             | 8     | 8    | 12     | 0    | 28         | 8       | 13      | 1      | 0      | 22         | 10     | 9      | 8       | 0      | 27         | 4     | 22   | 7      | 0    | 33         | 110        |
| 05:30 PM             | 12    | 7    | 8      | 0    | 27         | 6       | 17      | 2      | 0      | 25         | 12     | 13     | 10      | 0      | 35         | 5     | 23   | 8      | 0    | 36         | 123        |
| 05:45 PM             | 7     | 7    | 10     | 0    | 24         | 12      | 17      | 1      | 0      | 30         | 8      | 12     | 8       | 0      | 28         | 5     | 22   | 6      | 0    | 33         | 115        |
| Total                | 35    | 31   | 44     | 0    | 110        | 35      | 65      | 8      | 0      | 108        | 39     | 51     | 37      | 0      | 127        | 21    | 92   | 26     | 0    | 139        | 484        |
|                      | ι.    |      |        |      | • •        |         |         |        |        |            |        |        |         |        |            |       |      | _      |      |            |            |
| 06:00 PM             | 4     | 11   | 13     | 0    | 28         | 6       | 20      | 1      | 0      | 27         | 6      | 12     | 8       | 0      | 26         | 6     | 23   | 5      | 0    | 34         | 115        |
| 06:15 PM             | 8     | 9    | 9      | 0    | 26         | 5       | 21      | 4      | 0      | 30         | 5      | 12     | 11      | 0      | 28         | 4     | 24   | 6      | 0    | 34         | 118        |
| 06:30 PM             | 8     | 5    | 3      | 0    | 16         | 6       | 13      | 3      | 0      | 22         | 3      | 15     | 7       | 0      | 25         | 4     | 13   | 4      | 0    | 21         | 84         |
| 06:45 PM             | 6     | 4    | 7      | 0    | 17         | 5       | 16      | 4      | 0      | 25         | 4      | 15     | 13      | 0      | 32         | 4     | 16   | 6      | 0    | 26         | 100        |
| Total                | 26    | 29   | 32     | 0    | 87         | 22      | 70      | 12     | 0      | 104        | 18     | 54     | 39      | 0      | 111        | 18    | 76   | 21     | 0    | 115        | 417        |
|                      |       |      |        |      |            |         |         |        |        |            |        |        |         |        |            |       |      |        |      |            |            |
| Grand Total          | 396   | 445  | 365    | 0    | 1206       | 341     | 793     | 159    | 0      | 1293       | 171    | 494    | 320     | 0      | 985        | 356   | 871  | 361    | 0    | 1588       | 5072       |
| Apprch %             | 32.8  | 36.9 | 30.3   | 0    |            | 26.4    | 61.3    | 12.3   | 0      |            | 17.4   | 50.2   | 32.5    | 0      |            | 22.4  | 54.8 | 22.7   | 0    |            |            |
| Total %              | 7.8   | 8.8  | 7.2    | 0    | 23.8       | 6.7     | 15.6    | 3.1    | 0      | 25.5       | 3.4    | 9.7    | 6.3     | 0      | 19.4       | 7     | 17.2 | 7.1    | 0    | 31.3       | 2.000      |
| Passenger Cars       | 272   | 360  | 324    | 0    | 956        | 293     | 570     | 113    | 0      | 976        | 130    | 406    | 159     | 0      | 695        | 195   | 633  | 235    | 0    | 1063       | 3690       |
| % Passenger Cars     | 68.7  | 80.9 | 88.8   | 0    | 79.3       | 85.9    | 71.9    | 71.1   | 0      | 75.5       | 76     | 82.2   | 49.7    | 0      | 70.6       | 54.8  | 72.7 | 65.1   | 0    | 66.9       | 72.8       |
| Semi-Trailers        | 82    | 46   | 22     | 0    | 150        | 31      | 154     | 29     | 0      | 214        | 25     | 57     | 130     | 0      | 212        | 118   | 167  | 79     | 0    | 364        | 940        |
| % Semi-Trailers      | 20.7  | 10.3 | 6      | 0    | 12.4       | 9.1     | 19.4    | 18.2   | 0      | 16.6       | 14.6   | 11.5   | 40.6    | 0      | 21.5       | 33.1  | 19.2 | 21.9   | 0    | 22.9       | 18.5       |
| Single Unit Trucks   | 42    | 39   | 19     | 0    | 100        | 17      | 69      | 17     | 0      | 103        | 16     | 31     | 31      | 0      | 78         | 43    | 71   | 47     | 0    | 161        | 442        |
| % Single Unit Trucks | 10.6  | 8.8  | 5.2    | 0    | 8.3        | 5       | 8.7     | 10.7   | 0      | 8          | 9.4    | 6.3    | 9.7     | 0      | 7.9        | 12.1  | 8.2  | 13     | 0    | 10.1       | 8.7        |

North Dakota State University

Fargo, ND



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Fargo, ND

|               |         |         | ND8     |        |            |        | US2    |        |      |            |       | ND8  |        |      |            |       | US2  |        |      |            |            |
|---------------|---------|---------|---------|--------|------------|--------|--------|--------|------|------------|-------|------|--------|------|------------|-------|------|--------|------|------------|------------|
|               |         | So      | uthbou  | ind    |            |        | W      | estbou | ind  |            |       | No   | orthbo | und  |            |       | E    | astbou | nd   |            |            |
| Start Time    | Right   | Thru    | Left    | Peds   | App. Total | Right  | Thru   | Left   | Peds | App. Total | Right | Thru | Left   | Peds | App. Total | Right | Thru | Left   | Peds | App. Total | Int. Total |
| Peak Hour A   | nalysi  | s Fron  | n 07:00 | AM to  | 0 11:45    | AM -   | Peak 1 | of 1   |      |            |       |      |        |      |            |       |      |        |      |            |            |
| Peak Hour for | or Enti | re Inte | rsectio | n Begi | ns at 07   | :45 AI | М      |        |      |            |       |      |        |      |            |       |      |        |      |            |            |
| 07:45 AM      | 11      | 11      | 6       | Ō      | 28         | 19     | 21     | 6      | 0    | 46         | 1     | 12   | 8      | 0    | 21         | 8     | 7    | 6      | 0    | 21         | 116        |
| 08:00 AM      | 8       | 10      | 5       | 0      | 23         | 12     | 23     | 8      | 0    | 43         | 1     | 8    | 4      | 0    | 13         | 6     | 9    | 10     | 0    | 25         | 104        |
| 08:15 AM      | 8       | 12      | 6       | 0      | 26         | 12     | 20     | 4      | 0    | 36         | 2     | 12   | 6      | 0    | 20         | 7     | 13   | 9      | 0    | 29         | 111        |
| 08:30 AM      | 7       | 8       | 6       | 0      | 21         | 10     | 17     | 4      | 0    | 31         | 1     | 11   | 3      | 0    | 15         | 15    | 12   | 9      | 0    | 36         | 103        |
| Total Volume  | 34      | 41      | 23      | 0      | 98         | 53     | 81     | 22     | 0    | 156        | 5     | 43   | 21     | 0    | 69         | 36    | 41   | 34     | 0    | 111        | 434        |
| % App. Total  | 34.7    | 41.8    | 23.5    | 0      |            | 34     | 51.9   | 14.1   | 0    |            | 7.2   | 62.3 | 30.4   | 0    |            | 32.4  | 36.9 | 30.6   | 0    |            |            |
| PHF           | .773    | .854    | .958    | .000   | .875       | .697   | .880   | .688   | .000 | .848       | .625  | .896 | .656   | .000 | .821       | .600  | .788 | .850   | .000 | .771       | .935       |



North Dakota State University

Fargo, ND

|              |         |          | ND8     |        |            |        | US2    |        |      |            |       | ND8  |        |      |            |       | US2  |        |      |            | ]          |
|--------------|---------|----------|---------|--------|------------|--------|--------|--------|------|------------|-------|------|--------|------|------------|-------|------|--------|------|------------|------------|
|              |         | So       | uthbou  | ınd    |            |        | W      | estbou | ind  |            |       | No   | orthbo | und  |            |       | Ea   | astbou | nd   |            |            |
| Start Time   | Right   | Thru     | Left    | Peds   | App. Total | Right  | Thru   | Left   | Peds | App. Total | Right | Thru | Left   | Peds | App. Total | Right | Thru | Left   | Peds | App. Total | Int. Total |
| Peak Hour A  | nalysi  | s From   | 12:00   | PM to  | 06:45      | PM - F | Peak 1 | of 1   |      |            |       |      |        |      |            |       |      |        |      |            |            |
| Peak Hour fo | or Enti | re Inter | rsectio | n Begi | ns at 04   | :15 PN | Л      |        |      |            |       |      |        |      |            |       |      |        |      |            |            |
| 04:15 PM     | 11      | 10       | 11      | Õ      | 32         | 4      | 17     | 3      | 0    | 24         | 3     | 8    | 9      | 0    | 20         | 6     | 25   | 7      | 0    | 38         | 114        |
| 04:30 PM     | 13      | 13       | 14      | 0      | 40         | 6      | 20     | 2      | 0    | 28         | 4     | 13   | 7      | 0    | 24         | 8     | 26   | 7      | 0    | 41         | 133        |
| 04:45 PM     | 8       | 9        | 9       | 0      | 26         | 5      | 24     | 2      | 0    | 31         | 4     | 11   | 7      | 0    | 22         | 6     | 25   | 7      | 0    | 38         | 117        |
| 05:00 PM     | 8       | 9        | 14      | 0      | 31         | 9      | 18     | 4      | 0    | 31         | 9     | 17   | 11     | 0    | 37         | 7     | 25   | 5      | 0    | 37         | 136        |
| Total Volume | 40      | 41       | 48      | 0      | 129        | 24     | 79     | 11     | 0    | 114        | 20    | 49   | 34     | 0    | 103        | 27    | 101  | 26     | 0    | 154        | 500        |
| % App. Total | 31      | 31.8     | 37.2    | 0      |            | 21.1   | 69.3   | 9.6    | 0    |            | 19.4  | 47.6 | 33     | 0    |            | 17.5  | 65.6 | 16.9   | 0    |            |            |
| PHF          | .769    | .788     | .857    | .000   | .806       | .667   | .823   | .688   | .000 | .919       | .556  | .721 | .773   | .000 | .696       | .844  | .971 | .929   | .000 | .939       | .919       |



Appendix B: Crash Data

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| Page 1 of        | -                      |                         |            |          | 1  | •               | :   |                             |                                  |               |                   |               |   |               |
|------------------|------------------------|-------------------------|------------|----------|--|-----------------|---|-----------------------------|----------------------------------|---------------|-------------------|---------------|---|---------------|
| Project:<br>PCN: |                        |                         |            | ŝ        | Co<br>ocation Descrip<br>tudy Period (Da | unty:<br>ates): | Mountrail<br>US 2 RP 90.644 &<br>1-1-04 to 12-31-08 | ND 8 RP 155.962 (S          | Stanley)                         |               |                   |               | 23 USC 9 409 DC<br>NDDDT Reserves A   | ll Objections |
| Number           | Date                   | Lighting                | <b>Veh</b> |          | Lic: Addr                                | .8 <b>5</b> 8   | Alcohol / Drug                                      | Contributing                | Vehicle                          | Vehicle       | Traffic           | Manner of     |   |               |
| Work Zone        | Time                   | Weather<br>Surface Cond | #          | Age      | City                                     | State           | Involvement   | Factors                     | Config.                          | Direction     | Control           | Collision     | Comments  | Ulagram       |
| 127910           | 10/2/2006              | Daylight                | ; 5        | ្ខ       | F Battleview                             | ; B             | Neither Present                                     | Failed To Yield             | PU/Van/Utility                   | North         | Stop Sign         |               | The EB US 2 roadway was barricaded (under<br>construction), and E/W traffic was head to head on   | 2             |
| Yes WZ           | Monday<br>11:50 AM     | Dry                     | V2         | ä        | M Williston                              | Z               | Neither Present                                     | No Clear                    | Iruck Iractor                    | rast          | None              | Right Angle   | the WB roadway. Traffic on ND 8 could still travel<br>NRS through the intersection, and NB traffic had a<br>stop sign in what is normally the median. D1<br>stopped at the stop sign did not see V2 attempted | ,             |
| 132589           | 12/6/2006              | Daylight                | 1          | 33       | M Bismarck                               | B               | Neither Present                                     |                             | Psgr Car                         | West          | None              |               | D2 stopped at stop sign, attempted to   | >             |
| PDO<br>No WZ     | Wednesday<br>2:48 PM   | Clear<br>Ice / Snow     | V2         | 86       | M New Town                               | ND              | Neither Present                                     | Atten Distracted            | PU/Van/Utility                   | North         | Stop Sign         | Right Angle   | cross line US Z cb and Wb rodoways, and<br>was hit by V1.   | 2<br>1        |
| 148690           | 10/24/2007             | Daylight                | ۲V         | 24       | F Williston                              | ND              | Neither Present                                     | No Clear                    | PU/Van/Utility                   | West          | None              |               | D2 stopped at stop sign, proceeded into   | >             |
| PDO<br>No WZ     | Wednesday<br>6:45 PM   | Clear<br>Dry            | V2         | 14       | M Stanley                                | ND              | Neither Present                                     | Failed To Yield             | PU/Van/Utility                   | North         | Stop Sign         | Right Angle   | rrieurali, slowed in mediali, alterripted to cross the WB US 2 roadway, and was hit by V1.  | 2             |
| 150191           | 11/8/2007              | Daylight                | 5          | 36       | M Moorehead                              | MN              | Unknown   | Vision Obstructed           | Psgr Car                         | South         | Stop Sign         |               | D1 was travelling 10mph, did not see V2,  |               |
|                  | 4:30 PM                | Dry                     | V2         | 23       | M Culbertson                             | M               | Unknown   | No Clear                    | PU/Van/Utility                   | East          | None              | Right Angle   | roadways, and hit V2. D1 said the sun obstructed his vision of V2.  |               |
| 153597<br>InjB   | 12/21/2007<br>Friday   | Daylight<br>Snow        | 5 5        | 33<br>33 | M Sturgis<br>M Sidney                    | MT SD           | Neither Present<br>Neither Present                  | Vision Obstructed           | PU/Van/Utility<br>PU/Van/Utility | South         | Stop Sign<br>None |               | D1 attempted to cross the US 2 WB and EB roadways and hit V2.   | <u> </u>      |
| No WZ            | 12:45 PM               | Snow                    |            |          |  |                 |   |                             |                                  |               |                   | Kignt Angle   |   | 22 ↓          |
| 158551<br>InjB   | 3/3/2008<br>Monday     | Dark (Lighted)<br>Clear | S2 S       | 51<br>24 | M Glasgow<br>M Palermo                   | N M             | Neither Present<br>Neither Present                  | Atten Distracted            | Psgr Car<br>Psgr Car             | West<br>South | None<br>Stop Sign | ]             | V2 SB stopped at a stop sign, then not seeing V1 WB, continued on into the  |               |
| No WZ            | 8:19 PM                | Dıy                     |            |          |  |                 |   |                             |                                  |               |                   | alfire nifire | Intersection and was nit by v1.   |               |
| 158074<br>Fat    | 3/20/2008<br>Thursday  | Dark (Lighted)<br>Clear | 5 5        | 25<br>32 | M Mohall<br>M Moorhead                   | M N             | Unknown<br>Neither Present                          | Failed To Yield<br>Other    | PU/Van/Utility<br>Truck Tractor  | North         | Stop Sign<br>None |               | V1 NB ran a stop sign and hit V2.   | <b>→</b> ∠∼   |
| No WZ            | 5;55 AM                | Dry                     |            |          |  |                 |   |                             |                                  |               |                   | Right Angle   |   |               |
| 164940<br>InjB   | 8/21/2008<br>Thursday  | Daylight<br>Cloudy      | ≲ ≤        | 42<br>29 | M Bar Nunn<br>M Williston                | ₽Ş              | Neither Present<br>Neither Present                  | Failed To Yield<br>No Clear | PU/Van/Utility<br>Psgr Car       | South<br>East | None              |               | V1 stopped in the median and then proceeded to cross the EB lanes of US 2   | <u></u>       |
| No WZ            | 12:35 PM               | Dıy                     |            |          |  |                 |   |                             |                                  |               |                   | rigin Ange    | and struck V2. D1 stated ne though V2<br>was going to turn left.  |               |
| 165698<br>InjB   | 9/10/2008<br>Wednesday | Daylight<br>Rain        | 5 5        | 58<br>25 | M Beifield<br>M Berthold                 |                 | Neither Present<br>Neither Present                  | No Clear<br>Failed To Yield | PU/Van/Utility<br>PU/Van/Utility | West          | None<br>Stop Sign |               | V2 NB stopped at a stop sign, then not seeing V1 WB, continued on into the  |               |
| No WZ            | 7:08 PM                | Wet                     |            |          |  |                 |   |                             |                                  |               |                   | Kignt Angle j | Intersection and was hit by V1.   | <br>د بر      |
| 167541<br>PDO    | 9/24/2008<br>Wednesday | Daylight<br>Clear       | ≲ ≤        | 65<br>27 | M Faith<br>M Rolette                     | ND SD           | Neither Present<br>Neither Present                  | Vision Obstructed           | Truck Tractor<br>Truck Tractor   | North<br>West | Stop Sign<br>Nane |               | V1 NB stopped at a stop sign, then not seeing V2 WB, continued on into the  | ^ 2           |
| No WZ            | 9:20 AM                | Dıy                     |            |          |  |                 |   |                             |                                  |               |                   | Kigni Angie   | ntersection and hit V2. D1 said he couldn't see V2 because of the sun.  |               |

Crash Summary

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| Page 1 of 1      |                         |                   |            |       |         |                          | 2              | <u>-</u>   |                   |                                 |               |                   |                    |   |               |
|------------------|-------------------------|-------------------|------------|-------|---------|--------------------------|----------------|--|-------------------|---------------------------------|---------------|-------------------|--------------------|---|---------------|
| Project:<br>PCN: |                         |                   |            | ŝĽ    | ocatio  | on Descrip<br>Period (Da | tion:<br>tes): | stanley<br>US Hwy 2 & ND Hw<br>1-1-09 to12-31-09 | ry 8 Intersection |                                 |               |                   |                    | NDDOT Reserves A  | II Objections |
| Number           | Date                    | Lighting          | V2F        |       |         | Lic. Addr                | ess            |  | Contribution      | Vahiala                         | Vationa       | T soldio          | Monnorof           |   |               |
| Severity         | Day                     | Weather           | # Yen      | Age   | Sex     | Citv                     | State          | Involvement                                      | Factors           | Confia.                         | Direction     | Control           | Collision          | Comments  | Diagra        |
| Vork Zone        | Time                    | Surface Cond      | 4          |       |         | City                     | State          |  | Factors           | Colling.                        |               |                   | Collision          |   |               |
| 177400<br>PDO    | 2/16/2009<br>Mondav     | Daylight<br>Snow  | 4          | 35    | Z       | Berthold                 | ND             | Neither Present                                  | No Clear          | PU/Van/Utility                  | West          | None              | Non-               | As V1 made a left turn, the trailer V1 was<br>nauling rotated to the left and slid toward | ר             |
| No WZ            | 11:32 AM                | Snow              |            |       |         |                          |                |  |                   |                                 |               |                   | Collision w/<br>MV | the vehicle. V1 and the trailer jackknifed and came to rest on the EB lanes.              | $\kappa^{1}$  |
| 179926           | 3/16/2009               | Daylight          | <b>V</b> 1 | 19    | Z       | Terry                    | MT             | Neither Present                                  | Failed To Yield   | PU/Van/Utility                  | North         | Stop Sign         |                    | V1 attempted to cross US 2 and hit V2.  | β             |
| InjB             | Monday                  | Clear             | 5 2        | 3 10  | : <     | Stanley                  | ; 8            | Neither Present                                  | No Clear          | Psgr Car                        | West          | None              | Right Angle        | V2 spun around from being hit and struck<br>V3. V3 was stopped at the stop sign.          | _^ •          |
| No WZ            | 6:55 PM                 | Dry               | V3         | 43    | Z       | Bismarck                 | ND             | Neither Present                                  | No Clear          | PU/Van/Utility                  | South         | Stop Sign         | (                  |   | 1             |
| 183520           | 5/17/2009               | Daylight          | ۷1         |       |         |                          |                | Unknown  |                   | Heavy Truck                     | South         | None              |                    | D2 reported that as it was stopping at the  |               |
| PDO<br>WZ        | Sunday<br>6:50 PM       | Clear<br>Drv      | V2         | 62    | Z       | -argo                    | ND             | Neither Present                                  |                   | PU/Van/Utility                  | North         | Stop Sign         | Collision w/       | Intersection, something flew off of V1 and hit V2's windshield.                           |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   | MIN                |   | <             |
| 183073<br>PDO    | 5/22/2009               | Daylight          | ξŚ         | 29    | ст<br>— | Minot                    | 5 8            | Neither Present                                  | No Clear          | Psgr Car                        | West          | None              |                    | V2 attempted to cross US 2 and was hit<br>ov V1.  |               |
|                  | 10-17 AM                | Clear             | ~~         | 40    | R       | New Lown                 | ND             | Neither Present                                  | Falled TO Yield   | PU/Van/Utility                  | South         | ubic dote         | <b>Right Angle</b> |   | ∾<br>↑        |
|                  |                         | ,                 |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   | ~             |
| 196024<br>PDO \  | 12/16/2009<br>Wednesday | Daylight<br>Clear | 52 5       | 44 57 | 2 2<br> | Minot<br>Wayland         | ≅ ₽            | Neither Present<br>Neither Present               | Atten Distracted  | Truck Tractor<br>PU/Van/Utility | East<br>South | None<br>Stop Sign |                    | V2 attempted to cross US 2 and was hit<br>by V1. D2 said he didn't see anyone             |               |
| No WZ            | 2:58 PM                 | Dry               |            |       |         |                          |                |  |                   |                                 |               |                   | Right Angle        | coming.   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |
|                  |                         |                   |            |       |         |                          |                |  |                   |                                 |               |                   |                    |   |               |

Crash Summary

Appendix C: Signal Warrant Worksheets

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### TRAFFIC SIGNAL WARRANT SUMMARY

| City: Sta<br>County: Mo   | nley, NE<br>puntrail  | )  |   |  |   | Organ                   | ization:<br>Date:                 |                                       | U<br>Feb  | GPTI<br>oruary 2        | ATAC<br>24, 2010                             | )                                    |
|---|---|--|---|--|---|-------------------------|-----------------------------------|---------------------------------------|---|-------------------------|--|--------------------------------------|
| Major Street:<br>Minor Street:  |   | US 2<br>ND 8   |   |  |   | Lar<br>Lar              | ies: /                            | 4<br>1                                | Critical  | l Approa                | ach Spe                                      | ed: <u>45</u>                        |
| Volume Level Criteria<br>1. Is the critical speed of<br>2. Is the intersection in a<br>If Question 1 or 2 above i                     | major st<br>built-up<br>s answe                                 | reet tra<br>area of<br>red "Ye                           | ffic > 70<br>isolated   | ) km/h (<br>d comm<br>use "7                 | 40 mph<br>Junity of<br>0%" vol            | )?<br><10,00<br>ume lev | 0 popul:<br>el                    | ation?                                |   | \<br>\<br>\             | Yes<br>Yes<br>70%                            | □ No<br>□ No<br>□ 100%               |
| WARRANT 1 - EIGHT-H<br>Warrant 1 is satisfied if Cond<br>Warrant is also satisfied if bo<br>Condition A - Minimum                     | OUR V<br>lition A or<br>oth Condi<br>Vehicul                    | EHICI<br>Conditi<br>tion A ar<br>ar Volu                 | ULAR<br>on B is "<br>nd Condi                                     | <b>VOLU</b><br>100%" si<br>tion B ar         | <b>ME</b><br>atisfied.<br>re "80%"        | satisfied               | 1                                 | <b>Appl</b><br>Sa<br>00% Sa<br>70% Sa | icable:<br>atisfied:<br>atisfied:<br>atisfied:                        |                         | Yes<br>Yes<br>Yes<br>Yes                     | No<br>✓ No<br>✓ No<br>✓ No           |
|   |   |  |   |  |   |                         | Eig                               | ht High                               | nest Ho   | urs                     |  |                                      |
| (volumes in veh/hr)<br>Approach Lanes   | Minir<br>(80%   | num Ro<br>Shown<br>I                                     | equiren<br>in Brac<br>2 or  | nents<br>ckets)<br>more                      | 16:00 -<br>17:00                          | 17:00 -<br>18:00        | 15:00 -<br>16:00                  | 8:00 -<br>9:00                        | 7:00 -<br>8:00  | 11:00 -<br>12:00        | 13:00 -<br>14:00                             | 14:00 -<br>15:00                     |
| Volume Level  | 100%  | 70%  | 100%  | 70%  | 1   |                         |                                   |                                       |   |                         | 1  |                                      |
| on Major Street   | 500<br>(400)  | 350  | 600<br>(480)  | 420  | 268                                       | 252                     | 252                               | 274                                   | 267   | 234                     | 221  | 226                                  |
| Highest Approach<br>on Minor Street   | 150<br>(120)  | 105  | 200<br>(160)  | 140  | 131                                       | 125                     | 117                               | 90                                    | 84  | 99                      | 110  | 103                                  |
| Record 8 highest hours<br>minimum volumes are n<br>Condition B - Interruptio<br>Condition B is intended<br>so heavy that traffic on t | and the c<br>net for eig<br>on of Cc<br>for applica<br>he minor | orrespoi<br>ht hours<br>ontinuo<br>ation wh<br>street su | nding vol<br>. Condi<br><b>us Traf</b><br>ere the t<br>uffers exe | tion is 80<br>fic<br>raffic vol<br>cessive o | boxes p<br>0% satisf<br>lume is<br>delay. | rovided.<br>ïed if par  | Conditic<br>renthetica<br>Ex<br>1 | App<br>cessive<br>00% Sa<br>70% Sa    | % satisfi<br>es are m<br>licable:<br>Delay:<br>atisfied:<br>atisfied: | ed if the<br>et for eig | ght hours<br>Yes<br>Yes<br>Yes<br>Yes<br>Yes | . No<br>✓ No<br>✓ No<br>✓ No<br>✓ No |
|   |   |  |   |  |   |                         | Eig                               | ht High                               | nest Ho   | urs                     |  |                                      |
| (volumes in veh/hr)<br>Approach Lanes   | Minir<br>(80%   | num Ro<br>Shown<br>I                                     | equiren<br>in Brac<br>2 or  | nents<br>ckets)<br>more                      | 16:00 -<br>17:00                          | 17:00 -<br>18:00        | 15:00 -<br>16:00                  | - 00:8<br>9:00                        | 7:00 -<br>8:00  | 11:00 -<br>12:00        | 13:00 -<br>14:00                             | 14:00 -<br>15:00                     |
| Poth Approaches   | 700%  | 10%  | 100%  | 10%  |   |                         |                                   |                                       |   |                         |  |                                      |
| on Major Street   | (600)   | 525  | 900<br>(720)  | 630  | 268                                       | 252                     | 252                               | 274                                   | 267   | 234                     | 221  | 226                                  |
| Highest Approach<br>on Minor Street   | 75<br>(60)  | 53   | 100<br>(80)   | 70   | 131                                       | 125                     | 117                               | 90                                    | 84  | 99                      | 110  | 103                                  |
| Record 8 highest hours<br>minimum volumes are n   | and the c<br>net for eig  | orrespoi   | nding vol   | tion is 80                                   | boxes p<br>)% satisf                      | rovided.<br>lied if par | Conditio<br>enthetica             | on is 100<br>al volume                | % satisfi<br>es are m   | ed if the<br>et for eig | ght hours                                    |                                      |

NCHRP Report 457, 2001

Manual on Uniform Traffic Control Devices 2009 (December 2009)

| City:<br>County:   | Stanley, ND<br>Mountrail  |  |                               |                        |                         | Or                      | ganiz                | zatior<br>Date         | ו:<br>e:            |                      | F                  | UGP<br>ebruz                            | TI - A<br>arv 24     | TAC                | 10                     |                  |
|--|---|--|-------------------------------|------------------------|-------------------------|-------------------------|----------------------|------------------------|---------------------|----------------------|--------------------|---|----------------------|--------------------|------------------------|------------------|
| Apior Stroot:  | Inountrun   | 16.2                                       | Lanes: 4                      |                        | <u> </u>                |                         | Critic               |                        |                     |                      | bood               |   |                      |                    |                        |                  |
| linor Street:  | N   | ID 8                                       | 8                             |                        |                         | _                       | Lanes: 4             |                        |                     | -                    | Chuc               | αι Αμ                                   | proac                | 511 54             | Jeeu                   | 4:               |
| Diume Level Criter<br>1. Is the critical s<br>2. Is the intersec<br>If Question 1 or 2 | tia<br>speed of major stre<br>tion in a built-up an<br>above is answere | et traffic ><br>ea of isola<br>d "Yes", th | 70 kr<br>ated co<br>nen us    | n/h (4<br>omm<br>e "70 | 40 mp<br>unity<br>)%" v | oh) ?<br>of <1<br>olume | 0,000<br>e leve      | ) pop<br>el            | oulatio             | on?                  |                    |   | ✓ Ye<br>✓ Ye<br>✓ 70 | es<br>es<br>0%     |                        | No<br>No<br>100% |
| ARRANT 2 - FC  | DUR-HOUR VEH<br>the above the appr                                      | HICULAF                                    | <mark>R VO</mark><br>, then t | LUM<br>the wa          | IE<br>arrant            | is sat                  | isfied.              |                        |                     | Appl<br>Sa           | cabl               | e:<br>d:                                |                      | es<br>es           | <br>✓                  | No<br>No         |
|  |   |  |                               |                        | U                       | lse the                 | e mida               | dle cu                 | rve of              | Figur                | e 4C-              | -2                                      |                      |                    |                        |                  |
| Four Vol<br>lighest Major<br>Hours Street<br>:45 PM -<br>:45 PM                        | umes<br>Minor<br>Street<br>138  | Higher Volume Minor Str<br>(VPH)           | 400<br>300<br>200<br>100<br>0 | 200                    | 300                     | 400                     | 500                  | 600<br>Ma              | <sup>2</sup> 00     | 800<br>treet         |                    | $\frac{1 \text{ LANE}}{1 \text{ LANE}}$ | ANES                 | & 1                | ιΕ<br>1 <sub>300</sub> | 1400             |
| 00 PM -<br>252:00 PM   | 125   | Note: 115 vµ<br>80 vpl                     | oh applie<br>h applies        | s as th<br>as the      | e lower<br>lower t      | thresh<br>thresho       | old voli<br>Id volui | ume foi<br>me thre     | r a min<br>eshold i | or stree<br>for a mi | t appro<br>nor str | oach wi<br>eet app                      | th two o<br>roach w  | r more<br>vith one | lanes<br>e lane.       | and              |
| 45 AM - 272<br>:45 AM  | 100   |  |                               |                        |                         | Us<br>F                 | e the<br>Figure      | middl<br><b>9 4C-2</b> | e curv<br>2 (70%    | /e of F<br>% Fact    | igure<br>or)       | 4C-2                                    |                      |                    |                        |                  |
| 245 PM 245   | 111   | Higher Volume Minor Street<br>(VPH)        | 400<br>300<br>200<br>100<br>0 | 200                    | 300                     |                         | 400                  | 500                    | 2 OF                |                      |                    | ANES<br>ANES<br>RE LA<br>ANE<br>LANE    | & 2 OF               | R 1<br>ANE<br>900  | 10                     |                  |

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01) NCHRP Report 457, 2001 Manual on Uniform Traffic Control Devices 2009 (December 2009)

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### TRAFFIC SIGNAL WARRANT SUMMARY

| City:   | Stanley, NI   | )   | Organization:  | UGPTI - ATAC  |
|---|---|---|--|---|
| Major Street:   | Mountrain   | US 2<br>ND 8  | Lanes: <u>4</u><br>Lanes: <u>1</u>                                   | Critical Approach Speed: 45   |
| Volume Level Criter<br>1. Is the critical s<br>2. Is the intersec<br>If Question 1 or 2<br>WARRANT 3 - PE<br>If all three criteria a<br>appropriate line (C   | tia<br>speed of major s<br>tion in a built-up<br>above is answe<br><b>EAK HOUR</b><br>re fullfilled (Condition B),then th | treet traffic > 70 km/h (40<br>area of isolated commun<br>ared "Yes", then use "70%<br>tion A) or the plotted point lies<br>be warrant is satisfed. | mph) ?<br>ity of <10,000 population<br>" volume level<br>s above the |   |
| Unusual condition   | justifying  |   | Use the middle curve of F  | Figure 4C-4   |
| use of warra<br>Not Applica<br>Record hour when crite<br>and the corresponding of<br>in boxes provided.<br>Peak Hou<br>-<br>Criteria<br>1. Delay on Minor<br>*(vehicle-hou<br>Approach Lanes<br>Delay Criteria*<br>Delay* | nt:<br>ble<br>ria are fulfilled<br>delay or volume<br>rr<br>Approach<br>urs)<br>1 2<br>4.0 5.0                            | 600<br>500<br><b>Hidher Address</b><br><b>Wind Wind Wind Wind Wind Wind Wind Wind </b>  | Figure 4C-3  | AORE LANES & 2 OR MORE LANES<br>2 OR MORE LANES & 1 LANE<br>1 LANE & 1 LANE<br>1 LANE & 1 LANE<br>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| Fulfilled?: Yes   | ✓ No  |   | Figure 4C-4 (70%   | Factor)   |
| 2. Volume on Minor<br>*(vehicles per<br>Approach Lanes<br>Volume Criteria*<br>Volume*<br>Fulfilled?: Yes  | Approach<br>hour)<br>1 2<br>100 150<br>✓ No   | 200<br>100<br>100<br>100<br>100<br>100<br>100<br>100  | 2 OR MOR   | E LANES & 2 OR MORE LANES<br>2 OR MORE LANES & 1 LANE<br>1 LANE & 1 LANE  |
| 3. Total Entering<br>*(vehicles per           No. of Approaches           Volume Criteria*           Volume*  | Volume           hour)           3         4           350         800  |   | 500 600 700 800  | 0 900 1000 1100 1200 1300   |
| Fulfilled?: Yes   | I ∕ No  | * Note: 100 vph applies as the lo   | Major Stro   | eet (VPH)<br>street approach with two or more lanes and   |

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01) NCHRP Report 457, 2001 Manual on Uniform Traffic Control Devices 2009 (December 2009)

| City:  | Stanley, ND<br>Mountrail   |   | UGPTI - ATA<br>February 24, 2   | JGPTI - ATAC<br>bruary 24, 2010   |  |  |                                  |
|--|--|---|---|---|--|--|----------------------------------|
|  | mountium   |   |   |   | 1 Coldary 24, 2  |  |                                  |
| Aajor Street:  |  |   | Lanes:  | 4 Cri   | itical Approach  | Speed:                                 | 4                                |
|  |  |   |   | <u> </u>  |  |  |                                  |
| <b>IARRANT 4 - F</b><br>Record hours who<br>frequency in the <i>k</i><br>and condition 3 is  | PEDESTRIAN VOLUME<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>fulfilled.  | prresponding volu<br>atisfied if conditio   | ıme or gap<br>n 1 or 2 is fulfille  | Applica<br>Satisf<br>d  | ble: Yes<br>ied: Yes   | ✓<br>✓                                 | No<br>No                         |
|  |  |   |   | Pedestrian  | Pedestrian   | Fulfi                                  | illed                            |
| Criteria   |  | Ho  | our   | Volume  | Gaps   | Yes                                    | N                                |
| . Pedestrian volum   | e crossing the major street is   | 7:00 AM   | 8:00 AM   | 0   | 0  |  |                                  |
| 100 ped/hr or mor  | re for each of any four hours  | 7:00 AM   | 8:00 AM   | 0   | 0  |  |                                  |
| and there are less   | s than 60 gaps/hour in the   | 7:00 AM   | 8:00 AM   | 0   | 0  |  |                                  |
| major street traffic   | c stream of adequate length.   | 7:00 AM   | 8:00 AM   | U   | U  |  | -                                |
| Pedestrian volum   | e crossing the major street is   |   |   |   |  |  |                                  |
|  | re for any one nour <u>and</u> there   | 7:00 A  | ١M  | - 8:  | 00 AM  |  |                                  |
| are less than 60 g   | japs/nour in the major   |   |   |   |  |  |                                  |
|  | m of odoguoto longth   |   |   |   |  |  |                                  |
| The nearest traffic  | m of adequate length.<br>c signal along the major street is  | located more tha  | n 90 m (300 ft) a   | way, or the near  | est signal   | × ×                                    | -                                |
| ARRANT 5 - S<br>Record hours whe   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>SCHOOL CROSSING<br>ere criteria are fulfilled and the co   | located more tha<br>al will not restrict  | n 90 m (300 ft) a<br>the progressive<br>ime or gap  | way, or the neare<br>movement of traf<br>Applica<br>Satisf  | est signal<br>ific.<br>ble: Yes<br>ied: Yes  | <b>X</b><br>✓                          | No                               |
| <i>ARRANT 5 - S</i><br><i>Record hours whe</i><br><i>frequency in the b</i><br><i>are fulfilled.</i>   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>SCHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa  | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria   | way, or the neare<br>movement of traf<br>Applica<br>Satisf  | est signal<br>fic.<br>ble: Yes<br>ied: Yes   | <b>X</b>                               | No<br>No                         |
| ARRANT 5 - S<br>Record hours whe<br>frequency in the b<br>are fulfilled.   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>SCHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa  | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>e of the criteria   | way, or the neare<br>movement of traf<br>Applica<br>Satisf  | est signal<br>ific.<br>ble: Yes<br>ied: Yes  | X                                      | No<br>No                         |
| A minimum of 20  | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>CHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa   | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>o of the criteria<br>Studen   | way, or the neare<br>movement of traf<br>Applica<br>Satisf<br>ts: Hour:   | est signal<br>ffic.  | X<br>✓<br>✓<br>Fulfi<br>Yes            | No<br>No                         |
| A minimum of 20<br>during the highest  | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>SCHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.  | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>e of the criteria<br>Studen   | way, or the neare<br>movement of traf<br>Applica<br>Satisf<br>ts: Hour:   | est signal<br>ffic.<br>ble: Yes<br>ied: Yes  | X<br>Fulfi<br>Yes                      | No<br>No                         |
| A minimum of 20<br>during the highest  | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>CHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stru-   | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria<br>et<br>eam during the p  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria<br>Studen<br>eriod when   | ts: Hour:<br>Minutes  | est signal<br>ffic.<br>ble: Yes<br>ied: Yes  | X<br>Fulfi<br>Yes                      |                                  |
| A minimum of 20     during the highesi     Fewer adequate g  | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>SCHOOL CROSSING</b><br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stre<br>sing the crossing than the number   | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria<br>et<br>eam during the p<br>er of minutes in th   | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>e of the criteria<br>Studen<br>eriod when<br>ne same period.  | ts: Hour:<br>Minutes  | est signal<br>ific.<br>ble: Yes<br>ied: Yes<br>s: Gaps:  | X<br>Fulfi<br>Yes                      | No<br>No                         |
| A minimum of 20<br>during the highest<br>Fewer adequate of<br>the children are u<br>The nearest traffic  | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>SCHOOL CROSSING</b><br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stru-<br>sing the crossing than the number<br>c signal along the major street is  | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria<br>et<br>eam during the p<br>er of minutes in th<br>located more tha   | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>e of the criteria<br>Studen<br>eriod when<br>ne same period.<br>n 90 m (300 ft) a   | ts: Hour:<br>Minutes  | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>F: Gaps:<br>est signal   | X<br>Fulfi<br>Yes                      | No<br>No                         |
| <ul> <li>3. The nearest traffic is within 90 m (30)</li> <li><b>/ARRANT 5 - S</b></li> <li><i>Record hours whe</i> frequency in the b are fulfilled.</li> <li>1. A minimum of 20 during the highest</li> <li>2. Fewer adequate g the children are u</li> <li>3. The nearest traffic is within 90 m (30)</li> </ul>   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>SCHOOL CROSSING</b><br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stra-<br>sing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign   | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br>Criteria<br>et<br>eam during the p<br>er of minutes in the<br>located more tha<br>al will not restrict  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria<br>Studen<br>eriod when<br>ne same period.<br>n 90 m (300 ft) a<br>the progressive  | ts: Hour:<br>Minutes<br>Minutes<br>Minutes  | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>fic.   | X<br>Fulfi<br>Yes                      |                                  |
| A minimum of 20<br>during the highesis<br>Fewer adequate of<br>the children are u<br>The nearest traffic<br>are fulfilled.   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>CCHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic strest<br>sing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>COORDINATED SIGNAL<br>eria are fulfilled in the boxes prov<br>criterion is fulfilled. This warrant to<br>pacing would be less than 300 m   | located more tha<br>al will not restrict<br>prresponding volu<br>atisfied if all three<br><b>Criteria</b><br>et<br>eam during the p<br>er of minutes in the<br>located more tha<br>al will not restrict<br><b>SYSTEM</b><br>vided. The warran<br>should not be app<br>(1,000 ft).   | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria<br>Studen<br>eriod when<br>ne same period.<br>n 90 m (300 ft) a<br>the progressive<br>nt is<br>plied when the   | ts: Hour:<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes                       | est signal<br>ffic. Yes<br>ied: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>ffic.<br>ble: Yes<br>ied: Yes                   | X<br>Fulfi<br>Yes<br>Ves               | No<br>No<br>Illed                |
| <ul> <li>The nearest traffic<br/>is within 90 m (30</li> <li>ARRANT 5 - S</li> <li>Record hours whe<br/>frequency in the b<br/>are fulfilled.</li> <li>A minimum of 20<br/>during the highest</li> <li>Fewer adequate g<br/>the children are u</li> <li>The nearest traffic<br/>is within 90 m (30</li> <li>ARRANT 6 - C</li> <li>Indicate if the critic<br/>satisfied if either of<br/>resulting signal sp</li> </ul>   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>CHOOL CROSSING<br>ere criteria are fulfilled and the co<br>boxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stru-<br>sing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>COORDINATED SIGNAL<br>eria are fulfilled in the boxes prov<br>criterion is fulfilled. This warrant<br>boxing would be less than 300 m  | located more tha<br>al will not restrict<br>prresponding volu-<br>atisfied if all three<br><b>Criteria</b><br>et<br>eam during the p<br>er of minutes in the<br>located more tha<br>al will not restrict<br><b>. SYSTEM</b><br>vided. The warra,<br>should not be ap<br>(1,000 ft).   | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria<br>Studen<br>eriod when<br>ne same period.<br>n 90 m (300 ft) a<br>the progressive<br>nt is<br>plied when the   | Applica<br>Satisf   | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>ied: Yes             | X<br>Fulfi<br>Yes<br>Fulfi             | No<br>No<br>No<br>No<br>No       |
| ARRANT 5 - S<br>Record hours whe<br>frequency in the b<br>are fulfilled.   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>CECHOOL CROSSING<br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stressing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br>COORDINATED SIGNAL<br>eria are fulfilled in the boxes prov<br>criterion is fulfilled. This warrant<br>boacing would be less than 300 m   | located more tha<br>al will not restrict<br>prresponding volu-<br>atisfied if all three<br><b>Criteria</b><br>et<br>eam during the p<br>er of minutes in the<br>located more tha<br>al will not restrict<br><b>SYSTEM</b><br>vided. The warran<br>should not be app<br>(1,000 ft).  | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>of the criteria<br>Studen<br>eriod when<br>ne same period.<br>n 90 m (300 ft) a<br>the progressive<br>nt is<br>plied when the   | ts: Hour:<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes   | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>ied: Yes | X<br>✓<br>✓<br>Yes<br>✓<br>✓<br>✓<br>✓ | No<br>No<br>No<br>No<br>No<br>No |
| <ul> <li>The nearest traffic is within 90 m (30)</li> <li>ARRANT 5 - S</li> <li>Record hours what frequency in the bare fulfilled.</li> <li>A minimum of 20 during the highest</li> <li>Fewer adequate of the children are ut</li> <li>The nearest traffic is within 90 m (30)</li> <li>ARRANT 6 - C</li> <li>Indicate if the critic satisfied if either of resulting signal spont spont the the spont the the spont the the spont spont spont the the spont spont spont the the spont spo</li></ul> | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>SCHOOL CROSSING</b><br>ere criteria are fulfilled and the co<br>poxes provided. The warrant is se<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stru-<br>sing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>COORDINATED SIGNAL</b><br>eria are fulfilled in the boxes prov<br>criterion is fulfilled. This warrant<br>bacing would be less than 300 m<br>eet or a street that has traffic pre-<br>back on the provide the proposed<br>the proposed traffic structures are that the straffic pre-<br>back on the provide the proposed traffic pre-<br>provide the provide the proposed tr | located more tha<br>al will not restrict<br>prresponding volu-<br>atisfied if all three<br><b>Criteria</b><br>et<br>eam during the p<br>er of minutes in the<br>located more tha<br>al will not restrict<br><b>SYSTEM</b><br>vided. The warran<br>should not be ap,<br>(1,000 ft).<br><b>Criteria</b><br>dominately in one  | n 90 m (300 ft) a<br>the progressive<br>me or gap<br>of the criteria<br>Studen<br>eriod when<br>he same period.<br>n 90 m (300 ft) a<br>the progressive<br>nt is<br>plied when the  | ts: Hour:<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes<br>Minutes | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>ied: Yes             | X<br>Fulfi<br>Yes<br>Fulfi<br>Yes      | No<br>No<br>No<br>No<br>No<br>No |
| A minimum of 20<br>during the highest<br>A minimum of 20<br>during the highest<br>Fewer adequate of<br>the children are ur<br>The nearest traffic<br>is within 90 m (30<br>ARRANT 6 - C<br>Indicate if the critic<br>satisfied if either of<br>resulting signal sp<br>On a one-way stre<br>so far apart that the   | m of adequate length.<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>SCHOOL CROSSING</b><br>ere criteria are fulfilled and the co<br>boxes provided. The warrant is sa<br>students crossing the major street<br>t crossing hour.<br>gaps in the major street traffic stru-<br>sing the crossing than the number<br>c signal along the major street is<br>0 ft) but the proposed traffic sign<br><b>COORDINATED SIGNAL</b><br>eria are fulfilled in the boxes prove-<br>criterion is fulfilled. This warrant<br>box provide the necessary<br>eria on the provide the necessary<br>pat adjacent signals do not provide   | located more tha<br>al will not restrict<br>prresponding volu-<br>atisfied if all three<br><b>Criteria</b><br>et<br>eam during the p<br>er of minutes in th<br>located more tha<br>al will not restrict<br><b>. SYSTEM</b><br><i>vided. The warra</i><br><i>should not be ap</i><br><i>(1,000 ft).</i><br><b>Criteria</b><br>dominately in one<br><i>(</i> degree of vehic)<br>de the percessor | n 90 m (300 ft) a<br>the progressive<br>ume or gap<br>e of the criteria<br>Studen<br>eriod when<br>he same period.<br>n 90 m (300 ft) a<br>the progressive<br>nt is<br>plied when the<br>e direction, the a<br>le platooning. | Applica<br>Satisf   | est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>s: Gaps:<br>est signal<br>fic.<br>ble: Yes<br>ied: Yes<br>ied: Yes             | X<br>Fulfi<br>Yes<br>Fulfi<br>Yes      | No<br>No<br>No<br>No<br>No<br>No |

Manual on Uniform Traffic Control Devices 2009 (December 2009)

| City:  | Stanley, ND   |  |  | Or   | ganizati<br>ص                                     | ion:  |   | UGPTI - ATAC<br>February 24, 2010   |   |                                   |  |  |
|--|---|--|--|--|---|---|---|---|---|-----------------------------------|--|--|
| County.  | mountrain   |  |  |  |   | ate   |   | Tebrua  | iy 24, 2  | .010                              |  |  |
| Major Street:  |   | <u>52</u>  |  |  | Lanes:  | 4   | . Cri   | itical Approach Spee  |   |                                   | əd: <u>45</u>  |  |
| wind Street.   |   | 50   |  |  | Lanes.  |   |   |   |   |                                   |  |  |
| VARRANT<br>Record hou<br>information<br>are fulfilled.   | 7 - CRASH EXPERIEN<br>rs where criteria are fulfilled, th<br>in the boxes provided. The wa  | <b>ICE</b><br>he correspol<br>arrant is sati   | nding volum<br>isfied if all th  | e, and oth<br>aree of the  | oer<br>e criteria                                 |   | Applica<br>Satisf   | ble:<br>ied:  | <ul><li>✓ Yes</li><li>✓ Yes</li></ul>   | <ul><li>□</li><li>✓</li></ul>     | No<br>No   |  |
|  |   |  | T  |  |   |   |   | Me  | ot?   | Fulfi                             | lled?  |  |
|  | Criteria  |  |  | Hour   |   | v   | olume   | Yes   | No  | Yes                               | No   |  |
| 1. One of the  | Warrant 1, Condition A (56%   | satisfied)   |  |  |   |   |   |   | $\checkmark$  |                                   |  |  |
| warrants   | warrants Warrant 1, Condition B (56% satisfied)   |  |  |  |   |   |   |   | $\checkmark$  |                                   |  |  |
| to the right   | Warrant 4, Pedestrian V   | /olume   |  |  |   |   |   |   |   |                                   | ✓  |  |
| is met.  | at 80% of volume require  | ements:  |  |  |   |   |   |   | ~   |                                   |  |  |
|  | 80 ped/hr for four (4) ho   | ours or  |  |  |   |   |   |   |   |                                   |  |  |
|  | 152 ped/hr for one (1)  | hour   |  |  |   |   |   |   |   |                                   |  |  |
| Adequate tr  | al of other remedial measure  |  | Measure  | e tried:   |   | Flas  | hing Bea  | acon  |   | ✓                                 |  |  |
|  | has failed to reduce crash frequency.   |  |  |  |   | Tried: Flashing Be  |   |   |   |                                   |  |  |
| has failed to  | reduce crash frequency.   | uaaantibla ta  |  | 1  |   | Number of crashes per 12 mon  |   |   |   |                                   |  |  |
| has failed to<br>has failed to<br>Five or more<br>correction b<br>/ARRANT<br>Record hou<br>information<br>is fulfilled ar  | a reduce crash frequency.<br>e reported crashes, of types su<br>y signal, have occurred within<br><b>8 - ROADWAY NETWO</b><br>rs where criteria are fulfilled, a<br>in the boxes provided. The wand<br>if all intersecting routes hav   | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sati<br>re one or mo   | eriod.<br>esponding vo<br>isfied if at lea<br>ore of the cha   | Number<br>Dume or c<br>ast one of<br>aracteristi   | er of cras  | hes per   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:   | 5<br>Yes<br>Yes   | ✓<br>□<br>✓                       | No<br>No   |  |
| has failed to<br>has failed to<br>Five or more<br>correction b<br>/ARRANT<br>Record hou<br>information<br>is fulfilled ar  | a reduce crash frequency.<br>e reported crashes, of types su<br>y signal, have occurred within<br><b>8 - ROADWAY NETW(</b><br>rs where criteria are fulfilled, a<br>in the boxes provided. The wand<br>if all intersecting routes hav   | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is satu<br>re one or mo   | eriod.<br>esponding vo<br>isfied if at lea<br>pre of the cha   | Number<br>olume or c<br>ast one of<br>aracteristi  | er of cras  | hes per   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Me   | 5   | ✓<br>□<br>✓<br>Fulfi              | No<br>No   |  |
| <ul> <li>has failed to<br/>has failed to</li> <li>Five or more<br/>correction b</li> <li>VARRANT</li> <li>Record hou<br/>information<br/>is fulfilled ar</li> </ul>  | a reduce crash frequency.<br>a reported crashes, of types su<br>y signal, have occurred within<br><b>8 - ROADWAY NETWO</b><br>rs where criteria are fulfilled, a<br>in the boxes provided. The wa<br>and if all intersecting routes hav   | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature<br>one or mo<br>Criteria  | eriod.<br>esponding vo<br>isfied if at lea<br>ore of the cha   | Number   | er of cras<br>other<br>f the crite<br>ics listed. | ria   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br><b>Me</b><br>Yes   | 5<br>Yes<br>Yes<br>Pt?<br>No  | ✓<br>✓<br>Fulfi<br>Yes            | No<br>No<br>Iled?  |  |
| has failed to<br>has failed to<br>Five or more<br>correction b<br>VARRANT<br>Record hou<br>information<br>is fulfilled ar  | a reduce crash frequency.<br>a reported crashes, of types su<br>y signal, have occurred within<br><b>8 - ROADWAY NETWO</b><br>rs where criteria are fulfilled, a<br>in the boxes provided. The wa<br>and if all intersecting routes hav<br>a. Total entering volume of  | ORK<br>and the corre<br>arrant is sature<br>cone or mo<br>Criteria<br>at least 1,00  | eriod.<br>esponding vo<br>isfied if at lea<br>ore of the cha   | Number<br>Dlume or c<br>ast one of<br>aracteristi  | er of cras  | ria   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes  | 5<br>✓ Yes<br>✓ Yes<br>×t?<br>No<br>✓   | ✓<br>□<br>✓<br>Fulfi<br>Yes       | No<br>No<br>Iled?  |  |
| Anas failed to<br>has failed to<br>Five or more<br>correction b<br>VARRANT<br>Record hou<br>information<br>is fulfilled an<br>1. Both of<br>the criteria   | a reduce crash frequency.<br>a reported crashes, of types su<br>y signal, have occurred within<br><b>8 - ROADWAY NETWO</b><br>rs where criteria are fulfilled, a<br>in the boxes provided. The wa<br>and if all intersecting routes hav<br>a. Total entering volume of<br>during a typical weekday  | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature<br>one or mo<br>Criteria<br>at least 1,00<br>peak hour.   | esponding vo<br>isfied if at lea<br>pre of the cha   | Number   | er of cras  | ria<br>y Volume<br>433  | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes  | 5<br>✓ Yes<br>☐ Yes<br>et?<br>No<br>✓   | ✓<br>□<br>Fulfi<br>Yes            | No<br>No<br>Illed?   |  |
| Analysia in the second has failed to has failed to has failed to has failed to have a second hour information is fulfilled and have a second hour information is fulfilled and have a second have a se           | <ul> <li>a. Total entering volume of<br/>during a typical weekday</li> </ul>  | ORK<br>and the corre<br>arrant is sature one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>mes that satu   | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr  | Number   | er of cras  | ria<br>y Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes  | 5<br>✓ Yes<br>✓ Yes<br>→ Yes<br>→<br>✓<br>✓   | ✓<br>□<br>✓<br>Fulfi<br>Yes       | No<br>No<br>Iled?  |  |
| Analysia in the second            | <ul> <li>a. Total entering volume of during a typical weekday</li> <li>b. Five-year projected volume of warrants</li> </ul>   | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature<br>one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>mes that sati<br>1, 2, or 3.   | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy V<br>S   | Numbo<br>olume or c<br>ast one of<br>aracteristi<br>Warrant:<br>atisfied?:                         | er of cras  | ria<br>g Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes  | 5<br>✓ Yes<br>✓ Yes<br>×<br>×<br>×  | ✓<br>✓<br>Fulfi<br>Yes            | No<br>No<br>Illed?<br>Nc   |  |
| Analysia in the second            | <ul> <li>a. Total entering volume of during a typical weekday</li> <li>b. Five-year projected volum of a volume at least</li> <li>c. Total of any 5 brs</li> </ul>  | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature<br>one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>nes that sati<br>1, 2, or 3.   | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy  | Number<br>olume or c<br>ast one of<br>aracteristi<br>Warrant:<br>atisfied?:                        | er of cras  | ria<br>y Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou   | 5<br>✓ Yes<br>✓ Yes<br>×<br>×<br>×<br>×<br>×  | ✓<br>✓<br>Fulfi<br>Yes            | No<br>No<br>Iled?  |  |
| Analysia in the second has failed to the correction b<br>VARRANT<br>Record hour<br>information<br>is fulfilled and<br>1. Both of<br>the criteria<br>to the right<br>are met.<br>2. Total enterin<br>1,000 veh/h<br>of a non-non  | <ul> <li>a. Total entering volume of during a typical weekday</li> <li>b. Five-year projected volum one or more of Warrants</li> </ul>  | ORK<br>and the correct<br>arrant is sature one or model<br>of the correct<br>arrant is sature one or model<br>Criteria<br>at least 1,00<br>peak hour.<br>mes that satu<br>1, 2, or 3.  | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy <u>N</u><br>S  | Number<br>olume or c<br>ast one of<br>aracteristi<br>Warrant:<br>atisfied?:                        | er of cras  | ria<br>y Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou   | 5<br>✓ Yes<br>✓ Yes<br>Pet?<br>No<br>✓<br>✓<br>Ir   | ✓<br>✓<br>Fulfi<br>Yes            | No<br>No<br>Illed?   |  |
| <ul> <li>has failed to<br/>has failed to</li> <li>Five or more<br/>correction b</li> </ul> <b>/ARRANT</b> <i>Record hou</i><br>information<br>is fulfilled and<br>to the right<br>are met. 2. Total enterint<br>1,000 veh/h<br>of a non-non<br>(Sat. or Sum)   | a. Total entering volume of during a typical weekday         b. Five-year projected volum one or more of Warrants         ng volume at least r for each of any 5 hrs mal business day         .)  | ORK<br>and the corre<br>arrant is sature<br>one or model<br>Criteria<br>at least 1,00<br>peak hour.<br>nes that sature<br>1, 2, or 3.  | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>sfy S   | Numbe  | er of cras  | ria<br>y Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol                                      | 5<br>✓ Yes<br>✓ Yes<br>et?<br>No<br>✓<br>✓<br>ume   | ✓<br>✓<br>Fulfi<br>Yes            | No<br>No<br>Illed?   |  |
| <ul> <li>has failed to has failed to have the correction be have the has failed has fulfilled and have the criteria to the right are met.</li> <li>1. Both of the criteria to the right are met.</li> <li>2. Total enterin 1,000 veh/h of a non-noi (Sat. or Sun</li> </ul>  | a. Total entering volume of during a typical weekday         b. Five-year projected volum one or more of Warrants         ng volume at least r for each of any 5 hrs  | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature<br>one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>nes that sati<br>1, 2, or 3.   | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy N<br>S   | Number   | er of cras  | ria   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol                                      | 5<br>✓ Yes<br>Yes<br>et?<br>No<br>✓<br>ume  | ✓<br>Fulfi<br>Yes                 | No<br>No<br>Iled?<br>Nc  |  |
| <ul> <li>has failed to has failed to have the correction be have the has failed and have the has fulfilled and have the criteria to the right are met.</li> <li>2. Total entering 1,000 veh/h of a non-non (Sat. or Sum)</li> </ul>  | a. Total entering volume of during a typical weekday         b. Five-year projected volum one or more of Warrants         ng volume at least r for each of any 5 hrs         mail business day  | ORK<br>and the correct<br>arrant is sature one or model<br>of the correct<br>arrant is sature one or model<br>Criteria<br>at least 1,00<br>peak hour.<br>mes that sature<br>1, 2, or 3.  | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy <u>V</u><br>S  | Number   | er of cras  | ria   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol                                      | 5<br>✓ Yes<br>Yes<br>Pt?<br>Vo<br>ume<br>Pt?<br>No  | ✓<br>Fulfi<br>Yes                 | No<br>No<br>No<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo<br>Vo       |  |
| As failed to<br>has failed to<br>Five or more<br>correction b<br>/ARRANT<br>Record hou<br>information<br>is fulfilled an<br>1. Both of<br>the criteria<br>to the right<br>are met.<br>2. Total enterir<br>1,000 veh/h<br>of a non-noi<br>(Sat. or Sun  | a reduce crash frequency.         a reported crashes, of types surverse of types and the second sec | usceptible to<br>a 12-mo. pe<br>ORK<br>and the corre<br>arrant is sature one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>nes that sati<br>1, 2, or 3.  | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy <u>v</u><br>ajor Route   | Number   | er of cras  | ria<br>y Volume<br>433<br>2   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol                                      | 5<br>✓ Yes<br>Yes<br>2t?<br>No<br>✓<br>ume<br>2t?<br>No   | ✓<br>Fulfi<br>Yes<br>Fulfi<br>Yes | No<br>No<br>Illed?<br>Vc<br>V  |  |
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| <ul> <li>has failed to has failed has failed has failed has fulfilled and has fulfilled an</li></ul> | a. Total entering volume of during a typical weekday         b. Five-year projected volum         one of any 5 hrs         mal business day         .)  | usceptible to<br>a 12-mo. pe<br>ORK<br>and the correct<br>arrant is sature<br>one or mo<br>Criteria<br>at least 1,00<br>peak hour.<br>nes that satu<br>1, 2, or 3.<br>stics of Ma<br>serves as the<br>tering, or trav  | esponding vo<br>isfied if at lea<br>ore of the cha<br>over over over over over over over over | Number<br>olume or co<br>ast one of<br>aracteristic<br>Warrant:<br>atisfied?:<br>es<br>padway      | er of cras  | ria<br>ria<br>Volume<br>433<br>2<br>Major<br>Major<br>Major   | 12 mont<br>Applica<br>Satisf  | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol<br>Me<br>Yes<br>✓<br>✓               | 5<br>✓ Yes<br>Yes<br>×<br>×<br>ume<br>v<br>No<br>×  | ✓<br>Fulfi<br>Yes<br>Fulfi<br>Yes | No<br>No<br>Iled?<br>Nc<br>✓   |  |
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| <ul> <li>Anas failed to has failed and has</li></ul> | a reduce crash frequency.         a reported crashes, of types surver a signal, have occurred within         8 - ROADWAY NETWO         8 - ROADWAY NETWO         rs where criteria are fulfilled, a sin the boxes provided. The ward if all intersecting routes have         a. Total entering volume of during a typical weekday         b. Five-year projected volum one or more of Warrants and volume at least         r for each of any 5 hrs         mal business day         .)         Characteria         attreet or highway system that set through traffic flow.         purban highway outside of, ent         a major route on an official place   | USCEPTIBLE TO<br>a 12-mo. per<br>ORK<br>and the correct<br>arrant is sature<br>re one or mo<br>Criteria<br>at least 1,000<br>peak hour.<br>mes that sature<br>1, 2, or 3.<br>Stics of Masserves as the<br>tering, or travelering   | esponding vo<br>isfied if at lea<br>ore of the cha<br>00 veh/hr<br>isfy <u>v</u><br>ajor Route<br>e principal ro<br>versing a city   | Number<br>olume or c<br>ast one of<br>aracteristi<br>Warrant:<br>atisfied?:<br>padway              | er of cras  | ria<br>ria<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>2<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>433<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>volume<br>43<br>volume<br>43<br>volume<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>43<br>volume<br>4<br>volume<br>43<br>volume<br>4<br>vol | 12 mont<br>Applica<br>Satisf<br>3<br>3<br>Street:<br>Street:<br>Street:<br>Street:<br>Street:                             | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol                                      | 5<br>✓ Yes<br>Yes<br>Ves<br>v<br>v<br>ume<br>v<br>v<br>v<br>v<br>v<br>v<br>v<br>v<br>v<br>v<br>v<br>v | ✓<br>Fulfi<br>Yes<br>Fulfi<br>Yes | No<br>No<br>Illed?<br>V<br>V   |  |
| <ul> <li>has failed to has failed and has f</li></ul> | a reduce crash frequency.         a reported crashes, of types survices of types survices of types and the poxes of types of the poxes of the poxes provided. The war and if all intersecting routes have         a. Total entering volume of during a typical weekday.         b. Five-year projected volum one or more of Warrants of the poxes day.         b. Five-year projected volum one or more of Warrants of the track of any 5 hrs of the track of the poxes day.         b. Five-typical weekday.         b. Total entering typical weekday.         b. Total entering typical weekday.  | ORK<br>and the corre<br>arrant is sature<br>one or model<br>criteria<br>at least 1,00<br>peak hour.<br>nes that sature<br>1, 2, or 3.<br>stics of Masserves as the<br>tering, or trave<br>an.  | esponding vo<br>isfied if at lea<br>ore of the cha<br>over over over over over over over over                    | Number<br>olume or c<br>ast one of<br>aracteristi<br>Warrant:<br>atisfied?:<br>es<br>badway        | er of cras  | ria<br>Volume<br>433<br>2<br>Major<br>Minor<br>Major<br>Minor<br>Major<br>Minor<br>Major  | 12 mont<br>Applica<br>Satisf<br>3<br>3<br>Street:<br>Street:<br>Street:<br>Street:<br>Street:<br>Street:<br>Street:       | hs:<br>ble:<br>ied:<br>Yes<br>← Hou<br>← Vol<br>Yes<br>✓<br>✓<br>✓<br>✓<br>✓      | 5<br>✓ Yes<br>✓ Yes<br>×<br>Yes<br>×<br>×<br>ume<br>×<br>×<br>×<br>×                                  | ✓<br>Fulfi<br>Yes<br>✓            | No<br>No<br>No<br>No<br>No<br>No<br>No<br>No<br>No<br>No   |  |
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Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01) NCHRP Report 457, 2001 Manual on Uniform Traffic Control Devices 2009 (December 2009)

| City: Si   | anley, NI  | )   |   |                                       |                                    | Organ                  | ization:              |                                     | U  | GPTI -                    |                          | n                            |
|--|--|---|---|---------------------------------------|------------------------------------|------------------------|-----------------------|-------------------------------------|--|---------------------------|--------------------------|------------------------------|
| aior Street:   | nountrail  | US 2  |   |                                       |                                    | Lar                    | Dale.                 | 4                                   | Critica                                      | Approa                    | ach Spe                  | eed: 4                       |
| inor Street:   |  | ND 8  |   |                                       |                                    | Lar                    | nes:                  | 1                                   |  |                           |                          |                              |
| Iume Level Criteria1. Is the critical speed2. Is the intersection in                                       | of major s<br>a built-up                         | treet tra<br>area of                                      | ffic > 70<br>isolate                          | ) km/h (<br>d comm                    | 40 mph<br>nunity of                | )?<br><10,00           | 0 popul               | ation?                              |  | ✓<br>✓                    | Yes<br>Yes               | No No                        |
| If Question 1 or 2 above   | is answe   | red "Ye   | es", ther                                     | use "7                                | 0%" vol                            | ume lev                | el                    |                                     |  | $\checkmark$              | 70%                      | <u> </u>                     |
| ARRANT 1 - EIGHT-<br>Warrant 1 is satisfied if Co<br>Warrant is also satisfied if<br>Condition A - Minimur | HOUR V<br>ndition A o<br>both Condi<br>n Vehicul | <b>/EHIC</b><br>r Conditi<br>ition A ar<br><b>ar Volu</b> | ULAR<br>fon B is "<br>nd Condi<br>I <b>me</b> | <b>VOLU</b><br>100%" si<br>ition B ar | <u>ME</u><br>atisfied.<br>re "80%" | satisfieo              | '.<br>1               | Appl<br>Sa                          | <b>icable:</b><br>atisfied:<br>atisfied:     |                           | Yes<br>Yes<br>Yes        | │ No<br>✓ No                 |
|  |  |   |   |                                       |                                    |                        |                       | 70% Sa                              | atisfied:                                    |                           | Yes                      | ✓ No                         |
|  |  | _   | _   |                                       |                                    |                        | Eig                   | ht High                             | nest Ho                                      | ours                      | 1                        | 1                            |
| (volumes in veh/hr)<br>Approach Lanes  | Minii<br>(80%                                    | num Ro<br><u>Shown</u><br>1                               | equiren<br>in Bra<br>2 or                     | nents<br>ckets)<br>more               | 17:00 -                            | 15:00 -<br>16:00       | 8:00 -<br>9:00        | 17:00 -<br>18:00                    | 11:00 -<br>12:00                             | 11:00 -<br>11:00          | 7:00 -<br>8:00           | 15:00 -<br>15:00             |
| Volume Level   | 100%   | <b>70%</b>  | 100%  | <b>70%</b>                            |                                    | ~                      |                       | ~                                   | ~  | -                         |                          | -                            |
| on Major Street  | (400)  | 350   | (480)   | 420                                   | 452                                | 449                    | 474                   | 404                                 | 439  | 428                       | 436                      | 398                          |
| Highest Approach<br>on Minor Street  | 150<br>(120)                                     | 105   | 200<br>(160)                                  | 140                                   | 210                                | 188                    | 138                   | 203                                 | 159  | 151                       | 128                      | 167                          |
| Record 8 highest hour<br>minimum volumes are   | s and the c<br>met for eig                       | orrespoi<br>ht hours                                      | nding vo.<br>Condi                            | lumes in<br>tion is 80                | boxes p<br>0% satisi               | rovided.<br>ïed if pai | Conditio<br>enthetica | on is 100<br>al volum               | % satisfi<br>es are m                        | ied if the<br>let for eig | ght hours                | 5.                           |
| <b>Condition B - Interrup</b><br>Condition B is intende<br>so heavy that traffic or                        | t <b>ion of Co</b><br>d for applic<br>the minor  | ontinuo<br>ation wh<br>street st                          | us Traf<br>ere the t<br>uffers ex             | fic<br>raffic vol<br>cessive o        | lume is<br>delay.                  |                        | Ex<br>1               | App<br>ccessive<br>00% Sa<br>80% Sa | licable:<br>Delay:<br>atisfied:<br>atisfied: |                           | Yes<br>Yes<br>Yes<br>Yes | │ No<br>✓ No<br>✓ No<br>✓ No |
|  |  |   |   |                                       |                                    |                        | Eig                   | ht Higi                             | nest Ho                                      | ours                      | 1                        | 1                            |
| (volumes in veh/hr)  | Minii<br>(80%                                    | num Ro<br>Shown   | in Bra  | nents<br>ckets)                       | - 00:<br>200:                      | - 00:0                 | - 00:                 | - 00:                               | - 00:5                                       | - 00:1                    | - 00<br>00               | - 00:0                       |
| Approach Lanes   | 100%   | 70%   | 2 or  | more                                  | 15                                 | 15<br>16               | o                     | 17                                  | 11   | <del>6</del> <del>/</del> | ~ ~ 8                    | 4 15                         |
|  | 750  | 525   | 900   | 630                                   | 450                                | 440                    | 474                   | 40.4                                | 400  | 400                       | 400                      | 200                          |
| Both Approaches  | (600)  |   | (720)   |                                       | 452                                | 449                    | 4/4                   | 404                                 | 439  | 428                       | 430                      | 398                          |
| Both Approaches<br>on Major Street   | (000)  |   |   |                                       |                                    |                        | -                     | -                                   |  |                           |                          |                              |

Manual on Uniform Traffic Control Devices 2009 (December, 2009)



Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01) NCHRP Report 457, 2001 Manual on Uniform Traffic Control Devices 2009 (December, 2009)



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