



NDSU Dept. 2880 – PO Box 6050
Fargo, ND 58108-6050
Tel 701-231-8058 – Fax 701-231-6265
www.ugpti.org – www.atacenter.org

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
Name

April 15, 2010
Date

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.

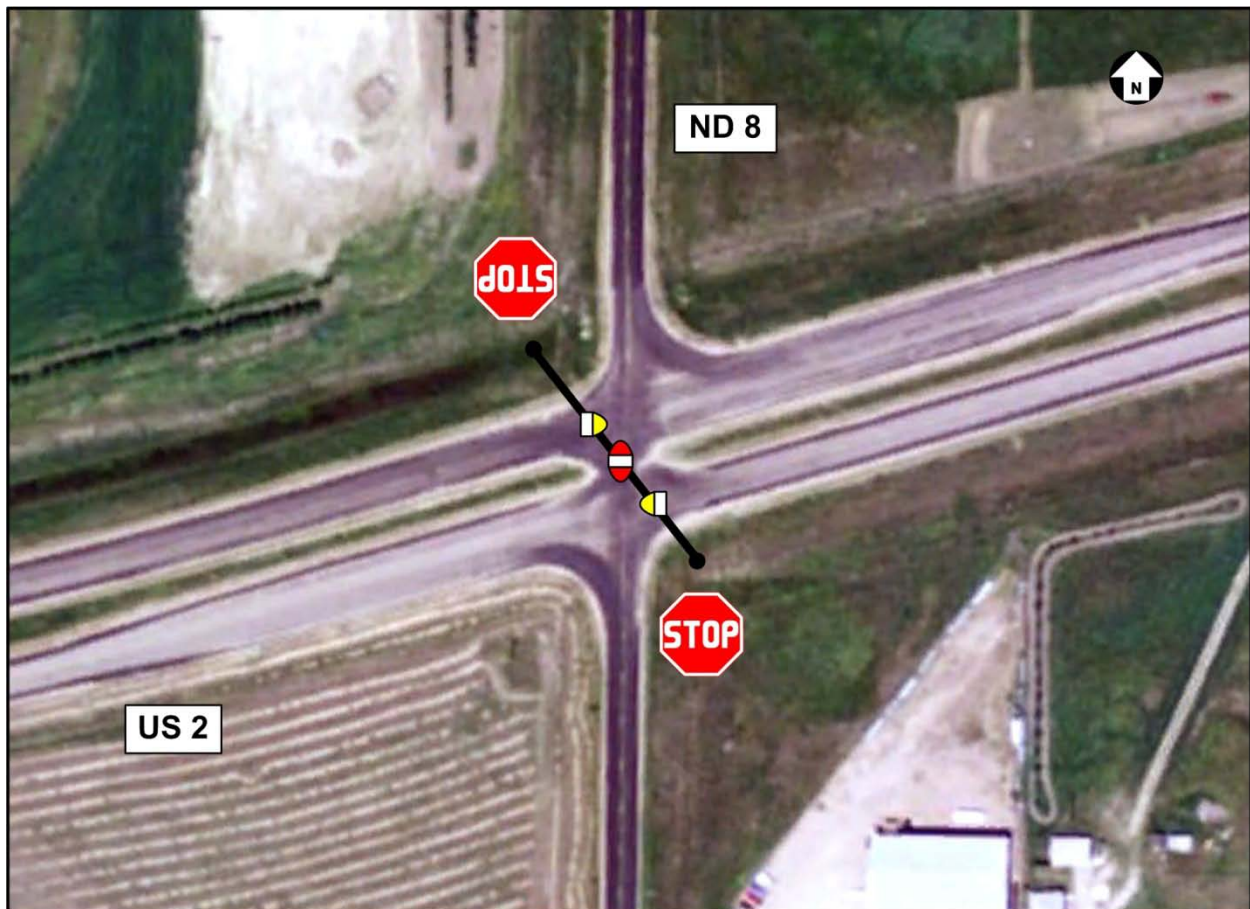


Figure 1. US 2 & ND 8 Intersection Geometry and Traffic Control

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.

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

Year	AADT		Trucks		Cars	
	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%

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

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 dual-wheels).

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.

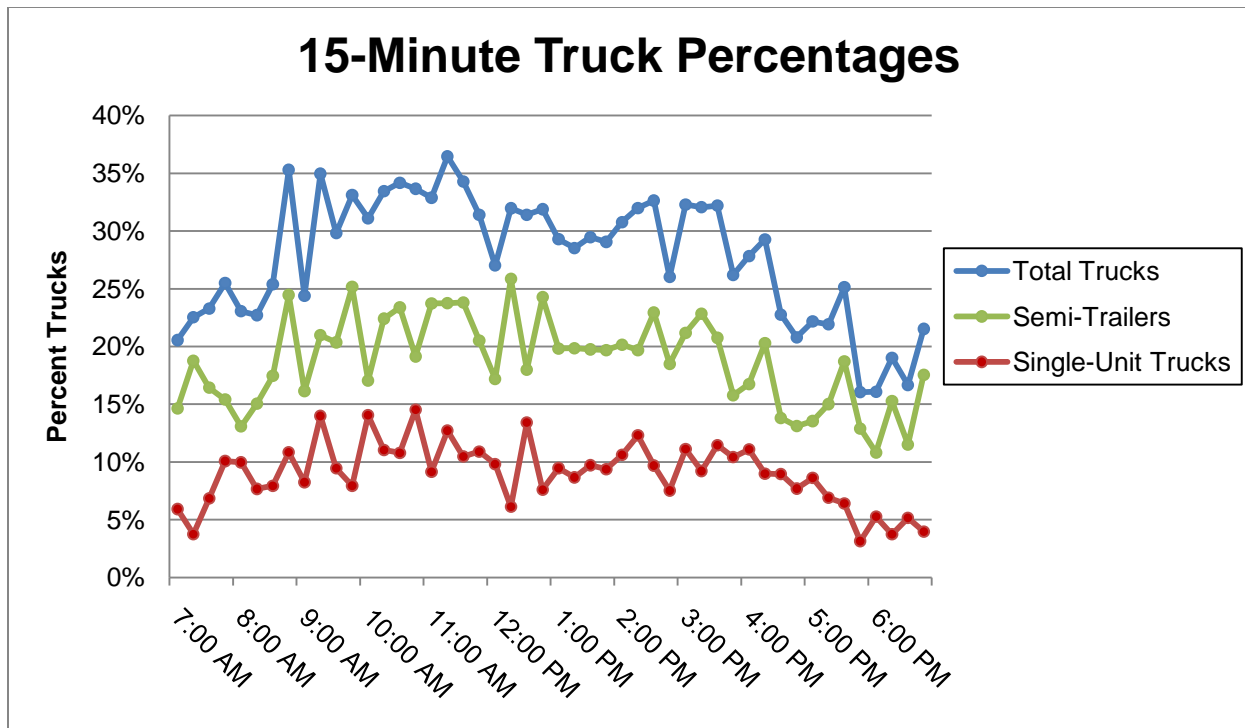


Figure 3. Truck percentages at the intersection of US 2 & ND 8

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,
- 2) 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).

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

Date	Direction of instigating vehicle	Type
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

*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

Advanced Traffic Analysis Center

North Dakota State University

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

Fargo, ND

File Name : 3-day count average
Site Code : 00000000
Start Date : 2/4/2010
Page No : 1

Groups Printed- Passenger Cars - Trailers - Single Unit Trucks

Start Time	ND8 Southbound					US2 Westbound					ND8 Northbound					US2 Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. 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

Advanced Traffic Analysis Center

North Dakota State University
 Fargo, ND

File Name : 3-day count average
 Site Code : 00000000
 Start Date : 2/4/2010
 Page No : 2

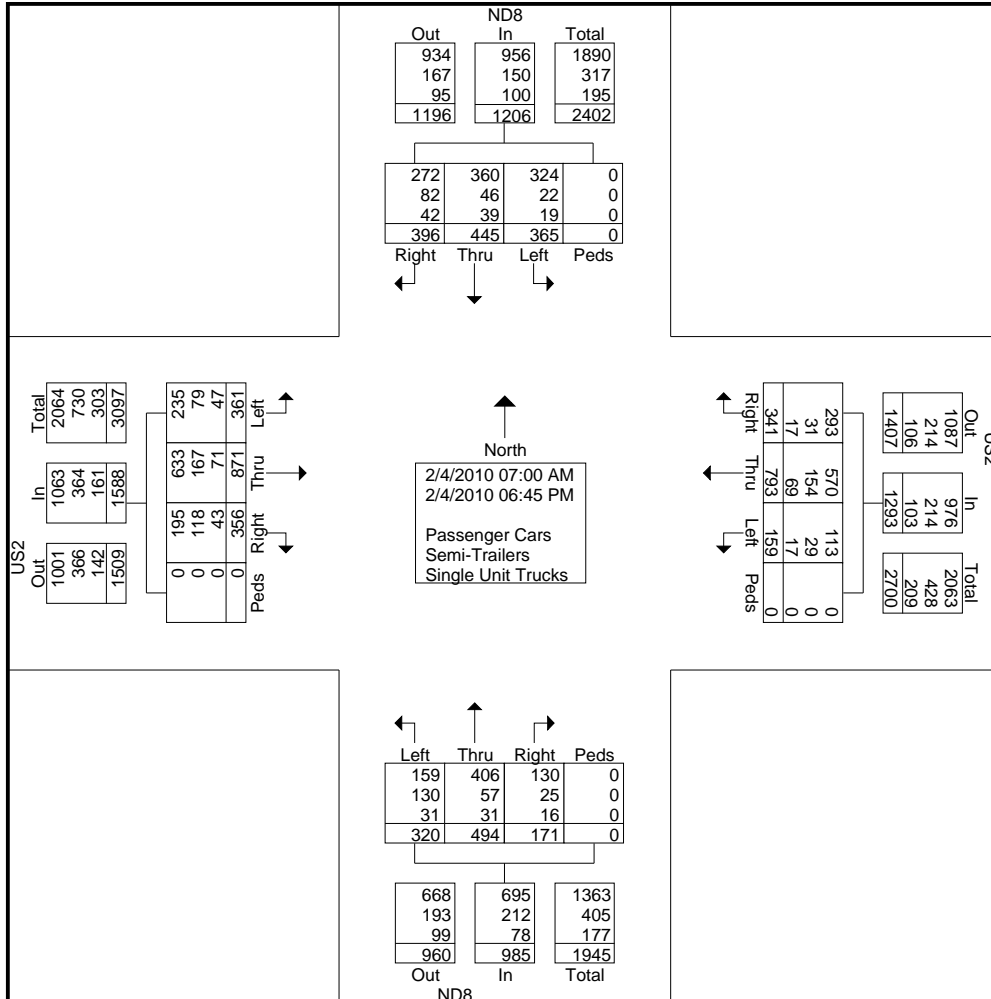
Groups Printed- Passenger Cars - Trailers - Single Unit Trucks

Start Time Factor	ND8 Southbound					US2 Westbound					ND8 Northbound					US2 Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
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
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
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	
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

Advanced Traffic Analysis Center

North Dakota State University
 Fargo, ND

File Name : 3-day count average
 Site Code : 00000000
 Start Date : 2/4/2010
 Page No : 3

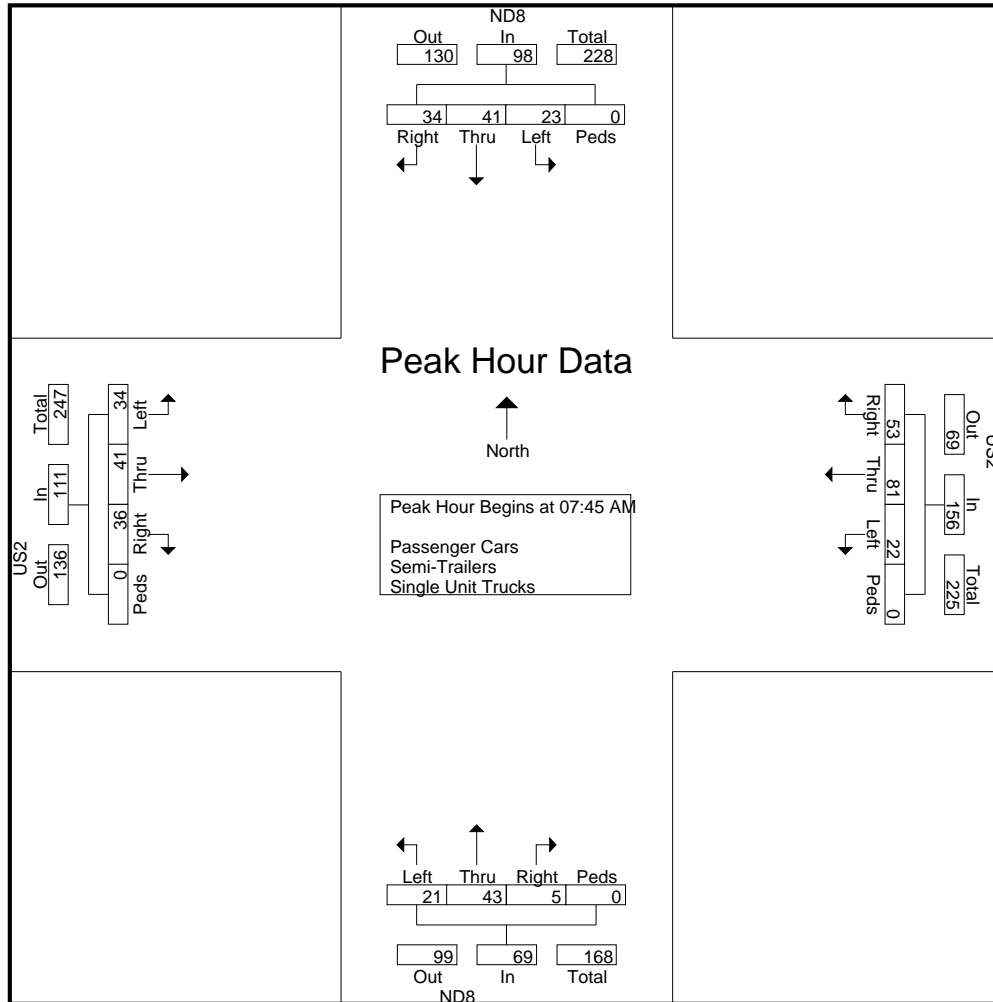


Advanced Traffic Analysis Center

North Dakota State University
 Fargo, ND

File Name : 3-day count average
 Site Code : 00000000
 Start Date : 2/4/2010
 Page No : 4

Start Time	ND8 Southbound					US2 Westbound					ND8 Northbound					US2 Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	11	11	6	0	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

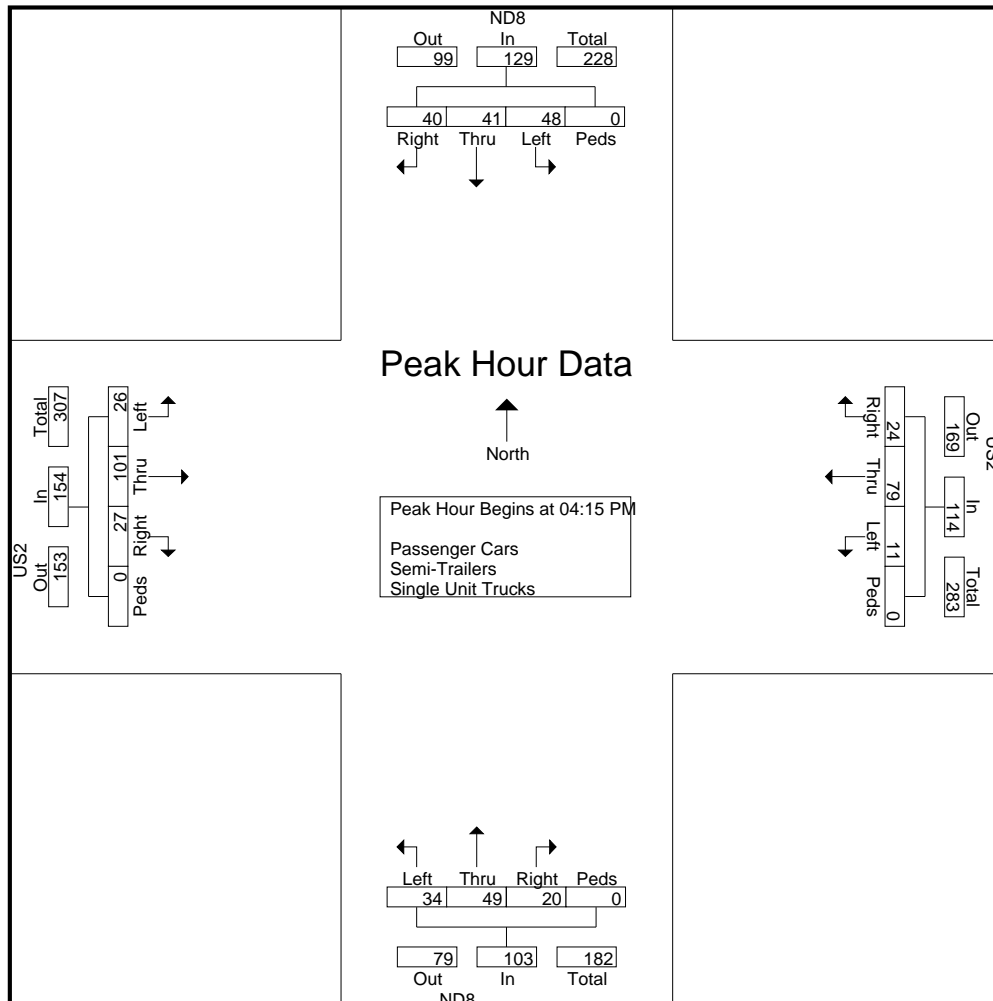


Advanced Traffic Analysis Center

North Dakota State University
 Fargo, ND

File Name : 3-day count average
 Site Code : 00000000
 Start Date : 2/4/2010
 Page No : 5

Start Time	ND8 Southbound					US2 Westbound					ND8 Northbound					US2 Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 12:00 PM to 06:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
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
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

Crash Summary

County: Mountain
 Location Description: US 2 RP 90.644 & ND 8 RP 155.962 (Stanley)
 Project: PCN:
 Study Period (Dates): 1-1-04 to 12-31-08

23 USC § 409 Documents
 NDDOT Reserves All Objections

Number	Date	Lighting	Weather	Surface Cond	Veh #	Age	Sex	Lic. Address			Alcohol / Drug Involvement	Contributing Factors	Vehicle Config.	Vehicle Direction	Traffic Control	Manner of Collision	Comments	Diagram
								City	State	Involve								
127910	10/22/2006	Daylight	Clear		V1 50	F	Battleview	ND	Neither Present	Failed To Yield	PUVan/Utility	North	Stop Sign	Right Angle	The EB US 2 roadway was barricaded (under construction), and EW traffic was heard on the WB roadway. Traffic on ND 8 could still travel through the intersection, and NB traffic had a stop sign in what is normally the median. D1 stopped at the stop sign, did not see V2, attempted to cross the US 2 EB and WB roadways, and was hit by V1.			
132588	12/6/2006	Daylight	Clear	Ice / Snow	V1 33	M	Bismarck	ND	Neither Present	Attention Distracted	Psg Car	West	None	Right Angle	D2 stopped at stop sign, attempted to cross the US 2 EB and WB roadways, and was hit by V1.			
148690	10/24/2007	Daylight	Clear		V1 24	F	Williston	ND	Neither Present	No Clear	PUVan/Utility	West	None	Right Angle	D2 stopped at stop sign, proceeded into median, slowed in median, attempted to cross the WB US 2 roadway, and was hit by V1.			
150191	11/8/2007	Daylight	Clear		V1 36	M	Moorehead	ND	Unknown	Vision Obstructed	Psg Car	South	Stop Sign	Right Angle	D1 was travelling 10mph, did not see V2, attempted to cross the US 2 WB and EB roadways, and hit V2. D1 said the sun obstructed his vision of V2.			
153597	12/21/2007	Daylight	Snow		V1 59	M	Sturgis	SD	Neither Present	Vision Obstructed	PUVan/Utility	South	Stop Sign	Right Angle	D1 attempted to cross the US 2 WB and EB roadways and hit V2.			
158551	3/3/2008	Dark (Lighted)	Clear		V1 51	M	Glasgow	MT	Neither Present	Attention Distracted	Psg Car	West	None	Right Angle	V2 SB stopped at a stop sign, then not seeing V1 WB, continued on into the intersection and was hit by V1.			
158074	3/20/2008	Dark (Lighted)	Clear		V1 25	M	Mohall	ND	Unknown	Failed To Yield	PUVan/Utility	North	Stop Sign	Right Angle	V1 NB ran a stop sign and hit V2.			
164940	8/21/2008	Daylight	Cloudy		V1 42	M	Bar Nunn	WY	Neither Present	Failed To Yield	PUVan/Utility	South	None	Right Angle	V1 stopped in the median and then proceeded to cross the EB lanes of US 2 and struck V2. D1 stated he thought V2 was going to turn left.			
165698	9/10/2008	Daylight	Rain		V1 58	M	Beffield	ND	Neither Present	No Clear	PUVan/Utility	West	None	Right Angle	V2 NB stopped at a stop sign, then not seeing V1 WB, continued on into the intersection and was hit by V1.			
167541	9/24/2008	Daylight	Clear		V1 65	M	Faith	SD	Neither Present	Vision Obstructed	Truck Tractor	North	Stop Sign	Right Angle	V1 NB stopped at a stop sign, then not seeing V2 WB, continued on into the intersection and hit V2. D1 said he couldn't see V2 because of the sun.			

For Crash Severity: Fatal = Fatality, InjA = Incapacitating Injury, InjB = Non-Incapacitating Injury, InjC = Possible/Claimed Injury, PDO = Property Damage Only

Crash Summary

Project: Stanley
 PCN: US Hwy 2 & ND Hwy 8 Intersection
 Location Description: US Hwy 2 & ND Hwy 8 Intersection
 Study Period (Dates): 1-1-09 to 12-31-09

23 USC § 409 Documents
 NDDOT Reserves All Objections

Number	Date	Lighting	Weather	Surface Cond	Veh #	Age	Sex	Lic. Address			Alcohol / Drug Involvement	Contributing Factors	Vehicle Config.	Vehicle Direction	Traffic Control	Manner of Collision	Comments	Diagram
								City	State	City								
177400	2/16/2009	Daylight	Snow	Snow	V1	35	M	Berthold	ND	Neither Present	No Clear	PUVan/Utility	West	None	Non-Collision w/ MV	As V1 made a left turn, the trailer V1 was hauling rotated to the left and slid toward the vehicle. V1 and the trailer jackknifed and came to rest on the EB lanes.		
179926	3/16/2009	Daylight	Clear	Dry	V1	19	M	Terry	MT	Neither Present	Failed To Yield	PUVan/Utility	North	Stop Sign	Right Angle	V1 attempted to cross US 2 and hit V2. V2 spun around from being hit and struck V3. V3 was stopped at the stop sign.		
183520	5/17/2009	Daylight	Clear	Dry	V1	62	M	Fargo	ND	Neither Present	Unknown	Heavy Truck	South	None	Non-Collision w/ MV	D2 reported that as it was stopping at the intersection, something flew off of V1 and hit V2's windshield.		
183073	5/22/2009	Daylight	Clear	Dry	V1	29	F	Minot	ND	Neither Present	No Clear	Psg Car	West	None	Right Angle	V2 attempted to cross US 2 and was hit by V1.		
196024	12/16/2009	Daylight	Clear	Dry	V1	57	M	Minot	ND	Neither Present	Atten Distracted	Truck Tractor	East	None	Right Angle	V2 attempted to cross US 2 and was hit by V1. D2 said he didn't see anyone coming.		

Appendix C: Signal Warrant Worksheets

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Stanley, ND**
County: **Mountrail**

Organization: **UGPTI - ATAC**
Date: **February 24, 2010**

Major Street: **US 2** Lanes: **4** Critical Approach Speed: **45**
Minor Street: **ND 8** Lanes: **1**

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
 If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 1 - EIGHT-HOUR VEHICULAR VOLUME

Applicable: Yes No
Satisfied: Yes No

Warrant 1 is satisfied if Condition A or Condition B is "100%" satisfied.
Warrant is also satisfied if both Condition A and Condition B are "80%" satisfied.

Condition A - Minimum Vehicular Volume

100% Satisfied: Yes No
70% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					1		2 or more		16:00 - 17:00	17:00 - 18:00	15:00 - 16:00	8:00 - 9:00
	100%	70%	100%	70%								
Both Approaches on Major Street	500 (400)	350	600 (480)	420	268	252	252	274	267	234	221	226
Highest Approach on Minor Street	150 (120)	105	200 (160)	140	131	125	117	90	84	99	110	103

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

Condition B - Interruption of Continuous Traffic

Condition B is intended for application where the traffic volume is so heavy that traffic on the minor street suffers excessive delay.

Applicable: Yes No
Excessive Delay: Yes No
100% Satisfied: Yes No
70% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					1		2 or more		16:00 - 17:00	17:00 - 18:00	15:00 - 16:00	8:00 - 9:00
	100%	70%	100%	70%								
Both Approaches on Major Street	750 (600)	525	900 (720)	630	268	252	252	274	267	234	221	226
Highest Approach on Minor Street	75 (60)	53	100 (80)	70	131	125	117	90	84	99	110	103

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

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)

TRAFFIC SIGNAL WARRANT SUMMARY

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

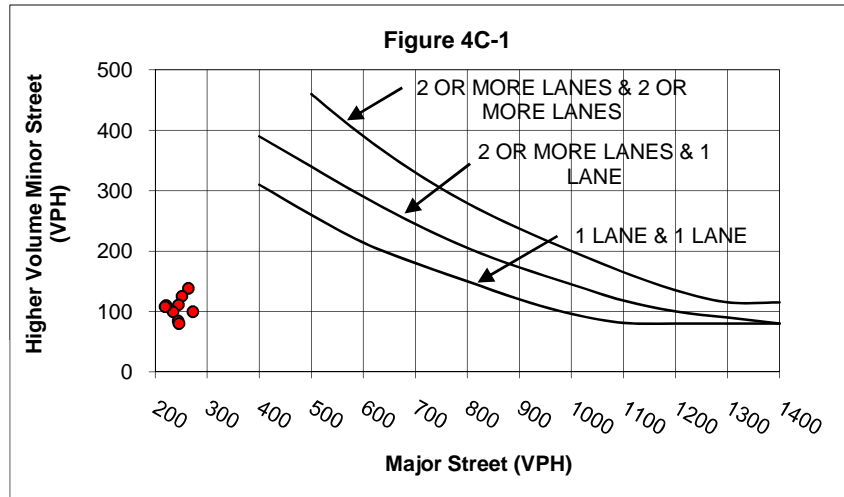
- 1. Is the critical speed of major street traffic > 70 km/h (40 mph) ? Yes No
 - 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 2 - FOUR-HOUR VEHICULAR VOLUME

If four or more points lie above the appropriate line, then the warrant is satisfied.

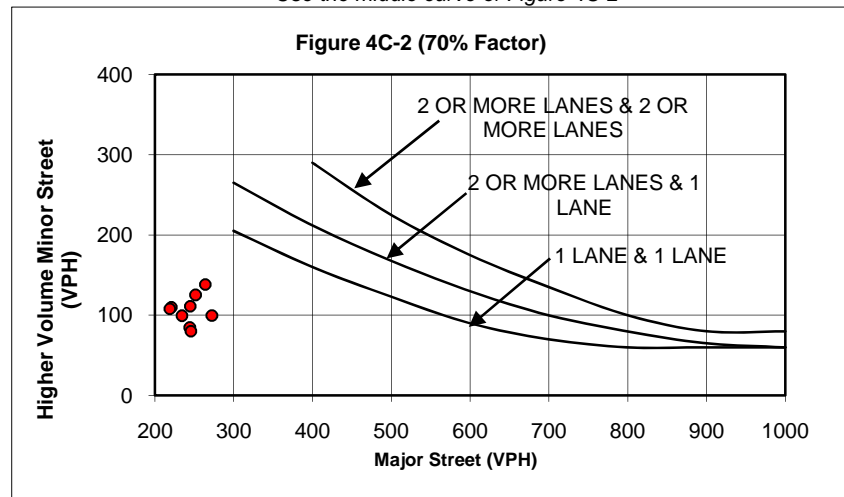
Applicable: Yes No
Satisfied: Yes No

Use the middle curve of Figure 4C-2



* Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

Use the middle curve of Figure 4C-2



* Note: 80 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 60 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

Four Highest Hours	Volumes	
	Major Street	Minor Street
3:45 PM - 4:45 PM	264	138
5:00 PM - 6:00 PM	252	125
7:45 AM - 8:45 AM	272	100
2:45 PM - 3:45 PM	245	111

TRAFFIC SIGNAL WARRANT SUMMARY

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 3 - PEAK HOUR

If all three criteria are fulfilled (Condition A) or the plotted point lies above the appropriate line (Condition B), then the warrant is satisfied.

Applicable: Yes No
Satisfied: Yes No

Use the middle curve of Figure 4C-4

Unusual condition justifying use of warrant:

Not Applicable

Record hour when criteria are fulfilled and the corresponding delay or volume in boxes provided.

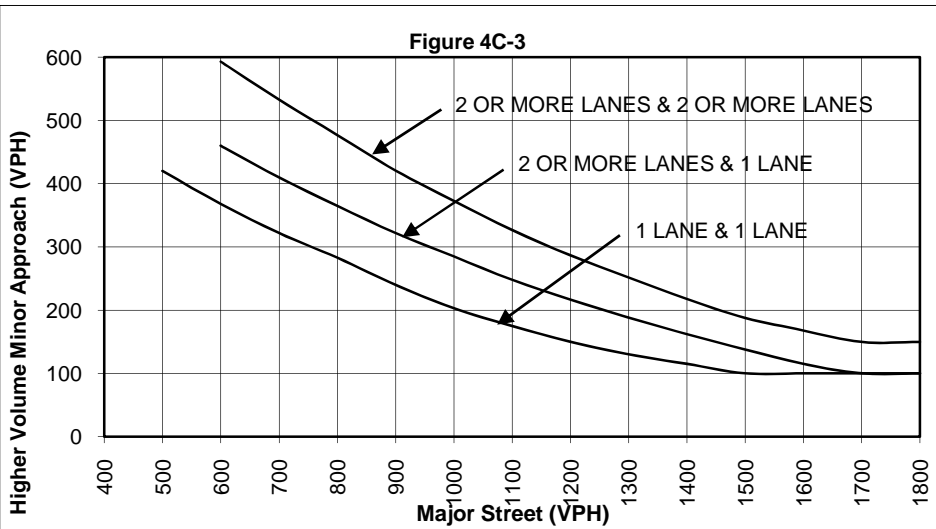
Peak Hour		
	-	

Criteria

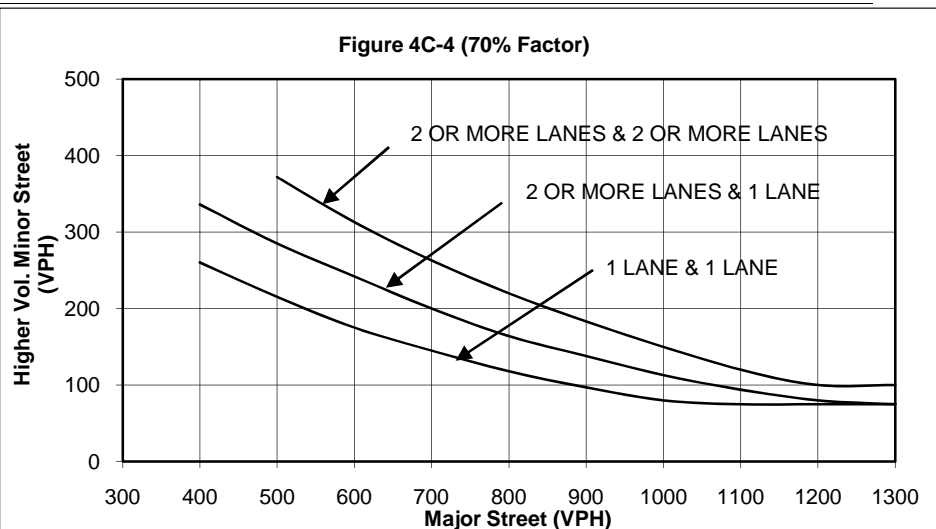
1. Delay on Minor Approach *(vehicle-hours)		
Approach Lanes	1	2
Delay Criteria*	4.0	5.0
Delay*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

2. Volume on Minor Approach *(vehicles per hour)		
Approach Lanes	1	2
Volume Criteria*	100	150
Volume*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

3. Total Entering Volume *(vehicles per hour)		
No. of Approaches	3	4
Volume Criteria*	650	800
Volume*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No



* Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume threshold for a minor street approach with one lane.



* Note: 100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

TRAFFIC SIGNAL WARRANT SUMMARY

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

WARRANT 4 - PEDESTRIAN VOLUME

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if condition 1 or 2 is fulfilled and condition 3 is fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria	Hour		Pedestrian Volume	Pedestrian Gaps	Fulfilled?	
					Yes	No
1. Pedestrian volume crossing the major street is 100 ped/hr or more for each of any four hours <u>and</u> there are less than 60 gaps/hour in the major street traffic stream of adequate length.	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
2. Pedestrian volume crossing the major street is 190 ped/hr or more for any one hour <u>and</u> there are less than 60 gaps/hour in the major street traffic stream of adequate length.	7:00 AM - 8:00 AM					X
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.					X	

WARRANT 5 - SCHOOL CROSSING

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria			Fulfilled?	
			Yes	No
1. A minimum of 20 students crossing the major street during the highest crossing hour.	Students:	Hour:		X
2. Fewer adequate gaps in the major street traffic stream during the period when the children are using the crossing than the number of minutes in the same period.	Minutes:	Gaps:		X
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.				X

WARRANT 6 - COORDINATED SIGNAL SYSTEM

Indicate if the criteria are fulfilled in the boxes provided. The warrant is satisfied if either criterion is fulfilled. This warrant should not be applied when the resulting signal spacing would be less than 300 m (1,000 ft).

Applicable: Yes No
Satisfied: Yes No

Criteria	Fulfilled?	
	Yes	No
1. On a one-way street or a street that has traffic predominately in one direction, the adjacent signals are so far apart that they do not provide the necessary degree of vehicle platooning.		X
2. On a two-way street, adjacent signals do not provide the necessary degree of platooning, and the proposed and adjacent signals will collectively provide a progressive operation.		X

TRAFFIC SIGNAL WARRANT SUMMARY

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

WARRANT 7 - CRASH EXPERIENCE

Record hours where criteria are fulfilled, the corresponding volume, and other information in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria	Hour	Volume	Met?		Fulfilled?	
			Yes	No	Yes	No
1. One of the warrants to the right is met.	Warrant 1, Condition A (56% satisfied)			✓		
	Warrant 1, Condition B (56% satisfied)			✓		
	Warrant 4, Pedestrian Volume at 80% of volume requirements: 80 ped/hr for four (4) hours or 152 ped/hr for one (1) hour				✓	✓
2. Adequate trial of other remedial measure has failed to reduce crash frequency.	Measure tried:	Flashing Beacon			✓	
3. Five or more reported crashes, of types susceptible to correction by signal, have occurred within a 12-mo. period.		Number of crashes per 12 months:		5	✓	

WARRANT 8 - ROADWAY NETWORK

Record hours where criteria are fulfilled, and the corresponding volume or other information in the boxes provided. The warrant is satisfied if at least one of the criteria is fulfilled and if all intersecting routes have one or more of the characteristics listed.

Applicable: Yes No
Satisfied: Yes No

Criteria	Met?		Fulfilled?		
	Yes	No	Yes	No	
1. Both of the criteria to the right are met.	a. Total entering volume of at least 1,000 veh/hr during a typical weekday peak hour.	Entering Volume: 433		✓	
	b. Five-year projected volumes that satisfy one or more of Warrants 1, 2, or 3.	Warrant: 1 2 3 Satisfied?:		✓	✓
2. Total entering volume at least 1,000 veh/hr for each of any 5 hrs of a non-normal business day (Sat. or Sun.)			← Hour		
			← Volume		✓

Characteristics of Major Routes	Met?		Fulfilled?	
	Yes	No	Yes	No
1. Part of the street or highway system that serves as the principal roadway network for through traffic flow.	Major Street:	✓		
	Minor Street:	✓		
2. Rural or suburban highway outside of, entering, or traversing a city.	Major Street:	✓		✓
	Minor Street:	✓		
3. Appears as a major route on an official plan.	Major Street:	✓		
	Minor Street:	✓		

CONCLUSIONS

Warrants Satisfied:

Remarks: _____

TRAFFIC SIGNAL WARRANT SUMMARY (5-Year Projection)

City: **Stanley, ND**
County: **Mountrail**

Organization: **UGPTI - ATAC**
Date: **February 24, 2010**

Major Street: **US 2** Lanes: **4** Critical Approach Speed: **45**
Minor Street: **ND 8** Lanes: **1**

Volume Level Criteria

- 1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
 - 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 1 - EIGHT-HOUR VEHICULAR VOLUME

Applicable: Yes No
Satisfied: Yes No

*Warrant 1 is satisfied if Condition A or Condition B is "100%" satisfied.
Warrant is also satisfied if both Condition A and Condition B are "80%" satisfied.*

Condition A - Minimum Vehicular Volume

100% Satisfied: Yes No
70% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					1		2 or more		16:00 - 17:00	15:00 - 16:00	8:00 - 9:00	17:00 - 18:00
	100%	70%	100%	70%								
Both Approaches on Major Street	500 (400)	350	600 (480)	420	452	449	474	404	439	428	436	398
Highest Approach on Minor Street	150 (120)	105	200 (160)	140	210	188	138	203	159	151	128	167

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

Condition B - Interruption of Continuous Traffic

Condition B is intended for application where the traffic volume is so heavy that traffic on the minor street suffers excessive delay.

Applicable: Yes No
Excessive Delay: Yes No
100% Satisfied: Yes No
80% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					1		2 or more		16:00 - 17:00	15:00 - 16:00	8:00 - 9:00	17:00 - 18:00
	100%	70%	100%	70%								
Both Approaches on Major Street	750 (600)	525	900 (720)	630	452	449	474	404	439	428	436	398
Highest Approach on Minor Street	75 (60)	53	100 (80)	70	210	188	138	203	159	151	128	167

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

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)

TRAFFIC SIGNAL WARRANT SUMMARY (5-Year Projection)

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

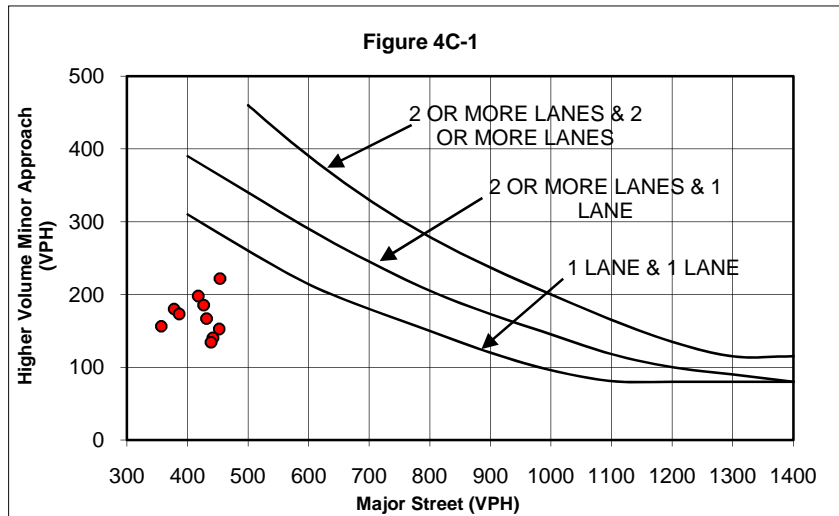
- 1. Is the critical speed of major street traffic > 70 km/h (40 mph) ? Yes No
 - 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 2 - FOUR-HOUR VEHICULAR VOLUME

If four or more points lie above the appropriate line, then the warrant is satisfied.

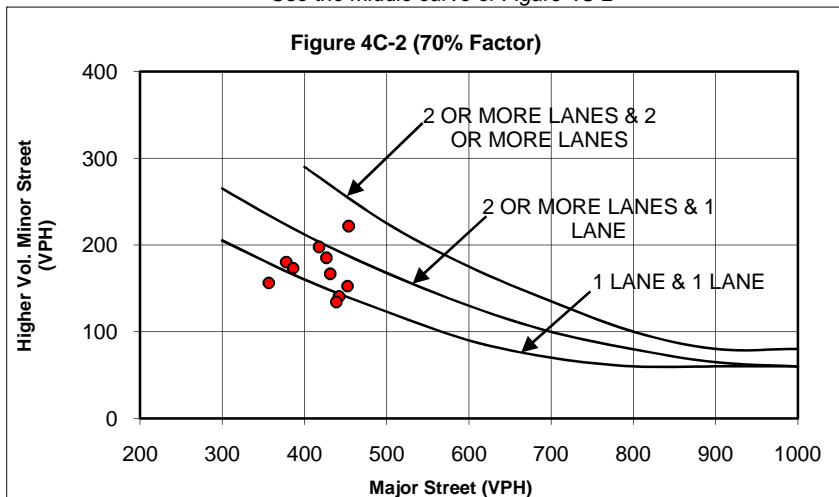
Applicable: Yes No
Satisfied: Yes No

Use the middle curve of Figure 4C-2



* Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

Use the middle curve of Figure 4C-2



* Note: 80 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 60 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

Four Highest Hours	Volumes	
	Major Street	Minor Street
3:45 PM - 4:45 PM	454	222
4:45 PM - 5:45 PM	418	198
2:30 PM - 3:30 PM	427	185
10:45 AM - 11:45 AM	431	167

TRAFFIC SIGNAL WARRANT SUMMARY (5-Year Projection)

City: Stanley, ND
County: Mountrail

Organization: UGPTI - ATAC
Date: February 24, 2010

Major Street: US 2
Minor Street: ND 8

Lanes: 4 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 3 - PEAK HOUR

If all three criteria are fulfilled (Condition A) or the plotted point lies above the appropriate line (Condition B), then the warrant is satisfied.

Applicable: Yes No
Satisfied: Yes No

Use the middle curve of Figure 4C-4

Unusual condition justifying use of warrant:

Not Applicable

Record hour when criteria are fulfilled and the corresponding delay or volume in boxes provided.

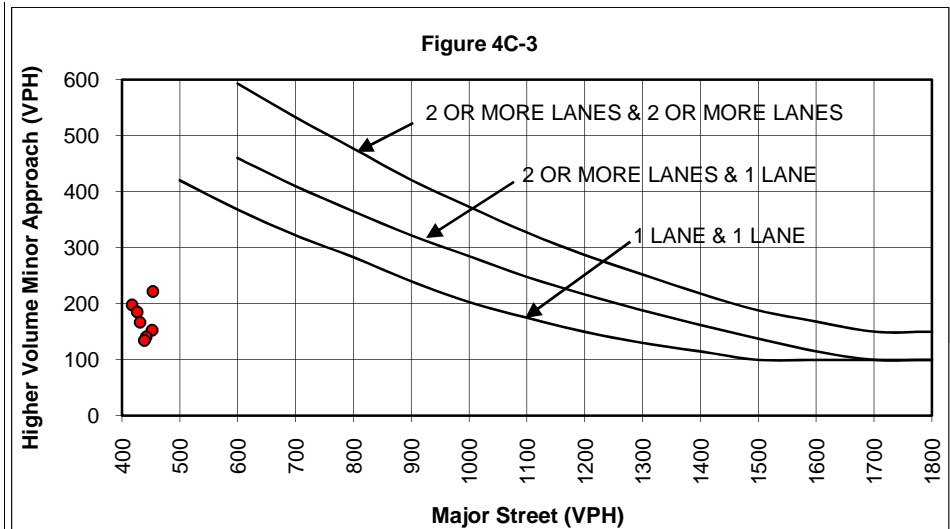
Peak Hour		
	-	

Criteria

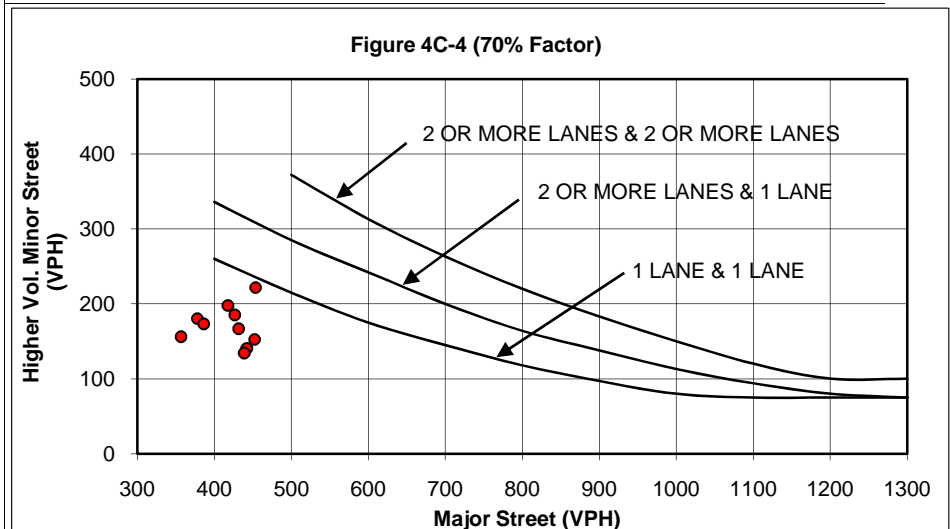
1. Delay on Minor Approach *(vehicle-hours)		
Approach Lanes	1	2
Delay Criteria*	4.0	5.0
Delay*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

2. Volume on Minor Approach *(vehicles per hour)		
Approach Lanes	1	2
Volume Criteria*	100	150
Volume*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

3. Total Entering Volume *(vehicles per hour)		
No. of Approaches	3	4
Volume Criteria*	650	800
Volume*		
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No



* Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume threshold for a minor street approach with one lane.



* Note: 100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume threshold for a minor street approach with one lane.