Interstate 90 Exit 32 to Exit 40 Corridor Study

Existing Traffic Operations

Technical Memorandum

March 19, 2018

Prepared for:
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Stantec

MEADE_IM 0901(195)32N_IM 0901(198)32N_I-90 Exit 32-40, Existing Conditions

I. STUDY ROADWAY SYSTEM AND FUNCTIONAL CLASSIFICATION

The project area is an approximate 10-mile section of Interstate 90 from northwest of Exit 32 in Sturgis to southeast of Exit 40 at Tilford. It includes four service interchanges:

- Exit 32, SR 79, Vanocker Canyon Road/Junction Avenue
- Exit 34, Black Hills National Cemetery/Pleasant Valley Drive
- Exit 37. Pleasant Valley Road
- Exit 40, Tilford Road

A map of the study area roadway network and functional classification is shown in **Figure 1**. Interstate 90 is the only Principal Arterial through the study area. At Exit 32, Junction Avenue is functionally classified as a Minor Arterial through the interchange, then transitions to a Major Collector south of I-90 as it becomes Vanocker Canyon Road. Pleasant Valley Road (Exit 37) and Tilford Road (Exit 40) are Minor Collectors, and Pleasant Valley Drive (Exit 34) is a Local Road.

All four interchanges are service interchanges of a diamond configuration and are unsignalized with STOP-control only on the exit ramp approach. At Exit 32, only during the Sturgis Motorcycle Rally, temporary signals are installed.

II. EXISTING TRAFFIC VOLUMES

Year 2017 existing traffic volumes were obtained from two sources:

1. Interstate 90 mainline 24-hour directional volumes were obtained at permanent automatic traffic recorder (ATR) stations from the South Dakota Department of Transportation. Traffic counts were obtained for the week of September 11 – 14, 2017 and included vehicle classification data.

2. Hourly intersection turning movement counts were collected by the consultant team on two occasions - August 8 - 9, 2017 (during the Sturgis Motorcycle Rally), and again on September 12, 2017. The counts collected during the rally (between 9:00 a.m. and 9:00 p.m.) were collected for reference purposes only and were provided to SDDOT to supplement turning movement counts collected during the rally from previous years. The counts obtained on September 12, 2017 were collected from 6:30 a.m. to 7:00 p.m. and were used as inputs to the intersection analyses. Both sets of counts included vehicle classification data.

The I-90 directional counts were corrected for daily and seasonal variation based on factors developed by the SDDOT from data collected at the weigh-in-motion station within the corridor ("WIM 901"). These are scaling factors that equate traffic counts by month of the year for which they are collected to an annual average daily traffic volume. Year 2017 average daily traffic volumes (ADT) for I-90 mainline study segments are shown in **Figure 2**.

Peak hour a.m. and p.m. intersection turning movements for study area intersections during the motorcycle rally are shown in **Figure 3**. Likewise, peak hour a.m. and p.m. intersection turning movements collected in September and used in the analyses are shown in **Figure 4**.

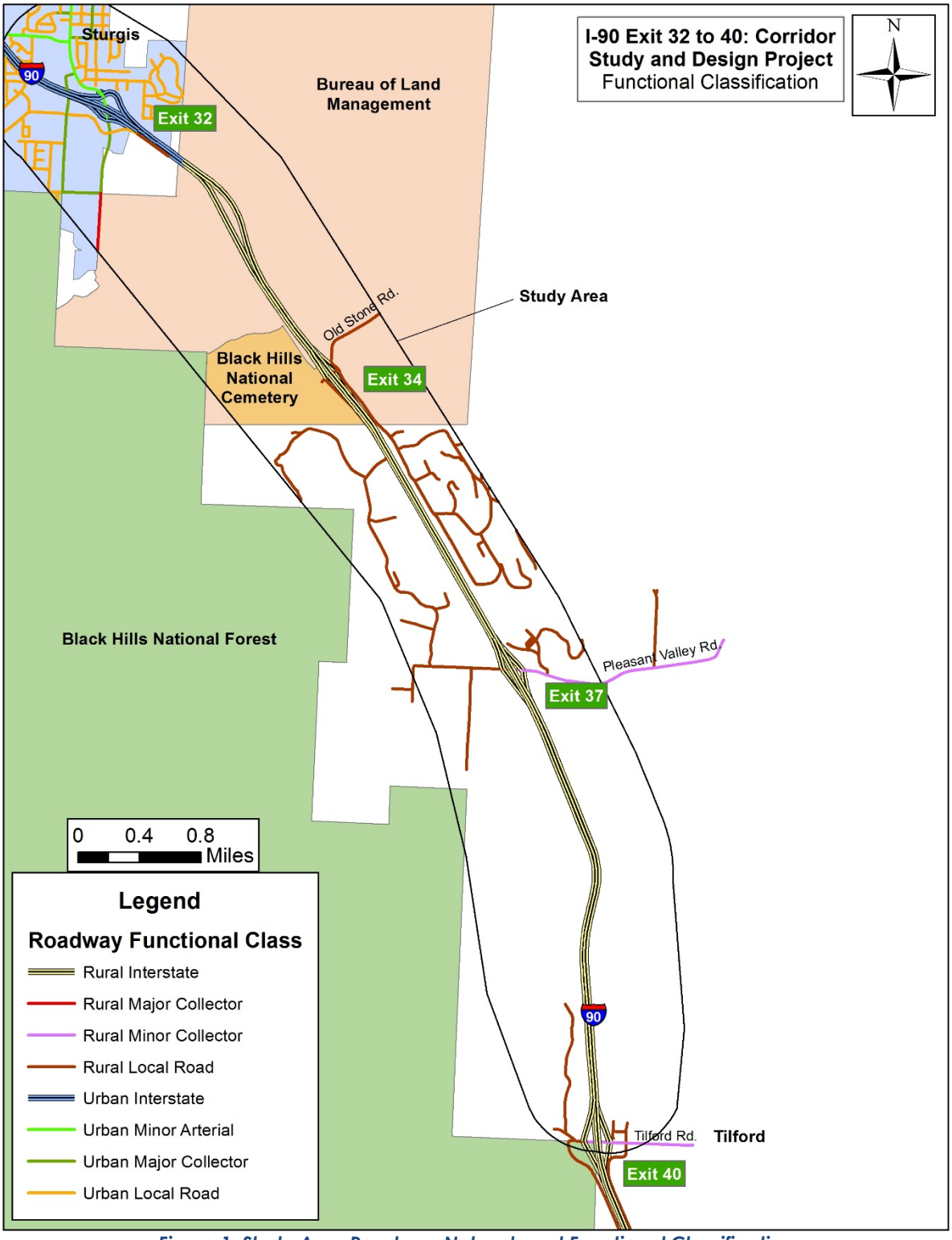


Figure 1. Study Area Roadway Network and Functional Classification

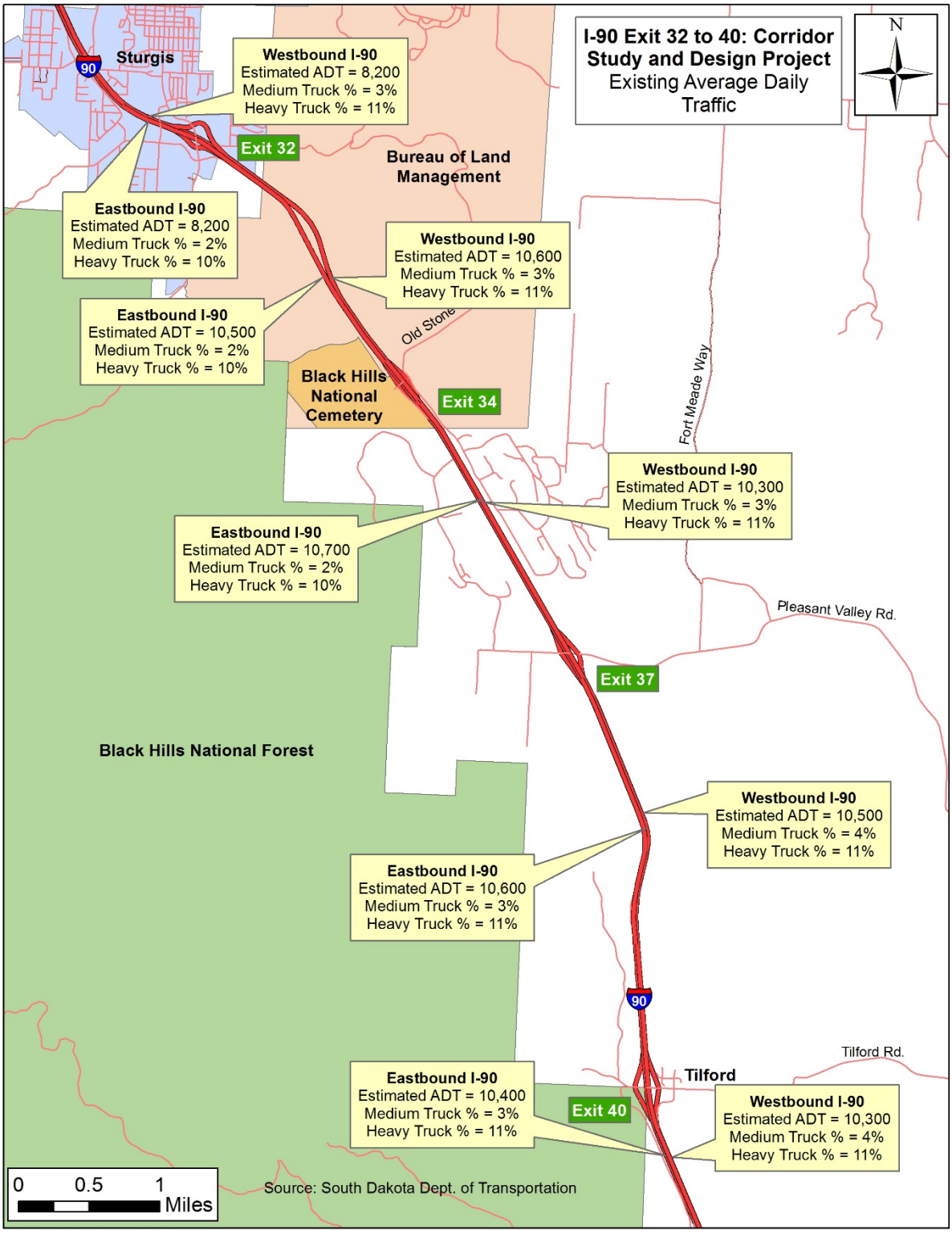


Figure 2. Existing Average Daily Traffic and Truck Percentages

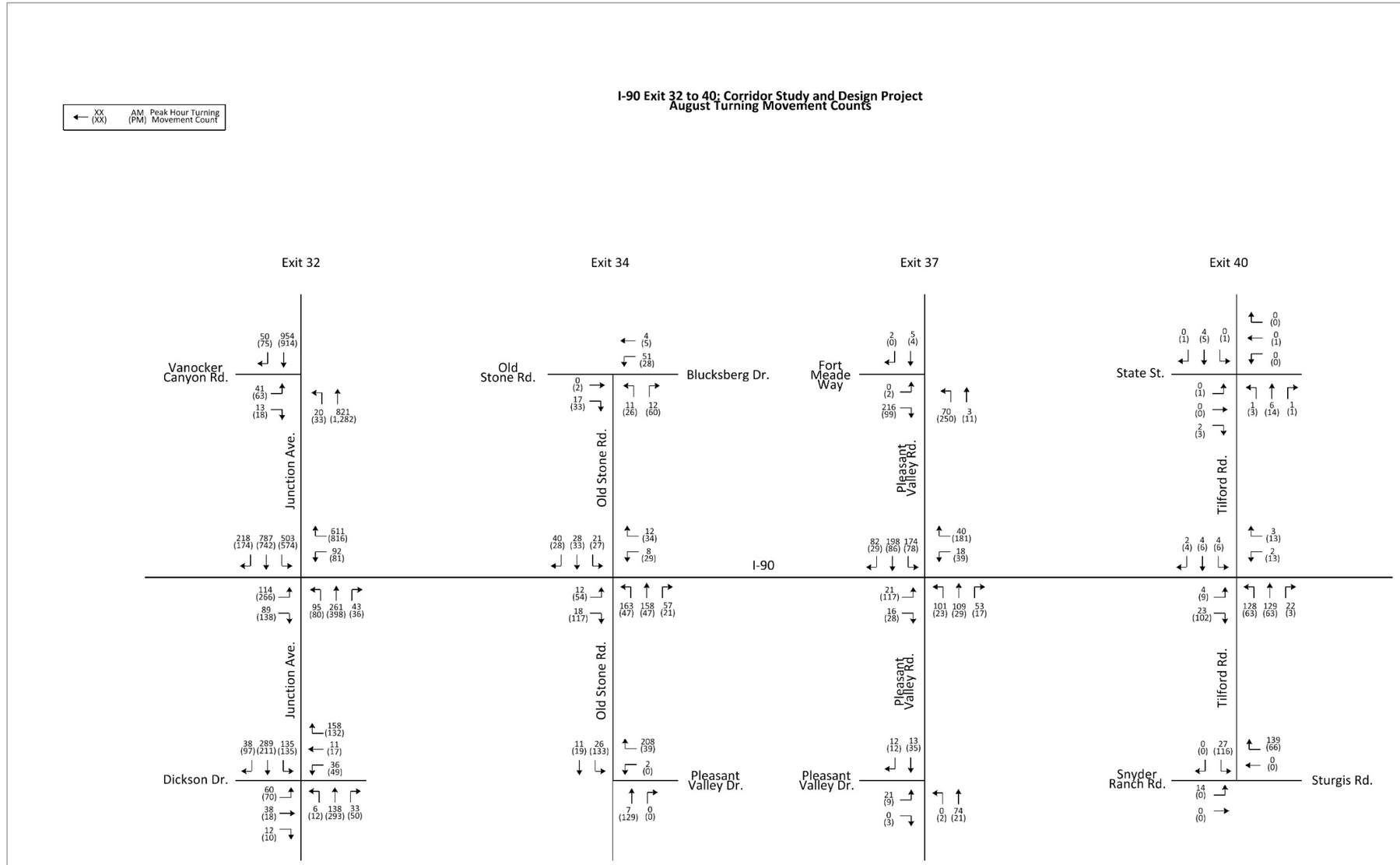


Figure 3. Intersection Turning Movement Counts - August 2017 Peak Hours

I-90 Exit 32 to 40: Corridor Study and Design Project
September Turning Movement Counts

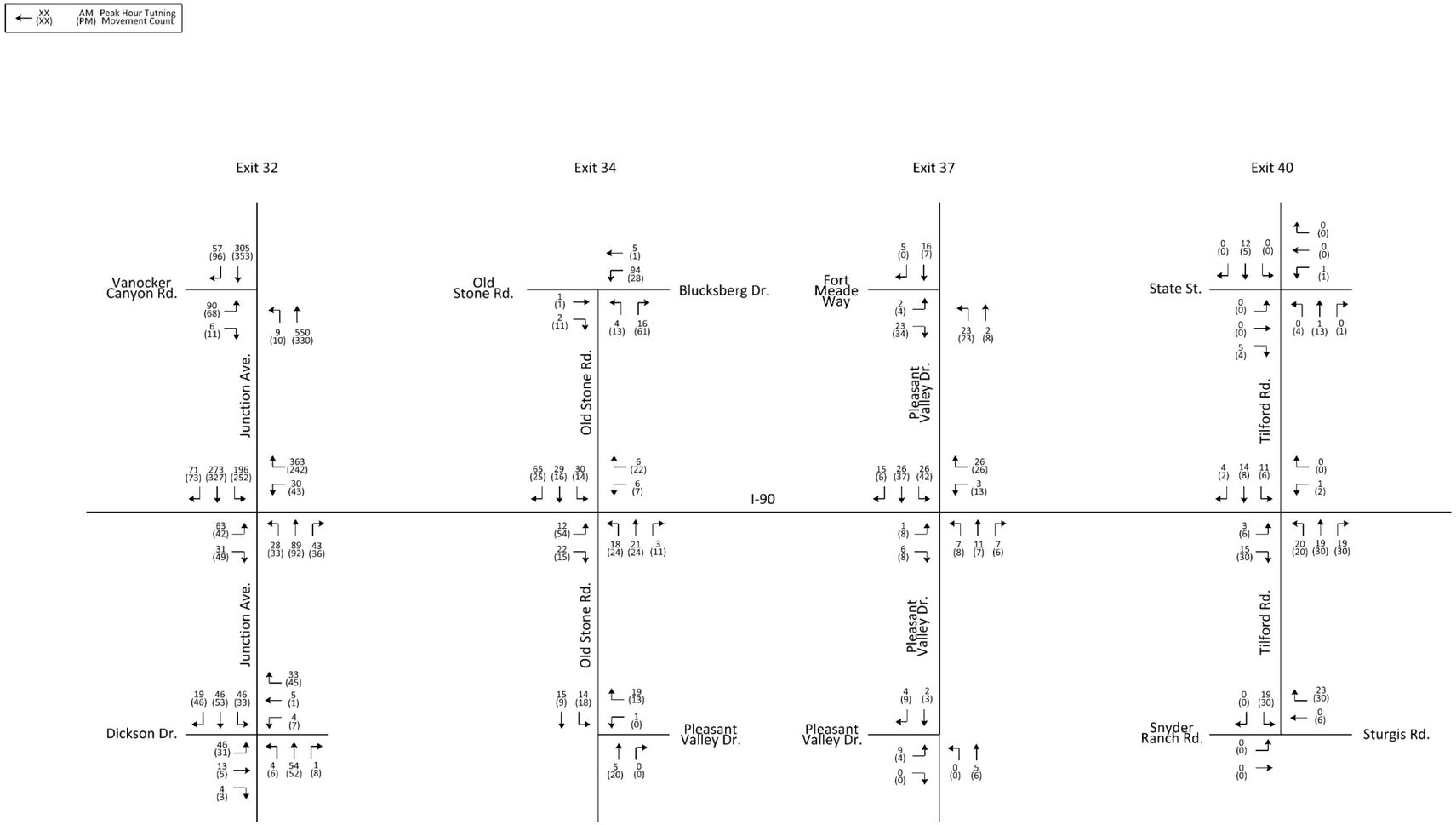


Figure 4. Intersection Turning Movement Counts - September 2017 Peak Hours

III. ANALYSIS OF CRASH DATA

Historical crash data were collected along the study area for the five-year period between 2012 and 2016 and constitute the "Analysis Period" for this report.

A. CRASH SEVERITY

Over the Analysis Period, there were 423 crashes in the study area. Of these, two resulted in fatalities, 21 resulted in incapacitating injuries, and 46 resulted in non-incapacitating injuries. **Figure 5** and **Figure 6** summarize the distribution of crashes by severity. It should be noted that 131 crashes were designated as "wild animal hit" crashes. Although this is not typically a crash severity category, it was included to highlight crashes that would be difficult to mitigate with safety improvements to the roadway.

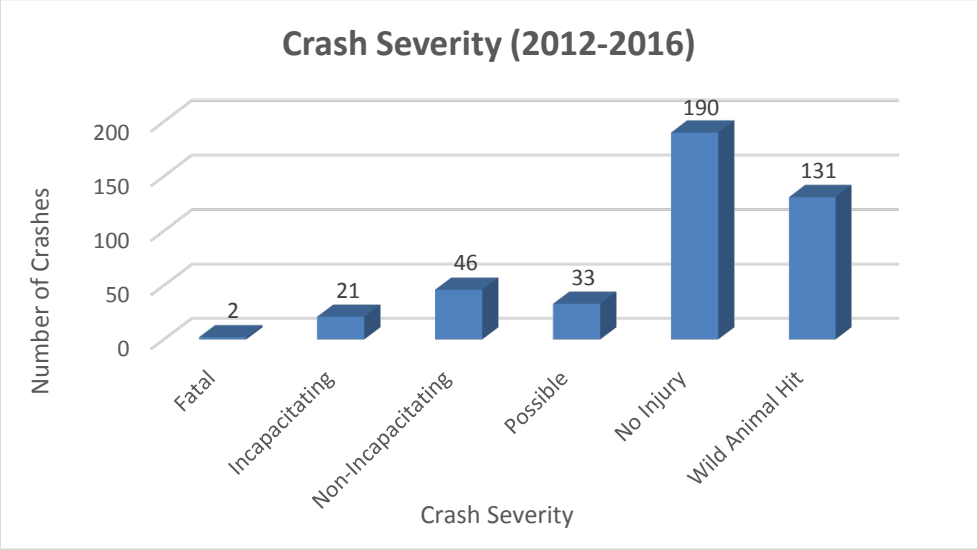


Figure 5. Distribution of Crashes by Severity

Crashes were evaluated by severity and by type. Crashes also were evaluated by location – first by segment, then by shorter 0.3-mile "spots."

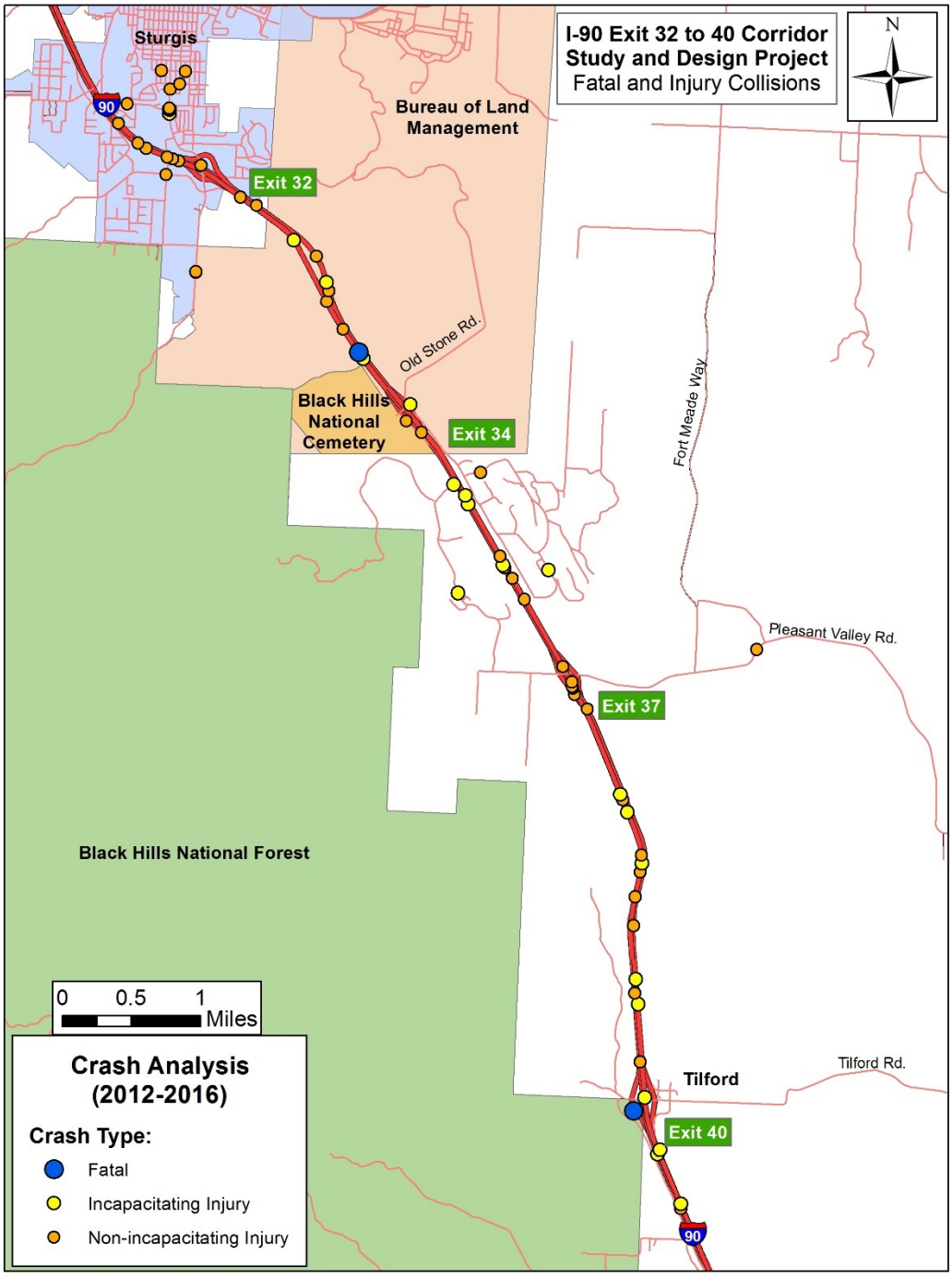


Figure 6. Locations of Fatal and Injury Collisions

B. CRASH TYPE

To better understand the crash history along this corridor, the crash types were examined based on the "Manner of Collision" field in the crash reports. **Figure 7** shows the distribution of crashes by crash type. Single vehicle crashes were the most common crash type (281 crashes, 66%) and were predominately run-off-the-road incidents. Animal collisions were the second most commonly reported crash type, however many of these collisions were coded as single vehicle collisions.

To further refine the crash history by crash type, the field "Events" in the crash reports was examined. This field allowed the respondent to choose one or more crash events such as "ran off road right" and "overturn/rollover." Of the 423 crashes, 167 (39 %) were coded as run-off-the-road collisions (ROR), which was the most common crash event. **Figure 8** summarizes the ROR collisions by location. There is a cluster of collisions at the horizontal curve (MRM 38.0-38.7) between Exit 37 and Exit 40. Of the 34 total collisions at this curve, 15 were ROR incidents and 19 occurred during wet weather conditions. (of the 15 ROR collisions, 12 occurred during wet weather conditions). Three of the 15 ROR collisions were coded as "Ran off left" and 12 were coded as "Ran off road right."

The second most common crash event was animal collisions, with 155 (37%) over the five-year analysis period. **Figure 9** summarizes the animal collisions by location. There is a cluster of animal collisions around Exit 37, with 44 crashes between MRM 36 and MRM 38. Thirty-one of these collisions occurred during low light conditions in an area where the roadway is not lighted.

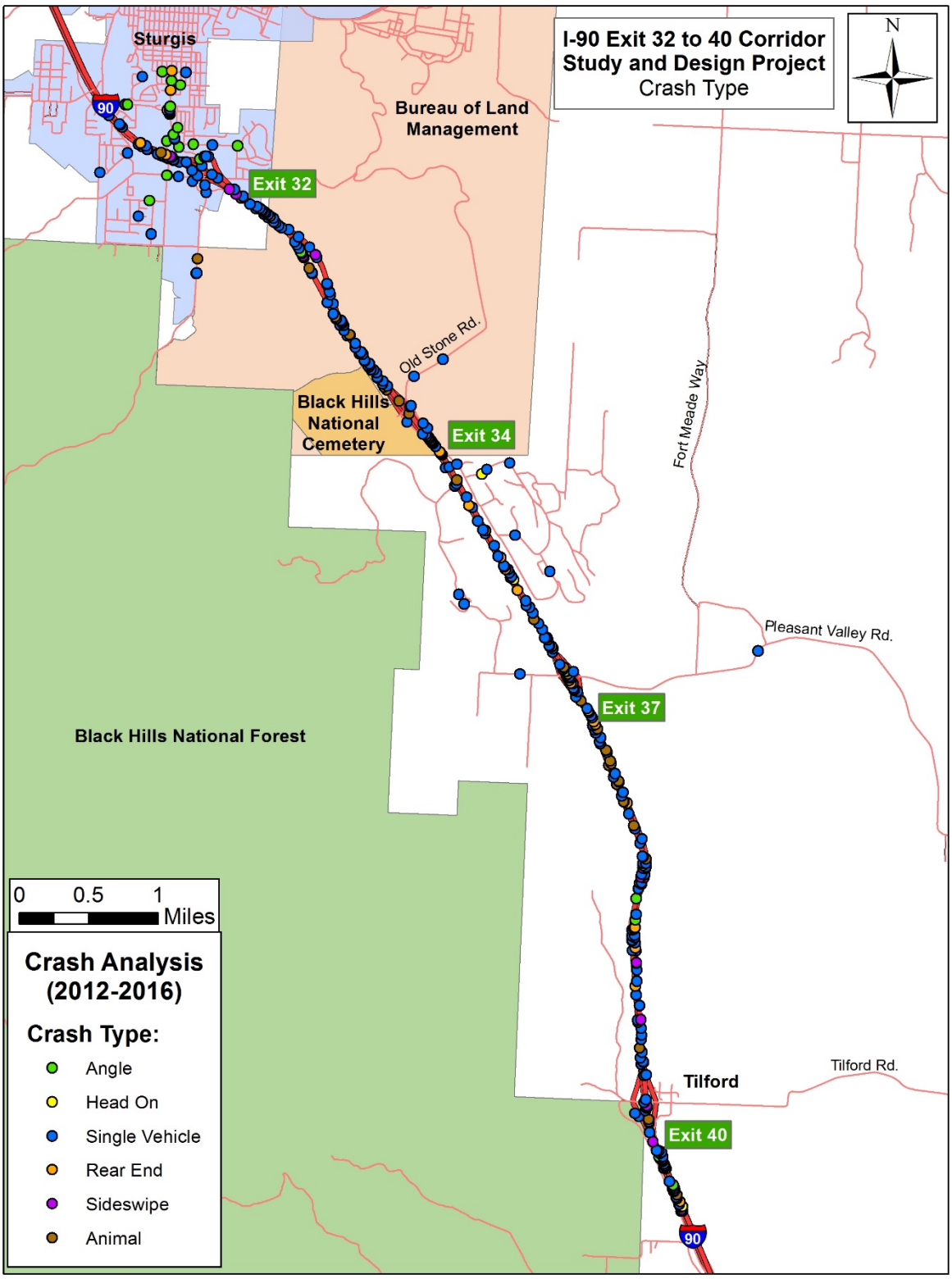


Figure 7. Distribution of Crashes by Type (2012 - 2016)

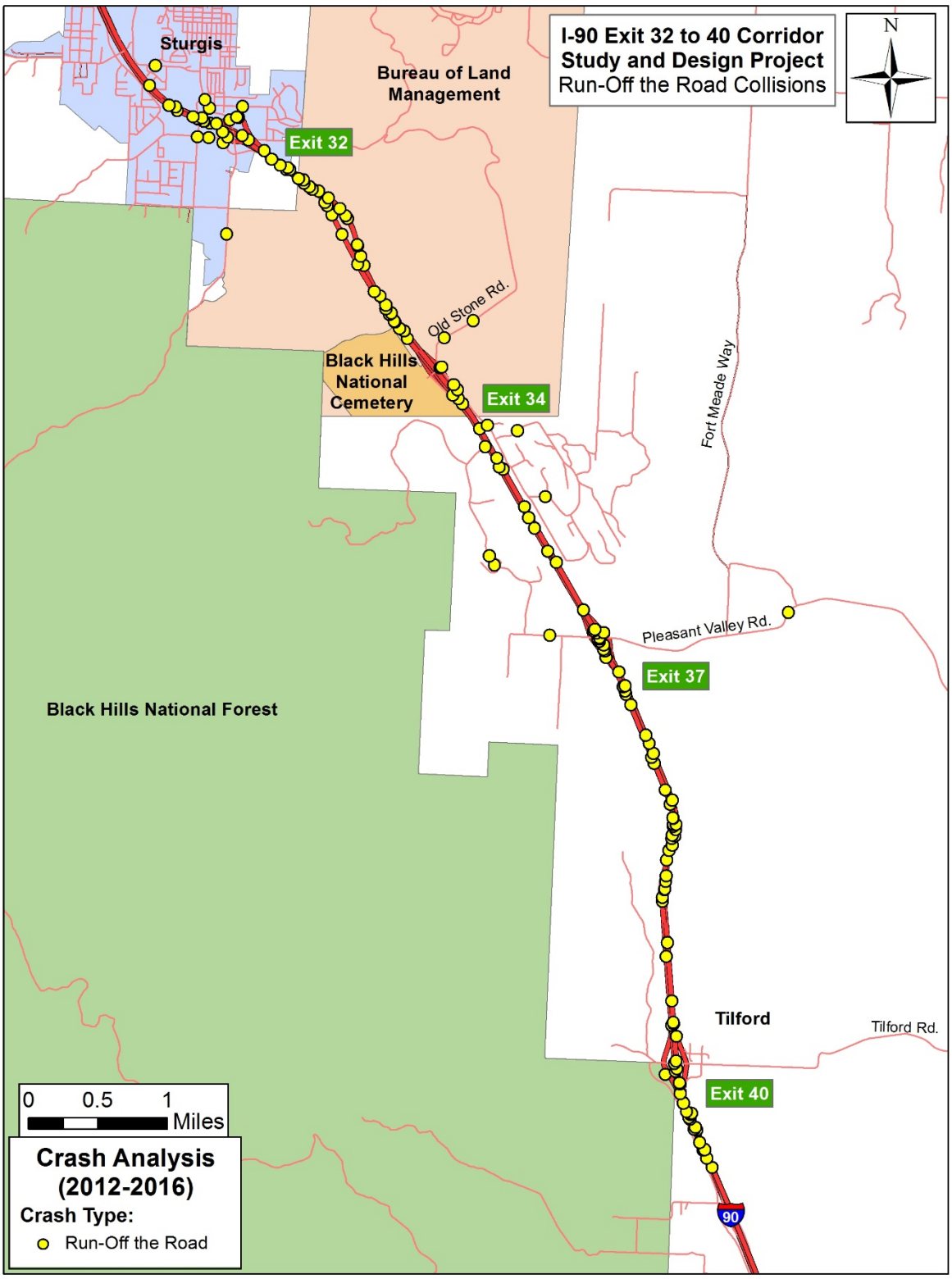


Figure 8. Run-off-the-Road Crash Locations (2012 - 2016)

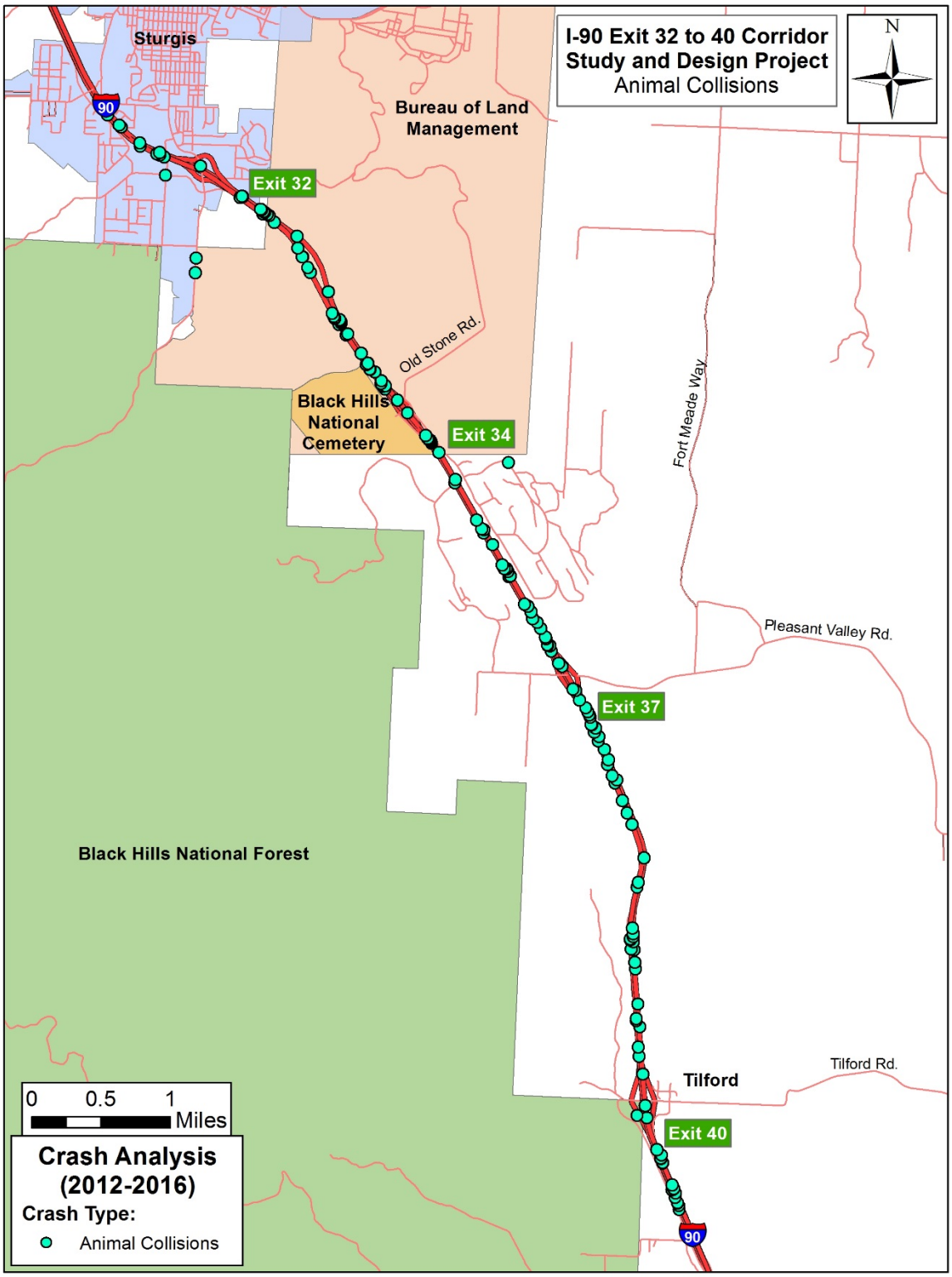


Figure 9. Animal Collision Locations (2012 - 2016)

C. SEGMENT ANALYSIS

A segment crash analysis was conducted on the study portion of I-90, and the results are shown in **Table 1**. For each segment, the number of crashes, segment length, and five-year ADT were evaluated to determine the crash rate. This crash rate was compared to the South Dakota statewide average for similar roadways in the state. Segment 5, east of Exit 40, was the only segment with a crash rate higher than the statewide average. However, the segment length for the end sections was arbitrary and the rates were based on locations of reported crashes within the functional area of interchanges at Exits 32 and 40. The computed crash rates for Segments 1 and 5, as shown in Table 1 are for informational purposes only and are not indicative of crash rates for those entire sections.

Table 1. Crash Analysis by Segment

Segment	Route	Description	Begin MRM	End MRM	Length (mi.)	Number of Crashes (2012-2016)	ADT[1] (veh./day)	Actual Crash Rate	Statewide Average Crash Rate[2]	Facility Type
								(Annual Crashes/100 million VMT[3])		
1	I-90	West of Exit 32	31.50	32.41	0.910[4]	39	14,132	166	302	Urban Interstate
2	I-90	Between Exits 32 & 34	32.41	34.81	2.400	79	18,546	97	302/129	Urban/Rural Interstate[5]
3	I-90	Between Exits 34 & 37	34.81	37.01	2.200	83	18,090	114	129	Rural Interstate
4	I-90	Between Exits 37 & 40	37.01	40.20	3.190	95	17,570	93	129	Rural Interstate
5	I-90	East of Exit 40	40.20	41.00	0.800[4]	37	17,528	145	129	Rural Interstate

[1] 5-year annual average (2012-2016)
[2] Source: South Dakota Accident Records
[3] Vehicle-Miles Traveled
[4] Segment lengths for end sections are arbitrary, based on locations of reported crashes within the functional area of interchanges at Exits 32 and 40. Computed crash rates are for informational purposes only and are not indicative of crash rates for those entire sections.
[5] Sturgis city limit lies at eastern terminus of Exit 32

D. SPOT ANALYSIS

In general, crashes were evenly distributed along the study portion of I-90. However, there are several 0.3-mile “hot-spots” with high concentrations of crashes. Table 2 presents a hot-spot crash analysis within the I-90 study area. Of the 423 crashes in the study area over the five-year period, 333 occurred on the 9.5-mile stretch of I-90, which equates to an average of 10.5 crashes per 0.3-miles. The spot with the highest number of crashes was located between Exit 32 and Exit 34 (MRM 33.0-33.3), with 43 crashes. The next highest crash location is located between Exit 34 and Exit 37 (MRM 36.0-36.3) with 34 crashes.

Table 2. Crash Analysis by 0.3-Mile Spot

Spot #	Begin MRM	End MRM	Crash Frequency	EPDO[1]	Alternative EPDO[2]	Number Killed	Number Incapacitating Injuries	Number Non-Incap Injuries	Animal Collisions	% Animal Collisions	Single Vehicle Collisions	% Single Vehicle Collisions	Ran off Road Left	Ran off Road Right	Wet Road	Wet Road %	Low Light	Low Light %
1	31.50	31.80	4	11.5	11.5	0	0	1	3	75.0%	1	25.0%	0	1	1	25.0%	2	50.0%
2	32.00	32.30	22	57.3	57.3	0	0	5	6	27.3%	12	54.5%	8	4	7	31.8%	6	27.3%
3	32.30	32.60	13	11.5	11.5	0	0	1	4	30.8%	7	53.8%	3	4	5	38.5%	3	23.1%
4	33.00	33.30	43	117.5	117.5	0	2	3	21	48.8%	20	46.5%	10	10	10	23.3%	27	62.8%
5	34.00	34.30	17	352.3	53.0	1	0	1	8	47.1%	8	47.1%	4	2	3	17.6%	11	64.7%
6	34.30	34.60	18	41.6	41.6	0	1	0	12	66.7%	6	33.3%	2	3	4	22.2%	13	72.2%
7	34.80	35.10	30	94.6	94.6	0	2	1	15	50.0%	11	36.7%	2	6	7	23.3%	15	50.0%
8	36.00	36.30	34	98.8	98.8	0	1	5	21	61.8%	8	23.5%	5	3	12	35.3%	20	58.8%
9	37.00	37.30	20	45.8	45.8	0	0	4	7	35.0%	7	35.0%	5	4	11	55.0%	11	55.0%
10	37.30	37.60	22	41.6	41.6	0	1	0	12	54.5%	8	36.4%	2	6	7	31.8%	9	40.9%
11	38.00	38.30	24	117.5	117.5	0	2	3	4	16.7%	15	62.5%	2	13	15	62.5%	10	41.7%
12	38.60	38.90	10	22.9	22.9	0	0	2	2	20.0%	5	50.0%	2	4	4	40.0%	5	50.0%
13	39.00	39.30	15	0.0	0.0	0	0	0	10	66.7%	3	20.0%	1	2	5	33.3%	10	66.7%
14	39.30	39.60	17	106.0	106.0	0	2	2	6	35.3%	9	52.9%	2	3	3	17.6%	8	47.1%
15	40.00	40.30	7	41.6	41.6	0	1	0	2	28.6%	3	42.9%	3	1	1	14.3%	4	57.1%
16	40.30	40.60	29	41.6	41.6	0	1	0	10	34.5%	15	51.7%	9	6	15	51.7%	12	41.4%
17	41.00	41.30	8	53.0	53.0	0	1	1	4	50.0%	1	12.5%	1	0	4	50.0%	4	50.0%

[1]EPDO - Equivalent Property Damage Only

[2]Fatal and Incapacitating Injuries combined so that fatalities are not overemphasized
https://safety.fhwa.dot.gov/hsip/resources/fhwasa09029/sec2.cfm

Severity	Cost	$f_{(weight)}$
K (Fatal Injury)	$11,213,000	340.82
A (Incapacitating Injury)	$1,367,100	41.55
B (Non-incapacitating Injury)	$376,800	11.45
C (Possible Injury)	$174,100	5.29
O (Property Damage Only)	$32,900	1.00

$f_{(weight)}$ - EPDO weighting factor

An analysis of the 0.3-mile-long segments throughout the corridor identified five "hot spots.":

1. Spot 4 (MRM 33.00 – MRM 33.30) – 43 total crashes

   Twenty (47%) of the collisions at this location single vehicle collisions, all of which were run-off-the-road collisions with an equal number exiting the road to the left and right. Twenty-seven (63%) of the collisions occurred under low light conditions.

2. Spot 8 (MRM 36.00 – MRM 36.30) – 34 total crashes

   There is location where the vertical geometry (i.e. curve) could be considered suspect. Twenty-one (62%) of the collisions at this location were animal collisions. Twenty (59%) of the collisions occurred under low light conditions.

3. Spot 7 (MRM 34.80 – MRM 35.10) – 30 total crashes

   Fifteen (50%) of the collisions at this location were animal collisions and fifteen (50%) of the collisions occurred during low light conditions.

4. Spot 16 (MRM 40.30 – MRM 40.60) – 29 total crashes

   Fifteen (52%) were single vehicle collisions, five of which were cross median/centerline collisions. Fifteen (52%) of the collisions at this location occurred during wet road conditions.

5. Spot 11 (MRM 38.00 – MRM 38.30) – 24 total crashes

   There is one inadequate horizontal curve and one inadequate vertical curve at this location. Fifteen (63%) of the collisions were single vehicle collisions, eight of which were overturn/rollover collisions.

A map of the top five spots is shown in **Figure 10**. The two segments with the highest and second highest crash frequencies, Spot 4 and Spot 8, can be considered as locations for further study. The spots with the third and fourth highest crash frequencies, Spot 7 and Spot 16, are both located near interchanges. Spot 7 is located near Exit 34 and Spot 16 is located near Exit 40. The most common crash type at Spot 7 was animal collisions and the most common crash type at Spot 16 was single vehicle collisions. The spot with the fifth highest crash frequency was Spot 11, which also could be considered for further study.

Screening locations for further study can include the use of additional safety performance measures such as:

- Equivalent Property Damage Only (EPDO)
- Excess expected average crash frequency using safety performance functions (SPF's)

This is consistent with guidance provided in the Highway Safety Manual (HSM).

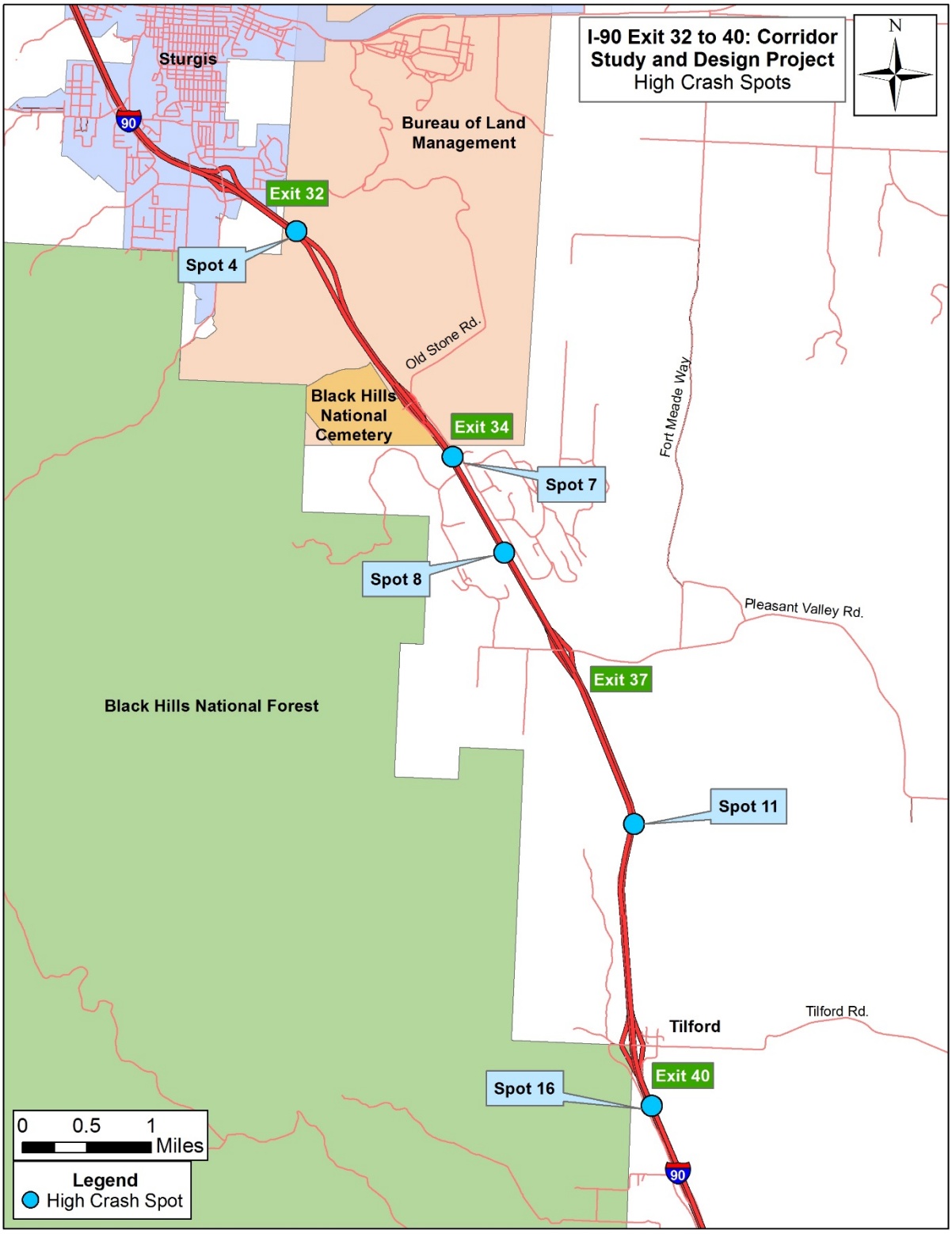


Figure 10. Top Five Crash "Hot Spots"

IV. TRAFFIC OPERATIONS

Existing traffic operations were assessed using methods prescribed in the Highway Capacity Manual (HCM) 6th Edition[1]. Operations were assessed for existing weekday a.m. and p.m. peak hour traffic conditions based on traffic counts and other data collected in September 2017. "Operations" were quantified based on performance measures associated with analytical methods for the following facility types within the project study area:

- Freeway Facilities (Chapter 10)
- Two-Way STOP-Controlled Intersections (Chapter 20)

A. I-90 FREEWAY SEGMENTS

The Interstate 90 mainline was evaluated using the Freeway Facilities methodology of the HCM. The method analyzes an extended length of freeway composed of continuously connected basic freeway, weaving, merge, and diverge segments. The methodology analyzes the connected segments over a set of sequential 15-minute time periods. The HCM core freeway facility method generates the following performance measures for each segment and time period:

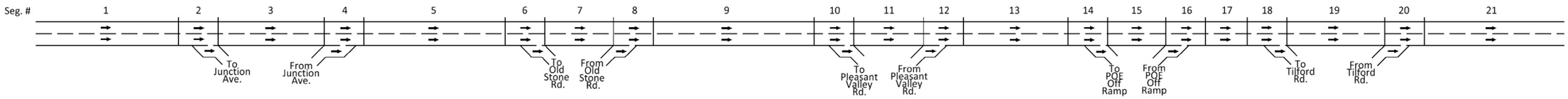
- Capacity
- Free-flow speed
- Demand-to-capacity (D/C) and volume-to-capacity (V/C) ratios
- Average speed (space mean speed)
- Average density
- Travel time (minutes per vehicle)
- Vehicle miles traveled (VMT)
- Vehicle hours of travel (VHT)
- Vehicle hours of delay (VHD)
- Motorized vehicle level of service (LOS) for each component and for the facility

Additionally, space mean speed, average density, travel time, VMT, VHT, VHD, and LOS are aggregated in each time interval across all segments in the facility. Performance measures are not aggregated across time periods, however.

Freeway Facilities analyses of existing conditions were performed for the a.m. peak period (7:00 – 8:30 a.m.) and for the p.m. peak period (4:00 – 5:30 p.m.), as determined from the traffic counts. The Freeway Facilities method is a directional analysis. For individual segments, the following performance measures are reported: average travel speed (mph), density (pc/mi/ln), LOS, and demand-to-capacity ratio (D/C). For the a.m. peak, these are summarized for the eastbound direction in **Figure 11** and for the westbound direction they are summarized in **Figure 12**. For the p.m. peak, these measures are summarized for the eastbound direction in **Figure 13** and for the westbound direction they are summarized in **Figure 14**.

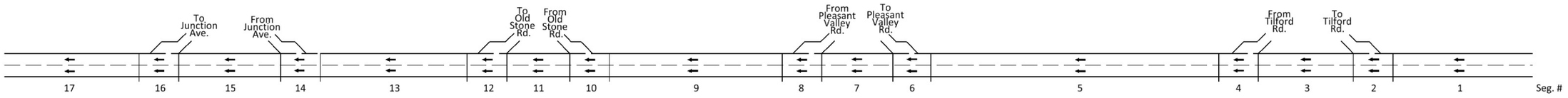
According to the HCM, studies on LOS perception by rural travelers indicate the presence of lower-density thresholds in comparison to urban freeway travelers. The Freeway Facilities method presents different LOS thresholds, both based on the same density criterion, for urban versus rural areas, as shown in **Table 3**. These different thresholds apply only to the facility-level analysis; for the individual segments, the LOS thresholds as defined for the different components, including basic segments, merge and diverge segments, etc. and do not differentiate between urban vs. rural. The majority of the I-90 study section is located outside the Sturgis city limits, thus the entire corridor was evaluated as a rural facility. Facility results by time period are presented in **Table 4**. Overall facility results are presented in **Table 5**.

[1] *Highway Capacity Manual 6th Edition: A Guide for Multimodal Mobility Analysis*, Transportation Research Board, National Academies, Washington, D.C., 2016.



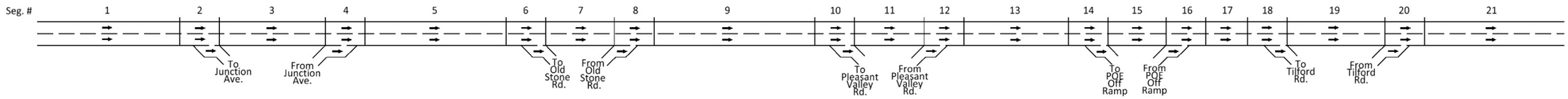
Segment #	Seg-1	Seg-2	Seg-3	Seg-4	Seg-5	Seg-6	Seg-7	Seg-8	Seg-9	Seg-10	Seg-11	Seg-12	Seg-13	Seg-14	Seg-15	Seg-16	Seg-17	Seg-18	Seg-19	Seg-20	Seg-21
Type	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic
Average Speed																					
07:00 - 07:15	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.7	70.0
07:15 - 07:30	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
07:30 - 07:45	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
07:45 - 08:00	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
08:00 - 08:15	74.0	60.3	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
08:15 - 08:30	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
Density (pc/mi/ln)																					
07:00 - 07:15	1.2	1.5	1.0	1.7	1.6	2.0	1.5	1.8	1.6	1.9	1.6	1.9	1.7	2.1	1.7	1.9	1.7	2.1	1.7	1.9	1.8
07:15 - 07:30	1.1	1.4	0.9	1.7	1.5	1.9	1.5	1.8	1.6	1.9	1.5	1.9	1.7	2.1	1.7	1.9	1.7	2.1	1.6	1.9	1.8
07:30 - 07:45	1.3	1.6	1.0	1.7	1.5	1.9	1.4	1.7	1.5	1.8	1.5	1.8	1.6	2.0	1.6	1.8	1.6	2.0	1.5	1.8	1.7
07:45 - 08:00	1.0	1.2	0.8	1.3	1.2	1.4	1.1	1.3	1.1	1.4	1.1	1.4	1.2	1.5	1.2	1.4	1.2	1.5	1.1	1.4	1.3
08:00 - 08:15	0.8	1.0	0.7	1.3	1.2	1.5	1.1	1.3	1.2	1.5	1.1	1.4	1.2	1.5	1.2	1.4	1.2	1.5	1.1	1.4	1.3
08:15 - 08:30	1.1	1.3	0.9	1.4	1.3	1.6	1.2	1.4	1.2	1.5	1.2	1.5	1.3	1.6	1.3	1.4	1.3	1.6	1.2	1.4	1.3
Level of Service (LOS)																					
07:00 - 07:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:15 - 07:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:30 - 07:45	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:45 - 08:00	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
08:00 - 08:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
08:15 - 08:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Demand-to-Capacity (D/C) Ratio																					
07:00 - 07:15	0.04	0.04	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
07:15 - 07:30	0.04	0.04	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
07:30 - 07:45	0.04	0.04	0.03	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
07:45 - 08:00	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
08:00 - 08:15	0.03	0.03	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
08:15 - 08:30	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Figure 11. Existing Conditions - Interstate 90 Eastbound, A.M. Peak



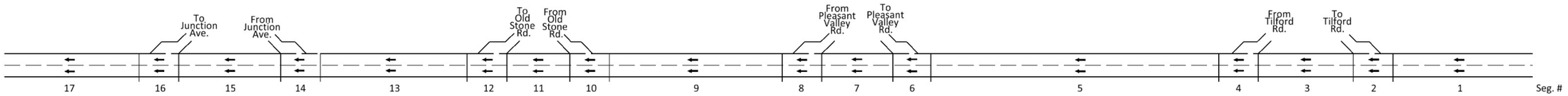
Segment #	Seg-17	Seg-16	Seg-15	Seg-14	Seg-13	Seg-12	Seg-11	Seg-10	Seg-9	Seg-8	Seg-7	Seg-6	Seg-5	Seg-4	Seg-3	Seg-2	Seg-1
Type	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic
Average Speed																	
07:00 - 07:15	75.0	65.5	74.0	60.1	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
07:15 - 07:30	75.0	65.5	74.0	59.9	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
07:30 - 07:45	75.0	65.5	74.0	59.9	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
07:45 - 08:00	75.0	65.5	74.0	60.0	75.0	66.3	75.0	60.8	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
08:00 - 08:15	75.0	65.5	74.0	60.1	75.0	66.3	75.0	60.8	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
08:15 - 08:30	75.0	65.5	74.0	60.1	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	64.8	73.0	59.7	68.0
Density (pc/mi/ln)																	
07:00 - 07:15	1.0	1.1	0.8	1.6	1.3	1.4	1.2	1.5	1.2	1.4	1.2	1.5	1.2	1.4	1.2	1.5	1.3
07:15 - 07:30	1.0	1.1	0.8	2.2	1.8	2.0	1.6	2.0	1.6	1.8	1.6	2.0	1.6	1.9	1.6	2.0	1.8
07:30 - 07:45	1.1	1.2	0.8	2.3	1.8	2.0	1.5	1.9	1.6	1.8	1.5	2.0	1.6	1.9	1.6	1.9	1.7
07:45 - 08:00	0.9	1.0	0.8	1.9	1.5	1.7	1.4	1.7	1.4	1.6	1.4	1.7	1.4	1.6	1.4	1.8	1.5
08:00 - 08:15	1.1	1.2	0.9	1.7	1.3	1.5	1.3	1.6	1.3	1.5	1.3	1.6	1.4	1.5	1.4	1.7	1.5
08:15 - 08:30	1.1	1.2	0.9	1.7	1.3	1.5	1.3	1.6	1.3	1.5	1.2	1.6	1.3	1.5	1.3	1.5	1.4
Level of Service (LOS)																	
07:00 - 07:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:15 - 07:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:30 - 07:45	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
07:45 - 08:00	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
08:00 - 08:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
08:15 - 08:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Demand-to-Capacity (D/C) Ratio																	
07:00 - 07:15	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
07:15 - 07:30	0.03	0.03	0.02	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
07:30 - 07:45	0.03	0.03	0.03	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
07:45 - 08:00	0.03	0.03	0.02	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
08:00 - 08:15	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
08:15 - 08:30	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Figure 12. Existing Conditions - Interstate 90 Westbound, A.M. Peak



Segment #	Seg-1	Seg-2	Seg-3	Seg-4	Seg-5	Seg-6	Seg-7	Seg-8	Seg-9	Seg-10	Seg-11	Seg-12	Seg-13	Seg-14	Seg-15	Seg-16	Seg-17	Seg-18	Seg-19	Seg-20	Seg-21
Type	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic
Average Speed																					
16:00 - 16:15	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	53.5	65.1	73.0	59.7	75.0	65.7	70.0
16:15 - 16:30	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.7	70.0
16:30 - 16:45	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.7	70.0
16:45 - 17:00	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
17:00 - 17:15	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
17:15 - 17:30	74.0	60.2	75.0	65.7	73.0	59.7	75.0	65.6	74.0	60.3	74.0	64.1	73.0	59.7	73.0	65.1	73.0	59.7	75.0	65.8	70.0
Density (pc/mi/ln)																					
16:00 - 16:15	1.3	1.6	1.1	1.9	1.8	2.2	1.6	1.9	1.7	2.1	1.6	2.0	1.8	2.2	2.4	2.0	1.8	2.2	1.7	1.9	1.8
16:15 - 16:30	1.4	1.7	1.2	2.0	1.9	2.3	1.7	2.0	1.8	2.2	1.8	2.2	1.9	2.3	1.9	2.1	1.9	2.3	1.7	2.0	1.9
16:30 - 16:45	1.3	1.6	1.1	1.9	1.8	2.2	1.6	1.9	1.7	2.1	1.6	2.1	1.8	2.2	1.8	2.0	1.8	2.2	1.7	1.9	1.8
16:45 - 17:00	1.4	1.7	1.2	1.8	1.7	2.0	1.5	1.8	1.6	1.9	1.5	1.8	1.6	2.0	1.6	1.8	1.6	2.0	1.5	1.8	1.7
17:00 - 17:15	1.3	1.6	1.1	1.9	1.8	2.1	1.6	1.8	1.6	2.0	1.6	2.0	1.8	2.2	1.8	2.0	1.8	2.2	1.6	1.9	1.8
17:15 - 17:30	1.1	1.4	1.0	1.6	1.5	1.9	1.3	1.6	1.4	1.7	1.4	1.7	1.5	1.8	1.5	1.7	1.5	1.8	1.4	1.6	1.5
Level of Service (LOS)																					
16:00 - 16:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:15 - 16:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:30 - 16:45	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:45 - 17:00	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
17:00 - 17:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
17:15 - 17:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Demand-to-Capacity (D/C) Ratio																					
16:00 - 16:15	0.04	0.04	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16:15 - 16:30	0.04	0.04	0.04	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05
16:30 - 16:45	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16:45 - 17:00	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
17:00 - 17:15	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
17:15 - 17:30	0.04	0.04	0.03	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.05

Figure 13. Existing Conditions - Interstate 90 Eastbound, P.M. Peak



Segment #	Seg-17	Seg-16	Seg-15	Seg-14	Seg-13	Seg-12	Seg-11	Seg-10	Seg-9	Seg-8	Seg-7	Seg-6	Seg-5	Seg-4	Seg-3	Seg-2	Seg-1
Type	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic	Merge	Basic	Diverge	Basic
Average Speed																	
16:00 - 16:15	75.0	66.2	75.0	60.6	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
16:15 - 16:30	75.0	66.2	75.0	60.7	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
16:30 - 16:45	75.0	66.2	75.0	60.7	75.0	66.3	75.0	60.8	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
16:45 - 17:00	75.0	66.2	75.0	60.6	75.0	66.3	75.0	60.9	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
17:00 - 17:15	75.0	66.2	75.0	60.6	75.0	66.3	75.0	60.8	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
17:15 - 17:30	75.0	66.2	75.0	60.6	75.0	66.3	75.0	60.8	75.0	66.2	75.0	60.8	74.0	62.6	70.0	58.0	68.0
Density (pc/mi/ln)																	
16:00 - 16:15	1.1	1.4	1.0	1.8	1.6	1.8	1.5	2.0	1.6	1.8	1.5	2.0	1.6	1.9	1.7	2.0	1.7
16:15 - 16:30	1.2	1.5	1.1	2.0	1.6	1.8	1.5	1.9	1.5	1.7	1.5	2.0	1.6	1.9	1.7	2.1	1.7
16:30 - 16:45	1.1	1.4	1.0	1.8	1.5	1.7	1.4	1.8	1.4	1.6	1.4	1.8	1.5	1.8	1.6	1.9	1.6
16:45 - 17:00	1.1	1.4	1.0	2.0	1.6	1.8	1.5	1.9	1.6	1.8	1.5	1.9	1.6	1.9	1.6	2.0	1.7
17:00 - 17:15	1.2	1.5	1.1	2.3	1.8	2.0	1.7	2.2	1.8	2.0	1.8	2.3	1.9	2.2	1.9	2.3	2.0
17:15 - 17:30	1.2	1.5	1.2	2.3	1.9	2.1	1.8	2.3	1.9	2.1	1.8	2.3	1.9	2.3	2.0	2.4	2.1
Level of Service (LOS)																	
16:00 - 16:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:15 - 16:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:30 - 16:45	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16:45 - 17:00	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
17:00 - 17:15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
17:15 - 17:30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Demand-to-Capacity (D/C) Ratio																	
16:00 - 16:15	0.03	0.04	0.03	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16:15 - 16:30	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16:30 - 16:45	0.03	0.04	0.03	0.05	0.05	0.05	0.04	0.05	0.05	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
16:45 - 17:00	0.03	0.04	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
17:00 - 17:15	0.04	0.04	0.04	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06
17:15 - 17:30	0.04	0.04	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Figure 14. Existing Conditions - Interstate 90 Westbound, P.M. Peak

Table 3. LOS Criteria for Urban and Rural Freeway Facilities

LOS	Freeway Facility Density (pc/mi/ln)	
	Urban	Rural
A	≤ 11	≤ 6
B	> 11 - 18	> 6 - 14
C	> 18 - 26	> 14 - 22
D	> 26 - 35	> 22 - 29
E	> 35 - 45	> 29 - 39
F	> 45 or any component D/C > 1.00	> 39 or

Source: HCM 6th Edition

Table 4. Facility Results by Time Period

A.M. Peak		Eastbound				Westbound			
Period	Time	Speed (mi/h)	Density (pc/mi/ln)	Travel Time (min)	LOS	Speed (mi/h)	Density (pc/mi/ln)	Travel Time (min)	LOS
1	07:00 - 07:15	70.1	1.6	9.3	A	71.3	1.2	9.4	A
2	07:15 - 07:30	70.1	1.6	9.3	A	71.3	1.6	9.4	A
3	07:30 - 07:45	70.2	1.6	9.3	A	71.3	1.6	9.4	A
4	07:45 - 08:00	70.2	1.2	9.3	A	71.3	1.4	9.4	A
5	08:00 - 08:15	70.1	1.2	9.3	A	71.2	1.4	9.4	A
6	08:15 - 08:30	70.2	1.3	9.3	A	71.3	1.3	9.4	A

P.M. Peak		Eastbound				Westbound			
Period	Time	Speed (mi/h)	Density (pc/mi/ln)	Travel Time (min)	LOS	Speed (mi/h)	Density (pc/mi/ln)	Travel Time (min)	LOS
1	16:00 - 16:15	69.1	1.8	9.5	A	71.0	1.6	9.4	A
2	16:15 - 16:30	70.1	1.8	9.3	A	71.0	1.6	9.4	A
3	16:30 - 16:45	70.1	1.7	9.3	A	71.0	1.5	9.4	A
4	16:45 - 17:00	70.2	1.6	9.3	A	71.0	1.6	9.4	A
5	17:00 - 17:15	70.1	1.7	9.3	A	71.0	1.8	9.4	A
6	17:15 - 17:30	70.2	1.4	9.3	A	71.0	1.9	9.4	A

Table 5. Overall Facility Results

Analysis Direction	Space Mean Speed (mi/h)	Ave. Travel Time (min.)	Density (pc/mi/ln)	LOS
A.M. Peak				
Eastbound	70.1	9.3	1.4	A
Westbound	71.3	9.4	1.4	A
P.M. Peak				
Eastbound	70.0	9.4	1.7	A
Westbound	71.0	9.4	1.6	A

The results indicate, both at the segment level and at the facility level, the study section of Interstate 90 operates at an acceptable level of service during typical weekday a.m. and p.m. peak hours. For this analysis, “typical” means no inclement weather, incidents, work zone activities, or special events.

B. UNSIGNALIZED INTERSECTIONS

Existing conditions for selected unsignalized intersections in the study also were evaluated, using the Two-Way Stop-Control method identified in the HCM 6th Edition. The method computes delay and LOS for those movements required to yield right-of-way, such as the left-turn movement on the major street approach and the side-street approaches. The following intersections were evaluated:

- Junction Avenue at Vanocker Canyon Road
- Junction Avenue at Dickson Drive
- Junction Avenue at I-90 Eastbound Ramps (Exit 32)
- Junction Avenue at I-90 Westbound Ramps (Exit 32)
- Horse Soldier Road (Old Stone Road) at I-90 Eastbound Ramps (Exit 34)
- Horse Soldier Road (Old Stone Road) at I-90 Westbound Ramps (Exit 34)
- Horse Soldier Road (Old Stone Road) at Blucksberg Drive
- Horse Soldier Road (Old Stone Road) at Pleasant Valley Drive
- Pleasant Valley Road at I-90 Eastbound Ramps (Exit 37)
- Pleasant Valley Road at I-90 Westbound Ramps (Exit 37)
- Pleasant Valley Drive at Pleasant Valley Road
- Pleasant Valley Road at Fort Meade Way
- Sturgis Road-Tilford Road at Snyder Ranch Road
- Tilford Road at I-90 Eastbound Ramps (Exit 40)
- Tilford Road at I-90 Westbound Ramps (Exit 40)
- Tilford Road at State Street

The Junction Avenue intersections with I-90 ramps (Exit 32) are signalized only during the motorcycle rally. They operate as unsignalized intersections with STOP-control on the exit ramp approaches during the remainder of the year.

Existing delay and levels of service for the a.m. peak at these intersections are shown in **Figure 15**. For the p.m. peak, existing delay and levels of service are shown in **Figure 16**. Full output reports of these analyses are provided in the **Appendix**.

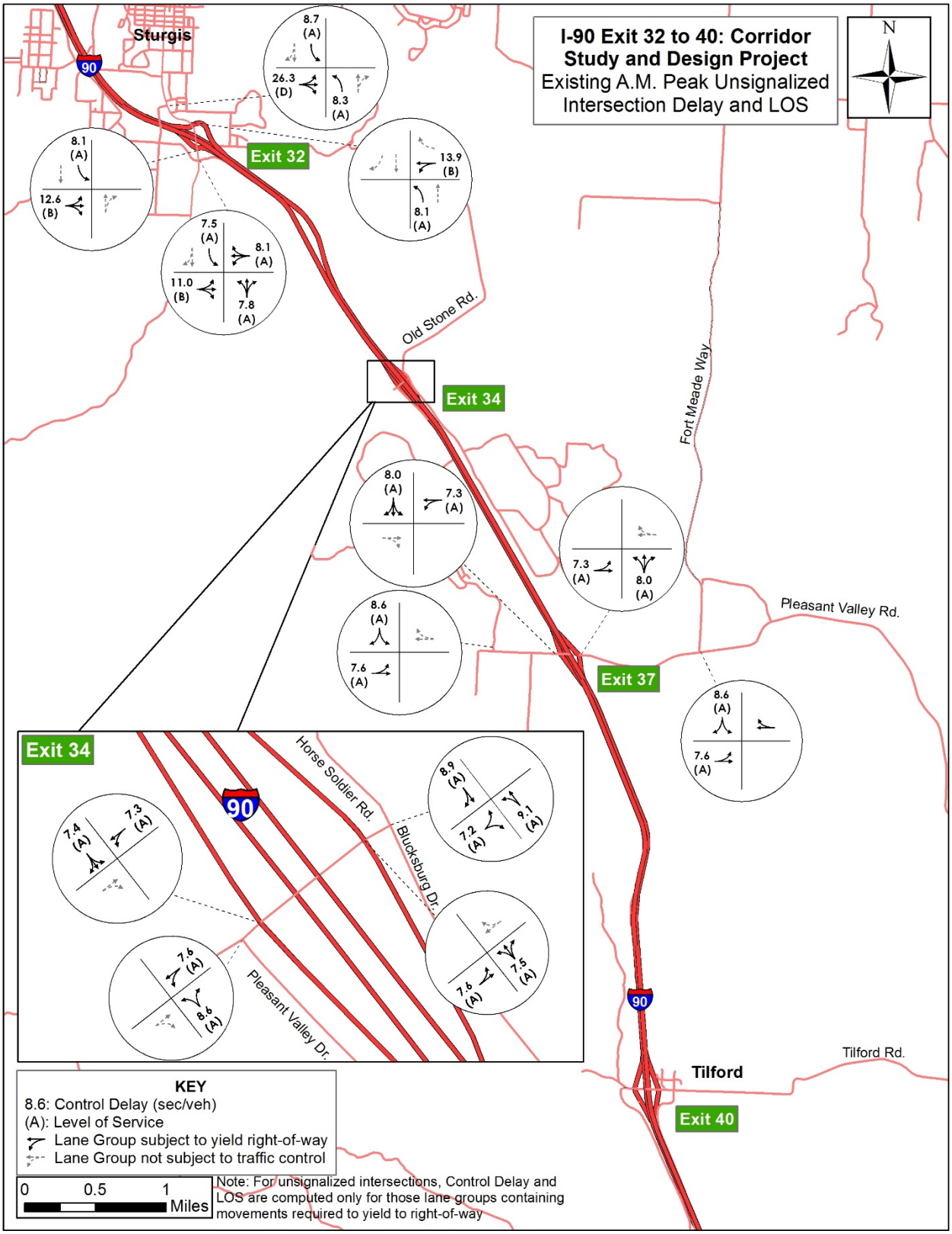


Figure 15. Existing Unsignalized Intersection Traffic Operations – A.M. Peak

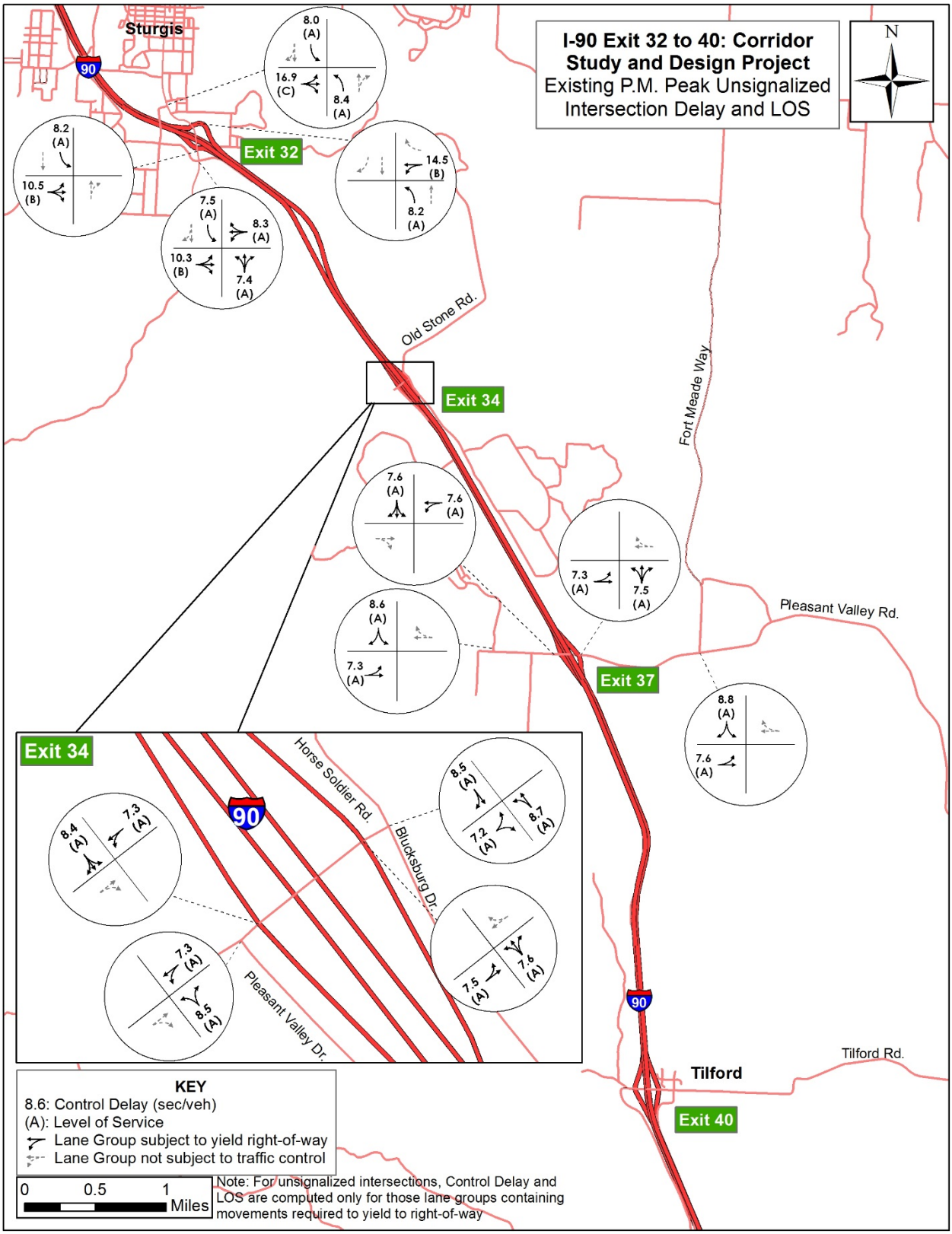


Figure 16. Existing Unsignalized Intersection Traffic Operations – P.M. Peak

V. EXISTING DEFICIENCIES AND NEEDS

There are no existing capacity deficiencies, for the I-90 mainline or for the crossroads that form its service interchanges within the study area. For typical weekday a.m. and p.m. peak periods, with one exception, all facilities operated at Level-of-Service B or better. The one exception was the STOP-controlled minor street approach of eastbound Vanocker Canyon Road at Junction Avenue, which operates at LOS D during the a.m. peak and LOS C during the p.m. peak.

Based on the analysis of crash data for the 5-year period from January 1, 2012 through December 31, 2016, it was determined that no section of I-90 between Exits 32 and 40 experienced an annual average crash rate higher than the statewide average for similar facilities. However, there were five 0.3-mile spots that were identified as candidates for further study of potential safety improvements. The most frequent types of crashes were related to run-off-the-road occurrences and collisions with animals.

VI. APPENDIX

Unsignalized Intersection Analysis Reports

HCS7 Two-Way Stop-Control Report

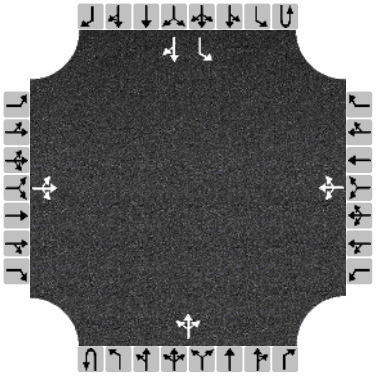
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/14/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:15-8:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction Ave @ Dickson Dr
Jurisdiction	
East/West Street	Dickson Dr.
North/South Street	Junction Ave.
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	1	1	0
Configuration			LTR				LTR				LTR			L		TR
Volume, V (veh/h)		46	13	4		4	5	33		4	54	1		46	46	19
Percent Heavy Vehicles (%)		13	3	0		25	0	18		50				9		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			70				47			4				51		
Capacity, c (veh/h)			673				1224			1272				1499		
v/c Ratio			0.10				0.04			0.00				0.03		
95% Queue Length, Q_{95} (veh)			0.3				0.1			0.0				0.1		
Control Delay (s/veh)			11.0				8.1			7.8				7.5		
Level of Service, LOS			B				A			A				A		
Approach Delay (s/veh)		11.0				8.1				0.6				3.1		
Approach LOS		B				A										

HCS7 Two-Way Stop-Control Report

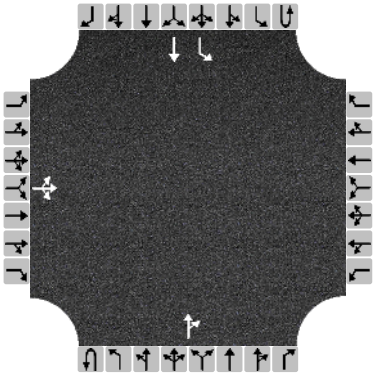
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	2/14/2018
Analysis Year	2018
Time Analyzed	AM Peak (7:15-8:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction@I-90 EB Ramps
Jurisdiction	
East/West Street	I-90 EB Ramps
North/South Street	Junction Ave.
Peak Hour Factor	0.82
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	1	1	0
Configuration			LTR									TR		L	T	
Volume, V (veh/h)		63	1	31							89	43		196	80	
Percent Heavy Vehicles (%)		3	3	2										5		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			116											239		
Capacity, c (veh/h)			588											1403		
v/c Ratio			0.20											0.17		
95% Queue Length, Q_{95} (veh)			0.7											0.6		
Control Delay (s/veh)			12.6											8.1		
Level of Service, LOS			B											A		
Approach Delay (s/veh)		12.6												5.7		
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

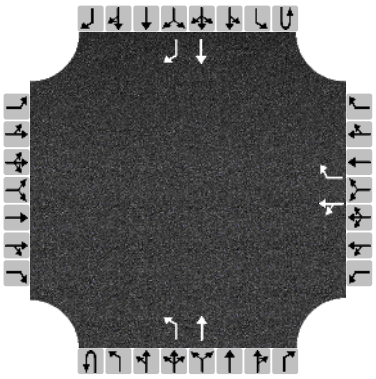
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	2/14/2018
Analysis Year	2018
Time Analyzed	AM Peak (7:15-8:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction @I-90WB Ramps
Jurisdiction	
East/West Street	I-90 WB Ramps
North/South Street	Junction Ave.
Peak Hour Factor	0.81
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	1	0	1	1	0	0	0	1	1
Configuration						LT		R		L	T				T	R
Volume, V (veh/h)						30	1	363		28	119				273	71
Percent Heavy Vehicles (%)						17	3	4		7						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				Yes		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						38		448		35						
Capacity, c (veh/h)						442		894		1196						
v/c Ratio						0.09		0.50		0.03						
95% Queue Length, Q_{95} (veh)						0.3		2.9		0.1						
Control Delay (s/veh)						13.9		13.0		8.1						
Level of Service, LOS						B		B		A						
Approach Delay (s/veh)						13.1				1.5						
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

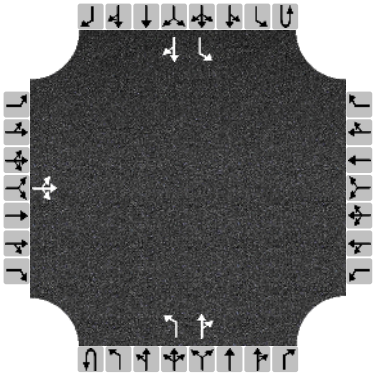
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/14/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:15-8:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction Ave @ Vanocker C
Jurisdiction	
East/West Street	Vanocker Canyon Rd.
North/South Street	Junction Ave.
Peak Hour Factor	0.89
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	1	1	0
Configuration			LTR							L		TR		L		TR
Volume, V (veh/h)		90	0	6						9	550	0		0	305	57
Percent Heavy Vehicles (%)		3	0	0						11				0		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			108							10				0		
Capacity, c (veh/h)			275							1105				972		
v/c Ratio			0.39							0.01				0.00		
95% Queue Length, Q_{95} (veh)			1.8							0.0				0.0		
Control Delay (s/veh)			26.3							8.3				8.7		
Level of Service, LOS			D							A				A		
Approach Delay (s/veh)		26.3								0.1				0.0		
Approach LOS		D														

HCS7 Two-Way Stop-Control Report

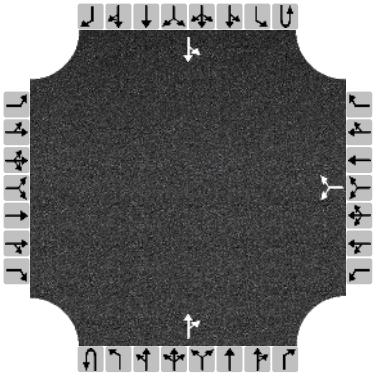
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (6:45-7:45)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & Pleasant
Jurisdiction	
East/West Street	Pleasant Valley Drive
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.68
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume, V (veh/h)						1		19			5	0		14	15	
Percent Heavy Vehicles (%)						0		16						36		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							29							21		
Capacity, c (veh/h)							1031							1420		
v/c Ratio							0.03							0.01		
95% Queue Length, Q_{95} (veh)							0.1							0.0		
Control Delay (s/veh)							8.6							7.6		
Level of Service, LOS							A							A		
Approach Delay (s/veh)						8.6								3.7		
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

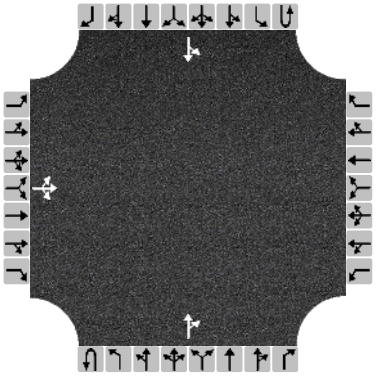
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (6:45-7:45)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & EB Ramps
Jurisdiction	
East/West Street	I-90 EB Ramps
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.78
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LTR									TR		LT		
Volume, V (veh/h)		12	0	22							21	3		30	6	
Percent Heavy Vehicles (%)		8	0	27										3		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			44											38		
Capacity, c (veh/h)			1555											1573		
v/c Ratio			0.03											0.02		
95% Queue Length, Q_{95} (veh)			0.1											0.1		
Control Delay (s/veh)			7.4											7.3		
Level of Service, LOS			A											A		
Approach Delay (s/veh)		7.4												6.2		
Approach LOS		A														

HCS7 Two-Way Stop-Control Report

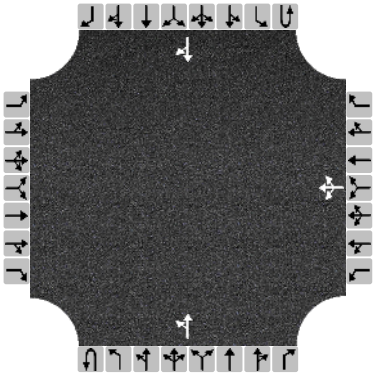
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (6:45-7:45)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & WB Ramps
Jurisdiction	
East/West Street	I-90 WB Ramps
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.74
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						6	0	5		18	15				29	65
Percent Heavy Vehicles (%)						18	0	20		13						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							15			24						
Capacity, c (veh/h)							1431			1392						
v/c Ratio							0.01			0.02						
95% Queue Length, Q_{95} (veh)							0.0			0.1						
Control Delay (s/veh)							7.5			7.6						
Level of Service, LOS							A			A						
Approach Delay (s/veh)						7.5				4.2						
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

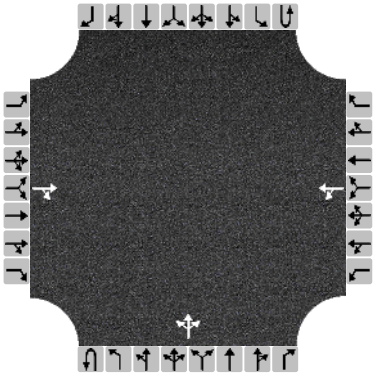
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (6:45-7:45)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier&Blucksberg
Jurisdiction	
East/West Street	Blucksberg Dr.
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.77
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	0	0
Configuration				TR		LT					LTR					
Volume, V (veh/h)			1	2		94	5			4	0	16				
Percent Heavy Vehicles (%)			100	0		6	0			0						
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				4		129				5						
Capacity, c (veh/h)				920		1006				1636						
v/c Ratio				0.00		0.13				0.00						
95% Queue Length, Q_{95} (veh)				0.0		0.4				0.0						
Control Delay (s/veh)				8.9		9.1				7.2						
Level of Service, LOS				A		A				A						
Approach Delay (s/veh)	8.9				9.1				1.5							
Approach LOS	A				A											

HCS7 Two-Way Stop-Control Report

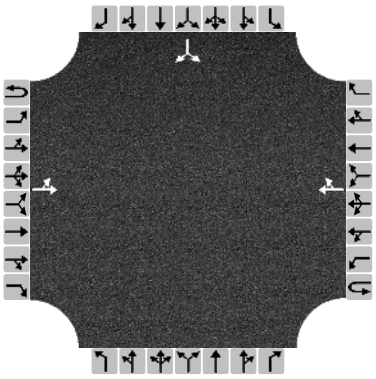
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:00-8:00)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@PleasantVDr
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	Pleasant Valley Dr.
Peak Hour Factor	0.71
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		0	5				2	4						9		0
Percent Heavy Vehicles (%)		3												0		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0													13	
Capacity, c (veh/h)		1604													1012	
v/c Ratio		0.00													0.01	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.2													8.6	
Level of Service, LOS		A													A	
Approach Delay (s/veh)	0.0												8.6			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

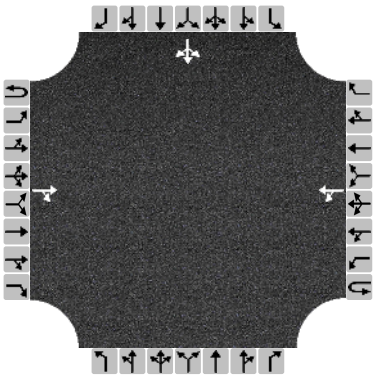
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:00-8:00)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@I90EBRamps
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	I-90 EB Ramps
Peak Hour Factor	0.76
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration				TR		LT									LTR	
Volume, V (veh/h)			11	7		26	1							1	0	6
Percent Heavy Vehicles (%)						4								0	3	17
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						34									9	
Capacity, c (veh/h)						1575									1216	
v/c Ratio						0.02									0.01	
95% Queue Length, Q_{95} (veh)						0.1									0.0	
Control Delay (s/veh)						7.3									8.0	
Level of Service, LOS						A									A	
Approach Delay (s/veh)					7.1								8.0			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

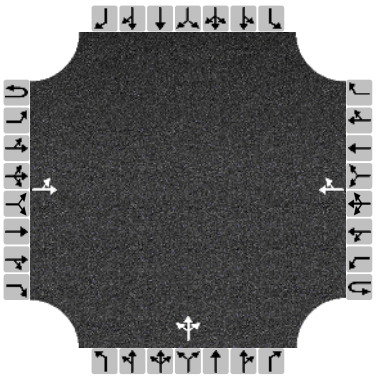
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:00-8:00)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@I90WBRamps
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	I-90 WB Ramps
Peak Hour Factor	0.88
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration		LT						TR			LTR					
Volume, V (veh/h)		7	2				26	15		3	2	26				
Percent Heavy Vehicles (%)		0								0	0	23				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		8									35					
Capacity, c (veh/h)		1574									1220					
v/c Ratio		0.01									0.03					
95% Queue Length, Q_{95} (veh)		0.0									0.1					
Control Delay (s/veh)		7.3									8.0					
Level of Service, LOS		A									A					
Approach Delay (s/veh)		5.7								8.0						
Approach LOS										A						

HCS7 Two-Way Stop-Control Report

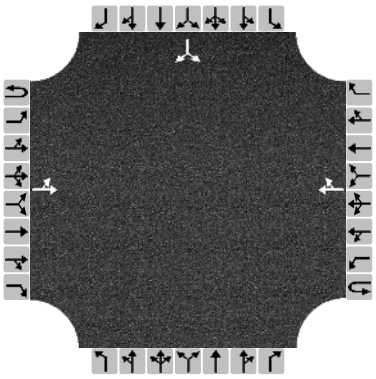
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	AM Peak (7:00-8:00)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@FtMeadeWay
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	Fort Meade Way
Peak Hour Factor	0.71
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		23	2				16	5						2		23
Percent Heavy Vehicles (%)		26												0		4
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		32													35	
Capacity, c (veh/h)		1443													1029	
v/c Ratio		0.02													0.03	
95% Queue Length, Q_{95} (veh)		0.1													0.1	
Control Delay (s/veh)		7.6													8.6	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		7.0												8.6		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

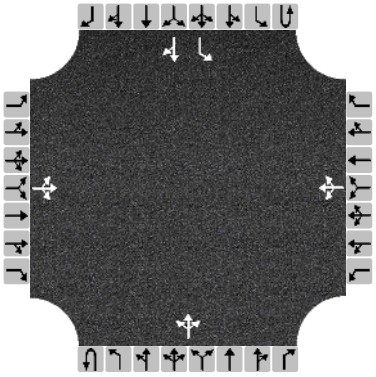
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/14/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction Ave @ Dickson Dr
Jurisdiction	
East/West Street	Dickson Dr.
North/South Street	Junction Ave.
Peak Hour Factor	0.95
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	1	1	0
Configuration			LTR				LTR				LTR			L		TR
Volume, V (veh/h)		31	5	3		7	1	43		6	52	8		33	53	46
Percent Heavy Vehicles (%)		0	20	0		14	0	14		0				9		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			41				54			6				35		
Capacity, c (veh/h)			715				1154			1500				1497		
v/c Ratio			0.06				0.05			0.00				0.02		
95% Queue Length, Q_{95} (veh)			0.2				0.1			0.0				0.1		
Control Delay (s/veh)			10.3				8.3			7.4				7.5		
Level of Service, LOS			B				A			A				A		
Approach Delay (s/veh)		10.3				8.3				0.7				1.9		
Approach LOS		B				A										

HCS7 Two-Way Stop-Control Report

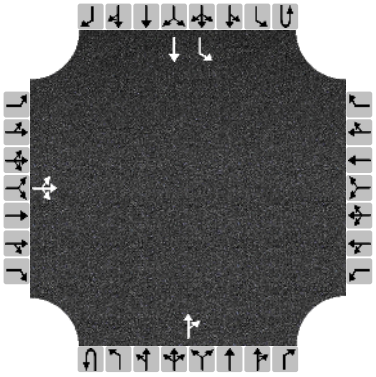
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	2/14/2018
Analysis Year	2018
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction@I-90 EB Ramps
Jurisdiction	
East/West Street	I-90 EB Ramps
North/South Street	Junction Ave.
Peak Hour Factor	0.87
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	1	1	0
Configuration			LTR									TR		L	T	
Volume, V (veh/h)		42	0	49							92	36		252	83	
Percent Heavy Vehicles (%)		5	3	8										6		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			105											290		
Capacity, c (veh/h)			755											1413		
v/c Ratio			0.14											0.20		
95% Queue Length, Q_{95} (veh)			0.5											0.8		
Control Delay (s/veh)			10.5											8.2		
Level of Service, LOS			B											A		
Approach Delay (s/veh)		10.5												6.2		
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

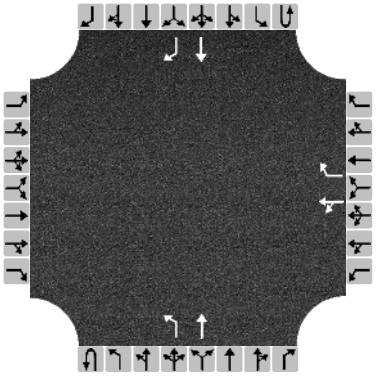
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	2/14/2018
Analysis Year	2018
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction @I-90WB Ramps
Jurisdiction	
East/West Street	I-90 WB Ramps
North/South Street	Junction Ave.
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	1	0	1	1	0	0	0	1	1
Configuration						LT		R		L	T				T	R
Volume, V (veh/h)						43	1	242		33	118				327	73
Percent Heavy Vehicles (%)						5	3	2		3						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				Yes		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						52		285		39						
Capacity, c (veh/h)						432		909		1167						
v/c Ratio						0.12		0.31		0.03						
95% Queue Length, Q_{95} (veh)						0.4		1.3		0.1						
Control Delay (s/veh)						14.5		10.8		8.2						
Level of Service, LOS						B		B		A						
Approach Delay (s/veh)						11.3				1.8						
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

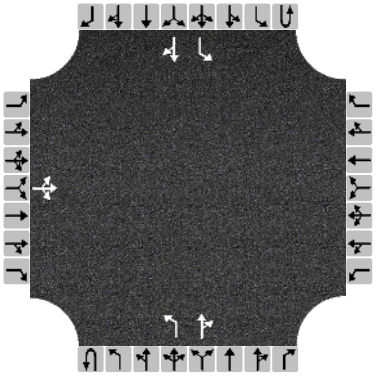
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/14/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 32

Site Information

Intersection	Junction Ave @ Vanocker C
Jurisdiction	
East/West Street	Vanocker Canyon Rd.
North/South Street	Junction Ave.
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	1	1	0
Configuration			LTR							L		TR		L		TR
Volume, V (veh/h)		68	0	11						10	330	0		0	353	96
Percent Heavy Vehicles (%)		1	0	9						0				0		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			88							11				0		
Capacity, c (veh/h)			390							1076				1203		
v/c Ratio			0.22							0.01				0.00		
95% Queue Length, Q_{95} (veh)			0.9							0.0				0.0		
Control Delay (s/veh)			16.9							8.4				8.0		
Level of Service, LOS			C							A				A		
Approach Delay (s/veh)		16.9								0.2				0.0		
Approach LOS		C														

HCS7 Two-Way Stop-Control Report

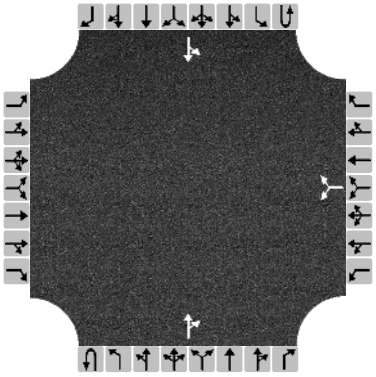
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & Pleasant
Jurisdiction	
East/West Street	Pleasant Valley Drive
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.79
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume, V (veh/h)						0		15			19	0		17	6	
Percent Heavy Vehicles (%)						0		8						5		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							19							22		
Capacity, c (veh/h)							1036							1575		
v/c Ratio							0.02							0.01		
95% Queue Length, Q_{95} (veh)							0.1							0.0		
Control Delay (s/veh)							8.5							7.3		
Level of Service, LOS							A							A		
Approach Delay (s/veh)						8.5								5.4		
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

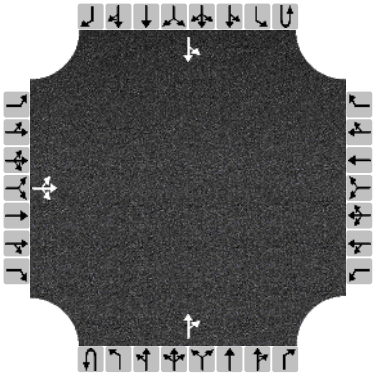
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & EB Ramps
Jurisdiction	
East/West Street	I-90 EB Ramps
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LTR									TR		LT		
Volume, V (veh/h)		54	4	15							24	11		14	8	
Percent Heavy Vehicles (%)		2	0	0										0		
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			81											16		
Capacity, c (veh/h)			1154											1584		
v/c Ratio			0.07											0.01		
95% Queue Length, Q_{95} (veh)			0.2											0.0		
Control Delay (s/veh)			8.4											7.3		
Level of Service, LOS			A											A		
Approach Delay (s/veh)		8.4												4.7		
Approach LOS		A														

HCS7 Two-Way Stop-Control Report

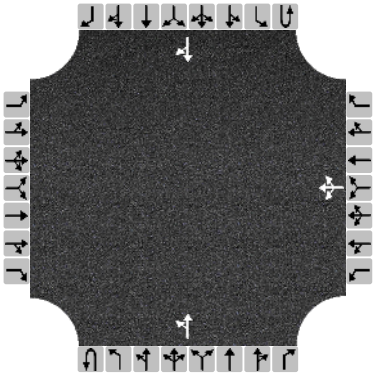
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier & WB Ramps
Jurisdiction	
East/West Street	I-90 WB Ramps
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LTR			LT						TR
Volume, V (veh/h)						7	2	22		24	54				20	25
Percent Heavy Vehicles (%)						18	0	4		19						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							36			28						
Capacity, c (veh/h)							1400			1451						
v/c Ratio							0.03			0.02						
95% Queue Length, Q_{95} (veh)							0.1			0.1						
Control Delay (s/veh)							7.6			7.5						
Level of Service, LOS							A			A						
Approach Delay (s/veh)						7.6				2.4						
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

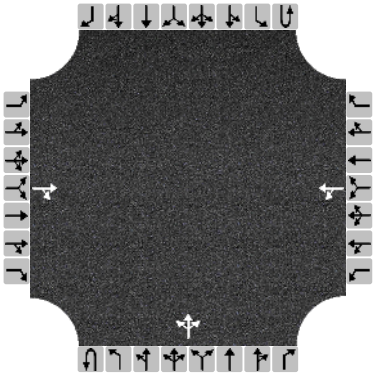
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	North-South
Project Description	SD I-90 Exit 34

Site Information

Intersection	Horse Soldier&Blucksberg
Jurisdiction	
East/West Street	Blucksberg Dr.
North/South Street	Horse Soldier (Old Stone)
Peak Hour Factor	0.80
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	0	0
Configuration				TR		LT					LTR					
Volume, V (veh/h)			1	11		28	1			13	0	61				
Percent Heavy Vehicles (%)			0	8		0	0			0						
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				15		36				16						
Capacity, c (veh/h)				1036		1019				1636						
v/c Ratio				0.01		0.04				0.01						
95% Queue Length, Q_{95} (veh)				0.0		0.1				0.0						
Control Delay (s/veh)				8.5		8.7				7.2						
Level of Service, LOS				A		A				A						
Approach Delay (s/veh)	8.5				8.7				1.3							
Approach LOS	A				A											

HCS7 Two-Way Stop-Control Report

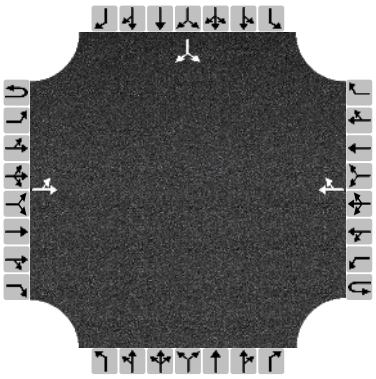
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@PleasantVDr
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	Pleasant Valley Dr.
Peak Hour Factor	0.69
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		0	6				3	9						4		0
Percent Heavy Vehicles (%)		3												0		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0													6	
Capacity, c (veh/h)		1592													1002	
v/c Ratio		0.00													0.01	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.3													8.6	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		0.0												8.6		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

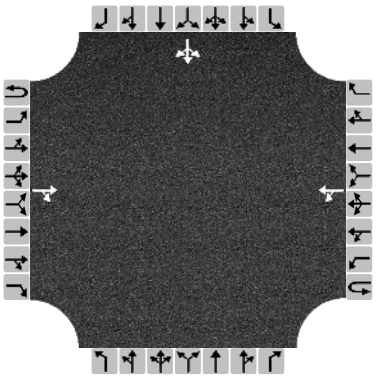
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@I90EBRamps
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	I-90 EB Ramps
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration				TR		LT									LTR	
Volume, V (veh/h)			7	6		42	7							8	3	8
Percent Heavy Vehicles (%)						26								13	3	13
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						51									23	
Capacity, c (veh/h)						1461									1406	
v/c Ratio						0.03									0.02	
95% Queue Length, Q_{95} (veh)						0.1									0.0	
Control Delay (s/veh)						7.6									7.6	
Level of Service, LOS						A									A	
Approach Delay (s/veh)					6.5								7.6			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

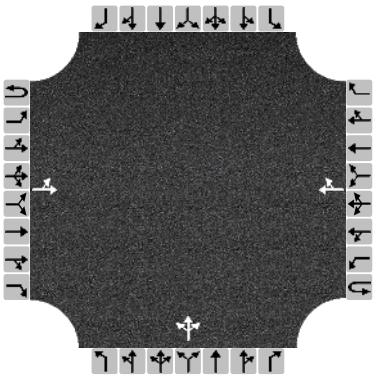
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@I90WBRamps
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	I-90 WB Ramps
Peak Hour Factor	0.84
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration		LT						TR			LTR					
Volume, V (veh/h)		8	7				37	6		13	0	26				
Percent Heavy Vehicles (%)		0								15	0	31				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		10									46					
Capacity, c (veh/h)		1568									1493					
v/c Ratio		0.01									0.03					
95% Queue Length, Q_{95} (veh)		0.0									0.1					
Control Delay (s/veh)		7.3									7.5					
Level of Service, LOS		A									A					
Approach Delay (s/veh)		3.9								7.5						
Approach LOS										A						

HCS7 Two-Way Stop-Control Report

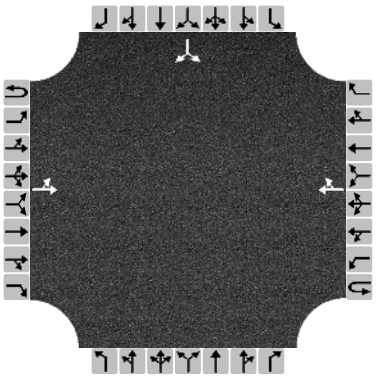
General Information

Analyst	GW
Agency/Co.	Stantec
Date Performed	12/5/2017
Analysis Year	2017
Time Analyzed	PM Peak (4:15-5:15)
Intersection Orientation	East-West
Project Description	SD I-90 Exit 37

Site Information

Intersection	PleasantVRd@FtMeadeWay
Jurisdiction	
East/West Street	Pleasant Valley Rd.
North/South Street	Fort Meade Way
Peak Hour Factor	0.86
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		23	8				7	0						4		34
Percent Heavy Vehicles (%)		35												0		32
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		27													44	
Capacity, c (veh/h)		1419													984	
v/c Ratio		0.02													0.04	
95% Queue Length, Q_{95} (veh)		0.1													0.1	
Control Delay (s/veh)		7.6													8.8	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		5.7												8.8		
Approach LOS														A		