February
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Final Report
Volume I

WV 45 in Martinsburg, WV Traffic Operations and Safety Study

State Project: S202-45-14.30
Federal Project: OCRO-0045(060)

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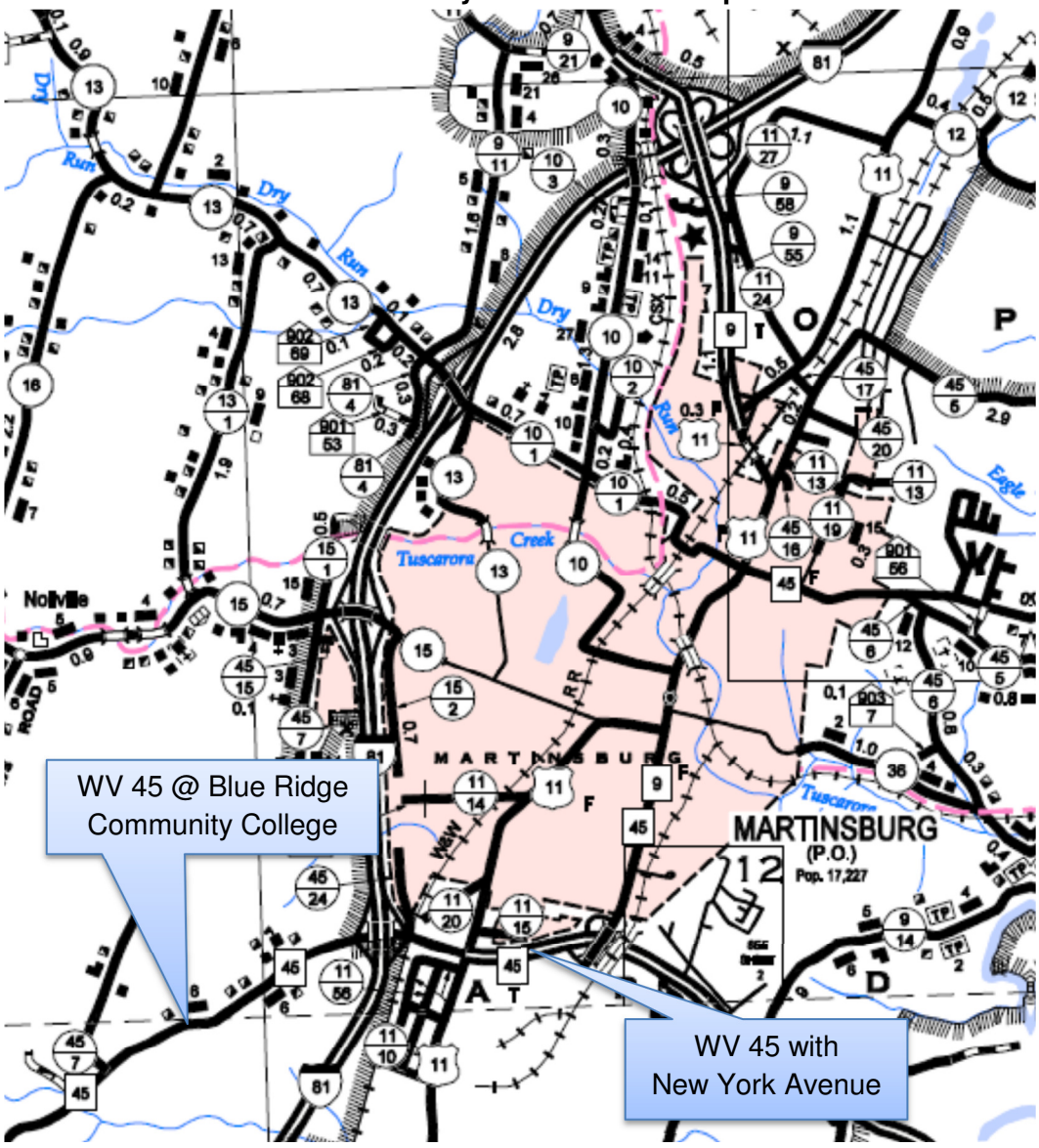
1 Introduction

1.1. Study Purpose

The purpose of this traffic operations and safety study is to evaluate current and future traffic conditions, identify potential deficiencies, and develop alternative improvements to enhance traffic flow and improve safety within the 1.46 mile study area along WV 45 (Apple Harvest Drive). The study limits extend from the Blue Ridge Community College driveway (MP 13.61) to New York Avenue (MP 15.07) in Martinsburg, Berkeley County. A location map of the study area is provided below.

WV 45 Study Area Location Map



1.2. Corridor Description

Within the study area, the WV 45 corridor varies from a two to four-lane roadway with a two-way left-turn lane (TWLTL) for part of its length. On the eastern side of the corridor, WV 45 is a heavily-traveled arterial through a major commercial district. On the western side of the I-81 Interchange, it becomes a two-lane, rural roadway outside of the city. Near I/S# 1 and 2, the travel lanes narrow to 10 feet in width. At the major intersections, the TWLTL becomes an exclusive left-turn lane. The corridor includes both signalized and unsignalized intersections and several driveways. Most signalized intersections in the corridor, which are closely spaced near the interchange and mall areas, are coordinated to provide a progressive movement for thru traffic along WV 45. The only exceptions are at Retail Commons Parkway and I-81 SB Ramps, which function more efficiently as actuated but uncoordinated. There is also a "Priority Control System" (PCS) in place for the local fire department. Highway lighting is provided along the entire corridor within the study area. The posted speed limit along the corridor is 45 mph from the western terminus to Retail Commons Parkway and 35 mph from Retail Commons Parkway to the eastern terminus at New York Avenue.

The WV 45 corridor is rural in nature for the three intersections to the west of the Retail Commons intersection. From that point eastward, the corridor is highly developed with retail and commercial developments. The highest density of development is centered around the I-81 Interchange; however, space is available for further development. This is particularly true to the west of the interchange, as indicated by the potential Cornerstone Development proposed at I/S #3 and the Weis Study, on the north side of WV 45, with two proposed driveways near I/S #4. There is also potential for development at locations just outside of the study area. Despite the development and potential for future development, there are no sidewalks or pedestrian facilities anywhere within the corridor.

Within the study limits, there are 34 intersections with city streets and major / minor driveways. Nine of the major intersections within the corridor are included as part of this study. These intersections are described in additional detail and photos of each intersection are provided in Appendix A. Figure 1-1 (Sheets 1 through 3) provides an overview of the study intersections.

I/S #1: WV45 with Blue Ridge Community College

Located at the western terminus of the study area, this "T" intersection provides access to the Blue Ridge Community College. The intersection is currently unsignalized, with stop-control for the College driveway only. There are no existing turn lanes on WV 45. Directly across from the College driveway are widely-spaced residential parcels.

I/S #2: WV 45 with Klee Drive

The WV 45 with Klee Drive intersection provides access to a residential neighborhood. WV 45 moves freely, while Klee Drive is stop-controlled. There is vacant land on both sides of Klee Drive, with large, residential parcels situated on the other side of WV 45.

I/S #3: WV 45 with Cornerstone Development (Proposed)

Although not constructed yet, the Cornerstone Development intersection is proposed to be just west of the Retail Commons Development. Similar to I/S #1 and #2, the side road is proposed to be stop-controlled. There currently are no turn lanes in place for the proposed development, but approved documents indicate that intersection improvements including widening and a WV 45 WB left-turn lane will be forthcoming.

I/S #4: WV 45 with Retail Commons Parkway (Target)

The WV 45 with Retail Commons Parkway intersection is signalized and serves as the only access to the Retail Commons commercial development. This center includes Best Buy, Target, Dicks Sporting Goods and several other retail outlets. The WV 45 WB approach has dual left-turn lanes along with two thru lanes. There is a protected-permitted phase for the WV 45 WB left-turn movement with a right-turn overlap from Retail Commons. The signal operates uncoordinated with the adjacent signals to the east. WV 45 EB has a right-turn lane into the development along with two thru lanes. Retail Commons Parkway has dual left-turn lanes and a right-turn lane. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection. WV 45 WB tapers down to a two-lane road approximately 250 feet west of this intersection. Because of this, the rightmost WV 45 WB thru lane is utilized less than the adjacent thru lane. Another factor contributing to this is that the upstream WV45 WB thru lane lines up with the inside thru lane at this intersection.

The Weis Study proposes a 151,107 sq. ft. commercial development on the north side of WV 45 in the vicinity of this intersection. The study proposes two driveways, one at I/S #4 and a second access approximately 250 feet west of this intersection. A second WV 45 WB thru lane would be extended from I/S #4 to the westernmost driveway and drop as a right-turn lane into the development. Access to the development from the intersection west of Retail Commons Parkway will be provided via Commercial Drive, a master-planned street connecting WV 45 to Tuscarora Pike.

I/S #5: WV 45 with Interstate 81 Southbound Ramps

As part of the diamond Interchange with I-81, this intersection serves as access to and from I-81 SB. The off-ramp has two left-turn lanes and one right-turn lane at the junction with WV 45. Exclusive right and left-turn lanes provide storage to the on-ramp from WV 45 EB and WB, respectively. The WV 45 WB left-turn movement has a protected-permitted signal phase. This signal operates uncoordinated with I/S #4 and the adjacent signals to the east. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

I/S #6: WV 45 with Interstate 81 Northbound Ramps

This intersection serves as access to and from I-81 NB. WV 45 maintains two thru lanes in each direction and has a channelized WV 45 WB right-turn lane, and a left-turn lane on WV 45 EB. The I-81 NB off-ramp has a left-turn and right-turn lane. The signal operates as coordinated with the signal system to the east, and operates as three phases: NB, EB left-turn and EB/WB thru. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

I/S #7: WV 45 with Foxcroft Avenue (Mall)

The intersection of WV 45 with Foxcroft Avenue is a signalized “plus” intersection. Foxcroft Avenue serves as one of three entrances to the Martinsburg Mall and several restaurants, gas stations and hotels. The southern leg of the intersection is a

McDonald's driveway. Foxcroft Avenue widens for about 100 feet at the intersection to allow for three lanes: right-turn only, left-thru lane and a left-turn only. WV 45 maintains its two thru lanes in each direction, plus exclusive left and right-turn lanes in each direction. A single railroad track crosses WV 45 within the intersection, located just east of Foxcroft Avenue. The northbound and southbound movements have dedicated signal phases, and the EB and WB mainline movements have leading left-turn phases with right-turn overlaps from the SB and NB approaches. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

Although train counts were not collected, it has been reported that the frequency and lengths of trains are increasing due to activity along the rail spur to the Essroc cement plant located southeast of the study area. As an example of train activity, the train pre-emption records for several days in November and December 2014 were reviewed. There was an average of 6 railroad pre-emption calls during the weekdays with no particular schedule observed. There was no train traffic observed during the weekend. With the increased train traffic, additional delays occur at this intersection and impact the rest of the corridor as this railroad bisects the study area.

I/S #LS: WV 45 with Lowes/Sheetz Driveways

The WV 45 with Lowes Plaza/Sheetz intersection (I/S #LS) provides access to these establishments. Sheetz is located on the southern side of WV 45 and the driveway has a left-thru lane and right-turn lane. Lowes Plaza is located on the northern side of WV 45 and its driveway has a similar lane configuration as Sheetz. WV 45 maintains two thru lanes and an exclusive left-turn lane in both directions, along with a short right-turn lane on WV 45 WB for access into Lowes. The intersection is signalized and has a protected-permitted phase for left-turn phases of WV 45. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

I/S #8: WV 45 with US 11 (Winchester Avenue)

US 11 connects this area to downtown Martinsburg and Inwood. This "plus" signalized intersection serves residential neighborhoods on either side of WV 45 and is in close proximity to driveways for a shopping plaza located within the southeastern quadrant of the intersection. This plaza includes Food Lion, K-Mart and other smaller retailers. This intersection has two thru lanes on WV 45 with left and right-turn lanes in each direction. US 11 (Winchester Avenue) has three lanes in each direction providing left-turn, thru and right-turn lanes. This signal operates with four phases, including concurrent, protected-permitted left-turn phases for all approaches with right-turn overlaps from the side roads. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

I/S #9: WV 45 with New York Avenue

The WV 45 with New York Avenue intersection is a signalized, "plus" intersection and is very similar in configuration to I/S #8: WV 45 with Winchester Avenue. The only difference is that the minor approaches have two lanes at the intersection (shared left-thru lane and right-turn lane). The shopping plaza mentioned in I/S #8 is located in the southwestern quadrant of the intersection. The signal phasing is similar to I/S #8 except that the minor approaches do not have a protected left-turn phase. There are no crosswalks, pedestrian push buttons, or pedestrian signals at this intersection.

1.3. Available Traffic Data

The following data were received from the West Virginia Department of Transportation (WVDOT), Traffic Engineering Division (Traffic Division):

- Growth rate for the corridor.
- Existing signal plans.

1.4. Previous Studies

The *Direction 2040 Long-Range Multimodal Transportation Plan*, prepared for the Hagerstown / Eastern Panhandle Metropolitan Planning Organization (HEPMPO) and adopted in July 2014, discusses improvement efforts on WV 45 within the study area. Identified as Fiscally Constrained Project 40 (in the 2026 to 2035 timeframe) to address congestion issues related to the commercial development along Apple Harvest Drive, WV 45 between I-81 and WV 9 (Queen Street) would be widened to a 6-lane divided facility with an auxiliary lane. Facility upgrades could also include center two-way left-turn lanes and raised medians depending on adjacent land uses. As a "fiscally constrained" project, this is a high-priority project for the region to be implemented through the 2040 planning horizon, and can reasonably be funded with currently forecasted funding sources.

The *City of Martinsburg's 2007 Comprehensive Plan*, (The Plan) adopted in June 2007, is currently being updated; however, development west of I-81 and related recommended improvements are discussed extensively. With a total area of approximately 1,100 acres, development on the West Side is a significant planning effort and could provide great economic growth for the area, especially with its proximity to I-81. The Plan proposes a commercial drive paralleling I-81 that would connect WV 45 to Delmar Orchard Road. This four-lane, "Main-Street" would include streetscape elements and bicycle/pedestrian features and would provide primary access to commercial destinations, businesses, and adjacent residential neighborhoods. Since development of the West Side is in various phases of planning, this traffic operations and safety study assumed an aggressive growth rate when forecasting and analyzing future traffic volumes for analysis.

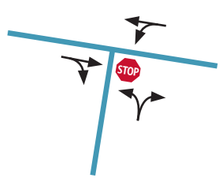
HEPMPO has additionally programed funds for railroad signal upgrades near I/S #7 as part of their Transportation Improvement Plan (TIP).

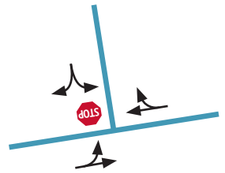
The Novak Drive Connector was considered in the past, but a study was not available. In addition, this concept is located outside of the study area to the south. It is discussed further in Section 5.7.

Figure 1-1: Existing Corridor, Geometry, and Peak Hour Volumes (Sheet 1 of 3)

Intersection ID# & Distance Between Intersections

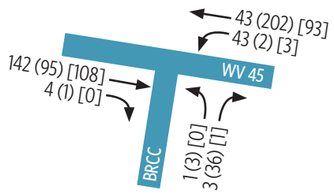
Existing Intersection Geometry





Existing Peak Hour Volumes

Peak Hour Factor:
0.92 (0.91) [0.85]



Peak Hour Factor:
0.88 (0.95) [0.95]

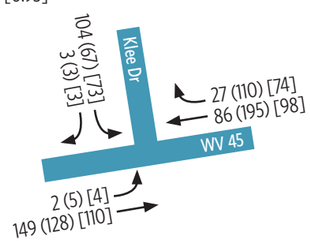
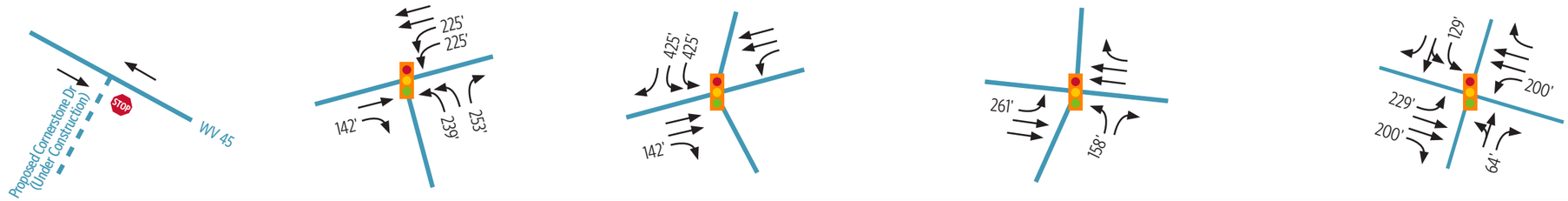


Figure 1-1: Existing Corridor, Geometry, and Peak Hour Volumes (Sheet 2 of 3)

Intersection ID# & Distance Between Intersections

Existing Intersection Geometry



Existing Peak Hour Volumes

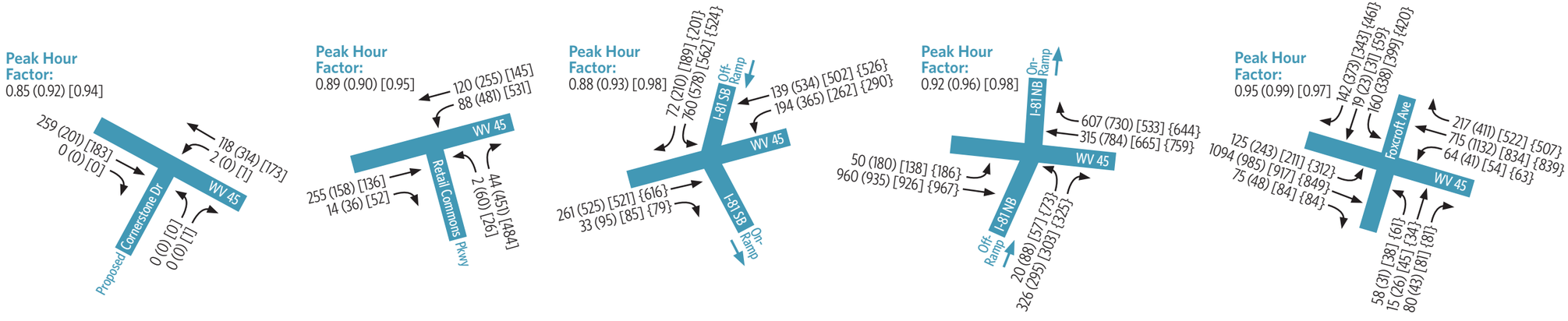
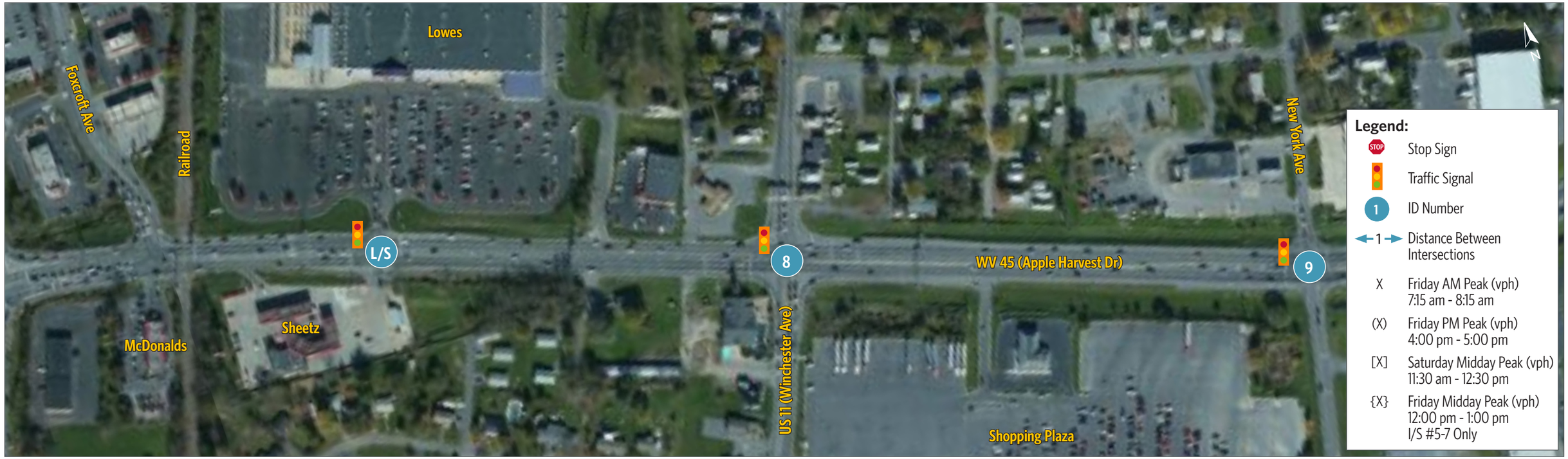
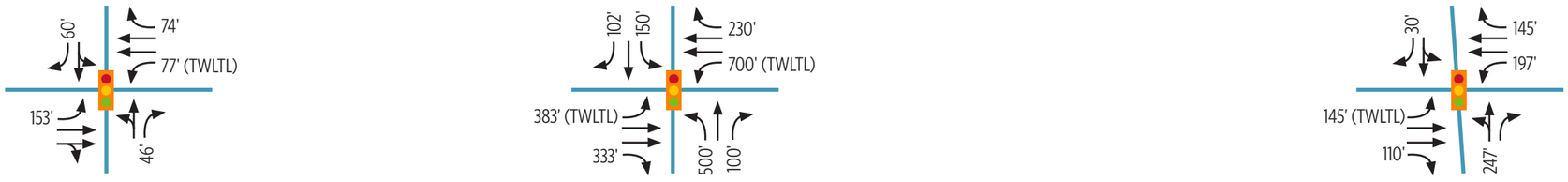


Figure 1-1: Existing Corridor, Geometry, and Peak Hour Volumes (Sheet 3 of 3)

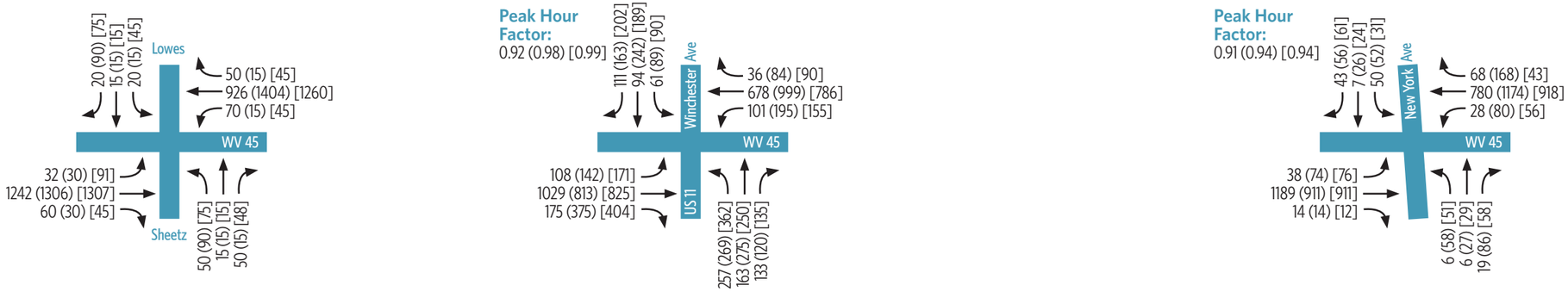


Intersection ID# & Distance Between Intersections

Existing Intersection Geometry



Existing Peak Hour Volumes



2 Traffic Analysis and Simulation Modeling

Traffic analyses were performed using Synchro / SimTraffic. Synchro / SimTraffic (Version 9, Build 901, Revision 75) was utilized to analyze the signalized and unsignalized intersections in the study area. Synchro models for the AM, PM, and Saturday peak hours were developed based on the lane configurations, signal timings, volumes, truck percentages, etc. to represent the existing conditions in the study area. The Friday Midday peak hour was also modeled for the I-81 Interchange and Foxcroft Avenue intersections only. These models were then calibrated and run in SimTraffic. Detailed descriptions of the programs, modeling, and calibration are discussed below.

2.1 SimTraffic Description

SimTraffic is a microscopic simulation model that provides time-based, stochastic simulation of individual vehicles along a roadway system. The simulation model attempts to reflect real-world conditions based on several input and default parameters. Inputs to the model include roadway geometry, traffic signal parameters, peak hour traffic volumes, etc. The model also includes default parameters that are related to various driving behaviors, such as reaction to a yellow light and gap acceptance, which are used to simulate traffic flow. The overall model itself includes ten different driver types and vehicle types that simulate a variety of traffic maneuvers (car following, lane changing, merging, etc.) along a particular roadway.

Comprehensive measures of effectiveness (MOEs) are collected for each vehicle in the model for every tenth of a second of model simulation. The MOEs collected by the model include system-wide measurements as well as measurements by link, such as average delay per vehicle, total intersection delay, and queuing. SimTraffic also generates animated graphics, which display street networks, traffic control device indications, and the animated movement of vehicles through the model.

2.2 Calibration of SimTraffic Models

As part of the traffic flow model within SimTraffic, there are different default driver and vehicle parameters that are available to the user for calibration purposes. Calibration is an important step in developing an existing conditions simulation model. The default parameters can be adjusted (within generally accepted limits) to more closely match field observed speeds, travel times, queue lengths, etc.

When developing the existing conditions models, adjustments to the headway factors were made to reflect the travel time and speeds between intersections. In a corridor such as WV 45, the numerous driveways and congestion during peak times impacts the ability for traffic to flow efficiently through the system. The changes made to these parameters force all driver types to increase the spacing between stopped vehicles – driver behavior changes that occur during periods of congestion, as experienced in the existing peak hours.

Once the default parameters were adjusted, the results of the SimTraffic closely matched the actual travel time runs between I/S #1 and #4 (discussed in further detail in Section 3.5). As depicted in Table 2-1, the simulated travel times along the corridor were within 2 mph of the actual travel times. These calibration parameters were then carried forward and used in the development of the 2024 No-Build and Build Alternative models.

Table 2-1: Comparison of Actual and SimTraffic Travel Times

	WV 45 EB		WV 45 EB		WV 45 EB		WV 45 WB	
	T (min)	V (mph)	T (min)	V (mph)	T (min)	V (mph)	T	V
AM Peak Hour								
WV 45 EB	4.09	21.56	3.98	22.16	-0.11	0.60	-2.8%	2.7%
WV 45 WB	3.55	25.18	3.33	26.85	-0.22	1.67	-6.6%	6.2%
PM Peak Hour								
WV 45 EB	6.99	10.39	6.60	11.00	-0.39	0.61	-5.9%	5.5%
WV 45 WB	7.16	12.49	7.79	11.48	0.63	-1.01	8.1%	-8.8%
Saturday Peak Hour								
WV 45 EB	4.45	20.09	4.89	18.28	0.44	-1.81	9.0%	-9.9%
WV 45 WB	6.21	14.40	6.27	14.26	0.06	-0.14	1.0%	-1.0%

2.3 Summary of Simulation Modeling Procedures

Simulations were seeded for 15 minutes, with each simulation recorded for four 15-minute periods to represent the peak hour. Five separate simulation runs were completed for each alternative, each using a different random number seed, therefore generating different results. The results of these five runs were averaged to account for the variability and randomness between runs.

2.4 Level of Service Criteria

A Policy on Geometric Design of Highways and Streets, 2011 6th Edition, by The American Association of State Highway and Transportation Officials (AASHTO) provides guidelines for the selection of design LOS. As per AASHTO Table 2-5, for a suburban arterial, such as WV 45, the acceptable LOS is C or D. For the local urban/suburban street network, the acceptable LOS is D.

The criteria provided in the HCM, December 2010, were used to determine the levels of service based on SimTraffic's MOEs. For signalized intersections, SimTraffic reports a delay and LOS for each movement, approach, and intersection. The signalized intersection LOS is based on a weighted average of the movement volumes and delays. At unsignalized intersection, SimTraffic reports the delay and LOS for the approach(es) controlled by the stop sign(s). All LOS results reported in this study are based on intersection LOS for signalized locations and the highest stop-controlled approach for unsignalized intersections. Table 2-2 provides a summary of the HCM thresholds.

Table 2-2: Summary of HCM LOS Thresholds

	Control Delay (sec/veh)		LOS Description
	Signalized (Exhibit 16-2)	Unsignalized[1] (Exhibit 17-2)	
A	≤ 10	≤ 10	Free flow, insignificant delays.
B	> 10-20	> 10-15	Stable operations, minimal delays.
C	> 20-35	> 15-25	Stable operations, acceptable delays.
D	> 35-55	> 25-35	Restricted flows, regular delays.
E	> 55-80	> 35-50	Maximum capacity, extended delays. Volumes at or near capacity. Long queues form upstream from intersection.
F[2]	> 80 or v/c > 1.0	> 50 or v/c > 1.0	Forced flow, excessive delays. Represents jammed conditions. Intersection operates below capacity with low volumes. Queues may block upstream intersections.

Notes:
1. Unsignalized LOS is for the worst stop controlled minor approach.
2. Any v/c > 1.0 results in LOS F regardless of delay.

3 Existing Conditions

3.1 Traffic Conditions

The study area was assessed to evaluate the existing traffic conditions and identify potential deficiencies within the corridor. The assessment included the evaluation of the corridor volumes, field-measured saturation flow rates, field-measured initial unmet demand, pedestrian accessibility, access management, and the results of existing travel speeds. In conjunction with the assessment, several key analyses were performed to quantitatively measure the existing corridor conditions. These included crash analyses, capacity analyses, and queue length analyses. The results of these analyses provided insight as to the existing problem areas in the study area. The existing roadway network in the study area, lane configurations, land use, and turn-lane lengths are provided in Figure 1-1 (Sheets 1 through 3).

3.2 Volumes

Based on the manual turning movement counts collected using MioVision technology, the Friday AM and PM peak hours were identified as 7:15 to 8:15 a.m. and 4:00 to 5:00 p.m., respectively. The Saturday peak hour was from 11:30 a.m. to 12:30 p.m. and the Friday Midday peak hour was from 12:00 p.m. to 1:00 p.m. The truck percentage along WV 45 was approximately 4%, 2% and 1% during the weekday AM, PM and Saturday peak hours, respectively. The eastern portion of the corridor had a slightly higher truck percentage than the western section, by around 1%. Figure 1-1 provides the 2014 Peak Hour Volumes (PHVs) for the study area. Using a K-factor of 10%, the existing Average Daily Traffic (ADT) volume was estimated to be approximately 24,000 vpd along the WV 45 corridor.

Peak hour factors (PHFs) were calculated for each intersection and are provided in Table 3-1. Reviewing the factors, the corridor tends to have a higher uniform peak hour during the Friday PM and Saturday peaks relative to the Friday AM Peak, i.e. the corridor does not have a strong 15-minute peak but rather a peak hour containing four 15-minute periods of similar volumes. The PHFs are also generally higher east of the I-81 interchange for all periods. They range from 0.85 to 0.94 west of the I-81 Interchange, and 0.88 to 0.98 east of the interchange, indicating more consistent flow in the eastern portion of the corridor.

Table 3-1: Summary of Peak Hour Factors (PHF) by Intersection

	Friday AM	Friday PM	Saturday	Friday Midday
I/S #1: WV 45 with Blue Ridge Community College	0.92	0.91	0.85	-
I/S #2: WV 45 with Klee Drive	0.88	0.95	0.95	-
I/S #3: WV 45 with Cornerstone Development	0.85	0.92	0.94	-
I/S #4: WV 45 with Retail Commons Parkway	0.89	0.90	0.95	-
I/S #5: WV 45 with I-81 Southbound Ramps	0.88	0.93	0.98	0.98
I/S #6: WV 45 with I-81 Northbound Ramps	0.92	0.96	0.98	0.96
I/S #7: WV 45 with Foxcroft Avenue	0.95	0.99	0.97	0.96
I/S #8: WV 45 with US 11 (Winchester Avenue)	0.92	0.98	0.99	-
I/S #9: WV 45 with New York Avenue	0.91	0.94	0.94	-

The Weekday and Saturday volumes are in general very comparable; however, the Weekday volumes are up to 25% higher near the eastern terminus of the study area. The traffic in the area around Foxcroft Avenue and Lowes / Sheetz is more consistent. As expected, the turning movement volumes into the retail areas in these areas as well as at Retail Commons are typically higher on a Saturday than Weekday.

Directional distribution analysis indicated that volumes are generally greater eastbound during the AM peak period and westbound in the PM peak period. For the Saturday and Friday Midday periods, the westbound direction has higher volumes as well, similar to the PM peak period. The distributions along WV 45 at Foxcroft Avenue were 0.43, 0.53, 0.54 and 0.53 for the AM, PM, Saturday and Friday Midday peak periods, respectively, in the westbound direction.

3.3 Saturation Flow Rate Study

A saturation flow rate study was conducted on Friday, August 15th and Saturday, August 16th, 2014 at the signalized intersections in the study area. At two locations (I/S #4 and #9), there were not adequate queues to collect headway data during the AM peak hour. This was due to the effective progression of the signal system through the corridor.

The saturation flow appeared to be consistent during all peak hours; therefore all of the data from all peak hours were utilized to determine the saturation flow rate. Based on the data collected, the average saturation flow rate for the study area was 1,683 passenger cars per hour per lane (pc/hr/ln). Although a value lower than the typical rate of 1,900 pc/hr/ln was expected, the observed value was much lower than originally anticipated. In an attempt to explain why this difference is so dramatic, the definition of saturation flow rate was reviewed as defined by the HCM:

> *"the equivalent hourly rate at which previously queued vehicles can traverse an intersection approach under prevailing conditions, assuming that the green signal is available at all times and no lost times are experienced, in vehicles per hour or vehicles per hour per lane."*

The saturation flow rate can be impacted by many conditions which are not considered ideal such as lane width, grade, heavy vehicles, presence of parking, etc. The WV 45 corridor appears to have ideal conditions including 12' wide lanes, minimal truck traffic, and no on-street parking; however, while conducting the study it was noticed that drivers tended to leave large gaps in-between queued vehicles at the traffic signals. Based on the field data provided in Appendix B, this appeared to increase the headways between vehicles and ultimately lowered the saturation flow rate.

After discussions with the Traffic Division, it was decided to use a saturation flow rate of 1,700 pc/hr/ln for this project.

3.4 Initial Unmet Demand Study

The initial unmet demand was studied at all the signalized intersections in the corridor on Friday, August 15th and Saturday, August 16th, 2014. Observations were recorded during the AM, PM and Saturday peak hours. The purpose of this study was to determine how many, if any, vehicles waited at an intersection for more than one full traffic signal cycle.

During the AM peak period, no initial unmet demand was identified. Despite the cyclic congestion and queuing, the mainline green times were long enough to allow the queues to entirely dissipate each cycle. This was true even at Foxcroft Avenue, where the eastbound queue often extended back to the I-81 Southbound Ramps intersection.

A similar condition was noted during the Saturday peak period. Despite heavy queues, the mainline green times were sufficient to dismiss the entire queues. In this case, queuing at Foxcroft Avenue westbound impacted the signal at Lowes/Sheetz, and in turn, created queues almost back to Winchester Avenue (US 11). Despite this congestion, all of the queued vehicles were serviced in one cycle.

However, during the PM peak period, WV 45 WB traffic approaching Winchester Avenue (US 11) was too heavy to make it through the intersection in one cycle. Initial unmet demand of 16, 9 and 13 vehicles were recorded on three consecutive cycles,

creating queues almost back to New York Avenue. The initial unmet demand was zero in the eastbound direction, as well as at all the other signalized intersections.

3.5 Travel Time Study

A travel time study was performed on Friday, August 15th and Saturday, August 16th, 2014 in the study area. The corridor was driven three (3) times during each peak period (AM, PM and Saturday), to determine the average travel time, length, and travel speed. The data was collected using a GPS logger that recorded position every second. Once processed, speed can be calculated and averaged at any point along the corridor. Appendix B provides the field data collected during the travel time study. Exhibit 3-1 illustrates the speed along corridor (by location) for the average of the three eastbound runs performed during each of the three study periods; Exhibit 3-2 illustrates the westbound direction. Note that because position and time were recorded using GPS technology, the speed was calculated over 20 data points, yielding an average over fractions of minutes. This was done to remove outlier data points due to significant digit issues and to "smooth" the data curve. The curve is still somewhat jagged, but smoothing it out any further could have resulted in loss of accuracy.

The peaks and valleys on the Exhibits indicate high and low speed areas throughout the corridor, respectively. By inspection, one can see the reduced speeds prior to several signalized intersections. These areas can be indicative of traffic congestion and queues, depending on the associated volumes and time period of interest.

Exhibit 3-1: WV 45 EB Speed vs. Position

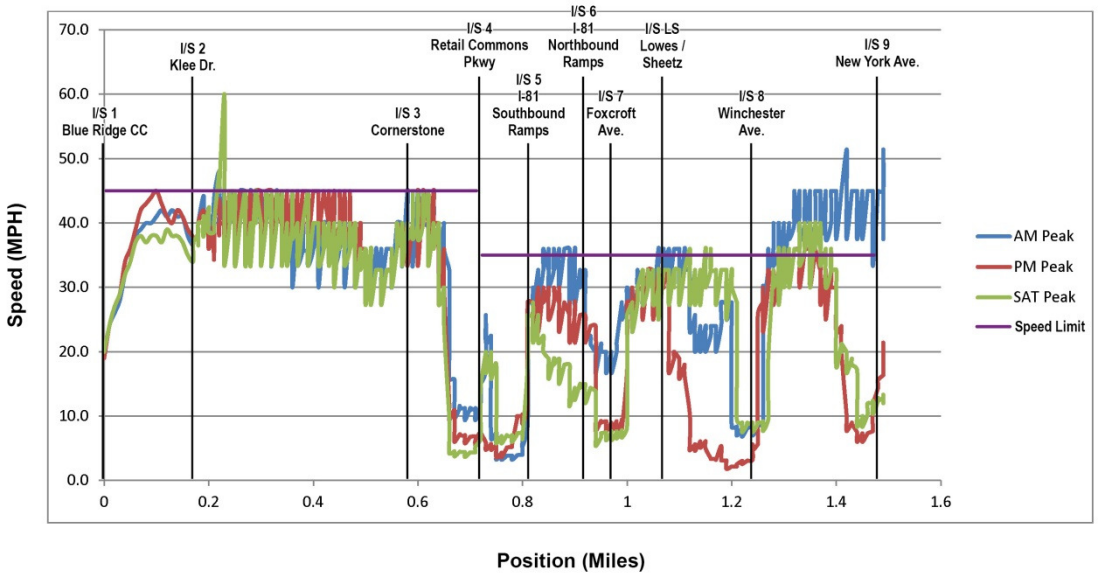


Exhibit 3- 2: WV 45 WB Speed vs. Position

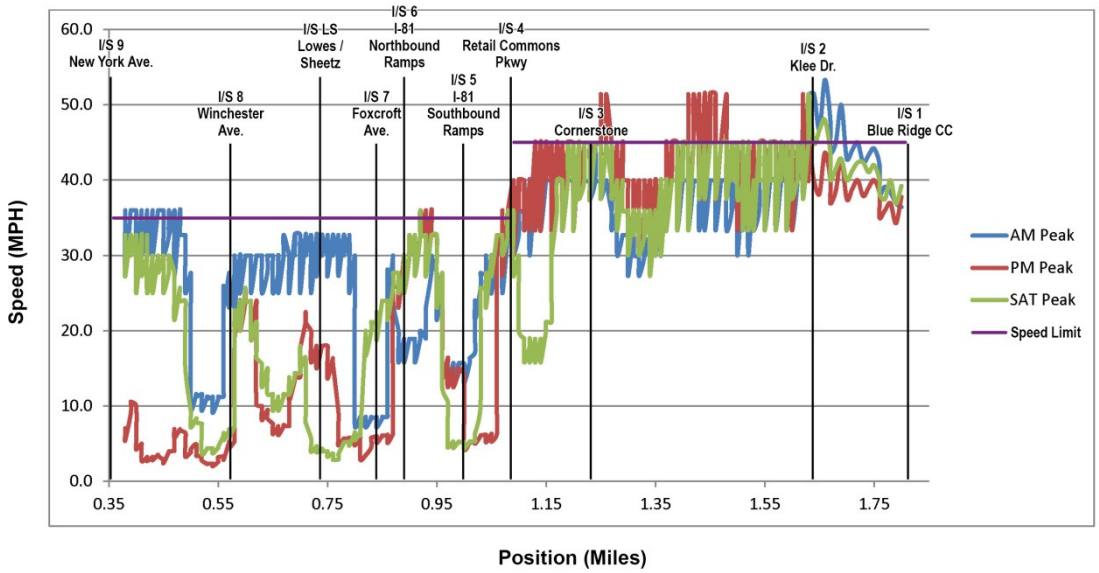


Table 3-2 presents the average times recorded and speeds calculated for the various study periods, for both WV 45 EB and WV 45 WB. The results indicate that the average travel speed is much less than the posted speeds particularly during the PM peak hour. This is indicative of the congestion level and is most notable in the vicinity of the closely spaced intersections.

Table 3-2: Summary of Travel Time Study

	WV 45 EB		WV 45 WB	
	Time (min)	Speed (mph)	Time (min)	Speed (mph)
AM Peak Hour	4.09	21.4	3.55	24.7
PM Peak Hour	6.99	12.5	7.16	12.2
Saturday Peak Hour	4.45	19.7	6.21	14.1

3.6 Crash and Safety Analyses

Crash data were provided for the study area for the period from January 1, 2011 to December 31, 2013. This data was referenced with respect to WV 45. Figure 3-1 provides the crash intensity within the study area and Figures 3-2 through 3-7 provide the crash diagram for each intersection. Note, crash diagrams were not prepared for I/S #1, 2, and 3 since no crashes were recorded during this time period. The crash summaries, crash listings by intersection, and crash rate calculations are provided in Appendix B.

WV 45 Corridor Crash Analyses

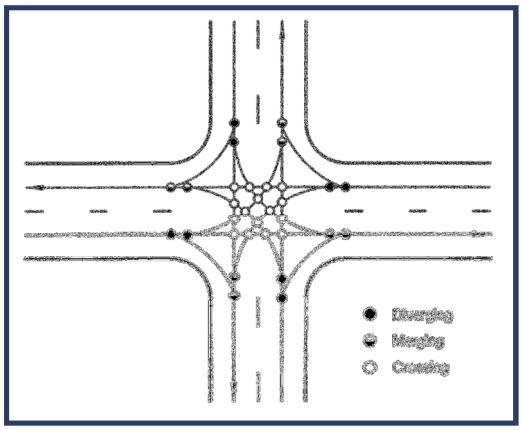
On the WV 45 corridor from I/S #1 (MP 13.61) to I/S #9 (MP 15.07), there was a total of 224 crashes during the three-year period resulting in 114 injuries and 3 fatalities. The crash rate for the western portion of the WV 45 corridor (I/S #1 to I/S #4) was 1,076 crashes per hundred million vehicle miles (HMVM). This portion of the corridor is more rural in nature and has less traffic volume, but where the roadway widens EB (narrows WB), there was a significant number of crashes (25). This rate was above the 2003 statewide average of 543 crashes per HMVM traveled for US and WV routes in municipalities. Similarly, the crash rate for the eastern portion of the WV 45 corridor (I/S #4 to I/S #9) was 893 crashes per hundred million vehicle miles (HMVM). This portion of the corridor is condensed and commercial in nature. This rate was above the 2003 statewide average of 543 crashes per HMVM traveled for US and WV routes in municipalities. It should be noted, however, that this rate is high primarily due to the fact the intersections are closely spaced (the greater the intersection density, the higher the crash rate since intersections have higher crash rates than roadway segments). As discussed later in the report, most of the intersections do not have unusually high crash rates.

Table 3-3 summarizes the crash types along the entire corridor length. In addition to providing a summary for the crashes at the “major” intersections studied, it also includes the crashes occurring in the study area. There were thirty-two crashes determined to not be under the influence of a study intersection, which is not surprising due to the close proximity of the intersections. Of these, six were located in the segment west of Retail Commons, where WV 45 becomes a two-lane road. These crashes mainly took place during daylight on dry pavement, and half of them were single vehicle crashes. Therefore, the crashes apart from intersections do not point to any underlying problems within the corridor.

Table 3-3: Summary of Crash Types

Crash Type	Corridor Total	Percent of Total
Rear End	82	37%
Single Vehicle	36	16%
Angle *Right Angle*	27	12%
Sideswipe *Same Direction*	26	12%
Angle *Opposite Direction*	19	8%
Angle *Same Direction*	14	6%
Head On	9	4%
Sideswipe *Opposite Direction*	8	4%
Angle *Direction Not Specified*	3	1%
Total	**224**	**100%**

The predominate type of crash was rear-end, accounting for 82 crashes or 37% of the total. This is likely attributable to the high density of intersections along WV 45. The number of rear-end crashes are indicative of drivers slowing or stopping to either perform their turn maneuver or decelerating due to queued traffic. This behavior was observed at the Lowes driveway. The second most common type was the single vehicle crash with 36 crashes or 16% of the total. These crashes, along with the 26 same-direction sideswipe crashes, could be indicative of weaving traffic and problems with changing lanes. There were also 27 right angle crashes between turning vehicles. In theory, each unrestricted "plus" intersection along WV 45 has a potential 32 conflict points as shown in the figure to the right. In addition, each unrestricted "T" intersection has a potential 9 conflict points. An illustration of the 32 conflict points within a plus intersection is shown above.



Referring to the crash intensity in Figure 3-1, crashes occurred along the entire length of the corridor with the highest intensities near the signalized intersections, especially at I/S #7 (Foxcroft Avenue) and #8 (Winchester Avenue). There is also another signalized intersection at the Lowes/Sheetz driveways that lies between these. This area, in general, is problematic due to the closely spaced intersections. Winchester Avenue is further to the east, but being a US route, has higher side road volumes than the other intersections. Therefore, this could explain the higher number of vehicular crashes at these locations.

WV 45 Intersection Crash Analyses

The crash rates for each intersection were calculated and are shown in Appendix B. Table 3-4 and Exhibit 3-3 provide a summary of crash types and rates by intersection during this time period. Crash diagrams for each intersection can be found in Figures 3-2 to 3-7. In general, the Division categorizes intersection crash rates in the following categories:

- Average < 1.5 crashes per million entering vehicles (MEV)
- Above Average > 1.5 crashes per MEV
- Significantly Above Average > 2.0 crashes per MEV

As expected, the most common crash type at the signalized intersections was rear-end. Only one intersection would be categorized as having above average crash rates (I/S #7: WV 45 with Foxcroft Avenue). All of the rest of the signalized intersections were categorized as having average crash rates, with rates ranging from 0.44 to 1.31 crashes per million entering vehicles (MEV). I/S #8: WV 45 with Winchester Avenue (US 11) experienced the highest crash rating of this group with 1.31 crashes per MEV.

Due to the closely spaced intersections, the portion of the study area between I/S #6 and I/S #8 is the most congested. There is a high degree of influence between these signals (including the signal at the Lowes/Sheetz driveway) as indicated by heavy queuing, which often impedes traffic flow at adjacent intersections. Not only could motorists be surprised by the excessive queues, leading to rear end collisions, but there is a higher degree of driver frustration in this area. This was noted during the field view in August 2014. Driver frustration leads to more erratic and risky driving behavior, and has a positive correlation to the crash rate. For example, quick acceleration and pulling out from driveways with nearly insufficient gap in traffic flow was noted.

A contributing factor to the high crash rate at Foxcroft Avenue involving angle crashes could be presence of the railroad signals, especially westbound. The traffic signals are situated far from the stop bar and could be obscured by the railroad equipment. Advanced electronic “(red) signal ahead” signs might be considered to alert mainline drivers of a red signal prior to entering the intersection.

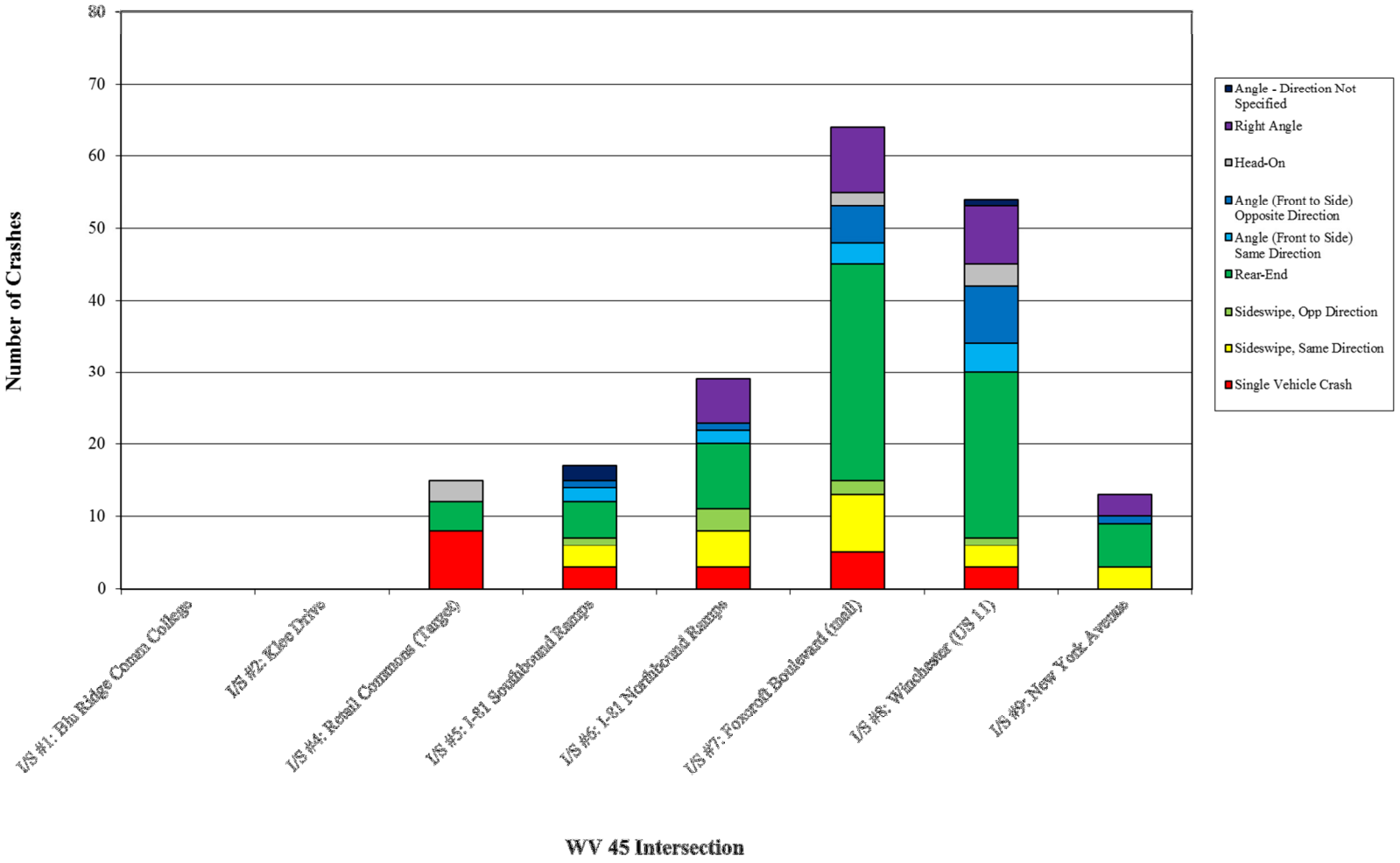
There were no recorded crashes during the study time period at the two existing unsignalized intersections along WV 45. This is not surprising since both intersections are very simple and lit, with adequate sight distance. WV 45 is a two-lane road in the area of these intersections and the volumes are much less that the eastern portion of the corridor.

Table 3-4: Summary of Crash Rates by Intersection

	Single Vehicle Crash	Sideswipe, Same Direction	Sideswipe, Opp Direction	Rear-End	Angle (F to S) Same Direction	Anfle (F to S) Same Direction	Head-On	Right Angle	Angle - Dir Not Specified	Total Crashes	Crash Rate (MEV)
I/S #1: WV 45 with	0	0	0	0	0	0	0	0	0	**0**	0.00
Blue Ridge Community College	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
I/S # 2: WV 45 with	0	0	0	0	0	0	0	0	0	**0**	0.00
Klee Drive	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
I/S #4: WV 45 with	8	0	0	4	0	0	3	0	0	**15**	0.95
Retail Commons Parkway (Target)	53.3%	0.0%	0.0%	26.7%	0.0%	0.0%	20.0%	0.0%	0.0%		
I/S #5: WV 45 with I-81 Southbound	3	3	1	5	2	1	0	0	2	**17**	0.67
Ramps	17.6%	17.6%	5.9%	29.4%	11.8%	5.9%	0.0%	0.0%	11.8%		
I/S #6: WV 45 with I-81 Northbound	3	5	3	9	2	1	0	6	0	**29**	0.88
Ramps	10.3%	17.2%	10.3%	31.0%	6.9%	3.4%	0.0%	20.7%	0.0%		
I/S #7: WV 45 with Foxcroft	5	8	2	30	3	5	2	9	0	**64**	1.58
Boulevard (Mall)	7.8%	12.5%	3.1%	46.9%	4.7%	7.8%	3.1%	14.1%	0.0%		
I/S #8: WV 45 with Winchester	3	3	1	23	4	8	3	8	1	**54**	1.31
Avenue (US 11)	5.6%	5.6%	1.9%	42.6%	7.4%	14.8%	5.6%	14.8%	1.9%		
I/S #9: WV 45 with New York	0	3	0	6	0	1	0	3	0	**13**	0.44
Avenue	0.0%	23.1%	0.0%	46.2%	0.0%	7.7%	0.0%	23.1%	0.0%		

Notes:
1 - Crash Data Dates: January 1, 2011 to December 31, 2013

Exhibit 3- 3: Summary of Crash Types



3.7 Left-turn Lane Analyses

Left-turn lanes are provided along WV 45 at each major intersection either as a marked exclusive left-turn lane or through the use of the TWLTL which runs the length of the corridor. Using the general rule of thumb that dual left-turn lanes should be provided where left-turn volumes exceed 200 vph, several locations currently satisfy this rule. Currently, dual left-turn lanes exist on WV 45 at I/S #4: WV 45 at Retail Commons Parkway. Other potential locations include WV 45 WB to I-81 SB and WV 45 EB to Foxcroft Avenue. The left-turn onto Winchester Avenue (US 11) from WV 45 Westbound is currently close to 200 vph; therefore, it is projected that this intersection will meet the criteria within the next few years.

Several of the side roads have multi-lane approaches which are used as an exclusive left-turn lane plus a shared thru-right lane or a shared left-thru lane plus an exclusive right-turn lane. In general, the usage of the available lanes is determined by the volume distribution and operations. For example, on a two-lane approach with a heavy right-turn volume, it may be necessary to stripe an exclusive right-turn lane to allow for effective right-turn-on-red and/or right-turn overlaps. This limits the availability to provide exclusive left-turn lanes on the minor approaches within the existing cross-section.

3.8 Left-turn Phase Analyses

Although no nationally accepted guidelines exist for determining when a protected left-turn phase is warranted, there are several resources providing guidance. They are the Highway Capacity Manual (HCM) Planning Criteria and guidance developed by the Institute of Transportation Engineers (ITE). The guidance is described and evaluated in more detail below.

HCM Planning Criteria

The HCM notes that protected left-turn phases should be considered if any of the other following criteria are satisfied:

- There is more than one turn lane.
- The left-turn volume is greater than 240 vehicles per hour.
- The product of the left-turn volume times the opposing traffic volume is greater than the thresholds shown in Table 3-5.

Table 3-5: HCM Left-turn Threshold Values

Number of Opposing Lanes	Threshold Value
1	50,000
2	90,000
3	110,000

However, the HCM notes that these criteria should be used only on a planning level and other factors such as crash trends and geometrics be considered for design applications. These criteria were tested against the existing volumes for the signalized intersections along the WV 45 corridor, which has two opposing lanes. The results are shown in Table 3-6. The only locations that are not warranted are at I/S #7 and #9 in the WV 45 WB direction; however, the left-turn phases are warranted in the WV 45 EB direction at these locations.

Table 3-6: Application of HCM Planning Criteria

I/S #	WV 45 Direction	Number of Opposing Lanes	Existing Left-turn Phase?	Weekday PM	Saturday	Warranted? (Weekday)	Warranted? (Saturday)
4	WB	2	Yes	93,314	99,828	Yes	Yes
5	WB	2	Yes	226,300	158,772	Yes	Yes
6	EB	2	Yes	272,520	165,324	Yes	Yes
7	EB	2	Yes	374,949	286,116	Yes	Yes
	WB	2	Yes	42,353	54,054	No	No
8	EB	2	Yes	153,786	149,796	Yes	Yes
	WB	2	Yes	231,660	190,495	Yes	Yes
9	EB	2	Yes	99,308	73,036	Yes	No
	WB	2	Yes	74,000	51,688	No	No

ITE's Traffic Control Devices Handbook

Additional guidelines are provided in ITE's Traffic Control Devices Handbook (Handbook) which augments the MUTCD. In the Handbook, it is noted that these criteria are not mandated but provided for information purposes only. The suggested guidelines relating to volume, delay, and crashes are listed on the next page. Given that these guidelines are provided for information only, the criteria were not evaluated for the WV 45 corridor.

- Product of the left-turns times the opposing thru traffic is greater than 100,000 and 50,000 on a four-lane and two-lane street, respectively.

- Left-turn peak of 90 vph or 50 vph on a street with through traffic over 45 mph.
- Left-turn delay greater than 2.0 vehicle-hours during the peak and there are more than 2 left-turns per cycle during the peak hour and average left-turn vehicle delay is greater than 35 seconds.
- On one approach, a total of 4 left-turn type crashes during one year or 6 left-turn type crashes over two years. For both approaches, the guideline increase to 6 crashes in one year or 10 crashes in two years.

3.9 Pedestrian Accessibility

The WV 45 corridor is rural in nature in the western section, west of Retail Commons Parkway. The rest of the corridor is commercial in nature with several businesses and the I-81 Interchange. There are no pedestrian accommodations anywhere within the entire corridor; all access is presumed to be via vehicle only. Specifically, there are no sidewalks, crosswalks or pedestrian pushbuttons / signals at or between any study intersections.

However, there were a few pedestrians spotted during the field view of the corridor. These pedestrians were seen in the vicinities of Klee Road, Retail Commons Parkway and Foxcroft Avenue. Although the nearest residential areas are not in close proximity to the study area, it can be assumed the density of retail stores attracts a few pedestrians that traverse the shoulders and adjacent land to the roadways.

A short, worn dirt path was observed on the northeastern corner of WV 45 and Foxcroft Avenue. The path continues on the eastern side of Foxcroft, as well as to Lowes Plaza along WV 45. This is a sign of pedestrian activity, although no pedestrians were observed on the path at the time.

A worn path exists along the eastern side of Foxcroft Avenue

A pedestrian travels northbound on Foxcroft Avenue, near WV 45.

3.10 Access Management

Excluding the stop-controlled and signalized intersections, there are a total of 24 driveways or access (connection) points along the corridor. This translates into a density of approximately 16 connections per mile. Table 3-7 tabulates the connection points by segment. All of the segments from I/S #4 eastward have an average connection spacing of more than 150 feet which is the minimum spacing guideline for posted speeds of 35 mph. The same is true for the intersections west of I/S #4, where the posted speed is 45 mph and the criteria is a minimum of 230 feet. Several of the segments do not have any access points at all. Therefore, all of the segments in the corridor meet criteria. As per Table 6 of the Division's *Manual on Rules and Regulations for Constructing Driveways on State Highway Rights-of-Way*, these minimum spacing guidelines are "based on average vehicle acceleration and deceleration rates and are considered necessary to maintain safe traffic operation." In general, the corridor is managed well and there is not a problem with excess driveways or driveways in close proximity to one another. The majority of the driveways is in the rural, western portion of the corridor and is residential in nature.

Table 3-7: Existing Connection Spacing

I/S #	Segment	Distance (feet)	Number of Connections		Average Connection Spacing (feet)	
			EB	WB	EB	WB
1 to 2	Blue Ridge CC to Klee Dr.	1000	1	4	1,000	250
2 to 4	Klee Dr. to Retail Commons Pkwy.	2900	9	4	322	725
4 to 5	Retail Commons Pkwy. To I-81 SB Ramps	450	0	0	450	450
5 to 6	I-81 SB Ramps to I-81 NB Ramps	600	0	0	600	600
6 to 7	I-81 NB Ramps to Foxcroft Blvd.	300	0	0	300	300
7 to LS	Foxcroft Blvd. to Lowes / Sheetz	500	1	0	500	500
LS to 8	Lowes / Sheetz to Winchester Ave. (US11)	900	2	2	450	450
8 to 9	Winchester Ave. (US11) to New York Ave.	1200	1	0	1,200	1,200

3.11 Capacity Analyses

To assess the existing capacity constraints and deficiencies of the corridor, analyses were performed using the 2014 AM, PM, and Saturday peak hour volumes, as well as Friday Midday for selected intersections near the I-81 Interchange. These analyses utilized the existing signal phasing and timings provided by the Traffic Division and assumed no improvements within the study area. The existing models were calibrated as discussed in Section 2.2. The results of the capacity analyses are shown in Table 3-8 and Figure 3-8. Appendix C provides the SimTraffic output along with the Synchro reports.

Table 3-8: Summary of 2014 Existing LOS

I/S	Signalized?	AM	PM	SAT	Fri Midday
I/S #1: WV45 with Blue Ridge Community College	No	A	A	A	- -
I/S #2: WV45 with Klee Drive	No	A	A	A	- -
I/S #3: WV45 with Cornerstone Development	No	A	A	A	- -
I/S #4: WV45 with Retail Commons Parkway	Yes	B	B	B	- -
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	D	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	B	B	B	C
I/S #7: WV 45 with Foxcroft Boulevard	Yes	C	C	C	D
I/S #LS: WV 45 with Lowes / Sheetz	Yes	B	C	D	- -
I/S #8: WV 45 with Winchester Avenue (US 11)	Yes	C	E	D	- -
I/S #9: WV 45 with New York Avenue	Yes	A	D	B	- -

Notes:
1 – Unsignalized LOS is the worst stop-controlled approach

WV 45 Corridor

Based on field observations while conducting the travel time, saturation flow rate, and initial unmet demand studies, the WV 45 corridor operates well near the western project termini and poorly especially in the vicinity of closely spaced intersections near the I-81 Interchange. There is also significant traffic and queuing at I/S #8: WV 45 with Winchester Avenue during the PM and Saturday peak periods. Lengthy green times for the mainline allow for the dissipation of queues such that initial unmet demand is not a primary concern. However, the close proximity of the intersections in the center of the study area appears to be the main cause of traffic congestion, and may present safety concerns relating to impatient drivers, lane changes and unsafe entry from driveways and side roads.

Unsignalized Intersections

In general, the unsignalized intersections in the study area operate well since they have lower volumes and less conflicting movements. As shown in Table 3-8 and Figure 3-8, the stop-controlled or shared lane with conflicting movements operate at LOS A for all study periods at both the Blue Ridge Community College driveway (I/S #1) and Klee Drive (I/S #2). The Cornerstone Development access (I/S #3) is presently a construction entrance and operates more like a residential driveway than an intersection.

Signalized Intersections

As shown in Table 3-8 and Figure 3-8, the majority of the signalized intersections currently operate at LOS B or C, although I/S #8 and #9 operate at LOS D or E during the PM peak hour and I/S #8 operating at LOS D on Saturday. The intersections are timed to promote progression along WV 45 at the expense of the side roads, and the mainline green times (70+ seconds) also add to this effect.

The left-turn movements at I/S #4 generally operate at LOS C. This is due to the majority of the green time being given to the WV 45 thru movements. During the AM peak, WV 45 WB traffic turning left onto Retail Commons Parkway operates at LOS E, primarily because the volume is low and there is heavy conflicting WV 45 EB thru movement.

The movements and overall LOS at I/S #5 perform worse than adjacent intersections, with overall LOS of C, D and C for the AM, PM and Saturday peaks, respectively. This could be a result of this intersection not being coordinated with the rest of the corridor

to the east. The WV 45 EB thru movement performs as poorly as the WV 45 WB left-turn movement, with LOS D or worse for all peak hours, except for LOS C for the WV 45 WB left-turn during the Saturday peak.

At I/S #6, the thru movements on WV 45 operate at LOS B or better during all periods. The I-81 off-ramp operates at LOS D for the left-turn movement and LOS C for the right-turning vehicles, due to the right-turn movement overlap phase. However, the ramp LOS is highly sensitive to WV 45 EB left-turn queues at the downstream Foxcroft Avenue intersection. These queues can impact the ramp due to the high number of drivers using the off-ramp that are heading to Foxcroft Avenue. This is seen in the model results for Friday Midday peak, in which the LOS of the ramp movements decreased to LOS F.

The intersection at Foxcroft Avenue (I/S #7) performs at LOS C for all periods except for the Friday Midday peak, which is hampered by high WV 45 WB left-turn vehicle volume. Even with dual left-turn lanes, the Foxcroft to WV 45 EB movement operates at LOS D during all periods. WV 45 WB thru movements also operate at LOS D during the PM and Saturday peak hours, mainly due to heavy traffic in this direction as well as the closely spaced upstream signals. Traffic into and out of the McDonald's Driveway on the southern leg of the intersection suffers from a lack of green time, and operates with LOS E or F during all time periods.

The driveways for Lowes to the north and Sheetz to the south are situated to form a signalized "plus" intersection. The movements into and out of these driveways operate at LOS D or E during all periods even with an existing phase overlap, with the exception of the right-turn movement coming from Sheetz. This was clearly observed in the field, especially during the PM and Saturday peak hours when westbound queues at the downstream intersection would block through this intersection.

I/S #8: WV 45 with Winchester Avenue (US 11) operates at LOS C, E, and D for the AM, PM and Saturday peak hours, respectively. Left-turn and thru movements on US 11 generally operate at LOS E or F during all time periods. LOS degradation is also prominent along the westbound approach during the PM periods. Heavy queuing occurs on each leg of the intersection. Platooning from this intersection for westbound traffic creates downstream queuing, which is amplified by the spacing of the series of intersections.

At I/S #9 (New York Avenue), the intersection operates in a similar manner as I/S #8, but with lower side road volumes. This intersection is especially problematic during the PM peak period with approach LOS of D or worse from every direction. At times, queuing from the downstream intersection (I/S #8) can almost extend to this intersection.

3.12 Queue Length Analyses

As noted previously, one of the MOEs generated by the SimTraffic models is the queue lengths for each movement. Similar to the delay values, the queue lengths are based on the average of five simulation runs using different random seed numbers. SimTraffic reports three queue lengths and each is defined as follows:

- Maximum Queue – the maximum back of queue observed for the entire analysis interval.
- Average Queue –the maximum back of queue observed for every two minute period. The Average Queue is average of all the 2 minute maximum queues.
- 95th Queue – equal to the Average Queue plus 1.65 standard deviations.

Table 3-9 summarizes the average queue lengths at key locations for the 2014 Existing and 2024 No-Build models. The queue lengths are rounded to the nearest 25' increment, which is assumed to be the average spacing for one vehicle. In addition, the queue lengths are provided as part of the SimTraffic output in Appendix C.

The most notable queues exist in the WV 45 WB direction during the PM peak hour and to a lesser extent during the Saturday Midday peak hour. Queues extend from Foxcroft Avenue back through the study area to New York Avenue at times, but due to long mainline green times the only initial unmet demand occurs at the Lowes/Sheetz driveway. Northbound and southbound queuing is also consistent during the PM and Saturday peak periods along Winchester Avenue, and thru block is present in the southbound direction. Finally, heavy demand along WV 45 EB left onto Foxcroft Avenue creates a queue back to the I-81 northbound intersection. This queue is significant since the intersections are closely spaced together and impacts the I-81 NB off-ramp. On average, the longest queue occurs during the Friday Midday peak period with a length of 450 feet. Although this does not impact I-81 NB, it is a concern and could have impacts during unusually heavy traffic.

Table 3-9: Summary of 2014 Existing and 2024 No Build Queue Lengths (feet)

I/S	Available Storage (ft.)	2014				2024			
		AM	PM	SAT	Fri-Mid	AM	PM	SAT	Fri-Mid
I/S #1: WV45 with Blue Ridge CC									
BRCC Driveway NB Left / Right		0	25	0	--	0	25	0	--
I/S #2: WV45 with Klee Drive									
Klee Drive SB Left / Righjt		25	25	25	--	50	25	25	--
I/S #3: WV45 with Cornerstone Dvmt									
WV 45 WB Left		N/A	N/A	N/A	--	0	25	25	--
Cornerstone NB Left		N/A	N/A	N/A	--	25	25	25	--
Cornerstone NB Right		N/A	N/A	N/A	--	25	25	25	--
I/S #4: WV45 with Retail Commons Pkwy									
WV 45 EB Thru		25	50	25	--	25	50	50	--
WV 45 EB Right		0	25	25	--	0	25	25	--
WV 45 WB Thru		25	50	25	--	25	25	50	--
WV 45 WB Left	240	75	125	125	--	75	125	150	--
RCP NB Left	275	0	25	25	--	0	25	25	--
RCP NB Right		0	50	50	--	0	50	75	--
I/S #5: WV45 with I-81 Southbound Ramps									
WV 45 EB Thru		75	225	150	225	75	150	125	175
WV 45 EB Right		25	75	50	75	25	75	50	75
WV 45 WB Thru		75	250	200	200	75	75	125	75
WV 45 WB Left		150	250	125	200	150	125	100	125
I-81 Off-Ramp SB Right		0	50	50	50	0	75	50	50
I-81 Off-Ramp SB Left	425	150	175	125	150	225	125	150	150
I/S #6: WV45 with I-81 Northbound Ramps									
WV 45 EB Thru		75	100	100	125	150	50	125	125
WV 45 EB Left	300	0	150	50	150	25	125	50	125
WV 45 WB Thru		25	100	100	100	25	75	75	100
WV 45 WB Right		25	0	25	0	50	0	25	0
I-81 Off-Ramp NB Right		150	150	100	450	325	175	150	250
I-81 Off-Ramp NB Left	200	25	75	50	100	25	75	50	75
I/S #7: WV 45 with Foxcroft Avenue									
WV 45 EB Left		125	200	175	250	150	200	175	225
WV 45 EB Thru		225	225	200	250	250	150	150	200
WV 45 EB Right	150	75	25	50	25	100	25	25	50
WV 45 WB Left		50	75	100	75	50	75	100	125
WV 45 WB Thru		150	325	300	200	200	350	350	375
WV 45 WB Right		25	25	75	50	25	50	50	100
Foxcroft SB Left	125	75	25	125	25	75	25	150	25
Foxcroft SB Left - Thru		125	125	200	125	125	125	275	125
Foxcroft SB Right		50	100	125	100	50	100	150	100
McDonalds NB Left - Thru	200	100	50	100	200	100	75	100	200
McDonalds NB Right	100	75	50	75	75	75	50	75	75
I/S #LS: WV 45 with Lowes / Sheetz									
WV 45 EB Left	100	25	25	75	--	50	25	75	--
WV 45 EB Thru		100	175	125	--	150	200	150	--
WV 45 WB Left	TWLTL	50	25	50	--	50	25	50	--
WV 45 WB Thru		100	225	500	--	125	450	675	--
WV 45 WB Right		0	0	25	--	25	25	50	--
Lowes SB Left - Thru		50	50	75	--	25	50	75	--
Lowes SB Right	100	25	50	50	--	25	50	75	--
Sheetz NB Left - Thru		75	100	75	--	75	75	75	--
Sheetz NB Right	100	50	25	50	--	50	25	50	--
I/S #8: WV 45 with Winchester Avenue (US 11)									
WV 45 EB Left	380	150	225	150	--	150	325	150	--
WV 45 EB Thru		175	500	150	--	350	475	275	--
WV 45 EB Right	330	50	275	75	--	150	250	175	--
WV 45 WB Left	TWLTL	100	200	125	--	100	300	225	--
WV 45 WB Thru		150	375	300	--	150	400	400	--
WV 45 WB Right	225	25	150	150	--	25	200	200	--
Winchester SB Left	150	50	100	75	--	50	175	175	--
Winchester SB Thru		100	250	200	--	100	375	375	--
Winchester SB Right		50	75	100	--	50	125	125	--
Winchester NB Left	500	250	200	400	--	200	375	400	--
Winchester NB Thru		175	200	200	--	150	225	200	--
Winchester NB Right	150	50	50	50	--	50	50	50	--
I/S #9: WV 45 with New York Avenue									
WV 45 EB Left	TWLTL	25	75	50	--	50	50	50	--
WV 45 EB Thru		25	200	25	--	50	50	75	--
WV 45 EB Right	150	0	0	0	--	0	0	0	--
WV 45 WB Left	225	25	100	50	--	25	150	100	--
WV 45 WB Thru		50	425	100	--	75	700	425	--
WV 45 WB Right	150	0	100	25	--	25	150	75	--
New York SB Left - Thru		75	100	75	--	75	75	100	--
New York SB Right	100	25	50	50	--	50	50	50	--
New York NB Left - Thru		0	75	75	--	25	75	150	--
New York NB Right		25	25	25	--	25	50	50	--

- Queue length exceeds storage length

3.13 Summary

The existing traffic conditions can be summarized by the following statements:

- The WV 45 corridor has a high density of signals in the central portion of the corridor, with an Interstate diamond interchange. To the east, the Winchester Avenue intersection is overcapacity in all directions.
- There is significant queuing in the westbound direction from Foxcroft Avenue back to the eastern terminus of the study area during the PM and Saturday periods. Eastbound queuing also takes place during the AM peak periods in the central portion of the study area.
- Initial unmet demand exists at the Lowes/Sheetz traffic signal during the PM peak hour. The queue at this intersection nearly extends back to Winchester Avenue.
- Left-turn vehicles onto Foxcroft Avenue from WV 45 EB do not have enough storage space for the queue. This creates queuing on the I-81 NB off-ramp.
- The saturation flow rate study indicated drivers tend to leave large headways between vehicles and/or are slow to start moving due to congestion at the signalized intersections. This corridor experiences a significantly reduced saturation flow rate. The field-collected saturation flow rate is therefore less than the HCM standard.
- The travel time study indicated the average speed is much less than the posted speed, particularly during the PM peak hour. During the PM peak hour the average travel speed was 11.4 mph in the WV 45 WB direction.
- 39% of the crashes occurring at the signalized intersections were rear-end type.
- One of the intersections experienced crash rates above the statewide average, Foxcroft Avenue. Rear end collisions in both the eastbound and westbound direction resulted in many injury crashes. Angle crashes were also numerous.
- The corridor is lacking pedestrian facilities and connectivity.

Figure 3-1: WV 45 Crash Intensity Diagram

Figure 3-2: Crash Diagram - Intersection #4

I/S #4 - Retail Commons Pkwy
3 yr pd from 01/11 to 12/13

Number of Accidents
9 PDO
5 Injury
1 Fatal
15 Total

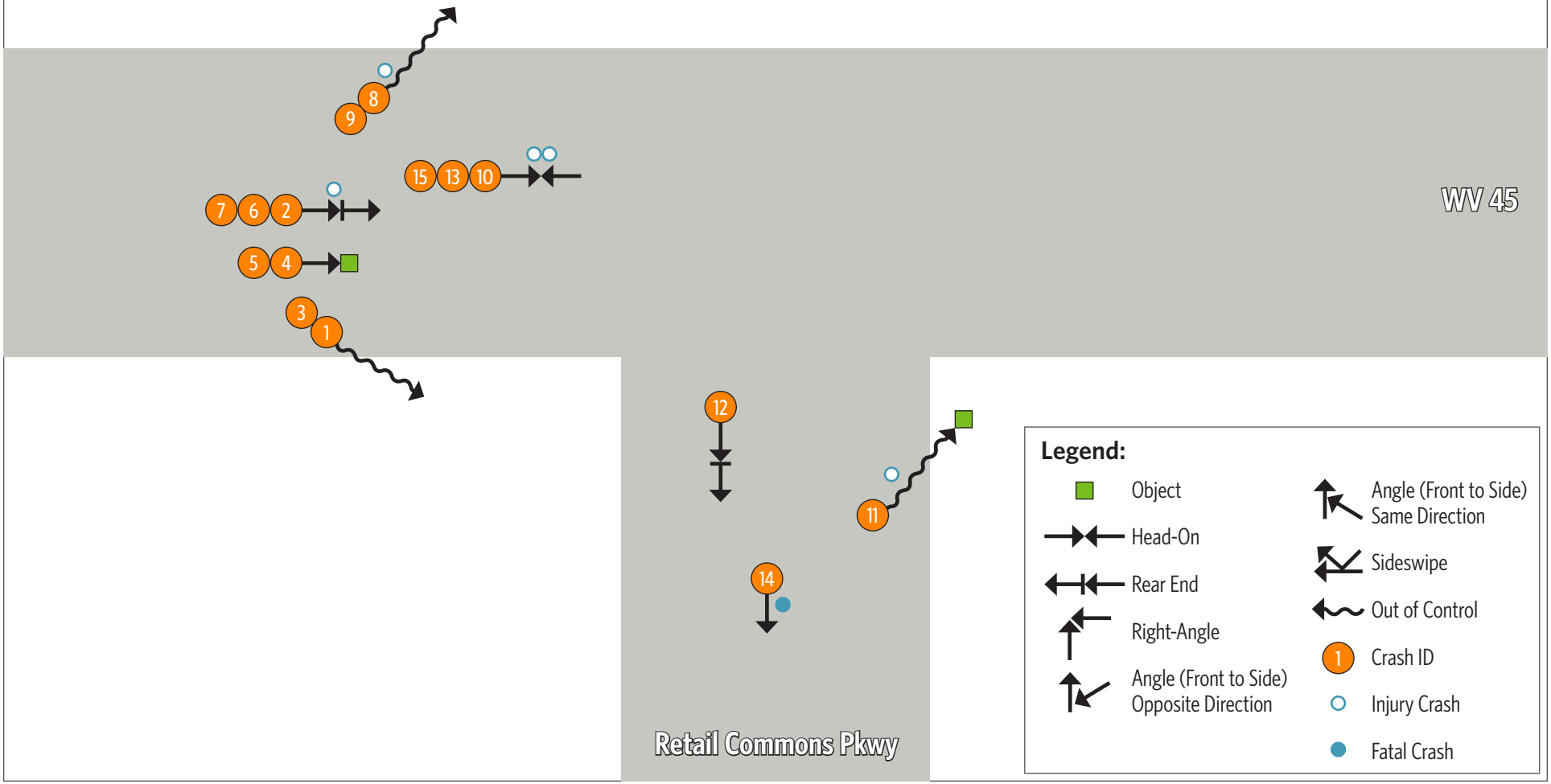


Figure 3-3: Crash Diagram - Intersection #5

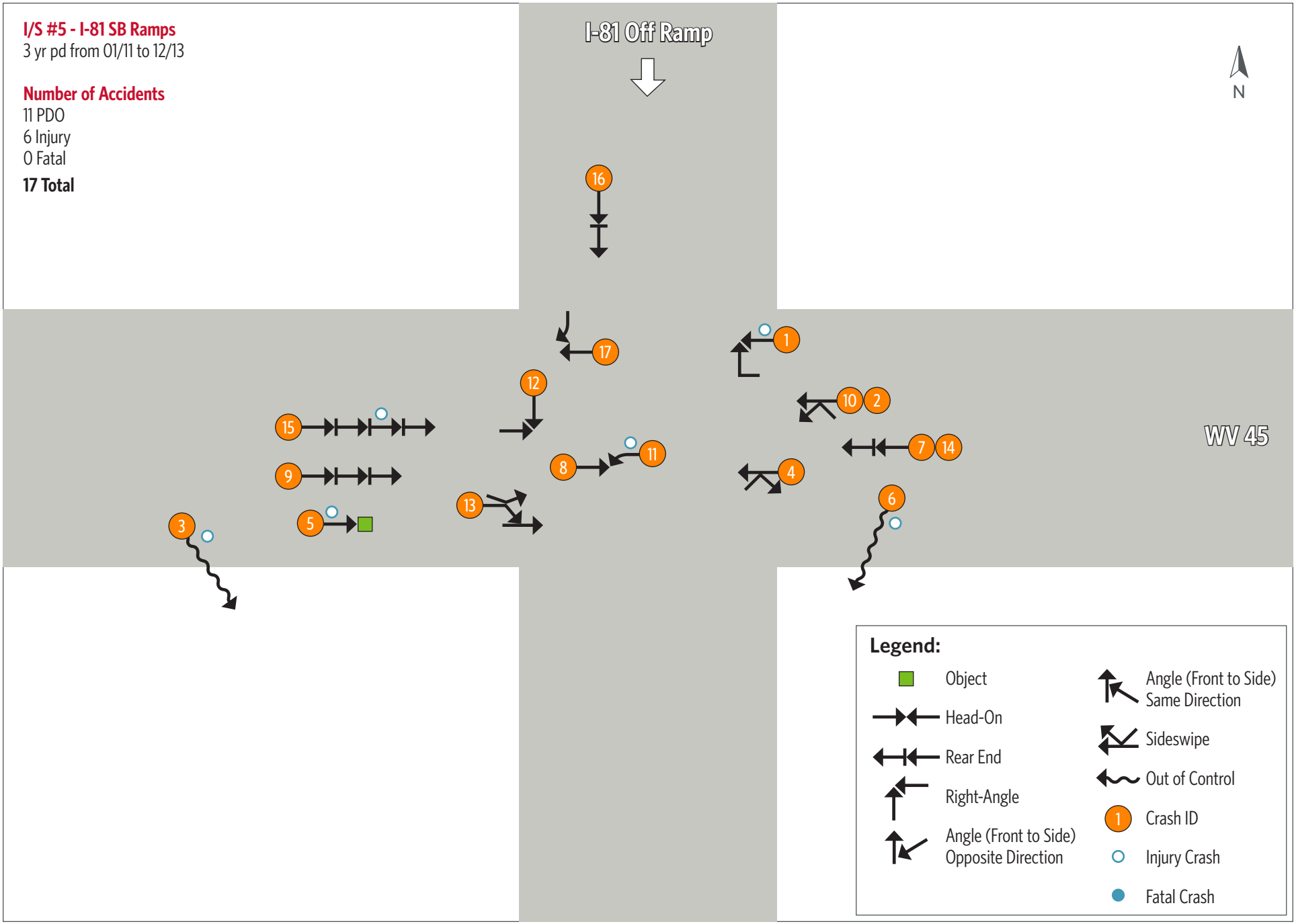


Figure 3-4: Crash Diagram - Intersection #6

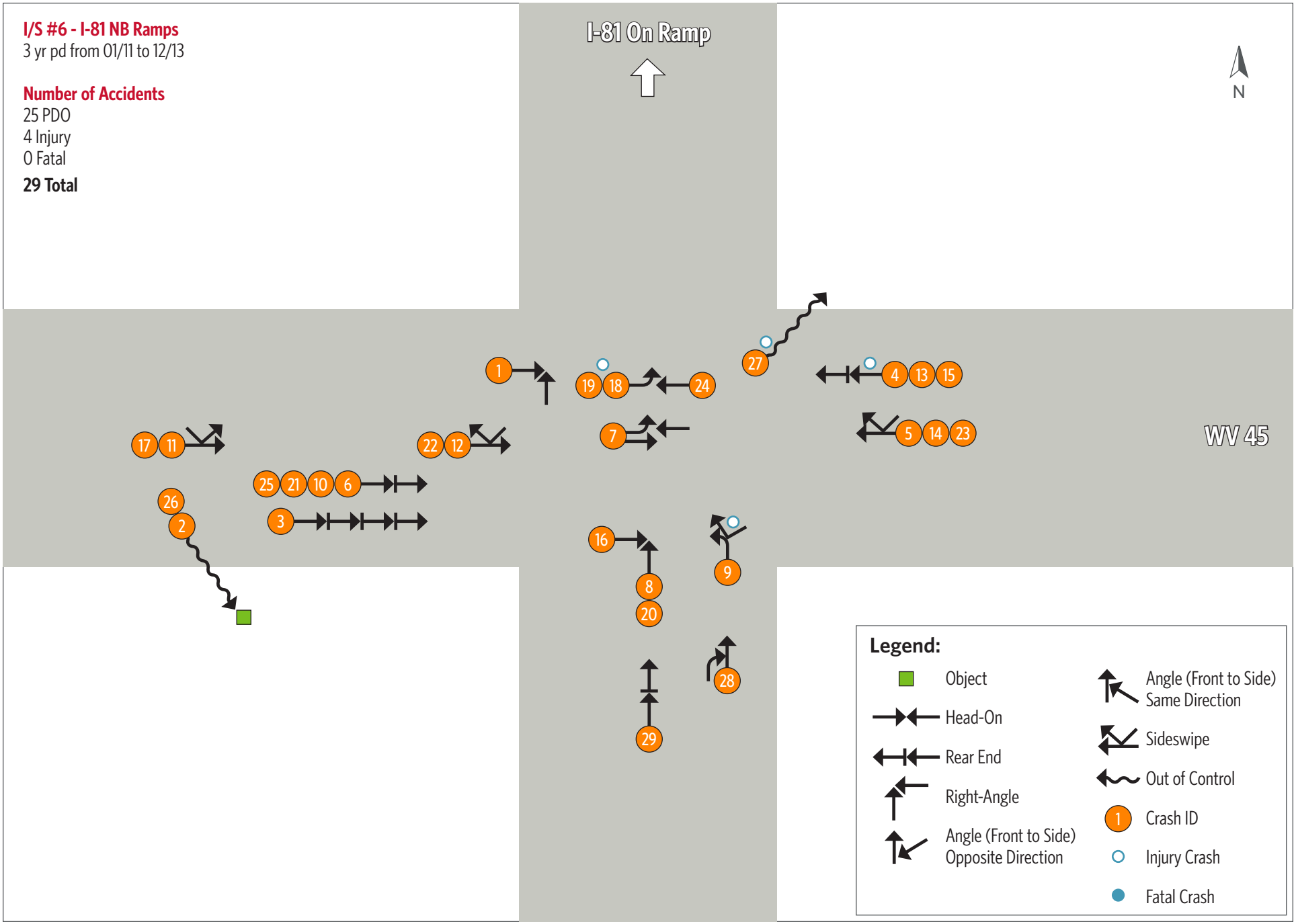


Figure 3-5: Crash Diagram - Intersection #7

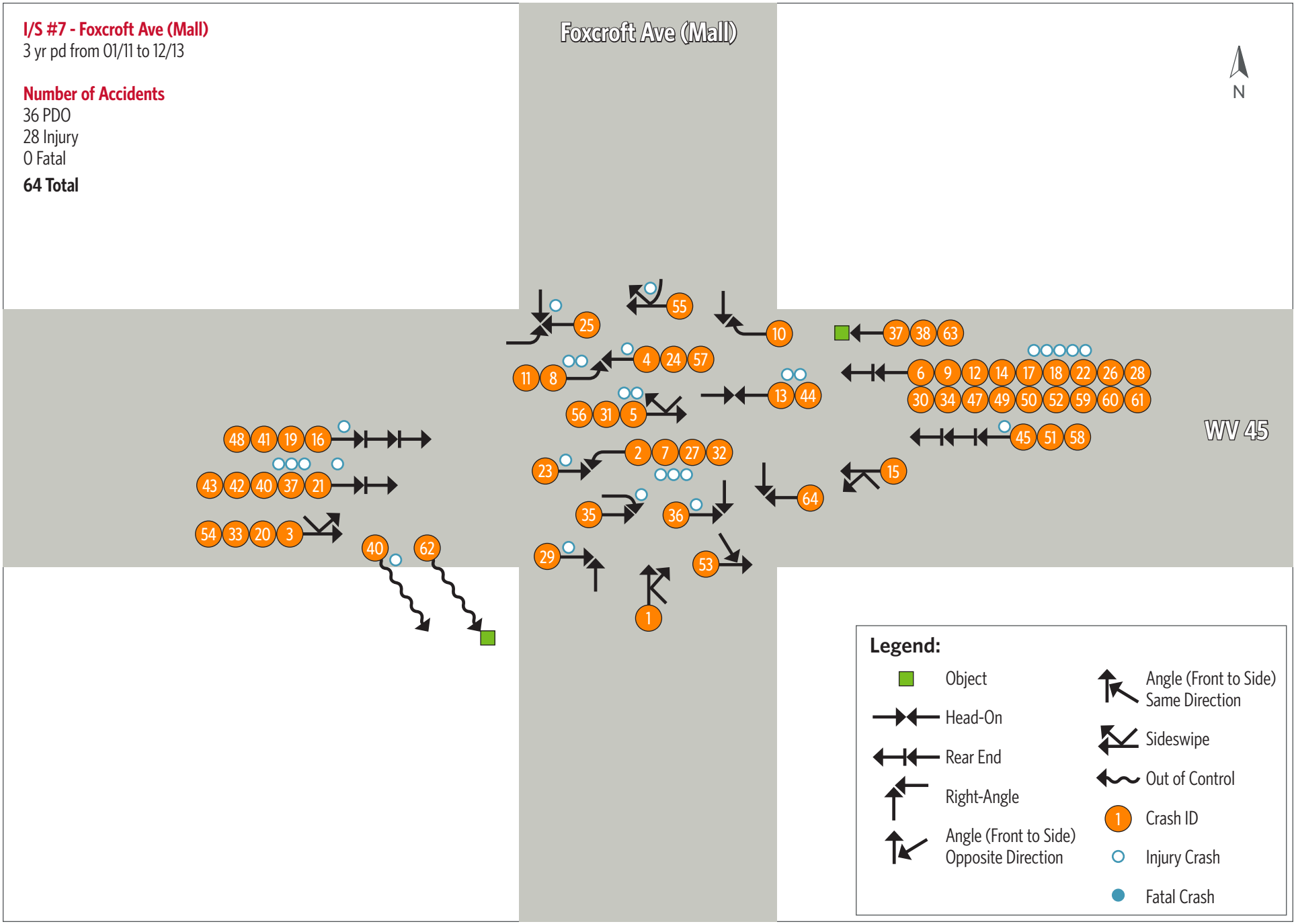


Figure 3-6: Crash Diagram - Intersection #8

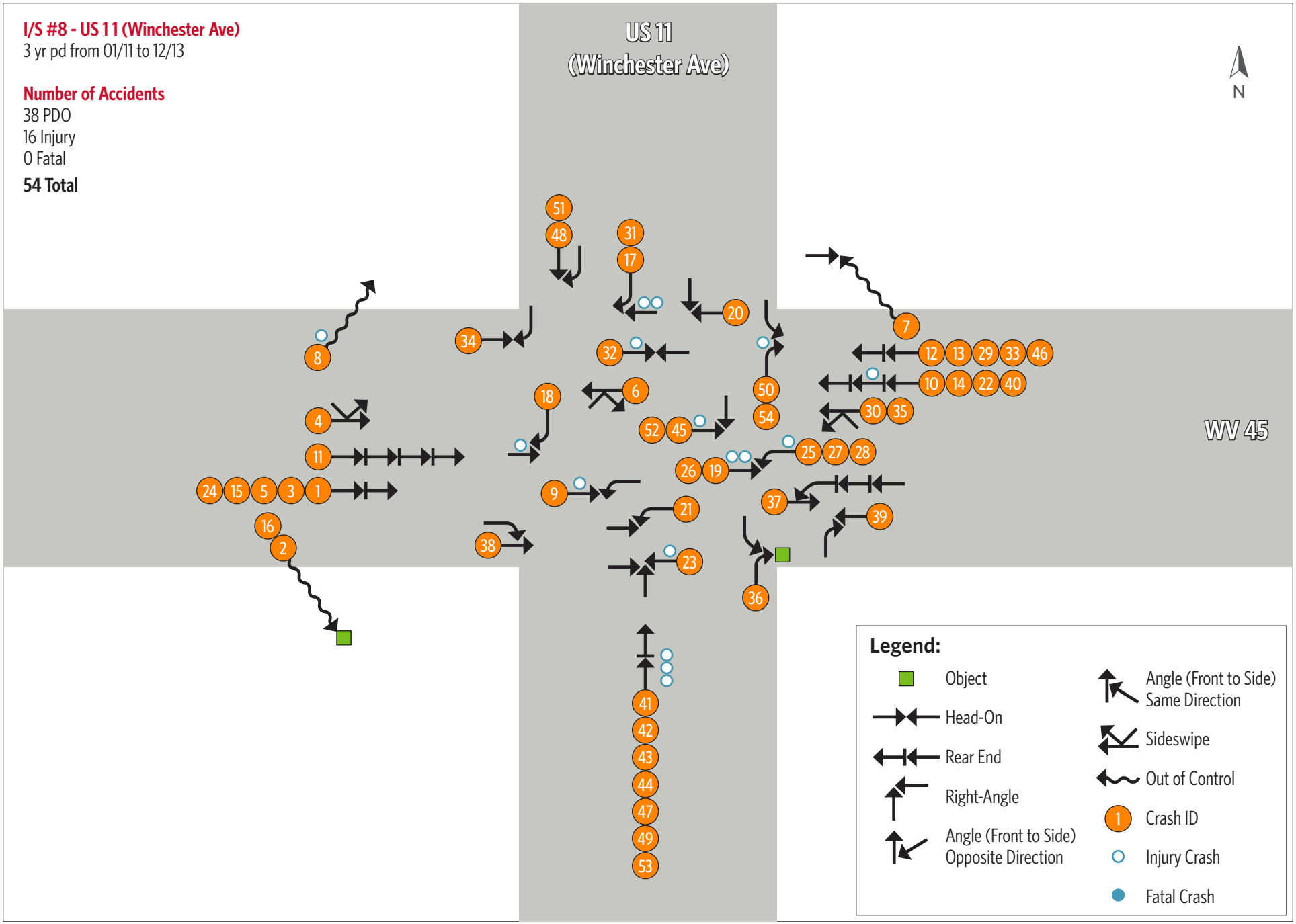


Figure 3-7: Crash Diagram - Intersection #9

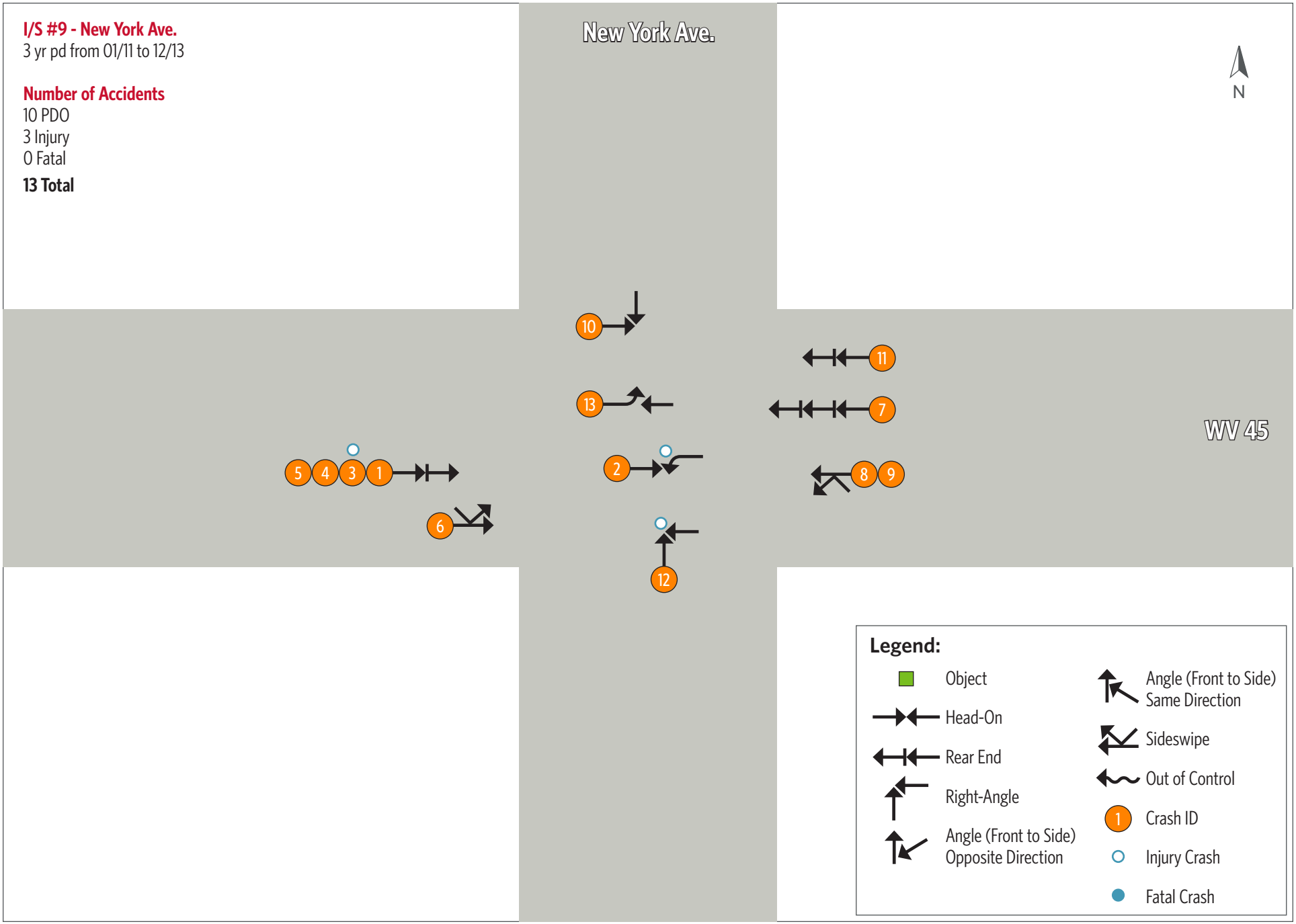
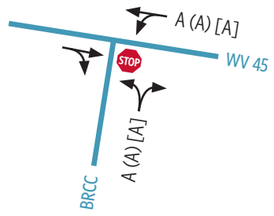


Figure 3-8: Existing Levels of Service (LOS)

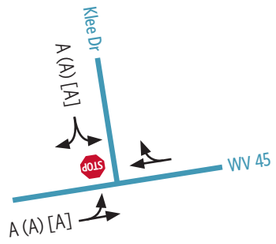
Blue Ridge Community College

1



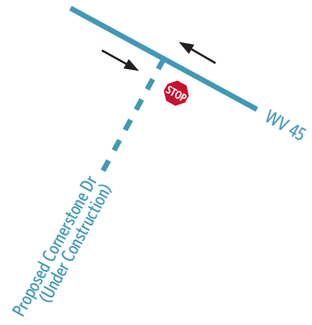
Klee Dr

2



Proposed Cornerstone Development

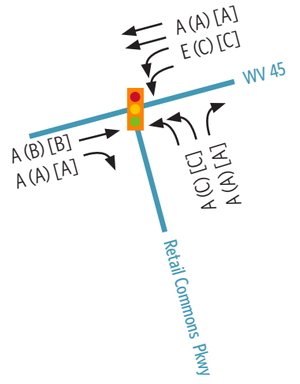
3



Retail Commons Pkwy

4

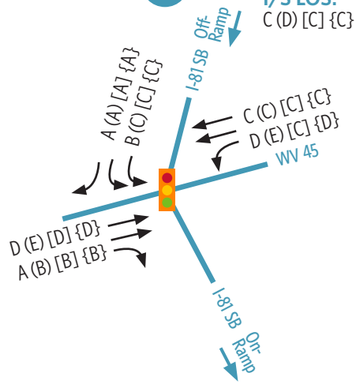
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

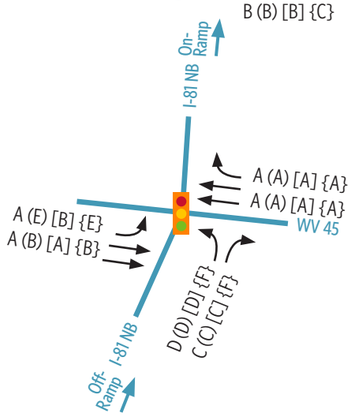
I/S LOS:
C (D) [C] {C}



I-81 NB Ramps

6

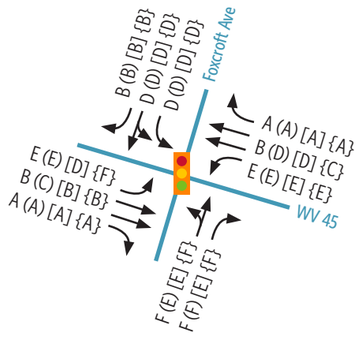
I/S LOS:
B (B) [B] {C}



Foxcroft Ave (Mall)

7

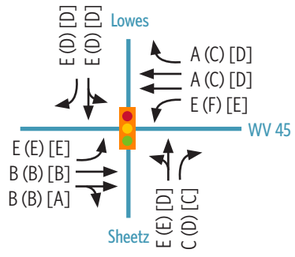
I/S LOS:
C (C) [C] {D}



Lowes/Sheetz

L/S

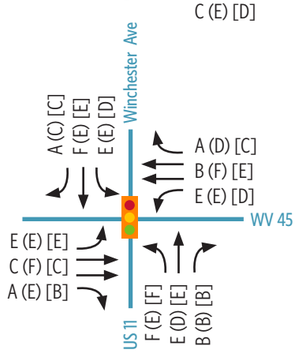
I/S LOS:
B (C) [C]



US 11 (Winchester Ave)

8

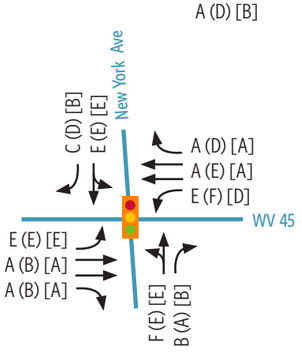
I/S LOS:
C (E) [D]



New York Ave

9

I/S LOS:
A (D) [B]



Legend:

1	ID Number		Traffic Signal
X	AM Peak LOS	STOP	Stop Sign
(X)	PM Peak LOS		
[X]	Sat Peak LOS		
{X}	Friday Midday LOS		

4 2024 No-Build Conditions

To determine the future traffic conditions if no improvements were made, the 2024 No-Build conditions were analyzed quantitatively to measure the future conditions. In addition, this analysis was necessary to determine the baseline conditions for the corridor to use as a benchmark for comparing the future alternatives. The results of these analyses provided insight as to future potential deficiencies in the study area if no improvements were made, other than the assumptions that the Cornerstone Development would be operating at full occupancy and the coordinated traffic signal system will be optimized for the future volumes.

4.1. Volumes

The basis for the 2024 PHVs were estimated by applying a 1.25% compounded growth rate (provided by the Traffic Division) to the 2014 PHVs and are shown in Figure 4-1. In addition, a trip generation and distribution analysis was performed for the Cornerstone Development, located at I/S #3 which is currently under construction. This development will include a hotel, several smaller retail outlets and residential townhome units. The Friday Midday Cornerstone trips were based on the PM model since trip generation data were not available for this time period. This analysis is located in Appendix B, and the volumes are shown in Figure 4-2. The final 2024 PHVs that were used for model analysis were the sum of the growth projected volumes and the trip generation. These volumes are presented in Figure 4-3. The projected 2024 ADT in the study area is expected to be approximately 28,500 vpd.

4.2. Capacity Analyses

The 2024 PHVs were simulated using SimTraffic with the existing geometrics to assess the impact of the anticipated future traffic. During the simulation modeling process, the existing signals were optimized using Synchro to adjust the timing patterns to better accommodate the traffic volumes. For the 2024 No-Build analyses, the signal timing optimization was the only improvement assumed on the corridor. The 2024 No-Build SimTraffic model output and Synchro HCM Reports are provided in Appendix C. The 2024 No-Build operations for the WV 45 corridor are provided in Table 4-1 and Figure 4-4.

Table 4-1: Summary of 2024 No-Build LOS

	Signalized?	AM	PM	SAT	Midday
I/S #1: WV45 with Blue Ridge Community College[1]	No	A	A	A	--
I/S #2: WV45 with Klee Drive[1]	No	A	A	A	--
I/S #3: WV45 with Cornerstone Development[1]	No	A	B	A	--
I/S #4: WV45 with Retail Commons Parkway	Yes	B	B	B	--
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	C	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	C	B	B	B
I/S #7: WV 45 with Foxcroft Blvd.	Yes	C	C	C	D
I/S #LS: WV 45 with Lowes / Sheetz	Yes	B	D	D	--
I/S #8: WV 45 with Winchester Avenue (US 11)	Yes	D	F	E	--
I/S #9: WV 45 with New York Avenue	Yes	A	E	E	--

Notes
1 – Unsignalized LOS is the worst stop-controlled approach

WV 45 Corridor

The WV 45 corridor is expected to degrade by 2024 with the eastern intersections operating at LOS E or F during the PM and Saturday peak hours. The WV 45 WB thru movement at Winchester Avenue (US 11) is expected to operate at LOS F for the PM peak hour. Based on the traffic simulation, the travel times are expected to increase for all scenarios except for the PM peak, eastbound direction. This can be attributed to the optimization of traffic signals along the corridor. The AM WV 45 EB and PM WV 45 WB movements will see significant increases of around 15%-18%, as these are the primary movements for those time periods. The greatest travel time increase was in the WV 45 WB direction for Saturday, which more than doubled the travel time due to congestion on the eastern portion of the corridor. This large increase illustrates the unstable nature of roadway network over capacity, in which even small degradations in traffic parameters can create disproportionate impacts. Table 4-2 compares the 2014 Existing travel times to the 2024 No-Build scenario for each peak hour.

Table 4-2: Comparison of 2014 Existing and 2024 No-Build Travel Times

	Travel Time (min)		Difference (min)	% Difference
	2014 Existing	2024 No-Build		
AM Peak Hour				
WV 45 EB	4.09	4.81	0.72	17.60%
WV 45 WB	3.55	3.63	0.08	2.25%
PM Peak Hour				
WV 45 EB	6.99	5.75	-1.24	-17.74%
WV 45 WB	7.16	8.24	1.08	15.08%
Saturday Peak Hour				
WV 45 EB	4.45	4.77	0.32	7.19%
WV 45 WB	6.21	13.31	7.1	114.33%

Signalized Intersections

As shown in Table 4-1, each signalized intersection from Lowes/Sheetz and east is expected to operate at LOS D or worse during the PM and Saturday peak hours, while intersections to the west will operate at LOS C or better. During these peak hours, many of the WV 45 WB thru movements are also expected to fail. These results indicate that there is not enough capacity westbound for the thru traffic and as result the entire WV 45 corridor breaks down. During the AM peak hour, only the intersection at Winchester Avenue is expected to operate below LOS C.

Unsignalized Intersections

Similar to the 2014 Existing analysis, the unsignalized intersections continue to operate well since they have lower volumes and less conflicting movements. As shown in Table 4-1 and Figure 4-4, most stop-controlled or shared lanes with conflicting movements operate at LOS A.

4.3. Queue Length Analyses

As mentioned previously, one of the measures of effectiveness (MOEs) generated by the SimTraffic model is queue lengths. Similar to the delay values, the queue lengths are based on the average of five simulation runs using different random seed numbers. Table 3-9 provides the average queue lengths for intersections in the study area for the 2024 No-Build analyses. In general, the queue lengths are slightly longer than expected, but still within exclusive lane storage limits for both mainline and side roads. The only exceptions are for the side road movements of Foxcroft Avenue SB left-turn (Saturday peak hour) and Winchester Avenue (PM and Saturday peak hours).

The largest difference in queuing can be found in the PM peak and Saturday scenarios, in the westbound direction.

Another particular movement of concern is once again the eastbound WV 45 left-turn onto Foxcroft Avenue. Although the average queue values do not appear to be extraordinary, the short distance between Foxcroft and the I-81 Interchange can be problematic. While thru block along WV 45 is not an issue, additional queuing can occur on the I-81 NB off ramp due to this issue. This can be seen especially in the morning peak hour and during the Friday Midday peak hour.

4.4. Summary

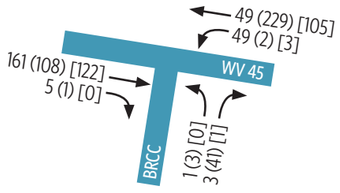
The traffic analyses for the 2024 No-Build conditions can be summarized by the following statements:

- The WV 45 corridor thru movements are expected to fail during the Friday PM and Saturday peak hours in the westbound direction.
- There will continue to be significant queuing at I/S #8, with increased impact to I/S #9.
- When compared to the 2014 Existing travel times, there are increases in travel time for all but the PM peak period eastbound. The most significant of these was for the Saturday westbound movement.

Figure 4-1: 2024 Peak Hour Volumes Based on a 1.25% Annual Growth Rate

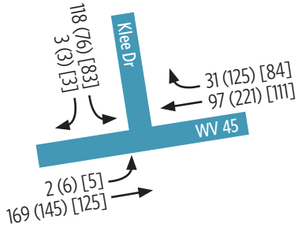
Blue Ridge Community College

1



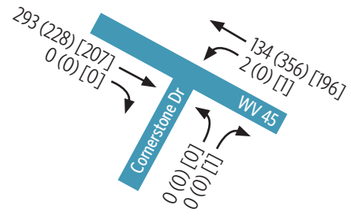
Klee Dr

2



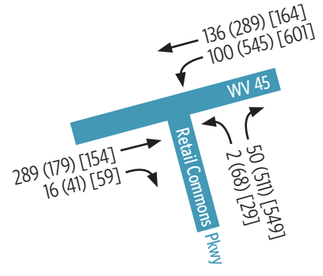
Proposed Cornerstone Development

3



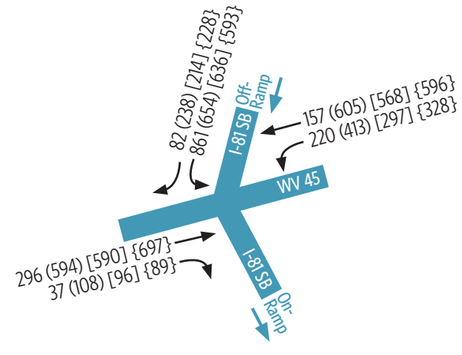
Retail Commons Pkwy

4



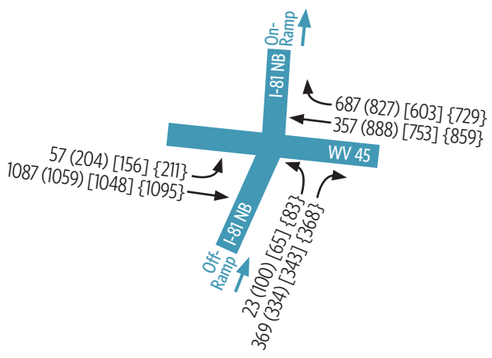
I-81 SB Ramps

5



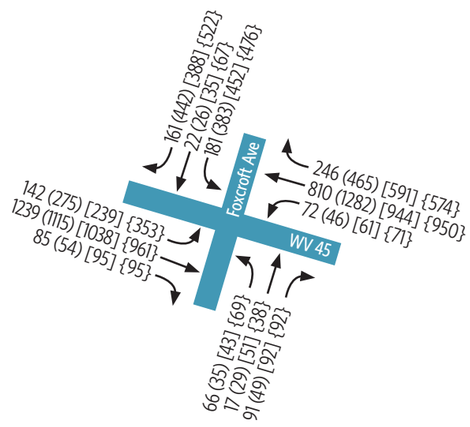
I-81 NB Ramps

6



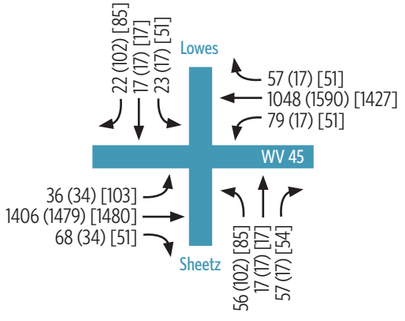
Foxcroft Ave (Mall)

7



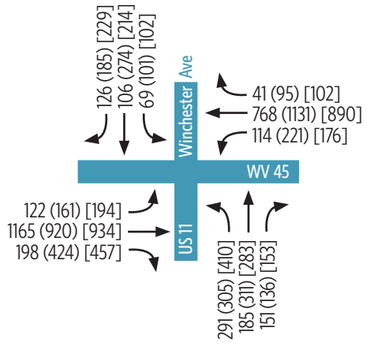
Lowes/Sheetz

L/S



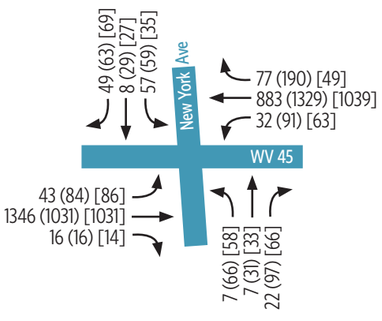
US 11 (Winchester Ave)

8



New York Ave

9



Legend:

1 ID Number

X Friday AM Peak (vph) 7:15 am - 8:15 am

(X) Friday PM Peak (vph) 4:00 pm - 5:00 pm

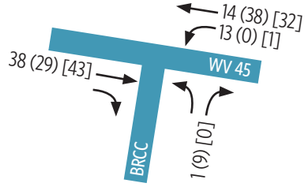
[X] Saturday Midday Peak (vph) 11:30 am - 12:30 pm

{X} Friday Midday Peak (vph) 12:00 pm - 1:00 pm I/S #5-7 Only

Figure 4-2: Cornerstone Development Trip Generation and Distribution

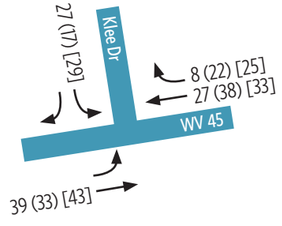
Blue Ridge Community College

1



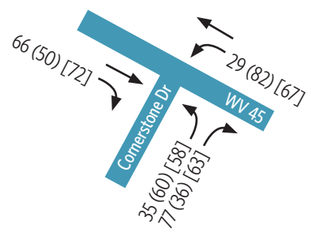
Klee Dr

2



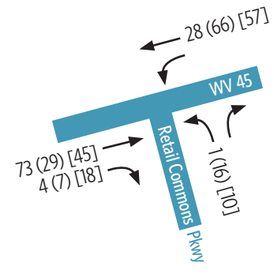
Proposed Cornerstone Development

3



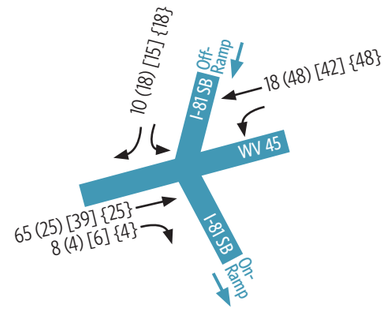
Retail Commons Pkwy

4



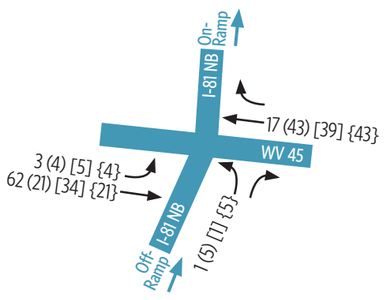
I-81 SB Ramps

5



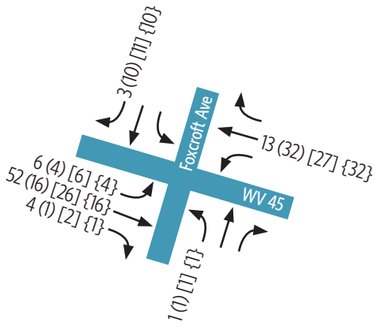
I-81 NB Ramps

6



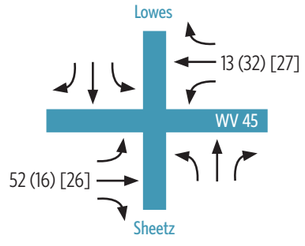
Foxcroft Ave (Mall)

7



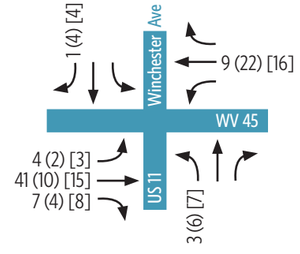
Lowes/Sheetz

L/S



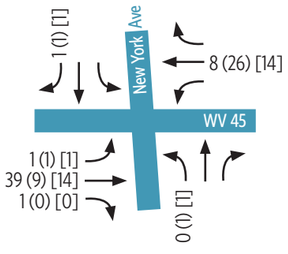
US 11 (Winchester Ave)

8



New York Ave

9



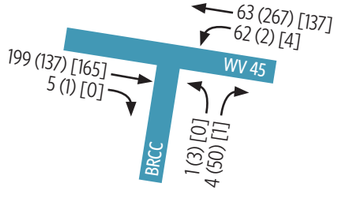
Legend:

- 1 ID Number
- X Friday AM Peak (vph) 7:15 am - 8:15 am
- (X) Friday PM Peak (vph) 4:00 pm - 5:00 pm
- [X] Saturday Midday Peak (vph) 11:30 am - 12:30 pm
- {X} Friday Midday Peak (vph) 12:00 pm - 1:00 pm I/S #5-7 Only

Figure 4-3: 2024 Peak Hour Volumes

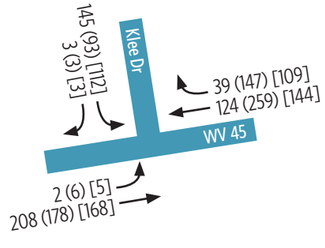
Blue Ridge Community College

1



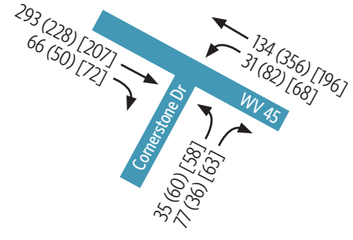
Klee Dr

2



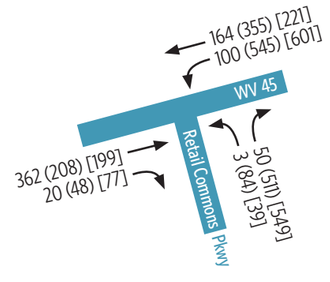
Proposed Cornerstone Development

3



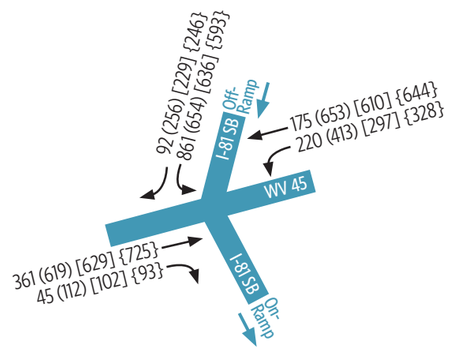
Retail Commons Pkwy

4



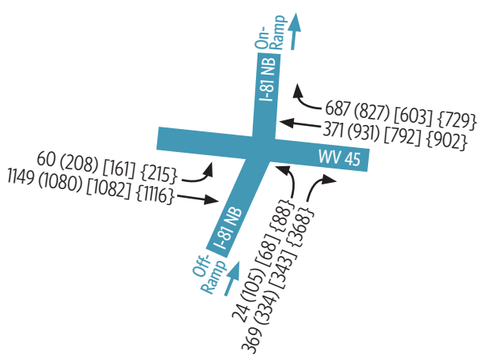
I-81 SB Ramps

5



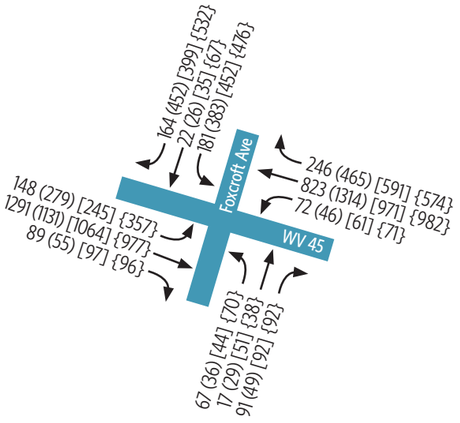
I-81 NB Ramps

6



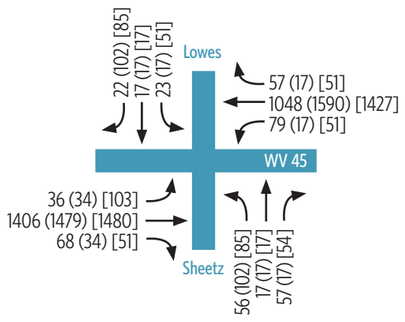
Foxcroft Ave (Mall)

7



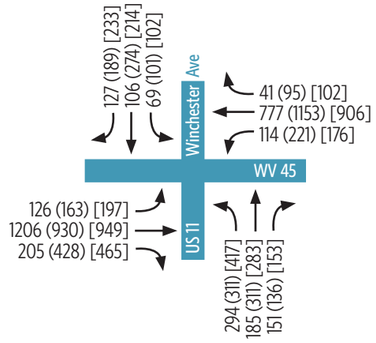
Lowes/Sheetz

L/S



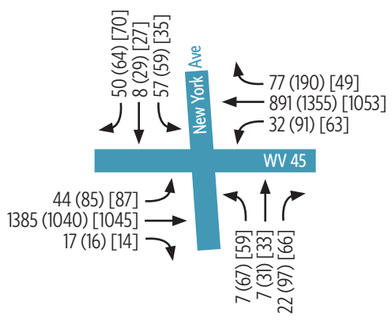
US 11 (Winchester Ave)

8



New York Ave

9



Legend:

1 ID Number

X Friday AM Peak (vph) 7:15 am - 8:15 am

(X) Friday PM Peak (vph) 4:00 pm - 5:00 pm

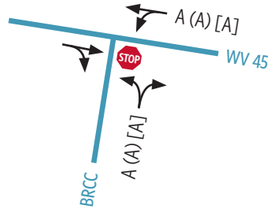
[X] Saturday Midday Peak (vph) 11:30 am - 12:30 pm

{X} Friday Midday Peak (vph) 12:00 pm - 1:00 pm I/S #5-7 Only

Figure 4-4: 2024 No-Build Levels of Service (LOS)

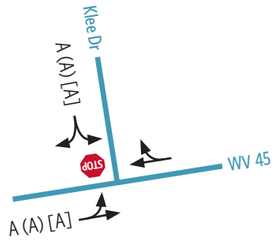
Blue Ridge Community College

1



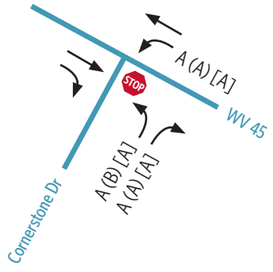
Klee Dr

2



Proposed Cornerstone Development

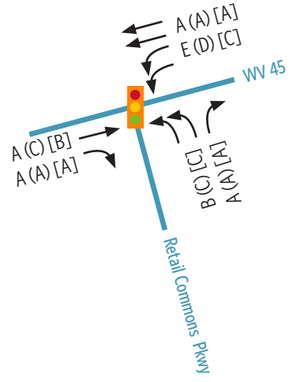
3



Retail Commons Pkwy

4

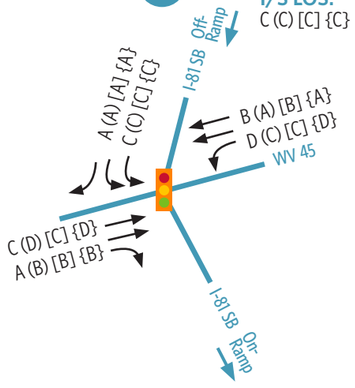
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

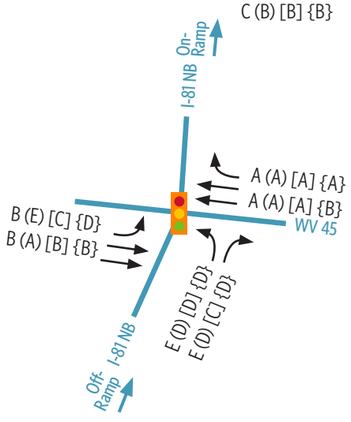
I/S LOS:
C (C) [C] {C}



I-81 NB Ramps

6

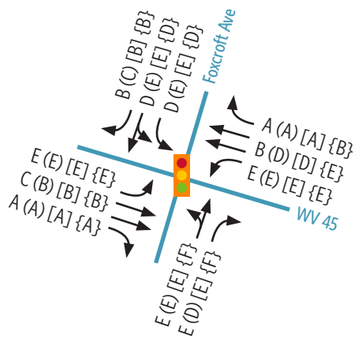
I/S LOS:
C (B) [B] {B}



Foxcroft Ave (Mall)

7

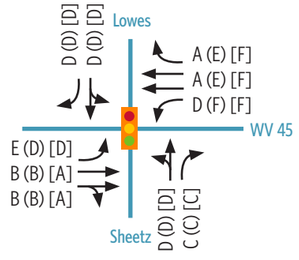
I/S LOS:
C (C) [C] {D}



Lowes/Sheetz

L/S

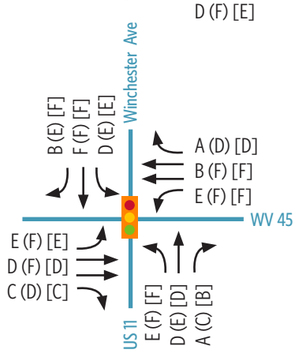
I/S LOS:
B (D) [D]



US 11 (Winchester Ave)

8

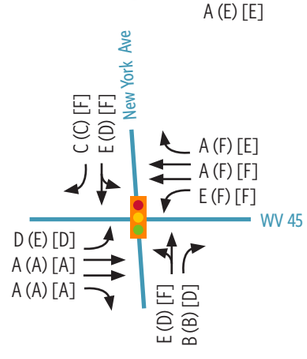
I/S LOS:
D (F) [E]



New York Ave

9

I/S LOS:
A (E) [E]



Legend:

1	ID Number
X	AM Peak LOS
(X)	PM Peak LOS
[X]	Sat Peak LOS
{X}	Friday Midday LOS
	Traffic Signal
STOP	Stop Sign

5 Build Alternatives

Alternatives were developed to address current and future issues of the WV 45 corridor with specific emphasis on the I-81 Interchange intersections, I/S #7 (Foxcroft Avenue) and I/S #8 (Winchester Avenue). To improve the overall operations in the corridor, the alternatives focused on several key areas including capacity improvements, safety improvements and access management. During the alternative development process, several goals were identified:

- Reduce queue lengths, especially during the PM and Saturday peak periods in the WV 45 WB direction.
- Maintain progression along WV 45 at the expense of the minor approaches.
- Ensure that the I-81 Interstate is not impacted by queuing on the northbound off-ramp due to congestion of left-turning vehicles onto Foxcroft Avenue.
- Improve the minor approach operations, if feasible.

The development process also worked within several constraints to provide realistic alternatives for consideration. The constraints included:

- There are closely spaced intersections in the center of the corridor that limit options with large land footprints.
- Many parking areas are located in close proximity to WV 45.

In addition, “corridor” or “ultimate” access management and pedestrian accommodation improvements were developed and are included at the end of this Section. The discussion at the end of this Section is intended to compliment the alternative improvements. Since many of the corridor access management and pedestrian accommodation improvements are subject to various factors such as right of way acquisitions, redevelopment, political factors, funding, etc., they were intentionally separated from the alternatives.

The corridor improvements and LOS are provided in Figures 5-1 through 5-11 for Alternatives 1 through 4A. Appendix D provides the detailed Synchro and SimTraffic reports. Also, as there were minimal queuing issues in the 2024 No-Build scenarios, a table to compare the Build Alternative queuing results was not prepared as each alternative included significant improvements to improve capacity. However, the queuing reports are provided in Appendix D for reference.

5.1. Improvements Included in All Alternatives

The primary focus of this study is to propose coordinated improvement options along WV 45; however, there were certain improvements that were modeled to accommodate potential growth and provide increased safety west of the interchange. In addition, the northbound leg of the Winchester intersection could be modified relatively easily to accommodate the heavy left-turn movements. These recommendations were included in each Alternative model:

Corridor Level

- Optimize signal timings and offsets.
- All signals are coordinated, including I/S #4 and I/S #5.

I/S #1: WV 45 with Blue Ridge Community College

- Add a 150 foot right-turn lane for WV 45 EB traffic into the college.
- Add a 150 foot left-turn lane for WV 45 WB traffic into the college.

I/S #3: WV 45 with Cornerstone Development

- Extend both WV 45 WB lanes from I/S #4, with a left-turn lane drop into the development.
- Add a 150 foot right-turn lane for WV 45 EB traffic into the development.
- Model the development exit as two lanes: exclusive left and right-turn lanes.

I/S #4: WV 45 with Retail Commons Parkway

- Extend the existing WV 45 EB right-turn lane back to I/S #3 and designate it as a thru-right lane.

I/S #5: WV 45 with I-81 Southbound Ramps

- Extend the existing WV 45 EB right-turn lane back to I/S #4.

I/S #9: WV 45 with Winchester Ave.

- Add a second northbound left-turn lane for 200 feet, using the existing, opposing left-turning lane into the K-Mart plaza. This existing lane would be reduced to 150 feet in length.

Because the 2024 No-Build Conditions maintain LOS A for I/S #1 through 3, no capacity improvements at these locations were identified. The primary reason for the improvements in this area is to allow for additional growth along this portion of the

corridor from new businesses not yet identified, as well as, safety for turning vehicles. Also, it is possible that the College generates concentrated peak volume periods outside of the study times, due to events or class schedules.

By implementing dual left-turn lanes on Winchester Avenue NB, queuing can be reduced, but more importantly, more green time can be allotted to the WV 45 mainline to help reduce congestion. Since the land is already available, this improvement can be implemented quickly and yield marked results for a relatively small cost.

With the improvements described, the corridor operations are expected to improve, particularly during the PM and Saturday peak hours in terms of queuing in the WV 45 WB direction. The greatest improvement is at New York Avenue since the downstream queue from Winchester Avenue is less of an impact. Note that while the LOS at some intersections improved, adjacent intersections may worsen due to localized improved progression. Also, some of this effect is due to some delays being very close to LOS thresholds, so LOS should not be the only performance indicator. Tables 5-1, 5-2, 5-3 and 5-4 provide a comparison of the 2024 No-Build to Build Alternatives for the AM, PM, Saturday and Midday peak hours, respectively.

Table 5-1: Comparison of 2024 AM No-Build and Build LOS

I/S	Signal?	No-Build	Alt 1	Alt 2	Alt 3	Alt 4
I/S #1: WV45 with Blue Ridge Community College	No[1]	A	A	A	A	A
I/S #2: WV45 with Klee Drive	No[1]	A	A	A	A	A
I/S #3: WV45 with Cornerstone Development	No[1]	A	A	A	A	A
I/S #4: WV45 with Retail Commons Parkway	Yes	B	B	B	B	B
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	D	C	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	C	D	A	B	A
I/S #7: WV 45 with Foxcroft Avenue	Yes	C	C	B	C	B
I/S #LS: WV 45 with Lowes / Sheetz	Yes	B	B	B	B	B
I/S #8: WV 45 with Winchester Avenue (US 11)	Yes	D	C	C	C	C
I/S #9: WV 45 with New York Avenue	Yes	A	B	A	B	A

Notes
1 – Unsignalized LOS is the worst stop-controlled approach

Table 5-2: Comparison of 2024 PM No-Build and Build LOS

I/S	Signal?	No-Build	Alt 1	Alt 2	Alt 3	Alt 4	Alt 4A
I/S #1: WV45 with Blue Ridge Community College	No[1]	A	A	A	A	A	A
I/S #2: WV45 with Klee Drive	No[1]	A	A	A	A	A	B
I/S #3: WV45 with Cornerstone Development	No[1]	B	B	B	B	B	B
New I/S: WV 45 with Commercial Drive	No[1]	N/A	N/A	N/A	N/A	N/A	A
I/S #4: WV45 with Retail Commons Parkway	Yes	B	B	B	B	B	C
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	C	C	C	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	B	B	B	B	A	B
I/S #7: WV 45 with Foxcroft Avenue	Yes	C	C	C	D	C	D
I/S #LS: WV 45 with Lowes / Sheetz	Yes	D	D	E	D	B	D
I/S #8: WV 45 with Winchester Avenue (US 11)	Yes	F	E	E	E	D	D
I/S #9: WV 45 with New York Avenue	Yes	E	D	B	B	B	B

Notes
1 – Unsignalized LOS is the worst stop-controlled approach

Table 5-3: Comparison of 2024 Saturday No-Build and Build LOS

I/S	Signal?	No-Build	Alt 1	Alt 2	Alt 3	Alt 4	Alt 4A
I/S #1: WV45 with Blue Ridge Community College	No[1]	A	A	A	A	A	A
I/S #2: WV45 with Klee Drive	No[1]	A	A	A	A	A	B
I/S #3: WV45 with Cornerstone Development	No[1]	A	A	A	A	B	B
New I/S: WV 45 with Commercial Drive	No[1]	N/A	N/A	N/A	N/A	N/A	A
I/S #4: WV45 with Retail Commons Parkway	Yes	B	B	B	B	B	C
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	B	B	C	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	B	B	A	B	A	B
I/S #7: WV 45 with Foxcroft Avenue	Yes	C	C	D	D	C	D
I/S #LS: WV 45 with Lowes / Sheetz	Yes	D	D	E	B	B	D
I/S #8: WV 45 with Winchester Avenue (US 11)	Yes	E	E	E	D	D	E
I/S #9: WV 45 with New York Avenue	Yes	E	C	B	B	B	B

Notes
1 – Unsignalized LOS is the worst stop-controlled approach

Table 5-4: Comparison of 2024 Friday Midday No-Build and Build LOS

I/S	Signal?	No-Build	Alt 1	Alt 2	Alt 3	Alt 4
I/S #5: WV45 with I-81 Southbound Ramps	Yes	C	C	C	C	C
I/S #6: WV45 with I-81 Northbound Ramps	Yes	B	B	C	B	A
I/S #7: WV 45 with Foxcroft Avenue	Yes	D	D	D	D	D

Notes
1 – Unsignalized LOS is the worst stop-controlled approach

During the 2024 No-Build scenario, the easternmost intersections are expected to perform poorly. The improvements within the alternatives are most notable at New York Avenue, which suffered from impacts at Winchester Avenue. While all four alternatives reduce queuing at Winchester, the reduction is not apparent when comparing LOS as an isolated indicator, especially for Alternatives 1 and 2. Alternative 3 and 4 performed the best by diverting traffic away from the heart of the corridor. More detailed analysis of each alternative follows.

5.2. 2024 Build Alternative 1: Intersection Improvements

Improvements (Figure 5-1)

The concept behind Alternative 1 is to provide intersection improvements at key intersections along the corridor. These improvements come in the form of extending or lengthening turning lanes. In order to determine the specifics, queuing, levels of service and available space were analyzed.

One such improvement included in all alternatives is the northbound dual left-turn lanes at Winchester Avenue. In this alternative, additional intersection work is assumed in the southbound and westbound directions. The southbound exclusive right and left-turn lanes are extended back an additional 50 and 150 feet, respectively, in order to eliminate thru block. The westbound excusive right-turn lane is extended back an additional 250 feet in this model. These improvements are realistic in terms of land use and capacity needs.

The other intersection improvement in this Alternative is for I/S #7 (Foxcroft Avenue). Due to the close proximity of I/S #6, left-turn vehicles from WV 45 EB onto Foxcroft do not have adequate storage space. This creates thru-block during peak periods on both WV 45, as well as, the I-81 NB off-ramp. By adding a dual-left condition, more vehicles

can be stored and this condition can be eliminated. In turn, more green time can be allotted to the WV 45 mainline, improving the corridor as a whole.

Operations (Figure 5-2)

The most consistent improvements in LOS that resulted were at the intersections where the upgrades were modeled: Foxcroft and Winchester Avenues. The LOS was improved to a D (from E) for all time scenarios for the left-turn movement onto Foxcroft. Although not a dramatic improvement, it is important for reducing the potential for I-81 NB off-ramp traffic backing onto the Interstate. At Winchester Avenue, the largest improvements were noted for the southbound and westbound right-turn movements. Levels of service were also improved in the WV 45 EB direction, but no improvement was noted in the WV 45 WB direction.

5.3. 2024 Build Alternative 2: Additional Thru Capacity

Improvements (Figure 5-3)

Alternative 2 attempts to reduce congestion by providing additional WV 45 EB and WB thru capacity in the heart of the corridor. The existing right-turn lanes are transformed and lengthened into an additional thru-right lane. The exclusive right-turn lanes are removed except at the end of each new lane run, which terminate as right-only lane drops.

In the eastbound direction, the additional lane would begin at I/S #6 (I-81 Northbound Ramps) and drop outside of the study area at the Queen Street interchange. Right-turns into the McDonalds and Sheetz driveways would take place from this lane as well.

In the westbound direction, the additional lane would begin at I/S #9 (New York Avenue) and drop at I/S #7 (Foxcroft Avenue). Right-turns at Winchester Avenue, as well as, into Lowes Plaza would take place from this lane. It was initially considered to extend this lane to I/S #6 (I-81 Northbound Ramps), but preliminary modeling indicated that this created lane utilization issues, with overuse occurring in the right-most lane. The high right-turn volume at Foxcroft also justifies this configuration.

Operations (Figure 5-4)

By adding extra capacity in either direction through the heart of the corridor, LOS improved consistently in most areas. This was especially true at New York Avenue where overall LOS improved to B (from E) during the PM and Saturday peak hours.

Thru and right-turn movements on WV 45 operated at LOS B or better during all periods. In general, the heart of the congestion moved westward. This can be seen in the LOS results at Sheetz/Lowes and Foxcroft Avenue where some movements improved while others worsened, most notably in the eastbound direction. Also, the LOS results at Sheetz/Lowes and Winchester for WV 45 WB were still E or lower for the PM and Saturday peak hours. This bottleneck was created by the lane drop at Foxcroft. In general, this alternative succeeded in reducing the length of the congestion area, but did not eliminate it altogether since the same amount of traffic must eventually pass through the same infrastructure.

5.4. 2024 Build Alternative 3: Trip Diversion

Improvements (Figure 5-5)

This Alternative takes a different approach by adding capacity adjacent to the WV 45 corridor through a backage road on the north side of WV 45. This improvement was coupled with relocating the I-81 NB off-ramp right-turn movement eastward to line up with IS #7. These improvements are modeled together in order to modify turning volumes and divert traffic away from the corridor.

The problem of left-turning vehicles onto Foxcroft as described above could potentially be helped by relocating eastbound off-ramp traffic heading towards Foxcroft or beyond. The existing northbound I-81 off-ramp operates for left-turn vehicles only. Those making a right at the end of the off-ramp are diverted to a new ramp that terminates as a “plus” intersection with Foxcroft. This ramp would allow left-thru or right-turn movements. This Alternative can be constructed in the area on the east side of McDonald’s parking lot; with McDonald’s driveway teeing into the diverted ramp.

The second improvement is the construction of a new 1,800-foot roadway, “Connector Road”, between Foxcroft Avenue and Winchester Avenue (US 11), behind and with access to the Lowes plaza. Portions of this road exist as Alonzo Drive (CR 11/20) behind Lowes and as a parking lot access way between Papa John’s and Huntington Banks on the east side of Foxcroft. A new railroad crossing would be required to connect these pieces, as well as new construction to tie into Winchester Avenue in the vicinity across from the Heritage Inn motel. The primary diversion away from the most congested part of the corridor would be to and from Foxcroft from the east, but also to and from northern Winchester to and from the west, as well as to and from Lowes Plaza and points north.

The new intersections created by the Connector Road termini were modeled as signalized and a 1,000 foot right-turn lane was provided at the western intersection with Foxcroft Avenue. The long turn lane was needed to reduce queuing along the Connector Road so that Winchester Avenue (and the network in general) was not impacted. This was particularly true during the Friday Midday period where heavy Foxcroft volumes were recorded.

New volumes were calculated based on trip diversion assumptions and the redistribution of the McDonald's O/D traffic throughout the network. It was assumed that 50% of southbound Foxcroft and Winchester trips would utilize Connector Road if their destinations were eastbound and westbound, respectively. The same assumption was made in the opposite direction. It was also assumed that 100% of Foxcroft to Winchester trips (or vice-versa) would use Connector Road and avoid WV 45 completely. The volume adjustments were ratio-based, and are shown in Figure 5-6.

Operations (Figure 5-7)

By diverting traffic away from the heart of the WV 45 corridor, improvements in LOS were realized from the I-81 Interchange to New York Avenue. The intersection LOS at Winchester Avenue and Lowes/Sheetz were slightly improved from F/D to E/D for the PM peak period. Similar increases (E/D to D/B) occurred during the Saturday peak period. Residual effects could also be seen corridor-wide.

At the new intersection of Foxcroft Avenue and Connector Road, the intersection operated at LOS A for all time periods. Intersection LOS A/B is anticipated at the US 11 with Connector Road intersection for all time periods. Queues along Connector Road could weaken the incentive for use as a WV 45 "bypass", but in time equilibrium within the network would be reached. Despite this, the construction of Connector Road would be beneficial for operations along WV 45.

5.5. 2024 Build Alternative 4: Ultimate Build

Improvements (Figure 5-8)

This alternative combines Alternatives 2 and 3 to provide an ultimate build alternative incorporating all proposed improvements. Major recommendations include additional thru capacity on WV 45 in each direction, relocation of the I-81 NB Off-ramp right-turn movement, and a new Connector Road parallel to WV 45 to the north.

Operations (Figure 5-9)

When comparing the intersection LOS, Alternative 4 functions very similarly to Alternative 3; however, when reviewing movement levels of service, Alternative 4 provides an increase in operations for the thru movements at several key locations including WV 45 EB thru between I/S #6 and 8.

5.6. 2024 Build Alternative 4A: Ultimate Build + Weis Development

Improvements (Figure 5-10)

This alternative combines Alternative 4 (Ultimate Build) with the proposed Weis development and recommended improvements. Per the Weis Property Traffic Impact Analysis (see inset in Figure 5-10), improvements at the WV 45 and Retail Commons Parkway intersection include:

- Provide EB left-turn lane and WB right-turn lane into subject site.
- Convert northbound Retail Commons Parkway approach to one left-turn lane, one thru lane, and one right-turn lane.
- Construct site access point to provide two left-turn lanes and a shared thru-right lane.
- Provide full coordination of signals with the WV 45 corridor.
- Pavement marking and signal modifications as needed.

The Weis development also includes the construction of Commercial Drive from WV 45 to CR 45/7 (Delmar Orchard Road). Along the frontage of the site, the facility will be four lanes, with a reduction down to two lanes north of the site to the intersection with CR 45/7. Recommend improvements at the new WV 45 and Commercial Drive intersection include:

- Extend existing second thru lane in WB direction to drop as a right-turn lane onto Commercial Drive.
- Provide one left-turn and one right-turn lane from southbound Commercial Drive onto WV 45.
- Provide shared thru-left lane from EB WV 45.
- Provide full stop control for Commercial Drive.

Operations (Figure 5-11)

An abbreviated analysis was performed to evaluate the impact of the proposed Weis Development traffic on the WV 45 corridor, assuming all improvements from the Ultimate Build Alternative (Alternative 4) are in place. Using the trip generation information provided in the Weis Property Traffic Impact Analysis, the PM and Saturday peak hours were evaluated.

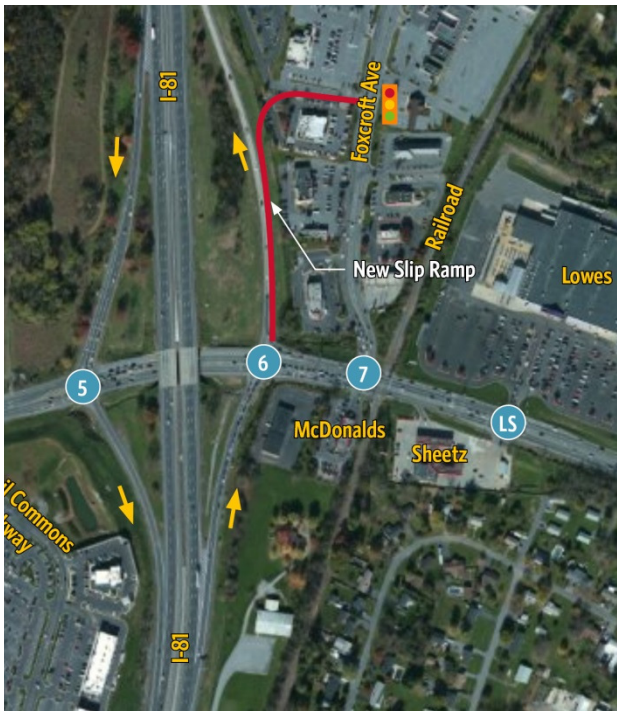
When comparing the intersection LOS, Alternative 4A operates similarly to Alternative 4; however operations decline during both PM and Saturday peak hours at several signalized intersections along the corridor. Due to the increase in thru traffic coming to and from the proposed Weis Development, intersection LOS declines by at least one LOS grade between the I-81 NB ramps (I/S #6) and Lowes/Sheetz (I/S #LS) in the PM peak hour. Similarly, intersection LOS is expected to decline by at least one letter grade between the I-81 NB ramps (I/S #6) and Winchester Avenue (I/S #8) during the Saturday peak hour. Due to the new Weis Development access (and related traffic) at the existing Retail Commons Parkway intersection, operations are expected to decline from LOS B to LOS C during both PM and Saturday peak hours.

5.7. Additional Alternatives Considered

During the analysis process, several options and improvements were considered but ultimately not included in the alternatives, due to excess right-of-way, geometric or cost issues. These options are described below:

I-81 NB On-Ramp Slip Ramp to Foxcroft Avenue

To reduce turning movements from the I-81 NB Off-ramp to WV 45 to Foxcroft Avenue, a concept of adding a slip ramp to the existing I-81 NB On-ramp was considered (see illustration to the right). The intent of this slip ramp was to eliminate the right-turn, then an immediate left-turn into Foxcroft Avenue for drivers who are going to the mall area. Based on current traffic distributions, an estimated 25% of the WV 45 EB left-turn at I/S #7 originates from the ramp. Using this to estimate the number of vehicles, it is unlikely that this type of improvement is justified for such a low volume. However, it is recommended that if this option was pursued, an origin-destination study should be performed to better evaluate the amount of traffic the slip ramp would serve.



Jughandles

Jughandle intersections are often used to eliminate left-turn movements from the mainline, but incur large land footprints. Due to the closely spaced intersections and adjacent commercial land use along the corridor, jughandles were eliminated from consideration due to property impacts and associated commercial / retail property takes.

Elevated Thru Movements

For intersections with heavy volumes on all approaches, such as Winchester Avenue, elevating one thru approach above the other can drastically improve LOS. Turning movements can be handled with one of several interchange configurations, with or

without traffic signals depending on the volumes. The only intersection considered for this option was Winchester Avenue; however, there would be numerous impacts to adjacent residences and businesses, and geometric constraints could present further issues given the close proximity of adjacent intersections.

Intersection Closures

With the presence of closely spaced intersections, the corridor could be improved by closing one or more intersections if traffic diversion is possible with frontage roads or similar connections. In the case with WV 45, the intersections either serve one or more businesses or feature side roads with significant volumes. Frontage roads are not possible due to the commercial nature of the corridor, and the railroad presents additional separation. Even in Alternative 3 where additional network capacity was analyzed, it was not feasible to close any of the study intersections.

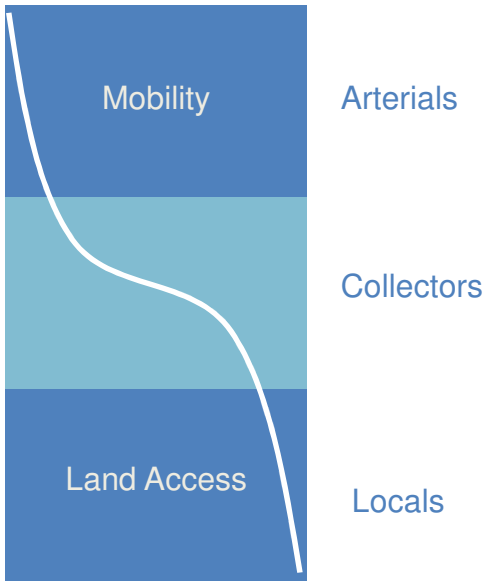
Right-In Right-Outs (RIROs)

A “lesser” option than a full intersection closure, RIRO options can be advantageous to remove left-turn traffic from the minor approaches if additional network connectivity is available. However, this was not the case along the WV 45 corridor. RIRO configurations would also add volumes to the WV 45 left-turn lanes to allow for U-turns.

Novak Drive Connector

An earlier project presented the idea of a connector from WV 9 at the existing Short Road interchange to Novak Drive, which connects to Tabler Station Road (CR 32) and I-81. This would divert traffic to and from WV 9 to I-81 one interchange to the south of WV 45. However, since this option is too far away from the study area, the impacts could only be evaluated using sophisticated origin / destination data for the region. This data was not available and was outside of the scope of study.

5.8. Access Management Improvements



The WV 45 corridor within the study area is well designed from an access management point of view. The western part of the corridor (west of I/S #4) is rural in nature and features periodic, residential driveways at a rate of 24 per mile (17 total). The commercial eastern portion of the corridor only has 6 non-signalized access points (rate of 8 per mile), including a local road (St. George Street) and the Sheetz right-in only access. The majority of the businesses are accessed via a signalized intersection or from side roads. This style of development is desirable from both a progression and safety standpoint.

According to Iowa State University's Center for Transportation, Research, and Education (CTRE), approximately 50% to 60% of crashes occur when a motorist is turning into or out of a driveway or intersection. Studies show that a proper access management program can reduce the number of these crashes by as much as 50%, providing safer access for property owners and uninterrupted travel for motorists. Correlated with the increased safety, travel speeds can be increased as much as 40% to 50% resulting in time saved. Mobility and land access are inversely related as shown in the figure to the right. The greater the access along a roadway, the less mobility it can provide. Each characteristic is viable under certain circumstances. Interstates, freeways, and arterial streets serve the need for high mobility, but access is significantly limited. Local streets provide a maximum degree of access to adjacent streets, at the cost of mobility. Because the WV 45 corridor is already designed with limited access management, many of these benefits already exist today and will exist in the design year, 2024. However, smaller, localized improvements can be made and future development can be designed with access management principles in mind.

The access management improvements in this Section supplement the alternatives developed for the WV 45 corridor. From reducing the number of driveways at a single development to replacing drop-curb driveways with standard curbs, the recommended

improvements strive to implement collaborative solutions while maintaining the integrity and serviceability of the corridor. Several of the pivotal access management solutions that should be implemented include:

- Restrict access to Flohr Pools from Winchester Avenue only.
- Sign St. George Street as a secondary “eastern” entrance to Lowes Plaza to reduce the burden at I/S LS downstream.

While it is understood that the Division may not be able to implement these improvements, as the WV 45 corridor continues to develop and incorporate capacity-type improvements, emphasis should remain on increasing the fusion between corridor access and mobility where feasible.

5.9. Pedestrian Accessibility Improvements

As discussed in Section 3.9, there are no pedestrian facilities anywhere in the corridor, in terms of sidewalks, crosswalks, pedestrian push buttons or pedestrian signals. Several pedestrians were noted in various locations along the corridor, suggesting that the need for adding facilities is present. Residential developments lie to the north and south of the corridor in the eastern portion, and a new residential development has been growing, accessed by Klee Avenue. Finally, the Blue Ridge Community College lies at the western limit of the study area and could be a pedestrian destination. The pedestrian improvements in this Section are intended to compliment the improvements identified in the Alternatives and can also be addressed as redevelopment of parcels occurs.

Since many of these improvements can be constructed independently, it is recommended that the Traffic Division prioritize and implement the following improvements:

- Install new ADA-compliant sidewalks on both sides of WV 45 from I/S #7 eastward, and on the south side of WV 45 between I/S #1 and I/S #7.
- Install new ADA-compliant pedestrian ramps at the study intersections.
- Install accessible, ADA-compliant pedestrian pushbuttons at the study intersections.
- Install painted crosswalks on WV 45 at the study intersections.
- Provide pedestrian countdown signals at signalized intersections.

5.10. Cost Estimates

Conceptual construction cost estimates were prepared for each alternative. General categories were developed for easily calculated pay items. The pay items and their corresponding units of measurement included minor signal modifications (each), new roadway pavement (yd^2), 5' sidewalk with curb and gutter (lf), light pole relocation (each). A 15% contingency was added to the total cost.

It should be noted that the construction cost estimates provided in this report are conceptual and only intended to provide the relative magnitude of the cost. Quantities are based on estimates obtained from conceptual layout of the alternatives. It should be noted these costs are based on 2014 dollars and do not include engineering, environmental, utility relocations, or right-of-way acquisitions, which will add to the overall cost of each alternative.

Table 5-5 presents the conceptual construction cost estimate for the alternatives. Additional information for the conceptual cost estimates can be found in Appendix E. Note, Alternative 4A is not included in Table 5-5 since it is an extension of Alterative 4.

Table 5-5: Conceptual Cost Estimate

	Conceptual Cost Estimate
Alternative 1 – Intersection Improvements	$1,549,000
Alternative 2 – Additional Thru Capacity	$2,106,000
Alternative 3 – Trip Diversion	$2,820,000
Alternative 4 – Ultimate Build	$3,300,000

5.11. Evaluation of Alternatives

A comparison matrix, shown in Table 5-6, was developed as a basis for evaluating the alternatives. It provides a concise summary of significant differentiating factors regarding performance, impacts, and characteristics of each alternative. The evaluation matrix is categorized in four areas: Safety, Design and Operations, Community, and Financial.

Safety

- Reduction of Conflict Points – This category is measured by change in number of conflict points.
- Crash Severity – This is measured by the type and severity of crashes that are typical for the type of improvement.

Design and Operations

- Improved Traffic Flow – The improvement of operations measured by LOS and delay.
- Driver Expectancy – A broad measure of the driver's understanding of the alternative.

Community

- Property Impacts – The property impacts are measured by the number of parcels affected.
- Constructability – A broad measure of the impact to the existing roadway network/operations and neighborhood impacts during constriction.
- Community Cohesion – A broad measure of the ability to either keep communities united or provide new opportunities to develop community.

Financial

- Construction Costs – The planning level construction cost including right-of-way and utilities.
- Future Maintenance Costs – The anticipated level of future costs to maintain the facility.

Each factor was ranked as good, average or poor and provided a score from 1 to 5 based on impacts with 1 being good and 5 being poor. A poor ranking indicates a high impact, cost, or does not satisfy the project goals. An average ranking indicates a moderate impact, cost, or satisfies the criteria. An average ranking also indicates no significant change in the category when compared to the existing condition. A good ranking indicates a low impact, cost, or generally satisfies the criteria.

Table 5-6: Alternatives Evaluation Matrix

Evaluation Considerations		Alternative			
		1	2	3	4
Safety	Reduction of Conflict Points	4	4	2	2
	Crash Severity	4	3	2	2
Design and Operations	Improved Traffic Flow	5	3	1	1
	Driver Expectancy	3	2	2	2
Community	Property Impacts	1	3	4	5
	Constructability	3	3	4	4
	Community Cohesion	4	4	1	1
Financial	Construction Costs	1	2	5	5
	Future Maintenance Costs	2	3	4	4
Score		**27**	**27**	**25**	**26**

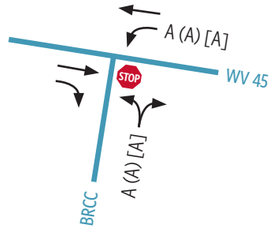
1-2	Lowest likely impacts, addresses elements with good conformance to projects goals, low construction/maintenance costs
3	Mid-range of impacts, addresses elements to somewhat conformance to project goals, medium construction/maintenance costs
4-5	High likely impacts, does not address elements or conform with project goals, high constriction/maintenance costs

Figure 5-1: Alternative 1 Improvements - Intersection Improvements

Figure 5-2: 2024 Build Alternative 1 Levels of Service (LOS)

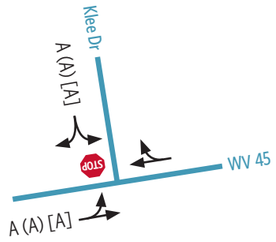
Blue Ridge Community College

1



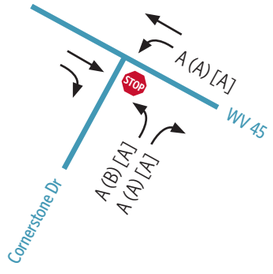
Klee Dr

2



Proposed Cornerstone Development

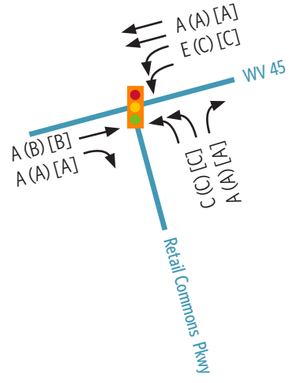
3



Retail Commons Pkwy

4

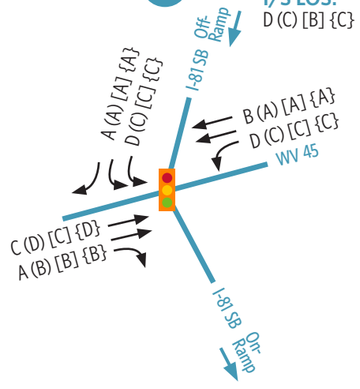
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

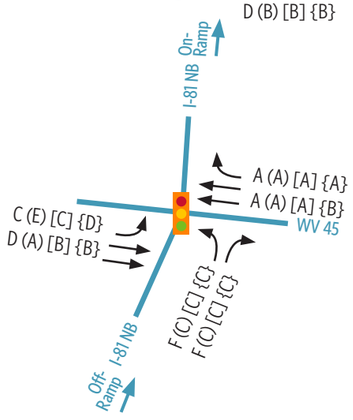
I/S LOS:
D (C) [B] {C}



I-81 NB Ramps

6

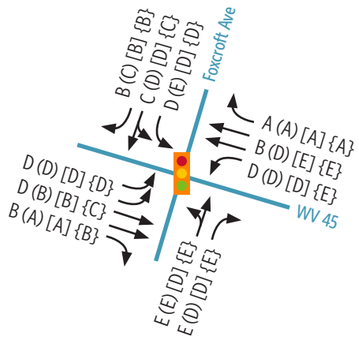
I/S LOS:
D (B) [B] {B}



Foxcroft Ave (Mall)

7

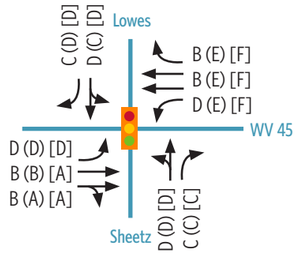
I/S LOS:
C (C) [C] {D}



Lowes/Sheetz

L/S

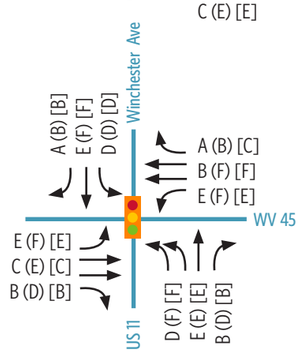
I/S LOS:
B (D) [D]



US 11 (Winchester Ave)

8

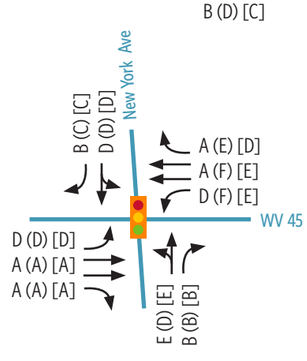
I/S LOS:
C (E) [E]



New York Ave

9

I/S LOS:
B (D) [C]



Legend:

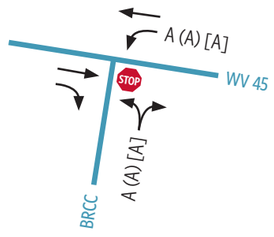
1	ID Number
X	AM Peak LOS
(X)	PM Peak LOS
[X]	Sat Peak LOS
{X}	Friday Midday LOS
	Traffic Signal
STOP	Stop Sign

Figure 5-3: Alternative 2 Improvements - Additional Thru Capacity

Figure 5-4: 2024 Build Alternative 2 Levels of Service (LOS)

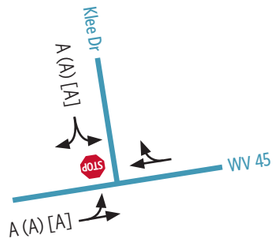
Blue Ridge Community College

1



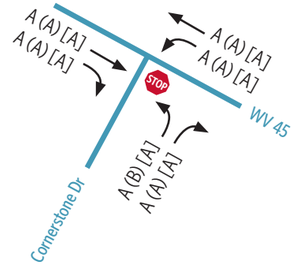
Klee Dr

2



Proposed Cornerstone Development

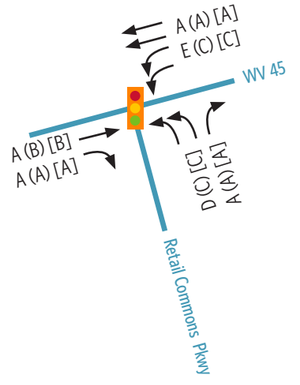
3



Retail Commons Pkwy

4

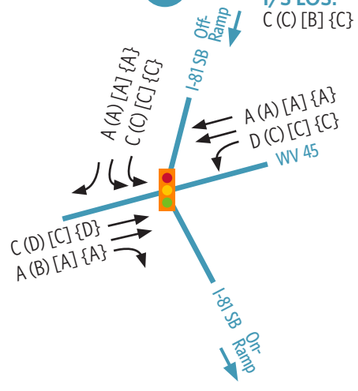
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

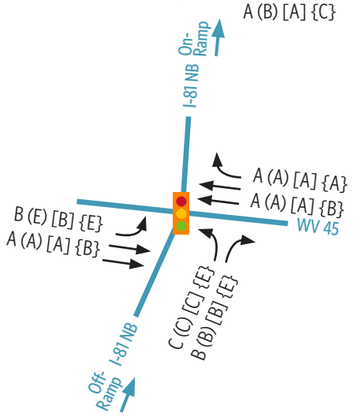
I/S LOS:
C (C) [B] {C}



I-81 NB Ramps

6

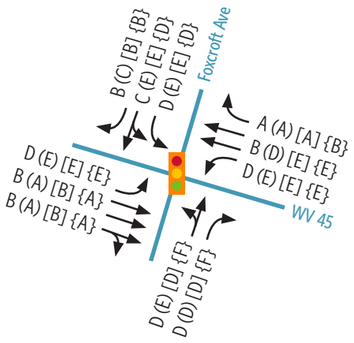
I/S LOS:
A (B) [A] {C}



Foxcroft Ave (Mall)

7

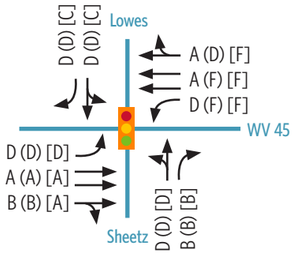
I/S LOS:
B (C) [D] {D}



Lowes/Sheetz

L/S

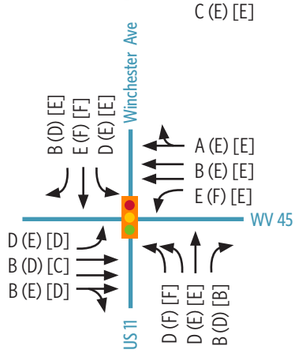
I/S LOS:
B (E) [E]



US 11 (Winchester Ave)

8

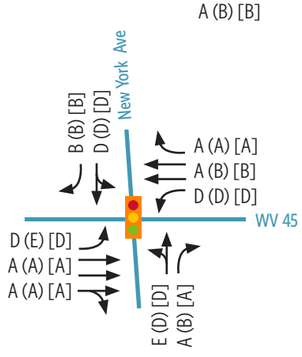
I/S LOS:
C (E) [E]



New York Ave

9

I/S LOS:
A (B) [B]



Legend:

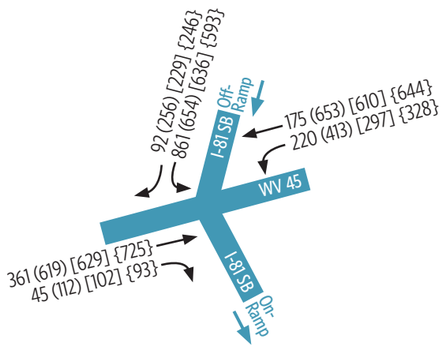
1	ID Number		Traffic Signal
X	AM Peak LOS	STOP	Stop Sign
(X)	PM Peak LOS		
[X]	Sat Peak LOS		
{X}	Friday Midday LOS		

Figure 5-5: Alternative 3 Improvements - Trip Diversion

Figure 5-6: Alternative 3 2024 Peak Hour Volumes (Includes Trip Diversion and Distribution)

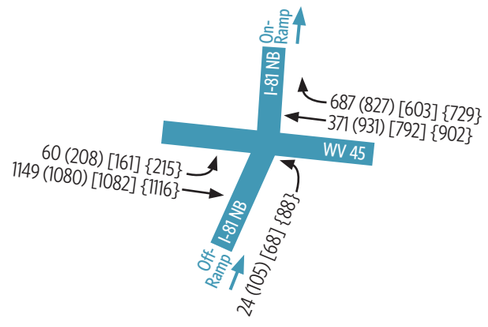
I-81 SB Ramps

5



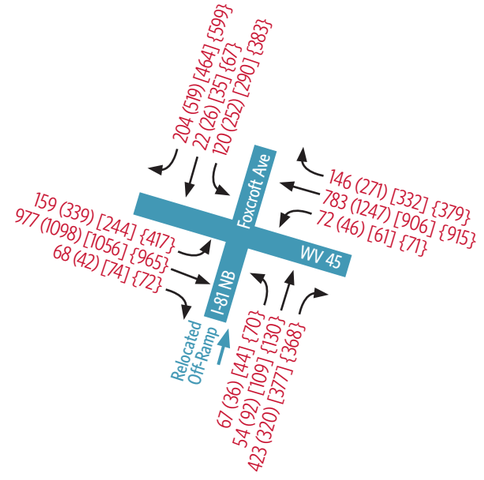
I-81 NB Ramps

6



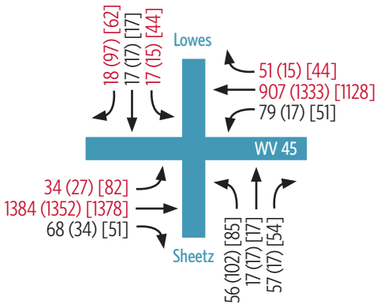
Foxcroft Ave (Mall)

7



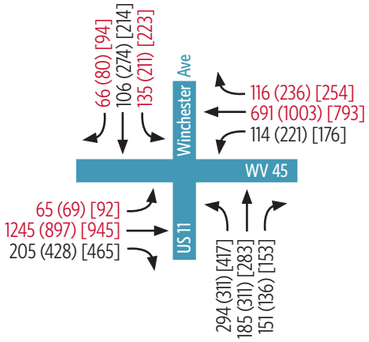
Lowes/Sheetz

L/S



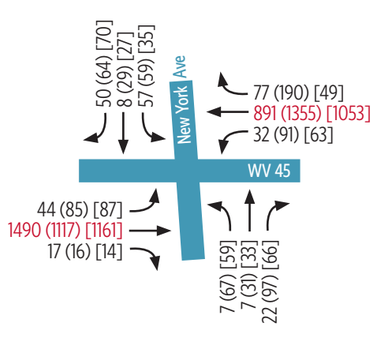
US 11 (Winchester Ave)

8



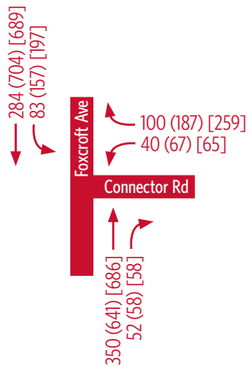
New York Ave

9



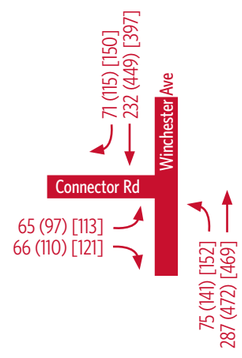
Connector Road West

C7



Connector Road East

C8



Legend:

1 ID Number

X Friday AM Peak (vph) 7:15 am - 8:15 am

(X) Friday PM Peak (vph) 4:00 pm - 5:00 pm

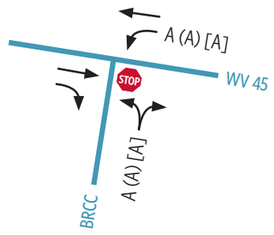
[X] Saturday Midday Peak (vph) 11:30 am - 12:30 pm

{X} Friday Midday Peak (vph) 12:00 pm - 1:00 pm I/S #5-7 Only

Figure 5-7: 2024 Build Alternative 3 Levels of Service (LOS)

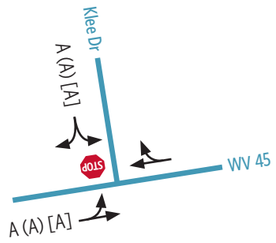
Blue Ridge Community College

1



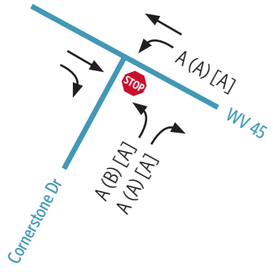
Klee Dr

2



Proposed Cornerstone Development

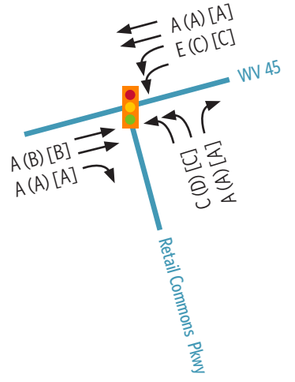
3



Retail Commons Pkwy

4

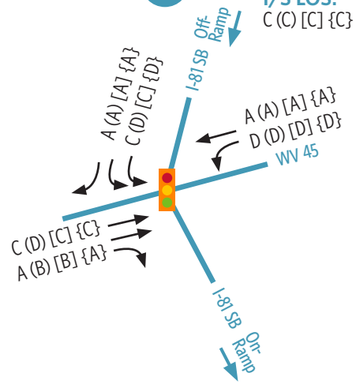
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

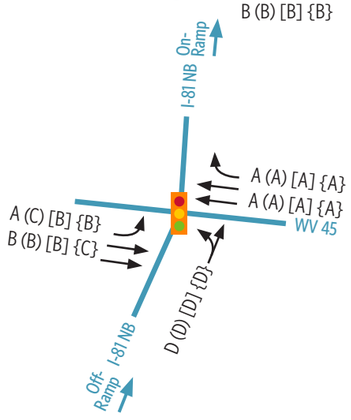
I/S LOS:
C (C) [C] {C}



I-81 NB Ramps

6

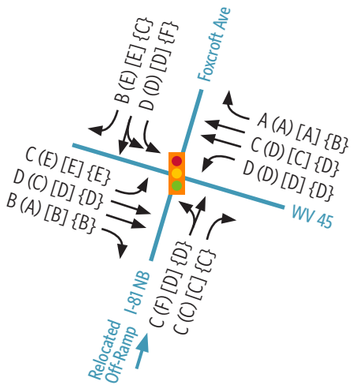
I/S LOS:
B (B) [B] {B}



Foxcroft Ave (Mall)

7

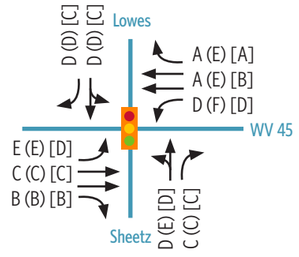
I/S LOS:
C (D) [D] {D}



Lowes/Sheetz

L/S

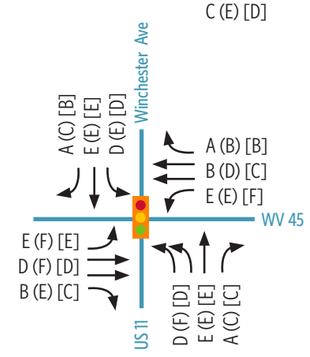
I/S LOS:
B (D) [B]



US 11 (Winchester Ave)

8

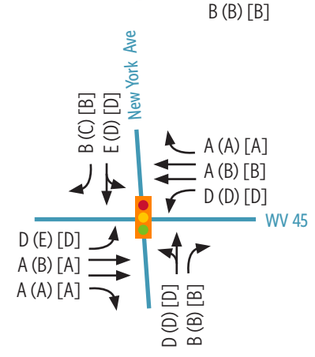
I/S LOS:
C (E) [D]



New York Ave

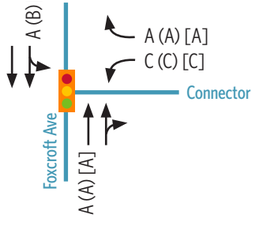
9

I/S LOS:
B (B) [B]



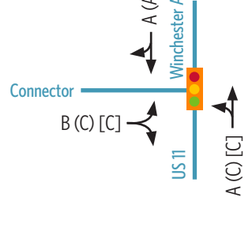
C7

I/S LOS:
A (A) [A]



C8

I/S LOS:
A (B) [B]



Legend:

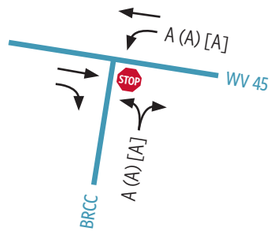
1	ID Number
X	AM Peak LOS
(X)	PM Peak LOS
[X]	Sat Peak LOS
{X}	Friday Midday LOS
	Traffic Signal
STOP	Stop Sign

Figure 5-8: 2024 Build Alternative 4 Improvements - Ultimate Build

Figure 5-9: 2024 Build Alternative 4 - Ultimate Build Levels of Service (LOS)

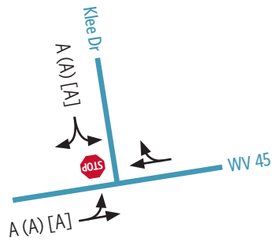
Blue Ridge Community College

1



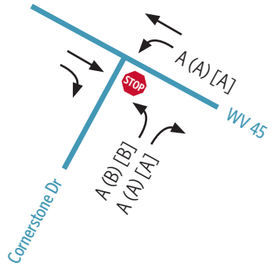
Klee Dr

2



Proposed Cornerstone Development

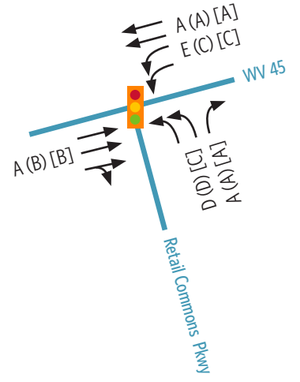
3



Retail Commons Pkwy

4

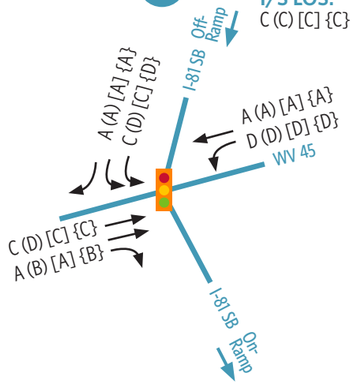
I/S LOS:
B (B) [B]



I-81 SB Ramps

5

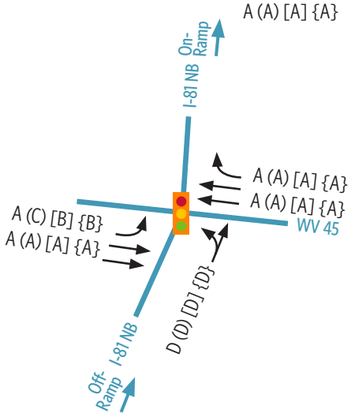
I/S LOS:
C (C) [C] {C}



I-81 NB Ramps

6

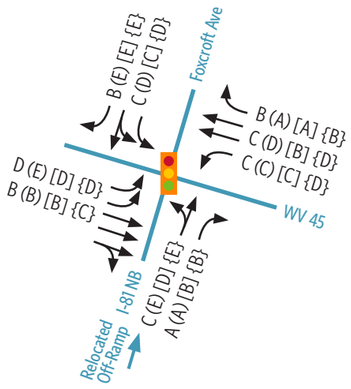
I/S LOS:
A (A) [A] {A}



Foxcroft Ave (Mall)

7

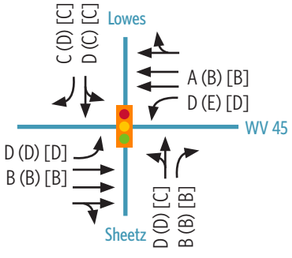
I/S LOS:
B (C) [C] {D}



Lowes/Sheetz

L/S

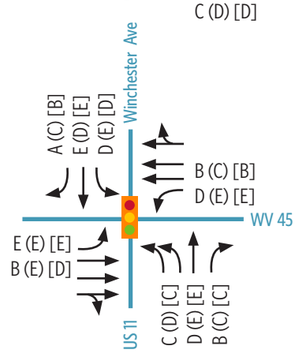
I/S LOS:
B (B) [B]



US 11 (Winchester Ave)

8

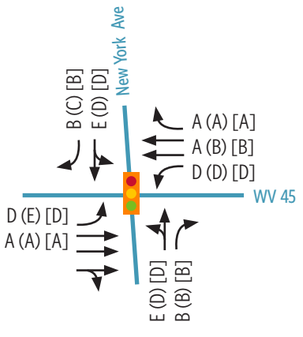
I/S LOS:
C (D) [D]



New York Ave

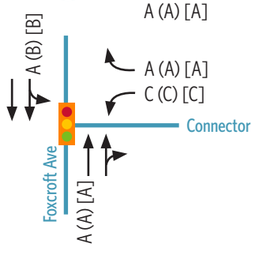
9

I/S LOS:
A (B) [B]



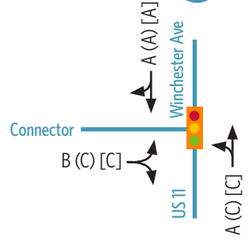
C7

I/S LOS:
A (A) [A]



C8

I/S LOS:
A (B) [B]

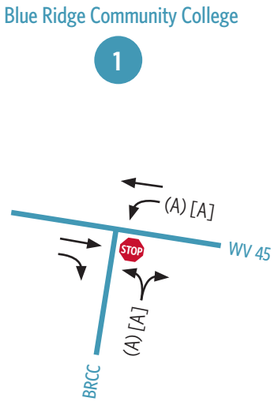


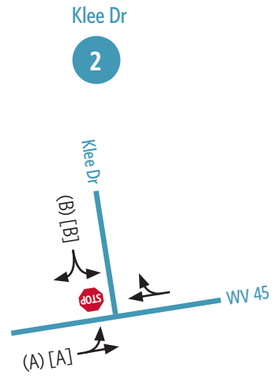
Legend:

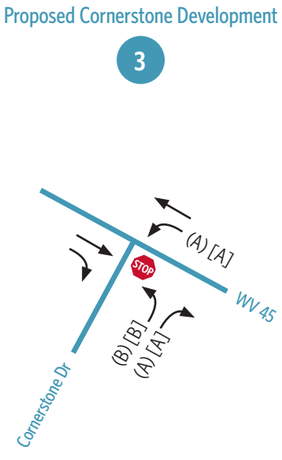
1	ID Number
X	AM Peak LOS
(X)	PM Peak LOS
[X]	Sat Peak LOS
{X}	Friday Midday LOS
	Traffic Signal
STOP	Stop Sign

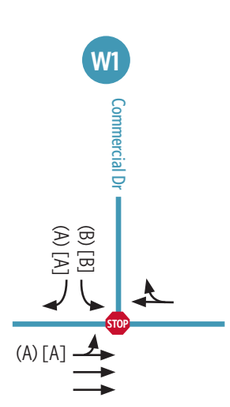
Figure 5-10: 2024 Build Alternative 4A Improvements - Ultimate Build + Weis Development

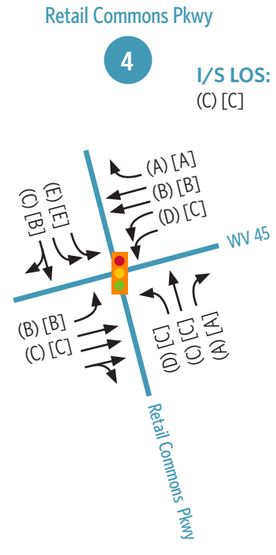
Figure 5-11: 2024 Build Alternative 4A - Ultimate Build + Weis Development Levels of Service (LOS)

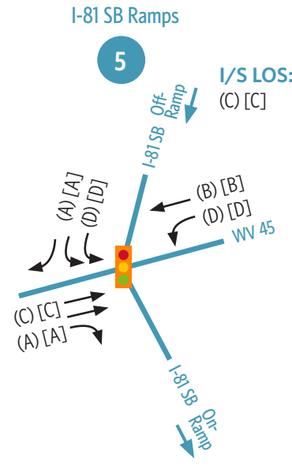


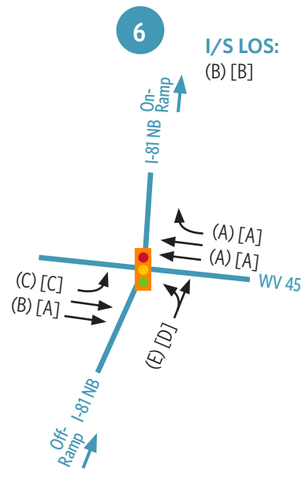


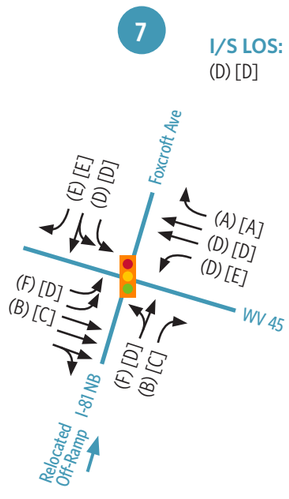


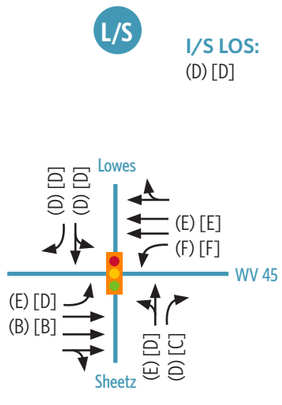


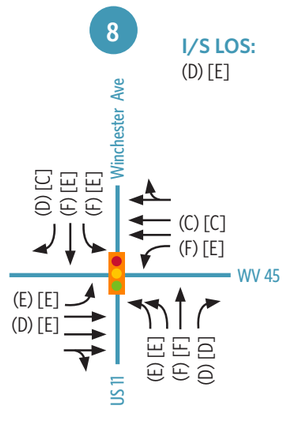


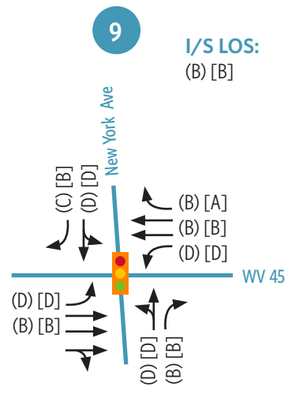


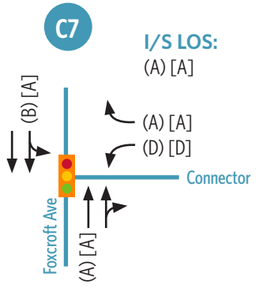


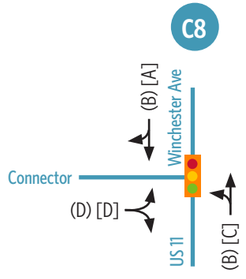












Legend:

1	ID Number
(X)	PM Peak LOS
[X]	Sat Peak LOS
	Traffic Signal
STOP	Stop Sign

6 Conclusions and Recommendations

The purpose of this traffic study was to evaluate current and future traffic conditions, identify potential deficiencies, and develop alternatives to enhance traffic flow and safety along WV 45 (Apple Harvest Drive) in Martinsburg, West Virginia. The traffic study limits extended from Blue Ridge Community College to New York Avenue.

Recommendations were made to address safety and capacity concerns throughout the corridor and were included with each of the four alternatives. In addition corridor-wide improvements were recommended to address access management and pedestrian/bicycle accessibility. The four alternatives to address the safety and operations are listed below:

- Alternative 1 – Intersection Improvements
- Alternative 2 – Additional Thru Capacity
- Alternative 3 – Trip Diversion
- Alternative 4 – Ultimate Build (combination of Alternatives 2 and 3)

At the request of WVDOH, Alternative 4A – Ultimate Build + Weis Development was evaluated to determine the impacts of the proposed Weis Development on the WV 45 corridor, assuming that all improvements from Alternative 4 (Ultimate Build) were implemented. This alternative operated similarly to Alternative 4; however operations do decline, especially at signalized intersections in the eastern portion of corridor.

Based on the alternative evaluation matrix, the alternatives scored very similarly; however, Alternative 4 provides the best option for the area in terms of congestion management, safety and community cohesion, despite the higher costs and property impacts. In addition, improvements could be staged to address immediate deficiencies within the corridor. This alternative included the following elements:

<u>Corridor Level</u>

- Optimize signal timings and offsets.
- All signals are coordinated, including I/S #4 and I/S #5.
- Install sidewalks, crosswalks, and pedestrian signal modifications from I/S #1 to I/S #7 on the south side of WV 45.
- Install sidewalks, crosswalks, and pedestrian signal modifications from I/S #7 to I/S #9 on the both sides of WV 45.

I/S #1: WV 45 with Blue Ridge Community College

- Add a 150 foot right-turn lane for WV 45 EB traffic into the College.
- Add a 150 foot left-turn lane for WV 45 WB traffic into the College.

I/S #3: WV 45 with Cornerstone Development

- Extend both WV 45 WB lanes from I/S #4, with a left-turn lane drop into the development.
- Add a 150 foot right-turn lane for WV 45 EB traffic into the development.
- Model the development exit as two lanes: exclusive left and right-turn lanes.

I/S #4: WV 45 with Retail Commons Parkway

- Extend the existing WV 45 EB right-turn lane back to I/S #3 and designate it as a thru-right lane.

I/S #5: WV 45 with I-81 Southbound Ramps

- Extend the existing WV 45 EB right-turn lane back to I/S #4.

I/S #6: WV 45 with I-81 Northbound Ramps

- Convert existing off-ramp to a left-turn only.
- Extend an additional WV 45 EB thru-right lane from I/S #6 to the Queen Street ramp

I/S #7: WV 45 with Foxcroft Avenue (Mall)

- Construct a new I-81 NB Off-ramp for thru-right movements connecting to this intersection.
- Extend an additional WV 45 WB thru-right lane from I/S #9 to I/S #7. This lane would drop as a right-turn movement onto Foxcroft Avenue.

I/S #9: WV 45 with Winchester Ave.

- Add a second northbound left-turn lane for 200 feet, using the existing, opposing left-turning lane into the K-Mart plaza. This existing lane would be reduced to 150 feet in length.

New Diversion

- Construct a new backage road connecting US 11 to Foxcroft Avenue with an additional access to Lowes. Both ends of the Connector Road would be signalized.

2416 Pennsylvania Avenue
Weirton, WV 26062
304.748.8740

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