US Route 33 Corridor Improvement Study

City of Harrisonburg, Virginia

December 2018

Prepared by

Kimley»Horn JACOBS

Prepared for

STARS VDOT

US ROUTE 33 Corridor Improvement Study

City of Harrisonburg, Virginia

December 2018

Prepared for

VDOT

Prepared by

Kimley»Horn JACOBS

Table of Contents

TABLE OF CONTENTS (Continued)

List of Figures

List of Tables

List of Appendices

List of Acronyms

AADT – Annual Average Daily Traffic
AAWDT – Annual Average Weekday Traffic
CAT – Crash Analysis Tools
CEI – Construction Engineering and Inspection
CGT – Continuous Green-T
CLRP – Constrained Long-Range Transportation Plan
CMAQ – Congestion Mitigation and Air Quality
CSPDC – Central Shenandoah Planning District Commission
CTB – Commonwealth Transportation Board
DGP – District Grants Program
DMV – Department of Motor Vehicles
FYA – Flashing Yellow Arrows
HCM – Highway Capacity Manual
HDPT – Harrisonburg Department of Public Transportation
HPPP – High-Priority Projects Program
HRMPO – Harrisonburg Rockingham Metropolitan Planning Organization
HSIP – Highway Safety Improvement Program
IAA – Interchange Alternative Analysis
L&D – Location and Design
LOS – Level of Service
MOE – Measure of Effectiveness
MUT – Median U-Turn
PCES – Project Cost Estimating System
PDO – Property Damage Only
PHF – Peak Hour Factor
RCUT – Restricted Crossing U-Turn
RIRO – Right-In/ Right-Out
RNS – Roadway Network System
SJR – Signal Justification Report
SPS – Statewide Planning System
STARS – Strategically Targeted Affordable Roadway Solutions
STIP – Statewide Transportation Improvement Plan
SYIP – Six-Year Improvement Program
SWG – Study Work Group
TIA – Traffic Impact Analysis
TIP – Transportation Improvement Plan
TREDS – Traffic Records Electronic Data System
TOSAM – Traffic Operations and Safety Analysis Manual
TMC – Turning Movement Count
TMPD – Transportation and Mobility Planning Division
TRB – Transportation Research Board
VDOT – Virginia Department of Transportation
VJuST – VDOT Junction Screening Tool

1 Introduction

1.1 Project Background

US Route 33 has both national and regional significance. It extends 139 miles in Virginia from the West Virginia state line west of Harrisonburg across the Shenandoah Valley, Blue Ridge Mountains, and Atlantic Piedmont to Richmond, its eastern terminus. Locally, it is a principal arterial with regional significance for the Harrisonburg-Rockingham metro area. US Route 33 continues into the City of Harrisonburg as Market Street. After curving through the downtown area, US Route 33 (East Market Street) becomes a divided highway at Vine Street, then intersects with I-81. To the east of I-81, US Route 33 expands to six lanes, passing through a commercial area that includes the Harrisonburg Crossing shopping center and the Valley Mall. Eastward, the route returns to a four-lane highway continuing through the city limits of Harrisonburg.

The increasing densification of vehicle-dependent development on the east side of Harrisonburg has brought with it challenges to preserving safe and efficient travel on US Route 33. With roughly 30 entrances per mile, 9 signalized intersections, over 150 acres of existing commercial development directly fronting the 2.1-mile study corridor, and a planned 118-acre residential and commercial site nearby on Linda Lane, maintaining reliable operations on US Route 33 is growing more difficult. This corridor was identified and selected for an improvement study by the Virginia Department of Transportation (VDOT) as part of the Strategically Targeted Affordable Roadway Solutions (STARS) program.

1.2 Purpose and Need

This STARS study identified strategies to reduce crashes, maximize existing vehicular capacity, and make spot improvements to this important corridor through analysis of existing and future conditions. The goal of this study was to identify targeted improvements that could be programmed into the VDOT Six-Year Improvement Program (SYIP). Consideration was given to the likelihood that recommended improvements would perform favorably in the SMART SCALE project prioritization program or other available transportation funding programs.

Existing safety and traffic operational issues in the project area were identified and reviewed with a goal of developing improvements to maximize vehicular mobility through minimizing congestion and delay, reducing crashes and improving access management. In addition to these general improvement objectives, the study proposes improvement alternatives for 2025 conditions by addressing operational enhancements and capital improvement projects in the project study area. One area of focus was the proposed extension of Martin Luther King Jr. Way from its current terminus at US Route 33 to a new intersection with Country Club Road, as recommended in the City of Harrisonburg Comprehensive Plan. Another focus area was to provide city staff with recommendations for improving access management, including the configuration of uncontrolled crossovers and the impact of commercial entrances on safety and capacity.

1.3 Project Location and Study Area

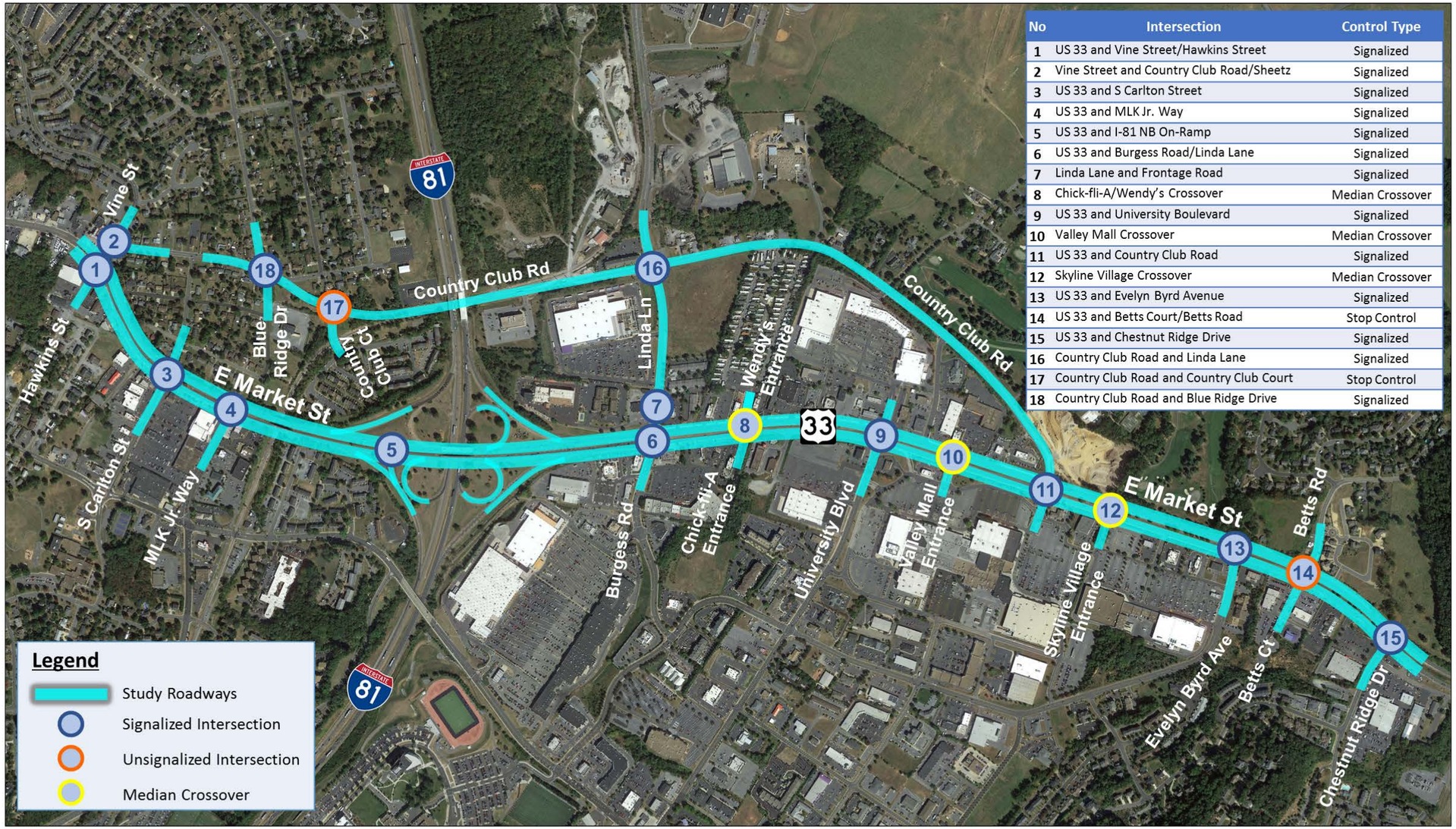
The study area is a 2.1-mile segment of US Route 33, East Market Street in Harrisonburg from Vine Street to Chestnut Ridge Drive and the functional areas of the intersections therein. US Route 33 in the study area is a 4- to 6-lane divided principal arterial corridor that is primarily commercial in character. This corridor study examines key roadway system elements along US Route 33 in the study area, including nine signalized intersections, three uncontrolled median crossovers, and one unsignalized intersection. US Route 33 intersects with Interstate 81, Exit 247, within the study area. Only ramp terminus intersections are included in the study. The interchange is not included in the traffic operations and safety analysis.

Country Club Road, a 2-lane undivided minor arterial roadway, parallels the study area of US Route 33 and is included in the study for traffic operational analysis insofar as it is impacted by the planned extension of Martin Luther King Jr. Way. Safety and access management analyses for County Club Road are not included in this study.

US Route 33 through Harrisonburg has been identified as a Mobility Preservation Segment in VDOT's Arterial Preservation Network, pending adoption into VTrans2040 by the Commonwealth Transportation Board (CTB). This network was adopted by the CTB in July 2017 in conjunction with the release of VDOT IIM-TE-387.0, requirements for Signal Justification Reports (SJRs) for New and Reconstructed Signals. Mobility Preservation Segments are defined as arterials within urban areas that serve a critical function for commerce, commuting, and multimodal mobility. This study takes these qualities into account and considers alternative intersection designs where appropriate.

Table 1.1: Study Intersections

No	Intersection	Control Type
1	US Route 33 and Vine Street/Hawkins Street	Signalized
2	Vine Street and Country Club Road/Sheetz	Signalized
3	US Route 33 and S Carlton Street	Signalized
4	US Route 33 and MLK Jr. Way	Signalized
5	US Route 33 and I-81 NB On-Ramp	Signalized
6	US Route 33 and Burgess Road/Linda Lane	Signalized
7	Linda Lane and Frontage Road	Signalized
8	Chick-fil-A/Wendy's Crossover	Directional Median Crossover
9	US Route 33 and University Boulevard	Signalized
10	Valley Mall Crossover	Full Median Crossover
11	US Route 33 and Country Club Road	Signalized
12	Skyline Village Crossover	Full Median Crossover
13	US Route 33 and Evelyn Byrd Avenue	Signalized
14	US Route 33 and Betts Court/Betts Road	Stop Control
15	US Route 33 and Chestnut Ridge Drive	Signalized
16	Country Club Road and Linda Lane	Signalized
17	Country Club Road and Country Club Court	Stop Control
18	Country Club Road and Blue Ridge Drive	Signalized



No	Intersection	Control Type
1	US 33 and Vine Street/Hawkins Street	Signalized
2	Vine Street and Country Club Road/Sheetz	Signalized
3	US 33 and S Carlton Street	Signalized
4	US 33 and MLK Jr. Way	Signalized
5	US 33 and I-81 NB On-Ramp	Signalized
6	US 33 and Burgess Road/Linda Lane	Signalized
7	Linda Lane and Frontage Road	Signalized
8	Chick-fli-A/Wendy's Crossover	Median Crossover
9	US 33 and University Boulevard	Signalized
10	Valley Mall Crossover	Median Crossover
11	US 33 and Country Club Road	Signalized
12	Skyline Village Crossover	Median Crossover
13	US 33 and Evelyn Byrd Avenue	Signalized
14	US 33 and Betts Court/Betts Road	Stop Control
15	US 33 and Chestnut Ridge Drive	Signalized
16	Country Club Road and Linda Lane	Signalized
17	Country Club Road and Country Club Court	Stop Control
18	Country Club Road and Blue Ridge Drive	Signalized

VDOT STARS

SCALE
0 750 FT. 1500 FT.

Study Area Map
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 1.1

Figure 1.1: US Route 33 Corridor Study Area Map

1.4 Study Work Group

A study work group (SWG) was formed for the study to capture input from local stakeholders and to shape the development of improvement concepts. The SWG provided local and institutional knowledge of the corridor; reviewed study methodologies; provided input on key assumptions; and reviewed and approved proposed improvements created through the study process. The SWG included members representing the following organizations and personnel.

Table 1.2: Study Work Group Members

Organization(s)	Division	Personnel
VDOT	Project Manager/District Planning Representative	Brad Reed, Terry Short
	Harrisonburg Residency	Don Komara, Burgess Lindsey
	Traffic Engineering/Operations	Matt Shiley, Keith Rider, Don Logan
	Location and Design (L&D)	Matt Dana
	Transportation and Mobility Planning Division (TMPD)	Jungwook Jun, Terrell Hughes, Bill Guiher
Local and Regional Partners	City of Harrisonburg, Public Works	Jim Baker, Tom Hartman, Erin Yancey, Ian Pike
	City of Harrisonburg, Transit	Gerald Gatobu
	Harrisonburg Rockingham Metropolitan Planning Organization (HRMPO)	Ann Cundy, Jonathan Howard
	Rockingham County, Planning	Rhonda Cooper, James May
Consultants	Consultant Project Manager	Tim White (Kimley-Horn)
	Sub-Consultant Project Manager	Bob Kuhns (Jacobs)
	Sub-Consultant Traffic Engineer Lead	George Lu (Jacobs)

2 Analysis Methodology

2.1 Analysis Years/Scenarios

The two analysis years for this study are the base year (2017) and one future year 2025. The traffic analysis included an assessment of typical weekday AM and/or PM peak-hour operations of the following scenarios:

- 2017 Existing conditions
- 2025 No-Build scenario
- 2025 Build scenarios
  - Alternative 1
  - Alternative 2
  - Alternative 3
  - Preferred Alternative

2.2 Background Project Assumptions

2.2.1 2017 Existing Conditions

Existing Traffic Conditions have been established primarily from traffic data collected by the City of Harrisonburg. These data are described in detail in **Chapter 3:** Existing Conditions Analysis. The data was collected during October 2017. Supplementary data was provided from the Interchange Alternatives Analysis Report for I-81 Exits 245 and 247 (dated August 2015) conducted for the Harrisonburg Rockingham Metropolitan Planning Organization (HRMPO).

2.2.2 2025 No-Build Background Projects

There are four approved site development projects and one programmed highway improvement project within the study area that are planned to be built before 2025. They are:

- Site development projects along the US Route 33 corridor:
  - Shoney's/Best Western: built out in 2017 (included in the existing conditions)
  - Spotswood Country Club Center: fully built out before 2025
  - Kroger Fueling Center: fully built out before 2025
  - The Retreat: Phases I & II built out before 2025
- Highway improvement project:
  - I-81 Exit 247 interchange modification

Two new signalized intersections are introduced within the study network; they are included in the 2025 No-Build scenario.

- Northbound I-81 off-ramp terminus intersection
- Retreat site entrance intersection on Country Club Road west of Linda Lane

Figure 2.1 illustrates the locations of the aforementioned background projects and proposed new signalized intersections.

2.2.3 2025 Build Background Project

In addition to the above projects, in the 2025 Build scenario, a new transportation improvement project is included. This project involves extending Martin Luther King Jr. Way to the south of US Route 33 and connecting it to Country Club Road. A new park-and-ride facility and transit transfer center are also included along the proposed Martin Luther King Jr. Way extension segment.

2.3 Data Collection

2.3.1 Traffic Data

Traffic data collection by the City or VDOT is targeted at the key intersection and road segment locations along the corridor. Peak period and daily volume and classification data was collected at 12 locations, as specified in Table 2.1. Data collection occurred in October 2017.

The data collection also included three crossover locations on US Route 33 and the intersection of Country Club Road and Linda Lane. Final data collection locations were determined at the project kickoff meeting. The City of Harrisonburg is in the process of upgrading video detection on portions of the US Route 33 corridor to the Gridsmart signal camera system, which has turning movement count (TMC) and vehicle classification capability using custom length-based bins. The Gridsmart data was deemed suitable and used for study purposes.

Intersection TMCs were collected on a typical weekday (Tuesday through Thursday) for 12 hours, 7:00 a.m. - 7:00 p.m., and included light/medium/heavy vehicle classification and pedestrian data, where applicable. To facilitate network calibration of traffic analysis models, travel time runs were collected within the study area during the 7:00 - 9:00 a.m. and 4:00 - 6:00 p.m. peak periods. VDOT provided data not readily available from the City.

Table 2.1: Traffic Data Collection Summary

No	Intersection	Control Type	Data Sources	Date
1	US Route 33 and Vine Street/Hawkins Street	Signalized	City of Harrisonburg	10/19/2017
2	Vine Street and Country Club Road/Sheetz	Signalized	City of Harrisonburg	10/20/2017
3	US Route 33 and S Carlton Street	Signalized	City of Harrisonburg	10/19/2017
4	US Route 33 and MLK Jr. Way	Signalized	City of Harrisonburg	10/19/2017
5	US Route 33 and I-81 NB On-Ramp	Signalized	I-81 Exits 245-247 IAA	2013
6	US Route 33 and Burgess Road/Linda Lane	Signalized	City of Harrisonburg	10/19/2017
7	Linda Lane and Frontage Road	Signalized	City of Harrisonburg	10/20/2017
8	Chick-fil-A/Wendy's Crossover	Median Crossover	VDOT	10/19/2017
9	US Route 33 and University Boulevard	Signalized	City of Harrisonburg	10/19/2017
10	Valley Mall Crossover	Median Crossover	VDOT	10/19/2017
11	US Route 33 and Country Club Road	Signalized	City of Harrisonburg	10/19/2017
12	Skyline Village Crossover	Median Crossover	VDOT	10/19/2017
13	US Route 33 and Evelyn Byrd Avenue	Signalized	VDOT	10/19/2017
14	US Route 33 and Betts Court/Betts Road	Stop Control	VDOT	10/19/2017
15	US Route 33 and Chestnut Ridge Drive	Signalized	City of Harrisonburg	10/19/2017
16	Country Club Road and Linda Lane	Signalized	VDOT	10/19/2017
17	Country Club Road and Country Club Court	Stop Control	City of Harrisonburg	10/19/2017
18	Country Club Road and Blue Ridge Drive	Signalized	VDOT Synchro file	2017

VDOT STARS

SCALE
0 750 FT. 1500 FT.

New Site Developments in US 33 Corridor
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE
2.1

Figure 2.1: 2025 No-Build Background Projects in US Route 33 Corridor

2.3.2 Crash Data

The most recent 6.5-year crash data available for the study area, from January 1, 2011, to June 30, 2017, was retrieved from VDOT's Crash Analysis Tools (CAT) version 8.2[1]. The crash data was from the DMV Traffic Records Electronic Data System (TREDS) database, which primarily consists of the following information:

- Crash location information: longitude and latitude
- Crash time and date
- Crash types
- Crash severity
- Likely crash causes

In addition, VDOT also provided crash and traffic data used in the Interchange Alternatives Analysis (IAA) Report for I-81 Exits 245 and 247 (dated August 2015).

2.4 Analysis Tools and Methodologies

2.4.1 Traffic Operational Analysis

The study team primarily used Synchro and SimTraffic (Version 9) to analyze peak hour traffic operational conditions. The following measures of effectiveness (MOEs) from Synchro were used to quantify the intersection and corridor-wide operations in the study area under existing (2017), future (2025) No-Build and Build conditions.

- Intersection-level operations
  - Control delay (sec/veh) by movement, approach and intersection using the Highway Capacity Manual (HCM) 2010 methodology where intersection configuration permits and HCM 2000 where it does not
  - Queue lengths expressed in 50th and 95th percentile (feet)
- Corridor-wide traffic operations
  - End-to-end travel times (seconds)

Synchro is a macroscopic deterministic traffic model. Synchro has limited functionality for travel time calibration. Therefore, the travel time results from Synchro were only used to compare the relative benefits of the overall corridor operations between 2025 Build alternatives and No-Build conditions.

Since the corridor currently does not operate at oversaturated conditions and will not in 2025, traffic operational analysis was mostly performed using Synchro. Microsimulation tool SimTraffic was only used for queuing analysis at key intersections. In addition, during the alternative screening phase, the study team used the VDOT Junction Screening Tool (VJuST) (version 1.0) and SIDRA INTERSECTION (version 7) for the preliminary analysis of potential innovative intersection and roundabout design concepts. The procedures in traffic operational analysis followed the guidance in the VDOT Traffic Operations and Safety Manual (TOSAM), Version 1.0.

2.4.2 Safety Analysis

The most recent 6.5 years of crash data on US Route 33 corridor was reviewed and formatted into GIS maps and statistic graphics to analyze crash patterns by locations, type, severity, time of day, and likely causes for crashes and summarized in a tabular format. Intersection collision diagrams and roadway segment crash density diagrams were developed to identify key hot spot locations and segments with the highest concentrations of collisions in the study area. The hot spot locations were the critical focus areas for the study team to develop mitigation recommendations to reduce crashes.

2.4.3 Access Management Assessment

Existing signalized intersections, unsignalized intersections, ramps, full median crossovers, directional median crossovers, full access points and partial access points along US Route 33 corridor in the study area were inventoried based on the latest aerial images. The spacing distances were measured and evaluated using the VDOT Road Design Manual Appendix F to determine if the minimum spacing requirements are met.

2.5 Future Traffic Forecasting

2.5.1 2025 No-Build Scenario Traffic Development

The 2025 No-Build peak hour traffic volumes were developed by applying a traffic growth rate to existing count data and distributing traffic volumes from approved developments within the study area. VDOT and the City of Harrisonburg developed traffic growth rates for US Route 33 and Country Club Road considering historical traffic growth trends and projected development patterns.

2.5.2 2025 Build Scenarios Traffic Development

Future traffic volumes for the Build alternatives were developed as manual adjustments to the future No-Build traffic volumes based on the proposed new intersection configurations and/or assumed new network connections and a redistribution of traffic patterns created from traffic zone origin/destinations, estimates of travel times, and professional judgment.

[1] Source: https://public.tableau.com/profile/tien.simmons#!/vizhome/Crashtools8_2/Main

3 Existing Conditions (2017)

3.1 Field Visit

The study team performed a field visit at midday (11:45 a.m. – 1:30 p.m.) and PM peak hour (4:45 – 5:45 p.m.) on Thursday, January 18, 2018. The observations included the traffic conditions and operations along the study corridor on US Route 33 (East Market Street) from Hawkins Street/Vine Street to Chestnut Ridge Drive and along Country Club Road from Vine Street to US Route 33. **Appendix A** includes detailed field visit notes.

3.1.1 US Route 33 (East Market Street)

The posted speed limit on US Route 33 is 35 mph on the 2.1-mile segment within the study area. There are nine signalized intersections, three unsignalized median crossovers, one two-way, stop-controlled intersection and over 50 commercial entrances. The I-81 interchange (Exit 247) is also within the study area. All nine signalized intersections are coordinated. During the PM peak hour, it took 5.75 minutes traveling eastbound along the corridor and 6.60 minutes traveling westbound. The travel speeds could be maintained over 30 mph between the intersections. Although there are multiple access points along the corridor, the entrance traffic from the access points did not significantly influence the through traffic.

3.1.2 Country Club Road

Country Club Road is a 1.6-mile undivided two-lane road with a posted speed limit of 35 mph. It includes four signalized intersections, five unsignalized intersections, multiple access points and bus stops. During the PM peak hour, it took 5.80 minutes traveling eastbound along the corridor and 7.75 minutes traveling westbound. There was no noticeable queue in the eastbound direction except the left-turn queue at the intersection of E. Market Street. In the westbound direction, the queue was observed to extend from Blue Ridge Drive to the entrance of American National University (over 2,000 feet). The primary causes of the queue are: 1) waiting at Blue Ridge Drive for green light, and 2) westbound left-turn vehicles at Country Club Court yielding to opposite through traffic and blocking the road.

3.2 Existing Traffic Volumes

3.2.1 Peak Hour Identification

VDOT and the City performed traffic data collection of turning volumes at the study intersections for 11 hours (7:00 a.m. – 6:00 p.m.) during a typical weekday in October 2017. To identify the system peak hour for the corridor, the combined total of all-way traffic volumes at all 15 study intersections on US Route 33 was summarized by hours of a weekday, as presented in **Figure 3.1**.

US Route 33 within the study area is a typical strip commercial corridor. Different from dual-peak traffic patterns in commuter corridors, the total traffic on US Route 33 gradually increases during the day between 7 a.m. and 6 p.m., which is consistent with the commercial activities during the day. In the morning, there is no obvious traffic peak along this corridor. The highest traffic in the morning occurs during 7:15 – 8:15 a.m. The total traffic in this hour is slightly higher than other hours in the morning but 36 percent lower than the PM peak hour traffic. The midday peak traffic occurs during 12:15 – 1:15 p.m., 17 percent higher than the AM peak hour traffic but 23 percent lower than the PM peak hour traffic. The highest traffic during the day occurs between 4:45 – 5:45 p.m., totaling 39,900 vehicles for that respective hour in both directions in the corridor. Since the traffic in the morning and midday is significantly lower, this study only included the analysis of the PM peak hour traffic operations. Therefore, the PM peak hour (**4:45 – 5:45 p.m.**) was identified as the system peak hour for traffic analysis.

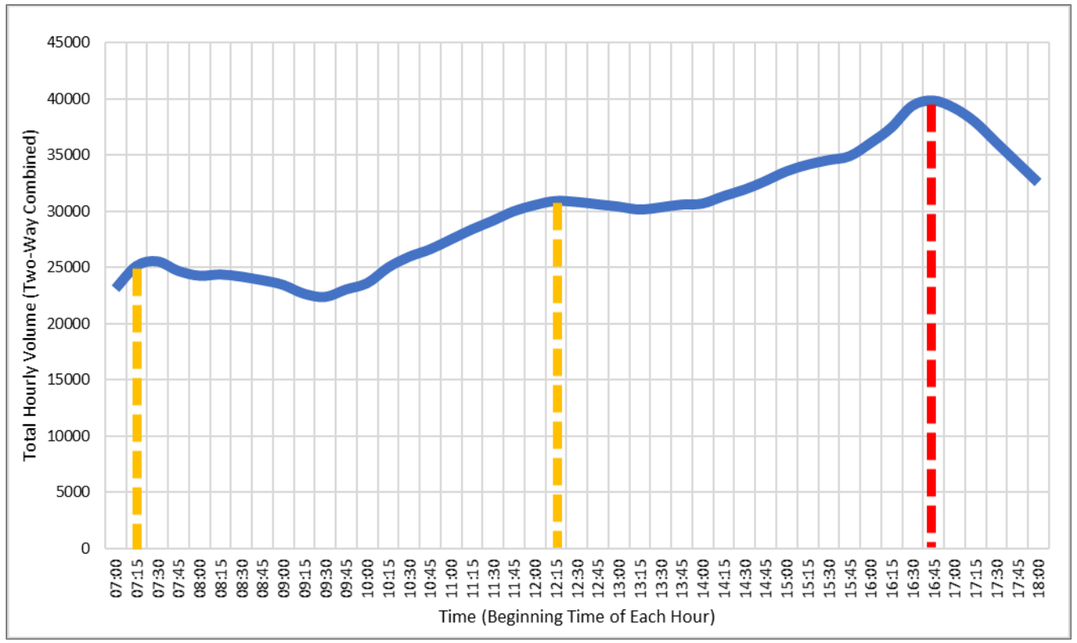


Figure 3.1: US Route 33 Total Combined Two-Way Traffic Volumes by Hours of a Weekday (Tuesday thru Thursday)

3.2.2 Existing PM Peak Hour Volumes

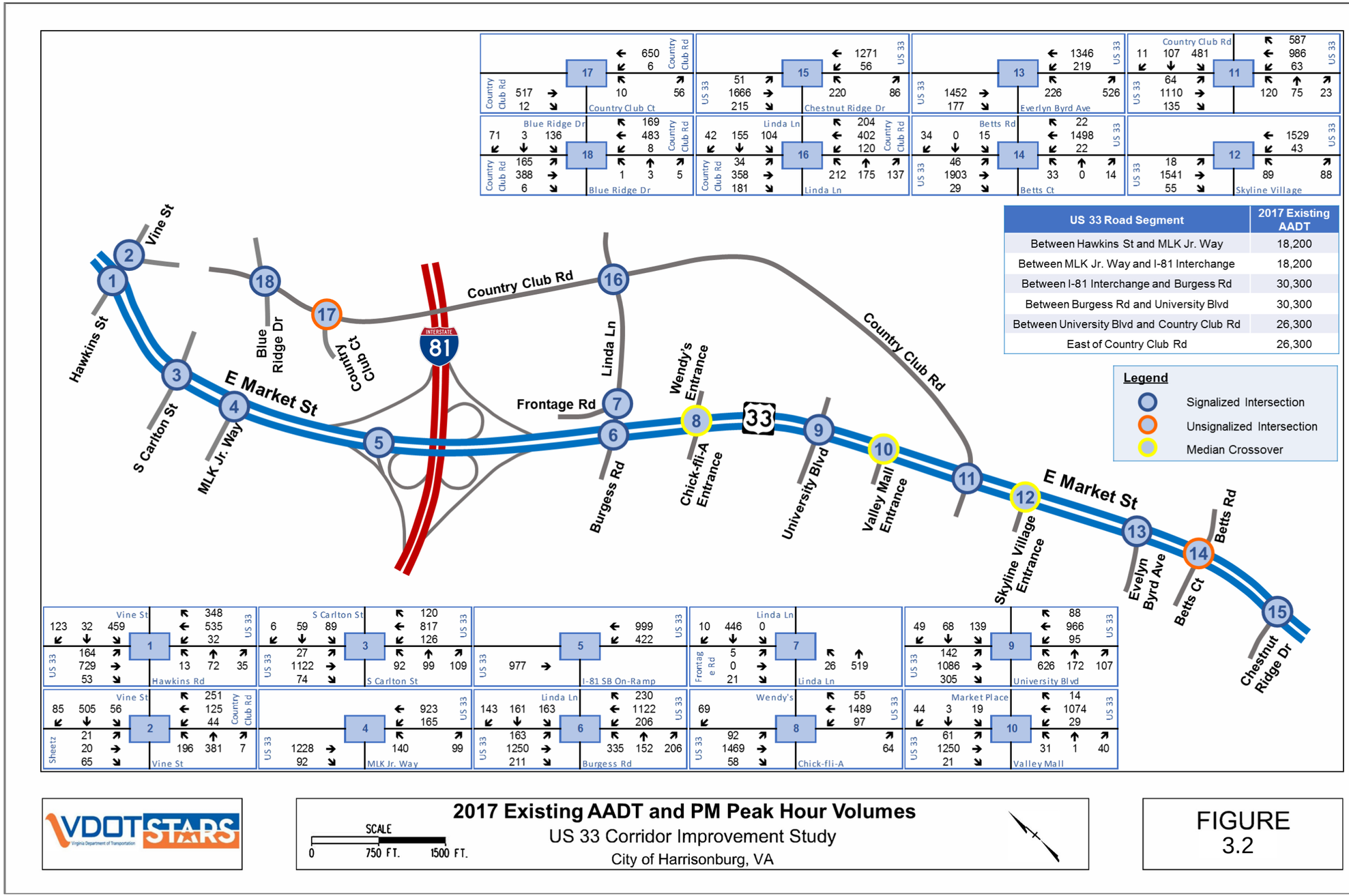
The raw traffic counts during the PM peak hour are processed and balanced through the corridor. **Figure 3.2** presents intersection turning movement volumes within the study area during the PM peak hour in the existing year (2017). The eastbound traffic is generally higher than the westbound traffic in the PM peak hour, however, between the Burgess Road intersection and University Boulevard intersection, through traffic on US Route 33 is almost evenly split between the eastbound and westbound directions.

3.2.3 Existing Daily Traffic Volumes

Annual average daily traffic data were extracted from the 2017 VDOT traffic count book. **Table 3.1** presents the 2017 Existing AADTs on different US Route 33 segments within the study area.

Table 3.1: 2017 Existing AADT on US Route 33 Within Study Area

US Route 33 Road Segment	2017 Existing AADT (vehicles per day)
Between Hawkins Street and MLK Jr. Way	18,200
Between MLK Jr. Way and I-81 Interchange	18,200
Between I-81 Interchange and Burgess Road	30,300
Between Burgess Road and University Boulevard	30,300
Between University Boulevard and Country Club Road	26,300
East of Country Club Road	26,300



US 33 Road Segment	2017 Existing AADT
Between Hawkins St and MLK Jr. Way	18,200
Between MLK Jr. Way and I-81 Interchange	18,200
Between I-81 Interchange and Burgess Rd	30,300
Between Burgess Rd and University Blvd	30,300
Between University Blvd and Country Club Rd	26,300
East of Country Club Rd	26,300

2017 Existing AADT and PM Peak Hour Volumes

US 33 Corridor Improvement Study

City of Harrisonburg, VA

SCALE 0 750 FT. 1500 FT.

FIGURE 3.2

Figure 3.2: 2017 Existing AADT and PM Peak Hour Volumes

On average, 18,200 vehicles travel daily on US Route 33 west of I-81 interchange; 30,300 vehicles between I-81 interchange and University Boulevard; and 26,300 vehicles east of University Boulevard and the city limits. The heaviest daily traffic on US Route 33 in the study area occurs on the segment between the I-81 interchange and University Boulevard.

3.2.4 Existing Heavy Vehicle Traffic

The corridor is characterized as a commercial strip and primarily serves passenger vehicles. The heavy vehicle volumes are low through the corridor. Based on the vehicle classification counts collected in October 2017, the truck percentages at most approaches were less than 3 percent. **Table 3.2** presents the truck percentages by approach at the intersections within the study area. The overall truck percentage on US Route 33 corridor in the study area is 1.6 percent, and the overall study area truck percentage is 1.5 percent. Truck traffic is not a major concern on US Route 33 and Country Club Road in the study area.

Table 3.2: Existing Truck Percentages at Study Intersections by Approach

No	Intersection	Eastbound	Westbound	Southbound	Northbound
1	US Route 33 and Vine Street/Hawkins Street	3%	1%	3%	2%
2	Vine Street and Country Club Road/Sheetz	2%	1%	9%	1%
3	US Route 33 and S Carlton Street	2%	0%	1%	0%
4	US Route 33 and MLK Jr. Way	1%	1%	N/A	0%
5	US Route 33 and I-81 NB On-Ramp	N/A	0%	N/A	N/A
6	US Route 33 and Burgess Road/Linda Lane	4%	1%	1%	1%
7	Linda Lane and Frontage Road	2%	N/A	1%	5%
8	Chick-fil-A/Wendy's Crossover	2%	2%	0%	8%
9	US Route 33 and University Boulevard	3%	1%	1%	0%
10	Valley Mall Crossover	1%	1%	0%	2%
11	US Route 33 and Country Club Road	1%	1%	0%	0%
12	Skyline Village Crossover	2%	0%	N/A	1%
13	US Route 33 and Evelyn Byrd Avenue	0%	0%	N/A	0%
14	US Route 33 and Betts Court/Betts Road	1%	1%	0%	0%
15	US Route 33 and Chestnut Ridge Drive	1%	1%	N/A	0%
16	Country Club Road and Linda Lane	2%	1%	0%	0%
17	Country Club Road and Country Club Court	0%	0%	N/A	0%
18	Country Club Road and Blue Ridge Drive	2%	2%	2%	2%
US Route 33 Corridor Truck Percentage		**1.6%**			
Study Area Truck Percentage		**1.5%**			

3.3 Existing Traffic Operational Analysis Results

The existing traffic operational conditions were analyzed using Synchro/SimTraffic version 9 to set up the baseline conditions. Two measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- 95th percentile queue length – measured in feet

3.3.1 Intersection Delay and LOS

Table 3.3 summarizes the overall intersection delay and LOS. **Appendix B** presents further detailed operational analysis results in delay and LOS by movement and approach.

Table 3.3: Existing Intersection Delay and LOS

No	Intersection	Control Type	Intersection Delay (second per vehicle)	Intersection LOS
1	US Route 33 and Vine Street/Hawkins Street	Signalized	42.7	D
2	Vine Street and Country Club Road/Sheetz	Signalized	58	E
3	US Route 33 and S Carlton Street	Signalized	27.3	C
4	US Route 33 and MLK Jr. Way	Signalized	29.3	C
5	US Route 33 and I-81 NB On-Ramp	Signalized	8.5	A
6	US Route 33 and Burgess Road/Linda Lane	Signalized	30.1	C
7	Linda Lane and Frontage Road	Signalized	35.3	D
8	Chick-fil-A/Wendy's Crossover	Median Crossover	1.1	A
9	US Route 33 and University Boulevard	Signalized	50.4	D
10	Valley Mall Crossover	Median Crossover	0.9	A
11	US Route 33 and Country Club Road	Signalized	48.4	D
12	Skyline Village Crossover	Median Crossover	2.6	A
13	US Route 33 and Evelyn Byrd Avenue	Signalized	23.5	C
14	US Route 33 and Betts Court/Betts Road	Stop Control	0.8	A
15	US Route 33 and Chestnut Ridge Drive	Signalized	33.9	C
16	Country Club Road and Linda Lane	Signalized	25.2	C
17	Country Club Road and Country Club Court	Stop Control	0.9	A
18	Country Club Road and Blue Ridge Drive	Signalized	18.8	B

Most Intersections within the study area, 17 out of 18, operate at LOS D or better. The only intersection operating at LOS E, is the Vine Street and Country Club Road/Sheetz entrance. The critical issue at this location is the close spacing with the adjacent intersection of US Route 33 and Hawkins Street/Vine Street and the limited space for queuing storage (see field visit photos in **Figure 3.3**). The distance between the two intersections is only 150 feet. Both intersections are operated under one signal controller. On the southbound approach of Vine Street at the US Route 33 intersection, the lane configuration is one left-turn exclusive lane and one right-turn-through-left-turn shared lane. At the Country Club Road intersection, one exclusive through lane and one 250-foot long shared storage lane for through and left-turn traffic are provided on the Vine Street approach. The remaining portion of Vine Street is one lane in each direction. The observed queue length at this approach was over 1,000 feet during the PM peak hour. The queues usually could be discharged within two signal cycles.

Figure 3.4 graphically summarizes the results of the operational analysis in terms of delay and LOS at each intersection in the corridor.

Figure 3.3: Field Photos of Intersections of US Route 33 and Vine Street/Hawkins Street and Vine Street and County Club Road/Sheetz

There are several intersections with movements operating at LOS E or F:

- US Route 33 and Vine Street/Hawkins Street
  - Northbound approach on Hawkins Street (LOS F)
  - Eastbound on US Route 33 (LOS E)
- Vine Street and Country Club Road/Sheetz
  - Southbound approach on Vine Street (LOS F)
  - Westbound approach on County Club Road (LOS E)
  - Eastbound approach on Sheetz entrance (LOS F)
- US Route 33 and S Carlton Street
  - Southbound approach on S Carlton Street (LOS F)
- US Route 33 and Martin Luther King Jr. Way
  - Northbound approach on Martin Luther King Jr. Way (LOS E)
- US Route 33 and Burgess Road/Linda Lane
  - Northbound approach on Burgess Road (LOS E)
- Linda Lane and Frontage Road
  - Southbound approach on Linda Lane (LOS E)
  - Eastbound approach on Frontage Road (LOS F)
- US Route 33 and University Boulevard
  - Northbound approach on University Boulevard (LOS E)
  - Southbound approach on shopping mall entrance (LOS E)
  - Westbound approach on US Route 33 (LOS F)
- US Route 33 and Country Club Road
  - Northbound approach on shopping mall entrance (LOS E)
  - Southbound approach on County Club Road (LOS E)
- US Route 33 and Chestnut Ridge Drive
  - Northbound approach Chestnut Ridge Drive (LOS F)

Most of these approaches or movements are left turns or shared movements from side streets. The nine signalized intersections on the US Route 33 corridor in the study area are coordinated along main road directions with a cycle length of 180 seconds. Therefore, the side street traffic has a higher probability of approaching a red light and needing to wait for another cycle to go through the intersection. Field observations have indicated that most of the waiting vehicles at these movements are discharged in the next signal cycle with no excessive delays. The overall intersection operations were at acceptable levels of service.

Figure 3.4: 2017 Existing Traffic Operational Conditions

3.3.2 Queuing Conditions

Queue length is another indicator of congestion at both signalized and unsignalized intersections. The 95th percentile queue is defined to be the queue length (in vehicles) that has only a 5-percent probability of being exceeded during the analysis time period. It is a useful parameter for determining the appropriate length of turn pockets, but it is not typical of what an average driver would experience. Synchro was used to calculate the 95th percentile queue length for each intersection lane group under existing conditions.

A table summarizing the 95th percentile queue lengths by lane group at each study area intersection is provided in **Appendix C**. The corresponding Synchro output sheets are also included in **Appendix C**.

Synchro results indicated that under existing conditions, the 95th percentile queue lengths exceeded 500 feet at the following lane groups or approaches:

- US Route 33 and Vine Street/Hawkins Street
  - Eastbound through and right-turn shared movement
- Vine Street and Country Club Road/Sheetz
  - Southbound approach
- US Route 33 and S Carlton Street
  - Eastbound through and right-turn shared movement
  - Westbound through and right-turn shared movement
- US Route 33 and University Boulevard
  - Westbound through and right-turn shared movement
- US Route 33 and Country Club Road
  - Westbound through movement
  - Westbound right-turn movement
- US Route 33 and Evelyn Byrd Avenue
  - Eastbound through and right-turn shared movement
- US Route 33 and Chestnut Ridge Drive
  - Eastbound through movement
- Country Club Road and Blue Ridge Drive
  - Westbound approach

There is no recurring congestion in the roadway network within the study area. These results are consistent with the observation from the field visit. Most of the above locations are on US Route 33 mainlines, and none of the 95th percentile queue lengths reported by Synchro exceeded the storage capacity of a turn lane or extended to an upstream intersection. Based on field observations, these queues could be discharged in one cycle length. The only exception is the southbound approach on Vine Street at the Country Club Road/Sheetz intersection. The 95th percentile queue length in Synchro was more than 600 feet due to the single-lane configuration and closely-spaced intersections under one signal controller, which is consistent with field observations. During the PM peak hour, it usually took two or three cycles to discharge the southbound queues.

3.4 Crash Analysis

3.4.1 Crash Frequency Analysis

The study area for crash analysis only includes the US Route 33 corridor between Vine Street and Chestnut Ridge Drive. Between January 2011 and June 2017, there were a total of 588 reported crashes, equivalent to an average of 90.5 crashes per year. **Figure 3.5** illustrates the trend of yearly crash frequencies on US Route 33. The average frequency was 83 crashes per year in 2011 – 2013, and 99 crashes per year in 2014 – 2016. This represents a 19.2 percent increase in the most recent three years. **Figure 3.6** depicts the distribution of crashes by the time of day. Over 50 percent of the crashes occurred between 12 p.m. and 6 p.m. There were fewer crashes in the morning, which matches the overall traffic volume diurnal patterns in the corridor. The highest traffic volume periods correspond to the times with the highest number of crashes.

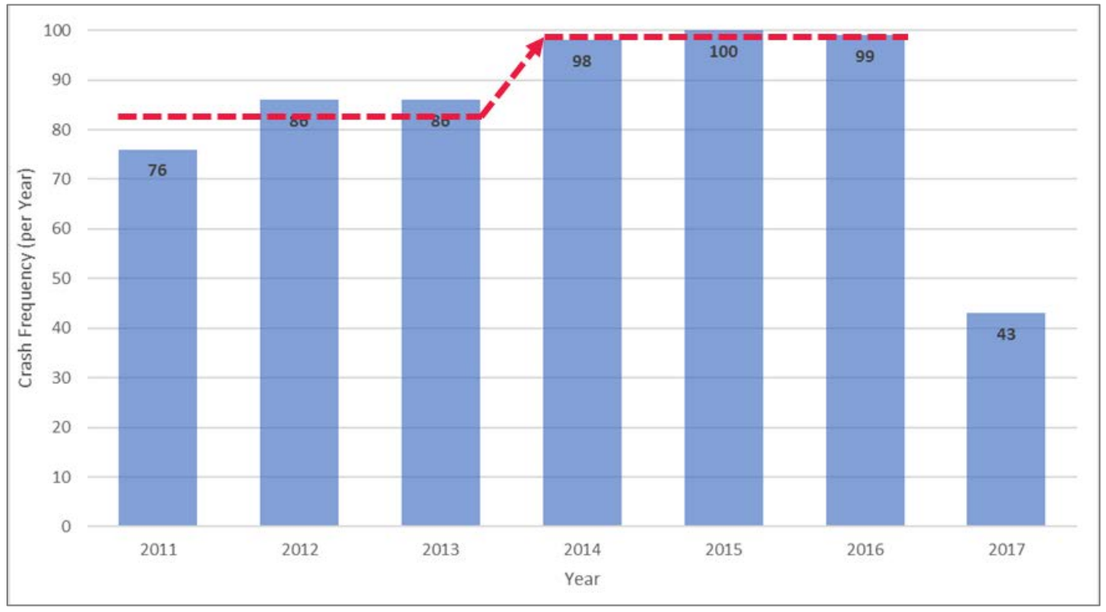


Figure 3.5: US Route 33 Corridor Yearly Crash Frequencies (1/2011 – 6/2017)

3.4.2 Crash Pattern Analysis

A summary of US Route 33 corridor crashes by crash type is provided in **Figure 3.7**. Rear end and angle crashes were the top two predominant crash types. They accounted for 85 percent of the total reported crashes in the study corridor. There were as many angle crashes as rear-end crashes, 42 percent and 43 percent, respectively. Usually in a signalized corridor, angle crashes are less frequent because traffic signals reduce conflicting movements. One possible reason for this crash pattern is the existence of many commercial access points along the study corridor. The next most frequent crash type was same direction sideswipe, which accounted for 7 percent of all reported crashes. Each of the rest of the crash types accounted for less than 5 percent. No outstanding issues were related to those crashes types.

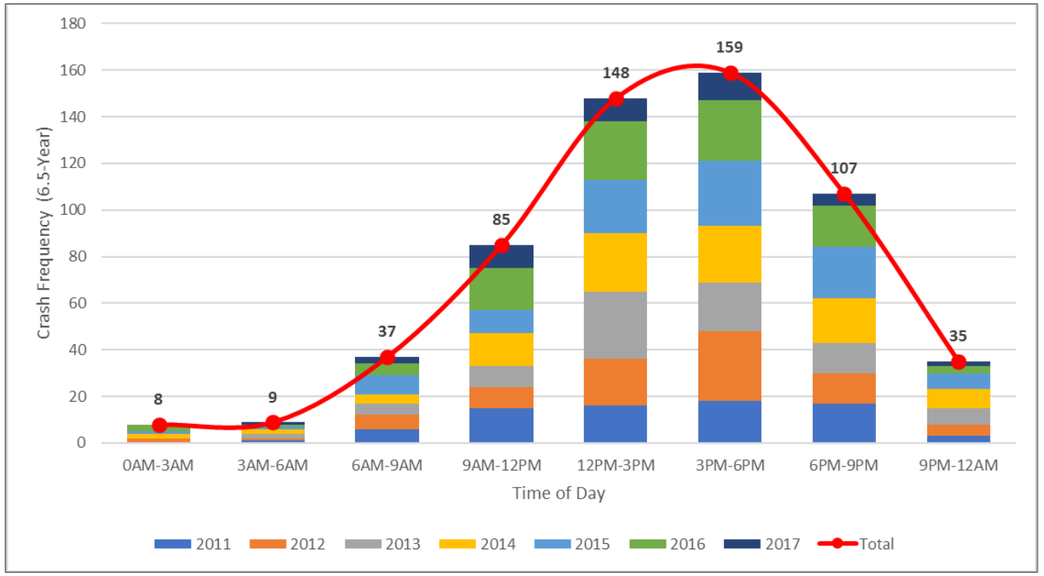


Figure 3.6: US Route 33 Corridor Crash Frequencies by Time of Day (1/2011 – 6/2017)

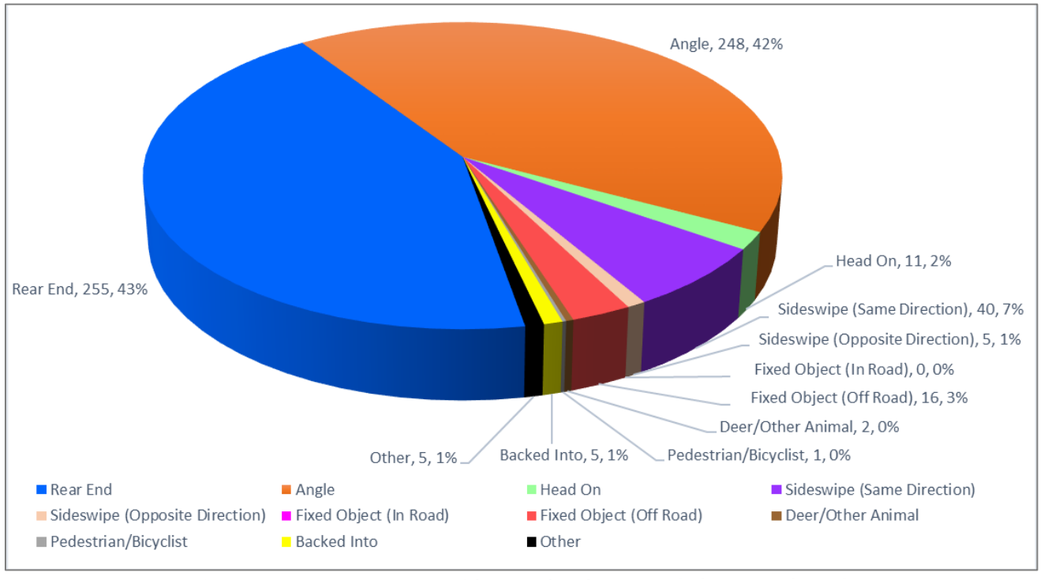


Figure 3.7: US Route 33 Corridor Crashes by Types (1/2011 – 6/2017)

Figure 3.8 summarizes the corridor crashes by severity. Most of the crashes, 77 percent, were property damage-only (PDO). The rest of the crashes (23 percent) resulted in injuries; but mostly in minor injuries. Only one percent of total crashes resulted in serious injuries. In the past six and half years, there were no crash fatalities in the study corridor. The possible reason for lower than expected crash severity in the study corridor was the 35 mph speed limit.

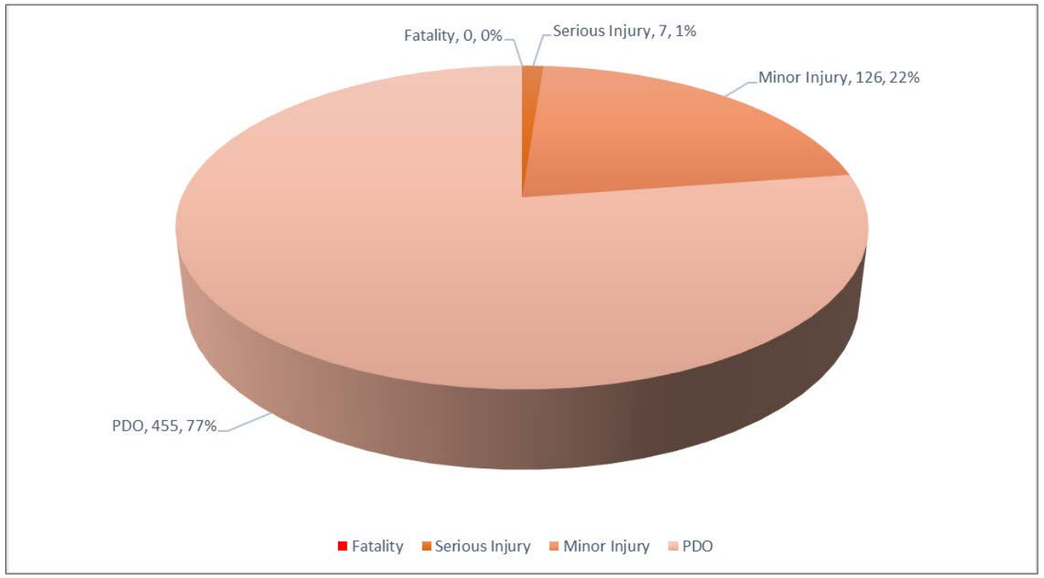


Figure 3.8: US Route 33 Corridor Crashes by Severities (1/2011 – 6/2017)

3.4.3 Corridor Segment Crash Density Analysis

Crash activity by quarter-mile segments of roadway, or crash density, on eastbound and westbound US Route 33 is shown on the histograms in **Figure 3.9**. The histograms illustrate the frequencies and types of crashes that occurred in each quarter-mile segment. Because US Route 33 is a divided roadway, crashes that occurred in the eastbound and westbound directions were broken into separate histograms. The corridor-wide average crash densities were 5.5 crashes per quarter mile per year in the westbound direction and 4.6 in the eastbound direction. The two segments with the highest crash density are summarized below.

3.4.3.1 Westbound Direction Between Mile Post 24.30 – 23.55

This segment is near the intersection of University Boulevard. The crash density was 15.1 crashes per quarter mile per year, the highest in the corridor, and nearly three times as much as the westbound average. Rear-end crashes were the predominate types on this segment. The possible contributing factor is the queuing conditions on westbound US Route 33 at the intersection of University Boulevard. There is also a high percentage of angle crashes on this segment, possibly due to the dense roadside access points.

3.4.3.2 Eastbound Direction Between Mile Post 24.05 – 24.30

This segment is the eastbound direction between Burgess Road and University Boulevard. The crash density was 8.9 crashes per quarter mile per year, nearly twice that of the westbound direction. On this segment, angle crashes were the predominate type, higher than the sum of other types. Numerous roadside access points and the full access median crossover at the Valley Mall entrance are key contributing factors to the high crash density at this location.

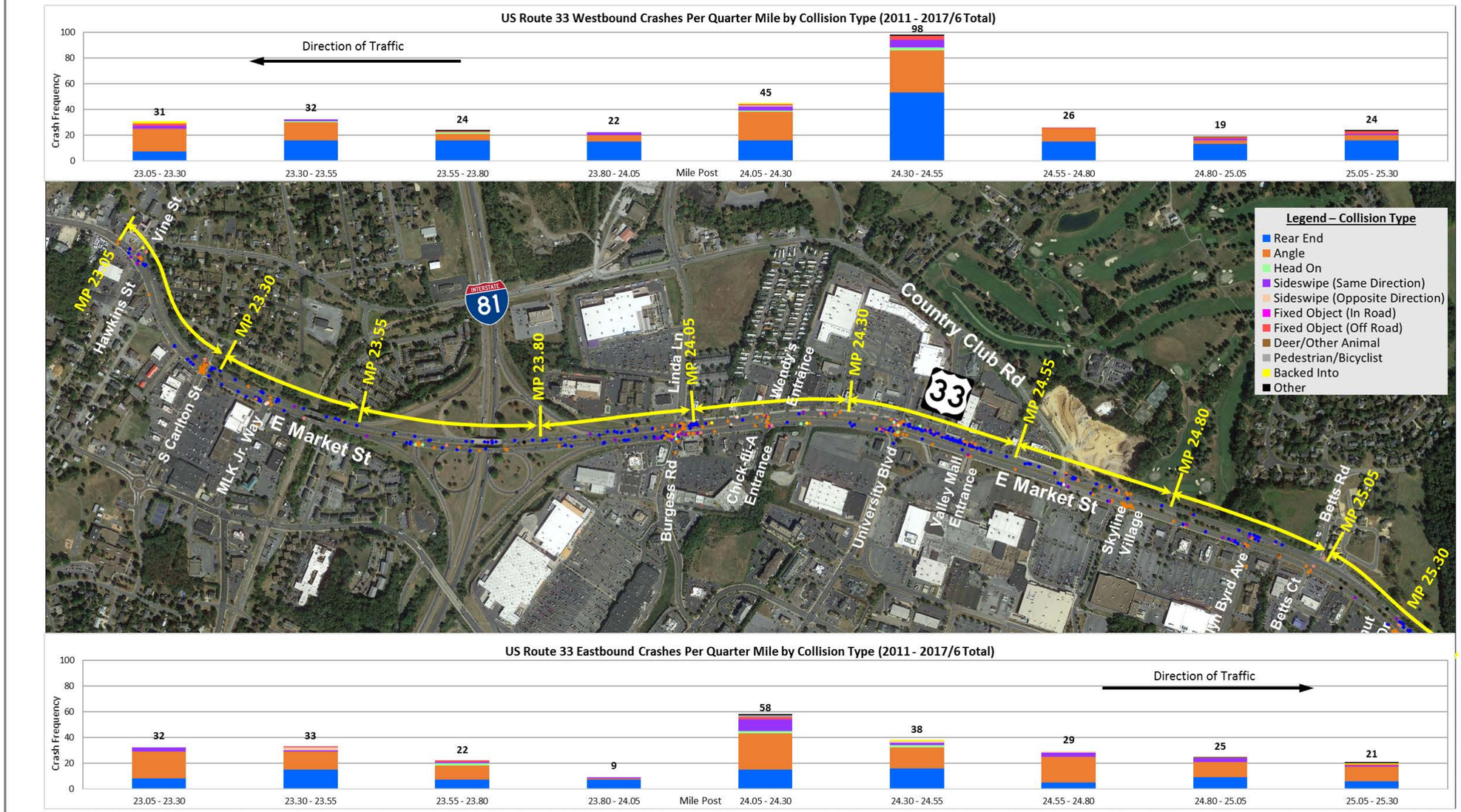


Figure 3.9: US Route 33 Corridor Crash Density (1/2011 – 6/2017)

3.4.4 Intersection Safety Analysis

Crash frequencies and patterns analyses for each study intersection on US Route 33 were performed for the nine signalized intersections, three crossovers, and one unsignalized intersection. The average intersection crash frequency on US Route 33 is 46.6 crashes per intersection. **Figure 3.10** presents a summary of crashes within a 250-foot radius of each intersection on US Route 33. The crash pattern by type at each intersection is illustrated in a pie chart, and the relative size of the pie chart demonstrates the contrasting magnitudes of total crash frequency. **Table** 3.4 summarizes the crash frequency at each US Route 33 intersections and the ranking from highest to lowest crash frequencies in the past 6.5 years. Because the distance between the intersection of US Route 33 and Vine Street/Hawkins Street and intersection of Vine Street and Country Club Road/Sheetz is about 150 feet, the crashes at both intersections were combined for this analysis. Similarly, crashes at the intersection of US Route 33 and Burgess Road/Linda Lane and the intersection of Linda Lane and the frontage road were combined. Four intersections had much higher crash frequencies than the average, and they were identified as safety hot spots on the study corridor as highlighted in red in **Table 3.4**.

Table 3.4: Intersection Crash Frequencies on US Route 33 (1/2011 – 6/2017)

No.	Intersection	Total Crash Frequency	Rank
1 2	US Route 33 and Vine Street/Hawkins Street Vine Street and Country Club Road/Sheetz	43	7
3	**US Route 33 and S Carlton Street**	**65**	**3**
4	US Route 33 and MLK Jr. Way	50	5
5	US Route 33 and I-81 NB On-Ramp	17	11
6 **7**	**US Route 33 and Burgess Road/Linda Lane** **Linda Lane and Frontage Road**	**136**	**1**
8	Chick-fil-A/Wendy's Crossover	12	12
9	**US Route 33 and University Boulevard**	**75**	**2**
10	**Valley Mall Crossover**	**61**	**4**
11	US Route 33 and Country Club Road	27	10
12	Skyline Village Crossover	28	9
13	US Route 33 and Evelyn Byrd Avenue	46	6
14	US Route 33 and Betts Court/Betts Road	5	13
15	US Route 33 and Chestnut Ridge Drive	41	8
Average		**46.6**	

3.4.4.1 Crash Pattern at Intersections of US Route 33 and Burgess Road/Linda Lane and Linda Lane and Frontage Road

The two intersections of US Route 33 and Burgess Road/Linda Lane and Linda Lane and the frontage road are closely spaced, only 130 feet apart. They are operated under one signal controller. Therefore, the crashes at these intersections are combined in the crash statistics and analysis. The location had the highest crash frequency along the corridor. From 2011 through June 2017, 126 crashes occurred at this location, more than 20 crashes per year. The crash frequency of this location is nearly three time as many as the corridor average. **Figure** 3.11 provides a collision diagram at these two intersections. Over 92 percent of the crashes occurred at the main intersection, US Route 33 and Burgess Road/Linda Lane, and only 10 crashes occurred on the Linda Lane approach at the intersection of the frontage road. Crashes on the westbound and eastbound approaches of the US Route 33 mainline were not frequent, and most of them were rear end. This is a typical crash pattern at the approaches of an intersection, which usually are caused by vehicle queuing conditions. The angle crashes are more critical at this intersection. Angle crashes dominated with a mix of several same direction sideswipes on the northbound approach on Burgess Road as well as in the center area of the intersection. On the Burgess Road approach to the intersection, there are five or six commercial entrances and exits along the roadsides within 250 feet distance. Poor access management was the leading contributing factor to the high frequency of angle and sideswipe crashes on this approach. While angle and sideswipe crashes in the center area of the intersection were more likely caused by the heavy turning movement volumes from side streets and relatively wide intersection distances.

3.4.4.2 Crash Patterns at Intersection of US Route 33 and University Boulevard

The signalized intersection of US Route 33 and University Boulevard had the second highest crash frequency in the corridor. Seventy-five crashes occurred at this location in the past 6.5 years, over 11 crashes per year. **Figure 3.12** provides a crash diagram for this intersection. On the westbound and eastbound approaches on US Route 33 mainlines, most crashes were rear end or same direction sideswipe, which were most likely caused by queuing conditions at the intersection. There were significant numbers of angle crashes in the middle of the intersection area. Heavy turning volumes and tight intersection areas for turning maneuvers were possible contributing factors. On the northbound approach on University Boulevard, there were more angle crashes than any other types. Multiple access points along the roadside of this approach were possibly the contributing factors.

3.4.4.3 Crash Patterns at the Valley Mall Crossover

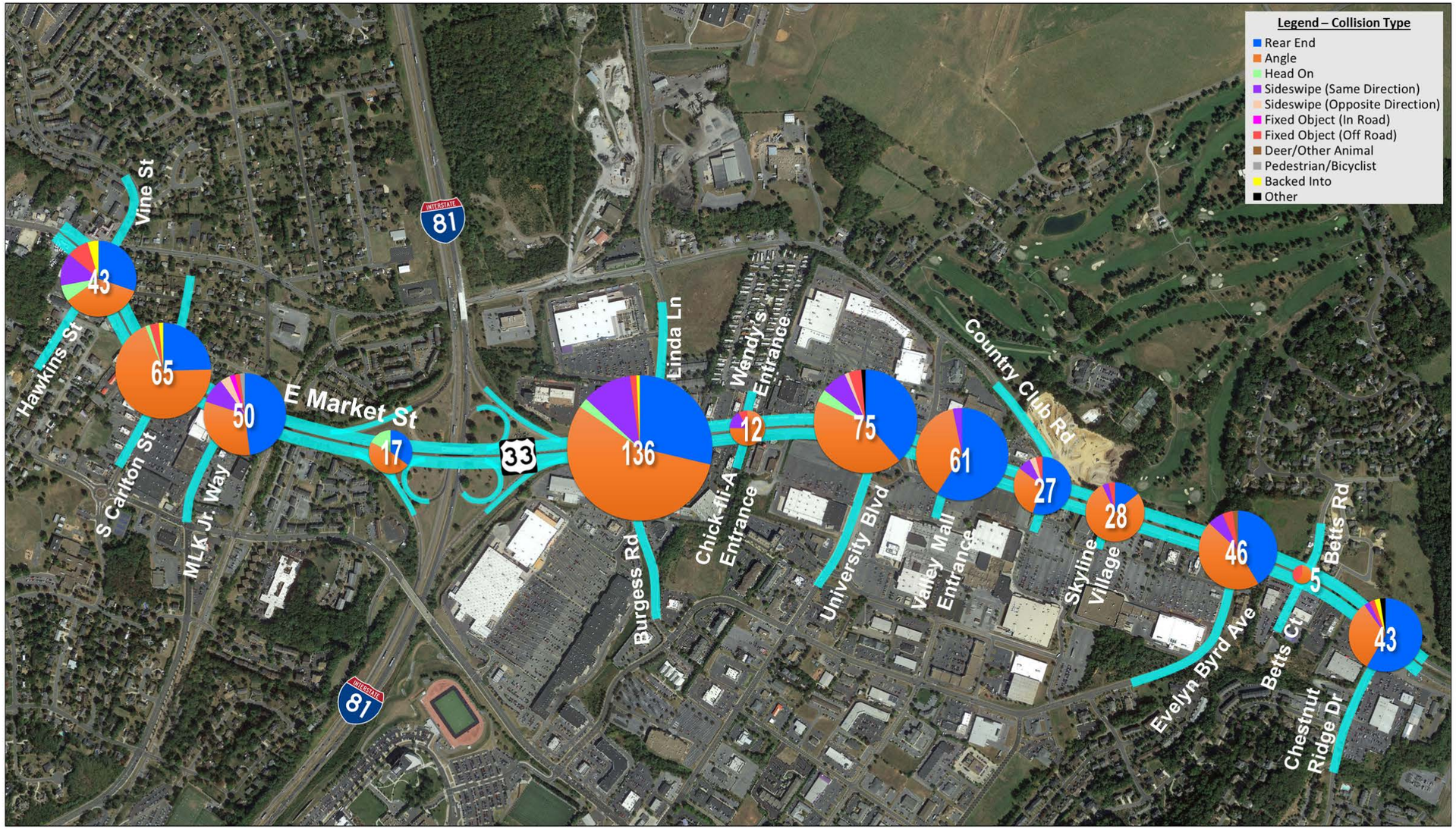
The Valley Mall median crossover is an unsignalized full-movement median opening, located roughly 600 feet east of the intersection of University Boulevard. There were 61 crashes that occurred in the recent 6.5 years as illustrated in **Figure 3.13**, ranked as the fourth highest crash frequency intersection on the US Route 33 corridor. Most of them occurred in the westbound direction, and only a few in the eastbound direction. Included within a 250-foot radius of the crossover were different crash patterns. Angle crashes clustered around the median opening of the crossover. Uncontrolled turning movements and multiple roadside access points are assumed to be the contributing factors to the angle crashes. The queuing conditions in the westbound approach spilled back from the upstream intersection of University Boulevard and was the leading cause of the many rear end crashes.

3.4.4.4 Crash Patterns at the Intersection of US Route 33 and S Carlton Street

There were 65 crashes that occurred at this signalized intersection in recent 6.5 years, the third highest on US Route 33 corridor. **Figure 3.14** illustrates the crash pattern at this intersection. Nearly 70 percent of the crashes were angle crashes concentrated in the central area of the intersection. For a signal-controlled intersection, this high angle crash frequency is not common. Based on the brief descriptions in the crash data, many angle crashes were permissive left-turn vehicles running into the opposite through traffic. The left-turn signal heads were recently converted from traditional green "ball" indicators to flashing yellow arrows (FYA). The FYA signals may potentially improve the safety at this intersection, but a longer examination period of time is required to obtain sufficient crash records after the FYA implementation to monitor its effectiveness.

3.4.4.5 Crash Patterns at US Route 33 and Skyline Valley Crossover

Figure 3.15 illustrates the crash pattern at this crossover. Most of crashes in the recent 6.5 years were angle crashes on eastbound US Route 33.



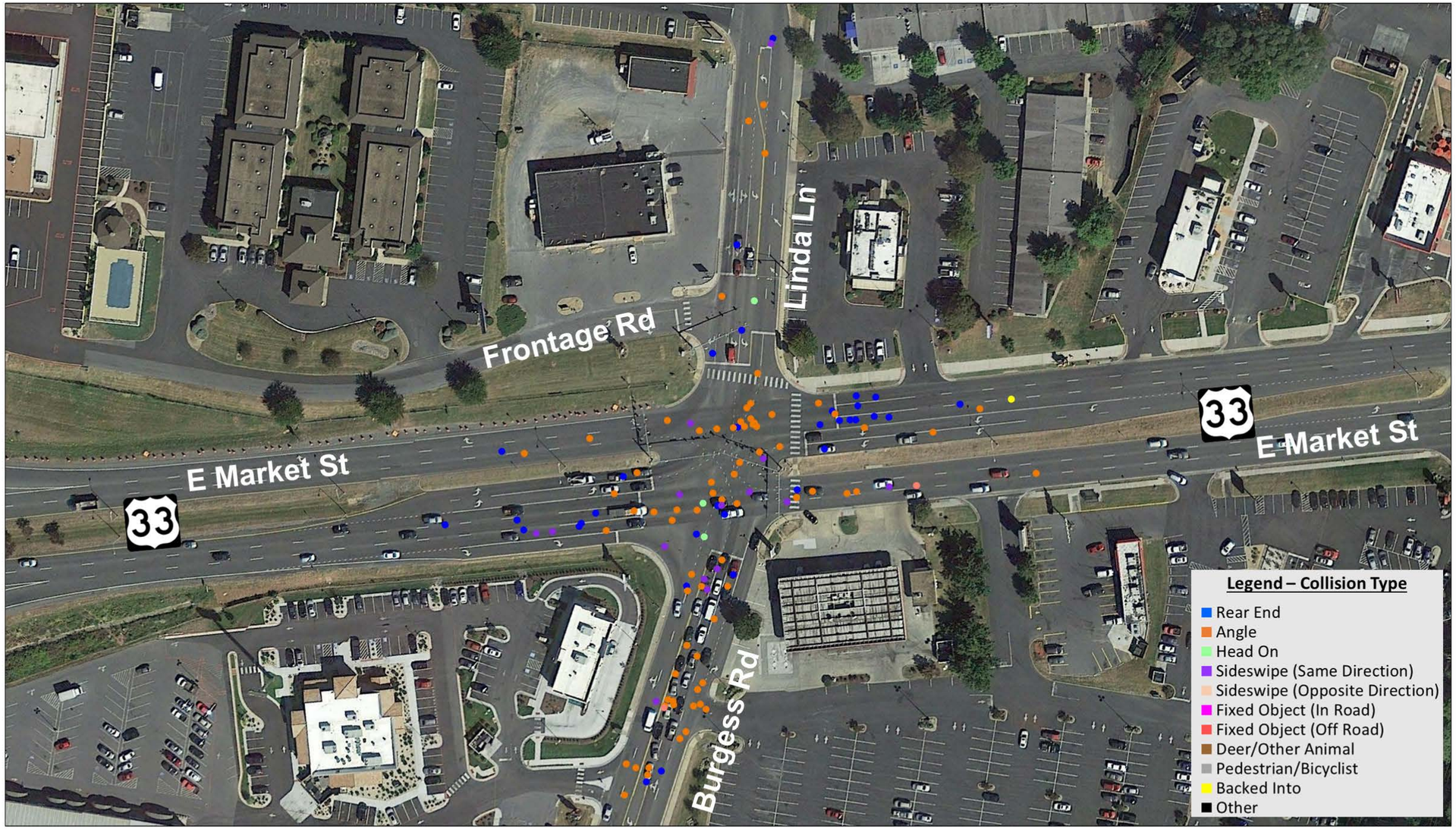
VDOT STARS

SCALE
0 750 FT. 1500 FT.

US 33 Intersection Crash Frequency (2011 – 2017/6)
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.10

Figure 3.10: US Route 33 Intersection Crash Frequency (1/2011 – 6/2017)



VDOT STARS
Virginia Department of Transportation

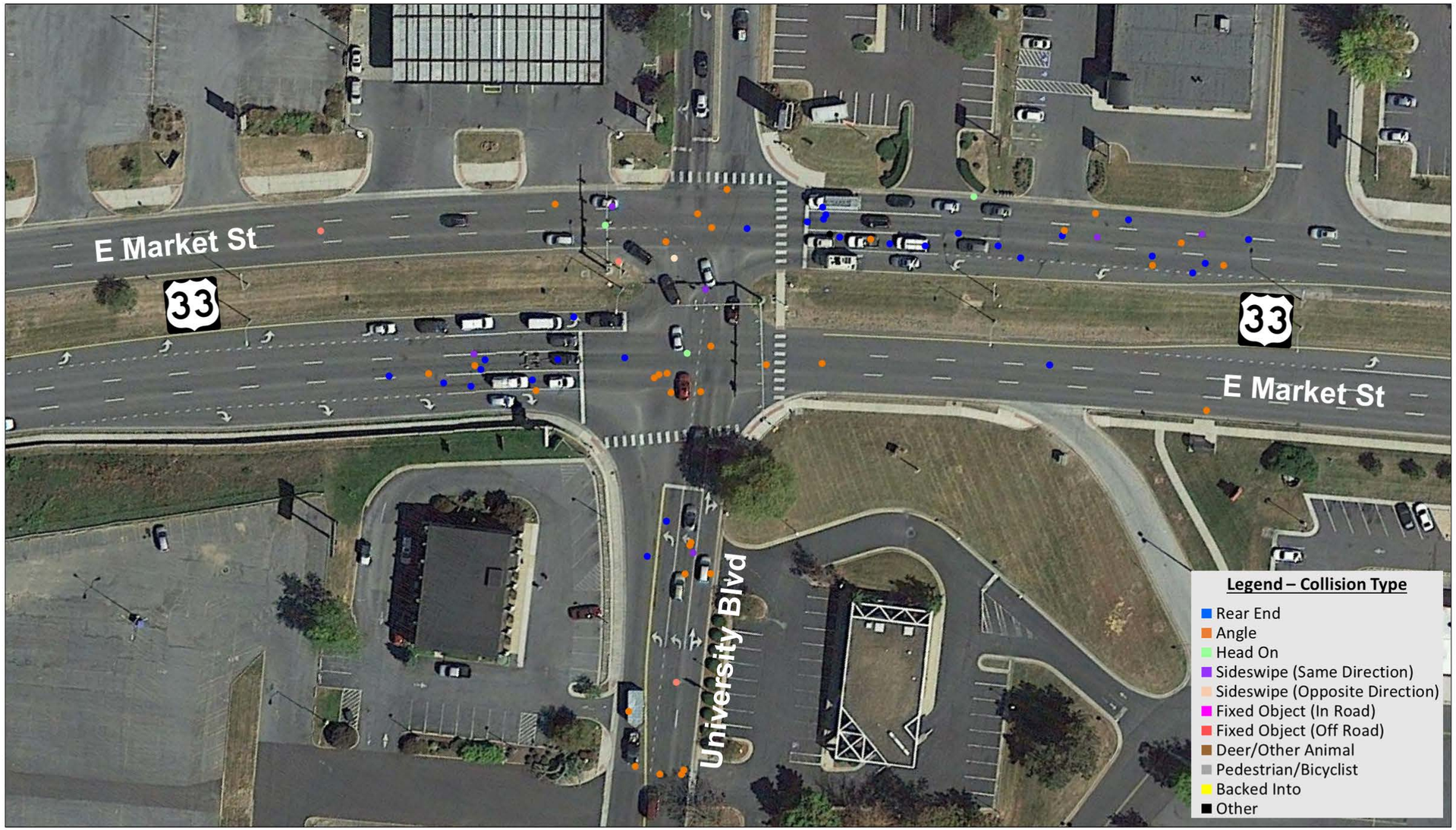
US 33 and Burgess Rd/Linda Ln Intersection Crash Diagram (2011 – 2017/6)

SCALE
0 80' 160'

US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.11

Figure 3.11: US Route 33 and Burgess Road/Linda Lane Intersection Crash Diagram (1/2011 – 6/2017)



VDOT STARS

US 33 and University Blvd Intersection Crash Diagram (2011 – 2017/6)

SCALE 0 50' 100'

US 33 Corridor Improvement Study

City of Harrisonburg, VA

FIGURE 3.12

Figure 3.12: US Route 33 and University Boulevard Intersection Crash Diagram (1/2011 – 6/2017)

VDOT STARS

US 33 and Valley Mall Crossover Crash Diagram (2011 – 2017/6)

SCALE 0 50' 100'

US 33 Corridor Improvement Study

City of Harrisonburg, VA

FIGURE 3.13

Figure 3.13: US Route 33 and Valley Mall Crossover Crash Diagram (1/2011 – 6/2017)

Figure 3.14: US Route 33 and S Carlton Street Intersection Crash Diagram (1/2011 – 6/2017)

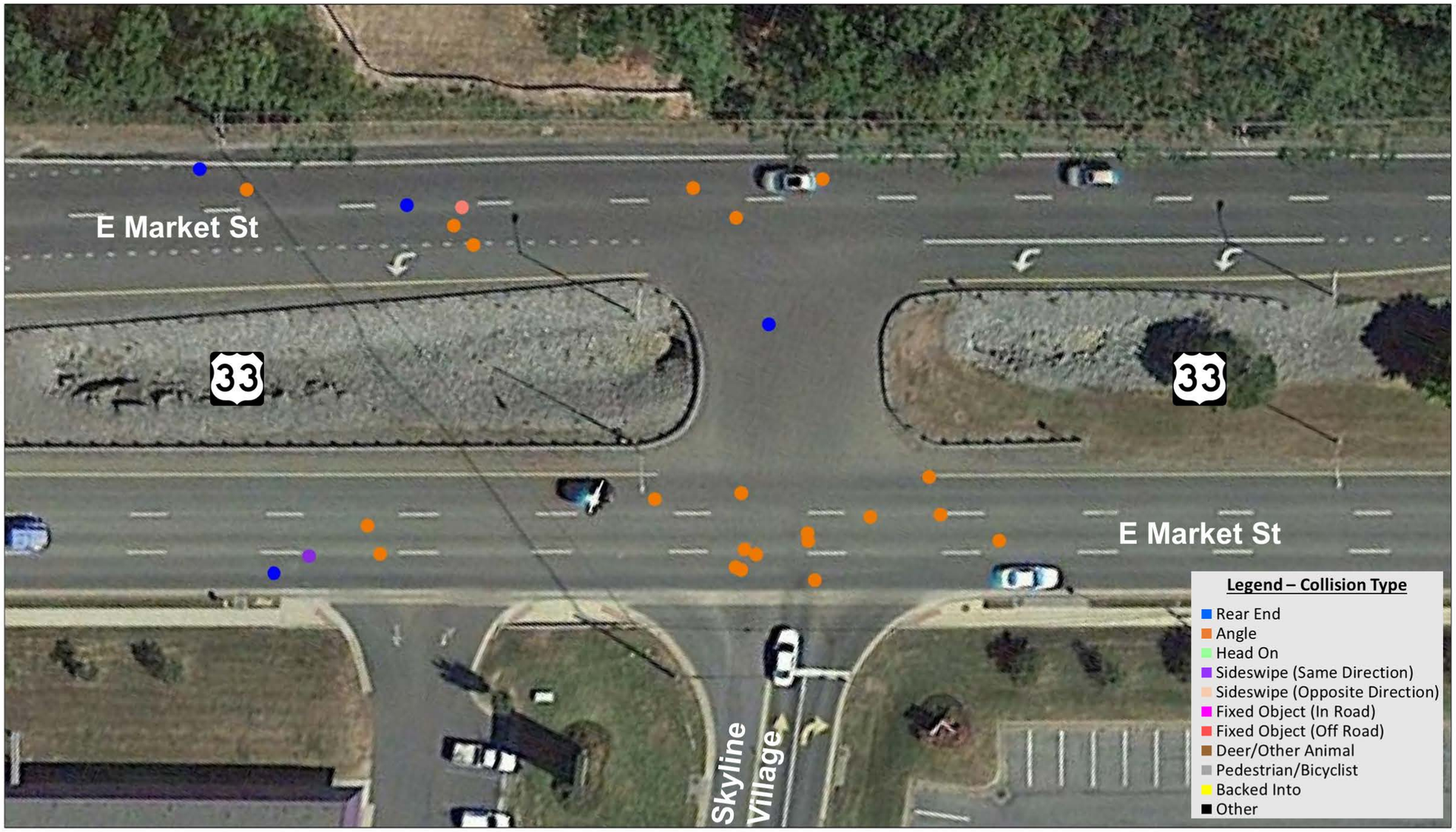


Figure 3.15: US Route 33 and Skyline Valley Crossover Crash Diagram (1/2011 – 6/2017)

3.5 Access Management

The existing access spacing on US Route 33 in the study area was evaluated according to the VDOT access management regulations in Appendix F of the *VDOT Road Design Manual*. The minimum spacing standards for intersections, median crossovers, and commercial entrances are dependent on the functional classification and posted speed limit of the roadway, and, as a result, the spacing standards varied within the study area. According to the VDOT 2014 Functional Classification Map, US Route 33 was classified as a Principal Arterial with a posted speed limit of 35 miles per hour. VDOT access management regulations applicable to the functional classifications and speed limits on US Route 33 are listed in **Table 3.5**. Existing centerline to centerline access point spacing on US Route 33 was measured using aerial maps. The existing spacing in the study area is shown in **Figure 3.16** through **Figure 3.19**. The access management condition is summarized in **Table 3.6**

Table 3.5: Access Management Spacing Requirements[2]

Minimum Spacing Standards for Entrance, Intersections, and Median Crossovers (feet)	Principal Arterial Speed Limit 35 mph	Minor Arterial Speed Limit 35 mph	Minor Collector Speed Limit 25 mph
Spacing from signalized intersections to other signalized intersections	1320	1050	660
Spacing from unsignalized intersections & full median crossovers to signalized or unsignalized intersections & full median crossovers	1050	660	440
Spacing from full access entrances or directional median to other full access entrances and any intersection or median crossover	565	470	225
Spacing from partial access one- or two-way entrances to any type of entrance, intersection or median crossover	305	250	200
Minimum Spacing Standards for Entrances/Intersections Near Interchange Areas (feet)			
Spacing from the end of the off-ramp terminal or the start of the on-ramp terminal to the first four-legged intersection	1320		
Spacing from the end of the off-ramp terminal to the first entrance or from the last entrance to the start of the on-ramp terminal	750		

Table 3.6: Summary of Existing Access Management on US Route 33

Spacing Type	Spacings Meet Requirements	Spacings Do Not Meet Requirements	Total
From signalized intersections to other signalized intersections	3	7	10
From unsignalized intersections & full median crossovers to signalized or unsignalized intersections & full median crossovers	0	6	6
From full access entrances or directional median to other full access entrances and any intersection or median crossover	2	0	2
From partial access one- or two-way entrances to any type of entrance, intersection or median crossover	11	61	72
From the end of the off-ramp terminal or the start of the on-ramp terminal to the first four-legged intersection	1	3	4
From the end of the off-ramp terminal to the first entrance or from the last entrance to the start of the on-ramp terminal	0	1	1

3.5.1 Signalized Intersection Spacing

There are nine signalized intersections along the US Route 33 corridor in the study area. The spacing of three signalized intersections west of the I-81 interchange are substandard. The spacings between signalized intersections east of the I-81 interchange all meet VDOT minimum spacing standards.

3.5.2 Unsignalized Intersection/Full Median Crossover Spacing

There is one unsignalized intersection and three full median crossovers on US Route 33 in the study area. They are labelled as the stop sign icon and orange circles in **Figure 3.18** and **Figure 3.19**. All the spacings from them to adjacent signalized, unsignalized intersection or full median crossover are less than 1050 feet, VDOT minimum spacing standards for unsignalized intersections or full median crossovers.

3.5.3 Directional Median Crossover Spacing

The study corridor includes one directional median crossover at Chick-Fil-A and Wendy's entrances, indicated as the yellow circle in **Figure 3.17** and **Figure 3.18**. The spacings from this directional median crossover to adjacent intersection on both sides meet VDOT minimum requirements.

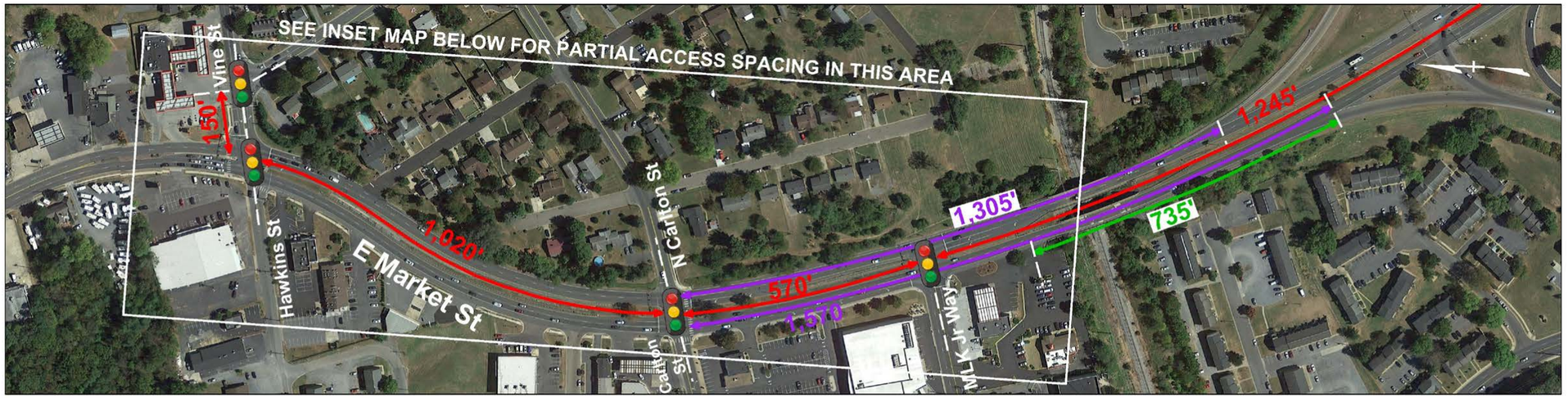
3.5.4 Partial Access Spacing

There are about 55 roadside commercial entrances on the 2.1-mile segment of the US Route 33 corridor in the study area. US Route 33 in the study area is a divided roadway, so there are no full access points. All these entrances are partial access points. Only 11 out of the 72 total accesses meet VDOT's minimum requirements for partial access spacing. Most entrance spacings are substandard. The westbound segment between the County Club Road intersection and Linda Lane intersection has the highest entrance density, 25 commercial entrance along 0.6-mile segment. As discussed in **Section 3.4.3**, this segment has the highest crash density in the corridor.

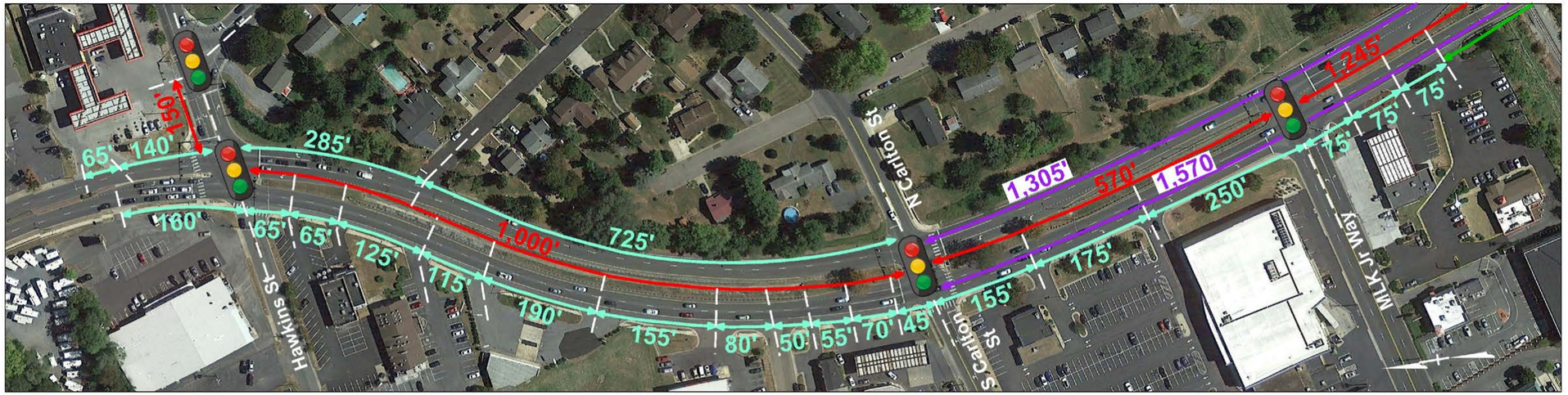
3.5.5 Interchange Ramp Terminal Spacing

Access spacing was also considered at the interchange of US 33 and I-88 in relation to on- and off-ramp terminals. Per VDOT standard, the minimum spacing requirement between the first four-legged intersection and the start or end of a ramp terminal is 1,320 feet. Only the distance between N Carlton Street and southbound I-81 on-ramp meets this requirement, which is 1,570 feet. The other three ramp terminals spacings do not meet the requirement.

[2] VDOT Road Design Manual, Appendix F: Access Management Design Standards for Entrances and Intersections



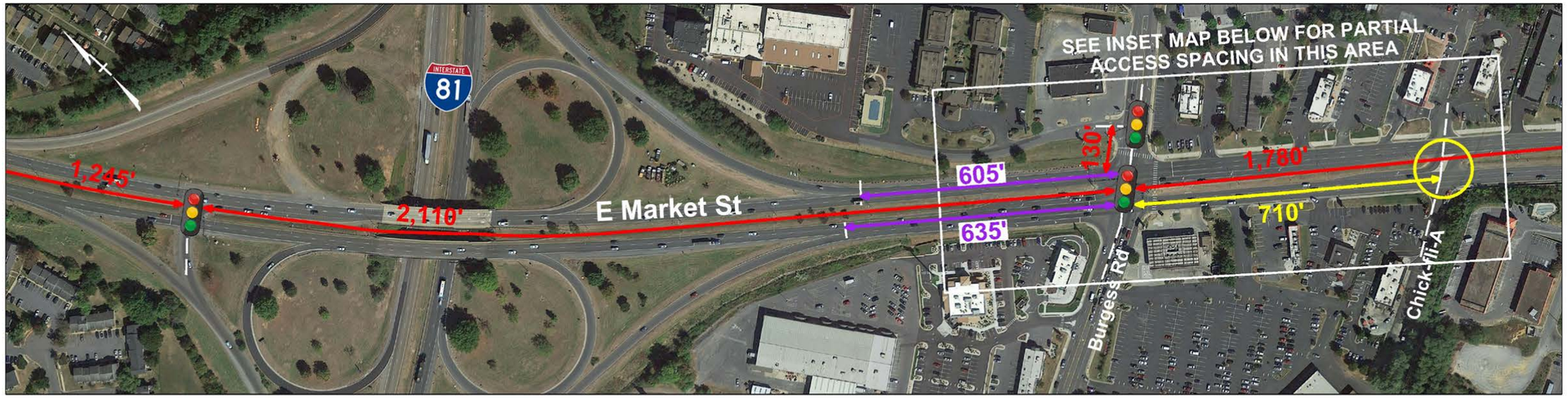
Legend		Spacing Types and VDOT Minimum Requirements for Principal Arterials (35 mph)					
Signalized Intersection	←→	Signalized Intersection ←→ Signalized Intersection	1320'	←→	Ramp Terminal ←→ First 4-legged Intersection	1320'
Unsignalized Intersection	←→	Unsignalized Intersection/Full Median ←→ Signalized/Unsignalized Intersection/Full Median	1050'	←→	Ramp Terminal ←→ First Entrance	750'
Directional Median Crossover	←→	Full Access Entrance/Directional Median ←→ Full Access Entrance/Intersection	565'			
Full Median Crossover	←→	Partial Access ←→ Entrance/Intersection/Crossover	305'			



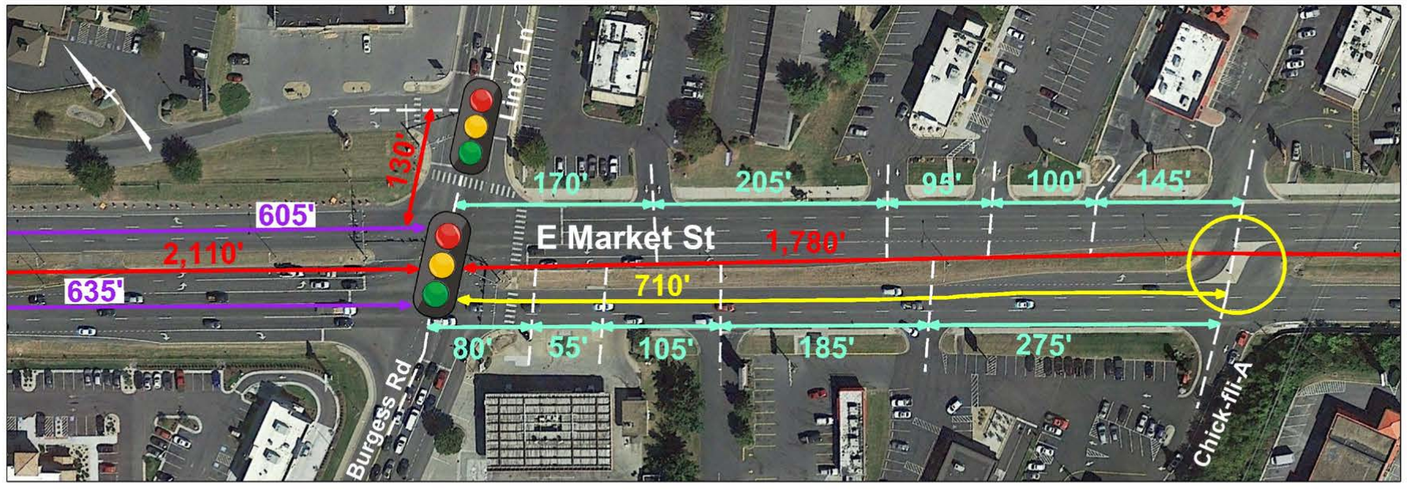
Existing Corridor Access Spacings (Sheet 1 of 4)
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.16

Figure 3.16: US Route 33 Corridor Existing Access Spacings (Sheet 1 of 4)



Legend		Spacing Types and VDOT Minimum Requirements for Principal Arterials (35 mph)					
Signalized Intersection	←→	Signalized Intersection ←→ Signalized Intersection	1320'	←→	Ramp Terminal ←→ First 4-legged Intersection	1320'
Unsignalized Intersection	←→	Unsignalized Intersection/Full Median ←→ Signalized/Unsignalized Intersection/Full Median	1050'	←→	Ramp Terminal ←→ First Entrance	750'
Directional Median Crossover	←→	Full Access Entrance/Directional Median ←→ Full Access Entrance/Intersection	565'			
Full Median Crossover	←→	Partial Access ←→ Entrance/Intersection/Crossover	305'			



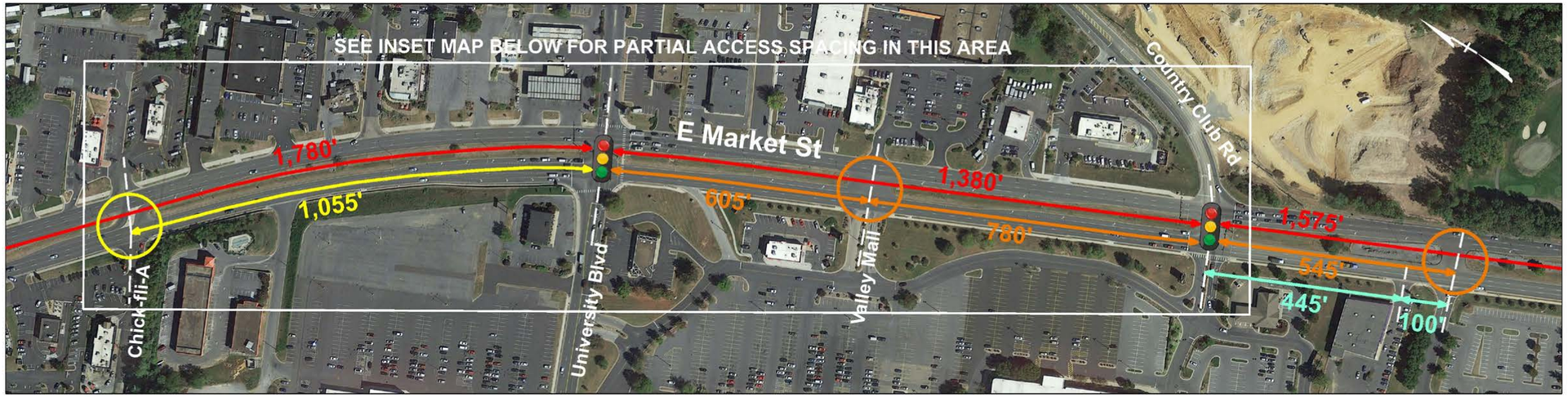
US-33 Corridor
Access Management Summary

Spacing Type	Meet Requirements	Not Meet Requirements	Total
←→	3	7	10
←→	0	6	6
←→	2	0	2
←→	11	61	72
←→	1	3	4
←→	0	1	1

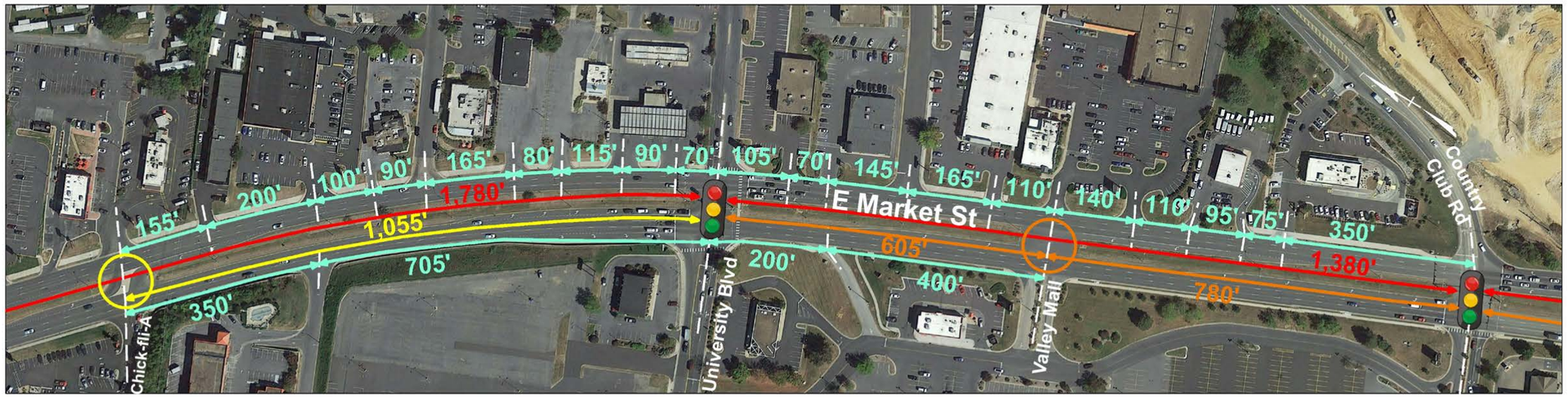
Existing Corridor Access Spacings (Sheet 2 of 4)
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.17

Figure 3.17: US Route 33 Corridor Existing Access Spacings (Sheet 2 of 4)



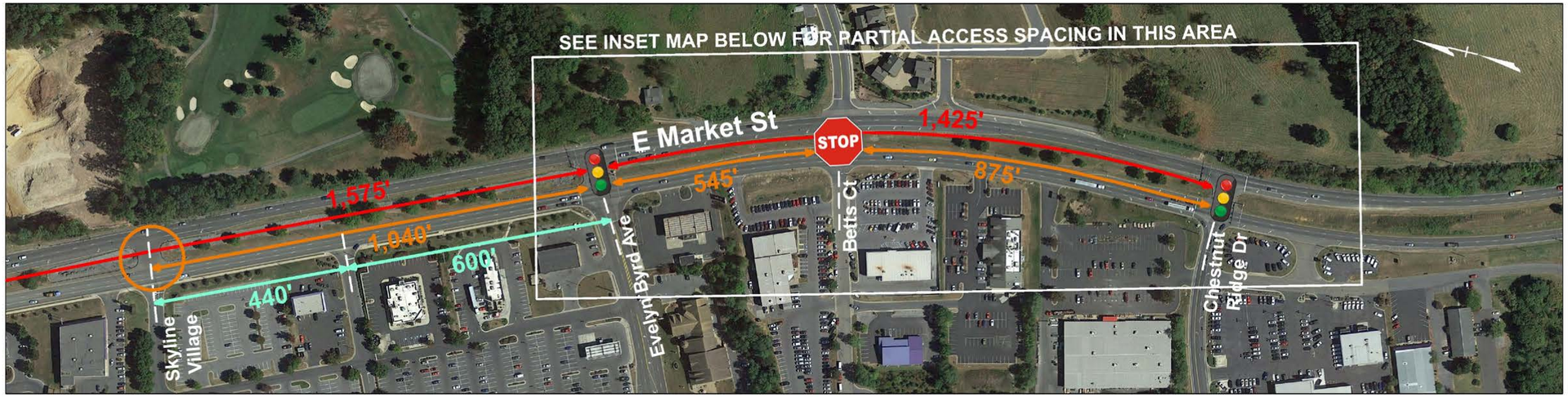
Legend		Spacing Types and VDOT Minimum Requirements for Principal Arterials (35 mph)					
Signalized Intersection	←→	Signalized Intersection ←→ Signalized Intersection	1320'	←→	Ramp Terminal ←→ First 4-legged Intersection	1320'
Unsignalized Intersection	←→	Unsignalized Intersection/Full Median ←→ Signalized/Unsignalized Intersection/Full Median	1050'	←→	Ramp Terminal ←→ First Entrance	750'
Directional Median Crossover	←→	Full Access Entrance/Directional Median ←→ Full Access Entrance/Intersection	565'			
Full Median Crossover	←→	Partial Access ←→ Entrance/Intersection/Crossover	305'			



Existing Corridor Access Spacings (Sheet 3 of 4)
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.18

Figure 3.18: US Route 33 Corridor Existing Access Spacings (Sheet 3 of 4)



Legend		Spacing Types and VDOT Minimum Requirements for Principal Arterials (35 mph)					
Signalized Intersection	←→	Signalized Intersection ←→ Signalized Intersection	1320'	←→	Ramp Terminal ←→ First 4-legged Intersection	1320'
Unsignalized Intersection	←→	Unsignalized Intersection/Full Median ←→ Signalized/Unsignalized Intersection/Full Median	1050'	←→	Ramp Terminal ←→ First Entrance	750'
Directional Median Crossover	←→	Full Access Entrance/Directional Median ←→ Full Access Entrance/Intersection	565'			
Full Median Crossover	←→	Partial Access ←→ Entrance/Intersection/Crossover	305'			

Existing Corridor Access Spacings (Sheet 4 of 4)
US 33 Corridor Improvement Study
City of Harrisonburg, VA

FIGURE 3.19

Figure 3.19: US Route 33 Corridor Existing Access Spacings (Sheet 4 of 4)

4 Future No-Build Traffic Conditions (2025)

4.1 2025 No-Build Traffic Forecasting

The development of 2025 No-Build traffic volumes is comprised of two components:

- Corridor background traffic growth
- Site traffic from new developments along the corridor

The following sections describe the details of the volume development process.

4.1.1 2025 Growth Rate Development

Historic annual average weekday traffic (AAWDT) data from 2012 to 2015 on US Route 33 in the study area was acquired from VDOT traffic data publications[3]. The growth trends in these three years were calculated and reviewed to develop traffic growth rates in the study area on the three roadway segments as listed in **Table 4.1**.

Table 4.1: Historic Traffic Data and Growth Rate on US Route 33

Segment	2012 AAWDT	2015 AAWDT	Annual Growth Rate
Between Vine Street and I-81	18,711	18,922	0.4%
Between I-81 and University Boulevard	29,379	31,397	2.3%
Between University Boulevard and City Limits	26,874	26,941	0.1%

On segments between Vine Street and I-81 and between University Boulevard and the city limits, the growth rates are 0.4 percent and 0.1 percent, respectively. The higher growth rate on the segment between I-81 and University Boulevard is likely affected by the recently completed Shoney's/BW development, as growth on the same segment from 2009 to 2012 was 0.5 percent, in line with the other segments. In all, the background growth on the study corridor will remain low. Therefore, VDOT, with concurrence by the City, recommended an annual growth rate of **0.5 percent** to develop the corridor background traffic growth.

4.1.2 Future Site Developments and Highway Improvement

As mentioned in **Section 2.2.2**, there will be three approved site development projects and one programmed highway improvement project within the study area that has been planned to be built before 2025. **Figure 2.1** illustrates the locations of these new site development projects:

- Spotswood Country Club Center: fully built out before 2025
- Kroger Fueling Center: fully built out before 2025
- The Retreat: Phases I and II built out before 2025[4]

The study obtained the projected trip generations from the following approved traffic impact analysis (TIA) reports for the above site development projects:

- TIA Report for Spotswood Country Club Center, prepared by Ramey Kemp & Associates, Inc., dated October 2015
- Kroger Fueling Center TIA Report, prepared by Valley Engineering, dated September 2016
- TIA Report for the Retreat at Harrisonburg, prepared by Ramey Kemp & Associates, Inc., dated February 2016

Appendix D includes the detailed trip generation diagrams from each of the reports. The total future site trips were derived by summarizing trip generations from all three developments.

4.1.3 2025 No-Build Traffic Volumes

The 2025 No-Build projected traffic volumes were developed using the following equation:

2025 No-Build Volumes = Background Corridor Traffic Growth + Site Trips from Future Developments

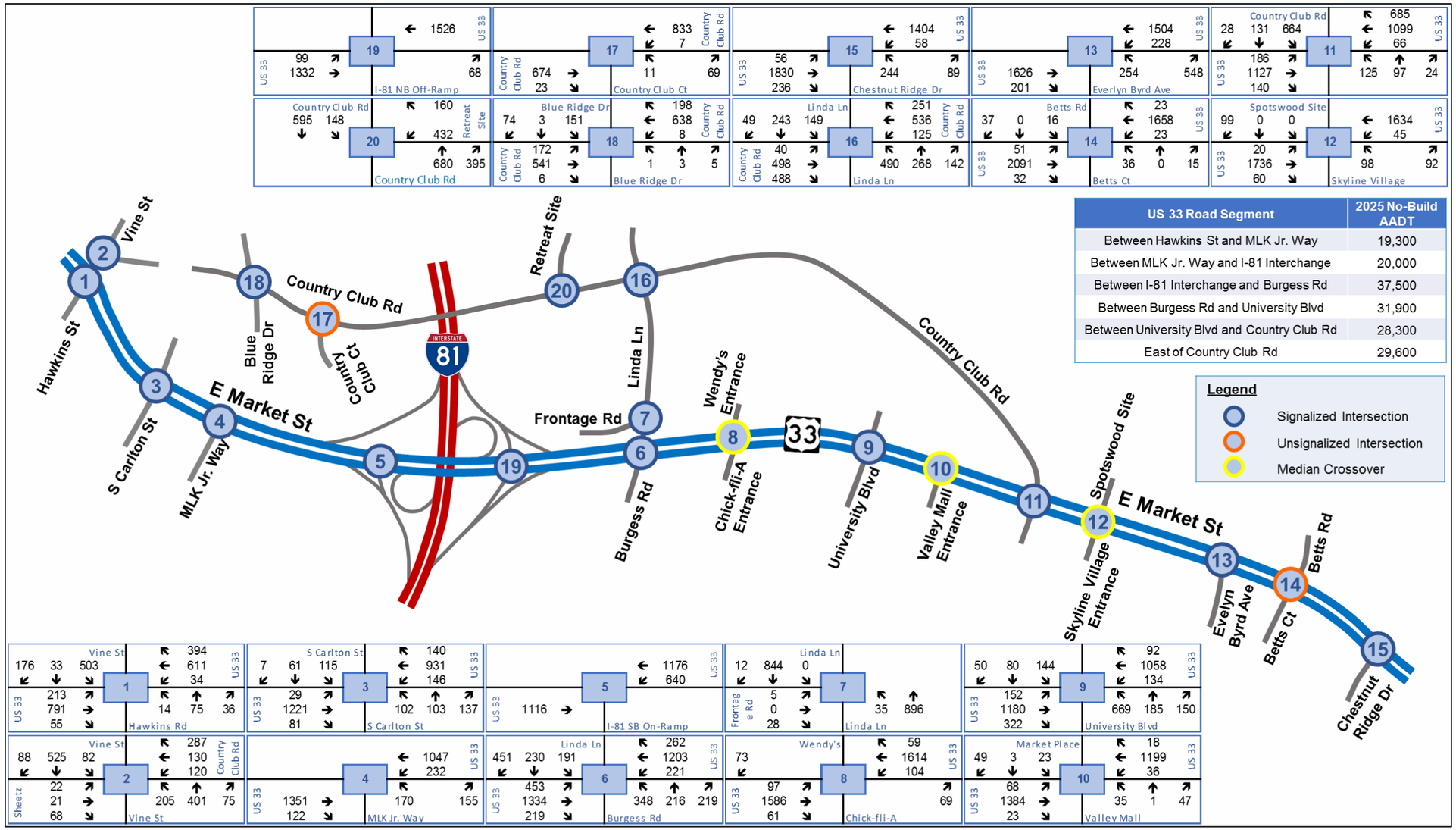
Linear traffic growth rates were applied to the 2017 existing traffic volumes to generate projected 2025 background growth traffic volumes. The site trips from new developments were obtained from the three TIA reports. The projected traffic volumes were re-balanced throughout the study network. **Figure 4.1** and **Table 4.2** present the projected 2025 AADT on different segments and PM peak hour TMCs at the study intersections in the study area.

Table 4.2: 2025 No-Build Projected AADT on US Route 33

Road Segment	2017 ADT	2025 Background ADT	Daily Site Trips	2025 No-Build ADT	Growth (%)
Between Hawkins Street and MLK Jr. Way	18,200	18,720	1,131	19,300	6%
Between MLK Jr. Way and I-81 Interchange	18,200	18,720	1,755	20,000	10%
Between I-81 Interchange and Burgess Road	30,300	31,200	7,230	37,500	24%
Between Burgess Road and University Boulevard	30,300	31,200	1,646	31,900	5%
Between University Boulevard and Country Club Road	26,300	27,040	2,027	28,300	8%
East of Country Club Road	26,300	27,040	3,308	29,600	13%

[3] Source: http://www.virginiadot.org/info/ct-trafficcounts.asp

[4] As informed by VDOT and the City, Phase III of the Retreat project will be built after 2025; therefore, it was not included in this study.



US 33 Road Segment	2025 No-Build AADT
Between Hawkins St and MLK Jr. Way	19,300
Between MLK Jr. Way and I-81 Interchange	20,000
Between I-81 Interchange and Burgess Rd	37,500
Between Burgess Rd and University Blvd	31,900
Between University Blvd and Country Club Rd	28,300
East of Country Club Rd	29,600

2025 No-Build AADT and PM Peak Hour Volumes
US 33 Corridor Improvement Study
City of Harrisonburg, VA

SCALE 0 750 FT. 1500 FT.

FIGURE 4.1

Figure 4.1: 2025 No-Build AADT and PM Peak Hour Volumes

4.2 2025 No-Build Traffic Operational Analysis Results

Figure 4.2 and **Table 4.3** summarize the overall intersection delay and LOS in the PM peak hour of 2025 No-Build scenario. **Appendix E** presents further detailed operational analysis results in delay and LOS by movement and approach.

Table 4.3: 2025 No-Build Intersection Delay and LOS

No	Intersection	Control Type	Intersection Delay (second per vehicle)	Intersection LOS
1	US Route 33 and Vine Street/Hawkins Street	Signalized	53.3	D
2	Vine Street and Country Club Road/Sheetz	Signalized	74.8	E
3	US Route 33 and S Carlton Street	Signalized	28.3	C
4	US Route 33 and MLK Jr. Way	Signalized	40.5	D
5	US Route 33 and I-81 NB On-Ramp	Signalized	16.1	B
6	US Route 33 and Burgess Road/Linda Lane	Signalized	63	E
7	Linda Lane and the frontage road	Signalized	71.2	E
8	Chick-fil-A/Wendy's Crossover	Median Crossover	1.1	A
9	US Route 33 and University Boulevard	Signalized	35.3	D
10	Valley Mall Crossover	Median Crossover	0.9	A
11	US Route 33 and Country Club Road	Signalized	64.5	E
12	Skyline Village Crossover	Median Crossover	14.9	B
13	US Route 33 and Evelyn Byrd Avenue	Signalized	19.5	B
14	US Route 33 and Betts Court/Betts Road	Stop Control	0.8	A
15	US Route 33 and Chestnut Ridge Drive	Signalized	35.6	D
16	Country Club Road and Linda Lane	Signalized	45.6	D
17	Country Club Road and Country Club Court	Stop Control	1.3	A
18	Country Club Road and Blue Ridge Drive	Signalized	22.6	C
19	US Route 33 and NB I-81 Off-Ramp	Signalized	1.8	A
20	County Club Road and Retreat Site Entrance	Signalized	25.1	C

Note: Intersections 19 and 20 are new intersections under 2025 No-Build scenario.

Under 2025 No-Build conditions, the operational conditions at the study intersections would slightly degrade due to the traffic growth. Other than the one identified in the existing conditions, there are three additional intersections that would operate at LOS E. These four intersections are:

- Vine Street and Country Club Road/Sheetz
- US Route 33 and Burgess Road/Linda Lane
- Linda Lane and the frontage road
- US Route 33 and Country Club Road

The two new intersections would have no obvious operational issues, operating at LOS A and LOS C, respectively.

Figure 4.2: 2025 No-Build Traffic Operational Conditions

5 Alternative Development and Screening

5.1 Locations for Potential Improvements

As described in **Chapter 1** (Introduction) the purpose of this project is to conduct a corridor improvement study while conducting operational analyses and safety analyses at spot locations to identify potential projects that can be programmed in the VDOT Six-Year Improvement Program (SYIP). MOEs have been summarized for the 2017 existing conditions and the 2025 No-Build conditions in previous chapters (**Chapters 3** and **4**). The MOEs included operational and safety characteristics. Additional measures have included estimated construction costs.

In the examination of existing 2017 and future 2025 No-Build conditions, comparisons are made between the two analysis years. From a traffic operational perspective, they can be summarized as shown in **Table 5.1.**

Table 5.1: Comparison of Existing (2017) and Future (2025) No-Build Traffic Operations Conditions

No	Intersection	Control Type	Existing 2017 Delay	Existing 2017 LOS	2025 No-Build Delay	2025 No-Build LOS
1	US Route 33 and Vine Street/Hawkins Street	Signalized	42.7	D	53.3	D
2	Vine Street and Country Club Road/Sheetz	Signalized	58	E	74.8	E
3	US Route 33 and S Carlton Street	Signalized	27.3	C	28.1	C
4	US Route 33 and MLK Jr. Way	Signalized	29.3	C	41.3	D
5	US Route 33 and I-81 NB On-Ramp	Signalized	8.5	A	15.4	B
6	US Route 33 and Burgess Road/Linda Lane	Signalized	30.1	C	68	E
7	Linda Lane and Frontage Road	Signalized	35.3	D	71.2	E
8	Chick-fil-A/Wendy's Crossover	Median Crossover	1.1	A	1.1	A
9	US Route 33 and University Boulevard	Signalized	50.4	D	42.7	D
10	Valley Mall Crossover	Median Crossover	0.9	A	0.9	A
11	US Route 33 and Country Club Road	Signalized	48.4	D	70	E
12	Skyline Village Crossover	Median Crossover	2.6	A	14.9	B
13	US Route 33 and Evelyn Byrd Avenue	Signalized	23.5	C	19.6	B
14	US Route 33 and Betts Court/Betts Road	Stop Control	0.8	A	0.8	A
15	US Route 33 and Chestnut Ridge Drive	Signalized	33.9	C	35.6	D
16	Country Club Road and Linda Lane	Signalized	25.2	C	45.6	D
17	Country Club Road and Country Club Court	Stop Control	0.9	A	1.3	A
18	Country Club Road and Blue Ridge Drive	Signalized	18.8	B	22.6	C
19	US Route 33 and NB I-81 Off-Ramp	Signalized	N/A	N/A	1.8	A
20	County Club Road and Retreat Site Entrance	Signalized	N/A	N/A	25.1	C

Three major categories of MOEs include: traffic operations, safety, and access management spacing. These categories were used in examining the 2017 existing conditions and were used in the evaluation of future 2025 No-Build conditions. The findings of these analyses have provided base conditions for addressing the needs of the corridor at the subject intersections from west of I-81, to east of I-81 and to the City/County border.

The results of the traffic operational comparisons indicate a relatively gradual decrease in traffic service levels by 2025. The existing conditions exhibited a mostly LOS C or better condition along the corridor. The worst condition (LOS E) occurs at Vine street and Country Club Road at one of the access points of the Sheetz Service Station. Slightly less degraded service levels (LOS D) have been identified at the intersection of US Route 33 and:

- Hawkins Street/Vine Street
- Linda Lane/Frontage Road
- University Boulevard
- Country Club Road

Many of the existing 2017 traffic operational issues are expected to remain in 2025. Several additional intersections in the study area will degrade to LOS E conditions:

- Burgess Road/Linda Lane at US Route 33
- Linda Lane at the frontage road near US Route 33
- Country Club Road at US Route 33

Another six intersections will operate at LOS D:

- Hawkins Street/Vine Street
- Martin Luther King Jr. Way
- University Boulevard
- Chestnut Ridge Drive
- Linda Lane and Country Club Road

Based on the traffic operations, safety, and access management analysis results on the US Route 33 corridor for both existing and 2025 No-Build conditions, the SWG identified the following seven locations for potential improvements.

- Vine Street
- South Carlton Street
- Martin Luther King Jr. Way
- Burgess Road/Linda Lane
- University Drive
- Valley Mall Crossover
- Country Club Road

5.2 Development of Alternatives

On February 26, 2018, the study team delivered a presentation to the SWG at the City of Harrisonburg on existing conditions (2017), future (2025) volumes development, and initial improvement alternatives recommendations. The study area was described from Hawkins/Vine Street to Chestnut Ridge along US Route 33 and from Vine Street to US Route 33 along Country Club Road. Existing traffic volumes and 6.5 years of crash statistics were presented. Intersections and crossings were evaluated and contrasted for traffic operations, safety, access management spacing, and field observations. The process to develop future 2025 volumes was described with growth assumptions and assumed, expected development background traffic.

The following sections summarize the findings and discussion from that meeting and represent the key issues utilized in addressing and developing alternatives at the respective intersections within the study corridor.

5.2.1 Hawkins Street/Vine Street at US Route 33

Issues: traffic operations (heavy left turns and long queues with LOS D/E for both existing and 2025 No-Build conditions) and access management (closely spaced intersections/access to/from Sheetz gas station); crash occurrences are satisfactory and lower than corridor average.

Option: remove traffic signal at Vine Street/Country Club and only allow right turns; extend two-lane left-turn(LT) section 365 feet on southbound Vine Street for queue storage and install flexpost delineators along median from US Route 33 to just past Country Club Road.

Pros: improves intersection operations from LOS E to LOS D, significantly reduces queuing conditions on southbound approach, provides fewer access points on Vine Street, enhances safety by reducing conflict points, and has limited right-of-way impact.

Cons: may create potential cut-through traffic diversion to N. Carlton Street.

5.2.2 S. Carlton Street at US Route 33

Issues: traffic operations (existing LOS C to 2025 No-Build LOS D); Safety - 3rd highest crash frequency in the corridor with 69 percent angle crashes; access management (multiple closely-spaced entrances); flashing yellow arrow was added to traffic control during Summer 2017.

Option 1: cut back medians allowing concurrent left turns from side streets; change geometry: left-turn only on southbound approach and left-turn only on northbound approach.

Option 2: restrictive crossing U-turn (RCUT), prohibiting thru and left turns at S. Carlton Street and redirecting traffic to U-turns at Martin Luther King Jr. Way and to the west (with loon).

Pros: enhances safety with reduced conflict points, improves traffic operations to LOS C, and has a limited right-of-way impact.

Cons: less than 600 feet from U-turn locations and adds more turning traffic to Martin Luther King Jr. Way intersection.

5.2.3 Martin Luther King Jr. Way at US Route 33

Issues: as a T-intersection in its current configuration: traffic operations (existing LOS C to 2025 No-Build LOS D); no safety or access management concerns.

Option 1: proposal by City includes extension of Martin Luther King Jr. Way to Country Club Road with a new transit center on the extension (shifting existing bus transfer on US Route 33) with park-and-ride spaces; transit routes to be redesigned to the new facility. Also, the new transfer center will include a stop by the new intercity bus, 'Virginia Breeze', with afternoon service. This improvement will require right-of-way acquisition.

Option 2: RCUT; improves intersection operations to LOS C and enhances safety by reducing conflict points, but also creates increase in U-turns at adjacent intersection.

5.2.4 Burgess Road/Linda Lane at US Route 33

Issues: traffic operations (existing LOS C/D to 2025 No-Build LOS E/E), the highest crash frequencies in the corridor occur at this intersection with over half being angle crashes, and access management (closely-spaced intersections) issues with multiple entrances.

Option: frontage road closure at Linda Lane (consider right-in/right-out (RIRO) at the private frontage road), improve access management on Burgess Road, revise median to allow concurrent left turns, and widen Linda Lane to 5 lanes to the north with a center turning lane.

Pros: removal of traffic signal at frontage road can improve signal efficiency and traffic operations from LOS E/E to LOS D; in combination with flexpost delineators, application along median of Burgess Road enhances safety and operations on side streets.

Cons: revised connection at private frontage road impacts right-of-way and entrance to/from hotels.

5.2.5 University Boulevard at US Route 33 and Valley Mall crossover at US Route 33

Issues (University Boulevard): traffic operations (LOS D for both existing and 2025 No-Build) but has 2nd highest crash frequency in corridor (43 percent angle and 39 percent rear end); heavy northbound left-turn movement (669 vehicles per hour) – 95th percentile queue over 500 feet.

Issues (Valley Mall crossover): no traffic operations issues (LOS A for existing and 2025 No-Build conditions), but 4th highest crash location (49 percent rear ends and 38 percent angle crashes); crash occurrences, especially rear ends, appear to be tied to nearby University Boulevard intersection.

Option 1: extend left-turn lane on University Boulevard up to 600 feet and change to directional crossover at Valley Mall crossing (consider reducing 600 feet to provide transition on southbound lane to two lanes and ability to stop at bus shelter without impeding traffic at top of hill). Pros: slightly reduces overall intersection delay, accommodates queues, and enhances safety by reducing conflict points. Cons: reduces southbound University Boulevard to a single lane.

Option 2: RCUT at University Boulevard and directional crossover at Valley Mall crossing. Improves intersection operations to LOS C and enhances safety by reducing conflict points. Creates heavy U-turn movement at crossover.

Option 3: median U-turn (MUT) at University and directional crossover at Valley Mall crossing. Restricts major movements and creates heavy U-turn movements along US Route 33.

5.2.6 Country Club Road at US Route 33

Issues: heavy left turns, LOS changes from an existing D to E in 2025, however, crashes are lower than corridor average.

Option 1: on southbound approach of Country Club, extend dual left turns to approximately 300 feet and include thru and right-turn shared lane, revise northbound approach to exclusive left-turn lane and thru + right-turn shared lane; Pros: improves to LOS D and reduces southbound queuing; Cons: potential right-of-way impacts along McDonalds property/drainage area.

Option 2: RCUT with U-turns at Skyline Village entrance and Valley Mall Entrance; Pros: improves intersection to LOS C and enhances safety by reducing conflict points; Cons: heavy U-turn movements at Valley Mall crossover.

5.2.7 Evelyn Byrd Avenue at US Route 33

Issues: traffic operations are adequate at LOS C for existing and 2025 conditions but has high number of angle crashes

Option 1: Continuous Green-T (CGT); Pros: allows free-flow westbound US Route 33 through traffic, retains LOS C and reduces conflict points; Cons: with continuous westbound through traffic, it may create a challenge for Skyline Village crossover traffic to find gap in US Route 33 traffic and it may impact drainage in the median.

Option 2: RCUT (with U-turns at Betts intersection); Pros: improves traffic to LOS C, maintains westbound non-stop through movements and reduces conflict points; Cons: close spacing with Betts, impact on right-of-way and drainage, and difficult for Skyline Village crossover traffic to find a gap in US Route 33 traffic.

5.2.8 Chestnut Ridge Drive at US Route 33

Issues: traffic expected to go from existing LOS C to LOS D in 2025 and crash history lower than corridor average.

Option: RCUT (with new U-turn over 600 feet to the east); Pros: improves traffic operations to LOS C, maintains westbound continuous through movements and reduces conflict points; the positioning of the U-turn in the median will allow the motorist to see the traffic signal sooner. Cons: difficult for downstream Betts Rd/Ct to find a gap in US Route 33 traffic due to westbound continuous through movement.

5.2.9 Build Alternatives

As a follow-up to the meeting, the City and VDOT met to discuss funding strategies and future submissions to SMART SCALE for the variety of potential improvements at the intersections and crossings within the study area. On March 30, 2018, a recommended list of concept alternatives (**Table 5.2**) was provided for further examination for each of the key study area intersections and crossings.

Table 5.2: Proposed Build Alternatives for Testing Purposes

Intersection	Build Alternative		
	Alternative 1	Alternative 2	Alternative 3
US Route 33 & Vine St	Remove traffic signal at Vine St & Country Club Rd/Sheetz Extend LT restriction on Vine St from US Route 33 to Chamber of Commerce entrance	Remove traffic signal at Vine St & Country Club Rd/Sheetz Sheetz entrance remains full access, no change to left-turn restriction	Remove traffic signal at Vine St & Country Club Rd/Sheetz Extend left-turn restriction on Vine St from US Route 33 to Chamber of Commerce entrance
Vine St & Country Club Rd	Right in-right out on Country Club Rd	Right in-Right Out on Country Club Rd	Right In-Right Out on Country Club Rd
US Route 33 & MLK Jr Way	MLK Extension from US Route 33 to Country Club Rd Park-and-Ride Transit Center	MLK Extension from US 33 to Country Club Rd 6Park-and-Ride Transit Center	MLK Extension from US Route 33 to Country Club Rd Park-and-Ride Transit Center
MLK Jr Way & Country Club Rd	Mini-roundabout	Modern roundabout	Traffic signal
US Route 33 & Linda Ln/Burgess Rd	Median on Burgess Rd Close frontage road on Linda Ln Create new full access entrance to Linda Ln through private parcels to Lowe's	Median on Burgess Rd Right in-right out on Linda Ln frontage road	Median on Burgess Rd
US Route 33 & University Blvd	Partial RCUT, restricting side-street thru movement (University Blvd-Kroger left-turn signal phase; thru/right diverted to right only)	Extend northbound left-turn lane on University Blvd to 500 ft	Extend northbound left-turn lane on University Blvd to 500 ft
US Route 33 & Valley Mall Crossover	Directional median	Directional median	Directional median
US Route 33 & Country Club Rd	Partial RCUT, restricting side-street thru movement (Country Club-Mall entrance left-turn signal phase; thru/right diverted to right-turn only)	Partial RCUT, restricting side-street thru movement (Country Club-Mall entrance left-turn signal phase; thru/right diverted to right-turn only)	No change
US Route 33 & Skyline Village Crossover	Directional median with eastbound left-turn lane	Directional median with eastbound left-turn lane	No change
US Route 33 & Evelyn Byrd Ave	Continuous green-T	Continuous green-T	Continuous green-T
US Route 33 & Betts Ct	Close westbound left-turn lane	Close westbound left-turn lane	Close westbound left-turn lane
US Route 33 & Chestnut Ridge Dr	Continuous green-T	Continuous green-T	Continuous green-T

5.3 2025 Build Traffic Forecasts

To develop the 2025 Build traffic volumes, three key steps were conducted to revise the 2025 No-Build traffic volumes:

5.3.1 Step 1: Estimate the 2025 traffic shifts due to the implementation of the Martin Luther King Jr. Way Extension from US Route 33 to Country Club Road just west of Country Club Court

With the extension connecting US Route 33 at the Martin Luther King Jr. Way intersection to Country Club Road, east/west travel could change as motorists decide to shift from the US Route 33 or the Country Club Road travel routes. Besides the slower travel speeds on Country Club Road (**Table 5.3**), the roadway is two lanes and would require significant upgrades at the I-81 underpass to increase its capacity. Unless major capacity or traffic operational improvements are made to Country Club Road, it is unlikely that a significant amount of traffic would divert from US Route 33.

Table 5.3: Existing Field Travel Speeds

Route	Distance (miles)	Average PM Eastbound Speed (mph)	Average PM Westbound Speed (mph)
US Route 33 between Vine Street and Chestnut Ridge Drive	2.1	22	19
Country Club Road between Vine Street and US Route 33	1.6	16	12

It was assumed that traffic would not divert from US Route 33 to Country Club Road and travel on Country Club Road to US Route 33. However, it is likely that traffic would shift to the new extension of Martin Luther King Jr. Way to avoid the interchange and the left turns at Linda Lane.

The study team made the following assumptions and traffic assignment adjustments.

- No traffic diversion between US Route 33 and Country Club Road between Martin Luther King Jr. Way and Country Club Road at US Route 33
- Some eastbound diversion between Martin Luther King Jr. Way and Linda Lane
- Some westbound diversion between Linda Lane and Martin Luther King Jr. Way

5.3.2 Step 2: Estimate the 2025 traffic diversions due to a RIRO intersection redesign at Vine Street/Country Club Road

Motorists will need to find alternative routes since the 12 current maneuvers will be reduced to 6 maneuvers and 580 vehicles need to be reassigned in the network. In coordination with the SWG, the study team made the following assumptions.

1. Turning east (left turn) from southbound Vine Street to Country Club Road - 82 vehicles. Assume 100 percent of the traffic diverts to eastbound US Route 33 with 50 percent destined to eastbound left turn at Linda Lane and 50 percent dispersed to various businesses along US Route 33 east of Country Club Road or exit system to the east.
2. Traveling east (thru) from the Sheetz station to Country Club Road - 21 vehicles. Assume 100 percent of the traffic diverts to eastbound US Route 33 with 50 percent destined to northbound Carlton Street to southbound Country Club Road, dispersed along Country Club Road; 30 percent destined to eastbound US Route 33 to left turn onto Linda Lane, dispersed along Linda Lane and Country Club Road; and 20 percent destined to various businesses along US Route 33 east of Country Club Rad or exit the system to the east.
3. Turning north (LT) from the Sheetz station to northbound Vine Street - 22 vehicles. Assume 100 percent of the traffic diverts to right turn from RIRO onto westbound US Route 33 right turn to northbound Old Furnace Road.
4. Traveling west (thru) from Country Club Road to the Sheetz station - 130 vehicles. Assume 85 percent of the traffic diverts to northbound Country Club Road for left turns onto southbound Carlton Street (70 percent of these take Spotswood Drive to US Route 33 westbound and 30 percent take Carlton to Carlton Street to US Route 33 westbound); assume 15 percent are removed from westbound US Route 33 to right turns onto Country Club Road, continuing westbound through the system on US Route 33.
5. Turning north (left turn) from Country Club Road to southbound Vine Street - 120 vehicles. Assume 50 percent of the traffic diverts to northbound Country Club Road left turns onto southbound Carlton Street (70 percent take Spotswood Drive to US Route 33 westbound and 30 percent take Carlton to US Route 33 westbound); assume 35 percent of the traffic diverts to northbound Country Club Road left turns onto Linda Lane, then right turn onto US Route 33 westbound (95 percent stay on US Route 33 westbound to Sheetz RIRO or beyond and 5 percent turn left onto Hawkins Street); 15 percent are removed from westbound US Route 33 right turns onto Country Club Road, continuing westbound through system on westbound US Route 33.
6. Turning west (left turn) from northbound Vine Street to the Sheetz Station - 205 vehicles. Assume 65 percent eastbound US Route 33 left turns at Vine Street convert to U-turns, then turn right to US Route 33 RIRO into Sheetz; 30 percent westbound US Route 33 right turns at Vine Street convert to thru movements, then right turn to US Route 33 westbound RIRO into Sheetz; and 5 percent northbound Hawkins Street thru at US Route 33 convert to left turn, then right turn to US Route 33 westbound RIRO into Sheetz.

Assume that motorists will not divert outside of the project study corridor and re-route within the corridor; assign all diverted traffic to one route, a 'most likely' route.

5.3.3 Step 3: Estimate site trip generation due to the replacement of the shipping facility at 241 Blue Ridge Drive with a transit transfer facility and park-and-ride lot alongside the Martin Luther King Jr. Way extension

The study team conducted the following trip generation and assignment steps:

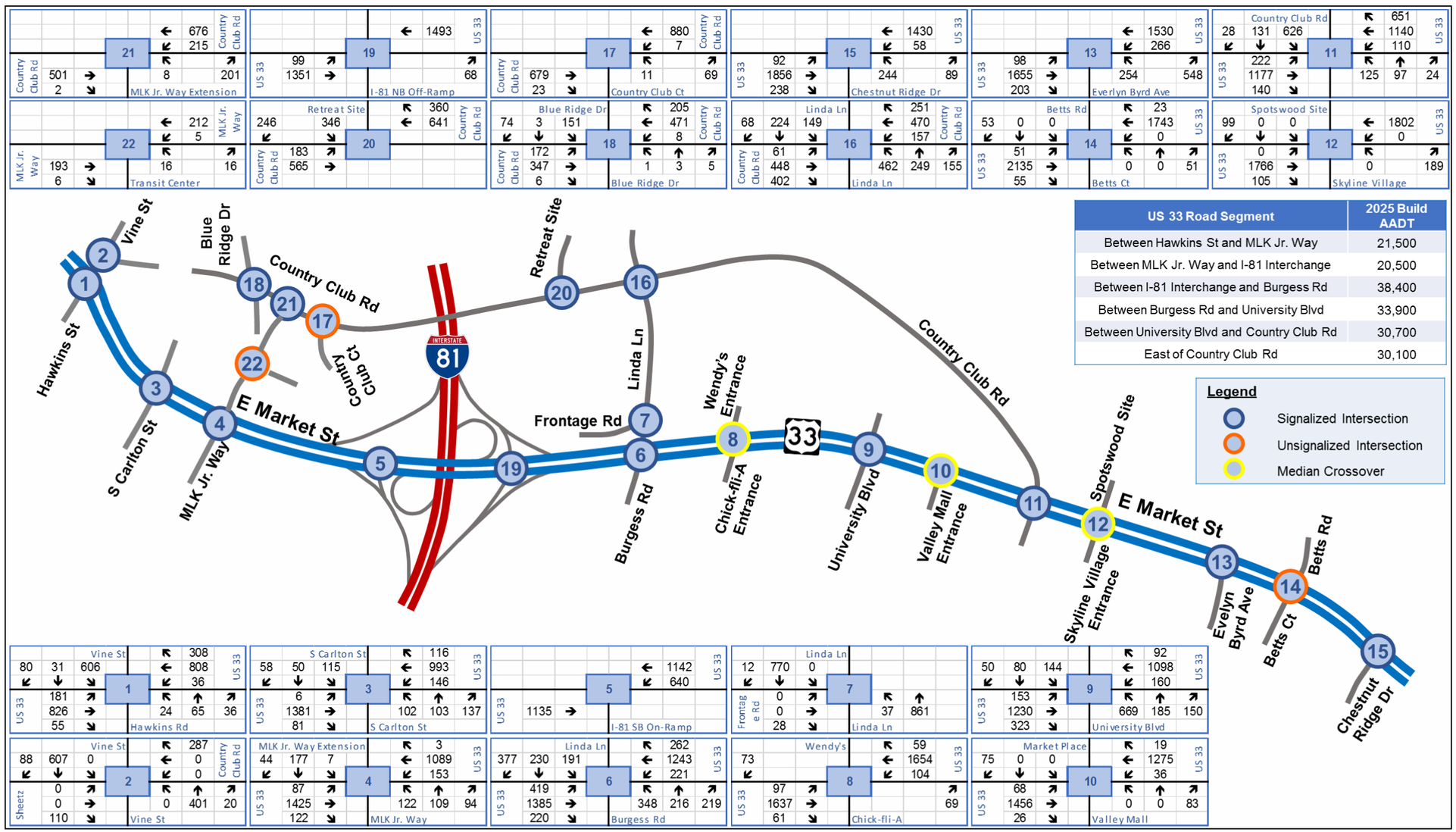
1. Remove truck trips from Blue Ridge Drive and Country Club Road.
2. Add bus trips to extension based upon the re-routing of Harrisonburg Department of Public Transportation (HDPT) bus routes using US Route 33: Route 1, Route 2 (also uses Country Club Road), Route 3, Route 4 and Route 5; consider PM peak hour trips to/from the new intercity bus service, “Virginia Breeze.”
3. Add new auto trips to/from new park-and-ride lot. Use lot characteristics and parking occupancy rates from CSPDC and VDOT (see **Table 5.4**) Assume short trips to and from the park-and-ride lot use HDPT buses. Assume long trips to and from the park-and-ride lot using I-81 northbound or southbound.

Table 5.4: Park-and-Ride Lots in Central Shenandoah Planning District Commission (CSPDC)

Lot Name	Capacity	Average Occupancy	Average Occupancy Rate	Jurisdiction	Handicapped spaces	Paved	Lights	Transit Service
Waynesboro	135	66	49%	Waynesboro	4	yes	yes	no
Mt. Crawford	50	30	60%	Rockingham	no	yes	yes	no
Bergton	44	5	11%	Rockingham	no	no	yes	no
Verona	35	25	71%	Augusta	2	yes	no	no
Massanutten	35	11	31%	Rockingham	3	yes	yes	no
Mauzy	32	20	63%	Rockingham	2	yes	yes	no
Elkton (west)	25	15	60%	NOT LISTED				
Elkton (east)	12	3	25%	Rockingham	2	no	no	no
Greenville	10	1	10%	Augusta	2	no	no	no
Average	42	20	47%					
Proposed	150 - 180			Harrisonburg				yes

These assumptions were used in establishing the 2025 Build Alternatives volumes as displayed on **Figure 5.1**.

An additional graphic has been developed to assist in the understanding of these steps in the development of the 2025 Build traffic volumes. See Technical **Appendix D**.



US 33 Road Segment	2025 Build AADT
Between Hawkins St and MLK Jr. Way	21,500
Between MLK Jr. Way and I-81 Interchange	20,500
Between I-81 Interchange and Burgess Rd	38,400
Between Burgess Rd and University Blvd	33,900
Between University Blvd and Country Club Rd	30,700
East of Country Club Rd	30,100

2025 Build Preferred Alternative AADT and PM Peak Hour Volumes
US 33 Corridor Improvement Study
City of Harrisonburg, VA
SCALE 0 750 FT. 1500 FT.

FIGURE 5.1

Figure 5.1: 2025 Build AADT and PM Peak Hour Volumes

5.4 Build Alternatives Traffic Operational Analysis

MOEs are summarized for the 2025 No-Build conditions in Chapter 4. In contrasting the 2025 No-Build and three alternative Build conditions in this chapter, evaluations are made between the No-Build and Build improvements for the 12 intersections along the corridor.

Traffic operational analyses were conducted for the three alternatives and 2025 Build conditions. The Delay and LOS are depicted on **Table 5.5**. **Appendix F** includes further detailed operational analysis results in delay and LOS by movement and approach.

Table 5.5: 2025 Build Alternative Traffic Operational Analysis Results (Key Intersections Only)

Intersection		Signal Control	Existing		No-Build		Alternative 1		Alternative 2		Alternative 3		Notes
			Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	
1	East Market Street and Vine Street / Hawkins Street	Signalized	42.7	D	52	D	42.8	D	41.7	D	44.2	D	
2	Vine Street and Country Club Road / Sheetz	Signalized	58	E	74.8	E	4.3	A	16	C	4.3	A	The signal is removed from all alternatives
4	East Market Street and Martin Luther King, Jr. Way	Signalized	29.3	C	48.5	D	35	C	36.8	D	35.1	D	
6	East Market Street and Burgess Road / Linda Lane	Signalized	30.1	C	60.3	E	53.7	D	48.7	D	60.4	E	
7	Linda Lane and Hotel / Strip Mall Frontage Road	Signalized	35.3	D	71.2	E	-	-	0.2	A	64.3	E	The signal is removed from Alternative 2
9	East Market Street and University Blvd	Signalized	50.4	D	52	D	33.1	C	48.6	D	48.9	D	
10	Valley Mall Crossover	Unsignalized	0.9	A	0.9	A	0.9	A	0.9	A	0.8	A	
11	East Market Street and Country Club Road	Signalized	48.8	D	67.3	E	38.3	D	37.4	D	59.5	E	
12	Skyline Village Crossover	Unsignalized	2.1	A	14.9	B	0.9	A	0.9	A	0.6	A	
13	East Market Street and Evelyn Byrd Avenue	Signalized	23.5	C	25.9	C	20.6	C	18.9	B	19.3	B	
14	East Market Street and Betts Court/Betts Road	Unsignalized	0.8	A	0.9	A	0.6	A	0.7	A	127.4	F	
15	East Market Street and Chestnut Ridge Drive	Signalized	33.9	C	42.7	D	32.1	C	31.6	C	44.9	D	
21	MLK Extension and Country Club Road	Roundabout	-	-	-	-	20.2	C	20.2	C	17.2	B	It is a signalized intersection in Alternative 3

5.5 Alternative Evaluation Matrix and Selection of the Preferred Alternative

On April 17, 2018, the results of the evaluation were presented to the SWG at the City of Harrisonburg. At the meeting, the study team delivered a review of the study area, 2017 existing traffic operations, 2025 No-Build traffic operations, key locations for potential improvements, and Build alternatives. An improvement evaluation matrix was prepared and presented to the SWG for consideration. This chart, shown in **Table 5.6**, addressed traffic operations, safety, right-of-way, and estimated costs for each of the improvement alternatives.

This chart provides contrasting measures for consideration. The comparisons provide a general perspective for considering the 12 improvement locations and project alternatives. Favorability for traffic operations contrast against the No-Build scenario for improved LOS, safety favorability (indicates reductions in conflict points), right-of-way favorability (indicates limited-to-no need for additional land or easements) and cost estimates (broadly summarized using TMPD cost estimating processes).

Table 5.6: Alternative Evaluation Matrix

#	Intersection	Alternative 1				Alternative 2				Alternative 3			
		Traffic Operation	Safety	R/W	Cost	Traffic Operation	Safety	R/W	Cost	Traffic Operation	Safety	R/W	Cost
1	Hawkins Street/Vine Street	O	↑	O	$2.1M	O	↑	O	$2.2M	O	↑	O	$2.1M
2	Vine Street and Country Club Road / Sheetz	↑	↑	O		↑	↓	O		↑	↑	O	
4	MLK, Jr. Way Extension and Transit Center	O	O	↓	$18.9 M	O	O	↓	$18.9 M	O	O	↓	$18.9 M
21	MLK, Jr. Way Extension and Country Club Road intersection		↑	↓	$3.4M		↑	↓	$3.9M		O	↓	$800K
6	Burgess Road / Linda Lane	↑	↑	O	$2.7M	↑	↑	O	$1.8M	O	↑	O	$1.2M
7	Linda Lane and Hotel / Strip Mall Frontage Road		↑	↓		↑	↑	O		O	↓	O	
9	University Blvd	O	↑	O	$1.8M	O	↓	O	$115K	O	↓	O	$115K
10	Valley Mall Crossover	O	↑	O	$700K	↑	↑	O	$700K	↑	↑	O	$700K
11	Country Club Road	↑	↑	O	$1.8M	↑	↑	O	$1.8M	O	O	O	-
12	Skyline Village Crossover	↑	↑	O	$700K	↑	↑	O	$700K	↓	O	O	-
13	Evelyn Byrd Avenue	↑	↑	O	$2.3M	↑	↑	O	$2.3M	↑	↑	O	$2.3M
14	Betts Court/Betts Road	↓	↑	O	$115K	↓	↑	O	$115K	↓	↑	O	$115K
15	Chestnut Ridge Drive	O	↑	O	$2.3M	O	↑	O	$2.3M	O	↑	O	$2.3M

Note: All cost estimates at this stage were preliminary.

Legend	
Favorable	↑
Neutral	O
Unfavorable	↓

The SWG discussions covered the following topics and made the selection of the final preferred alternative at each location.

- #1/#2: Hawkins/Vine at US Route 33 and Vine Street at Country Club Rd
  - Discussion: SWG preferred Alternative 1 (or 3 which is the same)
- #4/#21: MLK Jr. Way at US Route 33, Extension and intersection at Country Club Rd
  - Discussion: SWG considered either roundabout or signalized intersection but were not able to develop a consensus at the meeting
- #6/#7: Burgess Rd/Linda Ln at Route 33 and frontage road at Linda Ln
  - Discussion: SWG agreed with Burgess Road concept to allow left-turn access to/from Market Square East shopping center near service stations; consider removing traffic signal at Linda Lane and frontage road and provide 'pocket' left turn on northbound Linda Lane to frontage road.
- #9: University Blvd
  - Discussion: SWG agreed with alternatives providing extension of northbound left-turn lanes on University Boulevard to approximately 500 feet (allowing southbound vehicles at top of hill to maneuver around stopped buses at bus shelter); the partial RCUT, Alternative 3, was considered as a 'long-term' solution.
- #10: Valley Mall Crossover
  - Discussion: SWG agreed with directional median concept.
- #11: Country Club Rd
  - Discussion: SWG agreed with no change to intersection
- #12: Skyline Village Crossover
  - Discussion: SWG agreed with directional median concept and with eastbound left-turn lane
- #13: Evelyn Byrd Ave
  - Discussion: SWG agreed with continuous green-T concept
- #14: Betts Ct/Betts Rd
  - Discussion: SWG agreed with closing westbound left-turn lane
- #15: Chestnut Ridge Dr.
  - Discussion: SWG agreed with continuous green-T concept

5.6 Preferred Alternative Improvements

Following the selection of the preferred alternatives, Stage 2 conceptual designs of the improvements, Stage 2 planning level cost estimates for preliminary engineering, right-of-way and constructions costs, and proposed project construction schedules were developed. However, the 12 intersection/crossover improvements were combined into eight separate interrelated projects listed as:

- Project 1: Vine Street improvements
- Project 2: Martin Luther King Jr. Way Extension and new traffic signal
- Project 3: Burgess Road/Linda Lane improvements
- Project 4: University Boulevard improvements
- Project 5: Valley Mall Crossover improvements
- Project 6: Skyline Village Crossover improvements
- Project 7: Evelyn Byrd Avenue improvements
- Project 8: Betts Court/Betts Road and Chestnut Ridge Drive improvements

No improvement recommendations were included at the Country Club Road intersection at US Route 33.

Table 5.7 identifies these Preferred Alternatives within the eight groupings of interrelated projects. Once the Preferred Alternatives were selected, additional analyses were conducted to summarize the impacts of the improvements in contrast with the existing, 2025 No-Build condition and Preferred Alternative. In addition to the contrast of the three scenarios, corridor-based effects were also identified.

Table 5.7: Preferred Alternative for Improvements along US Route 33

Project #	Int #	Intersection	Actions in the Preferred Alternative
1	1	US Route 33 & Vine St	Remove traffic signal at Vine St & Country Club Rd/Sheetz Extend left-turn restriction on Vine St from US Route 33 to Chamber of Commerce entrance
	2	Vine St & Country Club Rd	Right in-right out on Country Club Rd
2	3	US Route 33 & MLK Jr Way	MLK Extension from US 33 to Country Club Rd with Park and Ride and Transit Center
	4	MLK Jr Way & Country Club Rd	Install traffic signal
3	5	US Route 33 & Linda Ln/Burgess Rd	Median on Burgess Rd; right in-right out on Linda Ln frontage road; remove frontage road signal and mark NB inside lane on Linda Ln as a dedicated left onto frontage road
4	6	US Route 33 & University Blvd	Extend northbound left-turn lane on University Blvd to 500 ft
5	7	US Route 33 & Valley Mall Crossover	Directional median
6	9	US Route 33 & Skyline Village Crossover	Directional median with eastbound left-turn lane
7	10	US Route 33 & Evelyn Byrd Ave	Continuous green-T
8	11	US Route 33 & Betts Ct/Rd	Close westbound left-turn lane
	12	US Route 33 & Chestnut Ridge Dr	Continuous green-T

Table 5.8 summarizes the expectations and impact of the improvements from 2017 existing conditions to 2025 No-Build and Build Preferred Alternative conditions. With the improvements in the Preferred Alternative in 2025, traffic operations within the study area are expected to improve. Intersection LOS will be equal to or better than either the 2017 existing conditions or the 2025 No-Build conditions. Under the Preferred Alternative conditions, both existing cycle and re-optimized cycle lengths were tested. The Linda Lane and Vine Street intersections are currently controlling the existing cycle length of the US Route 33 corridor within the study area, at 180 seconds. With the signal removal at both locations in the Preferred Alternative, the corridor cycle length can be potentially reduced to 140 seconds, with the signals at the I-81 ramps being half-cycled. The optimized cycle length slightly reduces delays at most intersections and further improves the overall corridor operations.

Table 5.8: Traffic Operational Conditions Comparison of Existing, 2025 No-Build (2025) and 2025 Preferred Alternative

Int #	Intersection	Existing			2025 No-Build			2025 Preferred Alternative (Existing Cycle Length 180 sec)			2025 Preferred Alternative (Optimized Cycle Length 140 sec)			Notes
		Signal Control	Delay (sec/veh)	LOS	Signal Control	Delay (sec/veh)	LOS	Signal Control	Delay (sec/veh)	LOS	Signal Control	Delay (sec/veh)	LOS	
1	East Market Street and Vine Street / Hawkins Street	S	42.7	D	S	53.3	D	S	44.8	D	S	40.9	D	
2	Vine Street and Country Club Road / Sheetz	S	58	E	S	74.8	E	U	4.3	A	U	4.3	A	The signal is removed in the Preferred Alternative.
3	East Market Street and Carlton Street	S	27.3	C	S	28.1	C	S	39.5	D	S	38.4	D	
4	East Market Street and Martin Luther King, Jr. Way	S	29.3	C	S	41.3	D	S	41.9	D	S	33.6	C	
5	East Market Street and I-81 SB Ramps	S	8.5	A	S	15.4	B	S	15.5	B	S	12.2	B	
6	East Market Street and Burgess Road / Linda Lane	S	30.1	C	S	68	E	S	51.2	D	S	42.9	D	
7	Linda Lane and Hotel / Strip Mall Frontage Road	S	35.3	D	S	71.2	E	S	35.8	D	S	30	C	Only SB signal is remained in the Preferred Alternative.
8	East Market Street and Wendy's/Chick-Fil-A Crossover	U	1.1	A	U	1.1	A	S	1.1	A	S	1.1	A	
9	East Market Street and University Blvd	S	50.4	D	S	42.7	D	S	45.5	D	S	31	C	
10	Valley Mall Crossover	U	0.9	A	U	0.9	A	U	0.8	A	U	0.8	A	
11	East Market Street and Country Club Road	S	48.4	D	S	70	E	S	65.2	E	S	52.5	D	
12	Skyline Village Crossover	U	2.6	A	U	14.9	B	U	0.9	A	U	0.9	A	
13	East Market Street and Evelyn Byrd Avenue	S	23.5	C	S	19.6	B	S	18.9	B	S	19.3	B	
14	East Market Street and Betts Court/Betts Road	U	0.8	A	U	0.8	A	U	0.6	A	U	0.6	A	
15	East Market Street and Chestnut Ridge Drive	S	33.9	C	S	35.6	D	S	26.9	C	S	16.9	B	
16	Country Club Road and Linda Lane	S	25.2	C	S	45.6	D	S	40	D	S	35.3	D	
17	Country Club Road and Country Club Court	U	0.9	A	U	1.3	A	U	1.3	A	U	1.3	A	
18	Country Club Road and Blue Ridge Drive	S	18.8	B	S	22.6	C	S	20.8	C	S	20.8	C	
19	East Market Street and I-81 NB Ramps	-	-	-	S	1.8	A	S	1.8	A	S	1.8	A	
20	MLK Extension and Retreat Driveway	-	-	-	S	25.1	C	S	24.2	C	S	12.6	B	
21	MLK Extension and Country Club Road	-	-	-	-	-	-	S	17.2	B	S	17.2	B	
22	MLK Extension and Transit Center	-	-	-		-	-	U	0.8	A	U	0.8	A	

In addition to these metrics, eastbound and westbound travel times along the US Route 33 are depicted in **Figure 5.2** and **Figure 5.3**. The eastbound travel time is expected to drop by 2025 with the inclusion of the proposed improvements, especially with the optimized cycle length. Travel times show very little difference in westbound direction between 2025 No-Build and 2025 Preferred Alternative even with the additional approach at Martin Luther King Jr. Way intersection due to the proposed extension.

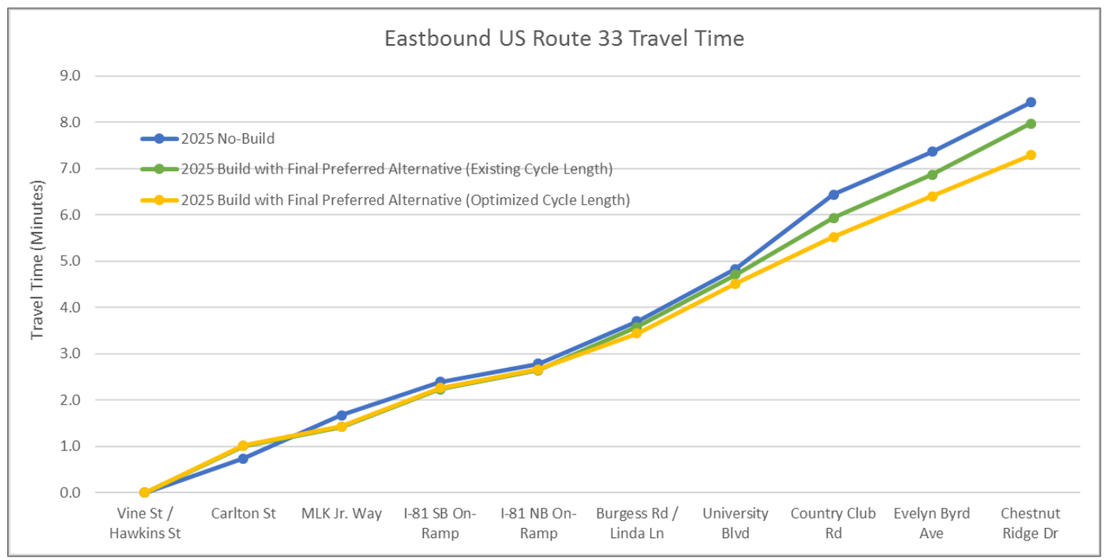


Figure 5.2: Eastbound US Route 33 Travel Time Comparison Between 2025 Scenarios

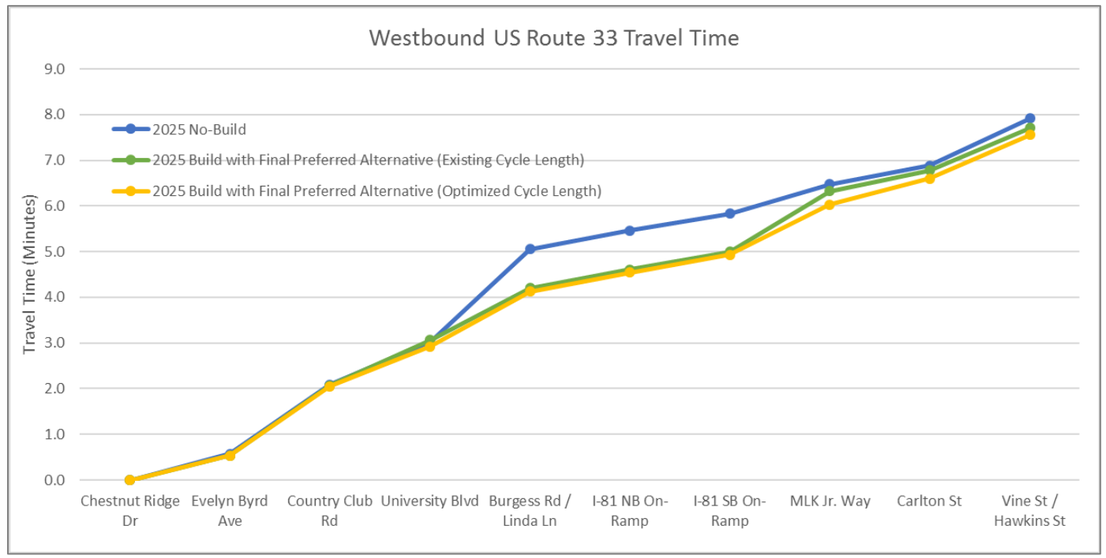


Figure 5.3: Westbound US Route 33 Travel Time Comparison Between 2025 Scenarios

6 Conclusions and Recommendations

6.1 Draft Project Summary Sheets

Draft Project Summary Sheets were developed to include conceptual designs, planning level cost estimates and planning level schedules. The draft Project Summary Sheets are included in Technical **Appendix G**. The following sections describe the steps in the development of each of the three project descriptors: conceptual designs, cost estimates and project schedules.

6.1.1 Conceptual Designs

Conceptual designs were developed for the improvement projects and are shown on the draft Project Summary Sheets. The designs were refined from the initial Stage 1 concepts to the Stage 2 drawings.

The primary design resources for the conceptual plans were based upon:

- AASHTO Green Book - A Policy on Geometric Design of Highways and Streets, 6th Edition (2011)
- VDOT Road Design Manual (2005, revised)
- Manual of Uniform Traffic Control Devices, MUTCD (2009 Edition with Revision Numbers 1 and 2, dated May 2012)
- Virginia Supplement to the MUTCD (revised)
- Design & Construction Standards Manual, Chapter 6, Appendix F (Harrisonburg)

Design criteria and guidance from these sources were used in developing the concept designs.

6.1.2 Draft Planning Level Cost Estimates

Planning level cost estimates have been developed using PCES for the eight selected improvements with cost estimates for preliminary engineering, right-of-way, and constructions. Quantities were developed from the concept designs. **Table 6.1** summarizes the cost estimates and major project development categories.

6.1.3 Draft Planning Level Schedule Estimates

Table 6.1 also summarizes the planning level schedule estimates, which incorporates SWG feedback.

6.2 Summary of Findings and Future Considerations

There are several areas of concern that were revealed during the examination of the existing (2017) and future No-Build (2025) conditions. Most notably, based upon the traffic operations, safety, and access management evaluation process, the key issues highlighted include:

- Traffic operations
  - Along Vine Street between US Route 33 and Country Club Road with two closely-spaced traffic signals and the long queues.
  - At Linda Lane with two closely-spaced traffic signals with the intersection at the private frontage road.
  - At University Boulevard experiencing the heaviest PM left-turn movements in the corridor.
- While no fatalities occurred in the 6.5-year study period, high occurrences in crashes, especially angle crashes, were exhibited at S. Carlton Street, Burgess Road and Linda Lane with rear-end crashes along US Route 33.
- Access in the corridor with commercial land use is characterized by numerous driveways and entrances/exits to/from US Route 33 and side streets such as Burgess Road.

With a steady growth in traffic in the corridor and numerous developments occurring and imminent in the near future, trends towards 2025 traffic levels will require monitoring and improvement to maintain a viable, economic climate for the City.

Table 6.1: Cost Estimates and Schedules

Project		Preliminary Engineering	R/W & Utility Relocation	Construction	Total Cost and Schedule
# 1	Vine Street	$95,000	N/A	$475,500	$570,500
	Schedule (months)	6	12	8	26
# 2	MLK Jr Way Ext + Traffic Signal	$1,546,000	$1,600,000	$12,889,000	$16,035,000
	Schedule (months)	by others	by others	by others	0
# 3	Burgess Rd/Linda Ln	$103,000	N/A	$517,500	$620,500
	Schedule (months)	6	12	10	28
# 4	University Blvd	$8,000	N/A	$220,000	$228,000
	Schedule (months)	4	4	4	12
# 5	Valley Mall Crossover	$22,000	N/A	$111,000	$133,000
	Schedule (months)	6	12	8	26
# 6	Skyline Village Crossover	$39,000	N/A	$188,000	$227,000
	Schedule (months)	6	12	8	26
# 7	Evelyn Byrd Ave	$160,000	N/A	$801,000	$961,000
	Schedule (months)	8	4	12	24
# 8	Betts Ct/Betts Rd and Chestnut Ridge Dr	$188,000	N/A	$943,500	$1,131,500
	Schedule (months)	8	12	16	36
Total Cost		$2,161,000	$1,600,000	$16,145,500	$19,906,500

The improvement projects recommended in this study will improve and maintain satisfactory traffic operations, safety, and access management. However, continued decision-making will require an acknowledgement of the ever-changing corridor travel patterns and priorities for funding and implementation of these and other improvements in the next few years. Several areas of concern have been highlighted for improvement and will help the corridor, especially along Vine Street, Linda Lane, and University Boulevard. Consideration of improvements addressing safety at the S. Carlton Street intersection and traffic flows at the key interconnection of Country Club Road and US Route 33 should be re-evaluated on a frequent basis.

Innovative intersection improvements are recommended along the eastern end of the corridor. It is expected that significant safety and operational efficiencies will result in traffic flows and reduced travel times. Consideration was given to other innovative measures in the corridor and should be emphasized at the intersection with University Boulevard, continuing the improvements in traffic flows towards I-81 and west of the interstate.

6.3 Project Advancement

This Study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified operational, safety and access management improvements in the study corridor. To advance these projects beyond the planning stage, the following steps can be used.

6.3.1 Gain Additional Support

Conduct outreach meeting(s) to stakeholders who were not part of the SWG to gain consensus for the proposed projects. Other stakeholders might include businesses owners on the corridor, as well as Rockingham County residents.

6.3.2 Prioritize Improvements

Improvement projects should be prioritized at a regional and local level. In addition to costs and right-of-way impacts, factors to consider in the prioritization process include operation improvements, safety improvements and access management improvements, as shown in **Table 6.2**.

Table 6.2: Factors for Prioritizing Improvements

Project #	Improvement Projects	Operational Improvements	Safety Improvements	Access Management Improvements
1	Vine Street	√	√	√
3	Burgess Road/Linda Lane	√	√	√
4	University Boulevard	√	√	
5	Valley Mall Crossover		√	√
6	Skyline Valley Crossover		√	√
7	Evelyn Byrd Avenue	√	√	
8	Betts Court/Betts Road and Chestnut Ridge Drive	√	√	

The City recommended the improvements along Vine Street for Project #1 should not be implemented until after the implementation of Project #2, extending Martin Luther King Jr. Way and connecting it with Country Club Road.

6.3.3 Prepare Projects for Advancement

Once projects have been prioritized at the regional and local level, high priority projects should be advanced to the following documents in preparation for funding application submissions:

- Constrained Long Range Transportation Plan (CLRP)
- Transportation Improvement Plan (TIP)
- Statewide Transportation Improvement Plan (STIP)
- City of Harrisonburg Comprehensive Plan

6.3.4 Apply for Prioritized Funding Programs

6.3.4.1 SMART SCALE

SMART SCALE is a data driven prioritization process to fund 'the right transportation projects that generate the greatest benefit for taxpayers'. The acronym stands for System for the Management and Allocation of Resources for Transportation. The key factors used in evaluating a project's merits include:

- Safety
- Congestion Mitigation
- Accessibility
- Environmental Quality
- Economic Development
- Land Use Coordination (for areas over 200,000 populations)

Project types that are eligible for SMART SCALE funding include:

- Highway Improvements (Widening, Operational Improvements, Access Management, Intelligent Transportation Systems, Technology Operational Improvements);
- Transit and Rail Capacity Expansion;
- Bicycle and Pedestrian Improvements; and
- Transportation Demand Management (Park & Ride facilities, vanpool, carpool, and trip reduction programs).

6.3.4.2 Revenue Sharing

Revenue sharing is a program that provides a dollar for dollar state match to local funds for transportation projects. Projects eligible for Revenue Sharing funds include construction, reconstruction, improvement, and maintenance projects.

6.3.4.3 Highway Safety Improvement Program (HSIP)

HSIP provides funding for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes. HSIP provides funding for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes.

HSIP is a core federal-aid program, with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads, including non-state-owned public roads and roads on tribal land. Federal aid contributes 90 to 100 percent of certain safety improvements. Emphasis is placed on strategies and actions with expected performance outcomes as documented in Virginia's 2017-21 Strategic Highway Safety Plan (SHSP).

6.3.5 Advance Selected Projects to VDOT SYIP

Once project applications are approved for funding through one or more of the aforementioned funding sources, the project should be incorporated in the VDOT SYIP, so it can enter the project development process.

Appendix A: Field Visit Notes (January 18, 2018)

US Route 33 (East Market St) Field Visit Summary

Harrisonburg, VA, January 18, 2018, Thursday

This field visit occurred between the noon time (11:45 a.m. – 1:30 p.m.) and the PM peak hour (16:45 – 17:45 p.m.) on Thursday, January 18, 2018. The weather was clear and there were no special events or incidents that occurred during the field visit. The observations included the traffic conditions and operations along the study corridor of East Market Street from Hawkins Street/Vine Street to Chestnut Ridge Drive, and along Country Club Road from Vine Street to E Market Street.

Corridors

US Route 33 (East Market Street)

The posted speed limit on this corridor is 35 mph through the 2.1-mile segment within the study area. However, under the free flow conditions, the average driving speeds along the corridor are above 40 mph. There are nine signalized intersections, three unsignalized median crossovers, one two-way-stop-controlled intersection and over 50 roadside commercial entrances. The I-81 interchange (Exit 247) is also within the study corridor. All nine signalized intersections are coordinated. During the PM peak hour, it took about 5.75 minutes traveling eastbound along the corridor and 6.6 minutes traveling westbound. During the peak hour, the traveling speeds can be maintained over 30 mph between the intersections. Although there are multiple access points along the corridor, the entrance traffic from the access points did not significantly influence through traffic.

Country Club Road

This corridor is a 1.6-mile undivided two-lane road with a posted speed limit of 35 mph. It includes four signalized intersections, five unsignalized intersections, and multiple access points. During the PM peak hour, it took 5.8 minutes traveling eastbound along the corridor and 7.75 minutes traveling westbound. There was no noticeable queue at the eastbound direction except the left-turn queue at the intersection of East Market Street. In the westbound direction, the queue was observed from Blue Ridge Drive back to the entrance of American National University (over 2,000 feet). The primary reasons causing the queue are: 1) waiting at Blue Ridge Drive for green light, and 2) westbound left-turn vehicles at Country Club Court yielding opposite through traffic and blocking the road.

Intersections

US Route 33 at Hawkins Street and Vine Street and Vine at Country Club Road

- The spacing between the signalized intersections is about 160 feet.
- Right turn on Red is restricted at northbound approach from Hawkins Street.
- On the southbound approach of Vine Street at the E Market Street intersection, the lane configuration is one left-turn exclusive lane and one right-turn-through-left-turn shared lane. At the Country Club Road intersection, one exclusive through lane and one 250-foot long shared storage lane for through and left-turn traffic are provided on the Vine Street approach. The rest of Vine Street is a one lane each direction. The observed queue length at this approach was over 1,000 feet during the PM peak hour. The queues usually could be discharged within two signal cycles.

- There were no significant queues and delays observed on other approaches (both directions on E Market Street, westbound from Country Club Road, and northbound from Hawkins Street). Other than the left turn queue from Vine onto eastbound Route 33, all vehicles could be discharged in one signal cycle.

US Route 33 and Burgess Road/Linda Lane and Linda Lane at the Frontage Road

- There are only 130 feet between the signalized intersections.
- Homeless people use this intersection and the US Route 33 median to solicit donations.
- There was no noticeable weaving issue with I-81 northbound off-ramp on the westbound approach to the intersection. Most traffic coming down from I-81 stayed on the right most lane and continued as a through movement or made a right turn onto Burgess Road southbound. No vehicle was observed changing lanes to make a left turn at the intersection.
- The double left-turn lanes on East Market Street eastbound were not used with the most efficiency. Motorists slow down in the leftmost lane due to the immediate merge of the receiving lanes on Linda Lane.
- No significant queue was observed on any of the approaches, and no spill back was observed on turning storage lanes. All waiting vehicles could be released within one signal cycle length.
- The traffic at frontage road approach was light during the entire day and very few turning vehicles were observed from and to Linda Lane.

US Route 33 and University Boulevard

- Pedestrians were noticed crossing E Market Street from south on University Boulevard (5 pedestrians within one cycle length).
- During the PM peak hour, the left-turn movement on University Blvd approach was heavy and the queue occasionally extended beyond the upstream signalized intersection with Valley Mall/BOA access road. However, most of queued vehicles were discharged in one single cycle.
- No significant queue was observed on the other approaches, and no spill back was observed on turning storage lanes. All waiting vehicles could be released within one signal cycle length.

US Route 33 and Country Club Road

- There was heavy westbound right-turn traffic from E Market Street onto Country Club Road but no spill back out of the storage lane was observed. The vehicles were constantly released as the Right Turn on Red is allowed. On the other hand, the westbound through traffic had been observed blocking right-turn vehicles entering the storage lane.
- The waiting vehicles from Country Club Road could be queuing for over 500 feet with storage of 275 feet for the left-turn lane. It was observed that fewer vehicles were using the left-only storage lane than the left/through/right shared lane, although most vehicles on the shared lane were making left turns as well.
- No significant queuing or spillback was observed on other approaches and movements.

US Route 33 and Evelyn Byrd Avenue

- The eastbound queuing vehicles due to the stopped phase may not be released within one cycle length after 5:00 PM. However, the queue did not extend to the Skyline Village crossover and impact the upstream intersection.

Other intersections

- No significant issue was observed at other intersections on E Market Street and Country Club Road during the field visit.

Uncontrolled Median Crossovers

- It was observed that during the peak hour no more than five vehicles wait for making left turns at all three crossovers on East Market Street: Chick-fil-A/Wendy's, Valley Mall, and Skyline Village Shopping Center. Thus, there was no spill back out of the left storage lane.

Other observations

At the westbound direction of E Market Street, the merge vehicle coming down from I-81 may slow down the through traffic, especially the merge point of I-81 southbound off-ramp where there is no merge area.

Linda Lane, connecting Country Club Road and E Market Street, is a two-lane road with a two-way-left-turn Lane serving two access points into/out of the Lowe's property and becoming the left turn lane at the Country Club Road signal. No significant traffic was observed and the 25-mph desired speed can be maintained.

Appendix B: Intersection Delay and LOS (Existing Conditions – 2017)

HCM Signalized Intersection Capacity Analysis
1: Hawkins Street/Vine St & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	164	729	53	32	535	348	13	72	35	459	32	123
Future Volume (vph)	164	729	53	32	535	348	13	72	35	459	32	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00		1.00		0.95	0.95	
Frt	1.00	0.99		1.00	1.00	0.85		0.96		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99		0.95	0.98	
Satd. Flow (prot)	1770	3469		1805	3574	1599		1780		1665	1606	
Flt Permitted	0.19	1.00		0.11	1.00	1.00		0.99		0.95	0.98	
Satd. Flow (perm)	353	3469		213	3574	1599		1780		1665	1606	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	180	801	58	35	588	382	14	79	38	504	35	135
RTOR Reduction (vph)	0	3	0	0	0	222	0	0	0	0	14	0
Lane Group Flow (vph)	180	856	0	35	588	160	0	131	0	343	317	0
Heavy Vehicles (%)	2%	3%	3%	0%	1%	1%	2%	2%	2%	3%	3%	3%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		3 4 7	3 4 7	
Permitted Phases	2			6		6						
Actuated Green, G (s)	63.5	51.6		49.1	43.5	43.5		14.8		73.9	73.9	
Effective Green, g (s)	65.8	53.9		53.7	45.8	45.8		18.0		76.5	76.5	
Actuated g/C Ratio	0.37	0.30		0.30	0.25	0.25		0.10		0.42	0.42	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3		7.2				
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0				
Lane Grp Cap (vph)	254	1038		133	909	406		178		707	682	
v/s Ratio Prot	c0.06	c0.25		0.01	0.16			c0.07		c0.21	0.20	
v/s Ratio Perm	0.20			0.07		0.10						
v/c Ratio	0.71	0.82		0.26	0.65	0.39		0.74		0.49	0.46	
Uniform Delay, d1	43.1	58.7		47.9	59.9	55.6		78.7		37.5	37.1	
Progression Factor	1.00	1.00		0.68	0.66	0.43		1.00		0.29	0.25	
Incremental Delay, d2	8.7	7.5		0.9	3.1	2.5		14.6		0.3	0.3	
Delay (s)	51.8	66.1		33.7	42.7	26.6		93.3		11.1	9.4	
Level of Service	D	E		C	D	C		F		B	A	
Approach Delay (s)		63.6			36.3			93.3			10.2	
Approach LOS		E			D			F			B	

Intersection Summary			
HCM 2000 Control Delay	42.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.7
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: Vine St/Vine Street & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	20	65	44	125	251	196	381	7	56	505	85
Future Volume (vph)	21	20	65	44	125	251	196	381	7	56	505	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		1.00	1.00		0.95	
Frt		1.00	0.85		1.00	0.85		1.00	0.85		0.98	
Flt Protected		0.98	1.00		0.99	1.00		0.98	1.00		1.00	
Satd. Flow (prot)		1853	1615		1876	1615		1850	1599		3233	
Flt Permitted		0.98	1.00		0.99	1.00		0.98	1.00		1.00	
Satd. Flow (perm)		1853	1615		1876	1615		1850	1599		3233	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	23	22	70	47	134	270	211	410	8	60	543	91
RTOR Reduction (vph)	0	0	65	0	0	237	0	0	4	0	7	0
Lane Group Flow (vph)	0	45	5	0	181	33	0	621	4	0	687	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	1%	1%	9%	9%	9%
Turn Type	Split	NA	Prot	Split	NA	Prot	Split	NA	Perm	Split	NA	
Protected Phases	3	3	3	4	4	4	2 5 6 8	2 5 6 8		7	7	
Permitted Phases									2 5 6 8			
Actuated Green, G (s)		10.9	10.9		18.9	18.9		78.3	78.3		38.8	
Effective Green, g (s)		12.2	12.2		22.0	22.0		82.9	82.9		42.0	
Actuated g/C Ratio		0.07	0.07		0.12	0.12		0.46	0.46		0.23	
Clearance Time (s)		5.3	5.3		7.1	7.1					7.2	
Vehicle Extension (s)		3.0	3.0		4.0	4.0					3.0	
Lane Grp Cap (vph)		125	109		229	197		852	736		754	
v/s Ratio Prot		c0.02	0.00		c0.10	0.02		c0.34			c0.21	
v/s Ratio Perm									0.00			
v/c Ratio		0.36	0.04		0.79	0.17		0.73	0.01		0.91	
Uniform Delay, d1		80.2	78.4		76.8	70.8		39.4	26.3		67.2	
Progression Factor		1.00	1.00		1.00	1.00		0.21	1.00		1.00	
Incremental Delay, d2		1.8	0.2		17.6	0.6		2.4	0.0		15.2	
Delay (s)		81.9	78.6		94.4	71.3		10.7	26.3		82.4	
Level of Service		F	E		F	E		B	C		F	
Approach Delay (s)		79.9			80.6			10.9			82.4	
Approach LOS		E			F			B			F	

Intersection Summary			
HCM 2000 Control Delay	58.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.2
Intersection Capacity Utilization	77.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: S Carlton St & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	1122	74	126	817	120	92	99	109	89	59	6
Future Volume (vph)	27	1122	74	126	817	120	92	99	109	89	59	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	7.5		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00		0.97	
Satd. Flow (prot)	1805	3507		1805	3541			1855	1583		1817	
Flt Permitted	0.19	1.00		0.09	1.00			0.98	1.00		0.71	
Satd. Flow (perm)	363	3507		172	3541			1855	1583		1325	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	1220	80	137	888	130	100	108	118	97	64	7
RTOR Reduction (vph)	0	3	0	0	6	0	0	0	92	0	1	0
Lane Group Flow (vph)	29	1297	0	137	1012	0	0	208	26	0	167	0
Heavy Vehicles (%)	0%	2%	2%	0%	0%	0%	0%	0%	2%	1%	1%	2%
Turn Type	D.P+P	NA		D.P+P	NA		Split	NA	Perm	Perm	NA	
Protected Phases	5	2		1	6		3	3			4	
Permitted Phases	6			2					3	4		
Actuated Green, G (s)	99.6	86.8		99.6	94.2			25.8	25.8		26.4	
Effective Green, g (s)	105.2	89.6		105.2	97.0			29.3	25.8		29.5	
Actuated g/C Ratio	0.58	0.50		0.58	0.54			0.16	0.14		0.16	
Clearance Time (s)	6.8	6.8		6.8	6.8			7.5	7.5		7.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	277	1745		242	1908			301	226		217	
v/s Ratio Prot	0.00	c0.37		c0.05	0.29			c0.11				
v/s Ratio Perm	0.06			0.28					0.02		c0.13	
v/c Ratio	0.10	0.74		0.57	0.53			0.69	0.12		0.77	
Uniform Delay, d1	18.7	36.0		27.9	26.8			71.1	67.2		72.0	
Progression Factor	0.46	0.38		1.57	0.53			1.00	1.00		1.00	
Incremental Delay, d2	0.1	2.1		2.8	1.0			6.7	0.2		15.4	
Delay (s)	8.8	15.7		46.6	15.1			77.8	67.4		87.5	
Level of Service	A	B		D	B			E	E		F	
Approach Delay (s)		15.5			18.9			74.0			87.5	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Cantrell Avenue (MLK) & East Market Street

12/14/2018

Movement	EBT	EBR	WBU	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	1228	92	10	165	923	140	99
Future Volume (vph)	1228	92	10	165	923	140	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00		0.97	0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3610	1615		3465	3574	1805	1615
Flt Permitted	1.00	1.00		0.20	1.00	0.95	1.00
Satd. Flow (perm)	3610	1615		726	3574	1805	1615
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	1364	102	11	183	1026	156	110
RTOR Reduction (vph)	0	31	0	0	0	0	9
Lane Group Flow (vph)	1364	71	0	194	1026	156	101
Heavy Vehicles (%)	0%	0%	2%	1%	1%	0%	0%
Turn Type	NA	Prot	custom	Prot	NA	Prot	pm+ov
Protected Phases	2	2		1	6	4	1!
Permitted Phases			1!				4
Actuated Green, G (s)	79.5	79.5		63.6	149.5	17.5	81.1
Effective Green, g (s)	81.9	81.9		66.0	151.9	20.1	85.9
Actuated g/C Ratio	0.46	0.46		0.37	0.84	0.11	0.48
Clearance Time (s)	6.4	6.4		6.4	6.4	6.6	6.4
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1642	734		266	3016	201	806
v/s Ratio Prot	c0.38	0.04			0.29	c0.09	0.05
v/s Ratio Perm				c0.27			0.02
v/c Ratio	0.83	0.10		0.73	0.34	0.78	0.13
Uniform Delay, d1	43.0	28.0		49.3	3.1	77.8	26.2
Progression Factor	0.71	1.01		1.36	1.34	1.00	1.00
Incremental Delay, d2	3.7	0.2		9.4	0.3	17.0	0.1
Delay (s)	34.2	28.4		76.4	4.4	94.7	26.2
Level of Service	C	C		E	A	F	C
Approach Delay (s)	33.8				15.9	66.4	
Approach LOS	C				B	E	

Intersection Summary			
HCM 2000 Control Delay	29.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		
! Phase conflict between lane groups.			
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: I-81 SB On & East Market Street

12/14/2018

Movement	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	977	0	422	999	0	0
Future Volume (vph)	977	0	422	999	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0		
Lane Util. Factor	0.95		1.00	0.95		
Frt	1.00		1.00	1.00		
Flt Protected	1.00		0.95	1.00		
Satd. Flow (prot)	3539		1770	3539		
Flt Permitted	1.00		0.23	1.00		
Satd. Flow (perm)	3539		422	3539		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1062	0	459	1086	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1062	0	459	1086	0	0
Turn Type	NA		D.P+P	NA		
Protected Phases	2		1	6		
Permitted Phases			2			
Actuated Green, G (s)	58.0		78.0	90.0		
Effective Green, g (s)	60.0		82.0	90.0		
Actuated g/C Ratio	0.67		0.91	1.00		
Clearance Time (s)	6.0		6.0	7.2		
Vehicle Extension (s)	3.0		3.0	3.0		
Lane Grp Cap (vph)	2359		714	3539		
v/s Ratio Prot	0.30		c0.16	0.31		
v/s Ratio Perm			c0.43			
v/c Ratio	0.45		0.64	0.31		
Uniform Delay, d1	7.1		5.6	0.0		
Progression Factor	1.89		2.47	1.00		
Incremental Delay, d2	0.4		1.7	0.2		
Delay (s)	13.9		15.6	0.2		
Level of Service	B		B	A		
Approach Delay (s)	13.9			4.8	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM 2000 Control Delay	8.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: Brugress Road /Linda Lane & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	163	1250	211	206	1122	230	335	152	206	163	161	143
Future Volume (vph)	163	1250	211	206	1122	230	335	152	206	163	161	143
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	4.1	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.97	0.91	1.00	0.97	0.91		0.91	0.91	1.00	0.91	0.91	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	0.95	0.99	1.00
Satd. Flow (prot)	3351	4940	1538	3502	5004		1626	3336	1599	1626	3379	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	0.95	0.99	1.00
Satd. Flow (perm)	3351	4940	1538	3502	5004		1626	3336	1599	1626	3379	1599
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	179	1374	232	226	1233	253	368	167	226	179	177	157
RTOR Reduction (vph)	0	0	80	0	0	0	0	0	168	0	0	121
Lane Group Flow (vph)	179	1374	152	226	1486	0	184	351	58	116	240	36
Heavy Vehicles (%)	1%	5%	5%	0%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2	8	1	6		8	8		4 3	4 3	
Permitted Phases			2						8			4 3
Actuated Green, G (s)	13.6	71.8	98.2	14.4	73.8		26.4	26.4	26.4	38.1	38.1	38.1
Effective Green, g (s)	17.0	74.5	105.2	19.0	76.5		30.0	30.0	30.0	41.3	41.3	41.3
Actuated g/C Ratio	0.09	0.41	0.58	0.11	0.42		0.17	0.17	0.17	0.23	0.23	0.23
Clearance Time (s)	7.4	6.7	7.6	8.6	6.7		7.6	7.6	7.6			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0			
Lane Grp Cap (vph)	316	2044	898	369	2126		271	556	266	373	775	366
v/s Ratio Prot	0.05	c0.28	0.03	0.06	c0.30		c0.11	0.11		c0.07	0.07	
v/s Ratio Perm			0.07						0.04			0.02
v/c Ratio	0.57	0.67	0.17	0.61	0.70		0.68	0.63	0.22	0.31	0.31	0.10
Uniform Delay, d1	78.0	42.8	17.3	77.0	42.3		70.5	69.8	64.8	57.5	57.5	54.7
Progression Factor	1.08	0.52	0.85	0.61	0.35		1.00	1.00	1.00	0.05	0.05	0.07
Incremental Delay, d2	2.3	1.7	0.1	2.3	1.5		6.6	2.3	0.4	0.4	0.2	0.1
Delay (s)	86.8	24.0	14.8	49.5	16.4		77.1	72.2	65.3	3.3	3.1	3.9
Level of Service	F	C	B	D	B		E	E	E	A	A	A
Approach Delay (s)		29.1			20.8			71.3			3.4	
Approach LOS		C			C			E			A	

Intersection Summary			
HCM 2000 Control Delay	30.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	19.3
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
7: Linda Lane & Frontage Road

12/14/2018

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	21	5	39	506	446	10
Future Volume (vph)	21	5	39	506	446	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1805	1615		3426	5119	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1805	1615		3426	5119	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	5	42	550	485	11
RTOR Reduction (vph)	0	5	0	0	1	0
Lane Group Flow (vph)	23	0	0	592	495	0
Heavy Vehicles (%)	0%	0%	5%	5%	1%	1%
Turn Type	Prot	Prot	Split	NA	NA	
Protected Phases	3	3	5 6 8	5 6 8	4	
Permitted Phases						
Actuated Green, G (s)	7.4	7.4		127.9	23.5	
Effective Green, g (s)	9.8	9.8		128.0	26.7	
Actuated g/C Ratio	0.05	0.05		0.71	0.15	
Clearance Time (s)	6.4	6.4			7.2	
Vehicle Extension (s)	3.0	3.0			3.0	
Lane Grp Cap (vph)	98	87		2436	759	
v/s Ratio Prot	c0.01	0.00		c0.17	c0.10	
v/s Ratio Perm						
v/c Ratio	0.23	0.00		0.24	0.65	
Uniform Delay, d1	81.5	80.5		9.1	72.3	
Progression Factor	1.00	1.00		0.04	1.00	
Incremental Delay, d2	1.2	0.0		0.0	2.0	
Delay (s)	82.7	80.5		0.4	74.3	
Level of Service	F	F		A	E	
Approach Delay (s)	82.3			0.4	74.3	
Approach LOS	F			A	E	

Intersection Summary			
HCM 2000 Control Delay	35.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: University Blvd & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	142	1086	305	95	966	88	626	172	107	139	68	49
Future Volume (vph)	142	1086	305	95	966	88	626	172	107	139	68	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		0.97	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	5085	1583	1805	4973		3467	1773		1805	1781	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1805	5085	1583	1805	4973		3467	1773		1805	1781	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	154	1180	332	103	1050	96	680	187	116	151	74	53
RTOR Reduction (vph)	0	0	99	0	6	0	0	12	0	0	15	0
Lane Group Flow (vph)	154	1180	233	103	1140	0	680	291	0	151	112	0
Heavy Vehicles (%)	0%	2%	2%	0%	3%	3%	1%	1%	1%	0%	0%	0%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA		Split	NA	
Protected Phases	5	2	4	1	6		4	4		3	3	
Permitted Phases			2									
Actuated Green, G (s)	25.6	71.9	115.8	14.5	61.5		43.9	43.9		19.8	19.8	
Effective Green, g (s)	28.1	73.8	126.4	17.7	63.4		49.2	49.2		23.3	23.3	
Actuated g/C Ratio	0.16	0.41	0.70	0.10	0.35		0.27	0.27		0.13	0.13	
Clearance Time (s)	6.5	5.9	9.3	7.2	5.9		9.3	9.3		7.5	7.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	281	2084	1111	177	1751		947	484		233	230	
v/s Ratio Prot	0.09	c0.23	0.06	0.06	c0.23		c0.20	0.16		c0.08	0.06	
v/s Ratio Perm			0.09									
v/c Ratio	0.55	0.57	0.21	0.58	0.65		0.72	0.60		0.65	0.49	
Uniform Delay, d1	70.1	40.8	9.4	77.6	49.0		59.1	56.9		74.5	72.8	
Progression Factor	0.58	0.33	0.82	1.20	1.62		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.9	0.1	3.9	1.5		2.6	2.1		6.1	1.6	
Delay (s)	42.5	14.4	7.7	96.8	80.9		61.8	59.0		80.5	74.4	
Level of Service	D	B	A	F	F		E	E		F	E	
Approach Delay (s)		15.7			82.2			60.9			77.7	
Approach LOS		B			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	50.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
11: Valley Mall Drive /Country Club Road & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	64	1110	135	63	986	587	120	75	23	481	107	11
Future Volume (vph)	64	1110	135	63	986	587	120	75	23	481	107	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00		1.00	1.00	0.95	0.95	
Frt	1.00	0.98		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97	1.00	0.95	0.97	
Satd. Flow (prot)	1805	4954		1805	3574	1599		1843	1615	1715	1742	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.97	1.00	0.95	0.97	
Satd. Flow (perm)	1805	4954		1805	3574	1599		1843	1615	1715	1742	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	69	1194	145	68	1060	631	129	81	25	517	115	12
RTOR Reduction (vph)	0	8	0	0	0	225	0	0	21	0	1	0
Lane Group Flow (vph)	69	1331	0	68	1060	406	0	210	4	321	322	0
Heavy Vehicles (%)	0%	3%	3%	0%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA	Prot	Split	NA	
Protected Phases	5	2		1	6		4	4	4	3	3	
Permitted Phases						6						
Actuated Green, G (s)	10.2	79.3		10.3	79.1	79.1		24.6	24.6	38.5	38.5	
Effective Green, g (s)	12.9	81.2		12.7	81.0	81.0		28.1	28.1	42.0	42.0	
Actuated g/C Ratio	0.07	0.45		0.07	0.45	0.45		0.16	0.16	0.23	0.23	
Clearance Time (s)	6.7	5.9		6.4	5.9	5.9		7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	129	2234		127	1608	719		287	252	400	406	
v/s Ratio Prot	c0.04	0.27		0.04	c0.30			c0.11	0.00	c0.19	0.18	
v/s Ratio Perm						0.25						
v/c Ratio	0.53	0.60		0.54	0.66	0.56		0.73	0.02	0.80	0.79	
Uniform Delay, d1	80.7	37.1		80.8	38.7	36.5		72.4	64.2	65.1	64.9	
Progression Factor	1.57	0.46		1.11	1.18	1.58		1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.6	1.0		3.6	1.8	2.7		9.2	0.0	11.1	10.2	
Delay (s)	130.2	18.2		93.6	47.4	60.4		81.6	64.3	76.1	75.2	
Level of Service	F	B		F	D	E		F	E	E	E	
Approach Delay (s)		23.7			53.9			79.8			75.6	
Approach LOS		C			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	48.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
13: Evelyn byrd Ave & East Market Street

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1452	177	219	1346	226	526
Future Volume (vph)	1452	177	219	1346	226	526
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.91		0.97	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	5058		3502	3574	1805	1615
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	5058		3502	3574	1805	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1578	192	238	1463	246	572
RTOR Reduction (vph)	16	0	0	0	0	1
Lane Group Flow (vph)	1754	0	238	1463	246	571
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	4	1
Permitted Phases						4
Actuated Green, G (s)	33.3		16.0	57.3	16.9	32.9
Effective Green, g (s)	36.2		20.0	60.2	21.8	40.9
Actuated g/C Ratio	0.40		0.22	0.67	0.24	0.45
Clearance Time (s)	6.9		8.0	6.9	8.9	8.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2034		778	2390	437	805
v/s Ratio Prot	c0.35		0.07	0.41	0.14	c0.16
v/s Ratio Perm						0.20
v/c Ratio	0.86		0.31	0.61	0.56	0.71
Uniform Delay, d1	24.6		29.2	8.4	29.9	19.8
Progression Factor	1.38		0.82	0.45	1.00	1.00
Incremental Delay, d2	4.3		0.2	0.8	1.7	2.9
Delay (s)	38.2		24.1	4.6	31.6	22.6
Level of Service	D		C	A	C	C
Approach Delay (s)	38.2			7.4	25.3	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	23.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
15: Chestnut Ridge Dr & East Market Street

12/14/2018

Movement	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	51	1666	215	56	1271	220	86
Future Volume (vph)	51	1666	215	56	1271	220	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.7	6.4	6.4	7.0	6.4	9.0	9.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1805	3539	1583	1805	3574	1787	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1805	3539	1583	1805	3574	1787	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	1811	234	61	1382	239	93
RTOR Reduction (vph)	0	0	101	0	0	0	82
Lane Group Flow (vph)	55	1811	133	61	1382	239	11
Heavy Vehicles (%)	0%	2%	2%	0%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA	Prot	Prot
Protected Phases	5	2		1	6	4	4
Permitted Phases			2				
Actuated Green, G (s)	5.8	51.0	51.0	5.6	51.1	11.0	11.0
Effective Green, g (s)	5.8	51.0	51.0	5.6	51.1	11.0	11.0
Actuated g/C Ratio	0.06	0.57	0.57	0.06	0.57	0.12	0.12
Clearance Time (s)	6.7	6.4	6.4	7.0	6.4	9.0	9.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	116	2005	897	112	2029	218	195
v/s Ratio Prot	0.03	c0.51		c0.03	0.39	c0.13	0.01
v/s Ratio Perm			0.08				
v/c Ratio	0.47	0.90	0.15	0.54	0.68	1.10	0.06
Uniform Delay, d1	40.6	17.3	9.2	41.0	13.7	39.5	34.9
Progression Factor	0.80	1.55	6.85	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	4.3	0.2	5.3	1.9	89.1	0.1
Delay (s)	34.2	31.2	63.4	46.3	15.6	128.6	35.0
Level of Service	C	C	E	D	B	F	D
Approach Delay (s)		34.9			16.9	102.4	
Approach LOS		C			B	F	

Intersection Summary			
HCM 2000 Control Delay	33.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
16: Linda Lane & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	358	181	120	402	204	212	175	137	104	155	42
Future Volume (vph)	34	358	181	120	402	204	212	175	137	104	155	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1805	1900	1599	1805	1900	1615	1787	1775		1805	1900	1615
Flt Permitted	0.36	1.00	1.00	0.27	1.00	1.00	0.42	1.00		0.38	1.00	1.00
Satd. Flow (perm)	687	1900	1599	522	1900	1615	796	1775		723	1900	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	389	197	130	437	222	230	190	149	113	168	46
RTOR Reduction (vph)	0	0	102	0	0	118	0	21	0	0	0	37
Lane Group Flow (vph)	37	389	95	130	437	104	230	318	0	113	168	9
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4			8		8
Actuated Green, G (s)	32.9	29.1	29.1	43.1	34.2	34.2	36.7	22.2		24.5	16.0	16.0
Effective Green, g (s)	36.9	31.1	31.1	46.0	36.2	36.2	38.7	24.2		28.5	18.0	18.0
Actuated g/C Ratio	0.40	0.34	0.34	0.50	0.39	0.39	0.42	0.26		0.31	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	343	637	536	409	741	630	510	463		344	368	313
v/s Ratio Prot	0.01	0.20		c0.04	c0.23		c0.08	c0.18		0.04	0.09	
v/s Ratio Perm	0.04		0.06	0.12		0.06	0.11			0.06		0.01
v/c Ratio	0.11	0.61	0.18	0.32	0.59	0.16	0.45	0.69		0.33	0.46	0.03
Uniform Delay, d1	17.6	25.7	21.8	14.5	22.4	18.4	18.4	30.8		23.9	33.0	30.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.1	1.7	0.2	0.5	1.2	0.1	0.6	4.2		0.6	0.9	0.0
Delay (s)	17.7	27.5	21.9	14.9	23.6	18.5	19.1	35.1		24.5	33.9	30.3
Level of Service	B	C	C	B	C	B	B	D		C	C	C
Approach Delay (s)		25.1			20.7			28.6			30.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	92.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
18: Blue Ridge Drive & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	165	388	6	8	483	169	1	3	5	136	3	71
Future Volume (vph)	165	388	6	8	483	169	1	3	5	136	3	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			4.0	4.0
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	1.00
Frt	1.00	1.00			0.97			0.93			1.00	0.85
Flt Protected	0.95	1.00			1.00			0.99			0.95	1.00
Satd. Flow (prot)	1770	1859			1797			1714			1776	1583
Flt Permitted	0.26	1.00			1.00			0.99			0.95	1.00
Satd. Flow (perm)	486	1859			1789			1714			1776	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	174	408	6	8	508	178	1	3	5	143	3	75
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	0	0	0	62
Lane Group Flow (vph)	174	414	0	0	683	0	0	9	0	0	146	13
Turn Type	pm+pt	NA		Perm	NA		Split	NA		Split	NA	Perm
Protected Phases	1	6			2		4	4		8	8	
Permitted Phases	6			2								8
Actuated Green, G (s)	52.6	52.6			38.4			1.0			12.9	12.9
Effective Green, g (s)	54.6	54.6			40.4			3.0			14.9	14.9
Actuated g/C Ratio	0.65	0.65			0.48			0.04			0.18	0.18
Clearance Time (s)	6.0	6.0			6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	469	1201			855			60			313	279
v/s Ratio Prot	0.04	c0.22						c0.01			c0.08	
v/s Ratio Perm	0.19				c0.38							0.01
v/c Ratio	0.37	0.34			0.80			0.15			0.47	0.05
Uniform Delay, d1	9.0	6.8			18.6			39.5			31.2	28.9
Progression Factor	1.00	1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2	0.5	0.2			5.3			1.2			1.1	0.1
Delay (s)	9.5	7.0			23.9			40.7			32.3	29.0
Level of Service	A	A			C			D			C	C
Approach Delay (s)		7.7			23.9			40.7			31.2	
Approach LOS		A			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	18.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	84.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Wendy's/Chick-Fil-a & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	92	1469	58	97	1489	55	0	0	64	0	0	69
Future Volume (Veh/h)	92	1469	58	97	1489	55	0	0	64	0	0	69
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	100	1597	63	105	1618	60	0	0	70	0	0	75
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		725			1074							
pX, platoon unblocked	0.83			0.78			0.87	0.87	0.78	0.87	0.87	0.83
vC, conflicting volume	1678			1660			2653	3716	564	2660	3718	569
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1086			869			1027	2251	0	1035	2253	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	81			83			100	100	92	100	100	92
cM capacity (veh/h)	528			613			112	24	853	112	24	899

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	100	639	639	382	105	647	647	384	70	75
Volume Left	100	0	0	0	105	0	0	0	0	0
Volume Right	0	0	0	63	0	0	0	60	70	75
cSH	528	1700	1700	1700	613	1700	1700	1700	853	899
Volume to Capacity	0.19	0.38	0.38	0.22	0.17	0.38	0.38	0.23	0.08	0.08
Queue Length 95th (ft)	17	0	0	0	15	0	0	0	7	7
Control Delay (s)	13.4	0.0	0.0	0.0	12.1	0.0	0.0	0.0	9.6	9.4
Lane LOS	B				B				A	A
Approach Delay (s)	0.8				0.7				9.6	9.4
Approach LOS									A	A

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	41.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Valley Mall & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	61	1250	21	29	1074	14	31	1	40	19	3	44
Future Volume (Veh/h)	61	1250	21	29	1074	14	31	1	40	19	3	44
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	66	1359	23	32	1167	15	34	1	43	21	3	48
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		612			772							
pX, platoon unblocked	0.81			0.83			0.89	0.89	0.83	0.89	0.89	0.81
vC, conflicting volume	1182			1382			2005	2748	464	1867	2752	396
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	385			728			395	1228	0	241	1232	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			96			92	99	95	96	98	95
cM capacity (veh/h)	955			731			414	143	902	541	142	880

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2	SB 1
Volume Total	66	544	544	295	32	467	467	248	35	43	72
Volume Left	66	0	0	0	32	0	0	0	34	0	21
Volume Right	0	0	0	23	0	0	0	15	0	43	48
cSH	955	1700	1700	1700	731	1700	1700	1700	393	902	629
Volume to Capacity	0.07	0.32	0.32	0.17	0.04	0.27	0.27	0.15	0.09	0.05	0.11
Queue Length 95th (ft)	6	0	0	0	3	0	0	0	7	4	10
Control Delay (s)	9.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	15.1	9.2	11.5
Lane LOS	A				B				C	A	B
Approach Delay (s)	0.4				0.3				11.8		11.5
Approach LOS									B		B

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	48.5%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
12: Skyline Village & East Market Street

12/14/2018

Movement	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (veh/h)	18	1541	55	43	1529	89	88
Future Volume (Veh/h)	18	1541	55	43	1529	89	88
Sign Control		Free			Free	Stop	
Grade		0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1675	60	47	1662	97	96
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None			None		
Median storage veh)							
Upstream signal (ft)		543			1038		
pX, platoon unblocked	0.00			0.81		0.85	0.81
vC, conflicting volume	0			1735		2630	588
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	0			1068		1185	0
tC, single (s)	0.0			4.1		6.8	6.9
tC, 2 stage (s)							
tF (s)	0.0			2.2		3.5	3.3
p0 queue free %	0			91		32	89
cM capacity (veh/h)	0			532		143	879

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	670	670	395	47	831	831	97	96
Volume Left	0	0	0	47	0	0	97	0
Volume Right	0	0	60	0	0	0	0	96
cSH	1700	1700	1700	532	1700	1700	143	879
Volume to Capacity	0.39	0.39	0.23	0.09	0.49	0.49	0.68	0.11
Queue Length 95th (ft)	0	0	0	7	0	0	96	9
Control Delay (s)	0.0	0.0	0.0	12.4	0.0	0.0	71.9	9.6
Lane LOS				B			F	A
Approach Delay (s)	0.0			0.3			40.9	
Approach LOS							E	

Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	55.2%	ICU Level of Service	B	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
14: Betts Rd & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	46	1903	29	22	1498	22	33	0	14	15	0	34
Future Volume (Veh/h)	46	1903	29	22	1498	22	33	0	14	15	0	34
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	50	2068	32	24	1628	24	36	0	15	16	0	37
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		558			856							
pX, platoon unblocked	0.71			0.69			0.84	0.84	0.69	0.84	0.84	0.71
vC, conflicting volume	1652			2100			3083	3884	705	2480	3876	814
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1109			1040			1006	1963	0	286	1953	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	89			95			74	100	98	97	100	95
cM capacity (veh/h)	446			469			139	45	757	468	46	778

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	50	827	827	446	24	814	814	24	51	53
Volume Left	50	0	0	0	24	0	0	0	36	16
Volume Right	0	0	0	32	0	0	0	24	15	37
cSH	446	1700	1700	1700	469	1700	1700	1700	183	648
Volume to Capacity	0.11	0.49	0.49	0.26	0.05	0.48	0.48	0.01	0.28	0.08
Queue Length 95th (ft)	9	0	0	0	4	0	0	0	27	7
Control Delay (s)	14.1	0.0	0.0	0.0	13.1	0.0	0.0	0.0	32.1	11.0
Lane LOS	B				B				D	B
Approach Delay (s)	0.3				0.2				32.1	11.0
Approach LOS									D	B

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	53.6%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
17: Country Club Court & Country Club Road

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	517	12	6	650	10	56
Future Volume (Veh/h)	517	12	6	650	10	56
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	562	13	7	707	11	61
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	588					
pX, platoon unblocked			0.90		0.90	0.90
vC, conflicting volume			575		1290	568
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			473		1266	466
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		93	89
cM capacity (veh/h)			981		167	537

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	575	714	72
Volume Left	0	7	11
Volume Right	13	0	61
cSH	1700	981	401
Volume to Capacity	0.34	0.01	0.18
Queue Length 95th (ft)	0	1	16
Control Delay (s)	0.0	0.2	15.9
Lane LOS		A	C
Approach Delay (s)	0.0	0.2	15.9
Approach LOS			C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	49.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix C: 95th Percentile Queue Lengths (Existing Conditions – 2017)

Queues
1: Hawkins Street/Vine St & East Market Street

12/14/2018

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	180	859	35	588	382	131	343	331
v/c Ratio	0.71	0.81	0.24	0.65	0.61	0.74	0.46	0.45
Control Delay	56.9	64.7	29.3	43.0	9.5	102.0	7.4	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	4.4	2.7	2.3
Total Delay	56.9	64.7	29.3	43.0	9.5	106.4	10.1	8.3
Queue Length 50th (ft)	151	504	12	351	240	153	32	17
Queue Length 95th (ft)	220	593	m22	266	30	#257	m69	m54
Internal Link Dist (ft)		1257		988		353		112
Turn Bay Length (ft)	125		115		200			
Base Capacity (vph)	254	1066	147	909	629	178	741	729
Starvation Cap Reductn	0	0	0	0	0	0	281	267
Spillback Cap Reductn	0	0	0	0	5	16	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.81	0.24	0.65	0.61	0.81	0.75	0.72

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Queues
2: Vine St/Vine Street & Country Club Road

12/14/2018

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	45	70	181	270	621	8	694
v/c Ratio	0.36	0.22	0.79	0.62	0.72	0.01	0.91
Control Delay	88.7	1.6	100.3	13.8	9.2	0.0	83.1
Queue Delay	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Total Delay	88.7	1.6	100.3	13.8	10.1	0.0	83.1
Queue Length 50th (ft)	52	0	212	0	93	0	420
Queue Length 95th (ft)	100	0	#336	96	112	m0	#534
Internal Link Dist (ft)	62		353		112		778
Turn Bay Length (ft)							
Base Capacity (vph)	125	321	229	434	860	798	761
Starvation Cap Reductn	0	0	0	0	69	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.22	0.79	0.62	0.79	0.01	0.91

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Queues
3: S Carlton St & East Market Street

12/14/2018

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	29	1300	137	1018	208	118	168
v/c Ratio	0.10	0.74	0.57	0.52	0.69	0.37	0.77
Control Delay	8.6	16.6	42.1	15.8	82.4	16.2	94.3
Queue Delay	0.0	0.1	0.0	0.4	0.0	0.0	0.0
Total Delay	8.6	16.8	42.1	16.2	82.4	16.2	94.3
Queue Length 50th (ft)	4	357	51	301	236	11	189
Queue Length 95th (ft)	m11	436	m132	476	314	72	#286
Internal Link Dist (ft)		988		492	890		375
Turn Bay Length (ft)	125		205			125	
Base Capacity (vph)	294	1748	254	1941	406	401	237
Starvation Cap Reductn	0	0	0	415	0	0	0
Spillback Cap Reductn	0	50	0	0	0	1	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.77	0.54	0.67	0.51	0.29	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues
4: Cantrell Avenue (MLK) & East Market Street

12/14/2018

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1364	102	194	1026	156	110
v/c Ratio	0.83	0.13	0.73	0.34	0.78	0.13
Control Delay	34.7	13.7	84.9	4.5	102.1	20.5
Queue Delay	1.1	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	13.7	84.9	4.5	102.1	20.5
Queue Length 50th (ft)	353	24	120	187	181	57
Queue Length 95th (ft)	415	m37	169	186	#288	96
Internal Link Dist (ft)	492			744	1358	
Turn Bay Length (ft)			165			
Base Capacity (vph)	1641	765	266	3015	210	816
Starvation Cap Reductn	109	0	0	0	0	0
Spillback Cap Reductn	0	0	0	52	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.13	0.73	0.35	0.74	0.13

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues
5: I-81 SB On & East Market Street

12/14/2018

Lane Group	EBT	WBL	WBT
Lane Group Flow (vph)	1062	459	1086
v/c Ratio	0.45	0.64	0.31
Control Delay	15.5	16.7	0.2
Queue Delay	0.0	0.0	0.0
Total Delay	15.5	16.7	0.2
Queue Length 50th (ft)	458	181	0
Queue Length 95th (ft)	613	241	0
Internal Link Dist (ft)	373		304
Turn Bay Length (ft)		250	
Base Capacity (vph)	2358	912	3539
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.50	0.31

Intersection Summary

Queues
6: Brugress Road /Linda Lane & East Market Street

12/14/2018

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	179	1374	232	226	1486	184	351	226	116	240	157
v/c Ratio	0.57	0.67	0.24	0.61	0.70	0.68	0.63	0.52	0.32	0.32	0.32
Control Delay	92.0	24.3	2.2	53.1	16.7	83.1	74.8	15.2	4.8	3.9	1.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.3	2.4
Total Delay	92.0	24.3	2.2	53.1	16.7	83.1	74.8	15.2	7.2	5.2	4.2
Queue Length 50th (ft)	104	260	16	135	289	225	213	24	6	6	0
Queue Length 95th (ft)	142	335	22	173	311	324	270	111	10	8	19
Internal Link Dist (ft)		512			645		752			71	
Turn Bay Length (ft)	250		190	400		300		100	50		
Base Capacity (vph)	320	2045	972	369	2127	307	629	465	368	764	489
Starvation Cap Reductn	0	0	0	0	0	0	0	0	156	341	223
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.67	0.24	0.61	0.70	0.60	0.56	0.49	0.55	0.57	0.59

Intersection Summary

Queues
7: Linda Lane & Frontage Road

12/14/2018

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	23	5	592	496
v/c Ratio	0.23	0.05	0.24	0.65
Control Delay	87.6	45.2	0.5	76.8
Queue Delay	0.0	0.0	0.6	0.0
Total Delay	87.6	45.2	1.2	76.8
Queue Length 50th (ft)	27	0	2	204
Queue Length 95th (ft)	61	16	2	254
Internal Link Dist (ft)	185		71	297
Turn Bay Length (ft)	75			
Base Capacity (vph)	100	94	2566	760
Starvation Cap Reductn	0	0	1528	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.23	0.05	0.57	0.65

Intersection Summary

Queues
9: University Blvd & East Market Street

12/14/2018

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	154	1180	332	103	1146	680	303	151	127
v/c Ratio	0.55	0.57	0.28	0.58	0.65	0.72	0.61	0.65	0.52
Control Delay	47.4	14.9	0.9	103.5	82.1	63.8	59.2	87.2	70.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.4	14.9	0.9	103.5	82.1	63.8	59.2	87.2	70.1
Queue Length 50th (ft)	172	313	2	126	512	365	288	172	123
Queue Length 95th (ft)	246	376	20	m194	545	450	408	250	194
Internal Link Dist (ft)		994			532		736		443
Turn Bay Length (ft)	325		250	235		150			
Base Capacity (vph)	280	2087	1199	200	1760	981	514	280	291
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.57	0.28	0.52	0.65	0.69	0.59	0.54	0.44

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
11: Valley Mall Drive /Country Club Road & East Market Street

12/14/2018

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	69	1339	68	1060	631	210	25	321	323
v/c Ratio	0.53	0.60	0.54	0.66	0.67	0.73	0.07	0.80	0.79
Control Delay	139.8	18.9	103.2	50.1	25.2	87.1	0.4	80.1	78.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	139.8	18.9	103.2	50.1	25.2	87.1	0.4	80.1	78.8
Queue Length 50th (ft)	86	111	80	620	375	238	0	377	377
Queue Length 95th (ft)	145	514	m131	714	557	332	0	492	491
Internal Link Dist (ft)		692		463		306			307
Turn Bay Length (ft)	400		400		250			275	
Base Capacity (vph)	136	2241	135	1606	944	327	370	459	467
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.60	0.50	0.66	0.67	0.64	0.07	0.70	0.69

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
13: Evelyn byrd Ave & East Market Street

12/14/2018

Lane Group	EBT	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1770	238	1463	246	572
v/c Ratio	0.86	0.31	0.61	0.56	0.70
Control Delay	38.6	24.8	4.9	34.6	21.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	38.6	24.8	4.9	34.6	21.5
Queue Length 50th (ft)	524	62	90	122	231
Queue Length 95th (ft)	#604	m75	m93	186	321
Internal Link Dist (ft)	958		478	719	
Turn Bay Length (ft)		100			
Base Capacity (vph)	2050	778	2390	521	822
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.86	0.31	0.61	0.47	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues
15: Chestnut Ridge Dr & East Market Street

12/14/2018

Lane Group	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	55	1811	234	61	1382	239	93
v/c Ratio	0.38	0.88	0.23	0.44	0.66	1.10	0.34
Control Delay	35.9	30.1	7.3	49.9	15.6	128.5	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	30.1	7.3	49.9	15.6	128.5	11.8
Queue Length 50th (ft)	35	522	41	34	283	~155	0
Queue Length 95th (ft)	m40	537	m59	74	361	#300	43
Internal Link Dist (ft)		301			766	758	
Turn Bay Length (ft)	225			200		225	
Base Capacity (vph)	146	2060	1019	140	2083	218	277
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.88	0.23	0.44	0.66	1.10	0.34

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Queues
16: Linda Lane & Country Club Road

12/14/2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	37	389	197	130	437	222	230	339	113	168	46
v/c Ratio	0.09	0.66	0.33	0.33	0.57	0.29	0.44	0.68	0.32	0.44	0.10
Control Delay	14.7	33.5	8.6	16.6	27.5	6.1	21.1	36.0	20.8	38.6	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.7	33.5	8.6	16.6	27.5	6.1	21.1	36.0	20.8	38.6	0.5
Queue Length 50th (ft)	11	189	18	40	211	11	82	157	37	84	0
Queue Length 95th (ft)	32	332	74	88	370	63	171	299	89	179	0
Internal Link Dist (ft)		599			572			364		1385	
Turn Bay Length (ft)	125		125	175		200	200		200		
Base Capacity (vph)	399	1372	1197	405	1416	1253	592	1009	372	828	790
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.28	0.16	0.32	0.31	0.18	0.39	0.34	0.30	0.20	0.06

Intersection Summary

Queues

18: Blue Ridge Drive & Country Club Road

12/14/2018

Lane Group	EBL	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	174	414	694	9	146	75
v/c Ratio	0.35	0.33	0.77	0.04	0.44	0.19
Control Delay	7.4	6.8	22.8	43.6	37.9	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.4	6.8	22.8	43.6	37.9	4.3
Queue Length 50th (ft)	22	60	230	4	59	0
Queue Length 95th (ft)	80	195	543	25	175	19
Internal Link Dist (ft)		538	508	626	729	
Turn Bay Length (ft)	125					100
Base Capacity (vph)	504	1799	1692	276	524	544
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.23	0.41	0.03	0.28	0.14

Intersection Summary

Appendix D: Trip Generation of Future Site Developments

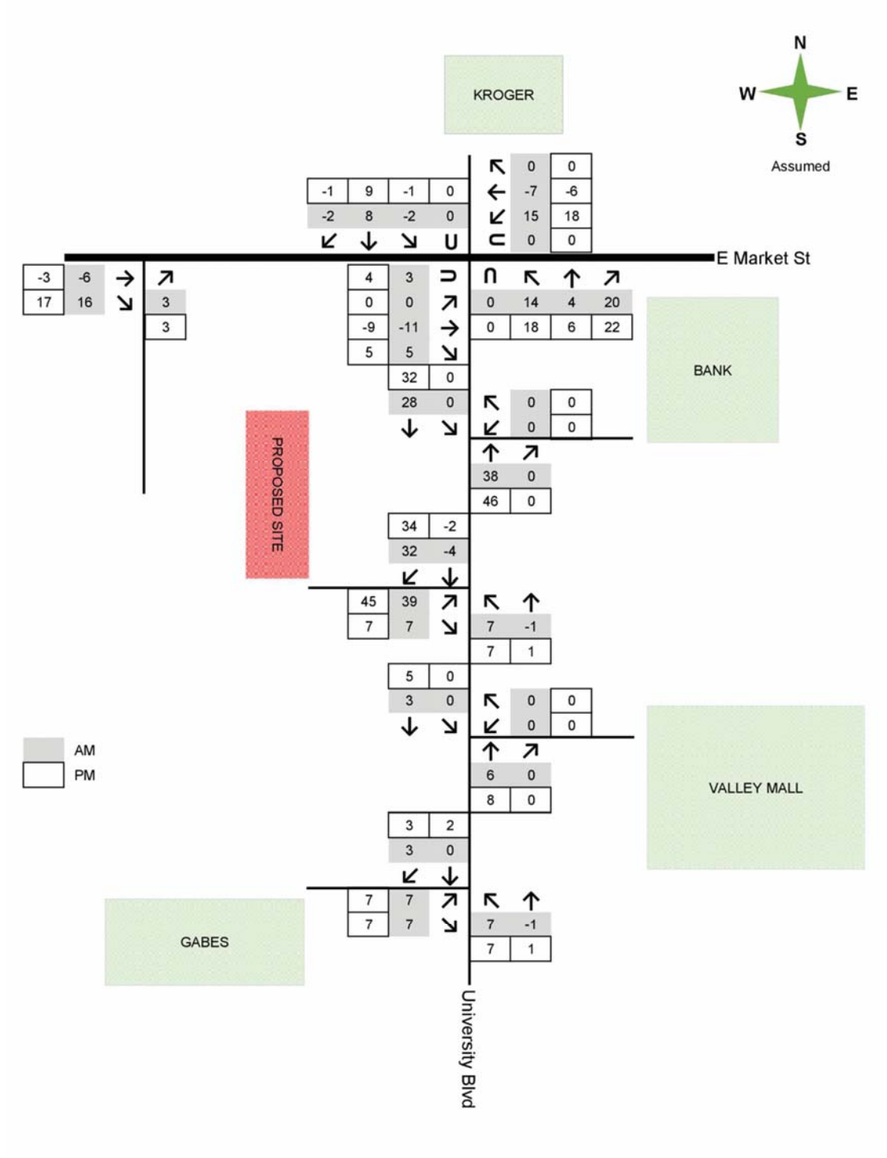
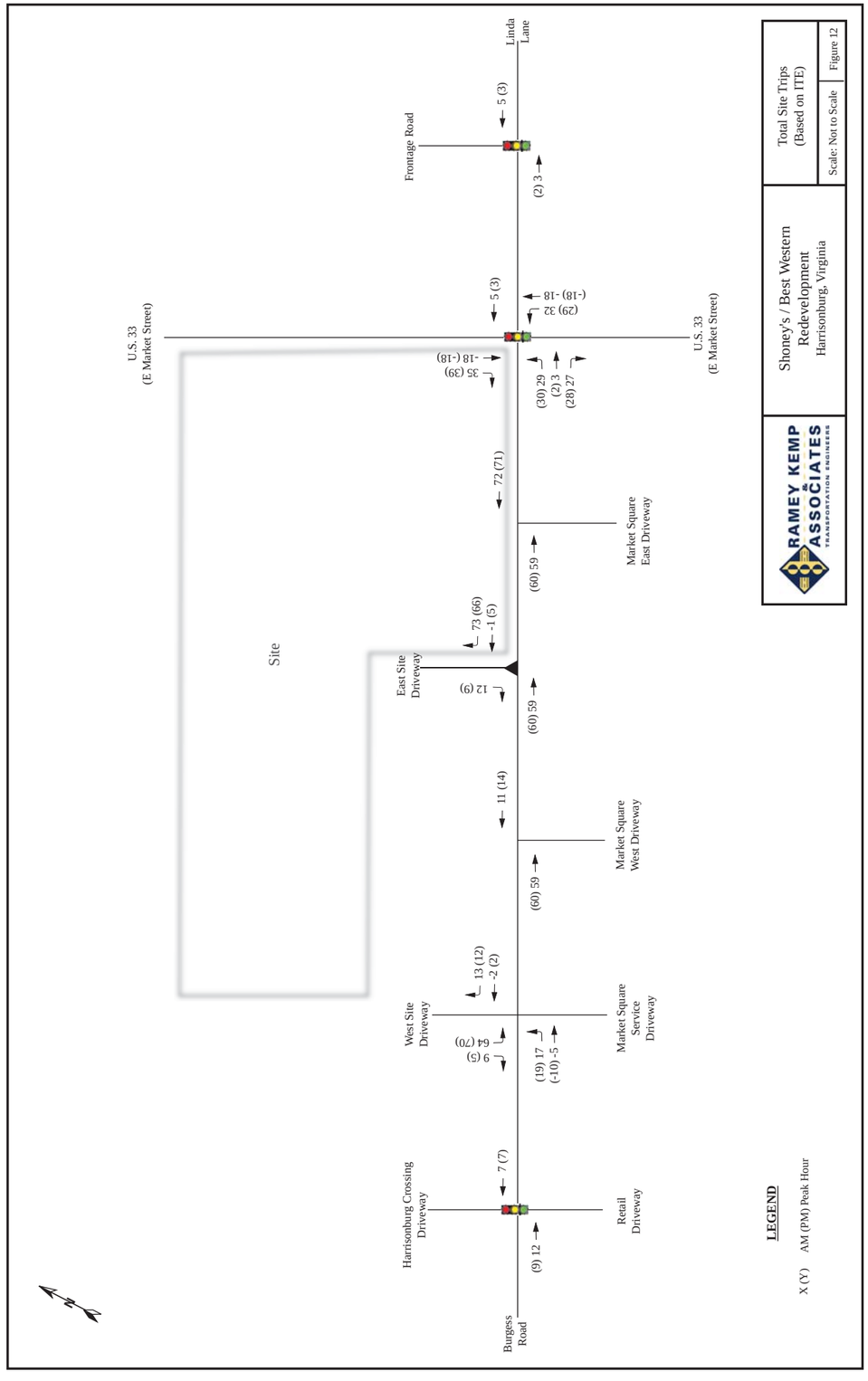
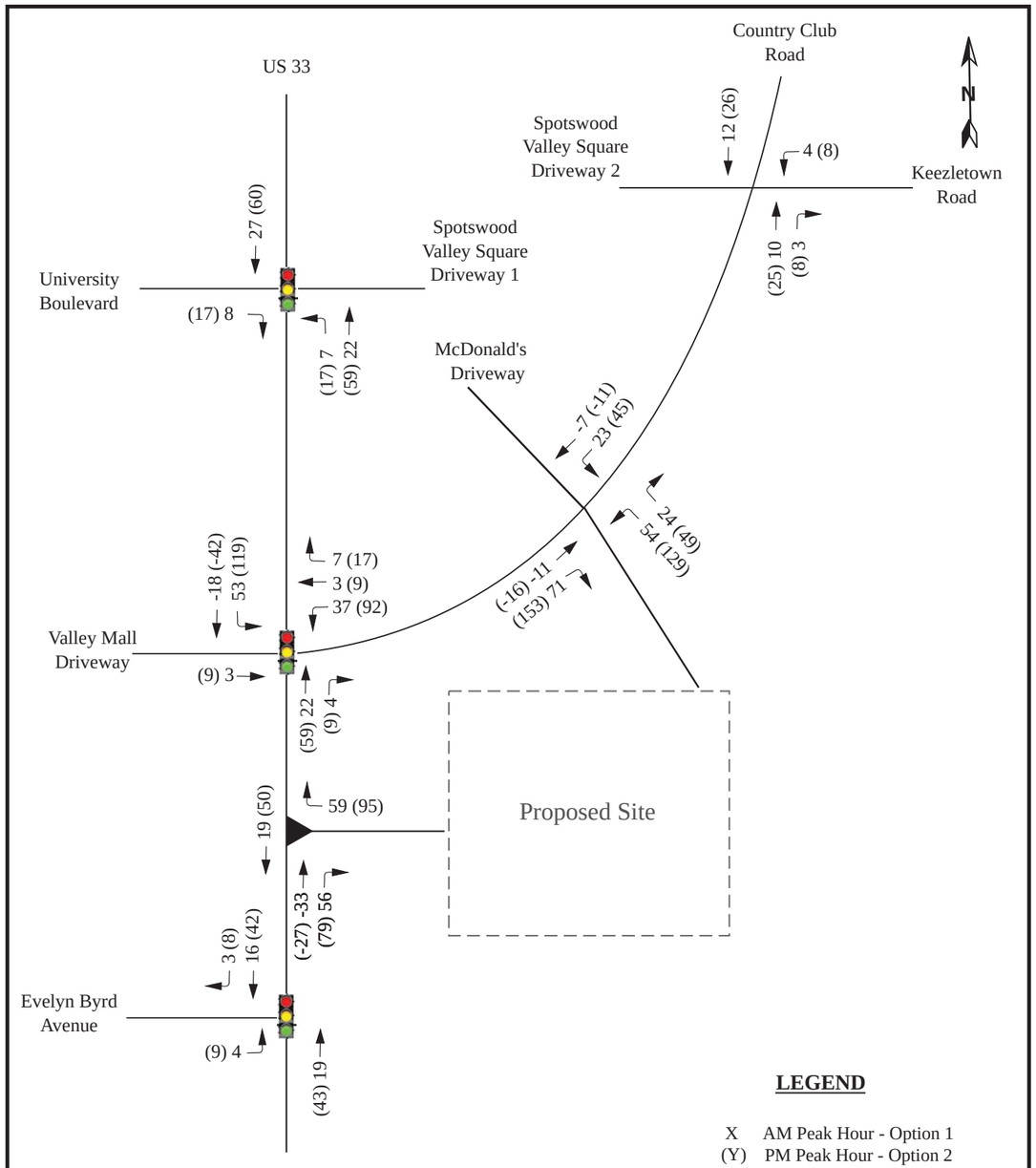
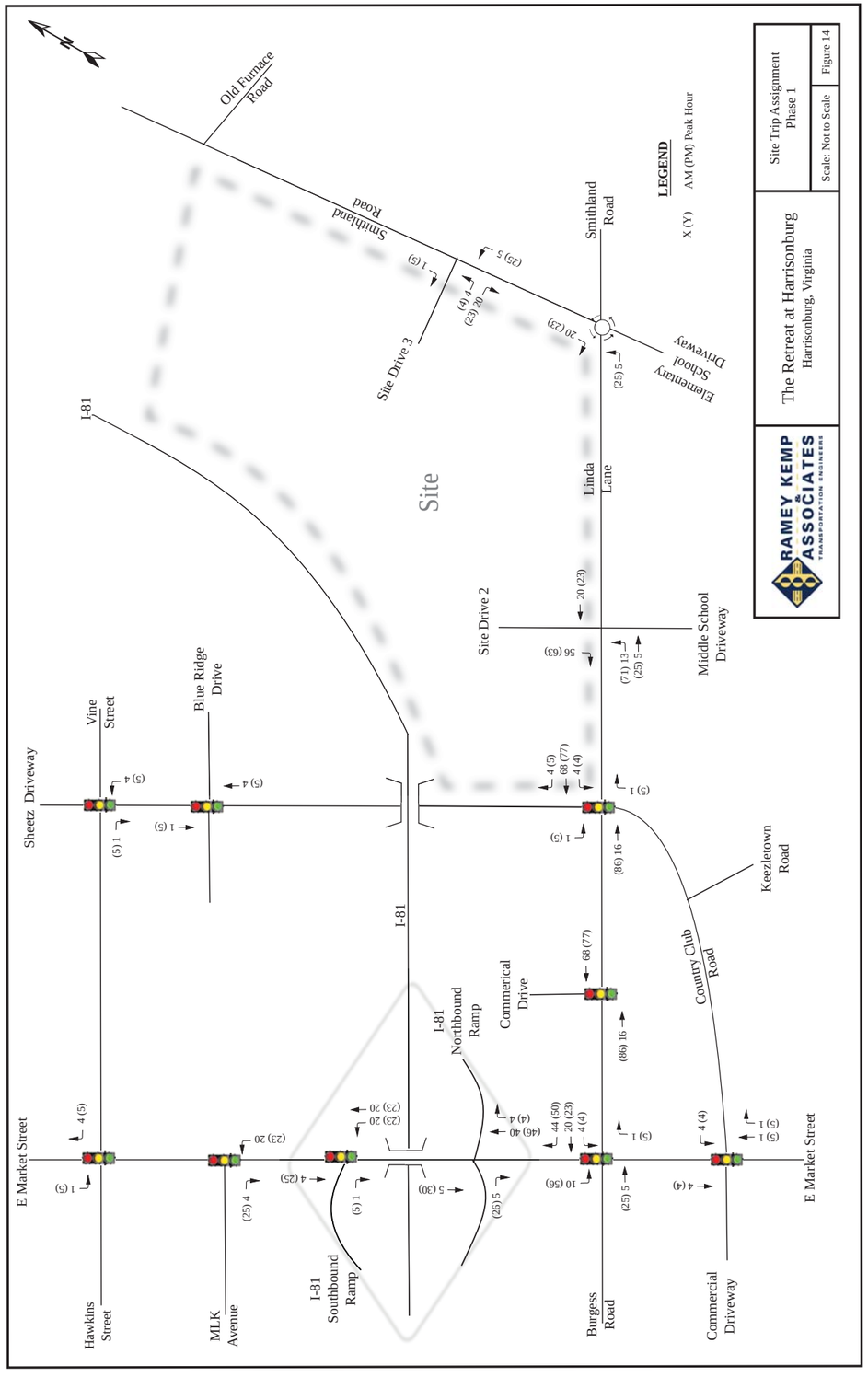
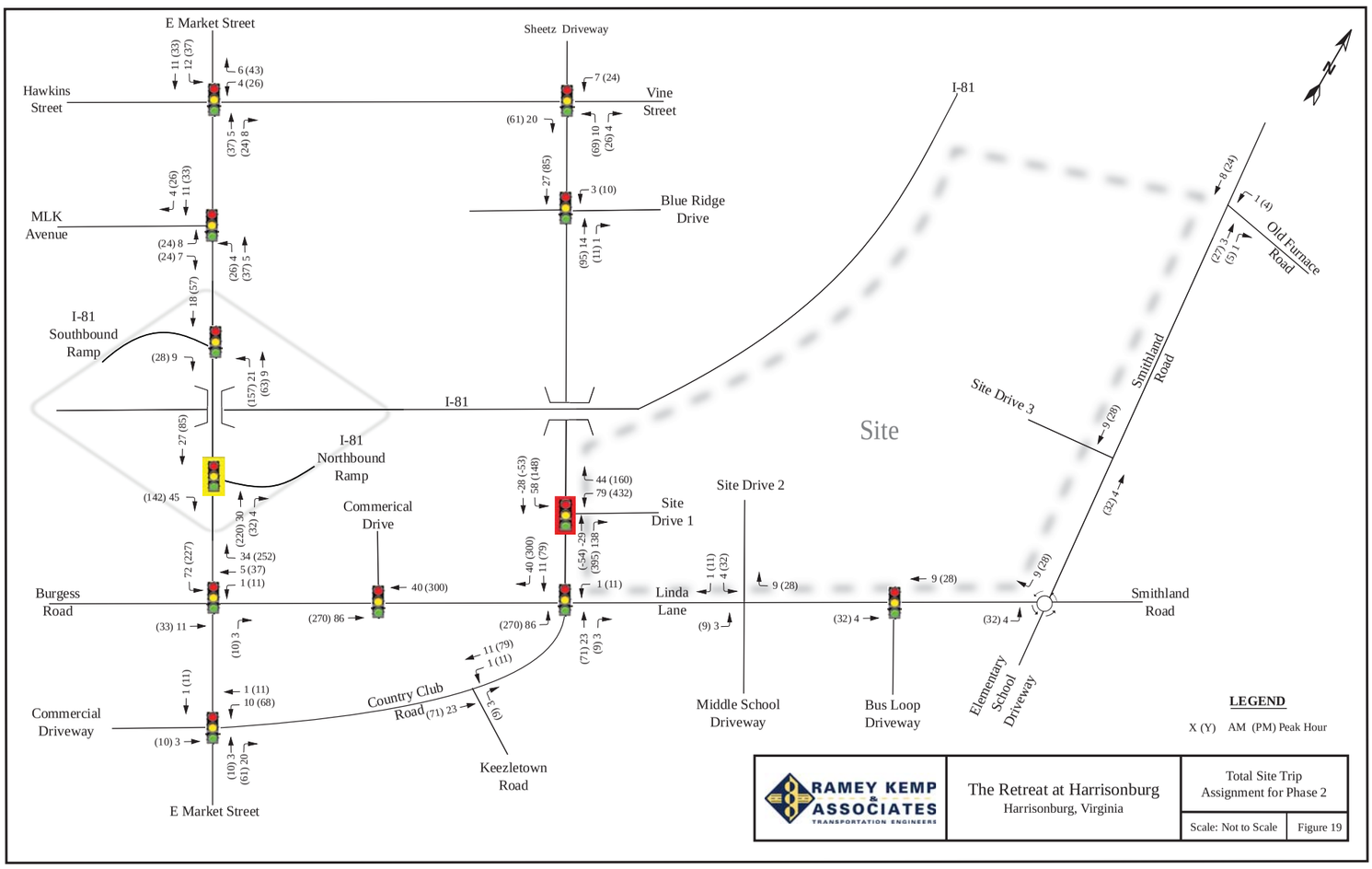


Figure 24 Total Assigned Site Generated Trips




US 33
Country Club Road
Spotswood Valley Square Driveway 2
Keezletown Road
Spotswood Valley Square Driveway 1
University Boulevard
McDonald's Driveway
Valley Mall Driveway
Evelyn Byrd Avenue
Proposed Site
27 (60)
(17) 8
(17) 7
(59) 22
12 (26)
4 (8)
(25) 10
(8) 3
-7 (-11)
23 (45)
24 (49)
54 (129)
(-16) -11
(153) 71
-18 (-42)
53 (119)
7 (17)
3 (9)
37 (92)
(9) 3
(59) 22
(9) 4
19 (50)
59 (95)
(-27) -33
(79) 56
3 (8)
16 (42)
(9) 4
(43) 19
N
LEGEND
X AM Peak Hour - Option 1
(Y) PM Peak Hour - Option 2
RAMEY KEMP & ASSOCIATES
TRANSPORTATION ENGINEERS
Spotswood Country Club Center
Harrisonburg, Virginia
Total Site Trip Assignment
Scale: Not to Scale
Figure 11


Old Furnace Road
Smithland Road
Site Drive 3
Smithland Road
Elementary School Driveway
LEGEND
X (Y) AM (PM) Peak Hour
I-81
Site
Linda Lane
Site Drive 2
Middle School Driveway
Vine Street
Blue Ridge Drive
Sheetz Driveway
I-81
Keezletown Road
Country Club Road
I-81 Northbound Ramp
Commerical Drive
E Market Street
Hawkins Street
MLK Avenue
I-81 Southbound Ramp
Burgess Road
Commercial Driveway
E Market Street
Site Trip Assignment Phase 1
Scale: Not to Scale
Figure 14
The Retreat at Harrisonburg
Harrisonburg, Virginia
RAMEY KEMP & ASSOCIATES
TRANSPORTATION ENGINEERS


E Market Street
Sheetz Driveway
Hawkins Street
Vine Street
MLK Avenue
Blue Ridge Drive
I-81
I-81 Southbound Ramp
I-81 Northbound Ramp
Site
Site Drive 3
Smithland Road
Old Furnace Road
Commerical Drive
Site Drive 1
Site Drive 2
Burgess Road
Linda Lane
Smithland Road
Middle School Driveway
Bus Loop Driveway
Elementary School Driveway
Commercial Driveway
Country Club Road
Keezletown Road
E Market Street
LEGEND
X (Y) AM (PM) Peak Hour
RAMEY KEMP & ASSOCIATES
TRANSPORTATION ENGINEERS
The Retreat at Harrisonburg
Harrisonburg, Virginia
Total Site Trip Assignment for Phase 2
Scale: Not to Scale
Figure 19

Appendix E: Intersection Delay and LOS (No-Build – 2025)

HCM Signalized Intersection Capacity Analysis
1: Hawkins Street & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	213	791	55	34	611	393	14	75	36	503	33	176
Future Volume (vph)	213	791	55	34	611	393	14	75	36	503	33	176
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00		1.00		0.95	0.95	
Frt	1.00	0.99		1.00	1.00	0.85		0.96		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99		0.95	0.98	
Satd. Flow (prot)	1770	3471		1805	3574	1599		1780		1665	1593	
Flt Permitted	0.17	1.00		0.09	1.00	1.00		0.90		0.95	0.98	
Satd. Flow (perm)	318	3471		177	3574	1599		1617		1665	1593	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	234	869	60	37	671	432	15	82	40	553	36	193
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	0	0	19	0
Lane Group Flow (vph)	234	926	0	37	671	432	0	137	0	376	387	0
Heavy Vehicles (%)	2%	3%	3%	0%	1%	1%	2%	2%	2%	3%	3%	3%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Split	NA	
Protected Phases	5	2		1	6			8		3 4 7	3 4 7	
Permitted Phases	2			6		6	8					
Actuated Green, G (s)	66.7	55.0		54.5	48.9	48.9		12.4		72.9	72.9	
Effective Green, g (s)	69.2	57.3		59.1	51.2	51.2		15.6		75.5	75.5	
Actuated g/C Ratio	0.38	0.32		0.33	0.28	0.28		0.09		0.42	0.42	
Clearance Time (s)	6.3	6.3		6.3	6.3	6.3		7.2				
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0				
Lane Grp Cap (vph)	235	1104		129	1016	454		140		698	668	
v/s Ratio Prot	c0.08	0.27		0.01	0.19					0.23	c0.24	
v/s Ratio Perm	c0.31			0.08		0.27		c0.08				
v/c Ratio	1.00	0.84		0.29	0.66	0.95		0.98		0.54	0.58	
Uniform Delay, d1	48.5	57.1		45.2	56.7	63.2		82.0		39.2	40.1	
Progression Factor	1.00	1.00		0.66	0.59	0.62		1.00		0.35	0.38	
Incremental Delay, d2	57.2	7.7		1.0	2.8	28.1		68.8		0.3	0.4	
Delay (s)	105.6	64.7		31.0	36.5	67.0		150.8		14.0	15.8	
Level of Service	F	E		C	D	E		F		B	B	
Approach Delay (s)		73.0			47.9			150.8			14.9	
Approach LOS		E			D			F			B	

Intersection Summary			
HCM 2000 Control Delay	53.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.7
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: Country Club Road & Vine Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	21	68	120	130	287	205	401	75	82	524	88
Future Volume (vph)	22	21	68	120	130	287	205	401	75	82	524	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		1.00	1.00		0.95	
Frt		1.00	0.85		1.00	0.85		1.00	0.85		0.98	
Flt Protected		0.98	1.00		0.98	1.00		0.98	1.00		0.99	
Satd. Flow (prot)		1853	1615		1856	1615		1850	1599		3230	
Flt Permitted		0.98	1.00		0.98	1.00		0.98	1.00		0.99	
Satd. Flow (perm)		1853	1615		1856	1615		1850	1599		3230	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	24	23	73	129	140	309	220	431	81	88	563	95
RTOR Reduction (vph)	0	0	69	0	0	207	0	0	43	0	6	0
Lane Group Flow (vph)	0	47	4	0	269	102	0	651	38	0	740	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	1%	1%	9%	9%	9%
Turn Type	Split	NA	Prot	Split	NA	Prot	Split	NA	Perm	Split	NA	
Protected Phases	3	3	3	4	4	4	2 5 6 8	2 5 6 8		7	7	
Permitted Phases									2 5 6 8			
Actuated Green, G (s)		8.9	8.9		22.9	22.9		79.1	79.1		35.8	
Effective Green, g (s)		10.2	10.2		26.0	26.0		83.9	83.9		39.0	
Actuated g/C Ratio		0.06	0.06		0.14	0.14		0.47	0.47		0.22	
Clearance Time (s)		5.3	5.3		7.1	7.1					7.2	
Vehicle Extension (s)	3.0	3.0		4.0	4.0						3.0	
Lane Grp Cap (vph)	105	91		268	233		862	745			699	
v/s Ratio Prot	c0.03	0.00		c0.14	0.06		c0.35				c0.23	
v/s Ratio Perm								0.02				
v/c Ratio	0.45	0.05		1.00	0.44		0.76	0.05			1.06	
Uniform Delay, d1	82.2	80.3		77.0	70.3		39.6	26.3			70.5	
Progression Factor	1.00	1.00		1.00	1.00		0.13	0.17			1.00	
Incremental Delay, d2	3.0	0.2		55.9	1.8		1.1	0.0			50.5	
Delay (s)	85.2	80.5		132.9	72.1		6.5	4.6			121.0	
Level of Service	F	F		F	E		A	A			F	
Approach Delay (s)	82.3			100.4			6.3				121.0	
Approach LOS	F			F			A				F	

Intersection Summary			
HCM 2000 Control Delay	74.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.2
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: S Carlton St & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1221	81	146	931	140	100	103	137	115	61	7
Future Volume (vph)	28	1221	81	146	931	140	100	103	137	115	61	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00		0.97	
Satd. Flow (prot)	1805	3506		1805	3539			1854	1615		1814	
Flt Permitted	0.15	1.00		0.07	1.00			0.98	1.00		0.97	
Satd. Flow (perm)	288	3506		124	3539			1854	1615		1814	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	1327	88	159	1012	152	109	112	149	125	66	8
RTOR Reduction (vph)	0	2	0	0	6	0	0	0	123	0	1	0
Lane Group Flow (vph)	30	1413	0	159	1158	0	0	221	26	0	198	0
Heavy Vehicles (%)	0%	2%	2%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	D.P+P	NA		D.P+P	NA		Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	6			2					3			
Actuated Green, G (s)	102.0	87.7		102.0	96.6			26.8	26.8		23.0	
Effective Green, g (s)	107.6	90.5		107.6	99.4			30.3	30.3		26.1	
Actuated g/C Ratio	0.60	0.50		0.60	0.55			0.17	0.17		0.15	
Clearance Time (s)	6.8	6.8		6.8	6.8			7.5	7.5		7.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	241	1762		233	1954			312	271		263	
v/s Ratio Prot	0.01	c0.40		c0.06	0.33			c0.12			c0.11	
v/s Ratio Perm	0.07			0.34					0.02			
v/c Ratio	0.12	0.80		0.68	0.59			0.71	0.10		0.75	
Uniform Delay, d1	19.0	37.3		41.4	26.8			70.7	63.3		73.9	
Progression Factor	0.55	0.43		1.44	0.36			1.00	1.00		1.00	
Incremental Delay, d2	0.2	2.7		7.4	1.2			7.2	0.2		11.6	
Delay (s)	10.6	18.7		67.0	11.0			77.9	63.4		85.4	
Level of Service	B	B		E	B			E	E		F	
Approach Delay (s)		18.5			17.7			72.0			85.4	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM 2000 Control Delay	28.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Cantrell Avenue (MLK) & East Market Street

12/14/2018

Movement	EBT	EBR	WBU	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	1351	122	10	232	1047	170	155
Future Volume (vph)	1351	122	10	232	1047	170	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00		0.97	0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3610	1615		3466	3574	1805	1615
Flt Permitted	1.00	1.00		0.17	1.00	0.95	1.00
Satd. Flow (perm)	3610	1615		632	3574	1805	1615
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	1501	136	11	258	1163	189	172
RTOR Reduction (vph)	0	37	0	0	0	0	3
Lane Group Flow (vph)	1501	99	0	269	1163	189	169
Heavy Vehicles (%)	0%	0%	2%	1%	1%	0%	0%
Turn Type	NA	Prot	custom	Prot	NA	Prot	pm+ov
Protected Phases	2	2		1	6	4	1!
Permitted Phases			1!				4
Actuated Green, G (s)	72.9	72.9		64.6	143.9	23.1	87.7
Effective Green, g (s)	75.3	75.3		67.0	146.3	25.7	92.5
Actuated g/C Ratio	0.42	0.42		0.37	0.81	0.14	0.51
Clearance Time (s)	6.4	6.4		6.4	6.4	6.6	6.4
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1510	675		235	2904	257	865
v/s Ratio Prot	c0.42	0.06			0.33	c0.10	0.07
v/s Ratio Perm				c0.43			0.03
v/c Ratio	0.99	0.15		1.14	0.40	0.74	0.20
Uniform Delay, d1	52.1	32.4		56.5	4.7	73.9	23.6
Progression Factor	0.44	0.21		1.26	2.31	1.00	1.00
Incremental Delay, d2	17.5	0.3		102.3	0.4	10.4	0.1
Delay (s)	40.6	7.0		173.7	11.2	84.3	23.8
Level of Service	D	A		F	B	F	C
Approach Delay (s)	37.8				41.7	55.5	
Approach LOS	D				D	E	

Intersection Summary			
HCM 2000 Control Delay	41.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		
! Phase conflict between lane groups.			
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: I-81 SB On & East Market Street

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1116	0	640	1176	0	0
Future Volume (vph)	1116	0	640	1176	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0		
Lane Util. Factor	0.95		1.00	0.95		
Frt	1.00		1.00	1.00		
Flt Protected	1.00		0.95	1.00		
Satd. Flow (prot)	3610		1787	3574		
Flt Permitted	1.00		0.13	1.00		
Satd. Flow (perm)	3610		237	3574		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1213	0	696	1278	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1213	0	696	1278	0	0
Heavy Vehicles (%)	0%	0%	1%	1%	2%	2%
Turn Type	NA		D.P+P	NA		
Protected Phases	2		1	6		
Permitted Phases			2			
Actuated Green, G (s)	43.2		78.0	90.0		
Effective Green, g (s)	45.2		82.0	90.0		
Actuated g/C Ratio	0.50		0.91	1.00		
Clearance Time (s)	6.0		6.0	7.2		
Vehicle Extension (s)	3.0		3.0	3.0		
Lane Grp Cap (vph)	1813		849	3574		
v/s Ratio Prot	0.34		c0.33	0.36		
v/s Ratio Perm			c0.41			
v/c Ratio	0.67		0.82	0.36		
Uniform Delay, d1	16.8		17.3	0.0		
Progression Factor	0.90		2.10	1.00		
Incremental Delay, d2	0.8		5.9	0.3		
Delay (s)	15.9		42.2	0.3		
Level of Service	B		D	A		
Approach Delay (s)	15.9			15.1	0.0	
Approach LOS	B			B	A	

Intersection Summary			
HCM 2000 Control Delay	15.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Brugress Road /Linda Lane & East Market Street

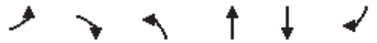
12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	453	1334	219	221	1203	262	348	216	219	191	230	451
Future Volume (vph)	453	1334	219	221	1203	262	348	216	219	191	230	451
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.60	0.91	1.00	0.97	0.91		0.91	0.91	1.00	0.91	0.91	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (prot)	2073	4940	1538	3502	4998		1626	3349	1599	1626	3378	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (perm)	2073	4940	1538	3502	4998		1626	3349	1599	1626	3378	1599
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	498	1466	241	243	1322	288	382	237	241	210	253	496
RTOR Reduction (vph)	0	0	62	0	0	0	0	0	169	0	0	287
Lane Group Flow (vph)	498	1466	179	243	1610	0	191	428	72	115	348	209
Heavy Vehicles (%)	1%	5%	5%	0%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2	8	1	6		8	8		4 3	4 3	
Permitted Phases			2						8			4 3
Actuated Green, G (s)	34.6	70.7	96.1	14.6	51.9		25.4	25.4	25.4	40.0	40.0	40.0
Effective Green, g (s)	38.0	73.4	103.3	19.2	54.6		29.0	29.0	29.0	43.2	43.2	43.2
Actuated g/C Ratio	0.21	0.41	0.57	0.11	0.30		0.16	0.16	0.16	0.24	0.24	0.24
Clearance Time (s)	7.4	6.7	7.6	8.6	6.7		7.6	7.6	7.6			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0			
Lane Grp Cap (vph)	437	2014	882	373	1516		261	539	257	390	810	383
v/s Ratio Prot	c0.24	0.30	0.03	0.07	c0.32		0.12	c0.13		0.07	0.10	
v/s Ratio Perm			0.08						0.04			c0.13
v/c Ratio	1.14	0.73	0.20	0.65	1.06		0.73	0.79	0.28	0.29	0.43	0.55
Uniform Delay, d1	71.0	44.9	18.5	77.2	62.7		71.8	72.6	66.3	55.9	58.0	59.8
Progression Factor	1.00	0.66	1.48	0.81	0.77		1.00	1.00	1.00	0.04	0.04	1.51
Incremental Delay, d2	87.1	2.2	0.1	2.9	38.5		10.1	7.9	0.6	0.0	0.0	0.1
Delay (s)	157.8	31.7	27.5	65.1	86.9		81.9	80.5	66.9	2.0	2.1	90.6
Level of Service	F	C	C	E	F		F	F	E	A	A	F
Approach Delay (s)		59.7			84.0			77.0			47.9	
Approach LOS		E			F			E			D	

Intersection Summary			
HCM 2000 Control Delay	68.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	19.2
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Linda Lane & Hotel Driveway

12/14/2018

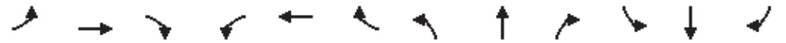


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	28	35	896	844	12
Future Volume (vph)	5	28	35	896	844	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1805	1615		3432	5125	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1805	1615		3432	5125	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	30	38	974	917	13
RTOR Reduction (vph)	0	28	0	0	1	0
Lane Group Flow (vph)	5	2	0	1012	929	0
Heavy Vehicles (%)	0%	0%	5%	5%	1%	1%
Turn Type	Prot	Prot	Split	NA	NA	
Protected Phases	3	3	5 6 8	5 6 8	4	
Permitted Phases						
Actuated Green, G (s)	7.0	7.0		126.0	25.8	
Effective Green, g (s)	9.4	9.4		126.1	29.0	
Actuated g/C Ratio	0.05	0.05		0.70	0.16	
Clearance Time (s)	6.4	6.4			7.2	
Vehicle Extension (s)	3.0	3.0			3.0	
Lane Grp Cap (vph)	94	84		2404	825	
v/s Ratio Prot	c0.00	0.00		c0.29	c0.18	
v/s Ratio Perm						
v/c Ratio	0.05	0.02		0.42	1.13	
Uniform Delay, d1	81.1	80.9		11.4	75.5	
Progression Factor	1.00	1.00		0.06	1.00	
Incremental Delay, d2	0.2	0.1		0.0	72.1	
Delay (s)	81.3	81.0		0.7	147.6	
Level of Service	F	F		A	F	
Approach Delay (s)	81.1			0.7	147.6	
Approach LOS	F			A	F	

Intersection Summary			
HCM 2000 Control Delay	71.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: University Blvd & East Market Street

12/14/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	152	1181	322	133	1058	92	669	185	150	144	80	50
Future Volume (vph)	152	1181	322	133	1058	92	669	185	150	144	80	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		0.97	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	5085	1583	1805	4975		3467	1755		1805	1791	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1805	5085	1583	1805	4975		3467	1755		1805	1791	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	1284	350	145	1150	100	727	201	163	157	87	54
RTOR Reduction (vph)	0	0	108	0	5	0	0	16	0	0	13	0
Lane Group Flow (vph)	165	1284	242	145	1245	0	727	348	0	157	128	0
Heavy Vehicles (%)	0%	2%	2%	0%	3%	3%	1%	1%	1%	0%	0%	0%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA		Split	NA	
Protected Phases	5	2	4	1	6		4	4		3	3	
Permitted Phases			2									
Actuated Green, G (s)	25.5	68.6	113.7	16.2	60.0		45.1	45.1		20.2	20.2	
Effective Green, g (s)	28.0	70.5	124.3	19.4	61.9		50.4	50.4		23.7	23.7	
Actuated g/C Ratio	0.16	0.39	0.69	0.11	0.34		0.28	0.28		0.13	0.13	
Clearance Time (s)	6.5	5.9	9.3	7.2	5.9		9.3	9.3		7.5	7.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	280	1991	1093	194	1710		970	491		237	235	
v/s Ratio Prot	0.09	c0.25	0.06	0.08	c0.25		c0.21	0.20		c0.09	0.07	
v/s Ratio Perm			0.09									
v/c Ratio	0.59	0.64	0.22	0.75	0.73		0.75	0.71		0.66	0.54	
Uniform Delay, d1	70.7	44.6	10.2	77.9	51.7		59.0	58.2		74.3	73.1	
Progression Factor	0.73	0.65	2.73	1.34	0.44		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	1.2	0.1	7.8	1.4		3.2	4.7		6.8	2.6	
Delay (s)	53.8	30.3	27.9	112.1	24.2		62.3	62.9		81.1	75.7	
Level of Service	D	C	C	F	C		E	E		F	E	
Approach Delay (s)		32.0			33.3			62.5			78.6	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	42.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
11: Country Club Road & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	186	1128	140	66	1100	685	125	97	24	664	132	28
Future Volume (vph)	186	1128	140	66	1100	685	125	97	24	664	132	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00		1.00	1.00	0.95	0.95	
Frt	1.00	0.98		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97	1.00	0.95	0.97	
Satd. Flow (prot)	1805	4952		1805	3574	1599		1848	1615	1715	1734	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.97	1.00	0.95	0.97	
Satd. Flow (perm)	1805	4952		1805	3574	1599		1848	1615	1715	1734	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	200	1213	151	71	1183	737	134	104	26	714	142	30
RTOR Reduction (vph)	0	8	0	0	0	257	0	0	22	0	1	0
Lane Group Flow (vph)	200	1356	0	71	1183	480	0	238	4	443	442	0
Heavy Vehicles (%)	0%	3%	3%	0%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA	Prot	Split	NA	
Protected Phases	5	2		1	6		4	4	4	3	3	
Permitted Phases						6						
Actuated Green, G (s)	20.0	71.6		12.1	63.4	63.4		22.4	22.4	46.6	46.6	
Effective Green, g (s)	22.7	73.5		14.5	65.3	65.3		25.9	25.9	50.1	50.1	
Actuated g/C Ratio	0.13	0.41		0.08	0.36	0.36		0.14	0.14	0.28	0.28	
Clearance Time (s)	6.7	5.9		6.4	5.9	5.9		7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	227	2022		145	1296	580		265	232	477	482	
v/s Ratio Prot	c0.11	0.27		0.04	c0.33			c0.13	0.00	c0.26	0.25	
v/s Ratio Perm						0.30						
v/c Ratio	0.88	0.67		0.49	0.91	0.83		0.90	0.02	0.93	0.92	
Uniform Delay, d1	77.3	43.4		79.2	54.6	52.2		75.8	66.1	63.2	62.9	
Progression Factor	0.85	1.47		0.96	0.93	0.88		1.00	1.00	1.00	1.00	
Incremental Delay, d2	25.5	1.4		2.1	9.6	10.7		29.9	0.0	24.4	22.0	
Delay (s)	90.9	65.0		78.5	60.6	56.7		105.6	66.1	87.6	85.0	
Level of Service	F	E		E	E	E		F	E	F	F	
Approach Delay (s)		68.3			59.8			101.7			86.3	
Approach LOS		E			E			F			F	

Intersection Summary			
HCM 2000 Control Delay	70.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	88.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
13: Evelyn byrd Ave & East Market Street

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1626	202	227	1504	254	548
Future Volume (vph)	1626	202	227	1504	254	548
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.91		0.97	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	5056		3502	3574	1805	1615
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	5056		3502	3574	1805	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1767	220	247	1635	276	596
RTOR Reduction (vph)	17	0	0	0	0	2
Lane Group Flow (vph)	1970	0	247	1635	276	594
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	4	1
Permitted Phases						4
Actuated Green, G (s)	37.0		16.0	61.0	13.2	29.2
Effective Green, g (s)	39.9		20.0	63.9	18.1	37.2
Actuated g/C Ratio	0.44		0.22	0.71	0.20	0.41
Clearance Time (s)	6.9		8.0	6.9	8.9	8.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2241		778	2537	363	739
v/s Ratio Prot	c0.39		0.07	0.46	0.15	c0.18
v/s Ratio Perm						0.19
v/c Ratio	0.88		0.32	0.64	0.76	0.80
Uniform Delay, d1	22.8		29.3	7.0	33.9	23.2
Progression Factor	0.94		0.72	0.60	1.00	1.00
Incremental Delay, d2	3.8		0.2	0.8	9.1	6.3
Delay (s)	25.3		21.2	5.0	43.0	29.5
Level of Service	C		C	A	D	C
Approach Delay (s)	25.3			7.1	33.8	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	19.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
15: Chestnut Ridge Dr & East Market Street

12/14/2018

Movement	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	56	1830	236	58	1404	244	89
Future Volume (vph)	56	1830	236	58	1404	244	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.7	6.4	6.4	7.0	6.4	9.0	9.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1805	3539	1583	1805	3574	1787	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1805	3539	1583	1805	3574	1787	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	1989	257	63	1526	265	97
RTOR Reduction (vph)	0	0	104	0	0	0	83
Lane Group Flow (vph)	61	1989	153	63	1526	265	14
Heavy Vehicles (%)	0%	2%	2%	0%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA	Prot	Prot
Protected Phases	5	2		1	6	4	4
Permitted Phases			2				
Actuated Green, G (s)	5.6	49.0	49.0	5.6	49.3	13.0	13.0
Effective Green, g (s)	5.6	49.0	49.0	5.6	49.3	13.0	13.0
Actuated g/C Ratio	0.06	0.54	0.54	0.06	0.55	0.14	0.14
Clearance Time (s)	6.7	6.4	6.4	7.0	6.4	9.0	9.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	112	1926	861	112	1957	258	230
v/s Ratio Prot	0.03	c0.56		c0.03	0.43	c0.15	0.01
v/s Ratio Perm			0.10				
v/c Ratio	0.54	1.03	0.18	0.56	0.78	1.03	0.06
Uniform Delay, d1	41.0	20.5	10.3	41.0	16.1	38.5	33.2
Progression Factor	0.95	0.87	1.36	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	23.9	0.2	6.3	3.2	63.2	0.1
Delay (s)	41.5	41.7	14.3	47.3	19.2	101.7	33.3
Level of Service	D	D	B	D	B	F	C
Approach Delay (s)		38.6			20.3	83.4	
Approach LOS		D			C	F	

Intersection Summary			
HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
16: Linda Lane & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	498	488	125	536	251	490	269	142	149	243	49
Future Volume (vph)	41	498	488	125	536	251	490	269	142	149	243	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1805	1900	1599	1805	1900	1615	1787	1802		1805	1900	1615
Flt Permitted	0.12	1.00	1.00	0.14	1.00	1.00	0.16	1.00		0.50	1.00	1.00
Satd. Flow (perm)	225	1900	1599	257	1900	1615	296	1802		959	1900	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	541	530	136	583	273	533	292	154	162	264	53
RTOR Reduction (vph)	0	0	266	0	0	113	0	12	0	0	0	44
Lane Group Flow (vph)	45	541	264	136	583	160	533	434	0	162	264	9
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4			8		8
Actuated Green, G (s)	53.2	47.9	47.9	56.8	49.7	49.7	67.2	50.9		31.6	21.3	21.3
Effective Green, g (s)	57.2	49.9	49.9	60.8	51.7	51.7	69.2	52.9		35.6	23.3	23.3
Actuated g/C Ratio	0.41	0.36	0.36	0.43	0.37	0.37	0.49	0.38		0.25	0.17	0.17
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	174	676	569	211	700	595	591	679		317	315	268
v/s Ratio Prot	0.01	0.28		c0.04	c0.31		c0.27	0.24		0.04	0.14	
v/s Ratio Perm	0.09		0.17	0.24		0.10	c0.18			0.08		0.01
v/c Ratio	0.26	0.80	0.46	0.64	0.83	0.27	0.90	0.64		0.51	0.84	0.03
Uniform Delay, d1	30.2	40.7	34.8	30.0	40.3	31.0	36.9	35.8		42.9	56.6	49.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	6.7	0.6	6.6	8.4	0.2	17.0	2.0		1.4	17.4	0.1
Delay (s)	31.0	47.4	35.4	36.6	48.7	31.3	53.8	37.8		44.3	74.0	49.1
Level of Service	C	D	D	D	D	C	D	D		D	E	D
Approach Delay (s)		41.1			42.2			46.5			61.2	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	45.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	140.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	87.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
18: Blue Ridge Drive & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	172	541	6	8	638	198	1	3	5	151	3	74
Future Volume (vph)	172	541	6	8	638	198	1	3	5	151	3	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			4.0	4.0
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	1.00
Frt	1.00	1.00			0.97			0.93			1.00	0.85
Flt Protected	0.95	1.00			1.00			0.99			0.95	1.00
Satd. Flow (prot)	1805	1897			1839			1748			1811	1615
Flt Permitted	0.25	1.00			0.99			0.99			0.95	1.00
Satd. Flow (perm)	481	1897			1831			1748			1811	1615
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	181	569	6	8	672	208	1	3	5	159	3	78
RTOR Reduction (vph)	0	0	0	0	9	0	0	5	0	0	0	65
Lane Group Flow (vph)	181	575	0	0	879	0	0	4	0	0	162	13
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA		Perm	NA		Split	NA		Split	NA	Perm
Protected Phases	1	6			2		4	4		8	8	
Permitted Phases	6			2								8
Actuated Green, G (s)	67.4	67.4			53.3			1.0			14.6	14.6
Effective Green, g (s)	69.4	69.4			55.3			3.0			16.6	16.6
Actuated g/C Ratio	0.69	0.69			0.55			0.03			0.16	0.16
Clearance Time (s)	6.0	6.0			6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	462	1303			1002			51			297	265
v/s Ratio Prot	0.04	c0.30						c0.00			c0.09	
v/s Ratio Perm	0.23				c0.48							0.01
v/c Ratio	0.39	0.44			0.88			0.08			0.55	0.05
Uniform Delay, d1	17.9	7.1			19.9			47.7			38.7	35.5
Progression Factor	1.00	1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2	0.6	0.2			8.8			0.7			2.0	0.1
Delay (s)	18.5	7.3			28.7			48.3			40.8	35.6
Level of Service	B	A			C			D			D	D
Approach Delay (s)		10.0			28.7			48.3			39.1	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	22.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	101.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
19: I-81 NB Ramps & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	1332	0	0	1526	0	0	0	68	0	0	0
Future Volume (vph)	99	1332	0	0	1526	0	0	0	68	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0				6.0			
Lane Util. Factor	1.00	0.95			0.95				1.00			
Frt	1.00	1.00			1.00				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	3539			3539				1565			
Flt Permitted	0.15	1.00			1.00				1.00			
Satd. Flow (perm)	275	3539			3539				1565			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	108	1448	0	0	1659	0	0	0	74	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	69	0	0	0
Lane Group Flow (vph)	108	1448	0	0	1659	0	0	0	5	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	2%
Turn Type	Perm	NA			NA				Prot			
Protected Phases		6			2				5			
Permitted Phases	6											
Actuated Green, G (s)	72.4	72.4			90.0				5.6			
Effective Green, g (s)	72.4	72.4			90.0				5.6			
Actuated g/C Ratio	0.80	0.80			1.00				0.06			
Clearance Time (s)	6.0	6.0			6.0				6.0			
Vehicle Extension (s)	3.0	3.0			3.0				3.0			
Lane Grp Cap (vph)	221	2846			3539				97			
v/s Ratio Prot		c0.41			c0.47				0.00			
v/s Ratio Perm	0.39											
v/c Ratio	0.49	0.51			0.47				0.05			
Uniform Delay, d1	2.8	2.9			0.0				39.7			
Progression Factor	0.65	0.26			1.00				1.00			
Incremental Delay, d2	6.5	0.6			0.2				0.2			
Delay (s)	8.4	1.3			0.2				39.9			
Level of Service	A	A			A				D			
Approach Delay (s)		1.8			0.2		39.9			0.0		
Approach LOS		A			A		D			A		

Intersection Summary			
HCM 2000 Control Delay	1.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Country Club Road & Retreat Driveway

12/14/2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	148	595	680	395	432	160
Future Volume (vph)	148	595	680	395	432	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1900	1615	3467	1615
Flt Permitted	0.32	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	607	1900	1900	1615	3467	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	161	647	739	429	470	174
RTOR Reduction (vph)	0	0	0	94	0	145
Lane Group Flow (vph)	161	647	739	335	470	29
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		6	2		8	
Permitted Phases	6			2		8
Actuated Green, G (s)	137.9	137.9	137.9	137.9	30.1	30.1
Effective Green, g (s)	137.9	137.9	137.9	137.9	30.1	30.1
Actuated g/C Ratio	0.77	0.77	0.77	0.77	0.17	0.17
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	465	1455	1455	1237	579	270
v/s Ratio Prot		0.34	c0.39		c0.14	
v/s Ratio Perm	0.27			0.21		0.02
v/c Ratio	0.35	0.44	0.51	0.27	0.81	0.11
Uniform Delay, d1	6.7	7.5	8.1	6.2	72.2	63.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.0	1.0	1.3	0.5	8.5	0.2
Delay (s)	8.7	8.5	9.3	6.7	80.7	63.7
Level of Service	A	A	A	A	F	E
Approach Delay (s)		8.5	8.4		76.1	
Approach LOS		A	A		E	

Intersection Summary			
HCM 2000 Control Delay	25.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
8: East Market Street & Wendy's

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	97	1586	61	104	1614	59	0	0	69	0	0	72
Future Volume (Veh/h)	97	1586	61	104	1614	59	0	0	69	0	0	72
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	105	1724	66	113	1754	64	0	0	75	0	0	78
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		725			1074							
pX, platoon unblocked	0.80			0.76			0.86	0.86	0.76	0.86	0.86	0.80
vC, conflicting volume	1818			1790			2856	4011	608	2872	4012	617
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1151			925			1015	2362	0	1034	2363	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	78			80			100	100	91	100	100	91
cM capacity (veh/h)	483			566			107	19	827	105	19	871

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	105	690	690	411	113	702	702	415	75	78
Volume Left	105	0	0	0	113	0	0	0	0	0
Volume Right	0	0	0	66	0	0	0	64	75	78
cSH	483	1700	1700	1700	566	1700	1700	1700	827	871
Volume to Capacity	0.22	0.41	0.41	0.24	0.20	0.41	0.41	0.24	0.09	0.09
Queue Length 95th (ft)	20	0	0	0	18	0	0	0	7	7
Control Delay (s)	14.5	0.0	0.0	0.0	12.9	0.0	0.0	0.0	9.8	9.5
Lane LOS	B				B				A	A
Approach Delay (s)	0.8				0.8				9.8	9.5
Approach LOS									A	A

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Valley Mall & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	68	1384	23	36	1199	18	35	1	47	23	3	49
Future Volume (Veh/h)	68	1384	23	36	1199	18	35	1	47	23	3	49
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	74	1504	25	39	1303	20	38	1	51	25	3	53
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		612			781							
pX, platoon unblocked	0.73			0.80			0.83	0.83	0.80	0.83	0.83	0.73
vC, conflicting volume	1323			1529			2231	3066	514	2092	3068	444
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	131			783			121	1129	0	0	1132	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			94			93	99	94	97	98	93
cM capacity (veh/h)	1067			675			584	149	872	722	149	793

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2	SB 1
Volume Total	74	602	602	326	39	521	521	281	39	51	81
Volume Left	74	0	0	0	39	0	0	0	38	0	25
Volume Right	0	0	0	25	0	0	0	20	0	51	53
cSH	1067	1700	1700	1700	675	1700	1700	1700	543	872	666
Volume to Capacity	0.07	0.35	0.35	0.19	0.06	0.31	0.31	0.17	0.07	0.06	0.12
Queue Length 95th (ft)	6	0	0	0	5	0	0	0	6	5	10
Control Delay (s)	8.6	0.0	0.0	0.0	10.7	0.0	0.0	0.0	12.1	9.4	11.2
Lane LOS	A				B				B	A	B
Approach Delay (s)	0.4				0.3				10.6		11.2
Approach LOS									B		B

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	51.7%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
12: Skyline Center & East Market Street

12/14/2018

Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (veh/h)	20	0	1736	60	45	1634	79	98	0	92	0	0
Future Volume (Veh/h)	20	0	1736	60	45	1634	79	98	0	92	0	0
Sign Control			Free			Free			Stop			Stop
Grade			0%			0%			0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	1887	65	49	1776	86	107	0	100	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			None			None						
Median storage veh)												
Upstream signal (ft)			548			1024						
pX, platoon unblocked	0.00	0.73			0.78			0.84	0.84	0.78	0.84	0.84
vC, conflicting volume	0	1862			1952			3014	3880	662	2603	3826
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	0	1450			1249			1475	2503	0	988	2440
tC, single (s)	0.0	4.1			4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)												
tF (s)	0.0	2.2			2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	0	100			89			0	100	88	100	100
cM capacity (veh/h)	0	347			442			58	22	855	137	23

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2	SB 1
Volume Total	472	944	537	49	888	888	86	107	100	108
Volume Left	0	0	0	49	0	0	0	107	0	0
Volume Right	0	0	65	0	0	0	86	0	100	108
cSH	347	1700	1700	442	1700	1700	1700	58	855	669
Volume to Capacity	0.00	0.56	0.32	0.11	0.52	0.52	0.05	1.85	0.12	0.16
Queue Length 95th (ft)	0	0	0	9	0	0	0	253	10	14
Control Delay (s)	0.0	0.0	0.0	14.2	0.0	0.0	0.0	554.2	9.8	11.4
Lane LOS				B				F	A	B
Approach Delay (s)	0.0			0.4				291.2		11.4
Approach LOS								F		B

Intersection Summary				
Average Delay	14.9			
Intersection Capacity Utilization	70.4%	ICU Level of Service		C
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Traffic Volume (veh/h)	99
Future Volume (Veh/h)	99
Sign Control	
Grade	
Peak Hour Factor	0.92
Hourly flow rate (vph)	108
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	0.73
vC, conflicting volume	888
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	123
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	84
cM capacity (veh/h)	669

Direction, Lane #

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	2091	32	23	1658	23	36	0	15	16	0	37
Future Volume (Veh/h)	51	2091	32	23	1658	23	36	0	15	16	0	37
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	55	2273	35	25	1802	25	39	0	16	17	0	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		554			855							
pX, platoon unblocked	0.64			0.65			0.81	0.81	0.65	0.81	0.81	0.64
vC, conflicting volume	1827			2308			3392	4278	775	2736	4270	901
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1166			1142			919	2008	0	112	1999	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	86			94			74	100	98	97	100	94
cM capacity (veh/h)	380			404			149	39	712	579	40	698

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	55	909	909	490	25	901	901	25	55	57
Volume Left	55	0	0	0	25	0	0	0	39	17
Volume Right	0	0	0	35	0	0	0	25	16	40
cSH	380	1700	1700	1700	404	1700	1700	1700	194	658
Volume to Capacity	0.14	0.53	0.53	0.29	0.06	0.53	0.53	0.01	0.28	0.09
Queue Length 95th (ft)	13	0	0	0	5	0	0	0	28	7
Control Delay (s)	16.1	0.0	0.0	0.0	14.5	0.0	0.0	0.0	30.8	11.0
Lane LOS	C				B				D	B
Approach Delay (s)	0.4				0.2				30.8	11.0
Approach LOS									D	B

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	58.6%	ICU Level of Service		B
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	674	23	7	833	11	69
Future Volume (Veh/h)	674	23	7	833	11	69
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	733	25	8	905	12	75
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	588					
pX, platoon unblocked			0.85		0.85	0.85
vC, conflicting volume			758		1666	746
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			629		1695	615
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		86	82
cM capacity (veh/h)			812		419	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	758	913	87
Volume Left	0	8	12
Volume Right	25	0	75
cSH	1700	812	273
Volume to Capacity	0.45	0.01	0.32
Queue Length 95th (ft)	0	1	33
Control Delay (s)	0.0	0.3	24.2
Lane LOS		A	C
Approach Delay (s)	0.0	0.3	24.2
Approach LOS			C

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		

Appendix F: Intersection Delay and LOS (Build – 2025)

F-1: 2025 Build with Existing Cycle Length (180 Seconds)

Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	133	48	826	55	36	808	308	24	65	36	606	31
Future Volume (vph)	133	48	826	55	36	808	308	24	65	36	606	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0		3.9		4.7	4.7
Lane Util. Factor		1.00	0.95		1.00	0.95	1.00		1.00		0.95	0.95
Frt		1.00	0.99		1.00	1.00	0.85		0.96		1.00	0.96
Flt Protected		0.95	1.00		0.95	1.00	1.00		0.99		0.95	0.97
Satd. Flow (prot)		1770	3472		1805	3574	1599		1773		1665	1632
Flt Permitted		0.15	1.00		0.19	1.00	1.00		0.99		0.95	0.97
Satd. Flow (perm)		274	3472		364	3574	1599		1773		1665	1632
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	146	53	908	60	40	888	338	26	71	40	666	34
RTOR Reduction (vph)	0	0	2	0	0	0	0	0	0	0	0	8
Lane Group Flow (vph)	0	199	966	0	40	888	338	0	137	0	453	327
Heavy Vehicles (%)	2%	2%	3%	3%	0%	1%	1%	2%	2%	2%	3%	3%
Turn Type	pm+pt	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA
Protected Phases	5	5	2		1	6		4	4		3	3
Permitted Phases	2	2			6		6					
Actuated Green, G (s)		89.6	77.5		71.9	66.1	66.1		17.5		53.5	53.5
Effective Green, g (s)		91.9	79.8		76.5	68.4	68.4		20.7		54.8	54.8
Actuated g/C Ratio		0.51	0.44		0.42	0.38	0.38		0.11		0.30	0.30
Clearance Time (s)		6.3	6.3		6.3	6.3	6.3		7.1		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0		4.0		3.0	3.0
Lane Grp Cap (vph)		301	1539		219	1358	607		203		506	496
v/s Ratio Prot		c0.07	0.28		0.01	0.25			c0.08		c0.27	0.20
v/s Ratio Perm		c0.27			0.07		0.21					
v/c Ratio		0.66	0.63		0.18	0.65	0.56		0.67		0.90	0.66
Uniform Delay, d1		30.7	38.6		32.2	46.0	43.9		76.4		59.9	54.5
Progression Factor		1.00	1.00		0.64	0.61	0.62		1.00		1.00	1.00
Incremental Delay, d2		5.4	1.9		0.3	2.0	3.0		9.3		18.1	3.2
Delay (s)		36.0	40.6		21.0	30.1	30.0		85.7		78.0	57.7
Level of Service		D	D		C	C	C		F		E	E
Approach Delay (s)			39.8			29.8			85.7			69.3
Approach LOS			D			C			F			E

Intersection Summary			
HCM 2000 Control Delay	44.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.9
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	80
Future Volume (vph)	80
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.91
Adj. Flow (vph)	88
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Heavy Vehicles (%)	3%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: S Carlton St & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	1381	81	146	993	116	102	103	137	115	50	58
Future Volume (vph)	6	1381	81	146	993	116	102	103	137	115	50	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85		0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00		0.97	
Satd. Flow (prot)	1805	3510		1805	3553			1854	1615		1769	
Flt Permitted	0.14	1.00		0.04	1.00			0.98	1.00		0.97	
Satd. Flow (perm)	266	3510		85	3553			1854	1615		1769	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	1501	88	159	1079	126	111	112	149	125	54	63
RTOR Reduction (vph)	0	3	0	0	4	0	0	0	89	0	7	0
Lane Group Flow (vph)	7	1586	0	159	1201	0	0	223	60	0	235	0
Heavy Vehicles (%)	0%	2%	2%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	D.P+P	NA		D.P+P	NA		Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	6			2					3			
Actuated Green, G (s)	98.0	86.6		98.0	96.7			26.9	26.9		26.9	
Effective Green, g (s)	103.6	89.4		103.6	99.5			30.4	30.4		30.0	
Actuated g/C Ratio	0.58	0.50		0.58	0.55			0.17	0.17		0.17	
Clearance Time (s)	6.8	6.8		6.8	6.8			7.5	7.5		7.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	188	1743		184	1964			313	272		294	
v/s Ratio Prot	0.00	c0.45		c0.07	0.34			c0.12			c0.13	
v/s Ratio Perm	0.02			0.43					0.04			
v/c Ratio	0.04	0.91		0.86	0.61			0.71	0.22		0.80	
Uniform Delay, d1	20.7	41.6		57.8	27.2			70.7	64.6		72.1	
Progression Factor	0.83	0.71		1.57	0.47			1.00	1.00		1.00	
Incremental Delay, d2	0.1	6.7		26.9	1.1			7.5	0.4		14.4	
Delay (s)	17.3	36.3		117.6	14.0			78.1	65.0		86.5	
Level of Service	B	D		F	B			E	E		F	
Approach Delay (s)		36.2			26.0			72.9			86.5	
Approach LOS		D			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	39.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Cantrell Avenue (MLK) & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	87	1425	122	10	153	1089	3	122	109	94	7	177
Future Volume (vph)	87	1425	122	10	153	1089	3	122	109	94	7	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	4.0	4.0		4.0	4.0		3.4	6.0		6.6	6.6
Lane Util. Factor	1.00	0.95	1.00		0.97	0.95		1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85		1.00	1.00		1.00	0.93		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1770	3610	1615		3465	3573		1805	1748		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1770	3610	1615		3465	3573		1805	1748		1770	1863
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.92	0.90	0.92	0.90	0.92	0.92
Adj. Flow (vph)	95	1583	136	11	170	1210	3	136	118	104	8	192
RTOR Reduction (vph)	0	0	43	0	0	0	0	0	18	0	0	0
Lane Group Flow (vph)	95	1583	93	0	181	1213	0	136	204	0	8	192
Heavy Vehicles (%)	2%	0%	0%	2%	1%	1%	2%	0%	2%	0%	2%	2%
Turn Type	Prot	NA	Prot	Prot	Prot	NA		Split	NA		Split	NA
Protected Phases	5	2	2	1	1	6		4	4		3	3
Permitted Phases												
Actuated Green, G (s)	14.2	96.9	96.9		10.6	93.7		24.4	24.4		22.7	22.7
Effective Green, g (s)	14.2	99.3	99.3		13.0	96.1		27.0	24.4		22.7	22.7
Actuated g/C Ratio	0.08	0.55	0.55		0.07	0.53		0.15	0.14		0.13	0.13
Clearance Time (s)	6.0	6.4	6.4		6.4	6.4		6.0	6.0		6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	139	1991	890		250	1907		270	236		223	234
v/s Ratio Prot	0.05	c0.44	0.06		0.05	c0.34		0.08	c0.12		0.00	c0.10
v/s Ratio Perm												
v/c Ratio	0.68	0.80	0.10		0.72	0.64		0.50	0.86		0.04	0.82
Uniform Delay, d1	80.7	32.2	19.2		81.7	29.6		70.3	76.2		69.0	76.7
Progression Factor	1.38	0.24	0.03		1.26	1.56		1.00	1.00		1.00	1.00
Incremental Delay, d2	7.0	1.8	0.1		9.6	1.6		1.5	26.3		0.1	20.1
Delay (s)	118.2	9.6	0.7		112.9	47.7		71.8	102.4		69.1	96.7
Level of Service	F	A	A		F	D		E	F		E	F
Approach Delay (s)		14.6				56.2			90.8			90.5
Approach LOS		B				E			F			F

Intersection Summary			
HCM 2000 Control Delay	41.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	22.6
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	44
Future Volume (vph)	44
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.6
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1583
Flt Permitted	1.00
Satd. Flow (perm)	1583
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	48
RTOR Reduction (vph)	42
Lane Group Flow (vph)	6
Heavy Vehicles (%)	2%
Turn Type	Perm
Protected Phases	
Permitted Phases	3
Actuated Green, G (s)	22.7
Effective Green, g (s)	22.7
Actuated g/C Ratio	0.13
Clearance Time (s)	6.6
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	199
v/s Ratio Prot	
v/s Ratio Perm	0.00
v/c Ratio	0.03
Uniform Delay, d1	69.0
Progression Factor	1.00
Incremental Delay, d2	0.1
Delay (s)	69.1
Level of Service	E
Approach Delay (s)	
Approach LOS	

Intersection Summary			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1135	0	640	1142	0	0
Future Volume (vph)	1135	0	640	1142	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0		
Lane Util. Factor	0.95		1.00	0.95		
Frt	1.00		1.00	1.00		
Flt Protected	1.00		0.95	1.00		
Satd. Flow (prot)	3610		1787	3574		
Flt Permitted	1.00		0.12	1.00		
Satd. Flow (perm)	3610		225	3574		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1234	0	696	1241	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1234	0	696	1241	0	0
Heavy Vehicles (%)	0%	0%	1%	1%	2%	2%
Turn Type	NA		D.P+P	NA		
Protected Phases	2		1	6		
Permitted Phases			2			
Actuated Green, G (s)	43.1		78.0	90.0		
Effective Green, g (s)	45.1		82.0	90.0		
Actuated g/C Ratio	0.50		0.91	1.00		
Clearance Time (s)	6.0		6.0	7.2		
Vehicle Extension (s)	3.0		3.0	3.0		
Lane Grp Cap (vph)	1809		845	3574		
v/s Ratio Prot	0.34		c0.34	0.35		
v/s Ratio Perm			c0.41			
v/c Ratio	0.68		0.82	0.35		
Uniform Delay, d1	17.0		17.7	0.0		
Progression Factor	1.06		1.67	1.00		
Incremental Delay, d2	1.3		6.2	0.3		
Delay (s)	19.4		35.8	0.3		
Level of Service	B		D	A		
Approach Delay (s)	19.4			13.0	0.0	
Approach LOS	B			B	A	

Intersection Summary			
HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Brugress Road /Linda Lane & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	419	1385	220	221	1243	262	348	216	219	191	230	377
Future Volume (vph)	419	1385	220	221	1243	262	348	216	219	191	230	377
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	2.4	4.0	4.0		2.4	2.4	2.4	4.0	4.0	4.0
Lane Util. Factor	*0.60	0.91	1.00	0.97	0.91		0.91	0.91	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (prot)	2073	4940	1538	3502	5002		1626	3349	1599	1626	3378	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (perm)	2073	4940	1538	3502	5002		1626	3349	1599	1626	3378	1599
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	460	1522	242	243	1366	288	382	237	241	210	253	414
RTOR Reduction (vph)	0	0	57	0	0	0	0	0	142	0	0	307
Lane Group Flow (vph)	460	1522	185	243	1654	0	191	428	99	115	348	107
Confl. Peds. (#/hr)	221											
Heavy Vehicles (%)	1%	5%	5%	0%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2	8	1	6		8	8		4	4	
Permitted Phases			2						8			4
Actuated Green, G (s)	38.6	85.5	105.5	14.2	62.3		20.0	20.0	20.0	31.8	31.8	31.8
Effective Green, g (s)	42.0	88.2	112.7	18.8	65.0		23.6	23.6	23.6	35.0	35.0	35.0
Actuated g/C Ratio	0.23	0.49	0.63	0.10	0.36		0.13	0.13	0.13	0.19	0.19	0.19
Clearance Time (s)	7.4	6.7	6.0	8.6	6.7		6.0	6.0	6.0	7.2	7.2	7.2
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	483	2420	962	365	1806		213	439	209	316	656	310
v/s Ratio Prot	c0.22	0.31	0.03	0.07	c0.33		0.12	c0.13		0.07	c0.10	
v/s Ratio Perm			0.10						0.06			0.07
v/c Ratio	0.95	0.63	0.19	0.67	0.92		0.90	0.97	0.48	0.36	0.53	0.35
Uniform Delay, d1	68.0	33.8	14.3	77.6	54.9		77.0	77.9	72.5	62.9	65.1	62.6
Progression Factor	0.99	0.90	2.35	0.55	0.36		1.00	1.00	1.00	0.12	0.11	2.01
Incremental Delay, d2	29.1	1.2	0.1	3.4	6.8		34.6	36.1	1.7	0.4	0.5	0.4
Delay (s)	96.6	31.6	33.7	46.0	26.5		111.6	114.0	74.2	8.2	7.8	126.4
Level of Service	F	C	C	D	C		F	F	E	A	A	F
Approach Delay (s)		45.3			29.0			102.3			63.9	
Approach LOS		D			C			F			E	

Intersection Summary			
HCM 2000 Control Delay	51.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	14.4
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Linda Lane & Hotel Driveway

12/14/2018

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	28	37	861	770	12
Future Volume (vph)	0	28	37	861	770	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		3.8	4.0	
Lane Util. Factor		1.00		0.95	0.91	
Frt		0.86		1.00	1.00	
Flt Protected		1.00		1.00	1.00	
Satd. Flow (prot)		1644		3431	5124	
Flt Permitted		1.00		0.95	1.00	
Satd. Flow (perm)		1644		3283	5124	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	30	40	936	837	13
RTOR Reduction (vph)	0	0	0	0	1	0
Lane Group Flow (vph)	0	30	0	976	849	0
Heavy Vehicles (%)	0%	0%	5%	5%	1%	1%
Turn Type		custom	D.P+P	NA	NA	
Protected Phases		5 6 8	5 6 8	4 5 6 8	4	
Permitted Phases		4	4			
Actuated Green, G (s)		166.8		166.8	31.8	
Effective Green, g (s)		167.3		166.3	35.0	
Actuated g/C Ratio		0.93		0.92	0.19	
Clearance Time (s)					7.2	
Vehicle Extension (s)					3.0	
Lane Grp Cap (vph)		1528		3140	996	
v/s Ratio Prot		0.01		c0.23	c0.17	
v/s Ratio Perm		0.00		0.06		
v/c Ratio		0.02		0.31	0.85	
Uniform Delay, d1		0.5		0.7	70.0	
Progression Factor		1.00		1.02	1.00	
Incremental Delay, d2		0.0		0.0	7.2	
Delay (s)		0.5		0.8	77.2	
Level of Service		A		A	E	
Approach Delay (s)	0.5			0.8	77.2	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	35.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	22.9
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	153	1230	323	26	133	1098	92	669	185	150	144	80
Future Volume (vph)	153	1230	323	26	133	1098	92	669	185	150	144	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.91	1.00		1.00	0.91		0.97	1.00		1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.99		1.00	0.93		1.00	0.94
Flt Protected	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1805	5085	1583		1799	4978		3467	1755		1805	1791
Flt Permitted	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1805	5085	1583		1799	4978		3467	1755		1805	1791
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	1337	351	28	145	1193	100	727	201	163	157	87
RTOR Reduction (vph)	0	0	112	0	0	5	0	0	16	0	0	12
Lane Group Flow (vph)	166	1337	239	0	173	1288	0	727	348	0	157	129
Heavy Vehicles (%)	0%	2%	2%	2%	0%	3%	3%	1%	1%	1%	0%	0%
Turn Type	Prot	NA	pm+ov	Prot	Prot	NA		Split	NA		Split	NA
Protected Phases	5	2	4	1	1	6		4	4		3	3
Permitted Phases			2									
Actuated Green, G (s)	21.5	69.1	110.1		21.3	69.6		41.0	41.0		18.7	18.7
Effective Green, g (s)	24.0	71.0	120.7		24.5	71.5		46.3	46.3		22.2	22.2
Actuated g/C Ratio	0.13	0.39	0.67		0.14	0.40		0.26	0.26		0.12	0.12
Clearance Time (s)	6.5	5.9	9.3		7.2	5.9		9.3	9.3		7.5	7.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	240	2005	1061		244	1977		891	451		222	220
v/s Ratio Prot	0.09	c0.26	0.06		c0.10	0.26		c0.21	0.20		c0.09	0.07
v/s Ratio Perm			0.09									
v/c Ratio	0.69	0.67	0.22		0.71	0.65		0.82	0.77		0.71	0.59
Uniform Delay, d1	74.5	44.8	11.5		74.3	44.1		62.8	61.9		75.8	74.5
Progression Factor	0.73	0.56	5.91		0.64	0.61		1.00	1.00		1.00	1.00
Incremental Delay, d2	6.8	1.4	0.1		4.9	0.9		5.8	8.0		9.8	3.9
Delay (s)	61.0	26.5	68.1		52.2	27.9		68.7	69.9		85.6	78.5
Level of Service	E	C	E		D	C		E	E		F	E
Approach Delay (s)		37.5				30.7			69.1			82.2
Approach LOS		D				C			E			F

Intersection Summary			
HCM 2000 Control Delay	45.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	19.2
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	50
Future Volume (vph)	50
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	54
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	36	186	1177	140	44	66	1140	651	125	97	24	626
Future Volume (vph)	36	186	1177	140	44	66	1140	651	125	97	24	626
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0			4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00	0.91			1.00	0.95	1.00		1.00	1.00	0.95
Frt		1.00	0.98			1.00	1.00	0.85		1.00	0.85	1.00
Flt Protected		0.95	1.00			0.95	1.00	1.00		0.97	1.00	0.95
Satd. Flow (prot)		1799	4955			1791	3574	1599		1848	1615	1715
Flt Permitted		0.95	1.00			0.95	1.00	1.00		0.97	1.00	0.95
Satd. Flow (perm)		1799	4955			1791	3574	1599		1848	1615	1715
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	39	200	1266	151	47	71	1226	700	134	104	26	673
RTOR Reduction (vph)	0	0	8	0	0	0	0	239	0	0	22	0
Lane Group Flow (vph)	0	239	1409	0	0	118	1226	461	0	238	4	417
Heavy Vehicles (%)	2%	0%	3%	3%	2%	0%	1%	1%	0%	0%	0%	0%
Turn Type	Prot	Prot	NA		Prot	Prot	NA	Perm	Split	NA	Prot	Split
Protected Phases	5	5	2		1	1	6		4	4	4	3
Permitted Phases								6				
Actuated Green, G (s)		23.3	69.5			21.6	67.5	67.5		21.5	21.5	40.1
Effective Green, g (s)		26.0	71.4			24.0	69.4	69.4		25.0	25.0	43.6
Actuated g/C Ratio		0.14	0.40			0.13	0.39	0.39		0.14	0.14	0.24
Clearance Time (s)		6.7	5.9			6.4	5.9	5.9		7.5	7.5	7.5
Vehicle Extension (s)		3.0	3.0			3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		259	1965			238	1377	616		256	224	415
v/s Ratio Prot		c0.13	0.28			0.07	c0.34			c0.13	0.00	0.24
v/s Ratio Perm								0.29				
v/c Ratio		0.92	0.72			0.50	0.89	0.75		0.93	0.02	1.00
Uniform Delay, d1		76.0	45.8			72.4	51.7	47.8		76.6	66.9	68.2
Progression Factor		0.65	0.87			0.95	0.93	0.84		1.00	1.00	1.00
Incremental Delay, d2		29.9	1.8			1.4	8.0	7.2		37.2	0.0	45.4
Delay (s)		79.6	41.5			70.3	56.0	47.4		113.9	66.9	113.6
Level of Service		E	D			E	E	D		F	E	F
Approach Delay (s)			47.0				53.9			109.2		
Approach LOS			D				D			F		

Intersection Summary			
HCM 2000 Control Delay	65.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	16.7
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBT	SBR
Lane Configurations		
Traffic Volume (vph)	131	28
Future Volume (vph)	131	28
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frt	0.99	
Flt Protected	0.97	
Satd. Flow (prot)	1734	
Flt Permitted	0.97	
Satd. Flow (perm)	1734	
Peak-hour factor, PHF	0.93	0.93
Adj. Flow (vph)	141	30
RTOR Reduction (vph)	2	0
Lane Group Flow (vph)	425	0
Heavy Vehicles (%)	0%	0%
Turn Type	NA	
Protected Phases	3	
Permitted Phases		
Actuated Green, G (s)	40.1	
Effective Green, g (s)	43.6	
Actuated g/C Ratio	0.24	
Clearance Time (s)	7.5	
Vehicle Extension (s)	3.0	
Lane Grp Cap (vph)	420	
v/s Ratio Prot	c0.25	
v/s Ratio Perm		
v/c Ratio	1.01	
Uniform Delay, d1	68.2	
Progression Factor	1.00	
Incremental Delay, d2	47.2	
Delay (s)	115.4	
Level of Service	F	
Approach Delay (s)	114.5	
Approach LOS	F	

Intersection Summary

Movement	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR
Lane Configurations								
Traffic Volume (vph)	98	1655	203	38	228	1530	254	548
Future Volume (vph)	98	1655	203	38	228	1530	254	548
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		8.0	4.0	0.1	4.0	4.9
Lane Util. Factor		0.91		1.00	1.00	0.95	1.00	1.00
Frt		0.98		1.00	1.00	1.00	1.00	0.85
Flt Protected		1.00		0.95	0.95	1.00	0.95	1.00
Satd. Flow (prot)		5046		1770	1805	3574	1805	1615
Flt Permitted		1.00		0.29	0.95	1.00	0.95	1.00
Satd. Flow (perm)		5046		532	1805	3574	1805	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	107	1799	221	41	248	1663	276	596
RTOR Reduction (vph)	0	16	0	0	0	0	0	3
Lane Group Flow (vph)	0	2111	0	41	248	1663	276	593
Heavy Vehicles (%)	2%	1%	0%	2%	0%	1%	0%	0%
Turn Type	Split	NA		custom	Prot	NA	Prot	pt+ov
Protected Phases	2!	2			1	6!	4!	4 1!
Permitted Phases				1!				
Actuated Green, G (s)		38.5		14.0	14.0	90.0	13.7	35.7
Effective Green, g (s)		41.4		14.0	18.0	90.0	18.6	35.7
Actuated g/C Ratio		0.46		0.16	0.20	1.00	0.21	0.40
Clearance Time (s)		6.9		8.0	8.0	3.0	8.9	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	2321		82	361	3574	373	640	
v/s Ratio Prot	c0.42			0.14	0.47	0.15	c0.37	
v/s Ratio Perm			0.08					
v/c Ratio	0.91		0.50	0.69	0.47	0.74	0.93	
Uniform Delay, d1	22.6		34.8	33.4	0.0	33.4	25.9	
Progression Factor	0.69		1.00	1.01	1.00	1.00	1.00	
Incremental Delay, d2	4.8		4.2	4.8	0.4	7.5	19.5	
Delay (s)	20.3		39.1	38.3	0.4	40.9	45.4	
Level of Service	C		D	D	A	D	D	
Approach Delay (s)	20.3				6.0	44.0		
Approach LOS	C				A	D		

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	15.8
Intersection Capacity Utilization	125.5%	ICU Level of Service	H
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	92	1856	238	58	1430	244	89
Future Volume (vph)	92	1856	238	58	1430	244	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4	6.4	7.0	2.0	9.0	7.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1805	3539	1583	1805	3574	1787	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1805	3539	1583	1805	3574	1787	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	2017	259	63	1554	265	97
RTOR Reduction (vph)	0	0	104	0	0	0	5
Lane Group Flow (vph)	100	2017	155	63	1554	265	92
Heavy Vehicles (%)	0%	2%	2%	0%	1%	1%	1%
Turn Type	Split	NA	Perm	Prot	NA	Prot	pm+ov
Protected Phases	2!	2		1	6!	4!	1
Permitted Phases			2				4
Actuated Green, G (s)	49.0	49.0	49.0	5.6	90.0	13.0	18.6
Effective Green, g (s)	49.0	49.0	49.0	5.6	90.0	13.0	18.6
Actuated g/C Ratio	0.54	0.54	0.54	0.06	1.00	0.14	0.21
Clearance Time (s)	6.4	6.4	6.4	7.0	2.0	9.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	982	1926	861	112	3574	258	330
v/s Ratio Prot	0.06	c0.57		0.03	c0.43	c0.15	0.02
v/s Ratio Perm			0.10				0.04
v/c Ratio	0.10	1.05	0.18	0.56	0.43	1.03	0.28
Uniform Delay, d1	9.9	20.5	10.4	41.0	0.0	38.5	30.1
Progression Factor	0.64	0.61	0.03	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	28.6	0.2	6.3	0.4	63.2	0.5
Delay (s)	6.4	41.0	0.5	47.3	0.4	101.7	30.5
Level of Service	A	D	A	D	A	F	C
Approach Delay (s)		35.1			2.2	82.6	
Approach LOS		D			A	F	

Intersection Summary			
HCM 2000 Control Delay	26.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	89.3%	ICU Level of Service	E
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
16: Linda Lane & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	61	448	402	157	470	251	462	249	155	149	224	68
Future Volume (vph)	61	448	402	157	470	251	462	249	155	149	224	68
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1805	1900	1599	1805	1900	1615	1787	1791		1805	1900	1615
Flt Permitted	0.21	1.00	1.00	0.14	1.00	1.00	0.21	1.00		0.51	1.00	1.00
Satd. Flow (perm)	390	1900	1599	273	1900	1615	404	1791		965	1900	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	66	487	437	171	511	273	502	271	168	162	243	74
RTOR Reduction (vph)	0	0	245	0	0	129	0	15	0	0	0	61
Lane Group Flow (vph)	66	487	192	171	511	144	502	424	0	162	243	13
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4			8		8
Actuated Green, G (s)	45.8	40.5	40.5	55.6	45.4	45.4	62.1	46.4		29.9	20.2	20.2
Effective Green, g (s)	49.8	42.5	42.5	58.7	47.4	47.4	64.1	48.4		33.9	22.2	22.2
Actuated g/C Ratio	0.38	0.32	0.32	0.45	0.36	0.36	0.49	0.37		0.26	0.17	0.17
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	227	617	519	265	688	585	598	662		325	322	274
v/s Ratio Prot	0.02	c0.26		c0.06	0.27		c0.24	0.24		0.04	0.13	
v/s Ratio Perm	0.09		0.12	0.23		0.09	c0.17			0.08		0.01
v/c Ratio	0.29	0.79	0.37	0.65	0.74	0.25	0.84	0.64		0.50	0.75	0.05
Uniform Delay, d1	28.4	40.1	33.9	27.0	36.4	29.2	29.2	34.0		39.4	51.7	45.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.7	6.7	0.4	5.3	4.3	0.2	10.1	2.1		1.2	9.6	0.1
Delay (s)	29.2	46.7	34.3	32.3	40.7	29.4	39.3	36.1		40.6	61.4	45.5
Level of Service	C	D	C	C	D	C	D	D		D	E	D
Approach Delay (s)		40.1			36.0			37.8			51.9	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	40.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	130.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
18: Blue Ridge Drive & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	172	347	6	8	471	205	1	3	5	151	3	74
Future Volume (vph)	172	347	6	8	471	205	1	3	5	151	3	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			4.0	4.0
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	1.00
Frt	1.00	1.00			0.96			0.93			1.00	0.85
Flt Protected	0.95	1.00			1.00			0.99			0.95	1.00
Satd. Flow (prot)	1805	1895			1822			1748			1811	1615
Flt Permitted	0.29	1.00			1.00			0.99			0.95	1.00
Satd. Flow (perm)	542	1895			1815			1748			1811	1615
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	181	365	6	8	496	216	1	3	5	159	3	78
RTOR Reduction (vph)	0	0	0	0	13	0	0	5	0	0	0	64
Lane Group Flow (vph)	181	371	0	0	707	0	0	4	0	0	162	14
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA		Perm	NA		Split	NA		Split	NA	Perm
Protected Phases	1	6			2		4	4		8	8	
Permitted Phases	6			2								8
Actuated Green, G (s)	53.1	53.1			39.1			0.9			13.8	13.8
Effective Green, g (s)	55.1	55.1			41.1			2.9			15.8	15.8
Actuated g/C Ratio	0.64	0.64			0.48			0.03			0.18	0.18
Clearance Time (s)	6.0	6.0			6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	495	1216			869			59			333	297
v/s Ratio Prot	c0.04	0.20						c0.00			c0.09	
v/s Ratio Perm	0.19				c0.39							0.01
v/c Ratio	0.37	0.30			0.81			0.07			0.49	0.05
Uniform Delay, d1	17.1	6.8			19.1			40.1			31.4	28.8
Progression Factor	1.00	1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2	0.5	0.1			5.9			0.5			1.1	0.1
Delay (s)	17.5	7.0			25.0			40.7			32.5	28.9
Level of Service	B	A			C			D			C	C
Approach Delay (s)		10.4			25.0			40.7			31.3	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	20.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
19: I-81 NB Ramps & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	1351	0	0	1493	0	0	0	68	0	0	0
Future Volume (vph)	99	1351	0	0	1493	0	0	0	68	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0				6.0			
Lane Util. Factor	1.00	0.95			0.95				1.00			
Frt	1.00	1.00			1.00				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	3539			3539				1565			
Flt Permitted	0.15	1.00			1.00				1.00			
Satd. Flow (perm)	285	3539			3539				1565			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	108	1468	0	0	1623	0	0	0	74	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	69	0	0	0
Lane Group Flow (vph)	108	1468	0	0	1623	0	0	0	5	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	2%
Turn Type	Perm	NA			NA				Prot			
Protected Phases		6			2				5			
Permitted Phases	6											
Actuated Green, G (s)	72.4	72.4			90.0				5.6			
Effective Green, g (s)	72.4	72.4			90.0				5.6			
Actuated g/C Ratio	0.80	0.80			1.00				0.06			
Clearance Time (s)	6.0	6.0			6.0				6.0			
Vehicle Extension (s)	3.0	3.0			3.0				3.0			
Lane Grp Cap (vph)	229	2846			3539				97			
v/s Ratio Prot		c0.41			c0.46				0.00			
v/s Ratio Perm	0.38											
v/c Ratio	0.47	0.52			0.46				0.05			
Uniform Delay, d1	2.8	2.9			0.0				39.7			
Progression Factor	0.47	0.22			1.00				1.00			
Incremental Delay, d2	5.9	0.6			0.2				0.2			
Delay (s)	7.2	1.2			0.2				39.9			
Level of Service	A	A			A				D			
Approach Delay (s)		1.6			0.2		39.9			0.0		
Approach LOS		A			A		D			A		

Intersection Summary			
HCM 2000 Control Delay	1.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Country Club Road & Retreat Driveway

12/14/2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	183	565	641	360	346	246
Future Volume (vph)	183	565	641	360	346	246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1900	1615	3467	1615
Flt Permitted	0.35	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	667	1900	1900	1615	3467	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	199	614	697	391	376	267
RTOR Reduction (vph)	0	0	0	81	0	230
Lane Group Flow (vph)	199	614	697	310	376	37
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		6	2		8	
Permitted Phases	6			2		8
Actuated Green, G (s)	142.8	142.8	142.8	142.8	25.2	25.2
Effective Green, g (s)	142.8	142.8	142.8	142.8	25.2	25.2
Actuated g/C Ratio	0.79	0.79	0.79	0.79	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	529	1507	1507	1281	485	226
v/s Ratio Prot		0.32	c0.37		c0.11	
v/s Ratio Perm	0.30			0.19		0.02
v/c Ratio	0.38	0.41	0.46	0.24	0.78	0.17
Uniform Delay, d1	5.5	5.7	6.1	4.8	74.7	68.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.0	0.8	1.0	0.4	7.6	0.3
Delay (s)	7.5	6.5	7.1	5.2	82.3	68.5
Level of Service	A	A	A	A	F	E
Approach Delay (s)		6.7	6.4		76.5	
Approach LOS		A	A		E	

Intersection Summary			
HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
21: MLK Jr. Way Extension & Country Club Road

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	501	2	215	676	8	201
Future Volume (vph)	501	2	215	676	8	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.99	0.95	1.00
Satd. Flow (prot)	1863	1583		1841	1770	1583
Flt Permitted	1.00	1.00		0.72	0.95	1.00
Satd. Flow (perm)	1863	1583		1338	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	545	2	234	735	9	218
RTOR Reduction (vph)	0	0	0	0	0	199
Lane Group Flow (vph)	545	2	0	969	9	19
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	6			2	4	
Permitted Phases		6	2			4
Actuated Green, G (s)	85.2	85.2		85.2	9.3	9.3
Effective Green, g (s)	85.2	85.2		85.2	9.3	9.3
Actuated g/C Ratio	0.80	0.80		0.80	0.09	0.09
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	1490	1266		1070	154	138
v/s Ratio Prot	0.29				0.01	
v/s Ratio Perm		0.00		c0.72		c0.01
v/c Ratio	0.37	0.00		0.91	0.06	0.14
Uniform Delay, d1	3.0	2.1		7.7	44.6	44.9
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	0.0		10.8	0.2	0.5
Delay (s)	3.2	2.1		18.5	44.7	45.4
Level of Service	A	A		B	D	D
Approach Delay (s)	3.2			18.5	45.3	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	17.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	106.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Country Club Road & Vine Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	110	0	0	287	0	401	20	0	607	88
Future Volume (Veh/h)	0	0	110	0	0	287	0	401	20	0	607	88
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	118	0	0	309	0	431	22	0	653	95
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								201				
pX, platoon unblocked												
vC, conflicting volume	1440	1154	374	876	1179	431	748			453		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1440	1154	374	876	1179	431	748			453		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	100	81	100	100	47	100			100		
cM capacity (veh/h)	44	199	629	200	192	578	863			1056		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	118	309	431	22	435	313
Volume Left	0	0	0	0	0	0
Volume Right	118	309	0	22	0	95
cSH	629	578	1700	1700	1700	1700
Volume to Capacity	0.19	0.53	0.25	0.01	0.26	0.18
Queue Length 95th (ft)	17	79	0	0	0	0
Control Delay (s)	12.0	18.1	0.0	0.0	0.0	0.0
Lane LOS	B	C				
Approach Delay (s)	12.0	18.1	0.0		0.0	
Approach LOS	B	C				

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: East Market Street & Wendy's

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	97	1637	61	104	1654	59	0	0	69	0	0	72
Future Volume (Veh/h)	97	1637	61	104	1654	59	0	0	69	0	0	72
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	105	1779	66	113	1798	64	0	0	75	0	0	78
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		725			1074							
pX, platoon unblocked	0.81			0.78			0.88	0.88	0.78	0.88	0.88	0.81
vC, conflicting volume	1862			1845			2925	4110	626	2934	4111	631
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1242			1099			1235	2587	0	1245	2589	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	77			77			100	100	91	100	100	91
cM capacity (veh/h)	451			502			72	13	852	72	13	881

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	105	712	712	422	113	719	719	424	75	78
Volume Left	105	0	0	0	113	0	0	0	0	0
Volume Right	0	0	0	66	0	0	0	64	75	78
cSH	451	1700	1700	1700	502	1700	1700	1700	852	881
Volume to Capacity	0.23	0.42	0.42	0.25	0.23	0.42	0.42	0.25	0.09	0.09
Queue Length 95th (ft)	22	0	0	0	21	0	0	0	7	7
Control Delay (s)	15.4	0.0	0.0	0.0	14.3	0.0	0.0	0.0	9.6	9.5
Lane LOS	C				B				A	A
Approach Delay (s)	0.8				0.8				9.6	9.5
Approach LOS									A	A

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	45.4%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
10: Valley Mall & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	68	1456	26	36	1275	19	0	0	83	0	0	75
Future Volume (Veh/h)	68	1456	26	36	1275	19	0	0	83	0	0	75
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	74	1583	28	39	1386	21	0	0	90	0	0	82
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		612			781							
pX, platoon unblocked	0.72			0.79			0.83	0.83	0.79	0.83	0.83	0.72
vC, conflicting volume	1407			1611			2367	3230	542	2240	3234	472
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	217			836			199	1242	0	46	1246	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	92			94			100	100	90	100	100	90
cM capacity (veh/h)	985			636			498	127	860	637	126	788

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	74	633	633	345	39	554	554	298	90	82
Volume Left	74	0	0	0	39	0	0	0	0	0
Volume Right	0	0	0	28	0	0	0	21	90	82
cSH	985	1700	1700	1700	636	1700	1700	1700	860	788
Volume to Capacity	0.08	0.37	0.37	0.20	0.06	0.33	0.33	0.18	0.10	0.10
Queue Length 95th (ft)	6	0	0	0	5	0	0	0	9	9
Control Delay (s)	8.9	0.0	0.0	0.0	11.0	0.0	0.0	0.0	9.7	10.1
Lane LOS	A				B				A	B
Approach Delay (s)	0.4				0.3				9.7	10.1
Approach LOS									A	B

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	40.5%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
12: Skyline Center & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1766	105	0	1802	79	0	0	189	0	0	99
Future Volume (Veh/h)	0	1766	105	0	1802	79	0	0	189	0	0	99
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1920	114	0	1959	86	0	0	205	0	0	108
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		548			1025							
pX, platoon unblocked				0.77			0.77	0.77	0.77	0.77	0.77	
vC, conflicting volume	2045			2034			2738	4022	697	2804	3993	653
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2045			1289			2206	3878	0	2292	3840	653
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	76	100	100	74
cM capacity (veh/h)	279			418			14	3	838	12	3	415

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	768	768	498	653	653	653	86	205	108
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	114	0	0	0	86	205	108
cSH	1700	1700	1700	1700	1700	1700	1700	838	415
Volume to Capacity	0.45	0.45	0.29	0.38	0.38	0.38	0.05	0.24	0.26
Queue Length 95th (ft)	0	0	0	0	0	0	0	24	26
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	16.7
Lane LOS								B	C
Approach Delay (s)	0.0			0.0				10.7	16.7
Approach LOS								B	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	54.8%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
14: Betts Rd & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	2135	55	0	1743	23	0	0	51	0	0	53
Future Volume (Veh/h)	51	2135	55	0	1743	23	0	0	51	0	0	53
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	55	2321	60	0	1895	25	0	0	55	0	0	58
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		554			855							
pX, platoon unblocked				0.63			0.63	0.63	0.63	0.63	0.63	
vC, conflicting volume	1920			2381			3151	4381	804	2834	4386	632
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1920			1126			2351	4311	0	1847	4318	632
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	82			100			100	100	92	100	100	86
cM capacity (veh/h)	304			394			9	1	685	23	1	428

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	55	928	928	524	632	632	632	25	55	58
Volume Left	55	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	60	0	0	0	25	55	58
cSH	304	1700	1700	1700	1700	1700	1700	1700	685	428
Volume to Capacity	0.18	0.55	0.55	0.31	0.37	0.37	0.37	0.01	0.08	0.14
Queue Length 95th (ft)	16	0	0	0	0	0	0	0	7	12
Control Delay (s)	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	14.7
Lane LOS	C								B	B
Approach Delay (s)	0.4				0.0				10.7	14.7
Approach LOS									B	B

Intersection Summary				
Average Delay	0.6			
Intersection Capacity Utilization	52.5%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
17: Country Club Ct & Country Club Road

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	679	23	7	880	11	69
Future Volume (Veh/h)	679	23	7	880	11	69
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	738	25	8	957	12	75
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	249					
pX, platoon unblocked			0.91		0.91	0.91
vC, conflicting volume			763		1724	750
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			692		1745	679
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		86	82
cM capacity (veh/h)			824		412	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	763	965	87
Volume Left	0	8	12
Volume Right	25	0	75
cSH	1700	824	270
Volume to Capacity	0.45	0.01	0.32
Queue Length 95th (ft)	0	1	34
Control Delay (s)	0.0	0.3	24.5
Lane LOS		A	C
Approach Delay (s)	0.0	0.3	24.5
Approach LOS			C

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
22: Transit Center & MLK Jr. Way Extension

12/14/2018

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	16	16	193	6	5	212
Future Volume (Veh/h)	16	16	193	6	5	212
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	17	210	7	5	230
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			470			561
pX, platoon unblocked						
vC, conflicting volume	454	214			217	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	454	214			217	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			100	
cM capacity (veh/h)	562	827			1353	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	34	217	5	230
Volume Left	17	0	5	0
Volume Right	17	7	0	0
cSH	669	1700	1353	1700
Volume to Capacity	0.05	0.13	0.00	0.14
Queue Length 95th (ft)	4	0	0	0
Control Delay (s)	10.7	0.0	7.7	0.0
Lane LOS	B		A	
Approach Delay (s)	10.7	0.0	0.2	
Approach LOS	B			

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	21.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
31: Country Club Road & Driveway

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	0	8	129	0	49	10	771	153	45	649	8
Future Volume (Veh/h)	10	0	8	129	0	49	10	771	153	45	649	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	0	9	140	0	53	11	838	166	49	705	9
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								477				
pX, platoon unblocked												
vC, conflicting volume	1716	1829	705	1672	1672	838	714			1004		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1716	1829	705	1672	1672	838	714			1004		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	81	100	98	0	100	86	99			93		
cM capacity (veh/h)	57	70	436	70	88	366	886			690		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	20	140	53	11	838	166	49	705	9
Volume Left	11	140	0	11	0	0	49	0	0
Volume Right	9	0	53	0	0	166	0	0	9
cSH	93	70	366	886	1700	1700	690	1700	1700
Volume to Capacity	0.21	2.01	0.14	0.01	0.49	0.10	0.07	0.41	0.01
Queue Length 95th (ft)	19	321	13	1	0	0	6	0	0
Control Delay (s)	53.8	595.2	16.5	9.1	0.0	0.0	10.6	0.0	0.0
Lane LOS	F	F	C	A			B		
Approach Delay (s)	53.8	436.3		0.1			0.7		
Approach LOS	F	F							

Intersection Summary				
Average Delay	43.1			
Intersection Capacity Utilization	58.7%	ICU Level of Service		B
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
32: Country Club Road & Keezletown Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	61	23	19	8	14	9	14	808	8	11	675	65
Future Volume (Veh/h)	61	23	19	8	14	9	14	808	8	11	675	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	66	25	21	9	15	10	15	878	9	12	734	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1688	1675	734	1704	1742	882	805			887		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1688	1675	734	1704	1742	882	805			887		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	73	95	83	82	97	98			98		
cM capacity (veh/h)	61	92	420	53	84	345	819			763		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	112	34	902	746	71
Volume Left	66	9	15	12	0
Volume Right	21	10	9	0	71
cSH	79	90	819	763	1700
Volume to Capacity	1.41	0.38	0.02	0.02	0.04
Queue Length 95th (ft)	221	38	1	1	0
Control Delay (s)	336.2	67.5	0.5	0.4	0.0
Lane LOS	F	F	A	A	
Approach Delay (s)	336.2	67.5	0.5	0.4	
Approach LOS	F	F			

Intersection Summary				
Average Delay	21.8			
Intersection Capacity Utilization	72.7%	ICU Level of Service		C
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
51: East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NWL	NWR	SWL	SWR
Lane Configurations										
Traffic Volume (veh/h)	0	1135	400	0	1142	0	0	0	0	113
Future Volume (Veh/h)	0	1135	400	0	1142	0	0	0	0	113
Sign Control		Free			Free		Stop		Yield	
Grade		0%			0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1234	435	0	1241	0	0	0	0	123
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type		None			None					
Median storage veh)										
Upstream signal (ft)		824			453					
pX, platoon unblocked				0.67			0.67	0.67	0.67	
vC, conflicting volume	1241			1669			1978	2475	2910	620
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1241			1024			1482	2220	2866	620
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)										
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	100	71
cM capacity (veh/h)	557			454			42	29	11	431

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SW 1
Volume Total	617	617	435	620	620	123
Volume Left	0	0	0	0	0	0
Volume Right	0	0	435	0	0	123
cSH	1700	1700	1700	1700	1700	431
Volume to Capacity	0.36	0.36	0.26	0.36	0.36	0.29
Queue Length 95th (ft)	0	0	0	0	0	29
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	16.7
Lane LOS						C
Approach Delay (s)	0.0			0.0		16.7
Approach LOS						C

Intersection Summary				
Average Delay	0.7			
Intersection Capacity Utilization	45.2%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
52: East Market Street

12/14/2018

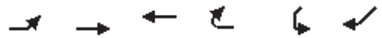
Movement	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	1135	0	0	1782	0	315
Future Volume (Veh/h)	1135	0	0	1782	0	315
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1234	0	0	1937	0	342
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	392			621		
pX, platoon unblocked			0.73		0.73	0.73
vC, conflicting volume			1234		1880	617
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			588		1470	0
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	57
cM capacity (veh/h)			725		86	791

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NE 1
Volume Total	617	617	646	646	646	342
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	342
cSH	1700	1700	1700	1700	1700	791
Volume to Capacity	0.36	0.36	0.38	0.38	0.38	0.43
Queue Length 95th (ft)	0	0	0	0	0	55
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	13.0
Lane LOS						B
Approach Delay (s)	0.0		0.0			13.0
Approach LOS						B

Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	73.5%	ICU Level of Service	D	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
53: East Market Street

12/14/2018



Movement	EBL	EBT	WBT	WBR	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	0	1451	1493	0	0	290
Future Volume (Veh/h)	0	1451	1493	0	0	290
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1577	1623	0	0	315
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		717	296			
pX, platoon unblocked					0.81	
vC, conflicting volume	1623				2149	812
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1623				1591	812
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	2
cM capacity (veh/h)	397				79	322

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SW 1
Volume Total	526	526	526	812	812	315
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	315
cSH	1700	1700	1700	1700	1700	322
Volume to Capacity	0.31	0.31	0.31	0.48	0.48	0.98
Queue Length 95th (ft)	0	0	0	0	0	261
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	81.4
Lane LOS						F
Approach Delay (s)	0.0			0.0		81.4
Approach LOS						F

Intersection Summary				
Average Delay	7.3			
Intersection Capacity Utilization	65.9%	ICU Level of Service		C
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
54: East Market Street & I-81 NB On

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SER	NEL	NER
Lane Configurations										
Traffic Volume (veh/h)	0	1419	0	0	1493	476	0	0	0	606
Future Volume (Veh/h)	0	1419	0	0	1493	476	0	0	0	606
Sign Control		Free			Free		Stop		Yield	
Grade		0%			0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1542	0	0	1623	517	0	0	0	659
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type		Raised			None					
Median storage veh)		1								
Upstream signal (ft)		489			592					
pX, platoon unblocked	0.69			0.91			0.73	0.73	0.73	0.91
vC, conflicting volume	2140			1542			2796	3165	3682	514
vC1, stage 1 conf vol							1623	1623	1542	
vC2, stage 2 conf vol							1173	1542	2140	
vCu, unblocked vol	1753			1263			2015	2519	3224	138
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	100	19
cM capacity (veh/h)	244			504			40	109	63	812

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NE 1
Volume Total	514	514	514	812	812	517	659
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	0	0	517	659
cSH	1700	1700	1700	1700	1700	1700	812
Volume to Capacity	0.30	0.30	0.30	0.48	0.48	0.30	0.81
Queue Length 95th (ft)	0	0	0	0	0	0	221
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	25.5
Lane LOS							D
Approach Delay (s)	0.0			0.0			25.5
Approach LOS							D

Intersection Summary				
Average Delay	3.9			
Intersection Capacity Utilization	71.6%	ICU Level of Service		C
Analysis Period (min)	15			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	861	782	0
Future Volume (Veh/h)	5	0	0	861	782	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	0	936	850	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)				660	570	
pX, platoon unblocked	0.88	0.82	0.82			
vC, conflicting volume	1786	850	850			
vC1, stage 1 conf vol	850					
vC2, stage 2 conf vol	936					
vCu, unblocked vol	1549	712	712			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	285	357	732			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	5	936	850
Volume Left	5	0	0
Volume Right	0	0	0
cSH	285	1700	1700
Volume to Capacity	0.02	0.55	0.50
Queue Length 95th (ft)	1	0	0
Control Delay (s)	17.9	0.0	0.0
Lane LOS	C		
Approach Delay (s)	17.9	0.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	55.3%	ICU Level of Service	B
Analysis Period (min)	15		

F-2: 2025 Build with Optimized Cycle Length (140 Seconds)

Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	133	48	826	55	36	808	308	24	65	36	606	31
Future Volume (vph)	133	48	826	55	36	808	308	24	65	36	606	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0		3.9		4.7	4.7
Lane Util. Factor		1.00	0.95		1.00	0.95	1.00		1.00		0.95	0.95
Frt		1.00	0.99		1.00	1.00	0.85		0.96		1.00	0.96
Flt Protected		0.95	1.00		0.95	1.00	1.00		0.99		0.95	0.97
Satd. Flow (prot)		1770	3472		1805	3574	1599		1773		1665	1632
Flt Permitted		0.15	1.00		0.18	1.00	1.00		0.99		0.95	0.97
Satd. Flow (perm)		282	3472		349	3574	1599		1773		1665	1632
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	146	53	908	60	40	888	338	26	71	40	666	34
RTOR Reduction (vph)	0	0	3	0	0	0	0	0	0	0	0	10
Lane Group Flow (vph)	0	199	965	0	40	888	338	0	137	0	453	325
Heavy Vehicles (%)	2%	2%	3%	3%	0%	1%	1%	2%	2%	2%	3%	3%
Turn Type	pm+pt	pm+pt	NA		pm+pt	NA	Perm	Split	NA		Split	NA
Protected Phases	5	5	2		1	6		4	4		3	3
Permitted Phases	2	2			6		6					
Actuated Green, G (s)		70.1	58.3		56.7	51.2	51.2		9.6		40.9	40.9
Effective Green, g (s)		72.4	60.6		61.3	53.5	53.5		12.8		42.2	42.2
Actuated g/C Ratio		0.52	0.43		0.44	0.38	0.38		0.09		0.30	0.30
Clearance Time (s)		6.3	6.3		6.3	6.3	6.3		7.1		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	4.0	3.0	3.0				
Lane Grp Cap (vph)	304	1502	233	1365	611	162	501	491				
v/s Ratio Prot	c0.07	0.28	0.01	0.25		c0.08	c0.27	0.20				
v/s Ratio Perm	c0.27		0.07		0.21							
v/c Ratio	0.65	0.64	0.17	0.65	0.55	0.85	0.90	0.66				
Uniform Delay, d1	23.3	31.2	24.2	35.6	33.9	62.6	47.0	42.7				
Progression Factor	1.00	1.00	1.07	0.86	0.88	1.00	1.00	1.00				
Incremental Delay, d2	5.0	2.1	0.3	1.9	2.9	32.3	19.6	3.3				
Delay (s)	28.3	33.3	26.2	32.5	32.5	94.9	66.5	46.0				
Level of Service	C	C	C	C	C	F	E	D				
Approach Delay (s)		32.5		32.3		94.9		57.8				
Approach LOS		C		C		F		E				

Intersection Summary			
HCM 2000 Control Delay	40.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.9
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	80
Future Volume (vph)	80
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.91
Adj. Flow (vph)	88
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Heavy Vehicles (%)	3%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

HCM Signalized Intersection Capacity Analysis
3: S Carlton St & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	1381	81	146	993	116	102	103	137	115	50	58
Future Volume (vph)	6	1381	81	146	993	116	102	103	137	115	50	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85		0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00		0.97	
Satd. Flow (prot)	1805	3510		1805	3553			1854	1615		1769	
Flt Permitted	0.13	1.00		0.06	1.00			0.98	1.00		0.97	
Satd. Flow (perm)	240	3510		115	3553			1854	1615		1769	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	1501	88	159	1079	126	111	112	149	125	54	63
RTOR Reduction (vph)	0	3	0	0	6	0	0	0	113	0	8	0
Lane Group Flow (vph)	7	1586	0	159	1199	0	0	223	36	0	234	0
Heavy Vehicles (%)	0%	2%	2%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	D.P+P	NA		D.P+P	NA		Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	6			2					3			
Actuated Green, G (s)	70.4	63.2		70.4	69.1			21.7	21.7		19.7	
Effective Green, g (s)	76.0	66.0		76.0	71.9			25.2	25.2		22.8	
Actuated g/C Ratio	0.54	0.47		0.54	0.51			0.18	0.18		0.16	
Clearance Time (s)	6.8	6.8		6.8	6.8			7.5	7.5		7.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	176	1654		183	1824			333	290		288	
v/s Ratio Prot	0.00	c0.45		c0.06	0.34			c0.12			c0.13	
v/s Ratio Perm	0.02			0.41					0.02			
v/c Ratio	0.04	0.96		0.87	0.66			0.67	0.12		0.81	
Uniform Delay, d1	18.6	35.7		39.9	25.0			53.5	48.1		56.5	
Progression Factor	0.80	0.72		1.60	0.82			1.00	1.00		1.00	
Incremental Delay, d2	0.1	11.2		26.5	1.4			5.0	0.2		15.8	
Delay (s)	14.9	36.8		90.3	22.0			58.6	48.3		72.3	
Level of Service	B	D		F	C			E	D		E	
Approach Delay (s)		36.7			30.0			54.5			72.3	
Approach LOS		D			C			D			E	

Intersection Summary			
HCM 2000 Control Delay	38.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Cantrell Avenue (MLK) & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	87	1425	122	10	153	1089	3	122	109	94	7	177
Future Volume (vph)	87	1425	122	10	153	1089	3	122	109	94	7	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	4.0	4.0		4.0	4.0		3.4	6.0		6.6	6.6
Lane Util. Factor	1.00	0.95	1.00		0.97	0.95		1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85		1.00	1.00		1.00	0.93		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1770	3610	1615		3465	3573		1805	1748		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1770	3610	1615		3465	3573		1805	1748		1770	1863
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.92	0.90	0.92	0.90	0.92	0.92
Adj. Flow (vph)	95	1583	136	11	170	1210	3	136	118	104	8	192
RTOR Reduction (vph)	0	0	59	0	0	0	0	0	23	0	0	0
Lane Group Flow (vph)	95	1583	77	0	181	1213	0	136	199	0	8	192
Heavy Vehicles (%)	2%	0%	0%	2%	1%	1%	2%	0%	2%	0%	2%	2%
Turn Type	Prot	NA	Prot	Prot	Prot	NA		Split	NA		Split	NA
Protected Phases	5	2	2	1	1	6		4	4		3	3
Permitted Phases												
Actuated Green, G (s)	12.3	71.3	71.3		7.7	67.1		18.3	18.3		17.3	17.3
Effective Green, g (s)	12.3	73.7	73.7		10.1	69.5		20.9	18.3		17.3	17.3
Actuated g/C Ratio	0.09	0.53	0.53		0.07	0.50		0.15	0.13		0.12	0.12
Clearance Time (s)	6.0	6.4	6.4		6.4	6.4		6.0	6.0		6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	155	1900	850		249	1773		269	228		218	230
v/s Ratio Prot	0.05	c0.44	0.05		0.05	c0.34		0.08	c0.11		0.00	c0.10
v/s Ratio Perm												
v/c Ratio	0.61	0.83	0.09		0.73	0.68		0.51	0.87		0.04	0.83
Uniform Delay, d1	61.6	28.0	16.5		63.6	26.9		54.8	59.7		54.0	60.0
Progression Factor	1.43	0.28	0.10		1.09	1.25		1.00	1.00		1.00	1.00
Incremental Delay, d2	3.3	2.1	0.1		9.8	2.1		1.5	28.8		0.1	22.2
Delay (s)	91.2	9.9	1.8		78.8	35.6		56.3	88.6		54.1	82.1
Level of Service	F	A	A		E	D		E	F		D	F
Approach Delay (s)		13.6				41.2			76.3			75.8
Approach LOS		B				D			E			E

Intersection Summary			
HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	22.6
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	44
Future Volume (vph)	44
Ideal Flow (vphpl)	1900
Total Lost time (s)	6.6
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1583
Flt Permitted	1.00
Satd. Flow (perm)	1583
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	48
RTOR Reduction (vph)	42
Lane Group Flow (vph)	6
Heavy Vehicles (%)	2%
Turn Type	Perm
Protected Phases	
Permitted Phases	3
Actuated Green, G (s)	17.3
Effective Green, g (s)	17.3
Actuated g/C Ratio	0.12
Clearance Time (s)	6.6
Vehicle Extension (s)	3.0
Lane Grp Cap (vph)	195
v/s Ratio Prot	
v/s Ratio Perm	0.00
v/c Ratio	0.03
Uniform Delay, d1	54.0
Progression Factor	1.00
Incremental Delay, d2	0.1
Delay (s)	54.0
Level of Service	D
Approach Delay (s)	
Approach LOS	

Intersection Summary			
HCM 2000 Control Delay		HCM 2000 Level of Service	
HCM 2000 Volume to Capacity ratio			
Actuated Cycle Length (s)		Sum of lost time (s)	
Intersection Capacity Utilization		ICU Level of Service	
Analysis Period (min)			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1135	0	640	1142	0	0
Future Volume (vph)	1135	0	640	1142	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0		
Lane Util. Factor	0.95		1.00	0.95		
Frt	1.00		1.00	1.00		
Flt Protected	1.00		0.95	1.00		
Satd. Flow (prot)	3610		1787	3574		
Flt Permitted	1.00		0.12	1.00		
Satd. Flow (perm)	3610		224	3574		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1234	0	696	1241	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1234	0	696	1241	0	0
Heavy Vehicles (%)	0%	0%	1%	1%	2%	2%
Turn Type	NA		D.P+P	NA		
Protected Phases	2		1	6		
Permitted Phases			2			
Actuated Green, G (s)	32.2		58.0	70.0		
Effective Green, g (s)	34.2		62.0	70.0		
Actuated g/C Ratio	0.49		0.89	1.00		
Clearance Time (s)	6.0		6.0	7.2		
Vehicle Extension (s)	3.0		3.0	3.0		
Lane Grp Cap (vph)	1763		819	3574		
v/s Ratio Prot	0.34		c0.34	0.35		
v/s Ratio Perm			c0.41			
v/c Ratio	0.70		0.85	0.35		
Uniform Delay, d1	13.9		14.5	0.0		
Progression Factor	1.34		0.82	1.00		
Incremental Delay, d2	1.3		7.8	0.3		
Delay (s)	19.9		19.7	0.3		
Level of Service	B		B	A		
Approach Delay (s)	19.9			7.2	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Brugress Road /Linda Lane & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	419	1385	220	221	1243	262	348	216	219	191	230	377
Future Volume (vph)	419	1385	220	221	1243	262	348	216	219	191	230	377
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	2.4	4.0	4.0		2.4	2.4	2.4	4.0	4.0	4.0
Lane Util. Factor	*0.60	0.91	1.00	0.97	0.91		0.91	0.91	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (prot)	2073	4940	1538	3502	5002		1626	3349	1599	1626	3378	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00	0.95	0.99	1.00
Satd. Flow (perm)	2073	4940	1538	3502	5002		1626	3349	1599	1626	3378	1599
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	460	1522	242	243	1366	288	382	237	241	210	253	414
RTOR Reduction (vph)	0	0	58	0	0	0	0	0	181	0	0	308
Lane Group Flow (vph)	460	1522	184	243	1654	0	191	428	60	115	348	106
Confl. Peds. (#/hr)	221											
Heavy Vehicles (%)	1%	5%	5%	0%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2	8	1	6		8	8		4	4	
Permitted Phases			2						8			4
Actuated Green, G (s)	27.6	61.5	77.5	10.8	45.9		16.0	16.0	16.0	23.2	23.2	23.2
Effective Green, g (s)	31.0	64.2	84.7	15.4	48.6		19.6	19.6	19.6	26.4	26.4	26.4
Actuated g/C Ratio	0.22	0.46	0.61	0.11	0.35		0.14	0.14	0.14	0.19	0.19	0.19
Clearance Time (s)	7.4	6.7	6.0	8.6	6.7		6.0	6.0	6.0	7.2	7.2	7.2
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	459	2265	930	385	1736		227	468	223	306	636	301
v/s Ratio Prot	c0.22	0.31	0.03	0.07	c0.33		0.12	c0.13		0.07	c0.10	
v/s Ratio Perm			0.09						0.04			0.07
v/c Ratio	1.00	0.67	0.20	0.63	0.95		0.84	0.91	0.27	0.38	0.55	0.35
Uniform Delay, d1	54.5	29.7	12.4	59.6	44.6		58.7	59.4	53.8	49.6	51.4	49.4
Progression Factor	0.99	0.68	0.99	0.60	0.45		1.00	1.00	1.00	0.18	0.16	2.14
Incremental Delay, d2	42.5	1.5	0.1	2.4	10.1		23.5	22.3	0.7	0.4	0.5	0.4
Delay (s)	96.7	21.7	12.3	38.1	30.2		82.2	81.7	54.5	9.3	8.8	105.8
Level of Service	F	C	B	D	C		F	F	D	A	A	F
Approach Delay (s)		36.2			31.2			74.2			54.7	
Approach LOS		D			C			E			D	

Intersection Summary			
HCM 2000 Control Delay	42.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.4
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Linda Lane & Hotel Driveway

12/14/2018

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	28	37	861	770	12
Future Volume (vph)	0	28	37	861	770	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		3.8	4.0	
Lane Util. Factor		1.00		0.95	0.91	
Frt		0.86		1.00	1.00	
Flt Protected		1.00		1.00	1.00	
Satd. Flow (prot)		1644		3431	5124	
Flt Permitted		1.00		0.95	1.00	
Satd. Flow (perm)		1644		3283	5124	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	30	40	936	837	13
RTOR Reduction (vph)	0	0	0	0	1	0
Lane Group Flow (vph)	0	30	0	976	849	0
Heavy Vehicles (%)	0%	0%	5%	5%	1%	1%
Turn Type		custom	D.P+P	NA	NA	
Protected Phases		5 6 8	5 6 8	4 5 6 8	4	
Permitted Phases		4	4			
Actuated Green, G (s)		126.8		126.8	23.2	
Effective Green, g (s)		127.3		126.3	26.4	
Actuated g/C Ratio		0.91		0.90	0.19	
Clearance Time (s)					7.2	
Vehicle Extension (s)					3.0	
Lane Grp Cap (vph)		1494		3067	966	
v/s Ratio Prot		0.01		c0.23	c0.17	
v/s Ratio Perm		0.00		0.06		
v/c Ratio		0.02		0.32	0.88	
Uniform Delay, d1		0.6		0.9	55.2	
Progression Factor		1.00		0.87	1.00	
Incremental Delay, d2		0.0		0.0	9.2	
Delay (s)		0.6		0.8	64.4	
Level of Service		A		A	E	
Approach Delay (s)	0.6			0.8	64.4	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	30.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	22.9
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	153	1230	323	26	133	1098	92	669	185	150	144	80
Future Volume (vph)	153	1230	323	26	133	1098	92	669	185	150	144	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.91	1.00		1.00	0.91		0.97	1.00		1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.99		1.00	0.93		1.00	0.94
Flt Protected	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (prot)	1805	5085	1583		1799	4978		3467	1755		1805	1791
Flt Permitted	0.95	1.00	1.00		0.95	1.00		0.95	1.00		0.95	1.00
Satd. Flow (perm)	1805	5085	1583		1799	4978		3467	1755		1805	1791
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	1337	351	28	145	1193	100	727	201	163	157	87
RTOR Reduction (vph)	0	0	119	0	0	7	0	0	21	0	0	16
Lane Group Flow (vph)	166	1337	232	0	173	1286	0	727	343	0	157	125
Heavy Vehicles (%)	0%	2%	2%	2%	0%	3%	3%	1%	1%	1%	0%	0%
Turn Type	Prot	NA	pm+ov	Prot	Prot	NA		Split	NA		Split	NA
Protected Phases	5	2	4	1	1	6		4	4		3	3
Permitted Phases			2									
Actuated Green, G (s)	14.7	44.3	81.8		14.4	44.7		37.5	37.5		13.9	13.9
Effective Green, g (s)	17.2	46.2	92.4		17.6	46.6		42.8	42.8		17.4	17.4
Actuated g/C Ratio	0.12	0.33	0.66		0.13	0.33		0.31	0.31		0.12	0.12
Clearance Time (s)	6.5	5.9	9.3		7.2	5.9		9.3	9.3		7.5	7.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	221	1678	1044		226	1656		1059	536		224	222
v/s Ratio Prot	0.09	c0.26	0.07		0.10	c0.26		c0.21	0.20		c0.09	0.07
v/s Ratio Perm			0.08									
v/c Ratio	0.75	0.80	0.22		0.77	0.78		0.69	0.64		0.70	0.56
Uniform Delay, d1	59.3	42.6	9.5		59.2	42.0		42.7	42.0		58.8	57.7
Progression Factor	0.61	0.47	0.94		0.77	0.45		1.00	1.00		1.00	1.00
Incremental Delay, d2	10.8	3.2	0.1		6.5	1.6		1.9	2.6		9.5	3.3
Delay (s)	47.1	23.3	9.0		51.9	20.7		44.6	44.6		68.3	61.0
Level of Service	D	C	A		D	C		D	D		E	E
Approach Delay (s)		22.7				24.4			44.6			64.8
Approach LOS		C				C			D			E

Intersection Summary			
HCM 2000 Control Delay	31.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.2
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	50
Future Volume (vph)	50
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.92
Adj. Flow (vph)	54
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	36	186	1177	140	44	66	1140	651	125	97	24	626
Future Volume (vph)	36	186	1177	140	44	66	1140	651	125	97	24	626
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0			4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00	0.91			1.00	0.95	1.00		1.00	1.00	0.95
Frt		1.00	0.98			1.00	1.00	0.85		1.00	0.85	1.00
Flt Protected		0.95	1.00			0.95	1.00	1.00		0.97	1.00	0.95
Satd. Flow (prot)		1799	4955			1791	3574	1599		1848	1615	1715
Flt Permitted		0.95	1.00			0.95	1.00	1.00		0.97	1.00	0.95
Satd. Flow (perm)		1799	4955			1791	3574	1599		1848	1615	1715
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	39	200	1266	151	47	71	1226	700	134	104	26	673
RTOR Reduction (vph)	0	0	11	0	0	0	0	307	0	0	22	0
Lane Group Flow (vph)	0	239	1406	0	0	118	1226	393	0	238	4	417
Heavy Vehicles (%)	2%	0%	3%	3%	2%	0%	1%	1%	0%	0%	0%	0%
Turn Type	Prot	Prot	NA		Prot	Prot	NA	Perm	Split	NA	Prot	Split
Protected Phases	5	5	2		1	1	6		4	4	4	3
Permitted Phases								6				
Actuated Green, G (s)		16.9	50.6			14.9	48.3	48.3		15.5	15.5	31.7
Effective Green, g (s)		19.6	52.5			17.3	50.2	50.2		19.0	19.0	35.2
Actuated g/C Ratio		0.14	0.38			0.12	0.36	0.36		0.14	0.14	0.25
Clearance Time (s)		6.7	5.9			6.4	5.9	5.9		7.5	7.5	7.5
Vehicle Extension (s)		3.0	3.0			3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		251	1858			221	1281	573		250	219	431
v/s Ratio Prot		c0.13	0.28			0.07	c0.34			c0.13	0.00	0.24
v/s Ratio Perm								0.25				
v/c Ratio		0.95	0.76			0.53	0.96	0.69		0.95	0.02	0.97
Uniform Delay, d1		59.7	38.2			57.6	43.8	38.2		60.0	52.4	51.8
Progression Factor		0.56	0.70			0.92	0.89	0.67		1.00	1.00	1.00
Incremental Delay, d2		34.1	2.0			2.2	15.3	5.8		43.6	0.0	34.6
Delay (s)		67.8	28.8			55.3	54.5	31.3		103.6	52.4	86.4
Level of Service		E	C			E	D	C		F	D	F
Approach Delay (s)			34.4				46.6			98.6		
Approach LOS			C				D			F		

Intersection Summary			
HCM 2000 Control Delay	52.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.7
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBT	SBR
Lane Configurations		
Traffic Volume (vph)	131	28
Future Volume (vph)	131	28
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.95	
Frt	0.99	
Flt Protected	0.97	
Satd. Flow (prot)	1734	
Flt Permitted	0.97	
Satd. Flow (perm)	1734	
Peak-hour factor, PHF	0.93	0.93
Adj. Flow (vph)	141	30
RTOR Reduction (vph)	2	0
Lane Group Flow (vph)	425	0
Heavy Vehicles (%)	0%	0%
Turn Type	NA	
Protected Phases	3	
Permitted Phases		
Actuated Green, G (s)	31.7	
Effective Green, g (s)	35.2	
Actuated g/C Ratio	0.25	
Clearance Time (s)	7.5	
Vehicle Extension (s)	3.0	
Lane Grp Cap (vph)	435	
v/s Ratio Prot	c0.24	
v/s Ratio Perm		
v/c Ratio	0.98	
Uniform Delay, d1	52.0	
Progression Factor	1.00	
Incremental Delay, d2	36.6	
Delay (s)	88.6	
Level of Service	F	
Approach Delay (s)	87.5	
Approach LOS	F	

Intersection Summary

HCM Signalized Intersection Capacity Analysis
13: Evelyn byrd Ave & East Market Street

12/14/2018

Movement	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR
Lane Configurations								
Traffic Volume (vph)	98	1655	203	38	228	1530	254	548
Future Volume (vph)	98	1655	203	38	228	1530	254	548
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		8.0	4.0	0.1	4.0	4.9
Lane Util. Factor		0.91		1.00	1.00	0.95	1.00	1.00
Frt		0.98		1.00	1.00	1.00	1.00	0.85
Flt Protected		1.00		0.95	0.95	1.00	0.95	1.00
Satd. Flow (prot)		5046		1770	1805	3574	1805	1615
Flt Permitted		1.00		0.50	0.95	1.00	0.95	1.00
Satd. Flow (perm)		5046		931	1805	3574	1805	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	107	1799	221	41	248	1663	276	596
RTOR Reduction (vph)	0	21	0	0	0	0	0	3
Lane Group Flow (vph)	0	2106	0	41	248	1663	276	593
Heavy Vehicles (%)	2%	1%	0%	2%	0%	1%	0%	0%
Turn Type	Split	NA		custom	Prot	NA	Prot	pt+ov
Protected Phases	2!	2			1	6!	4!	4 1!
Permitted Phases				1!				
Actuated Green, G (s)		29.1		8.0	8.0	70.0	9.1	25.1
Effective Green, g (s)		32.0		8.0	12.0	70.0	14.0	25.1
Actuated g/C Ratio		0.46		0.11	0.17	1.00	0.20	0.36
Clearance Time (s)		6.9		8.0	8.0	3.0	8.9	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	2306		106	309	3574	361	579	
v/s Ratio Prot	c0.42			0.14	0.47	0.15	c0.37	
v/s Ratio Perm			0.04					
v/c Ratio	0.91		0.39	0.80	0.47	0.76	1.02	
Uniform Delay, d1	17.7		28.7	27.9	0.0	26.4	22.4	
Progression Factor	0.65		0.94	0.97	1.00	1.00	1.00	
Incremental Delay, d2	4.9		2.1	12.7	0.4	9.3	43.6	
Delay (s)	16.4		29.1	39.8	0.4	35.7	66.0	
Level of Service	B		C	D	A	D	E	
Approach Delay (s)	16.4				6.0	56.4		
Approach LOS	B				A	E		

Intersection Summary			
HCM 2000 Control Delay	19.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	15.8
Intersection Capacity Utilization	125.5%	ICU Level of Service	H
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
15: Chestnut Ridge Dr & East Market Street

12/14/2018

Movement	EBU	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations							
Traffic Volume (vph)	92	1856	238	58	1430	244	89
Future Volume (vph)	92	1856	238	58	1430	244	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4	6.4	7.0	2.0	9.0	7.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1805	3539	1583	1805	3574	1787	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1805	3539	1583	1805	3574	1787	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	2017	259	63	1554	265	97
RTOR Reduction (vph)	0	0	69	0	0	0	9
Lane Group Flow (vph)	100	2017	190	63	1554	265	88
Heavy Vehicles (%)	0%	2%	2%	0%	1%	1%	1%
Turn Type	Split	NA	Perm	Prot	NA	Prot	pm+ov
Protected Phases	2!	2		1	6!	4!	1
Permitted Phases			2				4
Actuated Green, G (s)	85.6	85.6	85.6	7.0	140.0	25.0	32.0
Effective Green, g (s)	85.6	85.6	85.6	7.0	140.0	25.0	32.0
Actuated g/C Ratio	0.61	0.61	0.61	0.05	1.00	0.18	0.23
Clearance Time (s)	6.4	6.4	6.4	7.0	2.0	9.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1103	2163	967	90	3574	319	365
v/s Ratio Prot	0.06	c0.57		0.03	c0.43	c0.15	0.01
v/s Ratio Perm			0.12				0.04
v/c Ratio	0.09	0.93	0.20	0.70	0.43	0.83	0.24
Uniform Delay, d1	11.2	24.6	12.0	65.5	0.0	55.5	44.1
Progression Factor	0.65	0.67	0.43	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	4.5	0.2	21.1	0.4	16.6	0.3
Delay (s)	7.3	20.9	5.3	86.6	0.4	72.0	44.4
Level of Service	A	C	A	F	A	E	D
Approach Delay (s)		18.6			3.7	64.6	
Approach LOS		B			A	E	

Intersection Summary			
HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	89.3%	ICU Level of Service	E
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
16: Linda Lane & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	61	448	402	157	470	251	462	249	155	149	224	68
Future Volume (vph)	61	448	402	157	470	251	462	249	155	149	224	68
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1805	1900	1599	1805	1900	1615	1787	1791		1805	1900	1615
Flt Permitted	0.19	1.00	1.00	0.18	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Satd. Flow (perm)	361	1900	1599	334	1900	1615	1881	1791		1900	1900	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	66	487	437	171	511	273	502	271	168	162	243	74
RTOR Reduction (vph)	0	0	293	0	0	179	0	25	0	0	0	63
Lane Group Flow (vph)	66	487	144	171	511	94	502	414	0	162	243	11
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4			8		8
Actuated Green, G (s)	32.8	27.3	27.3	35.8	28.8	28.8	23.7	23.7		11.0	11.0	11.0
Effective Green, g (s)	36.8	29.3	29.3	39.8	30.8	30.8	25.7	25.7		13.0	13.0	13.0
Actuated g/C Ratio	0.41	0.33	0.33	0.45	0.35	0.35	0.29	0.29		0.15	0.15	0.15
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	270	625	526	298	657	558	543	517		277	277	235
v/s Ratio Prot	0.02	0.26		c0.06	c0.27		0.23	0.23		0.06	c0.13	
v/s Ratio Perm	0.08		0.09	0.20		0.06	c0.05			0.03		0.01
v/c Ratio	0.24	0.78	0.27	0.57	0.78	0.17	0.92	0.80		0.58	0.88	0.05
Uniform Delay, d1	17.8	26.9	22.0	17.7	26.0	20.2	30.0	29.3		35.6	37.2	32.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	6.1	0.3	2.7	5.8	0.1	21.6	8.7		3.1	25.2	0.1
Delay (s)	18.2	33.0	22.3	20.3	31.8	20.4	51.6	38.0		38.8	62.5	32.8
Level of Service	B	C	C	C	C	C	D	D		D	E	C
Approach Delay (s)		27.3			26.5			45.2			49.9	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	35.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	89.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
18: Blue Ridge Drive & Country Club Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	172	347	6	8	471	205	1	3	5	151	3	74
Future Volume (vph)	172	347	6	8	471	205	1	3	5	151	3	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			4.0	4.0
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	1.00
Frt	1.00	1.00			0.96			0.93			1.00	0.85
Flt Protected	0.95	1.00			1.00			0.99			0.95	1.00
Satd. Flow (prot)	1805	1895			1822			1748			1811	1615
Flt Permitted	0.29	1.00			1.00			0.99			0.95	1.00
Satd. Flow (perm)	542	1895			1815			1748			1811	1615
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	181	365	6	8	496	216	1	3	5	159	3	78
RTOR Reduction (vph)	0	0	0	0	13	0	0	5	0	0	0	64
Lane Group Flow (vph)	181	371	0	0	707	0	0	4	0	0	162	14
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA		Perm	NA		Split	NA		Split	NA	Perm
Protected Phases	1	6			2		4	4		8	8	
Permitted Phases	6			2								8
Actuated Green, G (s)	53.1	53.1			39.1			0.9			13.8	13.8
Effective Green, g (s)	55.1	55.1			41.1			2.9			15.8	15.8
Actuated g/C Ratio	0.64	0.64			0.48			0.03			0.18	0.18
Clearance Time (s)	6.0	6.0			6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	495	1216			869			59			333	297
v/s Ratio Prot	c0.04	0.20						c0.00			c0.09	
v/s Ratio Perm	0.19				c0.39							0.01
v/c Ratio	0.37	0.30			0.81			0.07			0.49	0.05
Uniform Delay, d1	17.1	6.8			19.1			40.1			31.4	28.8
Progression Factor	1.00	1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2	0.5	0.1			5.9			0.5			1.1	0.1
Delay (s)	17.5	7.0			25.0			40.7			32.5	28.9
Level of Service	B	A			C			D			C	C
Approach Delay (s)		10.4			25.0			40.7			31.3	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	20.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
19: I-81 NB Ramps & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	1351	0	0	1493	0	0	0	68	0	0	0
Future Volume (vph)	99	1351	0	0	1493	0	0	0	68	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0				6.0			
Lane Util. Factor	1.00	0.95			0.95				1.00			
Frt	1.00	1.00			1.00				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	3539			3539				1565			
Flt Permitted	0.15	1.00			1.00				1.00			
Satd. Flow (perm)	285	3539			3539				1565			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	108	1468	0	0	1623	0	0	0	74	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	68	0	0	0
Lane Group Flow (vph)	108	1468	0	0	1623	0	0	0	6	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	2%
Turn Type	Perm	NA			NA				Prot			
Protected Phases		6			2				5			
Permitted Phases	6											
Actuated Green, G (s)	52.4	52.4			70.0				5.6			
Effective Green, g (s)	52.4	52.4			70.0				5.6			
Actuated g/C Ratio	0.75	0.75			1.00				0.08			
Clearance Time (s)	6.0	6.0			6.0				6.0			
Vehicle Extension (s)	3.0	3.0			3.0				3.0			
Lane Grp Cap (vph)	213	2649			3539				125			
v/s Ratio Prot		c0.41			c0.46				0.00			
v/s Ratio Perm	0.38											
v/c Ratio	0.51	0.55			0.46				0.05			
Uniform Delay, d1	3.6	3.8			0.0				29.7			
Progression Factor	0.38	0.23			1.00				1.00			
Incremental Delay, d2	7.1	0.7			0.2				0.2			
Delay (s)	8.5	1.6			0.2				29.9			
Level of Service	A	A			A				C			
Approach Delay (s)		2.1			0.2		29.9			0.0		
Approach LOS		A			A		C			A		

Intersection Summary			
HCM 2000 Control Delay	1.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Country Club Road & Retreat Driveway

12/14/2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	183	565	641	360	346	246
Future Volume (vph)	183	565	641	360	346	246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1900	1615	3467	1615
Flt Permitted	0.29	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	549	1900	1900	1615	3467	1615
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	199	614	697	391	376	267
RTOR Reduction (vph)	0	0	0	166	0	156
Lane Group Flow (vph)	199	614	697	225	376	111
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		6	2		8	
Permitted Phases	6			2		8
Actuated Green, G (s)	32.1	32.1	32.1	32.1	11.6	11.6
Effective Green, g (s)	32.1	32.1	32.1	32.1	11.6	11.6
Actuated g/C Ratio	0.58	0.58	0.58	0.58	0.21	0.21
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	316	1094	1094	930	722	336
v/s Ratio Prot		0.32	c0.37		c0.11	
v/s Ratio Perm	0.36			0.14		0.07
v/c Ratio	0.63	0.56	0.64	0.24	0.52	0.33
Uniform Delay, d1	7.8	7.4	7.9	5.8	19.6	18.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.2	2.1	2.8	0.6	0.7	0.6
Delay (s)	17.0	9.5	10.7	6.4	20.3	19.3
Level of Service	B	A	B	A	C	B
Approach Delay (s)		11.3	9.2		19.9	
Approach LOS		B	A		B	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	55.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
21: MLK Jr. Way Extension & Country Club Road

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	501	2	215	676	8	201
Future Volume (vph)	501	2	215	676	8	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		0.99	0.95	1.00
Satd. Flow (prot)	1863	1583		1841	1770	1583
Flt Permitted	1.00	1.00		0.72	0.95	1.00
Satd. Flow (perm)	1863	1583		1338	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	545	2	234	735	9	218
RTOR Reduction (vph)	0	0	0	0	0	199
Lane Group Flow (vph)	545	2	0	969	9	19
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	6			2	4	
Permitted Phases		6	2			4
Actuated Green, G (s)	85.2	85.2		85.2	9.3	9.3
Effective Green, g (s)	85.2	85.2		85.2	9.3	9.3
Actuated g/C Ratio	0.80	0.80		0.80	0.09	0.09
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	1490	1266		1070	154	138
v/s Ratio Prot	0.29				0.01	
v/s Ratio Perm		0.00		c0.72		c0.01
v/c Ratio	0.37	0.00		0.91	0.06	0.14
Uniform Delay, d1	3.0	2.1		7.7	44.6	44.9
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	0.0		10.8	0.2	0.5
Delay (s)	3.2	2.1		18.5	44.7	45.4
Level of Service	A	A		B	D	D
Approach Delay (s)	3.2			18.5	45.3	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	17.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	106.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Country Club Road & Vine Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	110	0	0	287	0	401	20	0	607	88
Future Volume (Veh/h)	0	0	110	0	0	287	0	401	20	0	607	88
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	118	0	0	309	0	431	22	0	653	95
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								201				
pX, platoon unblocked												
vC, conflicting volume	1440	1154	374	876	1179	431	748			453		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1440	1154	374	876	1179	431	748			453		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	100	81	100	100	47	100			100		
cM capacity (veh/h)	44	199	629	200	192	578	863			1056		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	118	309	431	22	435	313
Volume Left	0	0	0	0	0	0
Volume Right	118	309	0	22	0	95
cSH	629	578	1700	1700	1700	1700
Volume to Capacity	0.19	0.53	0.25	0.01	0.26	0.18
Queue Length 95th (ft)	17	79	0	0	0	0
Control Delay (s)	12.0	18.1	0.0	0.0	0.0	0.0
Lane LOS	B	C				
Approach Delay (s)	12.0	18.1	0.0		0.0	
Approach LOS	B	C				

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: East Market Street & Wendy's

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	97	1637	61	104	1654	59	0	0	69	0	0	72
Future Volume (Veh/h)	97	1637	61	104	1654	59	0	0	69	0	0	72
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	105	1779	66	113	1798	64	0	0	75	0	0	78
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		725			1074							
pX, platoon unblocked	0.79			0.77			0.87	0.87	0.77	0.87	0.87	0.79
vC, conflicting volume	1862			1845			2925	4110	626	2934	4111	631
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1174			1048			1095	2453	0	1105	2454	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	78			78			100	100	91	100	100	91
cM capacity (veh/h)	468			517			92	16	839	92	16	863

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	105	712	712	422	113	719	719	424	75	78
Volume Left	105	0	0	0	113	0	0	0	0	0
Volume Right	0	0	0	66	0	0	0	64	75	78
cSH	468	1700	1700	1700	517	1700	1700	1700	839	863
Volume to Capacity	0.22	0.42	0.42	0.25	0.22	0.42	0.42	0.25	0.09	0.09
Queue Length 95th (ft)	21	0	0	0	21	0	0	0	7	7
Control Delay (s)	14.9	0.0	0.0	0.0	13.9	0.0	0.0	0.0	9.7	9.6
Lane LOS	B				B				A	A
Approach Delay (s)	0.8				0.8				9.7	9.6
Approach LOS									A	A

Intersection Summary				
Average Delay	1.1			
Intersection Capacity Utilization	45.4%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
10: Valley Mall & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	68	1456	26	36	1275	19	0	0	83	0	0	75
Future Volume (Veh/h)	68	1456	26	36	1275	19	0	0	83	0	0	75
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	74	1583	28	39	1386	21	0	0	90	0	0	82
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		612			781							
pX, platoon unblocked	0.72			0.77			0.84	0.84	0.77	0.84	0.84	0.72
vC, conflicting volume	1407			1611			2367	3230	542	2240	3234	472
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	207			732			71	1102	0	0	1106	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			94			100	100	89	100	100	90
cM capacity (veh/h)	992			676			621	156	836	693	155	786

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	74	633	633	345	39	554	554	298	90	82
Volume Left	74	0	0	0	39	0	0	0	0	0
Volume Right	0	0	0	28	0	0	0	21	90	82
cSH	992	1700	1700	1700	676	1700	1700	1700	836	786
Volume to Capacity	0.07	0.37	0.37	0.20	0.06	0.33	0.33	0.18	0.11	0.10
Queue Length 95th (ft)	6	0	0	0	5	0	0	0	9	9
Control Delay (s)	8.9	0.0	0.0	0.0	10.7	0.0	0.0	0.0	9.8	10.1
Lane LOS	A				B				A	B
Approach Delay (s)	0.4				0.3				9.8	10.1
Approach LOS									A	B

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	40.5%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
12: Skyline Center & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1766	105	0	1802	79	0	0	189	0	0	99
Future Volume (Veh/h)	0	1766	105	0	1802	79	0	0	189	0	0	99
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1920	114	0	1959	86	0	0	205	0	0	108
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		548			1025							
pX, platoon unblocked				0.76			0.76	0.76	0.76	0.76	0.76	
vC, conflicting volume	2045			2034			2738	4022	697	2804	3993	653
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2045			1264			2188	3873	0	2274	3835	653
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	75	100	100	74
cM capacity (veh/h)	279			424			15	3	831	12	3	415

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	768	768	498	653	653	653	86	205	108
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	114	0	0	0	86	205	108
cSH	1700	1700	1700	1700	1700	1700	1700	831	415
Volume to Capacity	0.45	0.45	0.29	0.38	0.38	0.38	0.05	0.25	0.26
Queue Length 95th (ft)	0	0	0	0	0	0	0	24	26
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	16.7
Lane LOS								B	C
Approach Delay (s)	0.0			0.0				10.7	16.7
Approach LOS								B	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	54.8%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
14: Betts Rd & East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	2135	55	0	1743	23	0	0	51	0	0	53
Future Volume (Veh/h)	51	2135	55	0	1743	23	0	0	51	0	0	53
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	55	2321	60	0	1895	25	0	0	55	0	0	58
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		554			855							
pX, platoon unblocked				0.63			0.63	0.63	0.63	0.63	0.63	
vC, conflicting volume	1920			2381			3151	4381	804	2834	4386	632
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1920			1149			2366	4312	0	1865	4320	632
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	82			100			100	100	92	100	100	86
cM capacity (veh/h)	304			389			9	1	690	23	1	428

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	55	928	928	524	632	632	632	25	55	58
Volume Left	55	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	60	0	0	0	25	55	58
cSH	304	1700	1700	1700	1700	1700	1700	1700	690	428
Volume to Capacity	0.18	0.55	0.55	0.31	0.37	0.37	0.37	0.01	0.08	0.14
Queue Length 95th (ft)	16	0	0	0	0	0	0	0	6	12
Control Delay (s)	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	14.7
Lane LOS	C								B	B
Approach Delay (s)	0.4				0.0				10.7	14.7
Approach LOS									B	B

Intersection Summary				
Average Delay	0.6			
Intersection Capacity Utilization	52.5%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
17: Country Club Ct & Country Club Road

12/14/2018

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	679	23	7	880	11	69
Future Volume (Veh/h)	679	23	7	880	11	69
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	738	25	8	957	12	75
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	249					
pX, platoon unblocked			0.91		0.91	0.91
vC, conflicting volume			763		1724	750
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			692		1745	679
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		86	82
cM capacity (veh/h)			824		412	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	763	965	87
Volume Left	0	8	12
Volume Right	25	0	75
cSH	1700	824	270
Volume to Capacity	0.45	0.01	0.32
Queue Length 95th (ft)	0	1	34
Control Delay (s)	0.0	0.3	24.5
Lane LOS		A	C
Approach Delay (s)	0.0	0.3	24.5
Approach LOS			C

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
22: Transit Center & MLK Jr. Way Extension

12/14/2018

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	16	16	193	6	5	212
Future Volume (Veh/h)	16	16	193	6	5	212
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	17	210	7	5	230
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			470			561
pX, platoon unblocked						
vC, conflicting volume	454	214			217	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	454	214			217	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			100	
cM capacity (veh/h)	562	827			1353	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	34	217	5	230
Volume Left	17	0	5	0
Volume Right	17	7	0	0
cSH	669	1700	1353	1700
Volume to Capacity	0.05	0.13	0.00	0.14
Queue Length 95th (ft)	4	0	0	0
Control Delay (s)	10.7	0.0	7.7	0.0
Lane LOS	B		A	
Approach Delay (s)	10.7	0.0	0.2	
Approach LOS	B			

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	21.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
31: Country Club Road & Driveway

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	0	8	129	0	49	10	771	153	45	649	8
Future Volume (Veh/h)	10	0	8	129	0	49	10	771	153	45	649	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	0	9	140	0	53	11	838	166	49	705	9
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								477				
pX, platoon unblocked												
vC, conflicting volume	1716	1829	705	1672	1672	838	714			1004		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1716	1829	705	1672	1672	838	714			1004		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	81	100	98	0	100	86	99			93		
cM capacity (veh/h)	57	70	436	70	88	366	886			690		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	20	140	53	11	838	166	49	705	9
Volume Left	11	140	0	11	0	0	49	0	0
Volume Right	9	0	53	0	0	166	0	0	9
cSH	93	70	366	886	1700	1700	690	1700	1700
Volume to Capacity	0.21	2.01	0.14	0.01	0.49	0.10	0.07	0.41	0.01
Queue Length 95th (ft)	19	321	13	1	0	0	6	0	0
Control Delay (s)	53.8	595.2	16.5	9.1	0.0	0.0	10.6	0.0	0.0
Lane LOS	F	F	C	A			B		
Approach Delay (s)	53.8	436.3		0.1			0.7		
Approach LOS	F	F							

Intersection Summary				
Average Delay	43.1			
Intersection Capacity Utilization	58.7%	ICU Level of Service		B
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
32: Country Club Road & Keezletown Road

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	61	23	19	8	14	9	14	808	8	11	675	65
Future Volume (Veh/h)	61	23	19	8	14	9	14	808	8	11	675	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	66	25	21	9	15	10	15	878	9	12	734	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1688	1675	734	1704	1742	882	805			887		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1688	1675	734	1704	1742	882	805			887		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	73	95	83	82	97	98			98		
cM capacity (veh/h)	61	92	420	53	84	345	819			763		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	112	34	902	746	71
Volume Left	66	9	15	12	0
Volume Right	21	10	9	0	71
cSH	79	90	819	763	1700
Volume to Capacity	1.41	0.38	0.02	0.02	0.04
Queue Length 95th (ft)	221	38	1	1	0
Control Delay (s)	336.2	67.5	0.5	0.4	0.0
Lane LOS	F	F	A	A	
Approach Delay (s)	336.2	67.5	0.5	0.4	
Approach LOS	F	F			

Intersection Summary				
Average Delay	21.8			
Intersection Capacity Utilization	72.7%	ICU Level of Service		C
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
51: East Market Street

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NWL	NWR	SWL	SWR
Lane Configurations										
Traffic Volume (veh/h)	0	1135	400	0	1142	0	0	0	0	113
Future Volume (Veh/h)	0	1135	400	0	1142	0	0	0	0	113
Sign Control		Free			Free		Stop		Yield	
Grade		0%			0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1234	435	0	1241	0	0	0	0	123
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type		None			None					
Median storage veh)										
Upstream signal (ft)		824			453					
pX, platoon unblocked				0.66			0.66	0.66	0.66	
vC, conflicting volume	1241			1669			1978	2475	2910	620
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1241			985			1452	2205	2864	620
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)										
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	100	71
cM capacity (veh/h)	557			460			43	29	11	431

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SW 1
Volume Total	617	617	435	620	620	123
Volume Left	0	0	0	0	0	0
Volume Right	0	0	435	0	0	123
cSH	1700	1700	1700	1700	1700	431
Volume to Capacity	0.36	0.36	0.26	0.36	0.36	0.29
Queue Length 95th (ft)	0	0	0	0	0	29
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	16.7
Lane LOS						C
Approach Delay (s)	0.0			0.0		16.7
Approach LOS						C

Intersection Summary				
Average Delay	0.7			
Intersection Capacity Utilization	45.2%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
52: East Market Street

12/14/2018

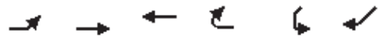
Movement	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	1135	0	0	1782	0	315
Future Volume (Veh/h)	1135	0	0	1782	0	315
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1234	0	0	1937	0	342
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	392			621		
pX, platoon unblocked			0.72		0.72	0.72
vC, conflicting volume			1234		1880	617
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			558		1451	0
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	56
cM capacity (veh/h)			735		87	782

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NE 1
Volume Total	617	617	646	646	646	342
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	342
cSH	1700	1700	1700	1700	1700	782
Volume to Capacity	0.36	0.36	0.38	0.38	0.38	0.44
Queue Length 95th (ft)	0	0	0	0	0	56
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	13.1
Lane LOS						B
Approach Delay (s)	0.0		0.0			13.1
Approach LOS						B

Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	73.5%	ICU Level of Service		D
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
53: East Market Street

12/14/2018



Movement	EBL	EBT	WBT	WBR	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	0	1451	1493	0	0	290
Future Volume (Veh/h)	0	1451	1493	0	0	290
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1577	1623	0	0	315
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		717	296			
pX, platoon unblocked					0.82	
vC, conflicting volume	1623				2149	812
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1623				1639	812
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	2
cM capacity (veh/h)	397				75	322

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SW 1
Volume Total	526	526	526	812	812	315
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	315
cSH	1700	1700	1700	1700	1700	322
Volume to Capacity	0.31	0.31	0.31	0.48	0.48	0.98
Queue Length 95th (ft)	0	0	0	0	0	261
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	81.4
Lane LOS						F
Approach Delay (s)	0.0			0.0		81.4
Approach LOS						F

Intersection Summary				
Average Delay	7.3			
Intersection Capacity Utilization	65.9%	ICU Level of Service		C
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
54: East Market Street & I-81 NB On

12/14/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SER	NEL	NER
Lane Configurations										
Traffic Volume (veh/h)	0	1419	0	0	1493	476	0	0	0	606
Future Volume (Veh/h)	0	1419	0	0	1493	476	0	0	0	606
Sign Control		Free			Free		Stop		Yield	
Grade		0%			0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1542	0	0	1623	517	0	0	0	659
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type		Raised			None					
Median storage veh)		1								
Upstream signal (ft)		489			592					
pX, platoon unblocked	0.68			0.89			0.74	0.74	0.74	0.89
vC, conflicting volume	2140			1542			2796	3165	3682	514
vC1, stage 1 conf vol							1623	1623	1542	
vC2, stage 2 conf vol							1173	1542	2140	
vCu, unblocked vol	1743			1173			1825	2323	3022	17
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	100	30
cM capacity (veh/h)	244			531			62	116	65	944

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NE 1
Volume Total	514	514	514	812	812	517	659
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	0	0	517	659
cSH	1700	1700	1700	1700	1700	1700	944
Volume to Capacity	0.30	0.30	0.30	0.48	0.48	0.30	0.70
Queue Length 95th (ft)	0	0	0	0	0	0	149
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	17.1
Lane LOS							C
Approach Delay (s)	0.0			0.0			17.1
Approach LOS							C

Intersection Summary				
Average Delay	2.6			
Intersection Capacity Utilization	71.6%	ICU Level of Service		C
Analysis Period (min)	15			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	861	782	0
Future Volume (Veh/h)	5	0	0	861	782	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	0	936	850	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)				660	570	
pX, platoon unblocked	0.91	0.84	0.84			
vC, conflicting volume	1786	850	850			
vC1, stage 1 conf vol	850					
vC2, stage 2 conf vol	936					
vCu, unblocked vol	1471	729	729			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	289	356	738			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	5	936	850
Volume Left	5	0	0
Volume Right	0	0	0
cSH	289	1700	1700
Volume to Capacity	0.02	0.55	0.50
Queue Length 95th (ft)	1	0	0
Control Delay (s)	17.7	0.0	0.0
Lane LOS	C		
Approach Delay (s)	17.7	0.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	55.3%	ICU Level of Service	B
Analysis Period (min)	15		

Appendix G: Project Summary Sheets

Improvement Summary Sheet - Preferred Alternative

1 - Vine Street: Reconfiguration of Left-Turn Lanes and Incorporation of RIRO Configuration Replacing Traffic Signal at Country Club Road

Project Description

This project on Vine Street at the US Route 33 and Country Club Road intersections includes multiple improvements at the two closely-spaced signalized intersections.

1. Remove the traffic signal at the intersection of Vine Street and Country Club Road near the Sheetz service station and extend the left-turn restriction on Vine Street from US Route 33 to the Chamber of Commerce entrance. The current queue from the US Route 33 intersection backs up to the curve near Honeysuckle Lane. Designating two lanes for left-turning and combining the right-most left-turn lane to share through movements and right turns reduces the queue distance necessary for accommodating the PM peak hour traffic.
2. With the removal of the traffic signal at Country Club Road, convert the intersection to a right-in/right-out (RIRO) configuration and add raised delineators on the centerline of Vine Street from US Route 33 to the Chamber of Commerce entrance.

Planning Level Cost Estimate

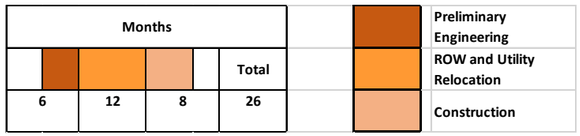
Phase	Six-Year Improvement Program
Preliminary Engineering	$ 95,000
ROW and Utility Relocation	$ 0
Construction	$ 475,000
Total Cost =	**$ 570,500**

Note 1: Cost estimates reported in 2018 dollars
Note 2: Could necessitate funding for construction easements

Project Benefits

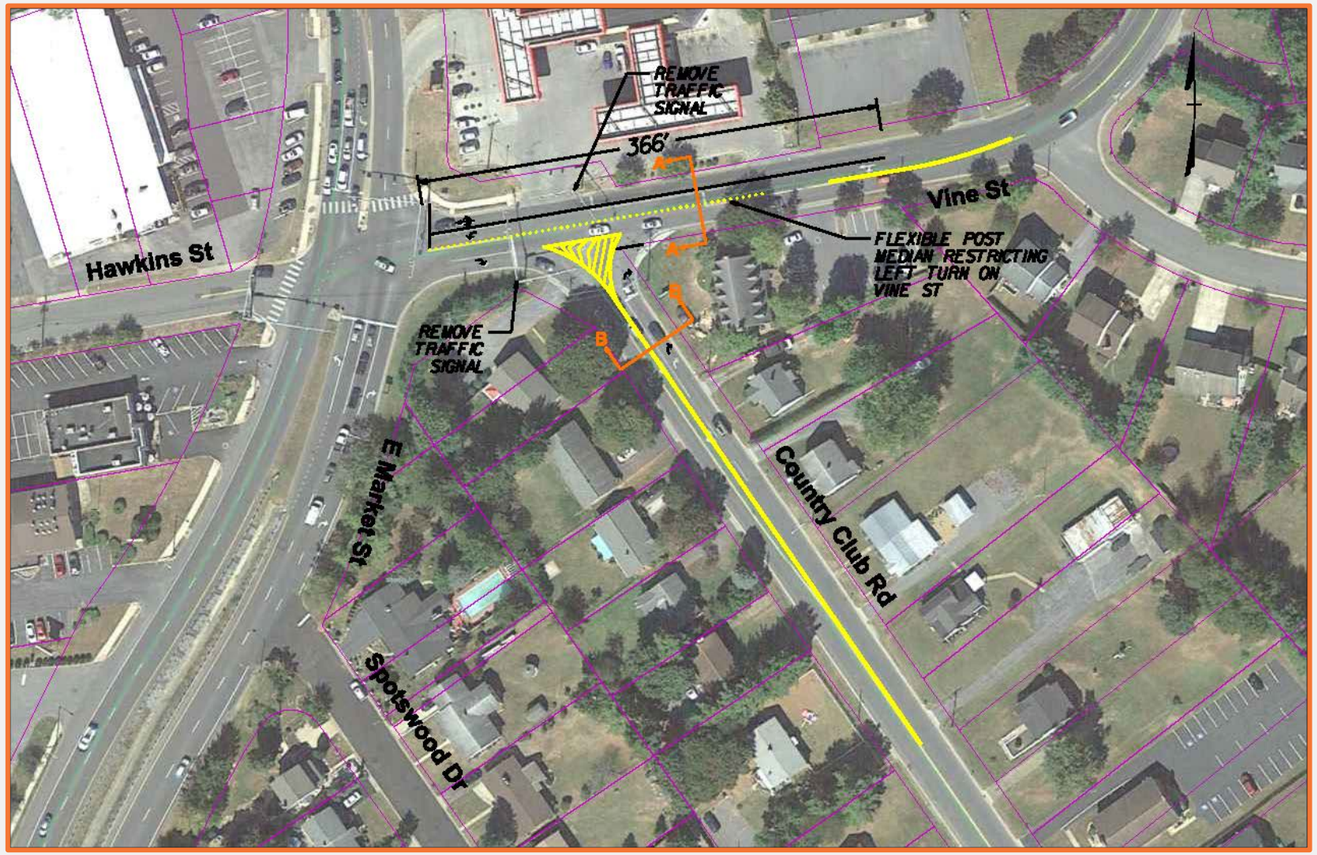
- Consolidates left-turn traffic and corresponding queuing into two lanes, reducing queues to 300 feet
- Improves LOS along Route 33 at Hawkins Street/Vine Street (13 % reduction in intersection delay)
- Reduces delays at the Vine Street/Country Club Road intersection via right-in/right-out (RIRO) with a 94 % reduction in intersection delay; LOS E to LOS A
- Removes one of two closely-spaced traffic signals on Vine Street

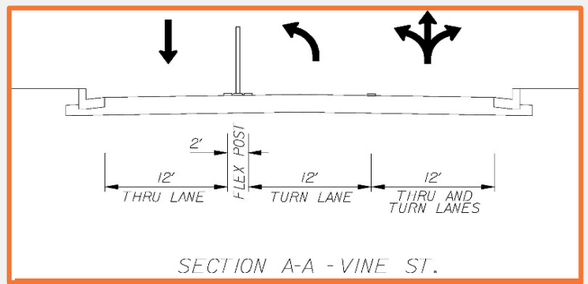
Project Schedule



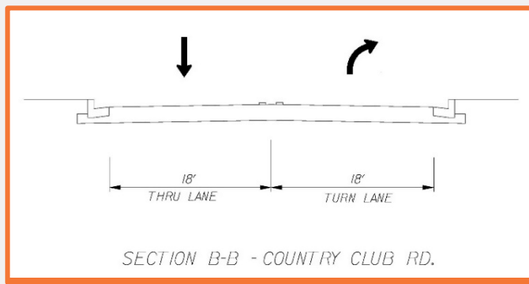
The City recommended improvements along Vine Street for Project #1 should not be implemented until after the implementation of Project #2, extending Martin Luther King Jr. Way and connecting it with Country Club Road.

Vine Street Improvements: US Route 33 and Country Club Road Intersection





Typical Section A-A: VINE STREET



Typical Section B-B: COUNTRY CLUB ROAD

Improvement Summary Sheet - Preferred Alternative

2 Martin Luther King Jr. Way: Extension and Inclusion of Traffic Signal at Country Club Road

Project Description

As part of consideration of a new roadway network connection between Route 33 and Country Club Road and in support of a planned new Transit Center:

1. Martin Luther King Jr Way is proposed to be extended from Route 33 to Country Club Road. The Extension will provide additional roadway connectivity in the corridor and access to/from the transit center. The extension has been in the City's Street Improvement Plan (and adopted in the Comprehensive Plan) since 2011.

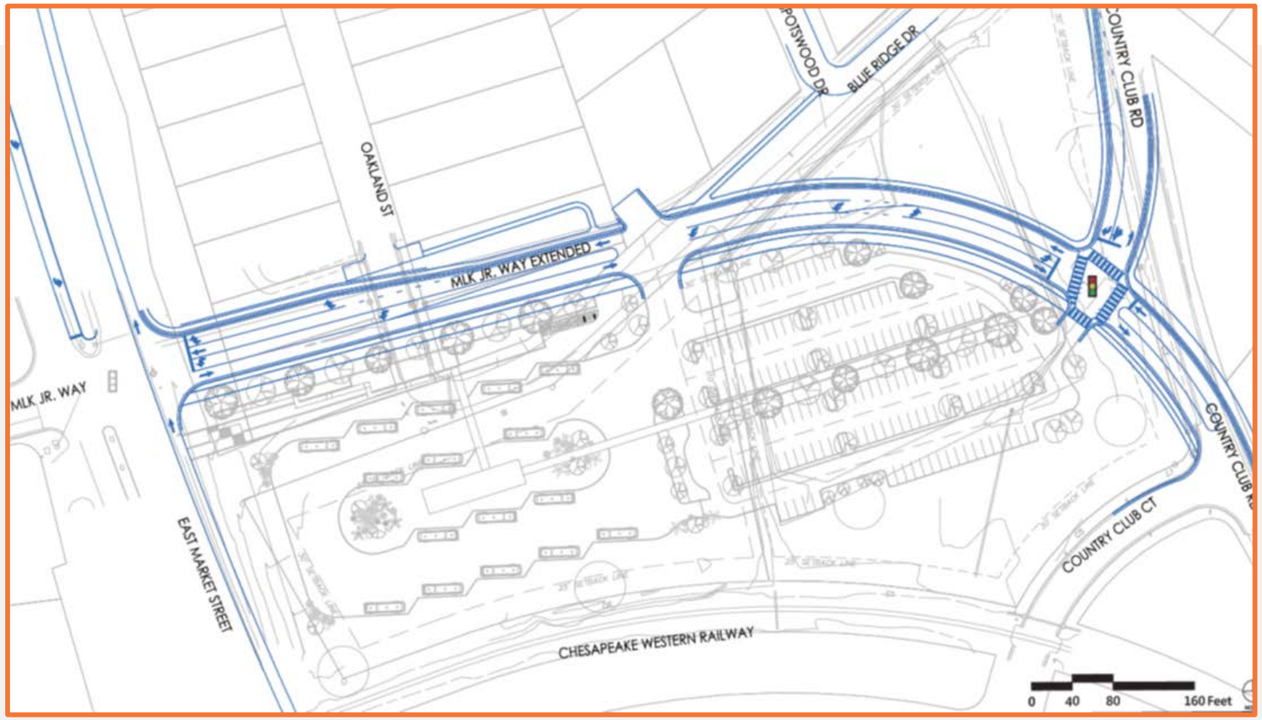
2. A new traffic signal is proposed at the Martin Luther King Jr Way extension and Country Club Road intersection contingent upon the approval of a traffic signal justification report (SJR).

Other features of this improvement include:

- The roadway is planned to be a 3-lane roadway with center turn lane and traffic signal at the new intersection of the MLK Jr Way Extension and Country Club Road.
- Benefits of the extension have been derived from an examination of existing and future (2025) traffic conditions. The extension will also serve an adjacent 16 Birth, 2,500 SF Transfer Center and a 150-180 space Park & Ride lot.

The City of Harrisonburg has developed a feasibility study for the project, documented in the Harrisburg Downtown Transit Center, Conceptual Design Report (March 14, 2018).

Preliminary Concept Design



Planning Level Cost Estimate

Phase	Six Year Improvement Program
Preliminary Engineering	$ 1,546,000
ROW and Utility Relocation	$ 1,600,000
Construction	$ 12,889,000
Total Cost =	**$ 16,035,000**

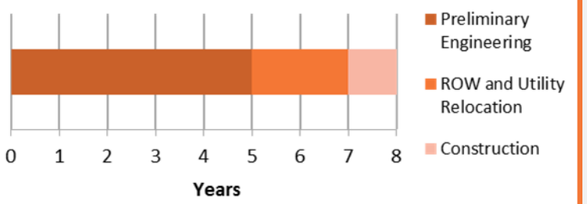
Source: Harrisonburg Downtown Transit Center, Conceptual Design Report, March 14, 2018 (Estimate by VHB using PCES)
Note: Cost estimates reported in 2018 dollars

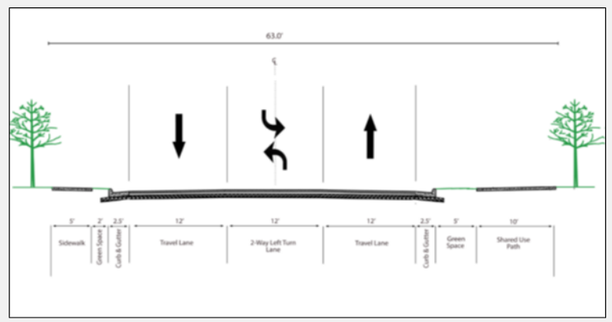
Project Benefits

- Removes PM Peak Hour traffic from Route 33 between MLK Jr Way and Linda Lane and through I-81 interchange
- Improves LOS along Route 33 at MLK Jr Way and at Linda Lane (23 % reduction in intersection delay)
- Reduces northbound left turns (-34 vehicles, 7.5%) from eastbound Route 33 to Linda Lane and southbound right turns (-74, 16%) from southbound Linda Lane to westbound Route 33

Project Schedule (Transfer Center/Extension)

- Aug, 2018 – Submit Smart Scale Application
- May, 2019 – Notified of Smart Scale Awards
- 2023 – Begin Engineering
- 2024 – Begin Right of Way / Utility Relocation
- 2026 – Construction
- Late 2026 – Open to Public





Typical Section of Martin Luther King Jr. Way Extended
Source: Harrisonburg Downtown Transit Center, Conceptual Design Report, March 14, 2018

Improvement Summary Sheet - Preferred Alternative

3 - Burgess Road/Linda Lane: Reconfigurations of Burgess Rd Median and Linda Ln/Frontage Rd Intersection with Removal of Traffic Signal

Project Description

This project addresses turning movement challenges at the intersection of US Route 33 at Burgess Road and Linda Lane. Improvements consist of changes on the Burgess Road and Linda Lane approaches.

1. On the Burgess Road approach, separate and delineate directional traffic with raised delineators in the centerline from US Route 33 to before the access point to the Market Square East shopping center.
2. On Linda Lane approach, allow the signalization on Linda Lane to remain in place at the frontage road only for SB traffic eliminating maneuvers at one of the two closely spaced intersections. This improvement would also include restricting turning movements to only allow southbound right-in and right-out turns and northbound left turns from Linda Lane to the private frontage road.

Planning Level Cost Estimate

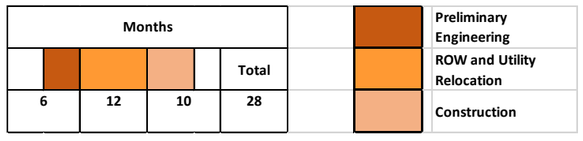
Phase	Six-Year Improvement Program
Preliminary Engineering	$ 103,000
ROW and Utility Relocation	$ 0
Construction	$ 517,500
Total Cost =	**$ 620,500**

Note 1: Cost estimates reported in 2018 dollars
Note 2: Could necessitate funding for construction easements

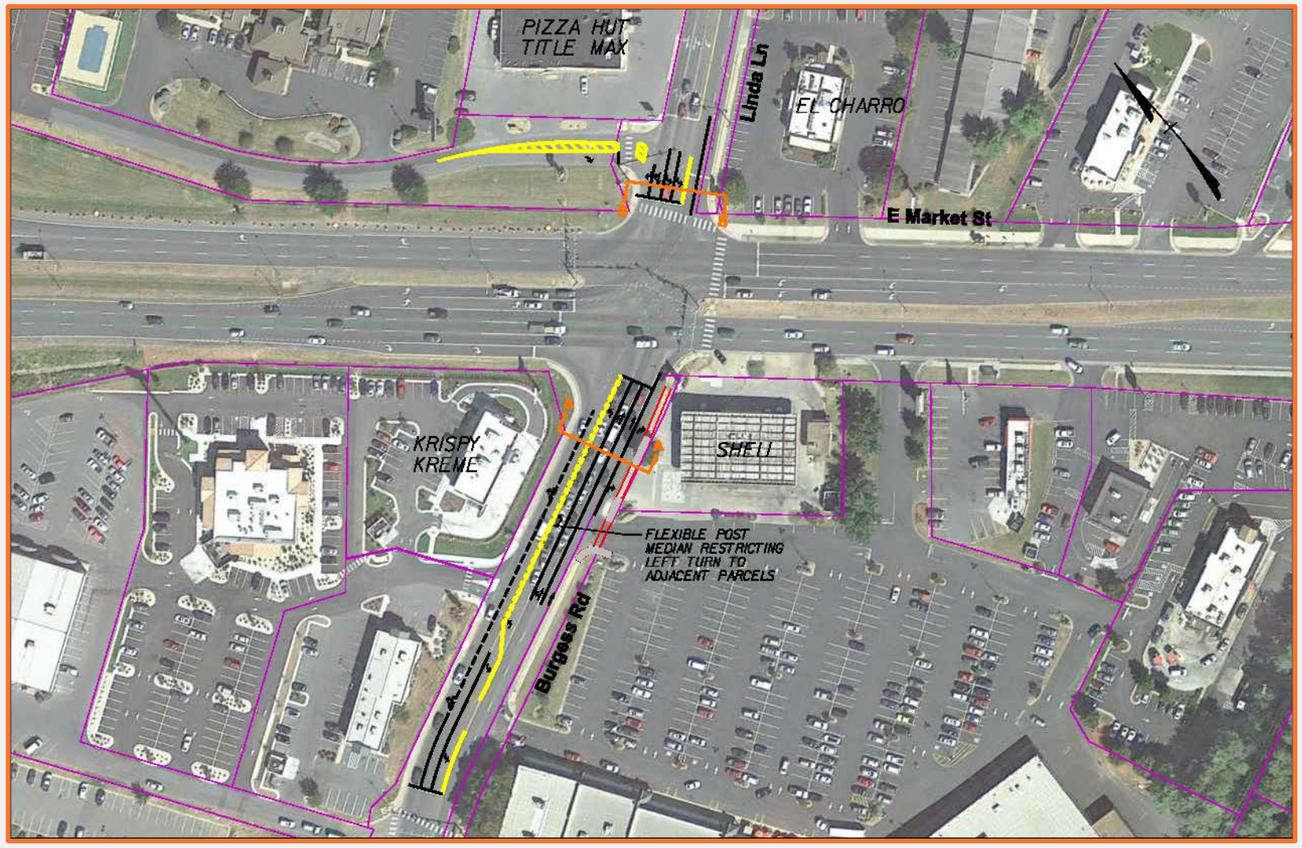
Project Benefits

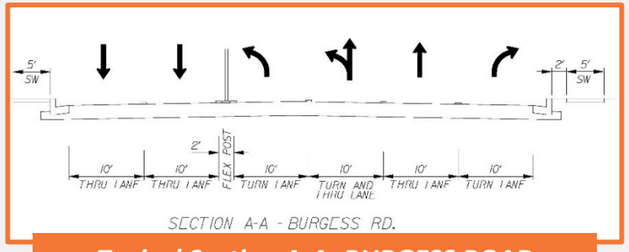
- Restricts left-turn movements to/from multiple entrances along Burgess Road from US Route 33 to second access point at Market Square East
- Reduces conflict points and angle crashes due to left-turn traffic along Burgess Road
- Improves LOS at intersection with private frontage driveway at Linda Lane from LOS E to LOS A
- Removes one of two closely-spaced traffic signals on Linda Lane.

Project Schedule

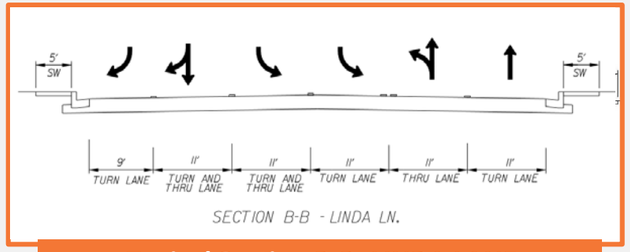


Burgess Road/Linda Lane Intersection Improvements





Typical Section A-A: BURGESS ROAD



Typical Section B-B: LINDA LANE

Improvement Summary Sheet - Preferred Alternative

4 - University Boulevard: Extension of Northbound Left-Turn Lanes

Project Description

The project at the US Route 33 and University Boulevard intersection includes the extension of the northbound left-turn lanes on University Boulevard to 500 feet. The northbound left-turn PM peak hour movement is 669 vehicles per hour. As a result, the northbound approach experiences a LOS E condition with a 95th percentile queue length of over 500 feet.

This improvement recommends the transition of the southbound right-turn lane with the addition of another right-turn lane immediately before the bus shelter stop at the top of the hill (and the reduction of the northbound left-turn lanes to one lane in the opposite direction).

Planning Level Cost Estimate

Phase	Six-Year Improvement Program
Preliminary Engineering	$ 8,000
ROW and Utility Relocation	$ 0
Construction	$ 220,000
Total Cost =	**$ 228,000**

Note: Cost estimates reported in 2018 dollars

Project Benefits

- Consolidates left-turn traffic and queuing into two lanes, improving vehicle delays by nearly 10 percent
- Reduces queue length to 504 feet

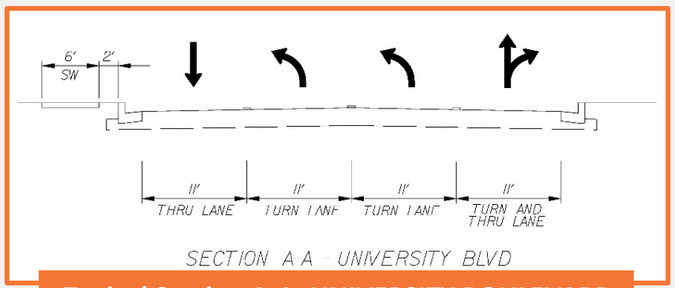
University Boulevard Improvements

Project Schedule

Months				Total
4	4	4		12

Preliminary Engineering
ROW and Utility Relocation
Construction

US Route 33 at Valley Mall Entrance



Typical Section A-A: UNIVERSITY BOULEVARD

Improvement Summary Sheet - Preferred Alternative

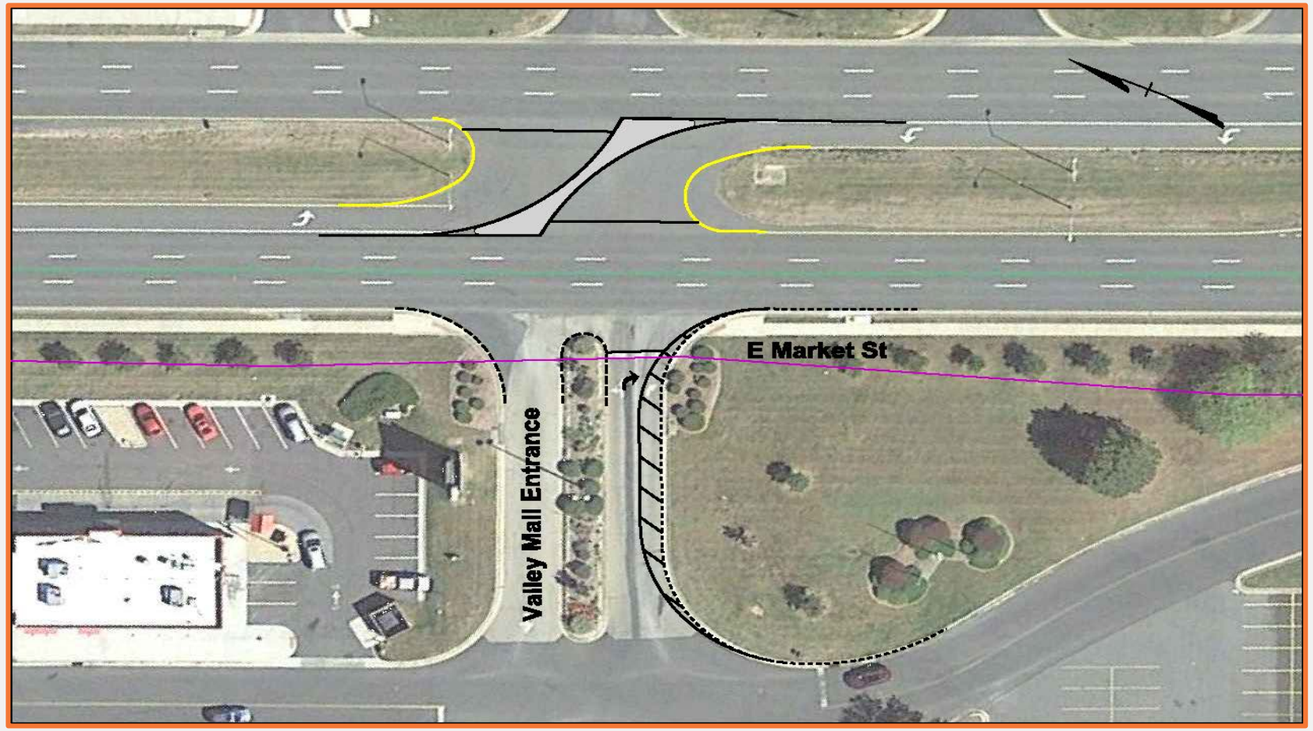
5 - Valley Mall Crossover: Reconfiguration to Directional Median

Project Description

This project includes the construction of a directional median at Valley Mall crossover, restricting left-turns from Valley Mall exit and from the Market Place Shopping Center exit across US Route 33. Left-turns are accommodated via:

1. U-turns at adjacent intersections at University Boulevard and at Skyline Village Crossover on US Route 33.
2. Rerouting of exiting traffic through retail areas interconnecting with University Boulevard or with the Skyline Village crossover connections.

Valley Mall Crossover Improvements



Planning Level Cost Estimate

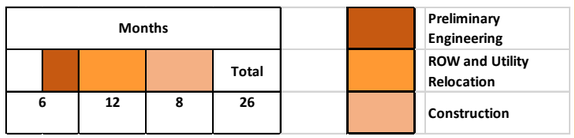
Phase	Six-Year Improvement Program
Preliminary Engineering	$ 22,000
ROW and Utility Relocation	$0
Construction	$ 111,000
Total Cost =	**$ 133,000**

Note 1: Cost estimates reported in 2018 dollars
Note 2: Could necessitate funding for construction easements

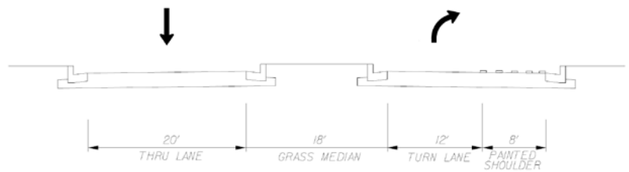
Project Benefits

- Removes left-turn traffic from side streets
- Retains access from US Route 33 into retail areas on both sides of corridor
- Reduces the number of crossing conflict points on US Route 33

Project Schedule



US Route 33 at Valley Mall Entrance



Typical Section A-A: VALLEY MALL ENTRANCE

Improvement Summary Sheet - Preferred Alternative

6 - Skyline Village Crossover: Reconfiguration to Directional Median

Project Description

This project includes the modification of the Skyline Village crossover to a directional median opening. The details of this concept are described below.

1. Provide directional median at Skyline Village Crossover to restrict exiting left-turns from the Skyline Village commercial entrance. Left turns are accommodated via U-turns at the adjacent Evelyn Byrd intersection.

Planning Level Cost Estimate

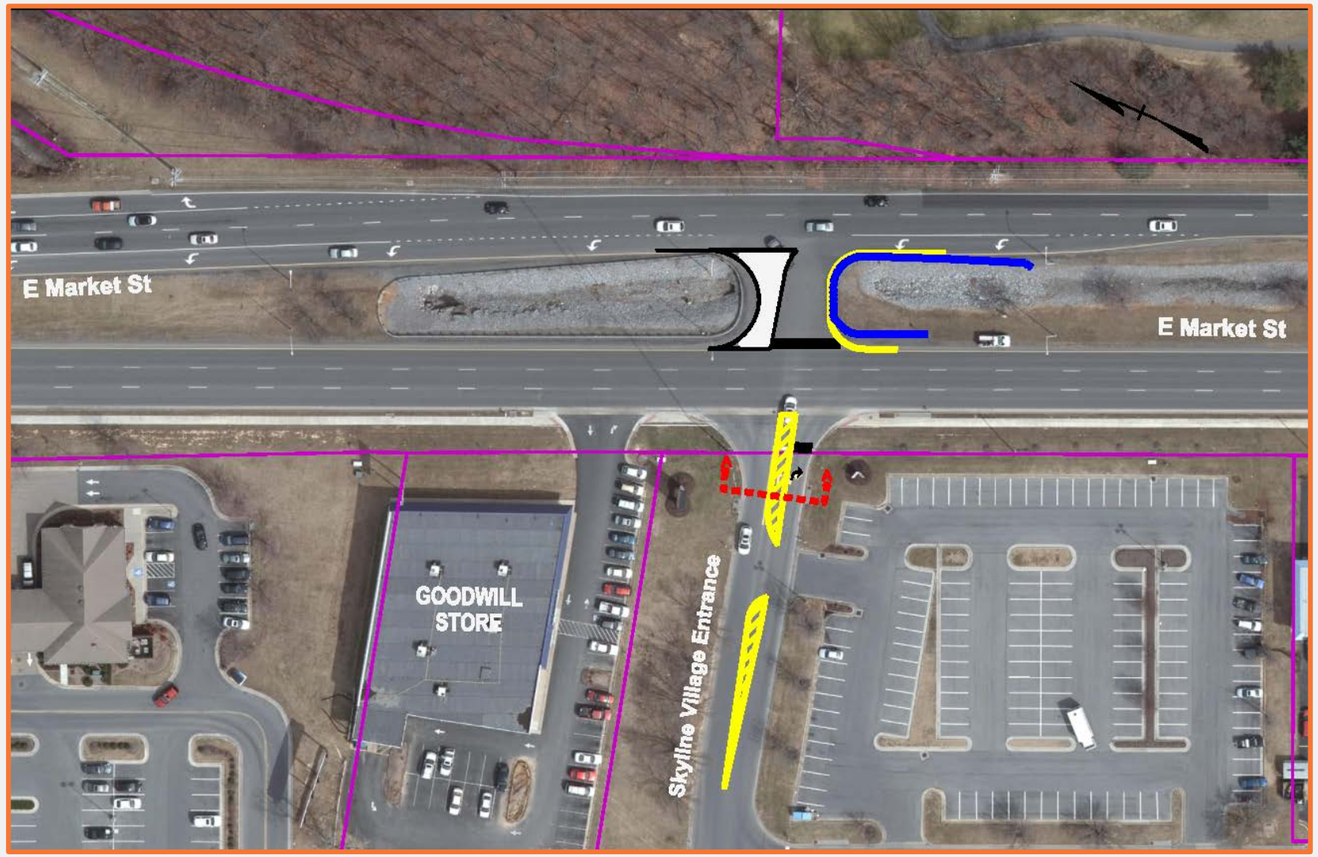
Phase	Six-Year Improvement Program
Preliminary Engineering	$ 39,000
ROW and Utility Relocation	$0
Construction	$ 188,000
Total Cost =	**$ 227,000**

Note: Cost estimates reported in 2018 dollars

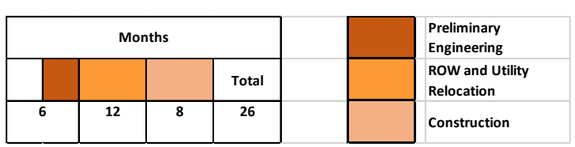
Project Benefits

- Removes left-turn movement from Skyline Village Crossover to westbound US Route 33
- Reduces the number of crossing conflict points on US Route 33

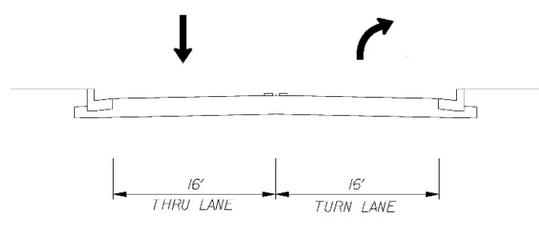
Skyline Village Crossover Improvements



Project Schedule



US Route 33 at Skyline Village Crossover



Typical Section A-A: SKYLINE VILLAGE ENTRANCE

Improvement Summary Sheet - Preferred Alternative

7 - Evelyn Byrd Avenue: Reconfiguration to Continuous Green-T (CGT) Intersection

Project Description

This project includes the construction of a continuous green-T (CGT) innovative intersection improvement at the US Route 33 and Evelyn Byrd Avenue intersection. This improvement will allow continuous flow of westbound through traffic on US Route 33 while westbound left turns on US Route 33 and northbound left turns from Evelyn Byrd Avenue can be accommodated without stopping the through traffic. Dual left turns from US Route 33 will be signal-controlled at the intersection with the eastbound traffic.

Planning Level Cost Estimate

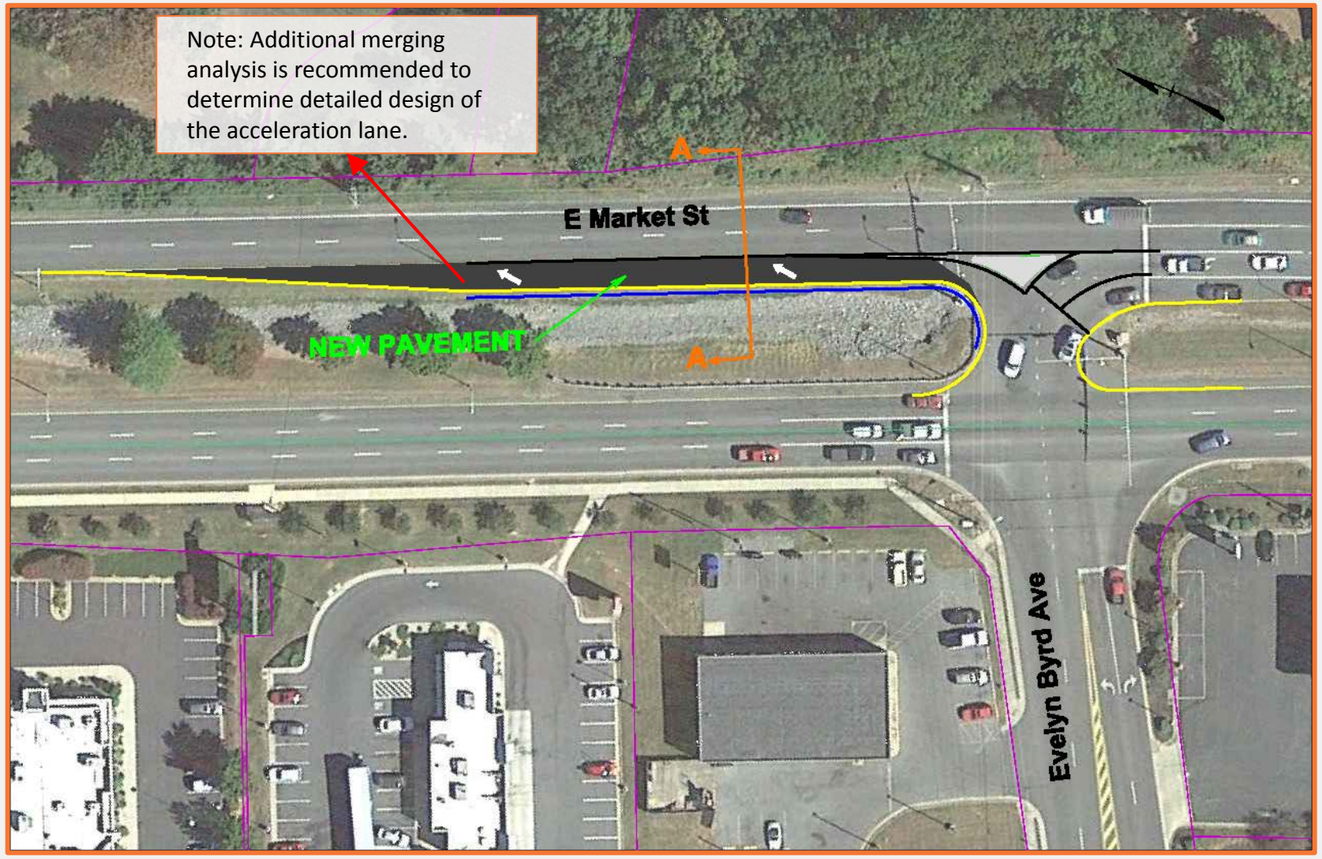
Phase	Six Year Improvement Program
Preliminary Engineering	$ 160,000
ROW and Utility Relocation	$0
Construction	$ 801,000
Total Cost =	**$ 961,000**

Note: Cost estimates reported in 2018 dollars

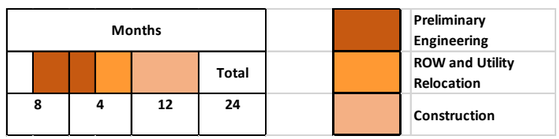
Project Benefits

- Improves operations at intersection from LOS C to B and with a 28 % reduction in vehicle delay
- Reduces potential for angle crashes
- Relative to mainline travel, allows for traffic signal synchronization and reduces corridor travel times

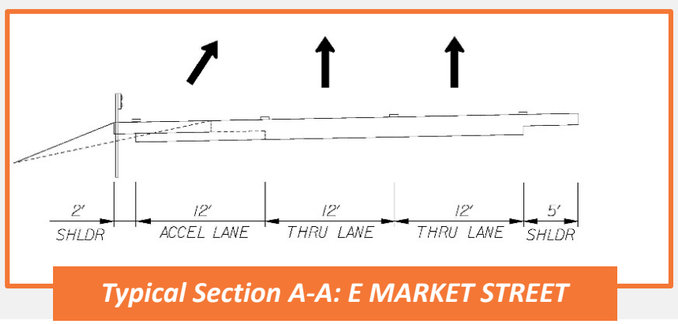
Improvements at US Route 33 and Evelyn Byrd Avenue



Project Schedule



US Route 33 at Evelyn Byrd Avenue



Typical Section A-A: E MARKET STREET

Improvement Summary Sheet - Preferred Alternative

8 - Betts Ct/Betts Rd and Chestnut Ridge Dr: Reconfigurations with Westbound Left-Turn Lane Closure and Continuous Green-T (CGT) Intersection

Project Description

This project includes multiple improvements on an between the Betts Road and Chestnut Drive intersections as described below.

1. Close the westbound left-turn lane from US Route 33 to Betts Court. Allow the eastbound left-turn lane from eastbound US Route 33 to remain and provide access to Betts Road.
2. Provide a continuous green-T (CGT) intersection at the Chestnut Ridge Drive intersection with US Route 33. This improvement will allow continuous flow of the westbound through traffic while left turns from the westbound and left-turns from Chestnut Ridge to the westbound flow can be accommodated without stopping the through westbound traffic. The left-turning traffic from US Route 33 will be signal controlled at the intersection with the eastbound movements.

Planning Level Cost Estimate

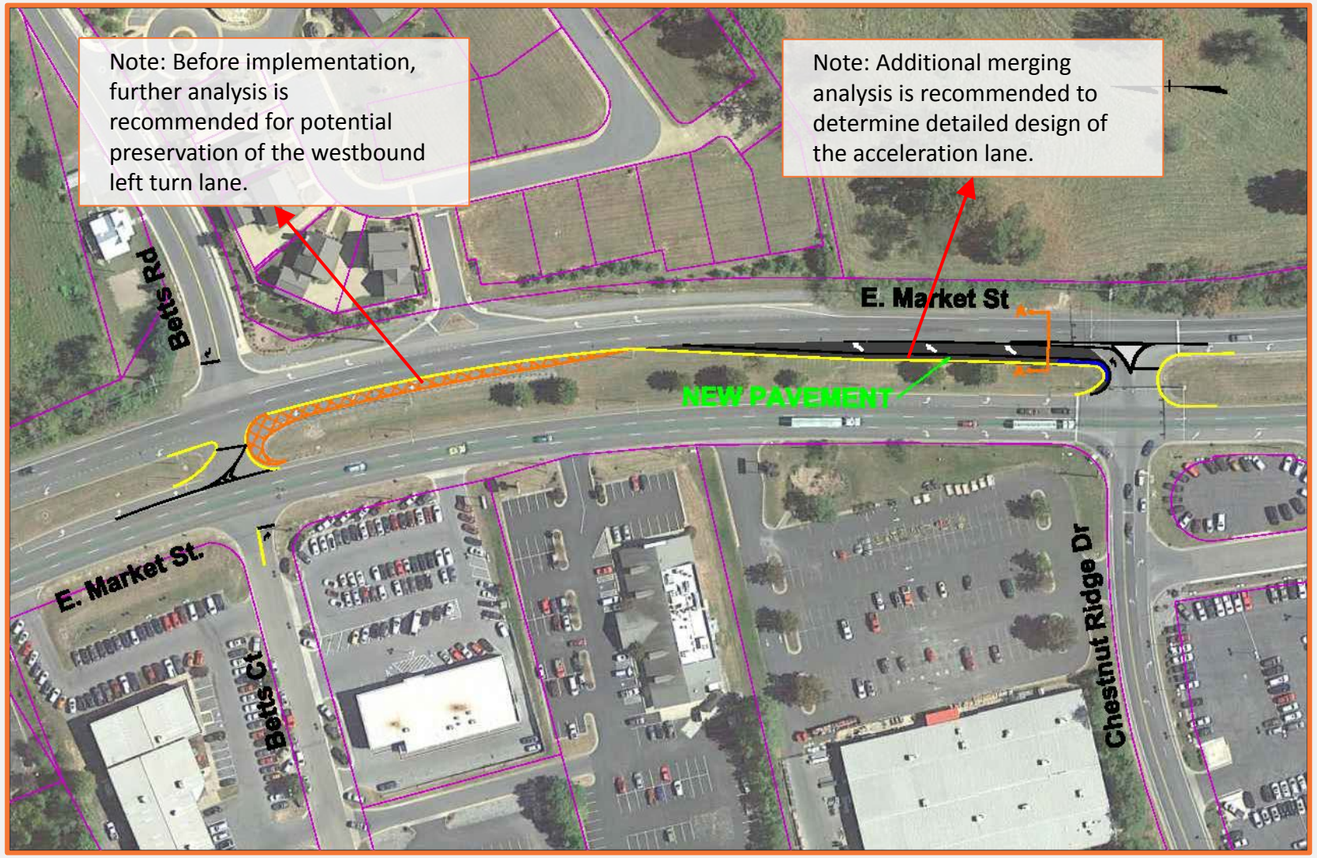
Phase	Six Year Improvement Program
Preliminary Engineering	$ 188,000
ROW and Utility Relocation	$0
Construction	$ 943,500
Total Cost =	**$ 1,131,500**

Note 1: Cost estimates reported in 2018 dollars
Note 2: Could necessitate funding for construction easements

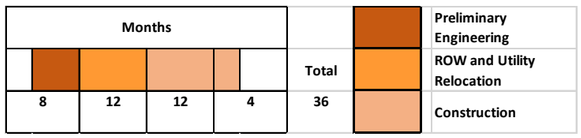
Project Benefits

- Pairing of intersection improvements provides opportunity to make U-turn at Chestnut Ridge Drive with removal of left turn from Betts Court - left-turns from Betts Road can be made to west with turns at Evelyn Byrd Avenue or Skyline Village Crossover
- Reduces potential for angle crashes at Chestnut Ridge Drive
- Relative to mainline travel, allows for traffic signal synchronization and reduces corridor travel times

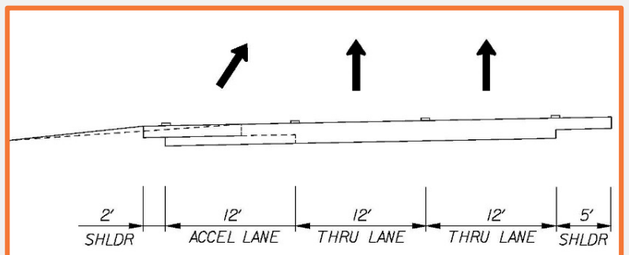
Betts Court/Betts Road and Chestnut Ridge Drive Improvements



Project Schedule



US Route 33 at Betts Court/Betts Road



Typical Section A-A – E. MARKET STREET

VINE ST & E. MARKET ST AND VINE ST & COUNTRY CLUB RD

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
1	Construction Surveying & Mobilization	LS	1	$ 29,000	$ 29,000
	Subtotal				**$ 29,000**
	Pavement Items				
4	Mill and Overlay Existing Pavement	SY	4,000	$ 25	$ 100,000
	Subtotal				**$ 100,000**
	Lump Sum Items				
15	Signal Removal	EA	1	$ 25,000	$ 25,000
18	Maintenance of Traffic	LS	1	$ 20,000	$ 20,000
21	flexible post delineators	EA	110	$ 112.00	$ 12,320
22	crosshatch markings 8", < 45 mph	LF	200	$ 5.62	$ 1,124
23	Pvmt line mrkg, 54076, 6"	LF	2000	$ 4.92	$ 9,840
	Pvmt line mrkg, 12"	LF	60	$ 13.20	$ 792
24	Pvmt Marking Arrows	EA	7	$ 320.00	$ 2,240
	Signs	LS	1	$ 1,000.00	$ 1,000
	traffic signal phasing @ Route 33	EA	1	$ 100,000.00	$ 100,000
	Subtotal				**$ 172,316**
	Construction Totals				
	Construction Contract Subtotal				**$ 301,316**
	Contingency (30%)	LS	1	$ 91,000	$ 91,000
	Construction Contract Total				**$ 392,316**
	Incentive (5%)	LS	1	$ 20,000	$ 20,000
	Construction Engineering & Inspection (16%)	LS	1	$ 63,000	$ 63,000
				Total Construction Phase	**$ 475,316**

5	**Preliminary Engineering**					
5A	**Preliminary Engineering (22%)**					$ 87,000
5B	**Environmental Mitigation & Permitting Allowance**					$ 8,000
					Total Preliminary Engineering Phase	**$ 95,000**

6	**Right of Way**					
6A	**Right of Way**					$ -
6B	**Utilities**					$ -
					Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars $ 570,316
Say $ 570,000

BURGESS ROAD & LINDA LANE

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
	Construction Surveying & Mobilization	LS	1	$ 31,000	$ 31,000
	Subtotal				**$ 31,000**
	Pavement Items				
	Mill and Overlay Existing Pavement	SY	3,778	$ 25	$ 94,445
	Demolish sidewalk	SY	56	$ 20.00	$ 1,120
	Remove Curb & Gutter (@demolished sidewalk)	LF	70	$ 17.00	$ 1,190
	New Curb & Gutter (@demolished sidewalk)	LF	70	$ 65.00	$ 4,550
	New sidewalk	SY	60	$ 96.00	$ 5,760
	Sidewalk ramp	EA	5	$ 4,000.00	$ 20,000
	Subtotal				**$ 127,065**
	Incidental Items				
	Signal Removal	EA	1	$ 25,000	$ 15,000
	Maintenance of Traffic	LS	1	$ 20,000	$ 20,000
	flexible post delineators	EA	108	$ 112.00	$ 12,096
	crosshatch markings 8", < 45 mph	LF	115	$ 5.62	$ 647
	6" Pvmt line mrkg	LF	2022	$ 4.92	$ 9,949
	4" White Skipped Line	LF	340	$ 4.00	$ 1,360
	12" Solid While Line	LF	123	$ 13.20	$ 1,624
	Pvmt Marking Arrows	EA	21	$ 320.00	$ 6,720
	Signs	LS	1	$ 1,000.00	$ 1,000
	traffic signal phasing @ Route 33	EA	1	$ 100,000.00	$ 100,000
	Subtotal				**$ 168,396**
	Construction Totals				
	Construction Contract Subtotal				**$ 327,581**
	Contingency (30%)	LS	1	$ 99,000	$ 99,000
	Construction Contract Total				**$ 426,581**
	Incentive (5%)	LS	1	$ 22,000	$ 22,000
	Construction Engineering & Inspection (16%)	LS	1	$ 69,000	$ 69,000
				Total Construction Phase	**$ 517,581**

5	**Preliminary Engineering**					
5A	**Preliminary Engineering (22%)**					$ 94,000
5B	**Environmental Mitigation & Permitting Allowance**					$ 9,000
					Total Preliminary Engineering Phase	**$ 103,000**

6	**Right of Way**					
6A	**Right of Way**					$ -
6B	**Utilities**					$ -
					Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars $ 620,581
Say $ 621,000

UNIVERSITY BLVD. & E MARKET STREET

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
	Construction Surveying & Mobilization	LS	1	$ 15,000	$ 5,000
	Subtotal				**$ 5,000**
	Pavement Items				
	Mill and Overlay Existing Pavement	SY	3,889	$ 25	$ 97,223
	Subtotal				**$ 97,223**
	Lump Sum Items				
	Maintenance of Traffic	LS	1	$ 20,000	$ 20,000
	flexible post delineators	EA	0	$ 112.00	$ -
	6" Pvmt line mrkg	LF	2300	$ 4.92	$ 11,316
	6" Pvmt skipped line mrkg	LF	150	$ 4.92	$ 738
	12" Pvmt line mrkg	LF	40	$ 13.20	$ 528
	Pvmt Marking Arrows	EA	10	$ 320.00	$ 3,200
	traffic signal phasing @ Route 33	EA	0	$ 100,000.00	$ -
	Signs	LS	1	$ 1,000.00	$ 1,000
	Subtotal				**$ 36,782**
	Construction Totals				
	Construction Contract Subtotal				**$ 139,005**
	Contingency (30%)	LS	1	$ 42,000	$ 42,000
	Construction Contract Total				**$ 181,005**
	Incentive (5%)	LS	1	$ 10,000	$ 10,000
	Construction Engineering & Inspection (16%)	LS	1	$ 29,000	$ 29,000
				Total Construction Phase	**$ 220,005**

5	**Preliminary Engineering**				
5A	**Preliminary Engineering (22%)**				$ 4,000
5B	**Environmental Mitigation & Permitting Allowance**				$ 4,000
				Total Preliminary Engineering Phase	**$ 8,000**

6	**Right of Way**				
6A	**Right of Way**				$ -
6B	**Utilities**				$ -
				Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars $ 228,005
Say $ 230,000

VALLEY MALL ENTRANCE & E. MARKET STREET

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
1	Construction Surveying & Mobilization	LS	1	$ 8,000	$ 8,000
	Subtotal				**$ 8,000**
	Pavement Items				
4	Mill and Overlay Existing Pavement	SY	600	$ 25	$ 15,000
5	Demolition of Pavement (Flexible)	SY	90	$ 30	$ 2,700
6	Saw-cut Asphalt Conc. (Full Depth)	LF	200	$ 5	$ 1,000
	Subtotal				**$ 18,700**
	Incidental Items				
8	Median Strip (MS-1 or MS-1A)	SY	90	$ 112	$ 10,080
	Subtotal				**$ 10,080**
18	Maintenance of Traffic	LS	1	$ 25,000	$ 25,000
19	Erosion and Sediment Control	LS	0	$ 5,000	$ -
22	crosshatch markings 8", < 45 mph	LF	100	$ 5.62	$ 562
23	6" Pvmt line mrkg	LF	800	$ 4.92	$ 3,936
	12" Pvmt line mrkg	LF	100	$ 13.20	$ 1,320
24	Pvmt Marking Arrows	EA	3	$ 320.00	$ 960
	Signs	LS	1	$ 1,000.00	$ 1,000
	Subtotal				**$ 32,778**
	Construction Totals				
	Construction Contract Subtotal				**$ 69,558**
	Contingency (30%)	LS	1	$ 21,000	$ 21,000
	Construction Contract Total				**$ 90,558**
	Incentive (5%)	LS	1	$ 5,000	$ 5,000
	Construction Engineering & Inspection (16%)	LS	1	$ 15,000	$ 15,000
				Total Construction Phase	**$ 110,558**

5	**Preliminary Engineering**				
5A	**Preliminary Engineering (22%)**				$ 20,000
5B	**Environmental Mitigation & Permitting Allowance**				$ 2,000
				Total Preliminary Engineering Phase	**$ 22,000**

6	**Right of Way**				
6A	**Right of Way**				$ -
6B	**Utilities**				$ -
				Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars $ 132,558
Say $ 140,000

SKYLINE VILLAGE ENTRANCE & E. MARKET STREET

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
1	Construction Surveying & Mobilization	LS	1	$ 13,000	$ 13,000
	Subtotal				**$ 13,000**
	Pavement Items				
4	Mill and Overlay Existing Pavement	SY	1,000	$ 25	$ 25,000
5	Demolition of Pavement (Flexible)	SY	70	$ 30	$ 2,100
6	Saw-cut Asphalt Conc. (Full Depth)	LF	200	$ 5	$ 1,000
	New Pavement	LS	-	$ 250,000	$ -
	Guardrail removal	LF	250	$ 22	$ 5,500
	New Guardrail	LF	250	$ 24	$ 6,000
	Subtotal				**$ 39,600**
	Incidental Items				
7	Median Reconstruction (MS-2 or Depressed)	LF	-	$ 60	$ -
8	Median Strip (MS-1 or MS-1A)	SY	70	$ 112	$ 7,840
	Subtotal				**$ 7,840**
	Lump Sum Items				
18	Maintenance of Traffic	LS	1	$ 50,000	$ 50,000
23	6" Pvmt line mrkg	LF	1100	$ 4.92	$ 5,412
	12" Line Marking	LF	55	$ 13.20	$ 726
24	Pvmt Marking Arrows	EA	4	$ 320.00	$ 1,280
	Signs	LS	1	$ 1,000.00	$ 1,000
	Subtotal				**$ 58,418**
	Construction Totals				
	Construction Contract Subtotal				**$ 118,858**
	Contingency (30%)	LS	1	$ 36,000	$ 36,000
	Construction Contract Total				**$ 154,858**
	Incentive (5%)	LS	1	$ 8,000	$ 8,000
	Construction Engineering & Inspection (16%)	LS	1	$ 25,000	$ 25,000
				Total Construction Phase	**$ 187,858**

5	**Preliminary Engineering**				
5A	**Preliminary Engineering (22%)**				$ 35,000
5B	**Environmental Mitigation & Permitting Allowance**				$ 4,000
				Total Preliminary Engineering Phase	**$ 39,000**

6	**Right of Way**				
6A	**Right of Way**				$ -
6B	**Utilities**				$ -
				Total Right of Way Phase	**$ -**

Total Project Cost in 2017 Dollars	**$ 226,858**
Say	**$ 227,000**

EVELYN BYRD AVE & E. MARKET ST

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
1	**Construction Surveying & Mobilization**	**LS**	**1**	**$ 45,000**	**$ 45,000**
	Subtotal				**$ 45,000**
	Pavement Items				
4	Mill and Overlay Existing Pavement	SY	450	$ 25	$ 11,250
5	Demolition of Pavement (Flexible)	SY	50	$ 30	$ 1,500
6	Saw-cut Asphalt Conc. (Full Depth)	LF	100	$ 5	$ 500
	New pavement - Widening	LS	1	$ 250,000	$ 250,000
	Guardrail removal	LF	240	$ 22	$ 5,280
	New Guardrail	LF	240	$ 24	$ 5,760
	Subtotal				**$ 274,290**
	Incidental Items				
	Median Strip (MS-1 or MS-1A)	SY	50	$ 112	$ 5,600
	Subtotal				**$ 5,600**
	Lump Sum Items				
	Signal Removal	EA	1	$ 25,000	$ 25,000
	Maintenance of Traffic	LS	1	$ 50,000	$ 50,000
	6" Pvmt line mrkg	LF	1250	$ 4.92	$ 6,150
	12" Pvmt line mrkg	LF	35	$ 13.20	$ 462
	Pvmt Marking Arrows	EA	2	$ 320.00	$ 640
	Signs	LS	1	$ 1,000.00	$ 1,000
	Traffic Signal Phasing	EA	1	$ 100,000.00	$ 100,000
	Subtotal				**$ 183,252**
	Construction Totals				
	Construction Contract Subtotal				**$ 508,142**
	Contingency (30%)	LS	1	$ 153,000	$ 153,000
	Construction Contract Total				**$ 661,142**
	Incentive (5%)	LS	1	$ 34,000	$ 34,000
	Construction Engineering & Inspection (16%)	LS	1	$ 106,000	$ 106,000
				Total Construction Phase	**$ 801,142**

5	**Preliminary Engineering**				
5A	**Preliminary Engineering (22%)**				$ 146,000
5B	**Environmental Mitigation & Permitting Allowance**				$ 14,000
				Total Preliminary Engineering Phase	**$ 160,000**

6	**Right of Way**				
6A	**Right of Way**				$ -
6B	**Utilities**				$ -
				Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars	**$ 961,142**
Say	**$ 970,000**

BETTS CT & BETTS RD AND CHESTNUT RIDGE DR & E. MARKET ST

Item	Description	Unit	Quantity	Unit Cost	Extension
	Construction Costs				
	Construction Surveying & Mobilization	LS	1	$ 52,000	$ 52,000
	Regular Excavation	CY	0	$ 21	$ -
	Borrow Excavation	CY	0	$ 25	$ -
	Subtotal				**$ 52,000**
	Pavement Items				
	Mill and Overlay Existing Pavement	SY	611	$ 25	$ 15,278
	New pavement - Additional Lane Widening	LS	1	$ 250,000	$ 250,000
	Demolition of Pavement (Flexible)	SY	70	$ 30	$ 2,100
	Saw-cut Asphalt Conc. (Full Depth)	LF	180	$ 5	$ 900
	Subtotal				**$ 268,278**
	Incidental Items				
	Median Strip (MS-1 or MS-1A)	SY	70	$ 112	$ 7,840
	Topsoil & Seeding	SY	570	$ 10	$ 5,700
	Guardrail removal and reset	LF	500	$ 40	$ 20,000
	Subtotal				**$ 33,540**
	Lump Sum Items				
	Signal Removal	EA	1	$ 25,000	$ 25,000
	Maintenance of Traffic	LS	1	$ 100,000	$ 100,000
	Erosion and Sediment Control	LS	0	$ -	$ -
	crosshatch markings 8", < 45 mph	LF	200	$ 5.62	$ 1,124
	6" Pvmt line mrkg	LF	2990	$ 4.92	$ 14,711
	12" Pvmt line mrkg	LF	131	$ 13.20	$ 1,730
	Pvmt Marking Arrows	EA	6	$ 320.00	$ 1,920
	Signs	LS	1	$ 1,000.00	$ 1,000
	traffic signal phasing @ Route 33	EA	1	$ 100,000.00	$ 100,000
	Subtotal				**$ 245,485**
	Construction Totals				
	Construction Contract Subtotal				**$ 599,303**
	Contingency (30%)	LS	1	$ 180,000	$ 180,000
	Construction Contract Total				**$ 779,303**
	Incentive (5%)	LS	1	$ 39,000	$ 39,000
	Construction Engineering & Inspection (16%)	LS	1	$ 125,000	$ 125,000
				Total Construction Phase	**$ 943,303**

	Preliminary Engineering				
	Preliminary Engineering (22%)				$ 172,000
	Environmental Mitigation & Permitting Allowance				$ 16,000
				Total Preliminary Engineering Phase	**$ 188,000**

	Right of Way				
	Right of Way				$ -
	Utilities				$ -
				Total Right of Way Phase	**$ -**

Total Project Cost in 2018 Dollars	**$ 1,131,303**
Say	**$ 1,130,000**