



To: Wendy Block Sanford
Transportation Director
City of Fairfax, Virginia

Date: September 19, 2016

Memorandum

Project #: 38509.00

From: Daniel Lovas, PE
Senior Transportation Engineer

Re: Northfax University Drive Extension Traffic Evaluation
Fairfax, Virginia

Executive Summary

VHB completed a traffic study to evaluate the proposed University Drive extension between Fairfax Boulevard (Route 50) and Eaton Place, which is proposed to improve circulation in the Northfax region of the City of Fairfax. Rinker Design Associates produced a roadway layout concept for the University Drive extension, which provided the basis for developing traffic volume forecasts and completing the traffic analyses.

Traffic forecasts for the study are based on existing traffic volume data and a holistic understanding of traffic patterns in the study area. However, the traffic forecasting approach isn't designed to account for driver behavior in saturated traffic conditions. Drivers will seek routes to minimize delay and shorten travel times, incentivizing some drivers to follow new travel patterns. Future land use approvals will influence individual driver decisions and contribute to long-term equilibrium in traffic patterns for the study area.

Traffic forecasts indicate that peak period traffic volumes will generally decrease on Chain Bridge Road and increase on Eaton Place and University Drive. Peak hour traffic volume data for University Drive corridor, south of Fairfax Boulevard, indicates that traffic activity currently operates well below the roadway's vehicular capacity. The maximum vehicular capacity for roadways of similar functional class to University Drive is approximately 17,000-18,000 vehicles per day. Table 1 summarizes the traffic volume forecasts for University Drive, south of Fairfax Boulevard, under the Baseline and University Drive extension project conditions. The traffic volume diversion estimates for University Drive indicate an approximately 15-25 percent increase in overall traffic activity, which is equivalent to 1,000-1,500 additional vehicles per day or approximately one additional vehicle per minute in each direction during peak periods. This increase remains well within the road's maximum operational capacity.

Table 1: Peak Hour Traffic Volume on University Drive, south of Fairfax Boulevard

Direction	2018 Baseline Condition		2018 University Drive Extension Condition		Traffic Volume Increase	
	Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak
Northbound	369	392	433	456	+64	+63
Southbound	118	324	198	382	+80	+58
Total	487	716	631	838	+144	+121

Based on the traffic volume forecasts and intersection lane geometry, the planned Eaton Place/University Drive intersection will not meet minimum thresholds for a traffic signal. Future development and evolving traffic patterns will influence the ultimate traffic volume conditions in the study area. Additional traffic signal warrant analyses may be appropriate for the planned intersection in the future. For the purposes of the traffic evaluation, this intersection was analyzed as an unsignalized intersection with Stop sign control on University Drive.

The traffic operations analysis indicates that traffic along the Eaton Place and University Drive corridors, north of Fairfax Boulevard, will experience significant delay and queuing, particularly during the weekday evening peak period. Intersection capacity constraints at the Chain Bridge Road/Eaton Place intersection will contribute to elevated congestion for traffic using the planned University Drive extension.

The City of Fairfax has previously optimized traffic signal timings in the study area and additional timing modifications at the Chain Bridge Road/Eaton Place intersection will not provide significant improvement on the Eaton Place and University Drive corridors. Significant intersection modifications to provide additional capacity at Chain Bridge Road/Eaton Place intersection are necessary to improve overall operations on Eaton Place and the planned University Drive extension and reduce anticipated future congestion.

Introduction

The City of Fairfax, Virginia is in the process of planning for redevelopment to revitalize Fairfax Boulevard (Route 29/50) in the Northfax area near the intersection of Fairfax Boulevard and Chain Bridge Road (Route 123). Land uses in the Northfax area are traditionally suburban, characterized by strip shopping centers and low-density commercial uses. Increased developer interest in higher-density land uses in Northfax have led the city to assess transportation options to provide adequate access to future development and support overall regional transportation.

As part of this planning effort, the City of Fairfax is assessing the potential benefits of extending University Drive between Fairfax Boulevard and Eaton Place. An extension of University Drive could provide a more direct route for drivers traveling between the city center, Northfax area, and I-66 linking drives to the regional freeway system.

VHB has conducted a traffic operations evaluation of the potential roadway extension. The purpose of this evaluation is to provide a planning-level forecast of future traffic volumes and identify potential benefits and issues associated with the roadway extension. VHB has previously conducted traffic evaluations of the adequacy of the roadway network in the Northfax area, and the available data and analysis were used as a basis for evaluation of the potential roadway extension. VHB has prepared this memorandum to summarize the methodology and findings of the evaluation.

Study Area

The study area includes the key roadways and signalized intersections surrounding the Northfax development site, where the University Drive extension would be constructed. The primary roadways included in the evaluation include Fairfax Boulevard (Route 29/50), Chain Bridge Road (Route 123), Eaton Place, and University Drive. A site location map showing the study area intersection locations is provided in Figure 1.

Figure 1
Study Area Map



Roadway and Intersection Network

The existing roadway network includes a combination of state routes providing regional access to the City of Fairfax and local roadways that provide local access to neighborhoods, employers, and other land uses in the city. The primary roadways comprising the study area include the following:

- *Fairfax Boulevard (Route 29/50)* is a four to six-lane divided arterial highway and major commuter route providing east-west connectivity between the city, neighboring communities, and several other major highways. The posted speed limit on Fairfax Boulevard is 35 miles per hour.
- *Chain Bridge Road (Route 123)* is a four to six-lane wide divided arterial highway providing generally north-south regional access to the City of Fairfax and direct access from Northfax to the city center and I-66. Chain Bridge Road transitions to a two-lane cross-section approximately 600 feet south of Fairfax Boulevard and maintains this configuration to the city center. The posted speed limit on Chain Bridge Road is 25 miles per hour south of Fairfax Boulevard and 30 mph north of Fairfax Boulevard.
- *Eaton Place* is a four-lane undivided east-west local collector roadway that connects Fairfax Boulevard (Route 50) to Chain Bridge Road (Route 123) and provides access to commercial and office properties in the Northfax area. The posted speed limit on Eaton Place is 25 miles per hour.
- *University Drive* is a two-lane undivided local roadway providing direct north-south access between Fairfax Boulevard (Route 50) and the city center.

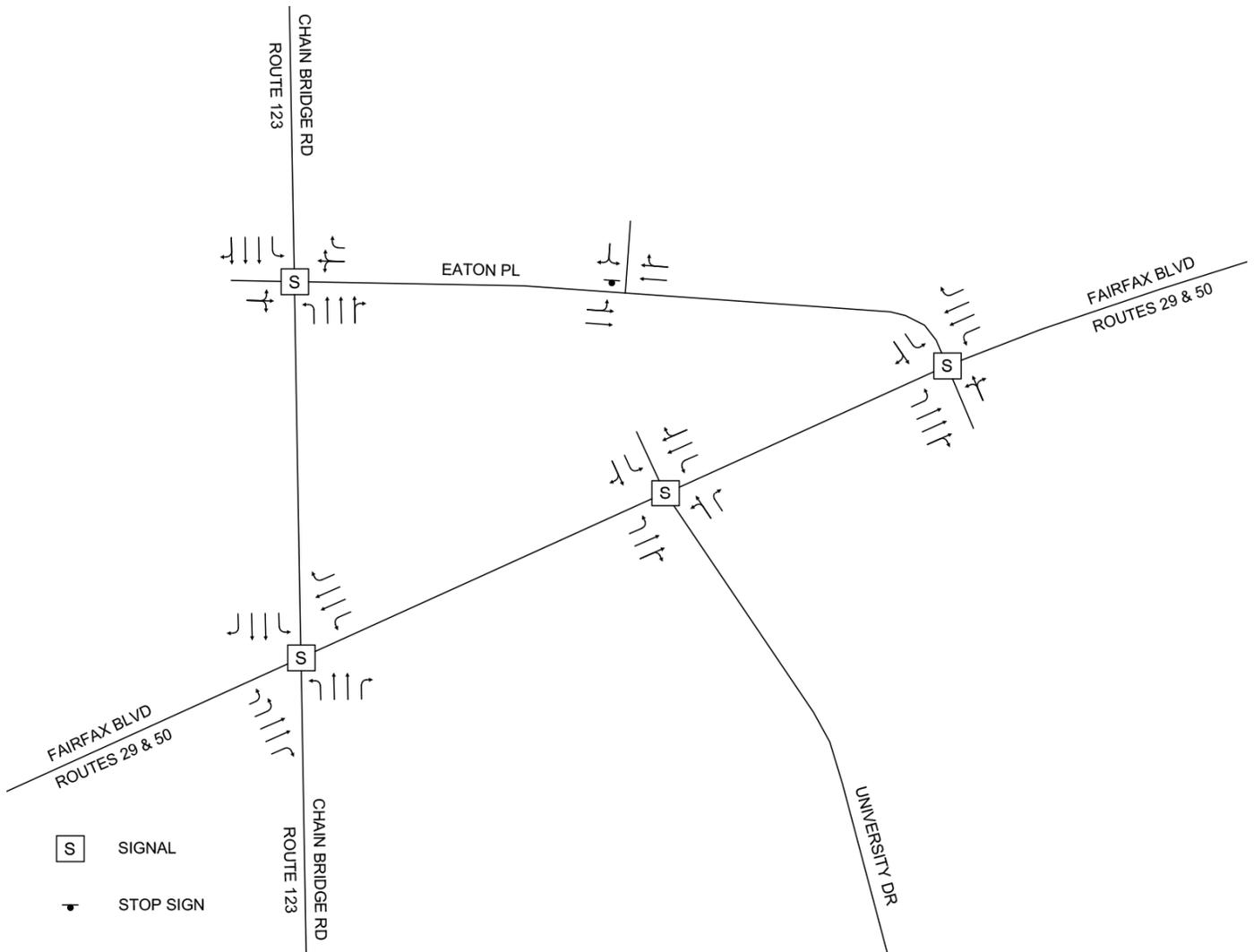
The Northfax study area includes a total of four existing intersections and one planned new intersection. All of the existing intersections are controlled by traffic signals. The following is a summary of the intersections included in the traffic evaluation:

- Fairfax Boulevard at Chain Bridge Road
- Fairfax Boulevard at University Drive
- Fairfax Boulevard at Eaton Place
- Chain Bridge Road at Eaton Place
- Eaton Place at University Drive extension (planned intersection)

Figure 2 summarizes the existing lane geometry at each of the study area intersections. The lane geometry at the planned Eaton Place/University Drive intersection, as well as the proposed University Drive north leg connection at Fairfax Boulevard, is based on preliminary concept plans for the University Drive extension by Rinker Design Associates for the city.

Figure 2

Existing Northfax Lane Geometry and Traffic Control



Planned Future Conditions

The purpose of the traffic evaluation is to analyze future traffic conditions at the Northfax study area intersections with and without the potential University Drive extension. A planning horizon of 2018 was selected for the potential roadway extensions and VHB used previous analysis data and information to develop baseline traffic volumes for the network.

VHB previously evaluated traffic operations in the Northfax study area and summarized the results of this traffic operations evaluation in the Northfax Road Improvements Traffic Analysis report, revised on September 4, 2014. The Future Build condition from the previous traffic evaluation, including planned development that is likely to be

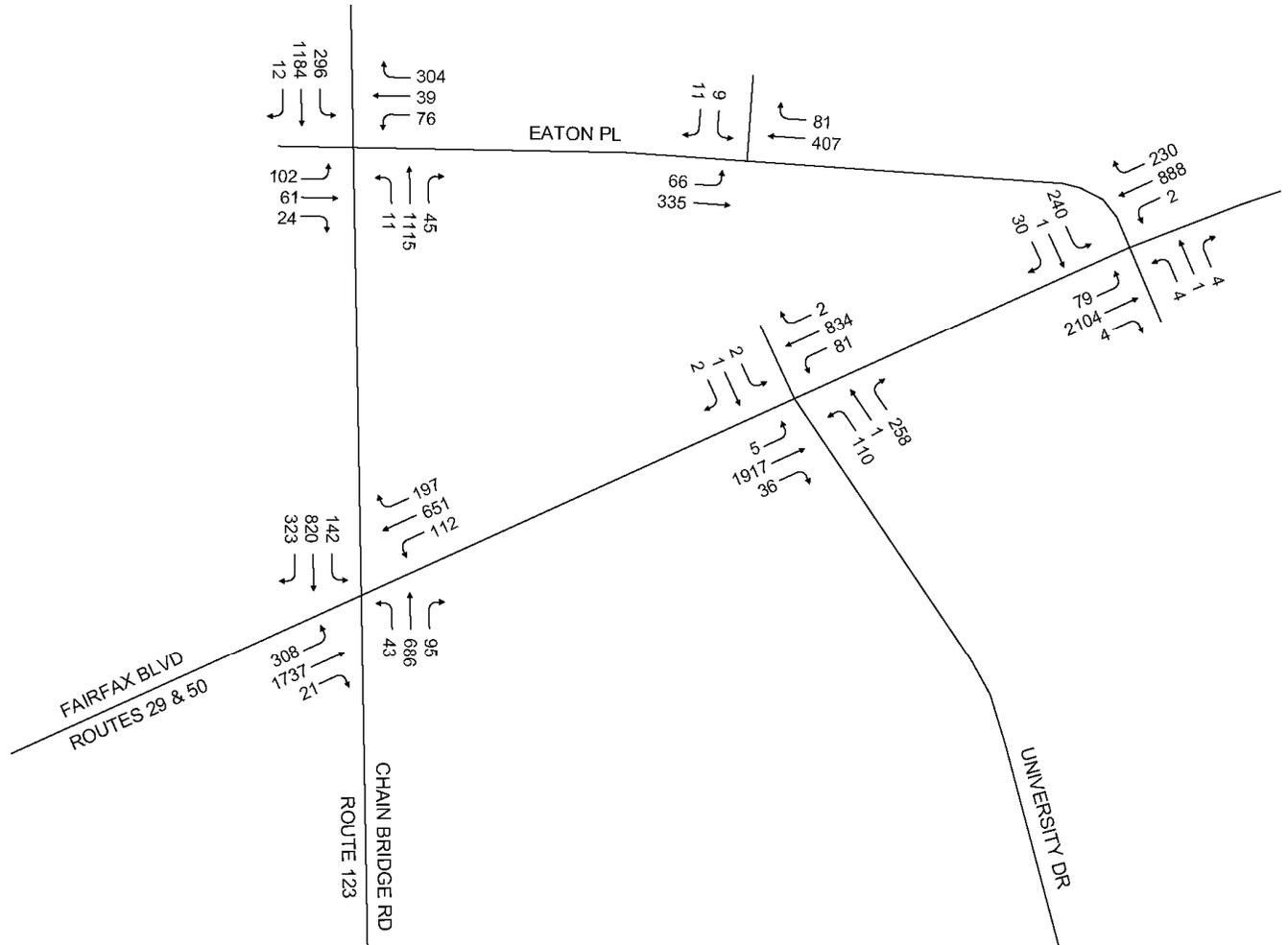
constructed before the 2018 planning horizon. The 2014 study identified the following development projects that are included in the future conditions analysis:

- The former Home Depot Expo; a Wal-Mart store at the intersection of Lee Highway and Jermantown Road
- AutoZone/ Convenience Store/ Walgreens; a mix of retail stores at the intersection of Fairfax Boulevard, Lee Highway, and Main Street
- Boulevard Marketplace; a retail development along Fairfax Boulevard just west of Plantation Parkway

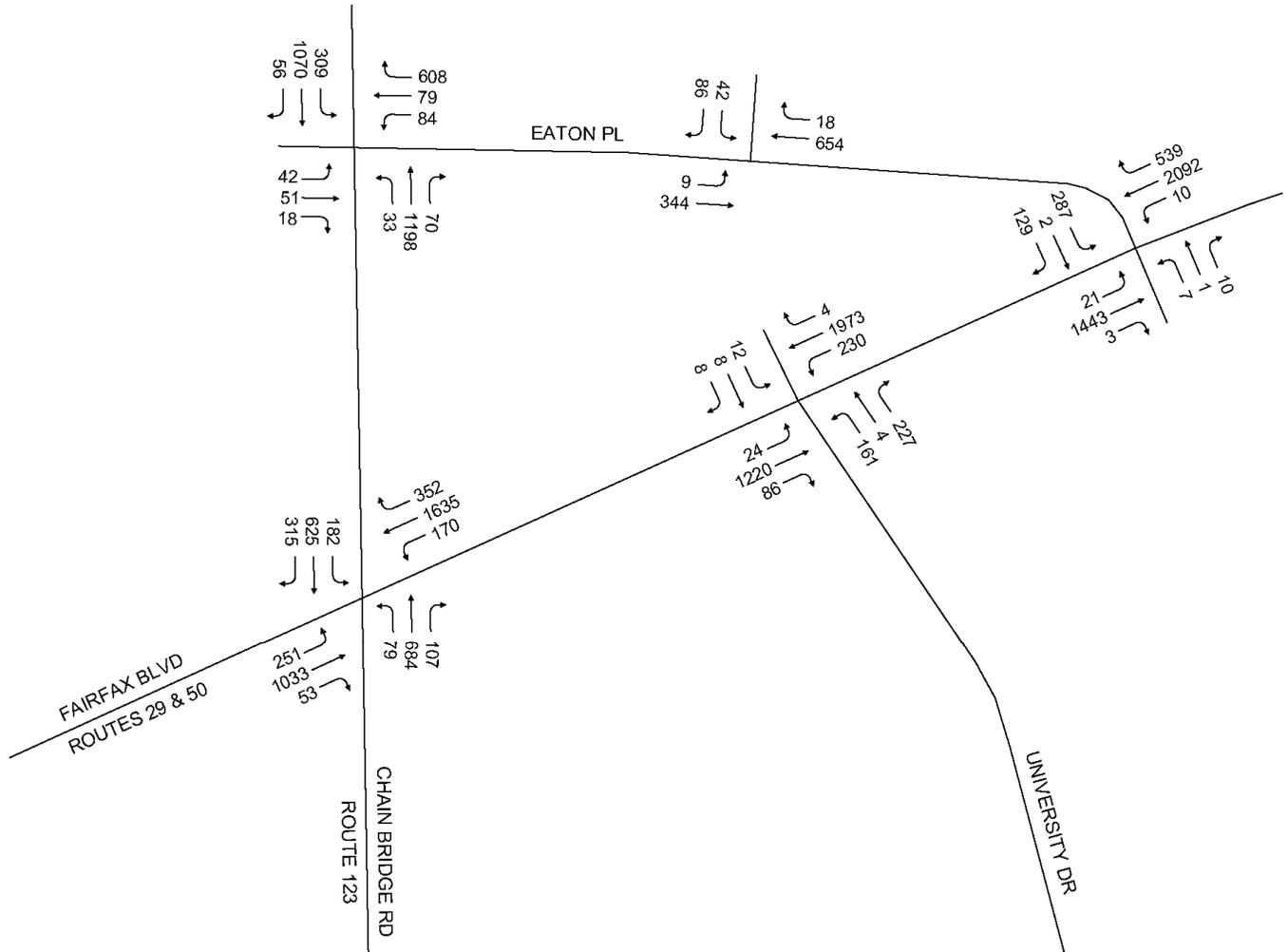
Baseline Traffic Volume Forecasts

The 2018 Baseline traffic volume forecasts for the University Drive extension study are based on the Future Build condition traffic volume projections developed in the 2014 Northfax Road Improvement Traffic Analysis study. Previous traffic forecasts for the study area applied separate growth rates, ranging from 0.36-1.40 percent, to various study area roadways. For the purposes of this evaluation, a unified annual growth rate of one percent was applied to the previous study's future traffic volume projections at all intersections to develop the 2018 Baseline traffic volume forecasts. Figures 3 and 4 summarize the 2018 Baseline traffic volume forecasts for the four existing intersections included in the study area.

Figure 3
 2018 Baseline Weekday Morning Peak Hour Traffic Volumes



*Figure 4
 2018 Baseline Weekday Evening Peak Hour Traffic Volumes*



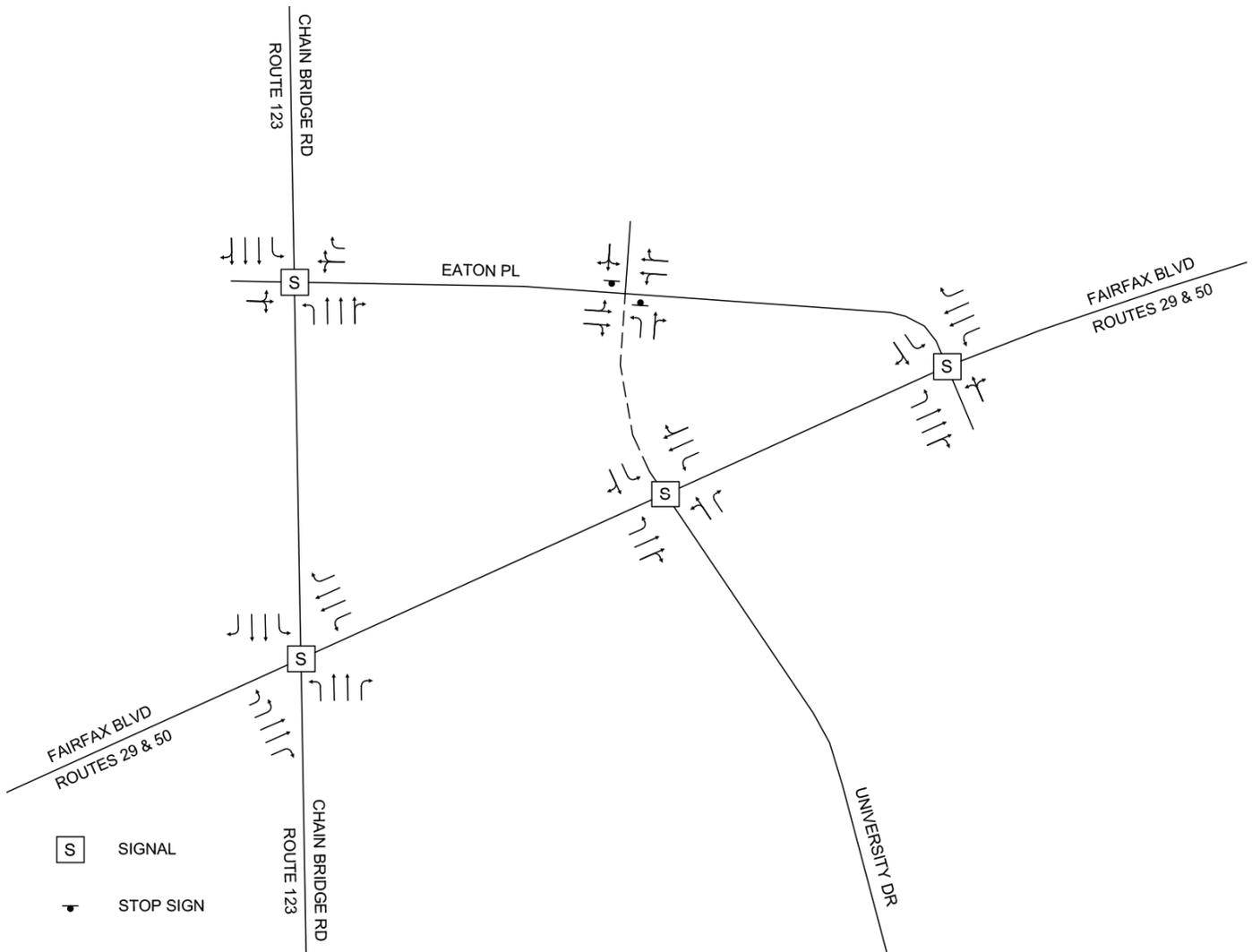
The Northfax site is the subject of preliminary planning for redevelopment with higher-density commercial and residential land uses. However, the planning, design, and permitting schedules for Northfax redevelopment are likely to exceed the 2018 planning horizon, and the purpose of this study is to evaluate the planned University Drive extension’s impact on area traffic operations prior to Northfax redevelopment. Therefore, no additional planned development was identified for inclusion in the 2018 Baseline traffic volume forecasts.

University Drive Extension Plan

Based on roadway plans produced for the University Drive extension, the planned roadway would be constructed along an alignment from the north side of the Fairfax Boulevard/University Drive intersection to a new intersection on Eaton Place opposite an existing WillowWood Plaza driveway. The planned roadway alignment travels through portions of the existing Fairfax Shopping Center and car dealership properties and would support potential future redevelopment of these properties. A copy of the preliminary concept plan for the University Drive extension prepared by Rinker Design Associates is included in the Appendix. Figure 5 summarizes the anticipated future lane

geometry and traffic control at the study intersections after constructing the University Drive extension. The University Drive extension concept developed by Rinker Design Associates provides the planned lane geometry for University Drive, and traffic control for the planned Eaton Place/University Drive intersection is assumed to be Stop sign control on the University Drive approach to the intersection.

*Figure 5
Future Northfax Lane Geometry and Traffic Control*



Future Roadway Extension Traffic Volume Forecasts

The 2018 Future Roadway Extension traffic volume forecasts were developed to account for potential traffic diversions associated with the completion of the University Drive extension between Fairfax Boulevard and Eaton Place. The planned roadway extension is anticipated to attract traffic from several other existing in the study area.

VHB primarily relied on engineering judgement based on our understanding of the study area developed through multiple traffic evaluations in this area to develop the traffic diversion forecasts. VHB evaluated the existing traffic

patterns and compared peak period travel times in the study area to develop traffic diversion forecasts on study area roadways. Regional travel demand model data and analysis runs were not available for this evaluation.

There are two primary categories of traffic volume diversions that the University Drive extension is likely to enable: traffic diversions between University Drive and Chain Bridge Road and traffic diversions between Chain Bridge Road/Fairfax Boulevard and Eaton Place. The following sections summarize the anticipated proportion of traffic volume diversions.

Diversions between University Drive and Chain Bridge Road

Some north-south traffic that currently uses either Fairfax Boulevard or Eaton Place to travel between University Drive and Chain Bridge Road is likely to divert to the University Drive extension. The University Drive extension is likely to provide a more direct route for some of the traffic using these roadways. The following is a summary of the level of anticipated traffic diversions between University Drive and Chain Bridge Road:

- 50% of the northbound left turn traffic from University Drive to Fairfax Boulevard will divert to the northbound through on University Drive (to the planned extension), left on Eaton Place, and right on Chain Bridge Road
- 50% of eastbound right turn traffic from Fairfax Boulevard to University Drive will be diverted left from Chain Bridge Road at Eaton Place, right on University Drive (extension), and cross Fairfax Boulevard to continue south
- 2% of the northbound right turn traffic from University Drive to Fairfax Boulevard will divert to the northbound through on University Drive (to the planned extension), left on Eaton Place, and right on Chain Bridge Road
- 2% of the westbound left turn traffic from Fairfax Boulevard to University Drive will be diverted left from Chain Bridge Road at Eaton Place, right on University Drive (extension), and cross Fairfax Boulevard to continue south
- 10% of northbound through traffic on Chain Bridge Road at Fairfax Boulevard will divert to the northbound through on University Drive at Fairfax Boulevard, left on Eaton Place, and right on Chain Bridge Road
- 10% of southbound through traffic on Chain Bridge Road at Fairfax Boulevard will be diverted left from Chain Bridge Road to Eaton Place, right on University Drive (extension), and southbound through at Fairfax Boulevard to continue south

The University Drive extension will provide a more direct and attractive route for some traffic to use University Drive to travel between Fairfax Boulevard and the Old Town district of the city. This project is likely contribute to increased traffic diverted from Chain Bridge Road to University Drive south of Fairfax Boulevard. Table 2 summarizes the projected peak hour traffic diversions to University Drive, south of Fairfax Boulevard.

Table 2: Future Traffic Diversions to University Drive, south of Fairfax Boulevard

Time Period	Traffic Volume Increase		
	Northbound	Southbound	Total
Weekday AM Peak	64	80	144
Weekday PM Peak	63	58	121

South of Fairfax Boulevard, University Drive is a two-lane urban collector street. Daily traffic volume data for University Drive, south of Fairfax Boulevard, collected by the Virginia Department of Transportation¹ in 2014 indicates an average daily traffic volume of 6,100 vehicles per day. This level of traffic activity is well within the operational capacity for a two-lane collector roadway, which can approach approximately 17,000-18,000 vehicles per day at maximum capacity.

The additional traffic projected on University Drive represents an increase of approximately 1,000-1,500 daily vehicle trips on the corridor, which represents an approximately 15-25 percent increase in daily traffic volume or approximately one additional vehicle per minute in each direction during peak periods. A significant proportion of the traffic increase is comprised of traffic diverted to University Drive from the Chain Bridge Road (Route 123) corridor, which will contribute to some reduction in vehicle delay and congestion on Chain Bridge Road. The projected peak hour and daily traffic volumes on University Drive remain well below the roadway’s operational capacity.

Diversions between Chain Bridge Road/Fairfax Boulevard and Eaton Place

Traffic originating from or destined to land uses on Eaton Place currently access Eaton Place directly from Chain Bridge Road or Fairfax Boulevard. The planned University Drive extension will provide a more direct route between both Chain Bridge Road and Fairfax Boulevard and some land uses on Eaton Place. The following is a summary of the anticipated traffic diversions between Chain Bridge Road or Fairfax Boulevard and Eaton Place:

- 40% of northbound right turn traffic from Chain Bridge Road to Eaton Place will be diverted proportionally from Chain Bridge Road and Fairfax Boulevard, travel east along Fairfax Boulevard to the eastbound left at University Drive (extension), and turn right and left (equally) at Eaton Place
- 40% of westbound left turn traffic from Eaton Place to Chain Bridge Road will be diverted onto University Drive (extension), right onto Fairfax Boulevard, and allocated proportionally to Chain Bridge Road and Fairfax Boulevard
- 20% of eastbound left turn traffic from Fairfax Boulevard onto Eaton Place will divert to the eastbound left onto University Drive (extension) and right on Eaton Place.
- 20% of southbound right turn traffic from Eaton Place to Fairfax Boulevard will divert to the westbound left from Eaton Place onto University Drive (extension) and southbound right onto Fairfax Boulevard

Figures 6 and 7 summarize the anticipated traffic volume diversions described above. These figures include positive and negative values, which represent increasing or decreasing traffic volume forecasts at specific intersection movements.

¹ Virginia Department of Transportation Daily Traffic Volume Estimates, Special Locality Report 151, City of Fairfax; 2014. http://www.virginiadot.org/info/resources/Traffic_2014/AADT_151_Fairfax_2014.pdf

Figure 6
 University Drive Extension Weekday Morning Peak Hour Traffic Volume Diversions

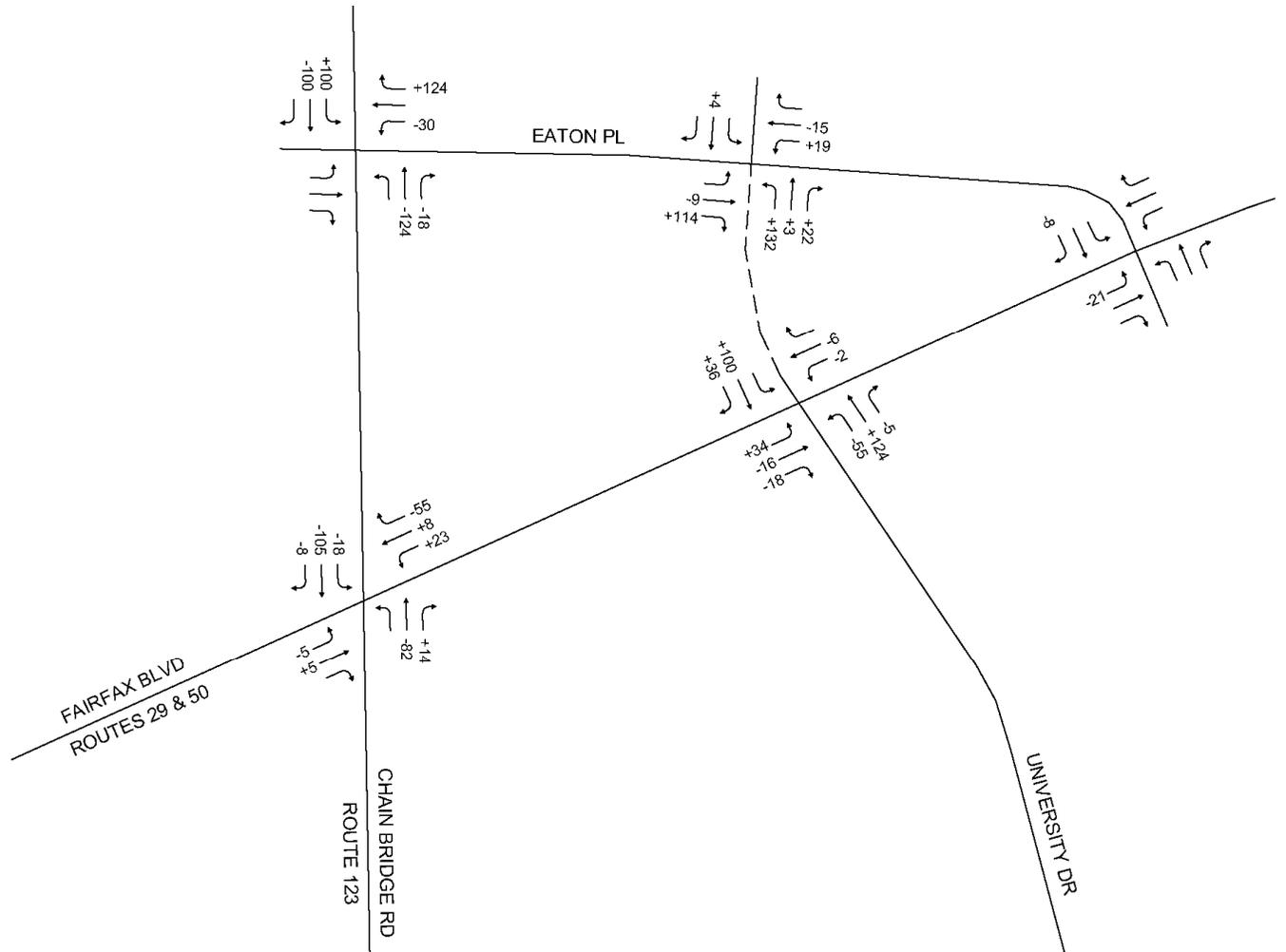
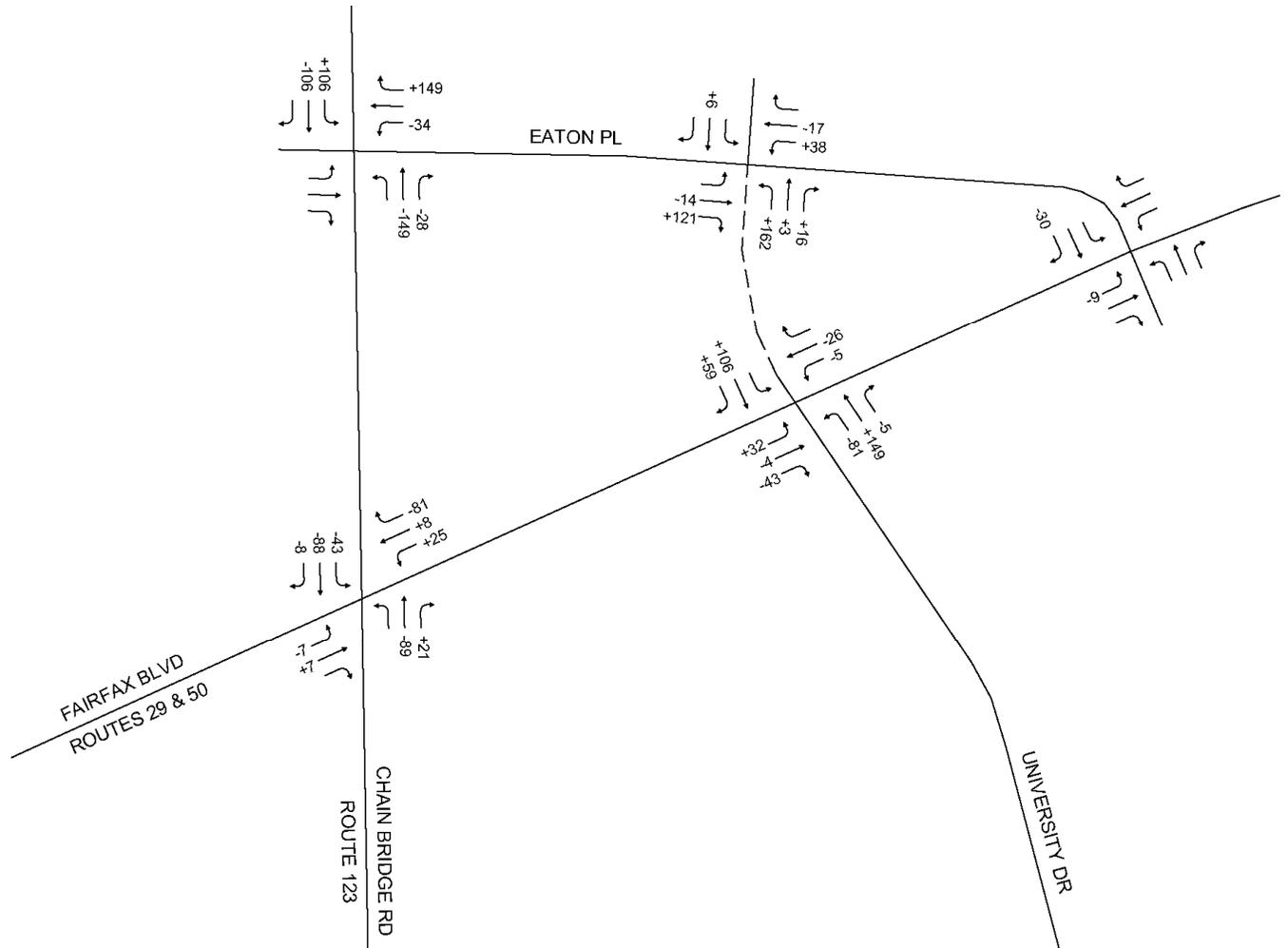


Figure 7
University Drive Extension Weekday Evening Peak Hour Traffic Volume Diversions



2018 Roadway Extension Traffic Volumes

The weekday morning and evening peak hour traffic volume diversions were applied to the 2018 Baseline peak hour traffic volumes to calculate the 2018 Roadway Extension peak hour traffic volumes. Figures 8 and 9 summarize the 2018 Roadway Extension peak hour traffic volumes.

Figure 8

2018 Roadway Extension Weekday Morning Peak Hour Traffic Volumes

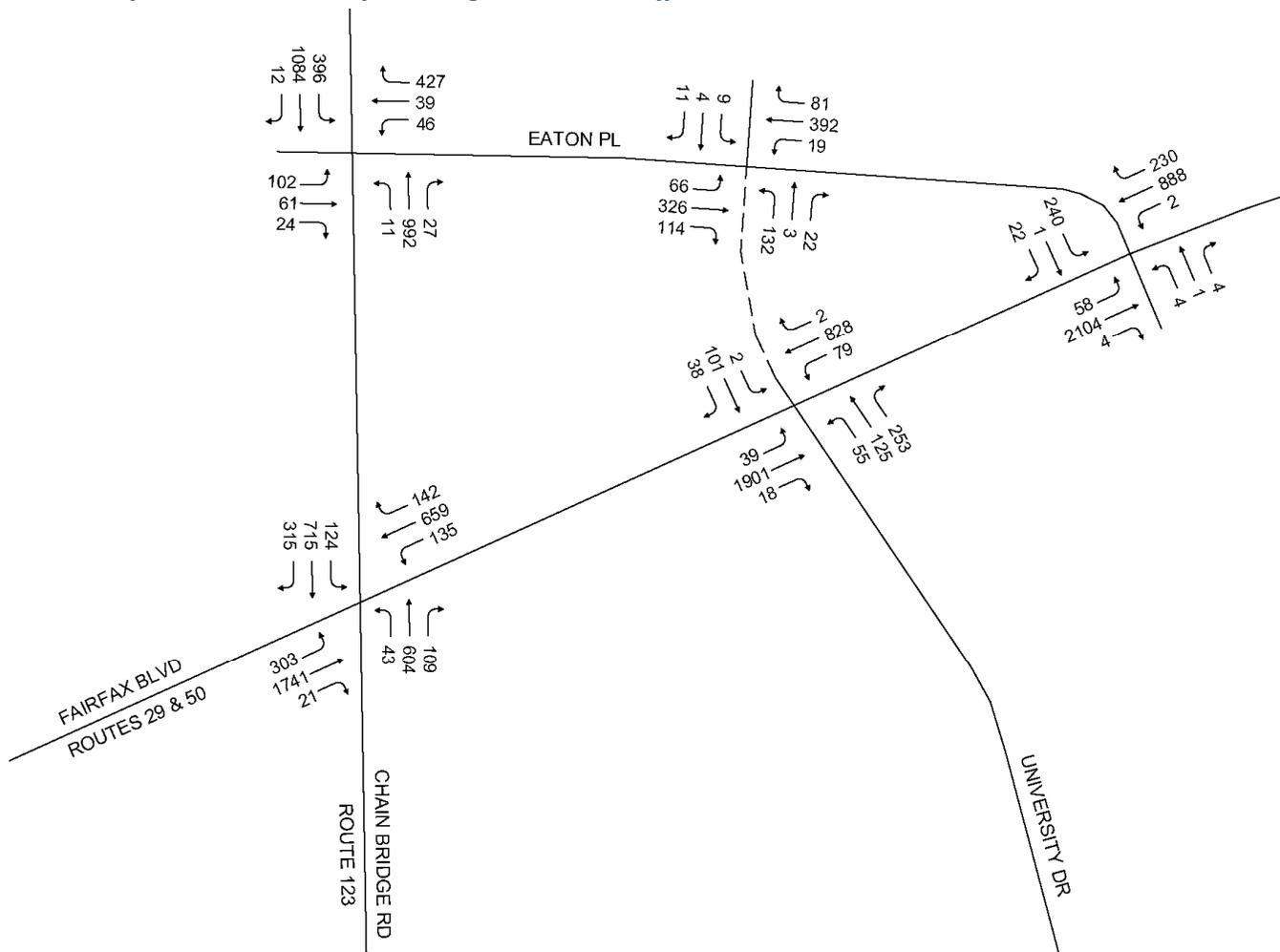
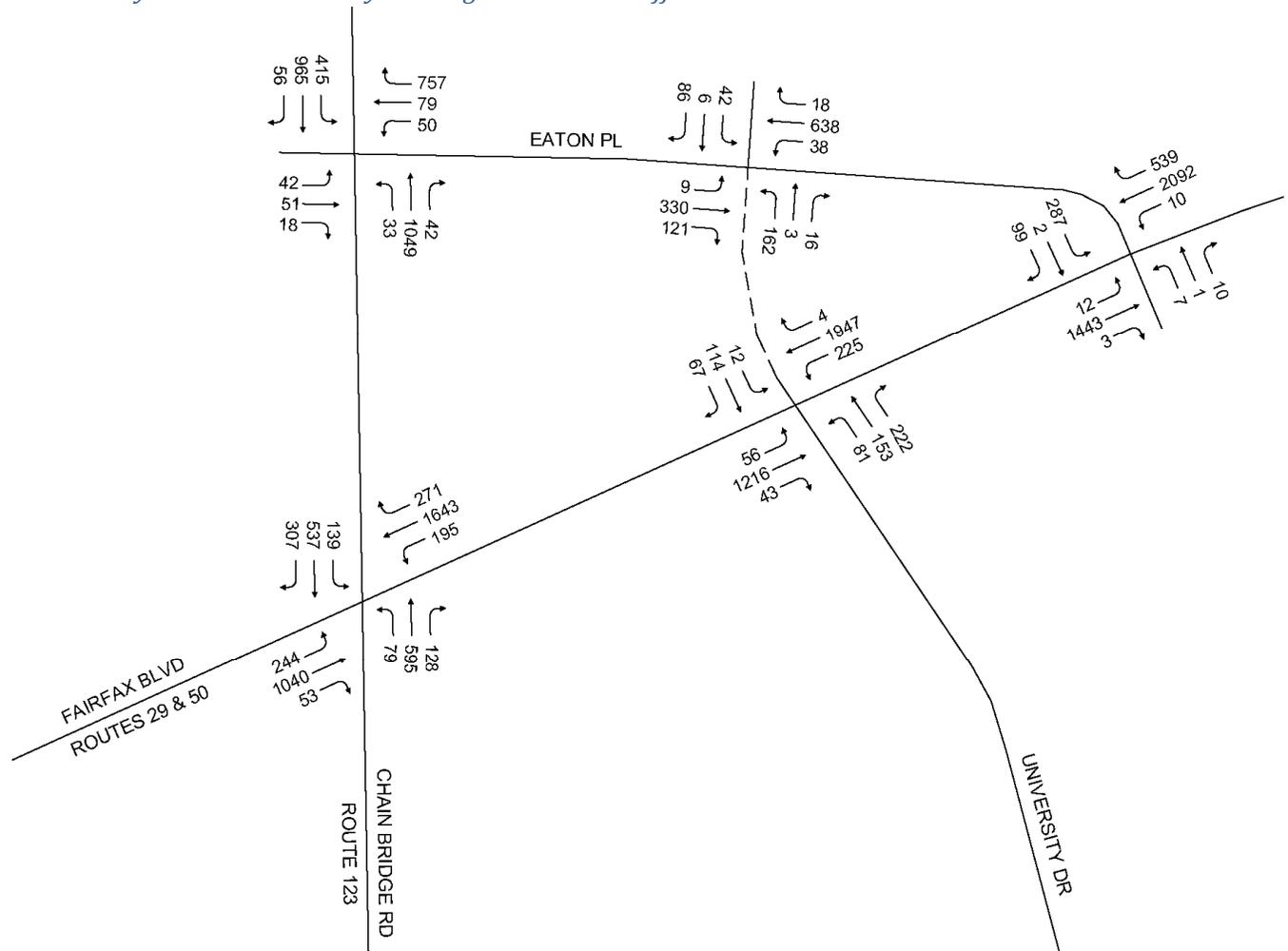


Figure 9
 2018 Roadway Extension Weekday Evening Peak Hour Traffic Volumes



Planned Traffic Control

The Manual on Uniform Traffic Control Devices (MUTCD)² provides traffic signal warrant guidelines that represent the minimum standards to install a new traffic signal at an intersection. The Peak Hour traffic signal warrant thresholds were applied to the traffic volume projections for the planned Eaton Place/University Drive intersection. Based on the traffic volume forecasts and planned intersection lane geometry, the Eaton Place/University Drive intersection will not meet the minimum Peak Hour warrant thresholds for a traffic signal. This finding confirms that two-way Stop control is appropriate for the planned intersection.

Future land use development and traffic control strategies will influence traffic volumes in the study area. Additional analysis of the planned intersection's traffic control may be appropriate and should be conducted based on updated traffic volume projections for the intersection or actual traffic volumes after implementation.

² Manual on Uniform Traffic Control Devices for Streets and Highways, Federal Highway Administration, Washington, D.C. 2009

Future Conditions Intersection Capacity Analysis

The 2018 Baseline and 2018 Roadway Extension peak hour traffic volumes were used to analyze the capacity of the five study-area intersections. Consistent with traffic analysis methodology used by VHB for previous Northfax traffic studies, the VISSIM analysis model was used to analyze traffic operations in this evaluation.

The VISSIM traffic micro-simulation model provides a comprehensive tool for traffic analysis of high-volume urban and suburban roadway networks. VISSIM is a powerful microscopic, time-step, and driver behavior based traffic simulation model that uses a psycho-physical driver behavior model for each vehicle in the system. VISSIM is capable of modeling high-volume and high-speed traffic volume conditions, including the movements of variety users, including automobiles, trucks, bicycles, and pedestrians on a detailed network of streets.

Unlike static traffic analysis methodologies and tools, a microsimulation model like VISSIM is designed to accurately evaluate traffic network operations at a system level, including a range of driver behaviors and the influences of vehicle interactions and congestion on adjacent intersections. Static intersection-based traffic analysis tools evaluate intersection operations in isolation and cannot reflect the effects of upstream and downstream operations along a roadway corridor.

After initial coding of the network, multiple runs of the existing conditions VISSIM model with varying random seeds were conducted to introduce variation to vehicle loadings and the vehicle arrivals within the simulation environment. Calibration of the existing conditions VISSIM model was conducted and some model settings were adjusted during previous studies of the Northfax study area by VHB to provide accurate and realistic model operations. VHB retained the settings from previous VISSIM modeling for the Northfax study area in the University Drive extension evaluation. The analysis maintains existing traffic signal timing and phasing settings for both the 2018 Baseline and 2018 Roadway Extension conditions.

The output from the VISSIM model provides results indicating the level of service for each intersection in the study area. Level of Service (LOS) is a qualitative assessment of vehicle mobility along a roadway or through an intersection, and represents a metric of traffic performance and roadway/intersection capacity. LOS is represented by a rating designation between "A" and "F", with "A" representing little or no delay and "F" representing extreme congestion. For signalized intersections, the prevailing LOS depends on a number of factors including the approach green per cycle (g/ C) ratio, volume to capacity (v/ c) ratio and traffic progression. For two-way stop controlled intersections, the LOS depends primarily on the availability of gaps in the mainline traffic stream for side-street vehicles. The level of service for each type of intersection is defined in terms of control delay, which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Table 3 summarizes the LOS thresholds defined in the Highway Capacity Manual (HCM)³ for evaluating intersection operational performance.

³ Transportation Research Board, Highway Capacity Manual, Washington, D.C., 2010

Table 3: Level of Service Thresholds

Level of Service	HCM Methodology (average control delay per vehicle in seconds)	
	Unsignalized Intersections	Signalized Intersections
A	< 10	< 10
B	10-15	10-20
C	15-25	20-35
D	25-35	35-55
E	35-50	55-80
F	> 50	> 80

Additionally, the VISSIM model provides vehicle queuing results for individual movements at each intersection based on dynamic simulation of vehicle progression between adjacent intersections. This evaluation focuses on the maximum queue results for each approach to the study intersections.

Capacity Analysis Results

The LOS for all intersections in the study area was determined based on these threshold values and the vehicular delays from the VISSIM microsimulation model. The traffic analysis LOS results are summarized in Table 4 and maximum queuing results are summarized in Table 5. Detailed summary tables including control delay, levels-of-service, and maximum vehicular queuing are included in the Appendix.

Table 4: Overall Intersection Level of Service Summary

Location	Time Period	2018 Baseline Condition		2018 Roadway Extension Condition	
		Delay (sec)	LOS	Delay (sec)	LOS
Fairfax Boulevard at Chain Bridge Road	Weekday AM Peak Hour	52.0	D	47.4	D
	Weekday PM Peak Hour	57.2	E	60.3	E
Fairfax Boulevard at University Drive	Weekday AM Peak Hour	11.9	B	18.9	B
	Weekday PM Peak Hour	16.1	B	45.3	D
Fairfax Boulevard at Eaton Place	Weekday AM Peak Hour	12.9	B	14.1	B
	Weekday PM Peak Hour	17.9	B	28.3	C
Chain Bridge Road at Eaton Place/Oak Lane	Weekday AM Peak Hour	66.4	E	56.3	E
	Weekday PM Peak Hour	87.5	F	87.4	F
Eaton Place at University Drive	Weekday AM Peak Hour	n/a	n/a	0.6	A
	Weekday PM Peak Hour	n/a	n/a	107.7	F

Table 5: Vehicle Queuing Summary

Location	Time Period	2018 Baseline Condition		2018 Roadway Extension Condition	
		Movement	Maximum Queue (feet)	Movement	Maximum Queue (feet)
Fairfax Boulevard at Chain Bridge Road	Weekday AM Peak Hour	EB T	975	EB T	1,006
		WB T	310	WB T	311
		NB T	1,012	NB T	715
		SB T	1,065	SB T	845
	Weekday PM Peak Hour	EB T	575	EB T	992
		WB T	1,133	WB T	1,123
		NB T	1,207	NB T	1,110
		SB T	1,154	SB T	1,037
Fairfax Boulevard at University Drive	Weekday AM Peak Hour	EB T	376	EB T	470
		WB T	161	WB T	312
		NB LT	471	NB LT	554
		SB L	21	SB T	277
	Weekday PM Peak Hour	EB T	372	EB L	1,098
		WB T	675	WB T	913
		NB LT	644	NB LT	710
		SB T	51	SB T	308
Fairfax Boulevard at Eaton Place	Weekday AM Peak Hour	EB T	605	EB T	834
		WB T	254	WB T	212
		NB LTR	28	NB LTR	28
		SB L	401	SB L	382
	Weekday PM Peak Hour	EB T	189	EB T	107
		WB T	921	WB T	1,376
		NB LTR	44	NB LTR	44
		SB L	729	SB L	480

Notes: EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound, L = Left Turn, T = Through, and R = Right Turn

Table 5: (cont.): Vehicle Queuing Summary

Location	Time Period	2018 Baseline Condition		2018 Roadway Extension Condition	
		Movement	Maximum Queue (feet)	Movement	Maximum Queue (feet)
Chain Bridge Road at Eaton Place/Oak Lane	Weekday AM Peak Hour	EB LTR	307	EB LTR	307
		WB LTR	410	WB LTR	406
		NB TR	554	NB TR	546
		SB T	588	SB L	496
	Weekday PM Peak Hour	EB LTR	263	EB LTR	285
		WB LTR	1,442	WB LTR	1,212
		NB TR	633	NB TR	549
		SB T	591	SB L	626
Eaton Place at University Drive	Weekday AM Peak Hour	n/a	n/a	EB LTR	18
		n/a	n/a	WB LTR	0
		n/a	n/a	NB T	25
		n/a	n/a	SB T	0
	Weekday PM Peak Hour	n/a	n/a	EB LTR	33
		n/a	n/a	WB LTR	698
		n/a	n/a	NB T	667
		n/a	n/a	SB T	73

Notes: EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound, L = Left Turn, T = Through, and R = Right Turn

The capacity analysis results indicate that the forecasted 2018 traffic volume forecasts for the roadway extension are anticipated to operate at similar or better LOS than the 2018 Baseline traffic volumes at all intersections during the weekday morning peak hour. The Eaton Place/University Drive intersection is expected to operate at LOS A during the weekday morning peak hour under the 2018 Roadway Extension condition. Queuing results for the weekday morning peak hour indicate that the 2018 Roadway Extension condition is likely to produce similar queuing levels to the 2018 Baseline condition, and may improve some localized queues, most notably on Chain Bridge Road at Fairfax Boulevard.

During the weekday evening peak hour, both of the existing intersections on Chain Bridge Road operate at LOS E or F under the 2018 Baseline conditions, which exceeds the city's standards for intersection performance. The LOS results indicate that several intersections are anticipated to experience significant increases in delay between the 2018 Baseline and 2018 Roadway Extension conditions. Vehicular delay is anticipated to increase significantly at three of the existing intersections and the planned Eaton Place/University Drive intersection is expected to operate at LOS F.

The maximum queuing results indicate that significant vehicular queuing on the westbound Eaton Place approach to Chain Bridge Road is present during the weekday evening peak hour under 2018 Baseline conditions. This queue is expected to extend well beyond the planned Eaton Place/University Drive intersection under the 2018 Roadway Extension condition, which will significantly impede traffic progression from northbound University Drive onto

westbound Eaton Place. The northbound queue on University Drive approaching Eaton Place is expected to extend the full length of the University Drive extension to Fairfax Boulevard and increase overall delay and congestion at the Fairfax Boulevard/University Drive intersection. Maximum queues at several intersections on Fairfax Boulevard are likely to exceed the available turning lane storage lengths, resulting in impacts to overall traffic progression during peak periods.

Traffic Signal Timing Modifications

The study indicates that traffic volume on Eaton Place will increase as a result of the University Drive extension project. Based on the initial capacity analysis results, VHB evaluated traffic signal timing modifications for the Chain Bridge Road/Eaton Place intersection during the weekday evening peak hour to improve overall traffic progression on Eaton Place and the University Drive extension. The traffic signal timing modifications involve transferring green time from Chain Bridge Road to the Eaton Place westbound approach to help improve vehicular progression and minimize queues on Eaton Place. However, increased traffic signal green time for Eaton Place will come at the expense of green time and vehicle progression on the currently congested Chain Bridge Road.

VHB performed an additional VISSIM analysis scenario based on the evening peak traffic signal timing modifications at this intersection. The results of this additional analysis scenario are included in Tables 6 and 7.

Table 6: Overall Intersection Level of Service Summary with Signal Timing Modifications

Location	Time Period	2018 Baseline Condition		2018 Roadway Extension Condition		2018 Roadway Extension with Signal Re-timing	
		Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Fairfax Boulevard at Chain Bridge Road	Weekday PM Peak Hour	57.2	E	60.3	E	57.0	E
Fairfax Boulevard at University Drive	Weekday PM Peak Hour	16.1	B	45.3	D	32.0	C
Fairfax Boulevard at Eaton Place	Weekday PM Peak Hour	17.9	B	28.3	C	17.9	B
Chain Bridge Road at Eaton Place/Oak Lane	Weekday PM Peak Hour	87.5	F	87.4	F	81.1	F
Eaton Place at University Drive	Weekday PM Peak Hour	n/a	n/a	107.7	F	47.1	E

Table 7: Vehicle Queuing Summary with Signal Timing Modifications

Location	Time Period	2018 Baseline Condition		2018 Roadway Extension Condition		2018 Roadway Extension with Signal Re-timing	
		Movement	Maximum Queue (feet)	Movement	Maximum Queue (feet)	Movement	Maximum Queue (feet)
Fairfax Boulevard at Chain Bridge Road	Weekday PM	EB T	575	EB T	992	EB T	606
	Peak Hour	WB T	1,133	WB T	1,123	WB T	1,120
		NB T	1,207	NB T	1,110	NB T	1,163
		SB T	1,154	SB T	1,037	SB T	984
Fairfax Boulevard at University Drive	Weekday PM	EB T	372	EB L	1,098	EB L	330
	Peak Hour	WB T	675	WB T	913	WB T	906
		NB LT	644	NB LT	710	NB LT	719
		SB T	51	SB T	308	SB T	345
Fairfax Boulevard at Eaton Place	Weekday PM	EB T	189	EB T	107	EB T	120
	Peak Hour	WB T	921	WB T	1,376	WB T	921
		NB LTR	44	NB LTR	44	NB LTR	44
		SB L	729	SB L	480	SB L	502
Chain Bridge Road at Eaton Place/Oak Lane	Weekday PM	EB LTR	263	EB LTR	285	EB LTR	269
	Peak Hour	WB LTR	1,442	WB LTR	1,212	WB LTR	1,210
		NB TR	633	NB TR	549	NB L	865
		SB T	591	SB L	626	SB L	751
Eaton Place at University Drive	Weekday PM	n/a	n/a	EB LTR	33	EB LTR	13
	Peak Hour	n/a	n/a	WB LTR	698	WB LTR	398
		n/a	n/a	NB LT	667	NB LT	550
		n/a	n/a	SB LTR	73	SB LTR	66

Notes: EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound, L = Left Turn, T = Through, and R = Right Turn

The results in Tables 6 and 7 indicate that traffic signal timing modifications at the Chain Bridge Road/Eaton Place intersection could reduce the overall weekday evening peak hour delay and congestion anticipated under the 2018 Roadway Extension condition. With the traffic signal timing modifications, overall LOS at all existing intersections is projected to remain similar to 2018 Baseline condition. The planned Eaton Place/University Drive intersection is projected to operate at overall LOS E.

The vehicle queuing results indicate that the traffic signal timing modifications could mitigate weekday evening peak period queues on Eaton Place, University Drive, and Fairfax Boulevard below the levels projected for the 2018 Roadway Extension condition. By providing additional green time for Eaton Place traffic to progress onto Chain

Bridge Road, additional roadway capacity is provided for traffic using the University Drive extension to progress onto Eaton Place. However, most queue results remain similar to 2018 Baseline conditions, suggesting that the University Drive extension is likely to provide minimal improvement for other study intersections. As a consequence of the transfer of green time from Chain Bridge Road to Eaton Place, the northbound and southbound queues on Chain Bridge Road at Eaton Place are projected to increase. Additionally, the projected northbound queue on University Drive at Eaton Place is still anticipated to approach the full length of the street segment to Fairfax Boulevard. The City of Fairfax has completed previous traffic signal timing optimization studies for this area that suggest any signal timing modifications reducing green time on Chain Bridge Road are unacceptable.

Conclusion

Review of the projected intersection delay and queuing results, as well as the visual microsimulation output, indicate that both Eaton Place and University Drive will operate at or beyond saturated conditions during the 2018 Roadway Extension weekday evening peak period, exceeding the capacity of multiple intersections. The signal timings at the Chain Bridge Road/Eaton Place intersection do not provide sufficient green time for vehicles to progress from both Eaton Place and University Drive onto Chain Bridge Road. As a result, the mounting vehicular queues are anticipated to exacerbate congested conditions on Eaton Place and University Drive extension, north of Fairfax Boulevard. The traffic volume diversion estimates for University Drive, south of Fairfax Boulevard, indicate an approximately 15-25 percent increase in overall traffic volume, which remains well within the road's operational capacity and will provide some relief on the more congested Chain Bridge Road (Route 123).

The findings suggest that the ability of the University Drive extension to reduce vehicular delay and traffic congestion at other study area intersections is limited. While the planned roadway extension project may provide modest queuing improvements at some locations, such as the Fairfax Boulevard/Chain Bridge Road intersection, the project will not significantly improve traffic operations at any intersections and is likely to contribute to elevated peak period delay and queuing on Fairfax Boulevard, Eaton Place and University Drive, north of Fairfax Boulevard. Operational measures to minimize congestion on Eaton Place and University Drive would result in increased traffic queuing and congestion on Chain Bridge Road (Route 123). Overall, the project will likely strain the limited roadway capacity on Eaton Place and contribute to persistent traffic congestion on the University Drive extension during the weekday evening peak period.

The City of Fairfax has already optimized traffic signal timings in the study area and timing modifications at the Chain Bridge Road/Eaton Place intersection will not provide complete improvement on the Eaton Place and University Drive corridors. Significant intersection modifications to provide additional capacity at Chain Bridge Road/Eaton Place intersection are necessary to improve overall operations on Eaton Place and the planned University Drive extension and reduce anticipated future congestion.

Future land use approvals and traffic management strategies will influence individual driver decisions and overall traffic volume. To avoid significant congestion, some of traffic forecasted to divert to University Drive will likely seek other routes to avoid long queues and will contribute to long-term equilibrium in traffic patterns for the study area. The long-term traffic balancing activity will moderate increases in traffic volume on Eaton Place and University Drive, but will also reduce the level of improvement in traffic operations at other intersections in the Northfax study area.

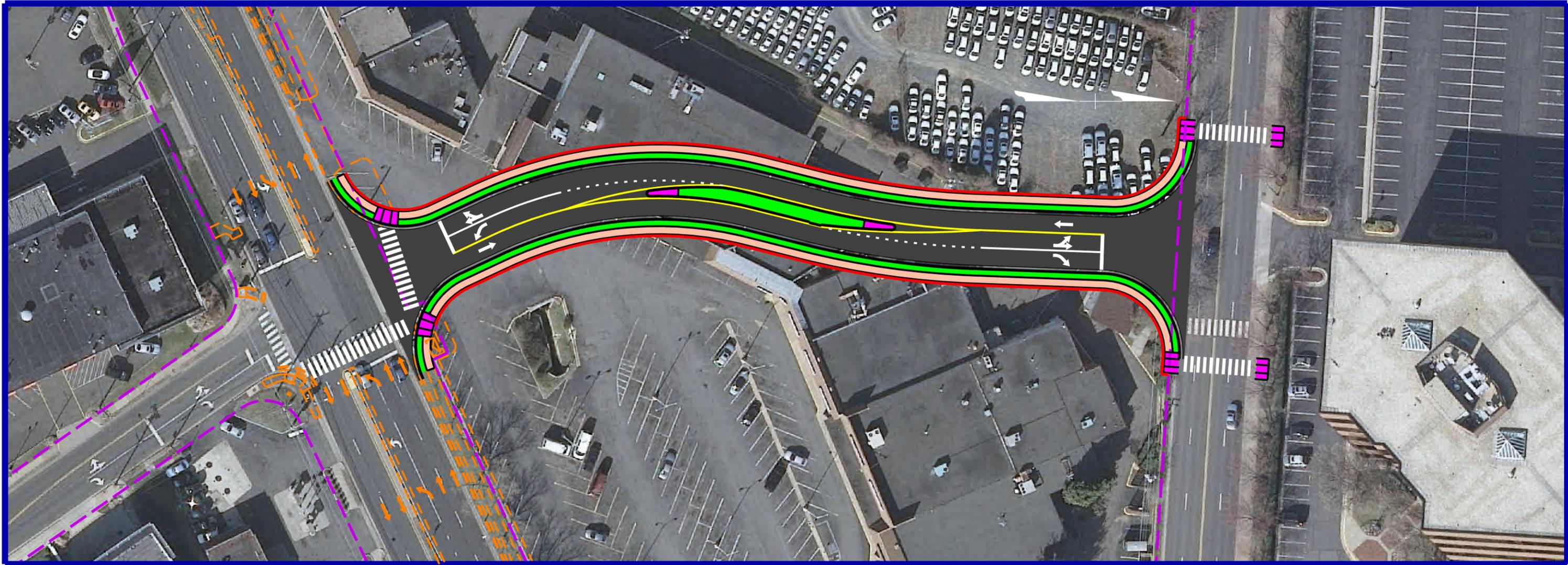
Appendix

Appendix A: University Drive Concept Plan

Appendix B: Detailed Capacity Analysis Summary Tables

Appendix A

University Drive Concept Plan

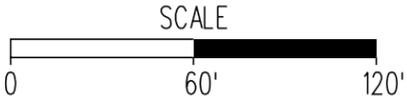


University Drive Extension

August 11, 2015

Legend

- Grass Median/Green Space
- Proposed Pavement/Mill and Overlay
- Concrete Curb Ramps/Medians
- Sidewalk
- Approximate Existing Right of Way
- Approximate Proposed Right of Way



Design Associates, P.C.
 Civil Engineering - Surveying - Land Planning
 Transportation - Environmental
 Right of Way Services

Office Locations

5955 Discovery Boulevard Suite 201 Manassas, VA 20108 Phone: (703) 968-7573 Fax: (703) 257-0948	301 Concourse Boulevard Suite 110 Glen Allen, VA 23060 Phone: (703) 618-0665 Fax: (703) 612-6988	927 Maple Grove Drive Suite 105 Fredericksburg, VA 22407 Phone: (540) 548-4470 Fax: (540) 548-4471
---	--	--

Appendix B

Detailed Capacity Analysis Summary Tables

Node #	2018 No Build AM Without University Dr. Extension		Input Volume	Vehicle	Ave Queue (ft)	Max Queue (ft)	Ave Movement Delay (s)	LOS	Ave Approach Delay (s)	LOS	Ave Intersection Delay (s)	LOS					
2	Fairfax Blvd. & Chain Bridge Rd	Fairfax Blvd EB	LT	308	296	78.9	263	83.53	F	39.54	D	52.0	D				
			Thru	1737	1661	283.7	975	31.70	C								
			RT	21	22	0.0	0	3.23	A								
		Fairfax Blvd WB	LT	112	109	51.2	203	84.43	F					293.50	F		
			Thru	651	658	72.3	310	34.63	C								
			RT	197	193	0.1	37	1.20	A								
	Chain Bridge Rd NB	LT	43	46	24.4	136	108.33	F	66.31	E							
		Thru	686	702	240.4	1012	69.00	E									
		RT	95	104	6.6	104	29.57	C									
	Chain Bridge Rd SB	LT	142	133	34.9	154	69.00	E	67.81	E							
		Thru	820	818	706.7	1065	87.20	F									
		RT	323	324	0.0	0	18.37	B									
3	Fairfax Blvd. & University Dr	Fairfax Blvd EB	LT	5	5	0.1	13	4.30	A	8.94	A	11.9	B				
			Thru	1917	1955	46.6	376	8.97	A								
			RT	36	33	25.5	293	8.17	A								
		Fairfax Blvd WB	LT	81	84	10.3	133	32.00	C					6.67	A		
			Thru	834	836	8.1	161	4.13	A								
			RT	2	3	0.9	86	4.77	A								
	University Dr NB	LT	110	115	58.4	471	78.53	E	40.87	D							
		Thru	1	1	58.4	471	29.70	C									
		RT	258	254	22.2	227	23.87	C									
	University Dr SB	LT	2	2	0.5	21	46.63	D	34.03	C							
		Thru	1	1	0.2	19	39.67	D									
		RT	2	1	0.0	0	3.17	A									
4	Fairfax Blvd. & Eaton Place	Fairfax Blvd EB	LT	79	77	1.1	46	13.77	B	7.64	A	12.9	B				
			Thru	2104	2144	37.1	605	7.40	A								
			RT 1	0	0	20.0	531	16.50	B								
		RT 2	4	4	37.1	605	16.50	B									
		Fairfax Blvd WB	LT 1	0	0	0.1	14	25.77	C					5.65	A		
			LT 2	2	1	0.1	14	25.77	C								
			Thru	888	895	16.0	254	6.70	A								
		Entrance 1 NB	RT	230	236	0.0	0	1.57	A	40.17	D						
			LT	3	2	1.2	28	130.10	F								
			Thru	0	0	1.2	28	#DIV/0!	#DIV/0!								
		Entrance 2 NB	RT	3	5	0.0	0	4.20	A	83.28	F						
			LT	1	1	1.2	21	80.93	F								
			Thru	1	1	1.2	21	85.63	F								
		Eaton Place SB	RT	1	0	0.0	0	#DIV/0!	#DIV/0!	86.17	F						
			LT	240	233	135.2	401	96.90	F								
			Thru 1	0	0	1.5	51	109.70	F								
		5	Chain Bridge Rd and Eaton Pl	Chain Bridge Rd NB	Thru 2	1	2	1.5	51	109.70	F			41.05	D	66.4	E
					RT	30	32	0.1	8	6.57	A						
LT	11				0	201.7	350	#DIV/0!	#DIV/0!								
Thru	1115			1099	119.1	554	41.00	D									
RT	45			46	119.1	554	42.13	D									
RT	45			46	119.1	554	42.13	D									
Frontage Rd NB	LT			5	5	4.9	76	91.46	F	52.48	D						
	Thru			1	1	4.9	76	187.00	F								
	RT			15	10	0.0	10	19.53	B								
Chain Bridge Rd SB	RT			15	10	0.0	10	19.53	B	64.60	E						
	LT			296	299	69.2	387	46.21	D								
	Thru			1184	1198	192.7	588	69.40	E								
Frontage Rd SB	RT			12	12	147.7	519	44.27	D	111.48	F						
	LT			38	35	105.4	410	108.27	F								
	Thru			0	0	105.4	410	#DIV/0!	#DIV/0!								
Oak Pl EB	RT			134	123	105.4	410	112.39	F	123.79	F						
	LT			102	95	127.5	307	112.70	F								
	Thru			61	67	127.5	307	128.63	F								
Eaton Pl WB	RT	24	25	87.2	256	152.97	F	100.60	F								
	LT	76	77	80.6	249	131.90	F										
	Thru	39	42	105.4	410	92.50	F										
	RT	304	289	80.6	249	92.90	F										
	LT	76	77	80.6	249	131.90	F										
	Thru	39	42	105.4	410	92.50	F										

Node #	2018 No Build PM Without University Dr. Extension		Input Volume	Simulated Volume	Ave Queue (ft)	Max Queue (ft)	Ave Movement Delay (s)	LOS	Ave Approach Delay (s)	LOS	Ave Intersection Delay (s)	LOS	
2	Fairfax Blvd. & Chain Bridge Rd	Fairfax Blvd EB	LT	251	256	78.6	241	97.83	F	45.51	57.2	E	
			Thru	1033	968	110.0	575	31.67	C				
			RT	53	54	0.0	5	4.97	A				
		Fairfax Blvd WB	LT	170	157	114.4	350	122.80	F	404.15			F
			Thru	1635	1638	314.5	1133	26.97	C				
			RT	352	344	0.4	38	1.83	A				
		Chain Bridge Rd NB	LT	79	74	49.7	201	134.63	F	103.32			F
			Thru	684	629	815.4	1207	110.40	F				
			RT	107	97	3.7	87	33.50	C				
		Chain Bridge Rd SB	LT	182	166	63.5	218	106.67	F	71.88			E
			Thru	625	664	481.0	1154	89.53	F				
			RT	315	310	0.0	14	15.43	B				
3	Fairfax Blvd. & University Dr	Fairfax Blvd EB	LT	24	23	0.9	46	26.10	C	9.79	16.1	B	
			Thru	1220	1216	35.3	372	9.53	A				
			RT	86	94	15.7	288	9.13	A				
		Fairfax Blvd WB	LT	230	219	22.7	474	23.40	C	13.03			B
			Thru	1973	1950	72.5	675	11.87	B				
			RT	4	3	49.1	598	11.57	B				
		University Dr NB	LT	161	169	120.3	644	92.00	F	50.60			D
			Thru	4	5	120.3	644	104.20	F				
			RT	227	227	5.9	109	18.60	B				
		University Dr SB	LT	12	14	4.3	41	70.30	E	58.28			E
			Thru	8	8	3.7	51	80.20	F				
			RT	8	10	0.1	7	23.90	C				
4	Fairfax Blvd. & Eaton Place	Fairfax Blvd EB	LT	21	21	0.2	24	42.73	D	3.63	17.9	B	
			Thru	1443	1453	8.3	189	3.07	A				
			RT 1	1	1	0.7	115	0.64	A				
			RT 2	2	2	8.3	189						
		Fairfax Blvd WB	LT 1	2	3	0.3	20	19.61	B				
			LT 2	8	8	0.3	20						
			Thru	2092	2056	79.9	921			10.07			B
			RT	539	544	9.1	145			7.00			A
		Entrance 1 NB	LT	5	5	3.6	30	125.43	F	73.51			E
			Thru	1	0	3.6	30	#DIV/0!	#DIV/0!				
			RT	5	4	0.0	0	8.60	A				
		Entrance 2 NB	LT	2	2	1.6	44	169.53	F	53.53			D
			Thru	0	0	1.6	44	#DIV/0!	#DIV/0!				
			RT	5	6	0.0	0	14.87	B				
		Eaton Place SB	LT	287	272	369.8	729	125.40	F	120.32			F
			Thru 1	1	1	304.6	717	89.15	F				
			Thru 2	1	1	304.6	717						
			RT	129	138	304.6	717						
5	Chain Bridge Rd and Eaton Pl	Chain Bridge Rd NB	LT	33	30	31.9	180			143.97	F	50.65	87.5
			Thru	1198	1136	141.0	633	47.90	D				
			RT	70	64	141.0	633	55.71	E				
						141.0	633						
		Frontage Rd NB	LT	12	8	5.7	50	88.93	F				
						5.7	50						
			Thru	1	2	5.7	50			105.17	F		
			RT	6	4	0.0	0			28.83	C		
		Chain Bridge Rd SB	LT	309	313	82.0	546	50.71	D				
						82.0	546						
			Thru	1070	1090	135.5	591			39.20	D		
			RT	56	54	99.0	523			34.17	C		
		Frontage Rd SB	LT	19	19	248.4	510	328.13	F	351.44	F		
						248.4	510						
			RT	106	96	248.4	510	356.05	F				
						248.4	510						
		Oak Pl EB	LT	42	42	85.5	263	151.37	F	134.98	F		
						85.5	263						
			Thru	51	55	85.5	263	127.37	F				
			RT	18	13	46.6	212	114.23	F				
		Eaton Pl WB	LT	84	84	910.8	1442	196.30	F				
						248.4	510						
						5.7	50						
			Thru	79	69	910.8	1442						
						248.4	510						
						5.7	50						
			RT	608	540	248.4	510			198.48	F		
						5.7	50						
					910.8	1442							

Node #	2018 Build AM With University Dr. Extension		From	To		Change	Input Volume	Vehicle	Vehicle	Delay (s)	Ave Queue (ft)	Max Queue (ft)	Stopped Delay (s)	kxI	Ave Movement Delay (s)	LOS	Ave Approach Delay (s)	LOS	Ave Intersection Delay (s)	LOS				
2	Fairfax Blvd. & Chain Bridge Rd	Fairfax Blvd EB	LT	126	133	1260133	-2.97%	303	294	294	83.5	77.8	254	75.7	24539.20	F								
			Thru	119	139	1190139	-3.96%	1741	1672	1672	31.3	285.1	1006	25.3	52333.60	C	39.10	D						
			RT	10207	10207	1.02E+08	0.00%	21	21	21	1.4	0.0	0	0.6	30.10	A								
		Fairfax Blvd WB	LT	142	127	1420127	2.22%	135	132	132	83.7	64.6	249	75.6	11048.40	F								
			Thru	141	120	1410120	1.06%	659	666	666	26.3	55.3	311	20.8	17515.80	C	216.40	F						
			RT	143	133	1430133	-2.11%	142	139	139	9.9	0.0	11	0.0	120.47	A								
		Chain Bridge Rd NB	LT	131	120	1310120	13.95%	43	49	49	99.1	24.9	151	92.3	4855.90	F					47.4	D		
			Thru	130	133	1300133	2.98%	604	622	622	61.4	147.0	715	54.6	38190.80	E	57.90	E						
			RT	132	139	1320139	11.01%	109	121	121	23.2	7.5	111	15.3	2811.23	C								
		Chain Bridge Rd SB	LT	136	139	1360139	-5.65%	124	117	117	65.9	27.3	130	59.2	7710.30	E								
			Thru	137	127	1370127	0.84%	715	721	721	82.9	335.2	845	72.6	59746.87	F	62.38	E						
			RT	138	120	1380120	4.44%	315	329	329	16.2	0.0	0	11.4	5340.77	B								
3	Fairfax Blvd. & University Dr	Fairfax Blvd EB	LT	140	155	1400155	-7.69%	39	36	36	11.3	1.3	44	8.0	405.60	B								
			Thru	184	153	1840153	1.95%	1901	1938	1938	12.6	67.1	470	8.1	24483.40	B	12.58	B						
			RT	184	147	1840147	-11.11%	18	16	16	8.7	38.3	387	5.7	139.73	A								
		Fairfax Blvd WB	LT	152	147	1520147	1.27%	79	80	80	40.9	14.0	185	32.8	3269.33	D								
			Thru	151	141	1510141	0.24%	828	830	830	9.4	21.7	312	6.1	7802.00	A	12.13	B						
			RT	151	155	1510155	50.00%	2	3	3	1.5	6.6	236	0.0	4.50	A								
		University Dr NB	LT	150	141	1500141	-3.64%	55	53	53	80.0	102.4	554	69.7	4240.00	E								
			Thru	150	155	1500155	-4.80%	125	119	119	82.6	102.4	554	71.3	9825.43	F	51.96	D						
			RT	149	153	1490153	2.37%	253	259	259	32.2	37.4	380	19.2	8331.17	C								
		University Dr SB	LT	144	153	1440153	0.00%	2	2	2	25.0	0.4	14	20.3	49.93	C								
			Thru	145	147	1450147	0.99%	101	102	102	55.1	40.5	277	48.6	5616.80	E	48.22	D						
			RT	145	141	1450141	18.42%	38	45	45	33.7	19.7	228	28.5	1518.00	C								
4	Fairfax Blvd. & Eaton Place	Fairfax Blvd EB	LT	154	165	1540165	-1.72%	58	57	57	18.7	1.6	61	11.4	1067.80	B								
			Thru	161	160	1610160	1.66%	2104	2139	2139	9.2	64.7	834	4.9	19607.50	A	9.41	A						
			RT	161	158	1610158	#DIV/0!	0	0	0	0.0	44.7	760	0.0	0.00	A								
		Fairfax Blvd WB	LT	161	157	1610157	-25.00%	4	3	3	6.3	64.7	834	3.3	19.00	A								
			Thru	164	158	1640158	#DIV/0!	0	0	0	0.0	0.1	14	0.0	0.00	C								
			RT	164	157	1640157	-50.00%	2	1	1	23.0	0.1	14	17.2	22.97	C								
		Entrance 1 NB	LT	164	151	1640151	0.45%	888	892	892	6.9	16.5	212	4.3	6125.07	A	5.77	A						
			Thru	163	165	1630165	2.61%	230	236	236	1.6	0.0	0	0.0	969.73	A								
			RT	159	151	1590151	-33.33%	3	2	2	129.4	1.1	28	124.8	258.73	F								
		Entrance 2 NB	LT	159	165	1590165	#DIV/0!	0	0	0	0.0	1.1	28	0.0	0.00	#DIV/0!	#DIV/0!	39.94	D					
			Thru	159	160	1590160	66.67%	3	5	5	4.2	0.0	0	2.0	20.83	A								
			RT	156	151	1560151	0.00%	1	1	1	82.3	1.0	21	79.6	82.27	F								
		Eaton Place SB	LT	156	165	1560165	0.00%	1	1	1	57.6	1.0	21	54.5	57.63	E	69.95	E						
			Thru	156	160	1560160	-100.00%	1	0	0	0.1	0.0	0	0.0	0.00	#DIV/0!	#DIV/0!							
			RT	167	160	1670160	2.50%	240	246	246	94.1	138.1	382	86.0	23148.60	F								
		5	Chain Bridge Rd and Eaton Pl	Chain Bridge Rd NB	LT	182	177	1820177	100.00%	11	0	0	0.0	286.5	454	0.0	0.00	#DIV/0!	#DIV/0!					
					Thru	134	174	1340174	-1.21%	992	980	980	46.8	114.7	546	37.2	45864.00	D	46.79	D				
					RT	134	173	1340173		27	26	26	52.6	114.7	546	40.1	473.70	D						
Frontage Rd NB	LT			134	166	1340166					42.7	114.7	546	32.9	683.20	D								
	Thru			134	171	1340171	-3.70%				45.6	114.7	546	38.5	45.57	D								
	RT			170	135	1700135					27.8	3.9	69	26.3	0.00	F								
Chain Bridge Rd SB	LT			170	177	1700177		5	4	4	44.7	3.9	69	41.2	44.70	F								
	Thru			170	174	1700174	-20.00%				95.0	3.9	69	89.5	284.90	F	36.00	D						
	RT			170	173	1700173	0.00%	1	1	1	93.7	3.9	69	89.1	93.70	F								
Frontage Rd SB	LT			170	166	1700166	-33.33%	15	10	10	11.7	0.0	10	9.8	116.67	B								
	Thru			175	173	1750173					47.2	98.1	496	38.3	2028.17	D								
	RT			175	171	1750171		396	405	405	47.5	98.1	496	39.5	47.50	D	36.56	D						
Oak Pl EB	LT			181	135	1810135	2.68%	1084	1113	1113	33.5	77.7	407	26.6	37322.60	C								
	Thru			181	177	1810177	0.00%	12	12	12	29.1	43.2	338	23.4	348.80	C								
	RT			172	166	1720166	-5.26%	38	36	36	126.2	118.8	406	114.8	4542.00	F								
Eaton Pl WB	LT			172	171	1720171	#DIV/0!	0	0	0	0.0	118.8	406	0.0	0.00	#DIV/0!	#DIV/0!							
	Thru			172	174	1720174					129.2	118.8	406	117.3	13824.40	F	129.49	F						
	RT			172	177	1720177		134	131	131	142.6	118.8	406	128.5	1568.23	F								
Eaton Pl EB	LT	176	174	1760174	-8.82%	102	93	93	84.0	93.5	307	76.3	7815.10	F										
	Thru	176	173	1760173					109.0	93.5	307	97.7	109.03	F										
	RT	176	166	1760166		61	68	68	86.7	93.5	307	77.9	5722.20	F	84.98	F								
Eaton Pl WB	LT	176	171	1760171	11.48%				64.0	93.5	307	58.1	64.03	F										
	Thru	165	135	1650135	8.33%	24	26	26	83.9	54.5	256	74.4	2180.53	F										
	RT	165	135	1650135					100.2	102.8	287	90.8	3608.40	F										
Eaton Pl WB	LT	172	135	1720135	6.52%	46	49	49	130.1	118.8	406	116.7	1690.87	F										
	Thru	170	135	1700135					27.8	3.9	69	26.3	0.00	F										
	RT	165	177	1650177					85.8	102.8	287	77.2	2317.50	F										
Eaton Pl WB	LT	172	177	1720177	0.00%	39	39	39	142.6	118.8	406	128.5	1568.23	F	100.81	F								
	Thru	170	177	1700177					44.7	3.9	69	41.2	44.70	F										
	RT	172	174	1720174					129.2	118.8	406	117.3	13824.40	F										
Eaton Pl WB	LT	170	174	1700174	-3.04%	427	414	414	95.0	3.9	69	89.5	284.90	F										
	Thru	165	174	1650174					89.7															

Node #	2018 Build PM With University Dr. Extension		From	To		Change	Input Volume	Simulated Volume	Vehicle	Delay (s)	Ave Queue (ft)	Max Queue (ft)	Stopped Delay (s)	KxL	Ave Movement Delay (s)	LOS	Ave Approach Delay (s)	LOS	Ave Intersection Delay (s)	LOS		
2	Fairfax Blvd. & Chain Bridge Rd	Fairfax Blvd EB	LT	126	133	1260133	-3.28%	244	236	236	95.0	71.2	226	87.7	22420.00	95.00	F	59.17	E	60.3	E	
			Thru	119	139	1190139	-11.06%	1040	925	925	50.0	264.2	992	38.3	46280.83	50.03	D					
			RT	10207	10207	102E+08	-11.32%	53	47	47	3.7	0.0	0	2.1	172.33	3.67	A					
		Fairfax Blvd WB	LT	142	127	1420127	-19.49%	195	157	157	157	156.4	150.7	389	146.4	24549.57	156.37	F	411.01			F
			Thru	141	120	1410120	-12.05%	1643	1445	1445	27.7	205.2	1123	23.8	39978.33	27.67	C					
			RT	143	133	1430133	2.95%	271	279	279	1.5	0.2	47	0.0	418.50	1.50	A					
		Chain Bridge Rd NB	LT	131	120	1310120	1.27%	79	80	80	118.8	53.0	284	112.0	9506.67	118.83	F	88.54	F			
			Thru	130	133	1300133	-0.17%	595	594	594	95.7	442.3	1110	88.7	56845.80	95.70	F					
			RT	132	139	1320139	7.03%	128	137	137	39.8	39.7	760	29.7	5452.60	39.80	D					
		Chain Bridge Rd SB	LT	136	139	1360139	-5.04%	139	132	132	120.0	55.6	169	110.0	15835.60	119.97	F	70.98	E			
			Thru	137	127	1370127	1.30%	537	544	544	92.5	268.7	1037	84.4	50338.13	92.53	F					
			RT	138	120	1380120	1.95%	307	313	313	12.9	0.0	24	8.2	4027.27	12.87	B					
3	Fairfax Blvd. & University Dr	Fairfax Blvd EB	LT	140	155	1400155	-50.00%	56	28	28	665.6	376.4	1098	624.6	18636.80	665.60	F	27.17	C	45.3	D	
			Thru	184	153	1840153	-5.10%	1216	1154	1154	12.4	235.8	876	9.0	14309.60	12.40	B					
			RT	184	147	1840147	2.33%	43	44	44	8.4	199.9	793	5.6	369.60	8.40	A					
		Fairfax Blvd WB	LT	152	147	1520147	-3.78%	225	194	194	37.3	66.9	908	25.4	7242.67	37.33	D	28.98	C			
			Thru	151	141	1510141	-7.91%	1947	1793	1793	27.3	300.9	913	18.1	49008.67	27.33	C					
			RT	151	155	1510155	-25.00%	4	3	3	475.3	254.4	836	453.5	1425.80	475.27	F					
		University Dr NB	LT	150	141	1500141	-64.20%	81	29	29	526.0	614.2	710	493.8	15254.97	526.03	F	376.55	F			
			Thru	150	155	1500155	-67.97%	153	49	49	633.1	614.2	710	591.6	31021.90	633.10	F					
			RT	149	153	1490153	-66.67%	222	74	74	148.1	202.7	706	128.2	10959.40	148.10	F					
		University Dr SB	LT	144	153	1440153	33.33%	12	16	16	73.1	5.4	131	67.6	1169.07	73.07	E	68.20	E			
			Thru	145	147	1450147	-1.75%	114	112	112	74.1	69.2	308	67.0	8302.93	74.13	E					
			RT	145	141	1450141	0.00%	67	67	67	57.1	40.5	258	51.5	3827.93	57.13	E					
4	Fairfax Blvd. & Eaton Place	Fairfax Blvd EB	LT	154	165	1540165	0.00%	12	12	12	48.8	0.1	7	42.7	585.20	48.77	D	1.95	A	28.3	C	
			Thru	161	160	1610160	-13.24%	1443	1252	1252	1.5	3.5	107	0.7	1878.00	1.50	A					
			RT	161	158	1610158	0.00%	1	1	1	0.7	0.0	27	0.0	0.67							
		Fairfax Blvd WB	LT	161	157	1610157	-50.00%	2	1	1	0.8	3.5	107	0.0	0.77	0.72	A	27.22	C			
			LT 1	164	158	1640158	50.00%	2	3	3	33.3	0.4	17	20.3	99.90	29.73	C					
			LT 2	164	157	1640157	-12.50%	8	7	7	28.2	0.4	17	20.2	197.40							
		Entrance 1 NB	Thru	164	151	1640151	-6.98%	2092	1946	1946	29.2	486.4	1376	15.8	56758.33	29.17	C	81.82	F			
			RT	159	160	1590160	-20.00%	5	4	4	7.9	0.0	0	7.0	31.73	7.93	A					
			LT	159	151	1590151	0.00%	5	5	5	140.9	3.6	30	134.5	704.67	140.93	F					
		Entrance 2 NB	Thru	159	165	1590165	-100.00%	1	0	0	31.6	3.6	30	30.3	0.00	#DIV/0!	#DIV/0!	55.52	E			
			RT	159	160	1590160	-20.00%	5	4	4	7.9	0.0	0	7.0	31.73	7.93	A					
			LT	156	151	1560151	0.00%	2	2	2	175.3	1.6	44	170.1	350.53	175.27	F					
Eaton Place SB	Thru	156	165	1560165	#DIV/0!	0	0	0	0.0	1.6	44	0.0	0.00	#DIV/0!	#DIV/0!	123.84	F					
	RT	156	160	1560160	20.00%	5	6	6	15.6	0.0	0	11.7	93.60	15.60	B							
	LT	167	160	1670160	-4.53%	287	274	274	110.2	199.9	480	100.6	30194.80	110.20	F							
Chain Bridge Rd NB	Thru 1	168	158	1680158	100.00%	1	2	2	97.3	116.2	461	85.4	194.60	142.57	F	39.19	D					
	Thru 2	168	157	1680157	100.00%	1	2	2	187.8	116.2	461	173.0	375.67									
	RT	168	151	1680151	-8.08%	99	91	91	164.1	116.2	461	144.8	14930.07	164.07	F							
5	Chain Bridge Rd and Eaton Pl	Chain Bridge Rd NB	LT	182	177	1820177	-24.24%	33	25	25	137.3	101.3	307	130.5	3431.67	137.27	F	51.04	D	87.4	F	
			Thru	134	174	1340174	-0.95%	1049	1039	1039	48.7	126.5	549	42.5	50599.30	48.70	D					
			RT	134	173	1340173					10	47.9	126.5	549	39.7	479.00						
		Frontage Rd NB	LT	170	177	1700177					29	61.8	126.5	549	54.5	1792.20			88.18			F
			Thru	170	174	1700174	-33.33%	12	8	8	1	105.0	6.1	57	100.7	105.00	104.91	F				
			RT	170	174	1700174	-33.33%	12	8	8	1	105.0	6.1	57	98.7	734.30						
		Chain Bridge Rd SB	LT	175	173	1750173					118	52.8	123.2	626	42.1	6230.40			300.41			F
			Thru	175	171	1750171					10	63.0	123.2	626	50.3	630.00	51.54	D				
			RT	175	166	1750166	0.96%	415	419	419	291	50.6	123.2	626	40.3	14734.30						
		Frontage Rd SB	Thru	181	135	1810135	2.90%	965	993	993	34.4	76.6	415	28.4	34159.20	34.40	C	145.81	F			
			RT	181	177	1810177	-10.71%	56	50	50	30.8	44.8	346	26.2	1538.33	30.77	C					
			LT	172	166	1720166	-5.26%	19	18	18	287.3	203.4	467	267.9	5172.00	287.33	F					
Oak Pl EB	Thru	176	174	1760174	-16.67%	42	35	35	148.3	89.8	285	139.2	5189.33	148.27	F	196.38	F					
	Thru	176	173	1760173					18	166.3	89.8	285	151.5	2992.80								
	RT	176	166	1760166					36	136.3	89.8	285	126.4	4906.80	145.01			F				
Eaton Pl WB	Thru	176	171	1760171	7.84%	51	55	55	1	76.1	89.8	285	71.2	76.13			197.53	F				
	RT	176	135	1760135	5.56%	18	19	19	143.6	49.4	234	133.7	2727.77	143.57	F							
	LT	165	135	1650135	-30.00%	50	35	35	31	173.1	1165.9	1212	155.3	5367.13	188.49	F						
Eaton Pl EB	Thru	166	166	1660166	-1.82%	330	324	324	1.9	0.5	33	1.2	615.60	1.90	A	1.51	A					
	RT	166	146	1660146	0.00%	121	121	121	0.5	0.5	33	0.0	64.53	0.53	A							
	LT	165	146	1650146	2.63%	38	39	39	106.2	265.0	698	89.8	4140.50	106.17	F							
University Dr NB	Thru	165	165	1650165	-7.69%	520	480	480	130.2	265.0	698	106.9	62512.00	130.23	F	127.37	F					
	RT	165	15	1650015	11.11%	18	20	20	100.0	265.0	698	85.8	2000.00	100.00	F							
	LT	186	165	1860165	-71.60%	162	46	46	926.2	529.5	667	853.4	42605.20	926.20	F							
University Dr SB	Thru	186	15	1860015	-66.67%	3	1	1	807.2	529.5	667	741.1	807.17	807.17	F	895.08	F					
	RT	155	166	1550166	-33.33%	6	4	4	559.1	0.0	0	523.5	2236.53	559.13	F							
	LT	16	166	160166	4.76%	42	44	44	76.0	26.2	73	61.7	3344.00	76.00	F							
Eaton Pl & University Dr	Thru	16	146	160146	-16.67%	6	5	5	46.8	26.2	73	32.5	233.83	46.77	E	88.81	F					
	RT	16	165	160165	-9.30%	86	78	78	98.7	26.2	73	78.9	7701.20	98.73	F							

2018 Roadway Extension including Signal Timing Modifications

Node #	2018 Build PM With University Dr. Extension		Change	Input Volume	Simulated Volume	Ave Queue (ft)	Max Queue (ft)	Ave Movement Delay (s)	LOS	Ave Approach Delay (s)	LOS	Ave Intersection Delay (s)	LOS	
2	Fairfax Blvd. & Chain Bridge Rd	Fairfax Blvd EB	LT	-1.23%	244	241	74.4	228	97.63	F	44.69	D	57.0	E
			Thru	-5.29%	1040	985	112.6	606	31.73	C				
			RT	-9.43%	53	48	0.0	0	2.40	A				
		Fairfax Blvd WB	LT	-11.28%	195	173	140.8	351	138.40	F	343.67	F		
			Thru	-5.48%	1643	1553	177.4	1120	22.87	C				
			RT	7.38%	271	291	0.4	37	1.53	A				
		Chain Bridge Rd NB	LT	-13.92%	79	68	39.0	189	112.23	F	83.11	F		
			Thru	0.00%	595	595	410.0	1163	94.70	F				
			RT	21.88%	128	156	6.2	148	26.23	C				
Chain Bridge Rd SB	LT	-7.91%	139	128	68.4	162	148.33	F	89.61	F				
	Thru	4.10%	537	559	310.6	984	117.20	F						
	RT	4.56%	307	321	0.0	15	18.13	B						
3	Fairfax Blvd. & University Dr	Fairfax Blvd EB	LT	-5.36%	56	53	18.9	138	104.47	F	17.83	B	32.0	C
			Thru	4.85%	1216	1275	57.3	330	14.43	B				
			RT	-9.30%	43	39	29.0	246	11.23	B				
		Fairfax Blvd WB	LT	-6.67%	225	210	54.6	735	36.63	D	20.34	C		
			Thru	-4.11%	1947	1867	144.9	906	18.33	B				
			RT	-25.00%	4	3	111.1	829	126.83	F				
		University Dr NB	LT	-28.40%	81	58	439.5	719	194.13	F	137.84	F		
			Thru	-27.45%	153	111	439.5	719	210.80	F				
			RT	-23.42%	222	170	67.7	682	71.00	E				
University Dr SB	LT	-7.91%	12	16	4.7	88	68.13	E	71.08	E				
	Thru	-1.75%	114	112	74.8	345	78.80	E						
	RT	0.00%	67	67	43.0	295	58.87	E						
4	Fairfax Blvd. & Eaton Place	Fairfax Blvd EB	LT	8.33%	12	13	0.3	29	42.00	D	2.48	A	17.9	B
			Thru	1.73%	1443	1468	5.2	120	2.13	A				
			RT 1	0.00%	1	1	0.1	47	0.57	A				
		Fairfax Blvd WB	LT 1	50.00%	2	3	0.3	21	18.68	B	10.52	B		
			LT 2	0.00%	8	8	0.3	21	18.68	B				
			Thru	-3.20%	2092	2025	95.8	921	12.43	B				
		Entrance 1 NB	RT	1.48%	539	547	0.0	0	3.27	A	73.13	E		
			LT	0.00%	5	5	3.6	30	124.97	F				
			Thru	-100.00%	1	0	3.6	30	#DIV/0!	#DIV/0!				
		Entrance 2 NB	RT	-20.00%	5	4	0.0	0	8.33	A	53.36	D		
			LT	0.00%	2	2	1.6	44	169.83	F				
			Thru	#DIV/0!	0	0	1.6	44	#DIV/0!	#DIV/0!				
		Eaton Place SB	RT	20.00%	5	6	0.0	0	14.53	B	127.96	F		
			LT	-4.18%	287	275	231.9	502	129.80	F				
			Thru 1	100.00%	1	2	93.8	441	136.57	F				
	Thru 2	100.00%	1	2	93.8	441	136.57	F						
	RT	-4.04%	99	95	93.8	441	122.27	F						
	5	Chain Bridge Rd and Eaton Pl	Chain Bridge Rd NB	LT	-100.00%	33	0	522.3	865	#DIV/0!	#DIV/0!	28.70	C	81.1
Thru				-0.10%	1049	1048	73.4	418	28.50	C				
RT					42	39	73.4	418	33.94	C				
Frontage Rd NB			LT		12	9	5.5	50	104.73	F	92.97	F		
			Thru	-25.00%	1	2	5.5	50	165.23	F				
			RT	-50.00%	6	3	0.0	0	9.53	A				
Chain Bridge Rd SB			LT		415	414	235.8	751	83.61	F	46.44	D		
			Thru	-0.24%	965	1000	69.1	354	32.10	C				
			RT	-7.14%	56	52	37.9	285	26.43	C				
Frontage Rd SB			LT	0.00%	19	19	230.9	474	329.87	F	326.02	F		
			RT		106	107	230.9	474	325.33	F				
			Thru	0.94%	106	107	230.9	474	325.33	F				
Oak Pl EB			LT	-11.90%	42	37	82.7	269	131.67	F	136.15	F		
			Thru		51	57	82.7	269	137.15	F				
			RT	11.76%	18	20	43.5	218	141.60	F				
Eaton Pl WB			LT	11.11%	18	20	43.5	218	141.60	F	167.91	F		
			Thru	-16.00%	50	42	1000.4	1210	163.00	F				
			RT		79	61	230.9	474	171.60	F				
			Thru	-22.78%	79	61	1000.4	1210	171.60	F				
			RT		757	708	5.5	50	167.88	F				
			Thru	-6.47%	757	708	1000.4	1210	167.88	F				
6	Eaton Pl & University Dr	Eaton Pl EB	LT	0.00%	9	9	0.0	13	0.63	A	0.57	A	47.1	E
			Thru	-3.94%	330	317	0.0	13	0.60	A				
			RT	-1.65%	121	119	0.0	13	0.47	A				
		Eaton Pl WB	LT	13.16%	38	43	53.1	398	31.13	D	36.59	E		
			Thru	1.73%	520	529	53.1	398	37.43	E				
			RT	22.22%	18	22	53.1	398	27.03	D				
		University Dr NB	LT	-25.31%	162	121	278.1	550	277.30	F	263.18	F		
			Thru	-33.33%	3	2	278.1	550	100.53	F				
			RT	50.00%	6	9	0.0	0	109.43	F				
		University Dr SB	LT	11.90%	42	47	8.1	66	22.63	C	36.08	E		
			Thru	0.00%	6	6	8.1	66	32.00	D				
			RT	-1.16%	86	85	8.1	66	43.80	E				