

# **LIBERTY TREE ACADEMY**

---

## **DRAFT TRAFFIC IMPACT STUDY**

***Prepared for:***

**El Paso County**

***Prepared by:***



1601 Blake Street, Suite 200  
Denver, Colorado 80202

Contact: David Kline, PE, PTOE  
(303)-572-0200

***On Behalf of:***

***Liberty Tree Academy  
8579 Eastonville Road  
Peyton, CO 80831***

**May 4, 2018**

**PPR-18-023**

## Table of Contents

Introduction.....	1
Project Description.....	1
Existing Traffic Conditions.....	4
Roadway Network.....	4
Traffic Volumes .....	4
Intersection and Roadway Capacity Analysis.....	4
Future Traffic .....	7
Future Background Traffic.....	7
Trip Generation .....	7
Trip Distribution.....	7
2019 Short Range Traffic Analysis.....	8
Roadway Improvements.....	8
Total Traffic .....	8
Level of Service Analysis .....	8
2040 Long Range Traffic Analysis.....	10
Roadway Improvements.....	10
Total Traffic .....	10
Level of Service Analysis .....	10
Mitigation Improvements.....	11
All Way Stop Control.....	11
Roundabout.....	11
Findings and Recommendations .....	13
Conclusion .....	13

### Appendices:

- A. Existing Traffic Counts
- B. 2017 Level of Service Output – Existing Traffic
- C. 2019 Level of Service Output – Total Traffic
- D. 2040 Level of Service Output – Total Traffic TWSC
- E. 2040 Level of Service Output – Total Traffic AWSC

## List of Figures

Figure 1 – Vicinity Map.....	2
Figure 2 – Site Plan.....	3
Figure 3 – Existing AM and PM Traffic Volumes .....	6
Figure 4 – 2019 AM and PM Total Traffic Volumes .....	9
Figure 5 – 2040 AM and PM Total Traffic Volumes .....	12

## List of Tables

Table 1 – Unsignalized Intersection Level of Service Criteria.....	5
Table 2 – 2018 Existing Traffic Level of Service.....	5
Table 3 – Trip Generation.....	7
Table 4 – 2019 Total Traffic Level of Service .....	8
Table 5 – 2040 Total Traffic TWSC Level of Service .....	10
Table 6 – 2040 Total Traffic AWSC Level of Service.....	11

## Introduction

The Liberty Tree Academy is a proposed private school with an initial kindergarten through 8<sup>th</sup> grade enrollment of 486 student in one building on approximately 4 acres of undeveloped land. For the purposes of this study the project is assumed to be fully built-out in 2019. In the long range condition the school may be expanded to include high school enrollment of an additional 264 students. The purpose of this Traffic Impact Study (TIS) is to assess the effects the site traffic has on the intersection serving the site in 1) the short range condition with 486 students, and 2) the long range condition, 2040, with 750 students. The remaining site may be developed at a later date to include an alternate use, but due to development uncertainty is not included in this TIS.

The proposed site is bounded on the north by Eastonville Road and the eastern property line, on the east by undeveloped property, on the south by a residential property, and on the west by Eastonville Road. Figure 1 depicts the location of the site.

## Project Description

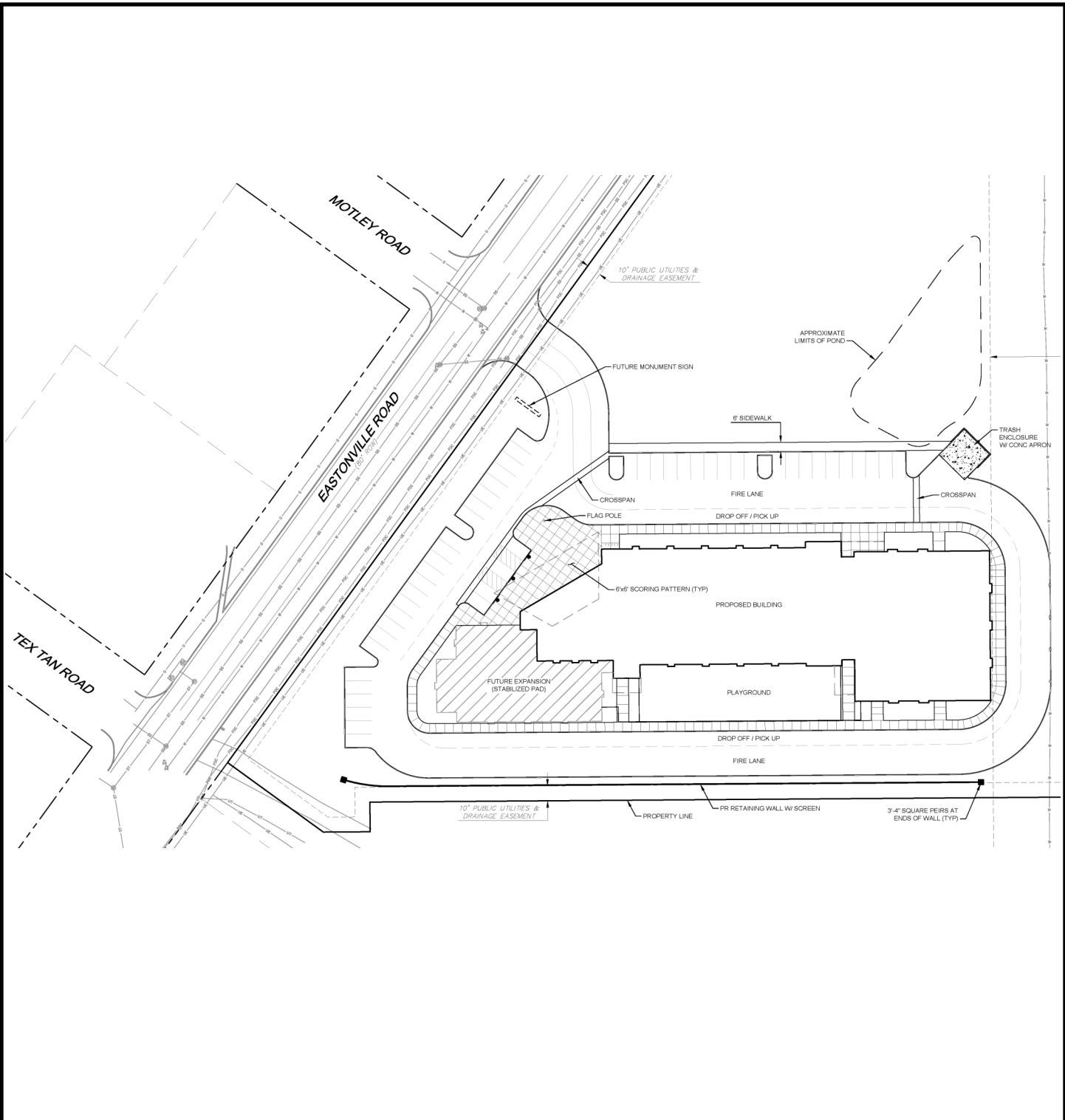
Phase 1 of Liberty Tree Academy is proposed as a single two story building and includes administrative offices, class rooms, gymnasium, warming kitchen, and ancillary rooms. The Phase 1 building area is 39,676 square feet. Phase 2 is proposed as an attached building with an additional 11, 640 square feet of class rooms. The total building area of both Phase 1 and Phase 2 is 51,316 square feet. Adjacent to and south of the building is a fenced play area for younger aged children. Exterior to the building the facility includes a circular one way drive aisle, with a near side drop off lane. Parking is located along the northwest and north portion of the site. Pedestrians are accommodated with sidewalks and curb ramps. Bicyclists share the drive aisle.

Access to the Site is proposed through one primary location at the existing Eastonville Road/Motley Road intersection. Eastonville Road is planned as an urban minor arterial roadway. Motley Road is a local street. The existing intersection is configured as a “T” which will be modified to a four-leg intersection, with stop control on the side street. Figure 2 shows the proposed access locations and internal drive aisle and circulation.



**LIBERTY TREE ACADEMY  
TRAFFIC IMPACT STUDY**

**Figure 1  
VICINITY MAP**



## Existing Traffic Conditions

### Roadway Network

The existing Eastonville Road is classified as an urban minor arterial roadway with a right of way (ROW) width of 80 feet with an ultimate ROW of 100 feet. Motley Road is a local street with a ROW of 60 feet. The existing intersection configuration is described below:

### Address condition of roadways and paving.

#### *Eastonville Road/Motley Road*

The existing intersection geometry at the Eastonville Road and Motley Road intersection includes.

- Northbound, striped center two way turn lane, and one through lane, and no right turn lane.
- Southbound, striped center two way turn lane, and one through lane, and on right turn lane.
- Eastbound, shared right/left turn lane.

### Traffic Volumes

Traffic counts were conducted for the intersection of Eastonville Road/Motley Road intersection in April 2018. Figure 3 shows both AM and PM peak hour intersection turning movement counts. Appendix A contains the raw traffic count data. The AM peak hour generally occurs between 7:00 and 8:00 AM. The PM peak hour generally occurs between 4:45 and 5:45 PM.

### Intersection and Roadway Capacity Analysis

For unsignalized (side-street stop controlled) intersections, Synchro 9 software was used. The software applies the Transportation Research Board's 2010 *Highway Capacity Manual* (HCM) methodology for unsignalized intersections to determine average control delay per vehicle (measured in seconds) for each stop-controlled movement. The method incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. For side street stop-controlled intersections, delay is represented as the average delay per vehicle for the worst approach, not the overall intersection. Table 1 summarizes the relationship between delay and level of service.

**Table 1 – Unsignalized Intersection Level of Service Criteria**

Level of Service	Average Total Delay (seconds per vehicle)	Description
A	< 10	Little or no conflicting traffic for minor street approach.
B	>10 to 15	Minor street begins to notice absence of available gaps.
C	>15 to 25	Minor street begins experiencing delay for available gaps.
D	>25 to 35	Minor street starts to experience queuing.
E	>35 to 50	Extensive minor street queuing due to insufficient gaps.
F	> 50	Insufficient gaps to allow minor street traffic to cross safely through the major street traffic stream.

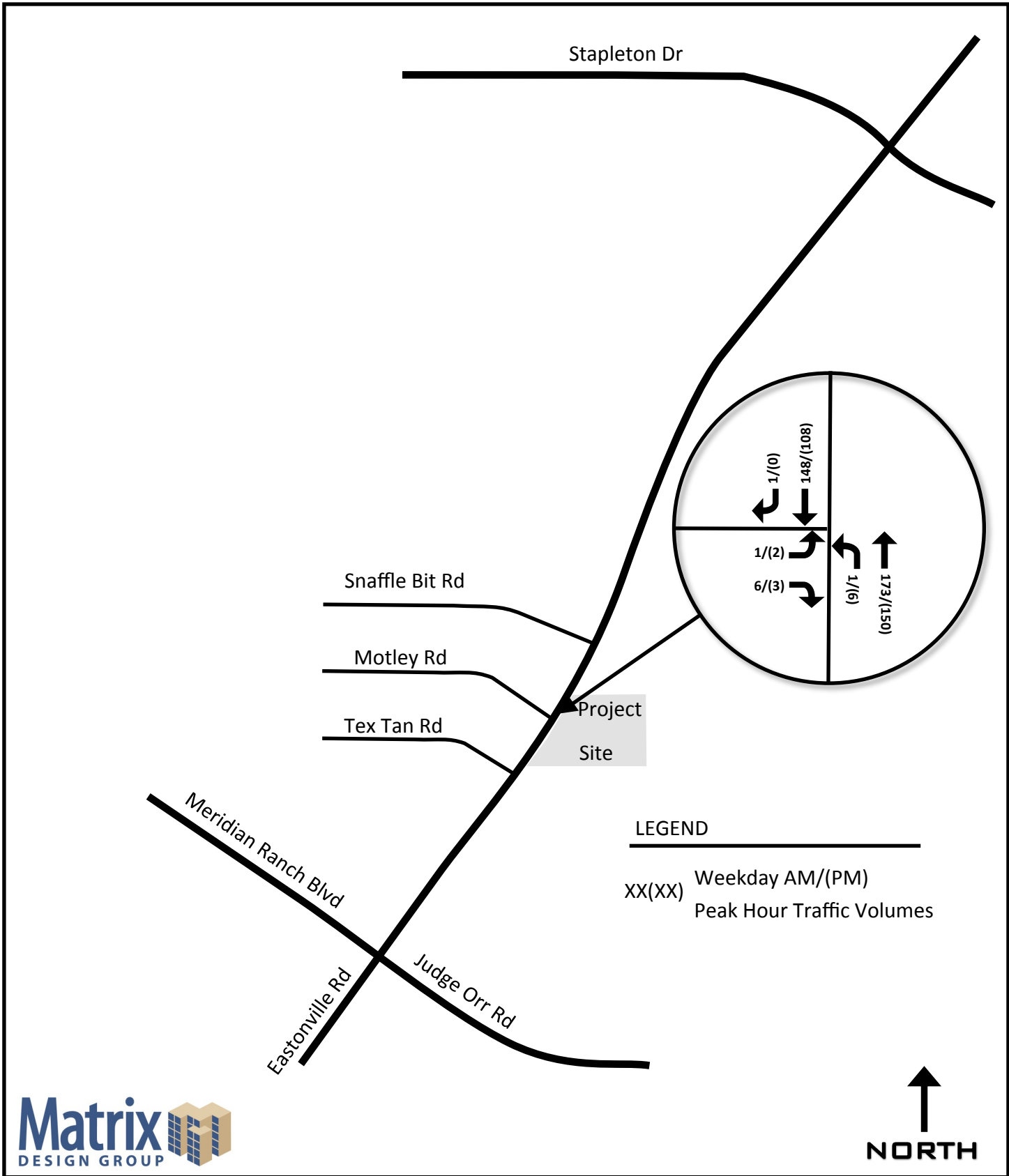
Source: *HCM2010 Highway Capacity Manual* (Transportation Research Board, 2010)

Table 2 presents the existing 2018 intersection levels of service (LOS). As presented, the Eastonville Road/Motley Road intersection currently operates well with an overall LOS of A in both the AM and PM peak hour.

**Table 2 – 2018 Existing Traffic Level of Service**

Intersection	Control	AM LOS	PM LOS
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Right	Stop	A	A
-Northbound Left	Free	A	A
-Northbound Thru	Free	A	A
-Southbound Thru/Right	Free	A	A





## Future Traffic

### Future Background Traffic

Future background traffic is intended to show how existing volumes are expected to grow over time without the proposed development. The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. Colorado Department of Transportation performs regional forecast modeling and publishes them on their website. In the case of US24 the annual growth rate of 1.5% per year is anticipated and is therefore assumed as the traffic background rate for Eastonville Road.

### Trip Generation

The vehicle trips associated with a private school are calculated using the *ITE Trip Generation Manual, Tenth Edition*. This methodology consists of choosing an independent variable for the land use for a particular time of day. The independent variable correlates to the variation in trip ends and is related to the land use. The value of the independent variable is either multiplied by a weighted average or used in a regression equation to calculate the trips generated by the land use. The *ITE Trip Generation Manual* provides guidance on when to use the weighted average versus the regression equation. In most cases, the regression equations are recommended when there are adequate study data points.

**Table 3 – Trip Generation**

Land Use	ITE Code	AM Peak			PM Peak*			Daily		
		Total	In	Out	Total	In	Out	Total	In	Out
<b>Phase 1</b>										
<b>Private School (K-8)</b>	534	442	243	199	126	58	68	1,997	999	998
<b>Phase 2</b>										
<b>Private School (K-12)</b>	536	600	366	243	128	55	73	1,860	930	930

\*PM peak hour of adjacent street traffic.

### Trip Distribution

The site generated trips are assigned to the roadway network based on existing counts and the external trip distribution assumptions. Since the site access is through the Eastonville Rd/Motley Rd intersection site trips are assigned predominately to/from Eastonville Road with a smaller percentage to/from the west, which serves adjacent residential area. As a north/south minor arterial roadway Eastonville Road is anticipated to accommodate 95% of the total site trips, with 50% to/from the south, and 45% to/from the north. Motley Road is anticipated to accommodate 5% of the site generated trips. Figure 3 and Figure 5 shows the percentage of trips that will be traveling along the roadway network.

## 2019 Short Range Traffic Analysis

### Roadway Improvements

The proposed roadway improvements include the addition of a westbound approach with one entering lane and two exiting lane (one shared left/thru lane and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane, Right
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

### Total Traffic

The existing traffic plus the background growth is added to the proposed 2019 developed traffic volumes to establish 2019 total traffic. Figure 4 shows the 2019 total volumes for both the AM and PM peak periods.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the short range future traffic volumes, the intersection serving the development was analyzed using Synchro 9 software. Table 4 presents the results by time period. Appendix C contains the 2019 total traffic analysis output for a side street stop control condition.

**Table 4 – 2019 Total Traffic Level of Service**

Intersection	Control	AM LOS	PM LOS
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Thru/Right	Stop	B	B
-Westbound Left/Thru	Stop	C	B
-Westbound Right	Stop	B	A
-Northbound Left	Free	A	A
-Northbound Thru/Right	Free	A	A
-Southbound Left	Free	A	A
-Southbound Thru/Right	Free	A	A

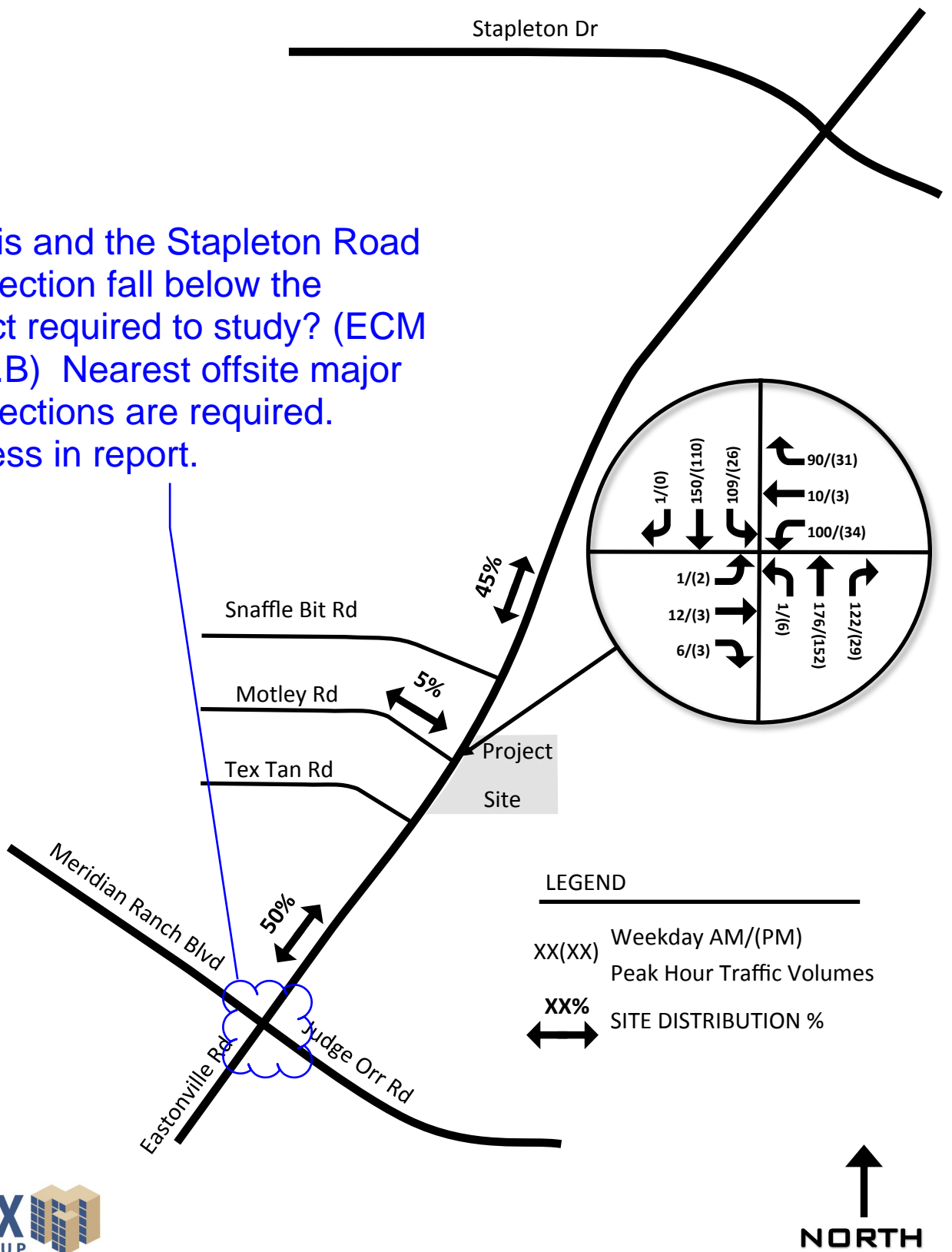
As presented in Table 4, with short range improvements, the overall intersection is expected to perform well and meet established performance standards at 2019 short range condition.

The intersection of Eastonville Rd/Motley Rd intersection is side street stop controlled.

Address the effects of school peak hours and schedules in relation to the background peak hours. Address anticipated queuing and how the site design accommodates queuing. Reference the web site:

<https://connect.ncdot.gov/municipalities/School/pages/default.aspx>  
(Municipal School Transportation Assistance (MSTA) in conjunction with North Carolina DOT, which contains tools that may be utilized.

Do this and the Stapleton Road intersection fall below the impact required to study? (ECM B.2.3.B) Nearest offsite major intersections are required. Address in report.



## 2040 Long Range Traffic Analysis

### Roadway Improvements

The proposed roadway improvements include the addition of a westbound approach with one entering lane and two exiting lane (one shared left/thru lane, and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane, Right
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

### Total Traffic

The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. The US24 annual growth rate of 1.5% per year is anticipated and is therefore assumed as background for Eastonville Road. The site traffic is added on top of the background volumes to get 2040 total traffic. Figure 5 show the 2040 total traffic volumes for both the AM and PM peak hours.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the future traffic volumes, the intersection serving the development is analyzed using Synchro 9 software. The results are presented as Levels of Service.

In the 2040 long range condition, the Eastonville Rd/Motley Rd intersection is expected to perform well and meet performance standard at build-out. The intersection of Eastonville Rd/ Motley Rd intersection is proposed as all-way stop control.

**Table 5 – 2040 Total Traffic TWSC Level of Service**

Intersection	Control	AM LOS	PM LOS
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Thru/Right	Stop	C	B
-Westbound Left/Thru	Stop	F	B
-Westbound Right	Stop	B	A
-Northbound Left	Free	A	A
-Northbound Thru/Right	Free	A	A
-Southbound Left	Free	A	A
-Southbound Thru/Right	Free	A	A

The intersection is analyzed as a two way stop condition on the eastbound and westbound approaches. As presented in Table 5, all the Eastonville Rd/Motley Rd intersection impeded approach movements operates at LOS C or better with the exception of the westbound shared left/thru lane which is expected to experience delays that exceeds the preferred operational threshold of LOS D.

## Mitigation Improvements

A couple improvements that can be considered to mitigate the delay include, 1) changing the intersection control from two-way stop to all-way stop or 2) changing the intersection to roundabout control.

Address potential modification of school schedule/phased start and end times.

### All Way Stop Control

One way to improve operation at the of Eastonville Rd/Motely Rd intersection is to change of traffic control from a two way stop control (TWSC) to an all way stop control (AWSC). This can be accomplished without further ROW or major improvements to the roadway.

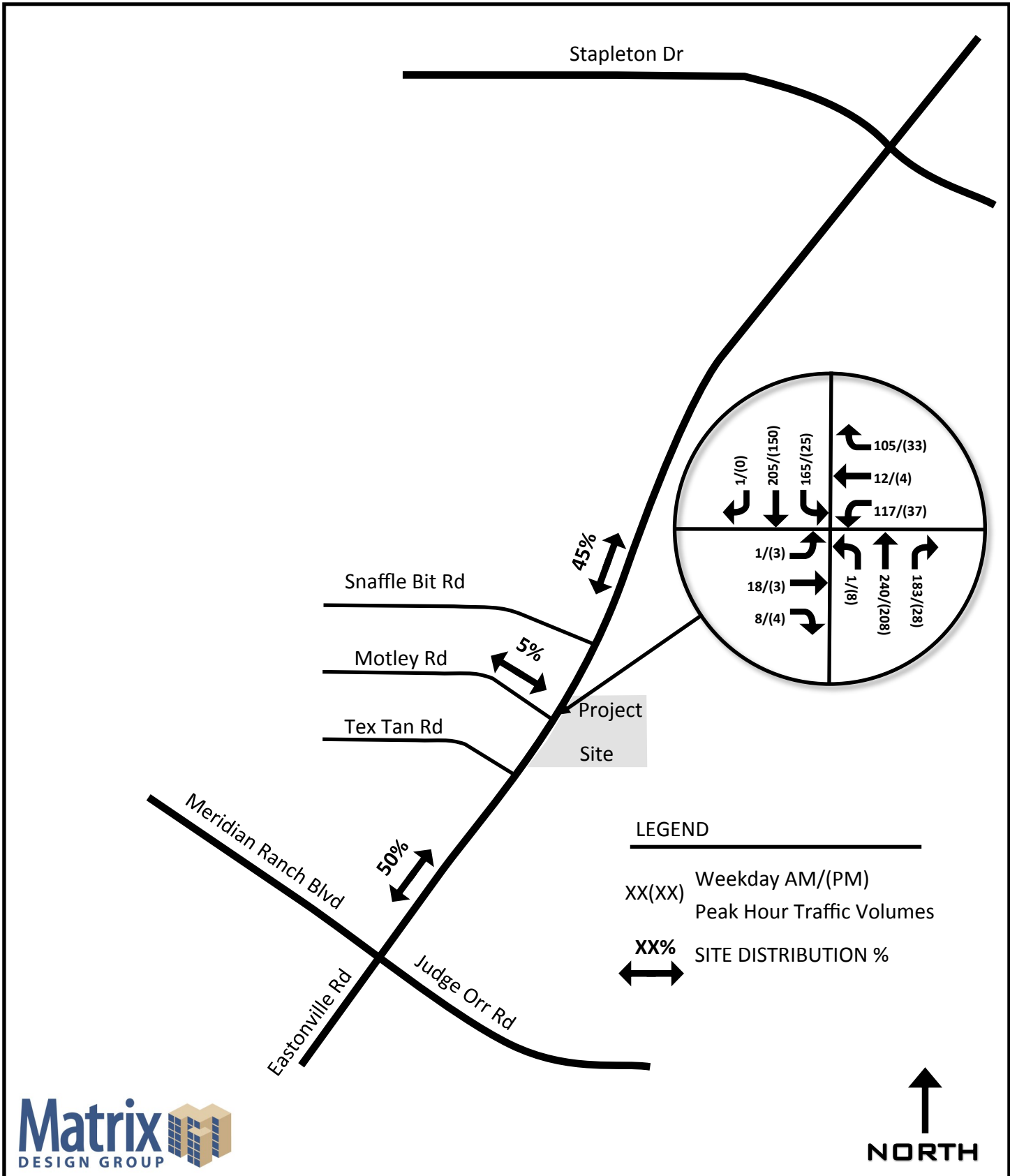
**Table 6 – 2040 Total Traffic AWSC Level of Service**

Intersection	Control	AM LOS	PM LOS
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Thru/Right	Stop	B	A
-Westbound Left/Thru	Stop	B	A
-Westbound Right	Stop	B	A
-Northbound Left	Stop	B	A
-Northbound Thru/Right	Stop	C	B
-Southbound Left	Stop	B	A
-Southbound Thru/Right	Stop	B	A

As presented in Table 6, an AWCS at the Eastonville Rd/Motley Rd intersection is expected to perform well with an overall LOS C or better in the 2040 total traffic condition. This mitigation measure alleviates the AM peak hour delay experienced by the site traffic. Another benefit is this allows a safe path for pedestrians to cross Eastonville Rd. A disadvantage to this option is the increase in delay to Eastonville Road corridor.

### Roundabout

Another mitigation option is changing the intersection to a roundabout. This alternative improves overall intersection delay, however has some challenges in implementation. These challenges include 1) less pedestrian friendly due to the free flow traffic condition, 2) Increase ROW need, and 3) increase construction costs associated with removal and replacement of a portion of the existing intersection.



## Findings and Recommendations

Based on the traffic operational analysis, the following finding and recommendations are presented.

- For the purpose of the TIS the Liberty Tree Academy development is anticipated to take place in two phases. Phase 1 will accommodate 486 K-8 students with build-out in 2019. Phase 2 will accommodate 750 K-12 students with build-out in 2040.
- At 2040 build-out, the project is expected to generate 600 trips in the AM peak hour, 128 trips in the PM peak hour, and 1,860 trips ADT.
- It is anticipated that the proposed development will make the following improvements to the Eastonville Rd/Motley Rd intersection at Phase 1 build-out in 2019:
  - Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Eastbound – Shared Right/Thru/Left Turn Lane, stop controlled
  - Westbound – Shared Thru/Left Turn Lane, Right Turn Lane stop controlled
  - Two Way Stop Control
- With the Eastonville Rd/Motley Rd intersection improvements in 2019 Short Range total traffic condition, the intersection impeding movements are expected to operate at LOS C or better which meets performance standards.
- In the 2040 Long Term total traffic condition with side street stop control the Eastonville Rd/Motley Rd intersection impeded approach movements operates at LOS C or better with the exception of the westbound shared left/thru lane. The delay is experienced by the site exiting traffic. In studying all-way stop intersection control this delay is improved, but overall corridor delay is increased. Roundabout mitigation also improves overall intersection operation but introduces pedestrian safety concerns, additional ROW and additional cost.

### Conclusion

Address proposed pedestrian improvements and all applicable items in ECM B.2.3.B and B.2.4.B.

The Traffic Impact Study results indicate in the 2019 Short Range condition with the Liberty Tree Academy K-8 traffic and intersection improvements the Eastonville Rd/Moltley Rd intersection operates well. In the 2040 Long Range condition with the Liberty Tree Academy K-12 traffic the Eastonville Rd/Moltley Rd intersection operates well with the exception of the site exiting traffic. Due to introducing delay to the Eastonville Rd corridor associated with all-way stop control and the impacts of a roundabout these mitigation options should be studied in greater detail. In the near term the project, as proposed, does not adversely impact the existing and proposed intersection operation or roadway corridor.



**Appendix A:  
Existing Traffic Counts**

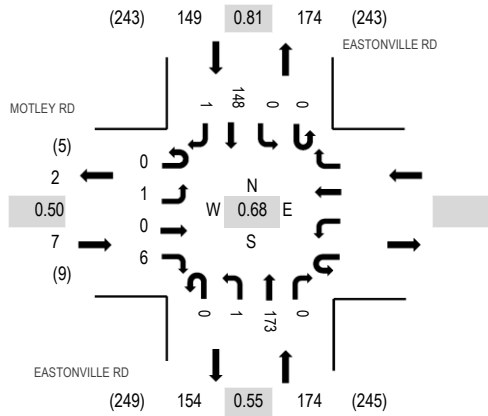
Also include for Eastonville at Stapleton and Judge Orr.



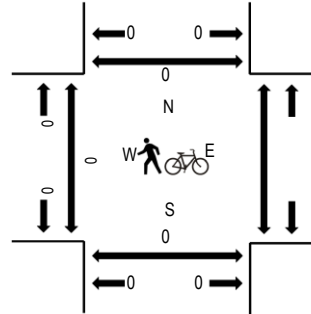
(303) 216-2439  
www.alltrafficdata.net

Location: 1 EASTONVILLE RD & MOTLEY RD AM  
Date and Start Time: Wednesday, April 11, 2018  
Peak Hour: 07:00 AM - 08:00 AM  
Peak 15-Minutes: 07:00 AM - 07:15 AM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

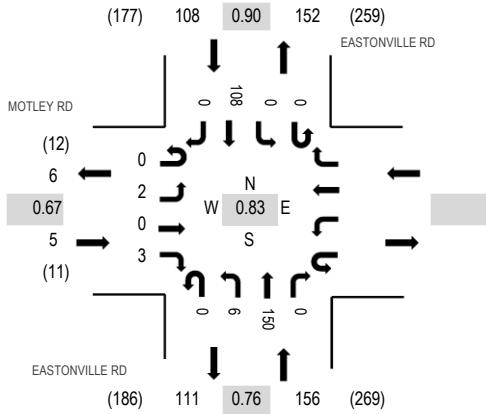
Interval Start Time	MOTLEY RD Eastbound				Westbound				EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings				
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North	
7:00 AM	0	0	0	0	0	0	0	0	0	0	79	0	0	0	0	42	0	121	330	0	0	0	0
7:15 AM	0	0	0	2	0	0	0	0	0	0	68	0	0	0	0	45	1	116	249	0	0	0	0
7:30 AM	0	0	0	4	0	0	0	0	0	1	13	0	0	0	0	38	0	56	205	0	0	0	0
7:45 AM	0	1	0	0	0	0	0	0	0	0	13	0	0	0	0	23	0	37	177	0	0	0	0
8:00 AM	0	0	0	1	0	0	0	0	0	1	10	0	0	0	0	27	1	40	167	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	1	33	0	0	0	0	38	0	72		0	0	0	0
8:30 AM	0	0	0	1	0	0	0	0	0	0	13	0	0	0	0	14	0	28		0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	14	0	27		0	0	0	0
Count Total	0	1	0	8	0	0	0	0	0	3	242	0	0	0	0	241	2	497		0	0	0	0
Peak Hour	0	1	0	6	0	0	0	0	0	1	173	0	0	0	0	148	1	330		0	0	0	0



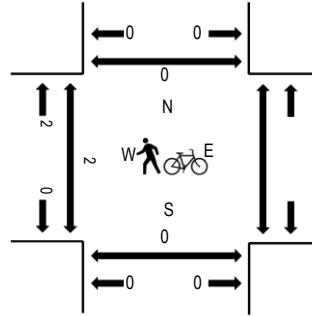
(303) 216-2439  
www.alltrafficdata.net

Location: 1 EASTONVILLE RD & MOTLEY RD PM  
Date and Start Time: Wednesday, April 11, 2018  
Peak Hour: 04:45 PM - 05:45 PM  
Peak 15-Minutes: 05:30 PM - 05:45 PM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	MOTLEY RD Eastbound				Westbound			EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South
4:00 PM	0	0	0	1					0	1	18	0	0	0	17	0	37	204	0	0	0
4:15 PM	0	0	0	3					0	0	31	0	0	0	11	0	45	232	0	0	0
4:30 PM	0	0	0	1					0	5	27	0	0	0	21	0	54	242	0	0	0
4:45 PM	0	0	0	2					0	1	37	0	0	0	28	0	68	269	0	0	0
5:00 PM	0	1	0	1					0	2	31	0	0	0	30	0	65	253	2	0	0
5:15 PM	0	1	0	0					0	3	31	0	0	0	20	0	55		0	0	0
5:30 PM	0	0	0	0					0	0	51	0	0	0	30	0	81		0	0	0
5:45 PM	0	0	0	1					0	0	31	0	0	0	20	0	52		0	0	0
Count Total	0	2	0	9					0	12	257	0	0	0	177	0	457		2	0	0
Peak Hour	0	2	0	3					0	6	150	0	0	0	108	0	269		2	0	0

**Appendix B:  
2018 Level of Service Output  
Existing Traffic**

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↑	
Traffic Vol, veh/h	1	6	1	173	148	1
Future Vol, veh/h	1	6	1	173	148	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	55	55	81	81
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	12	2	315	183	1

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	501	183	184	0	-	0
Stage 1	183	-	-	-	-	-
Stage 2	318	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	530	859	1391	-	-	-
Stage 1	848	-	-	-	-	-
Stage 2	738	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	529	859	1391	-	-	-
Mov Cap-2 Maneuver	529	-	-	-	-	-
Stage 1	848	-	-	-	-	-
Stage 2	737	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.6	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1391	-	789	-	-
HCM Lane V/C Ratio	0.001	-	0.018	-	-
HCM Control Delay (s)	7.6	-	9.6	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↑	
Traffic Vol, veh/h	2	3	6	150	108	0
Future Vol, veh/h	2	3	6	150	108	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	67	67	76	76	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	4	8	197	120	0

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	333	120	120	0	-	0
Stage 1	120	-	-	-	-	-
Stage 2	213	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	662	931	1468	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	823	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	658	931	1468	-	-	-
Mov Cap-2 Maneuver	658	-	-	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	819	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.6	0.3	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1468	-	798	-	-
HCM Lane V/C Ratio	0.005	-	0.009	-	-
HCM Control Delay (s)	7.5	-	9.6	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

**Appendix C:**  
**2019 Level of Service Output**  
**Total Traffic**

Intersection												
Int Delay, s/veh	5.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔	↔	↔		↔	↔	
Traffic Vol, veh/h	1	12	6	100	10	90	1	176	122	109	150	1
Future Vol, veh/h	1	12	6	100	10	90	1	176	122	109	150	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	50	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	13	12	109	11	98	1	191	133	118	163	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	666	727	164	673	661	258	164	0	0	324	0	0
Stage 1	401	401	-	260	260	-	-	-	-	-	-	-
Stage 2	265	326	-	413	401	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	373	351	881	369	383	781	1414	-	-	1236	-	-
Stage 1	626	601	-	745	693	-	-	-	-	-	-	-
Stage 2	740	648	-	616	601	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	295	317	881	327	346	781	1414	-	-	1236	-	-
Mov Cap-2 Maneuver	295	317	-	327	346	-	-	-	-	-	-	-
Stage 1	626	544	-	744	693	-	-	-	-	-	-	-
Stage 2	637	648	-	536	544	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.6	16.8	0	3.4
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1414	-	-	447	329	781	1236	-	-
HCM Lane V/C Ratio	0.001	-	-	0.058	0.363	0.125	0.096	-	-
HCM Control Delay (s)	7.5	-	-	13.6	22.1	10.3	8.2	-	-
HCM Lane LOS	A	-	-	B	C	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.2	1.6	0.4	0.3	-	-



Intersection												
Int Delay, s/veh	2.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	2	3	3	34	3	31	6	152	29	26	110	0
Future Vol, veh/h	2	3	3	34	3	31	6	152	29	26	110	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	50	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	3	6	37	3	34	7	165	32	28	120	0

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	372	386	120	375	370	181	120	0	0	197	0	0
Stage 1	176	176	-	194	194	-	-	-	-	-	-	-
Stage 2	196	210	-	181	176	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	585	548	931	582	560	862	1468	-	-	1376	-	-
Stage 1	826	753	-	808	740	-	-	-	-	-	-	-
Stage 2	806	728	-	821	753	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	549	534	931	565	546	862	1468	-	-	1376	-	-
Mov Cap-2 Maneuver	549	534	-	565	546	-	-	-	-	-	-	-
Stage 1	822	738	-	804	736	-	-	-	-	-	-	-
Stage 2	767	725	-	796	738	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB		
HCM Control Delay, s	10.3		10.7		0.2		1.5		
HCM LOS	B		B						

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1468	-	-	693	563	862	1376
HCM Lane V/C Ratio	0.004	-	-	0.017	0.071	0.039	0.021
HCM Control Delay (s)	7.5	-	-	10.3	11.9	9.3	7.7
HCM Lane LOS	A	-	-	B	B	A	A
HCM 95th %tile Q(veh)	0	-	-	0.1	0.2	0.1	0.1

**Appendix D:**  
**2040 Level of Service Output**  
**Total Traffic TWSC**

Intersection												
Int Delay, s/veh	11											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	1	18	8	117	12	105	1	240	183	165	205	1
Future Vol, veh/h	1	18	8	117	12	105	1	240	183	165	205	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	50	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	20	16	127	13	114	1	261	199	179	223	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	951	1044	223	963	946	360	224	0	0	460	0	0
Stage 1	582	582	-	363	363	-	-	-	-	-	-	-
Stage 2	369	462	-	600	583	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	240	229	817	235	262	684	1345	-	-	1101	-	-
Stage 1	499	499	-	656	625	-	-	-	-	-	-	-
Stage 2	651	565	-	488	499	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	167	192	817	186	219	684	1345	-	-	1101	-	-
Mov Cap-2 Maneuver	167	192	-	186	219	-	-	-	-	-	-	-
Stage 1	499	418	-	656	625	-	-	-	-	-	-	-
Stage 2	531	565	-	382	418	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.4	40.7	0	4
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1345	-	-	286	189	684	1101
HCM Lane V/C Ratio	0.001	-	-	0.128	0.742	0.167	0.163
HCM Control Delay (s)	7.7	-	-	19.4	64.6	11.3	8.9
HCM Lane LOS	A	-	-	C	F	B	A
HCM 95th %tile Q(veh)	0	-	-	0.4	4.8	0.6	0.6

Intersection												
Int Delay, s/veh	2.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	3	3	4	37	4	33	8	208	28	25	150	0
Future Vol, veh/h	3	3	4	37	4	33	8	208	28	25	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	50	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	3	8	40	4	36	9	226	30	27	163	0

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	478	491	163	482	476	241	163	0	0	257	0	0
Stage 1	217	217	-	259	259	-	-	-	-	-	-	-
Stage 2	261	274	-	223	217	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	498	478	882	495	488	798	1416	-	-	1308	-	-
Stage 1	785	723	-	746	694	-	-	-	-	-	-	-
Stage 2	744	683	-	780	723	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	463	465	882	478	475	798	1416	-	-	1308	-	-
Mov Cap-2 Maneuver	463	465	-	478	475	-	-	-	-	-	-	-
Stage 1	780	708	-	741	690	-	-	-	-	-	-	-
Stage 2	702	679	-	753	708	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	10.9		11.7		0.2		1.1	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1416	-	-	628	478	798	1308	-	-
HCM Lane V/C Ratio	0.006	-	-	0.023	0.093	0.045	0.021	-	-
HCM Control Delay (s)	7.6	-	-	10.9	13.3	9.7	7.8	-	-
HCM Lane LOS	A	-	-	B	B	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.3	0.1	0.1	-	-

**Appendix E:**  
**2040 Level of Service Output**  
**Total Traffic AWSC**

Intersection	
Intersection Delay, s/veh	16.7
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	1	18	8	117	12	105	1	240	183	165	205	1
Future Vol, veh/h	1	18	8	117	12	105	1	240	183	165	205	1
Peak Hour Factor	0.92	0.92	0.50	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	20	16	127	13	114	1	261	199	179	223	1
Number of Lanes	0	1	0	0	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	1
HCM Control Delay	11	11.9	23.3	12.6
HCM LOS	B	B	C	B

Lane	NBLn1	NBLn2	EBLn1	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	100%	0%	4%	91%	0%	100%	0%
Vol Thru, %	0%	57%	67%	9%	0%	0%	100%
Vol Right, %	0%	43%	30%	0%	100%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	1	423	27	129	105	165	206
LT Vol	1	0	1	117	0	165	0
Through Vol	0	240	18	12	0	0	205
RT Vol	0	183	8	0	105	0	1
Lane Flow Rate	1	460	37	140	114	179	224
Geometry Grp	7	7	6	7	7	7	7
Degree of Util (X)	0.002	0.739	0.075	0.287	0.196	0.331	0.381
Departure Headway (Hd)	6.604	5.789	7.339	7.371	6.196	6.639	6.127
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	541	621	485	487	576	540	584
Service Time	4.36	3.545	5.435	5.138	3.963	4.4	3.888
HCM Lane V/C Ratio	0.002	0.741	0.076	0.287	0.198	0.331	0.384
HCM Control Delay	9.4	23.3	11	13.1	10.5	12.7	12.6
HCM Lane LOS	A	C	B	B	B	B	B
HCM 95th-tile Q	0	6.4	0.2	1.2	0.7	1.4	1.8

Intersection	
Intersection Delay, s/veh	9.5
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	3	3	4	37	4	33	8	208	28	25	150	0
Future Vol, veh/h	3	3	4	37	4	33	8	208	28	25	150	0
Peak Hour Factor	0.92	0.92	0.50	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	3	8	40	4	36	9	226	30	27	163	0
Number of Lanes	0	1	0	0	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	1
HCM Control Delay	8.8	8.7	10.1	9.1
HCM LOS	A	A	B	A

Lane	NBLn1	NBLn2	EBLn1	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	100%	0%	30%	90%	0%	100%	0%
Vol Thru, %	0%	88%	30%	10%	0%	0%	100%
Vol Right, %	0%	12%	40%	0%	100%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	8	236	10	41	33	25	150
LT Vol	8	0	3	37	0	25	0
Through Vol	0	208	3	4	0	0	150
RT Vol	0	28	4	0	33	0	0
Lane Flow Rate	9	257	15	45	36	27	163
Geometry Grp	7	7	6	7	7	7	7
Degree of Util (X)	0.013	0.348	0.023	0.076	0.049	0.042	0.227
Departure Headway (Hd)	5.466	4.881	5.581	6.104	4.945	5.521	5.019
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	655	736	640	587	723	649	716
Service Time	3.194	2.608	3.628	3.843	2.684	3.25	2.748
HCM Lane V/C Ratio	0.014	0.349	0.023	0.077	0.05	0.042	0.228
HCM Control Delay	8.3	10.2	8.8	9.3	7.9	8.5	9.2
HCM Lane LOS	A	B	A	A	A	A	A
HCM 95th-tile Q	0	1.6	0.1	0.2	0.2	0.1	0.9

# Markup Summary

dsdrice (8)



**Subject:** Cloud+  
**Page Label:** 12  
**Author:** dsdrice  
**Date:** 6/14/2018 1:04:58 PM  
**Color:** ■

Do this and the Stapleton Road intersection fall below the impact required to study? (ECM B.2.3.B)  
Nearest offsite major intersections are required.  
Address in report.

Also include for Eastonville at Stapleton and Judge Orr.

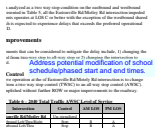
**Subject:** Text Box  
**Page Label:** 17  
**Author:** dsdrice  
**Date:** 6/14/2018 1:08:35 PM  
**Color:** ■

Also include for Eastonville at Stapleton and Judge Orr.



**Subject:** Text Box  
**Page Label:** 11  
**Author:** dsdrice  
**Date:** 6/14/2018 2:18:21 PM  
**Color:** ■

Address the effects of school peak hours and schedules in relation to the background peak hours. Address anticipated queuing and how the site design accommodates queuing. Reference the web site:  
<https://connect.ncdot.gov/municipalities/School/pages/default.aspx> (Municipal School Transportation Assistance (MSTA) in conjunction with North Carolina DOT, which contains tools that may be utilized.



**Subject:** Text Box  
**Page Label:** 14  
**Author:** dsdrice  
**Date:** 6/14/2018 2:19:45 PM  
**Color:** ■

Address potential modification of school schedule/phased start and end times.



**Subject:** Text Box  
**Page Label:** 16  
**Author:** dsdrice  
**Date:** 6/14/2018 2:22:11 PM  
**Color:** ■

Provide the Countywide road fee calculation.

Address what the school feels are equitable improvements or contributions.



**Subject:** Text Box  
**Page Label:** 7  
**Author:** dsdrice  
**Date:** 6/14/2018 2:23:07 PM  
**Color:** ■

Address condition of roadways and paving.



**Subject:** Text Box  
**Page Label:** 16  
**Author:** dsdrice  
**Date:** 6/14/2018 2:26:07 PM  
**Color:** ■

Address proposed pedestrian improvements and all applicable items in ECM B.2.3.B and B.2.4.B.

May 4, 2018

PPR-18-023

**Subject:** Text Box  
**Page Label:** 1  
**Author:** dsdrice  
**Date:** 6/14/2018 2:47:52 PM  
**Color:** ■

PPR-18-023