



Traffic Assessment

To: Dr. Paul Wolfe
The Cambridge School of Dallas

From: Christy Lambeth, P.E., PTOE
Lambeth Engineering Associates, PLLC, F-19508

Date: June 6, 2019

Re: Traffic Assessment for The Cambridge School of Dallas's Planned Location on Royal Lane in Dallas, Texas (City of Dallas # Z189-213(SM); Lambeth #007DAL)

Introduction

The services of Lambeth Engineering Associates, PLLC (Lambeth) were retained to conduct a traffic assessment for the Cambridge School of Dallas (Cambridge) new location southeast of the Royal Lane/Webb Chapel Road intersection at 3202 Royal Lane in Dallas, Texas.

Upon revising the site plan to include only one driveway for students and parents to utilize, the City of Dallas requested analysis of the Royal Lane driveway. This is not a comprehensive TIA, but addresses the level-of-service (LOS), queue and delays at the driveway.

Traffic Volumes

Existing Traffic Volumes

Existing traffic volumes were collected on Royal Lane (east of Webb Chapel) on Wednesday, February 20, 2019. Detailed traffic volume data is provided in the **Appendix**.

Background Traffic Volumes

The existing Royal Lane traffic volumes are actually less than 2001 historical volumes shown on the NCTCOG traffic volumes web page (provided by City of Dallas). However, in order to be conservative, a 0.5% annual growth factor was applied. For the purposes of this assessment, it is assumed that the school will be built out in year 2026; therefore, the growth rate was applied for seven (7) years to determine background volumes.

Projected Site-Generated Traffic Volumes

The Institute of Traffic Engineers (ITE) *Trip Generation Manual, 10th Edition*, is a collection of traffic data for specified uses. The manual provides data collected over several years for a wide variety of uses and is used for the purpose of calculating projected traffic volumes that a proposed development will generate. The traffic volumes are summarized in terms of "trips" to and from the development. For example, a motorist leaving home to go to work and then returning home will generate two "trips" – one outbound trip during the morning and one inbound trip during the afternoon. The *Trip Generation Manual* is used to project traffic volumes for new developments.

The projected traffic for the 240-student private school/residential lots is summarized in **Table 1**. There may be additional vehicles leaving/entering the site during the morning and afternoon periods; however, this activity is expected to occur outside of the typical “peak hours”.

For purposes of this study, the AM peak hour refers to the morning drop-off period from about 7:15 – 8:15 and the PM peak hour is the afternoon dismissal period from about 2:45 – 3:45.

Table 1. Projected Traffic Volume Summary

ITE #	Use	Quantity	Weekday	AM Peak Hour			PM Peak Hour		
				Total	In	Out	Total	In	Out
536	Private School K-12 - Generator	240 Students	595	205	125	80	183	77	106

The site-generated traffic was distributed to the study area based upon student ZIP codes and also taking into consideration parents proceeding to work after dropping off students. The resulting site-related traffic volumes are shown in **Exhibit 1**.

Background-plus-Site Traffic Volumes

The projected site-generated traffic volumes were added to the background traffic volumes to determine the projected background-plus-site traffic volumes shown in **Exhibit 1**.

Intersection Analysis

Intersection capacity analysis was conducted for the study intersection following the guidelines contained in the *Highway Capacity Manual, 6th Edition* using Synchro 10. Intersections are assigned a “level of service” (LOS) letter grade for the peak hour of traffic based upon the number of lanes at the intersection, traffic volumes, and traffic control. Level of Service A (LOS A) represents light traffic flow (free-flowing conditions) while LOS F represents heavy traffic flow (over-capacity conditions). Detailed LOS criteria and Synchro reports are provided in the **Appendix**.

The Cambridge driveway/Royal Lane intersection was analyzed considering the background-plus-site traffic volumes to determine the ability of school-related traffic to maneuver to/from Royal Lane. A new westbound, left-turn pocket enabling left-turning vehicles to enter the site without hindering the flow of westbound through vehicles was taken into consideration. The LOS results considering the following options are shown in **Table 1**.

- A. Vehicles permitted to turn either right or left when leaving or entering the site. STOP-controlled for northbound traffic leaving the school’s driveway and turning onto Royal Lane.
- B. Vehicles permitted to turn either right or left entering the site and permitted to only turn right when leaving the site. Prohibit left turns leaving the site by configuring the median opening to allow left turns into the site, but not out of the site. Outbound vehicles leaving site controlled with a STOP sign.

Table 1. Intersection Level-of-Service Summary

	Approach	Option A. Entering: Left and Right Turns Exiting: Left and Right Turns STOP Sign at Driveway						Option B. Entering: Left and Right Turns Exiting: Right Turns Only STOP Sign at Driveway					
		AM			PM			AM			PM		
		LOS	Delay (Sec)	Queue (95th % Vehicles)	LOS	Delay (Sec)	Queue (95th % Vehicles)	LOS	Delay (Sec)	Queue (95th % Vehicles)	LOS	Delay (Sec)	Queue (95th % Vehicles)
Royal Lane at Cambridge Driveway	NBL	F	(149.4)	2.2	F	(86.6)	3.2	--	--	--	--	--	--
	NBR	B	(14.4)	0.9	B	(13.9)	1.1	C	(15.2)	1.2	C	(15.7)	1.9
	WBL	B	(12.0)	0.8	B	(10.6)	0.5	B	(12.0)	0.8	B	(10.6)	0.5

- a) A, B, C, D, E, or F represents the level of service for the turning movement.
- b) The number in parenthesis is the average vehicle delay (in seconds) for the respective turning movement.
- c) NB, WB = Northbound, or westbound; L, T, R = Left, through or right

Summary

The Cambridge School of Dallas site plan provides one driveway for students and parents to enter/exit the site. A traffic analysis was conducted to evaluate this driveway during the AM arrival and PM dismissal periods. It was determined that, without restricting left-turns out of the site, there will be long delays for exiting, left-turning leaving vehicles resulting in an undesirable LOS. The site plan has queue space for only two left-turning vehicles leaving the site. With all parents and students entering/leaving turning right/left via the one access point on Royal Lane, the unsignalized intersection is projected to have a queue of three vehicles turning left, which would block the flow of right-turning vehicles exiting the site.

To improve traffic flow and safety for motorists leaving the site, it is recommended to restrict exiting movements to right-turn-only. The median opening should be configured to allow left turns into the site, but not out of the site.

The queue lengths obtained from Synchro show one westbound, left-turning vehicle queued at the Cambridge driveway. Therefore, a storage length of 50-100' will accommodate the westbound, left-turning vehicles exiting Cambridge. In addition to the left-turn pocket storage, a motorist can make his/her way into the median opening, preparing to turn left into the site.

With prohibiting left-turns from the site, motorists that desire to proceed westbound onto Royal Lane will likely make a U-turn after exiting. There is not a left-turn pocket at the Earlsire Drive median opening; therefore, it is recommended that motorists proceed to the Marquis Lane/Beauty Lane median opening to make a U-turn. Analysis estimates indicate that vehicles will have an average delay of about 20 seconds to make a U-turn and expect a queue of one vehicle. The additional U-turn movements added to the intersection will increase the delay for the vehicles turning onto Royal Lane from Marquis Lane/Beauty Lane by approximately 20-30 and 10-13 seconds in the morning and afternoon school peak periods, respectively. This increased delay will last only about 30 minutes in both the morning and afternoon periods.

The Cambridge School of Dallas is not expected to impact the overall roadway network.

END

Appendix

Royal Lane East of Webb Chapel Road, Between Median Opening and Alley

Start Date: 2/20/2019
 Start Time: 12:00:00 AM
 Site Code: 927

Collected by: John L, Gram
 Ordered by: Christy Lambeth

15 Min Start Time	Eastbound		Westbound	
	15 Min Total	Hourly Total	15 Min Total	Hourly Total
12:00 AM	11		12	
12:15 AM	3		3	
12:30 AM	2		7	
12:45 AM	6	22	6	28
01:00 AM	3	14	4	20
01:15 AM	0	11	3	20
01:30 AM	1	10	3	16
01:45 AM	4	8	4	14
02:00 AM	6	11	2	12
02:15 AM	5	16	3	12
02:30 AM	2	17	4	13
02:45 AM	3	16	2	11
03:00 AM	4	14	3	12
03:15 AM	5	14	3	12
03:30 AM	2	14	5	13
03:45 AM	3	14	7	18
04:00 AM	4	14	8	23
04:15 AM	8	17	8	28
04:30 AM	5	20	2	25
04:45 AM	6	23	16	34
05:00 AM	12	31	15	41
05:15 AM	16	39	13	46
05:30 AM	22	56	30	74
05:45 AM	33	83	57	115
06:00 AM	28	99	60	160
06:15 AM	52	135	86	233
06:30 AM	46	159	113	316
06:45 AM	82	208	118	377
07:00 AM	96	276	129	446
07:15 AM	162	386	160	520
07:30 AM	214	554	222	629
07:45 AM	220	692	266	777
08:00 AM	206	802	195	843
08:15 AM	208	848	188	871
08:30 AM	206	840	176	825
08:45 AM	203	823	174	733
09:00 AM	157	774	158	696
09:15 AM	133	699	118	626
09:30 AM	142	635	105	555
09:45 AM	108	540	85	466
10:00 AM	110	493	87	395
10:15 AM	110	470	98	375
10:30 AM	112	440	80	350
10:45 AM	93	425	94	359
11:00 AM	94	409	88	360
11:15 AM	97	396	104	366
11:30 AM	102	386	92	378
11:45 AM	116	409	122	406

15 Min Start Time	Eastbound		Westbound	
	15 Min Total	Hourly Total	15 Min Total	Hourly Total
12:00 PM	112	427	122	440
12:15 PM	105	435	109	445
12:30 PM	114	447	118	471
12:45 PM	118	449	128	477
01:00 PM	120	457	110	465
01:15 PM	118	470	132	488
01:30 PM	127	483	100	470
01:45 PM	108	473	115	457
02:00 PM	134	487	121	468
02:15 PM	122	491	120	456
02:30 PM	146	510	112	468
02:45 PM	158	560	146	499
03:00 PM	174	600	150	528
03:15 PM	180	658	161	569
03:30 PM	210	722	116	573
03:45 PM	210	774	175	602
04:00 PM	218	818	172	624
04:15 PM	282	920	194	657
04:30 PM	295	1,005	188	729
04:45 PM	332	1,127	204	758
05:00 PM	311	1,220	180	766
05:15 PM	354	1,292	194	766
05:30 PM	364	1,361	205	783
05:45 PM	314	1,343	173	752
06:00 PM	238	1,270	174	746
06:15 PM	232	1,148	116	668
06:30 PM	210	994	124	587
06:45 PM	124	804	109	523
07:00 PM	122	688	102	451
07:15 PM	76	532	63	398
07:30 PM	67	389	66	340
07:45 PM	75	340	63	294
08:00 PM	55	273	52	244
08:15 PM	52	249	54	235
08:30 PM	55	237	46	215
08:45 PM	42	204	40	192
09:00 PM	52	201	39	179
09:15 PM	34	183	34	159
09:30 PM	47	175	42	155
09:45 PM	20	153	38	153
10:00 PM	28	129	33	147
10:15 PM	32	127	32	145
10:30 PM	27	107	30	133
10:45 PM	24	111	18	113
11:00 PM	15	98	23	103
11:15 PM	12	78	12	83
11:30 PM	15	66	18	71
11:45 PM	6	48	6	59

EB 9,649 WB 8,217

Total: 17,866

2019 Existing Traffic Volumes:

Royal Lane			←	871	(573)
	848	(722)	→		
					Driveway

Site Traffic Distribution:

Royal Lane				↙	65%	(65%)
	35%	(35%)	↘	↙	35%	(35%)
				↘	65%	(65%)
						Driveway

Site Traffic Volumes:

Royal Lane				↙	81	(50)
	44	(27)	↘	↙	28	(37)
				↘	52	(69)
						Driveway

Option A. Background-plus-Site Traffic Volumes:

Royal Lane			←	902	(593)	
	878	(748)	→	↙	81	(50)
	44	(27)	↘	↙	28	(37)
				↘	52	(69)
						Driveway

Option B. Background-plus-Site Traffic Volumes:

Royal Lane			←	902	(593)	
	878	(748)	→	↙	81	(50)
	44	(27)	↘	↘	80	(106)
						Driveway

Intersection Capacity Analyses - Methodology

Intersection capacity analysis was conducted per the *Highway Capacity Manual, 6th Edition*, using *Synchro 10*. Intersections are assigned a “level of service” (LOS) letter grade for the peak hour of traffic based upon the number of lanes at the intersection, traffic volumes, and traffic control. Level of Service A (LOS A) represents light traffic flow (free flow conditions) while LOS F represents heavy traffic flow (over capacity conditions). LOS D is typically considered acceptable in the region. Individual movements are also assigned LOS grades. It is important to note that one or more individual movement typically operates at LOS F when the overall intersection is operating at LOS D.

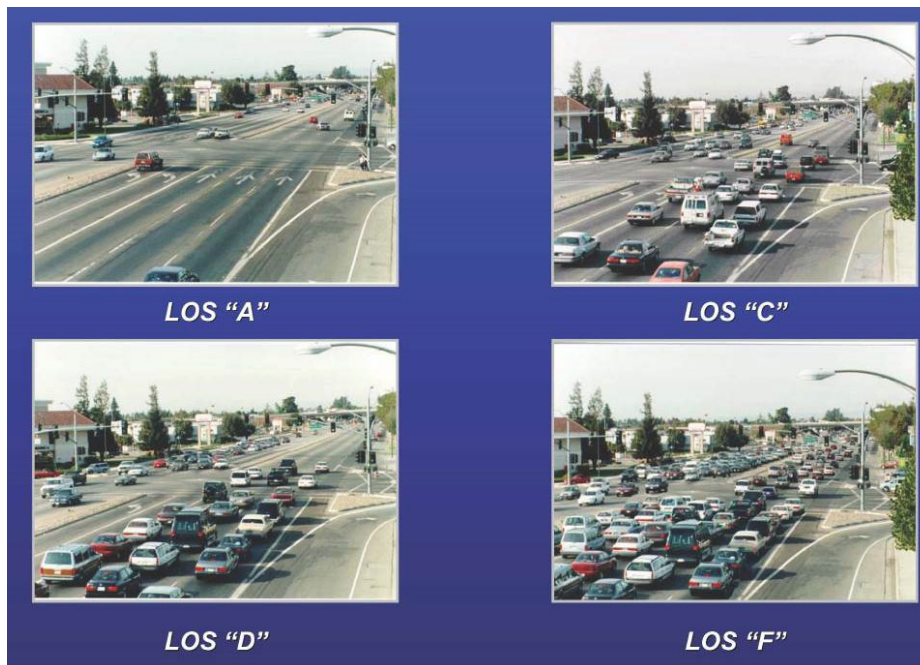
The following table summarizes the LOS criteria for signalized and unsignalized intersections as defined in Exhibit 19-8, Exhibit 20-2 and Exhibit 21-8 of the *Highway Capacity Manual, 6th Edition*.

Intersection LOS Criteria

	Signalized Intersection Average Total Delay (Seconds/ Vehicle)	Unsignalized Intersection Average Total Delay (Seconds/ Vehicle)
LOS A	≤ 10	≤ 10
LOS B	$>10 - \leq 20$	$>10 - \leq 15$
LOS C	$>20 - \leq 35$	$>15 - \leq 25$
LOS D	$>35 - \leq 55$	$>25 - \leq 35$
LOS E	$>55 - \leq 80$	$>35 - \leq 50$
LOS F	>80	>50

Obtained from *Highway Capacity Manual, 6th Edition Exhibits 19-8, 20-2 and 21-8*.

Below is an illustrative comparison of LOS thresholds.



Obtained from phasocal.org/1-22-14-ht-call-revisions-to-level-of-service-under-ceqa-per-sb-743 by Public Health Alliance of Southern California in December 2018.

AM Peak Hour
1: Cambridge Driveway & Royal Lane

Existing plus Full Buildout - Option A
06/05/2019

Intersection						
Int Delay, s/veh	3.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘	↑↑	↘	↘
Traffic Vol, veh/h	878	44	81	902	16	64
Future Vol, veh/h	878	44	81	902	16	64
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	33	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	91	55	55	79	55	55
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	965	80	147	1142	29	116

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1045	0	1870
Stage 1	-	-	-	-	1005
Stage 2	-	-	-	-	865
Critical Hdwy	-	-	4.14	-	6.84
Critical Hdwy Stg 1	-	-	-	-	5.84
Critical Hdwy Stg 2	-	-	-	-	5.84
Follow-up Hdwy	-	-	2.22	-	3.52
Pot Cap-1 Maneuver	-	-	661	-	64
Stage 1	-	-	-	-	315
Stage 2	-	-	-	-	373
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	661	-	50
Mov Cap-2 Maneuver	-	-	-	-	50
Stage 1	-	-	-	-	315
Stage 2	-	-	-	-	290

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	41.4
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	50	499	-	-	661	-
HCM Lane V/C Ratio	0.582	0.233	-	-	0.223	-
HCM Control Delay (s)	149.4	14.4	-	-	12	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	2.2	0.9	-	-	0.8	-

Intersection												
Int Delay, s/veh	3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	7	928	7	7	943	7	20	1	20	20	1	20
Future Vol, veh/h	7	928	7	7	943	7	20	1	20	20	1	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	120	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	79	79	79	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	1020	8	9	1194	9	22	1	22	22	1	22

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1203	0	0	1028	0	0	1656	2261	514	1744	2261	602
Stage 1	-	-	-	-	-	-	1040	1040	-	1217	1217	-
Stage 2	-	-	-	-	-	-	616	1221	-	527	1044	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	576	-	-	671	-	-	64	40	505	55	40	443
Stage 1	-	-	-	-	-	-	246	306	-	192	252	-
Stage 2	-	-	-	-	-	-	445	251	-	502	304	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	576	-	-	671	-	-	58	39	505	50	39	443
Mov Cap-2 Maneuver	-	-	-	-	-	-	58	39	-	50	39	-
Stage 1	-	-	-	-	-	-	243	302	-	189	249	-
Stage 2	-	-	-	-	-	-	416	248	-	472	300	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	0.1	67.2	83.5
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	100	576	-	-	671	-	-	87
HCM Lane V/C Ratio	0.446	0.013	-	-	0.013	-	-	0.512
HCM Control Delay (s)	67.2	11.3	-	-	10.4	-	-	83.5
HCM Lane LOS	F	B	-	-	B	-	-	F
HCM 95th %tile Q(veh)	1.9	0	-	-	0	-	-	2.2

* Traffic volumes estimated, actual counts were not obtained.

PM Peak Hour
1: Cambridge Driveway & Royal Lane

Intersection						
Int Delay, s/veh	4.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘	↑↑	↘	↘
Traffic Vol, veh/h	748	15	62	593	37	85
Future Vol, veh/h	748	15	62	593	37	85
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	33	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	55	55	89	55	55
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	870	27	113	666	67	155

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	897	0	1443 449
Stage 1	-	-	-	-	884 -
Stage 2	-	-	-	-	559 -
Critical Hdwy	-	-	4.14	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	-	-	2.22	-	3.52 3.32
Pot Cap-1 Maneuver	-	-	753	-	123 557
Stage 1	-	-	-	-	364 -
Stage 2	-	-	-	-	536 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	753	-	105 557
Mov Cap-2 Maneuver	-	-	-	-	105 -
Stage 1	-	-	-	-	364 -
Stage 2	-	-	-	-	456 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	35.9
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	105	557	-	-	753	-
HCM Lane V/C Ratio	0.641	0.277	-	-	0.15	-
HCM Control Delay (s)	86.6	13.9	-	-	10.6	-
HCM Lane LOS	F	B	-	-	B	-
HCM 95th %tile Q(veh)	3.2	1.1	-	-	0.5	-

Intersection												
Int Delay, s/veh	1.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	18	796	18	18	631	18	12	1	12	12	1	12
Future Vol, veh/h	18	796	18	18	631	18	12	1	12	12	1	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	86	86	89	89	89	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	926	21	20	709	20	13	1	13	13	1	13

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	729	0	0	947	0	0	1374	1748	474	1265	1748	365
Stage 1	-	-	-	-	-	-	979	979	-	759	759	-
Stage 2	-	-	-	-	-	-	395	769	-	506	989	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	871	-	-	721	-	-	105	85	537	126	85	632
Stage 1	-	-	-	-	-	-	268	326	-	365	413	-
Stage 2	-	-	-	-	-	-	602	409	-	517	323	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	871	-	-	721	-	-	98	81	537	117	81	632
Mov Cap-2 Maneuver	-	-	-	-	-	-	98	81	-	117	81	-
Stage 1	-	-	-	-	-	-	262	318	-	356	401	-
Stage 2	-	-	-	-	-	-	572	398	-	491	315	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	0.3	32.3	27.5
HCM LOS			D	D

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	159	871	-	-	721	-	-	187
HCM Lane V/C Ratio	0.171	0.024	-	-	0.028	-	-	0.145
HCM Control Delay (s)	32.3	9.2	-	-	10.1	-	-	27.5
HCM Lane LOS	D	A	-	-	B	-	-	D
HCM 95th %tile Q(veh)	0.6	0.1	-	-	0.1	-	-	0.5

* Traffic volumes estimated, actual counts were not obtained.

AM Peak Hour
1: Cambridge Driveway & Royal Lane

Intersection						
Int Delay, s/veh	1.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↖	↑↑		↗
Traffic Vol, veh/h	878	44	81	902	0	80
Future Vol, veh/h	878	44	81	902	0	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	33	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	91	55	55	79	55	55
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	965	80	147	1142	0	145

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1045	0	1870
Stage 1	-	-	-	-	1005
Stage 2	-	-	-	-	865
Critical Hdwy	-	-	4.14	-	6.84
Critical Hdwy Stg 1	-	-	-	-	5.84
Critical Hdwy Stg 2	-	-	-	-	5.84
Follow-up Hdwy	-	-	2.22	-	3.52
Pot Cap-1 Maneuver	-	-	661	-	64
Stage 1	-	-	-	-	315
Stage 2	-	-	-	-	373
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	661	-	50
Mov Cap-2 Maneuver	-	-	-	-	50
Stage 1	-	-	-	-	315
Stage 2	-	-	-	-	290

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	15.2
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	499	-	-	661	-
HCM Lane V/C Ratio	-	0.291	-	-	0.223	-
HCM Control Delay (s)	0	15.2	-	-	12	-
HCM Lane LOS	A	C	-	-	B	-
HCM 95th %tile Q(veh)	-	1.2	-	-	0.8	-

Intersection													
Int Delay, s/veh	4.2												
Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↕		↕	↕			↕			↕	
Traffic Vol, veh/h	16	7	928	7	7	943	7	20	1	20	20	1	20
Future Vol, veh/h	16	7	928	7	7	943	7	20	1	20	20	1	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	120	-	-	120	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	55	91	91	91	79	79	79	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	29	8	1020	8	9	1194	9	22	1	22	22	1	22

Major/Minor	Major1			Major2			Minor1			Minor2			
Conflicting Flow All	1203	1203	0	0	1028	0	0	1714	2319	514	1802	2319	602
Stage 1	-	-	-	-	-	-	-	1098	1098	-	1217	1217	-
Stage 2	-	-	-	-	-	-	-	616	1221	-	585	1102	-
Critical Hdwy	6.44	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.52	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	246	576	-	-	671	-	-	58	37	505	50	37	443
Stage 1	-	-	-	-	-	-	-	227	287	-	192	252	-
Stage 2	-	-	-	-	-	-	-	445	251	-	464	286	-
Platoon blocked, %			-	-	-	-	-						
Mov Cap-1 Maneuver	268	268	-	-	671	-	-	48	31	505	41	31	443
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	48	31	-	41	31	-
Stage 1	-	-	-	-	-	-	-	196	247	-	166	249	-
Stage 2	-	-	-	-	-	-	-	416	248	-	381	247	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.7	0.1	88.5	112.4
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	84	268	-	-	671	-	-	73
HCM Lane V/C Ratio	0.531	0.137	-	-	0.013	-	-	0.61
HCM Control Delay (s)	88.5	20.5	-	-	10.4	-	-	112.4
HCM Lane LOS	F	C	-	-	B	-	-	F
HCM 95th %tile Q(veh)	2.3	0.5	-	-	0	-	-	2.7

Increase in delay with U-turns: **21.3** **28.9**

* Traffic volumes estimated, actual counts were not obtained.

PM Peak Hour
1: Cambridge Driveway & Royal Lane

Intersection						
Int Delay, s/veh	2.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↖	↑↑		↗
Traffic Vol, veh/h	748	15	62	593	0	122
Future Vol, veh/h	748	15	62	593	0	122
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	33	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	55	55	89	55	55
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	870	27	113	666	0	222

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	897	0	1443 449
Stage 1	-	-	-	-	884 -
Stage 2	-	-	-	-	559 -
Critical Hdwy	-	-	4.14	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	-	-	2.22	-	3.52 3.32
Pot Cap-1 Maneuver	-	-	753	-	123 557
Stage 1	-	-	-	-	364 -
Stage 2	-	-	-	-	536 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	753	-	105 557
Mov Cap-2 Maneuver	-	-	-	-	105 -
Stage 1	-	-	-	-	364 -
Stage 2	-	-	-	-	456 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	15.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	557	-	-	753	-
HCM Lane V/C Ratio	-	0.398	-	-	0.15	-
HCM Control Delay (s)	0	15.7	-	-	10.6	-
HCM Lane LOS	A	C	-	-	B	-
HCM 95th %tile Q(veh)	-	1.9	-	-	0.5	-

Intersection													
Int Delay, s/veh	2												
Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↕		↕	↕			↕			↕	
Traffic Vol, veh/h	37	18	796	18	18	631	18	12	1	12	12	1	12
Future Vol, veh/h	37	18	796	18	18	631	18	12	1	12	12	1	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	0	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	55	86	86	86	89	89	89	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	67	21	926	21	20	709	20	13	1	13	13	1	13

Major/Minor	Major1			Major2			Minor1			Minor2			
Conflicting Flow All	729	729	0	0	947	0	0	1508	1882	474	1399	1882	365
Stage 1	-	-	-	-	-	-	-	1113	1113	-	759	759	-
Stage 2	-	-	-	-	-	-	-	395	769	-	640	1123	-
Critical Hdwy	6.44	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.52	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	495	871	-	-	721	-	-	83	70	537	100	70	632
Stage 1	-	-	-	-	-	-	-	222	282	-	365	413	-
Stage 2	-	-	-	-	-	-	-	602	409	-	430	279	-
Platoon blocked, %			-	-	-	-	-						
Mov Cap-1 Maneuver	543	543	-	-	721	-	-	69	57	537	83	57	632
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	69	57	-	83	57	-
Stage 1	-	-	-	-	-	-	-	186	236	-	306	401	-
Stage 2	-	-	-	-	-	-	-	572	398	-	350	234	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0.3	44.8	37.4
HCM LOS			E	E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	117	543	-	-	721	-	-	138
HCM Lane V/C Ratio	0.232	0.162	-	-	0.028	-	-	0.197
HCM Control Delay (s)	44.8	12.9	-	-	10.1	-	-	37.4
HCM Lane LOS	E	B	-	-	B	-	-	E
HCM 95th %tile Q(veh)	0.8	0.6	-	-	0.1	-	-	0.7

Increase in delay with U-turns: **12.5** **9.9**

* Traffic volumes estimated, actual counts were not obtained.