

SPRING LAKE FARMS SUBDIVISION

Traffic Impact Study

Bradley Lake Lane

Knoxville, TN

A Traffic Impact Study for the Spring Lake Farms Subdivision

Submitted to

Knoxville – Knox County Metropolitan Planning Commission

Revised December 17, 2018

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FMA Project No. 525.010

Submitted By:



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Executive Summary

Mesana Investments, LLC is proposing a residential development (i.e. Spring Lake Farms Subdivision) with single family lots located in Knox County. The project is located near the intersection of Amherst Road at Bradley Lake Lane and south of Ball Camp Pike. The development will consist of 119 single family lots. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

The proposed driveway connection for the Spring Lake Farms Subdivision is located on Bradley Lake Lane.

In order to maintain or provide an acceptable level-of-service for each of the intersections studied, some recommendations are presented.

Amherst Road @ Bradley Lake Lane

The full buildout traffic conditions at the unsignalized intersection of Amherst Road at Bradley Lake Lane were analyzed using the Highway Capacity Software (HCS7). The southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS B during both the AM and PM peak hours.

After the completion of the Spring Lake Farms Subdivision neither a northbound right turn lane nor a southbound left turn lane are warranted at the intersection of Amherst Road at Bradley Lake Lane.

Bradley Lake Lane @ Driveway Connection

After the completion of the Spring Lake Farms Subdivision the southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS A during both the AM and PM peak hours.

Bradley Lake Lane

The existing conditions of Bradley Lake Lane do not meet the current minimum Knox County roadway standards. Improvements on Bradley Lake Lane between the proposed driveway connection and Amherst Road including road widening, striping plan, etc. need to be coordinated with Knox County Engineering and Public Works.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the Spring Lake Farms Subdivision. The project is located near the intersection of Amherst Road at Bradley Lake Lane and south of Ball Camp Pike. The location of the site is shown in Figure 1.

The proposed Spring Lake Farms Subdivision will be within the Parent Responsibility Zone (PRZ) of Amherst Elementary School. The PRZ for an elementary school is defined as those who live within one (1) mile from a school by the shortest route, and are not eligible for transportation service.

The full buildout of the development will consist of 119 single family lots. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

The proposed driveway connection for the Spring Lake Farms Subdivision is located on Bradley Lake Lane. The proposed site layout is shown in Figure 2.

The purpose of this study is to evaluate the impacts to the traffic conditions caused by the proposed development.

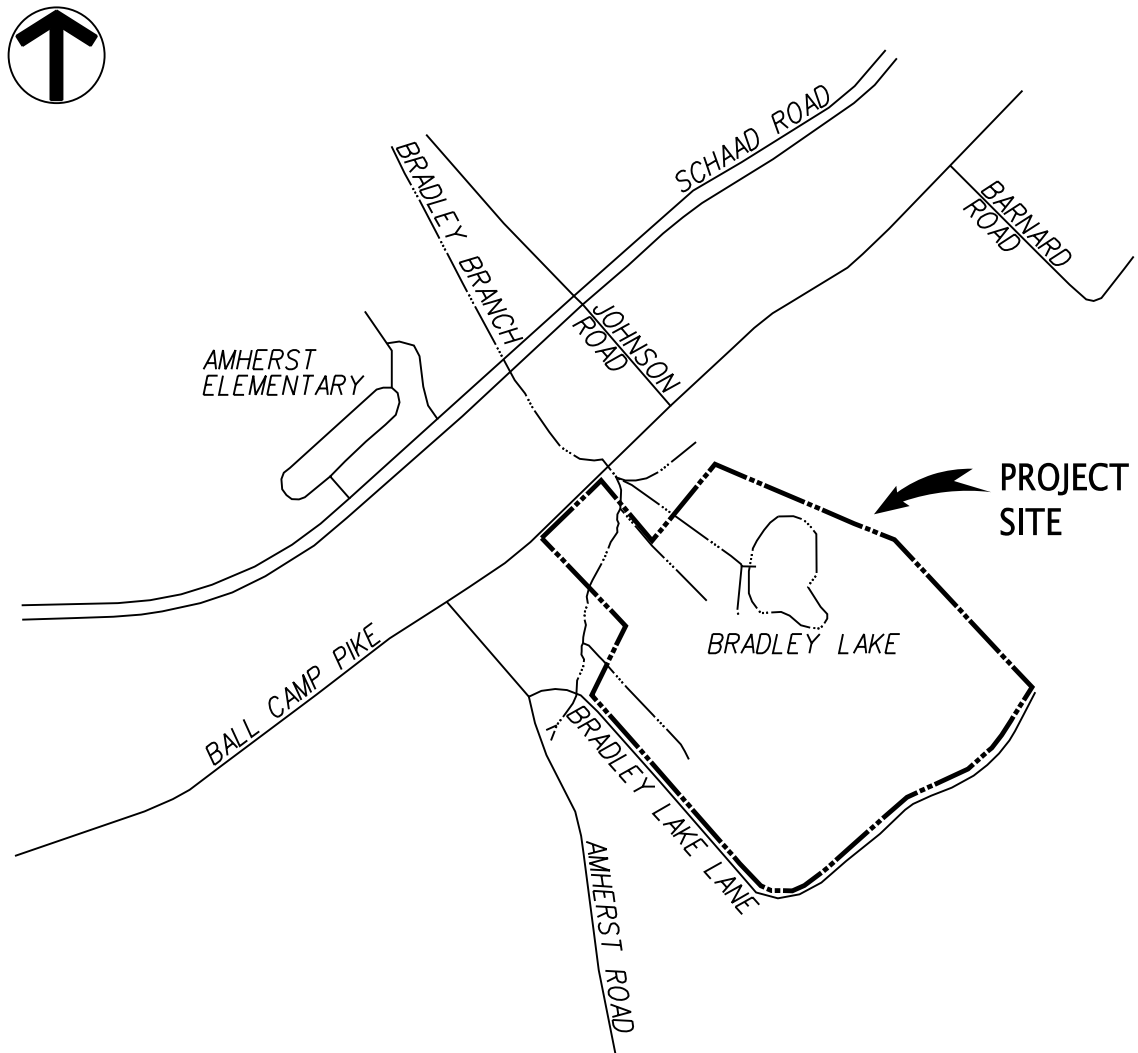


Figure 1: Location Map



Figure 2: Site Plan

1.2 Existing Site Conditions

The proposed driveway connection to Bradley Lake Lane is located approximately 600 feet east of the intersection with Amherst Road. The proposed driveway has a width of 22 feet and a sight distance that exceeds 250 feet north and south of the intersection. Bradley Lake Lane at the proposed driveway connection is one lane northbound and one lane southbound with an approximate width of 14 feet.

Bradley Lake Lane at the intersection with Amherst Road is a two-lane road. The Knoxville-Knox County Metropolitan Planning Commission does not classify Bradley Lake Lane per the Major Road Plan therefore; it is considered a local street. The posted speed limit on Bradley Lake Lane is 15 mph. Bradley Lake Lane is a dead end street with an approximate length of 2,800 feet.

Amherst Road is a two-lane road at the intersection with Bradley Lake Lane. The Knoxville-Knox County Metropolitan Planning Commission classifies Amherst Road as a major collector with a 70 foot right-of-way per the Major Road Plan. The posted speed limit on Amherst Road is 30 mph. The required sight distance on a road with a speed limit of 30 mph is 300 feet. The measured sight distance at the existing intersection of Amherst Road at Bradley Lake Lane is 500 feet northbound and 450 feet southbound.

There are existing sidewalks on Schaad Road near Amherst Elementary School but these do not extend down Johnson Road and there are no sidewalk connections to either Ball Camp Pike or Amherst Road.

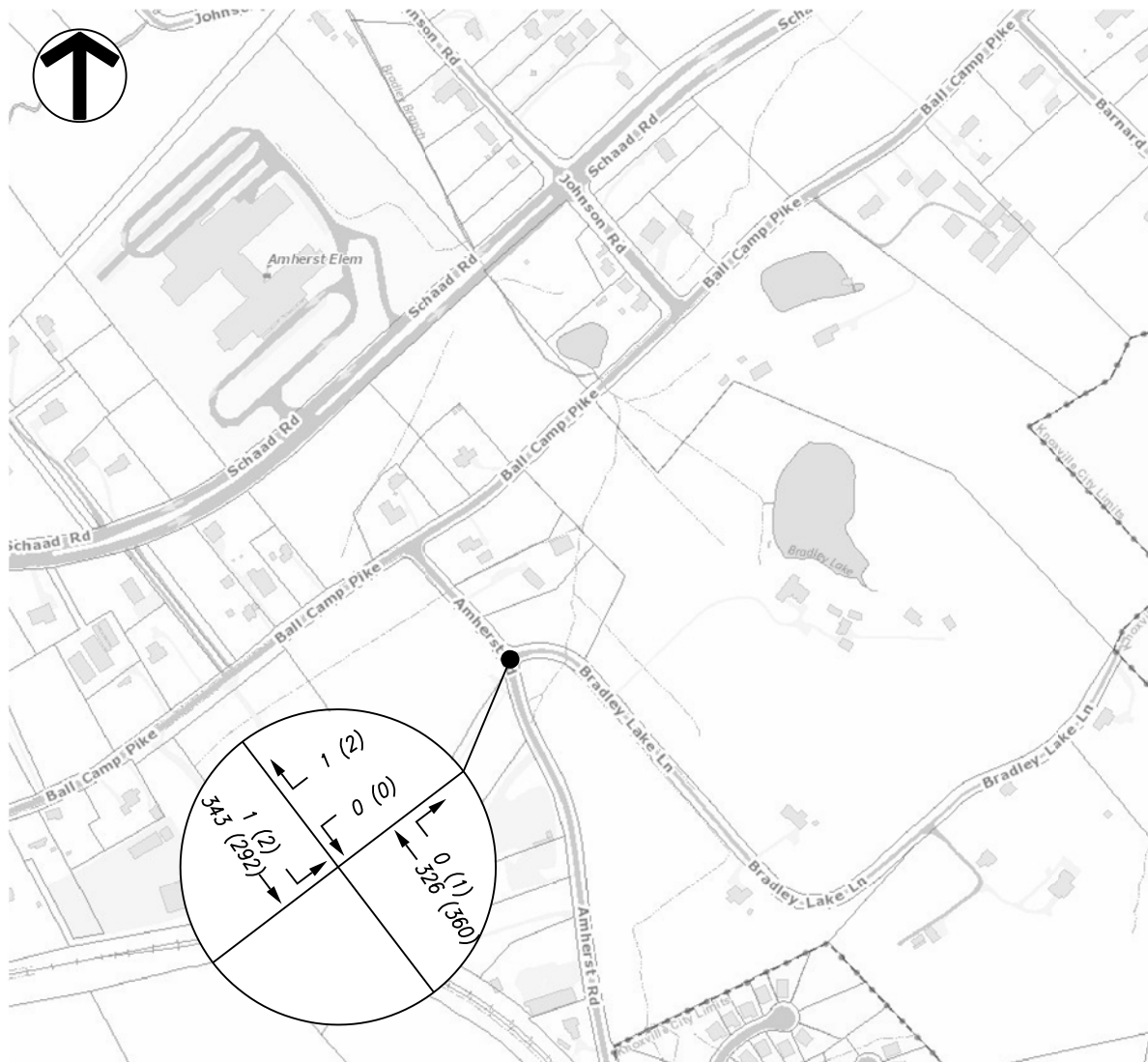
An aerial photo of the existing intersection is included in Attachment 1.

2 Existing Traffic Volumes

FMA conducted a turning movement count at the intersection of Amherst Road at Bradley Lake Lane on Wednesday November 14, 2018.

The current AM peak hour and PM peak hour were determined using the turning movement count that FMA conducted. At the intersection of Amherst Road at Bradley Lake Lane the AM peak hour occurred between 7:00 a.m. and 8:00 a.m., and the PM peak hour occurred between 5:00 p.m. and 6:00 p.m.

The existing volumes including the AM and PM peak hour traffic volumes at the count location are shown in Figure 3, and the count data collected is included in Attachment 2.



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 3: 2018 Existing Peak Hour Traffic

3 Background Growth

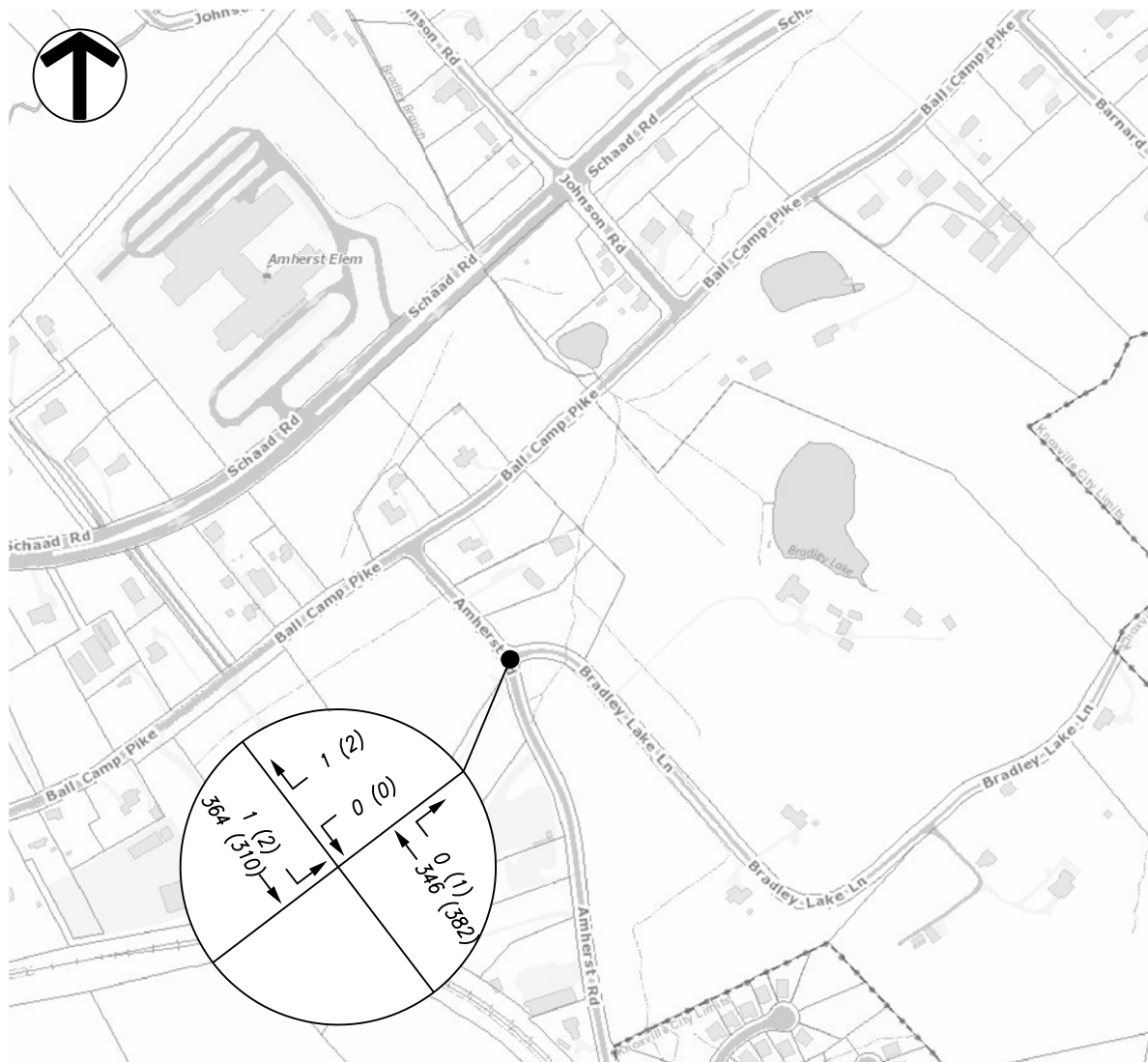
The Knoxville Regional Transportation Planning Organization (TPO) maintains count stations in the vicinity of the proposed development.

Knoxville TPO count station ID: 093M367 is located on Amherst Road south of Ball Camp Pike. The annual growth rate for this station over the last four years is approximately 0.54% and the 2015 ADT was 5,160 vehicles per day.

Knoxville TPO count station ID: 093M063 is located on Ball Camp Pike approximately 2,000 feet west of Oak Ridge Highway. The annual growth rate for this station over the last fifteen years is approximately 2.34% and the 2016 ADT was 7,650 vehicles per day.

For the purpose of this study, an annual growth rate of 2.0% was assumed for traffic at the intersection of Amherst Road at Bradley Lake Lane until full occupancy is reached in 2021. Attachment 3 shows the trend line growth charts for the Knoxville TPO count stations.

Figure 4 demonstrates the projected background peak hour volumes at the intersection of Amherst Road at Bradley Lake Lane after applying the background growth rate to the existing conditions.



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 4: 2021 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

The Spring Lake Farms Subdivision proposes 119 single family lots. Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the subdivision using the fitted curve equations from the *Trip Generation, 10th Edition*, published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 4.

The total trips generated by the Spring Lake Farms Subdivision was estimated to be 1,220 daily trips. The estimated trips are 89 trips during the AM peak hour and 120 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

**Table 4-1
Spring Lake Farms Subdivision
Trip Generation Summary**

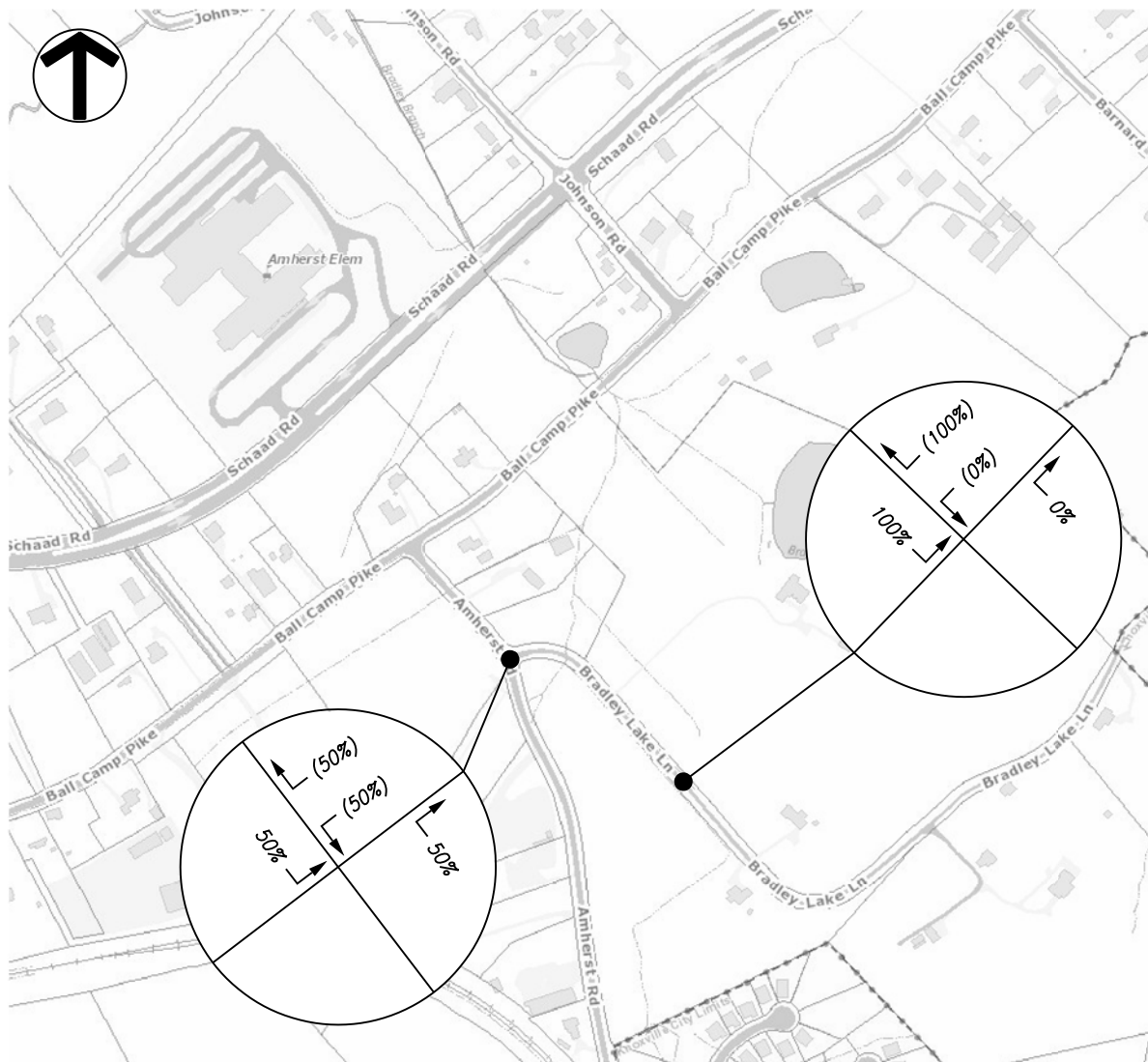
119 Single Family Units LUC 210					
	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	1,220	50	50	610	610
A.M. Peak	89	25	75	22	67
P.M. Peak	120	63	37	76	44

Amherst Road at the intersection with Bradley Lake Lane has a trip distribution of 50% northbound and 50% southbound during the AM peak hour and 55% northbound and 45% southbound during the PM peak hour.

The directional distribution of the traffic generated by the Spring Lake Farms Subdivision was determined using the existing traffic volumes in combination with the concept plan layout. It was assumed that 100% of traffic would enter/exit from Amherst Road during both the AM and PM peak hours due to Bradley Lake Lane being a dead end road.

Figure 5 shows the AM peak hour trip distribution and Figure 6 shows the PM peak hour trip distribution.

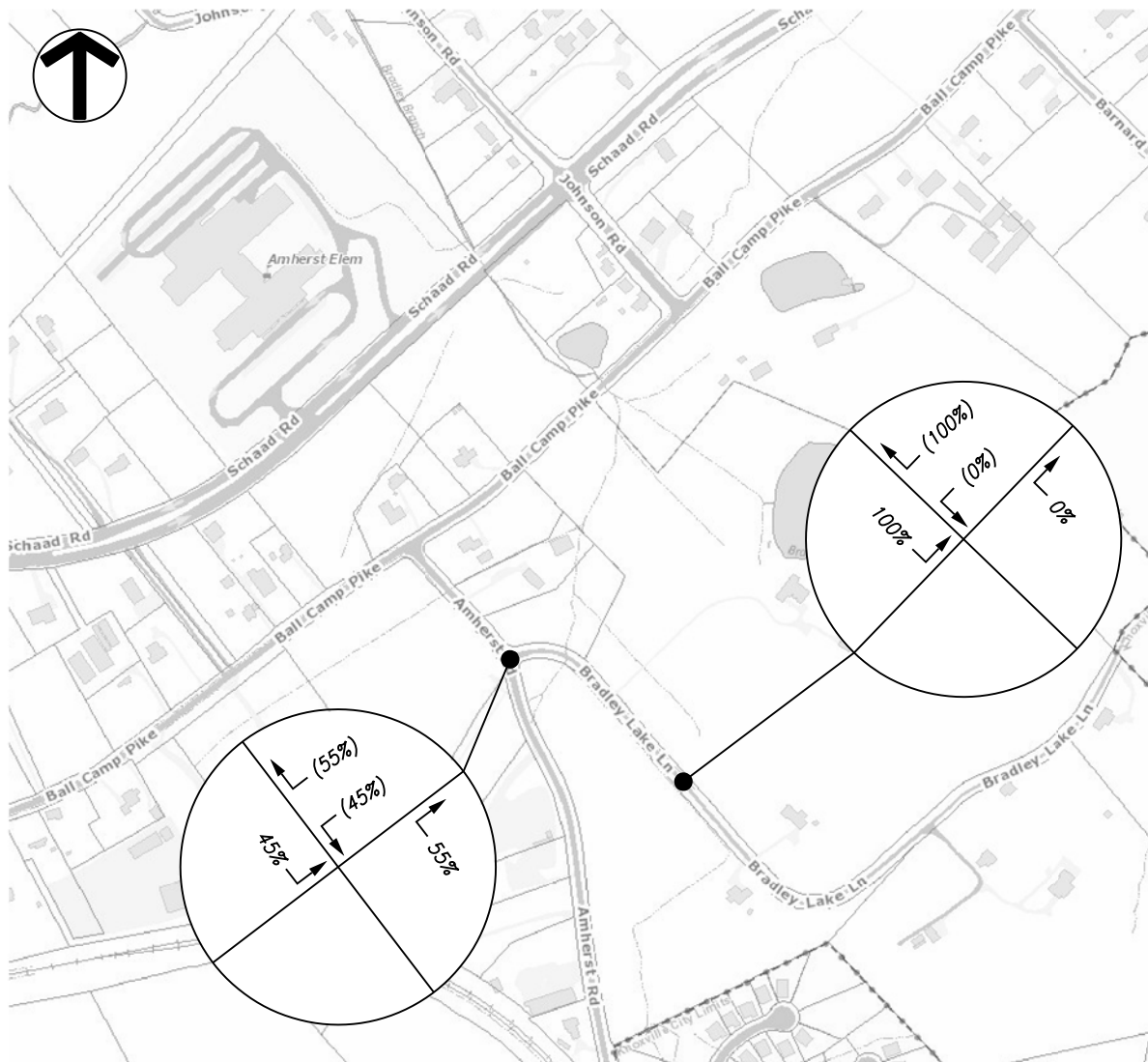
Figure 7 shows the peak hour site traffic from the subdivision and Figure 8 shows the peak hour full buildout traffic.



LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

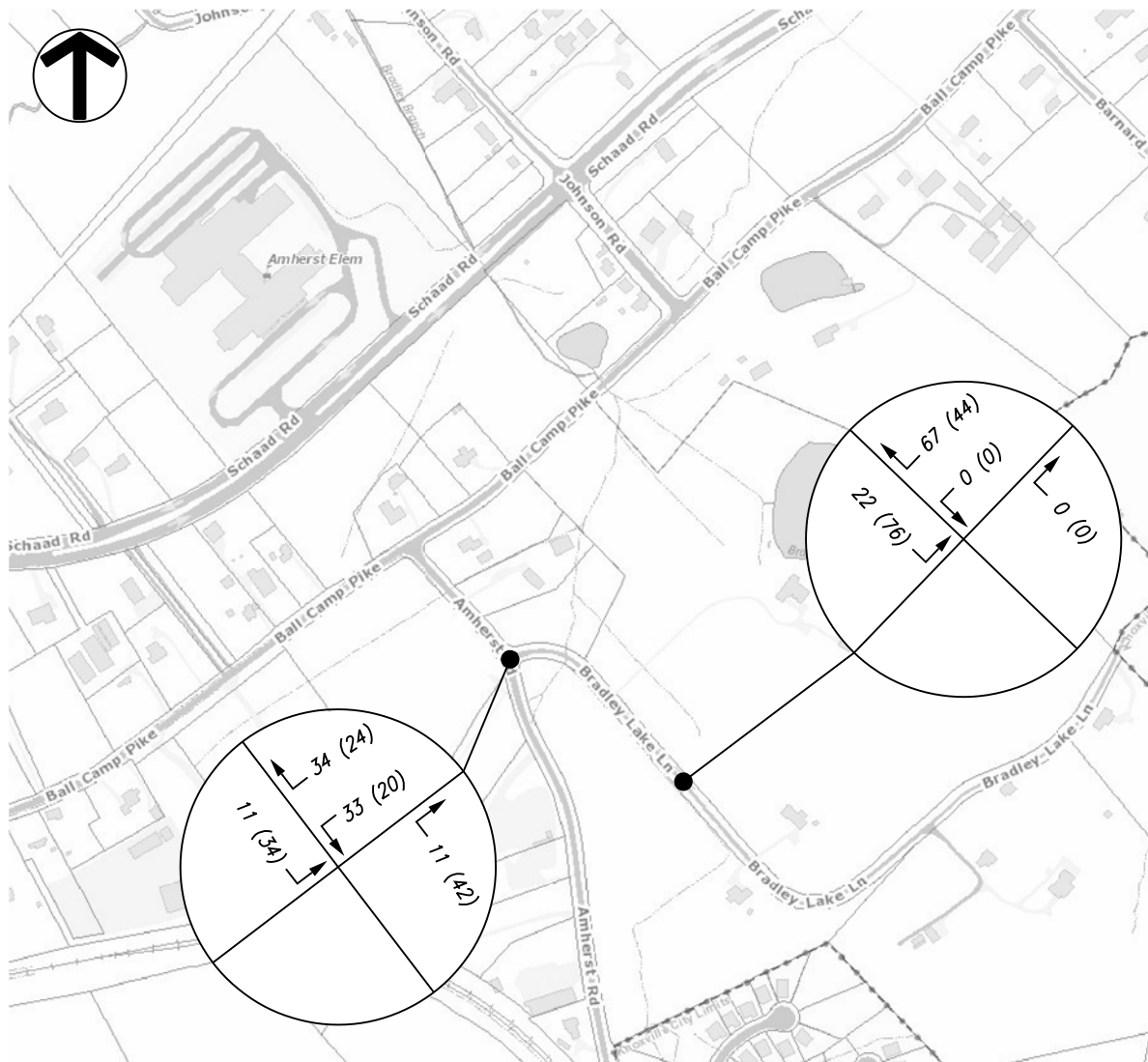
Figure 5: AM Peak Hour Trip Distribution



LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

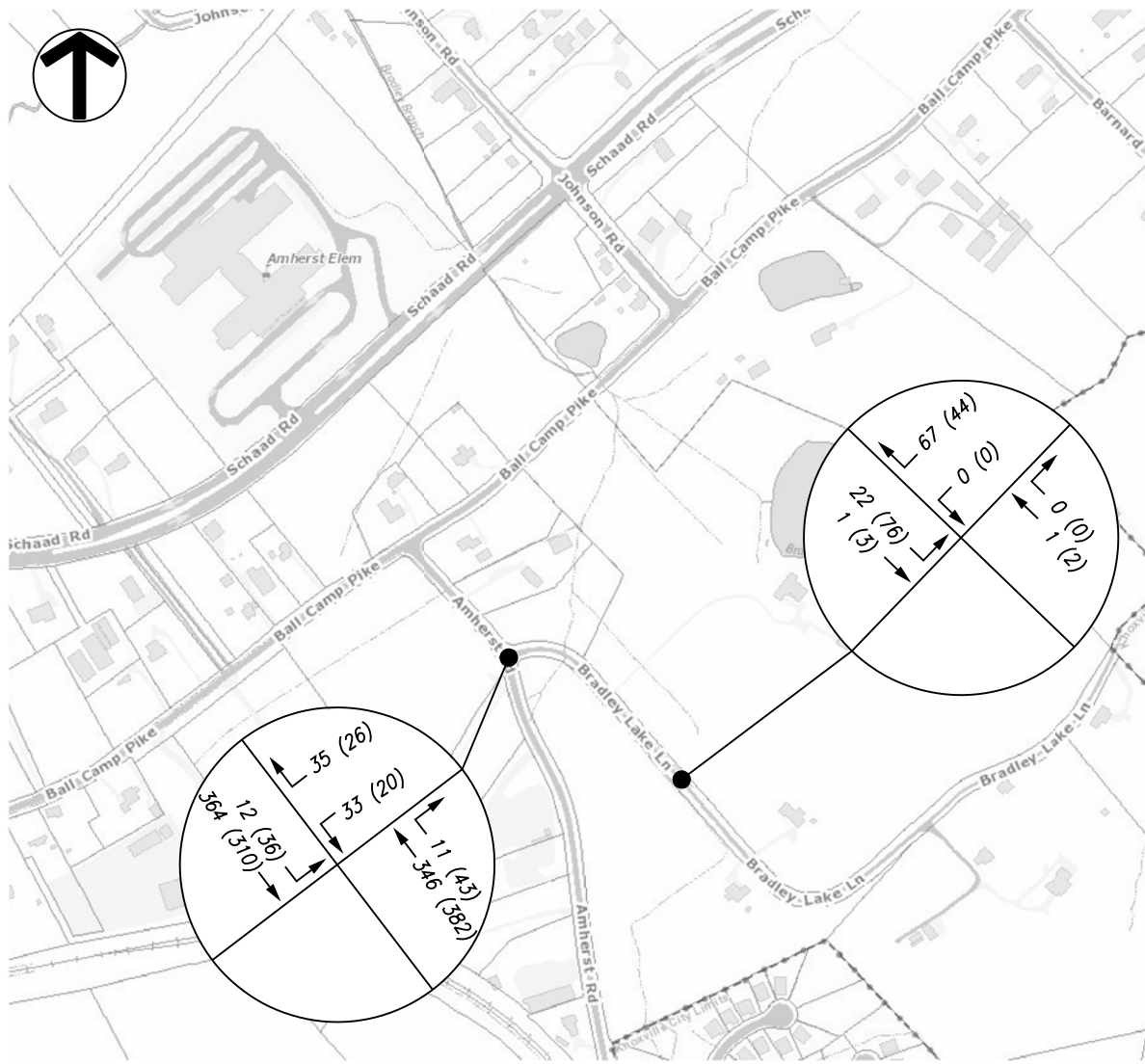
Figure 6: PM Peak Hour Trip Distribution



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 7: Peak Hour Site Traffic



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 8: Peak Hour Full Buildout Traffic

5 Projected Capacity and Level of Service

Unsignalized intersection capacity analyses were performed using the Highway Capacity Software (HCS7) for the AM and PM peak hours to evaluate the traffic conditions at the intersections of Amherst Road at Bradley Lake Lane and Bradley Lake Lane at the driveway connection.

The results from the analyses are expressed with a term “level of service” (LOS), which is based on the amount of delay experienced at the intersection. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions with excessive delay. LOS D generally is considered the minimum acceptable condition in urban areas. The existing, background and full buildout HCS7 worksheets are included in Attachments 5, 6 and 7.

Table 5-1 shows the results of the capacity analyses.

**Table 5-1
Intersection Analysis
Level of Service (LOS) Summary**

Delay (sec)/LOS		
Amherst Road @ Bradley Lake Lane (Existing 2018)		
AM Peak	WB Approach	10.4 / B
	SB Approach	8.0 / A
PM Peak	WB Approach	10.4 / B
	SB Approach	8.1 / A
Amherst Road @ Bradley Lake Lane (Background 2021)		
AM Peak	WB Approach	10.5 / B
	SB Approach	8.1 / A
PM Peak	WB Approach	10.6 / B
	SB Approach	8.1 / A
Amherst Road @ Bradley Lake Lane (Full Buildout 2021)		
AM Peak	WB Approach	15.0 / B
	SB Approach	8.2 / A
PM Peak	WB Approach	14.0 / B
	SB Approach	8.4 / A
Bradley Lake Lane @ Driveway Connection (Full Buildout 2021)		
AM Peak	WB Approach	8.6 / A
	SB Approach	7.3 / A
PM Peak	WB Approach	8.5 / A
	SB Approach	7.3 / A

6 Turn Lane Warrant Analysis

The intersection of Amherst Road at Bradley Lake Lane was evaluated to determine if a right turn lane or a left turn lane are warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information. Neither a right turn lane nor a left turn lane on Amherst Road is warranted. The turn lane warrant worksheets and analysis are included in Attachment 8.

7 Conclusions and Recommendations

7.1 Amherst Road @ Bradley Lake Lane

The existing traffic conditions at the unsignalized intersection of Amherst Road at Bradley Lake Lane were analyzed using the Highway Capacity Software (HCS7). The southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS B during both the AM and PM peak hours.

The background traffic conditions at the unsignalized intersection of Amherst Road at Bradley Lake Lane were analyzed using the Highway Capacity Software (HCS7). The southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS B during both the AM and PM peak hours.

The full buildout traffic conditions at the unsignalized intersection of Amherst Road at Bradley Lake Lane were analyzed using the Highway Capacity Software (HCS7). The southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS B during both the AM and PM peak hours.

After the completion of the Spring Lake Farms Subdivision neither a northbound right turn lane nor a southbound left turn lane are warranted at the intersection of Amherst Road at Bradley Lake Lane.

The minimum required sight distance for a road with a posted speed limit of 30 mph is 300 feet in each direction in accordance with the "Subdivision Regulations" for Knoxville and Knox County. FMA measured the sight distance at the existing intersection of Amherst Road at Bradley Lake Lane. At 15 feet from the edge of pavement the sight distance at the existing intersection is 500 feet northbound and 450 feet southbound. FMA recommends any landscaping be installed so as to

maintain the sight distance and continue to comply with Knox County Engineering and Public Works.

7.2 Bradley Lake Lane @ Driveway Connection

After the completion of the Spring Lake Farms Subdivision the southbound approach will operate at a LOS A during both the AM and PM peak hours and the westbound approach will operate at a LOS A during both the AM and PM peak hours.

The unsignalized intersection capacity analyses shows a 95% queue length at the full buildout for the driveway connection of less than one car length during both the AM and PM peak hours; therefore the existing storage at the intersection is adequate and no change is necessary.

Bradley Lake Lane is classified as a local street per the Major Road Plan. The minimum intersection spacing required on a local street is 125 feet per the "Knoxville-Knox County Subdivision Regulations." The proposed driveway connection is located approximately 600 feet east of the intersection with Amherst Road. This driveway connection exceeds the typical minimum separation on a local street; therefore, no change is necessary.

The minimum required sight distance for a road with a posted speed limit of 15 mph is 250 feet in each direction in accordance with the "Subdivision Regulations" for Knoxville and Knox County. FMA measured the sight distance at the proposed intersection of Bradley Lake Lane at Driveway Connection. At 15 feet from the edge of pavement the sight distance at the proposed intersection is greater than 300 feet northbound and 300 feet southbound.

7.3 Bradley Lake Lane

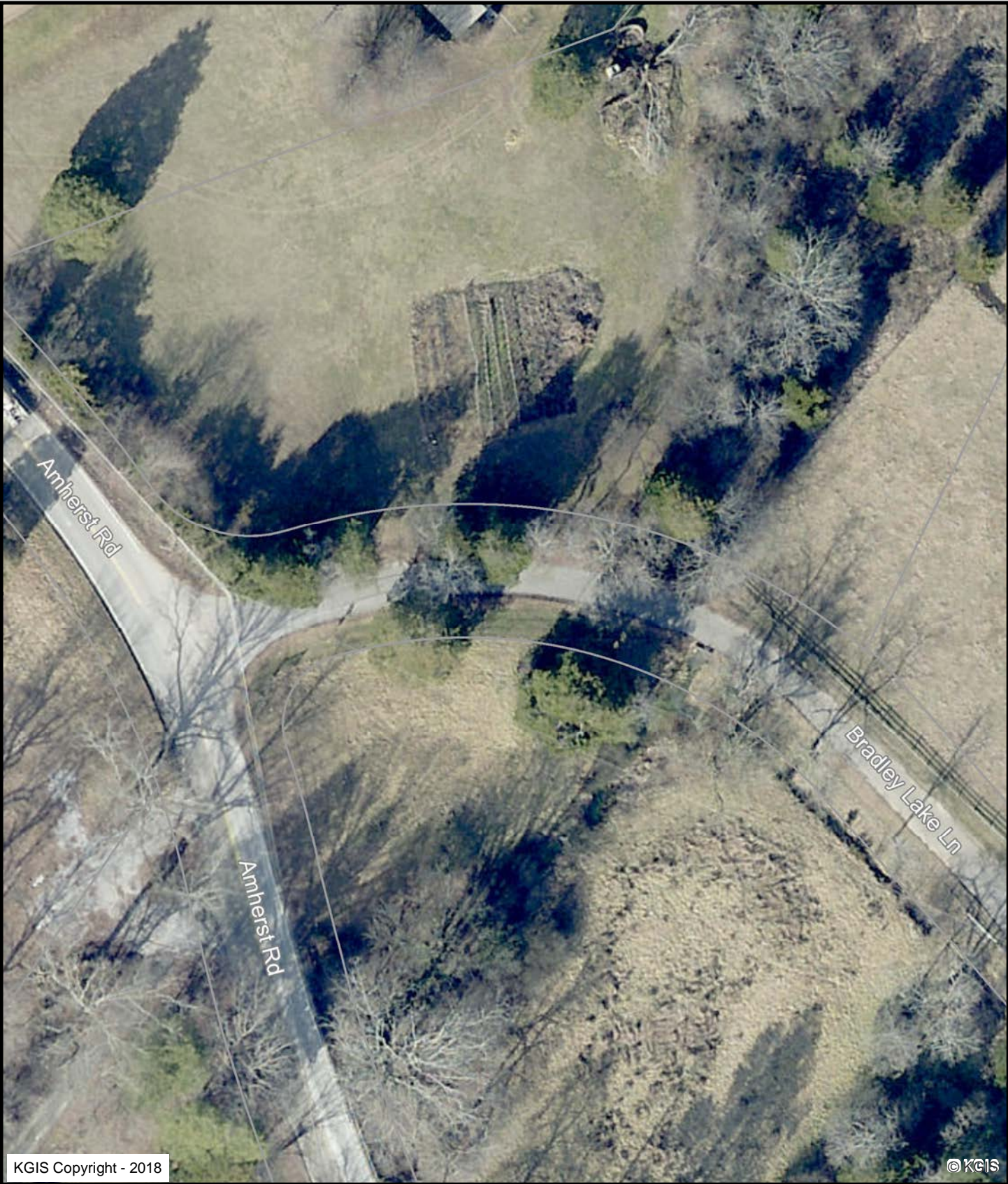
The proposed Spring Lake Farms Subdivision will be within the Parent Responsibility Zone (PRZ) of Amherst Elementary School. The PRZ for an elementary school is defined as those who live within one (1) mile from a school by the shortest route, and are not eligible for transportation service. There are existing sidewalks on Schaad Road near Amherst Elementary School but these do not extend down Johnson Road and there are no sidewalk connections to either Ball Camp Pike or Amherst Road.

The existing width of Bradley Lake Lane between the intersection with Amherst Road and the proposed driveway connection is approximately 14 feet. The existing conditions of Bradley Lake Lane do not meet the current minimum Knox County

**Spring Lake Farms Subdivision
Traffic Impact Study
December 17, 2018**

roadway standards. Improvements on Bradley Lake Lane between the proposed driveway connection and Amherst Road including road widening, striping plan, etc. need to be coordinated with Knox County Engineering and Public Works.

Attachment 1
Aerial Photo

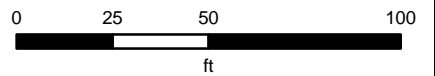


Amherst at Bradley Lake

Knoxville - Knox County - KUB Geographic Information System



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Attachment 2 Traffic Counts

Project: Spring Lake Farms Subdivision
Intersection: Amherst Rd at Bradley Lake Ln NW
Date Conducted: 11/14/2018

Start	Bradley Lake Ln NW Westbound			Amherst Road Northbound			Amherst Road Southbound			Int. Total
	Left	Right	Total	Thru	Right	Total	Left	Thru	Total	
7:00 AM	0	0	0	95	0	95	0	53	53	148
7:15 AM	0	1	1	84	0	84	0	96	96	181
7:30 AM	0	0	0	91	0	91	1	101	102	193
7:45 AM	0	0	0	56	0	56	0	93	93	149
Total	0	1	1	326	0	326	1	343	344	671
8:00 AM	0	1	1	53	0	53	1	78	79	133
8:15 AM	0	1	1	47	0	47	1	69	70	118
8:30 AM	0	3	3	30	0	30	0	55	55	88
8:45 AM	0	2	2	44	0	44	1	47	48	94
Total	0	7	7	174	0	174	3	249	252	433
2:00 PM	0	0	0	0	0	0	0	0	0	0
2:15 PM	0	1	1	57	1	58	0	47	47	106
2:30 PM	0	0	0	50	0	50	0	39	39	89
2:45 PM	0	0	0	34	0	34	1	34	35	69
Total	0	1	1	141	1	142	1	120	121	264
3:00 PM	0	0	0	49	0	49	1	60	61	110
3:15 PM	0	1	1	50	0	50	0	48	48	99
3:30 PM	0	1	1	56	0	56	0	49	49	106
3:45 PM	0	0	0	44	0	44	0	48	48	92
Total	0	2	2	199	0	199	1	205	206	407
4:00 PM	0	0	0	51	0	51	0	61	61	112
4:15 PM	0	0	0	73	0	73	0	56	56	129
4:30 PM	0	0	0	76	0	76	0	53	53	129
4:45 PM	0	0	0	92	0	92	0	61	61	153
Total	0	0	0	292	0	292	0	231	231	523
5:00 PM	0	0	0	92	0	92	0	78	78	170
5:15 PM	0	2	2	98	0	98	1	73	74	174
5:30 PM	0	0	0	82	0	82	1	63	64	146
5:45 PM	0	0	0	88	1	89	0	78	78	167
Total	0	2	2	360	1	361	2	292	294	657
Grand Total	0	13	13	1492	2	1494	8	1440	1448	2955
Approach %	0.0	100.0		99.9	0.1		0.6	99.4		
Total %	0.0	0.4	0.4	50.5	0.1	50.6	0.3	48.7	49.0	

Project: Spring Lake Farms Subdivision

Date Conducted: 11/14/2018

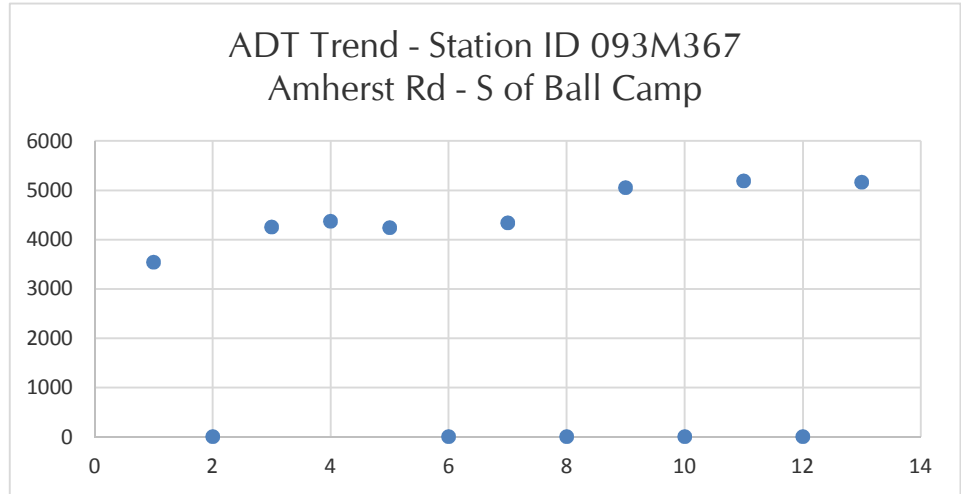
AM Peak Hour	7:00 AM - 8:00 AM	671
PM Peak Hour	5:00 PM - 6:00 PM	657

Start	Bradley Lake Ln NW			Amherst Rd Northbound			Amherst Rd Southbound			Int. Total
	Left	Right	Total	Thru	Right	Total	Left	Thru	Total	
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:00 AM										
7:00 AM	0	0	0	95	0	95	0	53	53	148
7:15 AM	0	1	1	84	0	84	0	96	96	181
7:30 AM	0	0	0	91	0	91	1	101	102	193
7:45 AM	0	0	0	56	0	56	0	93	93	149
Total Volume	0	1	1	326	0	326	1	343	344	671
Future (2% over 3 yrs)	0	1		346	0		1	364		712
PHF	-	0.25		0.86	-		0.25	0.85		0.87

Peak Hour Analysis from 2:30 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	0	0	0	92	0	92	0	78	78	170
5:15 PM	0	2	2	98	0	98	1	73	74	174
5:30 PM	0	0	0	82	0	82	1	63	64	146
5:45 PM	0	0	0	88	1	89	0	78	78	167
Total Volume	0	2	2	360	1	361	2	292	294	657
Future (2% over 3 yrs)	0	2		382	1		2	310		697
PHF	-	0.25		0.92	0.25		0.50	0.94		0.94

Attachment 3 ADT Trends

Year	Adjusted Average Daily Traffic
2003	3540
2004	0
2005	4254
2006	4370
2007	4240
2008	0
2009	4340
2010	0
2011	5050
2012	0
2013	5190
2014	0
2015	5160

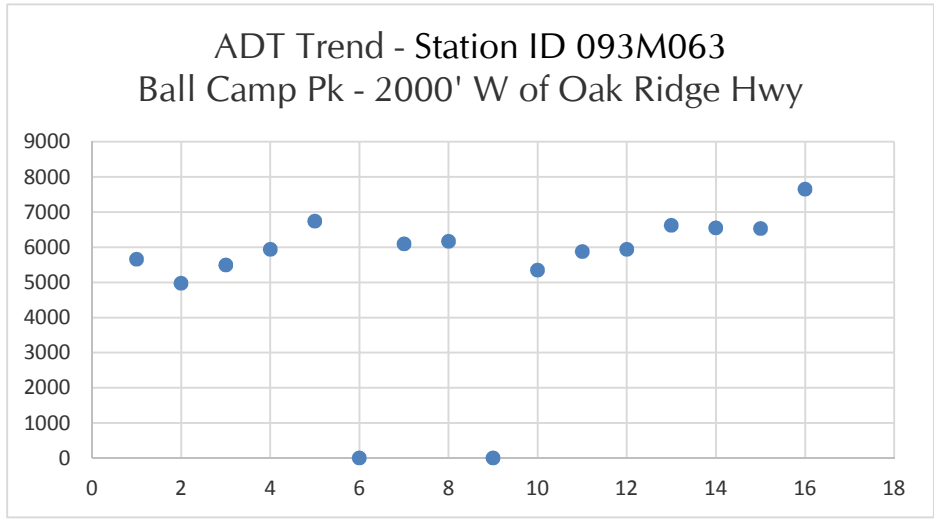


Most Recent Trend Line Growth

Year	ADT
2011	5050
2015	5160

Annual Percent Growth 0.54%

Year	Adjusted Average Daily Traffic
2001	5660
2002	4970
2003	5490
2004	5940
2005	6741
2006	0
2007	6090
2008	6170
2009	0
2010	5350
2011	5880
2012	5940
2013	6620
2014	6550
2015	6530
2016	7650



Most Recent Trend Line Growth

Year	ADT
2010	5660
2016	7650

Annual Percent Growth 2.34%

Attachment 4 Trip Generation

Project: Spring Lake Farms
Date Conducted: 12/17/2018

Single-Family Detached Housing (LUC 210)
119 Single Family Lots

Average Daily Traffic

$$\ln(T) = 0.92\ln(X) + 2.71$$

$$\ln(T) = 0.92\ln(119) + 2.71$$

$$T = 1220$$

Peak Hour of Adjacent Street Traffic

One Hour Between 7 and 9 a.m.

$$T = 0.71(X) + 4.80$$

$$T = 0.71(119) + 4.80$$

$$T = 89$$

Peak Hour of Adjacent Street Traffic

One Hour Between 4 and 6 p.m.

$$\ln(T) = 0.96\ln(X) + 0.20$$

$$\ln(T) = 0.96\ln(119) + 0.20$$

$$T = 120$$

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	1220	50%	50%	610	610
AM Peak Hour	89	25%	75%	22	67
PM Peak Hour	120	63%	37%	76	44

Single-Family Detached Housing (210)

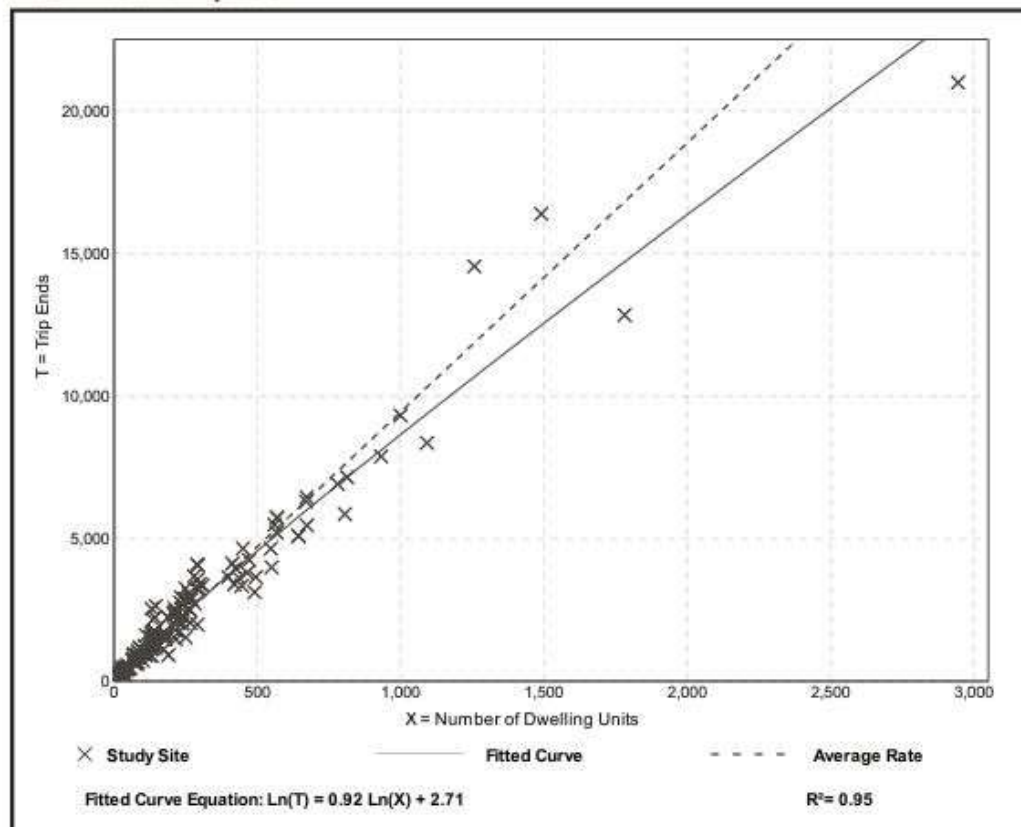
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 159
Avg. Num. of Dwelling Units: 264
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

Data Plot and Equation



Single-Family Detached Housing (210)

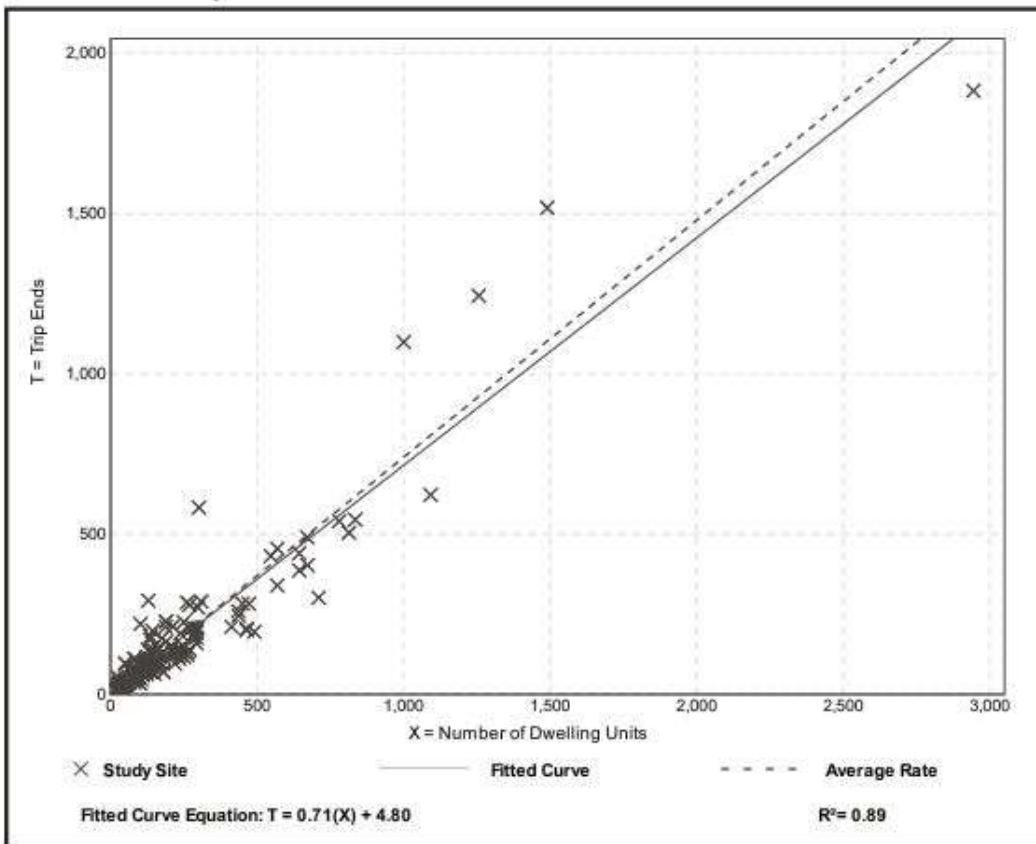
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban
 Number of Studies: 173
 Avg. Num. of Dwelling Units: 219
 Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

Data Plot and Equation



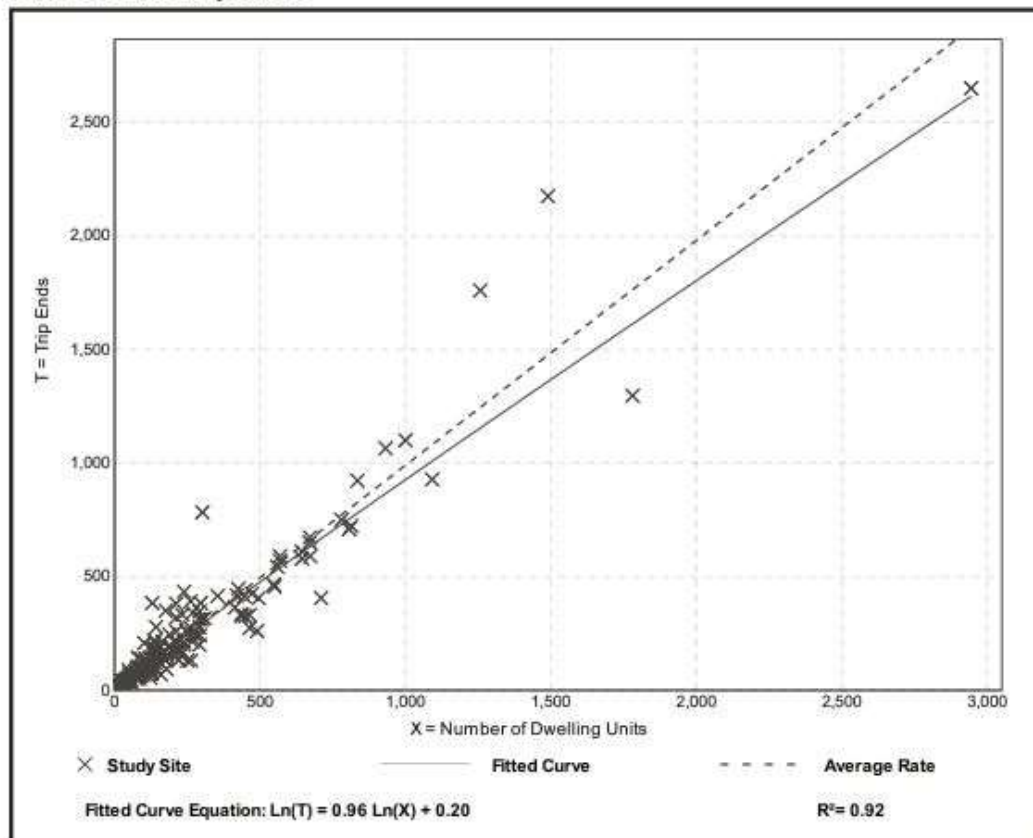
Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: General Urban/Suburban
 Number of Studies: 190
 Avg. Num. of Dwelling Units: 242
 Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

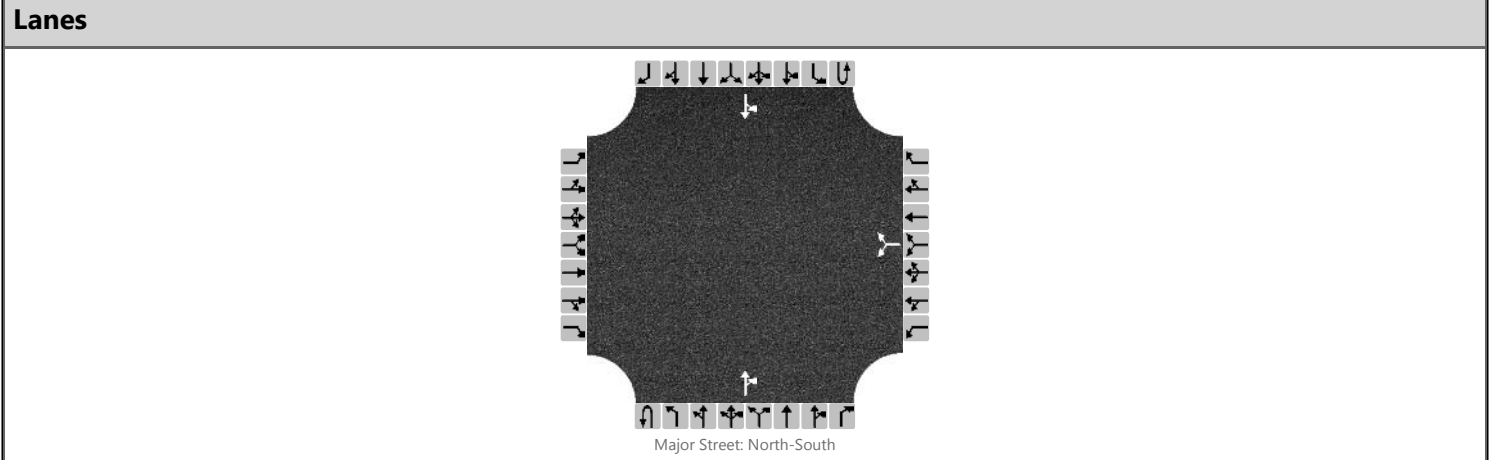
Data Plot and Equation



Attachment 5
Intersection Worksheets – Existing AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	11/14/2018	East/West Street	Bradley Lake Lane
Analysis Year	2018	North/South Street	Amherst Road
Time Analyzed	Existing AM Peak	Peak Hour Factor	0.87
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		1			326	0		1		343
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

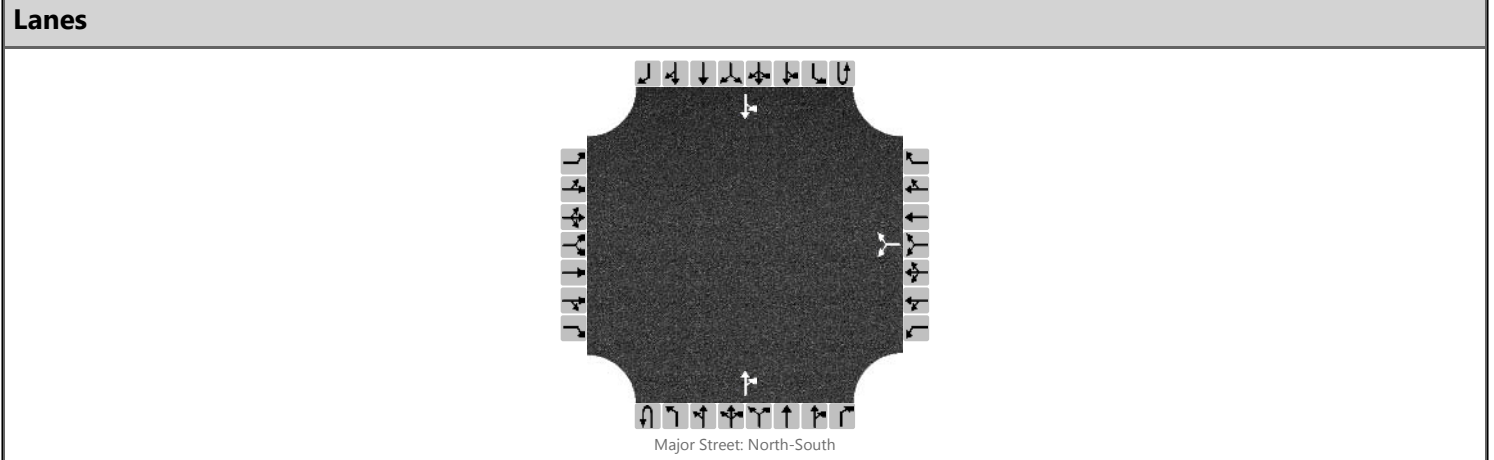
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						1									1	
Capacity, c (veh/h)						671									1183	
v/c Ratio						0.00									0.00	
95% Queue Length, Q ₉₅ (veh)						0.0									0.0	
Control Delay (s/veh)						10.4									8.0	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					10.4								0.0			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	11/15/2018	East/West Street	Bradley Lake Lane
Analysis Year	2018	North/South Street	Amherst Road
Time Analyzed	Existing PM Peak	Peak Hour Factor	0.94
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		2			360	1		2		292
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

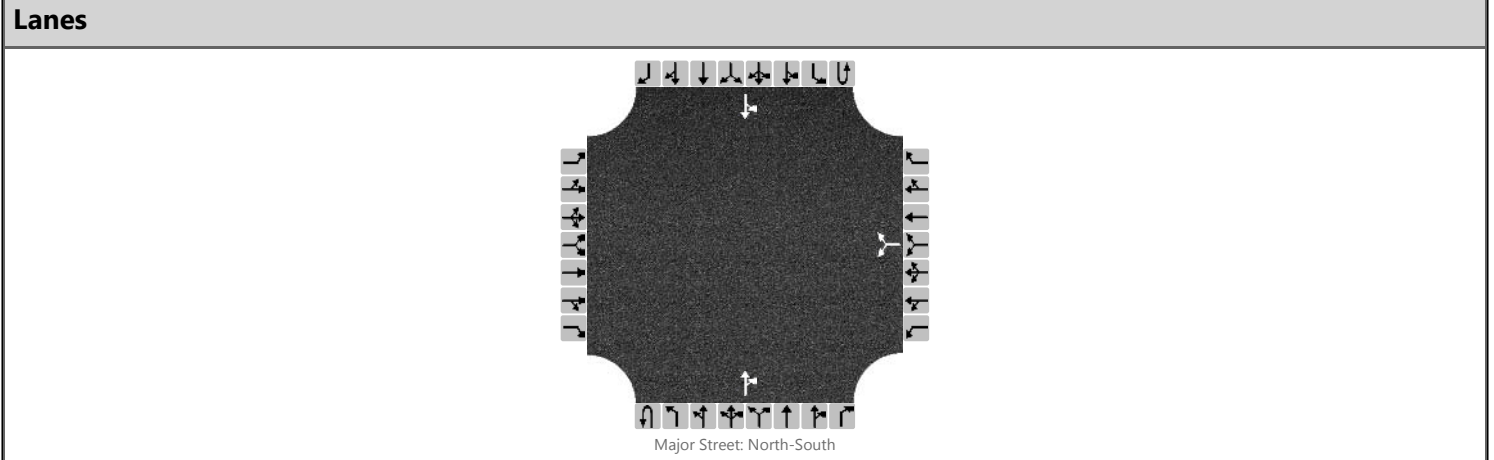
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						2									2	
Capacity, c (veh/h)						663									1174	
v/c Ratio						0.00									0.00	
95% Queue Length, Q ₉₅ (veh)						0.0									0.0	
Control Delay (s/veh)						10.4									8.1	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					10.4								0.1			
Approach LOS					B											

Attachment 6
Intersection Worksheets – Background AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	11/14/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Amherst Road
Time Analyzed	Background AM Peak	Peak Hour Factor	0.87
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		1			346	0			1	364
Percent Heavy Vehicles (%)						2		2							2	
Proportion Time Blocked						0.000		0.000							0.000	
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

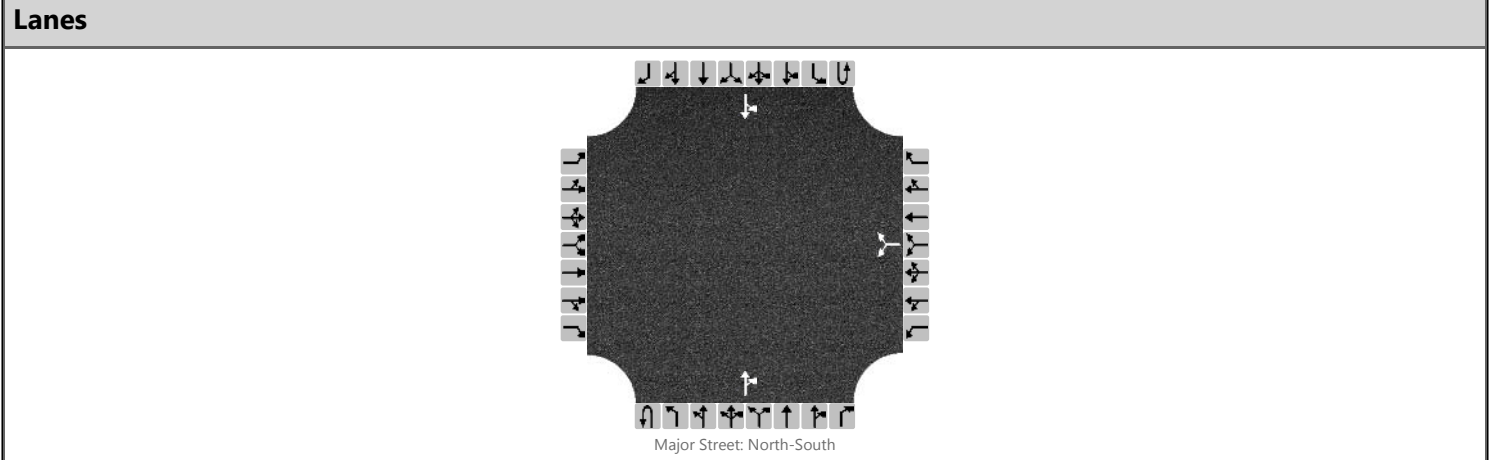
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						1									1	
Capacity, c (veh/h)						651									1160	
v/c Ratio						0.00									0.00	
95% Queue Length, Q ₉₅ (veh)						0.0									0.0	
Control Delay (s/veh)						10.5									8.1	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					10.5								0.0			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	11/15/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Amherst Road
Time Analyzed	Background PM Peak	Peak Hour Factor	0.94
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		2			382	1		2		310
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

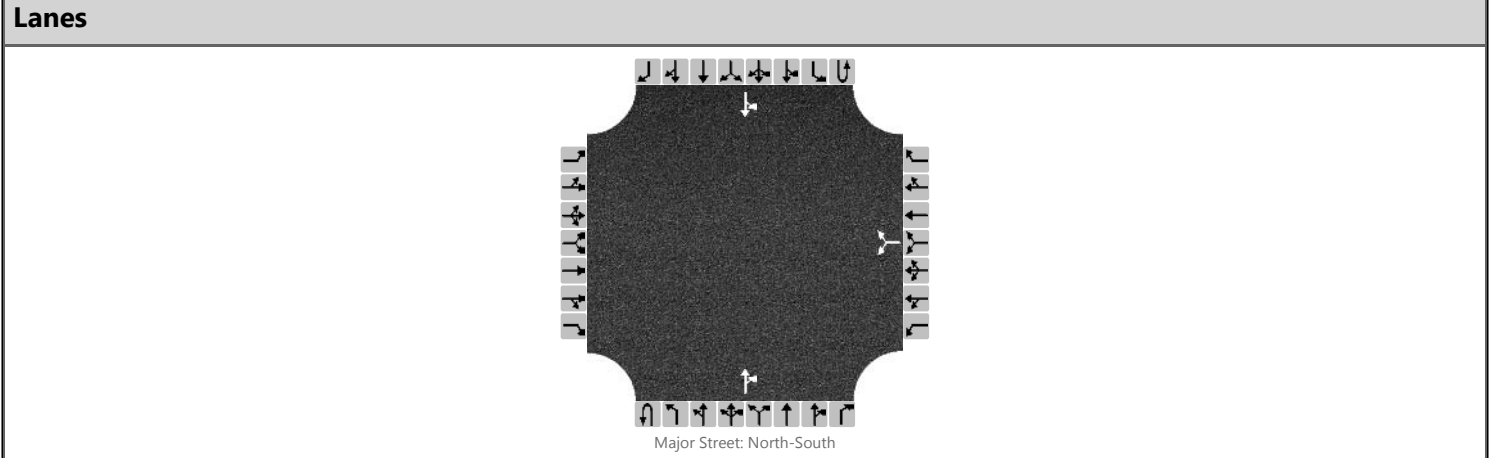
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						2									2	
Capacity, c (veh/h)						645									1151	
v/c Ratio						0.00									0.00	
95% Queue Length, Q ₉₅ (veh)						0.0									0.0	
Control Delay (s/veh)						10.6									8.1	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					10.6								0.1			
Approach LOS					B											

Attachment 7
Intersection Worksheets – Full Buildout AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	12/17/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Amherst Road
Time Analyzed	Full Buildout AM Peak	Peak Hour Factor	0.87
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						33		35			346	11			12	364
Percent Heavy Vehicles (%)						2		2							2	
Proportion Time Blocked						0.000		0.000							0.000	
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

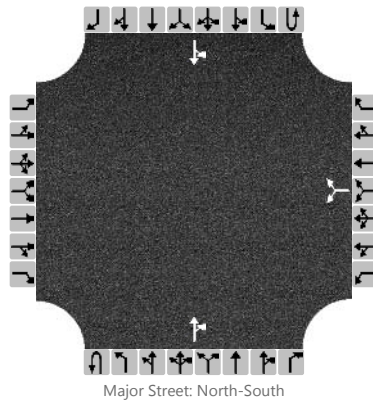
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						78									14	
Capacity, c (veh/h)						438									1147	
v/c Ratio						0.18									0.01	
95% Queue Length, Q ₉₅ (veh)						0.6									0.0	
Control Delay (s/veh)						15.0									8.2	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					15.0								0.4			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Amherst at Bradley Lake
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	12/17/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Amherst Road
Time Analyzed	Full Buildout PM Peak	Peak Hour Factor	0.94
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						20		26			382	43			36	310
Percent Heavy Vehicles (%)						2		2							2	
Proportion Time Blocked						0.000		0.000							0.000	
Percent Grade (%)					0											
Right Turn Channelized	No				No				No							
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

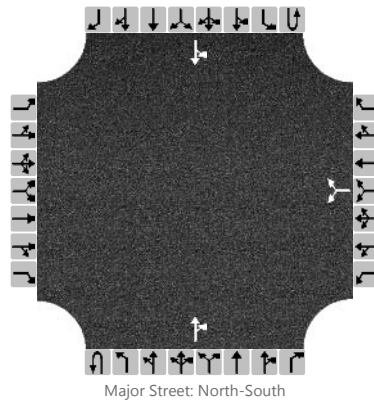
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						49									38	
Capacity, c (veh/h)						449									1108	
v/c Ratio						0.11									0.03	
95% Queue Length, Q ₉₅ (veh)						0.4									0.1	
Control Delay (s/veh)						14.0									8.4	
Level of Service, LOS						B									A	
Approach Delay (s/veh)					14.0								1.2			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Bradley Lake at Driveway
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	12/17/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Driveway Connection
Time Analyzed	Full Buildout AM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0		0	1	0		0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		67			1	0			22	1
Percent Heavy Vehicles (%)						2		2							2	
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

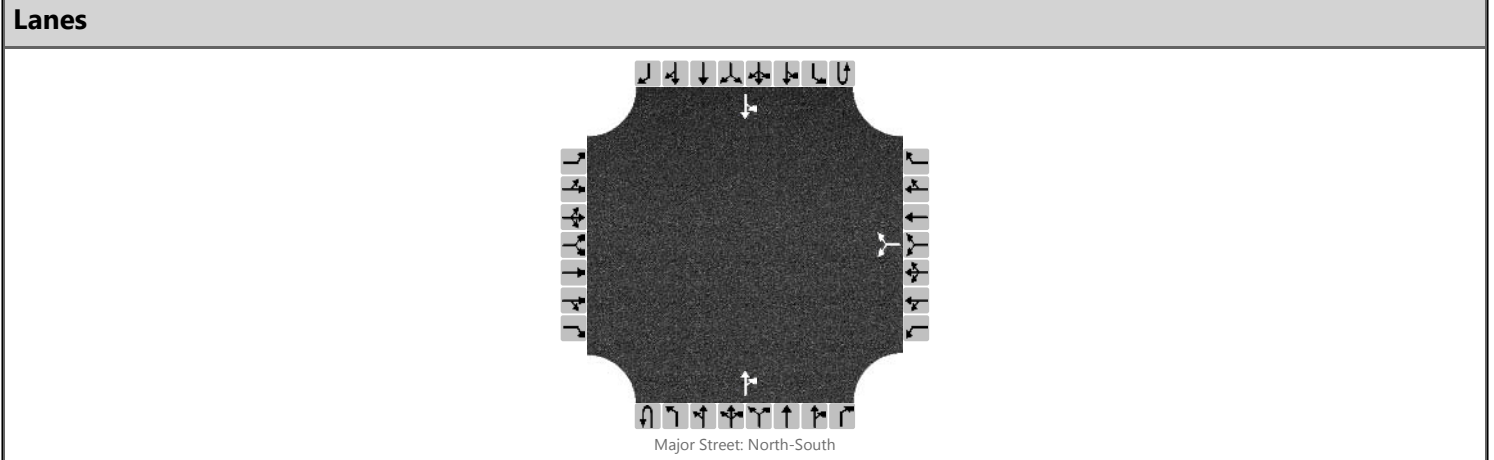
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						73									24	
Capacity, c (veh/h)						1083									1620	
v/c Ratio						0.07									0.01	
95% Queue Length, Q ₉₅ (veh)						0.2									0.0	
Control Delay (s/veh)						8.6									7.3	
Level of Service, LOS						A									A	
Approach Delay (s/veh)					8.6								7.0			
Approach LOS					A											

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Bradley Lake at Driveway
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	12/17/2018	East/West Street	Bradley Lake Lane
Analysis Year	2021	North/South Street	Driveway Connection
Time Analyzed	Full Buildout PM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	525.010 Spring Lake Farms Subdivision		



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0		0	1	0		0	1	0
Configuration							LR					TR			LT	
Volume, V (veh/h)						0		44			2	0			76	3
Percent Heavy Vehicles (%)						2		2							2	
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.42		6.22							4.12	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.52		3.32							2.22	

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						48									83	
Capacity, c (veh/h)						1082									1619	
v/c Ratio						0.04									0.05	
95% Queue Length, Q ₉₅ (veh)						0.1									0.2	
Control Delay (s/veh)						8.5									7.3	
Level of Service, LOS						A									A	
Approach Delay (s/veh)					8.5								7.1			
Approach LOS					A											

Attachment 8

Turn Lane Warrant Analysis

Project: Spring Lake Farms Subdivision

Amherst Road at Bradley Lake Lane

Amherst Road at Bradley Lake Lane	VOLUMES				
LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	357	364	12	60	NO
PM	425	310	36	65	NO

Amherst Road

Amherst Road at Bradley Lake Lane	VOLUMES				
RIGHT TURN	Thru	RT	RT MAX	Warrant Met	
AM	346	11	0	NO	
PM	382	43	0	NO	

TABLE 4A

LEFT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

(If the left-turn volume exceeds the table value a left -turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
150 - 199	245	200	160	130	110	90
200 - 249	205	170	140	115	100	80
250 - 299	175	150	125	105	90	70
300 - 349	155	135	110	95 AM Peak 12 LT	70	65
350 - 399	135	120	100	85	70	60
400 - 449	120	105	90	PM Peak 36 LT	60	55
450 - 499	105	90	80	70	60	50
500 - 549	95	80	70	65	55	50
550 - 599	85	70	65	60	50	45
600 - 649	75	65	60	55	45	40
650 - 699	70	60	55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

* Or through volume only if a right-turn lane exists.

TABLE 4B
RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99				AM Peak 11 RT	PM Peak 43 RT	
100 - 149 150 - 199						
200 - 249 250 - 299						Yes
300 - 349 350 - 399				Yes	Yes Yes	Yes Yes
400 - 449 450 - 499			Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599		Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					Yes	Yes Yes
100 - 149 150 - 199			Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.



Date: December 17, 2018

Project Name: Spring Lake Farms Subdivision

To: MPC and Knox County Engineering & Public Works

Subject: TIS Comment Response Document for Spring Lake Farms Subdivision Traffic Impact Study Review Comments Dated December 11, 2018.

Dear MPC and Knox County staff,

The following comment response document is submitted to address comments dated December 11, 2018:

- 1. Reviewer Comment:** In the Executive Summary (page 3) and in other sections of the report, there was no discussion concerning the substandard road condition of Bradley Lake Lane. This road will have to be improved (per Knox County Engineering) from the entrance of the subdivision to the intersection of Bradley Lake Lane and Amherst Road, as required by Knox County standards. Please ensure this is mentioned in the report, as well as what the current condition of the road is.

Response: Added the following to the executive summary and Conclusions and Recommendations. "The existing conditions of Bradley Lake Lane do not meet the current minimum Knox County roadway standards. Improvements on Bradley Lake Lane between the proposed driveway connection and Amherst Road including road widening, striping plan, etc. need to be coordinated with Knox County Engineering and Public Works."

- 2. Reviewer Comment:** This proposed development is within the Parent Responsibility Zone (PRZ), which is not referenced within the study. Amherst Elementary School off Schaad Road is the closest proximity to this proposed development, and the PRZ for an Elementary school is 1 mile. Please discuss the proposed development being within the limits of the PRZ. (Please reference Appendix B, page B-4 of the Subdivision Regulations)

Response: Added the following to the Conclusions and Recommendations. "The proposed Spring Lake Farms Subdivision will be within the Parent Responsibility Zone (PRZ) of Amherst Elementary School. The PRZ for an elementary school is defined as those who live within one (1) mile from a school by the shortest route, and are not eligible for transportation service. There are existing sidewalks on Schaad Road near Amherst Elementary School but these do not extend down Johnson Road and there are no sidewalk connections to either Ball Camp Pike or Amherst Road."

- 3. Reviewer Comment:** Please update the site plan (page 6) to the current one submitted for review for the January 10, 2019 Planning Commission meeting, which shows the proposed subdivision of the entire site being proposed.

Response: Updated Figure 2 – Site Plan to show the revised concept plan.

- 4. Reviewer Comment:** Please include an evaluation of the sight distance at the development entrance along Bradley Lake Lane and at the existing intersection of Bradley Lake Lane at Amherst Road. Any improvements mentioned for the intersection of Bradley Lake Lane at Amherst Road would be the responsibility of Knox County, but this is just to understand if there is a current and/or projected issue with this intersection.

Response: Added the following two paragraphs to the Conclusions and Recommendations. "FMA measured the sight distance at the proposed intersection of Bradley Lake Lane at Driveway Connection. At 15 feet from the edge of pavement the sight distance at the proposed intersection is greater than 300 feet northbound and 300 feet southbound." and "FMA measured the sight distance at the existing intersection of Amherst Road at Bradley Lake Lane. At 15 feet from the edge of pavement the sight distance at the existing intersection is 500 feet northbound and 450 feet southbound. FMA recommends any landscaping be installed so as to maintain the sight distance and continue to comply with Knox County Engineering and Public Works."

Sincerely,



Addie Kirkham, P.E.