AUTUMN WALK SUBDIVISION

Traffic Impact Study

Autumn Path Lane

Knoxville, TN

A Traffic Impact Study for the Proposed Autumn Walk Subdivision

Submitted to

Knoxville – Knox County Metropolitan Planning Commission

Revised September 4, 2018
Updated July 9, 2018
April 4, 2016
FMA Project No. 567.001

Submitted By:

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TABLE OF CONTENTS

FIGURES

ATTACHMENTS

Executive Summary

B & B Builders, Inc proposes an expansion of the existing Autumn Walk Subdivision with additional residential condominium units. The project site is located at the existing intersection of Dry Gap Pike and Autumn Path Lane south of E. Beaver Creek Drive in Knox County. As of June 2018 the subdivision has 78 completed condominium units and 12 units under construction of the previously approved 116 units. Phase 5 would add an additional 32 condominium units bringing the total for the Autumn Walk Subdivision to 148 units. Construction for Phase 5 is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

In order to maintain or provide an acceptable level-of-service the following recommendations are presented:

Autumn Path Lane
The existing intersection geometry is a 26-ft lane entering and exiting the subdivision. Autumn Path Lane westbound will operate at an acceptable LOS C during both the AM and PM peak hours after the full buildout of the Autumn Walk Subdivision expansion.

The unsignalized intersection capacity analyses shows a 95% queue length at the full buildout for the westbound traffic of two car lengths during both the AM and PM peak hours; therefore the existing storage at the intersection is adequate and no change is necessary.

Dry Gap Pike @ Autumn Path Lane
A southbound left turn lane is warranted at the intersection of Dry Gap Pike and Autumn Path Lane after the full buildout of the Autumn Walk Subdivision expansion. As of June 2018 the left turn lane has been built with a 100 foot storage length and a 120 foot bay taper length.

A northbound right turn lane is warranted at the intersection of Dry Gap Pike and Autumn Path Lane. Per the "TDOT – Roadway Design Guidelines" a bay taper of 133 feet and a minimum storage length of 50 feet is recommended for a 10 foot lane on a 40 mph road. FMA recommends the detailed design 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 an expansion of the Autumn Walk Subdivision on Dry Gap Pike. The project site is located at the existing intersection of Dry Gap Pike and Autumn Path Lane south of E. Beaver Creek Drive in Knox County. The location of the site is shown in Figure 1.

As of June 2018 the Autumn Walk Subdivision has 78 completed condominium units and 12 units under construction of the previously approved 116 units. Phase 5 would add an additional 32 condominium units bringing the total for the Autumn Walk Subdivision to 148 units. Construction for Phase 5 is proposed to take place this year and this study assumes full build out for the development will occur in 2021. 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 expansion of the subdivision.

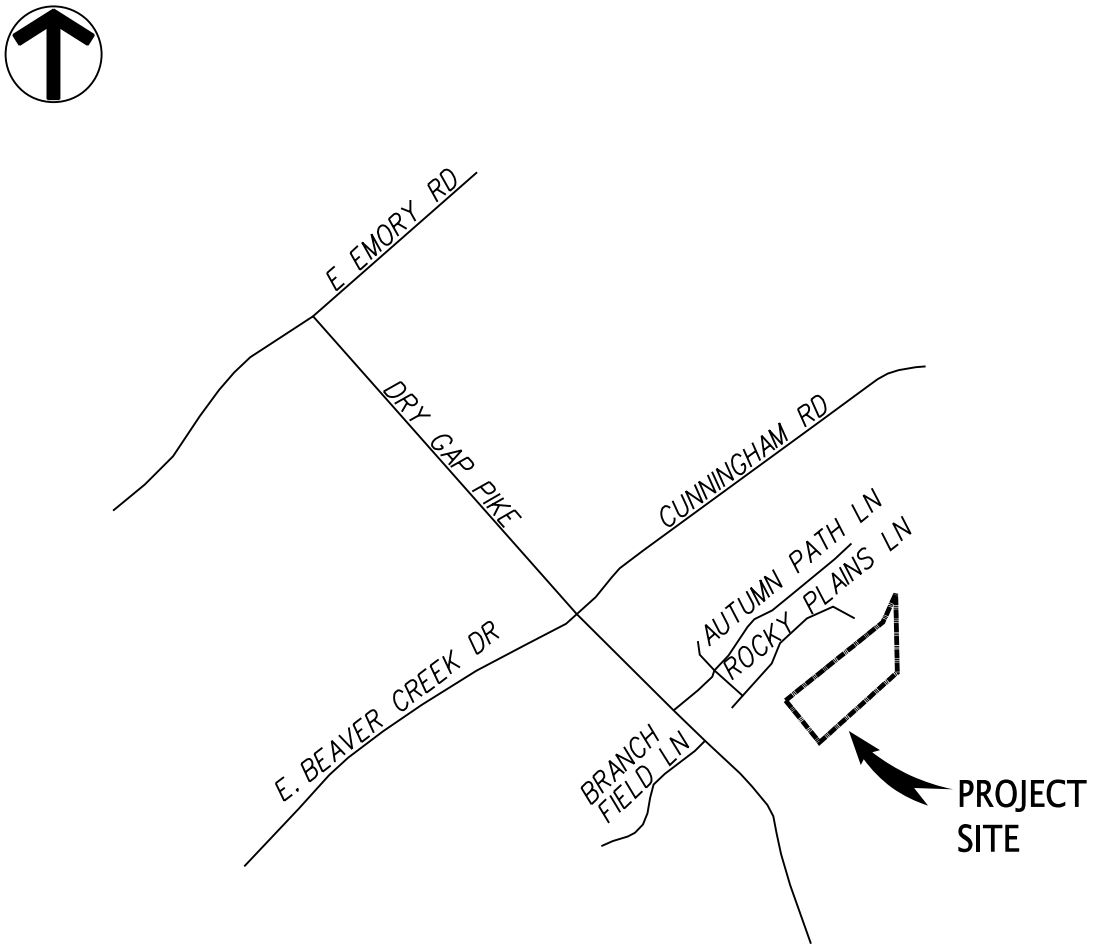


Figure 1: Location Map

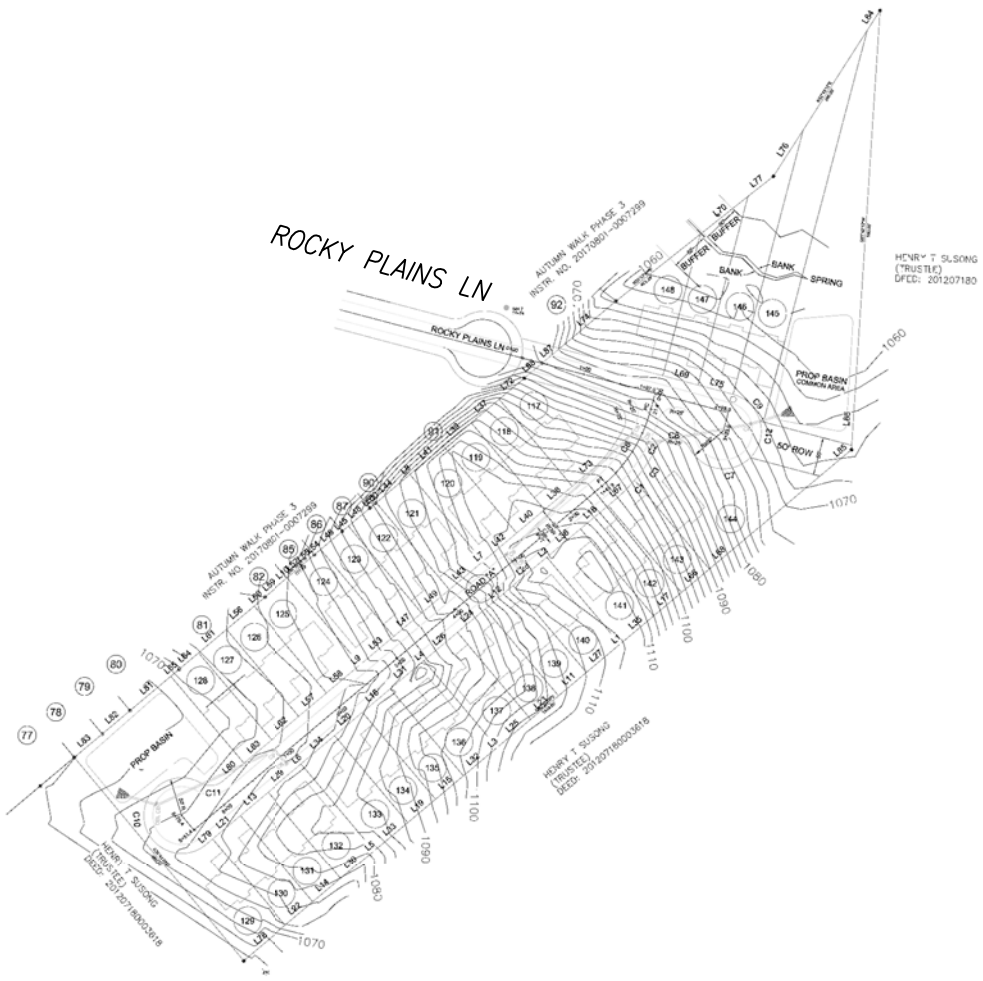


Figure 2: Site Plan

1.2 Existing Site Conditions

The existing subdivision site access currently ties into Dry Gap Pike approximately 1,110 feet south of the intersection of Dry Gap Pike and E. Beaver Creek Drive/Cunningham Road and approximately 375 feet north of the intersection of Dry Gap Pike and Branch Field Lane.

During a site visit it was determined that Autumn Path Lane is a two-lane road with a width of 26-ft at the existing project entrance. The posted speed limit on Autumn Path Lane is 25 mph. The Knoxville-Knox County Metropolitan Planning Commission does not list a classification for Autumn Path Lane per the Major Road Plan; therefore it is considered a local street. The intersection sight distance at the proposed driveway was measured to be in excess of 400-ft north and south of the intersection.

Dry Gap Pike is a two-lane road at the intersection of Autumn Path Lane with a posted speed limit of 40 mph. The Knoxville-Knox County Metropolitan Planning Commission classifies Dry Gap Pike as a Major Collector between E Emory Road and Dante Road with a right-of-way of 100 feet per the Major Road Plan.

2 Existing Traffic Volumes

Fulghum, MacIndoe & Associates (FMA) conducted an eight-hour turning movement count at the intersection of Dry Gap Pike and Autumn Path Lane on Tuesday March 22, 2016. The existing volume including the AM and PM peak hour traffic volumes at the count location is shown in Figure 3 and the count data collected is included in Attachment 1.

The current AM peak hour, and PM peak hour were determined using the eight-hour turning movement count that FMA conducted. The AM peak hour occurred between 7:00 am and 8:00 am and the PM peak hour occurred between 5:00 pm and 6:00 pm.

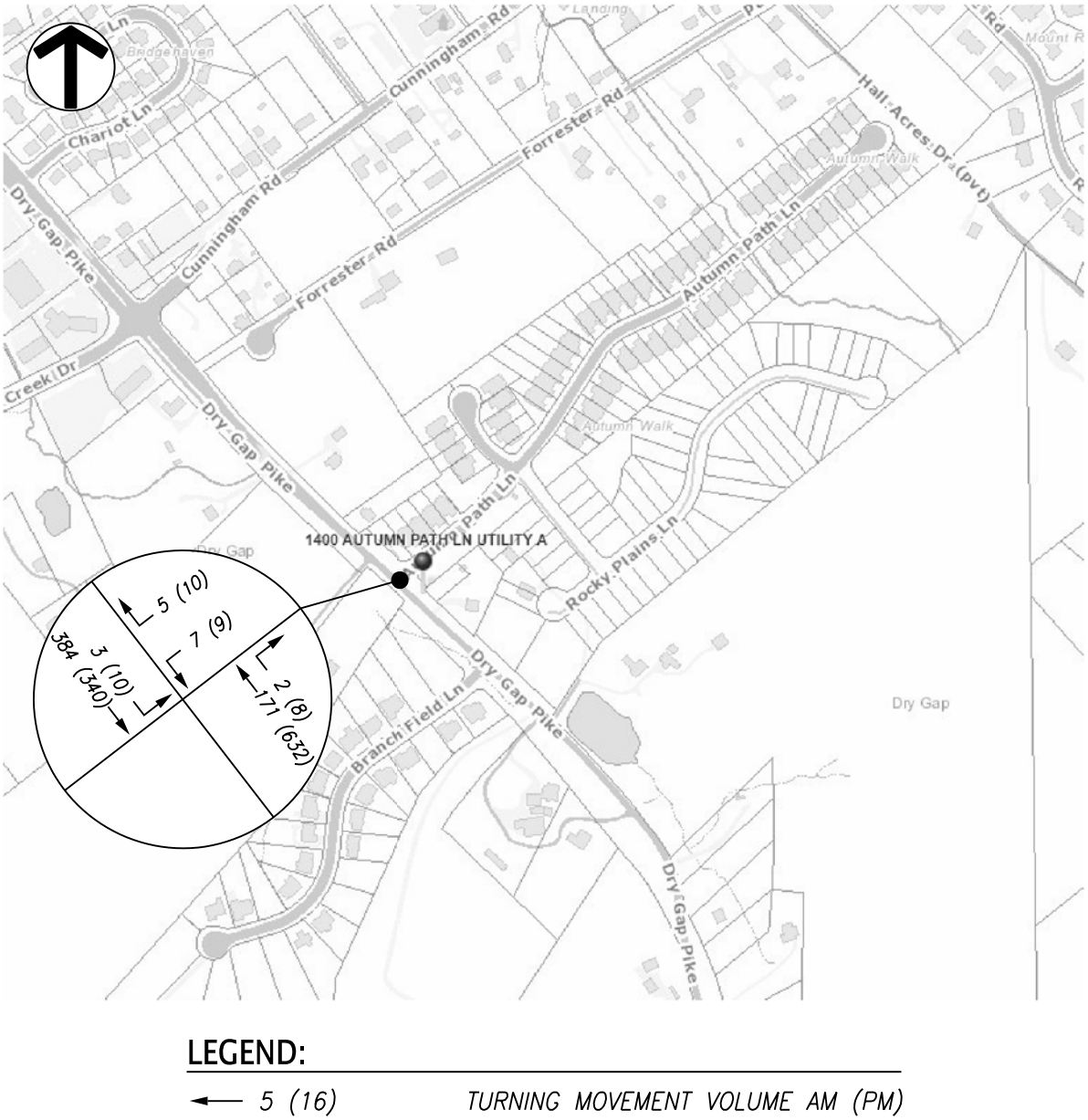


Figure 3: 2016 Existing Peak Hour Traffic

3 Background Growth

The Tennessee Department of Transportation (TDOT) and Knoxville Transportation Planning Organization (TPO) maintain count stations located north of the intersection of Autumn Path Lane at Dry Gap Pike.

TDOT count station #000469 is located on Dry Gap Pike south of E. Emory Road (SR 131) and north of E. Beaver Creek Drive. The annual traffic growth rate for this station over the last five years is approximately 4.24%.

TPO count station ID: 093M088 is located Dry Gap Pike south of E. Beaver Creek Drive. The annual growth rate for this station over the last ten years is approximately 1.76%.

For the purpose of this study, an annual growth rate of 3.0% for traffic at the intersection of Dry Gap Pike and Autumn Path Lane was assumed until full occupancy is reached in 2021. Attachment 2 shows the trend line growth charts for the TDOT and TPO count stations.

Figure 4 presents the projected background peak hour volumes at the intersections after applying the background growth rate to the existing traffic volumes.

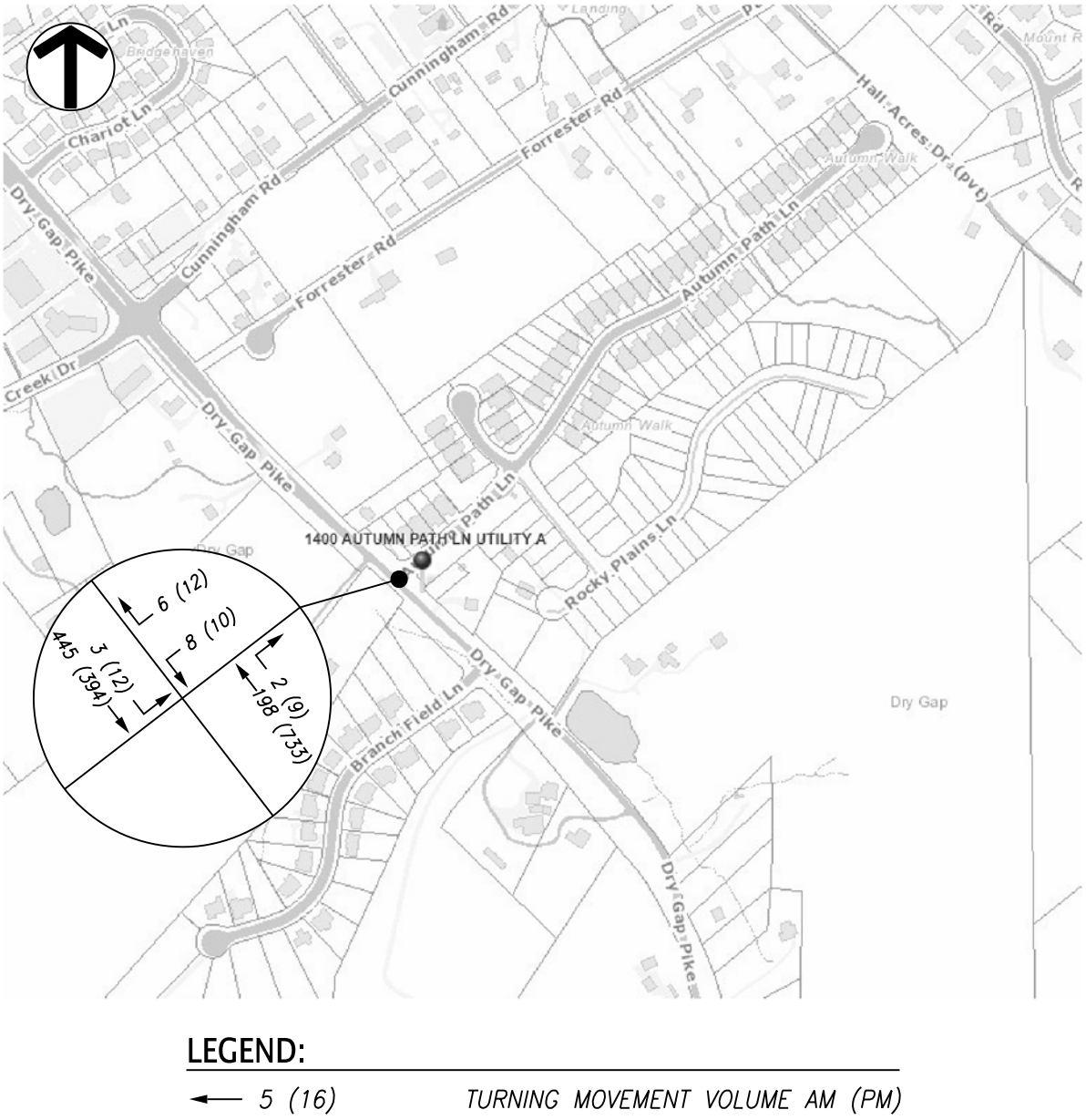


Figure 4: 2021 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the proposed single family housing using the fitted curve equations from The *Trip Generation,* 9th *Edition,* published by the Institute of Transportation Engineers. The land use worksheets are including in Attachment 7.

The total number of trips generated by 148 units or the proposed full buildout of the Autumn Walk Subdivision was estimated to be 1506 daily trips. During the peak hours the estimated trips are 113 trips during the AM peak hour and 150 trips during the PM peak hour.

A trip generation summary is shown in Table 4-1.

Table 4-1
Trip Generation Summary

Autumn Walk Subdivision – Full Buildout
Single-Family Detached Housing (Land Use 210)

	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	1506	50	50	753	753
A.M. Peak	113	25	75	28	85
P.M. Peak	150	63	37	95	56

The directional distribution of the traffic generated by the proposed Autumn Walk Subdivision was determined using the traffic data collected for the existing conditions. The typical weekday traffic pattern is for traffic to flow heavier in one direction in the morning peak period and then for the traffic to be heavier in the opposite direction during the evening peak period. Dry Gap Pike at the existing Project Entrance has a trip distribution of 30% northbound and 70% southbound during the AM peak hour and 65% northbound and 35% southbound during the PM peak hour.

Autumn Path Lane has a trip distribution for exiting traffic of 40% right turns and 60% left turns during the AM peak hour and 50% right turns and 50% left turns during the PM peak hour. Dry Gap Pike has a trip distribution for entering traffic onto Autumn Path Lane of 40% northbound right turns and 60% southbound left turns during the AM peak hour and 45% northbound right turns and 55% southbound left turns during the PM peak hour. The trip distribution for the Autumn Walk Subdivision is shown in Figure 5 and Figure 6.

Using the existing trip distribution the trips generated from the Autumn Walk Subdivision are shown in Figure 7. Figure 8 shows only the background thru traffic on Dry Gap Pike combined with the full buildout from the trip generation of Autumn Walk Subdivision.

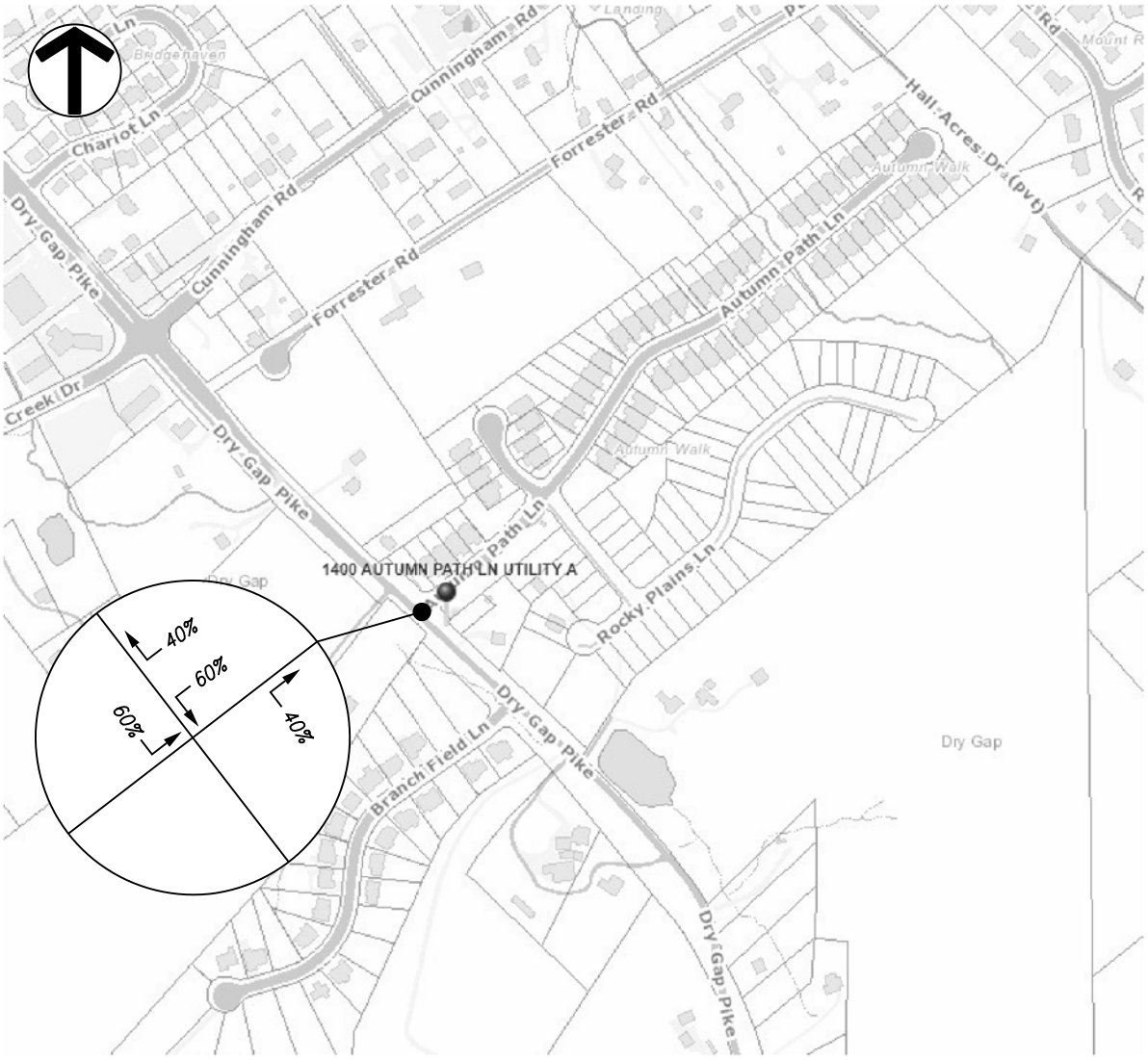


Figure 5: AM Peak Hour Trip Distribution

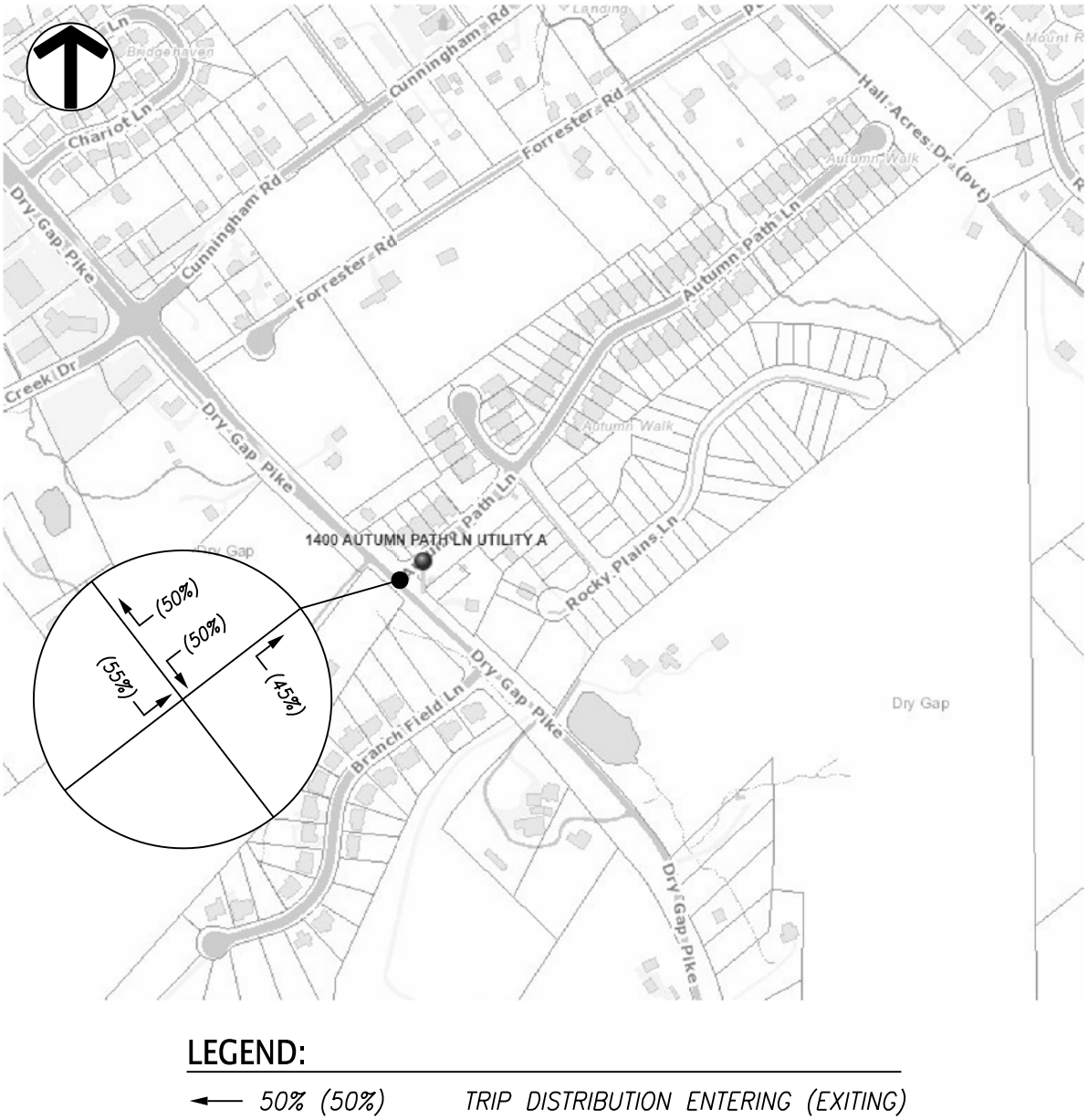


Figure 6: PM Peak Hour Trip Distribution

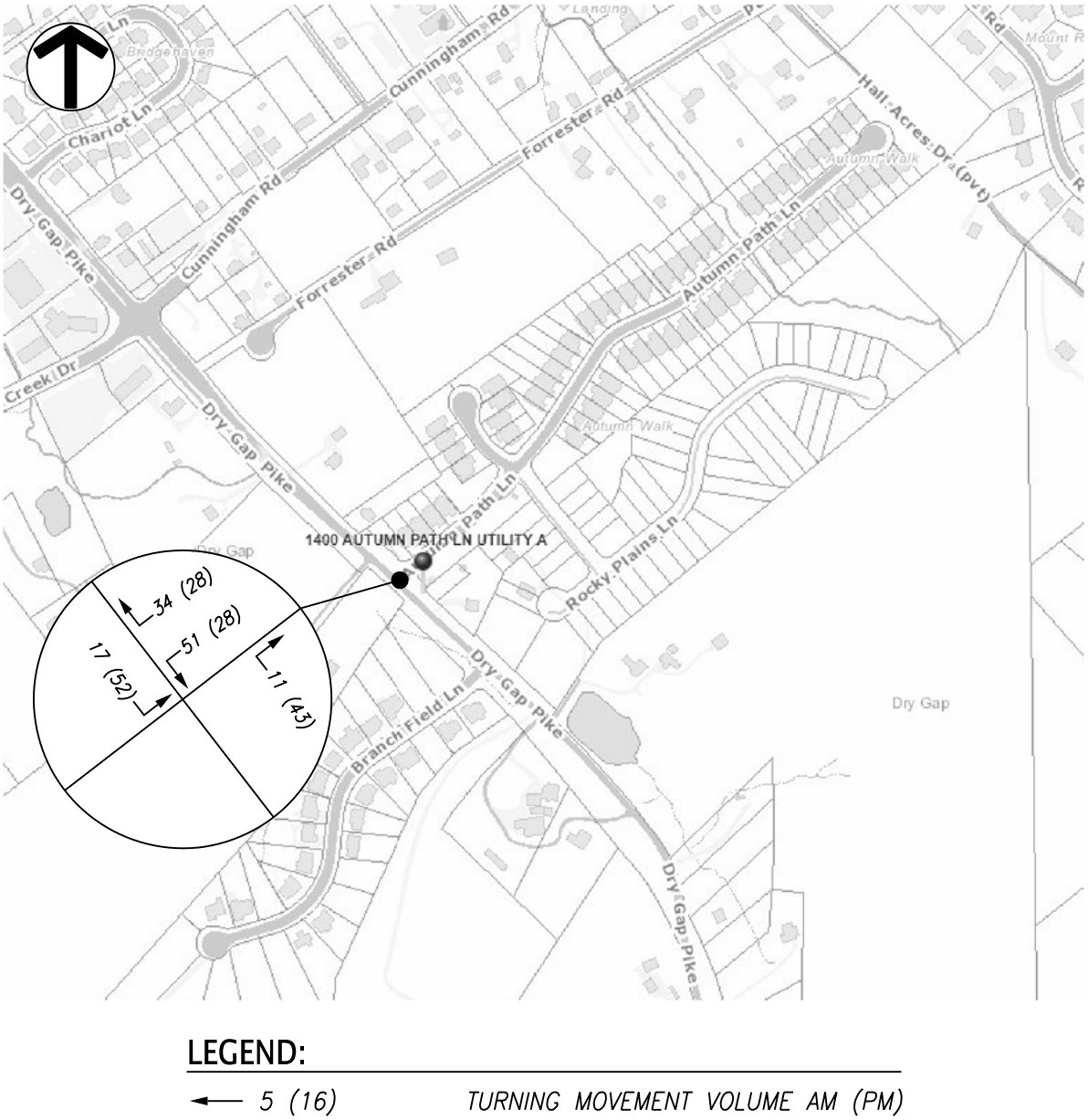


Figure 7: Peak Hour Site Traffic

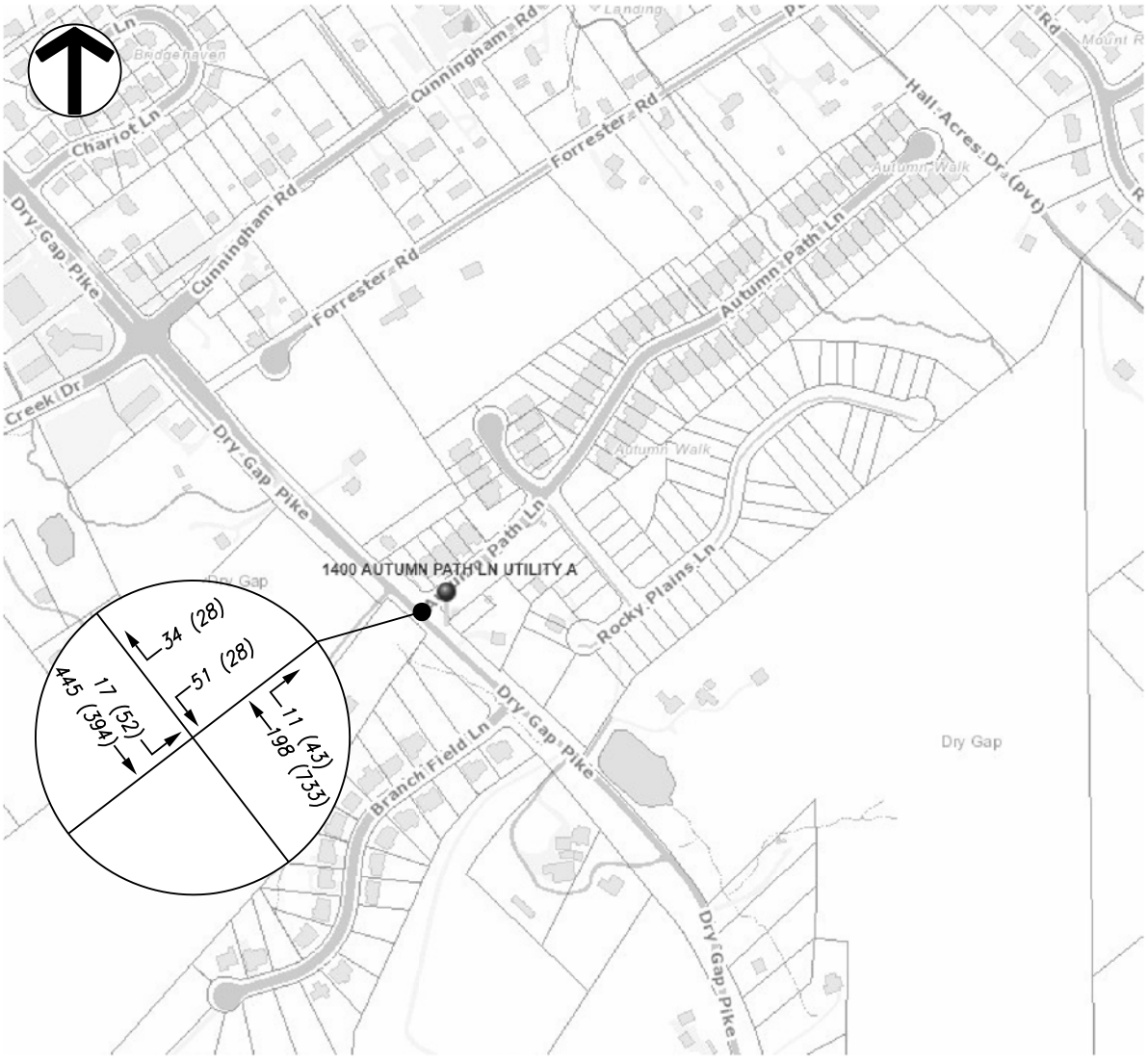


Figure 8: Peak Hour Full Buildout Traffic

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 intersection of Dry Gap Pike at Autumn Path Lane.

The results from the analyses are measured 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 HCS7 worksheets are included in Attachments 3, 4, and 5. Table 5-1 shows the results of the intersection capacity analyses.

Table 5-1

Intersection Analysis
Level of Service (LOS) Summary

	Approach	Delay (sec)/LOS
Dry Gap Pike @ Autumn Path Lane (Existing 2016)		
AM Peak	SB Approach	7.7 / A
	WB Approach	12.4 / B
PM Peak	SB Approach	8.9 / A
	WB Approach	16.4 / C
Dry Gap Pike @ Autumn Path Lane (Background Growth 2021)		
AM Peak	SB Approach	7.8 / A
	WB Approach	13.2 / B
PM Peak	SB Approach	9.3/ A
	WB Approach	18.9 / C
Dry Gap Pike @ Autumn Path Lane (Background Growth + Full Buildout 2021)		
AM Peak	SB Approach	7.8 / A
	WB Approach	16.5 / C
PM Peak	SB Approach	9.7 / A
	WB Approach	24.4 / C

6 Turn Lane Warrant Analysis

The intersection of Dry Gap Pike and Autumn Path Lane was evaluated to determine if a northbound right turn lane on Dry Gap Pike was warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information. A northbound right turn lane on Dry Gap Pike is warranted during the PM peak hour. The turn lane warrant worksheet and analysis is included in Attachment 6.

7 Conclusions and Recommendations

7.1 Autumn Path Lane

The existing intersection geometry is one 26-ft lane entering and exiting the subdivision. At the intersection of Dry Gap Pike and Autumn Path Lane the westbound approach currently operates at an acceptable LOS B during the AM peak hour and a LOS C during the PM peak hour. Autumn Path Lane westbound will operate at an acceptable LOS C during both the AM and PM peak hours after the full buildout of the Autumn Walk Subdivision.

The unsignalized intersection capacity analyses shows a 95% queue length at the full buildout for the westbound traffic of two car lengths during both the AM and PM peak hours; therefore the existing storage at the intersection is adequate and no change is necessary.

7.2 Dry Gap Pike @ Autumn Path Lane

At the intersection of Dry Gap Pike and Autumn Path Lane the southbound approach currently operates at an acceptable LOS A during both AM and PM peak hours. Dry Gap Pike southbound will continue to operate at a LOS A during both the AM and PM peak hours after the full buildout of the Autumn Walk Subdivision.

A northbound right turn lane is warranted at the intersection of Dry Gap Pike and Autumn Path Lane. This warrant is met only during the PM peak hour due to the high volume of traffic on Dry Gap Pike. The right turn lane warrant will be met after 77 of the 148 residential condominium units are completed. Per the "TDOT – Roadway Design Guidelines" a bay taper of 133 feet and a minimum storage length of 50 feet is recommended for a 10 foot lane on a 40 mph road. FMA recommends the detailed design be coordinated with Knox County Engineering and Public Works.

The minimum intersection spacing required for a collector is 300 feet per the "Minimum Subdivision Regulations" for Knoxville and Knox County. The nearest road intersection to the project entrance is currently 375 feet south at the intersection of Dry Gap Pike and Branch Field Lane. This intersection exceeds the typical minimum separation of 300 feet between roads on a collector street; therefore, no change is necessary.

The minimum required sight distance for a road with a posted speed limit of 40 mph is 400 feet in each direction in accordance with the "Minimum Subdivision Regulations" for Knoxville and Knox County. The existing intersection of Dry Gap Pike and Autumn Path Lane has a measured sight distance that exceeds 400-ft north and south of the intersection, which meets the requirement. FMA recommends any necessary landscaping that may be involved to maintain this sight distance and continue to comply with Knox County Engineering & Public Works.

Attachment 1
Traffic Counts

Project: Autumn Walk Subdivision
Intersection: Dry Gap Pike at Autumn Walk Lane
Date Conducted: Tuesday 3/22/2016

	Dry Gap Pike Northbound			Dry Gap Pike Southbound			Autumn Walk Lane Westbound			
Start	Thru	Right	Total	Left	Thru	Total	Left	Right	Total	Int. Total
7:00 AM	31	0	31	0	66	66	1	0	1	98
7:15 AM	38	0	38	2	92	94	2	2	4	136
7:30 AM	54	0	54	0	99	99	1	2	3	156
7:45 AM	48	2	50	1	127	128	3	1	4	182
Total	171	2	173	3	384	387	7	5	12	572
8:00 AM	25	2	27	2	58	60	3	2	5	92
8:15 AM	40	1	41	0	61	61	2	3	5	107
8:30 AM	30	0	30	3	56	59	3	3	6	95
8:45 AM	36	0	36	1	23	24	2	2	4	64
Total	131	3	134	6	198	204	10	10	20	358
11:00 AM	25	0	25	2	28	30	1	2	3	58
11:15 AM	41	1	42	2	42	44	2	3	5	91
11:30 AM	33	0	33	3	32	35	0	1	1	69
11:45 AM	39	0	39	3	29	32	2	2	4	75
Total	138	1	139	10	131	141	5	8	13	293
12:00 PM	36	3	39	3	47	50	0	2	2	91
12:15 PM	36	1	37	1	40	41	1	2	3	81
12:30 PM	46	0	46	9	38	47	2	2	4	97
12:45 PM	43	2	45	2	37	39	3	1	4	88
Total	161	6	167	15	162	177	6	7	13	357
2:00 PM	57	1	58	2	47	49	0	4	4	111
2:15 PM	66	0	66	2	36	38	0	0	0	104
2:30 PM	65	3	68	2	46	48	2	2	4	120
2:45 PM	57	2	59	4	57	61	0	2	2	122
Total	245	6	251	10	186	196	2	8	10	457
3:00 PM	59	0	59	2	57	59	1	0	1	119
3:15 PM	58	4	62	5	61	66	1	2	3	131
3:30 PM	76	3	79	0	59	59	2	0	2	140
3:45 PM	97	2	99	3	47	50	3	2	5	154
Total	290	9	299	10	224	234	7	4	11	544
4:00 PM	89	1	90	1	71	72	1	2	3	165
4:15 PM	93	2	95	5	52	57	0	5	5	157
4:30 PM	121	6	127	4	63	67	3	3	6	200
4:45 PM	129	1	130	3	69	72	0	3	3	205
Total	432	10	442	13	255	268	4	13	17	727
5:00 PM	168	4	172	3	79	82	4	3	7	261
5:15 PM	147	2	149	4	92	96	1	1	2	247
5:30 PM	159	2	161	1	89	90	2	3	5	256
5:45 PM	158	0	158	2	80	82	2	3	5	245
Total	632	8	640	10	340	350	9	10	19	1009
Grand Total	2200	45	2245	77	1880	1957	50	65	115	4317
Approach %	98.0	2.0		3.9	96.1		43.5	56.5		
Total %	51.0	1.0	52.0	1.8	43.5	45.3	1.2	1.5	2.7	

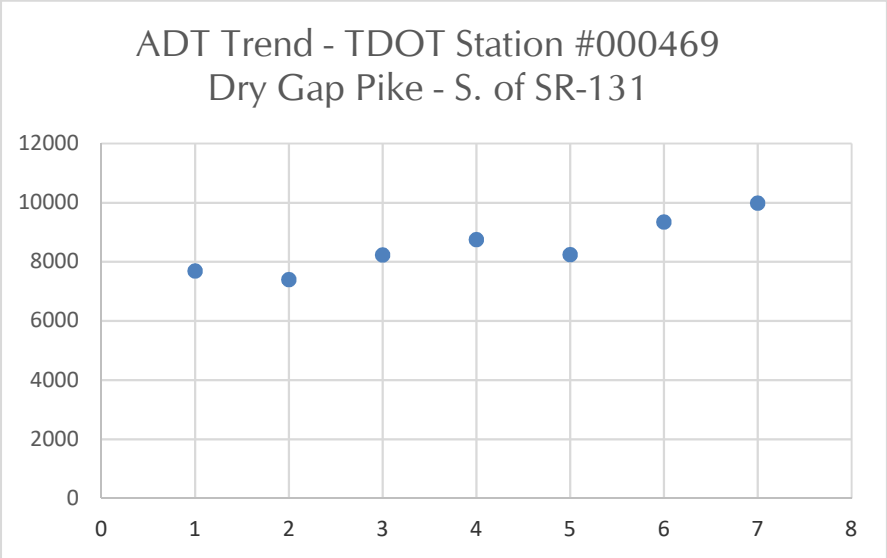
Project: Autumn Walk Subdivision
Intersection: Dry Gap Pike at Autumn Path Lane
Date Conducted: Tuesday 3/22/2016

AM Peak Hour	7:00 AM - 8:00 AM	572
Lunch Peak Hour	12:00 PM - 1:00 PM	357
PM Peak Hour	5:00 PM - 6:00 PM	1009

	Dry Gap Pike Northbound			Dry Gap Pike Southbound			Autumn Walk Lane Westbound			
Start	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:15 AM										
7:00 AM	31	0	31	0	66	66	1	0	1	98
7:15 AM	38	0	38	**2**	92	94	2	**2**	4	136
7:30 AM	**54**	0	54	0	99	99	1	2	3	156
7:45 AM	48	**2**	50	1	**127**	128	**3**	1	4	**182**
Total Volume	171	2	173	3	384	387	7	5	12	572
Future (3% over 5 yrs)	198	2		3	445		8	6		663
PHF	0.79	0.25		0.38	0.76		0.58	0.63		0.79
Peak Hour Analysis from 11:00 AM to 1:00 PM										
Lunch Peak Hour begins at 11:45 PM										
12:00 PM	36	**3**	39	3	**47**	50	0	**2**	2	91
12:15 PM	36	1	37	1	40	41	1	2	3	81
12:30 PM	**46**	0	46	**9**	38	47	2	2	4	**97**
12:45 PM	43	2	45	2	37	39	**3**	1	4	88
Total Volume	161	6	167	15	162	177	6	7	13	357
Future (3% over 5 yrs)	187	7		17	188		7	8		414
PHF	0.88	0.50		0.42	0.86		0.50	0.88		0.92
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	**168**	**4**	172	3	79	82	**4**	**3**	7	**261**
5:15 PM	147	2	149	**4**	**92**	96	1	1	2	247
5:30 PM	159	2	161	1	89	90	2	3	5	256
5:45 PM	158	0	158	2	80	82	2	3	5	245
Total Volume	632	8	640	10	340	350	9	10	19	1009
Future (3% over 5 yrs)	733	9		12	394		10	12		1170
PHF	0.94	0.50		0.63	0.92		0.56	0.83		0.97

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2010	7686
2	2011	7397
3	2012	8233
4	2013	8752
5	2014	8246
6	2015	9344
7	2016	9979

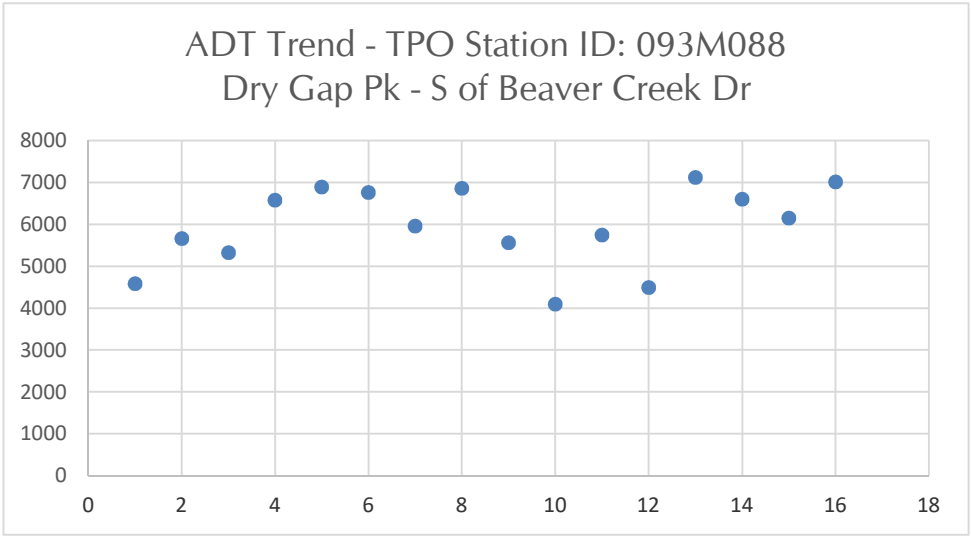


Most Recent Trend Line Growth

Year	ADT
2012	8233
2016	9979

Annual Percent Growth **4.24%**

	Year	Adjusted Average Daily Traffic
1	2001	4580
2	2002	5660
3	2003	5320
4	2004	6580
5	2005	6893
6	2006	6760
7	2007	5960
8	2008	6860
9	2009	5560
10	2010	4090
11	2011	5740
12	2012	4490
13	2013	7120
14	2014	6600
15	2015	6150
16	2016	7010



Most Recent Trend Line Growth

Year	ADT
2007	5960
2016	7010

Annual Percent Growth **1.76%**

Attachment 3
Intersection Worksheets – Existing AM/PM Peaks

HCS7 Two-Way Stop-Control Report

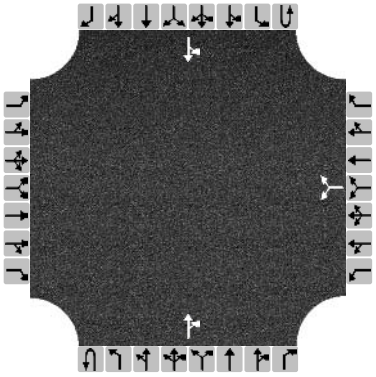
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2016
Time Analyzed	Existing AM Peak
Intersection Orientation	North-South
Project Description	567.001 - Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.79
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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)						7		5			171	2		3	384	
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)							15							4		
Capacity, c (veh/h)							501							1349		
v/c Ratio							0.03							0.00		
95% Queue Length, Q_{95} (veh)							0.1							0.0		
Control Delay (s/veh)							12.4							7.7		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						12.4								0.1		
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

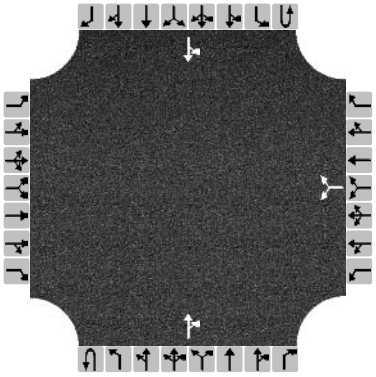
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2016
Time Analyzed	Existing PM Peak
Intersection Orientation	North-South
Project Description	567.001 Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.97
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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)						9		10			632	8		10	340	
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)							19							10		
Capacity, c (veh/h)							336							928		
v/c Ratio							0.06							0.01		
95% Queue Length, Q_{95} (veh)							0.2							0.0		
Control Delay (s/veh)							16.4							8.9		
Level of Service, LOS							C							A		
Approach Delay (s/veh)						16.4								0.4		
Approach LOS						C										

Attachment 4
Intersection Worksheets – Background AM/PM Peaks

HCS7 Two-Way Stop-Control Report

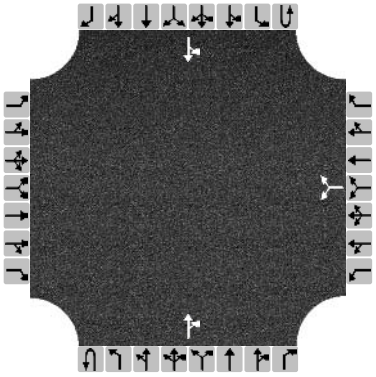
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2021
Time Analyzed	Background AM Peak
Intersection Orientation	North-South
Project Description	567.001 - Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.79
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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)						8		6			198	2		3	445	
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)							18							4		
Capacity, c (veh/h)							456							1310		
v/c Ratio							0.04							0.00		
95% Queue Length, Q_{95} (veh)							0.1							0.0		
Control Delay (s/veh)							13.2							7.8		
Level of Service, LOS							B							A		
Approach Delay (s/veh)							13.2							0.1		
Approach LOS							B									

HCS7 Two-Way Stop-Control Report

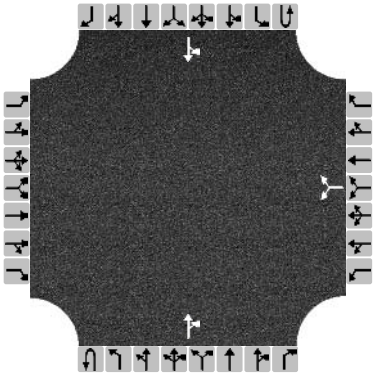
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2021
Time Analyzed	Background PM Peak
Intersection Orientation	North-South
Project Description	567.001 Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.97
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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)						10		12			733	9		12	394	
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)							22							12		
Capacity, c (veh/h)							280							848		
v/c Ratio							0.08							0.01		
95% Queue Length, Q_{95} (veh)							0.3							0.0		
Control Delay (s/veh)							18.9							9.3		
Level of Service, LOS							C							A		
Approach Delay (s/veh)						18.9								0.4		
Approach LOS						C										

Attachment 5
Intersection Worksheets – Full Buildout AM/PM Peaks

HCS7 Two-Way Stop-Control Report

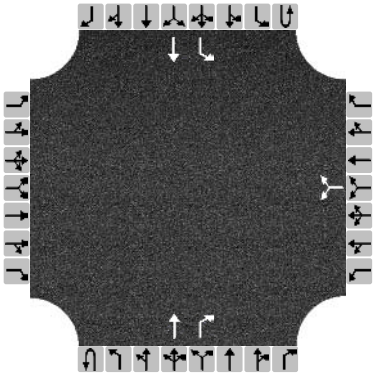
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2021
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	North-South
Project Description	567.001 - Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.79
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	1	0	1	1	0
Configuration							LR				T	R		L	T	
Volume, V (veh/h)						51		34			198	11		17	445	
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)							108							22		
Capacity, c (veh/h)							421							1298		
v/c Ratio							0.26							0.02		
95% Queue Length, Q_{95} (veh)							1.0							0.1		
Control Delay (s/veh)							16.5							7.8		
Level of Service, LOS							C							A		
Approach Delay (s/veh)						16.5								0.3		
Approach LOS						C										

HCS7 Two-Way Stop-Control Report

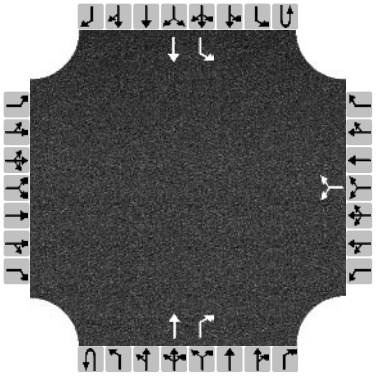
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/1/2018
Analysis Year	2021
Time Analyzed	Full Buildout PM Peak
Intersection Orientation	North-South
Project Description	567.001 Autumn Walk Subdivision

Site Information

Intersection	Dry Gap Pk @ Autumn Path
Jurisdiction	Knox County
East/West Street	Autumn Path Lane
North/South Street	Dry Gap Pike
Peak Hour Factor	0.97
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
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	1	0	1	1	0
Configuration							LR				T	R		L	T	
Volume, V (veh/h)						28		28			733	43		52	394	
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)							58							54		
Capacity, c (veh/h)							243							822		
v/c Ratio							0.24							0.07		
95% Queue Length, Q_{95} (veh)							0.9							0.2		
Control Delay (s/veh)							24.4							9.7		
Level of Service, LOS							C							A		
Approach Delay (s/veh)						24.4								1.1		
Approach LOS						C										

Attachment 6
Turn Lane Warrant Analysis

Project: Autumn Walk Subdivision

Dry Gap Pike
at Autumn Path Lane

RIGHT TURN	VOLUMES Thru	RT	RT MAX	Warrant Met
AM	198	11	24	NO
PM	733	43	24	YES

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

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				
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	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			PM Peak 43 RT	Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes 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.

Attachment 7
Trip Generation

Project: Autumn Walk Subdivision Expansion
Date Conducted: 6/21/2018

Single-Family Detached Housing (Land Use 210)
148 Units

Average Daily Traffic
$Ln(T) = 0.92Ln(X) + 2.72$
$Ln(T) = 0.92Ln(148) + 2.72$
$T = 1506$

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
$T = 0.70(X) + 9.74$
$T = 0.70(148) + 9.74$
$T = 113$

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
$Ln(T) = 0.90Ln(X) + 0.51$
$Ln(T) = 0.90Ln(X) + 0.51$
$T = 150$

		Percent		Number	
Time Period	Total Trips	Enter	Exit	Enter	Exit
Weekday (24 hours)	1506	50%	50%	753	753
AM Peak Hour	113	25%	75%	28	85
PM Peak Hour	150	63%	37%	95	56

Single-Family Detached Housing
(210)

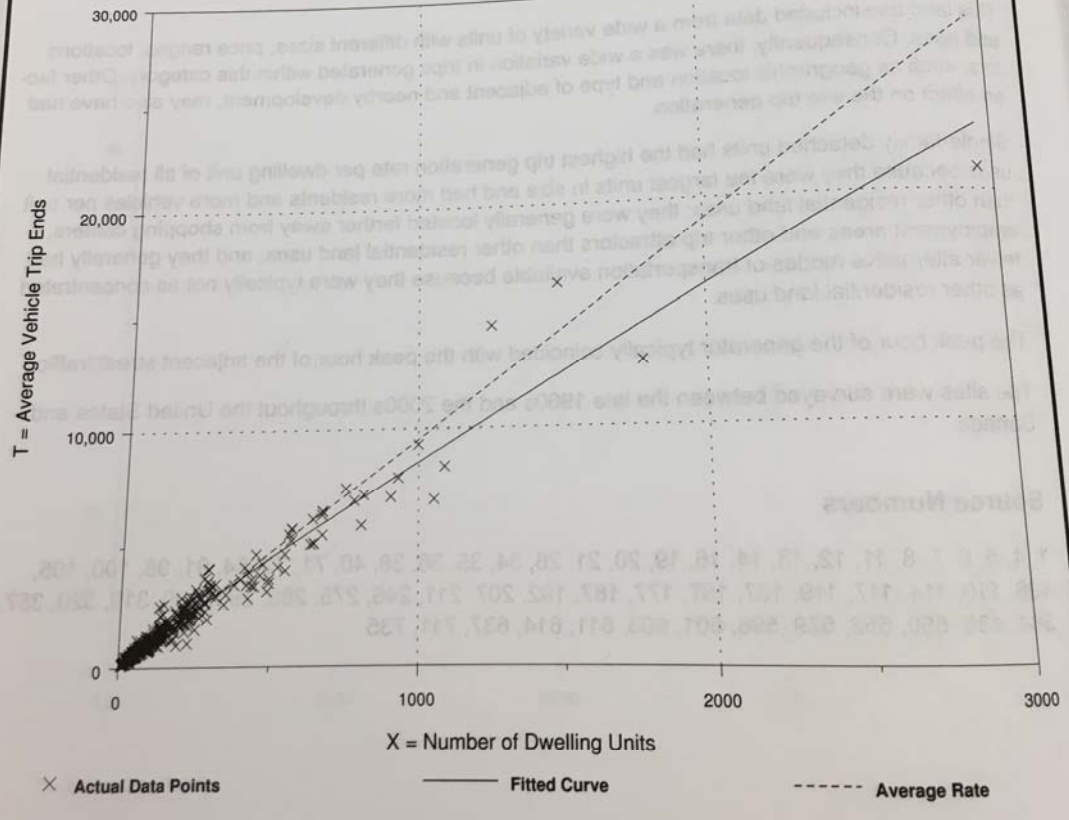
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 355
Avg. Number of Dwelling Units: 198
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.52	4.31 - 21.85	3.70

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.92\ Ln(X) + 2.72$

$R^2 = 0.95$

Single-Family Detached Housing
(210)

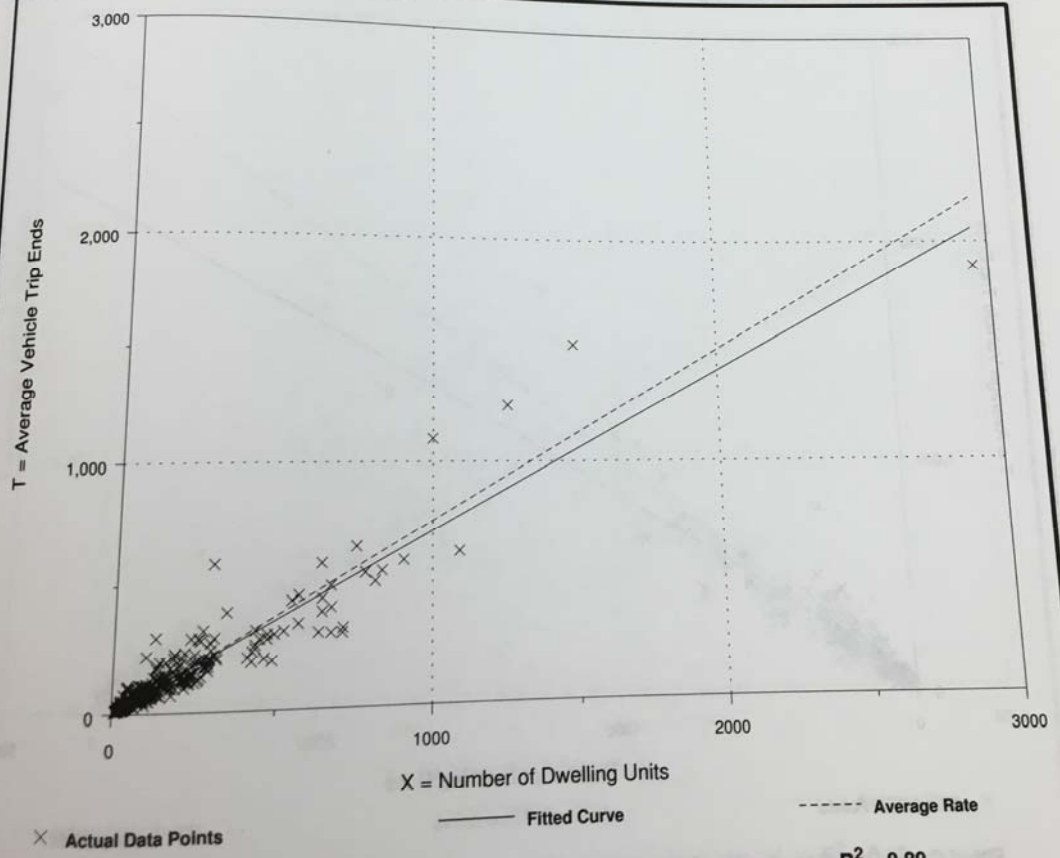
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 292
Avg. Number of Dwelling Units: 194
Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.75	0.33 - 2.27	0.90

Data Plot and Equation



$R^2 = 0.89$

Fitted Curve Equation: T = 0.70(X) + 9.74

Single-Family Detached Housing
(210)

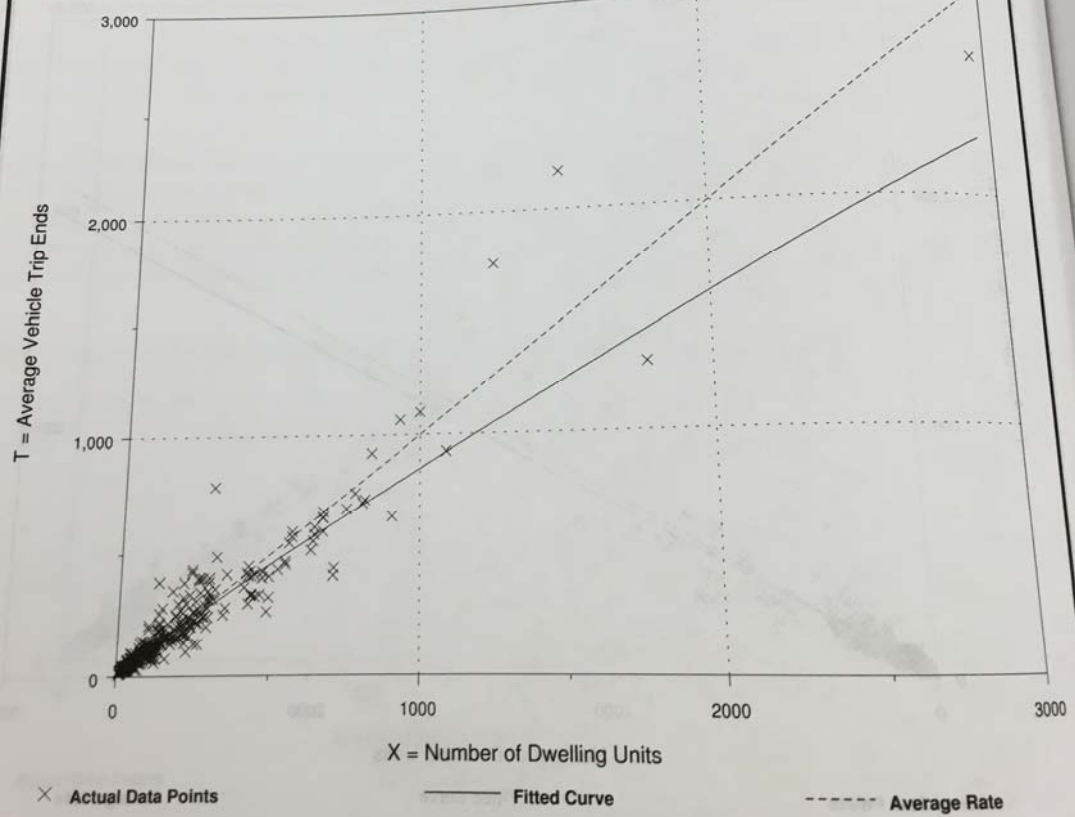
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 321
Avg. Number of Dwelling Units: 207
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.00	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.90\ Ln(X) + 0.51$

$R^2 = 0.91$

Date: September 4, 2018

Project Name: Autumn Walk Subdivision Phase 4

To: MPC and Knox County Engineering & Public Works

Subject: TIS Comment Response Document for the Autumn Walk Subdivision Phase 4 Review Comments Dated August 30, 2018

Dear MPC and Knox County staff,

The following comment response document is submitted to address comments dated August 30, 2018:

1. **Reviewer Comment: On page 3 first paragraph and page 4 second paragraph, the previously approved units were 116, not 117. Please revise.**

   Response: Revised previously approved unit count to 116.

2. **Reviewer Comment: On all Figures, the highlighted area is not where the expansion of the subdivision is taking place. Please revise this location map with the appropriate location of the expansion for this application.**

   Response: Revised the location map and updated the background map for figures 3-8.

3. **Reviewer Comment: On page 19 first paragraph, please relook at the number of residential condominiums that are completed. The review team believes there have been 148 units completed at the time of our review.**

   Response: Updated the report to read "77 of the 148 residential condominium units"

4. **Reviewer Comment: Please address revision comments by John Sexton with Knox County Engineering in the attachment.**

   Response: Completed

Knox County Comments dated July 18, 2018:

1. **Reviewer Comment: Page 2**
    a. **Please add page numbers for the figures.**
    b. **Title of Figure 7 should be "Peak Hour Site Traffic"**
    c. **Title of Figure 8 should be "Peak Hour Full Buildout Traffic"**
    d. **The Trip Generation worksheets should be added to the attachment.**

    Response: Revised the figures on page 2, added page numbers and added the trip generation worksheets to the list of attachments.

2. **Reviewer Comment: Page 3**
    a. **First paragraph, lines 3 and 4 – change "Beaver Creek Dr" to "E. Beaver Creek Drive".**
    b. **Under "Autumn Path Lane", first paragraph, line 1 – change geometry to "26-ft lane entering and exiting".**
        i. **Same paragraph, last line – add "expansion" after "subdivision".**
    c. **Under "Dry Gap Pike @ Autumn Path Lane", first paragraph, line 2 – add "expansion" after "subdivision".**
        i. **Same paragraph, line 3 – add "bay" after "120 foot".**
        ii. **Second paragraph, line 3 – the proposed 100-foot bay taper is less than per TDOT L=WS/3. At 40 mph, the bay taper for a 10-foot lane is 133 feet.**

    Response: Revised page 3 per Knox County comments and updated the right turn lane dimensions per TDOT recommendations.

3. **Reviewer Comment: Page 4**
    a. **First paragraph, lines 1 and 2 – rewrite "was performed for an expansion of Autumn Walk ..."**
        i. **Line 3 – change "Beaver Creek Drive" to "E. Beaver Creek Drive".**
    b. **Third paragraph, line 3 – change "development" to "expansion" and delete "proposed".**

    Response: Revised page 4 per Knox County comments.

4. **Reviewer Comment: Page 5 - In Figure 1, add "E." to "Beaver Creek Dr"**

    Response: Revised Figure 1 to add "E. Beaver Creek Dr"

5. **Reviewer Comment: Page 7**

    a. **Under "Existing Site Conditions, first paragraph, lines 3 and 4 – change "Beaver Creek Dr" to "E. Beaver Creek Drive".**
        i. **Third paragraph, last line – spell out right-of-way.**

b. **Under "Existing Traffic Volumes", first paragraph, line 1 – replace "FMA" with "Fulghum MacIndoe and Associates (FMA)"**
    i. **Same paragraph, line 2 – the turning movement count is from 2016. It would have been prefereable to have a count less than one year old.**
    ii. **Same paragraph, line 3 – rewrite "count location is"**

Response: Revised page 7 per Knox County comments.

6. **Reviewer Comment: Page 9**
    a. **Second paragraph, line 1 - replace "SR 131" with "E. Emory Road (SR 131)".**
        i. **Same paragraph, line 2 – change "Beaver Creek Drive" to "E. Beaver Creek Drive".**
    b. **Third paragraph, line 1 – change "Beaver Creek Drive" to "E. Beaver Creek Drive".**
    c. **Paragraph 5, line 1 – change "demonstrates" to "presents".**
        i. **Same paragraph, line 2 – change "conditions" to "traffic volumes".**

Response: Revised page 9 per Knox County comments.

7. **Reviewer Comment: Page 11**
    a. **The engineer has used single family detached housing for the land use. Is this the most appropriate land use for this development?**

    Response: Single Family Detached Housing is what Cindy Pionke recommended using for the development in 2016 in order to be conservative.

    b. **The engineer has done trip generation for the total number of units. It would seem more reasonable to have done a recent count and then done trip generation for approved and proposed units not yet built.**

    Response: I spoke with John Sexton about the traffic count and it was decided that the 2016 traffic count would be adequate for this study.

    c. **Please add the pages from Trip Generation used in the study to the attachments.**

    Response: Added the trip generation worksheet and the pages from the Trip Generation 9th edition to Attachment 7.

8. **Reviewer Comment: Page 18**
    a. **Under "Turn Lane Warrant Analysis", line 2 – delete "or a southbound left turn" since it has been stated that the left-turn lane exists.**
        i. **Same paragraph, Lines 6 and 7 – delete "A southbound left turn lane on Dry Gap Pike is warranted during the PM peak hour" since it has been stated that the left-turn lane exists.**
        ii. **Same paragraph, line 7 – rewrite "worksheet and analysis is…"**
    b. **Under "Autumn Path Lane", first paragraph, line 1 – change geometry to "26-ft lane entering and exiting"**
    c. **Under "Dry Gap Pike @ Autumn Path Lane", delete the second paragraph since it has been stated that the left-turn lane exists.**

    Response: Revised page 18 per Knox County comments.

9. **Reviewer Comment: Page 19**
    a. **First paragraph, line 6 – add "bay" before "taper".**
        i. **Same paragraph, line 7 – see comments from page 3 regarding the proposed bay taper length.**

    Response: Revised page 18 per Knox County comments.
    Response: Added the following to page 19 "Per the "TDOT – Roadway Design Guidelines" a bay taper of 133 feet and a minimum storage length of 50 feet is recommended for a 10 foot lane on a 40 mph road. FMA recommends the detailed design be coordinated with Knox County Engineering and Public Works."

10. **Reviewer Comment: Attachment 6 – Delete the left-turn lane warrant analysis since this lane exists.**

    Response: Revised Attachment 6 and deleted the left-turn lane warrant analysis.

11. **Reviewer Comment: Attachment Other – Add the pages from Trip Generation used in the study to the attachments.**

    Response: Added Attachment 7 – Trip Generation and included both the worksheet and the pages from the Trip Generation 9th edition.

Sincerely,

Addie Kirkham, P.E.