

# TAZEWELL PIKE RESIDENTIAL DEVELOPMENT

## KNOX COUNTY, TENNESSEE

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TRAFFIC IMPACT STUDY

TAZEWELL PIKE  
KNOX COUNTY, TENNESSEE

CCI PROJECT NO. 00773-0017

PREPARED FOR:

Southland Engineering  
Consultants  
4909 Ball Road  
Knoxville, TN 37931

SUBMITTED BY:

Cannon & Cannon, Inc.  
8550 Kingston Pike  
Knoxville, TN 37919  
865.670.8555



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December 22

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## EXECUTIVE SUMMARY

This report provides a summary of a traffic impact study that was performed for a proposed single-family residential development on Tazewell Pike in Knox County, Tennessee. The project site is located on the west side of Tazewell Pike north of Harbison Crossroads and Gibbs Elementary, Middle, and High Schools in the Gibbs Community. The development plan for this project 144 single-family residential units. The proposed development will create two new full-movement access locations onto Tazewell Pike. The southern access point (Access #1) will provide access to 139 units and the northern access (Access #2) will provide access to 5 units.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon roadways in the vicinity of the project site. Discussion with Knox County and the Tennessee Department of Transportation staff resulted in the two proposed site access intersections at Tazewell Pike being identified for detailed study. Appropriate intersection evaluations such as capacity analyses, intersection sight distance analyses, and turn lane warrant evaluations were conducted at the study intersections for existing and future conditions, both with and without site generated traffic, in order to determine the anticipated impacts and to establish recommended measures to mitigate these impacts.

The primary conclusion of this study is that the traffic generated from the proposed development will not have a significant impact on the studied site access intersections at Tazewell Pike. Intersection levels-of-service are expected to be "B" or better exiting the site during peak traffic periods for each of the site access intersections during peak traffic periods.

The following is a listing of recommendations that were developed to address traffic concerns in the vicinity of the project site:

1. Tazewell Pike at Access Point #1:
  - a. Install an eastbound approach leg (Proposed Access #1) to create the intersection of Access #1 at Tazewell Pike.
  - b. Install northbound left-turn lane with 100-foot storage lane and 330-foot tapers
2. Tazewell Pike at Access Point #2:
  - a. Install an eastbound approach leg (Proposed Access #2) to create the intersection of Access #2 at Tazewell Pike.
3. Maintain intersection corner sight distances on the site access locations by ensuring that site grading, landscaping, signage, and other site features do not restrict intersection sight distance lines of sight.

## INTRODUCTION & PURPOSE OF STUDY

This report provides a summary of a traffic impact study that was performed for a proposed single-family residential development on Tazewell Pike in Knox County, Tennessee. The project site is located on the west side of Tazewell Pike north of Harbison Crossroads and Gibbs Elementary, Middle, and High Schools in the Gibbs Community. FIGURE 1 is a location map showing the major roadways in the project site vicinity.



**FIGURE 1  
LOCATION MAP**

The development plan for this project 144 single-family residential units. The proposed development will create two new full-movement access locations onto Tazewell Pike. The southern access point (Access #1) will provide access to 139 units and the northern access (Access #2) will provide access to 5 units. FIGURE 2 is a Conceptual Site Plan detailing the proposed site.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon roadways in the vicinity of the project site. Discussion with Knox County and the Tennessee Department of Transportation staff resulted in the two proposed site access intersections at Tazewell Pike being identified for detailed study. Appropriate intersection evaluations such as capacity analyses, intersection sight distance analyses, and turn lane warrant evaluations were conducted at the study intersections for existing and future conditions, both with and without site generated traffic, in order to determine the anticipated impacts and to establish recommended measures to mitigate these impacts.

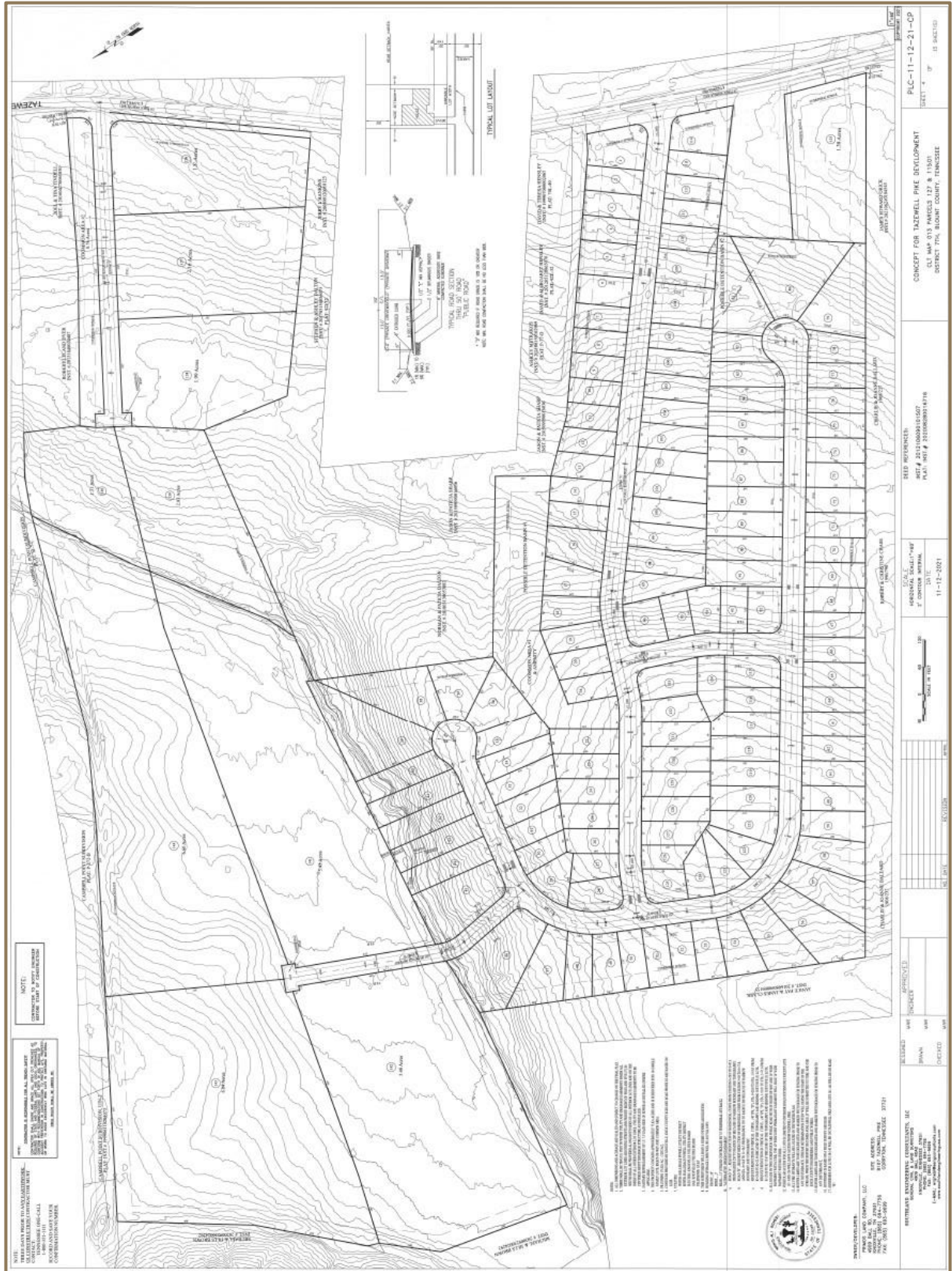


FIGURE 2  
CONCEPTUAL SITE PLAN

## **EXISTING CONDITIONS**

### **EXISTING ROADWAY CONDITIONS**

Roadway conditions for the study roadways are summarized as follows:

- Tazewell Pike (SR 131) is a two-lane roadway with one lane in each direction within the vicinity of the proposed site. It is classified as a minor arterial per the Knoxville-Knox County Planning Major Road Plan. Lane widths are 10-11 feet with open shoulders on both sides of Tazewell Pike and the posted speed limit is 45 mph.

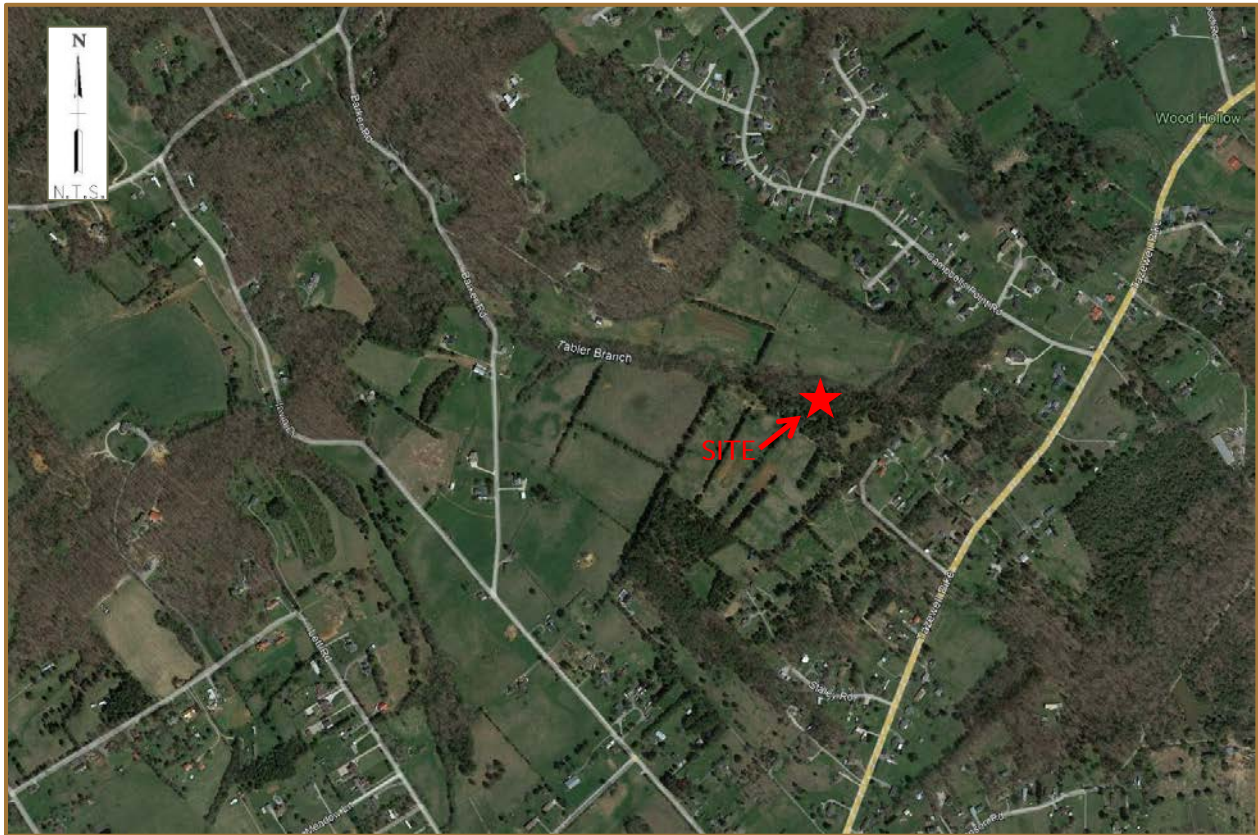
Traffic control for the study intersection is as follows:

- Access Point #1 & Access Point #2 at Tazewell Pike are proposed to be side-street STOP controlled.

### **EXISTING SITE CONDITIONS**

The proposed development is located on the west side of Tazewell Pike north of Harbison Crossroads and Gibbs Elementary, Middle, and High Schools. The site will be adjacent to existing single family residential development and cross Tabler Branch to four (4) "estate" lots ranging in size from 5 to 6 acres. FIGURE 3 provides an aerial view of the project site and the surrounding area.





**FIGURE 3**  
**EXISTING SITE CONDITIONS**

**EXISTING TRAFFIC DATA**

Two types of existing traffic data were gathered for this study. The Tennessee Department of Transportation (TDOT) collects annual average daily traffic (AADT) data on roadways in the study area. Two count stations were found near the project site that were felt to have particular relevance for this study. The most currently available data from this station is contained in Table 1.

**TABLE 1: ANNUAL AVERAGE DAILY TRAFFIC COUNT SUMMARY**

COUNT YEAR	TDOT COUNT STATION 47000205 TAZEWELL PIKE NORTH OF PROPOSED SITE	TDOT COUNT STATION 47000006 TAZEWELL PIKE SOUTH OF PROPOSED SITE
2016	4,742	7,258
2017	4,911	7,202
2018	5,141	8,153
2019	5,426	7,958
2020	4,512	7,390

In addition to the available AADT data, intersection turning movement traffic counts were collected at the adjacent intersection of Campbells Point Road at Tazewell Pike. The adjacent intersection traffic was utilized as the 2021 existing traffic volumes for this study since the study intersections do not currently exist.

The existing turning movement count data is summarized in FIGURE 4 and the count summary sheets are contained in APPENDIX A.

### **EXISTING CAPACITY ANALYSES / LEVELS-OF-SERVICE**

Capacity analyses employing the methods of the *Highway Capacity Manual* are typically conducted for the existing conditions at the study intersections. Since the studied intersections are currently proposed and do not exist, existing capacity analysis could not be performed. APPENDIX C contains a section entitled "Capacity and Level of Service Concepts", which provides a description of the utilized procedures.

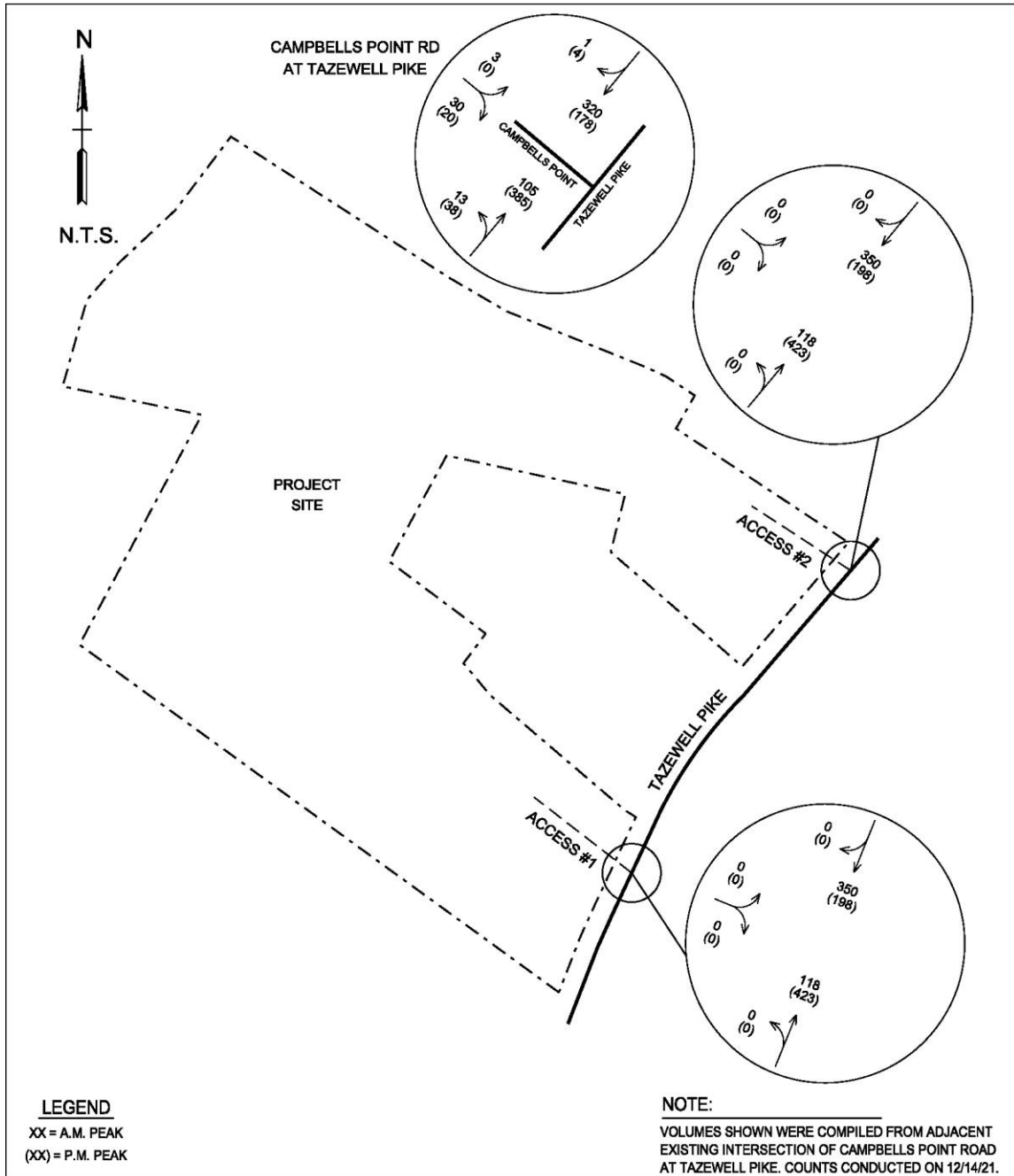


FIGURE 4  
2021 EXISTING TRAFFIC VOLUMES

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**BACKGROUND CONDITIONS****BACKGROUND TRAFFIC GROWTH**

The proposed development is anticipated to be constructed in one general phase with completion anticipated by 2026. Therefore, year 2026 was established as the appropriate design / analysis year for the study. In order to determine traffic volumes resulting solely from background traffic growth to year 2026, it was necessary to establish an annual growth rate for existing traffic. The TDOT AADT values previously discussed, as well as knowledge of the area, were used to determine an approximate annual growth rate. Based on the available data, a background annual growth rate of two percent was assumed. FIGURE 5 contains the background traffic volumes that would result from this annual growth rate from year 2021 to year 2026.

**BACKGROUND CAPACITY ANALYSES / LEVELS-OF-SERVICE**

Capacity analyses employing the methods of the *Highway Capacity Manual* are typically conducted for the background conditions at the study intersections to provide a baseline for comparing build and no-build traffic scenarios. Since the studied intersections are currently proposed and do not exist, background capacity analysis could not be performed.

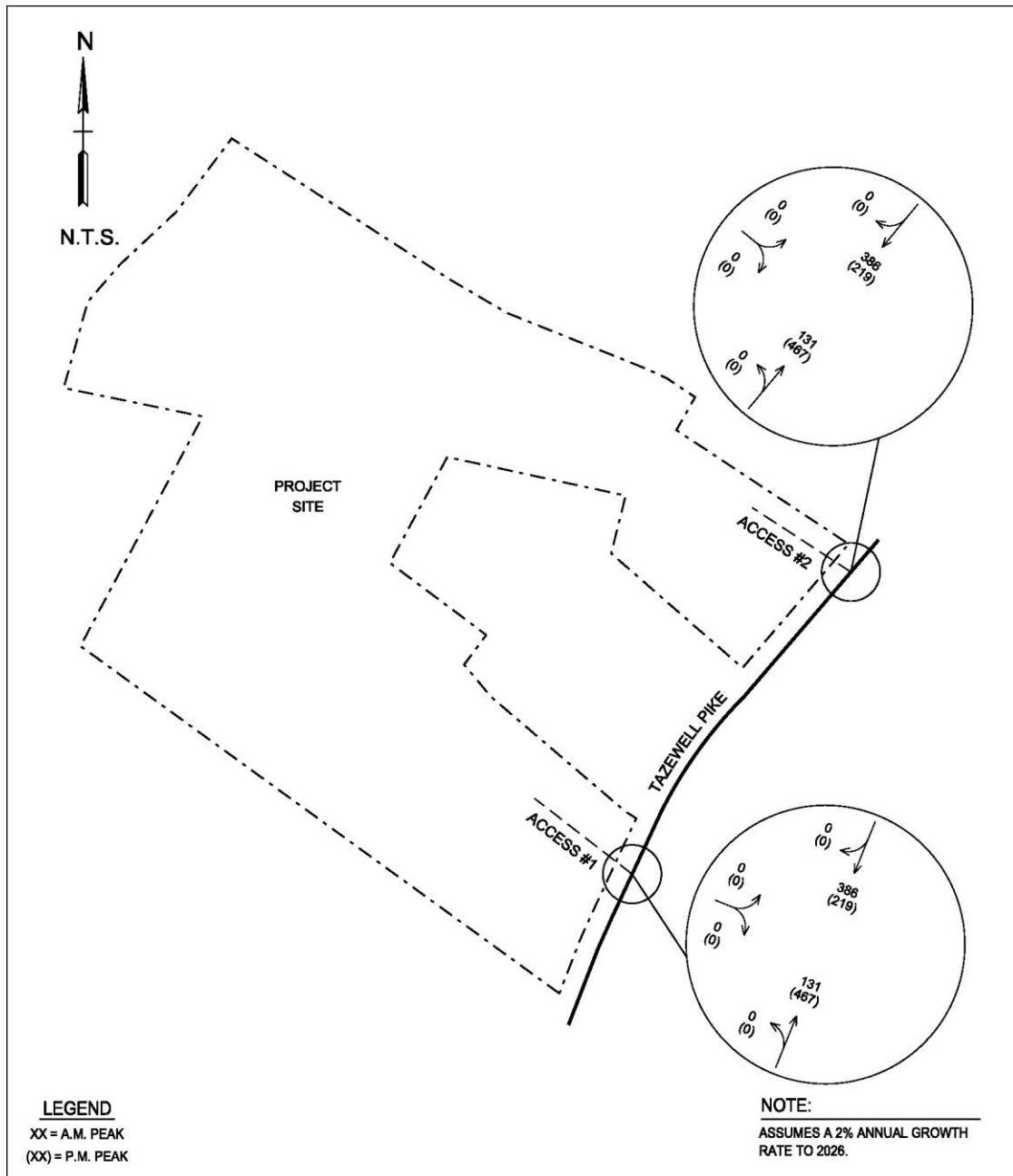


FIGURE 5  
 2026 BACKGROUND TRAFFIC VOLUMES

**FUTURE CONDITIONS**

**TRIP GENERATION**

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures of *Trip Generation, Tenth Edition* (Institute of Transportation Engineers-ITE) were utilized. The generated traffic volumes were determined based on the data for the peak hours of adjacent street traffic for Land Use Code 210 (Single Family Detached Housing). See TABLE 2 for a summary of the traffic generated for this project. More detailed information is contained in APPENDIX B.

**TABLE 2: TRIP GENERATION SUMMARY**

LAND USE	ITE CODE	SIZE	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HOUR)	PM PEAK HOUR (TRIPS/HOUR)
Single Family Detached Housing	210	144 Units	1,454	107	144
Entering Trips			727 (50%)	27 (25%)	91 (63%)
Exiting Trips			727 (50%)	80 (75%)	53 (37%)

**TRIP DISTRIBUTION AND ASSIGNMENT**

The proposed trip distribution for this development was determined through a review of existing travel patterns, local knowledge of the study area, proposed site location in relation to surrounding roadway network, and engineering judgment. FIGURE 6 provides a summary of how the above site generated trips would be assigned to the study intersections. FIGURE 7 provides the proposed trip assignment volumes to the studied intersections.

**FUTURE TRAFFIC VOLUMES**

Future projected traffic volumes for the study intersections were developed by adding the generated and assigned trips shown in FIGURE 7 to the 2026 background traffic volumes developed in the previous section and shown in FIGURE 5. These combined 2026 volumes reflect the existing traffic, the background traffic growth, and the generated traffic from the proposed development. These future volumes are shown on FIGURE 8 and are the combined volumes used in the analyses of future conditions with the proposed development.

**FUTURE CAPACITY ANALYSES / LEVELS-OF-SERVICE**

Capacity analyses were conducted for future conditions utilizing the traffic volumes shown in the build-out scenario. These analyses utilized proposed intersection traffic control and proposed lane configurations to determine if any mitigation is required to accommodate traffic generated by the proposed site. Tabular summaries of the analysis results and associated discussion are also contained in the EVALUATIONS section. In addition, detailed computer printout summaries of the analyses are contained in APPENDIX C.

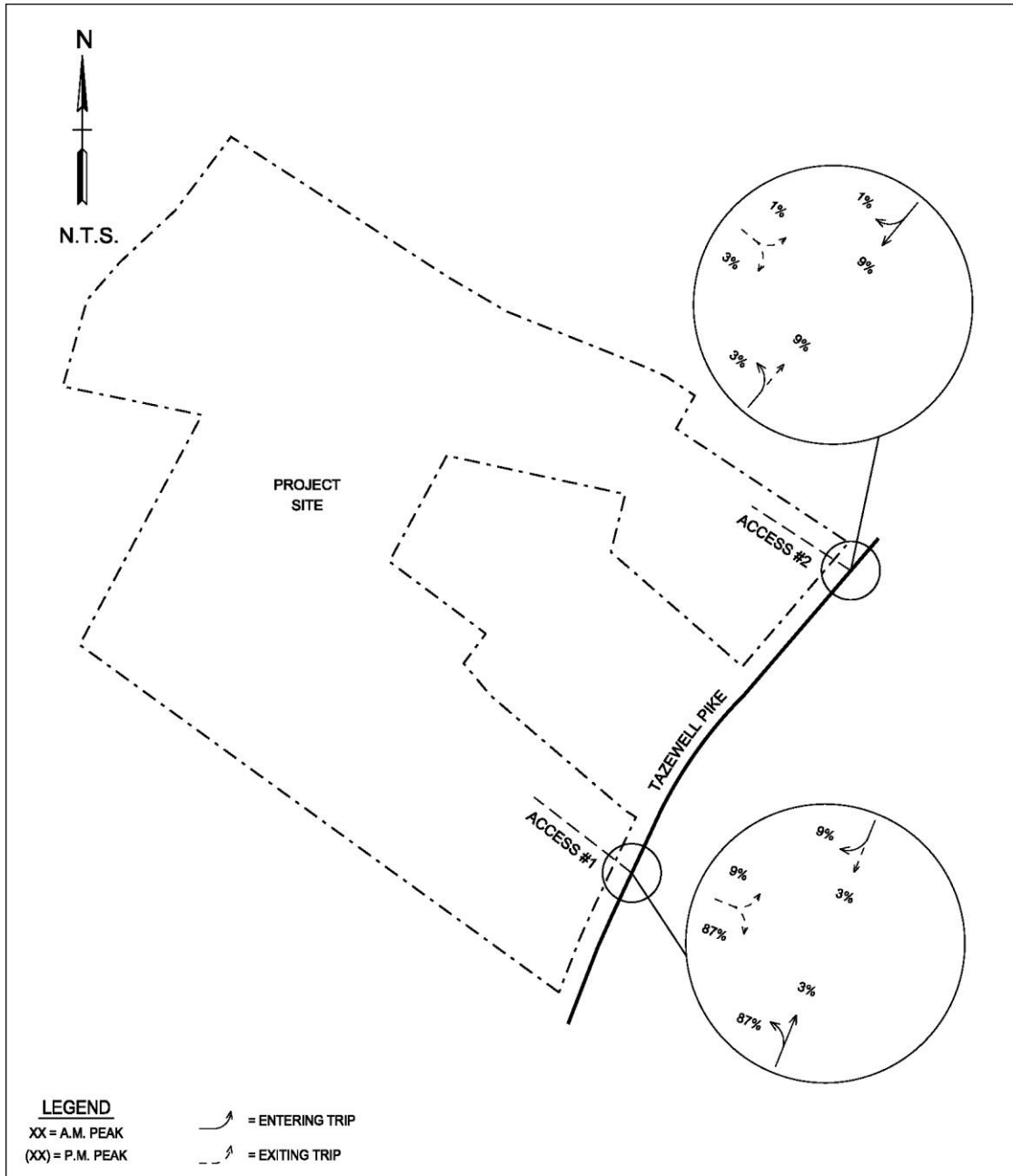


FIGURE 6  
TRIP DISTRIBUTION



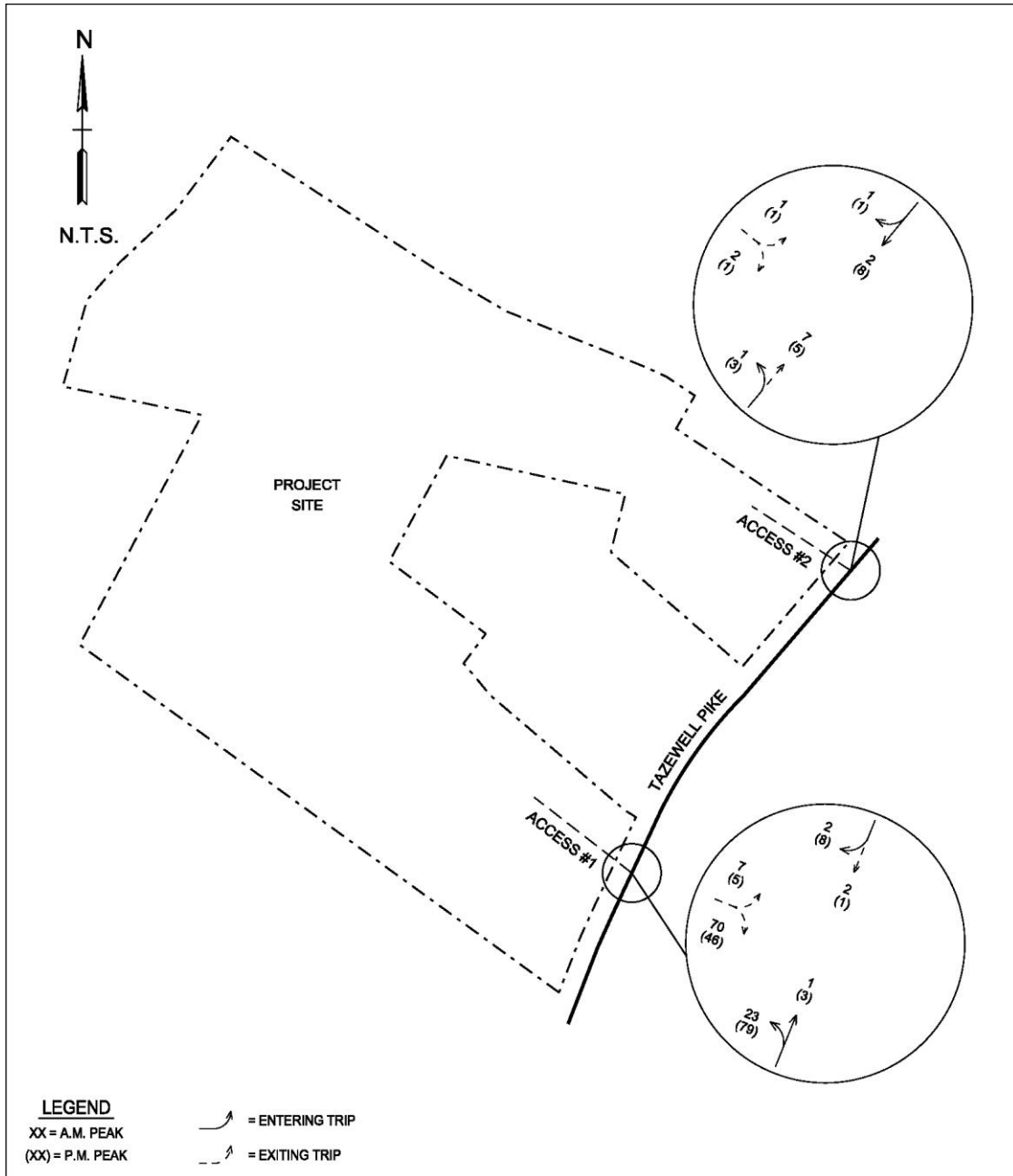


FIGURE 7  
TRIP ASSIGNMENT

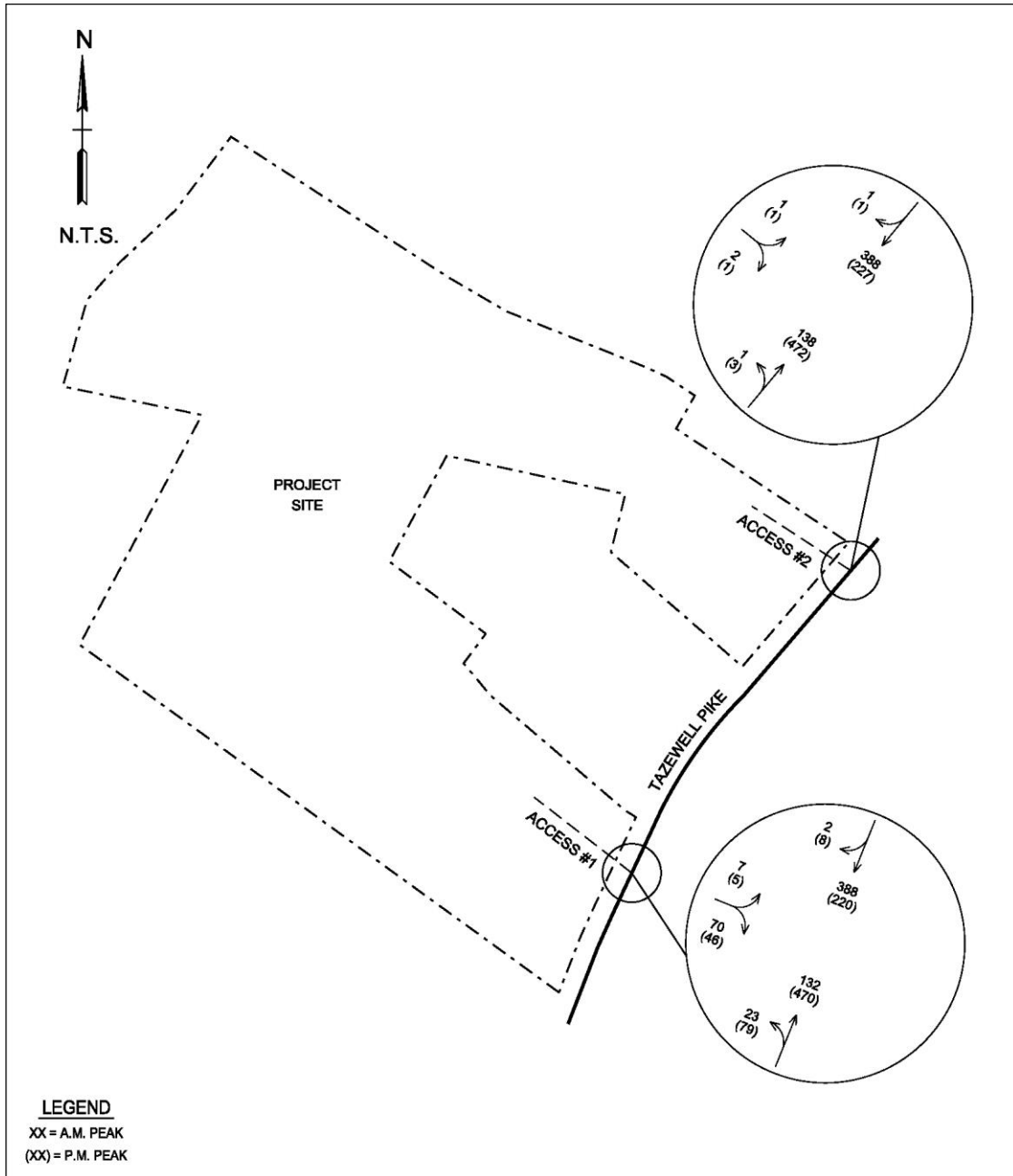


FIGURE 8  
2026 COMBINED TRAFFIC VOLUMES

**EVALUATIONS**

**INTERSECTION CAPACITY ANALYSES**

As discussed in the preceding sections of this report, capacity analyses employing the methods of the Highway Capacity Manual (HCM 6<sup>th</sup> Edition) were conducted for the study intersections. These analyses were performed for the previously discussed development scenario. A summary of the capacity analyses results is shown in TABLE 3, while the resulting conclusions and recommendations are covered in the CONCLUSIONS and RECOMMENDATIONS section of this report. The complete capacity analysis reports are contained in APPENDIX C.

**TABLE 3: CAPACITY ANALYSES SUMMARY**

INTERSECTION	TIME PERIOD	YEAR 2021 EXISTING (LOS/DELAY)	YEAR 2026 BACKGROUND (LOS/DELAY)	YEAR 2026 COMBINED (LOS/DELAY)
Tazewell Pike at Access Point #1 (Southern) <sup>1</sup> SIDE STREET STOP CONTROL	EB A.M. EB P.M.	-	-	B 11.9 B 10.9
Tazewell Pike at Access Point #2 (Northern) <sup>1</sup> SIDE STREET STOP CONTROL	EB A.M. EB P.M.	-	-	B 11.4 B 12.2

<sup>1</sup>SIDE STREET STOP CONTROL – Data shown are Level-of-Service and Average Vehicular Delay (seconds) for the critical side street approaches and major street left turn movements utilizing HCM methodology.

**TURN LANE ASSESSMENTS**

A left-turn lane warrant evaluation was conducted at the studied intersection of Tazewell Pike at Access #1. This evaluation found that a left-turn lane on Tazewell Pike is warranted for PM peak hour. The capacity analysis and northbound left-turn vehicle queue were reviewed in order to determine the proposed northbound left-turn lane dimensions. The capacity analysis indicated typically around one vehicle would queue in the northbound left-turn lane during the PM peak hour.

In order to accommodate the possibility of more than one vehicle queuing in the proposed left-turn lane at a time, it is recommended to provide a 100-foot storage lane with an accommodating 330-foot taper. The recommended taper length assumes symmetrical widening of 5.5 feet on either side of Tazewell Pike and includes a 247.5-foot approach taper as well as an 82.5-foot bay taper. Additionally, the departure taper is recommended to be 330 feet assuming symmetrical widening.

The evaluations utilized Knox County left and right-turn lane volume thresholds. The spreadsheets summarizing these evaluations are contained in APPENDIX D.

**SIGHT DISTANCE ASSESSMENT**

Intersection sight distance was assessed looking both directions from the proposed site driveway intersections. Based on AASHTO sight distance requirements for 45 mph roadways, 500 feet of sight

distance is required to make a left turn and 430 feet of sight distance is required to make a right turn from a side street stop-controlled scenario.

At the Access #1 and Access #2 site access intersections, the available sight distance is in excess of the 430 feet required to make a right turn from a side street stop-controlled scenario. The southbound approach to the proposed site driveway intersections is relatively flat and without excessive sight limiting vegetation or fixed objects.

At the Access #1 and Access #2 site access intersections, the available sight distance meets the 500 feet required to make a left turn from a side street stop-controlled scenario. Field measurements indicate right at 500 feet of sight distance is available when looking right to make a left turn from the proposed primary site access intersection. Care should be taken during the site development process to ensure that site features such as landscaping and signage to do not restrict the existing sight distances.

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## CONCLUSIONS & RECOMMENDATIONS

The primary conclusion of this study is that the traffic generated from the proposed development will not have a significant impact on the studied site access intersections at Tazewell Pike. Intersection levels-of-service are expected to be "B" or better exiting the site during peak traffic periods for each of the site access intersections during peak traffic periods.

The following is a listing of recommendations that were developed to address traffic concerns in the vicinity of the project site:

1. Tazewell Pike at Access Point #1:
  - a. Install an eastbound approach leg (Proposed Access #1) to create the intersection of Access #1 at Tazewell Pike.
  - b. Install northbound left-turn lane with 100-foot storage lane and 330-foot tapers. See FIGURE 9 for a conceptual sketch of the recommended left turn lane improvements.
2. Tazewell Pike at Access Point #2:
  - a. Install an eastbound approach leg (Proposed Access #2) to create the intersection of Access #2 at Tazewell Pike.
3. Maintain intersection corner sight distances on the site access locations by ensuring that site grading, landscaping, signage, and other site features do not restrict intersection sight distance lines of sight.

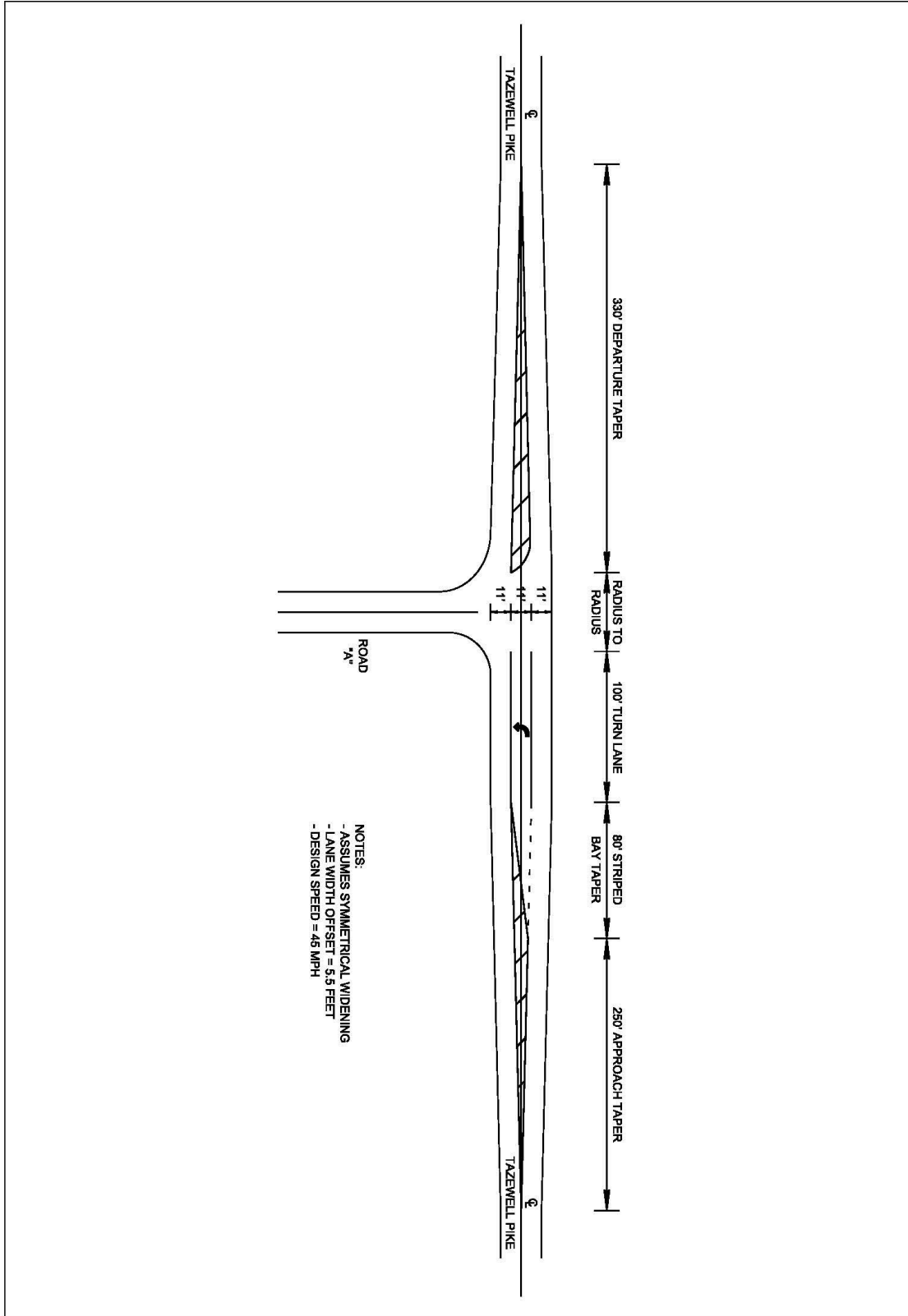


FIGURE 9  
CONCEPTUAL TURN LANE IMPROVEMENTS

**APPENDIX**

**APPENDIX ORDER:**

**A. TRAFFIC DATA**

**B. TRIP GENERATION INFORMATION**

**C. CAPACITY ANALYSES**

**D. TURN LANE WARRANT SHEETS**

**APPENDIX A – TRAFFIC DATA**



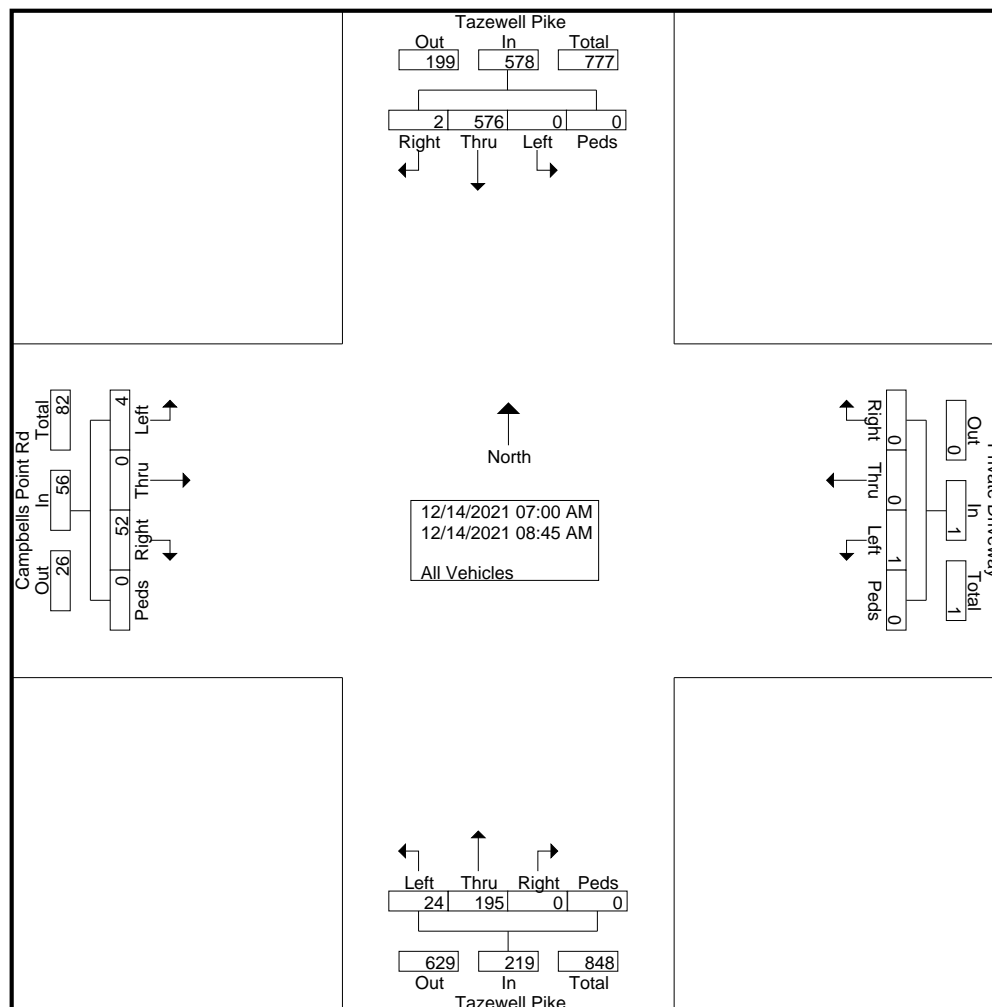
# CANNON & CANNON, INC.

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Knoxville, TN 37919  
(865) 670-8555

File Name : Campbells Point @ Tazewell - Existing AM  
Site Code : 12142101  
Start Date : 12/14/2021  
Page No : 1

## Groups Printed- All Vehicles

Start Time	Tazewell Pike Southbound					Private Driveway Westbound					Tazewell Pike Northbound					Campbells Point Rd Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	0	85	0	0	85	0	0	0	0	0	2	21	0	0	23	1	0	8	0	9	117
07:15 AM	0	100	0	0	100	0	0	0	0	0	3	30	0	0	33	0	0	9	0	9	142
07:30 AM	0	64	0	0	64	0	0	0	0	0	2	29	0	0	31	0	0	10	0	10	105
07:45 AM	0	71	1	0	72	0	0	0	0	0	6	25	0	0	31	2	0	3	0	5	108
Total	0	320	1	0	321	0	0	0	0	0	13	105	0	0	118	3	0	30	0	33	472
08:00 AM	0	67	0	0	67	0	0	0	0	0	3	19	0	0	22	0	0	4	0	4	93
08:15 AM	0	67	0	0	67	1	0	0	0	1	3	19	0	0	22	1	0	8	0	9	99
08:30 AM	0	60	0	0	60	0	0	0	0	0	2	30	0	0	32	0	0	6	0	6	98
08:45 AM	0	62	1	0	63	0	0	0	0	0	3	22	0	0	25	0	0	4	0	4	92
Total	0	256	1	0	257	1	0	0	0	1	11	90	0	0	101	1	0	22	0	23	382
Grand Total	0	576	2	0	578	1	0	0	0	1	24	195	0	0	219	4	0	52	0	56	854
Apprch %	0	99.7	0.3	0		100	0	0	0		11	89	0	0		7.1	0	92.9	0		
Total %	0	67.4	0.2	0	67.7	0.1	0	0	0	0.1	2.8	22.8	0	0	25.6	0.5	0	6.1	0	6.6	



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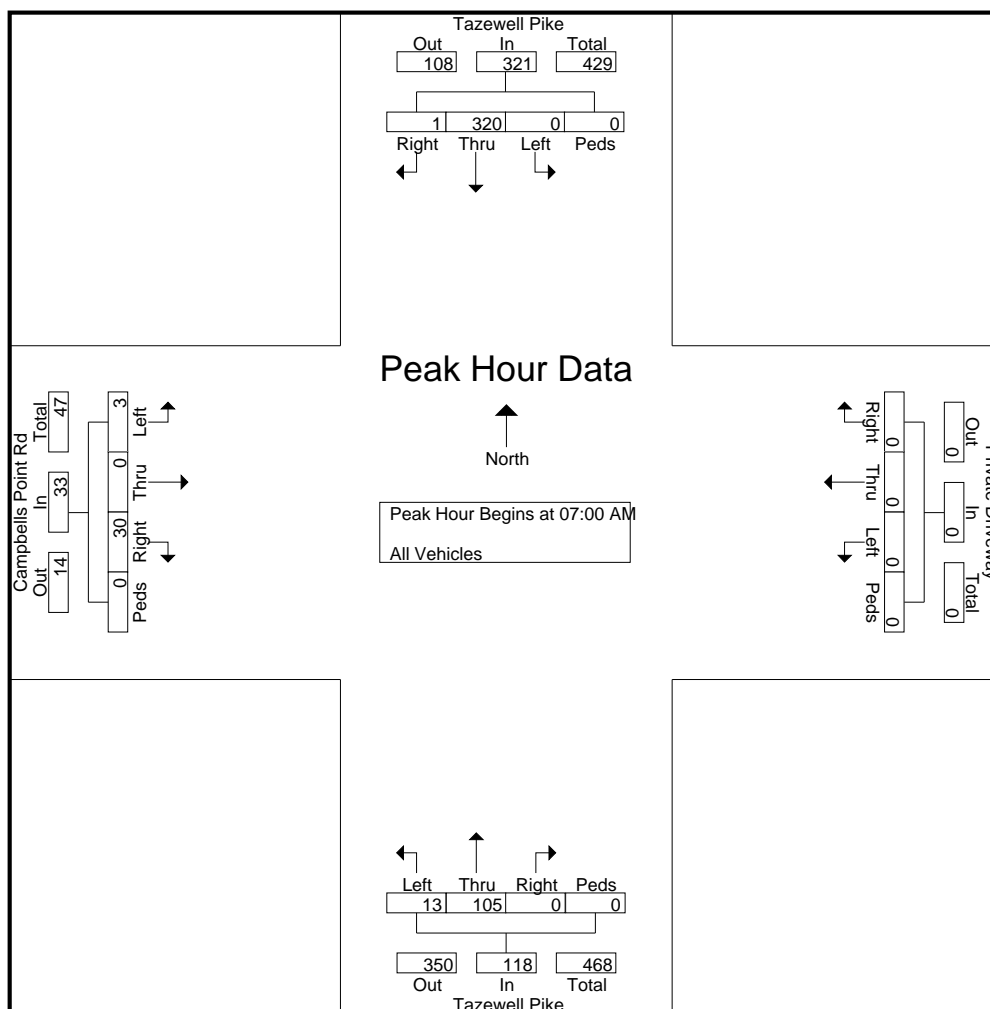
File Name : Campbells Point @ Tazewell - Existing AM  
Site Code : 12142101  
Start Date : 12/14/2021  
Page No : 2

Start Time	Tazewell Pike Southbound					Private Driveway Westbound					Tazewell Pike Northbound					Campbells Point Rd Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 07:00 AM

07:00 AM	0	85	0	0	85	0	0	0	0	0	2	21	0	0	23	1	0	8	0	9	117
07:15 AM	0	100	0	0	100	0	0	0	0	0	3	30	0	0	33	0	0	9	0	9	142
07:30 AM	0	64	0	0	64	0	0	0	0	0	2	29	0	0	31	0	0	10	0	10	105
07:45 AM	0	71	1	0	72	0	0	0	0	0	6	25	0	0	31	2	0	3	0	5	108
Total Volume	0	320	1	0	321	0	0	0	0	0	13	105	0	0	118	3	0	30	0	33	472
% App. Total	0	99.7	0.3	0		0	0	0	0		11	89	0	0		9.1	0	90.9	0		
PHF	.000	.800	.250	.000	.803	.000	.000	.000	.000	.000	.542	.875	.000	.000	.894	.375	.000	.750	.000	.825	.831



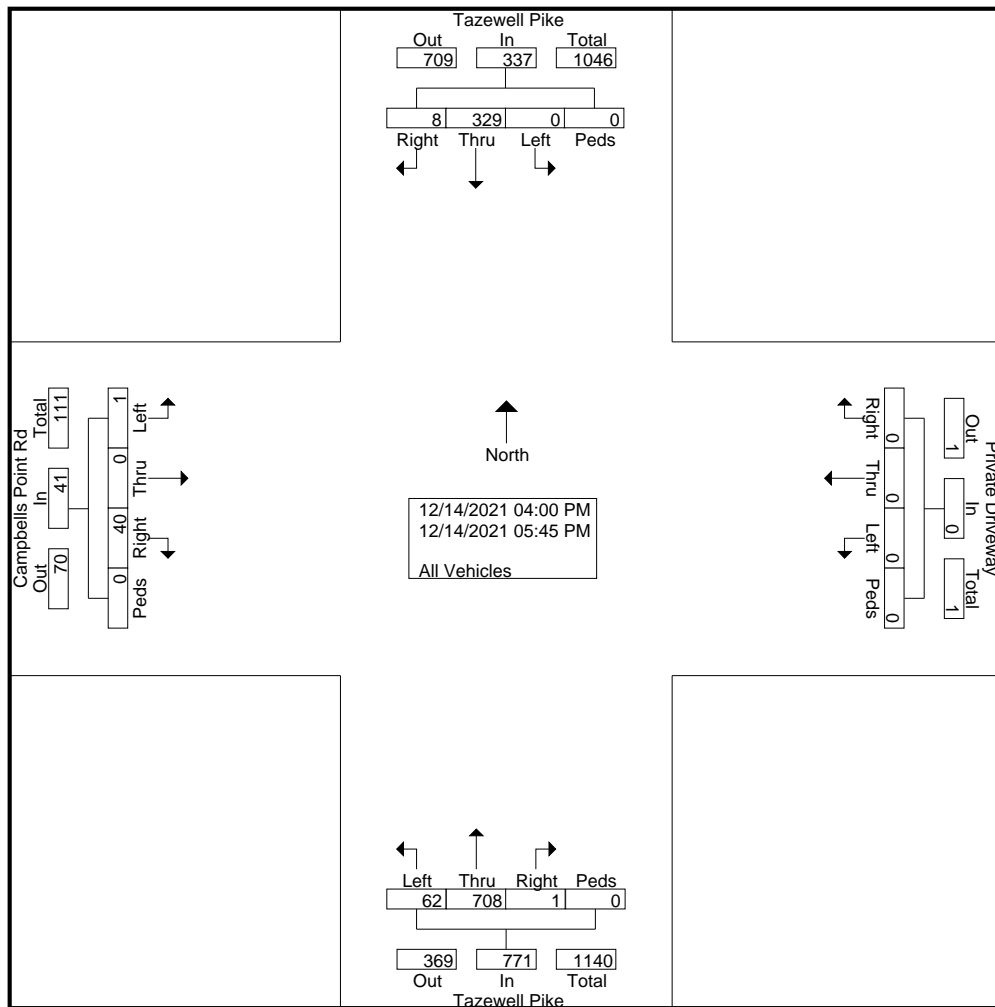
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File Name : Campbells Point @ Tazewell - Existing PM  
Site Code : 12142102  
Start Date : 12/14/2021  
Page No : 1

## Groups Printed- All Vehicles

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	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
04:00 PM	0	32	2	0	34	0	0	0	0	0	4	82	0	0	86	0	0	5	0	5	125
04:15 PM	0	46	0	0	46	0	0	0	0	0	4	76	0	0	80	0	0	5	0	5	131
04:30 PM	0	34	0	0	34	0	0	0	0	0	5	83	0	0	88	0	0	3	0	3	125
04:45 PM	0	38	3	0	41	0	0	0	0	0	10	85	0	0	95	0	0	6	0	6	142
Total	0	150	5	0	155	0	0	0	0	0	23	326	0	0	349	0	0	19	0	19	523
05:00 PM	0	42	0	0	42	0	0	0	0	0	9	102	0	0	111	0	0	3	0	3	156
05:15 PM	0	50	0	0	50	0	0	0	0	0	8	97	0	0	105	0	0	6	0	6	161
05:30 PM	0	48	1	0	49	0	0	0	0	0	11	101	1	0	113	0	0	5	0	5	167
05:45 PM	0	39	2	0	41	0	0	0	0	0	11	82	0	0	93	1	0	7	0	8	142
Total	0	179	3	0	182	0	0	0	0	0	39	382	1	0	422	1	0	21	0	22	626
Grand Total	0	329	8	0	337	0	0	0	0	0	62	708	1	0	771	1	0	40	0	41	1149
Apprch %	0	97.6	2.4	0		0	0	0	0		8	91.8	0.1	0		2.4	0	97.6	0		
Total %	0	28.6	0.7	0	29.3	0	0	0	0	0	5.4	61.6	0.1	0	67.1	0.1	0	3.5	0	3.6	

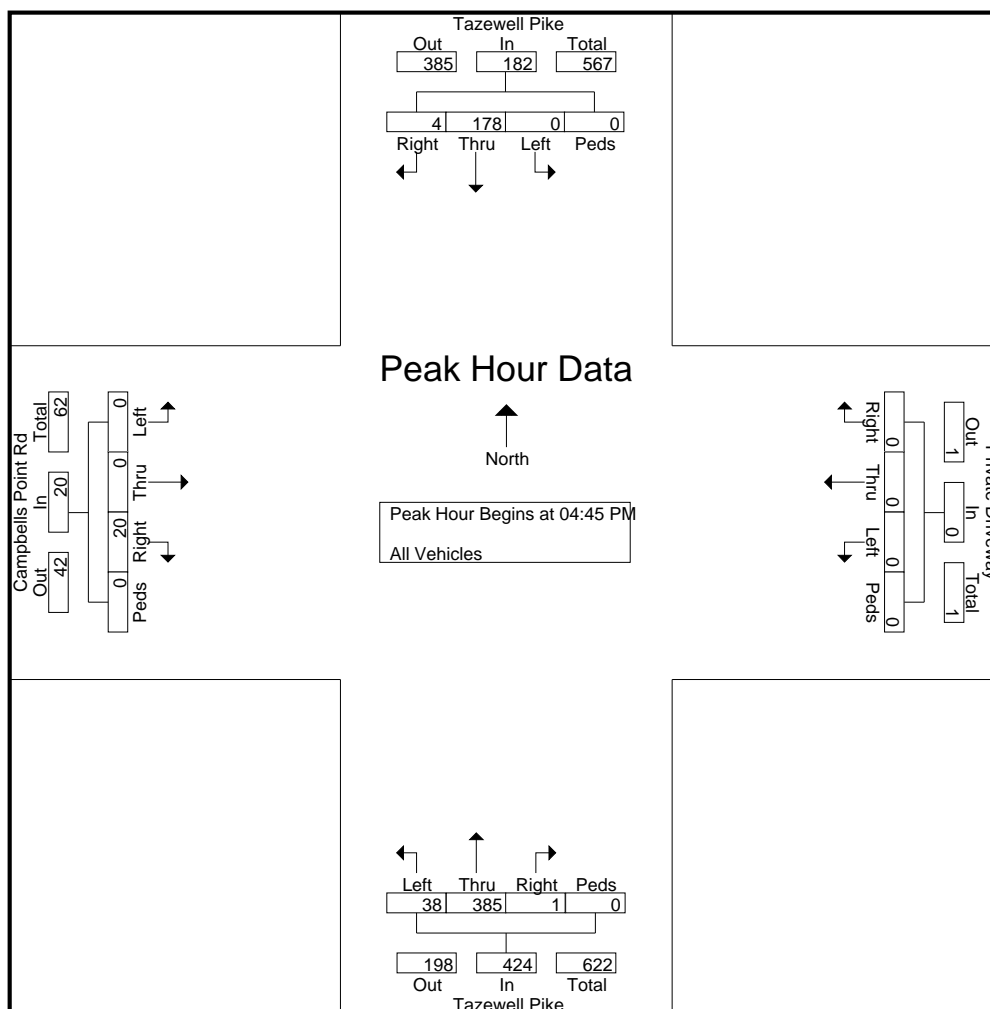


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File Name : Campbells Point @ Tazewell - Existing PM  
Site Code : 12142102  
Start Date : 12/14/2021  
Page No : 2

Start Time	Tazewell Pike Southbound					Private Driveway Westbound					Tazewell Pike Northbound					Campbells Point Rd Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	38	3	0	41	0	0	0	0	0	10	85	0	0	95	0	0	6	0	6	142
05:00 PM	0	42	0	0	42	0	0	0	0	0	9	102	0	0	111	0	0	3	0	3	156
05:15 PM	0	50	0	0	50	0	0	0	0	0	8	97	0	0	105	0	0	6	0	6	161
05:30 PM	0	48	1	0	49	0	0	0	0	0	11	101	1	0	113	0	0	5	0	5	167
Total Volume	0	178	4	0	182	0	0	0	0	0	38	385	1	0	424	0	0	20	0	20	626
% App. Total	0	97.8	2.2	0		0	0	0	0		9	90.8	0.2	0		0	0	100	0		
PHF	.000	.890	.333	.000	.910	.000	.000	.000	.000	.000	.864	.944	.250	.000	.938	.000	.000	.833	.000	.833	.937



**APPENDIX B – TRIP GENERATION INFORMATION**

# Land Use: 210

## Single-Family Detached Housing

### Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

### Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project, and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas, and other trip attractors than other residential land uses; and they generally had fewer alternative modes of transportation available because they were typically not as concentrated as other residential land uses.

Time-of-day distribution data for this land use are presented in Appendix A. For the six general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:00 and 5:00 p.m., respectively. For the two sites with Saturday data, the overall highest vehicle volume was counted between 3:00 and 4:00 p.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 10:15 and 11:15 a.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in California, Connecticut, Delaware, Illinois, Indiana, Maryland, Minnesota, Montana, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, and Virginia.

### Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 903, 925, 936

# Single-Family Detached Housing (210)

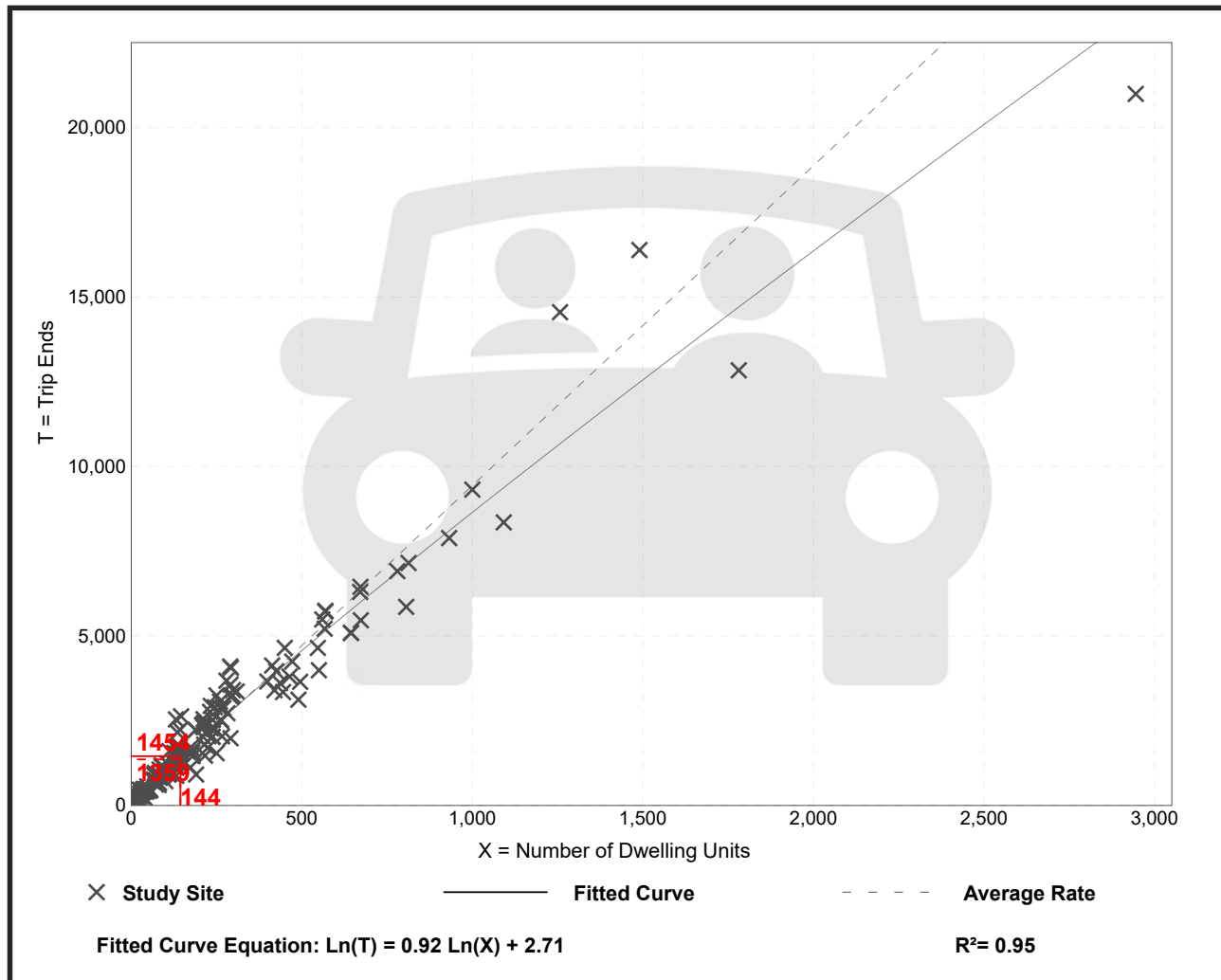
Vehicle Trip Ends vs: Dwelling Units  
On a: Weekday

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



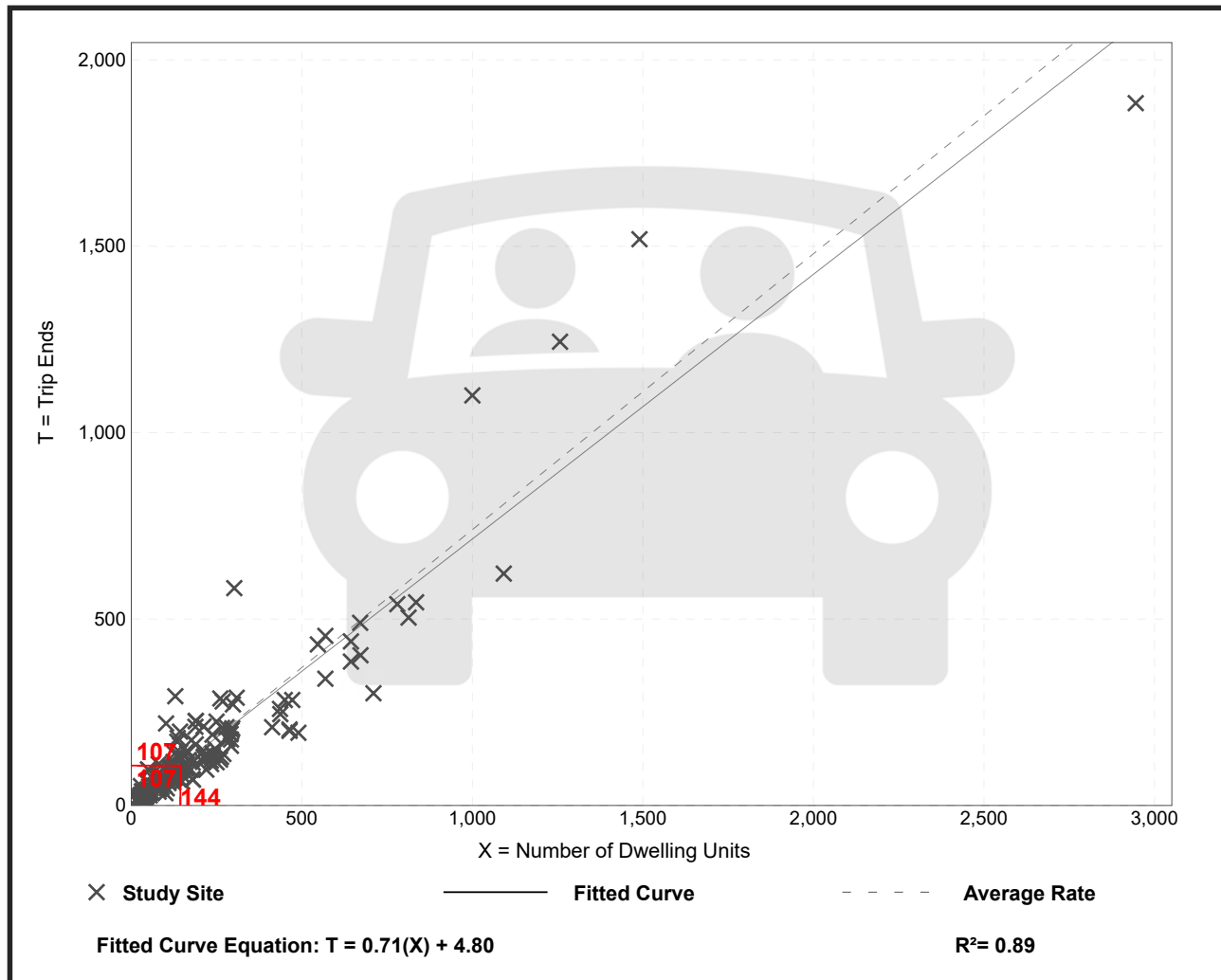
# Single-Family Detached Housing (210)

**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





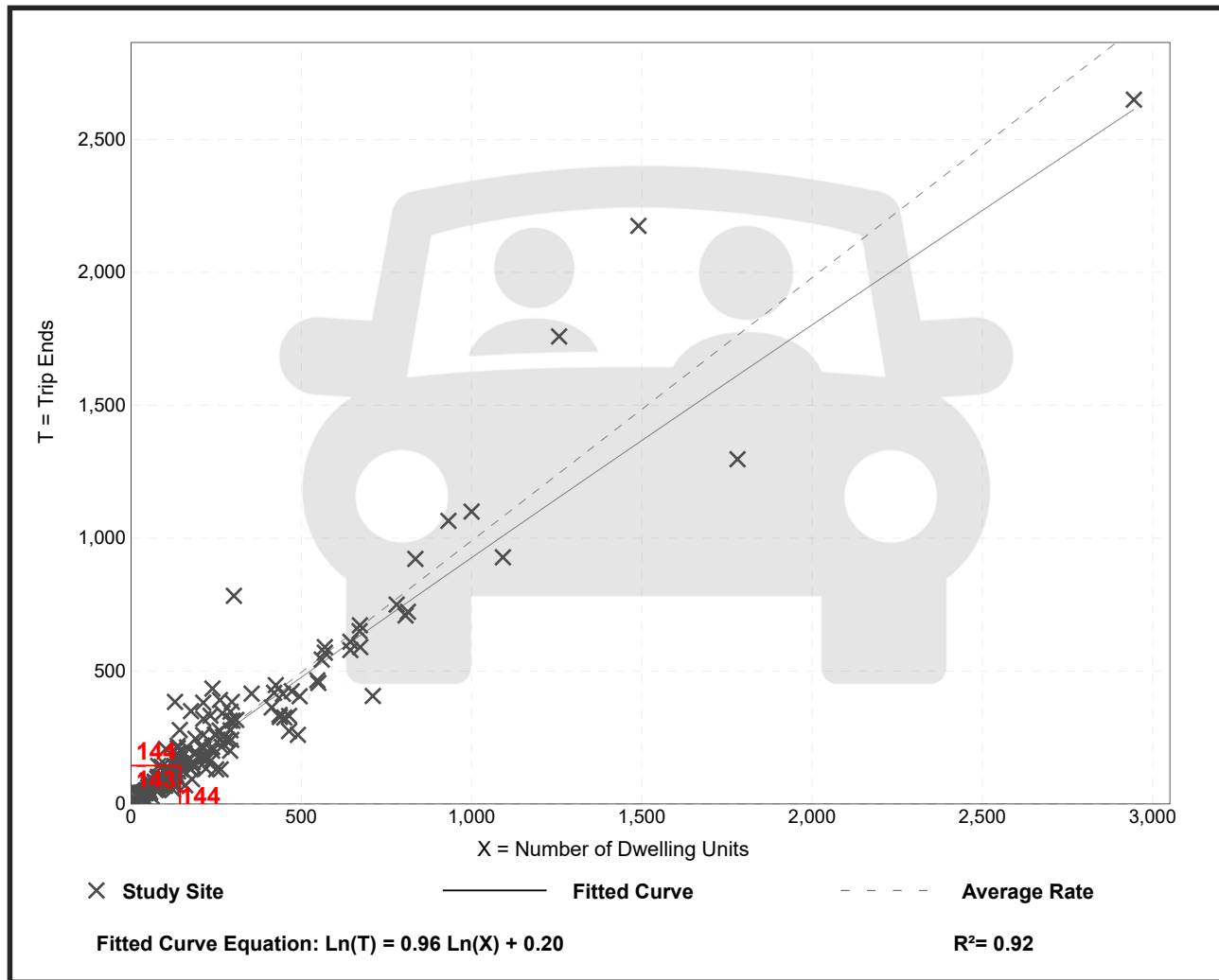
# Single-Family Detached Housing (210)

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



**APPENDIX C – CAPACITY ANALYSES**

## CAPACITY AND LEVEL-OF-SERVICE CONCEPTS

In a general sense, a roadway is similar to a pipeline or other material carrying conduit in that it has a certain capacity for the amount of material (vehicles) that it can efficiently carry. As the number of vehicles in a given time period gradually increases, the quality of traffic flow gradually decreases. On roadway sections this results in increasing turbulence in the traffic stream, and at intersections it results in increasing stops and delay. As the volumes begin to approach the capacity of the facility, these problems rapidly magnify, with resulting serious levels of congestion, stops, delay, excess fuel consumption, pollutant emissions, etc.

The Transportation Research Board has published the Year 2010 Highway Capacity Manual (HCM2010), which establishes theoretical techniques to quantify the capacity conditions on all types of roadways, intersections, ramps, pedestrian facilities, etc. A basic concept that is applicable to most of these techniques is the idea of level of service (LOS). This concept establishes a rating system that quantifies the quality of traffic flow, as perceived by motorists and/or passengers. The general system is similar to a school grade scale, and is outlined as follows:

Level of Service (LOS)	General Quality of Traffic Flow	Description of Corresponding Conditions
A	Excellent	Roadways – Free flow, high maneuverability Intersections – Very few stops, very low delay
B	Very Good	Roadways – Free flow, slightly lower maneuverability Intersections – Minor stops, low delay
C	Good	Roadways – Stable flow, restricted maneuverability Intersections – Significant stops, significant delay
D	Fair	Roadways – Marginally stable flow, congestion seriously restricts maneuverability Intersections – High stops, long but tolerable delay
E	Poor	Roadways – Unstable flow*, lower operating speeds, congestion severely restricts maneuverability Intersections – All vehicles stop, very long queues and very long intolerable delay
F	Very Poor	Roadways – Forced flow, stoppages may be lengthy, congestion severely restricts maneuverability Intersections – All vehicles stop, extensive queues and extremely long intolerable delay

\*Unstable flow is such that minor fluctuations or disruptions can result in rapid degradation to LOS F.

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**LOS CRITERIA: SIGNALIZED & UNSIGNALIZED INTERSECTIONS**

LOS	CONTROL DELAY (S/VEH)		
	SIGNALIZED	UNSIGNALIZED	ROUNDAABOUT
A	≤10	≤10	≤10
B	>10-20	>10-15	>10-15
C	>20-35	>15-25	>15-25
D	>35-55	>25-35	>25-35
E	>55-80	>35-50	>35-50
F	>80	>50	>50

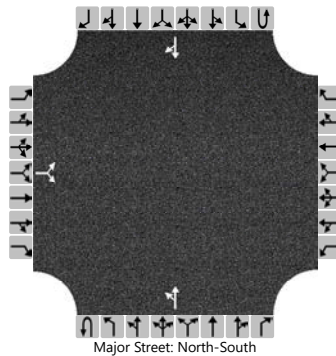
Another measure of intersection capacity that is often used in the evaluation of intersection operations is the volume to capacity (V/C) ratio. This ratio is defined as “the ratio of flow rate to capacity”, and is a good measure of how much of an intersection’s available capacity has been used up by the analysis volumes. Conversely, it also provides an indication of the reserve capacity available for future growth in traffic volumes.

The Intersection Capacity Utilization (ICU) is another measure that expresses a value similar to the V/C ratio. Specifically, the ICU method “sums the amount of the time required to serve all movements at saturation for a given cycle length and divides by that reference cycle length.” The ICU is considered a more accurate measure of volume to capacity conditions for a signalized intersection, primarily because it accounts for the effects of the signal timing on intersection capacity.

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Wesley Stokes	Intersection	Tazewell Pk @ Access #1				
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County				
Date Performed	12/21/2021	East/West Street	Access Point #1				
Analysis Year	2026	North/South Street	Tazewell Pike				
Time Analyzed	AM Peak	Peak Hour Factor	0.92				
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25				
Project Description	2026 Combined						

## 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	1	0		0	0	0		0	1	0		0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		7		70						23	132				388	2
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.43		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

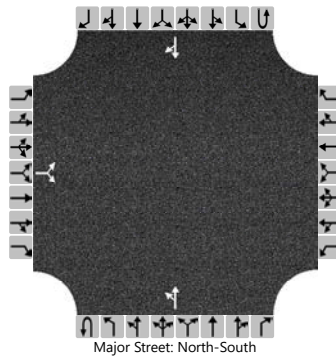
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			84							25						
Capacity, c (veh/h)			605							1130						
v/c Ratio			0.14							0.02						
95% Queue Length, Q <sub>95</sub> (veh)			0.5							0.1						
Control Delay (s/veh)			11.9							8.3						
Level of Service (LOS)			B							A						
Approach Delay (s/veh)	11.9								1.4							
Approach LOS	B															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Wesley Stokes			Intersection	Tazewell Pk @ Access #1		
Agency/Co.	Cannon & Cannon, Inc.			Jurisdiction	Knox County		
Date Performed	12/21/2021			East/West Street	Access Point #1		
Analysis Year	2026			North/South Street	Tazewell Pike		
Time Analyzed	PM Peak			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	2026 Combined						

## 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
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		5		46						79	470				220	8
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.43		6.23						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

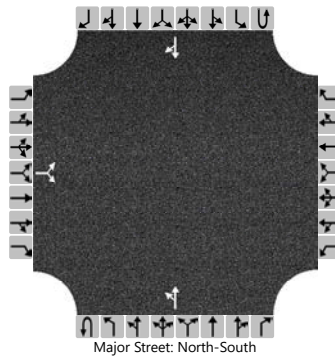
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			55							86						
Capacity, c (veh/h)			666							1312						
v/c Ratio			0.08							0.07						
95% Queue Length, Q <sub>95</sub> (veh)			0.3							0.2						
Control Delay (s/veh)			10.9							7.9						
Level of Service (LOS)			B							A						
Approach Delay (s/veh)	10.9								1.8							
Approach LOS	B															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Wesley Stokes			Intersection	Tazewell Pk @ Access #2		
Agency/Co.	Cannon & Cannon, Inc.			Jurisdiction	Knox County		
Date Performed	12/21/2021			East/West Street	Access Point #2		
Analysis Year	2026			North/South Street	Tazewell Pike		
Time Analyzed	AM Peak			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	2026 Combined						

## 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
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		1		2						1	138				388	1
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2									4.1				
Critical Headway (sec)		6.43		6.23									4.13				
Base Follow-Up Headway (sec)		3.5		3.3									2.2				
Follow-Up Headway (sec)		3.53		3.33									2.23				

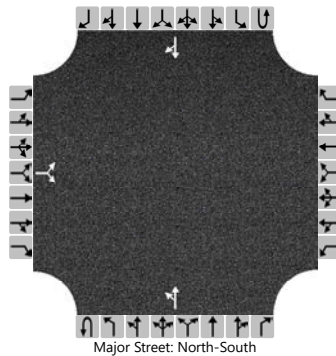
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			3										1				
Capacity, c (veh/h)			569										1131				
v/c Ratio			0.01										0.00				
95% Queue Length, Q <sub>95</sub> (veh)			0.0										0.0				
Control Delay (s/veh)			11.4										8.2				
Level of Service (LOS)			B										A				
Approach Delay (s/veh)	11.4								0.1								
Approach LOS	B																

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Wesley Stokes			Intersection	Tazewell Pk @ Access #2		
Agency/Co.	Cannon & Cannon, Inc.			Jurisdiction	Knox County		
Date Performed	12/21/2021			East/West Street	Access Point #2		
Analysis Year	2026			North/South Street	Tazewell Pike		
Time Analyzed	PM Peak			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	2026 Combined						

## 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
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume (veh/h)		1		1						3	472				227	1
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized																
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2							4.1					
Critical Headway (sec)		6.43		6.23							4.13					
Base Follow-Up Headway (sec)		3.5		3.3							2.2					
Follow-Up Headway (sec)		3.53		3.33							2.23					

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			2								3					
Capacity, c (veh/h)			502								1312					
v/c Ratio			0.00								0.00					
95% Queue Length, Q <sub>95</sub> (veh)			0.0								0.0					
Control Delay (s/veh)			12.2								7.8					
Level of Service (LOS)			B								A					
Approach Delay (s/veh)	12.2								0.1							
Approach LOS	B															



**APPENDIX D – TURN LANE WARRANT SHEETS**

TABLE 5A  
KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS  
FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

Project No: 00773-0017  
Project Name: Tazewell Pike Residential Dev.  
Notes:

(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	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160	115	85	75	65	55
250 - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399	100	80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Tazewell @ Access #1	AM Peak	388	132	23	100	No
Tazewell @ Access #1	PM Peak	220	470	79	40	Yes