



TRANSPORTATION IMPACT STUDY

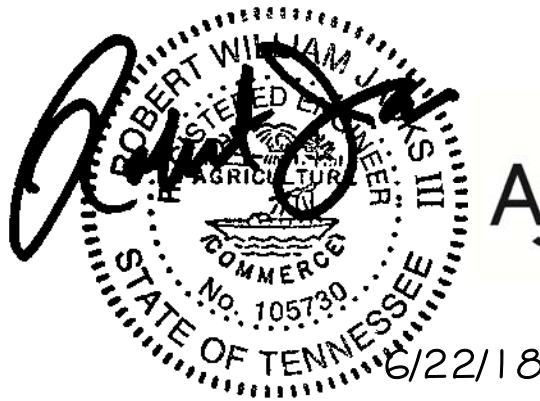
BERRY PATCH FARMS SUBDIVISION

KNOX COUNTY, TENNESSEE

-Prepared For-

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EXECUTIVE SUMMARY

Preface:

Mr. Bryan Petett is proposing to construct a residential development that is adjacent to McCloud Road in north Knox County, TN. The name of this proposed residential development is “Berry Patch Farms” and will consist of a single-family detached lot subdivision. The purpose of this study is to determine and evaluate the potential impacts of the proposed development on the adjacent transportation system. The study includes a review of the operating characteristics of the existing transportation system that will provide access to the proposed development site. Recommendations and mitigation measures will be analyzed and offered where traffic operations have been projected to be below traffic engineering standards.

Study Results:

The findings of this study include the following:

- At full build-out, the proposed 116-lot single-family detached lot residential development is expected to generate approximately 1,204 new trips on an average weekday. Approximately 91 of these new trips are estimated to occur during the AM peak hour and 121 trips in the PM peak hour at full build-out.
- The addition of the new residential development road approach at the existing intersection of McCloud Road at Stillbrook Lane is anticipated to operate very well in the projected conditions for vehicular traffic in the year 2023 with respect to road capacity.

Recommendations:

The following recommendations are offered based on the study analyses:

- The internal roadways and intersections within the Berry Patch Farms subdivision should include design elements with the appropriate sight distance requirements, road signage, pavement markings, and the construction of internal sidewalks.
- A sight distance requirement of 300 feet for the new residential development road approach at McCloud Road needs to be measured and verified by a licensed land surveyor.

DESCRIPTION OF EXISTING CONDITIONS

■ STUDY AREA:

The proposed location of this new residential subdivision is shown on a map in Figure 1. This proposed development is located adjacent to McCloud Road in north Knox County. The proposed development is to be comprised of several new internal paved roadways and will contain 116 single-family detached residential lots on approximately 44 acres. To analyze the transportation impacts associated with the proposed development, the following roadway and intersection were reviewed in this report where the greatest impact is expected:

- McCloud Road
- McCloud Road at Stillbrook Lane and the proposed new residential development road approach (Dennis Fox Drive)

In the adjacent vicinity of this study area, there are several other residential subdivisions, individual residences, and undeveloped properties. The development property currently consists of a home, barns, and outbuildings. The property was formerly a farm that operated as “The Fruit and Berry Patch”.

The proposed site for the Berry Patch Farms subdivision is bounded by residential subdivisions to the east and north, McCloud Road to the south, and undeveloped property to the west that contains a handful of residences.



Figure 1
Location Map

■ **EXISTING ROADWAYS:**

Table 1 shows the characteristics of the key existing roadway included in the study:

TABLE 1
STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION ¹	SPEED LIMIT	LANES	ROAD WIDTH ²	TRANSIT ³	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
McCloud Road	Minor Collector	30 mph	2 undivided	20 feet	None	No sidewalks along roadway	No bike lanes

¹ Major Road Plan - May 2011 by Knoxville/Knox County Metropolitan Planning Commission

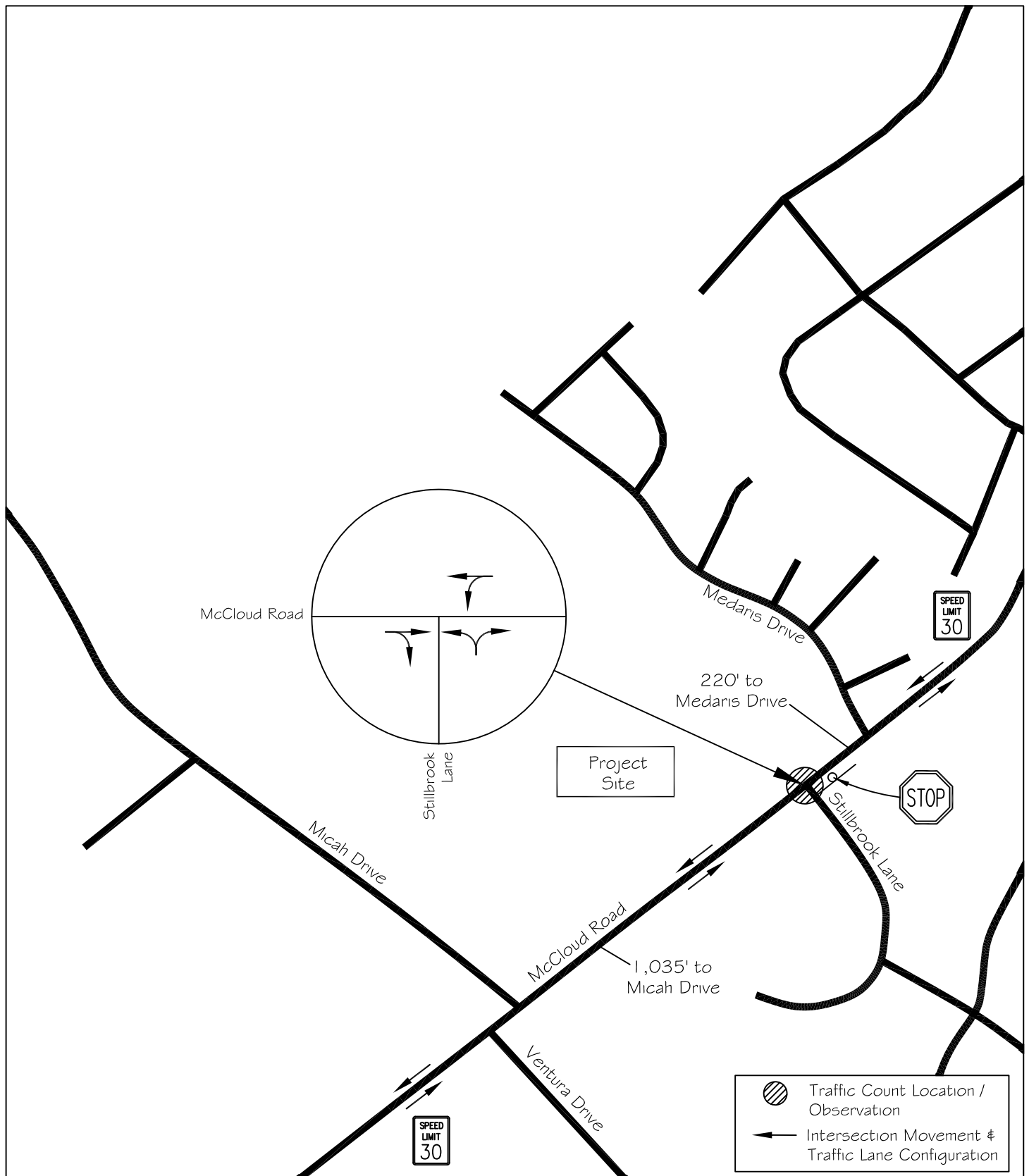
² Edge of curb to edge of curb or edge of pavements near project site

³ According to Knoxville Area Transit System Map

McCloud Road traverses in a general northeast-southwest direction adjacent to the development property. McCloud Road is a winding road that has many horizontal and vertical curves. McCloud Road adjacent to the project site currently consists of a 2-lane pavement section approximately 20 feet wide with approximately 9-foot lanes with minimal clearance outside the pavement surface. A rumble strip exists on the double yellow centerline on McCloud Road.

McCloud Road intersects Fort Sumter Road on the north end and at the south end it terminates at Andersonville Pike. McCloud Road currently provides access to several residential subdivisions and individual residences. The proposed new subdivision road entrance (Dennis Fox Drive) will tie into the existing t-intersection of McCloud Road at Stillbrook Lane and will create a 4-way intersection. Roadway lighting is not provided in this area along McCloud Road.

Figure 2 shows the lane configurations of the study area roadway and the intersection where the traffic count location was conducted. It also shows the posted speed limit in the area along with distances in between the intersection of McCloud Road/Stillbrook Lane and the other downstream existing intersections. The pages following Figure 2 give an overview of the site study area with photographs.



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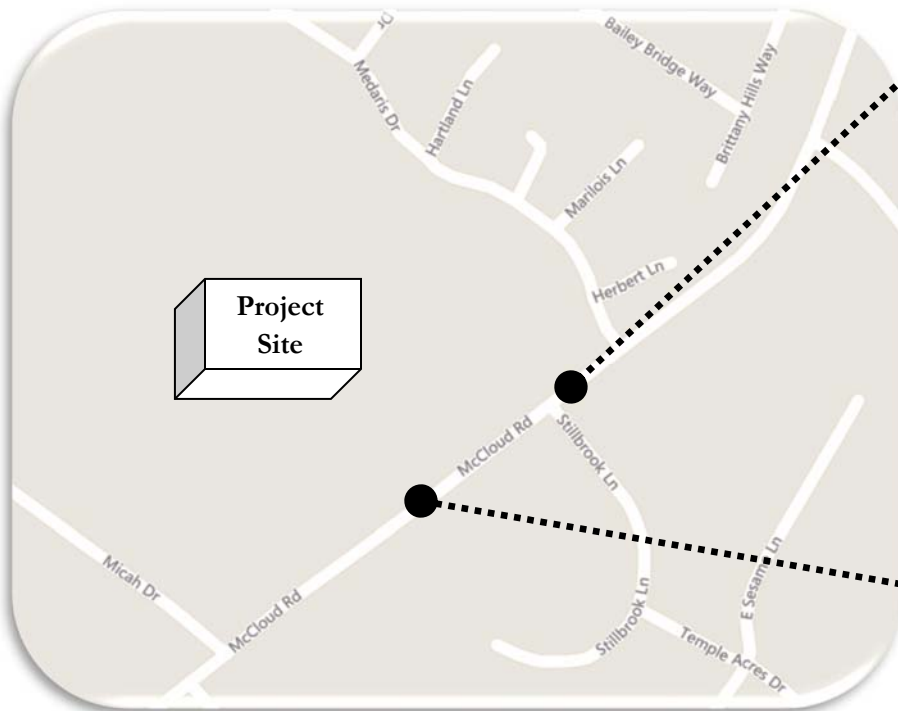


FIGURE 2

Berry Patch Farms Subdivision

Traffic Count Location & Existing Lane Configurations

PHOTO EXHIBITS



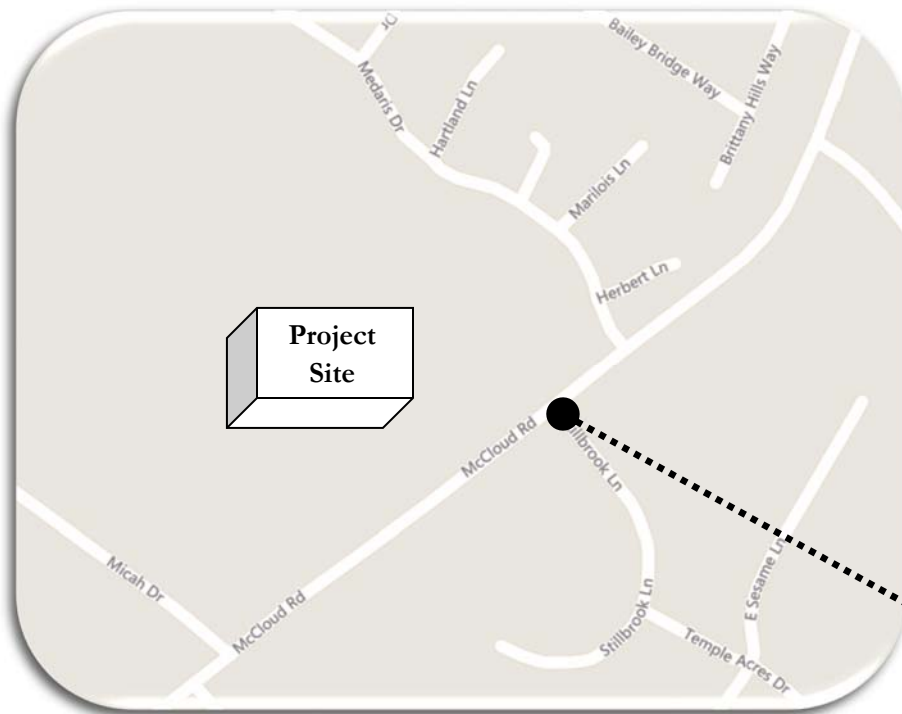
McCloud Road at Stillbrook Lane



**View of McCloud Road at Stillbrook Lane
(Looking Southwest)**



**View of McCloud Road
(Looking Northeast towards Stillbrook Lane)**



McCloud Road at Stillbrook Lane



**View of Project Site
(Looking Northwest from Stillbrook Lane)**

■ **EXISTING TRANSPORTATION VOLUMES PER MODE:**

There are two traffic count locations nearby to the project site. One count location is located to the southwest of the project site on McCloud Road and is conducted by the Metropolitan Planning Commission (MPC). This count location is conducted every other year. The other traffic count location is conducted yearly by the Tennessee Department of Transportation (TDOT) and is to the northwest of the MPC location and is located on Hill Road.

- Existing vehicular roadway traffic:
 - Average Daily Traffic (ADT) on McCloud Road southwest of the project site was reported by the MPC at 4,630 vehicles per day in 2016.
 - Average Daily Traffic (ADT) on Hill Road west of the project site was reported by TDOT at 3,831 vehicles per day in 2016. Historical traffic count data can be viewed in Appendix A.
- Existing bicycle and pedestrian volumes: The average daily pedestrian and bicycle traffic along the study corridor is not known. Sidewalks and bicycle lanes are not provided on McCloud Road and thus assumed to be minimal to non-existent.

■ **ON-STREET PARKING:**

Currently, on-street parking is not allowed on McCloud Road adjacent to the project site.

■ **PEDESTRIAN AND BICYCLE FACILITIES:**

Bicycle facilities (lanes) and pedestrian sidewalks are not currently available within the project site study area on McCloud Road. A couple of short greenway links are located to the south of the proposed site. These include Halls Greenway which runs for a short distance to Halls Elementary School and a larger link at the Halls Community Park. None of these greenway links are directly connected to the proposed development property at this time.

■ **WALK SCORE:**

A private company offers an online website that grades and gives scores to locations within the United States based on “walkability”. According to the website, the numerical value assigned (the Walk Score) is based on the distance to the closest amenity in various relevant categories (businesses, schools, parks, etc.). Appendix B shows a map and gives information for the site development Walk Score at McCloud Road. Based on the project location, the site is given a Walk Score of 13. This Walk Score indicates that the site is almost completely dependent on vehicles for errands and travel. This is due to the complete lack of sidewalks in the study area to outside destinations/amenities.

■ **TRANSIT SERVICES:**

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available in this area of Knox County. The overall KAT bus system map is in Appendix C. The closest public transit KAT bus service is 4.4 miles away (by roadway) at the intersection of Garden Drive at Jacksboro Pike. This KAT service is Route 22 “Broadway”. It operates on weekdays and weekends and this route map is also included in Appendix C. Other transit services include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC) which provides transportation services when requested along with private taxis, and ride-sharing opportunities (Uber, etc.).

PROJECT DESCRIPTION

■ LOCATION AND SITE PLAN:

The proposed plan layout given by Sterling Engineering, Inc. is shown in Figure 3. As can be seen in the figure, one new entrance roadway will tie onto McCloud Road at Stillbrook Lane on the southeast side of the development. This residential development is expected to be comprised of 116 single-family detached residential lots on approximately 44 acres. The residential lots in the development will average approximately 1/8 acre to 1/3 acre in size. The proposed home sites and roadways are designed to maximize the lots on the property while providing large amounts of open space. The existing site has an existing home and other unattached buildings that will be removed for the construction of the development.

The proposed subdivision is expected to be constructed with four new internal paved roadways within the development. The total length of the roadways within the development will be just over 4,400 feet. Five areas within the property will be dedicated as common areas which will total approximately 9.3 acres. One other area near the front of the development will encompass the stormwater detention controls on a half-acre of property.

The actual schedule for completion of this new residential development is dependent on economic factors and construction timelines. This project is also contingent on permitting, design, and other issues. However, for the purposes of this study, it was assumed that the total construction build-out of the development and full occupancy will occur by the year 2023.

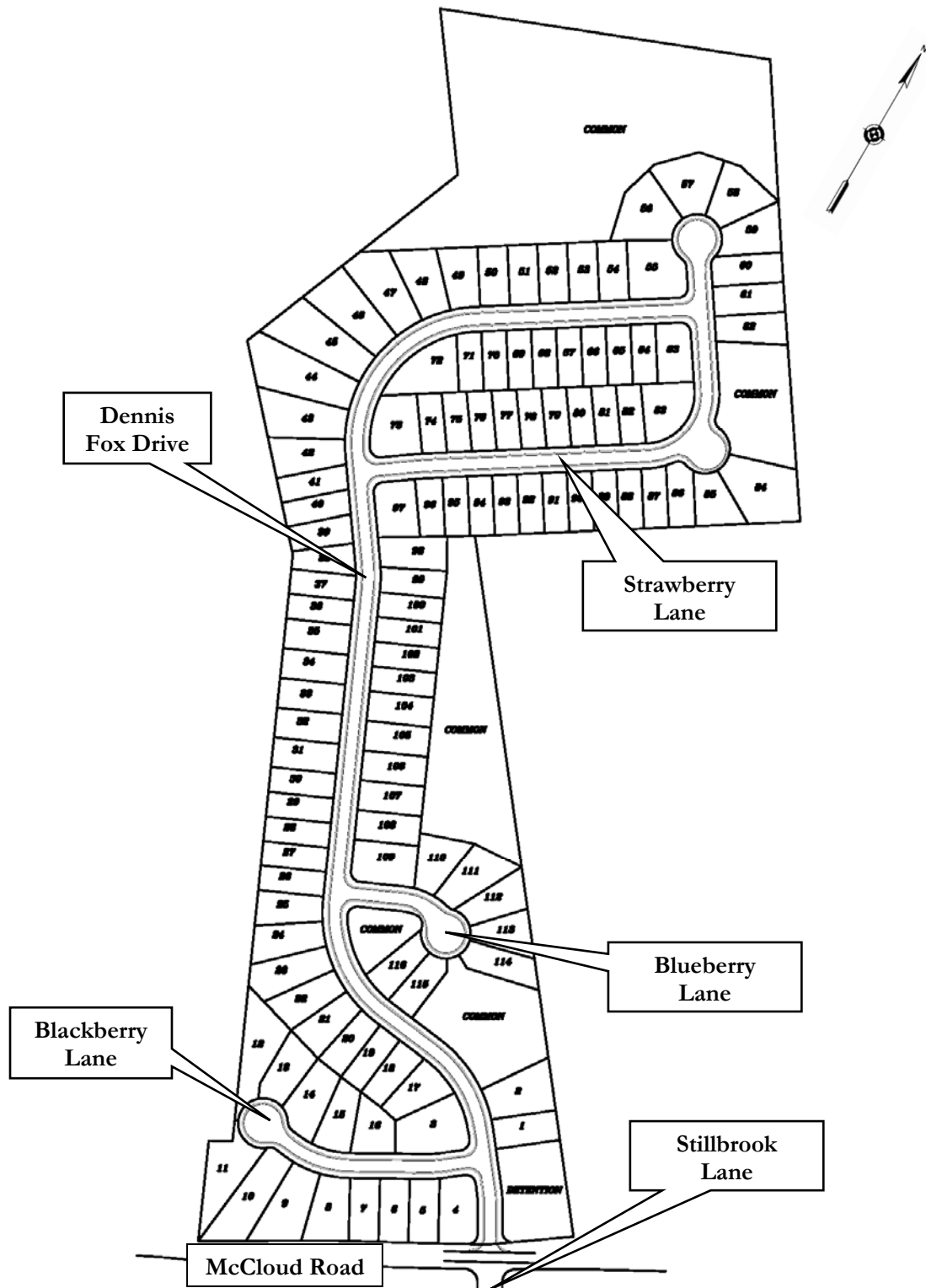


Figure 3
Plan Layout
Berry Patch Farms Subdivision

■ **PROPOSED USES AND ZONING REQUIREMENTS:**

The proposed single-family detached residential development is expected to be comprised of four new internal roadways with 116 lots on approximately 44 acres. The development will incorporate lots dedicated to common/green space in which some will incorporate the storm water controls for the development.

The property for the development was recently rezoned from Agricultural (A) to Planned Residential (PR) with a density of 3.5 units per acre. This rezoning was approved by the MPC on March 8th, 2018 and by the Knox County Commission on April 23rd, 2018. The adjacent surrounding land uses are the following:

- The property to the northwest of the development is zoned Planned Residential (PR) with a density of 3 units per acre and consists of Hidden View Subdivision.
- The property to the northeast of the development is zoned Agricultural (A).
- To the south, the development site is bound by McCloud Road. The properties on the other side of McCloud Road to the south are zoned as Low Density Residential (RA).
- The property to the east is zoned Planned Residential (PR) with a density of 1-5 units per acre and consists of Peterson Place and Bethany Springs neighborhoods.
- The property to the west of the development is zoned Agricultural (A).

The Planned Residential (PR) zone allows for a variety of land uses primarily within the residential realm. Uses permitted in this zone include single family dwellings, duplexes, and multi-dwelling structures and developments. The current zoning map is provided in Appendix D.

■ **DEVELOPMENT DENSITY:**

The proposed density for the residential development is 2.64 dwelling units per acre based on 116 lots on 44 acres which is less than the allowable provided by the rezoning of the property at 3.5 dwelling units per acre.

■ **ON-SITE CIRCULATION:**

The total length of the new internal roadways within the development will be just over 4,400 feet in length. The internal roadways for the development will be paved, include 6” extruded concrete curbing and the lane widths will be 13 feet for a total of 26-foot pavement width. A five-foot sidewalk with a 2-foot grass strip will be provided on one side of the internal roadways.

■ **SERVICE AND DELIVERY VEHICLE ACCESS AND CIRCULATION:**

In addition to passenger vehicles, the proposed internal roadways will also provide access to service, delivery, maintenance, and fire protection vehicles. It is not expected that any of these vehicles will interfere with off-site adjacent roadway operations other than when these vehicles occasionally enter and exit the development. The internal roadways in the subdivision are expected to be able to accommodate these types of vehicles along with passenger vehicles.

TRAFFIC ANALYSIS OF EXISTING AND PROPOSED CONDITIONS

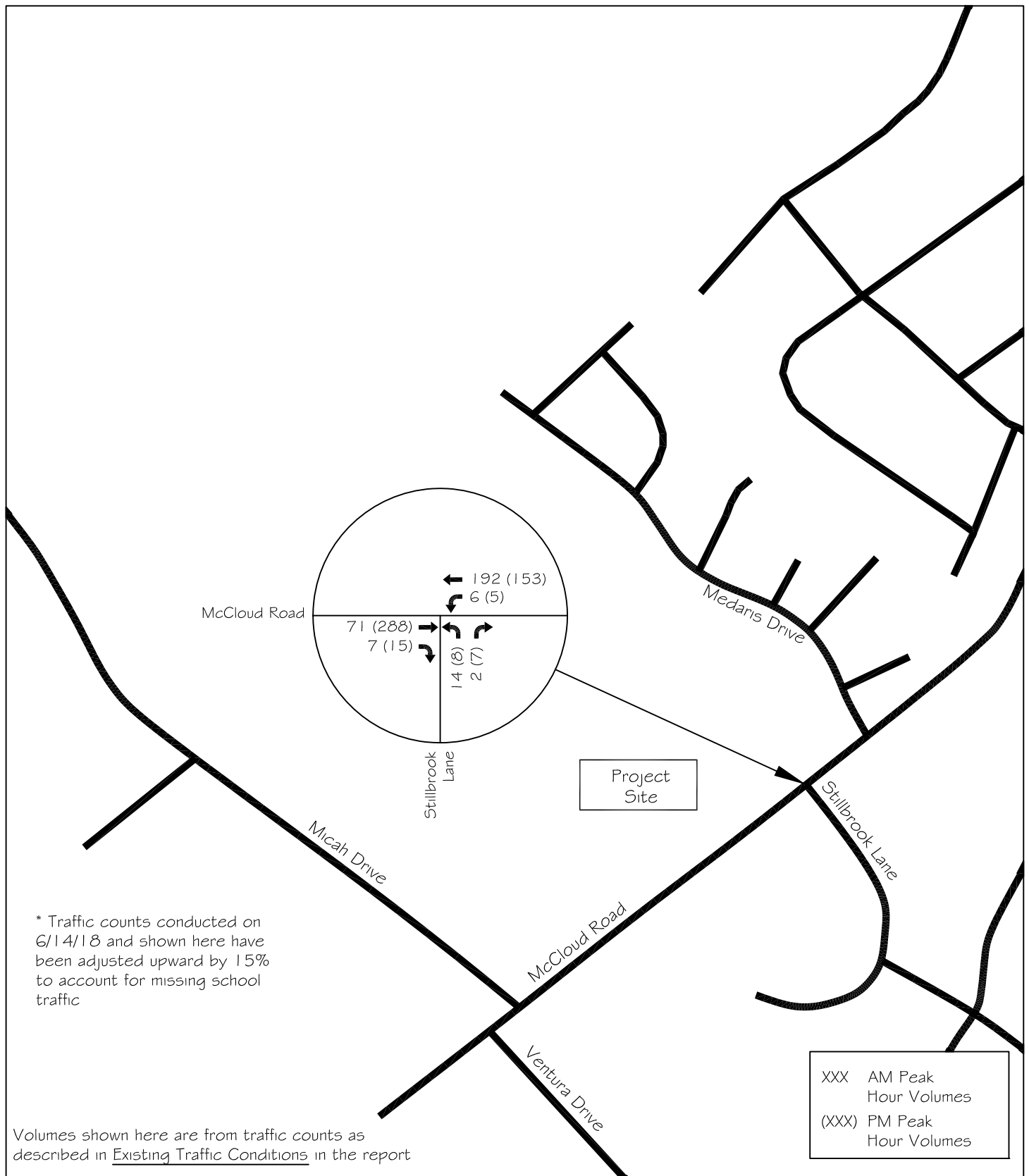
■ EXISTING TRAFFIC CONDITIONS

Traffic counts were conducted at the existing unsignalized intersection of McCloud Road at Stillbrook Lane as directed by the MPC.

Traffic counts at McCloud Road at Stillbrook Lane were obtained on Thursday, June 14, 2018 for a total of 5 hours. The counts were conducted during the morning and afternoon peak periods. Local schools were not in session when the traffic counts were conducted. Based on the traffic volumes counted, the AM peak hour was observed from 8:00 – 9:00 AM. The PM peak hour of traffic was observed from 5:00 – 6:00 PM.

The manual tabulated traffic counts can be reviewed in Appendix E. It is expected that higher volumes would be observed, and the AM and PM peak hour would be observed earlier if this traffic count was conducted while schools were in session. It is also expected that this report will be updated with new traffic counts once local schools are back in session in August. The existing counts that are shown in Appendix E have been adjusted in Figure 4 by increasing the observed volumes by 15% to account for the missing school traffic.

In Figure 4, the volumes shown are adjusted from the existing traffic count volumes during the AM and PM peak hours observed at the intersection. Very low volumes were observed for right and left turns from McCloud Road to southbound Stillbrook Lane. Low volumes were also observed for northbound left and right turns onto McCloud Road from Stillbrook Lane.



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FIGURE 4

Berry Patch Farms Subdivision

2018 Peak Hour Traffic Volumes -
EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the existing Level of Service (LOS) for the studied intersection with respect to vehicular traffic. The capacity analyses were calculated by following the methods outlined in the Highway Capacity Manual and using Synchro Traffic Software (Version 8). LOS is a qualitative measurement developed by the transportation profession of how well an intersection or roadway performs based on a driver's perception. LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at the worst. This grading system provides a reliable straightforward means to communicate road operations to the public. The Highway Capacity Manual (HCM) lists level of service criteria for unsignalized intersections and signalized intersections. For unsignalized intersections, Level of Service is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes travel time, driver discomfort, and fuel consumption. The LOS for a two-way stop (or yield) controlled intersection is defined by the delay for each minor approach and major street left-turn movement. Generally, LOS D is usually considered the lowest acceptable LOS by government agencies. Table 2 lists the level of service criteria for unsignalized intersections.

A/B



C/D



E/F



(Source: FDOT)

From the capacity calculations, the results from the existing peak hour vehicular traffic can be seen in Table 3 for the unsignalized intersection. The intersection is shown with a LOS designation, delay (in seconds), and v/c ratio (volume/capacity) for the AM and PM peak hours in the table. A v/c ratio of 1 would indicate that the traffic volumes are at the roadway capacity. Appendix F includes the worksheets from the capacity analyses for the existing peak hour vehicular traffic. For the intersection, the existing peak hour levels of service are shown to operate at a very good level during the AM and PM peak hours for vehicular traffic.

TABLE 2



**LEVEL OF SERVICE AND DELAY FOR
UNSIGNALIZED INTERSECTIONS**




LEVEL OF SERVICE	DESCRIPTION	DELAY RANGE (seconds/vehicle)
A	Little or no delay	≤ 10
B	Short Traffic Delays	>10 and ≤ 15
C	Average Traffic Delays	>15 and ≤ 25
D	Long Traffic Delays	>25 and ≤ 35
E	Very Long Traffic Delays	>35 and ≤ 50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual

TABLE 3

2018 PEAK HOUR LEVEL OF SERVICE & DELAY - EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH	AM PEAK			PM PEAK		
			LOS	DELAY (seconds)	V/C	LOS	DELAY (seconds)	V/C
McCloud Road at Stillbrook Lane	 Unsignalized	Northbound Left/Right	B	11.0	0.051	B	12.1	0.052
		Westbound Left	A	7.4	0.006	A	8.0	0.004

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2010 methodology

■ **OPENING YEAR TRAFFIC CONDITIONS (WITHOUT PROJECT):**

Opening year traffic volume estimates represent the future condition the proposed study area is potentially subject to without the proposed project being developed (no-build option). As previously stated, the build-out and full occupancy for this proposed new residential development was assumed to occur in the year 2023. This corresponds to five years for the development to reach full capacity and occupancy.

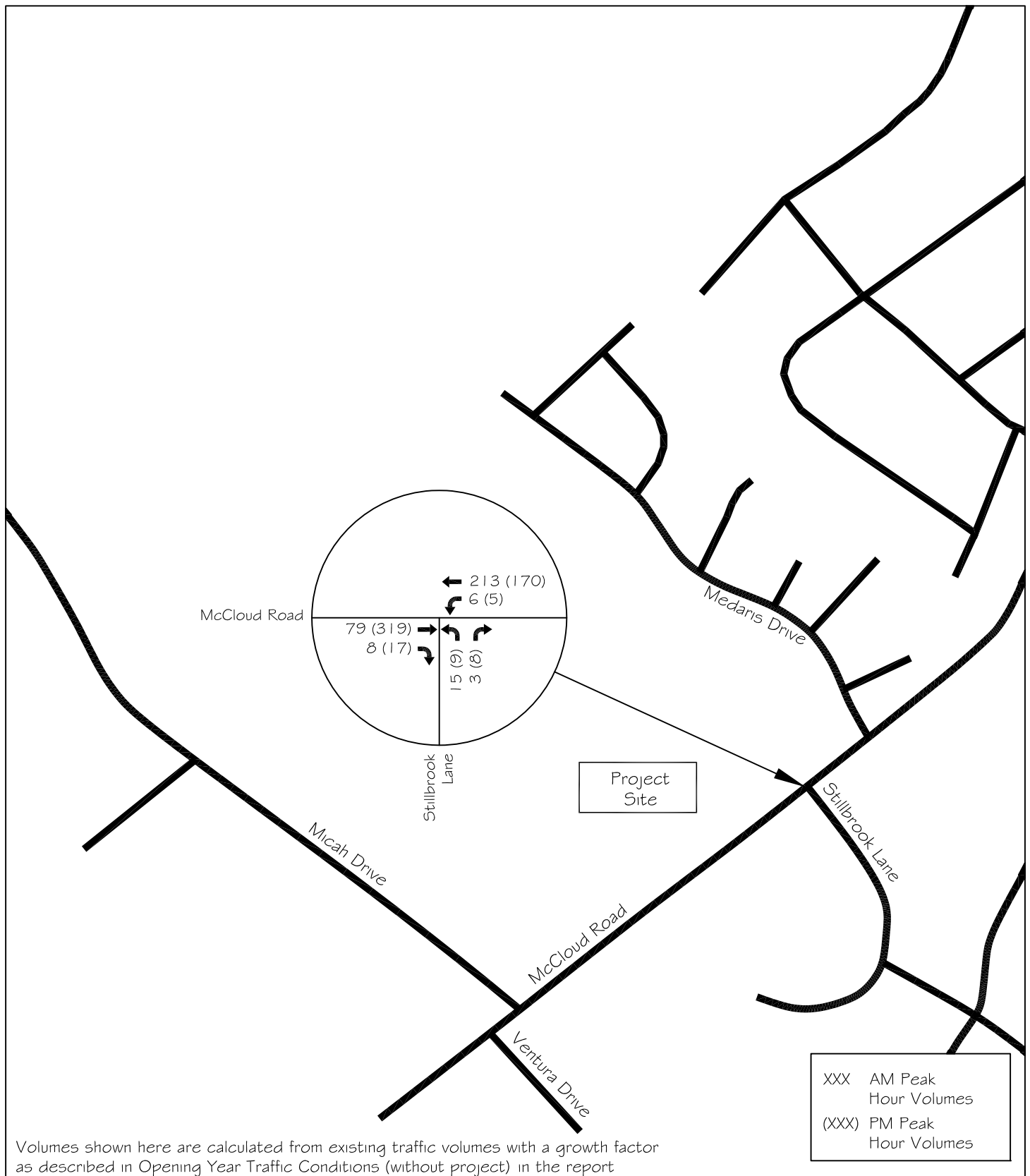
There are two traffic count locations adjacent to this project site conducted by other agencies. Traffic growth on McCloud Road has shown fairly moderate growth over the past 10 years according to the MPC count station (historical traffic data is shown in Appendix A). From 2006 thru 2016 (and interpolating values in between the years in which counts were not conducted), the average annual growth rate was calculated to be 2.3%. Currently, there are no known other relevant significant upcoming developments adjacent to the proposed site on McCloud Road that would indicate large future increased traffic volumes in the study area in the short term. To insure a reasonable and conservative estimate for this study, a 2.5% annual growth rate was used to consider any future development in the area and potential rising travel volumes. The results of this growth rate application to the existing traffic volumes (that were adjusted upward by 15%) can be seen in Figure 5 for the year 2023. Figure 5 shows the projected opening year traffic volumes during the AM and PM peak hours on McCloud Road at Stillbrook Lane based on an assumed annual growth rate of 2.5%. These volumes that are shown in Figure 5 could potentially exist in the future even without the proposed residential project being constructed and developed.

The capacity analysis for the intersection of McCloud Road at Stillbrook Lane was calculated and shown to operate extremely well during the AM and PM peak hours for the opening year conditions (without project) in the year 2023. Table 4 reports the results for the projected opening year traffic conditions (without project) in 2023 and Appendix F contains the LOS capacity worksheets.

TABLE 4
2023 PEAK HOUR LEVEL OF SERVICE & DELAY - BACKGROUND TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH	AM PEAK			PM PEAK		
			LOS	DELAY (seconds)	V/C	LOS	DELAY (seconds)	V/C
McCloud Road at Stillbrook Lane	 Unsignalized	Northbound Left/Right	B	11.3	0.059	B	12.7	0.063
		Westbound Left	A	7.4	0.006	A	8.1	0.004

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2010 methodology



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FIGURE 5

Berry Patch Farms Subdivision

2023 Peak Hour Traffic Volumes -
 OPENING YEAR TRAFFIC (WITHOUT
 PROJECT)

■ **TRIP GENERATION**

The estimated amount of traffic that will be generated by the proposed residential development was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 9th Edition, a publication of the Institute of Transportation Engineers (ITE). A generated trip is a single or one-direction vehicle movement that is either entering or exiting the study site. The Trip Generation Manual is the traditional and most popular resource for determining trip generation rates when traffic impact studies are produced. The Manual lists and includes data for a variety of land uses and correlates trips generated based on different variables such as dwelling units, square footage, etc. The data from ITE for the proposed land use is shown in Appendix G. A summary of this information is presented in the following table:

TABLE 5
TRIP GENERATION FOR BERRY PATCH FARMS SUBDIVISION
 116 single family detached homes

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	116 Lots	1,204	25%	75%		63%	37%	
				23	68	91	76	45	121
Total New Volume Site Trips			1,204	23	68	91	76	45	121

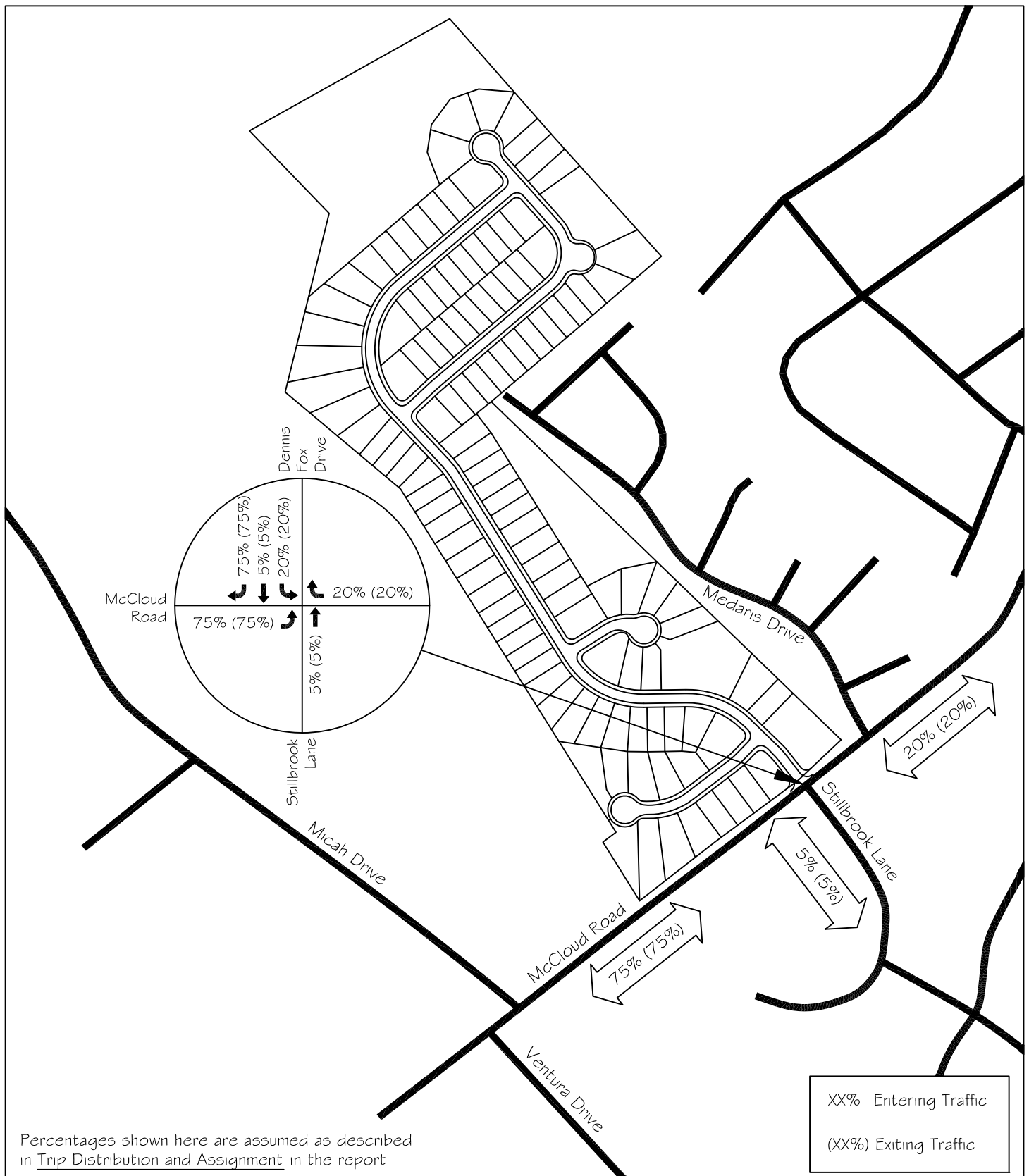
ITE Trip Generation Manual, 9th Edition

With a total of 116 single-family detached residences, based on the calculations, it is estimated that 23 vehicles will enter the development, 68 will exit, for a total of 91 new generated trips during the AM Peak Hour in the year 2023. Similarly, it is estimated that 76 vehicles will enter the development, 45 will exit, for a total of 121 new generated trips during the PM Peak Hour in the year 2023. The calculated trips generated for an average weekday could be expected to be approximately 1,204 vehicles for the entire 116 lot development in the year 2023. No trip reductions were included either for pass-by or internal trips.

■ TRIP DISTRIBUTION AND ASSIGNMENT

Figure 6 shows the projected distribution for traffic entering/exiting the new residential subdivision during the future AM peak hour and the future PM peak hour at the intersection on McCloud Road. The percentages that are shown only pertain to the new trips generated by the new proposed residential dwellings in the subdivision that were calculated from the ITE Trip Generation Manual. There are a variety of developments and destinations that will potentially “attract” the projected traffic to and from the new residential development; Interstate 40/75, downtown Knoxville, various industries and businesses for employment, and a variety of public and private elementary, middle, and high schools. The projected trip distributions of Figure 6 are based on the existing traffic movements on McCloud Road and are also surmised from surrounding concentrations of development and population.

Figure 7 shows the Traffic Assignment of the computed trips that will be generated by the development (from Table 5) and applied to the various intersection movements based on the assumed distribution of trips shown in Figure 6.



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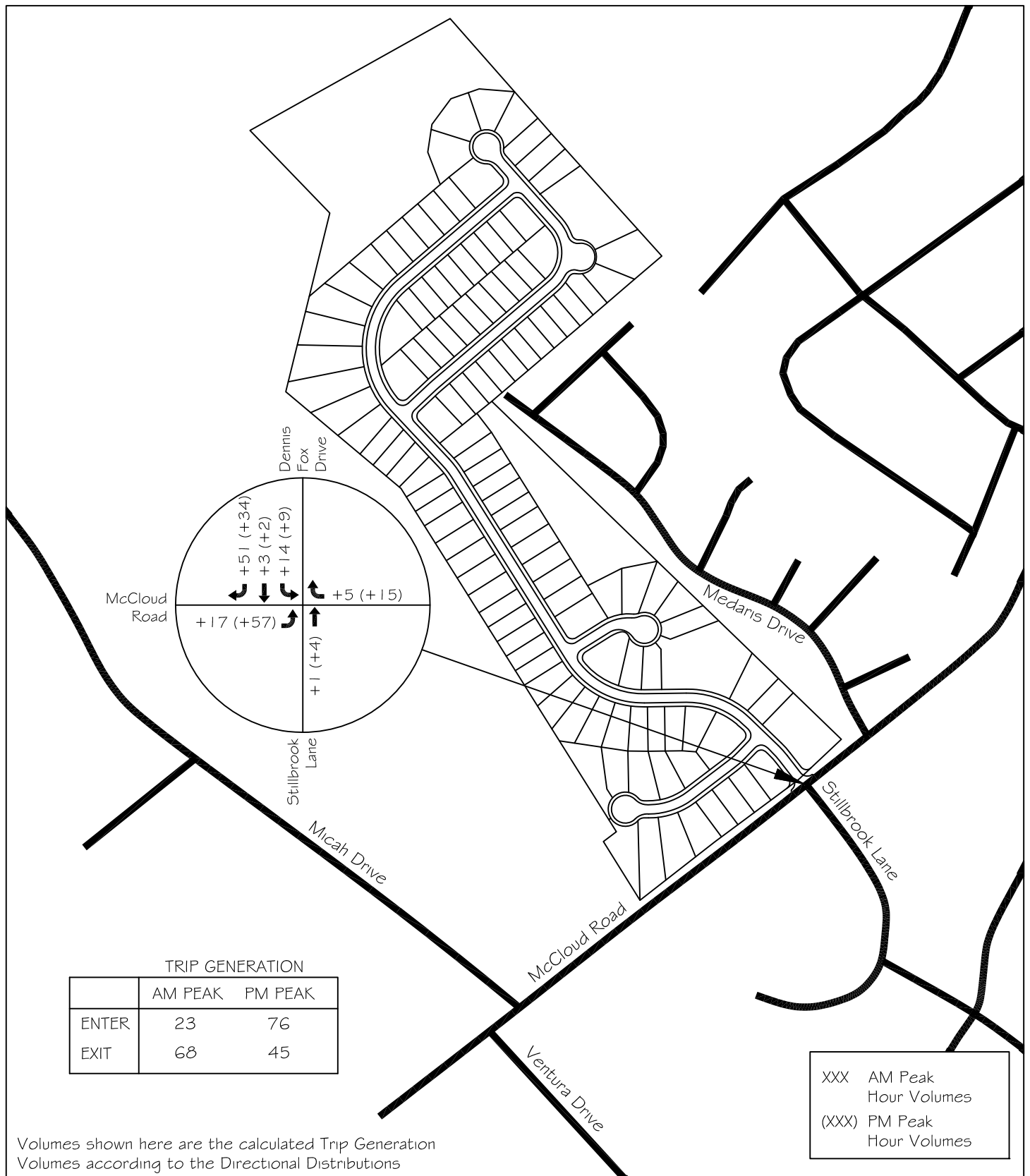
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FIGURE 6

Berry Patch Farms Subdivision

Directional Distribution of Generated Traffic during AM and PM Peak Hour



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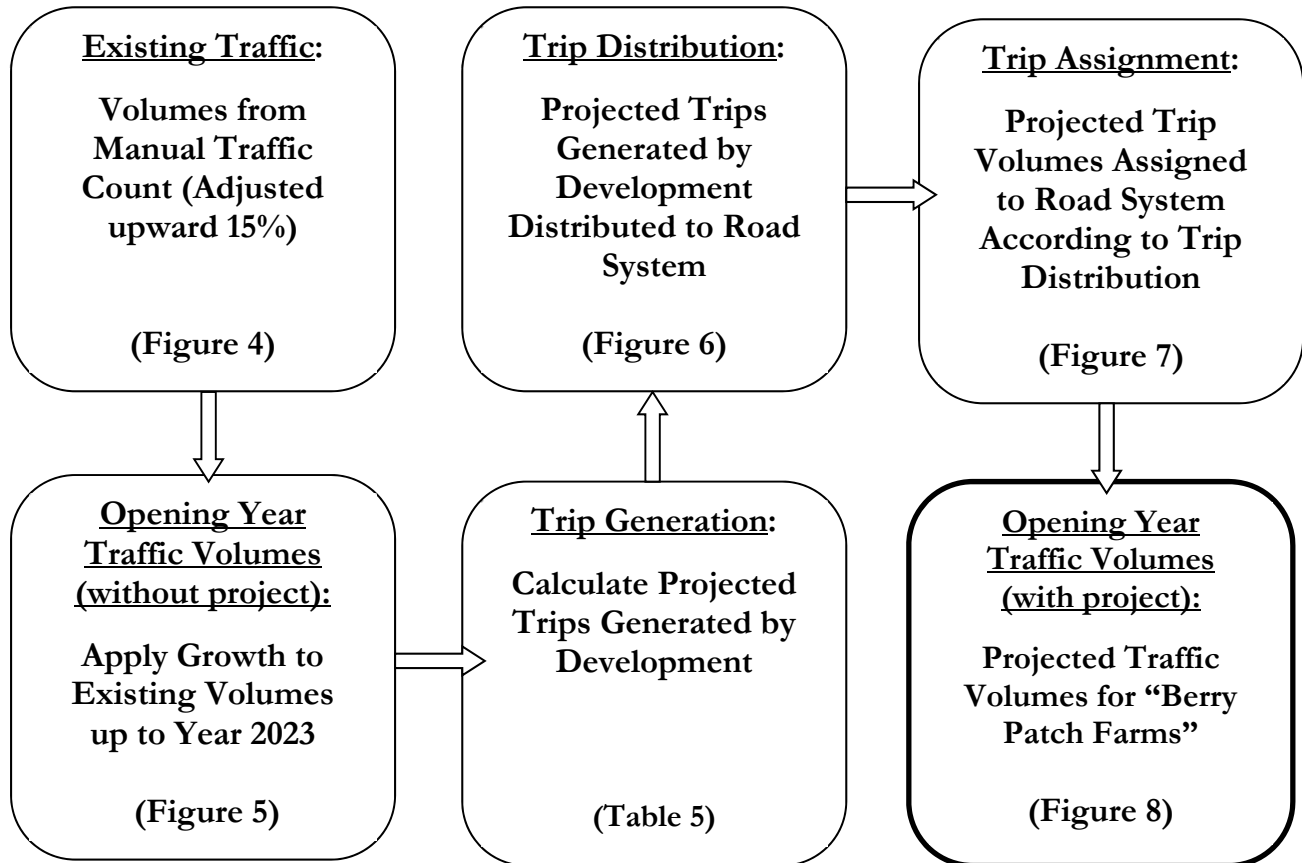
FIGURE 7

Berry Patch Farms Subdivision

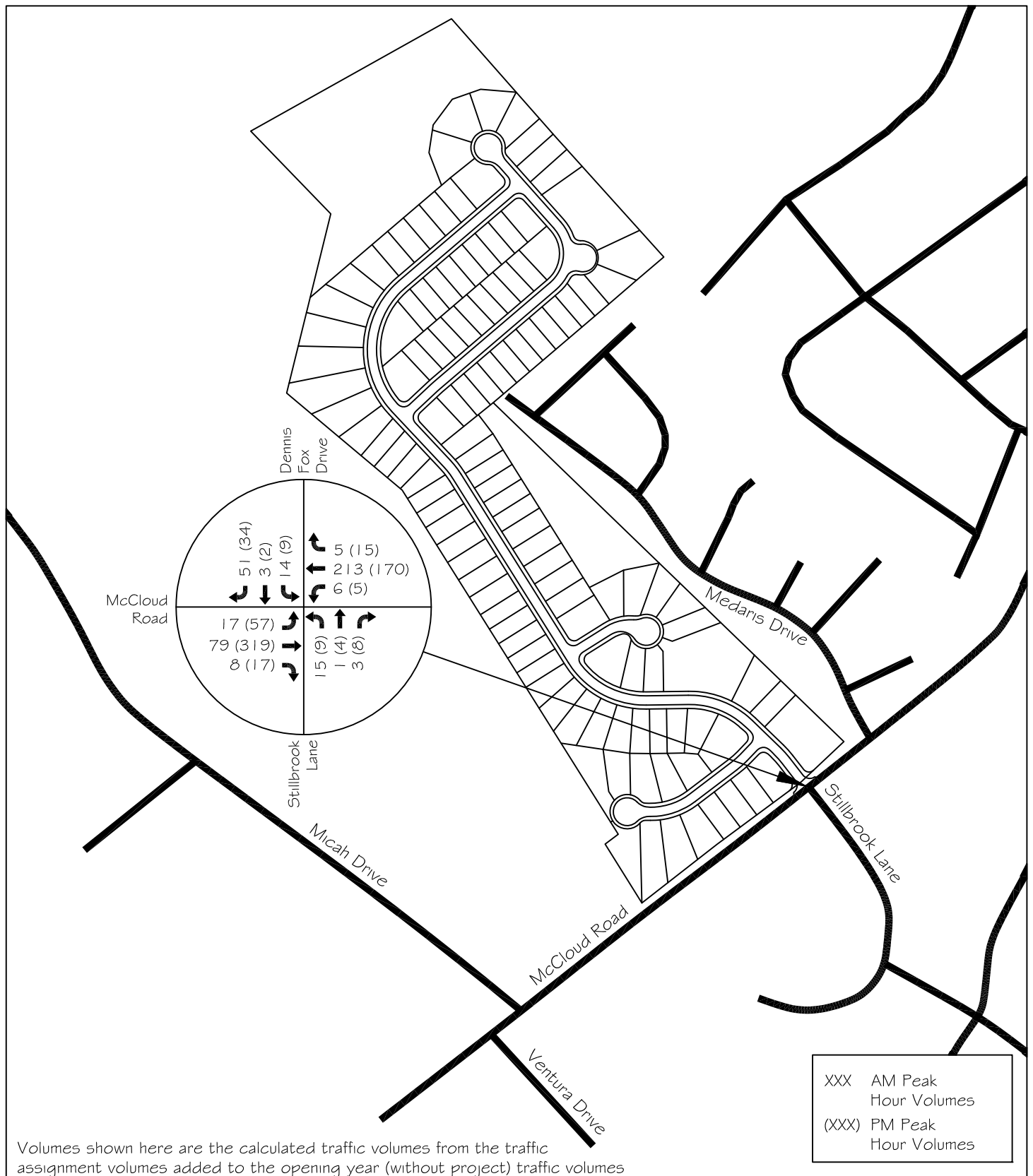
Traffic Assignment of Generated Traffic during AM and PM Peak Hour

■ **OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)**

Overall, several additive steps were taken to estimate the total opening year projected traffic volumes at the intersection on McCloud Road when the residential development is fully constructed and occupied in the year 2023. The steps are illustrated below for clarity:



To calculate the total future projected traffic volumes at the studied intersection, the calculated peak hour traffic (from ITE Trip Generation) generated by the new proposed residential development was added to the 2023 opening year traffic volumes on McCloud Road (shown in Figure 5) in accordance with the predicted directional distributions and assignments (shown in Figures 6 and 7). This procedure was necessary to obtain the total projected traffic volumes at the time the development is fully built-out. Figure 8 shows the projected AM and PM peak hour volumes at the studied intersection for the year 2023.



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FIGURE 8


Berry Patch Farms Subdivision

2022 Peak Hour Traffic Volumes -
OPENING YEAR TRAFFIC (WITH
PROJECT)

Capacity analyses were undertaken to determine the projected Level of Service (LOS) for vehicles at the studied intersection in the year 2023. Appendix F includes the worksheets for these capacity analyses.

The results of the capacity calculations of the projected peak hour vehicular traffic can be seen in Table 6 for the studied intersection for the year 2023. As can be seen in the table, the intersection of McCloud Road at Stillbrook Lane/Dennis Fox Drive is calculated to operate very well with respect to the level of service.

TABLE 6
2023 PEAK HOUR LEVEL OF SERVICE & DELAY - OPENING YEAR (WITH PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH	AM PEAK			PM PEAK		
			LOS	DELAY (seconds)	V/C	LOS	DELAY (seconds)	V/C
McCloud Road at Stillbrook Lane / Dennis Fox Drive	 Unsignalized	Northbound Left/Thru/Right	B	13.2	0.078	C	16.6	0.104
		Eastbound Left	A	7.7	0.014	A	7.7	0.046
		Westbound Left	A	7.4	0.006	A	8.1	0.004
		Southbound Left/Thru/Right	B	10.3	0.100	B	10.9	0.075

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2010 methodology

■ **POTENTIAL SAFETY ISSUES**

The study area was investigated for potential safety issues. Several features of the adjacent transportation system were identified and are discussed in the following pages as having potential safety issues.

■ **EVALUATION OF TURN LANE THRESHOLDS**

The McCloud Road at Stillbrook Lane/Dennis Fox Drive intersection was evaluated for the need for separate turn lanes on McCloud Road for entering vehicles into the development. Based on the projected traffic volumes at the intersection on McCloud Road and according to “Knox County’s Access Control and Driveway Design Policy”, separate turn lanes are not warranted on McCloud Road for entering vehicles. The Knox County turn lane policy worksheet is in Appendix H and the results shown in the Appendix are based on the projected volumes during the PM peak hour since this time period is estimated to have the highest volumes at the intersection.

The design policy for turn lane warrants relates volume thresholds based on prevailing speeds for two-lane roadways. The speed classification that was chosen for this evaluation was based on the posted speed limit of 30 mph. Therefore, this study evaluation used the Knox County classification for speeds of 35 mph or less with the calculated projected volumes.

■ **EVALUATION OF SIGHT DISTANCE**

Based on a posted speed limit of 30 mph on McCloud Road; the typical required intersection sight distance would be 300 feet looking each direction at the intersection on McCloud Road based on Knox County policy of requiring 10 feet of sight distance per 1 mph of speed.

Using a rolling measuring wheel and looking southwest at the approximate location of the proposed intersection on McCloud Road at Stillbrook Lane/Dennis Fox Drive, the sight distance was measured to be approximately 450 feet at the roadway edge. Sight distance at the proposed intersection on McCloud Road at Stillbrook Lane/Dennis Fox Drive looking northeast was measured to be approximately 490 feet at the roadway edge. Suppressing

vegetation at this proposed new intersection will need to be maintained in the future. The site designer should ensure that these sight distance lengths are met, and they should be labeled on the plans. Measuring more accurate sight distances on McCloud Road needs to be performed by a licensed surveyor.

CONCLUSIONS AND RECOMMENDATIONS

The following is an overview of recommendations to minimize the traffic impacts of the proposed development on the surrounding road system while attempting to achieve an acceptable level of traffic flow and safety.

1) **McCloud Road at Stillbrook Lane/Dennis Fox Drive:** From the capacity calculations, it has been shown (Table 6) that the traffic movements at this entrance should operate very well with minimal delays during the AM and PM peak periods once the development is completed.

1a) The capacity analysis shows that only a single exiting lane for left and right exiting vehicles is required on Dennis Fox Drive. Also, separate left turn lanes or right turn lanes on McCloud Road into the subdivision entrance are not required based on the projected volumes.

1b) The recommended intersection sight distance requirement is 300 feet at the proposed entrance at McCloud Road. The sight distance in both directions at this intersection on McCloud Road will need to be maintained in the future and must not be impacted by future landscaping or by existing vegetation. The designer should insure that this intersection is given the maximum amount of sight distance to provide clear unobstructed views.

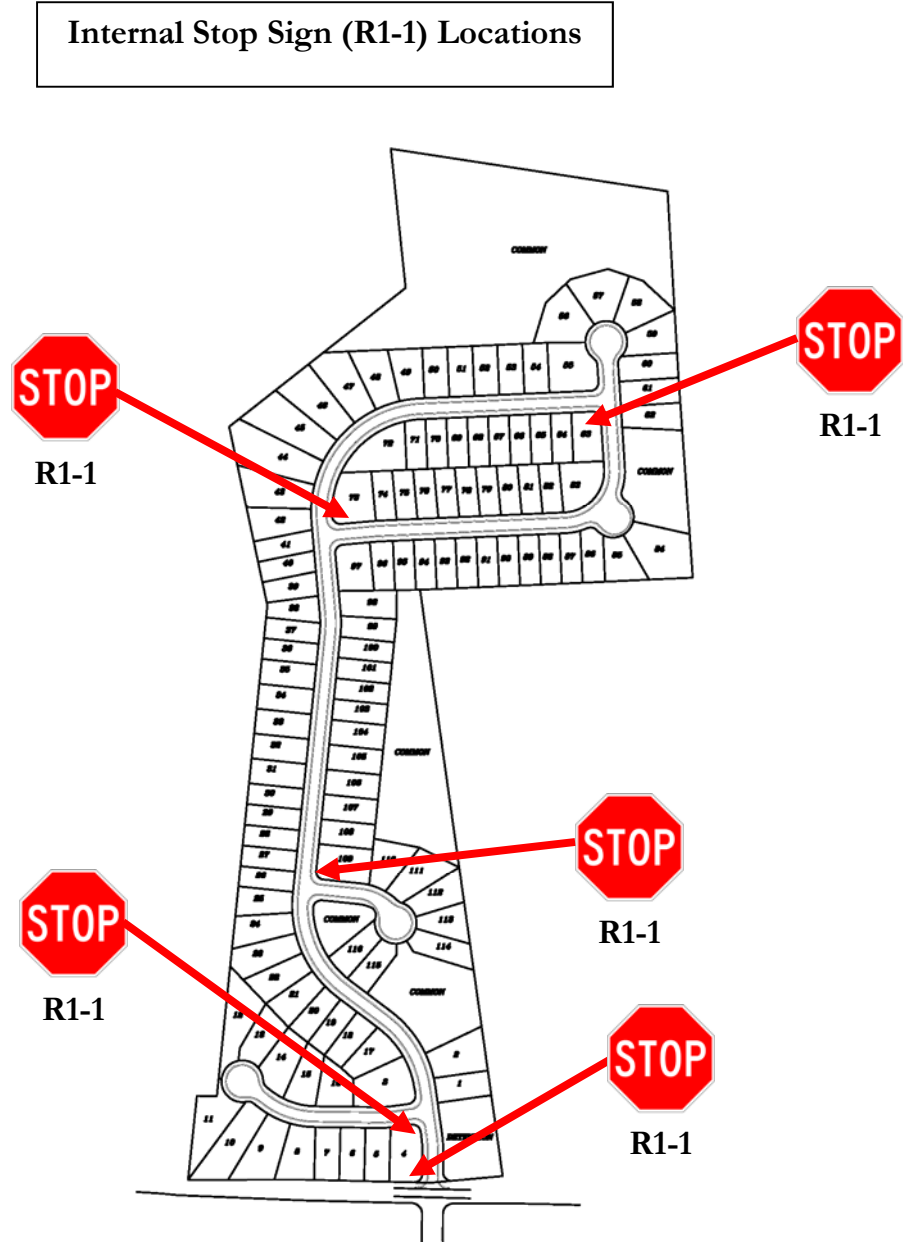
The required sight distance should be measured at the intersection at a minimum of 15 feet from the edge of the roadway per Knox County Subdivision Regulations (Section 3.04.J.5). The sight distance should be measured from a driver eye height of three and one-half (3.50) feet on the minor road to a height of object at three and one-half (3.50) feet above the pavement surface on the major road. The sight distance must be measured and verified by a licensed land surveyor.

1c) It is recommended that a Stop Sign (R1-1) and 24" white stop bar be applied to the pavement of the Dennis Fox Drive approach at McCloud Road. The stop bar should be applied at a minimum of 4 feet away from the edge of McCloud

Road and should be placed at the desired stopping point that provides the maximum sight distance.

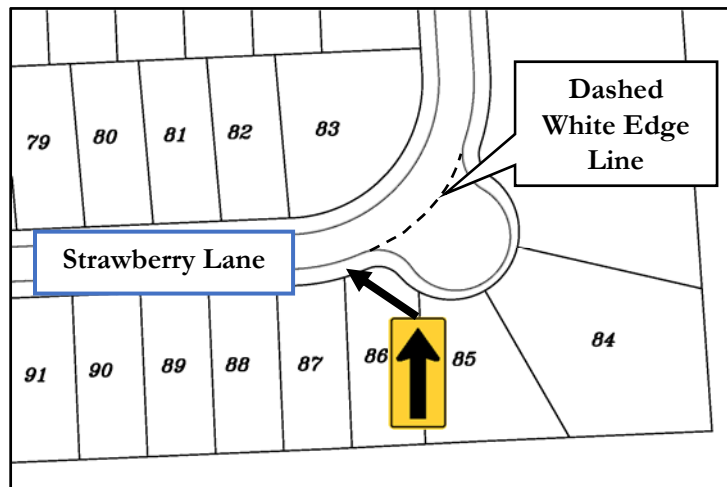
2) **Berry Patch Farms Subdivision Internal Roads:** The layout plan shows several new roadways being constructed within the development as shown in Figure 3.

2a) Stop Signs (R1-1) should be installed at the internal intersections as shown below:



- 2b) Sight distance at the new internal intersections must not be impacted by new signage, future landscaping, or parked vehicles. For a posted 25 mph speed limit for the internal residential development streets, the internal intersection sight distance requirement is 250 feet. The road layout designer should insure that these sight distance lengths are met, maximized, and they should be labeled on the plans.

- 2c) Strawberry Lane in the residential subdivision has been designed with a short stub-out/cul-de-sac on the southeast corner. This non-traditional road layout will require additional pavement markings and signage to reduce the possibility of



vehicle conflicts. It is recommended that a white dashed line be installed in the outside path of Strawberry Lane. A Left Direction Arrow Sign (W1-6) should be installed facing the eastbound approach of Strawberry Lane prior to the stub-out/cul-de-sac.

- 2d) It is recommended that a 25-mph speed limit and “No Outlet” (W14-2a) sign be posted on Dennis Fox Drive into the new residential subdivision.
- 2e) The proposed lots within the development that are adjacent to McCloud Road should not be allowed to have direct access.
- 2f) All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County Engineering specifications and guidelines to ensure proper operation.

3) **Pedestrian and Bicycle Considerations:**

- 3a) Construct a 5-foot concrete sidewalk with a minimum 2-foot planting strip along all the internal roadways at a minimum of one side of each road.
- 3b) The sidewalks that are proposed for the development should have appropriate ADA compliant curbed ramps at the intersection corners.
- 3c) All drainage grates and covers for the residential development need to be pedestrian and bicycle friendly.

APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

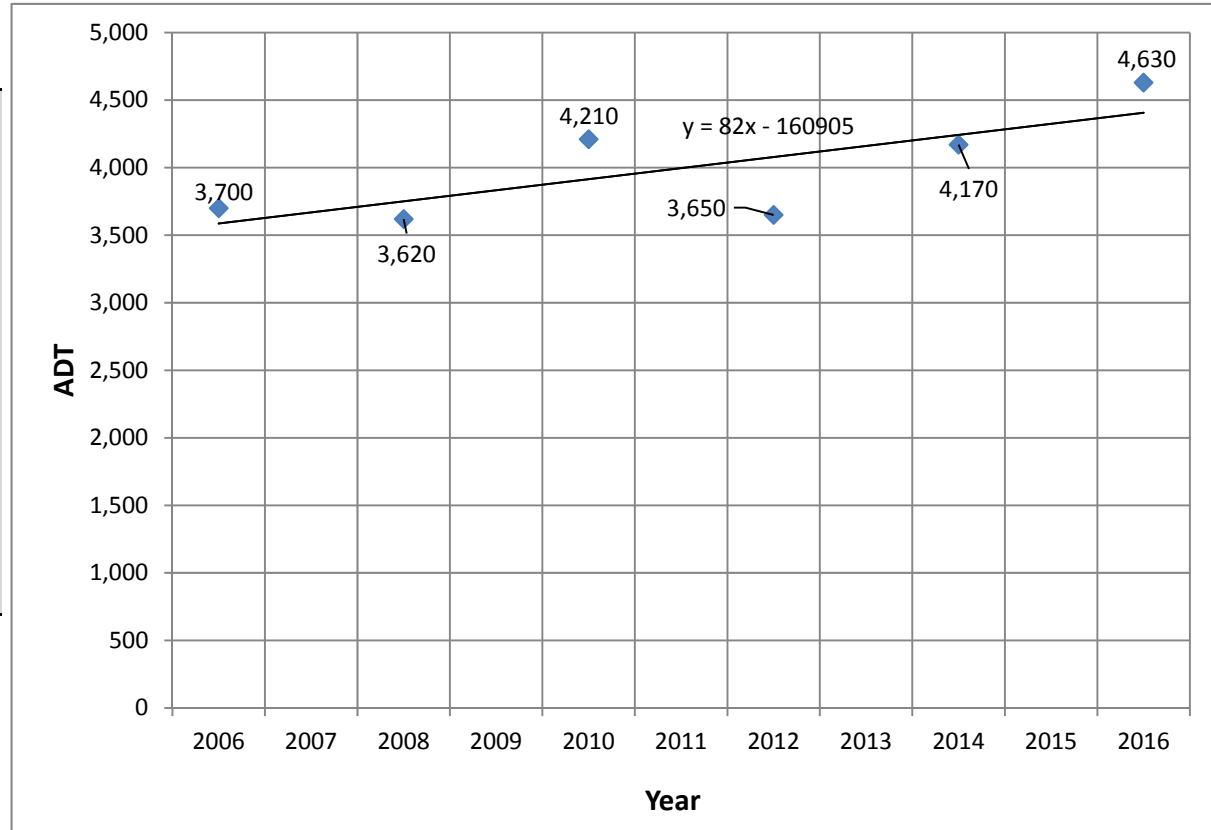
Historical Traffic Counts

Organization: MPC

Station ID #: 093M206

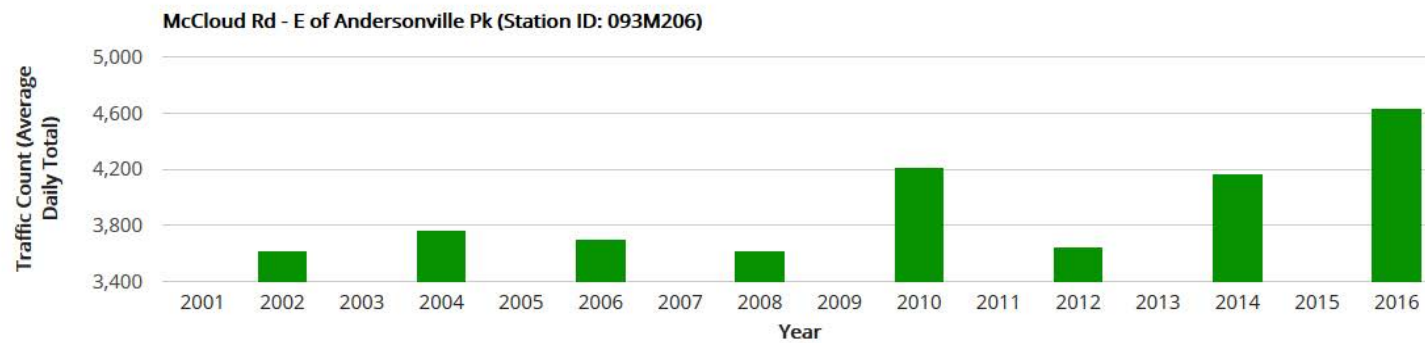
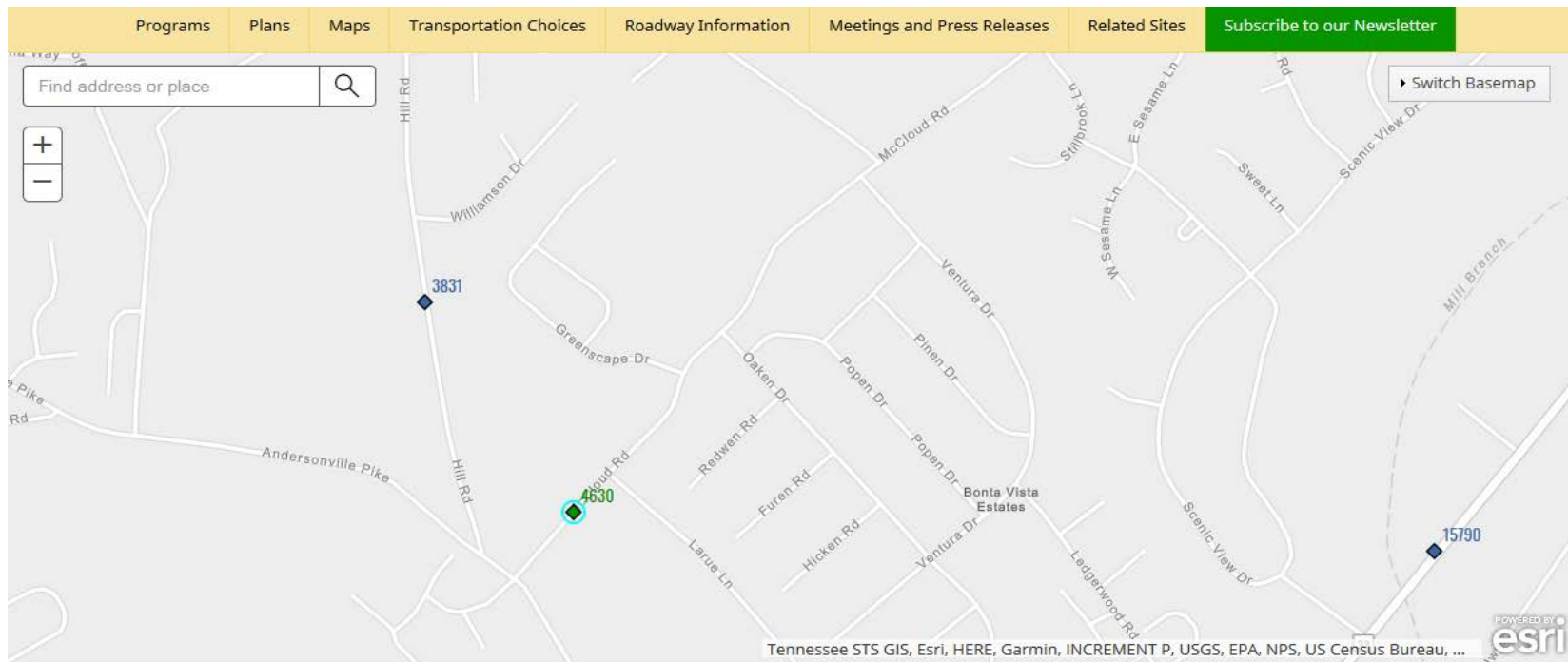
Location: McCloud Road (west of Larue Lane)

YEAR	ADT	Trendline
2006	3,700	
2007		
2008	3,620	
2009		
2010	4,210	
2011		
2012	3,650	
2013		
2014	4,170	
2015		
2016	4,630	



2006 - 2016 Growth Rate = 25.1%

Average Annual Growth Rate = 2.3%



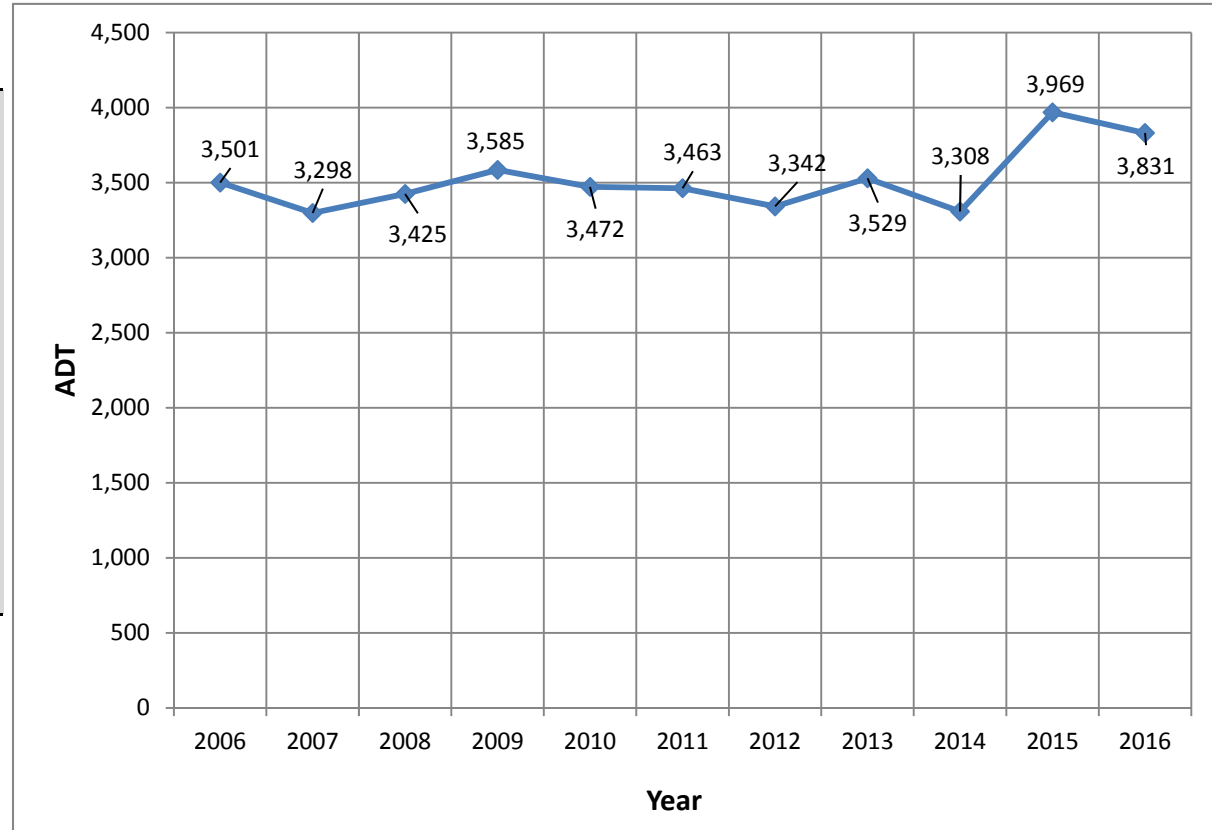
Historical Traffic Counts

Organization: TDOT

Station ID #: 000021

Location: Hill Road (north of McCloud Road)

YEAR	ADT	Trendline
2006	3,501	
2007	3,298	
2008	3,425	
2009	3,585	
2010	3,472	
2011	3,463	
2012	3,342	
2013	3,529	
2014	3,308	
2015	3,969	
2016	3,831	



2006 - 2016 Growth Rate = 9.4%

Average Annual Growth Rate = 0.9%



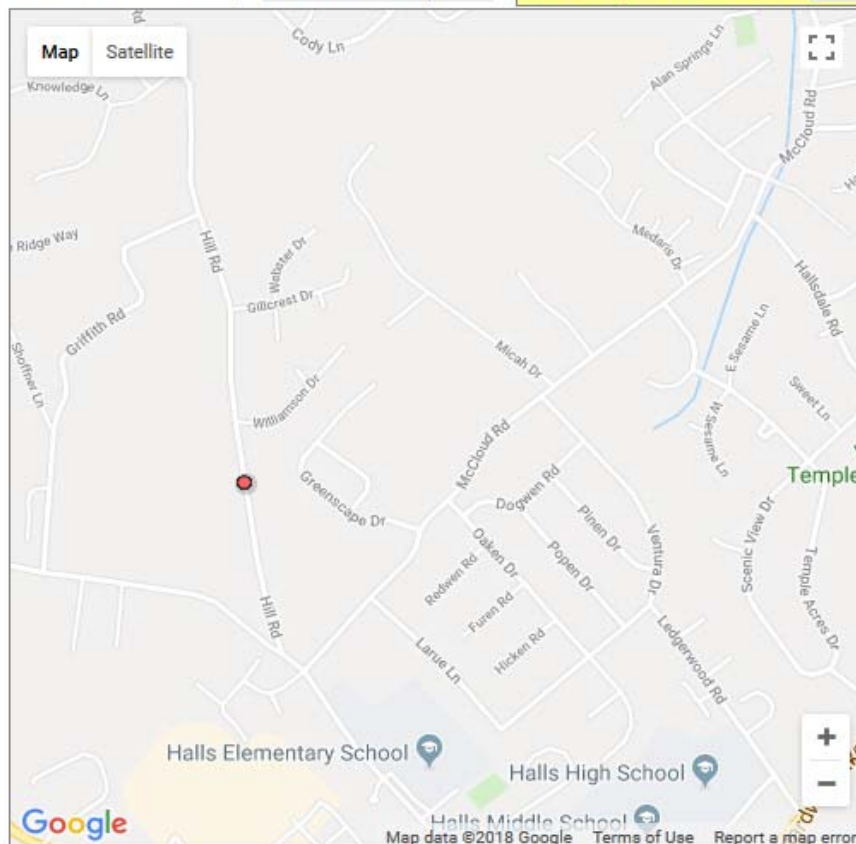
Traffic History

Traffic History reflects the Annual Average Daily Traffic (AADT) count along specific locations on Tennessee's road network

View stations on map:

Non-Map Record Search:

Station Number:



Station Information	
Station	000021
Route	02409
Location	SALEM CH RD-NEAR HALLS CROSS ROADS
County	Knox
2016	3831
2015	3969
2014	3308
2013	3529
2012	3342
2011	3463
2010	3472
2009	3585
2008	3425
2007	3298
2006	3501
2005	3323
2004	3258
2003	2575
2002	2704
2001	2783
2000	2897
1999	2260

Download File:

[KML](#)

[ESRI Geodatabase](#)

[ESRI Shapefile](#)

[Database Table](#)

Open With:

[Google Earth](#)

[ArcGIS Explorer](#)


[MS Access or Excel](#)

APPENDIX B

WALK SCORE

WALK SCORE


(from walkscore.com)




Walk Score  [Get Scores](#) [Find Apartments](#) [My Favorites](#) [Add to Your Site](#)

[Go](#)


4411 McCloud Road

Knoxville, Tennessee, 37938

Commute to **Downtown Knoxville** 

 34 min  60+ min  60+ min [View Routes](#)

[Favorite](#) [Map](#) [Nearby Apartments](#)

[Looking for a home for sale in Knoxville?](#) 

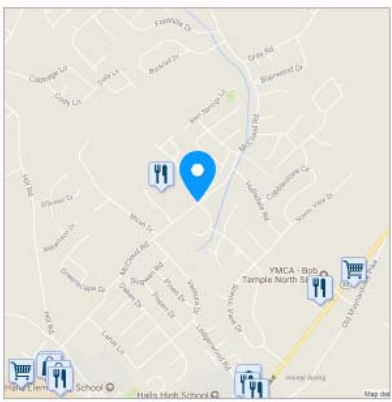
Walk Score
13

Car-Dependent
Almost all errands require a car.

Transit Score
0

Minimal Transit
It is possible to get on a bus.

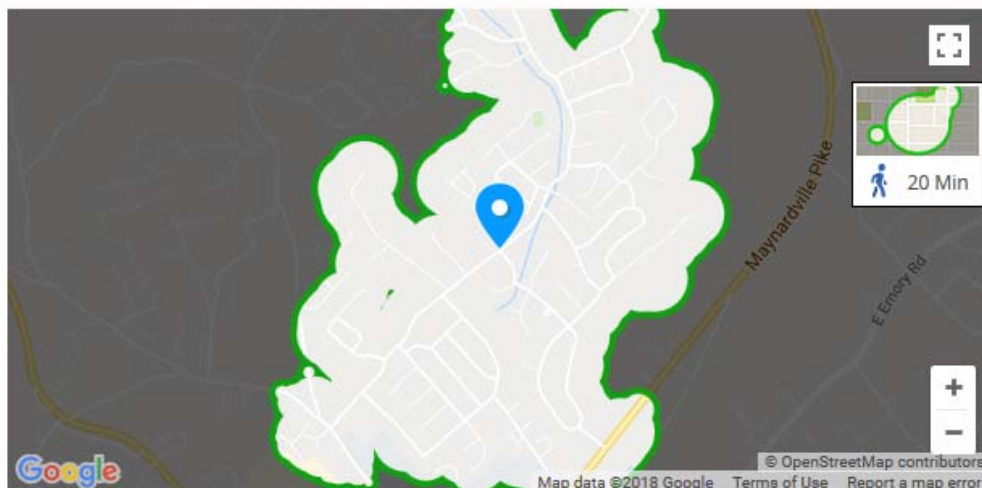
[About your score](#)



Travel Time Map

[Add to your site](#)

Explore how far you can travel by car, bus, bike and foot from 4411 McCloud Road.



What's Nearby

Restaurants:

The Fruit and Berry Patch

.2mi

Coffee:

McDonald's

1.9mi

Bars:

The Rocks Tavern

1.6mi

Groceries:

Avanti Savioia Imports, LLC

.6mi

Parks:

Fountain City Park

4.3mi

Schools:

North Knox Career Technical ...

.7mi

Shopping:

Hibbett Sports

.9mi

Entertainment:

Edwards Theatres Inc

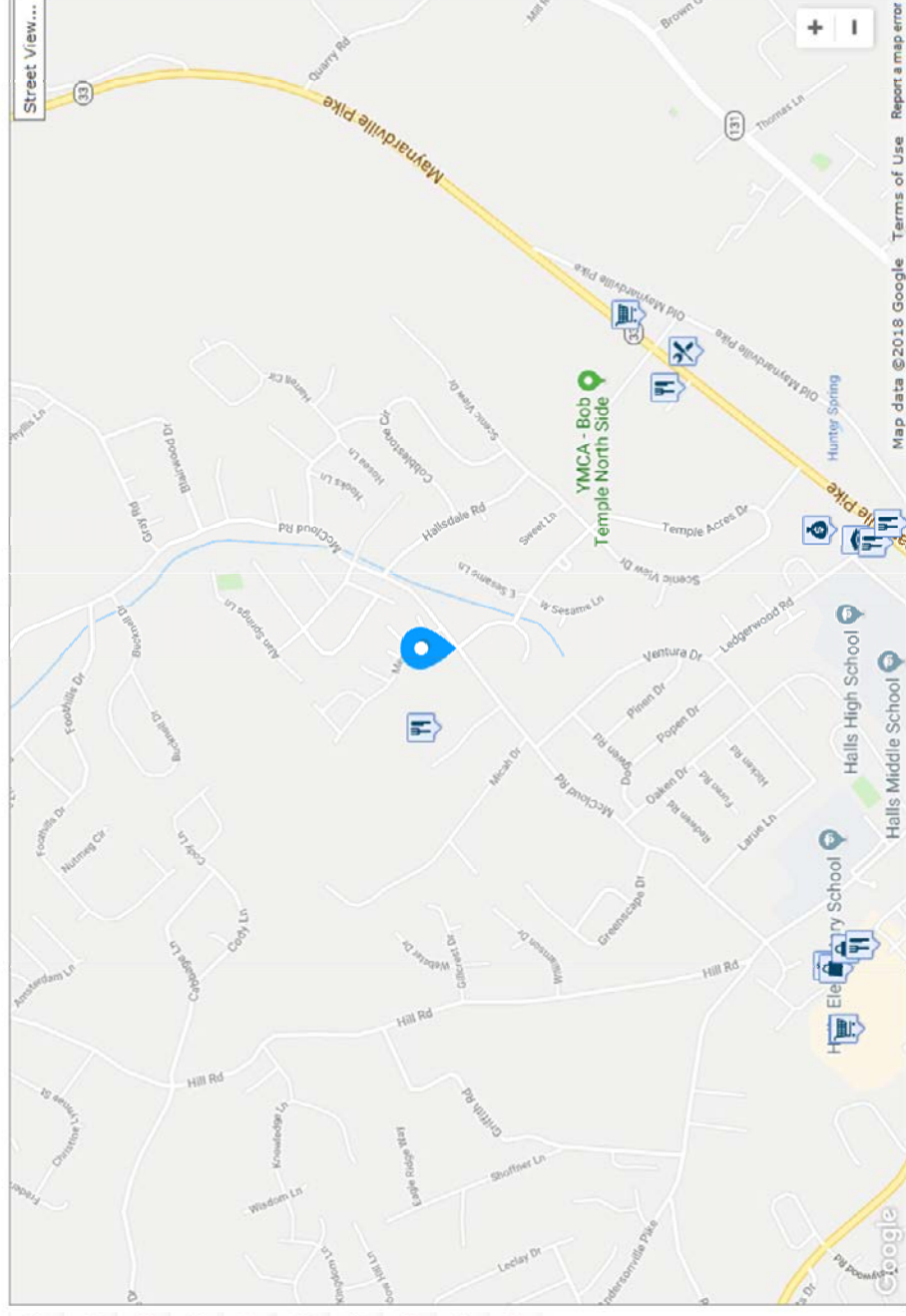
1.4mi

Errands:

Tractor Supply Co.

.7mi

Search Nearby:

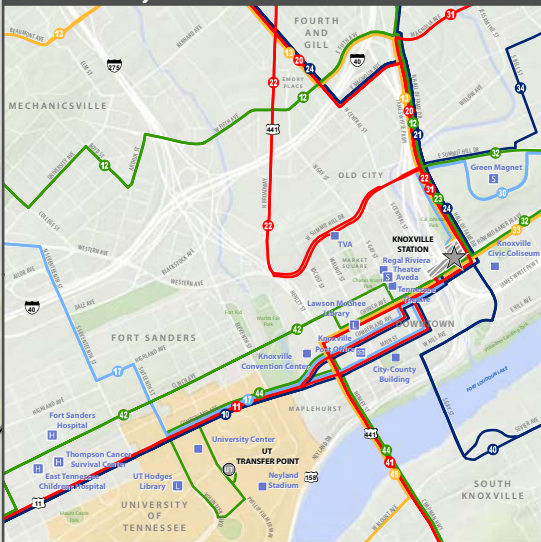


Something missing? [Add a place](#)

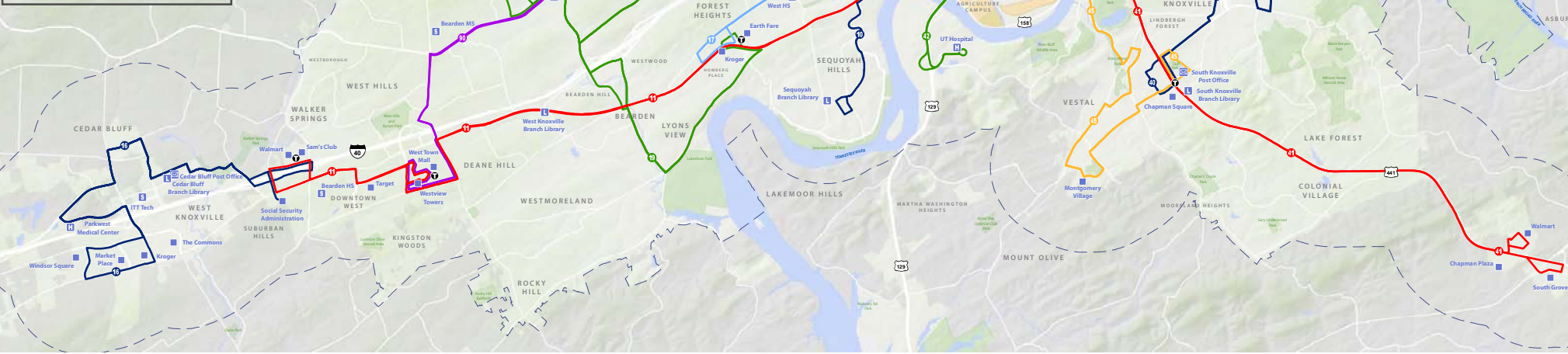
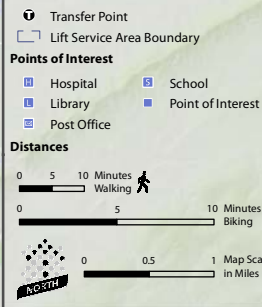
APPENDIX C

KNOXVILLE AREA TRANSIT MAP AND INFORMATION

Knoxville City Center

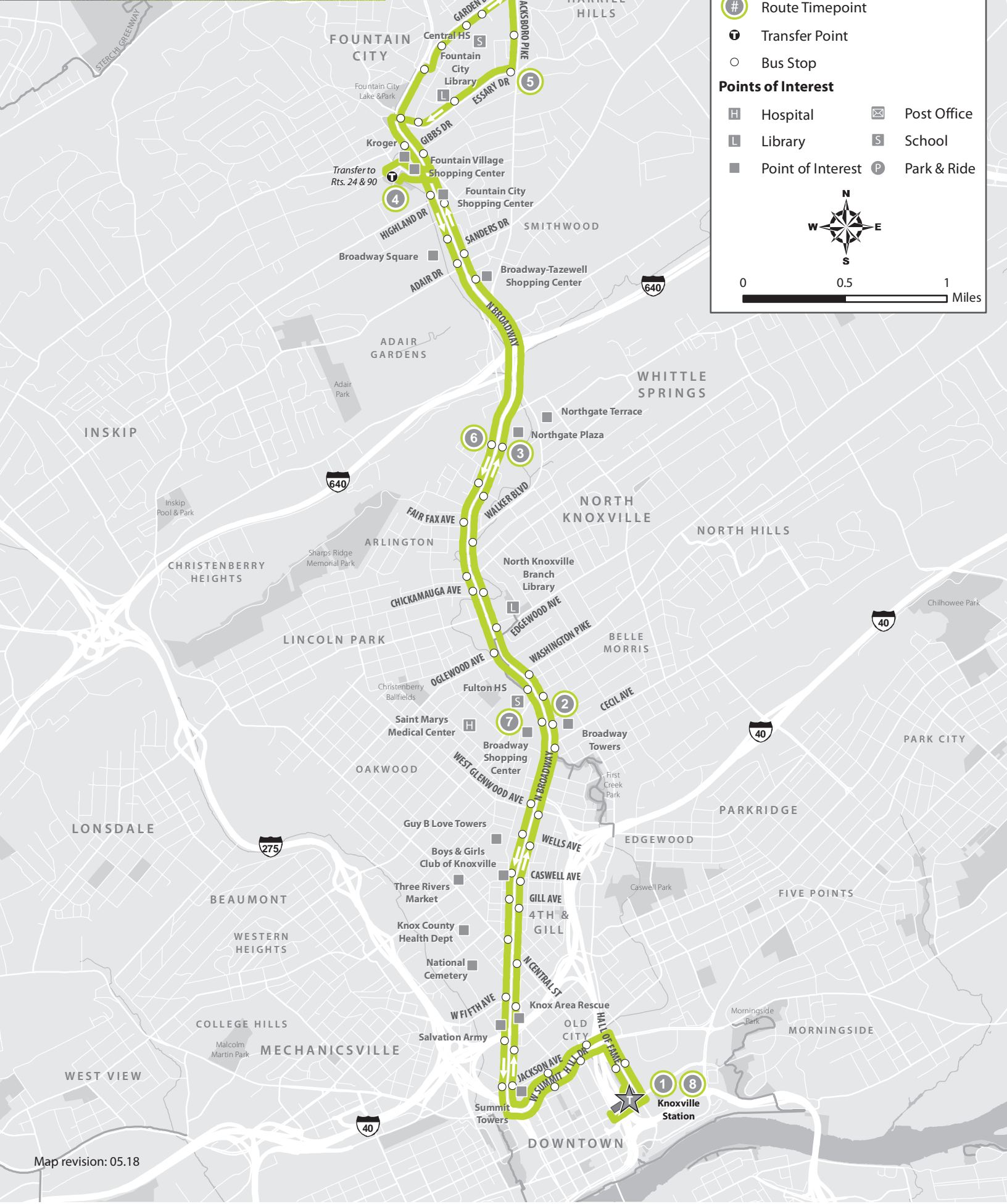


Legend



22 BROADWAY

(Weekdays and Weekends)



22

BROADWAY

(Weekdays and Weekends)

SERVES:

★ Broadway Shopping Center

★ Central High School

★ Fountain City

★ Fountain City Library

★ Fulton High School

★ Knox Road/Kroger

★ Knoxville Station/Downtown

★ Northgate Shopping Center

★ North Knoxville Branch Library

kat

KNOXVILLE

AREA TRANSIT

Information Updated: May 14, 2018

Weekday Schedule Route 22: Broadway

Going away from Downtown				Going toward Downtown			
T Transfer to:			Rts. 24 & 90				
Knoxville Station—Platform H	Broadway Shopping Center	Northgate Shopping Center	Fountain City Superstop	Jacksboro at Essary	Northgate Shopping Center	Broadway Shopping Center	Knoxville Station
1	2	3	4	5	6	7	8

WEEKDAY SCHEDULE								
A.M.	—	—	—	—	5:40	5:51	5:56	6:10
	—	—	—	—	5:55	6:06	6:11	6:25
	—	—	—	—	6:10	6:21	6:26	6:40
	—	—	—	—	6:25	6:36	6:41	6:55
	6:00	6:13	6:20	6:35	6:40	6:51	6:56	7:10
	6:15	6:28	6:35	6:50	6:55	7:06	7:11	7:25
	6:30	6:43	6:50	7:05	7:10	7:21	7:26	7:40
	6:45	6:58	7:05	7:20	7:25	7:36	7:41	7:55
	7:00	7:13	7:20	7:35	7:40	7:51	7:56	8:10
	7:15	7:28	7:35	7:50	7:55	8:06	8:11	8:25
	7:30	7:43	7:50	8:05	8:10	8:21	8:26	8:40
	7:45	7:58	8:05	8:20	8:25	8:36	8:41	8:55
	8:00	8:13	8:20	8:35	8:40	8:51	8:56	9:10
	8:15	8:28	8:35	8:50	8:55	9:06	9:11	9:25
	8:30	8:43	8:50	9:05	9:10	9:21	9:26	9:40
	8:45	8:58	9:05	9:20	9:25	9:36	9:41	9:55
	9:00	9:13	9:20	9:35	9:40	9:51	9:56	10:10
	9:30	9:43	9:50	10:05	10:10	10:21	10:26	10:40
	10:00	10:13	10:20	10:35	10:40	10:51	10:56	11:10
	10:30	10:43	10:50	11:05	11:10	11:21	11:26	11:40
	11:00	11:13	11:20	11:35	11:40	11:51	11:56	12:10
	11:30	11:43	11:50	12:05	12:10	12:21	12:26	12:40
P.M.	12:00	12:13	12:20	12:35	12:40	12:51	12:56	1:10
	12:30	12:43	12:50	1:05	1:10	1:21	1:26	1:40
	1:00	1:13	1:20	1:35	1:40	1:51	1:56	2:10
	1:30	1:43	1:50	2:05	2:10	2:21	2:26	2:40
	2:00	2:13	2:20	2:35	2:40	2:51	2:56	3:10
	2:30	2:43	2:50	3:05	3:10	3:21	3:26	3:40
	3:00	3:13	3:20	3:35	3:40	3:51	3:56	4:10
	—	—	—	—	3:55	4:06	4:11	4:25
	3:30	3:43	3:50	4:05	4:10	4:21	4:26	4:40
	3:45	3:58	4:05	4:20	4:25	4:36	4:41	4:55
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	4:15	4:28	4:35	4:50	4:55	5:06	5:11	5:25
	4:30	4:43	4:50	5:05	5:10	5:21	5:26	5:40
	4:45	4:58	5:05	5:20	5:25	5:36	5:41	5:55
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	9:15	9:28	9:35	9:45	9:55	10:06	10:11	10:25
	9:45	9:58	10:05	10:15	10:25	10:36	10:41	10:55
	10:15	10:28	10:35	10:45	10:55	11:06	11:11	11:25
	11:15	11:28	11:35	11:40	To Garage			

22

BROADWAY

(Weekdays and Weekends)

SERVES:

★ Broadway Shopping Center

★ Central High School

★ Fountain City

★ Fountain City Library

★ Fulton High School

★ Knox Road/Kroger

★ Knoxville Station/Downtown

★ Northgate Shopping Center

★ North Knoxville Branch Library

kat

KNOXVILLE

AREA TRANSIT

Information Updated: May 14, 2018

Saturday-Sunday Schedule Route 22: Broadway

Going away from Downtown					Going toward Downtown			
T Transfer to:				Rts. 24 & 90				
Knoxville Station—Platform H	Broadway Shopping Center	Northgate Shopping Center	Fountain City Superstop	Jacksboro at Essary	Northgate Shopping Center	Broadway Shopping Center	Knoxville Station	
1	2	3	4	5	6	7	8	
SATURDAY SCHEDULE								
A.M.	7:00	7:13	7:20	7:35	7:40	7:51	7:56	8:10
	7:30	7:43	7:50	8:05	8:10	8:21	8:26	8:40
	8:00	8:13	8:20	8:35	8:40	8:51	8:56	9:10
	8:30	8:43	8:50	9:05	9:10	9:21	9:26	9:40
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P.M.	12:00	12:13	12:20	12:35	12:40	12:51	12:56	1:10
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	10:00	10:13	10:20	10:35	10:40	10:51	10:56	11:10
	10:30	10:43	10:50	11:05	11:10	11:21	11:26	
	11:15	11:28	11:35	11:50	11:55	12:06	12:11	To Garage
SUNDAY SCHEDULE								
A.M.	8:15	8:28	8:35	8:44	—	8:47	8:55	9:10
	9:15	9:28	9:35	9:44	—	9:47	9:55	10:10
	10:15	10:28	10:35	10:44	—	10:47	10:55	11:10
	11:15	11:28	11:35	11:44	—	11:47	11:55	12:10
P.M.	12:15	12:28	12:35	12:44	—	12:47	12:55	1:10
	1:15	1:28	1:35	1:44	—	1:47	1:55	2:10
	2:15	2:28	2:35	2:44	—	2:47	2:55	3:10
	3:15	3:28	3:35	3:44	—	3:47	3:55	4:10
	4:15	4:28	4:35	4:44	—	4:47	4:55	5:10
	5:15	5:28	5:35	5:44	—	5:47	5:55	6:10
	6:15	6:28	6:35	6:44	—	6:47	6:55	7:10
	7:15	7:28	7:35	7:44	—	7:47	7:55	8:10
	8:15	8:28	8:35	8:40	To Garage			

Need help reading this schedule?
Need other general information on how to ride?
[Click here to Download the General Schedule Information pdf](#) available from [katbus.com](#)

APPENDIX D

ZONING MAP

APPENDIX E

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: McCloud Road (WB - EB)

Minor Street: Stillbrook Lane (NB)

Traffic Control: Stop Control on Stillbrook Lane

6/14/2018 (Thursday)

Partly Sunny/Warm

Conducted by: Ajax Engineering

TIME BEGIN	McCloud Road		Stillbrook Lane		McCloud Road		VEHICLE TOTAL	PEAK HOUR
	WESTBOUND		NORTHBOUND		EASTBOUND			
	LT	THRU	LT	RT	THRU	RT		
7:00 AM	2	58	2	0	11	0	73	
7:15 AM	0	61	1	0	6	0	68	
7:30 AM	0	38	2	0	7	1	48	
7:45 AM	0	35	0	0	12	0	47	
8:00 AM	1	42	3	1	11	2	60	8:00 AM - 9:00 AM
8:15 AM	2	47	6	1	15	1	72	
8:30 AM	2	38	3	0	20	2	65	
8:45 AM	0	40	0	0	16	1	57	
TOTAL	7	359	17	2	98	7	490	
3:00 PM	0	26	1	0	39	2	68	
3:15 PM	1	25	0	0	30	7	63	
3:30 PM	0	26	0	1	48	4	79	
3:45 PM	3	21	2	2	43	4	75	
4:00 PM	0	26	1	2	39	5	73	
4:15 PM	1	28	1	2	42	6	80	
4:30 PM	1	37	2	0	56	9	105	
4:45 PM	1	32	2	1	50	5	91	
5:00 PM	1	31	2	1	64	5	104	5:00 PM - 6:00 PM
5:15 PM	1	30	3	3	72	2	111	
5:30 PM	1	34	1	2	61	3	102	
5:45 PM	1	38	1	0	53	3	96	
TOTAL	11	354	16	14	597	55	1047	

2018 AM Peak Hour 8:00 AM - 9:00 AM

TIME BEGIN	McCloud Road		Stillbrook Lane		McCloud Road	
	WESTBOUND		NORTHBOUND		EASTBOUND	
	LT	THRU	LT	RT	THRU	RT
7:15 AM	1	42	3	1	11	2
7:30 AM	2	47	6	1	15	1
7:45 AM	2	38	3	0	20	2
8:00 AM	0	40	0	0	16	1
TOTAL	5	167	12	2	62	6
PHF	0.63	0.89	0.50	0.50	0.78	0.75

2018 PM Peak Hour 5:00 PM - 6:00 PM

TIME BEGIN	McCloud Road		Stillbrook Lane		McCloud Road	
	WESTBOUND		NORTHBOUND		EASTBOUND	
	LT	THRU	LT	RT	THRU	RT
3:45 PM	1	31	2	1	64	5
4:00 PM	1	30	3	3	72	2
4:15 PM	1	34	1	2	61	3
4:30 PM	1	38	1	0	53	3
TOTAL	4	133	7	6	250	13
PHF	1.00	0.88	0.58	0.50	0.87	0.65

APPENDIX F

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 8)

EXISTING TRAFFIC CONDITIONS

HCM 2010 TWSC
3: Stillbrook Lane & McCloud Road

6/17/2018

Intersection						
Int Delay, s/veh	1.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	71	7	6	192	14	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	2	-	-	-2	5	-
Peak Hour Factor	78	75	63	89	50	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	91	9	10	216	28	4
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	100	0	331	96
Stage 1	-	-	-	-	96	-
Stage 2	-	-	-	-	235	-
Critical Hdwy	-	-	4.1	-	7.4	6.7
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1505	-	609	953
Stage 1	-	-	-	-	908	-
Stage 2	-	-	-	-	758	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1505	-	604	953
Mov Cap-2 Maneuver	-	-	-	-	604	-
Stage 1	-	-	-	-	908	-
Stage 2	-	-	-	-	752	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.3		11	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	633	-	-	1505	-	
HCM Lane V/C Ratio	0.051	-	-	0.006	-	
HCM Control Delay (s)	11	-	-	7.4	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.2	-	-	0	-	

HCM 2010 TWSC

3: Stillbrook Lane & McCloud Road

6/17/2018

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	288	15	5	153	8	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	2	-	-	-2	5	-
Peak Hour Factor	87	65	100	88	58	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	331	23	5	174	14	14
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	354	0	527	343
Stage 1	-	-	-	-	343	-
Stage 2	-	-	-	-	184	-
Critical Hdwy	-	-	4.1	-	7.4	6.7
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1216	-	445	671
Stage 1	-	-	-	-	657	-
Stage 2	-	-	-	-	810	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1216	-	443	671
Mov Cap-2 Maneuver	-	-	-	-	443	-
Stage 1	-	-	-	-	657	-
Stage 2	-	-	-	-	806	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.2		12.1	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	534	-	-	1216	-	
HCM Lane V/C Ratio	0.052	-	-	0.004	-	
HCM Control Delay (s)	12.1	-	-	8	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.2	-	-	0	-	

OPENING YEAR TRAFFIC CONDITIONS (WITHOUT PROJECT)

HCM 2010 TWSC

3: Stillbrook Lane & McCloud Road

6/17/2018

Intersection						
Int Delay, s/veh	1.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	79	8	6	213	15	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	2	-	-	-2	5	-
Peak Hour Factor	78	75	63	89	50	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	101	11	10	239	30	6
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	112	0	365	107
Stage 1	-	-	-	-	107	-
Stage 2	-	-	-	-	258	-
Critical Hdwy	-	-	4.1	-	7.4	6.7
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1490	-	577	938
Stage 1	-	-	-	-	895	-
Stage 2	-	-	-	-	735	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1490	-	572	938
Mov Cap-2 Maneuver	-	-	-	-	572	-
Stage 1	-	-	-	-	895	-
Stage 2	-	-	-	-	729	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.3		11.3	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	612	-	-	1490	-	
HCM Lane V/C Ratio	0.059	-	-	0.006	-	
HCM Control Delay (s)	11.3	-	-	7.4	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.2	-	-	0	-	

HCM 2010 TWSC
3: Stillbrook Lane & McCloud Road

6/17/2018

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	319	17	5	170	9	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	2	-	-	-2	5	-
Peak Hour Factor	87	65	100	88	58	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	367	26	5	193	16	16
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	393	0	583	380
Stage 1	-	-	-	-	380	-
Stage 2	-	-	-	-	203	-
Critical Hdwy	-	-	4.1	-	7.4	6.7
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1177	-	407	637
Stage 1	-	-	-	-	626	-
Stage 2	-	-	-	-	790	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1177	-	405	637
Mov Cap-2 Maneuver	-	-	-	-	405	-
Stage 1	-	-	-	-	626	-
Stage 2	-	-	-	-	786	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.2		12.7	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	497	-	-	1177	-	
HCM Lane V/C Ratio	0.063	-	-	0.004	-	
HCM Control Delay (s)	12.7	-	-	8.1	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.2	-	-	0	-	

OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)

Intersection

Int Delay, s/veh 3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	17	79	8	6	213	5	15	1	3	14	3	51
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	2	-	-	-2	-	-	5	-	-	-5	-
Peak Hour Factor	90	78	75	63	89	90	50	90	50	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	19	101	11	10	239	6	30	1	6	16	3	57

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	245	0	0	112	0	0	435	408	107	409	411	242
Stage 1	-	-	-	-	-	-	144	144	-	261	261	-
Stage 2	-	-	-	-	-	-	291	264	-	148	150	-
Critical Hdwy	4.1	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.7
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1333	-	-	1490	-	-	474	478	938	623	598	829
Stage 1	-	-	-	-	-	-	830	751	-	805	748	-
Stage 2	-	-	-	-	-	-	665	645	-	895	810	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1333	-	-	1490	-	-	432	467	938	607	584	829
Mov Cap-2 Maneuver	-	-	-	-	-	-	432	467	-	607	584	-
Stage 1	-	-	-	-	-	-	818	740	-	793	742	-
Stage 2	-	-	-	-	-	-	612	640	-	875	798	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0.3	13.2	10.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	474	1333	-	-	1490	-	-	758
HCM Lane V/C Ratio	0.078	0.014	-	-	0.006	-	-	0.1
HCM Control Delay (s)	13.2	7.7	0	-	7.4	0	-	10.3
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.3	0	-	-	0	-	-	0.3

Intersection

Int Delay, s/veh 2.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	57	319	17	5	170	15	9	4	8	9	2	34
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	2	-	-	-2	-	-	5	-	-	-5	-
Peak Hour Factor	90	87	65	100	88	90	58	90	50	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	63	367	26	5	193	17	16	4	16	10	2	38

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	210	0	0	393	0	0	738	726	380	729	731	202
Stage 1	-	-	-	-	-	-	506	506	-	212	212	-
Stage 2	-	-	-	-	-	-	232	220	-	517	519	-
Critical Hdwy	4.1	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.7
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1373	-	-	1177	-	-	274	289	637	417	430	868
Stage 1	-	-	-	-	-	-	480	472	-	843	775	-
Stage 2	-	-	-	-	-	-	727	682	-	629	619	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1373	-	-	1177	-	-	248	271	637	382	403	868
Mov Cap-2 Maneuver	-	-	-	-	-	-	248	271	-	382	403	-
Stage 1	-	-	-	-	-	-	452	444	-	793	771	-
Stage 2	-	-	-	-	-	-	690	679	-	571	582	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0.2	16.6	10.9
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	345	1373	-	-	1177	-	-	665
HCM Lane V/C Ratio	0.104	0.046	-	-	0.004	-	-	0.075
HCM Control Delay (s)	16.6	7.7	0	-	8.1	0	-	10.9
HCM Lane LOS	C	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.3	0.1	-	-	0	-	-	0.2

APPENDIX G

ITE TRIP GENERATION RATES

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.

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

The sites were surveyed between the late 1960s and the 2000s throughout the United States and Canada.

Source Numbers

1, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 19, 20, 21, 26, 34, 35, 36, 38, 40, 71, 72, 84, 91, 98, 100, 105, 108, 110, 114, 117, 119, 157, 167, 177, 187, 192, 207, 211, 246, 275, 283, 293, 300, 319, 320, 357, 384, 435, 550, 552, 579, 598, 601, 603, 611, 614, 637, 711, 735

Single-Family Detached Housing (210)

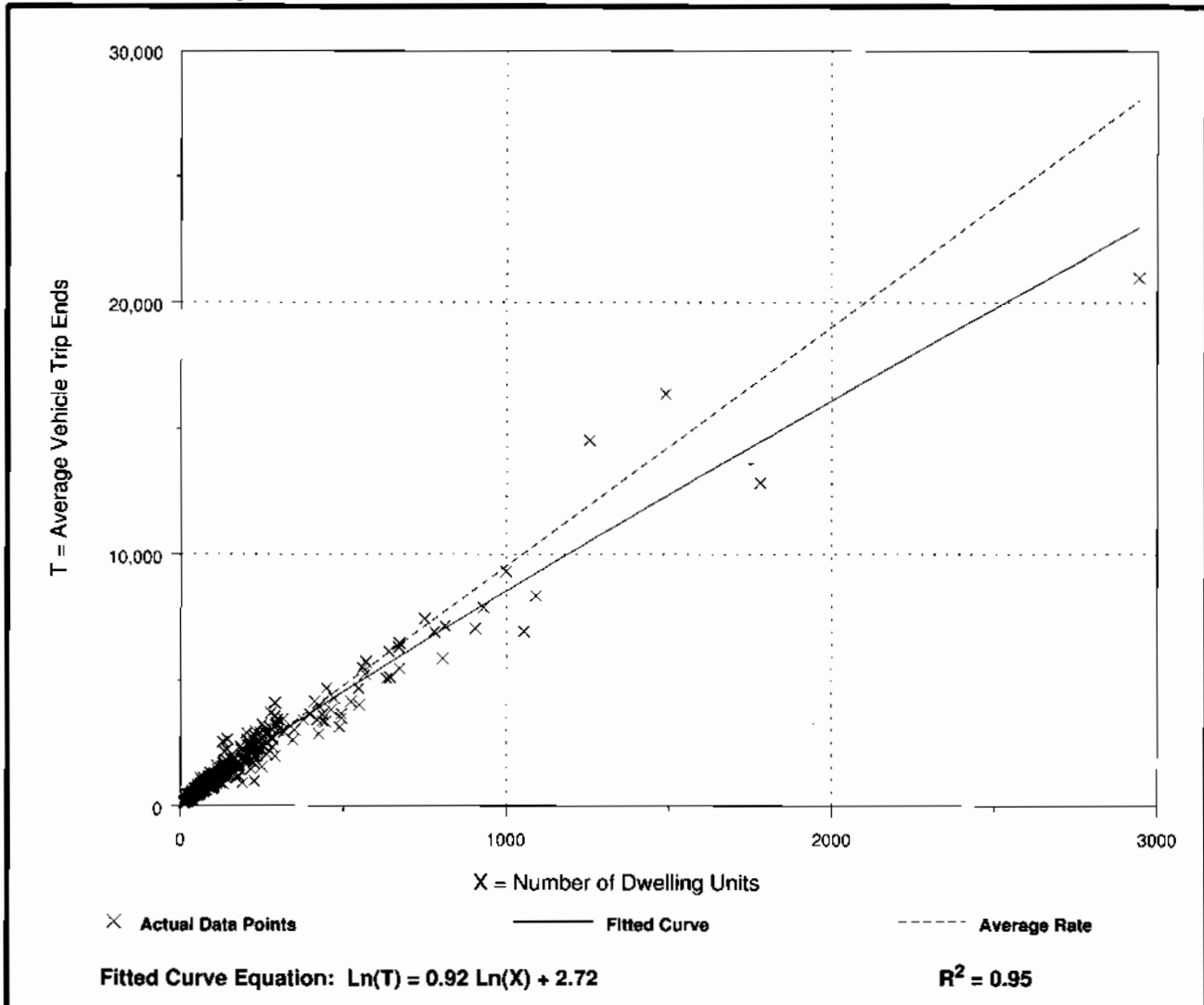
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

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



Single-Family Detached Housing (210)

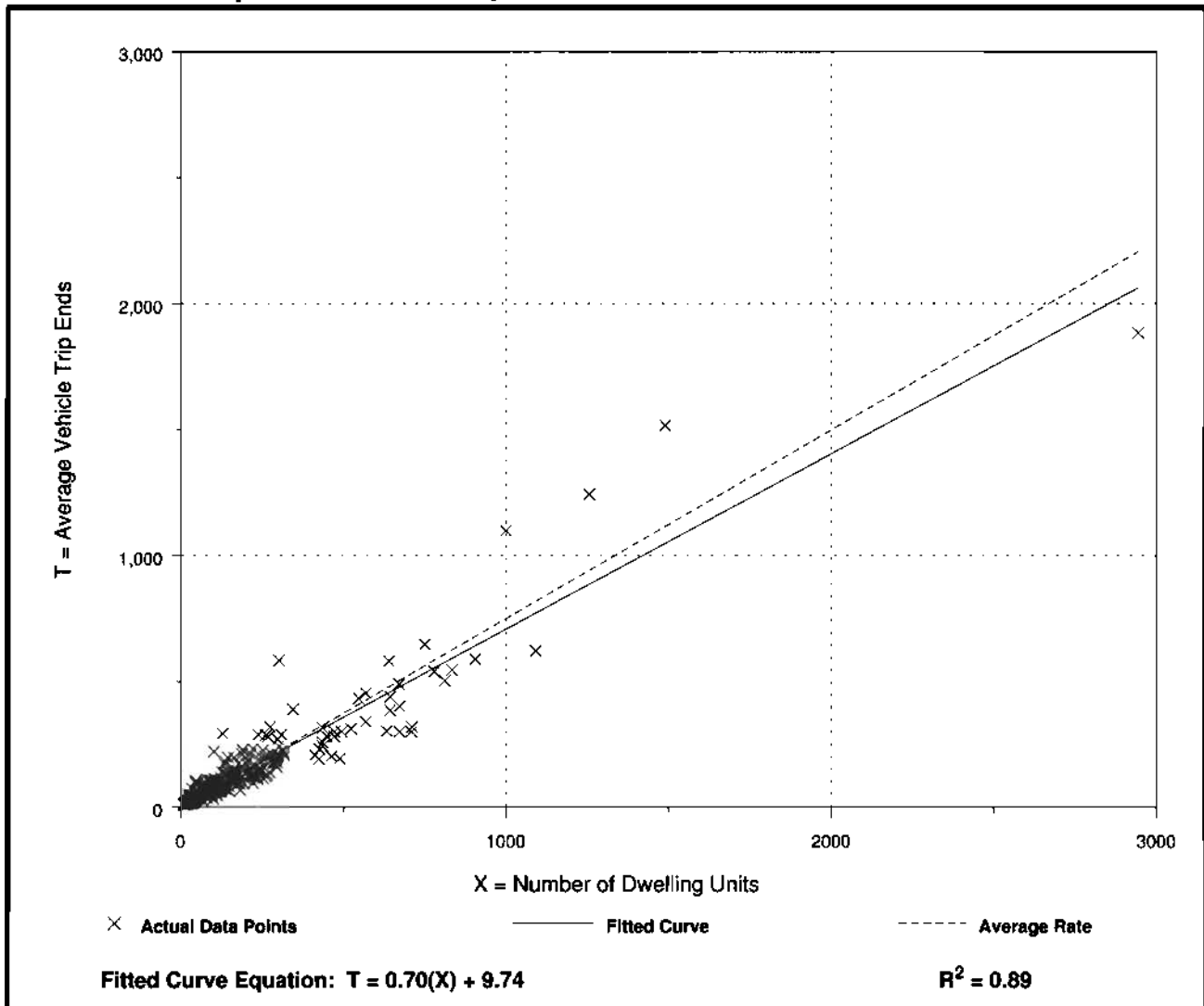
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

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



Single-Family Detached Housing (210)

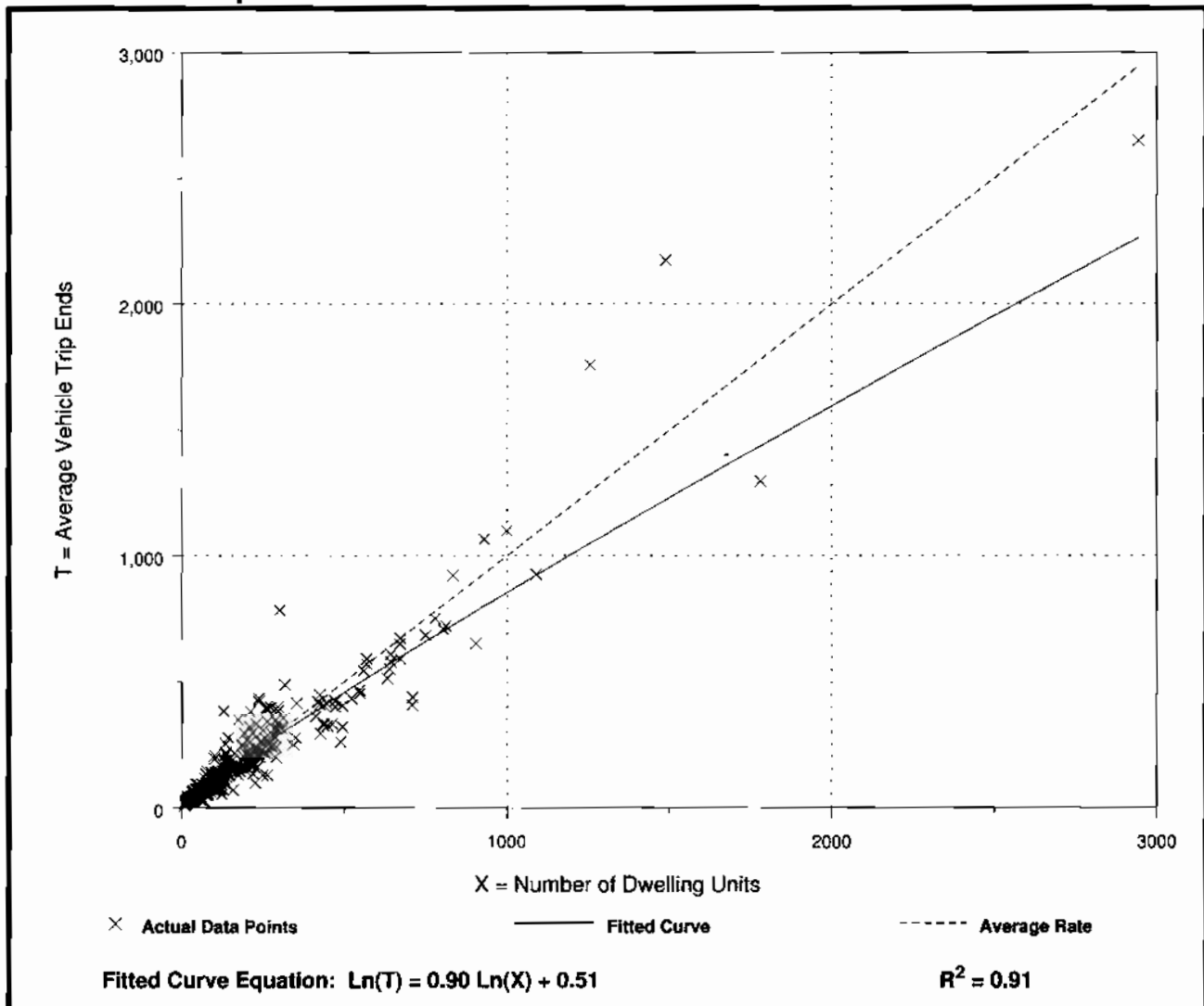
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

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



TRIP GENERATION FOR BERRY PATCH FARMS SUBDIVISION
116 single family detached homes

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	116 Lots	1,204	25%	75%		63%	37%	
				23	68	91	76	45	121
Total New Volume Site Trips			1,204	23	68	91	76	45	121

TRIP GENERATION FOR BERRY PATCH FARMS SUBDIVISION
116 single family detached homes

116 Residential Units = X

Weekday:

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

$$\ln(T) = 0.92 * 4.75 + 2.72$$

$$\ln(T) = 7.09$$

$$\underline{\underline{T = 1,204 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

$$T = 0.70 * 116 + 9.74$$

$$\underline{\underline{T = 91 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

$$\ln(T) = 0.90 * 4.75 + 0.51$$

$$\ln(T) = 4.79$$

$$\underline{\underline{T = 121 \text{ trips}}}$$

APPENDIX H

KNOX COUNTY TURN LANE VOLUME THRESHOLD WORKSHEET

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	110	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	McCloud Road at Stillbrook Lane/ Dennis Fox Drive Projected PM Left Turns = 57 < 110 Turn Lane NOT Warranted	95	80	65
350 - 399	135	120		85	70	60
400 - 449	120	105		75	65	55
450 - 499	105	90		70	60	50
500 - 549	95	80		65	55	50
550 - 599	85	70		60	50	45
600 - 649	75	65	55	55	45	40
650 - 699	70	60		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	60	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						
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

Projected PM Right
Turns = 15

Turn Lane NOT
Warranted

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.