

REZONING REPORT

▶ **FILE #:** 5-F-21-RZ

AGENDA ITEM #: 20

AGENDA DATE: 5/13/2021

▶ **APPLICANT:** HOMESTEAD LAND HOLDINGS, INC.

OWNER(S): W C Hoppe, Jr.

TAX ID NUMBER: 116 06701

[View map on KGIS](#)

JURISDICTION: County Commission District 6

STREET ADDRESS: 12119 Hardin Valley Rd.

▶ **LOCATION:** North of intersection at Hardin Valley Road and Marietta Church Road

▶ **APPX. SIZE OF TRACT:** 36.91 acres

SECTOR PLAN: Northwest County

GROWTH POLICY PLAN: Rural Area

ACCESSIBILITY: Access is via Hardin Valley Road, a minor arterial with a pavement width of 20.5-ft within a right-of-way width of 60-ft.

UTILITIES: Water Source: West Knox Utility District

Sewer Source: West Knox Utility District

WATERSHED: Conner Creek

▶ **PRESENT ZONING:** A (Agricultural) & CA (General Business)

▶ **ZONING REQUESTED:** PR (Planned Residential)

▶ **EXISTING LAND USE:** Agriculture/forestry/vacant

▶ **DENSITY PROPOSED:** up to 3 du/ac

EXTENSION OF ZONE: Yes, PR zoning is adjacent.

HISTORY OF ZONING: None noted.

SURROUNDING LAND USE AND ZONING: North: Single family residential - PR (Planned Residential) up to 3 du/ac

South: Rural residential, Agriculture/forestry/vacant - CA (General Business), PR (Planned Residential) up to 2 du/ac

East: Agriculture/forestry/vacant - A (Agriculture)

West: Single family residential - PR (Planned Residential) up to 1.8 du/ac

NEIGHBORHOOD CONTEXT: This area is transistioning from large, agricultural lots to single family residential. Steep slopes and stream protection areas are also in the vicinity

STAFF RECOMMENDATION:

▶ **Approve PR (Planned Residential) up to 2 du/ac because it is consistent with the surrounding development, adjacent residential densities and the slope analysis.**

COMMENTS:

REZONING REQUIREMENTS FROM ZONING ORDINANCES (must meet all of these):

THE PROPOSED AMENDMENT SHALL BE NECESSARY BECAUSE OF SUBSTANTIALLY CHANGED OR

CHANGING CONDITIONS IN THE AREA AND DISTRICTS AFFECTED, OR IN THE CITY/COUNTY GENERALLY:

1. Infrastructure improvements have occurred in this area since the 2016 Northwest County Sector Plan update, including the expansion of wastewater capacity.
2. Electrical line improvements are currently being planned for the larger Hardin Valley area by West Knox Utility District and TVA.

THE PROPOSED AMENDMENT SHALL BE CONSISTENT WITH THE INTENT AND PURPOSE OF THE APPLICABLE ZONING ORDINANCE:

1. The proposed amendment to PR zoning is intended to provide optional methods of land development which encourage more imaginative solutions to environmental design problems. Residential areas thus established would be characterized by a unified building and site development program, open space for recreation and provision for commercial, religious, educational, and cultural facilities which are integrated with the total project by unified architectural and open space treatment.
2. Each planned unit development shall be compatible with the surrounding or adjacent zones. Such compatibility shall be determined by the planning commission by review of the development plans.

THE PROPOSED AMENDMENT SHALL NOT ADVERSELY AFFECT ANY OTHER PART OF THE COUNTY, NOR SHALL ANY DIRECT OR INDIRECT ADVERSE EFFECTS RESULT FROM SUCH AMENDMENT.

1. The proposed amendment to PR (Planned Residential) up to 2 du/ac is consistent with the surrounding development and expected to create minimal impacts if built out at the maximum density of approximately 72 additional dwelling units.
2. A revised Traffic Impact Letter (TIL) has been submitted on behalf of Ajax Engineering on April 23, 2021 which proposes a 78-unit residential subdivision.
3. The development plan review during the subsequent, required, use on review process will provide for an opportunity to address potential conflicts with adjacent and surrounding development.
4. The slope analysis yields a reduced density of 1.9 du/ac due to the topographical constraints of the site and staff is recommending up to 2 du/ac.
5. The floodplain of Connor Creek is also delineated on the site and shown in Exhibit A, a greenway is proposed for this area by the 2020 adopted Knox County Greenway Corridor Study, see Exhibit B

THE PROPOSED AMENDMENT SHALL BE CONSISTENT WITH AND NOT IN CONFLICT WITH THE GENERAL PLAN OF KNOXVILLE AND KNOX COUNTY, INCLUDING ANY OF ITS ELEMENTS, MAJOR ROAD PLAN, LAND USE PLAN, COMMUNITY FACILITIES PLAN, AND OTHERS:

1. The PR (Planned Residential) zone up to 2 du/ac is consistent with the RR (Rural Residential) and HP (Hillside Protection) overlay designations of the sector plan. The recommended density is also consistent with the Rural Area of the Growth Policy Plan.
2. The Knox County Greenways Corridor Study was adopted by Knox County Commission in January 2020 and recommended a preferred alignment for the Beaver Creek West Greenway connecting Brighton Farms Boulevard to Melton Hill Park through this area, adjacent to Connor Creek (See Exhibit B). The applicant and Knox County Parks and Recreation staff have been connected regarding this preferred greenway alignment. The PR zone district will also require site plan review by the Knoxville-Knox County Planning Commission through the use on review process to address site concerns related to floodplain and steep slopes, as well as compatibility with surrounding and adjacent development.

OTHER CONSIDERATIONS:

The Transportation Impact Letter (TIL) noted the following;

- a. The study assumes that there will be 78 total dwellings comprised of 45 attached townhomes and 33 single-family detached homes. The attached and detached units will likely have separate access roads and are separated by Connor Creek with no connection being planned across the creek.
- b. Total traffic generated at buildout year of 2025 is estimated to be 841 daily trips, 55 AM peak hour trips and 77 PM peak hour trips.
- c. A general assessment of the overall capacity/Level of Service (LOS) of Hardin Valley Rd with the additional traffic in the buildout year and stated the following "The number of additional trips generated by the Hoppe Property Subdivision based on allowing rezoning from Agricultural (A) to Planned Residential (PR) will not be a measurable detriment to the overall roadway capacity of Hardin Valley Road."
- d. Information and recommendations on a proposed connection to the adjoining property to the west with the stub out for Deer Crossing Drive and notes that the applicant would like to work with the property owners on the east side of the property to connect to Mission Hill Lane.
- e. A westbound left turn lane on Hardin Valley Rd at Marietta Church Rd will be warranted regardless of this property's development/impact. If the entrance to this property is located at the intersection with Marietta Church Rd an intersection of upgrade should be investigated, a roundabout improvement may be appropriate if the intersection is upgraded.
- f. A full Transportation Impact Study (TIS) with the Concept Plan will be required to be submitted, if the proposed residential subdivision exceeds the 750 daily trip threshold for requiring a TIS during the Use on

Review process.

ESTIMATED TRAFFIC IMPACT: 840 (average daily vehicle trips)

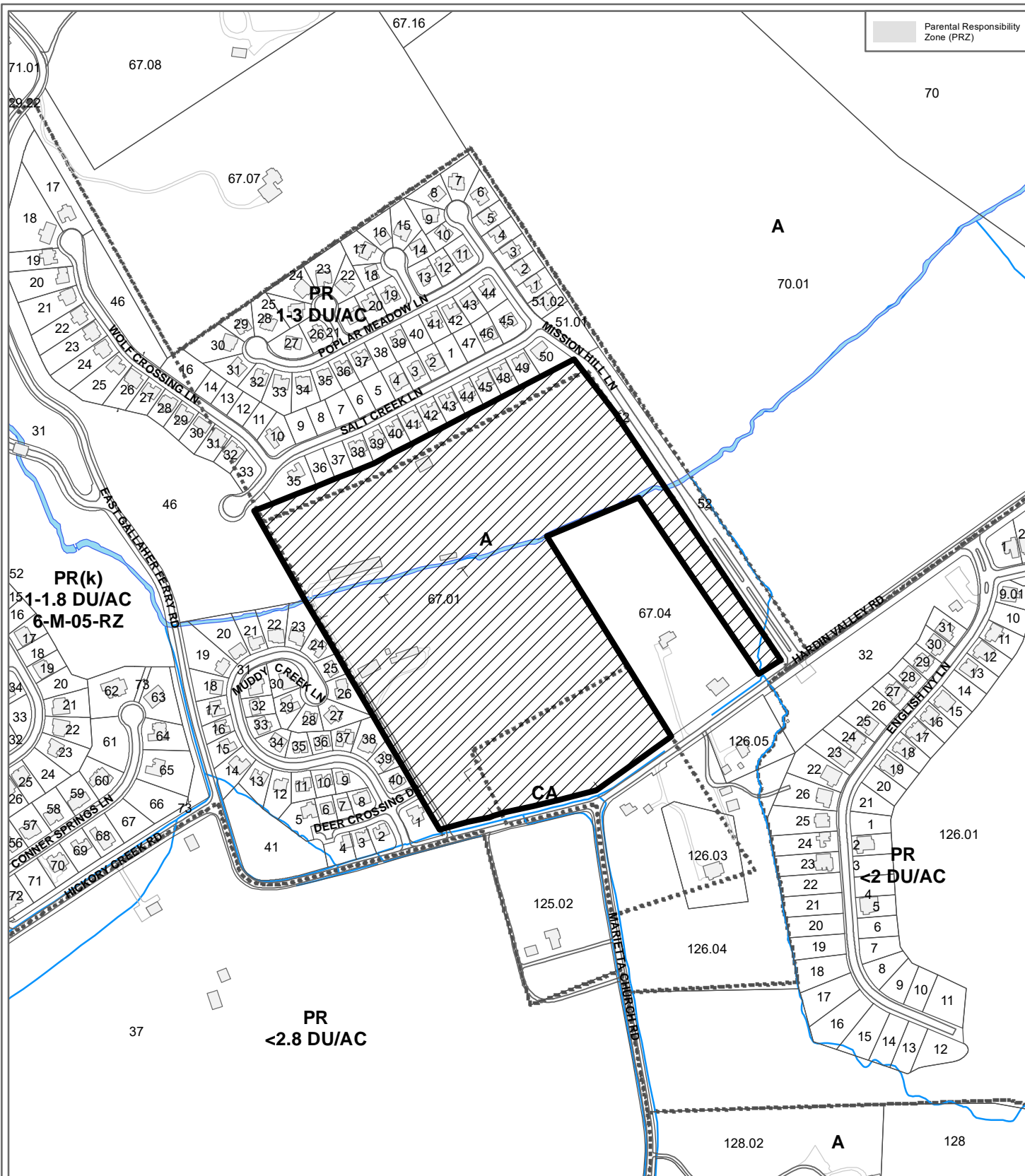
Average Daily Vehicle Trips are computed using national average trip rates reported in the latest edition of "Trip Generation," published by the Institute of Transportation Engineers. Average Daily Vehicle Trips represent the total number of trips that a particular land use can be expected to generate during a 24-hour day (Monday through Friday), with a "trip" counted each time a vehicle enters or exits a proposed development.

ESTIMATED STUDENT YIELD: 45 (public school children, grades K-12)

Schools affected by this proposal: Hardin Valley Elementary, Hardin Valley Middle, and Hardin Valley Academy.

- Potential new school population is estimated using locally-derived data on public school student yield generated by new housing.
- Students are assigned to schools based on current attendance zones as determined by Knox County Schools. Students may request transfers to different zones, and zone boundaries are subject to change.
- Estimates presume full build-out of the proposed development. Build-out is subject to market forces, and timing varies widely from proposal to proposal.
- Student yields from new development do not reflect a net addition of children in schools. Additions occur incrementally over the build-out period. New students may replace current population that ages through the system or moves from the attendance zone.

If approved, this item will be forwarded to Knox County Commission for action on 6/28/2021. If denied, Knoxville-Knox County Planning Commission's action is final, unless the action to deny is appealed to Knox County Commission. The date of the appeal hearing will depend on when the appeal application is filed. Appellants have 30 days to appeal a Planning Commission decision in the County.



Parental Responsibility Zone (PRZ)

**5-F-21-RZ
REZONING**

From: A (Agricultural) & CA (General Business)

To: PR (Planned Residential)



Original Print Date: 4/7/2021
 Revised:
 Knoxville - Knoxville Planning Commission * City / County Building * Knoxville, TN 37902

Petitioner: Homestead Land Holdings, Inc.

Map No: 116
 Jurisdiction: County



Slope / Density Analysis
Case: 5-F-21-RZ

CATEGORY	ACRES	RECOMMENDED DENSITY (Dwelling Units / Acre)	NUMBER OF UNITS
Non-Hillside	25.30	2.00	50.6
0-15% Slope	4.32	2.00	8.6
15-25% Slope	5.30	2.00	10.6
25-40% Slope	1.31	0.50	0.7
Greater than 40% Slope	0.06	0.20	0.0
Ridgetops	0.00		0.0
Subtotal: Sloped Land	11.00		19.9
Maximum Density Guideline (Hillside & Ridgetop Protection Plan)	36.30	1.94	70.5
Proposed Density (Applicant)	36.30	2.00	72.6

From Hillside & Ridgetop Protection Plan, page 33

LOW DENSITY AND RURAL RESIDENTIAL USES

Density and Land Disturbance Guidelines

As proposals for changes to the zoning map and development plans/concept plans are considered, the following factors are recommended to determine the overall allowable density for residential rezonings and the overall land disturbance allowable in new development or subdivisions for those portions of parcels that are within the Hillside and Ridgetop Protection Area. These factors should be codified as regulations in the future. The areas of the Growth Policy Plan referenced below are presented on page 18.

Table 3: Residential Density and Land Disturbance Guidelines
for Recommendations on Changes to the Zoning Map and Development Plan/
Concept Plan Review within the Hillside and Ridgetop Protection Area
that is within the Urban Growth and the Planned Growth Area

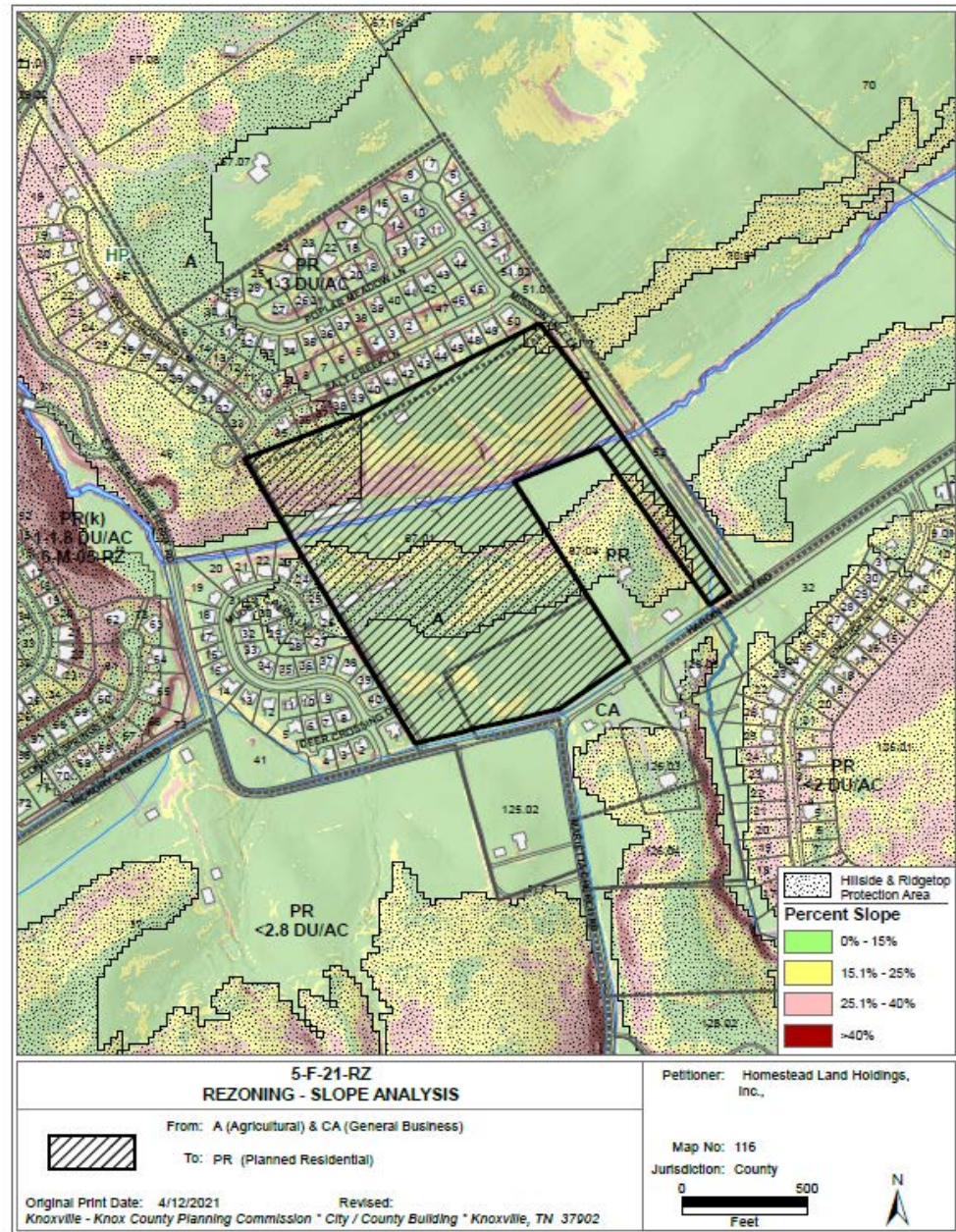
Percent of Slope	Recommended Maximum Density Factor*	Recommended Maximum Land Disturbance Factor**
0 - 15	Knox County: 5 du/a City of Knoxville: 6 du/a	100%
15 - 25	2 du/a	50%
25 - 40	0.5 du/a	20%
40 or more	0.2 du/a	10%
Ridgetops***	***	***

du/a: dwelling units per acre

* These factors should be considered guidelines to determine an overall recommended residential density for requests for changes to the zoning map to planned residential (RP-1 in the city and PR in the county) zone districts that are considered by the Metropolitan Planning Commission prior to being considered by the appropriate legislative body. The resulting zone district development right would be considered a budget for dwelling units to be applied over the entire proposed development.

** Until such time as regulations are codified by the appropriate legislative body, these factors should be considered guidelines to determine an overall recommended land disturbance area for development plans and concept plans that are considered for approval by the Metropolitan Planning Commission. The overall land disturbance area would be considered a budget for land disturbance to be applied over the entire proposed development.

*** Ridgetops are generally the more level areas on the highest elevations of a ridge. Because the shapes of Knox County ridges are so varied (see pages 8 - 9), the ridgetop area should be determined on a case-by-case basis with each rezoning and related development proposal.



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			Acres
Non-Hillside Portions			25.3
Hillside and Ridgetop Protection Area			
Value	Percent Slope	Count	Acres
1	0%-15%	7527	4.32
2	15%-25%	9242	5.30
3	25%-40%	2285	1.31
4	0	107	0.06
			11.00
Ridgetop Area			0
Site Total			36.30

Exhibit A. 5-F-21-RZ Contextual Images

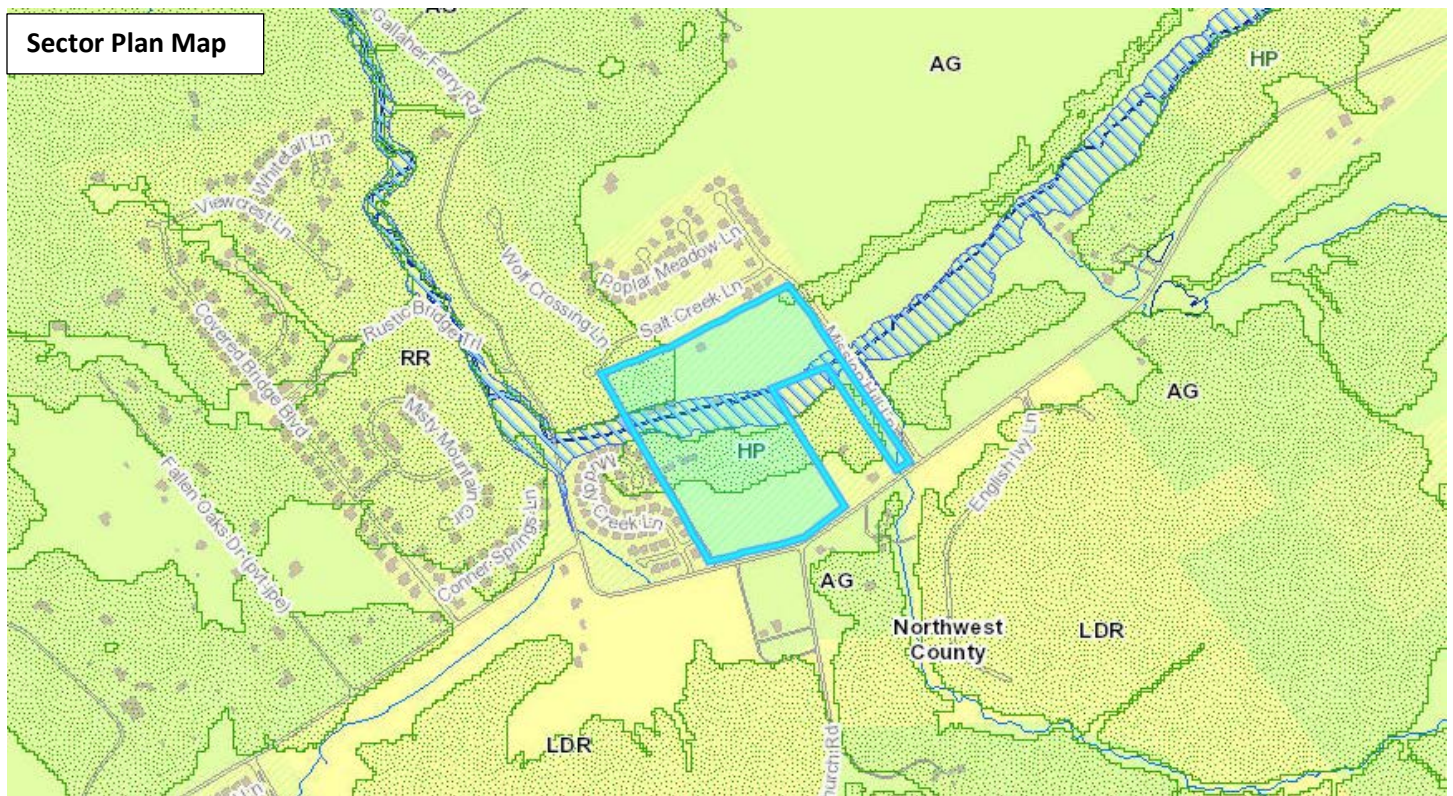
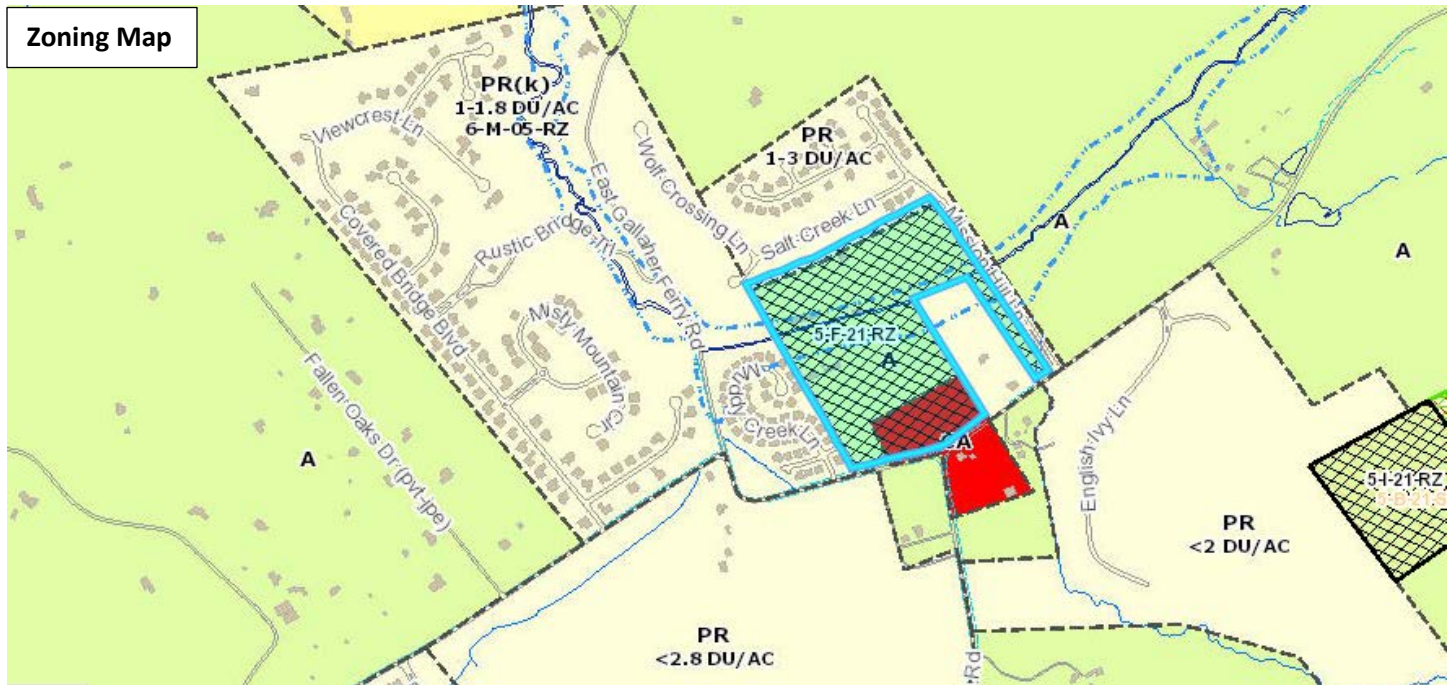


Exhibit A. 5-F-21-RZ Contextual Images

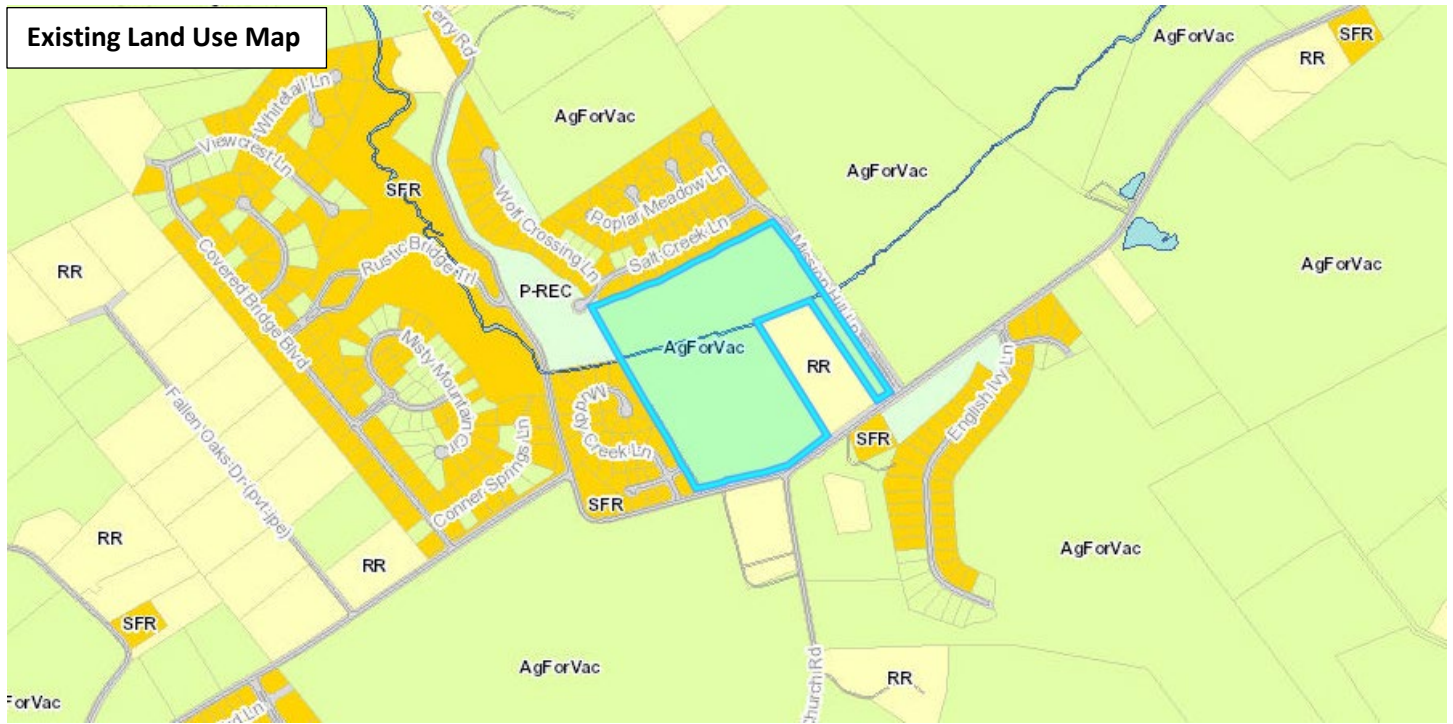


Exhibit A. 5-F-21-RZ Contextual Images



TRAFFIC IMPACT LETTER
HOPPE PROPERTY SUBDIVISION
KNOX COUNTY, TENNESSEE

-Prepared For-

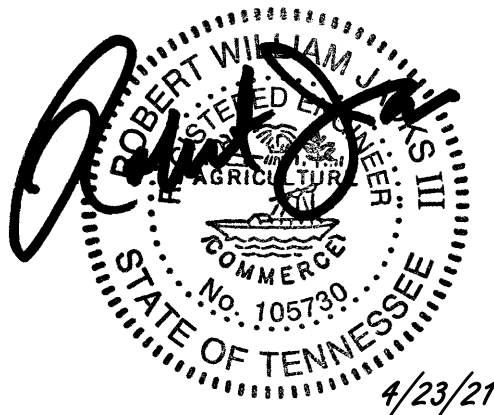


Rackley Engineering
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-Prepared By-



Ajax Engineering, LLC
11812 Black Road
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Robert W. Jacks, PE



Revised April 23, 2021



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Revised April 23, 2021

TO: Knoxville-Knox County Planning

**RE: Hoppe Property Subdivision – Traffic Impact Letter
Knox County, Tennessee**

This Traffic Impact Letter (TIL) is being submitted for the Hoppe Property Subdivision. The Hoppe Property Subdivision is a proposed 78-unit residential subdivision off Hardin Valley Road in West Knox County, Tennessee. This submittal addresses the Traffic Impact Letter requirements outlined in the “Transportation Impact Analysis Guidelines” as adopted by the Knoxville-Knox County Planning Commission on January 9, 2020.

This TIL includes a project description summary, an overview of the adjacent road characteristics, traffic counts, data from a field review, trip generation, and other pertinent data with supporting information in the Appendix. The TIL has been revised to address the comments from a Knoxville/Knox County Planning letter dated April 22, 2021.

If you have any questions or comments about this submittal, please feel free to contact me. Overall, this initial analysis shows that the proposed subdivision is not expected to unreasonably impair traffic flow on Hardin Valley Road or Marietta Church Road.

We look forward to your review and approval.

Sincerely,

Robert W. Jacks, P.E.
Ajax Engineering, LLC

PROJECT DESCRIPTION

■ GENERAL DESCRIPTION:

The Hoppe Property Subdivision is proposed to have 45 attached townhouses and 33 single-family detached homes on 36.9 acres with a density of 2.11 units/acre. The property is currently zoned as Agricultural (A) but will be requested to be rezoned to Planned Residential (PR).

Connor Creek bisects the development property, and the 45 attached townhouses will be constructed on the north side of the property and creek. The 33 single-family detached homes will be constructed on the south side of the property and the creek. The subdivision will have two entrances to avoid crossing Connor Creek. Proposed Subdivision Entrance (East) will tie into Mission Hills Lane and provide road access for the townhouses on the north side. Proposed Subdivision Entrance (South) will provide road access for the single-family detached homes at the existing intersection of Hardin Valley Road at Marietta Church Road. This south subdivision entrance will tie into the existing intersection from the north side and create the 4th leg of the existing t-intersection.

The proposed development site includes only one property parcel and is primarily undeveloped, with most of the area used for farm production. A smaller portion of the property is forested, and a couple of single-family structures are located on the property, which will be removed. It is assumed that the total construction build-out of the development and full occupancy will occur within the next four years (2025).



**Existing Development Site at Hardin Valley Road
(Looking North)**

■ SITE LOCATION:

The location of this proposed subdivision is shown on a map in Figure 1. Figure 2 shows the existing development property with more detail from KGIS mapping.

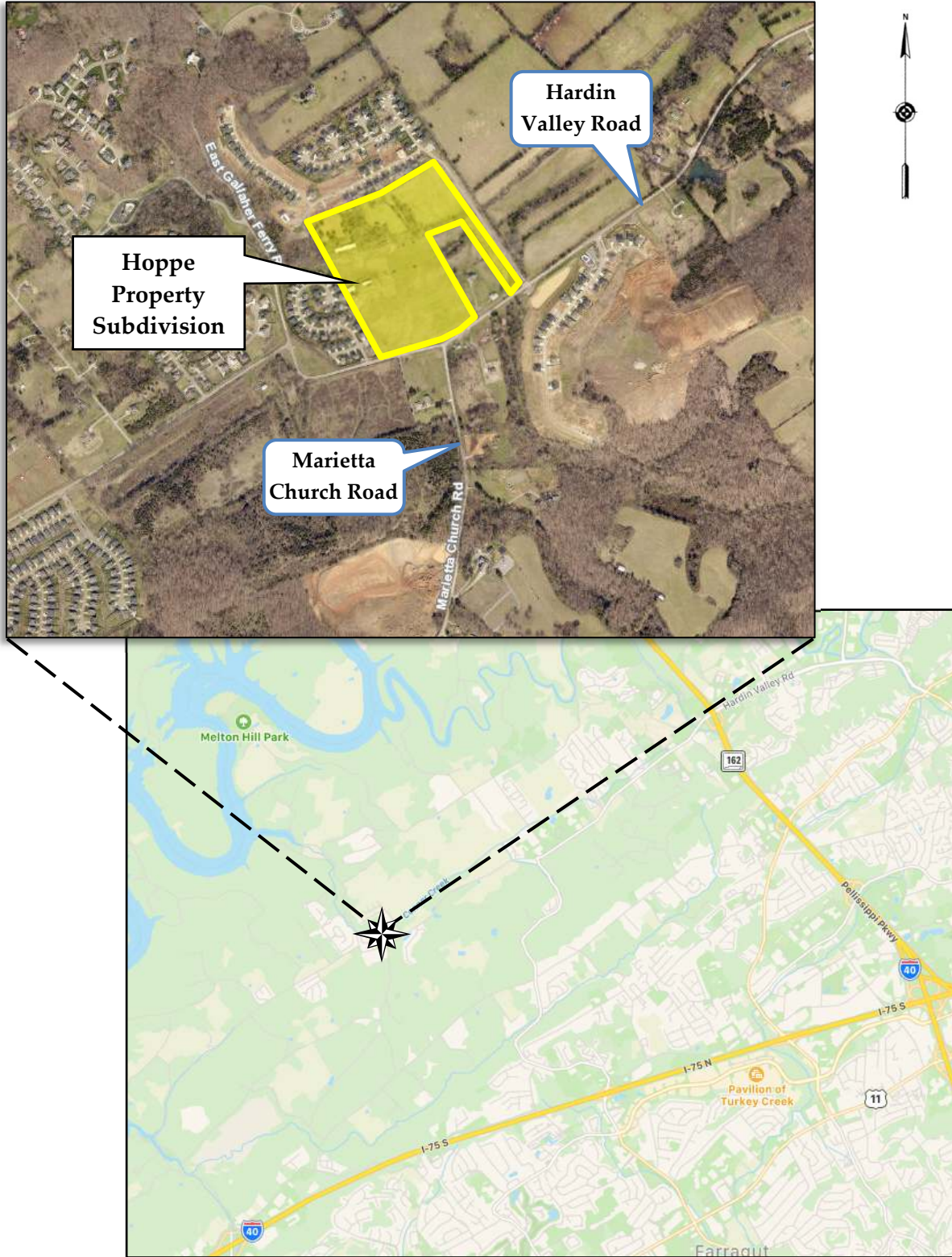


Figure 1
Location Map



Figure 2
Site Development Property

DESCRIPTION OF EXISTING TRANSPORTATION CONDITIONS

■ EXISTING ADJACENT ROADWAYS:

This proposed development will be located on the north side of Hardin Valley Road between Mission Hill Lane and Muddy Creek Lane with Marietta Church Road to the south. The Proposed Subdivision Entrance (South) at the intersection of Hardin Valley Road at Marietta Church Road will be located 725 feet to the east of Muddy Creek Lane and 925 feet to the west of Mission Hill Lane. The Proposed Subdivision Entrance (East) will be located approximately 500 feet to the south of Salt Creek Lane in Massey Creek Subdivision and 1,125 feet north of Hardin Valley Road.

There are several other residential subdivisions in the study area, individual standalone residences, undeveloped properties, and some residential subdivisions currently under construction.

Table 1 lists the characteristics of the main existing roadway adjacent to the development property:

TABLE 1
STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION ¹	SPEED LIMIT	LANES	ROAD WIDTH ²	TRANSIT ³	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Hardin Valley Road	Minor Arterial	40 mph	2 undivided	22 feet	None	No sidewalks along roadway	No bike lanes

¹ 2018 Major Road Plan by Knoxville/Knox County Planning

² Edge of pavement near project site

³ According to Knoxville Area Transit System Map

Hardin Valley Road is classified as a Minor Arterial and traverses in a generally northeast-southwest direction. On its northeast side, Hardin Valley Road begins at a signalized intersection with Ball Camp Byington Road (SR 131). On its southwest side, the road terminates at the t-intersection of Hickory Creek Road at East Gallaher Ferry Road with a total length of 6.0 miles. To the east, Hardin Valley Road provides access to several public schools, a community college, and Pellissippi Parkway (SR 162). The Pellissippi Parkway (SR 162) access is 4.1 miles to the northeast of the Proposed Subdivision Entrance (South) on Hardin Valley Road.



**Hardin Valley Road at Marietta Church Road
(Looking West)**

At the Proposed Subdivision Entrance (South), Hardin Valley Road currently consists of a 2-lane pavement section with white edge lines and a double yellow centerline. The double yellow centerline is delineated with grooved pavement rumble stripes. Near the proposed development site on Hardin Valley Road, the road pavement was measured to fluctuate between 21 feet in width to just over 22 feet. Roadway lighting is not present in the adjacent area along Hardin Valley Road.

■ **EXISTING VEHICULAR TRAFFIC VOLUMES:**

There are two semi-yearly vehicular traffic count locations near the project site. The semi-yearly counts are conducted by the Knoxville Transportation Planning Organization (TPO). The traffic count location data is the following:

- Existing vehicular roadway traffic:
 - The Knoxville TPO reported an Average Daily Traffic (ADT) on Hardin Valley Road, east of Marietta Church Road and the project site, at 6,920 vehicles per day in 2019. This count location has had sporadic counts conducted every year. From 2010 – 2019, this count station has indicated an 8.2% average annual growth rate.
 - The Knoxville TPO reported an Average Daily Traffic (ADT) on Marietta Church Road, south of Hardin Valley Road and the project site, at 2,050 vehicles per day in 2019. This count location has had sporadic counts conducted every year. From 2009 – 2019, this count station has indicated a 6.3% average annual growth rate. All the researched historical traffic count data for this report can be viewed in the Appendix.

Due to the impact of the current pandemic on vehicular travel, traffic counts were not conducted for this analysis, and prior traffic count data was used. This count data was collected at the intersection of Hardin Valley Road at Marietta Church Road on November 1st, 2016, and was conducted by Ajax Engineering, LLC. Based on this earlier count, it was determined that the AM Peak Hour was 7:15 – 8:15 AM and the PM Peak Hour was 5:00 – 6:00 PM. The data from this previous traffic count is shown in the Appendix.

The volumes collected in 2016 were increased by a 10% annual growth rate to account for general growth in the area and to adjust the traffic volumes to the current existing year 2021. This high growth rate was assumed due to the rapid growth of residential development in the surrounding area. Vehicle delay and Level of Service (LOS) calculations were undertaken for these adjusted existing 2021 traffic volumes. The LOS results are shown in Table 2, and the adjusted volumes for the year 2021 at the intersection of Hardin Valley Road at Marietta Church Road are shown in Figure 3. Due to the lack of traffic data at this time, analyses were not conducted at any other intersections.

The capacity analyses were calculated by following the Highway Capacity Manual (HCM)

methods and using Synchro Traffic Software (Version 8), and the worksheets are in the Appendix.

TABLE 2
2021 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Hardin Valley Road at Marietta Church Road	 Unsignalized	Westbound Left/Thru/Right	A	2.1	0.050	A	2.2	0.080
		Northbound Left/Thru/Right	C	15.9	0.350	B	15.0	0.300

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

^a Level of Service

^b Average Delay (sec/vehicle)

^c Volume-to-Capacity Ratio



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NOT TO SCALE

NORTH

FIGURE 3

Hoppe Property Subdivision

2021 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS

PRELIMINARY TRAFFIC ANALYSIS OF PROJECTED CONDITIONS

■ TRIP GENERATION:

The estimated amount of traffic that the 33 single-family detached houses will generate was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 10th Edition, a publication of the Institute of Transportation Engineers (ITE). The trip rate for the 45 attached townhouses was based upon equations for peak hour trips provided by Knoxville-Knox County Planning. These equations were developed from local studies to estimate apartment (and townhouse) trip generation in the surrounding area and were published in December 1999. For Knox County, this is the preferred rate to use for apartments and townhouses. This local rate calculates higher trip rates than the similar ITE land use. The data from ITE and the local study for the proposed land uses are shown in the Appendix. A summary of this information is presented in the following table:

TABLE 3
TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION
33 Single-Family Detached Homes and 45 Townhouses

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	33 Houses	375	25%	75%		63%	37%	
				7	22	29	23	13	36
Local Trip Rate	Townhouses	45 Townhouses	466	22%	78%		55%	45%	
				6	20	26	23	18	41
Total New Volume Site Trips			841	13	42	55	46	31	77

ITE Trip Generation Manual, 10th Edition and Local Trip Rates
Trips calculated by using Fitted Curve Equation

For the proposed residential subdivision, with 33 single-family detached houses and 45 townhouses, it is estimated that 13 vehicles will enter and 42 will exit, for a total of 55 generated trips during the AM Peak Hour in the year 2025. Similarly, it is estimated that 46 vehicles will enter, and 31 will exit, for a total of 77 generated trips during the PM Peak Hour in the year 2025. The calculated trips generated for an average weekday are 841 vehicles for the proposed development in 2025. No trip reductions were included in the analysis.

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

Opening year traffic volumes represent the future condition the proposed study area is potentially subject to even without the proposed project (no-build option). As previously stated, the build-out and full occupancy for this proposed new residential development is assumed to occur in 2025. This horizon year corresponds to four years for the subdivision to reach full capacity and occupancy.

According to the adjacent TPO traffic count stations, traffic growth on Hardin Valley Road has been substantial over the past ten years. For this analysis, a +10% annual growth rate was assumed to consider future development in the area, rising travel volumes and is assumed a very conservative estimate for analyzing the projected 2025 opening year traffic volumes.

The results of this growth rate applied to the existing 2021 traffic volumes from Figure 3 are shown in Figure 4. Figure 4 shows the projected opening year traffic volumes in 2025 during the AM and PM peak hours without the project. The capacity analyses for the projected 2025 conditions at the Hardin Valley Road at Marietta Church Road intersection without the project being developed are shown in Table 4. The results shown in Table 4 indicate higher vehicle delays for the northbound approach of Marietta Church Road than the current year, 2021.

TABLE 4
2025 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (2025 WITHOUT THE PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Hardin Valley Road at Marietta Church Road	 Unsignalized	Westbound Left/Thru/Right	A	2.5	0.070	A	2.6	0.100
		Northbound Left/Thru/Right	C	24.0	0.540	C	21.8	0.480

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

^a Level of Service

^b Average Delay (sec/vehicle)

^c Volume to Capacity Ratio



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FIGURE 4

Hoppe Property Subdivision

2025 Peak Hour Traffic Volumes -
 OPENING YEAR TRAFFIC (WITHOUT THE PROJECT)

■ **TRIP DISTRIBUTION & ASSIGNMENT:**

Figure 5 shows the projected distribution for traffic entering and exiting the proposed development. The percentages in Figure 5 only pertain to the new proposed residential dwellings' trips in the development calculated from the ITE and local trip rates and shown in Table 3.

The percentages assumed and shown in Figure 5 are based on the 2016 traffic count conducted at the intersection of Hardin Valley Road at Marietta Church Road. It is also based on the previously discussed concentration of schools, development, and access to further "attractors" via Pellissippi Parkway (SR 131) to the east. Overall, 85% of the generated traffic is assumed will occur to/from the east, 10% to/from the south, and 5% to/from the west.

Figure 6 shows the Traffic Assignment of the computed trips generated by the development (from Table 3) and applying the intersection movement volumes based on the assumed distribution of trips shown in Figure 5.

Even though there will be two entrances constructed for this development, for this part of the analysis, all the projected generated traffic by the development was assumed to only occur at the Proposed Subdivision Entrance (South). This assumption was initially pursued to analyze a worst-case scenario analysis. This assumption was also necessary since traffic count data was not available to analyze the Proposed Subdivision Entrance (East) at Mission Hill Lane or Hardin Valley Road at Mission Hill Lane intersections. As currently proposed, in actuality, many of the trips shown at the south entrance at Hardin Valley Road in Figure 6 will occur at the Hardin Valley Road at Mission Hill Lane intersection instead. This more realistic scenario and analysis are discussed and provided later in this report.



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FIGURE 5
Hoppe Property Subdivision
Directional Distribution of Generated Traffic during AM and PM Peak Hour



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NOT TO SCALE

NORTH

FIGURE 6
Hoppe Property Subdivision
Traffic Assignment of Generated Traffic during AM and PM Peak Hour

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

Figure 7a shows the projected opening year traffic volumes in 2025 during the AM and PM peak hours with the project. Capacity analyses were undertaken to determine the 2025 projected LOS for the Proposed Subdivision Entrance (South) at Hardin Valley Road and Marietta Church Road intersection. This analysis assumed a single entering and exiting lane at the south entrance and assumed all the generated traffic from the townhouses and single-family houses would utilize this entrance exclusively.

The projected peak hour vehicular traffic results can be seen in Table 5a for the intersection, with the worksheets included in the Appendix. As shown in Table 5a, the studied intersection is calculated to operate at acceptable levels except for the Proposed Subdivision Entrance (South) approach. In the AM and PM peak hour, the southbound approach is calculated to be LOS F. These results are based on assuming that all generated traffic by the subdivision only enters and exits at this entrance.

Due to these poor results for the southbound entrance, a more realistic scenario analysis was undertaken. The development will have a second entrance, Proposed Subdivision Entrance (East) at Mission Hill Lane, which will provide exclusive access to the 45 townhouses on the north side of the property. The calculations were conducted again, removing the townhouse-generated trips at the south entrance to present a fairer analysis. Table 5b shows these results when removing the townhouse-generated trips. Figure 7b shows the projected opening year traffic volumes in 2025 during the AM and PM peak hours with only the trips generated from the single-family houses at the Proposed Subdivision Entrance (South). After removing the generated trips from the townhouses in the capacity analysis calculations, the results show slightly improved results for the Proposed Subdivision Entrance (South) approach with overall decreased delays for the other approaches.

TABLE 5a
2025 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (2025 WITH PROJECT) - ALL GENERATED TRAFFIC

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Hardin Valley Road at Marietta Church Road & Proposed Subdivision Entrance (South)	 Unsignalized	Eastbound Left/Thru/Right	A	0.0	0.000	A	0.1	0.000
		Westbound Left/Thru/Right	A	2.5	0.070	A	2.5	0.100
		Northbound Left/Thru/Right	D	27.0	0.580	D	30.3	0.600
		Southbound Left/Thru/Right	F	83.4	0.520	F	56.0	0.330

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

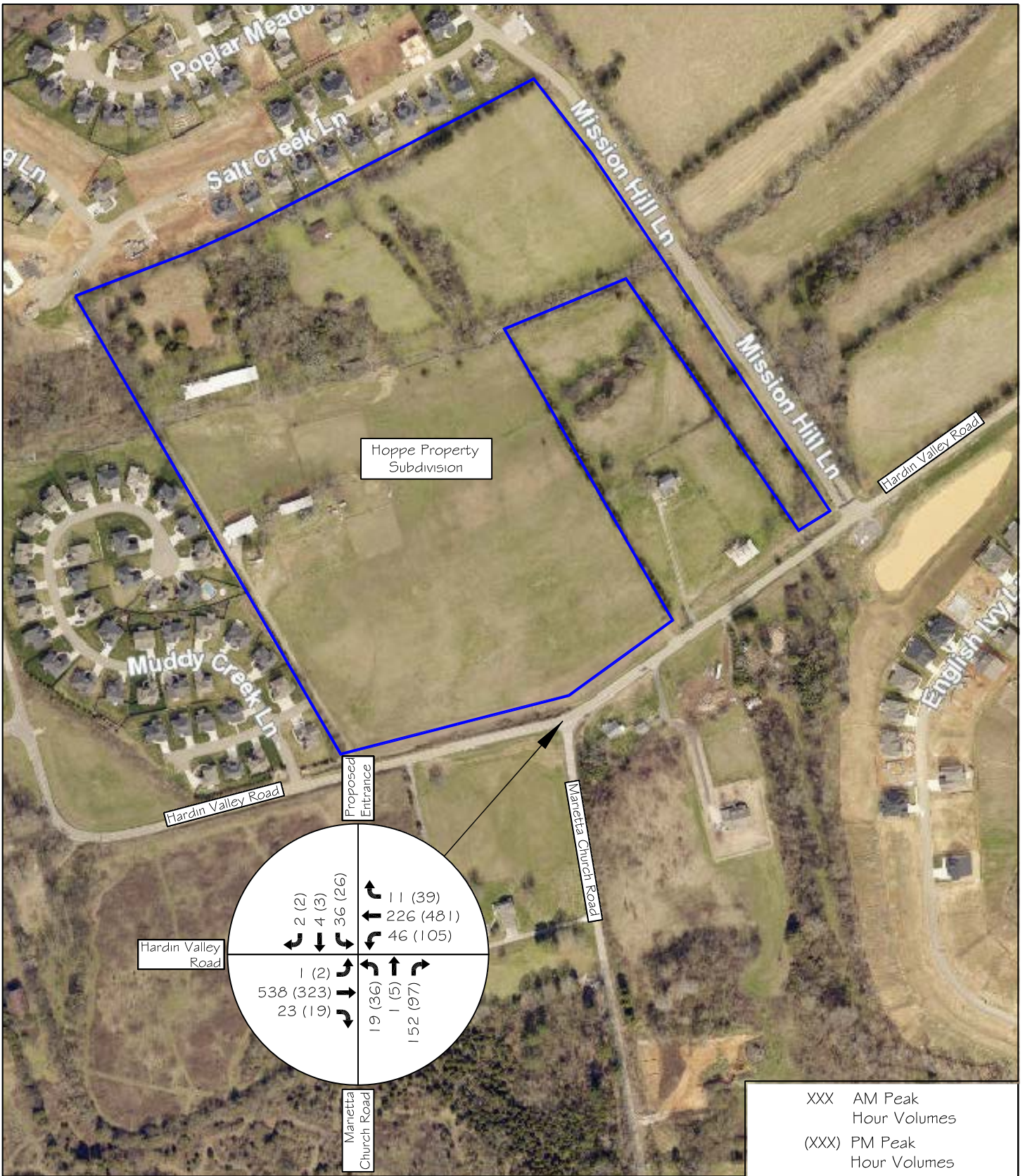
- ^a Level of Service
- ^b Average Delay (sec/vehicle)
- ^c Volume-to-Capacity Ratio

TABLE 5b
2025 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (2025 WITH PROJECT) - 33 SINGLE-FAMILY DETACHED HOUSES GENERATED TRAFFIC ONLY

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Hardin Valley Road at Marietta Church Road & Proposed Subdivision Entrance (South)	 Unsignalized	Eastbound Left/Thru/Right	A	0.0	0.000	A	0.0	0.000
		Westbound Left/Thru/Right	A	2.5	0.070	A	2.6	0.100
		Northbound Left/Thru/Right	D	26.7	0.580	D	27.7	0.570
		Southbound Left/Thru/Right	F	59.9	0.270	E	43.6	0.130

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

- ^a Level of Service
- ^b Average Delay (sec/vehicle)
- ^c Volume-to-Capacity Ratio



XXX AM Peak Hour Volumes
 (XXX) PM Peak Hour Volumes

11812 Black Road
 Knoxville, TN 37932
 Phone: (865) 556-0042
 Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 7a
 Hoppe Property Subdivision
 2025 Peak Hour Traffic Volumes -
 OPENING YEAR TRAFFIC (WITH PROJECT)
 All Development Generated Traffic



XXX AM Peak Hour Volumes
 (XXX) PM Peak Hour Volumes

11812 Black Road
 Knoxville, TN 37932
 Phone: (865) 556-0042
 Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 7b
 Hoppe Property Subdivision
 2025 Peak Hour Traffic Volumes -
 OPENING YEAR TRAFFIC (WITH PROJECT)
 33 Single-Family Detached Houses Only

■ **EVALUATION OF TURN LANE THRESHOLDS:**

An evaluation of the need for separate auxiliary turn lanes on Hardin Valley Road for entering vehicles into the proposed development in the year 2025 was conducted. The design policy used for these turn lane evaluations is based on “Knox County’s Access Control and Driveway Design Policy”. This design policy relates vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. This Knox County policy is based on TDOT and nationally accepted guidelines for unsignalized intersections.

Based on the entering projected 2025 AM and PM peak hour traffic volumes at the Proposed Subdivision Entrance (South) and the posted speed limit of 40-mph on Hardin Valley Road, the results show the need for a separate eastbound left-turn lane or a westbound right-turn lane on Hardin Valley Road is not warranted. The Knox County turn lane policy worksheets are in the Appendix. These results are based on assuming that the townhouse and single-family houses will have separate entrances. Only the trips generated by the single-family houses will enter and exit at the Proposed Subdivision Entrance (South) Hardin Valley Road and Marietta Church Road, and this is the scenario analyzed for the turn lane warrant evaluation.

At Knox County’s request, the evaluation for the need for a separate westbound left-turn lane on Hardin Valley Road at Marietta Church Road was also conducted. The 2025 AM and PM peak hour volumes projected for the westbound left-turn lane is 46 and 105 vehicles, respectively. The evaluation determined that a westbound left-turn lane on Hardin Valley Road at Marietta Church Road would be warranted based on a posted speed limit of 40 mph. The Knox County turn lane policy worksheets for this evaluation are in the Appendix. The westbound left-turn lane traffic movements are not associated with the proposed Hoppe Property Subdivision generated trips but should be considered if and when remediation is pursued at this intersection when potentially accommodating a new subdivision entrance and adding a 4th leg at the intersection.

■ **EVALUATION OF VEHICLE QUEUES:**

When considerable vehicle delays are calculated for minor side streets, this does not always necessitate mitigation. If only one vehicle experiences a significant delay in attempting to enter a high-volume major street, mitigation is not realistic nor particularly cost-effective. Likewise, if many vehicles on a minor side street are experiencing significant delays, mitigation should be pursued. Besides LOS calculations, another appropriate metric to determine whether mitigation

should be pursued is by calculating projected vehicle queue lengths.

The projected vehicle queue lengths on the minor approaches at the entrance intersection were examined based on the projected 2025 traffic volumes, with only the single-family homes utilizing the intersection. The previously mentioned Synchro Traffic Software includes SimTraffic. The Synchro portion of the software performs the macroscopic calculations for intersections, and SimTraffic performs micro-simulation and animation of vehicular traffic. SimTraffic (Version 8) software was utilized to estimate the vehicle queue lengths at the intersection.

Based on the software results from the projected 2025 volumes, the 95th percentile vehicle queue lengths were calculated. The 95th percentile vehicle queue is the recognized measurement in the traffic engineering profession as the design standard used when considering queue lengths. A 95th percentile vehicle queue means a 95% certainty that the vehicle queue will not extend beyond that point. The calculated vehicle queue results were based on averaging the outcome obtained during ten traffic simulations, and the vehicle queue results from the SimTraffic software are in the Appendix. The calculated 95th percentile queue lengths at the intersection in 2025 are shown in Table 6.

TABLE 6
95TH PERCENTILE VEHICLE QUEUE LENGTHS
2025 PROJECTED PEAK HOUR TRAFFIC VOLUMES

INTERSECTION	APPROACH/ MOVEMENT	SIMTRAFFIC 95 th PERCENTILE VEHICLE QUEUE LENGTH (ft)	
		AM PEAK HOUR	PM PEAK HOUR
Hardin Valley Road at Marietta Church Road & Proposed Subdivision Entrance (South)	Eastbound Left/Thru/Right	3	7
	Westbound Left/Thru/Right	53	85
	Northbound Left/Thru/Right	89	86
	Southbound Left/Thru/Right	41	35

Note: 95th percentile queues were calculated in SimTraffic 8 software

Based on these results, the projected vehicle queue lengths at the intersection are minimal in the projected conditions in 2025. In particular, the southbound approach, the Proposed Subdivision Entrance (South), is expected to have a queue of only one to two vehicles based on an average vehicle length of 25 feet. The northbound approach, Marietta Church Road, is expected to have only three to four vehicles in a queue at its longest. These minimal queues suggest that even though the southbound approach will have high vehicle delays, the vehicle queues are not expected to be large enough to necessitate mitigation based on the projections.

■ **INTERSECTION SIGHT DISTANCE:**

Based on a posted speed limit of 40-mph on Hardin Valley Road, the Intersection Sight Distance (ISD) would be 400 feet looking east and west on Hardin Valley Road from the Proposed Subdivision Entrance (South) at Marietta Church Road based on Knox County policy of requiring 10 feet of sight distance per 1-mph of speed. Based on a posted speed limit of 40-mph on Hardin Valley Road and an existing 3% road grade on Hardin Valley Road, the Stopping Sight Distance (SSD) is 290 feet for eastbound vehicles and 315 feet for westbound vehicles.

A cursory examination of the sight distances from the Proposed Subdivision Entrance (South) at the intersection of Hardin Valley Road at Marietta Church Road was undertaken. Based on visual observation, it appears that the intersection sight distance from the Proposed Subdivision Entrance (South) will be adequate. Using a Nikon Laser Rangefinder at the Proposed Subdivision Entrance (South) location, the intersection sight distance was estimated to be 500+ feet to the east and more than 999+ feet (limit of laser rangefinder) to the west. The actual distance will be dependent on the amount of hedgerow and other vegetation that will be cleared for the development on the north side of Hardin Valley Road. Images of the existing sight distances from the Proposed Subdivision Entrance (South) location are presented below.



View of Sight Distance on Hardin Valley Road at Proposed Subdivision Entrance (Looking Northeast)



View of Sight Distance on Hardin Valley Road at Proposed Subdivision Entrance (Looking Southwest)

The Proposed Subdivision Entrance (East) was not examined since the exact location on Mission Hill Lane is not known. However, Mission Hill Lane has a very straight horizontal alignment, and it is assumed that sight distance will be adequate at this proposed subdivision entrance.

ADDITIONAL ANALYSES

▪ **TRIP GENERATION COMPARISON UNDER EXISTING ZONING:**

The Knox County Growth Policy Plan required this Traffic Impact Letter (TIL) since the rezoning request of the property would result in a higher density than permitted under the current zoning of Agricultural (A). The housing density for this property zoned as Agricultural (A) is one dwelling unit per acre. The Hoppe property is 36.9 acres, which would allow 36 dwelling units if the zoning was not changed.

The estimated amount of traffic that 36 single-family detached houses would generate was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 10th Edition, a publication of the Institute of Transportation Engineers (ITE). The data from ITE for 36 single-family houses are shown in the Appendix. A summary of this information is presented in the following table:

TABLE 7
TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION
36 Single-Family Houses based on 1 dwelling unit/acre in Agricultural (A) zone

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	36 Houses	407	25%	75%		63%	37%	
				8	23	31	25	14	39
Total New Volume Site Trips			407	8	23	31	25	14	39

ITE Trip Generation Manual, 10th Edition
Trips calculated by using Fitted Curve Equation

The potential number of daily trips generated by the property with one density unit per acre under the existing Agricultural (A) zone would be 407 vehicles as compared to 841 vehicles for 33 single-family houses and 45 townhouses proposed under the requested Planned Residential (PR) zone (shown in Table 3). Changing the zoning from Agricultural (A) to Planned Residential (PR) could essentially double the number of potential trips generated. This doubling of trips generated corresponds directly to the roughly doubling of housing units from 36 to 78.

ROADWAY CAPACITY OF HARDIN VALLEY ROAD:

Hardin Valley Road will be the main access road between the proposed residential development and outside destinations. In most cases, transportation impact studies (and TIL's) do not analyze road segments since vehicle volumes and flow are most critical and impactful at intersections. The following, however, provides some context to the future road capacity of Hardin Valley Road in the study area.

Methodology:

Much research has been made to determine two-lane roadways' capacity based on vehicle speeds, road geometry, and various other parameters. The latest edition of the Highway Capacity Manual (6th Edition) by the Transportation Research Board has presented new research and analysis methodologies for transportation facilities that include roadways and intersections. Based on the analysis methods presented in the latest Highway Capacity Manual, the Florida Department of Transportation (FDOT) developed LOSPLAN, a group of software evaluation tools that provides computational methods for analyzing freeways, highways, and arterials road sections. The software provides conceptual level planning results for determining the capacity and Level of Service (LOS) of roadway facilities. For this report, this software is regarded to be appropriate for use in this level of study.

Various factors are used to calculate the actual "real world" capacity of a roadway. In almost all cases, the actual roadway capacity is reduced as more significant numbers of heavy vehicles comprise the traffic flow, road grades increase, and other aspects are introduced. For 2-lane highway segments in the software, FDOT has set the maximum amount of vehicle flow in developed areas at 1,650 vehicles per hour per lane (vphpl).

Conservative values were inputted in the FDOT software to ensure precautions results to analyze Hardin Valley Road in this study. The analysis included Hardin Valley Road's segment between Marietta Church Road and North Campbell Station Road for a length of 1.7 miles. The significant inputs in the software were the following:

- assumed a free-flow speed of 45 mph
- an AADT (Average Annual Daily Traffic) of 11,787 vehicles in 2025
- 2% heavy truck traffic

- Left turn/blockage impact is present due to the lack of left-turn storage bays
- Rolling terrain
- 0% no passing zones present

The AADT of 11,787 vehicles was based on the 6,920 ADT volume on Hardin Valley Road to the east reported by the TPO in 2019, adjusting it upwards with 10% growth up to 2025, and by adding the daily volumes generated by the proposed Hoppe Property Subdivision (841 daily trips) to and from the east. The additional daily traffic volumes on Hardin Valley Road generated by the proposed development were calculated by multiplying the 841 total daily generated trips by 85%, which is the assumed direction of travel to and from the east on Hardin Valley Road.

Based on these factors and other inputs, the Level of Service for this segment of Hardin Valley Road was calculated to be LOS D in 2025. This result was based on the projected conditions when the proposed Hoppe Property Subdivision is fully built-out and occupied in 2025. The results from the software are shown in the Appendix.

It should be noted that the projected generated trips by the Hoppe Property Subdivision will consist of just 6% of the daily trips on Hardin Valley Road to the east in the year 2025 based on an ADT of 11,787.

OVERVIEW OF FINDINGS

The following is an overview of the findings for the proposed Hoppe Property Subdivision off Hardin Valley Road based on the initial assessment of the existing and projected conditions:

- Sight distance at the Proposed Subdivision Entrance (South) at Hardin Valley Road and Marietta Church Road has been estimated to be adequate. The sight distance at the Proposed Subdivision Entrance (East) at Mission Hill Lane is expected to be adequate based on visual observation. Sight distance at both locations will need to be verified by a licensed surveyor.
- The Proposed Subdivision Entrance (South) at Hardin Valley Road and Marietta Church Road is calculated to operate at excellent levels with respect to vehicular capacity and vehicle delays for motorists on Hardin Valley Road. Assuming the Proposed Subdivision Entrance (South) is only utilized by the residents in the 33 single-family houses, the southbound entrance approach is calculated to operate at LOS F and E in the AM and PM peak hours. Under the same assumption, Marietta Church Road is calculated to operate at LOS D in the AM and PM peak hours. Even with these less-than-ideal results, only a couple of vehicles are expected to be queued at any one time on these approaches during the peak hours and does not particularly suggest a need for mitigation on the north and south approaches.

As proposed, the generated townhouse trips will only occur at the east subdivision entrance. This other entrance, Proposed Subdivision Entrance (East) at Mission Hill Lane, will exclusively provide road access to the 45 townhouses on the north side of the property.

- Separate entering auxiliary turn lanes on Hardin Valley Road at the Proposed Subdivision Entrance (South) are not warranted based on the projected 2025 traffic volumes with separate entrances for the single-family houses and the townhouses.
- While not associated with the Hoppe Property Subdivision generated trips, it is projected that a separate westbound left-turn lane will be warranted at the intersection of Hardin Valley Road at Marietta Church Road in 2025 whether or

not the proposed subdivision entrance is constructed on the north side.

- The Knox County requirement for intersection spacing on an arterial road is 400 feet. This requirement is met since the Proposed Subdivision Entrance (South) location on Hardin Valley Road at Marietta Church Road will be located 725 feet to the east of Muddy Creek Lane and 925 feet to the west of Mission Hill Lane. The Proposed Subdivision Entrance (East) will be located approximately 500 feet to the south of Salt Creek Lane and 1,125 feet to the north of Hardin Valley Road. The Knox County requirement for intersection spacing on a local street is 125 feet. This requirement will be met for the Proposed Subdivision Entrance (East) on Mission Hill Lane.
- The exiting traffic generated by this development could be better served if the entrance did not occur on the north side of the intersection of Hardin Valley Road at Marietta Church Road. Shifting the exiting traffic from the intersection to another entrance location on Hardin Valley Road would reduce the vehicular conflicts induced by the growing traffic volumes on Marietta Church Road. While the thru movement volumes on Hardin Valley Road would roughly be the same, exiting subdivision vehicles would not have to compete with vehicles turning left or right from Marietta Church Road.

The developer of the Hoppe Property Subdivision is planning on connecting to the existing subdivision (Hunters Crossing) to the west on Deer Crossing Drive and is also interested in connecting to the adjacent property to the east (see Figure 2), which is surrounded by this development property. Creating connectivity between the individual properties/developments would facilitate shifting the proposed entrance for the Hoppe Property Subdivision to the east and away from the intersection of Hardin Valley Road at Marietta Church Road. The property owner to the east is planning a subdivision development, and conversations have been occurring with the developer of the Hoppe Property Subdivision. The developer of the Hoppe Property Subdivision is interested in a connection between the two properties resulting in a cohesive development. The distance between Marietta Church Road and Mission Hill Lane on Hardin Valley Road is just over 900 feet. With the Knox County constraint of 400 feet spacing between local streets on an arterial road, there is adequate separation to construct a unified

subdivision entrance that could serve both properties and shift away from the more numerous traffic movements at the Hardin Valley Road at Marietta Church Road intersection.

- Utilizing a planning-level analysis of the 2-lane section of Hardin Valley Road between Marietta Church Road and North Campbell Station Road, the results presented in this report suggest that the road will be adequate with respect to capacity in 2025, assuming a future 10% annual growth rate. The number of additional trips generated by the Hoppe Property Subdivision based on allowing rezoning from Agricultural (A) to Planned Residential (PR) will not be a measurable detriment to the overall roadway capacity of Hardin Valley Road.

APPENDIX

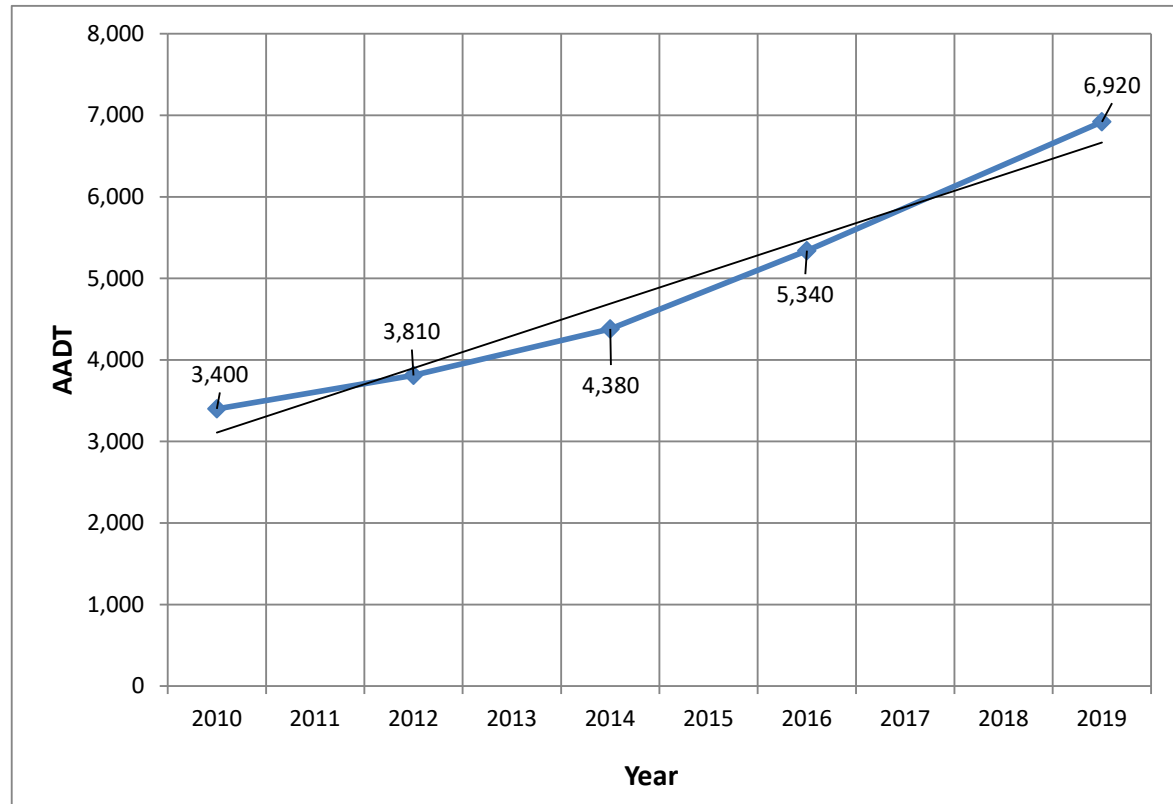
Historical Traffic Counts

Organization: Knoxville TPO

Station ID #: 093M353

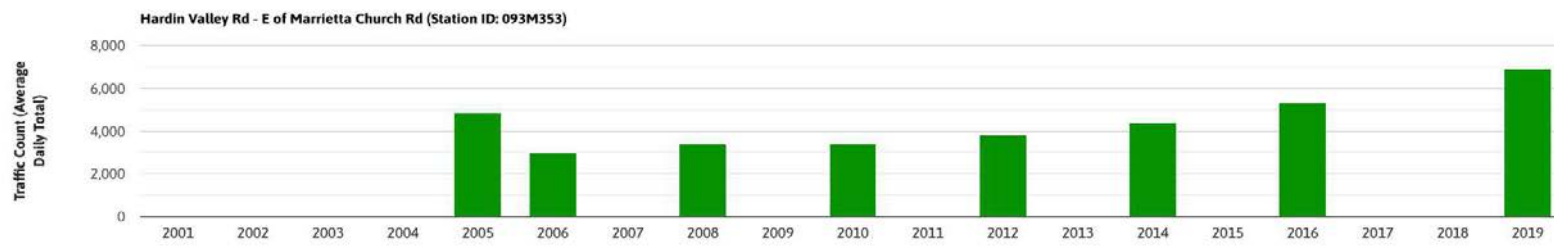
Location: Hardin Valley Road, east of Marietta Church Road

YEAR	AADT	
2009	-	
2010	3,400	Trendline
2011	-	
2012	3,810	
2013	-	
2014	4,380	
2015	-	
2016	5,340	
2017	-	
2018	-	
2019	6,920	



2010 - 2019 Growth Rate = 103.5%

Average Annual Growth Rate = 8.2%



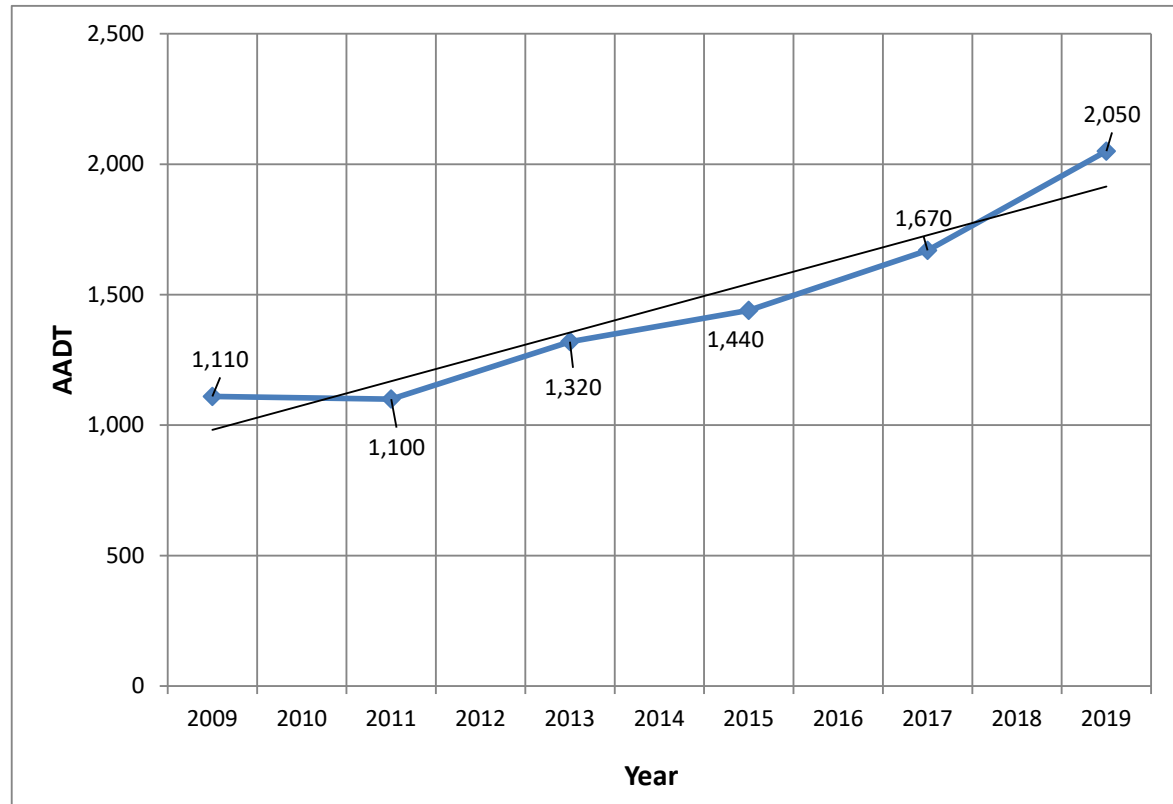
Historical Traffic Counts

Organization: Knoxville TPO

Station ID #: 093M275

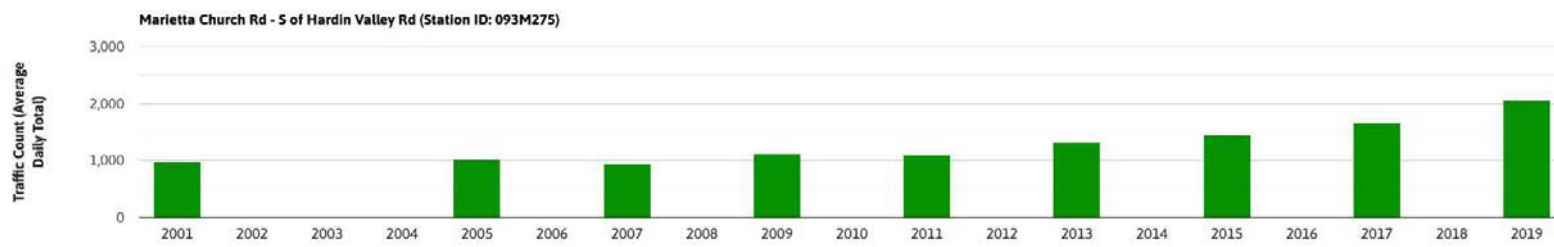
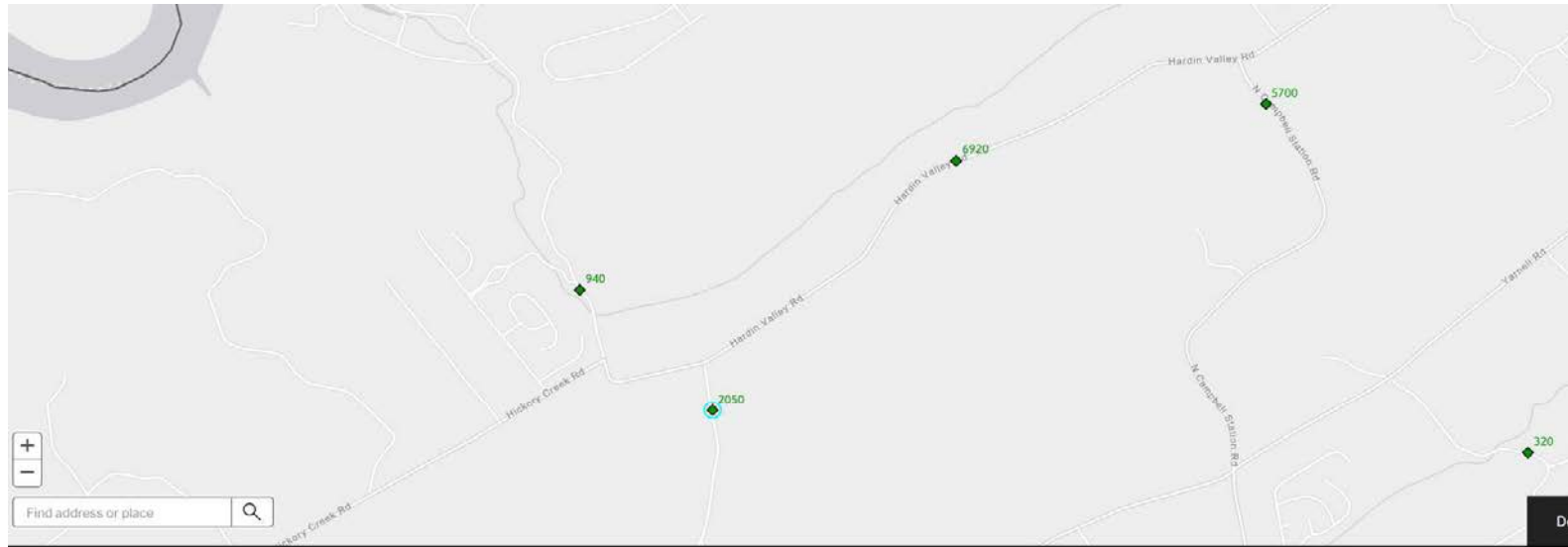
Location: Marietta Church Road, south of Hardin Valley Road

YEAR	AADT	
2009	1,110	Trendline
2010	-	
2011	1,100	
2012	-	
2013	1,320	
2014	-	
2015	1,440	
2016	-	
2017	1,670	
2018	-	
2019	2,050	



2009 - 2019 Growth Rate = 84.7%

Average Annual Growth Rate = 6.3%



TRAFFIC COUNT DATA

Major Street: Hardin Valley Road (EB-WB)
 Minor Street: Marietta Church Road (NB)
 Traffic Control: Stop Control on Minor Street

11/1/2016 (Tuesday)
 Warm/Sunny
 Conducted by: Ajax Engineering

Primary Movement: Vehicles

TIME BEGIN	WESTBOUND		NORTHBOUND		EASTBOUND		VEHICLE TOTAL	PEAK HOUR
	LT	THRU	LT	RT	THRU	RT		
7:00 AM	4	13	2	17	56	1	93	
7:15 AM	3	26	3	15	85	2	134	7:15 AM - 8:15 AM
7:30 AM	9	31	4	17	78	5	144	
7:45 AM	7	26	3	23	54	3	116	
8:00 AM	5	36	0	25	66	2	134	
8:15 AM	6	35	2	19	50	1	113	
8:30 AM	4	44	2	18	45	2	115	
8:45 AM	3	20	1	10	52	1	87	
TOTAL	41	231	17	144	486	17	936	
2:00 PM	11	41	5	5	32	1	95	
2:15 PM	4	40	2	5	25	2	78	
2:30 PM	5	27	5	5	38	2	82	
2:45 PM	13	45	3	2	45	0	108	
3:00 PM	13	40	4	10	28	3	98	
3:15 PM	6	39	2	6	40	0	93	
3:30 PM	16	38	7	8	25	2	96	
3:45 PM	24	55	4	4	31	2	120	
4:00 PM	14	42	3	3	28	6	96	
4:15 PM	9	54	2	6	31	2	104	
4:30 PM	9	48	3	6	37	7	110	
4:45 PM	7	61	6	6	35	2	117	
5:00 PM	13	60	2	19	37	3	134	5:00 PM - 6:00 PM
5:15 PM	16	66	5	17	46	0	150	
5:30 PM	14	55	7	6	44	5	131	
5:45 PM	12	72	5	9	43	2	143	
TOTAL	186	783	65	117	565	39	1755	

AM Peak Hour 7:15 AM - 8:15 AM

TIME BEGIN	WESTBOUND		NORTHBOUND		EASTBOUND	
	LT	THRU	LT	RT	THRU	RT
7:15 AM	3	26	3	15	85	2
7:30 AM	9	31	4	17	78	5
7:45 AM	7	26	3	23	54	3
8:00 AM	5	36	0	25	66	2
TOTAL	24	119	10	80	283	12
PHF	0.67	0.83	0.63	0.80	0.83	0.60

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

TIME BEGIN	WESTBOUND		NORTHBOUND		EASTBOUND	
	LT	THRU	LT	RT	THRU	RT
5:00 PM	13	60	2	19	37	3
5:15 PM	16	66	5	17	46	0
5:30 PM	14	55	7	6	44	5
5:45 PM	12	72	5	9	43	2
TOTAL	55	253	19	51	170	10
PHF	0.86	0.88	0.68	0.67	0.92	0.50

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road & Hardin Valley Road

4/19/2021



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	425	18	36	179	15	120
Sign Control	Free			Free	Stop	
Grade	2%			-2%	-2%	
Peak Hour Factor	0.83	0.60	0.67	0.83	0.63	0.80
Hourly flow rate (vph)	512	30	54	216	24	150
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			542		850	527
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			542		850	527
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		92	73
cM capacity (veh/h)			1037		316	555

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	542	269	174
Volume Left	0	54	24
Volume Right	30	0	150
cSH	1700	1037	503
Volume to Capacity	0.32	0.05	0.35
Queue Length 95th (ft)	0	4	38
Control Delay (s)	0.0	2.1	15.9
Lane LOS		A	C
Approach Delay (s)	0.0	2.1	15.9
Approach LOS			C

Intersection Summary			
Average Delay		3.4	
Intersection Capacity Utilization		53.1%	ICU Level of Service
Analysis Period (min)		15	A

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road & Hardin Valley Road

4/19/2021



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→			←	↘	↙
Volume (veh/h)	255	15	83	380	29	77
Sign Control	Free			Free	Stop	
Grade	2%			-2%	-2%	
Peak Hour Factor	0.92	0.50	0.86	0.88	0.68	0.67
Hourly flow rate (vph)	277	30	97	432	43	115
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			307		917	292
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			307		917	292
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		85	85
cM capacity (veh/h)			1265		282	752

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	307	528	158
Volume Left	0	97	43
Volume Right	30	0	115
cSH	1700	1265	518
Volume to Capacity	0.18	0.08	0.30
Queue Length 95th (ft)	0	6	32
Control Delay (s)	0.0	2.2	15.0
Lane LOS		A	B
Approach Delay (s)	0.0	2.2	15.0
Approach LOS			B

Intersection Summary			
Average Delay		3.5	
Intersection Capacity Utilization	55.3%		ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road & Hardin Valley Road

4/20/2021



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→			←	↔	↔
Volume (veh/h)	538	23	46	226	19	152
Sign Control	Free			Free	Stop	
Grade	2%			-2%	-2%	
Peak Hour Factor	0.83	0.60	0.67	0.83	0.63	0.80
Hourly flow rate (vph)	648	38	69	272	30	190
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			687		1077	667
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			687		1077	667
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		87	59
cM capacity (veh/h)			917		227	462

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	687	341	220
Volume Left	0	69	30
Volume Right	38	0	190
cSH	1700	917	405
Volume to Capacity	0.40	0.07	0.54
Queue Length 95th (ft)	0	6	79
Control Delay (s)	0.0	2.5	24.0
Lane LOS		A	C
Approach Delay (s)	0.0	2.5	24.0
Approach LOS			C

Intersection Summary			
Average Delay		4.9	
Intersection Capacity Utilization	64.6%		ICU Level of Service C
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road & Hardin Valley Road

4/20/2021



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Volume (veh/h)	323	19	105	481	36	97
Sign Control	Free			Free	Stop	
Grade	2%			-2%	-2%	
Peak Hour Factor	0.92	0.50	0.86	0.88	0.68	0.67
Hourly flow rate (vph)	351	38	122	547	53	145
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			389		1161	370
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			389		1161	370
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		73	79
cM capacity (veh/h)			1180		196	680

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	389	669	198
Volume Left	0	122	53
Volume Right	38	0	145
cSH	1700	1180	409
Volume to Capacity	0.23	0.10	0.48
Queue Length 95th (ft)	0	9	64
Control Delay (s)	0.0	2.6	21.8
Lane LOS		A	C
Approach Delay (s)	0.0	2.6	21.8
Approach LOS			C

Intersection Summary			
Average Delay		4.8	
Intersection Capacity Utilization		67.2%	ICU Level of Service C
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

4/20/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	1	538	23	46	226	11	19	1	152	36	4	2
Sign Control		Free			Free			Stop			Stop	
Grade		2%			-2%			-2%			0%	
Peak Hour Factor	0.92	0.83	0.60	0.67	0.83	0.92	0.63	0.92	0.80	0.90	0.90	0.90
Hourly flow rate (vph)	1	648	38	69	272	12	30	1	190	40	4	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	284			687			1090	1091	667	1276	1104	278
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	284			687			1090	1091	667	1276	1104	278
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			93			83	99	59	50	98	100
cM capacity (veh/h)	1278			917			180	199	462	80	197	765
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	688	353	221	47								
Volume Left	1	69	30	40								
Volume Right	38	12	190	2								
cSH	1278	917	379	89								
Volume to Capacity	0.00	0.07	0.58	0.52								
Queue Length 95th (ft)	0	6	89	58								
Control Delay (s)	0.0	2.5	27.0	83.4								
Lane LOS	A	A	D	F								
Approach Delay (s)	0.0	2.5	27.0	83.4								
Approach LOS			D	F								
Intersection Summary												
Average Delay			8.2									
Intersection Capacity Utilization			66.4%		ICU Level of Service				C			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

4/20/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	2	323	19	105	481	39	36	5	97	26	3	2
Sign Control		Free			Free			Stop			Stop	
Grade		2%			-2%			-2%			0%	
Peak Hour Factor	0.92	0.92	0.50	0.86	0.88	0.92	0.68	0.92	0.67	0.92	0.92	0.92
Hourly flow rate (vph)	2	351	38	122	547	42	53	5	145	28	3	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	589			389			1190	1208	370	1334	1205	568
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	589			389			1190	1208	370	1334	1205	568
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			90			65	97	79	70	98	100
cM capacity (veh/h)	986			1180			150	164	680	93	166	526
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	391	711	203	34								
Volume Left	2	122	53	28								
Volume Right	38	42	145	2								
cSH	986	1180	339	103								
Volume to Capacity	0.00	0.10	0.60	0.33								
Queue Length 95th (ft)	0	9	92	32								
Control Delay (s)	0.1	2.5	30.3	56.0								
Lane LOS	A	A	D	F								
Approach Delay (s)	0.1	2.5	30.3	56.0								
Approach LOS			D	F								
Intersection Summary												
Average Delay			7.4									
Intersection Capacity Utilization			69.5%		ICU Level of Service				C			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

4/20/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	0	538	23	46	226	6	19	1	152	19	2	1
Sign Control		Free			Free			Stop			Stop	
Grade		2%			-2%			-2%			0%	
Peak Hour Factor	0.92	0.83	0.60	0.67	0.83	0.92	0.63	0.92	0.80	0.90	0.90	0.90
Hourly flow rate (vph)	0	648	38	69	272	7	30	1	190	21	2	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	279			687			1082	1083	667	1271	1099	276
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	279			687			1082	1083	667	1271	1099	276
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			93			84	99	59	74	99	100
cM capacity (veh/h)	1284			917			184	201	462	81	198	768

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	687	347	221	24
Volume Left	0	69	30	21
Volume Right	38	7	190	1
cSH	1284	917	381	89
Volume to Capacity	0.00	0.07	0.58	0.27
Queue Length 95th (ft)	0	6	88	25
Control Delay (s)	0.0	2.5	26.7	59.9
Lane LOS		A	D	F
Approach Delay (s)	0.0	2.5	26.7	59.9
Approach LOS			D	F

Intersection Summary			
Average Delay		6.4	
Intersection Capacity Utilization	64.6%		ICU Level of Service C
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

4/20/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	1	323	19	105	481	20	36	2	97	11	1	1
Sign Control		Free			Free			Stop			Stop	
Grade		2%			-2%			-2%			0%	
Peak Hour Factor	0.92	0.92	0.50	0.86	0.88	0.92	0.68	0.92	0.67	0.92	0.92	0.92
Hourly flow rate (vph)	1	351	38	122	547	22	53	2	145	12	1	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	568			389			1176	1185	370	1320	1193	557
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	568			389			1176	1185	370	1320	1193	557
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			90			66	99	79	88	99	100
cM capacity (veh/h)	1004			1180			155	169	680	97	169	533
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	390	690	200	14								
Volume Left	1	122	53	12								
Volume Right	38	22	145	1								
cSH	1004	1180	353	107								
Volume to Capacity	0.00	0.10	0.57	0.13								
Queue Length 95th (ft)	0	9	83	11								
Control Delay (s)	0.0	2.6	27.7	43.6								
Lane LOS	A	A	D	E								
Approach Delay (s)	0.0	2.6	27.7	43.6								
Approach LOS			D	E								
Intersection Summary												
Average Delay			6.1									
Intersection Capacity Utilization			68.1%		ICU Level of Service				C			
Analysis Period (min)			15									

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)

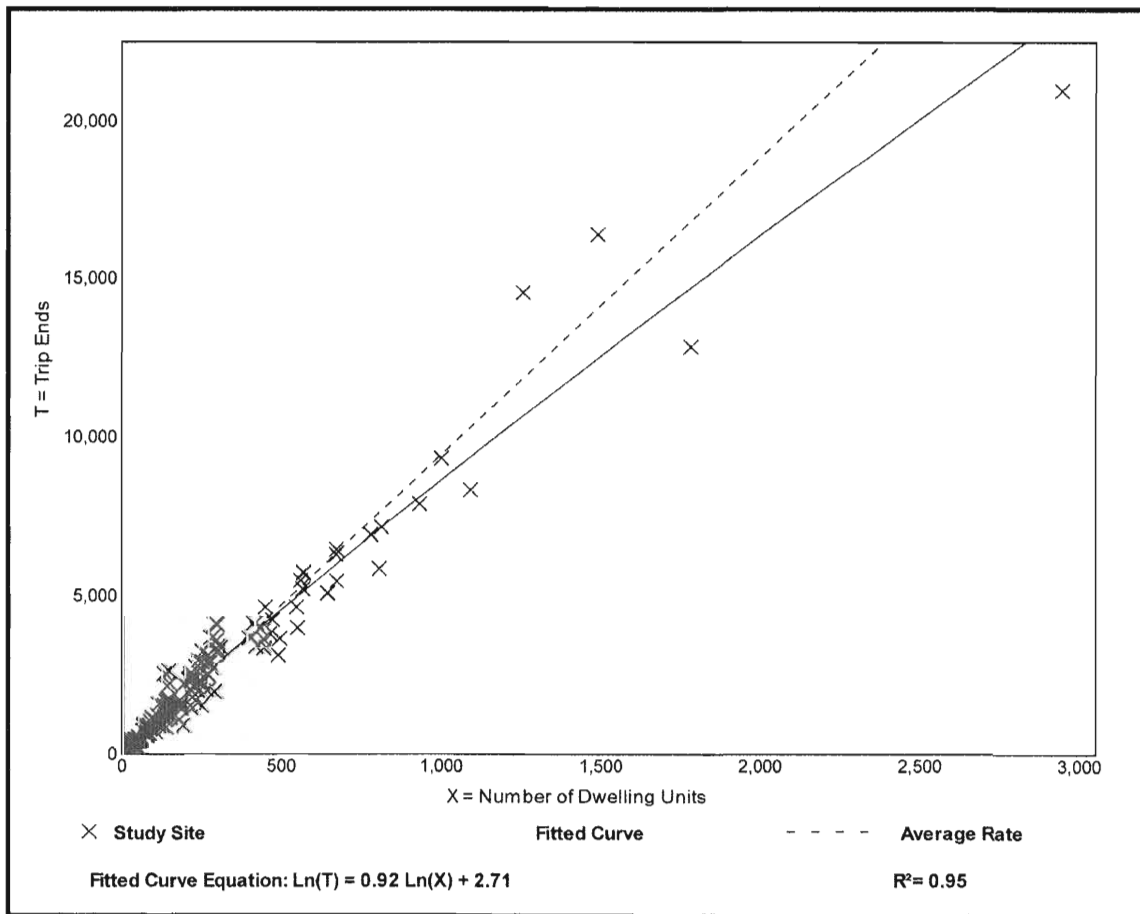
Vehicle Trip Ends vs: Dwelling Units
On a: **Weekday**

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)

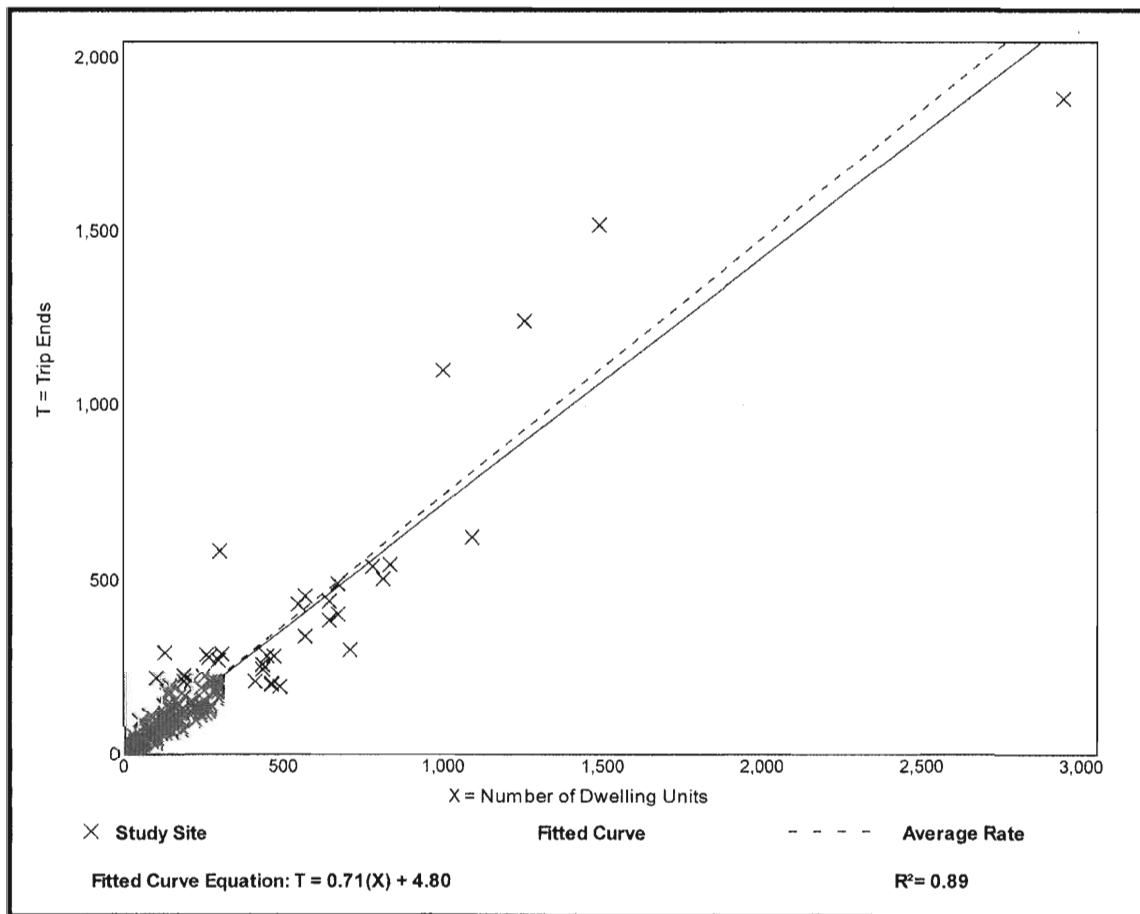
Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 7 and 9 a.m.

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)

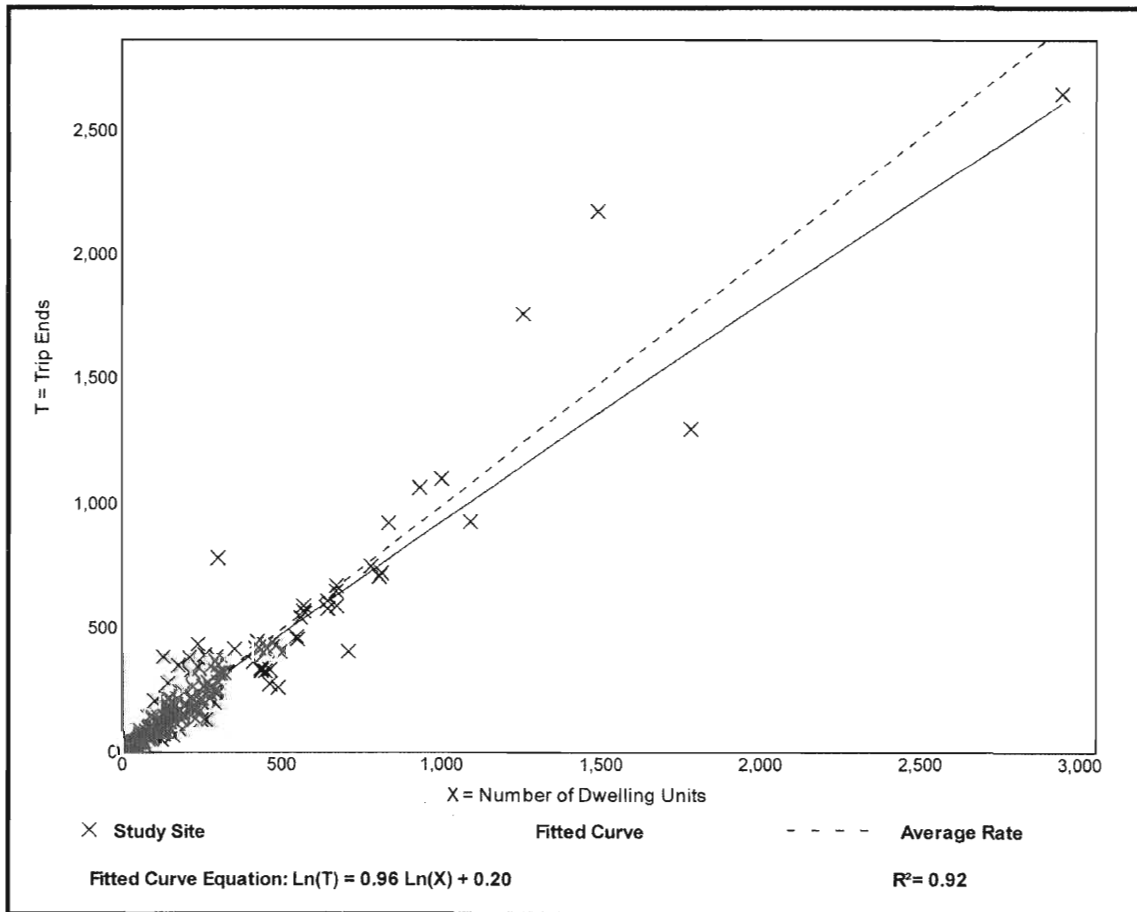
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

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



Local Apartment Trip Generation Study

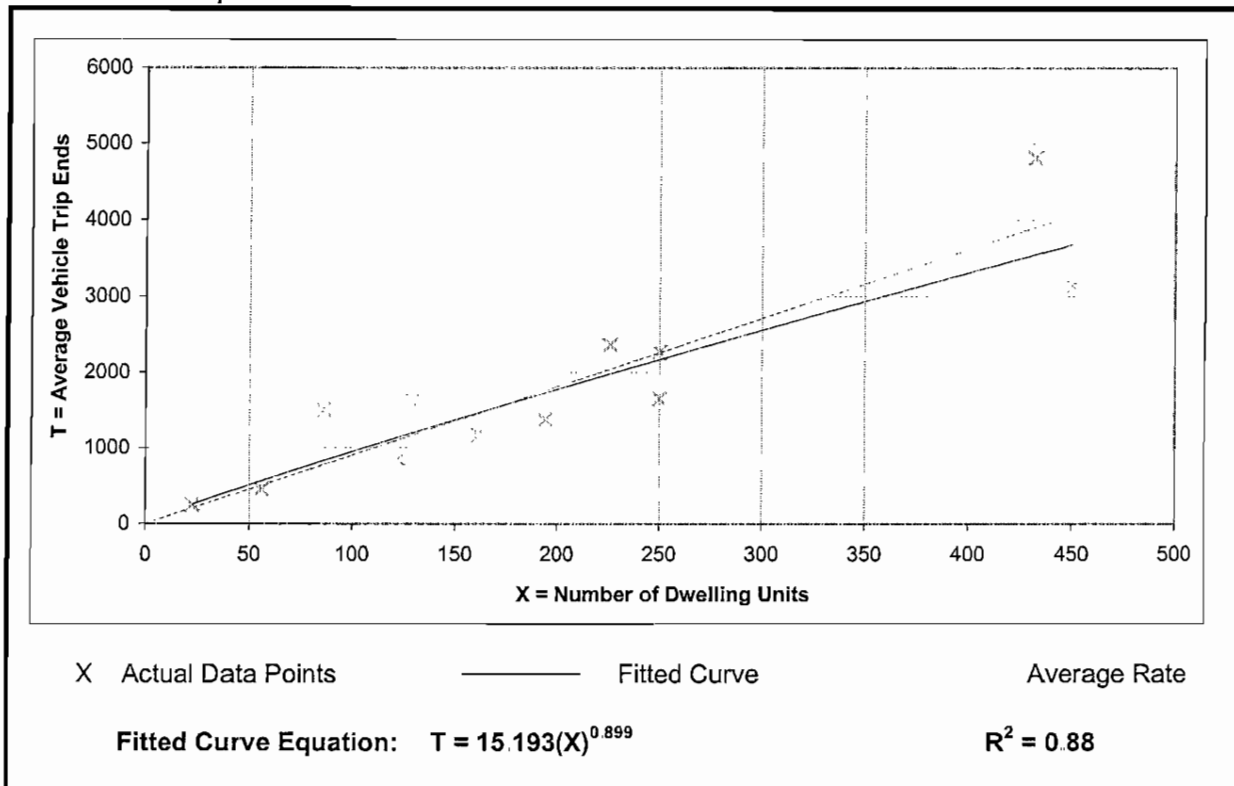
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 13
Average Number of Dwelling Units: 193
Directional Distribution: 50% entering, 50% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
9.03	6.59 - 17.41	2.47

Data Plot and Equation



Local Apartment Trip Generation Study

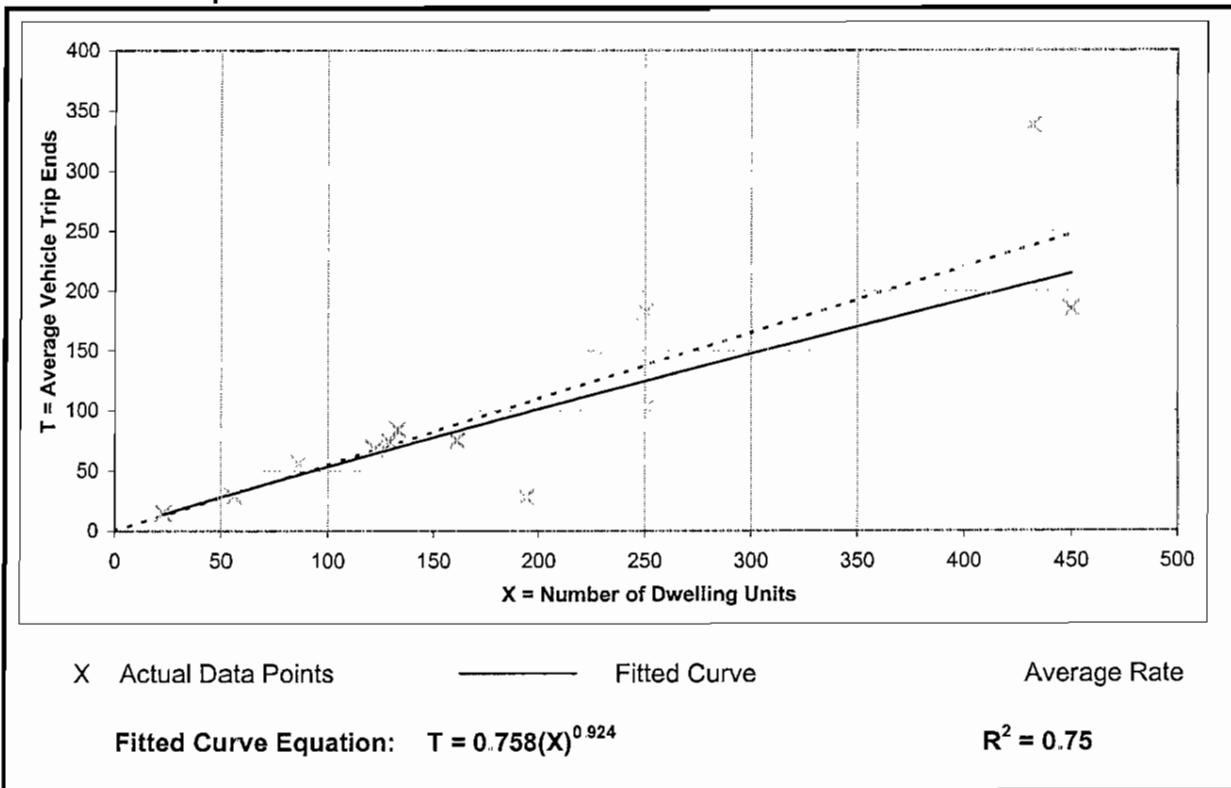
Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 7 and 9 a.m.

Number of Studies: 13
 Average Number of Dwelling Units: 193
 Directional Distribution: 22% entering, 78% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.55	0.14 - 0.78	0.18

Data Plot and Equation



Local Apartment Trip Generation Study

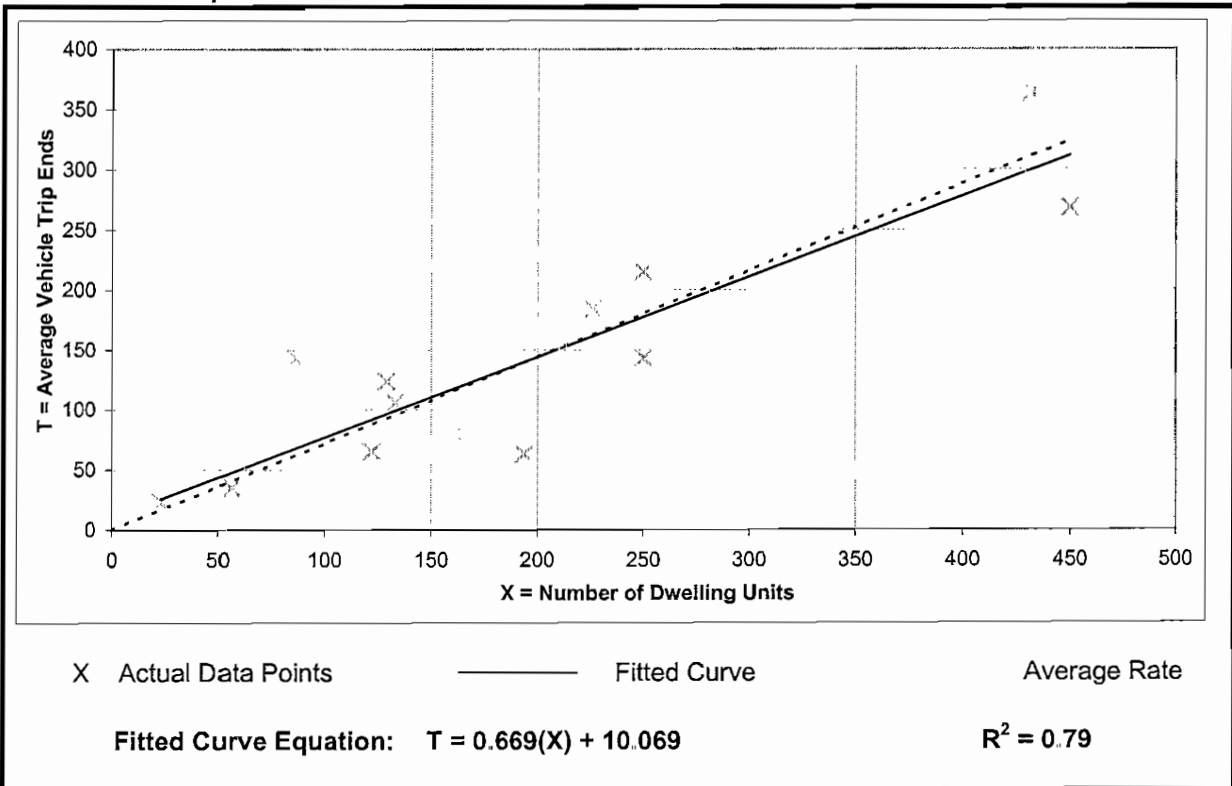
Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 4 and 6 p.m.

Number of Studies: 13
 Average Number of Dwelling Units: 193
 Directional Distribution: 55% entering, 45% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.72	0.32 - 1.66	0.25

Data Plot and Equation



TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION

33 Single-Family Detached Homes and 45 Townhouses

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	33 Houses	375	25%	75%		63%	37%	
				7	22	29	23	13	36
Local Trip Rate	Townhouses	45 Townhouses	466	22%	78%		55%	45%	
				6	20	26	23	18	41
Total New Volume Site Trips			841	13	42	55	46	31	77

ITE Trip Generation Manual, 10th Edition and Local Trip Rates

Trips calculated by using Fitted Curve Equation

TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION
33 Single-Family Detached Houses

33 Residential Houses = X

Weekday:

Fitted Curve Equation: $\text{Ln}(T) = 0.92 \text{Ln}(X) + 2.71$

$$\text{Ln}(T) = 0.92 * 3.50 + 2.71$$

$$\text{Ln}(T) = 5.93$$

$$\underline{\underline{T = 375 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

Fitted Curve Equation: $T = 0.71(X) + 4.80$

$$T = 0.71 * 33 + 4.80$$

$$\underline{\underline{T = 29 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: $\text{Ln}(T) = 0.96 \text{Ln}(X) + 0.2$

$$\text{Ln}(T) = 0.96 * 3.50 + 0.20$$

$$\text{Ln}(T) = 3.56$$

$$\underline{\underline{T = 36 \text{ trips}}}$$

TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION

45 Townhouses

45 Residential Houses = X

Weekday:

Fitted Curve Equation: $T = 15.193(X)^{0.899}$

$$T = 15 * 30.64$$

$$T = \underline{\underline{466 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

Fitted Curve Equation: $T = 0.758(X)^{0.924}$

$$T = 0.758 * 34$$

$$T = \underline{\underline{26 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: $T = 0.669(X)+10.069$

$$T = 0.669 * 45 + 10.07$$

$$T = \underline{\underline{41 \text{ trips}}}$$

TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION

36 Single-Family Houses based on 1 dwelling unit/acre in Agricultural (A) zone

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	36 Houses	407	25%	75%		63%	37%	
				8	23	31	25	14	39
Total New Volume Site Trips			407	8	23	31	25	14	39

ITE Trip Generation Manual, 10th Edition

Trips calculated by using Fitted Curve Equation

TRIP GENERATION FOR THE HOPPE PROPERTY SUBDIVISION
36 Single-Family Houses based on 1 dwelling unit/acre in Agricultural (A) zone

36 Residential Houses = X

Weekday:

Fitted Curve Equation: $\text{Ln}(T) = 0.92 \text{Ln}(X) + 2.71$

$$\text{Ln}(T) = 0.92 * 3.58 + 2.71$$

$$\text{Ln}(T) = 6.01$$

$$\underline{\underline{T = 407 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

Fitted Curve Equation: $T = 0.71(X) + 4.80$

$$T = 0.71 * 36 + 4.80$$

$$\underline{\underline{T = 31 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: $\text{Ln}(T) = 0.96 \text{Ln}(X) + 0.2$

$$\text{Ln}(T) = 0.96 * 3.58 + 0.20$$

$$\text{Ln}(T) = 3.64$$

$$\underline{\underline{T = 39 \text{ trips}}}$$

TABLE 5A

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

(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

$46 + 226 + 6 = 278$

$538 + 23 = 561$

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			25	20
400 - 449	35	30			20	20
450 - 499	30	25			20	20
500 - 549	25	25			20	15
550 - 599	25	20			20	15
600 - 649	25	20			20	15
650 - 699	20	20			20	15
700 - 749	20	20			15	15
750 or More	20	20	20	15	15	15

Hardin Valley Road at
Proposed Subdivision
Entrance (South)

2025 Projected AM
EB Left Turns = 0

Left Turn Lane NOT
Warranted

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

TABLE 5B

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

$46 + 226 = 272$

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	Yes
300 - 349 350 - 399				Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499				Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Hardin Valley Road at
Proposed Subdivision
Entrance (South)

2025 Projected AM
WB Right Turns = 6

Right 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	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

TABLE 5A

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

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

$105 + 481 + 20 = 606$

$323 + 19 = 342$

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	2	<div style="border: 1px dashed green; border-radius: 50%; padding: 5px; display: inline-block;"> Hardin Valley Road at Proposed Subdivision Entrance (South) 2025 Projected PM EB Left Turns = 1 Left Turn Lane NOT Warranted </div>	140	110	80	70
150 - 199	2		105	90	70	60
200 - 249	1		85	75	65	55
250 - 299	1		75	65	60	50
300 - 349	1		70	60	55	45
350 - 399	1		65	55	50	40
400 - 449	9		60	50	45	35
450 - 499	8		55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	35	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

TABLE 5B

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

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

105 + 481 = 586

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
200 - 249 250 - 299	Yes			Yes	Yes	Yes
300 - 349 350 - 399	Yes			Yes	Yes	Yes
400 - 449 450 - 499	Yes			Yes	Yes	Yes
500 - 549 550 - 599	Yes		Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Hardin Valley Road at
Proposed Subdivision
Entrance (South)

2025 Projected PM
WB Right Turns = 20

Right Turn Lane NOT
Warranted

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

TABLE 5A

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

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

$0 + 538 + 23 = 561$

$226 + 6 = 232$

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	50	40
350 - 399	100	80	65	55	45	35
400 - 449	90	70	60	50	40	30
450 - 499	80	65	55	45	35	25
500 - 549	70	60	45	35	25	20
550 - 599	65	55	40	30	20	15
600 - 649	60	45	35	25	15	10
650 - 699	55	35	35	25	15	10
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

Hardin Valley Road at Marietta Church Road
2025 Projected AM WB Left Turns = 46
Left Turn Lane NOT Warranted

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

TABLE 5A

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

(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

$1 + 323 + 19 = 343$

$481 + 20 = 501$

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	25
400 - 449	35	30	30	25	25	25
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	20
550 - 599	25	20	20	20	20	20
600 - 649	25	20	20	20	20	20
650 - 699	20	20	20	20	20	20
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

Hardin Valley Road at Marietta Church Road
2025 Projected PM WB Left Turns = 105
Left Turn Lane Warranted

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

Queuing and Blocking Report
Townhouse Generated Trips Removed

4/20/2021

Intersection: 2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	4	68	109	41
Average Queue (ft)	0	19	51	16
95th Queue (ft)	3	53	89	41
Link Distance (ft)	290	391	499	265
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Queuing and Blocking Report
Townhouse Generated Trips Removed

4/20/2021

Intersection: 2: Marietta Church Road/Proposed Entrance & Hardin Valley Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	12	121	117	34
Average Queue (ft)	0	33	46	11
95th Queue (ft)	7	85	86	35
Link Distance (ft)	290	391	499	308
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

HIGHPLAN 2012 Conceptual Planning Analysis

Project Information

Analyst	RWJ	Highway Name	Hardin Valley Road	Study Period	Standard K
Date Prepared	4/23/2021 4:29:34 PM	From	Marietta Church Road	Analysis Type	Two-Lane Segment
Agency		To	N. Campbell Station Road	Program	HIGHPLAN 2012
Area Type	Transitioning/Urban	Peak Direction	Eastbound	Version Date	12/12/2012
File Name	C:\Land Projects 2009\2106 - Hoppe Property Subdivision TIL\Report\hardin valley road.xhp				
User Notes					

Highway Data

Roadway Variables				Traffic Variables			
Segment Length	1.700	Median	No	AADT	11787	PHF	0.900
# Thru Lanes	2	Left Turn Impact	Yes	K	0.090	% Heavy Vehicles	2.0
Terrain	Rolling	Pass Lane Length	N/A	D	0.700	Base Capacity	1700
Posted Speed	40	% NPZ	0	Peak Dir. Hrly. Vol.	743	Local Adj. Factor	0.90
Free Flow Speed	45	Class	3	Off Peak Dir. Hrly. Vol.	318	Adjusted Capacity	1216

LOS Results

v/c Ratio	0.68	Density	N/A	PTSF	83.5	ATS	31.4	% FFS	69.7
FFS Delay	59.1	LOS Thresh. Delay	72.7	Service Measure	PctFFS	LOS	D		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1650 veh/h/ln.

	A	B	C	D	E
Lanes	Hourly Volume In Peak Direction				
1	130	330	580	830	1090
2					
3					
4					
Lanes	Hourly Volume In Both Directions				
2	190	480	830	1190	1560
4					
6					
8					
Lanes	Annual Average Daily Traffic				
2	2200	5400	9300	13300	17400

4
6
8

* Cannot be achieved based on input data provided.

Performance measure results are no longer applicable with the presence of passing lanes. Refer to the service volume tables to obtain the LOS.



CIVIL ENGINEERING / TRAFFIC ENGINEERING

11812 Black Road
Knoxville, Tennessee 37932
Phone (865) 556-0042
ajaxengineering@gmail.com

April 23, 2021

PROJECT NAME: Hoppe Property TIL

TO: Knoxville-Knox County Planning

SUBJECT: Hoppe Property Subdivision Rezoning Review TIL Comments
Review Comments dated April 22, 2021

Dear Knoxville-Knox County Planning Staff:

The following comment response document is submitted to address comments dated April 22, 2021, and is included at the end of the revised report (letter).

- 1. Please include a preliminary evaluation of the need for a westbound left turn lane on Hardin Valley Rd at Marietta Church Rd based on the documented traffic volumes. The TIL can note that this is specifically non-development related as it appears to be warranted under existing PM peak traffic conditions, but this should be noted and discussed for potential mitigation especially as the intersection is potentially reconstructed to add a fourth leg of an entrance to this development. This obviously would need to be further studied and discussed at such time that a concept plan is actually developed, but the purpose of the TIL is specifically to identify these types of issues to get them on the radar at the rezoning stage.**

Response: A discussion regarding evaluating the need for a separate westbound left-turn lane based on the projected 2025 traffic volumes was added on page 19. The evaluation determined that a westbound left-turn lane would be warranted based on the projected volumes.

- 2. The TIL was specifically required due to the requirements of the Knox County Growth Policy Plan for a rezoning of higher density than permitted under Ag zoning in the Rural Area of 1 DU per acre and as such this should be referenced in the report. Please include a quantification of the total number of daily trips that would be produced in a before and after scenario, i.e. under current 1 DU per acre versus what is being proposed for the rezoning case. A general assessment of the capacity of the**

adjoining arterial system (Hardin Valley Rd) leading to the Planned Growth Area needs to be included as well to ensure it is sufficient.

Response: The TIL has been updated with additional analyses and discussion to compare the trip generation rates based on the existing zoning vs. the proposed zoning. Other discussion includes the planning-level road capacity of Hardin Valley Road. Both of these additions to the report (letter) are added before and in the Overview of Findings.

3. We understand that at this stage the specific development access points have not yet been finalized but we appreciate the information provided on page 23 about the potential for tying into access points from adjoining properties, which would be preferred from Knox Planning's standpoint. The section on page 23 references Figure 2 although it is not entirely clear which locations are referenced. Please include additional callouts on Figure 2 showing potential connections to Deer Crossing Drive and property to the east or include a new figure that highlights these locations for better reference.

Response: Additional callouts have been provided in Figure 2 to highlight for better reference.

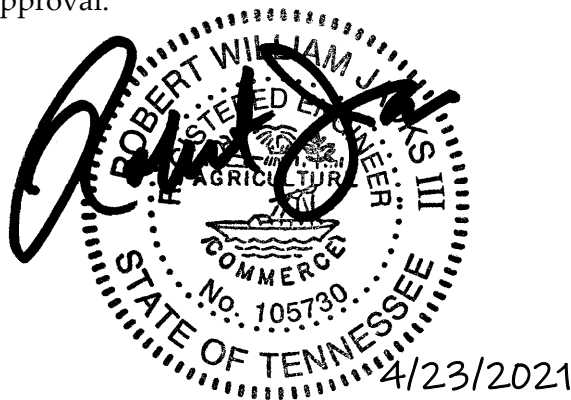
In addition to the requested revisions, other changes in the report (letter) include the following:

- Updated Title Page
- Updated Page Footers
- Updated Overview of Findings
- Added additional worksheets for the westbound left-turn lane evaluation in the Appendix
- Added additional trip generation for the development under existing zoning in the Appendix
- Added roadway capacity analysis results in the Appendix
- Added this response letter to the end of the Appendix

If you have any questions or further comments, please feel free to contact me at any time. I look forward to your review and approval.

Sincerely,

Ajax Engineering, LLC
Robert W. Jacks, P.E.



Ajax Engineering, LLC
11812 Black Road
Knoxville, TN 37932
ajaxengineering@gmail.com
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DEVELOPMENT REQUEST

DEVELOPMENT

- Development Plan
- Planned Development
- Use on Review / Special Use

SUBDIVISION

- Concept Plan
- Final Plat

ZONING

- Plan Amendment
- Rezoning

Homestead Land Holdings, LLC

Applicant Name	Affiliation	
March 29, 2021	May 13, 2021	5-F-21-RZ
Date Filed	Meeting Date (if applicable)	File Numbers(s)

CORRESPONDENCE

All correspondence related to this application should be directed to the approved contact listed below.

- Applicant
 Owner
 Option Holder
 Project Surveyor
 Engineer
 Architect/Landscape Architect

Russell N. Rackley, PE	Rackley Engineering
Name	Company
PO Box 30456	Knoxville TN 37930
Address	City State Zip
865-622-6560	rnrackley@rackleyengineering.com
Phone	Email

CURRENT PROPERTY INFO

W C Hoppe, JR	101 Amanda Place, Oak Ridge, TN 37830	
Owner Name (if different)	Owner Address	Owner Phone
12119 Hardin Valley Rd	116 06701	
Property Address	Parcel ID	
intersection of Hardin Valley Rd and Marietta Church Rd	36.91 ac	
General Location	Tract Size	
6	A and CA	
Jurisdiction (specify district above) <input type="checkbox"/> City <input checked="" type="checkbox"/> County	Zoning District	
NW County	RR	Rural Area
Planning Sector	Sector Plan Land Use Classification	Growth Policy Plan Designation
Agg	N WKUD	WKUD
Existing Land Use	Septic (Y/N)	Sewer Provider
		Water Provider


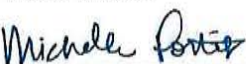
REQUEST

DEVELOPMENT	<input type="checkbox"/> Development Plan <input type="checkbox"/> Use on Review / Special Use <input type="checkbox"/> Residential <input type="checkbox"/> Non-Residential	
	<input type="checkbox"/> Home Occupation (specify): _____	
	<input type="checkbox"/> Other (specify): _____	
SUBDIVISION	<input type="checkbox"/> Proposed Subdivision Name _____ Unit / Phase Number _____	
	<input type="checkbox"/> Parcel Change <input type="checkbox"/> Combine Parcels <input type="checkbox"/> Divide Parcel Total Number of Lots Created: _____	
	<input type="checkbox"/> Other (specify): _____	
	<input type="checkbox"/> Attachments / Additional Requirements	
ZONING	<input checked="" type="checkbox"/> Zoning Change: <u>PR 1-3 du/ac</u> Proposed Zoning	
	<input checked="" type="checkbox"/> Plan Amendment Change: <u>Planned Growth</u> n/a Proposed Plan Designation(s)	
	<u>3 du/ac</u> Proposed Density (units/acre) Previous Rezoning Requests	
	<input type="checkbox"/> Other (specify): _____	

STAFF USE ONLY	PLAT TYPE		FEE 1:	TOTAL: \$2,445.50
	<input type="checkbox"/> Staff Review <input type="checkbox"/> Planning Commission		0325 \$2,445.50	
	ATTACHMENTS		FEE 2:	
	<input type="checkbox"/> Property Owners / Option Holders <input type="checkbox"/> Variance Request			
ADDITIONAL REQUIREMENTS		FEE 3:		
<input type="checkbox"/> Design Plan Certification (<i>Final Plat only</i>) <input type="checkbox"/> Use on Review / Special Use (<i>Concept Plan only</i>) <input type="checkbox"/> Traffic Impact Study				

AUTHORIZATION

By signing below, I certify I am the property owner, applicant or the owners authorized representative.

	Russell N Rackley, PE	03/29/21
Applicant Signature	Please Print	Date
865-850-1535	Rnrackley@rackleyengineering.com	
Phone Number	Email	
	Michelle Portier	3/29/21 swm
Staff Signature	Please Print	Date