

TRANSPORTATION IMPACT STUDY

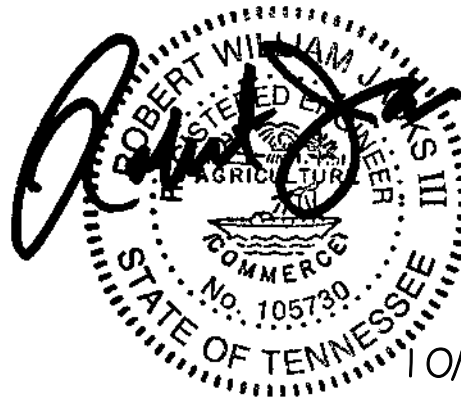
LAUREL RIDGE - PHASE 3

KNOX COUNTY, TENNESSEE

-Prepared For-

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10/22/18

Revised October 2018

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EXECUTIVE SUMMARY

Preface:

Ball Homes, LLC is proposing a subsequent phase of an existing residential development that is currently under construction and is adjacent to Hardin Valley Road in west Knox County, TN. The name of this subsequent residential development is “Laurel Ridge – Phase 3”. Phase 1 and Phase 2 of this residential development were originally approved in 2016 and dozens of homes have since been constructed in Phase 1 of the development. Phase 1 included 79 single-family residential detached lots and has nearly reached full build-out and occupancy. The infrastructure for Phase 2 is currently under construction and will eventually include 118 single-family residential detached lots. A concept plan for the final phase, Phase 3, is being submitted to allow for further residential home construction adjacent to Phase 2. Phase 3 will include an additional 45 single-family residential detached lots. The construction of all three phases will result in a total of 242 single-family residential detached lots. This report addresses the transportation impacts of all three phases of the Laurel Ridge residential development and will supersede the original transportation impact study that was produced in March of 2016 for only Phase 1 and 2. The purpose of this study is to determine and evaluate the potential impacts of the entire residential development on the adjacent transportation system. The study includes a review of the operating characteristics of the transportation system that will provide access to the proposed site. Recommendations and mitigation measures will be analyzed and offered where traffic operations have been estimated to be below traffic engineering standards.

Study Results:

The findings of this study include the following:

- At full build-out, the Laurel Ridge residential development of all three phases with 242 single-family residential detached lots is expected to generate approximately 2,345 new trips on an average weekday. It is calculated that 177 of these new trips will occur during the AM peak hour and 238 trips in the PM peak hour at full build-out of the residential subdivision in the year 2022.
- When all phases in Laurel Ridge Subdivision are fully constructed and occupied in the year 2022, the intersection of Hardin Valley Road at Blackberry Ridge

Boulevard is anticipated to operate adequately in the peak hours for most of the intersection approaches with respect to vehicular delays. However, the southbound left turn movement at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard was calculated to operate at a poor Level of Service (LOS) during the AM peak hour in the projected conditions in the year 2022. In the AM peak in the year 2022, southbound left turns are projected to operate at LOS E. The intersection of Hardin Valley Road at Blackberry Ridge Boulevard was analyzed to determine if traffic signal warrants could be met justifying a traffic signal based on the projected volumes. It was calculated that the intersection could possibly meet warrants for traffic signalization in the future projected conditions.

Recommendations:

The following recommendations are listed here and offered based on the study analyses:

- The recently constructed exclusive westbound right turn lane at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard needs to be re-stripped and the turn lane delineated to separate it from the westbound through lane on Hardin Valley Road.
- The southbound approach of Blackberry Ridge Boulevard needs the installation of pavement markings. These pavement markings include white cross-walk markings, a 24" white stop bar, and white turn arrow markings. Additionally, the southbound approach will need to be striped for a minimum of 200 feet with white lane lines to delineate separate left turn and right turn lanes. These lanes will need to be 10 feet in width at a minimum. If the recently constructed southbound road section does not currently provide these minimum widths for a total length of 200 feet, modifications to the landscaped median may be required to accommodate these lane widths.
- It is projected that by the end of the year 2021, due to the rapidly increasing traffic growth on Hardin Valley Road and based on the projected traffic volumes, the intersection of Hardin Valley Road at Blackberry Ridge Boulevard could potentially meet warrants for traffic signalization. As the Laurel Ridge Subdivision is being constructed, this intersection will need to be monitored

and traffic counts conducted to determine whether a traffic signal could be justified at this intersection at some point in the future. This will require coordination with Knox County and their efforts to reduce congestion on Hardin Valley Road. This coordination will need to be included in the Knoxville/Knox County Metropolitan Planning Commission's (MPC) upcoming Hardin Valley Mobility Study.

- If a traffic signal is constructed for the intersection of Hardin Valley Road at Blackberry Ridge Boulevard, the traffic signal design will also require controlling the traffic movements of Berrywood Drive. Berrywood Drive is located approximately 120 feet to the east of Blackberry Ridge Boulevard and intersects Hardin Valley Road from the south. Berrywood Drive is the sole ingress/egress point for 74 homes in a residential subdivision to the south of Laurel Ridge Subdivision. The traffic signal design will involve both subdivision entrances operating as offset signalized t-intersections. For this design to work properly and safely at this location, the southbound turning movements on Blackberry Ridge Boulevard and the northbound turning movements on Berrywood Drive would need to be designed with split phase timing where the southbound and northbound movements from each street would have separate green signal phases.
- The existing continuous center two-way left turn lane on Hardin Valley Road should be re-striped to accommodate the recently constructed intersection with the new left turning movements into the development. The existing pavement markings for the continuous center turn lane should be converted into a pavement marking scheme that delineates an exclusive left turn lane into the subdivision or as determined by Knox County Engineering.
- An inter-subdivision road connection between Laurel Ridge Subdivision and another residential subdivision to the east by Vertex Development is currently under construction and is stipulated as a condition of Knox County approval. This road connection will provide secondary access for both residential developments.
- All the remaining phases (Phase 2 and 3) of Laurel Ridge should construct sidewalks at a minimum of one side of each roadway. The sidewalks should be 5 feet in width and have ADA compliant ramps at all intersections.

- An existing road, Bryant Lane, will need to be terminated prior to the limits of Laurel Ridge - Phase 3 and include constructing a cul-de-sac. This cul-de-sac should meet Knox County standards and guidelines. Access to Bryant Lane from Phase 3 of Laurel Ridge should be prohibited.
- The Laurel Ridge Subdivision internally should include design elements with the appropriate sight distance and appropriate road signage.

DESCRIPTION OF EXISTING CONDITIONS

■ **STUDY AREA:**

The proposed location of Phase 3 of the Laurel Ridge residential subdivision is shown on a map in Figure 1 and its location relative to Phase 1 and Phase 2. Phase 3 of the development is located to the northeast of Phase 1 and 2. The Laurel Ridge residential subdivision is adjacent and north of Hardin Valley Road and is located in the western end of Knox County, TN. Phase 3 is proposed to include one new internal paved roadway and an extension of a yet to be constructed road from Phase 2. Phase 3 will contain a maximum of 45 single-family residential lots on approximately 16.1 acres. Phase 1 is nearly filled with completed and occupied homes and has a community lot that contains a neighborhood clubhouse and swimming pool. Phase 2 of Laurel Ridge will contain 118 single-family residential detached lots on 44 acres. The infrastructure of Phase 2 is currently being constructed and no homes are being built currently. To analyze the transportation impacts associated with the proposed development, the intersection of Hardin Valley Road at Blackberry Ridge Boulevard was analyzed where the greatest impact is expected. Additionally, the existing intersection of Hardin Valley Road at Berrywood Drive was also included in the analysis. This intersection is located just to the east of the intersection of Blackberry Ridge Boulevard at Hardin Valley Road.

In the adjacent vicinity of this study area, there are several other residential subdivisions, individual residences, undeveloped properties, businesses, and schools. Some of the adjacent residential areas are within existing subdivisions and others exist as single residential properties.

The proposed development site of Phase 3 currently consists of undeveloped farmland, an existing home, and woodlands. Roadway access for the Laurel Ridge Subdivision is provided by the recently constructed Blackberry Ridge Boulevard which connects into Hardin Valley Road at a t-intersection. Phase 3 will be bounded by undeveloped property to the north, Phase 2 to the west, Pellissippi State Community College to the east, and a single-family residential subdivision (Vertex Development) currently under construction and Conners Creek subdivision to the south.

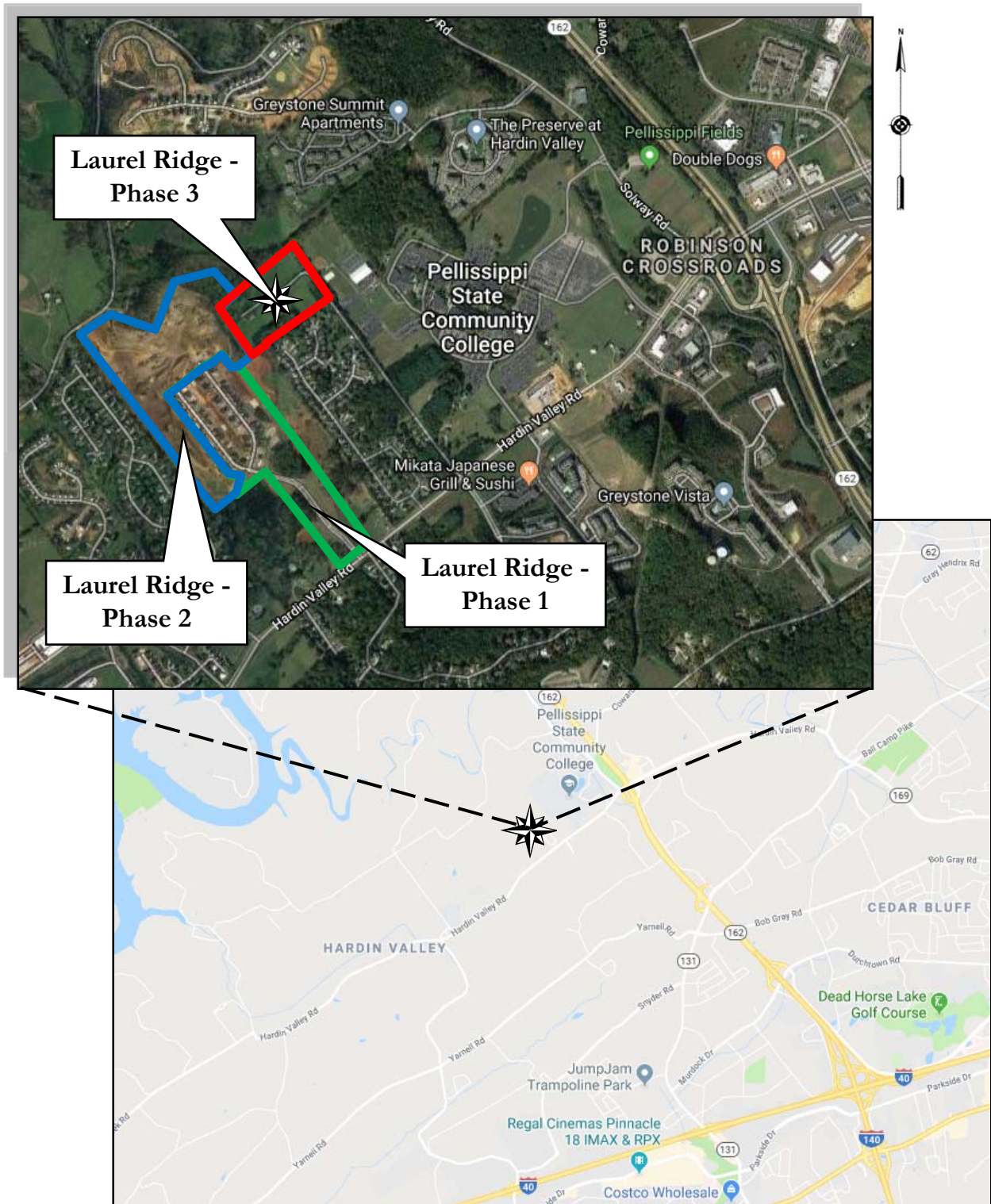


Figure 1
Location Map

■ **EXISTING ROADWAYS:**

Table 1 shows the characteristics of the primary existing roadways included in the study:

**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	3 undivided	44 feet	None	Sidewalks on both sides of roadway	No bike lanes
Blackberry Ridge Boulevard	Local Street	25 mph	2 boulevard	48 feet	None	Sidewalk on one side of roadway	No bike lanes
Berrywood Drive	Local Street	25 mph	2 undivided	26 feet	None	No sidewalks	No bike lanes

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

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

³ According to Knoxville Area Transit System Map

Hardin Valley Road is classified as a minor arterial and traverses in a general northeast-southwest direction. Hardin Valley Road intersects Pellissippi Parkway (SR 162) at a bridge underpass 1 mile to the northeast of the Laurel Ridge Subdivision. The speed limit on Hardin Valley Road is posted at 40 mph in the project area. Hardin Valley Road at the road connection for the subdivision consists of a 3-lane section that includes a continuous center two-way left turn lane that separates the opposing traffic. There are 5-foot wide concrete sidewalks on both sides of the road. Hardin Valley Road in the study area has a fairly level vertical alignment and has a very straight horizontal alignment.

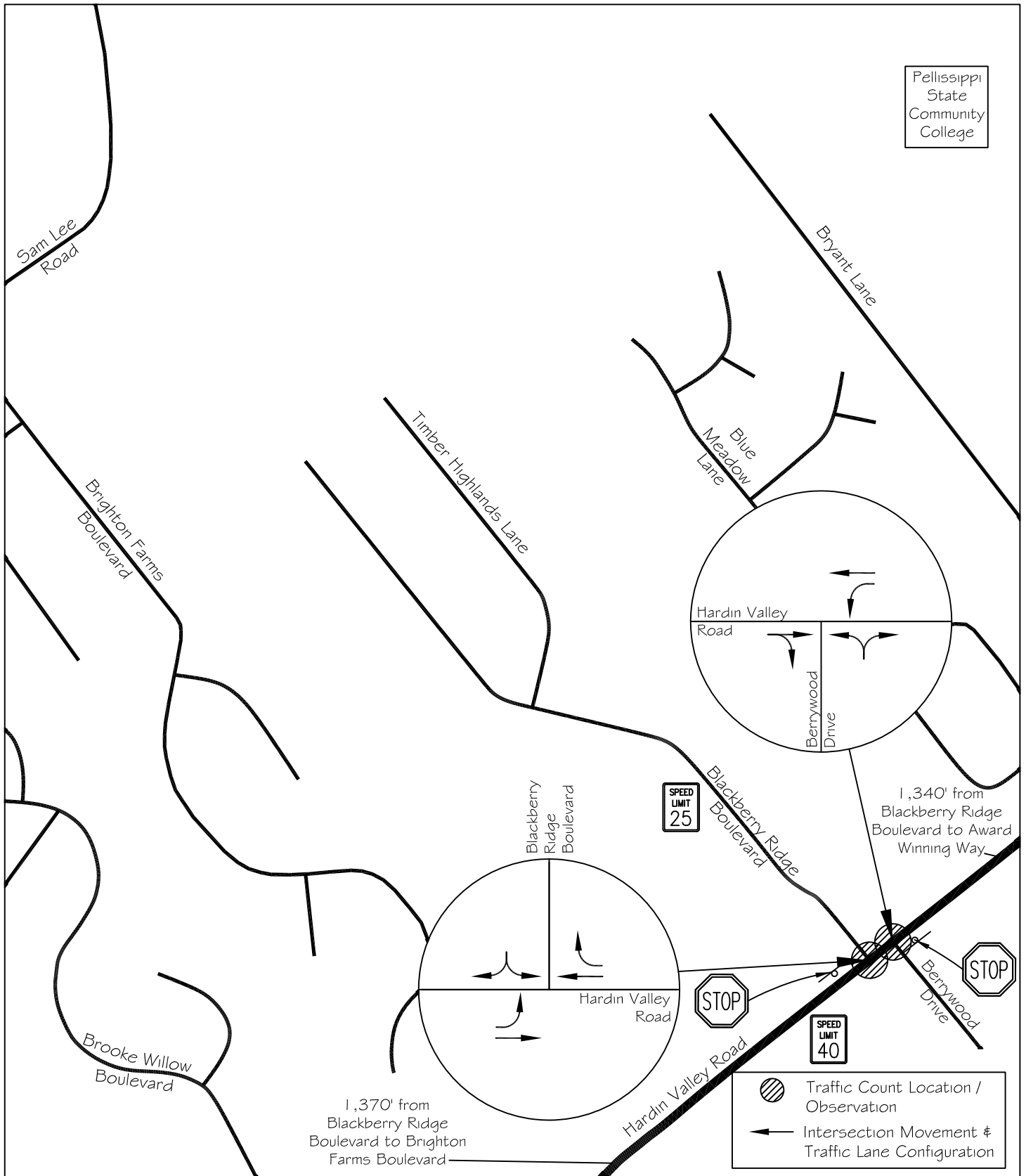
Hardin Valley Road provides road access to several schools in the surrounding area. Pellissippi State Community College is located about 2,100 feet to the northeast of the site and Hardin Valley Academy (high school), Hardin Valley Middle School, and Hardin Valley Elementary are located approximately 4,800 feet to the southwest of the project site. The Hardin Valley schools have flashing school beacons for northeast-bound and southwest-bound traffic on Hardin Valley Road. During the periods of operation, the flashing school beacon has a posted speed limit of 20 mph.

Blackberry Ridge Boulevard is a recently constructed local street for Laurel Ridge Subdivision that traverses in a general northwest-southeast direction between Hardin Valley Road on the south side and into the first phase of the Laurel Ridge development on the north side. It currently stops at an abrupt ending where Phase 2 is currently under construction. The southern leg of Blackberry Ridge Boulevard has a boulevard road section with a landscaped 10-foot median in between Hardin Valley Road and the internal Laurel Ridge Subdivision intersection at Timber Highlands Lane. The landscaped median runs for approximately 1,450 feet into the Laurel Ridge Subdivision. There are 4 openings in the landscaped median in between Hardin Valley Road and the intersection at Timber Highlands Lane. A residential speed limit sign of 25 mph is posted on Blackberry Ridge Boulevard on the south end at Hardin Valley Road. Minor residential street lighting is provided within the landscaped median. A 5' sidewalk has been constructed on the west side of Blackberry Ridge Boulevard and runs in between Hardin Valley Road and currently terminates within the Phase 1 construction at the intersection of Timber Highlands Lane.

The boulevard section of Blackberry Ridge Boulevard is 48 feet from face of curb to face of curb. The southbound approach (west side of the boulevard) of Blackberry Ridge Boulevard at Hardin Valley Road is 20-feet wide. The northbound approach (east side of the boulevard) of Blackberry Ridge Boulevard at Hardin Valley Road is 18-feet wide.

Berrywood Drive is a local residential street that provides access to Hardin Valley Road for an existing residential subdivision of 74 single-family residences. This subdivision is located to the southeast of Laurel Ridge Subdivision and is completely built-out. Berrywood Drive at Hardin Valley Road traverses in a general northeast-southwest direction. This road is approximately 0.8 miles in length and it ends at an abrupt ending (no cul-de-sac or turnaround).

Figure 2 shows the lane configurations of the study intersections and shows the study traffic count locations. It also shows the posted speed limits in the area along with distances in between the nearest larger intersections. The pages following Figure 2 give an overview of the site study area with photographs.



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NOT TO SCALE

NORTH

FIGURE 2
 Laurel Ridge - Phase 3
 Traffic Count Location & Existing Lane Configurations

PHOTO EXHIBITS



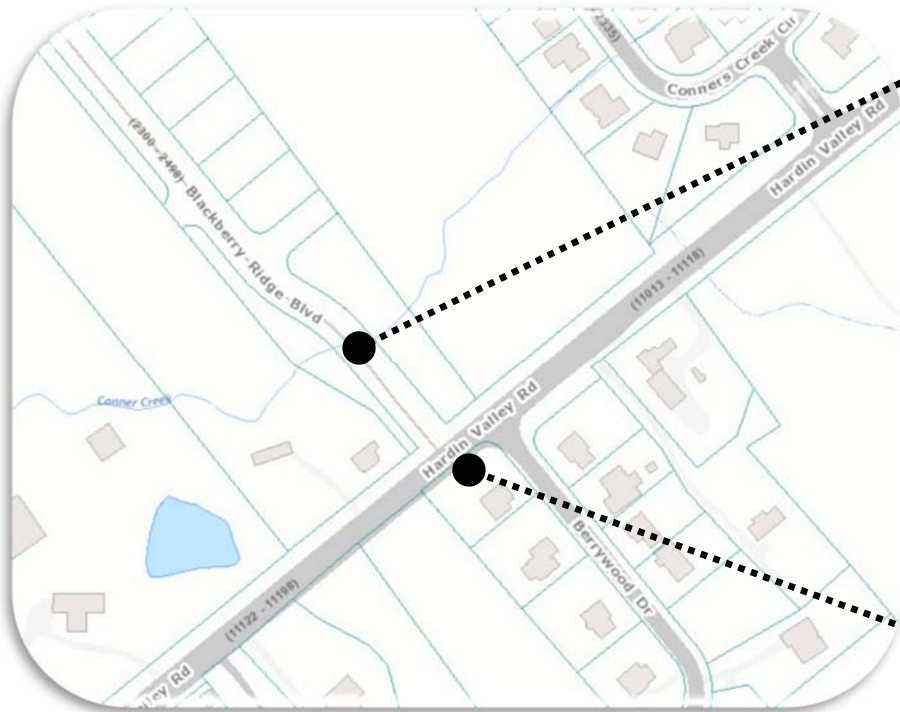
Hardin Valley Road at Blackberry Ridge Boulevard



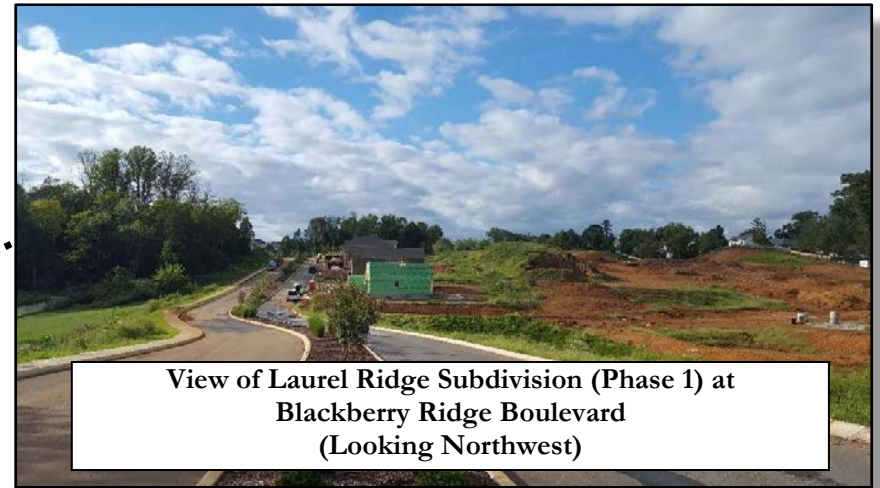
**View of Hardin Valley Road at Blackberry Ridge Boulevard
(Looking Southwest)**



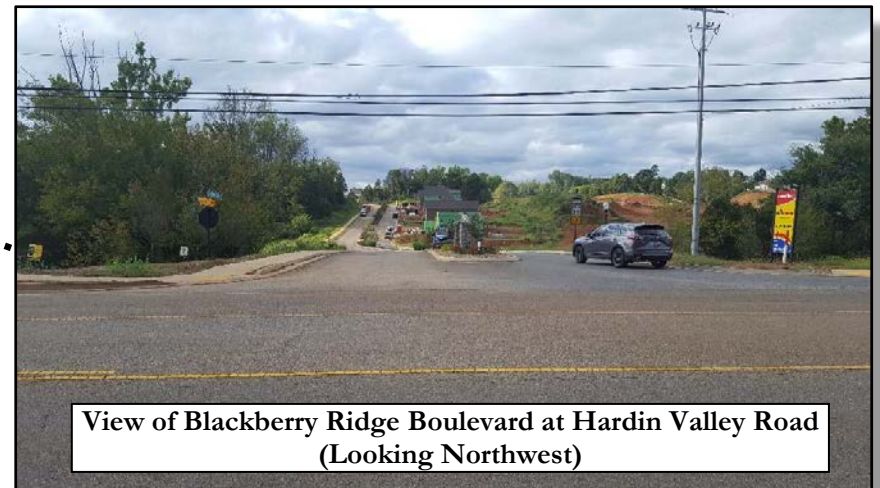
**View of Hardin Valley Road at Blackberry Ridge Boulevard
(Looking Northeast)**



Hardin Valley Road at Blackberry Ridge Boulevard



View of Laurel Ridge Subdivision (Phase 1) at Blackberry Ridge Boulevard (Looking Northwest)



View of Blackberry Ridge Boulevard at Hardin Valley Road (Looking Northwest)

■ **EXISTING TRANSPORTATION VOLUMES PER MODE:**

There is one annual vehicular traffic count location adjacent to this project site.

- Existing vehicular roadway traffic:
 - Average Daily Traffic (ADT) on Hardin Valley Road to the east of the project site was reported by the Tennessee Department of Transportation (TDOT) at 17,791 vehicles per day in 2016. From 2006 – 2016, this count station has indicated a 7.3% average annual growth rate. The researched historical traffic count data for this report can be viewed in Appendix A.
- Existing bicycle and pedestrian volumes: The average daily pedestrian and bicycle traffic along the study corridor is not known. A couple of bicyclists were observed during the manual traffic counts crossing the Blackberry Ridge Boulevard approach at Hardin Valley Road. These bicyclists were riding on the Hardin Valley Road sidewalk rather than within the roadway. Also, a fair number of pedestrians were observed crossing the Blackberry Ridge Boulevard approach especially during the afternoon hours. Most of the observed pedestrians appeared to be exercising and a large group (approximately 20) was observed around 3:45 PM. It is suspected that this large group were students practicing for the Hardin Valley High School track team. It is reasonably assumed that most of the pedestrians are utilizing the sidewalks along Hardin Valley Road for exercise purposes rather than utility purposes due to the long distances to amenity destinations.

■ **ON-STREET PARKING:**

Currently, on-street parking is not allowed on Hardin Valley Road. However, on-street parking was observed and appears to be allowed at the interior roads of Laurel Ridge in Phase 1. Most vehicles parked along the interior streets appear to be construction related. It is not known if on-street parking will be allowed once the Laurel Ridge Subdivision is completed.

■ **PEDESTRIAN AND BICYCLE FACILITIES:**

Bicycle facilities (lanes) are not currently available on Hardin Valley Road or on the interior roads of Laurel Ridge. The closest bike lanes are located along Valley Vista Road which is a road located to the east of the project site and runs parallel and to the west of Pellissippi Parkway (SR 162). The closest Knox County Greenway is located at Pellissippi State Community College and runs from Pellissippi State Community College to Carmichael Road and parallels Pellissippi Parkway on the west side. The greenway is paved and is approximately 1 mile in length. Appendix B shows a map of this greenway. A Greenway Master Plan for Knox County to Oak Ridge was developed in 2015 by the Knoxville Regional Transportation Planning Organization (TPO). In this report, a plan was developed to connect Knoxville, Knox County, and Oak Ridge communities via trails and greenways and this existing greenway is proposed to be included in the route to connect the communities sometime in the future.

Sidewalks are provided on both sides of Hardin Valley Road. A sidewalk has been constructed on the western side of Blackberry Ridge Boulevard and connects to the sidewalk on the north side of Hardin Valley Road. Sidewalks are partially completed in Phase 1 of Laurel Ridge and exist on one side of each roadway. The subsequent phases in Laurel Ridge are expected to provide sidewalks on at least one side of each roadway.

■ **WALK SCORE:**

A private company offers an online website that grades and gives scores to locations within the United States based on “walkability”. According to the website, the numerical value assigned, the Walk Score, is based on the distance to the closest amenity in various relevant categories (businesses, schools, parks, etc.) and is graded from 0 to 100.

Appendix C shows a map and gives information for the Laurel Ridge development Walk Score at Blackberry Ridge Boulevard within the first phase of the development. Based on the project location, the site is given a Walk Score of 11. This Walk Score indicates that the site is almost completely dependent on vehicles for errands and travel.

■ **TRANSIT SERVICES:**

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available in this area of Knox County. The overall KAT bus system map is in Appendix D. The closest public transit bus service is located to the southeast just over 5 miles away (by roadway) at Parkwest Medical Center. This KAT service is Route 16 “Cedar Bluff Connector”. It operates on weekdays and Saturdays and this route map is also included in Appendix D.

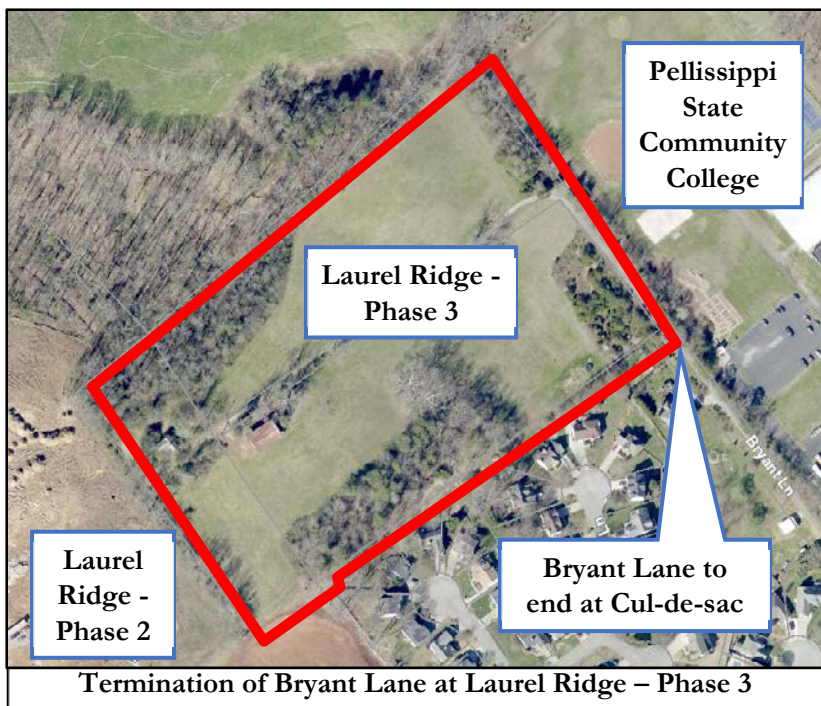
Other transit services include the East Tennessee Human Resource Agency (ETHRA) and Knoxville-Knox County Community Action Committee (CAC) which provides transportation services in Knox County when requested. Other services include private taxis and ride-sharing opportunities (Uber, etc.).

PROJECT DESCRIPTION

■ LOCATION AND SITE PLAN:

The overall proposed plan layout for all three phases of Laurel Ridge and designed by Ideal Engineering Solutions, Inc. is shown in Figure 3a. As can be seen in the figure, Phase 3 of the development will have a single road access point via the road system that will be constructed for Phase 2. A closer view of the proposed plan layout of Phase 3 is shown in Figure 3b. For Phase 3, one completely new road will be constructed and a yet to be constructed road from Phase 2 will be extended (Road “B”) into Phase 3.

Currently, Bryant Lane exists within the proposed development area of Phase 3 of Laurel Ridge. Bryant Lane is an extremely narrow road that serves as access to Hardin Valley Road for a handful of single-family residences. At its northern terminus within the proposed development area for Phase 3, Bryant Lane currently ends and provides access to one residential/farm property. This home site will be razed



for the construction of Phase 3 of Laurel Ridge. Additionally, Bryant Lane will be terminated where shown in Figure 3b and in the figure shown on this page. The termination of Bryant Lane will necessitate constructing a cul-de-sac. Phase 3 of Laurel Ridge will not have access to Bryant Lane.

Phase 3 of the residential development is expected to be comprised of a maximum of 45 single-family residential detached lots on approximately 16.1 acres. The size of the

residential lots in Phase 3 will be similar to Phase 1 and Phase 2. Phase 1 is nearly filled with completed and occupied homes and consists of 79 single-family residential detached lots. The infrastructure for Phase 2 is currently being constructed and will consist of 118 single-family residential detached lots.

The actual schedule for completion of this residential development is dependent on economic factors and construction timelines. This project is also contingent on permitting, design, and other issues. The developer is expecting continued high demand for housing in the Knoxville market (especially within the Hardin Valley area) and is estimating full construction and occupancy of all phases occurring within the next 3.5 years. Thus, for the purposes of this study, it was assumed that the total construction build-out and full occupancy of all three phases of the development will occur by the end of the year 2022.

At this point, the development is expected to start construction for Phase 3 as soon as possible while home construction will continue for the first and second phases of the development for the remaining undeveloped lots.

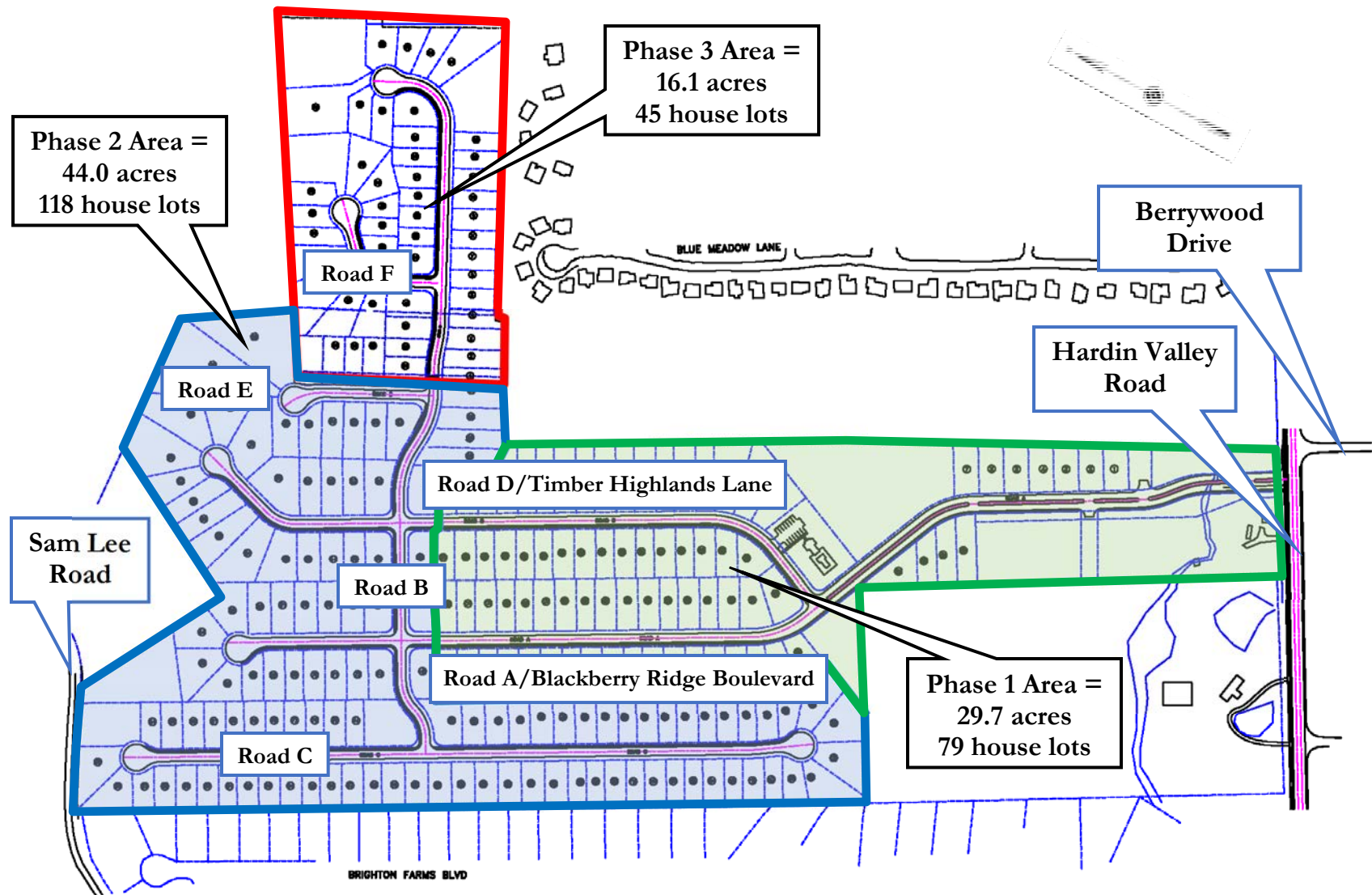


Figure 3a
Proposed Plan Layout
Laurel Ridge

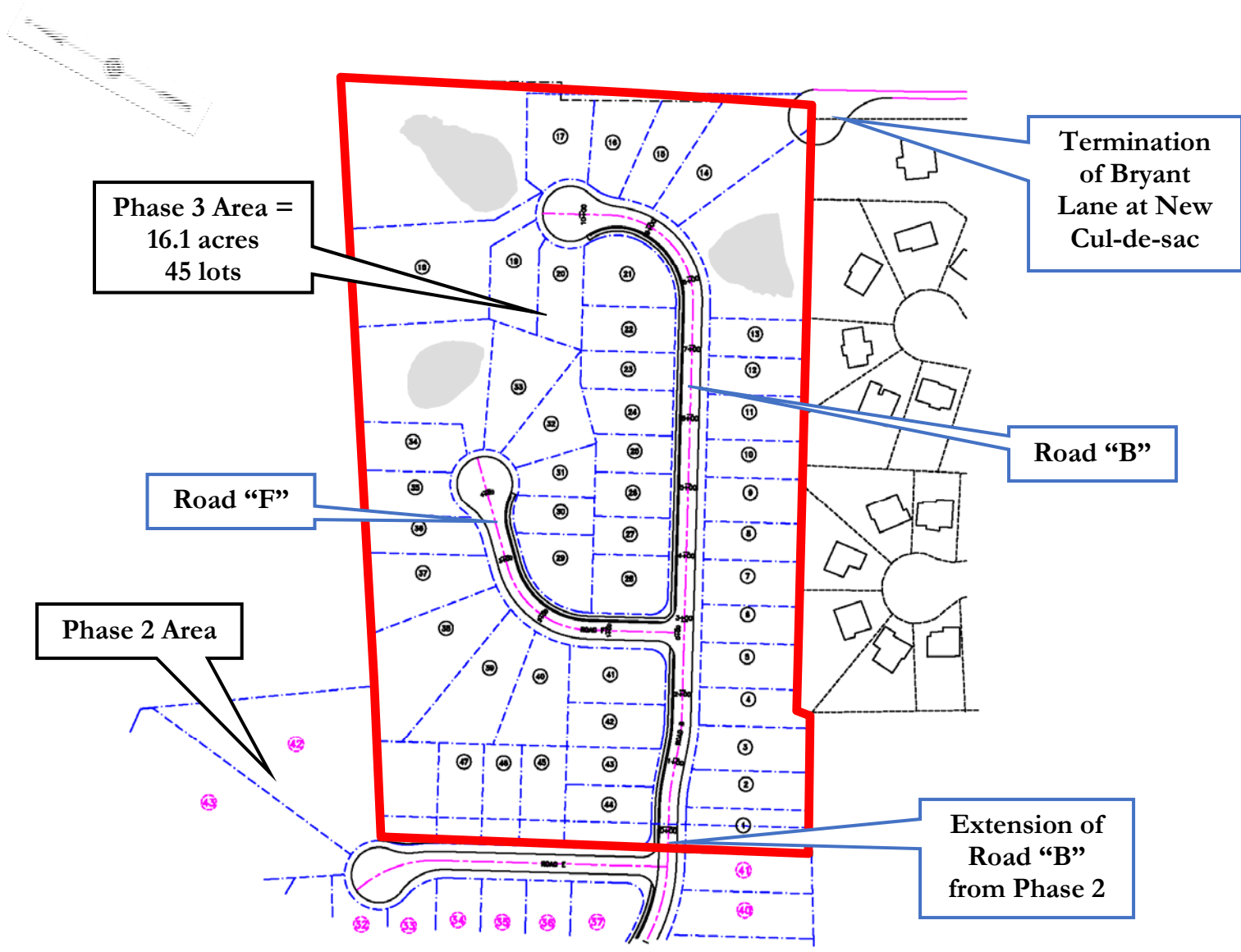


Figure 3b
Proposed Plan Layout – Phase 3
Laurel Ridge

■ **PROPOSED USES AND ZONING REQUIREMENTS:**

The third phase of this residential development is expected to be comprised of one new internal roadway and an extension of a yet to be constructed road from Phase 2 (Road “B”) with a maximum of 45 lots on approximately 16.1 acres.

The property for Phase 3 is currently zoned within Knox County, TN as Planned Residential (PR) within the Technology Overlay (TO). This Planned Residential zoning (PR) for the property is currently zoned to allow 3.06 dwelling units per acre. The current zoning map for the project site is provided in Appendix E. The adjacent surrounding land uses for Phase 3 are the following:

- The property to the east is zoned as Business and Technology (BP) within the Technology Overlay (TO) and consists of the Pellissippi State Community College campus. The property to the southeast is Planned Residential (PR) within the Technology Overlay (TO) and consists of single-family residences in the Conners Creek subdivision.
- To the southwest, the development property is bounded by an unrelated proposed residential subdivision by Vertex Development which is currently under construction. This development will consist of 56 residential lots and is zoned Planned Residential (PR).
- Phase 3 to the west is bound by Phase 2 of Laurel Ridge and is zoned as Planned Residential (PR).
- To the north, the adjacent property is zoned Planned Residential (PR) within the Technology Overlay (TO), is currently undeveloped, but will eventually include a future phase of the Hayden Hills subdivision located off Sam Lee Road.

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

■ **DEVELOPMENT DENSITY:**

The allowable density by Knox County for this phase of development is 3.06 dwelling units per acre based on the zoning. 45 single-family residential detached lots located on 16.1 acres results in a density of 2.79 dwelling units per acre.

■ **ON-SITE CIRCULATION AND VEHICLE PARKING:**

Phase 3 of the proposed residential development is expected to be comprised of one new internal paved roadway and an extension of a yet to be constructed road from Phase 2. The one new internal road in Phase 3 will be a cul-de-sac. The new road and extension of an existing road in Phase 3 shown in Figure 3b are labeled as Road “F” and the road extension from Phase 2 is labeled as Road “B”. The road lengths and the phasing of all the roads in Laurel Ridge are the following:

- Road “A” / Blackberry Ridge Boulevard (Phase 1 and 2) = 3,324 feet
- Road “B” (Phase 2 and 3) = 2,228 feet
- Road “C” (Phase 2) = 2,078 feet
- Road “D” / Timber Highlands Lane (Phase 1 and 2) = 2,034 feet
- Road “E” (Phase 2) = 462 feet
- Road “F” (Phase 3) = 450 feet

The total length of all the roads in Laurel Ridge Subdivision will be right at 2 miles. All the internal roadways for the development will be paved, include extruded concrete curbing, and the lane widths will be 13 feet for a total of 26-foot pavement width within a 50-foot right-of-way. All the home sites will have garages and driveways for vehicle parking.

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

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

TRAFFIC ANALYSIS OF EXISTING AND PROJECTED CONDITIONS

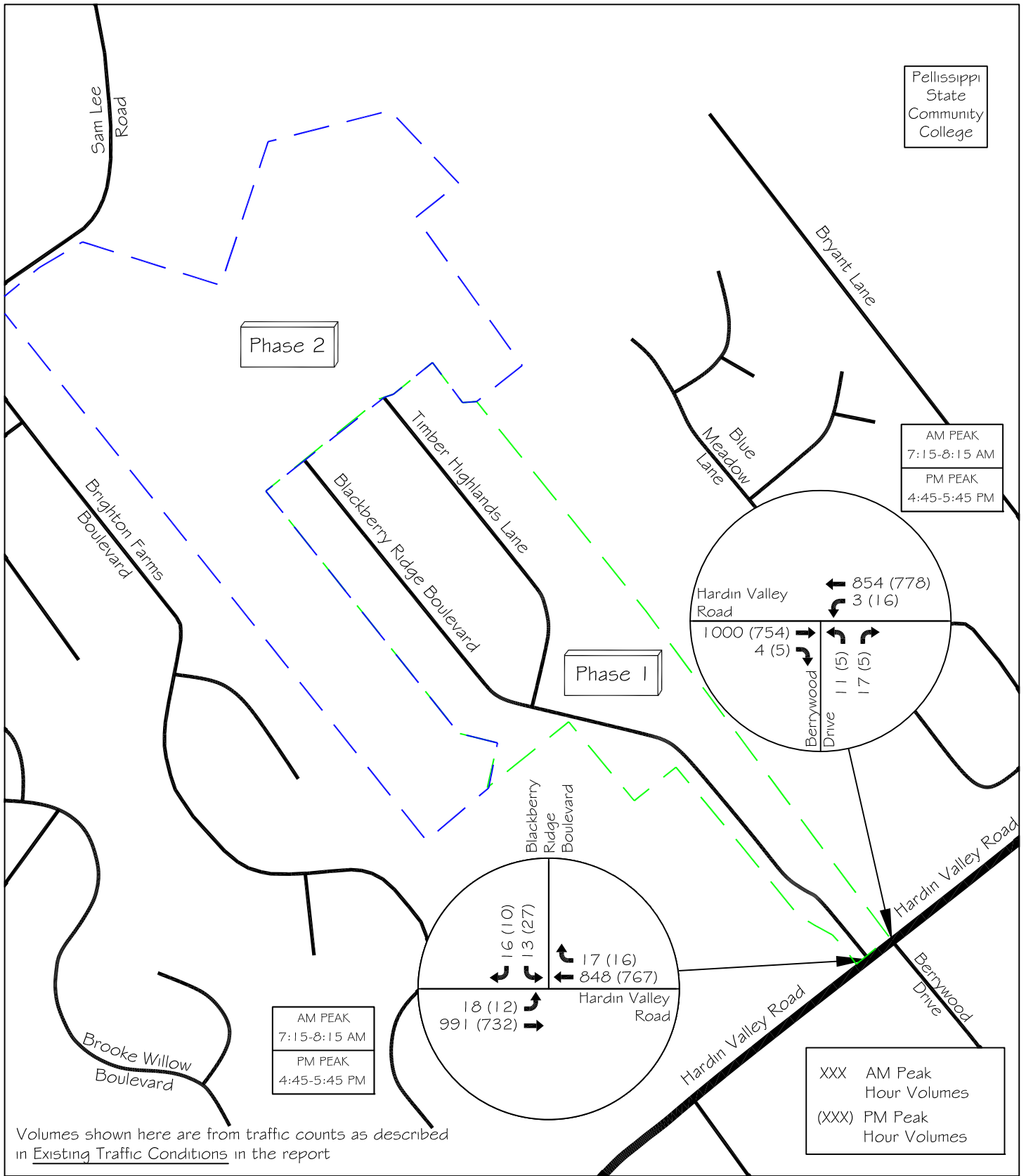
■ EXISTING TRAFFIC CONDITIONS

Traffic counts were conducted at the existing unsignalized intersection of Hardin Valley Road at Blackberry Ridge Boulevard and at the existing unsignalized intersection of Hardin Valley Road at Berrywood Drive as directed by the MPC.

Traffic counts were obtained on Tuesday, September 11th, 2018. The counts were conducted during the morning, mid-day, and afternoon peak periods. Local schools and Pellissippi State Community College were in session when the traffic counts were conducted, and numerous school busses were counted.

The intersection of Hardin Valley Road at Blackberry Ridge Boulevard was counted from 7 – 9 am, 11 am – 1 pm, and 2 – 6 pm for a total of 8 hours. Based on the traffic volumes counted at the intersection, the AM, Mid-Day, and PM peak hour of traffic were observed at the following times: 7:15 – 8:15 am, 11:30 am – 12:30 pm, and 4:45 – 5:45 pm. The intersection of Hardin Valley Road at Berrywood Road was counted during the AM and PM peak hours of 7:15 – 8:15 am and 4:45 – 5:45 pm for a total of 2 hours. The manual tabulated traffic counts can be reviewed in Appendix F. In Figure 4, the volumes are shown from the existing traffic counts during the AM and PM peak hours observed at the intersections.

During the traffic counts at the intersections, it was observed that significant eastbound traffic queues formed on Hardin Valley Road in the morning from approximately 7:45 to 8:00 am. There was also a significant backup in the same direction from approximately 3:45 to 4:05 pm on Hardin Valley Road. These queues extended back from traffic congestion around Pellissippi State Community College and Pellissippi Parkway (SR 162). These observed backups extended to a maximum of a couple hundred feet to the west of Blackberry Ridge Boulevard. These traffic backups are assumed to be a result of large amounts of traffic traveling towards Pellissippi Parkway (SR 162) during peak traffic activity at Pellissippi State Community College combined with the dismissal traffic from the Hardin Valley schools located to the west of Laurel Ridge. In particular, the capacity of the signalized intersection at the main driveway of Pellissippi State Community College at Greenland Way becomes oversaturated during these extreme traffic peaks.



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FIGURE 4

Laurel Ridge - Phase 3

2018 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the existing Level of Service (LOS) for the studied intersections with respect to vehicular traffic. The capacity analyses were calculated by following the methods outlined in the Highway Capacity Manual and using Synchro Traffic Software (Version 8). LOS is a qualitative measurement developed by the transportation profession to indicate how well an intersection or roadway performs based on a driver's perception. LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at the worst. This grading system provides a reliable straightforward means to communicate road operations to the public. The Highway Capacity Manual (HCM) lists level of service criteria for unsignalized intersections and signalized intersections.

For unsignalized intersections, Level of Service is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes travel time, driver discomfort, and fuel consumption. The LOS for a two-way stop (or yield) controlled intersection is defined by the delay for each minor approach and major street left-turn movement. Table 2 lists the level of service criteria for unsignalized intersections.

From the capacity calculations, the results from the existing peak hour vehicular traffic can be seen in Table 3 for the intersections. The intersections in the table are shown with a LOS designation, delay (in seconds), and v/c ratio (volume/capacity) for the AM and PM peak hours. A v/c ratio of 1 would indicate that the traffic volumes are at the roadway capacity. Appendix G includes the worksheets from the capacity analyses for the existing peak hour vehicular traffic. The studied intersection approaches are shown to operate at a good level during the existing AM and PM peak hours for vehicular traffic. (Note: For the existing conditions calculations, the southbound approach of Blackberry Ridge Boulevard at Hardin Valley Road was analyzed as having a single exiting lane. This is because the existing southbound approach is not striped to delineate separate left and right turn lanes.)

A/B



C/D



E/F



(Source: FDOT)

TABLE 2



LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS



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

Source: Highway Capacity Manual

TABLE 3
2018 PEAK HOUR LEVEL OF SERVICE & DELAY - EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH	AM PEAK			PM PEAK		
			LOS	DELAY (seconds)	V/C	LOS	DELAY (seconds)	V/C
Hardin Valley Road at Blackberry Ridge Boulevard	Unsignalized	Eastbound Left	B	10.9	0.060	A	9.8	0.031
		Southbound Left/Right	C	22.6	0.190	C	23.1	0.195
Hardin Valley Road at Berrywood Road	Unsignalized	Westbound Left	B	10.5	0.000	A	9.5	0.024
		Northbound Left/Right	C	20.7	0.120	C	17.9	0.054

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

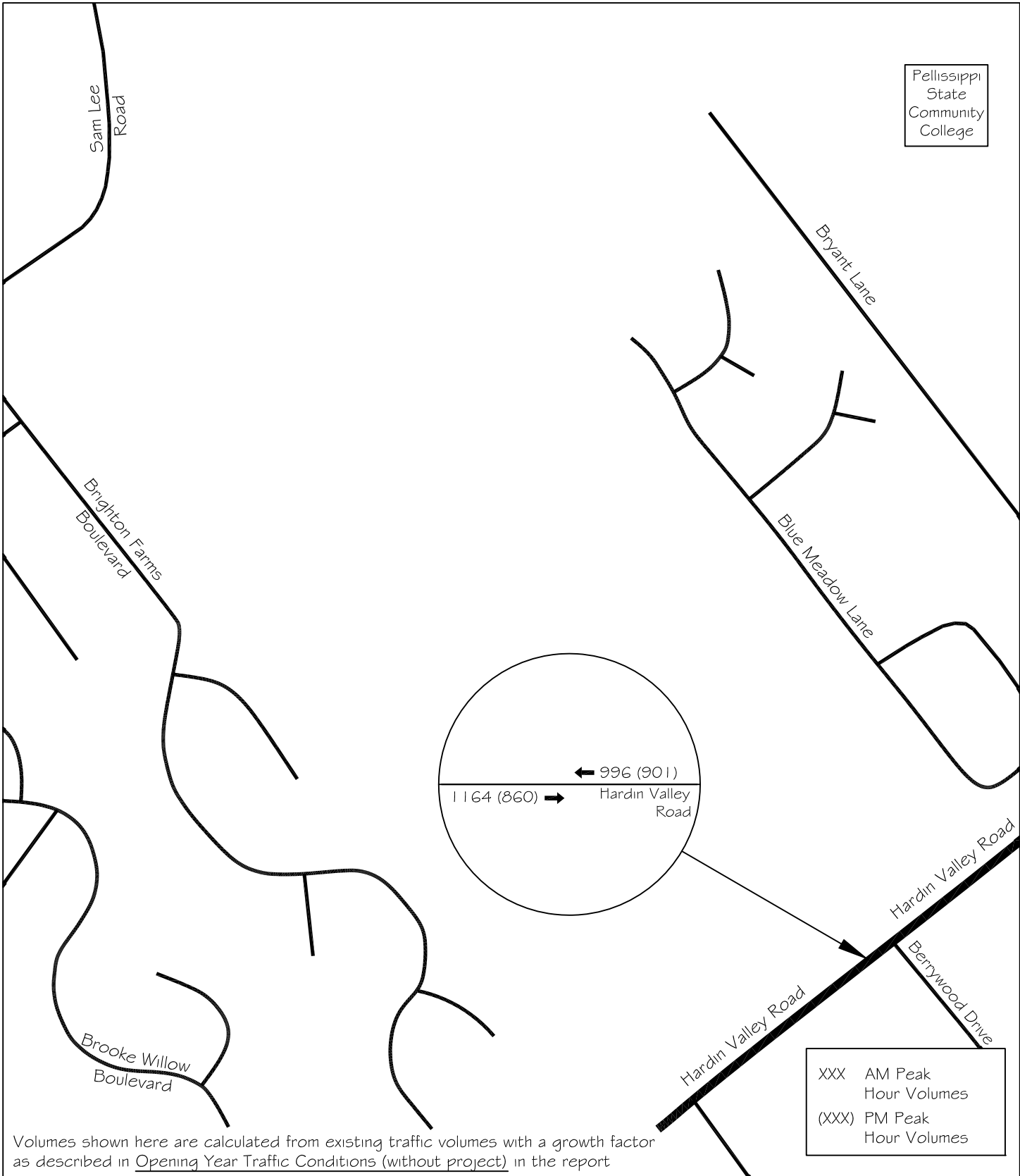
■ **OPENING YEAR TRAFFIC CONDITIONS (WITHOUT PROJECT):**

Estimated opening year traffic represents the future traffic conditions the study area is potentially subject to without the proposed project being developed (no-build option). As previously stated, the build-out and full occupancy for all three phases of the Laurel Ridge residential development were assumed to occur at the end of the year 2022. This corresponds with nearly 3-1/2 years for all three phases of the development to be constructed and reach full occupancy.

Traffic growth on Hardin Valley Road has exploded over the last 10 years due to the construction of the nearby Hardin Valley public schools and the expansion of residential development in the area. Vehicular traffic over the past 10 years (2006 – 2016) has shown an average annual growth rate of 7.3% according to the TDOT count station on Hardin Valley Road (historical traffic data is shown in Appendix A). However, recent traffic growth on Hardin Valley Road has shown a plateau. The past 5 years (2011 – 2016) of traffic growth on Hardin Valley Road at the TDOT count station has only shown a 0.1% average annual growth rate. A large increase in ADT was observed at the count station in between 2010 and 2011.

Currently, there are several other residential developments under construction and being proposed in the Hardin Valley area that would indicate increased future traffic volumes in the study area. To ensure a conservative traffic growth estimate for this study and to account for potential traffic growth in the study area, an average annual growth rate of 5% was used to calculate future growth up to the year 2022 (3.5 years) for the projected conditions. This assumed rate is a conservative value in between the growth rate observed over the past 10 years and the growth rate plateau experienced the past 5 years. The results of this growth rate to the existing traffic volumes can be seen in Figure 5. Figure 5 shows the projected opening year traffic volumes in 2022 during the AM and PM peak hours on Hardin Valley Road without the project being developed. Figure 5 does not show future entering and exiting traffic of the Laurel Ridge Subdivision. The existing traffic that was counted during the traffic counts for these traffic movements consisted of a mixture of resident vehicles and a large amount of construction vehicles associated with the on-going construction in Laurel Ridge Subdivision. Use of these existing movements would not be representative of future growth. Thus, for the remainder of this study, these traffic movements will be estimated by the calculated projected amount of traffic generated by all three phases in the future conditions.

Level of service calculations were not performed for the future conditions in the year 2022 since the turning movements at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard were removed. Figure 5 shows the predicted future thru volumes on Hardin Valley Road in the year 2022 even if the proposed residential project was not constructed and developed.



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FIGURE 5
 Laurel Ridge - Phase 3
 2022 Peak Hour Traffic Volumes -
 OPENING YEAR TRAFFIC (WITHOUT
 PROJECT)

■ **TRIP GENERATION**

A generated trip is a single or one-direction vehicle movement that is either entering or exiting the development site. The Trip Generation Manual, a publication of the Institute of Transportation Engineers, is the traditional and most-sourced resource for determining trip generation rates when traffic impact studies are produced. The Manual lists and includes data for a variety of land uses. The estimated amount of traffic that will be generated by the single-family detached lots for this entire development (all three phases) was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 10th Edition.

The trip generation data and calculations for the proposed land use is shown in Appendix H. A summary of this information is presented in the following table.

TABLE 4
TRIP GENERATION FOR LAUREL RIDGE SUBDIVISION
242 Single-Family Detached Homes

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	242 Lots	2,345	25%	75%		63%	37%	
				44	133	177	150	88	238
Total New Volume Site Trips			2,345	44	133	177	150	88	238

ITE Trip Generation Manual, 10th Edition

With all three phases with a total of 242 single-family detached residential lots, based on the calculations, it is estimated that 44 vehicles will enter the development, 133 will exit, for a total of 177 new generated trips during the AM Peak Hour in the year 2022. Similarly, it is estimated that 150 vehicles will enter the development, 88 will exit, for a total of 238 new generated trips during the PM Peak Hour in the year 2022. The calculated trips generated for an average weekday could be expected to be 2,345 vehicles for the entire development. For this study, no trip reductions were included for pass-by, diverted, or internal trips.

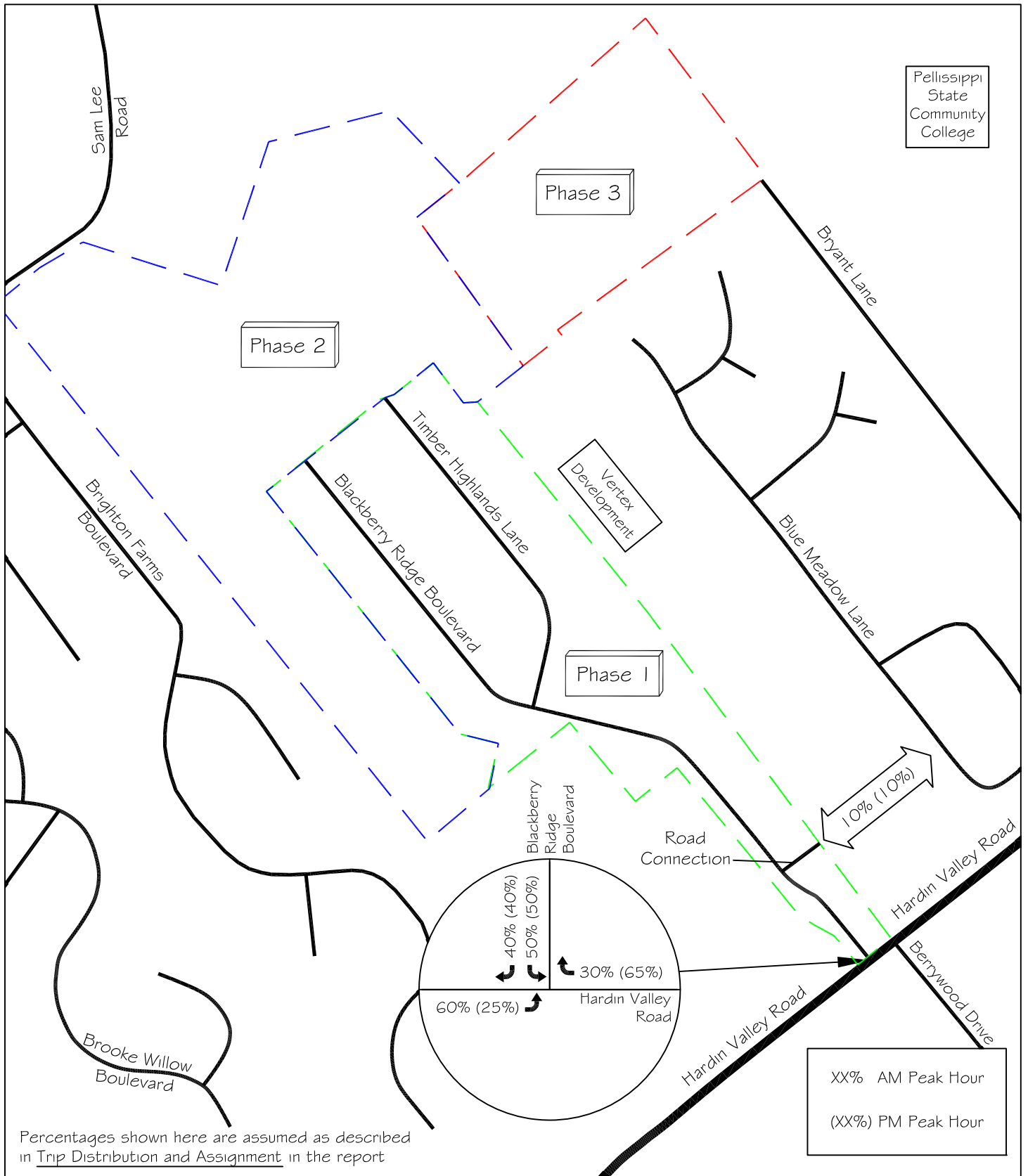
■ TRIP DISTRIBUTION AND ASSIGNMENT

Figure 6 shows the projected distribution for traffic entering and exiting for the entire development (all three phases) during the future AM and PM peak hour at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard. The percentages shown in the figure only pertain to the trips generated by the single-family detached homes from all three phases that are calculated from the ITE trip generation rates. As shown in Figure 6, the projected distribution of generated traffic at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard only shows an entering and exiting distribution of 90%. It is believed and assumed that 10% of the generated traffic by Laurel Ridge Subdivision will enter and leave via a road connection that is currently under construction. This road connection will provide secondary access for Laurel Ridge Subdivision and the adjacent residential development by Vertex Development currently under construction. This road connection will be discussed later in the report.

There are a variety of nearby developments that will potentially “attract” the projected generated traffic to and from the residential subdivision; the largest being the Hardin Valley public schools (elementary, middle, and high school) and Pellissippi State Community College. Pellissippi Parkway (SR 162) will be the major nearby roadway for access to further destinations in the surrounding Knoxville area.

The entering and exiting traffic at the adjacent residential subdivision across the street on Hardin Valley Road at Berrywood Drive was counted during the AM and PM peak hours. The turning movements that were counted at the intersection of Hardin Valley Road at Berrywood Drive were used to help assume projected trip distributions. Currently, 74 residential lots use Berrywood Drive as the only means of access to Hardin Valley Road. These additional traffic counts are included in Appendix F. Overall, the projected trip distributions are based on the observed existing traffic movements and based on the surrounding concentrations of development and population.

Figure 7 shows the Traffic Assignment of the generated trips by the development at the subdivision entrance for traffic entering and exiting the Laurel Ridge development during the future AM and PM peak hours. This is based on the assumed distribution of trips shown in Figure 6 and the total trips generated shown in Table 4.



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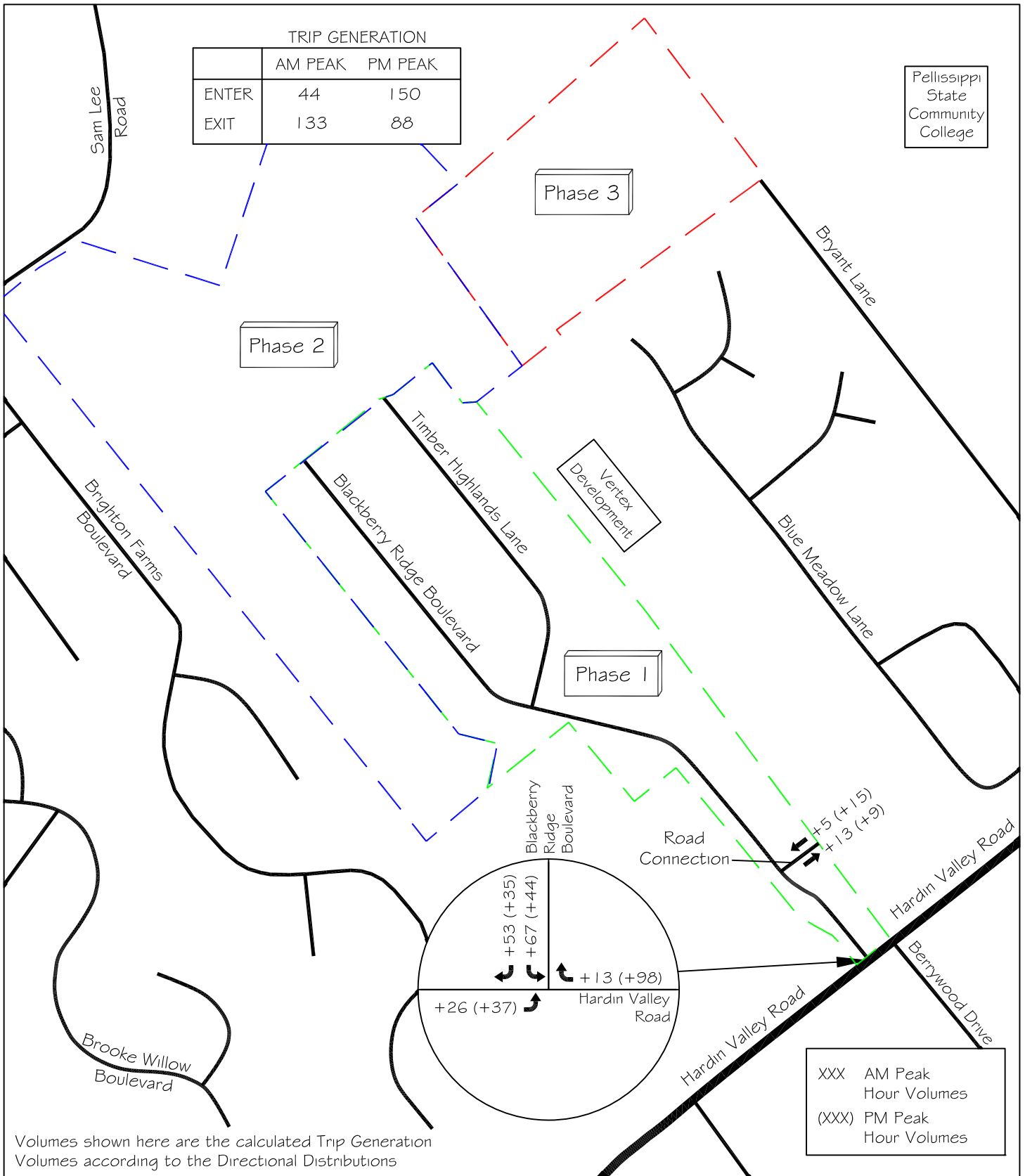
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FIGURE 6

Laurel Ridge - Phase 3

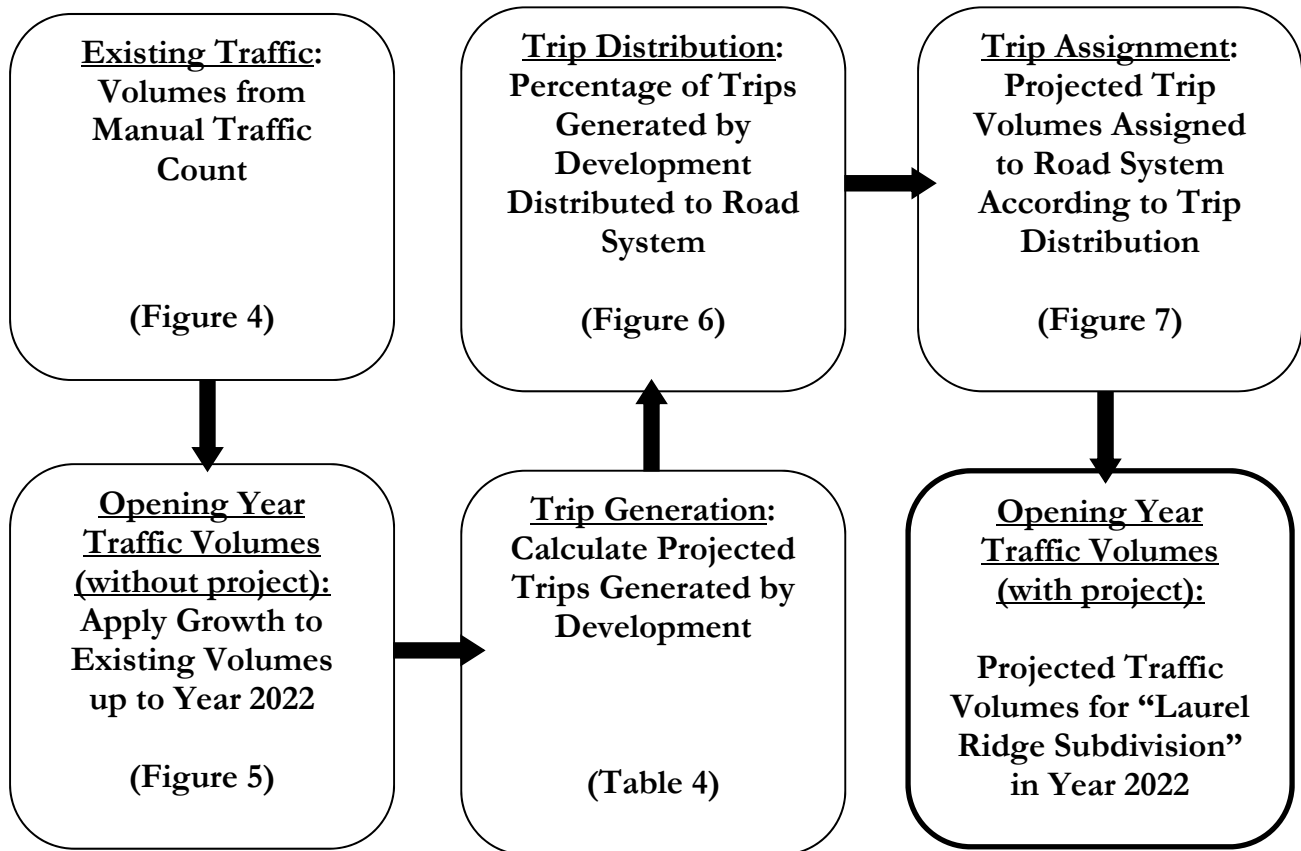
Directional Distribution of Generated Traffic during AM and PM Peak Hour



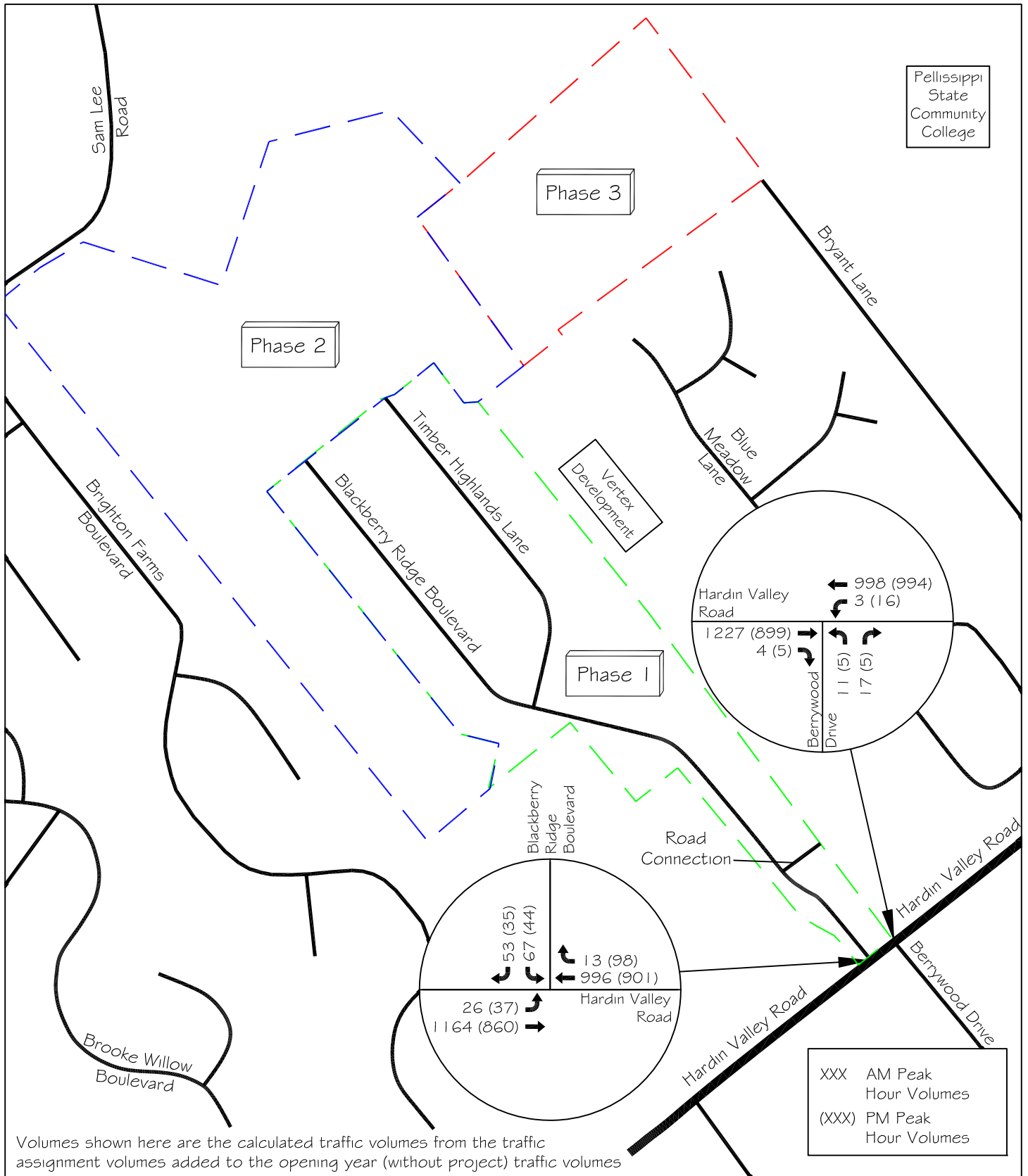
 <p>11812 Black Road Knoxville, TN 37932 Phone: (865) 556-0042 Email: ajaxengineering@gmail.com</p>	<p>NOT TO SCALE</p>  <p>NORTH</p>	<p>FIGURE 7</p> <p>Laurel Ridge - Phase 3</p> <p>Traffic Assignment of Generated Traffic during AM and PM Peak Hour</p>
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■ **OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)**

Several additive steps were taken to estimate the total opening year projected traffic volumes at the studied intersections when all three phases of the Laurel Ridge residential development are fully constructed and occupied in the year 2022. The steps are illustrated below for clarity:



To calculate the total projected traffic volumes at the studied intersections, the trips generated (calculated from the ITE trip rates) by the entire residential development (all three phases) were added to the 2022 opening year traffic volumes on Hardin Valley Road (shown in Figure 5) in accordance with the predicted directional distributions and assignments (shown in Figures 6 and 7). This procedure was necessary to obtain the total projected traffic volumes at the time the development is fully built-out and occupied in the year 2022. Figure 8 shows the projected AM and PM peak hour volumes at the studied intersections for the year 2022 with the development traffic.



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FIGURE 8
Laurel Ridge - Phase 3
2022 Peak Hour Traffic Volumes -
OPENING YEAR TRAFFIC (WITH
PROJECT)

Capacity analyses were conducted to determine the projected Level of Service for vehicles at the studied intersections for the year 2022 with the development traffic. Appendix G includes the worksheets for these capacity analyses.

The results of the capacity calculations of the projected 2022 peak hour vehicular traffic volumes at the studied intersections can be seen in Table 5 for the AM and PM peak hour. As can be seen in the table, the southbound left turn movement at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard is projected to operate at LOS E during the AM peak hour in the year 2022. The other movements in the AM and PM peak hours are expected to operate adequately in the year 2022. (Note: For the projected conditions in the year 2022, the southbound approach of Blackberry Ridge Boulevard was analyzed as having separate left and right turn lanes.)

TABLE 5
2022 PEAK HOUR LEVEL OF SERVICE & DELAY - OPENING YEAR (WITH PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH	AM PEAK			PM PEAK		
			LOS	DELAY (seconds)	V/C	LOS	DELAY (seconds)	V/C
Hardin Valley Road at Blackberry Ridge Boulevard	 Unsignalized	Eastbound Left	B	11.0	0.050	B	11.0	0.060
		Southbound Left	E	37.5	0.410	C	23.9	0.200
		Southbound Right	C	23.0	0.230	C	18.9	0.130
Hardin Valley Road at Berrywood Road	 Unsignalized	Westbound Left	B	12.1	0.010	B	10.3	0.030
		Northbound Left/Right	D	28.6	0.170	C	19.6	0.040

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

▪ **POTENTIAL SAFETY ISSUES**

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

➤ **EVALUATION OF TURN LANE THRESHOLDS**

The original traffic impact study for the Laurel Ridge Subdivision for Phase 1 and 2 indicated that the westbound approach at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard would require a separate right turn lane. Any need for a separate eastbound left turn lane is already provided on Hardin Valley Road by the continuous center two-way left turn lane.

The Hardin Valley Road at Blackberry Ridge Boulevard intersection was re-evaluated for the need for a separate westbound right turn lane on Hardin Valley Road for entering vehicles into the development based on the updated projected traffic volumes. Based on the projected traffic volumes at the intersection of Hardin Valley Road at Blackberry Ridge Boulevard and according to “Knox County’s Access Control and Driveway Design Policy”, a separate right turn lane is still warranted. The Knox County turn lane policy worksheets are in Appendix I. The results shown in the Appendix are based on the projected volumes during the AM and PM peak hour. The PM peak hour projected traffic volumes are estimated to be at a level that requires the need for a separate right turn lane for westbound right turns off Hardin Valley Road onto Blackberry Ridge Boulevard verifying the results from the original study.

The design policy for turn lane warrants relates volume thresholds based on prevailing speeds for two-lane roadways. The speed classification that was chosen for this evaluation was based on the posted speed limit of 40 mph. Therefore, this study evaluation used the Knox County classification for speeds of 36 mph – 45 mph and the calculated projected volumes. Based on the recommendations from the original study for Phase 1 and 2, a westbound exclusive right turn lane was recently constructed. Further discussion of this lane is provided later in the report.

➤ **EVALUATION OF SIGHT DISTANCE**

Based on a posted speed limit of 40 mph on Hardin Valley Road, the required intersection sight distance should be a minimum of 400 feet looking east and west on Hardin Valley Road from Blackberry Ridge Boulevard based on Knox County policy of requiring 10 feet of sight distance per 1 mph of speed. While a survey-grade measurement was not made at the intersection, from visual observation this distance is more than available in both directions for vehicles exiting onto Hardin Valley Road from Blackberry Ridge Boulevard. Using consumer-grade GPS, the estimated sight distance is more than 1,000 feet from Blackberry Ridge Boulevard looking to the west and to the east.



View of Sight Distance Looking West from Blackberry Ridge Boulevard



View of Sight Distance Looking East from Blackberry Ridge Boulevard

CONCLUSIONS AND RECOMMENDATIONS

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

1) HARDIN VALLEY ROAD AT BLACKBERRY RIDGE BOULEVARD

From the capacity calculations, it has been shown (Table 5) that the level of service for exiting vehicles out of the development will operate at a reduced level in the projected conditions in the year 2022, especially in the AM peak hour. For the projected AM peak period in the year 2022, southbound left-turning exiting vehicles are calculated to operate at LOS E. This lower level of service is directly related to the large amount of eastbound and westbound thru movements on Hardin Valley Road in the peak periods that conflict with exiting vehicles. During peak periods, queues should be expected to form at this southbound left exiting turn and drivers will experience large delays.

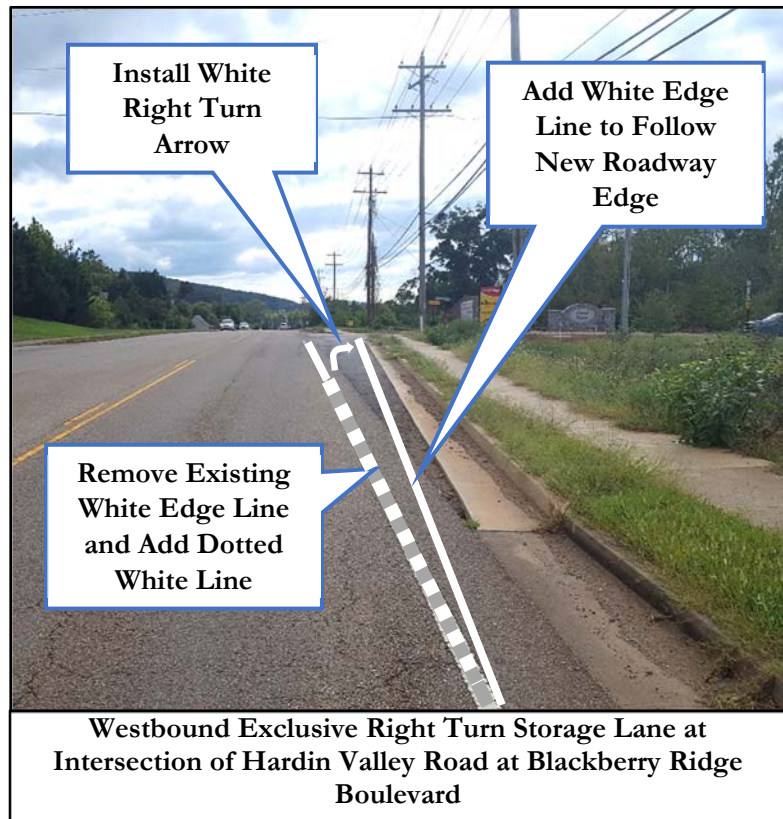
- 1a) The original traffic impact study for Phase 1 and 2 that was conducted in 2016 recommended a right turn lane be constructed for entering traffic off Hardin Valley Road onto Blackberry Ridge Boulevard. The recommended westbound right turn lane has been constructed since the original report and during the construction of the first phase of Laurel Ridge. The need for a separate right turn lane on Hardin Valley Road for turning vehicles onto Blackberry Ridge Boulevard was verified based on the updated projected volumes. The Hardin Valley Road at Blackberry Ridge Boulevard intersection turn lane evaluation was evaluated based on the projected 2022 traffic volumes at the intersection and according to “Knox County’s Access Control and Driveway Design Policy”.

Typically, the length of a right turn lane would be determined by calculating the stopping sight distance based on the observed operating speed. The length recommended by A Policy on Geometric Design of Highway and Streets by AASHTO (American Association of State Highway and Transportation Officials) is 330 feet to decelerate from a posted speed limit of 40 mph. However, this

recommended length is based on vehicles coming to a complete stop and the right turning vehicles coming off Hardin Valley Road onto Blackberry Ridge Boulevard will not completely stop. As stated in the original study, the amount of available roadway frontage property for this development is only around 90 feet from the centerline of Blackberry Ridge Boulevard to the adjacent property line located to the east. Also, the original study stated that the right turn lane should be constructed with a maximum length within the right-of-way that the property lines can allow, and the design plan for Phase 1 and Phase 2 showed a right turn lane of 120 feet (including the lane taper).

The constructed westbound right turn lane was measured during the field review for this updated study and showed a taper of 115 feet with 45-feet of storage. The 45-foot storage lane width is just over 9 feet. It would be desirable for this turn lane width to be wider to facilitate right turn maneuvers into the subdivision. The photograph below shows the modification that was made at the intersection to accommodate a westbound right turn lane and shows the final pavement marking modifications that need to be installed. TDOT Standard Drawing T-M-4 gives

guidance on the recommended pavement markings shown in the photograph.



Ultimately, it would have been beneficial if this westbound exclusive right turn lane were extended further to the east. When the original traffic study was completed for Phase 1 and 2 of Laurel Ridge in 2016, it was not known that another residential subdivision was going to be proposed shortly thereafter on the adjacent property located to the east of Laurel Ridge Subdivision. This other residential subdivision (by Vertex Development) is proposing 56 lots on 20.52 acres, is currently under construction, and will have an entrance to Hardin Valley Road approximately 340 feet to the east of Blackberry Ridge Boulevard. Based on reviewing the planning documents for this other subdivision, it does not appear that this development will be required to construct modifications along Hardin Valley Road. In hindsight, it would have been beneficial for both developments to combine their frontage property to dedicate and install a much longer westbound exclusive right turn lane that would serve both subdivisions.

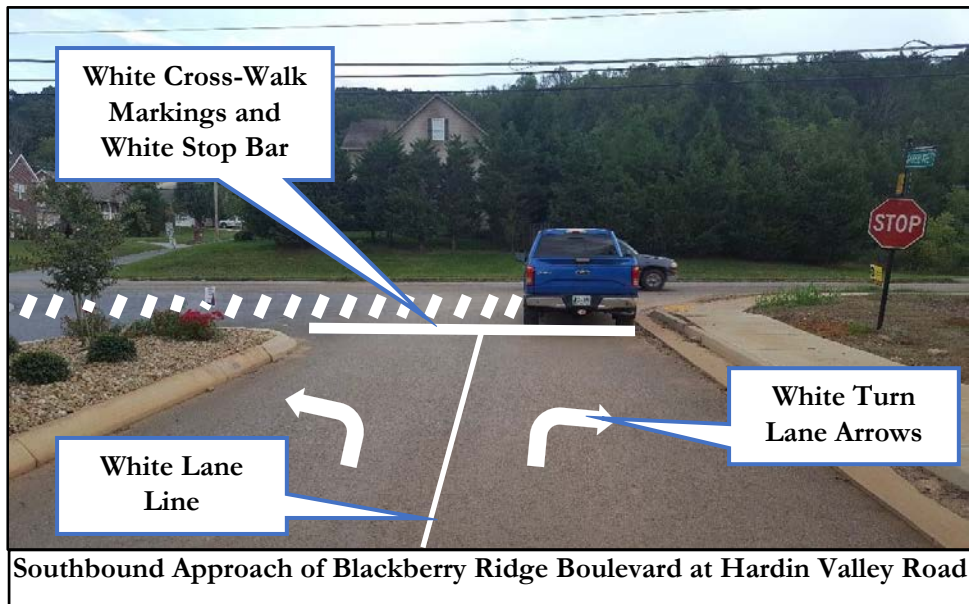
- 1b) As part of the analysis of the intersection, the estimated queue lengths of the southbound left turn lane on Blackberry Ridge Boulevard in the year 2022 were calculated.

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. Both programs estimate 95th percentile queue lengths. The 95th percentile queue is a traditional measurement used when estimating queue distances. For this proposed intersection, the queue results were calculated from Synchro since SimTraffic is not able to accurately model intersections with center two-way left turn lanes and their effects on gap acceptance.

Based on the software results in Synchro with the projected volumes, the 95th percentile queue distance for the southbound left turn lane was calculated to be 68 feet during the AM peak and 26 feet during the PM peak. However, to account for the variability of the traffic growth in the area and the potential for eastbound vehicle backups on Hardin Valley Road, it is recommended that a separate left turn lane exiting at the entrance be constructed with at least 200 feet of left turn storage. This recommendation is the same as described in the original study. This would

allow for approximately 10 vehicles to queue during peak times. Thus, at a minimum, the southbound approach of Blackberry Ridge Boulevard at Hardin Valley Road should have dual lanes for at least 200 feet for separate left and right turn lanes.

The current width of the recently constructed southbound approach of Blackberry Ridge Boulevard at Hardin Valley Road is 20 feet from the face of curb to face of curb. This constructed width is at a minimum to allow for 2 lanes of traffic to queue. Also, the constructed southbound approach is not currently striped to delineate two lanes of exiting traffic. Not delineating the approach with 2 exiting lanes can result in unnecessary delays for the southbound right turns attempting to head west on Hardin Valley Road. The photograph below shows the recommended pavement marking additions. These lanes should be striped at a minimum of 200 feet as described above. If 10-foot lanes are not available for this 200-foot distance, modifications (narrowing) of the landscaped median will need to be made. In addition to lane striping delineation, white pavement turn arrows, a 24" white stop bar, and white longitudinal cross-walk markings need to be applied to the pavement as shown in the photograph below and as detailed in TDOT Standard Drawing T-M-4.



1c) The centerline of the southbound left turn exiting lane of Blackberry Ridge Boulevard at Hardin Valley Road has been constructed approximately 120 feet from the centerline of the exiting lane of Berrywood Drive. The narrowness of the Laurel Ridge property confined the location available for the subdivision entrance intersecting into Hardin Valley Road. The proximity of Blackberry Ridge Boulevard and Berrywood Drive does provide the possibility for exiting left turning vehicles from each intersecting street to potentially interfere with each others' movements. This is particularly possible if the drivers utilize the existing continuous two-way center turn lane as a refuge in completing their turns onto Hardin Valley Road. However, the distance in between the exiting lane of Blackberry Ridge Boulevard and the exiting lane of Berrywood Drive should be adequate for maintaining enough separation to avoid these conflicting turning movements. For a driver utilizing the center turn lane as a temporary refuge for completing their left turn, nearly 75 feet of two-way center turn lane storage would be left available if a turning radius of 25 feet for left turning exiting vehicles is assumed. Further discussion regarding the proximity of these two roads at Hardin Valley Road in the future conditions is provided in the following section.

1d) As an investigation into a potential remediation for the projected high southbound left turn vehicle delays, the intersection of Hardin Valley Road at Blackberry Ridge Boulevard was examined with the projected 2022 traffic volumes with respect to traffic signal warrants. The recent traffic counts at this intersection were conducted from 7-9 am, 11 am–1 pm and 2-6 pm for a total of 8 hours.

The Manual on Uniform Traffic Control Devices – 2009 Edition (MUTCD) presents 9 different warrants that have been developed by the traffic engineering profession to determine whether a traffic signal is warranted. These warrants cover a broad range of minimum elements required to indicate whether a traffic signal is justified for any particular location. These elements consist of traffic volumes, pedestrian volumes, crash history, and other factors. The MUTCD explicitly states that a traffic control signal should not be installed unless one or more of the signal warrants in the manual are met. However, the satisfaction of a warrant does not entirely in itself justify the need for a traffic signal. Sometimes further engineering studies and judgments also need to be applied before justifying the need for a traffic

signal to be installed. These further studies are a very important step in ensuring that an installation of a traffic signal will not actually bring about degradations in traffic safety and efficiencies.

The MUTCD defines 9 different warrants, two of which are potentially applicable for this intersection at this time and are explained below:

➤ Warrant 1, Eight-Hour Vehicular Volume:

Warrant 1 is comprised of 2 conditions – A and B. The Minimum Vehicular Volume, Condition A, is intended for application where the volume of intersecting traffic is the principal reason for consideration of signal installation. The Interruption of Continuous Traffic, Condition B, is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.

➤ Warrant 2, Four-Hour Vehicular Volume:

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

The intersection of Hardin Valley Road at Blackberry Ridge Boulevard was evaluated for possible justification for a traffic signal based on the MUTCD Warrants listed above and the projected 2022 traffic count volumes. Blackberry Ridge Boulevard was used as the minor side street for the warrant analysis and Hardin Valley Road was the major street. The analysis shows that this intersection could potentially meet Warrant 1, Condition B or Warrant 2 in the projected 2022 conditions. The results of the traffic signal warrant assessment at this intersection for the projected future volumes are in Appendix J.

Traffic signal warrants should be viewed as guidelines, and not as absolute. Satisfying the requirements of a warrant is not a guarantee that a traffic signal is needed or beneficial. Knox County Engineering and the Tennessee Department of Transportation considers Warrant 1 as the primary warrant considered for traffic

signal approval. Nonetheless, the rapid growth experienced on Hardin Valley Road above what was projected in the original traffic study has placed a substantial burden on traffic movements from the side streets along Hardin Valley Road. This increased traffic growth burden is evident on Hardin Valley Road during the extremely long vehicle eastbound queues experienced during peak times. This burden has only increased since the construction and opening of Hardin Valley Middle School in August 2018.

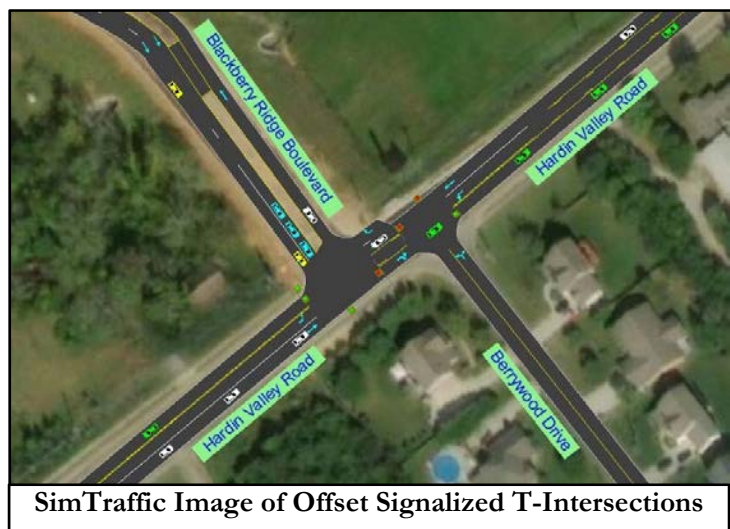
The original traffic study for Phase 1 and 2 of Laurel Ridge did not conclude that a traffic signal would be warranted by the year 2021 when it was expected that the original project would be fully constructed and occupied. However, with the more rapid increased growth on Hardin Valley Road and an additional year of growth (2021 was the original study's horizon year), the intersection of Hardin Valley Road at Blackberry Ridge Boulevard could satisfy warrants for traffic signalization in the future year of 2022.

A further analysis was conducted to determine when in the future this intersection could potentially meet traffic signal warrants. Assuming linear growth between the construction and occupancy of homes in Laurel Ridge and the assumed average annual growth rate on Hardin Valley Road of 5%, it is calculated that the intersection of Hardin Valley Road at Blackberry Ridge Road could meet Warrant 2 by the end of the year 2021. These calculations are included in Appendix J. Knox County Engineering will not install a traffic signal based on projected traffic volumes. The traffic volumes will need to be present and documented before a traffic signal is justified.

As Laurel Ridge Subdivision is being constructed further and Hardin Valley Road continues to experience traffic growth, the intersection of Hardin Valley Road at Blackberry Ridge Boulevard will need to be monitored and traffic counts conducted in the future to decide if and when a traffic signal should be installed. If at some point in the future a traffic signal is warranted, several issues will need to be addressed in the design and construction of a traffic signal at this location.

Due to the limited opportunities for the placement of the Laurel Ridge Subdivision entrance, Blackberry Ridge Boulevard was designed and constructed approximately 120 feet to the west of the existing Berrywood Drive which is located on the south side of Hardin Valley Road. It would have been advantageous for the two subdivision entrances to line up to form a 4-way intersection instead of offset t-intersections. Designing, constructing, and operating a traffic signal at this location would be more desirable and efficient if the two entrances had formed a 4-way intersection. Nonetheless, for a traffic signal to be constructed for the intersection of Hardin Valley Road at Blackberry Ridge Boulevard, the traffic signal design would need to include controlling the traffic movements at Berrywood Drive. The traffic signal design will involve both subdivision entrances operating as offset signalized t-intersections. For this design to work properly and safely at this location, the southbound turning movements on Blackberry Ridge Boulevard and the northbound turning movements on Berrywood Drive would need to be designed with split phase timing where the southbound and northbound movements from each street would have separate green signal phases. With offset signalized t-intersections, large operating inefficiencies are introduced due to the split phases and the lost time in clearing out the area in between the two intersections during the signal phase changes. Operating these offset signalized t-intersections can be provided using one traffic controller. While this type of traffic control has large capacity inefficiencies due to the offset distance, the advantage would be that a split phase timing plan will reduce vehicle conflicts between the northbound and southbound movements at Blackberry Ridge Boulevard and Berrywood Drive.

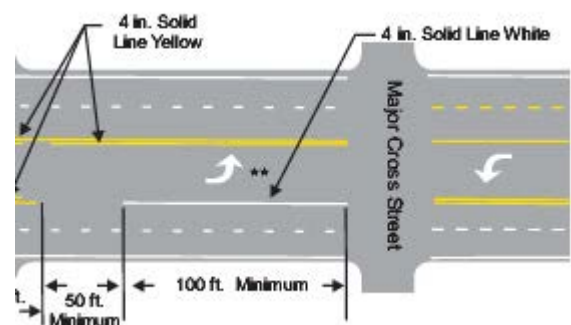
A model of this traffic signal design with the two roads operating as offset signalized t-intersections (and under one traffic signal controller) was developed in SimTraffic software and image of it is shown here.



SimTraffic Image of Offset Signalized T-Intersections

Also, the MPC and Knox County has recently announced that they will be conducting a “Hardin Valley Mobility Study”. The announcement of this study is shown in Appendix K. According to the announcement, this study will “examine existing transportation conditions and future needs in the Hardin Valley area. The study will prioritize improvements with the goal of maintaining mobility and addressing safety for people using types of transportation.” This study is stated to begin currently and will be completed by the spring of 2019. The projected traffic signal should be included in this study and possibly will provide congestion relief in this area of Hardin Valley.

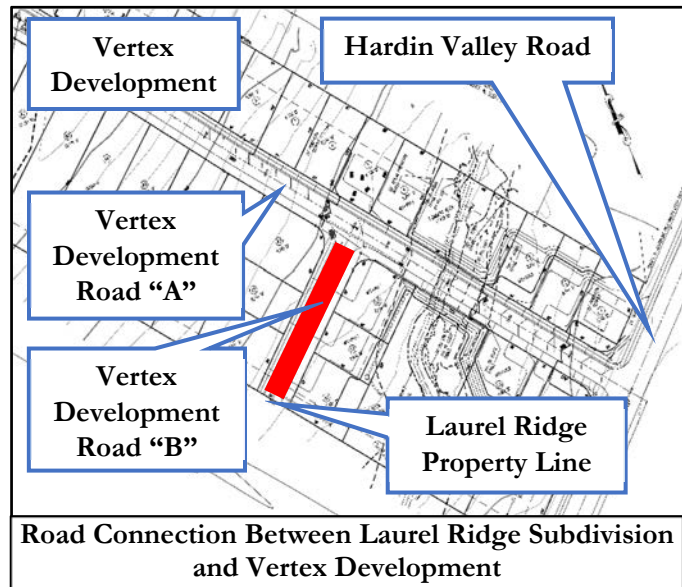
- 1e) The existing continuous center two-way left turn lane on Hardin Valley Road should be re-stripped to accommodate the recently constructed intersection at Blackberry Ridge Boulevard with the new left turning movements into the development. The existing pavement markings for the continuous center turn lane should be converted into a



pavement marking scheme that delineates an exclusive left turn lane into the subdivision or as determined by Knox County Engineering. To accommodate the future left turns into the development from Hardin Valley Road, the exclusive left turn should be marked to delineate a storage length of 100 feet minimum. The gap opening in the pavement marking for the left turns should be 50 feet minimum.

2) INTER-SUBDIVISION ROAD CONNECTION

As described earlier, another adjacent residential subdivision was proposed shortly after the Laurel Ridge Subdivision was begun. This development by Vertex Development will have one main access road to Hardin Valley Road. As part of the approval process for this other subdivision, Knox County stipulated that a connector road be



constructed between the Vertex Development and the Laurel Ridge Subdivision. This would provide both residential developments secondary access to Hardin Valley Road.

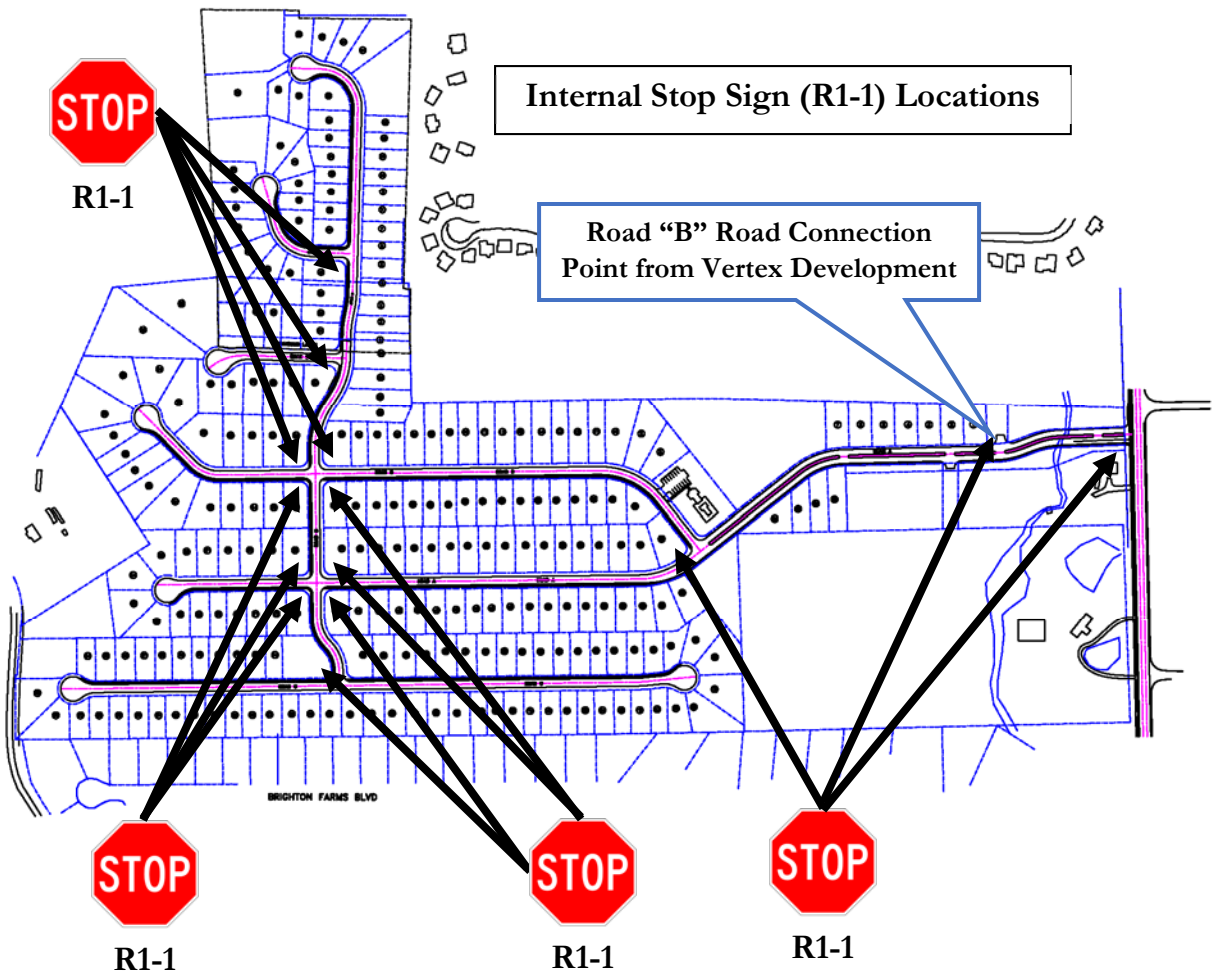
The proposed road connection will occur in between Blackberry Ridge Boulevard on the west side and Road "A" (the main access road for Vertex Development to Hardin Valley Road) of the Vertex Development on the east side. This road connection is currently being constructed. According to the concept plan for the Vertex Development dated 11/04/16, Vertex Development Road "B" will be extended 253 feet from Road "A" of the Vertex Development to the shared property line in between the 2 developments. The distance from the shared property line to the edge of Blackberry Ridge Boulevard is approximately 130 feet. Both end connections of Road "B" will need to ensure that the appropriate sight distance will be available. Based on a posted speed limit in both the residential developments of 25 mph, the required sight distance should be 250 feet.

As stated previously in the "Trip Distribution and Assignment" section, it is assumed that 10% of the generated traffic from Laurel Ridge Subdivision will use this connector road to and from the 2 subdivision during peak hours.

3) LAUREL RIDGE SUBDIVISION INTERNAL ROADS

The plans for Laurel Creek Subdivision shows a total of 6 roadways being constructed within the three phases of the development.

- 3a) Stop Signs (R1-1) should be installed at the internal intersections in all three phases as shown below:



- 3b) All drainage grates and covers for the residential development need to be pedestrian and bicycle-safe.

- 3c) Sight distance at all the new internal intersections must not be impacted by new signage, future landscaping, or parked vehicles. For a posted 25 mph speed for the internal development streets, the recommended intersection sight distance requirement is 250 feet.
- 3d) The construction of Laurel Ridge – Phase 3 will involve reducing the length of an existing road, Bryant Lane. Bryant Lane will need to be terminated prior to the limits of Phase 3 and include constructing a cul-de-sac. This cul-de-sac should meet Knox County standards and guidelines. Access to Bryant Lane from Phase 3 of Laurel Ridge should be prohibited.
- 3e) The internal sidewalks that are proposed for the development should have appropriate ADA compliant curbed ramps at intersection corners and the sidewalks are recommended to be 5 feet minimum in width.
- 3f) All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County Engineering specifications and guidelines to ensure proper and safe vehicle operation.

APPENDIX A

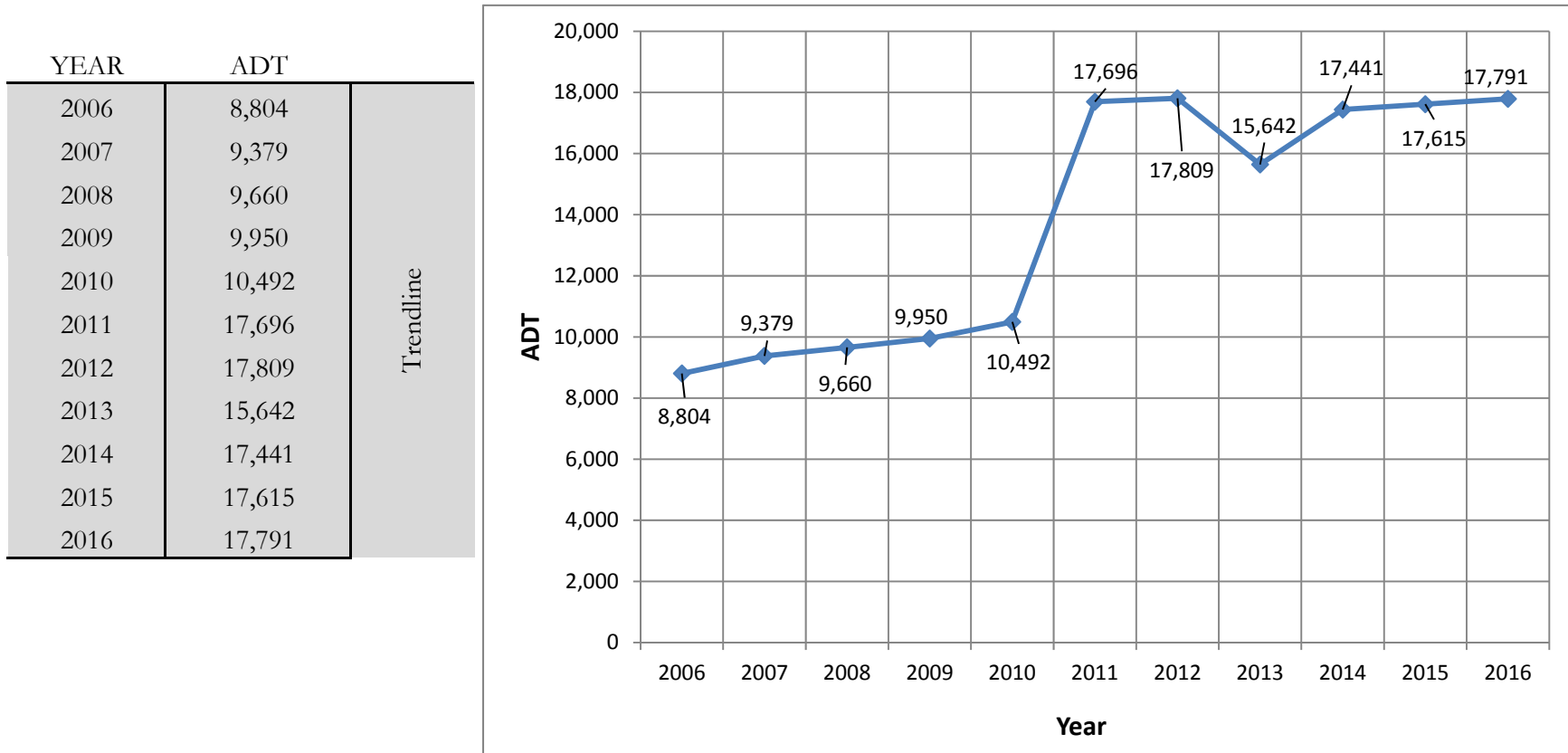
HISTORICAL TRAFFIC COUNT DATA

Historical Traffic Counts

Organization: TDOT

Station ID #: 000084

Location: Hardin Valley Road - Near Anderson County Line



2006- 2016 Growth Rate = 85.7%

10 Year Average Annual Growth Rate = 7.3%



Traffic History

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

View stations on map: Non-Map Record Search: Station Number:

Station Information

Station	000084
Route	01277
Location	VALLEY RD-NEAR ANDERSON CO LINE
County	Knox
2016	17791
2015	17615
2014	17441
2013	15642
2012	17809
2011	17696
2010	10492
2009	9950
2008	9660
2007	9379
2006	8804
2005	8457
2004	7761
2003	7533
2002	7179
2001	7019
2000	7520
1999	5587

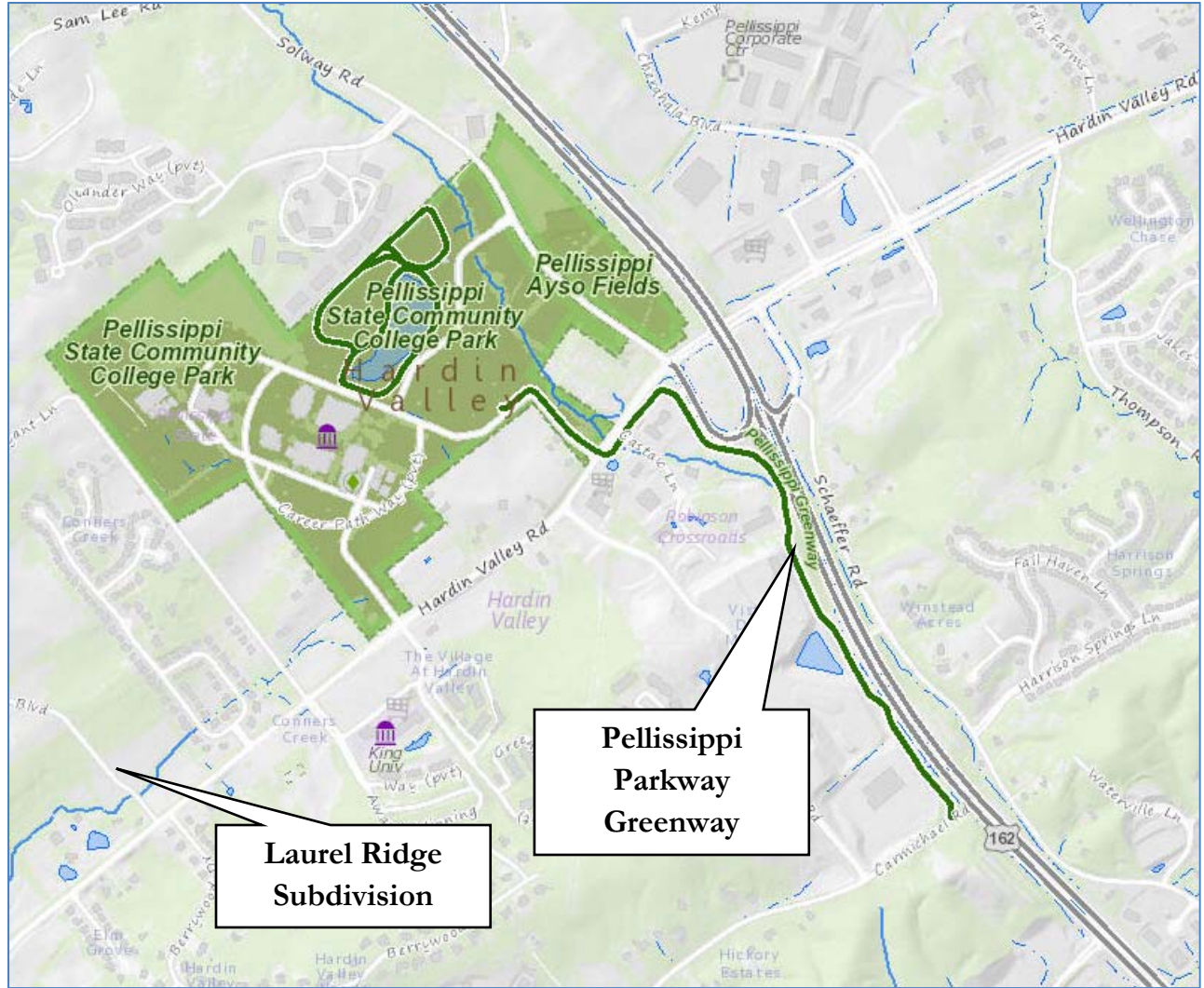
Download File: [KML](#) | [ESRI Geodatabase](#) | [ESRI Shapefile](#) | [Database Table](#)

Open With: [Google Earth](#) | [ArcGIS Explorer](#) | [MS Access or Excel](#)

APPENDIX B

PELLISSIPPI PARKWAY GREENWAY INFORMATION

PELLISSIPPI PARKWAY GREENWAY MAP



APPENDIX C

WALK SCORE

WALK SCORE
(from walkscore.com)

Walk Score® Get Scores Find Apartments My Favorites Add to Your Site

Type an address, neighborhood or city **Go**

Blackberry Ridge Blvd

Knoxville, Tennessee, 37932

Commute to **Downtown Farragut**

40 min 60+ min 60+ min View Routes

Favorite **Map** **Nearby Apartments**

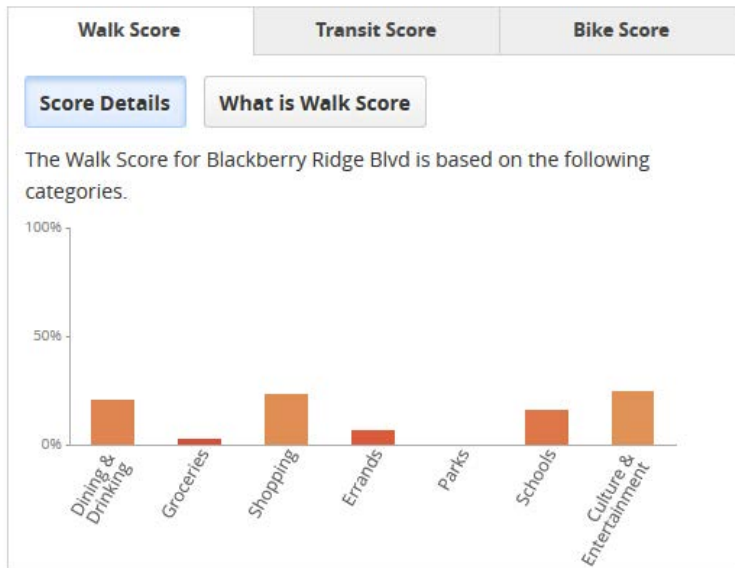
Looking for a home for sale in Knoxville?

Walk Score 11 **Car-Dependent**
Almost all errands require a car.

About your score
Add scores to your site

Scores for Blackberry Ridge Blvd

Walk Score
11

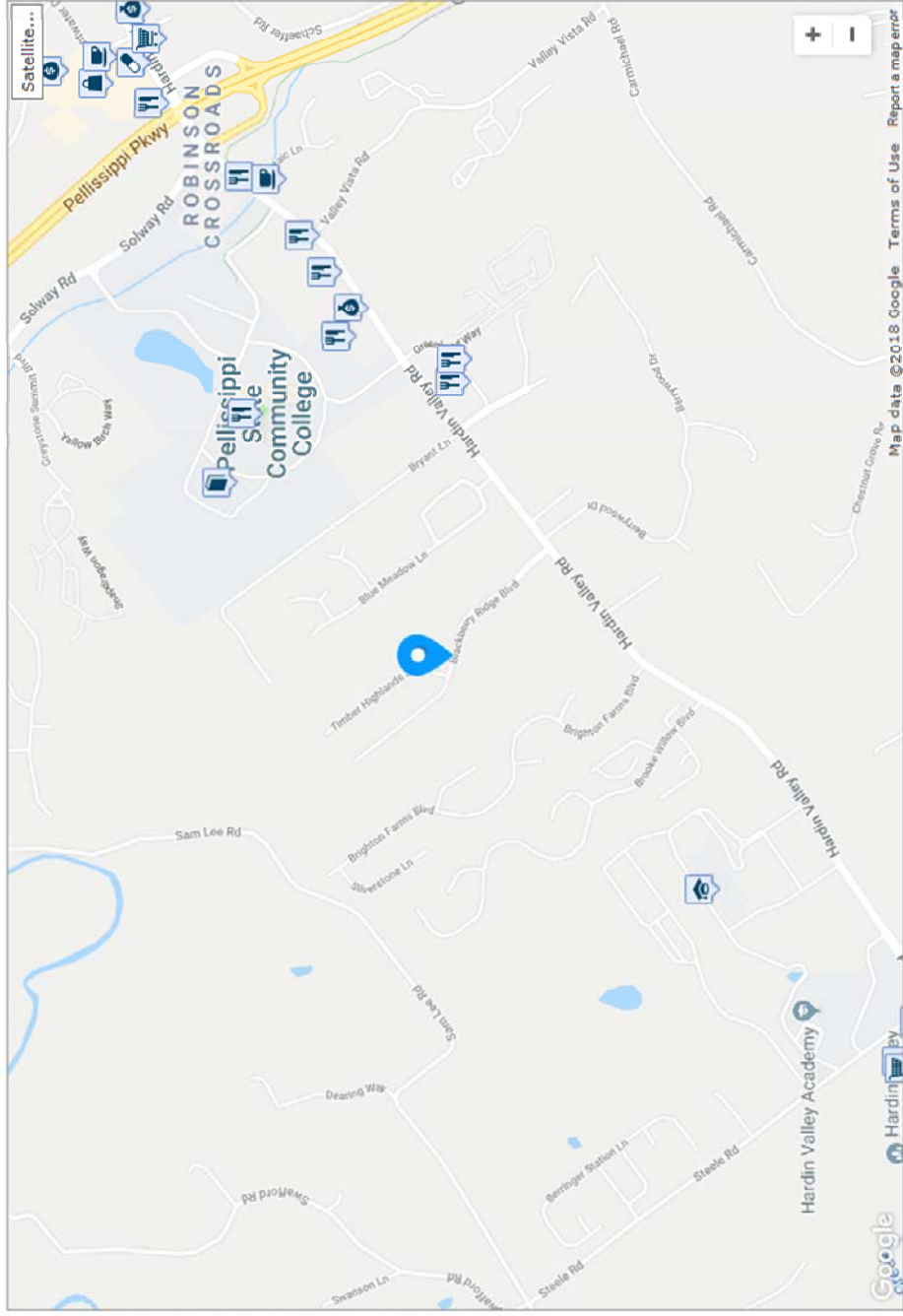


[Methodology](#)

Close

What's Nearby

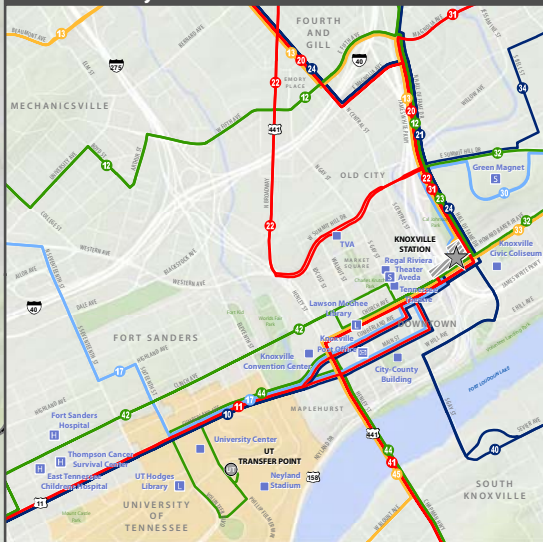
- Restaurants:**
 - Marco's Pizza .5mi
- Coffee:**
 - McDonald's .9mi
- Bars:**
 - Roger 4.2mi
- Groceries:**
 - Food City 1.1mi
- Parks:**
 - Guinn Road Park 2.6mi
- Schools:**
 - Hardin Valley Academy .6mi
- Shopping:**
 - Pellissippi State College Book... .5mi
- Entertainment:**
 - Freels Bend Cabin 3.1mi
- Errands:**
 - Southeast Bank .6mi
- Search Nearby:**



APPENDIX D

KNOXVILLE AREA TRANSIT MAP AND INFORMATION

Knoxville City Center



Legend

- Transfer Point
- Lift Service Area Boundary

Points of Interest

- Hospital
- School
- Library
- Point of Interest
- Post Office

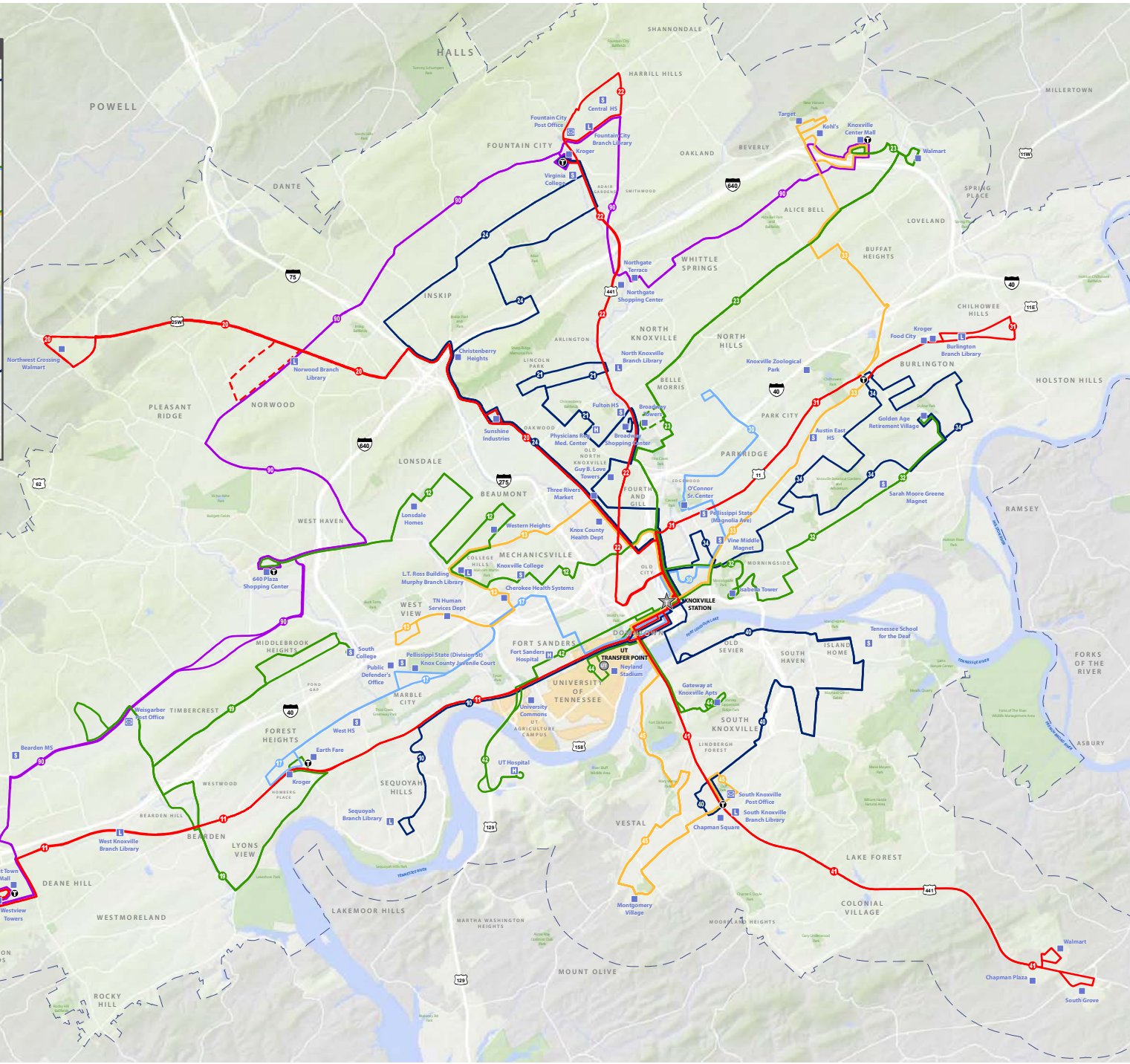
Distances

0 5 10 Minutes Walking

0 5 10 Minutes Biking

0 0.5 1 Map Scale in Miles

North



16 CEDAR BLUFF CONNECTOR

(Weekdays and Saturdays)



Legend

- Route Timepoint
- Transfer Point
- Bus Stop

Points of Interest

- Hospital
- Library
- Point of Interest
- Post Office
- School
- Park & Ride



CEDAR BLUFF CONNECTOR

(Weekdays and Saturdays)

EXTENDED EVENING HOURS JANUARY 2017

SERVES:

- ★ Cedar Bluff
- ★ Knoxville Catholic High School
- ★ Kroger at The Landing
- ★ Parkwest Hospital

Social Security Administration
Walmart
Windsor Square



Information Updated: January 9, 2017

Going from Wal Mart to Windsor Square					Going from Windsor Square to Wal Mart				
T Transfer to:									Rt. 11
Walmart	Social Security Admin	Park Village at Woodpark	Parkwest Hospital	Windsor Square	Parkwest Hospital	Cedar Bluff at Fox Lonas	Social Security Admin	Walmart	
1	2	3	4	5	6	7	8	9	
WEEKDAY SCHEDULE									
A.M.	6:15	—	6:27	6:32	6:42	6:50	6:54	—	7:10
	7:15	—	7:27	7:32	7:42	7:50	7:54	—	8:10
	8:15	—	8:27	8:32	8:42	8:50	8:54	9:02	9:10
	9:15	9:19	9:27	9:32	9:42	9:50	9:54	10:02	10:10
	10:15	10:19	10:27	10:32	10:42	10:50	10:54	11:02	11:10
	11:15	11:19	11:27	11:32	11:42	11:50	11:54	12:02	12:10
P.M.	12:15	12:19	12:27	12:32	12:42	12:50	12:54	1:02	1:10
	1:15	1:19	1:27	1:32	1:42	1:50	1:54	2:02	2:10
	2:15	2:19	2:27	2:32	2:42	2:50	2:54	3:02	3:10
	3:15	—	3:27	3:32	3:42	3:50	3:54	—	4:10
	4:15	—	4:27	4:32	4:42	4:50	4:54	—	5:10
	5:15	—	5:27	5:32	5:42	5:50	5:54	—	6:10
	6:15	—	6:27	6:32	6:42	6:50	6:54	—	7:10
	7:15	—	7:27	7:32	7:42	7:50	7:54	—	8:10
	8:15	—	8:27	8:32	8:42	8:50	8:54	—	9:10
	9:15	—	9:27	9:32	9:42	9:50	9:54	—	10:10
SATURDAY SCHEDULE									
A.M.	7:15	—	7:27	7:32	7:42	7:50	7:54	—	8:10
	8:15	—	8:27	8:32	8:42	8:50	8:54	—	9:10
	9:15	—	9:27	9:32	9:42	9:50	9:54	—	10:10
	10:15	—	10:27	10:32	10:42	10:50	10:54	—	11:10
	11:15	—	11:27	11:32	11:42	11:50	11:54	—	12:10
P.M.	12:15	—	12:27	12:32	12:42	12:50	12:54	—	1:10
	1:15	—	1:27	1:32	1:42	1:50	1:54	—	2:10
	2:15	—	2:27	2:32	2:42	2:50	2:54	—	3:10
	3:15	—	3:27	3:32	3:42	3:50	3:54	—	4:10
	4:15	—	4:27	4:32	4:42	4:50	4:54	—	5:10
	5:15	—	5:27	5:32	5:42	5:50	5:54	—	6:10
	6:15	—	6:27	6:32	6:42	6:50	6:54	—	7:10
	7:15	—	7:27	7:32	7:42	7:50	7:54	—	8:10
	8:15	—	8:27	8:32	8:42	8:50	8:54	—	9:10
	9:15	—	9:27	9:32	9:42	9:50	9:54	—	10:10

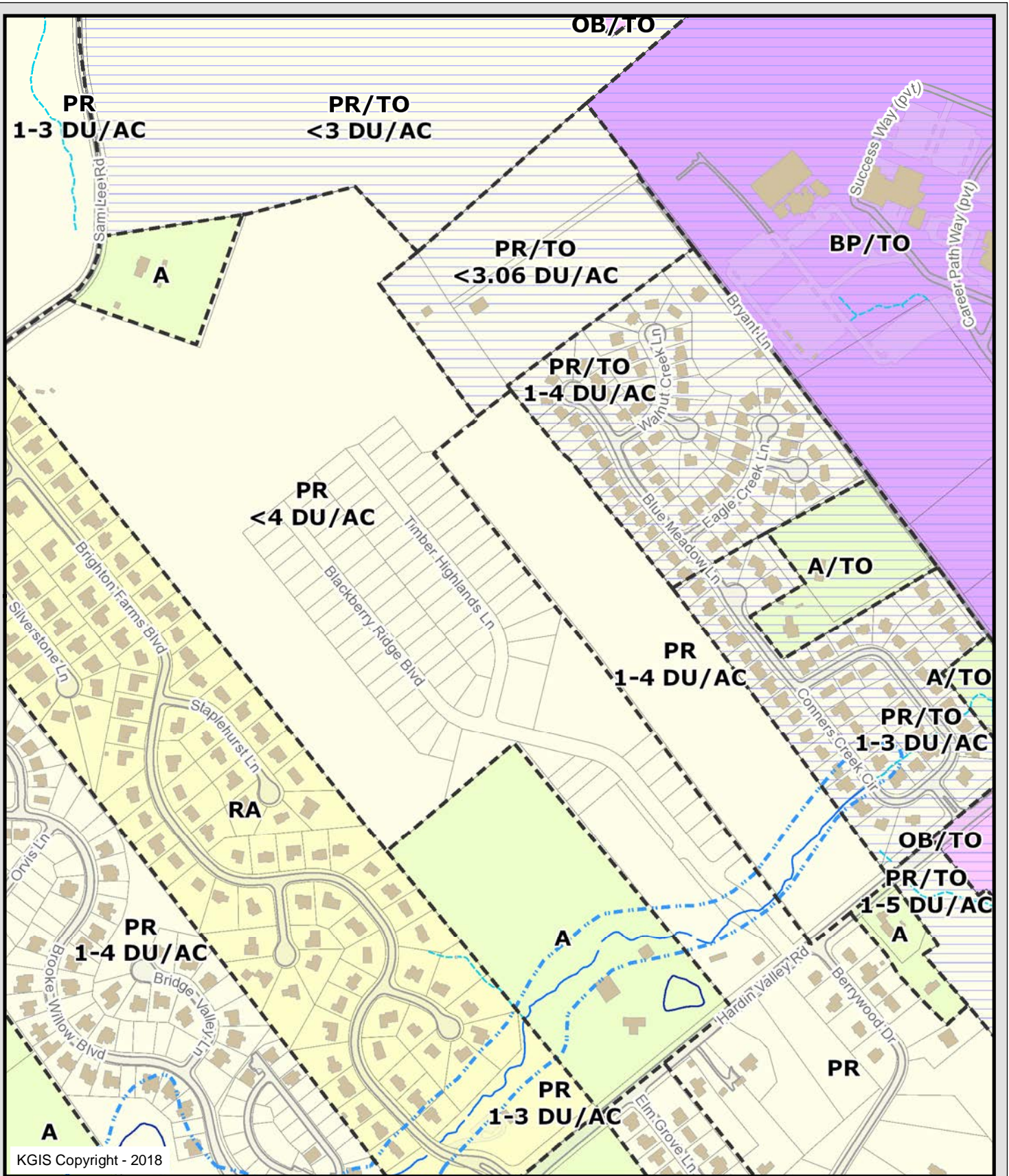
Need help reading this schedule?

Need other general information on how to ride?

[Click here to Download the General Schedule Information pdf](#) available from katbus.com

APPENDIX E

ZONING MAP



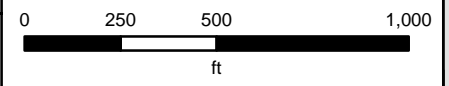
KGIS Copyright - 2018

Laurel Ridge Zoning Map

Knoxville - Knox County - KUB Geographic Information System



Printed: 9/9/2018 at 5:41:47 PM



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APPENDIX F

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Hardin Valley Road (WB - EB)
 Minor Street: Blackberry Ridge Boulevard (SB)
 Traffic Control: Stop Control on Blackberry Ridge Boulevard

9/11/2018 (Tuesday)
 Overcast/Hot
 Conducted by: Ajax Engineering

TIME BEGIN	Blackberry Ridge Boulevard		Hardin Valley Road		Hardin Valley Road		VEHICLE TOTAL	PEAK HOUR
	SOUTHBOUND		WESTBOUND		EASTBOUND			
	LT	RT	THRU	RT	LT	THRU		
7:00 AM	11	7	193	0	3	176	390	
7:15 AM	<i>1</i>	<i>4</i>	<i>247</i>	<i>1</i>	<i>2</i>	<i>215</i>	<i>470</i>	7:15 AM - 8:15 AM
7:30 AM	<i>3</i>	<i>7</i>	<i>180</i>	<i>3</i>	<i>3</i>	<i>273</i>	<i>469</i>	
7:45 AM	<i>5</i>	<i>0</i>	<i>203</i>	<i>7</i>	<i>10</i>	<i>287</i>	<i>512</i>	
8:00 AM	<i>4</i>	<i>5</i>	<i>218</i>	<i>6</i>	<i>3</i>	<i>216</i>	<i>452</i>	
8:15 AM	2	4	124	6	5	250	391	
8:30 AM	5	3	65	3	3	164	243	
8:45 AM	3	1	53	7	1	181	246	
TOTAL	34	31	1283	33	30	1762	3173	
11:00 AM	9	2	71	9	4	73	168	
11:15 AM	7	4	81	1	1	100	194	
11:30 AM	<i>8</i>	<i>3</i>	<i>84</i>	<i>5</i>	<i>2</i>	<i>129</i>	<i>231</i>	11:30 AM - 12:30 PM
11:45 AM	<i>15</i>	<i>3</i>	<i>82</i>	<i>12</i>	<i>3</i>	<i>87</i>	<i>202</i>	
12:00 PM	<i>7</i>	<i>1</i>	<i>100</i>	<i>6</i>	<i>4</i>	<i>123</i>	<i>241</i>	
12:15 PM	<i>9</i>	<i>2</i>	<i>119</i>	<i>7</i>	<i>2</i>	<i>77</i>	<i>216</i>	
12:30 PM	4	1	75	6	2	92	180	
12:45 PM	8	1	111	4	0	103	227	
TOTAL	67	17	723	50	18	784	1659	
2:00 PM	5	0	135	3	2	176	321	
2:15 PM	4	4	126	10	1	126	271	
2:30 PM	4	2	131	8	3	97	245	
2:45 PM	5	5	126	5	3	128	272	
3:00 PM	3	3	145	3	3	87	244	
3:15 PM	5	4	194	4	5	89	301	
3:30 PM	3	4	157	2	1	210	377	
3:45 PM	3	4	157	6	4	210	384	
4:00 PM	6	3	149	4	5	158	325	
4:15 PM	4	9	192	9	2	131	347	
4:30 PM	7	3	184	1	2	152	349	
4:45 PM	<i>4</i>	<i>2</i>	<i>197</i>	<i>3</i>	<i>6</i>	<i>175</i>	<i>387</i>	4:45 PM - 5:45 PM
5:00 PM	<i>8</i>	<i>4</i>	<i>166</i>	<i>5</i>	<i>2</i>	<i>176</i>	<i>361</i>	
5:15 PM	<i>8</i>	<i>2</i>	<i>197</i>	<i>6</i>	<i>2</i>	<i>195</i>	<i>410</i>	
5:30 PM	<i>7</i>	<i>2</i>	<i>207</i>	<i>2</i>	<i>2</i>	<i>186</i>	<i>406</i>	
5:45 PM	5	1	178	1	1	162	348	
TOTAL	81	52	2641	72	44	2458	5348	

2018 AM Peak Hour 7:15 AM - 8:15 AM

TIME BEGIN	Blackberry Ridge Boulevard		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
7:15 AM	1	4	247	1	2	215
7:30 AM	3	7	180	3	3	273
7:45 AM	5	0	203	7	10	287
8:00 AM	4	5	218	6	3	216
TOTAL	13	16	848	17	18	991
PHF	0.65	0.57	0.86	0.61	0.45	0.86

2018 Mid-Day Peak Hour 11:30 AM - 12:30 PM

TIME BEGIN	Blackberry Ridge Boulevard		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
4:45 PM	8	3	84	5	2	129
5:00 PM	15	3	82	12	3	87
5:15 PM	7	1	100	6	4	123
5:30 PM	9	2	119	7	2	77
TOTAL	39	9	385	30	11	416
PHF	0.65	0.75	0.81	0.63	0.69	0.81

2018 PM Peak Hour 4:45 PM - 5:45 PM

TIME BEGIN	Blackberry Ridge Boulevard		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
4:45 PM	4	2	197	3	6	175
5:00 PM	8	4	166	5	2	176
5:15 PM	8	2	197	6	2	195
5:30 PM	7	2	207	2	2	186
TOTAL	27	10	767	16	12	732
PHF	0.84	0.63	0.93	0.67	0.50	0.94

TRAFFIC COUNT DATA

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

9/11/2018 (Tuesday)
 Overcast/Hot
 Conducted by: Ajax Engineering

Primary Movement: Vehicles

TIME BEGIN	WESTBOUND		NORTHBOUND		EASTBOUND		VEHICLE TOTAL
	LT	THRU	LT	RT	THRU	RT	
7:15 AM	2		5	4		0	11
7:30 AM	0		1	4		0	5
7:45 AM	0		4	4		2	10
8:00 AM	1		1	5		2	9
TOTAL	3		11	17		4	35
PHF	0.38		0.55	0.85		0.50	
% EXIT			39.3%	60.7%			
% ENTER	42.9%					57.1%	
4:45 PM	2		0	2		1	5
5:00 PM	5		2	2		2	11
5:15 PM	4		2	0		2	8
5:30 PM	5		1	1		0	7
TOTAL	16		5	5		5	31
PHF	0.80		0.63	0.63		0.63	
% EXIT			50.0%	50.0%			
% ENTER	76.2%					23.8%	

APPENDIX G

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 8)

EXISTING TRAFFIC CONDITIONS

HCM Unsignalized Intersection Capacity Analysis

3: Berrywood Drive & Hardin Valley Road

10/18/2018



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→		←	→	←	→
Volume (veh/h)	1000	4	3	854	11	17
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.50	0.38	0.86	0.55	0.85
Hourly flow rate (vph)	1163	8	8	993	20	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage (veh)	2			2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1171		2176	1167
vC1, stage 1 conf vol					1167	
vC2, stage 2 conf vol					1009	
vCu, unblocked vol			1171		2176	1167
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)			2.2		3.5	3.3
p0 queue free %			99		91	92
cM capacity (veh/h)			604		226	238

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	1171	8	993	40
Volume Left	0	8	0	20
Volume Right	8	0	0	20
cSH	1700	604	1700	232
Volume to Capacity	0.69	0.01	0.58	0.17
Queue Length 95th (ft)	0	1	0	15
Control Delay (s)	0.0	11.0	0.0	23.7
Lane LOS		B		C
Approach Delay (s)	0.0	0.1		23.7
Approach LOS				C

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		62.9%	ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

5: Hardin Valley Road & Blackberry Ridge Boulevard

10/18/2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	18	991	848	17	13	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		2%	
Peak Hour Factor	0.45	0.86	0.86	0.61	0.65	0.57
Hourly flow rate (vph)	40	1152	986	28	20	28
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage (veh)		2	2			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1014				2218	986
vC1, stage 1 conf vol					986	
vC2, stage 2 conf vol					1232	
vCu, unblocked vol	1014				2218	986
tC, single (s)	4.2				6.4	6.3
tC, 2 stage (s)					5.4	
tF (s)	2.3				3.5	3.4
p0 queue free %	94				90	90
cM capacity (veh/h)	650				209	295
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	40	1152	986	28	48	
Volume Left	40	0	0	0	20	
Volume Right	0	0	0	28	28	
cSH	650	1700	1700	1700	252	
Volume to Capacity	0.06	0.68	0.58	0.02	0.19	
Queue Length 95th (ft)	5	0	0	0	17	
Control Delay (s)	10.9	0.0	0.0	0.0	22.6	
Lane LOS	B				C	
Approach Delay (s)	0.4		0.0		22.6	
Approach LOS					C	
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			62.2%		ICU Level of Service	B
Analysis Period (min)			15			

HCM 2010 TWSC
 3: Berrywood Drive & Hardin Valley Road

10/18/2018

Intersection

Int Delay, s/veh 0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	754	5	16	778	5	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	63	80	93	63	63
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	802	8	20	837	8	8

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	810
Stage 1	-	-	806
Stage 2	-	-	877
Critical Hdwy	-	-	4.1
Critical Hdwy Stg 1	-	-	6.4
Critical Hdwy Stg 2	-	-	6.2
Follow-up Hdwy	-	-	5.4
Pot Cap-1 Maneuver	-	-	2.2
Stage 1	-	-	825
Stage 2	-	-	105
Platoon blocked, %	-	-	385
Mov Cap-1 Maneuver	-	-	443
Mov Cap-2 Maneuver	-	-	410
Stage 1	-	-	-
Stage 2	-	-	-
Stage 1	-	-	102
Stage 2	-	-	385
Stage 1	-	-	238
Stage 2	-	-	443
Stage 1	-	-	400
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	17.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	294	-	-	825	-
HCM Lane V/C Ratio	0.054	-	-	0.024	-
HCM Control Delay (s)	17.9	-	-	9.5	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection

Int Delay, s/veh 0.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	12	732	767	16	27	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	500	-	-	25	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	2	-
Peak Hour Factor	50	94	93	67	84	63
Heavy Vehicles, %	8	4	5	0	0	19
Mvmt Flow	24	779	825	24	32	16

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	825	0	1652
Stage 1	-	-	825
Stage 2	-	-	827
Critical Hdwy	4.18	-	6.8
Critical Hdwy Stg 1	-	-	5.8
Critical Hdwy Stg 2	-	-	5.8
Follow-up Hdwy	2.272	-	3.5
Pot Cap-1 Maneuver	780	-	91
Stage 1	-	-	396
Stage 2	-	-	395
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	780	-	88
Mov Cap-2 Maneuver	-	-	218
Stage 1	-	-	396
Stage 2	-	-	383

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	23.1
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	780	-	-	-	246
HCM Lane V/C Ratio	0.031	-	-	-	0.195
HCM Control Delay (s)	9.8	-	-	-	23.1
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	0.7

OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)

HCM Unsignalized Intersection Capacity Analysis

3: Berrywood Drive & Hardin Valley Road

10/18/2018



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩		↩	↩	↩	↩
Volume (veh/h)	1227	4	3	998	11	17
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1363	4	3	1109	12	19
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage (veh)	2			2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1368		2481	1366
vC1, stage 1 conf vol					1366	
vC2, stage 2 conf vol					1116	
vCu, unblocked vol			1368		2481	1366
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)			2.2		3.5	3.3
p0 queue free %			99		93	90
cM capacity (veh/h)			509		186	182

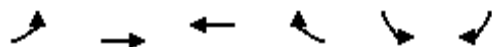
Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	1368	3	1109	31
Volume Left	0	3	0	12
Volume Right	4	0	0	19
cSH	1700	509	1700	184
Volume to Capacity	0.80	0.01	0.65	0.17
Queue Length 95th (ft)	0	0	0	15
Control Delay (s)	0.0	12.1	0.0	28.6
Lane LOS		B		D
Approach Delay (s)	0.0	0.0		28.6
Approach LOS				D

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization		74.8%	ICU Level of Service
Analysis Period (min)		15	D

HCM Unsignalized Intersection Capacity Analysis

5: Hardin Valley Road & Blackberry Ridge Boulevard

10/18/2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	26	1164	996	13	67	53
Sign Control		Free	Free		Stop	
Grade		0%	0%		2%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	29	1293	1107	14	74	59
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLT	TWLT			
Median storage (veh)		2	2			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1121				2458	1107
vC1, stage 1 conf vol					1107	
vC2, stage 2 conf vol					1351	
vCu, unblocked vol	1121				2458	1107
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	95				59	77
cM capacity (veh/h)	630				183	258
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	29	1293	1107	14	74	59
Volume Left	29	0	0	0	74	0
Volume Right	0	0	0	14	0	59
cSH	630	1700	1700	1700	183	258
Volume to Capacity	0.05	0.76	0.65	0.01	0.41	0.23
Queue Length 95th (ft)	4	0	0	0	45	21
Control Delay (s)	11.0	0.0	0.0	0.0	37.5	23.0
Lane LOS	B				E	C
Approach Delay (s)	0.2		0.0		31.1	
Approach LOS					D	
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			71.6%		ICU Level of Service	C
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

3: Berrywood Drive & Hardin Valley Road

10/18/2018



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→		↙	↑	↘	
Volume (veh/h)	899	5	16	994	5	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	999	6	18	1104	6	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage (veh)	2			2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1004		2142	1002
vC1, stage 1 conf vol					1002	
vC2, stage 2 conf vol					1140	
vCu, unblocked vol			1004		2142	1002
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)			2.2		3.5	3.3
p0 queue free %			97		98	98
cM capacity (veh/h)			698		229	297

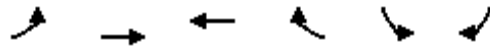
Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	1004	18	1104	11
Volume Left	0	18	0	6
Volume Right	6	0	0	6
cSH	1700	698	1700	258
Volume to Capacity	0.59	0.03	0.65	0.04
Queue Length 95th (ft)	0	2	0	3
Control Delay (s)	0.0	10.3	0.0	19.6
Lane LOS		B		C
Approach Delay (s)	0.0	0.2		19.6
Approach LOS				C

Intersection Summary			
Average Delay		0.2	
Intersection Capacity Utilization		62.3%	ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis

5: Hardin Valley Road & Blackberry Ridge Boulevard

10/18/2018



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	37	860	901	98	44	35
Sign Control		Free	Free		Stop	
Grade		0%	0%		2%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	41	956	1001	109	49	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage (veh)		2	2			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1110				2039	1001
vC1, stage 1 conf vol					1001	
vC2, stage 2 conf vol					1038	
vCu, unblocked vol	1110				2039	1001
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	94				80	87
cM capacity (veh/h)	637				239	297

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	41	956	1001	109	49	39
Volume Left	41	0	0	0	49	0
Volume Right	0	0	0	109	0	39
cSH	637	1700	1700	1700	239	297
Volume to Capacity	0.06	0.56	0.59	0.06	0.20	0.13
Queue Length 95th (ft)	5	0	0	0	19	11
Control Delay (s)	11.0	0.0	0.0	0.0	23.9	18.9
Lane LOS	B				C	C
Approach Delay (s)	0.5		0.0		21.7	
Approach LOS					C	

Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization			57.4%		ICU Level of Service	B
Analysis Period (min)			15			

APPENDIX H

ITE TRIP GENERATION RATES

Land Use: 210

Single-Family Detached Housing

Description

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

Additional Data

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

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

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

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)

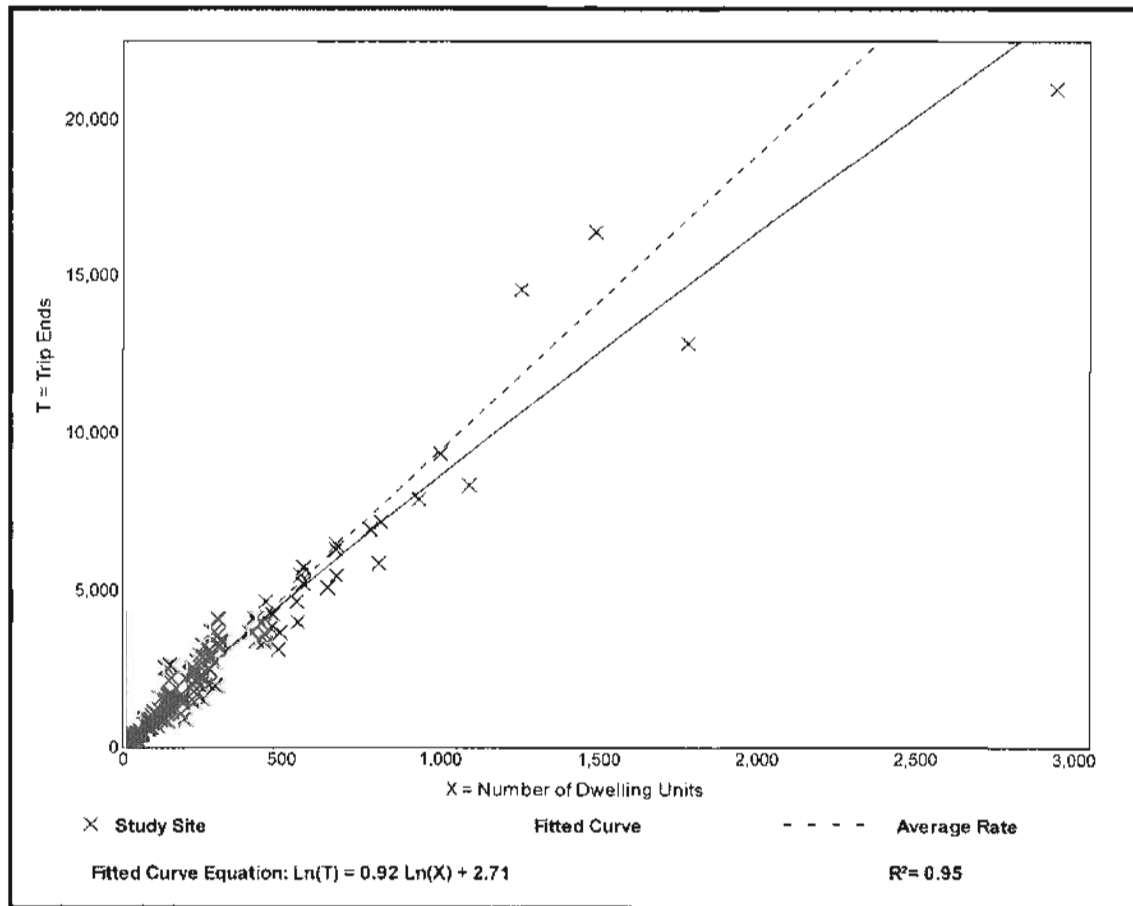
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

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)

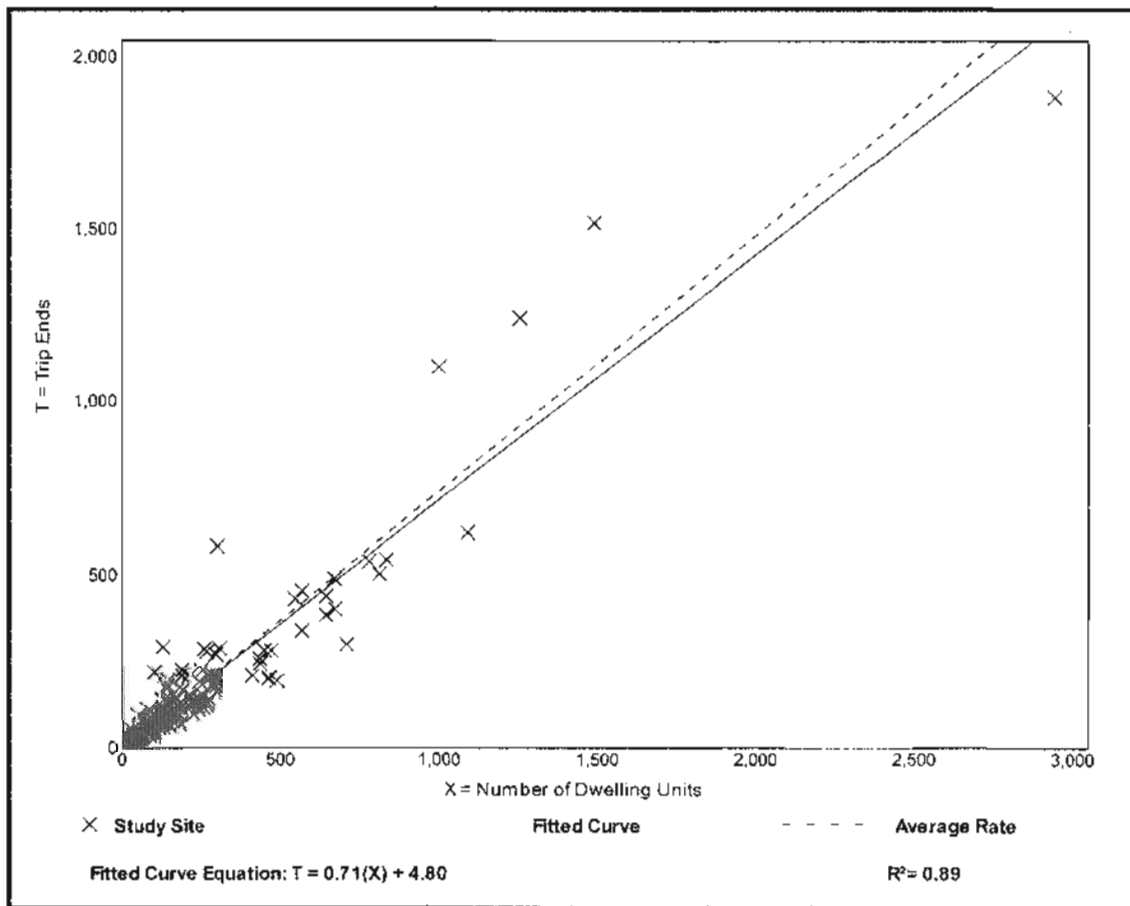
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

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



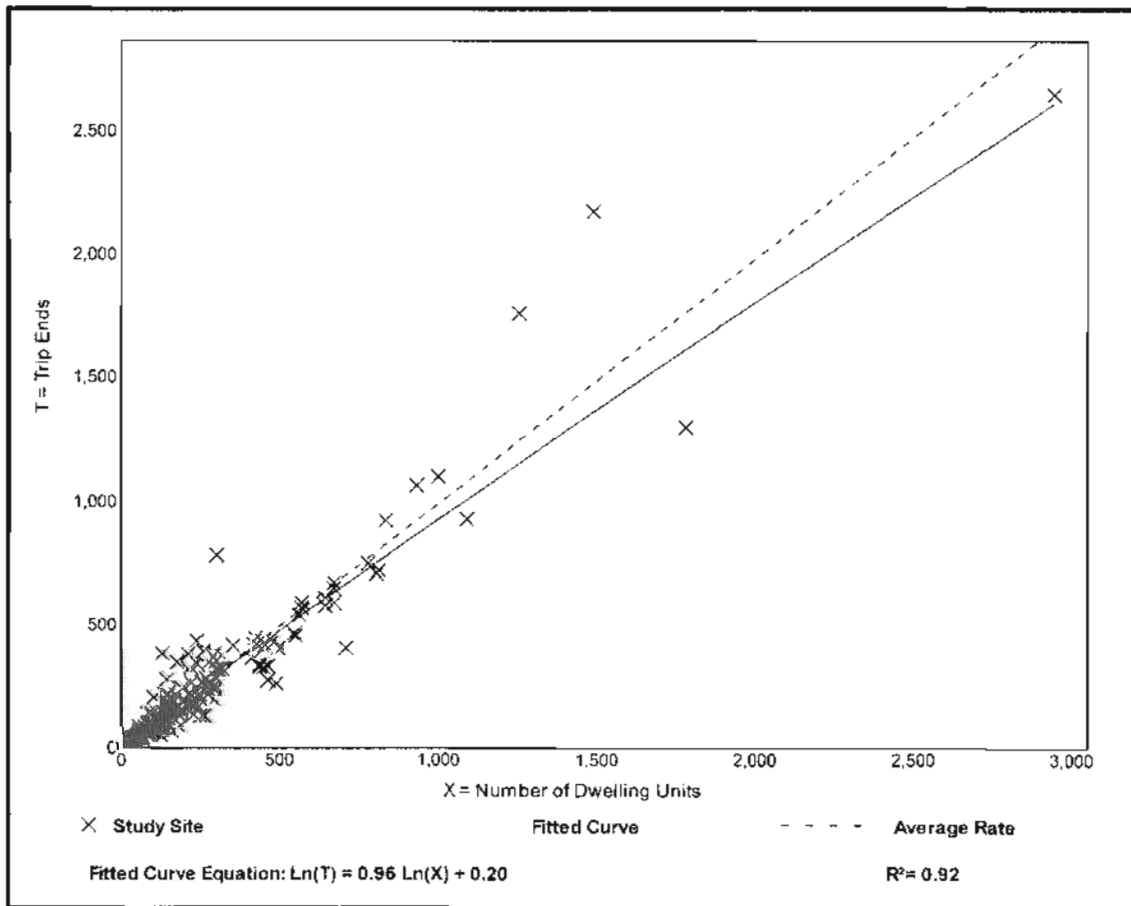
Single-Family Detached Housing (210)

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



TRIP GENERATION FOR LAUREL RIDGE SUBDIVISOIN
242 Single-Family Detached Homes

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	242 Lots	2,345	25%	75%		63%	37%	
				44	133	177	150	88	238
Total New Volume Site Trips			2,345	44	133	177	150	88	238

ITE Trip Generation Manual, 10th Edition

TRIP GENERATION FOR LAUREL RIDGE SUBDIVISION
242 single family detached homes

242 Residential Units = X

Weekday:

Fitted Curve Equation: $\ln(T) = 0.92 \ln(X) + 2.71$

$$\ln(T) = 0.92 * 5.49 + 2.71$$

$$\ln(T) = 7.76$$

$$\underline{\underline{T = 2,345 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

$$T = 0.71 * 242 + 4.80$$

$$\underline{\underline{T = 177 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: $\ln(T) = 0.96 \ln(X) + 0.2$

$$\ln(T) = 0.96 * 5.49 + 0.20$$

$$\ln(T) = 5.47$$

$$\underline{\underline{T = 238 \text{ trips}}}$$

APPENDIX I

KNOX COUNTY TURN LANE VOLUME THRESHOLD WORKSHEET

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

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

Hardin Valley Road at
Blackberry Ridge
Boulevard
Projected AM
Right Turns = 13

Right Turn Lane
NOT Warranted

* Or through volume only if a left-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

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
100 - 149 150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249 250 - 299	Yes	Yes	Yes	Yes	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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Hardin Valley Road at
Blackberry Ridge
Boulevard
Projected PM
Right Turns = 98

Right Turn Lane
Warranted

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

APPENDIX J

TRAFFIC SIGNALIZATION WARRANTS

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES

TIME BEGIN	Blackberry Ridge Blvd.		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
7:00 AM			193			176
7:15 AM			247			215
7:30 AM			180			273
7:45 AM			203			287
SUM			823			951
7-8 am			61.725			71.325
Year 2022	34	22	885	6	11	1022
8:00 AM			218			216
8:15 AM			124			250
8:30 AM			65			164
8:45 AM			53			181
SUM			460			811
8-9 am			34.5			60.825
Year 2022	25	16	495	4	8	872
11:00 AM			71			73
11:15 AM			81			100
11:30 AM			84			129
11:45 AM			82			87
SUM			318			389
11am-12 pm			23.85			29.175
Year 2022	22	15	342	4	7	418
12:00 PM			100			123
12:15 PM			119			77
12:30 PM			75			92
12:45 PM			111			103
SUM			405			395
12-1 pm			30.375			29.625
Year 2022	30	20	435	5	10	425
2:00 PM			135			176
2:15 PM			126			126
2:30 PM			131			97
2:45 PM			126			128
SUM			518			527
2-3 pm			38.85			39.525
Year 2022	30	20	557	5	10	567
3:00 PM			145			87
3:15 PM			194			89
3:30 PM			157			210
3:45 PM			157			210
SUM			653			596
3-4 pm			48.975			44.7
Year 2022	37	25	702	6	12	641
4:00 PM			149			158
4:15 PM			192			131
4:30 PM			184			152
4:45 PM			197			175
SUM			722			616
4-5 pm			54.15			46.2
Year 2022	42	28	776	7	14	662
5:00 PM			166			176
5:15 PM			197			195
5:30 PM			207			186
5:45 PM			178			162
SUM			748			719
5-6 pm			56.1			53.925
Year 2022	43	29	804	7	14	773

Existing Volumes

Existing Volumes

Existing Volumes

Existing Volumes

Sum

Growth Rate of 5% for 1.5 Years

Existing Volumes in Future

Volumes in Future

Assumed Growth Rate (%)= 5
Number of years = 1.5 (2020)

Note: The existing entering and exiting traffic that was counted was not used due to construction traffic. The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from NCHRP Report 365)

Entire Development: 1,005 Daily Trips Generated

Entering and Exiting %:		Directional Distribution Assumptions:	
25% Entering	AM Hours	30% from East	60% from West
75% Exiting		60% to East	40% to West
50% Entering	Mid-Day Hours	40% from East	50% from West
50% Exiting		50% to East	50% to West
63% Entering	PM Hours	65% from East	25% from West
37% Exiting		60% to East	40% to West

NCHRP Report 365 - Table 41
Urban Size = 500,000 - 999,999
Knoxville Urban Size (2014) = 857,585

Time of Day	Percentage of Trips
7-8 am	7.42%
8-9 am	5.42%
11 am-Noon	4.95%
Noon-1 pm	6.64%
2-3 pm	6.56%
3-4 pm	8.28%
4-5 pm	9.31%
5-6 pm	9.52%
	58.10%

For example, 7-8 AM for SB Left Turns:

Volume = 2,345 Daily Trips * 75% Exiting * 60% Trips to East * 7.42% Trips (at 7-8 AM)

Volume = 2345 x .75 x .6 x .0742

Volume = 78 Trips

This spreadsheet is used to estimate the future project hourly volumes to determine if an intersection will meet traffic signal warrants.

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES

TIME BEGIN	Blackberry Ridge Blvd.		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
7:00 AM			193			176
7:15 AM			247			215
7:30 AM			180			273
7:45 AM			203			287
SUM			823			951
7-8 am			102.875			118.875
Year 2022	56	37	926	9	19	1070
8:00 AM			218			216
8:15 AM			124			250
8:30 AM			65			164
8:45 AM			53			181
SUM			460			811
8-9 am			57.5			101.375
Year 2022	41	27	518	7	14	912
11:00 AM			71			73
11:15 AM			81			100
11:30 AM			84			129
11:45 AM			82			87
SUM			318			389
11am-12 pm			39.75			48.625
Year 2022	37	25	358	6	12	438
12:00 PM			100			123
12:15 PM			119			77
12:30 PM			75			92
12:45 PM			111			103
SUM			405			395
12-1 pm			50.625			49.375
Year 2022	50	33	456	8	17	444
2:00 PM			135			176
2:15 PM			126			126
2:30 PM			131			97
2:45 PM			126			128
SUM			518			527
2-3 pm			64.75			65.875
Year 2022	49	33	583	8	16	593
3:00 PM			145			87
3:15 PM			194			89
3:30 PM			157			210
3:45 PM			157			210
SUM			653			596
3-4 pm			81.625			74.5
Year 2022	62	42	735	10	21	671
4:00 PM			149			158
4:15 PM			192			131
4:30 PM			184			152
4:45 PM			197			175
SUM			722			616
4-5 pm			90.25			77
Year 2022	70	47	812	12	23	693
5:00 PM			166			176
5:15 PM			197			195
5:30 PM			207			186
5:45 PM			178			162
SUM			748			719
5-6 pm			93.5			89.875
Year 2022	72	48	842	12	24	809

Existing Volumes

Existing Volumes

Existing Volumes

Existing Volumes

Sum

Growth Rate of 5% for 2.5 Years

Existing Volumes in Future

Volumes in Future

Assumed Growth Rate (%)= 5
Number of years = 2.5 (2021)

Note: The existing entering and exiting traffic that was counted was not used due to construction traffic. The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from NCHRP Report 365)

Entire Development: 1,675 Daily Trips Generated

Entering and Exiting %:		Directional Distribution Assumptions:	
25% Entering	AM Hours	30% from East	60% from West
75% Exiting		60% to East	40% to West
50% Entering	Mid-Day Hours	40% from East	50% from West
50% Exiting		50% to East	50% to West
63% Entering	PM Hours	65% from East	25% from West
37% Exiting		60% to East	40% to West

NCHRP Report 365 - Table 41
Urban Size = 500,000 - 999,999
Knoxville Urban Size (2014) = 857,585

Time of Day	Percentage of Trips
7-8 am	7.42%
8-9 am	5.42%
11 am-Noon	4.95%
Noon-1 pm	6.64%
2-3 pm	6.56%
3-4 pm	8.28%
4-5 pm	9.31%
5-6 pm	9.52%
	58.10%

For example, 7-8 AM for SB Left Turns:

Volume = 2,345 Daily Trips * 75% Exiting * 60% Trips to East * 7.42% Trips (at 7-8 AM)

Volume = 2345 x .75 x .6 x .0742

Volume = 78 Trips

This spreadsheet is used to estimate the future project hourly volumes to determine if an intersection will meet traffic signal warrants.

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES

TIME BEGIN	Blackberry Ridge Blvd.		Hardin Valley Road		Hardin Valley Road	
	SOUTHBOUND		WESTBOUND		EASTBOUND	
	LT	RT	THRU	RT	LT	THRU
7:00 AM			193			176
7:15 AM			247			215
7:30 AM			180			273
7:45 AM			203			287
SUM			823			951
7-8 am			144.025			166.425
Year 2022	78	52	967	13	26	1117
8:00 AM			218			216
8:15 AM			124			250
8:30 AM			65			164
8:45 AM			53			181
SUM			460			811
8-9 am			80.5			141.925
Year 2022	57	38	541	10	19	953
11:00 AM			71			73
11:15 AM			81			100
11:30 AM			84			129
11:45 AM			82			87
SUM			318			389
11am-12 pm			55.65			68.075
Year 2022	52	35	374	9	17	457
12:00 PM			100			123
12:15 PM			119			77
12:30 PM			75			92
12:45 PM			111			103
SUM			405			395
12-1 pm			70.875			69.125
Year 2022	70	47	476	12	23	464
2:00 PM			135			176
2:15 PM			126			126
2:30 PM			131			97
2:45 PM			126			128
SUM			518			527
2-3 pm			90.65			92.225
Year 2022	69	46	609	12	23	619
3:00 PM			145			87
3:15 PM			194			89
3:30 PM			157			210
3:45 PM			157			210
SUM			653			596
3-4 pm			114.275			104.3
Year 2022	87	58	767	15	29	700
4:00 PM			149			158
4:15 PM			192			131
4:30 PM			184			152
4:45 PM			197			175
SUM			722			616
4-5 pm			126.35			107.8
Year 2022	98	65	848	16	33	724
5:00 PM			166			176
5:15 PM			197			195
5:30 PM			207			186
5:45 PM			178			162
SUM			748			719
5-6 pm			130.9			125.825
Year 2022	100	67	879	17	33	845

Existing Volumes

Existing Volumes

Existing Volumes

Existing Volumes

Sum

Growth Rate of 5% for 3.5 Years

Existing Volumes in Future

Volumes in Future

Assumed Growth Rate (%)= 5
Number of years = 3.5 (2022)

Note: The existing entering and exiting traffic that was counted was not used due to construction traffic. The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from NCHRP Report 365)

Entire Development: 2,345 Daily Trips Generated

Entering and Exiting %:		Directional Distribution Assumptions:	
25% Entering	AM Hours	30% from East	60% from West
75% Exiting		60% to East	40% to West
50% Entering	Mid-Day Hours	40% from East	50% from West
50% Exiting		50% to East	50% to West
63% Entering	PM Hours	65% from East	25% from West
37% Exiting		60% to East	40% to West

NCHRP Report 365 - Table 41
Urban Size = 500,000 - 999,999
Knoxville Urban Size (2014) = 857,585

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11 am-Noon	4.95%
Noon-1 pm	6.64%
2-3 pm	6.56%
3-4 pm	8.28%
4-5 pm	9.31%
5-6 pm	9.52%
	58.10%

For example, 7-8 AM for SB Left Turns:

Volume = 2,345 Daily Trips * 75% Exiting * 60% Trips to East * 7.42% Trips (at 7-8 AM)

Volume = 2345 x .75 x .6 x .0742

Volume = 78 Trips

This spreadsheet is used to estimate the future project hourly volumes to determine if an intersection will meet traffic signal warrants.



Traffic Signal Warrant Analysis

CIVIL ENGINEERING / TRAFFIC ENGINEERING

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2020 - Projected Traffic Volumes

Intersection Information	
Major Street Name	Hardin Valley Road
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	1
% of Right Turn Traffic to Include	0%
Minor Street Name	Blackberry Ridge Blvd.
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	No
All-Way Stop Warrant	No



Traffic Signal Warrant Analysis

CIVIL ENGINEERING TRAFFIC ENGINEERING

Hardin Valley Road (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	11	1,022		
8 - 9 AM	8	872		
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	418		
12 - 1 PM	10	425		
1 - 2 PM				
2 - 3 PM	10	567		
3 - 4 PM	12	641		
4 - 5 PM	14	662		
5 - 6 PM	14	773		
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,466	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM		885	6	
8 - 9 AM		495	4	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM		342	4	
12 - 1 PM		435	5	
1 - 2 PM				
2 - 3 PM		557	5	
3 - 4 PM		702	6	
4 - 5 PM		776	7	
5 - 6 PM		804	7	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,040	0

Blackberry Ridge Blvd. (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM				
8 - 9 AM				
9 - 10 AM				
10 - 11 AM				
11 - 12 PM				
12 - 1 PM				
1 - 2 PM				
2 - 3 PM				
3 - 4 PM				
4 - 5 PM				
5 - 6 PM				
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			0	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	34		22	
8 - 9 AM	25		16	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	22		15	
12 - 1 PM	30		20	
1 - 2 PM				
2 - 3 PM	30		20	
3 - 4 PM	37		25	
4 - 5 PM	42		28	
5 - 6 PM	43		29	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			438	0



Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2020 - Projected Traffic Volumes

Intersection Information			
Major Street (E/W Road)	Hardin Valley Road	Minor Street (N/S Road)	Blackberry Ridge Blvd.
Analyzed with	1 approach lane	Analyzed with	2 or more approach lanes
Total Approach Volume	10506 vehicles	Total Approach Volume	438 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Hardin Valley Road

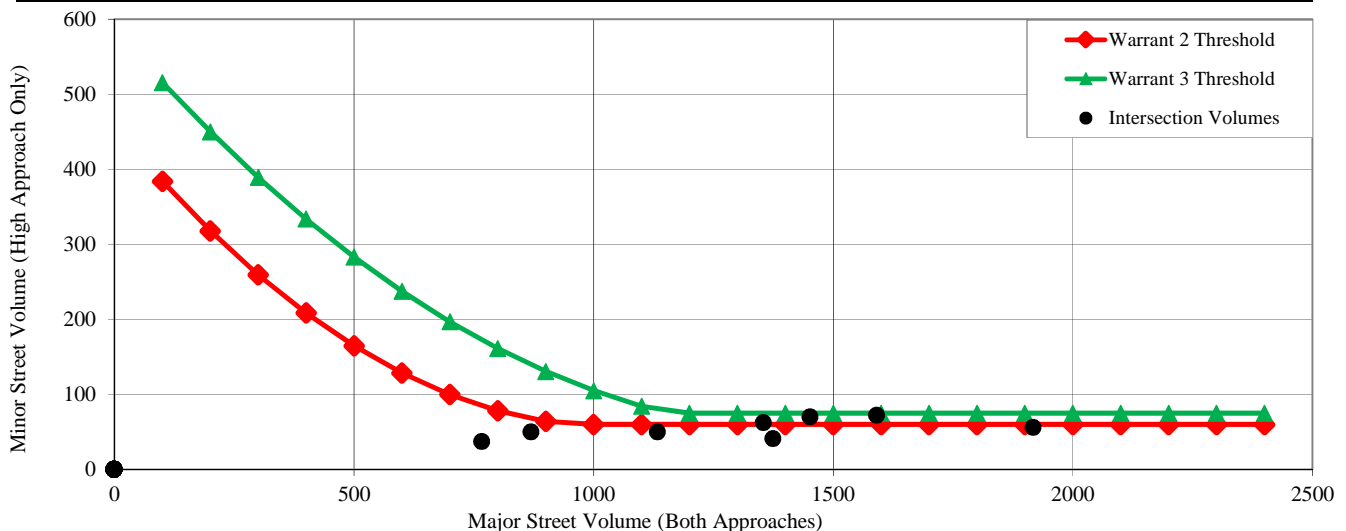
Warrant 1, Eight Hour Vehicular Volume			
Condition Satisfied?	Condition A Not satisfied	Condition B Not satisfied	Condition A+B* Not satisfied
Required values reached for	0 hours	2 hours	0 (Cond. A) & 4 (Cond. B)
Criteria - Major Street (veh/hr)	350	525	280 (Cond. A) & 420 (Cond. B)
Criteria - Minor Street (veh/hr)	140	70	112 (Cond. A) & 56 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	Not satisfied
Required values reached for	3 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
Condition Satisfied?	Condition A Not Examined	Condition B Not Satisfied
Required values reached for		0 hours
Criteria - Total Approach Volume (veh in one hour)		See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)		
Criteria - Minor Street High Side Delay (veh-hrs)		

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)





Traffic Signal Warrant Analysis

CIVIL ENGINEERING / TRAFFIC ENGINEERING

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2021 - Projected Traffic Volumes

Intersection Information	
Major Street Name	Hardin Valley Road
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	1
% of Right Turn Traffic to Include	0%
Minor Street Name	Blackberry Ridge Blvd.
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	No
All-Way Stop Warrant	No



Traffic Signal Warrant Analysis

CIVIL ENGINEERING TRAFFIC ENGINEERING

Hardin Valley Road (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	19	1,070		
8 - 9 AM	14	912		
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	12	438		
12 - 1 PM	17	444		
1 - 2 PM				
2 - 3 PM	16	593		
3 - 4 PM	21	671		
4 - 5 PM	23	693		
5 - 6 PM	24	809		
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,776	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM		926	9	
8 - 9 AM		518	7	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM		358	6	
12 - 1 PM		456	8	
1 - 2 PM				
2 - 3 PM		583	8	
3 - 4 PM		735	10	
4 - 5 PM		812	12	
5 - 6 PM		842	12	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,302	0

Blackberry Ridge Blvd. (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM				
8 - 9 AM				
9 - 10 AM				
10 - 11 AM				
11 - 12 PM				
12 - 1 PM				
1 - 2 PM				
2 - 3 PM				
3 - 4 PM				
4 - 5 PM				
5 - 6 PM				
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			0	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	56		37	
8 - 9 AM	41		27	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	37		25	
12 - 1 PM	50		33	
1 - 2 PM				
2 - 3 PM	49		33	
3 - 4 PM	62		42	
4 - 5 PM	70		47	
5 - 6 PM	72		48	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			729	0



Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2021 - Projected Traffic Volumes

Intersection Information			
Major Street (E/W Road)	Hardin Valley Road	Minor Street (N/S Road)	Blackberry Ridge Blvd.
Analyzed with	1 approach lane	Analyzed with	2 or more approach lanes
Total Approach Volume	11078 vehicles	Total Approach Volume	729 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Hardin Valley Road

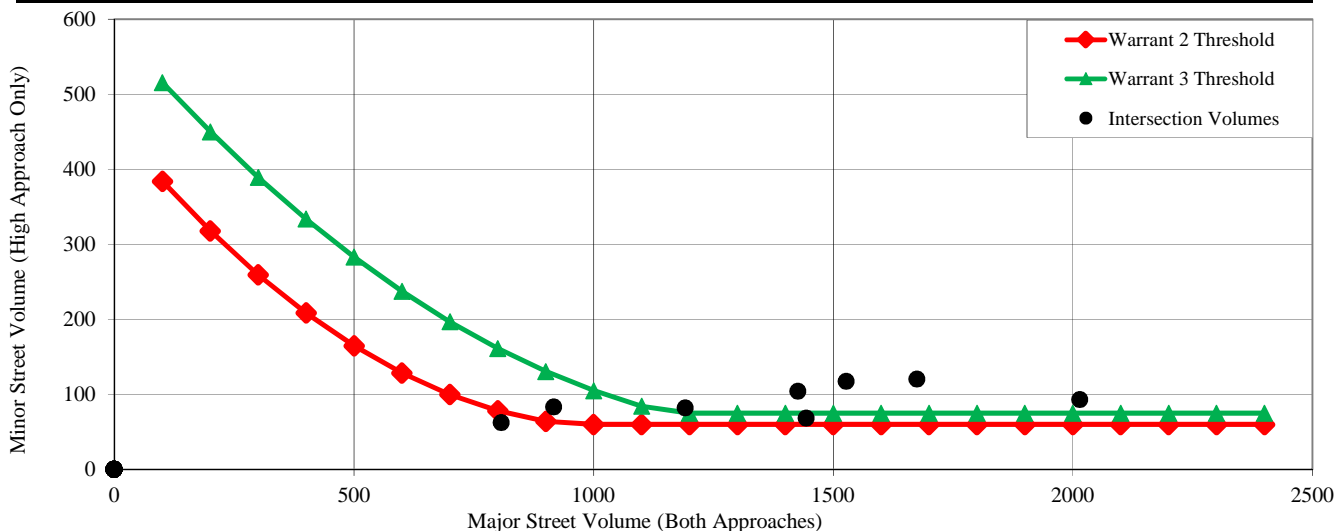
Warrant 1, Eight Hour Vehicular Volume			
Condition Satisfied?	Condition A	Condition B	Condition A+B*
	Not satisfied	Not satisfied	Not satisfied
Required values reached for	0 hours	6 hours	2 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	350	525	280 (Cond. A) & 420 (Cond. B)
Criteria - Minor Street (veh/hr)	140	70	112 (Cond. A) & 56 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	Satisfied
Required values reached for	7 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
Condition Satisfied?	Condition A	Condition B
	Not Examined	Satisfied
Required values reached for		5 hours
Criteria - Total Approach Volume (veh in one hour)		See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)		
Criteria - Minor Street High Side Delay (veh-hrs)		

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)





Traffic Signal Warrant Analysis

CIVIL ENGINEERING / TRAFFIC ENGINEERING

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2022 - Projected Traffic Volumes

Intersection Information	
Major Street Name	Hardin Valley Road
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	1
% of Right Turn Traffic to Include	0%
Minor Street Name	Blackberry Ridge Blvd.
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	No
All-Way Stop Warrant	No



Traffic Signal Warrant Analysis

CIVIL ENGINEERING TRAFFIC ENGINEERING

Hardin Valley Road (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	26	1,117		
8 - 9 AM	19	953		
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	17	457		
12 - 1 PM	23	464		
1 - 2 PM				
2 - 3 PM	23	619		
3 - 4 PM	29	700		
4 - 5 PM	33	724		
5 - 6 PM	33	845		
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,082	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM		967	13	
8 - 9 AM		541	10	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM		374	9	
12 - 1 PM		476	12	
1 - 2 PM				
2 - 3 PM		609	12	
3 - 4 PM		767	15	
4 - 5 PM		848	16	
5 - 6 PM		879	17	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,565	0

Blackberry Ridge Blvd. (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM				
8 - 9 AM				
9 - 10 AM				
10 - 11 AM				
11 - 12 PM				
12 - 1 PM				
1 - 2 PM				
2 - 3 PM				
3 - 4 PM				
4 - 5 PM				
5 - 6 PM				
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			0	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	78		52	
8 - 9 AM	57		38	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	52		35	
12 - 1 PM	70		47	
1 - 2 PM				
2 - 3 PM	69		46	
3 - 4 PM	87		58	
4 - 5 PM	98		65	
5 - 6 PM	100		67	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			1,019	0



Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Laurel Ridge Subdivision
Project/File #	1813
Scenario	2022 - Projected Traffic Volumes

Intersection Information			
Major Street (E/W Road)	Hardin Valley Road	Minor Street (N/S Road)	Blackberry Ridge Blvd.
Analyzed with	1 approach lane	Analyzed with	2 or more approach lanes
Total Approach Volume	11647 vehicles	Total Approach Volume	1019 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Hardin Valley Road

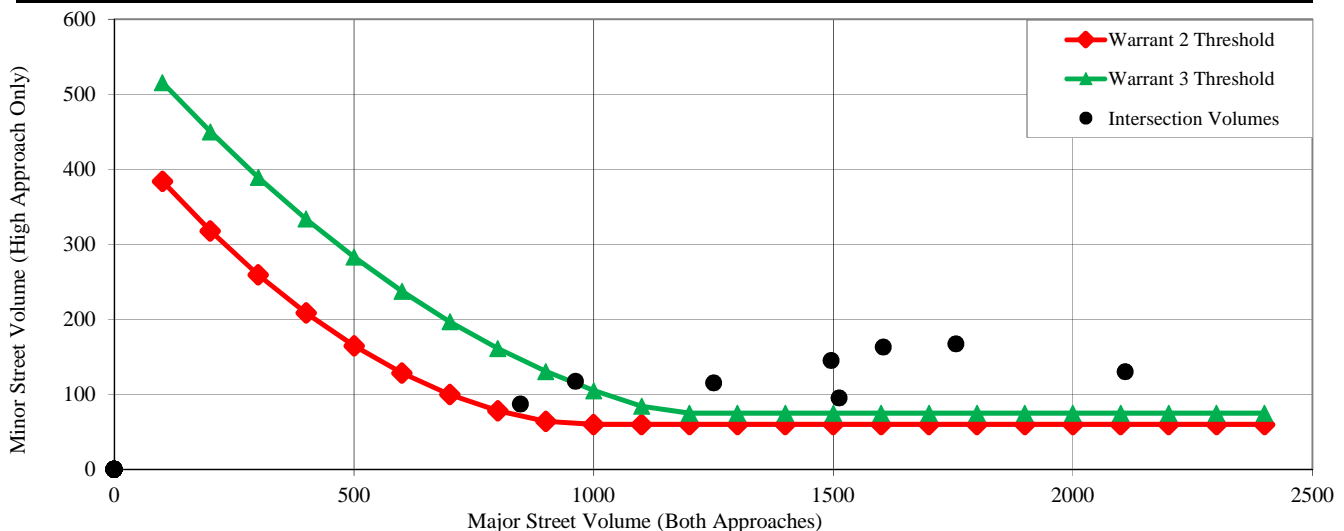
Warrant 1, Eight Hour Vehicular Volume			
Condition Satisfied?	Condition A	Condition B	Condition A+B*
Condition Satisfied?	Not satisfied	Satisfied	Not satisfied
Required values reached for	3 hours	8 hours	6 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	350	525	280 (Cond. A) & 420 (Cond. B)
Criteria - Minor Street (veh/hr)	140	70	112 (Cond. A) & 56 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	Satisfied
Required values reached for	8 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
Condition Satisfied?	Condition A	Condition B
Condition Satisfied?	Not Examined	Satisfied
Required values reached for		7 hours
Criteria - Total Approach Volume (veh in one hour)		See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)		
Criteria - Minor Street High Side Delay (veh-hrs)		

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)



APPENDIX K

MPC AND KNOX COUNTY HARDIN VALLEY MOBILITY STUDY

THE MOBILITY STUDY IS JUST GETTING UNDERWAY.

More information, including meeting notices, will be posted when it becomes available.

Hardin Valley Mobility Study

MPC and Knox County have partnered to examine existing transportation conditions and future needs in the Hardin Valley area. The study will prioritize improvements with the goal of maintaining mobility and addressing safety for people using types of transportation.



Hardin Valley is situated in the northwest part of Knox County. As measured by building activity, northwestern Knox County is the fastest growing area of the county. Rising traffic volumes, new schools and continued growth warrant a closer look at area transportation issues.

A stakeholder committee has been formed and community meetings will be scheduled after the first of the year.

Meeting Schedule

No meetings are currently scheduled. Please check back soon.

Contact Us

Community input will be a key part of developing road projects that serve the needs of residents and other travelers moving through the area by car, bike, bus and walking.

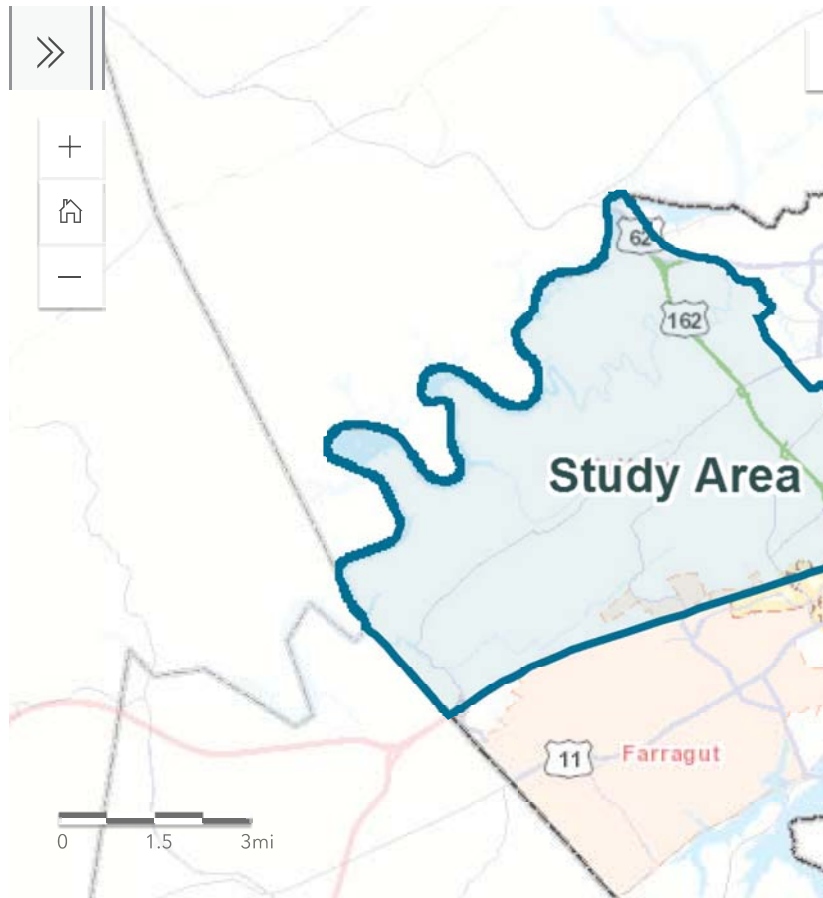
Upcoming Meeting

No meetings are currently scheduled. Please check back soon.

About the Study

The project is focused on identifying existing and future transportation facility deficiencies. Transportation improvements that were identified in past studies will be prioritized, and improvements to the road network that address safety, congestion and connections across the area will be recommended. Preliminary cost estimates for 5, 10 and 20-year horizons will then be given. Because the study will focus on travel within Hardin Valley, as well as the major roadways leading to and from it, the study will cover a larger area.

Because the studies will focus on travel within the Hardin Valley, as well as the major roadways leading to and from it, the study will include a larger area.



There are significant topographical constraints in the study area that create mobility and connectivity challenges.

Project Schedule

If you would like to discuss the study or have questions, contact us below.

Jeff Welch
(865) 215-3790 |
jeff.welch@knoxtrans.org

Questions? Comments? Concerns?
Fill out the form below, and voice your input for this project.

Name

*Email

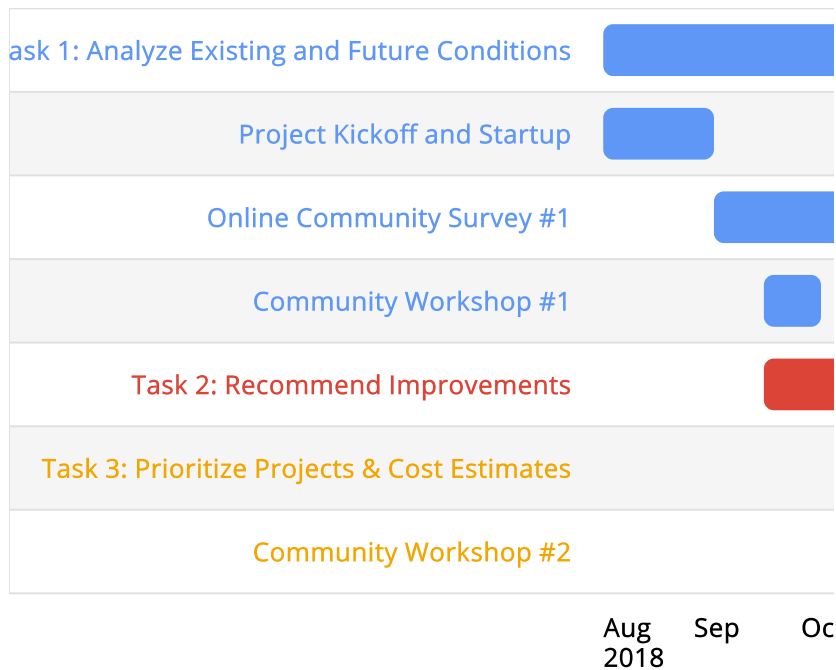
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The project is expected to begin in the summer of 2018 and be completed by the spring of 2019. Data collection activities, such as traffic counts, will begin in the Fall of 2018, when school returns to session.



Community Input

Throughout the project, MPC will work to engage citizens, property owners, the business community, and elected officials. Outreach will include:

- Formation of a steering committee
- Stakeholder interviews
- Two public meetings to gather input on the issues in the area and to solicit feedback on project recommendations
- Online input opportunities



CIVIL ENGINEERING / TRAFFIC ENGINEERING

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October 22, 2018

PROJECT NAME: Laurel Ridge Phase 3

TO: Knoxville/Knox County Metropolitan Planning Commission (MPC)
Knox County Engineering Department

SUBJECT: TIS Comment Response Document for Laurel Ridge Phase 3
Review Comments dated October 16, 2018

Dear MPC and Knox County staff,

The following comment response document is submitted to address comments dated October 16, 2018.

- 1. Reviewer Comment: Please discuss and evaluate the offset intersections of Blackberry Ridge Blvd and Berrywood Drive within the report. The previous TIS discussed this small separation and the hazards it poses to traffic circulation along Hardin Valley Road. Please include discussion of this. Also, please discuss and evaluate the internal road connection between this subdivision and the adjacent subdivision to the east. It is assumed that this connection will be completed and be a condition of the Staff's recommendation for this development plan. The connection is mentioned in the back of the report on page 43, but is not discussed in the Executive Summary or the rest of the report. The review team believes the traffic split to the adjacent subdivision should at least be 10 percent or higher to and from.**

Response: On page 41 section 1c, the report has been revised to include a discussion regarding the potential hazards of the existing offset intersections of Blackberry Ridge Boulevard and Berrywood Drive at Hardin Valley Road. These offset intersections are also discussed on page 44 with respect to potential traffic signalization. The discussion of the internal road connection has been updated on page 46 and is also included in the Executive Summary recommendations on page 3.

Also, the projected trip distribution of Laurel Ridge Subdivision has been updated and revised to indicate that it is assumed that 10% of generated traffic will use this internal road connection. This assumed distribution change is reflected on page 29 and in Figure 6.

- 2. Reviewer Comment: Within the study's Recommendations on pages 2-3, please discuss what would happen with the movement of traffic from Berrywood Drive if there was a signal installed at some point in the future. Would the signal need to be an offset signalized intersection with Berrywood Drive? How would Berrywood Drive traffic turn left onto Hardin Valley with a signal at Blackberry Ridge Blvd? Would the available TWLTL be enough for Berrywood Drive left turns onto Hardin Valley Drive? Etc.**

Response: The report has been updated in the Executive Summary on page 3 and in the Conclusions and Recommendations on page 44 to include the discussion on what the impact would be on installing a traffic signal. This discussion includes the impact and need for offset signalized t-intersections.

- 3. Reviewer Comment: On page 3 first full bullet down, please add "or as determined by Knox County Engineering" after "subdivision".**

Response: On page 3 second bullet down (formerly first full bullet down), "or as determined by Knox County Engineering" after "subdivision" was added. This phrase was also changed on page 45, part 1e.

- 4. Reviewer Comment: On page 4 first paragraph, please re-word "being constructed and no are being built" to "being constructed and no homes are being built."**

Response: On page 5 (formerly page 4) first paragraph, "being constructed and no are being built" was changed to "being constructed and no homes are being built."

- 5. Reviewer Comment: On page 19 second paragraph, please re-word "The new roads in Phase 3" to "The new road and extension of an existing road in Phase 3".**

Response: On page 20 (formerly page 19) second paragraph, "The new roads in Phase 3" was re-worded to "The new road and extension of an existing road in Phase 3".

- 6. Reviewer Comment: In discussion about the traffic growth along Hardin Valley Road on page 24, there would be no need to look at the past 10 years of growth along this corridor, especially with the abrupt anomaly between 2010 and 2011. In this case, please just use the data for the past 5 years of**

traffic counts. The anomaly is not a good representation of what the growth has been over the past several years.

Response: On page 25 (formerly page 24), the discussion regarding the assumed traffic growth rate has been revised and updated. The report has been changed to reflect an assumed annual growth rate of 5%.

7. Reviewer Comment: On page 34, the report discusses sight distance. Please measure and report the available sight distance at both locations available to the subdivision.

Response: On page 36 (formerly page 34), the discussion regarding sight distance has been updated to include approximate measurements for sight distance.

8. Reviewer Comment: On page 41 last paragraph of 1c), please reword the last sentence. The “signal” will possibly provide some congestion...

Response: On page 45 (formerly page 41) last paragraph of 1d (formerly 1c), the last sentence was re-worded to “The projected traffic signal should be included in this study and possibly will provide congestion relief in this area of Hardin Valley.”

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

- Updated Title Page
- Updated Table of Contents and page numbers
- Updated Page Footers
- Updated Figures 2, 3a, 3b, 4 - 8
- Updated Tables 1, 3, and 5
- Updated Appendix F, G, H, and I
- Miscellaneous updates on pages 5, 7, 8, 21 to include the intersection of Hardin Valley Road at Berrywood Drive in the analyses

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.

