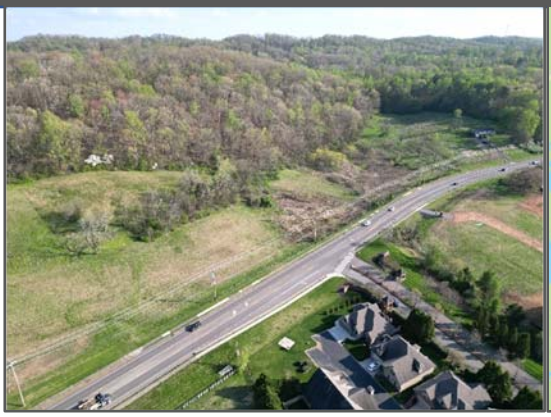
AJAX ENGINEERING

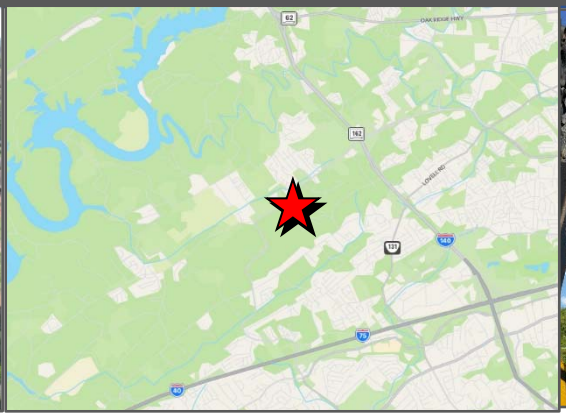
CIVIL ENGINEERING / TRAFFIC ENGINEERING

Transportation Impact Study

Cruz Landing & Maya Hill Subdivisions

Knox County, Tennessee





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5/19/2023

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EXECUTIVE SUMMARY

Preface:

Two residential developments are being proposed on three parcels adjacent to Hardin Valley Road in Northwest Knox County, TN. The proposed developments will include a total of 117 attached townhouses on 59.5 +/- acres. One of the developments will construct 62 units and is named "Cruz Landing Subdivision". The other residential development, "Maya Hills Subdivision, " will include 55 units. These residential subdivisions are anticipated to be fully built out and occupied by 2026 and propose two separate entrances on the south side of Hardin Valley Road.

This study's primary purpose is to determine and evaluate the potential impacts of the developments on the adjacent transportation system. The study includes a review of the primary access road and subdivision entrance intersections and is a Level 1 study established by Knoxville/Knox County Planning. Recommendations and mitigation measures are offered where transportation operations are projected to be below recognized engineering standards.

Study Results:

The significant findings of this study include the following:

- Cruz Landing Subdivision, with 62 attached townhouse units, is estimated to generate 621 trips at full build-out and occupancy on an average weekday. Of these daily trips, 34 are estimated to occur during the AM peak hour and 52 in the PM peak hour in 2026. Maya Hills Subdivision, with 55 attached townhouse units, is estimated to generate 557 trips at full build-out and occupancy on an average weekday. Of these daily trips, 31 are estimated to occur during the AM peak hour and 47 in the PM peak hour in 2026. Combined, the two subdivisions will generate 1,178 daily trips, 65 trips in the AM peak hour, and 99 in the PM peak hour.
- The proposed entrances for Cruz Landing and Maya Hills Subdivisions at Hardin Valley Road are expected to operate with reasonable vehicle delays in the projected 2026 AM and PM peak hours. These results are based on free-flow operations occurring on Hardin Valley Road; however, when local schools are open, significant backups and vehicle queues occur on Hardin Valley Road during the school's arrival and departure periods.

- The projected 2026 traffic volumes do not warrant the construction of separate entering eastbound right-turn lanes on Hardin Valley Road at the proposed entrances for Cruz Landing and Maya Hills Subdivisions. However, the projected 2026 traffic volumes warrant the construction of a separate westbound left-turn lane on Hardin Valley Road at the proposed Maya Hills Subdivision entrance. The existing center lane on Hardin Valley Road will serve westbound left turns at the proposed Cruz Landing Subdivision entrance. A single exiting lane for the development entrances at Hardin Valley Road will be sufficient.
- Due to the ongoing regular vehicle backups on Hardin Valley Road during peak periods, it is apparent that this road needs additional throughput vehicle capacity. Overall, these proposed developments will contribute minimal volumes to the traffic stream on Hardin Valley Road in the AM and PM peak hours.

Recommendations:

The following recommendations are offered based on the study analyses to minimize the impacts of the proposed developments on the adjacent transportation system while attempting to achieve an acceptable traffic flow and improved safety. More details regarding these recommendations are discussed at the end of the report.

Cruz Landing Subdivision

- It is recommended that the center of Hardin Valley Road be modified between the proposed Cruz Landing Subdivision entrance and Brighton Farms Boulevard to accommodate the new entrance. The modification should include restriping the center lane on Hardin Valley Road to provide 75 feet of dedicated vehicle storage for a westbound left-turn lane at the Cruz Landing Subdivision entrance. It should also include maintaining the 100 feet of dedicated vehicle storage for the eastbound left-turn lane at Brighton Farms Boulevard as currently provided. The remaining 50 feet between the two left-turn storage lanes should incorporate a double yellow centerline taper separating the two opposing lanes.
- It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Cruz Landing Subdivision entrance approach at Hardin Valley Road. The stop bar should be applied a minimum of 4 feet away from the edge of Hardin Valley Road and placed at the desired stopping point that maximizes the sight distance.
- The continuous center two-way left-turn lane (TWLTL) pavement striping in the center of Hardin Valley Road should be removed in front of the new Cruz Landing

Subdivision entrance to accommodate this new intersection with the new turning movements.

- Based on a posted speed limit of 40-mph on Hardin Valley Road, the required intersection sight distance is 400 feet for exiting left and right-turning vehicles at the proposed Cruz Landing Subdivision entrance. The site designer must verify that these distances will be available. If possible, the site designer should consider sloping back the existing earthen bank on the south side of Hardin Valley Road to increase the available sight distance looking to the northeast. Intersection sight distance at the proposed Cruz Landing Subdivision entrance at Hardin Valley Road must not be impacted by future landscaping or signage.

Cruz Landing Subdivision

- The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Hardin Valley Road at the proposed entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.
- The developer should request a variance to allow the proposed Cruz Landing Subdivision entrance to have spacing on Hardin Valley Road below the Knox County minimum. Due to the wetlands, site topography, and high-impact utility lines, this variance should be requested since the Cruz Landing Subdivision development property has a limited area to provide an entrance on Hardin Valley Road at any other location.
- The projected left-turn volumes in 2026 warrant the construction of an exclusive westbound left-turn lane on Hardin Valley Road at the Maya Hills Subdivision entrance based on Knox County standards. To provide this new westbound left-turn lane for Maya Hills Subdivision, it is recommended that the existing center TWLTL on Hardin Valley Road be extended between Brooke Willow Boulevard and the school access entrance. It is recommended that a left-turn lane be constructed with 75 feet of storage at the Maya Hills Subdivision Entrance.

Maya Hills Subdivision

- It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Maya Hills Subdivision entrance approach at Hardin Valley Road. The stop bar should be applied a minimum of 4 feet away from the edge of Hardin Valley Road and placed at the desired stopping point that maximizes the sight distance.
- The double yellow centerline in the center of Hardin Valley Road should be removed in front of the new Maya Hills Subdivision entrance to accommodate this new intersection with the new turning movements.

Maya Hills Subdivision

- Based on a posted speed limit of 40-mph on Hardin Valley Road, the required intersection sight distance is 400 feet for exiting left and right-turning vehicles at the proposed Maya Hills Subdivision entrance. The site designer must verify that these distances will be available. Intersection sight distance at the proposed Maya Hills Subdivision entrance at Hardin Valley Road must not be impacted by future landscaping or signage.
- The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Hardin Valley Road at the proposed Maya Hills Subdivision entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.
- A 25-mph Speed Limit Sign (R2-1) is recommended to be posted near the beginning of the development entrances off Hardin Valley Road. It is recommended that a "No Outlet" Sign (W14-2a) be installed at the front of the Cruz Landing Subdivision at Hardin Valley Road. The "No Outlet" (W14-2a) sign can be installed above or below the street name sign or separately posted. It is recommended that a "Dead End" Sign (W14-1) be installed at the front of the Maya Hills Subdivision at Hardin Valley Road.
- A Stop Sign (R1-1) and a 24" white stop bar are recommended at the end of Road "A" at Road "B" in Cruz Landing Subdivision.
- Sight distance at the new internal intersections must not be impacted by new signage, parked cars, or future landscaping in the subdivisions. With a speed limit of 25-mph in the developments, the internal intersection sight distance is 250 feet. The required stopping sight distance is 155 feet for a level road grade. The site designer should ensure that internal sight distance lengths are met.
- All drainage grates and covers for the residential developments must be pedestrian and bicycle safe.
- If directed by the local post office, the site designer should include a parking area within the developments for a centralized mail delivery center. The site plans do show a general location in both developments, but a specific plan with a parking area should be designed and provided if required.
- All road grade and intersection elements should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.

DESCRIPTION OF EXISTING CONDITIONS

- **STUDY AREA:**

The proposed location of the two new residential developments is shown on a map in Figure 1. These proposed developments will be located off Hardin Valley Road, just east of the Hardin Valley public schools in Northwest Knox County, TN. The proposed access entrances for these developments will be constructed entering Hardin Valley Road from the south, separated by approximately 990 feet. These proposed subdivisions will not have a direct internal road connection to each other.

As Knoxville/Knox County Planning requested, transportation impacts associated with the proposed developments were analyzed at the proposed entrances on Hardin Valley Road, where the proposed developments will have road access to and from external destinations. The analysis of these two subdivisions was combined due to their proximity to each other and because they share a common developer.

View of Development Sites along Hardin Valley Road
(Looking Southeast across from Hardin Valley Road)

The proposed developments will be located in an aggressively growing area of Northwest Knox County, TN. Many new and established subdivisions, some remaining undeveloped properties, and public schools are near the proposed development sites. The existing development sites have challenging topography, with the southern rear portion of the properties sloped towards the north, towards Hardin Valley Road. A large wetland with a drainage easement exists between the two proposed subdivisions and will remain undisturbed. The development properties will be located on three existing parcels. An abandoned single-family detached house currently occupies the westernmost, smallest parcel and will be removed during construction. Most of the land on the larger two parcels is occupied by woodlands, maintained fields, and wetland areas.

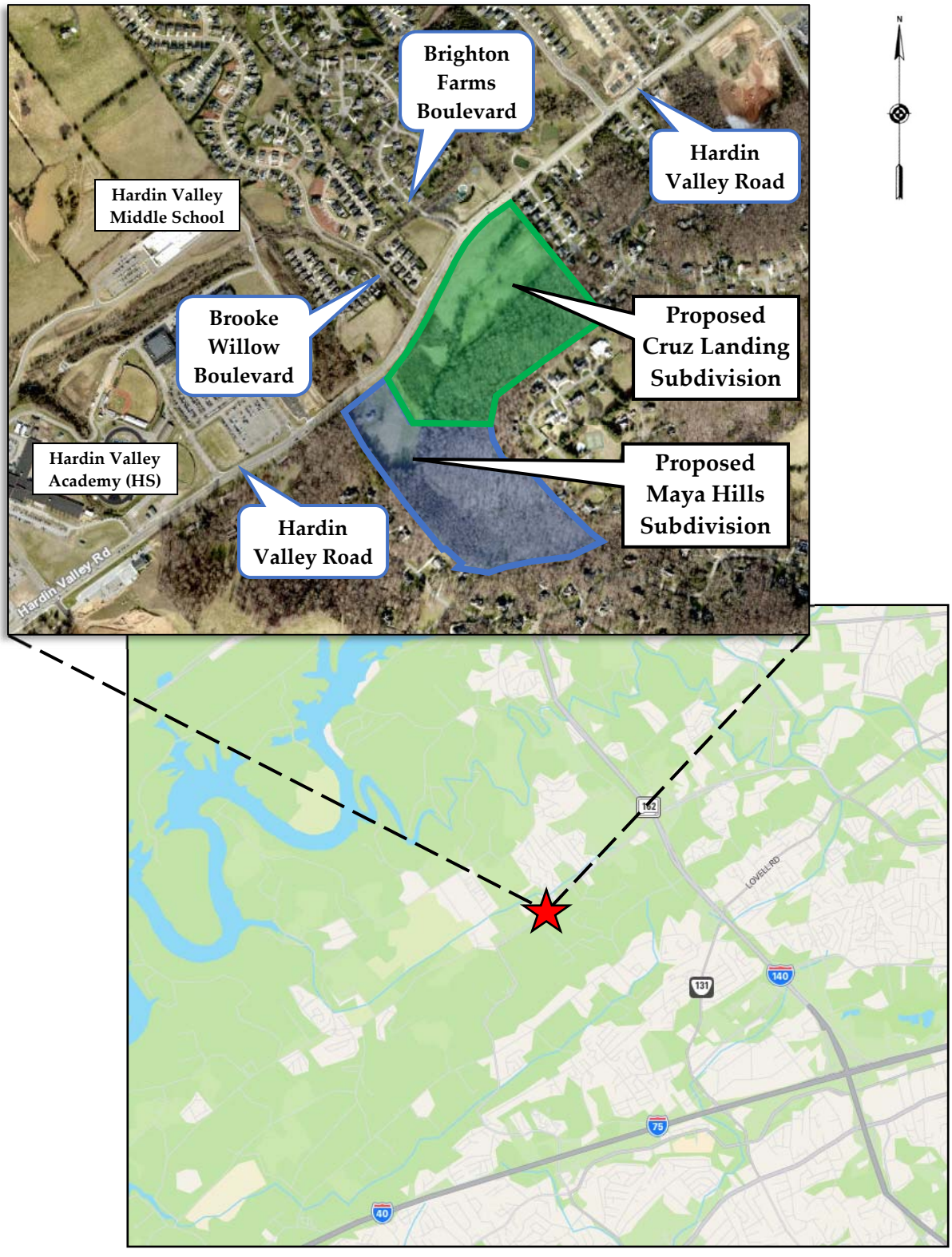


Figure 1
Location Map

- **EXISTING ROADWAYS:**

Table 1 lists the characteristics of the existing primary access roadway adjacent to the development properties and included in the study:

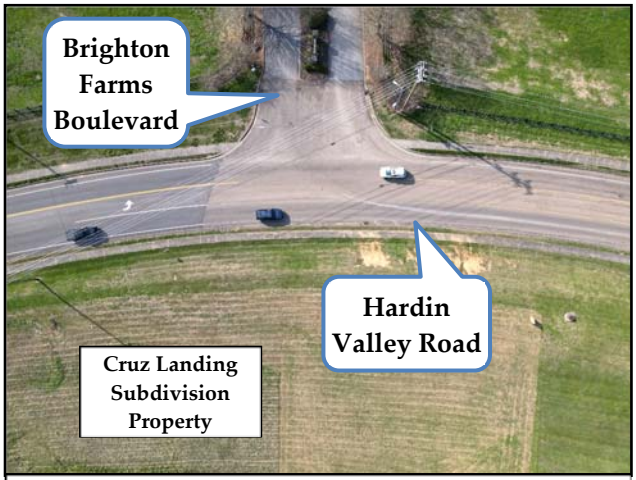
TABLE 1
STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION [1]	SPEED LIMIT	LANES	ROAD WIDTH [2]	TRANSIT [3]	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Hardin Valley Road (at Proposed Cruz Landing Subdivision Entrance)	Minor Arterial	40 mph	3 lanes with TWLTL	43.5 feet	None	Sidewalks on both sides of roadway	No bike lanes
Hardin Valley Road (at Proposed Maya Hills Subdivision Entrance)	Minor Arterial	40 mph	2 lanes undivided	43 feet	None	Sidewalks on both sides of roadway	No bike lanes

[1] 2018 Major Road Plan by Knoxville/Knox County Planning
[2] Edge of curb face to edge of curb face near project site
[3] According to Knoxville Area Transit System Map

Hardin Valley Road is classified as a minor arterial and traverses in a generally northeast-southwest direction. Hardin Valley Road is 6.1 miles long. This road runs between Ball Camp Byington Road on the northeast side to the intersection with Hickory Creek Road and Gallaher Ferry Road on its southwest end at a recently constructed roundabout. To the east of the study area, Hardin Valley Road provides access to Pellissippi Parkway (SR 162) for travel to the south towards Interstate 40/75/140 and to the north towards Oak Ridge, TN. The posted speed limit on Hardin Valley Road is 40 mph at the development properties.

Across from the development properties and on the northwest side of Hardin Valley Road, two existing subdivision entrances for Brighton Farms and The Glen at Hardin Valley intersect Hardin Valley Road. These t-intersections are unsignalized, and the minor approaches of Brighton Farms Boulevard and Brooke Willow Boulevard are controlled by Stop Signs (R1-1). The centerline to centerline distance between Brighton Farms Boulevard and Brooke Willow Boulevard is 605 feet.



Hardin Valley Road at Brighton Farms Boulevard

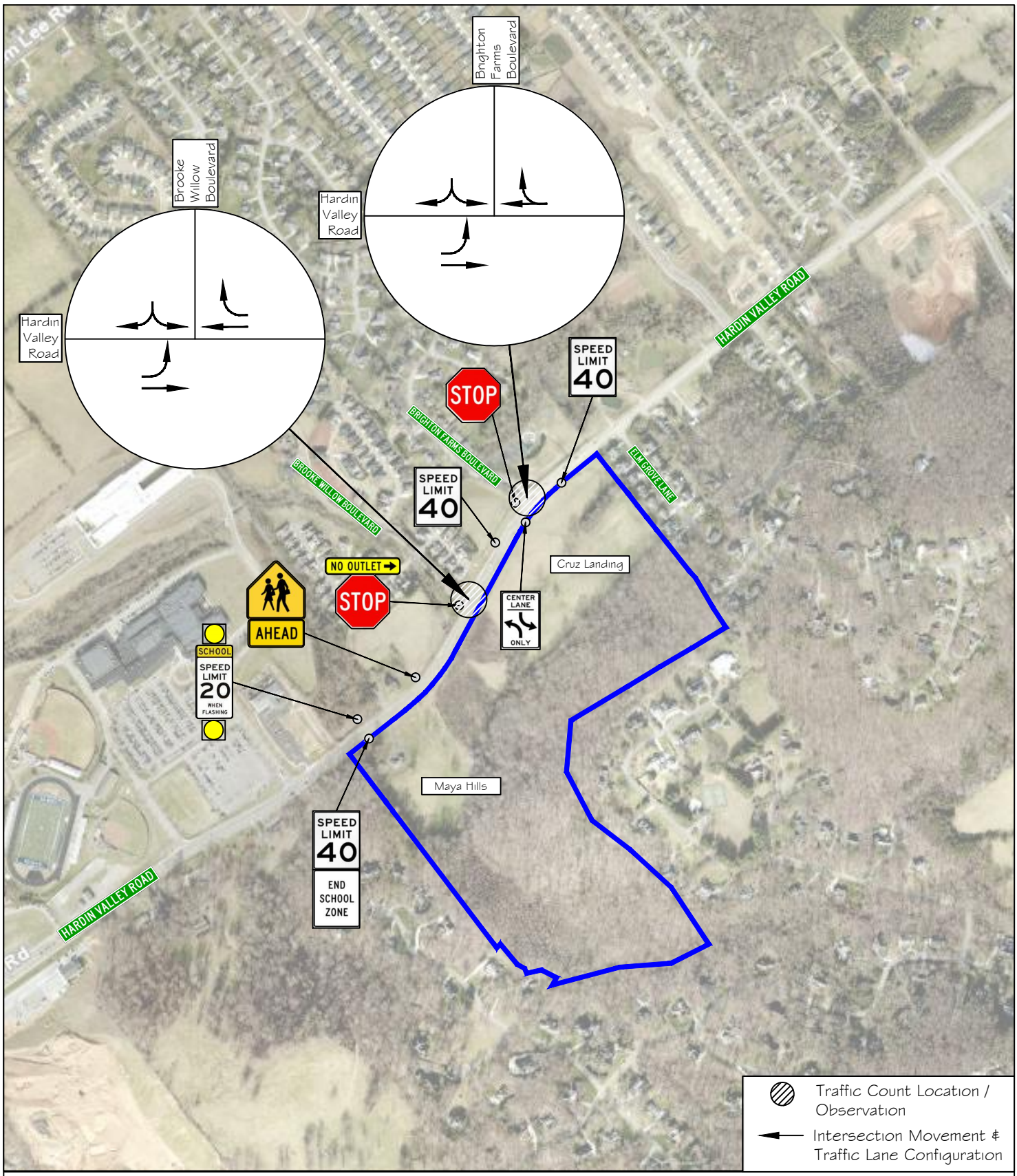
Cruz Landing Subdivision will be located across from Brighton Farms Boulevard, and its proposed entrance will be 280 feet west of this existing intersection on Hardin Valley Road. Hardin Valley Road at the proposed entrance for the Cruz Landing Subdivision consists of a 3-lane road section with a continuous center two-way left turn lane (TWLTL) separating the opposing traffic. At the Brighton Farms Boulevard intersection, the eastbound approach of Hardin Valley Road has an exclusive left-turn lane with 100 feet of vehicle storage designated in the TWLTL.

Hardin Valley Road at the proposed road entrance for Maya Hills Subdivision currently has a 2-lane road section. The Maya Hills Subdivision entrance will be constructed further west on Hardin Valley Road and west of Brooke Willow Boulevard. This proposed entrance will be approximately 660 feet southwest of Brooke Willow Boulevard. At the Brooke Willow Boulevard entrance for The Glen at Hardin Valley Subdivision, Hardin Valley Road has an exclusive left-turn lane with 100 feet of vehicle storage designated in the center lane and a westbound exclusive right-turn lane with 75 feet of vehicle storage and a 140-foot taper. To the west of Brooke Willow Boulevard, Hardin Valley Road is reduced to two lanes before being expanded with turn lanes in front of the Hardin Valley public schools. To the west of the proposed Maya Hills Subdivision entrance, Hardin Valley Road is posted with a flashing school limit sign which reduces the speed limit to 20 mph when flashing.

Hardin Valley Road at Brooke Willow Boulevard

Hardin Valley Road in the study area has a relatively level vertical alignment and minor horizontal curvature. There are 5-foot wide concrete sidewalks on both sides of Hardin Valley Road, and the roadway is lined with 6" concrete curbs and 24" gutters. A few utility street lights are provided along Hardin Valley Road in the adjacent study area.

Figure 2 shows the existing lane configurations of the intersections and locations where the traffic counts were conducted for the study and the current traffic road signage in the study area. The road signage shown in Figure 2 only includes warning and regulatory signage near the development site. The pages following Figure 2 give a further overview of the site study area with photographs.



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NOT TO SCALE

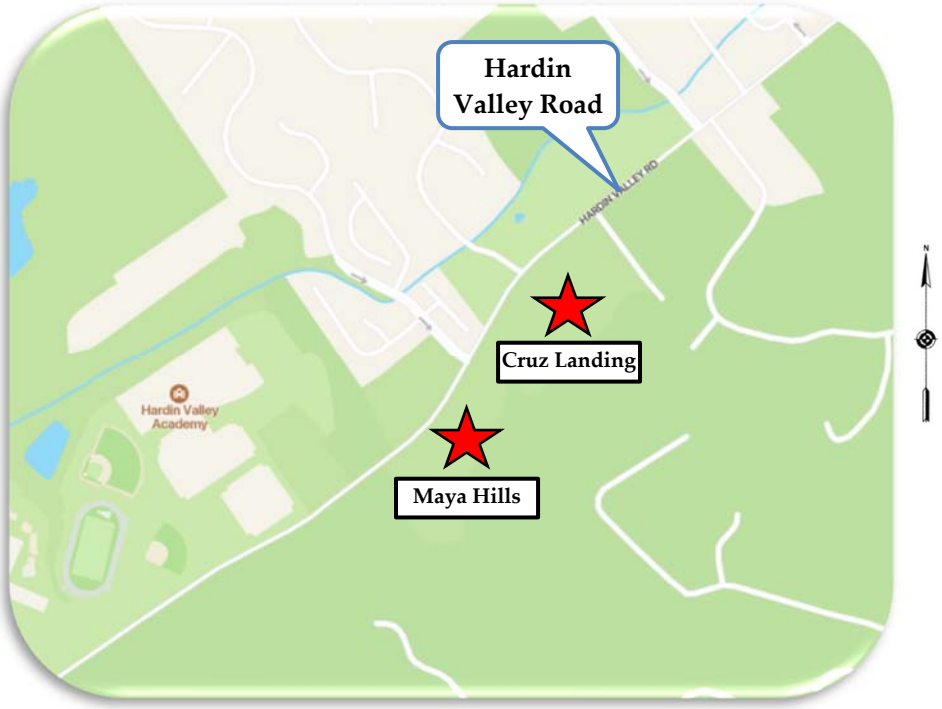
NORTH

FIGURE 2

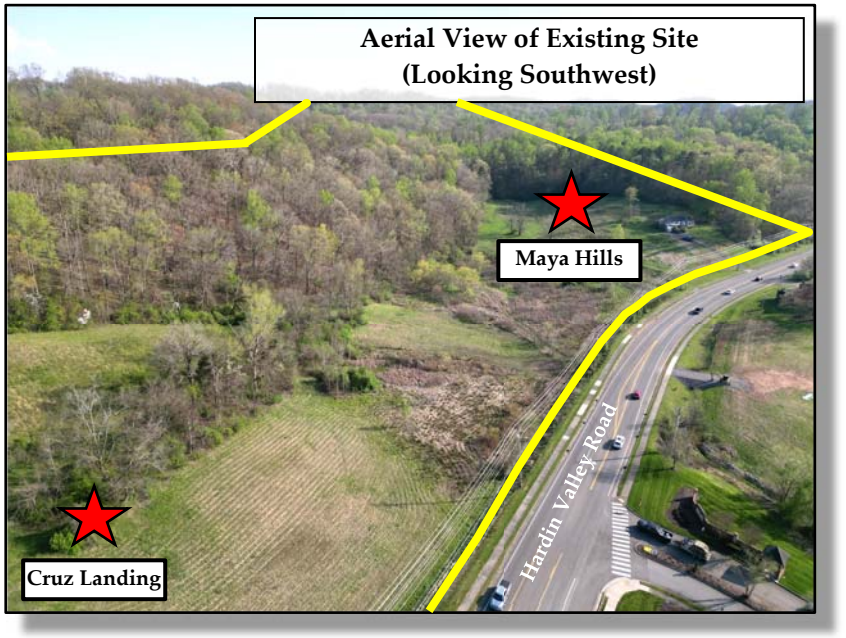
Cruz Landing & Maya Hills Subdivisions

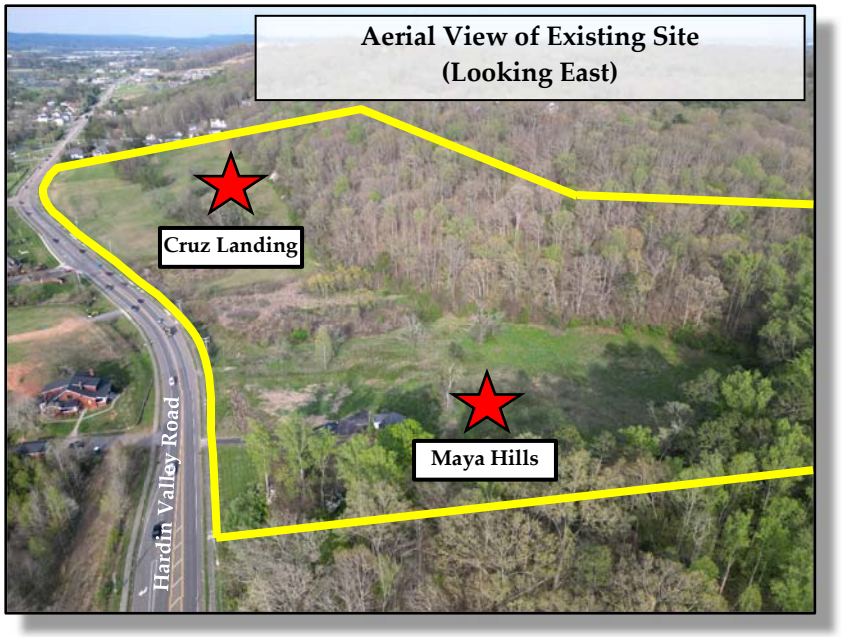
Traffic Count Locations, Traffic Signage & Existing Lane Configurations

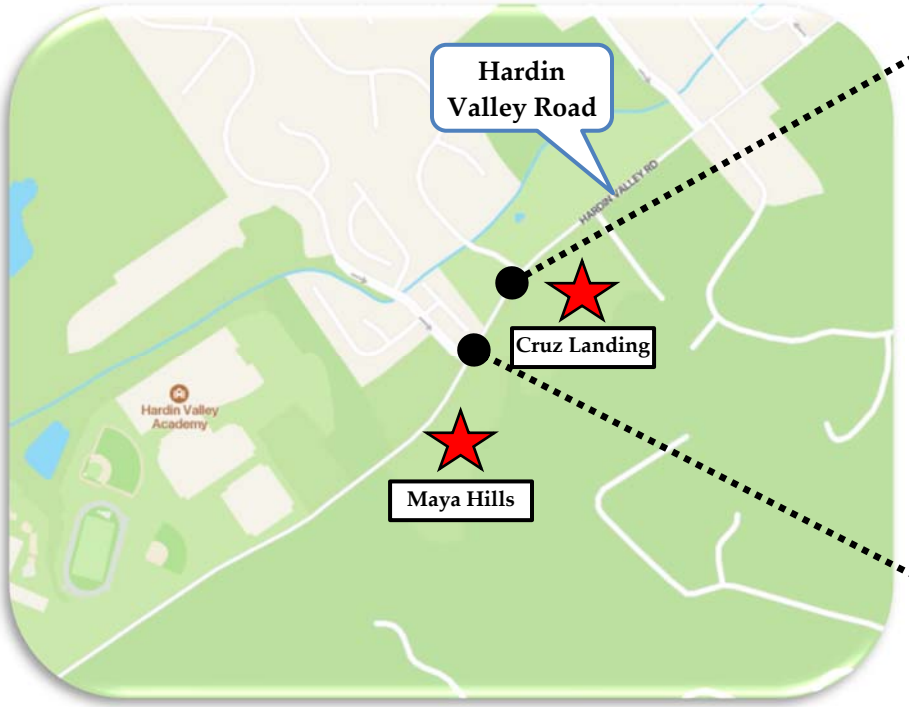
PHOTO EXHIBITS



Hardin Valley Road at Proposed Development Sites

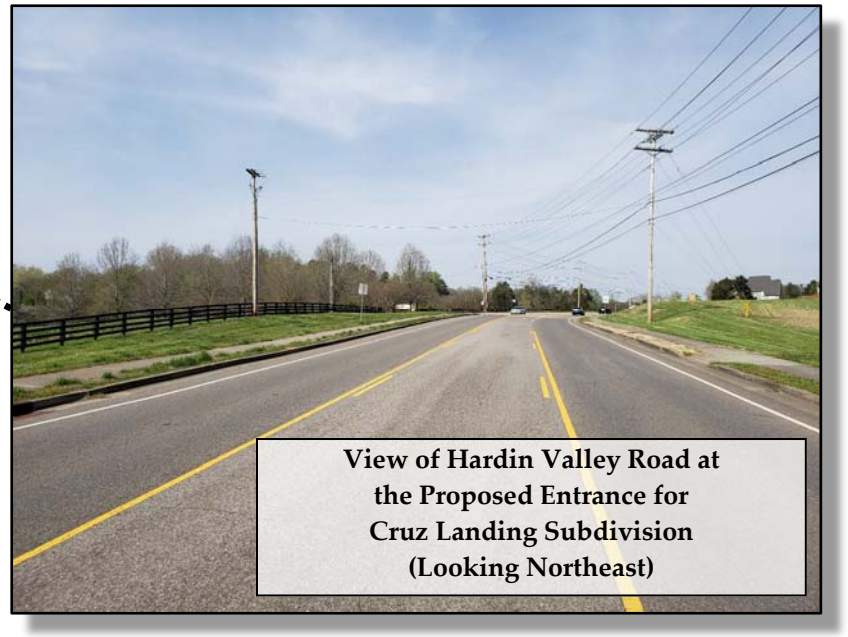




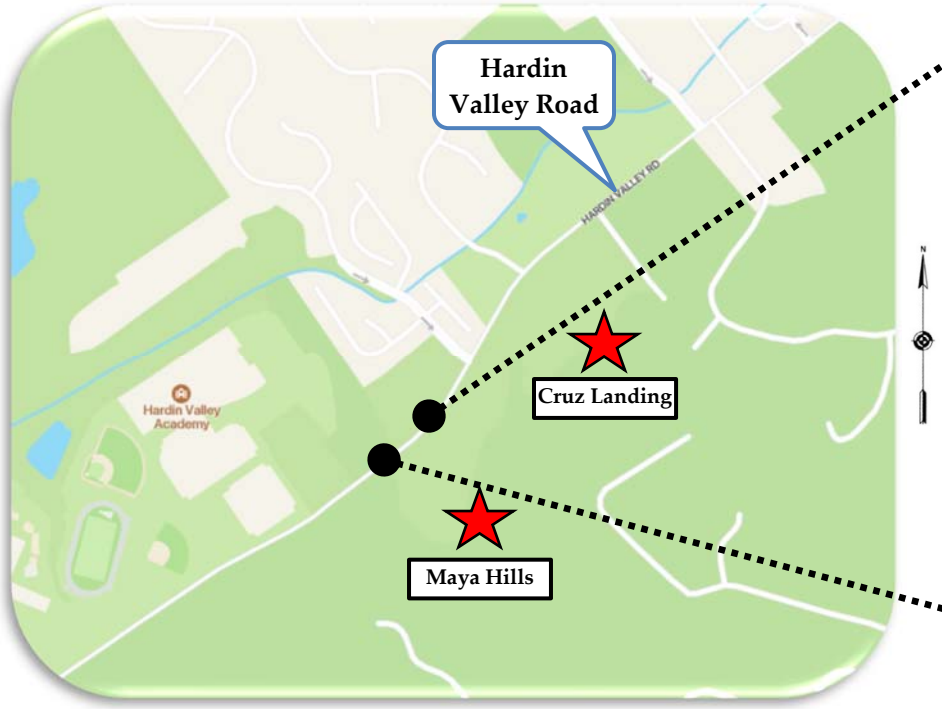


Hardin Valley Road at Proposed Development Sites

View of Hardin Valley Road at Proposed Entrance for Cruz Landing Subdivision (Looking Southwest)

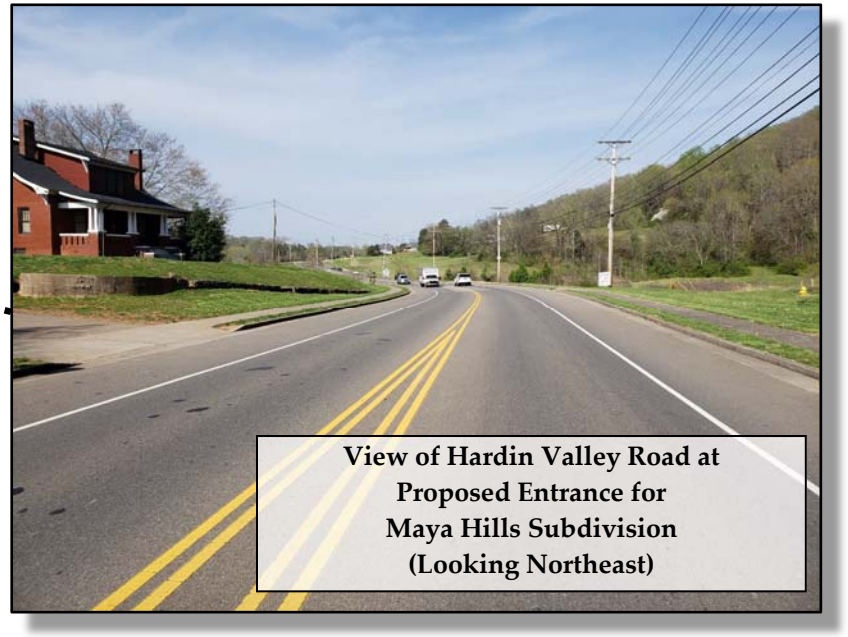


View of Hardin Valley Road at the Proposed Entrance for Cruz Landing Subdivision (Looking Northeast)



Hardin Valley Road at Proposed Development Sites

View of Hardin Valley Road at Proposed Entrance for Maya Hills Subdivision (Looking Southwest)



View of Hardin Valley Road at Proposed Entrance for Maya Hills Subdivision (Looking Northeast)

- **EXISTING TRANSPORTATION VOLUMES PER MODE**:

A few annual vehicular traffic count locations exist near the study area, and the Tennessee Department of Transportation (TDOT) and the Knoxville Regional Transportation Planning Organization (TPO) conduct these counts. The TPO counts are intermittently conducted. The count location data is the following and can be viewed with further details in Appendix A:

- Existing vehicular roadway traffic:
  - TDOT reported an Average Daily Traffic (ADT) on Hardin Valley Road, west of Valley Vista Road and east of the development site, at 17,402 vehicles per day in 2022. From 2012 to 2022, this count station has indicated a -0.2% average annual traffic growth rate. However, from 2021 to 2022, this count station indicated a 5.5% average annual growth rate.
  - TPO reported an Average Daily Traffic (ADT) on Hardin Valley Road, west of North Campbell Station Road and west of the development site, at 7,690 vehicles per day in 2022. From 2019 to 2022, this count station has indicated a 3.6% average annual traffic growth rate.

- Existing bicycle and pedestrian volumes:
  The average daily pedestrian and bicycle traffic is unknown along Hardin Valley Road. However, with sidewalks on both sides of Hardin Valley Road, this corridor was observed to have some pedestrian and bicyclist activity during the traffic counts. In addition to exercise activities, the commercial developments to the east towards the Pellissippi Parkway interchange could generate some non-motorized traffic. To the west, the Food City shopping center could also generate pedestrians or bicyclists. The public schools nearby are also potential generators for pedestrians or bicyclists. During the 6-hour traffic counts for this study, 11 bicyclists and 77 pedestrians were observed traveling eastbound and westbound on Hardin Valley Road. In the afternoon, many pedestrians were joggers of high-school age, likely related to the high school's track or other sports teams.

  An online website, strava.com, provides "heat" maps detailing exercise routes taken by pedestrians, joggers, and bicyclists. The provided heat maps show the last two years of data, are updated monthly, and are gathered from individuals allowing their smart devices to track and compile their routes (millions of users). The activities in the maps are shown on the roads with color intensities with lighter colors signifying higher

activity. The Strava heat maps show some bicycle and pedestrian activity in the study area. Higher pedestrian activity is shown along Hardin Valley Road, the adjacent residential developments, and the public schools to the west of the proposed developments. Lower bicycle traffic is shown on Hardin Valley Road and the surrounding roadways. Bicycle traffic is lighter on Hardin Valley Road, likely due to the lack of bike lanes and the high vehicle volumes on the corridor.

The proposed residential developments will be located relatively close to commercial developments to the east and west and public schools to the west but are not expected to generate measurable amounts of bicycle or pedestrian trips that would significantly reduce vehicle trips. Thus, these potential reductions are ignored for the study analyses in this report.

Strava Heat Map for Pedestrian and Joggers

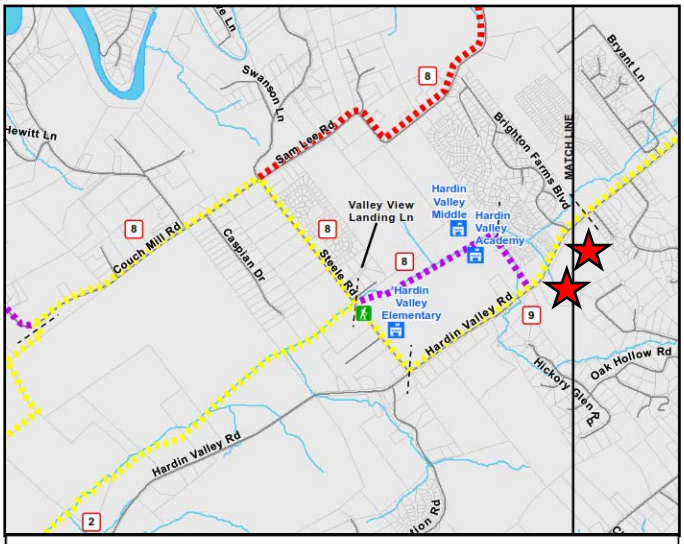
Strava Heat Map for Bicyclists

- **PEDESTRIAN AND BICYCLE FACILITIES**:

Bicycle lanes are unavailable on Hardin Valley Road adjacent to the proposed development sites. The closest bicycle facilities are located over a mile away to the northeast at Pellissippi State Community College on the Pellissippi Parkway Greenway. The Pellissippi Parkway Greenway runs from Pellissippi State Community College south to Carmichael Road and parallels Pellissippi Parkway to the west. The greenway is paved and is approximately one mile in length.

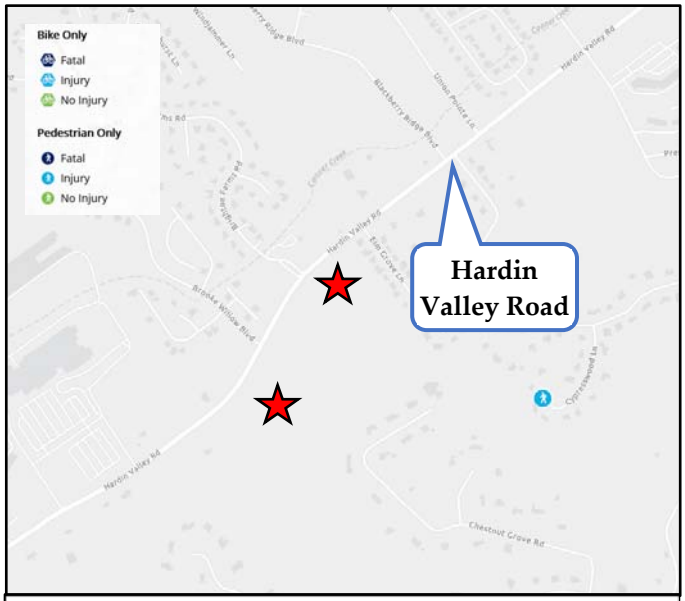
Knox County recently completed a Greenway Corridor Study in 2020. This study evaluated potential alignments for greenways throughout Knox County. The study identified and evaluated one of the corridors, Beaver Creek West. This corridor would run from Melton Hill

Park in Hardin Valley to Interstate 75 in Powell. One of the preferred routes for this corridor is shown along Hardin Valley Road directly in front of the proposed development sites. As shown in the image from the greenway study, the yellow dashed lines are the preferred route, the red dashed line is the alternate route, and the purple line is a proposed connector route.



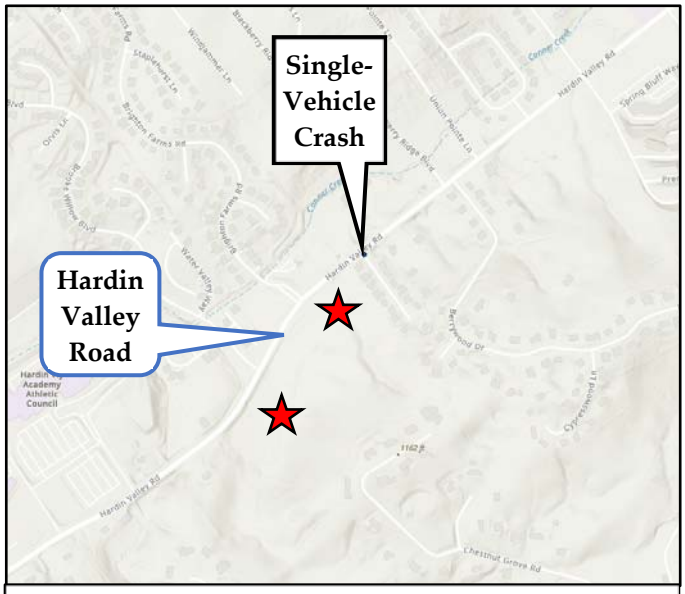
Knox County Greenway Corridor Study (2020)
Beaver Creek West Greenway
Potential Routes

- **CRASH DATA**:



Pedestrian / Bicycle Crash Data in Study Area

The Knoxville Transportation Planning Organization (TPO) provided a 2020 update to bicycle and pedestrian crash data for Knox County and other surrounding counties. The data shows that none of these incidents occurred in the study area in the past few years.

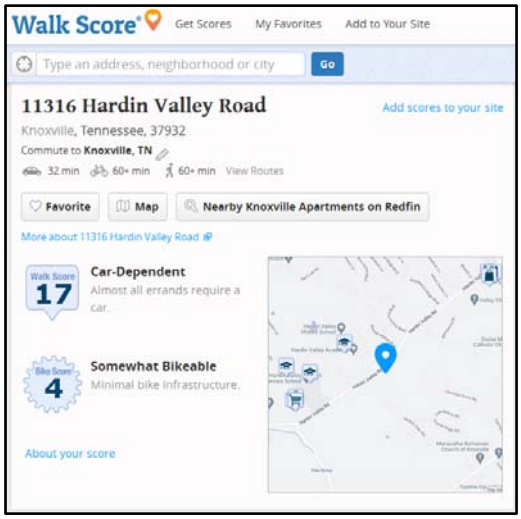


Vehicular Crash Data in Study Area

The Knoxville TPO also provides data related to "Life-Altering Traffic Crashes". This data lists the location of traffic crashes in the Knoxville region that resulted in a fatality or serious injury between October 2016 and September 2021. According to the data, only one of these incidents occurred near the proposed development sites in the past couple of years. A single-vehicle crash with a serious injury occurred at an adjacent intersection to the east at the intersection of Hardin Valley Road at Elm Grove Lane on October 23rd, 2016. However, no crash factors for this incident are listed as being identified.

- **WALK SCORE**:

A private company offers a website at walkscore.com that grades and gives scores to locations within the United States based on "walkability", "bikeability", and transit availability based on a patented system. According to the website, the numerical values assigned for the Walk Score and the Bike Score are based on the distance to the closest amenity in various relevant categories (businesses, schools, parks, etc.) and are graded from 0 to 100.



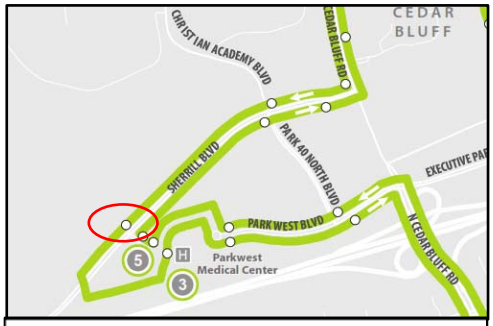
The location of the development properties is graded with a Walk Score of 17. This Walk Score indicates that the current properties are car-dependent and that most errands require a vehicle to travel to and from external locations. The site is given a Bike Score of 4 which indicates minimal bike infrastructure. The site is not given a Transit Score since public transportation is unavailable near the development sites. Appendix B shows maps and other information for the Walk Score and Bike Score at the approximate developments address of 11316 Hardin Valley Road.

The existing sidewalk system provided adjacent to the development sites on Hardin Valley Road would allow pedestrians to walk 0.8 miles west up to the intersection of North Campbell Station Road in front of the Food City shopping center. To the east, the existing sidewalk system would allow pedestrians to travel 1.7 miles to the intersection of Solway Road at the southbound Pellissippi Parkway on/off ramps. The existing sidewalk system would also allow pedestrians to walk into several residential developments located along Hardin Valley Road, the public schools to the west, and the Pellissippi State Community College entrance to the east.

- **TRANSIT SERVICES:**

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available near the development sites, and the overall KAT bus system map is provided in Appendix C.

The closest public transit bus service is 6.2 miles away to the southeast at Parkwest Medical Center on Sherrill Boulevard and is Route 16, "Cedar Bluff Connector". It operates on weekdays and weekends, and this route map is also included in Appendix C. KAT had to reduce its service schedule due to workforce shortages. These changes took place on August 29th, 2022, and the reduced schedule for this route is included in Appendix C. Other transit services in the area include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC), which provides transportation services when requested.



KAT Route 16

Since the distance to the nearest KAT bus service is several miles away, the proposed developments will not have any reduced vehicle trips due to public transit usage. Public transportation by ETHRA or CAC is assumed will be negligible for these developments.

PROJECT DESCRIPTION

- **LOCATION AND SITE PLAN:**

The proposed plan layouts with 62 attached townhouses in the Cruz Landing Subdivision and 55 attached townhouses in the Maya Hills Subdivision located on 59.5 +/- acres are designed by Urban Engineering, Inc., and are shown in Figure 3. The design shows three new streets for the residential developments – two in Cruz Landing Subdivision and one in Maya Hills Subdivision. In the Cruz Landing Subdivision, the entrance road, Road "A", will be 160 feet long and will intersect Road "B" just to the southeast of Hardin Valley Road. Both ends of Road "B" in the Cruz Landing Subdivision will end at cul-de-sacs. The single road in Maya Hills Subdivision is also labeled as Road "A" in the site plan and will be 975 feet long. The end of this road will terminate at a cul-de-sac.

Cruz Landing Subdivision will be located on 31.1 acres on one existing parcel. The open space designated to the Cruz Landing Subdivision will be 23.75 acres, with the hillside protection area including 19.7 acres. The average area of the attached townhouse lots will be around 3,500 square feet (0.08 acre), with a typical lot layout of 115 feet deep and 20 – 40 feet in width. Each townhouse will have a garage and driveway. Internal sidewalks are not proposed for this development.

Maya Hills Subdivision will be located on 28.4 acres on two existing parcels. The open space designated to the Maya Hills Subdivision will be 20.52 acres, with the hillside protection area being 21.1 acres. The average area of the attached townhouse lots will be around 3,600 square feet (0.08 acre), with a typical lot layout of 120 feet deep and 20 – 40 feet in width. Some of the lots in Maya Hills Subdivision will be much deeper in length than the typical, with an average area of 7,000 square feet (0.16 acre). Each townhouse will have a garage and driveway. Internal sidewalks are not proposed for this development.

Both these residential developments will include large undeveloped areas. The areas on the southeastern portion of the developments will remain undisturbed for hilltop protection. The large existing wetland areas between the two developments will also remain undisturbed. An unnamed tributary of Conner Creek exists on the far southern portion of the Maya Hills Subdivision development property and will not be impacted.

An area at the rear of the cul-de-sac in Maya Hills Subdivision has been reserved for amenities. The developer plans to build a swimming pool and clubhouse with off-street parking and

pickleball/tennis courts. These two subdivisions will not be connected directly by roadway, but a 5-foot walking trail is proposed to connect the two subdivisions for non-motorized travel.

Existing Abandoned House at 11316 Hardin Valley Road

One single-family residential house at 11316 Hardin Valley Road exists on the far southwestern side of the development property for the Maya Hills Subdivision. This existing house will be removed, and its property will be incorporated into the Maya Hills Subdivision development property.

The schedule for completing these new residential developments depends on economic factors and construction timelines. These projects are also contingent on permitting, design, and other regulatory approvals. Currently, the real estate market in the area is still maintaining large amounts of activity and growth. This study assumed that both developments' total construction build-out and full occupancy would occur within the next three years (2026).

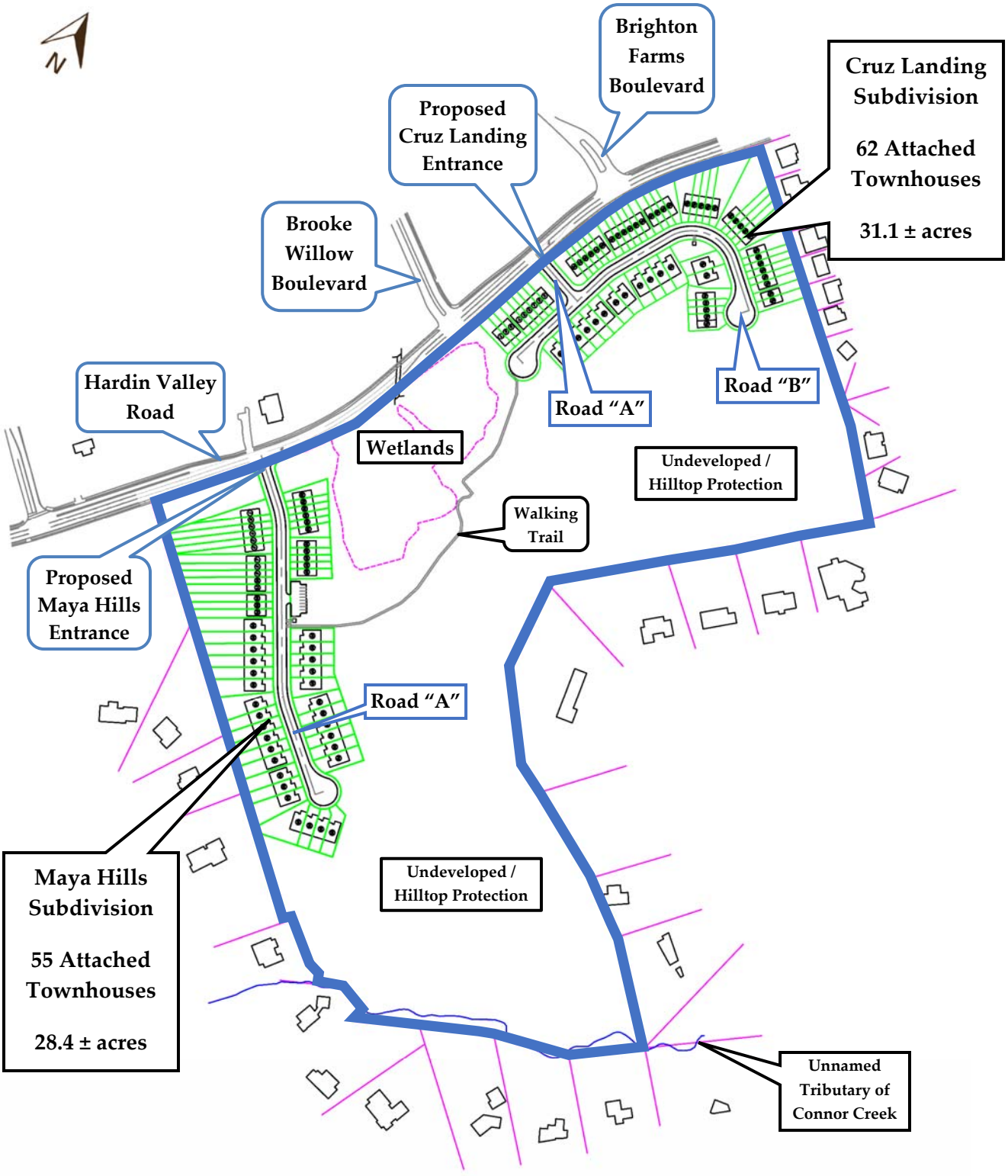


Figure 3
Proposed Plan Layout
Cruz Landing & Maya Hills Subdivisions

Not to Scale

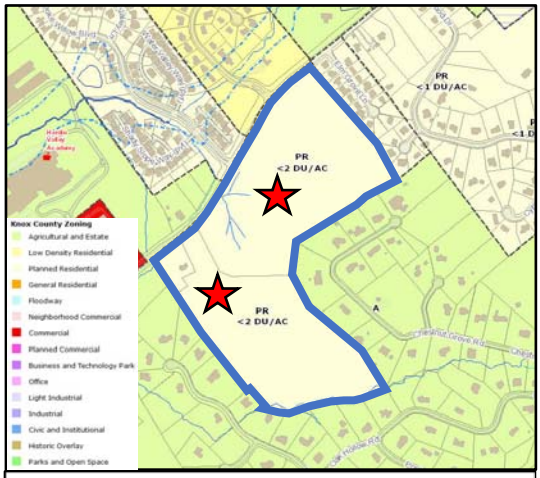
- **PROPOSED USES AND ZONING REQUIREMENTS:**

The three existing parcels comprising the Cruz Landing and Maya Hills Subdivision development properties are all zoned as Planned Residential (PR) with a density of < 2 units per acre. Uses permitted in the Planned Residential (PR) zone include single-family dwellings, duplexes, and multi-dwelling structures and developments. The most recently published online KGIS zoning map is provided in Appendix D. The existing adjacent surrounding zoning and land uses are the following:

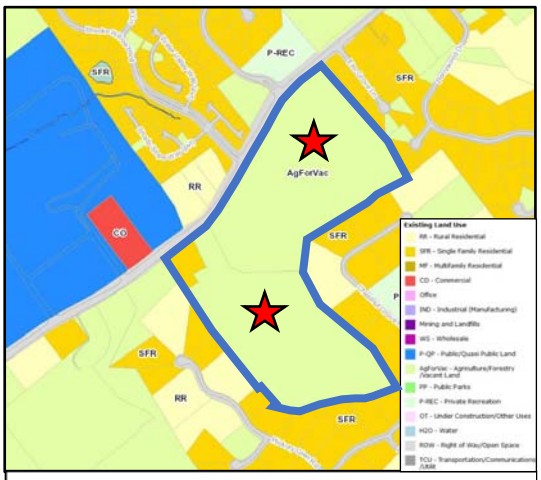
- The developments will be bound by Hardin Valley Road to the northwest. On Hardin Valley Road, across from the property reserved for Maya Hills Subdivision, four parcels are zoned as Agricultural (A). Two of these parcels are undeveloped grass fields, and a single-family detached house occupies the third one at 11313 Hardin Valley Road. These three parcels have adjacent road access to Hardin Valley Road. The fourth parcel is part of Knox County's Hardin Valley Academy school grounds, with road access provided to Hardin Valley Road further to the southwest.
- The Glen at Hardin Valley Subdivision is across Hardin Valley Road to the northwest and roughly midway between the proposed subdivisions. The lots in this subdivision are zoned as Planned Residential (PR) with a density of 1-4 units per acre. This subdivision has 183 house lots with singular external road access provided via Brooke Willow Boulevard at Hardin Valley Road.
- Brighton Farms Subdivision is adjacent to and northeast of The Glen at Hardin Valley Subdivision. Brighton Farms Subdivision will be roughly across from the Cruz Landing Subdivision on Hardin Valley Road. The lots in this subdivision are zoned as Low Density Residential (RA). This subdivision has 109 house lots with singular external road access provided via Brighton Farms Boulevard at Hardin Valley Road.
- Elm Grove and Hardin Valley Woods Subdivisions are located immediately to the northeast and on the same side of Hardin Valley Road as the proposed developments. The parcels in these subdivisions will be the adjacent properties to Cruz Landing Subdivision. The adjacent homes in Elm Grove and Hardin Valley Woods Subdivisions are zoned as Planned Residential (PR) with a density of 1-3 units per acre. Elm Grove Subdivision has 17 house lots with road access to Hardin Valley Road to the north via a short cul-de-sac road, Elm Grove Lane. Elm Grove Lane is 570 feet northeast of Brighton Farms Boulevard at Hardin Valley

Road. The adjacent houses in Hardin Woods Subdivision have access to Hardin Valley Road via Elm Crest Lane and Berrywood Drive.

- All the properties south and southeast of the proposed Cruz Landing and Maya Hills Subdivisions are zoned as Agricultural (A). Twenty lots abut the proposed developments and consist of single-family detached houses on large lots. These homes are in Chestnut Grove Subdivision with external road access to the southeast at Carmichael Road.



KGIS Existing Zoning Map



KGIS Existing Land Use Map

- **DEVELOPMENT DENSITY:**

The Cruz Landing Subdivision's proposed density is based on a maximum of 62 units on 31.1 acres. Sixty-two dwelling units on 31.1 acres compute to 1.99 dwelling units per acre, just slightly less than allowed for this property with a density of fewer than two units per acre in the Planned Residential (PR) zone. The Maya Hills Subdivision's proposed density is based on a maximum of 55 units on 28.4 acres. Fifty-five dwelling units on 28.4 acres compute to 1.94 dwelling units per acre, slightly less than allowed with a density of fewer than two units per acre in the Planned Residential (PR) zone.

- **ON-SITE CIRCULATION:**

The total length of the two internal roads in Cruz Landing Subdivision will be approximately 1,122 feet (0.21 miles). The total length of the single internal road in Maya Hills Subdivision will be 975 feet (0.18 miles). These internal roads will be designed and constructed to Knox County, TN specifications. The developments will have asphalt-paved internal roadways and 8" extruded

concrete curbs. The lane widths internally will be 13 feet each for a total 26-foot pavement width. The public right-of-way within the developments will be 50 feet. Sidewalks are not proposed along the internal roads in either subdivision. Knox County will maintain the streets in the developments after construction, and these will be dedicated public roads.

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

Besides residential passenger vehicles, the internal roadways will provide access to service, delivery, maintenance, and fire protection/rescue vehicles. These vehicle types will not impact roadway operations except when they occasionally enter and exit the development. Curbside private garbage collection services are expected to be available for these residential subdivisions.

The new public streets will be designed and constructed to Knox County specifications and are expected to be adequate for fire protection and rescue vehicles, trash collection trucks, and single-unit delivery trucks. The development's internal drives will accommodate the larger vehicle types and residents' standard passenger vehicles.

ANALYSIS OF EXISTING AND PROJECTED CONDITIONS

- **EXISTING TRAFFIC CONDITIONS:**

This study conducted 6-hour traffic counts at the unsignalized t-intersections of Hardin Valley Road at Brighton Farms Boulevard and Brooke Willow Boulevard, adjacent to the proposed development sites, on Tuesday, April 11th, 2023. Local public schools were fully open on this day. Manual traffic counts were conducted to tabulate the morning and afternoon peak period volumes, travel directions, and patterns near the proposed development sites. Based on the traffic volumes collected at the intersections, the AM and PM peak hours were observed at 7:30 – 8:30 am and 4:45 – 5:45 pm.

The manual tabulated traffic counts can be reviewed in Figure 4 and Appendix E; some observations from the counts are listed below.

- Overall, higher traffic volumes were observed in the morning than in the afternoon.
- Many Knox County school buses were observed during the traffic counts on Hardin Valley Road. The heavy presence of school buses can be attributed to the nearby Hardin Valley public schools. No Knox County school bus stops were observed on Hardin Valley Road. School buses were observed entering and exiting the existing subdivision entrances.
- Heavy truck traffic was less than 1% during the PM peak hour but constituted around 3% of the vehicles in the thru movement traffic streams on Hardin Valley Road in the AM peak hour. Most traffic observed during the traffic counts were typical passenger vehicles. However, a fair amount of dump trucks were observed on Hardin Valley Road and are assumed to be associated with the residential development further west. Other observed heavy trucks included trash collection trucks and concrete mixer trucks. A few semi-tractor trailers were also observed.
- Eleven bicyclists were observed during the traffic counts, most traveling on the sidewalks on either side of Hardin Valley Road. Two of these bicyclists were observed traveling in the road lanes on Hardin Valley Road. During the traffic count, 77 pedestrians were observed on both sides of the sidewalks on Hardin Valley Road, with the vast majority on the northern side of Hardin Valley Road.
- Heavy traffic volumes with vehicle backups were observed on Hardin Valley Road during peak periods, especially in the morning. In the morning, the traditional peak rush hour traffic coincides with the Hardin Valley public school's arrival times. Vehicles were

observed backing up from the west to the east (from the Hardin Valley public schools) between 8:15 – 8:30 am and 3:35 – 4:15 pm. These vehicle backups extended past Brighton Farms Boulevard to the east. In the opposite direction on Hardin Valley Road (from the east), vehicle backups were observed from 7:45 – 8:00 am, 8:30 – 8:45 am, and 3:40 – 4:20 pm. These vehicle backups were spillback from the traffic signal a little over a half-mile to the east at the intersection of Hardin Valley Road at Performing Arts Way and Greenland Way. These vehicle backups are associated with large influxes of vehicles heading east on Hardin Valley Road, congestion from the Pellissippi Parkway interchange, and traffic generated by Pellissippi State Community College and the surrounding developments.

Vehicle Backups in Both Directions on Hardin Valley Road at 4:00 PM on 4/20/23 (Looking East)

- During the vehicle backups on Hardin Valley Road, the motorists exiting Brighton Farms Boulevard and Brooke Willow Boulevard regularly used the center TWLTL as a merge lane. When entering the traffic stream on Hardin Valley Road, the motorists relied on the courtesy of the other motorists to enter the vehicle queue/backup.
- During vehicle backups on Hardin Valley Road from the east, a few motorists wanting to turn left onto Brighton Farms Boulevard illegally used the center TWLTL initially as a travel lane to advance and turn and avoid the vehicle queue/backup.
- From observation, some parents use Brooke Willow Boulevard to "short-cut" the parent pick-up lines at the Hardin Valley public schools. Shortly after the afternoon school dismissal, several students were observed walking down Hardin Valley Road to meet their waiting parents in their vehicles on Brooke Willow Boulevard. This occurrence appears to be an ongoing issue since Brooke Willow Boulevard is posted with "No Parking or Standing Between Signs" on the exiting lane of the boulevard where it approaches Hardin Valley Road.

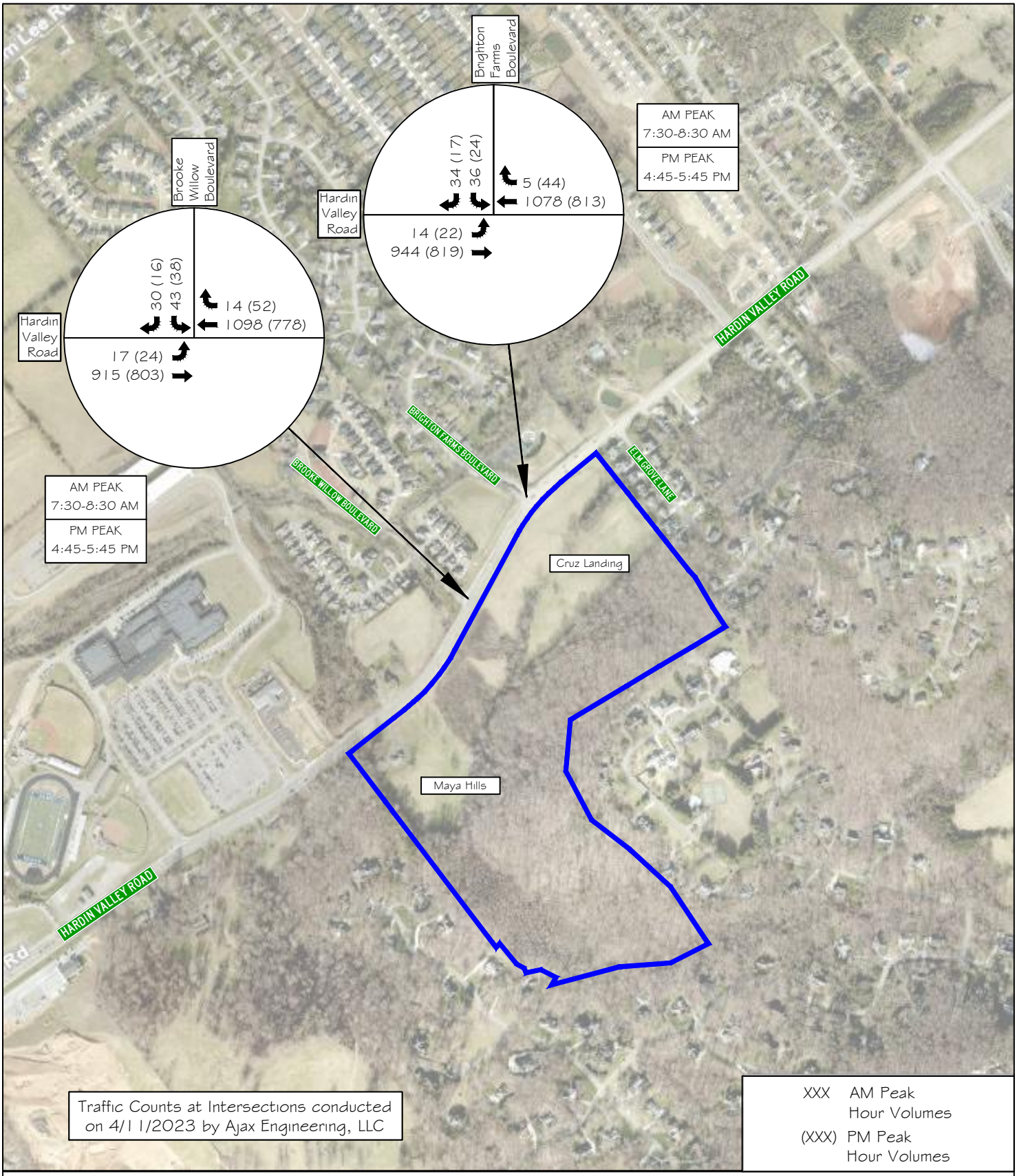


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FIGURE 4

Cruz Landing & Maya Hills Subdivisions

2023 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the Level of Service (LOS) for the existing 2023 traffic volumes shown in Figure 4 at the intersections of Hardin Valley Road at Brighton Farms Boulevard and Brooke Willow Boulevard. The capacity analyses were calculated following the Highway Capacity Manual (HCM) methods and Synchro Traffic Software (Version 11).

Methodology:

LOS is a qualitative measurement developed by the transportation profession to express 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 worst. This grading system provides a reliable, straightforward means to communicate road operations to the public. The HCM lists level of service criteria for unsignalized intersections and signalized intersections.

LOS is defined by delay per vehicle (seconds), and roadway facilities are also characterized by the volume-to-capacity ratio (v/c). LOS designations, which are based on delay, are reported differently for unsignalized and signalized intersections. For example, a delay of 20 seconds at an unsignalized intersection would indicate LOS C, representing the additional delay a motorist would experience traveling through the intersection. Also, for example, a v/c ratio of 0.75 for an approach at an unsignalized intersection would indicate that it is operating at 75% of its available capacity. This difference is primarily due to motorists' different expectations between the two road facilities. Generally, for most instances, the LOS D / LOS E boundary is considered the upper limit of acceptable delay during peak periods in urban and suburban areas.

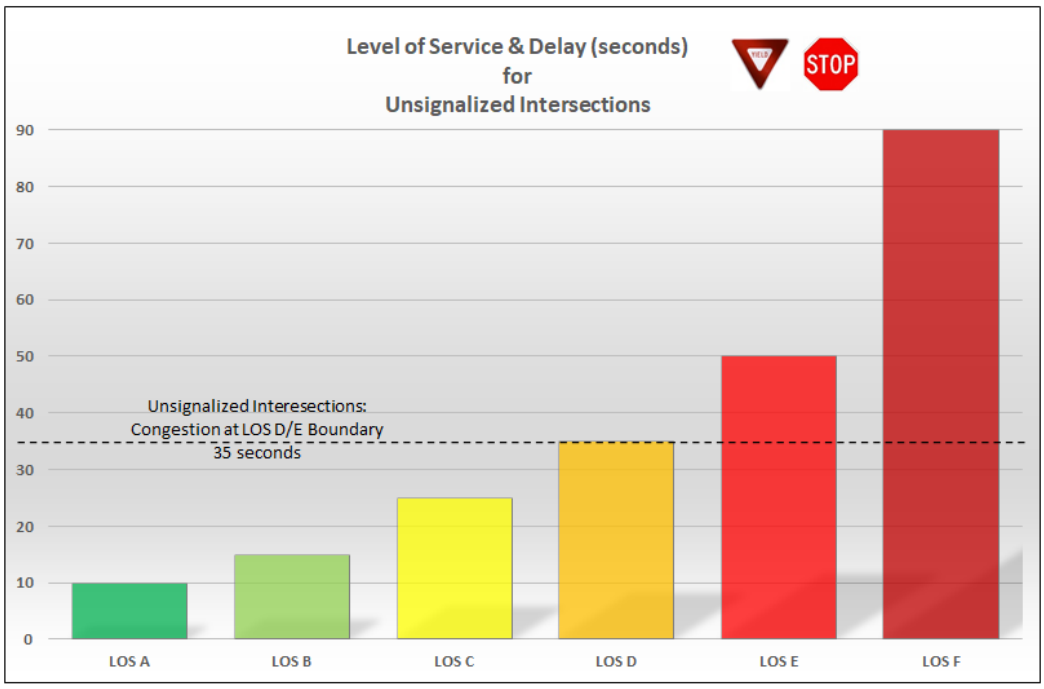
For unsignalized intersections, LOS is measured in terms of delay (in seconds). This measure is an attempt to quantify delay, including travel time, driver discomfort, and fuel consumption. For unsignalized intersections, the analysis assumes that the mainline thru and right-turn traffic does not stop and is not affected by the traffic on the minor side streets. Thus, 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 movements. Table 2 lists the level of service criteria for unsignalized intersections. The analysis results of unsignalized intersections using the HCM methodologies are conservative due to the more significant vehicle gap parameters used in the method. More often, in normal road conditions, drivers are more willing to accept smaller gaps in traffic than what is modeled using the HCM methodology. The unsignalized intersection methodology also does not account for more significant gaps sometimes produced by nearby upstream and downstream signalized intersections. For unsignalized intersections, in most instances, the upper limit of acceptable delay during peak hours is the LOS D/E boundary at 35 seconds.

TABLE 2
LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	DESCRIPTION	CONTROL DELAY (seconds/vehicle)
A	Little or no delay	0 - 10
B	Short Traffic Delays	>10 -15
C	Average Traffic Delays	>15 - 25
D	Long Traffic Delays	>25 - 35
E	Very Long Traffic Delays	>35 - 50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual, 6th Edition



Intersection capacity results from the existing 2023 peak hour traffic are shown in Table 3. 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. Appendix F includes the worksheets for the existing 2023 peak hour capacity analyses.

As shown in Table 3, the intersections are calculated to operate with very poor LOS and considerable vehicle delays in the existing 2023 conditions. These intersections especially operate poorly in the morning peak hour compared to the afternoon peak hour. These results are based on free-flowing operations, but as described, Hardin Valley Road is afflicted by vehicle backups during peak hours. The results for these intersections are presented in this report as a courtesy since they were not included in the requested Knoxville/Knox County Planning scope of work. However, these existing intersections were included in the study for tabulating volumes on Hardin Valley Road. They were also included to observe traffic patterns at two similar adjacent land uses as proposed for Cruz Landing and Maya Hills Subdivisions. They are also included in the study's projected conditions since they will be closely located to the proposed Cruz Landing and Maya Hills subdivision entrances but will not be offered any recommendations.

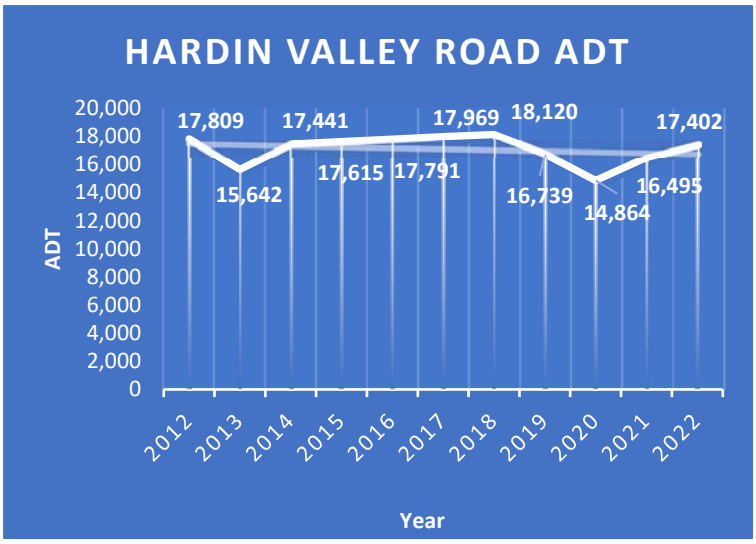
TABLE 3
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Hardin Valley Road (EB & WB) at Brighton Farms Boulevard (SB)	Unsignalized	Eastbound Left	B	11.6	0.049	B	10.0	0.043
		Southbound Left/Right	F	53.2	0.570	D	26.3	0.262
Hardin Valley Road (EB & WB) at Brooke Willow Boulevard (SB)	Unsignalized	Eastbound Left	B	11.9	0.065	A	9.9	0.042
		Southbound Left/Right	F	103.0	0.829	D	30.1	0.361

Note: All analyses were calculated in Synchro 11 software and reported using HCM 2010 intersection methodology
[a] Level of Service , [b] Average Delay (sec/vehicle) , [c] Volume-to-Capacity Ratio

- **PROJECTED TRAFFIC CONDITIONS (WITHOUT THE PROJECTS):**

Horizon year traffic conditions represent the projected traffic volumes in the study area without the proposed projects being developed (no-build option). The build-out and full occupancy for these proposed developments are assumed to occur by 2026.



Vehicular traffic data in the study area has shown puzzling growth over the past ten years, based on the nearest TDOT count station. As shown in Appendix A, Hardin Valley Road has experienced average annual growth of -0.2% over the past ten years, according to TDOT data. The data is puzzling since this recorded growth does not match the observed considerable growth over the past ten years due to the construction of numerous residential subdivisions in the Hardin Valley area, the addition of Hardin Valley Middle School (opened in 2018), and other commercial development.

Further to the southwest of the development sites and North Campbell Station Road, the Knoxville Regional TPO count location on Hardin Valley Road has shown a growth rate of 3.6% from 2019 to 2022. North Campbell Station Road is a significant roadway that ties into Hardin Valley Road between the count station and the proposed development sites. Assuming a growth rate of 3.6% for Hardin Valley Road adjacent to the proposed development sites based on data on Hardin Valley Road on the other side of North Campbell Station Road would be inappropriate. With all this data considered, for this study, an annual growth rate of 5% was assumed and used to calculate future growth on Hardin Valley Road at the proposed developments up to 2026 to account for potential traffic growth in the study area.

The assumed annual growth rate was applied to the existing thru 2023 volumes on Hardin Valley Road obtained at the adjacent existing intersections to calculate the future volumes in 2026 without the proposed developments being constructed.

Capacity analyses were undertaken to determine the projected LOS in 2026 at the Brighton Farms

Boulevard and Brooke Willow Boulevard intersections on Hardin Valley Road without the proposed developments' generated traffic. The results are shown in Table 4, and Appendix F includes the capacity analysis worksheets. The results in Table 4 are similar to the 2023 results shown in Table 3 but with increased vehicle delays. The analyses for the proposed entrances for Cruz Landing and Maya Hills Subdivisions were not conducted at this step in the study analyses since these intersection entrances on Hardin Valley Road only exist in the projected 2026 conditions with the projects.

TABLE 4
2026 INTERSECTION CAPACITY ANALYSIS RESULTS -
PROJECTED TRAFFIC CONDITIONS (WITHOUT THE PROJECTS)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Hardin Valley Road (EB & WB) at Brighton Farms Boulevard (SB)	STOP Unsignalized	Eastbound Left	B	12.9	0.058	B	10.6	0.048
		Southbound Left/Right	F	87.6	0.733	D	32.4	0.315
Hardin Valley Road (EB & WB) at Brooke Willow Boulevard (SB)	STOP Unsignalized	Eastbound Left	B	13.1	0.076	B	10.5	0.046
		Southbound Left/Right	F	187.5	1.067	E	39.2	0.438

Note: All analyses were calculated in Synchro 11 software and reported using HCM 2010 intersection methodology
[a] Level of Service , [b] Average Delay (sec/vehicle) , [c] Volume-to-Capacity Ratio

Figure 5 shows the projected 2026 horizon year traffic volumes on Hardin Valley Road without the projects' generated traffic at the proposed development entrance locations and the adjacent intersections during the AM and PM peak hours.

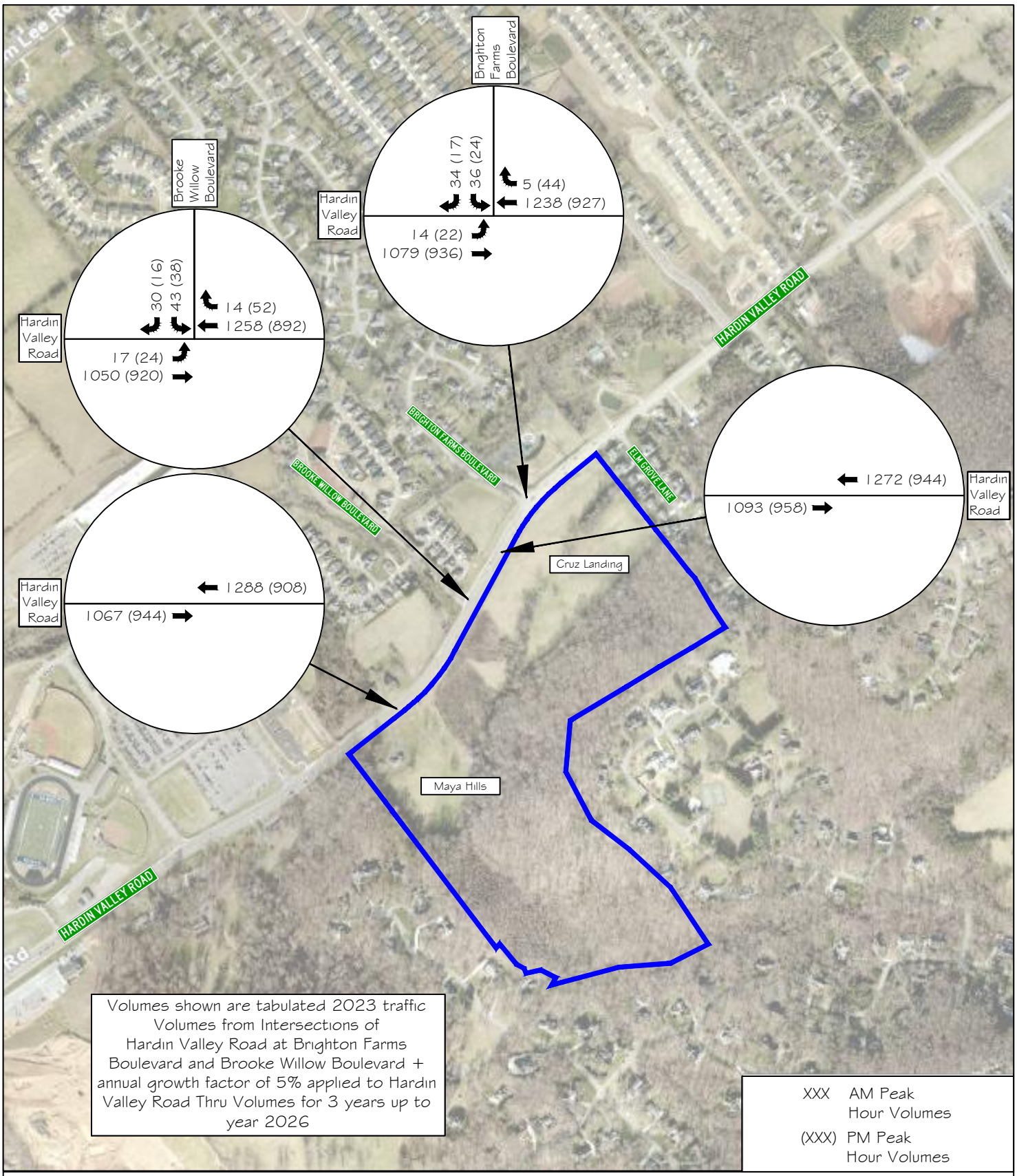


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FIGURE 5

Cruz Landing & Maya Hills Subdivisions

2026 Peak Hour Traffic Volumes - PROJECTED TRAFFIC CONDITIONS (WITHOUT THE PROJECTS)

- **TRIP GENERATION:**

A generated trip is a single or one-direction vehicle movement entering or exiting the study site. The estimated traffic for the townhouses in Cruz Landing and Maya Hills Subdivisions was based on the equations provided by Knoxville/Knox County Planning. These equations were developed from an extensive local study to estimate townhouse (and apartment) trip generation in the surrounding area and were published in December 1999. For Knox County, this is the preferred rate to use for townhouses and apartments. This local rate calculates higher trip rates than the similar land use in the often-referenced Institute of Transportation (ITE) Trip Generation Manual.

The data and calculations from the local trip generation study for the two proposed developments are shown in Appendix G. A summary of this information is presented in the following tables:

TABLE 5a
TRIP GENERATION FOR CRUZ LANDING SUBDIVISION
62 Attached Townhouses

ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Attached Townhouses	62	621	22%	78%		55%	45%	
				7	27	34	29	23	52
Total New Volume Site Trips			**621**	**7**	**27**	**34**	**29**	**23**	**52**

Data from Local Trip Rates and calculated by using Fitted Curve Equations

For the proposed Cruz Landing Subdivision, it is estimated that 7 vehicles will enter and 27 will exit, for a total of 34 generated trips during the AM peak hour in the year 2026. Similarly, it is estimated that 29 vehicles will enter and 23 will exit, for a total of 52 generated trips during the PM peak hour in the year 2026. The calculated trips generated for an average weekday are estimated to be 621 vehicles for the proposed Cruz Landing Subdivision.

For the proposed Maya Hills Subdivision, it is estimated that 7 vehicles will enter and 24 will exit, for a total of 31 generated trips during the AM peak hour in the year 2026. Similarly, it is estimated that 26 vehicles will enter and 21 will exit, for a total of 47 generated trips during the

PM peak hour in the year 2026. The calculated trips generated for an average weekday are estimated to be 557 vehicles for the proposed Maya Hills Subdivision.

Combining the two developments results in 65 trips in the AM peak hour, 99 in the PM peak hour, and 1,178 daily trips. Even with a higher potential for school-age children to walk to and from the nearby public schools, no vehicle trip reductions to account for this were included in the calculations or study analyses.

TABLE 5b
TRIP GENERATION FOR MAYA HILLS SUBDIVISION
55 Attached Townhouses

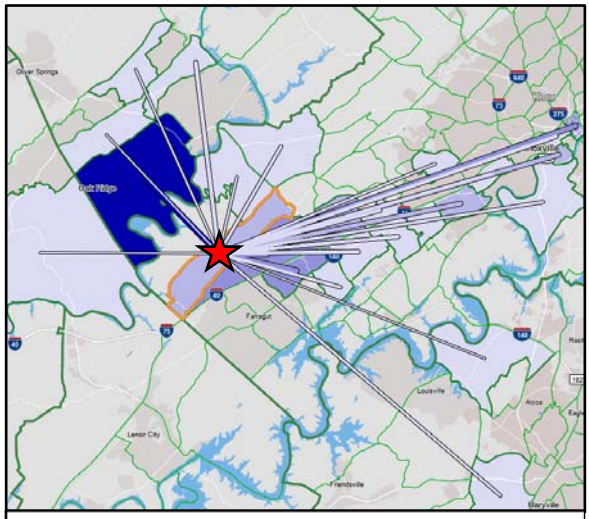
ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Attached Townhouses	55	557	22%	78%		55%	45%	
				7	24	31	26	21	47
Total New Volume Site Trips			**557**	**7**	**24**	**31**	**26**	**21**	**47**

Data from Local Trip Rates and calculated by using Fitted Curve Equations

- **TRIP DISTRIBUTION AND ASSIGNMENT:**

The projected trip distribution and assignment for the Cruz Landing and Maya Hills Subdivisions were based on several sources and engineering judgment. The first source is based on the existing traffic count volumes and the observed travel directions collected at the intersections of Hardin Valley Road at Brighton Farms Boulevard and Brooke Willow Boulevard adjacent to the proposed development sites.

During the traffic counts, as expected due to the nearby presence of the Hardin Valley public schools, more significant vehicle splits at the existing subdivisions were observed traveling to and from the west in the morning compared to the afternoon peak hour. The afternoon school dismissals were spread over a more extended time and occurred before the traditional, later PM peak hour rush hour. While the PM peak hour at the intersections occurred closer to the traditional afternoon rush hour, the AM peak hour occurred during the traditional morning rush hour simultaneously with the school's arrival period.

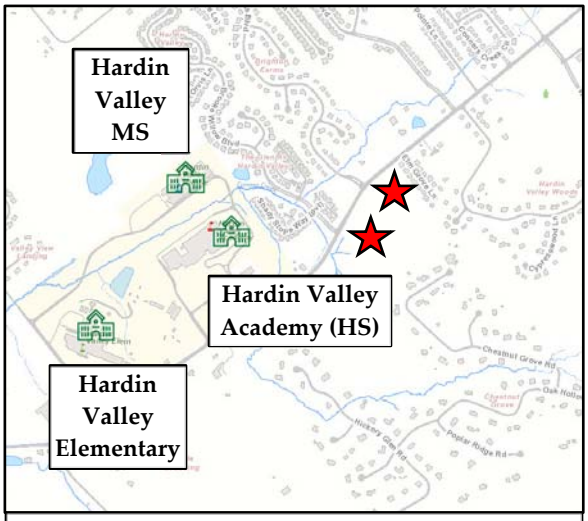


Top 25 Locations of 2019 Census Bureau Work-Based Trips to & from Census Tract 59.05

The second source for assisting in determining the projected trip distribution is based on work-related trips. Work-based trips will be a significant impetus for generated trips by the developments, and these trips are more likely to travel to and from the northwest and east. This assertion is based on data from the United States Bureau website for Census Tract 59.05, where the development property is located. Based on 2019 (latest available) census data and as shown in Appendix H, most work-based trips in the surrounding area correspond to Oak Ridge, West Knoxville, downtown Knoxville, the University of Tennessee area, and areas of Blount County.

In addition to employment centers, some generated traffic will travel to and from public and private schools. Schools will be another impetus for external trip-making. The development property is currently zoned for Hardin Valley Elementary, Hardin Valley Middle, and Hardin Valley Academy (High School). All these zoned public schools are less than a mile to the southwest off Hardin Valley Road.

The Knox County Schools Transportation Department has developed Parental Responsibility Zones (PRZ) to determine whether students are offered transportation services to and from school. The PRZ is defined as being 1.5 miles for grades 6 – 12 and 1.0 miles for grades K – 5 from where the students' parcel is accessed to the point where the buses unload at the school. These developments will be inside the PRZ for all the zoned schools, and thus, all school-age children in these proposed subdivisions attending public schools will not be offered school bus transportation. School-age children in the proposed subdivisions will have to rely on personal vehicles or walk or bike to school.



Zoned Public School Locations

Figures 6a and 6b shows the projected distribution of traffic entering and exiting the proposed subdivision entrances on Hardin Valley Road. Figure 6a is for Cruz Landing Subdivision, and Figure 6b is for Maya Hills Subdivision. The percentages shown in the figures only pertain to the trips generated by the proposed dwellings in the developments calculated from the local trip rates. They are assumed to be the same for both subdivisions. Ultimately, the projected trip distribution was heavily based on the observed traffic at the intersections of Hardin Valley Road at Brighton Farms Boulevard and Brooke Willow Boulevard and the traffic flows adjacent to the development sites on Hardin Valley Road.

Figures 7a and 7b show the traffic assignment of the computed trips generated by the developments listed in Tables 5a and 5b and are based on the assumed distribution of trips shown in Figures 6a and 6b. Figure 7c shows the combination of the traffic assignment of both proposed residential developments.

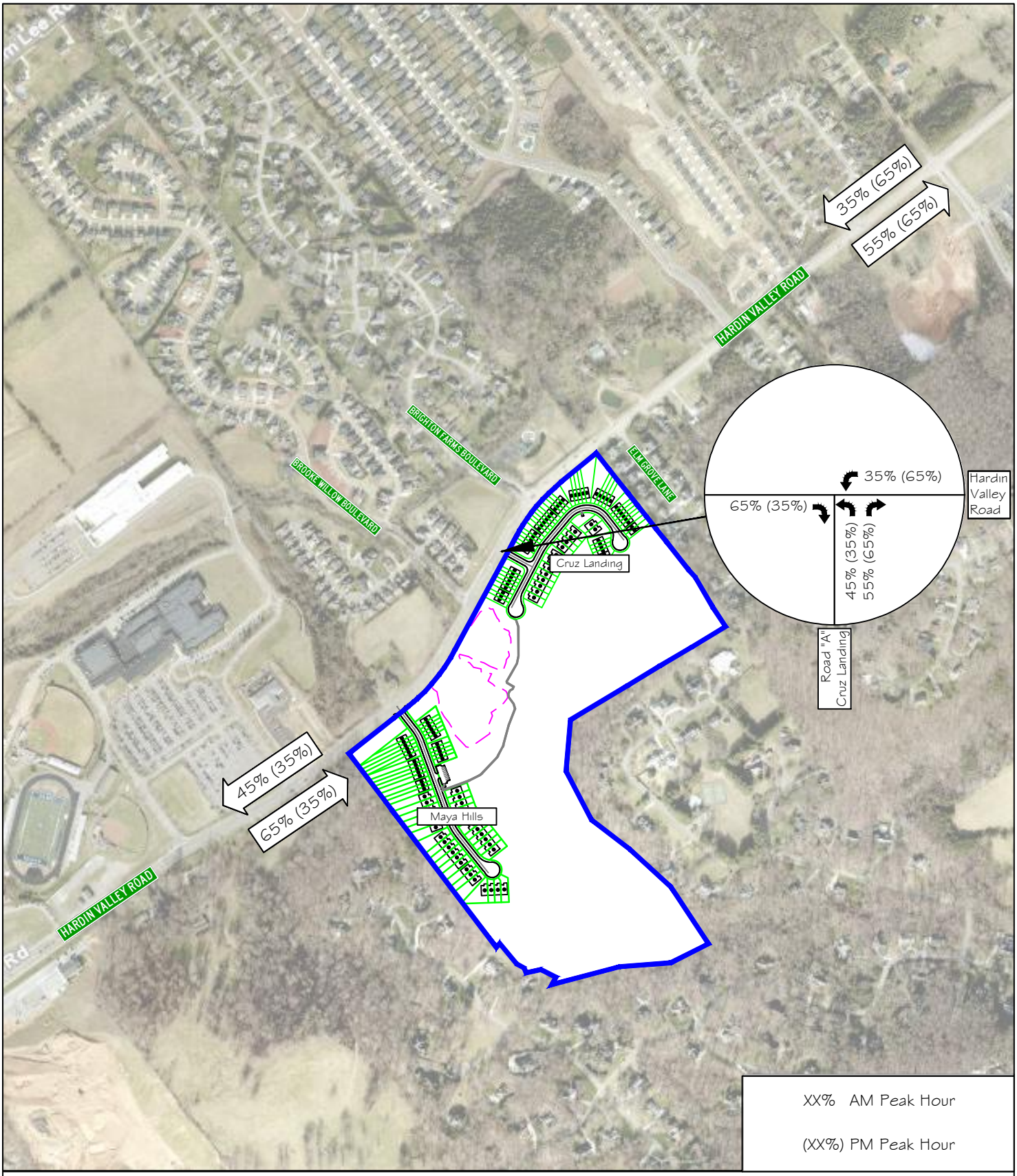


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FIGURE 6a

Cruz Landing & Maya Hills Subdivisions

Directional Distribution of Generated Traffic during AM and PM Peak Hour for Cruz Landing Subdivision

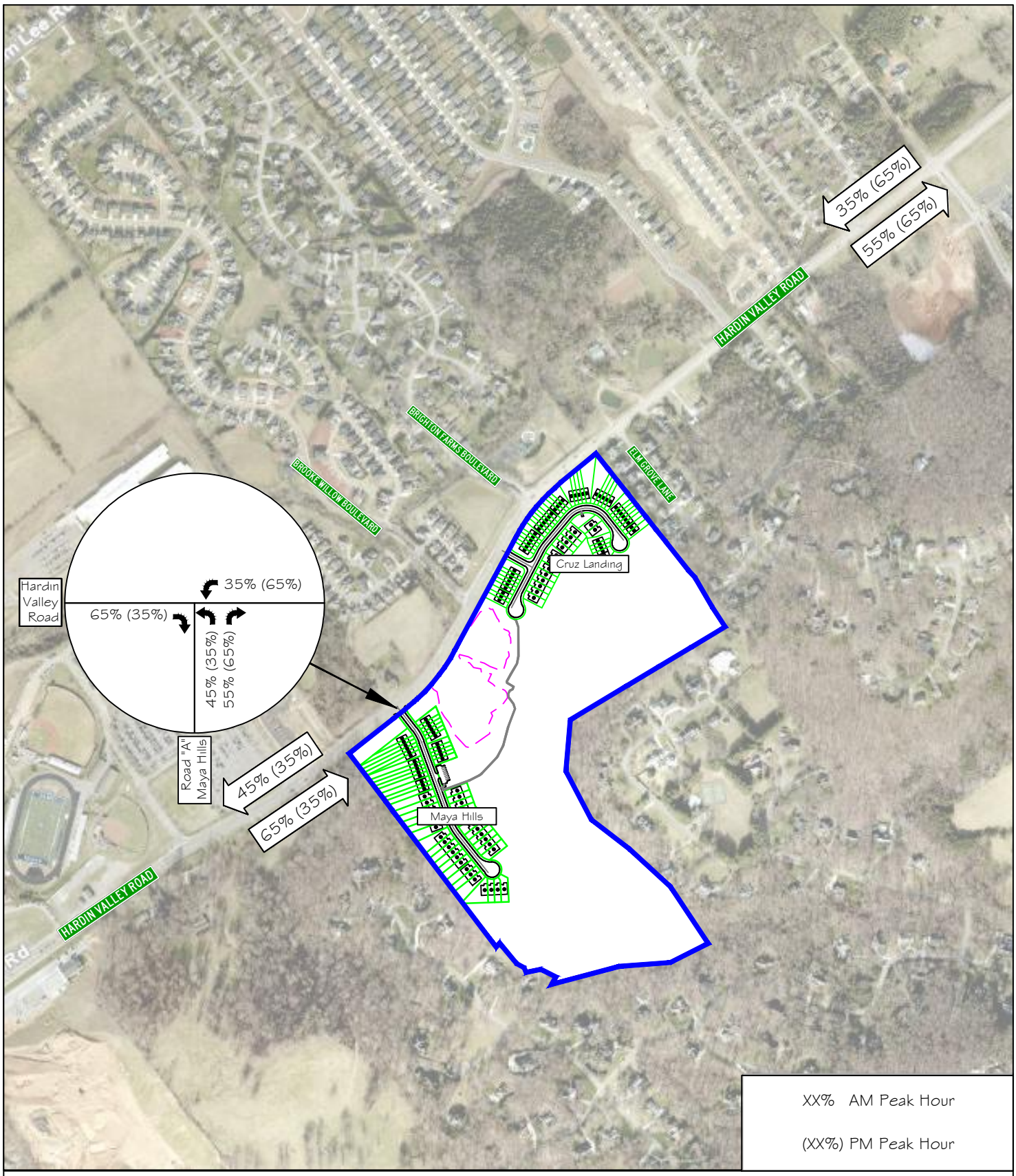

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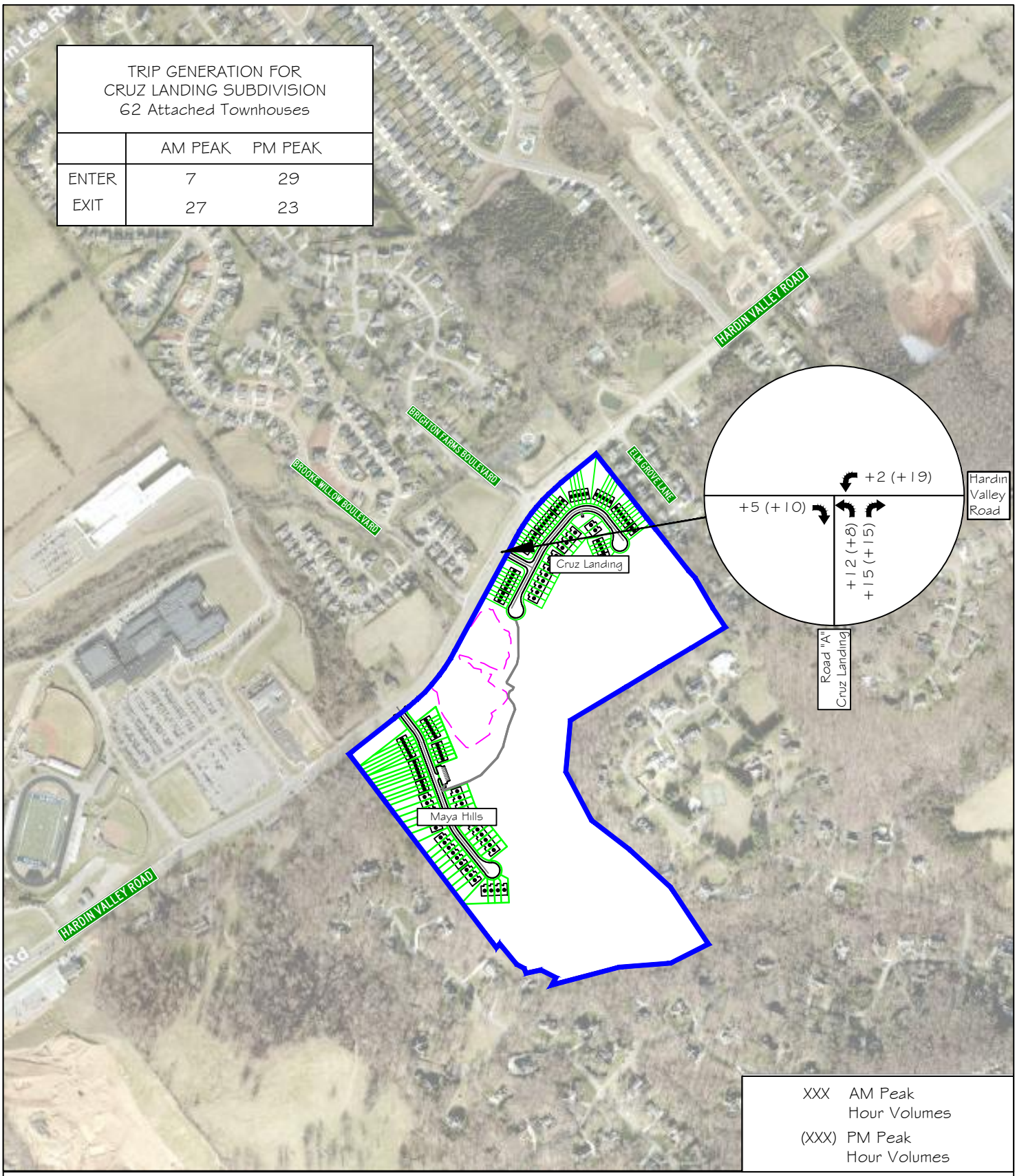
FIGURE 6b

Cruz Landing & Maya Hills Subdivisions

Directional Distribution of Generated Traffic during AM and PM Peak Hour for Maya Hills Subdivision



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

NOT TO SCALE

NORTH

FIGURE 7a

Cruz Landing & Maya Hills Subdivisions

Traffic Assignment of Generated Traffic during AM and PM Peak Hour for Cruz Landing Subdivision

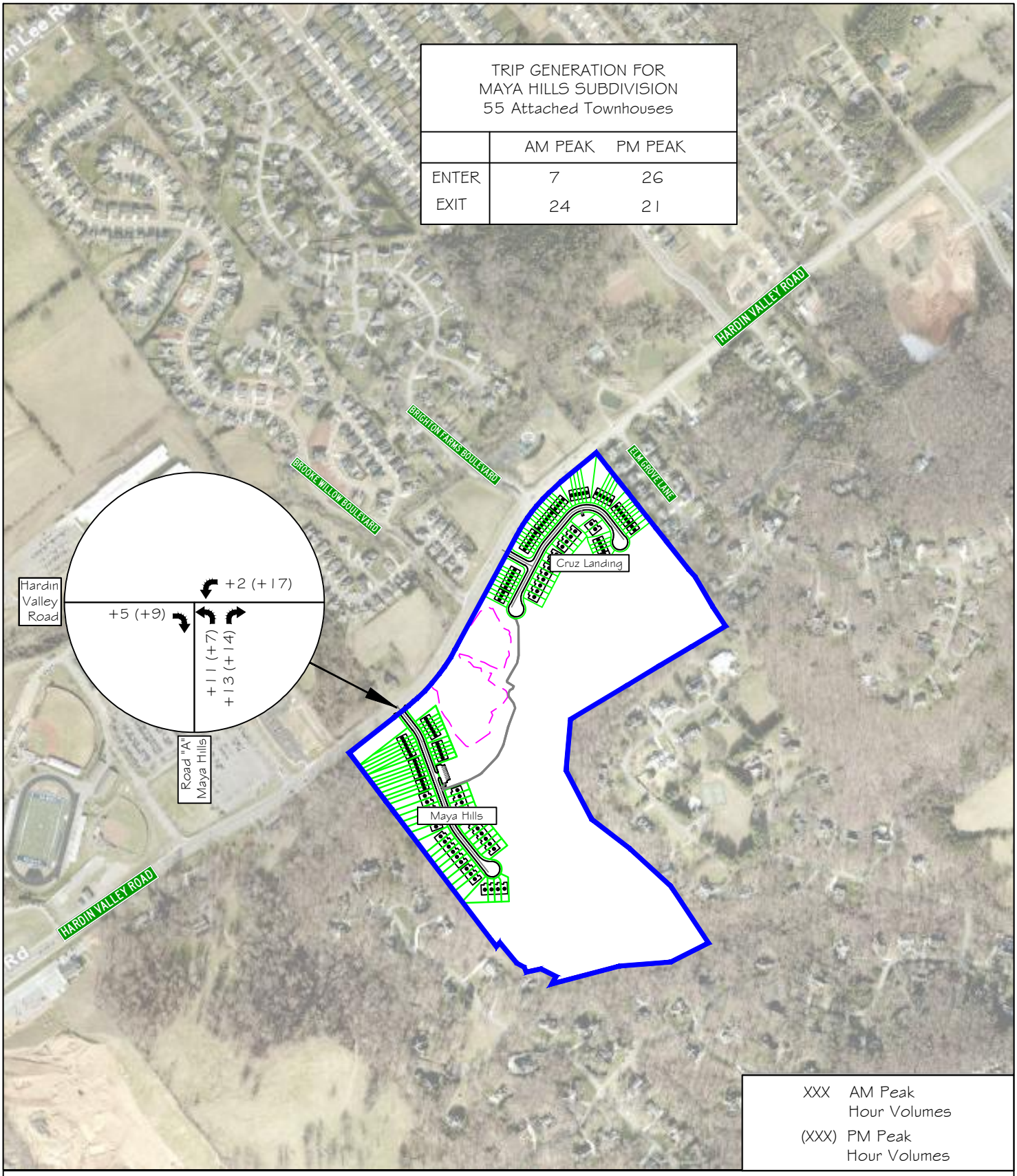


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FIGURE 7b

Cruz Landing & Maya Hills Subdivisions

Traffic Assignment of Generated Traffic during AM and PM Peak Hour for Maya Hills Subdivision

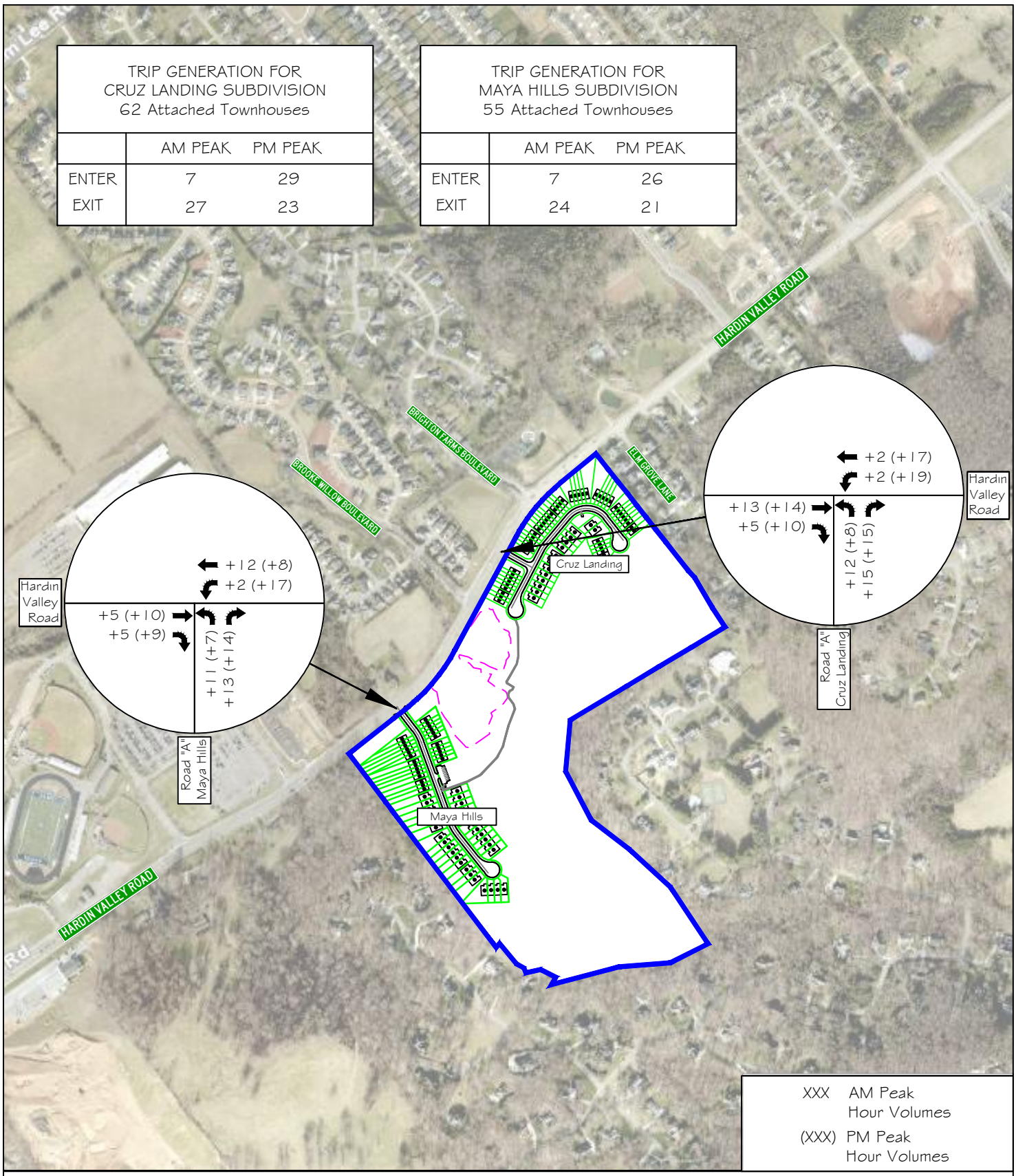

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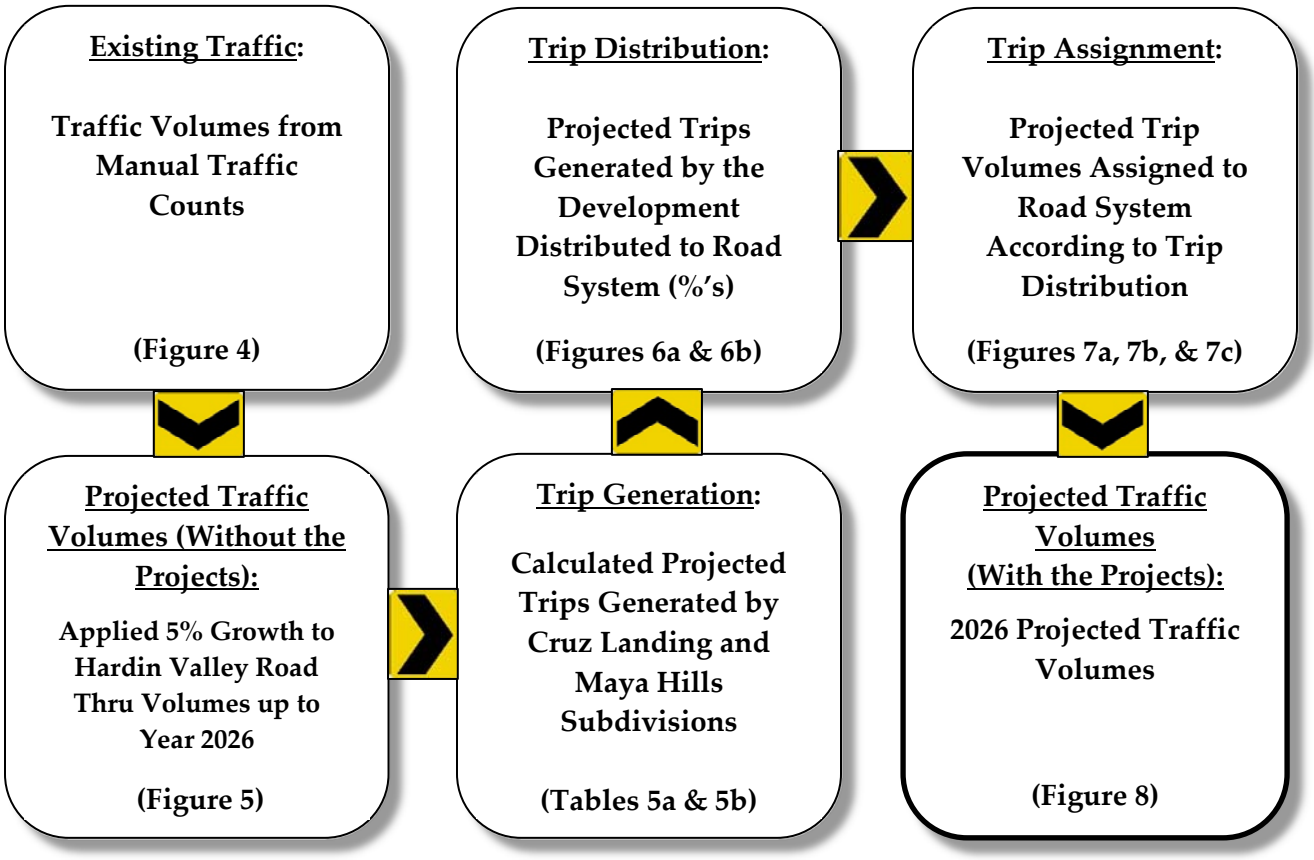
FIGURE 7c

Cruz Landing & Maya Hills Subdivisions

Traffic Assignment of Generated Traffic during AM and PM Peak Hour for Cruz Landing & Maya Hills Subdivisions

- **PROJECTED TRAFFIC CONDITIONS (WITH THE PROJECTS):**

Overall, several additive steps were taken to estimate the total projected traffic volumes at the proposed entrances on Hardin Valley Road when the Cruz Landing and Maya Hills Subdivisions are constructed and fully occupied in 2026. The steps are illustrated below for clarity and review:



The calculated peak hour traffic (Tables 5a & 5b) generated by the Cruz Landing and Maya Hills Subdivisions was added to the 2026 horizon year traffic (Figure 5) by following the predicted trip distributions and assignments (Figures 6a, 6b, 7a, 7b, & 7c). This procedure was completed to obtain the total projected traffic volumes at the intersections on Hardin Valley Road when the subdivisions are fully built and occupied in 2026. Figure 8 shows the projected 2026 AM and PM peak hours with the generated development traffic at the proposed subdivision entrances and the existing intersections included in the study.

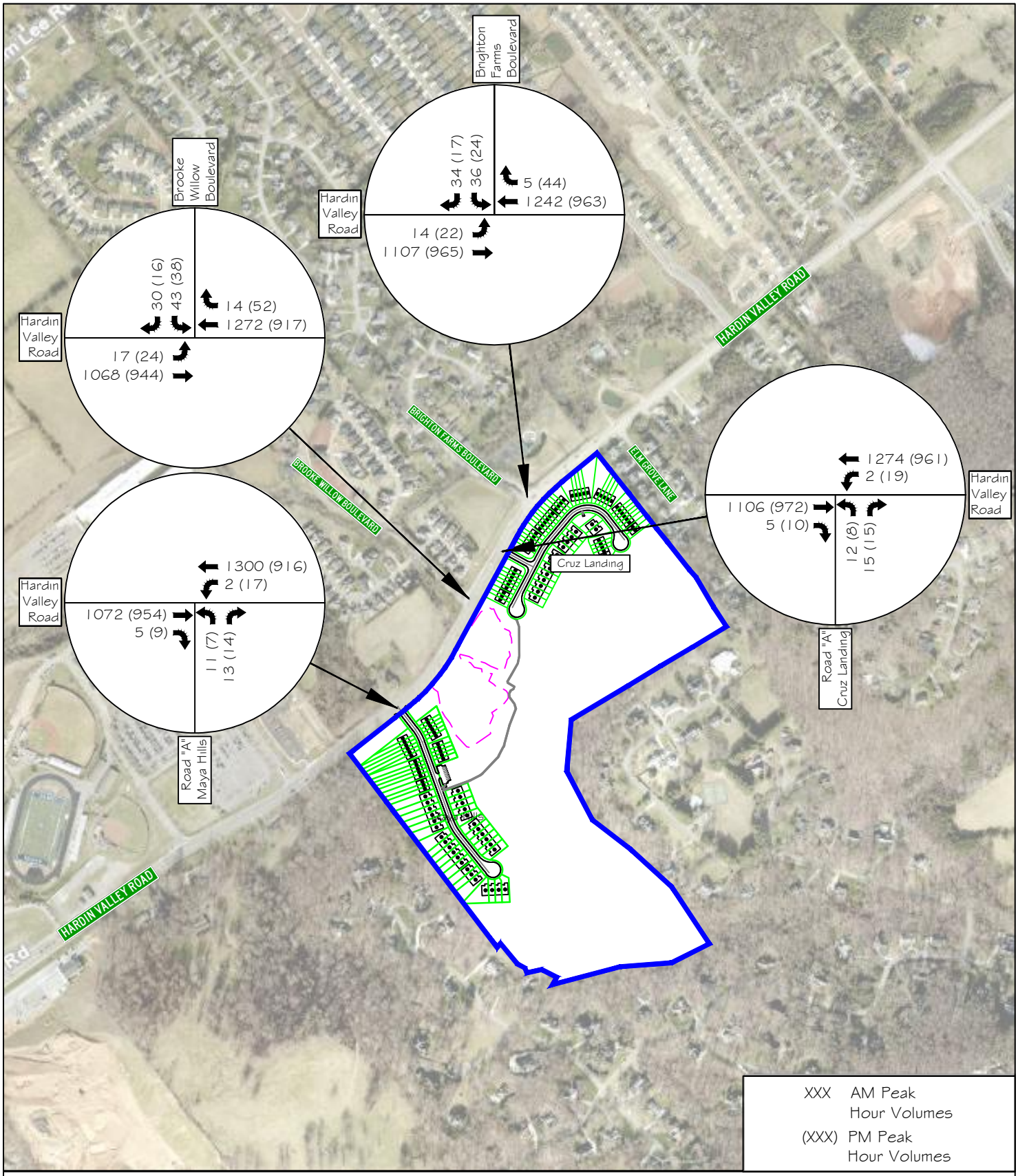


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FIGURE 8

Cruz Landing & Maya Hills Subdivisions

2026 Peak Hour Traffic Volumes - PROJECTED TRAFFIC CONDITIONS (WITH THE PROJECTS)

Capacity analyses were conducted to determine the projected LOS at the proposed entrances and existing intersections on Hardin Valley Road with the development traffic in 2026. Appendix F includes the worksheets for these capacity analyses. The projected 2026 peak hour calculations for the existing intersections of Hardin Valley Road at Brighton Farms Boulevard and Brooke Willow Boulevard are shown with substantial vehicle delays, as shown previously, even without the proposed developments being constructed. However, as shown in Table 6, the proposed entrances for Cruz Landing and Maya Hills Subdivisions are calculated to operate with more reasonable vehicle delays and LOS. The lower vehicle delays at the proposed entrances are due to the proposed subdivisions having substantially fewer housing units than the existing subdivisions of Brighton Farms and The Glen at Hardin Valley. It should be noted that the results for the intersection of Hardin Valley Road at Road "A" Maya Hills in Table 6 are analyzed with the entrance having a separate westbound left-turn lane, as discussed later in the study in "Evaluation of Turn Lane Thresholds".

TABLE 6
2026 INTERSECTION CAPACITY ANALYSIS RESULTS -
PROJECTED TRAFFIC CONDITIONS (WITH THE PROJECTS)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Hardin Valley Road (EB & WB) at Brighton Farms Boulevard (SB)	STOP Unsignalized	Eastbound Left	B	12.9	0.058	B	10.8	0.049
		Southbound Left/Right	F	89.1	0.738	D	34.6	0.332
Hardin Valley Road (EB & WB) at Brooke Willow Boulevard (SB)	STOP Unsignalized	Eastbound Left	B	13.3	0.077	B	10.6	0.047
		Southbound Left/Right	F	205.7	1.111	E	41.5	0.455
Hardin Valley Road (EB & WB) at Road "A" Cruz Farms (NB)	STOP Unsignalized	Northbound Left/Right	D	33.0	0.190	C	22.1	0.108
		Westbound Left	B	11.6	0.004	B	10.5	0.031
Hardin Valley Road (EB & WB) at Road "A" Maya Hills (NB)	STOP Unsignalized	Northbound Left/Right	D	31.2	0.163	C	21.2	0.095
		Westbound Left	B	11.1	0.004	B	10.4	0.028

Note: All analyses were calculated in Synchro 11 software and reported using HCM 2010 intersection methodology
[a] Level of Service , [b] Average Delay (sec/vehicle) , [c] Volume-to-Capacity Ratio

- **POTENTIAL TRANSPORTATION SAFETY ISSUES:**

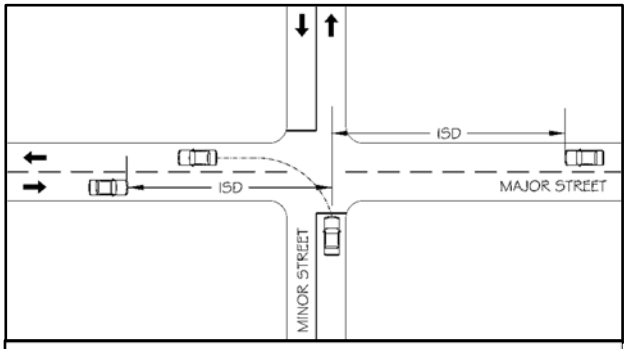
The study area was investigated for potential existing and future safety issues when the developments are constructed. These adjacent transportation system features are discussed in the following pages.

- **EVALUATION OF SIGHT DISTANCE**

For intersections, sight distance evaluations have two categories: Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD).

Methodology:
SSD is the distance required for a motorist on a major street to perceive, react, and the vehicle to come to a complete stop before colliding with an object on the road. For evaluating intersections, this object would be another vehicle entering the intersection from a minor street. SSD can be considered the minimum visibility distance standard for evaluating the safety of an intersection.

ISD is the required visibility distance standard for evaluating the safety of an intersection per Section 3.04.J.5 in the Knoxville-Knox County Subdivision Regulations. ISD is based on the time required to perceive, react, and complete the desired traffic maneuver once a motorist on a minor street decides to perform a traffic maneuver.



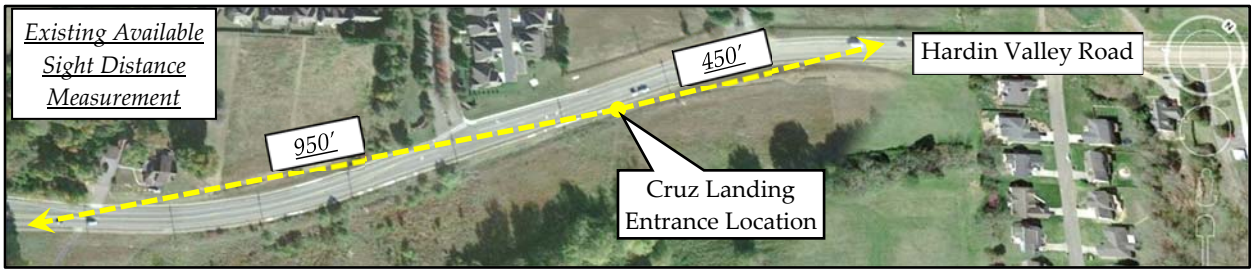
Intersection Sight Distance Diagram

Three traffic maneuvers are available for vehicles stopped on a minor street at a 4-way intersection: (1) left-turn, (2) right-turn, (3) or a crossing maneuver across the major street. For turns from the minor street, ISD is needed to allow a stopped motorist to turn onto a major street without being overtaken by an approaching vehicle. The most critical ISD is for left turns from the minor street. The ISD for this maneuver includes the time to turn left and clear half of the intersection without conflicting with the oncoming traffic from the left and accelerating to the road's operating speed without causing the approaching vehicles from the right to reduce their speed substantially.

With an assumed speed limit of 40-mph on Hardin Valley Road at the subdivision entrances, the ISD is 400 feet based on Knox County's requirement of providing 10 feet of sight distance per 1 mph of vehicle speed.

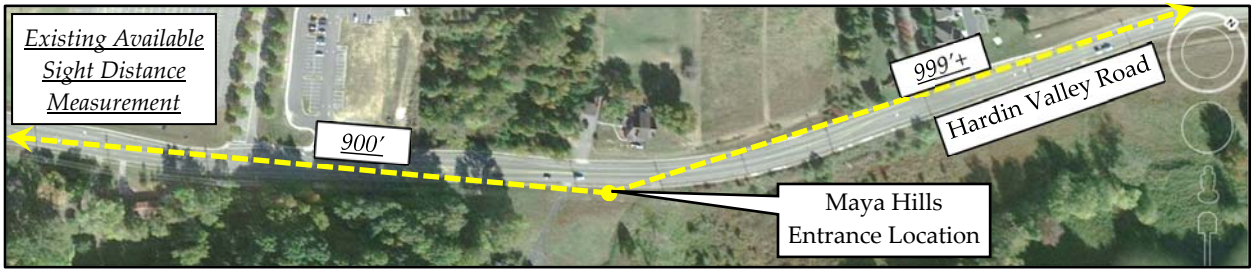
Visual observations of the sight distances at the proposed entrance locations on Hardin Valley Road were undertaken. Using a Nikon Laser Rangefinder at the proposed entrance location for Cruz Landing Subdivision, the available sight distance was visually estimated to be 950′ feet to the southwest and 450′ feet to the northeast. The sight distance to the northeast is reduced by an existing earthen bank on the southern side of Hardin Valley Road. Using a Nikon Laser Rangefinder at the proposed entrance location for Maya Hills Subdivision, the available sight distance was visually estimated to be 900′ feet to the southwest and 999′+ (limit of the rangefinder) feet to the northeast.

Thus, the available sight distances from the proposed entrances on Hardin Valley Road will be adequate based on visual observations. Images of the existing sight distances at the proposed entrance locations are labeled below with the ISD and rangefinder-measured sight distances.

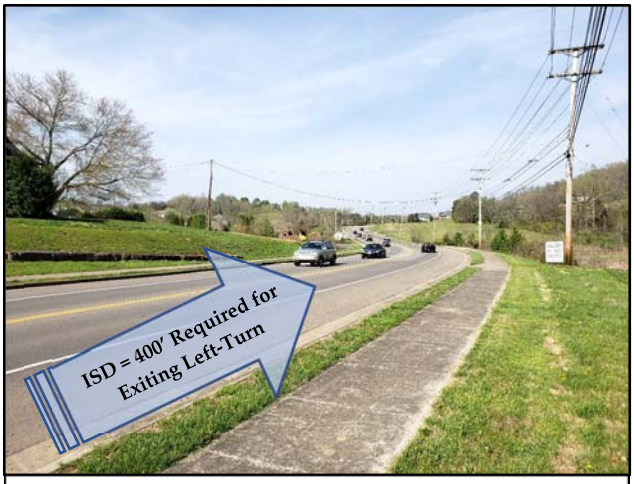


View of Sight Distance on Hardin Valley Road at the Cruz Landing Entrance Location (Looking Southwest)

View of Sight Distance on Hardin Valley Road at the Cruz Landing Entrance Location (Looking Northeast)



View of Sight Distance on Hardin Valley Road at the Maya Hills Entrance Location (Looking Southwest)



View of Sight Distance on Hardin Valley Road at the Maya Hills Entrance Location (Looking Northeast)

- **EVALUATION OF TURN LANE THRESHOLDS**

The need for separate turn lanes was evaluated in the projected 2026 conditions for Hardin Valley Road at the proposed subdivision entrances. The evaluation did not include left turns on Hardin Valley Road at the proposed Cruz Landing Subdivision entrance since a TWLTL is already provided in the center of the road for this movement. The evaluation did include left turns on Hardin Valley at the proposed Maya Hills Subdivision entrance since the road section at this location is only two lanes without a center TWLTL.

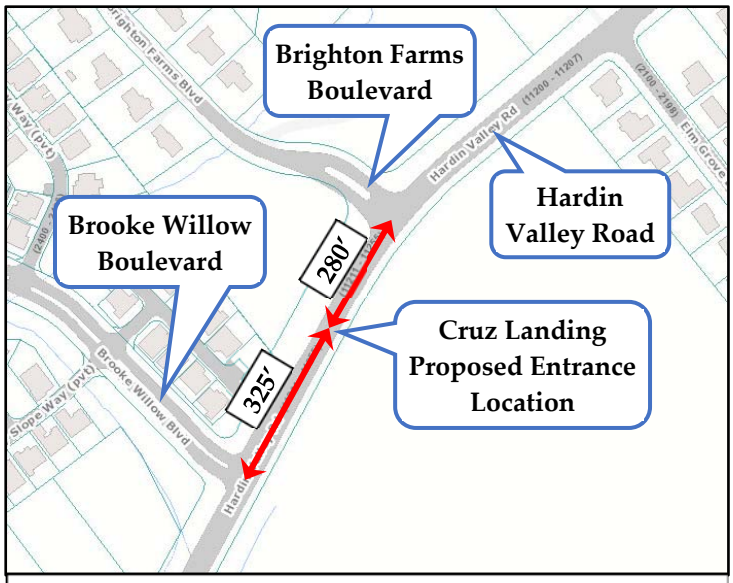
The criteria used for these turn lane evaluations were based on Knox County's "Access Control and Driveway Design Policy". This design policy relates vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. The location of the proposed entrances on Hardin Valley Road is within a 40-mph speed zone; thus, they were evaluated based on this speed.

According to Knox County's guidelines, a separate westbound left-turn lane on Hardin Valley Road at the proposed Maya Hills Subdivision is warranted based on the projected 2026 peak hour

traffic volumes. Exclusive right-turn lanes on Hardin Valley Road at the proposed subdivision entrances are not warranted based on the projected 2026 traffic volumes. The worksheets for these evaluations are provided in Appendix I.

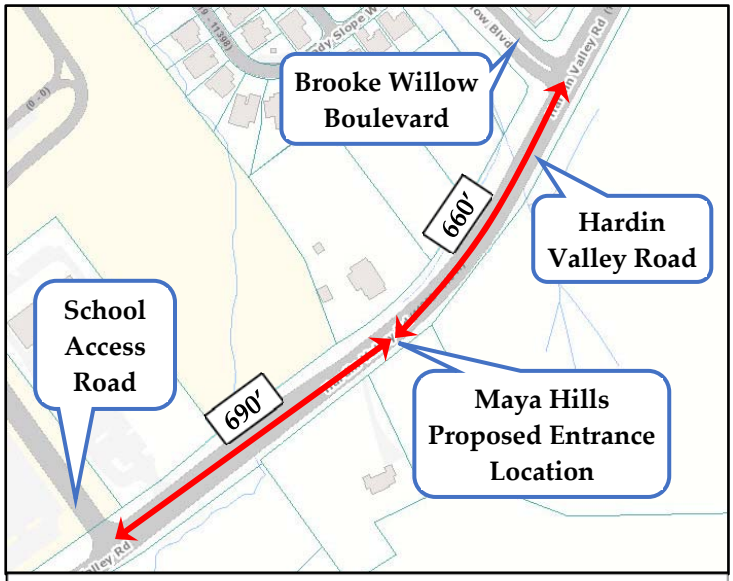
- **EVALUATION OF INTERSECTION SPACING**

Knox County requires specific minimum spacing between intersecting streets. This standard is stated in Section 3.04.J.4 of the Knoxville-Knox County Subdivision Regulations. Since Hardin Valley Road is designated as a minor arterial at the proposed entrance locations, the minimum intersection spacing is 400 feet.



Proposed Hardin Valley Road Intersection Spacing

The proposed spacing between Brighton Farms Boulevard and the proposed entrance for the Cruz Landing Subdivision is approximately 280 feet from centerline to centerline, less than the Knox County minimum. The proposed spacing between Brooke Willow Boulevard and the proposed entrance for the Cruz Landing Subdivision is approximately 325 feet from centerline to centerline, also less than the Knox County minimum.



Proposed Hardin Valley Road Intersection Spacing

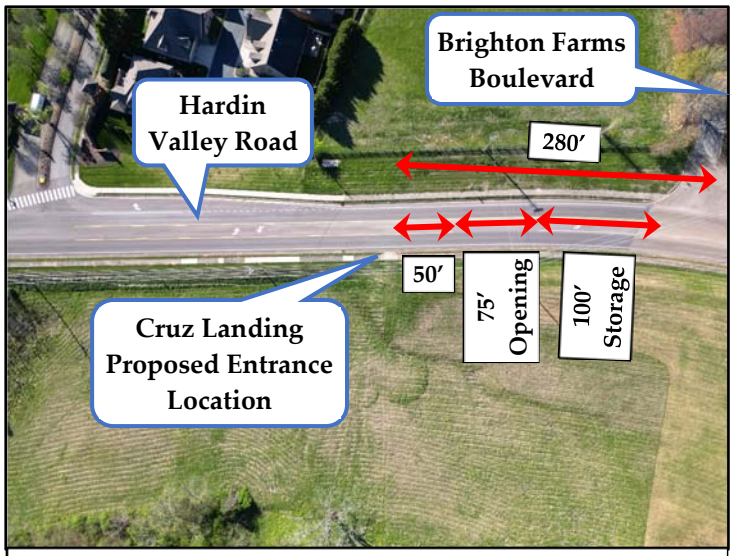
The proposed spacing between Brooke Willow Boulevard and the proposed entrance for the Maya Hills Subdivision is approximately 660 feet from centerline to centerline, greater than the Knox County minimum. The proposed spacing between the School Access Road and the proposed entrance

for the Maya Hills Subdivision is approximately 690 feet from centerline to centerline, also greater than the Knox County minimum.

- **PROJECTED VEHICLE QUEUES**

Due to the limited vehicle storage length provided in the center TWLTL on Hardin Valley Road between Brighton Farms Boulevard and the proposed entrance for Cruz Landing Subdivision, it is critical to ensure enough storage length is available for both developments. It is also essential to analyze the potential storage length needed for the warranted westbound left-turn lane on Hardin Valley Road at the proposed entrance for Maya Hills Subdivision.

Currently, 100 feet of vehicle storage is designated for eastbound left turns in the center TWLTL at Brighton Farms Boulevard. The vehicle opening in the TWLTL for this designated left turn is 75 feet, for a total of 175 feet designated by pavement markings for this movement at Brighton Farms Boulevard. The proposed spacing between Brighton Farms Boulevard and the proposed entrance for the Cruz Landing Subdivision is approximately 280 feet from centerline to centerline. Taking into account the length of the openings at the intersections, this leaves less than an optimal length of 50 feet for a designated westbound left turn in the center TWLTL at the proposed entrance for Cruz Landing Subdivision.



Distances Between Brighton Farms Boulevard and Proposed Cruz Landing Entrance

An additional software program was used to determine the projected left-turn vehicle queues at the studied intersections to ensure vehicle storage length adequacy. The previously mentioned Synchro Traffic Software includes SimTraffic. The Synchro portion of the software performs the macroscopic calculations for intersections, and SimTraffic performs micro-simulation and animation of vehicular traffic. However, both programs estimate 95th percentile vehicle queue lengths.

The 95th percentile vehicle queue length is the recognized measurement in the traffic engineering profession as the design standard used when considering vehicle queue lengths. A 95th percentile vehicle queue length means 95% certainty that the vehicle queue will not extend beyond that point.

For the proposed entrance intersections for Cruz Landing and Maya Hills Subdivisions, the projected vehicle queue results for the exiting northbound lanes were calculated from the Synchro software. SimTraffic cannot accurately model intersections with center TWLTL's with their effects on vehicle gap acceptance from minor exiting approaches. SimTraffic will only model vehicles to wait for gaps in both directions of traffic before turning (i.e., the vehicles are not allowed to cross halfway into the center TWLTL and wait for another gap to enter the opposite lane traffic stream). Due to this limitation, the Synchro 95th percentile vehicle queue results were used to determine the exiting vehicle queue lengths at the proposed entrances since it accounts for two-stage left turns when a center lane is sufficient to store a vehicle temporarily. However, SimTraffic excels in determining vehicle queue lengths when a TWLTL or center median is not involved in the analysis. Thus, the entering left-turn vehicle queue lengths on Hardin Valley Road were calculated from the SimTraffic software. The calculated vehicle queue results for the entering left-turn vehicle queues were based on averaging the outcome obtained during ten traffic simulations in the SimTraffic software.

The results from the Synchro software for the exiting lanes for the Cruz Landing and Maya Hills Subdivision entrances are included in the worksheets in the capacity analyses presented in Appendix F. The vehicle queue results from the SimTraffic software for the entering left-turn lanes on Hardin Valley Road are in Appendix J.

The 95th percentile vehicle queue lengths at the intersections for the projected 2026 conditions are shown in Table 7. The intersection of Hardin Valley Road at Brooke Willow Boulevard is not shown in Table 7 since vehicle queues at this intersection will not impact either of the proposed subdivision entrances and vice versa.

TABLE 7
TURN LANE STORAGE & VEHICLE QUEUE SUMMARY -
2026 PROJECTED PEAK HOUR TRAFFIC (WITH THE PROJECTS)

INTERSECTION	APPROACH / MOVEMENT	EXISTING OR PROPOSED STORAGE LENGTH (ft)	95th PERCENTILE QUEUE LENGTH (ft)	
			AM PEAK HOUR	PM PEAK HOUR
Hardin Valley Road at Brighton Farms Boulevard	Eastbound Left *	n/a	35	43
Hardin Valley Road at Road "A" Cruz Landing	Westbound Left *	n/a	11	37
	Northbound Left/Right **	n/a	17.5	10
Hardin Valley Road at Road "A" Maya Hills	Westbound Left *	75	11	33
	Northbound Left/Right **	n/a	15	7.5

* 95th percentile queues were calculated in SimTraffic 11 software
** 95th percentile queues were calculated in Synchro 11 software (assuming 1 vehicle = 25 feet)

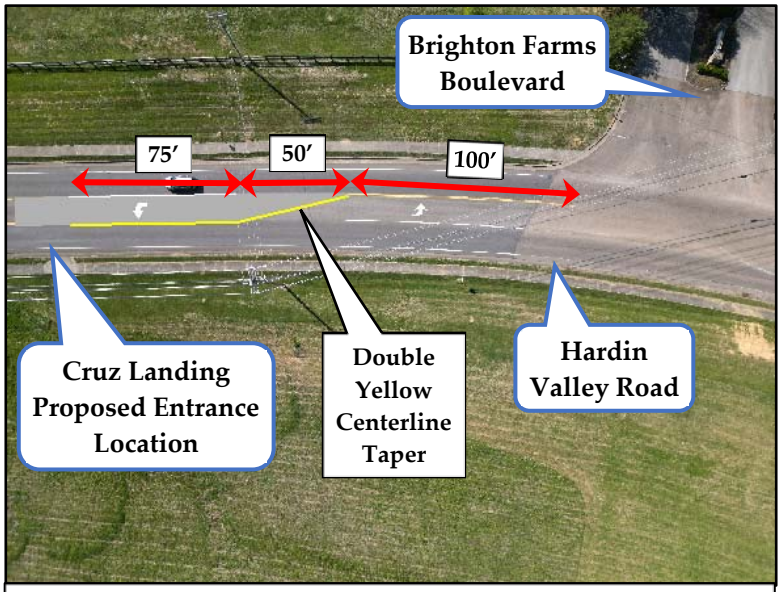
Thus, based on the results shown in Table 7, providing a westbound 75-foot left-turn lane on Hardin Valley Road at Road "A" Maya Hills will adequately contain the projected vehicle queue. The largest 95th percentile vehicle queue for westbound left turns at Road "A" for Cruz Landing is calculated to be 37 feet in the PM peak hour. Also, as shown in Table 7, the largest 95th percentile vehicle queue for eastbound left turns at Brighton Farms Boulevard is estimated to be 43 feet in the PM peak hour. These calculated results indicate that the proposed spacing between the intersections of Brighton Farms Boulevard and Road "A" Cruz Landing can adequately contain the projected vehicle queue lengths in the center lane of Hardin Valley Road.

CONCLUSIONS & RECOMMENDATIONS

The following is an overview of recommendations to minimize the transportation impacts of the Cruz Landing and Maya Hills Subdivisions on the adjacent transportation system while attempting to achieve an acceptable traffic flow and safety level. However, due to the existing constraints of Hardin Valley Road, there will be periods where vehicle movement to and from these proposed subdivisions will be severely limited by the backups that occur due to the nearby Hardin Valley public schools to the west and the east due to development and congestion around the Pellissippi Parkway interchange.

1 **Hardin Valley Road at Cruz Landing Subdivision Entrance**: The 2026 projected level of service calculations for this proposed intersection resulted in acceptable vehicle delays and LOS.

1a) The construction of an eastbound right-turn lane on Hardin Valley Road for entering traffic is not warranted at the Cruz Landing Subdivision Entrance based on the projected 2026 traffic volumes. Left turns entering Cruz Landing Subdivision will be served by the existing center lane of Hardin Valley Road. It is recommended that the center of Hardin Valley Road be modified between the proposed entrance and Brighton Farms Boulevard to accommodate a new entrance for Cruz Landing Subdivision. The modification should include restriping the center lane on Hardin Valley Road to provide 75 feet of dedicated vehicle storage for a westbound left-turn lane at the Cruz Landing Subdivision entrance. It should also include maintaining the 100 feet of dedicated vehicle storage for the eastbound left-turn lane at Brighton Farms Boulevard as currently provided. The remaining 50 feet between the two left-turn storage lanes should incorporate a double yellow centerline taper



Proposed Modifications to Hardin Valley Road for Proposed Cruz Landing Entrance

separating the two opposing lanes.

1b) It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Cruz Landing Subdivision entrance approach at Hardin Valley Road. The stop bar should be applied a minimum of 4 feet away from the edge of Hardin Valley Road and placed at the desired stopping point that maximizes the sight distance.

1c) The continuous center two-way left-turn lane (TWLTL) pavement striping in the center of Hardin Valley Road should be removed in front of the new Cruz Landing Subdivision entrance to accommodate this new intersection with the new turning movements.

1d) A single exiting lane for the Cruz Landing Subdivision entrance at Hardin Valley Road will be sufficient. The northbound exiting lane at Hardin Valley Road is proposed as a shared left/right turn lane. The 95th percentile vehicle queue lengths were calculated for this shared lane for the 2026 projected conditions with the project, and the calculated vehicle queues are reasonable. The longest exiting queue in the projected 2026 conditions is calculated to be 17.5 feet in the AM peak hour and 10 feet in the PM peak hour.

1e) Intersection sight distance at the proposed Cruz Landing Subdivision entrance at Hardin Valley Road must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on Hardin Valley Road, the required ISD is 400 feet for exiting left and right-turning vehicles at the proposed entrance. The site designer must verify that these distances will be available. Based on visual observations, these distances are available at the proposed location. If possible, the site designer should consider sloping back the existing earthen bank on the south side of Hardin Valley Road to increase the available sight distance looking to the northeast.

1f) The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Hardin Valley Road at the proposed entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.

1g) Knox County requires a 400-foot minimum intersection spacing distance for arterial roads. The intersection of Hardin Valley Road at the proposed entrance for Cruz

Landing Subdivision will be approximately 280 feet away to the southwest from Brighton Farms Boulevard and 325 feet to the northeast from Brooke Willow Boulevard. The developer should request a variance to allow the proposed Cruz Landing Subdivision entrance to have spacing on Hardin Valley Road below the Knox County minimum. The centerline to centerline distance between the existing intersections between Brighton Farms Boulevard and Brooke Willow Boulevard on the north side of Hardin Valley Road is 605 feet. Thus, providing an entrance on the other side of Hardin Valley Road at any point between these two existing boulevards would not meet the 400-foot minimum distance. This variance should be requested since the Cruz Landing Subdivision development property has a limited area to provide an entrance on Hardin Valley Road at any other location. The area is limited due to the wetlands and site topography. Furthermore, providing an entrance directly across from Brighton Farms Boulevard is not a viable possibility due to high-impact utility lines on the opposite side of Hardin Valley Road. These utility lines include underground water and gas transmission facilities.

As shown previously, the projected left-turn vehicle queues in the center of Hardin Valley Road at Brighton Farms Boulevard and the proposed entrance for Cruz Landing are not projected back up into each other. With the recommended modifications to the center lane of Hardin Valley Road, the proposed spacing between these two intersections should operate sufficiently.

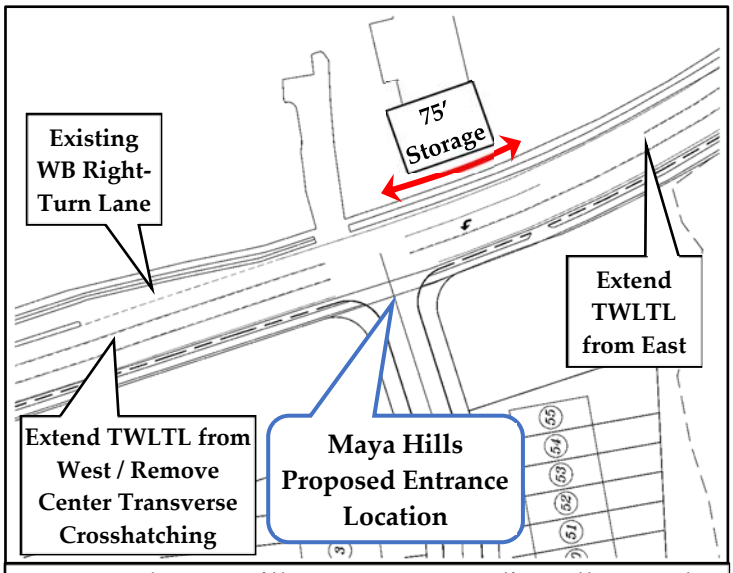
1h) During the nearby school's arrival and dismissal periods and afternoon peak periods, traffic on Hardin Valley Road regularly backs up for brief periods. During these high streams of traffic on Hardin Valley Road, the residents in Cruz Landing Subdivision will need to rely on the courtesy of the motorists in the thru traffic stream on Hardin Valley Road to allow entering and exiting movements from this subdivision.

Hardin Valley Road at Maya Hills Subdivision Entrance: The 2026 projected level of service calculations for this proposed intersection resulted in acceptable vehicle delays and LOS.

2a) The construction of an eastbound right-turn lane on Hardin Valley Road for entering traffic is not warranted at the Maya Hills Subdivision Entrance based on the projected 2026 traffic volumes. The projected left-turn volumes in 2026 warrant the construction of an exclusive westbound left-turn lane on Hardin Valley Road at the entrance of Maya Hills Subdivision based on Knox County standards. To provide this new westbound left-turn lane for Maya Hills Subdivision, it is recommended that the existing center TWLTL on Hardin Valley Road be extended between Brooke Willow Boulevard and the school access entrance. It is recommended that a left-turn lane be constructed with 75 feet of storage at the Maya Hills Subdivision Entrance.

At the proposed entrance location on Hardin Valley Road, the roadway has a width of 43 feet from the face of the curb to the face of the curb. The existing roadway section at this location has only two lanes but has 7.5' wide paved shoulders outside the white line on each side. This additional existing pavement would allow enough room to extend the existing TWLTL and provide 75 feet of storage for a westbound left-turn lane at the Maya Hills Subdivision without modifying the existing pavement section on Hardin Valley Road. Extending the TWLTL from the east and the west with left-turn storage at this location will require shifting and modifying the existing pavement markings upstream and downstream of the proposed intersection on Hardin Valley Road.

To the west of the proposed Maya Hills Entrance on Hardin Valley Road, the modification of the pavement striping will entail removing the center transverse crosshatching.



Proposed Maya Hills Entrance at Hardin Valley Road

2b) It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Maya Hills Subdivision entrance approach at Hardin Valley Road. The stop bar should be applied a minimum of 4 feet away from the edge of Hardin Valley Road and placed at the desired stopping point that maximizes the sight distance.

2c) The double yellow centerline in the center of Hardin Valley Road should be removed in front of the new Maya Hills Subdivision entrance to accommodate this new intersection with the new turning movements.

2d) A single exiting lane for the Maya Hills Subdivision entrance at Hardin Valley Road will be sufficient. The northbound exiting lane at Hardin Valley Road is proposed as a shared left/right turn lane. The 95th percentile vehicle queue lengths were calculated for this shared lane for the 2026 projected conditions with the project, and the calculated vehicle queues are reasonable. The longest exiting queue in the projected 2026 conditions is calculated to be 15 feet in the AM peak hour and 7.5 feet in the PM peak hour.

2e) Intersection sight distance at the proposed entrance at Hardin Valley Road must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on Hardin Valley Road, the required ISD is 400 feet for exiting left and right-turning vehicles at the proposed Maya Hills Subdivision entrance. Based on visual observations, these distances are available at the proposed location. The site designer must verify that these distances will be available.

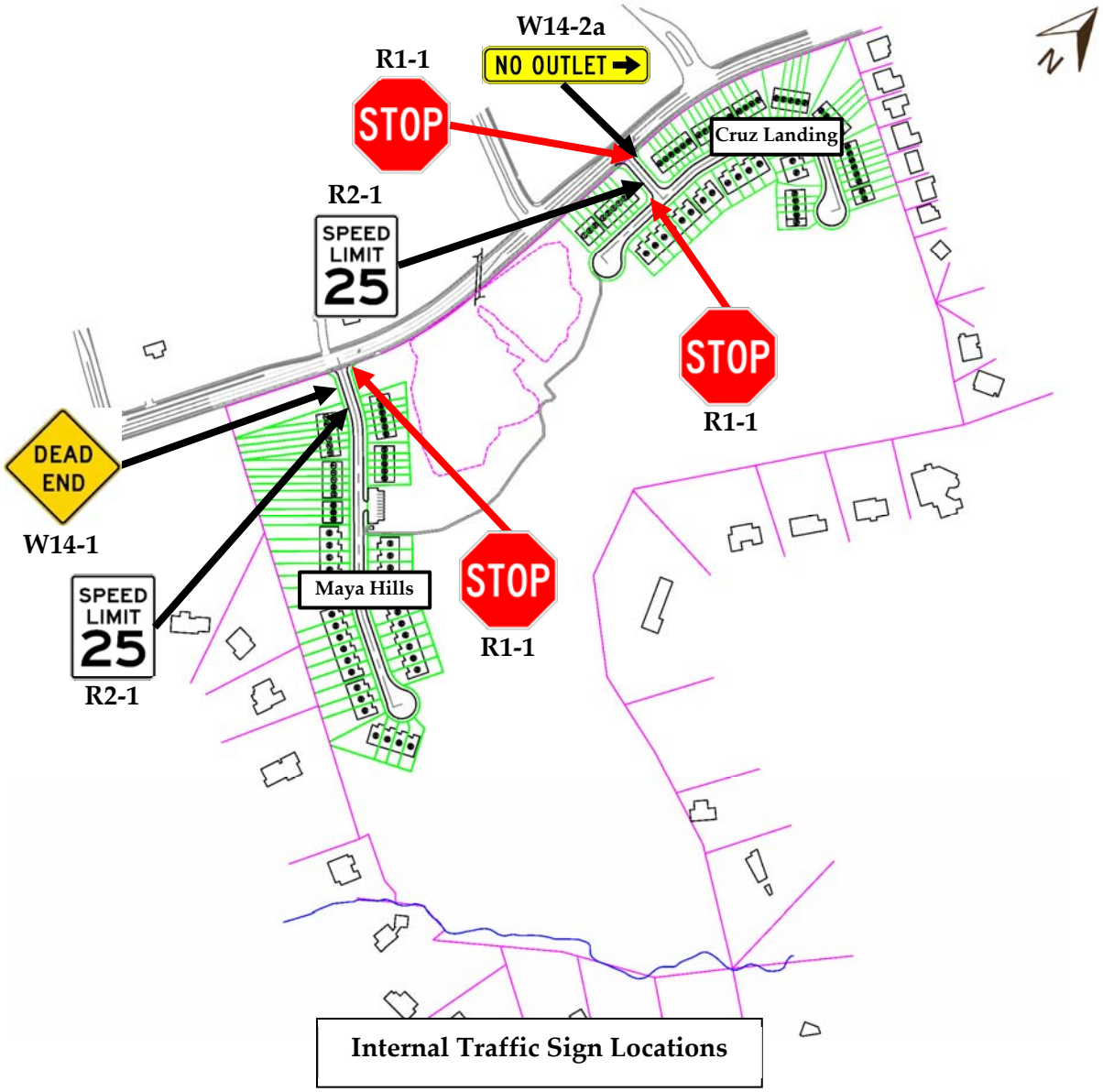
2f) The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Hardin Valley Road at the proposed entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.

2g) During the nearby school's arrival and dismissal periods and afternoon peak periods, traffic on Hardin Valley Road regularly backs up for brief periods. During these high streams of traffic on Hardin Valley Road, the residents in Maya Hills Subdivision will need to rely on the courtesy of the motorists in the thru traffic stream on Hardin Valley Road to allow entering and exiting movements from this subdivision.

3 **Cruz Landing & Maya Hills Subdivision Internal Roads:** The layout plan shows two entrances on Hardin Valley Road constructed for the developments, as shown in Figure 3.

3a) A 25-mph Speed Limit Sign (R2-1) is recommended to be posted near the beginning of the development entrances off Hardin Valley Road. It is recommended that a "No Outlet" Sign (W14-2a) be installed at the front of the Cruz Landing Subdivision at Hardin Valley Road. The "No Outlet" (W14-2a) sign can be installed above or below the street name sign or separately posted. It is recommended that a "Dead End" Sign (W14-1) be installed at the front of the Maya Hills Subdivision at Hardin Valley Road.

3b) Stop Signs (R1-1) with 24" white stop bars and other traffic signage are recommended to be installed at the internal locations, as shown below:



Internal Traffic Sign Locations

3c) Sight distance at the new internal road intersections must not be impacted by signage, parked cars, or future landscaping in the subdivisions. The development property is located within Knox County, requiring an ISD of 10 feet of sight distance per 1 mph of vehicle speed. Thus, with a proposed speed limit of 25-mph in the developments, the internal intersection sight distance is 250 feet. The required stopping sight distance is 155 feet for a level road grade. The site designer should ensure that these internal sight distance lengths are met.

3d) All drainage grates and covers for the residential developments must be pedestrian and bicycle safe.

3e) If directed by the local post office, the site designer should include a parking area within the developments for a centralized mail delivery center. The site plans do show a general location in both developments, but a specific plan with a parking area should be designed and provided if required.

3f) The roads in Cruz Landing and Maya Hills Subdivisions will not have internal sidewalks, but sidewalks are available on Hardin Valley Road adjacent to the development sites. School-age children walking or riding their bikes will be able to cross Hardin Valley Road at a marked pedestrian crossing in front of Hardin Valley Academy. This existing crossing on Hardin Valley Road will be 1,400 feet west of the Maya Hills Subdivision entrance.

3g) All road grade and intersection elements should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.

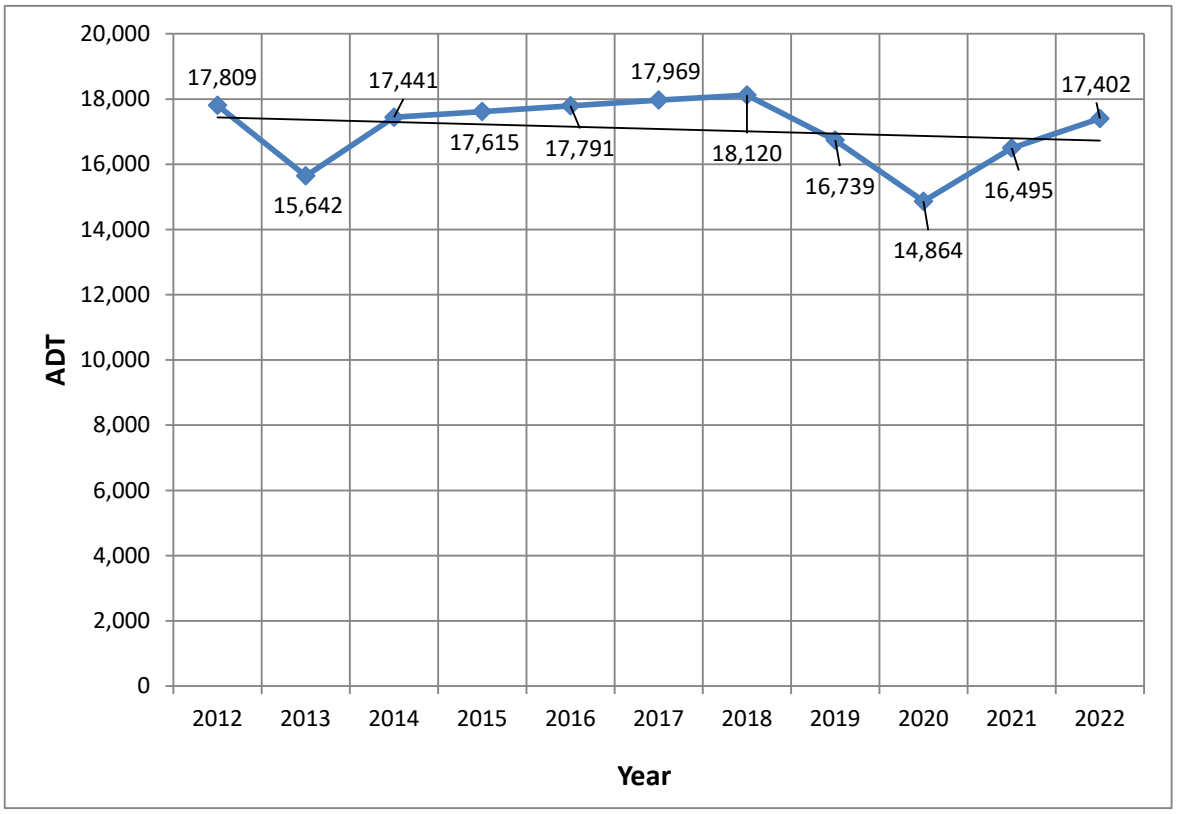
APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

Historical Traffic Counts

Organization: TDOT
Station ID #: 47000084
Location: Hardin Valley Road, west of Valley Vista Road

YEAR	ADT	
2012	17,809	
2013	15,642	
2014	17,441	
2015	17,615	
2016	17,791	
2017	17,969	
2018	18,120	
2019	16,739	
2020	14,864	
2021	16,495	Trendline
2022	17,402	



2021 - 2022 Growth Rate = 5.5%
Average Annual Growth Rate = 5.5%

TN TDOT Department of Transportation

TCDS Help MS2

Transportation Data Management System

Home | Login | Locate | Locate All | Email This

Auto-Locate OFF

List View | All DIRs

Record 7202 of 15616 Goto Record go

Location ID	47000084	**MPO ID**	
Type	SPOT	**HPMS ID**	
On NHS		**On HPMS**	
LRS ID	4701277001	**LRS Loc Pt.**	6.612
SF Group	Urban	**Route Type**	
AF Group	Urban Minor Arterial	**Route**	
GF Group	Knox	**Active**	Yes
Class Dist Grp	Urban Minor Arterial	**Category**	CC
Seas Clss Grp			
WIM Group			
QC Group	Default		
Fnct'l Class	Minor Arterial	**Milepost**	
Located On	01277		
Loc On Alias	HARDIN VALLEY DR.		
	VALLEY RD-NEAR ANDERSON CO LINE		

More Detail

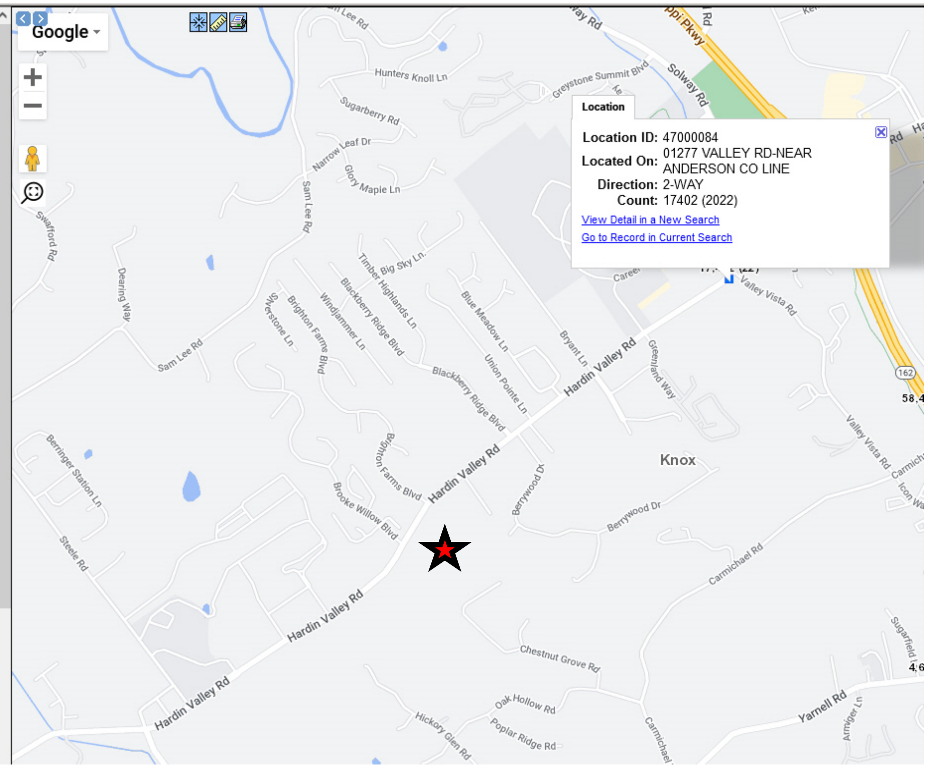
STATION DATA

Directions: 2-WAY EB WB

AADT

	Year	AADT	DHV-30	K %	D %	PA	BC	Src
	2022	17,402	1,874	11	65	16,916 (97%)	486 (3%)	
	2021	16,495	1,464	9	65	15,952 (97%)	543 (3%)	
	2020	14,864[3]		13	65	14,298 (96%)	566 (4%)	Grown from 2019
	2019	16,739		13	65			
	2018	18,120[2]						

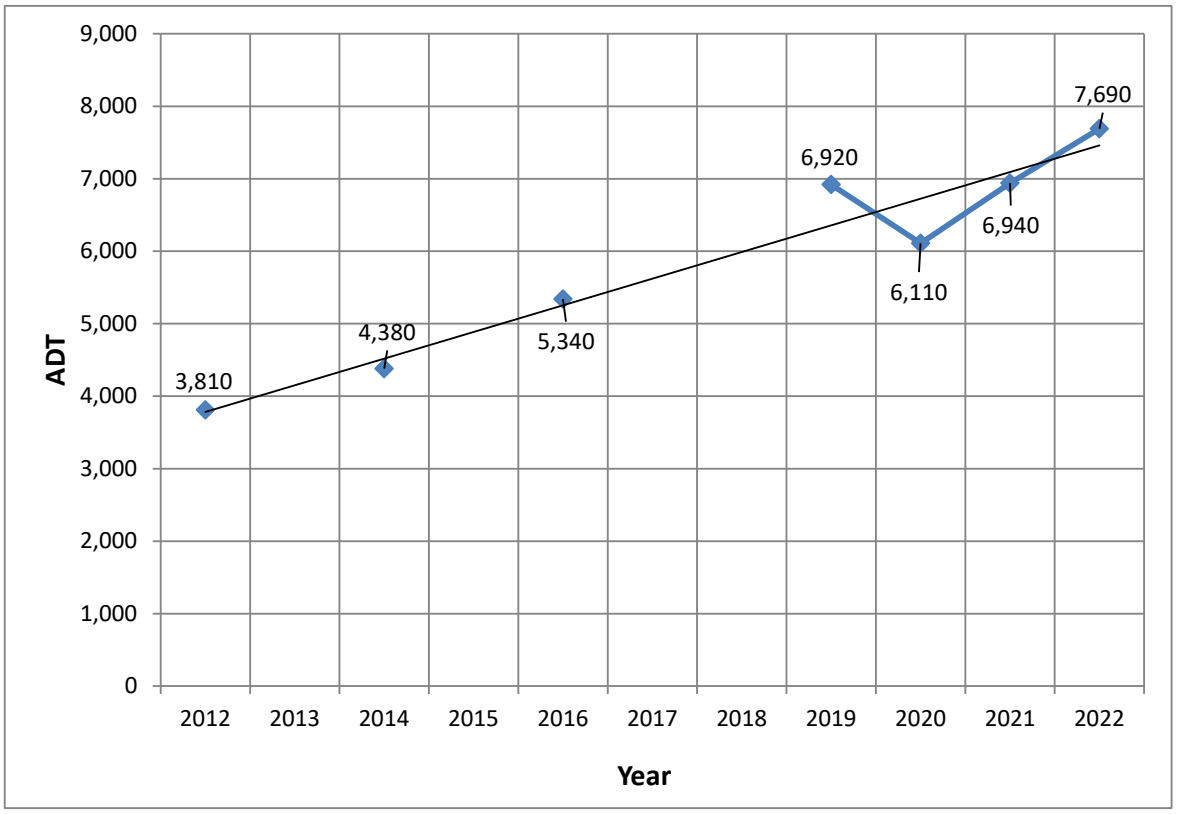
|<< < > >>| 1-5 of 38



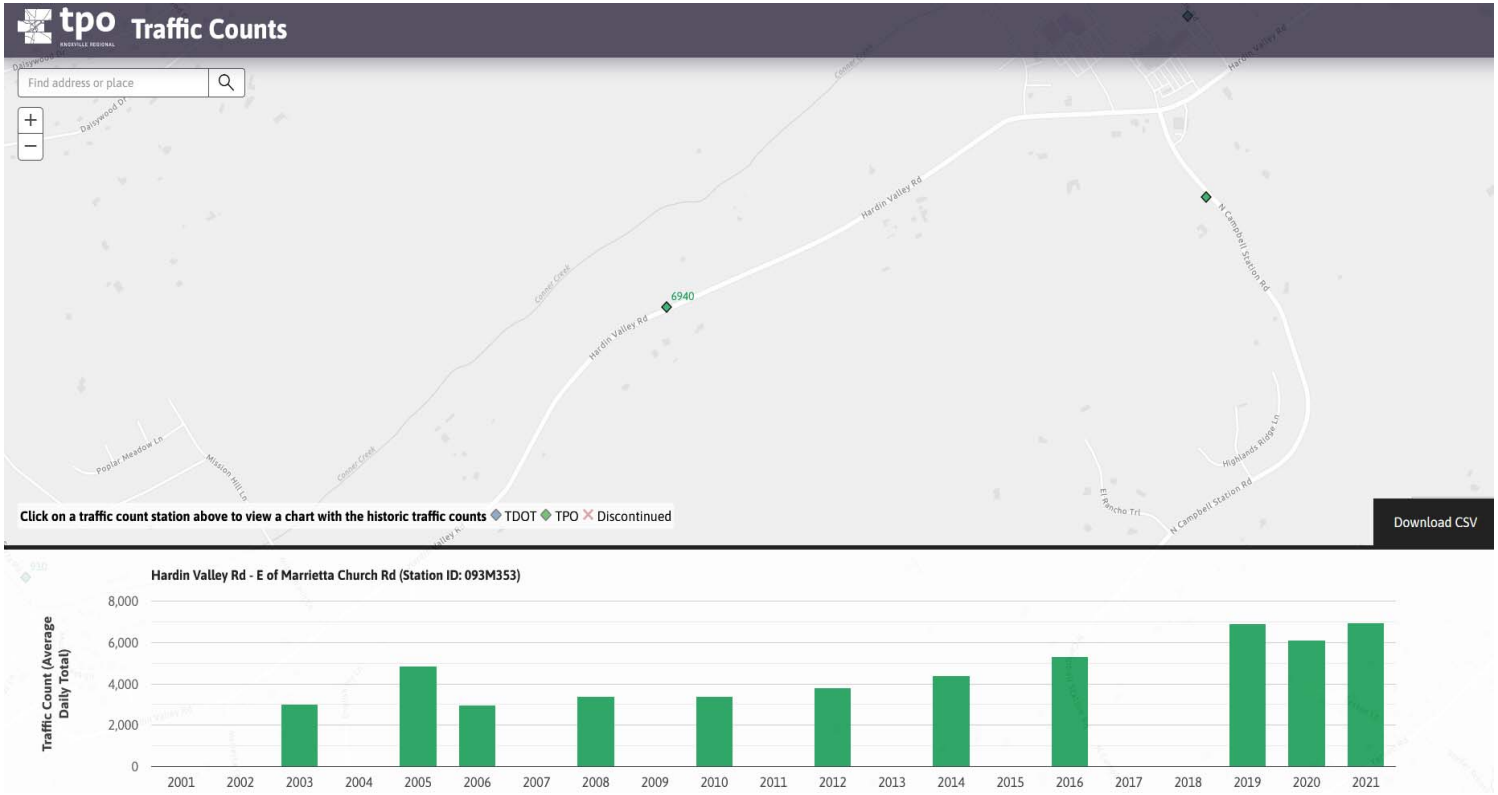
Historical Traffic Counts

Organization: TPO
Station ID #: 093M353
Location: Hardin Valley Road, west of N Campbell Station Road

YEAR	ADT	
2012	3,810	
2013		
2014	4,380	
2015		
2016	5,340	
2017		
2018		
2019	6,920	Trendline
2020	6,110	
2021	6,940	
2022	7,690	



2019 - 2022 Growth Rate = 11.1%
Average Annual Growth Rate = 3.6%

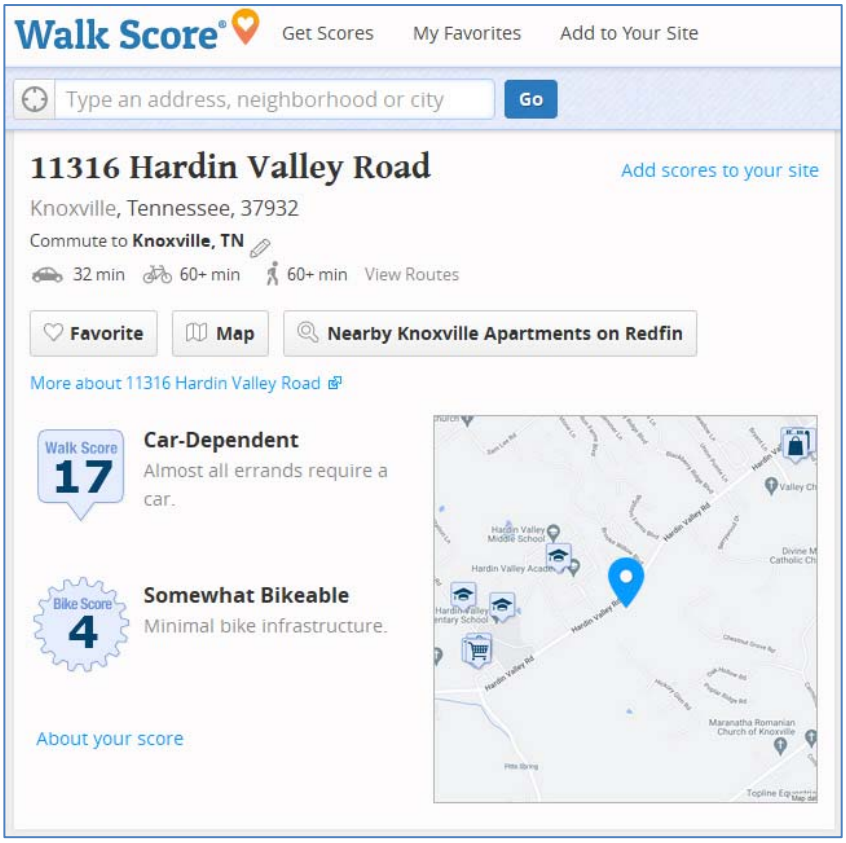

tpo
KNOXVILLE REGIONAL
Traffic Counts
Find address or place
Hardin Valley Rd
6940
N Campbell Station Rd
Click on a traffic count station above to view a chart with the historic traffic counts
TDOT
TPO
Discontinued
Download CSV
Hardin Valley Rd - E of Marrietta Church Rd (Station ID: 093M353)
Traffic Count (Average Daily Total)
8,000
6,000
4,000
2,000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

APPENDIX B

WALK SCORE

WALKSCORE

(from walkscore.com)



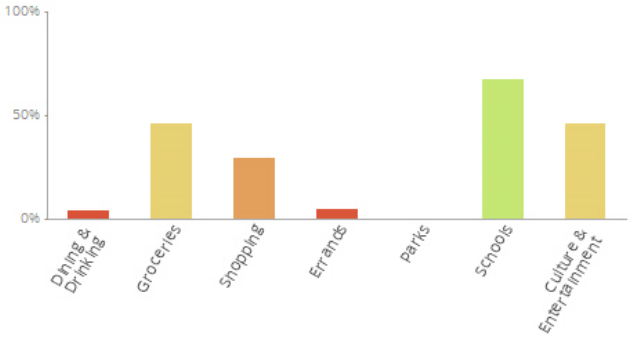
Scores for 11316 Hardin Valley Road

Walk Score 17 | Bike Score 4

Walk Score | Transit Score | Bike Score

Score Details | What is Walk Score

The Walk Score for 11316 Hardin Valley Road is based on the following categories.



Scores for 11316 Hardin Valley Road

Walk Score 17 | Bike Score 4

Walk Score | Transit Score | Bike Score

Transit Score measures how well a location is served by public transit based on the distance and type of nearby transit lines.

90–100	**Rider's Paradise** World-class public transportation
70–89	**Excellent Transit** Transit is convenient for most trips
50–69	**Good Transit** Many nearby public transportation options
25–49	**Some Transit** A few nearby public transportation options
0–24	**Minimal Transit** It is possible to get on a bus

Scores for 11316 Hardin Valley Road

Walk Score 17

Bike Score 4

Walk Score	Transit Score	Bike Score

Bike Score measures whether an area is good for biking based on bike lanes and trails, hills, road connectivity, and destinations.

90–100	**Biker's Paradise** Daily errands can be accomplished on a bike
70–89	**Very Bikeable** Biking is convenient for most trips
50–69	**Bikeable** Some bike infrastructure
0–49	**Somewhat Bikeable** Minimal bike infrastructure

Travel Time Map

Add to your site

Explore how far you can travel by car, bus, bike and foot from 11316 Hardin Valley Road.

What's Nearby

Restaurants:
Marco's Pizza .9mi

Coffee:
Tealicious - Hard 1.3mi

Bars:

Groceries:
Food City .6mi

Parks:
Guinn Road Park 2.9mi

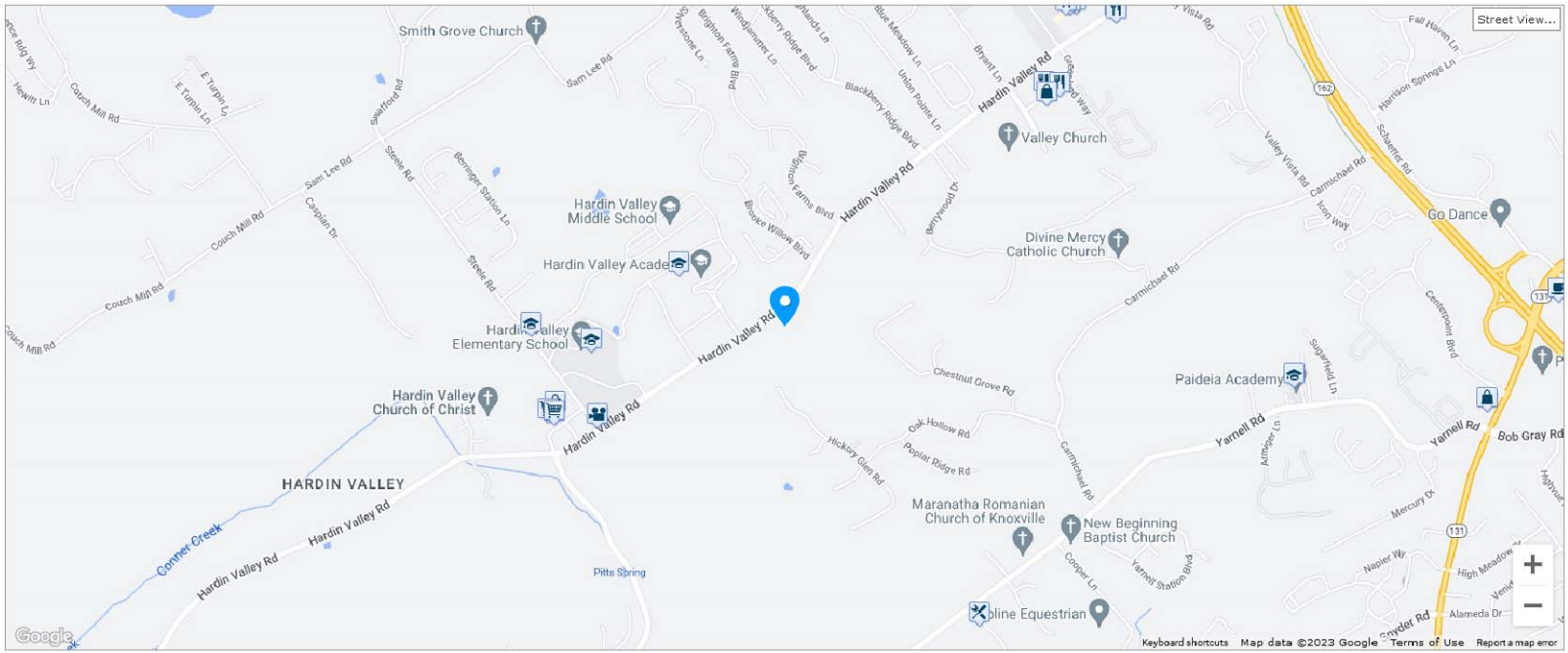
Schools:
Hardin Valley Academy .3mi

Shopping:
Bellario's Tuxedo & Formalwear .6mi

Entertainment:
Redbox .5mi

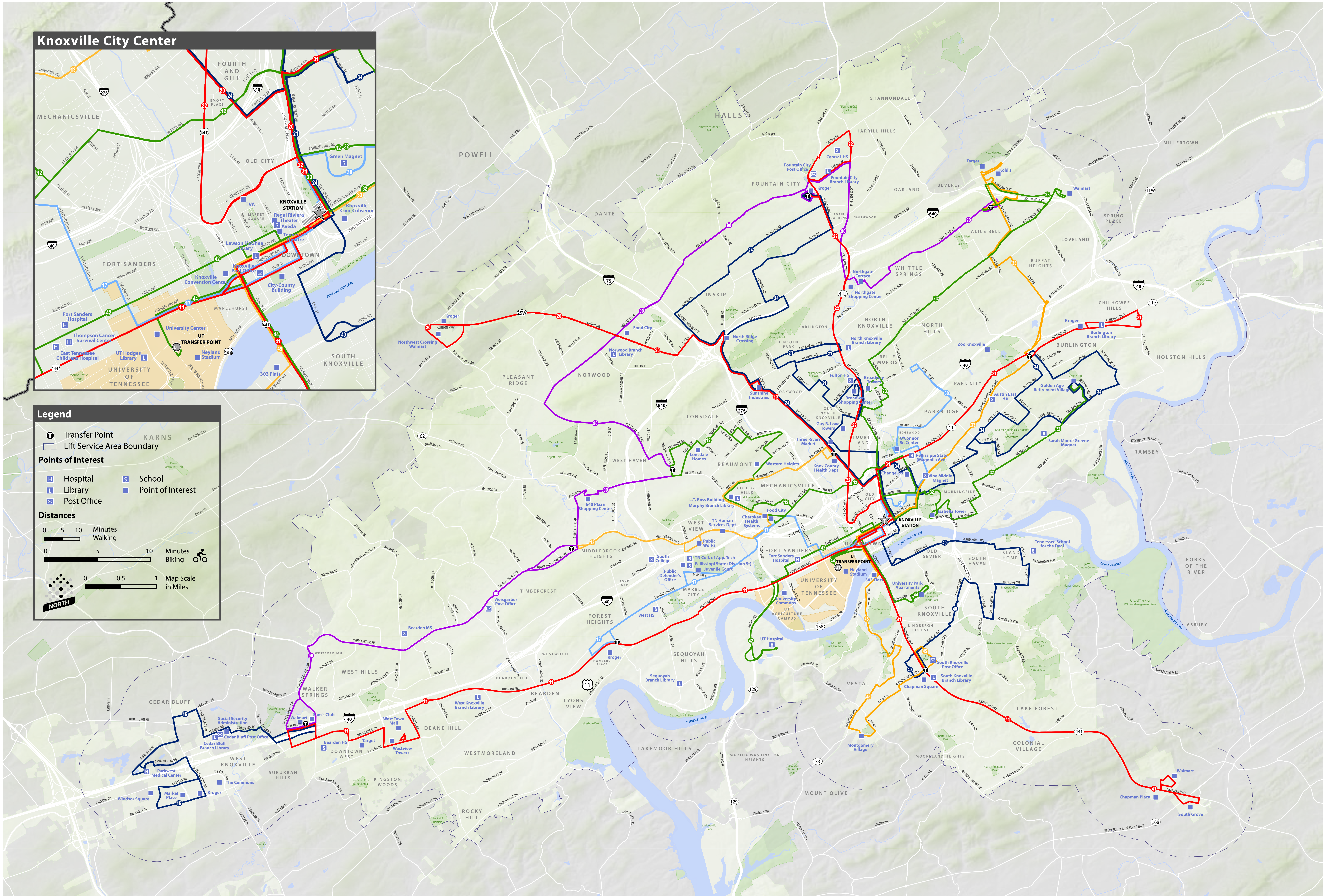
Errands:
Ace Hardware .8mi

Search Nearby:



APPENDIX C

KNOXVILLE AREA TRANSIT MAP AND INFORMATION


Knoxville City Center
FOURTH AND GILL
MECHANICSVILLE
OLD CITY
Green Magnet
KNOXVILLE STATION
Regal Riviera Theater
Aveda
Knoxville Civic Coliseum
TVA
MARKET SQUARE
Lawson McGhee Library
DOWNTOWN
FORT SANDERS
Knoxville Post Office
Knoxville Convention Center
City-County Building
Fort Sanders Hospital
Thompson Cancer Survival Center
East Tennessee Children's Hospital
MAPLEHURST
University Center
UT TRANSFER POINT
UT Hodges Library
Neyland Stadium
UNIVERSITY OF TENNESSEE
303 Flats
SOUTH KNOXVILLE
Legend
Transfer Point
Lift Service Area Boundary
Points of Interest
Hospital
Library
Post Office
School
Point of Interest
Distances
0 5 10 Minutes Walking
0 5 10 Minutes Biking
0 0.5 1 Map Scale in Miles
NORTH
KARNS
POWELL
HALLS
SHANNONDALE
HARRILL HILLS
FOUNTAIN CITY
Fountain City Post Office
Central HS
Fountain City Branch Library
Kroger
OAKLAND
BEVERLY
Target
Kohl's
Walmart
MILLERTOWN
SPRING PLACE
ALICE BELL
LOVELAND
BUFFAT HEIGHTS
DANTE
WHITTLE SPRINGS
Northgate Terrace
Northgate Shopping Center
INSKIP
NORTH KNOXVILLE
NORTH HILLS
CHILHOWEE HILLS
Burlington Branch Library
BURLINGTON
HOLSTON HILLS
Northwest Crossing Walmart
Food City
Norwood Branch Library
North Ridge Crossing
ARLINGTON
LINCOLN PARK
North Knoxville Branch Library
BELLE MORRIS
Zoo Knoxville
PLEASANT RIDGE
NORWOOD
Fulton HS
Broadway Towers
Broadway Shopping Center
PARK CITY
Golden Age Retirement Village
Austin East HS
PARKRIDGE
LONSDALE
Sunshine Industries
OAKWOOD
OLD NORTH KNOXVILLE
Guy B. Love Towers
Sarah Moore Greene Magnet
RAMSEY
WEST HAVEN
Lonsdale Homes
BEAUMONT
Western Heights
Three Rivers Market
FOURTH AND GILL
O'Connor Sr. Center
Pellissippi State (Magnolia Ave)
Vine Middle Magnet
Change Ctr.
Knox County Health Dept
MECHANICSVILLE
COLLEGE HILLS
MORNINGSIDE
Isabella Tower
L.T. Ross Building
Murphy Branch Library
640 Plaza Shopping Center
Food City
OLD CITY
KNOXVILLE STATION
WEST VIEW
TN Human Services Dept
Cherokee Health Systems
Tennessee School for the Deaf
MIDDLEBROOK HEIGHTS
Public Works
FORT SANDERS
Fort Sanders Hospital
UT TRANSFER POINT
Neyland Stadium
OLD SEVIER
SOUTH HAVEN
ISLAND HOME
FORKS OF THE RIVER
South College
TN Coll. of App. Tech
Pellissippi State (Division St)
Juvenile Court
Public Defender's Office
MARBLE CITY
UNIVERSITY OF TENNESSEE
303 Flats
University Park Apartments
University Commons
UT AGRICULTURE CAMPUS
TIMBERCREST
Weisgarber Post Office
FOREST HEIGHTS
West HS
SOUTH KNOXVILLE
LINDBERGH FOREST
ASBURY
Bearden MS
UT Hospital
Kroger
SEQUOYAH HILLS
Sequoyah Branch Library
South Knoxville Post Office
South Knoxville Branch Library
Chapman Square
WESTBOROUGH
WEST HILLS
BEARDEN
VESTAL
WALKER SPRINGS
LYONS VIEW
CEDAR BLUFF
Social Security Administration
Walmart
Sam's Club
West Knoxville Branch Library
West Town Mall
DEANE HILL
LAKE FOREST
Cedar Bluff Post Office
Cedar Bluff Branch Library
Bearden HS
Target
Westview Towers
WESTMORELAND
LAKEMOOR HILLS
MARTHA WASHINGTON HEIGHTS
COLONIAL VILLAGE
Montgomery Village
MOORELAND HEIGHTS
WEST KNOXVILLE
DOWNTOWN WEST
SUBURBAN HILLS
KINGSTON WOODS
Parkwest Medical Center
The Commons
Market Place
Kroger
Windsor Square
ROCKY HILL
MOUNT OLIVE
Walmart
Chapman Plaza
South Grove

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

N W E S

0 0.25 0.5 Miles

Map revised: 02.21

Route 16 - Cedar Bluff: Weekdays

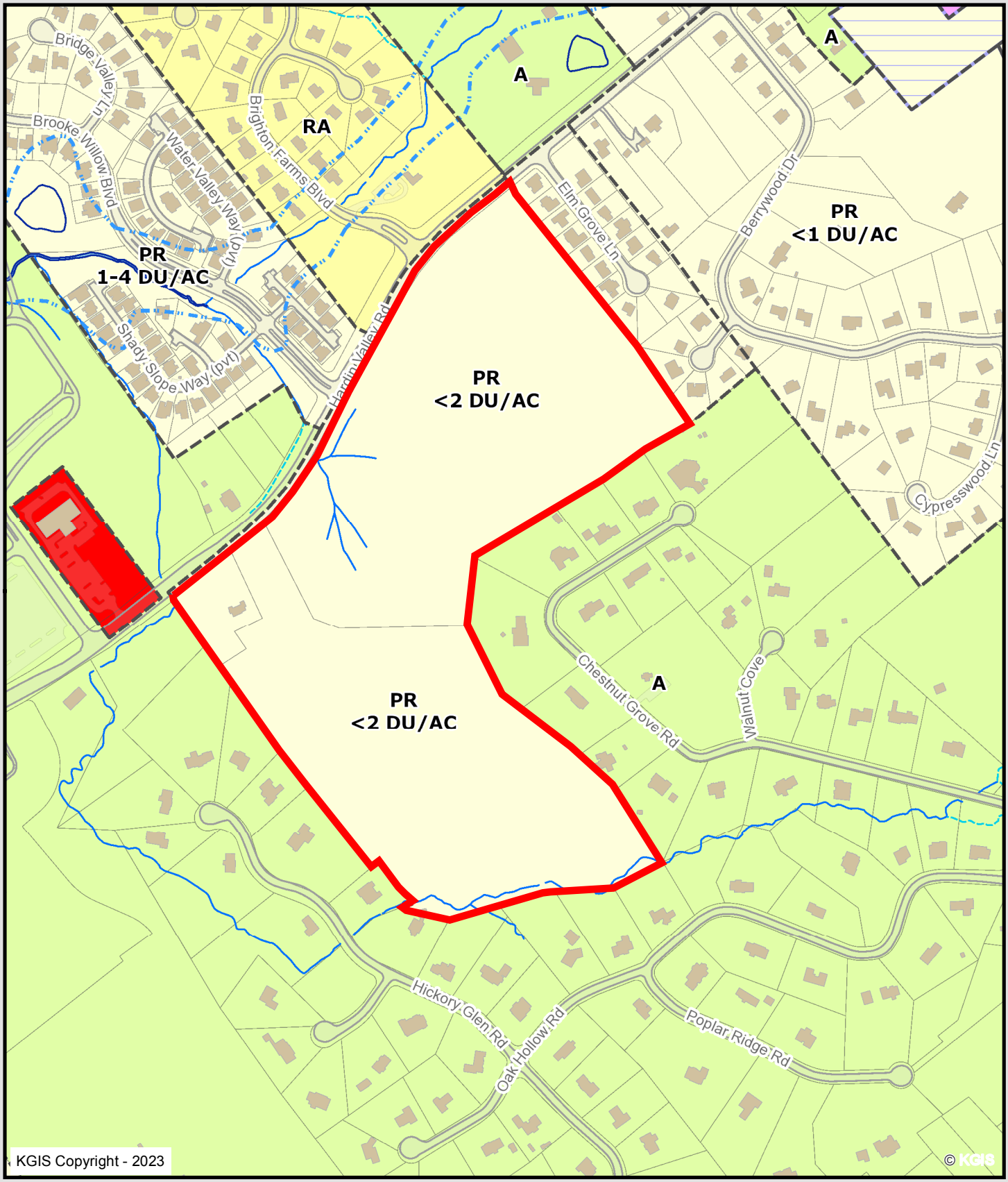
Going away from Walmart				*Going to Walmart*		
Walmart	**Park Village @ Woodpark**	**Parkwest Hospital**	**Windsor Square**	**Parkwest Hospital**	**Cedar Bluff @ Fox Lonas**	**Walmart**
1	**2**	**3**	**4**	**5**	**6**	**7**
6:15 AM	6:27 AM	6:32 AM	6:42 AM	6:50 AM	6:54 AM	7:10 AM
7:15 AM	7:27 AM	7:32 AM	7:42 AM	7:50 AM	7:54 AM	8:10 AM
8:15 AM	8:27 AM	8:32 AM	8:42 AM	8:50 AM	8:54 AM	9:10 AM
9:15 AM	9:27 AM	9:32 AM	9:42 AM	9:50 AM	9:54 AM	10:10 AM
10:15 AM	10:27 AM	10:32 AM	10:42 AM	10:50 AM	10:54 AM	11:10 AM
11:15 AM	11:27 AM	11:32 AM	11:42 AM	11:50 AM	11:54 AM	12:10 PM
12:15 PM	12:27 PM	12:32 PM	12:42 PM	12:50 PM	12:54 PM	1:10 PM
1:15 PM	1:27 PM	1:32 PM	1:42 PM	1:50 PM	1:54 PM	2:10 PM
2:15 PM	2:27 PM	2:32 PM	2:42 PM	2:50 PM	2:54 PM	3:10 PM
3:15 PM	3:27 PM	3:32 PM	3:42 PM	3:50 PM	3:54 PM	4:10 PM
4:15 PM	4:27 PM	4:32 PM	4:42 PM	4:50 PM	4:54 PM	5:10 PM
5:15 PM	5:27 PM	5:32 PM	5:42 PM	5:50 PM	5:54 PM	6:10 PM
6:15 PM	6:27 PM	6:32 PM	6:42 PM	6:50 PM	6:54 PM	7:10 PM
7:15 PM	7:27 PM	7:32 PM	7:42 PM	7:50 PM	7:54 PM	8:10 PM
8:15 PM	8:27 PM	8:32 PM	8:42 PM	8:50 PM	8:54 PM	9:10 PM
9:15 PM	9:27 PM	9:32 PM	9:42 PM	9:50 PM	9:54 PM	10:10 PM

Route 16 - Cedar Bluff: SATURDAYS

Going away from Walmart				*Going to Walmart*		
Walmart	**Park Village @ Woodpark**	**Parkwest Hospital**	**Windsor Square**	**Parkwest Hospital**	**Cedar Bluff @ Fox Lonas**	**Walmart**
1	**2**	**3**	**4**	**5**	**6**	**7**
7:15 AM	7:27 AM	7:32 AM	7:42 AM	7:50 AM	7:54 AM	8:10 AM
8:15 AM	8:27 AM	8:32 AM	8:42 AM	8:50 AM	8:54 AM	9:10 AM
9:15 AM	9:27 AM	9:32 AM	9:42 AM	9:50 AM	9:54 AM	10:10 AM
10:15 AM	10:27 AM	10:32 AM	10:42 AM	10:50 AM	10:54 AM	11:10 AM
11:15 AM	11:27 AM	11:32 AM	11:42 AM	11:50 AM	11:54 AM	12:10 PM
12:15 PM	12:27 PM	12:32 PM	12:42 PM	12:50 PM	12:54 PM	1:10 PM
1:15 PM	1:27 PM	1:32 PM	1:42 PM	1:50 PM	1:54 PM	2:10 PM
2:15 PM	2:27 PM	2:32 PM	2:42 PM	2:50 PM	2:54 PM	3:10 PM
3:15 PM	3:27 PM	3:32 PM	3:42 PM	3:50 PM	3:54 PM	4:10 PM
4:15 PM	4:27 PM	4:32 PM	4:42 PM	4:50 PM	4:54 PM	5:10 PM
5:15 PM	5:27 PM	5:32 PM	5:42 PM	5:50 PM	5:54 PM	6:10 PM
6:15 PM	6:27 PM	6:32 PM	6:42 PM	6:50 PM	6:54 PM	7:10 PM
7:15 PM	7:27 PM	7:32 PM	7:42 PM	7:50 PM	7:54 PM	8:10 PM
8:15 PM	8:27 PM	8:32 PM	8:42 PM	8:50 PM	8:54 PM	9:10 PM
9:15 PM	9:27 PM	9:32 PM	9:42 PM	9:50 PM	9:54 PM	10:10 PM

APPENDIX D

ZONING MAP



Zoning Map for Cruz Landing and Maya Hills Subdivision

Zoning Map - 4.21.23

Knoxville - Knox County - KUB Geographic Information System

Printed: 4/21/2023 at 1:38:11 PM

0 250 500 1,000

ft

APPENDIX E

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Hardin Valley Road (EB and WB)
Minor Street: Brooke Willow Boulevard (SB)
Traffic Control: Stop Condition on Brooke Willow Boulevard

4/11/2023 (Tuesday)
Mostly Sunny
Conducted by: Ajax Engineering

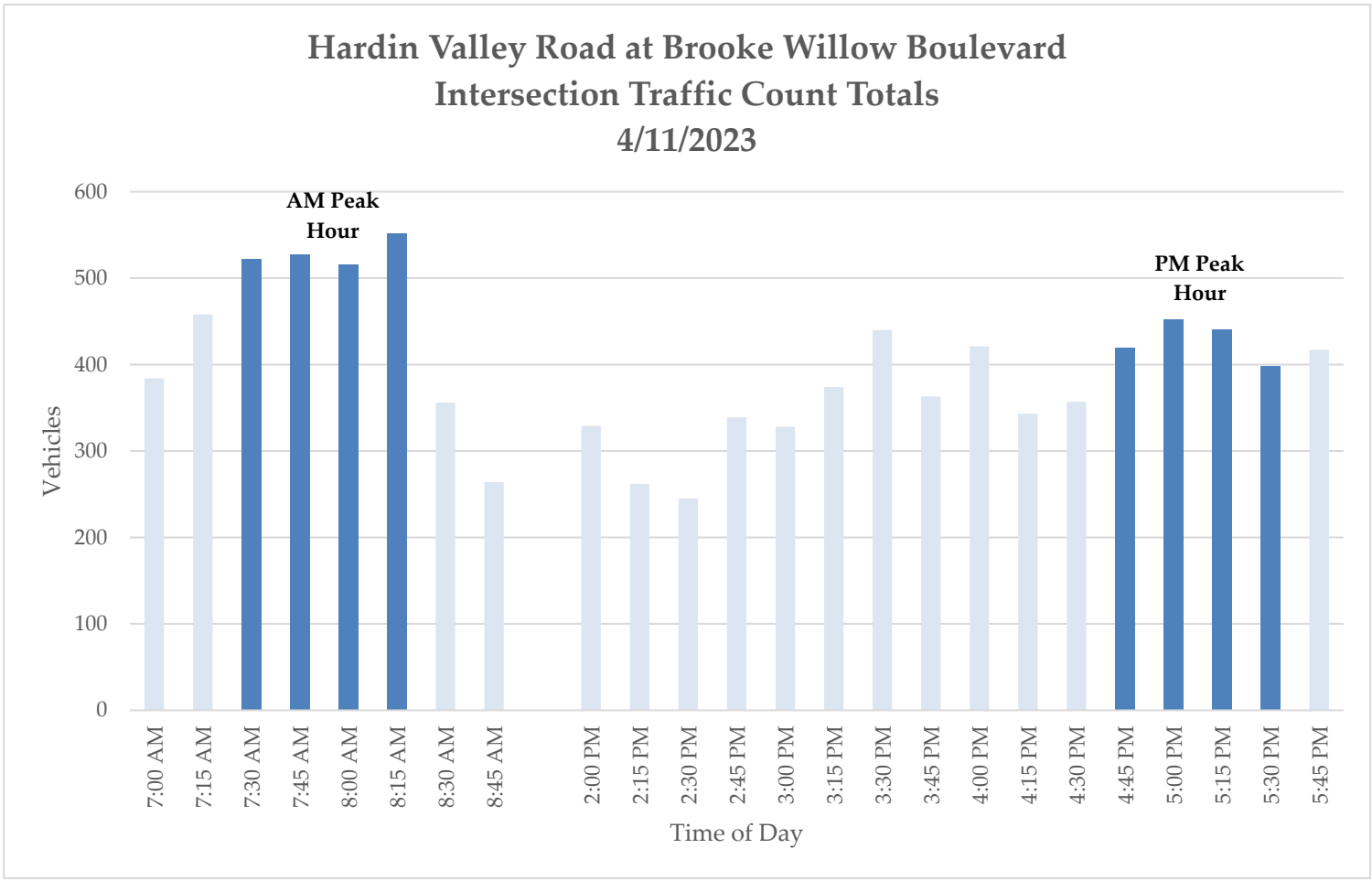
	Brooke Willow Boulevard		Hardin Valley Road		Hardin Valley Road			
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND		VEHICLE	PEAK
BEGIN	LT	RT	THRU	RT	LT	THRU	TOTAL	HOUR
7:00 AM	12	13	199	4	5	151	384	
7:15 AM	17	13	228	3	5	192	458	
7:30 AM	18	9	230	3	9	253	522	**7:30 AM - 8:30 AM**
7:45 AM	7	4	271	2	5	238	527	
8:00 AM	10	9	290	6	2	199	516	
8:15 AM	8	8	307	3	1	225	552	
8:30 AM	6	3	122	8	1	216	356	
8:45 AM	12	2	91	3	0	156	264	
TOTAL	90	61	1738	32	28	1630	3579	
2:00 PM	3	1	137	7	1	180	329	
2:15 PM	5	3	134	12	3	105	262	
2:30 PM	5	0	139	9	3	89	245	
2:45 PM	4	8	155	10	2	160	339	
3:00 PM	6	4	156	9	7	146	328	
3:15 PM	2	6	207	14	4	141	374	
3:30 PM	23	5	175	16	5	216	440	
3:45 PM	11	5	149	8	4	186	363	
4:00 PM	5	2	179	13	7	215	421	
4:15 PM	4	3	154	10	5	167	343	
4:30 PM	6	7	174	6	5	159	357	
4:45 PM	12	2	182	14	8	202	420	**4:45 PM - 5:45 PM**
5:00 PM	8	4	207	17	5	211	452	
5:15 PM	7	8	200	10	3	213	441	
5:30 PM	11	2	189	11	8	177	398	
5:45 PM	10	7	219	11	4	166	417	
TOTAL	122	67	2756	177	74	2733	5929	

2023 AM Peak Hour **7:30 AM - 8:30 AM**

	Brooke Willow Boulevard		Hardin Valley Road		Hardin Valley Road	
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND	
BEGIN	LT	RT	THRU	RT	LT	THRU
7:30 AM	18	9	230	3	9	253
7:45 AM	7	4	271	2	5	238
8:00 AM	10	9	290	6	2	199
8:15 AM	8	8	307	3	1	225
TOTAL	**43**	**30**	**1098**	**14**	**17**	**915**
PHF	**0.60**	**0.83**	**0.89**	**0.58**	**0.47**	**0.90**
Truck %	**0.0%**	**0.0%**	**3.2%**	**0.0%**	**0.0%**	**2.3%**

2023 PM Peak Hour **4:45 PM - 5:45 PM**

	Brooke Willow Boulevard		Hardin Valley Road		Hardin Valley Road	
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND	
BEGIN	LT	RT	THRU	RT	LT	THRU
4:45 PM	12	2	182	14	8	202
5:00 PM	8	4	207	17	5	211
5:15 PM	7	8	200	10	3	213
5:30 PM	11	2	189	11	8	177
TOTAL	**38**	**16**	**778**	**52**	**24**	**803**
PHF	**0.79**	**0.50**	**0.94**	**0.76**	**0.75**	**0.94**
Truck %	**0.0%**	**0.0%**	**0.5%**	**0.0%**	**0.1%**	**0.0%**


Hardin Valley Road at Brooke Willow Boulevard
Intersection Traffic Count Totals
4/11/2023
AM Peak Hour
PM Peak Hour
Vehicles
600
500
400
300
200
100
0
7:00 AM
7:15 AM
7:30 AM
7:45 AM
8:00 AM
8:15 AM
8:30 AM
8:45 AM
2:00 PM
2:15 PM
2:30 PM
2:45 PM
3:00 PM
3:15 PM
3:30 PM
3:45 PM
4:00 PM
4:15 PM
4:30 PM
4:45 PM
5:00 PM
5:15 PM
5:30 PM
5:45 PM
Time of Day

PEAK HOUR DATA

Major Street: Hardin Valley Road (EB and WB)
Minor Street: Brooke Willow Boulevard (SB)
Traffic Control: Stop Condition on Brooke Willow Boulevard

4/11/2023 (Tuesday)
Mostly Sunny
Conducted by: Ajax Engineering

Total Vehicles On Approach		104	
Vehicles Entering Intersection	73	Vehicles Exiting Intersection	31
Southbound			
Truck %	**0.0%**	**-**	**0.0%**
Total	**30**	**-**	**43**

Total Vehicles on Approach	Vehicles Entering Intersection	Eastbound	Truck %	Total
2060	932		0.0%	17
	Vehicles Exiting Intersection 1128		2.3%	915
			-	-

AM PEAK HOUR

Total	Truck %	Westbound	Vehicles Entering Intersection	Total Vehicles on Approach
14	0.0%		1112	2070
1098	3.2%		Vehicles Exiting Intersection 958	
-	-			

Total Vehicles On Approach		130	
Vehicles Entering Intersection	54	Vehicles Exiting Intersection	76
Southbound			
Truck %	**0.0%**	**-**	**0.0%**
Total	**16**	**-**	**38**

Total Vehicles on Approach	Vehicles Entering Intersection	Eastbound	Truck %	Total
1621	827		0.1%	24
	Vehicles Exiting Intersection 794		0.0%	803
			-	-

PM PEAK HOUR

Total	Truck %	Westbound	Vehicles Entering Intersection	Total Vehicles on Approach
52	0.0%		830	1671
778	0.5%		Vehicles Exiting Intersection 841	
-	-			

TRAFFIC COUNT DATA

Major Street: Hardin Valley Road (EB and WB)
Minor Street: Brighton Farms Boulevard (SB)
Traffic Control: Stop Condition on Brighton Farms Boulevard

4/11/2023 (Tuesday)
Mostly Sunny
Conducted by: Ajax Engineering

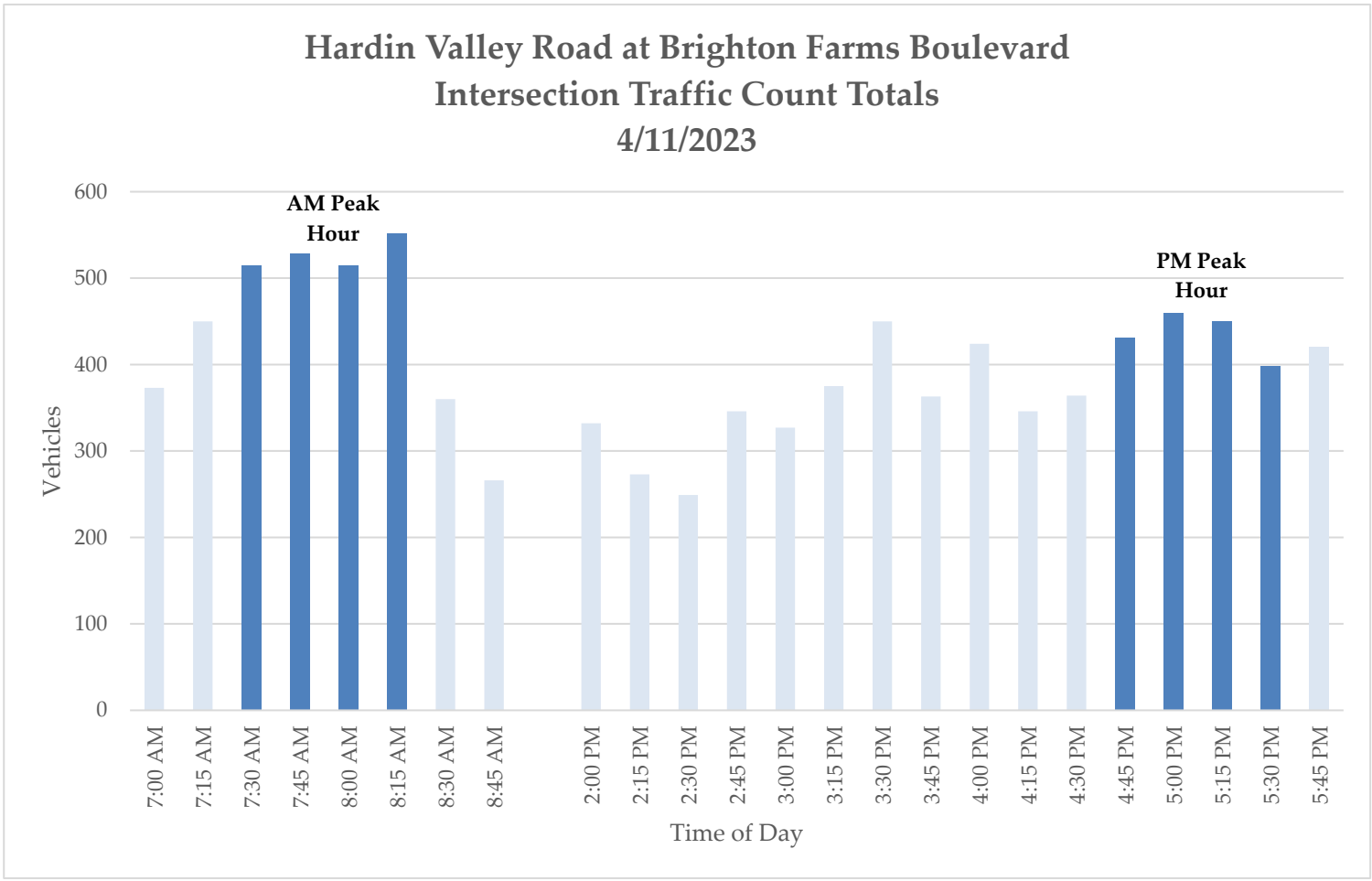
	Brighton Farms Boulevard		Hardin Valley Road		Hardin Valley Road			
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND		VEHICLE	PEAK
BEGIN	LT	RT	THRU	RT	LT	THRU	TOTAL	HOUR
7:00 AM	5	7	196	2	2	161	373	
7:15 AM	10	7	224	0	0	209	450	
7:30 AM	10	6	227	1	2	269	515	**7:30 AM - 8:30 AM**
7:45 AM	10	10	263	1	3	242	529	
8:00 AM	7	13	283	3	2	207	515	
8:15 AM	9	5	305	0	7	226	552	
8:30 AM	4	1	129	4	0	222	360	
8:45 AM	2	0	94	2	2	166	266	
TOTAL	57	49	1721	13	18	1702	3560	
2:00 PM	4	3	141	1	1	182	332	
2:15 PM	7	3	143	10	1	109	273	
2:30 PM	2	1	147	5	1	93	249	
2:45 PM	8	3	162	9	4	160	346	
3:00 PM	5	3	162	5	3	149	327	
3:15 PM	8	1	220	3	6	137	375	
3:30 PM	8	5	186	12	2	237	450	
3:45 PM	4	4	153	5	4	193	363	
4:00 PM	2	4	188	10	13	207	424	
4:15 PM	4	4	160	7	3	168	346	
4:30 PM	5	3	177	14	5	160	364	
4:45 PM	9	3	193	12	6	208	431	**4:45 PM - 5:45 PM**
5:00 PM	5	6	218	12	8	211	460	
5:15 PM	7	3	207	13	5	215	450	
5:30 PM	3	5	195	7	3	185	398	
5:45 PM	8	4	226	7	7	169	421	
TOTAL	89	55	2878	132	72	2783	6009	

2023 AM Peak Hour **7:30 AM - 8:30 AM**

	Brighton Farms Boulevard		Hardin Valley Road		Hardin Valley Road	
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND	
BEGIN	LT	RT	THRU	RT	LT	THRU
7:30 AM	10	6	227	1	2	269
7:45 AM	10	10	263	1	3	242
8:00 AM	7	13	283	3	2	207
8:15 AM	9	5	305	0	7	226
TOTAL	**36**	**34**	**1078**	**5**	**14**	**944**
PHF	**0.90**	**0.65**	**0.88**	**0.42**	**0.50**	**0.88**
Truck %	**0.0%**	**0.0%**	**3.2%**	**0.0%**	**0.0%**	**2.3%**

2023 PM Peak Hour **4:45 PM - 5:45 PM**

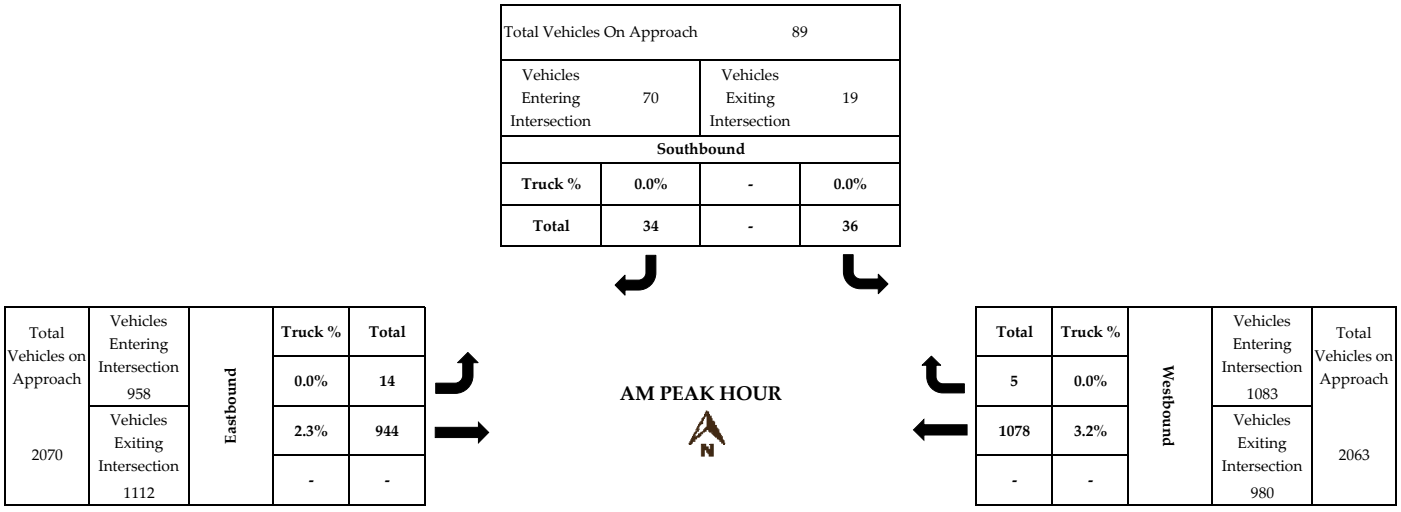
	Brighton Farms Boulevard		Hardin Valley Road		Hardin Valley Road	
TIME	SOUTHBOUND		WESTBOUND		EASTBOUND	
BEGIN	LT	RT	THRU	RT	LT	THRU
4:45 PM	9	3	193	12	6	208
5:00 PM	5	6	218	12	8	211
5:15 PM	7	3	207	13	5	215
5:30 PM	3	5	195	7	3	185
TOTAL	**24**	**17**	**813**	**44**	**22**	**819**
PHF	**0.67**	**0.71**	**0.93**	**0.85**	**0.69**	**0.95**
Truck %	**0.0%**	**0.0%**	**0.5%**	**0.0%**	**0.1%**	**0.0%**

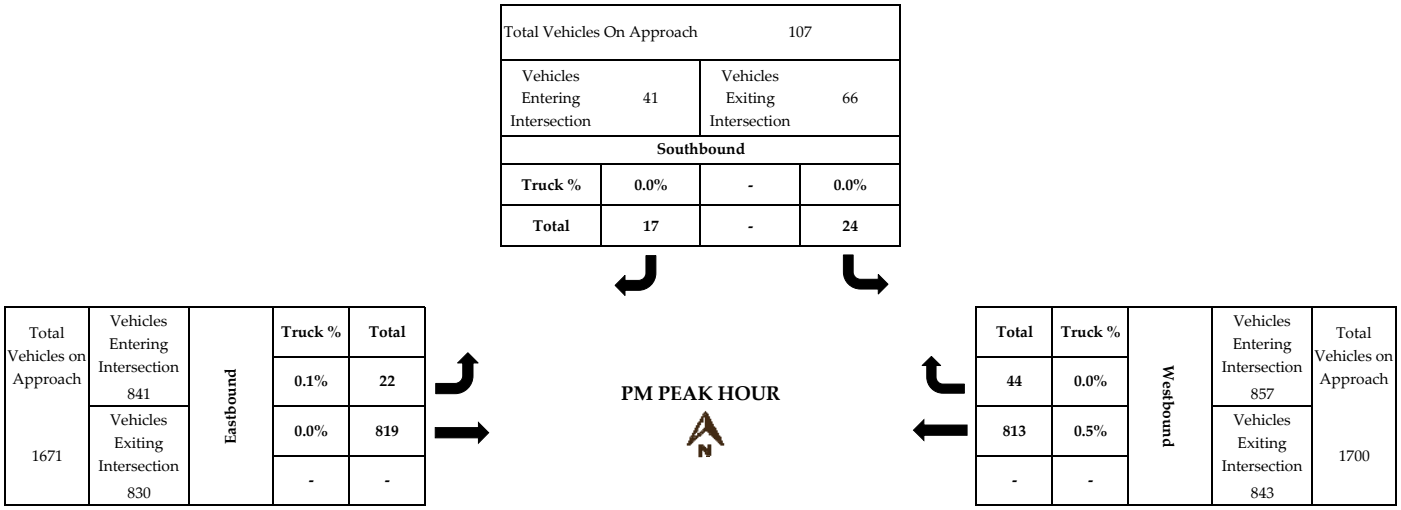

Hardin Valley Road at Brighton Farms Boulevard
Intersection Traffic Count Totals
4/11/2023
AM Peak Hour
PM Peak Hour
Vehicles
600
500
400
300
200
100
0
7:00 AM
7:15 AM
7:30 AM
7:45 AM
8:00 AM
8:15 AM
8:30 AM
8:45 AM
2:00 PM
2:15 PM
2:30 PM
2:45 PM
3:00 PM
3:15 PM
3:30 PM
3:45 PM
4:00 PM
4:15 PM
4:30 PM
4:45 PM
5:00 PM
5:15 PM
5:30 PM
5:45 PM
Time of Day

PEAK HOUR DATA

Major Street: Hardin Valley Road (EB and WB)
Minor Street: Brighton Farms Boulevard (SB)
Traffic Control: Stop Condition on Brighton Farms Boulevard

4/11/2023 (Tuesday)
Mostly Sunny
Conducted by: Ajax Engineering





APPENDIX F

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 11)

EXISTING CONDITIONS

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	915	1098	14	43	30
Future Vol, veh/h	17	915	1098	14	43	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	47	90	89	58	60	83
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	36	1017	1234	24	72	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1258	0	-	0	2323	1234
Stage 1	-	-	-	-	1234	-
Stage 2	-	-	-	-	1089	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	560	-	-	-	~ 25	190
Stage 1	-	-	-	-	211	-
Stage 2	-	-	-	-	256	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	560	-	-	-	~ 23	190
Mov Cap-2 Maneuver	-	-	-	-	112	-
Stage 1	-	-	-	-	197	-
Stage 2	-	-	-	-	256	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	103
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	560	-	-	-	130
HCM Lane V/C Ratio	0.065	-	-	-	0.829
HCM Control Delay (s)	11.9	-	-	-	103
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	5.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	944	1078	5	36	34
Future Vol, veh/h	14	944	1078	5	36	34
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	50	88	88	42	90	65
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	28	1073	1225	12	40	52

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1237	0	-	0	2360	1231
Stage 1	-	-	-	-	1231	-
Stage 2	-	-	-	-	1129	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	570	-	-	-	~ 30	204
Stage 1	-	-	-	-	243	-
Stage 2	-	-	-	-	275	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	570	-	-	-	~ 29	204
Mov Cap-2 Maneuver	-	-	-	-	128	-
Stage 1	-	-	-	-	231	-
Stage 2	-	-	-	-	275	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	53.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	570	-	-	-	162
HCM Lane V/C Ratio	0.049	-	-	-	0.57
HCM Control Delay (s)	11.6	-	-	-	53.2
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	3

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	803	778	52	38	16
Future Vol, veh/h	24	803	778	52	38	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	75	94	94	76	79	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	854	828	68	48	32

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	896	0	-	0	1746	828
Stage 1	-	-	-	-	828	-
Stage 2	-	-	-	-	918	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	766	-	-	-	65	341
Stage 1	-	-	-	-	360	-
Stage 2	-	-	-	-	320	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	766	-	-	-	62	341
Mov Cap-2 Maneuver	-	-	-	-	180	-
Stage 1	-	-	-	-	345	-
Stage 2	-	-	-	-	320	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	30.1
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	766	-	-	-	222
HCM Lane V/C Ratio	0.042	-	-	-	0.361
HCM Control Delay (s)	9.9	-	-	-	30.1
HCM Lane LOS	A	-	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.6

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	22	819	813	44	24	17
Future Vol, veh/h	22	819	813	44	24	17
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	69	95	93	85	67	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	862	874	52	36	24

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	926	0	-	0	1826	900
Stage 1	-	-	-	-	900	-
Stage 2	-	-	-	-	926	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	746	-	-	-	70	323
Stage 1	-	-	-	-	362	-
Stage 2	-	-	-	-	351	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	746	-	-	-	67	323
Mov Cap-2 Maneuver	-	-	-	-	190	-
Stage 1	-	-	-	-	346	-
Stage 2	-	-	-	-	351	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	26.3
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	746	-	-	-	228
HCM Lane V/C Ratio	0.043	-	-	-	0.262
HCM Control Delay (s)	10	-	-	-	26.3
HCM Lane LOS	B	-	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1

PROJECTED CONDITIONS (WITHOUT THE PROJECTS)

Intersection	
Int Delay, s/veh	7.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	1050	1258	14	43	30
Future Vol, veh/h	17	1050	1258	14	43	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	47	90	89	58	60	83
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	36	1167	1413	24	72	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1437	0	-	0	2652	1413
Stage 1	-	-	-	-	1413	-
Stage 2	-	-	-	-	1239	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	479	-	-	-	~ 14	146
Stage 1	-	-	-	-	166	-
Stage 2	-	-	-	-	209	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	479	-	-	-	~ 13	146
Mov Cap-2 Maneuver	-	-	-	-	87	-
Stage 1	-	-	-	-	154	-
Stage 2	-	-	-	-	209	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	187.5
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	479	-	-	-	101
HCM Lane V/C Ratio	0.076	-	-	-	1.067
HCM Control Delay (s)	13.1	-	-	-	187.5
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	6.8

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	1079	1238	5	36	34
Future Vol, veh/h	14	1079	1238	5	36	34
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	50	88	88	42	90	65
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	28	1226	1407	12	40	52

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1419	0	-	0	2695	1413
Stage 1	-	-	-	-	1413	-
Stage 2	-	-	-	-	1282	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	486	-	-	-	~ 18	158
Stage 1	-	-	-	-	194	-
Stage 2	-	-	-	-	228	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	486	-	-	-	~ 17	158
Mov Cap-2 Maneuver	-	-	-	-	100	-
Stage 1	-	-	-	-	183	-
Stage 2	-	-	-	-	228	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	87.6
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	486	-	-	-	126
HCM Lane V/C Ratio	0.058	-	-	-	0.733
HCM Control Delay (s)	12.9	-	-	-	87.6
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	4.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	920	892	52	38	16
Future Vol, veh/h	24	920	892	52	38	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	75	94	94	76	79	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	979	949	68	48	32

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1017	0	-	0	1992	949
Stage 1	-	-	-	-	949	-
Stage 2	-	-	-	-	1043	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	690	-	-	-	~ 43	287
Stage 1	-	-	-	-	307	-
Stage 2	-	-	-	-	272	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	690	-	-	-	~ 41	287
Mov Cap-2 Maneuver	-	-	-	-	147	-
Stage 1	-	-	-	-	293	-
Stage 2	-	-	-	-	272	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	39.2
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	690	-	-	-	183
HCM Lane V/C Ratio	0.046	-	-	-	0.438
HCM Control Delay (s)	10.5	-	-	-	39.2
HCM Lane LOS	B	-	-	-	E
HCM 95th %tile Q(veh)	0.1	-	-	-	2

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	22	936	927	44	24	17
Future Vol, veh/h	22	936	927	44	24	17
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	69	95	93	85	67	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	985	997	52	36	24

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1049	0	-	0	2072	1023
Stage 1	-	-	-	-	1023	-
Stage 2	-	-	-	-	1049	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	671	-	-	-	48	273
Stage 1	-	-	-	-	312	-
Stage 2	-	-	-	-	303	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	671	-	-	-	46	273
Mov Cap-2 Maneuver	-	-	-	-	158	-
Stage 1	-	-	-	-	297	-
Stage 2	-	-	-	-	303	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	32.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	671	-	-	-	190
HCM Lane V/C Ratio	0.048	-	-	-	0.315
HCM Control Delay (s)	10.6	-	-	-	32.4
HCM Lane LOS	B	-	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.3

PROJECTED CONDITIONS (WITH THE PROJECTS)

Intersection	
Int Delay, s/veh	8.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	1068	1272	14	43	30
Future Vol, veh/h	17	1068	1272	14	43	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	47	90	89	58	60	83
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	36	1187	1429	24	72	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1453	0	-	0	2688	1429
Stage 1	-	-	-	-	1429	-
Stage 2	-	-	-	-	1259	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	472	-	-	-	~ 13	143
Stage 1	-	-	-	-	162	-
Stage 2	-	-	-	-	204	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	472	-	-	-	~ 12	143
Mov Cap-2 Maneuver	-	-	-	-	84	-
Stage 1	-	-	-	-	150	-
Stage 2	-	-	-	-	204	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	205.7
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	472	-	-	-	97
HCM Lane V/C Ratio	0.077	-	-	-	1.111
HCM Control Delay (s)	13.3	-	-	-	205.7
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	7.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	1107	1242	5	36	34
Future Vol, veh/h	14	1107	1242	5	36	34
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	50	88	88	42	90	65
Heavy Vehicles, %	0	2	3	0	0	0
Mvmt Flow	28	1258	1411	12	40	52

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1423	0	-	0	2731	1417
Stage 1	-	-	-	-	1417	-
Stage 2	-	-	-	-	1314	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	484	-	-	-	~ 17	157
Stage 1	-	-	-	-	193	-
Stage 2	-	-	-	-	219	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	484	-	-	-	~ 16	157
Mov Cap-2 Maneuver	-	-	-	-	98	-
Stage 1	-	-	-	-	182	-
Stage 2	-	-	-	-	219	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	89.1
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	484	-	-	-	125
HCM Lane V/C Ratio	0.058	-	-	-	0.738
HCM Control Delay (s)	12.9	-	-	-	89.1
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	4.2

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	0.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1106	5	2	1274	12	15
Future Vol, veh/h	1106	5	2	1274	12	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	3	-	-	-3	0	-
Peak Hour Factor	88	90	90	88	90	90
Heavy Vehicles, %	2	0	3	0	0	0
Mvmt Flow	1257	6	2	1448	13	17

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1263	0	2712	1260
Stage 1	-	-	-	-	1260	-
Stage 2	-	-	-	-	1452	-
Critical Hdwy	-	-	4.13	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.227	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	547	-	24	210
Stage 1	-	-	-	-	270	-
Stage 2	-	-	-	-	217	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	547	-	24	210
Mov Cap-2 Maneuver	-	-	-	-	120	-
Stage 1	-	-	-	-	270	-
Stage 2	-	-	-	-	216	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	33
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	158	-	-	547	-
HCM Lane V/C Ratio	0.19	-	-	0.004	-
HCM Control Delay (s)	33	-	-	11.6	-
HCM Lane LOS	D	-	-	B	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1072	5	2	1300	11	13
Future Vol, veh/h	1072	5	2	1300	11	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	75	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	-2	-	-	2	0	-
Peak Hour Factor	90	90	90	89	90	90
Heavy Vehicles, %	2	0	0	3	0	0
Mvmt Flow	1191	6	2	1461	12	14

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1197	0	2659	1194
Stage 1	-	-	-	-	1194	-
Stage 2	-	-	-	-	1465	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	590	-	25	230
Stage 1	-	-	-	-	290	-
Stage 2	-	-	-	-	214	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	590	-	25	230
Mov Cap-2 Maneuver	-	-	-	-	123	-
Stage 1	-	-	-	-	290	-
Stage 2	-	-	-	-	213	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	31.2
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	164	-	-	590	-
HCM Lane V/C Ratio	0.163	-	-	0.004	-
HCM Control Delay (s)	31.2	-	-	11.1	-
HCM Lane LOS	D	-	-	B	-
HCM 95th %tile Q(veh)	0.6	-	-	0	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	944	917	52	38	16
Future Vol, veh/h	24	944	917	52	38	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	75	-	-	100	0	-
Veh in Median Storage, #	-	0	0	-	1	-
Grade, %	-	2	-2	-	4	-
Peak Hour Factor	75	94	94	76	79	50
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	1004	976	68	48	32

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1044	0	-	0	2044	976
Stage 1	-	-	-	-	976	-
Stage 2	-	-	-	-	1068	-
Critical Hdwy	4.1	-	-	-	7.2	6.6
Critical Hdwy Stg 1	-	-	-	-	6.2	-
Critical Hdwy Stg 2	-	-	-	-	6.2	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	674	-	-	-	~ 40	276
Stage 1	-	-	-	-	297	-
Stage 2	-	-	-	-	263	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	674	-	-	-	~ 38	276
Mov Cap-2 Maneuver	-	-	-	-	142	-
Stage 1	-	-	-	-	283	-
Stage 2	-	-	-	-	263	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	41.5
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	674	-	-	-	176
HCM Lane V/C Ratio	0.047	-	-	-	0.455
HCM Control Delay (s)	10.6	-	-	-	41.5
HCM Lane LOS	B	-	-	-	E
HCM 95th %tile Q(veh)	0.1	-	-	-	2.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	22	965	963	44	24	17
Future Vol, veh/h	22	965	963	44	24	17
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	-	1	-
Grade, %	-	3	-3	-	2	-
Peak Hour Factor	69	95	93	85	67	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	32	1016	1035	52	36	24

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1087	0	-	0	2141	1061
Stage 1	-	-	-	-	1061	-
Stage 2	-	-	-	-	1080	-
Critical Hdwy	4.1	-	-	-	6.8	6.4
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	649	-	-	-	43	259
Stage 1	-	-	-	-	298	-
Stage 2	-	-	-	-	292	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	649	-	-	-	41	259
Mov Cap-2 Maneuver	-	-	-	-	150	-
Stage 1	-	-	-	-	283	-
Stage 2	-	-	-	-	292	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	34.6
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	649	-	-	-	180
HCM Lane V/C Ratio	0.049	-	-	-	0.332
HCM Control Delay (s)	10.8	-	-	-	34.6
HCM Lane LOS	B	-	-	-	D
HCM 95th %tile Q(veh)	0.2	-	-	-	1.4

Intersection	
Int Delay, s/veh	0.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	972	10	19	961	8	15
Future Vol, veh/h	972	10	19	961	8	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	3	-	-	-3	0	-
Peak Hour Factor	95	90	90	93	90	90
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	1023	11	21	1033	9	17

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1034	0	2104	1029
Stage 1	-	-	-	-	1029	-
Stage 2	-	-	-	-	1075	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	680	-	57	286
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	331	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	680	-	55	286
Mov Cap-2 Maneuver	-	-	-	-	177	-
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	321	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	22.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	236	-	-	680	-
HCM Lane V/C Ratio	0.108	-	-	0.031	-
HCM Control Delay (s)	22.1	-	-	10.5	-
HCM Lane LOS	C	-	-	B	-
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	954	9	17	916	7	14
Future Vol, veh/h	954	9	17	916	7	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	75	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	-2	-	-	2	0	-
Peak Hour Factor	94	90	90	94	90	90
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	1015	10	19	974	8	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1025	0	2032	1020
Stage 1	-	-	-	-	1020	-
Stage 2	-	-	-	-	1012	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	685	-	64	290
Stage 1	-	-	-	-	351	-
Stage 2	-	-	-	-	354	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	685	-	62	290
Mov Cap-2 Maneuver	-	-	-	-	187	-
Stage 1	-	-	-	-	351	-
Stage 2	-	-	-	-	344	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	21.2
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	245	-	-	685	-
HCM Lane V/C Ratio	0.095	-	-	0.028	-
HCM Control Delay (s)	21.2	-	-	10.4	-
HCM Lane LOS	C	-	-	B	-
HCM 95th %tile Q(veh)	0.3	-	-	0.1	-

APPENDIX G

LOCAL TRIP GENERATION RATES

Local Apartment
Trip Generation Study

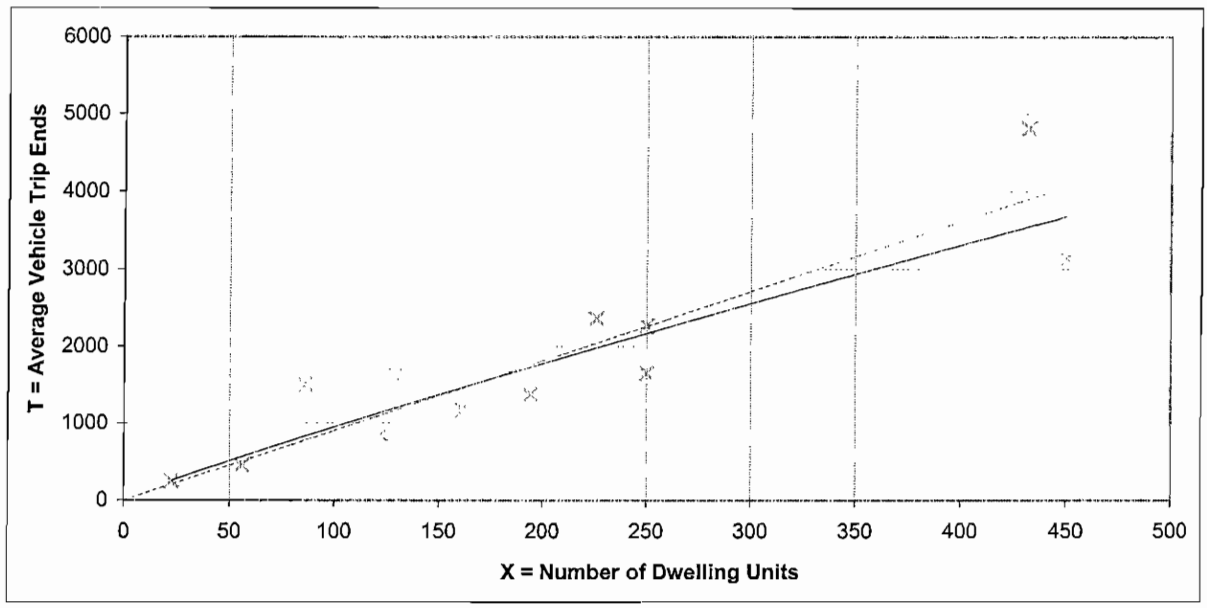
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

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

Trip Generation Per Dwelling Unit

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

Data Plot and Equation



X Actual Data Points ———— Fitted Curve Average Rate

Fitted Curve Equation: $T = 15.193(X)^{0.899}$ $R^2 = 0.88$

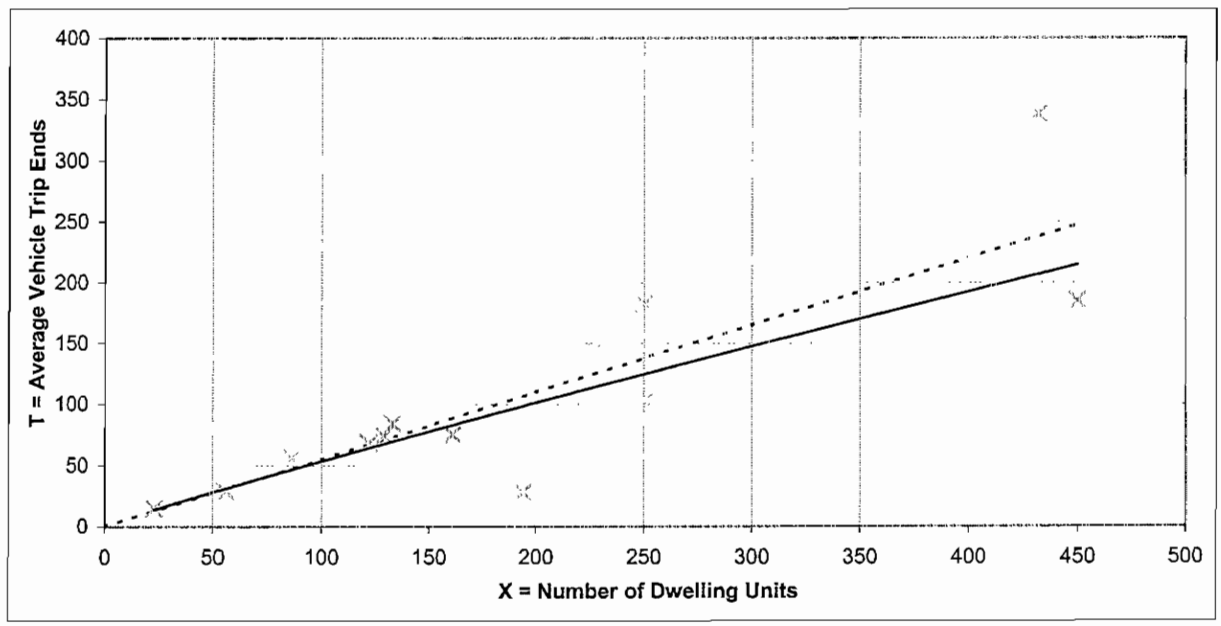
Local Apartment
Trip Generation Study

Average Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday,** **Peak Hour of Adjacent Street Traffic,** **One Hour Between 7 and 9 a.m.**
Number of Studies:	13
Average Number of Dwelling Units:	193
Directional Distribution:	22% entering, 78% exiting

Trip Generation Per Dwelling Unit

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

Data Plot and Equation



X Actual Data Points ——— Fitted Curve Average Rate

Fitted Curve Equation: $T = 0.758(X)^{0.924}$ $R^2 = 0.75$

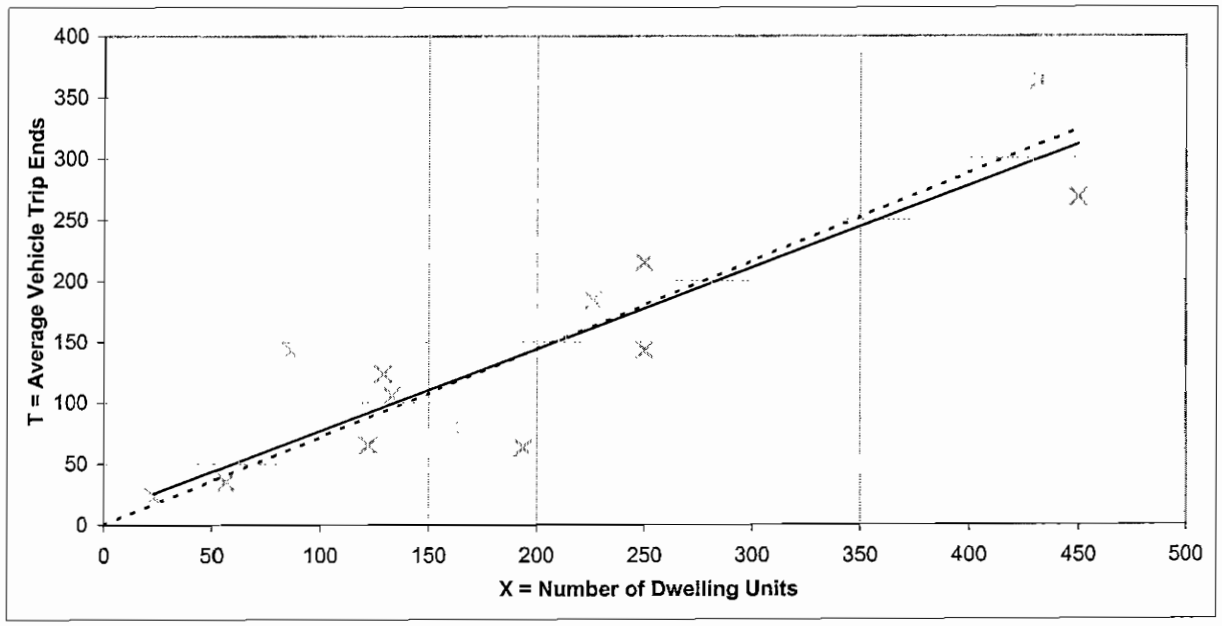
Local Apartment
Trip Generation Study

Average Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday,** **Peak Hour of Adjacent Street Traffic,** **One Hour Between 4 and 6 p.m.**
Number of Studies:	13
Average Number of Dwelling Units:	193
Directional Distribution:	55% entering, 45% exiting

Trip Generation Per Dwelling Unit

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

Data Plot and Equation



X Actual Data Points ——— Fitted Curve Average Rate

Fitted Curve Equation: T = 0.669(X) + 10.069 **R^2 = 0.79**

TRIP GENERATION FOR CRUZ LANDING SUBDIVISION

62 Attached Townhouses

ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Attached Townhouses	62	621	22%	78%		55%	45%	
				7	27	34	29	23	52
Total New Volume Site Trips			**621**	**7**	**27**	**34**	**29**	**23**	**52**

Data from Local Trip Rates and calculated by using Fitted Curve Equations

TRIP GENERATION FOR CRUZ LANDING SUBDIVISION

62 Attached Townhouses

62 Units = X

Weekday:

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

T = 15 * 40.87

T = 621 trips

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

T = 0.758 * 45

T = 34 trips

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

T = 0.669 * 62 + 10.07

T = 52 trips

TRIP GENERATION FOR MAYA HILLS SUBDIVISION

55 Attached Townhouses

ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Attached Townhouses	55	557	22%	78%		55%	45%	
				7	24	31	26	21	47
Total New Volume Site Trips			**557**	**7**	**24**	**31**	**26**	**21**	**47**

Data from Local Trip Rates and calculated by using Fitted Curve Equations

TRIP GENERATION FOR MAYA HILLS SUBDIVISION

55 Attached Townhouses

55 Units = X

Weekday:

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

T = 15 * 36.69

T = 557 trips

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

T = 0.758 * 41

T = 31 trips

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

T = 0.669 * 55 + 10.07

T = 47 trips

APPENDIX H

2019 CENSUS BUREAU DATA

United States Census Bureau OnTheMap

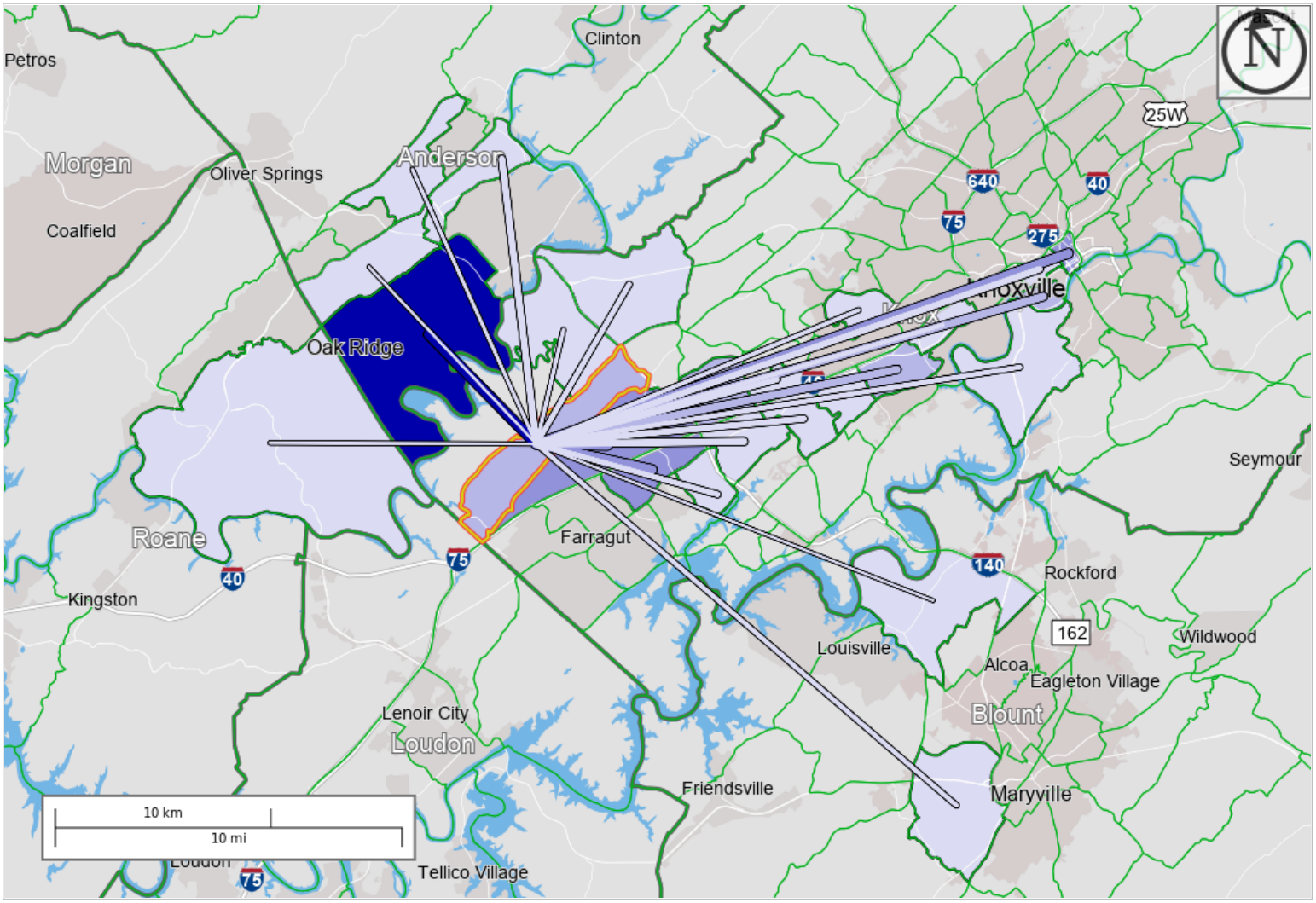
Work Destination Report - Home Selection Area to Work Census Tracts

All Jobs for All Workers in 2019

Created by the U.S. Census Bureau's OnTheMap `https://onthemap.ces.census.gov` on 04/01/2023

Counts of All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers



Map Legend

Job Count
- 140 - 161
- 119 - 139
- 98 - 118
- 77 - 97
- 56 - 76
- 35 - 55
- 13 - 34

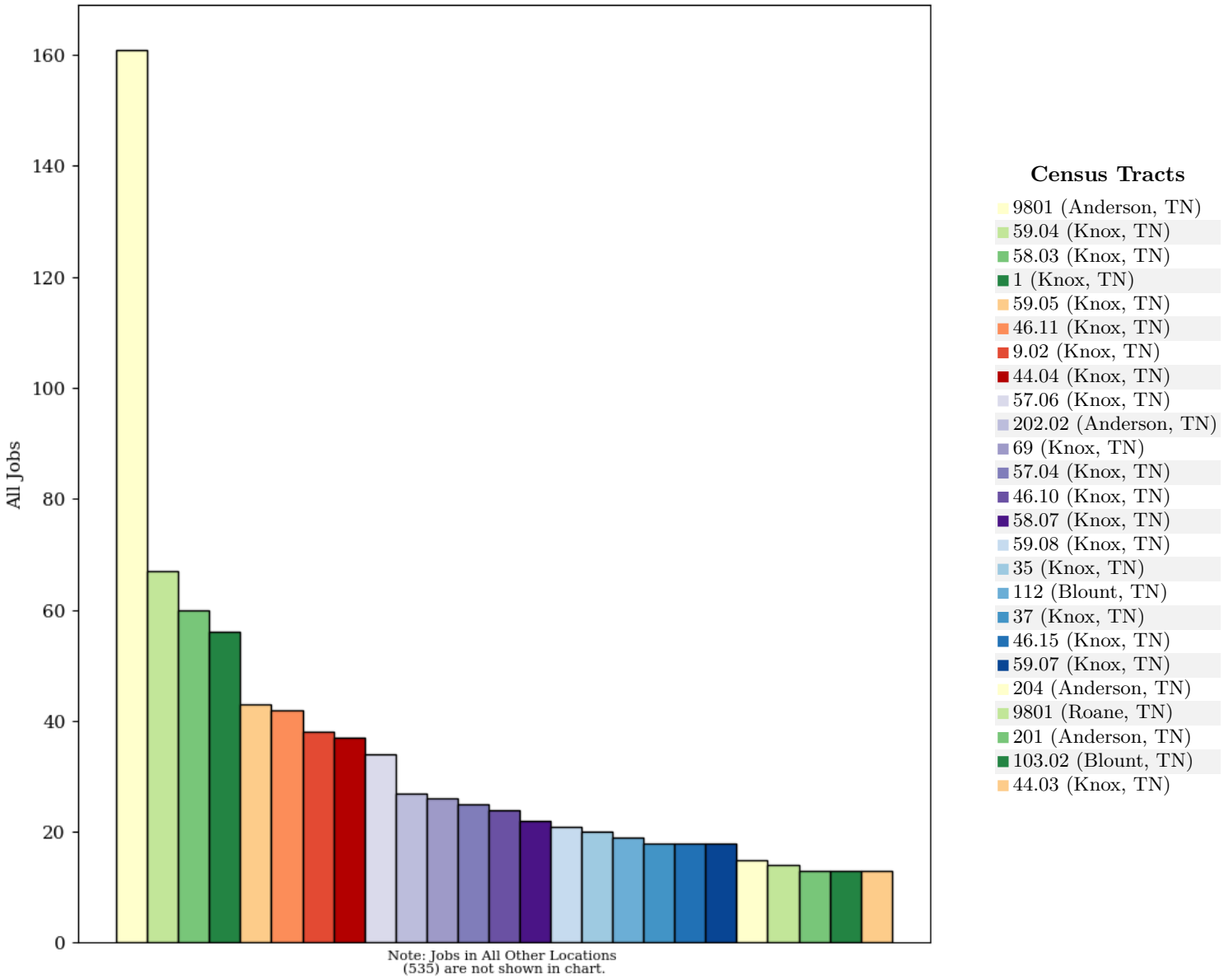
Selection Areas
- Analysis Selection

Job Count
- 140 - 161
- 119 - 139
- 98 - 118
- 77 - 97
- 56 - 76
- 35 - 55
- 13 - 34

United States Census Bureau

All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers



All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers

Census Tracts as Work Destination Area	2019 Count	2019 Share
All Census Tracts	1,379	100.0
9801 (Anderson, TN)	161	11.7
59.04 (Knox, TN)	67	4.9
58.03 (Knox, TN)	60	4.4
1 (Knox, TN)	56	4.1
59.05 (Knox, TN)	43	3.1
46.11 (Knox, TN)	42	3.0
9.02 (Knox, TN)	38	2.8
44.04 (Knox, TN)	37	2.7
57.06 (Knox, TN)	34	2.5
202.02 (Anderson, TN)	27	2.0

Census Tracts as Work Destination Area	2019 Count	Share
69 (Knox, TN)	26	1.9
57.04 (Knox, TN)	25	1.8
46.10 (Knox, TN)	24	1.7
58.07 (Knox, TN)	22	1.6
59.08 (Knox, TN)	21	1.5
35 (Knox, TN)	20	1.5
112 (Blount, TN)	19	1.4
37 (Knox, TN)	18	1.3
46.15 (Knox, TN)	18	1.3
59.07 (Knox, TN)	18	1.3
204 (Anderson, TN)	15	1.1
9801 (Roane, TN)	14	1.0
201 (Anderson, TN)	13	0.9
103.02 (Blount, TN)	13	0.9
44.03 (Knox, TN)	13	0.9
All Other Locations	535	38.8

Additional Information

Analysis Settings

Analysis Type	Destination
Destination Type	Census Tracts
Selection area as	Home
Year(s)	2019
Job Type	All Jobs
Selection Area	59.05 (Knox, TN) from Census Tracts
Selected Census Blocks	40
Analysis Generation Date	04/01/2023 11:13 - OnTheMap 6.8.1
Code Revision	f9358819d46a60bb89052036516a1c8fe8bbbeac
LODES Data Version	20211018_1647

Data Sources

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2019).

Notes

1. Race, Ethnicity, Educational Attainment, and Sex statistics are beta release results and are not available before 2009.
2. Educational Attainment is only produced for workers aged 30 and over.
3. Firm Age and Firm Size statistics are beta release results for All Private jobs and are not available before 2011.

APPENDIX I

KNOX COUNTY TURN LANE VOLUME THRESHOLD WORKSHEETS

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						Yes
250 - 299					Yes	Yes
300 - 349				Yes	Yes	Yes
350 - 399			Yes	Yes	Yes	Yes
400 - 449			Yes	Yes	Yes	Yes
450 - 499		Yes	Yes	Yes	Yes	Yes
500 - 549		Yes	Yes	Yes	Yes	Yes
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					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199			Yes	Yes	Yes	Yes
200 - 249	Yes		Yes	Yes	Yes	Yes
250 - 299	Yes		Yes	Yes	Yes	Yes
300 - 349	Yes		Yes	Yes	Yes	Yes
350 - 399	Yes		Yes	Yes	Yes	Yes
400 - 449	Yes		Yes	Yes	Yes	Yes
450 - 499	Yes		Yes	Yes	Yes	Yes
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

1106

5

Hardin Valley Road at Road "A" Cruz Landing

2026 Projected AM EB Right Turns = 5

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	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

10

972

Hardin Valley Road at Road "A" Cruz Landing

2026 Projected PM EB Right Turns = 10

Right Turn Lane NOT Warranted

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

TABLE 5A

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160	115	85	75	65	55
250 - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399	100	80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

1300

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

Hardin Valley Road at Road "A" Maya Hills

2026 Projected AM WB Left Turns = 2

Left Turn Lane NOT Warranted

1072 + 5 = 1077

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

TABLE 5B

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

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

1072

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

Hardin Valley Road at Road "A" Maya Hills

2026 Projected AM EB Right Turns = 5

Right Turn Lane NOT Warranted

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

TABLE 5A

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149 150 - 199	250 200	180 140	140 105	110 90	80 70	70 60
200 - 249 250 - 299	160 130	115 100	85 75	75 65	65 60	55 50
300 - 349 350 - 399	110 100	90 80	70 65	60 55	55 50	45 40
400 - 449 450 - 499	90 80	70 65	60 55	50 45	45 40	35 30
500 - 549 550 - 599	70 65	60 55	45 40	35 35	35 30	25 25
600 - 649 650 - 699	60 55	45 35	35 35	30 30	25 25	25 20
700 - 749 750 or More	50 45	35 35	30 25	25 25	20 20	20 20

916

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

Hardin Valley Road at Road "A" Maya Hills

2026 Projected PM WB Left Turns = 17

Left Turn Lane Warranted

954 + 9 = 963

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

TABLE 5B

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

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

954

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

Hardin Valley Road at Road "A" Maya Hills

2026 Projected PM EB Right Turns = 9

Right Turn Lane NOT Warranted

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

APPENDIX J

SIMTRAFFIC VEHICLE QUEUE WORKSHEETS

Intersection: 4: Hardin Valley Road & Brooke Willow Boulevard

Movement	EB	EB	WB	WB	SB
Directions Served	L	T	T	R	LR
Maximum Queue (ft)	48	8	26	2	482
Average Queue (ft)	12	0	1	0	340
95th Queue (ft)	38	8	12	3	580
Link Distance (ft)		586	214		490
Upstream Blk Time (%)					27
Queuing Penalty (veh)					0
Storage Bay Dist (ft)	75			100	
Storage Blk Time (%)	0	0			
Queuing Penalty (veh)	1	0			

Intersection: 5: Hardin Valley Road & Brighton Farms Boulevard

Movement	EB	SB
Directions Served	L	LR
Maximum Queue (ft)	39	379
Average Queue (ft)	11	260
95th Queue (ft)	35	435
Link Distance (ft)		398
Upstream Blk Time (%)		15
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	100	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 7: Road "A" Cruz Landing & Hardin Valley Road

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (ft)	18	87
Average Queue (ft)	1	30
95th Queue (ft)	11	72
Link Distance (ft)		85
Upstream Blk Time (%)		5
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	50	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 10: Road "A" Maya Hills & Hardin Valley Road

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (ft)	18	116
Average Queue (ft)	1	39
95th Queue (ft)	11	100
Link Distance (ft)		154
Upstream Blk Time (%)		1
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	75	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 1

Intersection: 4: Hardin Valley Road & Brooke Willow Boulevard

Movement	EB	WB	SB
Directions Served	L	R	LR
Maximum Queue (ft)	47	6	186
Average Queue (ft)	14	0	75
95th Queue (ft)	40	4	176
Link Distance (ft)			490
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	75	100	
Storage Blk Time (%)	0		
Queuing Penalty (veh)	0		

Intersection: 5: Hardin Valley Road & Brighton Farms Boulevard

Movement	EB	WB	SB
Directions Served	L	TR	LR
Maximum Queue (ft)	46	4	108
Average Queue (ft)	16	0	43
95th Queue (ft)	43	3	95
Link Distance (ft)		503	398
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	100		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 7: Road "A" Cruz Landing & Hardin Valley Road

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (ft)	44	62
Average Queue (ft)	11	19
95th Queue (ft)	37	50
Link Distance (ft)		85
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	50	
Storage Blk Time (%)	0	
Queuing Penalty (veh)	3	

Intersection: 10: Road "A" Maya Hills & Hardin Valley Road

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (ft)	36	46
Average Queue (ft)	9	16
95th Queue (ft)	33	42
Link Distance (ft)		154
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	75	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 3

APPENDIX K

RESPONSE LETTER TO ADDRESS COMMENTS

AJAX ENGINEERING
CIVIL ENGINEERING / TRAFFIC ENGINEERING

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

May 19, 2023

PROJECT NAME: Cruz Landing and Maya Hills Subdivisions (6-SB-23-C & 6-SC-23-C)
TO: Knoxville-Knox County Planning
SUBJECT: Response Document for Cruz Landing and Maya Hills Subdivisions TIS Review Comments

Knoxville-Knox County Planning and Knox County Engineering Staff:

The following response document addresses the comments in a letter from Mike Conger, PE, dated May 12, 2023. This letter is added to the end of the revised report in Appendix K.

1. **The study recommends installing a new westbound left-turn lane at Maya Hills subdivision to be accomplished by beginning at the taper point for the eastbound left-turn lane serving Brooke Willow Blvd. It is likely more preferable to instead extend the existing center 2-way left-turn lane through this intersection and tie into the center 2-way left-turn lane to the west to accommodate other potential needs. Please provide your assessment of the continuous turn lane option and revise the recommendations as necessary.**

   Response: The recommendation for this new westbound left-turn lane at Maya Hills Subdivision has been updated to reflect the preference for extending the center TWLTL on Hardin Valley Road. This update was made on Page 3, 4th bullet point, and in the discussion on Page 55, recommendation 2a.

2. **Additionally, and regardless of the left-turn lane scenario described in comment #1, there needs to be further description/graphics provided to show how everything ties back in to the west along Hardin Valley Rd since it appears as though some sort of transition/re-striping may be necessary where the existing school entrance westbound right turn lane develops in relation to the shifted through-lane geometry that will result near the Maya Hills entrance location. Please also coordinate with the civil engineer to depict the appropriate laneage/striping pattern on a set of updated site plans for our review that also shows locations of access points/public streets on the north side of Hardin Valley Rd for better context.**

   Response: The proposed layout of the pavement striping on Hardin Valley Road is shown in an image at the bottom of Page 55 and is discussed in recommendation 2a on the same page.

3. **The proposed access for Cruz Landing will require a variance for intersection spacing as noted in the study and it was further stated that any entrance location would require a variance due to limited available existing spacing between public road intersections however this is not entirely true since there is an option to construct the access directly across from Brighton Farms Blvd. Please add an explanation as to why the access cannot be provided opposite Brighton Farms Blvd since this would be preferable in terms of preventing the issue of interlocking left turns within a short section of center turn lane as currently proposed.**

   Response: The reason for not providing an entrance directly across from Brighton Farms Boulevard is discussed in more detail in the first paragraph on Page 54. Besides the wetlands and site topography, further information in the discussion includes: "Furthermore, providing an entrance directly across from Brighton Farms Boulevard is not a viable possibility due to high-impact utility lines on the opposite side of Hardin Valley Road. These utility lines include underground water and gas transmission facilities." The recommendation on Page 3 in the third bullet point has also been updated.

4. **Please update the recommendation for "No Outlet" signs to be "Dead End" instead as being the more appropriate sign per the MUTCD. (Later correction by Mike Conger, PE via email: "One slight correction to my comment letter - the "Dead End" sign only applies to Maya Hills with its one cul-de-sac street so that's the only reference that needs to be changed from the "No Outlet" signage.)**

   Response: This correction has been made on Page 4, second bullet point, and in recommendation 3a on Page 57. It has also been updated in the image on Page 57.

5. **The intersection sight distance requirement is based on 10 feet of sight distance per 1 mph instead of the 1:1 cited in the TIS in multiple places – please correct where needed.**

   Response: This correction has been made in the first paragraphs on Pages 46 and 58.

6. **Knox County will be requesting the site plan be updated to include traditional cul-de-sacs for the interior streets instead of hammerhead turnarounds so please update any references in the TIS accordingly.**

   Response: All references and recommendations for the original hammerhead turnarounds have been removed. The images of the hammerheads were removed from Figure 3 and other figures and references were removed from the document on Page 4, 2nd bullet point; Page 18, 1st paragraph; and on Page 57, recommendation 3a.

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

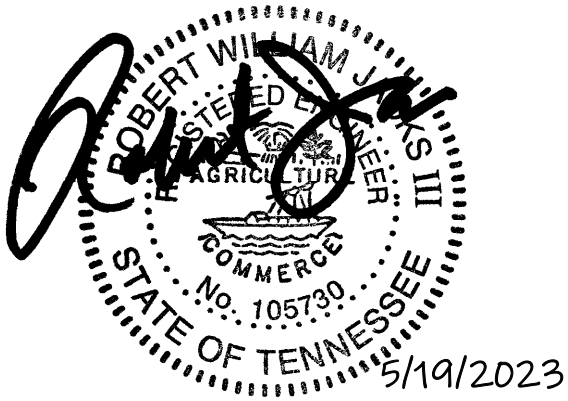
- Updated Title Page
- Updated Table of Contents
- Updated Page Footers
- Updated Figure 3

- Updated Site Layout in Figures 6a, 6b, 7a, 7b, 7c, and 8 and in Internal Traffic Sign Locations figure on Page 57
- Added Appendix K to include this response letter

If you have any questions or further comments, don't hesitate to contact me. I look forward to your review and approval.

Sincerely,

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



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CIVIL ENGINEERING / TRAFFIC ENGINEERING