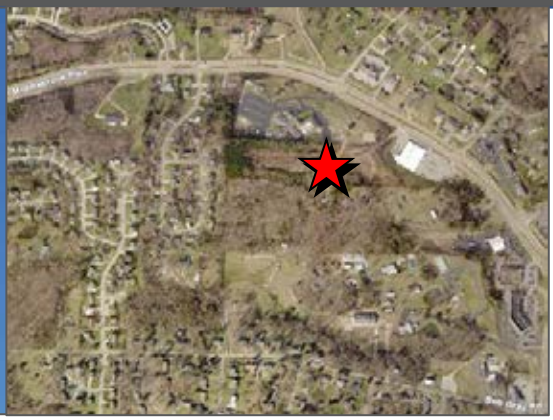
Transportation Impact Study
Middlebrook Commons
Knox County, Tennessee



Revised June 2021

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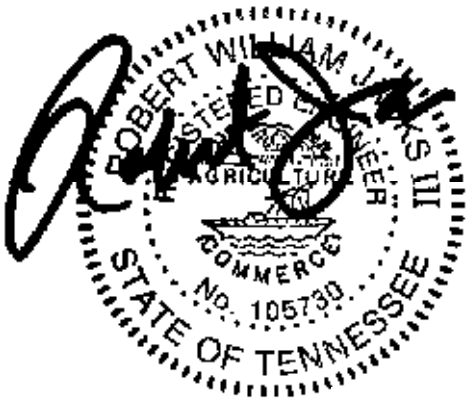

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EXECUTIVE SUMMARY

Preface:

MB Commons, LLC is proposing a multi-family residential development on the south side of Middlebrook Pike between Frederick Drive and Andes Road in West Knox County, TN. This proposed residential development is "Middlebrook Commons" and will consist of either a minimum of 90 or a maximum of 120 multi-family apartments on 5.03± acres. This development is anticipated to be fully built-out and occupied by 2023 and will have one entrance on the south side of Middlebrook Pike. This study's primary purpose is to determine and evaluate the potential impacts of the development on the adjacent transportation system with two analyses: the development constructed with 90 and 120 apartments. The study includes a review of the primary access roads and intersections and is a Level 2 study established by Knoxville/Knox County Planning. Recommendations and mitigation measures will be offered if transportation operations have been projected to be below recognized engineering standards.

Study Results:

The findings of this study include the following:

- Middlebrook Commons with 90 multi-family apartment units is calculated to generate 868 trips on an average weekday at full build-out and occupancy. Of these trips, 49 will occur during the AM peak hour and 71 trips in the PM peak hour in the year 2023. With 120 multi-family apartment units, the development is calculated to generate 1,125 trips on an average weekday. Of these trips, 64 will occur during the AM peak hour and 91 trips in the PM peak hour in the year 2023.
- This development will have one entrance on Middlebrook Pike, a 4-lane divided highway. The entrance will be on the south side of Middlebrook Pike, adjacent and shared with an existing rear entrance for a Dollar General Market. The entrance is calculated in the 2023 projected conditions to operate with minimal vehicle delays. TDOT has stated that this proposed development would not be allowed to have a center median opening on Middlebrook Pike, requiring a right-turn-in/right-turn-out-only entrance and thus requiring entering and exiting traffic to make U-turns at existing upstream and downstream intersections. These existing intersections are currently unsignalized and operate with high vehicle delays on the minor approaches in the AM and PM peak hours. One of these intersections, Middlebrook Pike at Andes Road/Church Driveway, currently meets Warrant #2 and #3 for a traffic signal, and the other intersection,

Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main), currently meets Warrant #3 for a traffic signal. The Middlebrook Pike at Andes Road/Church Driveway is deemed more critical in this study to be considered for traffic signalization due to its higher northbound and southbound traffic volumes, vehicle delays, and vehicle queues.

- The addition of Middlebrook Commons with either 90 or 120 apartment units will not appreciably increase vehicle delays at the adjacent existing upstream and downstream unsignalized intersections. The difference in projected vehicle delays between constructing 90 or 120 apartment units at the adjacent existing unsignalized intersections is negligible.
- As discussed in the report, it is recommended that TDOT re-examine and allow a center median opening for the proposed entrance on Middlebrook Pike. The potential median opening location is feasible based on the minimum spacing required, available median width, sight distance and offers several operational benefits. At a minimum, it is recommended that TDOT allow a center median opening to allow westbound left-turns into the development.

Recommendations:

The following recommendations are offered based on the study analyses. The recommendations are offered to minimize the traffic impacts of the proposed development on the adjacent road system while attempting to achieve an acceptable traffic flow and safety level. The recommendations marked with an asterisk indicate an existing transportation need and are not associated with the proposed development's projected impacts.

* • It is recommended that traffic counts be conducted again at the intersection of Middlebrook Pike at Andes Road/Church Driveway when either the current pandemic has ended and overall traffic volumes return closer to pre-pandemic levels, or when it is surmised that overall traffic volumes have reached a "new normal" to ensure the traffic signal warrant evaluations are valid and reasonable. This will allow for a re-comparison of the Traffic Signal Warrants and establish a timeframe of if and when this intersection could be signalized. Traffic crash data should also be included in the examination. Serious consideration should be given to transitioning this intersection to a traffic signal due to the existing large vehicle delays and queues on the northbound and southbound minor approaches of Andes Road and the Church Driveway.

- Without a center median opening, some apartment residents will be required to perform a westbound u-turn at the intersection of Middlebrook Pike at Andes Road/Church Driveway. A visual examination of the sight distance available for westbound U-turns at this intersection was conducted and estimated to exceed the recommended sight distance. Due to the horizontal curvature of Middlebrook Pike to the west, the sight distance at this location could be reduced if vegetation is not maintained on the south side of Middlebrook Pike. This vegetation will need to be maintained in the future.

* - It is recommended that traffic counts be conducted again at the intersection of Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main) when either the current pandemic has ended and overall traffic volumes return closer to pre-pandemic levels, or when it is surmised that overall traffic volumes have reached a "new normal" to ensure these traffic signal warrant evaluations are valid and reasonable. This will allow for a re-comparison of the Traffic Signal Warrants and establish a timeframe of if and when this intersection could be signalized. Traffic crash data should also be included in the examination.
- If a center median opening on Middlebrook Pike is not allowed, it is recommended that a 75-foot eastbound right-turn lane be constructed on Middlebrook Pike at the Dollar General Driveway (Rear)/Proposed Apartment Driveway with a taper length of 60 feet (5:1). The right-turn lane should be marked with the appropriate right-turn pavement marking symbols.
- It is recommended that the Dollar General Driveway (Rear) and Proposed Apartment Driveway entrances be separated as much as possible. Separating the entrances as the properties are currently configured will be impossible since they share a single access point at Middlebrook Pike with limited property availability. The concern is that detrimental operational issues could occur if the entrance location remains as is. The driveways should have 40 feet minimum edge clearance spacing as shown in TDOT's Manual for Constructing Driveway Entrances on State Highways in urban locations. This spacing is not possible based on the existing configuration and the property lines and limits as proposed. Obtaining additional property to the west would facilitate separating the entrances. The details and layout for this entrance should be clarified further during the detailed design phase with Knox County and TDOT.
- It is recommended that a Stop Sign (R1-1) and a 24" white stop bar be applied to the Proposed Apartment Driveway approach pavement at Middlebrook Pike.

According to the MUTCD, Stop Signs (R1-1) can be installed up to a maximum of 50 feet from the edge of the intersecting street. The stop bar should be applied at a minimum of 4 feet away from the extended edge of the proposed right-turn lane on Middlebrook Pike and should be placed at the desired stopping point that maximizes the sight distance.

- Intersection sight distance at Dollar General Driveway (Rear)/Proposed Apartment Driveway must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on Middlebrook Pike, the required intersection sight distance is 475 feet looking to the west. Based on an existing grade of 3% on Middlebrook Pike and a posted speed limit of 40-mph, the stopping sight distance is calculated to be 315 feet for eastbound vehicles on Middlebrook Pike. The site designer must verify that these distances will be available.
- It is recommended that a 15-mph Speed Limit Sign (R2-1) be posted near the beginning of the apartment driveway off Middlebrook Pike.
- Stop Signs (R1-1) and 24" white stop bars should be installed on the new internal aisleways and locations, as shown in the report.
- Sight distance at the new internal intersections in the development must not be impacted by new signage or future landscaping. With a speed limit of 15-mph in the development, the internal intersection sight distance requirement is 170 feet. The stopping sight distance required is 80 feet for a level road grade. The site designer should ensure that internal sight distance lengths are met.
- Due to the long, straight internal east-west parking lot aisleway to the north of Buildings 1 and 2, it is recommended that speed humps or tables be considered to reduce internal traffic speeds in the development. Alternatively, parking lot islands could be extended toward the aisleway.
- Due to the vast expanse of pavement in front of the access gate, it is recommended this pavement area be marked to show the predominant travel pattern expected for entering vehicles. These pavement markings should include a single yellow centerline from Middlebrook Pike south to the access gate and a painted island with white transverse crosshatch markings on the pavement.
- All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.
- It would be beneficial for the internal sidewalk system to tie to the sidewalk system on Middlebrook Pike. However, due to the narrow width of the entrance access property and the steep grade, it is most likely not feasible.

- All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.
- It is recommended that TDOT re-examine the decision of not allowing a center median opening at the Proposed Apartment Driveway location. Allowing a center median opening would allow left-turns-in and out or, at a minimum, allow for westbound left-turns-in. Allowing left-turns-in would eliminate U-turns from the apartment residents at the intersection of Middlebrook Pike at Andes Road/Church Driveway, would facilitate the majority of entering generated traffic, and eliminate the need for the exclusive eastbound right-turn lane. If a center median opening is not allowed on Middlebrook Pike, the possibility of cut-thru traffic by the apartment residents occurring on the Dollar General Market property will remain high.
- If a center median opening is not allowed for the apartment development, it is recommended that Do Not Enter Signs (R5-1) and speed humps be installed on the north side of the Dollar General Market property at the existing one-way parking lot aisle. These installations will require cooperation between the two entities and may require Knox County's assistance to facilitate the installation to reduce cut-thru traffic.

DESCRIPTION OF EXISTING CONDITIONS

- **STUDY AREA:**

The proposed location of this new development is shown on a map in Figure 1. The proposed development will be located on the south side of Middlebrook Pike between Frederick Drive to the east and Andes Road to the west in West Knox County, TN. The residential development will comprise a single driveway and several parking lot aisleways built for a minimum of 90 or a maximum of 120 apartments on 5.03± acres. Transportation impacts associated with the proposed development were analyzed at the following existing and proposed roadways and intersections, where the most significant impact is expected and as requested by Knoxville/Knox County Planning:

- Middlebrook Pike (SR 169) at Andes Road/Church Driveway
- Middlebrook Pike (SR 169) at Frederick Drive/Dollar General Driveway (Main)
- Middlebrook Pike (SR 169) at Dollar General Driveway (Rear)/Proposed Apartment Driveway

The proposed development property is in a suburbanized area of West Knox County, TN. There are many single-family residences, established residential subdivisions, some remaining unused/woodland properties, and a church and private school near this development. Also, commercial buildings, formerly single-family homes converted to business use, and other businesses line Middlebrook Pike near the project site in addition to an adjacent Dollar General Market. Most of the proposed development property is relatively flat from previous earth grading, consists of scrubland, and an overhead powerline and 250' powerline easement clips a portion of the property on the east side.

View of Existing Access to Site Development Property off Middlebrook Pike (Looking Southwest)

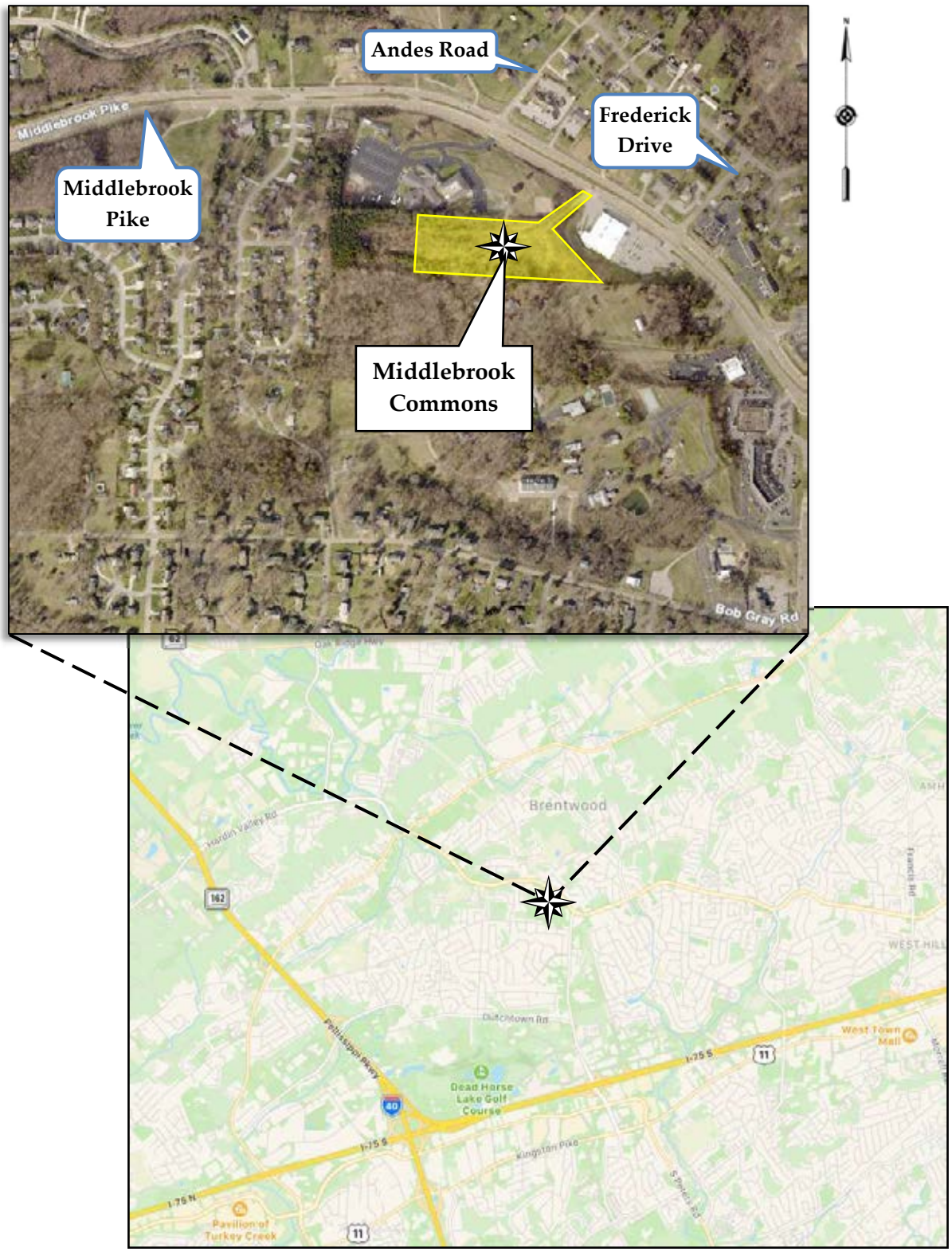


Figure 1
Location Map

- **EXISTING ROADWAYS:**

Table 1 lists the characteristics of the key existing roadways adjacent to the development property and included in the study:

TABLE 1
STUDY CORRIDOR CHARACTERISTICS

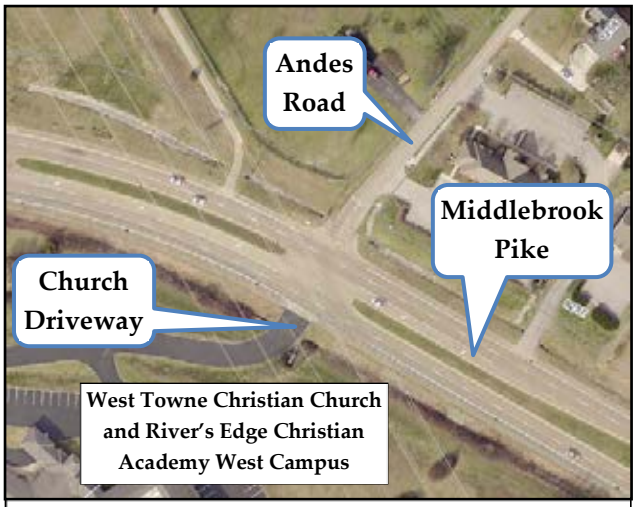
NAME	CLASSIFICATION [1]	SPEED LIMIT	LANES	ROAD WIDTH [2]	TRANSIT [3]	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Middlebrook Pike (SR 169)	Major Arterial	40 mph	4 divided	80 feet	None	7' sidewalk on south side / 4.5' sidewalk on north side	No bike lanes
Andes Road	Local Street	30 mph	2 undivided	22 feet	None	No sidewalks along roadway	No bike lanes
Frederick Drive	Local Street	Not Posted	2 undivided	26 feet	None	No sidewalks along roadway	No bike lanes

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

Middlebrook Pike (SR 169) is a 4-lane major arterial that traverses in a generally east-west direction. Middlebrook Pike is 11.7 miles in length and runs between Lovell Road/Ball Camp Pike/Ball Camp Byington Road on the west side to the intersection of Western Avenue (SR 62) and University Avenue on the east side. Closer to the study area, Middlebrook Pike provides convenient access to North Cedar Bluff Road for travel to the south towards Interstate 40. Further to the west, the Middlebrook Pike roadway transitions to Hardin Valley Road with access to Pellissippi Parkway (SR 162) further west. The posted speed limit on Middlebrook Pike is 40 mph near the project site.

Middlebrook Pike is a divided highway with raised grassed medians adjacent to the proposed development site. The grassed median widths are variable in width, with an average width of around 20 feet. In the vicinity, separate eastbound and westbound left-turn lanes are provided on Middlebrook Pike at intersecting public streets with generous vehicle storage lengths. Median openings are numerous along Middlebrook Pike; however, a new median opening is not available on Middlebrook Pike for the proposed Middlebrook Commons development, according to TDOT. Middlebrook Pike has 6" concrete curbs with 24" gutters. Sidewalks are available on both sides, with a narrower sidewalk on the north side.

There are not any utility street lights provided along Middlebrook Pike in the adjacent study area. However, utility lights are provided on the adjacent Dollar General Market parking lot.

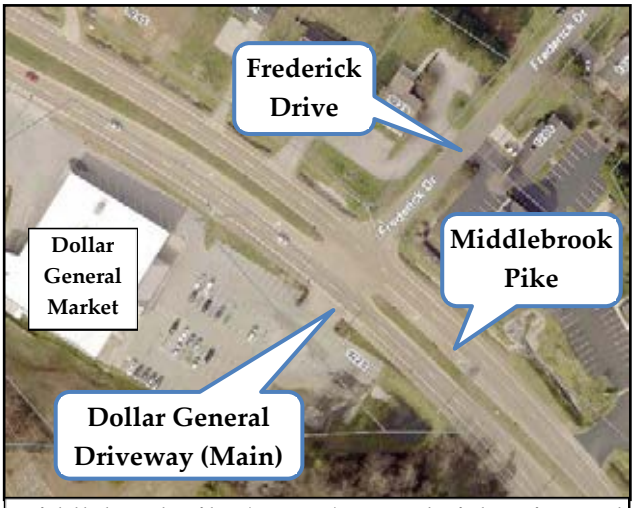


Middlebrook Pike (SR 169) at Andes Road and Church Driveway

The intersection of Middlebrook Pike at Andes Road is a 4-legged two-way stop unsignalized intersection. Andes Road is controlled by a Stop Sign (R1-1), and to the south, a private driveway for West Towne Christian Church and River's Edge Christian Academy West Campus comprises the northbound approach. At this intersection, Middlebrook Pike has a separate westbound left-turn lane with 180 feet of vehicle storage and an eastbound left-turn lane with 320 feet of vehicle storage.

The church has traditional hours of operations on Sundays, with daily office hours from 9 am to 4 pm. The vast majority of the trips generated by the church are Sundays and are outside the typical weekday peak morning and afternoon traffic rush hours. According to their website, the River's Edge Christian Academy West Campus provides private education for children from kindergarten to 5th grade with older students at another campus. The school has a weekday student drop-off from 8:00 – 8:25 in the morning and student pickup from 1:30 – 1:45 in the afternoon.

The intersection of Middlebrook Pike at Frederick Drive is also a 4-legged two-way stop unsignalized intersection. Frederick Drive is controlled by a Stop Sign (R1-1), and to the south, a private driveway for the Dollar General Market is the northbound approach. At this intersection, Middlebrook Pike has a separate westbound left-turn lane with 150 feet of vehicle storage and an eastbound left-turn lane with 185 feet of vehicle storage.



Middlebrook Pike (SR 169) at Frederick Drive and Dollar General Driveway (Main)

The Dollar General Market has operating hours from 7 am to 10 pm, seven days a week. According to Knox County, the building has a floor area of 24,781 square feet. There are 115 automobile parking spaces provided with truck docks in the rear. A separate rear entrance, the Dollar General Driveway (Rear), will share access with the proposed apartment driveway.

In addition to the church, school, and market, there are also several other businesses along the north side of Middlebrook Pike. Some of these businesses include a financial consultant, veterinarian, physical therapist, doctor, and an education center for Carson-Newman University.

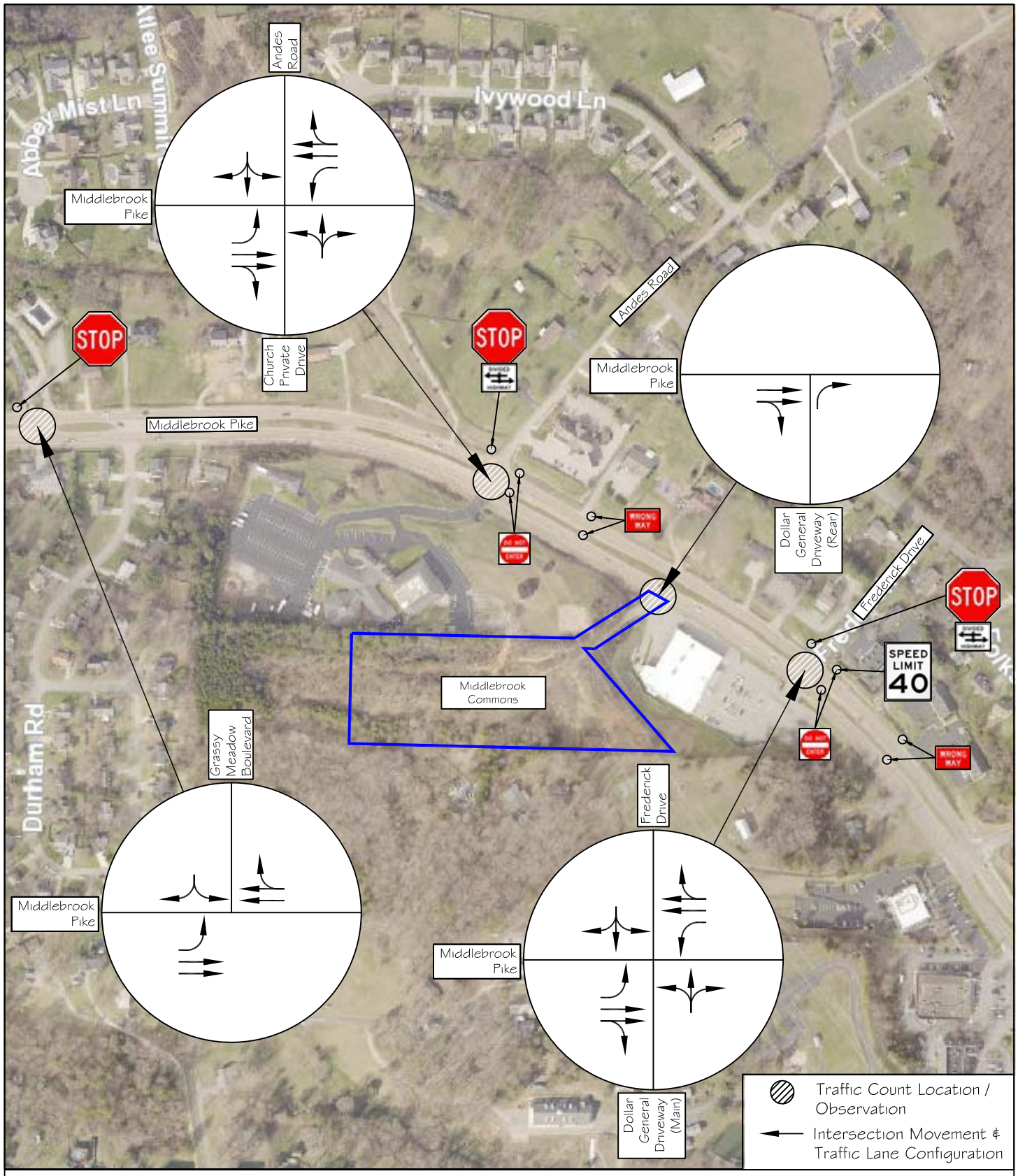
Andes Road is a 1.7-mile long, 2-lane local street that traverses in a generally north and south direction between Middlebrook Pike and Ball Camp Pike. Besides a church further to the north and the commercial development near Middlebrook Pike, Andes Road primarily provides road access to numerous residential subdivisions and stand-alone single-family homes. Further to the north, between Chert Pit Road and Ball Camp Pike, Andes Road is classified as a major collector.

Andes Road has a posted speed limit of 30-mph and is a fairly narrow roadway. Near Middlebrook Pike, Andes Road is approximately 22 feet in width, but the road narrows quickly as it traverses to the north.

Frederick Drive is only 450 feet in length and is a 2-lane local street that traverses in a north and south direction between Slade Drive and Middlebrook Pike. Besides a driveway provided for a veterinarian's office and one for a small multi-use commercial building, there are only two other driveways on Frederick Drive. These are for private single-family homes. Frederick Drive provides access to more single-family homes further inside the Hundred Oaks Subdivision.

Frederick Drive does not have a posted speed limit but is assumed to be 25-mph. Near Middlebrook Pike, Frederick Drive is approximately 26 feet in width. Note: Frederick Drive is listed on KGIS mapping and the posted street sign as “Frederick Drive”. Google Maps lists this street as “Fredrick Drive”.

Figure 2 shows the lane configurations of the roadways and intersections examined in the study, the study traffic count locations, and traffic signage in the near vicinity. The traffic signage shown only includes warning and regulatory signage. The pages following Figure 2 give an overview of the site study area with photographs.



AJAX ENGINEERING
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NOT TO SCALE

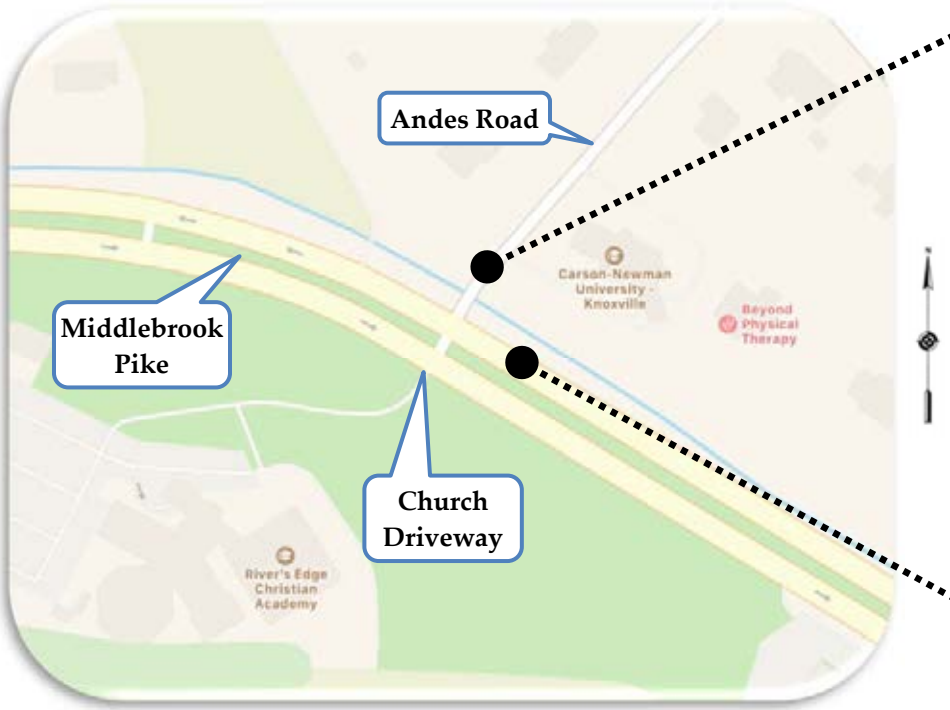
NORTH

FIGURE 2

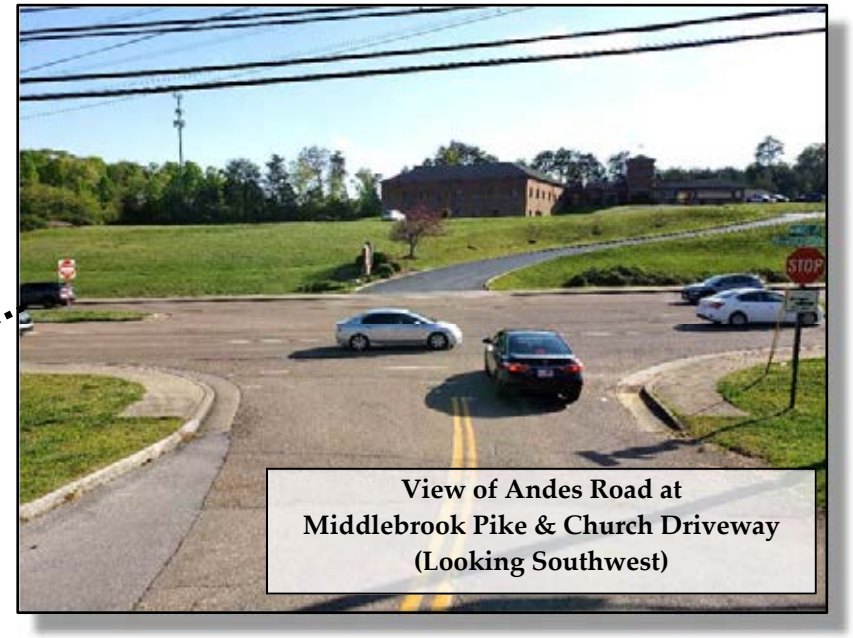
Middlebrook Commons

Traffic Count Locations, Traffic Signage & Existing Lane Configurations

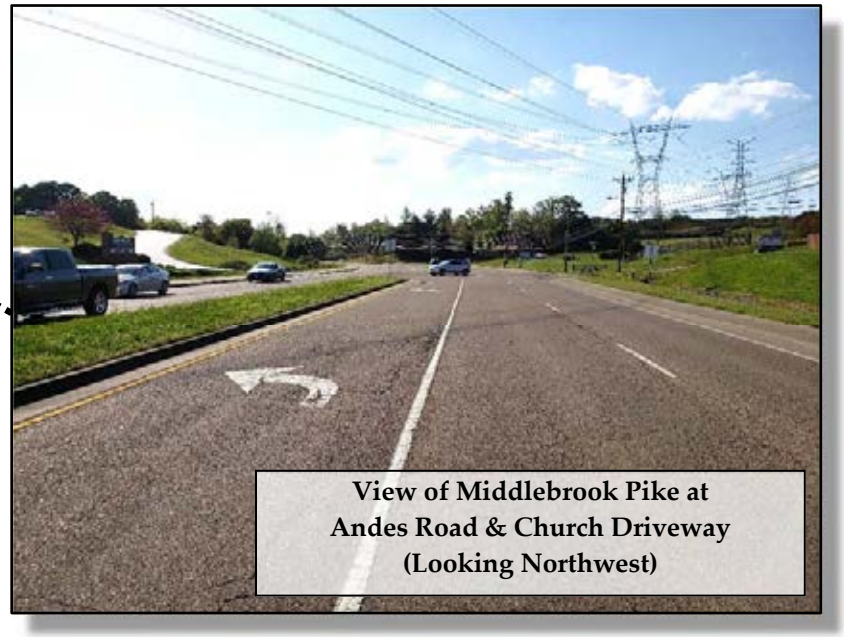
PHOTO EXHIBITS



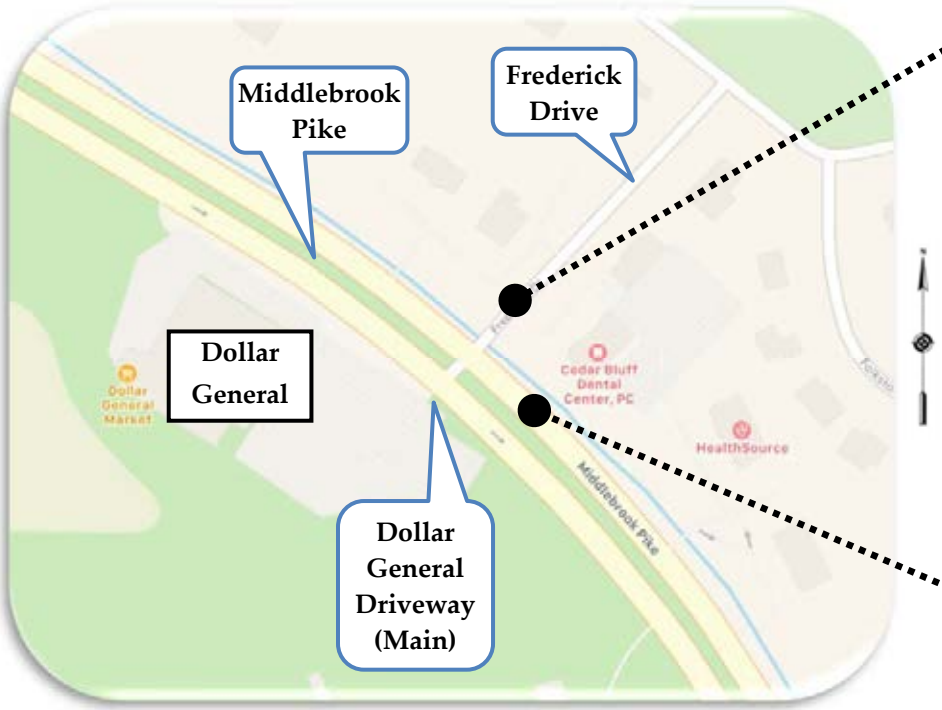
Middlebrook Pike at Andes Road & Church Driveway



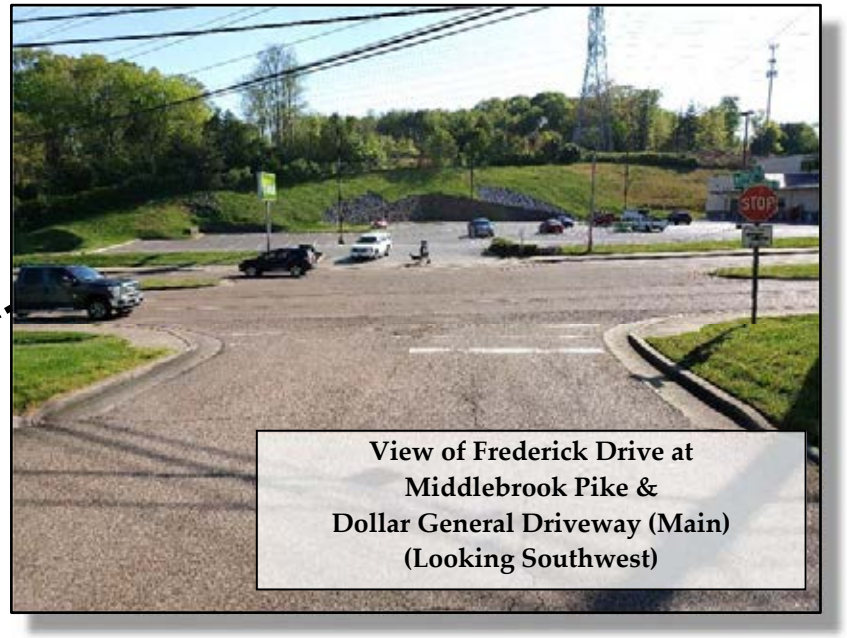
View of Andes Road at Middlebrook Pike & Church Driveway (Looking Southwest)



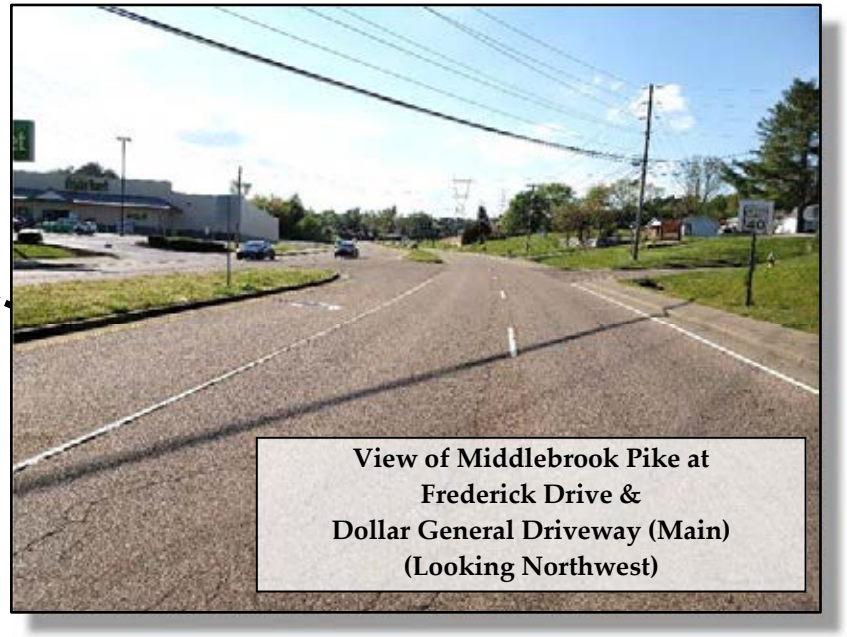
View of Middlebrook Pike at Andes Road & Church Driveway (Looking Northwest)



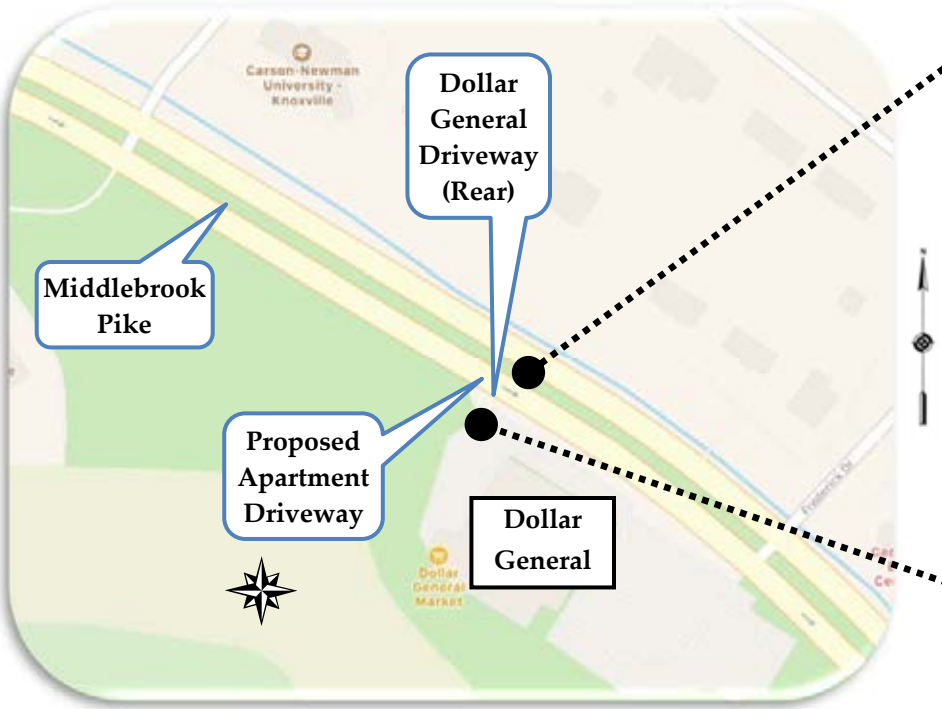
Middlebrook Pike at Frederick Drive & Dollar General Driveway (Main)



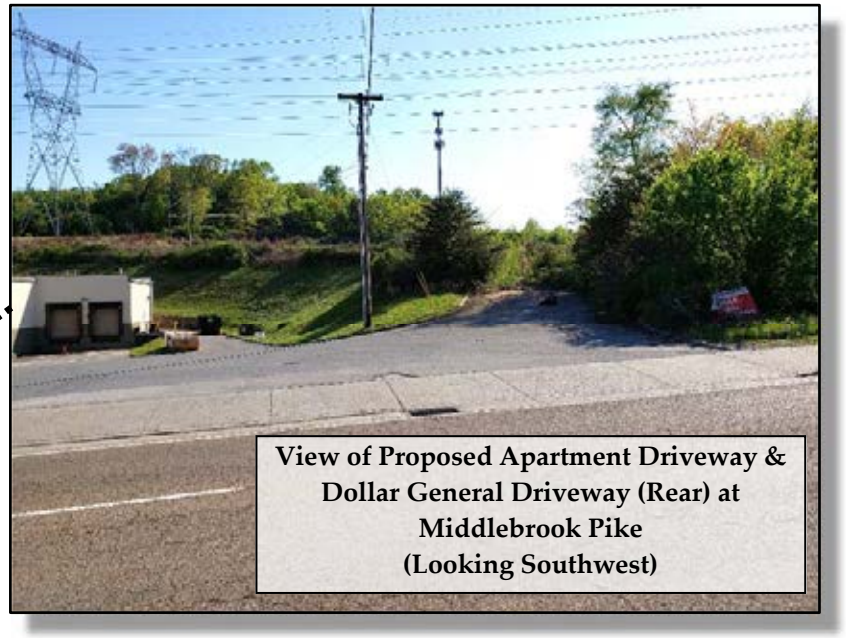
View of Frederick Drive at Middlebrook Pike & Dollar General Driveway (Main) (Looking Southwest)



View of Middlebrook Pike at Frederick Drive & Dollar General Driveway (Main) (Looking Northwest)

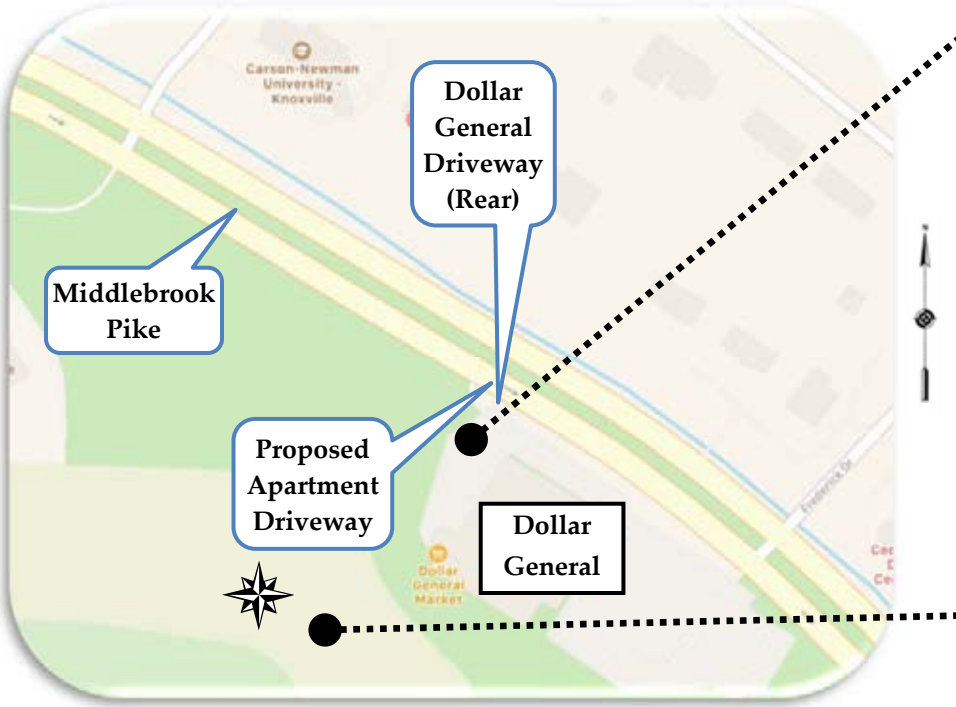


Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway



View of Proposed Apartment Driveway & Dollar General Driveway (Rear) at Middlebrook Pike (Looking Southwest)

View of Proposed Apartment Driveway & Dollar General Driveway (Rear) at Middlebrook Pike (Looking Northeast)



Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway

View of Proposed Apartment Driveway (Looking Southwest)

View of Proposed Site (Looking Southwest)

- **EXISTING TRANSPORTATION VOLUMES PER MODE:**

There is one permanent vehicular traffic count location near the development site. This count location is conducted by the Tennessee Department of Transportation (TDOT) every year. The count location data is the following:

- Existing vehicular roadway traffic:
  TDOT reported an Average Annual Daily Traffic (AADT) on Middlebrook Pike to the east of Lovell Road and west of the project site at 18,891 vehicles per day in 2019. From 2009 – 2019, this count station has indicated a 1.6% average annual growth rate. The researched historical traffic count data for this report can be viewed in Appendix A.

- Existing bicycle and pedestrian volumes:
  The average daily pedestrian and bicycle traffic along and around the study area is not known. Only a handful of pedestrians were observed during the manual traffic counts for this study. No bicyclists were observed during the manual traffic counts. An online website, Strava, provides "heat" maps detailing exercise routes taken by pedestrians, joggers, and bicyclists. This data is gathered from individuals allowing their smart devices to track and compile their routes (over 700 million activities). Based on the heat maps, more pedestrians/joggers than bicyclists traverse the area.

Strava Data for Bicyclists

Strava Data for Pedestrian/Joggers

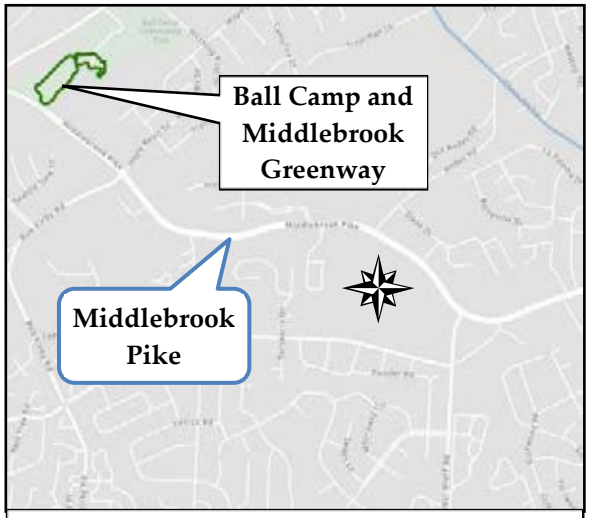
- **ON-STREET PARKING:**

Currently, on-street parking is not allowed or observed on any of the studied roadways adjacent to the project site. Off-street parking is provided adjacent to Middlebrook Pike at the Dollar General Market and at the other smaller businesses along Middlebrook Pike.

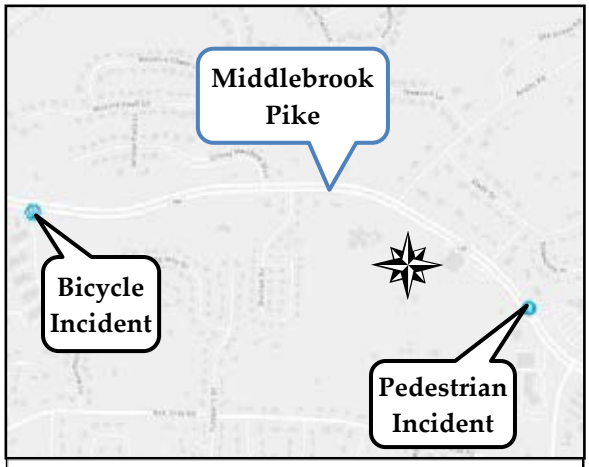
- **PEDESTRIAN AND BICYCLE FACILITIES:**

Bicycle lanes are not currently available within the project site study area. The closest bicycle facilities are located at Nicholas Ball Park, 1.5 miles (by roadway) to the northwest of the development site. The Nicholas Ball Park contains the Ball Camp and Middlebrook Greenway.

The Ball Camp and Middlebrook Greenway is a paved trail that is 0.8 miles in length.



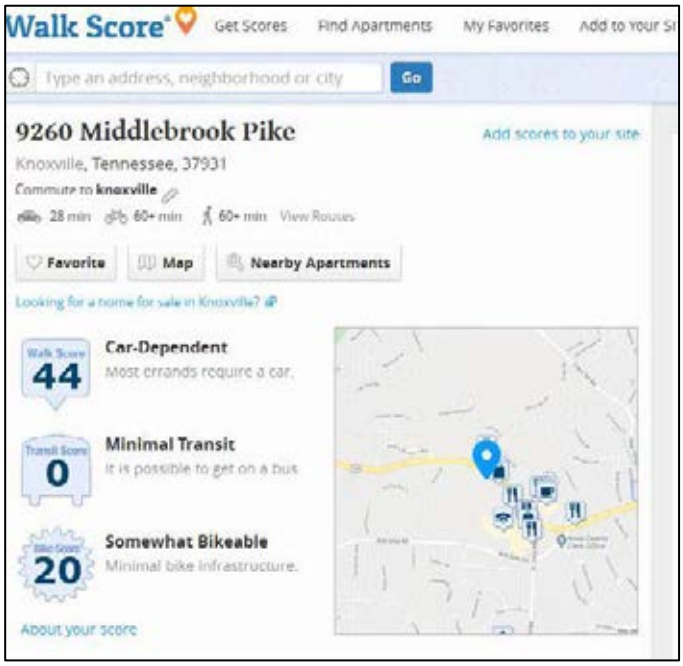
Location of Nicholas Ball Park



Pedestrian and Bicycle Crashes in Study Area

The Knoxville Regional Transportation Planning Organization (TPO) provided a 2020 update to bicycle and pedestrian crash data for Knox County and a few other surrounding counties. According to the data, two of these incidents occurred within the vicinity of the study area. A bicycle crash was reported in December 2018, to the west of the project site, at the intersection of Middlebrook Pike at Walden Legacy Way. This incident resulted in an injury, and the crash factor was identified as a motorist failing to yield. To the east of the project site, a pedestrian incident occurred in August 2013. This incident resulted in an injury, but there was not enough information to determine a cause. This incident occurred on the westbound lanes of Middlebrook Pike to the east of Frederick Drive.

- **WALK SCORE:**



A private company offers an online website at walkscore.com that grades and gives scores to locations within the United States based on "walkability", "bikeability", and transit availability. 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 Transit Score measures how well a location is served by public transit based on distance and type of nearby transit. The Transit Score is also graded from 0 to 100.

Appendix B shows maps and other information for the Walk Score, Bike Score, and Transit Score at the approximate property site address (9260 Middlebrook Pike). The project location is graded with a Walk Score of 44, indicating that most errands require a car. The site is graded with a Bike Score of 20, which means there is minimal bike infrastructure but is somewhat bikeable. The site is not given a transit score. The furthest possible sidewalk travel provided at this location on Middlebrook Pike would allow pedestrians to walk 2.1 miles to the west, just past Ball Camp-Byington Road at Hardin Valley Road. The sidewalk system would allow pedestrians to walk to South Northshore Drive near I-140, over 7 miles to the south.

- **TRANSIT SERVICES:**

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available in this area. The overall KAT bus system map is in Appendix C. The closest public transit bus service is 1.3 miles away to the south at the intersection of North Cedar Bluff Road at Fox Lonas Road and is Route 16, "Cedar Bluff Connector". It operates on weekdays and weekends, and this route map is also included in Appendix C. Other transit services include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC), which provides transportation services when requested.

PROJECT DESCRIPTION

- **LOCATION AND SITE PLAN:**

The proposed plan layout with a maximum of 120 apartments is given by Silvus Engineering and shown in Figure 3. As shown in the figure, one new driveway will be constructed for the development, and access at Middlebrook Pike will share access with the Dollar General Driveway (Rear). The total length of the driveway entrance and parking lot aisleways will be approximately 1,859 feet (0.35 miles). The driveway and internal aisleways will have a width of 26 feet. This existing entrance is approximately 500 feet to the east of the existing Andes Road/Church Driveway intersection and 430 feet to the west of the existing Frederick Drive/Dollar General Driveway (Main) intersection.

The current plan shown in Figure 3 shows four large buildings containing 120 apartment units. Three of the large buildings will contain the apartment units, and the other building will be a clubhouse constructed for numerous uses for the residents. These uses include an exercise room, conference room, and mail center. It will also contain the development leasing office. A smaller building behind the clubhouse will be for the property and swimming pool maintenance. The three buildings containing the apartment units will include one-bedroom and two-bedroom apartments. The unit breakdown is the following:

Building	1 BR	2 BR
1	24	16
2	24	16
3	24	16
Totals	**72**	**48**

A total of 193 parking spaces will be provided in several internal parking lots and will include the appropriate number of ADA accessible parking spaces. Five and six and a half-foot concrete sidewalks are proposed internally for this development.

Due to the existing topography and property constraints, several retaining walls will be constructed for the development, and the entrance driveway will have a significant road grade (14%). An existing 250′ powerline easement bisects the east portion of the property. No structures will be constructed within this easement except for at-grade parking lots.

Middlebrook Pike at Proposed Apartment Driveway/Dollar General Driveway (Rear)

As mentioned previously, the Proposed Apartment Driveway will occur at a location where a center median opening is not available. TDOT has previously stated that a median opening at this location will not be allowed. The proposed driveway will share the existing wide entrance for the Dollar General Market. Currently, any westbound traffic on Middlebrook Pike that wants to enter the Dollar General rear driveway must travel further to the west on Middlebrook Pike and complete a U-turn at Andes Road/Church Driveway. Without a center median opening on Middlebrook Pike, the apartment residents will have to complete the same U-turn maneuver to enter.

The schedule for completion of this new residential development is dependent on economic factors and construction timelines. This project is also contingent on permitting, design, and other issues. However, for this study, it was assumed that the total construction build-out of the development and full occupancy would occur within the next two years (2023).

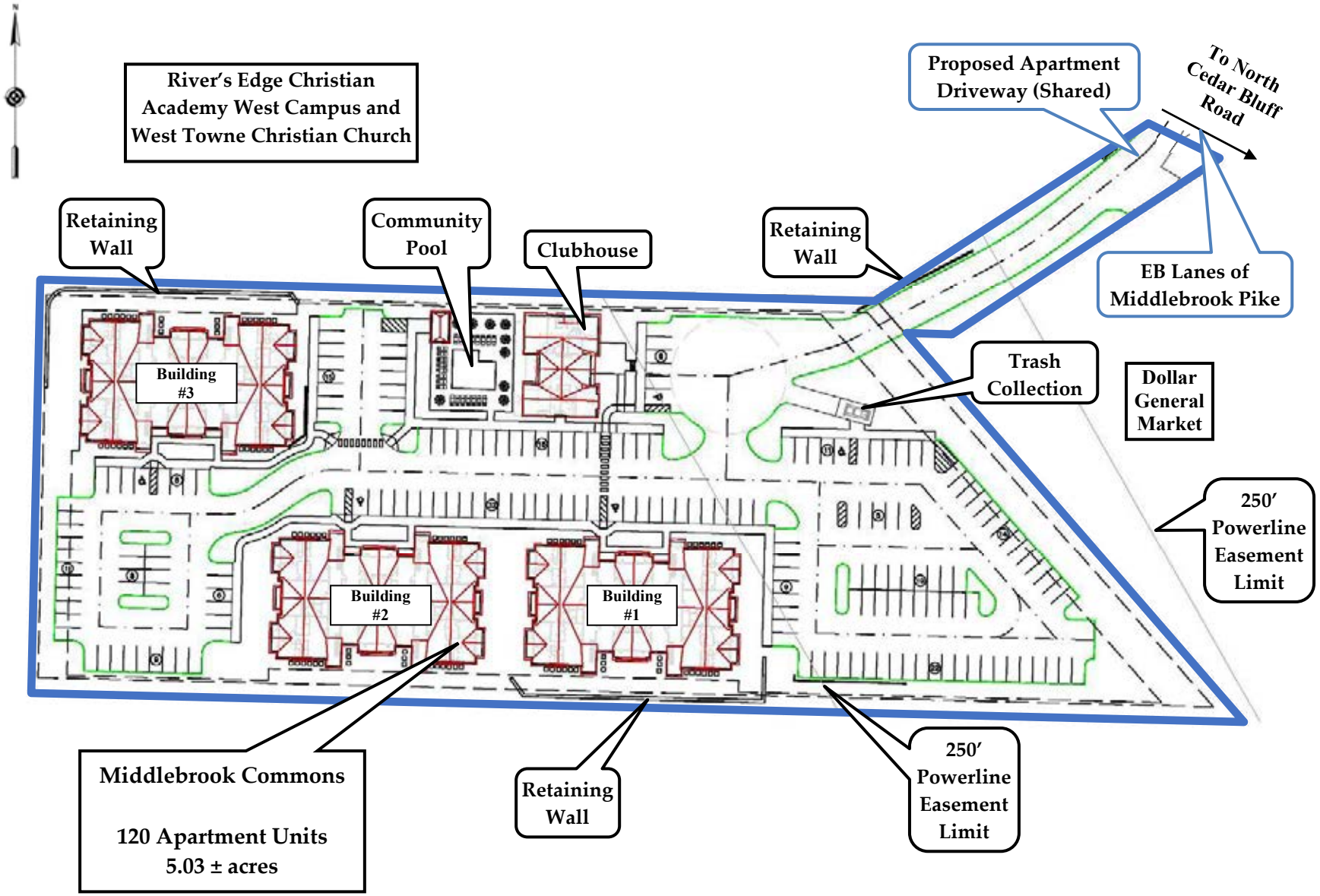


Figure 3
Proposed Plan Layout
Middlebrook Commons

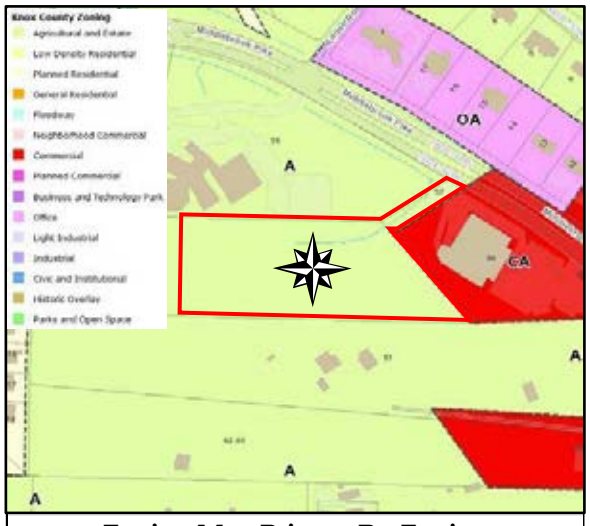
Not to Scale

- **PROPOSED USES AND ZONING REQUIREMENTS:**

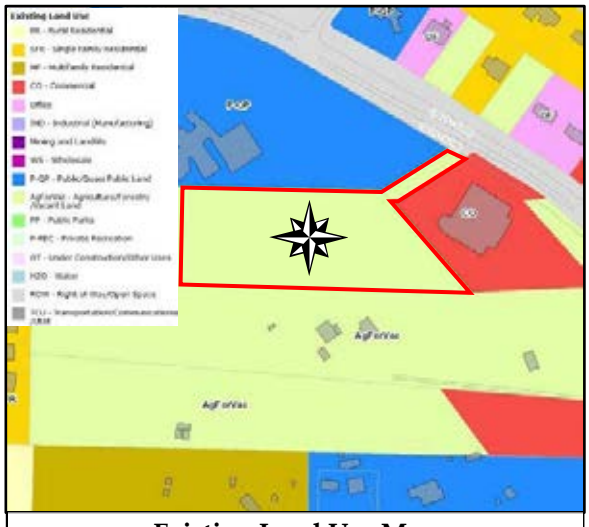
The development property parcel was recently requested to be rezoned from Agricultural (A) to Office (O)/Hillside Protection (HP)/Office, Medical, and Related Services (OB). The most recent published KGIS zoning map is provided in Appendix D. As stated by Knoxville/Knox County Planning, the property rezoning to Office (O) / Hillside Protection (HP) "provides a transitional land use designation between the commercial area and the adjacent low density residential uses". The Office, Medical, and Related Services (OB) zone "provides a transition zone to buffer the low density residential uses from the commercial zoning".

The existing adjacent surrounding zoning and land uses are the following:

- All the properties to the north, west, and south are in the Agricultural (A) zone. The property to the north and northwest consists of a combined campus for a private Christian school and church and consists of several buildings and parking lots. The private school is River's Edge Christian Academy West Campus, and the church is West Towne Christian Church. The single property to the west is undeveloped, forested, and owned by the church. The property to the south is forested and is occupied by a cell tower, a single-family home, and outbuildings on one parcel.
- A single property is zoned as Commercial (CA) and consists of the Dollar General Market to the east. The Dollar General Market is a single building with a parking lot and a truck dock loading area on the northeast side.



Zoning Map Prior to Re-Zoning



Existing Land Use Map

- **DEVELOPMENT DENSITY:**

Middlebrook Commons' proposed density is based on a maximum of 120 apartments on 5.03 acres. The density computes to 24 dwelling units per acre.

- **ON-SITE CIRCULATION:**

The total length of the driveway and parking lot aisleways will be approximately 1,859 feet (0.35 miles) and designed and constructed to Knox County, TN specifications. The internal drive and aisleways will be asphalt paved and include 6" concrete curbs. The lane widths will be 13 feet each for a total 26-foot pavement driveway and parking lot aisle width. Five and six and a half-foot concrete sidewalks are being proposed internally along the parking lot aisleways. The driveway entrance and aisleways will be private and will be maintained in the future by the development.

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

Besides residential passenger vehicles, the apartment driveway will also provide access for service, delivery, maintenance, and fire protection/rescue vehicles. None of these other types of vehicles will impact roadway operations other than when they occasionally enter and exit the development. A trash collection area is designed for the apartment residents at the front of the development complex. A concrete pad is shown in front of the trash collection areas to provide heavy-duty pavement to resist surface damage. The new driveway and parking lot aisleways will be designed and constructed to Knox County specifications and are expected to be adequate for fire protection and rescue vehicles. The development's internal drive is anticipated to accommodate the larger vehicle types and residents' standard passenger vehicles.

A large-paved area, 80 feet in diameter, will be constructed on the south end of the entrance driveway in front of a controlled access gate. This large-paved area will allow vehicles to turn around before the gate. Knox County recommends a turn-around area of this size in front of controlled access gates in private developments.

TRAFFIC ANALYSIS OF EXISTING AND PROJECTED CONDITIONS

EXISTING TRAFFIC CONDITIONS:

Over the past year and a half, the Covid-19 pandemic has not only closed schools and eliminated school-related traffic, but overall general traffic has been affected due to stay-at-home orders, work layoffs, job furloughs, and general anxiety with travel outside the home. More recently, while overall travel has noticeably increased and returned closer to pre-pandemic levels in the area, there is still a potential reduction in overall travel due to the pandemic. This reduction can be attributed to some school-age children and families choosing to learn virtually online and due to professions and jobs that have transitioned to at-home work for the time being. Knox County Planning compiled traffic count data during the Fall of 2020 and determined that overall traffic volumes were reduced compared to pre-pandemic Fall 2019. A few of the Fall 2020 traffic counts compiled by Knox County Planning showed slight increases in growth over the past year, but most counts showed decreases ranging from 5% up to 30%. More recent counts and comparisons have not been conducted.

For this study, traffic counts were conducted at the existing unsignalized intersections of Middlebrook Pike at Andes Road/Church Driveway, Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main), and Middlebrook Pike at Dollar General Driveway (Rear) as requested. An abbreviated traffic count was also conducted at the intersection of Middlebrook Pike at Grassy Meadow Boulevard, as shown in Figure 2. The reasoning for conducting this other traffic count is discussed in Trip Distribution and Assignment later in the report.

Manual traffic counts were obtained on Wednesday, April 21st, 2021, for a total of eight hours at the intersection of Middlebrook Pike at Andes Road/Church Driveway and Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main). The Middlebrook Pike at Dollar General Driveway (Rear) was counted for 6 hours. The counts were conducted to tabulate the morning and afternoon peak periods. Local county public schools were in session when the traffic counts were conducted. Based on the traffic volumes counted, the AM and PM peak hours of traffic were observed at 7:30 – 8:30 AM and 4:45 – 5:45 PM at all the intersections.

The manual tabulated traffic counts can be reviewed in Appendix E, and some observations are listed below.

- Many Knox County school buses were observed during the traffic counts on Middlebrook Pike. A Knox County school bus stop occurred in the morning and afternoon at the northwest corner of Middlebrook Pike at Frederick Drive for a handful of students. However, most of the traffic observed during the traffic counts were typical passenger vehicles with some large trucks and heavy vehicles. Large trucks and heavy vehicles were primarily observed in the thru movements on Middlebrook Pike, but a few were observed entering at Dollar General Driveway (Rear). One of the large Dollar General delivery trucks was observed making a U-turn at the intersection of Middlebrook Pike at Andes Road/Church Driveway. This U-turn maneuver briefly caused a backup for eastbound motorists on Middlebrook Pike. This large truck could not fully complete a U-turn in one movement due to the limited width of the roadway and the larger turning radius required by the truck.
- No bicyclists were observed during the traffic counts. A couple of pedestrians were observed eastbound and westbound on Middlebrook Pike, with the majority using the south side sidewalk.
- A fair number of U-turns were observed during the traffic counts at the intersections of Middlebrook Pike at Andes Road/Church Driveway and Frederick Drive/Dollar General Driveway (Main). It was observed that most of these U-turns were being completed by motorists entering and exiting the businesses on the north side of Middlebrook Pike that do not have a median opening at their entrances.
- There was a fair amount of traffic generated by the church/private school at the intersection of Middlebrook Pike at Andes Road/Church Driveway. The generated AM peak traffic from these entities coincided with the adjacent Middlebrook Pike AM peak rush hour. Due to the earlier daily school dismissal (1:30-1:45 PM), the church/private school contributed very little traffic during the adjacent Middlebrook PM peak hour.
- During the AM peak hour, the Dollar General Market generated little traffic. It was substantially increased during the afternoon rush hours.
- The Dollar General Driveway (Rear) had very few vehicles entering and exiting. No vehicles were observed exiting, and a total of 15 vehicles were observed entering (eastbound right turn) during the 6-hour count. The few large trucks that entered this driveway all exited at the Dollar General Driveway (Main).

As discussed, Knox County Planning has determined that traffic volumes in the area are still potentially reduced due to the ongoing pandemic. At the direction of Knox County Planning, to account for potentially reduced traffic volumes due to the pandemic, this study also includes

analyses with the raw tabulated traffic volumes increased by 20%. This percentage is an average value based on the local area sampling of traffic volumes comparing Fall 2019 traffic volumes with the Fall 2020 traffic volumes. Figure 4a shows the raw volumes from the existing traffic counts during the AM and PM peak hours observed at the studied intersections. Figure 4b shows the raw volumes from the existing traffic counts during the AM and PM peak hours observed at the studied intersections increased by 20%.

While Knox County Planning has requested that this report base the study on increasing the existing raw volumes by 20% to account for the pandemic, this study also provides results based on not increasing the existing volumes by 20%. It could be debated that increasing the raw traffic counts by 20% could overestimate the existing traffic conditions since local travel currently appears to have returned to pre-pandemic conditions. However, including a 20% increase would absorb and include trips generated in the projected conditions for a recently approved large residential subdivision to the north of the intersection of Middlebrook Pike at Andes Road that otherwise would not be accounted for in this analysis. This other development is briefly discussed further in the next section of the report.

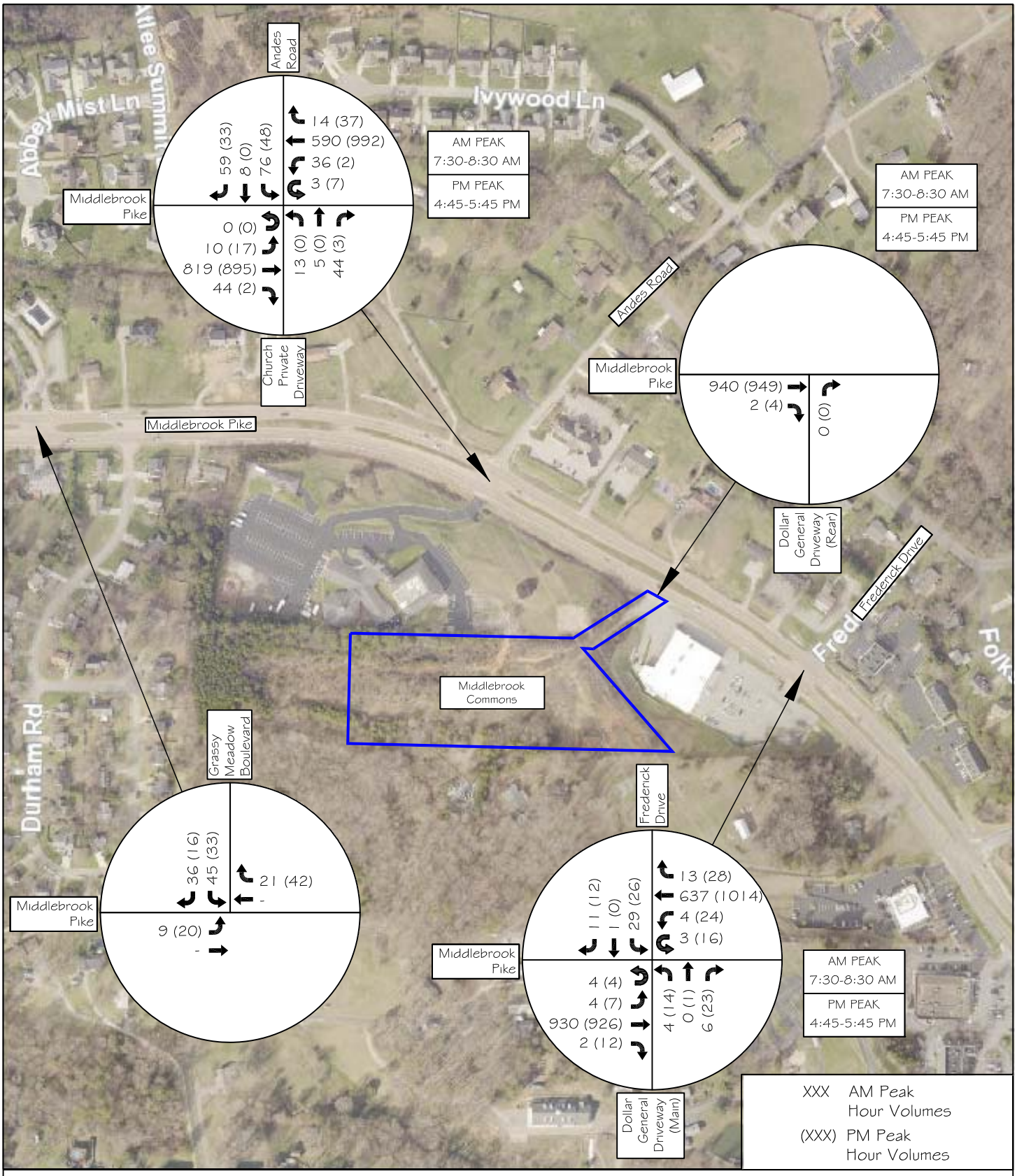


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FIGURE 4a

Middlebrook Commons

2021 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS

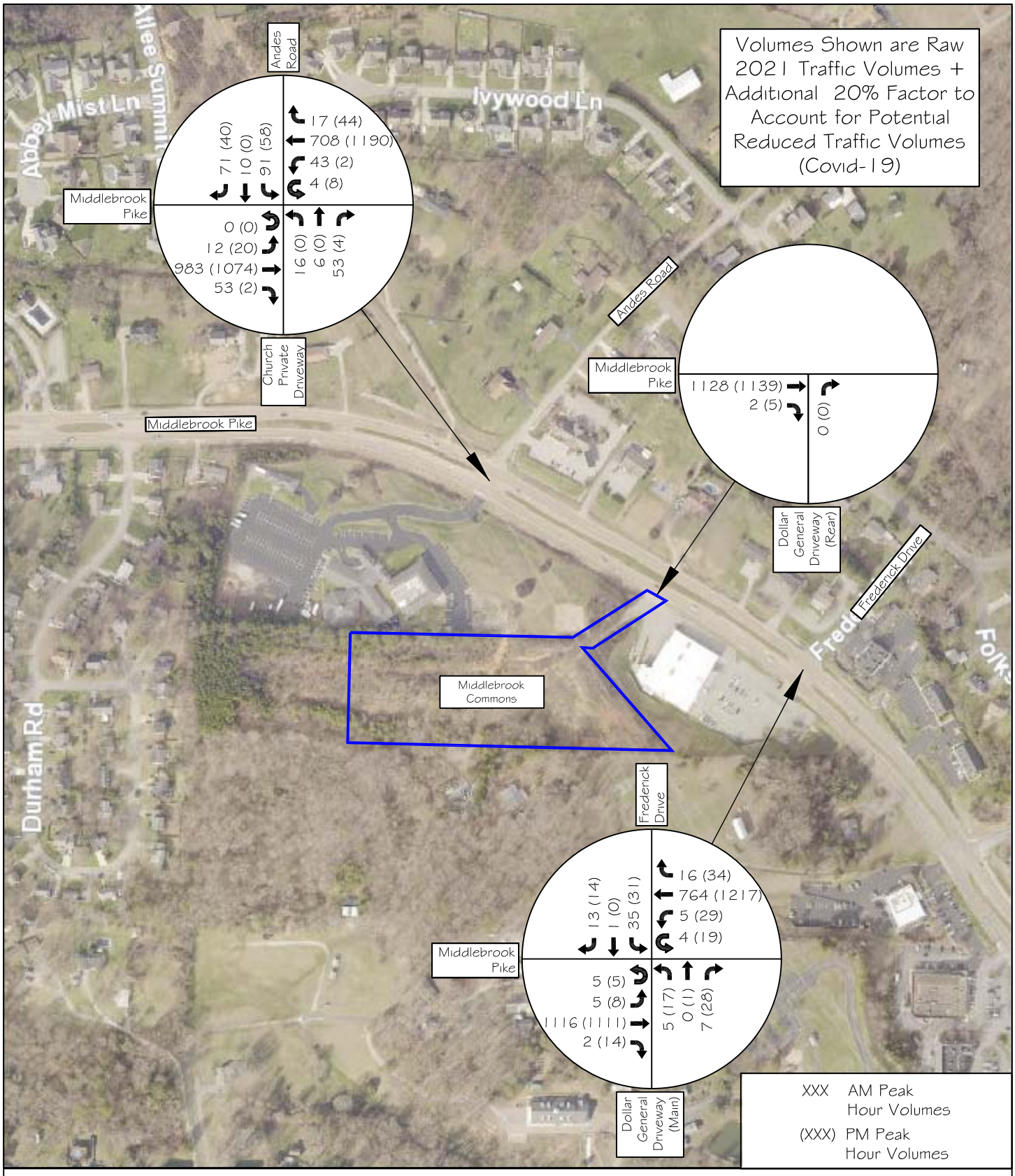

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FIGURE 4b

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2021 Peak Hour Traffic Volumes with 20% Factor Increase - EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the Level of Service (LOS) for the studied intersections for the existing year 2021 traffic volumes shown in Figure 4a and Figure 4b with a 20% increase. The capacity analyses were calculated by following the Highway Capacity Manual (HCM) methods and utilized Synchro Traffic Software (Version 8).

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). For example, a delay of 20 seconds at an unsignalized intersection would indicate LOS C. This delay represents 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 operates at 75% of its available capacity. LOS designations, which are based on delay, are reported differently for unsignalized and signalized intersections. This difference is primarily due to motorists having 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 that includes 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.

Capacity calculation results at the intersections from the existing peak hour traffic are shown in Tables 3a and 3b. Table 3a shows the results based on the existing raw tabulated traffic counts. Table 3b shows the results based on the existing raw tabulated traffic counts with a 20% increase. The intersections in the tables 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 from the capacity analyses for the existing peak hour vehicular traffic.

As seen in Tables 3a and 3b, all the traffic movements at the intersections are calculated to operate currently with average LOS and vehicle delays. The exception being the southbound approaches of Frederick Drive and Andes Road, which are calculated to currently operate with high vehicle delays in the AM and PM peak hours. When the existing raw traffic volumes are increased by 20%, the results indicate LOS F with intolerable vehicle delays for the southbound approach of Andes Road. The 20% increase also resulted in the northbound approach of Middlebrook Pike at Andes Road/Church Driveway in the AM peak hour being reduced to LOS E. The southbound approach of Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main) reaches LOS F with a 20% increase.

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

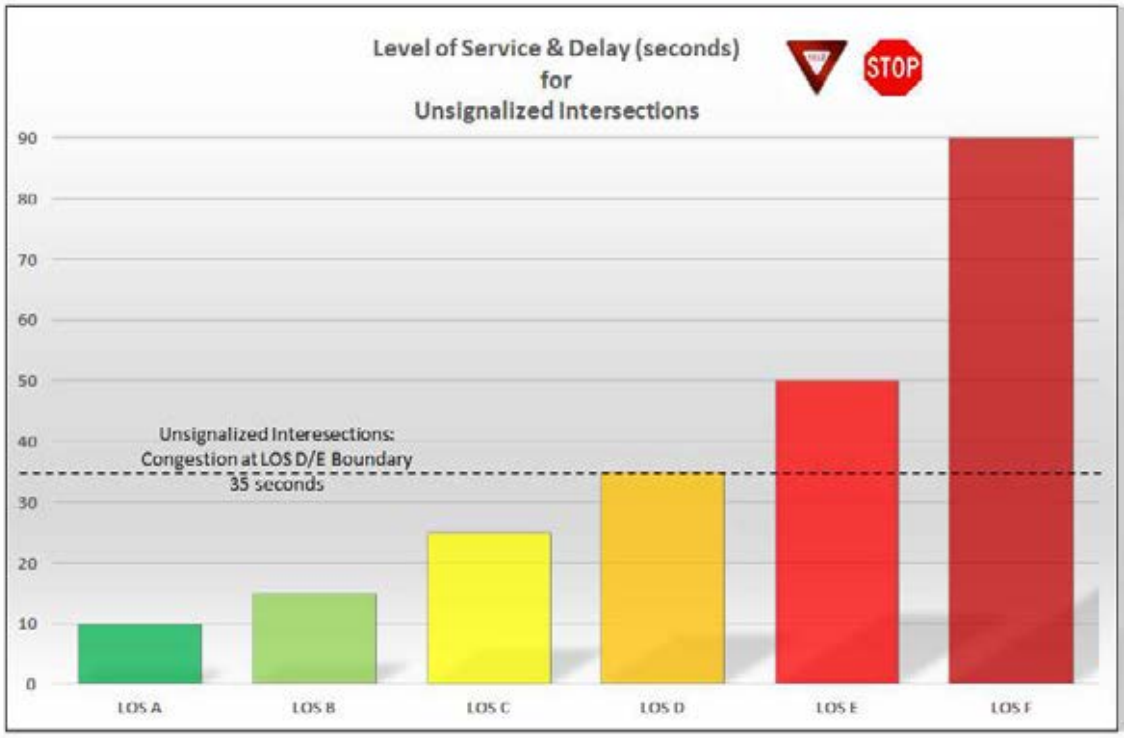


TABLE 3a
2021 INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.0	0.030	B	10.9	0.040
		Westbound Left/U-turn	B	10.7	0.090	A	10.0	0.010
		Northbound Left/Thru/Right	C	23.4	0.440	B	11.8	0.010
		Southbound Left/Thru/Right	F	53.0	0.750	D	31.3	0.430
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	8.9	0.010	B	10.9	0.010
		Westbound Left/U-turn	B	10.1	0.010	B	10.4	0.050
		Northbound Left/Thru/Right	C	17.9	0.050	C	23.7	0.230
		Southbound Left/Thru/Right	C	19.2	0.190	D	30.5	0.270
Middlebrook Pike at Dollar General Driveway (Rear)	STOP Unsignalized	Northbound Right	A	0.0	0.000	A	0.0	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

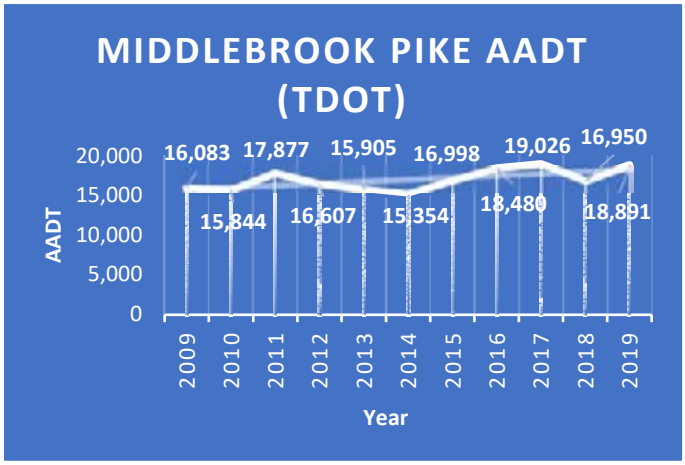
TABLE 3b
2021 INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS (+20%)

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.5	0.030	B	12.3	0.050
		Westbound Left/U-turn	B	12.2	0.130	B	10.9	0.010
		Northbound Left/Thru/Right	E	43.2	0.680	B	12.9	0.020
		Southbound Left/Thru/Right	F	240.6	1.340	F	60.5	0.680
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	9.4	0.010	B	12.3	0.020
		Westbound Left/U-turn	B	11.1	0.020	B	11.6	0.070
		Northbound Left/Thru/Right	C	22.4	0.090	D	33.9	0.350
		Southbound Left/Thru/Right	C	24.6	0.280	F	51.2	0.450
Middlebrook Pike at Dollar General Driveway (Rear)	STOP Unsignalized	Northbound Right	A	0.0	0.000	A	0.0	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

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

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



Vehicular traffic on Middlebrook Pike has shown moderate growth (1.6%) over the past few years, according to the permanent TDOT traffic count station and as shown in Appendix A. To conservatively account for potential traffic growth in the study area, an average annual growth rate of 2% was used to calculate future growth up to 2023 for the studied intersections. This growth rate was applied to the existing raw volumes, and also to the existing raw volumes increased by 20%. The results of this growth rate applied to the existing 2021 traffic volumes from Figure 4a (raw volumes) and Figure 4b (with 20% factor) are shown in Figures 5a and 5b. Figures 5a and 5b show the projected opening year traffic volumes at the studied intersections in 2023 during the AM and PM peak hours without the project.

As mentioned earlier, a large residential subdivision to the north of the intersection of Middlebrook Pike at Andes Road was recently approved by Knox County. This subdivision will include 170 single-family homes and be located approximately 1,200 feet to the north of Middlebrook Pike off Andes Road. The transportation impact study for this other development reported that this subdivision will generate 1,694 total daily trips and that 80% of these trips would be to and from the south via Middlebrook Pike. The study for the subdivision assumed that it would also be fully built and occupied by 2023. It is assumed that the required 20% increase to the existing raw tabulated volumes in this study would more than account for the trips generated by this other development.

Capacity analyses were conducted for the projected 2023 conditions at the intersections without

the project being developed. The results from the 2023 projected opening year traffic conditions (without the project) can be seen in Tables 4a and 4b for the intersections. The calculation worksheets are in Appendix F. It is important to point out that these projected calculated LOS designations for the intersections could exist in the future, even without the proposed apartment development being constructed and developed.

As expected, the 2023 projected conditions without the project resulted in similar outcomes obtained for the existing conditions. In the 2023 projected conditions without the project, the southbound approach of Andes Road will experience LOS F when not including a 20% increase. The northbound and southbound approaches of Andes Road, the Church Driveway, and Frederick Drive will operate at LOS F when a 20% increase is included. Also, the Dollar General Driveway (Main) will operate at LOS E in the PM peak hour.

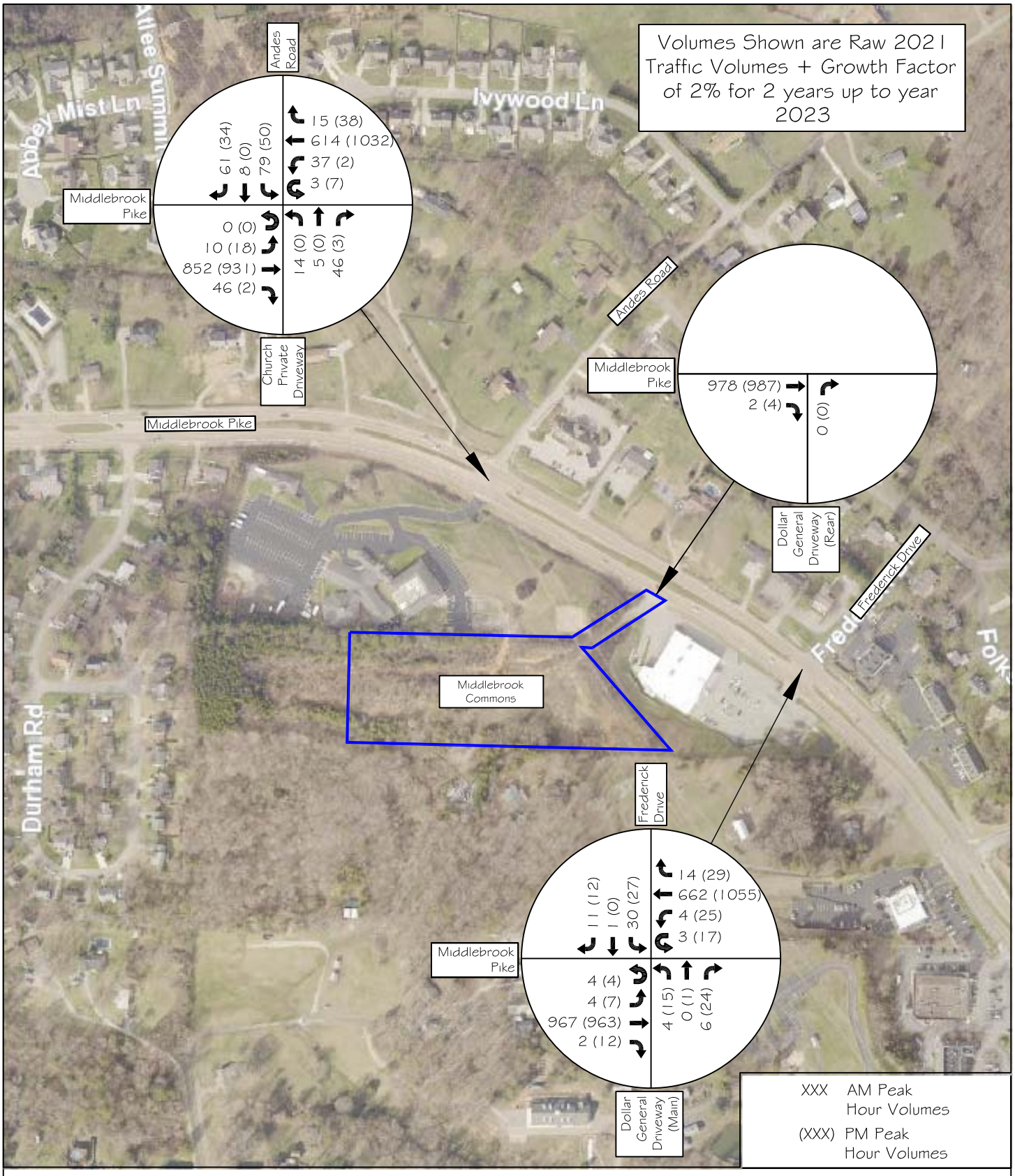


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FIGURE 5a

Middlebrook Commons

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

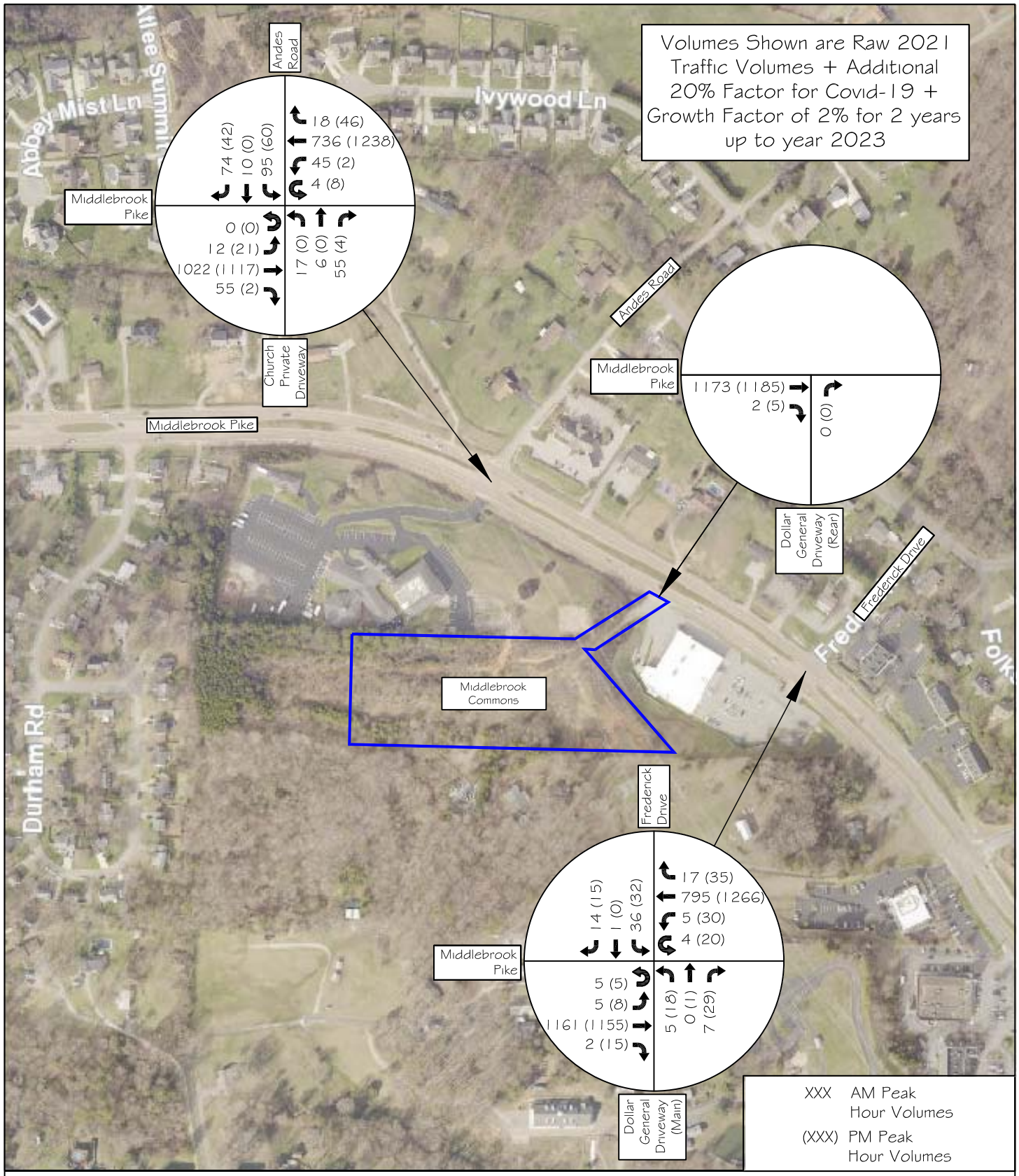

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FIGURE 5b

Middlebrook Commons

2023 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC +20% (WITHOUT THE PROJECT)

TABLE 4a
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITHOUT THE PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Middlebrook Pike at Andes Road / Church Driveway	Unsignalized	Eastbound Left/U-turn	A	9.1	0.030	B	11.2	0.040
		Westbound Left/U-turn	B	11.0	0.100	B	10.1	0.010
		Northbound Left/Thru/Right	D	25.8	0.480	B	12.0	0.020
		Southbound Left/Thru/Right	F	67.2	0.830	D	34.9	0.470
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	Unsignalized	Eastbound Left/U-turn	A	9.0	0.010	B	11.2	0.010
		Westbound Left/U-turn	B	10.3	0.010	B	10.6	0.030
		Northbound Left/Thru/Right	C	18.6	0.060	D	25.4	0.250
		Southbound Left/Thru/Right	C	20.0	0.200	D	33.6	0.300
Middlebrook Pike at Dollar General Driveway (Rear)	Unsignalized	Northbound Right	A	0.0	0.000	A	0.0	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

TABLE 4b
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITHOUT THE PROJECT +20%)

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]
Middlebrook Pike at Andes Road / Church Driveway	Unsignalized	Eastbound Left/U-turn	A	9.6	0.040	B	12.7	0.060
		Westbound Left/U-turn	B	12.6	0.140	B	11.1	0.010
		Northbound Left/Thru/Right	F	53.0	0.760	B	13.1	0.020
		Southbound Left/Thru/Right	F	332.5	1.550	F	74.2	0.760
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	Unsignalized	Eastbound Left/U-turn	A	9.5	0.010	B	12.7	0.020
		Westbound Left/U-turn	B	11.4	0.020	B	11.9	0.070
		Northbound Left/Thru/Right	C	23.6	0.090	E	37.9	0.400
		Southbound Left/Thru/Right	D	26.1	0.300	F	59.1	0.510
Middlebrook Pike at Dollar General Driveway (Rear)	Unsignalized	Northbound Right	A	0.0	0.000	A	0.0	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

- **TRIP GENERATION:**

The proposed development will construct a minimum of 90 or a maximum of 120 apartment units. To provide a range of potential traffic generated by the development, the remaining portion of the study will also provide the results based on constructing 90 and 120 apartment units with scenarios using the existing raw volumes versus increasing the existing raw volumes by 20%. The estimated amount of traffic generated by the proposed residential development was calculated based on local rates and equations for peak hour trips provided by Knoxville/Knox County Planning. A generated trip is a single or one-direction vehicle movement that enters or exits the study site. These equations were developed from local studies to estimate apartment trip generation in the surrounding area and were published in December 1999. The data and calculations from the local rates for the proposed apartment development are shown in Appendix G. A summary of this information is presented in the following tables. Table 5a presents the results for 90 apartments, and Table 5b is for 120 apartments.

TABLE 5a
TRIP GENERATION FOR MIDDLEBROOK COMMONS
90 Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Apartments	90 Apartments	868	22%	78%		55%	45%	
				11	38	49	39	32	71
Total New Volume Site Trips			**868**	**11**	**38**	**49**	**39**	**32**	**71**

Local Trip Rates
Trips calculated by using Fitted Curve Equation

For the proposed residential subdivision, with a minimum of 90 apartments, it is estimated that 11 vehicles will enter and 38 will exit, for a total of 49 generated trips during the AM Peak Hour in the year 2023. Similarly, it is estimated that 39 vehicles will enter and 32 will exit, for a total of 71 generated trips during the PM Peak Hour in the year 2023. The calculated trips generated for an average weekday are expected to be 868 vehicles for the proposed development with 90 apartments in 2023. No trip reductions were included in the analysis.

TABLE 5b
TRIP GENERATION FOR MIDDLEBROOK COMMONS
120 Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Apartments	120 Apartments	1,125	22%	78%		55%	45%	
				14	50	64	50	41	91
Total New Volume Site Trips			**1,125**	**14**	**50**	**64**	**50**	**41**	**91**

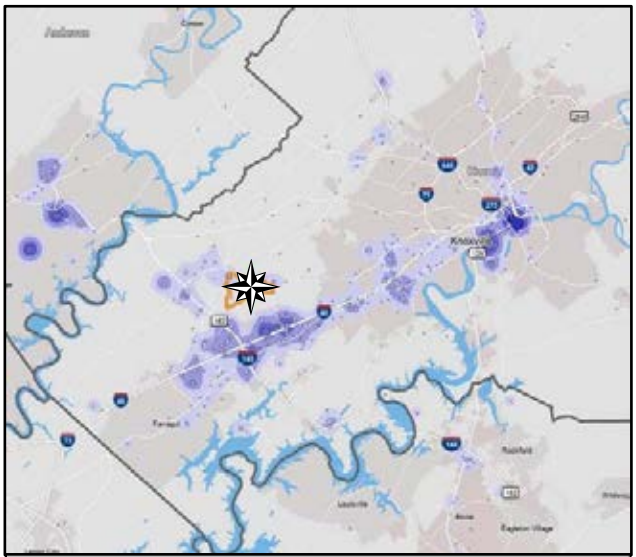
Local Trip Rates
Trips calculated by using Fitted Curve Equation

For the proposed residential subdivision, with a maximum of 120 apartments, it is estimated that 14 vehicles will enter and 50 will exit, for a total of 64 generated trips during the AM Peak Hour in the year 2023. Similarly, it is estimated that 50 vehicles will enter and 41 will exit, for a total of 91 generated trips during the PM Peak Hour in the year 2023. The calculated trips generated for an average weekday are expected to be 1,125 vehicles for the proposed development with 120 apartments in 2023. No trip reductions were included in the analysis.

- **TRIP DISTRIBUTION AND ASSIGNMENT:**

Figure 6 shows the projected distribution of traffic entering and exiting the proposed development. The percentages shown only pertain to the trips generated by the new proposed residential dwellings in the development calculated from the local trip rates and shown in Tables 5a and 5b.

The percentages assumed and shown in Figure 6 are based on several sources and factors. The first source is based on the traffic count results at the intersection of an existing adjacent similar land use. In addition to the previously discussed existing intersections, a brief traffic count during the AM and PM peak hours was conducted at the intersection of Middlebrook Pike at Grassy Meadow Boulevard. The tabulated results of this other count are shown in Figure 4a and Appendix E. Grassy Meadow Boulevard is the only road access for the Atlee Fields Subdivision. This subdivision has 165 single-family homes, has been established for many years, and is located just to the west of the proposed development on the north side of Middlebrook Pike. The turning movement counts and directions from this intersection were assumed to be a reasonable estimate for the proposed Middlebrook Commons travel patterns on Middlebrook Pike.



2018 Census Bureau Work-Based Trips to/from Census Tract 46.12

The second source for potential trip distribution is based on work-related trips in the area. Work-based trips will be a significant driver of generated trips by the development. These trips are more likely to travel to and from the east and southeast. This assertion is based on data from the United States Census Bureau website for Census Tract 46.12, where the development property is located. Based on 2018 (latest available) census data and shown in Appendix H, most work-based trips are to and from the east and southeast. Those trips correspond to the Cedar Bluff Corridor and travel further east towards downtown Knoxville.

In addition to employment centers and commercial developments, some traffic will travel to and from various public and private elementary, middle, and high schools. This site development property is currently zoned for Cedar Bluff Elementary and Middle School and Hardin Valley High School. The Cedar Bluff schools are to the south on North Cedar Bluff Road and are 1.2 miles away by roadway. Hardin Valley High School is located to the west, approximately 6 miles by roadway.

The Knox County Schools Transportation Department has developed Parental Responsibility Zones (PRZ) to determine whether a student is offered transportation services to and from school. According to the Knox County School system, the PRZ is defined as 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 busses unload at the school. This proposed development will be outside the PRZ for the elementary, middle, and high schools. Any school-age children in the apartments will be eligible for school bus transportation based on these distance limits.

Overall, the study used a 65%/35% split on Middlebrook Pike, with 65% of trips assumed to and from the east on Middlebrook Pike and 35% of trips to and from the west on Middlebrook Pike I the AM and PM peak hours. Due to the lack of an available median opening on Middlebrook Pike, many trips generated by the apartments will have to complete U-turns to enter and exit the development.

Figures 7a and 7b show the Traffic Assignment of the computed trips generated by the development (from Tables 5a and 5b) and applying the intersection movement volumes based on the assumed distribution of trips shown in Figure 6. Figure 7a shows the distribution of generated trips for 90 apartment units, and Figure 7b shows the trips for 120 apartment units.

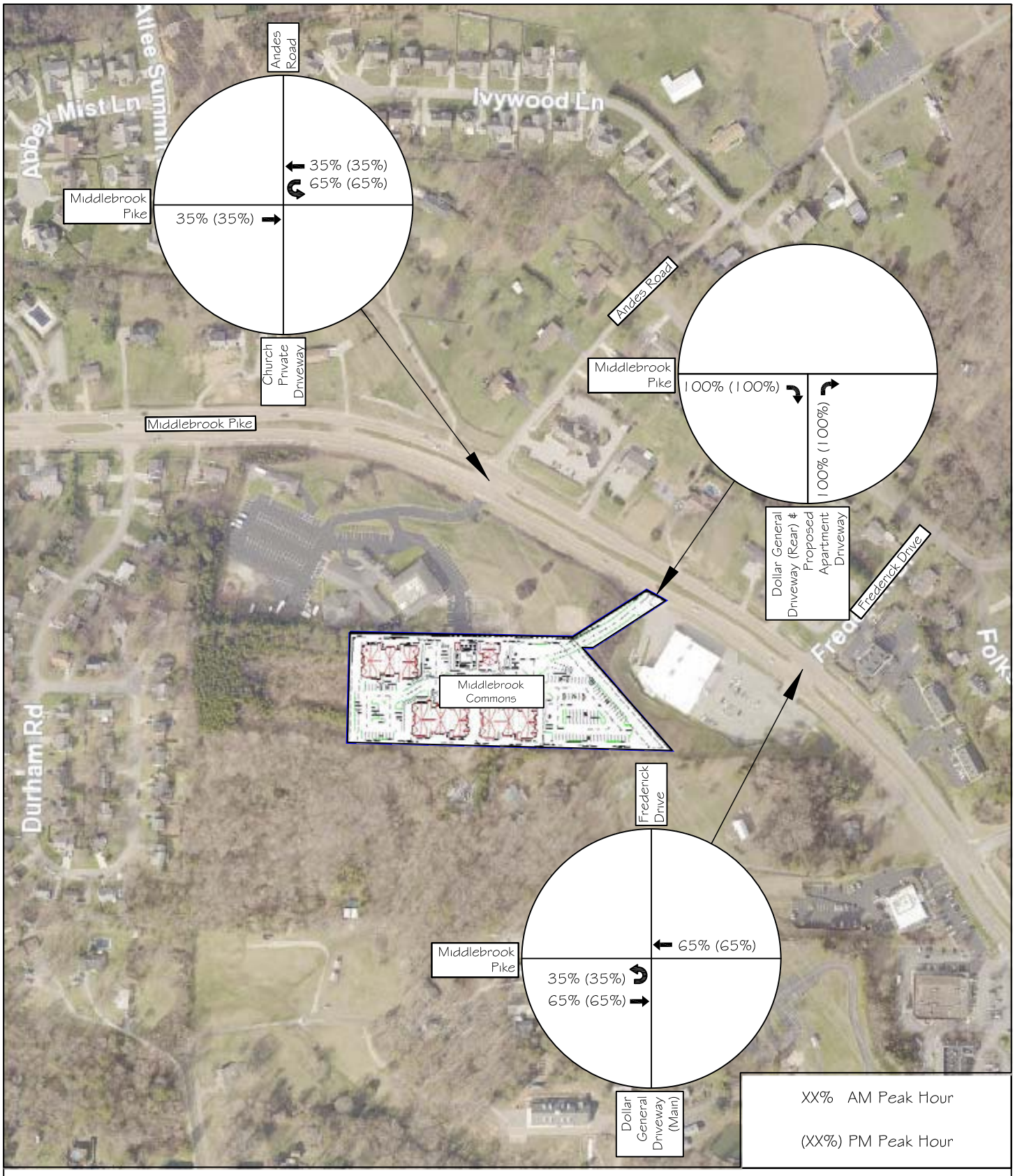


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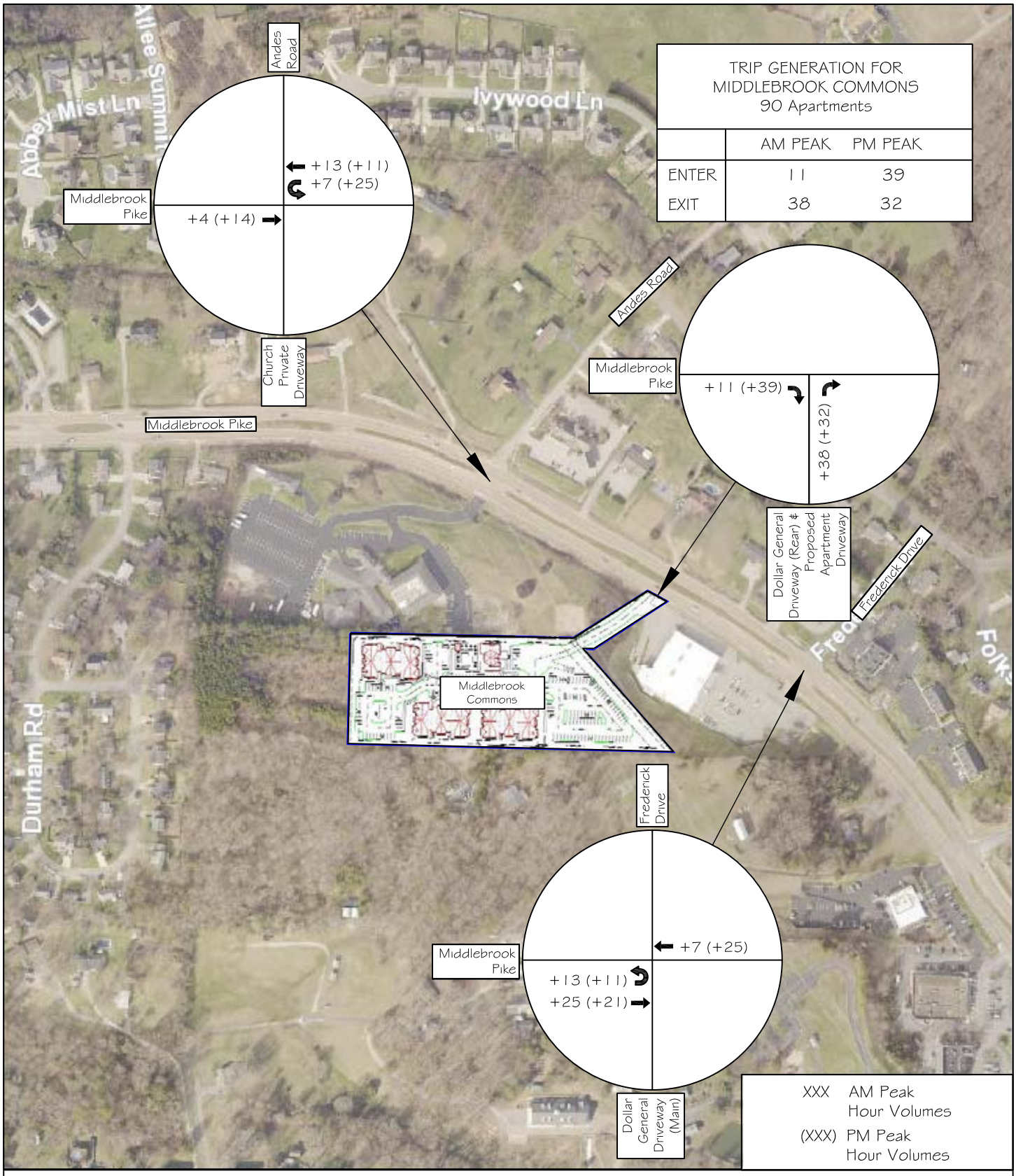
FIGURE 6

Middlebrook Commons

Directional Distribution of Generated Traffic during AM and PM Peak Hour



TRIP GENERATION FOR
MIDDLEBROOK COMMONS
90 Apartments

	AM PEAK	PM PEAK
ENTER	11	39
EXIT	38	32

XXX AM Peak Hour Volumes

(XXX) PM Peak Hour Volumes

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FIGURE 7a

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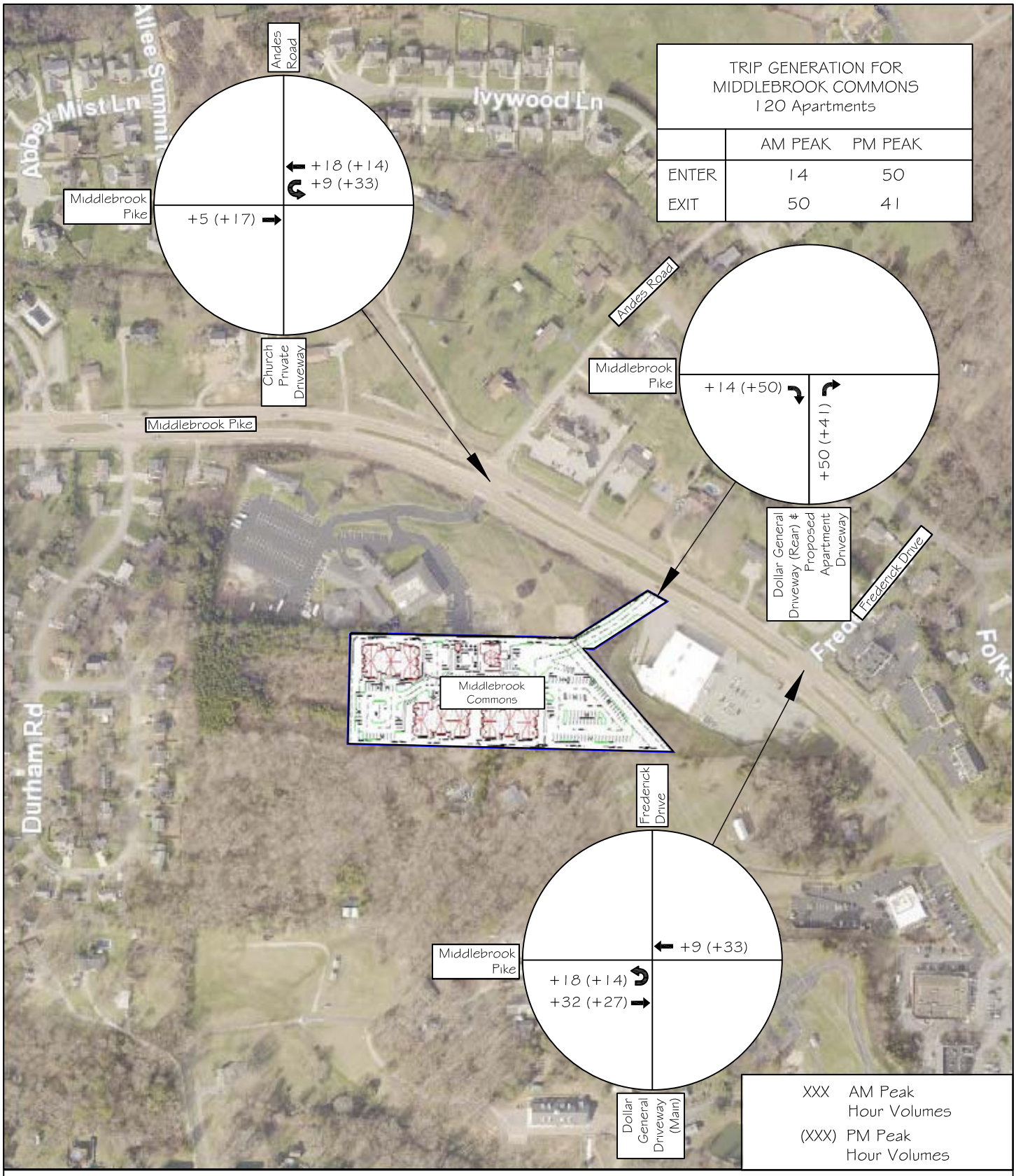
Traffic Assignment of Generated Traffic during AM and PM Peak Hour - 90 Apartments



TRIP GENERATION FOR MIDDLEBROOK COMMONS
120 Apartments

	AM PEAK	PM PEAK
ENTER	14	50
EXIT	50	41

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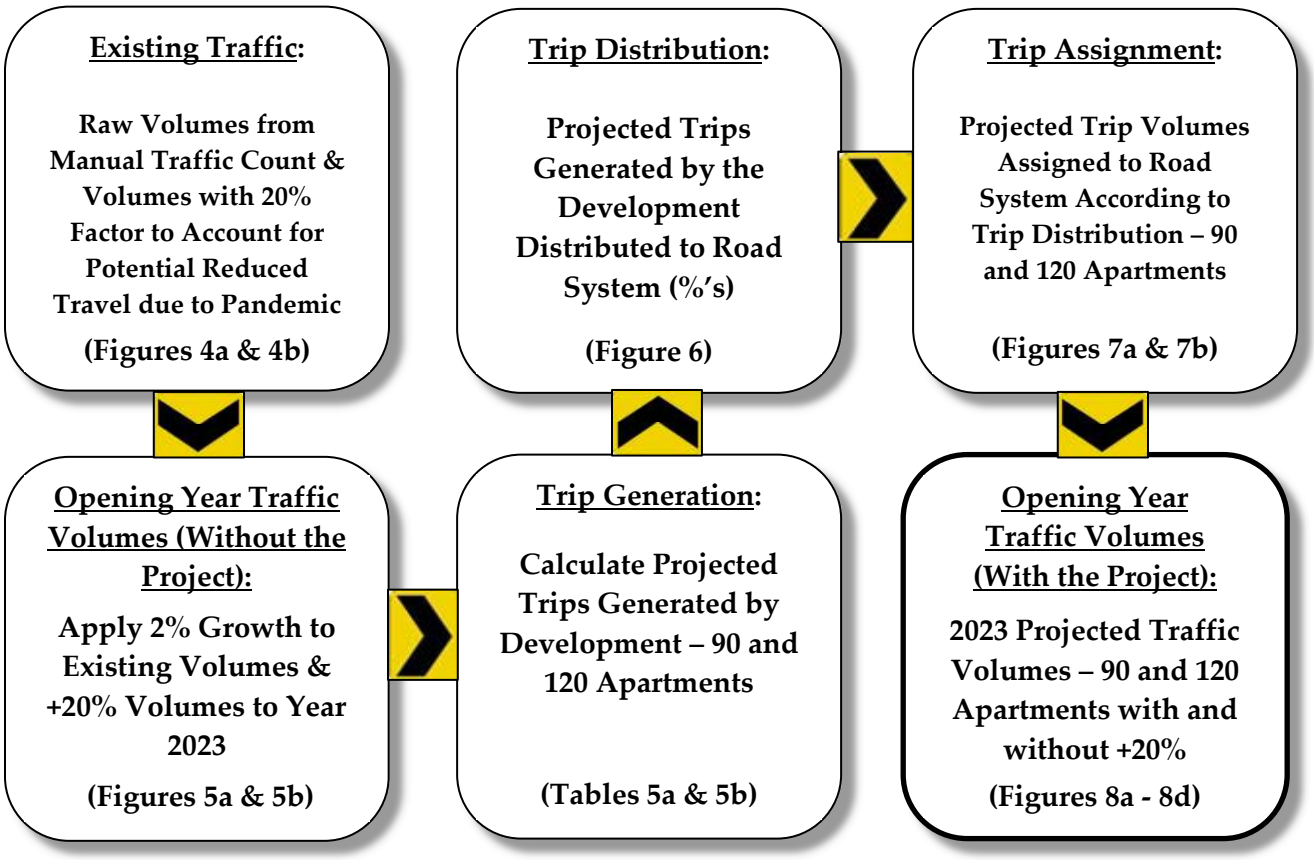
FIGURE 7b

Middlebrook Commons

Traffic Assignment of Generated Traffic during AM and PM Peak Hour - 120 Apartments

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

Overall, several additive steps were taken to estimate the total opening year projected traffic volumes at the studied intersections when Middlebrook Commons is entirely constructed and occupied by 2023. The steps are illustrated below for clarity:



To calculate the total future projected traffic volumes at the studied intersections, the calculated peak hour traffic volumes for 90 and 120 apartments (from the local trip generation rate study) generated by Middlebrook Commons was added to the 2023 opening year traffic volumes (Figures 5a & 5b) by following the predicted directional distributions and assignments (Figures 6 and 7a & 7b). This procedure was completed to obtain the total projected traffic volumes when the development is fully built-out and occupied in 2023. Figures 8a - 8d show the projected AM and PM peak hour volumes at the studied intersections for 2023 with the development traffic. Figures 8a and 8b show the projected 2023 peak hour volumes for 90 and 120 apartments without increasing the existing raw volumes by 20%. Figures 8c and 8d show the projected 2023 peak hour volumes for 90 and 120 apartments based on increasing the existing raw volumes by 20%.

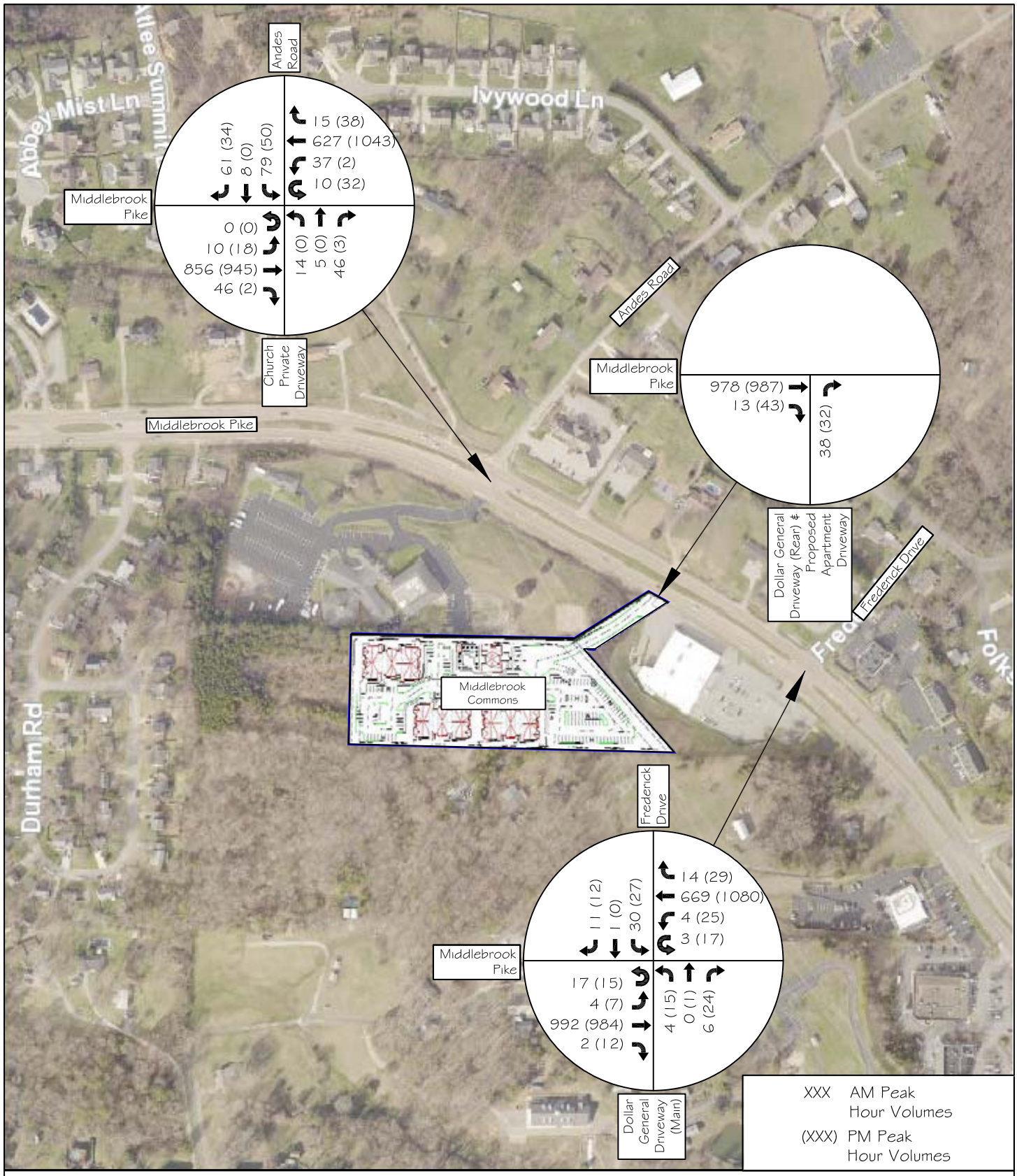


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FIGURE 8a

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2023 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITH THE PROJECT - 90 Apartments)

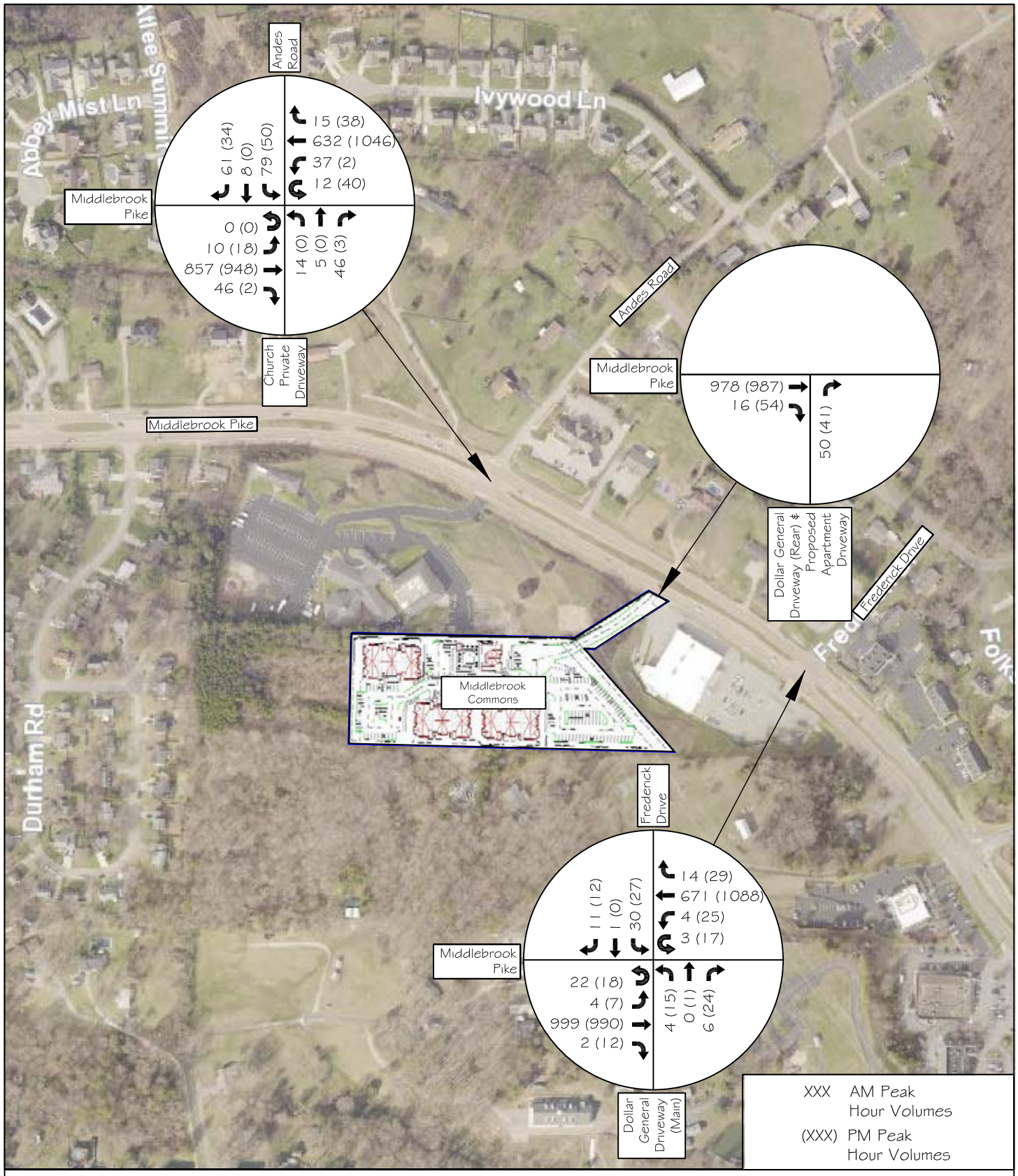

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FIGURE 8b

Middlebrook Commons

2023 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITH THE PROJECT - 120 Apartments)

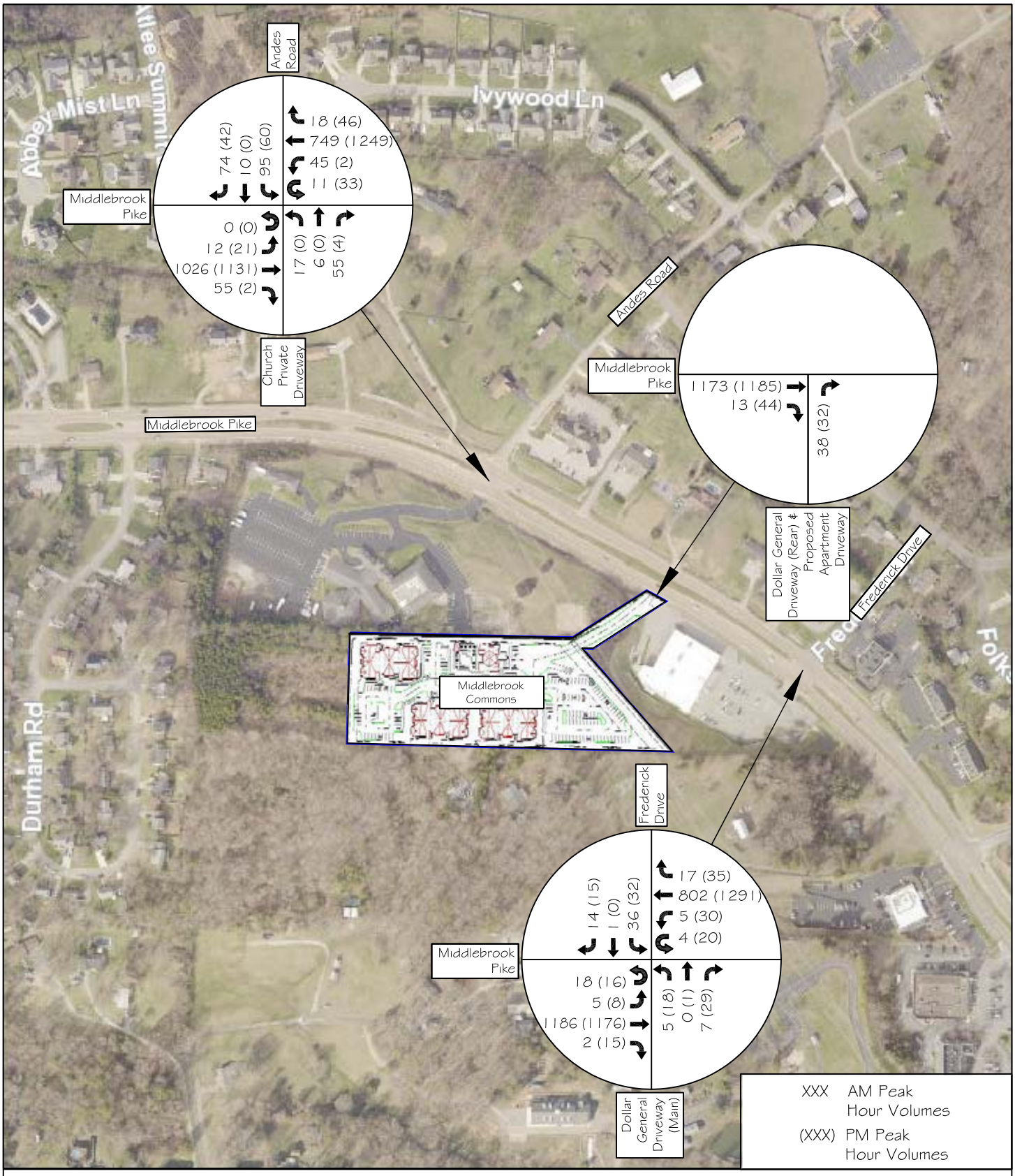

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FIGURE 8c

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2023 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC +20% (WITH THE PROJECT - 90 Apartments)

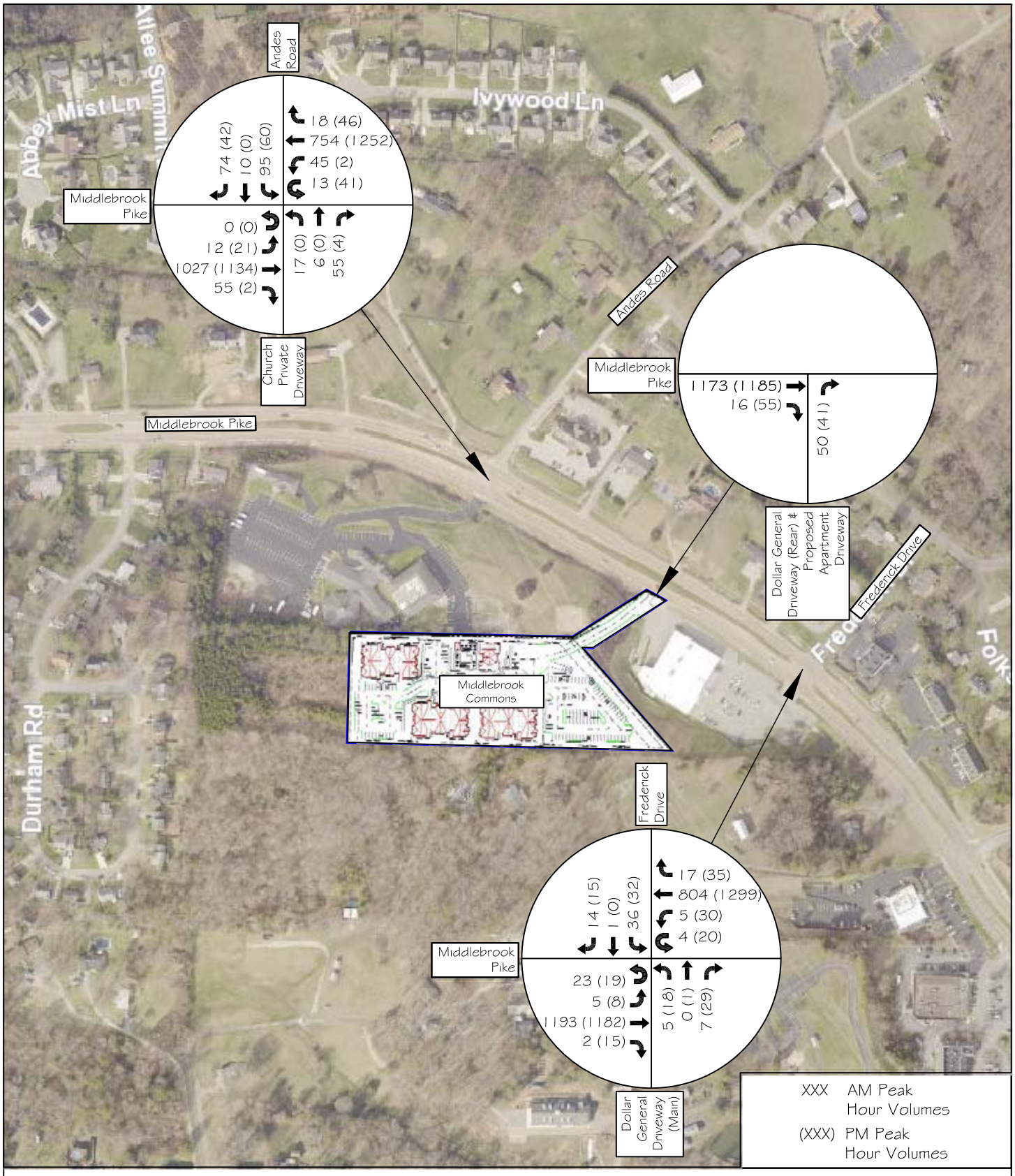

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FIGURE 8d

Middlebrook Commons

2023 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC +20% (WITH THE PROJECT - 120 Apartments)

Capacity analyses were conducted to determine the projected Level of Service for vehicles at the studied intersections with the development traffic in the year 2023. Appendix F includes the worksheets for these capacity analyses. As expected, the additional traffic generated from the proposed apartment development increased the calculated vehicle delays at the intersections but minimally did so. Furthermore, the additional traffic generated from the proposed apartment development with 120 apartments did not appreciably increase the calculated vehicle delays at the intersections compared with only 90 apartments.

The projected 2023 peak hour vehicular traffic results at the studied intersections can be seen in Tables 6a – 6d for the AM and PM peak hours. Tables 6a and 6b report the results for the AM and PM peak hours in the projected 2023 conditions with 90 and 120 apartments, respectively, without a 20% increase due to the pandemic. Tables 6c and 6d report the results for the AM and PM peak hours in the projected 2023 conditions with 90 and 120 apartments, respectively, with a 20% increase due to the pandemic. These results are reported with the inclusion of the Proposed Apartment Driveway at the Dollar General Driveway (Rear), which will become a shared driveway in the future conditions.

A summary of the Middlebrook Pike at Andes Road/Church Driveway, Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main), and Middlebrook Pike at Dollar General Driveway (Rear) intersection analysis results are presented in Tables 7a – 7f. These tables and graphs are presented to compare the different results of 90 versus 120 apartments and increasing versus not increasing the existing raw tabulated traffic volumes by 20%. Graphs follow the tables highlighting the LOS results. The tables provide a side-by-side summary and comparison of the intersections for 2021 existing conditions, projected conditions in the year 2023 without the project, and projected conditions in the year 2023 with the project.

Tables 7a – 7c provide a side-by-side summary of the three studied intersections for the project with 90 and 120 apartments without a 20% increase of the existing raw tabulated volumes. Tables 7d – 7f provide a side-by-side summary of the three intersections for the project with 90 and 120 apartments with a 20% increase of the existing raw tabulated volumes.

Overall, the development with 90 or 120 apartments did not appreciably impact the vehicle delays at the intersections. The northbound and southbound approaches at the intersections are currently experiencing considerable vehicle delays. The proposed apartment development is shown to increase the vehicle delays only slightly at the intersections.

TABLE 6a
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITH THE PROJECT - 90 APARTMENTS)

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.1	0.030	B	11.2	0.040
		Westbound Left/U-turn	B	11.0	0.100	B	10.2	0.010
		Northbound Left/Thru/Right	D	26.1	0.490	B	12.0	0.020
		Southbound Left/Thru/Right	F	69.9	0.840	E	35.7	0.480
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	9.0	0.010	B	11.3	0.010
		Westbound Left/U-turn	B	10.4	0.010	B	10.8	0.050
		Northbound Left/Thru/Right	C	19.0	0.060	D	26.3	0.260
		Southbound Left/Thru/Right	C	20.4	0.210	E	35.0	0.310
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway	STOP Unsignalized	Northbound Right	B	13.1	0.090	B	13.6	0.080

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

TABLE 6b
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITH THE PROJECT - 120 APARTMENTS)

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.1	0.030	B	11.3	0.040
		Westbound Left/U-turn	B	11.0	0.100	B	10.2	0.010
		Northbound Left/Thru/Right	D	26.2	0.490	B	12.1	0.020
		Southbound Left/Thru/Right	F	70.8	0.850	E	35.9	0.480
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	9.0	0.010	B	11.4	0.010
		Westbound Left/U-turn	B	10.5	0.010	B	10.8	0.050
		Northbound Left/Thru/Right	C	19.1	0.060	D	26.5	0.260
		Southbound Left/Thru/Right	C	20.5	0.210	E	35.5	0.310
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway	STOP Unsignalized	Northbound Right	B	13.4	0.110	B	14.1	0.100

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

TABLE 6c
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITH THE PROJECT - 90 Apartments +20%)

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.7	0.040	B	12.8	0.060
		Westbound Left/U-turn	B	12.6	0.150	B	11.2	0.010
		Northbound Left/Thru/Right	F	54.2	0.760	B	13.2	0.020
		Southbound Left/Thru/Right	F	342.6	1.580	F	77.0	0.770
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	9.6	0.010	B	12.9	0.020
		Westbound Left/U-turn	B	11.5	0.020	B	12.1	0.070
		Northbound Left/Thru/Right	C	24.2	0.090	E	39.5	0.410
		Southbound Left/Thru/Right	D	26.6	0.310	F	62.8	0.520
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway	STOP Unsignalized	Northbound Right	B	14.6	0.100	C	15.3	0.090

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

TABLE 6d
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITH THE PROJECT - 120 Apartments +20%)

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]
Middlebrook Pike at Andes Road / Church Driveway	STOP Unsignalized	Eastbound Left/U-turn	A	9.7	0.040	B	12.8	0.060
		Westbound Left/U-turn	B	12.6	0.150	B	11.2	0.010
		Northbound Left/Thru/Right	F	54.5	0.760	B	13.3	0.020
		Southbound Left/Thru/Right	F	346.1	1.580	F	77.8	0.770
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	STOP Unsignalized	Eastbound Left/U-turn	A	9.6	0.010	B	12.9	0.020
		Westbound Left/U-turn	B	11.6	0.020	B	12.1	0.070
		Northbound Left/Thru/Right	C	24.4	0.090	E	40.0	0.410
		Southbound Left/Thru/Right	D	26.8	0.310	F	64.1	0.530
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Apartment Driveway	STOP Unsignalized	Northbound Right	C	15.0	0.130	C	15.9	0.120

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

TABLE 7a
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT ANDES ROAD / CHURCH DRIVEWAY
90 APARTMENTS / 120 APARTMENTS

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Andes Road / Church Driveway												
AM Peak												
Eastbound Left/U-turn	A	9.0	0.030	A	9.1	0.030	A	9.1	0.030	A	9.1	0.030
Westbound Left/U-turn	B	10.7	0.090	B	11.0	0.100	B	11.0	0.100	B	11.0	0.100
Northbound Left/Thru/Right	C	23.4	0.440	D	25.8	0.480	D	26.1	0.490	D	26.2	0.490
Southbound Left/Thru/Right	F	53.0	0.750	F	67.2	0.830	F	69.9	0.840	F	70.8	0.850
PM Peak												
Eastbound Left/U-turn	B	10.9	0.040	B	11.2	0.040	B	11.2	0.040	B	11.3	0.040
Westbound Left/U-turn	A	10.0	0.010	B	10.1	0.010	B	10.2	0.010	B	10.2	0.010
Northbound Left/Thru/Right	B	11.8	0.010	B	12.0	0.020	B	12.0	0.020	B	12.1	0.020
Southbound Left/Thru/Right	D	31.3	0.430	D	34.9	0.470	E	35.7	0.480	E	35.9	0.480

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

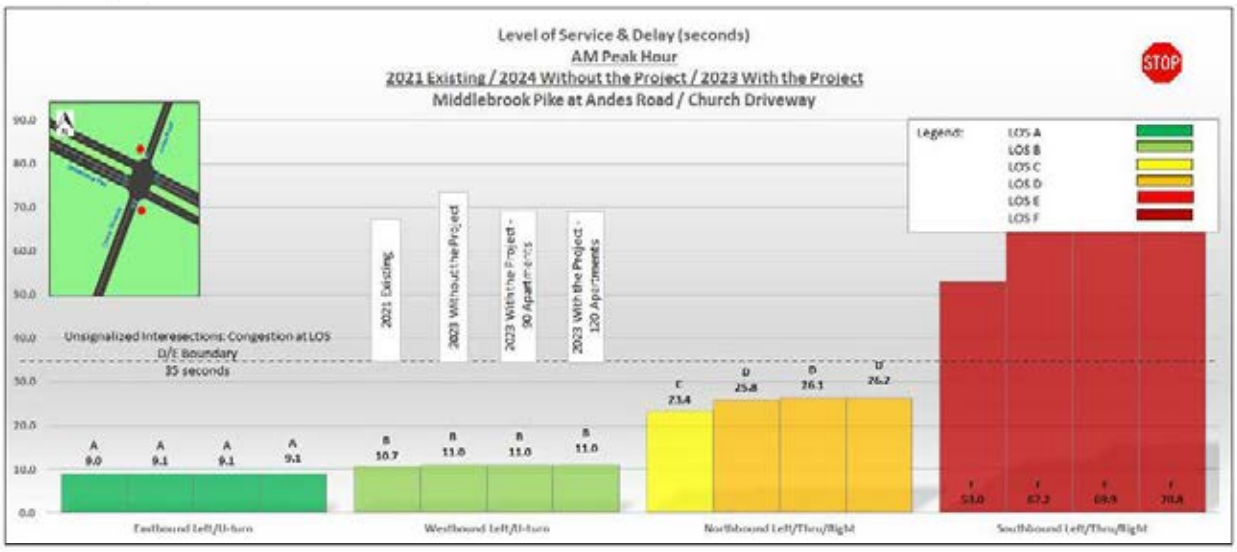
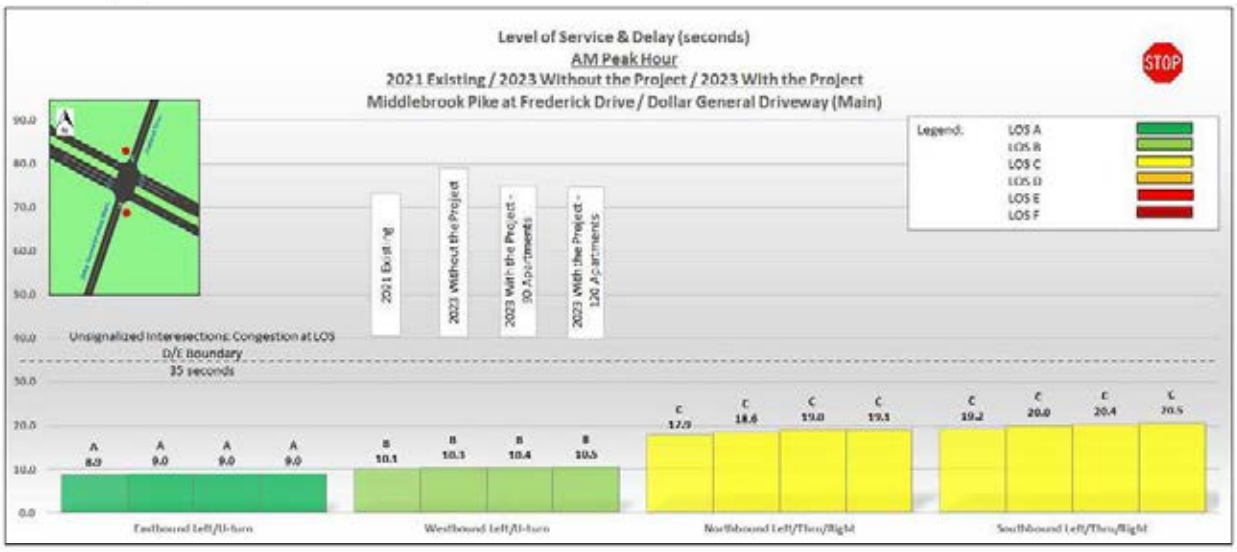


TABLE 7b
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT FREDERICK DRIVE / DOLLAR GENERAL DRIVEWAY (MAIN)
90 APARTMENTS / 120 APARTMENTS

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main) STOP												
AM Peak												
Eastbound Left/U-turn	A	8.9	0.010	A	9.0	0.010	A	9.0	0.010	A	9.0	0.010
Westbound Left/U-turn	B	10.1	0.010	B	10.3	0.010	B	10.4	0.010	B	10.5	0.010
Northbound Left/Thru/Right	C	17.9	0.050	C	18.6	0.060	C	19.0	0.060	C	19.1	0.060
Southbound Left/Thru/Right	C	19.2	0.190	C	20.0	0.200	C	20.4	0.210	C	20.5	0.210
PM Peak												
Eastbound Left/U-turn	B	10.9	0.010	B	11.2	0.010	B	11.3	0.010	B	11.4	0.010
Westbound Left/U-turn	B	10.4	0.050	B	10.6	0.050	B	10.8	0.050	B	10.8	0.050
Northbound Left/Thru/Right	C	23.7	0.230	D	25.4	0.250	D	26.3	0.260	D	26.5	0.260
Southbound Left/Thru/Right	D	30.5	0.270	D	33.6	0.300	E	35.0	0.310	E	35.5	0.310

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



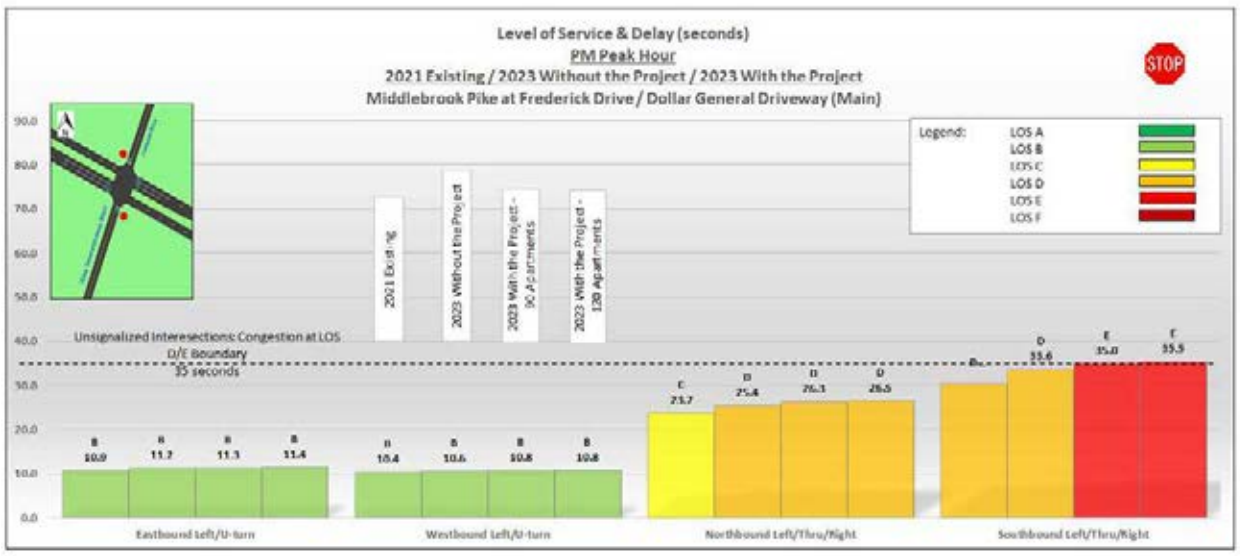
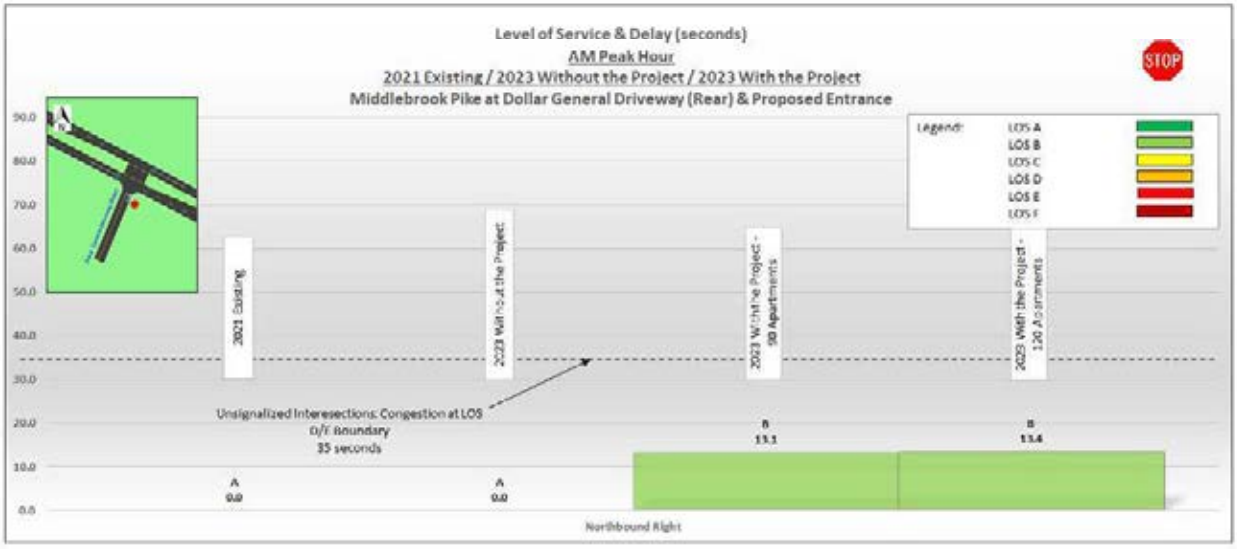


TABLE 7c
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT DOLLAR GENERAL DRIVEWAY (REAR) & PROPOSED ENTRANCE
90 APARTMENTS / 120 APARTMENTS

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Entrance					STOP							
AM Peak												
Northbound Right	A	0.0	0.000	A	0.0	0.000	B	13.1	0.090	B	13.4	0.110
PM Peak												
Northbound Right	A	0.0	0.000	A	0.0	0.000	B	13.6	0.080	B	14.1	0.100

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



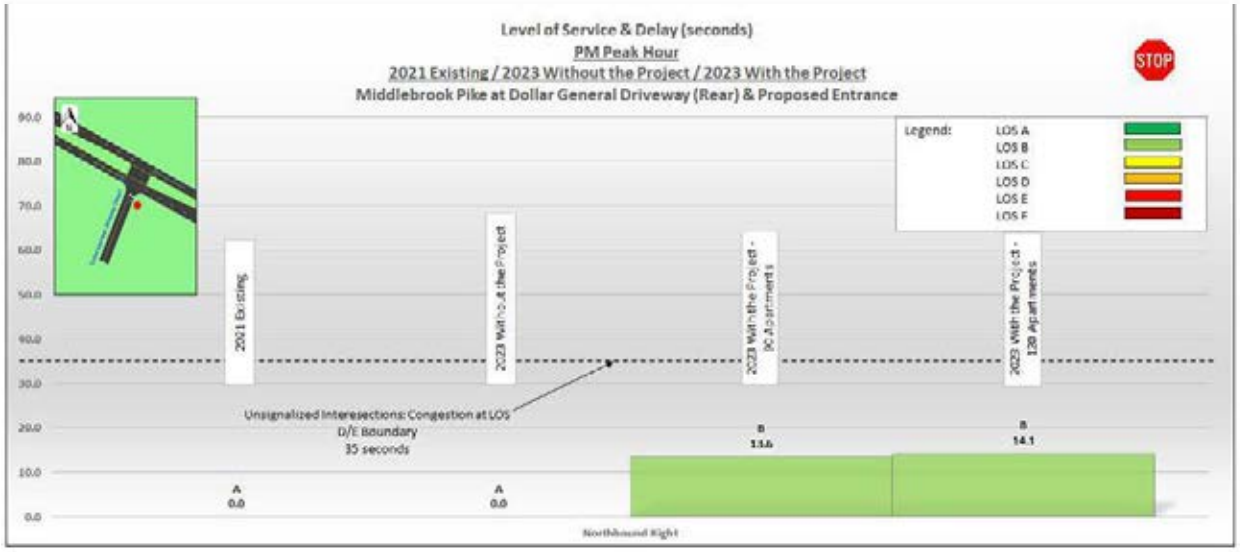


TABLE 7d
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT ANDES ROAD / CHURCH DRIVEWAY
90 APARTMENTS / 120 APARTMENTS +20%

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Andes Road / Church Driveway			STOP									
AM Peak												
Eastbound Left/U-turn	A	9.5	0.030	A	9.6	0.040	A	9.7	0.040	A	9.7	0.040
Westbound Left/U-turn	B	12.2	0.130	B	12.6	0.140	B	12.6	0.150	B	12.6	0.150
Northbound Left/Thru/Right	E	43.2	0.680	F	53.0	0.760	F	54.2	0.760	F	54.5	0.760
Southbound Left/Thru/Right	F	240.6	1.340	F	332.5	1.550	F	342.6	1.580	F	346.1	1.580
PM Peak												
Eastbound Left/U-turn	B	12.3	0.050	B	12.7	0.060	B	12.8	0.060	B	12.8	0.060
Westbound Left/U-turn	B	10.9	0.010	B	11.1	0.010	B	11.2	0.010	B	11.2	0.010
Northbound Left/Thru/Right	B	12.9	0.020	B	13.1	0.020	B	13.2	0.020	B	13.3	0.020
Southbound Left/Thru/Right	F	60.5	0.680	F	74.2	0.760	F	77.0	0.770	F	77.8	0.770

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

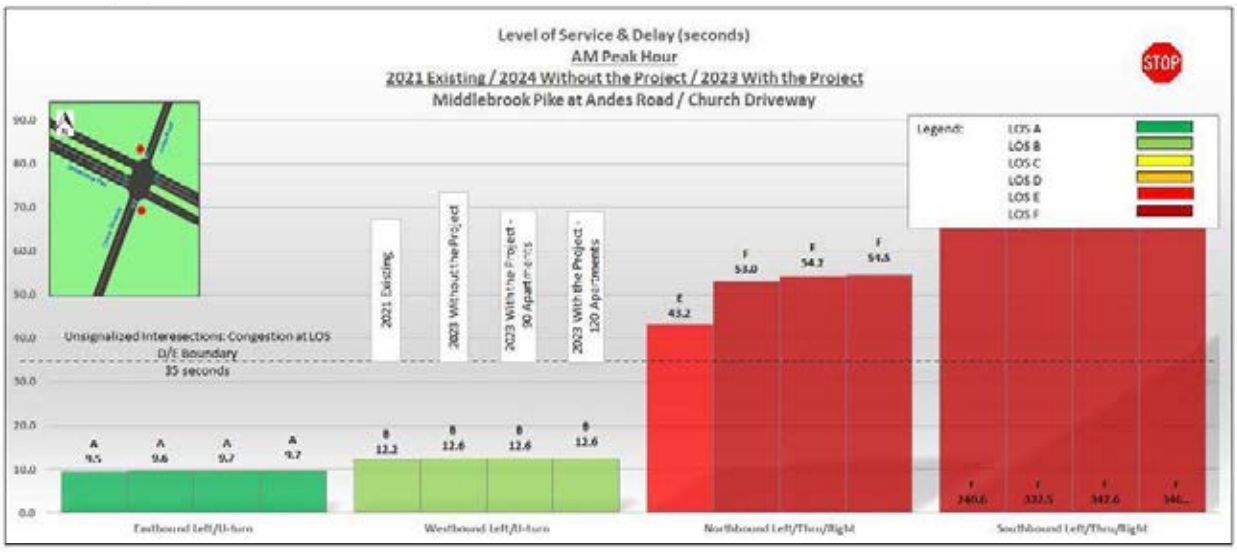
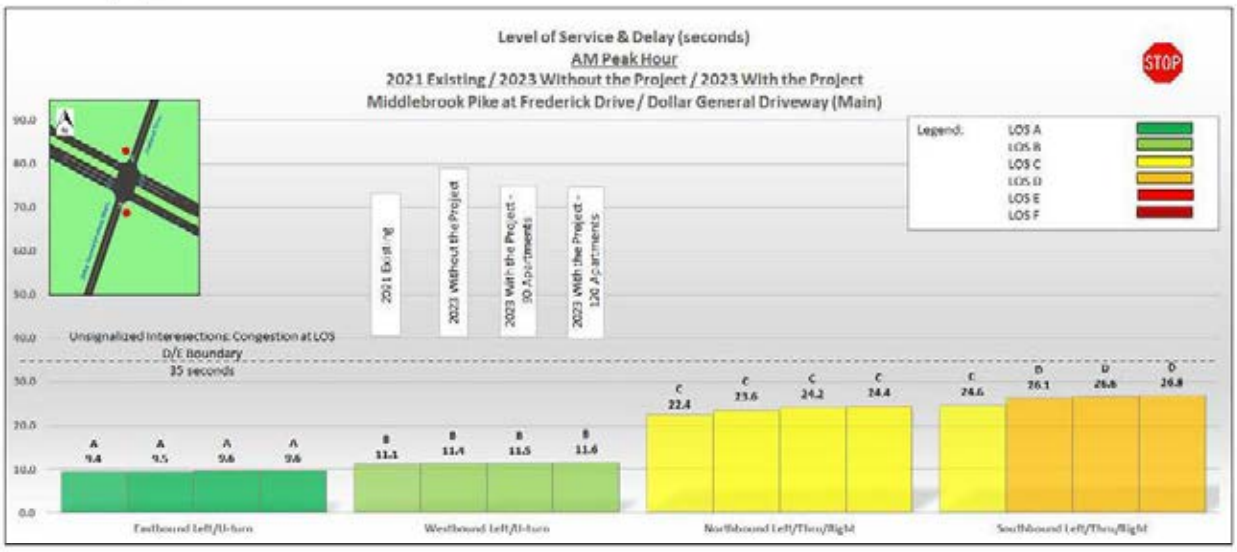


TABLE 7e
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT FREDERICK DRIVE / DOLLAR GENERAL DRIVEWAY (MAIN)
90 APARTMENTS / 120 APARTMENTS +20%

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)												
AM Peak												
Eastbound Left/U-turn	A	9.4	0.010	A	9.5	0.010	A	9.6	0.010	A	9.6	0.010
Westbound Left/U-turn	B	11.1	0.020	B	11.4	0.020	B	11.5	0.020	B	11.6	0.020
Northbound Left/Thru/Right	C	22.4	0.090	C	23.6	0.090	C	24.2	0.090	C	24.4	0.090
Southbound Left/Thru/Right	C	24.6	0.280	D	26.1	0.300	D	26.6	0.310	D	26.8	0.310
PM Peak												
Eastbound Left/U-turn	B	12.3	0.020	B	12.7	0.020	B	12.9	0.020	B	12.9	0.020
Westbound Left/U-turn	B	11.6	0.070	B	11.9	0.070	B	12.1	0.070	B	12.1	0.070
Northbound Left/Thru/Right	D	33.9	0.350	E	37.9	0.400	E	39.5	0.410	E	40.0	0.410
Southbound Left/Thru/Right	F	51.2	0.450	F	59.1	0.510	F	62.8	0.520	F	64.1	0.530

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



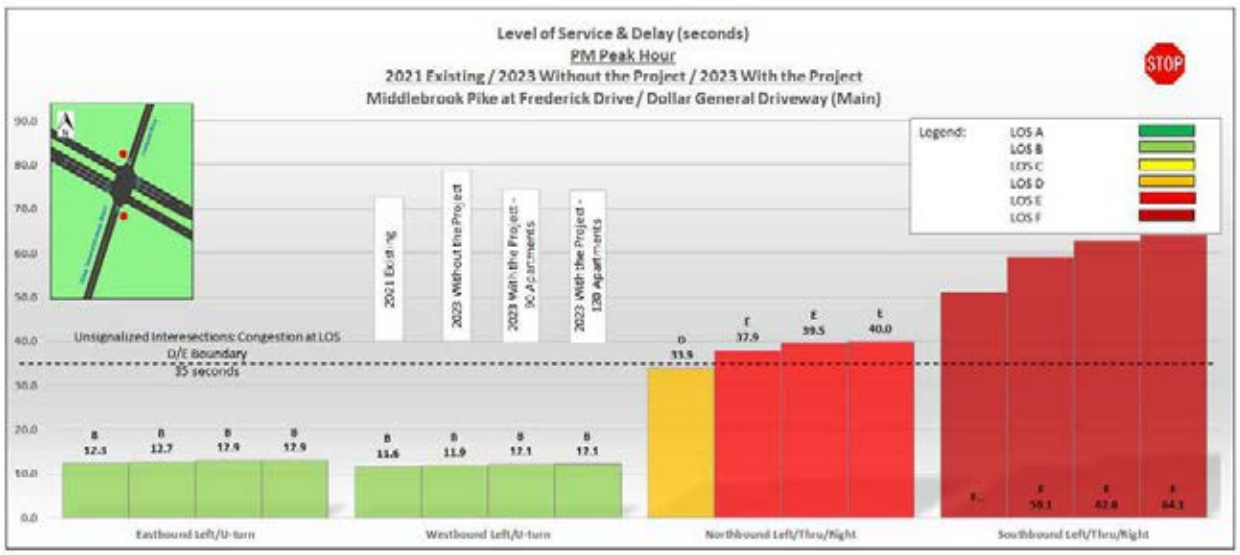
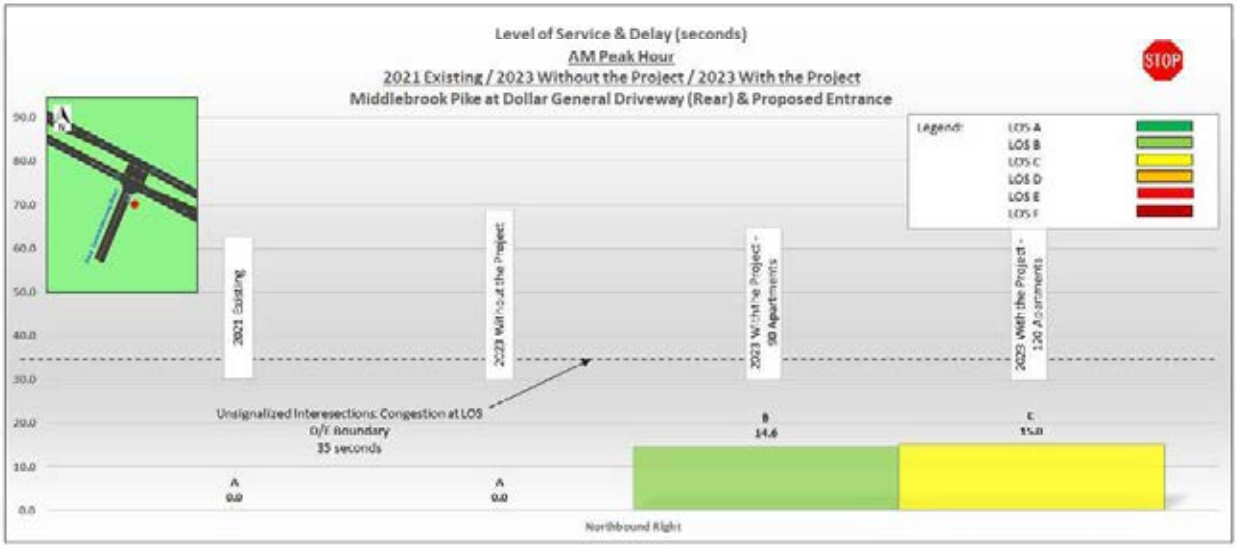
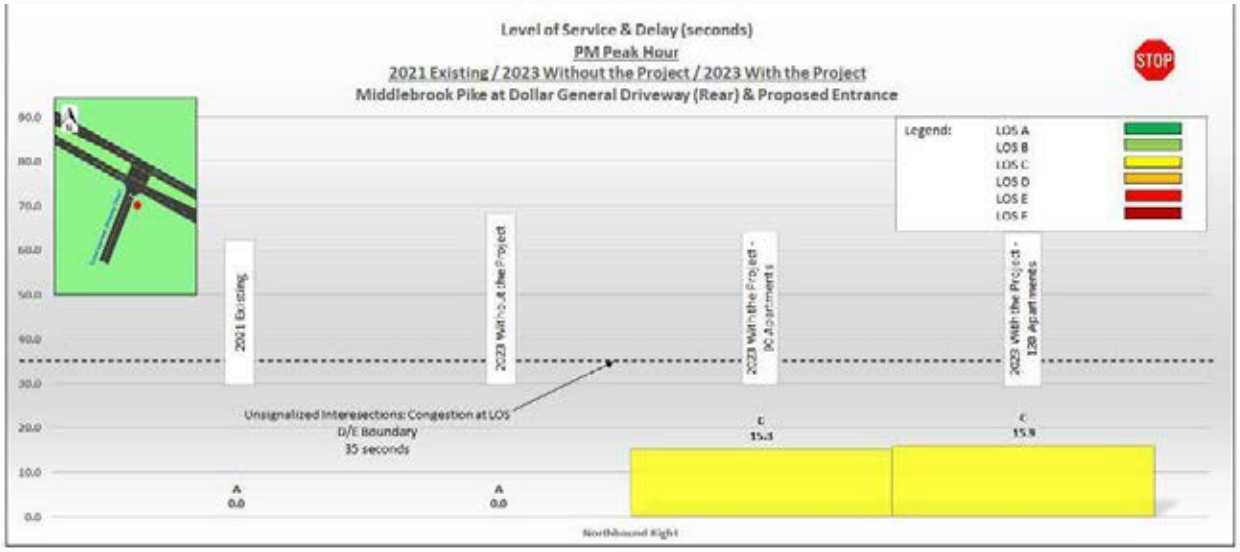


TABLE 7f
INTERSECTION CAPACITY ANALYSIS SUMMARY
MIDDLEBROOK PIKE AT DOLLAR GENERAL DRIVEWAY (REAR) & PROPOSED ENTRANCE
90 APARTMENTS / 120 APARTMENTS +20%

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING			2023 WITHOUT THE PROJECT			2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed Entrance					STOP							
AM Peak												
Northbound Right	A	0.0	0.000	A	0.0	0.000	B	14.6	0.100	C	15.0	0.130
PM Peak												
Northbound Right	A	0.0	0.000	A	0.0	0.000	C	15.3	0.090	C	15.9	0.120

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio





▪ POTENTIAL TRANSPORTATION SAFETY ISSUES:

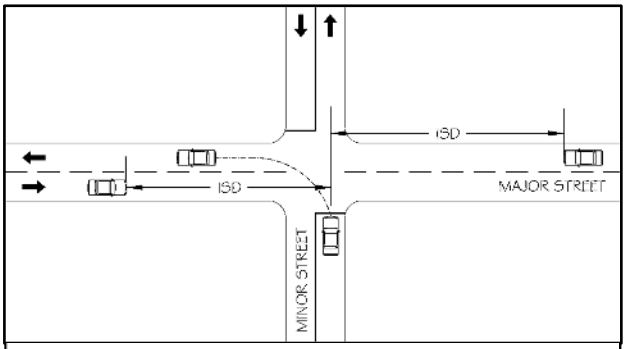
The study area was investigated for potential existing and future safety issues. A couple of features of the adjacent transportation system are discussed in the following pages.

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 to perceive, react, and the vehicle to come to a complete stop before colliding with an object in 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.



Intersection Sight Distance Diagram

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. Three traffic maneuvers are available for vehicles stopped on a minor street at a 4-way intersection: left-turn, right-turn, or a crossing maneuver across the major road. For turns from the minor street, ISD is needed to allow a stopped motorist on a minor street 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 to 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. SSD is considered the desirable visibility distance standard for evaluating the safety of an intersection. In general, SSD is generally more critical than ISD; however, the ISD must be at least the same distance or greater than SSD to provide safe operations at an intersection.

The proposed entrance driveway for the development is proposed to be right-turn-in/right-turn-out (RIRO) only due to the raised center median on Middlebrook Pike and TDOT stating a center median opening would not be allowed. Based on a posted speed limit of 40-mph on Middlebrook Pike, the ISD would be 475 feet looking west at the Proposed Apartment Driveway based on the guidelines outlined in A Policy on Geometric Design of Highway and Streets by AASHTO (American Association of State Highway and Transportation Officials). This sight distance standard is applied at this intersection since it is located on a State Route and supersedes Knox County ISD policy. Based on an existing 3% grade on Middlebrook Pike at the Proposed Apartment Driveway and a posted speed limit of 40-mph, the SSD is calculated to be 315 feet for eastbound vehicles.

A cursory examination of the sight distance on Middlebrook Pike at the Proposed Apartment Driveway location was undertaken. Based on visual observation, the ISD looking to the west is adequate. Using a Nikon Laser Rangefinder, the ISD was estimated to be 850 feet to the west.

Since the proposed entrance driveway will be RIRO, the vehicles generated by the development will be required to perform U-turn maneuvers at the upstream and downstream intersections on Middlebrook Pike. These U-turn maneuvers will occur at the intersections of Middlebrook Pike at Andes Road/Church Driveway and Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main). These maneuvers will also require sufficient sight distance. A U-turn's sight distance must be large enough to allow a motorist to perceive a gap in the oncoming traffic, complete the U-turn, and accelerate to the road's operating speed without causing the approaching vehicles to reduce their speed substantially.

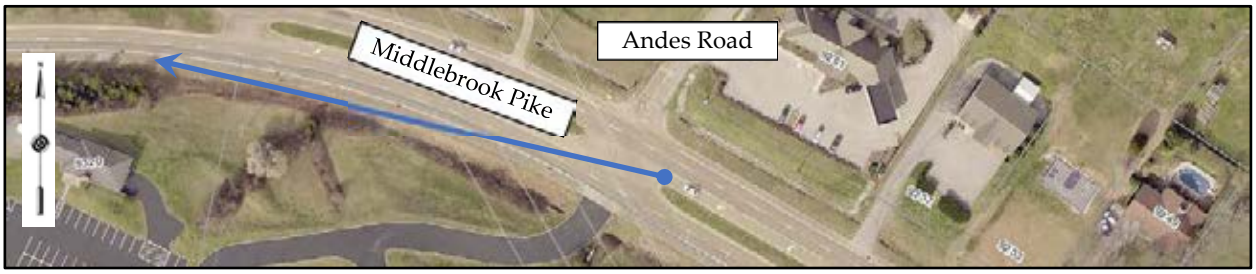
NCHRP Report 524, Safety of U-Turns at Unsignalized Median Openings, by the Transportation Research Board, provides guidance for these types of traffic maneuvers. In the report, the Florida Median Handbook is listed as a resource for recommended sight distance values for U-turns at unsignalized median openings. Based on Table 8 in the Florida handbook, for a speed of 40-mph (the posted speed limit), the table recommends a sight distance of 640 feet. This recommendation is provided for passenger cars, a reaction time of two seconds, the U-turn maneuver beginning at 0-mph, and a 50-foot clearance factor, all of which are appropriate for this setting.

A cursory examination of the sight distances on Middlebrook Pike where the U-turns will occur at the intersections of Middlebrook Pike at Andes Road/Church Driveway, and Frederick Drive/Dollar General Driveway (Main) was completed. Based on visual observation, the

available sight distances for performing a U-turn at these locations are adequate. Using a Nikon Laser Rangefinder, the sight distance was estimated to be 999+ feet (limit of the rangefinder) to the east from Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main) at the point where the apartment trip U-turns would occur. The sight distance from the point where the apartment trip U-turns would occur at the intersection of Middlebrook Pike at Andes Road/Church Driveway was estimated to be 700 feet. A licensed land surveyor should verify sight distances at these locations.

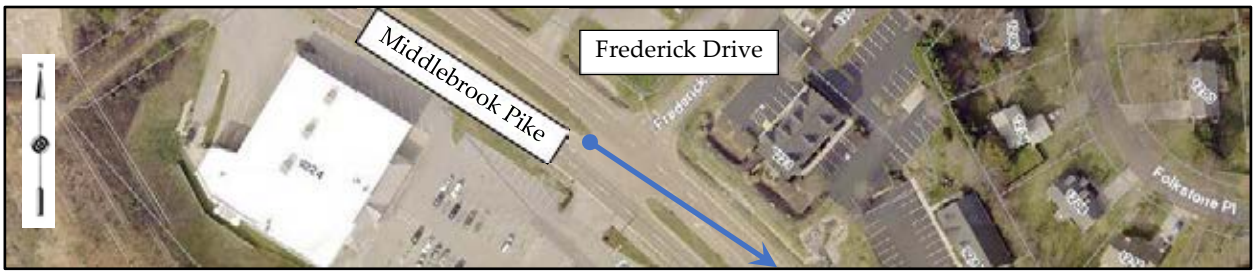
Images of the existing sight distances are presented below with the intersection's respective required sight distances.

View of Sight Distance on Middlebrook Pike at Proposed Apartment Driveway (Looking West)



View of Sight Distance on Middlebrook Pike at Andes Road/Church Driveway for U-turns (Looking West)

View of Sight Distance on Middlebrook Pike at Frederick Drive/Dollar General (Main) for U-turns (Looking East)



EVALUATION OF TURN LANE THRESHOLDS

An evaluation of the need for separate entering turn lanes on Middlebrook Pike for the development in 2023 was conducted. In this case, with a RIRO, the evaluation only examined the need for a separate eastbound right-turn lane. The design policy used for these turn lane evaluations is based on "Knox County's Access Control and Driveway Design Policy". This design policy relates vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. This Knox County policy is based on TDOT and nationally accepted guidelines for unsignalized intersections.

The evaluation was based on the entering projected 2023 AM and PM peak hour traffic volumes at the Proposed Apartment Driveway entrance shared with the Dollar General Driveway (Rear) and the posted speed limit of 40-mph on Middlebrook Pike. The right-turn lane evaluations were analyzed according to the different scenarios examined in this study: 90 apartments with and without a 20% increase to the raw tabulated traffic volumes to account for the pandemic and the same for 120 apartments. The results indicated that an eastbound right-turn lane would be warranted in the PM peak hour in the following conditions:

- 90 Apartments with a 20% increase to the raw existing tabulated traffic volumes
- 120 Apartments without a 20% increase to the raw existing tabulated traffic volumes
- 120 Apartments with a 20% increase to the raw existing tabulated traffic volumes

Essentially, a right-turn lane would be warranted if 90 apartments are built if a 20% increase to the raw existing tabulated volumes is included and would also be warranted for 120 apartments regardless. The Knox County turn lane policy worksheets are in Appendix I. This right-turn lane is warranted since all the entering traffic will enter from the west since a median opening is not available and will not be allowed.

CONCLUSIONS & RECOMMENDATIONS

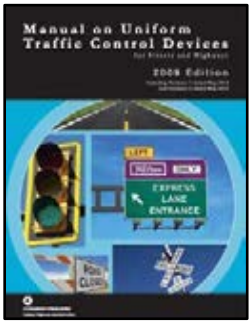
As shown in the results, the addition of generated trips from the Middlebrook Commons Development with 90 or 120 apartments will not appreciably increase the vehicle delays at the studied intersections in 2023. It was determined that the northbound and southbound approaches at the studied intersections are currently experiencing considerable vehicle delays in the existing conditions. Furthermore, these substandard results were obtained in both scenarios when the existing tabulated raw traffic volumes were increased by 20% for the pandemic and when they were not.

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

1 **Middlebrook Pike at Andes Road/Church Driveway:** This intersection was calculated to operate poorly in the existing conditions and the projected 2023 conditions. The apartment development trips do not substantially increase the vehicle delays at the intersection; however, several discussions regarding this are offered.

1a) As an investigation into potential remediation for this intersection, this intersection was examined with respect to traffic signal warrants.

Methodology:



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

ensuring that a traffic signal's installation will not bring about degradations in safety and efficiencies.

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

Warrant #1, Eight-Hour Vehicular Volume:

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

Warrant #2, Four-Hour Vehicular Volume:

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

Even though nine warrants are offered to justify a traffic signal, according to the TDOT Traffic Signal Manual, the agency gives precedence to Warrant #1 (Eight Hour Vehicular Volume) and Warrant #7 (Crash Experience). Even though Warrant #2 is not a primary warrant used by TDOT, it is included in this study. Furthermore, TDOT does not allow installing a traffic signal on a state route based on speculative developments or unrealized traffic volumes.

The intersection of Middlebrook Pike at Andes Road/Church Driveway was evaluated in the existing conditions to justify a traffic signal based on the MUTCD Warrants listed above and including the existing raw tabulated traffic count volumes with and without a 20% increase to account for the pandemic. Andes Road and the Church Driveway were used as the minor side streets for the warrant analysis, and Middlebrook Pike was the major street. Warrant #7 was not analyzed at this intersection for this study.

Warrant #7 was not included because one of the primary criteria for an intersection to meet the warrant is that an "Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency…" It is not believed that any specific alternatives have been implemented and observed at this intersection; therefore, this warrant was not included in this study.

The evaluation concluded that for the existing raw and existing (+20% adjusted) traffic volumes, the intersection does not currently meet Warrant #1 but does meet Warrant #2 in both scenarios.

Even though TDOT does not typically accept justification for traffic signals except for Warrant #1 and #7, the intersection also met Warrant #3. Warrant #3 is usually only used in rare instances such as locations near office complexes, manufacturing plants, etc. According to the MUTCD, Warrant #3 "is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street." The additional evaluation shows that Warrant #3 was met for the intersection based on the existing raw volumes and existing raw (+20% adjusted) traffic volumes. Appendix J shows the traffic signal warrant assessment for these evaluations.

For the projected conditions, a spreadsheet was developed to determine the traffic volumes generated by the development being added to the intersection during the highest 8 hours of traffic based on the assumed traffic distribution in the projected conditions. This spreadsheet is shown in Appendix J. Based on this spreadsheet output and evaluating the results against the traffic signal warrant thresholds and including the +20% increase for the pandemic, it is calculated that this intersection will still not meet Warrant #1 in the year 2023 with the inclusion of trips from 90 or 120 apartments.

Table 8 reports the traffic signal warrant evaluation results for the different scenarios for the Middlebrook Pike at Andes Road/Church Driveway intersection.

TABLE 8
TRAFFIC SIGNAL WARRANT SUMMARY
MIDDLEBROOK PIKE AT ANDES ROAD/CHURCH DRIVEWAY

SCENARIO	VOLUME WARRANT (REQUIRED NUMBER OF HOURS SATISFIED)				
	WARRANT 1			WARRANT 2	WARRANT 3
	CONDITION #1A (8 hours)	CONDITION #1B (8 hours)	CONDITION #1A & 1B - COMBINATION (8 hours)	(4 hours)	(1 hour)
2021 Existing Volumes	Not Satisfied (1 hour)	Not Satisfied (5 hours)	Not Satisfied	Satisfied (4 hours)	Satisfied
2021 Existing Volumes (with +20% Increase)	Not Satisfied (2 hours)	Not Satisfied (6 hours)	Not Satisfied	Satisfied (5 hours)	Satisfied
2023 Projected Volumes (with +20% Increase) and 2% General Growth 90 Apartments	Not Satisfied (3 hours)	Not Satisfied (6 hours)	Not Satisfied	Satisfied (5 hours)	Satisfied
2023 Projected Volumes (with +20% Increase) and 2% General Growth 120 Apartments	Not Satisfied (3 hours)	Not Satisfied (6 hours)	Not Satisfied	Satisfied (5 hours)	Satisfied

Since the "true" and "agreed-to" existing traffic volumes are difficult to distinguish at this time, it is recommended that traffic counts be conducted again at this intersection when either the current pandemic has ended and overall traffic volumes return closer to pre-pandemic levels or when it is surmised that overall traffic volumes have reached a "new normal" to ensure these traffic signal warrant evaluations are valid and reasonable. This will allow for a re-comparison of the Traffic Signal Warrants and establish a timeframe of if and when this intersection could be signalized. Traffic crash data should also be included in the examination.

- Furthermore, as part of evaluating the projected conditions, vehicle queue lengths at the intersection were calculated based on the projected 2023 traffic volumes. The previously mentioned Synchro Traffic Software includes SimTraffic. The Synchro portion of the software performs the macroscopic calculations for intersections, and SimTraffic performs micro-simulation and animation of vehicular traffic. SimTraffic (Version 8) software was utilized to estimate whether the existing turn lane storage lengths at the intersection will be adequate with the projected 2023 volumes. The worst-case scenario was chosen for the turn-lane evaluation: the 2023 AM and PM peak hour traffic volumes with 120 apartments and with an increase of 20% to account for the pandemic.

Based on the software results from this scenario, the 95th percentile vehicle queue lengths were calculated based on the intersection operating in unsignalized conditions. The 95th percentile vehicle queue is the recognized measurement in the traffic engineering profession as the design standard used when considering queue lengths. A 95th percentile vehicle queue length means 95% certainty that the vehicle queue will not extend beyond that point. The calculated vehicle queue results were based on averaging the outcome obtained during ten traffic simulations. The vehicle queue results from the SimTraffic software are in Appendix K. The 95th percentile queue lengths at the intersection are shown in Table 9.

Based on this worse-case result, the existing westbound and eastbound left-turn storage turn lane lengths at the intersection will be adequate in the projected conditions in 2023, operating under unsignalized conditions. However, the northbound and southbound approaches will experience long vehicle queues.

TABLE 9
TURN LANE STORAGE & VEHICLE QUEUE SUMMARY -
2023 PROJECTED PEAK HOUR TRAFFIC VOLUMES - 120 APARTMENTS (+20%)

INTERSECTION	APPROACH/ MOVEMENT	EXISTING STORAGE (ft)	SIMTRAFFIC 95th PERCENTILE QUEUE LENGTH (ft)	
			AM PEAK HOUR	PM PEAK HOUR
Middlebrook Pike at Andes Road / Church Driveway	Southbound Left/Thru/Right	N/A	195	191
	Westbound Left/U-Turn	180	49	44
	Northbound Left/Thru/Right	N/A	322	23
	Eastbound Left/U-Turn	320	22	34

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

If these projected volumes are realized in 2023 with the associated long vehicle delays and vehicle queues on Andes Road and the Church Driveway, the potential exists for decreased traffic safety. Without adequate traffic gaps on Middlebrook Pike and considerable delays, northbound and southbound motorists could attempt to enter the Middlebrook Pike traffic stream that they otherwise would not. This could lead to traffic conflicts and the potential for traffic crashes.

- Since this intersection theoretically meets justification for a traffic signal installation, an initial traffic signal timing plan was created and modeled in Synchro software. The signal timing plan was based on the projected volumes in the year 2023 for 120 apartments with a 20% increase, and the results are shown in Table 10. The plan included permitted and protective phases for the eastbound and westbound U-turns and left-turns and a cycle length of 60 seconds. The results indicate that a traffic signal could remedy the high vehicle delays on the northbound and southbound approaches.

TABLE 10
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
OPENING YEAR (WITH THE PROJECT - 120 Apartments +20%)
MIDDLEBROOK PIKE AT ANDES ROAD/CHURCH DRIVEWAY

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]
Middlebrook Pike at Andes Road / Church Driveway	Signalized	Eastbound	B	11.7		A	8.4	
		Westbound	A	8.2		A	9.0	
		Northbound	B	16.5		B	16.5	
		Southbound	C	20.2		B	17.4	
		Summary	B	11.6	0.660	A	9.1	0.620

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for signalized intersections
AM Cycle Length = 60 seconds / PM Cycle Length = 60 seconds
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

Just because an intersection satisfies a warrant for traffic signalization, it does not necessitate that the intersection must or should be signalized. Further engineering studies and judgments need to be made for this intersection to determine if a traffic signal is appropriate. Before a new traffic signal is implemented, further analysis must consider its effect on the surrounding road system. A traffic signal at the intersection would need to consider the adjacent existing traffic signal on Middlebrook Pike at North Cedar Bluff Road.

Overall, serious consideration should be given to the transition of this intersection to a traffic signal due to the high vehicle delays on the northbound and southbound approaches. This consideration should include an investigation to determine if there is a history of crashes occurring at this intersection. Furthermore, if the new other residential development to the north off Andes Road is completed, the possibility that traffic signalization warrants being met will be increased due to the additional generated traffic volumes by this development.

1b) The recommended sight distance for U-turns at unsignalized median openings for 40-mph is 640 feet. A visual examination of the sight distance at this intersection's westbound U-turn location was conducted and estimated to be 700 feet. Due to the horizontal curvature of Middlebrook Pike to the west, the sight distance at this location could be reduced if vegetation is not maintained on the south side of Middlebrook Pike. This vegetation will need to be maintained in the future.

View of South Side of Middlebrook Pike Vegetation (Looking West at 9320 Middlebrook Pike)

1c) The recommended median width for a passenger vehicle to complete a U-turn at a divided 4-lane highway is 18 feet according to the A Policy on Geometric Design of Highway and Streets by AASHTO. This minimum width would allow a passenger vehicle at a divided highway to complete a U-turn from the turn lane and enter the opposite direction outer lane without striking the outside concrete curb. This minimum width is available at this intersection. The median distance between the yellow centerline pavement lines at the Middlebrook Pike westbound left-turn lane is 19 feet. However, as observed during the traffic count, large trucks cannot easily or fully complete a U-turn at this location without either crossing up over the opposite concrete curb or by making an initial turn, backing up and then completing the full U-turn maneuver. Large trucks not completing U-turns in one complete maneuver can cause momentary traffic backups and increase the possibility of a traffic crash.

2 **Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main):** This intersection was calculated to operate poorly in the existing conditions and the projected 2023 conditions. The apartment development trips do not substantially increase the vehicle delays at the intersection; however, several discussions regarding this are offered.

2a) As an investigation into potential remediation for this intersection, this intersection was examined with respect to traffic signal warrants.

The intersection of Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main) was evaluated for justifying a traffic signal based on the MUTCD Warrants. Frederick Drive and the Dollar General Driveway (Main) were used as the minor side streets for the warrant analysis, and Middlebrook Pike was the major street. Warrant #7 was not analyzed at this intersection for this study.

The evaluation concluded that this intersection would not meet Warrant #1 or #2 in the existing or the projected 2023 conditions. However, the intersection currently does and will meet Warrant #3 in the projected conditions. Appendix J shows the traffic signal warrant assessment for these evaluations and the spreadsheet used to project the future volumes at the intersection. Table 11 reports the traffic signal warrant evaluation results for the different scenarios for the Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main) intersection.

TABLE 11
TRAFFIC SIGNAL WARRANT SUMMARY
MIDDLEBROOK PIKE AT FREDERICK DRIVE/DOLLAR GENERAL DRIVEWAY (MAIN)

SCENARIO	VOLUME WARRANT (REQUIRED NUMBER OF HOURS SATISFIED)				
	WARRANT 1			WARRANT 2	WARRANT 3
	CONDITION #1A (8 hours)	CONDITION #1B (8 hours)	CONDITION #1A & 1B - COMBINATION (8 hours)	(4 hours)	(1 hour)
2021 Existing Volumes	Not Satisfied (0 hours)	Not Satisfied (0 hours)	Not Satisfied	Not Satisfied (0 hours)	Satisfied
2021 Existing Volumes (with +20% Increase)	Not Satisfied (0 hours)	Not Satisfied (2 hours)	Not Satisfied	Not Satisfied (0 hours)	Satisfied
2023 Projected Volumes (with +20% Increase) and 2% General Growth 90 Apartments	Not Satisfied (0 hours)	Not Satisfied (2 hours)	Not Satisfied	Not Satisfied (0 hours)	Satisfied
2023 Projected Volumes (with +20% Increase) and 2% General Growth 120 Apartments	Not Satisfied (0 hours)	Not Satisfied (2 hours)	Not Satisfied	Not Satisfied (0 hours)	Satisfied

Since the "true" and "agreed-to" existing traffic volumes are difficult to distinguish at this time, it is recommended that traffic counts be conducted again at this intersection when either the current pandemic has ended and overall traffic volumes return closer to pre-pandemic levels or when it is surmised that overall traffic volumes have reached a "new normal" to ensure these traffic signal warrant evaluations are valid and reasonable. This will allow for a re-examination of the intersection, a re-comparison of the Traffic Signal Warrants, and establish a timeframe of if and when this intersection could be signalized. Traffic crash data should also be included in the examination.

- As part of the evaluation of the projected conditions, the projected vehicle queue lengths at the intersection were calculated based on the projected 2023 traffic volumes. For this evaluation, the worst-case scenario was chosen: the 2023 AM and PM peak hours with 120 apartments and with an increase of 20% to account for the pandemic.

  Based on the software results with the 2023 projected volumes, the 95th percentile vehicle queue lengths were calculated based on the intersection operating in unsignalized conditions. The vehicle queue results from the SimTraffic software are in Appendix K. The 95th percentile queue lengths at the intersection are shown

in Table 12.

Based on this worse-case result, the existing westbound and eastbound left-turn storage turn lane lengths at the intersection will be adequate in the projected conditions in 2023, operating under unsignalized conditions. However, the northbound and southbound approaches will experience large vehicle queues.

TABLE 12
TURN LANE STORAGE & VEHICLE QUEUE SUMMARY -
2023 PROJECTED PEAK HOUR TRAFFIC VOLUMES - 120 APARTMENTS (+20%)

INTERSECTION	APPROACH/ MOVEMENT	EXISTING STORAGE (ft)	SIMTRAFFIC 95th PERCENTILE QUEUE LENGTH (ft)	
			AM PEAK HOUR	PM PEAK HOUR
Middlebrook Pike at Frederick Drive / Dollar General Driveway (Main)	Southbound Left/Thru/Right	N/A	128	231
	Westbound Left/U-Turn	150	21	59
	Northbound Left/Thru/Right	N/A	39	280
	Eastbound Left/U-Turn	185	30	32

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

If these projected volumes are realized in 2023 with the associated long vehicle delays and vehicle queues on Frederick Drive and the Dollar General Driveway (Main), the potential exists for decreased traffic safety. Without adequate traffic gaps on Middlebrook Pike and considerable delays, northbound and southbound motorists could attempt to enter the Middlebrook Pike traffic stream that they would otherwise not. This could lead to traffic conflicts and the potential for traffic crashes.

Overall, if the intersection of Middlebrook Pike at Andes Road/Church Driveway to the west is reconstructed with a traffic signal, this could potentially increase gaps in the traffic on Middlebrook Pike downstream, reducing the overall vehicle delays and queues at the intersection at Frederick Drive and the Dollar General Driveway (Main).

2b) The recommended sight distance for U-turns at unsignalized median openings for 40-mph is 640 feet. A visual examination of the sight distance at this intersection's eastbound U-turn location was conducted and estimated to be 999+ feet.

2c) The recommended median width for a passenger vehicle to complete a U-turn at a divided 4-lane highway is 18 feet according to the A Policy on Geometric Design of Highway and Streets by AASHTO. This minimum width is available at this intersection. The median distance between the yellow centerline pavement lines on Middlebrook Pike at the eastbound left-turn lane is 19 feet.

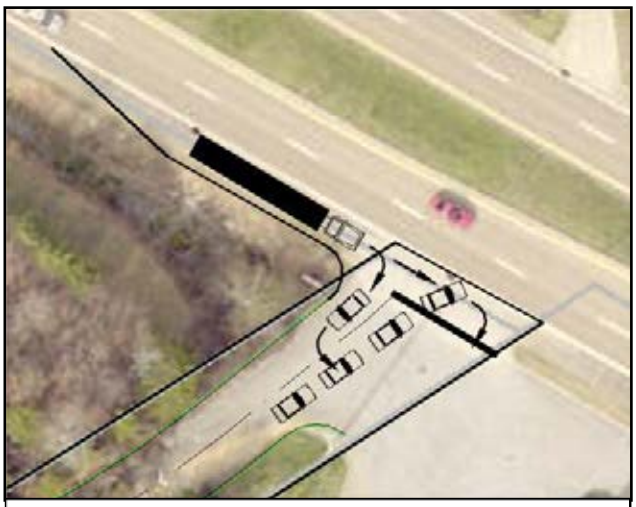
3 **Middlebrook Pike at Dollar General Driveway (Rear)/Proposed Apartment Driveway**: The intersection of Middlebrook Pike at Dollar General Driveway (Rear)/Proposed Apartment Driveway was calculated to operate very well with respect to the level of service in the projected conditions in 2023. Recommendations for this intersection are complicated due to the existing and proposed physical limitations and will need to be further worked on in the detailed design phase. Some of the proposed entrance layouts offered in this section are conceptual and will require further design once the specifics of the property limits are known.

3a) As discussed earlier in Potential Safety Issues, Evaluation of Turn Lane Thresholds, an exclusive eastbound right-turn lane is warranted on Middlebrook Pike since this development will only be allowed right-turns-in. Due to the development property's limited highway frontage on Middlebrook Pike, this right-turn lane will need to be constructed along the frontage of the adjacent church/private school property to the west.

Typically, the length of a right-turn lane would be determined by calculating the stopping sight distance based on the observed operating speed. The length recommended in A Policy on Geometric Design of Highway and Streets by AASHTO is calculated to be 315 feet for eastbound vehicles to decelerate and stop from a posted speed of 40 mph. However, this recommended length is based on vehicles coming to a complete stop. The right-turning vehicles coming off Middlebrook Pike onto the Proposed Apartment Driveway will not completely stop. It is offered that a 75-foot right-turn storage length is a reasonable length for this approach. With 75 feet of right-turn storage, a WB-67 truck making deliveries to the Dollar General Market could be fully contained outside the thru lanes and movements of Middlebrook Pike. A recommended taper length of 60 feet (5:1) is based on a 12-foot lane due to the limited right-of-way available. The right-turn lane should be marked with the appropriate right-turn pavement marking symbols.

3b) The existing rear driveway for the Dollar General Market is nearly 60 feet wide (maximum allowed by TDOT is 50 feet for locations where heavy truck traffic is expected). It is right-turn-in/right-turn-out-only due to the raised center median on Middlebrook Pike. It is not known why this rear entrance for the Dollar General Market was constructed so wide or why it was built outside the Dollar General Market property

and on the apartment property strip. It is possible an agreement or easement that allowed this encroachment, but it is unknown at this time. Nonetheless, this intersection currently only provides access to the Dollar General Market but will need to be modified to a shared intersection with the Proposed Apartment Driveway.



Middlebrook Pike at Proposed Apartment Driveway/Dollar General Driveway (Rear) Potential Conflicts of Shared Driveway

It is recommended that the two entrances be separated as much as possible. Separating the entrances as the properties are currently configured will be impossible since they share a single access point at Middlebrook Pike with limited property availability. The concern is that detrimental operational issues could occur if motorists queue at the apartment driveway exit, especially if an exclusive eastbound right-turn lane is constructed as warranted. As shown in the image, these issues could include: blocking traffic entering the Dollar General Market (including large delivery trucks), confuse motorists wanting to enter the Dollar General Market by turning into the apartment driveway entrance instead, and then being blocked into Dollar General by a vehicle queue, or by exiting residents assuming incorrectly that an eastbound right-turn will turn into the apartment driveway when the vehicle is actually turning right slightly further to the east to enter the Dollar General Market.

The driveways should have 40 feet minimum edge clearance spacing as shown in TDOT's Manual for Constructing Driveway Entrances on State Highways in urban locations. This spacing is not possible based on the existing configuration and the property lines and limits as proposed. Obtaining additional property to the west would facilitate separating the entrances. The details and layout for this entrance should be clarified further during the detailed design phase with Knox County and TDOT.

3c) It is recommended that a Stop Sign (R1-1) and a 24" white stop bar be applied to the Proposed Apartment Driveway approach pavement at Middlebrook Pike. According to

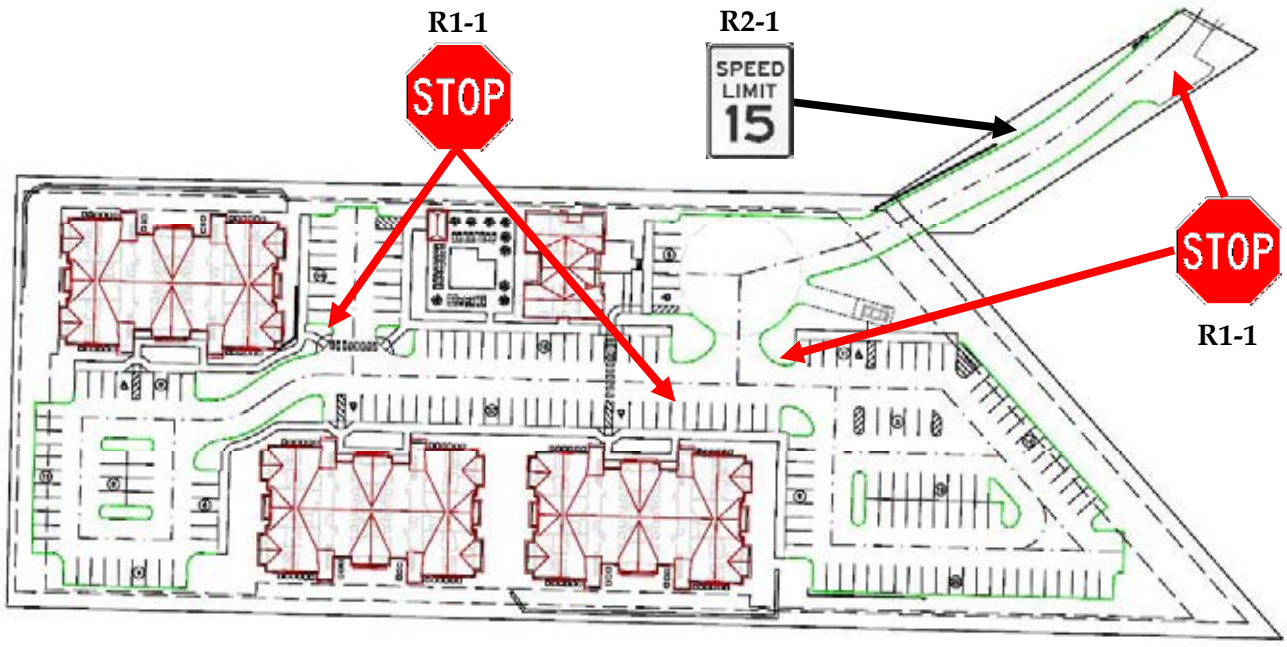
the MUTCD, Stop Signs (R1-1) can be installed up to a maximum of 50 feet from the edge of the intersecting street. The stop bar should be applied at a minimum of 4 feet away from the extended edge of the proposed right-turn lane on Middlebrook Pike and should be placed at the desired stopping point that maximizes the sight distance.

3d) Intersection sight distance at Dollar General Driveway (Rear)/Proposed Apartment Driveway must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on Middlebrook Pike, the required ISD is 475 feet looking to the west. Based on an existing grade of 3% on Middlebrook Pike and a posted speed limit of 40-mph, the SSD is calculated to be 315 feet for eastbound vehicles on Middlebrook Pike. The site designer must verify that these distances will be available.

4 **Middlebrook Commons Internal Drive/Parking Lot Aisleways:** The current layout plan shows a single driveway with several parking lot aisleways constructed for the development, as shown in Figure 3.

4a) It is recommended that a 15-mph Speed Limit Sign (R2-1) be posted near the beginning of the driveway off Middlebrook Pike. Since the apartment driveway will not be a public road, a posted speed limit less than 25-mph is acceptable.

4b) Stop Signs (R1-1) with 24" white stop bars and other traffic signage should be installed at the locations, as shown below:



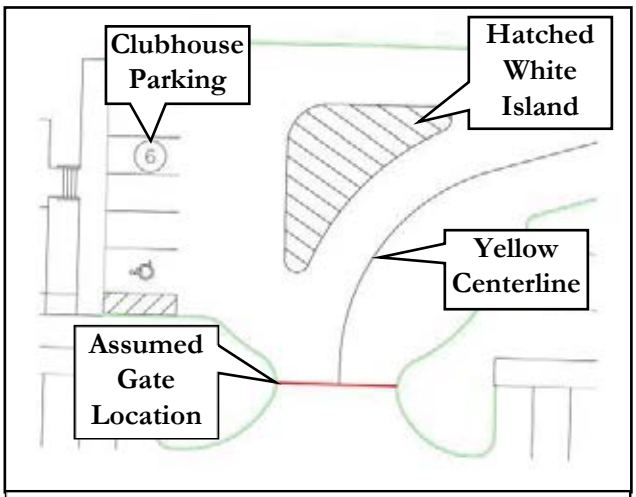
Internal Traffic Sign Locations

As shown above, it is recommended that entering traffic operate uncontrolled (except as controlled by the access gate) at the first internal intersection, with the internal east and west aisleway approaches operating under Stop control. A parking space will need to be deleted from the design and an island installed instead to facilitate a Stop Sign (R1-1) being installed for the west approach as shown. The east approach will have an island to the side that will allow installing a Stop Sign (R1-1).

4c) Sight distance at the new internal intersections in the development must not be impacted by new signage or future landscaping. With a speed limit of 15-mph in the development, the internal intersection sight distance requirement is 170 feet. The stopping sight distance required is 80 feet for a level road grade. The site designer should ensure that internal sight distance lengths are met.

4d) Due to the long and straight internal east-west parking lot aisleway to the north of Buildings 1 and 2, it is recommended that speed humps or tables be considered to reduce internal traffic speeds in the development. Alternatively, parking lot islands could be extended toward the aisleway. The parking lot aisleway is shown with a 26-foot width which is appropriate and is generous for vehicles backing out of parking spaces, but it also could provide too much driver comfortability and encourage higher speeds for residents driving inside the development at this aisleway. Extending the parking lot islands several feet would narrow the aisleway width and reduce the available driving surface at several points. This design would potentially reduce driver comfort and subsequently reduce vehicle speeds. A few parking spaces will need to be removed as shown, but the overall number of parking spaces shown provided is more than required and can be reduced while maintaining the minimum requirement.

4e) The entrance driveway near the trash collection area and the parking area for the clubhouse is shown with a large pavement/cul-de-sac area. This area is an inscribed 80-foot circle as recommended by Knox County for gated access developments. This pavement area would allow for a large vehicle to turn around at the gate. Due to the vast expanse of pavement, it is recommended that the pavement area be marked to show the predominant travel pattern expected for entering vehicles. These pavement markings should include a single yellow centerline from Middlebrook Pike south to the access gate and a painted island with white transverse crosshatch markings on the pavement.



Middlebrook Pike at Proposed Apartment Driveway/Dollar General Driveway (Rear)

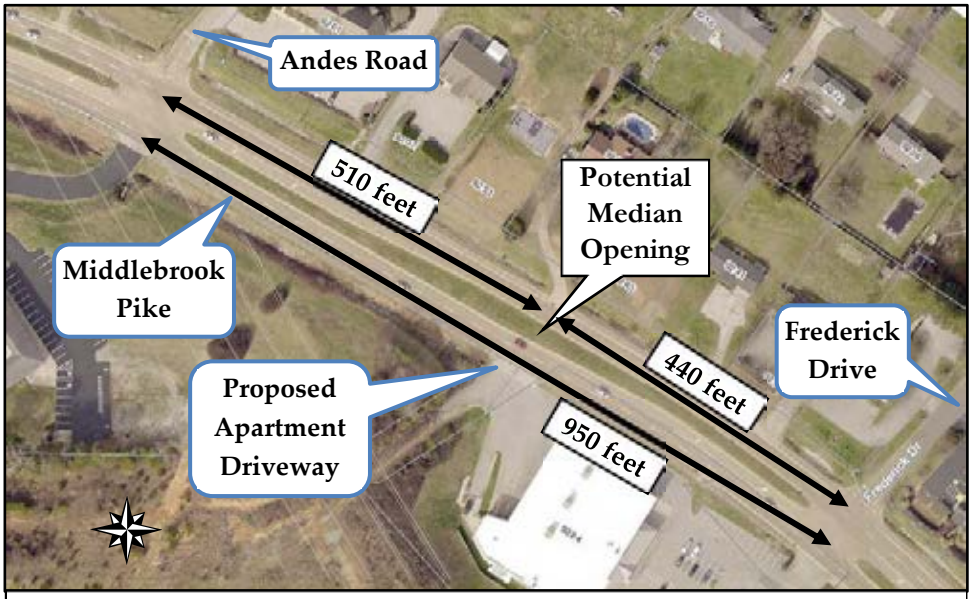
4f) All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.

4g) Internal sidewalks are proposed throughout the development. It would be beneficial for the internal sidewalk system to tie to the sidewalk system on Middlebrook Pike. Tying the two sidewalk systems would also allow residents to walk to the nearby Dollar General Market and other amenities further away. However, due to the narrow width of the entrance access property and the steep grade, it is most likely not feasible.

4h) All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.

5 **Middlebrook Pike Median Spacing:** TDOT has stated that this proposed development would not be allowed to have a median opening on Middlebrook Pike, requiring entering and exiting apartment traffic to make U-turns at existing upstream and downstream intersections. These existing intersections are currently experiencing considerable vehicle delays on the northbound and southbound approaches. These vehicle delays will be slightly exacerbated due to the increase in U-turn maneuvers by the trips generated by the development.

According to TDOT's Roadway Design Guidelines in Section 2-140.0, TDOT lists desirable median opening spacings for rural and urban locations. For this location in an urban environment on Middlebrook Pike, TDOT states that the desirable spacing is 660 feet centerline to centerline. However, it also states that a range of 440 feet to 880 feet is acceptable. Based on a TDOT minimum median spacing of 440 feet, the potential location for a new median opening for the Proposed Apartment Driveway would meet the 440-foot minimum precisely, as shown below.



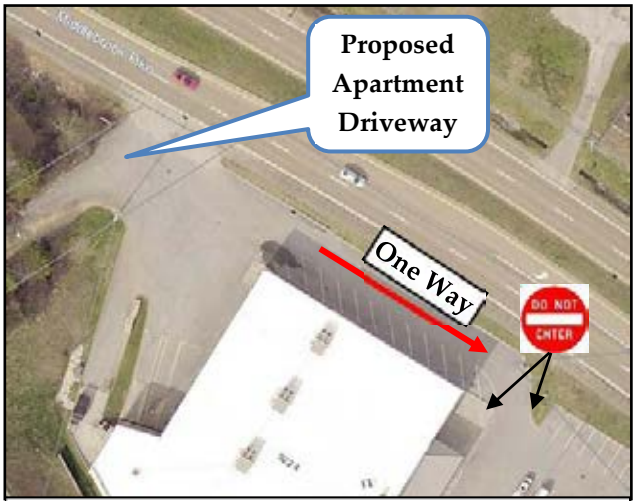
Existing Median Openings on Middlebrook Pike

There is enough existing width in the center median to construct a westbound exclusive left-turn lane at a potential median opening. The required sight distance is also available at this potential median opening.

If the decision is reversed to allow for a median opening, this will reduce the number of U-turns at the upstream and downstream intersections that are already suffering considerable vehicle delays and queues on the northbound and southbound approaches. It would also eliminate the need for the recommended eastbound right-turn lane for the Proposed Apartment Driveway.

Furthermore, it would even be beneficial if only a westbound left-turn-in movement is allowed to be constructed in the median. Allowing a left-turn-in only opening in the median, combined with a physical barrier to restrict left-turns-out (J-turn), would reduce the number of U-turns at the Middlebrook Pike at Andes Road/Church Driveway intersection. Allowing a left-turn-in from the median would also serve the more significant inbound movements for the apartments since it is expected and assumed in the study that the predominant travel direction for the apartment development will be to and from the east. This would also eliminate the need to construct an eastbound right-turn lane at the proposed driveway. A J-turn that would allow a large delivery truck to turn at this location into the Dollar General Driveway (Rear) would be beneficial and would eliminate truck U-turns from occurring at the intersection of Middlebrook Pike at Andes Road/Church Driveway. However, it would be challenging to design and construct a J-turn large enough to accommodate a large truck without opening the median too much to induce a motorist to make an illegal left-turn out. However, U-turns at Frederick Drive/Dollar General Driveway (Main) would still be necessary if left-turns-out were disallowed and physically blocked in the center median.

Furthermore, there is a high possibility that cut-thru traffic may be generated thru the Dollar General Market property if a median opening of any kind is not allowed at the Proposed Apartment Driveway location. Drivers will take the most direct route when travel time is potentially reduced. Forcing entering residents from the east to complete a U-turn further to the west may entice motorists to cut-thru the parking lot



One-Way Parking Lot Aisleway on North Side of Dollar General Market

areas at Dollar General.

The existing layout of the Dollar General Market includes a one-way parking aisle on the north side of the building; however, signage is not posted stating this restriction. This restriction is implied from the angled parking abutting the building on the north side. Large amounts of traffic on the one-way aisle would dissuade future apartment residents from cutting thru and traveling in the wrong direction on this aisle. However, there were very few observed vehicles traveling east on the one-way parking lot aisle. It is recommended that Do Not Enter Signs (R5-1) be installed on the east side of the aisleway, as shown in the image, to reduce this from occurring. This installation will need to be agreed to by Dollar General and may require facilitating by Knox County since it is on private property. While the signs will notify motorists of the restriction, the installation of speed humps would slow vehicle speeds and increase travel time to dissuade cut-thru traffic.

Overall, allowing a center median opening would be beneficial by reducing U-turns at the intersection of Middlebrook Pike at Andes Road/Church Driveway, eliminate the need for an exclusive eastbound right-turn lane, reduce operational turning conflicts at the shared driveway, and reduce the potential for cut-thru traffic on the Dollar General Market property. These issues could be resolved or lessened if a full median center opening or a left-turn-in only opening is allowed by TDOT.

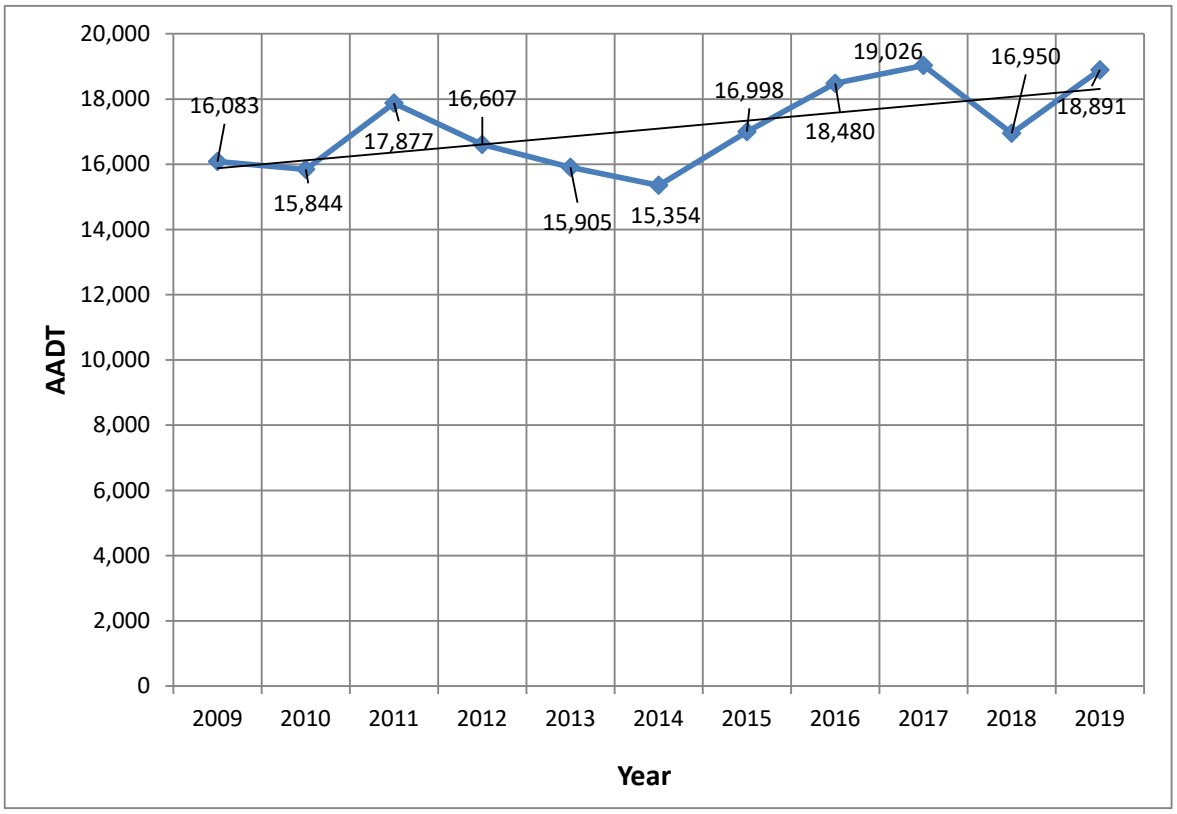
APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

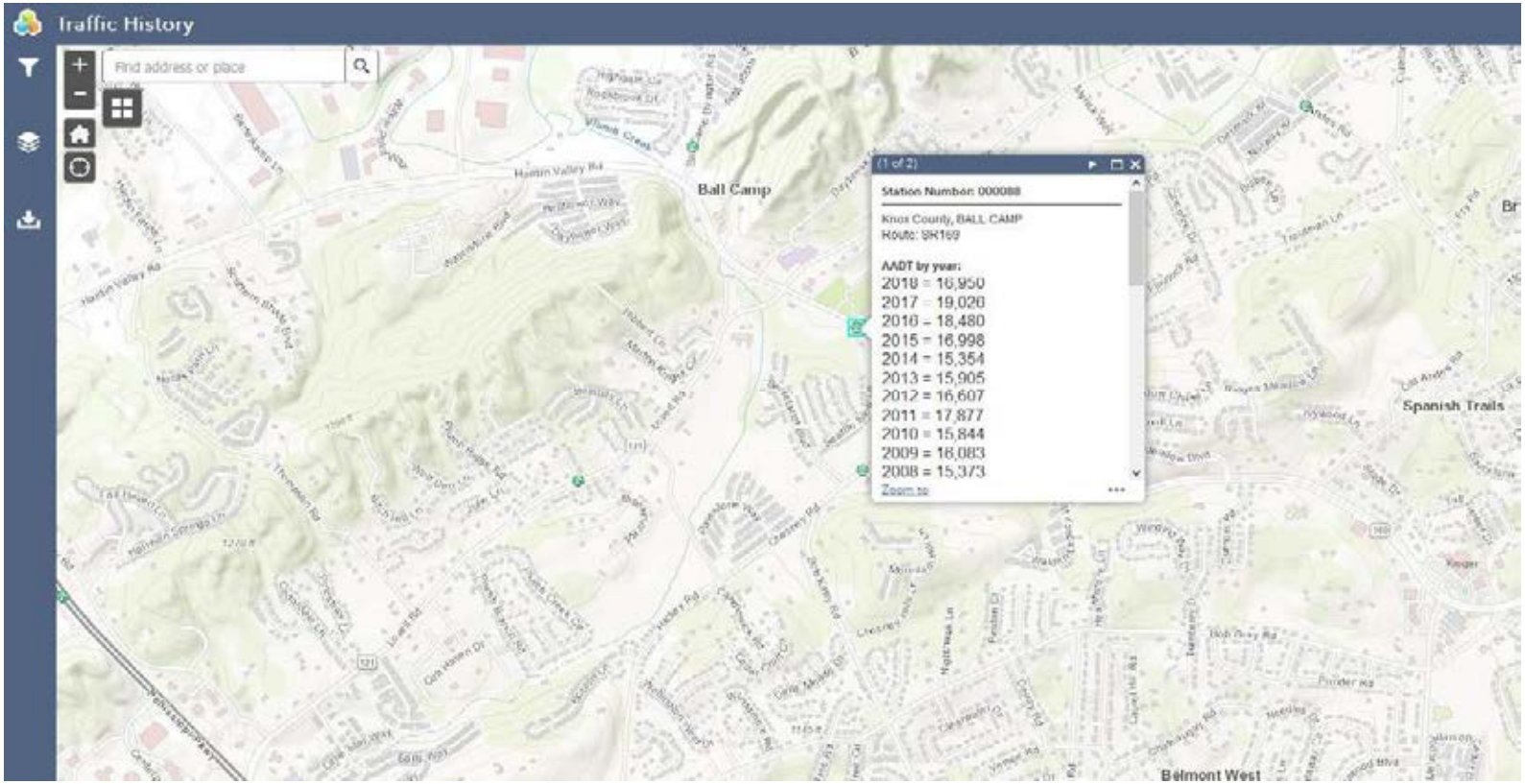
Historical Traffic Counts

Organization: TDOT
Station ID #: 000088
Location: Middlebrook Pike, east of Ball Camp Pike

YEAR	AADT
2009	16,083
2010	15,844
2011	17,877
2012	16,607
2013	15,905
2014	15,354
2015	16,998
2016	18,480
2017	19,026
2018	16,950
2019	18,891



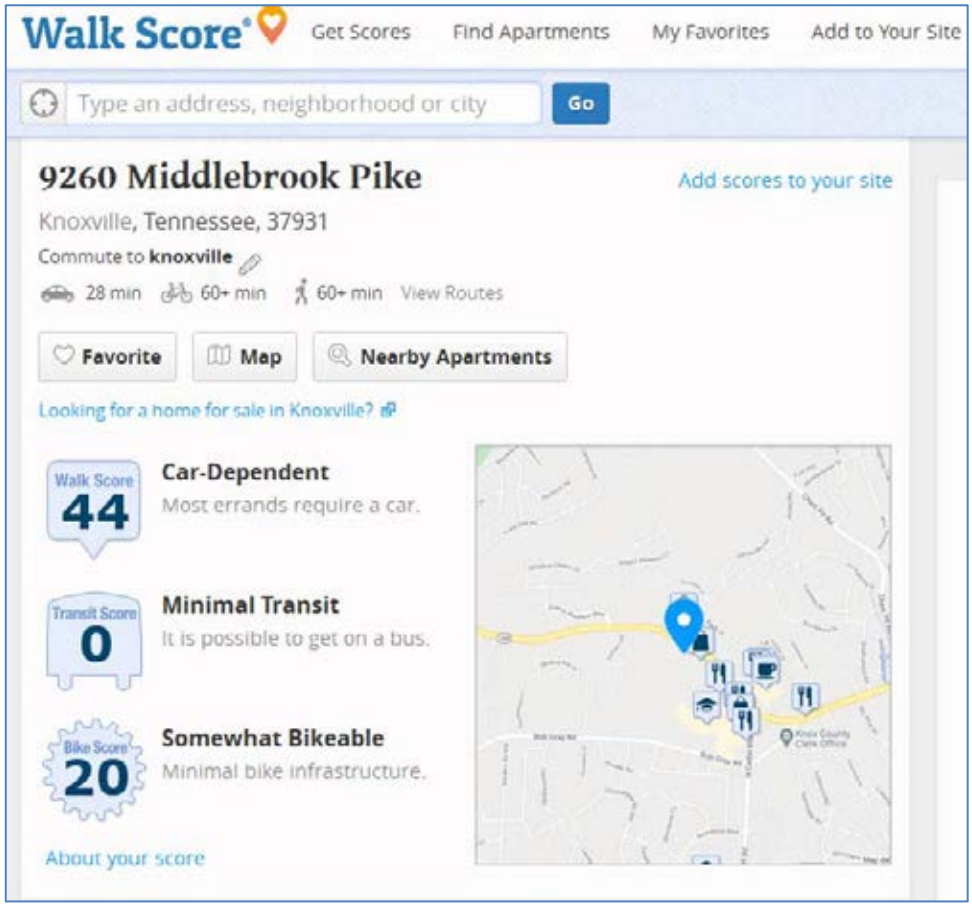
2009 - 2019 Growth Rate = 17.5%
Average Annual Growth Rate = 1.6%


Traffic History
Find address or place
Ball Camp
Spanish Trails
Belmont West
(1 of 2)
Station Number: 000088
Knox County, BALL CAMP
Route: SR169
AADT by year:
2018 = 16,950
2017 = 19,026
2016 = 18,480
2015 = 16,998
2014 = 15,354
2013 = 15,905
2012 = 16,607
2011 = 17,877
2010 = 15,844
2009 = 16,083
2008 = 15,373
Zoom to

APPENDIX B

WALK SCORE

WALKSCORE
(from walkscore.com)



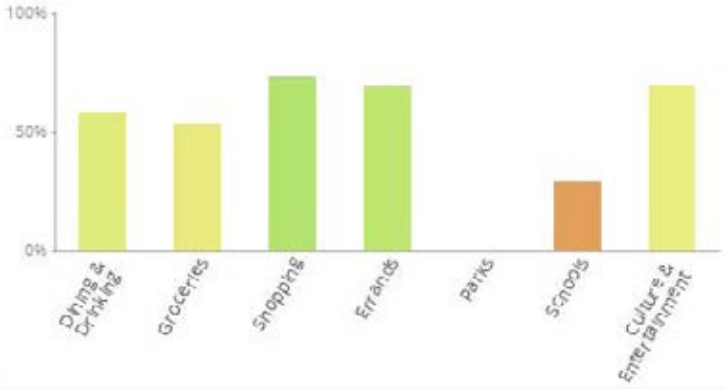
Scores for 9260 Middlebrook Pike

Walk Score 44 | Bike Score 20

Walk Score | Transit Score | Bike Score

Score Details | What is Walk Score

The Walk Score for 9260 Middlebrook Pike is based on the following categories.



Scores for 9260 Middlebrook Pike

Walk Score 44 | Bike Score 20

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 9260 Middlebrook Pike

Walk Score	Transit Score	Bike Score

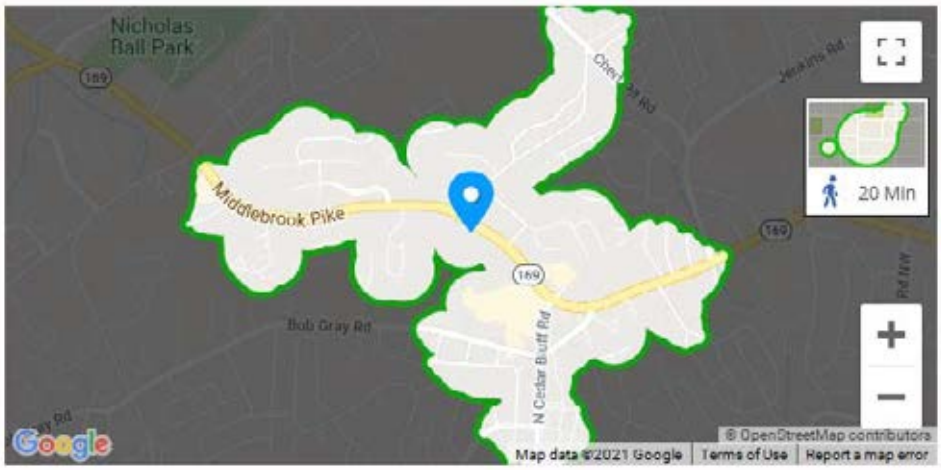
Bike Score measures whether an area is good for biking based on bike lanes and trails, hills, road connectivity, and destinations.

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 9260 Middlebrook Pike.



What's Nearby

Restaurants:
Aubrey's .2mi

Coffee:
Starbucks .3mi

Bars:
Roger .7mi

Groceries:
Kroger .3mi

Parks:
Ball Camp Park 1.1mi

Schools:
Tate's School of Discovery .3mi

Shopping:
Dollar General .03mi

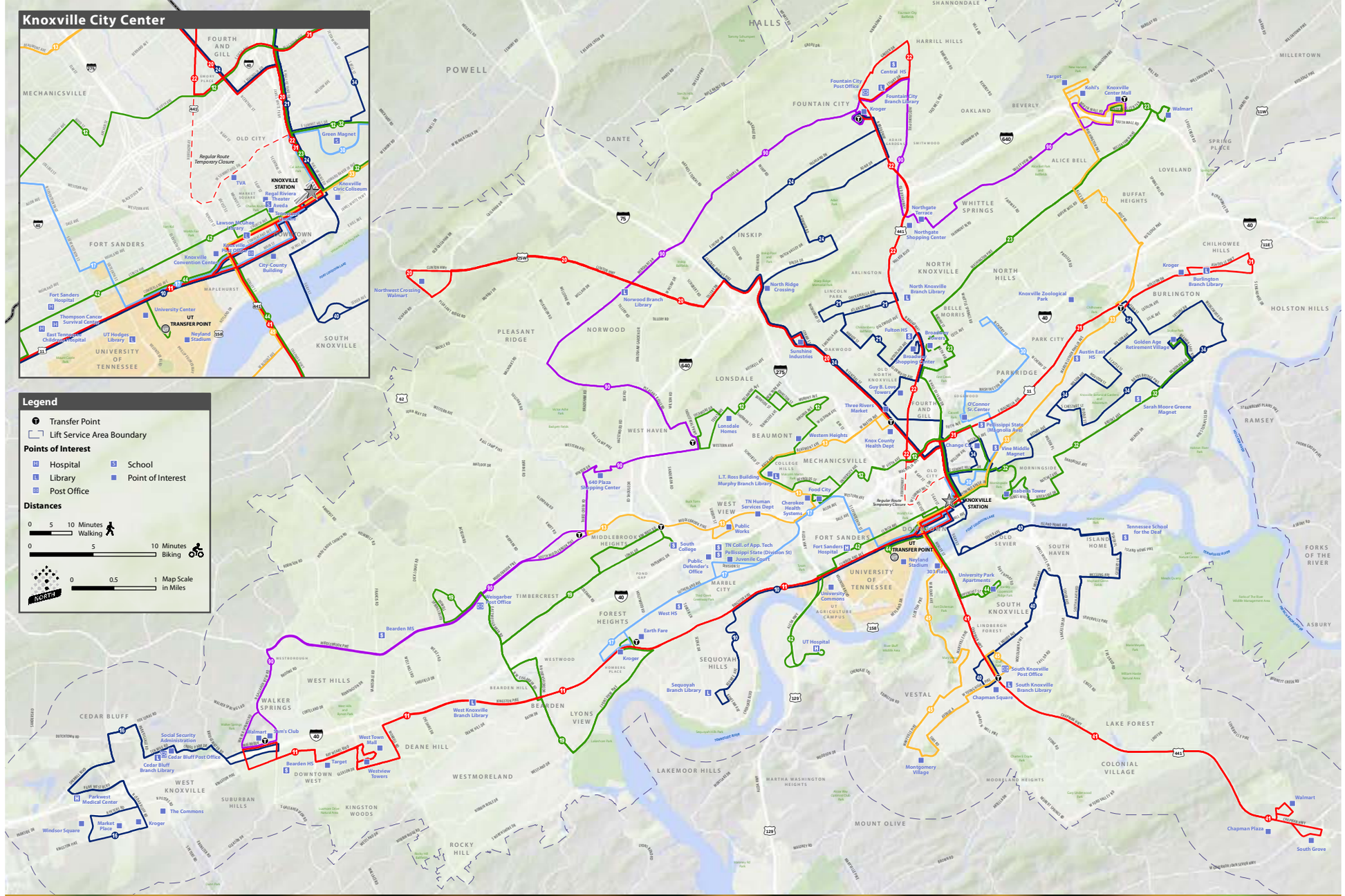
Entertainment:
Redbox .03mi

Errands:
Walgreens .3mi

Search Nearby:

APPENDIX C

KNOXVILLE AREA TRANSIT MAP AND INFORMATION



FARE INFORMATION

With a base fare of $1.50, KAT offers a variety of passes. Please note that only the fares marked with an asterisk can be purchased when boarding the bus. Others are available at KAT's Customer Service Counter at Knoxville Station (301 Church Ave.) or by mail via katbus.com.

FARE TYPE	REGULAR FARE	REDUCED FARE
One-Ride Pass*	$1.50	$0.75
1 Day Pass*	$4.00	$2.00
7 Day Pass	$15.00	$7.50
30 Day Pass	$50.00	$25.00
20 Ride Pass	$25.00	$12.50
Transfer*	$0.50	$0.25

REDUCED FARE INFORMATION

A reduced fare is available to those who qualify. Qualifying individuals include seniors age 65 or over, Medicare card holders, students under the age of 18, and persons with disabilities. Proper identification (Medicare card or a valid KAT I.D. card) is required before boarding. For more information on how to obtain a discounted-fare I.D. visit katbus.com/fares or call 637-3000.

BUS STOPS ONLY!

KAT buses stop ONLY at locations designated by bus stop signs. Generally, bus stops are located at least every ¼ mile along the route.

KAT HOLIDAYS

KAT buses do not run on the following holidays:

- New Year's Day
- Independence Day
- Thanksgiving
- Christmas

Please note that KAT's Knoxville Station Customer Service counter is also closed during those days.

KAT buses run on a Saturday schedule on the following holidays:

- Martin Luther King, Jr. Day
- Memorial Day
- Labor Day
- Day after Thanksgiving
- Christmas Eve

KAT's administrative offices are closed on all holidays listed above.

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

16 CEDAR BLUFF CONNECTOR

(Weekdays and Saturdays)

SERVES:

- Cedar Bluff
- Knoxville Catholic High School
- Kroger at The Landing
- Parkwest Hospital
- Social Security Administration
- Walmart
- Windsor Square

kat KNOXVILLE AREA TRANSIT

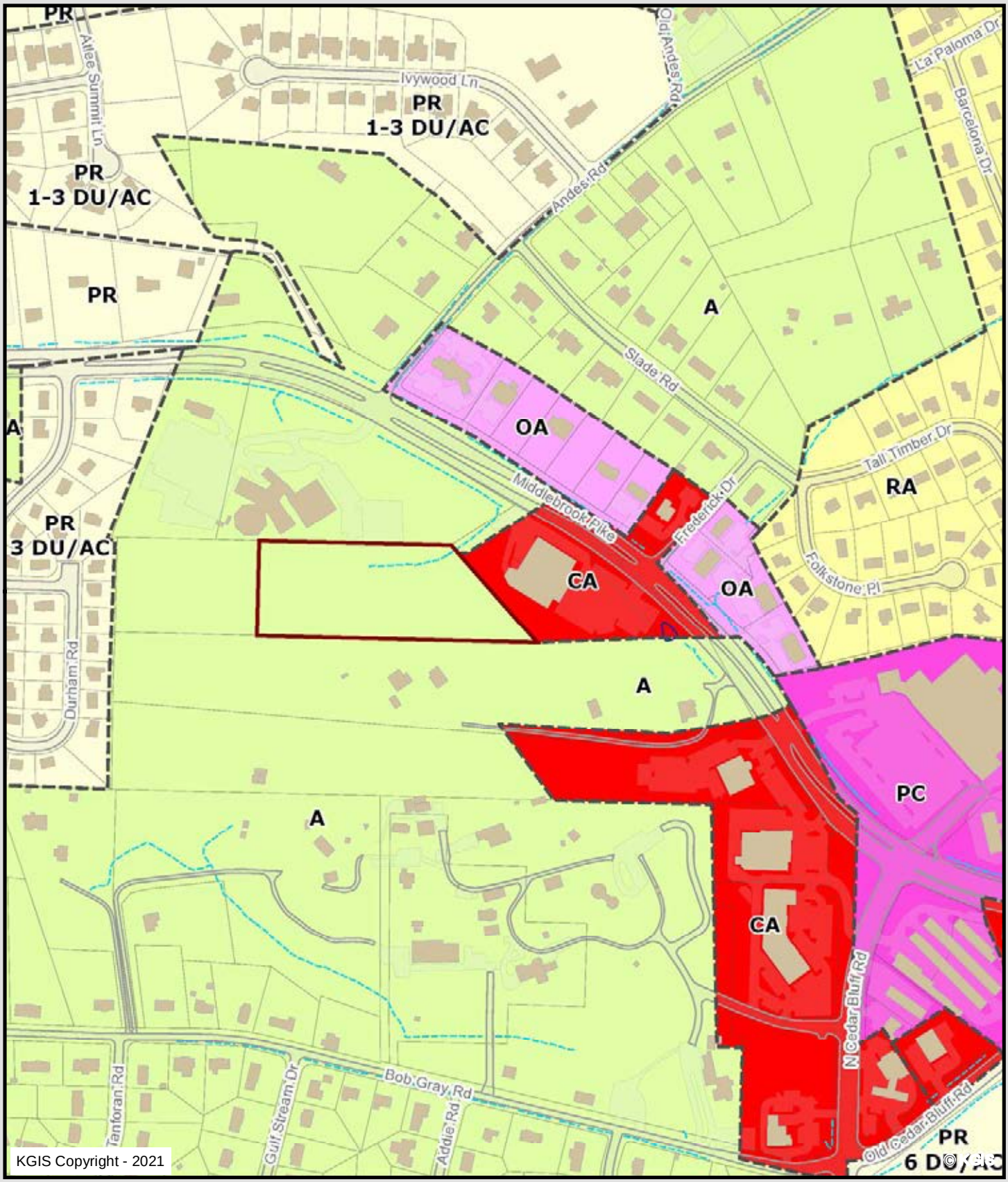
Information Updated: February 1, 2021

	Going from Wal Mart to Windsor Square				*Going from Windsor Square to Wal Mart*		
	T *Transfer to:*						*Rts. 11 & 90*
	Walmart 1	Park Village at Woodpark 2	Parkwest Hospital 3	Windsor Square 4	Parkwest Hospital 5	Cedar Bluff at Fox Lonas 6	Walmart 7
WEEKDAY SCHEDULE							
A.M.	6:15	6:27	6:32	6:42	6:50	6:54	7:10
	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10
	10:15	10:27	10:32	10:42	10:50	10:54	11:10
	11:15	11:27	11:32	11:42	11:50	11:54	**12:10**
P.M.	**12:15**	**12:27**	**12:32**	**12:42**	**12:50**	**12:54**	**1:10**
	1:15	**1:27**	**1:32**	**1:42**	**1:50**	**1:54**	**2:10**
	2:15	**2:27**	**2:32**	**2:42**	**2:50**	**2:54**	**3:10**
	3:15	**3:27**	**3:32**	**3:42**	**3:50**	**3:54**	**4:10**
	4:15	**4:27**	**4:32**	**4:42**	**4:50**	**4:54**	**5:10**
	5:15	**5:27**	**5:32**	**5:42**	**5:50**	**5:54**	**6:10**
	6:15	**6:27**	**6:32**	**6:42**	**6:50**	**6:54**	**7:10**
	7:15	**7:27**	**7:32**	**7:42**	**7:50**	**7:54**	**8:10**
	8:15	**8:27**	**8:32**	**8:42**	**8:50**	**8:54**	**9:10**
	9:15	**9:27**	**9:32**	**9:42**	**9:50**	**9:54**	**10:10**
SATURDAY SCHEDULE							
A.M.	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10
	10:15	10:27	10:32	10:42	10:50	10:54	11:10
	11:15	11:27	11:32	11:42	11:50	11:54	**12:10**
P.M.	**12:15**	**12:27**	**12:32**	**12:42**	**12:50**	**12:54**	**1:10**
	1:15	**1:27**	**1:32**	**1:42**	**1:50**	**1:54**	**2:10**
	2:15	**2:27**	**2:32**	**2:42**	**2:50**	**2:54**	**3:10**
	3:15	**3:27**	**3:32**	**3:42**	**3:50**	**3:54**	**4:10**
	4:15	**4:27**	**4:32**	**4:42**	**4:50**	**4:54**	**5:10**
	5:15	**5:27**	**5:32**	**5:42**	**5:50**	**5:54**	**6:10**
	6:15	**6:27**	**6:32**	**6:42**	**6:50**	**6:54**	**7:10**
	7:15	**7:27**	**7:32**	**7:42**	**7:50**	**7:54**	**8:10**
	8:15	**8:27**	**8:32**	**8:42**	**8:50**	**8:54**	**9:10**
	9:15	**9:27**	**9:32**	**9:42**	**9:50**	**9:54**	**10:10**

Need help reading this schedule?
Need other general information on how to ride?
Visit www.katbus.com or call 865-637-3000

APPENDIX D

ZONING MAP



Zoning Map

Knoxville - Knox County - KUB Geographic Information System

Printed: 4/14/2021 at 10:43:26 AM

0 200 400 800

ft

APPENDIX E

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Middlebrook Pike (EB-WB)
Minor Street: Andes Road (SB) and Church Driveway (NB)
Traffic Control: Stop Control on Minor Streets

4/21/2021 (Wednesday)
Mostly Cloudy/Cool
Conducted by: Ajax Engineering

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike					
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	TOTAL	HOUR
7:00 AM	7	0	8	0	94	0	0	0	0	0	0	110	0	0	219	
7:15 AM	15	0	6	2	122	1	0	0	0	0	0	151	0	0	297	
7:30 AM	21	0	22	7	160	1	0	1	0	1	3	205	3	0	424	**7:30 AM - 8:30 AM**
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	230	4	0	438	
8:00 AM	20	3	12	7	146	6	1	6	1	12	6	207	13	0	440	
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0	419	
8:30 AM	7	0	6	2	91	0	0	2	0	4	1	176	0	0	289	
8:45 AM	19	0	3	2	98	1	0	0	0	2	1	133	0	0	259	
TOTAL	124	8	82	42	995	16	3	15	5	50	12	1389	44	0	2785	
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1	260	
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	272	
11:30 AM	8	0	3	0	117	3	0	1	0	0	2	105	0	0	239	
11:45 AM	8	0	1	0	118	2	1	1	0	0	1	126	0	0	258	
12:00 PM	8	0	4	1	149	4	3	0	0	1	5	125	0	1	301	**12:00 PM - 1:00 PM**
12:15 PM	8	0	3	0	142	4	1	0	1	0	3	140	0	0	302	
12:30 PM	4	0	3	0	130	8	1	0	0	0	2	147	0	0	295	
12:45 PM	5	0	4	0	127	5	2	0	0	2	4	149	2	0	300	
TOTAL	57	0	24	3	1008	36	11	2	1	5	20	1056	2	2	2227	
2:00 PM	8	0	5	1	160	9	1	0	1	6	3	136	0	0	330	
2:15 PM	12	0	2	4	150	3	0	0	1	3	2	128	1	0	306	
2:30 PM	7	1	0	6	170	3	0	1	0	3	3	166	3	0	363	
2:45 PM	1	1	7	0	151	3	2	3	2	12	1	142	0	0	325	
3:00 PM	11	1	4	0	171	4	0	0	0	0	0	159	0	0	350	
3:15 PM	10	0	4	0	183	5	2	0	0	0	1	170	0	0	375	
3:30 PM	8	0	2	0	181	3	0	0	0	0	1	191	0	0	386	
3:45 PM	8	0	9	0	171	8	2	0	0	2	6	185	0	1	392	
4:00 PM	13	0	16	0	208	12	3	1	0	1	3	220	1	0	478	
4:15 PM	10	0	6	0	191	13	1	0	0	1	7	188	0	0	417	
4:30 PM	12	0	6	0	199	15	0	0	0	0	0	212	1	0	445	
4:45 PM	14	0	7	1	240	10	4	0	0	2	6	237	0	0	521	**4:45 PM - 5:45 PM**
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0	475	
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0	527	
5:30 PM	9	0	7	0	267	13	1	0	0	1	3	211	1	0	513	
5:45 PM	9	0	1	1	204	6	0	0	0	0	6	169	1	0	397	
TOTAL	157	3	95	14	3131	121	18	5	4	31	50	2961	9	1	6600	

2021 AM Peak Hour **7:30 AM - 8:30 AM**

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike			
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND			
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN
7:30 AM	21	0	22	7	160	1	0	1	0	1	3	205	3	0
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	230	4	0
8:00 AM	20	3	12	7	146	6	1	6	1	12	6	207	13	0
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0
TOTAL	**76**	**8**	**59**	**36**	**590**	**14**	**3**	**13**	**5**	**44**	**10**	**819**	**44**	**0**
PHF	**0.90**	**0.50**	**0.67**	**0.56**	**0.92**	**0.58**	**0.38**	**0.54**	**0.42**	**0.38**	**0.42**	**0.89**	**0.46**	**-**

2021 PM Peak Hour **4:45 PM - 5:45 PM**

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike			
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND			
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN
4:45 PM	14	0	7	1	240	10	4	0	0	2	6	237	0	0
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0
5:30 PM	9	0	7	0	267	13	1	0	0	1	3	211	1	0
TOTAL	**48**	**0**	**33**	**2**	**992**	**37**	**7**	**0**	**0**	**3**	**17**	**895**	**2**	**0**
PHF	**0.86**	**-**	**0.75**	**0.50**	**0.93**	**0.71**	**0.44**	**-**	**-**	**0.38**	**0.71**	**0.94**	**0.50**	**-**

TRAFFIC COUNT DATA

Major Street: Middlebrook Pike (EB-WB)
Minor Street: Frederick Drive (SB) and Dollar General Driveway (Main) (NB)
Traffic Control: Stop Control on Minor Streets

4/21/2021 (Wednesday)
Mostly Cloudy/Cool
Conducted by: Ajax Engineering

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike					
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	TOTAL	HOUR
7:00 AM	4	0	2	1	92	1	0	1	0	1	2	114	1	0	219	
7:15 AM	11	0	3	1	120	2	0	1	0	0	0	165	1	0	304	
7:30 AM	9	0	2	1	163	4	1	1	0	2	0	227	0	0	410	**7:30 AM - 8:30 AM**
7:45 AM	4	0	2	0	162	5	0	0	0	0	2	245	2	2	424	
8:00 AM	10	1	4	2	157	2	2	2	0	2	0	239	0	1	422	
8:15 AM	6	0	3	1	155	2	0	1	0	2	2	219	0	1	392	
8:30 AM	7	0	0	2	86	3	2	1	0	2	2	182	2	1	290	
8:45 AM	10	0	0	1	109	5	1	1	0	1	3	149	0	1	281	
TOTAL	61	1	16	9	1044	24	6	8	0	10	11	1540	6	6	2742	
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1	276	
11:15 AM	3	0	3	0	116	4	0	0	0	4	1	147	2	0	280	
11:30 AM	4	0	2	4	122	2	2	0	0	3	2	107	4	0	252	
11:45 AM	6	0	2	3	121	6	2	1	0	6	3	130	2	0	282	
12:00 PM	4	0	1	2	150	3	1	5	0	2	3	129	5	0	305	**12:00 PM - 1:00 PM**
12:15 PM	2	0	3	5	144	4	2	2	0	5	1	142	6	0	316	
12:30 PM	4	1	0	4	139	2	2	4	0	6	1	147	4	0	314	
12:45 PM	6	0	4	5	119	4	2	5	0	8	0	157	0	1	311	
TOTAL	36	1	18	26	1025	28	14	19	0	40	13	1089	25	2	2336	
2:00 PM	2	0	1	5	167	6	0	4	0	7	2	141	6	0	341	
2:15 PM	5	0	5	5	150	5	2	3	0	6	1	140	2	0	324	
2:30 PM	3	0	4	5	169	2	0	4	0	7	0	171	5	0	370	
2:45 PM	5	0	2	3	154	8	0	2	0	4	1	151	4	0	334	
3:00 PM	6	0	5	8	164	5	2	4	0	9	1	162	4	1	371	
3:15 PM	2	0	2	8	188	2	2	3	0	6	3	174	4	0	394	
3:30 PM	4	0	0	7	170	2	3	6	0	7	2	190	6	0	397	
3:45 PM	2	0	0	7	182	6	1	3	0	9	0	196	1	0	407	
4:00 PM	4	0	1	5	220	3	3	1	1	7	4	226	5	0	480	
4:15 PM	2	0	1	6	201	5	0	3	0	13	1	194	4	0	430	
4:30 PM	2	0	2	3	209	8	6	4	0	7	3	215	5	0	464	
4:45 PM	4	0	5	6	244	6	3	3	0	7	2	246	6	2	534	**4:45 PM - 5:45 PM**
5:00 PM	8	0	5	3	229	6	9	6	1	6	2	220	3	0	498	
5:15 PM	8	0	1	7	261	7	1	3	0	4	1	243	1	1	538	
5:30 PM	6	0	1	8	280	9	3	2	0	6	2	217	2	1	537	
5:45 PM	5	0	1	6	200	7	0	5	0	5	1	172	4	1	407	
TOTAL	68	0	36	92	3188	87	35	56	2	110	26	3058	62	6	6826	

2021 AM Peak Hour **7:30 AM - 8:30 AM**

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike			
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND			
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN
7:30 AM	9	0	2	1	163	4	1	1	0	2	0	227	0	0
7:45 AM	4	0	2	0	162	5	0	0	0	0	2	245	2	2
8:00 AM	10	1	4	2	157	2	2	2	0	2	0	239	0	1
8:15 AM	6	0	3	1	155	2	0	1	0	2	2	219	0	1
TOTAL	**29**	**1**	**11**	**4**	**637**	**13**	**3**	**4**	**0**	**6**	**4**	**930**	**2**	**4**
PHF	**0.73**	**0.25**	**0.69**	**0.50**	**0.98**	**0.65**	**0.38**	**0.50**	**-**	**0.75**	**0.50**	**0.95**	**0.25**	**0.50**

2021 PM Peak Hour **4:45 PM - 5:45 PM**

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike			
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND			
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN
4:45 PM	4	0	5	6	244	6	3	3	0	7	2	246	6	2
5:00 PM	8	0	5	3	229	6	9	6	1	6	2	220	3	0
5:15 PM	8	0	1	7	261	7	1	3	0	4	1	243	1	1
5:30 PM	6	0	1	8	280	9	3	2	0	6	2	217	2	1
TOTAL	**26**	**0**	**12**	**24**	**1014**	**28**	**16**	**14**	**1**	**23**	**7**	**926**	**12**	**4**
PHF	**0.81**	**-**	**0.60**	**0.75**	**0.91**	**0.78**	**0.44**	**0.58**	**0.25**	**0.82**	**0.88**	**0.94**	**0.50**	**0.50**

TRAFFIC COUNT DATA

Major Street: Middlebrook Pike (EB)
Minor Street: Dollar General Driveway (Rear) (NB)
Traffic Control: None

4/21/2021 (Wednesday)
Mostly Cloudy/Cool
Conducted by: Ajax Engineering

	Dollar General Driveway (Rear)	Middlebrook Pike			
TIME	NORTHBOUND	EASTBOUND		VEHICLE	PEAK
BEGIN	RT	THRU	RT	TOTAL	HOUR
7:00 AM	0	117	0	117	
7:15 AM	0	166	0	166	
7:30 AM	0	227	0	227	**7:30 AM - 8:30 AM**
7:45 AM	0	251	1	252	
8:00 AM	0	240	0	240	
8:15 AM	0	222	1	223	
8:30 AM	0	187	0	187	
8:45 AM	0	153	1	154	
TOTAL	0	1563	3	1566	
2:00 PM	0	149	2	151	
2:15 PM	0	143	0	143	
2:30 PM	0	176	0	176	
2:45 PM	0	156	1	157	
3:00 PM	0	168	2	170	
3:15 PM	0	181	1	182	
3:30 PM	0	198	1	199	
3:45 PM	0	197	0	197	
4:00 PM	0	235	2	237	
4:15 PM	0	199	1	200	
4:30 PM	0	223	1	224	
4:45 PM	0	256	1	257	**4:45 PM - 5:45 PM**
5:00 PM	0	225	3	228	
5:15 PM	0	246	0	246	
5:30 PM	0	222	0	222	
5:45 PM	0	178	0	178	
TOTAL	0	3152	15	3167	

2021 AM Peak Hour **7:30 AM - 8:30 AM**

	Dollar General Driveway (Rear)	Middlebrook Pike	
TIME	NORTHBOUND	EASTBOUND	
BEGIN	RT	THRU	RT
7:30 AM	0	227	0
7:45 AM	0	251	1
8:00 AM	0	240	0
8:15 AM	0	222	1
TOTAL	**0**	**940**	**2**
PHF	**-**	**0.94**	**0.50**

2021 PM Peak Hour **4:45 PM - 5:45 PM**

	Dollar General Driveway (Rear)	Middlebrook Pike	
TIME	NORTHBOUND	EASTBOUND	
BEGIN	RT	THRU	RT
4:45 PM	0	256	1
5:00 PM	0	225	3
5:15 PM	0	246	0
5:30 PM	0	222	0
TOTAL	**0**	**949**	**4**
PHF	**-**	**0.93**	**0.33**

TRAFFIC COUNT DATA

Major Street: Middlebrook Pike (EB-WB) 4/21/2021 (Wednesday)
Minor Street: Grassy Meadow Boulevard (SB) Mostly Cloudy/Cool
Traffic Control: Stop Control on Grassy Meadow Boulevarc Conducted by: Ajax Engineering

	Grassy Meadow Boulevard		Middlebrook Pike	Middlebrook Pike		
TIME	SOUTHBOUND		WESTBOUND	EASTBOUND	VEHICLE	PEAK
BEGIN	LT	RT	RT	LT	TOTAL	HOUR
7:00 AM					0	
7:15 AM					0	
7:30 AM	15	10	4	2	31	
7:45 AM	9	12	3	5	29	
8:00 AM	9	11	9	1	30	
8:15 AM	12	3	5	1	21	
8:30 AM					0	
8:45 AM					0	
TOTAL	45	36	21	9	111	
2:00 PM					0	
2:15 PM					0	
2:30 PM					0	
2:45 PM					0	
3:00 PM					0	
3:15 PM					0	
3:30 PM					0	
3:45 PM					0	
4:00 PM					0	
4:15 PM					0	
4:30 PM					0	
4:45 PM	9	6	11	4	30	
5:00 PM	9	5	6	6	26	
5:15 PM	9	2	16	5	32	
5:30 PM	6	3	9	5	23	
5:45 PM					0	
TOTAL	33	16	42	20	111	

APPENDIX F

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 8)

EXISTING TRAFFIC CONDITIONS

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	10	819	44	3	36	590	14	13	5	44	76	8
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	24	920	96	0	64	641	24	24	12	116	84	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	665			0	1016			1561	1810	508	1411	1845
vC1, stage 1 conf vol								1016	1016		782	782
vC2, stage 2 conf vol								545	794		629	1063
vCu, unblocked vol	665			0	1016			1561	1810	508	1411	1845
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	97			0	91			85	93	78	48	90
cM capacity (veh/h)	933			0	691			160	181	516	162	159

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	24	613	402	64	428	238	152	189
Volume Left	24	0	0	64	0	0	24	84
Volume Right	0	0	96	0	0	24	116	88
cSH	933	1700	1700	691	1700	1700	344	250
Volume to Capacity	0.03	0.36	0.24	0.09	0.25	0.14	0.44	0.75
Queue Length 95th (ft)	2	0	0	8	0	0	54	135
Control Delay (s)	9.0	0.0	0.0	10.7	0.0	0.0	23.4	53.0
Lane LOS	A			B			C	F
Approach Delay (s)	0.2			0.9			23.4	53.0
Approach LOS							C	F

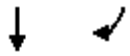
Intersection Summary				
Average Delay	6.9			
Intersection Capacity Utilization	52.3%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	59
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	88
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	333
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	333
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	87
cM capacity (veh/h)	670
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	4	4	930	2	3	4	637	13	4	0	6	29
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	8	979	8	0	8	650	20	8	0	8	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	670			0	987			1358	1685	493	1189
vC1, stage 1 conf vol									999	999		676
vC2, stage 2 conf vol									359	686		513
vCu, unblocked vol	0	670			0	987			1358	1685	493	1189
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	99			96	100	98	85
cM capacity (veh/h)	0	930			0	708			205	211	527	270

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	653	334	8	433	237	16	60
Volume Left	8	0	0	8	0	0	8	40
Volume Right	0	0	8	0	0	20	8	16
cSH	930	1700	1700	708	1700	1700	295	314
Volume to Capacity	0.01	0.38	0.20	0.01	0.25	0.14	0.05	0.19
Queue Length 95th (ft)	1	0	0	1	0	0	4	17
Control Delay (s)	8.9	0.0	0.0	10.1	0.0	0.0	17.9	19.2
Lane LOS	A			B			C	C
Approach Delay (s)	0.1			0.1			17.9	19.2
Approach LOS							C	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	36.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	11
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	16
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	1679	335
vC1, stage 1 conf vol	676	
vC2, stage 2 conf vol	1003	
vCu, unblocked vol	1679	335
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	98	98
cM capacity (veh/h)	210	667

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	940	2	0	656	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1011	6	0	729	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1017		1378	508
vC1, stage 1 conf vol					1014	
vC2, stage 2 conf vol					364	
vCu, unblocked vol			1017		1378	508
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			690		249	515

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	674	343	364	364	0
Volume Left	0	0	0	0	0
Volume Right	0	6	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.40	0.20	0.21	0.21	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	29.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	17	895	2	7	2	992	37	0	0	3	48	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	24	952	4	0	4	1067	52	0	0	8	56	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1119			0	956			1587	2129	478	1633	2105
vC1, stage 1 conf vol								1002	1002		1101	1101
vC2, stage 2 conf vol								585	1127		532	1004
vCu, unblocked vol	1119			0	956			1587	2129	478	1633	2105
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	99			100	100	99	67	100
cM capacity (veh/h)	632			0	727			170	151	540	167	160

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	24	635	321	4	711	408	8	100
Volume Left	24	0	0	4	0	0	0	56
Volume Right	0	0	4	0	0	52	8	44
cSH	632	1700	1700	727	1700	1700	540	235
Volume to Capacity	0.04	0.37	0.19	0.01	0.42	0.24	0.01	0.43
Queue Length 95th (ft)	3	0	0	0	0	0	1	50
Control Delay (s)	10.9	0.0	0.0	10.0	0.0	0.0	11.8	31.3
Lane LOS	B			A			B	D
Approach Delay (s)	0.3			0.0			11.8	31.3
Approach LOS							B	D

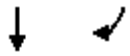
Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	46.6%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	33
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	44
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	559
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	559
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	91
cM capacity (veh/h)	478
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	4	7	926	12	16	24	1014	28	14	1	23	26
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	8	985	24	0	32	1114	36	24	4	28	32
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1150			0	1009			1654	2227	505	1735
vC1, stage 1 conf vol									1013	1013		1196
vC2, stage 2 conf vol									641	1214		539
vCu, unblocked vol	0	1150			0	1009			1654	2227	505	1735
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	95			86	97	95	77
cM capacity (veh/h)	0	615			0	695			168	142	518	141

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	657	352	32	743	407	56	52
Volume Left	8	0	0	32	0	0	24	32
Volume Right	0	0	24	0	0	36	28	20
cSH	615	1700	1700	695	1700	1700	248	192
Volume to Capacity	0.01	0.39	0.21	0.05	0.44	0.24	0.23	0.27
Queue Length 95th (ft)	1	0	0	4	0	0	21	26
Control Delay (s)	10.9	0.0	0.0	10.4	0.0	0.0	23.7	30.5
Lane LOS	B			B			C	D
Approach Delay (s)	0.1			0.3			23.7	30.5
Approach LOS							C	D

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	12
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2221	575
vC1, stage 1 conf vol	1196	
vC2, stage 2 conf vol	1025	
vCu, unblocked vol	2221	575
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	96
cM capacity (veh/h)	140	467

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	949	4	0	1044	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1020	12	0	1160	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1033		1606	516
vC1, stage 1 conf vol					1026	
vC2, stage 2 conf vol					580	
vCu, unblocked vol			1033		1606	516
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			681		220	509

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	680	352	580	580	0
Volume Left	0	0	0	0	0
Volume Right	0	12	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.40	0.21	0.34	0.34	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	32.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Church Driveway/Andes Road & Middlebrook Pike

5/13/2021

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	12	983	53	4	43	708	17	16	6	53	91	10
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	29	1104	115	0	77	770	29	30	14	139	101	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	799			0	1220			1874	2172	610	1694	2215
vC1, stage 1 conf vol								1219	1219		938	938
vC2, stage 2 conf vol								654	952		756	1277
vCu, unblocked vol	799			0	1220			1874	2172	610	1694	2215
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	97			0	87			74	89	69	1	82
cM capacity (veh/h)	833			0	579			112	136	443	103	109

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	29	736	483	77	513	286	183	227
Volume Left	29	0	0	77	0	0	30	101
Volume Right	0	0	115	0	0	29	139	106
cSH	833	1700	1700	579	1700	1700	268	169
Volume to Capacity	0.03	0.43	0.28	0.13	0.30	0.17	0.68	1.34
Queue Length 95th (ft)	3	0	0	11	0	0	114	338
Control Delay (s)	9.5	0.0	0.0	12.2	0.0	0.0	43.2	240.6
Lane LOS	A			B			E	F
Approach Delay (s)	0.2			1.1			43.2	240.6
Approach LOS							E	F

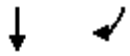
Intersection Summary				
Average Delay	25.2			
Intersection Capacity Utilization	58.8%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	71
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	106
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	399
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	399
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	83
cM capacity (veh/h)	607
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	5	5	1116	2	4	5	764	16	5	0	7	35
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	10	1175	8	0	10	780	25	10	0	9	48
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	804			0	1183			1629	2023	591	1429
vC1, stage 1 conf vol									1199	1199		812
vC2, stage 2 conf vol									431	824		617
vCu, unblocked vol	0	804			0	1183			1629	2023	591	1429
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	98			94	100	98	78
cM capacity (veh/h)	0	829			0	598			154	165	455	214

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	10	783	400	10	520	284	19	71
Volume Left	10	0	0	10	0	0	10	48
Volume Right	0	0	8	0	0	25	9	19
cSH	829	1700	1700	598	1700	1700	226	253
Volume to Capacity	0.01	0.46	0.24	0.02	0.31	0.17	0.09	0.28
Queue Length 95th (ft)	1	0	0	1	0	0	7	28
Control Delay (s)	9.4	0.0	0.0	11.1	0.0	0.0	22.4	24.6
Lane LOS	A			B			C	C
Approach Delay (s)	0.1			0.1			22.4	24.6
Approach LOS							C	C

Intersection Summary				
Average Delay	1.1			
Intersection Capacity Utilization	42.2%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	13
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	19
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2015	402
vC1, stage 1 conf vol	812	
vC2, stage 2 conf vol	1203	
vCu, unblocked vol	2015	402
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	98	97
cM capacity (veh/h)	164	604

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1128	2	0	787	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1213	6	0	874	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1219		1653	609
vC1, stage 1 conf vol					1216	
vC2, stage 2 conf vol					437	
vCu, unblocked vol			1219		1653	609
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			579		194	443

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	809	410	437	437	0
Volume Left	0	0	0	0	0
Volume Right	0	6	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.48	0.24	0.26	0.26	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Church Driveway/Andes Road & Middlebrook Pike

5/13/2021

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	20	1074	2	8	2	1190	44	0	0	4	58	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	28	1143	4	0	4	1280	62	0	0	11	67	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1342			0	1147			1902	2550	573	1957	2521
vC1, stage 1 conf vol								1201	1201		1319	1319
vC2, stage 2 conf vol								701	1350		638	1203
vCu, unblocked vol	1342			0	1147			1902	2550	573	1957	2521
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	95			0	99			100	100	98	45	100
cM capacity (veh/h)	520			0	617			124	111	468	122	120

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	28	762	385	4	853	488	11	121
Volume Left	28	0	0	4	0	0	0	67
Volume Right	0	0	4	0	0	62	11	53
cSH	520	1700	1700	617	1700	1700	468	177
Volume to Capacity	0.05	0.45	0.23	0.01	0.50	0.29	0.02	0.68
Queue Length 95th (ft)	4	0	0	0	0	0	2	102
Control Delay (s)	12.3	0.0	0.0	10.9	0.0	0.0	12.9	60.5
Lane LOS	B			B			B	F
Approach Delay (s)	0.3			0.0			12.9	60.5
Approach LOS							B	F

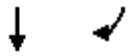
Intersection Summary				
Average Delay	3.0			
Intersection Capacity Utilization	53.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	40
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	53
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	671
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	671
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	87
cM capacity (veh/h)	405
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	5	8	1111	14	19	29	1217	34	17	1	28	31
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	9	1182	28	0	39	1337	44	29	4	34	38
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1381			0	1210			1983	2672	605	2082
vC1, stage 1 conf vol									1214	1214		1436
vC2, stage 2 conf vol									769	1458		645
vCu, unblocked vol	0	1381			0	1210			1983	2672	605	2082
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	98			0	93			76	96	92	61
cM capacity (veh/h)	0	503			0	584			123	103	446	98

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	788	422	39	892	489	67	62
Volume Left	9	0	0	39	0	0	29	38
Volume Right	0	0	28	0	0	44	34	23
cSH	503	1700	1700	584	1700	1700	191	137
Volume to Capacity	0.02	0.46	0.25	0.07	0.52	0.29	0.35	0.45
Queue Length 95th (ft)	1	0	0	5	0	0	37	51
Control Delay (s)	12.3	0.0	0.0	11.6	0.0	0.0	33.9	51.2
Lane LOS	B			B			D	F
Approach Delay (s)	0.1			0.3			33.9	51.2
Approach LOS							D	F

Intersection Summary				
Average Delay	2.2			
Intersection Capacity Utilization	51.1%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	14
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	23
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2665	690
vC1, stage 1 conf vol	1436	
vC2, stage 2 conf vol	1228	
vCu, unblocked vol	2665	690
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	94
cM capacity (veh/h)	101	393

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1139	5	0	1253	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1225	15	0	1392	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1240		1928	620
vC1, stage 1 conf vol					1232	
vC2, stage 2 conf vol					696	
vCu, unblocked vol			1240		1928	620
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			569		169	436

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	816	423	696	696	0
Volume Left	0	0	0	0	0
Volume Right	0	15	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.48	0.25	0.41	0.41	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

OPENING YEAR TRAFFIC CONDITIONS (WITHOUT THE PROJECT)

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	10	852	46	3	37	614	15	14	5	46	79	8
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	24	957	100	0	66	667	26	26	12	121	88	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	693			0	1057			1620	1880	529	1466	1917
vC1, stage 1 conf vol								1055	1055		812	812
vC2, stage 2 conf vol								565	825		653	1105
vCu, unblocked vol	693			0	1057			1620	1880	529	1466	1917
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	97			0	90			83	93	76	41	89
cM capacity (veh/h)	911			0	666			150	172	500	150	149

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	24	638	419	66	445	248	159	195
Volume Left	24	0	0	66	0	0	26	88
Volume Right	0	0	100	0	0	26	121	91
cSH	911	1700	1700	666	1700	1700	328	234
Volume to Capacity	0.03	0.38	0.25	0.10	0.26	0.15	0.48	0.83
Queue Length 95th (ft)	2	0	0	8	0	0	63	161
Control Delay (s)	9.1	0.0	0.0	11.0	0.0	0.0	25.8	67.2
Lane LOS	A			B			D	F
Approach Delay (s)	0.2			1.0			25.8	67.2
Approach LOS							D	F

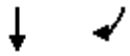
Intersection Summary				
Average Delay	8.3			
Intersection Capacity Utilization	53.5%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	61
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	91
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	347
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	347
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	86
cM capacity (veh/h)	656
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	4	4	967	2	3	4	662	14	4	0	6	30
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	8	1018	8	0	8	676	22	8	0	8	41
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	697			0	1026			1410	1751	513	1235
vC1, stage 1 conf vol									1038	1038		702
vC2, stage 2 conf vol									372	713		533
vCu, unblocked vol	0	697			0	1026			1410	1751	513	1235
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	99			96	100	98	84
cM capacity (veh/h)	0	909			0	685			194	201	512	258

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	679	347	8	450	247	16	61
Volume Left	8	0	0	8	0	0	8	41
Volume Right	0	0	8	0	0	22	8	16
cSH	909	1700	1700	685	1700	1700	282	300
Volume to Capacity	0.01	0.40	0.20	0.01	0.26	0.15	0.06	0.20
Queue Length 95th (ft)	1	0	0	1	0	0	4	19
Control Delay (s)	9.0	0.0	0.0	10.3	0.0	0.0	18.6	20.0
Lane LOS	A			B			C	C
Approach Delay (s)	0.1			0.1			18.6	20.0
Approach LOS							C	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	37.6%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	11
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	16
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	1744	349
vC1, stage 1 conf vol	702	
vC2, stage 2 conf vol	1042	
vCu, unblocked vol	1744	349
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	98	98
cM capacity (veh/h)	201	654

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	978	2	0	681	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1052	6	0	757	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1058		1433	529
vC1, stage 1 conf vol					1055	
vC2, stage 2 conf vol					378	
vCu, unblocked vol			1058		1433	529
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			666		236	500

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	701	357	378	378	0
Volume Left	0	0	0	0	0
Volume Right	0	6	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.41	0.21	0.22	0.22	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	30.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	18	931	2	7	2	1032	38	0	0	3	50	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	25	990	4	0	4	1110	54	0	0	8	58	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1163			0	994			1651	2214	497	1698	2190
vC1, stage 1 conf vol								1043	1043		1144	1144
vC2, stage 2 conf vol								608	1171		554	1045
vCu, unblocked vol	1163			0	994			1651	2214	497	1698	2190
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	99			100	100	98	63	100
cM capacity (veh/h)	608			0	704			160	142	524	157	151

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	25	660	334	4	740	423	8	103
Volume Left	25	0	0	4	0	0	0	58
Volume Right	0	0	4	0	0	54	8	45
cSH	608	1700	1700	704	1700	1700	524	221
Volume to Capacity	0.04	0.39	0.20	0.01	0.44	0.25	0.02	0.47
Queue Length 95th (ft)	3	0	0	0	0	0	1	57
Control Delay (s)	11.2	0.0	0.0	10.1	0.0	0.0	12.0	34.9
Lane LOS	B			B			B	D
Approach Delay (s)	0.3			0.0			12.0	34.9
Approach LOS							B	D

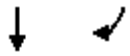
Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	47.9%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	34
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	45
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	582
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	582
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	90
cM capacity (veh/h)	463
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	4	7	963	12	17	25	1055	29	15	1	24	27
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	8	1024	24	0	33	1159	37	26	4	29	33
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1197			0	1048			1719	2316	524	1804
vC1, stage 1 conf vol									1052	1052		1245
vC2, stage 2 conf vol									666	1263		559
vCu, unblocked vol	0	1197			0	1048			1719	2316	524	1804
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	95			84	97	94	75
cM capacity (veh/h)	0	590			0	671			158	134	503	131

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	683	365	33	773	424	59	53
Volume Left	8	0	0	33	0	0	26	33
Volume Right	0	0	24	0	0	37	29	20
cSH	590	1700	1700	671	1700	1700	235	178
Volume to Capacity	0.01	0.40	0.21	0.05	0.45	0.25	0.25	0.30
Queue Length 95th (ft)	1	0	0	4	0	0	24	30
Control Delay (s)	11.2	0.0	0.0	10.6	0.0	0.0	25.4	33.6
Lane LOS	B			B			D	D
Approach Delay (s)	0.1			0.3			25.4	33.6
Approach LOS							D	D

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	12
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2309	598
vC1, stage 1 conf vol	1245	
vC2, stage 2 conf vol	1064	
vCu, unblocked vol	2309	598
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	96
cM capacity (veh/h)	131	451

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	987	4	0	1086	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1061	12	0	1207	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1073		1671	537
vC1, stage 1 conf vol					1067	
vC2, stage 2 conf vol					603	
vCu, unblocked vol			1073		1671	537
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			657		209	494

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	708	366	603	603	0
Volume Left	0	0	0	0	0
Volume Right	0	12	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.42	0.22	0.35	0.35	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	33.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	12	1022	55	4	45	736	18	17	6	55	95	10
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	29	1148	120	0	80	800	31	31	14	145	106	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	831			0	1268			1946	2257	634	1759	2301
vC1, stage 1 conf vol								1265	1265		976	976
vC2, stage 2 conf vol								681	992		783	1325
vCu, unblocked vol	831			0	1268			1946	2257	634	1759	2301
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	86			70	89	66	0	80
cM capacity (veh/h)	810			0	555			103	127	428	91	99

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	29	766	502	80	533	298	191	236
Volume Left	29	0	0	80	0	0	31	106
Volume Right	0	0	120	0	0	31	145	110
cSH	810	1700	1700	555	1700	1700	252	152
Volume to Capacity	0.04	0.45	0.30	0.14	0.31	0.18	0.76	1.55
Queue Length 95th (ft)	3	0	0	13	0	0	136	401
Control Delay (s)	9.6	0.0	0.0	12.6	0.0	0.0	53.0	332.5
Lane LOS	A			B			F	F
Approach Delay (s)	0.2			1.1			53.0	332.5
Approach LOS							F	F

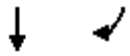
Intersection Summary				
Average Delay	34.1			
Intersection Capacity Utilization	60.3%	ICU Level of Service		B
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	74
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	110
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	416
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	416
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	81
cM capacity (veh/h)	593
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	5	5	1161	2	4	5	795	17	5	0	7	36
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	10	1222	8	0	10	811	26	10	0	9	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	837			0	1230			1694	2103	615	1485
vC1, stage 1 conf vol									1246	1246		844
vC2, stage 2 conf vol									448	857		640
vCu, unblocked vol	0	837			0	1230			1694	2103	615	1485
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	98			93	100	98	76
cM capacity (veh/h)	0	806			0	573			144	156	439	204

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	10	815	415	10	541	297	19	74
Volume Left	10	0	0	10	0	0	10	49
Volume Right	0	0	8	0	0	26	9	20
cSH	806	1700	1700	573	1700	1700	213	243
Volume to Capacity	0.01	0.48	0.24	0.02	0.32	0.17	0.09	0.30
Queue Length 95th (ft)	1	0	0	1	0	0	7	31
Control Delay (s)	9.5	0.0	0.0	11.4	0.0	0.0	23.6	26.1
Lane LOS	A			B			C	D
Approach Delay (s)	0.1			0.1			23.6	26.1
Approach LOS							C	D

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	43.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	14
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2094	419
vC1, stage 1 conf vol	844	
vC2, stage 2 conf vol	1250	
vCu, unblocked vol	2094	419
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	97	97
cM capacity (veh/h)	154	589

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1173	2	0	819	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1261	6	0	910	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1267		1719	634
vC1, stage 1 conf vol					1264	
vC2, stage 2 conf vol					455	
vCu, unblocked vol			1267		1719	634
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			555		183	427

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	841	426	455	455	0
Volume Left	0	0	0	0	0
Volume Right	0	6	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.49	0.25	0.27	0.27	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	35.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	21	1117	2	8	2	1238	46	0	0	4	60	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	30	1188	4	0	4	1331	65	0	0	11	70	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1396			0	1192			1979	2653	596	2035	2623
vC1, stage 1 conf vol								1249	1249		1372	1372
vC2, stage 2 conf vol								730	1404		664	1251
vCu, unblocked vol	1396			0	1192			1979	2653	596	2035	2623
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	94			0	99			100	100	98	39	100
cM capacity (veh/h)	496			0	593			114	102	452	114	112

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	30	792	400	4	887	509	11	126
Volume Left	30	0	0	4	0	0	0	70
Volume Right	0	0	4	0	0	65	11	56
cSH	496	1700	1700	593	1700	1700	452	166
Volume to Capacity	0.06	0.47	0.24	0.01	0.52	0.30	0.02	0.76
Queue Length 95th (ft)	5	0	0	1	0	0	2	120
Control Delay (s)	12.7	0.0	0.0	11.1	0.0	0.0	13.1	74.2
Lane LOS	B			B			B	F
Approach Delay (s)	0.3			0.0			13.1	74.2
Approach LOS							B	F

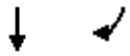
Intersection Summary				
Average Delay	3.6			
Intersection Capacity Utilization	54.9%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	42
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	56
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	698
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	698
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	86
cM capacity (veh/h)	389
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	5	8	1155	15	20	30	1266	35	18	1	29	32
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	9	1229	30	0	40	1391	45	31	4	35	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1436			0	1259			2063	2778	629	2164
vC1, stage 1 conf vol									1262	1262		1494
vC2, stage 2 conf vol									801	1516		670
vCu, unblocked vol	0	1436			0	1259			2063	2778	629	2164
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	98			0	93			73	96	92	56
cM capacity (veh/h)	0	479			0	559			114	96	430	90

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	819	440	40	927	509	70	65
Volume Left	9	0	0	40	0	0	31	40
Volume Right	0	0	30	0	0	45	35	25
cSH	479	1700	1700	559	1700	1700	178	128
Volume to Capacity	0.02	0.48	0.26	0.07	0.55	0.30	0.40	0.51
Queue Length 95th (ft)	1	0	0	6	0	0	44	59
Control Delay (s)	12.7	0.0	0.0	11.9	0.0	0.0	37.9	59.1
Lane LOS	B			B			E	F
Approach Delay (s)	0.1			0.3			37.9	59.1
Approach LOS							E	F

Intersection Summary				
Average Delay	2.5			
Intersection Capacity Utilization	52.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	15
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	25
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2771	718
vC1, stage 1 conf vol	1494	
vC2, stage 2 conf vol	1277	
vCu, unblocked vol	2771	718
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	93
cM capacity (veh/h)	93	377

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1185	5	0	1304	0	0
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1274	15	0	1449	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1289		2006	645
vC1, stage 1 conf vol					1282	
vC2, stage 2 conf vol					724	
vCu, unblocked vol			1289		2006	645
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			545		159	420

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	849	440	724	724	0
Volume Left	0	0	0	0	0
Volume Right	0	15	0	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.50	0.26	0.43	0.43	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					A
Approach Delay (s)	0.0		0.0		0.0
Approach LOS					A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	39.4%	ICU Level of Service	A
Analysis Period (min)	15		

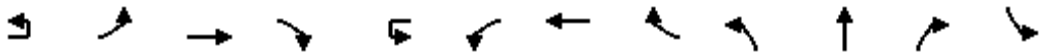
OPENING YEAR TRAFFIC CONDITIONS (WITH THE PROJECT)

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	10	856	46	10	37	627	15	14	5	46	79	8
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	24	962	100	0	66	682	26	26	12	121	88	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	707			0	1062			1631	1899	531	1482	1936
vC1, stage 1 conf vol								1059	1059		827	827
vC2, stage 2 conf vol								572	840		656	1109
vCu, unblocked vol	707			0	1062			1631	1899	531	1482	1936
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	97			0	90			83	93	76	41	89
cM capacity (veh/h)	901			0	664			148	170	499	148	147

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	24	641	421	66	454	253	159	195
Volume Left	24	0	0	66	0	0	26	88
Volume Right	0	0	100	0	0	26	121	91
cSH	901	1700	1700	664	1700	1700	326	231
Volume to Capacity	0.03	0.38	0.25	0.10	0.27	0.15	0.49	0.84
Queue Length 95th (ft)	2	0	0	8	0	0	64	164
Control Delay (s)	9.1	0.0	0.0	11.0	0.0	0.0	26.1	69.9
Lane LOS	A			B			D	F
Approach Delay (s)	0.2			0.9			26.1	69.9
Approach LOS							D	F

Intersection Summary				
Average Delay	8.5			
Intersection Capacity Utilization	53.7%	ICU Level of Service		A
Analysis Period (min)	15			

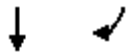
Movement	SBR
Lane Configurations	
Volume (veh/h)	61
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	91
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	354
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	354
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	86
cM capacity (veh/h)	649
Direction, Lane #	



Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	17	4	992	2	3	4	669	14	4	0	6	30
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	8	1044	8	0	8	683	22	8	0	8	41
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	704			0	1052			1439	1784	526	1256
vC1, stage 1 conf vol									1064	1064		709
vC2, stage 2 conf vol									375	720		546
vCu, unblocked vol	0	704			0	1052			1439	1784	526	1256
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	99			96	100	98	84
cM capacity (veh/h)	0	903			0	669			188	196	502	253

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	696	356	8	455	249	16	61
Volume Left	8	0	0	8	0	0	8	41
Volume Right	0	0	8	0	0	22	8	16
cSH	903	1700	1700	669	1700	1700	273	295
Volume to Capacity	0.01	0.41	0.21	0.01	0.27	0.15	0.06	0.21
Queue Length 95th (ft)	1	0	0	1	0	0	5	19
Control Delay (s)	9.0	0.0	0.0	10.4	0.0	0.0	19.0	20.4
Lane LOS	A			B			C	C
Approach Delay (s)	0.1			0.1			19.0	20.4
Approach LOS							C	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	38.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	11
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	16
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	1778	352
vC1, stage 1 conf vol	709	
vC2, stage 2 conf vol	1068	
vCu, unblocked vol	1778	352
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	98	98
cM capacity (veh/h)	195	651

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	978	13	0	701	0	38
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1052	39	0	779	0	42
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1091		1461	546
vC1, stage 1 conf vol					1071	
vC2, stage 2 conf vol					389	
vCu, unblocked vol			1091		1461	546
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	91
cM capacity (veh/h)			647		231	488

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	701	390	389	389	42
Volume Left	0	0	0	0	0
Volume Right	0	39	0	0	42
cSH	1700	1700	1700	1700	488
Volume to Capacity	0.41	0.23	0.23	0.23	0.09
Queue Length 95th (ft)	0	0	0	0	7
Control Delay (s)	0.0	0.0	0.0	0.0	13.1
Lane LOS					B
Approach Delay (s)	0.0		0.0		13.1
Approach LOS					B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	18	945	2	32	2	1043	38	0	0	3	50	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	25	1005	4	0	4	1122	54	0	0	8	58	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1175			0	1009			1672	2241	505	1718	2216
vC1, stage 1 conf vol								1058	1058		1156	1156
vC2, stage 2 conf vol								614	1183		561	1060
vCu, unblocked vol	1175			0	1009			1672	2241	505	1718	2216
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	99			100	100	98	62	100
cM capacity (veh/h)	602			0	695			156	139	519	154	148

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	25	670	339	4	748	427	8	103
Volume Left	25	0	0	4	0	0	0	58
Volume Right	0	0	4	0	0	54	8	45
cSH	602	1700	1700	695	1700	1700	519	218
Volume to Capacity	0.04	0.39	0.20	0.01	0.44	0.25	0.02	0.48
Queue Length 95th (ft)	3	0	0	0	0	0	1	58
Control Delay (s)	11.2	0.0	0.0	10.2	0.0	0.0	12.0	35.7
Lane LOS	B			B			B	E
Approach Delay (s)	0.3			0.0			12.0	35.7
Approach LOS							B	E

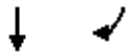
Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	48.2%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	34
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	45
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	588
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	588
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	90
cM capacity (veh/h)	459
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	15	7	984	12	17	25	1080	29	15	1	24	27
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	8	1047	24	0	33	1187	37	26	4	29	33
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1224			0	1071			1755	2365	535	1843
vC1, stage 1 conf vol									1075	1075		1272
vC2, stage 2 conf vol									680	1291		571
vCu, unblocked vol	0	1224			0	1071			1755	2365	535	1843
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	95			83	97	94	74
cM capacity (veh/h)	0	577			0	659			153	129	495	126

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	698	373	33	791	433	59	53
Volume Left	8	0	0	33	0	0	26	33
Volume Right	0	0	24	0	0	37	29	20
cSH	577	1700	1700	659	1700	1700	228	172
Volume to Capacity	0.01	0.41	0.22	0.05	0.47	0.25	0.26	0.31
Queue Length 95th (ft)	1	0	0	4	0	0	25	31
Control Delay (s)	11.3	0.0	0.0	10.8	0.0	0.0	26.3	35.0
Lane LOS	B			B			D	E
Approach Delay (s)	0.1			0.3			26.3	35.0
Approach LOS							D	E

Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	45.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	12
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2359	612
vC1, stage 1 conf vol	1272	
vC2, stage 2 conf vol	1087	
vCu, unblocked vol	2359	612
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	95
cM capacity (veh/h)	127	442

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	987	43	0	1122	0	32
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1061	130	0	1247	0	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1192		1750	596
vC1, stage 1 conf vol					1126	
vC2, stage 2 conf vol					623	
vCu, unblocked vol			1192		1750	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	92
cM capacity (veh/h)			593		195	452

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	708	484	623	623	36
Volume Left	0	0	0	0	0
Volume Right	0	130	0	0	36
cSH	1700	1700	1700	1700	452
Volume to Capacity	0.42	0.28	0.37	0.37	0.08
Queue Length 95th (ft)	0	0	0	0	6
Control Delay (s)	0.0	0.0	0.0	0.0	13.6
Lane LOS					B
Approach Delay (s)	0.0		0.0		13.6
Approach LOS					B

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	38.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	10	857	46	12	37	632	15	14	5	46	79	8
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	24	963	100	0	66	687	26	26	12	121	88	16
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	713			0	1063			1635	1906	531	1488	1943
vC1, stage 1 conf vol								1061	1061		832	832
vC2, stage 2 conf vol								575	845		656	1111
vCu, unblocked vol	713			0	1063			1635	1906	531	1488	1943
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	97			0	90			82	93	76	40	89
cM capacity (veh/h)	896			0	663			148	169	498	147	147

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	24	642	421	66	458	255	159	195
Volume Left	24	0	0	66	0	0	26	88
Volume Right	0	0	100	0	0	26	121	91
cSH	896	1700	1700	663	1700	1700	325	230
Volume to Capacity	0.03	0.38	0.25	0.10	0.27	0.15	0.49	0.85
Queue Length 95th (ft)	2	0	0	8	0	0	64	166
Control Delay (s)	9.1	0.0	0.0	11.0	0.0	0.0	26.2	70.8
Lane LOS	A			B			D	F
Approach Delay (s)	0.2			0.9			26.2	70.8
Approach LOS							D	F

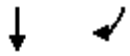
Intersection Summary				
Average Delay	8.5			
Intersection Capacity Utilization	53.7%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	61
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	91
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	356
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	356
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	86
cM capacity (veh/h)	647
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	22	4	999	2	3	4	671	14	4	0	6	30
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	8	1052	8	0	8	685	22	8	0	8	41
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	706			0	1060			1448	1794	530	1261
vC1, stage 1 conf vol									1072	1072		711
vC2, stage 2 conf vol									376	722		550
vCu, unblocked vol	0	706			0	1060			1448	1794	530	1261
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	99			96	100	98	84
cM capacity (veh/h)	0	901			0	665			186	195	499	252

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	701	359	8	456	250	16	61
Volume Left	8	0	0	8	0	0	8	41
Volume Right	0	0	8	0	0	22	8	16
cSH	901	1700	1700	665	1700	1700	271	293
Volume to Capacity	0.01	0.41	0.21	0.01	0.27	0.15	0.06	0.21
Queue Length 95th (ft)	1	0	0	1	0	0	5	19
Control Delay (s)	9.0	0.0	0.0	10.5	0.0	0.0	19.1	20.5
Lane LOS	A			B			C	C
Approach Delay (s)	0.1			0.1			19.1	20.5
Approach LOS							C	C

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	38.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	11
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	16
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	1787	353
vC1, stage 1 conf vol	711	
vC2, stage 2 conf vol	1076	
vCu, unblocked vol	1787	353
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	98	98
cM capacity (veh/h)	194	650

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	978	16	0	708	0	50
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1052	48	0	787	0	56
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1100		1469	550
vC1, stage 1 conf vol					1076	
vC2, stage 2 conf vol					393	
vCu, unblocked vol			1100		1469	550
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	89
cM capacity (veh/h)			642		230	484

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	701	399	393	393	56
Volume Left	0	0	0	0	0
Volume Right	0	48	0	0	56
cSH	1700	1700	1700	1700	484
Volume to Capacity	0.41	0.23	0.23	0.23	0.11
Queue Length 95th (ft)	0	0	0	0	10
Control Delay (s)	0.0	0.0	0.0	0.0	13.4
Lane LOS					B
Approach Delay (s)	0.0		0.0		13.4
Approach LOS					B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	37.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	18	948	2	40	2	1046	38	0	0	3	50	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	25	1009	4	0	4	1125	54	0	0	8	58	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1178			0	1013			1677	2247	506	1722	2223
vC1, stage 1 conf vol								1061	1061		1159	1159
vC2, stage 2 conf vol								616	1186		563	1063
vCu, unblocked vol	1178			0	1013			1677	2247	506	1722	2223
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	99			100	100	98	62	100
cM capacity (veh/h)	600			0	693			156	138	517	154	147

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	25	672	340	4	750	428	8	103
Volume Left	25	0	0	4	0	0	0	58
Volume Right	0	0	4	0	0	54	8	45
cSH	600	1700	1700	693	1700	1700	517	217
Volume to Capacity	0.04	0.40	0.20	0.01	0.44	0.25	0.02	0.48
Queue Length 95th (ft)	3	0	0	0	0	0	1	59
Control Delay (s)	11.3	0.0	0.0	10.2	0.0	0.0	12.1	35.9
Lane LOS	B			B			B	E
Approach Delay (s)	0.3			0.0			12.1	35.9
Approach LOS							B	E

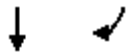
Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	53.1%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	34
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	45
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	589
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	589
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	90
cM capacity (veh/h)	458
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	18	7	990	12	17	25	1088	29	15	1	24	27
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	8	1053	24	0	33	1196	37	26	4	29	33
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1233			0	1077			1766	2381	539	1855
vC1, stage 1 conf vol									1081	1081		1281
vC2, stage 2 conf vol									684	1299		574
vCu, unblocked vol	0	1233			0	1077			1766	2381	539	1855
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	95			83	97	94	73
cM capacity (veh/h)	0	572			0	655			151	128	493	124

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	702	375	33	797	436	59	53
Volume Left	8	0	0	33	0	0	26	33
Volume Right	0	0	24	0	0	37	29	20
cSH	572	1700	1700	655	1700	1700	226	170
Volume to Capacity	0.01	0.41	0.22	0.05	0.47	0.26	0.26	0.31
Queue Length 95th (ft)	1	0	0	4	0	0	25	32
Control Delay (s)	11.4	0.0	0.0	10.8	0.0	0.0	26.5	35.5
Lane LOS	B			B			D	E
Approach Delay (s)	0.1			0.3			26.5	35.5
Approach LOS							D	E

Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	45.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	12
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2374	616
vC1, stage 1 conf vol	1281	
vC2, stage 2 conf vol	1093	
vCu, unblocked vol	2374	616
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	95
cM capacity (veh/h)	125	439

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	987	54	0	1133	0	41
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1061	164	0	1259	0	46
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1225		1773	612
vC1, stage 1 conf vol					1143	
vC2, stage 2 conf vol					629	
vCu, unblocked vol			1225		1773	612
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	90
cM capacity (veh/h)			576		191	441

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	708	517	629	629	46
Volume Left	0	0	0	0	0
Volume Right	0	164	0	0	46
cSH	1700	1700	1700	1700	441
Volume to Capacity	0.42	0.30	0.37	0.37	0.10
Queue Length 95th (ft)	0	0	0	0	9
Control Delay (s)	0.0	0.0	0.0	0.0	14.1
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.1
Approach LOS					B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	12	1026	55	11	45	749	18	17	6	55	95	10
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	29	1153	120	0	80	814	31	31	14	145	106	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	845			0	1272			1958	2276	636	1776	2320
vC1, stage 1 conf vol								1270	1270		990	990
vC2, stage 2 conf vol								688	1006		785	1330
vCu, unblocked vol	845			0	1272			1958	2276	636	1776	2320
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	85			69	89	66	0	80
cM capacity (veh/h)	800			0	553			102	125	426	89	98

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	29	769	504	80	543	302	191	236
Volume Left	29	0	0	80	0	0	31	106
Volume Right	0	0	120	0	0	31	145	110
cSH	800	1700	1700	553	1700	1700	250	150
Volume to Capacity	0.04	0.45	0.30	0.15	0.32	0.18	0.76	1.58
Queue Length 95th (ft)	3	0	0	13	0	0	138	406
Control Delay (s)	9.7	0.0	0.0	12.6	0.0	0.0	54.2	342.6
Lane LOS	A			B			F	F
Approach Delay (s)	0.2			1.1			54.2	342.6
Approach LOS							F	F

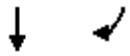
Intersection Summary			
Average Delay	34.9		
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	SBR
Lane Configurations	
Volume (veh/h)	74
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	110
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	423
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	423
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	81
cM capacity (veh/h)	586
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	18	5	1186	2	4	5	802	17	5	0	7	36
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	10	1248	8	0	10	818	26	10	0	9	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	845			0	1256			1724	2137	628	1505
vC1, stage 1 conf vol									1272	1272		851
vC2, stage 2 conf vol									451	865		654
vCu, unblocked vol	0	845			0	1256			1724	2137	628	1505
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	98			93	100	98	75
cM capacity (veh/h)	0	801			0	560			139	152	431	200

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	10	832	424	10	546	299	19	74
Volume Left	10	0	0	10	0	0	10	49
Volume Right	0	0	8	0	0	26	9	20
cSH	801	1700	1700	560	1700	1700	207	239
Volume to Capacity	0.01	0.49	0.25	0.02	0.32	0.18	0.09	0.31
Queue Length 95th (ft)	1	0	0	1	0	0	8	31
Control Delay (s)	9.6	0.0	0.0	11.5	0.0	0.0	24.2	26.6
Lane LOS	A			B			C	D
Approach Delay (s)	0.1			0.1			24.2	26.6
Approach LOS							C	D

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	44.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	14
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2128	422
vC1, stage 1 conf vol	851	
vC2, stage 2 conf vol	1276	
vCu, unblocked vol	2128	422
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	97	97
cM capacity (veh/h)	150	586

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1173	13	0	839	0	38
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1261	39	0	932	0	42
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1301		1747	650
vC1, stage 1 conf vol					1281	
vC2, stage 2 conf vol					466	
vCu, unblocked vol			1301		1747	650
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	90
cM capacity (veh/h)			539		179	417

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	841	460	466	466	42
Volume Left	0	0	0	0	0
Volume Right	0	39	0	0	42
cSH	1700	1700	1700	1700	417
Volume to Capacity	0.49	0.27	0.27	0.27	0.10
Queue Length 95th (ft)	0	0	0	0	8
Control Delay (s)	0.0	0.0	0.0	0.0	14.6
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.6
Approach LOS					B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	42.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Church Driveway/Andes Road & Middlebrook Pike

5/13/2021

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	21	1131	2	33	2	1249	46	0	0	4	60	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	30	1203	4	0	4	1343	65	0	0	11	70	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1408			0	1207			2000	2680	604	2055	2650
vC1, stage 1 conf vol								1264	1264		1383	1383
vC2, stage 2 conf vol								736	1416		671	1266
vCu, unblocked vol	1408			0	1207			2000	2680	604	2055	2650
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	94			0	99			100	100	98	37	100
cM capacity (veh/h)	491			0	585			112	100	447	112	110

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	30	802	405	4	895	512	11	126
Volume Left	30	0	0	4	0	0	0	70
Volume Right	0	0	4	0	0	65	11	56
cSH	491	1700	1700	585	1700	1700	447	163
Volume to Capacity	0.06	0.47	0.24	0.01	0.53	0.30	0.02	0.77
Queue Length 95th (ft)	5	0	0	1	0	0	2	123
Control Delay (s)	12.8	0.0	0.0	11.2	0.0	0.0	13.2	77.0
Lane LOS	B			B			B	F
Approach Delay (s)	0.3			0.0			13.2	77.0
Approach LOS							B	F

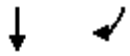
Intersection Summary				
Average Delay	3.7			
Intersection Capacity Utilization	55.2%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	42
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	56
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	704
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	704
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	85
cM capacity (veh/h)	385
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	16	8	1176	15	20	30	1291	35	18	1	29	32
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	9	1251	30	0	40	1419	45	31	4	35	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1464			0	1281			2099	2828	641	2202
vC1, stage 1 conf vol									1284	1284		1521
vC2, stage 2 conf vol									814	1544		681
vCu, unblocked vol	0	1464			0	1281			2099	2828	641	2202
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	98			0	93			72	96	92	54
cM capacity (veh/h)	0	468			0	549			110	93	423	86

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	834	447	40	946	518	70	65
Volume Left	9	0	0	40	0	0	31	40
Volume Right	0	0	30	0	0	45	35	25
cSH	468	1700	1700	549	1700	1700	173	123
Volume to Capacity	0.02	0.49	0.26	0.07	0.56	0.30	0.41	0.52
Queue Length 95th (ft)	1	0	0	6	0	0	45	62
Control Delay (s)	12.9	0.0	0.0	12.1	0.0	0.0	39.5	62.8
Lane LOS	B			B			E	F
Approach Delay (s)	0.1			0.3			39.5	62.8
Approach LOS							E	F

Intersection Summary				
Average Delay	2.5			
Intersection Capacity Utilization	52.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	15
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	25
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2820	732
vC1, stage 1 conf vol	1521	
vC2, stage 2 conf vol	1299	
vCu, unblocked vol	2820	732
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	93
cM capacity (veh/h)	90	369

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1185	44	0	1340	0	32
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1274	133	0	1489	0	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1408		2085	704
vC1, stage 1 conf vol					1341	
vC2, stage 2 conf vol					744	
vCu, unblocked vol			1408		2085	704
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	91
cM capacity (veh/h)			491		149	384

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	849	558	744	744	36
Volume Left	0	0	0	0	0
Volume Right	0	133	0	0	36
cSH	1700	1700	1700	1700	384
Volume to Capacity	0.50	0.33	0.44	0.44	0.09
Queue Length 95th (ft)	0	0	0	0	8
Control Delay (s)	0.0	0.0	0.0	0.0	15.3
Lane LOS					C
Approach Delay (s)	0.0		0.0		15.3
Approach LOS					C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Church Driveway/Andes Road & Middlebrook Pike

5/13/2021

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	12	1027	55	13	45	754	18	17	6	55	95	10
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.42	0.89	0.46	0.38	0.56	0.92	0.58	0.54	0.42	0.38	0.90	0.50
Hourly flow rate (vph)	29	1154	120	0	80	820	31	31	14	145	106	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	851			0	1273			1962	2282	637	1782	2326
vC1, stage 1 conf vol								1271	1271		996	996
vC2, stage 2 conf vol								691	1011		786	1331
vCu, unblocked vol	851			0	1273			1962	2282	637	1782	2326
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	96			0	85			69	89	66	0	79
cM capacity (veh/h)	796			0	552			102	125	426	89	98

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	29	769	504	80	546	304	191	236
Volume Left	29	0	0	80	0	0	31	106
Volume Right	0	0	120	0	0	31	145	110
cSH	796	1700	1700	552	1700	1700	249	149
Volume to Capacity	0.04	0.45	0.30	0.15	0.32	0.18	0.76	1.58
Queue Length 95th (ft)	3	0	0	13	0	0	138	408
Control Delay (s)	9.7	0.0	0.0	12.6	0.0	0.0	54.5	346.1
Lane LOS	A			B			F	F
Approach Delay (s)	0.2			1.1			54.5	346.1
Approach LOS							F	F

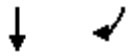
Intersection Summary			
Average Delay	35.1		
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	SBR
Lane Configurations	
Volume (veh/h)	74
Sign Control	
Grade	
Peak Hour Factor	0.67
Hourly flow rate (vph)	110
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	425
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	425
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	81
cM capacity (veh/h)	584
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	23	5	1193	2	4	5	804	17	5	0	7	36
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.50	0.95	0.25	0.38	0.50	0.98	0.65	0.50	0.90	0.75	0.73
Hourly flow rate (vph)	0	10	1256	8	0	10	820	26	10	0	9	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	847			0	1264			1732	2146	632	1511
vC1, stage 1 conf vol									1280	1280		853
vC2, stage 2 conf vol									452	867		657
vCu, unblocked vol	0	847			0	1264			1732	2146	632	1511
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	99			0	98			93	100	98	75
cM capacity (veh/h)	0	799			0	557			138	151	428	199

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	10	837	427	10	547	300	19	74
Volume Left	10	0	0	10	0	0	10	49
Volume Right	0	0	8	0	0	26	9	20
cSH	799	1700	1700	557	1700	1700	205	238
Volume to Capacity	0.01	0.49	0.25	0.02	0.32	0.18	0.09	0.31
Queue Length 95th (ft)	1	0	0	1	0	0	8	32
Control Delay (s)	9.6	0.0	0.0	11.6	0.0	0.0	24.4	26.8
Lane LOS	A			B			C	D
Approach Delay (s)	0.1			0.1			24.4	26.8
Approach LOS							C	D

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	44.5%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	1	14
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.25	0.69
Hourly flow rate (vph)	4	20
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2137	423
vC1, stage 1 conf vol	853	
vC2, stage 2 conf vol	1284	
vCu, unblocked vol	2137	423
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	97	97
cM capacity (veh/h)	149	585

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1173	16	0	846	0	50
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1261	48	0	940	0	56
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1310		1756	655
vC1, stage 1 conf vol					1286	
vC2, stage 2 conf vol					470	
vCu, unblocked vol			1310		1756	655
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	87
cM capacity (veh/h)			535		177	414

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	841	469	470	470	56
Volume Left	0	0	0	0	0
Volume Right	0	48	0	0	56
cSH	1700	1700	1700	1700	414
Volume to Capacity	0.49	0.28	0.28	0.28	0.13
Queue Length 95th (ft)	0	0	0	0	12
Control Delay (s)	0.0	0.0	0.0	0.0	15.0
Lane LOS					C
Approach Delay (s)	0.0		0.0		15.0
Approach LOS					C

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Church Driveway/Andes Road & Middlebrook Pike

5/13/2021

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (veh/h)	21	1134	2	41	2	1252	46	0	0	4	60	0
Sign Control		Free				Free			Stop			Stop
Grade		-4%				4%			-10%			-14%
Peak Hour Factor	0.71	0.94	0.50	0.44	0.50	0.93	0.71	0.90	0.90	0.38	0.86	0.90
Hourly flow rate (vph)	30	1206	4	0	4	1346	65	0	0	11	70	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised				Raised						
Median storage veh)		1				1						
Upstream signal (ft)												
pX, platoon unblocked				0.00								
vC, conflicting volume	1411			0	1210			2005	2687	605	2060	2656
vC1, stage 1 conf vol								1268	1268		1387	1387
vC2, stage 2 conf vol								737	1419		673	1270
vCu, unblocked vol	1411			0	1210			2005	2687	605	2060	2656
tC, single (s)	4.1			0.0	4.1			7.5	6.5	6.9	7.5	6.5
tC, 2 stage (s)								6.5	5.5		6.5	5.5
tF (s)	2.2			0.0	2.2			3.5	4.0	3.3	3.5	4.0
p0 queue free %	94			0	99			100	100	98	37	100
cM capacity (veh/h)	490			0	583			111	100	446	111	110

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	30	804	406	4	897	514	11	126
Volume Left	30	0	0	4	0	0	0	70
Volume Right	0	0	4	0	0	65	11	56
cSH	490	1700	1700	583	1700	1700	446	163
Volume to Capacity	0.06	0.47	0.24	0.01	0.53	0.30	0.02	0.77
Queue Length 95th (ft)	5	0	0	1	0	0	2	124
Control Delay (s)	12.8	0.0	0.0	11.2	0.0	0.0	13.3	77.8
Lane LOS	B			B			B	F
Approach Delay (s)	0.3			0.0			13.3	77.8
Approach LOS							B	F

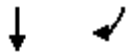
Intersection Summary				
Average Delay	3.7			
Intersection Capacity Utilization	55.3%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	SBR
Lane Configurations	
Volume (veh/h)	42
Sign Control	
Grade	
Peak Hour Factor	0.75
Hourly flow rate (vph)	56
Pedestrians	
Lane Width (ft)	
Walking Speed (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Median type	
Median storage veh)	
Upstream signal (ft)	
pX, platoon unblocked	
vC, conflicting volume	706
vC1, stage 1 conf vol	
vC2, stage 2 conf vol	
vCu, unblocked vol	706
tC, single (s)	6.9
tC, 2 stage (s)	
tF (s)	3.3
p0 queue free %	85
cM capacity (veh/h)	384
Direction, Lane #	

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Volume (veh/h)	19	8	1182	15	20	30	1299	35	18	1	29	32
Sign Control			Free				Free			Stop		
Grade			-3%				3%			-5%		
Peak Hour Factor	0.50	0.88	0.94	0.50	0.44	0.75	0.91	0.78	0.58	0.25	0.82	0.81
Hourly flow rate (vph)	0	9	1257	30	0	40	1427	45	31	4	35	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type			Raised				Raised					
Median storage veh)			1				1					
Upstream signal (ft)												
pX, platoon unblocked	0.00				0.00							
vC, conflicting volume	0	1472			0	1287			2109	2843	644	2214
vC1, stage 1 conf vol									1291	1291		1530
vC2, stage 2 conf vol									819	1552		684
vCu, unblocked vol	0	1472			0	1287			2109	2843	644	2214
tC, single (s)	0.0	4.1			0.0	4.1			7.5	6.5	6.9	7.5
tC, 2 stage (s)									6.5	5.5		6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
p0 queue free %	0	98			0	93			72	96	92	54
cM capacity (veh/h)	0	464			0	545			109	92	421	85

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	838	449	40	952	521	70	65
Volume Left	9	0	0	40	0	0	31	40
Volume Right	0	0	30	0	0	45	35	25
cSH	464	1700	1700	545	1700	1700	171	121
Volume to Capacity	0.02	0.49	0.26	0.07	0.56	0.31	0.41	0.53
Queue Length 95th (ft)	1	0	0	6	0	0	46	63
Control Delay (s)	12.9	0.0	0.0	12.1	0.0	0.0	40.0	64.1
Lane LOS	B			B			E	F
Approach Delay (s)	0.1			0.3			40.0	64.1
Approach LOS							E	F

Intersection Summary				
Average Delay	2.6			
Intersection Capacity Utilization	52.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	SBT	SBR
Lane Configurations		
Volume (veh/h)	0	15
Sign Control	Stop	
Grade	-10%	
Peak Hour Factor	0.90	0.60
Hourly flow rate (vph)	0	25
Pedestrians		
Lane Width (ft)		
Walking Speed (ft/s)		
Percent Blockage		
Right turn flare (veh)		
Median type		
Median storage veh)		
Upstream signal (ft)		
pX, platoon unblocked		
vC, conflicting volume	2836	736
vC1, stage 1 conf vol	1530	
vC2, stage 2 conf vol	1306	
vCu, unblocked vol	2836	736
tC, single (s)	6.5	6.9
tC, 2 stage (s)	5.5	
tF (s)	4.0	3.3
p0 queue free %	100	93
cM capacity (veh/h)	89	367

Direction, Lane #

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1185	55	0	1351	0	41
Sign Control	Free			Free	Stop	
Grade	-3%			3%	-3%	
Peak Hour Factor	0.93	0.33	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1274	167	0	1501	0	46
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh)	1			1		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1441		2108	720
vC1, stage 1 conf vol					1358	
vC2, stage 2 conf vol					751	
vCu, unblocked vol			1441		2108	720
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	88
cM capacity (veh/h)			477		146	375

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	849	591	751	751	46
Volume Left	0	0	0	0	0
Volume Right	0	167	0	0	46
cSH	1700	1700	1700	1700	375
Volume to Capacity	0.50	0.35	0.44	0.44	0.12
Queue Length 95th (ft)	0	0	0	0	10
Control Delay (s)	0.0	0.0	0.0	0.0	15.9
Lane LOS					C
Approach Delay (s)	0.0		0.0		15.9
Approach LOS					C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX G

LOCAL TRIP GENERATION RATES

Local Apartment
Trip Generation Study

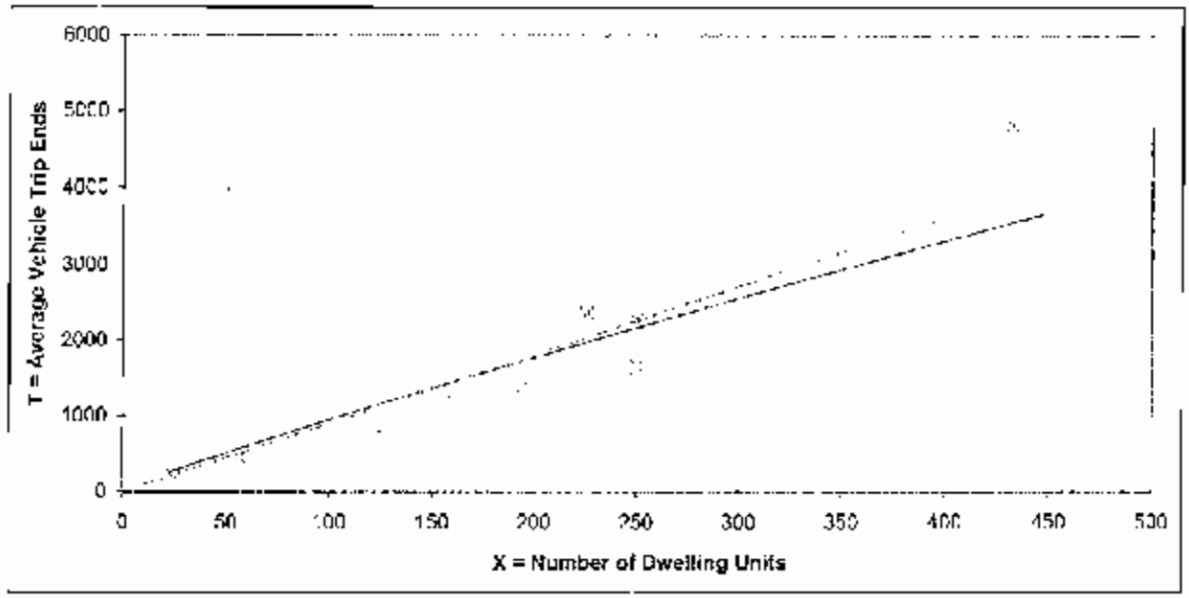
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

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

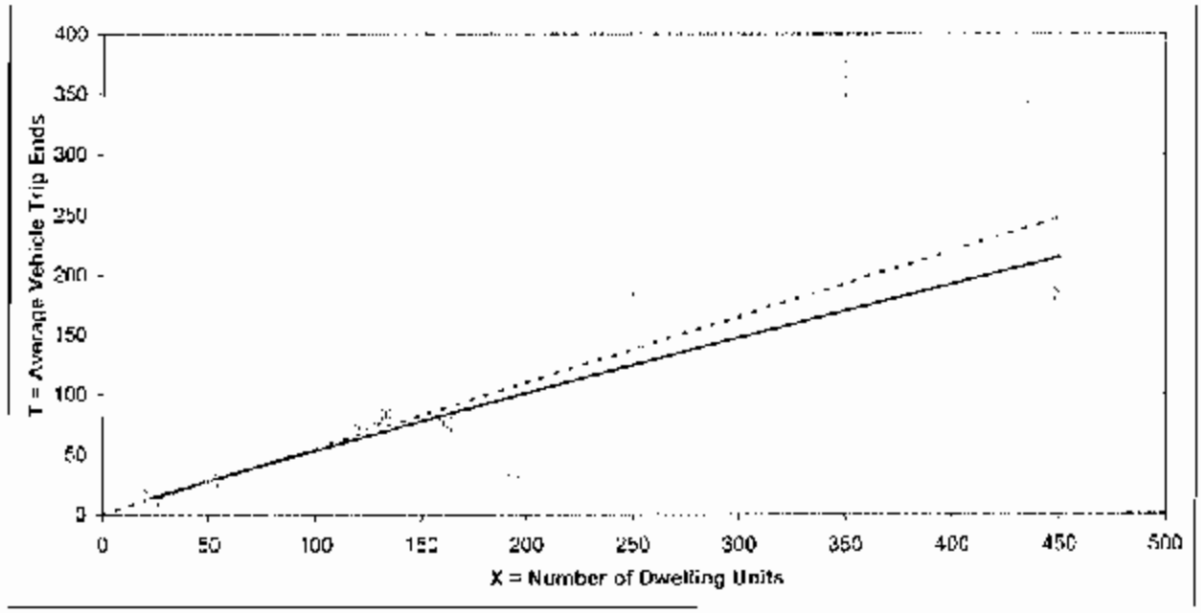
Local Apartment
Trip Generation Study

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

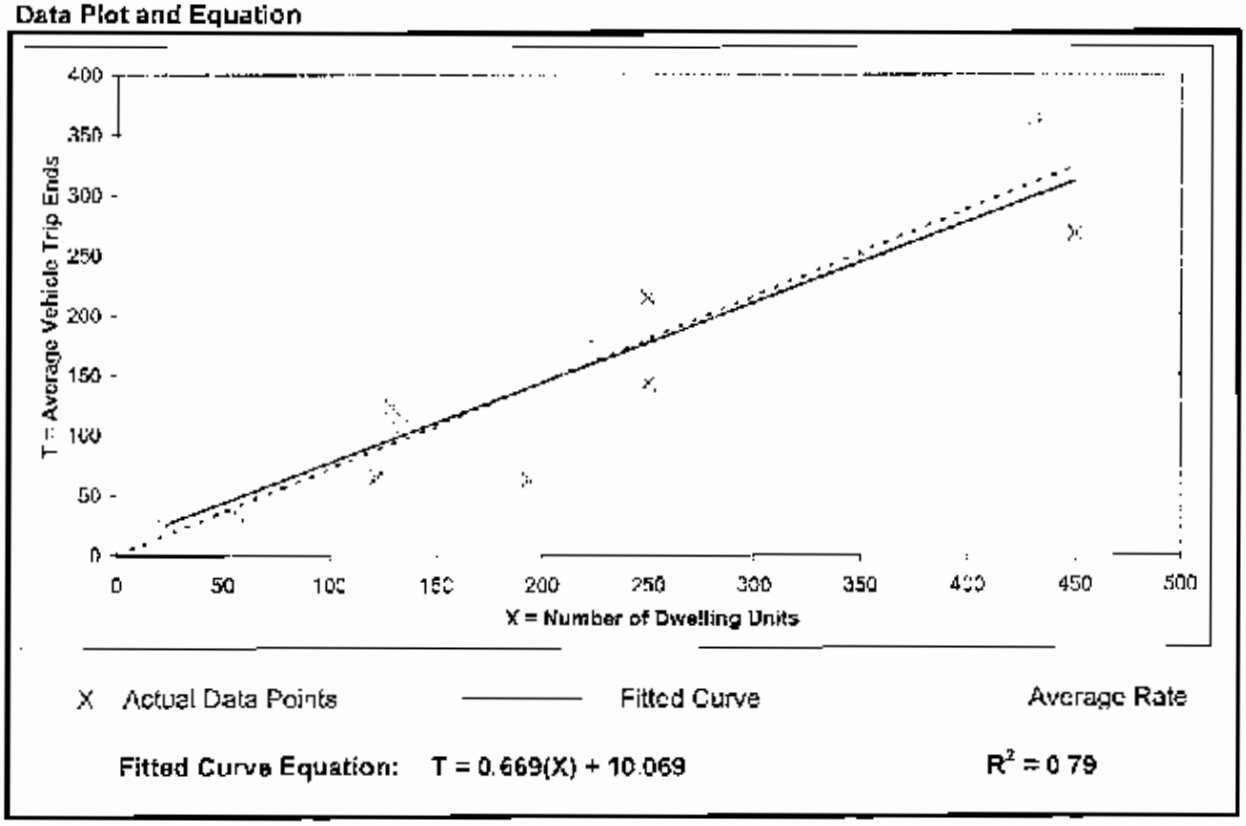
Local Apartment
Trip Generation Study

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



TRIP GENERATION FOR MIDDLEBROOK COMMONS

90 Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Apartments	90 Apartments	868	22%	78%		55%	45%	
				11	38	49	39	32	71
Total New Volume Site Trips			**868**	**11**	**38**	**49**	**39**	**32**	**71**

Local Trip Rates

Trips calculated by using Fitted Curve Equation

TRIP GENERATION FOR MIDDLEBROOK COMMONS

90 Apartments

90 Residences = X

Weekday:

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

T = 15 * 57.13

T = 868 trips

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

T = 0.758 * 64

T = 49 trips

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

T = 0.669 * 90 + 10.07

T = 71 trips

TRIP GENERATION FOR MIDDLEBROOK COMMONS

120 Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Apartments	120 Apartments	1,125	22%	78%		55%	45%	
				14	50	64	50	41	91
Total New Volume Site Trips			**1,125**	**14**	**50**	**64**	**50**	**41**	**91**

Local Trip Rates

Trips calculated by using Fitted Curve Equation

TRIP GENERATION FOR MIDDLEBROOK COMMONS

120 Apartments

120 Residences = X

Weekday:

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

T = 15 * 73.99

T = 1125 trips

Peak Hour of Adjacent Traffic between 7 and 9 am:

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

T = 0.758 * 83

T = 64 trips

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

T = 0.669 * 120 + 10.07

T = 91 trips

APPENDIX H

2018 CENSUS BUREAU DATA

OnTheMap

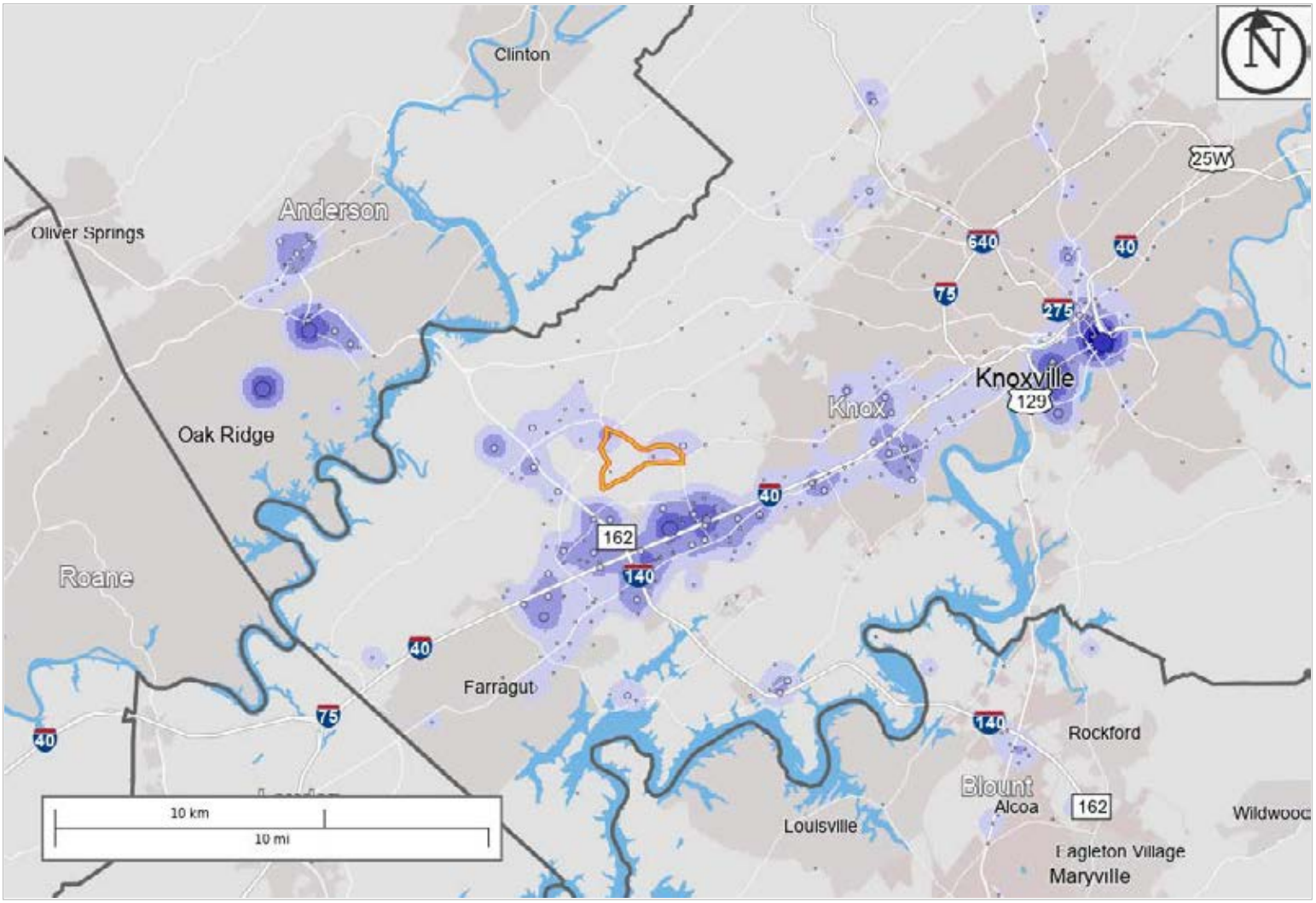
Distance/Direction Report - Home to Work

All Jobs for All Workers in 2018

Created by the U.S. Census Bureau's OnTheMap `https://onthemap.ces.census.gov` on 04/17/2021

Counts and Density of Work Locations for All Jobs in Home Selection Area in 2018

All Workers



Map Legend

Job Density [Jobs/Sq. Mile]

- 5 - 14
- 15 - 42
- 43 - 89
- 90 - 154
- 155 - 239

Job Count [Jobs/Census Block]

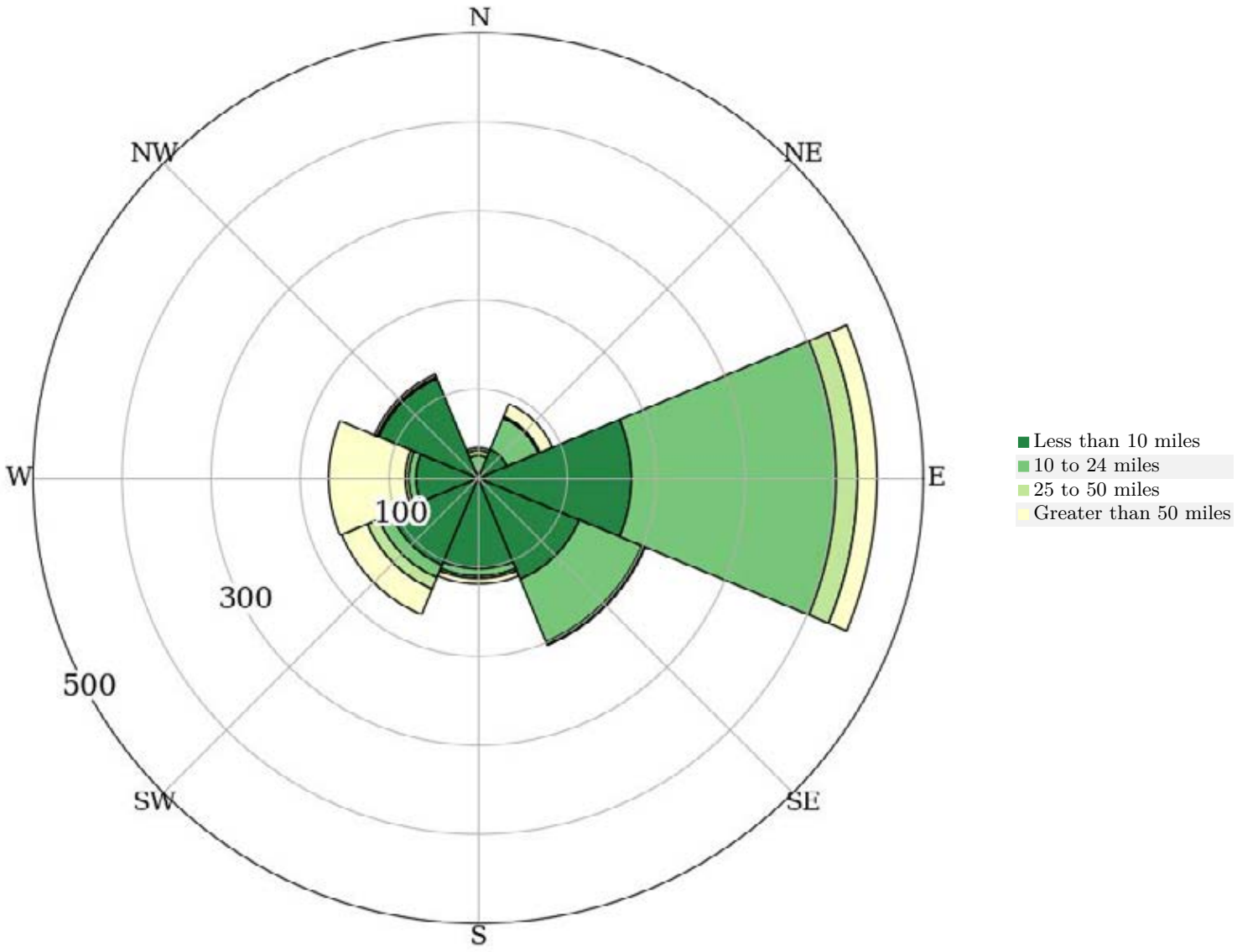
- 1 - 3
- 4 - 11
- 12 - 25
- 26 - 44
- 45 - 69

Selection Areas

- Analysis Selection

All Jobs for All Workers in 2018

Distance and Direction from Home Census Block to Work Census Block, Living in Selection Area



All Jobs for All Workers in 2018

Distance from Home Census Block to Work Census Block, Living in Selection Area

Distance	2018 Count	2018 Share
Total All Jobs	1,354	100.0
Less than 10 miles	735	54.3
10 to 24 miles	394	29.1
25 to 50 miles	58	4.3
Greater than 50 miles	167	12.3

Additional Information

Analysis Settings

Analysis Type	Distance/Direction
Selection area as	Home
Year(s)	2018
Job Type	All Jobs
Selection Area	46.12 (Knox, TN) from Census Tracts
Selected Census Blocks	16
Analysis Generation Date	04/17/2021 12:34 - OnTheMap 6.8
Code Revision	5dc8e60ec2609d78ebfa7d4b188db13aacbb1ba6
LODES Data Version	20201117_1559

Data Sources

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2018).

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 and in 2018.

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 - 249 250 - 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

978/2 = 489 * 1.05 = 514

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments

2023 Projected AM EB Right Turns = 13 without 20% Increase due to Pandemic

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 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

1173/2 = 586.5 * 1.05 = 616

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments

2023 Projected AM EB Right Turns = 13 with 20% Increase due to Pandemic

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 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

978/2 = 489 * 1.05 = 514

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 120 Apartments

2023 Projected AM EB Right Turns = 16 without 20% Increase due to Pandemic

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

1173/2 = 586.5 * 1.05 = 616

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance- 120 Apartments

2023 Projected AM EB Right Turns = 16 with 20% Increase due to Pandemic

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

987/2 = 493.5 * 1.05 = 519

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments

2023 Projected PM EB Right Turns = 43 without 20% Increase due to Pandemic

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 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

1185/2 = 592.5 * 1.05 = 623

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
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
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments

2023 Projected PM EB Right Turns = 44 with 20% Increase due to Pandemic

Right Turn Lane 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 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

987/2 = 493.5 * 1.05 = 519

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
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
600 or More	Yes			Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance - 120 Apartments

2023 Projected PM EB Right Turns = 54 without 20% Increase due to Pandemic

Right Turn Lane 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

1185/2 = 592.5 * 1.05 = 623

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
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
600 or More	Yes			Yes	Yes	Yes

Middlebrook Pike at Proposed Apartment Entrance- 120 Apartments

2023 Projected PM EB Right Turns = 55 with 20% Increase due to Pandemic

Right Turn Lane Warranted

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

APPENDIX J

MUTCD TRAFFIC SIGNAL WARRANT WORKSHEETS

Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2021 - Existing Traffic Volumes**

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

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	4	696	7	
8 - 9 AM	8	693	37	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	495	0	
12 - 1 PM	15	561	2	
1 - 2 PM				
2 - 3 PM	9	572	4	
3 - 4 PM	9	705	0	
4 - 5 PM	16	857	2	
5 - 6 PM	17	827	3	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,546	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	15	531	4	
8 - 9 AM	30	464	12	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	6	460	15	
12 - 1 PM	8	548	21	
1 - 2 PM				
2 - 3 PM	14	631	18	
3 - 4 PM	4	706	20	
4 - 5 PM	9	838	50	
5 - 6 PM	5	956	33	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,398	0

Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	2	1	3	
8 - 9 AM	13	4	47	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	2	0	2	
12 - 1 PM	0	1	3	
1 - 2 PM				
2 - 3 PM	4	4	24	
3 - 4 PM	0	0	2	
4 - 5 PM	1	0	4	
5 - 6 PM	0	0	1	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			118	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	63	1	51	
8 - 9 AM	61	7	31	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	32	0	10	
12 - 1 PM	25	0	14	
1 - 2 PM				
2 - 3 PM	28	2	14	
3 - 4 PM	37	1	19	
4 - 5 PM	49	0	35	
5 - 6 PM	43	0	27	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			550	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2021 - Existing Traffic Volumes

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Andes Road/Church Driveway
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	10944 vehicles	Total Approach Volume	668 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

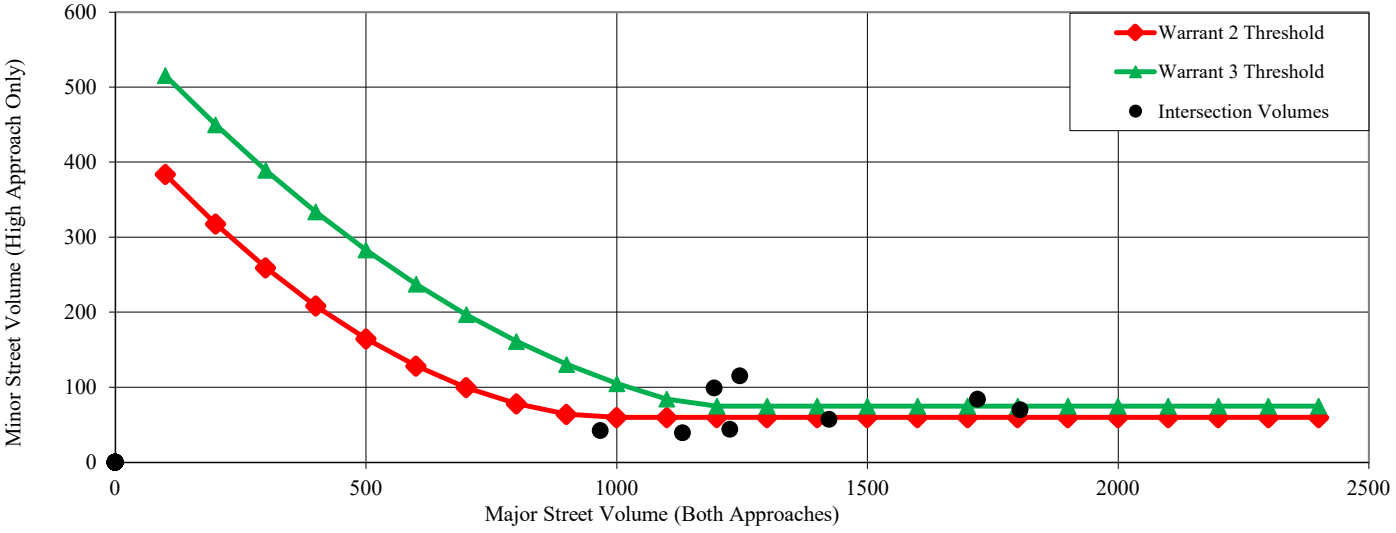
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	1 hour	5 hours	3 (Cond. A) & 7 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	4 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	3 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2021 - Existing Traffic Volumes (+20% Covid)**

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

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	835	8	
8 - 9 AM	10	832	44	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	8	594	0	
12 - 1 PM	18	673	2	
1 - 2 PM				
2 - 3 PM	11	686	5	
3 - 4 PM	11	846	0	
4 - 5 PM	19	1028	2	
5 - 6 PM	20	992	4	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,653	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	18	637	5	
8 - 9 AM	36	557	14	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	552	18	
12 - 1 PM	9	658	25	
1 - 2 PM				
2 - 3 PM	17	757	22	
3 - 4 PM	5	847	24	
4 - 5 PM	11	1006	60	
5 - 6 PM	6	1147	40	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,478	0

Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	2	1	4	
8 - 9 AM	16	5	56	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	2	0	2	
12 - 1 PM	0	1	4	
1 - 2 PM				
2 - 3 PM	5	5	29	
3 - 4 PM	0	0	2	
4 - 5 PM	1	0	5	
5 - 6 PM	0	0	1	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			141	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	76	1	61	
8 - 9 AM	73	8	37	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	38	0	12	
12 - 1 PM	30	0	17	
1 - 2 PM				
2 - 3 PM	34	2	17	
3 - 4 PM	44	1	23	
4 - 5 PM	59	0	42	
5 - 6 PM	52	0	32	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			659	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2021 - Existing Traffic Volumes (+20% Covid)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Andes Road/Church Driveway
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	13131 vehicles	Total Approach Volume	800 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

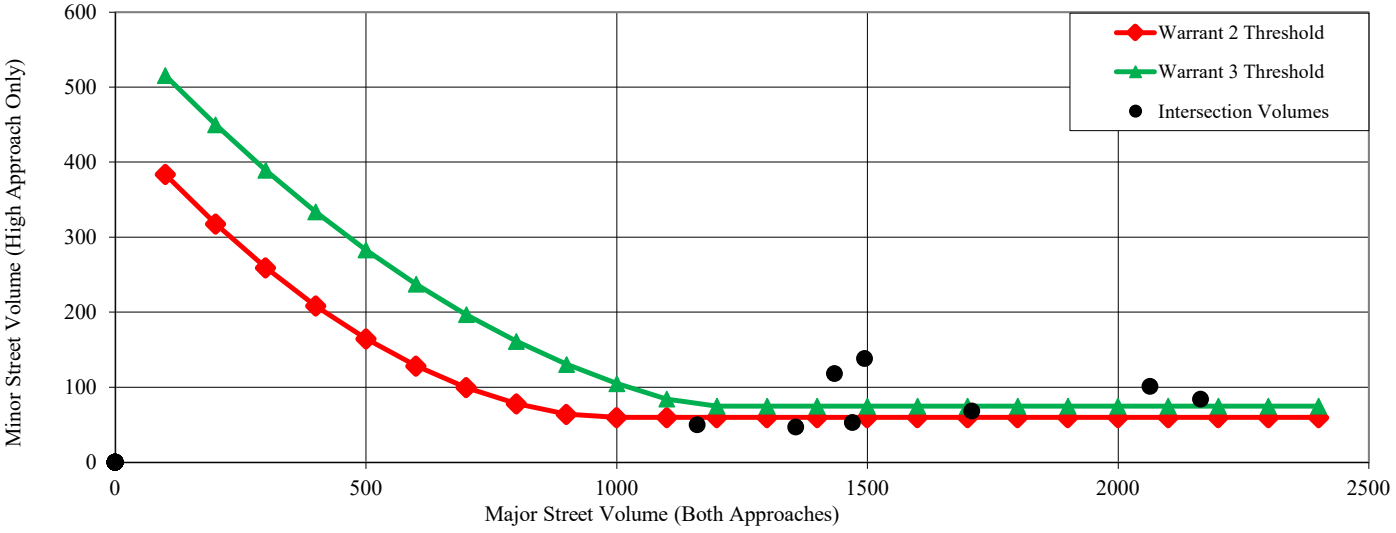
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	2 hours	6 hours	4 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	5 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	4 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2023 - Projected Traffic Volumes - 90 Apartments (+20% Covid + 2% Growth)**

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

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	875	8	
8 - 9 AM	10	870	46	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	8	626	0	
12 - 1 PM	19	709	2	
1 - 2 PM				
2 - 3 PM	11	724	5	
3 - 4 PM	11	892	0	
4 - 5 PM	20	1083	2	
5 - 6 PM	21	1048	4	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,999	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	28	680	5	
8 - 9 AM	45	595	15	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	23	582	19	
12 - 1 PM	27	694	26	
1 - 2 PM				
2 - 3 PM	38	796	23	
3 - 4 PM	28	891	25	
4 - 5 PM	38	1058	62	
5 - 6 PM	36	1206	42	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,982	0

Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	2	1	4	
8 - 9 AM	17	5	58	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	2	0	2	
12 - 1 PM	0	1	4	
1 - 2 PM				
2 - 3 PM	5	5	30	
3 - 4 PM	0	0	2	
4 - 5 PM	1	0	5	
5 - 6 PM	0	0	1	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			145	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	79	1	63	
8 - 9 AM	76	8	38	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	40	0	12	
12 - 1 PM	31	0	18	
1 - 2 PM				
2 - 3 PM	35	2	18	
3 - 4 PM	46	1	24	
4 - 5 PM	61	0	44	
5 - 6 PM	54	0	33	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			684	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2023 - Projected Traffic Volumes - 90 Apartments (+20% Covid + 2% Growth)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Andes Road/Church Driveway
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	13981 vehicles	Total Approach Volume	829 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

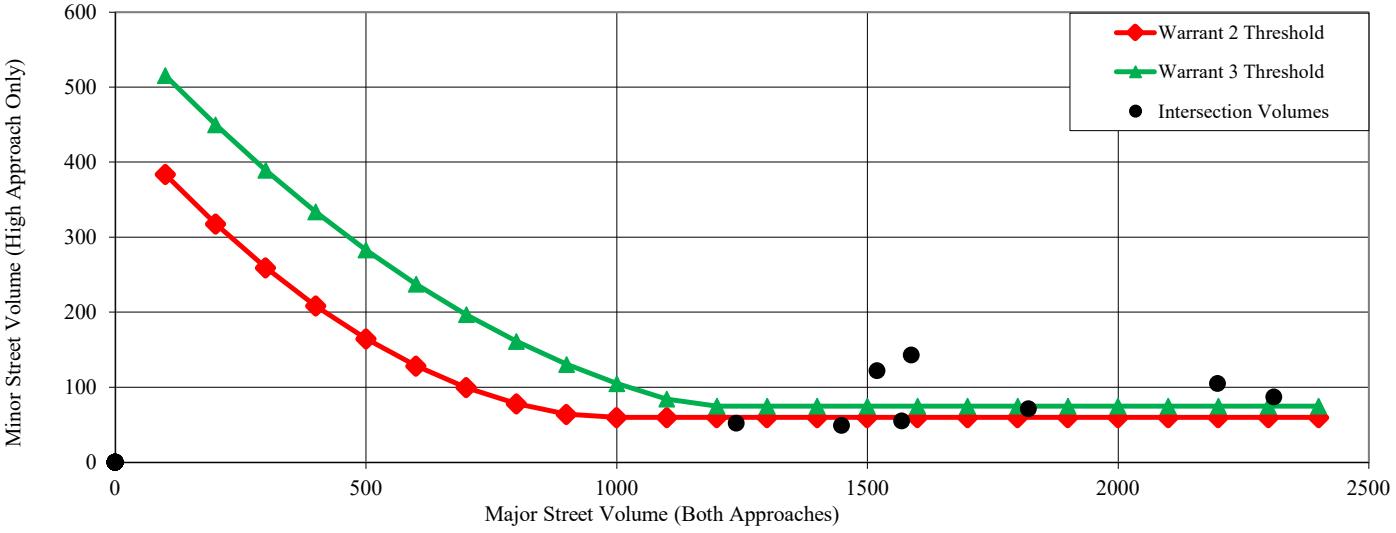
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	3 hours	6 hours	4 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	5 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	4 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2023 - Projected Traffic Volumes - 120 Apartments (+20% Covid + 2% Growth)**

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

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	875	8	
8 - 9 AM	10	871	46	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	8	629	0	
12 - 1 PM	19	712	2	
1 - 2 PM				
2 - 3 PM	11	727	5	
3 - 4 PM	11	896	0	
4 - 5 PM	20	1087	2	
5 - 6 PM	21	1052	4	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,021	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	31	685	5	
8 - 9 AM	48	600	15	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	27	585	19	
12 - 1 PM	32	696	26	
1 - 2 PM				
2 - 3 PM	44	799	23	
3 - 4 PM	35	894	25	
4 - 5 PM	46	1061	62	
5 - 6 PM	45	1210	42	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,055	0

Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	2	1	4	
8 - 9 AM	17	5	58	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	2	0	2	
12 - 1 PM	0	1	4	
1 - 2 PM				
2 - 3 PM	5	5	30	
3 - 4 PM	0	0	2	
4 - 5 PM	1	0	5	
5 - 6 PM	0	0	1	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			145	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	79	1	63	
8 - 9 AM	76	8	38	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	40	0	12	
12 - 1 PM	31	0	18	
1 - 2 PM				
2 - 3 PM	35	2	18	
3 - 4 PM	46	1	24	
4 - 5 PM	61	0	44	
5 - 6 PM	54	0	33	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			684	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2023 - Projected Traffic Volumes - 120 Apartments (+20% Covid + 2% Growth)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Andes Road/Church Driveway
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	14076 vehicles	Total Approach Volume	829 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

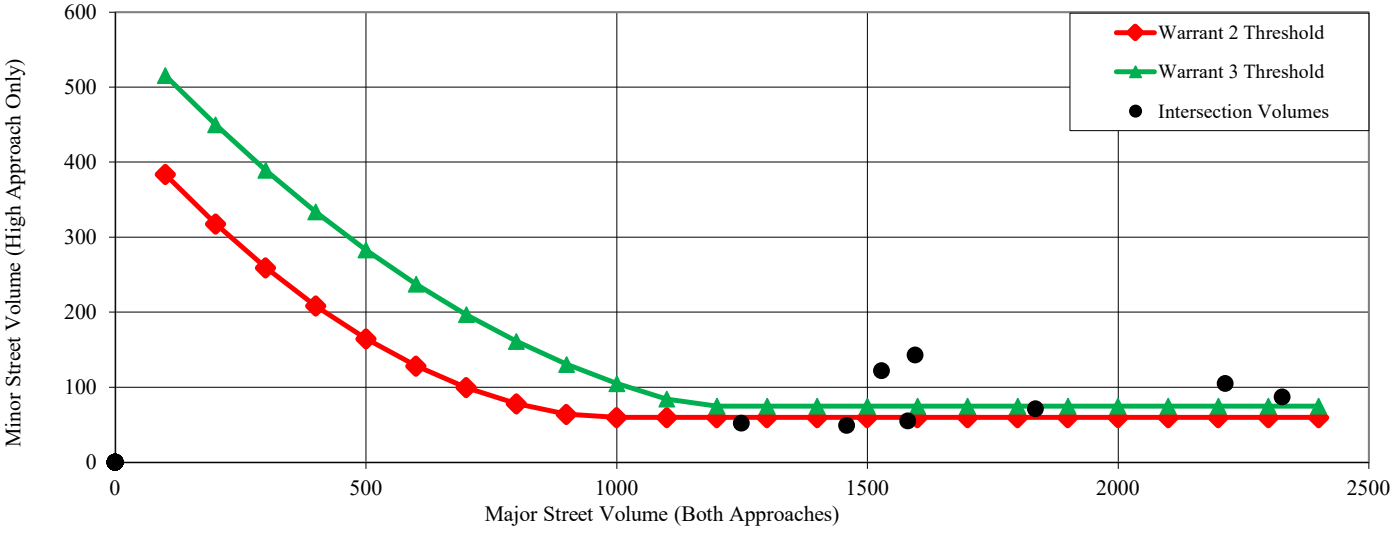
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	3 hours	6 hours	4 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	5 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	4 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2021 - Existing Traffic Volumes**

Intersection Information	
Major Street Name	Middlebrook Pike
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	0%
Minor Street Name	Frederick Drive/Dollar General (Main)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	6	751	4	
8 - 9 AM	11	789	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	9	514	10	
12 - 1 PM	6	575	15	
1 - 2 PM				
2 - 3 PM	4	603	17	
3 - 4 PM	7	722	15	
4 - 5 PM	12	881	20	
5 - 6 PM	9	852	10	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			**5,844**	**0**

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	681	15	
8 - 9 AM	13	643	15	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	20	611	19	
12 - 1 PM	28	711	17	
1 - 2 PM				
2 - 3 PM	25	824	26	
3 - 4 PM	47	908	19	
4 - 5 PM	40	1125	27	
5 - 6 PM	47	1249	36	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			**7,151**	**0**

Frederick Drive/Dollar General (Main) (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	3	0	3	
8 - 9 AM	5	0	7	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	3	0	19	
12 - 1 PM	16	0	21	
1 - 2 PM				
2 - 3 PM	13	0	24	
3 - 4 PM	16	0	31	
4 - 5 PM	11	1	34	
5 - 6 PM	16	1	21	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			**245**	**0**

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	28	0	9	
8 - 9 AM	33	1	7	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	20	0	10	
12 - 1 PM	16	1	8	
1 - 2 PM				
2 - 3 PM	15	0	12	
3 - 4 PM	14	0	7	
4 - 5 PM	12	0	9	
5 - 6 PM	27	0	8	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			**237**	**0**

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2021 - Existing Traffic Volumes

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Frederick Drive/Dollar General (Main)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	12995 vehicles	Total Approach Volume	482 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

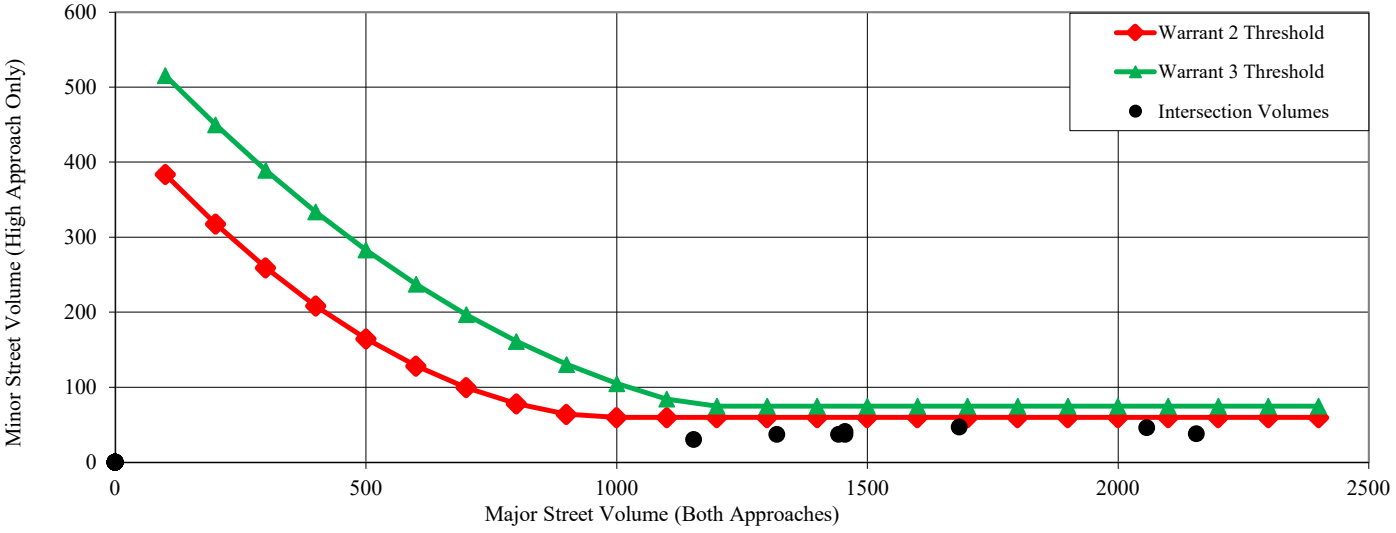
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	0 hours	0 hours	0 (Cond. A) & 2 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Not satisfied**
Required values reached for	0 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Not Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	0 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2021 - Existing Traffic Volumes (+20% Covid)**

Intersection Information	
Major Street Name	Middlebrook Pike
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	0%
Minor Street Name	Frederick Drive/Dollar General (Main)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	7	901	5	
8 - 9 AM	13	947	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	11	617	12	
12 - 1 PM	7	690	18	
1 - 2 PM				
2 - 3 PM	5	724	20	
3 - 4 PM	8	866	18	
4 - 5 PM	14	1057	24	
5 - 6 PM	13	1022	12	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,013	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	644	14	
8 - 9 AM	13	608	14	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	20	568	18	
12 - 1 PM	27	662	16	
1 - 2 PM				
2 - 3 PM	24	768	25	
3 - 4 PM	46	845	18	
4 - 5 PM	38	1049	26	
5 - 6 PM	45	1164	35	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			6,692	0

Frederick Drive/Dollar General (Main) (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	4	0	4	
8 - 9 AM	6	0	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	4	0	23	
12 - 1 PM	19	0	25	
1 - 2 PM				
2 - 3 PM	16	0	29	
3 - 4 PM	19	0	37	
4 - 5 PM	13	1	41	
5 - 6 PM	19	1	25	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			294	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	34	0	11	
8 - 9 AM	40	1	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	24	0	12	
12 - 1 PM	19	1	10	
1 - 2 PM				
2 - 3 PM	18	0	14	
3 - 4 PM	17	0	8	
4 - 5 PM	14	0	11	
5 - 6 PM	32	0	10	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			284	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2021 - Existing Traffic Volumes (+20% Covid)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Frederick Drive/Dollar General (Main)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	13705 vehicles	Total Approach Volume	578 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

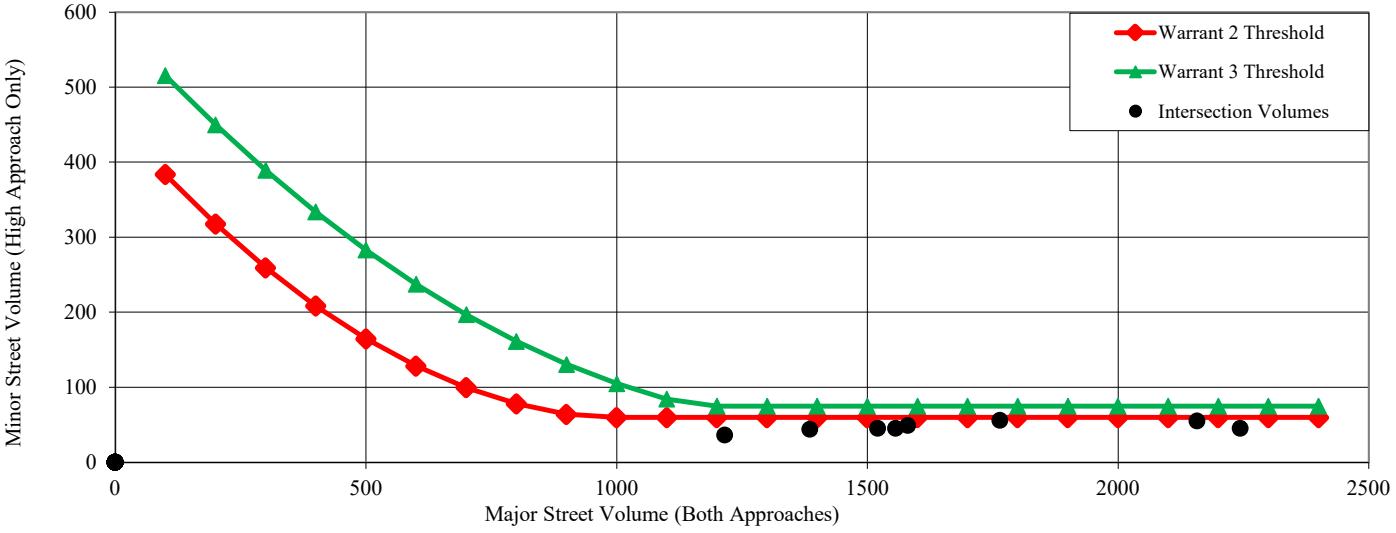
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	0 hours	2 hours	0 (Cond. A) & 7 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Not satisfied**
Required values reached for	0 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Not Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	0 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2023 - Projected Traffic Volumes - 90 Apartments (+20% Covid + 2% Growth)**

Intersection Information	
Major Street Name	Middlebrook Pike
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	0%
Minor Street Name	Frederick Drive/Dollar General (Main)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	24	696	5	
8 - 9 AM	29	1014	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	19	657	12	
12 - 1 PM	16	735	19	
1 - 2 PM				
2 - 3 PM	14	769	21	
3 - 4 PM	18	919	19	
4 - 5 PM	26	1121	25	
5 - 6 PM	24	1087	12	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,283	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	679	15	
8 - 9 AM	13	641	15	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	20	606	19	
12 - 1 PM	28	706	17	
1 - 2 PM				
2 - 3 PM	25	819	26	
3 - 4 PM	47	902	19	
4 - 5 PM	40	1117	27	
5 - 6 PM	47	1240	36	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,109	0

Frederick Drive/Dollar General (Main) (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	4	0	4	
8 - 9 AM	6	0	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	4	0	24	
12 - 1 PM	20	0	26	
1 - 2 PM				
2 - 3 PM	17	0	30	
3 - 4 PM	20	0	38	
4 - 5 PM	14	1	43	
5 - 6 PM	20	1	26	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			306	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	35	0	11	
8 - 9 AM	42	1	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	25	0	12	
12 - 1 PM	20	1	10	
1 - 2 PM				
2 - 3 PM	19	0	15	
3 - 4 PM	18	0	18	
4 - 5 PM	15	0	11	
5 - 6 PM	33	0	10	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			304	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2023 - Projected Traffic Volumes - 90 Apartments (+20% Covid + 2% Growth)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Frederick Drive/Dollar General (Main)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	14392 vehicles	Total Approach Volume	610 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

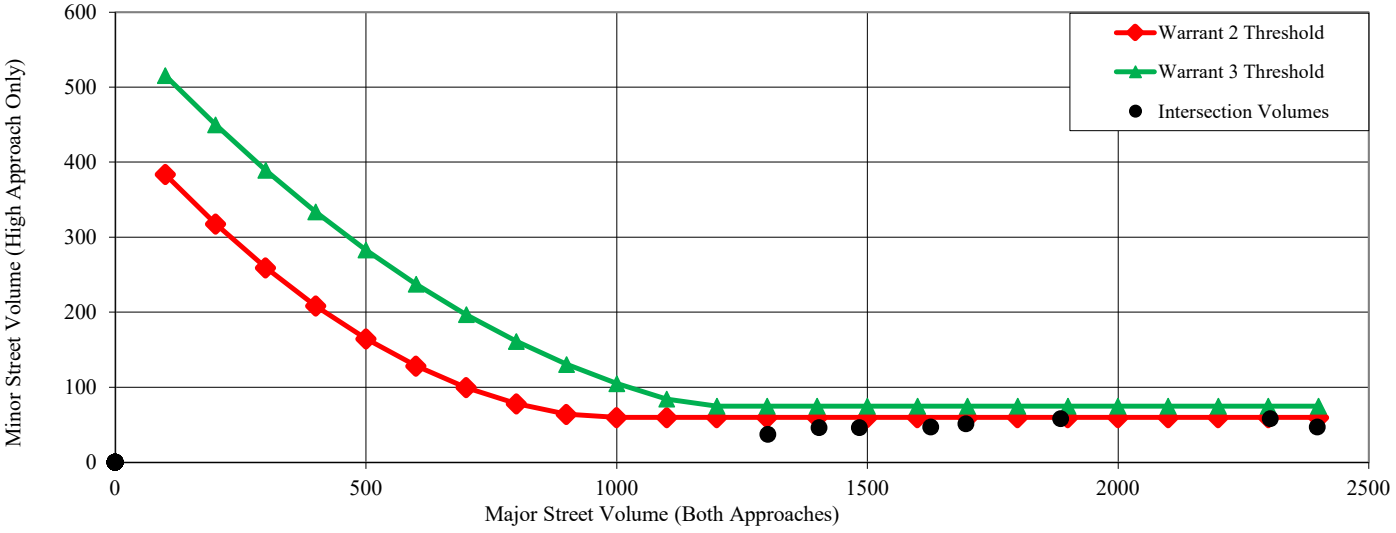
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	0 hours	2 hours	0 (Cond. A) & 7 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Not satisfied**
Required values reached for	0 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Not Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	0 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



Traffic Signal Warrant Analysis

Project Name	**Middlebrook Commons**
Project/File #	**#2107**
Scenario	**2023 - Projected Traffic Volumes - 120 Apartments (+20% Covid + 2% Growth)**

Intersection Information	
Major Street Name	Middlebrook Pike
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	0%
Minor Street Name	Frederick Drive/Dollar General (Main)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

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

Traffic Signal Warrant Analysis

Middlebrook Pike (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	29	978	5	
8 - 9 AM	33	1023	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	22	662	12	
12 - 1 PM	19	740	19	
1 - 2 PM				
2 - 3 PM	16	774	21	
3 - 4 PM	21	925	19	
4 - 5 PM	29	1127	25	
5 - 6 PM	28	1094	12	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,635	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	681	15	
8 - 9 AM	13	643	15	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	20	611	19	
12 - 1 PM	28	711	17	
1 - 2 PM				
2 - 3 PM	25	824	26	
3 - 4 PM	47	908	19	
4 - 5 PM	40	1125	27	
5 - 6 PM	47	1249	36	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,151	0

Frederick Drive/Dollar General (Main) (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	4	0	4	
8 - 9 AM	6	0	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	4	0	24	
12 - 1 PM	20	0	26	
1 - 2 PM				
2 - 3 PM	17	0	30	
3 - 4 PM	20	0	38	
4 - 5 PM	14	1	43	
5 - 6 PM	20	1	26	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			306	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	35	0	11	
8 - 9 AM	42	1	8	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	25	0	12	
12 - 1 PM	20	1	10	
1 - 2 PM				
2 - 3 PM	19	0	15	
3 - 4 PM	18	0	18	
4 - 5 PM	15	0	11	
5 - 6 PM	33	0	10	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			304	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons
Project/File #	#2107
Scenario	2023 - Projected Traffic Volumes - 120 Apartments (+20% Covid + 2% Growth)

Intersection Information			
Major Street (E/W Road)	Middlebrook Pike	Minor Street (N/S Road)	Frederick Drive/Dollar General (Main)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	14786 vehicles	Total Approach Volume	610 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	1 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Middlebrook Pike

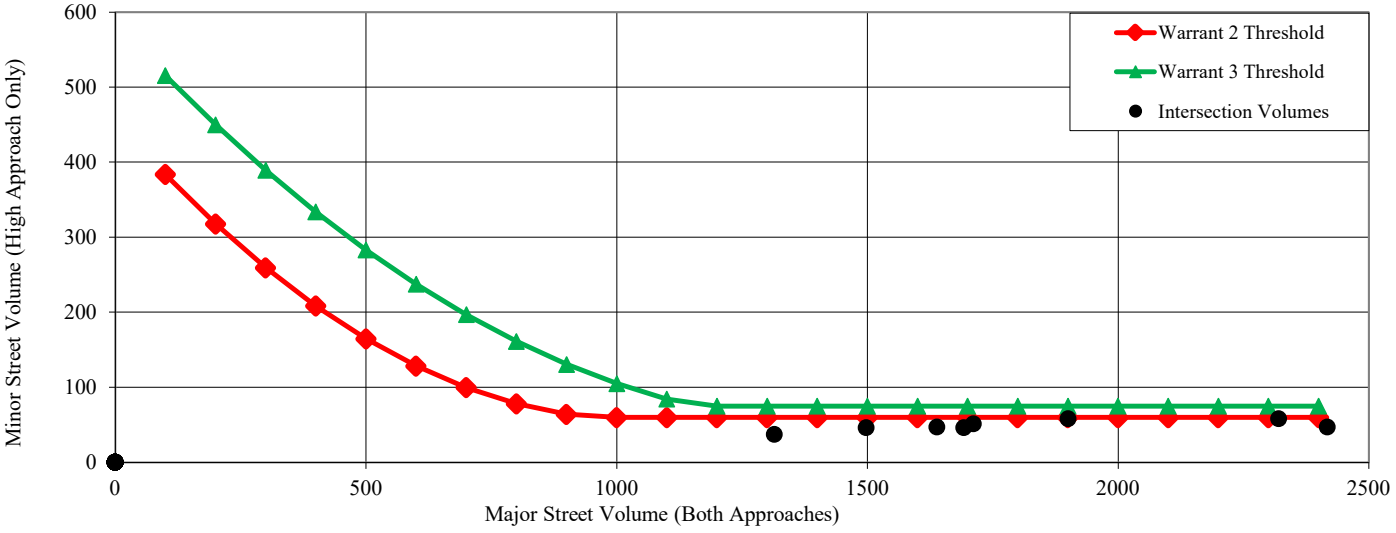
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	0 hours	2 hours	0 (Cond. A) & 7 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

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

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Not satisfied**
Required values reached for	0 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Not Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	0 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

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



TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2021 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Andes Road/Church Driveway

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	7	0	8	0	94	0	0	0	0	0	0	110	0	0	Existing Volumes
7:15 AM	15	0	6	2	122	1	0	0	0	0	0	151	0	0	Existing Volumes
7:30 AM	21	0	22	7	160	1	0	1	0	1	3	205	3	0	Existing Volumes
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	230	4	0	Existing Volumes
Sum	63	1	51	15	531	4	0	2	1	3	4	696	7	0	Sum
+20% Increase	76	1	61	18	637	5	0	2	1	4	5	835	8	0	Increase of 20% due to Covid
General Growth															
Trips Generated 7-8 am															
2021															
8:00 AM	20	3	12	7	146	6	1	6	1	12	6	207	13	0	
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0	
8:30 AM	7	0	6	2	91	0	0	2	0	4	1	176	0	0	
8:45 AM	19	0	3	2	98	1	0	0	0	2	1	133	0	0	
Sum	61	7	31	27	464	12	3	13	4	47	8	693	37	0	
+20% Increase	73	8	37	32	557	14	4	16	5	56	10	832	44	0	
General Growth															
Trips Generated 8-9 am															
2021															
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1	
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	
11:30 AM	8	0	3	0	117	3	0	1	0	0	2	105	0	0	
11:45 AM	8	0	1	0	118	2	1	1	0	0	1	126	0	0	
Sum	32	0	10	2	460	15	4	2	0	2	6	495	0	1	
+20% Increase	38	0	12	2	552	18	5	2	0	2	7	594	0	1	
General Growth															
Trips Generated 11am-12 pm															
2021															
12:00 PM	8	0	4	1	149	4	3	0	0	1	5	125	0	1	
12:15 PM	8	0	3	0	142	4	1	0	1	0	3	140	0	0	
12:30 PM	4	0	3	0	130	8	1	0	0	0	2	147	0	0	
12:45 PM	5	0	4	0	127	5	2	0	0	2	4	149	2	0	
Sum	25	0	14	1	548	21	7	0	1	3	14	561	2	1	
+20% Increase	30	0	17	1	658	25	8	0	1	4	17	673	2	1	
General Growth															
Trips Generated 12-1 pm															
2021															
2:00 PM	8	0	5	1	160	9	1	0	1	6	3	136	0	0	
2:15 PM	12	0	2	4	150	3	0	0	1	3	2	128	1	0	
2:30 PM	7	1	0	6	170	3	0	1	0	3	3	166	3	0	
2:45 PM	1	1	7	0	151	3	2	3	2	12	1	142	0	0	
Sum	28	2	14	11	631	18	3	4	4	24	9	572	4	0	
+20% Increase	34	2	17	13	757	22	4	5	5	29	11	686	5	0	
General Growth															
Trips Generated 2-3 pm															
2021															
3:00 PM	11	1	4	0	171	4	0	0	0	0	0	159	0	0	
3:15 PM	10	0	4	0	183	5	2	0	0	0	1	170	0	0	
3:30 PM	8	0	2	0	181	3	0	0	0	0	1	191	0	0	
3:45 PM	8	0	9	0	171	8	2	0	0	2	6	185	0	1	
Sum	37	1	19	0	706	20	4	0	0	2	8	705	0	1	
+20% Increase	44	1	23	0	847	24	5	0	0	2	10	846	0	1	
General Growth															
Trips Generated 3-4 pm															
2021															
4:00 PM	13	0	16	0	208	12	3	1	0	1	3	220	1	0	
4:15 PM	10	0	6	0	191	13	1	0	0	1	7	188	0	0	
4:30 PM	12	0	6	0	199	15	0	0	0	0	0	212	1	0	
4:45 PM	14	0	7	1	240	10	4	0	0	2	6	237	0	0	
Sum	49	0	35	1	838	50	8	1	0	4	16	857	2	0	
+20% Increase	59	0	42	1	1006	60	10	1	0	5	19	1028	2	0	
General Growth															
Trips Generated 4-5 pm															
2021															
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0	
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0	
5:30 PM	9	0	7	0	267	13	1	0	0	1	3	211	1	0	
5:45 PM	9	0	1	1	204	6	0	0	0	0	6	169	1	0	
Sum	43	0	27	2	956	33	3	0	0	1	17	827	3	0	
+20% Increase	52	0	32	2	1147	40	4	0	0	1	20	992	4	0	
General Growth															
Trips Generated 5-6 pm															
2021															

Assumed Average Growth Rate (%)= 0.0% 20% Increase due to Covid

Number of years = 0

Horizon Year = 2021 # of Horizon Years = 0

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

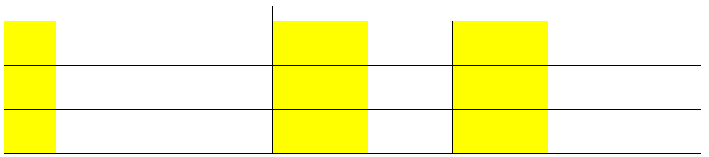
Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 0

Daily Trips Generated from Subdivision/Year #DIV/0! = 0 / 0

#DIV/0! trips by 2021

Traffic Movement Assumed Distribution:	AM	PM



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

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Andes Road/Church Driveway

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	7	0	8	0	94	0	0	0	0	0	0	110	0	0	Existing Volumes
7:15 AM	15	0	6	2	122	1	0	0	0	0	0	151	0	0	Existing Volumes
7:30 AM	21	0	22	7	160	1	0	1	0	1	3	205	3	0	Existing Volumes
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	230	4	0	Existing Volumes
Sum	63	1	51	15	531	4	0	2	1	3	4	696	7	0	Sum
+20% Increase	76	1	61	18	637	5	0	2	1	4	5	835	8	0	Increase of 20% due to Covid
General Growth	3.04	0.04	2.44	0.72	25.48	0.2	0	0.08	0.04	0.16	0.2	33.4	0.32	0	Growth Rate of 2.0% for 2 years
Trips Generated 7-8 am	0	0	0	0	17	0	9	0	0	0	0	5	0	0	Trips Generated
2023	79	1	63	19	680	5	9	2	1	4	5	873	8	0	Total Sum
8:00 AM	20	3	12	7	146	6	1	6	1	12	6	207	13	0	
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0	
8:30 AM	7	0	6	2	91	0	0	2	0	4	1	176	0	0	
8:45 AM	19	0	3	2	98	1	0	0	0	2	1	133	0	0	
Sum	61	7	31	27	464	12	3	13	4	47	8	693	37	0	
+20% Increase	73	8	37	32	557	14	4	16	5	56	10	832	44	0	
General Growth	2.92	0.32	1.48	1.28	22.28	0.56	0.16	0.64	0.2	2.24	0.4	33.28	1.76	0	
Trips Generated 8-9 am	0	0	0	0	16	0	8	0	0	0	0	4	0	0	
2023	76	8	38	33	595	15	12	17	5	58	10	870	46	0	
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1	
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	
11:30 AM	8	0	3	0	117	3	0	1	0	0	2	105	0	0	
11:45 AM	8	0	1	0	118	2	1	1	0	0	1	126	0	0	
Sum	32	0	10	2	460	15	4	2	0	2	6	495	0	1	
+20% Increase	38	0	12	2	552	18	5	2	0	2	7	594	0	1	
General Growth	1.52	0	0.48	0.08	22.08	0.72	0.2	0.08	0	0.08	0.28	23.76	0	0.04	
Trips Generated 11am-12 pm	0	0	0	0	8	0	16	0	0	0	0	8	0	0	
2023	40	0	12	2	582	19	21	2	0	2	7	626	0	1	
12:00 PM	8	0	4	1	149	4	3	0	0	1	5	125	0	1	
12:15 PM	8	0	3	0	142	4	1	0	1	0	3	140	0	0	
12:30 PM	4	0	3	0	130	8	1	0	0	0	2	147	0	0	
12:45 PM	5	0	4	0	127	5	2	0	0	2	4	149	2	0	
Sum	25	0	14	1	548	21	7	0	1	3	14	561	2	1	
+20% Increase	30	0	17	1	658	25	8	0	1	4	17	673	2	1	
General Growth	1.2	0	0.68	0.04	26.32	1	0.32	0	0.04	0.16	0.68	26.92	0.08	0.04	
Trips Generated 12-1 pm	0	0	0	0	9	0	17	0	0	0	0	9	0	0	
2023	31	0	18	1	694	26	26	0	1	4	18	709	2	1	
2:00 PM	8	0	5	1	160	9	1	0	1	6	3	136	0	0	
2:15 PM	12	0	2	4	150	3	0	0	1	3	2	128	1	0	
2:30 PM	7	1	0	6	170	3	0	1	0	3	3	166	3	0	
2:45 PM	1	1	7	0	151	3	2	3	2	12	1	142	0	0	
Sum	28	2	14	11	631	18	3	4	4	24	9	572	4	0	
+20% Increase	34	2	17	13	757	22	4	5	5	29	11	686	5	0	
General Growth	1.36	0.08	0.68	0.52	30.28	0.88	0.16	0.2	0.2	1.16	0.44	27.44	0.2	0	
Trips Generated 2-3 pm	0	0	0	0	9	0	20	0	0	0	0	11	0	0	
2023	35	2	18	14	796	23	24	5	5	30	11	724	5	0	
3:00 PM	11	1	4	0	171	4	0	0	0	0	0	159	0	0	
3:15 PM	10	0	4	0	183	5	2	0	0	0	1	170	0	0	
3:30 PM	8	0	2	0	181	3	0	0	0	0	1	191	0	0	
3:45 PM	8	0	9	0	171	8	2	0	0	2	6	185	0	1	
Sum	37	1	19	0	706	20	4	0	0	2	8	705	0	1	
+20% Increase	44	1	23	0	847	24	5	0	0	2	10	846	0	1	
General Growth	1.76	0.04	0.92	0	33.88	0.96	0.2	0	0	0.08	0.4	33.84	0	0.04	
Trips Generated 3-4 pm	0	0	0	0	10	0	23	0	0	0	0	12	0	0	
2023	46	1	24	0	891	25	28	0	0	2	10	892	0	1	
4:00 PM	13	0	16	0	208	12	3	1	0	1	3	220	1	0	
4:15 PM	10	0	6	0	191	13	1	0	0	1	7	188	0	0	
4:30 PM	12	0	6	0	199	15	0	0	0	0	0	212	1	0	
4:45 PM	14	0	7	1	240	10	4	0	0	2	6	237	0	0	
Sum	49	0	35	1	838	50	8	1	0	4	16	857	2	0	
+20% Increase	59	0	42	1	1006	60	10	1	0	5	19	1028	2	0	
General Growth	2.36	0	1.68	0.04	40.24	2.4	0.4	0.04	0	0.2	0.76	41.12	0.08	0	
Trips Generated 4-5 pm	0	0	0	0	12	0	26	0	0	0	0	14	0	0	
2023	61	0	44	1	1058	62	37	1	0	5	20	1083	2	0	
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0	
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0	
5:30 PM	9	0	7	0	267	13	1	0	0	1	3	211	1	0	
5:45 PM	9	0	1	1	204	6	0	0	0	0	6	169	1	0	
Sum	43	0	27	2	956	33	3	0	0	1	17	827	3	0	
+20% Increase	52	0	32	2	1147	40	4	0	0	1	20	992	4	0	
General Growth	2.08	0	1.28	0.08	45.88	1.6	0.16	0	0	0.04	0.8	39.68	0.16	0	
Trips Generated 5-6 pm	0	0	0	0	13	0	30	0	0	0	0	16	0	0	
2023	54	0	33	2	1206	42	34	0	0	1	21	1048	4	0	

Assumed Average Growth Rate (%)= 2.0% — 20% Increase due to Covid

Number of years = 2

Horizon Year = 2023 — # of Horizon Years = 2

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 868 (90 Apartments)

Daily Trips Generated from Subdivision/Year: 434 = 868 / 2 trips by 2023

Traffic Movement Assumed Distribution:	AM	PM
	65% from WB UTURN, 35% from EB THRU 35% to WB THRU	65% from WB UTURN, 35% from EB THRU 35% to WB THRU

Local Apartment Rate - Apartments

Entering and Exiting %'s (from Local Apartment Rate):		Directional Distribution Assumptions:	
22% Enter 78% Exit	AM Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru
50% Enter 50% Exit	Mid-Day Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru
55% Enter 45% Exit	PM Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru

TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual

Population Tier = A (Knoxville)

TDOT Region 1 Average for Arterial Facilities (Two Lane)

Time of Day	Percentage of Trips
7-8 am	7.20%
8-9 am	6.60%
11 am-Noon	5.52%
Noon-1 pm	6.11%
2-3 pm	6.39%
3-4 pm	7.34%
4-5 pm	8.48%
5-6 pm	9.57%
	57.21%

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

Volume = (847 Daily Trips * (1/5)) * 75% Exiting * 20% Trips from SB RT * 9.03% Trips (at 7-8 AM)

Volume = 169.4 x .75 x .20 x .093

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

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Andes Road/Church Driveway

	Andes Road			Middlebrook Pike				Church Driveway			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	7	0	8	0	94	0	0	0	0	0	0	110	0	0	Existing Volumes
7:15 AM	15	0	6	2	122	1	0	0	0	0	0	151	0	0	Existing Volumes
7:30 AM	21	0	22	7	160	1	0	1	0	1	3	205	3	0	Existing Volumes
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	230	4	0	Existing Volumes
Sum	63	1	51	15	531	4	0	2	1	3	4	696	7	0	Sum
+20% Increase	76	1	61	18	637	5	0	2	1	4	5	835	8	0	Increase of 20% due to Covid
General Growth	3.04	0.04	2.44	0.72	25.48	0.2	0	0.08	0.04	0.16	0.2	33.4	0.32	0	Growth Rate of 2.0% for 2 years
Trips Generated 7-8 am	0	0	0	0	22	0	12	0	0	0	0	6	0	0	Trips Generated
2023	79	1	63	19	685	5	12	2	1	4	5	875	8	0	Total Sum
8:00 AM	20	3	12	7	146	6	1	6	1	12	6	207	13	0	
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0	
8:30 AM	7	0	6	2	91	0	0	2	0	4	1	176	0	0	
8:45 AM	19	0	3	2	98	1	0	0	0	2	1	133	0	0	
Sum	61	7	31	27	464	12	3	13	4	47	8	693	37	0	
+20% Increase	73	8	37	32	557	14	4	16	5	56	10	832	44	0	
General Growth	2.92	0.32	1.48	1.28	22.28	0.56	0.16	0.64	0.2	2.24	0.4	33.28	1.76	0	
Trips Generated 8-9 am	0	0	0	0	20	0	11	0	0	0	0	6	0	0	
2023	76	8	38	33	600	15	15	17	5	58	10	871	46	0	
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1	
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	
11:30 AM	8	0	3	0	117	3	0	1	0	0	2	105	0	0	
11:45 AM	8	0	1	0	118	2	1	1	0	0	1	126	0	0	
Sum	32	0	10	2	460	15	4	2	0	2	6	495	0	1	
+20% Increase	38	0	12	2	552	18	5	2	0	2	7	594	0	1	
General Growth	1.52	0	0.48	0.08	22.08	0.72	0.2	0.08	0	0.08	0.28	23.76	0	0.04	
Trips Generated 11am-12 pm	0	0	0	0	11	0	20	0	0	0	0	11	0	0	
2023	40	0	12	2	585	19	25	2	0	2	7	629	0	1	
12:00 PM	8	0	4	1	149	4	3	0	0	1	5	125	0	1	
12:15 PM	8	0	3	0	142	4	1	0	1	0	3	140	0	0	
12:30 PM	4	0	3	0	130	8	1	0	0	0	2	147	0	0	
12:45 PM	5	0	4	0	127	5	2	0	0	2	4	149	2	0	
Sum	25	0	14	1	548	21	7	0	1	3	14	561	2	1	
+20% Increase	30	0	17	1	658	25	8	0	1	4	17	673	2	1	
General Growth	1.2	0	0.68	0.04	26.32	1	0.32	0	0.04	0.16	0.68	26.92	0.08	0.04	
Trips Generated 12-1 pm	0	0	0	0	12	0	22	0	0	0	0	12	0	0	
2023	31	0	18	1	696	26	31	0	1	4	18	712	2	1	
2:00 PM	8	0	5	1	160	9	1	0	1	6	3	136	0	0	
2:15 PM	12	0	2	4	150	3	0	0	1	3	2	128	1	0	
2:30 PM	7	1	0	6	170	3	0	1	0	3	3	166	3	0	
2:45 PM	1	1	7	0	151	3	2	3	2	12	1	142	0	0	
Sum	28	2	14	11	631	18	3	4	4	24	9	572	4	0	
+20% Increase	34	2	17	13	757	22	4	5	5	29	11	686	5	0	
General Growth	1.36	0.08	0.68	0.52	30.28	0.88	0.16	0.2	0.2	1.16	0.44	27.44	0.2	0	
Trips Generated 2-3 pm	0	0	0	0	11	0	26	0	0	0	0	14	0	0	
2023	35	2	18	14	799	23	30	5	5	30	11	727	5	0	
3:00 PM	11	1	4	0	171	4	0	0	0	0	0	159	0	0	
3:15 PM	10	0	4	0	183	5	2	0	0	0	1	170	0	0	
3:30 PM	8	0	2	0	181	3	0	0	0	0	1	191	0	0	
3:45 PM	8	0	9	0	171	8	2	0	0	2	6	185	0	1	
Sum	37	1	19	0	706	20	4	0	0	2	8	705	0	1	
+20% Increase	44	1	23	0	847	24	5	0	0	2	10	846	0	1	
General Growth	1.76	0.04	0.92	0	33.88	0.96	0.2	0	0	0.08	0.4	33.84	0	0.04	
Trips Generated 3-4 pm	0	0	0	0	13	0	30	0	0	0	0	16	0	0	
2023	46	1	24	0	894	25	35	0	0	2	10	896	0	1	
4:00 PM	13	0	16	0	208	12	3	1	0	1	3	220	1	0	
4:15 PM	10	0	6	0	191	13	1	0	0	1	7	188	0	0	
4:30 PM	12	0	6	0	199	15	0	0	0	0	0	212	1	0	
4:45 PM	14	0	7	1	240	10	4	0	0	2	6	237	0	0	
Sum	49	0	35	1	838	50	8	1	0	4	16	857	2	0	
+20% Increase	59	0	42	1	1006	60	10	1	0	5	19	1028	2	0	
General Growth	2.36	0	1.68	0.04	40.24	2.4	0.4	0.04	0	0.2	0.76	41.12	0.08	0	
Trips Generated 4-5 pm	0	0	0	0	15	0	34	0	0	0	0	18	0	0	
2023	61	0	44	1	1061	62	45	1	0	5	20	1087	2	0	
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0	
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0	
5:30 PM	9	0	7	0	267	13	1	0	0	1	3	211	1	0	
5:45 PM	9	0	1	1	204	6	0	0	0	0	6	169	1	0	
Sum	43	0	27	2	956	33	3	0	0	1	17	827	3	0	
+20% Increase	52	0	32	2	1147	40	4	0	0	1	20	992	4	0	
General Growth	2.08	0	1.28	0.08	45.88	1.6	0.16	0	0	0.04	0.8	39.68	0.16	0	
Trips Generated 5-6 pm	0	0	0	0	17	0	38	0	0	0	0	21	0	0	
2023	54	0	33	2	1210	42	43	0	0	1	21	1052	4	0	

Assumed Average Growth Rate (%)= 2.0% — 20% Increase due to Covid

Number of years = 2

Horizon Year = 2023 — # of Horizon Years = 2

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 1,125 (120 Apartments)

Daily Trips Generated from Subdivision/Year: 562.5 = 1,125 / 2

1125 trips by 2023

Traffic Movement Assumed Distribution:	AM	PM
	65% from WB UTURN, 35% from EB THRU 35% to WB THRU	65% from WB UTURN, 35% from EB THRU 35% to WB THRU

Local Apartment Rate - Apartments

Entering and Exiting %'s (from Local Apartment Rate):		Directional Distribution Assumptions:	
22% Enter 78% Exit	AM Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru
50% Enter 50% Exit	Mid-Day Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru
55% Enter 45% Exit	PM Hours	65% from WB Uturn	35% from EB Thru 35% to WB Thru

TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual

Population Tier = A (Knoxville)

TDOT Region 1 Average for Arterial Facilities (Two Lane)

Time of Day	Percentage of Trips
7-8 am	7.20%
8-9 am	6.60%
11 am-Noon	5.52%
Noon-1 pm	6.11%
2-3 pm	6.39%
3-4 pm	7.34%
4-5 pm	8.48%
5-6 pm	9.57%
	57.21%

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

Volume = (847 Daily Trips * (1/5)) * 75% Exiting * 20% Trips from SB RT * 9.03% Trips (at 7-8 AM)

Volume = 169.4 x .75 x .20 x .093

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

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2021 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	4	0	2	1	92	1	0	1	0	1	2	114	1	0	Existing Volumes
7:15 AM	11	0	3	1	120	2	0	1	0	0	0	165	1	0	Existing Volumes
7:30 AM	9	0	2	1	163	4	1	1	0	2	0	227	0	0	Existing Volumes
7:45 AM	4	0	2	0	162	5	0	0	0	0	2	245	2	2	Existing Volumes
Sum	28	0	9	3	537	12	1	3	0	3	4	751	4	2	Sum
+20% Increase	34	0	11	4	644	14	1	4	0	4	5	901	5	2	Increase of 20% due to Covid
General Growth															Growth Rate of 0.0% for 0 years
Trips Generated 7-8 am															Trips Generated
2021															Total Sum
8:00 AM	10	1	4	2	157	2	2	2	0	2	0	239	0	1	
8:15 AM	6	0	3	1	155	2	0	1	0	2	2	219	0	1	
8:30 AM	7	0	0	2	86	3	2	1	0	2	2	182	2	1	
8:45 AM	10	0	0	1	109	5	1	1	0	1	3	149	0	1	
Sum	33	1	7	6	507	12	5	5	0	7	7	789	2	4	
+20% Increase	40	1	8	7	608	14	6	6	0	8	8	947	2	5	
General Growth															
Trips Generated 8-9 am															
2021															
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1	
11:15 AM	3	0	3	0	116	4	0	0	0	4	1	147	2	0	
11:30 AM	4	0	2	4	122	2	2	0	0	3	2	107	4	0	
11:45 AM	6	0	2	3	121	6	2	1	0	6	3	130	2	0	
Sum	20	0	10	10	473	15	7	3	0	19	8	514	10	1	
+20% Increase	24	0	12	12	568	18	8	4	0	23	10	617	12	1	
General Growth															
Trips Generated 11am-12 pm															
2021															
12:00 PM	4	0	1	2	150	3	1	5	0	2	3	129	5	0	
12:15 PM	2	0	3	5	144	4	2	2	0	5	1	142	6	0	
12:30 PM	4	1	0	4	139	2	2	4	0	6	1	147	4	0	
12:45 PM	6	0	4	5	119	4	2	5	0	8	0	157	0	1	
Sum	16	1	8	16	552	13	7	16	0	21	5	575	15	1	
+20% Increase	19	1	10	19	662	16	8	19	0	25	6	690	18	1	
General Growth															
Trips Generated 12-1 pm															
2021															
2:00 PM	2	0	1	5	167	6	0	4	0	7	2	141	6	0	
2:15 PM	5	0	5	5	150	5	2	3	0	6	1	140	2	0	
2:30 PM	3	0	4	5	169	2	0	4	0	7	0	171	5	0	
2:45 PM	5	0	2	3	154	8	0	2	0	4	1	151	4	0	
Sum	15	0	12	18	640	21	2	13	0	24	4	603	17	0	
+20% Increase	18	0	14	22	768	25	2	16	0	29	5	724	20	0	
General Growth															
Trips Generated 2-3 pm															
2021															
3:00 PM	6	0	5	8	164	5	2	4	0	9	1	162	4	1	
3:15 PM	2	0	2	8	188	2	2	3	0	6	3	174	4	0	
3:30 PM	4	0	0	7	170	2	3	6	0	7	2	190	6	0	
3:45 PM	2	0	0	7	182	6	1	3	0	9	0	196	1	0	
Sum	14	0	7	30	704	15	8	16	0	31	6	722	15	1	
+20% Increase	17	0	8	36	845	18	10	19	0	37	7	866	18	1	
General Growth															
Trips Generated 3-4 pm															
2021															
4:00 PM	4	0	1	5	220	3	3	1	1	7	4	226	5	0	
4:15 PM	2	0	1	6	201	5	0	3	0	13	1	194	4	0	
4:30 PM	2	0	2	3	209	8	6	4	0	7	3	215	5	0	
4:45 PM	4	0	5	6	244	6	3	3	0	7	2	246	6	2	
Sum	12	0	9	20	874	22	12	11	1	34	10	881	20	2	
+20% Increase	14	0	11	24	1049	26	14	13	1	41	12	1057	24	2	
General Growth															
Trips Generated 4-5 pm															
2021															
5:00 PM	8	0	5	3	229	6	9	6	1	6	2	220	3	0	
5:15 PM	8	0	1	7	261	7	1	3	0	4	1	243	1	1	
5:30 PM	6	0	1	8	280	9	3	2	0	6	2	217	2	1	
5:45 PM	5	0	1	6	200	7	0	5	0	5	1	172	4	1	
Sum	27	0	8	24	970	29	13	16	1	21	6	852	10	3	
+20% Increase	32	0	10	29	1164	35	16	19	1	25	7	1022	12	4	
General Growth															
Trips Generated 5-6 pm															
2021															

Assumed Average Growth Rate (%)= 0.0% 20% Increase due to Covid

Number of years = 0

Horizon Year = 2021 # of Horizon Years = 0

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 120 Apartments

Daily Trips Generated from Subdivision/Year = trips by

Traffic Movement Assumed Distribution:	AM	PM

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

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	4	0	2	1	92	1	0	1	0	1	2	114	1	0	Existing Volumes
7:15 AM	11	0	3	1	120	2	0	1	0	0	0	165	1	0	Existing Volumes
7:30 AM	9	0	2	1	163	4	1	1	0	2	0	227	0	0	Existing Volumes
7:45 AM	4	0	2	0	162	5	0	0	0	0	2	245	2	2	Existing Volumes
Sum	28	0	9	3	537	12	1	3	0	3	4	751	4	2	Sum
+20% Increase	34	0	11	4	644	14	1	4	0	4	5	901	5	2	Increase of 20% due to Covid
General Growth	1.36	0	0.44	0.16	25.76	0.56	0.04	0.16	0	0.16	0.2	36.04	0.2	0.08	Growth Rate of 2.0% for 2 years
Trips Generated 7-8 am	0	0	0	0	9	0	0	0	0	0	0	32	0	17	Trips Generated
2023	35	0	11	4	679	15	1	4	0	4	5	969	5	19	Total Sum
8:00 AM	10	1	4	2	157	2	2	2	0	2	0	239	0	1	
8:15 AM	6	0	3	1	155	2	0	1	0	2	2	219	0	1	
8:30 AM	7	0	0	2	86	3	2	1	0	2	2	182	2	1	
8:45 AM	10	0	0	1	109	5	1	1	0	1	3	149	0	1	
Sum	33	1	7	6	507	12	5	5	0	7	7	789	2	4	
+20% Increase	40	1	8	7	608	14	6	6	0	8	8	947	2	5	
General Growth	1.6	0.04	0.32	0.28	24.32	0.56	0.24	0.24	0	0.32	0.32	37.88	0.08	0.2	
Trips Generated 8-9 am	0	0	0	0	8	0	0	0	0	0	0	29	0	16	
2023	42	1	8	7	641	15	6	6	0	8	8	1014	2	21	
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1	
11:15 AM	3	0	3	0	116	4	0	0	0	4	1	147	2	0	
11:30 AM	4	0	2	4	122	2	2	0	0	3	2	107	4	0	
11:45 AM	6	0	2	3	121	6	2	1	0	6	3	130	2	0	
Sum	20	0	10	10	473	15	7	3	0	19	8	514	10	1	
+20% Increase	24	0	12	12	568	18	8	4	0	23	10	617	12	1	
General Growth	0.96	0	0.48	0.48	22.72	0.72	0.32	0.16	0	0.92	0.4	24.68	0.48	0.04	
Trips Generated 11am-12 pm	0	0	0	0	16	0	0	0	0	0	0	16	0	8	
2023	25	0	12	12	606	19	8	4	0	24	10	657	12	9	
12:00 PM	4	0	1	2	150	3	1	5	0	2	3	129	5	0	
12:15 PM	2	0	3	5	144	4	2	2	0	5	1	142	6	0	
12:30 PM	4	1	0	4	139	2	2	4	0	6	1	147	4	0	
12:45 PM	6	0	4	5	119	4	2	5	0	8	0	157	0	1	
Sum	16	1	8	16	552	13	7	16	0	21	5	575	15	1	
+20% Increase	19	1	10	19	662	16	8	19	0	25	6	690	18	1	
General Growth	0.76	0.04	0.4	0.76	26.48	0.64	0.32	0.76	0	1	0.24	27.6	0.72	0.04	
Trips Generated 12-1 pm	0	0	0	0	17	0	0	0	0	0	0	17	0	9	
2023	20	1	10	20	706	17	8	20	0	26	6	735	19	10	
2:00 PM	2	0	1	5	167	6	0	4	0	7	2	141	6	0	
2:15 PM	5	0	5	5	150	5	2	3	0	6	1	140	2	0	
2:30 PM	3	0	4	5	169	2	0	4	0	7	0	171	5	0	
2:45 PM	5	0	2	3	154	8	0	2	0	4	1	151	4	0	
Sum	15	0	12	18	640	21	2	13	0	24	4	603	17	0	
+20% Increase	18	0	14	22	768	25	2	16	0	29	5	724	20	0	
General Growth	0.72	0	0.56	0.88	30.72	1	0.08	0.64	0	1.16	0.2	28.96	0.8	0	
Trips Generated 2-3 pm	0	0	0	0	20	0	0	0	0	0	0	16	0	9	
2023	19	0	15	23	819	26	2	17	0	30	5	769	21	9	
3:00 PM	6	0	5	8	164	5	2	4	0	9	1	162	4	1	
3:15 PM	2	0	2	8	188	2	2	3	0	6	3	174	4	0	
3:30 PM	4	0	0	7	170	2	3	6	0	7	2	190	6	0	
3:45 PM	2	0	0	7	182	6	1	3	0	9	0	196	1	0	
Sum	14	0	7	30	704	15	8	16	0	31	6	722	15	1	
+20% Increase	17	0	8	36	845	18	10	19	0	37	7	866	18	1	
General Growth	0.68	0	0.32	1.44	33.8	0.72	0.4	0.76	0	1.48	0.28	34.64	0.72	0.04	
Trips Generated 3-4 pm	0	0	0	0	23	0	0	0	0	0	0	19	0	10	
2023	18	0	8	37	902	19	10	20	0	38	7	919	19	11	
4:00 PM	4	0	1	5	220	3	3	1	1	7	4	226	5	0	
4:15 PM	2	0	1	6	201	5	0	3	0	13	1	194	4	0	
4:30 PM	2	0	2	3	209	8	6	4	0	7	3	215	5	0	
4:45 PM	4	0	5	6	244	6	3	3	0	7	2	246	6	2	
Sum	12	0	9	20	874	22	12	11	1	34	10	881	20	2	
+20% Increase	14	0	11	24	1049	26	14	13	1	41	12	1057	24	2	
General Growth	0.56	0	0.44	0.96	41.96	1.04	0.56	0.52	0.04	1.64	0.48	42.28	0.96	0.08	
Trips Generated 4-5 pm	0	0	0	0	26	0	0	0	0	0	0	22	0	12	
2023	15	0	11	25	1117	27	15	14	1	43	12	1121	25	14	
5:00 PM	8	0	5	3	229	6	9	6	1	6	2	220	3	0	
5:15 PM	8	0	1	7	261	7	1	3	0	4	1	243	1	1	
5:30 PM	6	0	1	8	280	9	3	2	0	6	2	217	2	1	
5:45 PM	5	0	1	6	200	7	0	5	0	5	1	172	4	1	
Sum	27	0	8	24	970	29	13	16	1	21	6	852	10	3	
+20% Increase	32	0	10	29	1164	35	16	19	1	25	7	1022	12	4	
General Growth	1.28	0	0.4	1.16	46.56	1.4	0.64	0.76	0.04	1	0.28	40.88	0.48	0.16	
Trips Generated 5-6 pm	0	0	0	0	30	0	0	0	0	0	0	24	0	13	
2023	33	0	10	30	1240	36	17	20	1	26	7	1087	12	17	

Assumed Average Growth Rate (%)= 2.0% — 20% Increase due to Covid

Number of years = 2

Horizon Year = 2023 — # of Horizon Years = 2

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 868 (90 Apartments)

Daily Trips Generated from Subdivision/Year: 434 = 868 / 2 (868 trips by 2023)

	AM	PM
Traffic Movement Assumed Distribution:	65% from WB THRU 35% to EB UTURN, 65% to EB THRU	65% from WB THRU 35% to EB UTURN, 65% to EB THRU

Local Apartment Rate - Apartments

Entering and Exiting %'s (from Local Apartment Rate):		Directional Distribution Assumptions:	
22% Enter	AM Hours	65% from WB Thru	
78% Exit		35% to EB Uturn	65% to EB Thru
50% Enter	Mid-Day Hours	65% from WB Thru	
50% Exit		35% to EB Uturn	65% to EB Thru
55% Enter	PM Hours	65% from WB Thru	
45% Exit		35% to EB Uturn	65% to EB Thru

TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual
Population Tier = A (Knoxville)
TDOT Region 1 Average for Arterial Facilities (Two Lane)

Time of Day	Percentage of Trips
7-8 am	7.20%
8-9 am	6.60%
11 am-Noon	5.52%
Noon-1 pm	6.11%
2-3 pm	6.39%
3-4 pm	7.34%
4-5 pm	8.48%
5-6 pm	9.57%
	57.21%

For example, 7-8 AM for SB Right Turns:
Volume = (847 Daily Trips * (1/5)) * 75% Exiting * 20% Trips from SB RT * 9.03% Trips (at 7-8 AM)
Volume = 169.4 x .75 x .20 x .093

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

TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC

Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike				
TIME	SOUTHBOUND			WESTBOUND				NORTHBOUND			EASTBOUND				
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	
7:00 AM	4	0	2	1	92	1	0	1	0	1	2	114	1	0	Existing Volumes
7:15 AM	11	0	3	1	120	2	0	1	0	0	0	165	1	0	Existing Volumes
7:30 AM	9	0	2	1	163	4	1	1	0	2	0	227	0	0	Existing Volumes
7:45 AM	4	0	2	0	162	5	0	0	0	0	2	245	2	2	Existing Volumes
Sum	28	0	9	3	537	12	1	3	0	3	4	751	4	2	Sum
+20% Increase	34	0	11	4	644	14	1	4	0	4	5	901	5	2	Increase of 20% due to Covid
General Growth	1.36	0	0.44	0.16	25.76	0.56	0.04	0.16	0	0.16	0.2	36.04	0.2	0.08	Growth Rate of 2.0% for 2 years
Trips Generated 7-8 am	0	0	0	0	12	0	0	0	0	0	0	41	0	22	Trips Generated
2023	35	0	11	4	681	15	1	4	0	4	5	978	5	24	Total Sum
8:00 AM	10	1	4	2	157	2	2	2	0	2	0	239	0	1	
8:15 AM	6	0	3	1	155	2	0	1	0	2	2	219	0	1	
8:30 AM	7	0	0	2	86	3	2	1	0	2	2	182	2	1	
8:45 AM	10	0	0	1	109	5	1	1	0	1	3	149	0	1	
Sum	33	1	7	6	507	12	5	5	0	7	7	789	2	4	
+20% Increase	40	1	8	7	608	14	6	6	0	8	8	947	2	5	
General Growth	1.6	0.04	0.32	0.28	24.32	0.56	0.24	0.24	0	0.32	0.32	37.88	0.08	0.2	
Trips Generated 8-9 am	0	0	0	0	11	0	0	0	0	0	0	38	0	20	
2023	42	1	8	7	643	15	6	6	0	8	8	1023	2	25	
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1	
11:15 AM	3	0	3	0	116	4	0	0	0	4	1	147	2	0	
11:30 AM	4	0	2	4	122	2	2	0	0	3	2	107	4	0	
11:45 AM	6	0	2	3	121	6	2	1	0	6	3	130	2	0	
Sum	20	0	10	10	473	15	7	3	0	19	8	514	10	1	
+20% Increase	24	0	12	12	568	18	8	4	0	23	10	617	12	1	
General Growth	0.96	0	0.48	0.48	22.72	0.72	0.32	0.16	0	0.92	0.4	24.68	0.48	0.04	
Trips Generated 11am-12 pm	0	0	0	0	20	0	0	0	0	0	0	20	0	11	
2023	25	0	12	12	611	19	8	4	0	24	10	662	12	12	
12:00 PM	4	0	1	2	150	3	1	5	0	2	3	129	5	0	
12:15 PM	2	0	3	5	144	4	2	2	0	5	1	142	6	0	
12:30 PM	4	1	0	4	139	2	2	4	0	6	1	147	4	0	
12:45 PM	6	0	4	5	119	4	2	5	0	8	0	157	0	1	
Sum	16	1	8	16	552	13	7	16	0	21	5	575	15	1	
+20% Increase	19	1	10	19	662	16	8	19	0	25	6	690	18	1	
General Growth	0.76	0.04	0.4	0.76	26.48	0.64	0.32	0.76	0	1	0.24	27.6	0.72	0.04	
Trips Generated 12-1 pm	0	0	0	0	22	0	0	0	0	0	0	22	0	12	
2023	20	1	10	20	711	17	8	20	0	26	6	740	19	13	
2:00 PM	2	0	1	5	167	6	0	4	0	7	2	141	6	0	
2:15 PM	5	0	5	5	150	5	2	3	0	6	1	140	2	0	
2:30 PM	3	0	4	5	169	2	0	4	0	7	0	171	5	0	
2:45 PM	5	0	2	3	154	8	0	2	0	4	1	151	4	0	
Sum	15	0	12	18	640	21	2	13	0	24	4	603	17	0	
+20% Increase	18	0	14	22	768	25	2	16	0	29	5	724	20	0	
General Growth	0.72	0	0.56	0.88	30.72	1	0.08	0.64	0	1.16	0.2	28.96	0.8	0	
Trips Generated 2-3 pm	0	0	0	0	26	0	0	0	0	0	0	21	0	11	
2023	19	0	15	23	824	26	2	17	0	30	5	774	21	11	
3:00 PM	6	0	5	8	164	5	2	4	0	9	1	162	4	1	
3:15 PM	2	0	2	8	188	2	2	3	0	6	3	174	4	0	
3:30 PM	4	0	0	7	170	2	3	6	0	7	2	190	6	0	
3:45 PM	2	0	0	7	182	6	1	3	0	9	0	196	1	0	
Sum	14	0	7	30	704	15	8	16	0	31	6	722	15	1	
+20% Increase	17	0	8	36	845	18	10	19	0	37	7	866	18	1	
General Growth	0.68	0	0.32	1.44	33.8	0.72	0.4	0.76	0	1.48	0.28	34.64	0.72	0.04	
Trips Generated 3-4 pm	0	0	0	0	30	0	0	0	0	0	0	24	0	13	
2023	18	0	8	37	908	19	10	20	0	38	7	925	19	14	
4:00 PM	4	0	1	5	220	3	3	1	1	7	4	226	5	0	
4:15 PM	2	0	1	6	201	5	0	3	0	13	1	194	4	0	
4:30 PM	2	0	2	3	209	8	6	4	0	7	3	215	5	0	
4:45 PM	4	0	5	6	244	6	3	3	0	7	2	246	6	2	
Sum	12	0	9	20	874	22	12	11	1	34	10	881	20	2	
+20% Increase	14	0	11	24	1049	26	14	13	1	41	12	1057	24	2	
General Growth	0.56	0	0.44	0.96	41.96	1.04	0.56	0.52	0.04	1.64	0.48	42.28	0.96	0.08	
Trips Generated 4-5 pm	0	0	0	0	34	0	0	0	0	0	0	28	0	15	
2023	15	0	11	25	1125	27	15	14	1	43	12	1127	25	17	
5:00 PM	8	0	5	3	229	6	9	6	1	6	2	220	3	0	
5:15 PM	8	0	1	7	261	7	1	3	0	4	1	243	1	1	
5:30 PM	6	0	1	8	280	9	3	2	0	6	2	217	2	1	
5:45 PM	5	0	1	6	200	7	0	5	0	5	1	172	4	1	
Sum	27	0	8	24	970	29	13	16	1	21	6	852	10	3	
+20% Increase	32	0	10	29	1164	35	16	19	1	25	7	1022	12	4	
General Growth	1.28	0	0.4	1.16	46.56	1.4	0.64	0.76	0.04	1	0.28	40.88	0.48	0.16	
Trips Generated 5-6 pm	0	0	0	0	38	0	0	0	0	0	0	31	0	17	
2023	33	0	10	30	1249	36	17	20	1	26	7	1094	12	21	

Assumed Average Growth Rate (%)= 2.0% 20% Increase due to Covid

Number of years = 2

Horizon Year = 2023 # of Horizon Years = 2

Note 1: The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Note 2: It is assumed that the construction of homes is linear growth

Trips Generated by Entire Development: 1,125 (120 Apartments)

Daily Trips Generated from Subdivision/Year: 562.5 = 1,125 / 2

1125 trips by 2023

Traffic Movement Assumed Distribution:	AM	PM
	65% from WB THRU 35% to EB UTURN, 65% to EB THRU	65% from WB THRU 35% to EB UTURN, 65% to EB THRU

Local Apartment Rate - Apartments

Entering and Exiting %'s (from Local Apartment Rate):		Directional Distribution Assumptions:	
22% Enter	AM Hours	65% from WB Thru	
78% Exit		35% to EB Uturn	65% to EB Thru
50% Enter	Mid-Day Hours	65% from WB Thru	
50% Exit		35% to EB Uturn	65% to EB Thru
55% Enter	PM Hours	65% from WB Thru	
45% Exit		35% to EB Uturn	65% to EB Thru

TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual
Population Tier = A (Knoxville)
TDOT Region 1 Average for Arterial Facilities (Two Lane)

Time of Day	Percentage of Trips
7-8 am	7.20%
8-9 am	6.60%
11 am-Noon	5.52%
Noon-1 pm	6.11%
2-3 pm	6.39%
3-4 pm	7.34%
4-5 pm	8.48%
5-6 pm	9.57%
	57.21%

For example, 7-8 AM for SB Right Turns:
Volume = (847 Daily Trips * (1/5)) * 75% Exiting * 20% Trips from SB RT * 9.03% Trips (at 7-8 AM)
Volume = 169.4 x .75 x .20 x .093

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

APPENDIX K

SIMTRAFFIC VEHICLE QUEUE LENGTHS

Intersection: 3: Church Driveway/Andes Road & Middlebrook Pike

Movement	EB	EB	EB	WB	WB	NB	SB
Directions Served	L	T	TR	UL	TR	LTR	LTR
Maximum Queue (ft)	28	2	8	63	1	269	187
Average Queue (ft)	5	0	0	22	0	148	182
95th Queue (ft)	22	2	4	49	1	322	195
Link Distance (ft)		397	397		461	285	172
Upstream Blk Time (%)						18	100
Queuing Penalty (veh)						0	0
Storage Bay Dist (ft)	320			180			
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

Movement	EB	EB	WB	NB	SB
Directions Served	UL	TR	UL	LTR	LTR
Maximum Queue (ft)	39	1	27	46	137
Average Queue (ft)	10	0	5	12	57
95th Queue (ft)	30	1	21	39	128
Link Distance (ft)		344		255	173
Upstream Blk Time (%)					3
Queuing Penalty (veh)					0
Storage Bay Dist (ft)	185		150		
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 9: Dollar General Driveway (Rear) & Middlebrook Pike

Movement	NB
Directions Served	R
Maximum Queue (ft)	62
Average Queue (ft)	28
95th Queue (ft)	54
Link Distance (ft)	188
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Church Driveway/Andes Road & Middlebrook Pike

Movement	EB	WB	WB	WB	NB	SB
Directions Served	L	UL	T	TR	LTR	LTR
Maximum Queue (ft)	42	54	2	4	32	187
Average Queue (ft)	12	19	0	0	5	175
95th Queue (ft)	34	44	2	2	23	191
Link Distance (ft)			461	461	285	172
Upstream Blk Time (%)						100
Queuing Penalty (veh)						0
Storage Bay Dist (ft)	320	180				
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

Movement	EB	EB	WB	WB	WB	NB	SB
Directions Served	UL	TR	UL	T	TR	LTR	LTR
Maximum Queue (ft)	37	5	76	21	7	256	188
Average Queue (ft)	12	0	25	1	0	140	149
95th Queue (ft)	32	2	59	19	4	280	231
Link Distance (ft)		344		252	252	255	173
Upstream Blk Time (%)						14	60
Queuing Penalty (veh)						0	0
Storage Bay Dist (ft)	185		150				
Storage Blk Time (%)			0				
Queuing Penalty (veh)			1				

Intersection: 9: Dollar General Driveway (Rear) & Middlebrook Pike

Movement	EB	NB
Directions Served	T	R
Maximum Queue (ft)	3	50
Average Queue (ft)	0	23
95th Queue (ft)	3	48
Link Distance (ft)	461	188
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 1

APPENDIX L

RESPONSE LETTER TO ADDRESS REVIEW COMMENTS

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

June 15, 2021

PROJECT NAME: Middlebrook Commons Apartments TIS

TO: Knoxville-Knox County Planning

SUBJECT: TIS Comment Response Document for Middlebrook Commons Apartments (#7-B-21-UR)
Review Comments dated June 15, 2021

Dear Knoxville-Knox County Planning Staff:

The following comment response document is submitted to address comments from an email dated June 15, 2021, and this letter is added to the end of the revised report.

1. **On page 27, Figure 4a, the eastbound right-turn volume at the west driveway to the Dollar General store has different numbers shown in the summary table versus the raw count data shown in Appendix E for the AM Peak. It is showing both a "4" and a "2". Please verify and revise as appropriate.**

   Response: The data shown in the table in Appendix E for this intersection was incorrectly summarized in the AM peak hour. This was corrected. The numbers shown in Figure 4a were correct.

2. **On page 33, second paragraph, the study cites an observed traffic growth rate of 1.7%, but on page 16 the cited value is 1.6%. Please make these agree.**

   Response: The report has been updated to reflect this request. The traffic growth on Page 33 was changed to 1.6% to reflect the correct percentage and match Page 16.

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

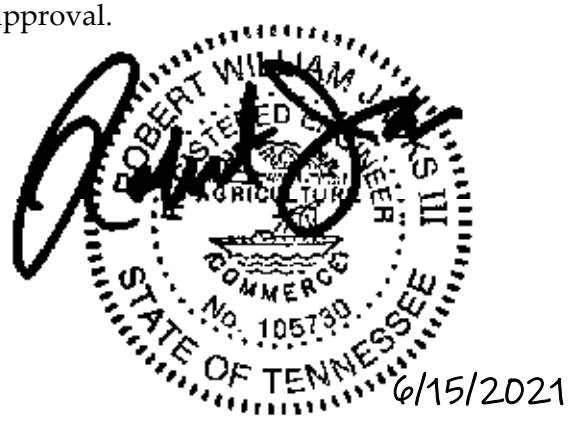
   - Updated Title Page
   - Updated Table of Contents

- Updated Page Footers
- Added Appendix L to include this response letter

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

Sincerely,

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



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