

Transportation Impact Study Middlebrook Commons Knox County, Tennessee



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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 prepandemic 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:

- o 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 а 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 flat from previous earth relatively 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 <sup>1</sup>	SPEED LIMIT	LANES	ROAD WIDTH <sup>2</sup>	TRANSIT <sup>3</sup>	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

<sup>1</sup> 2018 Major Road Plan by Knoxville/Knox County Planning

<sup>2</sup> Edge of curb to edge of curb or edge of pavements near project site

<sup>3</sup> According to Knoxville Area Transit System Map

<u>Middlebrook Pike (SR 169)</u> 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.



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 leftturn 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 leftturn lane with 185 feet of vehicle storage.





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.

<u>Andes Road</u> 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.

<u>Frederick Drive</u> 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.





## **PHOTO EXHIBITS**



Middlebrook Pike at Andes Road & Church Driveway







Transportation Impact Study Middlebrook Commons



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











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











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





Transportation Impact Study Middlebrook Commons

#### • 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.







### • <u>ON-STREET PARKING</u>:

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.





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 "walkability", States based on "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	<u>1 BR</u>	<u>2 BR</u>
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.





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. traffic Currently, westbound any on Middlebrook Pike that wants to enter the Dollar General rear driveway must travel further to the west on Middlebrook Pike and complete a Uturn 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).







#### 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.







### 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 <u>Trip Distribution and Assignment</u> 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. Figure 4b shows the raw volumes from the existing traffic counts during the AM and PM peak hours observed at the studied intersections.

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.







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
В	Short Traffic Delays	>10 -15
С	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

	TRAFFIC	APPROACH/		AM PEAK		PM PEAK			
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.0	0.030	В	10.9	0.040	
Andes Road / Church	STOP	Westbound Left/U-turn	В	10.7	0.090	A	10.0	0.010	
Driveway	Se Se	Northbound Left/Thru/Right	C	23.4	0.440	В	11.8	0.010	
	5	Southbound Left/Thru/Right	F	53.0	0.750	D	31.3	0.430	
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	8.9	0.010	В	10.9	0.010	
Frederick Drive / Dollar	STOP	Westbound Lett/U-turn	В	10.1	0.010	В	10.4	0.050	
General Driveway (Main)	50	Northbound Left/Thru/Right	C	17.9	0.050	С	23.7	0.230	
8,0 B	5	Southbound Left/Thru/Right	С	19.2	0.190	D	30.5	0.270	
Middlebrook Pike at Dollar General	STOP STOP	Northbound Right	A	0.0	0.000	A	0.0	0.000	
Driveway (Rear)	Unsig								

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio

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

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.5	0.030	В	12.3	0.050
Andes Road / Church	STOP	Westbound Left/U-turn	В	12.2	0.130	В	10.9	0.010
Driveway	Se Se	Northbound Left/Thru/Right	E	43.2	0.680	В	12.9	0.020
	n -	Southbound Left/Thru/Right	F	240.6	1.340	F	60.5	0.680
							45 A	
Middlebrook Pike at	Ied	Eastbound Left/U-turn	A	9.4	0.010	В	12.3	0.020
Frederick Drive / Dollar	STOP	Westbound Lett/U-turn	В	11.1	0.020	В	11.6	0.070
General Driveway (Main)	5	Northbound Left/Thru/Right	C	22.4	0.090	D	33.9	0.350
1. S. S. S.	5	Southbound Left/Thru/Right	С	24.6	0.280	F	51.2	0.450
Middlebrook Pike at	hzed	Northbound Right	A	0.0	0.000	A	0.0	0.000
Dollar General Driveway (Rear)	STOP Publish							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> 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.







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

	TRAFFIC	APPROACH/		AM PEAK		PM PEAK			
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.1	0.030	В	11.2	0.040	
Andes Road / Church	STOP	Westbound Left/U-turn	В	11.0	0.100	В	10.1	0.010	
Driveway	Se Se	Northbound Left/Thru/Right	D	25.8	0.480	В	12.0	0.020	
	en -	Southbound Left/Thru/Right	F	67.2	0.830	D	34.9	0.470	
	-	· · · · · · · · · · · · · · · · · · ·							
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.0	0.010	В	11.2	0.010	
Frederick Drive / Dollar	STOP	Westbound Lett/U-turn	В	10.3	0.010	В	10.6	0.050	
General Driveway (Main)		Northbound Left/Thru/Right	C	18.6	0.060	D	25.4	0.250	
6.00 S	5	Southbound Left/Thru/Right	С	20.0	0.200	D	33.6	0.300	
Middlebrook Pike at	ized	Northbound Right	A	0.0	0.000	A	0.0	0.000	
Dollar General Driveway (Rear)	STOP								

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>e</sup> Volume-to-Capacity Ratio

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

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>e</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c *
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.6	0.040	В	12.7	0.060
Andes Road / Church	STOP	Westbound Left/U-turn	В	12.6	0.140	В	11.1	0.010
Driveway	Se Se	Northbound Left/Thru/Right	F	53.0	0.760	В	13.1	0.020
	5	Southbound Left/Thru/Right	F	332.5	1.550	F	74.2	0.760
							45 A	
Middlebrook Pike at	Ied	Eastbound Left/U-turn	A	9.5	0.010	В	12.7	0.020
Frederick Drive / Dollar	STOP	Westbound Lett/U-turn	В	11.4	0.020	В	11.9	0.070
General Driveway (Main)	5	Northbound Left/Thru/Right	C	23.6	0.090	E	37.9	0.400
6.00	5	Southbound Left/Thru/Right	D	26.1	0.300	F	59.1	0.510
Middlebrook Pike at	hzed	Northbound Right	A	0.0	0.000	A	0.0	0.000
Dollar General Driveway (Rear)	STOP Indian							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>e</sup> 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	GE 7 AM 1	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR			
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL		
Local Trip				22%	78%		55%	45%			
Rate	Apartments	90 Apartments	868	11	38	49	39	32	71		
То	tal New Volume Si	te 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 LAND USE USE CODE DESCRIPTIO		UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR			
			ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL		
Local Trip		100.1		22%	78%		55%	45%		
Rate	Apartments	120 Apartments	1,125	14	50	64	50	41	91	
To	tal New Volume Si	te 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.



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.









## • OPENING YEAR TRAFFIC CONDITIONS (WITH THE PROJECT):

Overall, several additive steps were taken to estimate the <u>total</u> 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%.











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 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, <u>without</u> 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, <u>with a</u> 20% increase due to the pandemic. Tables 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 <u>without</u> 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 <u>with</u> 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)

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>
Middlebrook Pike at	zed	Eastbound Left/U-turn	A	9.1	0.030	В	11.2	0.040
Andes Road / Church	STOP	Westbound Left/U-turn	В	11.0	0.100	В	10.2	0.010
Driveway	is a	Northbound Left/Thru/Right	D	26.1	0.490	В	12.0	0.020
	5	Southbound Left/Thru/Right	F	69.9	0.840	E	35.7	0.480
Middlebrook Pike at	Pa l	Eastbound Left/U-turn	A	9.0	0.010	В	11.3	0.010
Frederick Drive / Dollar	STOP 2	Westbound Lett/U-turn	В	10.4	0.010	В	10.8	0.050
General Driveway (Main)		Northbound Left/Thru/Right	C	19.0	0.060	D	26.3	0.260
• • •	5	Southbound Left/Thru/Right	С	20.4	0.210	E	35.0	0.310
Middlebrook Pike at Dollar General	alized	Northbound Right	В	13.1	0.090	В	13.6	0.080
Driveway (Rear) & Proposed Apartment Driveway	Angien U							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio

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

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c *	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>
Middlebrook Pike at	ped	Eastbound Left/U-turn	A	9.1	0.030	В	11.3	0.040
Andes Road / Church	STOP	Westbound Left/U-turn	В	11.0	0.100	В	10.2	0.010
Driveway	- Se	Northbound Left/Thru/Right	D	26.2	0.490	В	12.1	0.020
	n <sup>a</sup>	Southbound Left/Thru/Right	F	70.8	0.850	E	35.9	0.480
Middlebrook Pike at	ted	Eastbound Left/U-turn	A	9.0	0.010	В	11.4	0.010
Frederick Drive / Dollar	STOP	Westbound Lett/U-turn	В	10.5	0.010	В	10.8	0.050
General Driveway (Main)	5	Northbound Left/Thru/Right	C	19.1	0.060	D	26.5	0.260
1,00 - 20 1	5	Southbound Left/Thru/Right	C	20.5	0.210	E	35.5	0.310
			-					
Middlebrook Pike at	ize:	Northbound Right	B	13.4	0.110	В	14.1	0.100
Dollar General	STOP 2							
Driveway (Rear) & Proposed	a ii							
Apartment Driveway	5							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio



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

	TRAFFIC	APPROACH/		AM PEAK		PM PEAK			
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	
Middlebrook Pike at	ped	Eastbound Left/U-turn	A	9.7	0.040	В	12.8	0.060	
Andes Road / Church	STOP	Westbound Left/U-turn	В	12.6	0.150	В	11.2	0.010	
Driveway	<b>9</b>	Northbound Left/Thru/Right	F	54.2	0.760	В	13.2	0.020	
191	5	Southbound Left/Thru/Right	F	342.6	1.580	F	77.0	0.770	
Middlebrook Pike at	Pa -	Eastbound Left/U-turn	A	9.6	0.010	В	12.9	0.020	
Frederick Drive / Dollar	STOP	Westbound Left/U-turn	В	11.5	0.020	В	12.1	0.070	
General Driveway (Main)	S 20	Northbound Left/Thru/Right	C	24.2	0.090	E	39.5	0.410	
	5	Southbound Left/Thru/Right	D	26.6	0.310	F	62.8	0.520	
Middlebrook Pike at Dollar General Driveway (Rear) & Proposed	stoP 9013	Northbound Right	В	14.6	0.100	с	15.3	0.090	
Apartment Driveway	5	21							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio

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

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>
Middlebrook Pike at	ped	Eastbound Left/U-turn	A	9.7	0.040	В	12.8	0.060
Andes Road / Church	STOP	Westbound Left/U-turn	В	12.6	0.150	В	11.2	0.010
Driveway	<b>6</b>	Northbound Left/Thru/Right	F	54.5	0.760	В	13.3	0.020
	5	Southbound Left/Thru/Right	F	346.1	1.580	F	77.8	0.770
Middlebrook Pike at	Pa -	Eastbound Left/U-turn	A	9.6	0.010	В	12.9	0.020
Frederick Drive / Dollar	STOP 2	Westbound Lett/U-turn	В	11.6	0.020	В	12.1	0.070
General Driveway (Main)		Northbound Left/Thru/Right	C	24.4	0.090	E	40.0	0.410
•	5	Southbound Left/Thru/Right	D	26.8	0.310	F	64.1	0.530
Middlebrook Pike at	ized	Northbound Right	С	15.0	0.130	с	15.9	0.120
Dollar General Driveway (Rear) & Proposed Apartment Driveway	STOP Hwugieur							

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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>e</sup> 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	26	2021 EXISTING			2023 WITHOUT THE PROJECT		2023 WITH THE PROJECT 90 Apartments			2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	<b>v/c</b> *	LOS*	Delay	v/c"	LOS*	Delay	v/c*
Middlebrook Pike at Andes Roa	d / Church	Driveway	STOP									
AM Peak	5 392	0.0	0.000	2	0.1	0.020	1.23	0.1	0.030		0.1	0.020
Eastbound Left/O-furn	A	9.0	0.030	A	9.1	0.050	A	9.1	0.050	A	9,1	0.050
Westbound Left/U-turn	в	10.7	0.090	В	11.0	0.100	В	11.0	0.100	В	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	В	10.9	0.040	B	11.2	0.040	В	11.2	0.040	В	11.3	0.040
Westbound Left/U-turn	A	10.0	0.010	B	10.1	0.010	В	10.2	0.010	B	10.2	0.010
Northbound Left/Thru/Right	В	11.8	0.010	B	12.0	0.020	В	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

\*Level of Service

\* Average Delay (sec/vehicle)

\* 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 W	TTH THE P 0 Apartmen	ROJECT its	2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	w/c*	LOS <sup>4</sup>	Delay	v/c"	LOS*	Delay <sup>b</sup>	v/c*
Middlebrook Pike at Frederick I	Drive / Dolla	ar General I	eiveway (?	Main)	TOP							
AM Peak												
Eastbound Left/U-turn	A	8.9	0.010	A	9.0	0.010	Α	9.0	0.010	A	9.0	0.010
Westbound Left/U-turn	В	10.1	0.010	B	10.3	0.010	В	10.4	0.010	B	10.5	0.010
Northbound Left/Thru/Right	C	17.9	0.050	C	18.6	0.060	С	19.0	0.060	C	19.1	0.060
Southbound Left/Thru/Right	с	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	В	10.9	0.010	B	11.2	0.010	В	11.3	0.010	В	11.4	0.010
Westbound Left/U-turn	В	10.4	0.050	B	10.6	0.050	В	10.8	0.050	B	10.8	0.050
Northbound Left/Thru/Right	С	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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

" 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 W	TTH THE PI 0 Apartmen	ROJECT ts	2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay	v/c*	LOS*	Delay <sup>b</sup>	v/c*
Middlebrook Pike at Dollar Ge	eneral Drivev	way (Rear) &	Proposed	Entrance	STOP							
AM Peak	4.° 0.500			2.7								
Northbound Right	A	0.0	0.000	A	0.0	0.000	В	13.1	0.090	B	13.4	0.110
PM Peak												
Monthly and Dialet	Δ	0.0	0.000	A	0.0	0.000	B	13.6	0.080	R	14.1	0.100

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections \* Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

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 W	TTH THE PI 0 Apartmen	ROJECT .ts	2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	w/c*	LOS4	Delay	v/c"	LOS*	Delay	v/c*
Middlebrook Pike at Andes Roa	d / Church	Driveway	STOP									
AM Peak												
Eastbound Left/U-turn	A	9.5	0.030	A	9.6	0.040	Α	9.7	0.040	A	9.7	0.040
Westbound Left/U-turn	В	12.2	0.130	B	12.6	0.140	В	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	В	12.3	0.050	B	12.7	0.060	В	12.8	0.060	В	12.8	0.060
Westbound Left/U-turn	В	10.9	0.010	B	11.1	0.010	В	11.2	0.010	B	11.2	0.010
Northbound Left/Thru/Right	В	12.9	0.020	B	13.1	0.020	В	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

\*Level of Service

\* Average Delay (sec/vehicle)

" 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 W	TTH THE PI 0 Apartmen	ROJECT	2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	w/c*	LOS <sup>4</sup>	Delay	v/c"	LOS'	Delay	v/c*
Middlebrook Pike at Frederick I	Drive / Dolla	ar General I	Driveway ()	Main)	TOP							
AM Peak					_							
Eastbound Left/U-turn	Α	9.4	0.010	A	9.5	0.010	А	9.6	0.010	A	9.6	0.010
Westbound Left/U-turn	В	11.1	0.020	B	11.4	0.020	В	11.5	0.020	B	11.6	0.020
Northbound Left/Thru/Right	С	22.4	0.090	C	23.6	0.090	С	24.2	0.090	C	24.4	0.090
Southbound Left/Thru/Right	с	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	В	12.3	0.020	В	12.7	0.020	В	12.9	0.020	В	12.9	0.020
Westbound Left/U-turn	В	11.6	0.070	B	11.9	0.070	В	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

\* Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

\* 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 W 9	TTH THE PI 0 Apartmen	ROJECT ts	2023 WITH THE PROJECT 120 Apartments		
	LOS*	Delay <sup>b</sup>	v/c*	LOS*	Delay <sup>b</sup>	w/c*	LOS*	Delay	<b>v/c</b> "	LOS*	Delay	v/c"
Middlebrook Pike at Dollar Ge	eneral Drivev	vay (Rear) &	Proposed	Entrance	STOP							
AM Peak	1.1 Doctor			22						20		
Northbound Right	A	0.0	0.000	A	0.0	0.000	В	14.6	0.100	с	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

\* Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

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 <u>minimum</u> visibility distance standard



for evaluating the safety of an intersection.

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 <u>desirable</u> 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-turnout (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 <u>A Policy on Geometric Design of Highway and Streets</u> 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, <u>Safety of U-Turns at Unsignalized Median Openings</u>, by the Transportation Research Board, provides guidance for these types of traffic maneuvers. In the report, the Florida <u>Median Handbook</u> 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.

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

## <u>Methodology</u>:

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 <u>existing</u> 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 <u>projected</u> 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

	VOLUME WARRANT (REQUIRED NUMBER OF HOURS SATISFIED)											
SCENARIO		WARRANT	WARRANT 2	WARRANT 3								
	CONDITION #1A (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/	EXISTING	SIMTRAFFIC 95 <sup>th</sup> PERCENTILE QUEUE LENGTH (ff)			
	MOVEMENT	STORAGE (ft)	AM PEAK HOUR	PM PEAK HOUR		
Middlebrook Pike at	Southbound Left/Thru/Right	N/A	195	191		
Andes Road / Church	Westbound Left/U-Turn	180	49	44		
Driveway	Northbound Left/Thru/Right	N/A	322	23		
200 CENTRAL	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

TRAFFIC		APPROACH/		AM PEAK		FM PEAK			
INTERSECTION	CONTROL	MOVEMENT	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	LOS*	DELAY <sup>b</sup> (seconds)	v/c <sup>c</sup>	
Middlebrook Pike at	- 2	Eastbound	В	11.7	_	A	8.4	-	
Andes Road / Church	P i	Westbound	A	8.2		A	9.0		
Driveway	E E	Northbound	B	16.5		В	16.5		
	3	Southbound	C	20.2		В	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

\*Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>e</sup> 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 this intersection's distance at 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 <u>A Policy on Geometric Design of Highway and Streets</u> 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.



- 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 DRIVE	WAY (MAIN)

	VOLUME WARRANT (REQUIRED NUMBER OF HOURS SATISFIED)											
SCENARIO		WARRANT	WARRANT 2	WARRANTS								
	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/	EXISTING	SIMTRAFFIC 95 <sup>th</sup> PERCENTILE QUEUE LENGTH (ft)			
	MOVEMENT	STORAGE (ft)	AM PEAK HOUR	PM PEAK HOUR		
Middlebrook Pike at	Southbound Left/Thru/Right	N/A	128	231		
Frederick Drive / Dollar	Westbound Left/U-Turn	150	21	59		
General Driveway (Main)	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 40mph 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 <u>A Policy on Geometric Design of Highway and Streets</u> 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 <u>Potential Safety Issues</u>, <u>Evaluation of Turn Lane Thresholds</u>, 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 <u>A Policy on Geometric Design of Highway and Streets</u> 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.

It is recommended that the two entrances be separated as much as possible. Separating the entrances as the properties currently are 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



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

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 <u>Manual for Constructing Driveway Entrances on State Highways</u> 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.





- <u>Middlebrook Commons Internal Drive/Parking Lot Aisleways</u>: 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.
- The entrance driveway near the 4e) 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.



- 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.



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.



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 Jturn 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	ine
2014	15,354	llbu
2015	16,998	Tre
2016	18,480	
2017	19,026	
2018	16,950	
2019	18,891	







# **APPENDIX B**

WALK SCORE

# WALKSCORE

(from walkscore.com)

Walk So	ore 🖓	Get Scores	Find Apartments	My Favorites	Add to Your Site
O Type an a	address, neij	ghborhood (	or city Go		
9260 Mi Knoxville, Ter Commute to kn	ddlebro nnessee, 379 oxville // Ho 60+ min ;	<b>ok Pike</b> 931 ( 60+min Vie	w Routes	Add scores	to your site
⊖ Favorite	🕮 Мар	Rearby	Apartments		
Looking for a ho	ime for sale in K	noxville? #P			
Walk Score 44	Car-Depende Aost errands r	ent require a car.	2	5)	R
Transit Score	Ainimal Tra	nsit	~	-	1 1
	is possible to	o get on a bus			THE IT
Sake Scores S	omewhat B	likeable	T Belling the	2 (H)	P Cole Course
20	/inimal bike ii	nfrastructure.		7	911
			and a second	CONTROLLOOPER IN C	100000

### Scores for 9260 Middlebrook Pike



SCOLO IOL 2200 MIMMICULOUX LINC

Walk Score 20

Walk S	core	Transit Score	Bike Score						
Transit Scor based on th	e measures e distance a	how well a location is ser nd type of nearby transit	ved by public transit lines						
90-100	Rider's Par World class	Rider's Paradise World-class public transportation							
70-89	Excellent T Transit is co	r <b>ansit</b> nvenient for most trips							
50-69	Good Trans Many neart	<b>it</b> y public transportation opti	ons						
25-49	Some Tran A few nearb	sit y public transportation optic	ons						
0-24	Minimal Tr	0-24 Minimal Transit							

### Scores for 9260 Middlebrook Pike

- Ang

-

Walk S	core Transit Score Bike Score
like Score n	neasures whether an area is good for biking based on bike
anes and tr	ails, 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 blke infrastructure

# Travel Time Map

### Add to your site

Explore how far you can travel by car, bus, bike and foot from 9260 Middlebrook Pike.





**APPENDIX C** 

# KNOXVILLE AREA TRANSIT MAP AND INFORMATION



#### REDUCED FARE INFORMATION KAT HOLIDAYS FARE KAT buses do not run on the following holidays: FARE TYPE REGULAR FARE REDUCED FARE A reduced fare is available to those who qualify. Qualifying individuals include seniors age 65 New Year's Day Thanksgiving One-Ride Pass\* \$1.50 or over, Medicare card holders, students under the age of 18, and persons with disabilities. INFORMATION \$0.75 Christmas Proper identification (Medicare card or a valid KAT LD. card) is required before boarding. For more information on how to obtain a discounted-fare LD. visit katbus.com/fares or cal Independence Day \$4.00 \$2.00 With a base fare of \$1.50, KAT offers a variety of Please note that KAT's Knoxville Station Customer Service counter is also closed during those days. 7 Day Pass \$15.00 \$7.50 passes. Please note that only the fares marked with 637-3000. KAT buses run on a Saturday schedule on the following holidays: 30 Day Pass \$50.00 \$25.00 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 BUS STOPS ONLY Martin Luther King, Jr. Day Day after Thanksgiving 20 Ride Pass \$25.00 Memorial Day Christmas Eve Transfer\* \$0.50 \$0.25 KAT buses stop ONLY at locations designated by bus stop signs. Generally, bus stops Labor Day at least every ¼ mile along the ro by mail via



# **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



Information Updated: February 1, 2021

	Going	Going from Wal Mart to Windsor Square Going from Windsor Square							
	Transfer to	o:					Rts. 11 & 90		
	Walmart	Park Village at Woodpark	Parkwest Hospital	Windsor Square	Parkwest Hospital	Cedar Bluff at Fox Lonas	Walmart		
	1	2	3	4	5	6	7		
			WEEKDA		ULE				
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		
			SATURD	<b>AY SCHED</b>	ULE				
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



**APPENDIX E** 

MANUAL 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	l		Middleb	rook Pike		Cł	nurch Drivew	vay	Middlebrook Pike					
TIME	S	OUTHBOUN	JD		WESTE	BOUND		N	ORTHBOUN	JD		EASTB	OUND		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	
L		1	1		1	1	1		1			1		1		

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

	Andes Road			Middlebrook Pike			Church Driveway			Middlebrook Pike				
TIME	S	OUTHBOUN	JD	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

	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	-

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

	F	Frederick Drive Middlebrook Pike				Dollar Ge	neral Drivew	ay (Main)	Middlebrook Pike							
TIME	S	OUTHBOUN	JD		WESTE	OUND		N	ORTHBOUN	ID		EASTB	OUND		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	
101111	00		00	·	0100	0,	55	50	-	110	20	0000	~		0020	

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

	F	rederick Driv	ve		Middlebrook Pike			Dollar General Driveway (Main)			Middlebrook Pike			
TIME	SC	OUTHBOUN	JD		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 I

4:45 PM - 5:45 PM

	Frederick Drive			Middlebrook Pike				Dollar General Driveway (Main)			Middlebrook Pike				
TIME	SO	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	

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	EASTB	OUND	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 Pik				
TIME	NORTHBOUND	EASTB	OUND			
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	EASTB	OUND			
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			

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

	Grassy Mead	ow Boulevard	Middlebrook Pike	Middlebrook Pike		
TIME	SOUTH	BOUND	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** 

	≯	-	$\mathbf{F}$	F	-	+	*	1	1	1	1	Ŧ
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ሻ	A			5	A			4			4
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	А			В			С	F				
Approach Delay (s)	0.2			0.9			23.4	53.0				
Approach LOS							С	F				
Intersection Summary												
Average Delay			6.9									
Intersection Capacity Utilization	۱		52.3%	10	CU Level	of Service			А			
Analysis Period (min)			15									

	-
Movement	SBR
Lane	
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 #

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

Movement         EBU         EBL         EBR         WBU         WBL         WBR         NBL         NBT         NBR         SBL           Lane Configurations         1         1         1         1         4         0         6         29           Sign Control         Free		1	۶	-	$\mathbf{F}$	F	∢	+	*	٩.	Ť	1	1
Lane Configurations       N	Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Volume (veh/h)         4         4         920         2         3         4         637         13         4         0         6         29           Sign Control         Free         Free         Stop         -3%         -3%         -5%         -5%           Peak Hour Factor         0.50         0.50         0.95         0.25         0.38         0.50         0.90         0.75         0.73         0.73         13         4         0         6         29           Peak Hour Factor         0.50         0.50         0.95         0.25         0.38         0.50         0.90         0.75         0.73         13         4         0         6         29         8         0         8         40         8         40         8         40         8         40         8         40         8         40         8         40         8         40         8         40         8         40         8         40         1         1         1         1         1         1         1         1         1         1         5         5         5         13         40         3         180         VCL words and and and and and and and and and	Lane Configurations		۲	A⊅			۲	<b>≜</b> t≽			4		
Sign Control       Free       Free       Free       Stop         Grade       -3%       -3%       3%       -5%       -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       0.73         Hourly flow rate (vph)       0       8       979       8       0       8       650       20       8       0       8       40         Pedestrians       Lane Width (th)       Values	Volume (veh/h)	4	4	930	2	3	4	637	13	4	0	6	29
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           Peak Hour Factor         0.00         8         979         8         0         8         650         20         8         0         8         40           Pedestrians         Lane Width (ft)               8         40           Valking Speed (IV/s)           Raised         Raised	Sign Control			Free				Free			Stop		
Peak Hour Factor       0.50       0.50       0.90       0.75       0.73       Hourly flow rate (vph)       0       8       979       8       0       8       650       20       8       0       8       40         Peak Hourly flow rate (vph)       0       8       979       8       0       8       650       20       8       0       8       40         Peak Hourly flow rate (vph)       Peak Hourly flow rate (vph)       Peak Hourly flow rate (vph)       Raised       Raise	Grade			-3%				3%			-5%		
Hourty flow rate (vph)       0       8       979       8       0       8       650       20       8       0       8       40         Pedestrians       Lane Width (th)       Hame Width (th)<	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
Pedestrians       Lane Width (ft)         Walking Speed (ft/s)       Percent Blockage         Right turn flare (veh)       1         Median storage veh)       1         T       1         yz, platoon unblocked       0.00         vC, conflicting volume       0         0       670       0.08         vC, stage 1 conf vol       0         vC, stage 1 conf vol       0         vC, stage 2 conf vol       -         vC, stage 2 conf vol       670         vC, unblocked vol       0         0       987         T, stage 1 conf vol       999         vC, unblocked vol       0         0       987         t, stage 1 conf vol       670         vC, unblocked vol       0         0       971         t, Stage 2 conf vol       -         vC, unblocked vol       0         0       92         0       930         0       97         980       981         MB 4       323         1       55         50       5.5         51       5.5         52       5.5	Hourly flow rate (vph)	0	8	979	8	0	8	650	20	8	0	8	40
Lane Width (ft) Walking Speed (ft/s) Percent Blockage Right turn flare (vch) Median storage vch) 1 Upstream signal (ft) y C, conflicting volume 0 670 0 987 1358 1685 493 1189 vC2, stage 1 conf vol vC2, stage 2 conf vol vC2, stage 2 conf vol vC3, stage 1 conf vol vC3, stage 2 conf vol vC3, stage 1 conf vol vC3, stage 1 conf vol vC3, stage 2 conf vol vC4, unblocked vol 0 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 1189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 493 189 vC4, unblocked vol 0 670 0 987 1358 1685 403 189 VC4, unblocked vol 0 670 0 987 1358 1685 403 33 4 8 433 237 16 60 Volume Ieft 8 653 334 8 433 237 16 60 Volume Ieft 8 653 334 8 433 237 16 60 Volume Ieft 8 653 334 8 433 237 16 60 Volume Ieft 8 653 334 8 433 237 16 60 Volume Ieft 8 65 334 8 433 237 16 60 Volume Ieft 8 65 334 8 433 237 16 60 Volume Ieft 8 0 0 0 8 0 0 0 0 1 1 0 0 0 1 0 0 0 1 0 0 0 0	Pedestrians												
Walking Speed (ft/s)         Percent Blockage         Right turn flare (veh)         Median storage veh)       1         1       1         Upstream signal (ft)         VC, conflicting volume       0         0       670         VC1, stage 1 conf vol         VC2, stage 2 conf vol         VC2, stage 1 conf vol         VC2, stage 1 conf vol         VC2, stage 2 conf vol         VC2, stage 2 conf vol         VC2, stage 1 conf vol         VC2, stage 1 conf vol         VC2, stage 1 conf vol         VC3, stage 1 conf vol         VC2, stage 1 conf vol         VC3, stage 1 conf vol         VC4, stage 1 conf vol         VC3, stage 1 conf vol         VC3, stage 1 conf vol         VC4, stage 1 conf vol         V0, unblocked vol	Lane Width (ft)												
Percent Blockage       Right turn flare (veh)         Median type       Raised         Median storage veh)       1         pX, platoon unblocked       0.00         vC, conflicting volume       0         0       670       0         vC, conflicting volume       0         vC, single (s)       0.0         0       99         0       99         0       99	Walking Speed (ft/s)												
Right turn flare (veh)       Raised       Raised       Raised       I         Median storage veh)       1       1       1       1       Upstream signal (ft)       pX, platon unblocked       0.00       0.00       VC, conflicting volume       0       670       0       987       1358       1685       493       1189         VC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         VC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         VC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         VC1, stage (s)       0.0       4.1       7.5       6.5       5.5       6.5         IF (s)       0.0       2.2       0.0       2.2       3.5       4.0       3.3       3.5         pd queue free %       0       99       0       708       205       211       527       270         Direction, Lane #       EB1       EB2       EB3       WB1       WB2       WB3       NB1       SB1       SB1       VD unb coazit (wh/h)       0       8       0 <td>Percent Blockage</td> <td></td>	Percent Blockage												
Median type       Raised       Raised         Median storage veh)       1       1         pX, platoon unblocked       0.00       0.00         vC, conflicting volume       0       670       0       987       1358       1685       493       1189         vC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         vC2, stage 2 conf vol       0       670       0       987       1358       1685       493       1189         vC2, stage 2 conf vol       0       670       0       987       1358       1685       493       1189         vC2, stage (s)       .       .       0.0       4.1       7.5       6.5       6.5       6.5         pd 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	Right turn flare (veh)												
Median storage veh)       1       1         Upstream signal (ft)       0       0.00         yc, platoon unblocked       0.00       0       999       999       676         vC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         vC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         vC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         vC1, stage 1 conf vol       0       670       0       987       1358       1685       493       1189         tC2, stage (s)       .       .       0.0       4.1       7.5       6.5       5.5       6.5         tC, stage (s)       .       .       0.0       2.2       3.5       4.0       3.3       3.5         pd queue free %       0       99       0       0       98       205       211       527       270         Direction, Lane #       EB 1       EB 2       EB 3       WB 1       WB 2       WB 3       NB 1       SB 1       SB 1       S1       S205	Median type			Raised				Raised					
Upstream signal (II)       0       0.00       0.00       v         pX, platoon unblocked       0.00       0       987       1358       1685       493       1189         vC, conflicting volume       0       670       0       987       1358       1685       493       1189         vC, conflicting volume       0       670       0       987       1358       1685       493       1189         vC, stage 2 conf vol	Median storage veh)			1				1					
pX, platoon unblocked 0.00 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 99 946 100 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 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 Ouceue Length 95th (ft) 1 0 0 1 0 0 4 17 Control Delay (s) 8.9 0.0 0.0 10.1 0.1 17.9 19.2 Lane LOS A B C C Approach LOS A B C A B C A Average Delay 0.1 0.1 0.1 17.9 19.2 Lane LOS A B C A B C A Average Delay 0.9 Intersection Summary Average Delay 0.9 Intersection Capacity Utilization 36.4% ICU Level of Service A Analysis Period (min) 15	Upstream signal (ft)												
vC, conflicting volume       0       670       0       987       1358       1885       493       1189         vC2, stage 1 conf vol       999       999       999       666       513         vC2, stage 2 conf vol       0       670       0       987       1358       1685       493       1189         vC2, stage 2 conf vol       0       670       0       987       1358       1685       493       1189         vC, 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       6.5       5.5       6.5         p0 queue free %       0       99       0       0.99       96       100       98       85         cM capacity (veh/h)       0       930       0       708       205       211       527       270         Direction, Lane #       EB1       EB2       EB3       WB1       WB2       WB3       NB1       SB1       SB1         Volume Total	pX, platoon unblocked	0.00	(70			0.00	0.07			1050	4 ( 05	100	1100
Vc1, stage 1 cont vol       359       646       513         vc2, stage 2 conf vol       0       670       0       987       1358       1685       493       1189         Vc, unblocked vol       0       670       0       987       1358       1685       493       1189         Vc, stage (s)         6.5       5.5       6.5       6.9       7.5         tC, 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         cd 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 10       930       700       8       0       8       40       Volume 10       0.33       333       8       433       237       16       60       Sci       CS       Sci       1700       708 </td <td>vC, conflicting volume</td> <td>0</td> <td>6/0</td> <td></td> <td></td> <td>0</td> <td>987</td> <td></td> <td></td> <td>1358</td> <td>1685</td> <td>493</td> <td>1189</td>	vC, conflicting volume	0	6/0			0	987			1358	1685	493	1189
VC2, stage 2 cont vol       0       670       0       987       1358       1685       493       1189         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       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 161       8       653       334       8       433       237       16       60       Volume 163       Volume 163       0       0       8       40       Volume 163       0.0       1700       1700       1700       295       314       Volum	vC1, stage 1 conf vol									999	999		6/6
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)       .       .       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       527       270         Direction, Lane #       EB 1       EB 2       EB 3       WB 1       WB 2       WB 3       NB 1       SB 1       527       270         Direction, Lane #       EB 1       EB 2       EB 3       WB 1       WB 2       WB 3       NB 1       SB 1       527       270         Direction, Lane #       EB 1       EB 2       EB 3       WB 1       WB 2       WB 3       NB 1       SB 1       527       270         Othume Total	VC2, stage 2 cont vol	0	(70			0	007			359	686	400	513
Ict, Single (s)       0.0       4.1       0.0       4.1       7.5       6.5       6.5       7.5         Ict, 2 stage (s)       6.5       5.5       6.5       5.5       6.5         If (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 10       930       0       708       205       211       527       270         Volume Total       8       653       334       8       433       237       16       60       Volume 10       205       211       527       270         Volume Right       0       0       8       0       28       16       SE       55       6.5         CSH       930       1700       1700       708       1700       1700       295       314       Volume 10       205	VCU, UNDIOCKED VOI	0	6/0			0	987			1358	1685	493	1189
IC, 2 Stage (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 Lane #       Volume Total       8       653       334       8       433       237       16       60       Volume Lane #       Volume Total       8       653       334       8       433       237       16       60       Volume Lane #       Volume Total       8       60       0       8       40       Volume Total       8       0       0       8       0       0       8       40       Volume Total       8       40       Volume Total       8       40       Volume Total       8       40       Volume Total       8       40       0       10       10       10       10	tC, single (s)	0.0	4.1			0.0	4.1			/.5	6.5 E E	6.9	/.5
It* (s)       0.0       2.2       0.0       2.2       3.3       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	IC, Z Stage (S)	0.0	<u> </u>			0.0	<u> </u>			0.0	5.5	2.2	0.5
Did dede fiele %       0       99       0       99       90       100       93       63       63         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 Total       8       653       334       8       433       237       16       60         Volume Total       8       653       334       8       433       237       16       60         Volume Edft       8       0       0       8       0       205       314       770         Volume Right       0       0       8       0       295       314       770 <td>IF (S)</td> <td>0.0</td> <td>2.2</td> <td></td> <td></td> <td>0.0</td> <td>2.2</td> <td></td> <td></td> <td>3.0</td> <td>4.0</td> <td>3.3</td> <td>3.3</td>	IF (S)	0.0	2.2			0.0	2.2			3.0	4.0	3.3	3.3
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 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         8         40           Volume to Capacity         0.01         0.38         0.20         0.01         1700         295         314           Volume to Capacity         0.01         0.38         0.20         0.01         1700         295         314           Volume to Capacity         0.01         0.38         0.20         0.01         17.00         295         314           Volume to Capacity         0.01         0.38         0.20         0.01         17.9         19.2           Lane LOS         A         B         C         C         C         C         C	p0 queue liee %	0	99			0	99 700			90 205	211	90 527	20
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         295         314           Volume to Capacity         0.01         0.38         0.20         0.01         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         17.9         19.2           Lane LOS         A         B         C         C         C           Approach LOS         0.1         0.1         17.9         19.2           Aproach LOS         0.9         C         C	civi capacity (veri/ii)	U	930			0	700			205	211	527	270
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       0.4       17         Control Delay (s)       8.9       0.0       0.0       10.1       0.0       17.9       19.2         Lane LOS       A       B       C       C       C         Approach Delay (s)       0.1       0.1       17.9       19.2         Approach LOS       C       C       C       C         Intersection Summary       0.9       Intersection Capacity Utilization       36.4%       ICU Level of Service       A         Analysis Period (min)       15       15       ICU Level of Service <t< th=""><th>Direction, Lane #</th><th>EB 1</th><th>EB 2</th><th>EB 3</th><th>WB 1</th><th>WB 2</th><th>WB 3</th><th>NB 1</th><th>SB 1</th><th></th><th></th><th></th><th></th></t<>	Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1				
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       C         Approach Delay (s)       0.1       0.1       17.9       19.2         Approach LOS       C       C       C       C         Intersection Summary       0.9       0.1       0.1       17.9       19.2         Average Delay       0.9       ICU Level of Service       A         Analysis Period (min)       15       15	Volume Total	8	653	334	8	433	237	16	60				
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         C           Approach Delay (s)         0.1         0.1         17.9         19.2           Approach LOS         0.1         0.1         17.9         19.2           Approach LOS         C         C         C         C           Intersection Summary         0.9         ICU Level of Service         A           Analysis Period (min)         15         15         A	Volume Left	8	0	0	8	0	0	8	40				
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       C         Approach Delay (s)       0.1       0.1       17.9       19.2         Approach LOS       C       C       C       C         Approach LOS       0.1       0.1       17.9       19.2         Approach LOS       C       C       C       C         Intersection Summary       C       C       C         Average Delay       0.9       ICU Level of Service       A         Analysis Period (min)       15       15	Volume Right	0	0	8	0	0	20	8	16				
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         C           Approach Delay (s)         0.1         0.1         17.9         19.2           Approach LOS         C         C         C         C           Approach LOS         0.1         0.1         17.9         19.2           Approach LOS         C         C         C         C           Intersection Summary         0.9         C         C         C           Intersection Capacity Utilization         36.4%         ICU Level of Service         A           Analysis Period (min)         15         15         C         C	CSH	930	1/00	1/00	/08	1/00	1/00	295	314				_
Outeue Length 95th (tt)       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       C         Intersection Summary       0.9       C       C         Average Delay       0.9       0.9       A         Intersection Capacity Utilization       36.4%       ICU Level of Service       A         Analysis Period (min)       15       15       A	Volume to Capacity	0.01	0.38	0.20	0.01	0.25	0.14	0.05	0.19				
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         C           Approach Delay (s)         0.1         0.1         17.9         19.2           Approach LOS         C         C         C           Intersection Summary         0.9         ICU Level of Service         A           Analysis Period (min)         15         15         10.1         17.9         19.2	Queue Length 95th (II)		0	0	10.1	0	0	4	10.0				_
Lane LOSABCCApproach Delay (s)0.10.117.919.2Approach LOSCCCIntersection SummaryAverage Delay0.9Intersection Capacity Utilization36.4%ICU Level of ServiceAAnalysis Period (min)15	Control Delay (S)	8.9	0.0	0.0	10.1 D	0.0	0.0	17.9	19.2				
Approach Delay (s)     0.1     0.1     17.7     17.2       Approach LOS     C     C       Intersection Summary     0.9       Intersection Capacity Utilization     36.4%     ICU Level of Service       Analysis Period (min)     15	Lane LUS Approach Dolay (c)	A 0.1			D 0 1			17.0	10.2				
Intersection Summary       0.9         Intersection Capacity Utilization       36.4%       ICU Level of Service       A         Analysis Period (min)       15       A	Approach LOS	0.1			0.1			C	19.2 C				
Average Delay     0.9       Intersection Capacity Utilization     36.4%       ICU Level of Service     A       Analysis Period (min)     15	Intersection Summary												
Intersection Capacity Utilization36.4%ICU Level of ServiceAAnalysis Period (min)15	Average Delay			0.9									
Analysis Period (min) 15	Intersection Capacity Utiliza	ation		36.4%	IC	CU Level	of Service			А			
	Analysis Period (min)			15									

	-	
Movement	SBT	SBR
Lane Configurations	4	
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 #		
Direction, Lane #		

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜</b> 16			44		1
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					А	
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS					А	
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utiliz	zation		29.4%	IC	U Level o	of Service
Analysis Period (min)			15			
			10			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ሻ	tβ			۲	<b>≜</b> t≽			\$			4
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	121			1/0	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	В			A			В	D				
Approach Delay (s)	0.3			0.0			11.8	31.3				
Approach LOS							В	D				
Intersection Summary												
Average Delay			1.6									
Intersection Capacity Utilization	l		46.6%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBR
Lan	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	₫	≯	-	$\rightarrow$	F	•	←	*	1	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲	¢γ			۲	A			4		
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	9/	95	//
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	В			В			С	D				
Approach Delay (s)	0.1			0.3			23.7	30.5				
Approach LOS							С	D				
Intersection Summary												
Average Delay			1.4									
Intersection Capacity Utilizati	ion		43.8%	IC	CU Level	of Service			A			
Analysis Period (min)			15									

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Movement	SBT	SBR
Lane Configurations	4	
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 #		
Direction, Lane #		

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜</b> 16			44		1
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 #	ER I	EB 2	WR I	WB 2	NRT	
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					А	
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS					A	
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utiliz	ation		32.2%	IC	U Level o	of Service
Analysis Period (min)			15			
/						

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ኘ	A			۲	<b>≜</b> †}			\$			4
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	А			В			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%	10	CU Level	of Service			В			
Analysis Period (min)			15									

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Movomont	CDD
	JDK
	71
Volume (ven/n)	/ 1
Sign Control	
Grade Deale Have Factor	0 / 7
Peak Hour Factor	0.67
Houriy flow rate (vpn)	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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲	A12			ሻ	<b>≜</b> †}			4		
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	004			0.00	1100			1 ( 0 0	0000	504	4 4 6 6
vC, conflicting volume	0	804			0	1183			1629	2023	591	1429
vC1, stage 1 conf vol									1199	1199		812
VC2, stage 2 cont vol	0	004			0	1100			431	824	F01	617
vCu, unblocked vol	0	804			0	1183			1629	2023	591	1429
tC, Single (S)	0.0	4.1			0.0	4.1			/.5 4 E	0.0	0.9	/.5 4 E
tC, Z Staye (S)	0.0	2.2			0.0	2.2			0.0	0.0	2.2	0.0
IF (S)	0.0	2.2			0.0	Z.Z 00			3.0 04	4.0	3.3 00	3.0
pu queue liee 70	0	99 920			0	90 500			94 154	165	90 455	21/
	0	027			0	570			154	105	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	1/00	1/00	598	1/00	1/00	226	253				
Volume to Capacity	0.01	0.46	0.24	0.02	0.31	0.17	0.09	0.28				
Queue Length 95th (IT)		0	0	11 1	0	0	/	28				_
Control Delay (S)	9.4	0.0	0.0		0.0	0.0	22.4	24.6				
Lalle LUS	A			D 0 1			22.4	24.6				
Approach LOS	0.1			0.1			22.4 C	24.0 C				
Intersection Summary												
Average Delay			1.1									
Intersection Capacity Utilizat	ion		42.2%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

Movement         SBT         S           Lane Configurations         Image: Configuration s         Image: Configuration s         Image: Configuration s           Volume (veh/h)         1         Image: Configuration s         Image: Configurat         Image: Configuration s	SBR 13
Lane Configurations	13
Volume (veh/h) 1	13
Class Cambral Chan	10
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 #	

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ⊾			44		1
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					А	
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS					А	
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utili	zation		34.6%	IC	U Level o	of Service
Analysis Period (min)			15			2
			10			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲	†î≽			<u> </u>	<b>≜</b> 1≩			\$			4
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	В			В			В	F				
Approach Delay (s)	0.3			0.0			12.9	60.5				
Approach LOS							В	F				
Intersection Summary												
Average Delay			3.0									
Intersection Capacity Utilization 5			53.3%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBR
Lane	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	<b>≜</b> †Ъ			٦	<b>≜</b> †}			4		
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			/6	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	В			В			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	on		51.1%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

	-	
Movement	SBT	SBR
Lane Configurations	4	
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 #		
Direction, Lane #		

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜</b> 16			44		1
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 #	ER I	EB 2	WB I	WB 2	NRI	
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 Utiliz	ation		38.0%	IC	U Level o	of Service
Analysis Period (min)			15			
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**OPENING YEAR TRAFFIC CONDITIONS (WITHOUT THE PROJECT)** 

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ኘ	<b>≜</b> †}			ሻ	At≱			\$			4
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	А			В			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			53.5%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBR
Laneconfigurations	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲.	At}			ኘ	At≱			4		
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)	0.00				0.00							
pX, platoon unblocked	0.00	(07			0.00	100/			1.110	1751	F10	1005
vC, conflicting volume	0	697			0	1026			1410	1/51	513	1235
VCT, stage 1 cont vol									1038	1038		702
VCZ, Stage Z coni voi	0	607			0	1004			3/2	1751	E10	233
tC single (s)	0	097			0	1020			75	65	60	1255
tC, single (s)	0.0	4.1			0.0	4.1			7.5	0.0	0.9	7.5
tF (s)	0.0	2.2			0.0	2.2			2.5	10	2 2	25
n0 queue free %	0.0	2.2			0.0	2.2			96	100	98	84
cM canacity (veh/h)	0	909			0	685			194	201	512	258
		50,							171	201	012	200
Direction, Lane #	ER 1	EB 2	EB 3	WBI	WB 2	WB 3	NB 1	SB 1				
Volume Lotal	8	6/9	347	8	450	247	16	61				
Volume Lett	8	0	0	8	0	0	8	41				
	000	1700	8	0	1700	1700	8	16				
CSH Maluma ta Canacitu	909	1700	1700	085	1/00	0.15	282	300				
Oucus Longth OFth (ft)	0.01	0.40	0.20	0.01	0.20	0.15	0.00	0.20				
Control Dolay (c)	0.0	0	0.0	10.2	0	0	4 10 6	20.0				
Lano LOS	9.0 A	0.0	0.0	10.3 R	0.0	0.0	10.0 C	20.0				
Approach Delay (s)	0.1			0.1			18.6	20.0				
Approach LOS	0.1			0.1			C	20.0 C				
Intersection Summary												
Average Delay			0.9									
Intersection Capacity Utiliza	tion		37.6%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜1</b> ≽			44		1
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					А	
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utili	zation		30.4%	IC	U Level o	of Service
Analysis Period (min)			15			
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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	٦	A			۲	A			4			4
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	В			В			В	D				
Approach Delay (s)	0.3			0.0			12.0	34.9				
Approach LOS							В	D				
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utiliza	tion		47.9%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

Movement	SBR
Laneconfigurations	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	₫	۶	-	$\mathbf{r}$	F	∢	+	*	٠	Ť	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲	<b>≜</b> 16			ሻ	<b>≜t</b> ≽			4		
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	119/			0	1048			1/19	2316	524	1804
tC, single (s)	0.0	4.1			0.0	4.1			1.5	6.5	6.9	/.5
tC, 2 stage (s)		0.0			0.0	0.0			6.5	5.5	0.0	6.5
tF (s)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
pu queue free %	0	99			0	95			84	97	94	/5
civi capacity (ven/n)	0	590			0	6/1			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	В			В			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	n		45.5%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

Movement	SBT	SBR
Lane Configurations	4	
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 #		

	-	$\mathbf{r}$	1	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ≽			<b>^</b>		1
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	
Oueue 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 Delav			0.0			
Intersection Capacity Utili	zation		33.4%	IC	U Level o	of Service
Analysis Period (min)			15	10	5 201010	
			15			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲,	A1⊅			ሻ	<b>≜</b> 1≩			\$			4
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	Α			В			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	1		60.3%	IC	CU Level	of Service			В			
Analysis Period (min)			15									

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Movement	SBR
Lan	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	A ₽₽			۲	<b>≜</b> †}			4		
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)	0.00				0.00							
pX, platoon unblocked	0.00	007			0.00	1000			1/04	0100	/15	1405
vC, conflicting volume	0	837			0	1230			1094	2103	615	1485
VCI, stage I confivel									1246	1246		844
VC2, Stage 2 cont vol	0	027			0	1000			448	857	/15	640 1405
tC, cingle (c)	0	837			0	1230			1094	2103	610	1485
tC, Siriyie (S)	0.0	4.1			0.0	4.1			7.5 4 E	0.0 5 5	0.9	7.5 4 E
tC, Z Staye (S)	0.0	2.2			0.0	2.2			0.0	5.5	2.2	0.5
n (s)	0.0	2.2			0.0	2.2			03	4.0	0.0 0.0	76
p0 queue nee 70 cM canacity (veh/h)	0	806			0	573			7J	100	70 // 20	204
	0	000			0	575			177	150	437	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 Maharana ha Qarana'ha	806	1700	1700	5/3	1700	1/00	213	243				
Volume to Capacity	0.01	0.48	0.24	0.02	0.32	0.17	0.09	0.30				
Queue Lengin 95in (II)		0	0	11 /	0	0	1	31				
Control Delay (S)	9.5	0.0	0.0	11.4 D	0.0	0.0	23.0	20.1				
Lalle LUS	A 0.1			D 0 1			12 K	D 24 1				
Approach LOS	0.1			0.1			23.0 C	20.1 D				
Intersection Summary												
Average Delay			1.2									
Intersection Capacity Utilizati	on		43.6%	IC	CU Level	of Service			А			
Analysis Period (min)			15									
	-											
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Movement	SBT	SBR										
Lane Configurations	4											
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 #												
DIRECTION, LANE #												

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜</b> 16			<b>^</b>		1
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 #	FR 1	FR 2	WR 1	WB 2	NR 1	
Volume Total	8/1	126	/155	//55	0	
Volume Left	0	420	4JJ	455	0	
Volume Right	0	6	0	0	0	
rSH	1700	1700	1700	1700	1700	
Volume to Canacity	0.49	0.25	0.27	0.27	0.00	
Oueue Length 95th (ft)	0.47	0.23	0.27	0.27	0.00	
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	0.0	0.0	0.0	
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS	0.0		0.0		A	
Intersection Summary						
			0.0			
Intersection Canacity Litili	zation		25 00/	10		of Sonvice
Analysis Dariad (min)	zation		33.0 <i>7</i> 0 1E	IC IC	O Level (	I Selvice
Analysis Penou (min)			15			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲	A			۲	<b>≜</b> 15-			\$			4
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	В			В			В	F				
Approach Delay (s)	0.3			0.0			13.1	74.2				
Approach LOS							В	F				
Intersection Summary												
Average Delay			3.6									
Intersection Capacity Utiliz	zation		54.9%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBR
Lane	
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 #

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		5	<b>≜1</b> }			ሻ	<b>≜</b> t≽			4		
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			/3	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	В			В			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	n		52.9%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

	-	
Movement	SBT	SBR
Lane Configurations	4	
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 #		
tC, 2 stage (s) tF (s) p0 queue free % cM capacity (veh/h) Direction, Lane #	5.5 4.0 100 93	3.3 93 377

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>4</b> 12			<b>^</b>		1
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					А	
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS					А	
Intersection Summary						
Average Delav			0.0			
Intersection Capacity Util	ization		39.4%	IC	CU Level o	of Service
Analysis Period (min)			15	10		2
			10			

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

	≯	-	$\mathbf{F}$	⋤	4	-	*	1	1	1	1	Ŧ
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲,	<b>4</b> 12			ሻ	<b>≜</b> 1≩			\$			4
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	А			В			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%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

	-
Movomont	CRD
	JDK
	/1
Volume (ven/n)	01
Sign Control	
Glaue Dook Hour Factor	0.47
FEAN ITUUI FACIUI	0.07
Dodostrians	91
r cucsilialis Lano Width (ft)	
Walking Spood (ft/s)	
Percent Blockage	
Right turn flare (veh)	
Modian type	
Median storade veh)	
Linstroam signal (ff)	
nX nlatoon unblocked	
vC conflicting volume	35/
vC1_stage 1 conf vol	
vC2_stage 2 conf vol	
vCu, unblocked vol	354
tC, single (s)	69
tC. 2 stage (s)	0.7
tF (s)	3.3
p0 queue free %	86
cM capacity (veh/h)	649
Direction, Lane #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	⊴	۶	-	$\mathbf{r}$	F	4	+	*	1	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	<b>≜</b> †Ъ			۲	<b>≜</b> t≽			4		
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)	0.00				0.00							
pX, platoon unblocked	0.00	704			0.00	1050			1400	1704	F0/	105/
vC, conflicting volume	0	/04			0	1052			1439	1/84	526	1256
vC1, stage 1 cont vol									1064	1064		709
vC2, stage 2 cont vol	0	704			0	1050			3/5	1704	E 94	540 1054
tC single (s)	0	/04			0	1052			1439	1/04	520	1200
tC, Siriyie (S)	0.0	4.1			0.0	4.1			7.0	0.0	0.9	7.0
tC, Z Staye (S)	0.0	<b></b>			0.0	2.2			2.5	1.0	2 2	0.5
n anene tree %	0.0	2.2			0.0	2.2			96	4.0	08 08	3.3 8/
cM canacity (veh/h)	0	903			0	669			188	100	502	253
		703	== .		0	007			100	170	502	200
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1				
Volume Lotal	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 Maluma ta Canaditu	903	1/00	1/00	009	1/00	0.15	2/3	295				
Volume to Capacity	0.01	0.41	0.21	0.01	0.27	0.15	U.U0 E	0.21				
Control Doloy (c)	0.0	0	0	10.4	0	0	0 10 0	20.4				
Long LOS	9.0	0.0	0.0	10.4 D	0.0	0.0	19.0	20.4				
Lane LOS Approach Dolay (s)	A 0.1			0.1			10.0	20.4				
Approach LOS	0.1			0.1			C	20.4 C				
Intersection Summary												
Average Delay			0.9									
Intersection Capacity Utilization	on		38.3%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

MovementSBTSBRLane Configurations $\clubsuit$ Volume (veh/h)111Sign ControlStopGrade-10%Peak Hour Factor0.250.69Hourly flow rate (vph)416PedestriansImage: StopLane Width (ft)Image: StopWalking Speed (ft/s)Image: StopPercent BlockageImage: StopRight turn flare (veh)Image: StopMedian storage veh)Image: StopUpstream signal (ft)Image: StoppX, platoon unblockedImage: StopvC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol1778352StoptC, single (s)5.5tF (s)4.09898cM capacity (veh/h)195651			
Lane Configurations $\clubsuit$ Volume (veh/h)111Sign ControlStopGrade-10%Peak Hour Factor0.250.69Hourly flow rate (vph)416PedestriansImage: Control Contrel Control Control Control Control Control Cont	Movement	SBT	SBR
Volume (veh/h)111Sign ControlStopGrade $-10\%$ Peak Hour Factor $0.25$ $0.69$ Hourly flow rate (vph)416PedestriansImage: Control of the stress	Lane Configurations	4	
Sign ControlStopGrade $-10\%$ Peak Hour Factor $0.25$ $0.69$ Hourly flow rate (vph)416PedestriansImage: Control of the strainsImage: Control of the strainsLane Width (ft)Image: Control of the strainsImage: Control of the strainsLane Width (ft)Image: Control of the strainsImage: Control of the strainsWalking Speed (ft/s)Image: Control of the strainsImage: Control of the strainsPercent BlockageImage: Control of the strainsImage: Control of the strainsMedian storage veh)Image: Control of the strainsImage: Control of the strainsUpstream signal (ft)Image: Control of the strainsImage: Control of the strainspX, platoon unblockedImage: Control of the strainsImage: Control of the strainsvC1, stage 1 conf vol709Image: Control of the strainsvC2, stage 2 conf volImage: Control of the strainsImage: Control of the strainsvC4, unblocked volImage: Control of the strainsImage: Control of the strainsvC4, unblocked volImage: Control of the strainsImage: Control of the strainsvC4, stage (s)Image: Control of the strainsImage: Control of the strainsvC5, stage (s)Image: Control of the strainsImage: Control of the strainsvC4, unblocked volImage: Control of the strainsImage: Control of the strainsvC5, stage (s)Image: Control of the strainsImage: Control of the strainsvC4, unblocked volImage: Control of the strainsImage	Volume (veh/h)	1	11
Grade-10%Peak Hour Factor $0.25$ $0.69$ Hourly flow rate (vph)416PedestriansImage: Constraint of the second sec	Sign Control	Stop	
Peak Hour Factor $0.25$ $0.69$ Hourly flow rate (vph)416PedestriansLane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol17783525.5tC, single (s)5.5tF (s)4.090 queue free %9898cM capacity (veh/h)195651	Grade	-10%	
Hourly flow rate (vph)416Pedestrians	Peak Hour Factor	0.25	0.69
PedestriansLane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume1778352vC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol17783525.5tC, single (s)6.56.95.5tF (s)4.090 queue free %9898cM capacity (veh/h)195651	Hourly flow rate (vph)	4	16
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	Pedestrians		
Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume1778352vC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol1778352tC, single (s)6.56.9tC, 2 stage (s)5.5tF (s)90 queue free %98cM capacity (veh/h)195651	Lane Width (ft)		
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) 98 98 cM capacity (veh/h) 195 651	Walking Speed (ft/s)		
Right turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume1778vC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol17783526.5tC, single (s)6.5tC, 2 stage (s)5.5tF (s)4.090 queue free %9898cM capacity (veh/h)195651	Percent Blockage		
Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume1778352vC1, stage 1 conf vol709vC2, stage 2 conf vol1068vCu, unblocked vol17783526.5tC, single (s)6.5tC, 2 stage (s)5.5tF (s)4.090 queue free %9898cM capacity (veh/h)195651	Right turn flare (veh)		
Median storage veh)     Upstream signal (ft)     pX, platoon unblocked     vC, conflicting volume   1778     vC1, stage 1 conf vol   709     vC2, stage 2 conf vol   1068     vCu, unblocked vol   1778     vCu, unblocked vol   1778     vC, single (s)   6.5     tC, single (s)   5.5     tF (s)   4.0     p0 queue free %   98     cM capacity (veh/h)   195	Median type		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 98 98   cM capacity (veh/h) 195 651	Median storage veh)		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 98 98   cM capacity (veh/h) 195 651	Upstream signal (ft)		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 98 98   cM capacity (veh/h) 195 651	pX, platoon unblocked		
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   5.5     tF (s)   4.0   3.3     p0 queue free %   98   98     cM capacity (veh/h)   195   651	vC, conflicting volume	1778	352
vC2, stage 2 conf vol   1068     vCu, unblocked vol   1778   352     tC, single (s)   6.5   6.9     tC, 2 stage (s)   5.5   6.5     tF (s)   4.0   3.3     p0 queue free %   98   98     cM capacity (veh/h)   195   651	vC1, stage 1 conf vol	709	
vCu, unblocked vol   1778   352     tC, single (s)   6.5   6.9     tC, 2 stage (s)   5.5   5.5     tF (s)   4.0   3.3     p0 queue free %   98   98     cM capacity (veh/h)   195   651	vC2, stage 2 conf vol	1068	
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	vCu, unblocked vol	1778	352
tC, 2 stage (s) 5.5   tF (s) 4.0 3.3   p0 queue free % 98 98   cM capacity (veh/h) 195 651	tC, single (s)	6.5	6.9
tF (s)   4.0   3.3     p0 queue free %   98   98     cM capacity (veh/h)   195   651	tC, 2 stage (s)	5.5	
p0 queue free %   98   98     cM capacity (veh/h)   195   651	tF (s)	4.0	3.3
cM capacity (veh/h) 195 651	p0 queue free %	98	98
	cM capacity (veh/h)	195	651
Direction Lane #	Direction Lane #		

	-	$\mathbf{r}$	1	-	▲	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ≽			<b>^</b>		1
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 #	FB 1	FB 2	WB 1	WB 2	NB 1	
Volume Total	701	390	389	389	42	
Volume Left	0	0	0	0	0	
Volume Right	0	20	0	0	42	
rSH	1700	1700	1700	1700	488	
Volume to Canacity	0.41	0.23	0.23	0.23	0.09	
Oueue Length 95th (ft)	0.41	0.23	0.20	0.20	0.07	
Control Delay (s)	0.0	0.0	0.0	0.0	13.1	
Lane LOS	0.0	0.0	0.0	0.0	R	
Approach Delay (s)	0.0		0.0		13.1	
Approach LOS	0.0		0.0		B	
Intersection Summarv						
Average Delay			0.3			
Intersection Canacity Utili:	zation		37.4%	IC	Ulevelo	of Service
Analysis Period (min)			15	10		
			IJ			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ሻ	<b>†</b> 12			۲	<b>≜</b> 16			\$			4
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	В			В			В	E				
Approach Delay (s)	0.3			0.0			12.0	35.7				
Approach LOS							В	E				
Intersection Summary												
Average Delay			1.8									_
Intersection Capacity Utilizati	on		48.2%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

7

Movement SBR Land Configurations
Lane Configurations
- 0
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 #

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲.	<b>≜1</b> }			ኘ	<b>≜</b> t≽			4		
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	1004			0.00	4074			4755	00/5	505	10.10
vC, conflicting volume	0	1224			0	1071			1/55	2365	535	1843
vC1, stage 1 conf vol									1075	1075		1272
vC2, stage 2 conf vol	0	1004			•	4074			680	1291	505	5/1
VCu, unblocked vol	0	1224			0	10/1			1/55	2365	535	1843
tC, single (s)	0.0	4.1			0.0	4.1			1.5	6.5	6.9	/.5
tC, 2 stage (s)	0.0	2.2			0.0	2.2			0.5	5.5	2.2	6.5
IF (S)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
pu queue free %	0	99			0	95			83	97	94 405	124
civi capacity (ven/n)	0	577			0	009			153	129	495	120
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	В			В			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 Utilizatio	n		45.5%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

MovementSBTSBRLane Configurations $\clubsuit$ Volume (veh/h)012Sign ControlStopGrade-10%Peak Hour Factor0.900.60Hourly flow rate (vph)020Pedestrians2Lane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median type4Median storage veh)1272Upstream signal (ft)1272pX, platoon unblocked2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol2359cf. 2 stage (s)5.5tF (s)4.0p0 queue free %100p0 queue free %100Lane %100p12127VC2, stage 2 conf vol1272VC2, stage (s)5.5tr (s)4.03.3p0 queue free %127442		-	
Lane Configurations $\clubsuit$ Volume (veh/h)012Sign ControlStopGrade-10%Peak Hour Factor0.900.60Hourly flow rate (vph)020Pedestrians	Movement	SBT	SBR
Volume (veh/h)012Sign ControlStopGrade $-10\%$ Peak Hour Factor $0.90$ $0.60$ Hourly flow rate (vph)020Pedestrians $20$ Lane Width (ft) $30$ Walking Speed (ft/s) $70$ Percent Blockage $70$ Right turn flare (veh) $30$ Median storage veh) $1272$ Upstream signal (ft) $1272$ vC1, stage 1 conf vol $1272$ vC2, stage 2 conf vol $1087$ vCu, unblocked vol $2359$ 612 $5.5$ tC, single (s) $6.5$ 6.9 $5.5$ tF (s) $4.0$ 90 queue free % $100$ 95cM capacity (veh/h)127 $442$	Lane Configurations	\$	
Sign ControlStopGrade $-10\%$ Peak Hour Factor $0.90$ $0.60$ Hourly flow rate (vph) $0$ $20$ Pedestrians $120$ Lane Width (ft) $120$ Walking Speed (ft/s) $120$ Percent Blockage $120$ Right turn flare (veh) $120$ Median storage veh) $1272$ Upstream signal (ft) $1272$ vC1, stage 1 conf vol $1272$ vC2, stage 2 conf vol $1087$ vCu, unblocked vol $2359$ 612 $1259$ tC, single (s) $6.5$ 6.9 $5.5$ tF (s) $4.0$ 90 queue free % $100$ 95cM capacity (veh/h)127 $442$	Volume (veh/h)	0	12
Grade-10%Peak Hour Factor $0.90$ $0.60$ Hourly flow rate (vph) $0$ $20$ Pedestrians $20$ Lane Width (ft) $20$ Walking Speed (ft/s) $20$ Percent BlockageRight turn flare (veh)Median type $4000000000000000000000000000000000000$	Sign Control	Stop	
Peak Hour Factor $0.90$ $0.60$ Hourly flow rate (vph) $0$ $20$ Pedestrians $100$ $20$ Lane Width (ft) $100$ $200$ Walking Speed (ft/s) $100$ $100$ Percent Blockage $100$ $100$ Right turn flare (veh) $100$ $100$ Median type $100$ $100$ Median storage veh) $100$ $100$ Upstream signal (ft) $100$ $100$ pX, platoon unblocked $100$ $100$ vC1, stage 1 conf vol $1272$ $100$ vC2, stage 2 conf vol $1087$ $100$ vCu, unblocked vol $2359$ $612$ tC, single (s) $6.5$ $6.9$ tC, 2 stage (s) $5.5$ $100$ tF (s) $4.0$ $3.3$ p0 queue free % $100$ $95$ cM capacity (veh/h) $127$ $442$	Grade	-10%	
Hourly flow rate (vph)020Pedestrians20Lane Width (ft)20Walking Speed (ft/s)20Percent Blockage20Right turn flare (veh)20Median type20Median storage veh)20Upstream signal (ft)2359pX, platoon unblocked2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol2359cf, 2 stage (s)5.5tF (s)4.03.3p0 queue free %100cM capacity (veh/h)127442	Peak Hour Factor	0.90	0.60
PedestriansLane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol23596126.5ft, 2 stage (s)5.5tF (s)4.03.3p0 queue free %100cM capacity (veh/h)127442	Hourly flow rate (vph)	0	20
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	Pedestrians		
Walking Speed (fl/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol23596126.5ft, single (s)6.5ft (s)4.0a, and polyceue free %100pS queue free %100cM capacity (veh/h)127442	Lane Width (ft)		
Percent Blockage Right turn flare (veh) Median type Median storage veh) Upstream signal (ft) pX, platoon unblocked vC, conflicting volume vC2, conflicting volume vC2, stage 1 conf vol vC2, stage 2 conf vol vC4, unblocked vol vC4, unblocked vol vC4, unblocked vol vC5, single (s) tC, 2 stage (s) tF (s) p0 queue free % cM capacity (veh/h) P0 Welling	Walking Speed (ft/s)		
Right turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol2359cf, single (s)6.5cf, 2 stage (s)5.5tF (s)4.0p0 queue free %100p5cM capacity (veh/h)127442	Percent Blockage		
Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2359vC1, stage 1 conf vol1272vC2, stage 2 conf vol1087vCu, unblocked vol2359cf, 2 stage (s)6.5tC, 2 stage (s)5.5tF (s)4.03.3p0 queue free %100vSequencing (veh/h)127v42	Right turn flare (veh)		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 100 95   cM capacity (veh/h) 127 442	Median type		
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   5.5     tF (s)   4.0   3.3     p0 queue free %   100   95     cM capacity (veh/h)   127   442	Median storage veh)		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 100 95   cM capacity (veh/h) 127 442	Upstream signal (ft)		
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   5.5     tF (s)   4.0   3.3     p0 queue free %   100   95     cM capacity (veh/h)   127   442	pX, platoon unblocked		
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 5.5   tF (s) 4.0 3.3   p0 queue free % 100 95   cM capacity (veh/h) 127 442	vC, conflicting volume	2359	612
vC2, stage 2 conf vol   1087     vCu, unblocked vol   2359   612     tC, single (s)   6.5   6.9     tC, 2 stage (s)   5.5   5.5     tF (s)   4.0   3.3     p0 queue free %   100   95     cM capacity (veh/h)   127   442	vC1, stage 1 conf vol	1272	
vCu, unblocked vol   2359   612     tC, single (s)   6.5   6.9     tC, 2 stage (s)   5.5   5     tF (s)   4.0   3.3     p0 queue free %   100   95     cM capacity (veh/h)   127   442	vC2, stage 2 conf vol	1087	
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	vCu, unblocked vol	2359	612
tC, 2 stage (s)5.5tF (s)4.03.3p0 queue free %10095cM capacity (veh/h)127442	tC, single (s)	6.5	6.9
tF (s) 4.0 3.3   p0 queue free % 100 95   cM capacity (veh/h) 127 442	tC, 2 stage (s)	5.5	
p0 queue free %   100   95     cM capacity (veh/h)   127   442	tF (s)	4.0	3.3
cM capacity (veh/h) 127 442	p0 queue free %	100	95
	cM capacity (veh/h)	127	442
Direction Lane #	Direction Lane #		

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ≽			<b>^</b>		1
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 #	FB 1	FB 2	WB 1	WB 2	NB 1	
Volume Total	708	484	623	623	36	
Volume Left	0	0	020	020	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	0.20	0.07	0.07	6	
Control Delay (s)	0.0	0.0	0.0	0.0	13.6	
Lane LOS	0.0	0.0	0.0	0.0	B	
Approach Delay (s)	0.0		0.0		13.6	
Approach LOS	0.0		0.0		В	
Intersection Summary						
Average Delav			0.2			
Intersection Capacity Util	ization		38.7%	IC	U Level o	of Service
Analysis Period (min)			15		2 201010	
			15			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ኘ	<b>≜</b> †}			ሻ	A12			\$			4
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	А			В			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	1		53.7%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBR
	JDR
Volume (veh/h)	61
Sign Control	01
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

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Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲	At}			۲	<b>≜</b> t≽			4		
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	70/			0.00	10/0			1.1.10	1704	500	10/1
vC, conflicting volume	0	/06			0	1060			1448	1/94	530	1261
vC1, stage 1 conf vol									1072	1072		/11
VC2, stage 2 conf vol	0	70/			0	10/0			3/6	122	F 2 0	550
	0	/06			0	1060			1448	1/94	530	1261
IC, single (s)	0.0	4.1			0.0	4.1			1.5	0.5	6.9	/.5
IC, Z Slage (S)	0.0	2.2			0.0	2.2			0.0	5.5	2.2	0.5
IF (S)	0.0	2.2			0.0	2.2			3.0	4.0	3.3	3.3
pu queue nee %	0	99			0	99 445			90 104	100	98	04 252
civi capacity (ven/n)	0	901			0	000			100	195	499	202
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			В			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	on		38.5%	IC	CU Level	of Service			A			
Analysis Period (min)			15									

	-	$\mathbf{r}$	1	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ⊾			**		1
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					В	
Approach Delay (s)	0.0		0.0		13.4	
Approach LOS					В	
Intersection Summary						
Average Delay			0.4			
Intersection Capacity Utiliz	zation		37.5%	IC	U Level o	of Service
Analysis Period (min)			15			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲	A			۲	A			4			4
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	В			В			В	E				
Approach Delay (s)	0.3			0.0			12.1	35.9				
Approach LOS							В	E				
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utiliza	ation		53.1%	IC	CU Level	of Service			A			
Analysis Period (min)			15									

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Movement	SBR
Lane	
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 #	

Page 2

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	₫	≯	-	$\mathbf{r}$	F	∢	+	*	٩.	Ť	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲.	<b>≜</b> †Ъ			ኘ	<b>≜</b> t≽			4		
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)	0.00				0.00							
pX, platoon unblocked	0.00	1000			0.00	1077			17//	0001	F 20	1055
vC, conflicting volume	0	1233			0	1077			1/00	2381	539	1855
									1081	1081		1281
	0	1000			0	1077			004 1744	1299	E20	5/4 1055
tC single (s)	0	1255			0	1077			7.5	2301	6.0	1000
tC, single (s) tC 2 stage (s)	0.0	4.1			0.0	4.1			7.J	0.J 5.5	0.7	7.5
tF (s)	0.0	2.2			0.0	2.2			25	10	2 2	3.5
n) queue free %	0.0	2.2			0.0	95			83	4.0 97	94	73
cM capacity (veh/h)	0	572			0	655			151	128	493	124
		572							101	120	170	121
Direction, Lane #	ER 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1				
Volume Lotal	8	/02	3/5	33	/9/	436	59	53				
Volume Lett	8	0	0	33	0	0	26	33				
	0 570	1700	24 1700	455	1700	37	29	20				
CSH Volume to Conscitu	572	0.41	1/00	000	0.47	0.26	220	17U				
Quoue Longth 05th (ft)	0.01	0.41	0.22	0.05	0.47	0.20	0.20	0.31				
Control Dolay (s)	11 /	0	0.0	4 10 Q	0.0	0	20	3Z 25 5				
Lang LOS	11.4 R	0.0	0.0	10.0 R	0.0	0.0	20.0 D	30.0 F				
Approach Delay (s)	0.1			03			26.5	25 5				
Approach LOS	0.1			0.5			20.3 D	55.5 E				
Intersection Summary												
Average Delay			1.6						-			
Intersection Capacity Utilizatio	n		45.5%	IC	CU Level (	of Service			A			
Analysis Period (min)			15									

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Movement	SBT	SBR
Lane Configurations	4	
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
Diraction Lana #		
DIECTION, LANE #		

	-	$\mathbf{F}$	1	-	▲	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ≽			<b>^</b>		1
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 #	FB 1	FB 2	WB 1	WB 2	NB 1	
Volume Total	708	517	629	629	46	
Volume Left	0	0	02,	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	0.00	0.07	0.07	9	
Control Delay (s)	0.0	0.0	0.0	0.0	14 1	
LaneLOS	0.0	0.0	0.0	0.0	B	
Approach Delay (s)	0.0		0.0		14 1	
Approach LOS	0.0		0.0		В	
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utili	zation		39.0%	IC	U Level o	of Service
Analysis Period (min)			15	10	0 201010	
			10			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲,	A12			5	<b>≜</b> t≽			\$			4
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	А			В			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	1		60.4%	IC	CU Level	of Service			В			
Analysis Period (min)			15									

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Movement	SBR
	501
Volume (veh/h)	74
Sign Control	7 -
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 cont vol	
vC2, stage 2 cont vol	100
vCu, unblocked vol	423
tC, single (s)	6.9
tC, 2 stage (s)	1 1
IF (S)	3.3
pu queue liee %	81
civi capacity (ven/n)	080
Direction, Lane #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	₫	۶	-	$\mathbf{r}$	F	∢	+	*	٩.	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	<b>≜</b> †Ъ			ሻ	<b>≜</b> †}			4		
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	0.45			0.00	105/			4704	0107	(00	4505
vC, conflicting volume	0	845			0	1256			1/24	2137	628	1505
vC1, stage 1 conf vol									12/2	1272		851
VC2, stage 2 cont vol	0	045			0	105/			451	865	( 20	654 1505
VCU, UNDIOCKED VOI	0	845			0	1256			1/24	2137	628	1505
tC, Single (S)	0.0	4.1			0.0	4.1			/.5 4 E	0.0	0.9	/.5 4 E
tC, Z Slaye (S)	0.0	<b></b>			0.0	2.2			0.0	0.0	2.2	0.0
IF (S)	0.0	2.2			0.0	Z.Z 00			3.0	4.0	3.3 00	3.0
pu queue nee 70	0	99 Q01			0	560			93 120	100	90 //21	200
	0	001			0	500			137	IJZ	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	1/00	1/00	560	1/00	1/00	207	239				
Volume to Capacity	0.01	0.49	0.25	0.02	0.32	0.18	0.09	0.31				
Queue Length 95th (IT)		0	0	11 Г	0	0	8	31				_
Control Delay (S)	9.0	0.0	0.0	11.5 D	0.0	0.0	24.2	20.0				
Lalle LUS Approach Dolay (c)	A			D 0 1			24.2	D 24.4				
Approach LOS	0.1			0.1			24.2 C	20.0 D				
Intersection Summary												
Average Delay			1.2									
Intersection Capacity Utilization	on		44.3%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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MovementSBTSBRLane ConfigurationsImage: Control StopVolume (veh/h)1114Sign ControlStopGrade-10%Peak Hour Factor0.250.250.69Hourly flow rate (vph)420PedestriansLane Width (ft)Valking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2128422vC1, stage 1 conf vol851vC2, stage 2 conf vol12761276	ment SBT
Lane Configurations♣Volume (veh/h)114Sign ControlStopGrade-10%Peak Hour Factor0.250.69Hourly flow rate (vph)420Pedestrians2Lane Width (ft)420Walking Speed (ft/s)9Percent Blockage8Right turn flare (veh)4Median type4Median storage veh)1Upstream signal (ft)7pX, platoon unblocked2128vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	
Volume (veh/h)114Sign ControlStopGrade-10%Peak Hour Factor0.250.69Hourly flow rate (vph)420Pedestrians2Lane Width (ft)420Walking Speed (ft/s)2Percent Blockage7Right turn flare (veh)4Median storage veh)2Upstream signal (ft)7pX, platoon unblocked2128vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	Configurations 🛛 🚓
Sign ControlStopGrade-10%Peak Hour Factor0.25Hourly flow rate (vph)4PedestriansLane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC1, stage 1 conf vol851vC2, stage 2 conf vol1276	ie (veh/h) 1
Grade-10%Peak Hour Factor0.250.69Hourly flow rate (vph)420Pedestrians20Lane Width (ft)20Walking Speed (ft/s)20Percent Blockage21Right turn flare (veh)2128Median storage veh)2128Upstream signal (ft)2128pX, platoon unblocked422vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	Control Stop
Peak Hour Factor0.250.69Hourly flow rate (vph)420Pedestrians20Lane Width (ft)20Walking Speed (ft/s)20Percent Blockage20Right turn flare (veh)20Median type20Median storage veh)2128Upstream signal (ft)2128vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	-10%
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	Hour Factor 0.25
PedestriansLane Width (ft)Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2128422vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	/ flow rate (vph) 4
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	strians
Walking Speed (ft/s)Percent BlockageRight turn flare (veh)Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2128422vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	Width (ft)
Percent Blockage Right turn flare (veh) Median type Median storage veh) Upstream signal (ft) pX, platoon unblocked vC, conflicting volume vC1, stage 1 conf vol 851 vC2, stage 2 conf vol 1276	ng Speed (ft/s)
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	nt Blockage
Median typeMedian storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2128422vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	turn flare (veh)
Median storage veh)Upstream signal (ft)pX, platoon unblockedvC, conflicting volume2128vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	n type
Upstream signal (ft) pX, platoon unblocked vC, conflicting volume 2128 422 vC1, stage 1 conf vol 851 vC2, stage 2 conf vol 1276	n storage veh)
pX, platoon unblockedvC, conflicting volume2128vC1, stage 1 conf vol851vC2, stage 2 conf vol1276	eam signal (ft)
vC, conflicting volume   2128   422     vC1, stage 1 conf vol   851     vC2, stage 2 conf vol   1276	atoon unblocked
vC1, stage 1 conf vol 851 vC2, stage 2 conf vol 1276	onflicting volume 2128
vC2, stage 2 conf vol 1276	stage 1 conf vol 851
	stage 2 conf vol 1276
vCu, unblocked vol 2128 422	unblocked vol 2128
tC, single (s) 6.5 6.9	igle (s) 6.5
tC, 2 stage (s) 5.5	stage (s) 5.5
tF (s) 4.0 3.3	4.0
p0 queue free % 97 97	eue free % 97
cM capacity (veh/h) 150 586	pacity (veh/h) 150
Direction Lane #	ion Lane #

	-	$\rightarrow$	-	-	1	
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜</b> †}			<b>††</b>		1
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					В	
Approach Delay (s)	0.0		0.0		14.6	
Approach LOS					В	
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Util	ization		42.8%	IC	U Level o	of Service
Analysis Period (min)			15			
			10			

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Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	٦	<b>4</b> 12			۲	<b>≜</b> t≽			\$			4
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	В			В			В	F				
Approach Delay (s)	0.3			0.0			13.2	77.0				
Approach LOS							В	F				
Intersection Summary												
Average Delay			3.7									
Intersection Capacity Utiliz	ation		55.2%	IC	CU Level	of Service			В			
Analysis Period (min)			15									

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Movement	SBR
Lane	
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 #

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

	₫	٦	-	$\mathbf{r}$	F	-	+	*	1	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	<b>∱1</b> }			٦	At≱			4		
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			1.5	6.5	6.9	/.5
tC, 2 stage (s)	0.0	0.0			0.0	0.0			6.5	5.5	0.0	6.5
tF (S)	0.0	2.2			0.0	2.2			3.5	4.0	3.3	3.5
pu queue free %	0	98			0	93			110	96	92	54
civi capacity (ven/n)	0	468			0	549			110	93	423	80
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	В			В			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	1		52.9%	IC	CU Level	of Service			А			
Analysis Period (min)			15									_
# ↓ √

	-	
Movement	SBT	SBR
Lane Configurations	4	
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 #		

	-	$\rightarrow$	-	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>4</b> 12			<b>^</b>		1
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					С	
Approach Delay (s)	0.0		0.0		15.3	
Approach LOS					С	
Intersection Summary						
Average Delav			0.2			
Intersection Capacity Util	ization		44.2%	IC	U Level o	of Service
Analysis Period (min)			15			
			10			

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

5/13/2021

	≯	-	$\mathbf{F}$	⋤	4	-	*	1	1	1	1	ŧ
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲,	A1⊅			ሻ	<b>≜</b> 16			\$			\$
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			В			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%	IC	CU Level	of Service			В			
Analysis Period (min)			15									

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Movement	SBR
Laneconfigurations	
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 #	

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

5/13/2021

	₫	≯	-	$\rightarrow$	F	•	←	*	1	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		۲	¥î≽			ሻ	đβ			4		
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			1/32	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	/5
cM capacity (ven/h)	0	/99			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	Α			В			С	D				
Approach Delay (s)	0.1			0.1			24.4	26.8				
Approach LOS							С	D				
Intersection Summary												
Average Delay			1.2									
Intersection Capacity Utilizatio	n		44.5%	IC	CU Level	of Service			А			
Analysis Period (min)			15									

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Movement	SBT	SBR
Lane Configurations	4	
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 #		

	-	$\rightarrow$	1	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>≜t</b> ≽			<b>^</b>		1
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 #	FR 1	FR 2	\//R 1	W/R 2	NR 1	
Volumo Total	<u> </u>	160	/70	470	56	
Volume Loft	041	409	470	470	0	
Volume Lett	0	18	0	0	56	
	1700	40 1700	1700	1700	JU /1/	
Volumo to Canacity	0.40	0.28	0.28	0.28	0.12	
Ouque Longth 95th (ft)	0.49	0.20	0.20	0.20	12	
Control Dolay (s)	0	0.0	0	0.0	15.0	
Lano LOS	0.0	0.0	0.0	0.0	13.0	
Approach Dolay (s)	0.0		0.0		15.0	
Approach LOS	0.0		0.0		13.0 C	
Intersection Summary					-	
Average Delev			0.4			
Average Delay	laction		U.4			of Condoc
Intersection Capacity Util	IZALION		42.9% 15	IC	U Level (	I Service
Analysis Period (min)			15			

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

5/13/2021

	≯	-	$\rightarrow$	F	4	←	*	1	1	1	1	ŧ
Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	۲	A			۲	¥î≽			4			4
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	В			В			В	F				
Approach Delay (s)	0.3			0.0			13.3	77.8				
Approach LOS							В	F				
Intersection Summary												
Average Delay			3.7									
Intersection Capacity Utilizatio	n		55.3%	IC	CU Level	of Service			В			
Analysis Period (min)			15									

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Movement	SBR
Lane	
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 #

HCM Unsignalized Intersection Capacity Analysis 6: Dollar General Driveway (Main)/Frederick Drive & Middlebrook Pike

5/13/2021

	₫	۶	-	$\mathbf{r}$	F	∢	+	*	٩.	1	1	1
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		ሻ	A ₽₽			۲	<b>≜</b> †}			4		
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	14/2			0	1287			2109	2843	644	2214
vC1, stage 1 conf vol									1291	1291		1530
vC2, stage 2 conf vol	0	1 4 7 0			0	1007			819	1552		684
	0	14/2			0	1287			2109	2843	644	2214
tC, single (s)	0.0	4.1			0.0	4.1			1.5	6.5	6.9	1.5
IC, Z Slage (S)	0.0	2.2			0.0	2.2			0.0	5.5	2.2	0.5
IF (S)	0.0	Z.Z			0.0	2.Z			3.5 70	4.0	3.3 02	3.3 E4
pu queue nee %	0	90			0	93 545			100	90	92	04 05
civi capacity (ven/n)	0	404			0	040			109	92	421	00
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	1/00	1/00	545	1/00	1/00	1/1	121				_
Volume to Capacity	0.02	0.49	0.26	0.07	0.56	0.31	0.41	0.53				
Queue Length 95th (II)	10.0	0	0	10.1	0	0	46	63				_
Control Delay (S)	12.9 D	0.0	0.0	IZ.I	0.0	0.0	40.0	64.I				
Lane LUS	D 1			B			E	F 4 1				
Approach LOS	0.1			0.3			40.0 E	04.1 E				
Approach 203							L	Г				
Intersection Summary												
Average Delay			2.6									
Intersection Capacity Utilization	on		52.9%	IC	CU Level	of Service			A			
Analysis Period (min)			15									

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Movement SBT S   Lane Configurations Image: Application state of the state of t	BR
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 #	

	-	$\rightarrow$	- 🗲	-	1	1
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	<b>4</b> 12			<b>^</b>		1
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 #	FB 1	FB 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	
c.SH	1700	1700	1700	1700	375	
Volume to Capacity	0.50	0.35	0 44	0 44	0.12	
Queue Length 95th (ft)	0.00	0.00	0	0	10	
Control Delay (s)	0.0	0.0	0.0	0.0	15.9	
Lane LOS	0.0	0.0	0.0	0.0	С	
Approach Delay (s)	0.0		0.0		15.9	
Approach LOS	0.0		0.0		C	
Intersection Summarv						
Average Delay			0.2			
Intersection Capacity Util	ization		44.5%	IC	ULevelo	of Service
Analysis Period (min)			15		0 201010	
			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 Dweiling Unit**

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

#### Data Plot and Equation



ż

# Local Apartment Trip Generation Study

Average Vehicle Trip Ends vs: On a:	Dwelling Units Weekday, Peak Hour of Adjacent Street Traffic One Hour Between 7 and 9 a.m
Number of Studies:	13
Average Number of Dweiling 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





# Local Apartment Trip Generation Study

Average Vehicle Trip Ends vs: On a:	Dwelling Units 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% exiling

#### 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		GI PM	GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip				22%	78%		55%	45%	
Rate	Apartments	90 Apartments	868	11	38	49	39	32	71
То	tal New Volume Si	te 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

#### <u>Weekday:</u>

				_
	T =	868	trips	=
	T =	15	*	57.13
Fitted Curve Equation:	T = 15.1	193(X) <sup>0.1</sup>	899	

# Peak Hour of Adjacent Traffic between 7 and 9 am:

1	
T = 49  trip	5
T = 0.758 *	64
Fitted Curve Equation: $T = 0.758(X)^{0.924}$	

# Peak Hour of Adjacent Traffic between 4 and 6 pm:

	<u>T</u> =	71 trips				
	T =	0.669 *	90	+ 10.07		
Fitted Curve Equation:	T = 0.6	T = 0.669(X) + 10.069				

#### TRIP GENERATION FOR MIDDLEBROOK COMMONS

#### 120 Apartments

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

## <u>Weekday:</u>

	T =	1125	trips	<u> </u>	
	T =	15	*	73.99	
Fitted Curve Equation:	$T = 15.193(X)^{0.899}$				

# Peak Hour of Adjacent Traffic between 7 and 9 am:

	T =	64	trips	=
	T =	0.758	*	83
Fitted Curve Equation:	T = 0.7	58(X) <sup>0.924</sup>	1	

# Peak Hour of Adjacent Traffic between 4 and 6 pm:

		<u> </u>	:	
	Т=	91 trips		
	T =	0.669 *	120	+ 10.07
Fitted Curve Equation:	T = 0.6	69(X)+10.069		

# **APPENDIX H**

2018 CENSUS BUREAU DATA

# United States ensus **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 **1**55 - 239

- Job Count [Jobs/Census Block]
  - . 1 3 . 4 - 11

  - 12 25
  - 26 44
  - 45 69
  - Selection Areas
  - ✤ Analysis Selection





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

	2018				
Distance	Count	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 - On The Map 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

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	THR	OUGH VOLUM	FT-TURN	VOLUM	E *	
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					Yes Yes	Yes Yes
100 - 149 150 - 199		Middlet Propose Entrance	Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments2023 Projected AM EB Right Turns = 13 without 20% Increase due to PandemicRight Turn Lane NOT Warranted		Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	2023 P EB Righ			Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	without 209 Pa			Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Right Tu W			Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes			Yes Yes	Yes Yes	Yes Yes
600 ar More	Yes	Yes	Yes	Yes	Yes	Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	

RIGHT-TURN	THR	OUGH VOL	UME PLUS LE	FT-TURN	VOLUM	E *
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99		Middle	Middlebrook Pike at Proposed Apartment Entrance - 90 Apartments		Yes Yes	Yes Yes
100 - 149 150 - 199		Propos Entrance			Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	EB Right 20% I	Turns $= 13$ with ncrease due to	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Right T	Pandemic Furn Lane NOT	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	V V	Yes Yes		Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes			Yes Yes	Yes Yes
600 or More	Yes	Yes Yes		Yes	Yes	Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	THR	OUGH VOLUN	FT-TURN	VOLUM	E *	
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					Yes Yes	Yes Yes
100 - 149 150 - 199		Middlel Propose Entrance -	Middlebrook Pike at Proposed Apartment Entrance - 120 Apartments		Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	2023 Projected AM EB Right Turns = 16		Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	without 209 Pa	without 20% Increase due to Pandemic Right Turn Lane NOT Warranted		Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Right Tu W			Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes			Yes Yes	Yes Yes	Yes Yes
600 ar More	Yes	Yes	Yes	Yes	Yes	Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *							
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600		
Fewer Than 25 25 - 49 50 - 99		Middle	Middlebrook Pike at Proposed Apartment Entrance- 120 Apartments		Yes Yes	Yes Yes		
100 - 149 150 - 199		Propos Entrance			Yes Yes	Yes Yes		
200 - 249 250 - 299	Yes Yes	EB Right 20% In	Turns $= 16$ with accease due to	Yes Yes	Yes Yes	Yes Yes		
300 - 349 350 - 399	Yes Yes	F Right T	Pandemic Furn Lane NOT	Yes Yes	Yes Yes	Yes Yes		
400 - 449 450 - 499	Yes Yes	V	Yes Yes		Yes Yes	Yes Yes		
500 - 549 550 - 599	Yes Yes	Yes			Yes Yes	Yes Yes		
600 or More	Yes	Yes Yes		Yes	Yes	Yes		

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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 THROUGH VOLUME PLUS LEFT-TURN VOLUME \*** VOLUME 350 - 399 400 - 449 450 - 499 500 - 549 550 - 600 + / > 600 Fewer Than 25 25 - 49 >Yes Yes 50 - 99 Yes Yes Yes Middlebrook Pike at 100 - 149 Yes Yes Yes **Proposed Apartment** Yes Yes Yes Entrance - 90 Apartments 150 - 199 200 - 249 Yes 2023 Projected PM Yes Yes Yes 250 - 299 EB Right Turns = 43Yes Yes Yes Yes without 20% Increase due to 300 - 349 Yes Yes Yes Yes Pandemic 350 - 399 Yes Yes Yes Yes Right Turn Lane NOT 400 - 449 Yes Yes Yes Yes Warranted 450 - 499 Yes Yes Yes Yes 500 - 549 Yes Yes Yes Yes 550 - 599 Yes Yes Yes Yes 600 ar More Yes Yes Yes Yes Yes Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
VOLUME	350 - 399	400 -	- 449	450 - 499	500 - 549	550 - 600	+ / > 60
Fewer Than 25 25 - 49					8	Yes	Yes
50 - 99			Middlebr	ook Pike at	Yes	Yes	Yes
100 - 149 150 - 199			Proposed Apartment Entrance - 90 Apartments 2023 Projected PM EB Right Turns = 44 with 20% Increase due to		Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes				Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes		Pan Right T	demic 'urn Lane	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes		Warranted Yes Yes		Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes				Yes Yes	Yes Yes	Yes Yes
600 ar More	Yes		Yes	Yes	Yes	Yes	Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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 THROUGH VOLUME PLUS LEFT-TURN VOLUME \*** VOLUME 350 - 399 400 - 449 450 - 499 500 - 549 550 - 600 + / > 600 Fewer Than 25 25 - 49 Yes Yes 50 - 99 Yes Yes Yes 100 - 149 Yes Yes Yes Yes Middlebrook Pike at Yes Yes Yes 150 - 199**Proposed Apartment** Entrance - 120 Apartments 200 - 249 Yes Yes Yes Yes 250 - 299 Yes Yes Yes Yes 2023 Projected PM 300 - 349 Yes Yes Yes Yes EB Right Turns = 54350 - 399 Yes Yes Yes without 20% Increase due to Yes Pandemic 400 - 449 Yes Yes Yes Yes 450 - 499 Yes Yes Yes Yes **Right Turn Lane** Warranted 500 - 549 Yes Yes Yes Yes 550 - 599 Yes Yes Yes Yes 600 ar More Yes Yes Yes Yes

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

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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	

RIGHT-TURN	<b>THROUGH VOLUME PLUS LEFT-TURN VOLUME *</b>						
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 Middlebrook Pike at		Yes Yes	Yes Yes	Yes Yes	
200 - 249 250 - 299	Yes Yes	Entrance- 12	2023 Projected PM EB Right Turns = 55 with 20% Increase due to		Yes Yes	Yes Yes	
300 - 349 350 - 399	Yes Yes	EB Right Tur 20% Incre			Yes Yes	Yes Yes	
400 - 449 450 - 499	Yes Yes	Pand Right Tu	Pandemic Bight Turn Lane	Yes Yes	Yes Yes	Yes Yes	
500 - 549 550 - 599	Yes Yes	Warr	anted	Yes Yes	Yes Yes	Yes Yes	
600 or More	Yes			Yes	Yes	Yes	

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	<b>Right Turns</b>	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	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 V	0					

## Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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	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


## 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				
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)		

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 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		
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below	
Criteria - Minor Street High Side Delay (veh-hrs)	5		





Project Name	Middlebrook Commons	ĺ
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		



Middlebrook Pike (Major Street) Volume

	Eastbou	nd Volume by	y Hour	
Time	Left Turns	Through	<b>Right Turns</b>	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				
.0 - 11 PM				
1 - 12 AM				

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 V	ehicles (unad	justed)	6,478	0

### Andes Road/Church Driveway (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	<b>Right Turns</b>	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	



## 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)		

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 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		
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below	
Criteria - Minor Street High Side Delay (veh-hrs)	5		





Project Name	Middlebrook Commons	
Project/File #	#2107	
Scenario	2023 - Projected Traffic Volumes - 90 Apartments (+20% Co	vid + 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	



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	<b>Right Turns</b>	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



## Warrants 1 - 3 (Volume Warrants)

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

Intersection Information				
Major Street (E/W 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)		

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 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			
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below		
Criteria - Minor Street High Side Delay (veh-hrs)	5			





Project Name	Middlebrook Commons	
Project/File #	#2107	
Scenario	2023 - Projected Traffic Volumes - 120 Apartments (+20% Co	ovid + 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 Yes			
All-Way Stop Warrant	No		



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	<b>Right Turns</b>	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



## Warrants 1 - 3 (Volume Warrants)

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

Intersection Information					
Major Street (E/W Road) Middlebrook Pike Minor Street (N/S Road) Andes Road/Church Driv					
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)		

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 F					
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				
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below			
Criteria - Minor Street High Side Delay (veh-hrs)	5				





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 Yes				
All-Way Stop Warrant	No			



Middlebrook Pike (Major Street) Volume

	Eastbou	nd Volume by	y Hour			We
Time	Left Turns	Through	<b>Right Turns</b>	Peds/Bikes	Time	Left Tu
12 - 1 AM					12 - 1 AM	
1 - 2 AM					1 - 2 AM	
2 - 3 AM					2 - 3 AM	
3 - 4 AM					3 - 4 AM	
4 - 5 AM					4 - 5 AM	
5 - 6 AM					5 - 6 AM	
6 - 7 AM					6 - 7 AM	
7 - 8 AM	6	751	4		7 - 8 AM	5
8 - 9 AM	11	789	2		8 - 9 AM	13
9 - 10 AM					9 - 10 AM	
10 - 11 AM					10 - 11 AM	
11 - 12 PM	9	514	10		11 - 12 PM	20
12 - 1 PM	6	575	15		12 - 1 PM	28
1 - 2 PM					1 - 2 PM	
2 - 3 PM	4	603	17		2 - 3 PM	25
3 - 4 PM	7	722	15		3 - 4 PM	47
4 - 5 PM	12	881	20		4 - 5 PM	40
5 - 6 PM	9	852	10		5 - 6 PM	47
6 - 7 PM					6 - 7 PM	
7 - 8 PM					7 - 8 PM	
8 - 9 PM					8 - 9 PM	
9 - 10 PM					9 - 10 PM	
10 - 11 PM					10 - 11 PM	
11 - 12 AM					11 - 12 AM	
Total	Vehicles (unadju	usted)	5,844	0	Total V	ehicles (ı

Westbound Volume by Hour						
Time	Left Turns	Through	<b>Right Turns</b>	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 V	0					

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

Northbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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	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 V	Total Vehicles (unadjusted) 237					



## 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)			

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 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				
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below			
Criteria - Minor Street High Side Delay (veh-hrs)	5				





Project Name	Middlebrook Commons	l
Project/File #	#2107	1
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 Yes				
All-Way Stop Warrant	No			



Middlebrook Pike (Major Street) Volume

	Eastbou	nd Volume by	/ Hour			
Time	Left Turns	Through	<b>Right Turns</b>	Peds/Bikes	Time	Le
12 - 1 AM					12 - 1 AM	
1 - 2 AM					1 - 2 AM	
2 - 3 AM					2 - 3 AM	
3 - 4 AM					3 - 4 AM	
4 - 5 AM					4 - 5 AM	
5 - 6 AM					5 - 6 AM	
6 - 7 AM					6 - 7 AM	
7 - 8 AM	7	901	5		7 - 8 AM	
8 - 9 AM	13	947	2		8 - 9 AM	
9 - 10 AM					9 - 10 AM	
10 - 11 AM					10 - 11 AM	
11 - 12 PM	11	617	12		11 - 12 PM	
12 - 1 PM	7	690	18		12 - 1 PM	
1 - 2 PM					1 - 2 PM	
2 - 3 PM	5	724	20		2 - 3 PM	
3 - 4 PM	8	866	18		3 - 4 PM	
4 - 5 PM	14	1057	24		4 - 5 PM	
5 - 6 PM	13	1022	12		5 - 6 PM	
6 - 7 PM					6 - 7 PM	
7 - 8 PM					7 - 8 PM	
8 - 9 PM					8 - 9 PM	
9 - 10 PM					9 - 10 PM	
10 - 11 PM					10 - 11 PM	
11 - 12 AM					11 - 12 AM	
Total	Vehicles (unadju	usted)	7,013	0	Total V	/ehi

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 V	0					

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

Northbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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	0				

Southbound Volume by Hour						
Time	Left Turns	Through	<b>Right Turns</b>	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 V	ehicles (unad	justed)	284	0		



## 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)			

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 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				
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below			
Criteria - Minor Street High Side Delay (veh-hrs)	5				





Project Name	Middlebrook Commons	
Project/File #	#2107	
Scenario	2023 - Projected Traffic Volumes - 90 Apartments (+20% Co	vid + 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 Yes				
All-Way Stop Warrant	No			



Middlebrook Pike (Major Street) Volume

	Eastbou	nd Volume by	y Hour			Westbo	bu
Time	Left Turns	Through	Right Turns	Peds/Bikes	Time	Left Turns	
12 - 1 AM					12 - 1 AM		
1 - 2 AM					1 - 2 AM		
2 - 3 AM					2 - 3 AM		
3 - 4 AM					3 - 4 AM		
4 - 5 AM					4 - 5 AM		
5 - 6 AM					5 - 6 AM		
6 - 7 AM					6 - 7 AM		
7 - 8 AM	24	696	5		7 - 8 AM	5	
8 - 9 AM	29	1014	2		8 - 9 AM	13	
9 - 10 AM					9 - 10 AM		
10 - 11 AM					10 - 11 AM		
11 - 12 PM	19	657	12		11 - 12 PM	20	
12 - 1 PM	16	735	19		12 - 1 PM	28	
1 - 2 PM					1 - 2 PM		
2 - 3 PM	14	769	21		2 - 3 PM	25	
3 - 4 PM	18	919	19		3 - 4 PM	47	
4 - 5 PM	26	1121	25		4 - 5 PM	40	
5 - 6 PM	24	1087	12		5 - 6 PM	47	
6 - 7 PM					6 - 7 PM		
7 - 8 PM					7 - 8 PM		
8 - 9 PM					8 - 9 PM		
9 - 10 PM					9 - 10 PM		
10 - 11 PM					10 - 11 PM		
11 - 12 AM					11 - 12 AM		
Total	Vehicles (unadju	usted)	7,283	0	Total V	ehicles (unad	ju

Westbound Volume by Hour							
Time	Left Turns	Through	<b>Right Turns</b>	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 V	0						

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

Northbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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	0				

	Southbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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 V	0					



## Warrants 1 - 3 (Volume Warrants)

Project Name	Middlebrook Commons	ľ
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)		

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			
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below		
Criteria - Minor Street High Side Delay (veh-hrs)	5			





Project Name	Middlebrook Commons	
Project/File #	#2107	
Scenario	2023 - Projected Traffic Volumes - 120 Apartments (+20% Co	ovid + 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	



Middlebrook Pike (Major Street) Volume

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

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 V	0				

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

Northbound Volume by Hour					
Time	Left Turns	Through	<b>Right Turns</b>	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	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 V	0					



## Warrants 1 - 3 (Volume Warrants)

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

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							
Criteria - Minor Street High Side Volume (veh in one hour)	150	See Figure Below						
Criteria - Minor Street High Side Delay (veh-hrs)	5							



#### PROJECTED FUTURE VOLUMES IN YEAR 2021 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Andes Road/Church Driveway

-		Andes Road			Middleb	rook Pike		C	hurch Drivew	/ay		Middleb	rook Pike		
TIME	S	OUTHBOUN	ND .		WEST	BOUND		N	ORTHBOU?	ND .		EASTI	BOUND		
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	6.5	1	51	15	531	4	0	2	1	5	4	696	/	0	Sum
+20% Increase	/6	1	61	18	6.57	5	0	2	1	4	5	835	8	0	Increase of 20% due to Covid
Tring 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	1
11:15 AM 11:20 AM	8	0	2	0	110	8	0	0	0	0	2	140	0	0	1
11:50 AM	8	0	1	0	11/	2	1	1	0	0		105	0	0	1
Sum	32	0	10	2	460	15	4	2	0	2	6	495	0	1	1
+20% Increase	38	0	12	2	552	18	5	2	0	2	7	594	0	1	1
General Growth															1
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	- 00	0	1/	-	658	25	8	0	1	4	1/	6/3	2	1	
Trine 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	10	1	4	0	1/1	4	0	0	0	0	0	159	0	0	
3:15 PM 2.20 PM	10	0	4	0	183	2	2	0	0	0	1	1/0	0	0	
3:45 PM	8	0	0	0	171	8	2	0	0	2	6	191	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	-	1006	60	10	1	0	5	19	1028	2	0	
Trips Generated 4-5 pm															1
2021															
5:00 PM	14	0	8	1	228	6	2	0	0	0	4	212	0	0	1
5:15 PM	11	0	11	0	257	8	0	0	0	0	4	235	1	0	1
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														I	
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 exing traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exing traffic, assumed percentages of directional traffic, and the assumed precentage of trajks 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



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

#### PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Andes Road/Church Driveway

		Andes Road			Middlebr	rook Pike		C	hurch Drivew	ay		Middlebr	ook Pike			
TIME	SO	DUTHBOUN	D		WESTE	BOUND		N	ORTHBOUN	JD		EASTE	OUND			
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	
/:50 AM	21	0	22	/	160	1	0	1	0	1	3	205	3	0	Existing Volumes	
/545 /141	20 63	1	51	15	521	4	0	2	1	2	4	230	7	0	Existing Volumes	
+20% Increase	76	1	61	13	637		0	2	1	4		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	vears
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		
Tring Conomted 8.0 am	2.92	0.32	1.48	0	14	0.56	0.16	0.04	0.2	0	0.4	33.28	1.70	0		
2023	76	8	38	33	595	15	12	17	5	58	10	870	46	0		Loca
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1		Enter
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	1	
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 2023	40	0	12	2	582	19	21	2	0	2	7	8	0	0		
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		
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	1/	1.5	/5/	22	4	5	5	29	0.44	080	5	0		
Tring Generated 2-3 pm	0	0.08	0.08	0.52	9	0.00	20	0.2	0.2	0	0.44	2/.44	0.2	0		
2023	35	2	18	14	706	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	1	
General Growth	1.77	0.04	0.00	0	22.00	0.07		0		0.00	0.4	33.84				
Trine Concess 12.4	1.76	0.04	0.92	0	33.88	0.96	0.2	0	0	0.08	0	12	0	0.04		
Trips Generated 3-4 pm 2023	1.76 0	0.04	0.92	0	33.88 10 891	0.96	0.2 23 28	0	0	0.08	0	12	0	0.04		
Trips Generated 3-4 pm 2023 4:00 PM	1.76 0 46 13	0.04 0 1 0	0.92 0 24 16	0 0 0 0 0	33.88 10 891 208	0.96 0 25 12	0.2 23 28 3	0 0 0 1	0 0 0 0 0	0.08 0 2 1	0 10 3	12 892 220	0	0.04 0 1 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM	1.76 0 46 13 10	0.04 0 1 0 0	0.92 0 24 16 6	0 0 0 0	33.88 10 891 208 191	0.96 0 25 12 13	0.2 23 28 3 1	0 0 1 0	0 0 0 0	0.08 0 2 1 1	0 10 3 7	12 892 220 188	0	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM	1.76 0 46 13 10 12	0.04 0 1 0 0 0 0	0.92 0 24 16 6 6	0 0 0 0 0	33.88 10 891 208 191 199	0.96 0 25 12 13 15	0.2 23 28 3 1 0	0 0 1 0 0	0 0 0 0 0	0.08 0 2 1 0	0 10 3 7 0	12 892 220 188 212	0 0 1 0 1	0.04 0 1 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM           4:45 PM	1.76 0 46 13 10 12 14	0.04 0 1 0 0 0 0 0	0.92 0 24 16 6 6 7	0 0 0 0 0 0 1	33.88 10 891 208 191 199 240	0.96 0 25 12 13 15 10	0.2 23 28 3 1 0 4	0 0 1 0 0 0	0 0 0 0 0 0 0	0.08 0 1 1 0 2	0 10 3 7 0 6	12 892 220 188 212 237	0 0 1 0 1 0	0.04 0 1 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM           4:45 PM           4:45 PM	1.76 0 46 13 10 12 14 49	0.04 0 1 0 0 0 0 0	0.92 0 24 16 6 7 35	0 0 0 0 0 1 1	33.88 10 891 208 191 199 240 838	0.96 0 25 12 13 15 10 50	0.2 23 28 3 1 0 4 8	0 0 1 0 0 0 1	0 0 0 0 0 0 0 0	0.08 0 1 1 0 2 4	0 10 3 7 0 6 16	12 892 220 188 212 237 857	0 0 1 0 1 0 2	0.04 0 1 0 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM           4:45 PM           4:45 PM           Sum           +20% Increase           Convert Care	1.76 0 46 13 10 12 14 49 59	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 7 35 42	0 0 0 0 0 1 1 1 1 0 0 1	33.88 10 891 208 191 199 240 838 1006	0.96 0 25 12 13 15 10 50 60 24	0.2 23 28 3 1 0 4 8 10	0 0 1 0 0 0 1 1 0 0	0 0 0 0 0 0 0 0 0 0	0.08 0 1 1 0 2 4 5 0.2	0 10 3 7 0 6 16 19 0.7(	12 892 220 188 212 237 857 1028	0 0 1 0 1 0 2 2 2	0.04 0 1 0 0 0 0 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM           4:45 PM           5 um           + 20% Increase           General Growth           Trips Generated 4.5 mm	1.76 0 46 13 10 12 14 49 59 2.36	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 7 35 42 1.68	0 0 0 0 1 1 1 1 0.04	33.88 10 891 208 191 199 240 838 1006 40.24 12	0.96 0 25 12 13 15 10 50 60 2.4	0.2 23 28 3 1 0 4 8 10 0.4 26	0 0 1 0 0 0 1 1 0.04	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 1 1 0 2 4 5 0.2	0 10 3 7 0 6 16 19 0.76 0	12 892 220 188 212 237 857 1028 41.12 14	0 0 1 0 1 0 2 2 0.08	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:30 PM           4:30 PM           4:30 PM           5:00 PM           6:00 PM           5:00 PM           6:00 PM           7:00 PM           7:00 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 7 35 42 1.68 0 44	0 0 0 0 1 1 1 1 0.04 0 1	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058	0.96 0 25 12 13 15 10 50 60 2.4 0 62	0.2 23 28 3 1 0 4 8 10 0.4 26 37	0 0 1 0 0 0 1 1 0.04 0 1		0.08 0 2 1 1 0 2 4 5 0.2 0 5	0 10 3 7 0 6 16 19 0.76 0 20	12 892 220 188 212 237 857 1028 41.12 14 1083	0 0 1 0 1 0 2 2 0.08 0 2	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tips Generatel 3-4 pm           2023           4:00 PM           4:35 PM           4:30 PM           4:45 PM           4:35 PM           6:General Growth           Trips Generated 4-5 pm           2023           5:00 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61 14	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 7 35 42 1.68 0 44 8	0 0 0 0 1 1 1 1 0.04 0 1 1	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228	0.96 0 25 12 13 15 10 50 60 24 0 62 6	0.2 23 28 3 1 0 4 8 10 0.4 26 37 2	0 0 1 0 0 0 1 1 0.04 0 1 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 2 1 1 0 2 4 5 0.2 0 5 0 0	0 10 3 7 0 6 16 19 0.76 0 20 4	12 892 220 188 212 237 857 1028 41.12 14 1083 212	0 0 1 0 1 0 2 2 0.08 0 2 0	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tips Generatel 3-4 pm           2023           400 PM           415 PM           4-50 PM           4-65 PM           500 PM           500 PM           Trips Generated 4-5 pm           2023           500 PM           515 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61 14 11	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 6 7 355 42 1.68 0 44 8 11	0 0 0 0 1 1 1 1 0.04 0 1 1 0 0	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228 257	0.96 0 25 12 13 15 10 50 60 24 0 62 6 8	0.2 23 28 3 1 0 4 8 10 0.4 26 37 2 0	0 0 1 0 0 0 1 1 0.04 0 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 2 1 1 0 2 4 5 0.2 0 5 0 0 0 0	0 10 3 7 0 6 16 19 0.76 0 20 4 4	12 802 220 188 212 237 857 1028 41.12 14 1083 212 235	0 0 1 0 2 2 0.08 0 2 0 0 1	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tipis Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:20 PM           4:45 PM           4:45 PM           4:50 PM           5:00 PM           5:00 PM           5:00 PM           5:00 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61 14 11 9	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 6 7 35 42 1.68 0 44 8 11 7	0 0 0 0 1 1 1 1 0.04 0 1 1 0 0 0	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228 257 267	0.96 0 25 12 13 15 10 50 60 2.4 0 62 6 8 13	0.2 23 28 3 1 0 4 8 10 0.4 26 37 2 0 0 1	0 0 1 0 0 0 0 1 1 1 0.04 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 1 1 0 2 4 5 0.2 0 5 0 0 1 1	0 10 3 7 0 6 16 19 0.76 0 20 4 4 3	12 802 220 188 212 237 857 1028 41.12 14 1083 212 235 211	0 0 1 0 2 2 0.08 0 2 0 1 1 1	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tips Generated 3-4 pm           2023           4-00 PM           4-15 PM           4-35 PM           4-45 PM           5-00 PM           5-00 PM           5-00 PM           5-00 PM           5-00 PM           5-30 PM           5-30 PM           5-30 PM           5-30 PM           5-36 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61 14 11 9 9	0.04 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 7 35 42 1.68 0 44 8 11 7 1	0 0 0 0 1 1 1 0.04 0 0 0 0 0 1 1	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228 2257 267 204	0.96 0 25 12 13 15 10 50 60 2.4 0 62 6 8 13 6	0.2 23 28 3 1 0 4 8 10 0.4 26 37 2 0 0 1 0	0 0 0 1 0 0 0 0 1 1 0.04 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 1 1 1 0 2 4 5 0.2 0 5 0 0 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 10 3 7 0 6 16 19 0.76 0 20 4 4 3 6	12 892 220 188 212 237 857 1028 41.12 14 1083 212 235 211 169	0 0 1 0 1 0 2 2 0.08 0 0 2 0 0 1 1 1 1 1	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tips Generate 3-4 pm           2023           4:00 PM           4:15 PM           4:51 PM           4:45 PM           5:00 PM           7:01 Generat 4-5 pm           5:00 PM           5:00 PM           5:50 PM           5:45 PM           5:45 PM           5:45 PM           5:45 PM	1.76 0 46 13 10 12 14 49 59 2.36 0 61 14 11 9 9 43	0.04 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 6 7 7 35 42 1.68 0 44 8 11 7 7 1 27 7	0 0 0 0 0 0 1 1 1 1 0 0 4 0 1 1 0 0 1 1 2 2	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228 257 267 204 956	0.96 0 25 12 13 15 10 50 60 24 0 62 6 8 13 6 33	0.2 23 28 3 1 0 4 8 10 0 4 8 10 0 4 4 8 10 0 2 6 37 2 0 1 1 0 0 3 3	0 0 1 1 0 0 0 1 1 1 1 0.04 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.08 0 2 1 1 1 0 2 4 5 0.2 4 5 0 0 5 0 0 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	0 10 3 7 0 6 16 19 0.76 0 20 4 4 4 3 6 17 17	12 892 220 188 212 237 857 1028 41.12 14 1083 212 235 211 169 827	0 0 1 1 0 2 2 2 0 0 2 0 0 1 1 1 1 1 3	0.04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Trips Generated 3-4 pm           2023           4:00 PM           4:15 PM           4:35 PM           4:45 PM           4:45 PM           4:45 PM           5:00 PM           5:15 PM           5:00 PM           5:35 PM           5:45 PM	$\begin{array}{c} 1.76 \\ 0 \\ 46 \\ 13 \\ 10 \\ 12 \\ 14 \\ 49 \\ 59 \\ 2.36 \\ 0 \\ 61 \\ 14 \\ 11 \\ 9 \\ 9 \\ 43 \\ 52 \\ 200 \end{array}$	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 6 7 35 42 1.68 0 44 8 11 7 1 27 32 1.62	0 0 0 0 0 0 1 1 1 0.04 0 1 0 0 1 1 0 0 0 1 2 2 2 2 2	33.88 10 891 208 191 199 240 838 1006 40.24 12 1058 228 257 267 204 956 1147 204	0.96 0 25 12 13 15 10 50 60 2.4 0 62 6 8 13 6 33 40 0 15 10 10 10 10 10 10 10 10 10 10	0.2 23 3 1 0 4 8 8 10 0 4 8 8 10 0 4 26 37 2 0 1 1 0 0 1 3 4 4 0 26 37 2 20 0 1 1 0 0 26 37 28 28 28 28 28 28 28 28 28 28 28 28 28	0 0 1 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0		0.08 0 2 1 1 1 0 2 4 5 0.2 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 10 3 7 0 6 16 19 0.76 0 20 4 4 4 3 6 17 20 0 0	12 12 892 200 188 212 237 857 1028 41.12 14 1083 212 235 211 235 211 235 211 202 200 827 992 200 200 200 200 200 200 200	0 0 1 0 0 1 0 2 2 0.08 0 0 1 1 1 3 4 4	0.04 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Tipic Generate 3-4 pm           2023           4-00 PM           4-15 PM           4-35 PM           4-45 PM           4-45 PM           5-45 PM           Tripic Generated 4-5 pm           2023           5-00 PM           5-30 PM           5-30 PM           5-35 PM           5-45 PM           Same 4-20% Increase           Generation Consolt           4-30% Increase           Generated Generation Consolt           Tipic Generated Generation Consolt	1.76 0 46 13 10 12 14 49 59 0 61 14 9 9 9 9 9 43 52 2.06 0	0.04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.92 0 24 16 6 6 7 7 35 42 1.68 0 44 8 11 7 1 27 32 0 0	0 0 0 0 0 0 0 0 1 1 1 1 0 0 0 1 1 0 0 0 1 1 0 0 0 1 1 1 0	33.88 10 891 208 191 199 240 838 1006 838 1006 838 1006 838 1006 838 1026 838 1026 112 1258 226 240 837 267 267 267 267 267 267 267 26	0.96 0 25 12 13 15 10 50 60 2.4 0 6 8 13 6 8 13 6 8 333 40 1.6	0.2 23 3 1 0 4 8 10 0 4 8 10 0 4 26 37 2 0 0 1 1 0 0 1 1 0 0 3 3 4 0 20	0 0 1 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0		0.08 0 2 1 1 0 2 4 5 0 2 0 2 4 5 0 0 0 0 1 1 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 10 3 7 0 6 16 19 0.76 0 20 4 4 3 6 17 20 0.8 0 0 0 0 0 0 0 0 0 0 0 0 0	12 12 802 220 188 212 237 1028 41.12 14 1083 211 14 1083 211 14 1083 211 169 992 39.08 16	0 0 1 0 2 2 0 0 2 0 0 1 1 1 1 1 3 3 4 0 0	0004 1 0 0 0 0 0 0 0 0 0 0 0 0 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

i.

#### 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



#### Local Apartment Rate - Apartments

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

 $\label{eq:transfer} \begin{array}{l} \mbox{TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual Population Tser = $\Lambda$ (Knoxville) \\ \mbox{TDOT Region 1 Average for Arterial Facilities (Two Lane) } \end{array}$ 



<u>For example, 7-8 AM for SB Right Turns:</u> 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

#### PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Andes Road/Church Driveway

		Andes Road			Middlebr	rook Pike		(	hurch Drivew	zay		Middleb	rook Pike		4	
TIME	S	OUTHBOUN	JD.		WESTI	BOUND		N	ORTHBOUN	D		EASTE	BOUND	-	4	
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	4	
7:00 AM	7	0	8	0	94	0	0	0	0	0	0	110	0	0	Existing Volumes	
7:15 AM	21	0	0	2	122	1	0	1	0	1	0	205	0	0	Existing Volumes	
7:45 AM	20	1	15	6	155	2	0	1	1	2	1	205	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	1	
8:15 AM	15	4	10	16	129	5	2	5	3	29	0	177	24	0	4	
8:30 AM	7	0	6	2	91	0	0	2	0	4	1	176	0	0	4	
8:45 AM	19	7	3	2	98	12	0	12	- 0	47	0 0	133	27	0	1	
+ 20% In opposite	72	· ·	31	27	404	14	3	15	4	4/	0	693	3/	0	1	
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	1	
Trips Generated 8-9 am	0	0	0	0	20	0	11	0	0	0	0	6	0	0	1	
2023	76	8	38	33	600	15	15	17	5	58	10	871	46	0	1	Local
11:00 AM	8	0	4	2	115	2	2	0	0	1	1	124	0	1	]	Enter
11:15 AM	8	0	2	0	110	8	1	0	0	1	2	140	0	0	4	
11:30 AM	8	0	3	0	117	3	0	1	0	0	2	105	0	0	1	
11:45 AM	8	0	1	0	118	2	1	1	0	0	1	126	0	0	4	
Sum	32	0	10	2	460	15	4	2	0	2	6	495	0	1	4	
+20% Increase	38	0	12	2	552	18	5	2	0	2	7	594	0	1	1	
Tring Consented 11em 12 pm	0	0	0.48	0.08	22.08	0.72	20	0.08	0	0.08	0.28	25.70	0	0.04	1	_
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	1	
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	4	
+20% Increase	30	0	17	1	658	25	8	0	1	4	17	673	2	1	4	
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	4	
Trips Generated 12-1 pm	0	0	0	0	12	0	22	0	0	0	19	712	0	0		
2023 200 PM	<u> </u>	0	5	1	160	20	1	0	1	6	2	136	0	0	1	
2:15 PM	12	0	2	4	150	3	0	0	1	3	2	128	1	0	1	
2:30 PM	7	1	0	6	170	3	0	1	0	3	3	166	3	0	1	
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	1	
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	1	
Trips Generated 2-3 pm	0	0	0	0	11	0	26	0	0	0	0	14	0	0	1	
2023	35	2	18	14	799	23	30	5	5	30	11	727	5	0	4	
3:00 PM	11	1	4	0	171	4	0	0	0	0	0	159	0	0	4	
3:15 PM	10	0	4	0	183	5	2	0	0	0	1	170	0	0	1	
3:30 PM	°	0	2	0	171	3	2	0	0	2	6	191	0	1	1	
5.45 FM	37	1	10	0	706	20	4	0	0	2	8	705	0	1	1	
+20% Increase	44	1	23	0	847	24	5	0	0	2	10	846	0	1	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	1	
4:15 PM	10	0	6	0	191	13	1	0	0	1	7	188	0	0	4	
4:30 PM	12	0	6	0	199	15	0	0	0	0	0	212	1	0	4	
4:45 PM	14	0	7		240	10	4	0	0	2	6	237	0	0	1	
	49	0	35		838	50	8	1	0	4	16	857	2	0	1	
T 20% Increase General Growth	2.36	0	92	0.04	40.24	2.4	0.4	0.04	0	0.2	0.76	41.12	0.08	0	1	
Trips Generated 4-5 pm	0	0	0	0.04	15	0	34	0.04	0	0	0	18	0.00	0	1	
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	1	
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	1	
+20% Increase	52	0	32	2	1147	40	4	0	0	1	20	992	4	0	4	
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	4	
This Control 5 ( and	0	0	0	0	17	0	38	0	0	0	0	21	0	0	1	
Trips Generated 5-6 pm																

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 percentage

i.

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



#### Local Apartment Rate - Apartments

Entering and Exitin	g %'s (from Local Apartment Rate):	Directional Distribution Assumptions:	
22% Enter	AM Hours	65% from WB Uturn	35% from EB Thru
78% Exit			35% to WB Thru
508/ E-+++	MAD	(50) Correct W/D Linear	250/ Community (The sec
50% Enter	Mid-Day riours	65% from wb Utum	3376 HOM EB Infu
50% Exit			35% to WB Thru
55% Enter	PM Hours	65% from WB Uturn	35% from EB Thru
45% Exit			35% to WB Thru
10/0 1.241			

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



<u>For example, 7-8 AM for SB Right Turns:</u> 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

#### PROJECTED FUTURE VOLUMES IN YEAR 2021 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

	I	rederick Driv	/e		Middlebr	rook Pike		Dollar G	eneral Drivew	ay (Main)		Middlebr	ook Pike		
TIME	S	OUTHBOUN	3D		WESTE	BOUND		N	ORTHBOUN	D		EASTB	OUND		
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 arr															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 arr															
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 nm															
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	130	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	
12-10 T M	16	1	0	16	552	12	7	16	0	21	5	575	15	1	
+ 202/. Increase	10	1	10	10	662	16		10	0	25	5	600	19	1	
Conoral Crowth			10		002	10	0			20	0	070	10		
Trins Conomited 12.1 pm															
2021															
2.00 DM	2	0		5	1/7		0	4	0	7	2	1.41		0	
2:00 PM	2	0	5	5	107	6	0	4	0		2	140	6	0	
2:15 PM	3	0	5	5	150	2	2	3	0	7	1	140	2	0	
2:50 PM 2:45 PM	5	0	4	2	169	2	0	4	0	4	1	1/1	3	0	
2.45 FM	5	0	-	5	1.54	0	0		0	4		151	4	0	
1 200/ T	15	0	12	18	640	21	2	15	0	24	4	605	20	0	
+20% Increase	10	0	14	22	/00	23	2	10	0	29	3	/24	20	0	
General Growth															
Thips Generated 2-5 ph															
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	1/4	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			-								I				
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	
		0	1	8	280	9	3	2	0	6	2	217	2	1	
5:30 PM	6	0											6 P	6 P	
5:30 PM 5:45 PM	6 5	0	1	6	200	7	0	5	0	5	1	172	4	1	
5:30 PM 5:45 PM Sum	6 5 27	0	1 8	6 24	200 970	7 29	0 13	5	0	5 21	6	172 852	4	1	
5:30 PM 5:45 PM \$20% Increase	6 5 27 32	0	1 8 10	6 24 29	200 970 1164	7 29 35	0 13 16	5 16 19	0	5 21 25	1 6 7	172 852 1022	4 10 12	1 3 4	
5:30 PM 5:45 PM +20% Increase General Growth	6 5 27 32	0 0 0 0	1 8 10	6 24 29	200 970 1164	7 29 35	0 13 16	5 16 19	0 1 1	5 21 25	1 6 7	172 852 1022	4 10 12	1 3 4	
5:30 PM 5:45 PM \$420% Increase General Growth Trips Generated 5-6 m	6 5 27 32	0	1 8 10	6 24 29	200 970 1164	7 29 35	0 13 16	5 16 19	0	5 21 25	1 6 7	172 852 1022	4 10 12	1 3 4	

	Assumed Average Growin Rate (76)=	0.0%		20% increase due to Covid	
	Number of years =	0			
	Horizon Year =	2021		# of Horizon Years = 0	)
Note 1: The er develo of din Note 2: It is as	ntering and exiting traffic volumes are estimated based on trig spment, based on assumed amounts of entering and exiting tr exitonal traffic, and the assumed percentage of trips based on sumed that the construction of homes is linear growth	generation of the er affic, assumed perce time of day (from T	ntire ntages DOT Table 4.2 in Traf	fic Design Manual)	



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

#### PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

	1	Frederick Driv	ve		Middlebr	rook Pike		Dollar G	eneral Drivew	ay (Main)		Middlebr	rook Pike		1	
TIME	S	OUTHBOUN	ND.		WESTE	BOUND		N	ORTHBOUN	JD		EASTE	BOUND		1	
BEGIN	LT	THRU	RT	LT	THRU	RT	U-TURN	LT	THRU	RT	LT	THRU	RT	U-TURN	4	
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	1.30	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
Inps Generated /-8 am	0	0	0	0	9	0	0	0	0	0	0	32	0	1/	I rips Generated	
2023	33	0		4	6/9	15	-	4	0	*	3	969	3	19	i otai Sum	
8:00 AM	10	1	4	2	15/	2	2	2	0	2	0	239	0	1	1	
8:15 AM 8:30 AM	7	0	0	2	86	3	2	1	0	2	2	182	2	1	1	
845 AM	10	0	0	1	109	5	1	1	0	1	3	149	0	1	1	
Sum	33	1	7	6	507	12	5	5	0	7	7	789	2	4	1	
±20% Increase	40	1	8	7	608	14	6	6	0	8	8	947	2	5	1	
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	1	
Trips Generated 8-9 am	0	0	0	0	8	0	0	0	0	0	0	29	0	16	1	
2023	42	1	8	7	641	15	6	6	0	8	8	1014	2	21	1	Local
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1	1	Enter
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	4	
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	4	
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	4	
Trips Generated 11am-12 pm	0	0	0	0	16	0	0	0	0	0	0	16	0	8	1	
2023	25	0	12	12	606	19	8	4	0	24	10	657	12	9	4	
12:00 PM	4	0	1	2	150	3	1	5	0	2	3	129	5	0	4	
12:15 PM	2	0	3	5	144	4	2	2	0	5	1	142	6	0	4	
12:30 PM	4	1	0	4	139	2	2	4	0	6	1	147	4	0	1	
1245 PM	0	0	4	3	119	4	2	3	0	0	0	13/	0	1	1	
5um	10	1	8	10	552	13	/	10	0	21	5	5/5	15	1	1	
Conord Crowth	0.76	0.04	0.4	0.76	26.49	0.64	0.22	0.76	0	1	0.24	27.6	0.72	0.04	1	
Trine Generated 12-1 nm	0.70	0.04	0.4	0.70	17	0.04	0.02	0.70	0	0	0.24	17	0.72	9	1	
2023	20	1	10	20	706	17	8	20	0	26	6	735	19	10	1	
2:00 PM	2	0	1	5	167	6	0	4	0	7	2	141	6	0	1	
2:15 PM	5	0	5	5	150	5	2	3	0	6	1	140	2	0	1	
2:30 PM	3	0	4	5	169	2	0	4	0	7	0	171	5	0	1	
2:45 PM	5	0	2	3	154	8	0	2	0	4	1	151	4	0	1	
Sum	15	0	12	18	640	21	2	13	0	24	4	603	17	0	1	
+20% Increase	18	0	14	22	768	25	2	16	0	29	5	724	20	0	1	
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	1	
Trips Generated 2-3 pm	0	0	0	0	20	0	0	0	0	0	0	16	0	9	1	
2023	19	0	15	23	819	26	2	17	0	30	5	769	21	9	1	
3:00 PM	6	0	5	8	164	5	2	4	0	9	1	162	4	1	1	
3:15 PM	2	0	2	8	188	2	2	3	0	6	3	174	4	0	4	
3:30 PM	4	0	0	7	170	2	3	6	0	7	2	190	6	0	4	
3:45 PM	2	0	0	7	182	6	1	3	0	9	0	196	1	0	4	
Sum	14	0	7	30	704	15	8	16	0	31	6	722	15	1	4	
+20% Increase	17	0	8	36	845	18	10	19	0	37	7	866	18	1	1	
General Growth	0.68	0	0.32	1.44	33.8	0.72	0.4	0.76	0	1.48	0.28	. 54.64	0.72	0.04	1	
Trips Generated 3-4 pm	0	0	0	0	23	0	0	20	0	0	0	19	0	10		
2023	10	0	0	- 51	902	19	10	20	1			219	19	0		
4:00 PM 4:15 PM	2	0	1	5	220	5	0	3	0	13	1	194		0		
4:30 PM	2	0	2	3	201	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	1	
	12	0	0	20	974	22	12	11	1	2.4	10	210	20	2	1	
+ 20% Iperesso	14	0	11	20	1049	26	14	13	1	41	10	1057	20	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	1	
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	0	1	6	200	7	0	5	0	5	1	172	4	1		
5:45 PM	5	0												1	1	
5:45 PM Sum	27	0	8	24	970	29	13	16	1	21	6	852	10	3		
5:45 PM Sum +20% Increase	27 32	0	8 10	24 29	970 1164	29 35	13 16	16 19	1	21 25	6	852 1022	10	3		
5:45 PM Sum +20% Increase General Growth	27 32 1.28	0	8 10 0.4	24 29 1.16	970 1164 46.56	29 35 1.4	13 16 0.64	16 19 0.76	1 0.04	21 25 1	6 7 0.28	852 1022 40.88	10 12 0.48	3 4 0.16		
5:45 PM +20% Increase General Growth Trips Generated 5-6 pm	27 32 1.28 0	0 0 0 0 0 0	8 10 0.4 0	24 29 1.16 0	970 1164 46.56 30	29 35 1.4 0	13 16 0.64 0	16 19 0.76 0	1 0.04 0	21 25 1 0	6 7 0.28 0	852 1022 40.88 24	10 12 0.48 0	3 4 0.16 13		

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



#### Local Apartment Rate - Apartments

Local Aparts	ment Rate - Apartments					
Entering an	d Exiting %'s (from Local Apartment	Rate): Directional Di	stributic	n 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)

Trips Generated by

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%

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

#### PROJECTED FUTURE VOLUMES IN YEAR 2023 WITH TRAFFIC GROWTH AND GENERATED TRAFFIC Middlebrook Pike at Frederick Drive/Dollar General Driveway (Main)

		redenck Dry	e		Middlebr	ook Pike		Dollar G	eneral Drivew	ay (Main)		Middleb	rook Pike		4	
TIME	SC	DUTHBOUN	D		WESTE	OUND		N	ORTHBOUN	D		EASTE	BOUND			
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		0	0.44	4	044	14	0.04	4	0	4	5	901	5	2	Increase of 20% due to Covid	
General Growth	1.30	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	25	0	11	4	691	15	1	4	0	0	0	41	0	24	Total Sum	
2023	33	0		4	001	15		4	0	*	3	9/8	3	24	i otai Sum	
8:00 AM	10	0	4	2	15/	2	2	2	0	2	0	259	0	1	•	
8:13 AM	7	0	0	2	96	2	2	1	0	2	2	192	0	1	1	
0.00 AM	10	0	0	1	100	5	1	1	0	1	2	140	0	1	1	
Sum	33	1	7	6	507	12	5	5	0	7	7	789	2	4	1	
+20% Increase	40	1	8	7	608	14	6	6	0	8	8	947	2	5	1	
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	1	
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		Local
11:00 AM	7	0	3	3	114	3	3	2	0	6	2	130	2	1		Enter
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		
0.17 101/				2	154	8	0	2	0	4	1	151	4	0		
2:45 PM	5	0	2	5	1.54											
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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



Traffic Movement Assumed Distribution: 65% from WB THRU 5% from WB THRU 35% to EB UTURN, 65% to EB THRU 35% to EB UTURN, 65% to EB THRU

#### Local Apartment Rate - Apartments

Entering an	d Exiting %'s (fi	rom Local Apartment Rate):	Directional Distributio	n 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 Tser = A (Knoxville) TDOT Region 1 Average for Arterial Facilities (Two Lane)



<u>For example, 7-8 AM for SB Right Turns:</u> 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	Т	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	FB	FR	W/B	NB	SB
	LD	LD	VV D	ND	30
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	Т	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	Т	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	Т	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.
  - <u>Response</u>: 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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