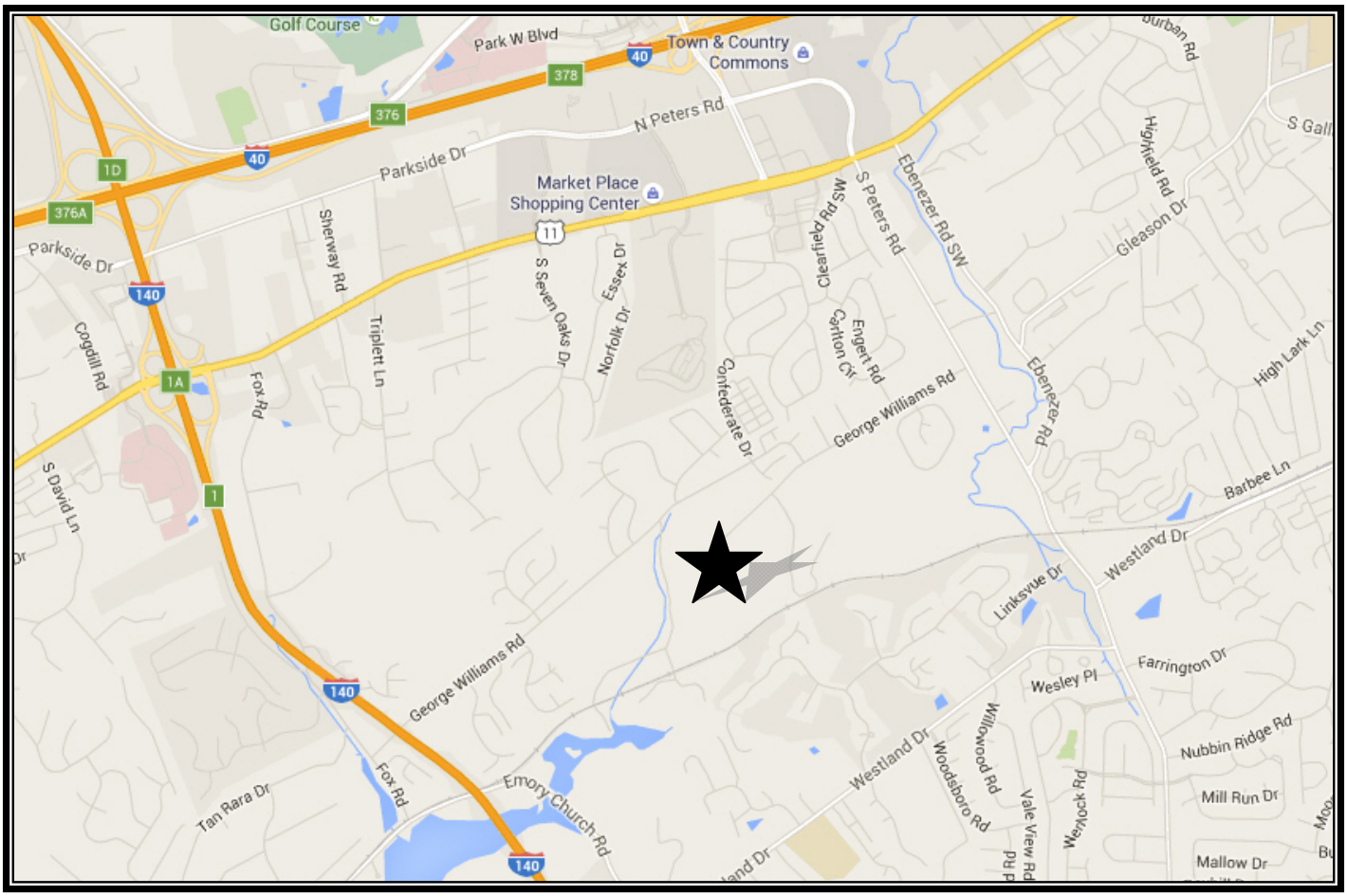

TRAFFIC IMPACT STUDY

MILLSTONE SUBDIVISION

KNOX COUNTY, TENNESSEE

-Prepared For-

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INTRODUCTION

The purpose of this traffic study is to analyze the traffic impacts of a new proposed residential subdivision in Knox County, Tennessee. At this point in the concept stage of design, this development is named Millstone Subdivision. This development is being proposed to the southwest of the intersection of Millstone Lane and Freels Lane near George Williams Road. This traffic impact study follows the procedures as outlined for a Level 1 study in accordance with the standards set forth by the Knoxville/Knox County Metropolitan Planning Commission.

In this study the following analyses/methodologies were conducted:

- A review of the operating characteristics of the existing adjacent roadway system that will provide access to the proposed site
- Determination and application of the trips to the existing adjacent road system that are expected to be generated by the proposed development
- Evaluation of the road system locations to determine the potential traffic impacts of the proposed development
- Identification of recommendations for road improvements to mitigate the expected increase in traffic volume from the projected future traffic volumes

PROJECT DESCRIPTION

The proposed location of this new development is shown on a map in Figure 1. The development is to be located adjacent to Millstone Lane and Freels Lane approximately 700 feet to the southwest of the signalized intersection of George Williams Road and Millstone Lane. In the adjacent vicinity of this study area, there are several other residential subdivisions, apartments, individual residences, undeveloped properties, and a public middle school. The existing site primarily consists of undeveloped woods and undeveloped open land. Norfolk Southern Railroad and Ten Mile Creek bound the site to the south.

The proposed subdivision is expected to be comprised of several new internal roads on approximately 40 acres. At this stage, the subdivision concept design shows 136 single family residential lots which vary in size with some lots slightly over a half acre. The design shows that the subdivision will tie into Millstone Lane approximately 240 feet to the west of the intersection of Freels Lane. No access road is being proposed to tie into Freels Lane.

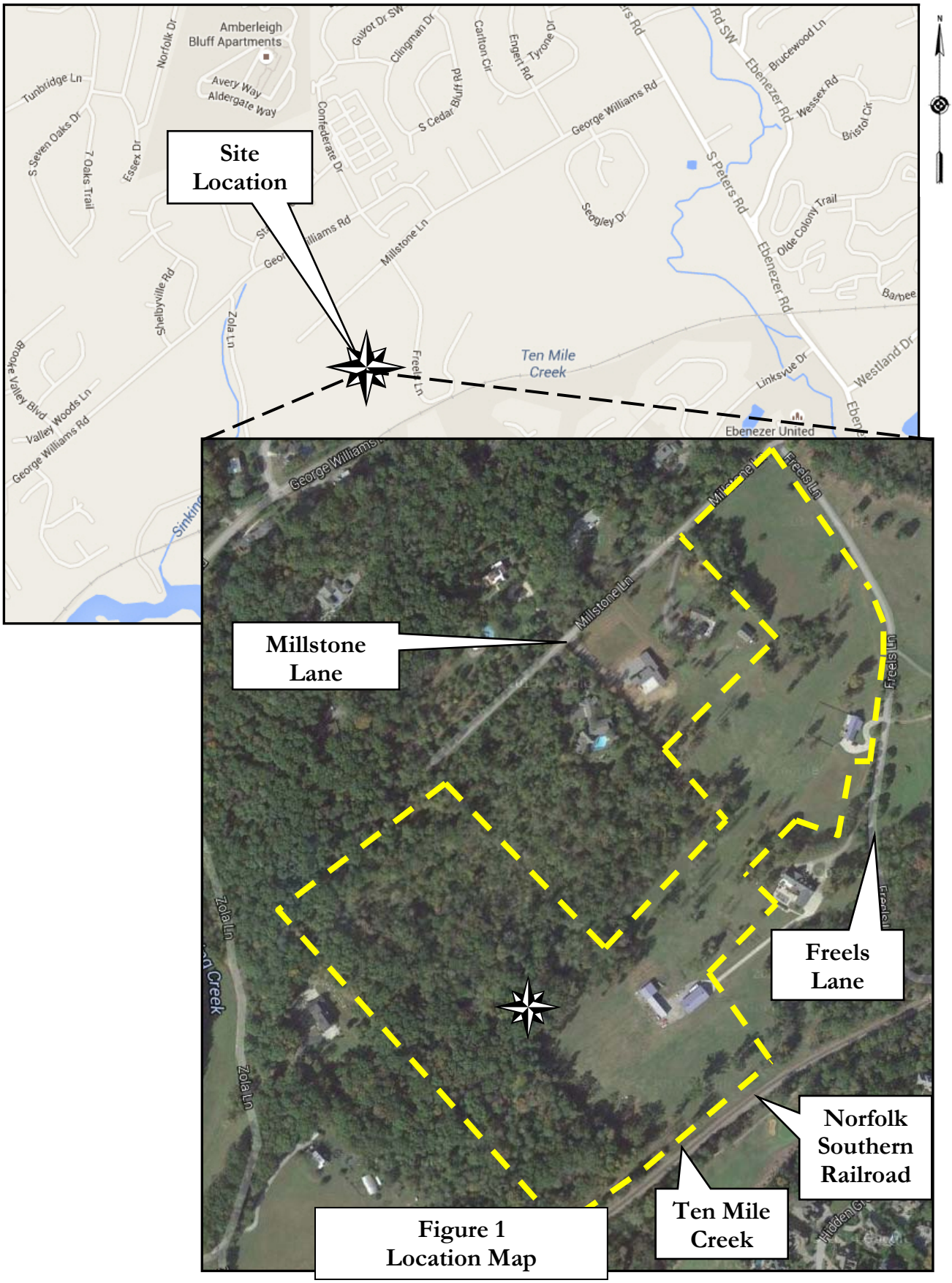


Figure 1
Location Map

The proposed concept plan layout given by David Campbell, PE is shown in Figure 2a. As can be seen in the figure, one main entrance is proposed to tie into Millstone Lane. Figure 2b shows the typical road cross sections for the development. The one entrance into the development will be located on the northeast side of the development at Road "A" and Millstone Lane. The road entrance will be a boulevard roadway section for almost 500 feet as shown in Figure 2b. The total length of the new roadways within the development will be approximately 4,800 feet and are labeled as Road "A" thru Road "F" on the concept plan. The internal roadways as shown in Figure 2b will have 5 foot wide sidewalks.

The actual schedule for completion of this new residential development is dependent on economic factors. However, the current residential market in Knox County is experiencing fairly rapid growth. This project is also contingent on permitting, design, and other issues. However, for the purposes of this study, it was assumed that the total construction build-out and full occupation of the development will occur by the year 2021 (in 5 years).

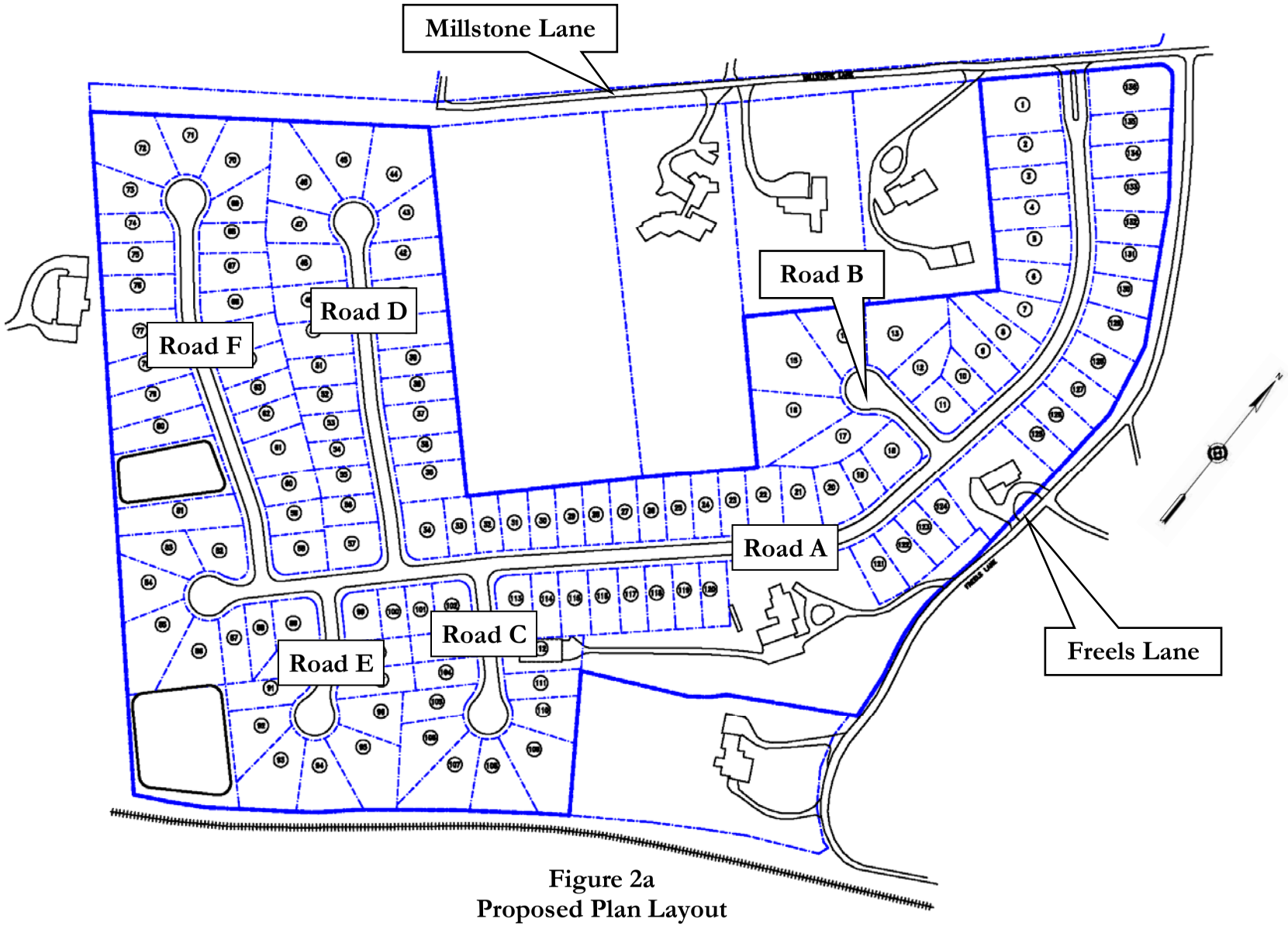
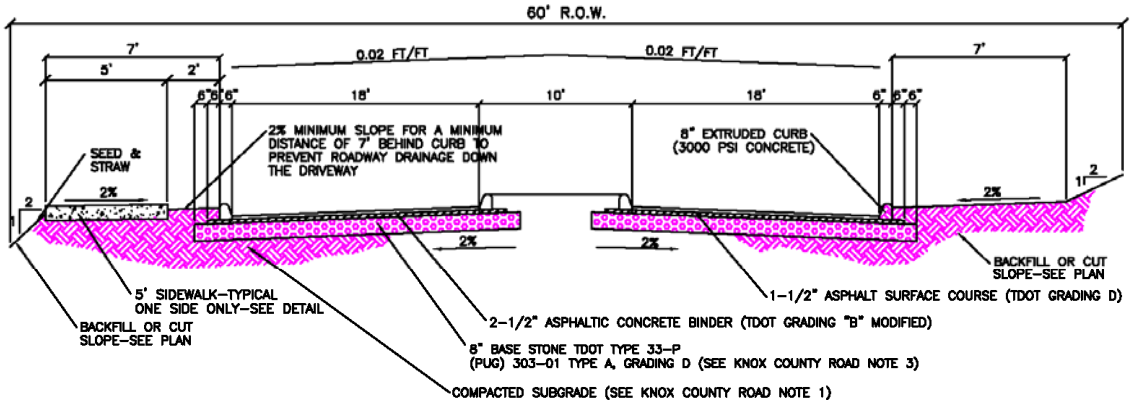
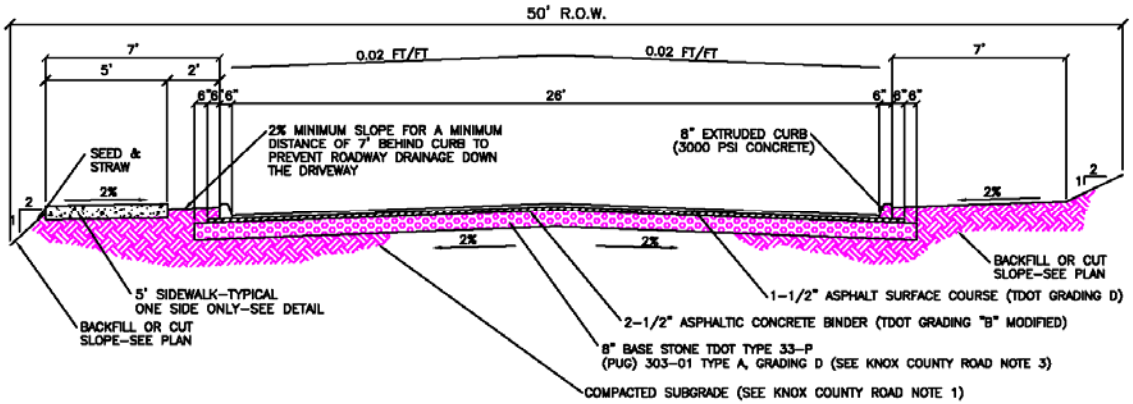


Figure 2a
Proposed Plan Layout
Millstone Subdivision



TYPICAL BOULEVARD ROAD CROSS SECTION STA 0+00 - 5+22
NOT TO SCALE



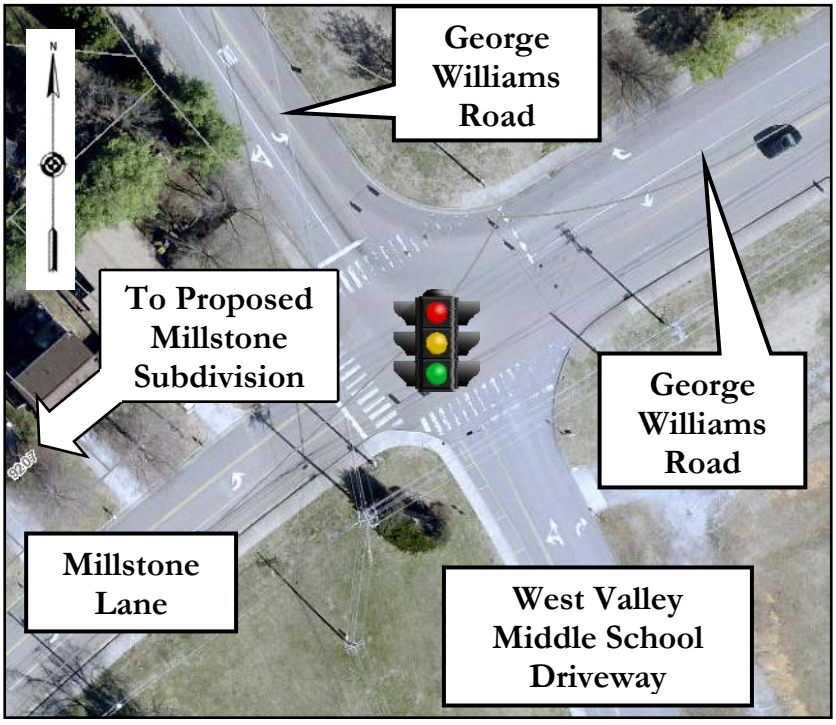
TYPICAL KNOX COUNTY ROAD CROSS SECTION
NOT TO SCALE

Figure 2b
Proposed Typical Road Cross Sections
Millstone Subdivision

EXISTING CONDITIONS IN STUDY AREA

George Williams Road is classified as a Major Arterial and traverses in a general northeast-southwest direction in west Knox County. George Williams Road terminates and intersects Fox Road 1.7 miles to the west and South Peters Road 0.6 miles to the east. The speed limit on George Williams Road is posted at 35 mph surrounding the intersection at Millstone Lane. George Williams Road, at the signalized intersection at Millstone Lane, continues at a "dog-leg" intersection. Refer to the image below for clarification.

George Williams Road directly to the north and to the east of the school includes a center two way turn lane that separates opposing traffic and provides for left turn movements. There are 6.5 foot wide concrete sidewalks on both sides of the road to the east of the intersection at Millstone Lane. In addition to the crosswalks at the signalized intersection, a couple of mid-block pedestrian crosswalks are marked across the roadway further towards the east. George Williams Road in front of West Valley Middle School has a fairly level vertical alignment and has 12 foot travel lanes. According to the Major Road Plan published by the MPC, George Williams Road is listed as having 70 feet of right-of-way.



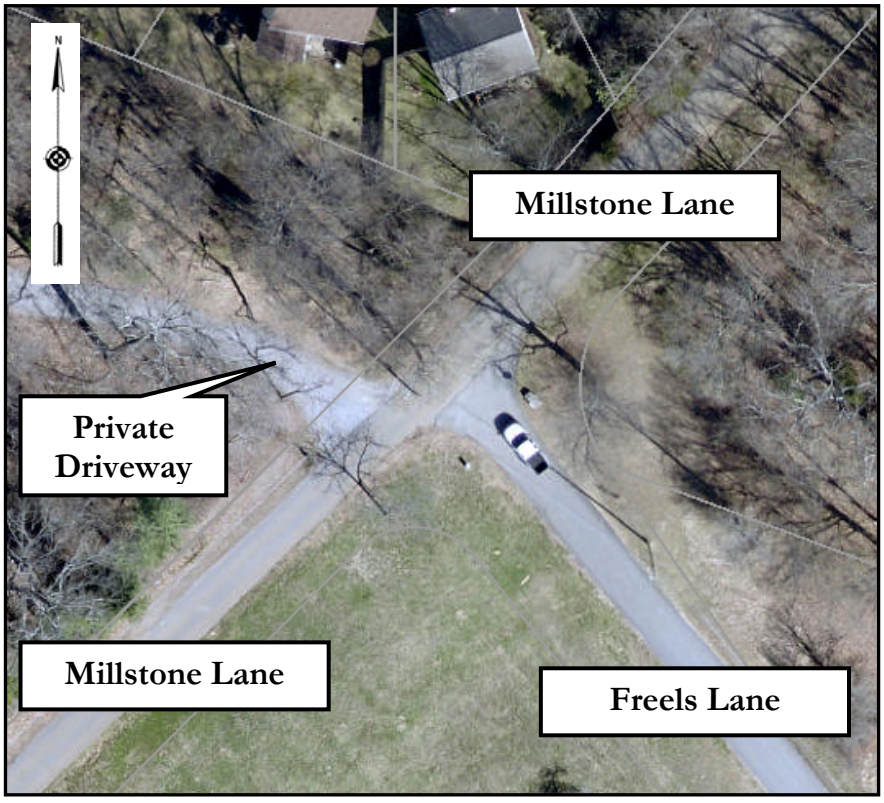
George Williams Road at Millstone Lane

George Williams Road provides road access to several residential subdivisions, individual homes and apartment complexes in the surrounding area. West Valley Middle School is located to the southeast of the intersection of George Williams Road and Millstone Lane. For the 2015-2016 school year, there were 1,192 students from the 6th to 8th grade attending the school. George Williams Road has flashing school beacons to the east and northwest of the

school. During the periods of operation, the flashing school beacon indicates a speed limit of 20 mph. Additionally, road signage near the school indicates that the speed limit is 20 mph during the periods of 7:50 – 8:35 am and 3:15 – 4:00 pm. The daily school schedule for students is from 8:00 am to 3:30 pm. Average Daily Traffic (ADT) on George Williams Road west of the project site (closer to Fox Road) was reported by the Tennessee Department of Transportation (TDOT) at 2,917 vehicles per day in 2015 (Station #000498). Historical TDOT traffic count data can be viewed in Appendix A.

Millstone Lane is a local low-volume street that intersects George Williams Road at the signalized intersection that is adjacent to West Valley Middle School. Several individual residences currently use Millstone Lane to access George Williams Road. The Millstone Lane approach and the other approaches at George Williams Road were upgraded and widened with curb, gutter, and sidewalk to accommodate the traffic signal that was installed in the late 90's concurrently with the construction of West Valley Middle School. A sidewalk on the south side of Millstone Lane extends 450 feet from the signalized intersection. Approximately 500 feet to the west of the traffic signal, Millstone Lane transitions to a narrower roadway with a pavement width of 17 feet. West of the intersection at Freels Lane, Millstone Lane has a pavement width of approximately 13 feet. Millstone Lane terminates at a dead end.

Freels Lane is also a local low-volume residential street that intersects Millstone Lane. Freels Lane is a circuitous roadway that does not have an outlet and serves only a couple of residences. The pavement width of Freels Lane is 14.5 feet. The intersection of Freels Lane at Millstone Lane does not have any traffic control.



Millstone Lane at Freels Lane

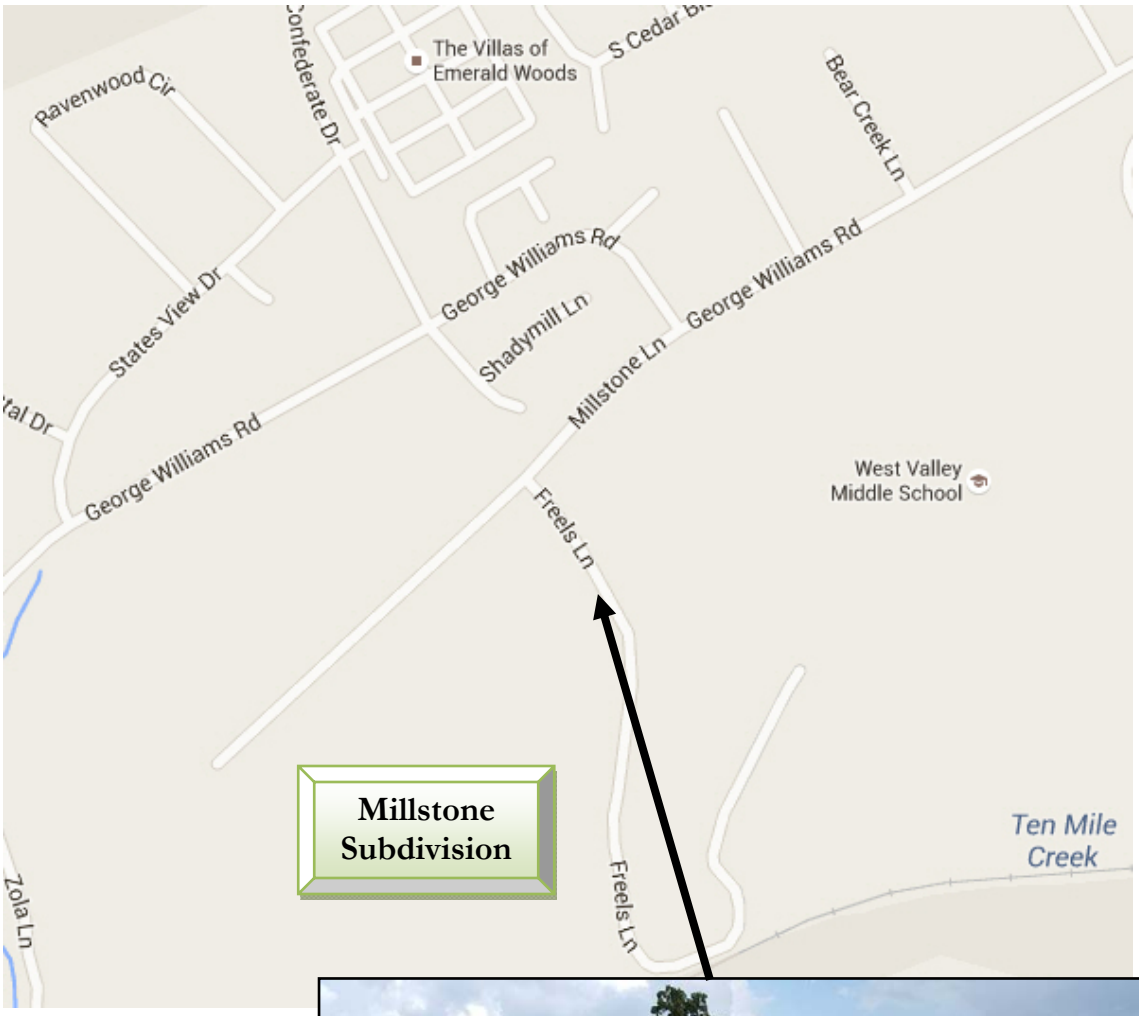
PHOTO EXHIBITS

View of Millstone Lane at Freels Lane
(Looking Northeast)

View of Millstone Lane at Freels Lane
(Looking Southwest)

View of Millstone Lane at George Williams Road
(Looking Northeast)

View of Millstone Lane at George Williams Road
(Looking Southwest)



View of Site Property at Freels Lane
(Looking South)

EXISTING TRAFFIC VOLUMES

In order to analyze the traffic impacts associated with the proposed future development, traffic counts were conducted at the intersection of Millstone Lane at Freels Lane and Millstone Lane at George Williams Road. The traffic counts were obtained on Wednesday, November 9th, 2016 during the morning and afternoon peak periods. West Valley Middle School and other local schools were in operation during the traffic counts. The AM peak hours were observed at 7:45 - 8:45 AM at Freels Road and Millstone Lane and at 7:30 – 8:30 AM at the intersection of Millstone Lane at George Williams Road. The PM peak hour was observed from 4:45 – 5:45 at both intersections. The manual tabulated traffic counts can be reviewed in Appendix B.

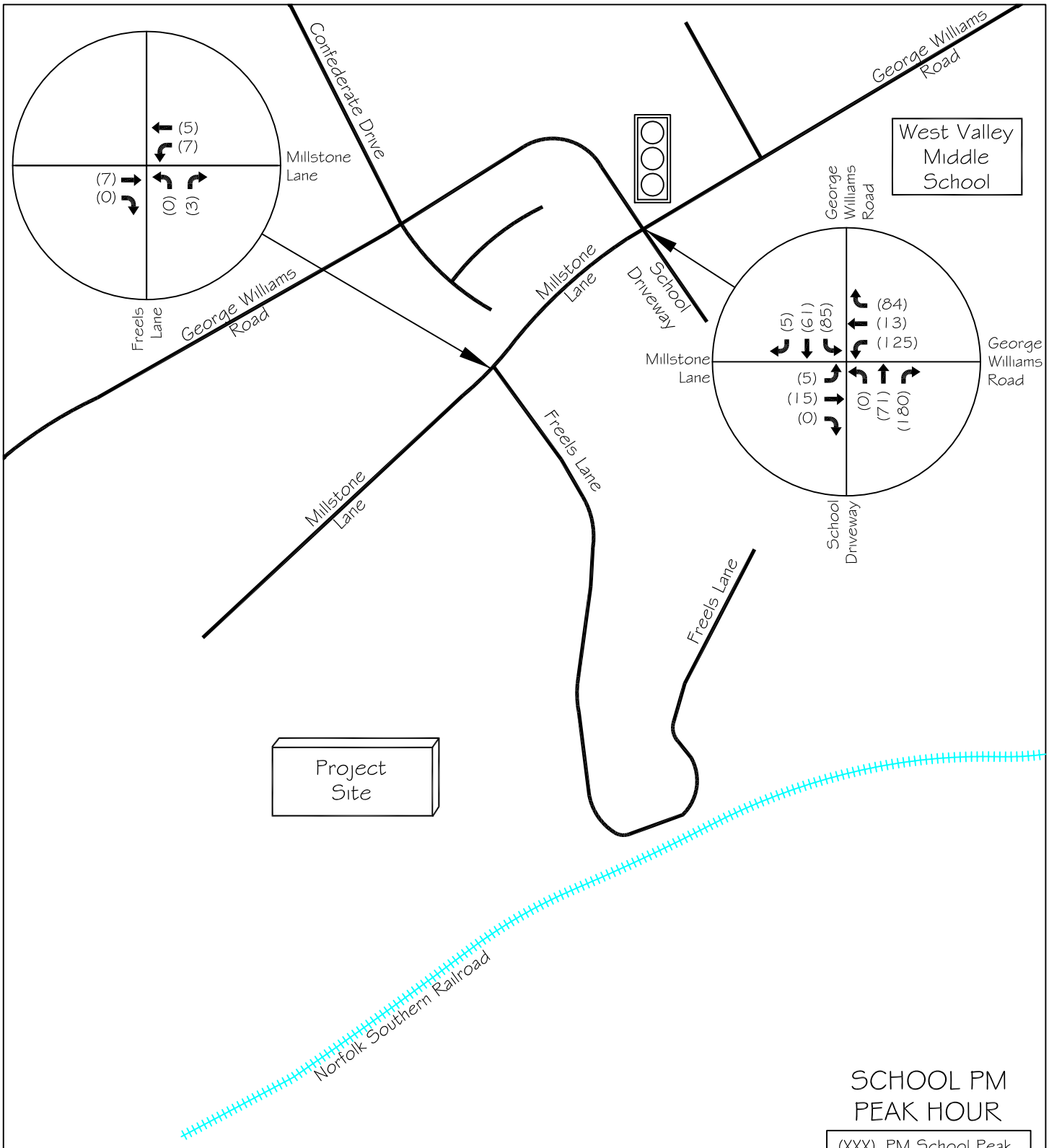
During the traffic counts, school crossing guards were observed to help students cross at the intersection of Millstone Lane at George Williams Road during morning arrivals and afternoon departures at the school. Several dozen students were observed walking to and from school and the nearby residences and apartments during the morning arrival and afternoon dismissal. Currently, there are 135 students residing within the Parent Responsibility Zone (PRZ) which means that school bus service is not available. It is not known how many of these students regularly walk to/from school or are transported by personal vehicle. This information and the historic student enrollment population at the school are presented in Appendix C which includes information given by the Knox County School system.

Also, during the afternoon dismissal period at the school, traffic queues were observed backing up at the signalized intersection of Millstone Lane at George Williams Road. Approximately 10 minutes before the afternoon dismissal at 3:30 pm, the dismissal line vehicle queue was observed backing all the way up to the signalized intersection on the school driveway leg at the intersection. This vehicle queue is formed by waiting guardians to pick up children at the school. Some queue jumping was also observed during this time. The queue from the school dismissal line ultimately resulted in queues forming on the southbound thru/right turn lane and the westbound left turn lane at the signalized intersection. By 3:45 pm the queues that had formed on the various approaches at the intersection had dissipated and the queue was contained within the school property.

Typically, in most instances, the daily morning peak traffic for schools coincides with the adjacent roadway peak hour traffic since the school arrival times correspond with the "traditional" rush hour morning commute periods. However, peak school traffic in the

afternoon does not usually coincide with the "traditional" afternoon peak hour due to earlier school dismissals in the afternoon. Thus for this study, it would be appropriate to assume that the morning peak hour traffic of the proposed residential subdivision will occur simultaneously with the school arrival morning peak traffic. However, the peak school traffic at dismissal in the afternoon will need to be analyzed separately since there will not be a simultaneous occurrence of peak hour adjacent roadway traffic and school dismissal traffic. Typically most traffic impact studies only analyze the AM and PM peak hours of traffic which occur during the traditional rush hours. The Institute of Transportation Engineers (ITE) recommended practices state that traffic impact studies should examine the time period(s) that provide the highest cumulative traffic demands to assess a development's impact on the adjacent street system. Therefore for this study, the traditional AM and PM peak hour of traffic were studied for the intersections along with the PM school peak hour which occurs earlier in the afternoon around the dismissal period (3:30 pm) at the school.

Figure 3a and Figure 3b show the existing traffic volumes for the intersections based on three different time periods. Figure 3a shows the existing traffic volumes at the intersections studied during the PM peak hour when the school dismissal occurs at 3:30 pm (PM School peak hour 3:00 – 4:00 pm). In Figure 3b, the volumes shown are from the existing traffic counts volumes during the traditional AM and PM peak hours. For this study, the AM and PM peak hours during the typical rush hours are labeled and referred as the "traditional" peak hours.



SCHOOL PM PEAK HOUR

(XXX) PM School Peak Hour Volumes 3:00 - 4:00 PM

Volumes shown here are from traffic counts as described in Existing Traffic Volumes in the report

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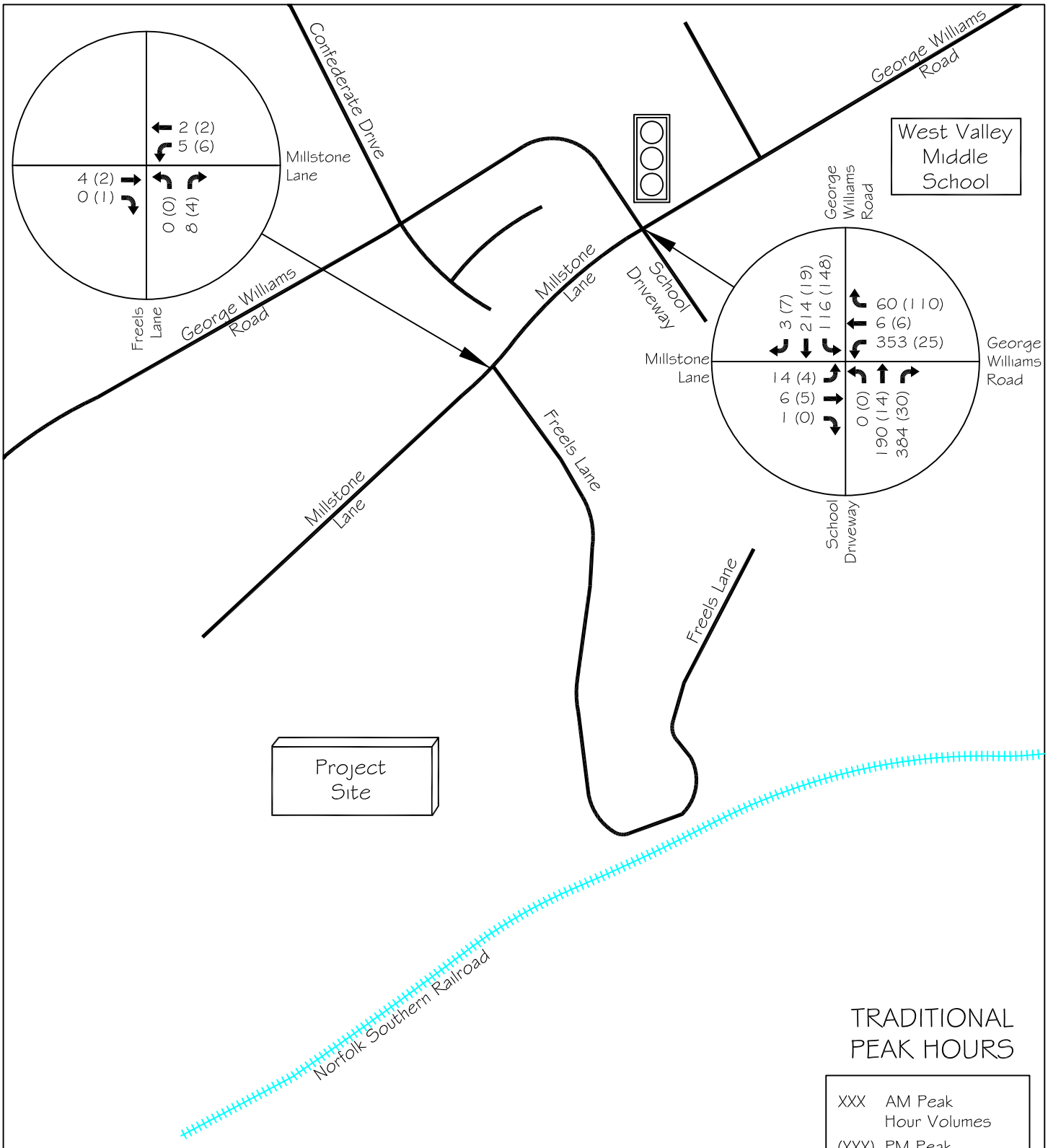
FIGURE 3a

Millstone Subdivision

2016 PM School Peak Hour Traffic Volumes - EXISTING



Volumes shown here are from traffic counts as described in Existing Traffic Volumes in the report

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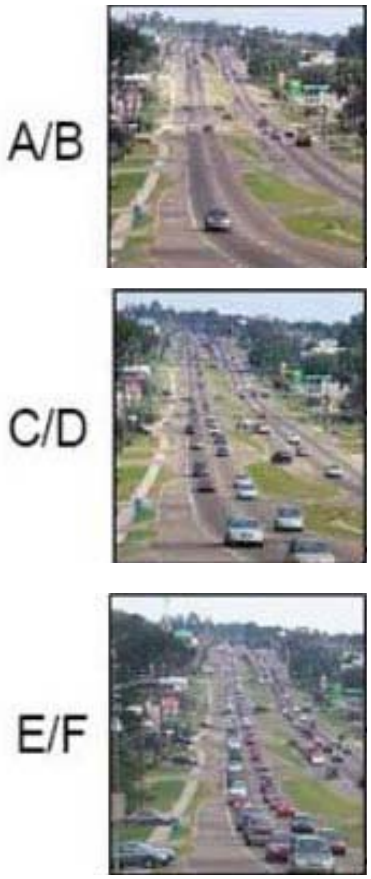
FIGURE 3b

Millstone Subdivision

2016 Traditional Peak Hour Traffic Volumes - EXISTING

Capacity analyses were undertaken to determine the existing Level of Service (LOS) for the intersections. The capacity analyses were calculated by following the methods outlined in the Highway Capacity Manual and using Synchro Traffic Software (Version 8).

LOS is a qualitative measurement developed by the transportation profession of how well an intersection or roadway performs based on a driver's perception. LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at the worst. The Highway Capacity Manual (HCM) lists level of service criteria for unsignalized intersections and is presented in this report as Table 1. For unsignalized intersections, Level of Service is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes travel time, driver discomfort, and fuel consumption. LOS for unsignalized intersections are only calculated for turning movements associated with stop or yield control and also for left turns on "un-controlled" major streets.



(Source: FDOT)

TABLE 1

LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS

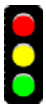
LEVEL OF SERVICE	DESCRIPTION	DELAY RANGE (seconds/vehicle)
A	Little or no delay	≤ 10
B	Short Traffic Delays	>10 and ≤15
C	Average Traffic Delays	>15 and ≤25
D	Long Traffic Delays	>25 and ≤35
E	Very Long Traffic Delays	>35 and ≤50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual

For signalized intersections, level of service is based upon control delay (in seconds) for various movements within the intersection. This delay is a measurement of driver discomfort, frustration, fuel consumption, lost travel time and is dependent on traffic signal cycle lengths, lengths of green phases, and the quality of traffic progression. This control delay includes deceleration/acceleration delay, queue move-up time, and stopped delay time. Generally, for most instances, LOS D is considered the upper limit of acceptable delay. Table 2 lists the level of service criteria for signalized intersections.

TABLE 2

LEVEL OF SERVICE AND DELAY FOR SIGNALIZED INTERSECTIONS



LEVEL OF SERVICE	DESCRIPTION	CONTROL DELAY PER VEHICLE (seconds)
A	Operation with very low control delay. Progression is extremely favorable and most vehicles do not stop at all.	≤10.0
B	Generally good level of progression. More vehicles stop than with LOS A, causing higher levels of average delay.	10.1 - 20.0
C	Higher delays with individual cycle failures may begin at this level. Many vehicles may still pass through without stopping.	20.1 - 35.0
D	Approaching unstable flow. The influence of congestion becomes more noticeable. Many vehicles stop.	35.1 - 55.0
E	Considered the limit of acceptable delay. High delays indicated by poor progression, long cycle lengths, and high v/c ratios.	55.1 - 80.0
F	Unacceptable delay occurs. Progression is extremely poor with long cycle lengths and high v/c ratios.	>80.0

Source: Highway Capacity Manual

The signal timing information that was used for this study was given by Knox County Engineering and is shown in Appendix D. The intersection of George Williams Road and Millstone Lane operates as an actuated traffic signal and is not in coordination with any other traffic signals.

From the capacity calculations, the results from the existing peak hour traffic can be seen in Table 3 for the intersections. The intersections are shown with a LOS designation for the AM, PM, and PM school peak hours in the table. The signalized intersection of Millstone Lane at George Williams Road shows an intersection-wide result in Table 3. The unsignalized intersection of Millstone Lane at Freels Lane gives results based on the individual movements. Appendix E includes the worksheets from the capacity analyses for the existing traffic peak hours. For the existing intersections, the existing peak hour levels of service are shown to operate at a very good level during the AM and PM peak hours. The PM school peak hours also operated at a very good level notwithstanding the brief queue backups from the school.

TABLE 3
2016 PEAK HOUR LEVEL OF SERVICE & DELAY - EXISTING

INTERSECTION	TRAFFIC CONTROL	APPROACH	LEVEL OF SERVICE			DELAY (seconds)		
			AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at Freels Lane	 Unsignalized	Westbound Left/Thru	A	A	A	5.4	4.9	5.4
		Northbound Left/Right	A	A	A	8.4	8.4	8.4

INTERSECTION	TRAFFIC CONTROL	V/C RATIO			LEVEL OF SERVICE			DELAY (seconds)		
		AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at George Williams Road	 Signalized	0.68	0.35	0.23	C	B	A	21.3	13.4	9.2

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
Note: Millstone Lane at Freels Lane was modeled as stop controlled for the Freels Lane approach

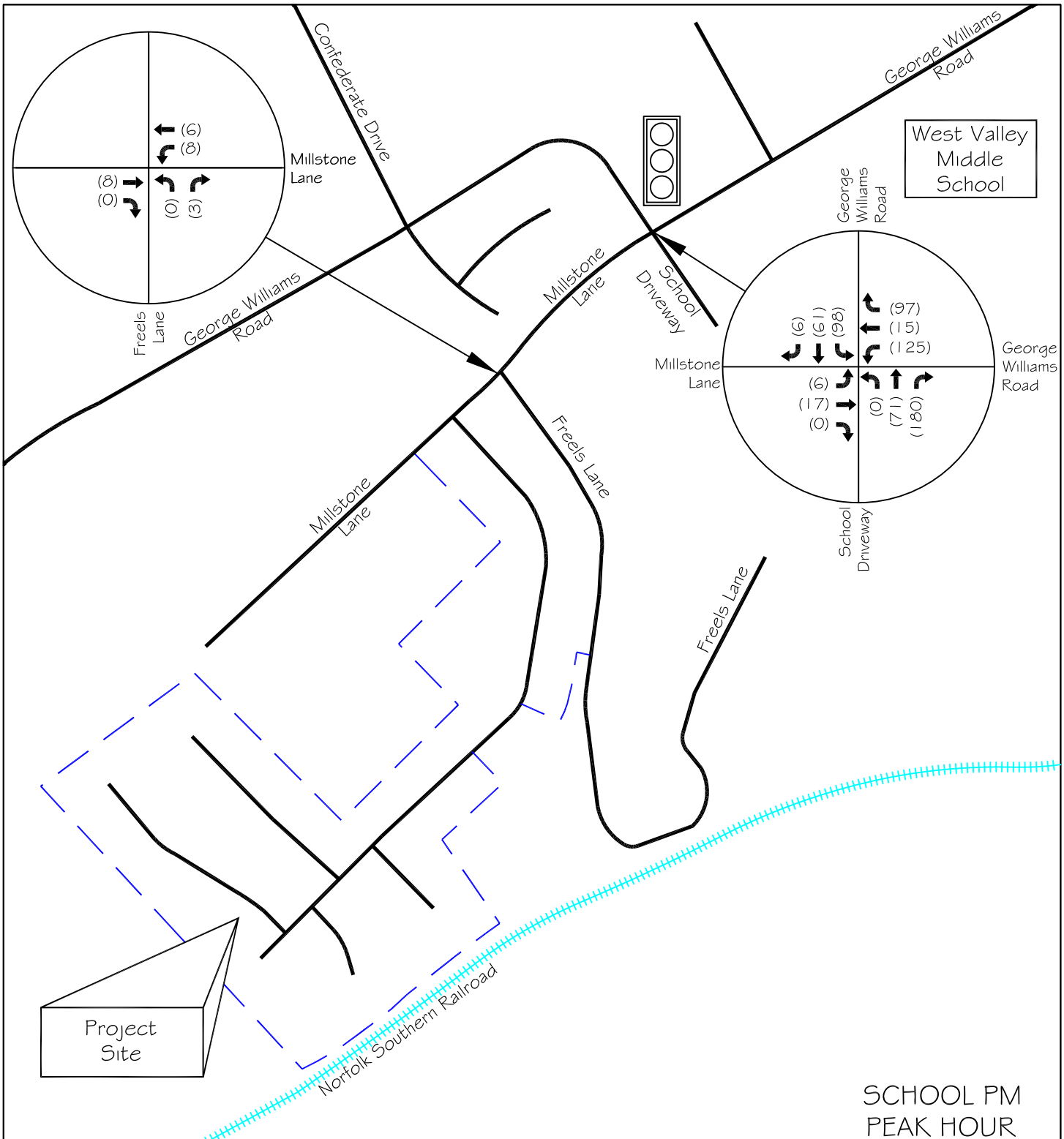
BACKGROUND TRAFFIC VOLUMES

Background traffic volumes are estimates of non-development related traffic for a particular horizon or design year. These background traffic volume estimates represent the future base condition for which the proposed study area is potentially subject to without the project being developed.

As previously stated, the build-out year for the proposed new residential subdivision was assumed to occur in 2021. Background traffic volumes for this project were calculated by applying an annual growth rate to the existing traffic volumes that are shown in Figure 3a and 3b. A background growth rate was determined by obtaining and analyzing the nearby traffic count in the area located on George Williams Road and provided by TDOT. This historical data is located in Appendix A. The traffic data at this count station indicates that the average daily traffic has fluctuated but has had positive growth over the past few years. Overall, the traffic count data has shown a more stabilized growth pattern of approximately 1.6% for the past 6 years.

Nonetheless, to insure a reasonable and conservative estimate for this study, a 3% growth was used to take into account any future development in the area and possible rising travel volumes. The results of this growth rate application to the existing traffic volumes can be seen in Figure 4a and 4b for the year 2021. Figure 4a shows the background traffic volumes during the PM school peak hour and Figure 4b shows the background traffic volumes during the traditional AM and PM peak hours. (Note: The growth factor was not applied to the volumes associated with the turning movements into and out of the school driveway since the student population has stabilized and remained fairly constant over the past five years.)

The application of background traffic to the existing intersections did not change the LOS designations from the existing traffic analysis for the AM, PM, and PM school peak hours. Table 4 reports the LOS results and Appendix E contains the LOS worksheets for the background conditions. It is important to point out that these projected LOS designations for the intersections would potentially exist in the future even without the proposed residential subdivision being developed.



Volumes shown here are calculated from existing traffic volumes with a growth factor as described in Background Traffic Volumes in the report

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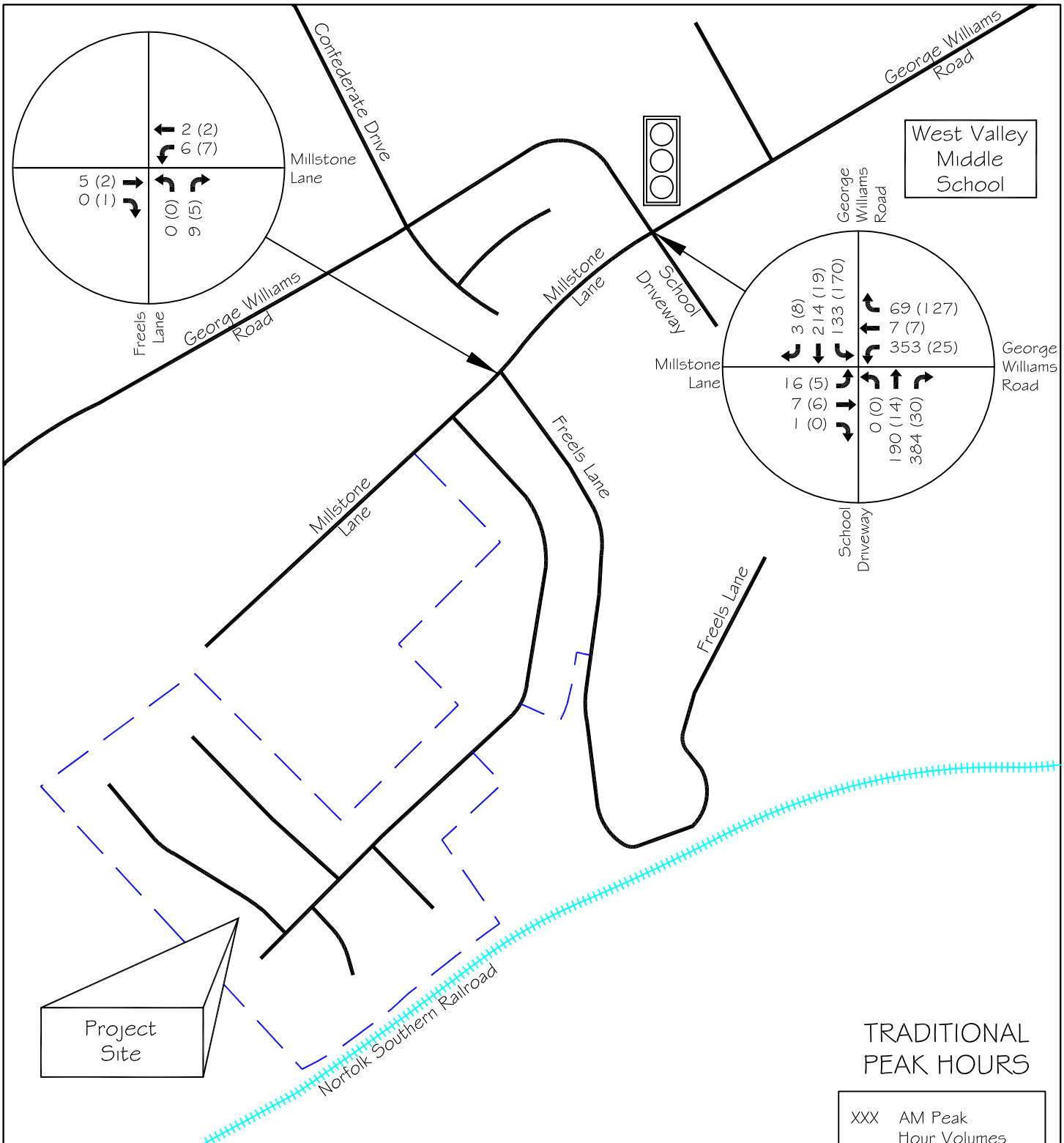
FIGURE 4a

Millstone Subdivision

2021 PM School Peak Hour Traffic Volumes - BACKGROUND



TRADITIONAL PEAK HOURS

XXX AM Peak Hour Volumes

(XXX) PM Peak Hour Volumes

Volumes shown here are calculated from existing traffic volumes with a growth factor as described in Background Traffic Volumes in the report

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FIGURE 4b

Millstone Subdivision

2021 Traditional Peak Hour Traffic Volumes - BACKGROUND

TABLE 4
2021 PEAK HOUR LEVEL OF SERVICE & DELAY - BACKGROUND

INTERSECTION	TRAFFIC CONTROL	APPROACH	LEVEL OF SERVICE			DELAY (seconds)		
			AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at Freels Lane	 Unsignalized	Westbound Left/Thru	A	A	A	5.7	4.8	5.6
		Northbound Left/Right	A	A	A	8.4	8.4	8.4

INTERSECTION	TRAFFIC CONTROL	V/C RATIO			LEVEL OF SERVICE			DELAY (seconds)		
		AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at George Williams Road	 Signalized	0.68	0.36	0.25	C	B	A	21.2	13.3	9.0

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
Note: Millstone Lane at Freels Lane was modeled as stop controlled for the Freels Lane approach

TRIP GENERATION

The estimated amount of traffic that will be generated by the proposed residential subdivision during peak hours was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 9th Edition, a publication of the Institute of Transportation Engineers (ITE). A generated trip is a single or one-direction vehicle movement that is either entering or exiting the study site. The Trip Generation Manual is the traditional and most-sourced resource for determining trip generation rates when traffic impact studies are produced. The Manual lists traffic generation data for a variety of land uses. The data from ITE for the land use below is shown in Appendix F. A summary of this information is presented in the following table:

TABLE 5
TRIP GENERATION FOR MILLSTONE SUBDIVISION

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	136 Lots		25%	75%		63%	37%	
			1,394	26	79	105	88	51	139
Total New Volume Site Trips			1,394	26	79	105	88	51	139

ITE Trip Generation Manual, 9th Edition

Based on these calculations, potentially it can be expected that 26 vehicles will enter the development, 79 will exit, for a total of 105 new generated trips during the AM Peak Hour in the year 2021. Similarly, potentially it can be expected that 88 vehicles will enter the development, 51 will exit, for a total of 139 new generated trips during the PM Peak Hour in the year 2021. The calculated trips generated for an average day are expected to be approximately 1,394 vehicles for the entire 136 lot development. These volumes are for the "traditional" time periods associated with rush hour traffic in the morning and afternoon.

The ITE Trip Generation Manual does not provide data for the generation of residential traffic during a "School Peak Hour" (i.e. school morning arrival and afternoon dismissal). As stated earlier, typically, peak school traffic in the morning coincides with the roadway morning peak hour since the arrival times at schools correspond with "traditional" rush hour morning

commutes. However, school peak traffic in the PM does not coincide with the "traditional" afternoon peak hour due to the earlier dismissal in the afternoon. To determine the residential site traffic generation for the development during the PM school peak hour (3:00 – 4:00 PM), several assumptions were made for the study.

According to the Knoxville/Knox County MPC Rezoning Report dated 7/6/2016 (included in Appendix G), this residential subdivision could potentially yield 126 school children. The schools affected by this would include A.L. Lotts Elementary School, Bearden High School, and the adjacent West Valley Middle School. A.L. Lotts Elementary School is located to the due south on Westland Drive and Bearden High School is located several miles further to the east. Also according to the MPC, this property lies within the Parental Responsibility Zone (PRZ) which would mean that bus service would not be provided to the students attending West Valley Middle School. According to the Knox County School system, the PRZ is defined as being 1.5 miles for grades 6 – 12 (1.0 mile for grades K – 5) from the point where the students parcel is accessed and the point where the busses unload at the school.

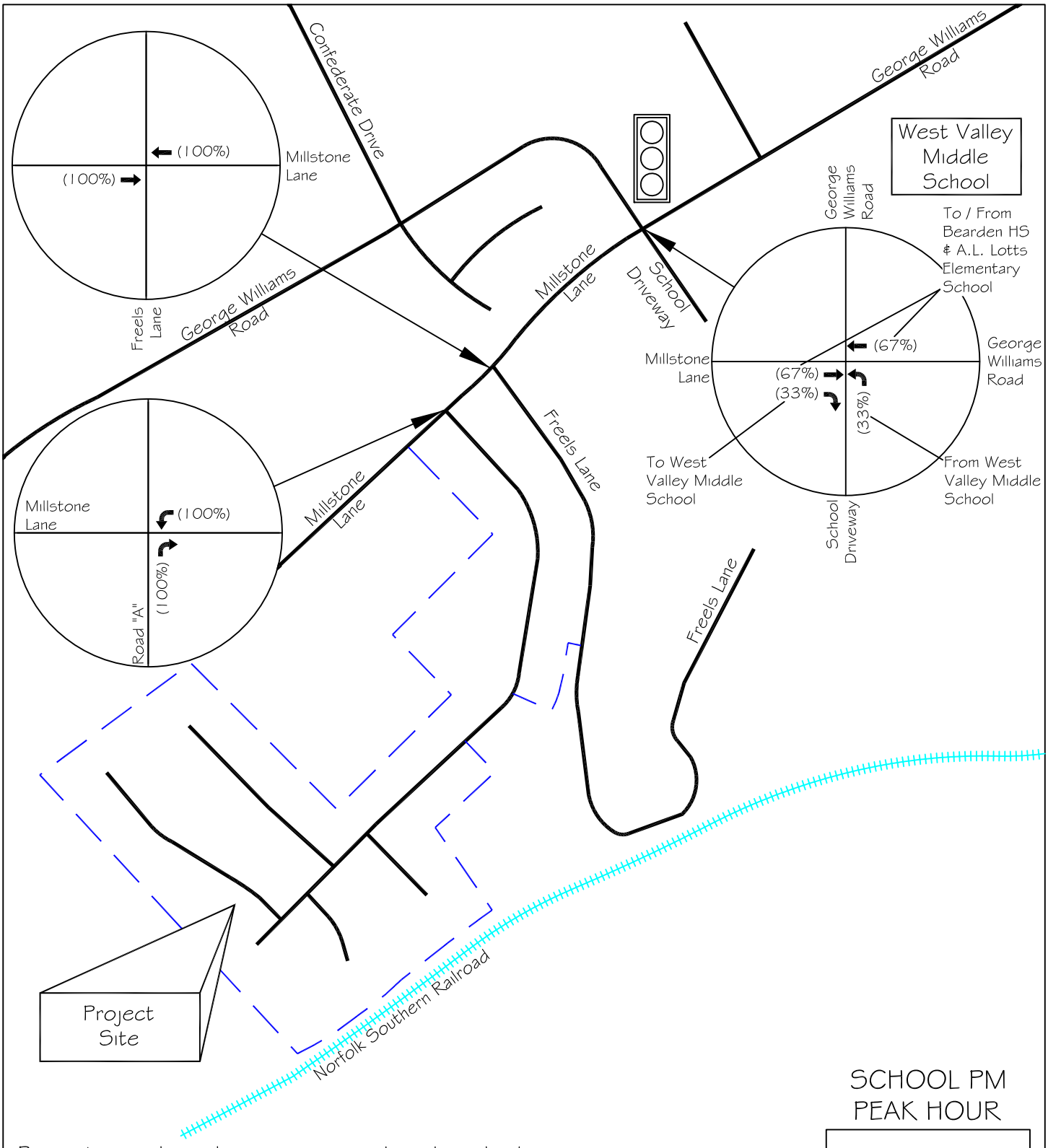
To provide some means of conservatively estimating the traffic impacts at the studied intersections during the "School Peak Hour", this study assumed that the 126 school children would be evenly divided among the three schools, all the students would travel by passenger vehicle, fellow students and parents would not carpool, none of the students would walk from school, each student would be in a separate household, the parent would go to the school and return home within the peak hour, and that none of the children would be homeschooled. Based on those assumptions, it can be calculated that each school would generate an additional 42 trips leaving and 42 trips returning to the subdivision during the school peak hour (126 students/3 schools = 42 trips per direction). This calculation would guarantee an extreme overestimation of trips generated and result in a very conservative analysis.

TRIP DISTRIBUTION & ASSIGNMENT

Figure 5a shows the projected distribution for traffic entering/exiting the new residential subdivision during the future PM school peak hour at the existing intersections and at the new proposed subdivision road entrance/exit on Millstone Lane. The percentages shown only pertain to the new trips generated by the new proposed residential dwellings in the subdivision and Figure 5a shows the conservatively estimated generated trips associated with the school dismissal period. The projected trip distributions shown in Figure 5a for the future PM school peak hour are based on the location of the three schools serving the proposed subdivision.

Figure 5b shows the projected distribution for traffic entering/exiting the new residential subdivision during the future AM peak and the future PM "traditional" peak hour at the existing intersections and at the new proposed subdivision road entrance/exit on Millstone Lane. Access to other areas in the Knoxville region outside of George Williams Road will be served by South Peters Road, Fox Road, and Confederate Drive. The projected trip distributions of Figure 5b are based on the existing traffic movements at the examined intersections and are also surmised from surrounding concentrations of development and population.

Figure 6a and 6b shows the Traffic Assignment of the computed trips that will be generated by the development and applied to the various intersection movements based on the assumed distribution of trips shown in Figure 5a and 5b.



Percentages shown here are assumed as described in Trip Distribution & Assignment in the report

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

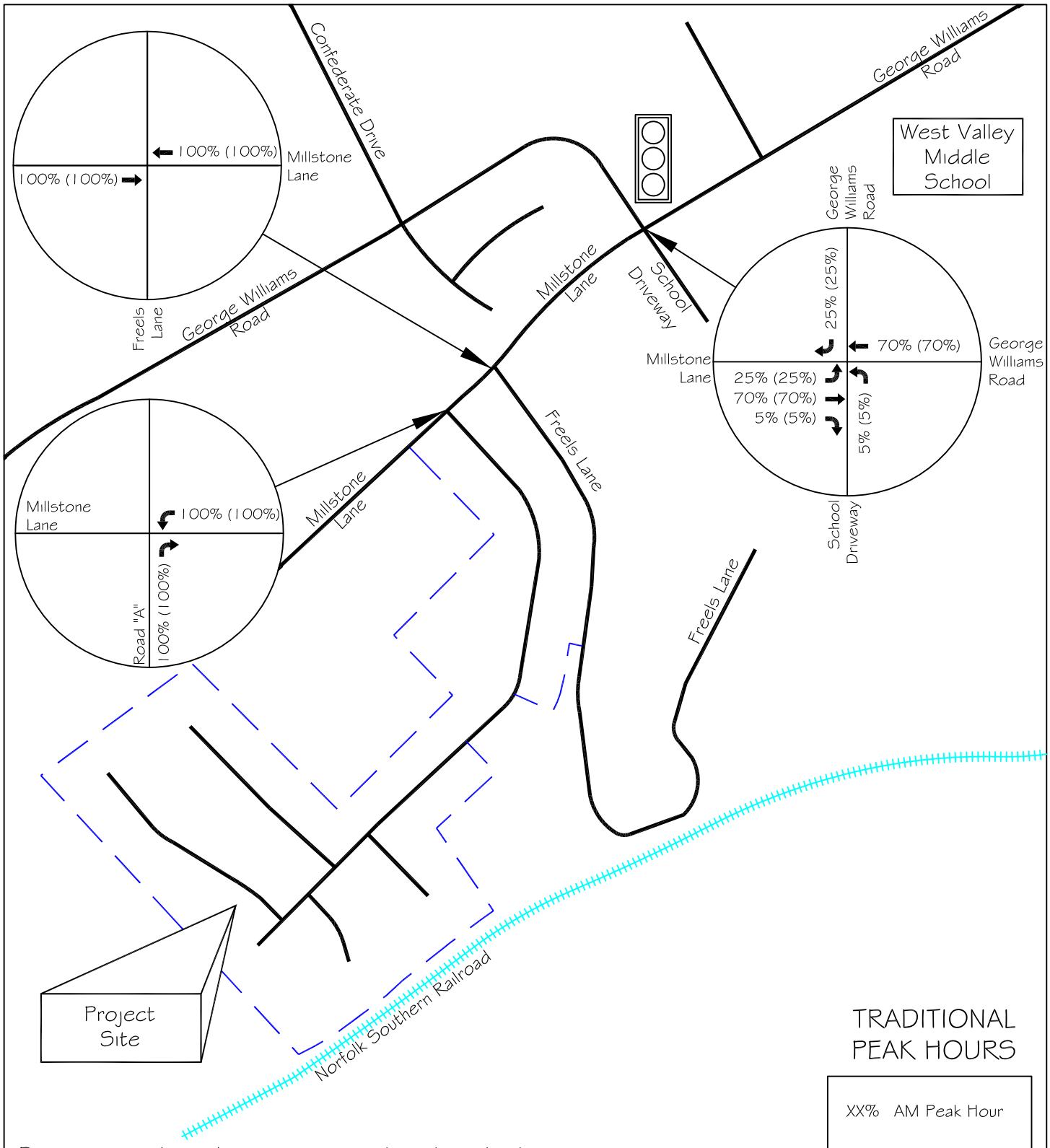
NOT TO SCALE

NORTH

FIGURE 5a

Millstone Subdivision

Directional Distribution of Generated Traffic to / from Schools during School PM Peak Hour



Percentages shown here are assumed as described in Trip Distribution & Assignment in the report

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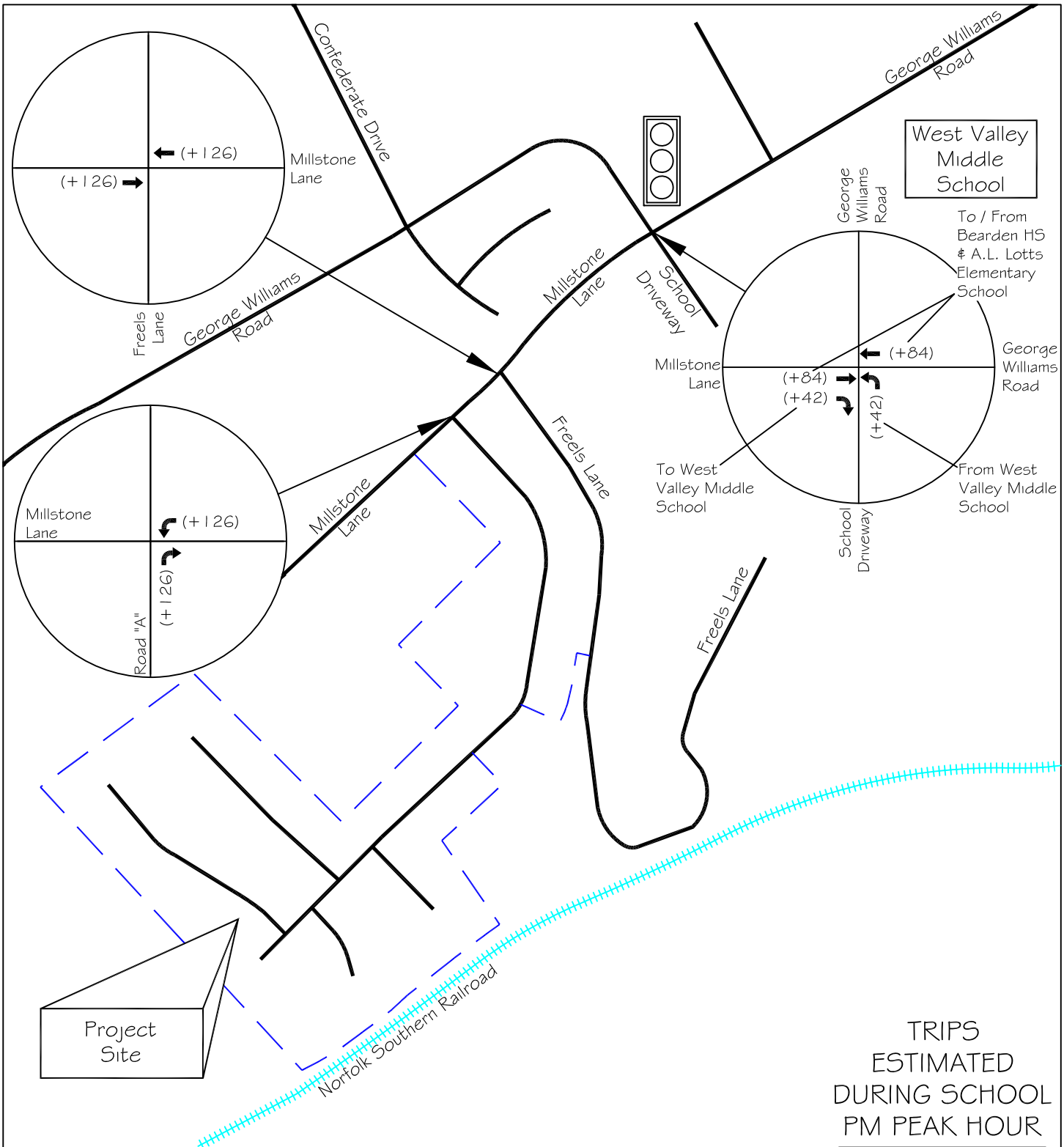
FIGURE 5b

Millstone Subdivision

Directional Distribution of Generated Traffic during Traditional AM and PM Peak Hour



TRIPS ESTIMATED DURING SCHOOL PM PEAK HOUR

(XXX) PM Peak Hour Volumes 3:00 - 4:00 PM

Volumes shown here are the calculated trips estimated as described in Trip Generation in the report according to the Directional Distributions from Figure 5a

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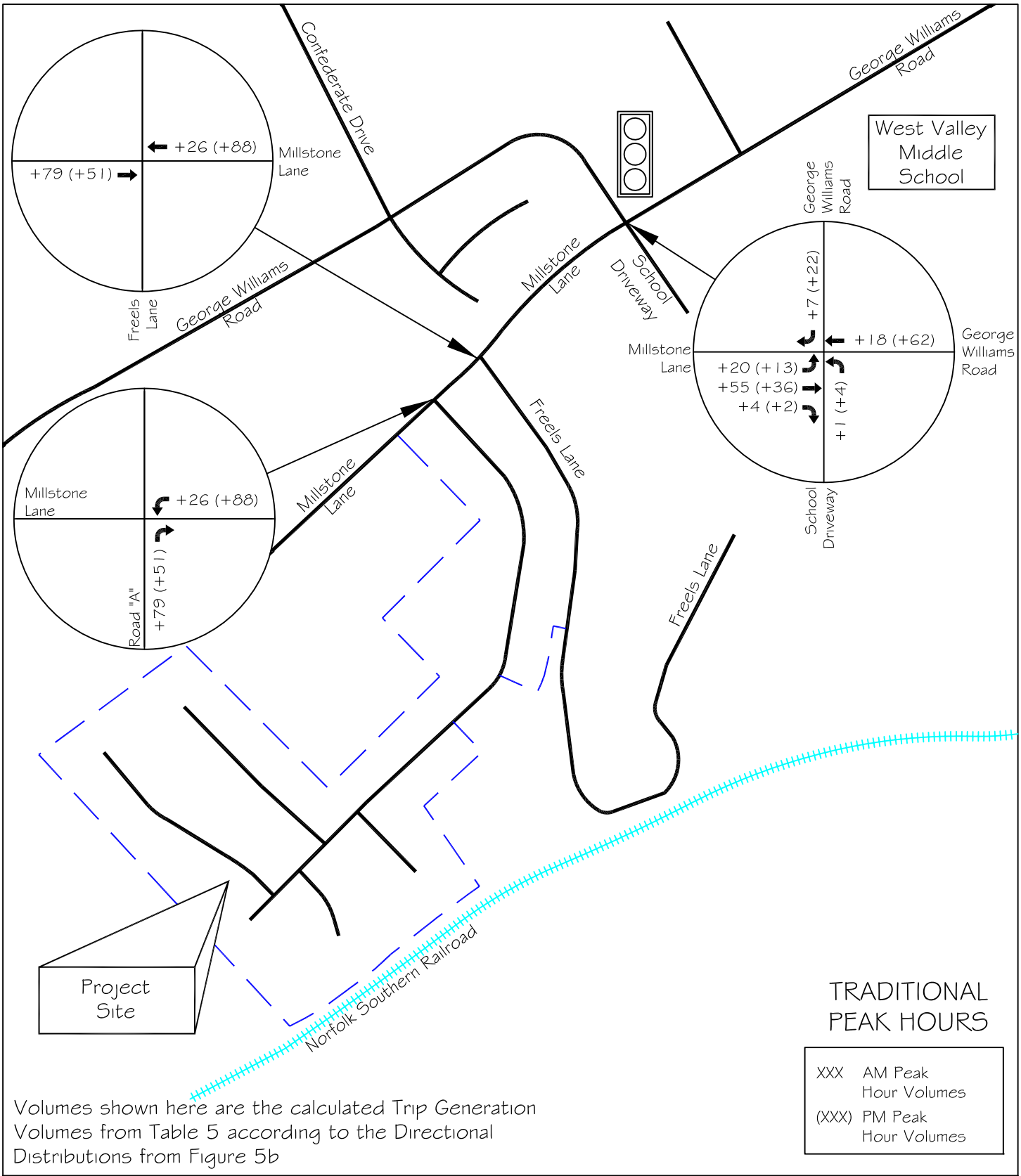
FIGURE 6a

Millstone Subdivision

Traffic Assignment of Generated Traffic to / from Schools during School PM Peak Hour



Volumes shown here are the calculated Trip Generation Volumes from Table 5 according to the Directional Distributions from Figure 5b

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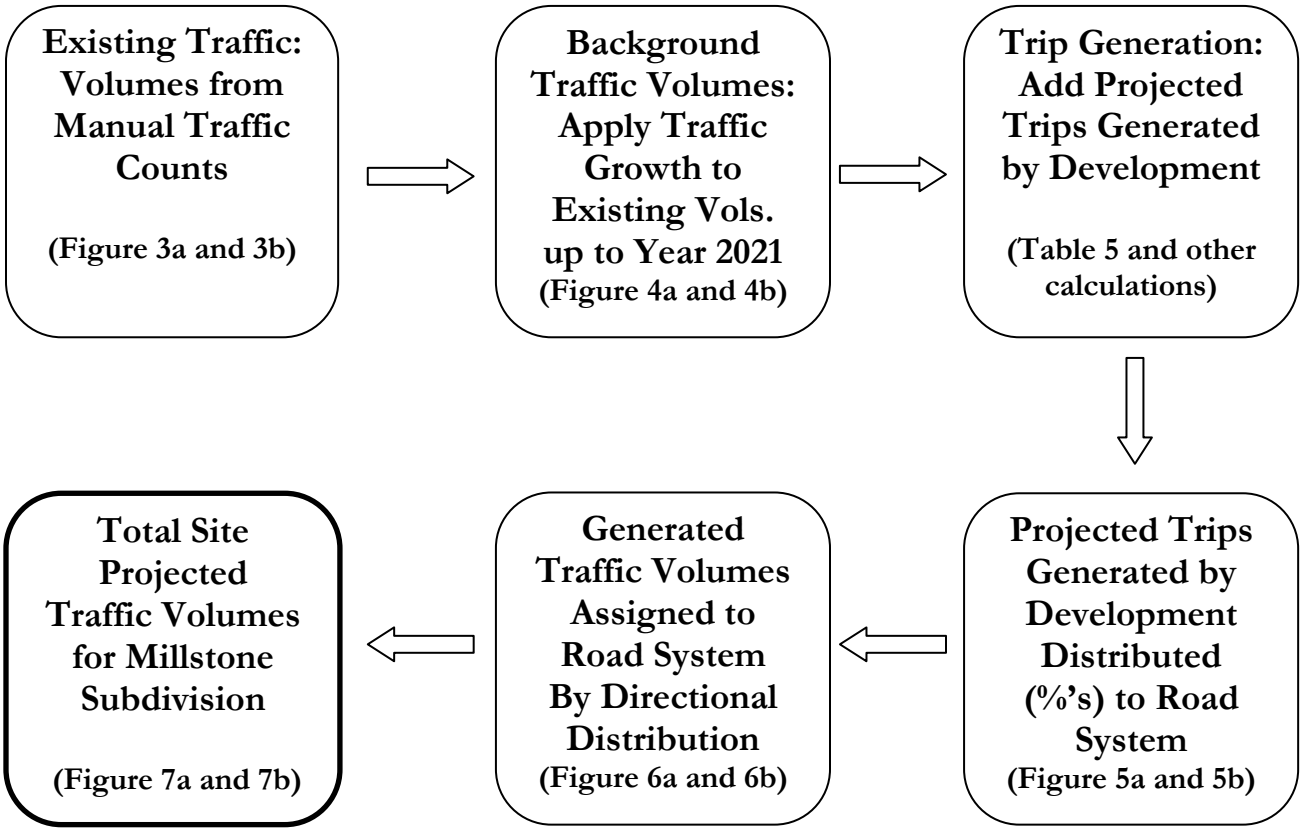
FIGURE 6b

Millstone Subdivision

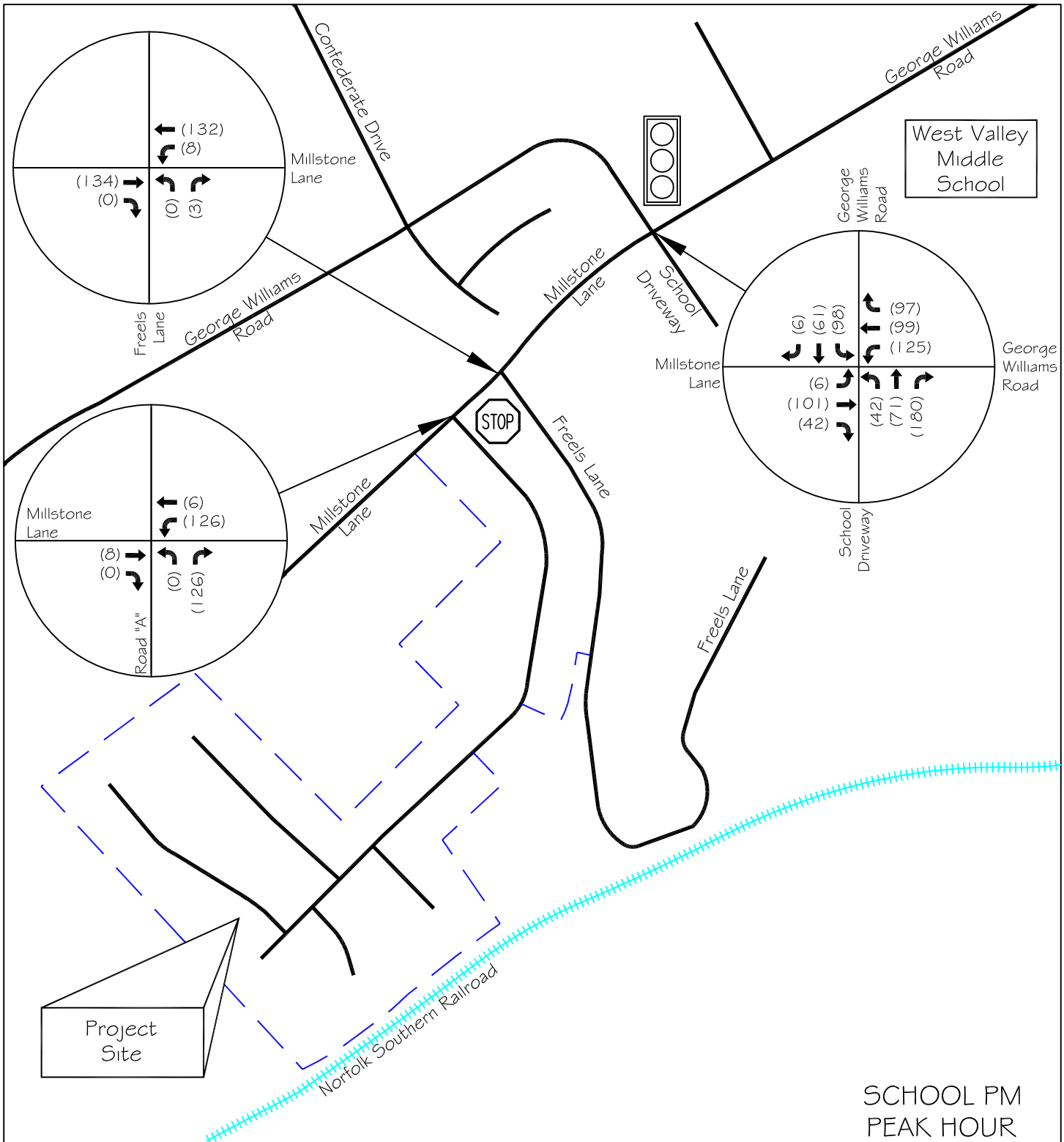
Traffic Assignment of Generated Traffic during Traditional AM and PM Peak Hour

PROJECTED TRAFFIC VOLUMES

Overall, several additive steps were taken to calculate the total future projected traffic volumes at the studied intersections when the residential subdivision is fully constructed, built-out, and occupied by 2021. The steps as described previously are illustrated below for clarity:



To calculate the total future projected traffic volumes at the intersections, application of the calculated peak hour traffic generated by the new proposed Millstone Subdivision were added to the 2021 background traffic volumes (shown in Figure 4a and 4b) in accordance to the predicted directional distributions and assignments (shown in Figure 5a, 5b, 6a, and 6b). This procedure was necessary to obtain the total projected traffic volumes at the time the development is fully built-out by the year 2021. Figure 7a shows the projected peak PM school hour volumes at the studied intersections for the year 2021. Figure 7b shows the "traditional" projected AM and PM peak hour volumes at the studied intersections for the year 2021.



SCHOOL PM PEAK HOUR

(XXX) PM Peak Hour Volumes 3:00 - 4:00 PM

Volumes shown here are the calculated traffic volumes from Figures 5a & 6a added to the background traffic volumes shown in Figure 4a

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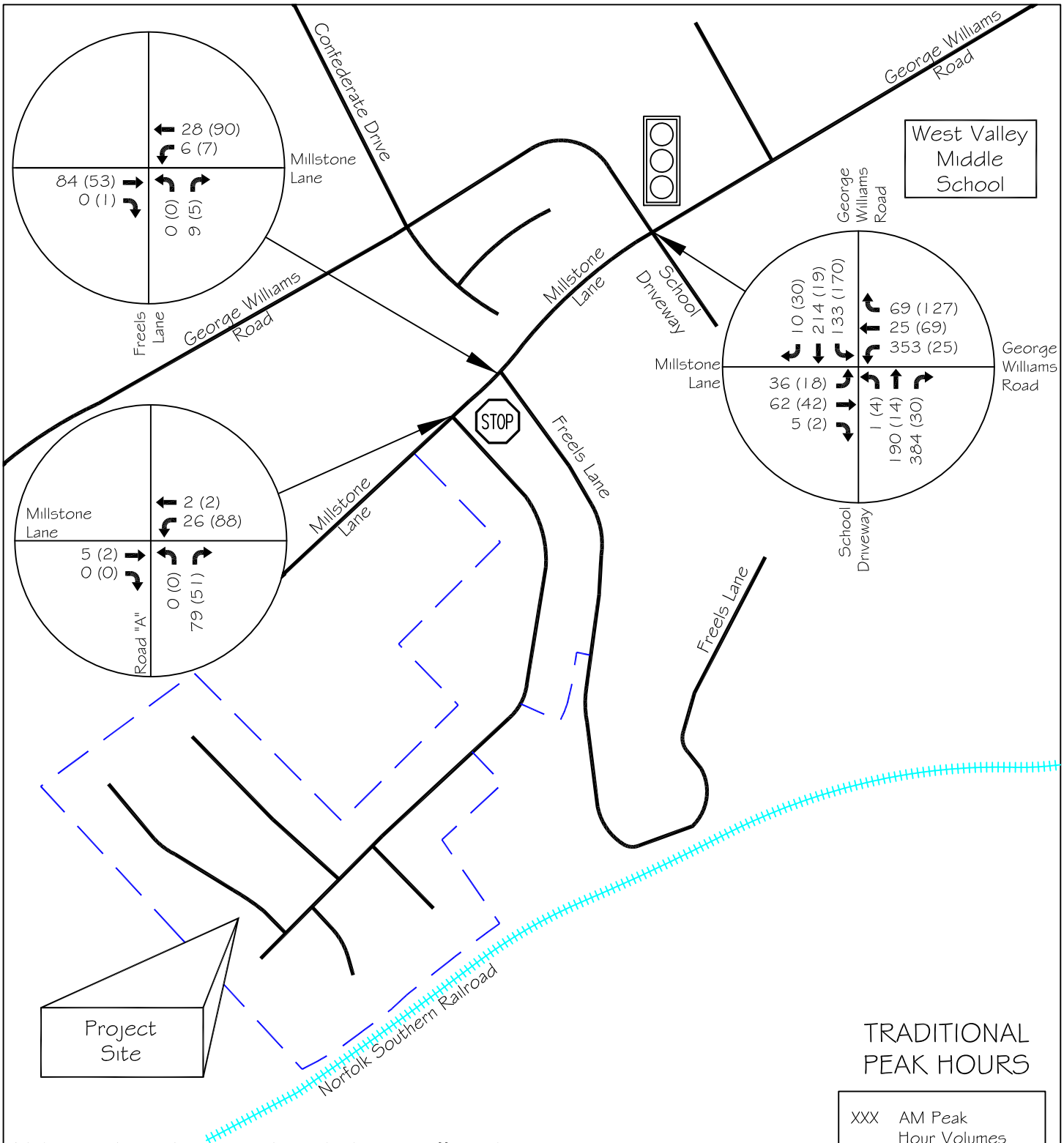
FIGURE 7a

Millstone Subdivision

2021 PM School Peak Hour Traffic Volumes - PROJECTED



Volumes shown here are the calculated traffic volumes from Figures 5b & 6b added to the background traffic volumes shown in Figure 4b

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FIGURE 7b

Millstone Subdivision

2021 Traditional Peak Hour Traffic Volumes - PROJECTED

Capacity analyses were once again undertaken to determine the projected Level of Service (LOS) for the studied intersections. Appendix E includes the worksheets for these capacity analyses. The projected capacity analyses include the new entrance, Millstone Lane at Road "A".

The results of the capacity calculations of the projected peak hour traffic can be seen in Table 6 for the intersections. For the intersections, the peak hour levels of service are once again shown to operate at very good levels during both the AM, PM, and PM school peak hours and did not substantially degrade from the previous capacity calculations.

TABLE 6
2021 PEAK HOUR LEVEL OF SERVICE & DELAY - PROJECTED

INTERSECTION	TRAFFIC CONTROL	APPROACH	LEVEL OF SERVICE			DELAY (seconds)		
			AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at Freels Lane	Unsignalized	Westbound Left/Thru	A	A	A	1.6	0.7	0.6
		Northbound Left/Right	A	A	A	8.7	9.9	9.4
Millstone Lane at Road "A"	Unsignalized	Westbound Left/Thru	A	A	A	6.8	7.1	7.2
		Northbound Left/Right	A	A	A	8.6	8.8	8.5

INTERSECTION	TRAFFIC CONTROL	V/C RATIO			LEVEL OF SERVICE			DELAY (seconds)		
		AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK	AM PEAK	SCHOOL PM PEAK	PM PEAK
Millstone Lane at George Williams Road	Signalized	0.74	0.44	0.3	C	B	B	23.0	15.3	11.4

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology
Note: Millstone Lane at Freels Lane was modeled as stop controlled for the Freels Lane approach

CONCLUSIONS AND RECOMMENDATIONS

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

1) **Millstone Lane at Millstone Subdivision Road "A":** From the capacity calculations, it has been shown (Table 6) that the traffic movements at the new entrance should operate very well during the AM, PM, and PM school peak periods when the development is complete and fully occupied.

   1a) **From the capacity calculations, the analysis shows that only a single exiting lane is required at the Millstone Subdivision entrance. Also, a separate left turn lane on Millstone Lane into the development is not required due to the low volumes.** This was determined by using "Knox County's Access Control and Driveway Design Policy" for turn lane requirements. The Knox County turn lane policy worksheets are located in Appendix H. The projected low volumes fall under the threshold for requiring a separate left turn lane.

   1b) **It is recommended that the 20 mph speed limit currently posted on Millstone Lane be changed to 25 mph once Millstone Lane upgrades are completed.** Based on a posted speed limit of 25 mph on Millstone Lane, the recommended intersection sight distance requirement is 250 feet. Using a rolling wheel, the measured sight distance at the new intersection on Millstone Lane looking west was found to be in excess of 750 feet. Sight distance at the new intersection on Millstone Lane looking east was measured to be at least a minimum of 300 feet. While not surveyed for this study, a sufficient sight distance is estimated to be available for vehicles exiting and entering from the new proposed main entrance. The site designer should ensure that these sight distance lengths are met and they should be labeled on the plans. A land surveyor should measure the sight distance available and verify these estimates. The overall required sight distance should be measured at the intersection at a minimum of 15 feet off of the edge of the roadway per Knox County subdivision regulations (Section 62-88).

1c) **It is recommended that the main entrance approach at the intersection with Millstone Lane be designed and constructed with a 24" white stop bar and with a Stop Sign (R1-1).**

1d) **Intersection sight distance at the new proposed main entrance at Millstone Lane must not be impacted by new signage, future landscaping or existing vegetation.**

2) **Millstone Subdivision Internal Drives**: The current layout plans show 6 new roadways being constructed within the development labeled Road "A" thru Road "F" as shown on Figure 2a. Road "A" will be the connecting road to Millstone Lane.

2a) **A Stop Sign (R1-1) should be installed at the Road "B", Road "C", Road "D", Road "E", and Road "F" approach intersections with Road "A".**

2b) **It is recommended that the internal speed limit for Millstone Subdivision be 25 mph and this speed limit be posted on signage in the new residential subdivision as required.**

2c) **Sight distance at all of the new internal "T" and four-way intersections must not be impacted by new signage, or future landscaping.** For an assumed posted 25 mph speed for the internal development streets, the intersection sight distance requirement is 250 feet. The road layout designer should ensure that these sight distance lengths are met, maximized, and they should be labeled on the plans.

2d) **Sidewalks should be installed within the development and have appropriate ADA compliant curbed ramps at all of the internal intersections corners.**

2e) **All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County Engineering specifications and guidelines to ensure proper operation.**

2f) **Possible traffic calming measures might be needed for this development on Road "A".** The Road "A" alignment within the development is fairly straight and has been designed to maximize the lots on the property within a fairly narrow land parcel. The narrowness of the land parcel hinders the potential to design curvature in the horizontal road alignment that could discourage excessive vehicular speeds. The possible need for traffic calming measures inside the project for Road "A" will need to be coordinated with the Knox County Engineering and Public Works during the detailed design phase. Speed humps could be considered to lower speeds through the subdivision.

3) **Millstone Lane at Freels Lane**:

3a) The intersection currently exists without any traffic control. Due to the volumes generated by the new development, **a Stop Sign (R1-1) should be installed on the northbound approach on Freels Lane**.

3b) **From the capacity calculations, the analysis shows that an additional northbound turn lane at Freels Lane is not required. Also, a separate left turn lane on Millstone Lane onto Freels Lane is not required due to the low volumes.** This was determined by using "Knox County's Access Control and Driveway Design Policy" for turn lane requirements. The Knox County turn lane policy worksheets are located in Appendix H. The projected low volumes fall under the threshold for requiring a separate left turn lane.

4) **Millstone Lane at George Williams Road**: From the capacity calculations, it has been shown (Table 6) that the LOS at the signalized intersection should be at a very good level during the AM, PM, and PM school peak periods when the development is constructed and occupied. The intersection was modeled under the projected future volumes and was shown to maintain a very good level of service.

4a) **The signal timing of the intersection should be reviewed for possible greater efficiencies after the residential subdivision is constructed and occupied**. However, the existing timing of the traffic signal used in this study showed very good operation even with the increased volumes of the proposed subdivision.

4b) During the projected AM peak hour when the proposed development peak traffic and school peak traffic coincide, the traffic volumes generated by the new development should not result in queues that would extend beyond the existing storage lane length capacities at the signalized intersection. To estimate these projected lengths, SimTraffic (Version 8) software was utilized which performs micro-simulation and animation of vehicular traffic and also calculates various vehicle parameters such as intersection queue lengths. The queue results from the SimTraffic software are located in Appendix I.

As stated in the Existing Traffic Volumes section of this report, this study did observe queues forming during the PM school peak hour around the West Valley Middle School dismissal time of 3:30 PM. The vehicle dismissal line queued from the front of the school back to the signalized intersection. This queue forms when parents and guardians arrive to pick up their children prior to the official dismissal at the school. This dismissal line backed up and spilled outside of the school property and eventually started forming queues along George Williams Road for the westbound left turn and southbound thru movements during the traffic counts. During the traffic count at the intersection, the following school traffic queue observations were made:

- the school dismissal queue line reached the signalized intersection at 3:22 PM
- queues began forming on the southbound thru/right turn lane and the westbound left turn lane by 3:24 PM
- the dismissal queue line within the school property began advancing away from the intersection at 3:36 PM
- all of the queues were dissipated within the intersection by 3:45 PM and allowed for free movement according to the traffic signal indications

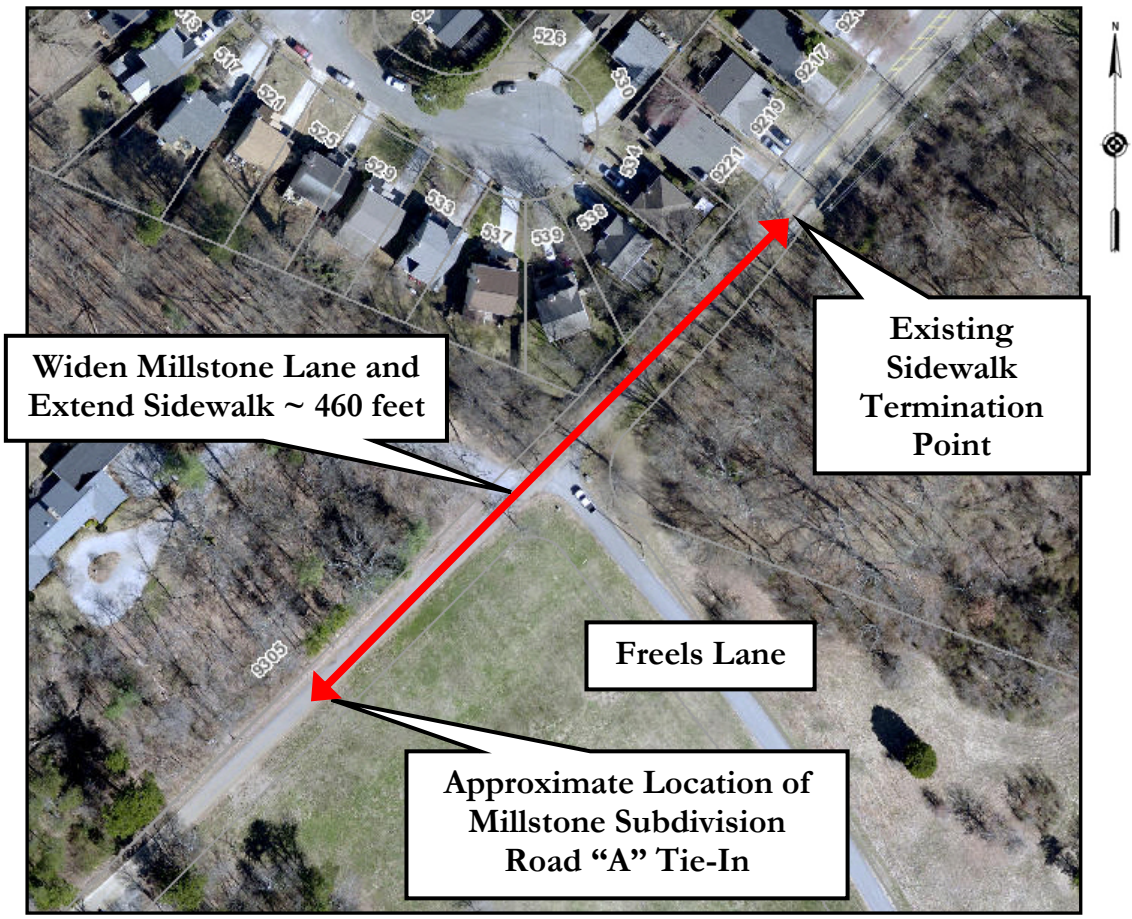
During the approximate 20 minute period where the school dismissal queues impacted the signalized intersection, the southbound thru/right turn lane experienced queues which impacted and impeded vehicles turning right onto Millstone Lane. The other queues at the intersection during the 20 minute period did not appear to have any impact on the existing access to/from Millstone Lane. It could be expected that due to the queue spillage at the intersection from the

school dismissal, traffic movements for southbound right turns at the intersection going to the proposed subdivision on Millstone Lane and eastbound thru and right turn movements at the intersection going from the proposed subdivision on Millstone Lane could be impeded in the future. Efficiencies or changes to the school dismissal could potentially be made to reduce the queue lengths and eliminate spill back to the signalized intersection, however that analysis is beyond the scope of this study. Due to the brevity of the approximate 20 minute period in which school dismissal queues spill back into the intersection, construction of additional southbound and eastbound turn lanes are not warranted.

5) **Millstone Lane**: As stated earlier in the report, Millstone Lane was upgraded and widened to 12 foot lanes at its approach to the signalized intersection at George Williams Road when the middle school was constructed. A sidewalk on the south side of Millstone Lane extends 450 feet from the signalized intersection towards the west. Approximately 500 feet to the west of the traffic signal, Millstone Lane transitions to a narrower roadway with a total pavement width of 17 feet (8.5 foot travel lanes). West of the intersection at Freels Lane, Millstone Lane has a pavement width of approximately 13 feet (6.5 foot travel lanes).

5a) For this proposed residential subdivision, **Millstone Lane should be widened from the existing curb, gutter, and sidewalk roadway section all the way to the proposed subdivision entrance at Road "A".** The roadway widening distance from the end of the existing sidewalk to the proposed intersection of Road "A" at Millstone Lane is approximately 460 feet. The roadway widening should follow Knox County Engineering's requirement for local streets **and should be 20 feet in width with a posted speed limit of 25 mph**. The MPC Rezoning Report (Appendix G) indicates that Millstone Lane has between 40 to 45 feet of right-of-way.

5b) **Along with the road widening, the sidewalk that currently exists on the south side of Millstone Lane should be extended to the new residential subdivision entrance and tied to the internal subdivision sidewalk network.** According to Knox County Subdivision Regulations, the inner edge of a sidewalk should not be closer than five feet to the street pavement and shall have a minimum width of 5 feet.



Millstone Lane Road Widening

APPENDIX A

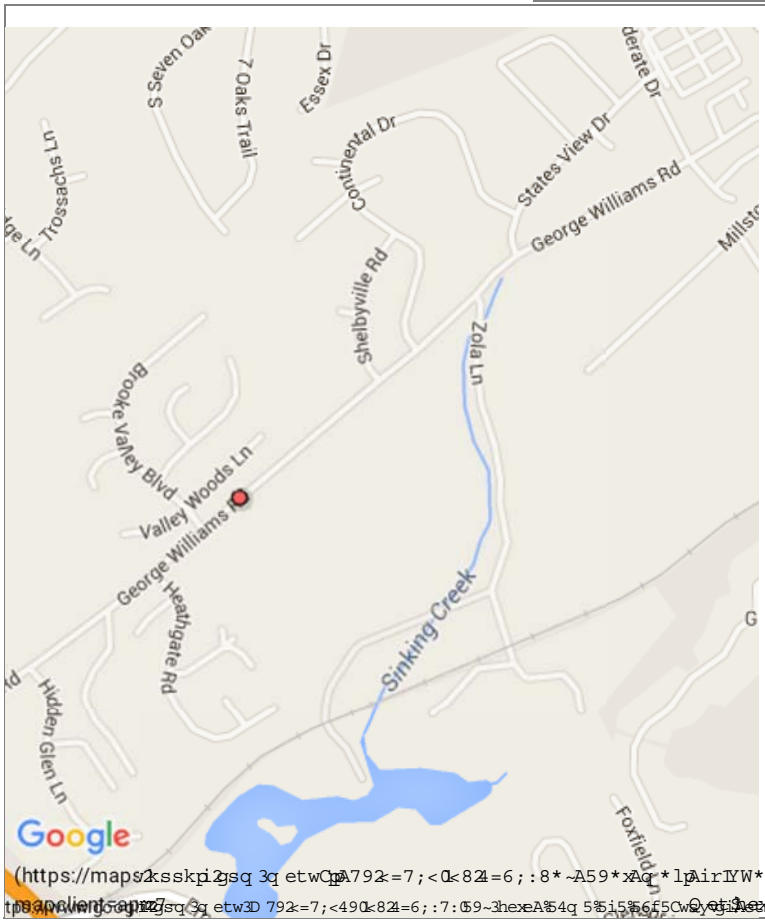
HISTORICAL TRAFFIC COUNT DATA

Traffic History

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

View stations on map: Select a county...

Non-Map Record Search: Knox Station Number: Search



Station Information

Station	000498
Route	05632
Location	GEORGE WILLIAMS DR. - N. OF I-140 SW
County	Knox
2015	2917
2014	2857
2013	2848
2012	2891
2011	2610
2010	2690
2009	NA
2008	NA
2007	NA
2006	NA
2005	NA
2004	NA
2003	NA
2002	NA
2001	NA
2000	NA
1999	NA
1998	NA

Download File:	KML (/Applications/Files/TrfcHist.kmz)	ESRI Geodatabase (/Applications/Files/TrfcHistFGDB.zip)	ESRI Shapefile (/Applications/Files/TrfcHistSHP.zip)	Database Table (/Applications/File/TrfcHistDBF.zip)
Open With:	Google Earth (https://earth.google.com/)	ArcGIS Explorer (http://www.esri.com/software/arcgis/explorer/index.html)		MS Access or Exce

Traffic History

Station #	County	Location	Route #
000498	Knox	GEORGE WILLIAMS DR. - N. OF I-140 SW	05632

Record	Year	AADT
1	2015	2917
2	2014	2857
3	2013	2848
4	2012	2891
5	2011	2610
6	2010	2690

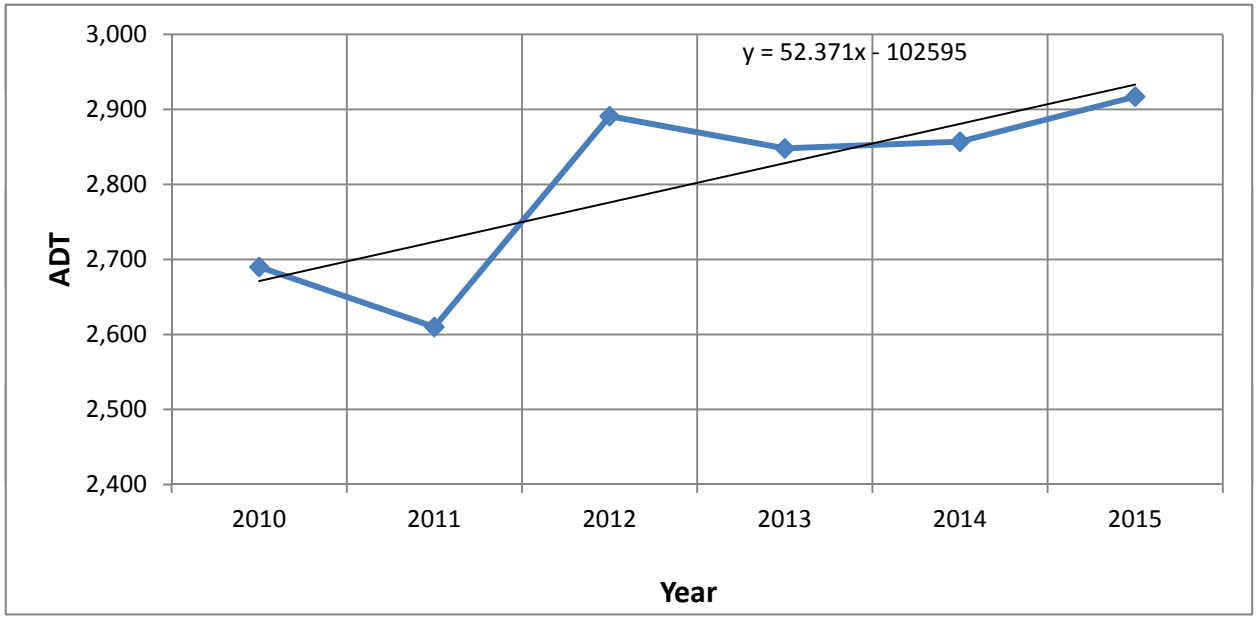
Historical Traffic Counts

Organization: TDOT

Station ID #: 000498

Location: George Williams Road - East of Fox Road

YEAR	ADT	
2010	2,690	Trendline
2011	2,610	
2012	2,891	
2013	2,848	
2014	2,857	
2015	2,917	



2010 - 2015 % Growth = 8.4%

Annual Growth Rate = 1.6%

APPENDIX B

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Millstone Lane (EB-WB) 11/9/2016 (Wednesday)
Minor Street: Freels Lane (NB) Sunny
Traffic Control: None Conducted by: Ajax Engineering

Primary Movement: Vehicles

	Millstone Lane		Freels Lane		Millstone Lane			
TIME	WESTBOUND		NORTHBOUND		EASTBOUND		VEHICLE	PEAK
BEGIN	LT	THRU	LT	RT	THRU	RT	TOTAL	HOUR
7:00 AM	0	2	0	2	0	0	4	
7:15 AM	2	1	0	1	1	0	5	
7:30 AM	0	1	0	1	1	0	3	
7:45 AM	***0***	***0***	***0***	***1***	***1***	***0***	***2***	7:45 AM - 8:45 AM
8:00 AM	***1***	***0***	***0***	***3***	***1***	***0***	***5***	
8:15 AM	***1***	***1***	***0***	***2***	***1***	***0***	***5***	
8:30 AM	***3***	***1***	***0***	***2***	***1***	***0***	***7***	
8:45 AM	0	0	0	2	0	0	2	
TOTAL	7	6	0	14	6	0	33	
2:00 PM	1	0	0	1	1	0	3	
2:15 PM	0	1	0	0	2	0	3	
2:30 PM	0	2	0	0	0	0	2	
2:45 PM	1	2	0	0	2	0	5	
3:00 PM	***1***	***1***	***0***	***0***	***4***	***0***	***6***	3:00 PM - 4:00 PM
3:15 PM	***4***	***2***	***0***	***2***	***0***	***0***	***8***	
3:30 PM	***0***	***1***	***0***	***1***	***1***	***0***	***3***	
3:45 PM	***2***	***1***	***0***	***0***	***2***	***0***	***5***	
4:00 PM	1	0	0	0	1	0	2	
4:15 PM	0	0	0	1	0	0	1	
4:30 PM	1	0	0	2	2	0	5	
4:45 PM	***2***	***0***	***0***	***0***	***0***	***0***	***2***	4:45 PM - 5:45 PM
5:00 PM	***1***	***1***	***0***	***1***	***0***	***1***	***4***	
5:15 PM	***0***	***0***	***0***	***1***	***2***	***0***	***3***	
5:30 PM	***3***	***1***	***0***	***2***	***0***	***0***	***6***	
5:45 PM	1	0	0	0	0	0	1	
TOTAL	18	12	0	11	17	1	59	

2016 AM Peak Hour 7:45 AM - 8:45 AM

TIME	WESTBOUND		NORTHBOUND		EASTBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
7:45 AM	0	0	0	1	1	0
8:00 AM	1	0	0	3	1	0
8:15 AM	1	1	0	2	1	0
8:30 AM	3	1	0	2	1	0
TOTAL	5	2	0	8	4	0
PHF	0.42	0.50	-	0.67	1.00	-

2016 PM School Peak Hour 3:00 PM - 4:00 PM

TIME	WESTBOUND		NORTHBOUND		EASTBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
3:00 PM	1	1	0	0	4	0
3:15 PM	4	2	0	2	0	0
3:30 PM	0	1	0	1	1	0
3:45 PM	2	1	0	0	2	0
TOTAL	7	5	0	3	7	0
PHF	0.44	0.63	-	0.38	0.44	-

2016 PM Peak Hour 4:45 PM - 5:45 PM

TIME	WESTBOUND		NORTHBOUND		EASTBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
4:45 PM	2	0	0	0	0	0
5:00 PM	1	1	0	1	0	1
5:15 PM	0	0	0	1	2	0
5:30 PM	3	1	0	2	0	0
TOTAL	6	2	0	4	2	1
PHF	0.50	0.50	-	0.50	0.25	0.25

TRAFFIC COUNT DATA

Major Street: George Williams Road (EB-WB) — 11/9/2016 (Wednesday)
Minor Street: Millstone Lane and West Valley Middle School Driveway — Sunny
Traffic Control: Traffic Signal — Conducted by: Ajax Engineering

Primary Movement: Vehicles

	George Williams Road			George Williams Road			W. Valley MS Driveway			Millstone Lane				
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND			VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	TOTAL	HOUR
7:00 AM	16	7	0	8	2	10	0	1	3	3	0	0	50	
7:15 AM	34	27	1	55	2	18	0	10	36	1	0	0	184	
7:30 AM	***40***	***50***	***1***	***86***	***1***	***23***	***0***	***55***	***90***	***2***	***4***	***0***	***352***	7:30 AM - 8:30 AM
7:45 AM	***33***	***82***	***1***	***118***	***1***	***14***	***0***	***48***	***103***	***2***	***1***	***0***	***403***	
8:00 AM	***23***	***64***	***1***	***104***	***2***	***13***	***0***	***56***	***126***	***5***	***1***	***1***	***396***	
8:15 AM	***20***	***18***	***0***	***45***	***2***	***10***	***0***	***31***	***65***	***5***	***0***	***0***	***196***	
8:30 AM	14	4	3	6	1	13	0	0	12	5	0	0	58	
8:45 AM	15	1	0	4	0	17	0	1	5	2	0	0	45	
TOTAL	195	253	7	426	11	118	0	202	440	25	6	1	1684	
2:00 PM	17	5	0	1	1	12	0	2	11	0	2	0	51	
2:15 PM	10	2	0	9	1	15	0	0	4	0	1	0	42	
2:30 PM	12	10	1	10	1	18	0	7	7	0	1	0	67	
2:45 PM	12	5	1	37	2	16	0	2	6	1	1	0	83	
3:00 PM	***18***	***24***	***2***	***45***	***1***	***12***	***0***	***1***	***7***	***1***	***1***	***0***	***112***	3:00 PM - 4:00 PM
3:15 PM	***25***	***5***	***0***	***29***	***8***	***13***	***0***	***3***	***4***	***0***	***6***	***0***	***93***	
3:30 PM	***18***	***19***	***2***	***26***	***2***	***25***	***0***	***37***	***109***	***2***	***6***	***0***	***246***	
3:45 PM	***24***	***13***	***1***	***25***	***2***	***34***	***0***	***30***	***60***	***2***	***2***	***0***	***193***	
4:00 PM	34	2	1	15	2	21	0	10	17	0	1	0	103	
4:15 PM	27	4	1	7	1	22	0	5	10	0	1	0	78	
4:30 PM	24	3	2	6	0	25	0	3	9	3	1	0	76	
4:45 PM	***31***	***9***	***0***	***11***	***2***	***22***	***0***	***0***	***2***	***1***	***3***	***0***	***81***	4:45 PM - 5:45 PM
5:00 PM	***34***	***6***	***2***	***8***	***2***	***26***	***0***	***9***	***21***	***0***	***2***	***0***	***110***	
5:15 PM	***39***	***3***	***1***	***4***	***1***	***37***	***0***	***4***	***7***	***2***	***0***	***0***	***98***	
5:30 PM	***44***	***1***	***4***	***2***	***1***	***25***	***0***	***1***	***0***	***1***	***0***	***0***	***79***	
5:45 PM	30	7	0	3	0	26	1	5	8	0	0	1	81	
TOTAL	399	118	18	238	27	349	1	119	282	13	28	1	1593	

2016 AM Peak Hour 7:30 AM - 8:30 AM

	George Williams Road			George Williams Road			W. Valley MS Driveway			Millstone Lane		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
7:30 AM	40	50	1	86	1	23	0	55	90	2	4	0
7:45 AM	33	82	1	118	1	14	0	48	103	2	1	0
8:00 AM	23	64	1	104	2	13	0	56	126	5	1	1
8:15 AM	20	18	0	45	2	10	0	31	65	5	0	0
TOTAL	116	214	3	353	6	60	0	190	384	14	6	1
PHF	0.73	0.65	0.75	0.75	0.75	0.65	-	0.85	0.76	0.70	0.38	0.25

2016 PM School Peak Hour 3:00 PM - 4:00 PM

	George Williams Road			George Williams Road			W. Valley MS Driveway			Millstone Lane		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
3:00 PM	18	24	2	45	1	12	0	1	7	1	1	0
3:15 PM	25	5	0	29	8	13	0	3	4	0	6	0
3:30 PM	18	19	2	26	2	25	0	37	109	2	6	0
3:45 PM	24	13	1	25	2	34	0	30	60	2	2	0
TOTAL	85	61	5	125	13	84	0	71	180	5	15	0
PHF	0.85	0.64	0.63	0.69	0.41	0.62	-	0.48	0.41	0.63	0.63	-

2016 PM Peak Hour 4:45 PM - 5:45 PM

	George Williams Road			George Williams Road			W. Valley MS Driveway			Millstone Lane		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
4:45 PM	31	9	0	11	2	22	0	0	2	1	3	0
5:00 PM	34	6	2	8	2	26	0	9	21	0	2	0
5:15 PM	39	3	1	4	1	37	0	4	7	2	0	0
5:30 PM	44	1	4	2	1	25	0	1	0	1	0	0
TOTAL	148	19	7	25	6	110	0	14	30	4	5	0
PHF	0.84	0.53	0.44	0.57	0.75	0.74	-	0.39	0.36	0.50	0.42	-

APPENDIX C

KNOX COUNTY SCHOOL SYSTEM INFORMATION EMAILS

From: RICK GRUBB [rick.grubb@knoxschools.org]
Sent: Friday, July 15, 2016 3:39 PM
To: Russ Oaks; ajaxengineering@gmail.com; DOUGLAS DILLINGHAM
Subject: Re: School Information Request for Traffic Study

Mr. Jacks,

There are 135 students residing within the parent responsibility zone (1.5 miles from the point where the students parcel is accessed and the point where the buses unload behind the school). We have no information related to the number of students that walk or bike to and from school.

The student enrollment for the last 5 years at West Valley Middle School is listed below:

2011	1162
2012	1141
2013	1153
2014	1229
2015	1215
2016	1192

The number of students projected to reside within the West Valley Middle School is listed below:

2017	1149
2018	1182
2019	1160
2020	1120

Dr. Rick Grubb
Knox County Schools
Director
Transportation & Enrollment
912 S Gay St
Knoxville, TN 37902
865-594-1532

From: Russ Oaks
Sent: Friday, July 15, 2016 8:32:49 AM
To: RICK GRUBB
Subject: FW: School Information Request for Traffic Study

Rick – can you answer the questions below re: West Valley Middle? Some of it is probably in the Brailsford report.

Russ Oaks
Chief Operating Officer
Knox County Schools
865-594-4488

From: DOUGLAS DILLINGHAM
Sent: Thursday, July 14, 2016 8:31 PM
To: Russ Oaks <russ.oaks@knoxschools.org>
Subject: Fwd: School Information Request for Traffic Study

Russ,

It appears that the majority of the information that Robert is requesting this time probably needs to come from Rick or Justin.

Thanks,
Doug

Douglas L. Dillingham, Director
Facilities and Construction
Knox County Schools
Office 865-594-1558
Cell. 865-740-7118

Begin forwarded message:

> **From:** "Robert Jacks" <ajaxengineering@gmail.com>
> **Date:** July 14, 2016 at 7:25:51 PM EDT
> **To:** "'DOUGLAS DILLINGHAM'" <douglas.dillingham@knoxschools.org>
> **Subject: RE: School Information Request for Traffic Study**
>
> Doug,
>
> You might be on vacation or might have missed this email below from earlier this week, but if you get the chance, I would appreciate it if you could help me out on these questions.
>
> Thanks,
>
> Robert
>
> ---
>
> **From:** Robert Jacks [mailto:ajaxengineering@gmail.com]
> **Sent:** Monday, July 11, 2016 1:54 PM
> **To:** 'DOUGLAS DILLINGHAM'
> **Subject:** RE: School Information Request for Traffic Study

Doug,

Now that I am further in the traffic study, could you help me with these questions as well?

a) Do you know if any of the student population walks to school regularly?
b) Has the enrollment at the school stabilized the past few years? Do you have any enrollment figures from the past few years (5 years)?
c) Outside of the development that I am currently preparing a traffic study for, do you have any expectations of future student growth? Is the school at capacity currently?

Once again, I appreciate your help on this. It really helps me get a grasp on the past and future traffic growth in the area.

Robert

From: DOUGLAS DILLINGHAM [mailto:douglas.dillingham@knoxschools.org]
Sent: Thursday, July 07, 2016 10:32 AM
To: Robert Jacks
Cc: Russ Oaks; DAVID CLAXTON; MELISSA TINDELL
Subject: RE: School Information Request for Traffic Study

Robert,

Thank you for your request. Based on our records, please find the answers to your questions listed below.

a) West Valley Middle School was opened in 1999.
b) The current enrollment is approximately 1200 students.
c) There are 12 busses that operate both morning and afternoon.
d) Ridership records indicate that approximately 425 students ride in the morning and 600 in the afternoon. We also have 4 special education busses that transport 14 students both morning and afternoon.

Please let me know if you have further questions or need additional information.

Thanks,
Doug

Douglas L. Dillingham, Director
Facilities and Construction Department
Knox County Schools
Office: 865-594-1825
Cell: 865-740-7118

From: Robert Jacks [mailto:ajaxengineering@gmail.com]
Sent: Thursday, July 07, 2016 9:45 AM
To: DOUGLAS DILLINGHAM <douglas.dillingham@knoxschools.org>
Subject: School Information Request for Traffic Study

Mr. Dillingham,

As Principal Claxton recommended, I would like to ask you the questions I originally posed to him in regards to West Valley Middle School. Could you assist me in answering these questions? This is being done in preparation of a traffic impact study for a potential subdivision located near West Valley Middle School.

a) The year the school was established (wasn't it around 2000 or so?)
b) The amount of students that are enrolled at West Valley
c) The number of busses that operate at the school in the morning and afternoon
d) Rough estimation of the number of students who ride on the bus versus car pickup

If you need to ask me questions about this request feel free to call or email me.

Thank you,

Robert Jacks, PE

AJAX ENGINEERING, LLC
11812 Black Road
Knoxville, Tennessee 37932
Phone (865) 556-0042
www.ajaxengineeringllc.com

From: DAVID CLAXTON [mailto:david.claxton@knoxschools.org]
Sent: Wednesday, July 06, 2016 5:18 PM
To: Robert Jacks
Cc: DOUGLAS DILLINGHAM; MELISSA TINDELL; BETH HOWARD; ROBIN CURRY
Subject: Re: School Information Request for Traffic Study

Mr. Jacks,

Good day to you and, after some digging, I'm happy to get you connected to the person with KCS that can assist with your questions. Doug DIllingham is the person that can best help. I am copying him on this email, but feel free to contact him directly at your convenience.

Sincerely,

David Claxton

Sent from my iPhone

On Jul 6, 2016, at 9:59 AM, Robert Jacks <ajaxengineering@gmail.com> wrote:

> Mr. Claxton,
>
> I am a local traffic/civil engineer that is currently in the process of developing a traffic impact study for a potential new subdivision located close by to your

school. As part of my study, I would like to include some general information in the report about West Valley Middle School to describe and examine the surrounding area. I have tried locating some general information on the Knox County Schools website, but I have not been able to find any information that I was hoping to find.

If this email and questions should be directed to someone else, please let me know. Specifically, I was hoping to find out the following:

e) The year the school was established (wasn't it around 2000 or so?)
f) The amount of students that are enrolled at West Valley
g) The number of busses that operate at the school in the morning and afternoon
h) Rough estimation of the number of students who ride on the bus versus car pickup

If you could answer these questions, I would greatly appreciate it.

If you need to ask me questions about this request feel free to call or email me.

Thank you,

Robert Jacks, PE

AJAX ENGINEERING, LLC
11812 Black Road
Knoxville, Tennessee 37932
Phone (865) 556-0042
www.ajaxengineeringllc.com

APPENDIX D

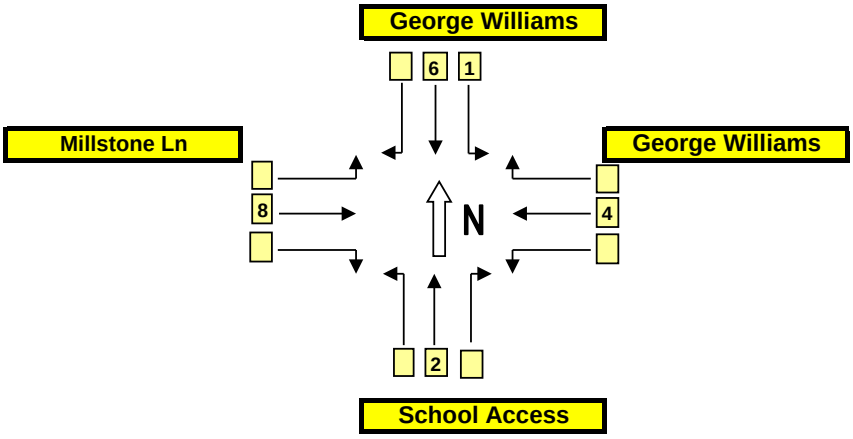
TRAFFIC SIGNAL INFORMATION

LOCAL CONTROLLER PROGRAMMING

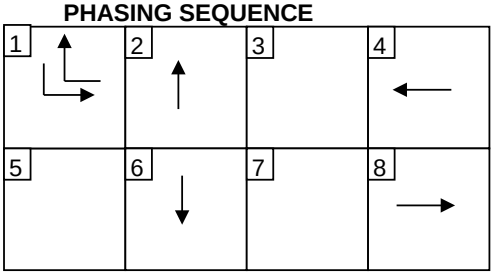
Intersection:	George Williams Rd at Millstone Ln
Timing changed:	2/18/11
Controller type:	Peek 3000

TIME BY PHASE (SEC) & FUNCTIONS

PHASE	1	2	3	4	5	6	7	8
MOVEMENTS	SBLT	NB		WB		SB		EB
INITIAL	8	15		10		15		10
PASSAGE	2.5	3		2.5		3		2.5
YELLOW	4	4		4		4		4
RED CLEAR	1.5	2		1.5		2		1.5
WALK		8		8		8		8
PED CLEAR		12		12		12		12
MAX 1	15	40		40		40		40
MAX 2	0	0		0		0		0
RECALL	MIN					MIN		

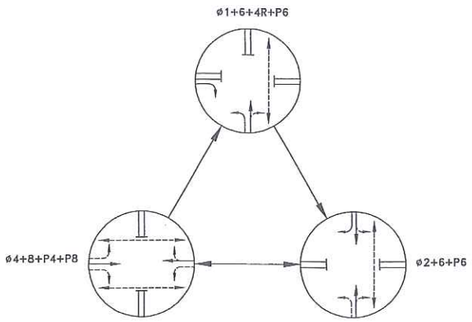


PHASING SEQUENCE



Date:	Initial:	Comment:

PHASING DIAGRAM



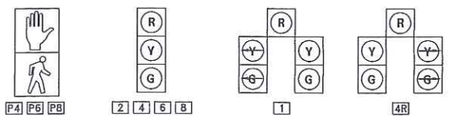
1. ⌐ PERMITTED BUT NOT PROTECTED VEHICULAR MOVEMENT.
2. ALL CLEARANCES SHALL BE IN ACCORDANCE WITH THE MUTCD.
3. FLASHING OPERATION:
   RED BALL FOR ALL HEADS
4. ABILITY TO SKIP PHASES SHALL BE LIMITED AS SHOWN.

INITIAL CONTROLLER TIMING

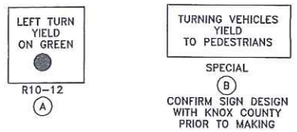
TIMING PHASE	INTERVAL								
	INIT	PASS	YELL	RED CLR	MAX1	MAX2	PED WALK	RED CLR	RECALL
1	8.0	4.0	4.0	1.0	25.0	25.0			MIN.
2	8.0	4.0	4.0	1.0	25.0	25.0			
4	8.0	4.0	4.0	1.0	25.0	25.0	12.0	12.0	
6	8.0	4.0	4.0	1.0	25.0	25.0	12.0	8.0	MIN.
8	8.0	4.0	4.0	1.0	25.0	25.0	12.0	12.0	

1. UTILIZE DUAL ENTRY FUNCTION FOR ALL PHASES.
2. OTHER REQUIRED CONTROLLER FUNCTIONS AND SETTINGS SHALL BE APPROPRIATE VALUES AS RECOMMENDED BY THE CONTROLLER MANUFACTURER.

SIGNAL HEAD DETAILS



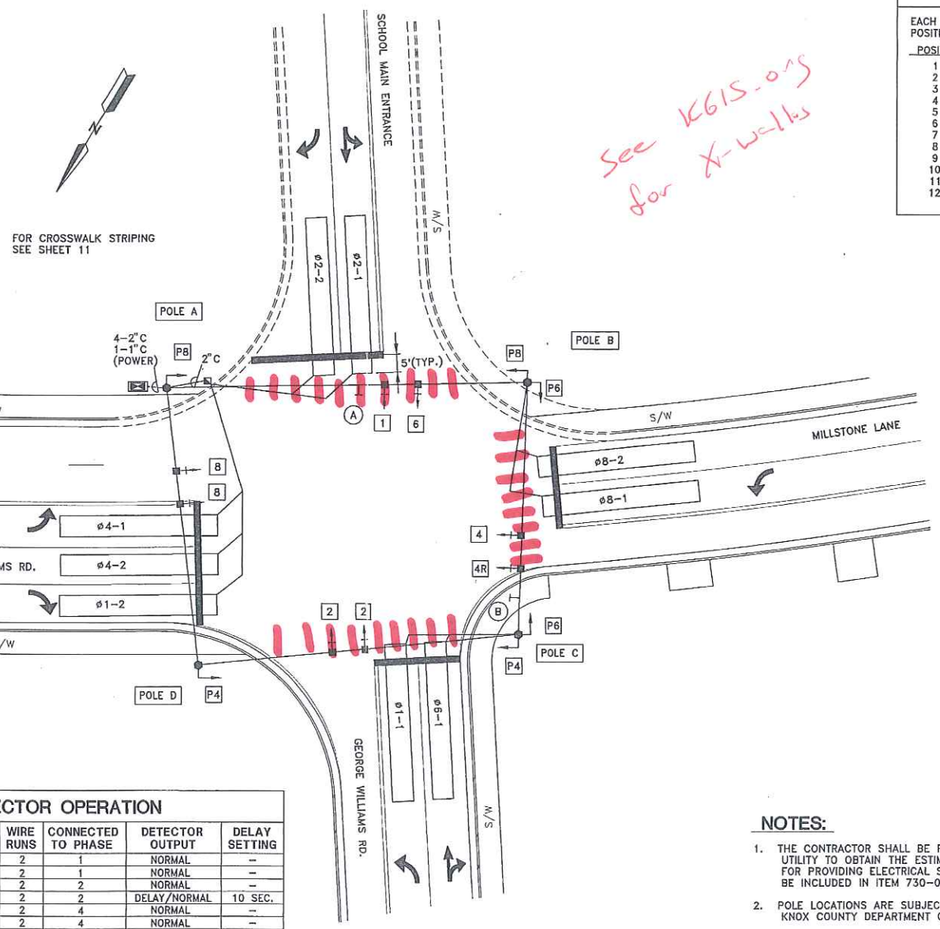
SIGN DETAILS



SPAN AND POLE DATA

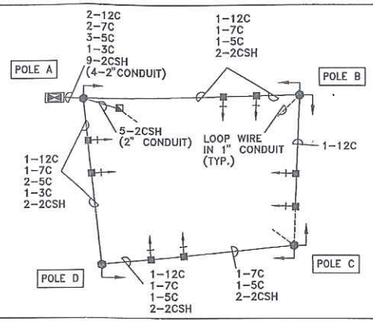
SPAN	POINT OF ATTACHMENT	POLE	FOOTING DEPTH	STATION	OFFSET	ROAD
A–B	27.5'	A	10'	STA 29+83.54	38.94' LT.	GEORGE WILLIAMS
B–C	26.0'	B	10'	STA 0+48.25	35.88' LT.	MILLSTONE
C–D	27.0'	C	10'	STA 0+39.93	35.66' RT.	MILLSTONE
A–D	26.5'	D	10'	STA 29+91.47	40.40' RT.	GEORGE WILLIAMS

1. POINT OF ATTACHMENT IS ELEVATION DIFFERENCE BETWEEN SPAN TIE-IN POINT ON POLE AND MAXIMUM PAVEMENT ELEVATION UNDER SPAN.
2. ACTUAL POLE PLACEMENT LOCATION MAY VARY FROM THAT SHOWN ON THESE PLANS. THEREFORE SHAFT LENGTH AND LOCATION OF SPAN TIE-IN POINT MAY ALSO VARY DEPENDING ON THE GROUND ELEVATION AT THE ACTUAL POLE PLACEMENT LOCATION. THE CONTRACTOR SHALL DETERMINE GROUND LINE ELEVATIONS, REQUIRED SHAFT LENGTHS AND REQUIRED LOCATIONS OF SPAN TIE-IN POINT PRIOR TO ORDERING POLES.
3. POLE MOMENT CAPACITY FOR ALL POLES SHALL BE MINIMUM 180,000 FT-LBS.
4. SPAN WIRE SUPPORT CABLE SHALL PROVIDE MINIMUM BREAKING STRENGTH OF 8000 LBS.



See KGIS.org for X-walks

WIRING DIAGRAM



EACH SIGNAL HEAD ASSEMBLY SHALL BE SUPPLIED WITH A 12 POSITION QUICK DISCONNECT HANGER WIRED AS FOLLOWS:

POSITION	CONDUCTOR COLOR	PHASE INDICATION
1	GREEN	ø2 OR ø6 GREEN BALL
2	ORANGE	ø2 OR ø6 YELLOW BALL
3	RED	ø2 OR ø6 RED BALL
4	BLUE	ø4 OR ø8 GREEN BALL OR SPARE
5	WHITE/BLACK	ø4 OR ø8 YELLOW BALL OR SPARE
6	BLACK	ø4 OR ø8 RED BALL OR SPARE
7	GREEN/BLACK	SPARE
8	ORANGE/BLACK	SPARE
9	RED/BLACK	SPARE
10	BLUE/BLACK	ø1/ø4R GREEN ARROW OR SPARE
11	BLACK/WHITE	ø1/ø4R YELLOW ARROW OR SPARE
12	WHITE	A.C. NEUTRAL

VEHICLE DETECTOR OPERATION

UNIT NO.	CONNECTED TO LOOP	LOOP SIZE	WIRE RUNS	CONNECTED TO PHASE	DETECTOR OUTPUT	DELAY SETTING
1	ø1-1	6' X 45'	2	1	NORMAL	–
2	ø1-2	6' X 45'	2	1	NORMAL	–
3	ø2-1	6' X 45'	2	2	NORMAL	–
4	ø2-2	6' X 45'	2	2	DELAY/NORMAL	10 SEC.
5	ø4-1	6' X 45'	2	4	NORMAL	–
6	ø4-2	6' X 45'	2	4	NORMAL	–
7	ø6-1	6' X 45'	2	6	NORMAL	–
8	ø8-1	6' X 45'	2	8	NORMAL	–
9	ø8-2	6' X 45'	2	8	NORMAL	–

1. ALL DETECTOR UNITS SHALL OPERATE IN CONTINUOUS-PRESENCE MODE.
2. DETECTOR UNITS WITH OUTPUT SPECIFIED AS DELAY/NORMAL SHALL HAVE A TIME-DELAYED OUTPUT, EXCEPT DURING ASSOCIATED PHASE GREEN WHEN OUTPUT SHALL BE NORMAL. DELAY SETTINGS SHALL BE AS SPECIFIED.

SIGNALIZATION LEGEND

ALL PROPOSED, NO EXISTING.

- STEEL STRAIN POLE
- CONTROLLER & CABINET (PAD MOUNT)
- 4 — SIGNAL HEAD WITH BACKPLATE AND ASSOCIATED PHASE
- ø1-1 — STOP BAR LOOP DETECTOR WITH LEAD-IN AND ASSOCIATED PHASE
- ø6-2 — ADVANCE LOOP DETECTOR WITH LEAD-IN ASSOCIATED PHASE
- PULLBOX
- ----1"C---- UNDERGROUND CONDUIT SIZED AS INDICATED

NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING THE LOCAL UTILITY TO OBTAIN THE ESTIMATE FOR ANY CHARGES BY THE UTILITY FOR PROVIDING ELECTRICAL SERVICE TO THE CONTROLLER. COST TO BE INCLUDED IN ITEM 730-05.01.
2. POLE LOCATIONS ARE SUBJECT TO MINOR CHANGES AS APPROVED BY THE KNOX COUNTY DEPARTMENT OF ENGINEERING AND PUBLIC WORKS.
3. SIGNS W3-3 SHALL BE INSTALLED ON ALL PUBLIC STREET APPROACHES AS INDICATED ON SHEET 11. THEY SHALL BE INSTALLED PRIOR TO THE ACTIVATION OF THE TRAFFIC SIGNAL TO STOP AND GO OPERATION
4. REMOVE THE EXISTING STOP SIGN ON MILLSTONE LANE IMMEDIATELY AFTER ACTIVATION OF THE TRAFFIC SIGNAL TO STOP AND GO OPERATION.
5. SEE SHEET 2C FOR SIGNALIZATION GENERAL NOTES.

ALLEN & HOSHALL

Established 1915

Architects Engineers

9950 Kingston Pike
Suite 300
Knoxville, TN 37922

Telephone 423-693-7881
Facsimile 423-693-7824

No.	Revision	Date

ALAN L. CHILDERS REGISTERED ENGINEER AGRICULTURE CIVIL No. 18835 STATE OF TENNESSEE 6.2.97

GEORGE WILLIAMS ROAD IMPROVEMENTS

KNOX COUNTY, TENNESSEE

TRAFFIC SIGNAL PLAN

Drawn: JWS. Checked: ALC. Date: 5-30-97
Job No.: K13453023 SCALE: 1" = 20'

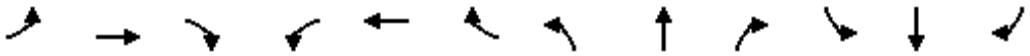
APPENDIX E

CAPACITY ANALYSES - HCM WORKSHEETS (SYNCHRO 8)

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	4	0	5	2	0	8
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	0.92	0.42	0.50	0.92	0.67
Hourly flow rate (vph)	4	0	12	4	0	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			4		32	4
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			4		32	4
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1631		980	1085

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	4	16	12
Volume Left	0	12	0
Volume Right	0	0	12
cSH	1700	1631	1085
Volume to Capacity	0.00	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	5.4	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	5.4	8.4
Approach LOS			A

Intersection Summary			
Average Delay	5.8		
Intersection Capacity Utilization	14.5%	ICU Level of Service	A
Analysis Period (min)	15		



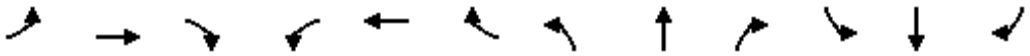
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	6	1	353	6	60	0	190	384	116	214	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85		1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1843		1805	1900	1615		1872	1591	1778	1868	
Flt Permitted	0.75	1.00		0.74	1.00	1.00		1.00	1.00	0.42	1.00	
Satd. Flow (perm)	1430	1843		1414	1900	1615		1872	1591	779	1868	
Peak-hour factor, PHF	0.70	0.38	0.25	0.75	0.75	0.65	0.92	0.85	0.76	0.73	0.65	0.75
Adj. Flow (vph)	20	16	4	471	8	92	0	224	505	159	329	4
RTOR Reduction (vph)	0	2	0	0	0	43	0	0	386	0	1	0
Lane Group Flow (vph)	20	18	0	471	8	49	0	224	119	159	332	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	29.7	29.7		29.7	29.7	38.7		17.2	17.2	31.7	31.7	
Effective Green, g (s)	29.7	29.7		29.7	29.7	38.7		17.2	17.2	31.7	31.7	
Actuated g/C Ratio	0.41	0.41		0.41	0.41	0.53		0.24	0.24	0.43	0.43	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	582	750		576	774	979		441	375	462	812	
v/s Ratio Prot		0.01			0.00	0.01		c0.12		0.04	c0.18	
v/s Ratio Perm	0.01			c0.33		0.02			0.07	0.11		
v/c Ratio	0.03	0.02		0.82	0.01	0.05		0.51	0.32	0.34	0.41	
Uniform Delay, d1	13.0	12.9		19.2	12.9	8.2		24.2	23.0	13.2	14.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0		8.6	0.0	0.0		0.9	0.5	0.3	0.3	
Delay (s)	13.0	12.9		27.8	12.9	8.3		25.1	23.5	13.5	14.5	
Level of Service	B	B		C	B	A		C	C	B	B	
Approach Delay (s)		13.0			24.4			24.0			14.2	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	21.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	72.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	2	1	6	2	0	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.25	0.50	0.50	0.92	0.50
Hourly flow rate (vph)	8	4	12	4	0	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			12		38	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			12		38	10
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1620		972	1077

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	16	8
Volume Left	0	12	0
Volume Right	4	0	8
cSH	1700	1620	1077
Volume to Capacity	0.01	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	5.4	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	5.4	8.4
Approach LOS			A

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	15.3%	ICU Level of Service	A
Analysis Period (min)	15		



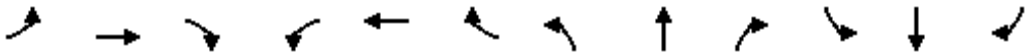
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	5	0	25	6	110	0	14	30	148	19	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900		1805	1900	1615		1872	1591	1778	1785	
Flt Permitted	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.45	1.00	
Satd. Flow (perm)	1900	1900		1900	1900	1615		1872	1591	834	1785	
Peak-hour factor, PHF	0.50	0.42	0.92	0.57	0.75	0.74	0.92	0.39	0.36	0.84	0.53	0.44
Adj. Flow (vph)	8	12	0	44	8	149	0	36	83	176	36	16
RTOR Reduction (vph)	0	0	0	0	0	80	0	0	68	0	5	0
Lane Group Flow (vph)	8	12	0	44	8	69	0	36	15	176	47	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	3.3	3.3		3.3	3.3	22.1		8.5	8.5	32.8	32.8	
Effective Green, g (s)	3.3	3.3		3.3	3.3	22.1		8.5	8.5	32.8	32.8	
Actuated g/C Ratio	0.07	0.07		0.07	0.07	0.46		0.18	0.18	0.69	0.69	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	131	131		131	131	936		334	284	947	1230	
v/s Ratio Prot		0.01			0.00	0.03		0.02		c0.07	0.03	
v/s Ratio Perm	0.00			c0.02		0.01			0.01	c0.05		
v/c Ratio	0.06	0.09		0.34	0.06	0.07		0.11	0.05	0.19	0.04	
Uniform Delay, d1	20.7	20.7		21.1	20.7	7.1		16.4	16.2	2.9	2.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.2		1.1	0.1	0.0		0.1	0.1	0.1	0.0	
Delay (s)	20.8	21.0		22.2	20.8	7.1		16.5	16.3	3.0	2.4	
Level of Service	C	C		C	C	A		B	B	A	A	
Approach Delay (s)		20.9			11.0			16.4			2.8	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	7	0	7	5	0	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.44	0.92	0.44	0.63	0.92	0.38
Hourly flow rate (vph)	16	0	16	8	0	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			16		56	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			16		56	16
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1615		948	1069

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	16	24	8
Volume Left	0	16	0
Volume Right	0	0	8
cSH	1700	1615	1069
Volume to Capacity	0.01	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	4.9	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	4.9	8.4
Approach LOS			A

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	16.5%	ICU Level of Service	A
Analysis Period (min)	15		



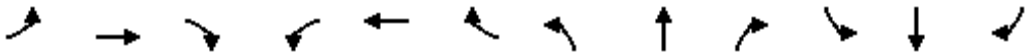
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	15	0	125	13	84	0	71	180	85	61	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900		1805	1900	1615		1872	1591	1778	1850	
Flt Permitted	0.74	1.00		0.74	1.00	1.00		1.00	1.00	0.49	1.00	
Satd. Flow (perm)	1399	1900		1409	1900	1615		1872	1591	911	1850	
Peak-hour factor, PHF	0.63	0.63	0.92	0.69	0.41	0.62	0.92	0.48	0.41	0.85	0.64	0.63
Adj. Flow (vph)	8	24	0	181	32	135	0	148	439	100	95	8
RTOR Reduction (vph)	0	0	0	0	0	83	0	0	312	0	3	0
Lane Group Flow (vph)	8	24	0	181	32	52	0	148	127	100	100	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	12.2	12.2		12.2	12.2	20.3		15.2	15.2	28.8	28.8	
Effective Green, g (s)	12.2	12.2		12.2	12.2	20.3		15.2	15.2	28.8	28.8	
Actuated g/C Ratio	0.23	0.23		0.23	0.23	0.39		0.29	0.29	0.55	0.55	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	325	441		327	441	793		541	460	633	1014	
v/s Ratio Prot		0.01			0.02	0.01		0.08		c0.02	0.05	
v/s Ratio Perm	0.01			c0.13		0.02			c0.08	0.06		
v/c Ratio	0.02	0.05		0.55	0.07	0.07		0.27	0.28	0.16	0.10	
Uniform Delay, d1	15.6	15.7		17.8	15.7	10.1		14.4	14.4	6.0	5.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0		1.6	0.1	0.0		0.3	0.3	0.1	0.0	
Delay (s)	15.6	15.7		19.4	15.8	10.2		14.7	14.7	6.1	5.7	
Level of Service	B	B		B	B	B		B	B	A	A	
Approach Delay (s)		15.7			15.5			14.7			5.9	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	52.5	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	5	0	6	2	0	9
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	0.92	0.42	0.50	0.92	0.67
Hourly flow rate (vph)	5	0	14	4	0	13
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			5		38	5
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			5		38	5
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1630		971	1084

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	5	18	13
Volume Left	0	14	0
Volume Right	0	0	13
cSH	1700	1630	1084
Volume to Capacity	0.00	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	5.7	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	5.7	8.4
Approach LOS			A

Intersection Summary			
Average Delay		5.9	
Intersection Capacity Utilization		15.3%	ICU Level of Service A
Analysis Period (min)		15	



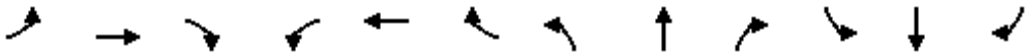
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	7	1	353	7	69	0	190	384	133	214	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85		1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1848		1805	1900	1615		1872	1591	1778	1868	
Flt Permitted	0.75	1.00		0.74	1.00	1.00		1.00	1.00	0.42	1.00	
Satd. Flow (perm)	1428	1848		1412	1900	1615		1872	1591	777	1868	
Peak-hour factor, PHF	0.70	0.38	0.25	0.75	0.75	0.65	0.92	0.85	0.76	0.73	0.65	0.75
Adj. Flow (vph)	23	18	4	471	9	106	0	224	505	182	329	4
RTOR Reduction (vph)	0	2	0	0	0	50	0	0	386	0	1	0
Lane Group Flow (vph)	23	20	0	471	9	56	0	224	119	182	332	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	29.9	29.9		29.9	29.9	39.0		17.2	17.2	31.8	31.8	
Effective Green, g (s)	29.9	29.9		29.9	29.9	39.0		17.2	17.2	31.8	31.8	
Actuated g/C Ratio	0.41	0.41		0.41	0.41	0.53		0.23	0.23	0.43	0.43	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	583	754		576	776	981		439	373	461	811	
v/s Ratio Prot		0.01			0.00	0.01		c0.12		0.05	c0.18	
v/s Ratio Perm	0.02			c0.33		0.03			0.07	0.12		
v/c Ratio	0.04	0.03		0.82	0.01	0.06		0.51	0.32	0.39	0.41	
Uniform Delay, d1	13.0	12.9		19.2	12.9	8.2		24.3	23.2	13.5	14.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0		8.6	0.0	0.0		1.0	0.5	0.4	0.3	
Delay (s)	13.0	13.0		27.8	12.9	8.3		25.3	23.6	13.9	14.6	
Level of Service	B	B		C	B	A		C	C	B	B	
Approach Delay (s)		13.0			24.1			24.2			14.3	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	21.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	73.2	Sum of lost time (s)	17.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	2	1	7	2	0	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.25	0.50	0.50	0.92	0.50
Hourly flow rate (vph)	8	4	14	4	0	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			12		42	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			12		42	10
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1620		966	1077

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	18	10
Volume Left	0	14	0
Volume Right	4	0	10
cSH	1700	1620	1077
Volume to Capacity	0.01	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	5.6	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	5.6	8.4
Approach LOS			A

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	16.2%	ICU Level of Service	A
Analysis Period (min)	15		



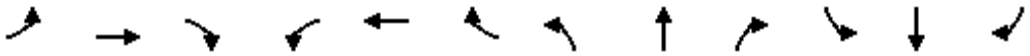
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	6	0	25	7	127	0	14	30	170	19	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900		1805	1900	1615		1872	1591	1778	1778	
Flt Permitted	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.45	1.00	
Satd. Flow (perm)	1900	1900		1900	1900	1615		1872	1591	834	1778	
Peak-hour factor, PHF	0.50	0.42	0.92	0.57	0.75	0.74	0.92	0.39	0.36	0.84	0.53	0.44
Adj. Flow (vph)	10	14	0	44	9	172	0	36	83	202	36	18
RTOR Reduction (vph)	0	0	0	0	0	92	0	0	68	0	6	0
Lane Group Flow (vph)	10	14	0	44	9	80	0	36	15	202	48	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	3.3	3.3		3.3	3.3	22.3		8.5	8.5	33.0	33.0	
Effective Green, g (s)	3.3	3.3		3.3	3.3	22.3		8.5	8.5	33.0	33.0	
Actuated g/C Ratio	0.07	0.07		0.07	0.07	0.47		0.18	0.18	0.69	0.69	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	131	131		131	131	939		332	282	951	1227	
v/s Ratio Prot		0.01			0.00	0.03		0.02		c0.08	0.03	
v/s Ratio Perm	0.01			c0.02		0.02			0.01	c0.06		
v/c Ratio	0.08	0.11		0.34	0.07	0.09		0.11	0.05	0.21	0.04	
Uniform Delay, d1	20.8	20.9		21.2	20.8	7.1		16.5	16.3	3.0	2.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.3		1.1	0.2	0.0		0.1	0.1	0.1	0.0	
Delay (s)	21.0	21.1		22.3	21.0	7.1		16.6	16.4	3.0	2.4	
Level of Service	C	C		C	C	A		B	B	A	A	
Approach Delay (s)		21.1			10.6			16.5			2.9	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	9.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	47.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	8	0	8	6	0	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.44	0.92	0.44	0.63	0.92	0.38
Hourly flow rate (vph)	18	0	18	10	0	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			18		64	18
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			18		64	18
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1612		936	1066

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	18	28	8
Volume Left	0	18	0
Volume Right	0	0	8
cSH	1700	1612	1066
Volume to Capacity	0.01	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	4.8	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	4.8	8.4
Approach LOS			A

Intersection Summary			
Average Delay		3.7	
Intersection Capacity Utilization		17.4%	ICU Level of Service A
Analysis Period (min)		15	



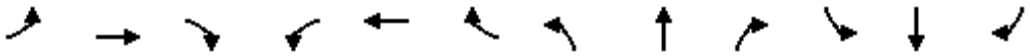
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	17	0	125	15	97	0	71	180	98	61	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900		1805	1900	1615		1872	1591	1778	1845	
Flt Permitted	0.73	1.00		0.74	1.00	1.00		1.00	1.00	0.49	1.00	
Satd. Flow (perm)	1393	1900		1405	1900	1615		1872	1591	911	1845	
Peak-hour factor, PHF	0.63	0.63	0.92	0.69	0.41	0.62	0.92	0.48	0.41	0.85	0.64	0.63
Adj. Flow (vph)	10	27	0	181	37	156	0	148	439	115	95	10
RTOR Reduction (vph)	0	0	0	0	0	95	0	0	312	0	4	0
Lane Group Flow (vph)	10	27	0	181	37	61	0	148	127	115	101	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov		NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	12.2	12.2		12.2	12.2	20.4		15.2	15.2	28.9	28.9	
Effective Green, g (s)	12.2	12.2		12.2	12.2	20.4		15.2	15.2	28.9	28.9	
Actuated g/C Ratio	0.23	0.23		0.23	0.23	0.39		0.29	0.29	0.55	0.55	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	323	440		325	440	795		540	459	635	1013	
v/s Ratio Prot		0.01			0.02	0.01		0.08		c0.03	0.05	
v/s Ratio Perm	0.01			c0.13		0.03			c0.08	0.07		
v/c Ratio	0.03	0.06		0.56	0.08	0.08		0.27	0.28	0.18	0.10	
Uniform Delay, d1	15.6	15.7		17.8	15.8	10.2		14.4	14.5	6.0	5.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0		1.7	0.1	0.0		0.3	0.3	0.1	0.0	
Delay (s)	15.7	15.8		19.5	15.9	10.2		14.7	14.8	6.1	5.7	
Level of Service	B	B		B	B	B		B	B	A	A	
Approach Delay (s)		15.7			15.2			14.8			5.9	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	13.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	52.6	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	84	0	6	28	0	9
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	0.92	0.42	0.50	0.92	0.67
Hourly flow rate (vph)	84	0	14	56	0	13
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			84		169	84
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			84		169	84
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1526		819	981

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	84	70	13
Volume Left	0	14	0
Volume Right	0	0	13
cSH	1700	1526	981
Volume to Capacity	0.05	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	1.6	8.7
Lane LOS		A	A
Approach Delay (s)	0.0	1.6	8.7
Approach LOS			A

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	62	4	353	25	69	1	190	384	133	214	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1875		1805	1900	1615		1871	1591	1778	1861	
Flt Permitted	0.74	1.00		0.64	1.00	1.00		1.00	1.00	0.39	1.00	
Satd. Flow (perm)	1398	1875		1224	1900	1615		1868	1591	738	1861	
Peak-hour factor, PHF	0.70	0.38	0.25	0.75	0.75	0.65	0.92	0.85	0.76	0.73	0.65	0.75
Adj. Flow (vph)	51	163	16	471	33	106	1	224	505	182	329	13
RTOR Reduction (vph)	0	3	0	0	0	46	0	0	394	0	2	0
Lane Group Flow (vph)	51	176	0	471	33	60	0	225	111	182	340	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	34.6	34.6		34.6	34.6	43.7		17.1	17.1	31.7	31.7	
Effective Green, g (s)	34.6	34.6		34.6	34.6	43.7		17.1	17.1	31.7	31.7	
Actuated g/C Ratio	0.44	0.44		0.44	0.44	0.56		0.22	0.22	0.41	0.41	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	621	833		544	844	1021		410	349	422	758	
v/s Ratio Prot		0.09			0.02	0.01				0.05	c0.18	
v/s Ratio Perm	0.04			c0.38		0.03		c0.12	0.07	0.13		
v/c Ratio	0.08	0.21		0.87	0.04	0.06		0.55	0.32	0.43	0.45	
Uniform Delay, d1	12.4	13.2		19.5	12.2	7.7		26.9	25.5	15.7	16.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.1		13.4	0.0	0.0		1.5	0.5	0.5	0.4	
Delay (s)	12.5	13.3		32.9	12.2	7.7		28.4	26.0	16.2	17.1	
Level of Service	B	B		C	B	A		C	C	B	B	
Approach Delay (s)		13.1			27.4			26.7			16.8	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	77.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	5	0	26	2	0	79
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	28	2	0	86
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				878		
pX, platoon unblocked						
vC, conflicting volume			5		64	5
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			5		64	5
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		100	92
cM capacity (veh/h)			1616		925	1078

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	5	30	86
Volume Left	0	28	0
Volume Right	0	0	86
cSH	1700	1616	1078
Volume to Capacity	0.00	0.02	0.08
Queue Length 95th (ft)	0	1	6
Control Delay (s)	0.0	6.8	8.6
Lane LOS		A	A
Approach Delay (s)	0.0	6.8	8.6
Approach LOS			A

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	19.8%	ICU Level of Service	A
Analysis Period (min)	15		

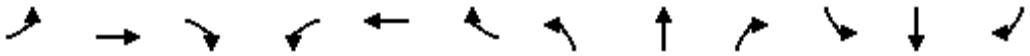
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	53	1	7	90	0	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.25	0.50	0.50	0.92	0.50
Hourly flow rate (vph)	212	4	14	180	0	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			216		422	214
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			216		422	214
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1366		586	831

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	216	194	10
Volume Left	0	14	0
Volume Right	4	0	10
cSH	1700	1366	831
Volume to Capacity	0.13	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	0.6	9.4
Lane LOS		A	A
Approach Delay (s)	0.0	0.6	9.4
Approach LOS			A

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		20.5%	ICU Level of Service
Analysis Period (min)		15	

HCM Signalized Intersection Capacity Analysis
3: W. Valley MS Driveway & Millstone Lane & George Williams Road

11/11/2016



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	42	2	25	69	127	4	14	30	170	19	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1894		1805	1900	1615		1862	1591	1778	1688	
Flt Permitted	0.70	1.00		0.69	1.00	1.00		0.97	1.00	0.49	1.00	
Satd. Flow (perm)	1325	1894		1313	1900	1615		1808	1591	920	1688	
Peak-hour factor, PHF	0.50	0.42	0.92	0.57	0.75	0.74	0.92	0.39	0.36	0.84	0.53	0.44
Adj. Flow (vph)	36	100	2	44	92	172	4	36	83	202	36	68
RTOR Reduction (vph)	0	1	0	0	0	97	0	0	64	0	26	0
Lane Group Flow (vph)	36	101	0	44	92	75	0	40	19	202	78	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	7.5	7.5		7.5	7.5	21.9		11.3	11.3	31.2	31.2	
Effective Green, g (s)	7.5	7.5		7.5	7.5	21.9		11.3	11.3	31.2	31.2	
Actuated g/C Ratio	0.15	0.15		0.15	0.15	0.44		0.23	0.23	0.62	0.62	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	197	282		196	283	881		406	358	817	1049	
v/s Ratio Prot		c0.05			0.05	0.02				c0.07	0.05	
v/s Ratio Perm	0.03			0.03		0.02		0.02	0.01	c0.08		
v/c Ratio	0.18	0.36		0.22	0.33	0.09		0.10	0.05	0.25	0.07	
Uniform Delay, d1	18.7	19.2		18.8	19.1	8.3		15.4	15.3	4.4	3.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.6		0.4	0.5	0.0		0.1	0.1	0.1	0.0	
Delay (s)	19.0	19.8		19.2	19.6	8.3		15.5	15.3	4.5	3.8	
Level of Service	B	B		B	B	A		B	B	A	A	
Approach Delay (s)		19.6			13.2			15.4			4.3	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	50.2	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	2	0	88	2	0	51
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	96	2	0	55
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				878		
pX, platoon unblocked						
vC, conflicting volume			2		196	2
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		196	2
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		100	95
cM capacity (veh/h)			1620		746	1082

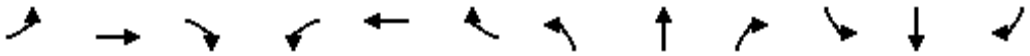
Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	2	98	55
Volume Left	0	96	0
Volume Right	0	0	55
cSH	1700	1620	1082
Volume to Capacity	0.00	0.06	0.05
Queue Length 95th (ft)	0	5	4
Control Delay (s)	0.0	7.2	8.5
Lane LOS		A	A
Approach Delay (s)	0.0	7.2	8.5
Approach LOS			A

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	21.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	134	0	8	132	0	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.44	0.92	0.44	0.63	0.92	0.38
Hourly flow rate (vph)	305	0	18	210	0	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				679		
pX, platoon unblocked						
vC, conflicting volume			305		550	305
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			305		550	305
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1268		492	740

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	305	228	8
Volume Left	0	18	0
Volume Right	0	0	8
cSH	1700	1268	740
Volume to Capacity	0.18	0.01	0.01
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	0.7	9.9
Lane LOS		A	A
Approach Delay (s)	0.0	0.7	9.9
Approach LOS			A

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		23.5%	ICU Level of Service
Analysis Period (min)		15	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	101	52	125	99	97	42	71	180	98	61	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			3%			3%	
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85		1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1825		1805	1900	1615		1850	1591	1778	1845	
Flt Permitted	0.57	1.00		0.61	1.00	1.00		0.90	1.00	0.47	1.00	
Satd. Flow (perm)	1085	1825		1168	1900	1615		1686	1591	885	1845	
Peak-hour factor, PHF	0.63	0.63	0.92	0.69	0.41	0.62	0.92	0.48	0.41	0.85	0.64	0.63
Adj. Flow (vph)	10	160	57	181	241	156	46	148	439	115	95	10
RTOR Reduction (vph)	0	16	0	0	0	92	0	0	313	0	4	0
Lane Group Flow (vph)	10	201	0	181	241	64	0	194	126	115	101	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA	Perm	pm+pt	NA	
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2		2	6		
Actuated Green, G (s)	14.5	14.5		14.5	14.5	22.9		16.0	16.0	29.9	29.9	
Effective Green, g (s)	14.5	14.5		14.5	14.5	22.9		16.0	16.0	29.9	29.9	
Actuated g/C Ratio	0.26	0.26		0.26	0.26	0.41		0.29	0.29	0.53	0.53	
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5		6.0	6.0	5.5	6.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5		3.0	3.0	2.5	3.0	
Lane Grp Cap (vph)	281	473		302	492	820		482	455	607	986	
v/s Ratio Prot		0.11			0.13	0.01				c0.03	0.05	
v/s Ratio Perm	0.01			c0.15		0.03		c0.12	0.08	0.07		
v/c Ratio	0.04	0.43		0.60	0.49	0.08		0.40	0.28	0.19	0.10	
Uniform Delay, d1	15.5	17.2		18.2	17.6	10.1		16.1	15.5	6.8	6.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.5		2.7	0.6	0.0		0.6	0.3	0.1	0.0	
Delay (s)	15.5	17.7		20.8	18.1	10.1		16.6	15.8	6.9	6.4	
Level of Service	B	B		C	B	B		B	B	A	A	
Approach Delay (s)		17.6			16.8			16.1			6.7	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	55.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	8	0	126	6	0	126
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	0	137	7	0	137
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				878		
pX, platoon unblocked						
vC, conflicting volume			9		289	9
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			9		289	9
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		100	87
cM capacity (veh/h)			1611		642	1073

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	9	143	137
Volume Left	0	137	0
Volume Right	0	0	137
cSH	1700	1611	1073
Volume to Capacity	0.01	0.08	0.13
Queue Length 95th (ft)	0	7	11
Control Delay (s)	0.0	7.1	8.8
Lane LOS		A	A
Approach Delay (s)	0.0	7.1	8.8
Approach LOS			A

Intersection Summary			
Average Delay	7.7		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX F

ITE TRIP GENERATION RATES

Land Use: 210
Single-Family Detached Housing

Description

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

Additional Data

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

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

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

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

The sites were surveyed between the late 1960s and the 2000s throughout the United States and Canada.

Source Numbers

1, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 19, 20, 21, 26, 34, 35, 36, 38, 40, 71, 72, 84, 91, 98, 100, 105, 108, 110, 114, 117, 119, 157, 167, 177, 187, 192, 207, 211, 246, 275, 283, 293, 300, 319, 320, 357, 384, 435, 550, 552, 579, 598, 601, 603, 611, 614, 637, 711, 735

Single-Family Detached Housing
(210)

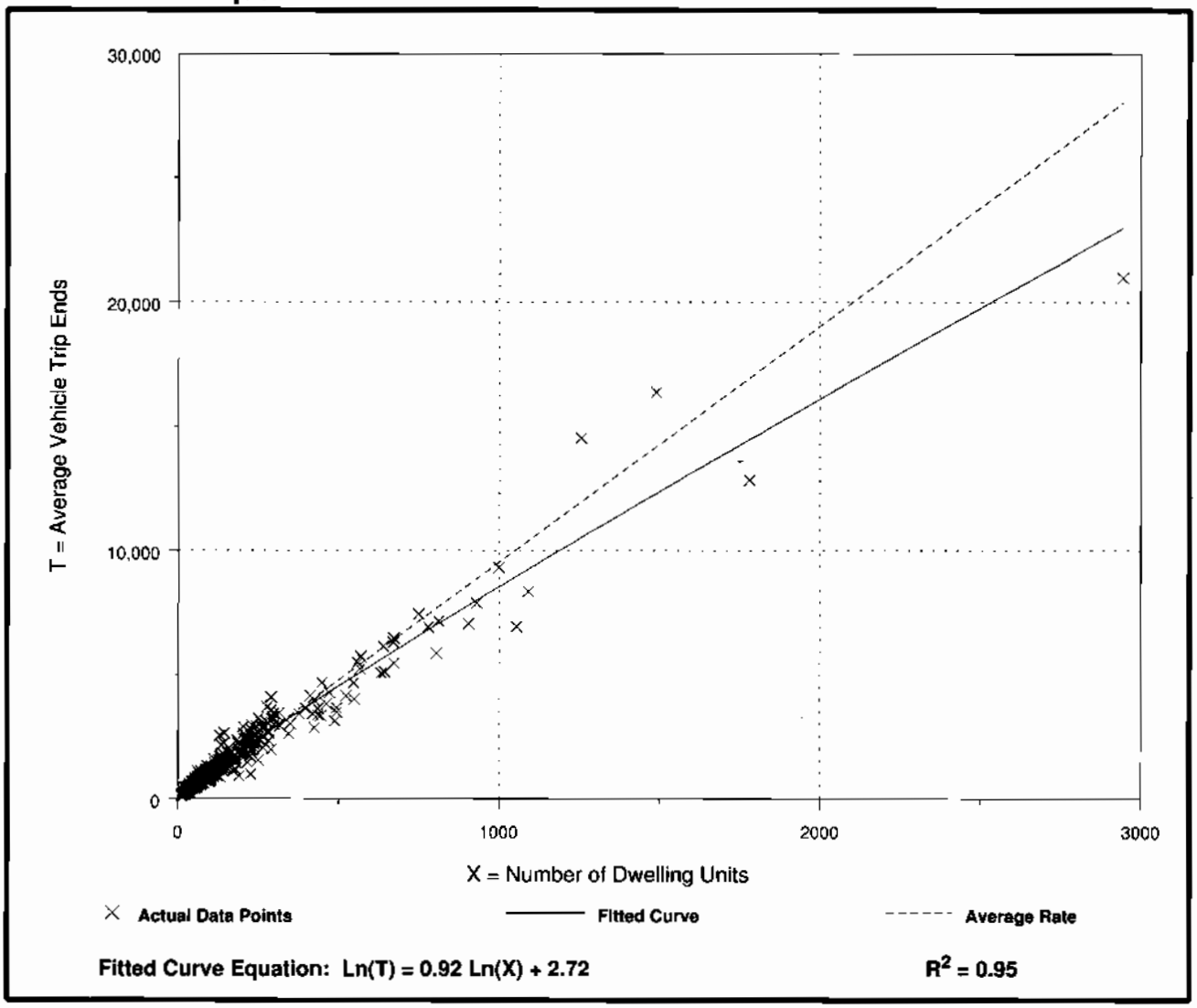
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 355
Avg. Number of Dwelling Units: 198
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.52	4.31 - 21.85	3.70

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.72

R^2 = 0.95

Single-Family Detached Housing
(210)

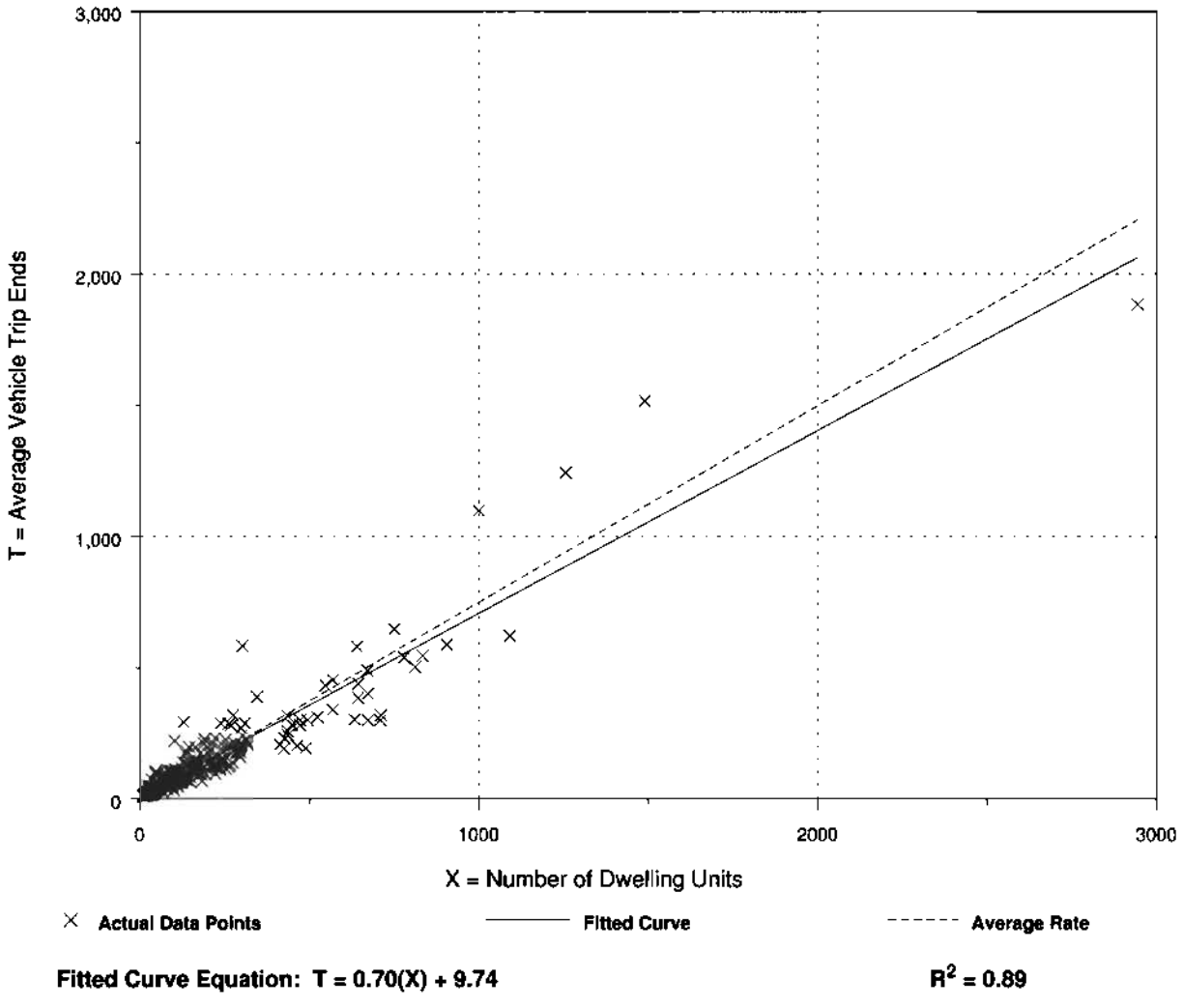
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 292
Avg. Number of Dwelling Units: 194
Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.75	0.33 - 2.27	0.90

Data Plot and Equation



Fitted Curve Equation: T = 0.70(X) + 9.74

R^2 = 0.89

Single-Family Detached Housing
(210)

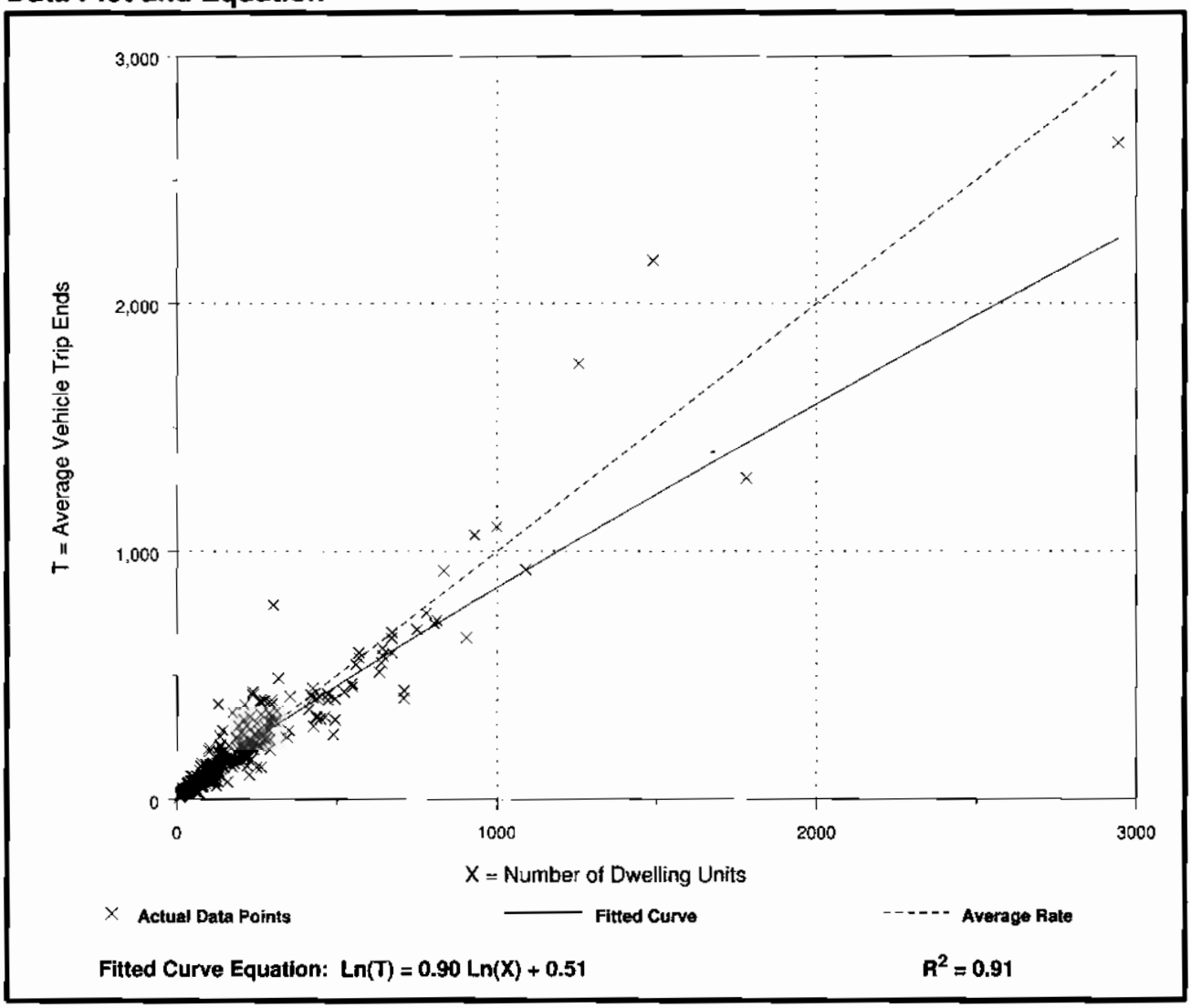
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 321
Avg. Number of Dwelling Units: 207
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.00	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.90 Ln(X) + 0.51

R^2 = 0.91

APPENDIX G

MPC REZONING REPORT

KNOXVILLE/KNOX COUNTY METROPOLITAN PLANNING COMMISSION
REZONING REPORT

FILE #: 7-D-16-RZ **AGENDA ITEM #: 31**

AGENDA DATE: 7/14/2016

APPLICANT: **S & E PROPERTIES**

OWNER(S): Eric Moseley

TAX ID NUMBER: 132 04909, 04917 & 04918 View map on KGIS

JURISDICTION: County Commission District 5

STREET ADDRESS: 825 Freels Ln

LOCATION: **Southeast side Millstone Ln., west side Freels Ln.**

APPX. SIZE OF TRACT: **40.34 acres**

SECTOR PLAN: Southwest County

GROWTH POLICY PLAN: Planned Growth Area

ACCESSIBILITY: Access is via Millstone Ln., a local street with 13-35' of pavement width within 40-45' of right-of-way, and Freels Ln., a local street with 14' of pavement within 40-50' of right-of-way.

UTILITIES: Water Source: First Knox Utility District

Sewer Source: First Knox Utility District

WATERSHED: Sinking Creek and Ten Mile Creek

PRESENT ZONING: **A (Agricultural)**

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

EXISTING LAND USE: **Residence and vacant land**

PROPOSED USE: **Residential development**

DENSITY PROPOSED: **5 du/ac**

EXTENSION OF ZONE: No

HISTORY OF ZONING: The PR zoning to the northeast was approved in the 70's and 80's and are developed with densities approximately 7-11 du/ac.

SURROUNDING LAND USE AND ZONING:

North: Large lot residential / A (Agricultural)

South: Large and small lot residential, Railroad right-of-way, Golf course, / A (Agricultural), OS-1 (Open Space Preservation), PR 1-3 du/ac (Planned Residential)

East: Large lot residential, West Valley Middle School / A (Agricultural)

West: Large lot residential / A (Agricultural)

NEIGHBORHOOD CONTEXT: Adjacent development consists of large lot single-family residences, and attached and detached residences and apartments to the north. West Valley Middle School is immediately to the east and S. Peters Rd. is less than a mile away.

STAFF RECOMMENDATION:

RECOMMEND that County Commission APPROVE PR (Planned Residential) zoning at a density of up to 3 du/ac. (Applicant requested 5 du/ac.)

PR zoning at the recommended density is consistent with the sector plan designation and will allow residential uses compatible with the surrounding land uses. The site is relatively flat with few environmental constraints

and is within a short walking distance to West Valley Middle School.

COMMENTS:

The subject property is currently zoned Agricultural (A), which allows houses on 1 acre lots, the same as the properties in the immediate vicinity. There are lots approximately 1 acre in size at the end of Freels Ln. The properties along Millstone Ln., west of Freels Ln., are also zoned Agricultural, however, the lots are 2 acres in size or greater, which is consistent with the Estate (E) zone district which requires a minimum lot size of 2 acres. The properties along Millstone Ln., east of Freels Ln., are zoned Planned Residential (PR) and have lot sizes of approximately 5,000 square feet. This subdivision was developed at approximately 6 dwelling units per acre. Millstone Lane is a local road that is improved with a sidewalk on the east end near the entrance to West Valley Middle School. The western portion of Millstone Ln. has a pavement width of approximately 14' with no sidewalk. If the PR zoning is approved at either the recommended or requested density, road improvements to a portion of Millstone Ln. and Freels Ln. will most likely be needed, including a sidewalk to connect to the existing sidewalk along Millstone Ln. A traffic study is typically required for residential developments that generate 750 trips per day or more, which if the site is developed at approximately 2 dwelling units per acre or more, a traffic study would be required. If the PR zoning is approved at the recommended 3 dwelling units per acre, the average lot size would be approximately 10,000 – 12,000 square feet, however, the lot sizes could be smaller if portions of the site are left undeveloped or if the lot sizes vary in size. This property is within the parental responsibility zone (PRZ) of West Valley Middle School, where school bus service is not provided. Because of this, sidewalks will be expected within the subdivision and as an improvement installed by the developer along Millstone Ln. and/or Freels Ln. from the neighborhood entrance to the existing sidewalk along Millstone Ln. In addition, the development should maintain the required 35' peripheral boundary when submitting a development plan for use-on-review approval and should include an amenity area for the development. The northwestern portion of the subject property has frontage along an improved portion of the Millstone Ln. right-of-way. There should not be full access to this portion of Millstone Ln. from a subdivision. Access to the western end of Millstone Ln. should be restricted to lots that have a size consistent with other lots along this portion of Millstone Lane.

REZONING REQUIREMENTS FROM ZONING ORDINANCES (must meet all of these):
THE PROPOSED AMENDMENT SHALL BE NECESSARY BECAUSE OF SUBSTANTIALLY CHANGED OR CHANGING CONDITIONS IN THE AREA AND DISTRICTS AFFECTED, OR IN THE CITY/COUNTY GENERALLY:
1. This site is accessed from Millstone Ln. and Freely Ln., narrow local streets, and is adjacent to large lot residential developed under the A zoning and is in the vicinity of other small lot residential developed under the PR zoning.
2. The property is located in the Planned Growth Area on the Growth Policy Plan and is proposed for low density residential uses on the sector plan, consistent with the proposal.
3. The proposed PR zoning at the recommended density of 3 du/ac, is not compatible with the scale and intensity of the immediate adjacent properties if developed with consistent lot sizes, but is compatible with the scale and intensity of the other nearby development and zoning. If the zoning is approved as recommended, the size and width of lots that are on the exterior boundary of the development should be more consistent with the surrounding properties. Landscape screening within the peripheral setback will also need to be considered.
4. The site is appropriate to be developed under PR zoning at the recommended density because it is within the recommended density range in the Low Density Residential sector plan designation (max. 5 dwelling units per acre).
5. The site is within close proximity to a public middle school.
6. The PR zone requires use on review approval of a development plan by MPC prior to construction. This will provide the opportunity for staff to review the plan and address issues such as road improvements, traffic circulation, lot layout, recreational amenities, drainage, types of units and other potential development concerns. It will also give the opportunity for public comment at the MPC meeting.

THE PROPOSED AMENDMENT SHALL BE CONSISTENT WITH THE INTENT AND PURPOSE OF THE APPLICABLE ZONING ORDINANCE:
1. PR zoning is intended to provide optional methods of land development which encourage more imaginative solutions to environmental design problems. Residential areas thus established would be characterized by a unified building and site development program, open space for recreation and provision for commercial, religious, educational and cultural facilities which are integrated with the total project by unified architectural and open space treatment.
2. Additionally, the zoning states that each development shall be compatible with the surrounding or adjacent zones. Such compatibility shall be determined by the Planning Commission by review of development plans. This could include varying the lot sizes within the development so that the lots along the exterior boundary of the development are more consistent with adjacent lots than those in the interior of the development. Staff maintains that PR is an appropriate zone for this development.

THE PROPOSED AMENDMENT SHALL NOT ADVERSELY AFFECT ANY OTHER PART OF THE COUNTY,

NOR SHALL ANY DIRECT OR INDIRECT ADVERSE EFFECTS RESULT FROM SUCH AMENDMENT:
1. At the requested density of up to 5 du/ac on the 40.34 acres, up to 201 dwelling units could be proposed for the site. At the recommended density of up to 3 du/ac, up to 121 dwelling units could be proposed for the site.
2. The proposed PR zoning at the recommended density of 3 du/ac, if developed with consistent lot sizes, is not compatible with the scale and intensity of the immediate adjacent properties and zoning, but is compatible with the scale and intensity of the other nearby development and zoning. If the zoning is approved as recommended, the size and width of lots that are on the exterior boundary of the development should be more consistent with the surrounding properties. Landscape screening within the peripheral setback will also need to be considered.
3. The PR zoning district has provisions for preservation of open space and providing recreational amenities as part of the development plan. The applicant will be expected to demonstrate how these provisions are met as part of the required development plan review.
4. Public water and sanitary sewer utilities are available to serve the site.

THE PROPOSED AMENDMENT SHALL BE CONSISTENT WITH AND NOT IN CONFLICT WITH THE GENERAL PLAN OF KNOXVILLE AND KNOX COUNTY, INCLUDING ANY OF ITS ELEMENTS, MAJOR ROAD PLAN, LAND USE PLAN, COMMUNITY FACILITIES PLAN, AND OTHERS:
1. The Southwest County Sector Plan proposes low density residential uses for this property, consistent with the requested PR zoning at up to 5 du/ac.
2. The site is located within the Planned Growth Area on the Knoxville-Knox County-Farragut Growth Policy Plan map.
3. The site is appropriate to be developed under PR zoning at the recommended density because it is within the recommended density range in the Low Density Residential sector plan designation (max. 5 dwelling units per acre).
4. The northwestern portion of the site has 11.3 acres within the hillside protection area, however, it primarily consists of low to moderate slopes with only .52 acres being over 25 percent slope.
5. Approval of this request could lead to future requests for PR zoning in this area, consistent with the sector plan's low density residential proposal for the area.

Upon final approval of the rezoning, the developer will be required to submit a development plan for MPC consideration of use on review approval prior to the property's development. The plan will show the property's proposed development, landscaping and street network and will also identify the types of residential units that may be constructed. Grading and drainage plans may also be required at this stage, if deemed necessary by Knox County Engineering and MPC staff.

ESTIMATED TRAFFIC IMPACT: 1970 (average daily vehicle trips)

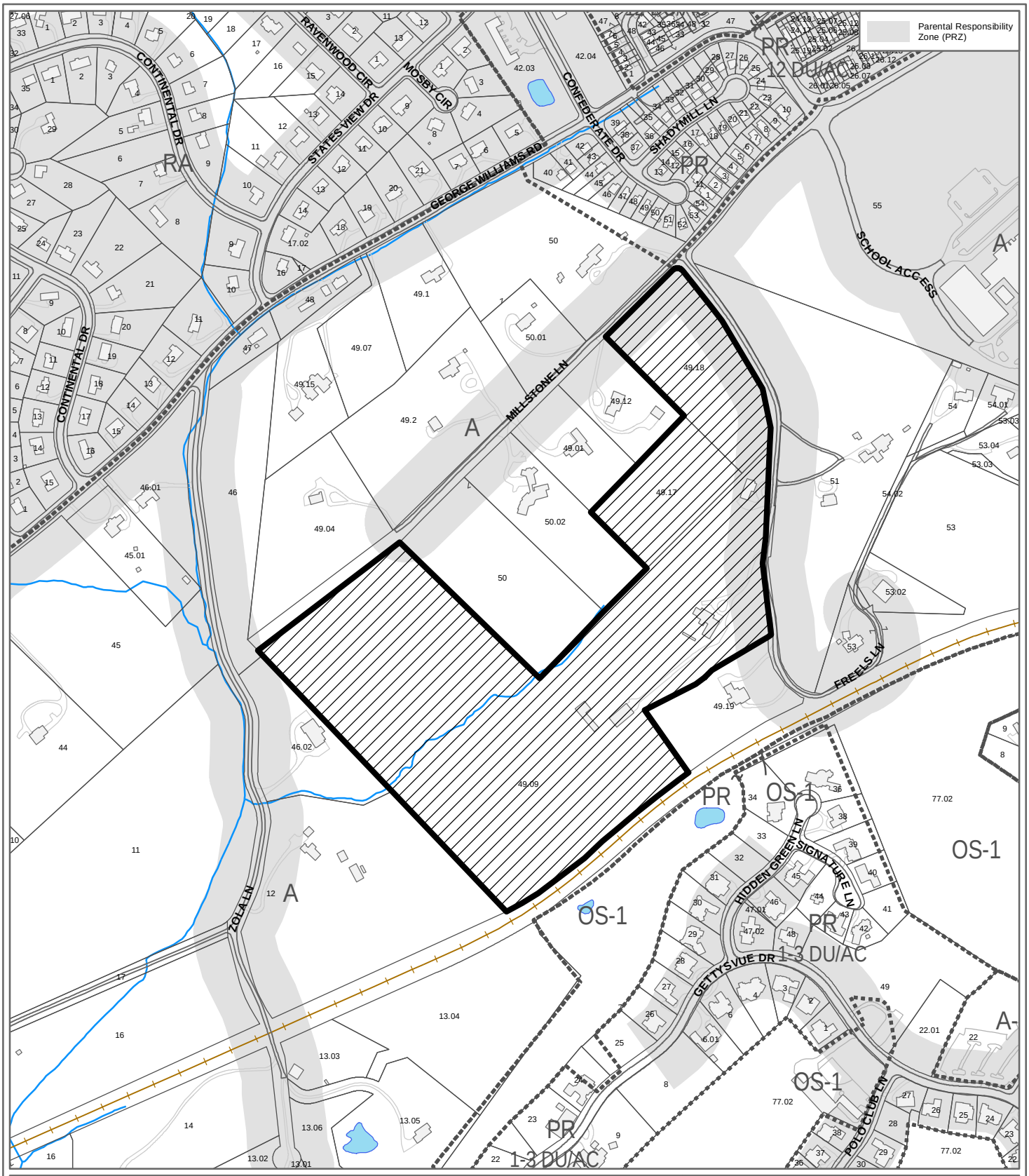
Average Daily Vehicle Trips are computed using national average trip rates reported in the latest edition of "Trip Generation," published by the Institute of Transportation Engineers. Average Daily Vehicle Trips represent the total number of trips that a particular land use can be expected to generate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

ESTIMATED STUDENT YIELD: 126 (public and private school children, ages 5-18 years)

Schools affected by this proposal: A. L. Lotts Elementary, West Valley Middle, and Bearden High.

- School-age population (ages 5–18) is estimated by MPC using data from a variety of sources.
- While most children will attend public schools, the estimate includes population that may be home-schooled, attend private schools at various stages of enrollment, or drop out of the public system.
- Students are assigned to schools based on current attendance zones as determined by Knox County Schools. Zone boundaries are subject to change.
- Estimates presume full build-out of the proposed development. Build-out is subject to market forces, and timing varies widely from proposal to proposal.
- Student yields from new development do not reflect a net addition of children in schools. Additions occur incrementally over the build-out period. New students may replace current population that ages through the system or moves from the attendance zone.
- School capacities are subject to change by Knox County Schools through building additions, curriculum or scheduling changes, or amendments to attendance zone boundaries.

If approved, this item will be forwarded to Knox County Commission for action on 8/22/2016. If denied, MPC's action is final, unless the action to deny is appealed to Knox County Commission. The date of the appeal hearing will depend on when the appeal application is filed. Appellants have 30 days to appeal an MPC decision in the County.



7-D-16-RZ
REZONING

From: A (Agricultural)

To: PR (Planned Residential)

Petitioner: S & E Properties

Map No: 132

Jurisdiction: County

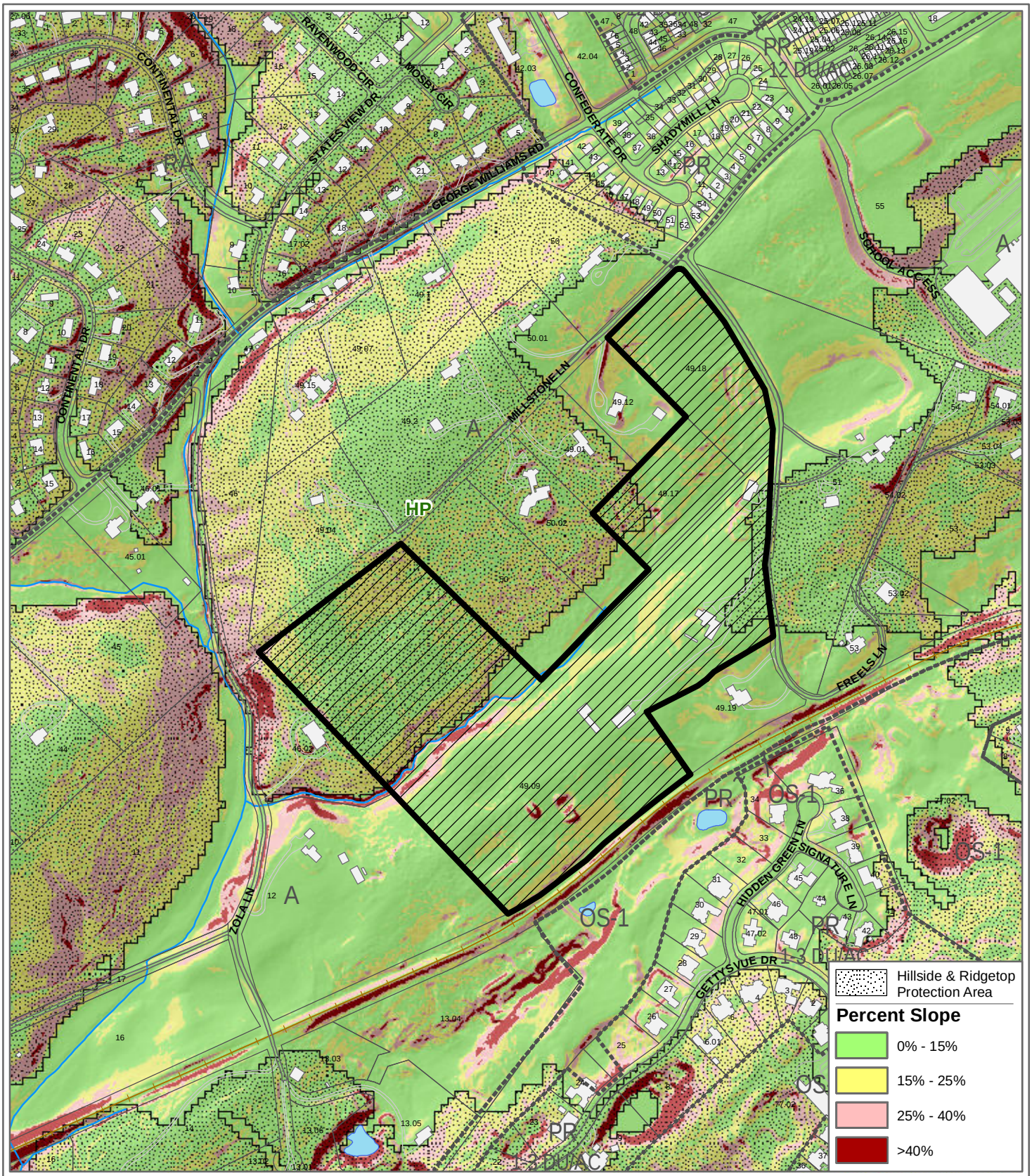
0 500 Feet

N

Original Print Date: 6/15/2016 Revised:

*Metropolitan Planning Commission * City / County Building * Knoxville, TN 37902*

MPC July 14, 2016 **Agenda Item # 31**



7-D-16-RZ
REZONING - SLOPE ANALYSIS

From: A (Agricultural)

To: PR (Planned Residential)

Petitioner: S & E Properties

Map No: 132

Jurisdiction: County

0 500 Feet

N

Original Print Date: 6/30/2016 Revised:

*Metropolitan Planning Commission * City / County Building * Knoxville, TN 37902*

7-D-16-RZ Slope Analysis

			Acreage
Non-Hillside Portions			28.94
Hillside and Ridgetop Protection Area			
Value	**Percent Slope**	**Count**	**Acres**
1	0%-15%	12061	6.92
2	15%-25%	6743	3.87
3	25%-40%	878	0.50
4	>40%	36	0.02
			11.32
Ridgetop Area			**0**
		Site Total	**40.26**

Gmail by Google

Betty Jo Mahan <bettyjo.mahan@knoxmpc.org>

[MPC Comment] Opposition to Proposed Rezoning Request for Millstone Ln 7-D-16-RZ

1 message

Campbell, Michael <MCampbell@scrippsnetworks.com> Tue, Jul 5, 2016 at 1:25 PM
Reply-To: mcampbell@scrippsnetworks.com
To: "commission@knoxmpc.org" <commission@knoxmpc.org>

Good morning MPC:

As a concerned neighbor and representative of the residents for Millstone Ln, Freels Ln and Zoya Ln we are opposed to the proposed rezoning of the properties in and around Millstone Ln (7-D-16-RZ). Formal opposition documentation will be coming shortly but we are opposed based on the following reasons:

1. Knox County Zoning Ordinance Section 4.10.16 - Be compatible with the character of the neighborhood including the size and location of buildings in the vicinity.
2. Knox County Zoning Ordinance Section 4.10.17 - The use will not significantly injure the value of adjacent property by noise, lights, fumes, odors, vibration, traffic congestion or other impacts which may detract from the immediate environment.
3. Knox County Zoning Ordinance Section 4.10.18 - The use is not of a nature or so located as to draw substantial additional traffic through residential streets.
4. Negative financial impact said rezoning will have on existing neighborhood residences.

Please note that we will be attending the July 14th rezoning meeting and will be presenting our position of opposition at that time.

Thank you in advance for your consideration of this matter.

Sincerely,

Michael Campbell,MBA,MS

Michael Campbell, MBA, MS | Director, Project Management | Business Process Management

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MPC July 14, 2016 **Agenda Item # 31**

APPENDIX H

KNOX COUNTY LEFT & RIGHT TURN LANE VOLUME THRESHOLD WORKSHEETS

TABLE 4A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
150 - 199	245	200	160	130	110	90
200 - 249	205	170	140	115	100	80
250 - 299	175	150	125	105	90	70
300 - 349	155	135	110	95	80	65
350 - 399	135	120	100	85	70	60
400 - 449	120	105	90	75	65	55
450 - 499	105	90	80	70	60	50
500 - 549	95	80	70	65	55	50
550 - 599	85	70	65	60	50	45
600 - 649	75	65	60	55	45	40
650 - 699	70	60	55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 4B

RIGHT-TURN LANE VOLUME THRESHOLDS

FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

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

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

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

APPENDIX I

SIMTRAFFIC QUEUE REPORTS

Intersection: 2: Freels Lane & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	14	34
Average Queue (ft)	1	10
95th Queue (ft)	10	33
Link Distance (ft)	625	319
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: W. Valley MS Driveway & Millstone Lane & George Williams Road

Movement	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	LT	R	L	TR
Maximum Queue (ft)	66	85	260	214	105	209	159	113	144
Average Queue (ft)	22	34	156	22	18	82	79	47	53
95th Queue (ft)	54	72	240	123	66	154	137	91	111
Link Distance (ft)		625		413		331			205
Upstream Blk Time (%)				0		0			0
Queuing Penalty (veh)				0		0			0
Storage Bay Dist (ft)	180		250		320		135	200	
Storage Blk Time (%)			1		0	1	1		0
Queuing Penalty (veh)			1		0	5	1		0

Intersection: 5: Road A & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	9	66
Average Queue (ft)	0	31
95th Queue (ft)	5	51
Link Distance (ft)	148	245
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 7

Intersection: 2: Freels Lane & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	11	29
Average Queue (ft)	0	4
95th Queue (ft)	7	21
Link Distance (ft)	625	319
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: W. Valley MS Driveway & Millstone Lane & George Williams Road

Movement	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	LT	R	L	TR
Maximum Queue (ft)	41	64	45	70	47	46	38	89	40
Average Queue (ft)	11	23	15	27	16	12	15	33	7
95th Queue (ft)	35	53	41	57	38	37	37	70	24
Link Distance (ft)		625		413		331			205
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	180		250		320		135	200	
Storage Blk Time (%)									
Queuing Penalty (veh)									

Intersection: 5: Road A & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	10	47
Average Queue (ft)	0	25
95th Queue (ft)	6	46
Link Distance (ft)	148	245
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Intersection: 2: Freels Lane & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	31	29
Average Queue (ft)	2	4
95th Queue (ft)	13	20
Link Distance (ft)	625	319
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: W. Valley MS Driveway & Millstone Lane & George Williams Road

Movement	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	LT	R	L	TR
Maximum Queue (ft)	31	126	118	96	54	106	77	71	49
Average Queue (ft)	5	58	56	39	20	50	40	28	12
95th Queue (ft)	22	104	99	77	42	90	67	57	34
Link Distance (ft)		625		413		331			205
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	180		250		320		135	200	
Storage Blk Time (%)						0			
Queuing Penalty (veh)						0			

Intersection: 5: Road A & Millstone Lane

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	16	75
Average Queue (ft)	1	36
95th Queue (ft)	10	60
Link Distance (ft)	148	245
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0