

**Ayer Commons 40B Housing
Development
Traffic Impact and Access Study
65 Fitchburg Road
Ayer, MA
July 2022**

Prepared for:

Neighborhood of Affordable Housing
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Executive Summary

BSC Group (BSC) has prepared this Traffic Impact and Access Study (TIAS) to evaluate the potential traffic impacts associated with the proposed construction of a 40B multifamily housing project, known as Ayer Commons, to be located at 65 Fitchburg Road in Ayer, Massachusetts. The development is proposed to consist of 106 residential units spread across multiple buildings.

This study includes a review of existing traffic and roadway conditions in the vicinity of the Project site and the motor vehicle crash history at study area intersections. This report identifies background traffic growth for study area roadways, estimates additional traffic generated by the Project, and evaluates potential traffic impacts due to Project-generated traffic.

This study shows that:

- The proposed 106-unit housing development project is expected to generate up to approximately 714 new weekday daily trips, with 56 new vehicle trips (13 entering, 43 exiting) during the weekday morning peak hour and 66 new vehicle trips (42 entering, 24 exiting) during the weekday evening peak hour.
- Motor vehicle crash records indicate that the crash rates of intersections within the Project study area are below the MassDOT District 3 average. A total of seven crashes were reported at the study intersections between 2017 and 2021, all of which occurred at the intersection of Fitchburg Road, Groton School Road, and Park Street.
- Compared to the Existing and No-Build conditions, the unsignalized intersections in the Project study area are expected to operate at similar levels of service under the Build conditions.

BSC recommends that the Project proponent implement Transportation Demand Management (TDM) strategies, such as:

- Posting ‘No Idling’ signage in parking areas
- Providing bicycle racks
- Encouraging residents to use the MBTA commuter rail by providing schedule information for the Ayer transit station

In conclusion, it is the opinion of BSC that the vehicle trips generated by the Project can be accommodated at the study area intersections and roadways. As MassDOT roadway improvement plans for Fitchburg Road develop, BSC recommends that the Town, with input by the Project proponent, coordinate with MassDOT to foster pedestrian sidewalk improvements along Fitchburg Road for connectivity to nearby destinations and downtown Ayer.

1 Introduction

BSC Group (BSC) has prepared this Traffic Impact and Access Study (TIAS) to evaluate the potential traffic impacts associated with the proposed construction of a 40B multifamily housing project, known as Ayer Commons, to be located at 65 Fitchburg Road in Ayer, Massachusetts. The development is proposed to consist of 106 residential units spread across multiple buildings.

This study includes a review of existing traffic and roadway conditions in the vicinity of the Project site and the motor vehicle crash history at study area intersections. This report identifies background traffic growth for study area roadways, estimates additional traffic generated by the Project, and evaluates potential traffic impacts due to Project-generated traffic.

The Project is proposed to be constructed in phases, with Phase 1 consisting of the construction of six residential buildings, ranging from two to three stories each, as well as amenities such as a community clubhouse, children's playground and a dog park. Phase 2 of the Project proposes to construct an additional four-story residential building. In total, the Project will provide 106 residential units and approximately 157 parking spaces on site. Access to the site will be provided by a single 24-foot wide driveway along Fitchburg Road.

The housing development is proposed to be constructed on a site that is currently occupied by several businesses, including a welding business, a tree service company, and a landscaping company.

2 Existing Conditions

The Project site is located at 65 Fitchburg Road in Ayer, Massachusetts, near the Ayer/Shirley town line, which lies to the west. The Town of Groton is located nearby to the north.

Notable locations near the study area include Ayer-Shirley Regional High School to the east and Moore Army Air Field directly to the south. Land uses along Fitchburg Road consist primarily of commercial and manufacturing facilities. The downtown Ayer area is located approximately one mile to the south of the Project location, as well as the Ayer transit station, which provides MBTA commuter rail service via the Fitchburg Line, which terminates at North Station in Boston.

The Project study area includes the nearby roadways and intersections expected to be impacted by the development. This section describes the study area roadways and intersections.

2.1. Study Area

The study area for the traffic impact analysis includes the following intersections:

- Fitchburg Road (Route 2A) at Groton-Shirley Road
- Fitchburg Road at Park Street and Groton School Road (Route 111)

This study area encompasses the intersections that will be used by vehicles traveling between the Project site and local and regional destinations. The proposed study area and site location are shown in **Figure 1**.

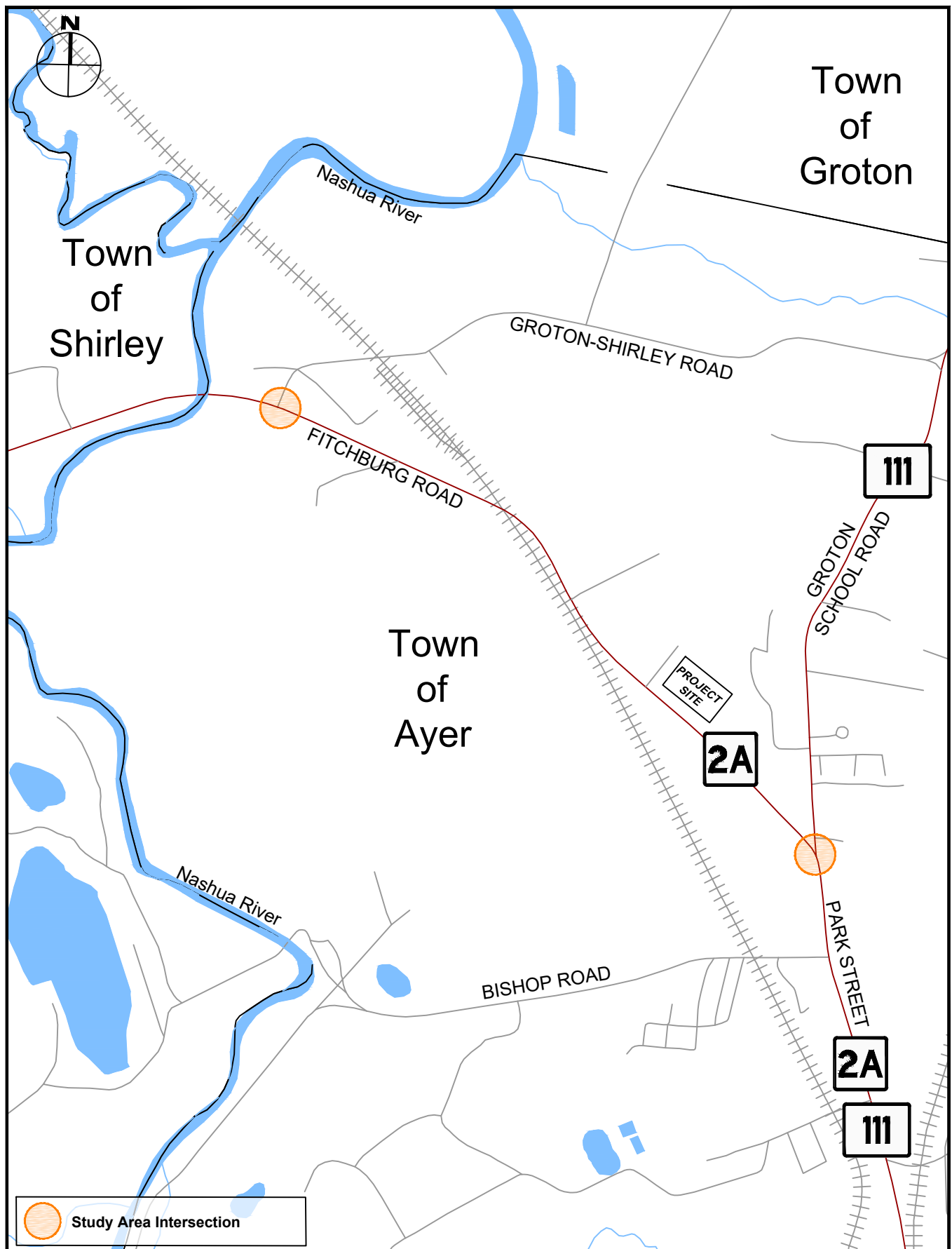
2.2. Existing Roadway Conditions

The site is located along Fitchburg Road, also known as Route 2A, which is classified as an urban principal arterial roadway under the jurisdiction of the Massachusetts Department of Transportation (MassDOT). In the study area, Fitchburg Road generally runs in a northwest-southeast direction. For the purposes of this report, Fitchburg Road will be considered as an east-west oriented roadway. Each travel direction consists of one 12-foot wide travel lane and shoulder of varying width, typically between 4 to 5 feet. The posted speed limit along Fitchburg Road is 30 to 40 miles per hour.

Near the Project site, no sidewalks are provided along Fitchburg Road. A sidewalk is provided along a portion of the south side of the road, which ends approximately 1,000 feet away from the Project site. There is no curbing provided along Fitchburg Road near the Project site.



Fitchburg Road, looking east



Project Location & Study Area
 65 Fitchburg Road 40B Housing Development
 Ayer, Massachusetts

Figure 1
 Not to Scale

2.3. Existing Intersection Conditions

The following section describes the geometric conditions and traffic control at the study area intersections. **Figure 2** shows the lane geometry and pedestrian crosswalks at the study area intersections.

Fitchburg Road at Groton-Shirley Road

Groton-Shirley Road intersects Fitchburg Road from the north to form an unsignalized T-intersection. Fitchburg Road eastbound and westbound operate freely while the Groton-Shirley Road southbound approach is stop controlled. One general purpose lane is provided at each approach. No sidewalks or pedestrian crossings are provided at this intersection.



Fitchburg Road at Groton-Shirley Road

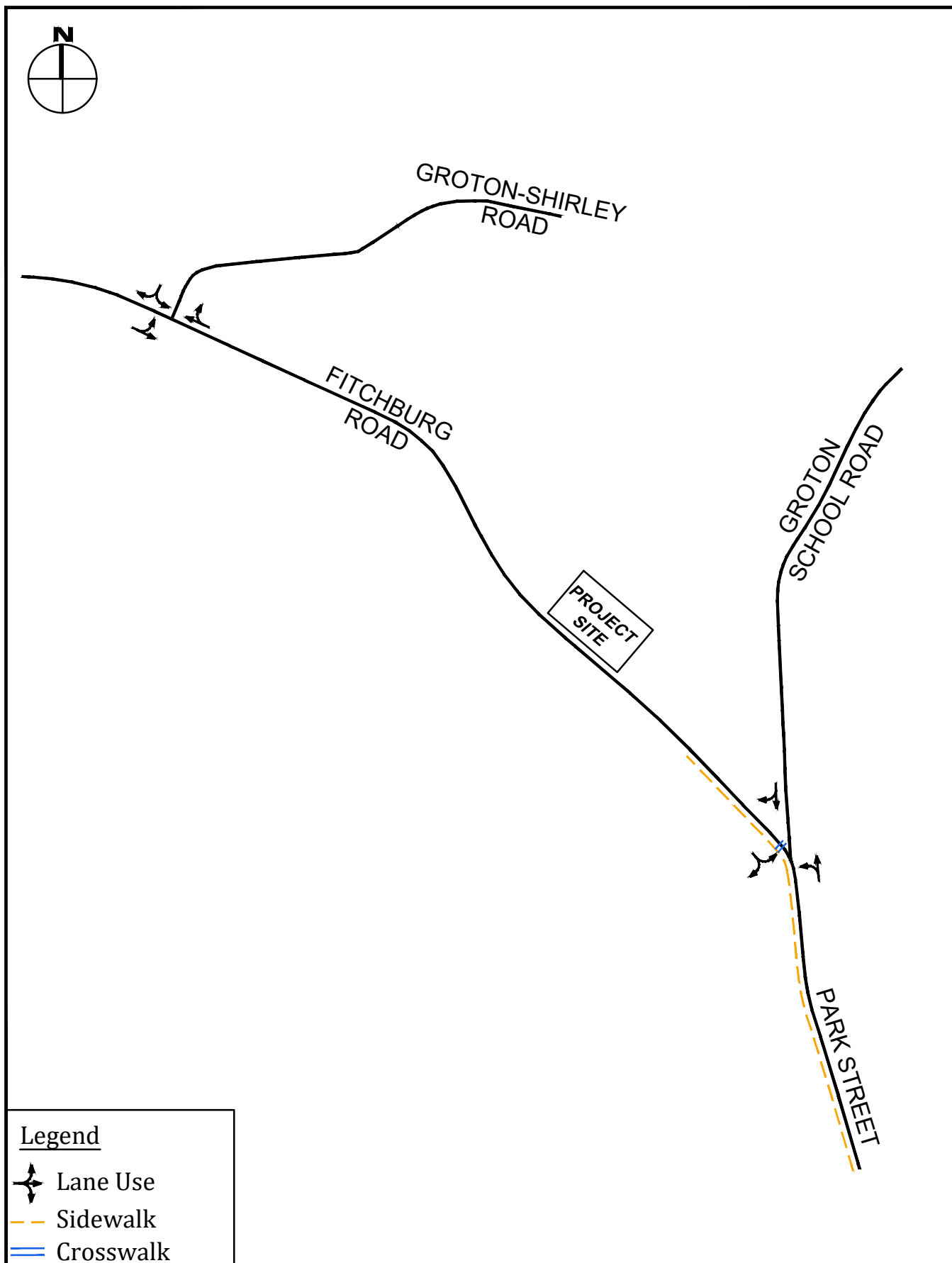
Fitchburg Road at Groton School Road and Park Street

Fitchburg Road intersects Groton School Road and Park Street to form an unsignalized Y-intersection. Fitchburg Road and Park Street operate freely while the Groton School Road southbound approach is stop controlled. In the northbound direction, Park Street provides two approach lanes, both of which may bear left onto Fitchburg Road. The right lane may also continue straight onto Groton School Road. One general purpose lane is provided at the Fitchburg Road eastbound approach and Groton School Road southbound approach. A mast arm at this intersection supports three signal lenses, one for each approach, that continuously flash yellow to urge motorists to use caution.



Fitchburg Road at Groton School Road and Park Street

A pedestrian sidewalk is provided along the west side of Park Street and continues along the south side of Fitchburg Road. A crosswalk is provided across Fitchburg Road at this intersection, but sidewalk does not continue on the north side of this crossing.



Study Area Lane Configuration & Pedestrian Facilities
 65 Fitchburg Road 40B Housing Development
 Ayer, Massachusetts

Figure 2
 Not to Scale

2.4. Existing Traffic Conditions

2.4.1. Turning Movement Count (TMC) Data

Traffic data was collected on Tuesday June 14, 2022 in the form of peak period turning movement counts (TMCs) at two study area intersections:

- Fitchburg Road (Route 2A) at Groton-Shirley Road
- Fitchburg Road at Park Street and Groton School Road (Route 111)

TMC data collected during the weekday morning and evening peak periods (7:00 – 9:00 AM and 4:00 – 6:00 PM, respectively) was used to determine traffic patterns during the most critical traffic periods for which the Project will have an impact. Local public schools were in session during the data collection period. The 2022 Existing condition peak hour turning movements are shown in **Figure 3**.

2.4.2. Automatic Traffic Recorder (ATR) Data

Traffic data was also collected on Tuesday and Wednesday June 14-15, 2022 in the form of a 48-hour weekday automatic traffic recorder (ATR) along Fitchburg Road between the two study area intersections. The ATR gathered volume, vehicle classification, and speed data during the 48-hour collected period. The volume data collected by the ATR is summarized in **Table 1**. The complete traffic count data is provided in the Appendix.

Table 1 Automatic Traffic Recorder (ATR) Data Summary

Fitchburg Road, between Groton-Shirley Road and Park Street	
Weekday Daily Volume¹	7,877
Weekday Morning Peak Hour	
Volume ²	635
K Factor ³	8.1%
Directional Flow ⁴	75% EB
Weekday Evening Peak Hour	
Volume	746
K Factor	9.5%
Directional Flow	70% WB

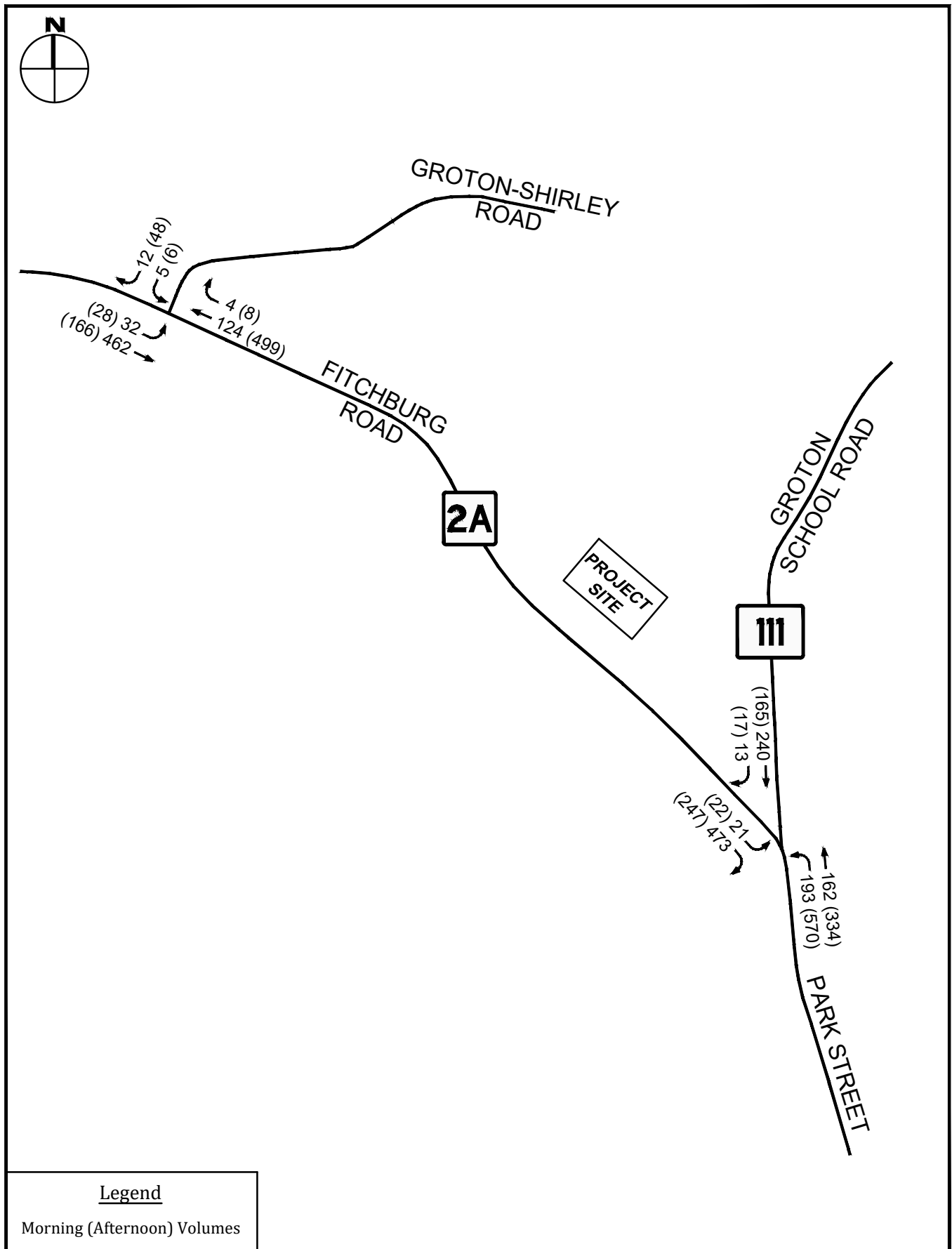
- 1 vehicles per day
- 2 vehicles per hour
- 3 percentage of daily trips that occur during the peak hour
- 4 percentage of peak hour traffic by direction

Table 2 displays the 85th percentile speeds along Fitchburg Road measured by the ATR.

Table 2 Automatic Traffic Recorder (ATR) Speed Summary

Fitchburg Road, between Groton-Shirley Road and Park Street	
85 th Percentile Vehicle Speed	
Eastbound	39 MPH
Westbound	41 MPH

As shown in **Table 2**, the 85th percentile vehicles speeds along Fitchburg Road were measured to be nearly equal to the posted speed limit of 40 miles per hour. Speeds in the westbound direction were slightly higher than in the eastbound direction.



Existing Weekday Peak Hour Traffic Volumes
65 Fitchburg Road 40B Housing Development
Ayer, Massachusetts

Figure 3
Not to Scale

2.5. Motor Vehicle Crash Data

Motor vehicle crash data were obtained for the Project's study area from the MassDOT crash database for the most recent five-year period (2017 – 2021). The current MassDOT average crash rate for unsignalized intersections in District 3 is 0.61 crashes per million entering vehicles (mev). **Table 3** presents the motor vehicle crash data for the years 2017-2021.

Table 3 Motor Vehicle Crash Data Summary

	Fitchburg Road at Groton-Shirley Road	Fitchburg Road at Groton School Road and Park Street
Total Crashes	0	7
Year		
2017	0	0
2018	0	1
2019	0	2
2020	0	3
2021	0	1
Severity		
Property Damage	0	7
Injury	0	0
Fatality	0	0
Collision Type		
Angle	0	2
Rear End	0	2
Sideswipe	0	0
Single Vehicle	0	2
Head-On	0	1
Time		
7AM – 9AM, Weekday	0	0
4PM – 6PM, Weekday	0	2
Weekday, Off-Peak	0	5
Weekend	0	0
Road Conditions		
Dry	0	6
Wet	0	1
Snow/Ice	0	0
Month		
Dec – Feb	0	1
Mar – May	0	1
June – Aug	0	2
Sept – Nov	0	3
Light Conditions		
Daylight	0	5
Dark	0	2
Dawn/Dusk	0	0
Average Per Year ¹	0.0	1.4
Crash Rate ²	0.00	0.25

1 Average crashes between 2017-2021

2 Crashes per million entering vehicles, as defined by the MassDOT Highway Division (calculated for 2017 – 2021)

As shown in **Table 3**, a total of seven crashes were reported at the study intersections between 2017 and 2021, all of which occurred at the intersection of Fitchburg Road, Groton School Road, and Park Street. These crashes consisted of two angle collisions, two rear-ends, two single vehicle crashes, and one head-on collision. No collisions were reported at the intersection of Fitchburg Road and Groton-Shirley Road in the last five years. The crash rates at both intersections (0.00 and 0.25 crashes per mev) are lower than the MassDOT District 3 average crash rate of 0.61 crashes per mev for unsignalized intersections. Crash rate worksheets are provided in the Appendix.

3 Future Conditions

Traffic volumes in the study area were projected to the year 2029, which reflects a seven-year traffic planning horizon from the 2022 baseline year. The future traffic volumes consider both general traffic growth trends in the area and new traffic expected to be generated by major planned and proposed developments in the vicinity of the Project. The 2029 No-Build conditions represent a future scenario that incorporates traffic growth and any planned roadway infrastructure projects that will impact traffic volumes in the study area. The Project impacts are analyzed by estimating the number of vehicular trips expected to be generated, distributing through the study area network, and then adding them to the 2029 No-Build conditions. The 2029 Build conditions represent a future scenario that incorporates the expected Project-generated trips. The following sections describe the development of the future conditions scenarios.

3.1. No-Build Conditions

3.1.1. Background Growth

A 1.0 percent annual growth rate was applied to the existing conditions traffic volumes to account for background growth within the study area. This growth rate was employed to reflect the annual growth rate that MassDOT has used to grow traffic volumes at a count station along Fitchburg Road in Ayer.

3.1.2. Background Development Projects

Based on discussions with the Town of Ayer, there is one development project proposed in the vicinity of the site that will have an impact on traffic operations. The proposed development is located at 22 Fitchburg Road, which is currently occupied by a supermarket. The supermarket is proposed to be retained, and a new retail strip and auto parts store are proposed to be added to the site. Vehicles may enter and exit the site via two driveways along Fitchburg Road. A trip generation analysis was performed to estimate the traffic volumes generated by the proposed development using data published by the Institute of Transportation Engineers (ITE) in the *Trip Generation Manual* (11th Edition, 2021). The peak hour trip generation impacts of the proposed development at 22 Fitchburg Road are summarized in **Table 4**.

Table 4 Background Development Project Trip Generation Summary

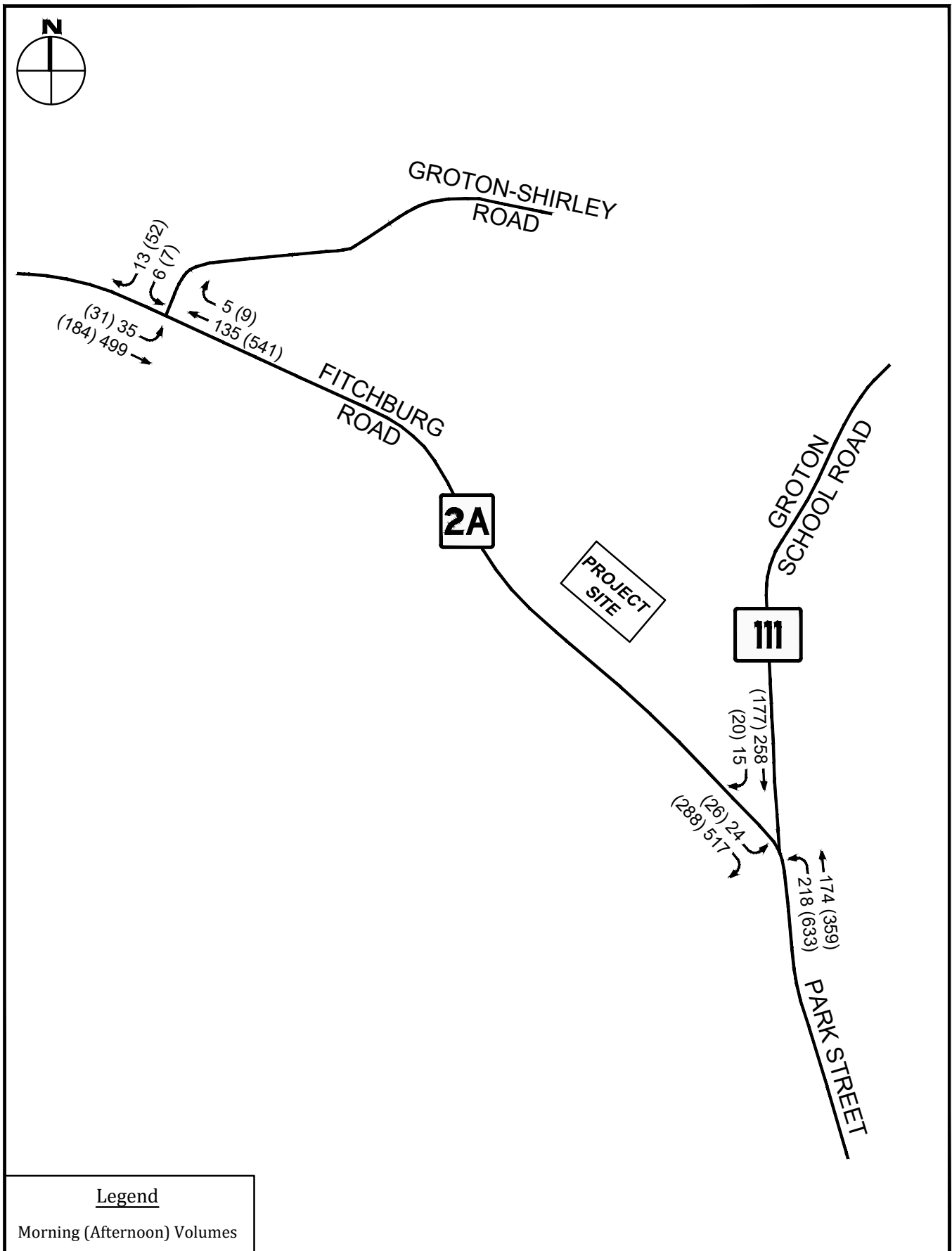
Address	Size (SF)	Use	ITE LUC	AM Peak Hour			PM Peak Hour		
				Entering	Exiting	Total	Entering	Exiting	Total
22 Fitchburg Road	3,633 SF	Retail Strip	822 ¹	5	4	9	12	12	24
	6,889 SF	Auto Parts Store	843 ²	9	8	17	16	18	34
Total				14	12	26	28	30	58

¹ Based on ITE LUC 822 – Strip Retail Plaza (<40k)

² Based on ITE LUC 843 – Automobile Parts Sales

Infrastructure improvements are also proposed along Fitchburg Road as part of MassDOT Project 606640, which is currently in the design phase. This project will resurface a 1.5-mile stretch of Route 2A from the Shirley Town line to Brook Street, and also proposes sidewalk improvements and signal upgrades at the intersection of Fitchburg Road, Park Street, and Groton School Road. At the time of this report, the specifics of the project design were not made available.

The background project-generated trips were distributed across the transportation network based on existing traffic patterns. These volumes, along with the 1.0 percent annual growth rate, were applied to the existing traffic volumes to develop the 2029 No-Build traffic volumes that are shown in **Figure 4**.



2029 Future No-Build Weekday Peak Hour Traffic Volumes
65 Fitchburg Road 40B Housing Development
Ayer, Massachusetts

Figure 4
Not to Scale

3.2. Build Conditions

3.2.1. Trip Generation

To estimate the number of trips generated by the Project, data published by the Institute of Transportation Engineers (ITE) in the *Trip Generation Manual* (11th Edition, 2021) were used. ITE provides data to estimate the total number of unadjusted vehicular trips associated with the Project. The ITE trip generation rates and equations for LUC 220 – Multifamily Housing (Low-Rise) were employed. **Table 4** presents the estimated trip generation characteristics of the proposed housing development. Trip generation calculations can be found in the Appendix.

Table 5 Proposed Project-Generated Trips

	# of Units	Daily Trips	AM Peak Hour			PM Peak Hour		
			Entering	Exiting	Total	Entering	Exiting	Total
Multifamily Housing (Low-Rise) – LUC 220	106	714	13	43	56	42	24	66

¹ Trip Generation Manual, 11th Edition; Institute of Transportation Engineers; Washington, DC; 2021.

Based on the data provided by ITE, the proposed 106-unit housing development is expected to generate 714 trips over the course of a weekday with 56 trips during the weekday morning peak hour and 66 trips during the weekday evening peak hour.

It should also be noted that the existing Project site, which is currently occupied by a welding business, a tree service company, and a landscaping company, contributes a certain number of daily and peak hour trips to the study area roadway network. The trip generation characteristics of the existing site were not calculated and subtracted from the Project-generated trips. Thus, the proposed Project-generated trips displayed in **Table 5** could be considered as a slightly conservative estimate.

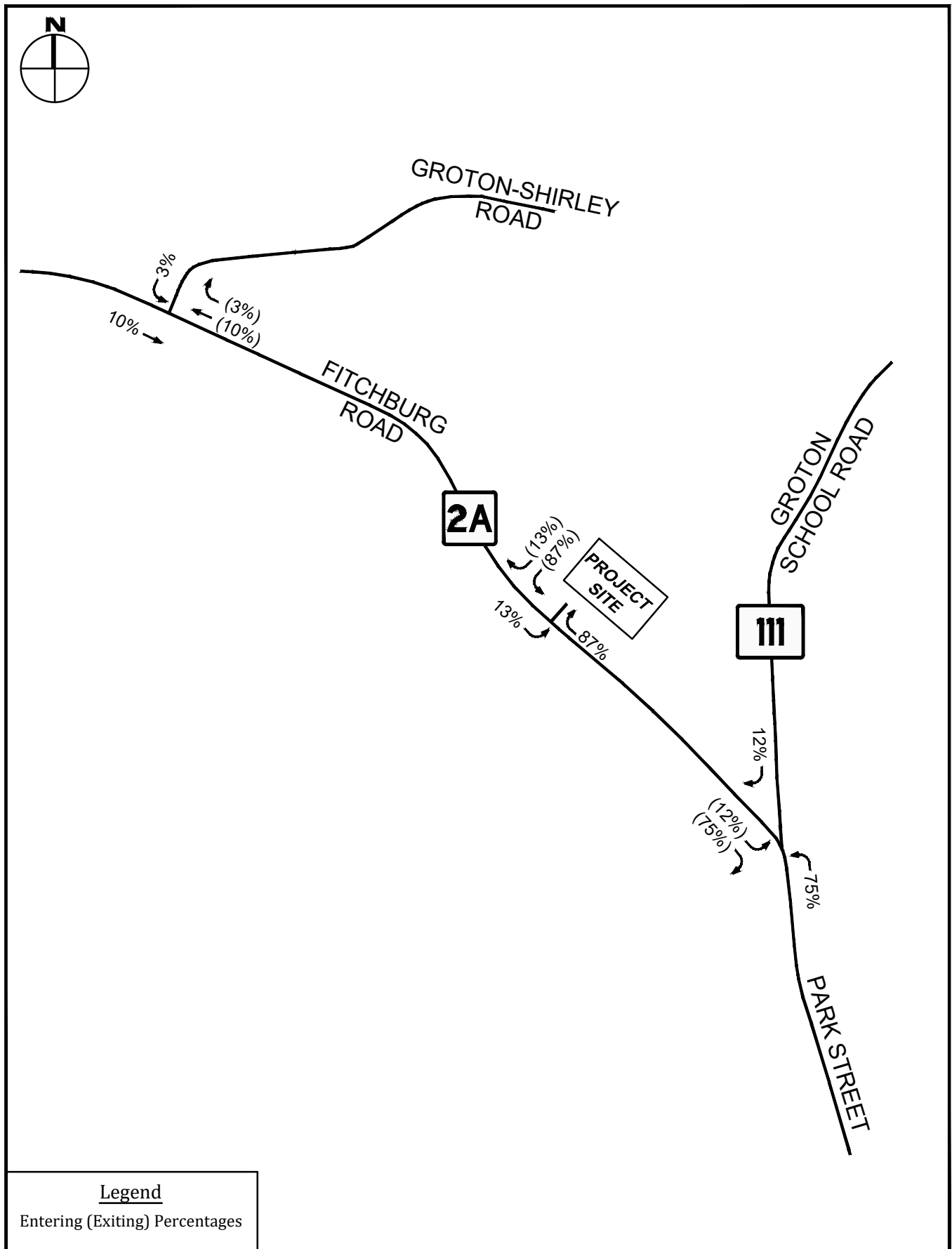
3.2.2. Parking Generation

The 106-unit residential development is proposed to provide 157 parking spaces, or 1.48 spaces per unit. The ITE *Parking Generation Manual* (5th Edition, 2019) provides data to estimate the expected parking demand of a development based on land use and size. For LUC 220 – Multifamily Housing (Low-Rise), the average parking demand rate is 1.21 spaces per unit and the 85th percentile rate is 1.52 spaces per unit. The proposed parking ratio of 1.48 spaces per unit is comparable to the ITE 85th percentile rate of 1.52, and therefore should be sufficient to satisfy the parking demand of the Project.

3.2.3. Trip Distribution

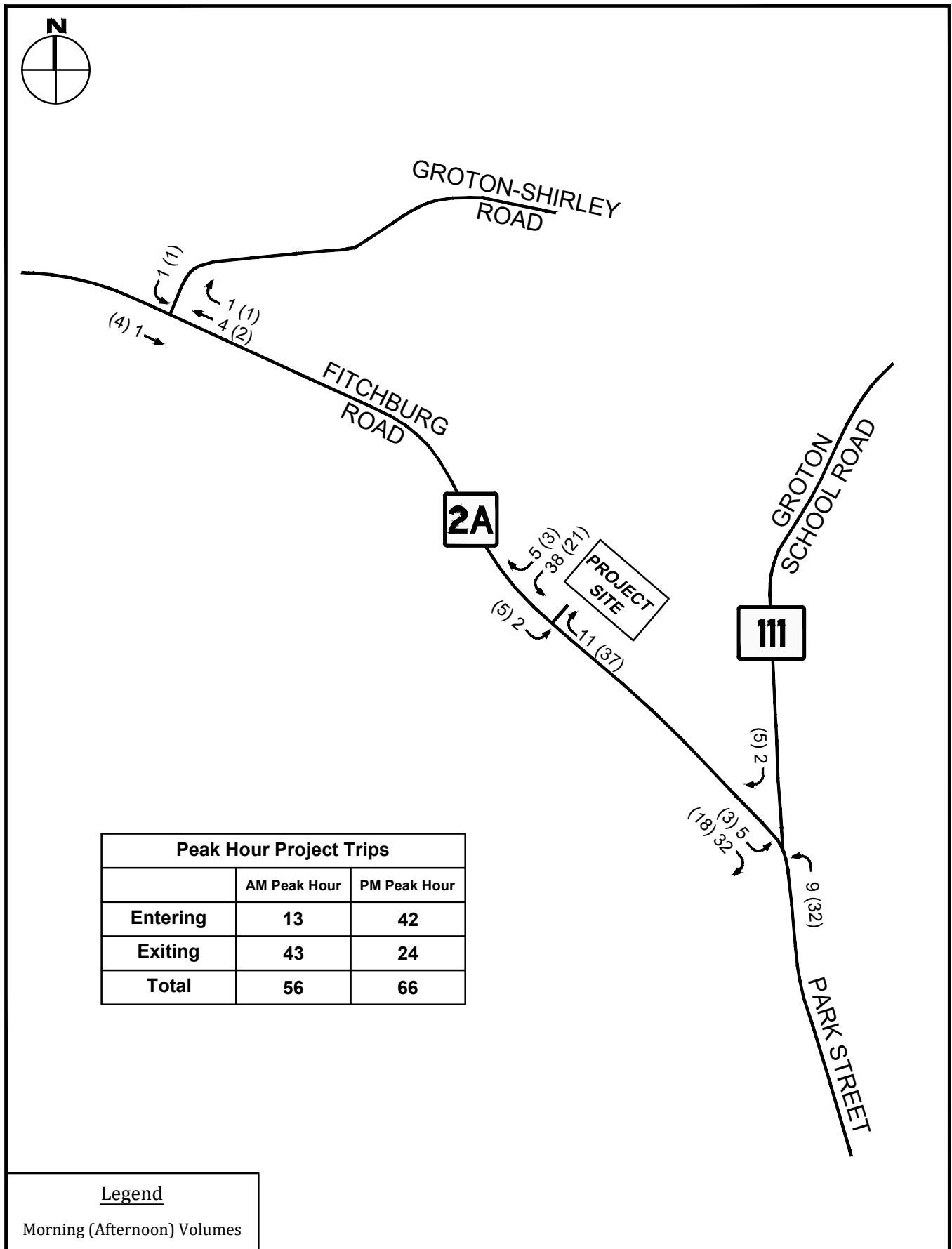
Vehicular trip distribution patterns identify the origins and destinations for trips related to the Project site. Trip distribution patterns for the commuter peak periods were identified using United States Census Journey-to-Work data for residents living in the Town of Ayer. Since the majority of the trips during the weekday morning and evening peak hours are assumed to be work-based commuter trips, this is the most appropriate methodology for determining overall trip distribution patterns for the Project. The trip distribution patterns are shown in **Figure 5**.

The Project-generated trips were assigned to the study area roadways and intersections based on the trip distribution patterns and are presented in **Figure 6** for the weekday morning and evening peak hours. The Project-generated trips were then added to the 2029 No-Build conditions traffic volumes to develop the 2029 Build conditions traffic volumes and are shown in **Figure 7**.



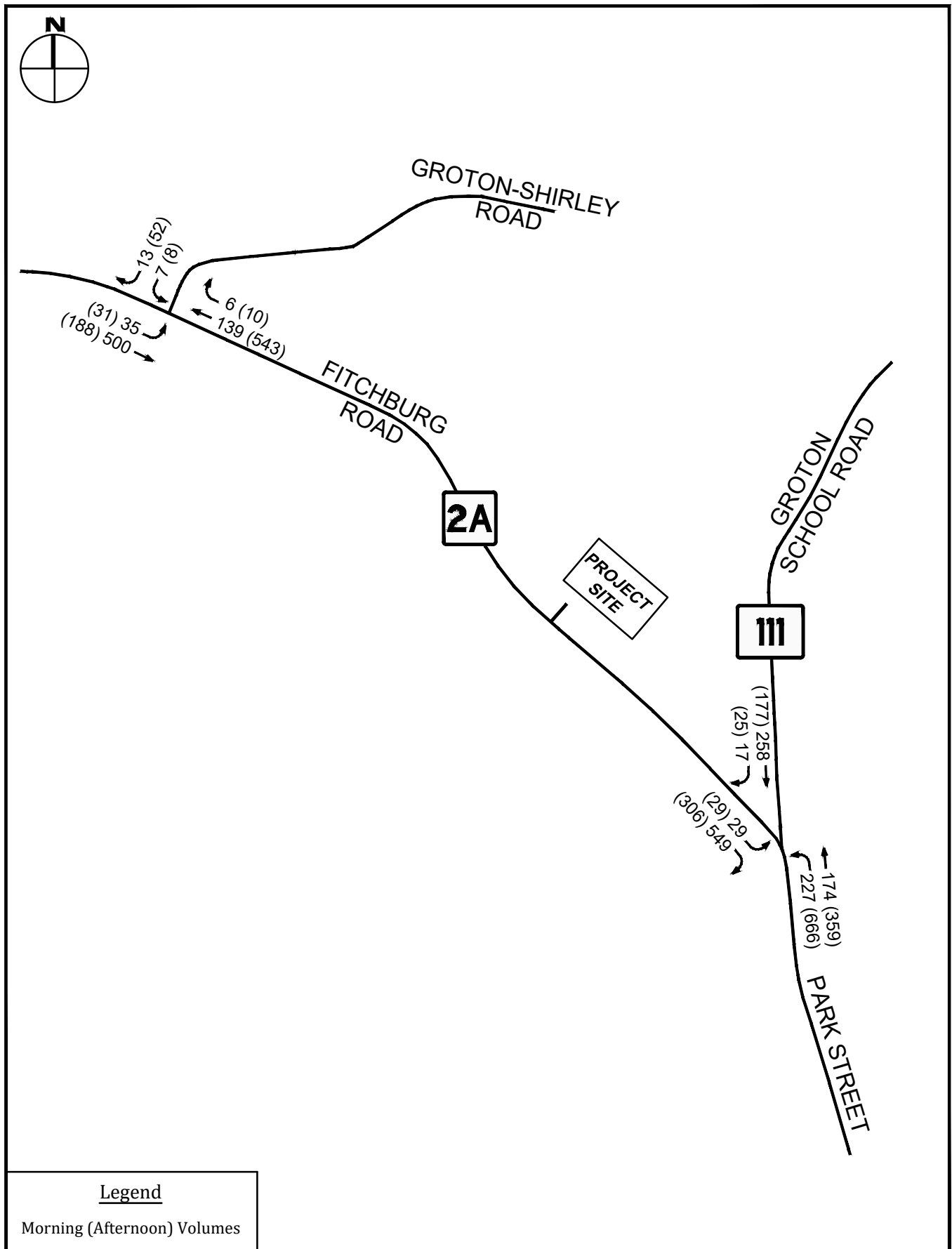
Trip Distribution Map
65 Fitchburg Road 40B Housing Development
Ayer, Massachusetts

Figure 5
Not to Scale



Weekday Peak Hour Project-Generated Traffic Volumes
65 Fitchburg Road 40B Housing Development
Ayer, Massachusetts

Figure 6
Not to Scale



2029 Future Build Weekday Peak Hour Traffic Volumes
65 Fitchburg Road 40B Housing Development
Ayer, Massachusetts

Figure 7
Not to Scale

4 Traffic Operations Analysis

4.1. Level of Service

To assess the quality of traffic flow, capacity analyses were conducted at the study area intersections for the weekday morning and weekday evening peak hours. Analyses were conducted using the Synchro 11 traffic analysis software, which is based on methods defined in the Highway Capacity Manual 2010. Operations analyses were conducted for the 2022 Existing, 2029 No-Build, and 2029 Build conditions.

A primary result of capacity analyses is the assignment of a Level of Service (LOS) to traffic facilities under various traffic flow conditions. Six Levels of Services are defined for each type of facility. They are given letter designations from A to F, with LOS A representing the best operating conditions with little delay and LOS F representing the worst, with the most delay.

The average delay per vehicle approaching an intersection is used to quantify the LOS at a particular intersection. The LOS designations are defined below in **Table 6**. Average delay measures the mean stopped delay experienced by vehicles entering an intersection during the analysis period. Average delay is measured for each individual turning movement that must yield the right of way and for the intersection as a whole, if signalized. The vehicular queues and volume-to-capacity ratios (v/c) are also presented as part of the traffic operations analysis. The 95th percentile queues represent the back of queue during a cycle that experiences the maximum traffic volume during the peak hour. This distinction is made to reflect the random nature of traffic throughout the course of the peak hour. The v/c ratios reflect the percentage of the overall operating capacity of a movement that the traffic volumes consume. A v/c ratio below 1.0 indicates that there is additional capacity that could be used if traffic volumes increase.

Table 6 Level of Service Designations

Level of Service	Delay (seconds per vehicle)	
	Unsignalized	Signalized
A	0.0 - 10.0	0.0 - 10.0
B	>10.0 – 15.0	>10.0 – 20.0
C	>15.0 – 25.0	>20.0 – 35.0
D	>25.0 – 35.0	>35.0 – 55.0
E	>35.0 – 50.0	>55.0 – 80.0
F	>50.0	>80.0

Source: Transportation Research Board, Highway Capacity Manual, National Research Council, 2010.

Tables 7 and 8 show the operating conditions of the study intersections during the weekday morning and weekday evening peak hours for the three scenarios analyzed. Detailed Synchro reports for each scenario are contained in the Appendix.

At the unsignalized intersection of Fitchburg Road and Groton-Shirley Road, the Groton-Shirley Road southbound approach currently operates at an overall LOS B during the weekday morning and evening peak hour periods. Under the No-Build and Build conditions, this approach is expected to remain at overall LOS B during both peak hour periods.

At the unsignalized intersection of Fitchburg Road, Groton School Road, and Park Street, the Groton School Road currently operates at an overall LOS F during the weekday morning and evening peak periods. Under the No-Build and Build conditions, this approach is expected to remain at overall LOS F during both peak hour periods.

When compared to the No-Build conditions, the delay for the Groton School Road southbound approach under the Build conditions is estimated to increase by approximately 32 seconds and 46 seconds during the weekday morning and evening peak periods, respectively. As presented in the Trip Generation section of this report, the proposed Project is expected to add just two (2) and five (5) trips to the Groton School Road southbound approach during the weekday morning and evening peak hour periods, respectively.

A site visit was conducted to observe traffic operations during a weekday afternoon at the intersection of Fitchburg Road, Park Street, and Groton School Road. The stop-controlled southbound approach was not observed to experience as significant queuing as estimated by the Synchro traffic operations model, and queues exceeding more than just a few vehicles were not frequently observed. BSC believes the delay and queuing estimated by the traffic model may be conservative for the Groton School Road southbound approach.

Table 7 Traffic Operations Analysis Summary – Weekday Morning Peak Hour

	2019 Existing Conditions				2029 No-Build Conditions				2029 Build Conditions			
	Delay	LOS	v/c	95th queue	Delay	LOS	v/c	95th queue	Delay	LOS	v/c	95th queue
UNSIGNALIZED INTERSECTIONS												
Fitchburg Road at Groton-Shirley Road												
Fitchburg Road EB L/T	0.7	A	0.02	2	0.8	A	0.03	2	0.8	A	0.03	2
Fitchburg Road WB T/R	0.0	A	0.08	0	0.0	A	0.09	0	0.0	A	0.09	0
Groton-Shirley Road SB L/R	10.7	B	0.03	2	11.5	B	0.04	3	11.7	B	0.04	3
Fitchburg Road at Groton School Road and Park Street												
Fitchburg Road EB L/R	0.6	A	0.02	2	0.7	A	0.02	2	0.8	A	0.03	2
Park Street WB L/T	0.0	A	0.23	0	0.0	A	0.25	0	0.0	A	0.26	0
Groton School Road SB T/R	54.0	F	0.84	185	97.5	F	1.02	273	129.0	F	1.11	315

Table 8 Traffic Operations Analysis Summary – Weekday Evening Peak Hour

	2019 Existing Conditions				2029 No-Build Conditions				2029 Build Conditions			
	Delay	LOS	v/c	95th queue	Delay	LOS	v/c	95th queue	Delay	LOS	v/c	95th queue
UNSIGNALIZED INTERSECTIONS												
Fitchburg Road at Groton-Shirley Road												
Fitchburg Road EB L/T	1.5	A	0.03	2	1.5	A	0.03	3	1.5	A	0.03	3
Fitchburg Road WB T/R	0.0	A	0.32	0	0.0	A	0.35	0	0.0	A	0.35	0
Groton-Shirley Road SB L/R	13.1	B	0.12	10	13.9	B	0.14	12	14.1	B	0.14	12
Fitchburg Road at Groton School Road and Park Street												
Fitchburg Road EB L/R	1.2	A	0.03	3	1.4	A	0.04	3	1.6	A	0.05	4
Park Street NB L/T	0.0	A	0.57	0	0.0	A	0.62	0	0.0	A	0.64	0
Groton School Road SB T/R	66.3	F	0.83	161	137.9	F	1.08	251	184.2	F	1.20	292

4.2. Transportation Demand Management Strategies

Table 9 summarizes various proposed transportation demand management mitigation measures to be implemented. These strategies are meant to reduce single occupancy vehicle trips in and out of the site. Measures are to be handled by the proponent of the development.

Table 9 Transportation Demand Management Strategies

Mitigation	Description
General TDM support	<ul style="list-style-type: none"> Development management shall serve as a transportation coordinator
Parking management	<ul style="list-style-type: none"> Post ‘No Idling’ signage in parking areas Provide bicycle racks on site
Public transit service	<ul style="list-style-type: none"> Proponent should encourage alternative modes of transportation by providing commuter rail schedule information for the Ayer transit station

BSC also recommends that the Project proponent should consider the installation of electric vehicle charging stations in the future.

In addition to the TDM strategies summarized in Table 9, the Town should work with MassDOT to extend the existing sidewalk along Fitchburg Road from where it currently ends at the Shop’n Save supermarket. The proposed MassDOT Project 606640 will resurface a 1.5-mile stretch of Route 2A from the Shirley Town line to Brook Street. This project, which is in the design phase, also proposes sidewalk improvements along Fitchburg Road. The Project proponent and the Town should coordinate with MassDOT to provide sidewalk connections to the site and a pedestrian crossing in the vicinity of the site, if not already proposed in the MassDOT design.

5 Summary and Conclusions

BSC has prepared this Traffic Impact and Access Study (TIAS) to evaluate the potential traffic impacts associated with the proposed construction of a 40B multifamily housing project, known as Ayer Commons, to be located at 65 Fitchburg Road in Ayer, Massachusetts. The development is proposed to consist of 106 residential units spread across multiple buildings.

Using standard industry practices, this Traffic Impact and Access Study has reviewed existing traffic and roadway conditions in the vicinity of the site; determined background traffic growth for the study area; and estimated and distributed the additional vehicular traffic that will be generated by the Project.

This study has shown that:

- The proposed 106-unit housing development project is expected to generate up to approximately 714 new weekday daily trips, with 56 new vehicle trips (13 entering, 43 exiting) during the weekday morning peak hour and 66 new vehicle trips (42 entering, 24 exiting) during the weekday evening peak hour.
- Motor vehicle crash records indicate that the crash rates of intersections within the Project study area are below the MassDOT District 3 average. A total of seven crashes were reported at the study intersections between 2017 and 2021, all of which occurred at the intersection of Fitchburg Road, Groton School Road, and Park Street.
- Compared to the Existing and No-Build conditions, the unsignalized intersections in the Project study area are expected to operate at similar levels of service under the Build conditions.
- Traffic and environmental impacts of the proposed development may be mitigated by implementing TDM strategies can be implemented to reduce the number of single occupancy vehicle trips to and from the site. Specific TDM strategies to be employed include posting 'No Idling' signage, provision of bicycle racks, and promoting the use of the MBTA Commuter Rail.

In conclusion, it is the opinion of BSC that the vehicle trips generated by the Project can be accommodated at the study area intersections and roadways. As MassDOT roadway improvement plans for Fitchburg Road develop, BSC recommends that the Town, with input by the Project proponent, coordinate with MassDOT to foster pedestrian sidewalk improvements along Fitchburg Road for connectivity to nearby destinations and downtown Ayer.

Technical Appendix

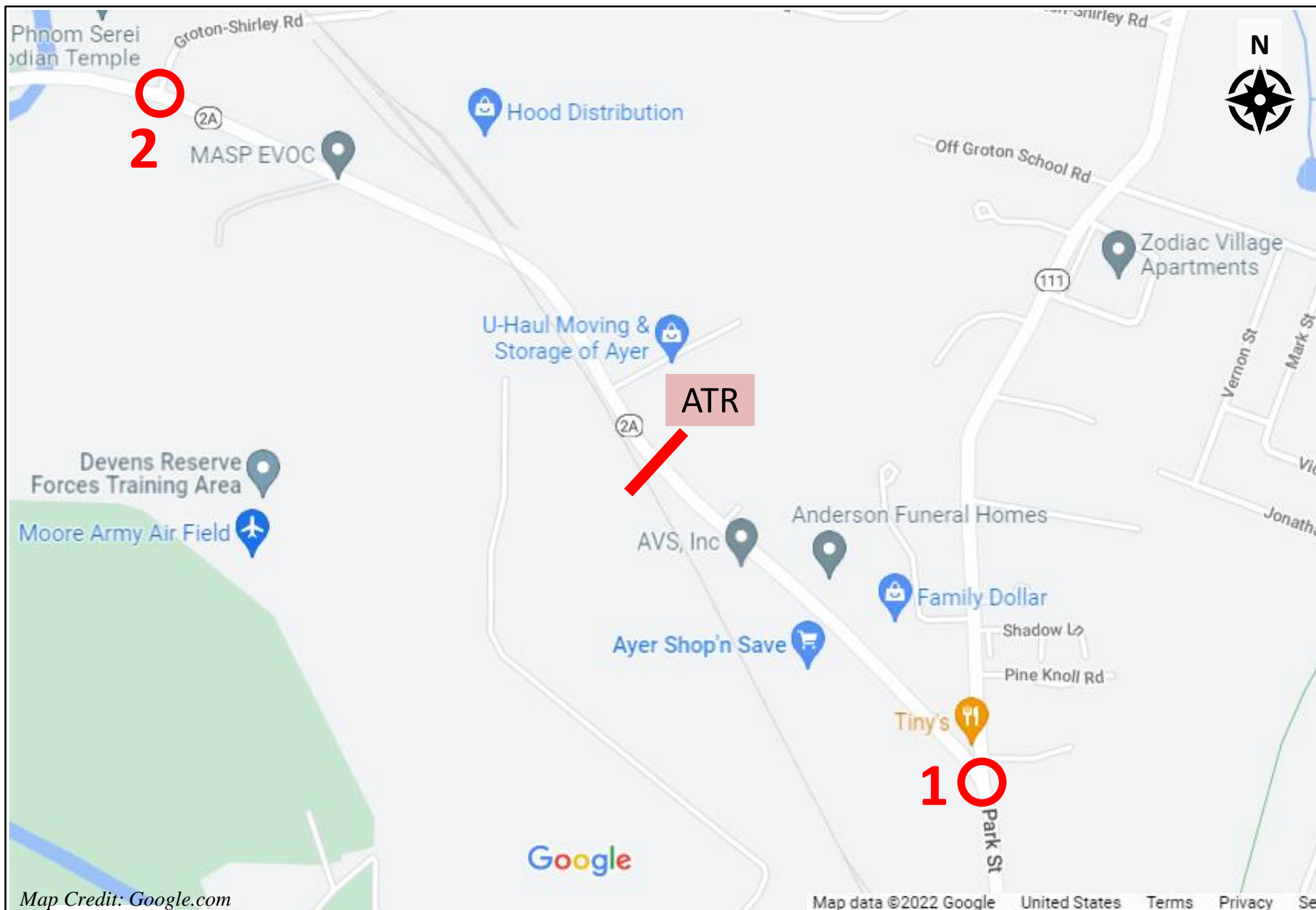
Traffic Count Data

Motor Vehicle Crash Rate Worksheets

Trip Generation Calculations

Traffic Operations Analysis

Traffic Count Data



Map Credit: Google.com

Map data ©2022 Google United States Terms Privacy Ser

BOSTON
TRAFFIC DATA

BTD ID: 974_001_BSC

Ayer, MA

Collected on June 14 to 15, 2022

of TMC's: 02

of ATR's: 01

Client: BSC Group

Contact: Knowles Spofford, EIT

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 1
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Park Street/Groton School Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
 Weather: Clouds & Sun, 70°F

BOSTON TRAFFIC DATA

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PASSENGER CARS & HEAVY VEHICLES COMBINED

PROCESSED AND CANCELLED VEHICLE COUNTS																
Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	42	21	0	0	0	57	3	0	5	0	108	0	0	0	0
7:15 AM	0	39	27	0	0	0	77	3	0	7	0	128	0	0	0	0
7:30 AM	0	49	40	0	0	0	58	4	0	3	0	129	0	0	0	0
7:45 AM	0	51	52	0	0	0	59	2	0	6	0	119	0	0	0	0
8:00 AM	0	54	43	0	0	0	46	4	0	5	0	97	0	0	0	0
8:15 AM	0	53	37	0	0	0	74	3	0	1	0	100	0	0	0	0
8:30 AM	0	61	56	0	0	0	36	5	0	1	0	78	0	0	0	0
8:45 AM	0	51	27	0	0	0	39	5	0	5	0	77	0	0	0	0

Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
4:00 PM	0	120	62	0	0	0	37	4	0	10	0	69	0	0	0	0
4:15 PM	0	142	68	0	0	0	53	8	0	4	0	62	0	0	0	0
4:30 PM	0	154	86	0	0	0	41	2	0	7	0	73	0	0	0	0
4:45 PM	0	142	84	0	0	0	32	2	0	6	0	52	0	0	0	0
5:00 PM	0	132	96	0	0	0	39	5	0	5	0	60	0	0	0	0
5:15 PM	0	147	76	0	0	0	37	3	0	9	0	52	0	0	0	0
5:30 PM	0	121	74	0	0	0	38	6	0	4	0	65	0	0	0	0
5:45 PM	0	89	52	0	0	0	35	2	0	9	0	49	0	0	0	0

Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	193	162	0	0	0	240	13	0	21	0	473	0	0	0	0
0.86				0.79				0.91				0.00			
0.0%	6.7%	6.8%	0.0%	0.0%	0.0%	4.2%	15.4%	0.0%	14.3%	0.0%	3.0%	0.0%	0.0%	0.0%	0.0%

Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	570	334	0	0	0	165	17	0	22	0	247	0	0	0	0
0.94				0.75				0.84				0.00			
0.0%	2.8%	2.1%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	2.4%	0.0%	0.0%	0.0%	0.0%

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 1
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Park Street/Groton School Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
 Weather: Clouds & Sun, 70°F

BOSTON

TRAFFIC DATA

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HEAVY VEHICLES

COUNTDOWN																
Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	0	2	0	0	0	1	0	0	2	0	8	0	0	0	0
7:15 AM	0	2	4	0	0	0	2	1	0	1	0	3	0	0	0	0
7:30 AM	0	5	1	0	0	0	3	1	0	0	0	6	0	0	0	0
7:45 AM	0	2	3	0	0	0	4	0	0	0	0	2	0	0	0	0
8:00 AM	0	4	3	0	0	0	1	0	0	2	0	3	0	0	0	0
8:15 AM	0	1	5	0	0	0	5	0	0	0	0	3	0	0	0	0
8:30 AM	0	7	2	0	0	0	1	0	0	0	0	3	0	0	0	0
8:45 AM	0	7	1	0	0	0	0	1	0	0	0	5	0	0	0	0

Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
4:00 PM	0	4	0	0	0	0	3	0	0	0	0	3	0	0	0	0
4:15 PM	0	6	1	0	0	0	1	0	0	0	0	2	0	0	0	0
4:30 PM	0	6	3	0	0	0	1	0	0	0	0	3	0	0	0	0
4:45 PM	0	3	2	0	0	0	0	0	0	0	0	1	0	0	0	0
5:00 PM	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0
5:30 PM	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
5:45 PM	0	3	2	0	0	0	1	0	0	0	0	1	0	0	0	0

Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	12	12	0	0	0	13	1	0	2	0	14	0	0	0	0
PHF 0.86				0.70				0.67				0.00			

Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	19	6	0	0	0	5	0	0	0	0	9	0	0	0	0
PHF 0.69				0.42				0.75				0.00			

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 1
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Park Street/Groton School Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
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PEDESTRIANS & BICYCLES

Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Park Street Northbound					Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
Start Time	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0
4:30 PM	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5:15 PM	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

AM PEAK HOUR ¹ 7:15 AM to 8:15 AM	Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

PM PEAK HOUR ¹ 4:15 PM to 5:15 PM	Park Street Northbound				Groton School Road Southbound				Fitchburg Road Eastbound				Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	1	3	0	0	0	0	0	0	0	0	3	2	0	0	0	0

¹ NOTE: Peak hour summaries here correspond to peak hours identified for passenger cars and heavy vehicles combined.

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 2
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Groton-Shirley Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
 Weather: Clouds & Sun, 70°F

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PASSENGER CARS & HEAVY VEHICLES COMBINED

Northbound					Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	0	0	0	0	1	0	3	0	6	98	0	0	0	21	2
7:15 AM	0	0	0	0	0	1	0	2	1	5	124	0	0	0	33	2
7:30 AM	0	0	0	0	0	2	0	4	0	10	132	0	0	0	31	0
7:45 AM	0	0	0	0	0	1	0	3	0	11	108	0	0	0	39	0
8:00 AM	0	0	0	0	0	2	0	2	0	5	90	0	0	0	29	1
8:15 AM	0	0	0	0	0	1	0	4	0	9	81	0	0	0	36	2
8:30 AM	0	0	0	0	0	0	0	3	0	7	65	0	0	0	45	0
8:45 AM	0	0	0	0	0	0	0	2	0	11	68	0	0	0	37	2

Northbound					Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
4:00 PM	0	0	0	0	0	2	0	15	0	9	40	0	0	0	112	3
4:15 PM	0	0	0	0	0	1	0	11	0	8	44	0	0	0	139	2
4:30 PM	0	0	0	0	0	1	0	11	0	4	46	0	0	0	131	2
4:45 PM	0	0	0	0	0	2	0	11	0	7	36	0	0	0	117	1
5:00 PM	0	0	0	0	0	2	0	4	0	5	29	0	0	0	124	1
5:15 PM	0	0	0	0	0	0	0	4	0	2	38	0	0	0	124	4
5:30 PM	0	0	0	0	0	0	0	12	0	10	38	0	0	0	119	2
5:45 PM	0	0	0	0	0	1	0	2	0	6	40	0	0	0	80	3

AM PEAK HOUR		Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
7:00 AM to 8:00 AM		U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
		0	0	0	0	0	5	0	12	1	32	462	0	0	0	124	4
PHF		0.00				0.71				0.87				0.82			
HV %		0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	3.1%	3.2%	0.0%	0.0%	0.0%	8.1%	0.0%

PM PEAK HOUR		Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
4:00 PM to 5:00 PM		U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
		0	0	0	0	0	6	0	48	0	28	166	0	0	0	499	8
PHF		0.00				0.79				0.93				0.90			
HV %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	0.0%	0.0%	4.8%	0.0%	0.0%	0.0%	4.0%	0.0%

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 2
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Groton-Shirley Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
 Weather: Clouds & Sun, 70°F

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HEAVY VEHICLES

Groton-Shirley Road									Fitchburg Road				Fitchburg Road			
Northbound					Southbound				Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
7:15 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0
7:30 AM	0	0	0	0	0	0	0	0	0	1	4	0	0	0	4	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0
8:30 AM	0	0	0	0	0	0	0	1	0	0	3	0	0	0	6	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	5	1

Groton-Shirley Road									Fitchburg Road				Fitchburg Road			
Northbound					Southbound				Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
4:00 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	4	0
4:15 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	6	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	8	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
5:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
5:30 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0

Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	0	0	0	0	1	0	0	0	1	15	0	0	0	10	0
PHF 0.00				0.25				0.50				0.63			

Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
0	0	0	0	0	0	0	2	0	0	8	0	0	0	20	0
PHF 0.00				0.50				0.50				0.63			

Client: Knowles Spofford
 Project #: 974_001_BSC
 BTM #: Location 2
 Location: Ayer, MA
 Street 1: Fitchburg Road
 Street 2: Groton-Shirley Road
 Count Date: 6/14/2022
 Day of Week: Tuesday
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BOSTON

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PEDESTRIANS & BICYCLES

Groton-Shirley Road																	Fitchburg Road				Fitchburg Road			
Northbound					Southbound				Eastbound				Westbound											
Start Time	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED								
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
8:00 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0								
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								

Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound				
Start Time	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0

AM PEAK HOUR ¹ 7:00 AM to 8:00 AM	Northbound				Groton-Shirley Road Southbound				Fitchburg Road Eastbound				Fitchburg Road Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PM PEAK HOUR ¹ 4:00 PM to 5:00 PM	Groton-Shirley Road								Fitchburg Road				Fitchburg Road			
	Northbound				Southbound				Eastbound				Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0

¹ NOTE: Peak hour summaries here correspond to peak hours identified for passenger cars and heavy vehicles combined.

Motor Vehicle Crash Rate Worksheets

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Ayer COUNT DATE : 2022

DISTRICT : 3 UNSIGNALIZED : ☒ SIGNALIZED : ☐

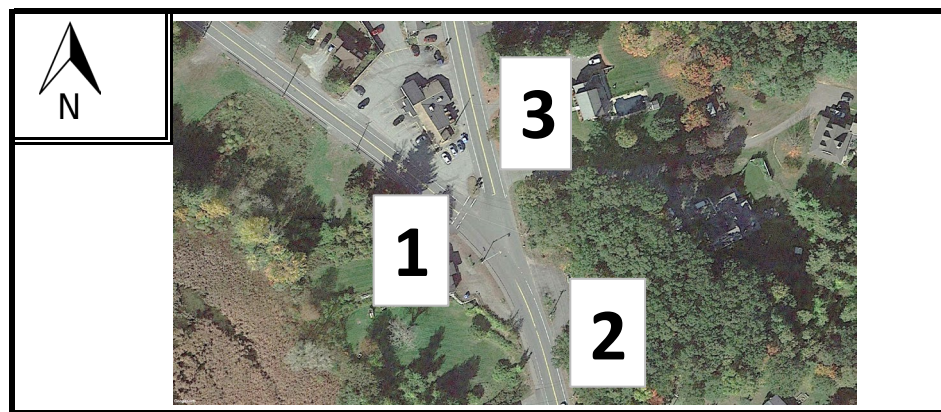
~ INTERSECTION DATA ~

MAJOR STREET : Fitchburg Road

MINOR STREET(S) : Groton School Road

Park Street

INTERSECTION
DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	NB	SB			
PEAK HOURLY VOLUMES (AM/PM) :	269	904	182			1,355

" K " FACTOR :

0.090

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

15,056

TOTAL # OF CRASHES :

7

OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR (A) :

1.40

CRASH RATE CALCULATION :

0.25

$$\text{RATE} = \frac{(A * 1,000,000)}{(V * 365)}$$

Comments : _____

Project Title & Date: _____

Trip Generation Calculations

Land Use: 220

Multifamily Housing (Low-Rise)

Description

Low-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have two or three floors (levels). Various configurations fit this description, including walkup apartment, mansion apartment, and stacked townhouse.

- A walkup apartment typically is two or three floors in height with dwelling units that are accessed by a single or multiple entrances with stairways and hallways.
- A mansion apartment is a single structure that contains several apartments within what appears to be a single-family dwelling unit.
- A fourplex is a single two-story structure with two matching dwelling units on the ground and second floors. Access to the individual units is typically internal to the structure and provided through a central entry and stairway.
- A stacked townhouse is designed to match the external appearance of a townhouse. But, unlike a townhouse dwelling unit that only shares walls with an adjoining unit, the stacked townhouse units share both floors and walls. Access to the individual units is typically internal to the structure and provided through a central entry and stairway.

Multifamily housing (mid-rise) (Land Use 221), multifamily housing (high-rise) (Land Use 222), affordable housing (Land Use 223), and off-campus student apartment (low-rise) (Land Use 225) are related land uses.

Land Use Subcategory

Data are presented for two subcategories for this land use: (1) not close to rail transit and (2) close to rail transit. A site is considered close to rail transit if the walking distance between the residential site entrance and the closest rail transit station entrance is ½ mile or less.

Additional Data

For the three sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.72 residents per occupied dwelling unit.

For the two sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96.2 percent of the total dwelling units were occupied.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip

generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

For the three sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.72 residents per occupied dwelling unit.

It is expected that the number of bedrooms and number of residents are likely correlated to the trips generated by a residential site. To assist in future analysis, trip generation studies of all multifamily housing should attempt to obtain information on occupancy rate and on the mix of residential unit sizes (i.e., number of units by number of bedrooms at the site complex).

The sites were surveyed in the 1980s, the 1990s, the 2000s, the 2010s, and the 2020s in British Columbia (CAN), California, Delaware, Florida, Georgia, Illinois, Indiana, Maine, Maryland, Massachusetts, Minnesota, New Jersey, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, and Washington.

Source Numbers

188, 204, 237, 300, 305, 306, 320, 321, 357, 390, 412, 525, 530, 579, 583, 638, 864, 866, 896, 901, 903, 904, 936, 939, 944, 946, 947, 948, 963, 964, 966, 967, 1012, 1013, 1014, 1036, 1047, 1056, 1071, 1076

Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday

Setting/Location: General Urban/Suburban

Number of Studies: 22

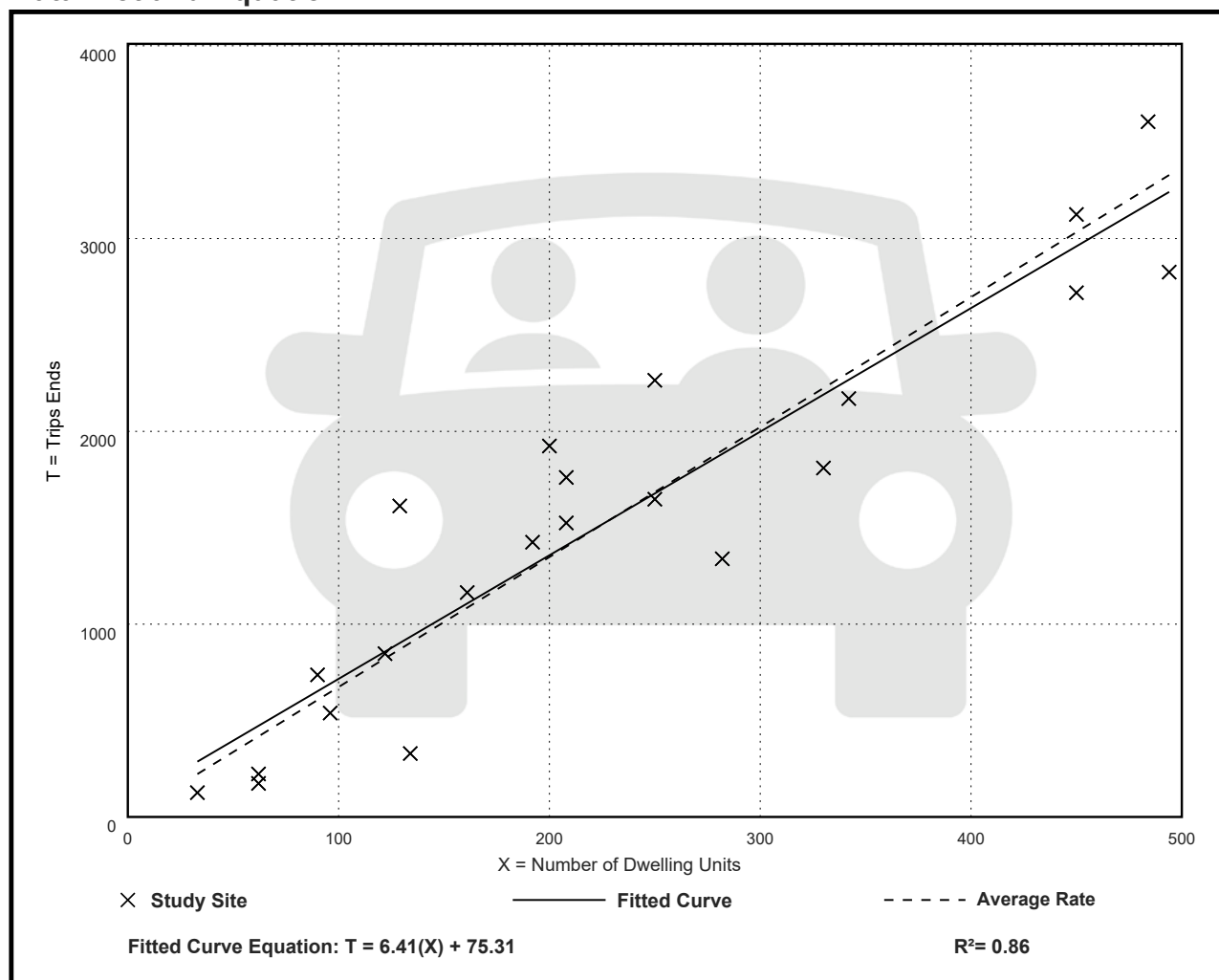
Avg. Num. of Dwelling Units: 229

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
6.74	2.46 - 12.50	1.79

Data Plot and Equation



Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 49

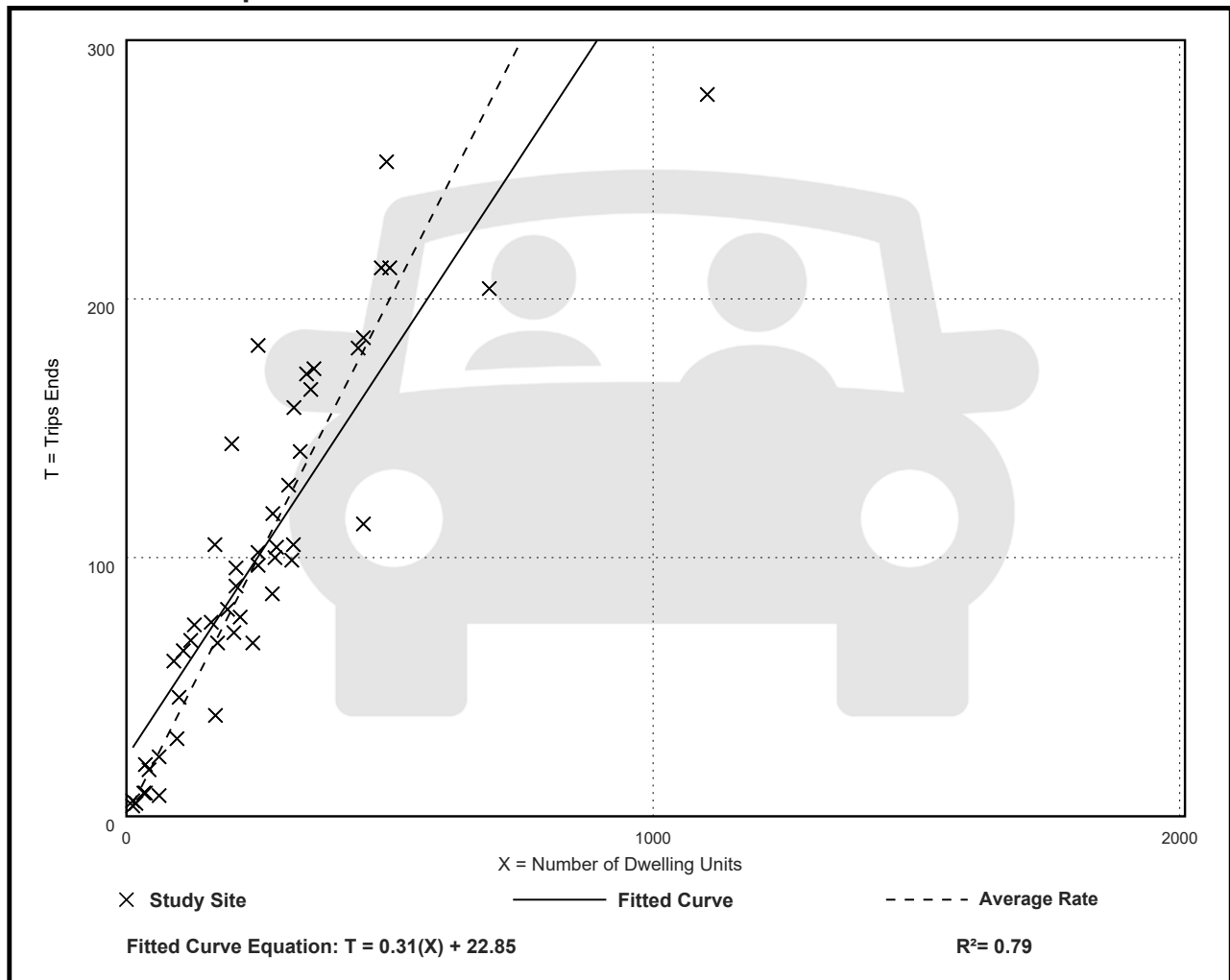
Avg. Num. of Dwelling Units: 249

Directional Distribution: 24% entering, 76% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.40	0.13 - 0.73	0.12

Data Plot and Equation



Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 59

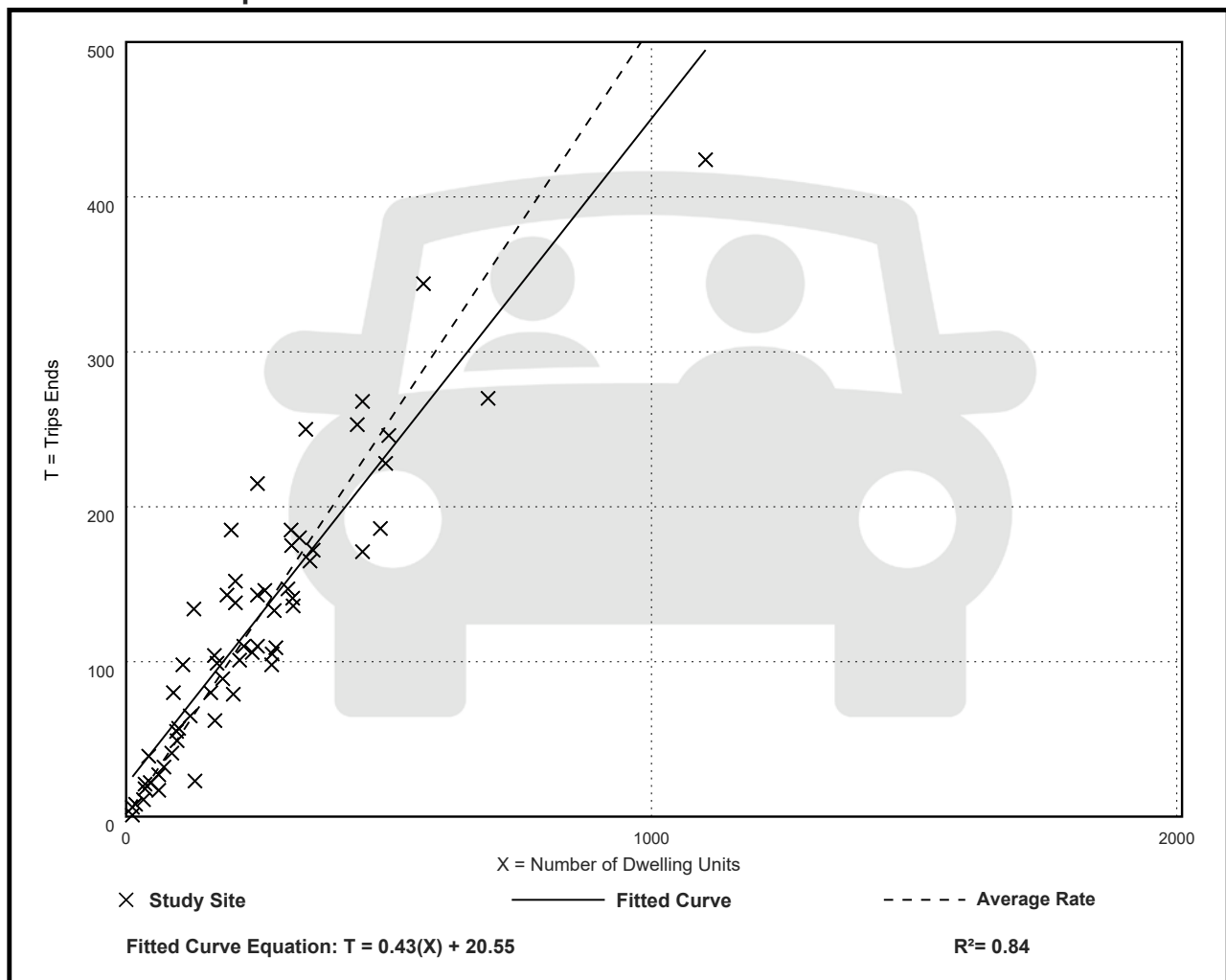
Avg. Num. of Dwelling Units: 241

Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.51	0.08 - 1.04	0.15

Data Plot and Equation



Land Use: 822

Strip Retail Plaza (<40k)

Description

A strip retail plaza is an integrated group of commercial establishments that is planned, developed, owned, and managed as a unit. Each study site in this land use has less than 40,000 square feet of gross leasable area (GLA). Because a strip retail plaza is open-air, the GLA is the same as the gross floor area of the building.

The 40,000 square feet GFA threshold between strip retail plaza and shopping plaza (Land Use 821) was selected based on an examination of the overall shopping center/plaza database. No shopping plaza with a supermarket as its anchor is smaller than 40,000 square feet GLA.

Shopping center (>150k) (Land use 820), shopping plaza (40-150k) (Land Use 821), and factory outlet center (Land Use 823) are related uses.

Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Alberta (CAN), California, Delaware, Florida, New Jersey, Ontario (CAN), South Dakota, Vermont, Washington, and Wisconsin.

Source Numbers

304, 358, 423, 428, 437, 507, 715, 728, 936, 960, 961, 974, 1009

Strip Retail Plaza (<40k) (822)

Vehicle Trip Ends vs: 1000 Sq. Ft. GLA
On a: Weekday

Setting/Location: General Urban/Suburban

Number of Studies: 4

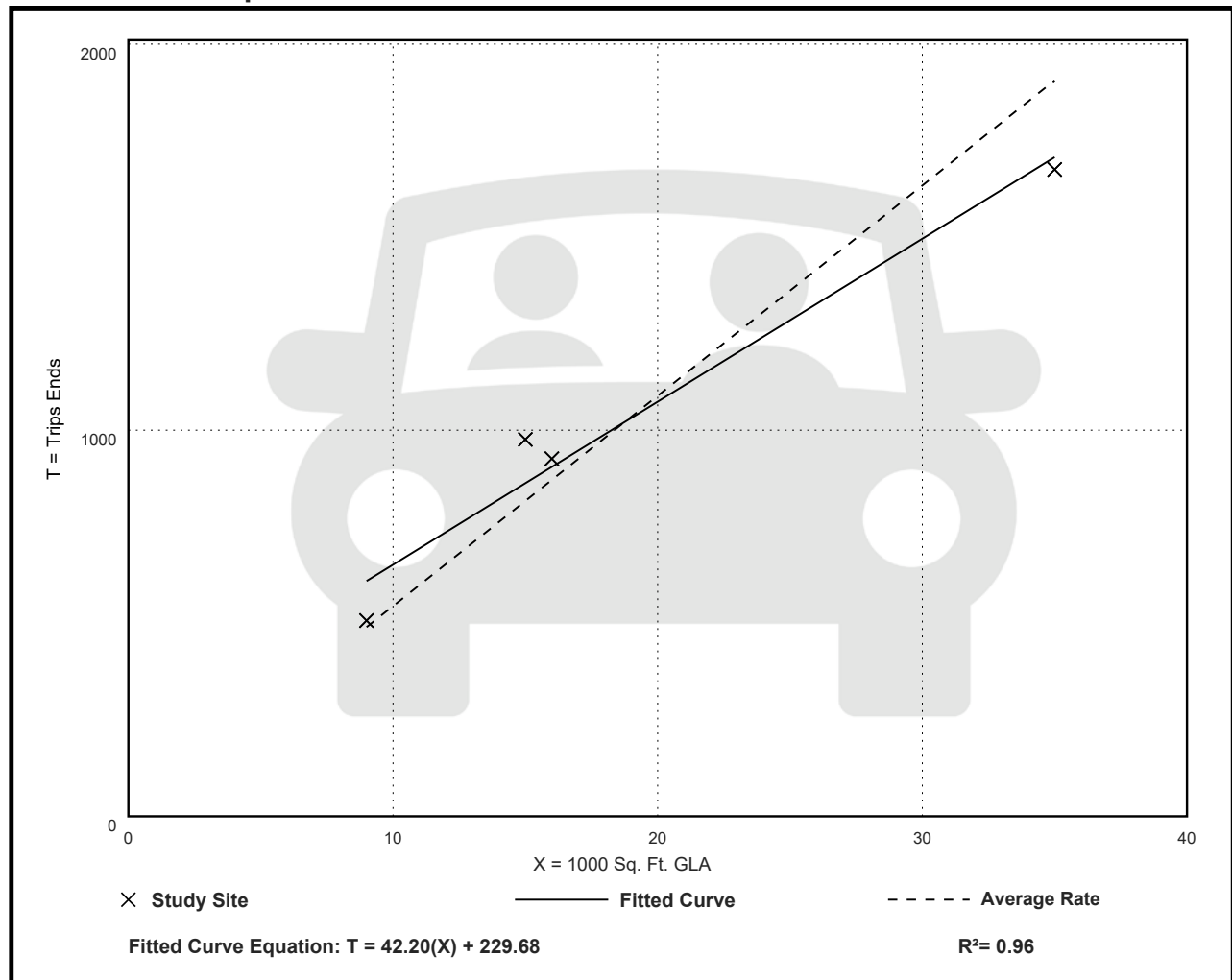
Avg. 1000 Sq. Ft. GLA: 19

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
54.45	47.86 - 65.07	7.81

Data Plot and Equation



Strip Retail Plaza (<40k) (822)

Vehicle Trip Ends vs: 1000 Sq. Ft. GLA

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 5

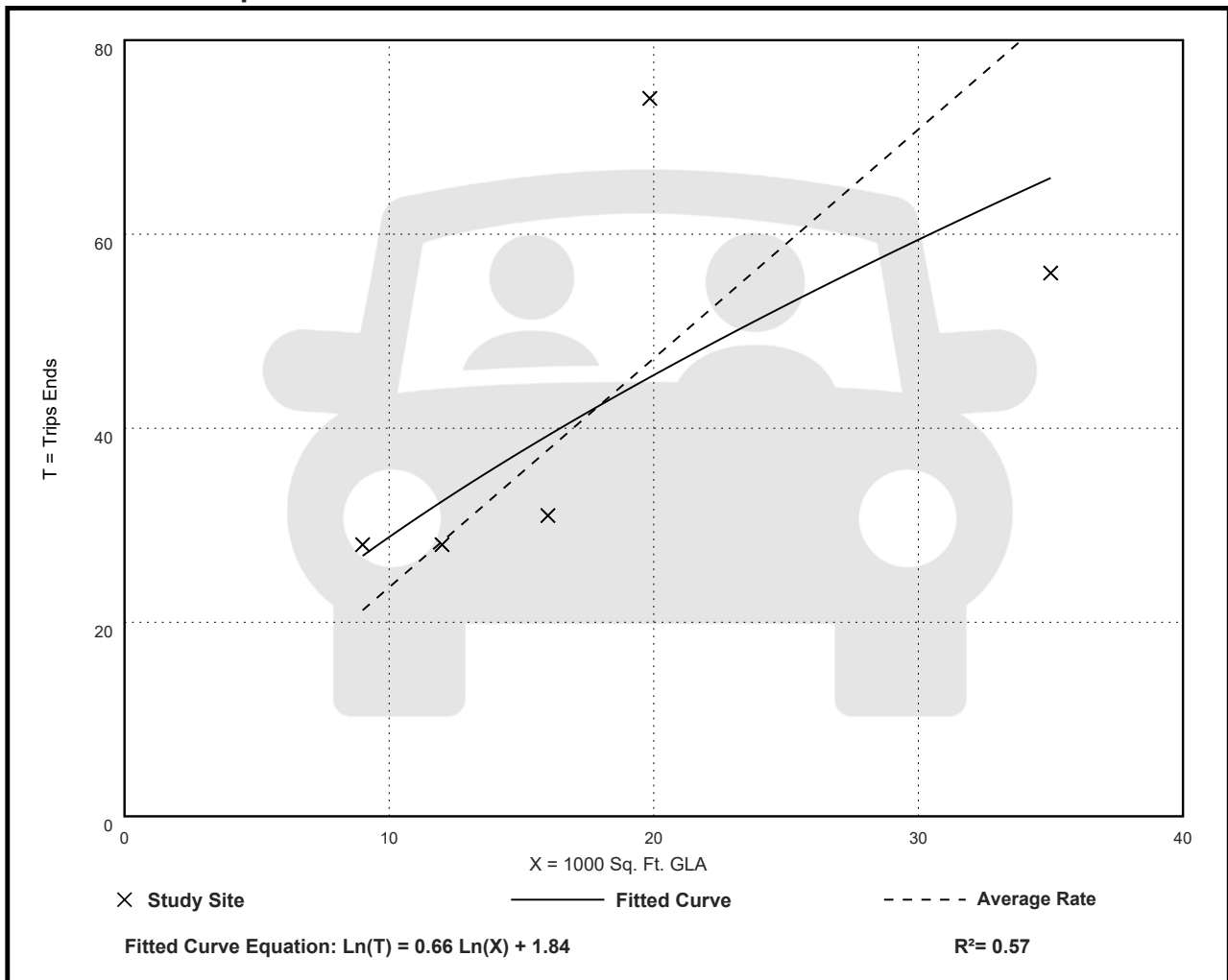
Avg. 1000 Sq. Ft. GLA: 18

Directional Distribution: 60% entering, 40% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
2.36	1.60 - 3.73	0.94

Data Plot and Equation



Strip Retail Plaza (<40k) (822)

Vehicle Trip Ends vs: 1000 Sq. Ft. GLA

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 25

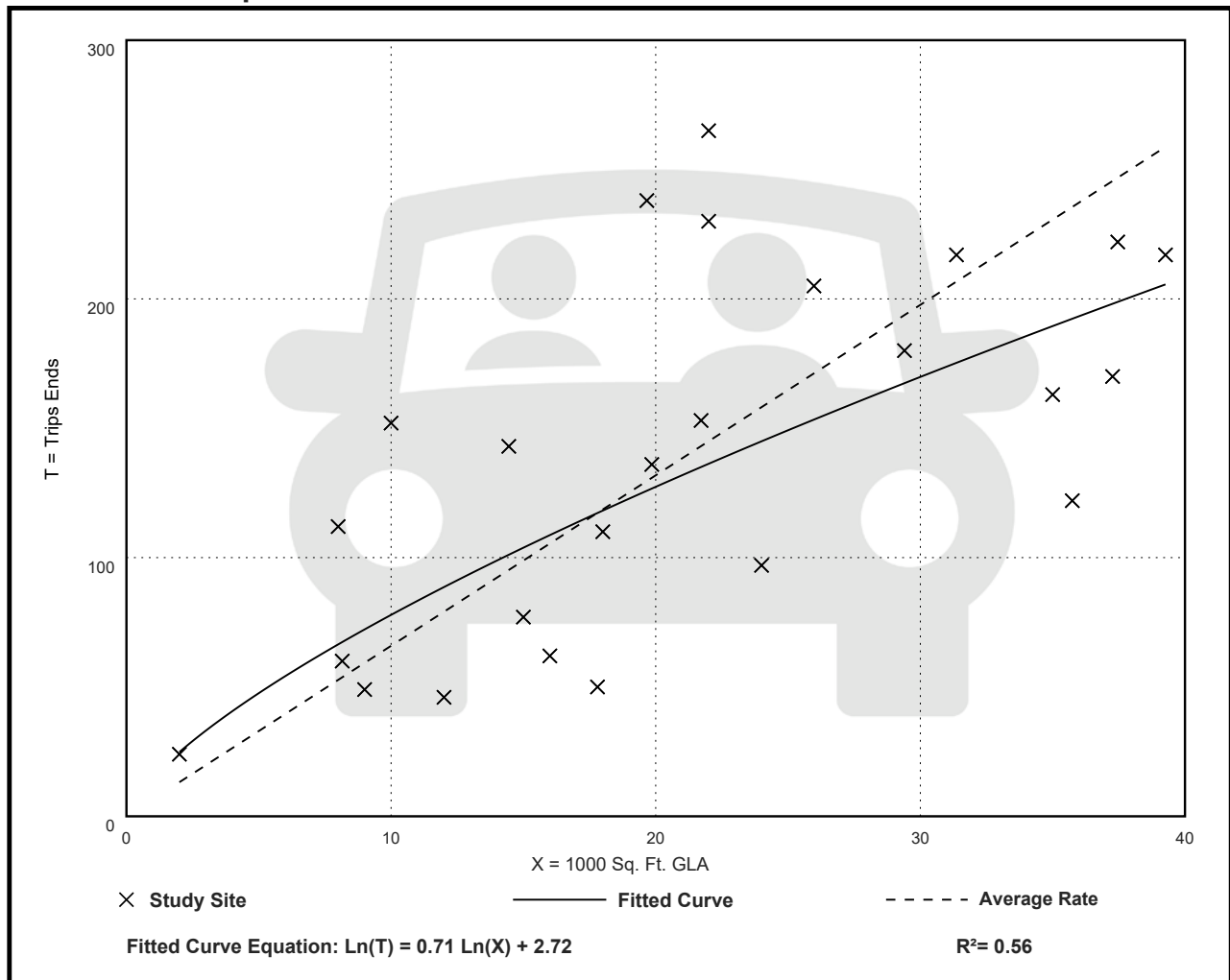
Avg. 1000 Sq. Ft. GLA: 21

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
6.59	2.81 - 15.20	2.94

Data Plot and Equation



Land Use: 843

Automobile Parts Sales

Description

An automobile parts sales facility specializes in the sale of automobile parts for maintenance and repair. The facilities within this land use are not typically equipped for on-site vehicle repair. Tire store (Land Use 848), tire superstore (Land Use 849), and automobile parts and service center (Land Use 943) are related uses.

Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1990s, the 2000s, and the 2010s in Alberta (CAN), Florida, Montana, New Hampshire, Texas, and Wisconsin.

Source Numbers

436, 439, 618, 881, 882, 959, 975, 1047

Automobile Parts Sales (843)

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
On a: Weekday

Setting/Location: General Urban/Suburban

Number of Studies: 14

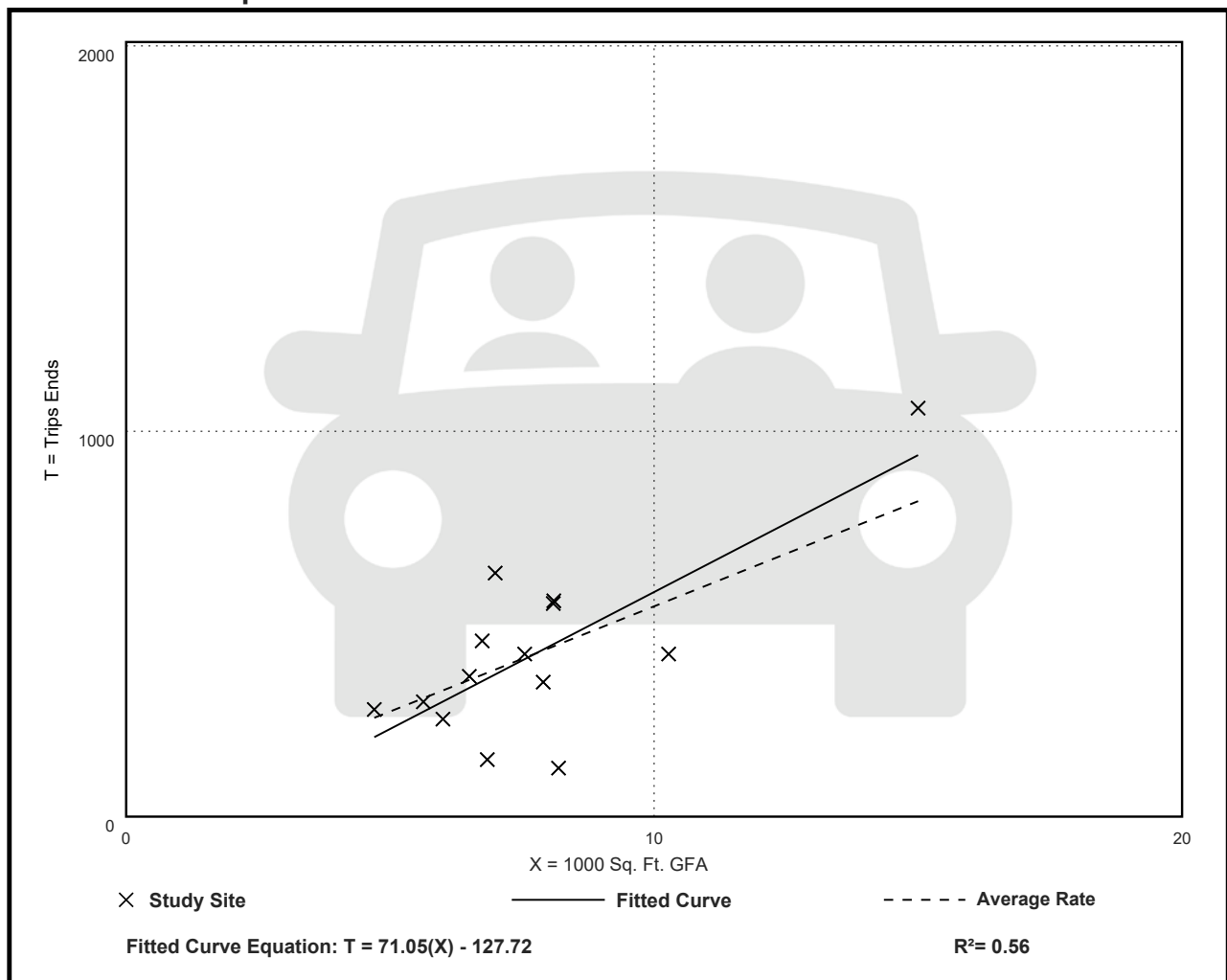
Avg. 1000 Sq. Ft. GFA: 8

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
54.57	15.38 - 90.41	20.19

Data Plot and Equation



Automobile Parts Sales (843)

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 14

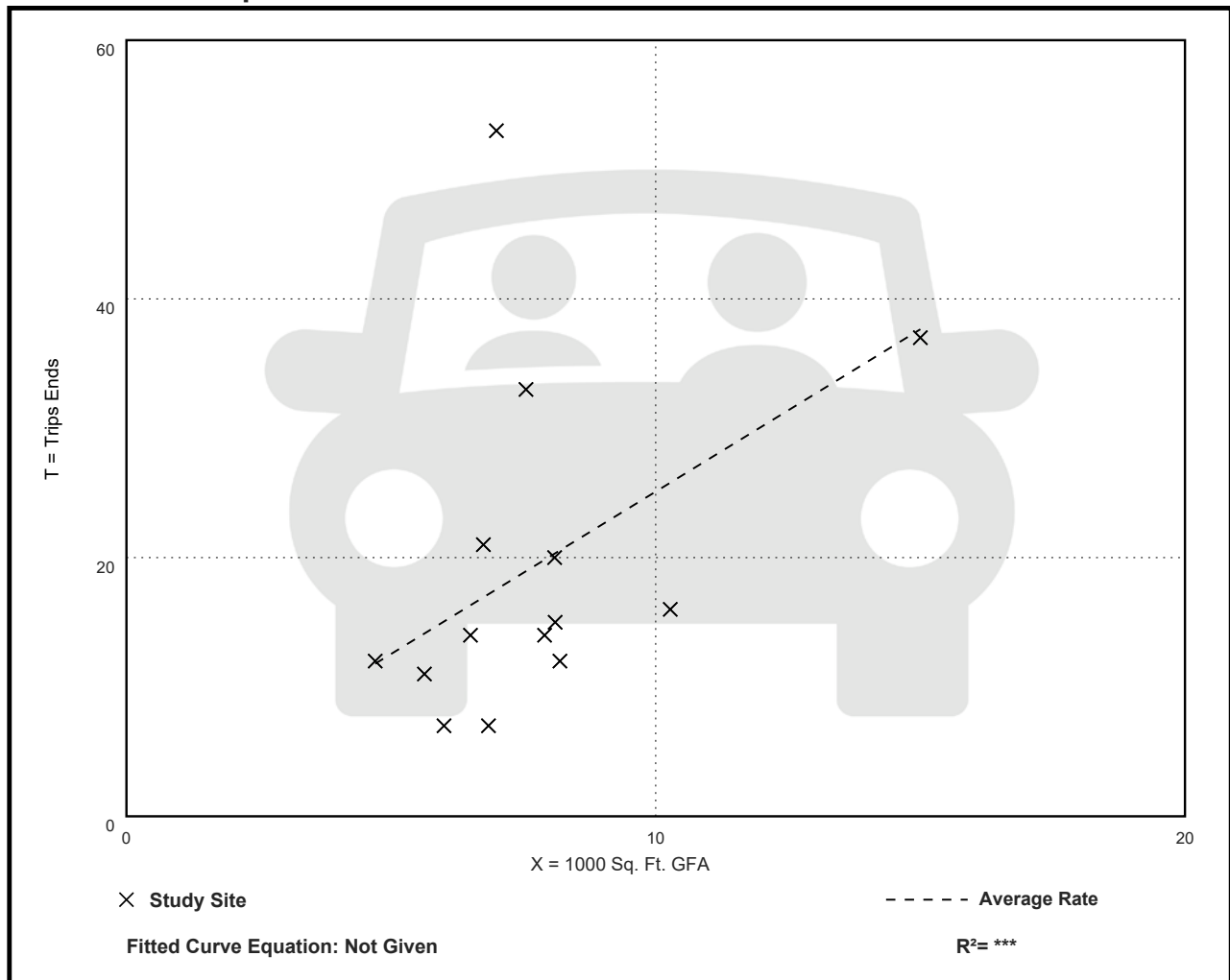
Avg. 1000 Sq. Ft. GFA: 8

Directional Distribution: 55% entering, 45% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
2.51	1.02 - 7.58	1.62

Data Plot and Equation



Automobile Parts Sales (843)

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 16

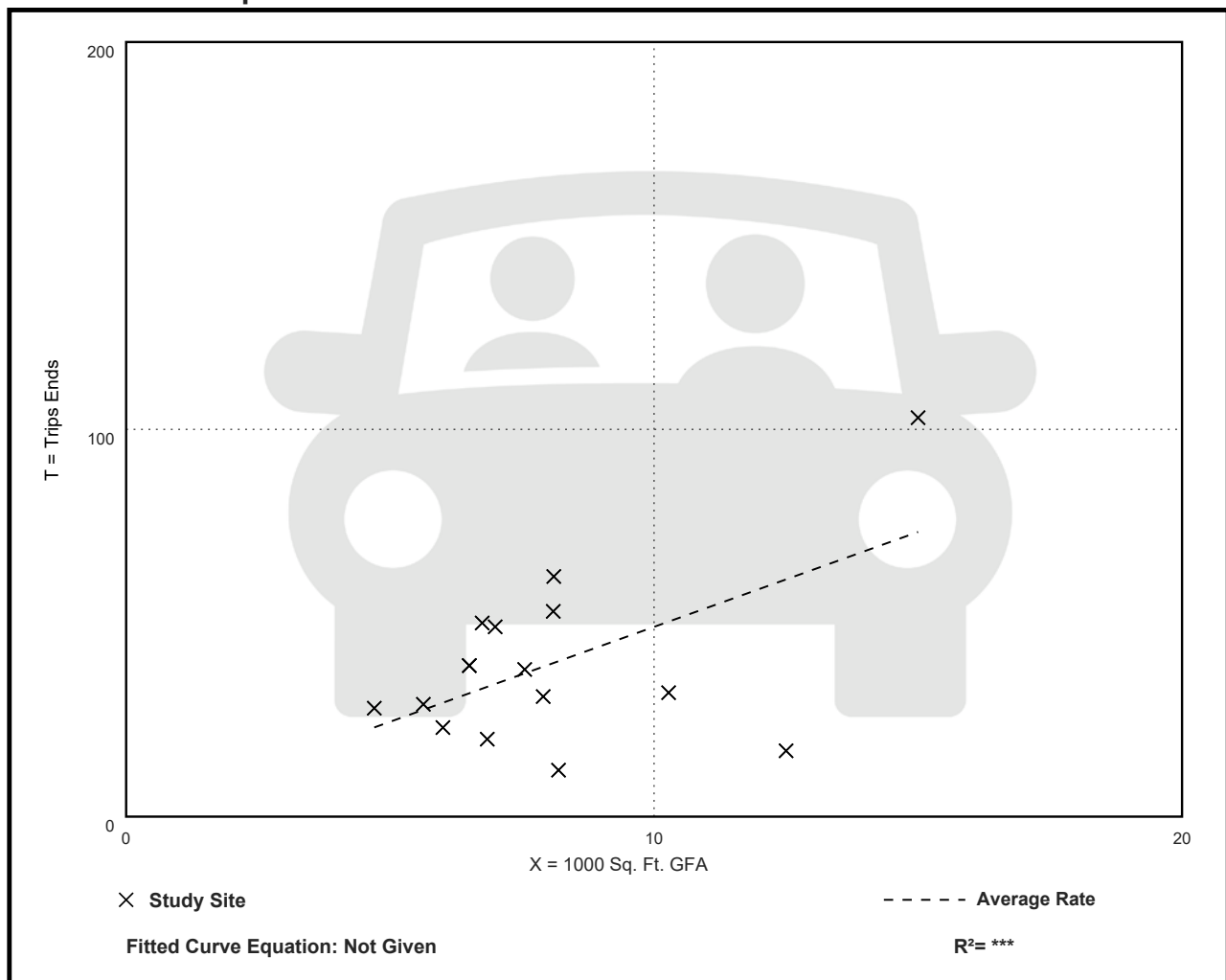
Avg. 1000 Sq. Ft. GFA: 8

Directional Distribution: 48% entering, 52% exiting










Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
4.90	1.36 - 7.65	2.17

Data Plot and Equation





















Traffic Operations Analysis

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	21	473	193	162	240	13
Future Volume (vph)	21	473	193	162	240	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	14%	3%	7%	7%	4%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	537	386	0	275	0
Sign Control		Free	Free		Stop	

Intersection Summary










Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 62.7%
 Analysis Period (min) 15
 ICU Level of Service B

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	21	473	193	162	240	13
Future Volume (Veh/h)	21	473	193	162	240	13
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)	23	514	210	176	261	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	386				858	298
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	386				858	298
tC, single (s)	4.2				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.4
p0 queue free %	98				18	98
cM capacity (veh/h)	1110				318	712
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	537	386	275			
Volume Left	23	0	261			
Volume Right	0	176	14			
cSH	1110	1700	327			
Volume to Capacity	0.02	0.23	0.84			
Queue Length 95th (ft)	2	0	185			
Control Delay (s)	0.6	0.0	54.0			
Lane LOS	A		F			
Approach Delay (s)	0.6	0.0	54.0			
Approach LOS			F			
Intersection Summary						
Average Delay			12.7			
Intersection Capacity Utilization			62.7%	ICU Level of Service	B	
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	32	462	124	4	5	12
Future Volume (vph)	32	462	124	4	5	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	8%	0%	20%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	537	139	0	18	0
Sign Control		Free	Free		Stop	

Intersection Summary










Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 46.2%
 Analysis Period (min) 15
 ICU Level of Service A










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	32	462	124	4	5	12
Future Volume (Veh/h)	32	462	124	4	5	12
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)	35	502	135	4	5	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)						
pX, platoon unblocked						
vC, conflicting volume	139				709	137
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	139				709	137
tC, single (s)	4.1				6.6	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.3
p0 queue free %	98				99	99
cM capacity (veh/h)	1438				366	917
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	537	139	18			
Volume Left	35	0	5			
Volume Right	0	4	13			
cSH	1438	1700	646			
Volume to Capacity	0.02	0.08	0.03			
Queue Length 95th (ft)	2	0	2			
Control Delay (s)	0.7	0.0	10.7			
Lane LOS	A		B			
Approach Delay (s)	0.7	0.0	10.7			
Approach LOS			B			
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization			46.2%		ICU Level of Service	A
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	24	517	218	174	258	15
Future Volume (vph)	24	517	218	174	258	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	14%	3%	7%	7%	4%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	588	426	0	296	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 68.6%
 Analysis Period (min) 15
 ICU Level of Service C










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	517	218	174	258	15
Future Volume (Veh/h)	24	517	218	174	258	15
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)	26	562	237	189	280	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	426				946	332
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	426				946	332
tC, single (s)	4.2				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.4
p0 queue free %	98				0	98
cM capacity (veh/h)	1072				281	681
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	588	426	296			
Volume Left	26	0	280			
Volume Right	0	189	16			
cSH	1072	1700	290			
Volume to Capacity	0.02	0.25	1.02			
Queue Length 95th (ft)	2	0	273			
Control Delay (s)	0.7	0.0	97.5			
Lane LOS	A		F			
Approach Delay (s)	0.7	0.0	97.5			
Approach LOS			F			
Intersection Summary						
Average Delay			22.3			
Intersection Capacity Utilization			68.6%		ICU Level of Service	C
Analysis Period (min)			15			










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	35	499	135	5	6	13
Future Volume (vph)	35	499	135	5	6	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	8%	0%	20%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	580	152	0	21	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 48.9%
Analysis Period (min) 15

ICU Level of Service A










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	499	135	5	6	13
Future Volume (Veh/h)	35	499	135	5	6	13
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)	38	542	147	5	7	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	152				768	150
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	152				768	150
tC, single (s)	4.1				6.6	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.3
p0 queue free %	97				98	98
cM capacity (veh/h)	1423				336	902
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	580	152	21			
Volume Left	38	0	7			
Volume Right	0	5	14			
cSH	1423	1700	578			
Volume to Capacity	0.03	0.09	0.04			
Queue Length 95th (ft)	2	0	3			
Control Delay (s)	0.8	0.0	11.5			
Lane LOS	A		B			
Approach Delay (s)	0.8	0.0	11.5			
Approach LOS			B			
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			48.9%		ICU Level of Service	A
Analysis Period (min)			15			










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	29	549	227	174	258	17
Future Volume (vph)	29	549	227	174	258	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	14%	3%	7%	7%	4%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	629	436	0	298	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 74.5%
 Analysis Period (min) 15










ICU Level of Service D









						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	29	549	227	174	258	17
Future Volume (Veh/h)	29	549	227	174	258	17
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)	32	597	247	189	280	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	436				1002	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	436				1002	342
tC, single (s)	4.2				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.4
p0 queue free %	97				0	97
cM capacity (veh/h)	1063				258	672
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	629	436	298			
Volume Left	32	0	280			
Volume Right	0	189	18			
cSH	1063	1700	268			
Volume to Capacity	0.03	0.26	1.11			
Queue Length 95th (ft)	2	0	315			
Control Delay (s)	0.8	0.0	129.0			
Lane LOS	A		F			
Approach Delay (s)	0.8	0.0	129.0			
Approach LOS			F			
Intersection Summary						
Average Delay			28.6			
Intersection Capacity Utilization			74.5%		ICU Level of Service	D
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	35	500	139	6	7	13
Future Volume (vph)	35	500	139	6	7	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	8%	0%	20%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	581	158	0	22	0
Sign Control		Free	Free		Stop	

Intersection Summary










Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 49.3%
 Analysis Period (min) 15
 ICU Level of Service A










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	500	139	6	7	13
Future Volume (Veh/h)	35	500	139	6	7	13
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)	38	543	151	7	8	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	158				774	154
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	158				774	154
tC, single (s)	4.1				6.6	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.3
p0 queue free %	97				98	98
cM capacity (veh/h)	1416				334	897
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	581	158	22			
Volume Left	38	0	8			
Volume Right	0	7	14			
cSH	1416	1700	556			
Volume to Capacity	0.03	0.09	0.04			
Queue Length 95th (ft)	2	0	3			
Control Delay (s)	0.8	0.0	11.7			
Lane LOS	A		B			
Approach Delay (s)	0.8	0.0	11.7			
Approach LOS			B			
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			49.3%		ICU Level of Service	A
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	22	247	570	334	165	17
Future Volume (vph)	22	247	570	334	165	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Heavy Vehicles (%)	0%	2%	3%	2%	1%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	292	961	0	197	0
Sign Control		Free	Free		Stop	

Intersection Summary










Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 67.2%
 Analysis Period (min) 15
 ICU Level of Service C








						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	22	247	570	334	165	17
Future Volume (Veh/h)	22	247	570	334	165	17
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Hourly flow rate (vph)	24	268	606	355	179	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	961				1100	784
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	961				1100	784
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				22	95
cM capacity (veh/h)	724				228	397
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	292	961	197			
Volume Left	24	0	179			
Volume Right	0	355	18			
cSH	724	1700	237			
Volume to Capacity	0.03	0.57	0.83			
Queue Length 95th (ft)	3	0	161			
Control Delay (s)	1.2	0.0	66.3			
Lane LOS	A		F			
Approach Delay (s)	1.2	0.0	66.3			
Approach LOS			F			
Intersection Summary						
Average Delay			9.2			
Intersection Capacity Utilization			67.2%	ICU Level of Service	C	
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	166	499	8	6	48
Future Volume (vph)	28	166	499	8	6	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	4%	0%	0%	4%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	208	551	0	59	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 42.5%
 Analysis Period (min) 15
 ICU Level of Service A










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	28	166	499	8	6	48
Future Volume (Veh/h)	28	166	499	8	6	48
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	178	542	9	7	52
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	551				784	546
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	551				784	546
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				98	90
cM capacity (veh/h)	1029				354	533
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	208	551	59			
Volume Left	30	0	7			
Volume Right	0	9	52			
cSH	1029	1700	503			
Volume to Capacity	0.03	0.32	0.12			
Queue Length 95th (ft)	2	0	10			
Control Delay (s)	1.5	0.0	13.1			
Lane LOS	A		B			
Approach Delay (s)	1.5	0.0	13.1			
Approach LOS			B			
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			42.5%		ICU Level of Service	A
Analysis Period (min)			15			



						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	26	288	633	359	177	20
Future Volume (vph)	26	288	633	359	177	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Heavy Vehicles (%)	0%	2%	3%	2%	1%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	341	1055	0	214	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 72.9%
 Analysis Period (min) 15










ICU Level of Service C










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	26	288	633	359	177	20
Future Volume (Veh/h)	26	288	633	359	177	20
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Hourly flow rate (vph)	28	313	673	382	192	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1055				1233	864
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1055				1233	864
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				0	94
cM capacity (veh/h)	668				188	357
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	341	1055	214			
Volume Left	28	0	192			
Volume Right	0	382	22			
cSH	668	1700	198			
Volume to Capacity	0.04	0.62	1.08			
Queue Length 95th (ft)	3	0	251			
Control Delay (s)	1.4	0.0	137.9			
Lane LOS	A		F			
Approach Delay (s)	1.4	0.0	137.9			
Approach LOS			F			
Intersection Summary						
Average Delay			18.6			
Intersection Capacity Utilization			72.9%		ICU Level of Service	C
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	31	184	541	9	7	52
Future Volume (vph)	31	184	541	9	7	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	4%	0%	0%	4%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	231	598	0	65	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 46.3%
 Analysis Period (min) 15
 ICU Level of Service A










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	31	184	541	9	7	52
Future Volume (Veh/h)	31	184	541	9	7	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	198	588	10	8	57
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	598				857	593
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	598				857	593
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				97	89
cM capacity (veh/h)	989				319	502
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	231	598	65			
Volume Left	33	0	8			
Volume Right	0	10	57			
cSH	989	1700	469			
Volume to Capacity	0.03	0.35	0.14			
Queue Length 95th (ft)	3	0	12			
Control Delay (s)	1.5	0.0	13.9			
Lane LOS	A		B			
Approach Delay (s)	1.5	0.0	13.9			
Approach LOS			B			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			46.3%		ICU Level of Service	A
Analysis Period (min)			15			










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	29	306	666	359	177	25
Future Volume (vph)	29	306	666	359	177	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		393	363		1467	
Travel Time (s)		8.9	8.3		33.3	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Heavy Vehicles (%)	0%	2%	3%	2%	1%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	365	1091	0	219	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 74.9%
 Analysis Period (min) 15

ICU Level of Service D










						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	29	306	666	359	177	25
Future Volume (Veh/h)	29	306	666	359	177	25
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.92	0.92
Hourly flow rate (vph)	32	333	709	382	192	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1091				1297	900
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1091				1297	900
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				0	92
cM capacity (veh/h)	647				171	340
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	365	1091	219			
Volume Left	32	0	192			
Volume Right	0	382	27			
cSH	647	1700	182			
Volume to Capacity	0.05	0.64	1.20			
Queue Length 95th (ft)	4	0	292			
Control Delay (s)	1.6	0.0	184.2			
Lane LOS	A		F			
Approach Delay (s)	1.6	0.0	184.2			
Approach LOS			F			
Intersection Summary						
Average Delay			24.4			
Intersection Capacity Utilization			74.9%		ICU Level of Service	D
Analysis Period (min)			15			

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	31	188	543	10	8	52
Future Volume (vph)	31	188	543	10	8	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30	30		30	
Link Distance (ft)		254	1051		367	
Travel Time (s)		5.8	23.9		8.3	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	4%	0%	0%	4%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	235	601	0	66	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 46.5%
 Analysis Period (min) 15

ICU Level of Service A

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	31	188	543	10	8	52
Future Volume (Veh/h)	31	188	543	10	8	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	202	590	11	9	57
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	601				864	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	601				864	596
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				97	89
cM capacity (veh/h)	986				317	500
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	235	601	66			
Volume Left	33	0	9			
Volume Right	0	11	57			
cSH	986	1700	464			
Volume to Capacity	0.03	0.35	0.14			
Queue Length 95th (ft)	3	0	12			
Control Delay (s)	1.5	0.0	14.1			
Lane LOS	A		B			
Approach Delay (s)	1.5	0.0	14.1			
Approach LOS			B			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			46.5%		ICU Level of Service	A
Analysis Period (min)			15			