MEMORANDUM

TO: Saverio Fulciniti
GSC Management, LLC
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Peabody, MA 01961

FROM: Scott W. Thornton, P.E. *and*
Stephan Zaets, P.E.
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DATE: October 21, 2025

RE: 10465

SUBJECT: Transportation Impact Assessment
Proposed Mixed-Use Development – 281 Main Street
Reading, Massachusetts

Vanasse & Associates, Inc. (VAI) has prepared this Transportation Impact Assessment (TIA) in order to identify traffic impacts associated with a proposed mixed-use development to be located at 281 Main Street in Reading, Massachusetts (hereafter referred to as the "Project"). The purpose of this memorandum is to review existing and future traffic conditions in the vicinity of the Project site, determine the traffic impact of the proposed Project at key intersections expected to experience increased traffic levels from the Project, and review the need for improvements to mitigate the Project's traffic impact.

PROJECT DESCRIPTION

The Project entails the redevelopment of an existing 0.77-acre lot containing office use. The proposed mixed-use scheme incorporates multifamily housing of 23 units above the first floor, which will include approximately 3,600 square feet (sf) of retail space. The Project site is bordered by Main Street (Route 28) to the west, commercial properties to the north and south, and wooded areas to the east.

Vehicle access to and from the Project will be provided via an existing curb cut to Route 28. No new curb cuts to public roadways are being proposed as part of the development.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in September 2025. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits, sight distance, and land use information within the study area. The study area for the Project includes the intersection of the Project driveway and Route 28. The study area is graphically depicted in Figure 1.

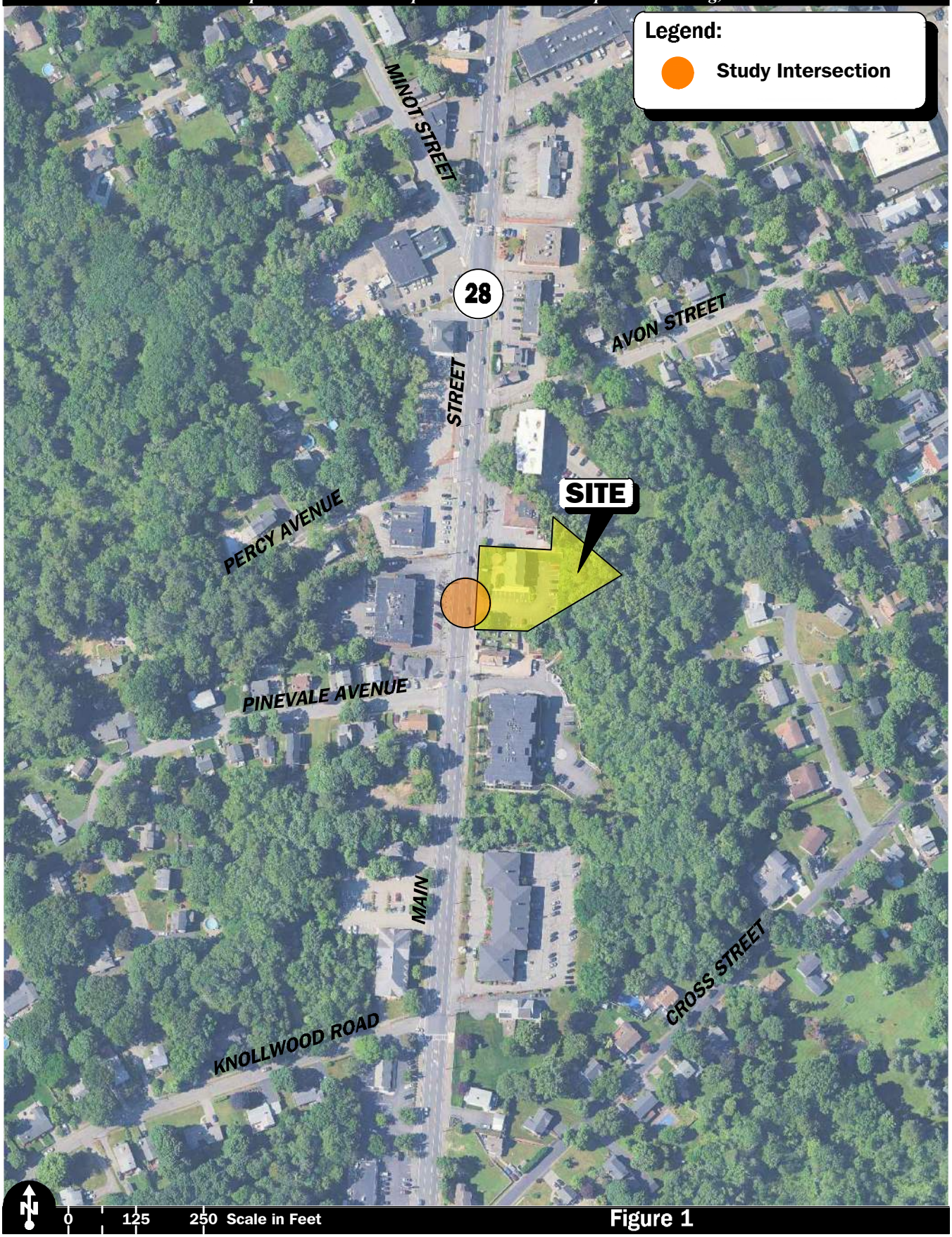

Figure 1

Site Location Map

Vanasse & Associates inc

The following describes the study area roadway and intersection:

Study Area

Roadway

Route 28 (Main Street)

Route 28 is a two- to three-lane principal arterial roadway under the Massachusetts Department of Transportation's (MassDOT) jurisdiction. In the study area, Route 28 features one (1) 11.5-foot-wide travel lane per direction, separated by an 11.5-foot-wide two-way left-turn lane. Illumination is provided within the study area through lights attached to utility poles. The posted speed limit along Route 28 within the study area is 40 miles per hour (mph). Land use within this area consists primarily of commercial properties.

Intersections

Figure 2 summarizes existing traffic control, lane use, travel lane widths, and pedestrian accommodations in the study area as observed in October 2025.

Existing Traffic Volumes

In order to establish base traffic-volume demands and flow patterns within the study area, manual turning movement counts (TMCs) were completed in October 2025. TMCs were conducted on Wednesday, October 8, 2025, during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods.

Traffic-Volume Adjustments

In order to develop 2025 Existing traffic-volume conditions, the MassDOT weekday seasonal factors for Urban Group 3 (Other Principal Arterial) were reviewed.[1] Based on a review of this data, it was determined that traffic volumes for the month of October are above average-month conditions. As such, the traffic volumes were not adjusted.

MassDOT no longer requires pandemic-related adjustments of traffic counts performed after March 2022, except in locations where the predominant land use consists of offices or similar uses.[2] No further adjustment beyond the seasonal adjustment is necessary. The 2025 Existing traffic volumes are summarized in Table 1, with weekday morning and weekday evening peak-hour traffic volumes graphically depicted on Figure 3.

[1] MassDOT statewide Traffic Data Collection; 2024 Weekday Seasonal Factors, Groups U3.

[2] *25% Design Submission Guidelines*; MassDOT Highway Division, Traffic and Safety Engineering; Revised May 31, 2022.

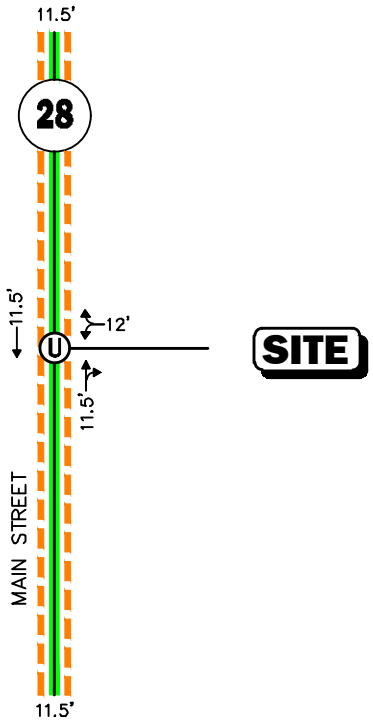

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Figure 2

Existing Intersection Lane Use, Travel Lane Width, and Pedestrian Facilities

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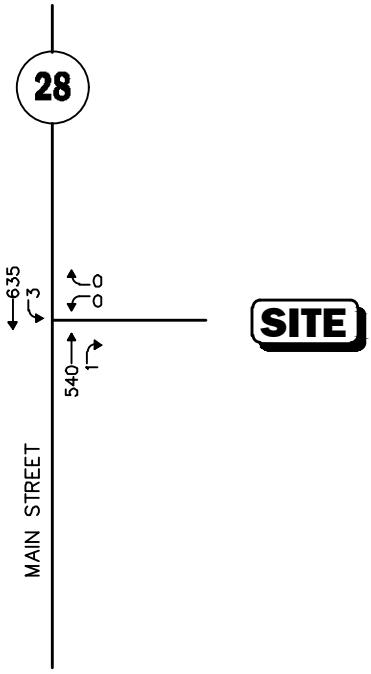
WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)

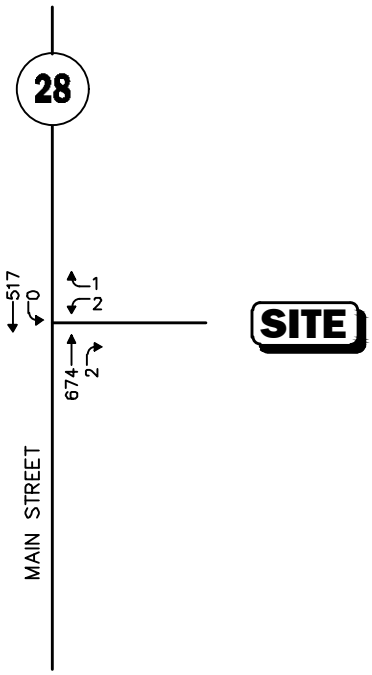


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Figure 3

2025 Existing
Peak-Hour Traffic Volumes

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Table 1
EXISTING ROADWAY TRAFFIC-VOLUME SUMMARY

Location/Peak Hour	Volume (vph)[a]	Directional Distribution[b]
Route 28, south of Project Site Driveway:		
Weekday Morning	1,176	54.0% SB
Weekday Evening	1,195	56.6% NB

Source: TMCs conducted by VAI in October 2025.
[a]Two-way peak-hour volume expressed in vehicles per hour.
[b]Percent traveling in peak direction.

As can be seen in Table 1, Route 28, north of the Project site driveway, was observed to carry approximately 1,176 vehicles per hour (vph) during the weekday morning peak hour and 1,195 vph during the weekday evening peak hour. During the weekday morning peak hour, 54.0 percent of the traffic travels southbound while 56.6 percent of the traffic travels northbound during the weekday evening peak hour.

Pedestrian and Bicycle Facilities

An inventory of pedestrian and bicycle facilities within the study area was undertaken in October 2025. There are sidewalk segments on both sides of Route 28, but no pedestrian accommodations to cross the roadway. Shoulders on Route 28 are approximately 4 feet wide, which would accommodate a bicyclist per MassDOT standards.

Public Transportation

The Town of Reading is supported by the Massachusetts Bay Transportation Authority (MBTA); however, there are no existing routes within or adjacent to the study area.

Motor Vehicle Crash Data

Motor vehicle crash information for the study area intersection was provided by the MassDOT Safety Management/Traffic Operations Unit for the most recent five-year period available (2017 through 2021) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized in Table 2 by intersection, type, weather condition, lighting condition, pavement condition, and severity.

Table 2
MOTOR VEHICLE CRASH DATA SUMMARY

Scenario	Main Street (Route 28) at Site Driveway
Year:	
2017	0
2018	2
2019	3
2020	1
2021	1
Total	8
Average[a]	1.6
Crash Rate[b]	0.33
Significant[c]	No
Type:	
Angle	0
Animal	0
Rear-End	2
Head-On	0
Sideswipe	2
Fixed Object	4
Pedestrian/Bike	0
Total	8
Weather Conditions:	
Clear	7
Cloudy/Rain	1
Snow/Ice	0
Fog	0
Total	8
Lighting Conditions:	
Daylight	8
Dawn/Dusk	0
Dark (lit)	0
Dark (unlit)	0
Total	8
Pavement Conditions :	
Dry	7
Wet	1
Snow/Ice	0
Total	8
Severity:	
Property Damage Only	6
Personal Injury	2
Fatality	0
Total	8

[a]Average number of crashes over five-year period.
[b]Crash rate per million entering vehicles (mev).
[c]Significant if crash rate >.57 for unsignalized intersections. intersections (MassDOT District 4/Statewide rates)
Source: MassDOT Crash Data, 2017 through 2021.

As can be seen in Table 2, the unsignalized intersection of Route 28 at the existing site driveway experienced 8 crashes over the five-year period, averaging 1.6 crashes per year. The majority of these

collisions were single vehicle crashes, followed by sideswipe and rear-end crashes. A majority of these craches occurred in daylight, on dry roadways, and resulted in property damage only. No fatalities were reported over the five-year period. The crash rate for the study intersection was observed to be lower than the MassDOT District 4/Statewide crash rates.

FUTURE CONDITIONS

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, existing traffic volumes in the study area were projected to the year 2032. Traffic volumes on the roadway network at that time, in the absence of the Project (i.e., the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others expected to be completed by 2032. Inclusion of these factors resulted in the development of 2032 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop the 2032 Build traffic-volume conditions.

Future Traffic Growth

Traffic growth on area roadways is a function of the expected land development impacting the study area. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all existing traffic volumes under study. In addition, we research the location and type of planned development affecting the study area.

General Background Growth

To assess general traffic growth trends within the study area, MassDOT traffic-volume data from surrounding towns were summarized and reviewed. Based on a review of this data and other area traffic studies, it was determined that the traffic volumes in the area are decreasing by approximately 2 percent per year on average.

In order to provide a prudent planning condition for the Project, a higher 0.5 percent annual compounded traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Specific Development by Others

The Town of Reading's Planning Department was contacted in order to determine if there are any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following developments have been identified:

- ***Proposed Mixed-Use Development – 459 Main Street –*** This project entails transforming an auto garage into a mixed-used development with 20 residential units above 1,542 sf ground floor retail space. This development is nearing completion of construction and is anticipated to be occupied by the 2032 No-Build and Build conditions. Traffic volumes associated with this development were obtained from a traffic study prepared for the project[3] and were added to the future condition traffic volumes.

- ***Proposed Mixed-Use Development – 252, 258, and 262 Main Street and 10 Pinevale Avenue –*** This project entails razing a commercial property and several residential properties to create a

[3] *Transportation Impact Assessment*, Proposed Mixed-Use Development, 549 Main Street, Reading; TEC; Novermber 2021.

mixed-use building consisting of 6,150 sf of commercial space, 2,000 sf of sit-down restaurant space, and 40 residential units. This development has been recently approved and is anticipated to be constructed and occupied by the 2032 No-Build and Build conditions. Traffic volumes associated with this development were obtained from a traffic study prepared for the project[4]. It is noted that the project was approved by the Planning Board with 30 residential units with 7,500 square feet of commercial space. To provide a more conservative estimate, the traffic volumes from the original traffic study were added to the future condition traffic volumes.

- ***Proposed Mixed-Use Development – 346-348 Main Street –*** This project entails the transformation of a three-story office building to 750 sf of office space with 12 residential dwelling units above. This development is under review within the Town and is anticipated to be constructed and occupied by the 2032 No-Build and Build conditions. Project-generated traffic is anticipated to be covered within the study's background growth rate based on the traffic study's[5] reported volumes.

- ***Primrose Childcare Center – 885 Main Street –*** This project entails the transformation of an existing residential development into a 14,058-sf child day care center. This development is under review within the Town and is anticipated to be constructed and occupied by the 2032 No-Build and Build conditions. Traffic volumes associated with this development were obtained from a traffic study prepared for the project[6] and were added to the future condition traffic volumes.

Planned Roadway Improvements

MassDOT was contacted in order to determine if there are any planned roadway improvements within the study area. At this time, there are no planned roadway improvements identified that would affect future No-Build or Build conditions.

No-Build Traffic Volumes

The 2032 No-Build peak-hour traffic-volume networks were developed by applying the 0.5 percent per year compounded annual background traffic growth rate to the 2025 Existing peak-hour traffic volumes for a seven-year period and including the Project trips from the background projects as noted above. The resulting 2032 No-Build weekday morning and weekday evening peak-hour traffic-volume networks are shown on Figure 4.

PROJECT-GENERATED TRAFFIC

Project Site Existing Trips

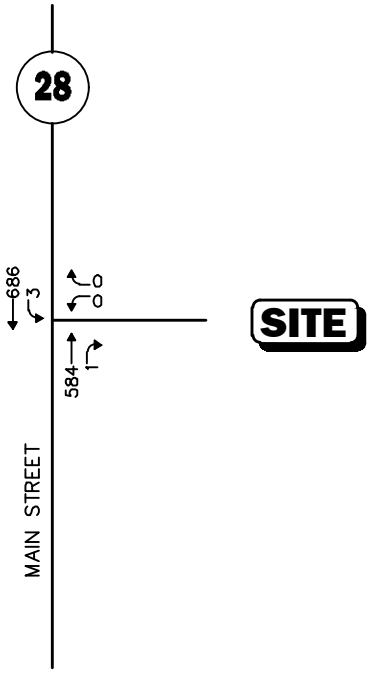
The Project site currently consists of a single building occupied for office use. The building currently hosts two businesses: Bay State Physical Therapy and BoliColi Insurance Agency. Since both of these businesses were operational during the counts, existing site trips were removed from the Build conditions. The network reduction of trips from the existing site is shown in the Appendix.

[4] *Transportation Impact Assessment*, Proposed Mixed-Use Development, 252, 258 & 262 Main Street, Reading; VAI; October 2023.

[5] *Trip Generation Letter*, Proposed Mixed-Use Development, 346-348 Main Street, Reading; GPI; June 2025.

[6] *Transportation Impact Assessment*, Proposed Childcare Center,885 Main Street; Stonefield Engineering; July 2025.

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)

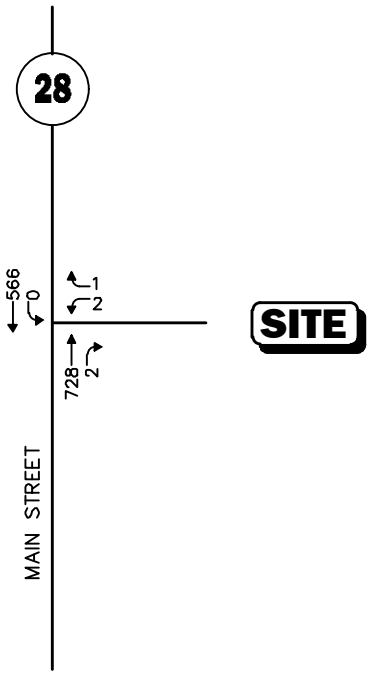


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Figure 4

2032 No-Build
Peak-Hour Traffic Volumes

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Project Future Trip Generation

In order to develop the traffic characteristics of the proposed Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[7] for similar land uses as those proposed were used. ITE Land Use Codes (LUC) 220, *Multifamily Housing (Low Rise)* and 822, *Strip Retail Plaza (<40k)*, was used to develop the anticipated traffic characteristics of the Project.

Trip-generation calculations were performed for typical weekday morning and evening peak hours, the critical time periods for Project-related traffic activity. A summary of the expected vehicle-trip generation is summarized in Table 3.

Table 3
PROJECT TRIP-GENERATION SUMMARY

Time Period/ Directional Distribution	Residential Trips[a] (A)	Retail Trips[b] (B)	New Trips (C=A+B)
Weekday Daily	144	196	340
Weekday Morning Peak Hour:			
Entering	2	8	10
Exiting	7	6	13
Total	9	14	23
Weekday Evening Peak Hour:			
Entering	7	12	19
Exiting	5	12	17
Total	12	24	36

Source: Trip Generation, 12th Edition; ITE.
[a]Based on ITE LUC 220, *Multifamily Housing (Low Rise);* 23 Dwelling units.
[b]Based on ITE LUC 822, *Strip Retail Plaza (<40k):* 3,600 sf.

As shown below in Table 3, the Project is expected to generate approximately 340 new vehicle trips on an average weekday, with 23 new vehicle trips (10 entering and 13 exiting) during the weekday morning peak hour and 36 new vehicle trips (19 entering and 17 exiting) during the weekday evening peak hour.

Trip Distribution and Assignment

The directional distribution of site-generated trips to and from the proposed mixed-use development was developed based on a review of *Journey-to-work* data provided by the United States Census Bureau,[8] which identifies the employer locations of individuals residing in Reading. In addition, these distributions were further refined based on the site's location relative to the developed area and an evaluation of existing travel

[7]*Trip Generation,* 12th Edition; Institute of Transportation Engineers; Washington, DC; 2025.

[8]Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2021).

patterns within the study area. The trip distribution for the Project is summarized in Table 4 and graphically depicted in Figure 5.

Table 4
TRIP-DISTRIBUTION SUMMARY

Roadway	Direction (To/From)	Distribution Percentage (To/From)
Route 28	North	23
Route 28	South	77
TOTAL		**100**

The weekday morning and evening peak-hour traffic volumes expected to be generated by the Project were assigned on the study area roadway network as shown on Figure 6.

Future Traffic Volumes – Build Condition

The 2032 Build condition networks consist of the 2032 No-Build traffic volumes with anticipated Project-generated traffic added to them. The 2032 Build weekday morning and weekday eveningpeak-hour traffic-volume networks are graphically depicted on Figure 7.

A summary of peak-hour projected traffic-volume increases external to the study area, which is the subject of this assessment, is shown in Table 5. These volumes are based on the expected increases from the Project.

Table 5
PEAK-HOUR TRAFFIC-VOLUME INCREASES[a]

Location/Peak Hour	2032 No-Build	2032 Build	Traffic-Volume Increase Over No-Build	Percent Increase Over No-Build
Route 28, south of Project Site Driveway:				
Weekday Morning	1,271	1,288	17	1.3
Weekday Evening	1,298	1,322	24	1.8

[a]Two-way traffic volumes.

As shown in Table 5, Project-related traffic-volume increases external to the study area relative to 2032 No-Build conditions are anticipated to range from 17 to 24 vehicles or 1.3 to 1.8 percent during the peak periods.

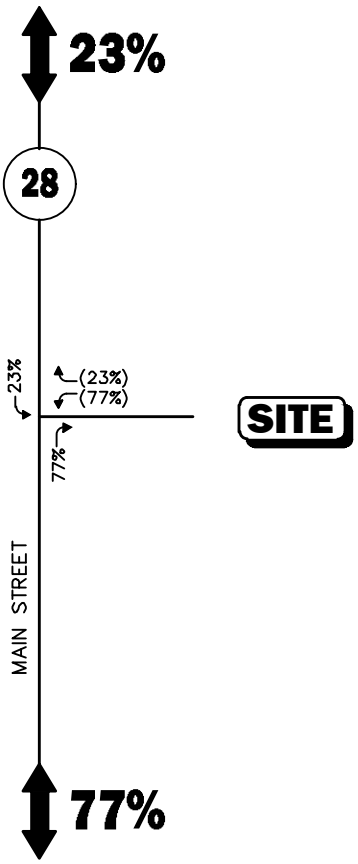

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Figure 5

Trip Distribution Map

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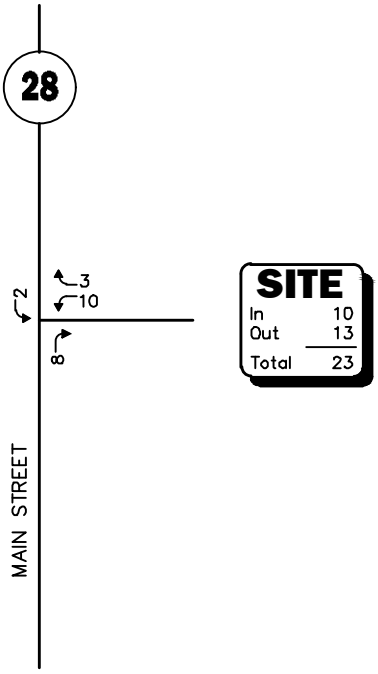
WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)

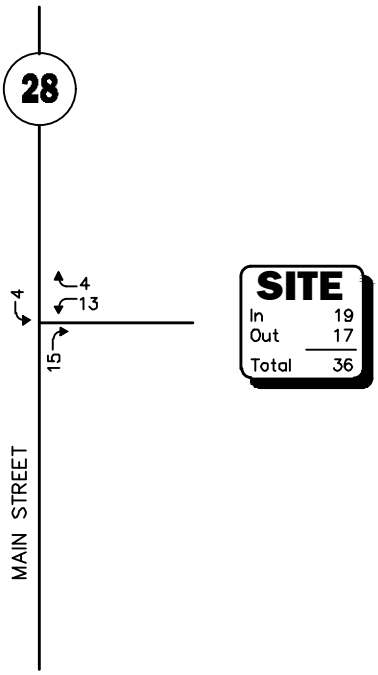


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Figure 6

Site Generated Peak-Hour Traffic Volumes

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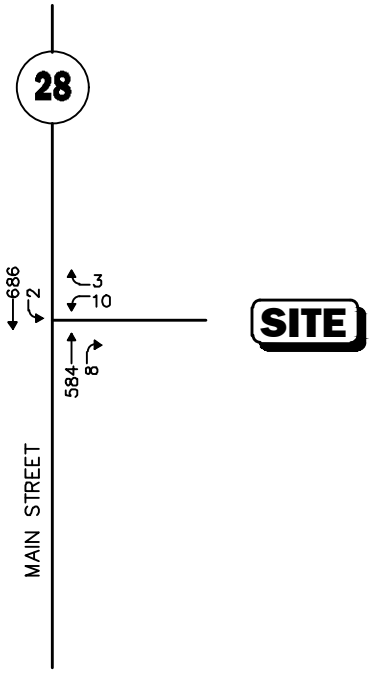
WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)

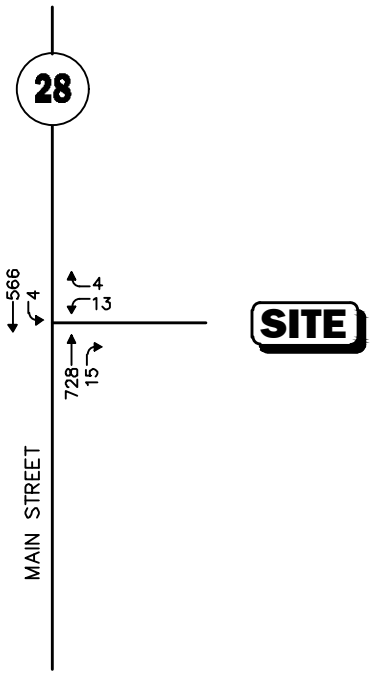


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Figure 7

2032 Build
Peak-Hour Traffic Volumes

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SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the site driveway intersection with Route 28 in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[9] recommendations. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance recommended to be provided by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD is the sight distance recommended to be provided by a driver entering or crossing an intersecting roadway to perceive an oncoming vehicle and safely complete a turning or crossing maneuver with oncoming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the recommended SSD value for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. Table 6 presents the measured SSD and ISD at the study area intersection.

Table 6
SIGHT DISTANCE ANALYSIS[a]

Intersection/Sight Distance Measurement	Recommended Distances (Feet)	Field Measured Distances (Feet)
Route 28 at the Proposed Site Driveway		
Stopping Sight Distance:		
Project site driveway approaching from the north	305	500+
Project site driveway approaching from the south	305	500+
Intersection Sight Distance:		
Left turn from site driveway (looking north)	445	500+
Right turn from site driveway (looking south)	385	500+

[a]Recommended values obtained from *A Policy on Geometric Design of Highways and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2018.

As can be seen in Table 6, the sight distances at the intersection of the Project site driveway with Route 28 were found to exceed the recommended values for SSD and ISD for both directions.

[9]*A Policy on Geometric Design of Highway and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2018.

TRAFFIC OPERATIONS ANALYSIS

Six levels of service[10] are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best-operating conditions and LOS F representing congested or constrained operating conditions.

The levels of service of unsignalized intersections are determined by application of a procedure described in the *Highway Capacity Manual 7th Edition.* Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the *Highway Capacity Manual 7th Edition*.

Analysis Results

Level-of-service analyses were conducted for 2025 Existing, 2032 No-Build, and 2032 Build conditions for the study area intersections. The results of the intersection capacity analysis within the study area are described below, with a tabular summary provided in Table 7.

Unsignalized Intersection

Route 28 at Project Site Driveway

Under Build conditions, the turning movements on Route 28 operate at LOS A while the driveway exit operates at LOS D during the weekday morning and weekday evening peak hours, which is typically considered acceptable for peak-hour conditions. Average vehicle queue is at most 1 vehicle during all analysis periods, which can be contained within the driveway without impeding vehicle, pedestrian, or bicyclists internally and externally to the site.

[10]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual 7th Edition;* Transportation Research Board; Washington, DC; 2022.

Table 7
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2025 Existing				2032 No-Build				2032 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Route 28 at Project Site Driveway												
Weekday Morning:												
Route 28 SB LT	3	8.7	A	0	3	8.8	A	0	2	8.8	A	0
Project Site Driveway WB LT/RT	0	0.0	A	0	0	0.0	A	0	13	26.0	D	0
Weekday Evening:												
Route 28 SB LT	0	0.0	A	0	0	0.0	A	0	4	9.4	A	0
Project Site Driveway WB LT/RT	3	22.0	C	0	3	23.9	C	0	17	27.9	D	1

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level of service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

RECOMMENDATIONS

Project Access

Access to and from the mixed-use development will be provided by a reconstructed version of the existing driveway. The following recommendations are offered with respect to the design and operation of the Project site driveway:

- The driveway should be placed under STOP-sign (*Manual on Uniform Traffic Control Devices* (MUTCD)[11] R1-1) control, with a painted STOP-bar included.
- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the current MUTCD.
- Signs and landscaping adjacent to the Project site driveway should be designed and maintained to remain below 24 inches above the driveway so as not to restrict lines of sight.
- Snow windrows within sight triangle areas of the Project site driveway should be promptly removed where such accumulations would impede sightlines.

CONCLUSIONS

VAI has prepared this TIA in order to identify traffic impacts associated with a mixed-use development to be located at 281 Main Street in Reading, Massachusetts. We have the following conclusions:

- No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study area intersection.
- The Project is expected to generate approximately 340 new vehicle trips on an average weekday (two-way, 24 hour volume), with 23 new vehicle trips (10 entering and 13 exiting) during the weekday morning peak hour and 36 new vehicle trips (19 entering and 17 exiting) during the weekday evening peak hour.
- Traffic-volume increases related to the Project, external to the study, are anticipated to range from 17 to 24 vehicles or 1.3 to 1.8 percent, during peak periods.
- Lines of sight at the Project site driveway with the Route 28 were found to exceed the recommended minimum sight distances, based on expected operating speeds on the roadway.
- The Project will not have a significant impact on motorist delays or vehicle queuing at signalized and unsignalized intersections compared to anticipated future conditions without the Project (No-Build conditions), with a maximum increase in overall intersection delay of less than five seconds.
- Under 2032 Build conditions, movements exiting the Project site driveway to Route 28 are expected to operate at LOS D under all analysis periods with residual vehicle queuing of up to 1 vehicle, which can be contained along the driveway without inhibiting access or the movement of vehicles, pedestrians, and bicyclists.

[11] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

As documented in this study, Project-related traffic increases will not result in significant increases in overall traffic volumes or traffic delays within the study area. The site driveways are expected to operate with minimal delays during all peak hours. In general, Project-related traffic can be adequately accommodated within the existing infrastructure with minimal impact on the traffic operations within the study area.

Attachments:
Technical Appendix

APPENDIX

TRAFFIC COUNT DATA
SEASONAL ADJUSTMENT DATA
MASSDOT CRASH RATE WORKSHEETS
GROWTH RATE DATA
BACKGROUND DEVELOPMENT
TRIP GENERATION DATA
TRIP DISTRIBUTION DATA
EXISTING SITE TRIP NETWORK
CAPACITY ANALYSIS

TRAFFIC COUNT DATA

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025
Page No : 1

Groups Printed- Cars - Trucks

	Route 28 From North		281 Main St From East		Route 28 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00 AM	0	135	0	0	83	0	218
07:15 AM	0	159	0	0	100	0	259
07:30 AM	0	199	0	0	133	0	332
07:45 AM	2	159	0	0	146	0	307
Total	2	652	0	0	462	0	1116
08:00 AM	0	139	0	0	140	1	280
08:15 AM	1	138	0	0	121	0	260
08:30 AM	1	195	0	2	130	1	329
08:45 AM	0	151	0	0	148	3	302
Total	2	623	0	2	539	5	1171
Grand Total	4	1275	0	2	1001	5	2287
Apprch %	0.3	99.7	0	100	99.5	0.5	
Total %	0.2	55.7	0	0.1	43.8	0.2	
Cars	4	1246	0	2	983	5	2240
% Cars	100	97.7	0	100	98.2	100	97.9
Trucks	0	29	0	0	18	0	47
% Trucks	0	2.3	0	0	1.8	0	2.1

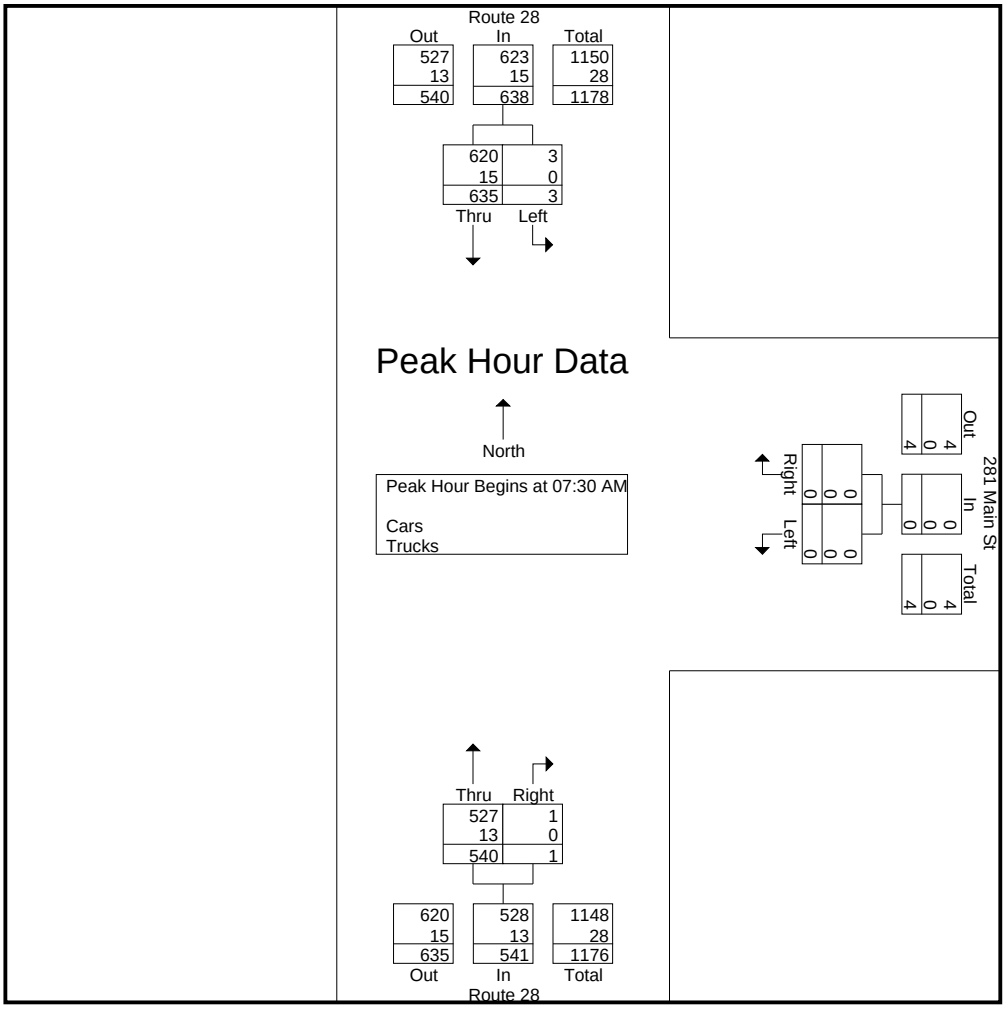
	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:30 AM										
07:30 AM	0	**199**	**199**	0	0	0	133	0	133	**332**
07:45 AM	**2**	159	161	0	0	0	**146**	0	**146**	307
08:00 AM	0	139	139	0	0	0	140	**1**	141	280
08:15 AM	1	138	139	0	0	0	121	0	121	260
Total Volume	3	635	638	0	0	0	540	1	541	1179
% App. Total	0.5	99.5		0	0		99.8	0.2		
PHF	.375	.798	.802	.000	.000	.000	.925	.250	.926	.888
Cars	3	620	623	0	0	0	527	1	528	1151
% Cars	100	97.6	97.6	0	0	0	97.6	100	97.6	97.6
Trucks	0	15	15	0	0	0	13	0	13	28
% Trucks	0	2.4	2.4	0	0	0	2.4	0	2.4	2.4

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:15 AM			07:45 AM			08:00 AM		
+0 mins.	0	159	159	0	0	0	140	1	141
+15 mins.	0	**199**	**199**	0	0	0	121	0	121
+30 mins.	**2**	159	161	0	0	0	130	1	131
+45 mins.	0	139	139	0	**2**	**2**	**148**	**3**	**151**
Total Volume	2	656	658	0	2	2	539	5	544
% App. Total	0.3	99.7		0	100		99.1	0.9	
PHF	.250	.824	.827	.000	.250	.250	.910	.417	.901
Cars	2	641	643	0	2	2	531	5	536
% Cars	100	97.7	97.7	0	100	100	98.5	100	98.5
Trucks	0	15	15	0	0	0	8	0	8
% Trucks	0	2.3	2.3	0	0	0	1.5	0	1.5

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025

Groups Printed- Trucks

	Route 28 From North		281 Main St From East		Route 28 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00 AM	0	4	0	0	1	0	5
07:15 AM	0	5	0	0	1	0	6
07:30 AM	0	6	0	0	7	0	13
07:45 AM	0	2	0	0	1	0	3
Total	0	17	0	0	10	0	27
08:00 AM	0	2	0	0	2	0	4
08:15 AM	0	5	0	0	3	0	8
08:30 AM	0	1	0	0	1	0	2
08:45 AM	0	4	0	0	2	0	6
Total	0	12	0	0	8	0	20
Grand Total	0	29	0	0	18	0	47
Apprch %	0	100	0	0	100	0	
Total %	0	61.7	0	0	38.3	0	

	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:30 AM										
07:30 AM	0	**6**	**6**	0	0	0	**7**	0	**7**	**13**
07:45 AM	0	2	2	0	0	0	1	0	1	3
08:00 AM	0	2	2	0	0	0	2	0	2	4
08:15 AM	0	5	5	0	0	0	3	0	3	8
Total Volume	0	15	15	0	0	0	13	0	13	28
% App. Total	0	100		0	0		100	0		
PHF	.000	.625	.625	.000	.000	.000	.464	.000	.464	.538

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025

Groups Printed- Bikes Peds

	Route 28 From North			281 Main St From East			Route 28 From South					
Start Time	Left	Thru	Peds	Left	Right	Peds	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	2	0	0	0	2	0	2
07:15 AM	0	0	0	0	0	6	1	0	0	6	1	7
07:30 AM	0	1	0	0	0	2	0	0	0	2	1	3
07:45 AM	0	0	0	0	0	3	0	0	0	3	0	3
Total	0	1	0	0	0	13	1	0	0	13	2	15
08:00 AM	0	0	0	0	0	1	0	0	0	1	0	1
08:15 AM	0	0	0	0	0	1	0	0	0	1	0	1
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	1	0	0	0	1	0	1
Total	0	0	0	0	0	3	0	0	0	3	0	3
Grand Total	0	1	0	0	0	16	1	0	0	16	2	18
Apprch %	0	100		0	0		100	0				
Total %	0	50		0	0		50	0		88.9	11.1	

	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	**1**	0	**1**	**1**
07:30 AM	0	**1**	**1**	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	1	0	0	0	1	0	1	2
% App. Total	0	100		0	0		100	0		
PHF	.000	.250	.250	.000	.000	.000	.250	.000	.250	.500

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025
Page No : 1

Groups Printed- Cars - Trucks

	Route 28 From North		281 Main St From East		Route 28 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
04:00 PM	0	121	0	2	174	0	297
04:15 PM	0	150	0	1	168	0	319
04:30 PM	0	104	0	1	155	0	260
04:45 PM	0	128	0	1	151	0	280
Total	0	503	0	5	648	0	1156
05:00 PM	0	127	0	0	170	1	298
05:15 PM	0	134	1	0	196	0	331
05:30 PM	0	128	1	0	157	1	287
05:45 PM	0	119	0	0	152	0	271
Total	0	508	2	0	675	2	1187
Grand Total	0	1011	2	5	1323	2	2343
Apprch %	0	100	28.6	71.4	99.8	0.2	
Total %	0	43.1	0.1	0.2	56.5	0.1	
Cars	0	1008	2	5	1319	2	2336
% Cars	0	99.7	100	100	99.7	100	99.7
Trucks	0	3	0	0	4	0	7
% Trucks	0	0.3	0	0	0.3	0	0.3

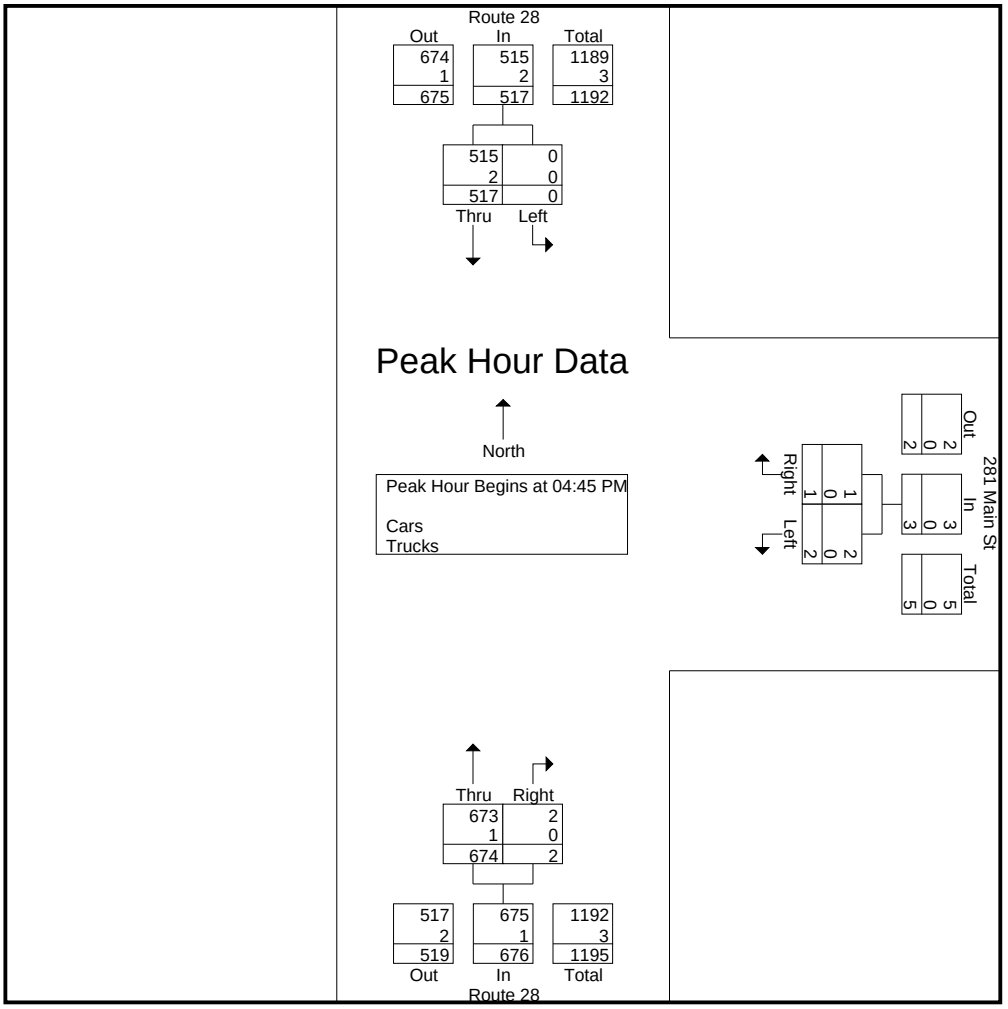
	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:45 PM										
04:45 PM	0	128	128	0	**1**	**1**	151	0	151	280
05:00 PM	0	127	127	0	0	0	170	**1**	171	298
05:15 PM	0	**134**	**134**	**1**	0	1	**196**	0	**196**	**331**
05:30 PM	0	128	128	1	0	1	157	1	158	287
Total Volume	0	517	517	2	1	3	674	2	676	1196
% App. Total	0	100		66.7	33.3		99.7	0.3		
PHF	.000	.965	.965	.500	.250	.750	.860	.500	.862	.903
Cars	0	515	515	2	1	3	673	2	675	1193
% Cars	0	99.6	99.6	100	100	100	99.9	100	99.9	99.7
Trucks	0	2	2	0	0	0	1	0	1	3
% Trucks	0	0.4	0.4	0	0	0	0.1	0	0.1	0.3

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	04:45 PM			04:00 PM			05:00 PM		
+0 mins.	0	128	128	0	**2**	**2**	170	**1**	171
+15 mins.	0	127	127	0	1	1	**196**	0	**196**
+30 mins.	0	**134**	**134**	0	1	1	157	1	158
+45 mins.	0	128	128	0	1	1	152	0	152
Total Volume	0	517	517	0	5	5	675	2	677
% App. Total	0	100		0	100		99.7	0.3	
PHF	.000	.965	.965	.000	.625	.625	.861	.500	.864
Cars	0	515	515	0	5	5	673	2	675
% Cars	0	99.6	99.6	0	100	100	99.7	100	99.7
Trucks	0	2	2	0	0	0	2	0	2
% Trucks	0	0.4	0.4	0	0	0	0.3	0	0.3

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025

Groups Printed- Trucks

	Route 28 From North		281 Main St From East		Route 28 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
04:00 PM	0	0	0	0	0	0	0
04:15 PM	0	1	0	0	2	0	3
04:30 PM	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0
Total	0	1	0	0	2	0	3
05:00 PM	0	2	0	0	0	0	2
05:15 PM	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	1	0	1
05:45 PM	0	0	0	0	1	0	1
Total	0	2	0	0	2	0	4
Grand Total	0	3	0	0	4	0	7
Apprch %	0	100	0	0	100	0	
Total %	0	42.9	0	0	57.1	0	

	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:15 PM										
04:15 PM	0	1	1	0	0	0	**2**	0	**2**	**3**
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	**2**	**2**	0	0	0	0	0	0	2
Total Volume	0	3	3	0	0	0	2	0	2	5
% App. Total	0	100		0	0		100	0		
PHF	.000	.375	.375	.000	.000	.000	.250	.000	.250	.417

Accurate Counts

978-664-2565

N/S Street : Route 28
E/W Street : 281 Main Street
City/State : Reading, MA
Weather : Rain / Cloudy

File Name : 10465001
Site Code : 10465001
Start Date : 10/8/2025

Groups Printed- Bikes Peds

	Route 28 From North			281 Main St From East			Route 28 From South					
Start Time	Left	Thru	Peds	Left	Right	Peds	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	1	0	0	0	1	0	1
04:15 PM	0	0	0	0	0	1	0	0	0	1	0	1
04:30 PM	0	0	0	0	0	1	0	0	0	1	0	1
04:45 PM	0	0	0	0	0	2	0	0	0	2	0	2
Total	0	0	0	0	0	5	0	0	0	5	0	5
05:00 PM	0	0	0	0	0	1	0	0	0	1	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	1	1	0	0	1	1	2
Total	0	0	0	0	0	2	1	0	0	2	1	3
Grand Total	0	0	0	0	0	7	1	0	0	7	1	8
Apprch %	0	0		0	0		100	0				
Total %	0	0		0	0		100	0		87.5	12.5	

	Route 28 From North			281 Main St From East			Route 28 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	**1**	0	**1**	**1**
Total Volume	0	0	0	0	0	0	1	0	1	1
% App. Total	0	0		0	0		100	0		
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250	.250

SEASONAL ADJUSTMENT DATA

Massachusetts Highway Department
Statewide Traffic Data Collection
2024 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.17	1.12	1.11	1.06	1.00	0.96	0.94	0.92	1.00	0.98	1.06	1.07	0.78
R3	1.10	1.04	1.04	1.02	0.91	0.88	0.88	0.87	0.92	0.92	0.99	1.01	0.98
R4-R7	1.16	1.12	1.08	1.03	0.92	0.89	0.88	0.89	0.92	0.94	1.04	1.10	0.98
U1-Boston	1.07	1.03	0.98	0.97	0.94	0.91	0.94	0.91	0.94	0.94	0.98	1.02	0.94
U1-Essex	1.13	1.09	1.06	1.04	0.95	0.89	0.88	0.87	0.95	0.95	1.03	1.05	0.96
U1-Southeast	1.14	1.10	1.04	0.99	0.93	0.86	0.87	0.85	0.91	0.93	0.99	1.02	0.96
U1-West	1.10	1.02	0.98	0.96	0.95	0.92	0.94	0.91	0.91	0.91	0.96	1.00	0.83
U1-Worcester	1.08	1.03	0.99	0.98	0.94	0.91	0.93	0.91	0.92	0.91	0.95	1.00	0.93
U3	1.06	1.02	0.98	0.96	0.93	0.91	0.95	0.94	0.93	0.93	0.96	1.00	0.98
U4-U7	1.04	1.02	0.96	0.95	0.91	0.90	0.94	0.94	0.93	0.94	0.98	1.02	0.99
UR2	1.08	1.02	0.98	0.97	0.93	0.90	0.93	0.90	0.92	0.92	0.97	1.01	0.98
Rec - East	1.21	1.20	1.09	1.01	0.91	0.81	0.77	0.79	0.91	0.95	1.05	1.13	0.99
Rec - West	1.46	1.38	1.32	1.06	0.94	0.79	0.59	0.69	0.97	0.99	1.18	1.28	0.99

Round off:
0-999 = 10
>1000 = 100

U = Urban
R = Rural

1 - Interstate
2 - Freeway and Expressway
3 - Other Principal Arterial
4 - Minor Arterial
5 - Major Collector
6 - Minor Collector
7 - Local Road and Street

UR2 Group - Combination of Urban Freeways and Expressways and Rural Freeways and Expressways.

Recreational - East Group - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.

Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113, 1114,1116,2196,2197 and 2198.

MASSDOT CRASH RATE WORKSHEETS

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Reading COUNT DATE : 10/8/2025

DISTRICT : 4 UNSIGNALIZED : ✓ SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : 281 Main Street Driveway

INTERSECTION DIAGRAM (Label Approaches)

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	WB			
PEAK HOURLY VOLUMES (AM/PM) :	676	517	3			1,196

" K " FACTOR : .09

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : 13,289

TOTAL # OF CRASHES : 8

OF YEARS : 5

AVERAGE # OF CRASHES PER YEAR (**A**) : 1.6

CRASH RATE CALCULATION : 0.33

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

Comments : PM TMC data, K-factor from Station 4848 (Route 28 North of Project Site)

Project Title & Date: 10465 - Reading

GROWTH RATE DATA

Massachusetts Highway Department
Annual Growth Rate

Location ID:	**4096**	**Seasonal Factor Group:**	**U1**
County:	**Middlesex**	**Daily Factor Group:**	
Functional Class	**1 - Interstate**	**Axle Factor Group:**	**U1**
Location:	**I-93 NB**	**Growth Factor Group:**	**U1**
	North of Route 129		

Year	**AADT**
2024	167,441
2019	173,765
A = 2024/2019	0.9636
B = A^(1/5)	0.9926
Average Annual Growth Rate	**-0.74**

Massachusetts Highway Department
Annual Growth Rate

Location ID:	**4123**	**Seasonal Factor Group:**	**U4-U7**
County:	**Middlesex**	**Daily Factor Group:**	
Functional Class	**4 - Minor Arterial**	**Axle Factor Group:**	**U4-U7**
Location:	**Park Street (Route 62)**	**Growth Factor Group:**	**U4-U7**
	West of Haverhill Street		

Year	**AADT**
2024	11,135
2019	12,229
A = 2024/2019	0.9105
B = A^(1/5)	0.9814
Average Annual Growth Rate	**-1.86**

Massachusetts Highway Department
Annual Growth Rate

Location ID:	**5127**	**Seasonal Factor Group:**	**U3**
County:	**Essex**	**Daily Factor Group:**	
Functional Class	**3 - Other Principal Arterial**	**Axle Factor Group:**	**U3**
Location:	**Andover Bypass (Route 125)**	**Growth Factor Group:**	**U3**
	Esouth of Route 28		

Year	**AADT**
2024	15,180
2019	17,055
A = 2024/2019	0.8901
B = A^(1/5)	0.9770
Average Annual Growth Rate	**-2.30**

Massachusetts Highway Department
Annual Growth Rate

Location ID:	**4848**	**Seasonal Factor Group:**	**U3**
County:	**Middlesex**	**Daily Factor Group:**	
Functional Class	**3 - Other Principal Arterial**	**Axle Factor Group:**	**U3**
Location:	**Main Street (Route 28)**	**Growth Factor Group:**	**U3**
	South of Minot Street		

Year	**AADT**
2024	11,635
2019	15,275
A = 2024/2019	0.7617
B = A^(1/5)	0.9470
Average Annual Growth Rate	**-5.30**

Massachusetts Highway Department
Annual Growth Rate

Location ID:	**4121**	**Seasonal Factor Group:**	**U1**
County:	**Middlesex**	**Daily Factor Group:**	
Functional Class	**1 - Interstate**	**Axle Factor Group:**	**U1**
Location:	**Interstate 95**	**Growth Factor Group:**	**U1**
	North of Main Street Lynnfield		

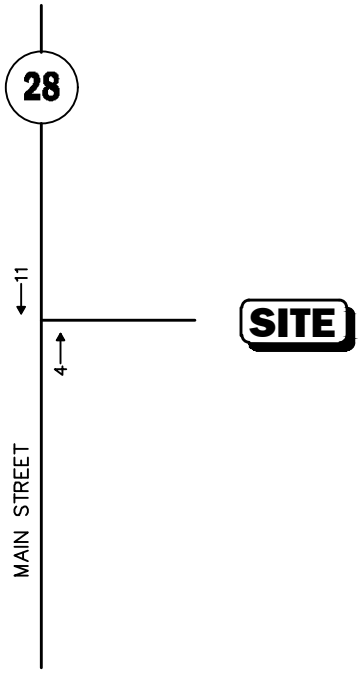
Year	**AADT**
2024	134,644
2019	142,046
A = 2024/2029	0.9479
B = A^(1/5)	0.9894
Average Annual Growth Rate	**-1.06**

Massachusetts Highway Department
Annual Growth Rate

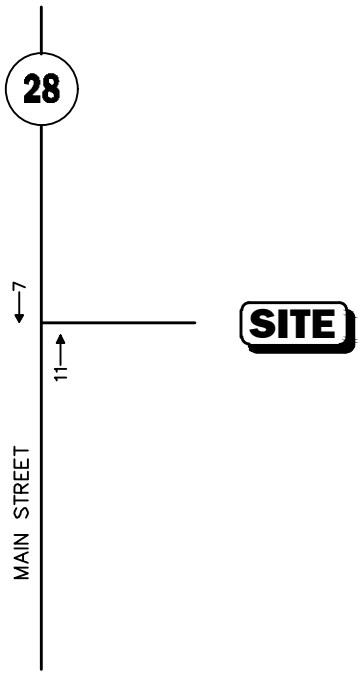
Station	Average Annual Growth
4096	-0.74
4159	-1.86
5127	-2.30
4848	-5.30
4097	-1.06
Average	**-2.25**

BACKGROUND DEVELOPMENT

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)



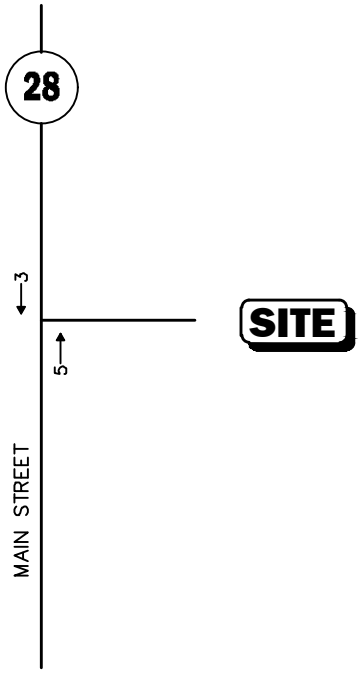
Not To Scale

Figure A-1

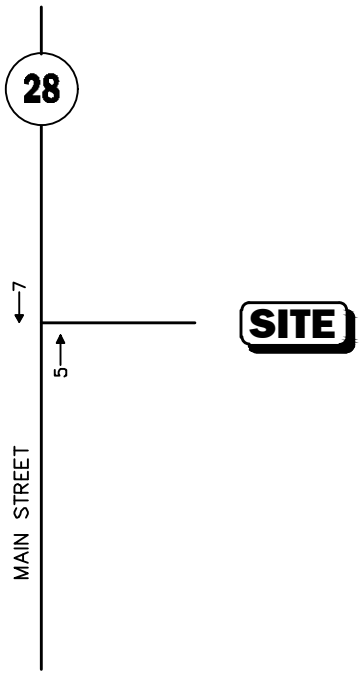
Proposed Mixed-Use Development
459 Main Street

Vanasse & Associates inc

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)



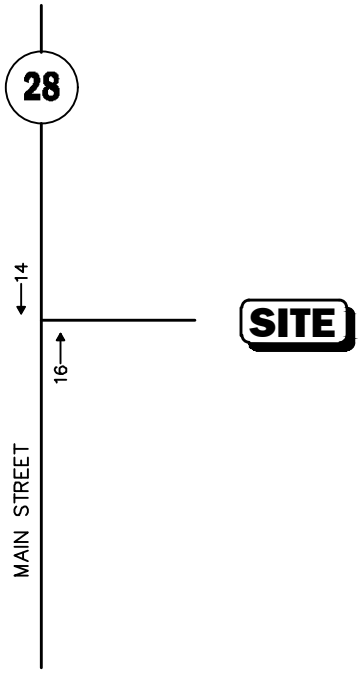
Not To Scale

Figure A-2

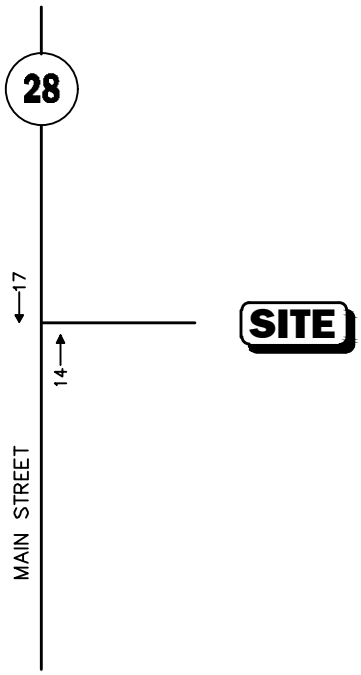
Proposed Mixed-Use Development 252, 258 and 262 Main Street and Pinevale Avenue

Vanasse & Associates inc

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)



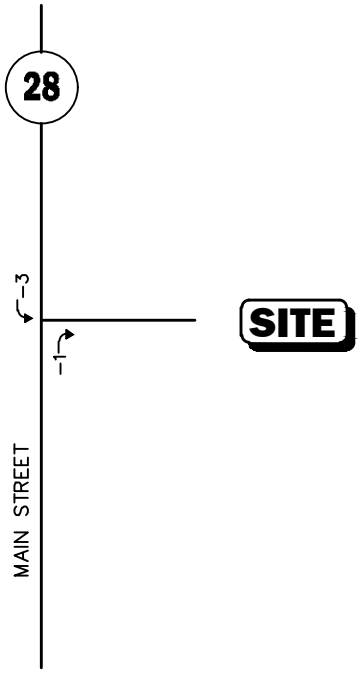
Not To Scale

Figure A-3

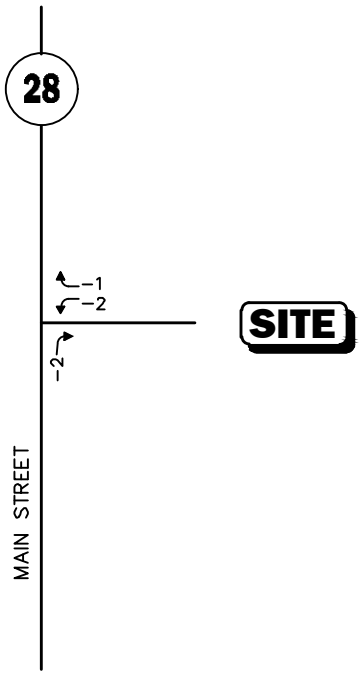
Proposed Child Care Center
885 Main Street

Vanasse & Associates inc

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)



Not To Scale

Figure A-4

Existing Site Generated Trip Reductions

Vanasse & Associates inc

TRIP GENERATION DATA

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
220

LAND USE GROUP:
(200-299) Residential

LAND USE :
220 - Multifamily Housing (Low-Rise)

LAND USE SUBCATEGORY:
Not Close to Rail Transit

SETTING/LOCATION:
General Urban/Suburban

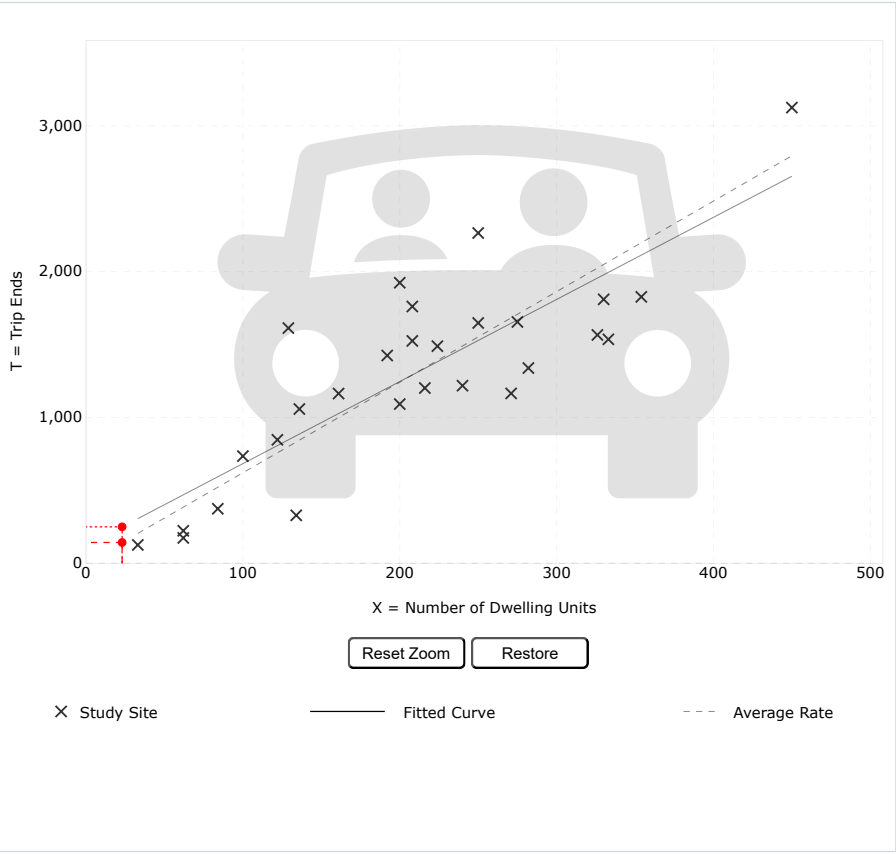
INDEPENDENT VARIABLE (IV):
Dwelling Units

TIME PERIOD:
Weekday

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
23 Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) Click for Description and Data Plots

Independent Variable:
Dwelling Units

Time Period:
Weekday

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
28

Avg. Num. of Dwelling Units:
208

Average Rate:
6.21

Range of Rates:
2.46 - 12.50

Standard Deviation:
1.87

Fitted Curve Equation:
T = 5.63(X) + 120.45

R^2:
0.70

Directional Distribution:
50% entering, 50% exiting

Calculated Trip Ends:
Average Rate: 143 (Total), 71 (Entry), 72 (Exit)
Fitted Curve: 250 (Total), 125 (Entry), 125 (Exit)

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
220

LAND USE GROUP:
(200-299) Residential

LAND USE :
220 - Multifamily Housing (Low-Rise)

LAND USE SUBCATEGORY:
Not Close to Rail Transit

SETTING/LOCATION:
General Urban/Suburban

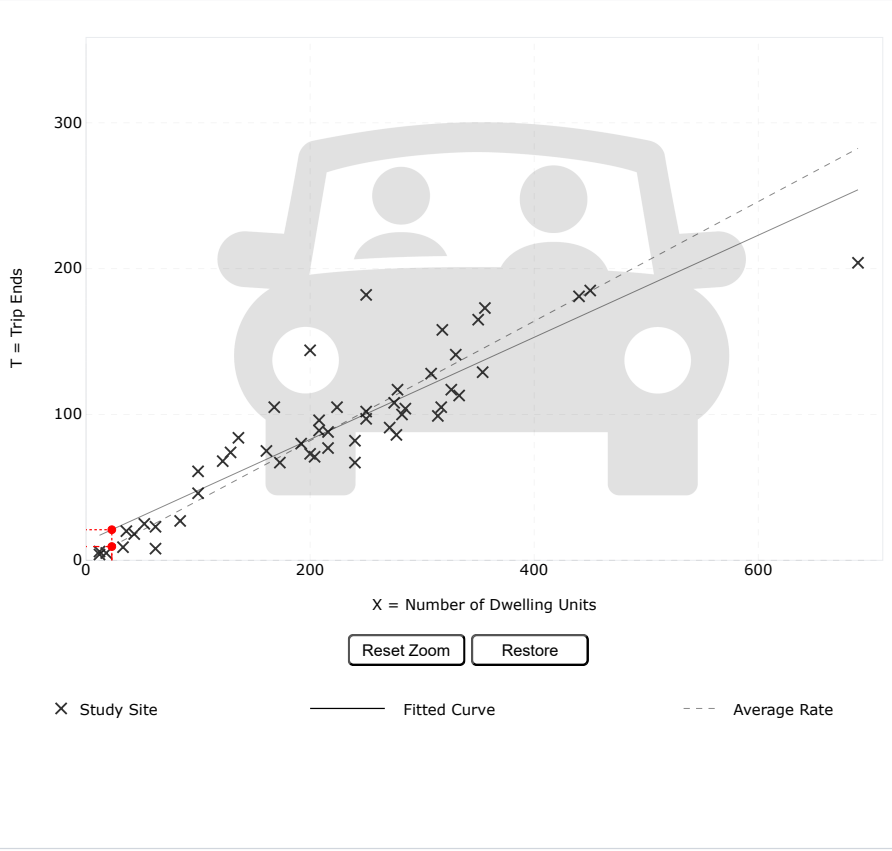
INDEPENDENT VARIABLE (IV):
Dwelling Units

TIME PERIOD:
Weekday, Peak Hour of Adjacent Stree

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
23 Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) Click for Description and Data Plots

Independent Variable:
Dwelling Units

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
51

Avg. Num. of Dwelling Units:
219

Average Rate:
0.41

Range of Rates:
0.13 - 0.73

Standard Deviation:
0.10

Fitted Curve Equation:
T = 0.35(X) + 12.93

R^2:
0.81

Directional Distribution:
24% entering, 76% exiting

Calculated Trip Ends:
Average Rate: 9 (Total), 2 (Entry), 7 (Exit)
Fitted Curve: 21 (Total), 5 (Entry), 16 (Exit)

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
220

LAND USE GROUP:
(200-299) Residential

LAND USE :
220 - Multifamily Housing (Low-Rise)

LAND USE SUBCATEGORY:
Not Close to Rail Transit

SETTING/LOCATION:
General Urban/Suburban

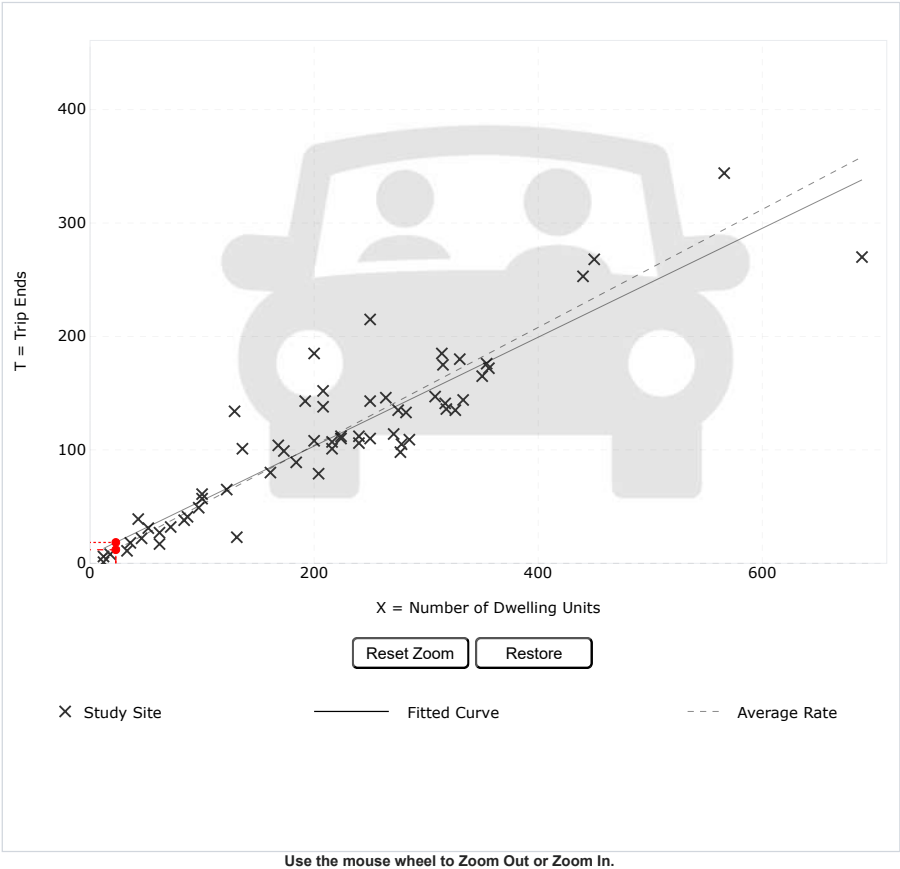
INDEPENDENT VARIABLE (IV):
Dwelling Units

TIME PERIOD:
Weekday, Peak Hour of Adjacent Stree

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
23 Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) Click for Description and Data Plots

Independent Variable:
Dwelling Units

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
61

Avg. Num. of Dwelling Units:
215

Average Rate:
0.52

Range of Rates:
0.08 - 1.04

Standard Deviation:
0.13

Fitted Curve Equation:
T = 0.48(X) + 7.35

R^2:
0.83

Directional Distribution:
62% entering, 38% exiting

Calculated Trip Ends:
Average Rate: 12 (Total), 7 (Entry), 5 (Exit)
Fitted Curve: 18 (Total), 11 (Entry), 7 (Exit)

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
822

LAND USE GROUP:
(800-899) Retail

LAND USE :
822 - Strip Retail Plaza (<40k)

LAND USE SUBCATEGORY:
All Sites

SETTING/LOCATION:
General Urban/Suburban

INDEPENDENT VARIABLE (IV):
1000 Sq. Ft. GLA

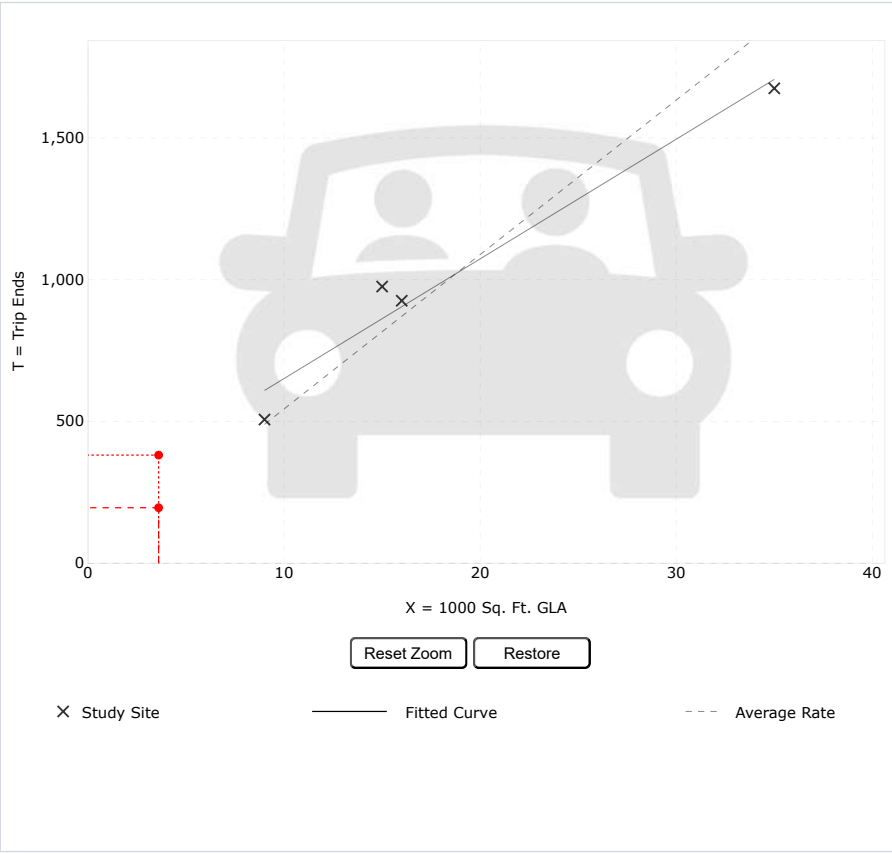
TIME PERIOD:
Weekday

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
3.6 Calculate

Data Plot and Equation

Caution – Small Sample Size



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Strip Retail Plaza (<40k) (822) Click for Description and Data Plots

Independent Variable:
1000 Sq. Ft. GLA

Time Period:
Weekday

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
4

Avg. 1000 Sq. Ft. GLA:
19

Average Rate:
54.45

Range of Rates:
47.86 - 65.07

Standard Deviation:
7.81

Fitted Curve Equation:
T = 42.20(X) + 229.68

R^2:
0.96

Directional Distribution:
50% entering, 50% exiting

Calculated Trip Ends:
Average Rate: 196 (Total), 98 (Entry), 98 (Exit)
Fitted Curve: 382 (Total), 191 (Entry), 191 (Exit)

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
822

LAND USE GROUP:
(800-899) Retail

LAND USE :
822 - Strip Retail Plaza (<40k)

LAND USE SUBCATEGORY:
All Sites

SETTING/LOCATION:
General Urban/Suburban

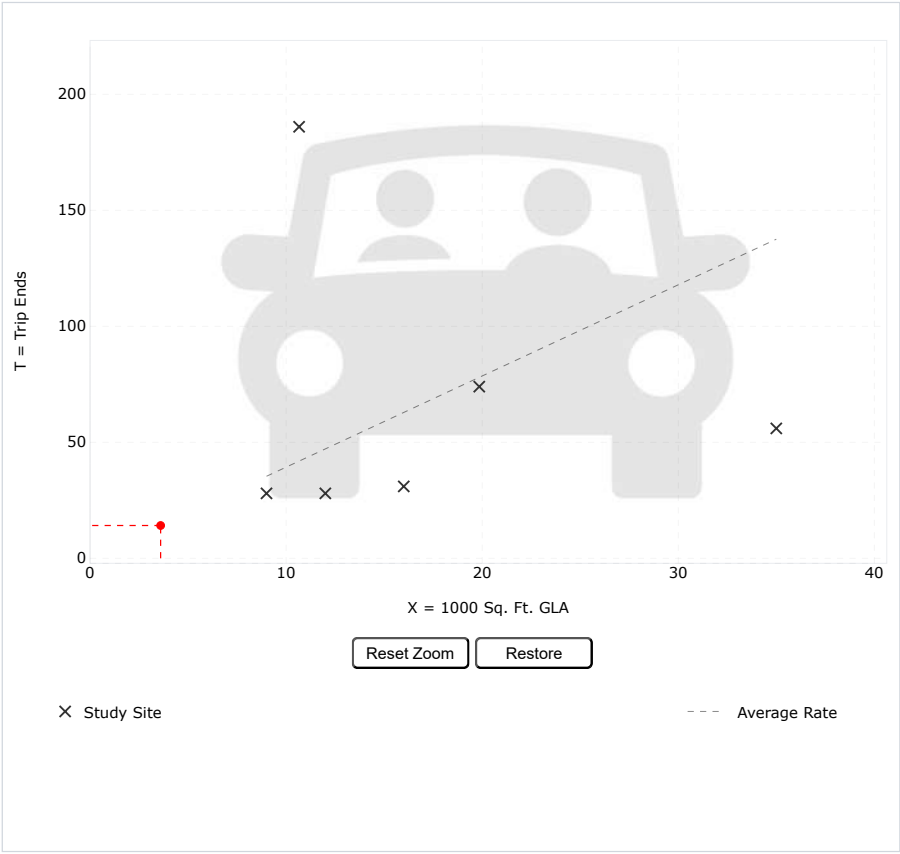
INDEPENDENT VARIABLE (IV):
1000 Sq. Ft. GLA

TIME PERIOD:
Weekday, Peak Hour of Adjacent Stree

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
3.6 Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Strip Retail Plaza (<40k) (822) Click for Description and Data Plots

Independent Variable:
1000 Sq. Ft. GLA

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
6

Avg. 1000 Sq. Ft. GLA:
17

Average Rate:
3.93

Range of Rates:
1.60 - 17.44

Standard Deviation:
5.12

Fitted Curve Equation:
Not Given

R^2:
****

Directional Distribution:
55% entering, 45% exiting

Calculated Trip Ends:
Average Rate: 14 (Total), 8 (Entry), 6 (Exit)

Graph Look Up

Query | Filter

DATA SOURCE:
Trip Generation Manual, 12th Ed

SEARCH BY LAND USE CODE:
822

LAND USE GROUP:
(800-899) Retail

LAND USE :
822 - Strip Retail Plaza (<40k)

LAND USE SUBCATEGORY:
All Sites

SETTING/LOCATION:
General Urban/Suburban

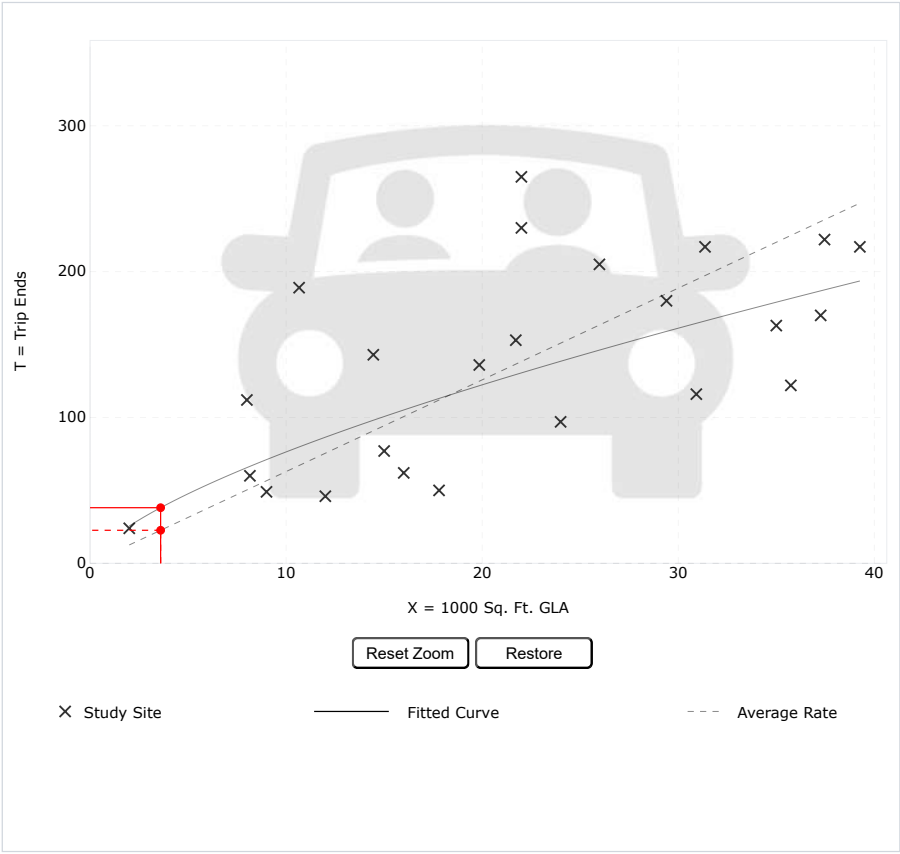
INDEPENDENT VARIABLE (IV):
1000 Sq. Ft. GLA

TIME PERIOD:
Weekday, Peak Hour of Adjacent Stree

TRIP TYPE:
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:
3.6 Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:
Strip Retail Plaza (<40k) (822) Click for Description and Data Plots

Independent Variable:
1000 Sq. Ft. GLA

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
24

Avg. 1000 Sq. Ft. GLA:
22

Average Rate:
6.29

Range of Rates:
2.81 - 17.72

Standard Deviation:
3.02

Fitted Curve Equation:
Ln(T) = 0.68 Ln(X) + 2.77

R^2:
0.54

Directional Distribution:
50% entering, 50% exiting

Calculated Trip Ends:
Average Rate: 23 (Total), 11 (Entry), 12 (Exit)
Fitted Curve: 38 (Total), 19 (Entry), 19 (Exit)

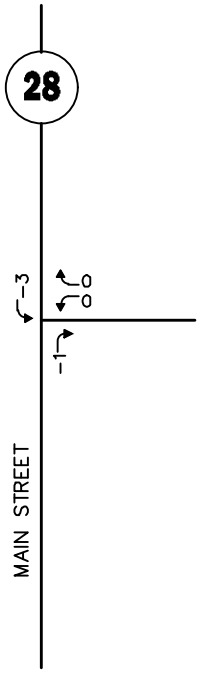
TRIP DISTRIBUTION DATA

Proposed Mixed-Use Development
Reading, Massachusetts

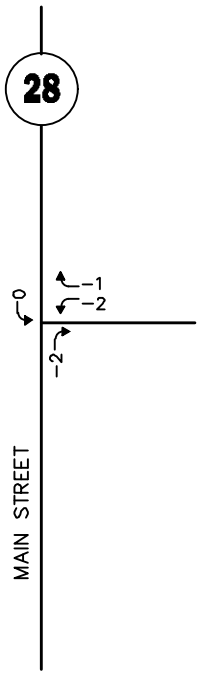
Residence	Workplace	Number	Route 28 (North)		Route 28 (South)	
Reading town	Boston city	2,202	0%	0	100%	2202
Reading town	Reading town	2,127	70%	1489	30%	638
Reading town	Woburn city	734	0%	0	100%	734
Reading town	Burlington town	614	50%	307	50%	307
Reading town	Cambridge city	511	0%	0	100%	511
Reading town	Stoneham town	350	0%	0	100%	350
Reading town	Wilmington town	340	50%	170	50%	170
Reading town	Wakefield town	285	20%	57	80%	228
Reading town	Winchester town	281	0%	0	100%	281
Reading town	Lexington town	279	0%	0	100%	279
Reading town	Malden city	273	0%	0	100%	273
Reading town	Medford city	270	0%	0	100%	270
Reading town	Waltham city	253	0%	0	100%	253
Reading town	Andover town	223	75%	167	25%	56
Reading town	Peabody city	223	0%	0	100%	223
Reading town	Billerica town	210	100%	210	0%	0
Reading town	Lowell city	201	75%	151	25%	50
Reading town	Somerville city	186	0%	0	100%	186
Reading town	Everett city	182	0%	0	100%	182
Reading town	Bedford town	178	0%	0	100%	178
Reading town	North Reading town	155	100%	155	0%	0
Reading town	Beverly city	148	0%	0	100%	148
Reading town	Danvers town	148	0%	0	100%	148
Reading town	Newton city	147	0%	0	100%	147
Reading town	Marlborough city	146	0%	0	100%	146
Reading town	Chelmsford town	115	0%	0	100%	115
Reading town	Framingham town	109	0%	0	100%	109
Reading town	Chelsea city	107	0%	0	100%	107
Reading town	Lawrence city	96	0%	0	100%	96
Reading town	Belmont town	94	0%	0	100%	94
Reading town	Arlington town	83	0%	0	100%	83
Reading town	Natick town	82	0%	0	100%	82
Reading town	Lynn city	73	0%	0	100%	73
Reading town	Clinton town	68	0%	0	100%	68
Reading town	Salem city	65	0%	0	100%	65
Reading town	North Andover town	63	40%	25	60%	38
Reading town	Hudson town	60	0%	0	100%	60
		11,681		2,731		8,950
				23.4%		76.6%
		SAY		**23%**		**77%**

EXISTING SITE TRIP NETWORK

WEEKDAY MORNING PEAK HOUR (7:30 AM - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:45 PM - 5:45 PM)



Not To Scale

Figure A-5

Existing Trips Network
Peak-Hour Traffic Volumes

Vanasse & Associates inc

CAPACITY ANALYSIS

2025 Existing Weekday Morning Peak Hour
2025 Existing Weekday Evening Peak Hour
2032 No-Build Weekday Morning Peak Hour
2032 No-Build Weekday Evening Peak Hour
2032 Build Weekday Morning Peak Hour
2032 Build Weekday Evening Peak Hour

2025 Existing Weekday Morning Peak Hour

Intersection	
Int Delay, s/veh	0

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	540	1	3	635
Future Vol, veh/h	0	0	540	1	3	635
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	89	89	80	80
Heavy Vehicles, %	2	2	2	0	0	2
Mvmt Flow	0	0	607	1	4	794

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1409	607	0	0	608	0
Stage 1	607	-	-	-	-	-
Stage 2	801	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.1	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.2	-
Pot Cap-1 Maneuver	153	496	-	-	980	-
Stage 1	544	-	-	-	-	-
Stage 2	442	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	152	496	-	-	980	-
Mov Cap-2 Maneuver	152	-	-	-	-	-
Stage 1	544	-	-	-	-	-
Stage 2	440	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	0	0	0.04
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	980	-
HCM Lane V/C Ratio	-	-	-	0.004	-
HCM Ctrl Dly (s/v)	-	-	0	8.7	-
HCM Lane LOS	-	-	A	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

2025 Existing Weekday Evening Peak Hour

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	2	1	674	2	0	517
Future Vol, veh/h	2	1	674	2	0	517
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	75	75	86	86	97	97
Heavy Vehicles, %	0	0	0	0	0	1
Mvmt Flow	3	1	784	2	0	533

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1318	785	0	0	786	0
Stage 1	785	-	-	-	-	-
Stage 2	533	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	175	396	-	-	842	-
Stage 1	453	-	-	-	-	-
Stage 2	593	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	175	396	-	-	842	-
Mov Cap-2 Maneuver	175	-	-	-	-	-
Stage 1	453	-	-	-	-	-
Stage 2	593	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	22.04	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	215	842	-
HCM Lane V/C Ratio	-	-	0.019	-	-
HCM Ctrl Dly (s/v)	-	-	22	0	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0	-

2032 No-Build Weekday Morning Peak Hour

Intersection	
Int Delay, s/veh	0

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	584	1	3	686
Future Vol, veh/h	0	0	584	1	3	686
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	0	2
Mvmt Flow	0	0	635	1	3	746

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1388	635	0	0	636	0
Stage 1	635	-	-	-	-	-
Stage 2	752	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.1	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.2	-
Pot Cap-1 Maneuver	157	478	-	-	957	-
Stage 1	528	-	-	-	-	-
Stage 2	466	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	157	478	-	-	957	-
Mov Cap-2 Maneuver	157	-	-	-	-	-
Stage 1	528	-	-	-	-	-
Stage 2	464	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	0	0	0.04
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	957	-
HCM Lane V/C Ratio	-	-	-	0.003	-
HCM Ctrl Dly (s/v)	-	-	0	8.8	-
HCM Lane LOS	-	-	A	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

2032 No-Build Weekday Evening Peak Hour

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	2	1	728	2	0	566
Future Vol, veh/h	2	1	728	2	0	566
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	1
Mvmt Flow	2	1	791	2	0	615

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1408	792	0	0	793	0
Stage 1	792	-	-	-	-	-
Stage 2	615	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	155	392	-	-	836	-
Stage 1	449	-	-	-	-	-
Stage 2	543	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	155	392	-	-	836	-
Mov Cap-2 Maneuver	155	-	-	-	-	-
Stage 1	449	-	-	-	-	-
Stage 2	543	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	23.9	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	194	836	-
HCM Lane V/C Ratio	-	-	0.017	-	-
HCM Ctrl Dly (s/v)	-	-	23.9	0	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0	-

2032 Build Weekday Morning Peak Hour

Intersection	
Int Delay, s/veh	0.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	3	584	8	2	686
Future Vol, veh/h	10	3	584	8	2	686
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	0	2
Mvmt Flow	11	3	635	9	2	746

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1389	639	0	0	643	0
Stage 1	639	-	-	-	-	-
Stage 2	750	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.1	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.2	-
Pot Cap-1 Maneuver	157	476	-	-	951	-
Stage 1	526	-	-	-	-	-
Stage 2	467	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	157	476	-	-	951	-
Mov Cap-2 Maneuver	157	-	-	-	-	-
Stage 1	526	-	-	-	-	-
Stage 2	466	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	26.01	0	0.03
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	185	951	-
HCM Lane V/C Ratio	-	-	0.076	0.002	-
HCM Ctrl Dly (s/v)	-	-	26	8.8	-
HCM Lane LOS	-	-	D	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0	-

2032 Build Weekday Evening Peak Hour

Intersection	
Int Delay, s/veh	0.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	13	4	728	15	4	566
Future Vol, veh/h	13	4	728	15	4	566
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	1
Mvmt Flow	14	4	791	16	4	615

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1423	799	0	0	808	0
Stage 1	799	-	-	-	-	-
Stage 2	624	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	151	388	-	-	826	-
Stage 1	446	-	-	-	-	-
Stage 2	538	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	150	388	-	-	826	-
Mov Cap-2 Maneuver	150	-	-	-	-	-
Stage 1	446	-	-	-	-	-
Stage 2	535	-	-	-	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	27.87	0	0.07
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	176	826	-
HCM Lane V/C Ratio	-	-	0.105	0.005	-
HCM Ctrl Dly (s/v)	-	-	27.9	9.4	-
HCM Lane LOS	-	-	D	A	-
HCM 95th %tile Q(veh)	-	-	0.3	0	-