

# *Cumberland Farms Convenience Store with Gasoline Sales*

Westfield,  
Massachusetts

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February 2013

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# 1

## Introduction

Vanasse Hangen Brustlin, Inc. (VHB) has completed a detailed Traffic Impact and Access Study to evaluate the traffic impacts associated with the development of a proposed Cumberland Farms Convenience Store with Gasoline Sales on an approximate 1.17 acre site. The site is located on the southwest corner of the intersection of Southamptton Road (Route 10/202) at North Road (Route 202) in the City of Westfield, Massachusetts. The site location can be seen on Figure 1. The site is currently zoned Commercial.

VHB has evaluated existing traffic operations in the area, assessed the impacts of this development, and identified transportation improvements necessary to accommodate this redevelopment and potential traffic growth in this area.

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### Project Description

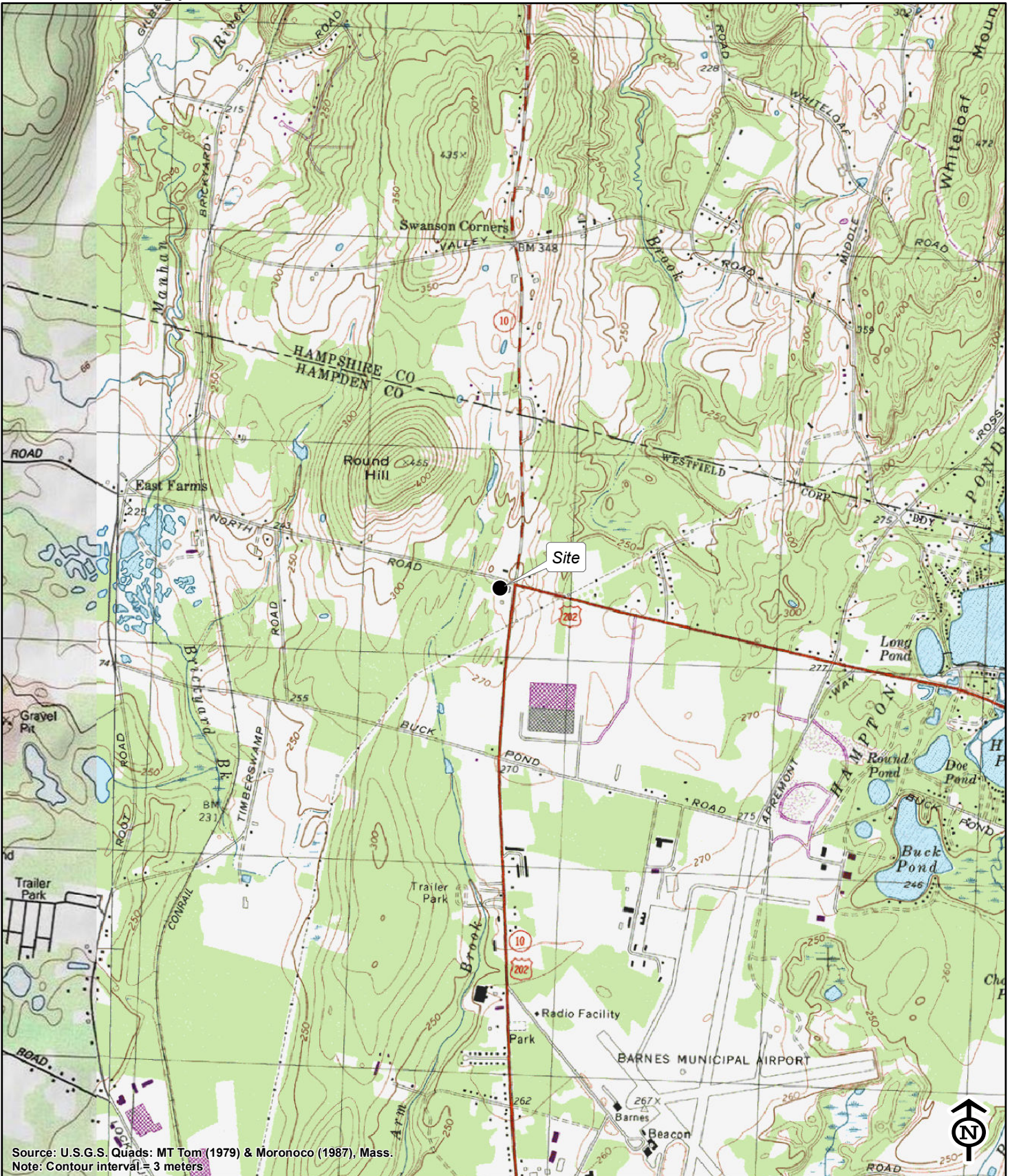
The project site is currently undeveloped, and is primarily wooded. The proposed project consists of a Cumberland Farms convenience store and fueling facility with 5 gasoline pumps (10 vehicle fueling positions) as well as a convenience store. The proposed Cumberland Farms convenience store is approximately 4,513 ± square feet.

Access to the site will be provided via three access points; a full-access driveway and an entrance-only driveway located off Southamptton Road (approximately 225 feet and 50 feet south of the intersection with North Road, respectively), and one full-access driveway located off North Road (approximately 115 feet west of the intersection with Southamptton Road).

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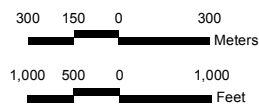
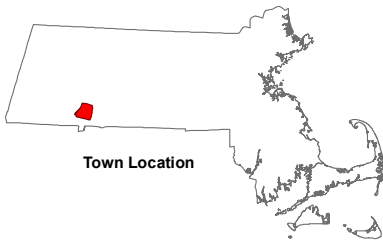
### Study Methodology

This traffic assessment has been conducted in the following manner. First, VHB assessed the existing traffic conditions within the project area including an inventory of existing roadway geometry, observations of traffic flow, peak period traffic counts, and a review of traffic safety in the area.



Vanasse Hangen Brustlin, Inc.

**Figure 1**  
**Site Location Map**  
**Proposed Convenience Store with Gas**  
**Southampton Road & North Road**  
**Westfield, Massachusetts**



Then, the framework for evaluating the transportation impacts of the proposed project was established. Specific travel demand forecasts for the project were assessed along with future traffic demands on the study area roadways due to projected background traffic growth and other proposed area development that will occur independent of the proposed development. This traffic impact and access study has been prepared in accordance with the guidelines for traffic impact analysis set forth by the Executive Office of Energy and Environmental Affairs (EOEEA), Executive Office of Transportation and Public Works (EOTPW) and the Massachusetts Highway Department (MassDOT). In accordance with these guidelines, the year 2018 (a five-year time horizon), was selected as the design year for analysis. The traffic analysis conducted identified both existing and projected future roadway capacities and demands.

## Existing Conditions

Evaluation of the transportation impacts associated with the proposed project requires a thorough understanding of the existing transportation conditions in the project study area. Existing transportation conditions in the study area include roadway geometry, traffic controls, traffic flow, and traffic safety data. Each of these elements is described in detail below.

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### Study Area

To effectively evaluate the transportation impacts associated with the proposed development, it is necessary to review the existing roadway system in the vicinity of the site. The study area for this analysis includes the following intersection:

- Southampton Road (Route 10/202) at North Road (signalized);

The existing conditions analysis consisted of an inventory of the traffic controls, roadway, driveway and intersection geometrics in the study area, the collection of peak hour traffic volumes, and a review of recent crash history.

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### Roadway Geometry

Descriptions of the study area roadways and intersections are included below.



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#### Roadways

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##### Southampton Road (Route 10/202)

Southampton Road (Route 10 & 202), a minor arterial roadway, is a north-south roadway that provides a connection between communities to the south and north of the project site, as well as Interstate 90 to the south. Southampton Road south of North Road is designated as Route 10 & 202, while north of North Road it is designated at Route 10. Southampton Road has a typical cross section consisting of



two travel lanes (1 lane per direction) with exclusive turning lanes at key intersections and wide shoulders. In front of the site the pavement width varies between 45 feet and 50 feet, carrying one travel lane in each direction. The posted speed limit along Southampton Road is 40 mph in the vicinity of the site. No sidewalks or pedestrian accommodations are provided along this section of Southampton Road. The abutting land uses along Southampton Road are a mix of commercial, institutional, and residential, as well as several large distribution facilities. Barnes Air National Guard Base is located off the opposite side of Southampton Road, in the vicinity of the site.

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## **North Road (Route 202)**

North Road (Route 202) is an east-west roadway providing connection to Interstate 91 to the east. North Road is a minor collector roadway. North Road to the east of Southampton Road is designated as Route 202, while North Road to the west of Southampton Road does not carry a designation. North Road has a cross section consisting of two travel lanes (1 per direction), without shoulders adjacent to the site. The pavement width is approximately 30 feet in the vicinity of the project site. The abutting land use along North Road in the study area is predominantly residential, minor commercial and institutional. The posted speed limit is 40 mph in the vicinity of the site. No sidewalks or pedestrian accommodations are provided along North Road.



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## **Intersections**

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### **Southampton Road (Rte 10 & 202) at North Road (Rte 202)**

North Road intersects Southampton Road from the east and west to form this four-way signalized intersection. The North Road eastbound and westbound approaches both consist of a single multi-purpose lane, however, vehicles were observed forming multiple lanes along the westbound approach. The northbound and southbound Southampton Road approaches each provide a single multi-purpose lane, however, vehicles were observed forming multiple lanes along the both of these approaches as well. The project site is located on the southwest corner of the intersection. Land uses in the vicinity of the intersection consist of a residential home on the northeast corner, 7B's Grill and Bar, a convenience store, a hair salon, and a drive-through ATM on the northwest corner, and wooded area and a large distribution center on the southeast corner. Movements at the intersection are controlled by a 2-phase actuated-uncoordinated traffic signal.

## Traffic Volumes

Peak hour turning movement and classification (TMC) counts were collected on a typical weekday evening from 4:00 PM to 6:00 PM and on a typical Saturday from 11:00 AM to 1:00 PM at the study area intersection on January 24, 2013 (Thursday) and January 26, 2013 (Saturday).

Based on the TMC data, the peak hours of traffic operations for the study area intersections were determined to be 4:15 PM to 5:15 PM on a typical weekday evening, and 11:30 AM to 12:30 PM on a typical Saturday midday.

Automatic traffic recorder counts were also conducted January 25<sup>th</sup> through January 26<sup>th</sup>, 2013 along Southampton Road in front of the project site. Table 1 summarizes daily traffic volume data obtained.

**Table 1**  
**Summary of Observed Traffic Volumes**

Location	Weekday ADT <sup>a</sup>	Friday Evening Peak Hour			Saturday ADT	Saturday Midday Peak Hour		
		Volume <sup>b</sup>	K Factor <sup>c</sup>	Dir. Dist. <sup>d</sup>		Volume	K Factor	Dir. Dist.
Southampton Road (south of North Road)	12,500	1,090	8.7%	58% NB	8,830	760	8.6%	51% NB

NOTE: ATRs conducted by Innovative Data, LLC

- a daily traffic expressed in vehicles per day
- b peak hour volumes expressed in vehicles per hour
- c percent of daily traffic that occurs during the peak hour period
- d directional distribution of peak period traffic

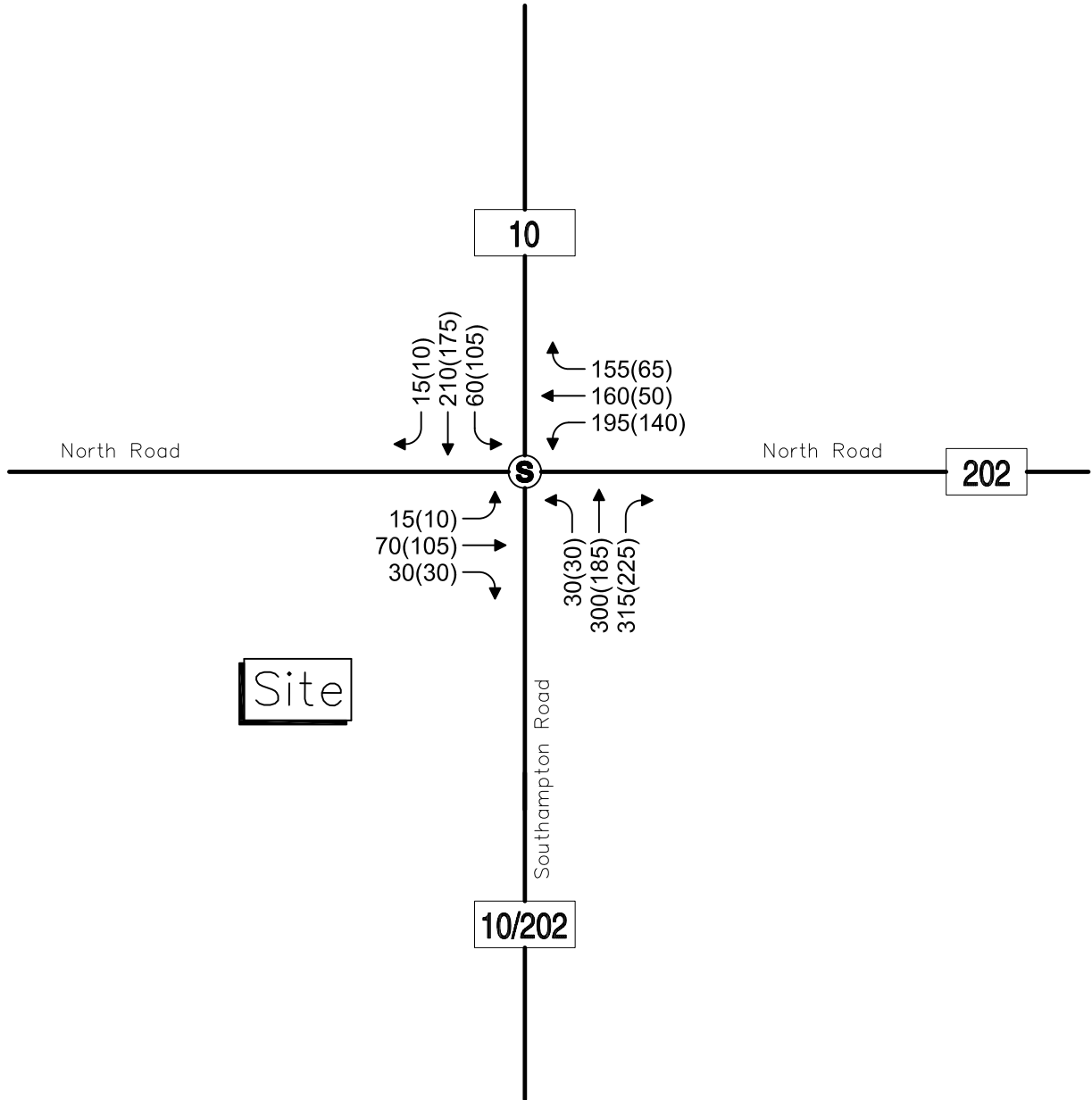
## Seasonal Adjustment

The traffic volume data collected for this project were obtained during the month of January. To quantify the seasonal variation of traffic volumes in the area, historic traffic data available from MassDOT were reviewed. This data indicates that traffic volumes in January are typically lower than the yearly average conditions. Therefore, a seasonal adjustment of 1.02% was applied to the traffic volumes in order to provide a conservative analysis. Figure 2 illustrates the resulting 2013 Existing conditions peak period traffic volumes for the weekday evening and Saturday midday peak hours.

**S** = Traffic Signal

Neg = < 5 Vehicles

Weekday Evening Peak (Saturday Midday Peak)



**Vanasse Hangen Brustlin, Inc.**

**↑**  
**Not to Scale**

Cumberland Farms Convenience Store  
and Fueling Facility

Figure 2

Peak Hour Traffic Volumes - 2013 Existing  
Weekday Evening and Saturday Midday Peak Hours  
Westfield, Massachusetts

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## Crash History

To identify accident trends and/or roadway deficiencies in the study area, crash data for the study area intersections were obtained from MassDOT for the most recently available three-year period (2008-2010). MassDOT reports vehicle crashes with damage greater than \$1,000 or personal injury occurrences, which can give a good indication of safety along the study corridor.

The 2011 MassDOT average crash rates for signalized intersections for District 2 (the MassDOT district designation for Westfield) is 0.82. As seen in the crash summary table found in the Appendix, the signalized intersection of Southampton Road (Route 10/202) at North Road (Route 202) is above the MassDOT District 2 average crash rate values, with a value of 1.14.

In that report, the signalized intersection experienced a total of twenty two (22) reported accidents over the three year period. The majority of the reported accidents were angle and rear-end accidents.

# 3

## Future Conditions

To determine future demands on the roadway network, existing traffic volumes in the study area were projected to the year 2018, reflecting a five year traffic-planning horizon. Traffic volumes on the roadway network under future conditions without the project (2018 No-Build) are assumed to include all existing traffic, any new traffic due to background traffic growth, and traffic related to any specific development projects expected to be completed by the horizon year. Anticipated traffic volumes from the proposed development were added to the No-Build traffic volumes to reflect conditions with the project in place (2018 Build scenario).

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### Background Traffic Growth

Traffic growth on area roadways is a function of the expected land development, economic activity, and changes in demographics. Several methods can be used to estimate this growth. A procedure frequently employed is to estimate an annual percentage increase and apply that increase to study area traffic volumes. An alternative procedure is to identify estimated traffic generated by planned new major developments that would be expected to impact the project study area roadways. For the purpose of this assessment, both methods were utilized.



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### Historic Traffic Growth

Many factors influence regional traffic growth including socio-economic factors such as population, employment, regional development, and dwelling unit changes. For the purpose of this study, an annual growth rate of 2-percent per year was applied to the existing traffic volumes over the 5-year forecast period. Regional traffic growth is projected by examining historical traffic volumes and other more recent traffic studies conducted within the area. The existing traffic volumes were grown by 2-percent per year to account for potential future traffic growth.



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## Site-Specific Growth

Traffic volumes in the area can be affected by other nearby developments. Based on information provided by the City of Westfield it was identified that while development opportunities currently exist within the City, they are either located too far from the study area to have a significant impact, or official applications have not been filed with the City yet.

One development that has been approved by the City but has been completely constructed is the Armbrook Senior Living Center, proposed to be located further west along North Road and provide 122 living units. Construction is currently underway, with occupancy set for the spring of 2013. Since these types of developments generate minimal traffic, it can be assumed that the traffic increase is accounted for as part of the conservative 2 percent per year background growth.

It was assumed that the site specific growth associated with any other potential developments can also be accounted for as part of the historic 2 percent per year background growth. The 2018 No-Build traffic volumes are shown on Figure 3.

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## Future Roadway Conditions

In assessing future traffic conditions, proposed roadway improvements within the study area were considered. Based on discussions with the City of Westfield, there are currently no improvement plans that would alter the roadway cross section or characteristics. One project that is currently planned is the construction of a new water and/or sewer main, but this project is not expected to impact traffic volumes or patterns in the vicinity of the site.



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## Trip Generation

To estimate the trip-generating characteristics for the proposed development, traffic projections were derived from trip generation rates published by the Institute of Transportation Engineers (ITE) *Trip Generation*<sup>1</sup> For the proposed gas station with convenience store, it was determined that ITE trip generation rates for gas/service station with convenience store (land use code 945) were the most appropriate rates to use. Saturday daily trips were estimated using a ratio of Saturday daily to Saturday midday peak hour estimates for LUC 820 (Shopping Center) for a corresponding square footage with trip generation similar to the Saturday midday peak hour. As noted earlier, the proposed gas station will consist of 10 vehicle fueling positions. A summary of the Cumberland Farms convenience store and fueling facility trip generation is detailed in Table 2.

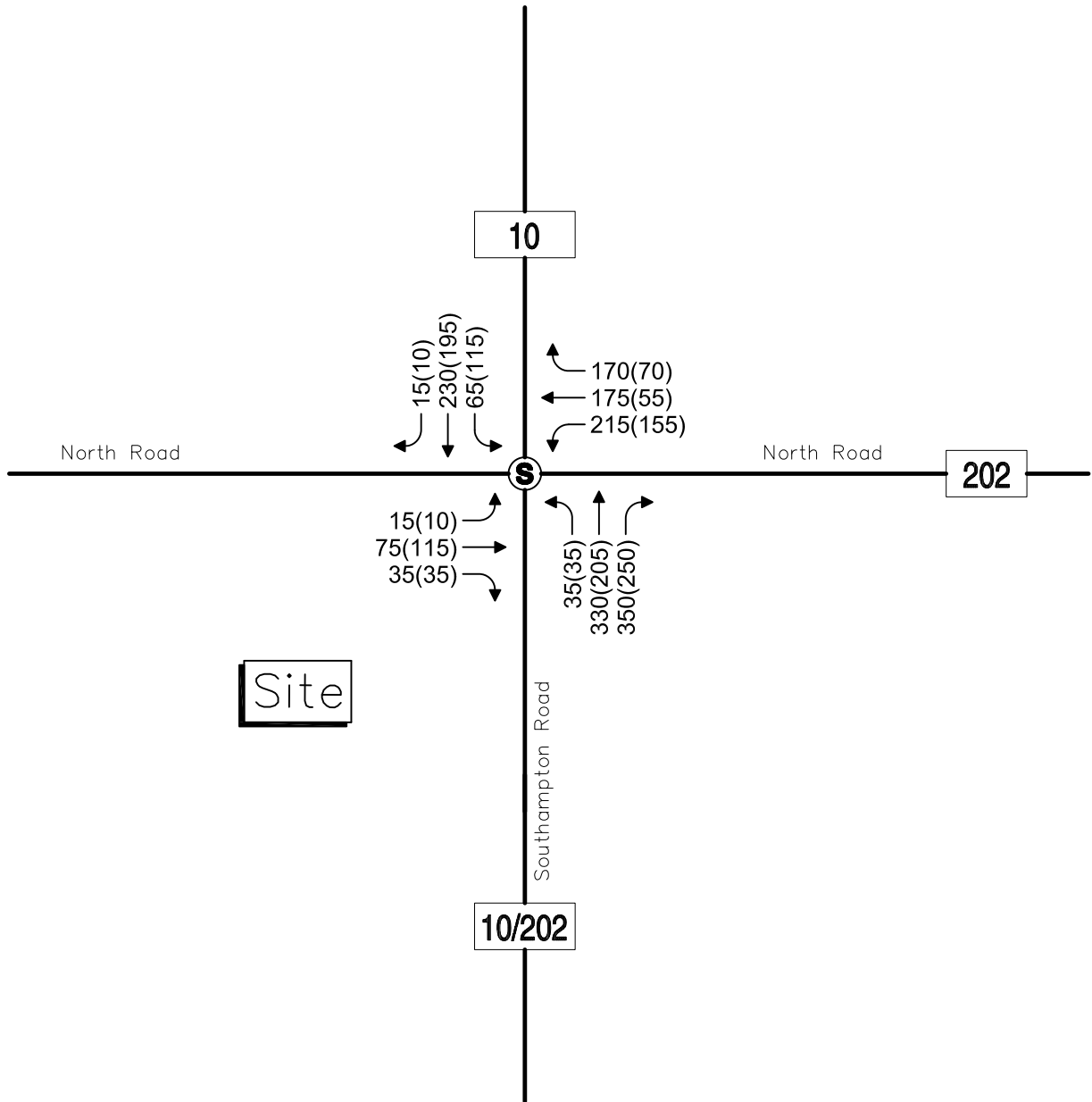


<sup>1</sup> Trip Generation; Eighth Edition; Institute of Transportation Engineers; Washington, D.C.; 2012.

**S** = Traffic Signal

Neg = < 5 Vehicles

Weekday Evening Peak (Saturday Midday Peak)



**Vanasse Hangen Brustlin, Inc.**

**↑**  
**Not to Scale**

Cumberland Farms Convenience Store  
and Fueling Facility

Figure 3

Peak Hour Traffic Volumes - 2018 No-Build  
Weekday Evening and Saturday Midday Peak Hours  
Westfield, Massachusetts

In addition, not all of the net new traffic generated by the site will be new traffic on the study area roadways. Given the nature of a fueling facility, the demand is generally a function of the adjacent street traffic volumes, and typically consists of primarily drive-by traffic. Drive-by traffic is defined as vehicles already on the roadway network who decide to stop at the fueling facility prior to proceeding to their original destination. ITE data suggests that approximately 62 percent of the traffic generated by a gas station with convenience store could be pass-by traffic. However, to be consistent with EOE/EOT Guidelines for Traffic Impact Assessments and to provide a conservative analysis, only 25 percent of the traffic generated by the site was assumed to be pass-by trips. The resulting trip generation is presented in Table 2.

**Table 2**  
**Site Generated Traffic Summary**

Time Period	Future <sup>1</sup> (16 vfp)	Pass-By Trips <sup>2</sup>	Total Site Trips
Weekday Daily <sup>a</sup>	1,630	410	1,220
Weekday Evening Peak Hour <sup>b</sup>			
Enter	70	20	50
Exit	<u>65</u>	<u>15</u>	<u>50</u>
Total	135	35	100
Saturday Daily <sup>a</sup>	1,820	460	1,360
Saturday Midday Peak Hour <sup>b</sup>			
Enter	90	25	65
Exit	<u>85</u>	<u>20</u>	<u>65</u>
Total	175	45	130

Source: Trip Generation, 8th Edition; Institute of Transportation Engineers (ITE); Washington, D.C. (2008).

Note: numbers rounded to the nearest 5.

a vehicles per day

b vehicles per hour

1 Trip generation based on LUC 945 (Gas/Service Station w/Convenience Store) for 10 vehicle fueling positions.

2 Represents a conservative 25% pass-by rate.

As shown in Table 2, the site is not expected to generate a significant amount of trips during the peak hours. To put the amount of site generated traffic into perspective, the 50 new trips during the weekday evening peak hour is less than 1 new vehicle entering the site per minute.





## Trip Distribution and Assignment

The regional trip distribution of site generated traffic due to the proposed development is expected to reflect the vehicle patterns of existing vehicle trips accessing the site. Table 3 illustrates the trip distribution along the study area approaches.

**Table 3**  
**Vehicle Trip Distribution Summary**

Direction (To/From)	Travel Route	New Site-Generated Traffic Weekday Evening Peak Hour	New Site-Generated Traffic Saturday Midday Peak Hour
East	North Road (Route 202)	33%	22%
West	North Road	7%	13%
North	Southampton Road (Route 10)	18%	26%
<u>South</u>	<u>Southampton Road (Route 10/202)</u>	<u>42%</u>	<u>39%</u>
Total	All Routes	100%	100%

As illustrated in Table 3, the majority of site generated traffic is expected to approach the site from the south on Southampton Road (Route 10/202). This accounts for approximately 42 percent and 39 percent of the peak hour traffic during the weekday evening and Saturday midday peak hours, respectively. Using these assumptions and the distribution of traffic to/from the site; traffic was assigned to the driveways.

By using the existing traffic volumes, the anticipated Trip Generation Increase numbers from Table 2, and the trip distribution percentages, the anticipated increase in traffic volumes along each leg of the surrounding roadway network can be estimated. For example, on a daily basis, Southampton Road (Route 10/202) carries approximately 12,500 vehicles per day south of North Road. The trip distribution exercise that was done shows that approximately 42% of site traffic comes from and returns to the south along Southampton Road during the weekday evening peak hour. The total estimated daily increase in traffic volumes is 1,220 as shown in Table 2. From this information, it can be calculated that Southampton Road is estimated to carry approximately 510 (42% of 1,220 total vehicles per day) more vehicles per day, representing only a 4% increase over existing conditions.

During the weekday evening peak hour, Southampton Road (Route 10/202) south of North Road currently carries 1,090 vehicles per hour (approximately 18 vehicles every minute). The total trips during the weekday evening peak hour that this site is proposed to generate is approximately 100 trips per hour (from Table 2). Of the 100 new trips per hour, approximately 42 (42% of 100) will travel along Southampton Road (Route 10/202) south of North Road, which represents a minimal increase of less than 1 new vehicle per minute.



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## Site Driveways and Circulation

As currently proposed, the Cumberland Farms convenience store and fueling facility will be adequately served by three site driveways, one full access driveway on Southampton Road (Route 10/202) and one full access driveway on North Road, as well as an entrance only driveway along Southampton Road located closer to the signalized intersection of Southampton Road (Route 10/202) at North Road (Route 202). The two new full-access driveways will be located further away from the signalized intersection to help avoid conflicts with traffic at the intersection.

The proposed *West Site Driveway* intersects North Road from the south to form an unsignalized intersection. North Road is proposed to continue operating freely, while the site driveway approach is to operate under “STOP” control. The driveway approach will provide a shared right/left turn lane. The proposed site driveway is located approximately 115 feet west of the signalized intersection.

The proposed *South Site Driveway* intersects Southampton Road (Route 10/202) from the west and forms a three-legged unsignalized intersection. Southampton Road is proposed to continue operating freely, while the site driveway approach is to operate under “STOP” control. The driveway approach will provide a shared right/left turn lane. This proposed site driveway is located approximately 225 feet south of the signalized intersection.

The proposed *North Site Driveway* intersects Southampton Road (Route 10/202) from the west and forms a three-legged unsignalized intersection. Southampton Road is proposed to continue operating freely, while the site driveway is an entrance only driveway, not allowing vehicles to exit. This proposed site driveway is located approximately 50 feet south of the signalized intersection.

The location of the site driveways allow for full use of the site from a vehicle circulation perspective. At fueling facilities it is ideal to allow multiple access and egress points so that traffic does not become congested on site. If vehicles are allowed to access the site and pull into a site driveway without conflict, it minimizes the chances of impacting the adjacent roadways.

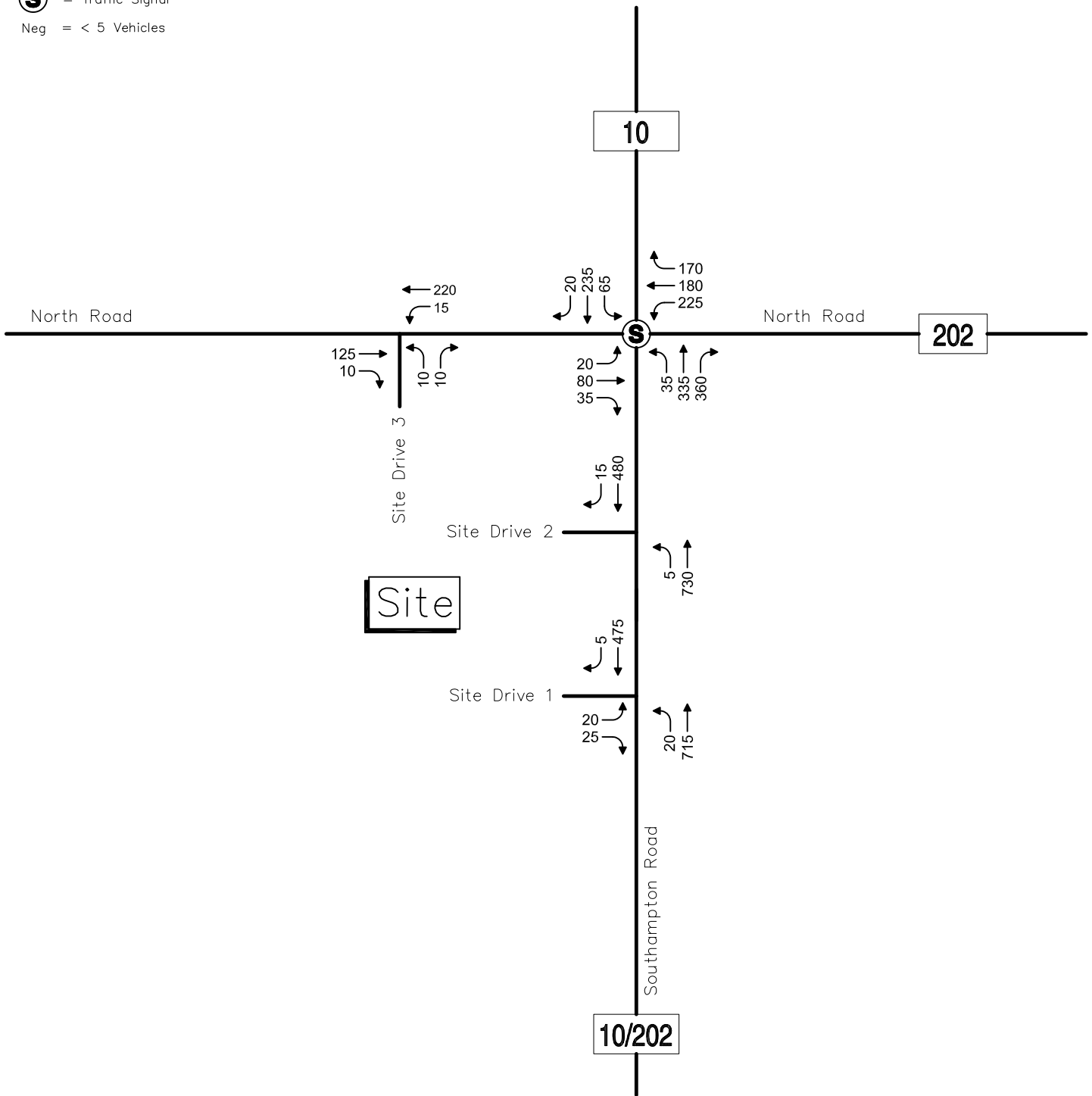


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## Build Traffic Volumes

Design year 2018 Build traffic volumes for study area roadways were determined by estimating site-generated traffic volumes and distributing these volumes over the study area roadways. These site-generated volumes were added to the 2018 No-Build traffic volumes to create the year 2018 Build traffic volume networks. The 2018 Build weekday evening and Saturday midday peak hour traffic volumes are illustrated on Figures 4 and 5, respectively.

**S** = Traffic Signal  
 Neg = < 5 Vehicles



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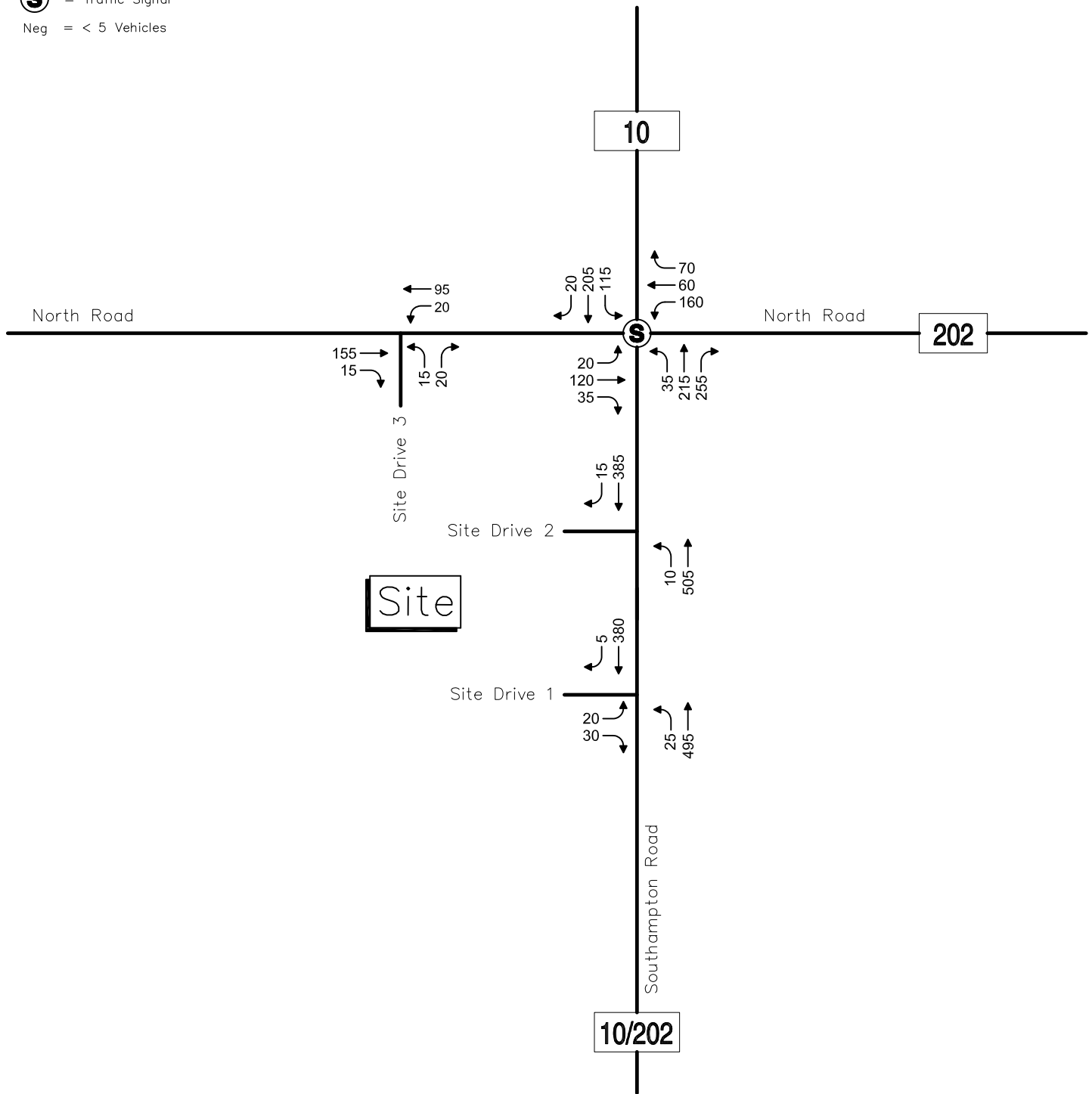
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Cumberland Farms Convenience Store  
 and Fueling Facility

Figure 4

Peak Hour Traffic Volumes  
 2018 Build Weekday Evening Peak Hour  
 Westfield, Massachusetts

**S** = Traffic Signal  
 Neg = < 5 Vehicles



**Vanasse Hangen Brustlin, Inc.**

**↑**  
**Not to Scale**

Cumberland Farms Convenience Store  
 and Fueling Facility

Figure 5

Peak Hour Traffic Volumes  
 2018 Build Saturday Midday Peak Hour  
 Westfield, Massachusetts

## Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to Existing, projected No-Build, and Build traffic volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them. Roadway operating conditions are classified by calculated levels of service.

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### Level-Of-Service Criteria

The evaluation criteria used to analyze area intersections in this traffic study are based on the 2000 Highway Capacity Manual (HCM)<sup>2</sup>. The term 'Level of service' (LOS) is used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is a qualitative measure that considers a number of factors including roadway geometry, speed, travel delay and freedom to maneuver. Level of service provides an index to the operational qualities of a roadway segment or an intersection. Level-of-service designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions.

In addition to LOS, two other measures of effectiveness (MOEs) are typically used to quantify the traffic operations at intersections; volume-to-capacity ratio (v/c) and delay (expressed in seconds per vehicle). For example, an existing v/c ratio of 0.9 for an intersection indicates that the intersection is operating at 90 percent of its available capacity. A delay of 15 seconds for a particular vehicular movement or approach indicates that vehicles on the movement or approach will experience an average additional travel time of 15 seconds. It should be noted that v/c and delay could have a range of values for a given LOS letter designation. Comparison of intersection capacity results therefore requires that, in addition to the LOS, the other MOEs should also be considered.

The level-of-service designations, which are based on delay, are reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection and the

<sup>2</sup>

Transportation Research Board, Highway Capacity Manual, Washington, D.C., 2000.

LOS designation is for overall conditions at the intersection. For unsignalized intersections, however, the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. Thus, the LOS designation is for the critical movement exiting the side street, which is generally the left turn out of the side street or site driveway. Table 4 shows the level of service criteria for both signalized intersections and unsignalized intersections.

It should be noted that the analytical methodologies typically used for the analysis of unsignalized intersections use conservative analysis parameters, such as long critical gaps. Actual field observations indicate that drivers on minor streets generally accept shorter gaps in traffic than those used in the analysis procedures and therefore experience less delay than reported by the analysis software. The analysis methodologies also do not fully take into account the beneficial grouping effects caused by nearby signalized intersections. The net effect of these analysis procedures is the over-estimation of calculated delays at unsignalized intersections in the study area. Cautious judgment should therefore be exercised when interpreting the capacity analysis results at unsignalized intersections.

**Table 4**  
**Level of Service Criteria**

<b>Level of Service</b>	<b>Signalized Intersection</b>	<b>Unsignalized Intersection</b>
A	0 to 10 seconds	0 to 10 seconds
B	10 to 20 seconds	10 to 15 seconds
C	20 to 35 seconds	15 to 25 seconds
D	35 to 55 seconds	25 to 35 seconds
E	55 to 80 seconds	35 to 50 seconds
F	Greater than 80 seconds	Greater than 50 seconds

Source: 2000 Highway Capacity Manual Exhibits 16-2 and 17-2

## Signalized Intersections Capacity Analysis

Capacity analyses conducted for the signalized intersections are summarized in Table 5. The capacity analyses were conducted for 2013 Existing, 2018 No-Build and 2018 Build conditions.

**Table 5**  
**Signalized Intersection Capacity Analysis Summary**

Location	Peak Hour	2013 Existing			2018 No-Build			2018 Build		
		v/c <sup>1</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>	v/c	Delay	LOS	v/c	Delay	LOS
Southampton Road (Route 10/202) at North Road (Route 202)*	Weekday Evening	0.81	17.6	B	0.90	23.5	C	0.93	27.1	C
	Saturday Midday	0.53	8.7	A	0.59	9.7	A	0.61	10.4	B

1 volume to capacity ratio  
 2 average delay in seconds per vehicle  
 3 level of service  
 \* the westbound approach was modeled as it operates in the field with two approach lanes

The signalized capacity analysis summary in Table 5 indicates that the signalized intersection of Southampton Road (Route 10/202) at North Road (Route 202) is not expected to deteriorate in LOS from the No-Build to the Build conditions during the weekday evening peak hour. Furthermore, the intersection is expected to operate at acceptable levels of service during the Build conditions, with slight increases in delay.

## Unsignalized Intersection Capacity Analysis

Three unsignalized site driveways were analyzed for the 2018 Build conditions. The results of the analyses are shown in Table 6.

Table 6 shows that during the 2018 Build conditions the two full access site driveways are expected to operate at an acceptable LOS during both the peak hours.

**Table 6**  
**Unsignalized Intersection Capacity Analysis Summary**

Location	Period	Lane Group	2018 No-Build				2018 Build			
			Dem <sup>1</sup>	v/c <sup>2</sup>	Delay <sup>3</sup>	LOS <sup>4</sup>	Dem	v/c	Delay	LOS
South Site Drive (Site Drive 1) at Southampton Road	Weekday Evening	EB			NA		45	0.19	21.9	C
	Saturday Midday	EB			NA		50	0.13	15.3	C
North Site Drive (Site Drive 2) at Southampton Road	Weekday Evening	NB			NA		5	0.01	0.1	A
	Saturday Midday	NB			NA		10	0.01	0.3	A
West Site Drive (Site Drive 3) at North Road	Weekday Evening	NB			NA		20	0.03	10.2	B
	Saturday Midday	NB			NA		35	0.05	10.0	A

- 1 demand in vehicles per hour
- 2 volume to capacity ratio
- 3 delay, measured in seconds per vehicle
- 4 level of service
- NA driveways do not exist during No-Build scenario



# 5

## Conclusions

This study has been prepared to evaluate the traffic impacts associated with the construction of a proposed Cumberland Farms Convenience Store with Gasoline Sales (10 vehicle fueling positions) to be located on the southwestern corner of the intersection of Southampton Road (Route 10/202) at North Road (route 202) in the City of Westfield, Massachusetts. The following is a summary of study findings:

- The proposed redevelopment is expected to generate approximately 135 (70 enter, 65 exit) total vehicle trips during the weekday afternoon peak hour, and 175 (90 enter, 85 exit) total vehicle trips during the Saturday midday peak hour. Given the nature of a fueling facility, the demand is generally a function of the adjacent street traffic volumes, and typically consists of primarily drive-by traffic. For this type of development, approximately 62 percent of the site-generated traffic could be drive-by traffic or traffic that is already on the roadway. However, because the project abuts State Highway, traffic guidelines set by the State and MassDOT only allow a 25 percent pass-by credit when conducting a traffic study. Therefore, this traffic study utilized a conservative methodology.
- The Cumberland Farms convenience store and fueling facility will be adequately served by three site driveways, one full access driveway on Southampton Road (Route 10/202) and one full access driveway on North Road, as well as an entrance only driveway along Southampton Road. The location of the site driveways allow for full use of the site from a vehicle circulation perspective. At fueling facilities it is ideal to allow multiple access points so that traffic does not impact the adjacent roadways, and so that traffic can circulate the site in a more efficient manner.
- The results of this study (as shown in Tables 5 and 6) indicate that the study area intersection and roadways are not expected to be significantly impacted by the proposed project, and there is sufficient capacity to accommodate the conservative increase in traffic that has been projected.

In summary, it is the finding of this traffic impact and access study is that the study area intersections and roadways are not expected to be significantly impacted by the addition of the anticipated traffic generated by the proposed development.



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# Traffic Appendix

- **Observed Traffic Volume Data**
  - Intersection Counts (PM & SAT Peak Hours)
  - Automatic Traffic Recorder (ATR) Data
  
- **ITE Trip Generation Calculations**
  - LUC 945 “Gasoline/Service Station with Convenience Market”
  - VHB Calculations
  
- **Crash Data**
  - 2008-2010 Crash Summary
  - Crash Rate Worksheet
  
- **Operational Analyses**
  - Intersection Capacity Analysis
  
- **Cumberland Farms Concept Plan**

# Observed Traffic Volume Data

Intersection Counts  
ATR Counts



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N / S: Southampton Road  
 E / W: North Road  
 City, State: Westfield, Massachusetts  
 Client: VHB / J. Locke

File Name : PM Peak - Southampton @ North  
 Site Code : 1  
 Start Date : 1/24/2013  
 Page No : 1

### Groups Printed- PCs and Peds - Heavy Vehicles - Bicycles

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
04:00 PM	2	46	22	0	70	31	31	80	0	142	96	44	10	0	150	7	12	1	0	20	382
04:15 PM	4	61	15	0	80	24	32	46	0	102	76	52	3	0	131	10	21	6	0	37	350
04:30 PM	4	40	18	0	62	37	35	58	0	130	66	77	8	0	151	7	17	5	0	29	372
04:45 PM	3	57	10	0	70	39	48	40	0	127	83	73	10	0	166	7	19	4	0	30	393
<b>Total</b>	<b>13</b>	<b>204</b>	<b>65</b>	<b>0</b>	<b>282</b>	<b>131</b>	<b>146</b>	<b>224</b>	<b>0</b>	<b>501</b>	<b>321</b>	<b>246</b>	<b>31</b>	<b>0</b>	<b>598</b>	<b>31</b>	<b>69</b>	<b>16</b>	<b>0</b>	<b>116</b>	<b>1497</b>
05:00 PM	5	47	18	0	70	52	39	47	0	138	85	94	11	0	190	6	13	1	0	20	418
05:15 PM	6	44	15	0	65	35	38	46	0	119	53	64	12	0	129	7	22	6	0	35	348
05:30 PM	4	42	10	0	56	32	42	44	0	118	39	52	3	0	94	12	32	6	0	50	318
05:45 PM	2	39	14	0	55	39	22	30	0	91	48	39	7	0	94	6	14	2	0	22	262
<b>Total</b>	<b>17</b>	<b>172</b>	<b>57</b>	<b>0</b>	<b>246</b>	<b>158</b>	<b>141</b>	<b>167</b>	<b>0</b>	<b>466</b>	<b>225</b>	<b>249</b>	<b>33</b>	<b>0</b>	<b>507</b>	<b>31</b>	<b>81</b>	<b>15</b>	<b>0</b>	<b>127</b>	<b>1346</b>
<b>Grand Total</b>	<b>30</b>	<b>376</b>	<b>122</b>	<b>0</b>	<b>528</b>	<b>289</b>	<b>287</b>	<b>391</b>	<b>0</b>	<b>967</b>	<b>546</b>	<b>495</b>	<b>64</b>	<b>0</b>	<b>1105</b>	<b>62</b>	<b>150</b>	<b>31</b>	<b>0</b>	<b>243</b>	<b>2843</b>
<b>Apprch %</b>	<b>5.7</b>	<b>71.2</b>	<b>23.1</b>	<b>0</b>		<b>29.9</b>	<b>29.7</b>	<b>40.4</b>	<b>0</b>		<b>49.4</b>	<b>44.8</b>	<b>5.8</b>	<b>0</b>		<b>25.5</b>	<b>61.7</b>	<b>12.8</b>	<b>0</b>		
<b>Total %</b>	<b>1.1</b>	<b>13.2</b>	<b>4.3</b>	<b>0</b>	<b>18.6</b>	<b>10.2</b>	<b>10.1</b>	<b>13.8</b>	<b>0</b>	<b>34</b>	<b>19.2</b>	<b>17.4</b>	<b>2.3</b>	<b>0</b>	<b>38.9</b>	<b>2.2</b>	<b>5.3</b>	<b>1.1</b>	<b>0</b>	<b>8.5</b>	
<b>PCs and Peds</b>	<b>93.3</b>	<b>98.1</b>	<b>98.4</b>	<b>0</b>	<b>97.9</b>	<b>98.3</b>	<b>97.2</b>	<b>92.6</b>	<b>0</b>	<b>95.7</b>	<b>97.4</b>	<b>98.6</b>	<b>98.4</b>	<b>0</b>	<b>98</b>	<b>96.8</b>	<b>94.7</b>	<b>96.8</b>	<b>0</b>	<b>95.5</b>	<b>97</b>
<b>Heavy Vehicles</b>	<b>6.7</b>	<b>1.9</b>	<b>1.6</b>	<b>0</b>	<b>2.1</b>	<b>1.7</b>	<b>2.8</b>	<b>7.4</b>	<b>0</b>	<b>4.3</b>	<b>2.6</b>	<b>1.4</b>	<b>1.6</b>	<b>0</b>	<b>2</b>	<b>3.2</b>	<b>5.3</b>	<b>3.2</b>	<b>0</b>	<b>4.5</b>	<b>3</b>
<b>% Heavy Vehicles</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Bicycles</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>% Bicycles</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. 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	4	<b>61</b>	15	0	<b>80</b>	24	32	46	0	102	76	52	3	0	131	<b>10</b>	<b>21</b>	<b>6</b>	0	<b>37</b>	350
04:30 PM	4	40	<b>18</b>	0	62	37	35	<b>58</b>	0	130	66	77	8	0	151	7	17	5	0	29	372
04:45 PM	3	57	10	0	70	39	<b>48</b>	40	0	127	83	73	10	0	166	7	19	4	0	30	393
05:00 PM	<b>5</b>	47	18	0	70	<b>52</b>	39	47	0	<b>138</b>	<b>85</b>	<b>94</b>	<b>11</b>	0	<b>190</b>	6	13	1	0	20	<b>418</b>
<b>Total Volume</b>	<b>16</b>	<b>205</b>	<b>61</b>	<b>0</b>	<b>282</b>	<b>152</b>	<b>154</b>	<b>191</b>	<b>0</b>	<b>497</b>	<b>310</b>	<b>296</b>	<b>32</b>	<b>0</b>	<b>638</b>	<b>30</b>	<b>70</b>	<b>16</b>	<b>0</b>	<b>116</b>	<b>1533</b>
<b>% App. Total</b>	<b>5.7</b>	<b>72.7</b>	<b>21.6</b>	<b>0</b>		<b>30.6</b>	<b>31</b>	<b>38.4</b>	<b>0</b>		<b>48.6</b>	<b>46.4</b>	<b>5</b>	<b>0</b>		<b>25.9</b>	<b>60.3</b>	<b>13.8</b>	<b>0</b>		
<b>PHF</b>	<b>.800</b>	<b>.840</b>	<b>.847</b>	<b>.000</b>	<b>.881</b>	<b>.731</b>	<b>.802</b>	<b>.823</b>	<b>.000</b>	<b>.900</b>	<b>.912</b>	<b>.787</b>	<b>.727</b>	<b>.000</b>	<b>.839</b>	<b>.750</b>	<b>.833</b>	<b>.667</b>	<b>.000</b>	<b>.784</b>	<b>.917</b>



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N / S: Southampton Road  
 E / W: North Road  
 City, State: Westfield, Massachusetts  
 Client: VHB / J. Locke

File Name : PM Peak - Southampton @ North  
 Site Code : 1  
 Start Date : 1/24/2013  
 Page No : 1

### Groups Printed- Heavy Vehicles

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
04:00 PM	0	2	0	0	2	0	2	4	0	6	1	1	0	0	2	1	2	0	0	3	13
04:15 PM	0	1	0	0	1	1	1	4	0	6	5	0	0	0	5	1	1	1	0	3	15
04:30 PM	0	0	0	0	0	0	3	6	0	9	1	1	1	0	3	0	0	0	0	0	12
04:45 PM	0	1	1	0	2	1	0	3	0	4	3	1	0	0	4	0	0	0	0	0	10
<b>Total</b>	0	4	1	0	5	2	6	17	0	25	10	3	1	0	14	2	3	1	0	6	50
05:00 PM	0	0	0	0	0	0	0	4	0	4	1	2	0	0	3	0	0	0	0	0	7
05:15 PM	1	0	0	0	1	0	1	3	0	4	2	1	0	0	3	0	1	0	0	1	9
05:30 PM	1	0	1	0	2	2	1	3	0	6	1	1	0	0	2	0	3	0	0	3	13
05:45 PM	0	3	0	0	3	1	0	2	0	3	0	0	0	0	0	0	1	0	0	1	7
<b>Total</b>	2	3	1	0	6	3	2	12	0	17	4	4	0	0	8	0	5	0	0	5	36
<b>Grand Total</b>	2	7	2	0	11	5	8	29	0	42	14	7	1	0	22	2	8	1	0	11	86
Apprch %	18.2	63.6	18.2	0		11.9	19	69	0		63.6	31.8	4.5	0		18.2	72.7	9.1	0		
Total %	2.3	8.1	2.3	0	12.8	5.8	9.3	33.7	0	48.8	16.3	8.1	1.2	0	25.6	2.3	9.3	1.2	0	12.8	

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru		Peds	App. Total	Right	Thru		Peds	App. Total	Right	Thru		Peds	App. Total	Right	Thru		Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	0	2	0	0	2	0	2	4	0	6	1	1	0	0	2	1	2	0	0	3	13
04:15 PM	0	1	0	0	1	1	1	4	0	6	5	0	0	0	5	1	1	1	0	3	15
04:30 PM	0	0	0	0	0	0	3	6	0	9	1	1	1	0	3	0	0	0	0	0	12
04:45 PM	0	1	1	0	2	1	0	3	0	4	3	1	0	0	4	0	0	0	0	0	10
Total Volume	0	4	1	0	5	2	6	17	0	25	10	3	1	0	14	2	3	1	0	6	50
% App. Total	0	80	20	0		8	24	68	0		71.4	21.4	7.1	0		33.3	50	16.7	0		
PHF	.000	.500	.250	.000	.625	.500	.500	.708	.000	.694	.500	.750	.250	.000	.700	.500	.375	.250	.000	.500	.833



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N / S: Southampton Road  
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 Client: VHB / J. Locke

File Name : Sat Peak - Southampton @ North  
 Site Code : 1  
 Start Date : 1/26/2013  
 Page No : 1

Groups Printed- PCs and Peds - Heavy Vehicles - Bicycles

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
11:00 AM	2	43	21	0	66	23	14	30	0	67	52	29	5	0	86	3	14	2	0	19	238
11:15 AM	3	45	26	0	74	15	22	26	0	63	41	43	5	0	89	1	10	3	0	14	240
11:30 AM	1	43	27	0	71	12	13	28	0	53	57	48	8	0	113	11	25	2	0	38	275
11:45 AM	1	47	25	0	73	22	13	34	0	69	48	31	7	0	86	9	24	4	0	37	265
<b>Total</b>	<b>7</b>	<b>178</b>	<b>99</b>	<b>0</b>	<b>284</b>	<b>72</b>	<b>62</b>	<b>118</b>	<b>0</b>	<b>252</b>	<b>198</b>	<b>151</b>	<b>25</b>	<b>0</b>	<b>374</b>	<b>24</b>	<b>73</b>	<b>11</b>	<b>0</b>	<b>108</b>	<b>1018</b>
12:00 PM	5	38	27	0	70	13	7	32	0	52	64	44	6	0	114	6	20	3	0	29	265
12:15 PM	2	41	25	0	68	18	17	42	0	77	53	56	7	0	116	5	38	2	0	45	306
12:30 PM	1	33	25	0	59	21	15	28	0	64	54	34	3	0	91	7	24	3	0	34	248
12:45 PM	1	42	20	0	63	15	13	32	0	60	47	40	3	0	90	5	18	1	0	24	237
<b>Total</b>	<b>9</b>	<b>154</b>	<b>97</b>	<b>0</b>	<b>260</b>	<b>67</b>	<b>52</b>	<b>134</b>	<b>0</b>	<b>253</b>	<b>218</b>	<b>174</b>	<b>19</b>	<b>0</b>	<b>411</b>	<b>23</b>	<b>100</b>	<b>9</b>	<b>0</b>	<b>132</b>	<b>1056</b>
<b>Grand Total</b>	<b>16</b>	<b>332</b>	<b>196</b>	<b>0</b>	<b>544</b>	<b>139</b>	<b>114</b>	<b>252</b>	<b>0</b>	<b>505</b>	<b>416</b>	<b>325</b>	<b>44</b>	<b>0</b>	<b>785</b>	<b>47</b>	<b>173</b>	<b>20</b>	<b>0</b>	<b>240</b>	<b>2074</b>
Apprch %	2.9	61	36	0		27.5	22.6	49.9	0		53	41.4	5.6	0		19.6	72.1	8.3	0		
Total %	0.8	16	9.5	0	26.2	6.7	5.5	12.2	0	24.3	20.1	15.7	2.1	0	37.8	2.3	8.3	1	0	11.6	
PCs and Peds	87.5	99.4	98	0	98.5	98.6	97.4	94.8	0	96.4	98.3	99.4	93.2	0	98.5	100	100	95	0	99.6	98.1
Heavy Vehicles	12.5	0.6	2	0	1.5	1.4	2.6	5.2	0	3.6	1.7	0.6	6.8	0	1.5	0	0	5	0	0.4	1.9
% Heavy Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:30 AM																					
11:30 AM	1	43	<b>27</b>	0	71	12	13	28	0	53	57	48	<b>8</b>	0	113	<b>11</b>	25	2	0	38	275
11:45 AM	1	<b>47</b>	25	0	<b>73</b>	<b>22</b>	13	34	0	69	48	31	7	0	86	9	24	<b>4</b>	0	37	265
12:00 PM	<b>5</b>	38	27	0	70	13	7	32	0	52	<b>64</b>	44	6	0	114	6	20	3	0	29	265
12:15 PM	2	41	25	0	68	18	<b>17</b>	<b>42</b>	0	<b>77</b>	53	<b>56</b>	7	0	<b>116</b>	5	<b>38</b>	2	0	<b>45</b>	<b>306</b>
Total Volume	9	169	104	0	282	65	50	136	0	251	222	179	28	0	429	31	107	11	0	149	1111
% App. Total	3.2	59.9	36.9	0		25.9	19.9	54.2	0		51.7	41.7	6.5	0		20.8	71.8	7.4	0		
PHF	.450	.899	.963	.000	.966	.739	.735	.810	.000	.815	.867	.799	.875	.000	.925	.705	.704	.688	.000	.828	.908



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 Start Date : 1/26/2013  
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### Groups Printed- Heavy Vehicles

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
11:00 AM	0	0	0	0	0	1	0	2	0	3	1	0	1	0	2	0	0	0	0	0	0
11:15 AM	1	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	1	0	2	0	3	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0
11:45 AM	0	1	0	0	1	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>7</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>6</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>
12:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	1	0	1	3
12:15 PM	0	1	0	0	1	0	2	2	0	4	0	0	1	0	1	0	0	0	0	0	6
12:30 PM	0	0	0	0	0	0	0	1	0	1	2	0	0	0	2	0	0	0	0	0	3
12:45 PM	0	0	0	0	0	1	1	5	0	7	1	2	1	0	4	0	0	0	0	0	11
<b>Total</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>8</b>	<b>0</b>	<b>12</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>23</b>
<b>Grand Total</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>8</b>	<b>2</b>	<b>3</b>	<b>13</b>	<b>0</b>	<b>18</b>	<b>7</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>12</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>39</b>
Apprch %	25	25	50	0		11.1	16.7	72.2	0		58.3	16.7	25	0		0	0	100	0		
Total %	5.1	5.1	10.3	0	20.5	5.1	7.7	33.3	0	46.2	17.9	5.1	7.7	0	30.8	0	0	2.6	0	2.6	

Start Time	Southampton From North					North From East					Southampton From South					North From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00 PM																					
12:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	1	0	1	3
12:15 PM	0	1	0	0	1	0	2	2	0	4	0	0	1	0	1	0	0	0	0	0	6
12:30 PM	0	0	0	0	0	0	0	1	0	1	2	0	0	0	2	0	0	0	0	0	3
12:45 PM	0	0	0	0	0	1	1	5	0	7	1	2	1	0	4	0	0	0	0	0	11
Total Volume	0	1	0	0	1	1	3	8	0	12	5	2	2	0	9	0	0	1	0	1	23
% App. Total	0	100	0	0		8.3	25	66.7	0		55.6	22.2	22.2	0		0	0	100	0		
PHF	.000	.250	.000	.000	.250	.250	.375	.400	.000	.429	.625	.250	.500	.000	.563	.000	.000	.250	.000	.250	.523

# Innovative Data, L L C

Location: Southampton Road  
 Location: South of North Road  
 Location: Westfield, Massachusetts  
 Client: VHB / J. Locke

PO Box 468  
 Belchertown, Massachusetts  
 innovativedatalc.com or 1.413.668.5094

Start Time	01-Feb-13 Fri		Northbound		Southbound		Combined		02-Feb-Sat	Northbound		Southbound		Combined	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00	20	112	9	89	29	201	23	114	17	80	40	194			
12:15	21	94	4	112	25	206	23	102	14	75	37	177			
12:30	24	106	3	102	27	208	10	72	14	80	24	152			
12:45	10	106	14	98	24	204	10	88	6	83	16	171			
01:00	15	88	6	94	21	182	25	86	8	87	33	173			
01:15	14	88	5	96	19	184	7	88	9	90	16	178			
01:30	6	90	6	92	12	182	11	96	5	84	16	180			
01:45	1	119	6	89	7	208	12	92	14	80	26	172			
02:00	10	106	8	102	18	208	8	87	13	62	21	149			
02:15	3	128	4	106	7	234	7	74	13	78	20	152			
02:30	8	136	7	112	15	248	5	96	4	108	9	204			
02:45	4	110	4	117	8	227	8	92	2	70	10	162			
03:00	15	142	4	98	19	240	2	80	5	72	7	152			
03:15	3	126	4	96	7	222	4	80	4	82	8	162			
03:30	4	164	8	141	12	305	3	95	5	72	8	167			
03:45	5	154	8	94	13	248	2	76	6	98	8	174			
04:00	6	172	8	105	14	277	1	78	2	81	3	159			
04:15	6	152	16	117	22	269	2	94	7	70	9	164			
04:30	12	138	16	123	28	261	6	83	6	63	12	146			
04:45	16	158	17	106	33	264	8	94	10	73	18	167			
05:00	15	167	18	106	33	273	10	104	11	70	21	174			
05:15	17	153	35	92	52	245	4	83	9	41	13	124			
05:30	29	130	48	120	77	250	16	66	18	64	34	130			
05:45	30	102	96	85	126	187	10	73	32	54	42	127			
06:00	42	111	69	88	111	199	16	74	22	58	38	132			
06:15	62	107	110	81	172	188	12	60	32	54	44	114			
06:30	85	80	127	68	212	148	19	63	38	64	57	127			
06:45	93	85	134	63	227	148	29	64	44	50	73	114			
07:00	78	66	114	58	192	124	24	48	32	78	56	126			
07:15	65	66	115	45	180	111	24	46	29	46	53	92			
07:30	90	46	156	55	246	101	30	46	32	40	62	86			
07:45	108	38	143	42	251	80	38	31	40	38	78	69			
08:00	103	42	87	42	190	84	26	38	38	38	64	76			
08:15	96	38	110	48	206	86	38	34	48	36	86	70			
08:30	88	54	108	51	196	105	28	22	47	30	75	52			
08:45	80	35	94	48	174	83	46	33	64	26	110	59			
09:00	78	58	88	47	166	105	48	24	48	22	96	46			
09:15	76	51	87	50	163	101	68	34	53	36	121	70			
09:30	86	36	80	42	166	78	70	25	62	33	132	58			
09:45	121	43	80	38	201	81	80	22	66	22	146	44			
10:00	86	39	96	39	182	78	82	35	62	23	144	58			
10:15	95	32	90	26	185	58	74	38	70	28	144	66			
10:30	100	28	78	27	178	55	75	23	73	28	148	51			
10:45	90	27	82	22	172	49	84	28	81	26	165	54			
11:00	93	26	76	18	169	44	82	8	80	24	162	32			
11:15	102	29	87	20	189	49	87	22	86	21	173	43			
11:30	80	22	80	22	160	44	92	19	74	23	166	42			
11:45	128	22	98	14	226	36	85	16	68	20	153	36			
Total	2419	4222	2743	3546	5162	7768	1474	2946	1523	2681	2997	5627			
Day Total	6641		6289		12930		4420		4204		8624				
% Total	18.7%	32.7%	21.2%	27.4%			17.1%	34.2%	17.7%	31.1%					
Peak	11:00	03:30	07:00	03:30	07:30	03:30	11:00	12:00	10:45	00:45	10:45	01:00			
Vol.	403	642	528	457	893	1099	346	376	321	344	666	703			
P.H.F.	0.787	0.933	0.846	0.810	0.889	0.901	0.940	0.825	0.933	0.956	0.962	0.976			

ADT            ADT 10,768            AADT 10,768



# Innovative Data, L L C

Location: Southampton Road  
 Location: South of North Road  
 Location: Westfield, Massachusetts  
 Client: VHB / J. Locke

PO Box 468  
 Belchertown, Massachusetts  
 innovativedatalc.com or 1.413.668.5094

Start Time	25-Jan-13		26-Jan-13		27-Jan-13		Daily Average	
	Fri A.M.	P.M.	Sat A.M.	P.M.	Sun A.M.	P.M.	A.M.	P.M.
12:00	30	200	39	186	*	*	34	193
12:15	16	183	22	196	*	*	19	190
12:30	20	196	15	182	*	*	18	189
12:45	12	170	20	150	*	*	16	160
01:00	26	178	34	180	*	*	30	179
01:15	16	171	26	173	*	*	21	172
01:30	15	192	19	172	*	*	17	182
01:45	16	190	22	194	*	*	19	192
02:00	11	170	10	206	*	*	10	188
02:15	14	204	30	166	*	*	22	185
02:30	10	255	11	146	*	*	10	200
02:45	10	193	8	148	*	*	9	170
03:00	11	258	12	157	*	*	12	208
03:15	7	248	5	166	*	*	6	207
03:30	6	286	5	140	*	*	6	213
03:45	11	248	6	146	*	*	8	197
04:00	14	266	16	152	*	*	15	209
04:15	20	268	10	170	*	*	15	219
04:30	28	260	20	159	*	*	24	210
04:45	41	232	12	162	*	*	26	197
05:00	34	272	20	188	*	*	27	230
05:15	58	238	26	144	*	*	42	191
05:30	78	218	28	139	*	*	53	178
05:45	108	186	49	123	*	*	78	154
06:00	113	181	33	129	*	*	73	155
06:15	146	169	57	114	*	*	102	142
06:30	219	152	54	95	*	*	136	124
06:45	220	126	58	98	*	*	139	112
07:00	178	127	48	138	*	*	113	132
07:15	179	111	72	88	*	*	126	100
07:30	235	97	66	106	*	*	150	102
07:45	224	93	74	102	*	*	149	98
08:00	180	98	64	76	*	*	122	87
08:15	197	77	84	62	*	*	140	70
08:30	186	85	98	62	*	*	142	74
08:45	171	70	110	67	*	*	140	68
09:00	158	94	100	68	*	*	129	81
09:15	152	72	110	65	*	*	131	68
09:30	170	78	107	44	*	*	138	61
09:45	160	57	120	56	*	*	140	56
10:00	144	57	138	52	*	*	141	54
10:15	147	56	152	47	*	*	150	52
10:30	168	58	174	50	*	*	171	54
10:45	158	48	151	31	*	*	154	40
11:00	196	39	166	46	*	*	181	42
11:15	218	51	166	32	*	*	192	42
11:30	203	24	182	24	*	*	192	24
11:45	184	30	184	26	*	*	184	28
Total	4918	7332	3033	5623	0	0	3972	6479
Combined Total	12250		8656		0		10451	
Peak	07:30	03:30	11:00	01:15			11:00	04:15
Vol.	836	1068	698	745			749	856
P.H.F.	0.889	0.934	0.948	0.904			0.975	0.930
ADT	ADT 10,441		AADT 10,441					

**ITE Trip Generation Worksheets**  
LUC 945 "Gasoline/Service Station with Convenience Market"  
VHB Calculations

## **Land Use: 945**

### **Gasoline/Service Station with Convenience Market**

#### **Description**

This land use includes gasoline/service stations with convenience markets where the primary business is the fueling of motor vehicles. These service stations may also have ancillary facilities for servicing and repairing motor vehicles. Some commonly sold convenience items are newspapers, coffee or other beverages and snack items that are usually consumed in the car. These service stations are generally located at intersections or interchanges. This land use does not include stations with car washes. Convenience market (open 24 hours) (Land Use 851), convenience market (open 15-16 hours) (Land Use 852), convenience market with gasoline pumps (Land Use 853), gasoline/service station (Land Use 944), gasoline/service station with convenience market and car wash (Land Use 946) and truck stop (Land Use 950) are related uses.

#### **Additional Data**

For the purpose of this land use, the independent variable, vehicle fueling positions, is defined as the maximum number of vehicles that can be fueled simultaneously.

Gasoline/service stations in this land use include "pay-at-the-pump" and traditional fueling stations.

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

The sites were surveyed between the late 1980s and the 2000s throughout the United States, with many conducted in New England.

#### **Source Numbers**

221, 255, 288, 347, 350, 351, 355, 440, 631, 718

# Gasoline/Service Station with Convenience Market (945)

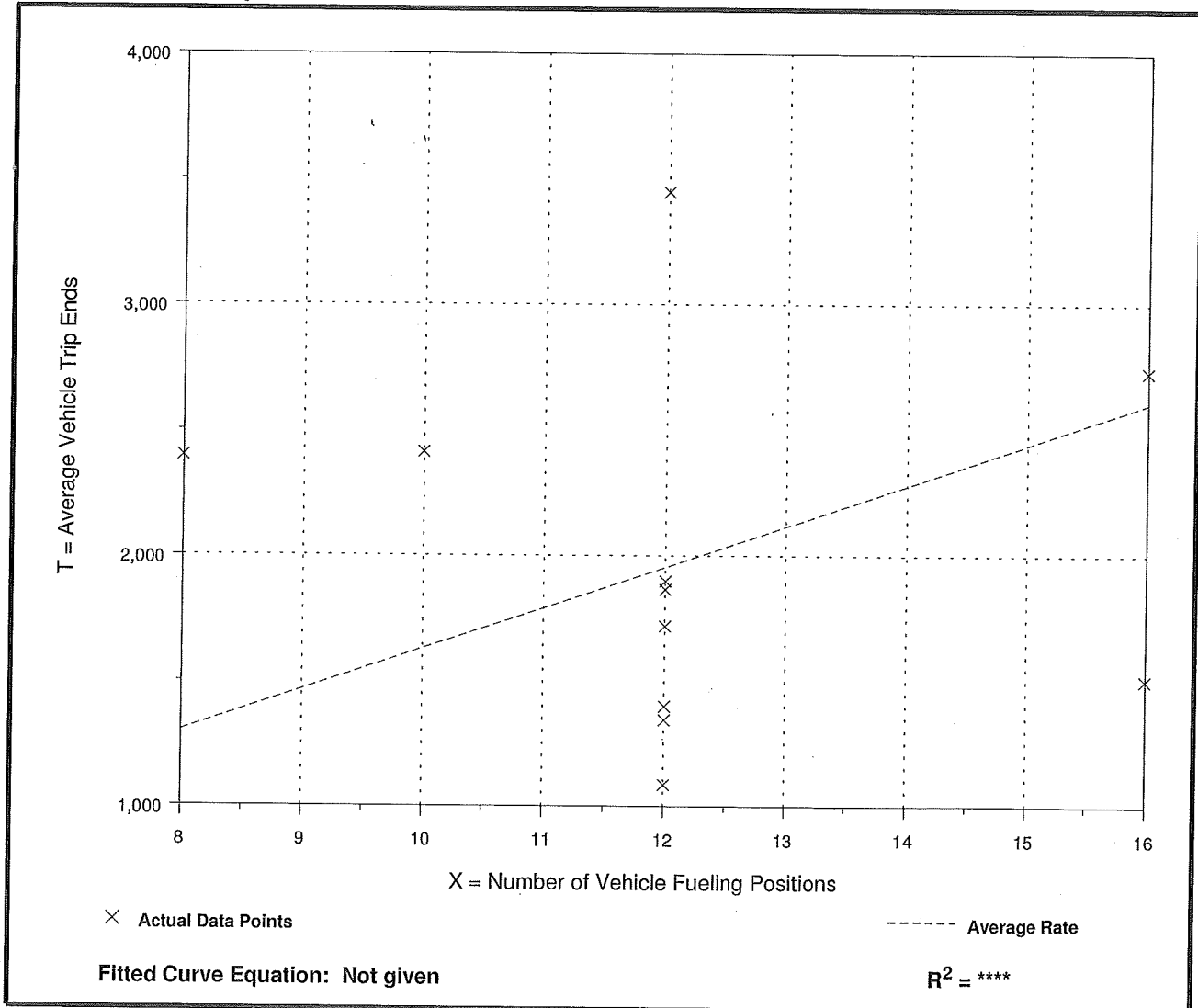
## Average Vehicle Trip Ends vs: Vehicle Fueling Positions On a: Weekday

Number of Studies: 11  
 Average Vehicle Fueling Positions: 12  
 Directional Distribution: 50% entering, 50% exiting

### Trip Generation per Vehicle Fueling Position

Average Rate	Range of Rates	Standard Deviation
162.78	90.67 - 299.50	68.16

### Data Plot and Equation



# Gasoline/Service Station with Convenience Market (945)

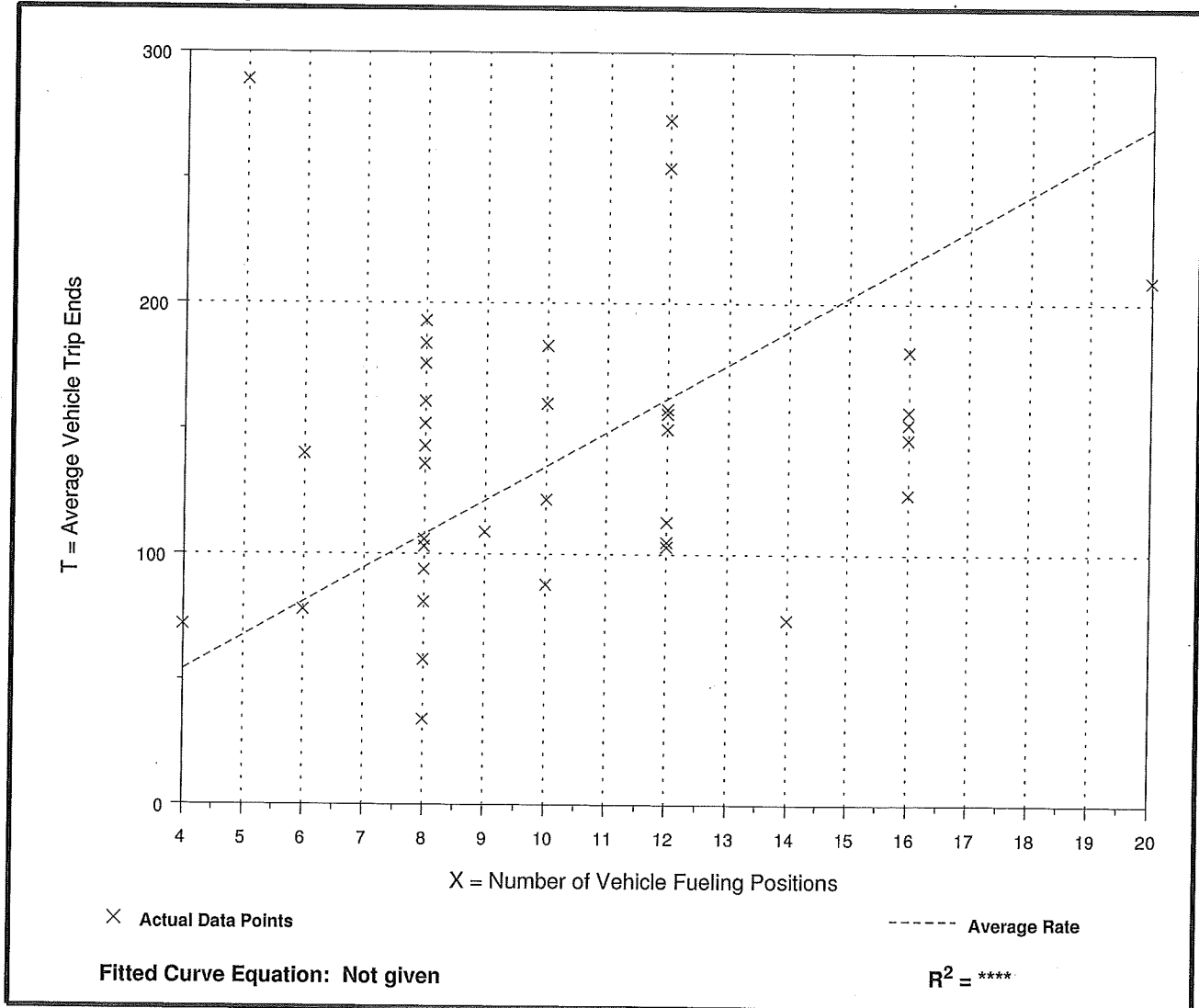
**Average Vehicle Trip Ends vs: Vehicle Fueling Positions**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**

Number of Studies: 39  
 Average Vehicle Fueling Positions: 10  
 Directional Distribution: 50% entering, 50% exiting

## Trip Generation per Vehicle Fueling Position

Average Rate	Range of Rates	Standard Deviation
13.51	4.25 - 57.80	7.91

## Data Plot and Equation



# Land Use: 820

## Shopping Center

### Description

A shopping center is an integrated group of commercial establishments that is planned, developed, owned and managed as a unit. A shopping center's composition is related to its market area in terms of size, location and type of store. A shopping center also provides on-site parking facilities sufficient to serve its own parking demands. Specialty retail center (Land Use 826) and factory outlet center (Land Use 823) are related uses.

### Additional Data

Shopping centers, including neighborhood centers, community centers, regional centers and super regional centers, were surveyed for this land use. Some of these centers contained non-merchandising facilities, such as office buildings, movie theaters, restaurants, post offices, banks, health clubs and recreational facilities (for example, ice skating rinks or indoor miniature golf courses). The centers ranged in size from 1,700 to 2.2 million square feet gross leasable area (GLA). The centers studied were located in suburban areas throughout the United States and, therefore, represent typical U.S. suburban conditions.

**Many shopping centers, in addition to the integrated unit of shops in one building or enclosed around a mall, include outparcels (peripheral buildings or pads located on the perimeter of the center adjacent to the streets and major access points). These buildings are typically drive-in banks, retail stores, restaurants, or small offices. Although the data herein do not indicate which of the centers studied included peripheral buildings, it can be assumed that some of the data show their effect.**

The vehicle trips generated at a shopping center are based upon the total GLA of the center. In cases of smaller centers without an enclosed mall or peripheral buildings, the GLA could be the same as the gross floor area of the building.

Separate equations have been developed for shopping centers during the Christmas shopping season. Plots were included for the weekday peak hour of adjacent street traffic and the Saturday peak hour of the generator.

**Information on approximate hourly, monthly and daily variation in shopping center traffic is shown in Tables 1–3. It should be noted, however, that the information contained in these tables is based on a limited sample size. Therefore, caution should be exercised when applying the data. Also, some information provided in the tables may conflict with the results obtained by applying the average rate or regression equations. When this occurs, it is suggested that the results from the average rate or regression equations be used, as they are based on a larger number of studies.**

# Shopping Center (820)

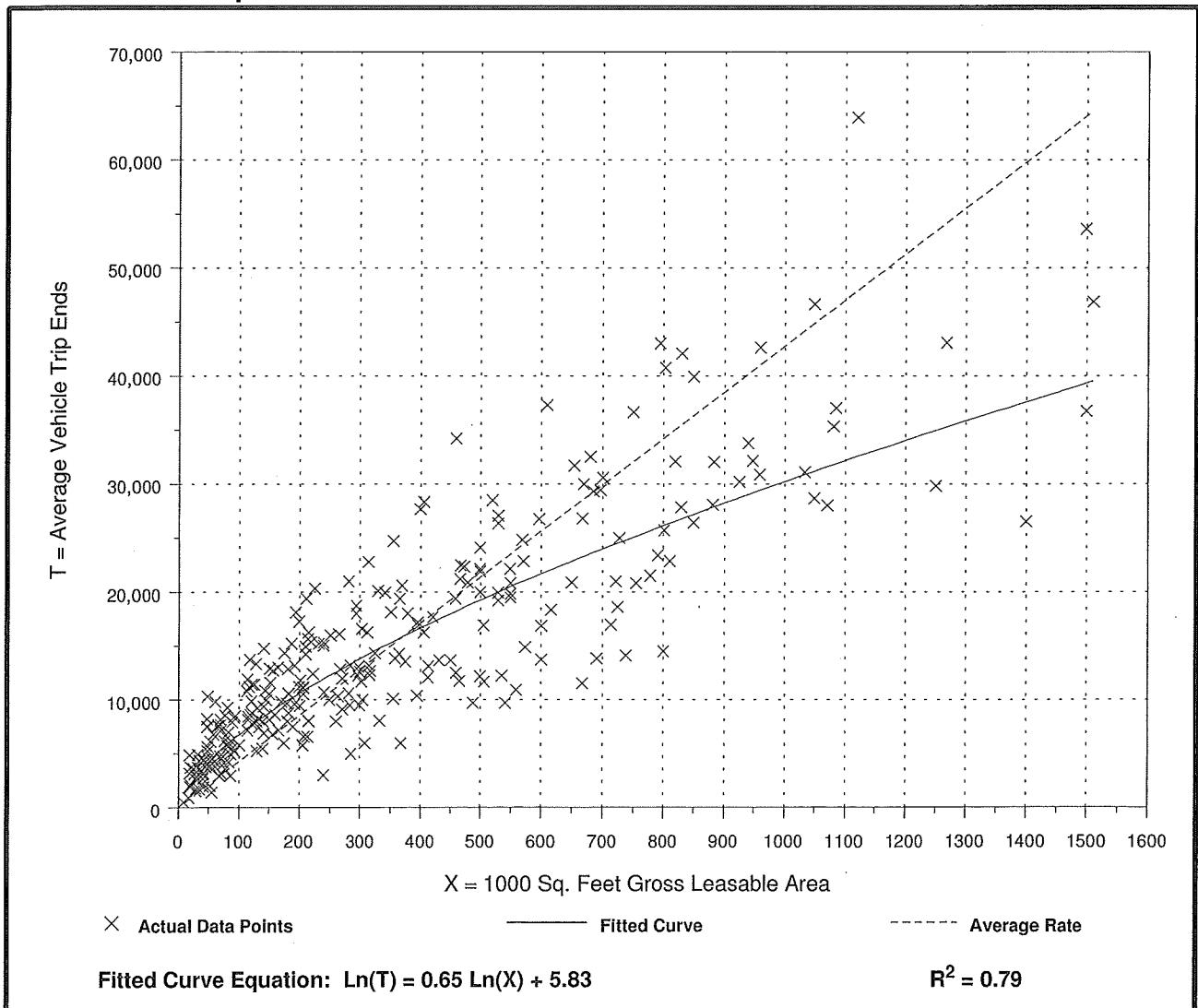
**Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area**  
On a: **Weekday**

Number of Studies: 302  
Average 1000 Sq. Feet GLA: 331  
Directional Distribution: 50% entering, 50% exiting

### Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
42.70	12.50 - 270.89	21.25

### Data Plot and Equation



# Shopping Center (820)

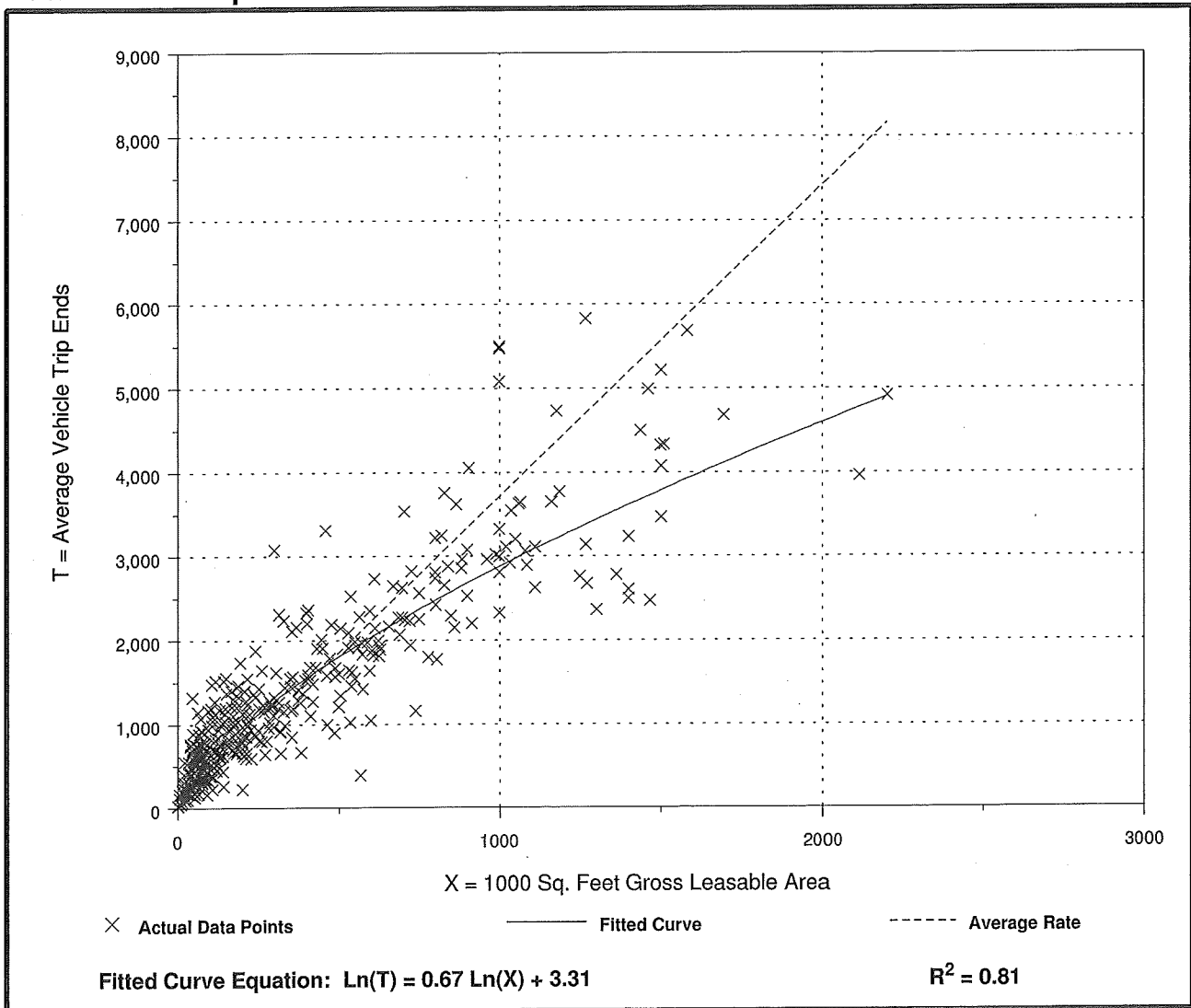
**Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**

Number of Studies: 426  
 Average 1000 Sq. Feet GLA: 376  
 Directional Distribution: 48% entering, 52% exiting

## Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
3.71	0.68 - 29.27	2.74

## Data Plot and Equation





# Shopping Center (820)

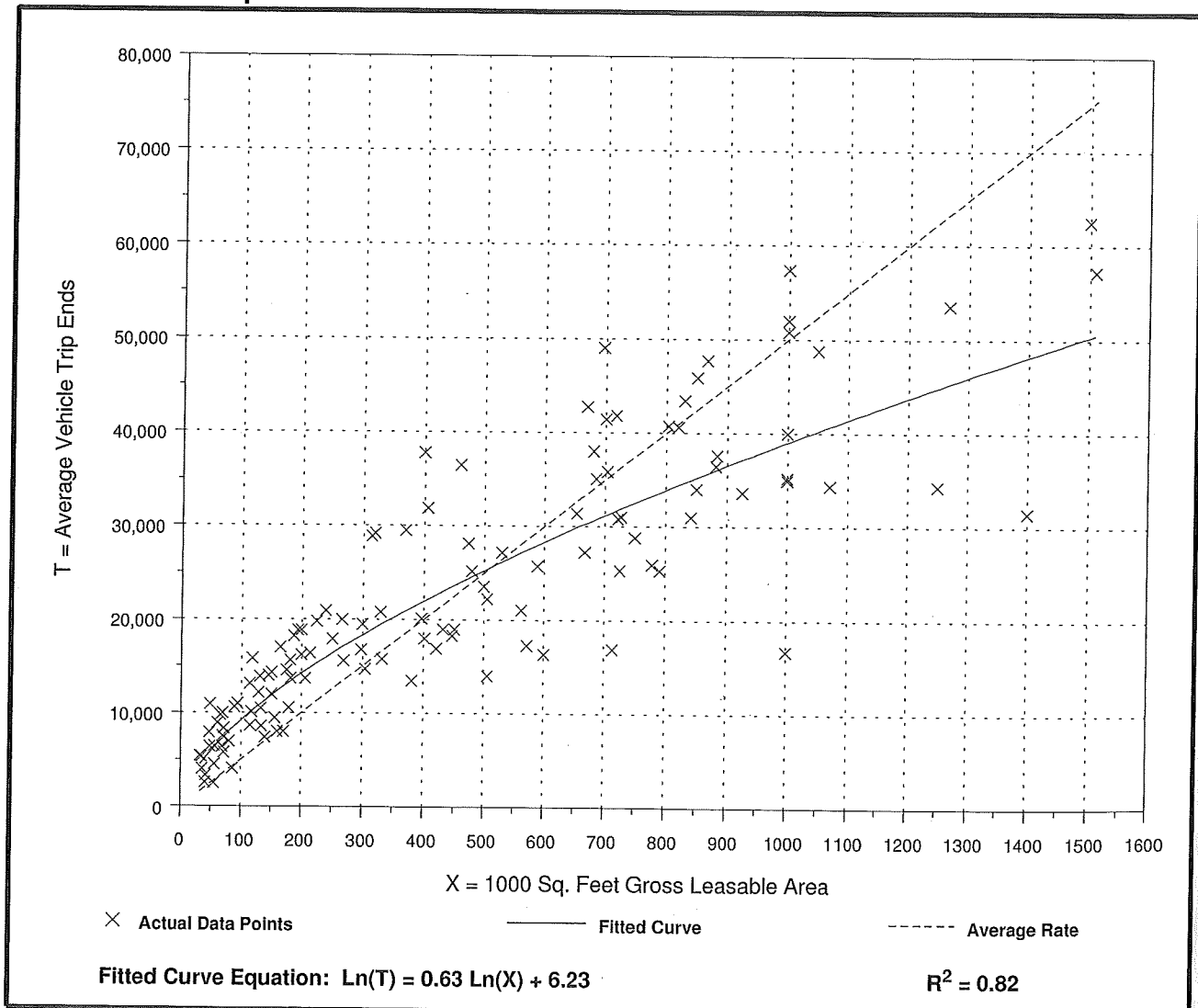
**Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area  
On a: Saturday**

Number of Studies: 123  
Average 1000 Sq. Feet GLA: 450  
Directional Distribution: 50% entering, 50% exiting

## Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
49.97	16.70 - 227.50	22.62

## Data Plot and Equation



# Shopping Center (820)

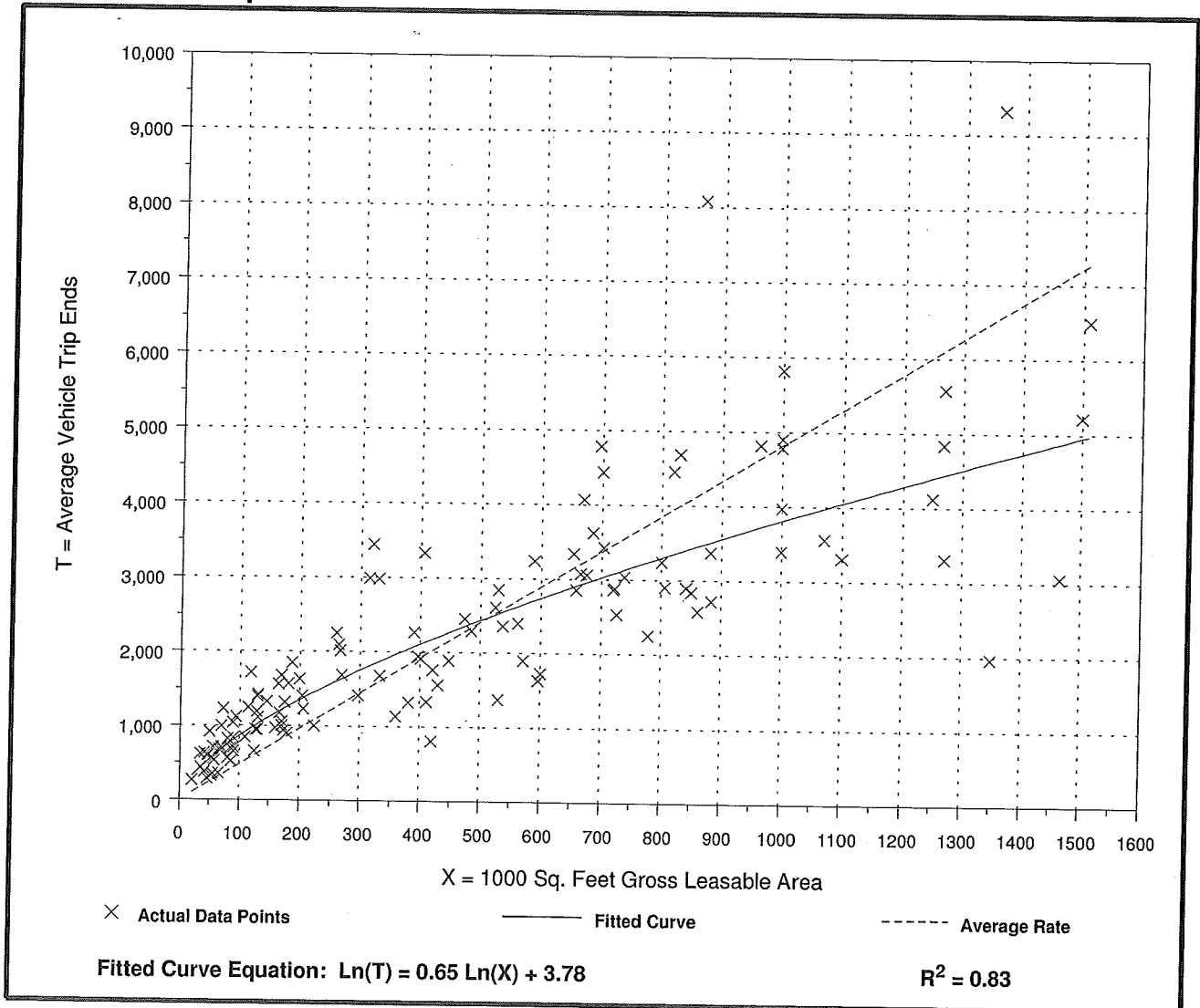
**Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area**  
**On a: Saturday,**  
**Peak Hour of Generator**

Number of Studies: 128  
 Average 1000 Sq. Feet GLA: 458  
 Directional Distribution: 52% entering, 48% exiting

## Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
4.82	1.46 - 18.32	3.10

## Data Plot and Equation





Project: CF Project # 41827.00  
 Location: Westfield Sheet 1 of 2  
 Calculated by: JLL Date: 2/4/2013  
 Checked by: Date:  
 Title: Trip Generation Calculations

Land use code 945: Gasoline/service station with  
 Convenience Market  
 for 10 fueling positions.

Weekday Daily average rate per pump = 162.78

$$\rightarrow 10 \times 162.78 = 1628 \text{ say } 1630$$

Weekday Evening average rate = 13.51

$$10 \times 13.51 = 135 \text{ (70 enter/65 exit)}$$

To estimate Saturday Daily and Saturday Peak,  
 use ratios from LUC 820.

\* for 135 weekday evening peak trips, calculate  
 corresponding SF w/ LUC 820

$$\rightarrow \frac{135}{3.71} = \underline{\underline{36.4 \text{ kSF}}}$$



Now use this SF to calculate  
 trips for Sat Daily & Peak hour  
 with LUC 820 rates.



Project: \_\_\_\_\_ Project # \_\_\_\_\_  
 Location: \_\_\_\_\_ Sheet 2 of 2  
 Calculated by: \_\_\_\_\_ Date: \_\_\_\_\_  
 Checked by: \_\_\_\_\_ Date: \_\_\_\_\_  
 Title \_\_\_\_\_

Saturday Daily : average rate / ksf = 49.97

$$36.4 \text{ ksf} \times 49.97 = 1820 \text{ trips}$$

Saturday Peak Hour : average rate / ksf = 4.82

$$36.4 \text{ ksf} \times 4.82 = 175 \text{ trips}$$

(90 enter / 85 exit)

Summary Table :

	<u>UIC 945</u>	<u>25% Pass-by</u>	<u>Total New</u>
Weekday	1630	410	1220
Weekday PM			
enter	70	20	50
exit	65	15	50
	<u>135</u>	<u>35</u>	<u>100</u>
Saturday	1820	460	1360
Saturday .			
midday	90	25	65
	<u>85</u>	<u>20</u>	<u>65</u>
	<u>175</u>	<u>45</u>	<u>130</u>

**Crash Data**  
2008-2010 Crash Summary  
Crash Rate Worksheet

## Vehicular Crash Summary (2008 - 2010)

	Southampton Road at North Road	Total
<b>Year</b>		
2008	6	6
2009	5	5
2010	11	11
Total	22	22
Average	7.33	7.33

<b>Collision Type</b>		
Angle	9	9
Head-on	1	1
Rear-end	7	7
Rear-to-Rear	0	0
Sideswipe, opposite direction	0	0
Sideswipe, same direction	2	2
Single vehicle crash	2	2
Unknown	0	0
Not reported	1	1
Total	22	22

<b>Crash Severity</b>		
Fatal injury	0	0
Non-fatal injury	10	10
Property damage only (none injured)	12	12
Not Reported	0	0
Unknown	0	0
Total	22	22

<b>Time of Day</b>		
Weekday, 7:00 AM - 9:00 AM	2	2
Weekday, 4:00 PM - 6:00 PM	6	6
Saturday, 11:00 AM - 2:00 PM	0	0
Weekday, other time	9	9
Weekend, other time	5	5
Total	22	22

<b>Pavement Conditions</b>		
Dry	19	19
Wet	3	3
Snow	0	0
Ice	0	0
Sand, mud, dirt, oil, gravel	0	0
Water (standing, moving)	0	0
Slush	0	0
Other	0	0
Unknown	0	0
Not reported	0	0
Total	22	22

<b>Non Motorist (Bike, Pedestrian)</b>		
Total	0	0

<b>MassHighway Crash Rates</b>	1.14	1.14
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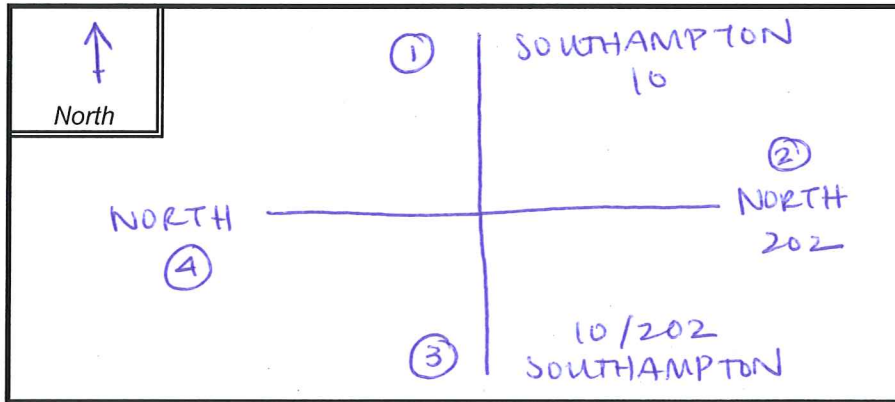
## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : WESTFIELD, MA      COUNT DATE : 1/24/2013  
 DISTRICT : 2      UNSIGNALIZED :       SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : SOUTHAMPTON ROAD (ROUTE 10/202)  
 MINOR STREET(S) : NORTH ROAD (ROUTE 202)

**INTERSECTION  
 DIAGRAM**  
 (Label Approaches)



**PEAK HOUR VOLUMES**

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	WB	NB	EB		
PEAK HOURLY VOLUMES (AM/PM) :	282	497	638	116		1533

"K" FACTOR : .087      INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME : 17620

TOTAL # OF CRASHES : 22      # OF YEARS : 3      AVERAGE # OF CRASHES PER YEAR (A) : 7.33

CRASH RATE CALCULATION : 1.14      RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : \_\_\_\_\_

Project Title & Date : CF - 10 fueling positions

# Operational Analyses

## Intersection Capacity Analysis



Queues  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2013 Existing PM Peak Hour

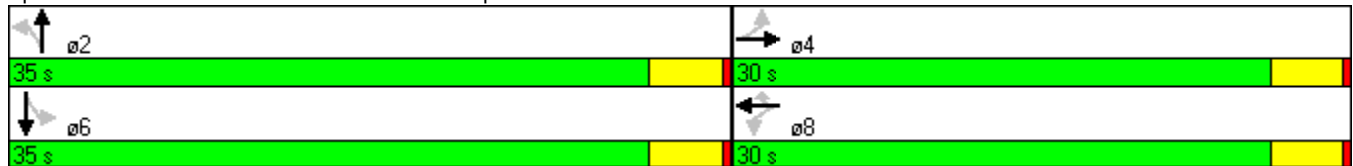


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↕		↕		↕
Volume (vph)	15	70	195	160	155	30	300	60	210
Lane Group Flow (vph)	0	125	0	395	172	0	768	0	324
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.20		0.76	0.26		0.88		0.45
Control Delay		10.9		26.7	3.6		26.0		12.6
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		10.9		26.7	3.6		26.0		12.6
Queue Length 50th (ft)		22		125	0		198		68
Queue Length 95th (ft)		53		219	32		#401		136
Internal Link Dist (ft)		455		249			573		237
Turn Bay Length (ft)									
Base Capacity (vph)		830		716	856		1044		876
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.15		0.55	0.20		0.74		0.37

Intersection Summary

Cycle Length: 65  
 Actuated Cycle Length: 55.4  
 Natural Cycle: 50  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 16: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2013 Existing PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	15	70	30	195	160	155	30	300	315	60	210	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.96			1.00	0.85		0.93			0.99	
Flt Protected		0.99			0.97	1.00		1.00			0.99	
Satd. Flow (prot)		1734			1778	1553		1736			1830	
Flt Permitted		0.94			0.79	1.00		0.98			0.80	
Satd. Flow (perm)		1640			1446	1553		1697			1478	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.84	0.84	0.84	0.88	0.88	0.88
Adj. Flow (vph)	16	76	33	217	178	172	36	357	375	68	239	17
RTOR Reduction (vph)	0	21	0	0	0	109	0	52	0	0	3	0
Lane Group Flow (vph)	0	104	0	0	395	63	0	716	0	0	321	0
Heavy Vehicles (%)	5%	5%	5%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		20.0			20.0	20.0		26.9			26.9	
Effective Green, g (s)		20.0			20.0	20.0		26.9			26.9	
Actuated g/C Ratio		0.36			0.36	0.36		0.49			0.49	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		597			527	566		831			724	
v/s Ratio Prot												
v/s Ratio Perm		0.06			0.27	0.04		0.42			0.22	
v/c Ratio		0.17			0.75	0.11		0.86			0.44	
Uniform Delay, d1		11.8			15.3	11.6		12.4			9.1	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.1			5.8	0.1		9.2			0.4	
Delay (s)		12.0			21.1	11.6		21.5			9.6	
Level of Service		B			C	B		C			A	
Approach Delay (s)		12.0			18.2			21.5			9.6	
Approach LOS		B			B			C			A	

Intersection Summary

HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	54.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2013 Existing SAT Midday Peak Hour

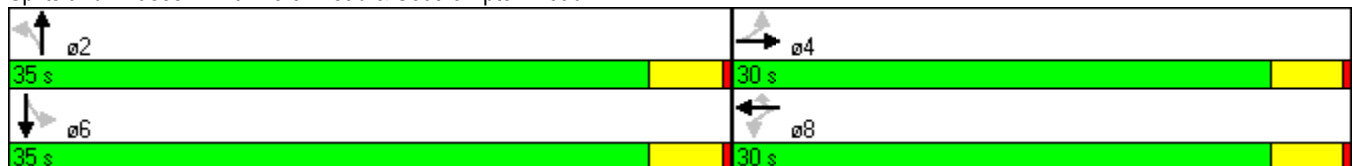


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↕		↕		↕
Volume (vph)	10	105	140	50	65	30	185	105	175
Lane Group Flow (vph)	0	159	0	232	79	0	473	0	298
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.26		0.51	0.14		0.59		0.47
Control Delay		9.4		14.8	3.9		10.2		11.1
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		9.4		14.8	3.9		10.2		11.1
Queue Length 50th (ft)		15		29	0		42		34
Queue Length 95th (ft)		61		92	17		152		115
Internal Link Dist (ft)		455		249			573		237
Turn Bay Length (ft)									
Base Capacity (vph)		1308		1012	1167		1445		1225
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.12		0.23	0.07		0.33		0.24

Intersection Summary

Cycle Length: 65  
 Actuated Cycle Length: 37.4  
 Natural Cycle: 40  
 Control Type: Actuated-Uncoordinated

Splits and Phases: 16: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2013 Existing SAT Midday Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	10	105	30	140	50	65	30	185	225	105	175	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.97			1.00	0.85		0.93			1.00	
Flt Protected		1.00			0.96	1.00		1.00			0.98	
Satd. Flow (prot)		1804			1762	1553		1728			1821	
Flt Permitted		0.97			0.75	1.00		0.97			0.78	
Satd. Flow (perm)		1764			1372	1553		1677			1439	
Peak-hour factor, PHF	0.91	0.91	0.91	0.82	0.82	0.82	0.93	0.93	0.93	0.97	0.97	0.97
Adj. Flow (vph)	11	115	33	171	61	79	32	199	242	108	180	10
RTOR Reduction (vph)	0	16	0	0	0	52	0	61	0	0	2	0
Lane Group Flow (vph)	0	143	0	0	232	27	0	412	0	0	296	0
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		12.4			12.4	12.4		16.5			16.5	
Effective Green, g (s)		12.4			12.4	12.4		16.5			16.5	
Actuated g/C Ratio		0.34			0.34	0.34		0.45			0.45	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		593			461	522		750			643	
v/s Ratio Prot												
v/s Ratio Perm		0.08			0.17	0.02		0.25			0.21	
v/c Ratio		0.24			0.50	0.05		0.55			0.46	
Uniform Delay, d1		8.9			9.8	8.3		7.5			7.1	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.2			0.9	0.0		0.8			0.5	
Delay (s)		9.1			10.7	8.3		8.3			7.6	
Level of Service		A			B	A		A			A	
Approach Delay (s)		9.1			10.1			8.3			7.6	
Approach LOS		A			B			A			A	

Intersection Summary

HCM Average Control Delay	8.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	36.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2018 No-Build PM Peak Hour

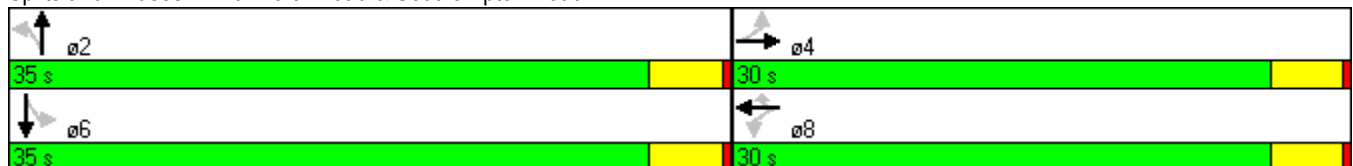


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↕		↕		↕
Volume (vph)	15	75	215	175	170	35	330	65	230
Lane Group Flow (vph)	0	136	0	433	189	0	852	0	352
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.23		0.87	0.28		0.93		0.48
Control Delay		11.0		37.3	3.6		32.6		13.3
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		11.0		37.3	3.6		32.6		13.3
Queue Length 50th (ft)		25		143	0		262		82
Queue Length 95th (ft)		57		#283	33		#478		154
Internal Link Dist (ft)		455		249			573		237
Turn Bay Length (ft)									
Base Capacity (vph)		728		617	779		921		735
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.19		0.70	0.24		0.93		0.48

Intersection Summary

Cycle Length: 65  
 Actuated Cycle Length: 60.5  
 Natural Cycle: 55  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 16: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2018 No-Build PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	15	75	35	215	175	170	35	330	350	65	230	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.96			1.00	0.85		0.93			0.99	
Flt Protected		0.99			0.97	1.00		1.00			0.99	
Satd. Flow (prot)		1731			1778	1553		1735			1831	
Flt Permitted		0.94			0.78	1.00		0.97			0.77	
Satd. Flow (perm)		1637			1424	1553		1689			1422	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.84	0.84	0.84	0.88	0.88	0.88
Adj. Flow (vph)	16	82	38	239	194	189	42	393	417	74	261	17
RTOR Reduction (vph)	0	23	0	0	0	123	0	49	0	0	2	0
Lane Group Flow (vph)	0	113	0	0	433	66	0	803	0	0	350	0
Heavy Vehicles (%)	5%	5%	5%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		21.2			21.2	21.2		31.2			31.2	
Effective Green, g (s)		21.2			21.2	21.2		31.2			31.2	
Actuated g/C Ratio		0.35			0.35	0.35		0.52			0.52	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		575			500	545		872			735	
v/s Ratio Prot												
v/s Ratio Perm		0.07			c0.30	0.04		c0.48			0.25	
v/c Ratio		0.20			0.87	0.12		0.92			0.48	
Uniform Delay, d1		13.7			18.3	13.3		13.5			9.4	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.2			14.5	0.1		14.8			0.5	
Delay (s)		13.8			32.8	13.4		28.2			9.8	
Level of Service		B			C	B		C			A	
Approach Delay (s)		13.8			26.9			28.2			9.8	
Approach LOS		B			C			C			A	

Intersection Summary

HCM Average Control Delay	23.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	60.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2018 No-Build SAT Midday Peak Hour

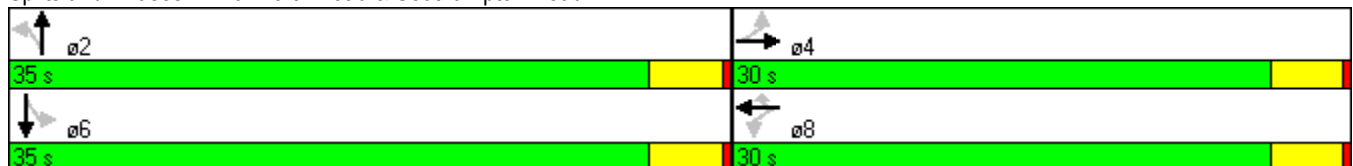


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↕		↕		↕
Volume (vph)	10	115	155	55	70	35	205	115	195
Lane Group Flow (vph)	0	175	0	256	85	0	527	0	330
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.29		0.57	0.15		0.65		0.53
Control Delay		10.6		17.4	4.1		11.9		12.6
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		10.6		17.4	4.1		11.9		12.6
Queue Length 50th (ft)		19		37	0		55		42
Queue Length 95th (ft)		76		117	19		199		146
Internal Link Dist (ft)		455		249			573		237
Turn Bay Length (ft)									
Base Capacity (vph)		1252		952	1120		1378		1124
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.14		0.27	0.08		0.38		0.29

Intersection Summary

Cycle Length: 65  
 Actuated Cycle Length: 40.3  
 Natural Cycle: 40  
 Control Type: Actuated-Uncoordinated

Splits and Phases: 16: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
16: North Road & Southampton Road

Proposed Cumberland Farms  
2018 No-Build SAT Midday Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	10	115	35	155	55	70	35	205	250	115	195	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.97			1.00	0.85		0.93			1.00	
Flt Protected		1.00			0.96	1.00		1.00			0.98	
Satd. Flow (prot)		1802			1762	1553		1728			1822	
Flt Permitted		0.98			0.74	1.00		0.96			0.74	
Satd. Flow (perm)		1765			1350	1553		1667			1379	
Peak-hour factor, PHF	0.91	0.91	0.91	0.82	0.82	0.82	0.93	0.93	0.93	0.97	0.97	0.97
Adj. Flow (vph)	11	126	38	189	67	85	38	220	269	119	201	10
RTOR Reduction (vph)	0	17	0	0	0	56	0	60	0	0	2	0
Lane Group Flow (vph)	0	158	0	0	256	29	0	467	0	0	328	0
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		13.5			13.5	13.5		18.1			18.1	
Effective Green, g (s)		13.5			13.5	13.5		18.1			18.1	
Actuated g/C Ratio		0.34			0.34	0.34		0.46			0.46	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		602			460	529		762			630	
v/s Ratio Prot												
v/s Ratio Perm		0.09			0.19	0.02		0.28			0.24	
v/c Ratio		0.26			0.56	0.05		0.61			0.52	
Uniform Delay, d1		9.4			10.6	8.8		8.1			7.7	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.2			1.5	0.0		1.5			0.8	
Delay (s)		9.7			12.1	8.8		9.6			8.4	
Level of Service		A			B	A		A			A	
Approach Delay (s)		9.7			11.3			9.6			8.4	
Approach LOS		A			B			A			A	

Intersection Summary

HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	39.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Queues  
1: North Road & Southampton Road

Proposed Cumberland Farms  
2018 Build PM Peak Hour



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗		↕		↕
Volume (vph)	20	80	225	180	170	35	335	65	235
Lane Group Flow (vph)	0	147	0	450	189	0	870	0	364
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.24		0.89	0.28		0.96		0.51
Control Delay		11.5		39.8	3.5		38.8		14.1
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		11.5		39.8	3.5		38.8		14.1
Queue Length 50th (ft)		28		152	0		~310		93
Queue Length 95th (ft)		63		#304	33		#493		161
Internal Link Dist (ft)		42		249			1		237
Turn Bay Length (ft)									
Base Capacity (vph)		700		597	769		907		716
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.21		0.75	0.25		0.96		0.51

Intersection Summary

Cycle Length: 65

Actuated Cycle Length: 61.5

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

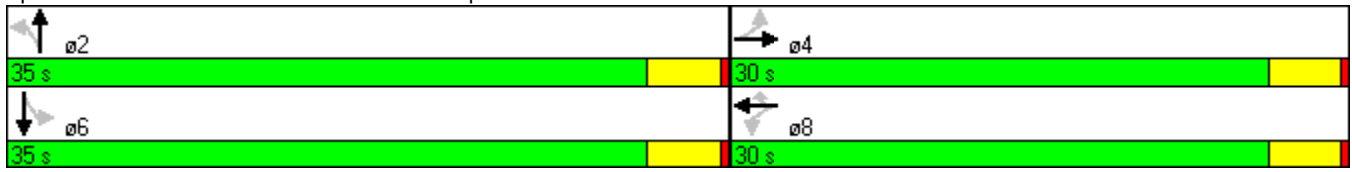
# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Queues  
1: North Road & Southampton Road

Proposed Cumberland Farms  
2018 Build PM Peak Hour

Splits and Phases: 1: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
1: North Road & Southampton Road

Proposed Cumberland Farms  
2018 Build PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	20	80	35	225	180	170	35	335	360	65	235	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.97			1.00	0.85		0.93			0.99	
Flt Protected		0.99			0.97	1.00		1.00			0.99	
Satd. Flow (prot)		1733			1778	1553		1735			1828	
Flt Permitted		0.92			0.77	1.00		0.97			0.76	
Satd. Flow (perm)		1601			1403	1553		1688			1405	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.84	0.84	0.84	0.88	0.88	0.88
Adj. Flow (vph)	22	87	38	250	200	189	42	399	429	74	267	23
RTOR Reduction (vph)	0	20	0	0	0	120	0	51	0	0	3	0
Lane Group Flow (vph)	0	127	0	0	450	69	0	819	0	0	361	0
Heavy Vehicles (%)	5%	5%	5%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		22.3			22.3	22.3		31.2			31.2	
Effective Green, g (s)		22.3			22.3	22.3		31.2			31.2	
Actuated g/C Ratio		0.36			0.36	0.36		0.51			0.51	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		581			509	563		856			713	
v/s Ratio Prot												
v/s Ratio Perm		0.08			c0.32	0.04		c0.49			0.26	
v/c Ratio		0.22			0.88	0.12		0.96			0.51	
Uniform Delay, d1		13.6			18.4	13.1		14.5			10.0	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.2			16.5	0.1		20.8			0.6	
Delay (s)		13.8			34.9	13.2		35.3			10.6	
Level of Service		B			C	B		D			B	
Approach Delay (s)		13.8			28.5			35.3			10.6	
Approach LOS		B			C			D			B	

Intersection Summary

HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	61.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis  
2: Site Drive 1 & Southampton Road

Proposed Cumberland Farms  
2018 Build PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	20	25	20	715	475	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	27	22	777	516	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)					258	
pX, platoon unblocked	0.93	0.93	0.93			
vC, conflicting volume	1340	519	522			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1328	450	452			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	86	95	98			
cM capacity (veh/h)	156	569	1035			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	49	799	522			
Volume Left	22	22	0			
Volume Right	27	0	5			
cSH	262	1035	1700			
Volume to Capacity	0.19	0.02	0.31			
Queue Length 95th (ft)	17	2	0			
Control Delay (s)	21.9	0.6	0.0			
Lane LOS	C	A				
Approach Delay (s)	21.9	0.6	0.0			
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			1.1			
Intersection Capacity Utilization			63.7%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 3: Site Drive 2 & Southampton Road

Proposed Cumberland Farms  
 2018 Build PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations				↕	↕	
Volume (veh/h)	0	0	5	730	480	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5	793	522	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)					66	
pX, platoon unblocked	0.89	0.89	0.89			
vC, conflicting volume	1334	530	538			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1315	416	425			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	99			
cM capacity (veh/h)	155	570	1015			
<b>Direction, Lane #</b>						
	NB 1	SB 1				
Volume Total	799	538				
Volume Left	5	0				
Volume Right	0	16				
cSH	1015	1700				
Volume to Capacity	0.01	0.32				
Queue Length 95th (ft)	0	0				
Control Delay (s)	0.1	0.0				
Lane LOS	A					
Approach Delay (s)	0.1	0.0				
Approach LOS						
<b>Intersection Summary</b>						
Average Delay			0.1			
Intersection Capacity Utilization			45.7%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
4: North Road & Site Drive 3

Proposed Cumberland Farms  
2018 Build PM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→			←	←	←
Volume (veh/h)	125	10	15	220	10	10
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)	136	11	16	239	11	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (ft)	122					
pX, platoon unblocked						
vC, conflicting volume			147		413	141
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			147		413	141
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		98	99
cM capacity (veh/h)			1435		589	907

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	147	255	22
Volume Left	0	16	11
Volume Right	11	0	11
cSH	1700	1435	714
Volume to Capacity	0.09	0.01	0.03
Queue Length 95th (ft)	0	1	2
Control Delay (s)	0.0	0.6	10.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.6	10.2
Approach LOS			B

Intersection Summary			
Average Delay		0.9	
Intersection Capacity Utilization		32.9%	ICU Level of Service A
Analysis Period (min)		15	

Queues  
1: North Road & Southampton Road

Proposed Cumberland Farms  
2018 Build SAT Midday Peak Hour

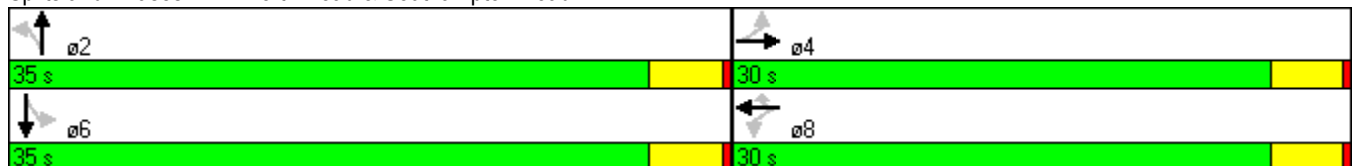


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↕		↕		↕
Volume (vph)	20	120	160	60	70	35	215	115	205
Lane Group Flow (vph)	0	192	0	268	85	0	543	0	351
Turn Type	Perm		Perm		Perm	Perm		Perm	
Protected Phases		4		8			2		6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	2	2	6	6
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0
Total Split (%)	46.2%	46.2%	46.2%	46.2%	46.2%	53.8%	53.8%	53.8%	53.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.32		0.59	0.14		0.68		0.58
Control Delay		11.1		18.1	4.0		13.1		13.8
Queue Delay		0.0		0.0	0.0		0.0		0.0
Total Delay		11.1		18.1	4.0		13.1		13.8
Queue Length 50th (ft)		23		41	0		61		48
Queue Length 95th (ft)		84		124	19		216		162
Internal Link Dist (ft)		42		249			1		237
Turn Bay Length (ft)									
Base Capacity (vph)		1243		947	1139		1349		1092
Starvation Cap Reductn		0		0	0		0		0
Spillback Cap Reductn		0		0	0		0		0
Storage Cap Reductn		0		0	0		0		0
Reduced v/c Ratio		0.15		0.28	0.07		0.40		0.32

Intersection Summary

Cycle Length: 65  
 Actuated Cycle Length: 41.4  
 Natural Cycle: 45  
 Control Type: Actuated-Uncoordinated

Splits and Phases: 1: North Road & Southampton Road



HCM Signalized Intersection Capacity Analysis  
1: North Road & Southampton Road

Proposed Cumberland Farms  
2018 Build SAT Midday Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕			↕	
Volume (vph)	20	120	35	160	60	70	35	215	255	115	205	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		4.0			4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frt		0.97			1.00	0.85		0.93			0.99	
Flt Protected		0.99			0.96	1.00		1.00			0.98	
Satd. Flow (prot)		1803			1763	1553		1730			1817	
Flt Permitted		0.95			0.72	1.00		0.96			0.74	
Satd. Flow (perm)		1722			1320	1553		1667			1370	
Peak-hour factor, PHF	0.91	0.91	0.91	0.82	0.82	0.82	0.93	0.93	0.93	0.97	0.97	0.97
Adj. Flow (vph)	22	132	38	195	73	85	38	231	274	119	211	21
RTOR Reduction (vph)	0	15	0	0	0	55	0	59	0	0	4	0
Lane Group Flow (vph)	0	177	0	0	268	30	0	484	0	0	347	0
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		14.3			14.3	14.3		18.3			18.3	
Effective Green, g (s)		14.3			14.3	14.3		18.3			18.3	
Actuated g/C Ratio		0.35			0.35	0.35		0.45			0.45	
Clearance Time (s)		4.0			4.0	4.0		4.0			4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		607			465	547		751			618	
v/s Ratio Prot												
v/s Ratio Perm		0.10			0.20	0.02		0.29			0.25	
v/c Ratio		0.29			0.58	0.05		0.64			0.56	
Uniform Delay, d1		9.5			10.7	8.7		8.6			8.2	
Progression Factor		1.00			1.00	1.00		1.00			1.00	
Incremental Delay, d2		0.3			1.7	0.0		1.9			1.2	
Delay (s)		9.8			12.4	8.7		10.5			9.4	
Level of Service		A			B	A		B			A	
Approach Delay (s)		9.8			11.5			10.5			9.4	
Approach LOS		A			B			B			A	

Intersection Summary

HCM Average Control Delay	10.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	40.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



HCM Unsignalized Intersection Capacity Analysis  
2: Site Drive 1 & Southampton Road

Proposed Cumberland Farms  
2018 Build SAT Midday Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	20	30	25	495	380	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	33	27	538	413	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)					258	
pX, platoon unblocked						
vC, conflicting volume	1008	416	418			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1008	416	418			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	95	98			
cM capacity (veh/h)	260	637	1141			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	54	565	418			
Volume Left	22	27	0			
Volume Right	33	0	5			
cSH	403	1141	1700			
Volume to Capacity	0.13	0.02	0.25			
Queue Length 95th (ft)	12	2	0			
Control Delay (s)	15.3	0.7	0.0			
Lane LOS	C	A				
Approach Delay (s)	15.3	0.7	0.0			
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			1.2			
Intersection Capacity Utilization		56.4%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 3: Site Drive 2 & Southampton Road

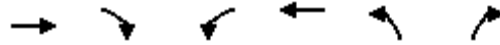
Proposed Cumberland Farms  
 2018 Build SAT Midday Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations				↕	↕	
Volume (veh/h)	0	0	10	505	385	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	11	549	418	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)					66	
pX, platoon unblocked	0.93	0.93	0.93			
vC, conflicting volume	997	427	435			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	960	347	356			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	99			
cM capacity (veh/h)	262	648	1120			
<b>Direction, Lane #</b>	<b>NB 1</b>	<b>SB 1</b>				
Volume Total	560	435				
Volume Left	11	0				
Volume Right	0	16				
cSH	1120	1700				
Volume to Capacity	0.01	0.26				
Queue Length 95th (ft)	1	0				
Control Delay (s)	0.3	0.0				
Lane LOS	A					
Approach Delay (s)	0.3	0.0				
Approach LOS						
<b>Intersection Summary</b>						
Average Delay			0.2			
Intersection Capacity Utilization			37.9%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
4: North Road & Site Drive 3

Proposed Cumberland Farms  
2018 Build SAT Midday Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→			←	←	↗
Volume (veh/h)	155	15	20	95	15	20
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)	168	16	22	103	16	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)	122					
pX, platoon unblocked						
vC, conflicting volume			185		323	177
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			185		323	177
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		98	97
cM capacity (veh/h)			1390		660	866
<b>Direction, Lane #</b>						
	EB 1	WB 1	NB 1			
Volume Total	185	125	38			
Volume Left	0	22	16			
Volume Right	16	0	22			
cSH	1700	1390	764			
Volume to Capacity	0.11	0.02	0.05			
Queue Length 95th (ft)	0	1	4			
Control Delay (s)	0.0	1.4	10.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.4	10.0			
Approach LOS			A			
<b>Intersection Summary</b>						
Average Delay			1.6			
Intersection Capacity Utilization			28.5%	ICU Level of Service	A	
Analysis Period (min)			15			

# Cumberland Farms Concept Plan

Saved Tuesday, January 29, 2013 1:16:25 PM MGR0001 Plotted Tuesday, January 29, 2013 3:54:17 PM Groat, Mark



**Vanasse Hangen Brustlin, Inc.**

Transportation  
Land Development  
Environmental Services

54 Tuttle Place  
Middletown, Connecticut 06457  
860.632.1500 • FAX 860.632.7879



**Cumberland Gulf Group of Companies**  
#100 Crossing Boulevard  
Framingham, Massachusetts 01702  
Phone (508) 270-1400

### Parking Summary Chart

Description	Size		Spaces	
	Required	Provided	Required	Provided
STANDARD SPACES	9 x 19	9 x 19	15	24
STANDARD ACCESSIBLE SPACES *	15 x 19	15 x 19	1	1
VAN ACCESSIBLE SPACES	16 x 19	16 x 19	1	1
TOTAL SPACES			16	26
LOADING BAYS**			-	-

\* ADA/STATE/LOCAL REQUIREMENTS: 1 VAN SPACE AND 1 STANDARD SPACE REQUIRED FOR 26 TO 50 PARKING SPACES PROVIDED.  
\*\* LOADING BAYS: FOR ONE LOADING BAY MIN. BUILDING AREA OF 25,000 SF IS REQUIRED. NO LOADING BAY IS REQUIRED.

**Parking Requirements:**

RETAIL*	4,513 SF	x	1 SPACES /	300 SF OFA =	15.04 SPACES
TOTAL PARKING REQUIRED =					16 SPACES

### Zoning Summary Chart

Zoning District(S):	BUSINESS - B	
Overlay District(S):	NONE	
Zoning Regulation Requirements	Required	Provided
MINIMUM LOT SIZE	12,000 SF	50,944 SF (1.17 AC)
MINIMUM LOT FRONTAGE (NORTH ROAD)	100 FT	177 FT
MAXIMUM BUILDING COVERAGE	80%	8.9% (EXCLUDES GAS CANOPY)
FRONT YARD SETBACK: SOUTHAMPTON ROAD	30 Feet	31.0 Feet (CANOPY)
FRONT YARD SETBACK: NORTH BLVD	30 Feet	72.4 Feet (CANOPY)
SIDE YARD SETBACK	20 Feet	67 Feet (CANOPY)
REAR YARD SETBACK	20 Feet	20.5 Feet (BUILDING OH)
MAXIMUM BUILDING HEIGHT	2.5 STORIES/ 35FT	30.83 Feet

### Signage Summary Chart

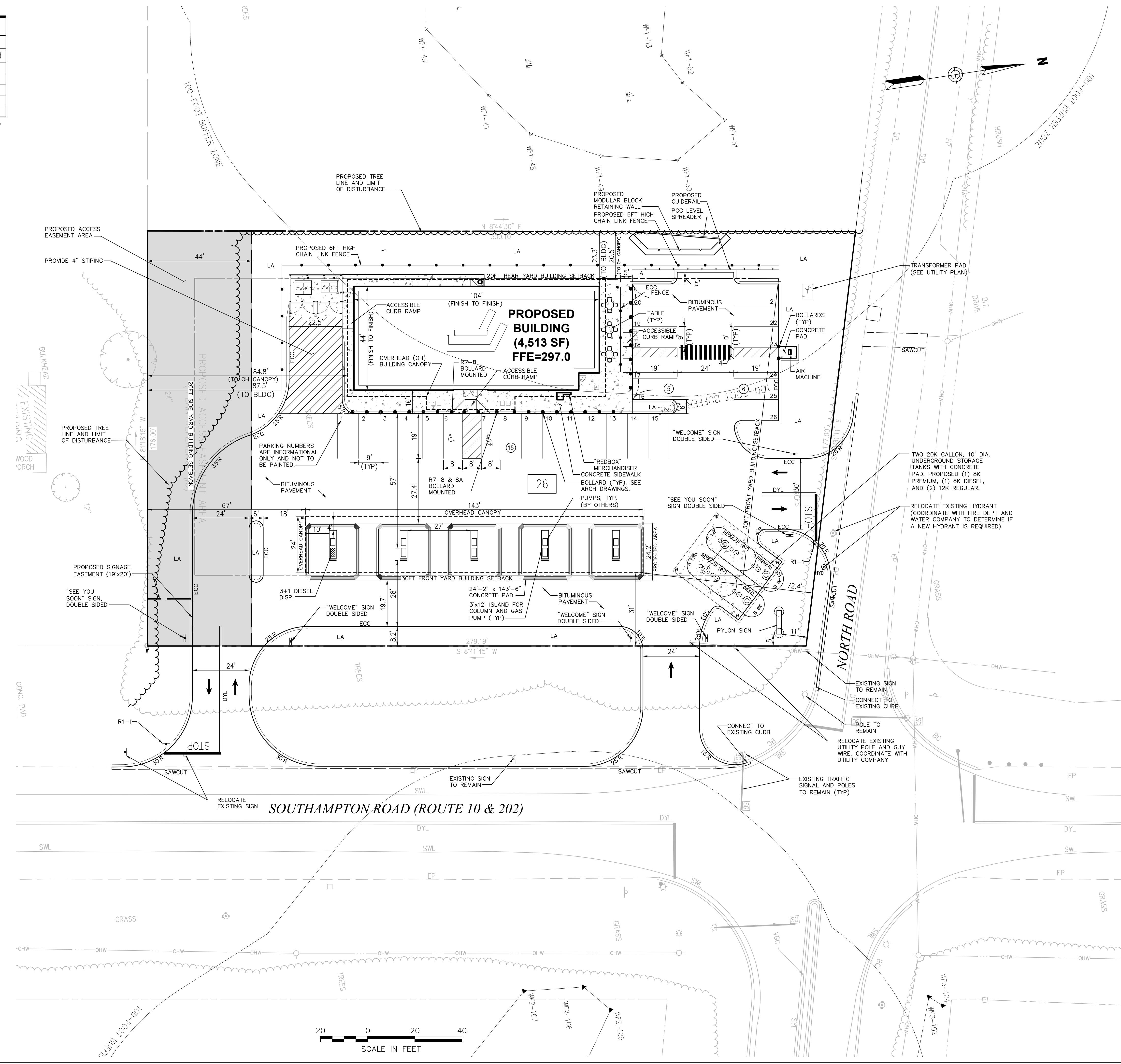
Zoning Regulation Requirements	Allowed	Provided
FREE-STANDING (PYLON) SIGN - AREA	40 SF PER SIDE	40 SF PER SIDE
FREE-STANDING SIGN (PYLON) - HEIGHT	22FT	22FT
CANOPY SIGN - AREA	TBD **	11 SF (x2)
BUILDING SIGN - AREA	279.19 SF / 177 SF *	37.6 SF / 27.8 SF

\* ACCESSORY SIGN: PER SEC. 8-10.2: MAX OVERALL SIZE OF PERMITTED ACCESSORY WALL SIGNS MAY NOT EXCEED 1 SF PER 1 LF OF FRONTAGE ON A STREET OR PUBLIC PEDESTRIAN WAY:  
SOUTHAMPTON ROAD: 279.19 FT = 279.19 SF SIGN  
NORTH ROAD: 177 LF = 177 SF SIGN

\*\* FURTHER INVESTIGATION REQUIRED WITH MUNICIPALITY

### On-Site Traffic Signage Chart

MUTCD Number	Specification		Desc.
	Width	Height	
R1-1	30"	30"	
R7-8	12"	18"	
R7-8a	12"	6"	



No.	Revision	Date	App'd.

Designed by: \_\_\_\_\_ Drawn by: \_\_\_\_\_ Checked by: \_\_\_\_\_  
CAD checked by: \_\_\_\_\_ Approved by: \_\_\_\_\_  
Scale 1"=20' Date January 31, 2013  
Project Title

## Proposed Cumberland Farms Convenience Store with Gas

Southampton Road & North Road  
Westfield, MA

Local Approvals

Not Issued For Construction

## Layout and Materials Plan

Drawing Number  
**C-2**  
Sheet 2 of 9  
Project Number  
41827.00