



# 362 Boston Street

---

# TRAFFIC IMPACT & ACCESS STUDY

---

*Prepared for*

**Walsh Properties**  
222 Boston Avenue  
Medford, MA 02155

*and*

**Town of Topsfield, Massachusetts**

*Prepared by*

**Howard/Stein-Hudson Associates, Inc.**  
38 Chauncy Street  
Boston, MA 02111

**May 28, 2010**

CREATIVE SOLUTIONS  
EFFECTIVE PARTNERING®

# Transportation Impact and Access Study

---

## 362 Boston Street, Topsfield, Massachusetts

### Project Description

Howard/Stein-Hudson Associates (HSH) has prepared this traffic impact and access study (TIAS) to address the impact of redeveloping 362 Boston Street in Topsfield, Massachusetts (see **Figure 1**). The existing project site is located on the southwest corner of the intersection of Boston Street (Route 1)/Ipswich Road and is occupied by a vacant, 2-story, single-family house and other ancillary buildings. The project site is bounded by Ipswich Road to the north and west, Averill Street to the south, and Boston Street to the east.

Two-way vehicular access to the existing site is currently provided via a curb cut on Boston Street approximately 75 feet south of the intersection with Ipswich Road. Secondary access to the site is provided via a curb cut on Ipswich Road approximately 130 feet west of Boston Street and on Averill Street approximately 80 feet east of Ipswich Road.

The proposed redevelopment consists of demolition of the existing residential buildings and construction of a new, 2-story building of approximately 6,300 square feet (sf), including 3,150 sf of retail space on the ground floor and 3,150 sf of office space on the upper floor. Parking for 21 vehicles will be provided in a surface parking lot, including 1 handicapped-accessible space. This provision is consistent with Town zoning requirements.

Primary vehicular access will be provided on Ipswich Road; the existing curb cut will be relocated approximately 60 feet west of its current location to improve sight distance and reduce vehicular conflicts with traffic waiting at the Ipswich Road eastbound approach at its intersection with Boston Street. The existing

driveway on Averill Street will be relocated approximately 40 feet east of its existing location and would provide secondary access for emergency vehicles only. The Proponent will work with the Town to identify the most appropriate solution for signage at this driveway. The existing curb cut on Boston Street would be discontinued.

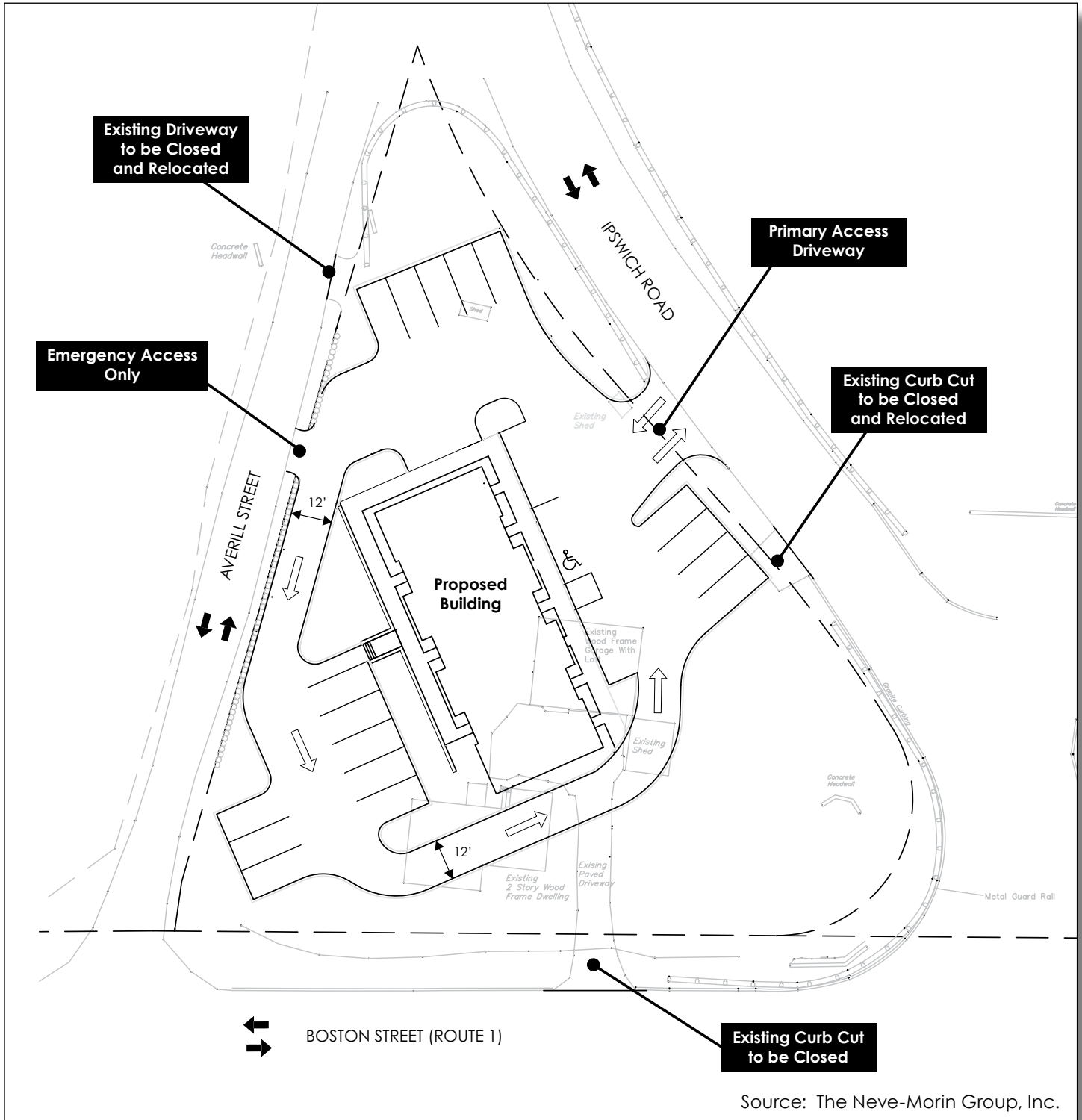
### Existing Traffic Volumes

Since the most critical combination of site-generated and adjacent roadway volumes occurs during the weekday evening peak hour and the Saturday mid-day peak hour for the proposed retail and office uses, the traffic study focuses on these time periods as the “worst case” scenario for analysis purposes. For this reason, HSH collected manual turning movement counts at the intersection of Boston Street/Ipswich Road on Thursday, March 25, 2010, from 4:00 to 6:00 p.m. and on Saturday, March 27, 2010, from 11:00 a.m. to 2:00 p.m. According to the traffic count data, the peak hour at the intersection of Boston Street/Ipswich Road occurs between 4:30 and 5:30 p.m. on weekdays and between noon and 1:00 p.m. on Saturday. Detailed traffic count data are provided in **Appendix A**.

### Existing Intersection and Roadway Conditions

The study area includes the signalized, 4-leg intersection of Boston Street/Ipswich Road. The eastbound Ipswich Road approach consists of a 22-foot multi-purpose lane; however, HSH field observations indicate that it operates as a designated left-turn lane and a shared through/right-turn lane. The westbound Ipswich Road approach consists of a 12-foot left-turn lane with approximately 110 feet of storage and an 11-foot, shared through/right-turn lane.

Figure 1. Site Plan



The northbound Boston Street approach consists of a 12-foot, shared left-turn/through lane and a 12-foot right-turn lane with approximately 130 feet of storage. The southbound Boston Street approach consists of a 15-foot, shared left-turn/through/right-turn lane. Pedestrian accommodations are not provided at the intersection.

Boston Street (Route 1) is a 2-way, north–south roadway and consists of 1 travel lane in each direction. Boston Street is classified as an urban principal arterial and falls under MassDOT jurisdiction. Ipswich Road is a 2-way, east–west roadway with 1 travel lane in each direction. Ipswich Road is classified as an urban minor arterial and falls under Town of Topsfield jurisdiction.

Averill Street is classified as a local roadway and falls under Town of Topsfield jurisdiction. Averill Street is only approximately 13-feet wide, but functions as a two-way roadway. According to traffic count data collected by HSH on Thursday, March 25, 2010, Averill Street carries approximately 20 to 30 vehicles per hour during the peak periods (see **Appendix A**).

## Trip Generation

Trip generation for the project was based on data contained in the 8<sup>th</sup> Edition of *Trip Generation*, published by the Institute of Transportation Engineers (ITE). The project-generated trips were estimated using Land Use Code (LUC) 710–General Office Building and LUC 820–Shopping Center.

**Table 1** summarizes the resulting project-generated trips. Detailed trip generation calculations are provided in **Appendix B**.

**Table 1. Trip Generation**

	Retail (3,150 sf)	Office (3,150 sf)	Total Vehicle Trips
<b>Weekday p.m. Peak Hour</b>			
In	6	1	7
Out	6	4	10
Total	12	5	17
<b>Saturday Mid-day Peak Hour</b>			
In	8	1	9
Out	7	1	8
Total	15	2	17

As indicated, the project will generate approximately 17 vehicle trips (7 trips in and 10 trips out) during the weekday evening peak hour and approximately 17 vehicle trips (9 trips in and 8 trips out) during the Saturday mid-day peak hour. This accounts for fewer than 1 new vehicle trip every 3 minutes during the weekday evening and Saturday mid-day peak periods.

According to data contained in ITE’s *Trip Generation*, between 20% and 80% of vehicle trips associated with retail uses are “pass-by trips” or trips that currently pass the site and will, in the future, choose to stop at the proposed retail use(s). However, to yield a conservative estimate, all vehicle trips associated with the proposed retail use(s) were assumed to be new trips.

It should also be noted that, due to the mixed-use nature of the site (i.e., office and retail), a small portion (up to approximately 20% of trips, per ITE) of the trips are likely to be “internal trips”—trips that are made on-site and do not use the adjacent roadway network. To yield a conservative estimate, no credit was taken for internal trips.

## Site Access

With the project in place, the existing curb cut on Ipswich Road (currently located approximately 130 feet west of Boston Street) would be relocated 60 feet west of its current location and would provide 2-way primary access to the site. The site plan is shown in **Figure 1**. Relocation of this driveway away from the Boston Street/Ipswich Road intersection will help

reduce potential conflicts with vehicular traffic waiting at the Ipswich Road eastbound approach to its intersection with Boston Street. The proposed location of the site driveway will also improve sight distance.

HSH evaluated stopping sight distance (SSD) and intersection sight distance (ISD) at the proposed site driveway location on Friday, March 5, 2010, per the requirements set forth in the *Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO), 2004.

**SSD** is the minimum visible length of roadway required for a motorist traveling at the design speed to react and stop before reaching a stationary object in the road (assumed to be a vehicle entering or exiting the site). **ISD** is the minimum distance required for a driver of a stopped vehicle to view the intersecting roadway and decide when to enter the roadway or cross it in order to anticipate and avoid collisions. The posted speed limit along Ipswich Road is 25 miles per hour (mph); however, HSH field observations indicate that vehicles traveling eastbound on Ipswich Road generally travel faster. Therefore, a design speed of 30 mph was chosen for this analysis.

HSH measured sight distance in the field at approximately 350 feet to the west of the driveway, which meets minimum requirements for SSD (200 feet) and ISD (335 feet for left turns and 290 feet for right-turns). Sight distance to the east of the driveway extends to the signalized intersection approximately 190 feet away that controls vehicular movements and speed along Ipswich Road.

Secondary access for emergency vehicles only will also be provided on Averill Street; the existing driveway on Averill Street will be relocated approximately 40 feet east of its existing location.

The existing curb cut on Boston Street would be closed.

## Traffic Operations Analysis

**Existing Conditions** traffic operations analysis is based on existing vehicle turning movement count data collected by HSH in March 2010. The peak hours at the intersection of Boston Street/Ipswich Road were identified as between 4:30 and 5:30 p.m. on weekdays and between noon and 1:00 p.m. on Saturdays. According to MassDOT permanent count station #5128L on Boston Street, traffic volumes in March are historically 4% lower than average month conditions. Therefore, traffic volumes were increased by 4%.

Future-year traffic operations were evaluated for a 5-year horizon. A **No-Build Conditions** scenario, independent of the proposed Project, is evaluated to determine a baseline of future traffic operating conditions. Based on historic traffic volumes collected at MassDOT permanent count stations #5128L and #6226, traffic volumes have remained relatively constant in recent years. However, to provide a conservative estimate, the year 2015 No-Build scenario assumes a general background growth rate of 1.0% per year to account for any anticipated background traffic growth and the impacts of any local area development projects.

The trip distribution for the Project was based on existing traffic patterns and is summarized in **Table 2**.

**Table 2. Trip Distribution**

Direction	Trips (%)
To/from points East	20%
To/from points West	10%
To/from points North	30%
To/from points South	40%
Total	100%

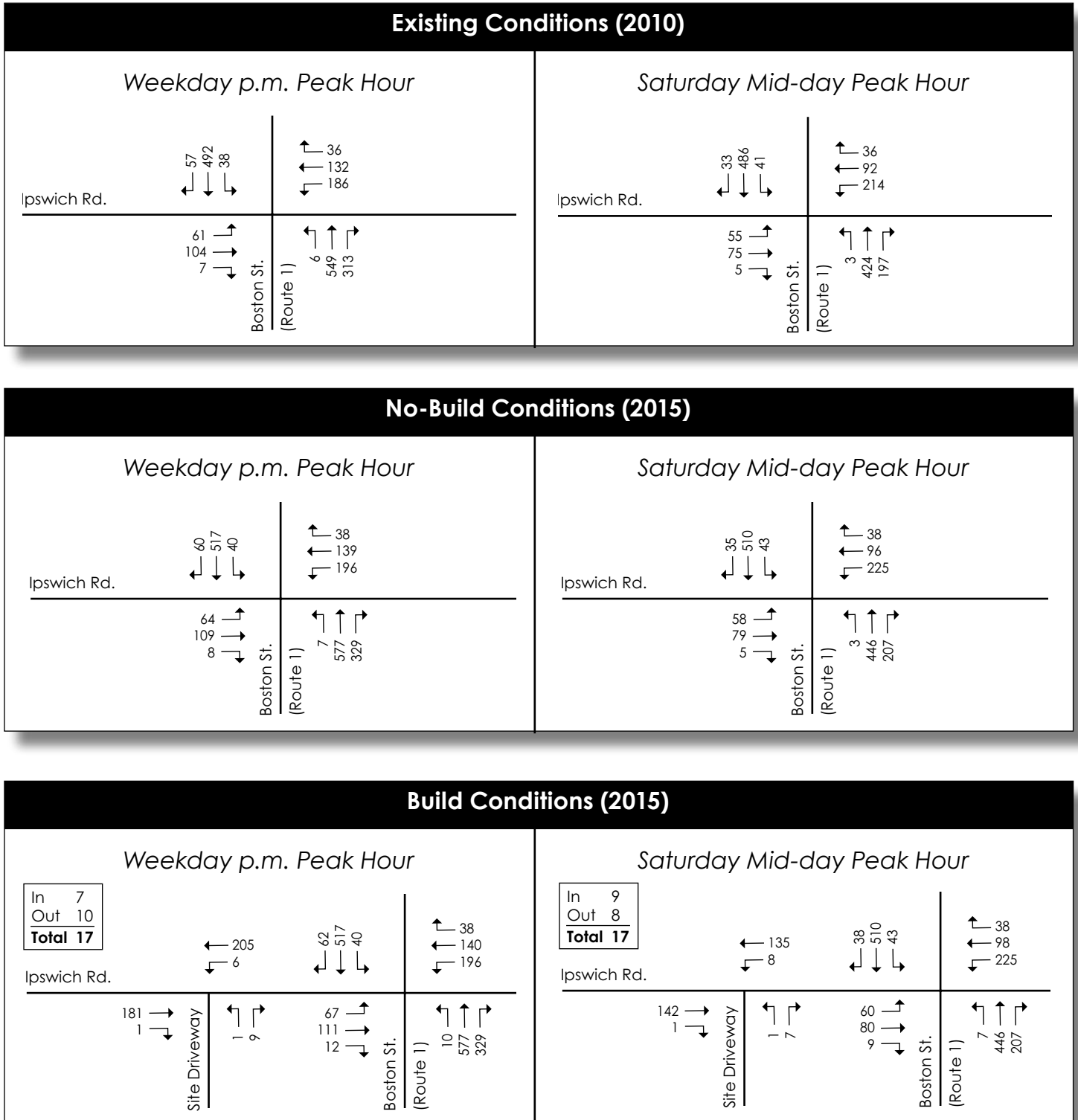
Project-generated vehicle trips were then added to the No-Build Conditions traffic volumes according to the trip distribution to create the **Build Conditions**. No changes in lane usage or roadway geometries were assumed under the Build Conditions assessment.

The 2010 Existing, 2015 No-Build, and 2015 Build Conditions traffic volumes are summarized in **Figure 2**.

Traffic operations are determined through an analysis of intersection Level of Service (LOS). HSH used Trafficware's Synchro 6 software to analyze LOS and delay at the intersections and to evaluate the effects closely spaced intersections may have on one another. It is based on the traffic operational analysis

methodology of the Transportation Research Board's *2000 Highway Capacity Manual* (HCM); HCM methods determine the LOS, delay (in seconds), volume-to-capacity ratio (v/c), and 95<sup>th</sup> percentile queue length (in feet), based on the intersection geometry and available traffic data for each intersection. MassDOT provided the signal timings and phasing used in this analysis.

**Figure 2. Traffic Volumes**



Not to scale.

Derived from the HCM, **Table 3** shows LOS criteria for signalized and unsignalized intersections. LOS A defines the most favorable conditions, with minimum traffic delay. LOS F represents the worst condition, with significant traffic delay. LOS D is generally considered acceptable in an urban environment.

**Table 3. Level of Service Criteria**

Level of Service	Average Stopped Delay (seconds/vehicle)	
	Signalized Intersection	Unsignalized Intersection
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Source: 2000 Highway Capacity Manual, Transportation Research Board.

The *v/c ratio* is a measure of congestion at an intersection approach. A v/c ratio of 1 or greater indicates that the intersection approach exceeds capacity.

The *95th percentile queue length* represents the farthest extent of the vehicle queue (to the last

stopped vehicle) upstream from the stop line during 95% of all signal cycles. The 95th percentile queue will not be seen during each cycle. The queue would be this long only 5% of the time. These queues would not be seen during off-peak hours.

**Table 4** compares the level of service (LOS) for Existing, No-Build, and Build Conditions. Synchro reports are provided in **Appendix C**.

As shown, the LOS at the Boston Street/Ipswich Road intersection will remain unchanged and well below capacity with the project in place—at LOS B during the weekday evening and Saturday mid-day peak hours.

The intersection of Ipswich Road/Site Driveway will operate at LOS A during both peak periods. The vehicle queues on the eastbound Ipswich Road approach at the adjacent intersection of Boston Street/Ipswich Road will not reach the Site driveway during either of the peak periods allowing vehicles to enter/exit the site with minimal conflict.

**Table 4. Level of Service Comparison**

Intersection	Existing (2010)				No-Build (2015)				Build (2015)			
	LOS	Delay (sec.)	v/c	95% queue (ft.)	LOS	Delay (sec.)	v/c	95% queue (ft.)	LOS	Delay (sec.)	v/c	95% queue (ft.)
<b>Weekday p.m. Peak Hour</b>												
<b>Boston Street/ Ipswich Road</b>	<b>B</b>	<b>16.8</b>	—	—	<b>B</b>	<b>18.7</b>	—	—	<b>B</b>	<b>19.3</b>	—	—
Ipswich EB left	C	33.3	0.44	60	D	36.2	0.47	63	D	37.2	0.50	65
Ipswich EB thru/right	C	30.4	0.50	95	C	33.1	0.54	100	C	33.8	0.58	104
Ipswich WB left	B	19.5	0.56	104	C	22.3	0.62	110	C	22.9	0.63	110
Ipswich WB thru/right	B	15.1	0.39	83	B	16.6	0.42	87	B	16.7	0.42	88
Boston NB left/thru	B	17.4	0.71	288	B	17.7	0.72	313	B	18.1	0.72	320
Boston NB right	A	0.9	0.27	16	A	1.0	0.28	17	A	1.1	0.28	18
Boston SB left/thru/right	B	19.4	0.76	309	C	23.6	0.82	#415	C	24.3	0.83	#422
<b>Ipswich Road/ Site Driveway</b>	—	—	—	—	—	—	—	—	—	—	—	—
Ipswich EB thru/right	—	—	—	—	—	—	—	—	A	0.0	0.12	0
Ipswich WB left/thru	—	—	—	—	—	—	—	—	A	0.3	0.00	0
Site Driveway NB left/right	—	—	—	—	—	—	—	—	A	9.5	0.01	1
<b>Saturday Midday Peak Hour</b>												
<b>Boston Street/ Ipswich Road</b>	<b>B</b>	<b>13.7</b>	—	—	<b>B</b>	<b>15.4</b>	—	—	<b>B</b>	<b>15.6</b>	—	—
Ipswich EB left	C	31.2	0.40	54	C	32.9	0.43	56	C	33.4	0.45	58
Ipswich EB thru/right	C	26.5	0.38	70	C	27.9	0.40	73	C	27.8	0.44	77
Ipswich WB left	B	17.8	0.51	121	B	18.4	0.52	127	B	18.6	0.53	127
Ipswich WB thru/right	B	11.8	0.24	66	B	12.3	0.25	69	B	12.3	0.25	70
Boston NB left/thru	B	11.9	0.43	189	B	13.2	0.50	202	B	13.4	0.53	205
Boston NB right	A	0.9	0.20	11	A	0.8	0.77	11	A	0.9	0.20	11
Boston SB left/thru/right	B	14.7	0.60	296	B	17.9	0.73	320	B	18.0	0.73	320
<b>Ipswich Road/ Site Driveway</b>	—	—	—	—	—	—	—	—	—	—	—	—
Ipswich EB thru/right	—	—	—	—	—	—	—	—	A	0.0	0.09	0
Ipswich WB left/thru	—	—	—	—	—	—	—	—	A	0.5	0.01	0
Site Driveway NB left/right	—	—	—	—	—	—	—	—	A	9.3	0.01	1

#95th percentile queue exceeds capacity. Queue may be longer. Queue shown is the maximum after 2 cycles.

## Traffic Increases

With the proposed project in place, vehicular traffic at the Boston Street/Ipswich Road intersection will increase by less than 1% during the weekday evening and Saturday mid-day peak hours. Overall, vehicular traffic generated by the project will have an imperceptible impact on area roadways.

## Conclusions

The project is expected to have a negligible impact on area traffic operations. With the project in place:

- The proposed office and retail uses will generate only approximately 17 vehicle trips (7 trips in and 10 trips out) during the weekday evening peak hour and approximately 17 vehicle trips (9 trips in and 8 trips out) during the Saturday mid-day peak hour. This corresponds to fewer than 1 new vehicle trip every 3 minutes on area

roadways during the peak periods—an increase imperceptible to the average driver.

- Traffic at the Boston Street/Ipswich Road intersection will increase by less than 1 % during the weekday evening and Saturday mid-day peak hours.
- The intersection of Boston Street/Ipswich Road will continue to operate at LOS B during the weekday evening peak hour and Saturday mid-day peak hour—well below capacity.
- The Project will provide 21 parking spaces, consistent with zoning requirements.
- Careful attention to site access has been given in the development of the site plan. Closure of the Boston Street curb cut and repositioning of the Ipswich Road curb cut will improve overall site access/circulation and vehicular safety.

# Appendix A. Traffic Count Data

---

362 Boston Street

# Accurate Counts

## 978-664-2565

Location : Averill Street South of  
 Location : Ipswich Road  
 City/State: Topsfield, MA  
 Counter : 16431

Site Code: 10029001  
 10029001

Start Time	25-Mar-10 Thu	NB		Hour Totals		SB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	6			0	4				
12:15		2	1			0	4				
12:30		0	9			0	1				
12:45		0	3	2	19	0	6	0	15	2	34
01:00		0	1			0	3				
01:15		0	3			0	1				
01:30		0	2			0	3				
01:45		0	3	0	9	0	3	0	10	0	19
02:00		0	1			0	7				
02:15		0	1			0	3				
02:30		0	4			0	9				
02:45		0	3	0	9	0	3	0	22	0	31
03:00		0	8			0	3				
03:15		0	6			0	4				
03:30		0	4			0	2				
03:45		0	5	0	23	0	6	0	15	0	38
04:00		0	3			0	6				
04:15		0	3			0	6				
04:30		0	5			0	3				
04:45		0	4	0	15	0	2	0	17	0	32
05:00		0	4			0	4				
05:15		0	1			2	2				
05:30		0	5			0	1				
05:45		0	7	0	17	0	6	2	13	2	30
06:00		2	7			1	4				
06:15		0	1			0	1				
06:30		0	0			3	2				
06:45		3	2	5	10	3	3	7	10	12	20
07:00		3	3			3	3				
07:15		1	2			4	4				
07:30		0	1			9	9				
07:45		2	0	6	6	14	13	30	29	36	35
08:00		6	0			5	5				
08:15		2	2			6	4				
08:30		0	0			3	7				
08:45		1	4	9	6	7	6	21	22	30	28
09:00		4	2			4	4				
09:15		2	1			6	2				
09:30		4	2			5	2				
09:45		0	7	10	12	6	5	21	13	31	25
10:00		3	0			4	2				
10:15		4	0			3	2				
10:30		1	3			6	1				
10:45		2	0	10	3	5	6	18	11	28	14
11:00		3	4			1	3				
11:15		3	3			4	1				
11:30		2	0			9	2				
11:45		6	7	14	14	2	2	16	8	30	22
<b>Total</b>		<b>56</b>	<b>143</b>			<b>115</b>	<b>185</b>			<b>171</b>	<b>328</b>
<b>Percent</b>		<b>28.1%</b>	<b>71.9%</b>			<b>38.3%</b>	<b>61.7%</b>			<b>34.3%</b>	<b>65.7%</b>
<b>Grand Total</b>		<b>56</b>	<b>143</b>			<b>115</b>	<b>185</b>			<b>171</b>	<b>328</b>
<b>Percent</b>		<b>28.1%</b>	<b>71.9%</b>			<b>38.3%</b>	<b>61.7%</b>			<b>34.3%</b>	<b>65.7%</b>

ADT

ADT 499

AADT 499

# Accurate Counts

## 978-664-2565

Location : Averill Street South of  
 Location : Ipswich Road  
 City/State: Topsfield, MA  
 Counter : 16431

Site Code: 10029001  
 10029001

Start Time	22-Mar-10		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 AM	*	*	*	*	*	*	2	0	*	*	*	*	*	*	2	0
01:00	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0
02:00	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0
03:00	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0
04:00	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0
05:00	*	*	*	*	*	*	0	2	*	*	*	*	*	*	0	2
06:00	*	*	*	*	*	*	5	7	*	*	*	*	*	*	5	7
07:00	*	*	*	*	*	*	6	30	*	*	*	*	*	*	6	30
08:00	*	*	*	*	*	*	9	21	*	*	*	*	*	*	9	21
09:00	*	*	*	*	*	*	10	21	*	*	*	*	*	*	10	21
10:00	*	*	*	*	*	*	10	18	*	*	*	*	*	*	10	18
11:00	*	*	*	*	*	*	14	16	*	*	*	*	*	*	14	16
12:00 PM	*	*	*	*	*	*	19	15	*	*	*	*	*	*	19	15
01:00	*	*	*	*	*	*	9	10	*	*	*	*	*	*	9	10
02:00	*	*	*	*	*	*	9	22	*	*	*	*	*	*	9	22
03:00	*	*	*	*	*	*	23	15	*	*	*	*	*	*	23	15
04:00	*	*	*	*	*	*	15	17	*	*	*	*	*	*	15	17
05:00	*	*	*	*	*	*	17	13	*	*	*	*	*	*	17	13
06:00	*	*	*	*	*	*	10	10	*	*	*	*	*	*	10	10
07:00	*	*	*	*	*	*	6	29	*	*	*	*	*	*	6	29
08:00	*	*	*	*	*	*	6	22	*	*	*	*	*	*	6	22
09:00	*	*	*	*	*	*	12	13	*	*	*	*	*	*	12	13
10:00	*	*	*	*	*	*	3	11	*	*	*	*	*	*	3	11
11:00	*	*	*	*	*	*	14	8	*	*	*	*	*	*	14	8
Lane	0	0	0	0	0	0	199	300	0	0	0	0	0	0	199	300
Day	0	0	0	0	0	0	499	499	0	0	0	0	0	0	499	499
AM Peak							11:00	07:00							11:00	07:00
Vol.							14	30							14	30
PM Peak							15:00	19:00							15:00	19:00
Vol.							23	29							23	29

Comb. Total	0	0	0	499	0	0	0	499
ADT	ADT 499		AADT 499					

Accurate Counts  
978-664-2565

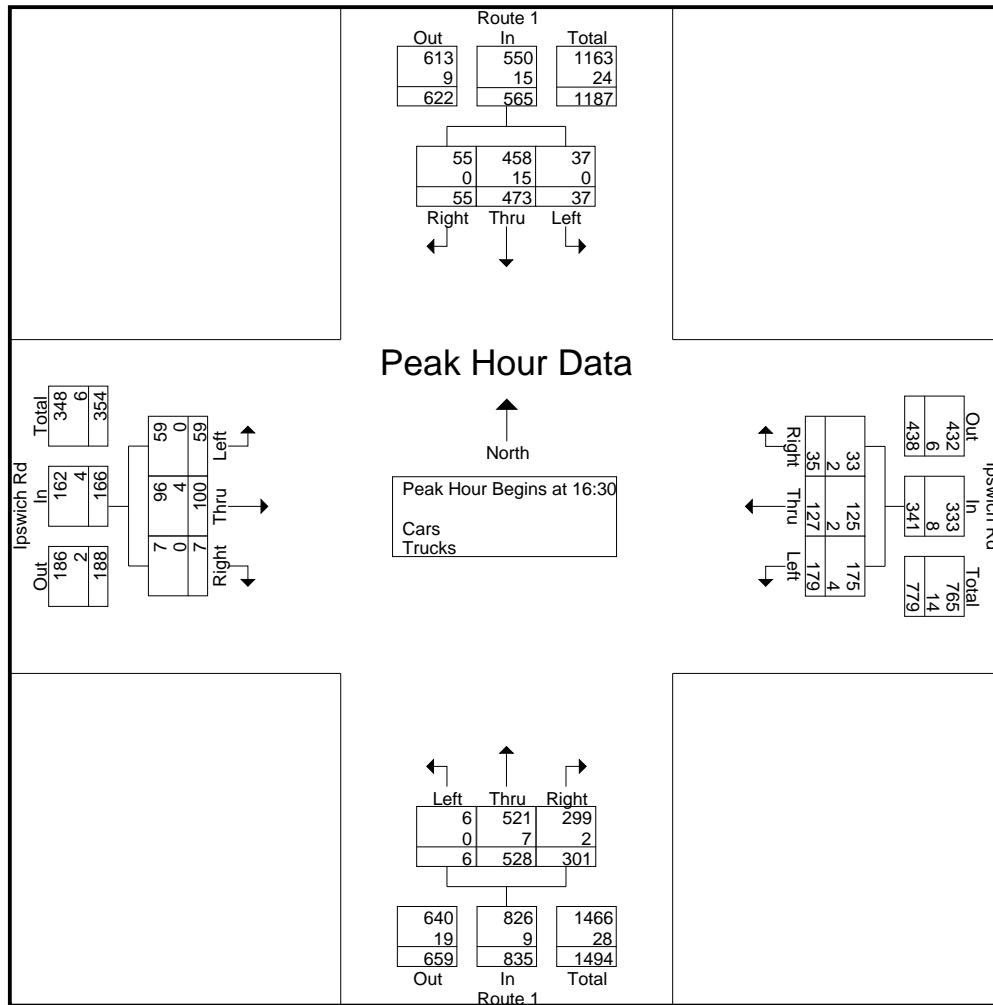
File Name : 10029001  
Site Code : 10029001  
Start Date : 3/25/2010  
Page No : 1

N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Cars - Trucks

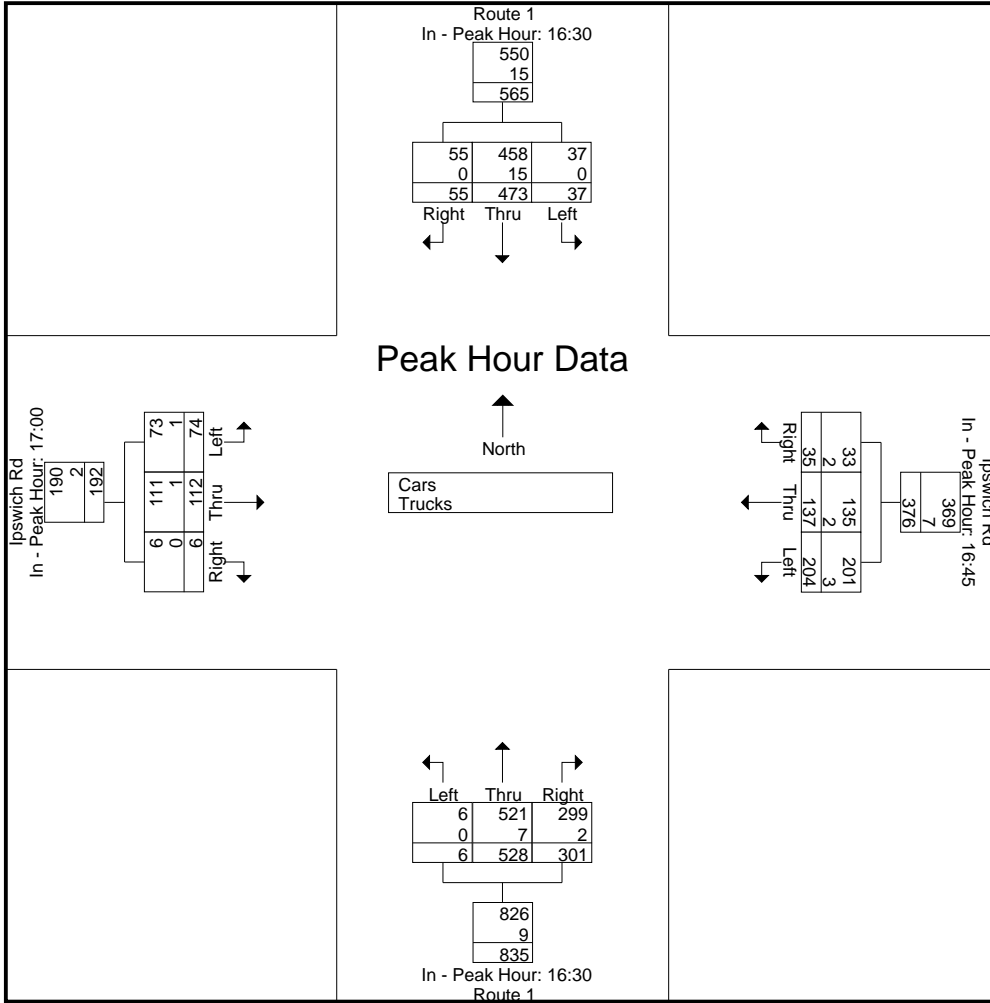
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
16:00	7	116	10	0	42	19	7	0	3	123	61	1	15	18	0	0	1	421	422
16:15	2	91	13	0	43	21	11	0	3	139	61	0	16	28	2	0	0	430	430
16:30	9	115	18	0	34	19	11	0	3	135	79	1	13	20	4	0	1	460	461
16:45	8	119	16	0	43	31	11	0	2	127	86	0	14	31	0	0	0	488	488
Total	26	441	57	0	162	90	40	0	11	524	287	2	58	97	6	0	2	1799	1801
17:00	9	116	9	1	40	29	8	0	0	118	69	0	19	23	1	0	1	441	442
17:15	11	123	12	0	62	48	5	0	1	148	67	0	13	26	2	0	0	518	518
17:30	7	93	13	0	59	29	11	0	0	140	61	0	14	30	2	0	0	459	459
17:45	8	80	7	0	30	28	11	0	0	139	92	0	28	33	1	0	0	457	457
Total	35	412	41	1	191	134	35	0	1	545	289	0	74	112	6	0	1	1875	1876
Grand Total	61	853	98	1	353	224	75	0	12	1069	576	2	132	209	12	0	3	3674	3677
Apprch %	6	84.3	9.7		54.1	34.4	11.5		0.7	64.5	34.8		37.4	59.2	3.4				
Total %	1.7	23.2	2.7		9.6	6.1	2		0.3	29.1	15.7		3.6	5.7	0.3		0.1	99.9	
Cars	61	829	96		341	220	70		12	1053	574		130	202	12		0	0	3603
% Cars	100	97.2	98	100	96.6	98.2	93.3	0	100	98.5	99.7	100	98.5	96.7	100	0	0	0	98
Trucks	0	24	2		12	4	5		0	16	2		2	7	0		0	0	74
% Trucks	0	2.8	2	0	3.4	1.8	6.7	0	0	1.5	0.3	0	1.5	3.3	0	0	0	0	2

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 16:30																	
16:30	9	115	18	142	34	19	11	64	3	135	79	217	13	20	4	37	460
16:45	8	119	16	143	43	31	11	85	2	127	86	215	14	31	0	45	488
17:00	9	116	9	134	40	29	8	77	0	118	69	187	19	23	1	43	441
17:15	11	123	12	146	62	48	5	115	1	148	67	216	13	26	2	41	518
Total Volume	37	473	55	565	179	127	35	341	6	528	301	835	59	100	7	166	1907
% App. Total	6.5	83.7	9.7		52.5	37.2	10.3		0.7	63.2	36		35.5	60.2	4.2		
PHF	.841	.961	.764	.967	.722	.661	.795	.741	.500	.892	.875	.962	.776	.806	.438	.922	.920
Cars	37	458	55	550	175	125	33	333	6	521	299	826	59	96	7	162	1871
% Cars	100	96.8	100	97.3	97.8	98.4	94.3	97.7	100	98.7	99.3	98.9	100	96.0	100	97.6	98.1
Trucks	0	15	0	15	4	2	2	8	0	7	2	9	0	4	0	4	36
% Trucks	0	3.2	0	2.7	2.2	1.6	5.7	2.3	0	1.3	0.7	1.1	0	4.0	0	2.4	1.9



Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	16:30				16:45				16:30				17:00			
+0 mins.	9	115	18	142	43	31	11	85	3	135	79	217	19	23	1	43
+15 mins.	8	119	16	143	40	29	8	77	2	127	86	215	13	26	2	41
+30 mins.	9	116	9	134	62	48	5	115	0	118	69	187	14	30	2	46
+45 mins.	11	123	12	146	59	29	11	99	1	148	67	216	28	33	1	62
Total Volume	37	473	55	565	204	137	35	376	6	528	301	835	74	112	6	192
% App. Total	6.5	83.7	9.7		54.3	36.4	9.3		0.7	63.2	36		38.5	58.3	3.1	
PHF	.841	.961	.764	.967	.823	.714	.795	.817	.500	.892	.875	.962	.661	.848	.750	.774
Cars	37	458	55	550	201	135	33	369	6	521	299	826	73	111	6	190
% Cars	100	96.8	100	97.3	98.5	98.5	94.3	98.1	100	98.7	99.3	98.9	98.6	99.1	100	99
Trucks	0	15	0	15	3	2	2	7	0	7	2	9	1	1	0	2
% Trucks	0	3.2	0	2.7	1.5	1.5	5.7	1.9	0	1.3	0.7	1.1	1.4	0.9	0	1



Accurate Counts  
978-664-2565

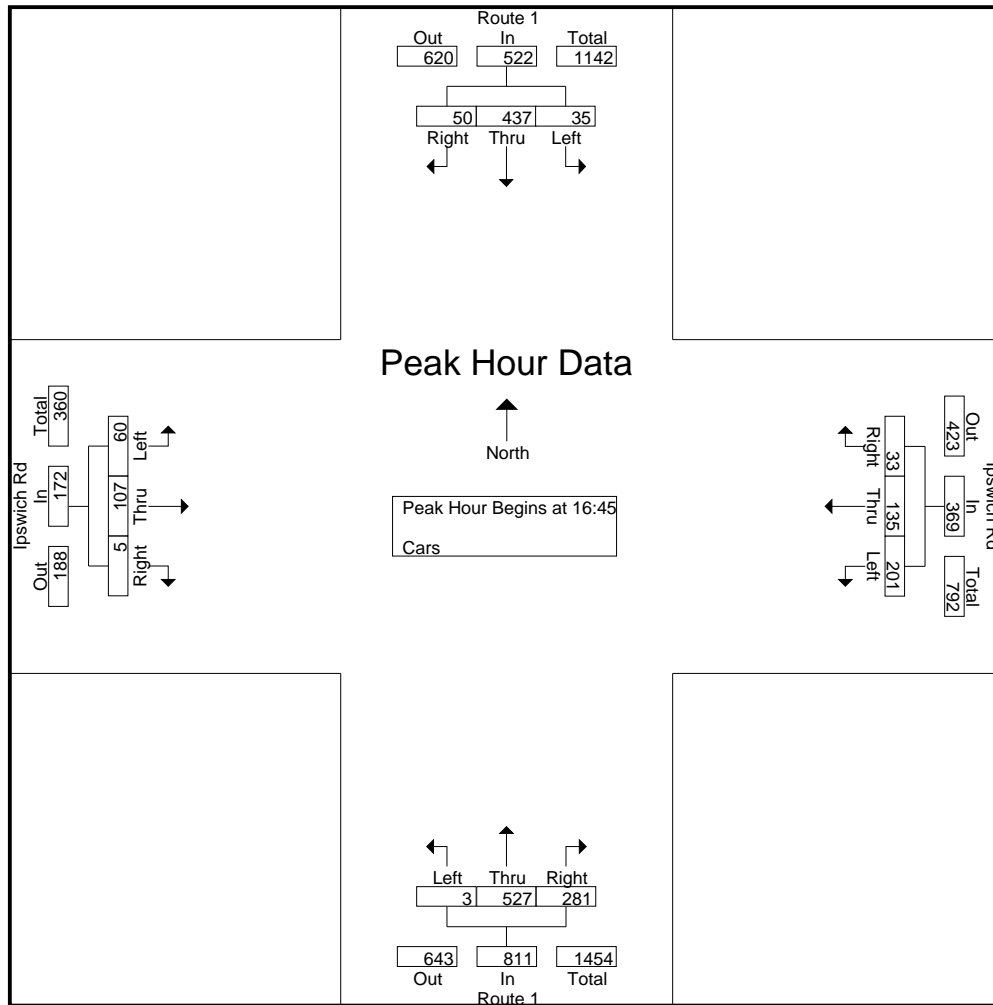
File Name : 10029001  
Site Code : 10029001  
Start Date : 3/25/2010  
Page No : 1

N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Cars

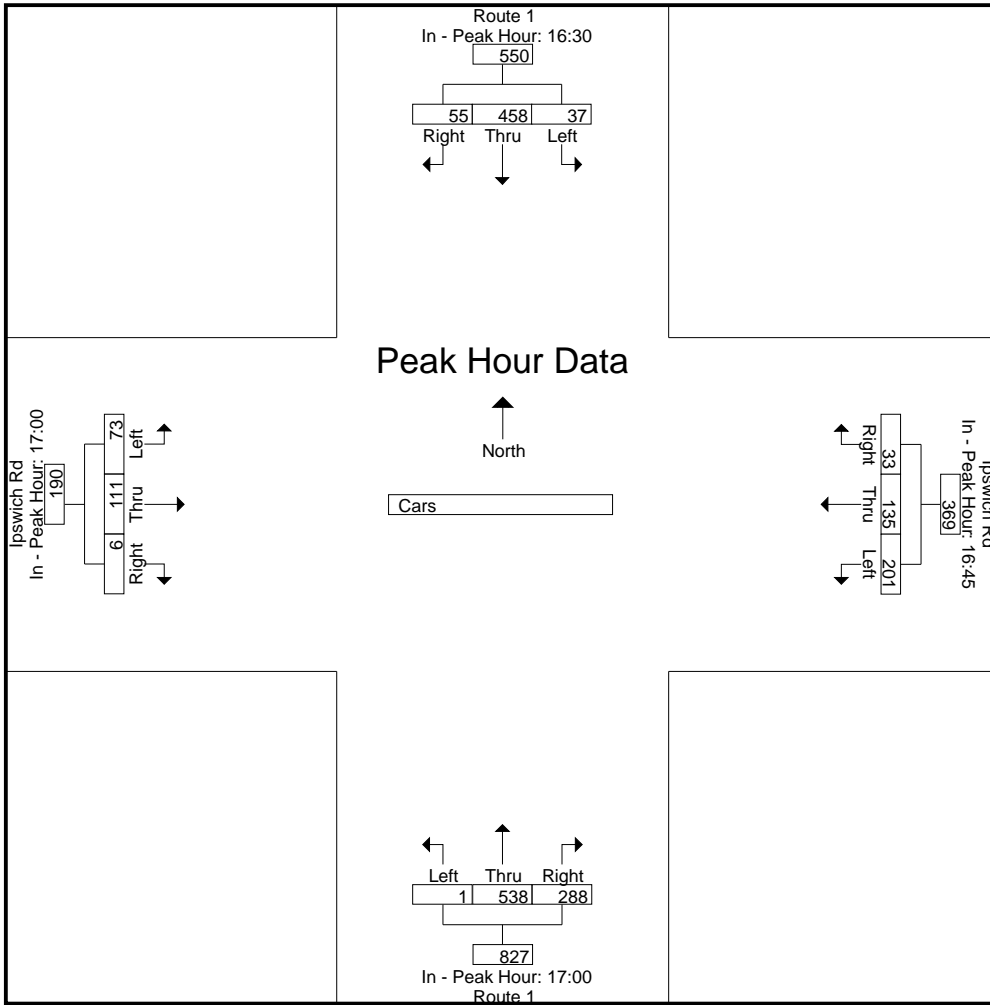
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
16:00	7	111	10	0	40	18	7	0	3	118	61	1	15	16	0	0	1	406	407
16:15	2	89	11	0	41	20	10	0	3	138	61	0	15	27	2	0	0	419	419
16:30	9	112	18	0	32	19	10	0	3	134	79	1	13	19	4	0	1	452	453
16:45	8	113	16	0	42	29	10	0	2	125	85	0	14	29	0	0	0	473	473
Total	26	425	55	0	155	86	37	0	11	515	286	2	57	91	6	0	2	1750	1752
17:00	9	111	9	1	40	29	8	0	0	117	69	0	19	22	1	0	1	434	435
17:15	11	122	12	0	61	48	5	0	1	145	66	0	13	26	2	0	0	512	512
17:30	7	91	13	0	58	29	10	0	0	140	61	0	14	30	2	0	0	455	455
17:45	8	80	7	0	27	28	10	0	0	136	92	0	27	33	1	0	0	449	449
Total	35	404	41	1	186	134	33	0	1	538	288	0	73	111	6	0	1	1850	1851
Grand Total	61	829	96	1	341	220	70	0	12	1053	574	2	130	202	12	0	3	3600	3603
Apprch %	6.2	84.1	9.7		54	34.9	11.1		0.7	64.2	35		37.8	58.7	3.5				
Total %	1.7	23	2.7		9.5	6.1	1.9		0.3	29.2	15.9		3.6	5.6	0.3		0.1	99.9	

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 16:45																	
16:45	8	113	16	137	42	29	10	81	2	125	85	212	14	29	0	43	473
17:00	9	111	9	129	40	29	8	77	0	117	69	186	19	22	1	42	434
17:15	11	122	12	145	61	48	5	114	1	145	66	212	13	26	2	41	512
17:30	7	91	13	111	58	29	10	97	0	140	61	201	14	30	2	46	455
Total Volume	35	437	50	522	201	135	33	369	3	527	281	811	60	107	5	172	1874
% App. Total	6.7	83.7	9.6		54.5	36.6	8.9		0.4	65	34.6		34.9	62.2	2.9		
PHF	.795	.895	.781	.900	.824	.703	.825	.809	.375	.909	.826	.956	.789	.892	.625	.935	.915



Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	16:30				16:45				17:00				17:00			
+0 mins.	9	112	18	139	42	29	10	81	0	117	69	186	19	22	1	42
+15 mins.	8	113	16	137	40	29	8	77	1	145	66	212	13	26	2	41
+30 mins.	9	111	9	129	61	48	5	114	0	140	61	201	14	30	2	46
+45 mins.	11	122	12	145	58	29	10	97	0	136	92	228	27	33	1	61
Total Volume	37	458	55	550	201	135	33	369	1	538	288	827	73	111	6	190
% App. Total	6.7	83.3	10		54.5	36.6	8.9		0.1	65.1	34.8		38.4	58.4	3.2	
PHF	.841	.939	.764	.948	.824	.703	.825	.809	.250	.928	.783	.907	.676	.841	.750	.779

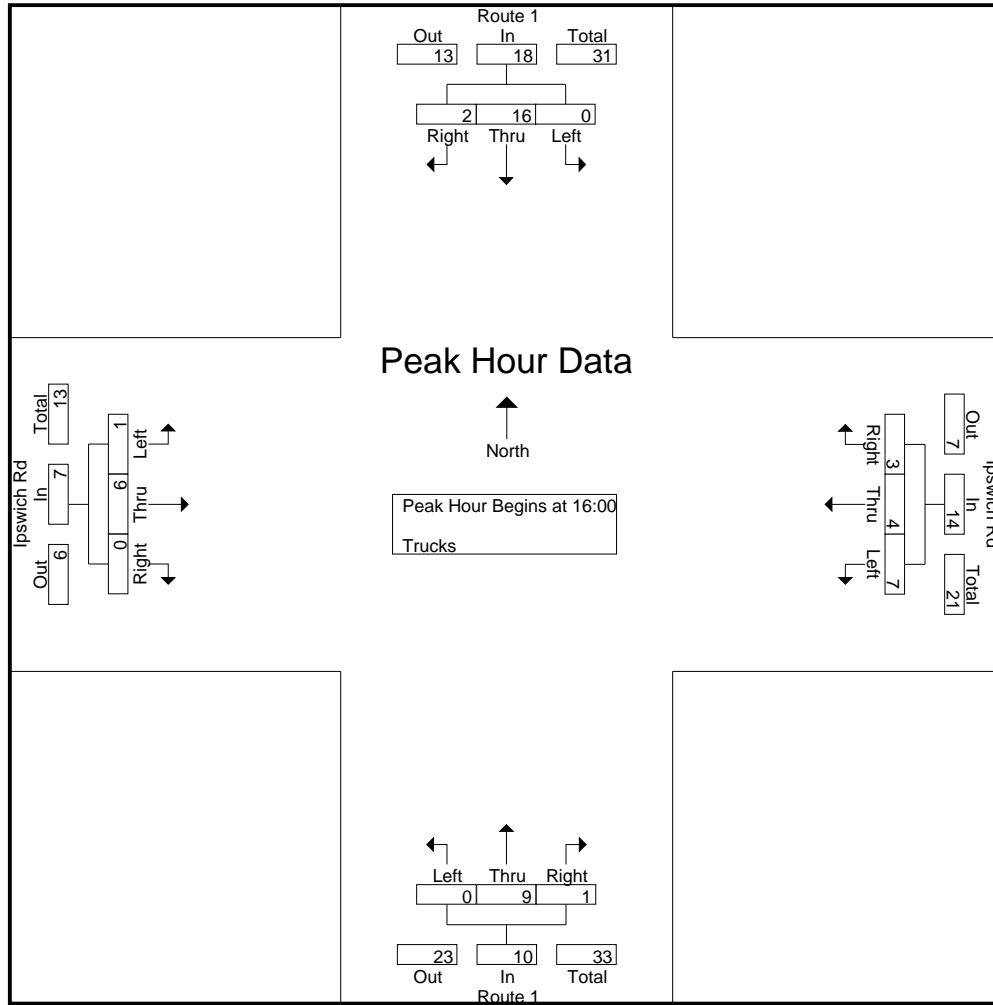


N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Trucks

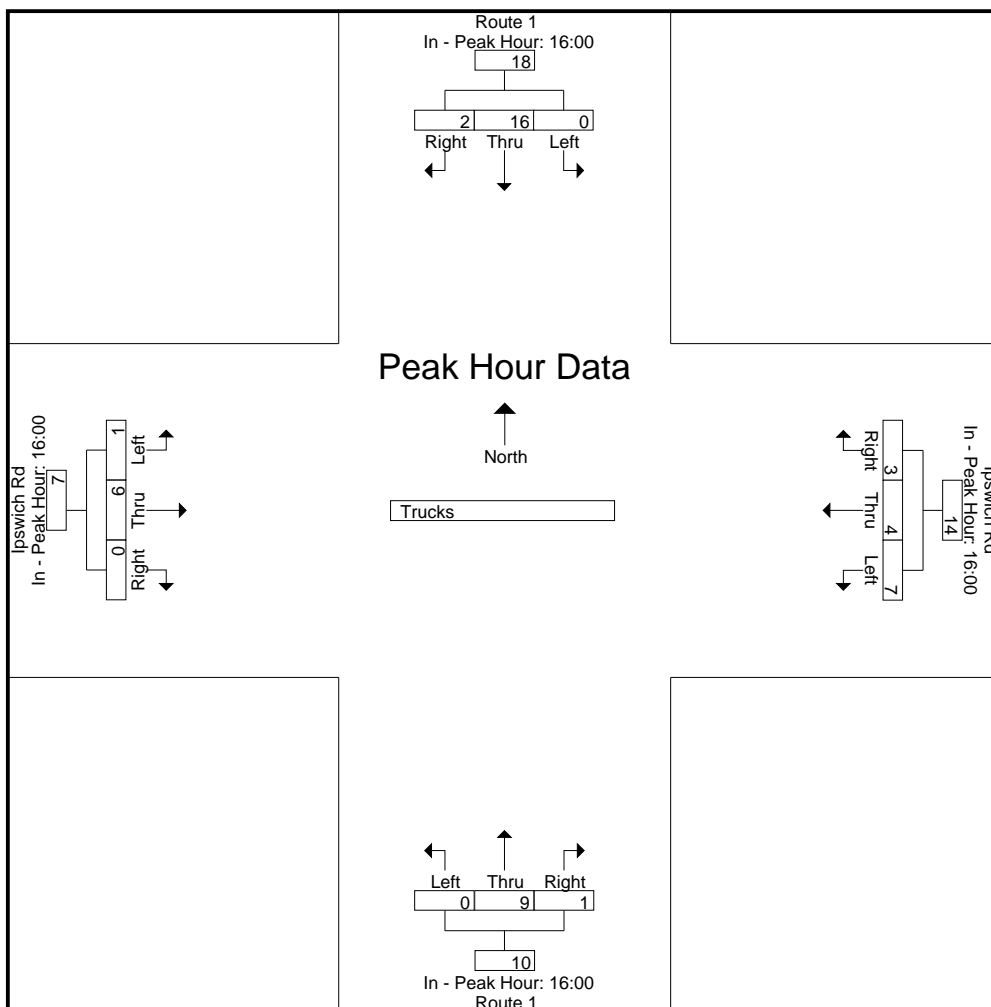
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total	
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds				
16:00	0	5	0	0	2	1	0	0	0	5	0	0	0	2	0	0	0	0	15	15
16:15	0	2	2	0	2	1	1	0	0	1	0	0	1	1	0	0	0	0	11	11
16:30	0	3	0	0	2	0	1	0	0	1	0	0	0	1	0	0	0	0	8	8
16:45	0	6	0	0	1	2	1	0	0	2	1	0	0	2	0	0	0	0	15	15
Total	0	16	2	0	7	4	3	0	0	9	1	0	1	6	0	0	0	0	49	49
17:00	0	5	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	7	7
17:15	0	1	0	0	1	0	0	0	0	3	1	0	0	0	0	0	0	0	6	6
17:30	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	4	4
17:45	0	0	0	0	3	0	1	0	0	3	0	0	1	0	0	0	0	0	8	8
Total	0	8	0	0	5	0	2	0	0	7	1	0	1	1	0	0	0	0	25	25
Grand Total	0	24	2	0	12	4	5	0	0	16	2	0	2	7	0	0	0	0	74	74
Apprch %	0	92.3	7.7		57.1	19	23.8		0	88.9	11.1		22.2	77.8	0			0		
Total %	0	32.4	2.7		16.2	5.4	6.8		0	21.6	2.7		2.7	9.5	0			0	100	

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 16:00																	
16:00	0	5	0	5	2	1	0	3	0	5	0	5	0	2	0	2	15
16:15	0	2	2	4	2	1	1	4	0	1	0	1	1	1	0	2	11
16:30	0	3	0	3	2	0	1	3	0	1	0	1	0	1	0	1	8
16:45	0	6	0	6	1	2	1	4	0	2	1	3	0	2	0	2	15
Total Volume	0	16	2	18	7	4	3	14	0	9	1	10	1	6	0	7	49
% App. Total	0	88.9	11.1		50	28.6	21.4		0	90	10		14.3	85.7	0		
PHF	.000	.667	.250	.750	.875	.500	.750	.875	.000	.450	.250	.500	.250	.750	.000	.875	.817

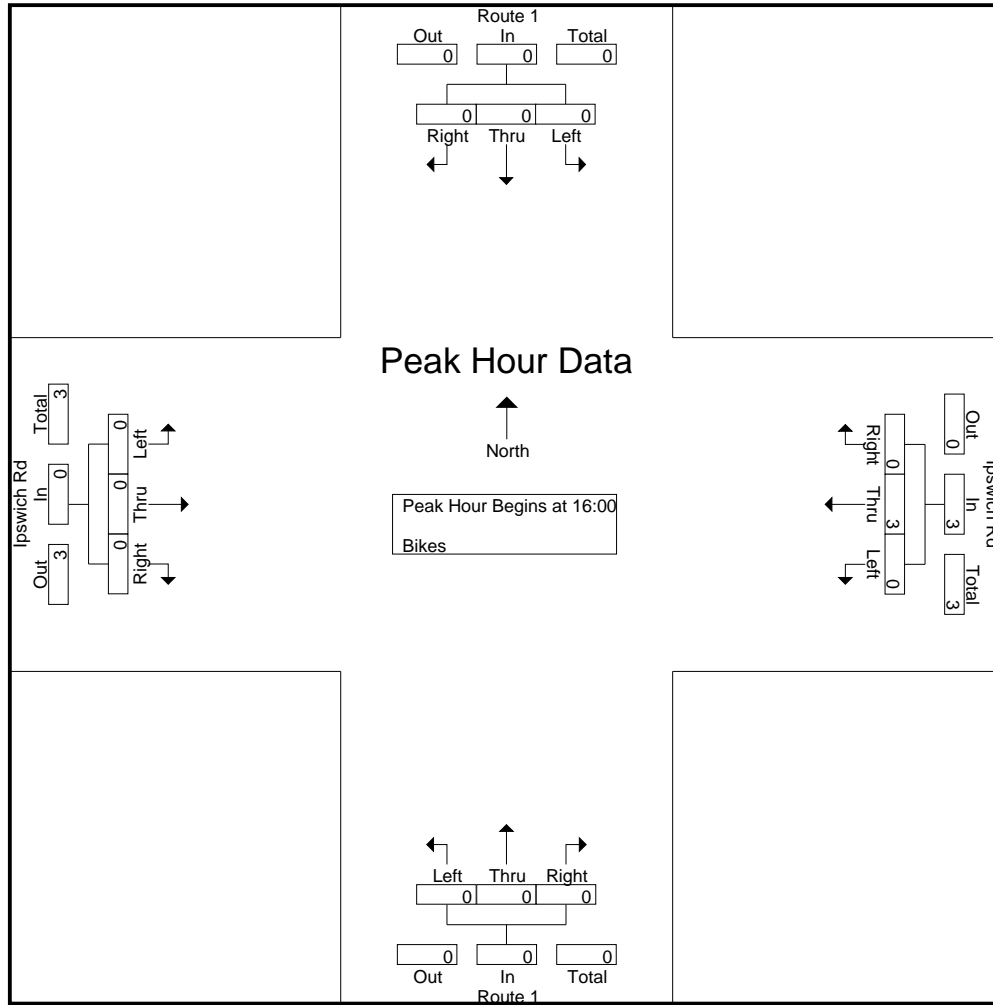


Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	16:00				16:00				16:00				16:00			
+0 mins.	0	5	0	5	2	1	0	3	0	5	0	5	0	2	0	2
+15 mins.	0	2	2	4	2	1	1	4	0	1	0	1	1	1	0	2
+30 mins.	0	3	0	3	2	0	1	3	0	1	0	1	0	1	0	1
+45 mins.	0	6	0	6	1	2	1	4	0	2	1	3	0	2	0	2
Total Volume	0	16	2	18	7	4	3	14	0	9	1	10	1	6	0	7
% App. Total	0	88.9	11.1		50	28.6	21.4		0	90	10		14.3	85.7	0	
PHF	.000	.667	.250	.750	.875	.500	.750	.875	.000	.450	.250	.500	.250	.750	.000	.875

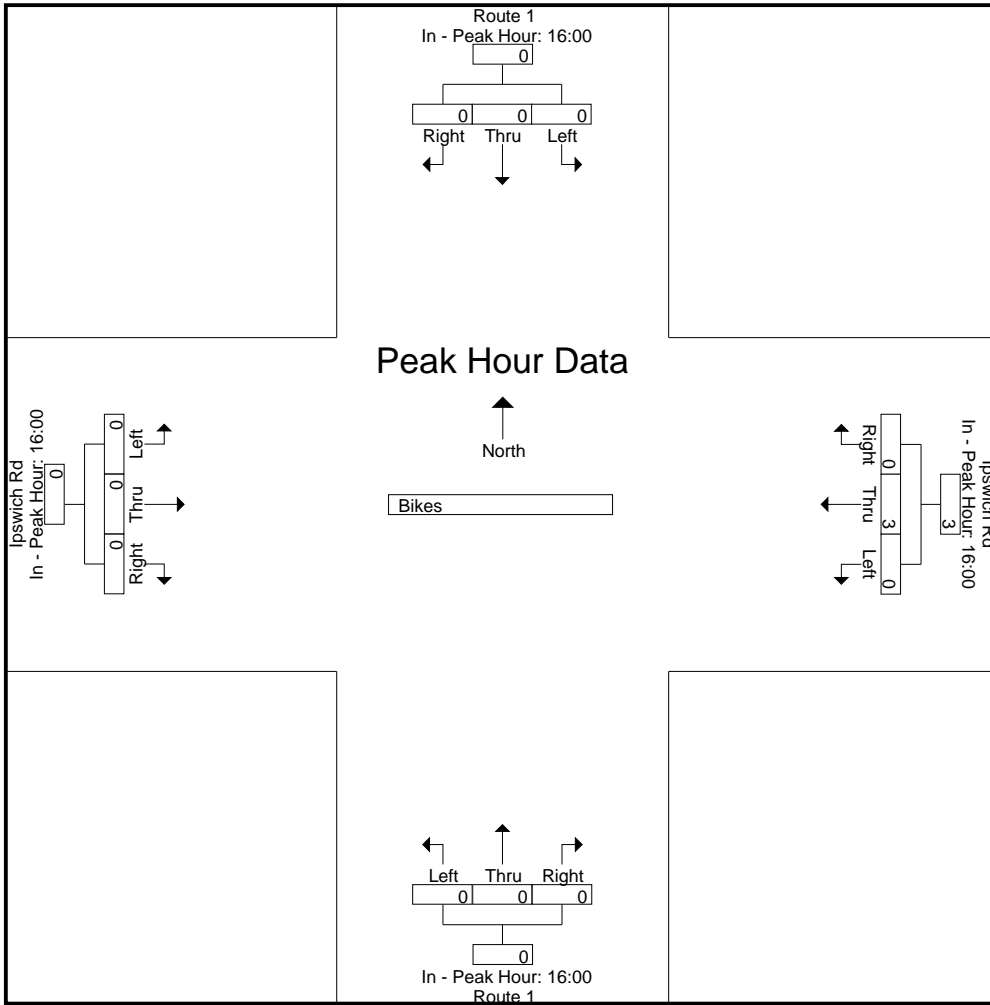






Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	16:00				16:00				16:00				16:00			
+0 mins.	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	100	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.000	.000	.000



Accurate Counts  
978-664-2565

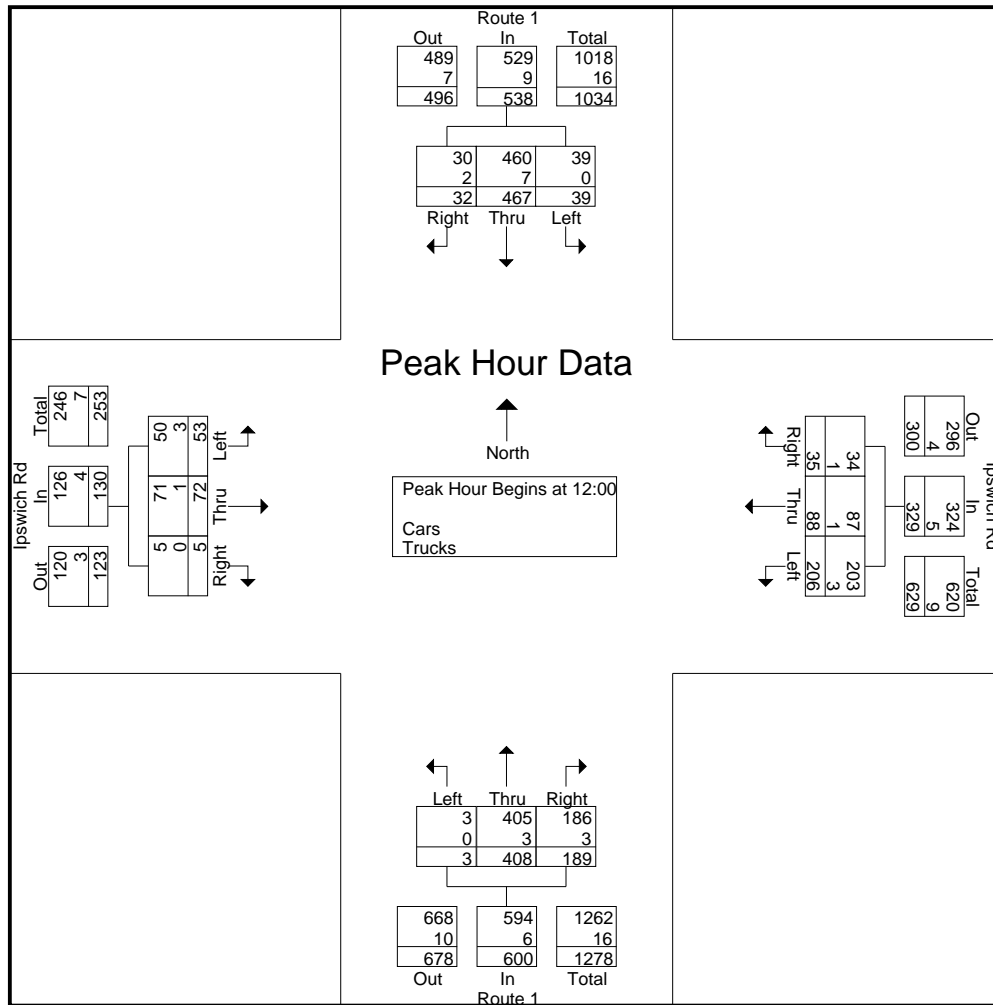
File Name : 100290A1  
Site Code : 10029001  
Start Date : 3/27/2010  
Page No : 1

N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Cars - Trucks

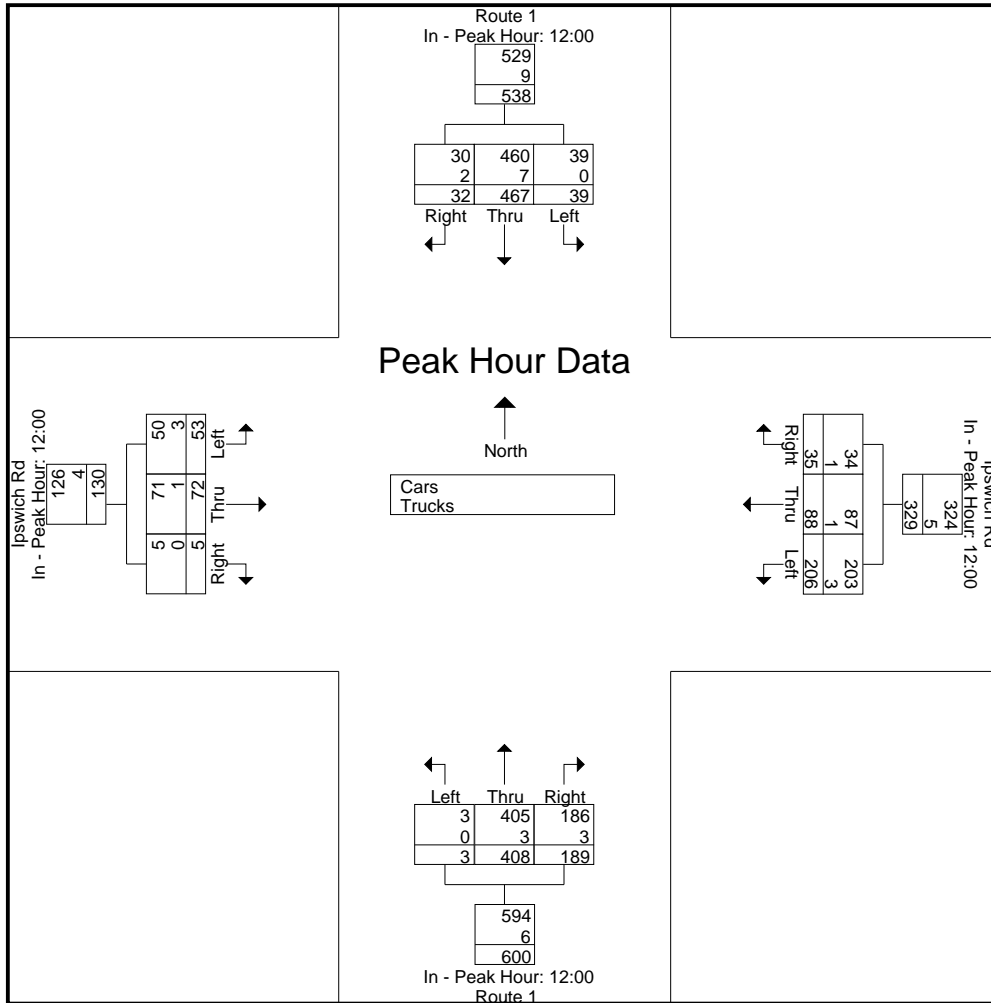
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
11:00	5	84	19	0	62	29	2	0	3	93	32	0	21	22	1	0	0	373	373
11:15	2	101	11	0	41	13	12	0	1	89	33	0	12	18	0	0	0	333	333
11:30	10	91	14	0	44	19	7	0	1	111	44	0	13	9	1	0	0	364	364
11:45	9	90	10	0	38	12	2	0	1	95	37	0	15	15	0	0	0	324	324
Total	26	366	54	0	185	73	23	0	6	388	146	0	61	64	2	0	0	1394	1394
12:00	9	103	10	0	53	23	9	0	0	100	57	0	13	23	0	0	0	400	400
12:15	7	126	8	0	47	26	10	0	1	102	43	0	18	17	0	0	0	405	405
12:30	13	128	8	0	54	15	9	0	1	109	43	0	10	15	2	0	0	407	407
12:45	10	110	6	0	52	24	7	0	1	97	46	0	12	17	3	0	0	385	385
Total	39	467	32	0	206	88	35	0	3	408	189	0	53	72	5	0	0	1597	1597
13:00	5	106	10	0	46	13	5	0	0	90	52	0	14	12	2	0	0	355	355
13:15	7	101	8	0	44	22	8	0	0	105	49	0	10	14	2	0	0	370	370
13:30	8	95	13	0	36	10	5	0	2	96	46	0	16	13	0	0	0	340	340
13:45	5	98	14	0	37	11	8	0	3	92	41	1	16	12	2	0	1	339	340
Total	25	400	45	0	163	56	26	0	5	383	188	1	56	51	6	0	1	1404	1405
Grand Total	90	1233	131	0	554	217	84	0	14	1179	523	1	170	187	13	0	1	4395	4396
Apprch %	6.2	84.8	9		64.8	25.4	9.8		0.8	68.7	30.5		45.9	50.5	3.5				
Total %	2	28.1	3		12.6	4.9	1.9		0.3	26.8	11.9		3.9	4.3	0.3		0	100	
Cars	89	1219	129		548	216	83		14	1166	515		165	184	13		0	0	4342
% Cars	98.9	98.9	98.5	0	98.9	99.5	98.8	0	100	98.9	98.5	100	97.1	98.4	100	0	0	0	98.8
Trucks	1	14	2		6	1	1		0	13	8		5	3	0		0	0	54
% Trucks	1.1	1.1	1.5	0	1.1	0.5	1.2	0	0	1.1	1.5	0	2.9	1.6	0	0	0	0	1.2

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 12:00																	
12:00	9	103	10	122	53	23	9	85	0	100	57	157	13	23	0	36	400
12:15	7	126	8	141	47	26	10	83	1	102	43	146	18	17	0	35	405
12:30	13	128	8	149	54	15	9	78	1	109	43	153	10	15	2	27	407
12:45	10	110	6	126	52	24	7	83	1	97	46	144	12	17	3	32	385
Total Volume	39	467	32	538	206	88	35	329	3	408	189	600	53	72	5	130	1597
% App. Total	7.2	86.8	5.9		62.6	26.7	10.6		0.5	68	31.5		40.8	55.4	3.8		
PHF	.750	.912	.800	.903	.954	.846	.875	.968	.750	.936	.829	.955	.736	.783	.417	.903	.981
Cars	39	460	30	529	203	87	34	324	3	405	186	594	50	71	5	126	1573
% Cars	100	98.5	93.8	98.3	98.5	98.9	97.1	98.5	100	99.3	98.4	99.0	94.3	98.6	100	96.9	98.5
Trucks	0	7	2	9	3	1	1	5	0	3	3	6	3	1	0	4	24
% Trucks	0	1.5	6.3	1.7	1.5	1.1	2.9	1.5	0	0.7	1.6	1.0	5.7	1.4	0	3.1	1.5



Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	12:00				12:00				12:00				12:00			
+0 mins.	9	103	10	122	53	23	9	85	0	100	57	157	13	23	0	36
+15 mins.	7	126	8	141	47	26	10	83	1	102	43	146	18	17	0	35
+30 mins.	13	128	8	149	54	15	9	78	1	109	43	153	10	15	2	27
+45 mins.	10	110	6	126	52	24	7	83	1	97	46	144	12	17	3	32
Total Volume	39	467	32	538	206	88	35	329	3	408	189	600	53	72	5	130
% App. Total	7.2	86.8	5.9		62.6	26.7	10.6		0.5	68	31.5		40.8	55.4	3.8	
PHF	.750	.912	.800	.903	.954	.846	.875	.968	.750	.936	.829	.955	.736	.783	.417	.903
Cars	39	460	30	529	203	87	34	324	3	405	186	594	50	71	5	126
% Cars	100	98.5	93.8	98.3	98.5	98.9	97.1	98.5	100	99.3	98.4	99	94.3	98.6	100	96.9
Trucks	0	7	2	9	3	1	1	5	0	3	3	6	3	1	0	4
% Trucks	0	1.5	6.2	1.7	1.5	1.1	2.9	1.5	0	0.7	1.6	1	5.7	1.4	0	3.1



Accurate Counts  
978-664-2565

File Name : 100290A1  
Site Code : 10029001  
Start Date : 3/27/2010  
Page No : 1

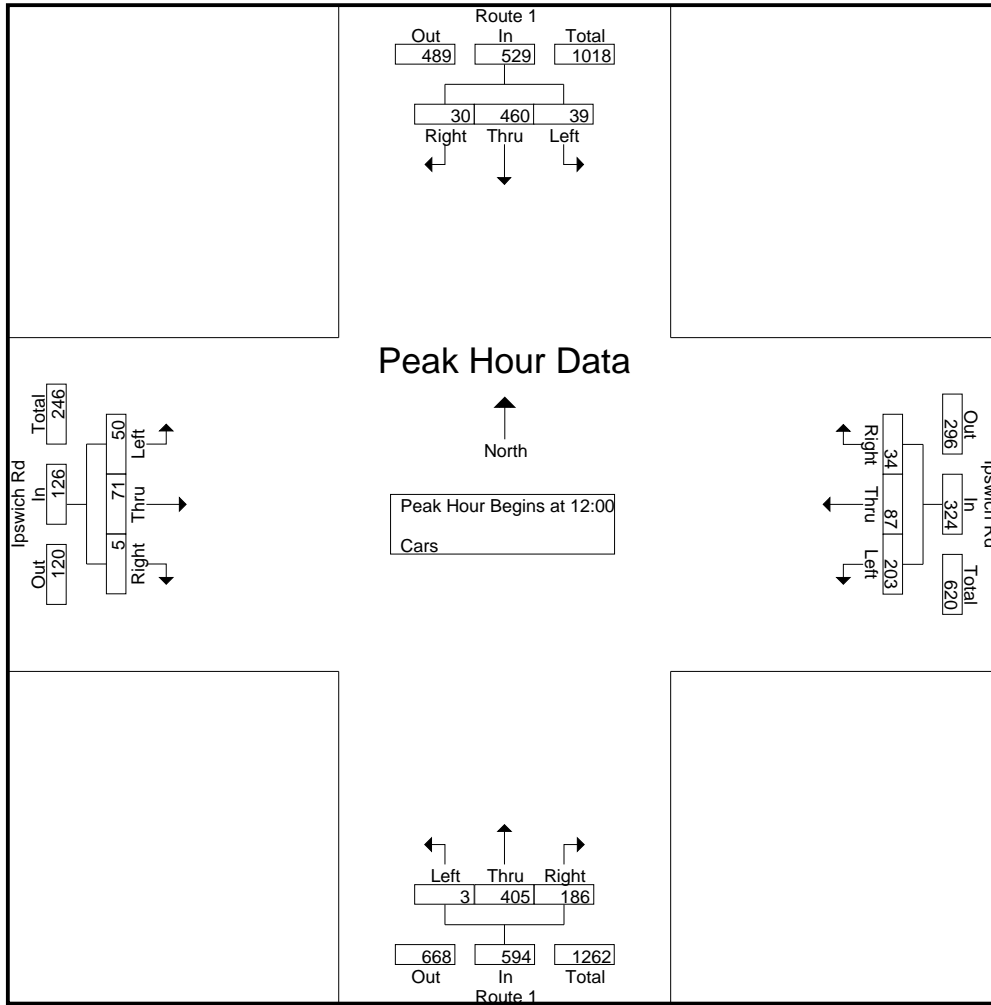
N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Cars

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
11:00	5	83	19	0	61	29	2	0	3	93	32	0	21	22	1	0	0	371	371
11:15	2	101	11	0	41	13	12	0	1	86	32	0	12	18	0	0	0	329	329
11:30	10	90	14	0	43	19	7	0	1	107	44	0	13	9	1	0	0	358	358
11:45	9	89	10	0	38	12	2	0	1	94	36	0	15	15	0	0	0	321	321
Total	26	363	54	0	183	73	23	0	6	380	144	0	61	64	2	0	0	1379	1379
12:00	9	100	10	0	51	22	9	0	0	98	55	0	13	23	0	0	0	390	390
12:15	7	124	7	0	47	26	10	0	1	102	42	0	17	17	0	0	0	400	400
12:30	13	127	7	0	54	15	9	0	1	109	43	0	9	15	2	0	0	404	404
12:45	10	109	6	0	51	24	6	0	1	96	46	0	11	16	3	0	0	379	379
Total	39	460	30	0	203	87	34	0	3	405	186	0	50	71	5	0	0	1573	1573
13:00	5	105	10	0	46	13	5	0	0	90	51	0	14	12	2	0	0	353	353
13:15	7	99	8	0	43	22	8	0	0	105	49	0	10	13	2	0	0	366	366
13:30	7	94	13	0	36	10	5	0	2	94	46	0	15	12	0	0	0	334	334
13:45	5	98	14	0	37	11	8	0	3	92	39	1	15	12	2	0	1	336	337
Total	24	396	45	0	162	56	26	0	5	381	185	1	54	49	6	0	1	1389	1390
Grand Total	89	1219	129	0	548	216	83	0	14	1166	515	1	165	184	13	0	1	4341	4342
Apprch %	6.2	84.8	9		64.7	25.5	9.8		0.8	68.8	30.4		45.6	50.8	3.6				
Total %	2.1	28.1	3		12.6	5	1.9		0.3	26.9	11.9		3.8	4.2	0.3		0	100	

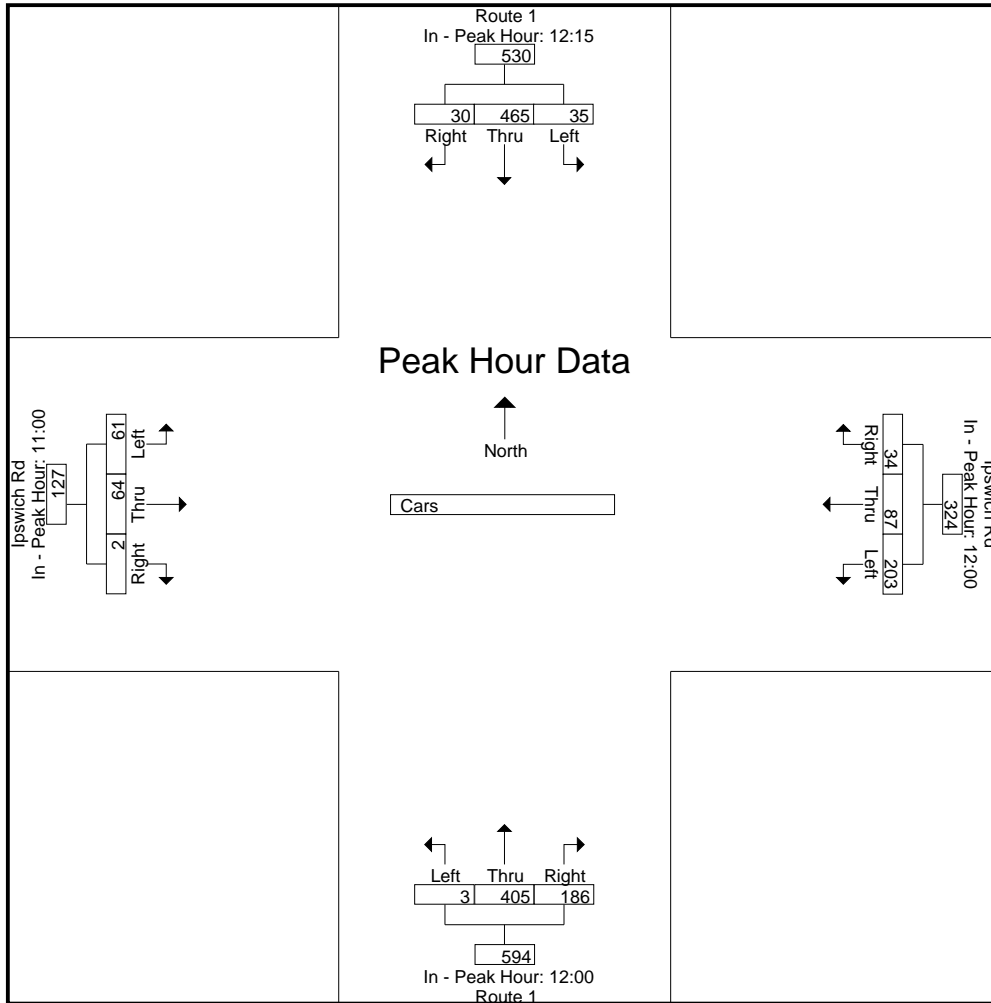
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
12:00	9	100	10	119	51	22	9	82	0	98	55	153	13	23	0	36	390
12:15	7	124	7	138	47	26	10	83	1	102	42	145	17	17	0	34	400
12:30	13	127	7	147	54	15	9	78	1	109	43	153	9	15	2	26	404
12:45	10	109	6	125	51	24	6	81	1	96	46	143	11	16	3	30	379
Total Volume	39	460	30	529	203	87	34	324	3	405	186	594	50	71	5	126	1573
% App. Total	7.4	87	5.7		62.7	26.9	10.5		0.5	68.2	31.3		39.7	56.3	4		
PHF	.750	.906	.750	.900	.940	.837	.850	.976	.750	.929	.845	.971	.735	.772	.417	.875	.973

Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Entire Intersection Begins at 12:00



Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	12:15				12:00				12:00				11:00			
+0 mins.	7	124	7	138	51	22	9	82	0	98	55	153	21	22	1	44
+15 mins.	13	127	7	147	47	26	10	83	1	102	42	145	12	18	0	30
+30 mins.	10	109	6	125	54	15	9	78	1	109	43	153	13	9	1	23
+45 mins.	5	105	10	120	51	24	6	81	1	96	46	143	15	15	0	30
Total Volume	35	465	30	530	203	87	34	324	3	405	186	594	61	64	2	127
% App. Total	6.6	87.7	5.7		62.7	26.9	10.5		0.5	68.2	31.3		48	50.4	1.6	
PHF	.673	.915	.750	.901	.940	.837	.850	.976	.750	.929	.845	.971	.726	.727	.500	.722



Accurate Counts  
978-664-2565

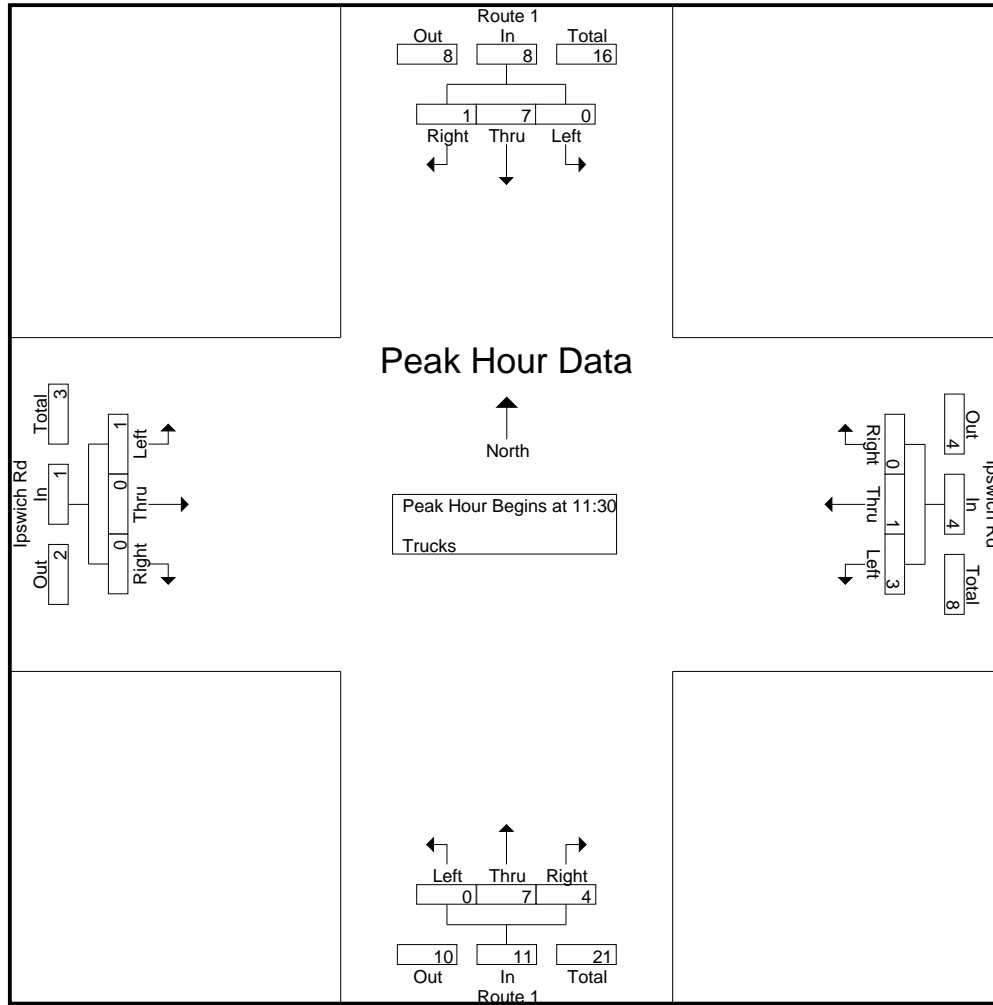
File Name : 100290A1  
Site Code : 10029001  
Start Date : 3/27/2010  
Page No : 1

N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Trucks

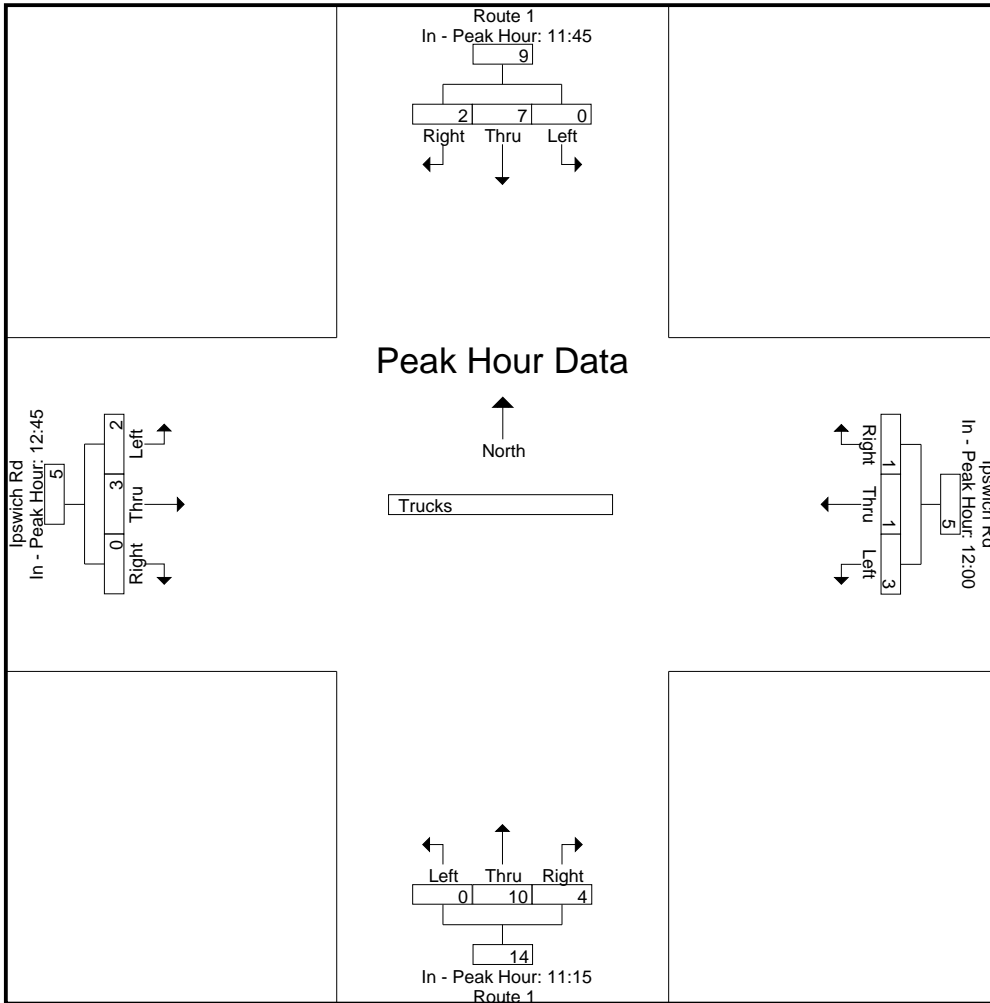
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total	
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds				
11:00	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
11:15	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	4	4
11:30	0	1	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	6	6
11:45	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	3	3
Total	0	3	0	0	2	0	0	0	0	8	2	0	0	0	0	0	0	0	15	15
12:00	0	3	0	0	2	1	0	0	0	2	2	0	0	0	0	0	0	0	10	10
12:15	0	2	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	5	5
12:30	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	3
12:45	0	1	0	0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	6	6
Total	0	7	2	0	3	1	1	0	0	3	3	0	3	1	0	0	0	0	24	24
13:00	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	2
13:15	0	2	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	4	4
13:30	1	1	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	6	6
13:45	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	3	3
Total	1	4	0	0	1	0	0	0	0	2	3	0	2	2	0	0	0	0	15	15
Grand Total	1	14	2	0	6	1	1	0	0	13	8	0	5	3	0	0	0	0	54	54
Apprch %	5.9	82.4	11.8		75	12.5	12.5		0	61.9	38.1		62.5	37.5	0			0		
Total %	1.9	25.9	3.7		11.1	1.9	1.9		0	24.1	14.8		9.3	5.6	0			0	100	

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total	
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total		
Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1																		
Peak Hour for Entire Intersection Begins at 11:30																		
11:30	0	1	0	1	1	0	0	1	0	4	0	4	0	0	0	0	0	6
11:45	0	1	0	1	0	0	0	0	0	1	1	2	0	0	0	0	0	3
12:00	0	3	0	3	2	1	0	3	0	2	2	4	0	0	0	0	0	10
12:15	0	2	1	3	0	0	0	0	0	0	1	1	1	0	0	0	1	5
Total Volume	0	7	1	8	3	1	0	4	0	7	4	11	1	0	0	1	1	24
% App. Total	0	87.5	12.5		75	25	0		0	63.6	36.4		100	0	0			
PHF	.000	.583	.250	.667	.375	.250	.000	.333	.000	.438	.500	.688	.250	.000	.000	.250	.600	



Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	11:45				12:00				11:15				12:45			
+0 mins.	0	1	0	1	2	1	0	3	0	3	1	4	1	1	0	2
+15 mins.	0	3	0	3	0	0	0	0	0	4	0	4	0	0	0	0
+30 mins.	0	2	1	3	0	0	0	0	0	1	1	2	0	1	0	1
+45 mins.	0	1	1	2	1	0	1	2	0	2	2	4	1	1	0	2
Total Volume	0	7	2	9	3	1	1	5	0	10	4	14	2	3	0	5
% App. Total	0	77.8	22.2		60	20	20		0	71.4	28.6		40	60	0	
PHF	.000	.583	.500	.750	.375	.250	.250	.417	.000	.625	.500	.875	.500	.750	.000	.625



Accurate Counts  
978-664-2565

File Name : 100290A1  
Site Code : 10029001  
Start Date : 3/27/2010  
Page No : 1

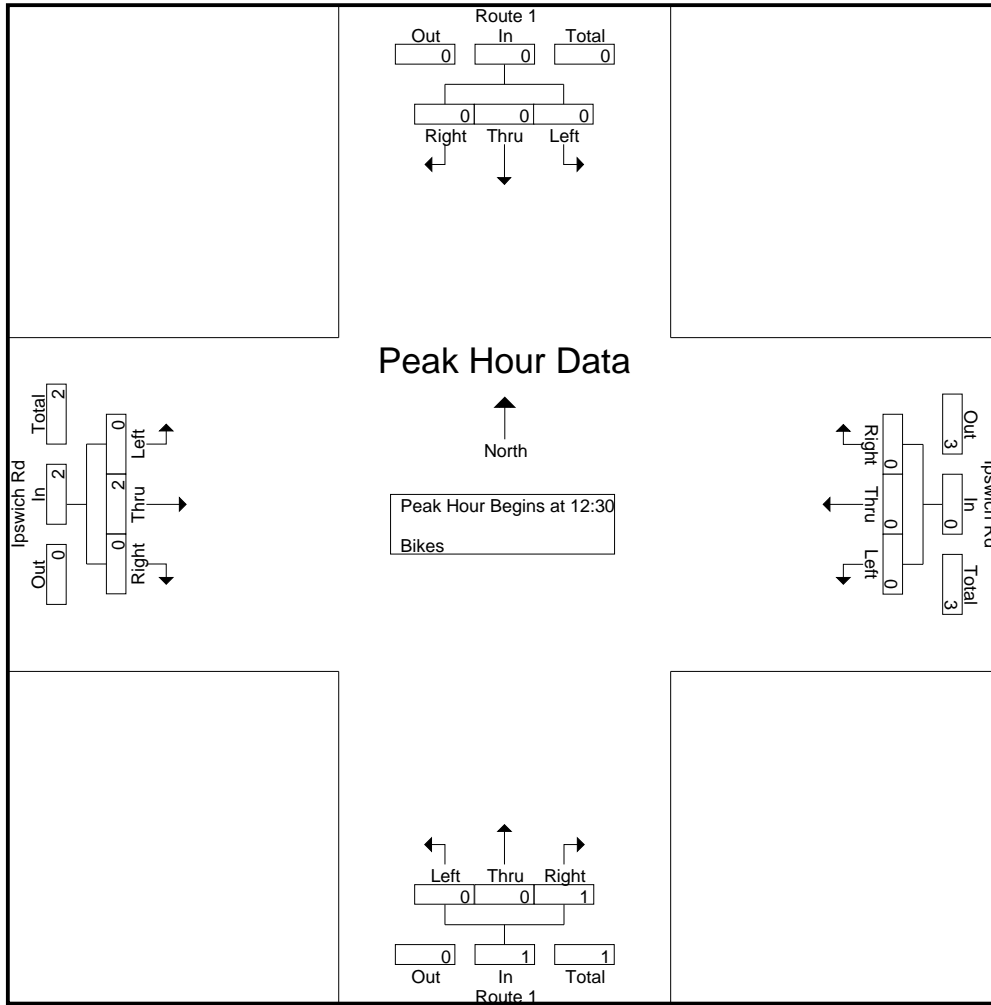
N/S Street : Route 1  
E/W Street: Ipswich Road  
City/State : Topsfield, MA  
Weather : Clear

Groups Printed- Bikes

Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Exclu. Total	Inclu. Total	Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	2
Grand Total	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0	0	0	4	4
Apprch %	0	0	0		0	100	0		0	0	100		0	100	0				
Total %	0	0	0		0	25	0		0	0	25		0	50	0		0	100	

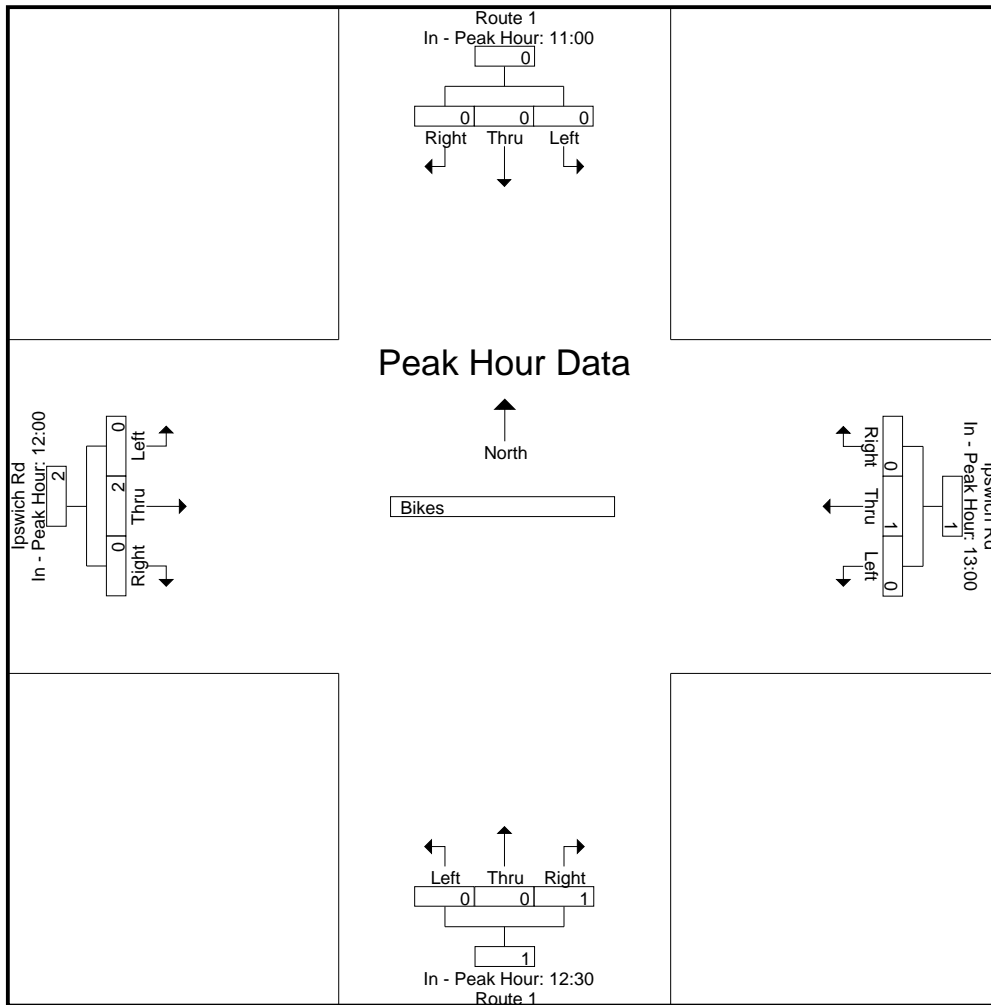
Start Time	Route 1 From North				Ipswich Rd From East				Route 1 From South				Ipswich Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total Volume	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	2	3
% App. Total	0	0	0		0	0	0		0	0	100		0	100	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.000	.500	.000	.500	.750

Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Entire Intersection Begins at 12:30



Peak Hour Analysis From 11:00 to 13:45 - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	11:00				13:00				12:30				12:00			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
+45 mins.	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0	1
Total Volume	0	0	0	0	0	1	0	1	0	0	1	1	0	2	0	2
% App. Total	0	0	0		0	100	0		0	0	100		0	100	0	
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.250	.250	.000	.500	.000	.500



## Appendix B. Trip Generation

---

362 Boston Street

# 362 Boston Street - Topsfield, MA

## Detailed Trip Generation Estimation

Howard/Stein-Hudson Associates, Inc.

April 5, 2010

Component	Size	Category	Trip Rates (Trips/ksf or unit)	Directionality	Unadjusted Vehicle Trips
<b>Daily</b>					
<b>Retail<sup>1</sup></b>	3.15	Total	42.94	1.00	135
	KSF	In	21.47	0.50	68
		Out	21.47	0.50	68
<b>Office<sup>2</sup></b>	3.15	Total	11.01	1.00	35
	KSF	In	5.51	0.50	17
		Out	5.51	0.50	17
<b>Total</b>	Total				170
	In				85
	Out				85
<b>PM Peak Hour</b>					
<b>Retail<sup>1</sup></b>	3.15	Total	3.73	1.00	12
	KSF	In	1.83	0.49	6
		Out	1.90	0.51	6
<b>Office<sup>2</sup></b>	3.15	Total	1.49	1.00	5
	KSF	In	0.25	0.17	1
		Out	1.24	0.83	4
<b>Total</b>	Total				17
	In				7
	Out				10
<b>Saturday Midday Peak Hour</b>					
<b>Retail<sup>1</sup></b>	3.15	Total	4.89	1.00	15
	KSF	In	2.54	0.52	8
		Out	2.35	0.48	7
<b>Office<sup>2</sup></b>	3.15	Total	0.41	1.00	2
	KSF	In	0.34	0.54	1
		Out	0.07	0.46	1
<b>Total</b>	Total				17
	In				9
	Out				8

Notes:

1. ITE Trip Generation Equation, 8th Edition, LUC 820 (Shopping Center), ave rate.

2. ITE Trip Generation Equation, 8th Edition, LUC 710 (General Office Building), ave rate.

## 362 Boston Street - Topsfield, MA

### Traffic Volumes

Howard/Stein-Hudson

3/29/2010

Seasonal Adj.<sup>1</sup> = 

4.0%
------

  
 Growth Rate<sup>2</sup> = 

1.0%
------

#### Trip Generation

Direction	PM	Saturday
IN	7	9
OUT	10	8
<b>TOTAL</b>	<b>17</b>	<b>17</b>

	EXISTING (unadj)	EXISTING (adj)	NO BUILD	BUILD (2015)				
	2010	2010	2015	DIST. IN %	DIST. OUT %	TRIPS IN	TRIPS OUT	VOLUME
<b>Weekday P.M. Peak Hour</b>								
Ipswich Road EB left	59	61	64		0.3	0	3	67
Ipswich Road EB thru	100	104	109		0.2	0	2	111
Ipswich Road EB right	7	7	8		0.4	0	4	12
Ipswich Road WB left	179	186	196			0	0	196
Ipswich Road WB thru	127	132	139	0.2		1	0	140
Ipswich Road WB right	35	36	38			0	0	38
Boston Street NB left	6	6	7	0.4		3	0	10
Boston Street NB thru	528	549	577			0	0	577
Boston Street NB right	301	313	329			0	0	329
Boston Street SB left	37	38	40			0	0	40
Boston Street SB thru	473	492	517			0	0	517
Boston Street SB right	55	57	60	0.3		2	0	62
<b>Saturday Midday Peak Hour</b>								
Ipswich Road EB left	53	55	58		0.3	0	2	60
Ipswich Road EB thru	72	75	79		0.2	0	2	80
Ipswich Road EB right	5	5	5		0.4	0	3	9
Ipswich Road WB left	206	214	225			0	0	225
Ipswich Road WB thru	88	92	96	0.2		2	0	98
Ipswich Road WB right	35	36	38			0	0	38
Boston Street NB left	3	3	3	0.4		4	0	7
Boston Street NB thru	408	424	446			0	0	446
Boston Street NB right	189	197	207			0	0	207
Boston Street SB left	39	41	43			0	0	43
Boston Street SB thru	467	486	510			0	0	510
Boston Street SB right	32	33	35	0.3		3	0	38

#### Notes:

1. Seasonal adjustment factor based on data from MassDOT permanent count station 5128L.
2. Growth rate based on data from MassDOT permanent count station 5128L and 6226.

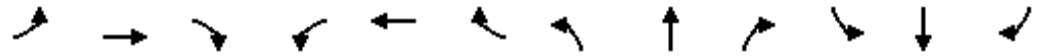
# Appendix C. Synchro Analysis

---

362 Boston Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.983			0.972				0.850		0.984	
Flt Protected	0.950			0.950				0.999			0.996	
Satd. Flow (prot)	1745	1743	0	1770	1738	0	0	1880	1599	0	2000	0
Flt Permitted	0.607			0.438				0.987			0.859	
Satd. Flow (perm)	1115	1743	0	816	1738	0	0	1857	1599	0	1725	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			18				356		14	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3888			1871			3488			1687	
Travel Time (s)		88.4			42.5			79.3			38.3	
Volume (vph)	61	104	7	186	132	36	6	549	313	38	492	57
Peak Hour Factor	0.78	0.81	0.44	0.72	0.66	0.80	0.50	0.89	0.88	0.84	0.96	0.76
Heavy Vehicles (%)	0%	4%	0%	2%	2%	6%	0%	1%	1%	0%	3%	0%
Adj. Flow (vph)	78	128	16	258	200	45	12	617	356	45	512	75
Lane Group Flow (vph)	78	144	0	258	245	0	0	629	356	0	632	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	9.1	9.1		19.5	19.5		26.2	41.8		26.2		
Actuated g/C Ratio	0.16	0.16		0.36	0.36		0.48	0.76		0.48		
v/c Ratio	0.44	0.50		0.56	0.39		0.71	0.27		0.76		
Control Delay	33.3	30.4		19.5	15.1		17.4	0.9		19.4		
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0		
Total Delay	33.3	30.4		19.5	15.1		17.4	0.9		19.4		
LOS	C	C		B	B		B	A		B		
Approach Delay		31.5			17.3			11.5			19.4	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			B			B		
Queue Length 50th (ft)	26	46		63	54			177	0		180	
Queue Length 95th (ft)	60	95		104	83			288	16		309	
Internal Link Dist (ft)	3808			1791			3408			1607		
Turn Bay Length (ft)	40			110			130					
Base Capacity (vph)	216	345		507	775			1055	1311		986	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.36	0.42		0.51	0.32			0.60	0.27		0.64	

**Intersection Summary**

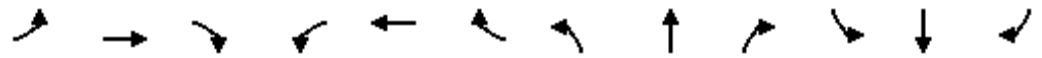
Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	54.7
Natural Cycle:	50
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.76
Intersection Signal Delay:	16.8
Intersection LOS:	B
Intersection Capacity Utilization:	87.2%
ICU Level of Service:	E
Analysis Period (min):	15

**Splits and Phases: 1: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**

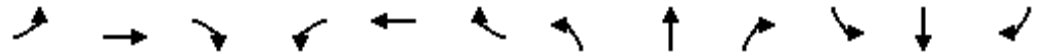


2010 Existing Saturday Midday Peak Hour  
 3: IPSWICH ROAD & BOSTON STREET (ROUTE 1)

362 Boston Street, Topsfield, MA  
 4/5/2010



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.983			0.959				0.850		0.991	
Flt Protected	0.950			0.950							0.996	
Satd. Flow (prot)	1694	1790	0	1752	1744	0	0	1845	1568	0	1945	0
Flt Permitted	0.662			0.504				0.996			0.931	
Satd. Flow (perm)	1180	1790	0	930	1744	0	0	1838	1568	0	1818	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			31				237		7	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3888			1871			3488			1687	
Travel Time (s)		88.4			42.5			79.3			38.3	
Volume (vph)	55	75	5	214	92	36	3	424	197	41	486	33
Peak Hour Factor	0.74	0.78	0.42	0.95	0.85	0.88	0.75	0.94	0.83	0.75	0.91	0.80
Heavy Vehicles (%)	3%	1%	0%	3%	1%	1%	0%	3%	3%	0%	7%	2%
Adj. Flow (vph)	74	96	12	225	108	41	4	451	237	55	534	41
Lane Group Flow (vph)	74	108	0	225	149	0	0	455	237	0	630	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	8.6	8.6		18.6	18.9			30.4	38.2		30.4	
Actuated g/C Ratio	0.16	0.16		0.34	0.34			0.57	0.70		0.57	
v/c Ratio	0.40	0.38		0.51	0.24			0.43	0.20		0.60	
Control Delay	31.2	26.5		17.8	11.8			11.9	0.9		14.7	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	31.2	26.5		17.8	11.8			11.9	0.9		14.7	
LOS	C	C		B	B			B	A		B	
Approach Delay		28.4			15.4			8.1			14.7	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			A			B		
Queue Length 50th (ft)	22	29		48	23			101	0		159	
Queue Length 95th (ft)	54	70		121	66			189	11		296	
Internal Link Dist (ft)	3808			1791			3408			1607		
Turn Bay Length (ft)	40			110						130		
Base Capacity (vph)	232	358		491	762			1161	1149		1150	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.32	0.30		0.46	0.20			0.39	0.21		0.55	

**Intersection Summary**

Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	53.1
Natural Cycle:	50
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.60
Intersection Signal Delay:	13.7
Intersection LOS:	B
Intersection Capacity Utilization:	81.8%
ICU Level of Service:	D
Analysis Period (min):	15

**Splits and Phases: 3: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.972				0.850		0.984	
Flt Protected	0.950			0.950				0.999			0.996	
Satd. Flow (prot)	1745	1742	0	1770	1738	0	0	1880	1599	0	2000	0
Flt Permitted	0.599			0.419				0.984			0.804	
Satd. Flow (perm)	1100	1742	0	780	1738	0	0	1851	1599	0	1614	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			19				359		14	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3888			1871			3488			1687	
Travel Time (s)		88.4			42.5			79.3			38.3	
Volume (vph)	64	109	8	196	139	38	7	577	329	40	517	60
Peak Hour Factor	0.78	0.81	0.44	0.72	0.66	0.80	0.50	0.89	0.88	0.84	0.96	0.76
Heavy Vehicles (%)	0%	4%	0%	2%	2%	6%	0%	1%	1%	0%	3%	0%
Adj. Flow (vph)	82	135	18	272	211	48	14	648	374	48	539	79
Lane Group Flow (vph)	82	153	0	272	259	0	0	662	374	0	666	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	9.4	9.4		20.0	20.0			28.8	44.9		28.8	
Actuated g/C Ratio	0.16	0.16		0.35	0.35			0.50	0.78		0.50	
v/c Ratio	0.47	0.54		0.62	0.42			0.72	0.28		0.82	
Control Delay	36.2	33.1		22.3	16.6			17.7	1.0		23.6	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	36.2	33.1		22.3	16.6			17.7	1.0		23.6	
LOS	D	C		C	B			B	A		C	
Approach Delay		34.2			19.5			11.6			23.6	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			B			C		
Queue Length 50th (ft)	31	56		81	70			201	1		215	
Queue Length 95th (ft)	63	100		110	87			313	17		#415	
Internal Link Dist (ft)	3808			1791			3408			1607		
Turn Bay Length (ft)	40			110			130					
Base Capacity (vph)	204	329		485	744			1043	1323		916	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.40	0.47		0.56	0.35			0.63	0.28		0.73	

**Intersection Summary**

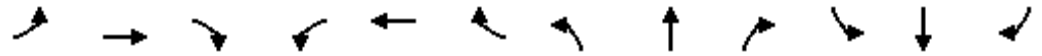
Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 57.9  
 Natural Cycle: 60  
 Control Type: Actuated-Uncoordinated  
 Maximum v/c Ratio: 0.82  
 Intersection Signal Delay: 18.7      Intersection LOS: B  
 Intersection Capacity Utilization 91.2%      ICU Level of Service F  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

**Splits and Phases: 1: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.984			0.959				0.850		0.991	
Flt Protected	0.950			0.950							0.996	
Satd. Flow (prot)	1694	1791	0	1752	1744	0	0	1845	1568	0	1945	0
Flt Permitted	0.658			0.502				0.996			0.929	
Satd. Flow (perm)	1173	1791	0	926	1744	0	0	1838	1568	0	1814	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			31				249		8	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3888			1871			3488			1687	
Travel Time (s)		88.4			42.5			79.3			38.3	
Volume (vph)	58	79	5	225	96	38	3	446	207	43	510	35
Peak Hour Factor	0.74	0.78	0.42	0.95	0.85	0.88	0.75	0.94	0.83	0.75	0.91	0.80
Heavy Vehicles (%)	3%	1%	0%	3%	1%	1%	0%	3%	3%	0%	7%	2%
Adj. Flow (vph)	78	101	12	237	113	43	4	474	249	57	560	44
Lane Group Flow (vph)	78	113	0	237	156	0	0	478	249	0	661	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	8.7	8.7		19.0	19.0			27.2	42.0		27.2	
Actuated g/C Ratio	0.15	0.15		0.35	0.35			0.50	0.77		0.50	
v/c Ratio	0.43	0.40		0.52	0.25			0.52	0.20		0.73	
Control Delay	32.9	27.9		18.4	12.3			13.2	0.8		17.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	32.9	27.9		18.4	12.3			13.2	0.8		17.9	
LOS	C	C		B	B			B	A		B	
Approach Delay		30.0			16.0			9.0			17.9	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			A			B		
Queue Length 50th (ft)	25	33		55	27			113	0		179	
Queue Length 95th (ft)	56	73		127	69			202	11		320	
Internal Link Dist (ft)	3808			1791			3408			1607		
Turn Bay Length (ft)	40			110			130					
Base Capacity (vph)	224	347		502	771			1053	1266		1043	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.35	0.33		0.47	0.20			0.45	0.20		0.63	

**Intersection Summary**

Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	54.9
Natural Cycle:	55
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.73
Intersection Signal Delay:	15.4
Intersection LOS:	B
Intersection Capacity Utilization:	85.2%
ICU Level of Service:	E
Analysis Period (min):	15

**Splits and Phases: 3: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.975			0.972				0.850		0.983	
Flt Protected	0.950			0.950				0.999			0.996	
Satd. Flow (prot)	1745	1733	0	1770	1738	0	0	1880	1599	0	1998	0
Flt Permitted	0.599			0.396				0.974			0.797	
Satd. Flow (perm)	1100	1733	0	738	1738	0	0	1833	1599	0	1599	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		12			19				352		15	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		167			1871			3488			1687	
Travel Time (s)		3.8			42.5			79.3			38.3	
Volume (vph)	67	111	12	196	140	38	10	577	329	40	517	62
Peak Hour Factor	0.78	0.81	0.44	0.72	0.66	0.80	0.50	0.89	0.88	0.84	0.96	0.76
Heavy Vehicles (%)	0%	4%	0%	2%	2%	6%	0%	1%	1%	0%	3%	0%
Adj. Flow (vph)	86	137	27	272	212	48	20	648	374	48	539	82
Lane Group Flow (vph)	86	164	0	272	260	0	0	668	374	0	669	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	9.5	9.5		20.2	20.2			29.2	45.3		29.2	
Actuated g/C Ratio	0.16	0.16		0.35	0.35			0.50	0.78		0.50	
v/c Ratio	0.50	0.58		0.63	0.42			0.73	0.28		0.83	
Control Delay	37.2	33.8		22.9	16.7			18.1	1.1		24.3	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	37.2	33.8		22.9	16.7			18.1	1.1		24.3	
LOS	D	C		C	B			B	A		C	
Approach Delay		35.0			19.9			12.0			24.3	



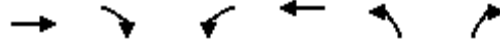
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			B			C		
Queue Length 50th (ft)	34	60		83	72			204	2		218	
Queue Length 95th (ft)	65	104		110	88			320	18		#422	
Internal Link Dist (ft)		87			1791			3408			1607	
Turn Bay Length (ft)	40			110					130			
Base Capacity (vph)	203	329		476	740			1031	1323		906	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.42	0.50		0.57	0.35			0.65	0.28		0.74	

**Intersection Summary**

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 58.4  
 Natural Cycle: 60  
 Control Type: Actuated-Uncoordinated  
 Maximum v/c Ratio: 0.83  
 Intersection Signal Delay: 19.3      Intersection LOS: B  
 Intersection Capacity Utilization 91.7%      ICU Level of Service F  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

**Splits and Phases: 1: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**

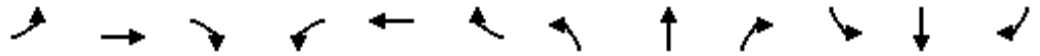




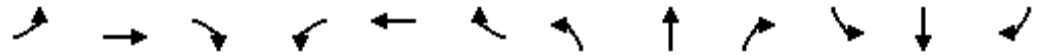
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	181	1	6	205	1	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	197	1	7	223	1	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)				167		
pX, platoon unblocked					0.99	
vC, conflicting volume			198		433	197
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			198		428	197
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			1375		576	844

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	198	229	11
Volume Left	0	7	1
Volume Right	1	0	10
cSH	1700	1375	806
Volume to Capacity	0.12	0.00	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.0	0.3	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	0.3	9.5
Approach LOS			A

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization	25.6%	ICU Level of Service	A
Analysis Period (min)		15	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	11	12	12	12	12	12	15	12
Storage Length (ft)	40		0	110		0	0		130	0		0
Storage Lanes	1		0	1		0	0		1	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.975			0.959				0.850		0.991	
Flt Protected	0.950			0.950				0.999			0.996	
Satd. Flow (prot)	1694	1776	0	1752	1744	0	0	1844	1568	0	1945	0
Flt Permitted	0.657			0.480				0.988			0.928	
Satd. Flow (perm)	1172	1776	0	885	1744	0	0	1824	1568	0	1812	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		12			31				249		8	
Headway Factor	1.04	1.04	1.00	1.00	1.04	1.00	1.00	1.00	1.00	1.00	0.88	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		169			1871			3488			1687	
Travel Time (s)		3.8			42.5			79.3			38.3	
Volume (vph)	60	80	9	225	98	38	7	446	207	43	510	35
Peak Hour Factor	0.74	0.78	0.42	0.95	0.85	0.88	0.75	0.94	0.83	0.75	0.91	0.80
Heavy Vehicles (%)	3%	1%	0%	3%	1%	1%	0%	3%	3%	0%	7%	2%
Adj. Flow (vph)	81	103	21	237	115	43	9	474	249	57	560	44
Lane Group Flow (vph)	81	124	0	237	158	0	0	483	249	0	661	0
Turn Type	Perm			pm+pt			Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Detector Phases	4	4		3	8		2	2	3	6	6	
Minimum Initial (s)	5.0	5.0		5.0	5.0		12.0	12.0	5.0	12.0	12.0	
Minimum Split (s)	10.0	10.0		10.0	10.0		18.0	18.0	10.0	18.0	18.0	
Total Split (s)	15.0	15.0	0.0	15.0	30.0	0.0	40.0	40.0	15.0	40.0	40.0	0.0
Total Split (%)	21.4%	21.4%	0.0%	21.4%	42.9%	0.0%	57.1%	57.1%	21.4%	57.1%	57.1%	0.0%
Maximum Green (s)	10.0	10.0		11.0	25.0		34.0	34.0	11.0	34.0	34.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		4.0	4.0	3.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	2.0	2.0	
Lead/Lag	Lag	Lag		Lead					Lead			
Lead-Lag Optimize?	Yes	Yes		Yes					Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Recall Mode	None	None		None	None		Min	Min	None	Min	Min	
Act Effct Green (s)	8.8	8.8		19.1	19.1			27.2	42.0		27.2	
Actuated g/C Ratio	0.15	0.15		0.35	0.35			0.50	0.77		0.50	
v/c Ratio	0.45	0.44		0.53	0.25			0.53	0.20		0.73	
Control Delay	33.4	27.8		18.6	12.3			13.4	0.9		18.0	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay	33.4	27.8		18.6	12.3			13.4	0.9		18.0	
LOS	C	C		B	B			B	A		B	
Approach Delay		30.0			16.1			9.1			18.0	



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	C			B			A			B		
Queue Length 50th (ft)	26	36		55	27			116	0		180	
Queue Length 95th (ft)	58	77		127	70			205	11		320	
Internal Link Dist (ft)		89			1791			3408			1607	
Turn Bay Length (ft)	40			110					130			
Base Capacity (vph)	224	348		496	770			1044	1265		1041	
Starvation Cap Reductn	0	0		0	0			0	0		0	
Spillback Cap Reductn	0	0		0	0			0	0		0	
Storage Cap Reductn	0	0		0	0			0	0		0	
Reduced v/c Ratio	0.36	0.36		0.48	0.21			0.46	0.20		0.63	

**Intersection Summary**

Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	54.9
Natural Cycle:	60
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.73
Intersection Signal Delay:	15.6
Intersection LOS:	B
Intersection Capacity Utilization:	85.8%
ICU Level of Service:	E
Analysis Period (min):	15

**Splits and Phases: 3: IPSWICH ROAD & BOSTON STREET (ROUTE 1)**





Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	181	1	6	205	1	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	197	1	7	223	1	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)				167		
pX, platoon unblocked					0.99	
vC, conflicting volume			198		433	197
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			198		428	197
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			1375		576	844

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	198	229	11
Volume Left	0	7	1
Volume Right	1	0	10
cSH	1700	1375	806
Volume to Capacity	0.12	0.00	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.0	0.3	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	0.3	9.5
Approach LOS			A

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization	25.6%	ICU Level of Service	A
Analysis Period (min)		15	

CREATIVE SOLUTIONS  
EFFECTIVE PARTNERING®

38 Chauncy Street  
Boston, MA 02111  
t 617.482.7080  
f 617.482.7417

[www.hshassoc.com](http://www.hshassoc.com)