TECHNICAL MEMORANDUM

Bruce Freeman Rail Trail – Phase 2C
Main Street (Route 62) at Commonwealth Avenue
Intersection Improvements

Concord, Massachusetts

MassDOT Project Number: 605189

Prepared for:

Massachusetts Department of Transportation
Ten Park Plaza
Boston, Massachusetts

June 2015

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INTRODUCTION

This memorandum presents a functional design of geometric, traffic control and safety improvements for the intersection of Main Street (Route 62) at Commonwealth Avenue in Concord, Massachusetts. The improvements to this intersection will be done along with the construction of the Bruce Freeman Rail Trail (BFRT) through Concord. The BFRT crossing of Main Street (Route 62) will be improved greatly by the realignment of the intersection.

Main Street (Route 62) is functionally classified as an 'Urban Principal Arterial' and Commonwealth Avenue is classified as an 'Urban Collector.' Both roads are under local (Town of Concord) jurisdiction.

The implementation of the proposed design for the intersection will require, but is not limited to: cold planing and a pavement overlay; full depth reconstruction, as necessary; the realignment of the intersection; the installation of new vertical granite curb; the installation of new handicap accessible wheelchair ramps; sidewalk installation or reconstruction; the installation of a new traffic signal; the demolition and reconstruction of the existing traffic signal; the retiming of an existing traffic signal; and new or improved signing and pavement markings.

EXISTING CONDITIONS

GEOMETRICS AND TRAFFIC CONTROL

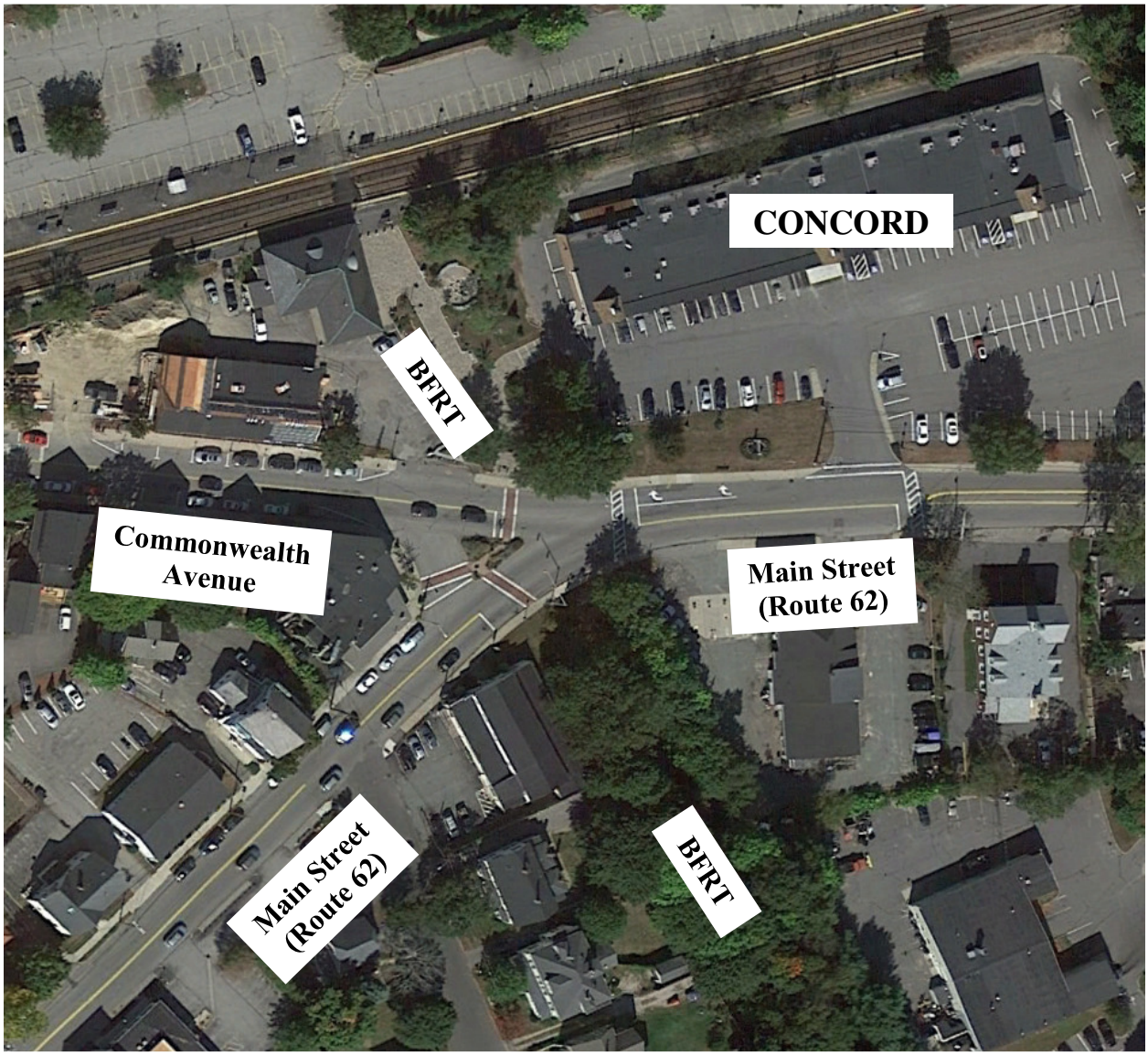
Main Street (Route 62) at Commonwealth Avenue is a signalized 3-way intersection with Main Street running northeast and west and Commonwealth Avenue heading east. The intersection is Y shaped , . Commonwealth Avenue has a channelized right turn under stop control with no storage, and a channelizing island that serves as a pedestrian refuge. There is also a long crosswalk (42') across the westbound approach, due to the geometry of the intersection, as well as shorter crosswalks to the refuge island from all three sides of the intersection.

The Main Street northeast bound approach has a 16 foot thru lane with no shoulder. No left turns from this approach are permitted. The Main Street westbound approach has an 11 foot thru lane and an approximately 11 foot right turn lane with no shoulder. The right turn lane is marked with a 60 foot white lane line, but there is no taper to differentiate the start of the right turn lane from the thru lane. Main Street leading up to the right turn lane leads directly into the right turn lane. The Commonwealth Avenue eastbound approach has a 10 foot thru lane with 7.5 Foot parking leading up to the intersection, with a 16 foot thru lane with no shoulder directly at the stop line. The channelized right turn lane is approximately 32 feet wide and has a crosswalk across it that is behind the stop bar. This is not a safe location for the crosswalk. There is also a driveway to a parking lot on the north side of Commonwealth Avenue that is very close to the intersection.

This intersection is controlled by a fully actuated coordinated traffic signal. Main Street has a posted speed limit of 25MPH, and Commonwealth Avenue has a posted speed limit of 20MPH. The land use near the intersection is all commercial. The 99 Restaurant is on the east corner of the intersection, Junction Park is to the north and Wave Gas Station and Top Cleaners are to the south of the intersection.

The intersection is shown on the map on Figure 1.

Figure 1


CONCORD
BFRT
Commonwealth Avenue
Main Street (Route 62)
Main Street (Route 62)
BFRT

TRAFFIC VOLUMES

Existing traffic conditions within the study area were developed by obtaining Automatic Traffic Recorder (ATR) counts and conducting manual-turning movement counts (TMCs) in March 2013. The raw count data information is included in the Appendix. The ATR count was conducted on Main Street (Route 62) east of Pine Street, and the TMC was conducted at the intersection of Main Street (Route 62) and Commonwealth Avenue. The TMCs were performed during the weekday AM peak period (7:00 to 9:00 AM) and the weekday PM peak period (4:00 to 6:00 PM).

Traffic on a given roadway typically fluctuates throughout the year depending on the area and the type of roadway. To determine if the data required adjustment to account for this fluctuation, Massachusetts Department of Transportation (MassDOT) seasonal adjustment factors were reviewed. Based on the Monthly Average Daily Traffic and MassDOT Seasonal Adjustment Factors, March volumes are expected to be approximately 1 percent lower than average-month conditions. Therefore, the March 2013 volumes were adjusted by 1 percent to reflect average-month conditions. The MassDOT seasonal adjustment data are provided in the Appendix.

Figure 2 graphically depicts the 2013 Base Year weekday AM and weekday PM peak-hour traffic conditions. Table 1 summarizes the 2013 Base Year daily and peak-hour traffic volumes for Main Street.

Table 1
BASE YEAR TRAFFIC-VOLUME SUMMARY

Location/Time Period	Daily Volume (vpd) [a]	Peak Hour Volume (vph) [b]	K Factor (%) [c]	Directional Distribution [d]
Main St (Route 62)				
East of Pine St:	10,379			
Weekday AM Peak Hour	--	796	7.7	69% EB
Weekday PM Peak Hour	--	782	7.5	62% WB

[a] March 2013 traffic volumes in vehicles per day.
[b] In vehicles per hour.
[c] Percentage of daily traffic occurring during the peak hour.
[d] SB = southbound, NB = northbound, EB = eastbound, WB = westbound.

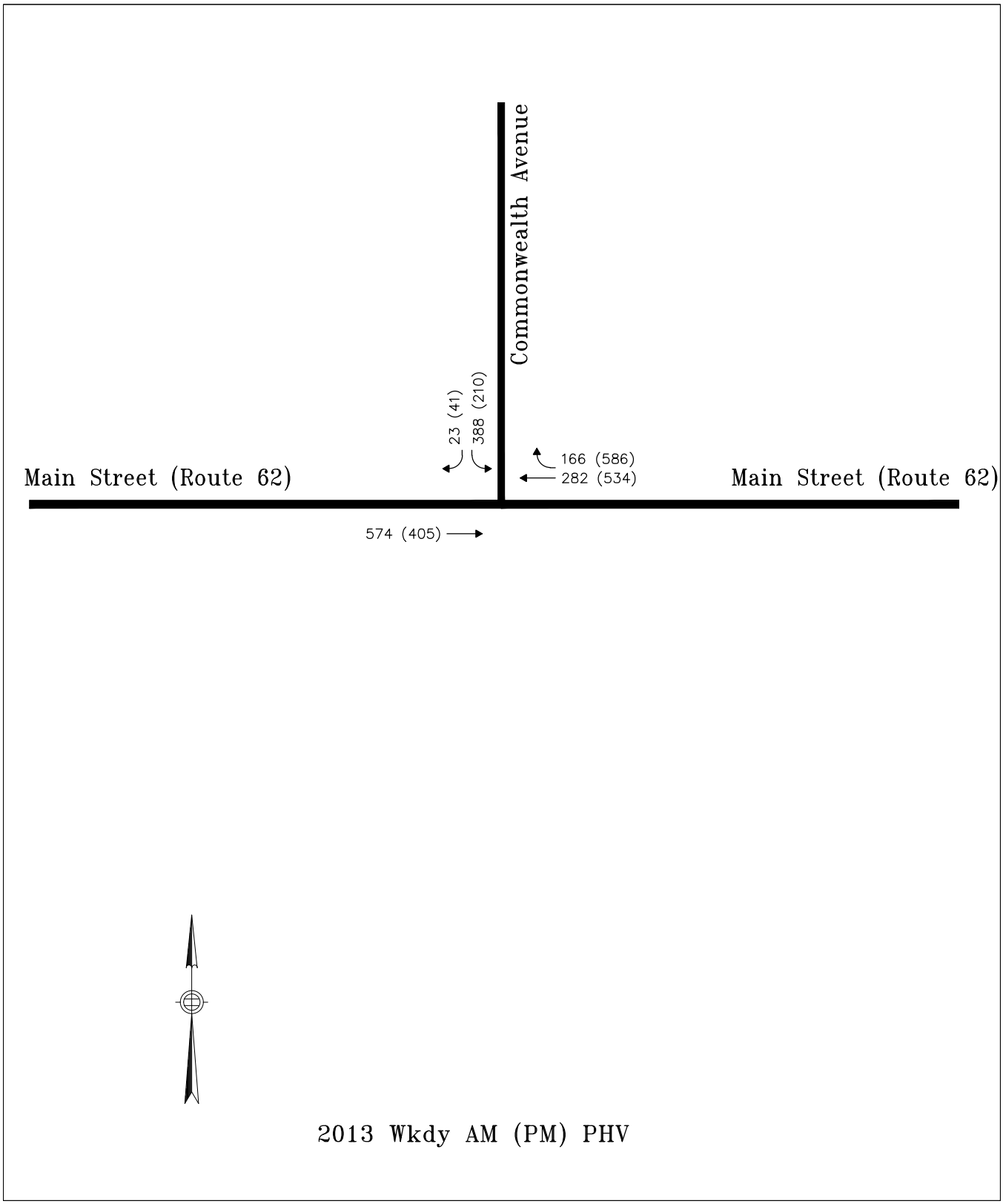


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Figure 2

2013 Peak Hour Volumes
Not To Scale

COLLISION HISTORY

Collision data have been researched from MassDOT crash data for the latest available three-year period (2012-2014). While the number of incidents is important, the crash rate is more significant as it accounts for different volumes through an intersection. Accordingly, the crash rate was calculated for the study area intersections where volumes were counted and compared with the statewide and district-wide averages. An intersection crash rate is a measure of the frequency of accidents compared to the volume of traffic through an intersection and is presented in crashes per million entering vehicles (c/mev).

For signalized intersections, the statewide average is 0.80 c/mev and the district-wide (MassDOT District 4) average is 0.77 c/mev. A comparison of the calculated crash rate to these averages can be used to establish the significance of incident occurrence and whether or not potential safety problems exist. Table 2 illustrates the results of the collision analysis.

The intersection of Main Street (Route 62) at Commonwealth Avenue has experienced 6 collisions over a three year period from 2012 to 2014 (a 2 per year average). According to the collision data, 67 percent of the reported crashes occurred during the peak hours and only one of the crashes occurred during wet conditions. Two (2) of the crashes were of the cross movement type and 2 were rear end crashes. Cross movement and rear end crashes account for 67 percent of the crashes at this intersection. This is most likely due to the signal operation and high volume of traffic. None of the crashes involved personal injury. The calculated crash rate for the intersection is 0.24 c/mev, which is significantly lower than the district-wide and statewide averages for signalized intersections. The MassDOT Crash Rate Worksheet is provided in the Appendix for all locations.

Table 2
ACCIDENT HISTORY

	Number of Accidents		Severity [a]			Accident Type [b]						Percent During	
Location (crash rate)	Total	Average per Year	PD	PI	F	CM	RE	HO	FO	SS	NR	Peak Hours	Wet/Icy Conditions
Concord Main Street (Route 62) at Comm. Ave **(0.24 acc/mev*)**	6	2	6	0	0	2	2	0	1	1	0	67%	17%

Source: Concord Police Department.
* acc/mev = accidents per million entering vehicles
[a]PD = property damage only; PI = personal injury; F = fatality;
[b]CM = cross movement/angle; RE = rear end; HO = head on;
FO = fixed object; SS = sideswipe; NR=not reported

DESIGN YEAR CONDITIONS

TRAFFIC GROWTH

The design for improvements at the intersection of Main Street (Route 62) at Commonwealth Avenue is based on traffic-volume conditions projected to a future design year. A 10-year projection was utilized for this project. This design horizon was selected to ensure that the recommended improvements would be practical in the future.

To develop the 2023 Design Year traffic volumes, two components of traffic growth were considered. First, an annual average traffic-growth percentage was determined. Historical traffic-volume data collected by MassDOT in the Town of Concord, Acton, Bedford, Lincoln, Maynard and Sudbury indicate that, on average, traffic volumes in the vicinity of the project have generally remained the same with a slight decrease in annual traffic of approximately 0.7 percent since 2000.[1] A 1 percent annual traffic-growth rate was used in order to be conservative. This 1 percent compounded annual traffic-growth rate was assumed to account for general population growth and the traffic generated by smaller area developments. The MassDOT historical traffic-volume data are provided in the Appendix.

The traffic-growth rate was compounded annually for the 10-year design year horizon and applied to the base year 2013 traffic volumes. The 2023 Design Year traffic volumes are shown on Figure 3 for the weekday AM and weekday PM peak hours.

[1] *MassDOT Traffic Volume Counts; 2009 Report.*

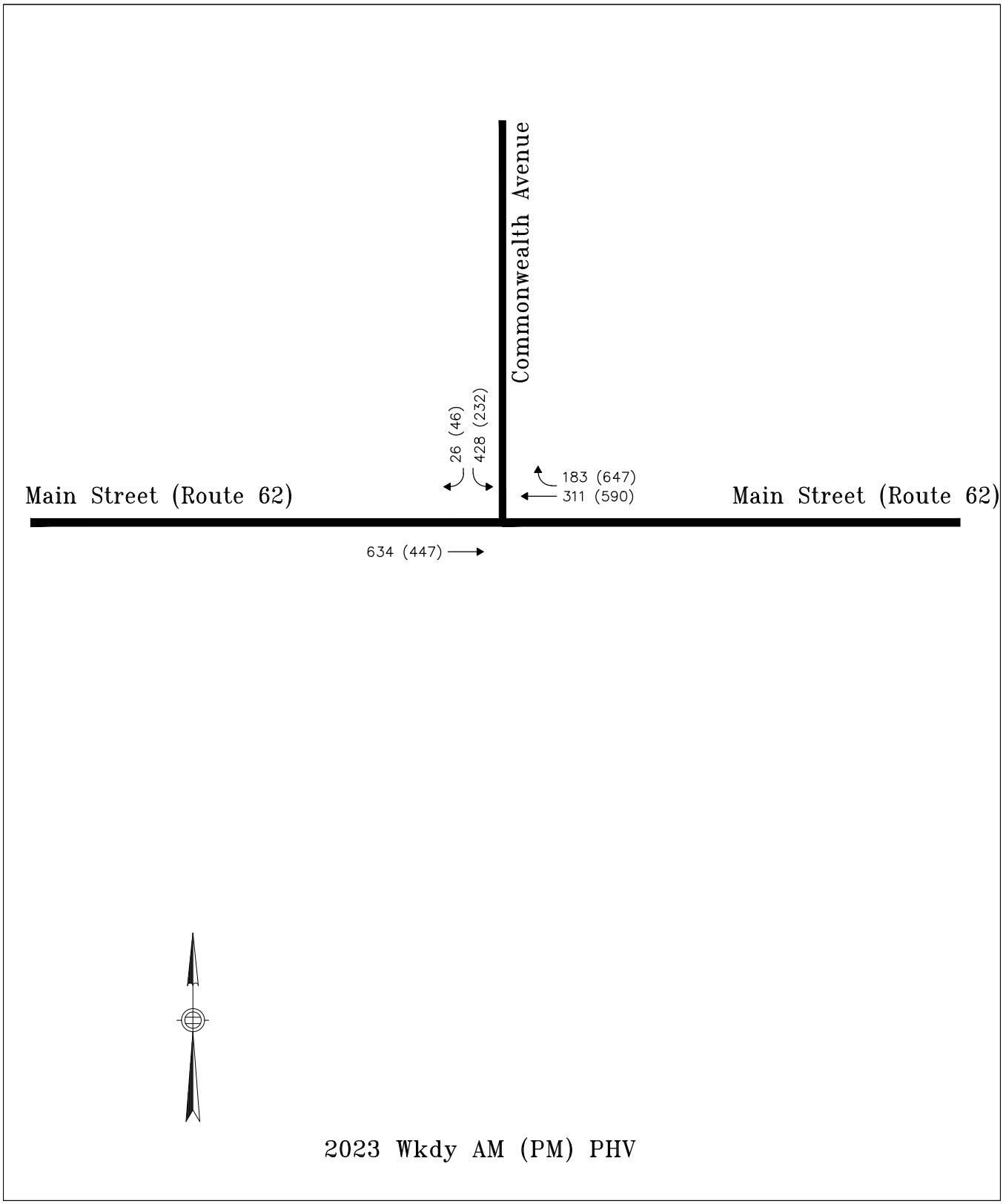

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Figure 3

2023 Peak Hour Volumes
Not To Scale

PROPOSED ROADWAY IMPROVEMENTS

Geometric and safety deficiencies exist at the intersection of Main Street (Route62) and Commonwealth Avenue without implementation of roadway improvements. The improvements proposed at the intersection are described below and are shown on the design plans accompanying this report. Traffic operations, right-of-way impacts, construction costs, environmental impacts, and safety concerns all were factors for choosing the current configuration of intersection improvements.

INTERSECTION/PROJECT IMPROVEMENTS

The implementation of the proposed design will require, but is not limited to: cold planing and pavement overlay; full depth reconstruction, as necessary; the installation of new or resetting of granite curb; the installation of new handicap accessible wheelchair ramps; sidewalk installation or reconstruction; the upgrading of the traffic signal with all new equipment; the installation of new loop detectors; the installation of new drainage facilities, as necessary; and new or improved signing and pavement markings.

The existing granite curbing will be removed and reset (where appropriate) and new vertical granite curbing will be installed as necessary. Signs and other roadside objects will be provided, relocated, or replaced where necessary to meet current standards. The travel lanes will be defined with widths of 11-feet wide (10-feet for the exclusive right-turn lane) and 5 foot shoulders will be provided. The proposed shoulder widths are acceptable to accommodate bicycle traffic as part of the intersection re-design. Wheelchair ramps conforming to American with Disabilities Act (ADA) and Massachusetts Architectural Access Board (MAAB) requirements and the latest MassDOT directives will be constructed at all roadway crossings near the intersection with crosswalks at designated areas as shown on the design plans.

New traffic signal equipment is proposed for the intersection to replace existing antiquated equipment. The signal timings will be optimized to provide traffic progression through the Route 62 corridor minimizing vehicle stops, delays, and queues.

The intersection geometry will be realigned in order to provide a shorter crosswalk distance for pedestrians. The intersection realignment is especially important since the Bruce Freeman Rail Trail will be crossing Route 62 through this intersection. The realignment will also increase safety at the intersection by forcing westbound right turning vehicles to slow down in order to turn. As it is existing, the right turning vehicles do not have to slow down to make the turn, and subsequently enter Commonwealth Avenue at higher than desired speeds. This is especially dangerous since Commonwealth Avenue has parking on both sides of the road and only 10 foot travel lanes. The realignment will also more clearly define the direction of Route 62, as well as affording Junction Park more park area while reducing the amount of pavement at the intersection.

CAPACITY AND QUEUE ANALYSIS

CAPACITY AND QUEUE LENGTH ANALYSIS METHODOLOGY

Capacity Analysis Methodology

A primary result of capacity analysis is the assignment of levels of service to traffic facilities under various traffic flow conditions. The capacity analysis methodology is based on the concepts and procedures in the Trafficware *Percentile Delay Method* as provided in the Synchro analysis program for signalized intersections.[2] The concept of level of service (LOS) is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruption, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with LOS A representing the best operating conditions and LOS F the worst. Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year. A description of the operating condition under each level of service is provided below:

- *LOS A* describes conditions with little to no delay to motorists.
- *LOS B* represents a desirable level with relatively low delay to motorists.
- *LOS C* describes conditions with average delays to motorists.
- *LOS D* describes operations where the influence of congestion becomes more noticeable. Delays are still within an acceptable range.

[2] *Synchro plus SimTraffic 7*; Trafficware ltd.; Sugar Land, TX; 2007

- *LOS E* represents operating conditions with high delay values. This level is considered by many agencies to be the limit of acceptable delay.
- *LOS F* is considered to be unacceptable to most drivers with high delay values that often occur, when arrival flow rates exceed the capacity of the intersection.

Levels of service for signalized intersections are calculated using the percentile delay methodology of Trafficware's *Synchro* analysis program. This methodology for signalized intersections assesses five levels of traffic arrivals so signals can be evaluated under varying traffic loads as well as capture and rationally model the non-linear behavior of actuated signals. The percentile delay method calculations are quite complex evaluating detailed arrival pattern information from adjacent signals. The definition of level of service for signalized intersections is a function of average *total* delay. Total delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. This delay analyzes the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics. Table 3 summarizes the relationship between level of service and average delay for signalized intersections.

Levels of service for unsignalized intersections are calculated using the operational analysis methodology of the HCM. The procedure accounts for lane configuration on the minor and major street approaches, conflicting traffic stream volumes, and the type of intersection control (STOP, YIELD, or all-way STOP control). The definition of level of service for unsignalized intersections is a function of average *control* delay. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The level-of-service criteria for unsignalized intersections are shown in Table 3.

Table 3
LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service	**Unsignalized Intersection Criteria** Average Control Delay (Seconds per Vehicle)	**Signalized Intersection Criteria** Average Control Delay (Seconds per Vehicle)
A	≤10	≤10
B	>10 and ≤15	>10 and ≤20
C	>15 and ≤25	>20 and ≤35
D	>25 and ≤35	>35 and ≤55
E	>35 and ≤50	>55 and ≤80
F	>50	>80

Source: *Highway Capacity Manual 2000*, Transportation Research Board; Washington, D.C.; 2000. Page 17-2.

For signalized intersections, this delay criterion may be applied in assigning level-of-service designations to individual lane groups, to individual intersection approaches, or to the entire intersection. For unsignalized intersections, this delay criterion may be applied in assigning level-of-service designations to individual lane groups or to individual intersection approaches.

Queue Analysis Methodology

The queue analysis methodology for signalized intersections is based on the concepts and procedures described in the Trafficware's *Synchro* analysis program. For signalized intersections, the 50th and 95th percentile back of queue were calculated for each critical lane group during the peak periods studied. The 50th percentile queue represents the length of queued vehicles that would not be expected to be exceeded during 50% of the time during the analyzed period and the 95th percentile queues would not be expected to be exceeded during 95% on the time. The back of queue is the length of a backup of vehicles from the stop line of a signalized intersection to the last vehicle in the queue that is required to stop, regardless of the signal indication. The length of this queue depends on a number of factors including signal timing, vehicle arrival patterns, and the saturation flow rate.

For unsignalized intersections, the 95th percentile queue is a function of the capacity of the movement and the movement's degree of saturation. The 50th percentile queue lengths are not calculated for unsignalized intersections.

CAPACITY AND QUEUE LENGTH ANALYSIS RESULTS

The level-of-service analyses for the study intersection was completed for the 2013 Base Year and 2023 Design Year traffic-volume conditions under both existing and improved conditions. The existing operation condition assumes that the roadway and intersection control are as they currently exist with no improvements. The proposed operation condition assumes the geometric and intersection control changes as described in the *Proposed Roadway Improvements* section of this report are implemented.

These analysis results are summarized in Table 4 and Table 5 for the study intersections and are discussed below. The tables summarize the volume to capacity (v/c) ratio, the average delay, the level of service (LOS), and the vehicle queue length. All analysis worksheets are provided in the Appendix.

Table 4
CAPACITY ANALYSIS SUMMARY – 2013 CONDITIONS
MAIN STREET (ROUTE 62) AT COMMONWEALTH AVENUE

2013	Existing				Proposed			
Intersection/Peak Hour/Movement	V/C[a]	Del.[b]	LOS[c]	Queue[d]	V/C	Del.	LOS	Queue
Route 62 at Comm. Ave.								
Weekday AM:								
Route 62 EB Thru	0.63	24.2	C	348/496	0.65	15.7	B	247/#502
Route 62 WB Thru	0.43	12.2	B	95/76	0.44	23.6	C	102/211
Route 62 WB Right	0.17	0.7	A	0/6	0.17	3.4	A	0/51
Comm. Ave. SB Left/Right	0.90	58.0	E	209/#582	0.87	48.6	D	221/#444
Overall Intersection	**--**	**27.4**	**C**	--	**--**	**24.6**	**C**	**--**
Route 62 at Comm. Ave.								
Weekday PM:								
Route 62 EB Thru	0.42	27.0	C	128/336	0.44	28.0	C	135/348
Route 62WB Thru	0.56	10.4	B	150/268	0.58	10.0	B	119/231
Route 62WB Right	0.45	0.8	A	0/0	0.46	0.9	A	0/0
Comm. Ave. SB Left/Right	0.76	45.2	D	152/222	0.78	46.9	D	153/224
Overall Intersection	**--**	**16.3**	**B**	**--**	**--**	**16.7**	**B**	**--**

[a] Volume-to-capacity ratio.
[b] Average total delay in seconds per vehicle.
[c] Level of service.
[d] $50^{th}/95^{th}$ percentile queue length in feet per lane (assuming 25 feet per vehicle).
- 95th percentile volume exceeds capacity, queue may be longer.
~ - Volume exceeds capacity, queue is theoretically infinite.

Table 5
CAPACITY ANALYSIS SUMMARY – 2023 CONDITIONS
MAIN STREET (ROUTE 62) AT COMMONWEALTH AVENUE

2023	Existing				Proposed			
Intersection/Peak Hour/Movement	V/C[a]	Del.[b]	LOS[c]	Queue[d]	V/C	Del.	LOS	Queue
Route 62 at Comm. Ave.								
Weekday AM:								
Route 62 EB Thru	0.70	25.6	C	405/541	0.79	22.4	C	312/#569
Route 62 WB Thru	0.47	12.8	B	105/94	0.53	26.2	C	119/230
Route 62 WB Right	0.18	0.9	A	0/13	0.18	3.2	A	0/47
Comm. Ave. SB Left/Right	1.00	76.5	E	240/#648	0.84	42.9	D	238/#510
Overall Intersection	**--**	**33.1**	**C**	--	**--**	**26.2**	**C**	**--**
Route 62 at Comm. Ave.								
Weekday PM:								
Route 62 EB Thru	0.47	28.0	C	141/369	0.49	28.7	C	150/381
Route 62WB Thru	0.63	11.7	B	187/242	0.66	11.6	B	157/208
Route 62WB Right	0.49	0.8	A	0/0	0.50	0.9	A	0/0
Comm. Ave. SB Left/Right	0.81	48.5	D	173/270	0.82	50.3	D	174/#278
Overall Intersection	**--**	**17.4**	**B**	**--**	**--**	**17.8**	**B**	**--**

[a] Volume-to-capacity ratio.
[b] Average total delay in seconds per vehicle.
[c] Level of service.
[d] 50th/95th percentile queue length in feet per lane (assuming 25 feet per vehicle).
- 95th percentile volume exceeds capacity, queue may be longer.
~ - Volume exceeds capacity, queue is theoretically infinite.

The signalized intersection of Main Street at Commonwealth Avenue currently operates at an overall LOS C during the AM peak hour and an overall LOS B in the PM peak hour with delays of 27 and 16 seconds respectively. If no changes are made to this intersection, the future year 2023 delay will only worsen slightly, while the LOS will stay the same. The proposed timings and conditions are very similar to existing and therefore the analysis results are very similar with modest improvements in the AM and no changes in the PM.

Although the proposed analysis does not show a significant improvement in operations, the proposed design mostly benefits the safety and function of the intersection, as described in the Proposed Improvements section of this memorandum.

CONCLUSION AND RECOMMENDATION

The intersection of Main Street (Route 62) and Commonwealth Avenue is a vital intersection to the Town of Concord, and more specifically West Concord. The implementation of the improvements described in this memorandum, and as shown in the associated Design Plans, are proposed to enhance the intersection, Bruce Freeman Rail Trail and Concords Junction Park by improving pedestrian and bicycle accommodations, increasing park area, reducing pedestrian and Rail Trail users crossing distance and improving safety. The Town looks forward to the continued design of this project and its eventual construction.

APPENDIX

TRAFFIC COUNT DATA

MASSDOT SEASONAL ADJUSTMENT FACTORS AND HISTORICAL GROWTH

CRASH DATA AND CRASH RATE WORKSHEETS

CAPACITY ANALYSIS AND QUEUE LENGTH ANALYSIS WORKSHEETS

TRAFFIC COUNT DATA

Main Street (Route 62)
east of Pine Street
City, State: Concord, MA
Client: VHB/ A. Silbovitz

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133252 B Volume
Site Code: 11707

Start		WB				EB				Combined			13-Mar-13
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Wed
12:00	13		80		5		81		18		161		
12:15	12		60		2		84		14		144		
12:30	5		69		4		72		9		141		
12:45	5	35	71	280	4	15	91	328	9	50	162	608	
01:00	3		77		2		95		5		172		
01:15	4		69		0		82		4		151		
01:30	2		69		2		82		4		151		
01:45	1	10	80	295	2	6	79	338	3	16	159	633	
02:00	2		87		0		78		2		165		
02:15	1		85		1		70		2		155		
02:30	1		82		0		63		1		145		
02:45	1	5	95	349	2	3	73	284	3	8	168	633	
03:00	2		115		0		67		2		182		
03:15	1		106		2		53		3		159		
03:30	1		93		3		66		4		159		
03:45	2	6	109	423	2	7	60	246	4	13	169	669	
04:00	0		120		2		75		2		195		
04:15	0		101		4		71		4		172		
04:30	2		130		5		81		7		211		
04:45	0	2	99	450	12	23	49	276	12	25	148	726	
05:00	3		114		15		64		18		178		
05:15	11		120		22		91		33		211		
05:30	6		110		41		78		47		188		
05:45	15	35	138	482	36	114	67	300	51	149	205	782	
06:00	8		126		49		75		57		201		
06:15	13		137		100		56		113		193		
06:30	29		113		132		61		161		174		
06:45	22	72	80	456	146	427	66	258	168	499	146	714	
07:00	35		87		161		64		196		151		
07:15	41		91		141		42		182		133		
07:30	37		69		146		46		183		115		
07:45	49	162	71	318	151	599	27	179	200	761	98	497	
08:00	40		75		156		31		196		106		
08:15	66		59		134		27		200		86		
08:30	64		62		118		28		182		90		
08:45	74	244	65	261	144	552	31	117	218	796	96	378	
09:00	111		44		98		25		209		69		
09:15	69		52		124		30		193		82		
09:30	75		48		97		12		172		60		
09:45	66	321	37	181	88	407	18	85	154	728	55	266	
10:00	83		32		83		11		166		43		
10:15	55		24		73		22		128		46		
10:30	66		20		81		20		147		40		
10:45	77	281	20	96	77	314	16	69	154	595	36	165	
11:00	66		27		71		10		137		37		
11:15	70		15		74		5		144		20		
11:30	87		15		64		3		151		18		
11:45	74	297	6	63	77	286	4	22	151	583	10	85	
Total	1470		3654		2753		2502		4223		6156		
Percent	34.8%		59.4%		65.2%		40.6%						
Day Total		5124				5255				10379			
Peak	08:45		05:45		07:00		00:45		08:15		05:15		
Vol.	329		514		599		350		809		805		
P.H.F.	0.741		0.931		0.930		0.921		0.928		0.954		

N/S: Parking Lot/ Main Street (Route 62)
E/W: Main St (Rte 62)/ Commonwealth Ave.
City, State: Concord, MA
Client: VHB/ A. Silbovitz

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 133252 A
Site Code : 11707
Start Date : 3/12/2013
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
07:00 AM	0	0	0	0	1	22	40	0	169	0	0	0	3	108	0	0	343
07:15 AM	0	0	0	0	0	19	44	0	158	0	0	0	5	114	0	0	340
07:30 AM	0	1	1	0	1	26	49	0	163	0	0	0	4	103	1	0	349
07:45 AM	0	0	0	0	0	36	59	0	164	0	0	0	1	99	0	0	359
Total	0	1	1	0	2	103	192	0	654	0	0	0	13	424	1	0	1391
08:00 AM	1	2	0	0	0	25	57	0	164	0	0	0	5	108	1	0	363
08:15 AM	0	0	0	0	3	40	66	0	145	0	0	0	3	88	0	0	345
08:30 AM	2	1	0	0	1	40	66	0	119	0	0	0	5	87	1	0	322
08:45 AM	0	1	1	0	1	59	90	0	140	0	0	0	10	101	0	0	403
Total	3	4	1	0	5	164	279	0	568	0	0	0	23	384	2	0	1433
Grand Total	3	5	2	0	7	267	471	0	1222	0	0	0	36	808	3	0	2824
Apprch %	30	50	20	0	0.9	35.8	63.2	0	100	0	0	0	4.3	95.4	0.4	0	
Total %	0.1	0.2	0.1	0	0.2	9.5	16.7	0	43.3	0	0	0	1.3	28.6	0.1	0	
Cars	3	5	2	0	6	255	454	0	1195	0	0	0	35	791	2	0	2748
% Cars	100	100	100	0	85.7	95.5	96.4	0	97.8	0	0	0	97.2	97.9	66.7	0	97.3
Heavy Vehicles	0	0	0	0	1	12	17	0	27	0	0	0	1	17	1	0	76
% Heavy Vehicles	0	0	0	0	14.3	4.5	3.6	0	2.2	0	0	0	2.8	2.1	33.3	0	2.7

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	1	**2**	0	0	**3**	0	25	57	0	82	**164**	0	0	0	**164**	5	**108**	**1**	0	**114**	363
08:15 AM	0	0	0	0	0	**3**	40	66	0	109	145	0	0	0	145	3	88	0	0	91	345
08:30 AM	**2**	1	0	0	3	1	40	66	0	107	119	0	0	0	119	5	87	1	0	93	322
08:45 AM	0	1	**1**	0	2	1	**59**	**90**	0	**150**	140	0	0	0	140	**10**	101	0	0	111	**403**
Total Volume	3	4	1	0	8	5	164	279	0	448	568	0	0	0	568	23	384	2	0	409	1433
% App. Total	37.5	50	12.5	0		1.1	36.6	62.3	0		100	0	0	0		5.6	93.9	0.5	0		
PHF	.375	.500	.250	.000	.667	.417	.695	.775	.000	.747	.866	.000	.000	.000	.866	.575	.889	.500	.000	.897	.889
Cars	3	4	1	0	8	4	159	274	0	437	551	0	0	0	551	23	376	1	0	400	1396
% Cars	100	100	100	0	100	80.0	97.0	98.2	0	97.5	97.0	0	0	0	97.0	100	97.9	50.0	0	97.8	97.4
Heavy Vehicles	0	0	0	0	0	1	5	5	0	11	17	0	0	0	17	0	8	1	0	9	37
% Heavy Vehicles	0	0	0	0	0	20.0	3.0	1.8	0	2.5	3.0	0	0	0	3.0	0	2.1	50.0	0	2.2	2.6

N/S: Parking Lot/ Main Street (Route 62)
E/W: Main St (Rte 62)/ Commonwealth Ave.
City, State: Concord, MA
Client: VHB/ A. Silbovitz

PRECISION DATA INDUSTRIES, LLC
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Groups Printed- Cars

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
07:00 AM	0	0	0	0	1	22	40	0	166	0	0	0	3	107	0	0	339
07:15 AM	0	0	0	0	0	16	39	0	155	0	0	0	4	112	0	0	326
07:30 AM	0	1	1	0	1	25	45	0	162	0	0	0	4	101	1	0	341
07:45 AM	0	0	0	0	0	33	56	0	161	0	0	0	1	95	0	0	346
Total	0	1	1	0	2	96	180	0	644	0	0	0	12	415	1	0	1352
08:00 AM	1	2	0	0	0	22	57	0	159	0	0	0	5	107	0	0	353
08:15 AM	0	0	0	0	2	40	65	0	141	0	0	0	3	88	0	0	339
08:30 AM	2	1	0	0	1	40	64	0	117	0	0	0	5	83	1	0	314
08:45 AM	0	1	1	0	1	57	88	0	134	0	0	0	10	98	0	0	390
Total	3	4	1	0	4	159	274	0	551	0	0	0	23	376	1	0	1396
Grand Total	3	5	2	0	6	255	454	0	1195	0	0	0	35	791	2	0	2748
Apprch %	30	50	20	0	0.8	35.7	63.5	0	100	0	0	0	4.2	95.5	0.2	0	
Total %	0.1	0.2	0.1	0	0.2	9.3	16.5	0	43.5	0	0	0	1.3	28.8	0.1	0	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	1	**2**	0	0	**3**	0	22	57	0	79	**159**	0	0	0	**159**	5	**107**	0	0	**112**	353
08:15 AM	0	0	0	0	0	**2**	40	65	0	107	141	0	0	0	141	3	88	0	0	91	339
08:30 AM	**2**	1	0	0	3	1	40	64	0	105	117	0	0	0	117	5	83	**1**	0	89	314
08:45 AM	0	1	**1**	0	2	1	**57**	**88**	0	**146**	134	0	0	0	134	**10**	98	0	0	108	**390**
Total Volume	3	4	1	0	8	4	159	274	0	437	551	0	0	0	551	23	376	1	0	400	1396
% App. Total	37.5	50	12.5	0		0.9	36.4	62.7	0		100	0	0	0		5.8	94	0.2	0		
PHF	.375	.500	.250	.000	.667	.500	.697	.778	.000	.748	.866	.000	.000	.000	.866	.575	.879	.250	.000	.893	.895

N/S: Parking Lot/ Main Street (Route 62)
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Client: VHB/ A. Silbovitz

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Groups Printed- Heavy Vehicles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	4
07:15 AM	0	0	0	0	0	3	5	0	3	0	0	0	1	2	0	0	14
07:30 AM	0	0	0	0	0	1	4	0	1	0	0	0	0	2	0	0	8
07:45 AM	0	0	0	0	0	3	3	0	3	0	0	0	0	4	0	0	13
Total	0	0	0	0	0	7	12	0	10	0	0	0	1	9	0	0	39
08:00 AM	0	0	0	0	0	3	0	0	5	0	0	0	0	1	1	0	10
08:15 AM	0	0	0	0	1	0	1	0	4	0	0	0	0	0	0	0	6
08:30 AM	0	0	0	0	0	0	2	0	2	0	0	0	0	4	0	0	8
08:45 AM	0	0	0	0	0	2	2	0	6	0	0	0	0	3	0	0	13
Total	0	0	0	0	1	5	5	0	17	0	0	0	0	8	1	0	37
Grand Total	0	0	0	0	1	12	17	0	27	0	0	0	1	17	1	0	76
Apprch %	0	0	0	0	3.3	40	56.7	0	100	0	0	0	5.3	89.5	5.3	0	
Total %	0	0	0	0	1.3	15.8	22.4	0	35.5	0	0	0	1.3	22.4	1.3	0	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	0	0	0	0	0	**3**	**5**	0	**8**	3	0	0	0	3	**1**	2	0	0	3	**14**
07:30 AM	0	0	0	0	0	0	1	4	0	5	1	0	0	0	1	0	2	0	0	2	8
07:45 AM	0	0	0	0	0	0	3	3	0	6	3	0	0	0	3	0	**4**	0	0	**4**	13
08:00 AM	0	0	0	0	0	0	3	0	0	3	**5**	0	0	0	**5**	0	1	**1**	0	2	10
Total Volume	0	0	0	0	0	0	10	12	0	22	12	0	0	0	12	1	9	1	0	11	45
% App. Total	0	0	0	0		0	45.5	54.5	0		100	0	0	0		9.1	81.8	9.1	0		
PHF	.000	.000	.000	.000	.000	.000	.833	.600	.000	.688	.600	.000	.000	.000	.600	.250	.563	.250	.000	.688	.804

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Groups Printed- Peds and Bicycles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	5	9
07:45 AM	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4	6
Total	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	9	17
08:00 AM	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	3
08:15 AM	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	5
08:30 AM	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	3
08:45 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	5	0	2	0	0	0	0	0	1	0	0	0	4	12
Grand Total	0	0	0	11	0	2	0	2	0	0	0	1	0	0	0	13	29
Apprch %	0	0	0	100	0	50	0	50	0	0	0	100	0	0	0	100	
Total %	0	0	0	37.9	0	6.9	0	6.9	0	0	0	3.4	0	0	0	44.8	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	0	**4**	**4**	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**	**5**	**9**
07:45 AM	0	0	0	0	0	0	0	0	**2**	**2**	0	0	0	0	0	0	0	0	4	4	6
08:00 AM	0	0	0	1	1	0	**1**	0	0	1	0	0	0	**1**	**1**	0	0	0	0	0	3
08:15 AM	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	5
Total Volume	0	0	0	7	7	0	1	0	2	3	0	0	0	1	1	0	0	0	12	12	23
% App. Total	0	0	0	100		0	33.3	0	66.7		0	0	0	100		0	0	0	100		
PHF	.000	.000	.000	.438	.438	.000	.250	.000	.250	.375	.000	.000	.000	.250	.250	.000	.000	.000	.600	.600	.639

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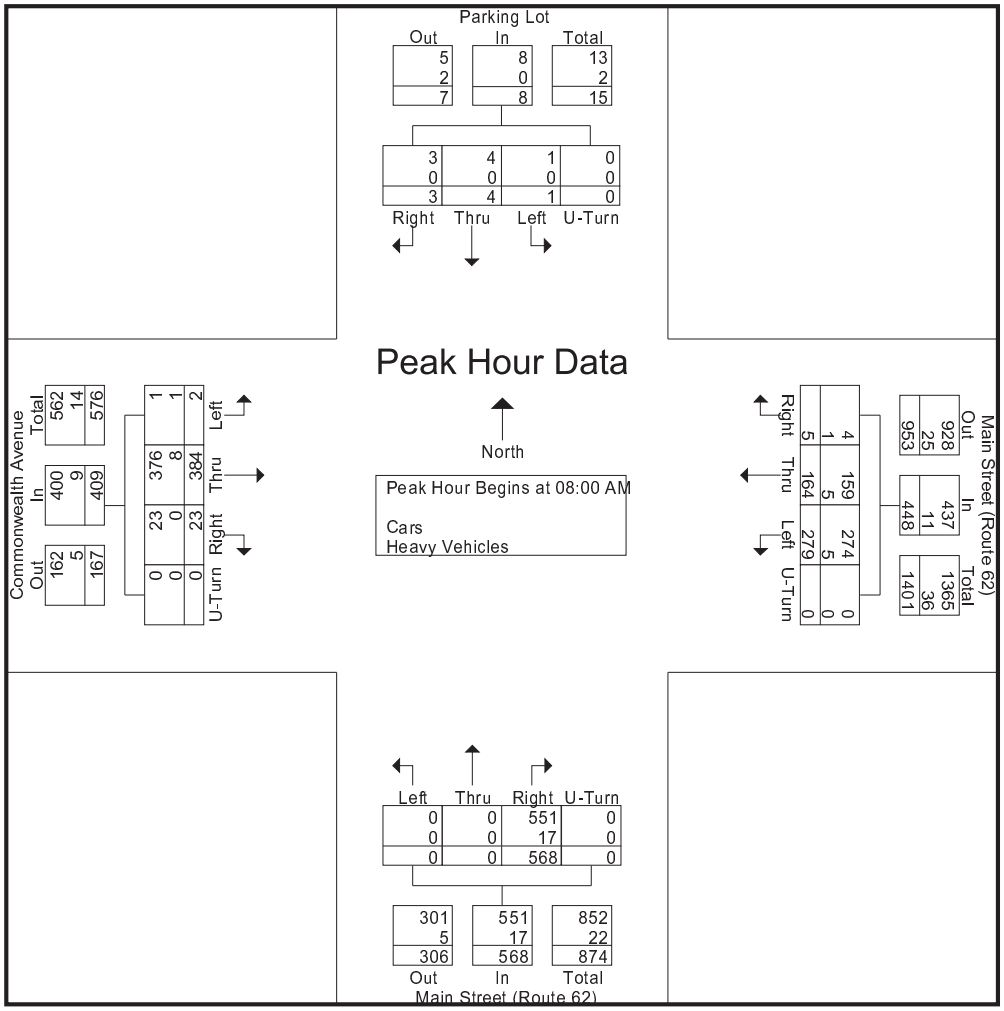
	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	1	**2**	0	0	**3**	0	25	57	0	82	**164**	0	0	0	**164**	5	**108**	**1**	0	**114**	363
08:15 AM	0	0	0	0	0	**3**	40	66	0	109	145	0	0	0	145	3	88	0	0	91	345
08:30 AM	**2**	1	0	0	3	1	40	66	0	107	119	0	0	0	119	5	87	1	0	93	322
08:45 AM	0	1	**1**	0	2	1	**59**	**90**	0	**150**	140	0	0	0	140	**10**	101	0	0	111	**403**
Total Volume	3	4	1	0	8	5	164	279	0	448	568	0	0	0	568	23	384	2	0	409	1433
% App. Total	37.5	50	12.5	0		1.1	36.6	62.3	0		100	0	0	0		5.6	93.9	0.5	0		
PHF	.375	.500	.250	.000	.667	.417	.695	.775	.000	.747	.866	.000	.000	.000	.866	.575	.889	.500	.000	.897	.889
Cars	3	4	1	0	8	4	159	274	0	437	551	0	0	0	551	23	376	1	0	400	1396
% Cars	100	100	100	0	100	80.0	97.0	98.2	0	97.5	97.0	0	0	0	97.0	100	97.9	50.0	0	97.8	97.4
Heavy Vehicles	0	0	0	0	0	1	5	5	0	11	17	0	0	0	17	0	8	1	0	9	37
% Heavy Vehicles	0	0	0	0	0	20.0	3.0	1.8	0	2.5	3.0	0	0	0	3.0	0	2.1	50.0	0	2.2	2.6



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Groups Printed- Cars - Heavy Vehicles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
04:00 PM	0	0	0	0	1	128	127	0	72	0	0	0	5	58	2	0	393
04:15 PM	1	0	1	0	0	113	119	0	83	0	0	0	11	47	0	0	375
04:30 PM	0	0	0	0	2	161	142	0	97	0	0	0	8	41	1	0	452
04:45 PM	1	0	0	0	2	141	131	0	95	0	0	0	16	58	1	0	445
Total	2	0	1	0	5	543	519	0	347	0	0	0	40	204	4	0	1665
05:00 PM	2	0	1	0	3	146	132	0	103	0	0	0	13	56	0	0	456
05:15 PM	0	2	0	0	0	132	124	0	106	0	0	0	4	53	0	0	421
05:30 PM	2	0	0	0	3	144	130	0	101	0	0	0	6	58	3	0	447
05:45 PM	1	0	1	0	0	144	141	0	87	0	0	0	10	47	0	0	431
Total	5	2	2	0	6	566	527	0	397	0	0	0	33	214	3	0	1755
Grand Total	7	2	3	0	11	1109	1046	0	744	0	0	0	73	418	7	0	3420
Apprch %	58.3	16.7	25	0	0.5	51.2	48.3	0	100	0	0	0	14.7	83.9	1.4	0	
Total %	0.2	0.1	0.1	0	0.3	32.4	30.6	0	21.8	0	0	0	2.1	12.2	0.2	0	
Cars	7	2	3	0	11	1100	1037	0	737	0	0	0	72	409	7	0	3385
% Cars	100	100	100	0	100	99.2	99.1	0	99.1	0	0	0	98.6	97.8	100	0	99
Heavy Vehicles	0	0	0	0	0	9	9	0	7	0	0	0	1	9	0	0	35
% Heavy Vehicles	0	0	0	0	0	0.8	0.9	0	0.9	0	0	0	1.4	2.2	0	0	1

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	0	0	0	0	2	**161**	**142**	0	**305**	97	0	0	0	97	8	41	**1**	0	50	452
04:45 PM	1	0	0	0	1	2	141	131	0	274	95	0	0	0	95	**16**	**58**	1	0	**75**	445
05:00 PM	**2**	0	**1**	0	**3**	**3**	146	132	0	281	103	0	0	0	103	13	56	0	0	69	**456**
05:15 PM	0	**2**	0	0	2	0	132	124	0	256	**106**	0	0	0	**106**	4	53	0	0	57	421
Total Volume	3	2	1	0	6	7	580	529	0	1116	401	0	0	0	401	41	208	2	0	251	1774
% App. Total	50	33.3	16.7	0		0.6	52	47.4	0		100	0	0	0		16.3	82.9	0.8	0		
PHF	.375	.250	.250	.000	.500	.583	.901	.931	.000	.915	.946	.000	.000	.000	.946	.641	.897	.500	.000	.837	.973
Cars	3	2	1	0	6	7	576	527	0	1110	394	0	0	0	394	40	203	2	0	245	1755
% Cars	100	100	100	0	100	100	99.3	99.6	0	99.5	98.3	0	0	0	98.3	97.6	97.6	100	0	97.6	98.9
Heavy Vehicles	0	0	0	0	0	0	4	2	0	6	7	0	0	0	7	1	5	0	0	6	19
% Heavy Vehicles	0	0	0	0	0	0	0.7	0.4	0	0.5	1.7	0	0	0	1.7	2.4	2.4	0	0	2.4	1.1

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PRECISION DATA INDUSTRIES, LLC
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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 133252 AA
Site Code : 11707
Start Date : 3/12/2013
Page No : 1

Groups Printed- Cars

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
04:00 PM	0	0	0	0	1	125	125	0	72	0	0	0	5	58	2	0	388
04:15 PM	1	0	1	0	0	112	116	0	83	0	0	0	11	44	0	0	368
04:30 PM	0	0	0	0	2	159	142	0	95	0	0	0	8	39	1	0	446
04:45 PM	1	0	0	0	2	141	129	0	93	0	0	0	15	58	1	0	440
Total	2	0	1	0	5	537	512	0	343	0	0	0	39	199	4	0	1642
05:00 PM	2	0	1	0	3	146	132	0	101	0	0	0	13	55	0	0	453
05:15 PM	0	2	0	0	0	130	124	0	105	0	0	0	4	51	0	0	416
05:30 PM	2	0	0	0	3	144	130	0	101	0	0	0	6	57	3	0	446
05:45 PM	1	0	1	0	0	143	139	0	87	0	0	0	10	47	0	0	428
Total	5	2	2	0	6	563	525	0	394	0	0	0	33	210	3	0	1743
Grand Total	7	2	3	0	11	1100	1037	0	737	0	0	0	72	409	7	0	3385
Apprch %	58.3	16.7	25	0	0.5	51.2	48.3	0	100	0	0	0	14.8	83.8	1.4	0	
Total %	0.2	0.1	0.1	0	0.3	32.5	30.6	0	21.8	0	0	0	2.1	12.1	0.2	0	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	0	0	0	0	2	**159**	**142**	0	**303**	95	0	0	0	95	8	39	**1**	0	48	446
04:45 PM	1	0	0	0	1	2	141	129	0	272	93	0	0	0	93	**15**	**58**	1	0	**74**	440
05:00 PM	**2**	0	**1**	0	**3**	**3**	146	132	0	281	101	0	0	0	101	13	55	0	0	68	**453**
05:15 PM	0	**2**	0	0	2	0	130	124	0	254	**105**	0	0	0	**105**	4	51	0	0	55	416
Total Volume	3	2	1	0	6	7	576	527	0	1110	394	0	0	0	394	40	203	2	0	245	1755
% App. Total	50	33.3	16.7	0		0.6	51.9	47.5	0		100	0	0	0		16.3	82.9	0.8	0		
PHF	.375	.250	.250	.000	.500	.583	.906	.928	.000	.916	.938	.000	.000	.000	.938	.667	.875	.500	.000	.828	.969

N/S: Parking Lot/ Main Street (Route 62)
E/W: Main St (Rte 62)/ Commonwealth Ave.
City, State: Concord, MA
Client: VHB/ A. Silbovitz

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Groups Printed- Heavy Vehicles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
04:00 PM	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	5
04:15 PM	0	0	0	0	0	1	3	0	0	0	0	0	0	3	0	0	7
04:30 PM	0	0	0	0	0	2	0	0	2	0	0	0	0	2	0	0	6
04:45 PM	0	0	0	0	0	0	2	0	2	0	0	0	1	0	0	0	5
Total	0	0	0	0	0	6	7	0	4	0	0	0	1	5	0	0	23
05:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	3
05:15 PM	0	0	0	0	0	2	0	0	1	0	0	0	0	2	0	0	5
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
05:45 PM	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3
Total	0	0	0	0	0	3	2	0	3	0	0	0	0	4	0	0	12
Grand Total	0	0	0	0	0	9	9	0	7	0	0	0	1	9	0	0	35
Apprch %	0	0	0	0	0	50	50	0	100	0	0	0	10	90	0	0	
Total %	0	0	0	0	0	25.7	25.7	0	20	0	0	0	2.9	25.7	0	0	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	0	0	0	0	0	0	**3**	2	0	**5**	0	0	0	0	0	0	0	0	0	0	5
04:15 PM	0	0	0	0	0	0	1	**3**	0	4	0	0	0	0	0	0	**3**	0	0	**3**	**7**
04:30 PM	0	0	0	0	0	0	2	0	0	2	**2**	0	0	0	**2**	0	2	0	0	2	6
04:45 PM	0	0	0	0	0	0	0	2	0	2	2	0	0	0	2	**1**	0	0	0	1	5
Total Volume	0	0	0	0	0	0	6	7	0	13	4	0	0	0	4	1	5	0	0	6	23
% App. Total	0	0	0	0		0	46.2	53.8	0		100	0	0	0		16.7	83.3	0	0		
PHF	.000	.000	.000	.000	.000	.000	.500	.583	.000	.650	.500	.000	.000	.000	.500	.250	.417	.000	.000	.500	.821

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Groups Printed- Peds and Bicycles

	Parking Lot From North				Main Street (Route 62) From East				Main Street (Route 62) From South				Commonwealth Avenue From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	6	10
04:15 PM	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	4	8
04:30 PM	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	1	7
04:45 PM	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	12	16
Total	0	0	0	14	0	0	0	2	0	0	0	2	0	0	0	23	41
05:00 PM	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	2	9
05:15 PM	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	5	8
05:30 PM	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	11	18
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Total	0	0	0	16	0	0	0	1	0	0	0	0	0	0	0	20	37
Grand Total	0	0	0	30	0	0	0	3	0	0	0	2	0	0	0	43	78
Apprch %	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	
Total %	0	0	0	38.5	0	0	0	3.8	0	0	0	2.6	0	0	0	55.1	

	Parking Lot From North					Main Street (Route 62) From East					Main Street (Route 62) From South					Commonwealth Avenue From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	0	0	3	3	0	0	0	**1**	**1**	0	0	0	0	0	0	0	0	**12**	**12**	16
05:00 PM	0	0	0	**7**	**7**	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	9
05:15 PM	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	8
05:30 PM	0	0	0	6	6	0	0	0	1	1	0	0	0	0	0	0	0	0	11	11	**18**
Total Volume	0	0	0	19	19	0	0	0	2	2	0	0	0	0	0	0	0	0	30	30	51
% App. Total	0	0	0	100		0	0	0	100		0	0	0	0		0	0	0	100		
PHF	.000	.000	.000	.679	.679	.000	.000	.000	.500	.500	.000	.000	.000	.000	.000	.000	.000	.000	.625	.625	.708

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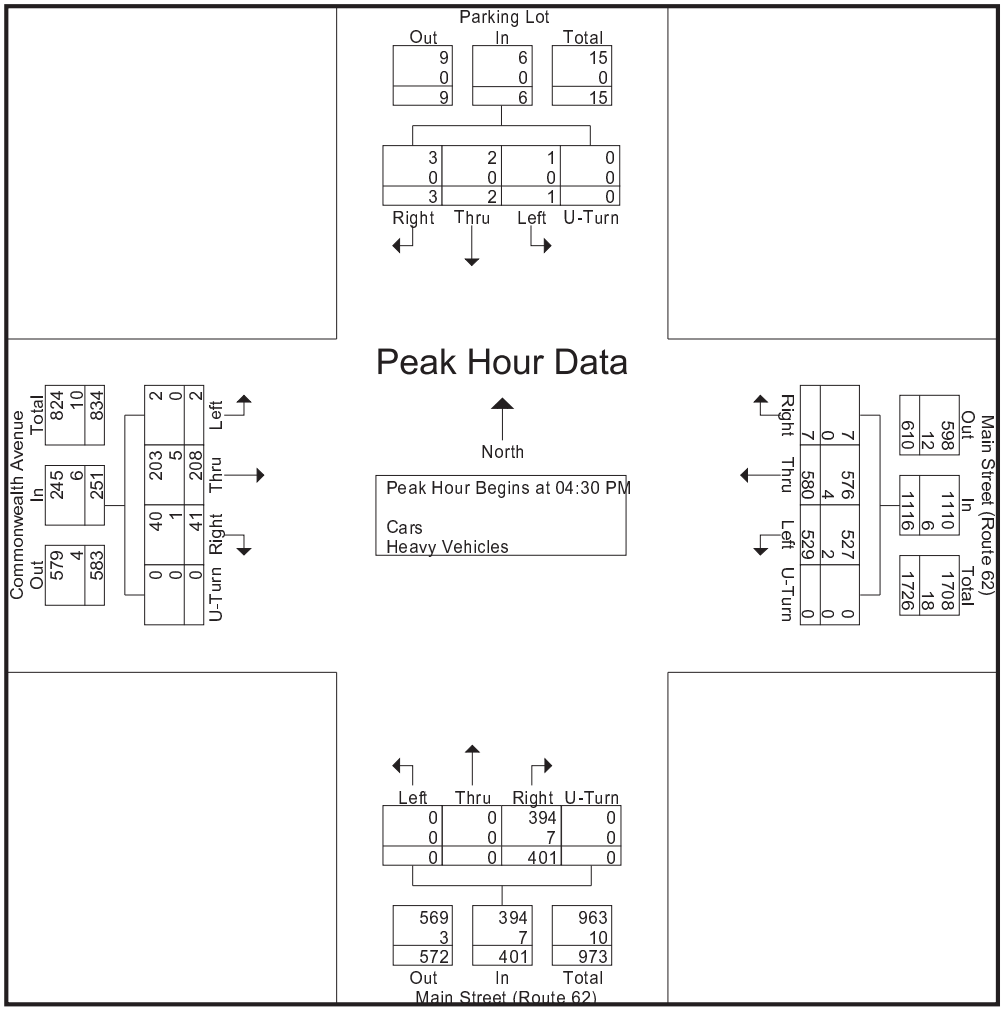
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	0	0	0	0	2	**161**	**142**	0	**305**	97	0	0	0	97	8	41	**1**	0	50	452
04:45 PM	1	0	0	0	1	2	141	131	0	274	95	0	0	0	95	**16**	**58**	1	0	**75**	445
05:00 PM	**2**	0	**1**	0	**3**	**3**	146	132	0	281	103	0	0	0	103	13	56	0	0	69	**456**
05:15 PM	0	**2**	0	0	2	0	132	124	0	256	**106**	0	0	0	**106**	4	53	0	0	57	421
Total Volume	3	2	1	0	6	7	580	529	0	1116	401	0	0	0	401	41	208	2	0	251	1774
% App. Total	50	33.3	16.7	0		0.6	52	47.4	0		100	0	0	0		16.3	82.9	0.8	0		
PHF	.375	.250	.250	.000	.500	.583	.901	.931	.000	.915	.946	.000	.000	.000	.946	.641	.897	.500	.000	.837	.973
Cars	3	2	1	0	6	7	576	527	0	1110	394	0	0	0	394	40	203	2	0	245	1755
% Cars	100	100	100	0	100	100	99.3	99.6	0	99.5	98.3	0	0	0	98.3	97.6	97.6	100	0	97.6	98.9
Heavy Vehicles	0	0	0	0	0	0	4	2	0	6	7	0	0	0	7	1	5	0	0	6	19
% Heavy Vehicles	0	0	0	0	0	0	0.7	0.4	0	0.5	1.7	0	0	0	1.7	2.4	2.4	0	0	2.4	1.1



MASSDOT SEASONAL ADJUSTMENT FACTORS AND HISTORICAL GROWTH

Seasonal Adjustment Factor Worksheet

Permanent Count Station

(Source: MassHighway Traffic Volumes 2005 - 2008)

STATION 403 - CONCORD - RTE.2 - EAST OF CONCORD ROTARY

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
2005		41,051	43,677	45,426	46,370	46,939	51,129	44,632	46,318	46,004	49,000	45,178	43,329	45,754
2006		44,150	43,659	46,395	45,607	46,453	49,481	43,449	45,449	45,925	49,000	44,963	43,417	45,662
2007		41,988	41,749	43,930	44,696	46,932	49,031	44,131	45,508	45,546	49,000	43,366	41,478	44,780
2008		43,000	42,665	43,583	45,399	45,662	47,666	43,805	43,567	45,196	46,795	42,144	39,843	44,110
Seasonal Adjustment Factor [a]	2005	1.11	1.05	1.01	0.99	0.97	0.89	1.03	0.99	0.99	0.93	1.01	1.06	1.00
	2006	1.03	1.05	0.98	1.00	0.98	0.92	1.05	1.00	0.99	0.93	1.02	1.05	1.00
	2007	1.07	1.07	1.02	1.00	0.95	0.91	1.01	0.98	0.98	0.91	1.03	1.08	1.00
	2008	1.03	1.03	1.01	0.97	0.97	0.93	1.01	1.01	0.98	0.94	1.05	1.11	1.00
	5-yrs Average	1.06	1.05	**1.01**	0.99	0.97	0.91	1.02	1.00	0.99	0.93	1.03	1.07	1.00

[a] Seasonal Adjustment Factor to Yearly Average.

Traffic Growth Factor Worksheet

Count Stations

Town of Concord

(Source: MassHighway Traffic Volumes 2000 - 2009)

				AVERAGE DAILY TRAFFIC										Average %
STA.	**CITY/TOWN**	**ROUTE/STREET**	**LOCATION**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Growth**
4166	CONCORD	CAMBRIDGE TURNPIK	EAST OF RTE.24		7,200			6,200			6,200			-2.4%
0403 L	CONCORD	RTE. 2	0.2 km EAST OF CONCORD ROTARY	47,011	46,354	47,595	47,137		45,754	45,662	44,647	44,110		-0.7%
4003	CONCORD	RTE. 62	AT ACTON T.L.	13,900			11,100			13,600			12,100	-1.3%
4172 L	ACTON	RTE. 2	1.6 km WEST OF RTE.27	37,736	38,060	38,331	38,094	39,693				36,774		0.7%
4002	ACTON	RTE. 2A & 119	AT LITTLETON T.L.		17,500			15,500			15,200			-2.3%
4001	ACTON	RTE. 27	NORTH OF RTE.2A		10,200			10,400			10,000			-0.3%
4002	ACTON	RTE.119 & 2A	AT LITTLETON T.L.		17,500			15,500						-4.0%
4167	ACTON	SCHOOL ST.	WEST OF PARKER ST.			3,000			4,000			3,200		1.4%
4153	BEDFORD	OLD BILLERICA RD.	WEST OF RTE.3		4,400	3,600			3,800			3,600		-6.0%
4013	LINCOLN	RTE. 2	AT LEXINGTON T.L.	50,100			47,600			48,700			46,200	-0.9%
4008	MAYNARD	RTE. 62	AT STOW T.L.						12,500			12,200		-0.8%
4009	SUDBURY	PEAKHAM RD.	NORTH OF AUSTIN RD.		1,500			2,100			2,400			8.2%

Average Growth: -0.7%

Say 1.0%

CRASH DATA AND CRASH RATE WORKSHEETS

	Crash Date	Crash Time	Total Nonfatal Injuries	Manner of Collision	Road Surface Condition	Weather Condition	Light Conditions
1	5-Sep-12	1:48 PM	0	Single vehicle crash	Dry	Clear	Daylight
2	29-Dec-12	7:33 PM	0	Sideswipe, opposite direction	Snow	Snow	Dark - lighted roadway
3	10-Jan-13	4:25 PM	0	Angle	Dry	Clear	Dusk
4	21-Jan-13	4:48 PM	0	Angle	Dry	Cloudy	Dusk
5	10-Nov-14	4:10 PM	0	Rear-end	Dry	Clear	Dusk
6	11/18/2014	11:15 AM	0	Rear-Side	Dry	Clear	Daylight

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Concord | COUNT DATE : Mar-13

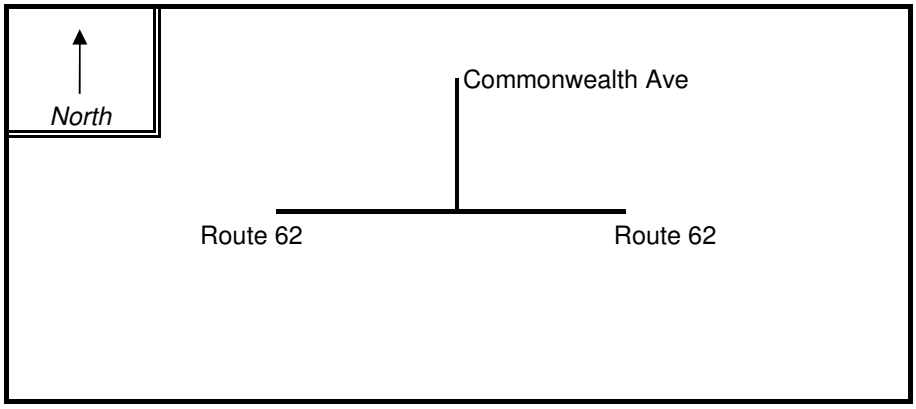
DISTRICT : 4 | UNSIGNALIZED : | SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Main Street (Route 62)

MINOR STREET(S) : Commonwealth Avenue

INTERSECTION DIAGRAM
(Label Approaches)



Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/PM) :		249	401	1,109		1,759

" K " FACTOR : 0.077 | APPROACH ADT : 22,844 | **ADT** = TOTAL VOL/"K" FACT.

TOTAL # OF CRASHES : 6 | # OF YEARS : 3 | AVERAGE # OF CRASHES (**A**) : 2.00

CRASH RATE CALCULATION : 0.24

RATE = (A * 1,000,000) / (ADT * 365)

CAPACITY ANALYSIS AND QUEUE LENGTH ANALYSIS WORKSHEETS

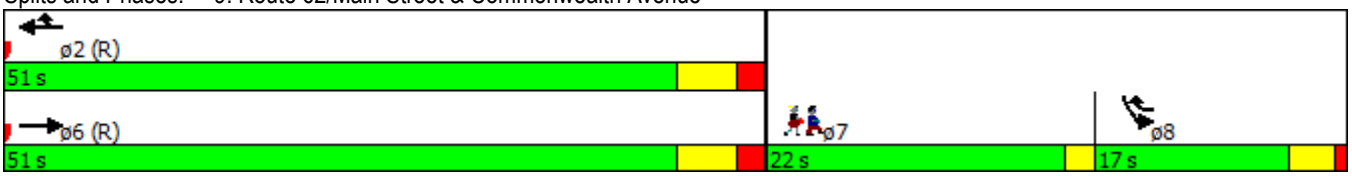
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	574	282	166	388	23	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	16	11	11	11	8	
Storage Length (ft)	0			150	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.992		
Flt Protected					0.955		
Satd. Flow (prot)	0	2051	1749	1501	1665	0	
Flt Permitted					0.955		
Satd. Flow (perm)	0	2051	1749	1501	1665	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				224	3		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.87	0.87	0.74	0.74	0.90	0.90	
Heavy Vehicles (%)	0%	5%	5%	4%	4%	13%	
Adj. Flow (vph)	0	660	381	224	431	26	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	660	381	224	457	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		10.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		51.0	51.0		17.0		22.0
Total Split (%)		56.7%	56.7%		18.9%		24%
Maximum Green (s)		45.0	45.0		13.0		20.0
Yellow Time (s)		4.0	4.0		3.0		2.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							10.0
Flash Dont Walk (s)							10.0
Pedestrian Calls (#/hr)							17
Act Effct Green (s)		46.0	46.0	79.2	27.2		
Actuated g/C Ratio		0.51	0.51	0.88	0.30		
v/c Ratio		0.63	0.43	0.17	0.90		
Control Delay		24.2	12.2	0.7	58.0		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		24.2	12.2	0.7	58.0		
LOS		C	B	A	E		
Approach Delay		24.2	7.9		58.0		
Approach LOS		C	A		E		
Queue Length 50th (ft)		348	95	0	209		
Queue Length 95th (ft)		496	76	6	#582		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				150			
Base Capacity (vph)		1048	893	1347	505		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.63	0.43	0.17	0.90		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 27.4	Intersection LOS: C
Intersection Capacity Utilization 60.6%	ICU Level of Service B
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



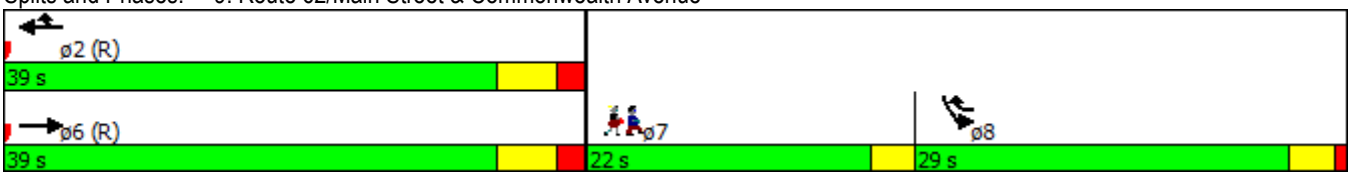
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	574	282	166	388	23	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	16	11	11	11	8	
Storage Length (ft)	0			175	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.992		
Flt Protected					0.955		
Satd. Flow (prot)	0	2051	1749	1501	1665	0	
Flt Permitted					0.955		
Satd. Flow (perm)	0	2051	1749	1501	1665	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				224	3		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.87	0.87	0.74	0.74	0.90	0.90	
Heavy Vehicles (%)	0%	5%	5%	4%	4%	13%	
Adj. Flow (vph)	0	660	381	224	431	26	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	660	381	224	457	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		7.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		39.0	39.0		29.0		22.0
Total Split (%)		43.3%	43.3%		32.2%		24%
Maximum Green (s)		33.0	33.0		25.0		19.0
Yellow Time (s)		4.0	4.0		3.0		3.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							7.0
Flash Dont Walk (s)							12.0
Pedestrian Calls (#/hr)							17
Act Effct Green (s)		44.9	44.9	79.2	28.3		
Actuated g/C Ratio		0.50	0.50	0.88	0.31		
v/c Ratio		0.65	0.44	0.17	0.87		
Control Delay		15.7	23.6	3.4	48.6		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		15.7	23.6	3.4	48.6		
LOS		B	C	A	D		
Approach Delay		15.7	16.2		48.6		
Approach LOS		B	B		D		
Queue Length 50th (ft)		247	102	0	221		
Queue Length 95th (ft)		#502	211	51	#444		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				175			
Base Capacity (vph)		1023	872	1334	527		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.65	0.44	0.17	0.87		

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 76 (84%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 24.6 Intersection LOS: C
Intersection Capacity Utilization 60.6% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



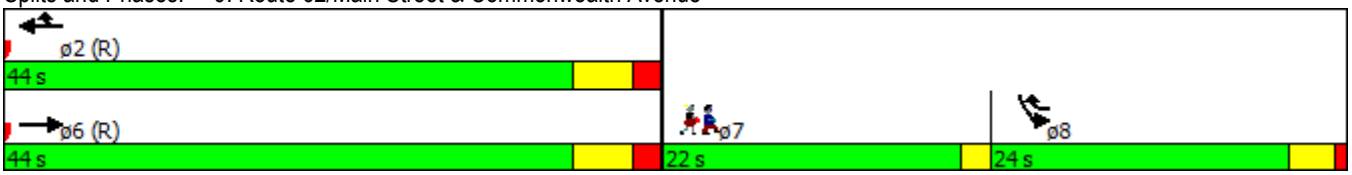
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	405	534	586	210	41	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	12	12	12	12	8	
Storage Length (ft)	0			150	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.978		
Flt Protected					0.960		
Satd. Flow (prot)	0	1863	1900	1599	1749	0	
Flt Permitted					0.960		
Satd. Flow (perm)	0	1863	1900	1599	1749	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				637	10		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.95	0.95	0.92	0.92	0.84	0.84	
Heavy Vehicles (%)	0%	2%	0%	1%	2%	2%	
Adj. Flow (vph)	0	426	580	637	250	49	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	426	580	637	299	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		10.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		44.0	44.0		24.0		22.0
Total Split (%)		48.9%	48.9%		26.7%		24%
Maximum Green (s)		38.0	38.0		20.0		20.0
Yellow Time (s)		4.0	4.0		3.0		2.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							10.0
Flash Dont Walk (s)							10.0
Pedestrian Calls (#/hr)							41
Act Effct Green (s)		49.0	49.0	73.8	19.8		
Actuated g/C Ratio		0.54	0.54	0.82	0.22		
v/c Ratio		0.42	0.56	0.45	0.76		
Control Delay		27.0	10.4	0.8	45.2		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		27.0	10.4	0.8	45.2		
LOS		C	B	A	D		
Approach Delay		27.0	5.4		45.2		
Approach LOS		C	A		D		
Queue Length 50th (ft)		128	150	0	152		
Queue Length 95th (ft)		336	m268	m0	222		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				150			
Base Capacity (vph)		1013	1033	1426	415		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.42	0.56	0.45	0.72		

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 23 (26%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 16.3 Intersection LOS: B
Intersection Capacity Utilization 49.7% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue

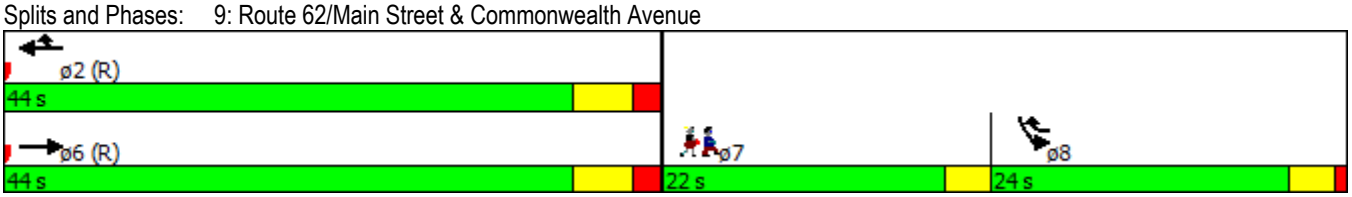


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	405	534	586	210	41	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	11	11	11	11	8	
Storage Length (ft)	0			175	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.978		
Flt Protected					0.960		
Satd. Flow (prot)	0	1801	1837	1546	1691	0	
Flt Permitted					0.960		
Satd. Flow (perm)	0	1801	1837	1546	1691	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				637	10		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.95	0.95	0.92	0.92	0.84	0.84	
Heavy Vehicles (%)	0%	2%	0%	1%	2%	2%	
Adj. Flow (vph)	0	426	580	637	250	49	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	426	580	637	299	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		7.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		44.0	44.0		24.0		22.0
Total Split (%)		48.9%	48.9%		26.7%		24%
Maximum Green (s)		38.0	38.0		20.0		19.0
Yellow Time (s)		4.0	4.0		3.0		3.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							7.0
Flash Dont Walk (s)							12.0
Pedestrian Calls (#/hr)							41
Act Effct Green (s)		48.8	48.8	73.8	20.0		
Actuated g/C Ratio		0.54	0.54	0.82	0.22		
v/c Ratio		0.44	0.58	0.46	0.78		
Control Delay		28.0	10.0	0.9	46.9		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		28.0	10.0	0.9	46.9		
LOS		C	B	A	D		
Approach Delay		28.0	5.2		46.9		
Approach LOS		C	A		D		
Queue Length 50th (ft)		135	119	0	153		
Queue Length 95th (ft)		348	m231	m0	224		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				175			
Base Capacity (vph)		976	995	1382	404		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.44	0.58	0.46	0.74		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 20 (22%), Referenced to phase 2:WBT and 6:EBT, Start of Green	
Natural Cycle: 70	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.78	
Intersection Signal Delay: 16.7	Intersection LOS: B
Intersection Capacity Utilization 49.7%	ICU Level of Service A
Analysis Period (min) 15	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



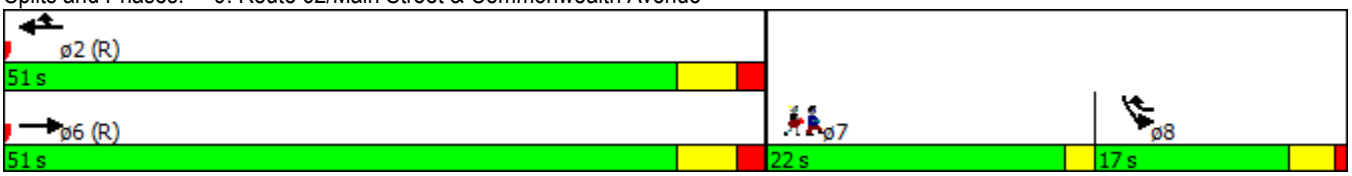
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	634	311	183	428	26	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	16	11	11	11	8	
Storage Length (ft)	0			150	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.992		
Flt Protected					0.955		
Satd. Flow (prot)	0	2051	1749	1501	1665	0	
Flt Permitted					0.955		
Satd. Flow (perm)	0	2051	1749	1501	1665	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				247	3		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.87	0.87	0.74	0.74	0.90	0.90	
Heavy Vehicles (%)	0%	5%	5%	4%	4%	13%	
Adj. Flow (vph)	0	729	420	247	476	29	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	729	420	247	505	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		10.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		51.0	51.0		17.0		22.0
Total Split (%)		56.7%	56.7%		18.9%		24%
Maximum Green (s)		45.0	45.0		13.0		20.0
Yellow Time (s)		4.0	4.0		3.0		2.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							10.0
Flash Dont Walk (s)							10.0
Pedestrian Calls (#/hr)							17
Act Effct Green (s)		46.0	46.0	79.2	27.2		
Actuated g/C Ratio		0.51	0.51	0.88	0.30		
v/c Ratio		0.70	0.47	0.18	1.00		
Control Delay		25.6	12.8	0.9	76.5		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		25.6	12.8	0.9	76.5		
LOS		C	B	A	E		
Approach Delay		25.6	8.4		76.5		
Approach LOS		C	A		E		
Queue Length 50th (ft)		405	105	0	240		
Queue Length 95th (ft)		541	94	13	#648		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				150			
Base Capacity (vph)		1048	893	1350	505		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.70	0.47	0.18	1.00		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.00	
Intersection Signal Delay: 33.1	Intersection LOS: C
Intersection Capacity Utilization 66.2%	ICU Level of Service C
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



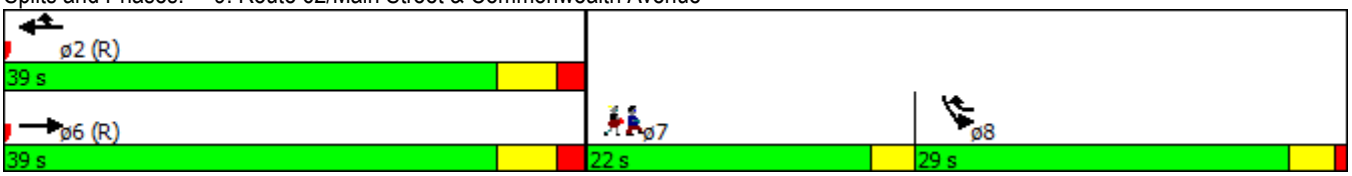
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	634	311	183	428	26	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	16	11	11	11	8	
Storage Length (ft)	0			175	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.992		
Flt Protected					0.955		
Satd. Flow (prot)	0	2051	1749	1501	1665	0	
Flt Permitted					0.955		
Satd. Flow (perm)	0	2051	1749	1501	1665	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				247	3		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.87	0.87	0.74	0.74	0.90	0.90	
Heavy Vehicles (%)	0%	5%	5%	4%	4%	13%	
Adj. Flow (vph)	0	729	420	247	476	29	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	729	420	247	505	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		7.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		39.0	39.0		29.0		22.0
Total Split (%)		43.3%	43.3%		32.2%		24%
Maximum Green (s)		33.0	33.0		25.0		19.0
Yellow Time (s)		4.0	4.0		3.0		3.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							7.0
Flash Dont Walk (s)							12.0
Pedestrian Calls (#/hr)							17
Act Effct Green (s)		40.7	40.7	79.2	32.5		
Actuated g/C Ratio		0.45	0.45	0.88	0.36		
v/c Ratio		0.79	0.53	0.18	0.84		
Control Delay		22.4	26.2	3.2	42.9		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		22.4	26.2	3.2	42.9		
LOS		C	C	A	D		
Approach Delay		22.4	17.7		42.9		
Approach LOS		C	B		D		
Queue Length 50th (ft)		312	119	0	238		
Queue Length 95th (ft)		#569	230	47	#510		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				175			
Base Capacity (vph)		927	791	1350	603		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.79	0.53	0.18	0.84		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 76 (84%), Referenced to phase 2:WBT and 6:EBT, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.84	
Intersection Signal Delay: 26.2	Intersection LOS: C
Intersection Capacity Utilization 66.2%	ICU Level of Service C
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



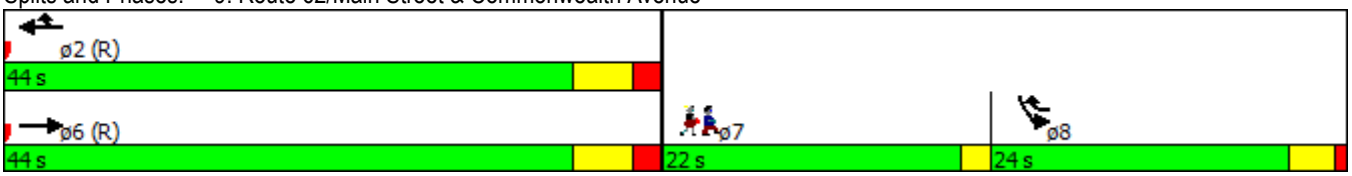
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	447	590	647	232	46	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	12	12	12	12	8	
Storage Length (ft)	0			150	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.978		
Flt Protected					0.960		
Satd. Flow (prot)	0	1863	1900	1599	1749	0	
Flt Permitted					0.960		
Satd. Flow (perm)	0	1863	1900	1599	1749	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				703	10		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.95	0.95	0.92	0.92	0.84	0.84	
Heavy Vehicles (%)	0%	2%	0%	1%	2%	2%	
Adj. Flow (vph)	0	471	641	703	276	55	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	471	641	703	331	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		10.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		44.0	44.0		24.0		22.0
Total Split (%)		48.9%	48.9%		26.7%		24%
Maximum Green (s)		38.0	38.0		20.0		20.0
Yellow Time (s)		4.0	4.0		3.0		2.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							10.0
Flash Dont Walk (s)							10.0
Pedestrian Calls (#/hr)							41
Act Effct Green (s)		48.1	48.1	73.8	20.7		
Actuated g/C Ratio		0.53	0.53	0.82	0.23		
v/c Ratio		0.47	0.63	0.49	0.81		
Control Delay		28.0	11.7	0.8	48.5		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		28.0	11.7	0.8	48.5		
LOS		C	B	A	D		
Approach Delay		28.0	6.0		48.5		
Approach LOS		C	A		D		
Queue Length 50th (ft)		141	187	0	173		
Queue Length 95th (ft)		369	m242	m0	#270		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				150			
Base Capacity (vph)		995	1015	1434	422		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.47	0.63	0.49	0.78		

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 23 (26%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 17.4 Intersection LOS: B
Intersection Capacity Utilization 54.2% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

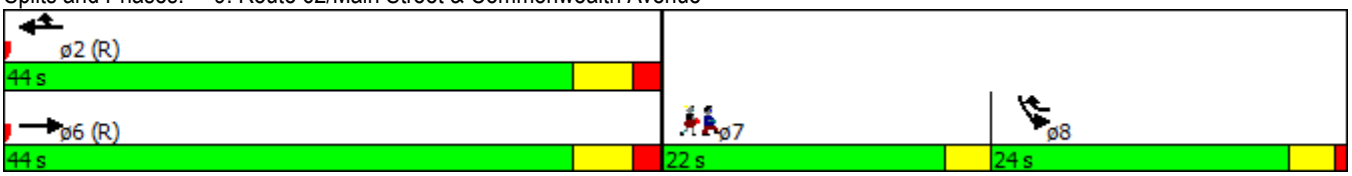
Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Lane Configurations							
Volume (vph)	0	447	590	647	232	46	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	11	11	11	11	8	
Storage Length (ft)	0			175	0	0	
Storage Lanes	0			1	1	0	
Taper Length (ft)	25				25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850	0.978		
Flt Protected					0.960		
Satd. Flow (prot)	0	1801	1837	1546	1691	0	
Flt Permitted					0.960		
Satd. Flow (perm)	0	1801	1837	1546	1691	0	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)				703	10		
Link Speed (mph)		30	30		30		
Link Distance (ft)		873	991		835		
Travel Time (s)		19.8	22.5		19.0		
Peak Hour Factor	0.95	0.95	0.92	0.92	0.84	0.84	
Heavy Vehicles (%)	0%	2%	0%	1%	2%	2%	
Adj. Flow (vph)	0	471	641	703	276	55	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	471	641	703	331	0	
Turn Type		NA	NA	pt+ov	Prot		
Protected Phases		6	2	2 8	8		7
Permitted Phases							
Detector Phase		6	2	2 8	8		
Switch Phase							
Minimum Initial (s)		10.0	10.0		8.0		7.0
Minimum Split (s)		16.0	16.0		12.5		22.0
Total Split (s)		44.0	44.0		24.0		22.0
Total Split (%)		48.9%	48.9%		26.7%		24%
Maximum Green (s)		38.0	38.0		20.0		19.0
Yellow Time (s)		4.0	4.0		3.0		3.0
All-Red Time (s)		2.0	2.0		1.0		0.0
Lost Time Adjust (s)		-1.0	-1.0		-1.0		
Total Lost Time (s)		5.0	5.0		3.0		
Lead/Lag					Lag		Lead
Lead-Lag Optimize?					Yes		Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0
Recall Mode		C-Max	C-Max		None		None
Walk Time (s)							7.0
Flash Dont Walk (s)							12.0
Pedestrian Calls (#/hr)							41
Act Effct Green (s)		47.8	47.8	73.8	21.0		
Actuated g/C Ratio		0.53	0.53	0.82	0.23		
v/c Ratio		0.49	0.66	0.50	0.82		
Control Delay		28.7	11.6	0.9	50.3		
Queue Delay		0.0	0.0	0.0	0.0		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø7
Total Delay		28.7	11.6	0.9	50.3		
LOS		C	B	A	D		
Approach Delay		28.7	6.0		50.3		
Approach LOS		C	A		D		
Queue Length 50th (ft)		150	157	0	174		
Queue Length 95th (ft)		381	m208	m0	#278		
Internal Link Dist (ft)		793	911		755		
Turn Bay Length (ft)				175			
Base Capacity (vph)		956	976	1390	412		
Starvation Cap Reductn		0	0	0	0		
Spillback Cap Reductn		0	0	0	0		
Storage Cap Reductn		0	0	0	0		
Reduced v/c Ratio		0.49	0.66	0.51	0.80		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 20 (22%), Referenced to phase 2:WBT and 6:EBT, Start of Green	
Natural Cycle: 80	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.82	
Intersection Signal Delay: 17.8	Intersection LOS: B
Intersection Capacity Utilization 54.2%	ICU Level of Service A
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Route 62/Main Street & Commonwealth Avenue