



Memorandum

To: Mr. Herbert Nolan
Solomon Foundation
10 Laurel Avenue, Suite 200
Wellesley, MA 02481

Date: May 13, 2014

Project No.: 12568.00

From: Matt Kealey, P.E., PTOE
Project Manager

Re: Greenough Boulevard
Watertown and Cambridge, Massachusetts

Kathleen Keen, EIT
Engineer

INTRODUCTION

Vanasse Hangen Brustlin, Inc. has completed an intersection capacity analyses for Greenough Boulevard at Grove Street in Watertown, MA. The results of the analysis will be used to support the proposed Riverfront Park Restoration Project.

TRAFFIC COUNT DATA

Traffic count data were collected in the form of turning movement counts (TMC) at the intersection of Greenough Boulevard and Grove Street and two automatic traffic recorders (ATR), which were placed across Greenough Blvd to the east and to the west of Grove Street. The TMCs were conducted from 7:00 to 9:00 AM and 4:00 to 6:00 PM on Wednesday, January 15, 2014. The ATR data were collected over a 48 hour period concurrent with the TMCs, on Tuesday and Wednesday, January 13-14, 2014. All traffic count data is included in the Attachments to this memorandum.

SEASONALITY OF TRAFFIC COUNT DATA

Comparison of the January traffic counts with historic seasonal data available from MassDOT showed that the January counts are lower than average season counts. In order to adjust the counts to average season, a seasonal adjustment factor of 1.03 was applied. The MassDOT seasonal adjustment factors are provided in the Attachments.

REGIONAL GROWTH

Based on discussions at public meetings held for this project, concerns were raised about the amount of future development that is planned in this area and the potential traffic impacts that future development could have on Greenough Boulevard. As such, through discussions with the Town of Watertown Department of Community Development and Planning, VHB identified future development or redevelopment projects in and around this area that could potentially impact traffic volumes along Greenough Boulevard. Table 1 lists the projects, their location, type and status.

Table 1 Planned or Projects Currently Under Review

Project Name	Address	Project type	Status
Repton Place Phase II	Pleasant Street	202 dwelling units	Under construction
Alta at the Estate	Waltham Street	150 dwelling units	Under construction
Bacon Howard development	Bacon Street	65 dwelling units with 10,000 sf retail	Approved
Residence at Watertown Square	Spring Street	90 assisted living units	Under construction
Ionics Site	Arsenal Street	297 dwelling units with 37,000 sf retail/grocery	Submitted and under review
Pirolli Site	Arsenal St & Irving	288 dwelling units with 14,100 sf retail	Submitted and under review
Reinvention/Expansion of Arsenal on the Charles	Arsenal Street	100,000 sf office with 50,000 sf retail	Preliminary Planning Stage
Arsenal Mall	Arsenal Street	Mixed use redevelopment	Preliminary Planning Stage
270 Pleasant Street	Pleasant Street	Mixed use development	Under construction
Lexus expansion	Arsenal Street	Relocate used car dealership	Approved
Saab dealership	Arsenal Street	148 room Hotel	Preliminary Planning Stage
33 Mt. Auburn Street	Mt. Auburn Street	24 dwelling units, 1,900 sf of retail	Submitted and under review
36 River Street (Waltham)	River Street	200 dwelling units	Under construction

Source: Town of Watertown

As shown in Table 1, there are currently 13 projects planned in the area. Of the 13 projects in the table, two projects (The Residence at Watertown Square and the Lexus expansion) are not expected to add traffic to Greenough Boulevard. Traffic associated with the remaining projects was evaluated either based on available traffic impact and access studies, or based on trip generation projections using the Institute of Transportation Engineers' publication, *Trip Generation, 9th Edition*. Also shown in Table 2, the background projects are in various stages of development ranging from preliminary planning to construction. Three of the projects (Expansion of Arsenal on the Charles, Arsenal Mall Expansion, and the proposed hotel on the Saab dealership site) have not been formally submitted to the Town of Watertown for review. While the Arsenal on the Charles and the Saab dealership projects appear to have established build programs, the details of the Arsenal Mall project are still unknown at this time. For the purposes of this assessment, it was assumed that an expansion of 50,000 sf of retail/entertainment/restaurant space would be included. Traffic volumes associated with each of the contributing background projects are provided in the Attachments.

INTERSECTION CAPACITY ANALYSIS

An intersection capacity analysis was completed for the intersection of Greenough Boulevard at Grove Street for 2014 existing conditions, 2024 No-Build conditions and 2024 Build conditions during the weekday morning and weekday evening peak hours. The analysis used Synchro 8 software, which is based on the criteria from the 2010 Highway Capacity Manual (HCM)¹. To obtain the 2024 volumes, traffic volumes generated by the future

¹ Highway Capacity Manual, Transportation Research Board, Washington D.C. [2010].

projects in Table 1 were added to the 2014 existing volumes. The resulting 2024 volumes are provided in the Attachments to this memorandum. Existing, No-Build, and Build level of service results are presented in Table 2 and included in the Attachments. The analysis conditions summarized in Table 2 are as follows:

- **2014 Existing conditions** – represents existing traffic volumes with existing intersection geometry
- **2024 No Build conditions** – represents future traffic volumes including background project traffic with existing intersection geometry
- **2024 Build conditions** - represents future traffic volumes including background project traffic with the proposed intersection geometry. The proposed intersection geometry involves the removal of a through lane in the Greenough Boulevard eastbound approach.

Table 2 Signalized Intersection Capacity Analysis

Peak Period	Movement	2014 Existing Conditions					2024 No Build Conditions					2024 Build Conditions				
		v/c ¹	Delay ²	LOS ³	50 th Q ⁴	95 th Q ⁵	v/c	delay	LOS	50 th Q	95 th Q	v/c	delay	LOS	50 th Q	95 th Q
Weekday	Greenough Blvd EBL	0.73	40	D	81	122	0.73	42	D	81	121	0.68	35	C	81	121
Morning	Greenough Blvd EBT	0.60	32	C	115	165	0.62	32	C	135	191	0.92	55	E	299	#514
	Greenough Blvd WBT/R	0.67	21	C	88	155	0.71	25	C	122	197	0.58	21	C	120	197
	Grove St SBL	0.83	34	C	265	#582	0.85	39	D	288	#617	0.92	50	D	336	#617
	Grove St SBR	0.07	6	A	9	31	0.08	6	A	10	33	0.08	7	A	14	33
	Overall		29	C				32	C				39	D		
Weekday	Greenough Blvd EBL	0.59	23	C	45	106	0.63	28	C	48	137	0.64	29	C	49	141
Evening	Greenough Blvd EBT	0.34	20	C	50	105	0.38	21	C	72	142	0.68	29	C	159	324
	Greenough Blvd WBT/R	0.69	13	B	62	134	0.72	18	B	111	209	0.70	17	B	113	209
	Grove St SBL	0.68	32	C	98	223	0.71	37	D	115	246	0.72	38	D	121	246
	Grove St SBR	0.16	5	A	12	44	0.17	7	A	15	49	0.17	7	A	16	49
	Overall		18	B				22	C				23	C		

Source: VHB, Inc. using Synchro 8 software

1 Volume to capacity ratio

2 Vehicle delay, in seconds

3 Level of Service

4 50th percentile queue, in feet

5 95th percentile queue, in feet

~ Volume exceeds capacity, queue is theoretically infinite

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

n/a Lane configuration does not exist under condition

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound L = Left-turn; T = Through; R = Right-turn

As shown in Table 2, all movements operate at an acceptable LOS D or better under 2014 Existing conditions during both the weekday morning and weekday evening peak hours. Under 2024 No-Build conditions, all movements continue to operate at LOS D or better, with only minor increases in delay. Under 2024 Build conditions, the overall intersection operations drop from LOS C to LOS D during the weekday morning peak hour and remain at LOS C during the weekday evening peak hour. Between both analysis periods, the only movement that experiences a notable increase in delay and queuing is the Greenough Boulevard eastbound through movement during the weekday morning peak hour, which is associated with the removal of the second through lane. All other movements experience the same levels of service during both peak hours. It should be noted that the primary impact of the lane reduction is limited to the 95th percentile queue for the eastbound through movements. Average queue lengths will clear the intersection under one signal cycle. As such, the impact is limited to a small portion of one peak hour of the day.

CONCLUSION

VHB has evaluated the capacity at the intersection of Greenough Boulevard and Grove Street. The overall intersection capacity analysis results at Greenough Boulevard and Grove Street show acceptable operations during both the weekday morning and weekday evening peak hours under 2014 Existing, 2024 No Build and 2024 Build conditions. Under 2024 Build conditions, only minimal increases in delay are expected with the exception of the eastbound through movement during the weekday morning peak hour. While an increase in delay and queuing are expected, this movement will still operate under capacity and the impacts are limited to the peak hour. The analysis presented herein focuses on the two peak traffic hours of the day. For 23 hours of the day, reducing the cross-section of Greenough Boulevard would not have a significant impact on traffic operations.

In response to verbal and written comments at public meeting the concept of a “trial” lane closure to emulate future conditions along Greenough Boulevard has been reviewed. The trial lane closure could be implemented to assess operations in a corridor using the “Special Event” criteria in the 2009 Manual On Uniform Traffic Control Devices, under the guidance of “Temporary Traffic Control” in Part 6 (generally considered for construction traffic management). However, we would discourage the set-up of such a plan understanding how the intersection works today, how it will work in the future compared to the predictable skewed result of a trial lane closure. Experience has shown that a trial lane closure or a special event closure typically result in significantly reduced speeds and upwards of 25% reduction in roadway capacity. In addition placement of traffic control devices on the roadway can produce confusion to the motorists potentially resulting in an unsafe condition.

Attachments

- o Traffic Count Data
- o MassDOT Seasonal Adjustment Factors
- o 2014 Existing Traffic Volume Networks
- o Background Traffic Volume Networks
- o 2024 Future Traffic Volume Networks
- o Intersection Capacity Analyses

N: Grove Street
 E/W: Greenough Boulevard
 City, State: Watertown, MA
 Client: VHB/ K. Malakorn



File Name : 143701 A
 Site Code : 99901.15
 Start Date : 1/15/2014
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
07:00 AM	21	84	0	30	37	0	53	18	0	243
07:15 AM	17	102	0	33	48	0	52	37	0	289
07:30 AM	24	116	0	52	59	0	87	33	0	371
07:45 AM	18	130	0	78	74	0	93	47	0	440
Total	80	432	0	193	218	0	285	135	0	1343
08:00 AM	17	134	0	76	68	0	73	52	0	420
08:15 AM	16	153	1	66	67	0	117	58	0	478
08:30 AM	18	143	0	65	75	0	116	46	0	463
08:45 AM	26	127	0	45	75	0	111	52	0	436
Total	77	557	1	252	285	0	417	208	0	1797
Grand Total	157	989	1	445	503	0	702	343	0	3140
Apprch %	13.7	86.2	0.1	46.9	53.1	0	67.2	32.8	0	
Total %	5	31.5	0	14.2	16	0	22.4	10.9	0	
Cars	157	986	1	438	501	0	695	342	0	3120
% Cars	100	99.7	100	98.4	99.6	0	99	99.7	0	99.4
Heavy Vehicles	0	3	0	7	2	0	7	1	0	20
% Heavy Vehicles	0	0.3	0	1.6	0.4	0	1	0.3	0	0.6

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 07:45 AM													
07:45 AM	18	130	0	148	78	74	0	152	93	47	0	140	440
08:00 AM	17	134	0	151	76	68	0	144	73	52	0	125	420
08:15 AM	16	153	1	170	66	67	0	133	117	58	0	175	478
08:30 AM	18	143	0	161	65	75	0	140	116	46	0	162	463
Total Volume	69	560	1	630	285	284	0	569	399	203	0	602	1801
% App. Total	11	88.9	0.2		50.1	49.9	0		66.3	33.7	0		
PHF	.958	.915	.250	.926	.913	.947	.000	.936	.853	.875	.000	.860	.942
Cars	69	558	1	628	279	283	0	562	396	202	0	598	1788
% Cars	100	99.6	100	99.7	97.9	99.6	0	98.8	99.2	99.5	0	99.3	99.3
Heavy Vehicles	0	2	0	2	6	1	0	7	3	1	0	4	13
% Heavy Vehicles	0	0.4	0	0.3	2.1	0.4	0	1.2	0.8	0.5	0	0.7	0.7

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Groups Printed- Cars										
	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
07:00 AM	21	84	0	30	37	0	52	18	0	242
07:15 AM	17	102	0	33	48	0	52	37	0	289
07:30 AM	24	116	0	51	59	0	84	33	0	367
07:45 AM	18	130	0	78	73	0	92	47	0	438
Total	80	432	0	192	217	0	280	135	0	1336
08:00 AM	17	133	0	72	68	0	72	51	0	413
08:15 AM	16	152	1	65	67	0	116	58	0	475
08:30 AM	18	143	0	64	75	0	116	46	0	462
08:45 AM	26	126	0	45	74	0	111	52	0	434
Total	77	554	1	246	284	0	415	207	0	1784
Grand Total	157	986	1	438	501	0	695	342	0	3120
Apprch %	13.7	86.2	0.1	46.6	53.4	0	67	33	0	
Total %	5	31.6	0	14	16.1	0	22.3	11	0	

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 07:45 AM													
07:45 AM	18	130	0	148	78	73	0	151	92	47	0	139	438
08:00 AM	17	133	0	150	72	68	0	140	72	51	0	123	413
08:15 AM	16	152	1	169	65	67	0	132	116	58	0	174	475
08:30 AM	18	143	0	161	64	75	0	139	116	46	0	162	462
Total Volume	69	558	1	628	279	283	0	562	396	202	0	598	1788
% App. Total	11	88.9	0.2		49.6	50.4	0		66.2	33.8	0		
PHF	.958	.918	.250	.929	.894	.943	.000	.930	.853	.871	.000	.859	.941



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N: Grove Street
E/W: Greenough Boulevard
City, State: Watertown, MA
Client: VHB/ K. Malakorn

File Name : 143701 A
Site Code : 99901.15
Start Date : 1/15/2014
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Groups Printed- Heavy Vehicles

	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
07:00 AM	0	0	0	0	0	0	1	0	0	1
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	1	0	0	3	0	0	4
07:45 AM	0	0	0	0	1	0	1	0	0	2
Total	0	0	0	1	1	0	5	0	0	7
08:00 AM	0	1	0	4	0	0	1	1	0	7
08:15 AM	0	1	0	1	0	0	1	0	0	3
08:30 AM	0	0	0	1	0	0	0	0	0	1
08:45 AM	0	1	0	0	1	0	0	0	0	2
Total	0	3	0	6	1	0	2	1	0	13
Grand Total	0	3	0	7	2	0	7	1	0	20
Apprch %	0	100	0	77.8	22.2	0	87.5	12.5	0	
Total %	0	15	0	35	10	0	35	5	0	

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 07:30 AM													
07:30 AM	0	0	0	0	1	0	0	1	3	0	0	3	4
07:45 AM	0	0	0	0	0	1	0	1	1	0	0	1	2
08:00 AM	0	1	0	1	4	0	0	4	1	1	0	2	7
08:15 AM	0	1	0	1	1	0	0	1	1	0	0	1	3
Total Volume	0	2	0	2	6	1	0	7	6	1	0	7	16
% App. Total	0	100	0		85.7	14.3	0		85.7	14.3	0		
PHF	.000	.500	.000	.500	.375	.250	.000	.438	.500	.250	.000	.583	.571



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Groups Printed- Peds and Bikes

	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	1	0	0	1
07:30 AM	0	0	0	0	0	0	1	0	0	1
07:45 AM	0	1	0	0	0	0	1	0	0	2
Total	0	1	0	0	0	0	3	0	0	4
08:00 AM	0	0	0	0	0	0	2	0	1	3
08:15 AM	0	1	0	0	0	0	0	0	0	1
08:30 AM	0	2	0	0	0	0	0	0	0	2
08:45 AM	0	1	0	0	0	0	0	0	0	1
Total	0	4	0	0	0	0	2	0	1	7
Grand Total	0	5	0	0	0	0	5	0	1	11
Apprch %	0	100	0	0	0	0	83.3	0	16.7	
Total %	0	45.5	0	0	0	0	45.5	0	9.1	

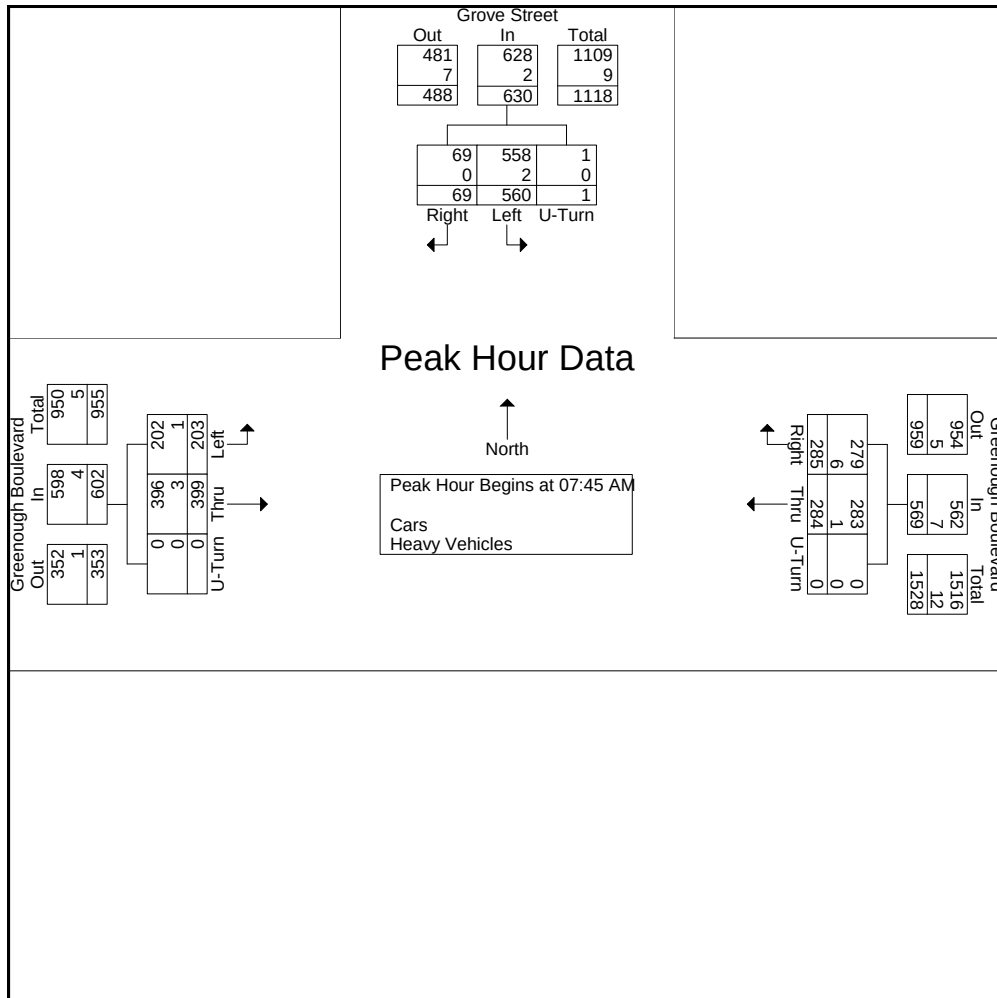
	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	1	0	1	0	0	0	0	1	0	0	1	2
08:00 AM	0	0	0	0	0	0	0	0	2	0	1	3	3
08:15 AM	0	1	0	1	0	0	0	0	0	0	0	0	1
08:30 AM	0	2	0	2	0	0	0	0	0	0	0	0	2
Total Volume	0	4	0	4	0	0	0	0	3	0	1	4	8
% App. Total	0	100	0		0	0	0		75	0	25		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.375	.000	.250	.333	.667

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	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 07:45 AM													
07:45 AM	18	130	0	148	78	74	0	152	93	47	0	140	440
08:00 AM	17	134	0	151	76	68	0	144	73	52	0	125	420
08:15 AM	16	153	1	170	66	67	0	133	117	58	0	175	478
08:30 AM	18	143	0	161	65	75	0	140	116	46	0	162	463
Total Volume	69	560	1	630	285	284	0	569	399	203	0	602	1801
% App. Total	11	88.9	0.2		50.1	49.9	0		66.3	33.7	0		
PHF	.958	.915	.250	.926	.913	.947	.000	.936	.853	.875	.000	.860	.942
Cars	69	558	1	628	279	283	0	562	396	202	0	598	1788
% Cars	100	99.6	100	99.7	97.9	99.6	0	98.8	99.2	99.5	0	99.3	99.3
Heavy Vehicles	0	2	0	2	6	1	0	7	3	1	0	4	13
% Heavy Vehicles	0	0.4	0	0.3	2.1	0.4	0	1.2	0.8	0.5	0	0.7	0.7





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Groups Printed- Cars

	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
04:00 PM	29	46	0	48	66	1	54	38	0	282
04:15 PM	23	54	0	55	73	0	49	57	0	311
04:30 PM	49	59	0	68	75	0	77	53	0	381
04:45 PM	40	58	0	70	64	0	70	41	0	343
Total	141	217	0	241	278	1	250	189	0	1317
05:00 PM	36	65	0	85	64	0	71	57	0	378
05:15 PM	21	64	0	78	57	0	78	67	0	365
05:30 PM	39	68	0	108	67	0	60	58	0	400
05:45 PM	26	53	0	119	74	0	72	38	1	383
Total	122	250	0	390	262	0	281	220	1	1526
Grand Total	263	467	0	631	540	1	531	409	1	2843
Apprch %	36	64	0	53.8	46.1	0.1	56.4	43.5	0.1	
Total %	9.3	16.4	0	22.2	19	0	18.7	14.4	0	

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 05:00 PM													
05:00 PM	36	65	0	101	85	64	0	149	71	57	0	128	378
05:15 PM	21	64	0	85	78	57	0	135	78	67	0	145	365
05:30 PM	39	68	0	107	108	67	0	175	60	58	0	118	400
05:45 PM	26	53	0	79	119	74	0	193	72	38	1	111	383
Total Volume	122	250	0	372	390	262	0	652	281	220	1	502	1526
% App. Total	32.8	67.2	0		59.8	40.2	0		56	43.8	0.2		
PHF	.782	.919	.000	.869	.819	.885	.000	.845	.901	.821	.250	.866	.954



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N: Grove Street
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City, State: Watertown, MA
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	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
04:00 PM	0	0	0	0	2	0	0	0	0	2
04:15 PM	1	1	0	0	0	0	0	2	0	4
04:30 PM	0	0	0	1	1	0	0	1	0	3
04:45 PM	0	1	0	0	1	0	0	0	0	2
Total	1	2	0	1	4	0	0	3	0	11
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	1	0	0	0	0	1
05:30 PM	0	0	0	1	2	0	0	0	0	3
05:45 PM	0	0	0	2	0	0	0	0	0	2
Total	0	0	0	3	3	0	0	0	0	6
Grand Total	1	2	0	4	7	0	0	3	0	17
Apprch %	33.3	66.7	0	36.4	63.6	0	0	100	0	
Total %	5.9	11.8	0	23.5	41.2	0	0	17.6	0	

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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	2	0	2	0	0	0	0	2
04:15 PM	1	1	0	2	0	0	0	0	0	2	0	2	4
04:30 PM	0	0	0	0	1	1	0	2	0	1	0	1	3
04:45 PM	0	1	0	1	0	1	0	1	0	0	0	0	2
Total Volume	1	2	0	3	1	4	0	5	0	3	0	3	11
% App. Total	33.3	66.7	0		20	80	0		0	100	0		
PHF	.250	.500	.000	.375	.250	.500	.000	.625	.000	.375	.000	.375	.688



PRECISION
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INDUSTRIES, LLC

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Email: datarequests@pdillc.com

N: Grove Street
E/W: Greenough Boulevard
City, State: Watertown, MA
Client: VHB/ K. Malakorn

File Name : 143701 AA
Site Code : 99901.15
Start Date : 1/15/2014
Page No : 1

Groups Printed- Peds and Bikes

	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	0	0	0	3	0	0	3
04:15 PM	0	0	0	1	0	0	1	0	0	2
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	1	0	0	0	0	0	2	0	1	4
Total	1	0	0	1	0	0	6	0	1	9
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	1	0	1
05:30 PM	0	0	0	0	1	0	0	0	0	1
05:45 PM	0	0	0	0	0	1	0	0	0	1
Total	0	0	0	0	1	1	0	1	0	3
Grand Total	1	0	0	1	1	1	6	1	1	12
Apprch %	100	0	0	33.3	33.3	33.3	75	12.5	12.5	
Total %	8.3	0	0	8.3	8.3	8.3	50	8.3	8.3	

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	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 04:00 PM													
04:00 PM	0	0	0	0	0	0	0	0	3	0	0	3	3
04:15 PM	0	0	0	0	1	0	0	1	1	0	0	1	2
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	1	0	0	1	0	0	0	0	2	0	1	3	4
Total Volume	1	0	0	1	1	0	0	1	6	0	1	7	9
% App. Total	100	0	0		100	0	0		85.7	0	14.3		
PHF	.250	.000	.000	.250	.250	.000	.000	.250	.500	.000	.250	.583	.563



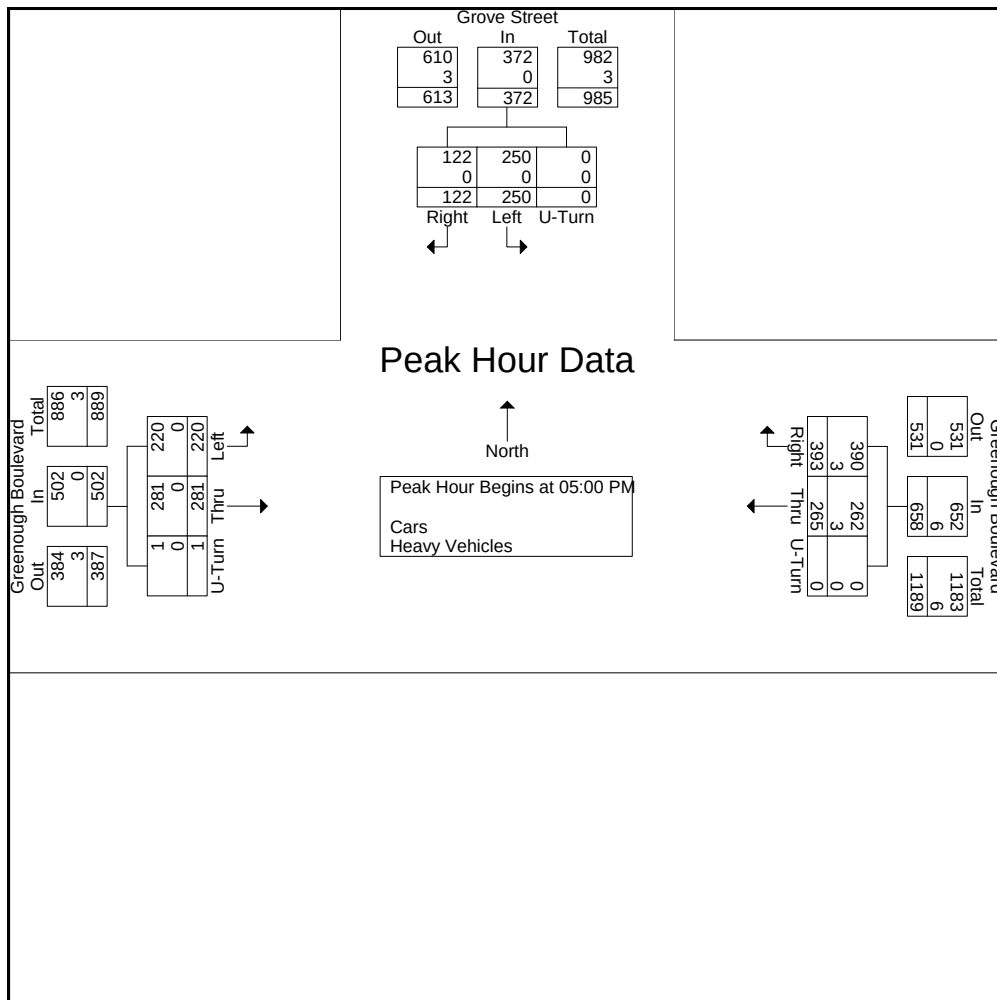
PRECISION
D A T A
INDUSTRIES, LLC

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N: Grove Street
E/W: Greenough Boulevard
City, State: Watertown, MA
Client: VHB/ K. Malakorn

File Name : 143701 AA
Site Code : 99901.15
Start Date : 1/15/2014
Page No : 1

	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	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 05:00 PM													
05:00 PM	36	65	0	101	85	64	0	149	71	57	0	128	378
05:15 PM	21	64	0	85	78	58	0	136	78	67	0	145	366
05:30 PM	39	68	0	107	109	69	0	178	60	58	0	118	403
05:45 PM	26	53	0	79	121	74	0	195	72	38	1	111	385
Total Volume	122	250	0	372	393	265	0	658	281	220	1	502	1532
% App. Total	32.8	67.2	0		59.7	40.3	0		56	43.8	0.2		
PHF	.782	.919	.000	.869	.812	.895	.000	.844	.901	.821	.250	.866	.950
Cars	122	250	0	372	390	262	0	652	281	220	1	502	1526
% Cars	100	100	0	100	99.2	98.9	0	99.1	100	100	100	100	99.6
Heavy Vehicles	0	0	0	0	3	3	0	6	0	0	0	0	6
% Heavy Vehicles	0	0	0	0	0.8	1.1	0	0.9	0	0	0	0	0.4



Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



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

143701 A CLASS
Site Code: 99901.15
Date Start: 14-Jan-14

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
01/14/1														
4	0	15	4	0	1	0	0	0	0	0	0	0	0	20
01:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
02:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
03:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
04:00	0	14	0	0	0	0	0	0	0	0	0	0	0	14
05:00	0	39	6	0	6	0	0	0	0	0	0	0	0	51
06:00	0	103	32	1	8	0	0	1	0	0	0	0	0	145
07:00	0	214	60	0	7	0	0	4	0	0	0	0	0	285
08:00	0	275	56	0	21	0	0	5	0	2	0	0	0	359
09:00	1	247	66	0	11	0	0	4	0	0	0	0	0	329
10:00	2	184	48	0	21	0	0	3	0	0	0	0	0	258
11:00	0	172	64	1	14	0	0	0	0	0	0	0	0	251
12 PM	1	184	53	0	16	0	0	7	0	0	0	0	0	261
13:00	0	187	58	1	16	0	0	4	0	0	0	0	0	266
14:00	0	181	57	0	13	0	0	3	0	0	0	0	0	254
15:00	1	250	89	0	9	0	0	3	0	0	0	0	0	352
16:00	2	244	78	1	13	0	0	2	0	0	0	0	0	340
17:00	0	173	175	0	9	0	0	3	0	0	0	0	0	360
18:00	0	104	165	0	36	0	0	2	0	1	0	0	0	308
19:00	0	9	153	0	40	0	0	1	0	0	0	0	0	203
20:00	0	10	134	0	28	0	0	0	0	0	0	0	0	172
21:00	0	10	96	0	11	0	0	0	0	0	0	0	0	117
22:00	0	6	68	0	14	0	0	0	0	0	0	0	0	88
23:00	1	1	25	0	6	0	0	0	0	0	0	0	0	33
Total	8	2631	1490	4	300	0	0	42	0	3	0	0	0	4478
Percent	0.2%	58.8%	33.3%	0.1%	6.7%	0.0%	0.0%	0.9%	0.0%	0.1%	0.0%	0.0%	0.0%	
AM Peak	10:00	08:00	09:00	06:00	08:00			08:00		08:00				08:00
Vol.	2	275	66	1	21			5		2				359
PM Peak	16:00	15:00	17:00	13:00	19:00			12:00		18:00				17:00
Vol.	2	250	175	1	40			7		1				360

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



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143701 A CLASS
Site Code: 99901.15
Date Start: 14-Jan-14

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
01/15/1														
4	0	4	10	0	3	0	0	0	0	0	0	0	0	17
01:00	0	1	3	0	0	0	0	0	0	0	0	0	0	4
02:00	0	1	4	0	1	0	0	0	0	0	0	0	0	6
03:00	0	0	4	0	2	1	0	0	0	0	0	0	0	7
04:00	0	0	13	0	3	1	0	0	0	0	0	0	0	17
05:00	0	19	25	1	8	0	0	0	0	0	0	0	0	53
06:00	0	97	29	1	14	0	0	1	0	0	0	0	0	142
07:00	1	195	61	0	14	0	0	2	0	0	0	0	0	273
08:00	0	283	44	1	9	0	0	3	0	0	0	0	0	340
09:00	0	258	64	0	21	0	0	3	0	0	0	0	0	346
10:00	0	197	72	0	20	0	0	4	0	0	0	0	0	293
11:00	1	188	63	1	11	0	0	0	0	0	0	0	0	264
12 PM	0	177	63	1	11	0	0	4	0	0	0	0	0	256
13:00	1	177	57	0	14	0	0	1	0	0	0	0	0	250
14:00	1	196	68	0	9	1	0	6	0	0	0	0	0	281
15:00	0	222	84	1	11	0	0	10	0	1	0	0	0	329
16:00	0	299	79	1	8	0	0	6	0	2	0	0	0	395
17:00	3	279	42	1	6	0	0	9	0	1	0	0	0	341
18:00	0	256	39	3	7	0	0	5	0	0	0	0	0	310
19:00	0	180	23	0	3	0	0	4	0	0	0	0	0	210
20:00	0	136	21	0	4	1	0	0	0	1	0	0	0	163
21:00	0	107	17	0	5	0	0	2	0	0	0	0	0	131
22:00	0	67	20	0	1	0	0	1	0	0	0	0	0	89
23:00	0	39	10	0	0	0	0	0	0	0	0	0	0	49
Total	7	3378	915	11	185	4	0	61	0	5	0	0	0	4566
Percent	0.2%	74.0%	20.0%	0.2%	4.1%	0.1%	0.0%	1.3%	0.0%	0.1%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	10:00	05:00	09:00	03:00		10:00						09:00
Vol.	1	283	72	1	21	1		4						346
PM Peak	17:00	16:00	15:00	18:00	13:00	14:00		15:00		16:00				16:00
Vol.	3	299	84	3	14	1		10		2				395
Total		6009	2405	15	485	4	0	103	0	8	0	0	0	9044

Greenough Blvd
west of Grove Street
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Client: VHB / K. Malakorn



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Email: datarequests@pdillc.com

143701 A CLASS
Site Code: 99901.15
Date Start: 14-Jan-14

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
01/14/1														
4	0	8	5	0	1	0	0	0	0	0	0	0	0	14
01:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
02:00	0	2	1	0	1	0	0	0	0	0	0	0	0	4
03:00	0	8	5	0	0	0	0	0	0	0	0	0	0	13
04:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
05:00	0	37	8	0	1	0	0	0	0	0	0	0	0	46
06:00	0	142	43	0	5	0	0	0	0	0	0	0	0	190
07:00	0	307	69	2	13	0	0	2	0	0	0	0	0	393
08:00	1	417	92	0	13	0	0	5	0	0	0	0	0	528
09:00	0	205	62	1	15	0	0	0	0	0	0	0	0	283
10:00	1	163	51	0	15	1	0	0	0	0	0	0	0	231
11:00	0	169	64	0	18	0	0	1	0	0	0	0	0	252
12 PM	0	172	66	0	18	0	0	3	0	0	0	0	0	259
13:00	0	181	65	0	14	0	0	0	0	0	0	0	0	260
14:00	0	218	80	0	21	0	0	4	0	0	0	0	0	323
15:00	1	248	88	1	20	0	0	3	0	0	0	0	0	361
16:00	0	308	97	1	17	0	0	0	0	0	0	0	0	423
17:00	2	354	92	0	9	0	0	0	0	0	0	0	0	457
18:00	0	302	74	0	5	0	0	0	0	0	0	0	0	381
19:00	0	131	54	0	4	0	0	1	0	0	0	0	0	190
20:00	1	72	84	0	3	0	0	0	0	0	0	0	0	160
21:00	0	56	57	0	4	0	0	0	0	0	0	0	0	117
22:00	0	38	37	0	5	0	0	0	0	0	0	0	0	80
23:00	0	25	25	0	3	0	0	0	0	0	0	0	0	53
Total	6	3579	1222	5	205	1	0	19	0	0	0	0	0	5037
Percent	0.1%	71.1%	24.3%	0.1%	4.1%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	11:00	10:00		08:00						08:00
Vol.	1	417	92	2	18	1		5						528
PM Peak	17:00	17:00	16:00	15:00	14:00			14:00						17:00
Vol.	2	354	97	1	21			4						457

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



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143701 A CLASS
Site Code: 99901.15
Date Start: 14-Jan-14

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
01/15/1														
4	0	10	6	0	1	0	0	0	0	0	0	0	0	17
01:00	0	7	6	0	0	0	0	0	0	0	0	0	0	13
02:00	0	2	3	0	1	0	0	0	0	0	0	0	0	6
03:00	0	2	6	0	2	2	0	0	0	0	0	0	0	12
04:00	0	1	6	0	1	1	0	0	0	0	0	0	0	9
05:00	0	6	28	0	3	0	0	0	0	0	0	0	0	37
06:00	0	16	127	0	18	0	0	1	0	0	0	0	0	162
07:00	0	48	312	1	29	1	0	8	0	0	0	0	0	399
08:00	1	69	386	0	60	0	0	10	0	0	0	0	0	526
09:00	0	25	221	1	47	0	0	1	0	0	0	0	0	295
10:00	0	25	149	0	35	1	0	6	0	0	0	0	0	216
11:00	0	21	157	1	43	0	0	3	0	0	0	0	0	225
12 PM	0	86	140	1	28	0	0	1	0	0	0	0	0	256
13:00	0	99	157	1	30	0	0	6	0	1	0	0	0	294
14:00	1	114	181	0	20	0	0	3	0	0	0	0	0	319
15:00	2	135	212	0	35	0	0	5	0	0	0	0	0	389
16:00	0	177	197	2	25	0	0	13	0	0	0	0	0	414
17:00	0	211	226	0	16	1	0	14	0	0	0	0	0	468
18:00	0	174	183	2	8	0	0	7	0	0	0	0	0	374
19:00	0	98	103	0	9	0	0	1	0	0	0	0	0	211
20:00	0	61	76	1	6	0	0	2	0	0	0	0	0	146
21:00	0	61	60	1	3	0	0	1	0	0	0	0	0	126
22:00	0	39	48	0	4	0	0	1	0	0	0	0	0	92
23:00	0	19	32	0	4	0	0	0	0	0	0	0	0	55
Total	4	1506	3022	11	428	6	0	83	0	1	0	0	0	5061
Percent	0.1%	29.8%	59.7%	0.2%	8.5%	0.1%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	08:00	03:00		08:00						08:00
Vol.	1	69	386	1	60	2		10						526
PM Peak	15:00	17:00	17:00	16:00	15:00	17:00		17:00		13:00				17:00
Vol.	2	211	226	2	35	1		14		1				468
Total		5085	4244	16	633	7	0	102	0	1	0	0	0	10098



PRECISION
DATA
INDUSTRIES, LLC

143701 A SPEED
Site Code: 99901.15
Date Start: 14-Jan-14

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
01/14/14	0	0	0	0	2	2	5	6	4	1	0	0	0	20	51	45
01:00	0	0	0	0	1	1	2	0	0	0	0	0	0	4	42	38
02:00	0	0	0	0	0	0	1	2	0	0	0	0	0	3	48	45
03:00	1	0	0	0	0	0	1	1	1	0	1	0	0	5	59	38
04:00	0	0	0	0	0	3	3	6	1	1	0	0	0	14	49	45
05:00	0	0	0	0	0	4	18	22	5	2	0	0	0	51	49	45
06:00	0	0	0	0	3	32	62	29	14	4	1	0	0	145	48	43
07:00	0	0	0	1	14	54	119	64	24	6	2	0	1	285	48	43
08:00	0	0	0	0	6	80	142	94	30	6	1	0	0	359	48	43
09:00	0	2	0	1	10	49	137	95	26	8	1	0	0	329	48	43
10:00	0	0	0	1	6	47	84	83	33	3	1	0	0	258	49	44
11:00	0	0	2	2	13	41	94	77	19	2	0	1	0	251	48	43
12 PM	0	0	0	0	12	53	112	61	17	5	1	0	0	261	47	43
13:00	0	0	0	0	9	57	91	71	31	5	2	0	0	266	49	44
14:00	0	0	0	0	10	49	109	61	14	9	2	0	0	254	48	43
15:00	0	0	0	1	16	76	144	83	24	6	2	0	0	352	47	43
16:00	0	0	1	1	17	93	135	71	20	1	1	0	0	340	46	42
17:00	0	0	0	2	13	109	133	79	18	5	1	0	0	360	47	42
18:00	0	0	0	0	10	66	95	73	27	18	12	4	3	308	51	45
19:00	0	0	0	0	2	7	36	56	55	24	16	6	1	203	56	50
20:00	0	0	0	0	1	12	34	58	34	19	9	3	2	172	55	48
21:00	0	0	0	0	0	6	24	40	23	13	10	1	0	117	56	49
22:00	0	0	0	0	1	3	13	17	24	19	10	1	0	88	58	51
23:00	0	0	0	0	0	2	4	8	12	6	1	0	0	33	55	50

%	0.0%	0.0%	0.1%	0.2%	3.3%	18.9%	35.7%	25.8%	10.2%	3.6%	1.7%	0.4%	0.2%	
AM Peak Vol.	03:00	09:00		07:00	07:00	08:00	08:00	09:00	08:00	09:00	07:00		07:00	08:00
	1	2		1	14	80	142	95	30	8	2		1	359
Midda y Peak Vol.			11:00	11:00	11:00	13:00	12:00	11:00	13:00	14:00	13:00	11:00		13:00
			2	2	13	57	112	77	31	9	2	1		266
PM Peak Vol.			16:00	17:00	16:00	17:00	15:00	15:00	19:00	19:00	19:00	19:00	18:00	17:00
			1	2	17	109	144	83	55	24	16	6	3	360
% files			15th Percentile :			36 MPH								
			50th Percentile :			42 MPH								
			85th Percentile :			49 MPH								
			95th Percentile :			55 MPH								

Page 1

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
D A T A
INDUSTRIES, LLC

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

143701 A SPEED
Site Code: 99901.15
Date Start: 14-Jan-14

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
01/15/																
14	0	0	0	0	0	1	2	5	5	2	1	1	0	17	56	50
01:00	0	0	0	0	0	0	1	1	2	0	0	0	0	4	52	48
02:00	0	0	0	0	0	0	3	1	1	0	1	0	0	6	58	48
03:00	0	0	0	1	0	1	1	3	1	0	0	0	0	7	49	43
04:00	0	0	0	1	1	0	1	5	4	2	2	0	1	17	57	49
05:00	0	0	0	0	0	4	18	16	13	2	0	0	0	53	51	46
06:00	0	0	0	0	5	27	47	52	10	1	0	0	0	142	48	43
07:00	0	0	0	0	3	50	95	90	31	2	1	1	0	273	49	44
08:00	0	0	0	1	8	70	113	104	35	6	3	0	0	340	49	44
09:00	0	0	0	0	4	47	125	113	42	11	3	1	0	346	49	45
10:00	0	0	1	1	8	42	105	89	40	6	0	1	0	293	49	44
11:00	0	0	0	0	5	49	96	68	37	9	0	0	0	264	50	44
12 PM	0	0	0	0	6	35	105	77	23	10	0	0	0	256	49	44
13:00	0	0	0	1	6	44	73	86	30	9	1	0	0	250	49	44
14:00	0	0	0	0	8	41	93	95	32	11	1	0	0	281	49	44
15:00	0	0	1	0	14	61	116	91	35	8	2	1	0	329	49	44
16:00	0	0	0	2	19	111	159	73	24	7	0	0	0	395	47	42
17:00	0	0	0	1	25	101	139	66	7	1	1	0	0	341	45	41
18:00	0	0	0	1	22	96	121	57	11	2	0	0	0	310	46	41
19:00	0	0	0	2	10	47	88	53	6	4	0	0	0	210	46	42
20:00	0	0	0	0	6	41	57	45	10	3	0	1	0	163	47	43
21:00	0	0	0	3	5	35	41	37	7	2	1	0	0	131	47	42
22:00	0	0	0	1	1	18	34	21	12	2	0	0	0	89	49	44
23:00	0	0	0	0	2	6	21	13	4	3	0	0	0	49	49	44

%	0.0%	0.0%	0.0%	0.3%	3.5%	20.3%	36.2%	27.6%	9.2%	2.3%	0.4%	0.1%	0.0%	
AM Peak				03:00	08:00	08:00	09:00	09:00	09:00	09:00	08:00	00:00	04:00	09:00
Vol.				1	8	70	125	113	42	11	3	1	1	346
Midda y Peak				13:00	14:00	11:00	12:00	14:00	11:00	14:00	13:00			14:00
Vol.				1	8	49	105	95	37	11	1			281
PM Peak			15:00	21:00	17:00	16:00	16:00	15:00	15:00	15:00	15:00	15:00		16:00
Vol.			1	3	25	111	159	91	35	8	2	1		395
% ile			15th Percentile :			36 MPH								
			50th Percentile :			42 MPH								
			85th Percentile :			48 MPH								
			95th Percentile :			52 MPH								

Stats 10 MPH Pace Speed : 39-48 MPH
 Number in Pace : 2787
 Percent in Pace : 61.1%
 Number of Vehicles > 45 MPH : 1473
 Percent of Vehicles > 45 MPH : 32.3%
 Mean Speed(Average) : 43 MPH

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
D A T A
INDUSTRIES, LLC

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

143701 A SPEED
Site Code: 99901.15
Date Start: 14-Jan-14

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
	14	19	24	29	34	39	44	49	54	59	64	69	9999			
01/14/																
14	0	0	0	0	3	3	6	1	1	0	0	0	0	14	44	40
01:00	0	0	0	0	2	2	5	3	0	0	0	0	0	12	45	41
02:00	0	0	0	0	1	0	3	0	0	0	0	0	0	4	43	39
03:00	0	0	0	0	2	4	2	3	2	0	0	0	0	13	49	42
04:00	0	0	0	0	0	2	1	2	1	1	0	0	0	7	53	46
05:00	0	0	0	0	0	13	21	8	4	0	0	0	0	46	47	42
06:00	0	0	0	1	12	47	73	46	9	2	0	0	0	190	47	42
07:00	0	0	0	2	13	105	172	87	14	0	0	0	0	393	46	42
08:00	0	0	0	3	17	134	236	106	29	2	1	0	0	528	46	42
09:00	0	0	0	0	13	76	117	62	14	1	0	0	0	283	46	42
10:00	0	0	0	0	9	55	105	47	12	2	1	0	0	231	46	42
11:00	0	0	0	0	12	80	97	52	11	0	0	0	0	252	46	41
12 PM	0	0	0	1	13	71	104	53	13	1	1	1	1	259	46	42
13:00	0	0	0	1	15	73	110	49	9	2	1	0	0	260	46	41
14:00	0	0	0	0	22	98	122	69	9	3	0	0	0	323	46	41
15:00	0	0	0	0	18	113	155	59	12	3	0	0	1	361	45	41
16:00	0	0	0	7	48	132	180	49	6	0	1	0	0	423	44	40
17:00	0	0	0	4	81	193	146	27	6	0	0	0	0	457	42	38
18:00	0	0	0	5	50	126	152	38	9	1	0	0	0	381	44	40
19:00	0	0	0	0	10	56	84	31	8	1	0	0	0	190	45	41
20:00	0	0	0	0	6	43	56	40	9	4	2	0	0	160	48	43
21:00	0	0	0	0	7	26	40	27	14	2	0	0	1	117	49	43
22:00	0	0	0	0	4	14	35	18	7	1	0	1	0	80	48	43
23:00	0	0	0	0	1	10	19	19	3	1	0	0	0	53	48	44

%	0.0%	0.0%	0.0%	0.5%	7.1%	29.3%	40.5%	17.8%	4.0%	0.5%	0.1%	0.0%	0.1%			
AM Peak				08:00	08:00	08:00	08:00	08:00	08:00	06:00	08:00			08:00		
Vol.				3	17	134	236	106	29	2	1			528		
Midda y Peak				12:00	14:00	14:00	14:00	14:00	12:00	14:00	12:00	12:00	12:00	14:00		
Vol.				1	22	98	122	69	13	3	1	1	1	323		
PM Peak				16:00	17:00	17:00	16:00	15:00	21:00	20:00	20:00	22:00	15:00	17:00		
Vol.				7	81	193	180	59	14	4	2	1	1	457		
% ile				15th Percentile :			35 MPH									
				50th Percentile :			40 MPH									
				85th Percentile :			46 MPH									
				95th Percentile :			49 MPH									

Stats

10 MPH Pace Speed :	36-45 MPH
Number in Pace :	3311
Percent in Pace :	65.8%
Number of Vehicles > 45 MPH :	920
Percent of Vehicles > 45 MPH :	18.3%
Mean Speed(Average) :	41 MPH

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
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INDUSTRIES, LLC

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143701 A SPEED
Site Code: 99901.15
Date Start: 14-Jan-14

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
01/15/																
14	0	0	0	0	1	3	8	4	0	1	0	0	0	17	47	43
01:00	0	0	0	1	0	5	3	4	0	0	0	0	0	13	46	40
02:00	0	0	0	0	0	1	3	2	0	0	0	0	0	6	46	43
03:00	0	0	0	2	3	0	3	3	1	0	0	0	0	12	47	39
04:00	0	0	0	1	1	0	4	1	2	0	0	0	0	9	50	42
05:00	0	0	0	0	0	8	10	7	10	2	0	0	0	37	52	45
06:00	0	0	0	0	3	14	34	65	31	11	3	1	0	162	52	47
07:00	0	0	0	0	0	11	101	143	91	43	10	0	0	399	53	48
08:00	0	1	0	0	3	25	83	198	132	62	17	1	4	526	54	49
09:00	1	0	0	0	0	7	37	84	80	51	22	9	4	295	57	51
10:00	0	0	1	3	2	9	36	74	53	24	12	1	1	216	55	48
11:00	0	0	0	0	1	9	43	83	51	30	5	2	1	225	54	48
12 PM	0	0	1	0	4	26	93	88	35	7	0	1	1	256	49	45
13:00	0	0	0	0	7	25	99	96	51	13	2	0	1	294	51	46
14:00	0	0	0	0	5	28	110	119	42	9	5	1	0	319	50	45
15:00	0	0	0	0	5	48	143	133	44	14	2	0	0	389	49	45
16:00	0	0	0	0	9	62	167	131	37	6	1	1	0	414	48	44
17:00	0	0	0	1	20	110	211	91	30	4	0	0	1	468	47	42
18:00	0	0	0	0	10	62	166	96	29	8	2	1	0	374	48	43
19:00	0	0	0	1	4	32	80	68	21	4	0	1	0	211	48	44
20:00	0	0	0	0	2	25	61	40	13	3	1	1	0	146	48	44
21:00	0	0	0	0	2	22	40	41	19	0	0	0	2	126	49	44
22:00	0	0	0	0	3	8	33	37	10	1	0	0	0	92	49	45
23:00	0	0	0	0	1	11	19	14	8	2	0	0	0	55	50	44

%	0.0%	0.0%	0.0%	0.2%	1.7%	10.9%	31.4%	32.0%	15.6%	5.8%	1.6%	0.4%	0.3%		
AM Peak	09:00	08:00		03:00	03:00	08:00	07:00	08:00	08:00	08:00	09:00	09:00	08:00	08:00	
Vol.	1	1		2	3	25	101	198	132	62	22	9	4	526	
Midda y Peak			12:00		13:00	14:00	14:00	14:00	11:00	11:00	11:00	11:00	11:00	14:00	
Vol.			1		7	28	110	119	51	30	5	2	1	319	
PM Peak				17:00	17:00	17:00	17:00	15:00	15:00	15:00	15:00	16:00	21:00	17:00	
Vol.				1	20	110	211	133	44	14	2	1	2	468	
% ile				15th Percentile :			38 MPH								
				50th Percentile :			44 MPH								
				85th Percentile :			51 MPH								
				95th Percentile :			56 MPH								

Stats

10 MPH Pace Speed : 40-49 MPH

Number in Pace : 2989

Percent in Pace : 59.2%

Number of Vehicles > 45 MPH : 2400

Percent of Vehicles > 45 MPH : 47.6%

Mean Speed(Average) : 46 MPH

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
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INDUSTRIES, LLC

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143701 A VOLUME
Site Code: 99901.15
Date Start: 14-Jan-14

Start	WB		EB		Combin		14-Jan-14	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue	
12:00	9	66	6	62	15	128		
12:15	4	66	3	67	7	133		
12:30	3	52	3	67	6	119		
12:45	4	77	2	63	6	140	520	
01:00	2	73	4	61	6	134		
01:15	2	61	6	66	8	127		
01:30	0	72	2	57	2	129		
01:45	0	60	0	76	0	136	526	
02:00	1	54	0	73	1	127		
02:15	1	77	1	73	2	150		
02:30	1	50	2	93	3	143		
02:45	0	73	1	84	1	157	577	
03:00	2	68	2	79	4	147		
03:15	0	96	7	97	7	193		
03:30	2	89	1	105	3	194		
03:45	1	99	3	80	4	179	713	
04:00	2	81	0	86	2	167		
04:15	3	93	1	111	4	204		
04:30	4	83	3	121	7	204		
04:45	5	83	3	105	8	188	763	
05:00	0	86	4	103	4	189		
05:15	9	101	3	121	12	222		
05:30	11	94	14	118	25	212		
05:45	31	79	25	115	56	194	817	
06:00	24	79	26	100	50	179		
06:15	29	91	34	93	63	184		
06:30	38	67	68	98	106	165		
06:45	54	71	62	90	116	161	689	
07:00	62	54	66	50	128	104		
07:15	70	56	86	47	156	103		
07:30	69	46	119	49	188	95		
07:45	84	47	122	44	206	91	393	
08:00	98	46	140	40	238	86		
08:15	71	58	122	40	193	98		
08:30	91	37	147	41	238	78		
08:45	99	31	119	39	218	70	332	
09:00	98	31	89	37	187	68		
09:15	84	35	74	34	158	69		
09:30	64	25	63	21	127	46		
09:45	83	26	57	25	140	51	234	
10:00	64	28	62	29	126	57		
10:15	55	20	63	20	118	40		
10:30	77	20	43	15	120	35		
10:45	62	20	63	16	125	36	168	
11:00	60	12	57	16	117	28		
11:15	68	9	66	15	134	24		
11:30	64	7	70	15	134	22		
11:45	59	5	59	7	118	12	86	
Total	1724	2754	1973	3064	3697	5818		
Percent	46.6%	47.3%	53.4%	52.7%				
Day Total	4478		5037		9515			
Peak	08:30	-	03:15	-	07:45	-	05:00	-
Vol.	372	-	365	-	531	-	457	-
P.H.F.	0.939	-	0.922	-	0.903	-	0.944	-

Greenough Blvd
west of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

143701 A VOLUME
Site Code: 99901.15
Date Start: 14-Jan-14

Start	WB		EB		Combin		15-Jan-
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	14 Wed
12:00	9	67	9	60	18	127	
12:15	3	63	3	57	6	120	
12:30	3	56	4	67	7	123	
12:45	2	70	1	72	3	142	512
01:00	0	58	5	79	5	137	
01:15	1	46	3	79	4	125	
01:30	2	77	1	66	3	143	
01:45	1	69	4	70	5	139	544
02:00	1	61	1	80	2	141	
02:15	2	82	1	69	3	151	
02:30	1	71	3	83	4	154	
02:45	2	67	1	87	3	154	600
03:00	2	78	0	90	2	168	
03:15	3	83	7	97	10	180	
03:30	1	74	3	105	4	179	
03:45	1	94	2	97	3	191	718
04:00	0	94	2	84	2	178	
04:15	4	85	4	114	8	199	
04:30	6	113	3	116	9	229	
04:45	7	103	0	100	7	203	809
05:00	3	86	2	125	5	211	
05:15	7	74	4	131	11	205	
05:30	12	92	11	112	23	204	
05:45	31	89	20	100	51	189	809
06:00	14	84	13	95	27	179	
06:15	35	87	26	94	61	181	
06:30	32	83	64	100	96	183	
06:45	61	56	59	85	120	141	684
07:00	55	56	68	73	123	129	
07:15	62	63	90	48	152	111	
07:30	70	45	120	48	190	93	
07:45	86	46	121	42	207	88	421
08:00	87	51	114	35	201	86	
08:15	71	44	156	37	227	81	
08:30	92	36	118	36	210	72	
08:45	90	32	138	38	228	70	309
09:00	103	31	98	37	201	68	
09:15	83	27	65	27	148	54	
09:30	73	36	64	27	137	63	
09:45	87	37	68	35	155	72	257
10:00	73	33	62	19	135	52	
10:15	71	25	57	32	128	57	
10:30	74	18	49	23	123	41	
10:45	75	13	48	18	123	31	181
11:00	56	19	54	19	110	38	
11:15	70	11	46	13	116	24	
11:30	62	8	64	14	126	22	
11:45	76	11	61	9	137	20	104
Total	1762	2804	1917	3144	3679	5948	
Percent	47.9%	47.1%	52.1%	52.9%			
Day Total	4566		5061		9627		
Peak	08:30	-	04:00	-	08:00	-	04:30
Vol.	368	-	395	-	472	-	848
P.H.F.	0.893	-	0.874	-	0.901	-	0.926

Greenough Blvd
east of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
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INDUSTRIES, LLC

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Email: datarequests@pdillc.com

143701 B VOLUME
Site Code: 99901.15
Date Start: 14-Jan-14

Start	WB		EB		Combin		14-Jan-14	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue	
12:00	15	76	7	73	22	149		
12:15	5	79	7	82	12	161		
12:30	6	65	5	76	11	141		
12:45	6	87	2	70	8	157	608	
01:00	5	77	2	61	7	138		
01:15	2	92	6	74	8	166		
01:30	4	80	3	72	7	152		
01:45	0	63	1	79	1	142	598	
02:00	2	78	0	71	2	149		
02:15	3	89	2	68	5	157		
02:30	2	80	4	101	6	181		
02:45	2	108	2	94	4	202	689	
03:00	1	89	3	82	4	171		
03:15	0	95	1	118	1	213		
03:30	3	119	5	116	8	235		
03:45	2	122	1	71	3	193	812	
04:00	3	95	4	78	7	173		
04:15	3	153	2	103	5	256		
04:30	6	125	4	120	10	245		
04:45	8	104	4	107	12	211	885	
05:00	4	138	10	109	14	247		
05:15	11	148	14	140	25	288		
05:30	28	143	20	105	48	248		
05:45	47	147	30	115	77	262	1045	
06:00	33	134	44	98	77	232		
06:15	36	143	48	75	84	218		
06:30	55	106	76	118	131	224		
06:45	77	104	83	71	160	175	849	
07:00	70	81	120	61	190	142		
07:15	79	101	140	50	219	151		
07:30	89	72	209	59	298	131		
07:45	134	62	206	38	340	100	524	
08:00	120	63	207	55	327	118		
08:15	110	73	224	42	334	115		
08:30	121	48	210	49	331	97		
08:45	108	45	203	34	311	79	409	
09:00	77	48	147	39	224	87		
09:15	92	43	127	40	219	83		
09:30	75	34	115	26	190	60		
09:45	94	40	84	35	178	75	305	
10:00	81	39	87	26	168	65		
10:15	80	35	81	18	161	53		
10:30	70	39	68	14	138	53		
10:45	60	29	78	17	138	46	217	
11:00	65	28	66	20	131	48		
11:15	78	18	80	14	158	32		
11:30	59	11	63	10	122	21		
11:45	75	14	71	10	146	24	125	
Total	2106	3862	2976	3204	5082	7066		
Percent	41.4%	54.7%	58.6%	45.3%				
Day Total		5968		6180		12148		
Peak	07:45	-	05:00	-	07:45	-	05:00	-
Vol.	485	-	576	-	476	-	1045	-
P.H.F.	0.905		0.973		0.850		0.907	

Greenough Blvd
east of Grove Street
City, State: Watertown, MA
Client: VHB / K. Malakorn



PRECISION
D A T A
INDUSTRIES, LLC

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

143701 B VOLUME
Site Code: 99901.15
Date Start: 14-Jan-14

Start		WB		EB		Combin		15-Jan-14	
Time	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.	Wed	
12:00	13	62		4	67	17	129		
12:15	6	76		5	51	11	127		
12:30	7	77		5	72	12	149		
12:45	5	31	78	0	14	86	276	5	45
01:00	6		75	5		82		11	157
01:15	3		62	2		71		5	133
01:30	8		84	2		85		10	169
01:45	2	19	89	3	12	72	310	5	31
02:00	3		79	0		85		3	164
02:15	4		109	2		69		6	178
02:30	3		91	2		110		5	201
02:45	3	13	102	3	7	80	344	6	20
03:00	2		111	2		90		4	201
03:15	3		100	3		97		6	197
03:30	3		96	3		122		6	218
03:45	2	10	114	3	11	91	400	5	21
04:00	4		109	1		105		5	214
04:15	3		127	5		97		8	224
04:30	6		136	2		127		8	263
04:45	10	23	124	4	12	131	460	14	35
05:00	5		139	7		124		12	263
05:15	11		143	9		141		20	284
05:30	19		155	17		121		36	276
05:45	44	79	180	30	63	114	500	74	142
06:00	23		144	30		94		53	238
06:15	43		122	40		95		83	217
06:30	38		131	63		93		101	224
06:45	82	186	100	81	214	66	348	163	400
07:00	67		70	128		78		195	148
07:15	73		67	140		62		213	129
07:30	104		61	191		60		295	121
07:45	141	385	63	217	676	44	244	358	1061
08:00	137		52	193		60		330	112
08:15	117		68	234		39		351	107
08:30	122		46	216		28		338	74
08:45	99	475	47	217	860	38	165	316	1335
09:00	111		45	167		33		278	78
09:15	88		40	136		37		224	77
09:30	77		51	125		33		202	84
09:45	75	351	52	107	535	36	139	182	886
10:00	78		55	86		25		164	80
10:15	73		39	85		27		158	66
10:30	77		39	84		22		161	61
10:45	78	306	16	86	341	18	92	164	647
11:00	71		22	82		17		153	39
11:15	84		23	74		22		158	45
11:30	69		12	73		13		142	25
11:45	75	299	10	67	306	4	56	152	605
Total	2177		3893	3051		3334		5228	7227
Percent	41.6%		53.9%	58.4%		46.1%			
Day Total			6070			6385		12455	
Peak	07:45	-	05:15	-	07:45	-	04:30	-	07:45
Vol.	517	-	622	-	860	-	523	-	1377
P.H.F.	0.917		0.864		0.919		0.927		0.962

MASSACHUSETTS HIGHWAY DEPARTMENT - STATEWIDE TRAFFIC DATA COLLECTION

2011 WEEKDAY SEASONAL FACTORS *

* Note: These are weekday factors. The average of the factors for the year will not equal 1, as weekend data are not considered.

FACTOR GROUP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUP 1 - WEST INTERSTATE	0.98	0.93	0.90	0.89	0.90	0.88	0.91	0.90	0.89	0.89	0.93	0.95
Use group 2 for R5, R6, & R0												
GROUP 2 - RURAL MAJOR COLLECTOR (R-5)	1.12	1.12	1.07	0.99	0.91	0.90	0.86	0.86	0.92	0.93	1.01	1.05
GROUP 3A - RECREATIONAL **(1-4) See below	1.26	1.25	1.20	1.06	0.96	0.89	0.76	0.76	0.92	0.99	1.08	1.14
GROUP 3B - RECREATIONAL *** (5) See below	1.22	1.26	1.22	1.06	0.96	0.90	0.72	0.74	0.97	1.02	1.14	1.15
GROUP 4 - I-495 INTERSTATE	1.02	1.00	1.00	0.96	0.92	0.89	0.85	0.83	0.93	0.96	1.01	1.03
GROUP 5 - EAST INTERSTATE	1.04	1.00	0.96	0.93	0.92	0.91	0.91	0.89	0.93	0.93	0.96	1.01
Use group 6 for U2, U3, U5, U6, U0, R2, & R3												
GROUP 6 - URBAN ARTERIALS, COLLECTORS & RURAL ARTERIALS (R-2, R-3)	1.03	1.01	0.96	0.92	0.91	0.90	0.92	0.92	0.93	0.92	0.97	0.97
GROUP 7 - I-84 PROXIMITY (STAS. 17,3921)	1.24	1.24	1.15	1.04	0.99	1.00	0.93	0.89	1.05	1.05	1.05	1.12
GROUP 8 - I-295 PROXIMITY (STA. 6590)	1.00	0.99	0.95	0.92	0.94	0.91	0.93	0.92	0.95	0.94	0.97	0.95
GROUP 9 - I-195 PROXIMITY (STA. 7)	1.13	1.05	1.03	0.95	0.89	0.87	0.86	0.79	0.88	0.91	0.99	1.03

RECREATIONAL: (ALL YEARS)

****GROUP 3A:**

1. CAPE COD (ALL TOWNS)
2. PLYMOUTH (SOUTH OF RTE. 3A)

7014, 7079, 7080, 7090, 7091, 7092, 7093, 7094, 7095, 7096, 7097, 7108, 7178

3. MARTHA'S VINEYARD

4. NANTUCKET

*****GROUP 3B:**

5. PERMANENTS 2 & 189

1066, 1067, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092,

1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104,

1105, 1106, 1107, 1108, 1113, 1114, 1116, 2196, 2197, 2198

2011 AXLE CORRECTION FACTORS

ROUND OFF

ROAD INVENTORY
FUNCTIONAL
CLASSIFICATION

RURAL

1	0.95
2	0.97
3	0.98
0,5,6	0.98

URBAN

1	0.96
2	0.98
3	0.98
5	0.98
0,6	0.99
I-84	0.90

Apply I-84 factor to stations: 3290, 3929

0 - 999.....10
> 1,000.....100



Computations

Project:

Project # 1256800

Location:

Sheet of

Calculated by: KK

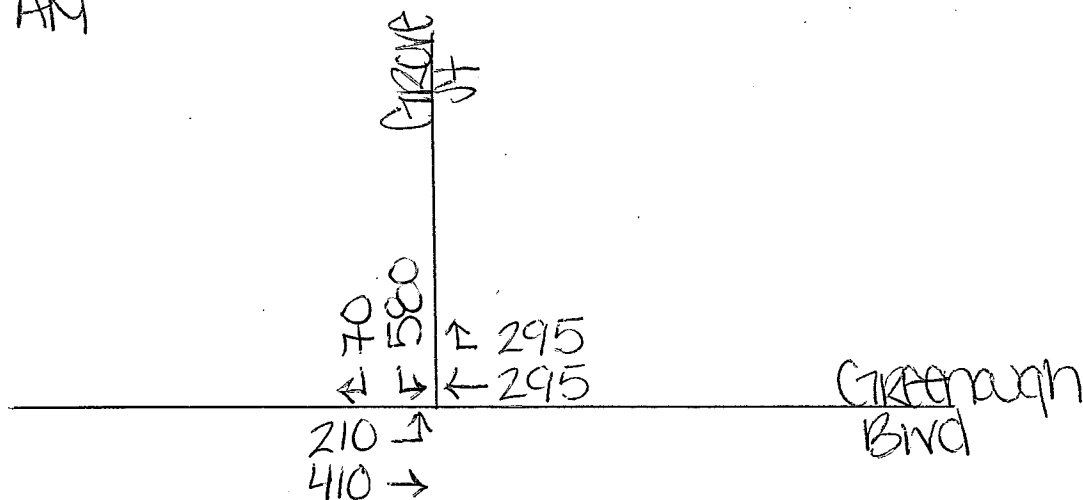
Date:

Checked by:

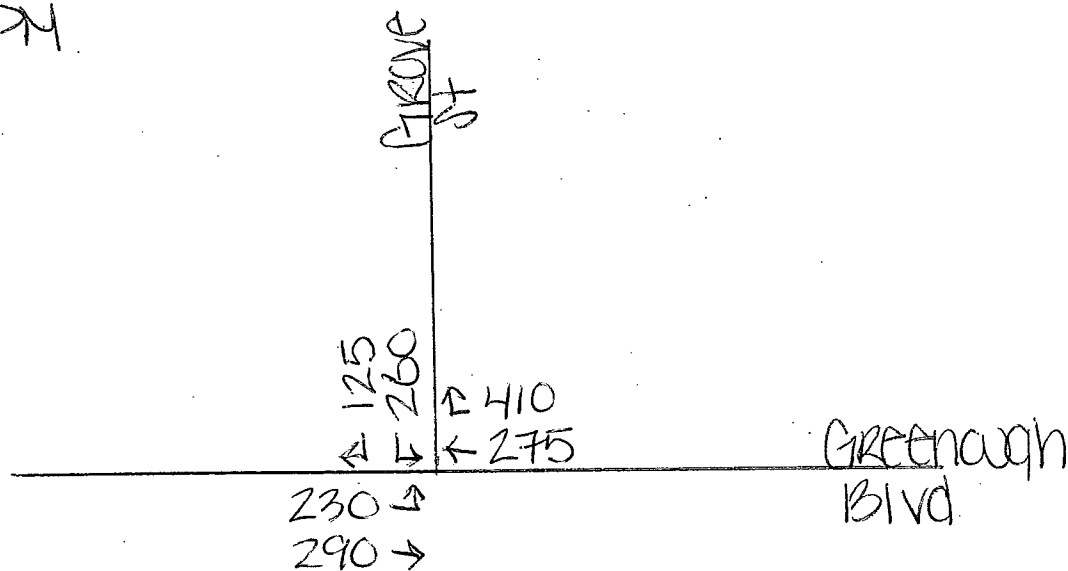
Date:

Title 2014 Existing Volumes

Weekday AM



Weekday PM





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

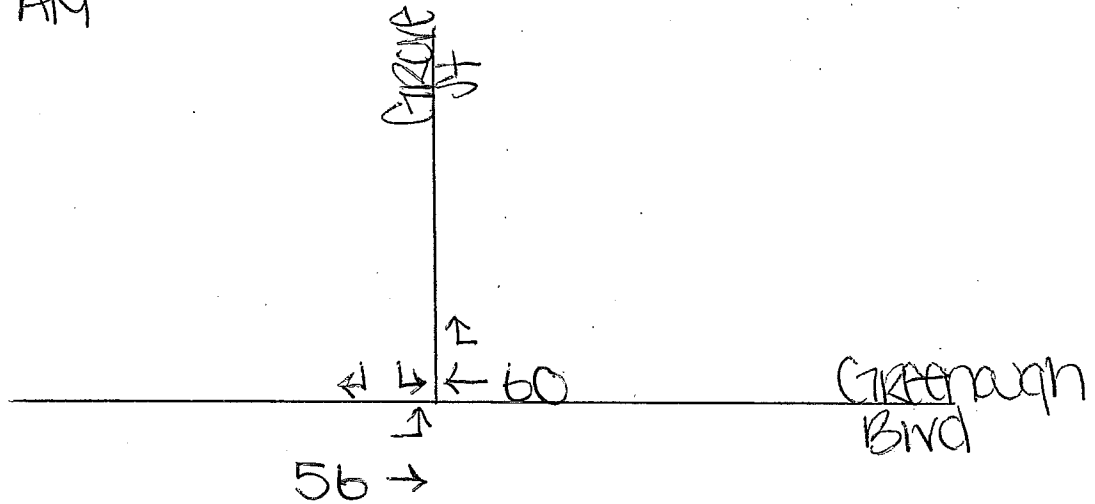
Date: 4/23/2014

Checked by:

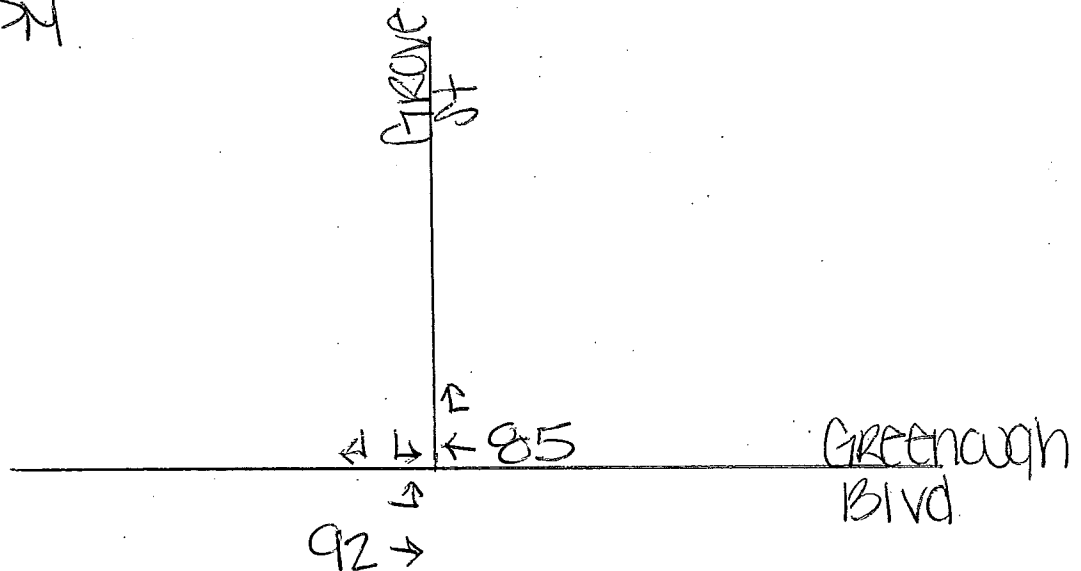
Date:

Title Total Background Projects

Weekday AM



Weekday PM





Computations

Project:

Project # 12568000

Location:

Sheet

Calculated by: KK

Date: 4/9/14

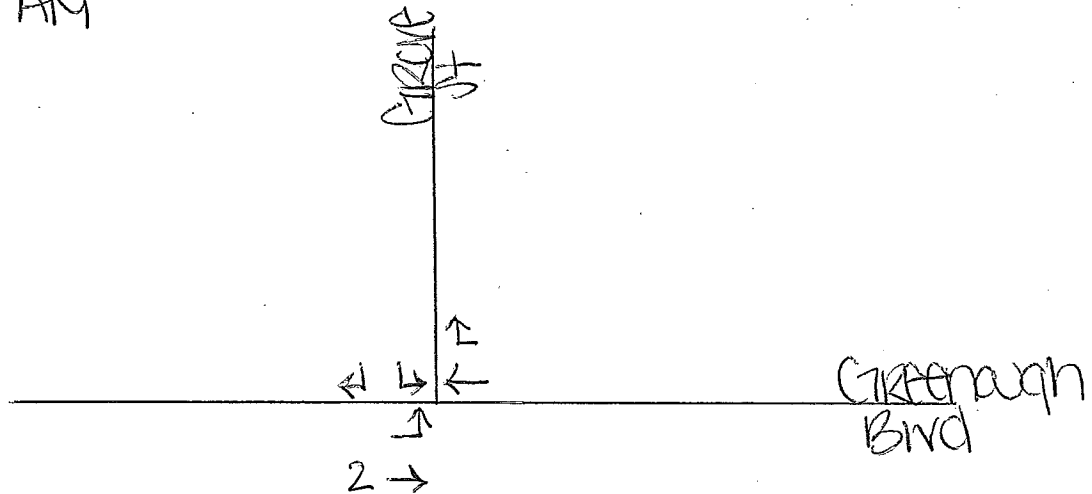
Checked by:

Date:

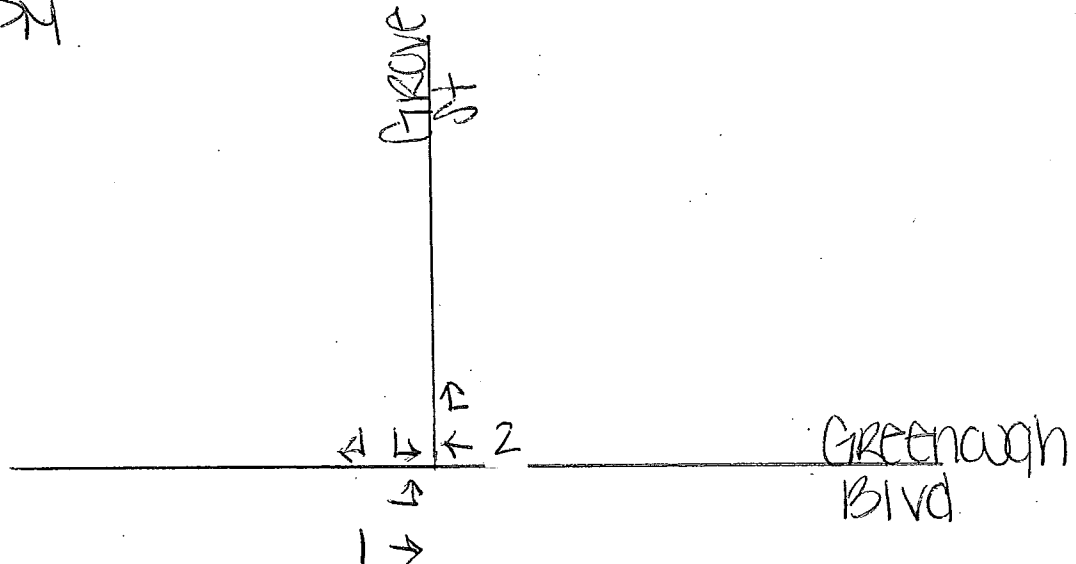
Title

Background Project
Repton Place (555 Pleasant St)

Weekday AM



Weekday PM





Computations

Project:

Project # 1256800

Location:

Sheet

of

Calculated by: KK

Date: 4/9/2014

Checked by:

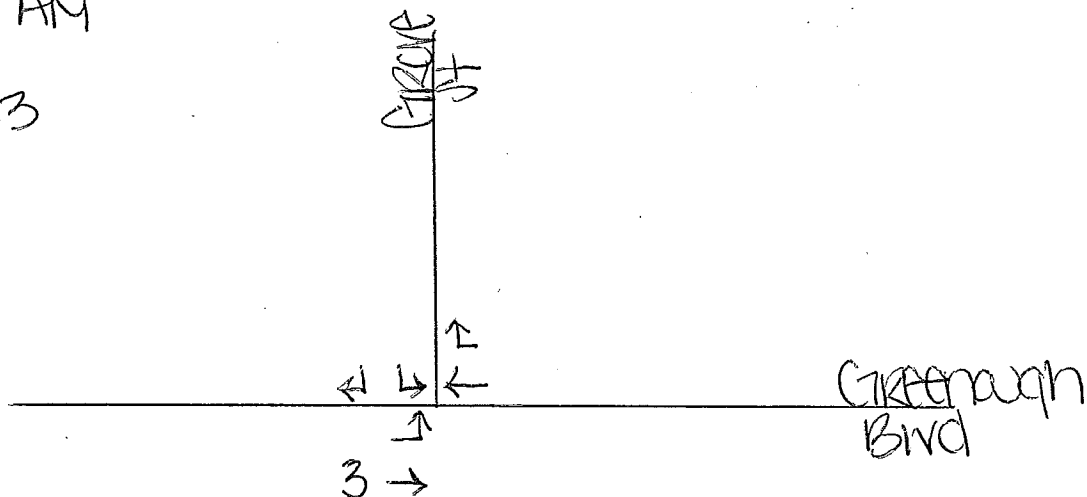
Date:

Title Background Project
Alta at the Estate

Weekday AM

Enter = 23

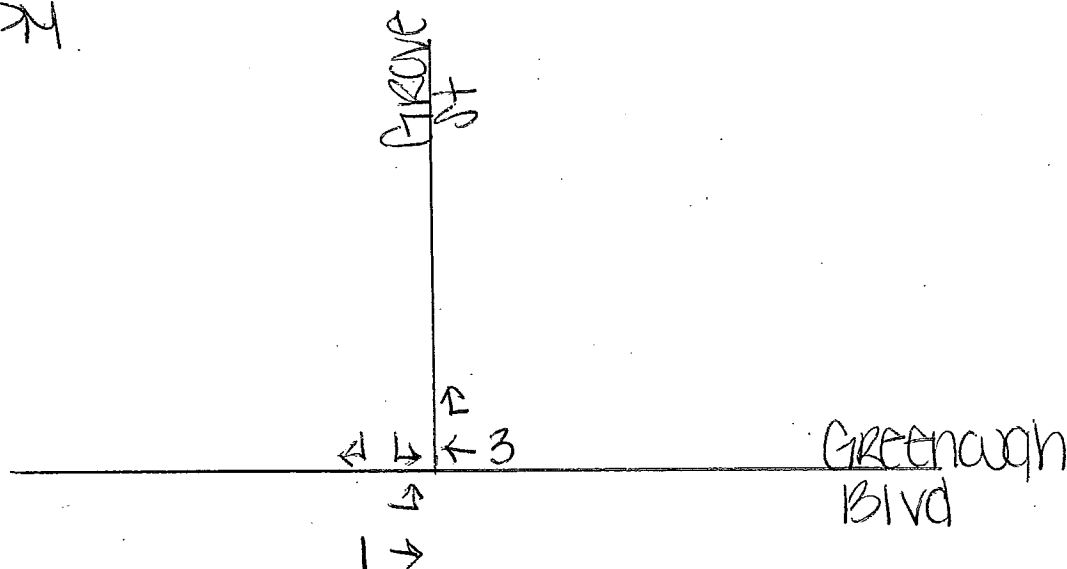
Exit = 90



Weekday PM

Enter = 91

Exit = 49





Computations

Project:

Project # 1256800

Location:

Sheet of

Calculated by: KK

Date: 4/9/14

Checked by:

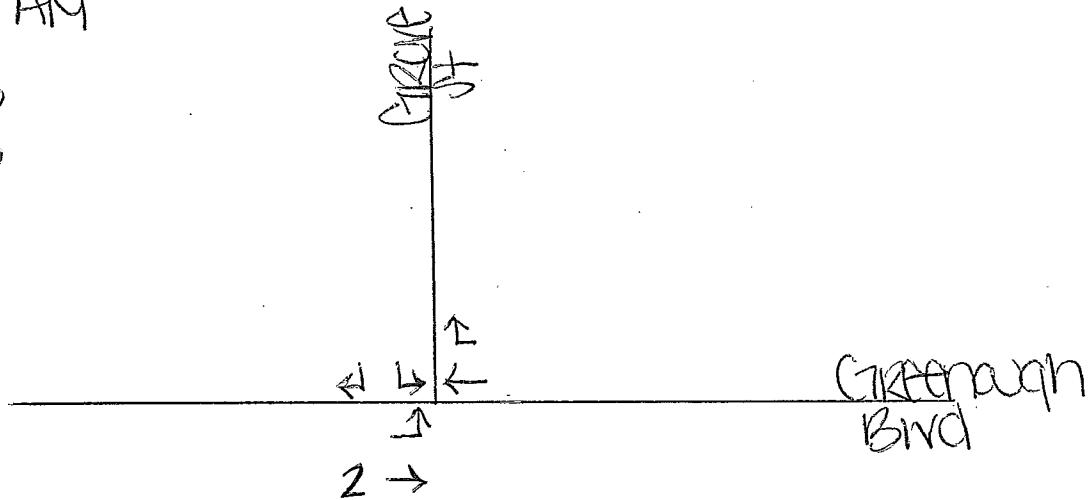
Date:

Title Background Project
Bacon - Howard Development

Weekday AM

ENTER=16

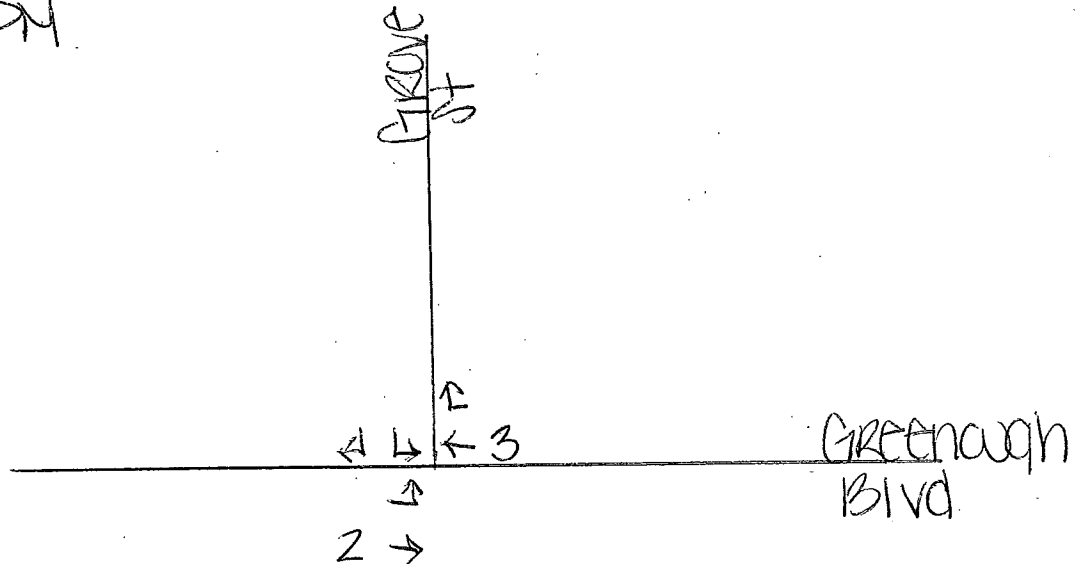
EXIT=30



Weekday PM

ENTER=58

EXIT=43





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/2014

Checked by:

Date:

Title

Background Project

IONICS Site (easterly parcel)

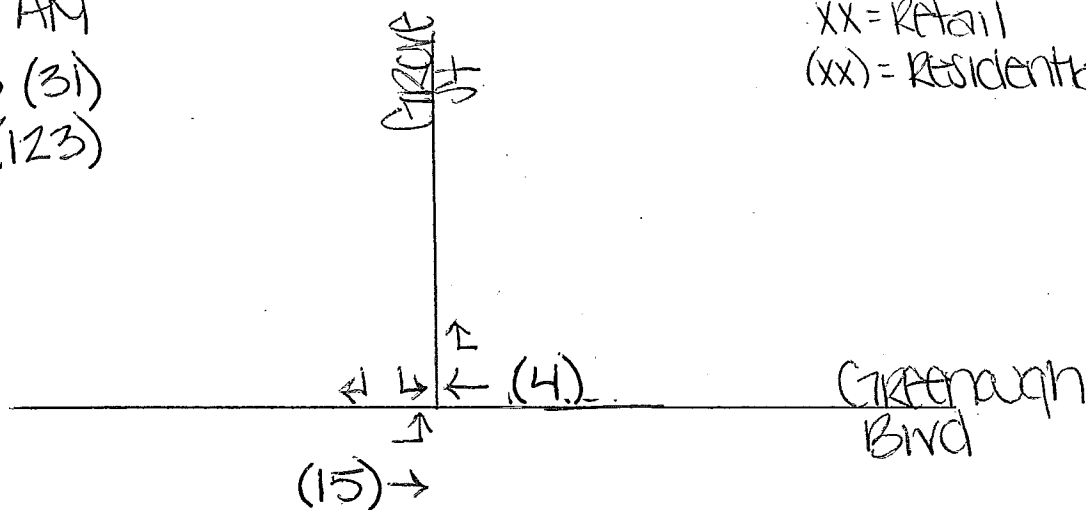
Weekday AM

Enter = 5 (31)

Exit = 2 (123)

XX = Retail

(xx) = Residential



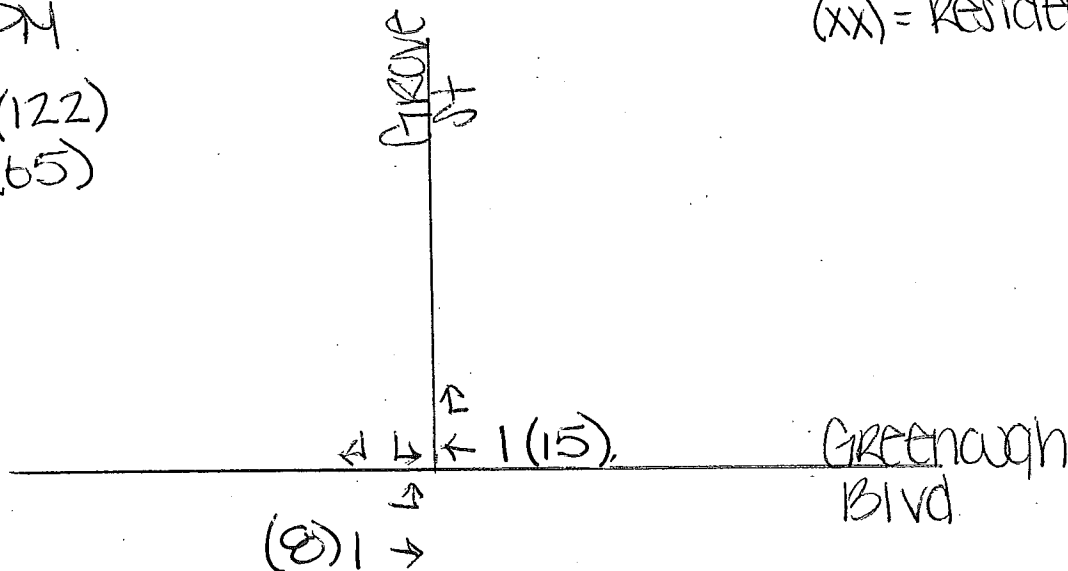
Weekday PM

Enter = 12 (122)

Exit = 16 (65)

XX = Retail

(xx) = Residential





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/22/2014

Checked by:

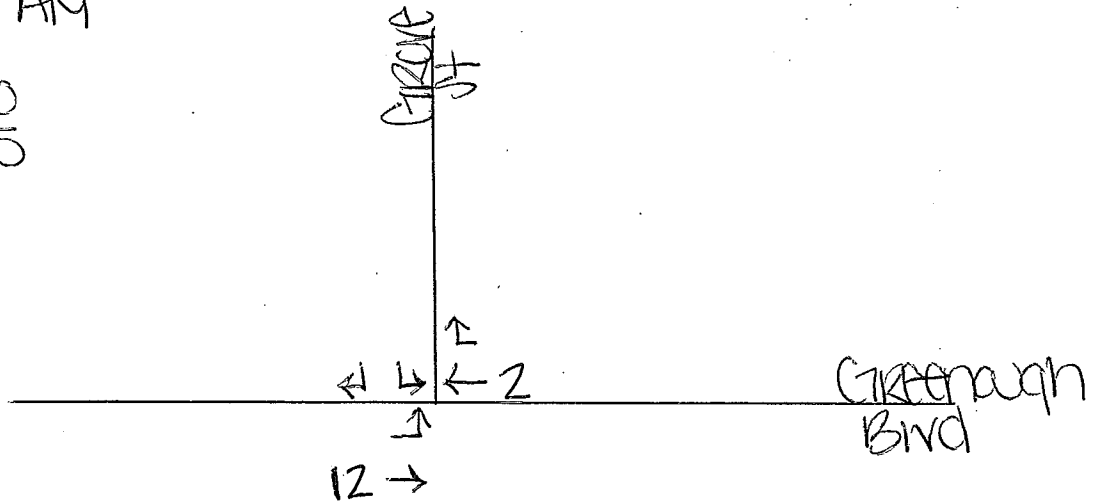
Date:

Title Background Project
Pirulli Site

Weekday AM

Enter = 18

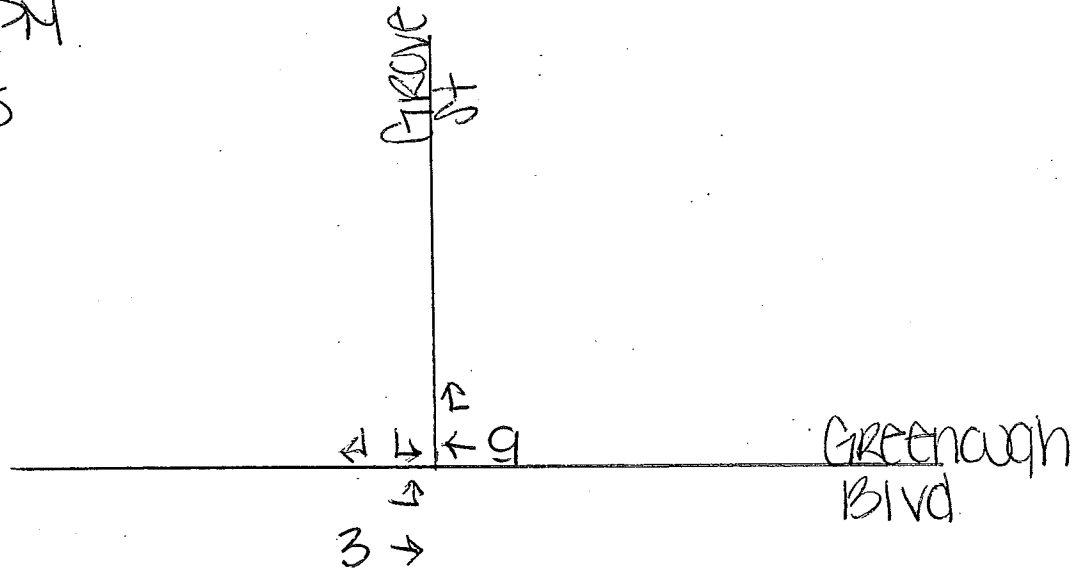
Exit = 105



Weekday PM

Enter = 75

Exit = 25





Computations

Project:

Project # 1256800

Location:

Sheet of

Calculated by: KK

Date: 4/22/2014

Checked by:

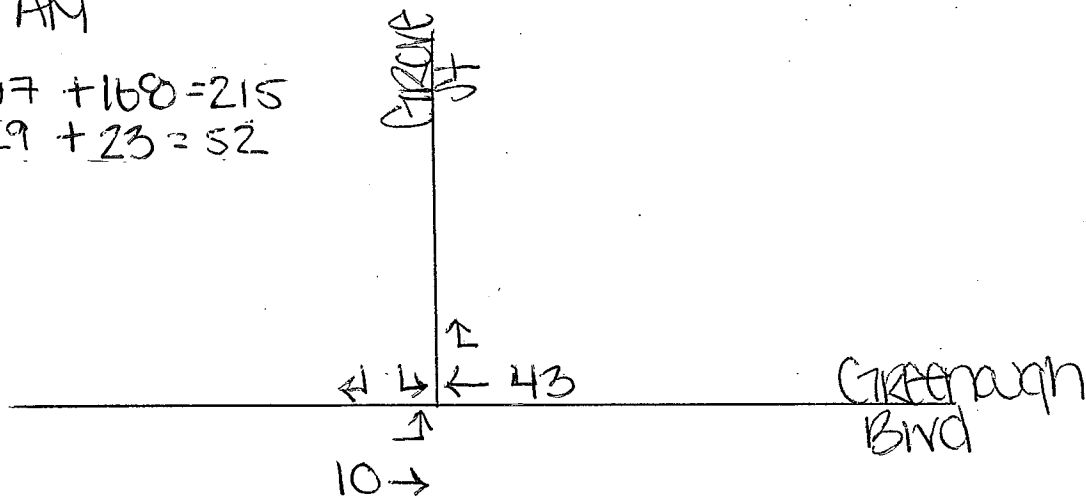
Date:

Title Background Project
Arsenal on the Charles

Weekday AM

$$\text{ENTER} = 47 + 168 = 215$$

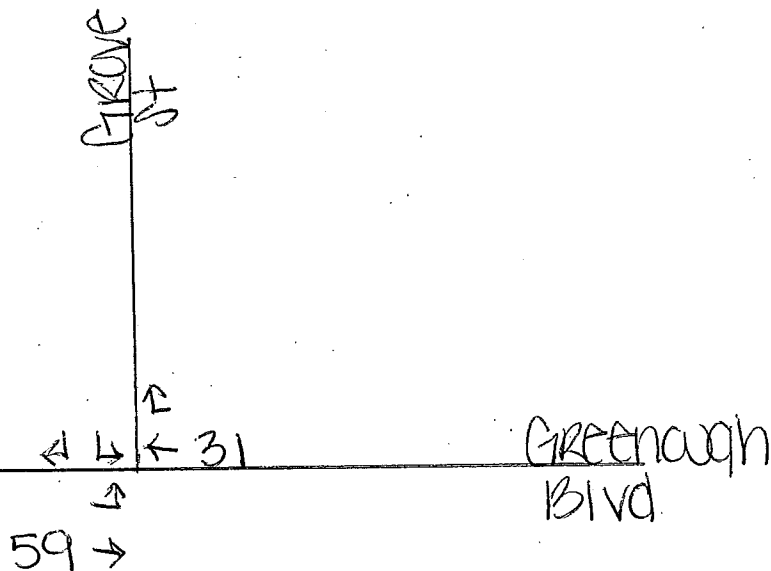
$$\text{EXIT} = 129 + 23 = 152$$



Weekday PM

$$\text{ENTER} = 131 + 26 = 157$$

$$\text{EXIT} = 144 + 154 = 298$$





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/23/2014

Checked by:

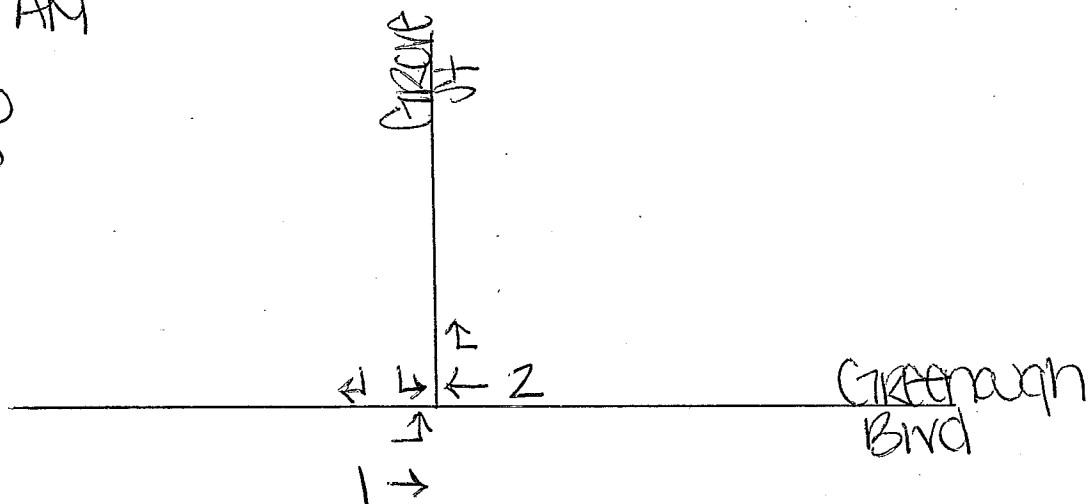
Date:

Title Background Project
Arsenal Mall Redevelopment

Weekday AM

Enter = 20

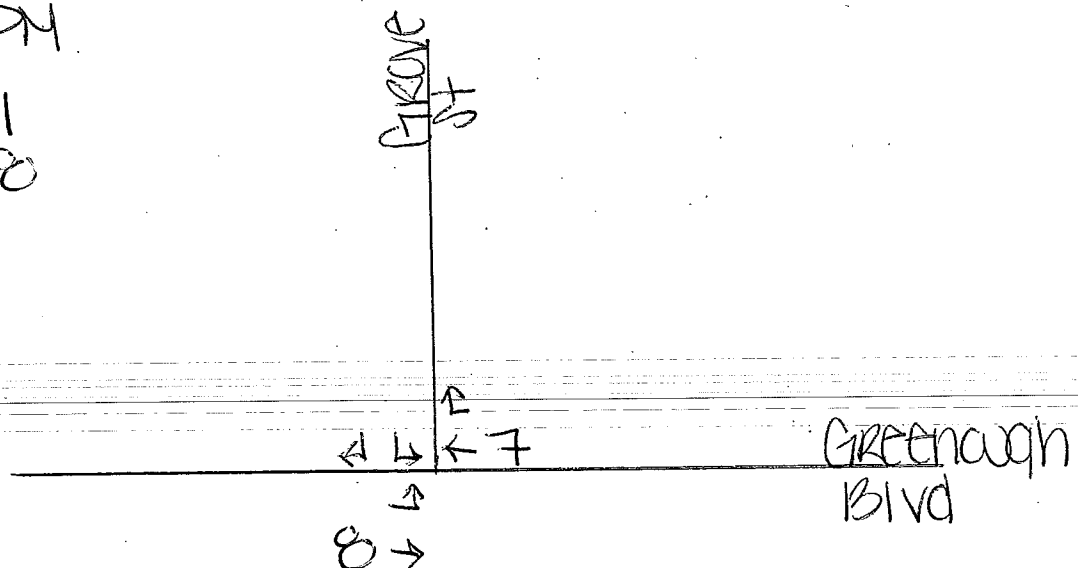
Exit = 10



Weekday PM

Enter = 61

Exit = 68





Computations

Project:

Project # 1256800

Location:

Sheet of

Calculated by: KK

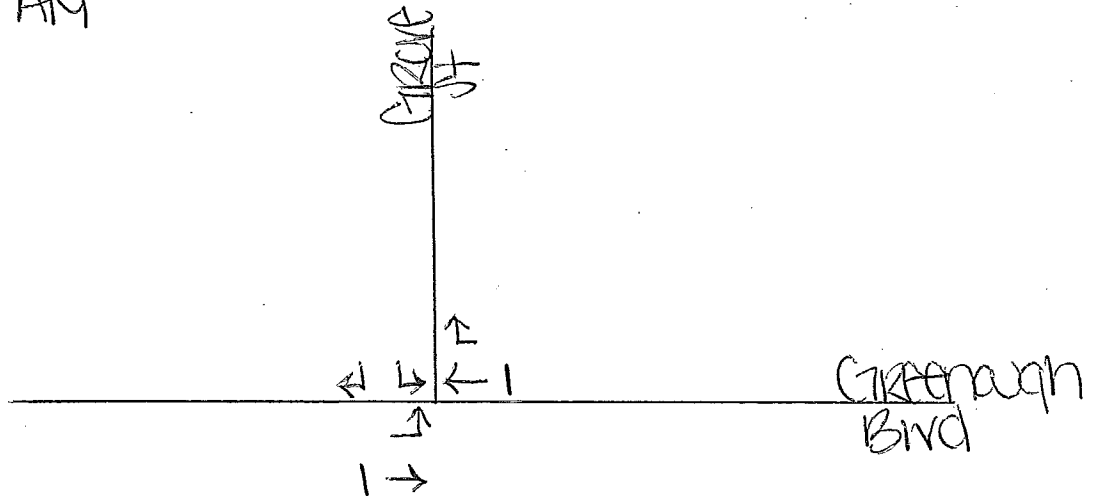
Date: 4/9/2014

Checked by:

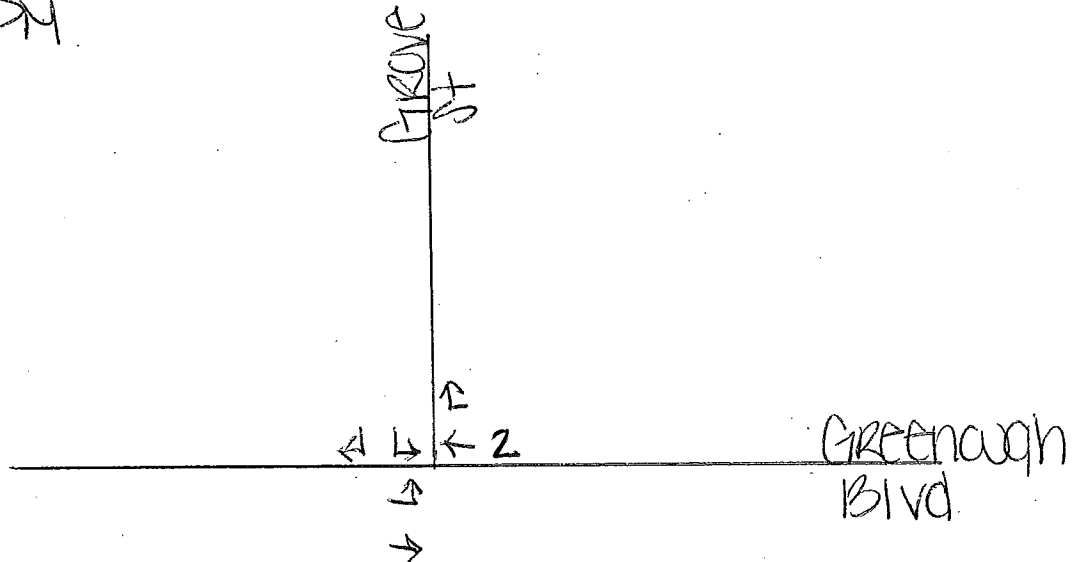
Date:

Title Background Project
270 Pleasant Street

Weekday AM



Weekday PM





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/22/2014

Checked by:

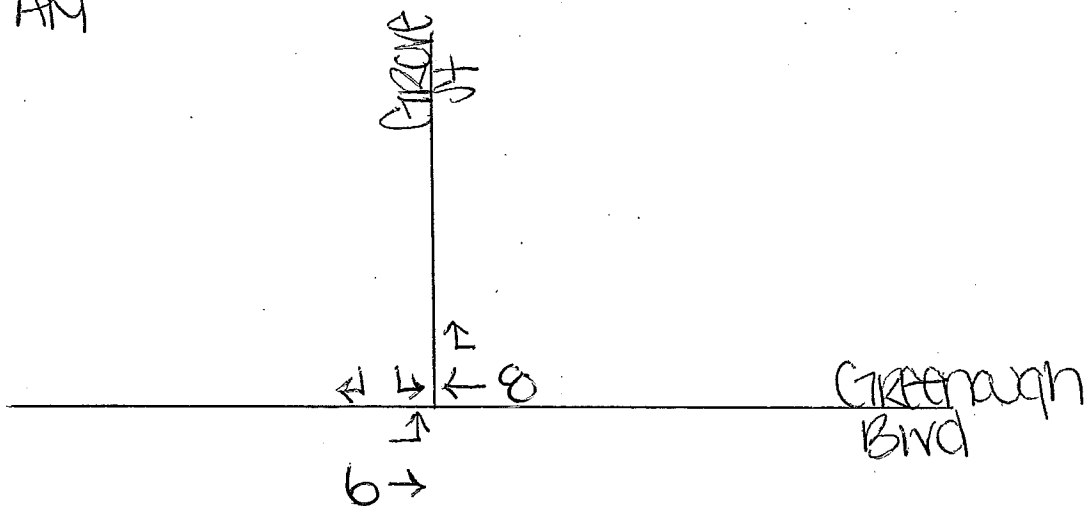
Date:

Title Background Project
Jazz - Hotel

Weekday AM

Enter = 46

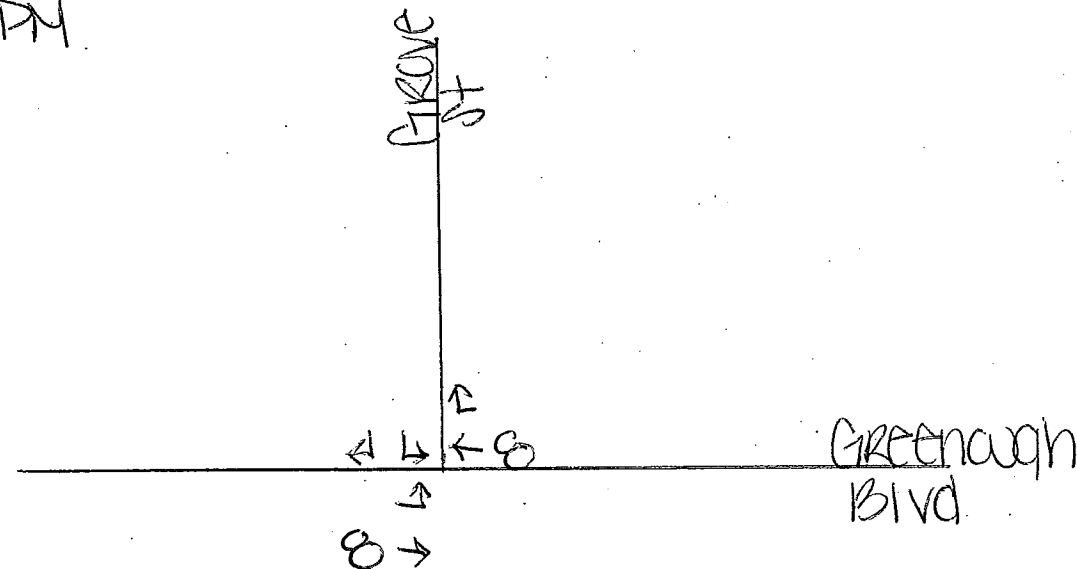
Exit = 32



Weekday PM

Enter = 45

Exit = 44





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/2014

Checked by:

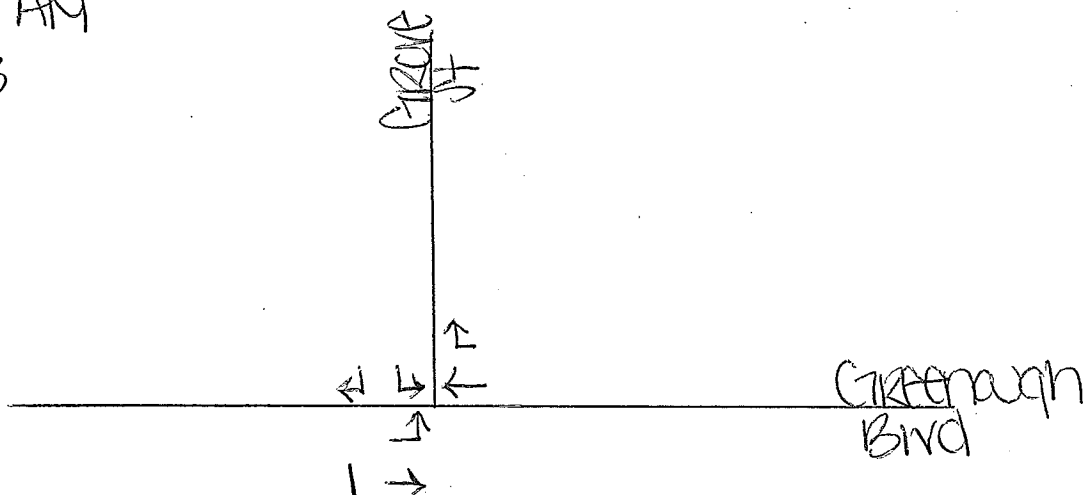
Date:

Title Background Development
33. Mt. Auburn St Condos

Weekday AM

Enter = 3

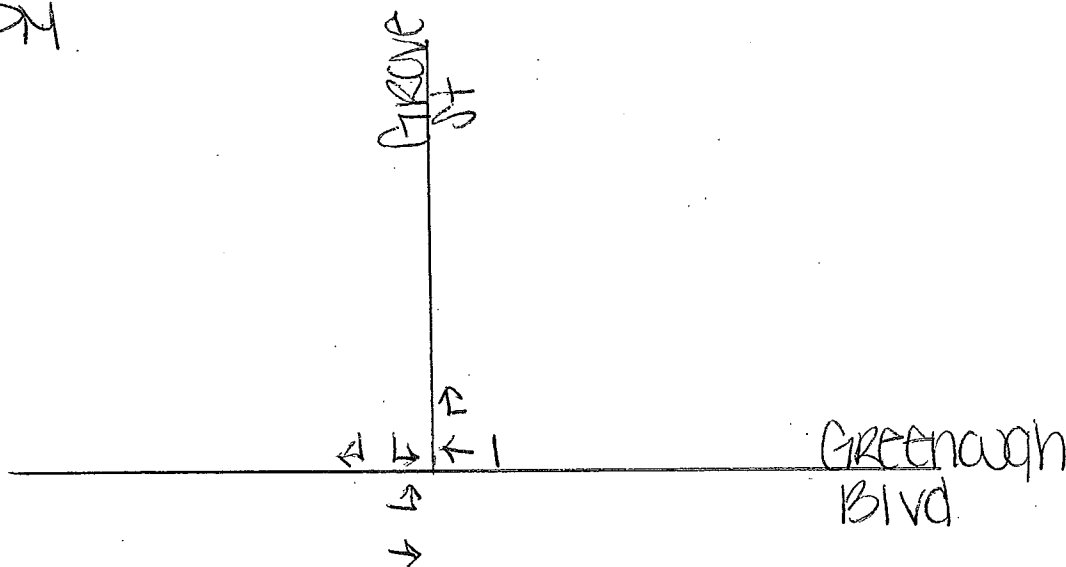
Exit = 9



Weekday PM

Enter = 10

Exit = 7





Computations

Project:

Project # 1256800

Location:

Sheet of

Calculated by: KK

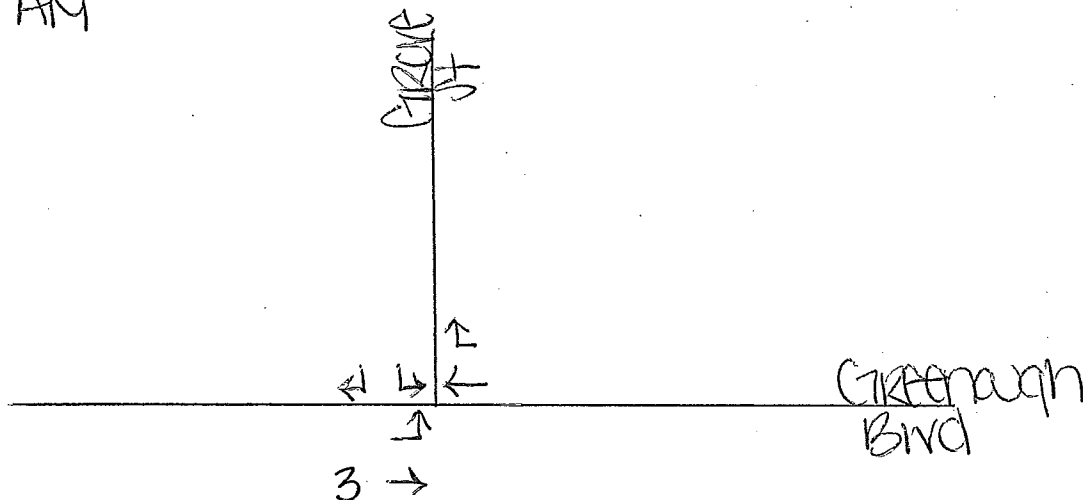
Date: 4/9/2014

Checked by:

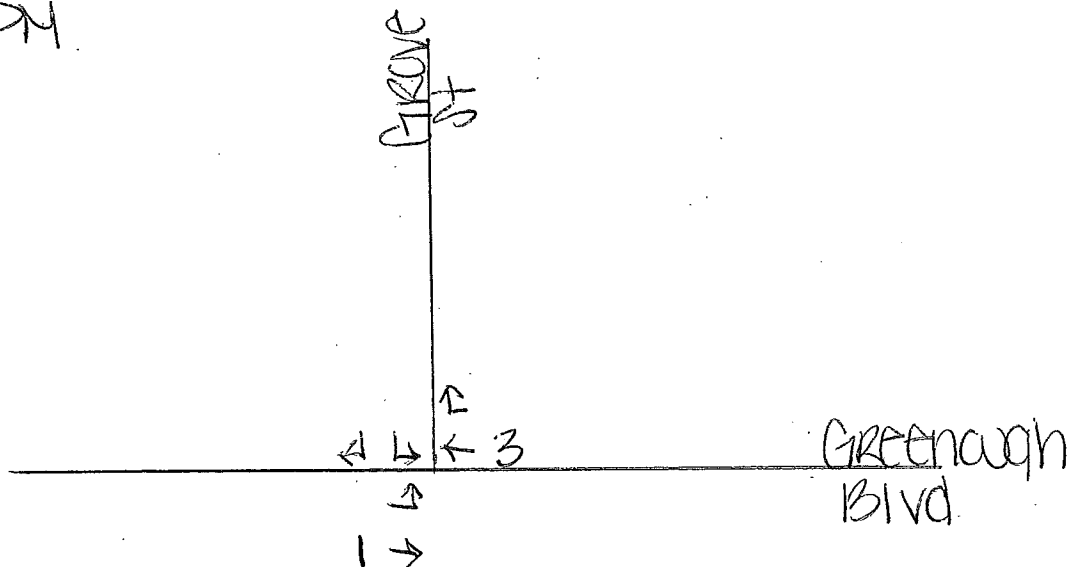
Date:

Title Background Project
36 RIVER STREET

Weekday AM



Weekday PM





Computations

Project:

Project #

1256800

Location:

Sheet

of

Calculated by: KK

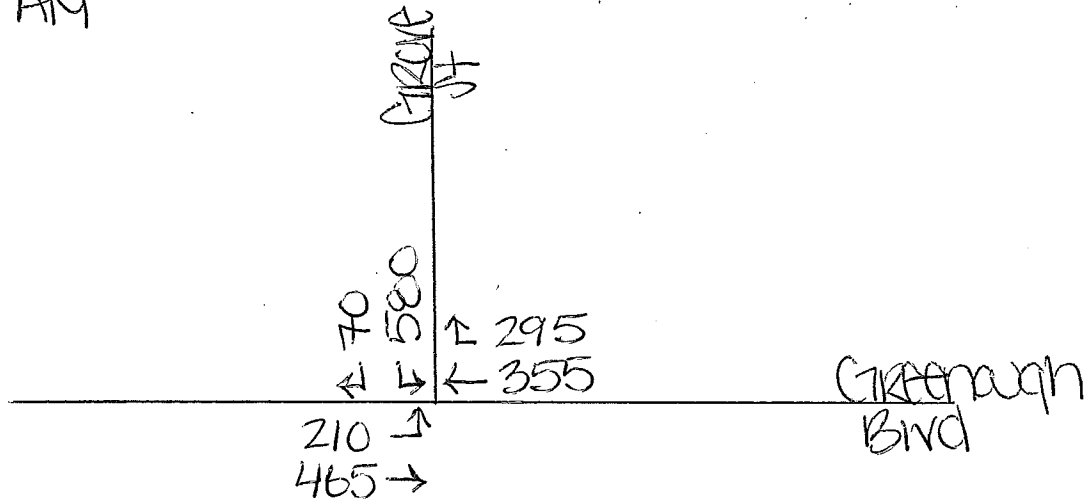
Date:

Checked by:

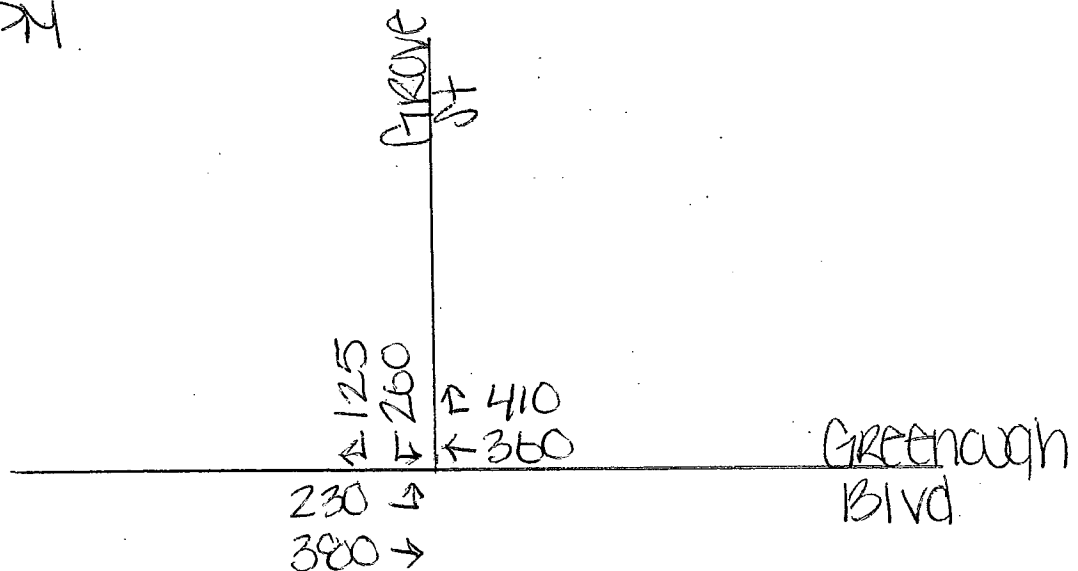
Date:

Title 2024 Future Volumes

Weekday AM



Weekday PM



Lanes, Volumes, Timings
1: Greenough Blvd & Grove Street

4/28/2014

						
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	210	410	295	295	580	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1787	3574	3306	0	1805	1615
Flt Permitted	0.227				0.950	
Satd. Flow (perm)	427	3574	3306	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			257			21
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.86	0.86	0.94	0.94	0.93	0.93
Heavy Vehicles (%)	1%	1%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	244	477	628	0	624	75
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	24.0	35.0	35.0		41.0	
Total Split (%)	24.0%	35.0%	35.0%		41.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effect Green (s)	28.9	18.0	18.0		33.9	50.8
Actuated g/C Ratio	0.36	0.22	0.22		0.42	0.63
v/c Ratio	0.73	0.60	0.67		0.83	0.07
Control Delay	40.0	31.9	20.6		34.2	5.6
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	40.0	31.9	20.6		34.2	5.6
LOS	D	C	C		C	A
Approach Delay		34.7	20.6		31.1	
Approach LOS		C	C		C	
Queue Length 50th (ft)	81	115	88		265	9
Queue Length 95th (ft)	122	165	155		#582	31
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	498	1299	1365		791	1039
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.49	0.37	0.46		0.79	0.07

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 81

Natural Cycle: 75

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 29.1

Intersection LOS: C

Intersection Capacity Utilization 76.4%

ICU Level of Service D

Analysis Period (min) 15

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

Queue shown is maximum after two cycles.

Splits and Phases: 1: Greenough Blvd & Grove Street



Lanes, Volumes, Timings
1: Greenough Blvd & Grove Street

4/28/2014

						
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	230	290	275	410	260	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1805	3610	3253	0	1805	1615
Flt Permitted	0.233				0.950	
Satd. Flow (perm)	443	3610	3253	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			416			74
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.87	0.87	0.84	0.84	0.87	0.87
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	264	333	815	0	299	144
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	26.0	41.0	41.0		33.0	
Total Split (%)	26.0%	41.0%	41.0%		33.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effect Green (s)	28.6	17.2	17.2		15.4	33.2
Actuated g/C Ratio	0.45	0.27	0.27		0.24	0.52
v/c Ratio	0.59	0.34	0.69		0.68	0.16
Control Delay	23.3	20.2	13.3		32.1	5.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	23.3	20.2	13.3		32.1	5.4
LOS	C	C	B		C	A
Approach Delay		21.6	13.3		23.4	
Approach LOS		C	B		C	
Queue Length 50th (ft)	45	50	62		98	12
Queue Length 95th (ft)	106	105	134		223	44
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	731	2140	2098		825	1200
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.36	0.16	0.39		0.36	0.12

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 63.3

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 18.4

Intersection LOS: B

Intersection Capacity Utilization 62.9%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Greenough Blvd & Grove Street



Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	210	465	355	295	580	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1787	3574	3331	0	1805	1615
Flt Permitted	0.197				0.950	
Satd. Flow (perm)	371	3574	3331	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			212			21
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.86	0.86	0.94	0.94	0.93	0.93
Heavy Vehicles (%)	1%	1%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	244	541	692	0	624	75
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	24.0	35.0	35.0		41.0	
Total Split (%)	24.0%	35.0%	35.0%		41.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effect Green (s)	32.2	20.7	20.7		34.3	51.8
Actuated g/C Ratio	0.38	0.24	0.24		0.40	0.61
v/c Ratio	0.73	0.62	0.71		0.85	0.08
Control Delay	41.6	32.0	24.5		38.5	6.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	41.6	32.0	24.5		38.5	6.3
LOS	D	C	C		D	A
Approach Delay		35.0	24.5		35.0	
Approach LOS		C	C		D	
Queue Length 50th (ft)	81	135	122		288	10
Queue Length 95th (ft)	121	191	197		#617	33
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	475	1241	1295		756	998
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.51	0.44	0.53		0.83	0.08

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 84.7

Natural Cycle: 80

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.85

Intersection Signal Delay: 31.7

Intersection LOS: C

Intersection Capacity Utilization 78.0%

ICU Level of Service D

Analysis Period (min) 15

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

Queue shown is maximum after two cycles.

Splits and Phases: 1: Greenough Blvd & Grove Street



						
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	230	380	360	410	260	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1805	3610	3288	0	1805	1615
Flt Permitted	0.175				0.950	
Satd. Flow (perm)	332	3610	3288	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			318			74
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.87	0.87	0.84	0.84	0.87	0.87
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	264	437	917	0	299	144
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	26.0	41.0	41.0		33.0	
Total Split (%)	26.0%	41.0%	41.0%		33.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effect Green (s)	35.3	22.9	22.9		16.7	35.5
Actuated g/C Ratio	0.50	0.32	0.32		0.23	0.50
v/c Ratio	0.63	0.38	0.72		0.71	0.17
Control Delay	27.7	20.5	17.7		37.0	6.5
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	27.7	20.5	17.7		37.0	6.5
LOS	C	C	B		D	A
Approach Delay		23.2	17.7		27.1	
Approach LOS		C	B		C	
Queue Length 50th (ft)	48	72	111		115	15
Queue Length 95th (ft)	137	142	209		246	49
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	649	1900	1881		732	1086
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.41	0.23	0.49		0.41	0.13

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 71.2

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 21.6

Intersection LOS: C

Intersection Capacity Utilization 65.3%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Greenough Blvd & Grove Street



	EBL	EBT	WBT	WBR	SEL	SER
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	210	465	355	295	580	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1787	1881	3331	0	1805	1615
Flt Permitted	0.252				0.950	
Satd. Flow (perm)	474	1881	3331	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			212			21
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.86	0.86	0.94	0.94	0.93	0.93
Heavy Vehicles (%)	1%	1%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	244	541	692	0	624	75
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	24.0	35.0	35.0		41.0	
Total Split (%)	24.0%	35.0%	35.0%		41.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effect Green (s)	40.0	29.0	29.0		34.9	52.0
Actuated g/C Ratio	0.43	0.31	0.31		0.38	0.56
v/c Ratio	0.68	0.92	0.58		0.92	0.08
Control Delay	34.9	55.1	20.9		49.6	7.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	34.9	55.1	20.9		49.6	7.2
LOS	C	E	C		D	A
Approach Delay		48.9	20.9		45.1	
Approach LOS		D	C		D	
Queue Length 50th (ft)	81	299	120		336	14
Queue Length 95th (ft)	121	#514	197		#617	33
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	494	587	1185		679	893
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.49	0.92	0.58		0.92	0.08

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 93

Natural Cycle: 90

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.92

Intersection Signal Delay: 38.8

Intersection LOS: D

Intersection Capacity Utilization 78.0%

ICU Level of Service D

Analysis Period (min) 15

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

Queue shown is maximum after two cycles.

Splits and Phases: 1: Greenough Blvd & Grove Street



						
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	230	380	360	410	260	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1805	1900	3288	0	1805	1615
Flt Permitted	0.168				0.950	
Satd. Flow (perm)	319	1900	3288	0	1805	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			318			74
Link Speed (mph)		30	30		30	
Link Distance (ft)		417	348		404	
Travel Time (s)		9.5	7.9		9.2	
Peak Hour Factor	0.87	0.87	0.84	0.84	0.87	0.87
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	264	437	917	0	299	144
Turn Type	pm+pt	NA	NA		NA	pt+ov
Protected Phases	2	1	1		3	2 3
Permitted Phases	1					
Detector Phase	2	1	1		3	2 3
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0		8.0	
Minimum Split (s)	24.0	14.0	14.0		14.0	
Total Split (s)	26.0	41.0	41.0		33.0	
Total Split (%)	26.0%	41.0%	41.0%		33.0%	
Yellow Time (s)	4.0	4.0	4.0		4.0	
All-Red Time (s)	2.0	2.0	2.0		2.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Lead/Lag	Lag	Lead	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	None	Min	Min		None	
Act Effct Green (s)	37.1	24.6	24.6		17.0	35.8
Actuated g/C Ratio	0.51	0.34	0.34		0.23	0.49
v/c Ratio	0.64	0.68	0.70		0.72	0.17
Control Delay	28.8	28.5	17.1		38.1	6.8
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	28.8	28.5	17.1		38.1	6.8
LOS	C	C	B		D	A
Approach Delay		28.6	17.1		27.9	
Approach LOS		C	B		C	
Queue Length 50th (ft)	49	159	113		121	16
Queue Length 95th (ft)	141	324	209		246	49
Internal Link Dist (ft)		337	268		324	
Turn Bay Length (ft)	70					25
Base Capacity (vph)	633	968	1831		709	1055
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.42	0.45	0.50		0.42	0.14

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 73.3
 Natural Cycle: 65
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.72
 Intersection Signal Delay: 23.3
 Intersection Capacity Utilization 65.3%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Greenough Blvd & Grove Street

