



**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

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**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, 9<sup>th</sup> 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)<sup>1</sup>. To obtain the 2024 volumes, traffic volumes generated by the future

<sup>1</sup> 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 <sup>1</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>	50 <sup>th</sup> Q <sup>4</sup>	95 <sup>th</sup> Q <sup>5</sup>	v/c	delay	LOS	50 <sup>th</sup> Q	95 <sup>th</sup> Q	v/c	delay	LOS	50 <sup>th</sup> Q	95 <sup>th</sup> 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
	<b>Overall</b>			<b>29</b>	<b>C</b>				<b>32</b>	<b>C</b>				<b>39</b>	<b>D</b>	
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
	<b>Overall</b>			<b>18</b>	<b>B</b>				<b>22</b>	<b>C</b>				<b>23</b>	<b>C</b>	

Source: VHB, Inc. using Synchro 8 software

1 Volume to capacity ratio

2 Vehicle delay, in seconds

3 Level of Service

4 50<sup>th</sup> percentile queue, in feet

5 95<sup>th</sup> percentile queue, in feet

~ Volume exceeds capacity, queue is theoretically infinite

# 95<sup>th</sup> 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 95<sup>th</sup> 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**

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



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

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

Groups Printed- Cars - Heavy Vehicles

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
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

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. 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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File Name : 143701 A  
Site Code : 99901.15  
Start Date : 1/15/2014  
Page No : 1

N: Grove Street  
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City, State: Watertown, MA  
Client: VHB/ K. Malakorn

Groups Printed- Cars

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. 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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File Name : 143701 A  
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Start Date : 1/15/2014  
Page No : 1

N: Grove Street  
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Client: VHB/ K. Malakorn

Groups Printed- Heavy Vehicles

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. 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

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. 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



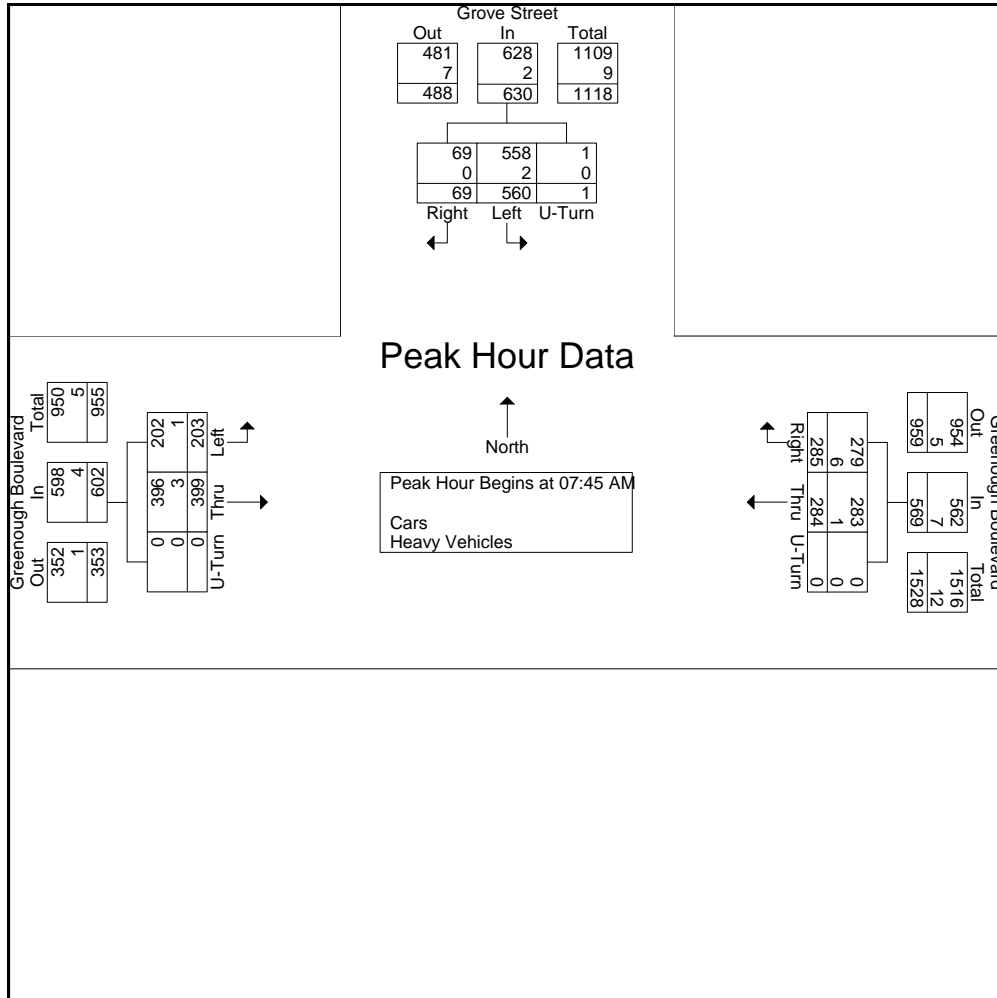
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	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	18	130	0	148	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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N: Grove Street  
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City, State: Watertown, MA  
Client: VHB/ K. Malakorn

Groups Printed- Cars

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. 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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File Name : 143701 AA  
Site Code : 99901.15  
Start Date : 1/15/2014  
Page No : 1

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

**Groups Printed- Heavy Vehicles**

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
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
<b>Total</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>11</b>
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
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>
<b>Grand Total</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>4</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>17</b>
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	0	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
<b>Total Volume</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>11</b>
<b>% App. Total</b>	<b>33.3</b>	<b>66.7</b>	<b>0</b>		<b>20</b>	<b>80</b>	<b>0</b>		<b>0</b>	<b>100</b>	<b>0</b>		
PHF	.250	.500	.000	.375	.250	.500	.000	.625	.000	.375	.000	.375	.688



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

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

Groups Printed- Peds and Bikes

Start Time	Grove Street From North			Greenough Boulevard From East			Greenough Boulevard From West			Int. Total
	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	
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	

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 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



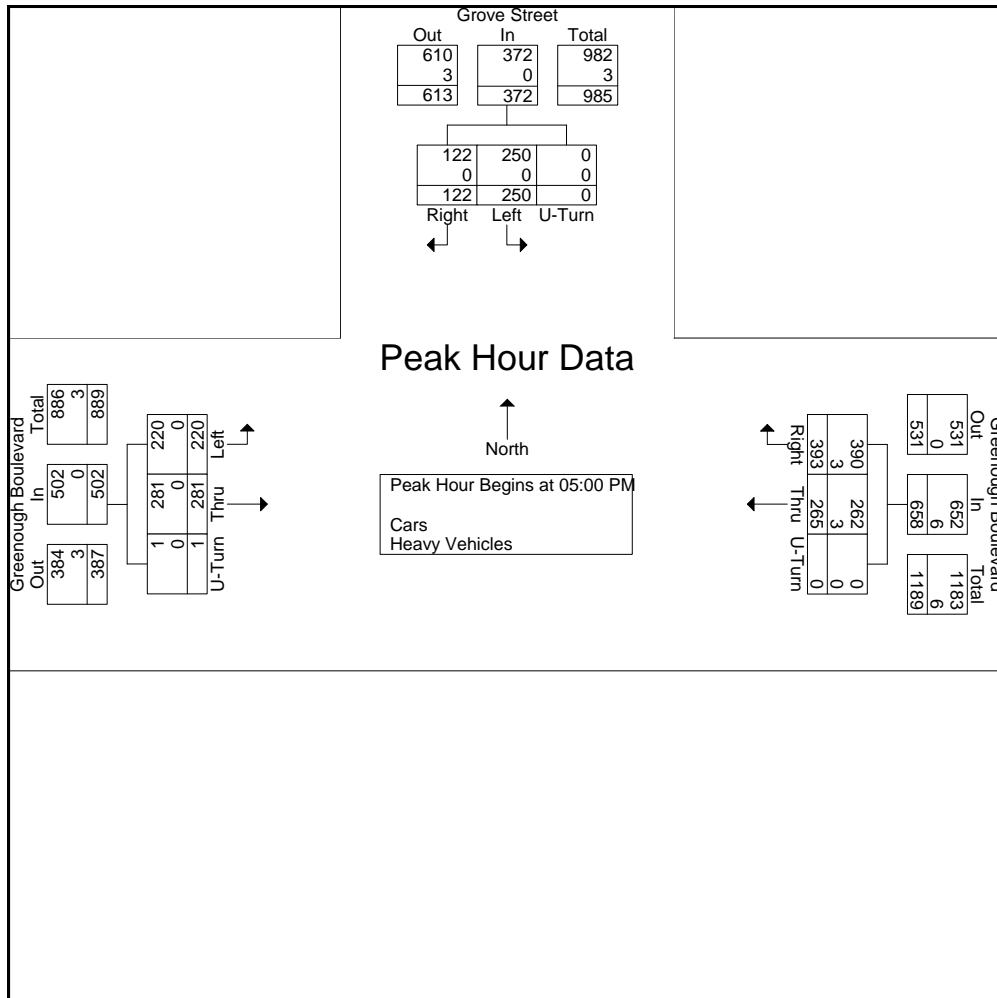
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File Name : 143701 AA  
Site Code : 99901.15  
Start Date : 1/15/2014  
Page No : 1

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

Start Time	Grove Street From North				Greenough Boulevard From East				Greenough Boulevard From West				Int. Total
	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. 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



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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
01/14/1														
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  
 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
01/14/1														
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

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
01/14/																
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	03:00	09:00		07:00	07:00	08:00	08:00	09:00	08:00	09:00	07:00		07:00	08:00		
Vol.	1	2		1	14	80	142	95	30	8	2		1	359		
Midda y Peak			11:00	11:00	11:00	13:00	12:00	11:00	13:00	14:00	13:00	11:00		13:00		
Vol.			2	2	13	57	112	77	31	9	2	1		266		
PM Peak			16:00	17:00	16:00	17:00	15:00	15:00	19:00	19:00	19:00	19:00	18:00	17:00		
Vol.			1	2	17	109	144	83	55	24	16	6	3	360		
% ile				15th Percentile :		36 MPH										
				50th Percentile :		42 MPH										
				85th Percentile :		49 MPH										
				95th Percentile :		55 MPH										

Stats  
 10 MPH Pace Speed : 39-48 MPH  
 Number in Pace : 2637  
 Percent in Pace : 59.0%  
 Number of Vehicles > 45 MPH : 1576  
 Percent of Vehicles > 45 MPH : 35.2%  
 Mean Speed(Average) : 44 MPH

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



PRECISION  
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 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 Vol.				03:00	08:00	08:00	09:00	09:00	09:00	09:00	08:00	00:00	04:00	09:00
				1	8	70	125	113	42	11	3	1	1	346
Midda y Peak Vol.				13:00	14:00	11:00	12:00	14:00	11:00	14:00	13:00			14:00
				1	8	49	105	95	37	11	1			281
PM Peak Vol.				15:00	21:00	17:00	16:00	16:00	15:00	15:00	15:00	15:00		16:00
				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



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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
01/14/																
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 Vol.				3	17	134	236	106	29	2	1		528
Midda y Peak Vol.				1	22	98	122	69	13	3	1	1	323
PM Peak Vol.				7	81	193	180	59	14	4	2	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



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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



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

Start Time	WB		EB		Combin ed		14-Jan-14 Tue							
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.								
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	20 77	261	2 14	63	259	6 34 140 520							
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	4 60	266	0 12	76	260	0 16 136 526							
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	3 73	254	1 4	84	323	1 7 157 577							
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	5 99	352	3 13	80	361	4 18 179 713							
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	14 83	340	3 7	105	423	8 21 188 763							
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	51 79	360	25 46	115	457	56 97 194 817							
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	145 71	308	62 190	90	381	116 335 161 689							
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	285 47	203	122 393	44	190	206 678 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	359 31	172	119 528	39	160	218 887 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	329 26	117	57 283	25	117	140 612 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	258 20	88	63 231	16	80	125 489 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	251 5	33	59 252	7	53	118 503 12 86							
Total	1724	2754	1973	3064	3697	5818								
Percent	46.6%	47.3%	53.4%	52.7%										
Day Total		4478		5037		9515								
Peak Vol.	08:30	-	03:15	-	07:45	-	05:00	-	08:00	-	05:00	-	-	-
P.H.F.	0.939	-	0.922	-	0.903	-	0.944	-	0.932	-	0.920	-	-	-



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



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

Start Time	WB		EB		Combin ed		15-Jan- 14 Wed
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
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	17 70	256	1 17 72	256	3 34 142	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	4 69	250	4 13 70	294	5 17 139	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	6 67	281	1 6 87	319	3 12 154	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	7 94	329	2 12 97	389	3 19 191	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	17 103	395	0 9 100	414	7 26 203	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	53 89	341	20 37 100	468	51 90 189	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	142 56	310	59 162 85	374	120 304 141	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	273 46	210	121 399 42	211	207 672 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	340 32	163	138 526 38	146	228 866 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	346 37	131	68 295 35	126	155 641 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	293 13	89	48 216 18	92	123 509 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	264 11	49	61 225 9	55	137 489 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	- 08:00	- 04:30	- - -
Vol.	368	- 395	- 526	- 472	- 866	- 848	- - -
P.H.F.	0.893	0.874	0.843	0.901	0.950	0.926	

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 Time	WB		EB		Combin ed		14-Jan-14 Tue
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
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	32 87	307 2	21 70	301 8	53 157	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	11 63	312 1	12 79	286 1	23 142	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	9 108	355 2	8 94	334 4	17 202	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	6 122	425 1	10 71	387 3	16 193	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	20 104	477 4	14 107	408 12	34 211	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	90 147	576 30	74 115	469 77	164 262	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	201 104	487 83	251 71	362 160	452 175	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	372 62	316 206	675 38	208 340	1047 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	459 45	229 203	844 34	180 311	1303 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	338 40	165 84	473 35	140 178	811 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	291 29	142 78	314 17	75 138	605 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	277 14	71 71	280 10	54 146	557 24	125
Total	2106	3862	2976	3204	5082	7066	
Percent	41.4%	54.7%	58.6%	45.3%			
Day Total		5968		6180		12148	
Peak Vol.	07:45 485	- 576	- 847	- 476	- 1332	- 1045	- -
P.H.F.	0.905	0.973	0.945	0.850	0.979	0.907	

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



PRECISION  
D A T A  
INDUSTRIES, LLC

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

Start Time	WB		EB		Combin ed		15-Jan- 14 Wed							
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.								
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	293 0	14 86	276 5	45 164	569							
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	310 3	12 72	310 5	31 161	620							
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	381 3	7 80	344 6	20 182	725							
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	421 3	11 91	400 5	21 205	821							
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	496 4	12 131	460 14	35 255	956							
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	617 30	63 114	500 74	142 294	1117							
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	497 81	214 66	348 163	400 166	845							
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	261 217	676 44	244 358	1061 107	505							
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	213 217	860 38	165 316	1335 85	378							
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	188 107	535 36	139 182	886 88	327							
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	149 86	341 18	92 164	647 34	241							
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 77	306 4	56 152	605 14	123							
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	-	05:00	-	-	-				
Vol.	517	-	622	-	860	-	523	-	1377	-	1117	-	-	-
P.H.F.	0.917		0.864		0.919		0.927		0.962		0.950			

**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
GROUP 2 - RURAL MAJOR COLLECTOR (R-5) Use group 2 for R5, R6, & R0	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 Use group 6 for U2, U3, U5, U6, U0, R2, & R3	1.04	1.00	0.96	0.93	0.92	0.91	0.91	0.89	0.93	0.93	0.96	1.01
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	AXLE CORRECTION FACTOR
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

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

Apply I-84 factor to stations: 3290, 3929



# Computations

Project:

Project # 12568000

Location:

Sheet of

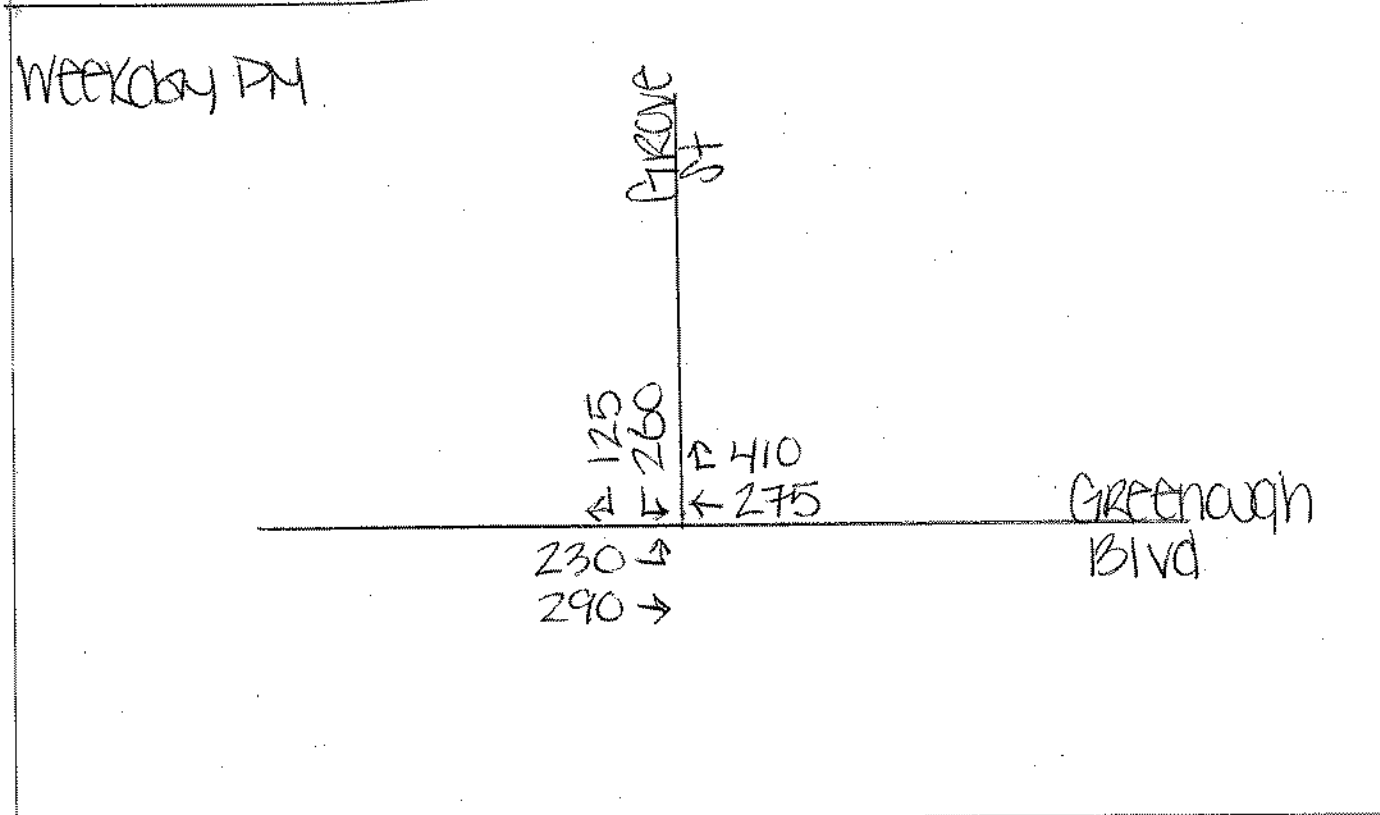
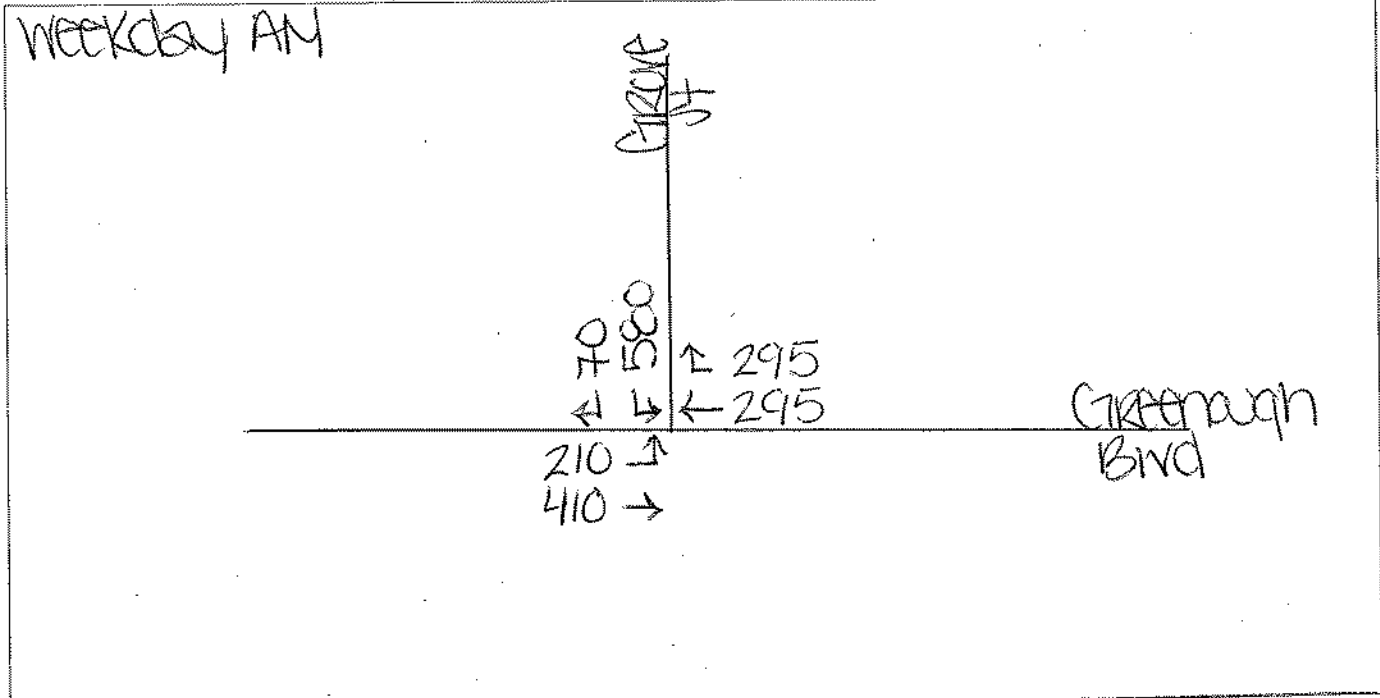
Calculated by: KK

Date:

Checked by:

Date:

Title 2014 Existing VOLUMES



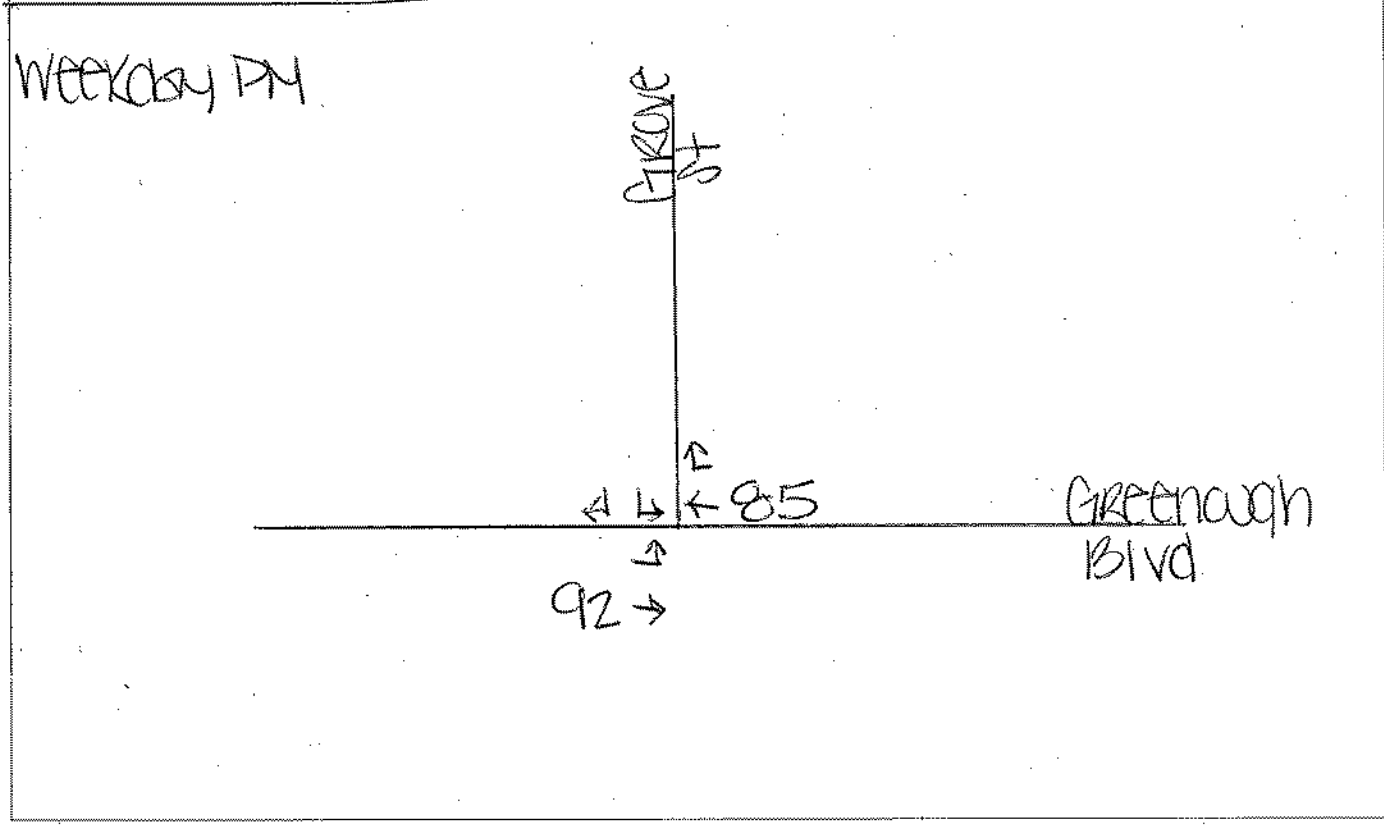
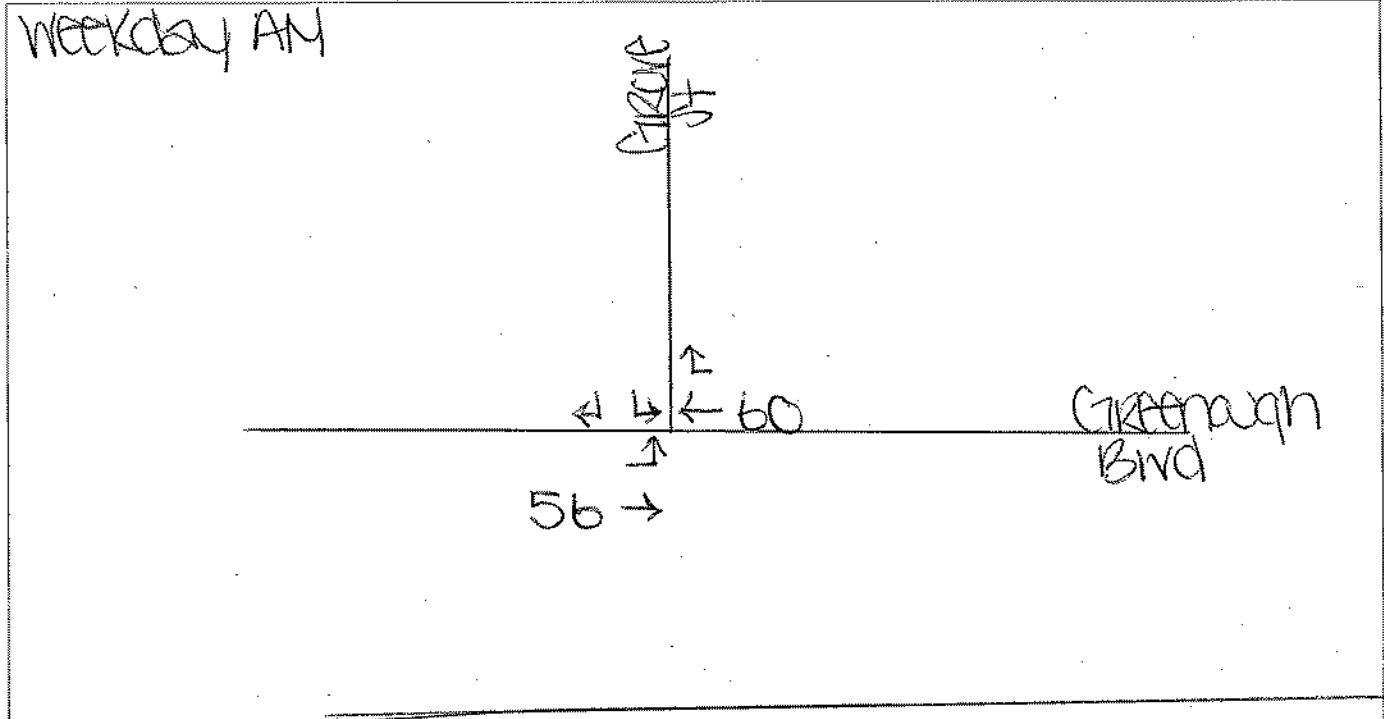


Computations

Project:  
Location:  
Calculated by: KK  
Checked by:

Project # 12568000  
Sheet of  
Date: 4/23/2014  
Date:

Title Total Background Projects





Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/14

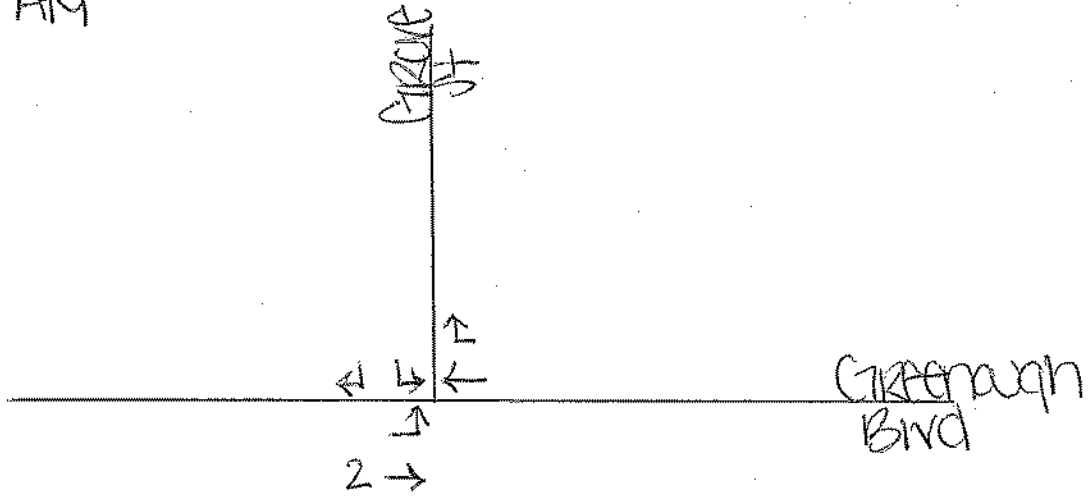
Checked by:

Date:

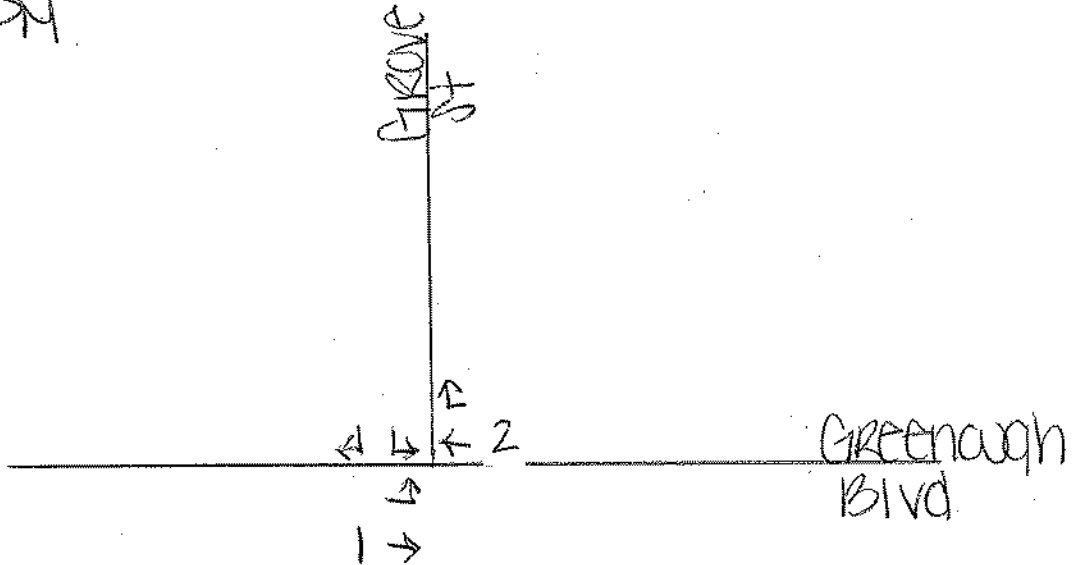
Title

Background Project  
Repton Place (555 Pleasant St)

Weekday AM



Weekday PM





Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/2014

Checked by:

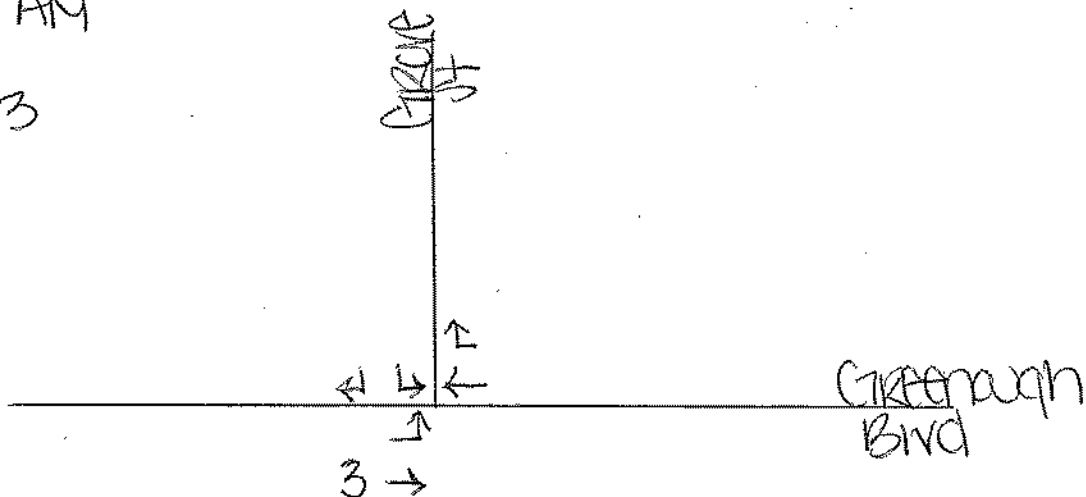
Date:

Title Background Project  
Alta at the Estate

Weekday AM

ENTER = 23

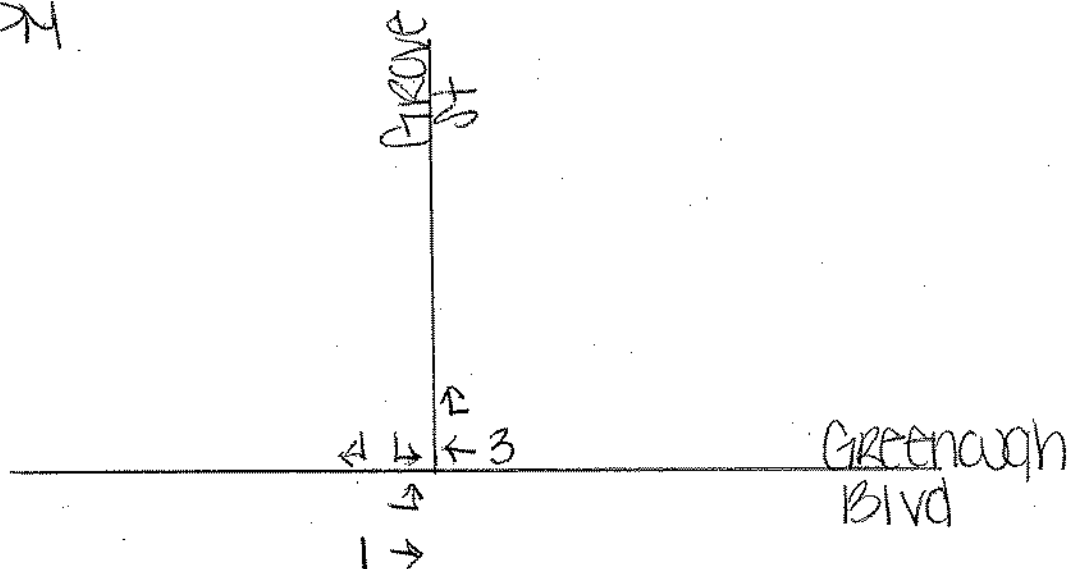
EXIT = 90



Weekday PM

ENTER = 91

EXIT = 49







Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/14

Checked by:

Date:

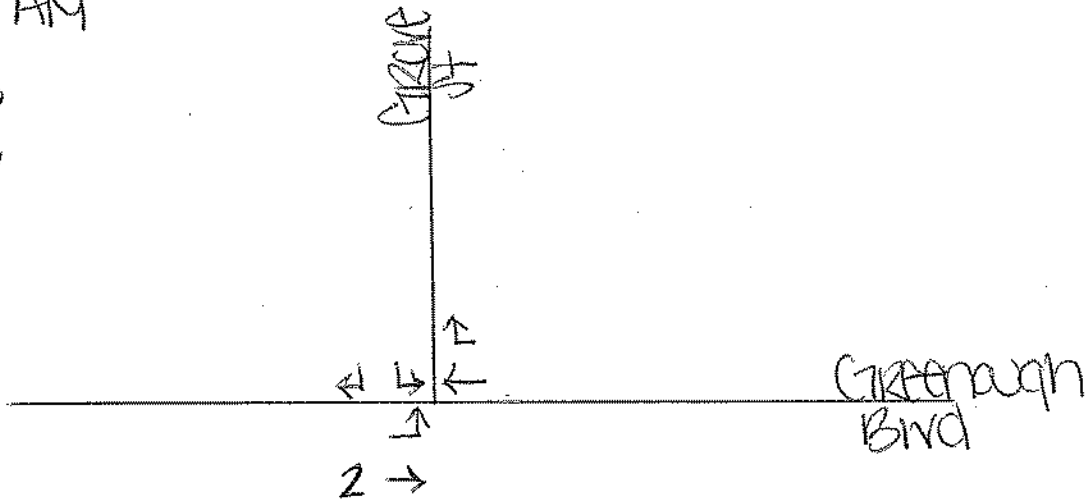
Title Background Project

Bacon - Howard Development

Weekday AM

ENTER = 16

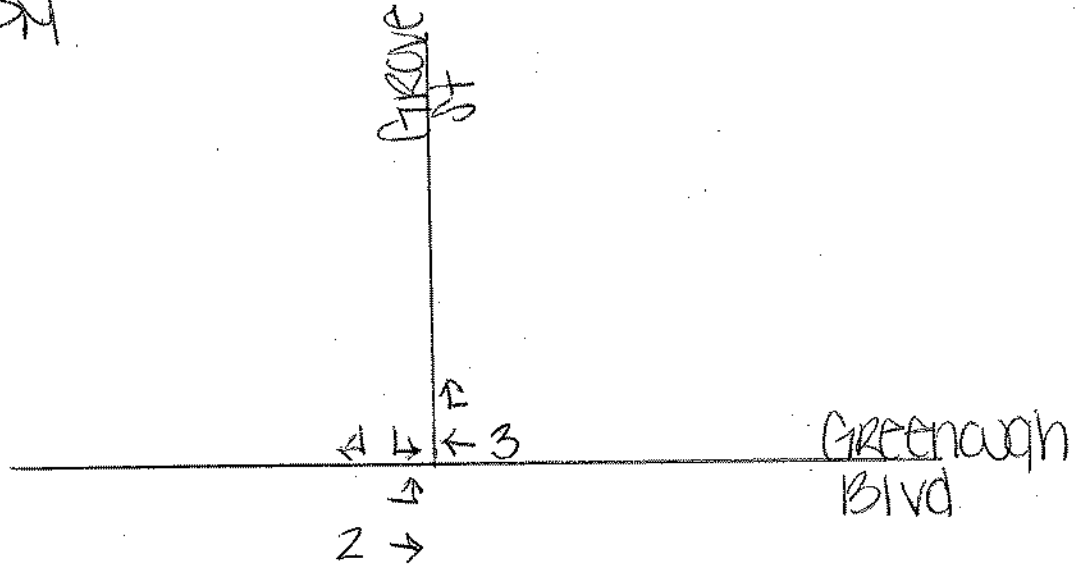
EXIT = 30



Weekday PM

ENTER = 58

EXIT = 43





Computations

Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/9/2014

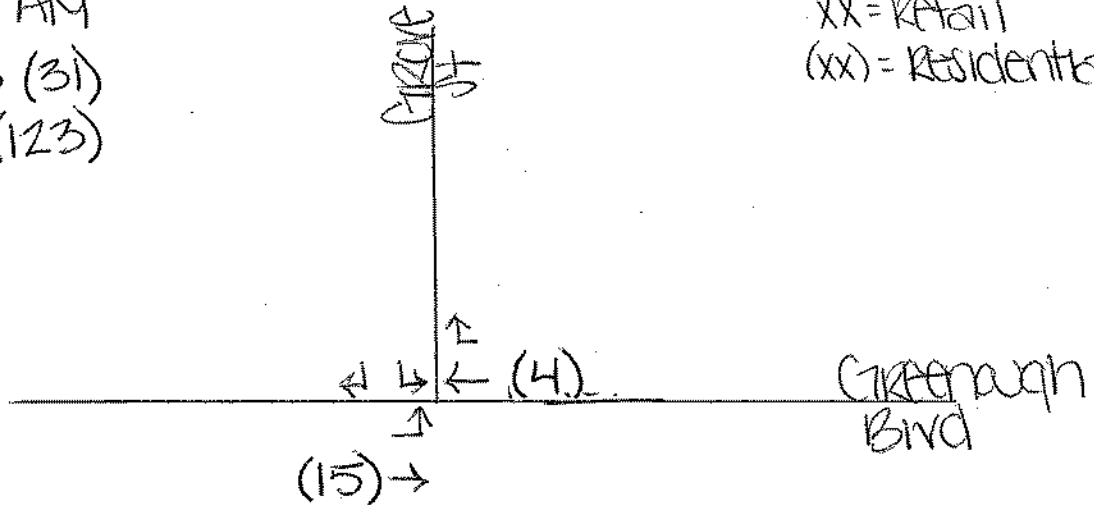
Checked by:

Date:

Title Background Project  
IONICS SITE (EASTERLY PARCEL)

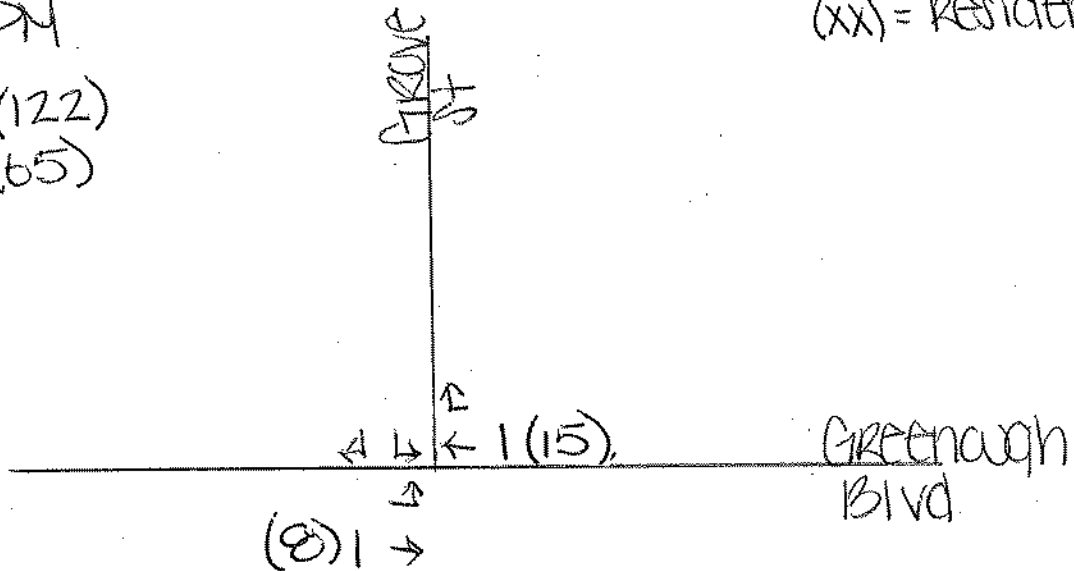
Weekday AM  
ENTER = 5 (31)  
EXIT = 2 (123)

XX = Retail  
(xx) = Residential



Weekday PM  
ENTER = 12 (122)  
EXIT = 16 (65)

XX = Retail  
(xx) = Residential





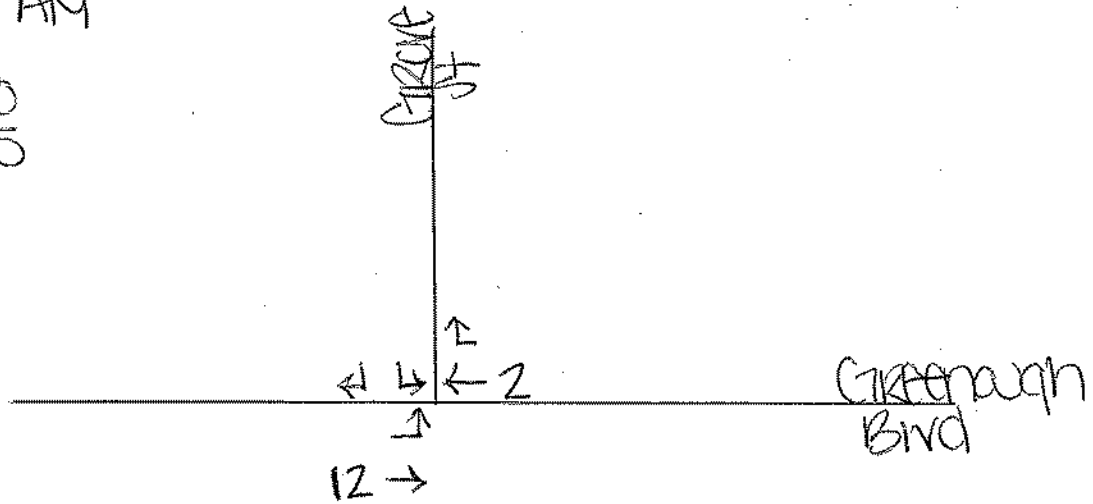
Project:  
Location:  
Calculated by: KK  
Checked by:

Project # 12568000  
Sheet of  
Date: 4/22/2014  
Date:

Title Background Project  
PIKOLL SITE

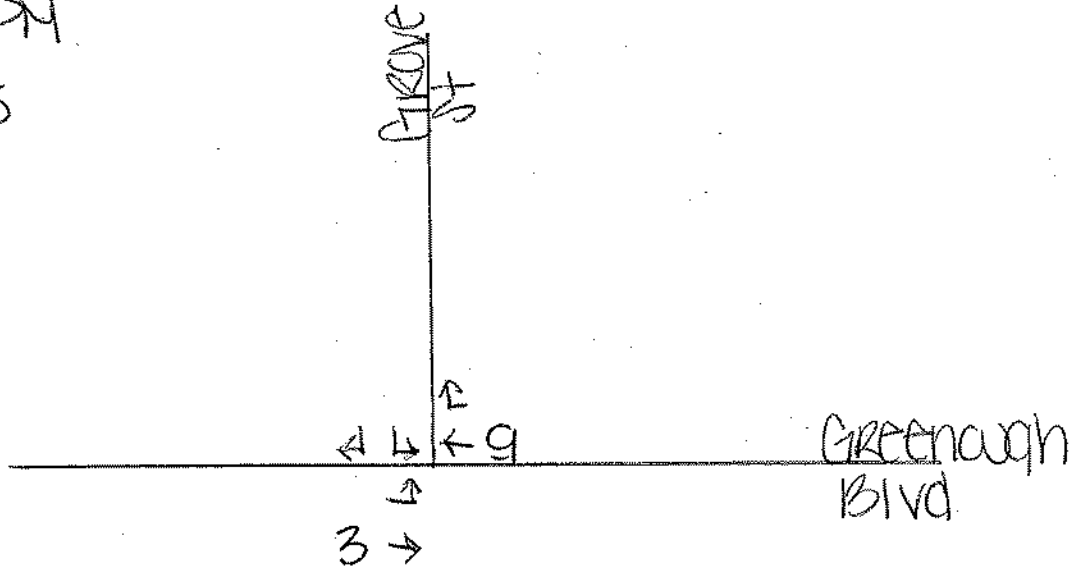
Weekday AM

ENTER = 18  
EXIT = 105



Weekday PM

ENTER = 75  
EXIT = 25





Computations

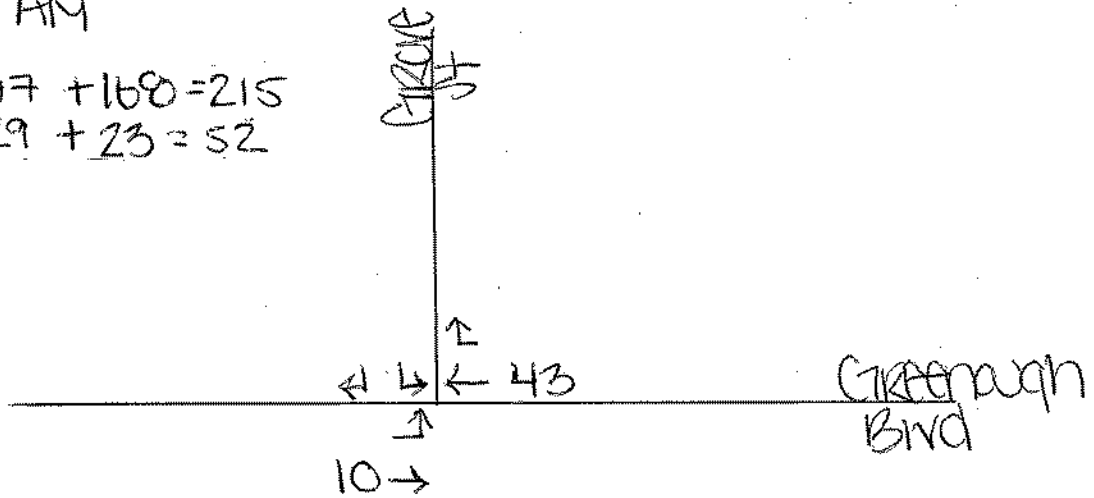
Project:  
Location:  
Calculated by: KK  
Checked by:

Project # 1256800  
Sheet of  
Date: 4/22/2014  
Date:

Title Background Project  
Arsenal on the Charles

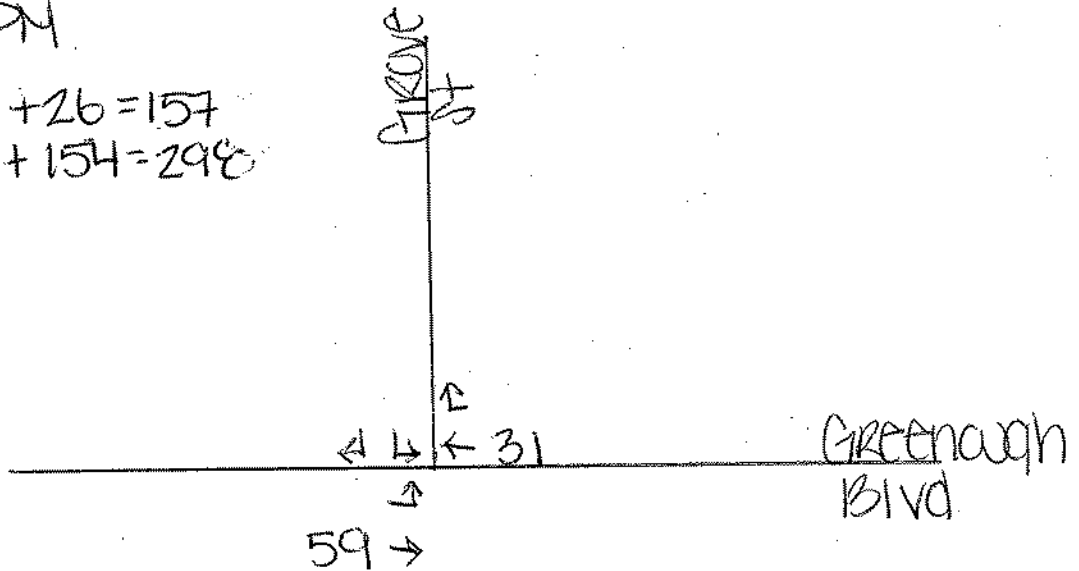
Weekday AM

enter = 47 + 168 = 215  
exit = 29 + 23 = 52



Weekday PM

enter = 131 + 26 = 157  
exit = 144 + 154 = 298





Project:

Project # 12568000

Location:

Sheet of

Calculated by: KK

Date: 4/23/2014

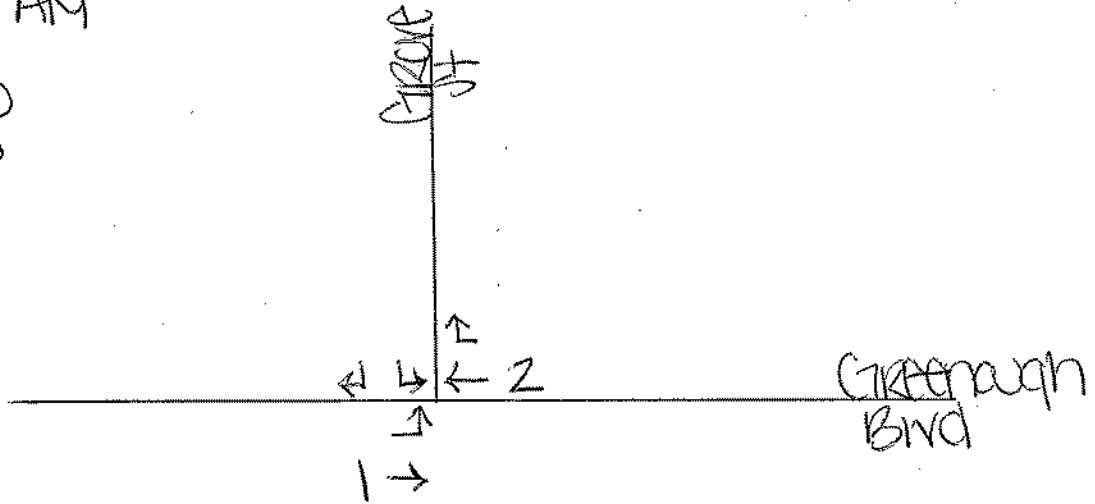
Checked by:

Date:

Title Background Project  
Arsenal Mall Redevelopment

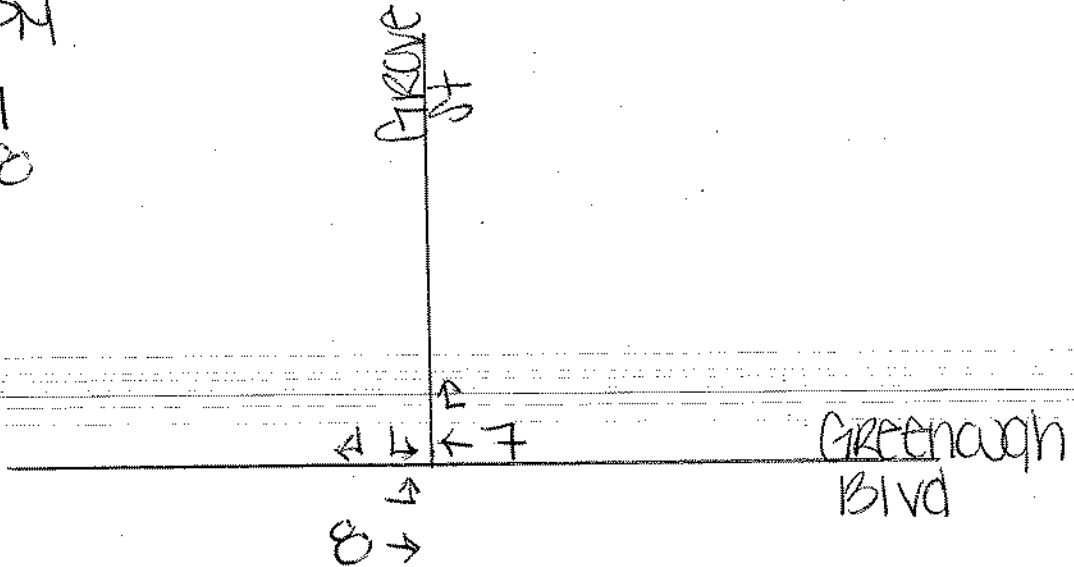
Weekday AM

Enter = 20  
Exit = 10



Weekday PM

Enter = 61  
Exit = 68





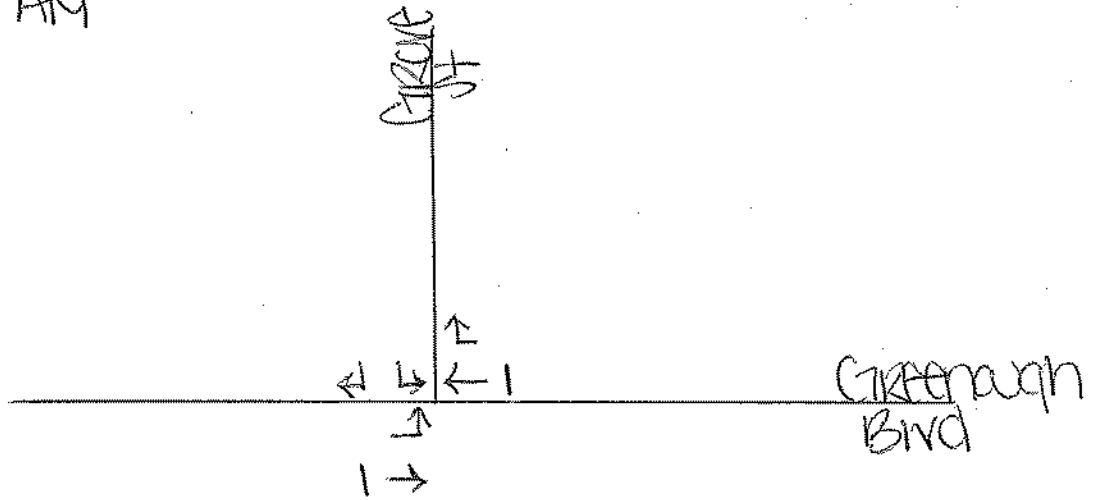
Computations

Project:  
Location:  
Calculated by: KK  
Checked by:

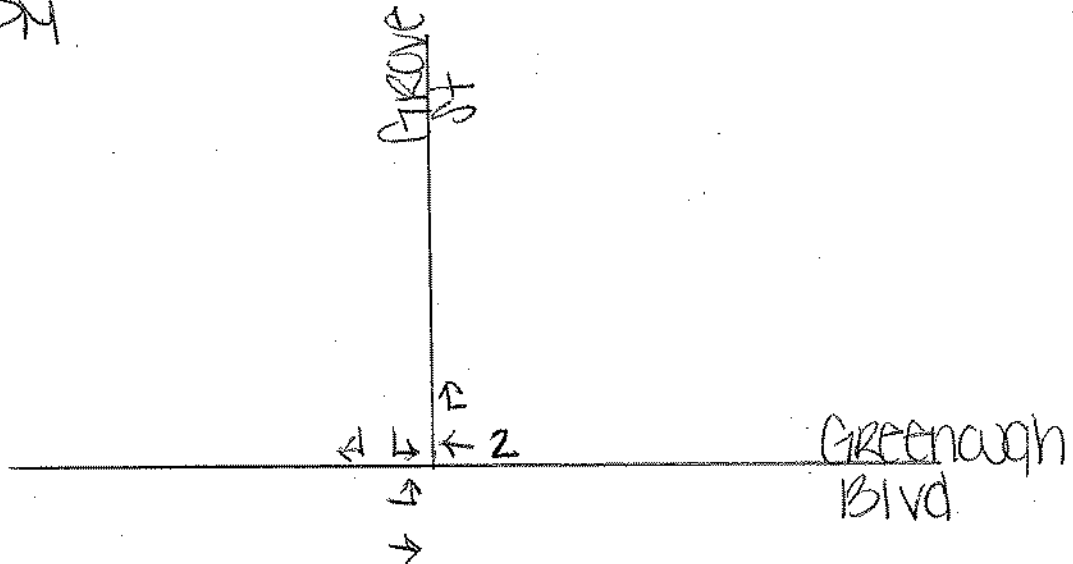
Project # 12568000  
Sheet of  
Date: 4/9/2014  
Date:

Title Background Project  
270 Pleasant Street

Weekday AM



Weekday PM





Computations

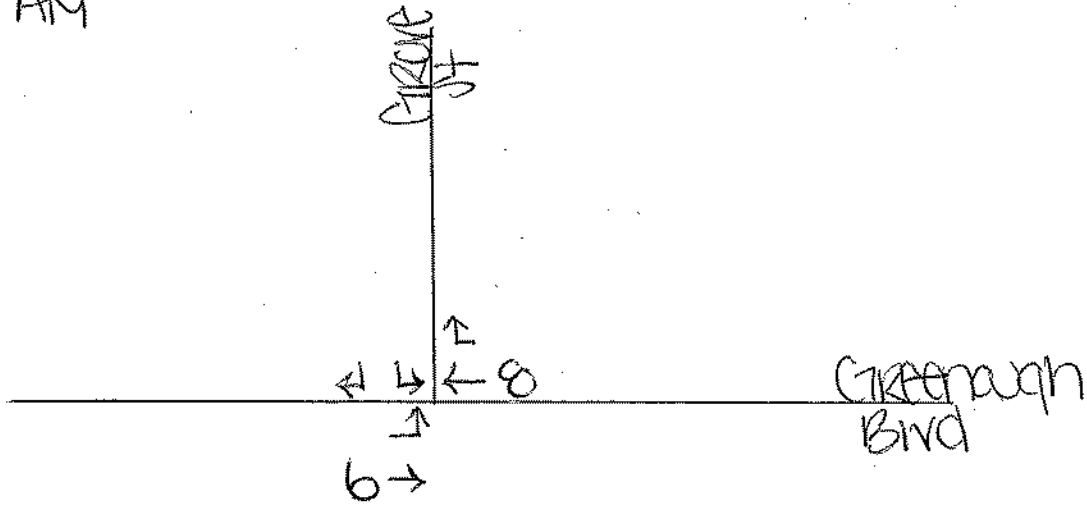
Project:  
Location:  
Calculated by: KK

Project # 12568000  
Sheet of  
Date: 4/22/2014

Checked by:  
Title: Background Project  
J3312 - HOTEL

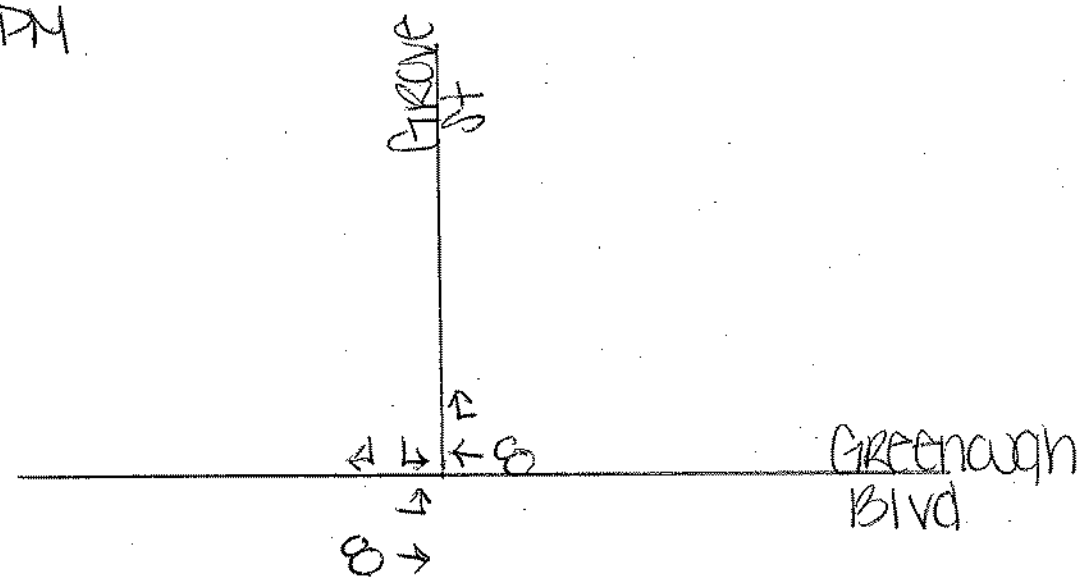
Weekday AM

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:

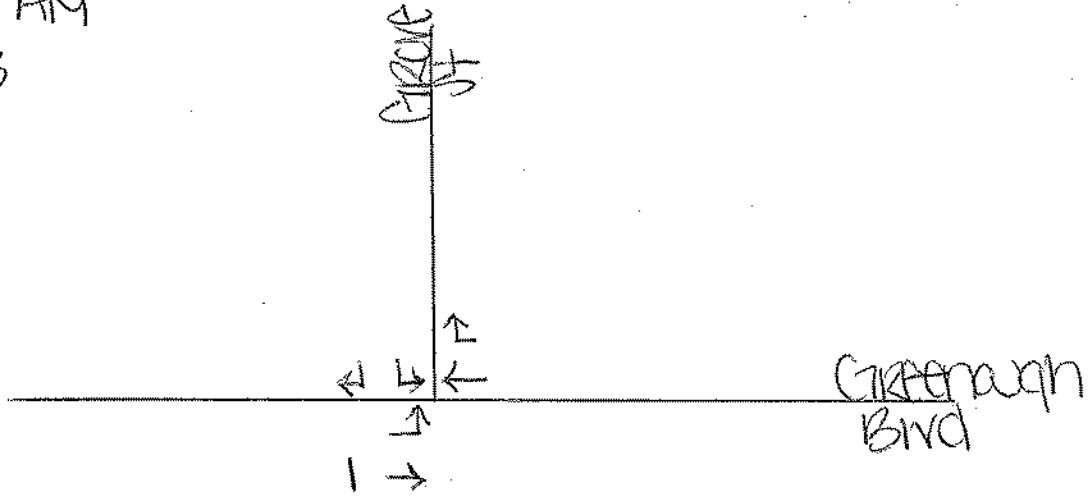
Date:

Title Background Development  
33 Mt. Auburn St Concord

Weekday AM

enter = 3

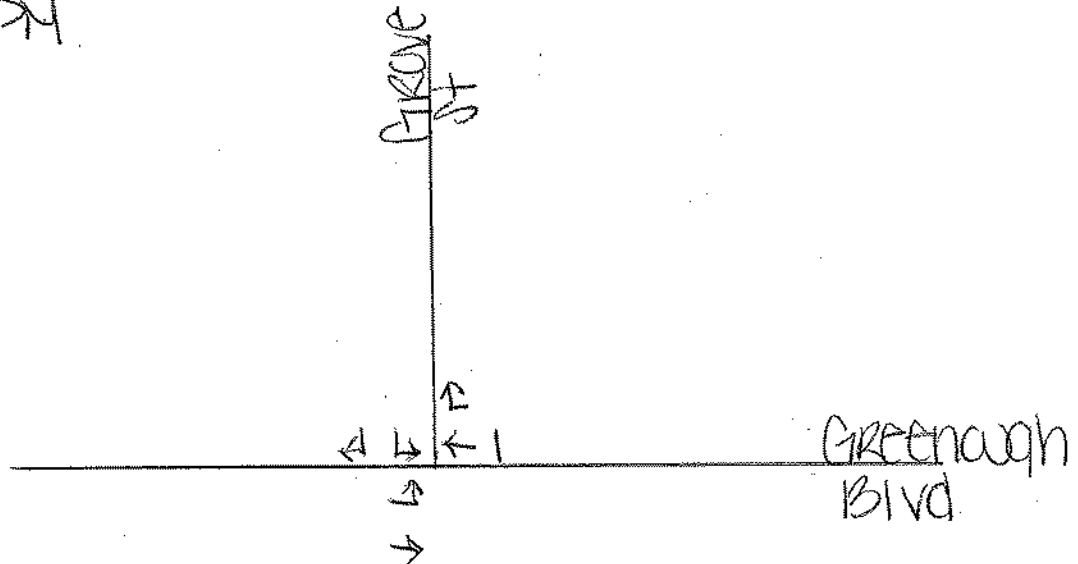
exit = 9



Weekday PM

enter = 10

exit = 7



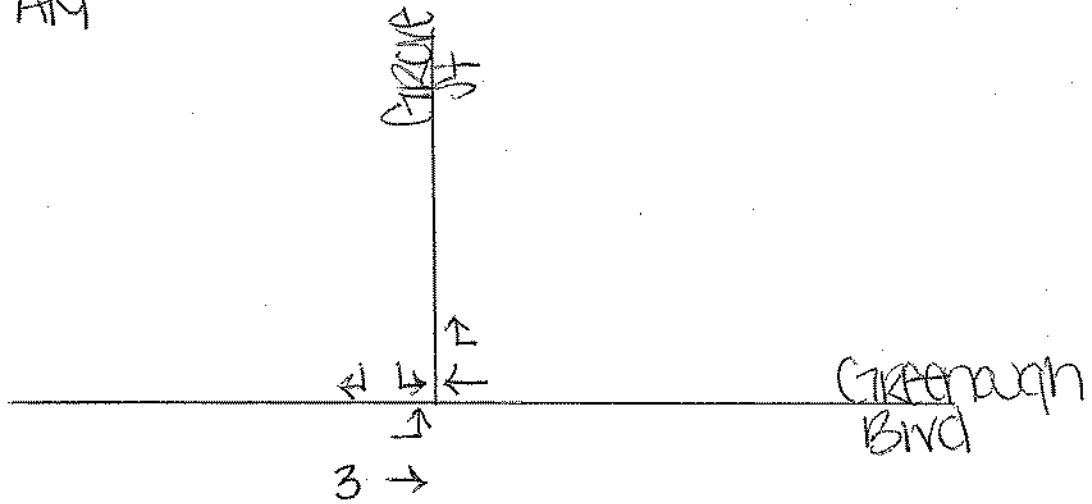




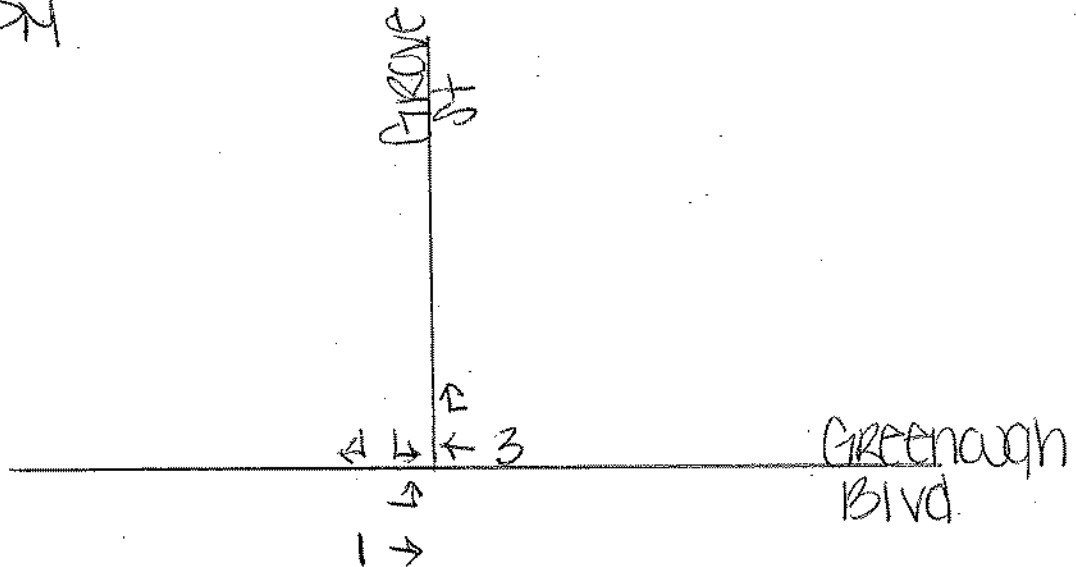
Computations

Project: Project # 12568000  
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

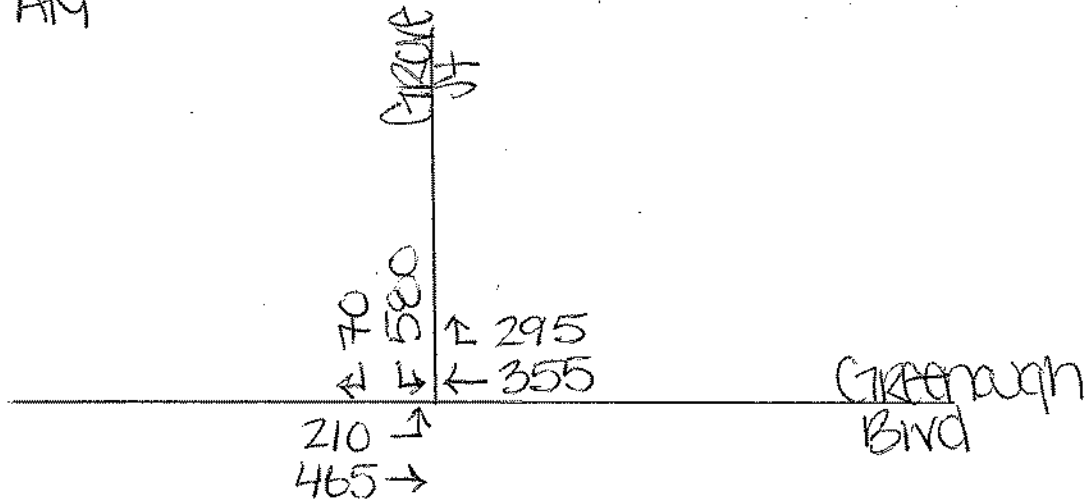
Date:

Checked by:

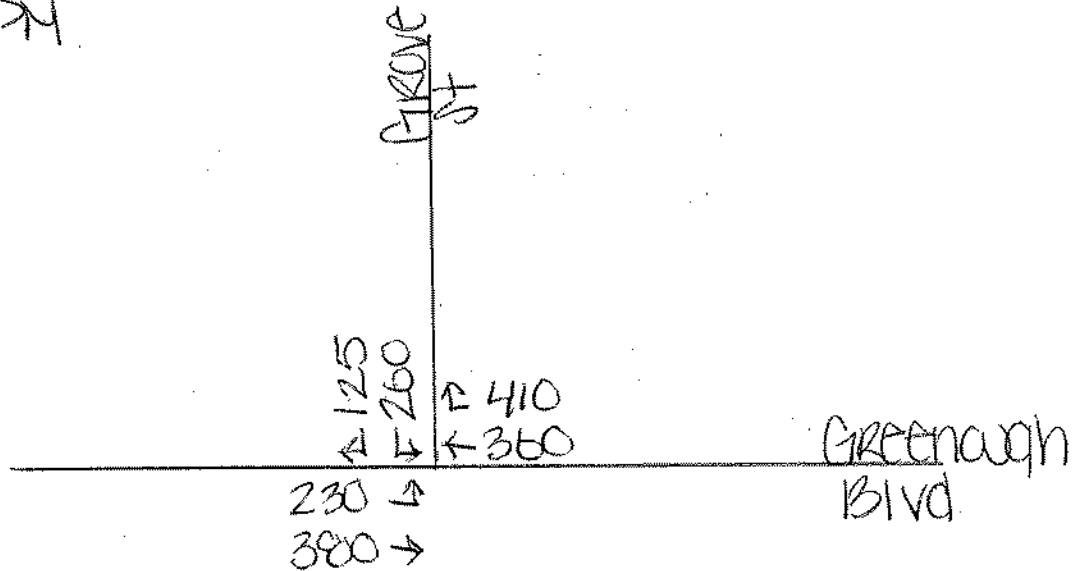
Date:

Title 2024 FUTURE VOLUMES

Weekday AM

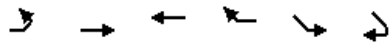


Weekday PM



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 Effct 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

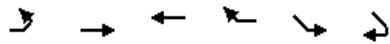
Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 81  
 Natural Cycle: 75  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 0.83  
 Intersection Signal Delay: 29.1  
 Intersection Capacity Utilization 76.4%  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, 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



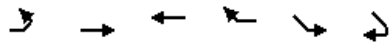
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	230	290	275	410	260	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1805	3610	3253	0	1805	1615
Flt Permitted	0.233				0.950	
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 Effct 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 Capacity Utilization 62.9%  
 Analysis Period (min) 15  
 Intersection LOS: B  
 ICU Level of Service B

Splits and Phases: 1: Greenough Blvd & Grove Street





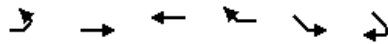
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	210	465	355	295	580	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1787	3574	3331	0	1805	1615
Fit Permitted	0.197				0.950	
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 Effct 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 Capacity Utilization 78.0%  
 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**





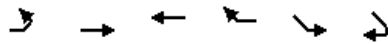
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	230	380	360	410	260	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1805	3610	3288	0	1805	1615
Fit Permitted	0.175				0.950	
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 Capacity Utilization 65.3%  
 Analysis Period (min) 15  
 Intersection LOS: C  
 ICU Level of Service C

Splits and Phases: 1: Greenough Blvd & Grove Street





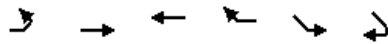
Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	210	465	355	295	580	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70			0	0	25
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Satd. Flow (prot)	1787	1881	3331	0	1805	1615
Flt Permitted	0.252				0.950	
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 Effct 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 Capacity Utilization 78.0%  
 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
Fit 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

