

APPENDIX A
Weekday 24-Hour Traffic Counts
April 12 to 15, 2016

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/12/2016

STA. 15B

1-WAY

Site Reference: 160110000545
 Site ID: 000000000102
 Location: FOURTH ST., NORTH OF BROADWAY
 Direction: SOUTH

File: 102.prn
 City: CHELSEA
 County: VOL ONE-WAY SB

TIME	MON	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00			87	111	126	108			108	324
02:00			81	80	87	82			82	248
03:00			68	50	64	60			60	182
04:00			46	53	50	49			49	149
05:00			77	62	84	74			74	223
06:00			181	189	171	180			180	541
07:00			265	289	291	281			281	845
08:00			331	356	330	339			339	1017
09:00			340	343	298	327			327	981
10:00			368	350		359			359	718
11:00		392	375	320		362			362	1087
12:00		430	392	330		384			384	1152
13:00		448	433	376		419			419	1257
14:00		394	422	424		413			413	1240
15:00		396	451	487		444			444	1334
16:00		485	492	429		468			468	1406
17:00		527	453	451		477			477	1431
18:00		446	451	461		452			452	1358
19:00		409	488	427		441			441	1324
20:00		347	329	376		350			350	1052
21:00		255	291	296		280			280	842
22:00		256	254	254		254			254	764
23:00		193	210	212		205			205	615
24:00		144	148	184		158			158	476
<hr/>										
TOTALS	0	5122	7033	6910	1501	6966	0	0	6966	20566
% AVG WKDY		73.5	100.9	99.1	21.5					
% AVG WEEK		73.5	100.9	99.1	21.5					
AM Times		12:00	12:00	08:00	08:00	12:00			12:00	
AM Peaks		430	392	356	330	384			384	
PM Times		17:00	16:00	15:00		17:00			17:00	
PM Peaks		527	492	487		477			477	

UB

AWD 6966

FAC .93 (.97)

ADT 6,300

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/12/2016

STA. 2 NB

1-WAY

Site Reference: 160110000876
 Site ID: 000000000201
 Location: HAWTHRONE ST., SOUTH OF BELLINGHAM ST.
 Direction: NORTH

File: 201.prn
 City: CHELSEA
 County: VOL ONE-WAY NB

TIME	MON	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00			116	143	172	143			143	431
02:00			97	103	81	93			93	281
03:00			75	67	86	76			76	228
04:00			66	51	91	69			69	208
05:00			90	78	102	90			90	270
06:00			213	227	183	207			207	623
07:00			339	325	329	331			331	993
08:00			459	438	463	453			453	1360
09:00			472	503	485	486			486	1460
10:00			486	481		483			483	967
11:00		511	566	523		533			533	1600
12:00		567	597	541		568			568	1705
13:00		626	580	494		566			566	1700
14:00		595	527	636		586			586	1758
15:00		555	651	665		623			623	1871
16:00		654	572	602		609			609	1828
17:00		615	679	680		658			658	1974
18:00		681	664	691		678			678	2036
19:00		531	606	517		551			551	1654
20:00		525	544	564		544			544	1633
21:00		403	436	455		431			431	1294
22:00		366	378	388		377			377	1132
23:00		273	280	298		283			283	851
24:00		195	232	250		225			225	677

TOTALS	0	7097	9725	9720	1992	9663	0	0	9663	28534

% AVG WKDY		73.4	100.6	100.5	20.6					
% AVG WEEK		73.4	100.6	100.5	20.6					

AM Times		12:00	12:00	12:00	09:00	12:00			12:00	
AM Peaks		567	597	541	485	568			568	

PM Times		18:00	17:00	18:00		18:00			18:00	
PM Peaks		681	679	691		678			678	

u5

AWD 9663

FAC .93 (.97)

ADT 8,700

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/12/2016

STA. 35B

1-WAY

Site Reference: 160110000807
 Site ID: 000000000302
 Location: WASHINGTON AVE., NORTH OF BROADWAY.
 Direction: SOUTH

File: 302.prn
 City: CHELSEA
 County: VOL ONE-WAY SB

TIME	MON	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00			96	124	101	107			107	321
02:00			65	61	68	64			64	194
03:00			54	47	52	51			51	153
04:00			50	60	72	60			60	182
05:00			103	125	112	113			113	340
06:00			287	328	282	299			299	897
07:00			492	477	265	411			411	1234
08:00			625	570	561	585			585	1756
09:00			745	842	773	786			786	2360
10:00			589	645		617			617	1234
11:00		586	575	593		584			584	1754
12:00		650	643	591		628			628	1884
13:00		595	645	608		616			616	1848
14:00		591	622	721		644			644	1934
15:00		559	621	602		594			594	1782
16:00		600	653	648		633			633	1901
17:00		650	630	669		649			649	1949
18:00		647	666	631		648			648	1944
19:00		598	658	639		631			631	1895
20:00		523	456	538		505			505	1517
21:00		340	459	523		440			440	1322
22:00		294	365	362		340			340	1021
23:00		274	241	269		261			261	784
24:00		156	179	196		177			177	531

TOTALS	0	7063	10519	10869	2286	10443	0	0	10443	30737

% AVG WKDY		67.6	100.7	104	21.8					
% AVG WEEK		67.6	100.7	104	21.8					

AM Times		12:00	09:00	09:00	09:00	09:00			09:00	
AM Peaks		650	745	842	773	786			786	

PM Times		17:00	18:00	14:00		17:00			17:00	
PM Peaks		650	666	721		649			649	

U5

AWD 10443

FAC .93(.97)

ADT 9,400

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/12/2016

STA. 4 EB

1-WAY

Site Reference: 160110000782
 Site ID: 000000000403
 Location: BELLINGHAM ST., EAST OF BROADWAY.
 Direction: EAST

File: 403.prn
 City: CHELSEA
 County: VOL ONE-WAY WB

TIME	MON	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00			18	11	9	12			12	38
02:00			9	10	7	8			8	26
03:00			12	2	9	7			7	23
04:00			11	9	10	10			10	30
05:00			14	14	9	12			12	37
06:00			15	12	17	14			14	44
07:00			21	29	28	26			26	78
08:00			42	39	25	35			35	106
09:00			40	38	40	39			39	118
10:00			67	57		62			62	124
11:00		43	58	45		48			48	146
12:00		55	50	39		48			48	144
13:00		80	64	58		67			67	202
14:00		75	43	54		57			57	172
15:00		49	50	55		51			51	154
16:00		57	58	62		59			59	177
17:00		65	53	47		55			55	165
18:00		75	66	79		73			73	220
19:00		49	42	43		44			44	134
20:00		28	53	50		43			43	131
21:00		39	42	44		41			41	125
22:00		30	39	28		32			32	97
23:00		25	20	27		24			24	72
24:00		16	24	21		20			20	61

TOTALS	0	686	911	873	154	887	0	0	887	2624
% AVG WKDY		77.3	102.7	98.4	17.3					
% AVG WEEK		77.3	102.7	98.4	17.3					
AM Times	12:00	10:00	10:00	09:00	10:00			10:00		
AM Peaks	55	67	57	40	62			62		
PM Times	13:00	18:00	18:00		18:00			18:00		
PM Peaks	80	66	79		73			73		

U6
 AWD 887
 FAC .93 (.97)
 ADT 800

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/12/2016

STA. 5 WB

1-WAY

Site Reference: 160110000462
 Site ID: 000000000504
 Location: BROADWAY., EAST OF FOURTH ST.
 Direction: WEST

File: 504.prn
 City: CHELSEA
 County: VOL ONE-WAY WB

TIME	MON	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00			70	104	40	71			71	214
02:00			58	46	54	52			52	158
03:00			42	34	43	39			39	119
04:00			46	53	60	53			53	159
05:00			79	98	87	88			88	264
06:00			205	224	197	208			208	626
07:00			340	352	330	340			340	1022
08:00			427	411	404	414			414	1242
09:00			533	606	545	561			561	1684
10:00			449	400		424			424	849
11:00			449	389		419			419	838
12:00		430	267	422		373			373	1119
13:00		463	416	317		398			398	1196
14:00		430	432	479		447			447	1341
15:00		407	411	434		417			417	1252
16:00		438	459	451		449			449	1348
17:00		420	445	455		440			440	1320
18:00		436	486	430		450			450	1352
19:00		405	410	461		425			425	1276
20:00		380	352	390		374			374	1122
21:00		307	339	401		349			349	1047
22:00		221	256	265		247			247	742
23:00		209	188	213		203			203	610
24:00		125	144	126		131			131	395

TOTALS	0	4671	7303	7561	1760	7372	0	0	7372	21295
% AVG WKDY		63.3	99	102.5	23.8					
% AVG WEEK		63.3	99	102.5	23.8					
AM Times	12:00	09:00	09:00	09:00	09:00	09:00			09:00	
AM Peaks	430	533	606	545	561				561	
PM Times	13:00	18:00	14:00		18:00				18:00	
PM Peaks	463	486	479		450				450	

43

AWD 7372

FAC .93(.97)

ADT 6,700

APPENDIX B
Intersection Turning Movement Counts
Broadway at Fifth Street
April 14 and 16, 2016

Study Name Chelsea - Broadway, Washington Ave., Bellingham, Fifth and Hawthorne Streets TM2 TMC
 Start Date Thursday, April 14, 2016 7:00 AM
 End Date Saturday, April 16, 2016 2:00 PM
 Site Code

Report Summary

Time Period	Class.	Southbound						Southwestbound				Westbound				Northbound				Northeastbound				Eastbound		Crosswalk		
		R	BR	L	HL	I	O	I	O	I	O	R	BR	L	HL	I	O	I	O	I	O	Total	Pedestrians	Total				
Peak 1	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	88	88	
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%			
7:00 AM - 9:00 AM	Cars	13	508	0	102	623	0	0	484	0	21	21	382	0	0	403	0	0	508	0	13	1026	NE	25	25			
One Hour Peak	%	87%	83%	0%	82%	83%	0%	0%	80%	0%	78%	78%	80%	0%	0%	79%	0%	0%	83%	0%	87%	82%	100%					
8:00 AM - 9:00 AM	Light Goods Vehicles	1	55	0	14	70	0	0	72	0	1	1	58	0	0	59	0	0	55	0	1	129	E	107	107			
	%	7%	9%	0%	11%	9%	0%	0%	12%	0%	4%	4%	12%	0%	0%	12%	0%	0%	9%	0%	7%	10%	100%					
	Buses	0	32	0	1	33	0	0	26	0	3	3	25	0	0	28	0	0	32	0	0	61	S	163	163			
	%	0%	5%	0%	1%	4%	0%	0%	4%	0%	11%	11%	5%	0%	0%	6%	0%	0%	5%	0%	0%	5%	100%					
	Single-Unit Trucks	1	11	0	7	19	0	0	19	0	2	2	12	0	0	14	0	0	11	0	1	33	SW	120	120			
	%	7%	2%	0%	6%	3%	0%	0%	3%	0%	7%	7%	3%	0%	0%	3%	0%	0%	2%	0%	7%	3%	100%					
	Articulated Trucks	0	1	0	0	1	0	0	3	0	0	0	3	0	0	3	0	0	1	0	0	4	W	310	310			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	100%					
	Bicycles on Road	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3		813	813			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	Total	15	610	0	124	749	0	0	604	0	27	27	480	0	0	507	0	0	610	0	15	1256						
	PHF	0.62	0.88	0	0.82	0.87	0	0	0.93	0	0.75	0.75	0.96	0	0	0.96	0	0	0.88	0	0.62	0.9						
	Approach %					60%	0%	0%	48%	0%	2%					40%	0%	0%	49%	0%	1%							
Peak 2	Motorcycles	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	N	109	109			
Specified Period	%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%					
4:00 PM - 6:00 PM	Cars	14	366	0	87	467	0	0	595	0	49	49	508	0	0	557	0	0	366	0	14	1024	NE	34	34			
One Hour Peak	%	100%	82%	0%	90%	84%	0%	0%	82%	0%	84%	84%	80%	0%	0%	81%	0%	0%	82%	0%	100%	82%	100%					
4:45 PM - 5:45 PM	Light Goods Vehicles	0	48	0	9	57	0	0	96	0	8	8	87	0	0	95	0	0	48	0	0	152	E	238	238			
	%	0%	11%	0%	9%	10%	0%	0%	13%	0%	14%	14%	14%	0%	0%	14%	0%	0%	11%	0%	0%	12%	100%					
	Buses	0	31	0	0	31	0	0	29	0	1	1	29	0	0	30	0	0	31	0	0	61	S	399	399			
	%	0%	7%	0%	0%	6%	0%	0%	4%	0%	2%	2%	5%	0%	0%	4%	0%	0%	7%	0%	0%	5%	100%					
	Single-Unit Trucks	0	1	0	0	1	0	0	6	0	0	0	6	0	0	6	0	0	1	0	0	7	SW	139	139			
	%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	1%	100%					
	Articulated Trucks	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	W	474	474			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%					
	Bicycles on Road	0	0	0	0	0	0	0	2	0	0	0	2	0	0	2	0	0	0	0	0	2		1393	1393			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	Total	14	446	0	97	557	0	0	730	0	58	58	633	0	0	691	0	0	446	0	14	1248						
	PHF	0.7	0.94	0	0.84	0.97	0	0	0.93	0	0.91	0.91	0.94	0	0	0.94	0	0	0.94	0	0.7	0.99						
	Approach %					45%	0%	0%	58%	0%	5%					55%	0%	0%	36%	0%	1%							

Study Name Chelsea - Broadway, Washington Ave., Bellingham, Fifth and Hawthorne Streets TM2 TMC
 Start Date Thursday, April 14, 2016 7:00 AM
 End Date Saturday, April 16, 2016 2:00 PM
 Site Code

Report Summary

Time Period	Class.	Southbound				Southwestbound				Westbound		Northbound				Northeastbound				Eastbound		Crosswalk			
		R	BR	L	HL	I	O	I	O	I	O	R	BR	L	HL	I	O	I	O	I	O	Total		Pedestrians	Total
Peak 1	Motorcycles	0	4	0	0	4	0	0	3	0	0	0	3	0	0	3	0	0	4	0	0	7	N	110	110
Specified Period	%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%		100%	
12:00 PM - 2:00 PM	Cars	25	419	0	61	505	0	0	634	0	41	41	573	0	1	615	0	0	420	0	25	1120	NE	41	41
One Hour Peak	%	83%	86%	0%	88%	86%	0%	0%	86%	0%	87%	87%	86%	0%	100%	86%	0%	0%	86%	0%	83%	86%		100%	
12:30 PM - 1:30 PM	Light Goods Vehicles	5	37	0	8	50	0	0	74	0	3	3	66	0	0	69	0	0	37	0	5	119	E	203	203
	%	17%	8%	0%	12%	9%	0%	0%	10%	0%	6%	6%	10%	0%	0%	10%	0%	0%	8%	0%	17%	9%		100%	
	Buses	0	15	0	0	15	0	0	14	0	1	1	14	0	0	15	0	0	15	0	0	30	S	325	325
	%	0%	3%	0%	0%	3%	0%	0%	2%	0%	2%	2%	2%	0%	0%	2%	0%	0%	3%	0%	0%	2%		100%	
	Single-Unit Trucks	0	9	0	0	9	0	0	12	0	2	2	12	0	0	14	0	0	9	0	0	23	SW	144	144
	%	0%	2%	0%	0%	2%	0%	0%	2%	0%	4%	4%	2%	0%	0%	2%	0%	0%	2%	0%	0%	2%		100%	
	Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	W	419	419
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		100%	
	Bicycles on Road	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	2		1242	1242
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	30	485	0	69	584	0	0	738	0	47	47	669	0	1	717	0	0	486	0	30	1301			
	PHF	0.75	0.9	0	0.91	0.91	0	0	0.89	0	0.78	0.78	0.89	0	0.25	0.91	0	0	0.9	0	0.75	0.96			
	Approach %					45%	0%	0%	57%	0%	4%				55%	0%	0%	37%	0%	2%					

APPENDIX C

**Pedestrian Crossings outside Marked Crosswalks
Broadway at Fifth Street
April 14 and 16, 2016**

Broadway at Fifth Street and Fourth Street in Chelsea – Safety and Operations Study
Unmarked Crosswalk Locations for Turning Movement Count



Study Name Chelsea - Broadway to/from Washington Avenue Pathway 1
Start Date 04/14/2016
Start Time 7:00 AM
Site Code

Channel Direction	Fifth Street/Washington Avenue to Broadway/Bellingham Street	Broadway/Bellingham Street to Fifth Street/Washington Avenue
	Southbound	Northbound
7:00 AM	15	27
7:15 AM	8	32
7:30 AM	13	44
7:45 AM	8	21
8:00 AM	12	30
8:15 AM	18	15
8:30 AM	17	21
8:45 AM	18	17
4:00 PM	30	36
4:15 PM	67	41
4:30 PM	41	36
4:45 PM	35	40
5:00 PM	60	51
5:15 PM	58	36
5:30 PM	36	27
5:45 PM	47	37
12:00 PM	23	39
12:15 PM	39	36
12:30 PM	22	25
12:45 PM	30	38
1:00 PM	41	29
1:15 PM	41	19
1:30 PM	29	51
1:45 PM	41	38

Study Name Chelsea - Broadway/Bellingham and Hawthorne/Bellingham Streets Pathway 2

Start Date 04/14/2016

Start Time 7:00 AM

Site Code

Channel Direction	Broadway/5th Street to Hawthorne/Bellingham Streets	Hawthorne/Bellingham Streets to Broadway/5th
	Southbound	Northbound
7:00 AM	19	32
7:15 AM	7	38
7:30 AM	7	35
7:45 AM	9	25
8:00 AM	4	32
8:15 AM	11	29
8:30 AM	5	15
8:45 AM	9	17
4:00 PM	11	21
4:15 PM	47	16
4:30 PM	37	20
4:45 PM	18	31
5:00 PM	12	13
5:15 PM	13	12
5:30 PM	12	6
5:45 PM	15	22
12:00 PM	13	16
12:15 PM	11	15
12:30 PM	11	16
12:45 PM	24	14
1:00 PM	12	8
1:15 PM	17	24
1:30 PM	12	14
1:45 PM	22	18

Study Name Chelsea - Broadway to/from Washington Avenue Pathway 3

Start Date 04/14/2016

Start Time 7:00 AM

Site Code

Channel Direction	Washington Avenue to Broadway	Broadway to Washington Avenue
	Southbound	Northbound
7:00 AM	9	39
7:15 AM	3	35
7:30 AM	5	42
7:45 AM	2	29
8:00 AM	3	29
8:15 AM	9	20
8:30 AM	1	9
8:45 AM	4	10
4:00 PM	10	14
4:15 PM	27	11
4:30 PM	24	12
4:45 PM	8	23
5:00 PM	17	7
5:15 PM	11	12
5:30 PM	12	16
5:45 PM	6	17
12:00 PM	5	12
12:15 PM	17	18
12:30 PM	10	30
12:45 PM	18	12
1:00 PM	7	18
1:15 PM	8	25
1:30 PM	2	17
1:45 PM	6	14

APPENDIX D
Intersection Turning Movement Counts
Broadway at Fourth Street
April 14 and 16, 2016

Study Name Chelsea - Broadway and Fourth Street TM1 TMC
Start Date Thursday, April 14, 2016 7:00 AM
End Date Saturday, April 16, 2016 2:00 PM
Site Code

Report Summary

Time Period	Class.	Southwestbound				Northwestbound		Northeastbound		Southeastbound				Total	Crosswalk		
		T	L	I	O	I	O	I	O	R	T	I	O		Pedestrians	Total	
Peak 1	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	87	87
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		100%	
7:00 AM - 9:00 AM	Cars	407	100	507	0	0	230	0	557	150	130	280	0	787	SE	76	76
One Hour Peak	%	87%	95%	88%	0%	0%	91%	0%	88%	90%	88%	89%	0%	89%		100%	
8:00 AM - 9:00 AM	Light Goods Vehicles	19	3	22	0	0	15	0	27	8	12	20	0	42	SW	39	39
	%	4%	3%	4%	0%	0%	6%	0%	4%	5%	8%	6%	0%	5%		100%	
	Buses	33	1	34	0	0	5	0	34	1	4	5	0	39	NW	97	97
	%	7%	1%	6%	0%	0%	2%	0%	5%	1%	3%	2%	0%	4%		100%	
	Single-Unit Trucks	9	0	9	0	0	1	0	15	6	1	7	0	16		299	299
	%	2%	0%	2%	0%	0%	0%	0%	2%	4%	1%	2%	0%	2%			
	Articulated Trucks	1	0	1	0	0	0	0	2	1	0	1	0	2			
	%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%			
	Bicycles on Road	1	1	2	0	0	1	0	1	0	0	0	0	2			
	%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	470	105	575	0	0	252	0	636	166	147	313	0	888			
	PHF	0.9	0.85	0.89	0	0	0.8	0	0.94	0.88	0.77	0.97	0	0.92			
	Approach %			65%	0%	0%	28%	0%	72%			35%	0%				
Peak 2	Motorcycles	1	0	1	0	0	0	0	1	0	0	0	0	1	NE	97	97
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		100%	
4:00 PM - 6:00 PM	Cars	247	130	377	0	0	331	0	400	153	201	354	0	731	SE	167	167
One Hour Peak	%	80%	86%	82%	0%	0%	86%	0%	83%	88%	85%	86%	0%	84%		100%	
4:45 PM - 5:45 PM	Light Goods Vehicles	29	21	50	0	0	48	0	46	17	27	44	0	94	SW	132	132
	%	9%	14%	11%	0%	0%	12%	0%	10%	10%	11%	11%	0%	11%		100%	
	Buses	29	0	29	0	0	3	0	29	0	3	3	0	32	NW	285	285
	%	9%	0%	6%	0%	0%	1%	0%	6%	0%	1%	1%	0%	4%		100%	
	Single-Unit Trucks	2	0	2	0	0	5	0	6	4	5	9	0	11		681	681
	%	1%	0%	0%	0%	0%	1%	0%	1%	2%	2%	2%	0%	1%			
	Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	308	151	459	0	0	387	0	482	174	236	410	0	869			
	PHF	0.92	0.94	0.93	0	0	0.99	0	0.89	0.75	0.94	0.88	0	0.93			
	Approach %			53%	0%	0%	45%	0%	55%			47%	0%				

Saturday

Study Name Chelsea - Broadway and Fourth Street TM1 TMC
 Start Date Thursday, April 14, 2016 7:00 AM
 End Date Saturday, April 16, 2016 2:00 PM
 Site Code

Report Summary

Time Period	Class.	Southwestbound				Northwestbound		Northeastbound		Southeastbound				Crosswalk			
		T	L	I	O	I	O	I	O	R	T	I	O	Total		Pedestrians	Total
Peak 1	Motorcycles	3	0	3	0	0	0	0	3	0	0	0	0	3	NE	133	133
Specified Period	%	1%	0%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%		100%	
12:00 PM - 2:00 PM	Cars	292	123	415	0	0	319	0	462	170	196	366	0	781	SE	235	235
One Hour Peak	%	85%	91%	87%	0%	0%	89%	0%	88%	93%	88%	90%	0%	89%		100%	
12:30 PM - 1:30 PM	Light Goods Vehicles	26	10	36	0	0	31	0	37	11	21	32	0	68	SW	105	105
	%	8%	7%	8%	0%	0%	9%	0%	7%	6%	9%	8%	0%	8%		100%	
	Buses	14	1	15	0	0	3	0	14	0	2	2	0	17	NW	377	377
	%	4%	1%	3%	0%	0%	1%	0%	3%	0%	1%	0%	0%	2%		100%	
	Single-Unit Trucks	6	1	7	0	0	4	0	8	2	3	5	0	12		850	850
	%	2%	1%	1%	0%	0%	1%	0%	2%	1%	1%	1%	0%	1%			
	Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Bicycles on Road	1	0	1	0	0	0	0	1	0	0	0	0	1			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	342	135	477	0	0	357	0	525	183	222	405	0	882			
	PHF	0.89	0.87	0.88	0	0	0.91	0	0.95	0.95	0.77	0.86	0	0.95			
	Approach %			54%	0%	0%	40%	0%	60%			46%	0%				

APPENDIX E

**Intersection Capacity Analyses
2016 Existing Conditions
Broadway at Fifth Street**

Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↘	↔↗	
Traffic Volume (vph)	0	0	0	0	124	625	
Future Volume (vph)	0	0	0	0	124	625	
Satd. Flow (prot)	0	0	0	0	1321	2621	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1285	2621	
Satd. Flow (RTOR)							
Confl. Peds. (#/hr)	85	163		30	30		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.87	0.87	
Heavy Vehicles (%)	2%	2%	2%	2%	7%	7%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	143	718	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Minimum Split (s)					40.0	40.0	21.0
Total Split (s)					40.0	40.0	21.0
Total Split (%)					65.6%	65.6%	34%
Yellow Time (s)					4.0	4.0	2.0
All-Red Time (s)					2.0	2.0	2.0
Lost Time Adjust (s)					0.0	0.0	
Total Lost Time (s)					6.0	6.0	
Lead/Lag					Lead	Lead	Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)					34.0	34.0	
Actuated g/C Ratio					0.56	0.56	
v/c Ratio					0.19	0.49	
Control Delay					7.6	9.7	
Queue Delay					0.0	0.0	
Total Delay					7.6	9.7	
LOS					A	A	
Approach Delay						9.3	
Approach LOS						A	
Queue Length 50th (ft)					23	75	
Queue Length 95th (ft)					46	108	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					736	1460	
Starvation Cap Reductn					0	0	
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.19	0.49	

Intersection Summary

Cycle Length: 61
 Actuated Cycle Length: 61
 Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Intersection Capacity Analysis

1: Broadway/Washington Avenue

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.49

Intersection Signal Delay: 9.3

Intersection LOS: A

Intersection Capacity Utilization 50.0%

ICU Level of Service A

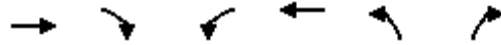
Analysis Period (min) 15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	507	0	0	0	0	0	
Future Volume (vph)	507	0	0	0	0	0	
Satd. Flow (prot)	2573	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2573	0	0	0	0	0	
Satd. Flow (RTOR)							
Confl. Peds. (#/hr)		100	100		88	122	
Peak Hour Factor	0.96	0.96	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	9%	9%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	528	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Minimum Split (s)	40.0						21.0
Total Split (s)	40.0						21.0
Total Split (%)	65.6%						34%
Yellow Time (s)	4.0						2.0
All-Red Time (s)	2.0						2.0
Lost Time Adjust (s)	0.0						
Total Lost Time (s)	6.0						
Lead/Lag	Lead						Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)	34.0						
Actuated g/C Ratio	0.56						
v/c Ratio	0.37						
Control Delay	8.4						
Queue Delay	0.0						
Total Delay	8.4						
LOS	A						
Approach Delay	8.4						
Approach LOS	A						
Queue Length 50th (ft)	51						
Queue Length 95th (ft)	79						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1434						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						
Reduced v/c Ratio	0.37						

Intersection Summary

Cycle Length: 61
 Actuated Cycle Length: 61
 Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Intersection Capacity Analysis

3: Hawthorn Street

Natural Cycle: 65

Control Type: Pre-timed

Maximum v/c Ratio: 0.49

Intersection Signal Delay: 8.4

Intersection LOS: A

Intersection Capacity Utilization 49.8%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3: Hawthorn Street



Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↙	↘↘	
Traffic Volume (vph)	0	0	0	0	97	460	
Future Volume (vph)	0	0	0	0	97	460	
Satd. Flow (prot)	0	0	0	0	1413	2646	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1350	2646	
Satd. Flow (RTOR)							
Confl. Peds. (#/hr)	106	399		50	50		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.97	0.97	
Heavy Vehicles (%)	2%	2%	2%	2%	0%	6%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	100	474	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Minimum Split (s)					40.0	40.0	21.0
Total Split (s)					40.0	40.0	21.0
Total Split (%)					65.6%	65.6%	34%
Yellow Time (s)					4.0	4.0	2.0
All-Red Time (s)					2.0	2.0	2.0
Lost Time Adjust (s)					0.0	0.0	
Total Lost Time (s)					6.0	6.0	
Lead/Lag					Lead	Lead	Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)					34.0	34.0	
Actuated g/C Ratio					0.56	0.56	
v/c Ratio					0.13	0.32	
Control Delay					7.0	8.0	
Queue Delay					0.0	0.0	
Total Delay					7.0	8.0	
LOS					A	A	
Approach Delay						7.8	
Approach LOS						A	
Queue Length 50th (ft)					16	44	
Queue Length 95th (ft)					35	69	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					787	1474	
Starvation Cap Reductn					0	0	
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.13	0.32	

Intersection Summary

Cycle Length: 61
 Actuated Cycle Length: 61
 Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Intersection Capacity Analysis

1: Broadway/Washington Avenue

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.50

Intersection Signal Delay: 7.8

Intersection LOS: A

Intersection Capacity Utilization 50.0%

ICU Level of Service A

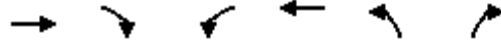
Analysis Period (min) 15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	701	0	0	0	0	0	
Future Volume (vph)	701	0	0	0	0	0	
Satd. Flow (prot)	2671	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2671	0	0	0	0	0	
Satd. Flow (RTOR)							
Confl. Peds. (#/hr)		100	100		109	117	
Peak Hour Factor	0.94	0.94	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	746	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Minimum Split (s)	40.0						21.0
Total Split (s)	40.0						21.0
Total Split (%)	65.6%						34%
Yellow Time (s)	4.0						2.0
All-Red Time (s)	2.0						2.0
Lost Time Adjust (s)	0.0						
Total Lost Time (s)	6.0						
Lead/Lag	Lead						Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)	34.0						
Actuated g/C Ratio	0.56						
v/c Ratio	0.50						
Control Delay	9.8						
Queue Delay	0.0						
Total Delay	9.8						
LOS	A						
Approach Delay	9.8						
Approach LOS	A						
Queue Length 50th (ft)	79						
Queue Length 95th (ft)	119						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1488						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						
Reduced v/c Ratio	0.50						

Intersection Summary

Cycle Length: 61
 Actuated Cycle Length: 61
 Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Intersection Capacity Analysis

3: Hawthorn Street

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.50

Intersection Signal Delay: 9.8

Intersection LOS: A

Intersection Capacity Utilization 49.8%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3: Hawthorn Street



Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↘	↗↗	
Traffic Volume (vph)	0	0	0	0	69	515	
Future Volume (vph)	0	0	0	0	69	515	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		0	150		
Storage Lanes	0	0		0	1		
Taper Length (ft)	25				25		
Satd. Flow (prot)	0	0	0	0	1413	2671	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1350	2671	
Right Turn on Red		No		No	No		
Satd. Flow (RTOR)							
Link Speed (mph)	25		25			25	
Link Distance (ft)	56		174			280	
Travel Time (s)	1.5		4.7			7.6	
Confl. Peds. (#/hr)	128	325		50	50		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.91	0.91	
Heavy Vehicles (%)	2%	2%	2%	2%	0%	5%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	76	566	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Minimum Split (s)					40.0	40.0	21.0
Total Split (s)					40.0	40.0	21.0
Total Split (%)					65.6%	65.6%	34%
Yellow Time (s)					4.0	4.0	2.0
All-Red Time (s)					2.0	2.0	2.0
Lost Time Adjust (s)					0.0	0.0	
Total Lost Time (s)					6.0	6.0	
Lead/Lag					Lead	Lead	Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)					34.0	34.0	
Actuated g/C Ratio					0.56	0.56	
v/c Ratio					0.10	0.38	
Control Delay					6.8	8.5	
Queue Delay					0.0	0.0	
Total Delay					6.8	8.5	
LOS					A	A	
Approach Delay						8.3	
Approach LOS						A	
Queue Length 50th (ft)					12	55	
Queue Length 95th (ft)					28	84	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					787	1488	
Starvation Cap Reductn					0	0	

Intersection Capacity Analysis

1: Broadway/Washington Avenue

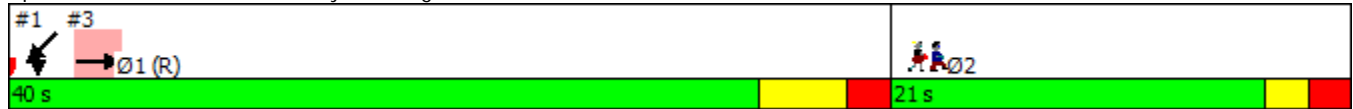


Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.10	0.38	

Intersection Summary

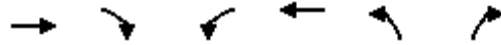
Area Type:	CBD
Cycle Length:	61
Actuated Cycle Length:	61
Offset:	0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.53
Intersection Signal Delay:	8.3
Intersection LOS:	A
Intersection Capacity Utilization	50.0%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	717	0	0	0	0	0	
Future Volume (vph)	717	0	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	2671	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2671	0	0	0	0	0	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)							
Link Speed (mph)	25			25	25		
Link Distance (ft)	208			89	51		
Travel Time (s)	5.7			2.4	1.4		
Confl. Peds. (#/hr)		100	100		110	122	
Peak Hour Factor	0.91	0.91	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	788	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Minimum Split (s)	40.0						21.0
Total Split (s)	40.0						21.0
Total Split (%)	65.6%						34%
Yellow Time (s)	4.0						2.0
All-Red Time (s)	2.0						2.0
Lost Time Adjust (s)	0.0						
Total Lost Time (s)	6.0						
Lead/Lag	Lead						Lag
Lead-Lag Optimize?							Yes
Act Effect Green (s)	34.0						
Actuated g/C Ratio	0.56						
v/c Ratio	0.53						
Control Delay	10.1						
Queue Delay	0.0						
Total Delay	10.1						
LOS	B						
Approach Delay	10.1						
Approach LOS	B						
Queue Length 50th (ft)	85						
Queue Length 95th (ft)	128						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1488						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						
Reduced v/c Ratio	0.53						

Intersection Capacity Analysis

3: Hawthorn Street

Intersection Summary

Area Type: CBD

Cycle Length: 61

Actuated Cycle Length: 61

Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.53

Intersection Signal Delay: 10.1

Intersection LOS: B

Intersection Capacity Utilization 49.8%

ICU Level of Service A

Analysis Period (min) 15

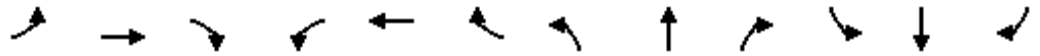
Splits and Phases: 3: Hawthorn Street



APPENDIX F
Intersection Capacity Analyses
2016 Existing Conditions
Broadway at Fourth Street

HCM Unsignalized Intersection Capacity Analysis

8: 4th Street & Broadway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑	↑
Traffic Volume (veh/h)	0	0	0	105	470	0	0	0	0	0	147	174
Future Volume (Veh/h)	0	0	0	105	470	0	0	0	0	0	147	174
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.89	0.89	0.89	0.92	0.92	0.92	0.97	0.97	0.97
Hourly flow rate (vph)	0	0	0	118	528	0	0	0	0	0	152	179
Pedestrians		87			39			97			76	
Lane Width (ft)		0.0			11.0			0.0			11.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			3			0			7	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					764							
pX, platoon unblocked												
vC, conflicting volume	604			97			939	937	136	879	937	427
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	604			97			939	937	136	879	937	427
tC, single (s)	4.1			4.2			7.5	6.5	6.9	7.6	6.6	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			92			100	100	100	100	32	67
cM capacity (veh/h)	905			1458			60	226	857	193	224	535
Direction, Lane #	WB 1	WB 2	SB 1	SB 2								
Volume Total	294	352	152	179								
Volume Left	118	0	0	0								
Volume Right	0	0	0	179								
cSH	1458	1700	224	535								
Volume to Capacity	0.08	0.21	0.68	0.33								
Queue Length 95th (ft)	7	0	107	36								
Control Delay (s)	3.5	0.0	49.2	15.1								
Lane LOS	A		E	C								
Approach Delay (s)	1.6		30.8									
Approach LOS			D									
Intersection Summary												
Average Delay			11.5									
Intersection Capacity Utilization			42.0%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

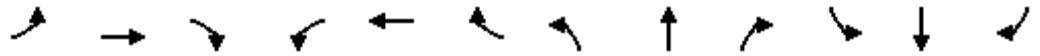
8: 4th Street & Broadway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕						↕	↗
Traffic Volume (veh/h)	0	0	0	151	308	0	0	0	0	0	236	166
Future Volume (Veh/h)	0	0	0	151	308	0	0	0	0	0	236	166
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.93	0.93	0.93	0.92	0.92	0.92	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	162	331	0	0	0	0	0	254	178
Pedestrians		97			132			285			167	
Lane Width (ft)		0.0			11.0			0.0			11.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			12			0			15	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					764							
pX, platoon unblocked												
vC, conflicting volume	498			285			1176	1107	417	954	1107	430
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	498			285			1176	1107	417	954	1107	430
tC, single (s)	4.1			4.2			7.5	6.5	6.9	7.6	6.6	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			87			0	100	100	100	0	64
cM capacity (veh/h)	907			1246			0	155	517	128	154	488
Direction, Lane #	WB 1	WB 2	SB 1	SB 2								
Volume Total	272	221	254	178								
Volume Left	162	0	0	0								
Volume Right	0	0	0	178								
cSH	1246	1700	154	488								
Volume to Capacity	0.13	0.13	1.65	0.36								
Queue Length 95th (ft)	11	0	446	41								
Control Delay (s)	5.4	0.0	371.0	16.6								
Lane LOS	A		F	C								
Approach Delay (s)	3.0		224.9									
Approach LOS			F									
Intersection Summary												
Average Delay			106.7									
Intersection Capacity Utilization			38.3%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

8: 4th Street & Broadway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕						↕	↗
Traffic Volume (veh/h)	0	0	0	135	342	0	0	0	0	0	222	183
Future Volume (Veh/h)	0	0	0	135	342	0	0	0	0	0	222	183
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.88	0.88	0.88	0.92	0.92	0.92	0.86	0.86	0.86
Hourly flow rate (vph)	0	0	0	153	389	0	0	0	0	0	258	213
Pedestrians		133			105			377			235	
Lane Width (ft)		0.0			11.0			0.0			11.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			9			0			21	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					764							
pX, platoon unblocked												
vC, conflicting volume	624			377			1352	1307	482	1035	1307	562
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	624			377			1352	1307	482	1035	1307	562
tC, single (s)	4.1			4.2			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			87			0	100	100	100	0	43
cM capacity (veh/h)	758			1164			0	109	482	103	110	376
Direction, Lane #	WB 1	WB 2	SB 1	SB 2								
Volume Total	283	259	258	213								
Volume Left	153	0	0	0								
Volume Right	0	0	0	213								
cSH	1164	1700	110	376								
Volume to Capacity	0.13	0.15	2.34	0.57								
Queue Length 95th (ft)	11	0	568	84								
Control Delay (s)	5.2	0.0	692.5	26.4								
Lane LOS	A		F	D								
Approach Delay (s)	2.7		391.3									
Approach LOS			F									
Intersection Summary												
Average Delay			183.4									
Intersection Capacity Utilization			40.9%		ICU Level of Service					A		
Analysis Period (min)			15									

APPENDIX G

**Preliminary Traffic Signal Warrants Analysis
Broadway at Fourth Street, Chelsea**

**Summary of Hourly Volumes and Warrant Analyses
Broadway at Fourth Street, Chelsea**

Hourly period starting	Broadway (main street) Traffic Volume	Fourth Street (minor street) Traffic Volume	Pedestrians Crossing Main Street	Volumes above the required minimum on main/minor street			
	WB	SB		Warrant 1	Warrant 2	Warrant 4	Warrant 7
6:00	340	281	-				
7:00	414	339	130				√
8:00	561	327	126	√			√
9:00	424	359	-				√
10:00	419	362	-				√
11:00	373	384	-				
12:00	398	419	-				√
13:00	447	413	-				√
14:00	417	444	-				√
15:00	449	468	-				√
16:00	440	477	246				√
17:00	450	452	208				√
18:00	425	441	-				√
19:00	374	350	-				

Warrants 1, 2, 4 and 7 in MUTCD Chapter 4C were analyzed for this intersection.

Warrant 1 (8-Hour Volume) is not fulfilled. It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any 8 hours of an average day. The interruption of continuous traffic (Conditions B) was applied in this case. The volume threshold for a major street (two-lane) is 480 vehicles per hour (vph) and for a minor street (two-lane) is 160 vph.

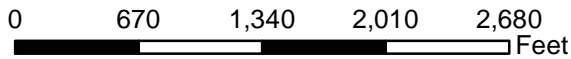
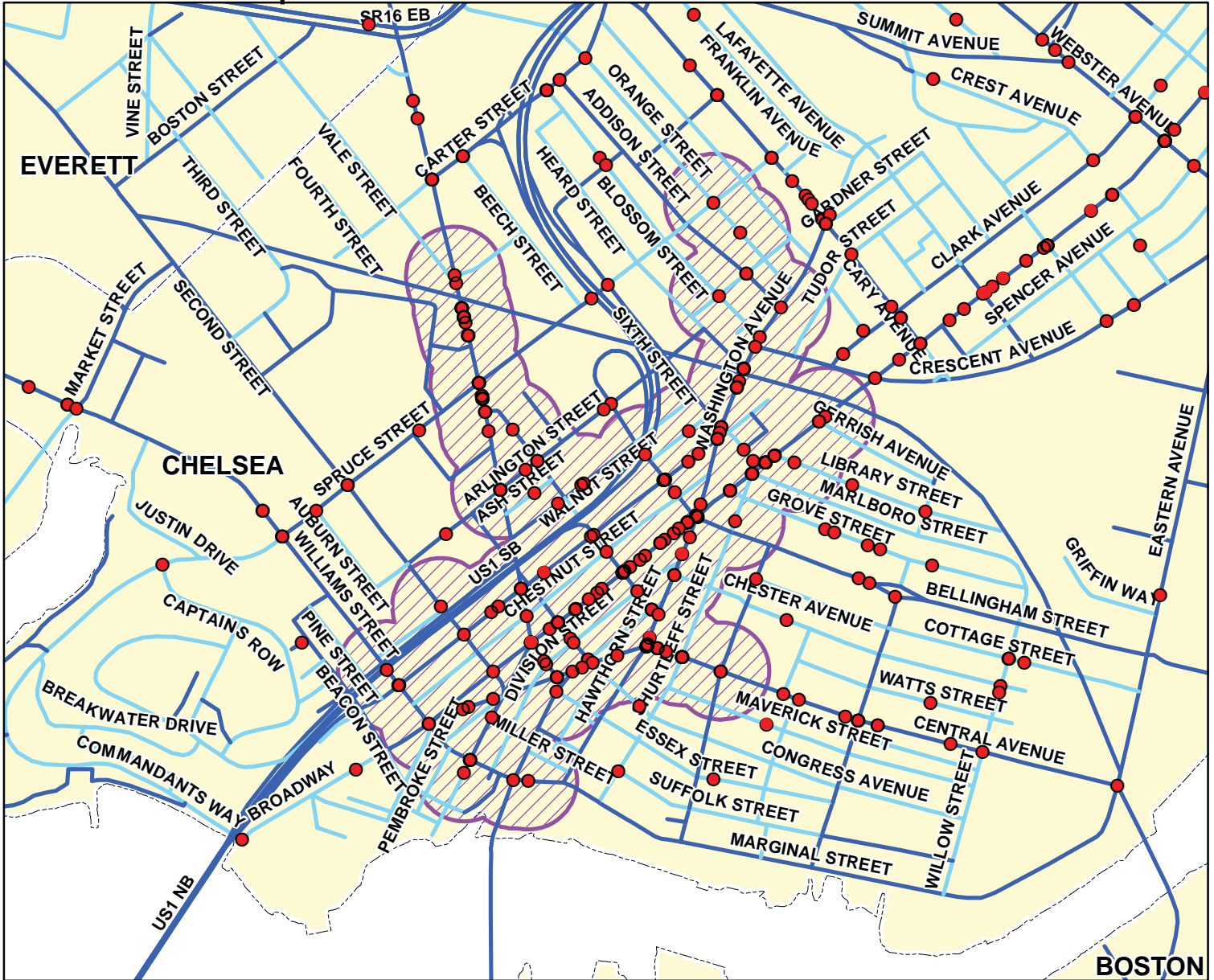
Warrant 2 (4-Hour Volume) is not fulfilled. It requires that the traffic conditions (the data point of main street and minor street volumes falling above an applicable curve) exist for each of any 4 hours of an average day. The data points all locate below the applicable curve .

Warrant 4 (Pedestrian Volume) is not fulfilled. It requires that the traffic conditions (the data point of main street traffic volume and pedestrian crossing falling above an applicable curve) exist for each of any 4 hours of an average day. The data points all locate below the applicable curve .

Warrant 7 (Crash Experience) is fulfilled. Traffic conditions in more than eight hours met the 80% threshold in Warrant 1. Meanwhile, there were more than five correctable crashes in the recent 12-month period.

APPENDIX H
Top Pedestrian Crash Cluster 2004–13
Downtown Chelsea

Top Pedestrian Crash Cluster 2004 - 2013



RANK 1

CHELSEA

MassDOT District 6

RPA MAPC

EPDO 949

Number of Fatal Crashes 1

Number of Injury Crashes 176

Number of Non-Injury Crashes 59

Total Crashes 236

Legend

- Crash Locations 2004-2013
- All Functional Classification Except Local Roads
- Local Roads
- Top Pedestrian Crash Cluster
- Municipal Boundary

APPENDIX I
Collision Diagrams and Crash Data Summary
MassDOT Road Safety Audit
July 27, 2016



COLLISION DIAGRAM

SYMBOLS		TYPE OF CRASH	SEVERITY	
→	Moving Vehicle	↔	Head on	
↔	Backing Vehicle	→	Rear End	
---	Non-Involved Vehicle	↗	Angle	
○	Involved	↻	Turning Movement	
○	Non-Involved	↔	Sideswipe	
🚶	Pedestrian	○	Out of Control	
🚲	Bicycle	■	Night Time Crash	
🐾	Animal			
→	Direction of Motion			
🚗	Parked Vehicle			
🚗	Fixed Object			
			○	Injury
			○	Fatal

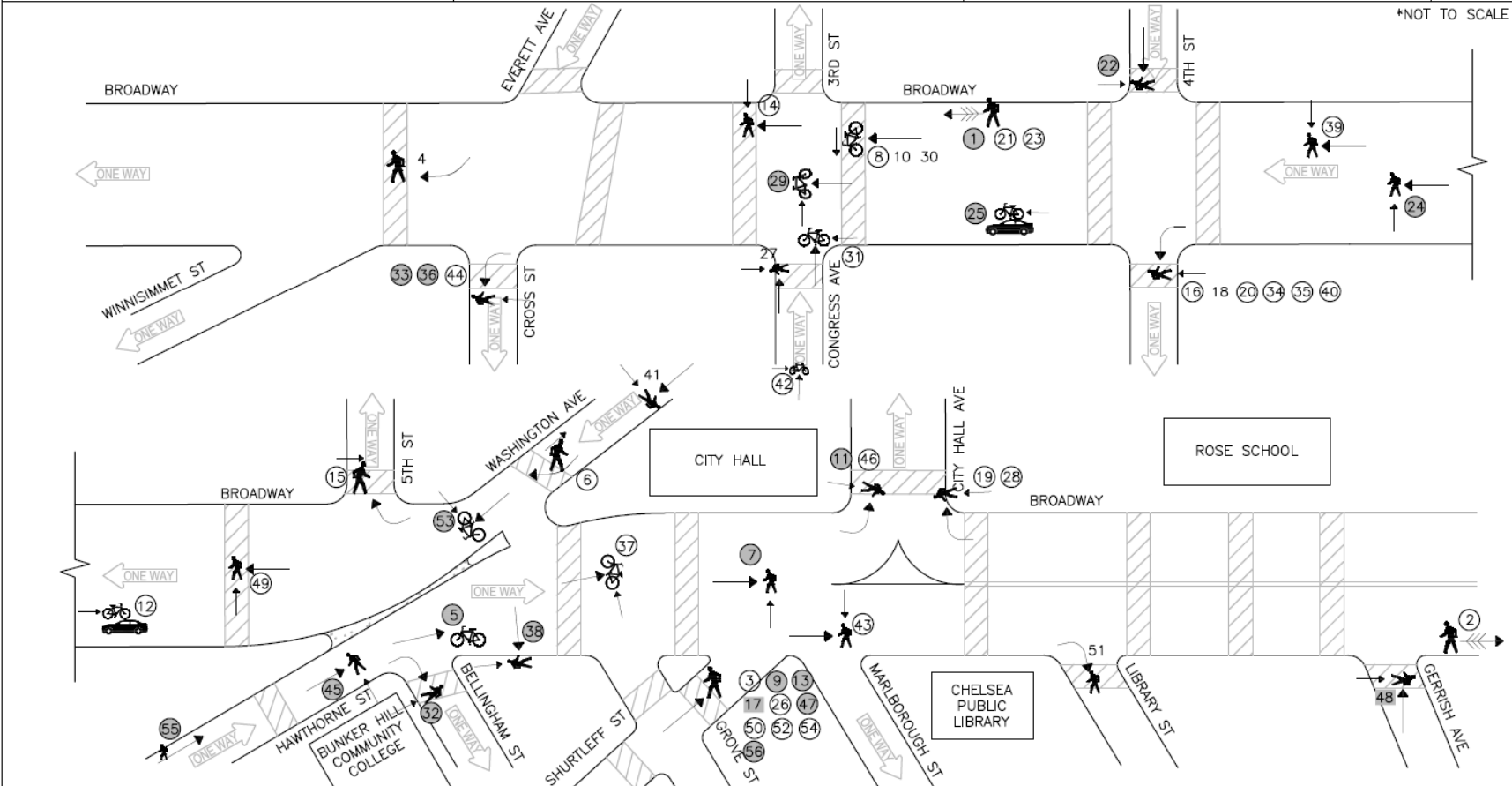
CHELSEA, MA

BROADWAY

REGION: METROPOLITAN AREA PLANNING COUNCIL

TIME PERIOD ANALYZED: 2011 - 2015
 SOURCE OF CRASH REPORTS: LOCAL POLICE
 DATE PREPARED: MAY 2016
 PREPARED BY:

SHEET 1 OF 1



Crash Data Summary Table

Broadway, Chelsea, MA
2011 - 2015

Crash Diagram	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages		Comments
1	1/22/11	Saturday	5:25 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Slush	Inattention	21		MV1 was backing up when struck pedestrian. Pedestrian was crossing street behind vehicle, not at crosswalk.
2	4/10/11	Sunday	4:38 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving	21		MV1 was backing out of parking spot, hitting pedestrian that was standing behind MV1. MV1 did not notice pedestrian.
3	6/4/11	Saturday	8:54 AM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	UNK		MV1 struck pedestrian in crosswalk. No information from MV1
4	6/5/11	Sunday	7:48 PM	Single Vehicle Crash	Dusk	Clear	Dry	careless, negligent, or aggressive	39		MV1 made a right turn, attempted to maneuver around pedestrians that were
5	6/6/11	Monday	2:37 AM	Angle	Dark - lighted roadway	Clear	Dry	Driving too fast for conditions	UNK		Cyclist had pulled over to let MV1 pass. MV1 struck cyclist and fled scene.
6	9/2/11	Friday	1:04 PM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	25		Pedestrian (motorized wheelchair) was travelling wrong way on one way. MV1 was stopped at red signal, turning left as light changed to green. MV1 did not see pedestrian during turn.
7	9/5/11	Monday	10:41 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	Unknown	64		MV1 states "pedestrian ran into road and could not avoid accident." Pedestrian states "walking across street when operator hit them."
8	9/18/11	Sunday	4:59 PM	Angle	Daylight	Clear	Dry	Unknown	64		MV1 SB. Bicycle EB crossing roadway inside crosswalk. MV1 states "bicycle suddenly crossed roadway." Bicycle states "another operator allowed them to cross." MV1 could not stop in time.
9	11/17/11	Thursday	10:21 PM	Head on	Dark - lighted roadway	Clear	Dry	Inattention	34		Pedestrian inside crosswalk. MV1 stops, then accidentally hits pedestrian.
10	3/22/12	Thursday	5:16 PM	Angle	Daylight	Clear	Dry	No Improper Driving	73		Cyclist approached intersection, travelling wrong way on one-way, failed to yield right of way. MV1 hits bicyclist in intersection.
11	4/7/12	Saturday	7:37 PM	Single Vehicle Crash	Dark - roadway not lighted	Cloudy	Dry	Unknown	46		MV1 making left turn, did not see pedestrian in roadway.
12	7/19/12	Thursday	3:01 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	34		MV1 recently parked vehicle. Rear-passenger opened door, didn't see bicyclist approaching.
13	7/29/12	Sunday	9:15 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	Unknown	37		MV1 stopped at stop sign allowing a pedestrian to cross. MV1 began moving when an additional pedestrian attempted to cross.
14	8/11/12	Saturday	5:16 PM	Single Vehicle Crash	Daylight	Clear	Dry	Failed to yield right of way	69		Pedestrian in crosswalk when MV1 struck pedestrian. MV1 cited for failure to yield.
15	1/23/13	Wednesday	4:03 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	24		MV1 turning right, did not see pedestrian due to sun.
16	1/23/13	Wednesday	3:25 PM	Head on	Daylight	Clear	Dry	Failed to yield right of way	61		MV1 turning left. Pedestrian in crosswalk, struck by MV1 during turn.
17	1/24/13	Thursday	5:25 PM	Single Vehicle Crash	Dark, unknown roadway lighting	Clear	Dry	Unknown	66		Pedestrian in crosswalk. MV1 struck pedestrian in crosswalk.
18	2/4/13	Monday	10:43 AM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	38		MV1 claims "pedestrian jumped into vehicle." Pedestrian states "struck by MV1 in leg."
19	3/9/13	Saturday	4:11 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	51		MV1 turning right. Pedestrians were walking in crosswalk. MV1 did not see pedestrians.
20	3/30/13	Saturday	1:09 PM	Single Vehicle Crash	Daylight	Clear	Dry	Failed to yield right of way	49		MV1 turning left. Pedestrian was walking in crosswalk. MV1 did not see pedestrian.
21	4/4/13	Thursday	11:20 AM	Single Vehicle Crash	Daylight	Clear	Dry	Inattention	54		MV1 backing into parking space, hits pedestrian.
22	4/12/13	Friday	8:26 PM	Single Vehicle Crash	Dark - lighted roadway	Rain	Wet	Unknown	27		MV1 claims "stopped at stop sign and looked both ways, then proceeded through intersection. Pedestrian ran out into street." No comment from pedestrian.
23	4/25/13	Thursday	12:56 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	UNK		Pedestrian standing in front of double-parked vehicle. MV1 backed into pedestrian.
24	5/23/13	Thursday	10:28 PM	Single Vehicle Crash	Dark - lighted roadway	Rain	Wet	Unknown	39		Pedestrian crossing street, was struck by MV1 who did not notice pedestrian.
25	5/26/13	Sunday	10:01 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	Unknown	UNK		MV1 operator exited driver side door and struck bicyclist with door. Operator did not see cyclist.
26	6/14/13	Friday	7:37 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	61		MV1 claims "pedestrian on phone and walked into left front of vehicle." Witnesses claim "pedestrian in crosswalk when MV1 drove over foot."
27	6/18/13	Tuesday	3:20 PM	Unknown	Daylight	Rain	Wet	No Improper Driving	34		Pedestrian entered crosswalk with bicycle, claiming "MV1 struck rear tire of bicycle." MV1 claims "didn't make contact."
28	6/21/13	Friday	5:36 AM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	55		MV1 turning right, did not see pedestrian crossing street. Pedestrian was not in a crosswalk area.
29	7/31/13	Wednesday	10:59 PM	Angle	Dark - lighted roadway	Clear	Dry	No Improper Driving	46		Bicyclist with passenger rides through stop sign. MV1, perpendicular to cyclist, are established in intersection. Bicyclist collides with MV1 in intersection.
30	8/10/13	Saturday	4:45 PM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	40		Cyclist travelling wrong way on one-way. MV1 (bus) could not stop in time for bicyclist. Cyclist made no attempt to stop.
31	9/7/13	Saturday	10:06 AM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	37		Bicyclist claims "struck by nail on MV1's trailer." MV1 claims "stopped at stop sign, observed bicyclist in street. Continued to drive and did not strike cyclist."

Crash Data Summary Table

Broadway, Chelsea, MA
2011 - 2015

Crash Diagram	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages		Comments
	11/17/13	Sunday	7:52 PM	Single Vehicle Crash	Dark - lighted roadway	Rain	Wet	Inattention	24		MV1 after making right hand turn claims "lightly hit pedestrian standing in street, then pedestrian threw himself on hood of vehicle." Witness claims the same.
	1/10/14	Friday	7:11 PM	Unknown	Dark - lighted roadway	Clear	Dry	Unknown	36		MV1 turning left, did not see pedestrian run out to cross street. Pedestrian was approximately 25 feet from crosswalk.
	2/7/14	Friday	10:04 AM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	31		MV1 was making a left turn, did not see pedestrian, who was in crosswalk.
	2/12/14	Wednesday	12:39 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	29		Pedestrian was crossing street in crosswalk. MV1 tried to stop but noticed pedestrian too late.
	3/30/14	Sunday	7:04 PM	Single Vehicle Crash	Dusk	Rain	Wet	Inattention	52		Pedestrian was in crosswalk when hit by MV1. MV1 was performing left turn. MV1 travelling on roadway when bicyclist entered roadway. MV1 could not avoid cyclist. Cyclist did not notice MV1 when entering roadway.
	4/29/14	Tuesday	12:31 PM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	20		MV1 made improper right hand turn in order to enter parking lot. Pedestrian was on sidewalk when hit by MV1 pulling into lot.
	5/11/14	Sunday	7:59 PM	Single Vehicle Crash	Dusk	Clear	Dry	Inattention	48		MV1 travelling straight when kid jumps out onto street. MV1 claims "swerved to avoid child but hits pins another pedestrian behind parked vehicle." Witness states "MV1 did not swerve but rather drove straight into parked vehicle."
	6/17/14	Tuesday	1:01 PM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	50		MV1 (police) was responding to a call, making a left turn with lights activated. Pedestrian walked into vehicle.
	7/5/14	Saturday	5:13 PM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	36		Pedestrian in motorized wheelchair states "MV1 struck them while in traffic." MV1 claims "at full stop when pedestrian hit MV1."
	8/13/14	Wednesday	2:23 PM	Single Vehicle Crash	Daylight	Rain	Wet	Inattention	36		Cyclist crossing intersection claims "MV1 stopped briefly then continued driving, striking the cyclist." MV1 claims "cyclist did not stop or look before crossing." Occurred at Congress and Division.
	8/16/14	Saturday	3:11 PM	Head on	Daylight	Clear	Dry	No Improper Driving	31		Pedestrian attempted to cross road without crosswalk. MV1 states "pedestrian ran in front of vehicle and MV1 couldn't stop in time."
	10/9/14	Thursday	4:35 PM	Head on	Daylight	Clear	Dry	Inattention	21		MV1 turning left, allowed pedestrian to cross street. MV1 claims "after allowing pedestrians to cross, an additional pedestrian abruptly entered crosswalk, which they didn't notice." Witness states "pedestrian did not look and quickly entered path of MV1."
	10/24/14	Friday	11:30 AM	Angle	Daylight	Rain	Wet	Inattention	30		Pedestrian was crossing street to catch bus, while in street was struck by MV1. No comment from MV1.
	10/29/14	Wednesday	9:27 PM	Sideswipe, same direction	Dark - lighted roadway	Rain	Wet	Unknown	29		MV1 states "did not see pedestrian while making left turn." Pedestrian states "in crosswalk when MV1 struck them."
	11/17/14	Monday	8:49 AM	Angle	Daylight	Rain	Wet	Unknown	28		Pedestrian crossing street when MV1 stopped then continued and struck pedestrian with right side of vehicle.
	12/9/14	Tuesday	8:22 PM	Angle	Dark - roadway not lighted	Rain	Wet	Inattention	38		Pedestrian in crosswalk hit by MV1. MV1 states "did not see pedestrian."
	1/14/15	Wednesday	6:15 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	No Improper Driving	36		MV1 claims "blinded by glare and tapped pedestrian in crosswalk." Pedestrian was walking in crosswalk.
	2/16/15	Monday	4:20 PM	Single Vehicle Crash	Daylight	Clear	Dry	Glare	26		Pedestrians in crosswalk when MV1 did not stop. MV1 claims "did not hit pedestrians and stopped at stop sign, then proceeded and didn't see pedestrians." Reviewing video shows MV1 did not stop at stop sign and hit one of the pedestrians.
	2/22/15	Sunday	10:59 AM	Single Vehicle Crash	Daylight	Cloudy	Wet	Other improper action	36		MV1 turning with three pedestrians in street. MV1 states "2 pedestrians tells 1 pedestrian to lay down in front of vehicle." Witness confirm that MV1 did not hit any pedestrian.
	4/8/15	Wednesday	7:41 PM	Angle	Dark - lighted roadway	Rain	Wet	No Improper Driving	66		MV1 came to stop at intersection. MV1 proceeded to enter intersection when MV1 struck a pedestrian. No information.
	5/22/15	Friday	11:45 AM	Angle	Daylight	Clear	Dry	Unknown	31		MV1 and cyclist with conflicting stories. MV1: cyclist crossed street and struck MV1. Cyclist: Cyclist crossed street when MV1 struck his bicycle.
	9/17/15	Thursday	7:42 PM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	Unknown	63		Pedestrian walking across street, struck by MV1. No info from MV1.
	9/19/15	Saturday	2:27 PM	Single Vehicle Crash	Daylight	Clear	Dry	Unknown	45		MV1 (cab) was stopped at cab stand. Two men were pushing each other and MV1 started to pull away. One pedestrian opened MV1's back door but operator did not notice and ran over pedestrian.
	12/27/15	Sunday	11:52 PM	Single Vehicle Crash	Dusk	Rain	Wet	No Improper Driving	53		Witnessed by police. Pedestrian was struck by MV1 in crosswalk.
	12/30/15	Wednesday	9:49 PM	Single Vehicle Crash	Dark - lighted roadway	Rain	Ice	Unknown	32		

*Courtesy Crash - A term used to describe a crash that occurs subsequent to a non-involved mainline driver who gives the right of way, contrary to the rules of the road, to another driver.

APPENDIX J
Crash Data Summary
Additional Data from Chelsea Police Department

Crash Diagram	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Injury Status	Driver Contributing Code	Comments
57	7/10/2011	Sunday	8:49AM	Rear-end	Daylight	Clear	Dry	Non-incapacitating	Unknown	Pedestrian was crossing the street in the cross walk when MV1 reversed and made contact with her left arm. She complained of left elbow pain and was treated and transported to the Whidden by Cataldo. MV1 stated that the victim was in the crosswalk, but he was reversing very slow to get a parking spot and does not believe he made contact with the victim.
58	9/23/2011	Friday	9:08PM	Angle	Dark - Lighted Roadway	Rain	Wet	No Injury	No Improper Driving	MV1 intends on make the left turn onto Fourth Street. MV2 then passed MV1 on the right side, then makes sudden left turn in front of MV1. MV2 rear left strikes MV1 front right, taking off MV1's front bumper. MV2 continued on Fourth Street without stopping, making a turn onto Hawthorne street. MV2 could only be described as an older model green Chevrolet pick up truck.
59	10/23/2011	Sunday	9:49AM	Single Vehicle Crash	Daylight	Clear	Dry	No Injury	Inattention	MV1 proceeded south on Broadway through intersection at Fourth St. At the same time pedestrian(#2) while operating a motorized chair crossed into lane of traffic beside marked pedestrian crosswalk when collision occurred.
60	12/24/2011	Saturday	6:06PM	Angle	Dark - Lighted Roadway	Clear	Dry	No Injury	No Improper Driving	Owner of MV1 stated he parked his vehicle legally in a parking spot to go into a store; when he returned he observed MV2 had struck his parked vehicle causing damage to the driver's side front headlight, bumper, and hood. Operator of MV2 stated that he was moving the vehicle to get out of someone else's way and he backed into MV1. MV2 had damage to the rear bumper passenger side and rear taillight.
61	4/16/2012	Monday	1:07PM	Sideswipe, same direction	Daylight	Clear	Dry	No Injury	Unknown	MV1 states his car was parked, and when he came out and observed damage to the front driver side of the MV. It appears that a MV drove by and sideswiped the car then drove off. He was advised to contact his insurance carrier.
62	5/27/2012	Sunday	1:12AM	Single Vehicle Crash	Dark - Lighted Roadway	Clear	Dry	Possible	No Improper Driving	Vehicle was turning from Washington Ave on Broadway, driver lost control, hit curb and also struck cement barrier. Impact caused deployment of 2 front air bags, minor damage to bumper and wheel, as well as control arm. The head of the driver and passenger hit the windshield causing windshield to crack. Both refused Medical on the scene. Vehicle towed by Todisco Towing.
63	9/21/2012	Friday	1:00PM	Sideswipe, same direction	Daylight	Cloudy	Dry	No Injury	No Improper Driving	Operator MV2 was driving when a vehicle from behind him sideswiped him. Operator of MV1 stated that he tried to go around MV2 when he hit it. No injuries were reported.
64	10/15/2012	Monday	10:13AM	Sideswipe, same direction	Daylight	Clear	Dry	Unknown	Unknown	Operator of MV1 stated he parked and went into a store and observed through a window, a truck drive and sideswipe his MV then turn right and go down Broadway. He was unable to get a plate number or description of MV2. He was advised to contact his insurance carrier.
65	2/25/2013	Monday	10:08AM	Rear-end	Daylight	Clear	Wet	No Injury	Inattention	MV1, a city of Chelsea DPW dump truck, was backing up and struck unoccupied vehicle #2, which was parked. The city of Chelsea vehicle had very minor damage to its rear bumper, and MV2 had minor damage to its front hood. No parties were injured and no vehicles were towed.
66	3/31/2013	Sunday	7:59PM	Sideswipe, same direction	Dark - Lighted Roadway	Clear	Dry	Unknown	Unknown	Owner of MV2 stated she went into Heiler's Liquor Mart and when she came out someone had struck her motor vehicle. The damage to motor vehicle was the entire passenger's side. No one observed the license plate of MV1.
67	11/13/2013	Wednesday	5:36PM	Rear-End	Dark - Lighted Roadway	Clear	Dry	No Injury	No Improper Driving	MV1 was traveling on Broadway and slowed due to traffic crossing on Fourth St. MV2 struck MV1 in the rear.
68	12/27/2013	Friday	10:58AM	Angle	Daylight	Clear	Wet	No Injury	Visibility Obstructed	MV2 struck as it was entering the intersection of Broadway and Fourth Street. View of MV1 at the intersection was blocked by and MBTA bus stopped at a bus stop.
69	12/27/2013	Friday	6:16PM	Single Vehicle Crash	Dark - Lighted Roadway	Clear	Dry	No Injury	No Improper Driving	Owner of MV1 stated she was informed her vehicle was struck by an unknown vehicle. MV1 sustained heavy damage to the rear passenger tire. Officers on scene followed debris to the address of MV2, which an arrest was made. MV2 had heavy front damage to the driver's side tire.
70	5/13/2014	Tuesday	4:20PM	Unknown	Daylight	Cloudy	Dry	Non-incapacitating	Inattention	MV1 backed into a MBTA bus. Operator of MV1 was complaining of head pain and transported to the Whidden Hospital.
71	6/16/2014	Monday	2:29AM	Head-on	Dark - Lighted Roadway	Clear	Dry	Possible	Unknown	Collision at the intersection of Fourth street and Broadway.
72	8/17/2014	Sunday	12:38AM	Rear-end	Dark - Lighted Roadway	Clear	Dry	No Injury	Followed too closely	MV1 was struck from behind by MV2 when MV1 had to stop abruptly for another MV.
73	8/26/2014	Tuesday	12:54PM	Unknown	Daylight	Clear; Cloudy	Dry	No Injury	Unknown	Pedestrian struck by a black MV while crossing the street.
74	9/13/2014	Saturday	11:41PM	Sideswipe, same direction	Dark - Lighted Roadway	Clear	Dry	No Injury	Unknown	MV1 was turning left on to Fourth St. from Broadway. MV2 was also turning left on to Fourth St. and made contact with MV1.
75	9/18/2014	Thursday	8:35PM	Angle	Dark - Lighted Roadway	Clear; Cloudy	Dry	No Injury	Inattention	The operator of MV stated that she did not know the MVs had collided. Operator of MV2 stated she did not see any damage until after operator of MV1 left the area.
76	4/25/2015	Saturday	11:55AM	Single Vehicle Crash	Daylight	Clear	Dry	No Injury	Operating defective equipment	MVs brakes failed. MV rolled backwards across Hawthorne St. and Broadway and struck a trash receptacle.
78	5/29/2015	Friday	4:56PM	Sideswipe, same direction	Daylight	Clear	Dry	No Injury	Inattention	MV1 was making a left turn when it collided with MV2. MV2 was turning left when it was struck by the trailer's rear tire of MV1.
79	8/24/2015	Monday	8:54AM	Angle	Daylight	Clear	Dry	Possible	Unknown	Collision at the intersection of Fourth street and Broadway.

APPENDIX K
Intersection Capacity Analyses
Proposed Signal Setting under 2040 Projected Conditions
Broadway at Fifth Street

Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↙	↔	
Traffic Volume (vph)	0	0	0	0	124	625	
Future Volume (vph)	0	0	0	0	124	625	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		0	150		
Storage Lanes	0	0		0	1		
Taper Length (ft)	25				25		
Satd. Flow (prot)	0	0	0	0	1321	2621	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1276	2621	
Right Turn on Red		No		No	No		
Satd. Flow (RTOR)							
Link Speed (mph)	25		25			25	
Link Distance (ft)	56		174			280	
Travel Time (s)	1.5		4.7			7.6	
Confl. Peds. (#/hr)	85	163		30	30		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.87	0.87	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	2%	2%	2%	2%	7%	7%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	164	826	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Minimum Split (s)					35.0	35.0	30.0
Total Split (s)					35.0	35.0	30.0
Total Split (%)					53.8%	53.8%	46%
Yellow Time (s)					4.0	4.0	2.0
All-Red Time (s)					2.0	2.0	2.0
Lost Time Adjust (s)					0.0	0.0	
Total Lost Time (s)					6.0	6.0	
Lead/Lag					Lead	Lead	Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)					29.0	29.0	
Actuated g/C Ratio					0.45	0.45	
v/c Ratio					0.28	0.71	
Control Delay					13.0	18.7	
Queue Delay					0.0	0.0	
Total Delay					13.0	18.7	
LOS					B	B	
Approach Delay						17.7	
Approach LOS						B	
Queue Length 50th (ft)					39	132	
Queue Length 95th (ft)					74	184	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					589	1169	

Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Starvation Cap Reductn					0	0	
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.28	0.71	

Intersection Summary

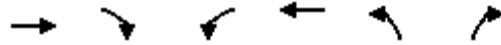
Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.71
Intersection Signal Delay:	17.7
Intersection LOS:	B
Intersection Capacity Utilization	43.7%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

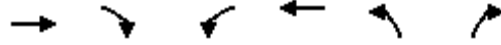
3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	507	0	0	0	0	0	
Future Volume (vph)	507	0	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	2573	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2573	0	0	0	0	0	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)							
Link Speed (mph)	25			25	25		
Link Distance (ft)	208			89	51		
Travel Time (s)	5.7			2.4	1.4		
Confl. Peds. (#/hr)		100	100		88	122	
Peak Hour Factor	0.96	0.96	0.92	0.92	0.92	0.92	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	9%	9%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	607	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Minimum Split (s)	35.0						30.0
Total Split (s)	35.0						30.0
Total Split (%)	53.8%						46%
Yellow Time (s)	4.0						2.0
All-Red Time (s)	2.0						2.0
Lost Time Adjust (s)	0.0						
Total Lost Time (s)	6.0						
Lead/Lag	Lead						Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)	29.0						
Actuated g/C Ratio	0.45						
v/c Ratio	0.53						
Control Delay	15.2						
Queue Delay	0.0						
Total Delay	15.2						
LOS	B						
Approach Delay	15.2						
Approach LOS	B						
Queue Length 50th (ft)	87						
Queue Length 95th (ft)	131						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1147						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						

Intersection Capacity Analysis

3: Hawthorn Street

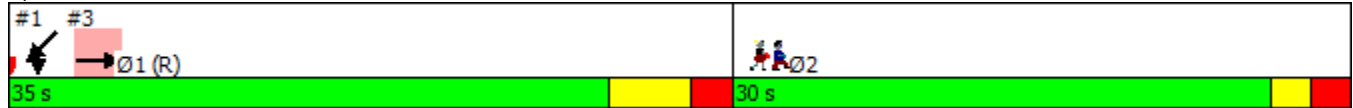


Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Reduced v/c Ratio	0.53						

Intersection Summary

Area Type:	CBD						
Cycle Length:	65						
Actuated Cycle Length:	65						
Offset:	0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection						
Natural Cycle:	65						
Control Type:	Pretimed						
Maximum v/c Ratio:	0.71						
Intersection Signal Delay:	15.2			Intersection LOS: B			
Intersection Capacity Utilization	39.4%			ICU Level of Service A			
Analysis Period (min)	15						

Splits and Phases: 3: Hawthorn Street



Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↘	↗↗	
Traffic Volume (vph)	0	0	0	0	97	460	
Future Volume (vph)	0	0	0	0	97	460	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		0	150		
Storage Lanes	0	0		0	1		
Taper Length (ft)	25				25		
Satd. Flow (prot)	0	0	0	0	1413	2646	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1334	2646	
Right Turn on Red		No		No	No		
Satd. Flow (RTOR)							
Link Speed (mph)	25		25			25	
Link Distance (ft)	56		174			280	
Travel Time (s)	1.5		4.7			7.6	
Confl. Peds. (#/hr)	106	399		50	50		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.97	0.97	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	2%	2%	2%	2%	0%	6%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	115	545	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Total Split (s)					35.0	35.0	30.0
Total Lost Time (s)					6.0	6.0	
Act Effct Green (s)					29.0	29.0	
Actuated g/C Ratio					0.45	0.45	
v/c Ratio					0.18	0.46	
Control Delay					11.9	14.2	
Queue Delay					0.0	0.0	
Total Delay					11.9	14.2	
LOS					B	B	
Approach Delay						13.8	
Approach LOS						B	
Queue Length 50th (ft)					26	75	
Queue Length 95th (ft)					55	114	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					630	1180	
Starvation Cap Reductn					0	0	
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.18	0.46	

Intersection Summary

Area Type: CBD

Intersection Capacity Analysis

1: Broadway/Washington Avenue

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Control Type: Pretimed

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 13.8

Intersection LOS: B

Intersection Capacity Utilization 38.3%

ICU Level of Service A

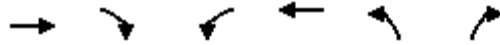
Analysis Period (min) 15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	701	0	0	0	0	0	
Future Volume (vph)	701	0	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	2671	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2671	0	0	0	0	0	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)							
Link Speed (mph)	25			25	25		
Link Distance (ft)	208			89	51		
Travel Time (s)	5.7			2.4	1.4		
Confl. Peds. (#/hr)		100	100		109	117	
Peak Hour Factor	0.94	0.94	0.92	0.92	0.92	0.92	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	858	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Total Split (s)	35.0						30.0
Total Lost Time (s)	6.0						
Act Effct Green (s)	29.0						
Actuated g/C Ratio	0.45						
v/c Ratio	0.72						
Control Delay	19.0						
Queue Delay	0.0						
Total Delay	19.0						
LOS	B						
Approach Delay	19.0						
Approach LOS	B						
Queue Length 50th (ft)	138						
Queue Length 95th (ft)	203						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1191						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						
Reduced v/c Ratio	0.72						

Intersection Summary

Area Type: CBD
 Cycle Length: 65
 Actuated Cycle Length: 65
 Offset: 0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection

Intersection Capacity Analysis

3: Hawthorn Street

Control Type: Pretimed

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 19.0

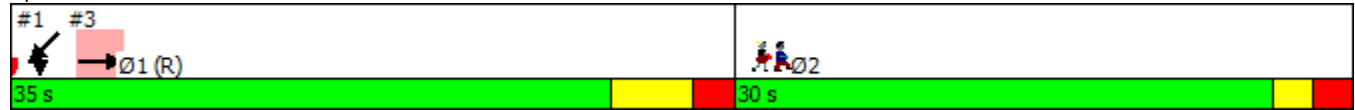
Intersection LOS: B

Intersection Capacity Utilization 46.2%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3: Hawthorn Street



Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Lane Configurations					↘	↗↗	
Traffic Volume (vph)	0	0	0	0	69	515	
Future Volume (vph)	0	0	0	0	69	515	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		0	150		
Storage Lanes	0	0		0	1		
Taper Length (ft)	25				25		
Satd. Flow (prot)	0	0	0	0	1413	2671	
Flt Permitted					0.950		
Satd. Flow (perm)	0	0	0	0	1334	2671	
Right Turn on Red		No		No	No		
Satd. Flow (RTOR)							
Link Speed (mph)	25		25			25	
Link Distance (ft)	56		174			280	
Travel Time (s)	1.5		4.7			7.6	
Confl. Peds. (#/hr)	128	325		50	50		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.91	0.91	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	2%	2%	2%	2%	0%	5%	
Bus Blockages (#/hr)	0	0	0	0	0	30	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	0	0	87	651	
Turn Type					Split	NA	
Protected Phases					1	1	2
Permitted Phases						1	
Minimum Split (s)					35.0	35.0	30.0
Total Split (s)					35.0	35.0	30.0
Total Split (%)					53.8%	53.8%	46%
Yellow Time (s)					4.0	4.0	2.0
All-Red Time (s)					2.0	2.0	2.0
Lost Time Adjust (s)					0.0	0.0	
Total Lost Time (s)					6.0	6.0	
Lead/Lag					Lead	Lead	Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)					29.0	29.0	
Actuated g/C Ratio					0.45	0.45	
v/c Ratio					0.14	0.55	
Control Delay					11.4	15.3	
Queue Delay					0.0	0.0	
Total Delay					11.4	15.3	
LOS					B	B	
Approach Delay						14.9	
Approach LOS						B	
Queue Length 50th (ft)					19	94	
Queue Length 95th (ft)					43	141	
Internal Link Dist (ft)	1		94			200	
Turn Bay Length (ft)					150		
Base Capacity (vph)					630	1191	

Intersection Capacity Analysis

1: Broadway/Washington Avenue



Lane Group	NBL	NBR	NET	NER	SWL	SWT	Ø2
Starvation Cap Reductn					0	0	
Spillback Cap Reductn					0	0	
Storage Cap Reductn					0	0	
Reduced v/c Ratio					0.14	0.55	

Intersection Summary

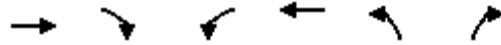
Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.76
Intersection Signal Delay:	14.9
Intersection LOS:	B
Intersection Capacity Utilization	39.9%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 1: Broadway/Washington Avenue



Intersection Capacity Analysis

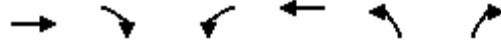
3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Lane Configurations	↑↑						
Traffic Volume (vph)	717	0	0	0	0	0	
Future Volume (vph)	717	0	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	2671	0	0	0	0	0	
Flt Permitted							
Satd. Flow (perm)	2671	0	0	0	0	0	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)							
Link Speed (mph)	25			25	25		
Link Distance (ft)	208			89	51		
Travel Time (s)	5.7			2.4	1.4		
Confl. Peds. (#/hr)		100	100		110	122	
Peak Hour Factor	0.91	0.91	0.92	0.92	0.92	0.92	
Growth Factor	115%	115%	115%	115%	115%	115%	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%	
Bus Blockages (#/hr)	30	30	0	0	0	0	
Parking (#/hr)	0	0	0	0	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	906	0	0	0	0	0	
Turn Type	NA						
Protected Phases	1						2
Permitted Phases							
Minimum Split (s)	35.0						30.0
Total Split (s)	35.0						30.0
Total Split (%)	53.8%						46%
Yellow Time (s)	4.0						2.0
All-Red Time (s)	2.0						2.0
Lost Time Adjust (s)	0.0						
Total Lost Time (s)	6.0						
Lead/Lag	Lead						Lag
Lead-Lag Optimize?							Yes
Act Effct Green (s)	29.0						
Actuated g/C Ratio	0.45						
v/c Ratio	0.76						
Control Delay	20.2						
Queue Delay	0.0						
Total Delay	20.2						
LOS	C						
Approach Delay	20.2						
Approach LOS	C						
Queue Length 50th (ft)	150						
Queue Length 95th (ft)	220						
Internal Link Dist (ft)	128			9	1		
Turn Bay Length (ft)							
Base Capacity (vph)	1191						
Starvation Cap Reductn	0						
Spillback Cap Reductn	0						
Storage Cap Reductn	0						

Intersection Capacity Analysis

3: Hawthorn Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø2
Reduced v/c Ratio	0.76						

Intersection Summary

Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 1:SWTL, Start of Green, Master Intersection
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.76
Intersection Signal Delay:	20.2
Intersection LOS:	C
Intersection Capacity Utilization	46.8%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 3: Hawthorn Street



APPENDIX L
Intersection Capacity Analyses
Proposed Signal Setting under 2040 Projected Conditions
Broadway at Fourth Street

Intersection Capacity Analysis

8: 4th Street & Broadway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕						↕	↗
Traffic Volume (vph)	0	0	0	105	470	0	0	0	0	0	147	174
Future Volume (vph)	0	0	0	105	470	0	0	0	0	0	147	174
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	0	0	0	2789	0	0	0	0	0	1444	1228
Flt Permitted					0.991							
Satd. Flow (perm)	0	0	0	0	2695	0	0	0	0	0	1444	1093
Right Turn on Red			No	No		No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		381			317			190			193	
Travel Time (s)		10.4			8.6			5.2			5.3	
Confl. Peds. (#/hr)	76		97	97		76	87		39	39		87
Peak Hour Factor	0.92	0.92	0.92	0.89	0.89	0.89	0.92	0.92	0.92	0.97	0.97	0.97
Growth Factor	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%
Heavy Vehicles (%)	2%	2%	2%	6%	6%	6%	2%	2%	2%	3%	3%	3%
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	743	0	0	0	0	0	174	206
Turn Type				Perm	NA						NA	Perm
Protected Phases					1						2	
Permitted Phases				1								2
Detector Phase				1	1						2	2
Switch Phase												
Minimum Initial (s)				5.0	5.0						5.0	5.0
Minimum Split (s)				21.0	21.0						21.0	21.0
Total Split (s)				23.0	23.0						21.0	21.0
Total Split (%)				35.4%	35.4%						32.3%	32.3%
Yellow Time (s)				3.0	3.0						3.0	3.0
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.0						4.0	4.0
Lead/Lag				Lead	Lead						Lag	Lag
Lead-Lag Optimize?				Yes	Yes						Yes	Yes
Recall Mode				Max	Max						None	None
Act Effct Green (s)					22.2						14.2	14.2
Actuated g/C Ratio					0.40						0.26	0.26
v/c Ratio					0.69						0.47	0.74
Control Delay					24.3						24.0	39.5
Queue Delay					0.0						0.0	0.0
Total Delay					24.3						24.0	39.5
LOS					C						C	D
Approach Delay					24.3						32.4	
Approach LOS					C						C	
Queue Length 50th (ft)					150						58	74
Queue Length 95th (ft)					#252						112	#171
Internal Link Dist (ft)		301			237			110			113	
Turn Bay Length (ft)												
Base Capacity (vph)					1075						464	351

Intersection Capacity Analysis

8: 4th Street & Broadway

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	21.0
Total Split (s)	21.0
Total Split (%)	32%
Yellow Time (s)	3.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

Intersection Capacity Analysis

8: 4th Street & Broadway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn					0						0	0
Spillback Cap Reductn					0						0	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					0.69						0.38	0.59

Intersection Summary

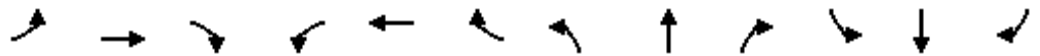
Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	55.6
Natural Cycle:	65
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.74
Intersection Signal Delay:	27.0
Intersection LOS:	C
Intersection Capacity Utilization	46.5%
ICU Level of Service	A
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 8: 4th Street & Broadway



Intersection Capacity Analysis

8: 4th Street & Broadway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕						↕	↗
Traffic Volume (vph)	0	0	0	151	308	0	0	0	0	0	236	166
Future Volume (vph)	0	0	0	151	308	0	0	0	0	0	236	166
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	0	0	0	2770	0	0	0	0	0	1444	1228
Flt Permitted					0.984							
Satd. Flow (perm)	0	0	0	0	2306	0	0	0	0	0	1444	1079
Right Turn on Red			No	No		No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		381			317			190			193	
Travel Time (s)		10.4			8.6			5.2			5.3	
Confl. Peds. (#/hr)	167		285	285		167	97		132	132		97
Peak Hour Factor	0.92	0.92	0.92	0.93	0.93	0.93	0.92	0.92	0.92	0.93	0.93	0.93
Growth Factor	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%
Heavy Vehicles (%)	2%	2%	2%	6%	6%	6%	2%	2%	2%	3%	3%	3%
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	568	0	0	0	0	0	292	205
Turn Type				Perm	NA						NA	Perm
Protected Phases					1						2	
Permitted Phases				1								2
Total Split (s)				23.0	23.0						21.0	21.0
Total Lost Time (s)					4.0						4.0	4.0
Act Effct Green (s)					20.4						14.6	14.6
Actuated g/C Ratio					0.38						0.27	0.27
v/c Ratio					0.65						0.75	0.70
Control Delay					23.5						35.3	36.7
Queue Delay					0.0						0.0	0.0
Total Delay					23.5						35.3	36.7
LOS					C						D	D
Approach Delay					23.5						35.9	
Approach LOS					C						D	
Queue Length 50th (ft)					110						107	74
Queue Length 95th (ft)					#195						#222	#170
Internal Link Dist (ft)		301			237			110			113	
Turn Bay Length (ft)												
Base Capacity (vph)					870						487	364
Starvation Cap Reductn					0						0	0
Spillback Cap Reductn					0						0	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					0.65						0.60	0.56

Intersection Summary

Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	54.1
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.75

Intersection Capacity Analysis

8: 4th Street & Broadway

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Total Split (s)	21.0
Total Lost Time (s)	
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Intersection Capacity Analysis

8: 4th Street & Broadway

Intersection Signal Delay: 29.3

Intersection LOS: C

Intersection Capacity Utilization 42.3%

ICU Level of Service A

Analysis Period (min) 15

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

Queue shown is maximum after two cycles.

Splits and Phases: 8: 4th Street & Broadway



Intersection Capacity Analysis

8: 4th Street & Broadway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑	↑
Traffic Volume (vph)	0	0	0	135	342	0	0	0	0	0	222	183
Future Volume (vph)	0	0	0	135	342	0	0	0	0	0	222	183
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	0	0	0	2829	0	0	0	0	0	1473	1252
Flt Permitted					0.986							
Satd. Flow (perm)	0	0	0	0	2394	0	0	0	0	0	1473	1050
Right Turn on Red			No	No		No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		381			317			190			193	
Travel Time (s)		10.4			8.6			5.2			5.3	
Confl. Peds. (#/hr)	235		377	377		235	133		105	105		133
Peak Hour Factor	0.92	0.92	0.92	0.88	0.88	0.88	0.92	0.92	0.92	0.86	0.86	0.86
Growth Factor	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%	115%
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Parking (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	623	0	0	0	0	0	297	245
Turn Type				Perm	NA						NA	Perm
Protected Phases					1						2	
Permitted Phases				1								2
Detector Phase				1	1						2	2
Switch Phase												
Minimum Initial (s)				5.0	5.0						5.0	5.0
Minimum Split (s)				21.0	21.0						21.0	21.0
Total Split (s)				23.0	23.0						21.0	21.0
Total Split (%)				35.4%	35.4%						32.3%	32.3%
Yellow Time (s)				3.0	3.0						3.0	3.0
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.0						4.0	4.0
Lead/Lag				Lead	Lead						Lag	Lag
Lead-Lag Optimize?				Yes	Yes						Yes	Yes
Recall Mode				Max	Max						None	None
Act Effct Green (s)					20.0						16.4	16.4
Actuated g/C Ratio					0.36						0.29	0.29
v/c Ratio					0.73						0.68	0.79
Control Delay					26.2						30.8	44.0
Queue Delay					0.0						0.0	0.0
Total Delay					26.2						30.8	44.0
LOS					C						C	D
Approach Delay					26.2						36.8	
Approach LOS					C						D	
Queue Length 50th (ft)					123						109	93
Queue Length 95th (ft)					#208						#207	#202
Internal Link Dist (ft)		301			237			110			113	
Turn Bay Length (ft)												
Base Capacity (vph)					859						473	337

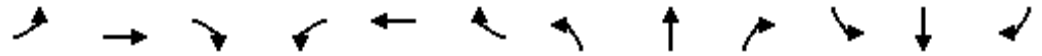
Intersection Capacity Analysis

8: 4th Street & Broadway

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	21.0
Total Split (s)	21.0
Total Split (%)	32%
Yellow Time (s)	3.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

Intersection Capacity Analysis

8: 4th Street & Broadway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn					0						0	0
Spillback Cap Reductn					0						0	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					0.73						0.63	0.73

Intersection Summary

Area Type:	CBD
Cycle Length:	65
Actuated Cycle Length:	55.6
Natural Cycle:	70
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.79
Intersection Signal Delay:	31.1
Intersection LOS:	C
Intersection Capacity Utilization	45.0%
ICU Level of Service	A
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 8: 4th Street & Broadway



APPENDIX M
MassDOT Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make

recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design

There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition

A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

8. Project Assessment

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
<p>Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT Highway District office which provides guidance to the proponent on the subsequent steps of the process.</p>	<p>The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.</p>	<p>1 to 3 months</p>
<p>Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.</p>	<p>For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.</p>	<p>Project Planning Report: 3 to 24+ months</p>
<p>Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT Highway District office, and formally reviewed by the PRC.</p>	<p>The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.</p>	<p>1 to 4 months</p>
<p>Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.</p>	<p>The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT Highway district and appropriate sections is completed in this step.</p>	<p>3 to 48+ months</p>
<p>Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.</p>	<p>The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.</p>	<p>3 to 12+ months</p>
<p>Step VI: Procurement The project is advertised for construction and a contract awarded.</p>	<p>Administration of competing projects can influence the advertising schedule.</p>	<p>1 to 12 months</p>
<p>Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.</p>	<p>The duration for this step is entirely dependent upon project complexity and phasing.</p>	<p>3 to 60+ months</p>
<p>Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.</p>	<p>The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.</p>	<p>1 month</p>

Source: MassDOT Highway Division Project Development and Design Guide