



Ohio Department of Transportation

District Four

INTEROFFICE COMMUNICATION

To: File

From: Aaron Conley, P.E., D4 Studies Engineer

Date: 5/9/2018

Subject: SUM 176 at Boston Rd (Multi-way Stop Conversion)

This memo is to document the upcoming conversion at SUM 176 at Boston Road from a two-way stop control to a multi-way stop control. District 4 is expecting to begin implementing the conversion in mid-June of 2018 or soon after. See below for additional information.

Existing Conditions

Approach	Legal Speed	ADT
Northbound	55 mph	4750
Southbound	50 mph	5310
Eastbound	45 mph	1890
Westbound	45 mph	2060

ISD on all approaches exceeds minimum for the legal speed. **Note:** Broadview Heights cleared obstructions on the NE corner in late summer of 2017 improving the view looking north.

Crash History

Year	Angle		Other	Total
	EB	WB		
2005	0	1	0	1
2006	1	1	0	2
2007	2	0	0	2
2008	0	0	0	0
2009	1	4	1	6
2010	0	1	1	2
2011	0	2	0	2
2012	1	0	0	1
2013	0	0	0	0
2014	0	2	2	4
2015	0	1	0	1
2016	2	1	1	4
2017	2	7	1	10
2018 (available)	1	2	0	3

Nine (9) angle crashes have occurred since Broadview Heights cleared obstructions on the NE corner in late summer of 2017 improving the view looking north.
ECAT analysis expects the average crash frequency to be reduced by nearly 75%. **See attached ECAT and Collision Diagram for 2013-2017**

Signal Warrant Analysis

The volume using the intersection does not warrant the installation of a traffic signal. Hourly side street volumes would need to grow by over 50% between 8 am and 3 pm before a signal would be warranted.

Multi-Way Stop Analysis

Criteria B (Crash Experience) and Criteria C (Volumes and Delays) are satisfied.
See attached MWS Warrant

Capacity Analysis

Condition	Year	Time Period	Delay / Level of Service				Intersection
			Approach				
			EB	WB	NB	SB	
TWSC	2018	AM	14.0 / B	12.6 / B	7.7 / A *	7.5 / A *	
		PM	16.9 / C	17.8 / C	7.7 / A *	7.9 / A *	
	2038	AM	15.8 / C	13.2 / B	7.8 / A *	7.5 / A *	
		PM	19.0 / C	19.5 / C	7.7 / A *	7.9 / A *	
AWSC	2018	AM	9.1 / A	8.6 / A	8.9 / A	10.6 / B	9.7 / A
		PM	9.2 / A	9.8 / A	11.3 / B	10.4 / B	10.5 / B
	2038	AM	9.4 / A	8.4 / A	9.0 / A	10.6 / B	9.8 / A
		PM	9.6 / A	10.3 / B	12.0 / B	11.1 / B	11.1 / B

*Only includes delay from left turns

The free flow condition along SR 176 will be changed to a stop condition at Boston Road. The northbound and southbound approaches will experience an average delay of 11 seconds after the conversion.

Recommendation

Convert the two-way stop control to multi-way stop control. Although this condition will increase the average delay along SR 176 by about 11 seconds, the crash frequency is expected to be reduced by nearly 75%. The increase in delay is reasonable considering the safety benefits.

District will continue to monitor this intersection to assess safety performance and operations for the next several years.

Respectfully,

Aaron R. Conley, P.E.

Traffic Studies Engineer

District 4 | Planning | Traffic

2088 S. Arlington Road. Akron, Ohio 44306

330.786.4850

transportation.ohio.gov

File: I:\Planning_Engineering\Planning\Studies\Spot location reports\SUM\SR 176 at Boston

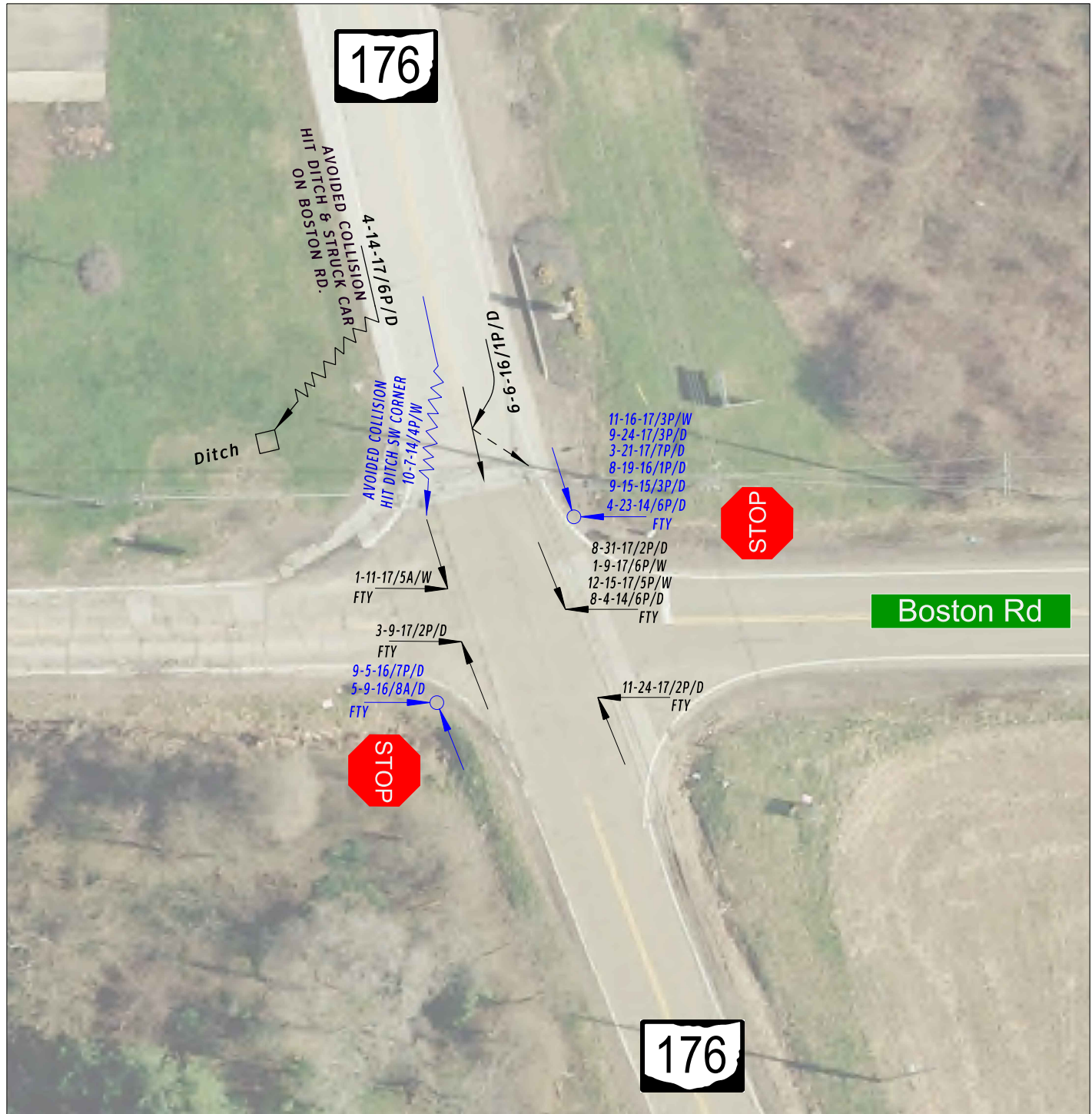


COLLISION DIAGRAM

SUM SR 176 at BOSTON RD (CR 127)

SLM 5.99

2013-2017



Vehicle Direction		Injury		<u>Road:</u> D = Dry W = Wet I = Ice S = Snow	FTC = Failure To Control FTS = Failure To Stop FTY = Failure To Yield LOC = Left of Center RRL = Ran Red Light OVI = Operating Vehicle Impaired	TOTAL CRASHES ON PAGE	
Backing		Fatal				FREQUENCY	CRASH SEVERITY
Pedestrian		Fixed Object				0 2013	9 NON - INJURY
Out of Control		Parked Vehicle				3 2014	9 INJURY OR FATAL
Overturn		TEXT	Date/Time/Road/Egress Direction			4 2016	18 TOTAL
						10 2017	
						1 2015	

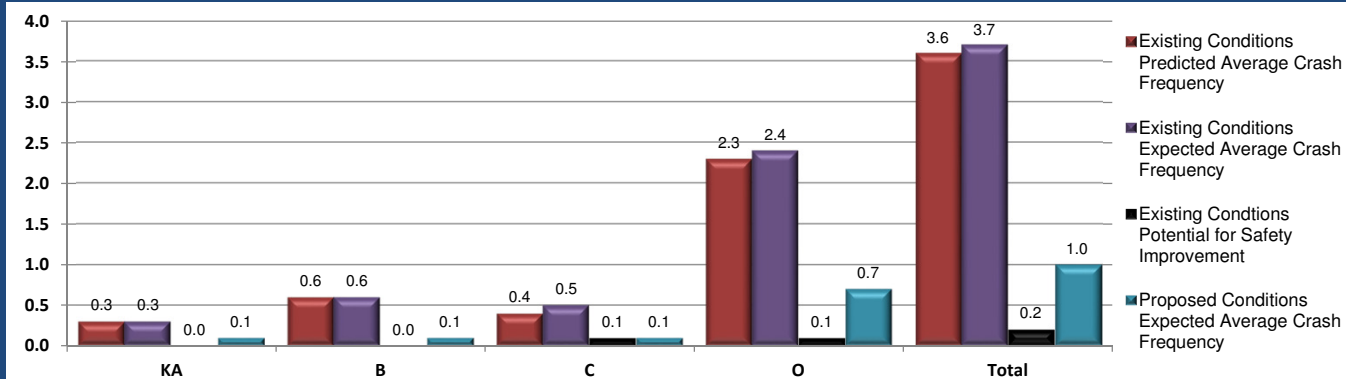


Project Safety Performance Report

General Information

Project Name	SUM SR 176 at Boston Road	Contact Email	
Project Description	TWSC to AWSC	Contact Phone	330-786-4941
Reference Number		Date Performed	4/24/2018
Analyst	Griff	Analysis Year	2018
Agency/Company	D4 ODOT		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.2618	0.6346	0.4226	2.2711	3.5901
N_{expected} - Existing Conditions	0.2676	0.6305	0.4824	2.3644	3.7449
N_{potential for improvement} - Existing Conditions	0.0058	-0.0041	0.0598	0.0933	0.1548
N_{expected} - Proposed Conditions	0.0615	0.1450	0.1110	0.6843	1.0018

ODOT D4
2088 S Arlington Rd
Akron, OH 44306

Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Signal Warrants - Summary

Major Street Approaches

Northbound: SR-176 (BROADVIEW RD.)

Number of Lanes : 1

Total Approach Volume: 1,833

Southbound: SR-176 (BROADVIEW RD.)

Number of Lanes : 1

Total Approach Volume: 1,966

Minor Street Approaches

Eastbound: BOSTON RD. (CR-127)

Number of Lanes : 1

Total Approach Volume: 632

Westbound: BOSTON RD. (CR-127)

Number of Lanes : 1

Total Approach Volume: 696

Warrant Summary (Urban Values Apply)

Warrant 1 - Eight Hour Vehicular Volumes.....Not Satisfied

Warrant 1A - Minimum Vehicular Volume.....Not Satisfied

Required volumes reached for 0 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic.....Not Satisfied

Required volumes reached for 0 hours, 8 are needed

Warrant 1C - Combination of Warrants.....Not Satisfied

Required 1A volumes reached for 1 hours, 8 are needed

Required 1B volumes reached for 0 hours, 8 are needed

Warrant 2 - Four Hour Volumes.....Not Satisfied

Number of hours (0) volumes exceed minimum < minimum required (4).

Warrant 3 - Peak Hour.....Not Satisfied

Warrant 3A - Peak Hour Delay.....Not Satisfied

Approach volumes on minor street don't exceed minimums for any one hour period. Delay data not evaluated.

Warrant 3B - Peak Hour Volumes.....Not Satisfied

Volumes do not exceed minimums for any one hour period.

Warrant 4 - Pedestrian Volumes.....Not Evaluated

Warrant 5 - School Crossing.....Not Evaluated

Warrant 6 - Coordinated Signal System.....Not Evaluated

Warrant 7 - Crash Experience.....Not Satisfied

Number of accidents (10) meet minimum (5) but volumes do not.

Warrant 8 - Roadway Network.....Not Evaluated

Warrant 9 - Intersection Near a Grade Crossing.....Not Evaluated

ODOT D4
2088 S Arlington Rd
Akron, OH 44306

Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Warrant 1A - Minimum Volumes

Description

Intended for sites where the volume of intersecting traffic is the principal reason for consideration of a signal installation.

Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **1**

Volume Requirements

Veh/Hr Major = **500**

Veh/Hr Minor = **150**

		Major Road				Minor Road				
		SR-176 (BROADVIEW RD.)				BOSTON RD. (CR-127)				
Time	Major NB	+	Major SB	=	Total		Minor EB		Minor WB	Met?
16:45 - 17:45	275	+	224	=	499		61		135	No
17:00 - 18:00	273	+	219	=	492		63		126	No
16:30 - 17:30	272	+	211	=	483		53		128	No
17:15 - 18:15	270	+	193	=	463		64		119	No
16:15 - 17:15	255	+	197	=	452		53		122	No
17:30 - 18:30	238	+	182	=	420		60		104	No
15:30 - 16:30	248	+	171	=	419		46		95	No
16:00 - 17:00	237	+	173	=	410		49		116	No
15:15 - 16:15	229	+	165	=	394		37		78	No
15:00 - 16:00	218	+	165	=	383		36		67	No
15:45 - 16:45	211	+	170	=	381		52		98	No
17:45 - 18:45	209	+	172	=	381		50		92	No
07:15 - 08:15	122	+	248	=	370		115		45	No
14:45 - 15:45	211	+	154	=	365		28		57	No
07:00 - 08:00	112	+	241	=	353		121		46	No
07:30 - 08:30	125	+	224	=	349		116		47	No
18:00 - 19:00	176	+	161	=	337		41		83	No
07:45 - 08:45	119	+	203	=	322		102		53	No
08:00 - 09:00	128	+	181	=	309		82		51	No
12:00 - 13:00	136	+	160	=	296		44		42	No
13:30 - 14:30	139	+	156	=	295		30		29	No
13:45 - 14:45	139	+	151	=	290		24		35	No
11:45 - 12:45	129	+	159	=	288		45		45	No
14:30 - 15:30	144	+	140	=	284		29		48	No
14:00 - 15:00	137		147		284		25		34	No

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Akron, OH 44306

Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Warrant 1B - Interruption of Continuous Traffic

Description

Intended for sites where the volume of the major street is so heavy that traffic on the minor street suffers excessive delay or hazard.

Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **1**

Volume Requirements

Veh/Hr Major = **750**

Veh/Hr Minor = **75**

Major Road						Minor Road		
SR-176 (BROADVIEW RD.)						BOSTON RD. (CR-127)		
Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met?
16:45 - 17:45	275	+	224	=	499	61	135	No
17:00 - 18:00	273	+	219	=	492	63	126	No
16:30 - 17:30	272	+	211	=	483	53	128	No
17:15 - 18:15	270	+	193	=	463	64	119	No
16:15 - 17:15	255	+	197	=	452	53	122	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No
17:45 - 18:45	209	+	172	=	381	50	92	No
07:15 - 08:15	122	+	248	=	370	115	45	No
14:45 - 15:45	211	+	154	=	365	28	57	No
07:00 - 08:00	112	+	241	=	353	121	46	No
07:30 - 08:30	125	+	224	=	349	116	47	No
18:00 - 19:00	176	+	161	=	337	41	83	No
07:45 - 08:45	119	+	203	=	322	102	53	No
08:00 - 09:00	128	+	181	=	309	82	51	No
12:00 - 13:00	136	+	160	=	296	44	42	No
13:30 - 14:30	139	+	156	=	295	30	29	No
13:45 - 14:45	139	+	151	=	290	24	35	No
11:45 - 12:45	129	+	159	=	288	45	45	No
14:30 - 15:30	144	+	140	=	284	29	48	No
14:00 - 15:00	137		147		284	25	34	No

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Study Date : 5/18/2017

Warrant 1C Combination of Warrants

Description

Intended for sites where the traffic volumes don't meet individual warrants but where Warrants 1A and 1B are both met to 80% of their stated values.

Summary

Only 1 hours meet 1A minimums.
 Only 0 hours meet 1B minimums.
 Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
 Number of Major Lanes = **1**
 Number of Minor Lanes = **1**

Volume Requirements

Warrant 1A 1B
 Veh/Hr Major = **400 600**
 Veh/Hr Minor = **120 60**

Major Road SR-176 (BROADVIEW RD.)

Minor Road BOSTON RD. (CR-127)

Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1A?
16:15 - 17:15	255	+	197	=	452	53	122	Yes
17:15 - 18:15	270	+	193	=	463	64	119	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No
17:45 - 18:45	209	+	172	=	381	50	92	No
07:15 - 08:15	122	+	248	=	370	115	45	No
14:45 - 15:45	211	+	154	=	365	28	57	No
07:00 - 08:00	112	+	241	=	353	121	46	No

Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1B?
16:45 - 17:45	275	+	224	=	499	61	135	No
17:00 - 18:00	273	+	219	=	492	63	126	No
16:30 - 17:30	272	+	211	=	483	53	128	No
17:15 - 18:15	270	+	193	=	463	64	119	No
16:15 - 17:15	255	+	197	=	452	53	122	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No
17:45 - 18:45	209	+	172	=	381	50	92	No

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Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Warrant 2 - Four Hour Volumes

Description

Intended for sites where the volume of intersecting traffic during any four hours of the day is the principal reason for consideration of a signal installation.

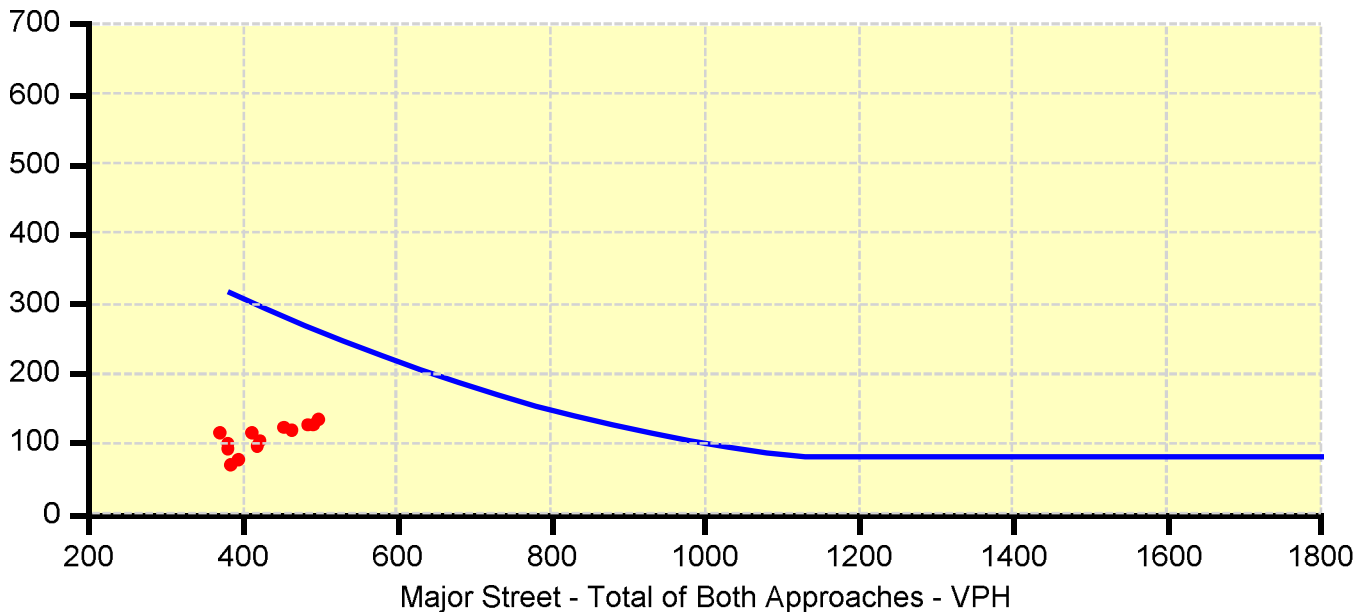
Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **1**

	Major Road					Minor Road					
	SR-176 (BROADVIEW RD.)					BOSTON RD. (CR-127)					
Time	Major NB	+	Major SB	=	Total		Minor EB		Minor WB		Met?
16:45 - 17:45	275	+	224	=	499		61		135		No
17:00 - 18:00	273	+	219	=	492		63		126		No
16:30 - 17:30	272	+	211	=	483		53		128		No
17:15 - 18:15	270	+	193	=	463		64		119		No
16:15 - 17:15	255	+	197	=	452		53		122		No
17:30 - 18:30	238	+	182	=	420		60		104		No
15:30 - 16:30	248	+	171	=	419		46		95		No
16:00 - 17:00	237	+	173	=	410		49		116		No
15:15 - 16:15	229	+	165	=	394		37		78		No
15:00 - 16:00	218	+	165	=	383		36		67		No
15:45 - 16:45	211	+	170	=	381		52		98		No



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Study Date : 5/18/2017

Warrant 3A - Peak Hour Delay

Description

Intended for sites where for one hour of the day minor street traffic suffers undue traffic delay entering or crossing the major street.

Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Number of Minor Lanes = 1

Volume and Delay Requirements

Veh/Hr All Approaches = 800

Veh/Hr Minor = 100

Total Delay (Veh-Hrs) = 4

Major Road						Minor Road			
SR-176 (BROADVIEW RD.)						BOSTON RD. (CR-127)			
Time	Total of All Approaches	Met?	Minor EB	Delay EB	Met?	Minor WB	Delay WB	Met?	Warrant Met?
16:45 - 17:45	695	No	61	-	---	135	-	Yes	No
17:00 - 18:00	681	No	63	-	---	126	-	Yes	No
16:30 - 17:30	664	No	53	-	---	128	-	Yes	No
17:15 - 18:15	646	No	64	-	---	119	-	Yes	No
16:15 - 17:15	627	No	53	-	---	122	-	Yes	No
17:30 - 18:30	584	No	60	-	---	104	-	Yes	No
16:00 - 17:00	575	No	49	-	---	116	-	Yes	No
15:30 - 16:30	560	No	46	-	---	95	-	No	No
15:45 - 16:45	531	No	52	-	---	98	-	No	No
07:15 - 08:15	530	No	115	-	Yes	45	-	---	No
17:45 - 18:45	523	No	50	-	---	92	-	No	No
07:00 - 08:00	520	No	121	-	Yes	46	-	---	No
07:30 - 08:30	512	No	116	-	Yes	47	-	---	No
15:15 - 16:15	509	No	37	-	---	78	-	No	No
15:00 - 16:00	486	No	36	-	---	67	-	No	No
07:45 - 08:45	477	No	102	-	Yes	53	-	---	No
18:00 - 19:00	461	No	41	-	---	83	-	No	No
14:45 - 15:45	450	No	28	-	---	57	-	No	No
08:00 - 09:00	442	No	82	-	No	51	-	---	No
08:15 - 09:15	394	No	73	-	No	47	-	---	No
06:45 - 07:45	386	No	85	-	No	35	-	---	No
12:00 - 13:00	382	No	44	-	No	42	-	---	No
11:45 - 12:45	378	No	45	-	---	45	-	No	No
14:30 - 15:30	361	No	29	-	---	48	-	No	No
11:30 - 12:30	359	No	46	-	No	40	-	---	No

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Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Warrant 3B - Peak Hour Volumes

Description

Intended for sites where the volume of intersecting traffic during one hour of the day is the principal reason for consideration of a signal installation.

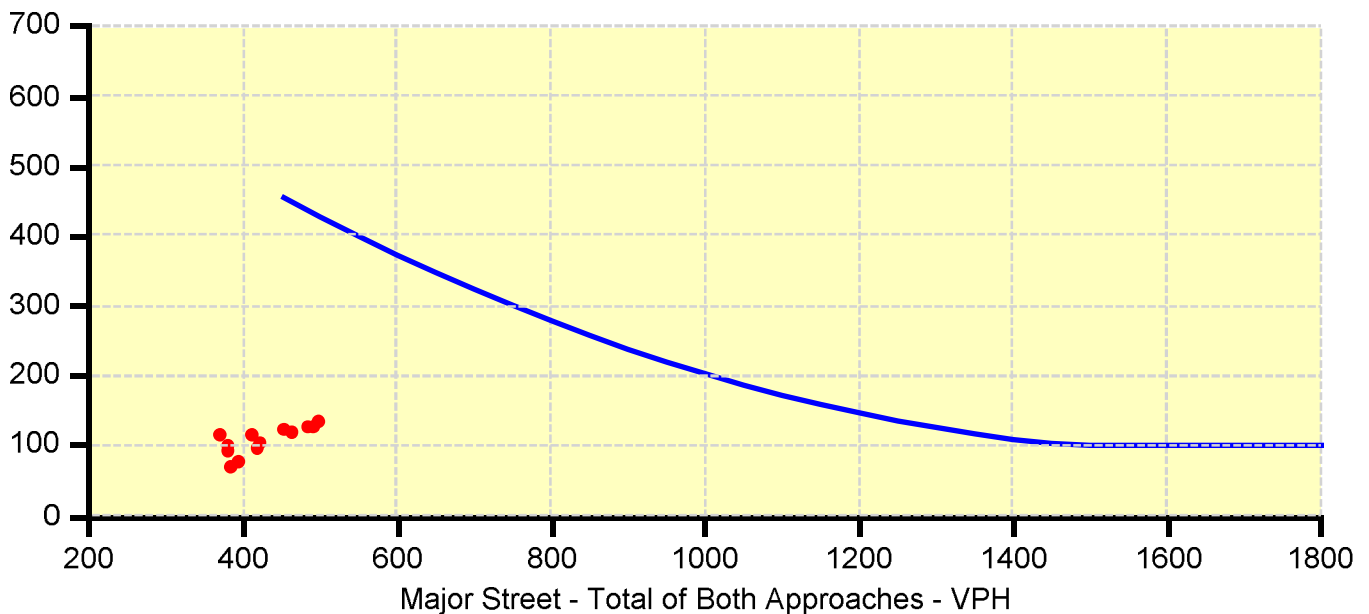
Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **1**

Major Road SR-176 (BROADVIEW RD.)						Minor Road BOSTON RD. (CR-127)		
Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met?
16:45 - 17:45	275	+	224	=	499	61	135	No
17:00 - 18:00	273	+	219	=	492	63	126	No
16:30 - 17:30	272	+	211	=	483	53	128	No
17:15 - 18:15	270	+	193	=	463	64	119	No
16:15 - 17:15	255	+	197	=	452	53	122	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No



ODOT D4
2088 S Arlington Rd
Akron, OH 44306

Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

Warrant 7 - Crash Experience

Description

Intended for sites where the frequency of correctible crashes in the past 12 months is the primary motivation for installing a traffic signal.

Summary

Number of crashes meet minimum.
 Pedestrian volumes do not meet the 80% criteria.
 War 1A or 1B volumes do not meet the 80% criteria.
 Warrant is NOT met.

Site Data Required

Number of crashes in last 12 months = 10

Rural Settings Apply = **False**
 Number of Major Lanes = **1**
 Number of Minor Lanes = **1**

Crash and Volume Requirements

Minimum number of crashes = 5

Veh/Hr Major: War 1A = **400** War 1B = **600**

Veh/Hr Minor: War 1A = **120** War 1B = **60**

Volume and Pedestrian Data

Hours data meets 80% requirements of Warrant 1A (8 needed) **1** Met? **No**
 Hours data meets 80% requirements of Warrant 1B (8 needed) **0** Met? **No**
 Hours data meets 80% requirements of Warrant 4 (4,1 needed) **0** Met? **No**

Major Road
SR-176 (BROADVIEW RD.)

Minor Road
BOSTON RD. (CR-127)

Warrant 1A Details

Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1A?
16:15 - 17:15	255	+	197	=	452	53	122	Yes
17:15 - 18:15	270	+	193	=	463	64	119	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No
17:45 - 18:45	209	+	172	=	381	50	92	No
07:15 - 08:15	122	+	248	=	370	115	45	No
14:45 - 15:45	211	+	154	=	365	28	57	No
07:00 - 08:00	112	+	241	=	353	121	46	No

Warrant 1B Details

Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1B?
16:45 - 17:45	275	+	224	=	499	61	135	No
17:00 - 18:00	273	+	219	=	492	63	126	No
16:30 - 17:30	272	+	211	=	483	53	128	No
17:15 - 18:15	270	+	193	=	463	64	119	No
16:15 - 17:15	255	+	197	=	452	53	122	No
17:30 - 18:30	238	+	182	=	420	60	104	No
15:30 - 16:30	248	+	171	=	419	46	95	No
16:00 - 17:00	237	+	173	=	410	49	116	No
15:15 - 16:15	229	+	165	=	394	37	78	No
15:00 - 16:00	218	+	165	=	383	36	67	No
15:45 - 16:45	211	+	170	=	381	52	98	No
17:45 - 18:45	209	+	172	=	381	50	92	No

ODOT D4
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Study Name: SUM 176 at Boston Rd (100_RTR) 2017

Study Date : 5/18/2017

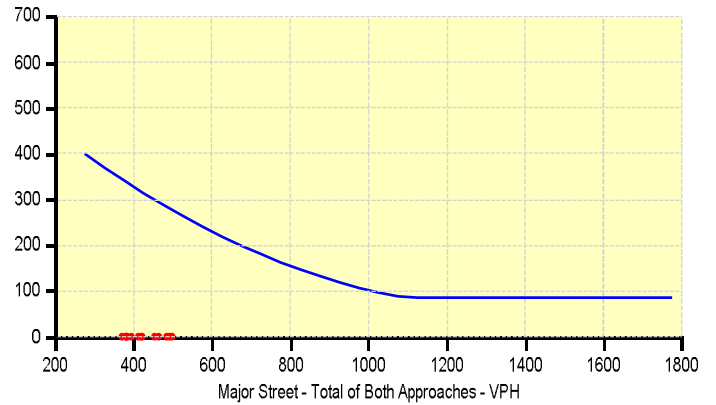
Warrant 7 - Crash Experience

Major Road

SR-176 (BROADVIEW RD.)

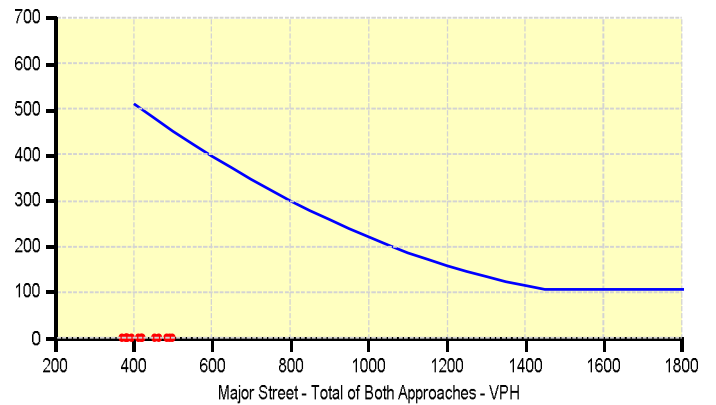
80% of Warrant 4 - 4 Hr Pedestrian Data

Time	NB Vehs	+	SB Vehs	=	Total Vehs	NB Peds	+	SB Peds	=	Ped Total	Met?
16:45 - 17:45	275	+	224	=	499	0	+	0	=	0	No
17:00 - 18:00	273	+	219	=	492	0	+	0	=	0	No
16:30 - 17:30	272	+	211	=	483	0	+	0	=	0	No
17:15 - 18:15	270	+	193	=	463	0	+	0	=	0	No
16:15 - 17:15	255	+	197	=	452	0	+	0	=	0	No
17:30 - 18:30	238	+	182	=	420	0	+	0	=	0	No
15:30 - 16:30	248	+	171	=	419	0	+	0	=	0	No
16:00 - 17:00	237	+	173	=	410	0	+	0	=	0	No
15:15 - 16:15	229	+	165	=	394	0	+	0	=	0	No
15:00 - 16:00	218	+	165	=	383	0	+	0	=	0	No
15:45 - 16:45	211	+	170	=	381	0	+	0	=	0	No
17:45 - 18:45	209	+	172	=	381	0	+	0	=	0	No



80% of Warrant 4 - 1 Hr Pedestrian Data

Time	NB Vehs	+	SB Vehs	=	Total Vehs	NB Peds	+	SB Peds	=	Ped Total	Met?
16:45 - 17:45	275	+	224	=	499	0	+	0	=	0	No
17:00 - 18:00	273	+	219	=	492	0	+	0	=	0	No
16:30 - 17:30	272	+	211	=	483	0	+	0	=	0	No
17:15 - 18:15	270	+	193	=	463	0	+	0	=	0	No
16:15 - 17:15	255	+	197	=	452	0	+	0	=	0	No
17:30 - 18:30	238	+	182	=	420	0	+	0	=	0	No
15:30 - 16:30	248	+	171	=	419	0	+	0	=	0	No
16:00 - 17:00	237	+	173	=	410	0	+	0	=	0	No
15:15 - 16:15	229	+	165	=	394	0	+	0	=	0	No
15:00 - 16:00	218	+	165	=	383	0	+	0	=	0	No
15:45 - 16:45	211	+	170	=	381	0	+	0	=	0	No
17:45 - 18:45	209	+	172	=	381	0	+	0	=	0	No



SUM SR 176 at BOSTON RD

70% CONDITION

ODOT - ARC

Volume Date : 03/28/17

Page No. : 1

Multi-Way Stop Warrant Report

Major Street Approaches

Northbound: SR-176 (BROADVIEW RD.)

Total Approach Volume: **1,833**

85% Speed > 40 MPH.

Southbound: SR-176 (BROADVIEW RD.)

Total Approach Volume: **1,966**

85% Speed > 40 MPH.

Minor Street Approaches

Eastbound: BOSTON RD. (CR-127)

Total Approach Volume: **670**

Westbound: BOSTON RD. (CR-127)

Total Approach Volume: **825**

Warrant Summary

Criteria A - Interim Measure Not Evaluated

Criteria B - Crash Experience Satisfied

Number of crashes (9) meets the minimum required (5).

Criteria C - Minimum Volumes and Delays Not Satisfied

Average Delay Per Vehicle (18) is 3 second less than minimum required (21).

Average of 8 highest hours exceeds volume criteria.

Volume Satisfied

Criteria D - 80% of Volumes, Delays, and Crashes Not Evaluated

Analysis of 8-Hour Volume Warrants:

Time	Major	Major	Minor	Minor	Crit C			Crit D		
	Total	Avg	Total	Avg	Major	Minor	Meets?	Major	Minor	Meets?
17:00 - 18:00	492	358.0	215	144.3	210-Yes	140-Yes	Both	240-Yes	160-No	Major
16:00 - 17:00	410		174							
15:00 - 16:00	383		123							
07:00 - 08:00	353		176							
18:00 - 19:00	337		145							
08:00 - 09:00	309		153							
12:00 - 13:00	296		100							
14:00 - 15:00	284		68							
13:00 - 14:00	249	0	88	0						
11:00 - 12:00	233		91							
10:00 - 11:00	233		80							
09:00 - 10:00	220		82							
23:00 - 00:00	0		0							
22:00 - 23:00	0		0							
21:00 - 22:00	0		0							
20:00 - 21:00	0		0							
19:00 - 20:00	0		0							
06:00 - 07:00	0		0							
05:00 - 06:00	0		0							
04:00 - 05:00	0		0							
03:00 - 04:00	0		0							
02:00 - 03:00	0		0							
01:00 - 02:00	0		0							
00:00 - 01:00	0		0							

HCS7 Two-Way Stop-Control Report

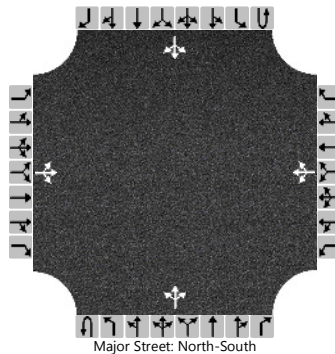
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2018
Time Analyzed	AM PEAK
Intersection Orientation	North-South
Project Description	Existing

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		20	70	40		20	10	20		20	80	20		40	200	10
Percent Heavy Vehicles (%)		2	2	2		1	1	1		2				2		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.12	6.52	6.22		7.11	6.51	6.21		4.12				4.12		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.52	4.02	3.32		3.51	4.01	3.31		2.22				2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			141				54			22				43		
Capacity, c (veh/h)			541				529			1340				1482		
v/c Ratio			0.26				0.10			0.02				0.03		
95% Queue Length, Q ₉₅ (veh)			1.0				0.3			0.0				0.1		
Control Delay (s/veh)			14.0				12.6			7.7		0.1		7.5		0.3
Level of Service (LOS)			B				B			A		A		A		A
Approach Delay (s/veh)	14.0				12.6				1.4				1.4			
Approach LOS	B				B											

HCS7 Two-Way Stop-Control Report

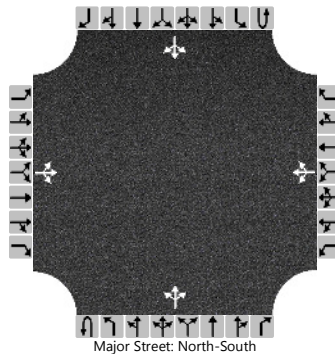
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2038
Time Analyzed	AM PEAK
Intersection Orientation	North-South
Project Description	Existing

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	80	40		20	20	30		20	90	20		50	210	10
Percent Heavy Vehicles (%)		2	2	2		1	1	1		2				2		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.12	6.52	6.22		7.11	6.51	6.21		4.12				4.12		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.52	4.02	3.32		3.51	4.01	3.31		2.22				2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			163				76			22				54		
Capacity, c (veh/h)			494				516			1328				1468		
v/c Ratio			0.33				0.15			0.02				0.04		
95% Queue Length, Q ₉₅ (veh)			1.4				0.5			0.0				0.1		
Control Delay (s/veh)			15.8				13.2			7.8		0.1		7.5		0.3
Level of Service (LOS)			C				B			A		A		A		A
Approach Delay (s/veh)	15.8				13.2				1.3				1.7			
Approach LOS	C				B											

HCS7 Two-Way Stop-Control Report

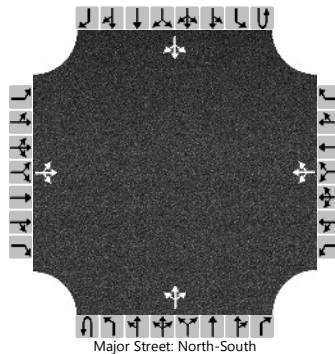
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2018
Time Analyzed	PM PEAK
Intersection Orientation	North-South
Project Description	Existing

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		20	30	20		10	90	50		40	220	20		50	150	20
Percent Heavy Vehicles (%)		2	2	2		1	1	1		2				2		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.12	6.52	6.22		7.11	6.51	6.21		4.12				4.12		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.52	4.02	3.32		3.51	4.01	3.31		2.22				2.22		

Delay, Queue Length, and Level of Service

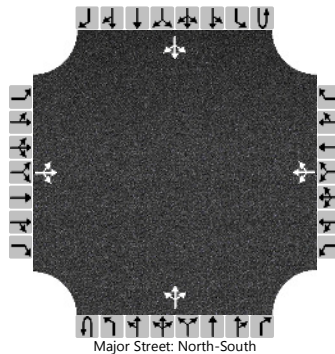
Flow Rate, v (veh/h)			76				163			43				54		
Capacity, c (veh/h)			377				443			1390				1304		
v/c Ratio			0.20				0.37			0.03				0.04		
95% Queue Length, Q ₉₅ (veh)			0.7				1.7			0.1				0.1		
Control Delay (s/veh)			16.9				17.8			7.7		0.3		7.9		0.4
Level of Service (LOS)			C				C			A		A		A		A
Approach Delay (s/veh)	16.9				17.8				1.3				2.1			
Approach LOS	C				C											

HCS7 Two-Way Stop-Control Report

General Information

Analyst	ARC	Intersection	SR 176 at Boston Rd
Agency/Co.	ODOT	Jurisdiction	ODOT/Boston Heights
Date Performed		East/West Street	Boston Rd
Analysis Year	2038	North/South Street	SR 176
Time Analyzed	PM PEAK	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Existing		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	30	30		10	100	50		40	230	20		50	160	30
Percent Heavy Vehicles (%)		2	2	2		1	1	1		2				2		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.12	6.52	6.22		7.11	6.51	6.21		4.12				4.12		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.52	4.02	3.32		3.51	4.01	3.31		2.22				2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			98				174			43				54		
Capacity, c (veh/h)			355				419			1365				1292		
v/c Ratio			0.28				0.41			0.03				0.04		
95% Queue Length, Q ₉₅ (veh)			1.1				2.0			0.1				0.1		
Control Delay (s/veh)			19.0				19.5			7.7		0.3		7.9		0.4
Level of Service (LOS)			C				C			A		A		A		A
Approach Delay (s/veh)	19.0				19.5				1.3				1.9			
Approach LOS	C				C											

HCS7 All-Way Stop Control Report

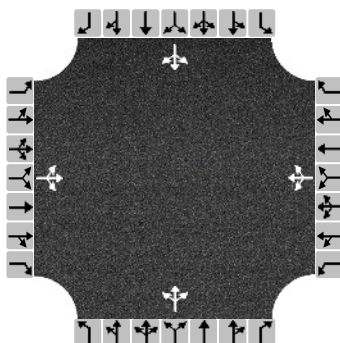
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2018
Analysis Time Period (hrs)	0.25
Time Analyzed	AM PEAK
Project Description	Proposed

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	70	40	20	20	30	20	90	20	50	210	10
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	141			76			141			293		
Percent Heavy Vehicles	2			1			2			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.126			0.068			0.126			0.261		
Final Departure Headway, hd (s)	4.95			4.98			4.80			4.69		
Final Degree of Utilization, x	0.194			0.105			0.188			0.382		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, ts (s)	2.95			2.98			2.80			2.69		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	141			76			141			293		
Capacity	728			722			750			767		
95% Queue Length, Q ₉₅ (veh)	0.7			0.4			0.7			1.8		
Control Delay (s/veh)	9.1			8.6			8.9			10.6		
Level of Service, LOS	A			A			A			B		
Approach Delay (s/veh)	9.1			8.6			8.9			10.6		
Approach LOS	A			A			A			B		
Intersection Delay, s/veh LOS	9.7						A					

HCS7 All-Way Stop Control Report

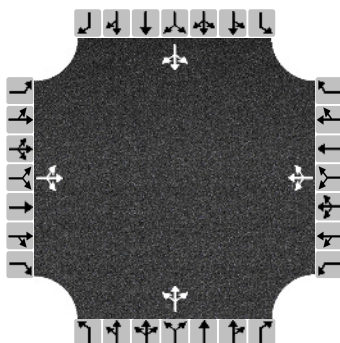
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2038
Analysis Time Period (hrs)	0.25
Time Analyzed	AM PEAK
Project Description	Proposed

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	80	40	10	20	30	20	90	20	50	210	10
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	163			65			141			293		
Percent Heavy Vehicles	2			1			2			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.145			0.058			0.126			0.261		
Final Departure Headway, hd (s)	4.97			4.96			4.84			4.72		
Final Degree of Utilization, x	0.225			0.090			0.190			0.385		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, ts (s)	2.97			2.96			2.84			2.72		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	163			65			141			293		
Capacity	724			726			744			762		
95% Queue Length, Q ₉₅ (veh)	0.9			0.3			0.7			1.8		
Control Delay (s/veh)	9.4			8.4			9.0			10.6		
Level of Service, LOS	A			A			A			B		
Approach Delay (s/veh)	9.4			8.4			9.0			10.6		
Approach LOS	A			A			A			B		
Intersection Delay, s/veh LOS	9.8						A					

HCS7 All-Way Stop Control Report

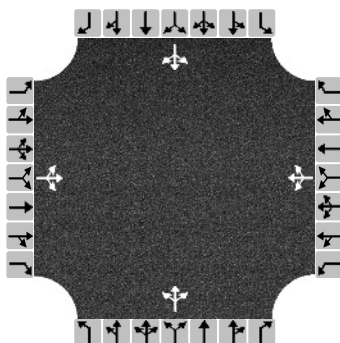
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2018
Analysis Time Period (hrs)	0.25
Time Analyzed	PM PEAK
Project Description	Proposed

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	30	20	10	90	50	40	220	20	50	150	20
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	76			163			304			239		
Percent Heavy Vehicles	2			1			2			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.068			0.145			0.271			0.213		
Final Departure Headway, hd (s)	5.45			5.21			4.90			4.99		
Final Degree of Utilization, x	0.115			0.236			0.414			0.331		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, ts (s)	3.45			3.21			2.90			2.99		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	76			163			304			239		
Capacity	661			691			734			721		
95% Queue Length, Q ₉₅ (veh)	0.4			0.9			2.0			1.5		
Control Delay (s/veh)	9.2			9.8			11.3			10.4		
Level of Service, LOS	A			A			B			B		
Approach Delay (s/veh)	9.2			9.8			11.3			10.4		
Approach LOS	A			A			B			B		
Intersection Delay, s/veh LOS	10.5						B					

HCS7 All-Way Stop Control Report

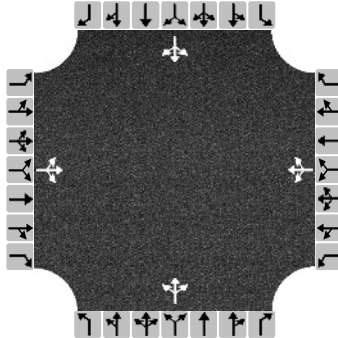
General Information

Analyst	ARC
Agency/Co.	ODOT
Date Performed	
Analysis Year	2038
Analysis Time Period (hrs)	0.25
Time Analyzed	PM PEAK
Project Description	Proposed

Site Information

Intersection	SR 176 at Boston Rd
Jurisdiction	ODOT/Boston Heights
East/West Street	Boston Rd
North/South Street	SR 176
Peak Hour Factor	0.92

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	30	20	10	100	50	40	230	20	50	160	30
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	87			174			315			261		
Percent Heavy Vehicles	2			1			2			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.077			0.155			0.280			0.232		
Final Departure Headway, hd (s)	5.67			5.38			5.04			5.10		
Final Degree of Utilization, x	0.137			0.260			0.442			0.369		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, ts (s)	3.67			3.38			3.04			3.10		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)	87			174			315			261		
Capacity	635			669			714			706		
95% Queue Length, Q ₉₅ (veh)	0.5			1.0			2.3			1.7		
Control Delay (s/veh)	9.6			10.3			12.0			11.1		
Level of Service, LOS	A			B			B			B		
Approach Delay (s/veh)	9.6			10.3			12.0			11.1		
Approach LOS	A			B			B			B		
Intersection Delay, s/veh LOS	11.1						B					