



City Of Raleigh
North Carolina

Transportation Operations Staff Report

To: Jason S. Myers, AICP – Transportation Planner
From: Thomas Fiorello, Project Engineer I
Date: July 31, 2015
Subject: Cross Link Road Multi-way Stop and Signalization Studies

Background:

Stop signs and traffic signals are classified as “traffic control devices.” These devices are intended to provide right-of-way control for vehicular movements at intersections. The Federal Highway Administration (FHWA) standardizes all traffic control devices in a guidebook called the *Manual on Uniform Traffic Control Devices* (MUTCD). This publication was developed and updated throughout the years based on engineering principles, research and experience. The MUTCD has been adopted by most governmental agencies across the nation, including NCDOT and the City of Raleigh, as traffic engineering standard practice. This means the same standards are used and same evaluations are conducted throughout the country as they are done in Raleigh.

Intersection Control Studies:

Stop signs are used to assign right-of-way when two streets intersect. Stop signs should not be used to slow vehicular speeds. For the most part this is ineffective and countless engineering studies have proven this. The MUTCD specifically states that yield or stop signs are not to be used for speed control. Stop sign/signs should be installed on the lower volume approaches or at the end of an intersecting road (T-intersection). When traffic volumes increase at an intersection, the MUTCD provides guidance on more significant traffic control devices such as multi-way stops or signalization. The MUTCD provides specific guidance on warrants or criteria that should be evaluated. Installing the inappropriate traffic control device for an intersection does have downsides. In addition to unnecessary delay, unwarranted traffic control devices can increase crashes, noise pollution and speed downstream as vehicles attempt to make up what motorists perceive as lost time.

Multi-way Stop Signs: Multi-way (four-way) stop control is a method of assigning right-of-way based on several criteria or warrants. Typically, upgrading a two-way stop to a multi-way stop is considered when there is enough traffic at two intersecting streets to make the movement from the stop-controlled, minor street difficult. Per the MUTCD, multi-way stops should only be considered if the side street volume is approximately equal to the volumes on the un-controlled main street. The volumes specified in the MUTCD for consideration of a multi-way stop have been refined over time and are reflected in Warrant C below.

Below are the main MUTCD warrants. Satisfaction of any one of these will result in city staff recommending a multi-way stop.

- A. *Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.*
- B. *Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation.*
- C. *Minimum volumes:*
 - 1. *The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*
 - 2. *The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but*
 - 3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*
- D. *Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.*

There are also some optional criteria that may be considered when evaluating an intersection for multi-way stops. When one or more of these are met, a multi-way stop may be recommended, but other alternatives should also be considered as well. For example, the need to control left turn conflicts and the inability to adequately see cross traffic can be mitigated by channelization, warning signage or pruning. The optional criteria are:

- A. *The need to control left turn conflicts.* This uncommon situation occurs when a high percentage of drivers are making left turns. Left-turn egress movements from the minor street can have excessive delay when major street traffic is heavy. In the case of major street drivers turning left, waiting for a gap increases the delay for the egress movements on the side streets.
- B. *The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes.* Typically this is only looked at when we document a significant amount of pedestrian activity. City staff typically defines this as 15 pedestrian crossings for two consecutive hours or 25 pedestrians in a one hour period. The age of pedestrians and school proximity are considered as well.
- C. *Locations where a driver, after stopping, cannot see conflicting traffic and cannot negotiate the intersection without having the cross traffic stop.* The area where a driver can see oncoming vehicles for the egress movement is called the sight triangle. Every year, all 8,000+ stop controlled intersections in the City of Raleigh are evaluated for proper sight triangles. Most cases, sight distance is adequate or can be obtained by pruning. In some situations, we have to install supplemental warning signs with an advisory speed limit.
- D. *The intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.* This is a situation where there is no clearly defined major or minor street because volumes on both are similar. This does not occur frequently.

Traffic Signalization: Signalizing an intersection is the most robust form of dictating right-of-way at an intersection aside from grade separated interchanges. The MUTCD has nine warrants that are evaluated

when considering signalization. Three of the nine warrants have to deal with vehicular volume and delay. Pedestrian traffic is also a warrant as well as reported crash history. The nine warrants are listed below:

1. Eight-hour Vehicular Volume
2. Four-hour Vehicular Volume
3. Peak Hour
4. Pedestrian Volume
5. School Crossing
6. Coordinated Signal System
7. Crash Experience
8. Roadway Network
9. Intersection near a Grade Crossing

Satisfaction of one warrant or more does not mean signalization is the right treatment. Every location needs to be fully evaluated and looked at on a case-by-case basis. The warrants for signalization require significantly higher thresholds than those for multi-way stops. Traffic signals have potential traffic impacts including increases in delay, air and noise pollution, rear-end crashes and maintenance.

Alternative Intersection Controls: Standard and mini-roundabouts are alternative devices to dictate right-of-way at intersecting streets. They can be used in lieu of a multi-way stop or signalization because they slow and control vehicles from all approaches. Roundabouts do not delay traffic as much as multi-way stops or signalization since vehicles, particularly those on the major street, only have to yield instead of stop. The treatments are still unfamiliar to many area motorists.

Evaluation: Cross Link Road at Dandridge Drive

In 2012, the intersection of Cross Link Road at Dandridge Drive was evaluated for multi-way stop control per the MUTCD. This evaluation involved collecting traffic volumes using pneumatic tube counters, reviewing the crash history and checking the sight triangles. As displayed on pages 5-6, the intersection did not satisfy any of the main three warrants and was not recommended for a multi-way stop installation.

City staff reevaluated the intersection for both multi-way stop control and signalization this year. Based on May 2015 data, this intersection does not meet the warrants for a multi-way stop or signalization. The volume from Dandridge Drive did meet the reduced minimum volume warrant C.3, but did not meet the delay portion of warrant C.2. The delay study found that the average delays are much lower than the minimum 30 seconds required for consideration. The northbound approach for Dandridge Drive had an average delay of 7.9 seconds with an average queue of one vehicle, while southbound approach had an average delay of 9.5 seconds with an average queue of one vehicle.

None of the minor warrants met the thresholds for multi-way stop control. Staff also reviewed the reported crash history. There were no crashes in the last year that could be considered correctable with the installation of a multi-way stop. The MUTCD warrant is five such crashes in a 12-month period. The differential between traffic volumes on the two Dandridge Drive approaches, compared to Cross Link Road, also do not support multi-way control.

Staff conducted a signal warrant analysis as well; it is not recommended.

Recommendation: The intersection of Cross Link Road and Dandridge Drive did not meet the warrant requirements for a multi-way stop based on the analyses conducted in 2012 and 2015. A signal warrant analysis was also conducted and did not satisfy the warrants for signalization.

MUTCD Multiway Stop Warrant Report

Intersection: Cross Link Road @ Dandridge Drive

Date: December 6, 2012

Citizen/Requestor	Ms. Fabette Smith 1205 Cross Link Road fabsway@bellsouth.net
Staff Contact	Tom Fiorello (919) 996-4066 thomas.fiorello@raleighnc.gov

Primary Criteria/Warrants		Warrant Met?
A. Future Location of Signal	Does not meet warrants	NO
B. Five Correctable Crashes in a 12-month period	<u>2</u> total, <u>0</u> correctable	NO
C. Minimum Volumes for any 8 hours of an average day (1 and 2) <input checked="" type="checkbox"/> <i>qualifies for reduced criteria: 85th Speed: <u>46.5</u> mph > 40mph</i>		NO
1. At least 300 vph on major street (210 reduced)	<u>479</u> vph over 8 hours	Yes
2. At least 200 vph on minor street (140 reduced), AND 30+ sec delay during highest hour	<u>129</u> vph over 8 hours < 140 vph: no delay study	No N/A

Optional Criteria		
A. <i>Need to control left-turn conflicts?</i>	<i>No excessive left turn delay or volume</i>	<i>No</i>
B. <i>Need to control vehicle/pedestrian conflicts where there are high pedestrian volumes?</i>	<i>Low pedestrian volumes</i>	<i>No</i>
C. <i>Sight distance inadequate?</i>	<i>Meets or exceeds the required minimum at this intersection.</i>	<i>No</i>
D. <i>Intersection of two residential neighborhood collector streets of similar design and operating characteristics?</i>	<i>Cross Link carries 3.5 times the volume of traffic that Dandridge carries.</i>	<i>No</i>

RECOMMENDATION:	Deny request for multi-way stops at this intersection.
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Multi-Way Stop Evaluation - Volume Worksheet

Intersection: Cross Link Road at Dandridge Drive

Date Counted: Thursday, December 06, 2012

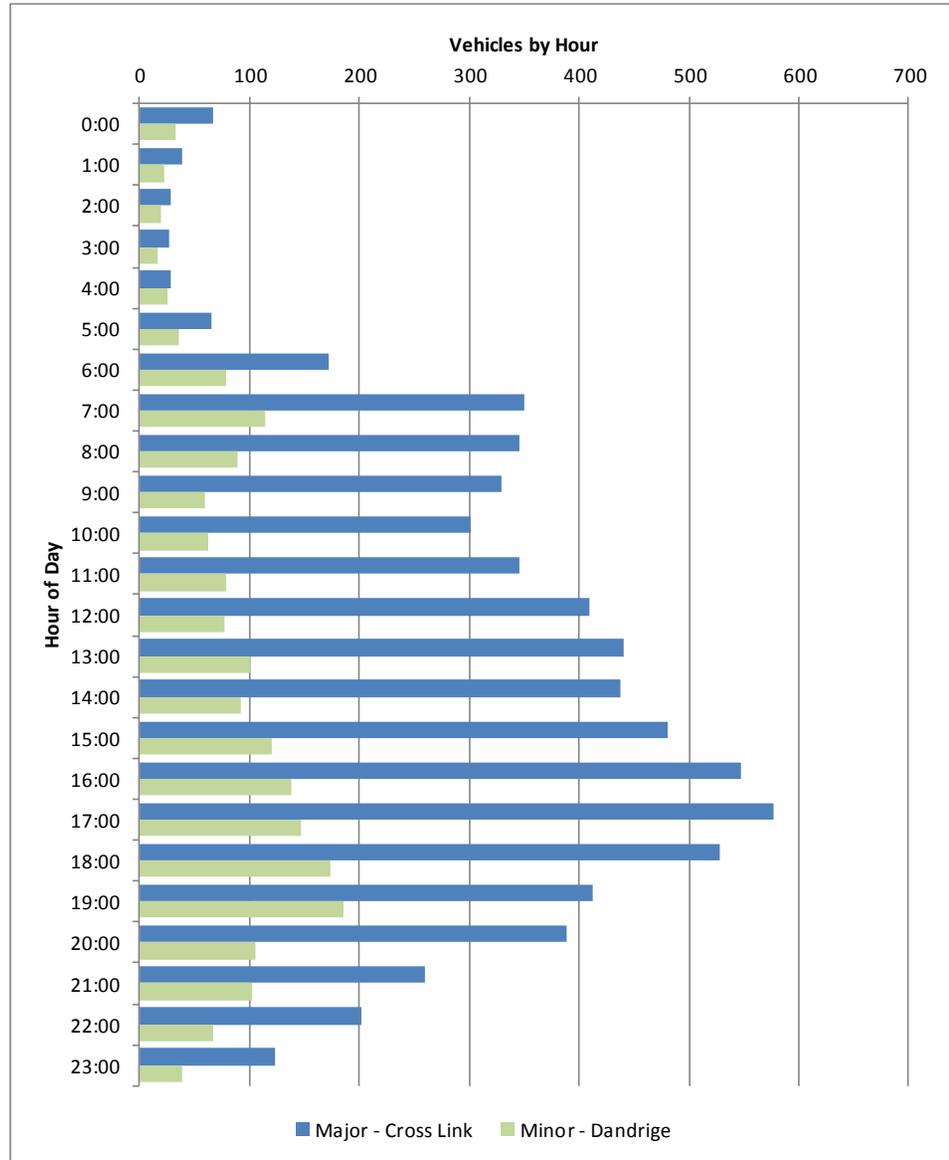
Time	Traffic Counts (vehicle/ped/bike)						TOTAL
	Major - Cross Link			Minor - Dandridge			
	EB	WB	Total	SB	NB	Total	
0:00	31	36	67	7	26	33	100
1:00	16	23	39	1	22	23	62
2:00	12	17	29	7	13	20	49
3:00	16	11	27	8	9	17	44
4:00	19	10	29	13	12	25	54
5:00	36	29	65	14	21	35	100
6:00	84	88	172	33	45	78	250
7:00	157	193	350	49	65	114	464
8:00	172	173	345	40	49	89	434
9:00	172	157	329	17	43	60	389
10:00	147	154	301	19	44	63	364
11:00	170	175	345	22	56	78	423
12:00	195	215	410	23	54	77	487
13:00	220	220	440	30	71	101	541
14:00	221	216	437	30	62	92	529
15:00	232	249	481	36	85	121	602
16:00	296	251	547	27	111	138	685
17:00	310	267	577	38	109	147	724
18:00	269	259	528	68	106	174	702
19:00	197	216	413	80	105	185	598
20:00	204	184	388	53	52	105	493
21:00	138	122	260	34	69	103	363
22:00	103	99	202	30	37	67	269
23:00	69	54	123	18	21	39	162
TOTAL	3486	3418	6904	697	1287	1984	8888

85th% Speed (mph):	46.5	Major/Minor Volume Ratio	3.48
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Highest 8 Hours for Major Street	Major - Cross Link	Minor - Dandridge	Volume #3 Met?	
			100%	70%
Total Volume	3833	1035	NO	NO
Average Volume	479.1	129.4		

Minor St. Delay Study?	No - low volumes		Delay #3 Met?
Average Minor Street Delay (s)	Northbound	0	NO
	Southbound	0	NO

WARRANT #3 (VOLUME AND DELAY) MET?	NO
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MUTCD Multiway Stop Warrant Report

Intersection: Cross Link Road @ Dandridge Drive

Date: May 20, 2015

Citizen/Requestor:	Mr. Jason Myers, City of Raleigh OTP (919) 996-2166 jason.myers@raleighnc.gov
Staff Contact	Tom Fiorello (919) 996-4066 thomas.fiorello@raleighnc.gov

Primary Criteria/Warrants		Warrant Met?
A. Future Location of Signal	Does not meet warrants	NO
B. Five Correctable Crashes in a 12-month period	<u>3</u> total, <u>1</u> correctable	NO
C. Minimum Volumes for any 8 hours of an average day (1 and 2) <input checked="" type="checkbox"/> <i>qualifies for reduced criteria: 85th Speed: <u>46.3</u> mph > 40mph</i>		NO
1. At least 300 vph on major street (210 reduced)	<u>604</u> vph over 8 hours	Yes
2. At least 200 vph on minor street (140 reduced), AND 30+ sec delay during highest hour	160 vph over 8 hours 7.9 (NB)/9.5 (SB) sec av. delay	Yes No

Other Criteria		
A. Need to control left-turn conflicts?	No excessive left turn delay or volume	No
B. Need to control vehicle/pedestrian conflicts where there are high pedestrian volumes?	Low pedestrian volumes	No
C. Sight distance inadequate?	Meets or exceeds the required minimum at this intersection.	No
D. Intersection of two residential neighborhood collector streets of similar design and operating characteristics?	Cross link carries 3.7 times the volume of traffic that Dandridge carries.	No

RECOMMENDATION:	<p>Staff recommends denying the request for multi-way stops at this intersection.</p> <p>Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal. Cross Link carries approximately four times the volume of Dandridge.</p>
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Multi-Way Stop Evaluation - Volume Worksheet

Intersection: Cross Link Road at Dandridge Drive

Date Counted: Wednesday, May 20, 2015

Time	Traffic Counts (vehicle/ped/bike)						TOTAL
	Major - Cross Link			Minor - Dandridge			
	EB	WB	Total	SB	NB	Total	
0:00	38	26	64	19	8	27	91
1:00	33	20	53	9	2	11	64
2:00	14	17	31	7	3	10	41
3:00	24	14	38	7	7	14	52
4:00	20	17	37	4	3	7	44
5:00	66	43	109	16	14	30	139
6:00	144	128	272	44	41	85	357
7:00	240	382	622	69	73	142	764
8:00	225	477	702	65	61	126	828
9:00	192	213	405	62	37	99	504
10:00	166	128	294	21	33	54	348
11:00	197	189	386	53	42	95	481
12:00	209	247	456	50	45	95	551
13:00	230	244	474	68	47	115	589
14:00	268	244	512	67	57	124	636
15:00	284	261	545	89	63	152	697
16:00	299	323	622	122	81	203	825
17:00	383	316	699	155	67	222	921
18:00	302	300	602	112	41	153	755
19:00	263	267	530	76	80	156	686
20:00	224	206	430	67	74	141	571
21:00	191	193	384	54	43	97	481
22:00	100	99	199	56	48	104	303
23:00	64	56	120	26	34	60	180
TOTAL	4176	4410	8586	1318	1004	2322	10908

85th% Speed (mph):	46.3	Major/Minor Volume Ratio	3.70
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Highest 8 Hours for Major Street	Major - Cross Link	Minor - Dandridge	Volume #3 Met?	
			100%	70%
Total Volume	4834	1278	NO	YES
Average Volume	604.3	159.8		

Minor St. Delay Study?	Yes		Delay #3 Met?
Average Minor Street Delay (s)	Northbound	7.9	NO
	Southbound	9.5	NO

WARRANT #3 (VOLUME AND DELAY) MET?	NO
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