MD 410 AT MD 195

MONTGOMERY COUNTY, MD

INTERSECTION STUDY

AUGUST 18TH, 2015



PREPARED BY:



800 King Farm Boulevard 4th Floor Rockville, MD 20850



INTRODUCTION

A. Morton Thomas & Associates, Inc. (AMT) conducted a traffic operations and safety study for the intersection of Ethan Allen Avenue (MD 410) at Carroll Avenue (MD 195). This intersection is located in Takoma Park, between US 29 and MD 650 and south of the I-495 Beltway, as shown in Figure I below. The existing intersection consists of MD 195 to the north, MD 410 to the east and west, Grant Avenue to the northwest, and Sycamore Avenue to the south which is offset to the east by approximately 125 feet.



Figure I: Intersection Vicinity Map

The signalized intersection at MD 410 and MD 195 has been proposed for an alignment modification of the north leg of MD 195. A proposed concept plan has been developed realigning MD 195 opposite to Sycamore Avenue to create a more traditional three-legged and four-legged intersection with MD 410. Seven (7) proposed options along with the existing conditions were studied. Proposed condition diagrams were prepared for Options 2-8 and are located in Appendix F.

- <u>Option I</u>: Existing (No-Build) conditions.
- <u>Option 2</u>: Existing (No-Build) conditions with Grant Avenue closed to traffic.
- <u>Option 3:</u> Existing (No-Build) conditions with Sycamore Avenue closed to traffic.
- Option 4: Existing (No-Build) conditions with Grant Avenue and Sycamore Avenue closed to traffic.
- Option 5: Re-align MD 195 opposite to Sycamore Avenue.
- Option 6: Re-align MD 195 opposite to Sycamore Avenue with Grant Avenue closed to traffic.





- <u>Option 7:</u> Re-align MD 195 opposite to Sycamore Avenue with Sycamore Avenue closed to traffic.
- <u>Option 8:</u> Re-align MD 195 opposite to Sycamore Avenue with Grant Avenue and Sycamore Avenue closed to traffic.

This study summarizes the existing condition operations, a safety analysis based on the latest crash data, respective geometric diagrams (existing and proposed), as well as, the operational analysis of the seven improvement scenarios.



SECTION I EXISTING CONDITIONS

I-I Existing Intersection Geometry

The existing intersection of MD 410 at MD 195 and Grant Avenue is a signalized 4-legged intersection. MD 410 (Ethan Allen Avenue) is generally a two (2) lane east/west roadway with an exclusive left-turn lane and a through lane on the eastbound approach at its intersection with Grant Avenue and MD 195. The westbound approach is a shared through/right-turn lane. The posted speed limit is 25 miles per hour (mph). MD 195 (Carroll Avenue) is generally a two (2) lane north/south roadway with an exclusive left-turn lane and an exclusive right-turn lane at its intersection with MD 410. The roadway is aligned northeast-southwest to MD 410. The posted speed limit is 25 mph. Grant Avenue is generally a one (1) lane roadway and it meets the MD 410/MD 195 intersection as a northwest-southeast roadway. Grant Avenue is a one-way street at this intersection with vehicles only allowed to enter the roadway but not exit at this intersection. The posted speed limit is 25 miles per hour (mph).



Eastbound MD 410



South bor Aler Hound 195 Westbound MD 410



Southbound MD 195



Northbound Grant Avenue



There are two bus-stops near the intersection near the eastbound and westbound approaches. There are crosswalks across MD 195, the east leg of MD 410 and Grant Avenue. There are pedestrian signals across MD 195 and the east leg of MD 410. There are sidewalks on all approaches. There are bike lanes and on-street parking on MD 195. Street lights are provided at the intersection. The western leg of MD 410 is commercial, the eastern leg of MD 410 is residential, Grant Avenue is residential and MD 195 is a mix of residential and commercial.

The intersection of MD 410 at Sycamore Avenue is offset to the right of the MD 410 at MD 195 and Grant Avenue intersection by approximately 125 feet. Sycamore Avenue is generally a two (2) lane north/south roadway with a shared left/right turn-lane at the intersection with MD 410. The speed limit on the road is 25 miles per hour (mph). There is a crosswalk across Sycamore Avenue, however there is no pedestrian signal. Sycamore Avenue is residential with 5 mph speed humps and sidewalks. The east leg of MD 410 is residential with sidewalk on one side. The west leg of MD 410 is integrated with the MD 410/MD 195 intersection. Lighting is provided at the intersection by a street lamp on the sidewalk on the west leg of MD 410. Eastbound and westbound MD 410 are one lane through the intersection and the intersection is signalized. Due to the close proximity of the two intersections, the signals at these two intersections are interconnected.





Eastbound MD 410 east of Sycamore Ave

Westbound MD 410 east of Sycamore Ave



Northbound Sycamore Avenue



The existing traffic control and lane use and peak hour traffic volumes are shown on Figure 2 and the existing conditions diagram (including turn lane lengths, signage, pavement markings, and signalization) is included in Appendix B.

I-2 Existing Traffic Counts

The most recent 13-hour traffic count data at the intersection was provided by SHA's Data Services Engineering Division (DSED) and is included in Appendix A. Traffic counts were conducted at the intersection of MD 410 at MD 195/Grant Avenue on January 28th, 2015. The AM peak hour occurs between 7:45AM-8:45AM and the PM peak hour occurs between 5:15PM-6:15PM. Traffic counts were conducted at the intersection of MD 410 at Sycamore Avenue on October 30th, 2014. The AM peak hour occurs between 7:45AM-8:45AM and the PM peak hour occurs between 5:00PM-6:00PM. The peak hour traffic counts are shown in Figure 2. This peak hour traffic count data was used as the basis for the existing and proposed scenarios analyses.



Figure 2: Existing Peak Hour Traffic Volumes

I-3 Existing Traffic Observations

During the various field reconnaissance efforts, various field observations were noted at the MD 410 and MD 195/Grant Avenue and MD 410 at Sycamore Avenue intersections:

- At the MD 410 at MD 195/Grant Avenue intersection, southbound right turning vehicles were observed to queue up. An average of 7-8 vehicles were observed to queue up per cycle and would spill back beyond S Manor Circle. Few vehicles (3 were noticed during the PM peak hour) wishing to make a left turn from S Manor Circle and continue southbound on MD 195 would find it difficult to enter MD 195.
- At the MD 410 at Sycamore Avenue intersection, westbound vehicles on MD 410 wanting to make a left turn into Sycamore Avenue often had to wait to find gaps within the eastbound through lanes depending on the eastbound through traffic volumes. Since it is a shared left/through lane, if a left turning vehicle waits in the front of the queue to turn left, through vehicles are queued up behind. Site observations noted that a vehicle waited between 7 to 10 seconds to find a gap. Only 3 vehicles were observed to make a left turn into Sycamore Avenue during the PM peak hour.



I-4 Option I: Existing (No-Build) Conditions

Existing condition level of service (LOS) and delays were determined at the intersections of MD 410 at MD 195 and Grant Avenue and MD 410 at Sycamore Avenue based on the existing traffic control and lane use (Figure 2), the existing peak hour volumes (Figure 2), the existing signal timings/phasing provided by SHA, and the Synchro/SimTraffic Version 9.0 software. The software package categorizes the LOS based on the HCM2000 methodology. Any intersection or approach with a LOS of E or F is considered substandard and may need solutions to improve the operational performance. Table I below lists the existing conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the existing conditions are included in Appendix C.

	0	Levels o	f Service		Storage		
		and Delay	/ (sec/veh)		Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Approach/Movement		AM Peak Hour	PM Peak Hour
Grant Ave at MD 410/MD 195	Signal						
Eastbound (MD 410)		B(14.5)	B(16.0)				
Eastbound Left		B(15.5)	B(15.5)	EBL	310	96	211
Eastbound Through		B(14.0)	B(16.3)	EBT	310	137	239
Westbound (MD 410)		A(0.5)	A(0.3)				
Westbound Sh Through/Right		A(0.5)	A(0.3)	WBTR	57	8	37
Southbound (MD 195)		D(39.2)	C(32.6)	1. S. 1.			
Southbound Left		E(58.2)	D(46.0)	SBL	300	125	145
Southbound Right		D(36.1)	C(26.7)	SBR	1.1	348	209
Overall		B(18.9)	B(17.7)				
MD 410 at Sycamore Ave	Signal						
Eastbound (MD 410)		A(0.1)	A(0.3)				
Eastbound Sh Th/Right		A(0.1)	A(0.3)	EBTR	57	21	50
Westbound (MD 410)		F(94.0)	E(69.6)				
Westbound Sh Left/Th		F(94.0)	E(69.6)	WBTR	>1000	309	278
Northbound (Sycamore Ave)		D(50.1)	D(46.3)				
Northbound Sh Left/Right		D(50.1)	D(46.3)	NBLR	>1000	85	145
Overall		E(55.2)	C(28.0)				

Table I: Option I Existing (No-Build) Conditions Intersection LOS/Delay/95th Percentile Queue Summary

The results indicate the intersection of MD 410 at MD 195 and Grant Avenue currently operates at overall acceptable LOS and delays during the AM and PM peak hours. The 95th percentile queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. The intersection of MD 410 at Sycamore Avenue currently operates at overall unacceptable conditions in the AM peak hour with the westbound movement having an unacceptable LOS and delay during both peak hours. The intersection operates at overall acceptable conditions in the PM peak hour. All queues are contained within the storage lanes in the AM and PM peak hour and there is no spillback into the upstream intersection.

I-5 Sight Distance Analysis

Field observations indicated that there are no sight distance issues. Both the study intersections are signalized and all the pedestrian warning signs are clearly visible as none of the approaches have any horizontal or vertical curves. Since there was no sight distance issues, no sight distance analysis was conducted for this study.



SECTION 2 SAFETY ANALYSIS

A safety analysis was conducted at the intersections of MD 410 at MD 195 and Grant Avenue and MD 410 at Sycamore Avenue, based upon the latest crash data provided by SHA (Office of Traffic and Safety – Traffic Development & Support Division). This crash data is located in Appendix D. Crash data for these intersections was provided for the years 2011 through 2013. The data is tabulated by year, crash type, injury versus property damage, daytime versus nighttime, and dry versus wet roads in Tables 2a and 2b below:

COLLISION TYPE	Year 2011	Year 2012	Year 2013	Total
Rear-End Collision	1			1
Fixed Object Collision	1		The second second	1
Total	2	0	0	2
Injury (Number Injured)				0
Property Damage Only	2		1	2
Total	2	0	2	2
Daytime Crashes		-	represented in	
Nighttime Crashes	2	474 -		2
Total	2	0	0	2
Dry Road Crashes	1	S. 7 - 4		1
Wet Road Crashes	1		Inter man	1
Total	2	0	0	2

Table 2a: Existing Crash Data Summary for MD 410 at MD 195 and Grant Avenue

The above table shows that two (2) crashes occurred at the MD 410 at MD 195 and Grant Avenue intersection within a three (3) year period. One was a rear end collision and the other was a fixed object collision. The most probable cause of the rear end collision was that the vehicle was following too closely. The fixed object collision appears that the vehicle may have traveled off the road. One crash happened when the road was dry and the other happened when the road was wet and both crashes occurred during nighttime. However, the streets, as well as, the intersection are well lit. The crash reports also state that the probable cause for both crashes was the influence of alcohol. Hence, these collisions appear to be mostly due to driver negligence and not because of geometric conditions of the intersection.

Since there were two (2) crashes at this intersection within the last three (3) years with one being a rear-end collision and the other being a fixed object collision, no specific crash patterns were noted.



COLLISION TYPE	Year 2011	Year 2012	Year 2013	Total
Rear-End Collision	1		1	2
Pedestrian Collision	-	-	1	1
Angle Collision	1	1.2 B		n- 1 1
Total	2	0	2	4
Injury (Number Injured)	-	-	1(1)	1
Property Damage Only	2	-	1	3
Total	2	0	2	4
Daytime Crashes	1	-	2	3
Nighttime Crashes	1		5 E 4 5 T	1
Total	2	0	2	4
Dry Road Crashes	2	-	2	4
Wet Road Crashes		in the second		0
Total	2	0	2	4

Table 2b: Existing Crash Data Summary for MD 410 at Sycamore Avenue

The above table shows that four (4) crashes occurred at the intersection of MD 410 at Sycamore Avenue within a three (3) year period. Two (2) crashes were rear-end collisions, one was a pedestrian collision, and one was an angle collision. The most probable cause for the rear end collisions was that the vehicles were following too closely. The angle collision likely occurred as the driver of the vehicle failed to give right-of-way to the other vehicle and the pedestrian collision likely occurred because the driver or the pedestrian was not paying full attention to their surroundings. Also, the pedestrian (bicyclist) crossed the east leg of MD 410 where there is no crosswalk. Three (3) out of the four (4) crashes occurred during the day and all crashes occurred when the road surface was dry. Hence, these collisions appear to be mostly due to driver negligence and not because of geometric conditions of the intersection.

Two (2) rear-end collisions did occur on the westbound approach, one in 2011 during the night and the other in 2013 during the day. Since there were only two similar collisions within a three (3) year period, both of which were likely caused by the driver either following too closely or not paying attention, no specific crash patterns were noted at this intersection.



SECTION 3 PROPOSED IMPROVEMENT SCENARIOS

To perform a traffic operations and safety study based upon the proposed concept plan of realigning MD 195 opposite to Sycamore Avenue, the following options were analyzed:

3-1 Option 2: Existing No-Build conditions with Grant Avenue closed to traffic

In this option, Grant Avenue is closed to traffic. Grant Avenue is a one-way street and traffic is only allowed to enter Grant Avenue. No vehicles exit Grant Avenue at the MD 410 and MD 195 intersection. With Grant Avenue closed to traffic, traffic entering Grant Avenue is rerouted under the following scenarios:

- Eastbound left turning vehicles along MD 410 are detoured to Philadelphia Avenue and access Grant Avenue from Maple Avenue.
- Vehicles traveling westbound on MD 410 and turning right to access Grant Avenue are now detoured to MD 195. These vehicles access Grant Avenue via Lee Avenue and Hancock Avenue.
- Vehicles traveling southbound along MD 195 and turning right to access Grant Avenue are now detoured to Lee Avenue and access Grant Avenue via Hancock Avenue.

Table 3 below lists the Option 2 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 2 conditions are included in Appendix E.

		Levels o	f Service	CHARLES IN SHIT	Storage	(E) I STUD	
		and Delay	/ (sec/veh)	And the second second	Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Approach/Movement		AM Peak Hour	PM Peak Hour
				a ma numeli	and a distant of	out to method	
Grant Ave at MD 410/MD 195	Signal			the management	a shart and it	the survey of the	
Eastbound (MD 410)		B(10.7)	B(15.9)			A REAL PROPERTY.	
Eastbound Left		B(118)	B(15.3)	EBL	310	97	190
Eastbound Through		B(10.2)	B(16.3)	EBT	310	137	247
				and the street firms	10h1mm ()	o in contra	
Westbound (MD 410)		A(0.7)	A(0.3)				
Westbound Sh Through/Right		A(0.7)	A(0.3)	WBTR	57	47	37
				The second second	and a state	and a small of	
Southbound (MD 195)		C(32.1)	C(33.3)		and the second second	Name of Street, or other	
Southbound Left		D(52.5)	D(45.5)	SBL	300	105	149
Southbound Right		C(28.8)	C(27.7)	SBR	inn ann n n	310	224
Overall		B(15.1)	B(17.7)				
MD 410 at Sycamore Ave	Signal						
Eastbound (MD 410)		A(0.1)	A(0.3)				
Eastbound Sh Th/Right		A(0,1)	A(0.3)	EBTR	57	26	45
Westbound (MD 410)		E(71.9)	E(68.4)				
Westbound Sh Left/Th		E(71.9)	E(68.4)	WBTR	>1000	294	281
		=(*) =/	_(
Northbound (Sycamore Ave)		D(53.3)	D(45.7)				
Northbound Sh Left/Right		D(53.3)	D(45.7)	NBLR	>1000	90	147
Overall		D(43.3)	C(27.5)				

Table 3: Proposed Option 2 Intersection LOS/Delay/95th Percentile Queue Summary



The Option 2 traffic analysis results indicate that both intersections operate at acceptable conditions in both the AM and PM peak hours. The LOS and delay improved slightly at the MD 410 at MD 195 intersection. However, at the MD 410 at Sycamore Avenue intersection, the overall delay was reduced by 11.9 seconds in the AM peak hour and 0.5 seconds in the PM peak hour. The 95th percentile queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. However, the westbound approach continues to operate at below acceptable conditions. Due to this reason, this option is not recommended.

3-2 Option 3: Existing (No-Build) conditions with Sycamore Avenue closed to traffic

In this option, Sycamore Avenue is closed to traffic. The signal at MD 410 and Sycamore Avenue intersection is removed. Traffic entering and exiting Sycamore Avenue is rerouted under the following scenarios:

- Eastbound right turning vehicles along MD 410 coming from west of MD 410/MD 195 intersection and entering Sycamore Avenue are detoured to Columbia Avenue to access Sycamore Avenue. The eastbound right turning vehicles entering Sycamore Avenue and coming southbound along MD 195 continue through the intersection and turn right at Woodland Avenue and another right at Beech Avenue. The traffic detoured from MD 410 and MD 195 onto Columbia Avenue and Woodland Avenue is based upon existing traffic distribution, to Sycamore Avenue.
- Westbound left turning vehicles from MD 410 entering Sycamore Avenue are detoured to Woodland Avenue and Beech Avenue.
- Northbound right turning vehicles exiting Sycamore Avenue are detoured to Woodland Avenue via Beech Avenue.
- Northbound left turning vehicles exiting Sycamore Avenue are detoured to Columbia Avenue.

Table 4 below lists the Option 3 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 3 conditions are included in Appendix E.

		Levels of Service			Storage		
		and Delay	(sec/veh)		Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Approach/Movement		AM Peak Hour	PM Peak Hour
					1		
Grant Ave at MD 195/Carroll Ave	Signal						
Eastbound (MD 410)		B(11.0)	B(13.8)				
Eastbound Left		B(13,3)	B(13.7)	EBL	310	91	157
Eastbound Through		A(9.7)	B(13.9)	EBT	310	103	187
Westbound (MD 410)		C(20.8)	B(12.8)				
Westbound Sh Through/Right		C(20.8)	B(12,8)	WBTR	74	88	101
						1.	
Southbound (MD 195)		C(27.5)	C(24.6)			1.000	
Southbound Left		D(48.3)	D(36.3)	SBL	300	68	146
Southbound Right		C(24.2)	B(19.5)	SBR		250	210
						1	
Overali		C(20.7)	B(16.4)				
						1.0	
MD 410 at Sycamore Ave	Free flow						
Eastbound (MD 410)				· · · · · · · · · · · · · · · · · · ·			
Eastbound Through		N/A	N/A	EBT	74	0	6
						10 C 10 C	
Westbound (MD 410)					-		
Westbound Through		N/A	N/A	WBT	>1000	167	105
Overall		N/A	N/A				

Table 4: Proposed Option 3 Intersection LOS/Delay/95th Percentile Queue Summary



The Option 3 traffic analysis results indicate that Grant Avenue at MD 195 intersection will continue to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at MD 410 at Sycamore intersection is removed, there is no delay at this intersection. The westbound through queue observed at this intersection is the spillover from the westbound queue at the Grant Avenue/MD 195 intersection. The westbound queues do increase compared to Option 2 since MD 410 at Sycamore Avenue is no longer signalized. However, comparing with Option 2, there is minimal change to LOS and delay at this intersection. The 95th percentile left turn queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. Pending public support to NOT realign MD 195, this option is recommended.

3-3 Option 4: Existing (No-Build) conditions with Grant Avenue and Sycamore Avenue closed to traffic

In this option, Grant Avenue and Sycamore Avenue are closed to traffic and the signal at MD 410 and Sycamore Avenue intersection is removed. Traffic accessing these roads are rerouted as described in Options 2 and 3.

Table 5 below lists the Option 4 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 4 conditions are included in Appendix E.

		Levels o	f Service		Storage		
		and Delay	(sec/veh)		Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Approach/Movement		AM Peak Hour	PM Peak Hour
	C:1			The second second second			
Grant Ave at MD 195/Carroll Ave	Signai	B(11.1)	D(13.7)	a second second second		and the second s	
Eastbound (MD 410)		B(11:1)	B(13.7)	501	210	70	140
Eastbound Left		B(13.0)	B(13.4)	EBL	310	78	169
Eastbound Through		B(10.1)	B(13.9)	EBT	310	117	234
	0	0(00.0)		and the second			
Westbound (MD 410)		C(20.2)	B(12.5)	And and a set in such that the set of the se			
Westbound Sh Through/Right		C(20.2)	B(12.5)	WBTR	74	90	100
Southbound (MD 195)		C(26.6)	C(25.1)			interest of the later	
Southbound Left		D(46_3)	D(35.9)	SBL	300	137	119
Southbound Right		C(23.4)	C(20.1)	SBR		293	202
				1.00		1	
Overall		C(20.1)	B(16.4)				
				TANK D		the second second	
MD 410 at Sycamore Ave	Free Flow			The second		and the second	
Eastbound (MD 410)							
Eastbound Through		N/A	NIA	EBT	74	0	14
						and the second se	
Westbound (MD 410)				1.		and the local division of the	
Westbound Through		N/A	N/A	WBT	>1000	170	106
				a second		1	
Overall		N/A	N/A				

Table 5: Proposed Option 4 Intersection LOS/Delay/95th Percentile Queue Summary

The Option 4 traffic analysis results indicate that Grant Avenue at MD 195 intersection will continue to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at MD 410 at Sycamore intersection is removed, there is no delay at this intersection. The westbound through queue observed at this intersection is the spillover from the westbound queue at the Grant Avenue/MD 195 intersection. The westbound queues do increase compared to Option 2 since MD 410 at Sycamore Avenue is no longer signalized. The queues are very similar to those observed in Option 3. There is minimal change to LOS and



delay at this intersection as compared to Option 3. The 95th percentile left turn queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. Option 3 and Option 4 produce similar results in terms of LOS, delay and 95th percentile queues. However, in Option 4, since Grant Avenue and Sycamore Avenue are both closed to traffic, more vehicles will be needed to be rerouted. <u>Since Option 3</u> achieves similar results in terms of level of service, delays and 95th percentile queues with less road closure and minimal traffic detour, Option 3 is recommended over Option 4.

3-4 Option 5: Realign MD 195 opposite to Sycamore Avenue

In this option, MD 195 is realigned opposite to Sycamore Avenue to create a more traditional four-legged intersection with MD 410. All roads are open to traffic as under existing conditions.

Table 6 below lists the Option 5 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 5 conditions are included in Appendix E.

		Levels o	f Service			Storage		
		and Delay	(sec/veh)	1		Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Approach/Movement			AM Peak Hour	PM Peak Hour
Grant Ave at MD 410	Signal							
Eastbound (MD 410)		B(12.6)	C(28.8)					
Eastbound Left		A(9.6)	B(13.3)	E	BL	310	18	20
Eastbound Through		B(12.6)	C(29.0)	E	BT	310	189	354
						1.1	Market Street	
Westbound (MD 410)		A(5.6)	A(6.6)			1 C C		
Westbound Sh Through/Right		A(5.6)	A(6.6)	W	BTR	100	149	91
						1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1.0	
Overall		A(9.0)	C(25.9)			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1.1.1	
					100	1.1.1.1	11.194	
MD 410 at MD 195/Sycamore Ave	Signal			1.1				
Eastbound (MD 410)		A(1.0)	A(0.8)		14.5			
Eastbound Left		A(0.3)	A(0.9)	E	BL	100	85	126
Eastbound Sh Th/Right		A(0.5)	A(0.7)	EE	BTR	100	24	48
						1		
Westbound (MD 410)		C(26.6)	C(24.1)					
Westbound Sh Left/Th/Right		C(26.6)	C(24.1)	W	BLTR	>1000	425	267
	()							
Northbound (Sycamore Ave)		E(79.0)	F(95.3)	1.1.1				
Northbound Sh Left/Through/Right		E(79.0)	F(95.3)	NE	BLTR		127	160
					1.00			
Southbound (MD 195)		E(74.8)	F(85.1)		1.1			
Southbound Sh Left/Th		D(54.6)	F(118.0)	SE	BLT		1382	193
Southbound Right		E(57.6)	E(70.9)	S	BR	300	409	113
						2		
Overall		C(31.9)	C(28.1)					

Table 6: Proposed Option 5 Intersection LOS/Delay/95th Percentile Queue Summary

The Option 5 traffic analysis results indicate that both intersections operate at overall acceptable conditions in both the AM and PM peak hours. However, at the realigned 4-legged intersection of MD 410 at MD 195/Sycamore Avenue, the northbound and southbound approaches operate below acceptable conditions. This is primarily due to longer wait times and increasing delays with more green time being provided to the eastbound and westbound approaches. However, this green time is not enough as queues still spillback into the upstream intersection for the westbound approaches at the MD 410 and Grant Avenue intersection during the AM peak hour and for the eastbound approaches at both the intersection during the PM peak hour. At the



realigned MD 195 approach, the southbound right turn queues spillback into the adjacent shared left/through lane during the AM peak hour. <u>This option is not recommended due to the above mentioned reasons.</u>

3-5 Option 6: Realign MD 195 opposite to Sycamore Avenue with Grant Avenue closed

In this option, MD 195 is realigned opposite to Sycamore Avenue to create a more traditional four-legged intersection with MD 410. Grant Avenue is closed to traffic and traffic entering Grant Avenue is rerouted in the same way as described under Option 2.

Table 7 below lists the Option 6 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 6 conditions are included in Appendix E.

		Levels o	f Service		tentional and	Storage	or Submitted	All manufactorial
		and Delay	(sec/veh)			Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	Ар	proach/Movement		AM Peak Hour	PM Peak Hour
					a Manual I			
Grant Ave at MD 410	Free Flow				and here			
Eastbound (MD 410)								
Eastbound Through		N/A	N/A		EBT	315	10	64, 100*
Marthauer d (MD 410)							ALC: NOT	
westbound (IND 410)		N1/8	NUA		MADT	96	0	0
vvestbound i nrougn	· · · · ·	INIA	IN/A		AAP1	70	U	U
Overall		N/A	N/A					
					- 3254		TTO DO DO DO	
MD 410 at MD 195/Sycamore Ave	Signal	(i					and the second	
Eastbound (MD 410)		A(8.3)	B(17.1)					
Eastbound Left		B(16.6)	C(27.7)		EBL	96	72	125
Eastbound Sh Th/Right		A(4.8)	B(11.6)		EBTR	96	- 73	134
							Section 1	
Westbound (MD 410)		C(27.2)	C(33.0)		10.116		in husbar	
Westbound Sh Left/Th/Right		C(27.2)	C(33.0)		WBLTR	>1000	380	280
		F(70.0)	5/05 ()				3-1-1-1-1	
Northbound (Sycamore Ave)		E(79.0)	F(95.6)		NIDITO		10	179
Northbound Sh Left/Through/Right		E(79.0)	F(95.6)		NBLIK		67	100
Southbound (MD 195)		E(58.6)	E(67.6)				1	
Southbound Sh Left/Th		F(83.3)	F(93.9)		SBLT		95	159
Southbound Right		D(54.5)	E(55.7)		SBR	300	217	96
		1						
Overall		C(34.3)	C(34.9)			Lat		

*Queue lengths for each of the double through lanes

Table 7: Proposed Option 6 Intersection LOS/Delay/95th Percentile Queue Summary

The Option 6 traffic analysis results indicate that the newly aligned MD 195 with MD 410/Sycamore intersection is expected to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at Grant Avenue and MD 410 is removed, there is no delay at this intersection and no queues on the westbound approach. The eastbound through queues observed at this intersection are the queues from each of the eastbound through lanes and is the result of the spillover from the eastbound queue at the MD 410/MD 195/Sycamore Avenue intersection. At the realigned 4-legged intersection of MD 410 at MD 195/Sycamore Avenue, the northbound and southbound approaches operate below acceptable conditions. This is primarily due to longer wait times and increasing delays with more green time being provided to the eastbound and westbound approaches. The eastbound left turn queues are not contained within the left turn storage lane and



are expected to spillover to the adjacent through lane. <u>This option is not recommended due to the above</u> mentioned reasons.

3-6 Option 7: Realign MD 195 opposite to Sycamore Avenue with Sycamore Avenue closed

In this option, MD 195 is realigned opposite to Sycamore Avenue to create a more traditional four-legged intersection with MD 410 with Sycamore Avenue closed to traffic. Traffic entering and exiting Sycamore Avenue is rerouted in the same way as described under Option 3.

Table 8 below lists the Option 7 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 7 conditions are included in Appendix E.

		Levels o	f Service	Т	S2 - 2 - 2	Storage		
		and Delay	(sec/veh)			Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour		Approach/Movement		AM Peak Hour	PM Peak Hour
	C 1							
Grant Ave at MD 410	Signal	D(I (A)	0(0) 5)		A		1000	
Eastbound (MD 410)		B(16.0)	C(23.5)				1.1	
Eastbound Left		B(14.5)	B(10.1)		EBL	310	15	16
Eastbound Through		B(16.0)	C(23.7)		EBT	310	183	317
Westbound (MD 410)		A(3.2)	A(2.6)				18 19 19	
Westbound Sh Through/Right		A(3.2)	A(2.6)		WBTR	104	157	150
		(3.2)	1(2,0)		THE IN	101	157	150
Overall		A(9.2)	C(20.6)					
MD 410 at MD 195/Sysamore Ave	Signal						o	
Eastbound (MD 410)	Jighan	A(0.9)	A(2.5)		Contraction of the			
Eastbound (FID 410)		A(0.7)	A(2.3)		EDI	104	77	112
Eastbound Through		A(2,7)	A(0, 4)		EBL	104	20	113
Lustoband Through		A(0.5)	A(0.4)		EDI	104	20	52
Westbound (MD 410)		D(36.9)	C(24.9)		1.		-	
Westbound Sh Th/Right		D(36.9)	C(24.9)		WBTR	>1000	433	298
Southbound (MD 195)		C(30 I)	D(42.6)					
Southbound (MD 175)		0(30.1)	D(12.0)		102	200	(35	242
Southbarred Pick		(37,3)	D(41.7)		SDL	300	635	242
Southbound Right		L(20.7)	D(43.0)		2BK		422	411
Overall		COAD	D(14.5)					
Overall		C(24.1)	D(10.5)					

Table 8: Proposed Option 7 Intersection LOS/Delay/95th Percentile Queue Summary

The Option 7 traffic analysis results indicate that both intersections are expected to operate at overall acceptable conditions in both the AM and PM peak hours including all approaches and individual lane groups. However, at the MD 410 and Grant Avenue intersection, eastbound queues still spillback into the upstream intersection during the PM peak hour and westbound queues spill back into the upstream intersection during the AM and PM peak hours. At the realigned MD 410 and MD 195/Sycamore Avenue intersection, the southbound right turn queues spillback into the adjacent left lane during the AM peak hour and the eastbound MD 410 left turns spill into the adjacent through lane during the PM peak hour. This option is not recommended due to the above mentioned reasons.



3-7 Option 8: Realign MD 195 opposite to Sycamore Avenue with Grant Avenue and Sycamore Avenue closed

In this option, MD 195 is realigned opposite to Sycamore Avenue to create a more traditional four-legged intersection with MD 410 with Grant Avenue and Sycamore Avenue closed to traffic. The signal at the MD 410/Grant Avenue intersection is removed. Traffic accessing these roads are rerouted as described under Options 2 and 3.

Table 9 below lists the Option 8 conditions LOS/delay results from the Synchro analysis and the 95th percentile queue results from the SimTraffic simulations (seeded for 10 minutes, five 60-minute runs averaged). The detailed result reports for the Option 8 conditions are included in Appendix E.

		Levels o	f Service	I		Storage		
		and Delay	(sec/veh)		1111.000	Length (ft)	95th Percent	ile Queues (ft)
Location	Control	AM Peak Hour	PM Peak Hour	A	pproach/Movement		AM Peak Hour	PM Peak Hour
Grant Ave at MD 410	Free Flow		*					
Eastbound (MD 410)					and a second	The second		
Eastbound Through		N/A	N/A		EBT	315	29	39, 64*
				t	IL.		-	
Westbound (MD 410)								
Westbound Through		N/A	N/A		WBT	101	21	0
					0.1	angle of	ALL ALL ALL	
Overall		N/A	N/A	÷.				
MD 410 at MD 195/Sycamore Ave	Signal							
Eastbound (MD 410)		B(11.0)	A(9.8)				-	
Eastbound Left		C(24.6)	C(21.0)	Ľ.	EBL	101	67	115
Eastbound Through		A(4.8)	A(3.5)	1	EBT	101	88	-117
Westbound (MD 410)		D(36.9)	C(29.6)		1000		the second second	
Westbound Sh Th/Right	· · · · · ·	D(36.9)	C(29.6)		WBTR	1 a.m.	310	218
Southbound (MD 195)		C(29.8)	C(28.4)		dama a	1000	a sea a sea a	
Southbound Left		D(37.2)	D(35.6)		SBL	300	99	150
Southbound Right		C(28.6)	C(25.3)		SBR		190	98
					states 1			
Overall		C(26.9)	B(18.6)	-				

*Queue lengths for each of the double through lanes

Table 9: Proposed Option 8 Intersection LOS/Delay/95th Percentile Queue Summary

The Option 8 traffic analysis results indicate that both intersections are expected to operate at overall acceptable conditions in both the AM and PM peak hours including all approaches and individual lane groups. Since, the signal at Grant Avenue and MD 410 is removed, there is no delay at this intersection. The eastbound through queues observed at this intersection are the queues from each of the eastbound through lanes and is the result of the spillover from the eastbound queue at the MD 410/MD 195/Sycamore Avenue intersection. At the realigned MD 410 and MD 195/Sycamore Avenue intersection, the eastbound MD 410 left turn queues spillback into the upstream intersection during the PM peak hour. However, this spillback is negligible (less than one vehicle). All other queues are contained within their storage lanes and there are no spillbacks into the adjacent through lanes. <u>Pending public support TO realign MD 195</u>, this option is recommended.



SECTION 4 CONCLUSIONS & RECOMMENDATIONS

The conclusions and recommendations of the intersection study conducted for the intersection of MD 410 at MD 195 are as follows:

- During the Existing (No-Build) conditions, the intersection of MD 410 at MD 195 and Grant Avenue currently operates at overall acceptable LOS and delays during the AM and PM peak hours. The 95th percentile queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. The intersection of MD 410 at Sycamore Avenue currently operates at overall unacceptable conditions during the AM peak hour with the overall westbound movement which has an unacceptable LOS and delay. The intersection operates at overall acceptable conditions in the PM peak hour. All queues are contained within the storage lanes in the AM and PM peak hour and there is no spillback into the upstream intersection. This was studied as <u>Option I</u>.
- During the various field reconnaissance efforts, various field observations were noted at the MD 410 and MD 195/Grant Avenue and MD 410 at Sycamore Avenue intersections:
 - At the MD 410 at MD 195/Grant Avenue intersection, southbound right turning vehicles were observed to queue up. An average of 7-8 vehicles were observed to queue up per cycle and would spill back beyond S Manor Circle. Few vehicles (3 were noticed during the PM peak hour) wishing to make a left turn from S Manor Circle and continue southbound on MD 195 would find it difficult to enter MD 195.
 - At the MD 410 at Sycamore Avenue, westbound vehicles on MD 410 wanting to make a left turn into Sycamore Avenue often had to wait between 7 to 10 seconds to find gaps within the eastbound through lanes. Since it is a shared left/through lane, if a left turning vehicle waits in the front of the queue to turn left, through vehicles are queued up behind. Only 3 vehicles were observed to make a left turn into Sycamore Avenue during the PM peak hour.
- Field observations indicated that there are no sight distance issues. Both the study intersections are signalized and all the pedestrian warning signs are clearly visible as none of the approaches have any horizontal or vertical curves. Since there was no sight distance issues, no sight distance analysis was conducted for this study.
- To perform a traffic operations and safety study based upon the proposed concept plan of realigning MD 195 opposite to Sycamore Avenue, the following options were analyzed:
 - Option 2: Existing (No-Build) conditions with Grant Avenue closed to traffic
 - Option 3: Existing (No-Build) conditions with Sycamore Avenue closed to traffic
 - Option 4: Existing (No-Build) conditions with Grant Avenue and Sycamore Avenue closed to traffic
 - Option 5: Realign MD 195 opposite to Sycamore Avenue and all roads open to traffic
 - o Option 6: Realign MD 195 opposite to Sycamore Avenue with Grant Avenue closed to traffic
 - Option 7: Realign MD 195 opposite to Sycamore Avenue with Sycamore Avenue closed to traffic
 - Option 8: Realign MD 195 opposite to Sycamore Avenue with Grant Avenue and Sycamore Avenue closed to traffic
- The Option 2 traffic analysis results indicate that both intersections operate at acceptable conditions during both the AM and PM peak hours. The LOS and delay improved slightly at the MD 410 at MD 195 intersection. However, at the MD 410 at Sycamore Avenue intersection, the overall delay was



reduced by 11.9 seconds in the AM peak hour and 0.5 seconds in the PM peak hour. The 95th percentile queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. However, the westbound approach is expected to operate below acceptable conditions in the AM and PM peak hour. Due to this reason, this option is not recommended.

- The Option 3 traffic analysis results indicate that Grant Avenue at MD 195 intersection will continue to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at MD 410 at Sycamore intersection is removed, there is no delay at this intersection. The westbound through queue observed at this intersection is the spillover from the westbound queue at the Grant Avenue/MD 195 intersection. The westbound queues do increase compared to Option 2 since MD 410 at Sycamore Avenue is no longer signalized. However, comparing with Option 2, there is minimal change to LOS and delay at this intersection. The 95th percentile left turn queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. <u>Pending public support to NOT realign MD 195, this option is recommended.</u>
- The Option 4 traffic analysis results indicate that Grant Avenue at MD 195 intersection will continue to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at MD 410 at Sycamore intersection is removed, there is no delay at this intersection. The westbound through queue observed at this intersection is the spillover from the westbound queue at the Grant Avenue/MD 195 intersection. The westbound queues do increase compared to Option 2 since MD 410 at Sycamore Avenue is no longer signalized. The queues are very similar to those observed in Option 3. There is minimal change to LOS and delay at this intersection as compared to Option 3. The 95th percentile left turn queues are contained within the storage lanes and queues do not spill into the adjacent through lanes. Option 3 and Option 4 produce similar results in terms of LOS, delay and 95th percentile queues. However, in Option 4, since Grant Avenue and Sycamore Avenue are both closed to traffic, more vehicles will be needed to be rerouted. Since Option 3 achieves similar results in terms of level of service, delays and 95th percentile queues with less road closure and minimal traffic detour, Option 3 is recommended over Option 4.
- The Option 5 traffic analysis results indicate that both intersections operate at overall acceptable conditions in both the AM and PM peak hours. However, at the realigned 4-legged intersection of MD 410 at MD 195/Sycamore Avenue, the northbound and southbound approaches operate below acceptable conditions. This is primarily due to longer wait times and increasing delays with more green time being provided to the eastbound and westbound approaches. However, this green time is not enough as queues still spillback into the upstream intersection for the westbound approach at the MD 410 and Grant Avenue intersection during the AM peak hour and for the eastbound approaches at both the intersection during the PM peak hour. At the realigned MD 195 approach, the southbound right turn queues spillback into the adjacent shared left/through lane during the AM peak hour. This option is not recommended due to the above mentioned reasons.
- The Option 6 traffic analysis results indicate that the newly aligned MD 195 with MD 410/Sycamore intersection is expected to operate at acceptable conditions in both the AM and PM peak hours. Since, the signal at Grant Avenue and MD 410 is removed, there is no delay at this intersection and no queues on the westbound approach. The eastbound through queues observed at this intersection are the queues from each of the eastbound through lanes and is the result of the spillover from the eastbound queue at the MD 410/MD 195/Sycamore Avenue intersection. At the realigned 4-legged intersection of MD 410 at MD 195/Sycamore Avenue, the northbound and southbound approaches operate below acceptable conditions. This is primarily due to longer wait times and increasing delays with more green time being provided to the eastbound and westbound approaches. The eastbound left turn queues are not contained within the left turn storage lane and are expected to spillover to the adjacent through lane. This option is not recommended due to the above mentioned reasons.



- The Option 7 traffic analysis results indicate that both intersections are expected to operate at overall acceptable conditions in both the AM and PM peak hours including all approaches and individual lane groups. However, at the MD 410 and Grant Avenue intersection, eastbound queues still spillback into the upstream intersection during the PM peak hour and westbound queues spill back into the upstream intersection during the AM and PM peak hours. At the realigned MD 410 and MD 195/Sycamore Avenue intersection, the southbound right turn queues spillback into the adjacent left lane during the AM peak hour and the eastbound MD 410 left turns spill into the adjacent through lane during the PM peak hour. This option is not recommended due to the above mentioned reasons.
- The Option 8 traffic analysis results indicate that both intersections are expected to operate at overall acceptable conditions in both the AM and PM peak hours including all approaches and individual lane groups. Since, the signal at Grant Avenue and MD 410 is removed, there is no delay at this intersection. The eastbound through queues observed at this intersection are the queues from each of the eastbound through lanes and is the result of the spillover from the eastbound queue at the MD 410/MD 195/Sycamore Avenue intersection. At the realigned MD 410 and MD 195/Sycamore Avenue intersection during the PM peak hour. However, this spillback is negligible (less than one vehicle). All other queues are contained within their storage lanes and there are no spillbacks into the adjacent through lanes. Pending public support TO realign MD 195, this option is recommended.
- Based on the study options, we would like to recommend two (2) options depending on the public support to realign MD 195.
- If there is public support to NOT realign MD 195, then we recommend Option 3 where Sycamore Avenue is closed to traffic is recommended to be implemented. Minimum traffic detour with maximum improvement to LOS/Delay. No spillbacks into adjacent lanes or upstream intersections are expected and no geometric realignment is required for MD 189.
- If there is public support TO realign MD 195, then we recommend Option 8 where MD 195 is realigned with Sycamore Avenue and Grant Avenue and Sycamore Avenue are closed to traffic. Grant Avenue is inbound only with minimal traffic volume and does not have much impact on traffic operations. The vehicles accessing Grant Avenue will be rerouted but not in a circuitous manner. With Sycamore Avenue closed, traffic can be rerouted to Woodland Avenue to the east and Columbia Avenue to the southwest.