MEMORANDUM

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To: Mr. Greg Hwang, P.E., Capital Projects Manager
Montgomery County Department of Transportation (MCDOT)

From: Jeff Parker, P.E., PTOE, RK&K
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Reference: Goldsboro Road Bicycle/Pedestrian Improvements Phase I Facility Planning

Subject: **Goldsboro Road (MD 614) and MacArthur Boulevard Intersection Improvement Feasibility Study *DRAFT***

Introduction

Montgomery County Department of Transportation (MCDOT) requested RK&K to conduct a study of the intersection of Goldsboro Road (MD 614) and MacArthur Boulevard, located north of the Town of Glen Echo. The purpose of the study is to evaluate alternative intersection configurations that will improve bicycle, pedestrian and vehicular operations and safety. The study is being performed as part of the Phase I Facility Planning Study for Goldsboro Road between MacArthur Boulevard and River Road (MD 190) which is evaluating the addition of sidewalks and bicycle lanes to enhance pedestrian and bicycle operations along the corridor. As part of the corridor study, RK&K evaluated pedestrian and bicycle crossings at the existing intersection. This traffic study includes capacity analyses for alternative intersection configuration options at Goldsboro Road and MacArthur Boulevard based on 2013 and 2035 traffic volumes.

Recent Crash History

The recent crash history at the Goldsboro Road/MacArthur Boulevard intersection was evaluated using data provided by the Maryland State Highway Administration. This data showed that, between January 1, 2008 through September 30, 2012, there were eight (8) crashes reported along the 630-foot long segment of MacArthur Boulevard extending from Oxford Road to just south of the traffic circle (including the traffic circle). Seven of these crashes occurred at the actual circle, while one took place at the shopping center access closer to Oxford Road. Of the seven crashes at the circle, two involved a vehicle colliding with a bicyclist. The crash near Oxford Road involved a vehicle striking multiple bicyclists. SHA officially classifies bicycle crashes as pedestrian crashes; however, additional detail provided by SHA indicated "pedestrian" crashes along this portion of MacArthur Boulevard each involved bicyclists, not pedestrians. Due to these bicycle crashes, the pedestrian crash rate (crashes per 100-million vehicle-miles traveled) along this segment of MacArthur Boulevard is significantly higher than the statewide average pedestrian crash rate for similar roadways. The crash data summary from SHA is attached following this memo.

Intersection Alignment Concepts

RK&K developed four options for the Goldsboro Road/MacArthur Blvd intersection:

- No-Build Option – Maintains the existing traffic circle and adds sidewalks and pedestrian crossings
- Option A – Four-legged intersection
- Option B – Traditional T-intersection
- Option C – Three-legged Roundabout

Diagrams of each of these intersection options are attached following this memo. The operational analyses for each option are described in the next section.

Capacity Analysis

The following is a list of the four intersection configuration options and the types of traffic control that was assumed for the operational analysis of each option:

- Existing/No-Build Option: STOP control on the westbound Goldsboro Road approach; traffic inside the circle must YIELD to traffic entering from northbound and southbound MacArthur Boulevard, which is uncontrolled
- Option A: Two-way STOP Control (TWSC), All-way STOP Control (AWSC), and Signalized
- Option B: Signalized
- Option C: Modern Roundabout (i.e., entering traffic must YIELD to all circulating traffic)

The software package SYNCHRO / SimTraffic (version 8) was used to perform capacity analyses for the No-Build option and Options A and B. The methodology specified in the Year 2010 edition of the Highway Capacity Manual (HCM) was applied using Synchro to calculate delay and level of service (LOS) for Options A and B. The software SIDRA (version 6) was used to perform capacity analyses for Option C (Roundabout).

The Year 2013 volume served as the base volume and the Year 2035 volume was projected by applying a 7% total growth factor to the Year 2013 volume. This growth factor was calculated using the Metropolitan Washington Council of Governments (COG) regional travel demand model. Each intersection improvement option was analyzed using both the Year 2013 volume and the Year 2035 volume. For the purpose of this study, LOS D is considered to be the worst-acceptable level of service for any specific movement or approach, or for the overall intersection.

Existing/No-Build Option

For the existing conditions and the No-Build option, traffic approaching the traffic circle along westbound Goldsboro Road must STOP prior to entering the circle. Traffic in the circle must YIELD to traffic entering from northbound and southbound MacArthur Boulevard. Traffic entering the circle from northbound or southbound MacArthur Boulevard is uncontrolled and is not required to stop or yield to any other traffic movement at this intersection. Due to the unconventional configuration and traffic control scheme at this circle, traffic operations were evaluated for 2013 (Existing) and 2035 (No-Build) using SimTraffic. Table 1 shows the SimTraffic results using Year 2013 volumes, and Table 2 shows the SimTraffic results using Year 2035 volumes.

Table 1
Goldsboro Road @ MacArthur Boulevard Existing Conditions
Capacity Analysis Results with 2013 Volumes

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS[3]	Queue[4]	Volume[1]	Delay[2]	LOS[3]	Queue[4]
SB MacArthur Blvd Left-turn	508	15.3	C	335	194	7.4	A	135
SB MacArthur Blvd Thru	516	14.0	B		459	5.8	A	
NB MacArthur Blvd Thru	66	0.3	A	None	188	0.3	A	None
NB MacArthur Blvd Right-turn	226	0.1	A		138	0.1	A	
WB Goldsboro Rd Left-turn	194	13.8	B	100	384	16.6	C	205
WB Goldsboro Rd Right-turn	148	4.2	A		198	10.2	B	
Intersection Delay	N/A				N/A			
Intersection LOS	N/A				N/A			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = Based on HCM LOS unsignalized intersection criteria; 4 = SimTraffic Queue in feet

Table 2
Goldsboro Road @ MacArthur Boulevard No-Build Option
Capacity Analysis Results with 2035 Volumes

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS[3]	Queue[4]	Volume[1]	Delay[2]	LOS[3]	Queue[4]
SB MacArthur Blvd Left-turn	544	20.0	C	360	208	10.0	A	215
SB MacArthur Blvd Thru	552	18.7	C		491	8.3	A	
NB MacArthur Blvd Thru	71	0.3	A	None	201	0.3	A	None
NB MacArthur Blvd Right-turn	242	0.1	A		148	0.1	A	
WB Goldsboro Rd Left-turn	208	14.9	B	90	411	20.3	C	235
WB Goldsboro Rd Right-turn	158	4.2	A		212	13.3	B	
Intersection Delay	N/A				N/A			
Intersection LOS	N/A				N/A			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = Based on HCM LOS unsignalized intersection criteria; 4 = SimTraffic Queue in feet

The results from the Year 2013 SimTraffic simulation shows that the worst-performing movement at the existing traffic circle is the left-turn from southbound MacArthur Boulevard during the AM peak hour, and the left-turn from westbound Goldsboro Road during the PM peak hour. However, all turning movements at the intersection currently operate at LOS C or better. The Year 2035 No-Build analysis assumed no geometric changes would be made to the existing traffic circle. Under Year 2035 traffic volumes, there would be slight increases in delay for most of the turning movements at this intersection. However, all of the movements would operate at the same LOS as under the existing Year 2013 volumes, except for the through movement along southbound MacArthur Boulevard, which would worsen to LOS C in 2035. All of the movements would continue to operate at LOS C or better in 2035.

Option A with Two-Way STOP control

With this option and traffic control type, the northbound approach of MacArthur Boulevard and the southbound exit from the gas station were assumed to be STOP controlled. Delay and LOS for the intersection as a whole are not defined for TWSC intersections because the HCM methodology assumes the major-street through vehicles experience no delay, which would skew the weighted average for all movements. Therefore, only the delay for left-turn movements from the major street, and all movements from the minor street approaches, will be evaluated. In addition, the delay for the southbound gas station access was not documented in this study due to very low estimated volume. Table 3 shows the SYNCHRO results based on the year 2013 volume and Table 4 shows the SYNCHRO results based on the year 2035 volume.

Table 3
Goldsboro Road @ MacArthur Boulevard Option A
2013 Volume TWSC Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left-turn	5	7.6	A	25	5	7.7	A	25
WB Goldsboro Road Left-turn	194	9.4	A	165	384	8.7	A	235
NB MacArthur Blvd Left+Thru	71	43.8	E	595	193	412.9	F	4,540
NB MacArthur Blvd Right-turn	226	14.5	B	230	138	9.8	A	305
Intersection Delay	N/A				N/A			
Intersection LOS	N/A				N/A			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Table 4
Goldsboro Road @ MacArthur Boulevard Option A
2035 Volume TWSC Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left-turn	5	7.6	A	25	5	7.7	A	25
WB Goldsboro Road Left-turn	208	9.6	A	195	411	8.9	A	250
NB MacArthur Blvd Left+Thru	76	64.6	F	1,555	206	632.7	F	6,695
NB MacArthur Blvd Right-turn	242	15.4	C	255	148	10.0	B	295
Intersection Delay	N/A				N/A			
Intersection LOS	N/A				N/A			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Results from the Year 2013 SYNCHRO analyses show that the northbound MacArthur Boulevard approach would operate at LOS E during the AM peak hour and LOS F during the PM peak hour. Similarly, results from the Year 2035 SYNCHRO analyses show that the northbound MacArthur Boulevard approach would operate in LOS F during both peak hours.

Option A with All-Way STOP control

In addition to TWSC traffic control, Option A was also analyzed using AWSC traffic control as a part of this study. Table 5 shows the SYNCHRO results based on the Year 2013 volume and Table 6 shows the SYNCHRO results based on the Year 2035 volume.

Table 5
Goldsboro Road @ MacArthur Boulevard Option A
2013 Volume AWSC Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	513	51.4	F	740	199	14.2	B	585
EB MacArthur Blvd Right-turn	516	32.0	D	270	459	30.8	D	170
WB Goldsboro Road Left-turn	194	16.2	C	90	384	35.6	E	140
WB Goldsboro Road Right+Thru	153	13.2	B	65	203	14.2	B	75
NB MacArthur Blvd Left+Thru	71	12.6	B	70	193	17.8	C	55
NB MacArthur Blvd Right-turn	226	15.7	C	145	138	12.5	B	25
Intersection Delay	31.2				24.4			
Intersection LOS	D				C			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Results from the Year 2013 SYNCHRO analyses show that the overall intersection of Goldsboro Road and MacArthur Boulevard would operate in LOS D during the AM peak hour and LOS C during the PM peak hour. As expected, the overall intersection would operate worse in Year 2035 due to increased traffic volume, operating at LOS E during the AM peak hour and LOS D during the PM peak hour. Although the overall intersection would operate at acceptable levels of service during the AM and PM peak hours in 2013 and during the PM peak hour in 2035, individual turning movements at the intersection would operate at LOS E or F during each of these time periods. Therefore, all-way stop control would not provide acceptable traffic operations at this intersection.

Table 6
Goldsboro Road @ MacArthur Boulevard Option A
2035 Volume AWSC Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	549	63.6	F	3,865	213	15.4	C	1,995
EB MacArthur Blvd Right-turn	552	45.6	E	280	491	43.4	E	260
WB Goldsboro Road Left-turn	208	17.2	C	90	411	48.5	E	280
WB Goldsboro Road Right+Thru	163	13.8	B	65	213	15.5	C	730
NB MacArthur Blvd Left+Thru	76	12.8	B	95	206	19.6	C	140
NB MacArthur Blvd Right-turn	242	16.7	C	150	148	13.2	B	95
Intersection Delay	39.4				31.8			
Intersection LOS	E				D			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Option A with Traffic Signal Control

An MUTCD traffic signal warrant analysis was completed using the Year 2013 volumes, and the results indicated that a traffic signal is currently warranted at the intersection of Goldsboro Road and MacArthur Boulevard. Accordingly, capacity analysis assuming a three-phase signal was evaluated at the intersection for Option A. Table 7 shows the capacity results based on the Year 2013 volume and Table 8 shows the capacity results based on the Year 2035 volume.

Table 7
Goldsboro Road @ MacArthur Boulevard Option A
2013 Volume Traffic Signal Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	513	14.3	B	260	199	14.5	B	115
EB MacArthur Blvd Right-turn	516	18.2	B	220	459	23.6	C	165
WB Goldsboro Road Left-turn	194	11.1	B	120	384	23.9	C	230
WB Goldsboro Road Right+Thru	153	4.7	A	55	203	8.1	A	235
NB MacArthur Blvd Left+Thru	71	22.8	C	90	193	36.9	D	180
NB MacArthur Blvd Right-turn	226	32.6	C	145	138	21.4	C	110
Intersection Delay	17.1				22.0			
Intersection LOS	B				C			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Table 8
Goldsboro Road @ MacArthur Boulevard Option A
2035 Volume Traffic Signal Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	549	16.0	B	335	213	14.7	B	145
EB MacArthur Blvd Right-turn	552	21.7	C	245	491	25.6	C	195
WB Goldsboro Road Left-turn	208	13.9	B	155	411	32.5	C	240
WB Goldsboro Road Right+Thru	163	5.0	A	75	213	8.2	A	290
NB MacArthur Blvd Left+Thru	76	22.6	C	105	206	40.7	D	195
NB MacArthur Blvd Right-turn	242	32.7	C	160	148	21.6	C	120
Intersection Delay	19.1				25.2			
Intersection LOS	B				C			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Results from the Year 2013 and 2035 SYNCHRO analyses show that Option A would operate at LOS B during the AM peak hour and LOS C during the PM peak hour with traffic signal control. Furthermore, the individual turning movements at the intersection would all operate at LOS D or better in 2013 and 2035, which is considered to be acceptable.

Option B with Traffic Signal Control

Since the MUTCD signal warrant analysis showed that a traffic signal is currently warranted at the MacArthur Boulevard/Goldsboro Road intersection, and the analyses of the Option A intersection configuration showed that TWSC and AWSC traffic control would not provide acceptable LOS, the Option B intersection configuration was analyzed only as a signalized intersection. Table 9 summarizes the SYNCHRO results for Option B using Year 2013 volumes, and Table 10 shows the results using Year 2035 volumes.

Table 9
Goldsboro Road @ MacArthur Boulevard Option B
2013 Volume Traffic Signal Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	508	14.0	B	330	194	11.3	B	165
EB MacArthur Blvd Right-turn	516	17.0	B	220	459	17.9	B	195
WB Goldsboro Road Left-turn	194	10.5	B	130	384	7.7	A	210
WB Goldsboro Road Right+Thru	148	4.5	A	65	198	3.8	A	120
NB MacArthur Blvd Left+Thru	66	24.6	C	90	188	33.1	C	185
NB MacArthur Blvd Right-turn	226	36.5	D	160	138	30.5	C	110
Intersection Delay	17.1				15.7			
Intersection LOS	B				B			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

Table 10
Goldsboro Road @ MacArthur Boulevard Option B
2035 Volume Traffic Signal Capacity Analysis Results

Movement	AM Peak-Period				PM Peak-Period			
	Volume[1]	Delay[2]	LOS	Queue[3]	Volume[1]	Delay[2]	LOS	Queue[3]
EB MacArthur Blvd Left+Thru	544	15.6	B	395	208	9.6	A	185
EB MacArthur Blvd Right-turn	552	19.8	B	245	491	15.7	B	200
WB Goldsboro Road Left-turn	208	12.7	B	160	411	12.9	B	240
WB Goldsboro Road Right+Thru	158	4.8	A	85	212	4.2	A	345
NB MacArthur Blvd Left+Thru	71	24.4	C	105	201	30.4	C	205
NB MacArthur Blvd Right-turn	242	37.6	D	170	148	28.1	C	115
Intersection Delay	18.9				15.7			
Intersection LOS	B				B			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SimTraffic Queue in feet

The analysis results indicate that Option B would operate at LOS B during both the AM and PM peak hours in Year 2013 and Year 2035. Additionally, each of the individual turning movements at this intersection would operate at LOS D or better in 2013 and 2035.

Option C

Option C consists of a single-lane roundabout at the intersection of Goldsboro Road and MacArthur Boulevard, with a 68-foot central island diameter, 16-foot circulating lane width, and 90-foot entry radius and 30-degree entry angle. For this option, the entrances to the gas station would be relocated further east and west of the intersection, resulting in a three-legged intersection. Table 11 shows the SIDRA capacity results based on the Year 2013 volume and Table 12 shows the results based on the Year 2035 volume for the single-lane roundabout.

Table 11
Goldsboro Road @ MacArthur Boulevard Option C
2013 Volume SIDRA Single-Lane Roundabout Capacity Results

	AM Peak-Hour				PM Peak-Hour			
Movement	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**
EB MacArthur Blvd Through	**516**	**74.3**	**E**	**1,555**	194	17.8	B	260
EB MacArthur Blvd Right-turn	**508**	**74.3**			459	17.8		
WB Goldsboro Road Left-turn	194	6.2	A	65	198	13.9	B	175
WB Goldsboro Road Through	148	6.2			384	13.9		
NB MacArthur Blvd Left-turn	66	15.6	B	115	188	8.8	A	75
NB MacArthur Blvd Right-turn	226	15.6			138	8.8		
Intersection Delay	49.9				14.5			
Intersection LOS	D				B			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SIDRA Queue in feet

Table 12
Goldsboro Road @ MacArthur Boulevard Option C
2035 Volume SIDRA Single-Lane Roundabout Capacity Results

	AM Peak-Hour				PM Peak-Hour			
Movement	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**
EB MacArthur Blvd Through	**544**	**110.2**	**F**	**2,215**	208	22.5	C	355
EB MacArthur Blvd Right-turn	**552**	**110.2**			491	22.5		
WB Goldsboro Road Left-turn	208	6.5	A	70	212	16.3	B	225
WB Goldsboro Road Through	158	6.5			411	16.3		
NB MacArthur Blvd Left-turn	71	16.4	B	125	201	9.6	A	85
NB MacArthur Blvd Right-turn	237	16.4			148	9.6		
Intersection Delay	**72.3**				17.5			
Intersection LOS	**F**				B			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SIDRA Queue in feet

Results from the Year 2013 volume SIDRA analyses of the single-lane roundabout indicated that the overall roundabout would operate at LOS D and LOS B during the AM and the PM peak hours, respectively. However, the eastbound MacArthur Boulevard approach would operate at LOS E during the AM peak hour in 2013. In addition, Results from the Year 2035 volume SIDRA analyses indicated that the overall roundabout would operate at LOS F and LOS B during the AM and the PM peak hours, respectively.

For the purpose of this study, LOS D was assumed to be the worst-acceptable level of service for any specific movement, approach, or the overall intersection. A sensitivity analysis was performed using SIDRA to test the effects of larger central island diameters on peak hour traffic operations at the roundabout. This analysis was performed using Year 2013 and Year 2035 traffic volumes. The results of the sensitivity analysis showed that a single lane roundabout would have all movements operating at LOS D or better if it were constructed with a 100-foot diameter central island. However, by 2035, this single-lane roundabout would again have individual turning movements that operate at LOS E or LOS F. Additional study is required to estimate the year between 2013 and 2035 during which traffic operations at this roundabout would reach unacceptable levels. A table summarizing the results of the sensitivity analysis is attached following this memo.

Since a single-lane roundabout with a larger, 100-foot diameter central island would fail to meet the minimum LOS D threshold under projected Year 2035 volumes, a modified single-lane roundabout design incorporating an additional short right-turn lane on the eastbound MacArthur Boulevard approach was also analyzed. This would create a two-lane entry on the eastbound approach to the roundabout and require two circulating lanes within the roundabout between the west leg and the south leg of the intersection. Note that a two-lane entry is not the same as a right-turn bypass lane. A right-turn bypass lane would have a raised island separating it from the roundabout. With a two-lane entry, both approach lanes enter the roundabout.

All other design and operating parameters were retained from the smaller, 68-foot diameter single-lane roundabout analyzed earlier. Table 13 shows the SIDRA capacity results based on the Year 2013 volume and Table 14 shows the results based on the Year 2035 volume for the modified single-lane roundabout.

Table 13
Goldsboro Road @ MacArthur Boulevard
2013 Volume SIDRA Single-Lane Roundabout Option C
with an Additional Eastbound Short Right-turn Lane Capacity Results

	AM Peak-Hour				PM Peak-Hour			
Movement	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**
EB MacArthur Blvd Through	516	10.7	B	105	194	7.6	A	95
EB MacArthur Blvd Right-turn	508	10.9			459	7.6		
WB Goldsboro Road Left-turn	194	6.2	A	65	198	13.9	B	175
WB Goldsboro Road Through	148	6.2			384	13.9		
NB MacArthur Blvd Left-turn	66	15.0	B	105	188	8.5	A	70
NB MacArthur Blvd Right-turn	226	15.0			138	8.5		
Intersection Delay	**10.6**				**10.4**			
Intersection LOS	**B**				**B**			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SIDRA Queue in feet

Results from the Year 2013 volume and the Year 2035 volume SIDRA analyses indicated that the 68-foot diameter single lane roundabout with two-lane EB entry design would operate at LOS B overall during both the AM and the PM peak hours. Additionally, each individual turning movement at the roundabout would operate at LOS B or better. This indicates that the revised single-lane roundabout design with an additional eastbound right-turn lane would meet the minimum LOS D criteria assumed for this study.

Table 14
Goldsboro Road @ MacArthur Boulevard
2035 Volume SIDRA Single-Lane Roundabout Option C
with an Additional Eastbound Short Right-turn Lane Capacity Results

	AM Peak-Hour				PM Peak-Hour			
Movement	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**	**Volume[1]**	**Delay[2]**	**LOS**	**Queue[3]**
EB MacArthur Blvd Through	544	10.1	A	115	208	8.0	A	110
EB MacArthur Blvd Right-turn	552	9.7			491	9.2		
WB Goldsboro Road Left-turn	208	6.5	A	70	212	16.2	B	225
WB Goldsboro Road Through	158	6.5			411	16.2		
NB MacArthur Blvd Left-turn	71	18.0	B	135	201	9.2	A	80
NB MacArthur Blvd Right-turn	237	18.0			148	9.2		
Intersection Delay	10.6				11.7			
Intersection LOS	B				B			

1 = Vehicles per Hour; 2 = Seconds per Vehicle; 3 = SIDRA Queue in feet

One advantage the roundabout concept has over the traditional four-legged and T-intersection concepts is the ability to accommodate Ride-On buses that need to make a U-turn at the Goldsboro Road/MacArthur Boulevard intersection. This intersection is currently the western terminus for a Ride-On bus route, and buses on this route use the existing traffic circle to turn around and return to the east along Goldsboro Road. Further coordination with MCDOT transit staff is needed to address this issue.

There are several issues related to the single-lane roundabout with eastbound right-turn lane option that would need to be addressed before this option could be recommended, such as:

- Accommodating vision-impaired pedestrians crossing the multilane eastbound approach and its associated multilane roundabout exit to the south
- Providing access to the gas station and shopping center

Research has indicated that multilane entries and exits at roundabouts are more difficult for vision-impaired pedestrians to cross safely, compared to single lane entries and exits. There is pending U.S. Access Board rulemaking that may require multilane entries and exits at roundabouts to be retrofitted with pedestrian-actuated traffic signals in the future. The operational impacts and capital/maintenance costs associated with this potential requirement should be considered when deciding whether to select a roundabout option with multilane entries or exits. Providing a separated eastbound right-turn bypass lane instead of the multilane entry and exit analyzed above would eliminate the need to provide pedestrian signals in the future due to the pending U.S. Access Board rulemaking. However, a separate lane that bypasses the roundabout would require a less-favorable crossing for pedestrians, since the crossing would not be located on a controlled intersection approach. Further analysis would be needed to determine if the bypass lane would function as well as the eastbound two-lane entry that was evaluated in this study.

The roundabout configurations that were analyzed did not include any direct access to the gas station and shopping center from within the actual roundabout. Further evaluation would be needed to assess the safety and operational implications of providing driveway access to these adjacent developments from within the roundabout, since this would be an unconventional design.

Conclusions

Table 15 shows a comparison of the pros and cons associated with each of the intersection options that were analyzed for this study.

Table 15
Goldsboro Road @ MacArthur Boulevard
Comparison of Intersection Configuration Options Studied

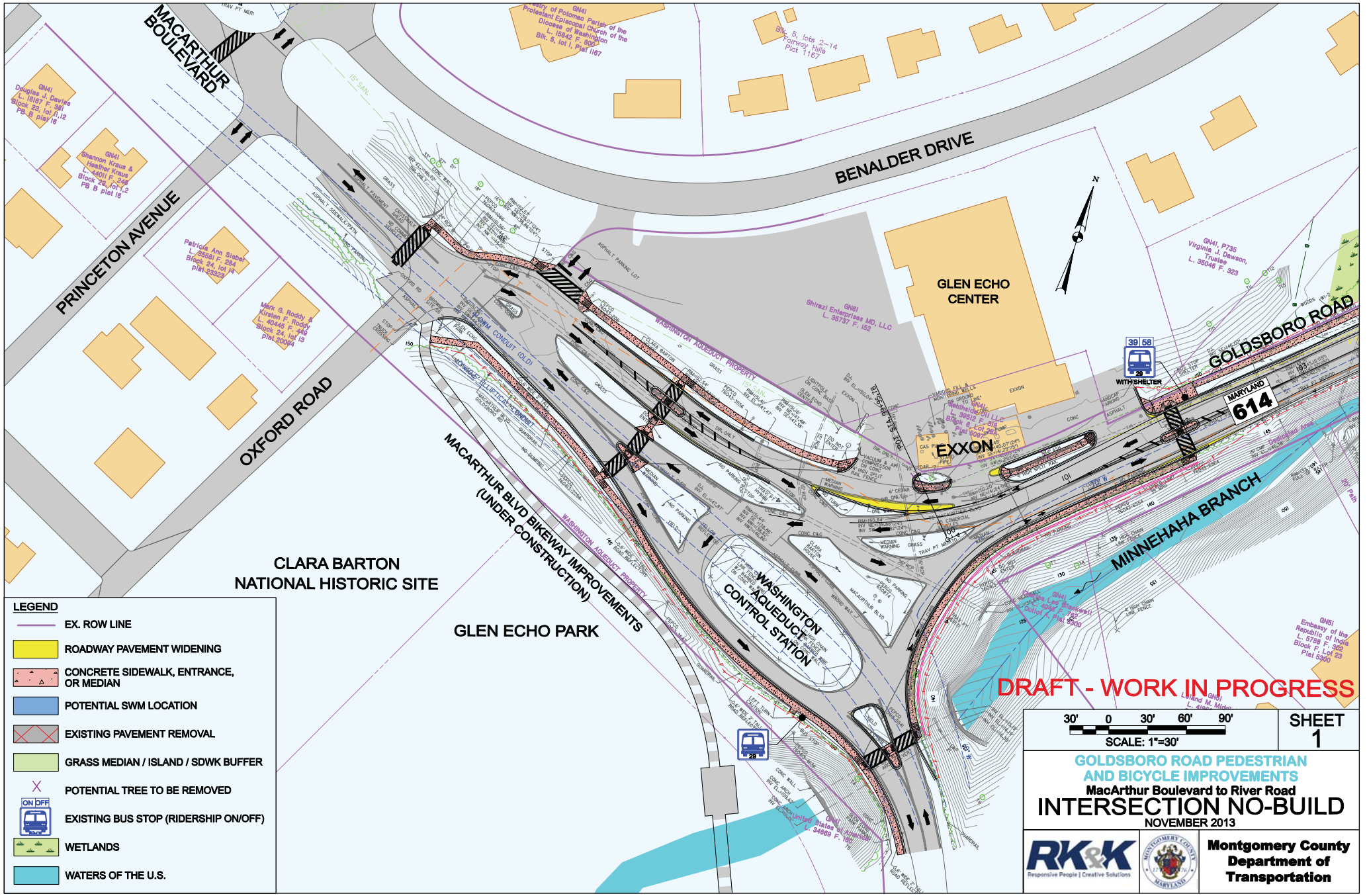
Intersection Option	Traffic Control / Sub-Type	Expected Benefits	Possible Disadvantages
No-Build	Unconventional traffic circle	• All movements are LOS C or better during peak hours in 2013 and 2035 • Provides marked pedestrian crossings, signing, and sidewalks • Provides turnaround for buses • No impact on adjacent property • Maintains all 3 existing access points to gas station	• Traffic on MacArthur Blvd not required to yield or stop which may lead to higher speeds that are detrimental to pedestrian and bicycle safety • Minimal safety improvement for on-road bicyclists • Aqueduct control station in central island limits available sight distance
Option A	Signalized	• All movements are LOS D or better during peak hours in 2013 and 2035 • Provides marked pedestrian crossings, signing, and sidewalks • Provides pedestrian-actuated Walk signals which may improve pedestrian safety • Simplifies vehicle and pedestrian movements	• More difficult for buses to turn around • Maintains only 2 of 3 existing gas station access points
Option B	Signalized	• All movements are LOS D or better during peak hours in 2013 and 2035 • Provides marked pedestrian crossings, signing, and sidewalks • Provides pedestrian-actuated Walk signals which may improve pedestrian safety • Simplifies vehicle and pedestrian movements	• More difficult for buses to turn around • Maintains only 1 of 3 existing gas station access points • Limited stopping sight distance due to aqueduct control station • Impacts to Minnehaha Branch

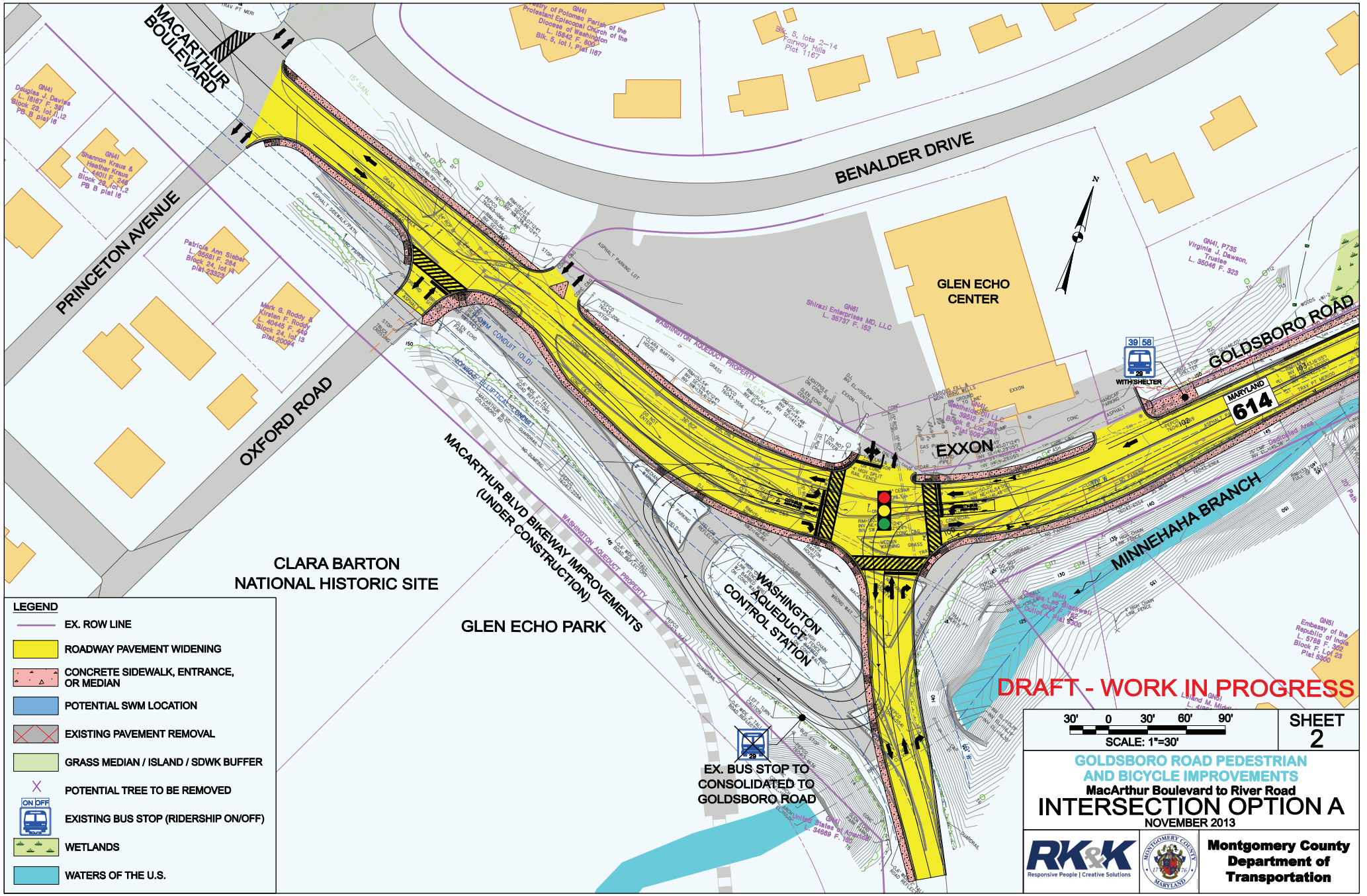
Table 15 (Continued)
Goldsboro Road @ MacArthur Boulevard
Comparison of Intersection Configuration Options Studied

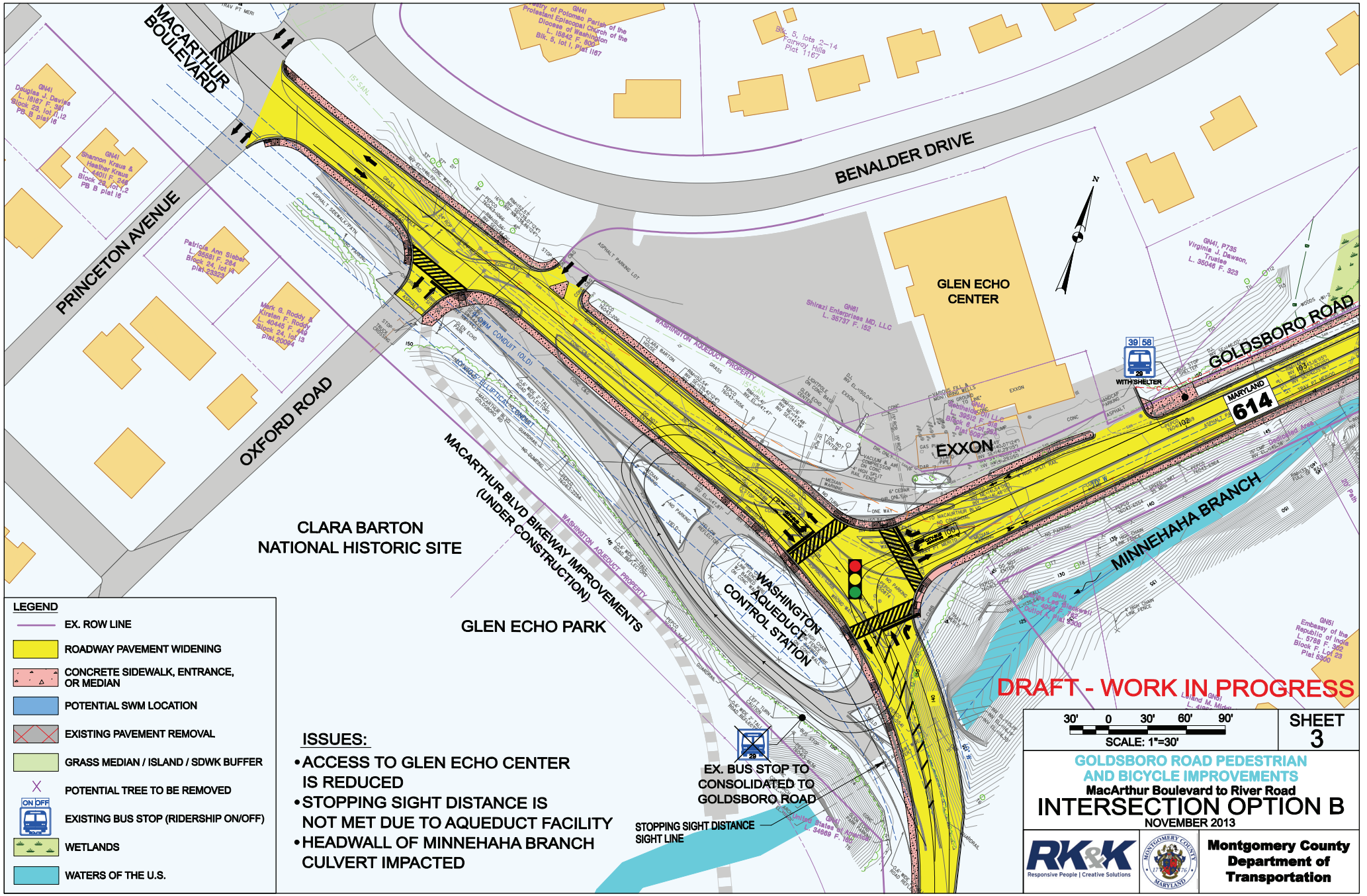
Option C	Roundabout w/ 68' dia. Central island	• Reduces travel speeds, which improves safety for pedestrians and bicycles • Provides marked pedestrian crossings, signing, and sidewalks • Provides turnaround for buses • Simplifies vehicle and pedestrian movements	• EB MacArthur Blvd approach at LOS E in 2013 AM peak hour and LOS F in 2035 AM peak hour • Larger footprint has more property impact vs. Options A and B • Maintains only 1 of 3 existing gas station access points • Impacts to aqueduct control station and gas station
	Roundabout w/ 68' dia. Central island & 2-lane EB entry	• All movements are LOS B or better during peak hours in 2013 and 2035 • Reduces travel speeds, which improves safety for pedestrians and bicycles • Provides marked pedestrian crossings, signing, and sidewalks • Provides turnaround for buses • Simplifies vehicle and pedestrian movements	• Pending U.S. Access Board rulemaking may require signalization of the 2-lane EB entry and exit to ensure accessibility to vision-impaired pedestrians • Larger footprint has more property vs. Options A and B • Maintains only 1 of 3 existing gas station access points • More impacts to aqueduct control station and gas station
	Roundabout w/ 68' dia. Central island & EB right-turn bypass lane	• EB right-turn bypass lane *may* reduce delay on the eastbound approach (needs further study) • Provides marked pedestrian crossings, signing, and sidewalks • Provides turnaround for buses • Simplifies vehicle and pedestrian movements	• Larger footprint has more property impact vs. Options A and B • Maintains only 1 of 3 existing gas station access points • Bypass lane may have higher speeds that are detrimental to pedestrian and bicycle safety • More impacts to aqueduct control station and gas station
	Roundabout w/ 100' dia. Central island	• All movements at LOS D or better in 2013 • Reduces travel speeds, which improves safety for pedestrians and bicycles • Provides marked pedestrian crossings, signing, and sidewalks • Provides turnaround for buses • Simplifies vehicle and pedestrian movements	• Some movements at LOS F in 2035 • Larger footprint has more property impact vs. Options A, B and C • Maintains only 1 of 3 existing gas station access points • Impacts to aqueduct control station and gas station

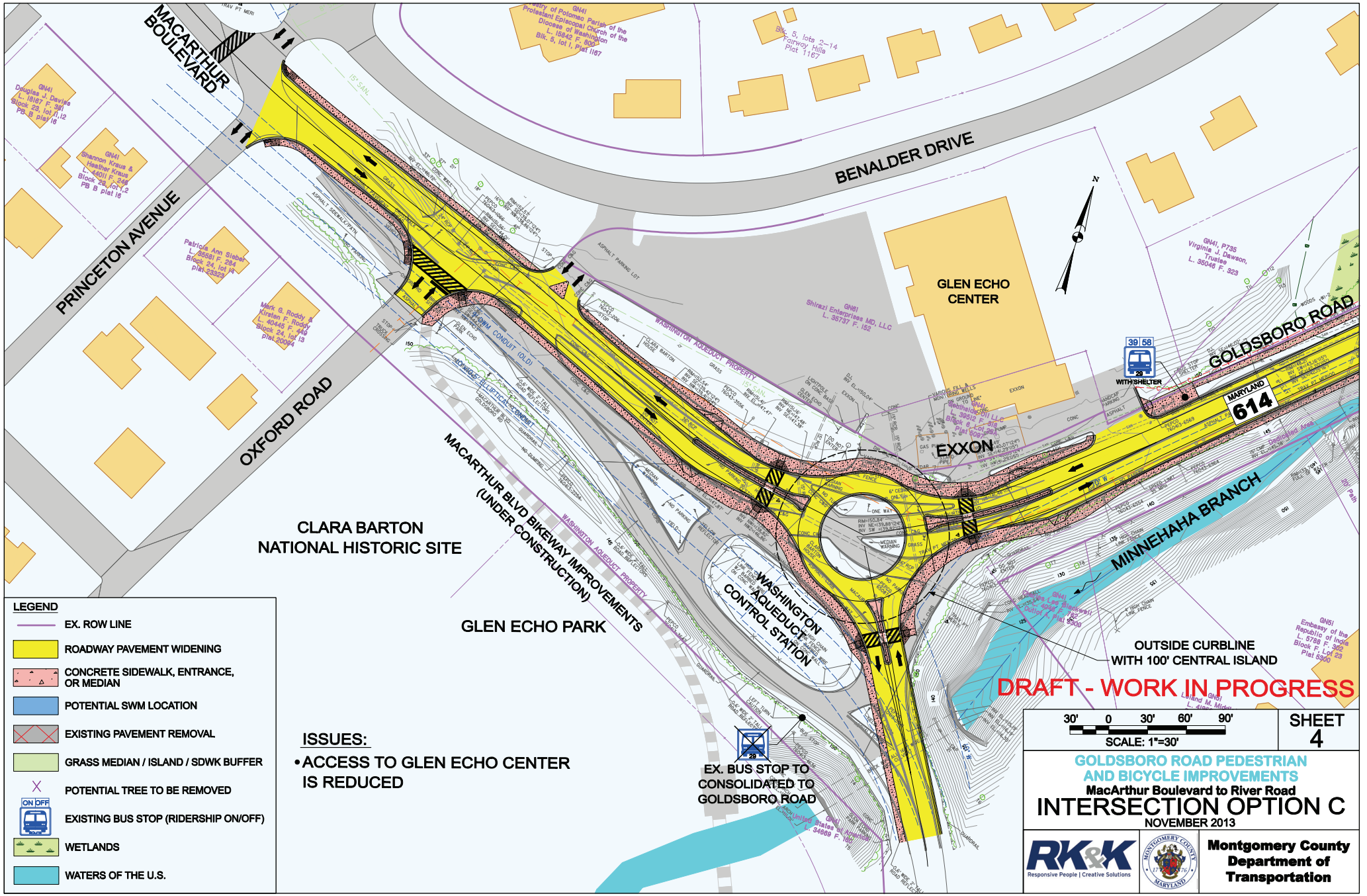
Attachments

\\BALSRV03\V2008\2008\08122_MCBOA\TASK 10 - GOLDSBORO ROAD\TRAFFIC\REPORT\TECHMEMODRAFT_GOLDSBORORD@MACARTHURBLVD-11-08-2013.DOCX


MACARTHUR BOULEVARD
BENALDER DRIVE
PRINCETON AVENUE
OXFORD ROAD
GOLDSBORO ROAD
MARYLAND 614
GLEN ECHO CENTER
EXXON
MINNEHAHA BRANCH
WASHINGTON AQUEDUCT CONTROL STATION
MACARTHUR BLVD BIKEWAY IMPROVEMENTS (UNDER CONSTRUCTION)
CLARA BARTON NATIONAL HISTORIC SITE
GLEN ECHO PARK
WASHINGTON AQUEDUCT PROPERTY
WITH SHELTER
LEGEND
EX. ROW LINE
ROADWAY PAVEMENT WIDENING
CONCRETE SIDEWALK, ENTRANCE, OR MEDIAN
POTENTIAL SWM LOCATION
EXISTING PAVEMENT REMOVAL
GRASS MEDIAN / ISLAND / SDWK BUFFER
POTENTIAL TREE TO BE REMOVED
EXISTING BUS STOP (RIDERSHIP ON/OFF)
WETLANDS
WATERS OF THE U.S.
DRAFT - WORK IN PROGRESS
30' 0 30' 60' 90'
SCALE: 1"=30'
SHEET 1
GOLDSBORO ROAD PEDESTRIAN AND BICYCLE IMPROVEMENTS
MacArthur Boulevard to River Road
INTERSECTION NO-BUILD
NOVEMBER 2013
RK&K
Responsive People | Creative Solutions
Montgomery County Department of Transportation


MACARTHUR BOULEVARD
BENALDER DRIVE
PRINCETON AVENUE
OXFORD ROAD
GLEN ECHO CENTER
GOLDSBORO ROAD
MARYLAND 614
WITH SHELTER
EXXON
MINNEHAHA BRANCH
WASHINGTON AQUEDUCT CONTROL STATION
WASHINGTON AQUEDUCT PROPERTY
MACARTHUR BLVD BIKEWAY IMPROVEMENTS (UNDER CONSTRUCTION)
CLARA BARTON NATIONAL HISTORIC SITE
GLEN ECHO PARK
EX. BUS STOP TO CONSOLIDATED TO GOLDSBORO ROAD
LEGEND
EX. ROW LINE
ROADWAY PAVEMENT WIDENING
CONCRETE SIDEWALK, ENTRANCE, OR MEDIAN
POTENTIAL SWM LOCATION
EXISTING PAVEMENT REMOVAL
GRASS MEDIAN / ISLAND / SDWK BUFFER
POTENTIAL TREE TO BE REMOVED
EXISTING BUS STOP (RIDERSHIP ON/OFF)
WETLANDS
WATERS OF THE U.S.
DRAFT - WORK IN PROGRESS
30' 0 30' 60' 90'
SCALE: 1"=30'
SHEET 2
GOLDSBORO ROAD PEDESTRIAN AND BICYCLE IMPROVEMENTS
MacArthur Boulevard to River Road
INTERSECTION OPTION A
NOVEMBER 2013
RK&K
Responsive People | Creative Solutions
Montgomery County Department of Transportation


MACARTHUR BOULEVARD
BENALDER DRIVE
PRINCETON AVENUE
OXFORD ROAD
GOLDSBORO ROAD
GLEN ECHO CENTER
EXXON
CLARA BARTON NATIONAL HISTORIC SITE
GLEN ECHO PARK
MACARTHUR BLVD BIKEWAY IMPROVEMENTS (UNDER CONSTRUCTION)
WASHINGTON AQUEDUCT CONTROL STATION
MINNEHAHA BRANCH
WASHINGTON AQUEDUCT PROPERTY
WITH SHELTER
MARYLAND 614
EX. BUS STOP TO CONSOLIDATED TO GOLDSBORO ROAD
STOPPING SIGHT DISTANCE SIGHT LINE
LEGEND
EX. ROW LINE
ROADWAY PAVEMENT WIDENING
CONCRETE SIDEWALK, ENTRANCE, OR MEDIAN
POTENTIAL SWM LOCATION
EXISTING PAVEMENT REMOVAL
GRASS MEDIAN / ISLAND / SDWK BUFFER
POTENTIAL TREE TO BE REMOVED
EXISTING BUS STOP (RIDERSHIP ON/OFF)
WETLANDS
WATERS OF THE U.S.
ISSUES:
•ACCESS TO GLEN ECHO CENTER IS REDUCED
•STOPPING SIGHT DISTANCE IS NOT MET DUE TO AQUEDUCT FACILITY
•HEADWALL OF MINNEHAHA BRANCH CULVERT IMPACTED
DRAFT - WORK IN PROGRESS
30' 0 30' 60' 90'
SCALE: 1"=30'
SHEET 3
GOLDSBORO ROAD PEDESTRIAN AND BICYCLE IMPROVEMENTS
MacArthur Boulevard to River Road
INTERSECTION OPTION B
NOVEMBER 2013
RK&K Responsive People | Creative Solutions
Montgomery County Department of Transportation


MACARTHUR BOULEVARD
BENALDER DRIVE
PRINCETON AVENUE
OXFORD ROAD
GLEN ECHO CENTER
GOLDSBORO ROAD
MARYLAND 614
EXXON
MINNEHAHA BRANCH
CLARA BARTON NATIONAL HISTORIC SITE
GLEN ECHO PARK
MACARTHUR BLVD BIKEWAY IMPROVEMENTS (UNDER CONSTRUCTION)
WASHINGTON AQUEDUCT CONTROL STATION
WASHINGTON AQUEDUCT PROPERTY
WITH SHELTER
OUTSIDE CURBLINE WITH 100' CENTRAL ISLAND
EX. BUS STOP TO CONSOLIDATED TO GOLDSBORO ROAD
LEGEND
EX. ROW LINE
ROADWAY PAVEMENT WIDENING
CONCRETE SIDEWALK, ENTRANCE, OR MEDIAN
POTENTIAL SWM LOCATION
EXISTING PAVEMENT REMOVAL
GRASS MEDIAN / ISLAND / SDWK BUFFER
POTENTIAL TREE TO BE REMOVED
EXISTING BUS STOP (RIDERSHIP ON/OFF)
WETLANDS
WATERS OF THE U.S.
ISSUES:
•ACCESS TO GLEN ECHO CENTER IS REDUCED
DRAFT - WORK IN PROGRESS
30' 0 30' 60' 90'
SCALE: 1"=30'
SHEET 4
GOLDSBORO ROAD PEDESTRIAN AND BICYCLE IMPROVEMENTS
MacArthur Boulevard to River Road
INTERSECTION OPTION C
NOVEMBER 2013
RK&K
Responsive People | Creative Solutions
Montgomery County Department of Transportation

Goldsboro Road @
MacArthur Boulevard

Single Lane Roundabout
Sensitivity Analysis

2013 AM Volume - Intersection Delay vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Delay	E (74.3)	E (69.5)	E (66.3)	E (63.2)	E (60.3)	E (57.5)	D (54.9)
WB Approach Delay	A (6.2)	A (6.1)	A (6.0)	A (6.0)	A (5.9)	A (5.9)	A (5.8)
NB Approach Delay	B (15.6)	B 15.3	B (15.1)	B (14.9)	B (14.7)	B (14.5)	B (14.3)
Intersection Delay	D (49.9)	D (46.9)	D (44.9)	D (42.9)	D (41.0)	D (39.3)	D (37.6)

2013 AM Volume - Queue vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Queue	1,554 ft	1,473 ft	1,417 ft	1,362 ft	1,309 ft	1,258 ft	1,208 ft
WB Approach Queue	62 ft	62 ft	61 ft	60 ft	60 ft	59 ft	59 ft
NB Approach Queue	112 ft	111 ft	110 ft	109 ft	108 ft	107 ft	106 ft

2013 PM Volume - Intersection Delay vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Delay	B (17.8)	B (17.1)	B (16.7)	B (16.2)	B (15.8)	B (15.4)	B (15.1)
WB Approach Delay	B (13.9)	B (13.5)	B (13.2)	B (12.9)	B (12.7)	B 12.4)	B (12.2)
NB Approach Delay	A (8.8)	A 8.6)	A (8.4)	A (8.3)	A (8.2)	A (8.0)	A (7.9)
Intersection Delay	B (14.5)	B (14.0)	B (13.7)	B (13.3)	B (13.0)	B (12.8)	B (12.5)

2013 PM Volume - Queue vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Queue	260 ft	249 ft	241 ft	234 ft	227 ft	221 ft	214 ft
WB Approach Queue	174 ft	168 ft	163 ft	158 ft	154 ft	150 ft	147 ft
NB Approach Queue	75 ft	73 ft	72 ft	71 ft	70 ft	69 ft	69 ft

2035 AM Volume - Intersection Delay vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Delay	F (110.2)	F (104.2)	F (100.0)	F (96.0)	F (92.0)	F (88.3)	F (84.6)
WB Approach Delay	A (6.5)	A (6.4)	A (6.4)	A (6.3)	A (6.2)	A (6.2)	A (6.1)
NB Approach Delay	B (16.4)	B (16.1)	B (15.9)	B 15.7)	B (15.4)	B (15.2)	B (15.1)
Intersection Delay	E (72.3)	E (68.5)	E (65.9)	E (63.3)	E (60.8)	E (58.5)	E (56.1)

2035 AM Volume - Queue vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Queue	2,214 ft	2,122 ft	2,057 ft	1,993 ft	1,929 ft	1,867 ft	1,806 ft
WB Approach Queue	69 ft	68 ft	67 ft	67 ft	66 ft	65 ft	65 ft
NB Approach Queue	125 ft	123 ft	122 ft	121 ft	119 ft	118 ft	117 ft

2035 PM Volume - Intersection Delay vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Delay	C (22.5)	C (21.4)	C (20.7)	C (20.1)	B (19.4)	B (18.8)	B (18.3)
WB Approach Delay	B (16.3)	B (15.7)	B (15.3)	B (14.9)	B (14.6)	B (14.3)	B (14.0)
NB Approach Delay	A (9.6)	A (9.3)	A (9.2)	A (9.0)	A (8.9)	A (8.7)	A (8.6)
Intersection Delay	B (17.5)	B (16.8)	B (16.3)	B (15.8)	B (15.4)	B (15.0)	B (14.7)

2035 PM Volume - Queue vs. Island Diameter (Single Lane Roundbout)							
	68 ft	**75 ft**	**80 ft**	**85 ft**	**90 ft**	**95 ft**	**100 ft**
EB Approach Queue	353 ft	335 ft	324 ft	313 ft	303 ft	293 ft	284 ft
WB Approach Queue	224 ft	215 ft	209 ft	203 ft	197 ft	192 ft	187 ft
NB Approach Queue	85 ft	84 ft	82 ft	81 ft	80 ft	79 ft	78 ft

RK&K

Last Updated: 11/7/2013

Maryland State Highway Administration

Office of Traffic and Safety - Traffic Development and Support Division

SHA 52.1 ADC Study Worksheet Output rev. 12/2012-3

Name: William MacLeod

Date: 10/11/2013

Location: MacArthur Blvd from S of MD 614 To Oxford Rd

Logmiles: From 002.50 To 002.62 Length: 0.12

County: Montgomery, D3

Period: January 01, 2008 To September 30, 2012

Note:

Type Controls: 8U-100%

*** Significantly Higher than Statewide**

YEAR >>	2008	2009	2010	2011	2012	Total	Study	StateWd
Fatal	0	0	0	0	0	0	0.0	1.4
No. Killed	0	0	0	0	0	0		
Injury	0	0	1	1	1	3	116.3	68.9
No. Injured	0	0	1	4	1	6		
Prop. Damage	1	2	0	1	1	5	193.8 *	97.8
Total Crashes	1	2	1	2	2	8	310.2 *	168.0
Severity Index	1	2	4	8	5	Avg 4		
RATE	184.7	369.3	184.1	367.2	489.4			
WAADT	12325	12365	12400	12435	12475			
VMT millions	0.5	0.5	0.5	0.5	0.4	2.6		
Opposite Dir.	0	0	0	0	0	0	0.0	8.8
Rear End	0	0	0	0	0	0	0.0	53.8
Sideswipe	0	0	0	0	0	0	0.0	10.5
Left Turn	0	0	0	0	0	0	0.0	13.0
Angle	0	2	0	2	1	5	193.8 *	32.8
Pedestrian	0	0	1	0	1	2	77.5 *	3.3
Parked Veh.	0	0	0	0	0	0	0.0	2.5
Fixed Object	1	0	0	0	0	1	38.8	29.5
Other	0	0	0	0	0	0	0.0	2.8
U-Turn	0	0	0	0	0	0		
Backing	0	0	0	0	0	0		
Animal	0	0	0	0	0	0		
Railroad	0	0	0	0	0	0		
Fire / Expl.	0	0	0	0	0	0		
Overturn	0	0	0	0	0	0		
Truck Related	0	0	0	0	0	0	0.0	10.4
Night Time	1	0	0	0	0	1	13 %	31 %
Wet Surface	1	0	0	1	0	2	25 %	21 %
Alcohol	0	0	0	0	0	0	0 %	8 %
Intersection	1	2	1	1	1	6		
Total Vehicles	1	4	1	3	3	12		
Total Trucks	0	0	0	0	0	0		
Truck %	0.0	0.0	0.0	0.0	0.0	0.0		

Comments:

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support Division
SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: William MacLeod
Date: 03/29/2013

Location: MacAruthur Blvd From S of MD 614 To Oxford Rd
Logmiles: From 002.50 To 002.62 Length: 0.12
County: Montgomery, D3
Period: January 1, 2008 To September 30, 2012
Note: 2012 data is preliminary

SEVERITY	FATAL	INJURY	P-DAMAGE	TOTAL
Accidents		3	5	8
Veh Occ				
Pedestrian		6		

AVG Severity Index: 4

DAY OF THE WEEK

SUN	MON	TUE	WED	THU	FRI	SAT	UNK
2	1	1		1	2	1	

MONTH OF THE YEAR

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	UNK
1	1		1					1	2	2		

CONDITION	DRIVER	PED
Normal:	10	2
Alcohol:		
Other:	2	1

TIME

	12	01	02	03	04	05	06	07	08	09	10	11	UNK
AM:			1						1	1	1		
PM:		1	1	1		1							

VEHICLES INVOLVED PER ACCIDENT

1	2	3	4	5	6+	UNK	TOTAL
4	4						12

VEHICLE TYPE

	Motorcycle/Moped	
7	Passenger Vehicle	1 Passenger Bus
3	Sport Utility Veh	School Bus
1	Pick-Up Truck	Emergency Veh
	Trucks (2+3 axles)	Other Types

SURFACE

2	Wet
5	Dry
1	Sno/Ice
	Mud
	Other

MOVEMENTS

NORTH			SOUTH			EAST			WEST		
LF	ST	RT	LF	ST	RT	LF	ST	RT	LF	ST	RT
	3	1	1	2					1	4	

OTHER MOVEMENTS

PROBABLE CAUSES

	Influence of Drugs		Improper Lane Change
	Influence of Alcohol		Improper Backing
	Influence of Medication		Improper Passing
	Influence of Combined Subst.		Improper Signal
	Physical/Mental Difficulty		Improper Parking
	Fell Asleep/Fainted, etc.		Passenger Interfere/Obstruct.
1	Fail to give full Attention		Illegally in Roadway
	Lic. Restr. Non-compliance		Bicycle Violation
	Fail to Drive in Single Lane		Clothing Not Visible
	Improper Right Turn on Red		Sleet, Hail, Freezing Rain
4	Fail to Yield Right-of-way		Severe Crosswinds
1	Fail to Obey Stop Sign		Rain, Snow
	Fail to Obey Traffic Signal		Animal
1	Fail to Obey Other Control		Vision Obstruction
	Fail to Keep Right of Center		Vehicle Defect
	Fail to Stop for School Bus		Wet
	Wrong Way on One Way		Icy or Snow Covered
	Exceeded Speed Limit		Debris or Obstruction
	Operator Using Cell Phone		Ruts, Holes or Bumps
	Stopping in Lane Roadway		Road Under Construction
	Too Fast for Conditions		Traffic Control Device Inop.
	Followed too Closely		Shoulders Low, Soft or High
	Improper Turn	1	Other or Unknown

COLLISION TYPES		FATAL	INJURY	PROP	TOTAL
Opposite Dir	Related:				
	UnRelated:				
Rear End	Related:				
	UnRelated:				
Sideswipe	Related:				
	UnRelated:				
Left Turn	Related:				
	UnRelated:				
Angle	Related:		1	3	4
	UnRelated:			1	1
Pedestrian	Related:		1		1
	UnRelated:		1		1
Parked Vehicle	Related:				
	UnRelated:				
Other Collision	Related:				
	UnRelated:				

F	Bridge	01			
I	Building	02			
X	Culvert/Ditch	03			
E	Curb	04			
D	Guardrail/Barrier	05			
	Embankment	06			
O	Fence	07			
B	Light Pole	08			
J	Sign Pole	09		1	1
E	Other Pole	10			
C	Tree/Shrubbery	11			
T	Contr. Barrier	12			
S	Crash Attenuator	13			
	Other Fixed Object				

WEATHER

7	Clear / Cloudy
	Foggy
	Raining
1	Snow / Sleet
	Other

ILLUMINATION

7	Day
	Dawn/Dusk
1	Dark - Lights On
	Dark - No Lights
	Other

TOTALS

08-12	8

Maryland State Highway Administration

Office of Traffic and Safety - Traffic Development and Support Division

SHA 52.1 ADC History Output rev. 03/2013-1 - Combined Year Listing

Name: William MacLeod

Date: 03/29/2013

Location: MacAruthur Blvd From S of MD 614 To Oxford Rd

Logmiles: From 002.50 To 002.62 Length: 0.12

County: Montgomery, D3 Period: January 01, 2008 To September 30, 2012

Note: 2012 data is preliminary

MilePt	Int Rel	Date	Severity	Time	Light	Surface	Alc Rel	FixObj	Collision	Movement V1	Movement V2	Probable Cause
CO4690												
2.54	✓	10262008	Property	02A	Night	Wet		09	FXOBJ	NR	--	Other or Unknown
2.54	✓	01272009	Property	08A	Day	Snow			ANGLE	SS	WS	Fail to yield right-of-way
2.54	✓	11222009	Property	03P	Day	Dry			ANGLE	WS	NS	Fail to give full attention
2.54	✓	10232010	1 Injured	01P	Day	Dry			PED	WS	--	Fail to yield right-of-way
2.54		02252011	Property	02P	Day	Wet			ANGLE	SS	NS	Fail to obey other control
2.54	✓	11252011	4 Injured	10A	Day	Dry			ANGLE	SL	uu	Fail to yield right-of-way
2.54	✓	04162012	Property	09A	Day	Dry			ANGLE	WS	NS	Fail to obey stop sign
2.54		09202012	1 Injured	05P	Day	Dry			PED	WL	--	Fail to yield right-of-way

Fixed Object: 01 = Bridge 02 = Building 03 = Culvert/Ditch 04 = Curb 05 = Guardrail/Barrier 06 = Embankment 07 = Fence
08 = Light Pole 09 = Sign Post 10 = Other Pole 11 = Tree/Shrubbery 12 = Construction Barrier 13 = Crash Attenuator

Maryland State Highway Administration

MAP KEY

Office of Traffic and Safety - Traffic Development and Support Division

SHA 52.1 ADC History Output rev. 03/2013-1 - Combined Year Listing

Name: William MacLeod

Date: 03/29/2013

Location: MacAruthure Blvd From S of MD 614 To Oxford Rd

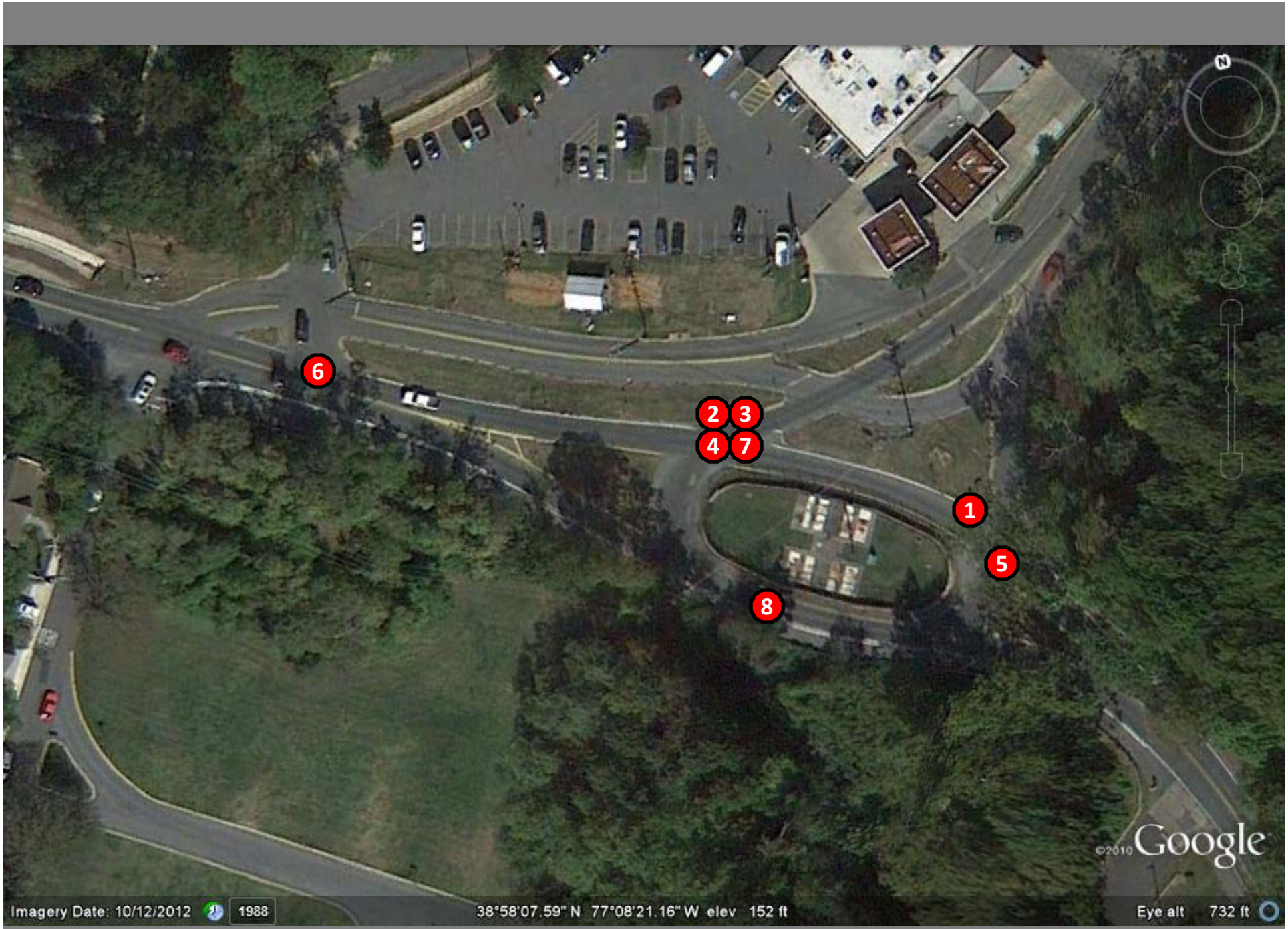
Logmiles: From 002.50 To 002.62 Length: 0.12

County: Montgomery, D3 Period: January 01, 2008 To September 30, 2012

Note: 2012 data is preliminary

MilePt	Int Rel	Date	Severity	Time	Light	Surface	Alc Rel	FixObj	Collision	Movement V1	Movement V2	Probable Cause
CO4690												
* (1) 2.54	✓	10262008	Property	02A	Night	Wet		09	FXOBJ	NR	--	Other or Unknown
* (2) 2.54	✓	01272009	Property	08A	Day	Snow			ANGLE	SS	WS	Fail to yield right-of-way
* (3) 2.54	✓	11222009	Property	03P	Day	Dry			ANGLE	WS	NS	Fail to give full attention
* (4) 2.54	✓	10232010	1 Injured	01P	Day	Dry			PED	WS	--	Fail to yield right-of-way
* (5) 2.54		02252011	Property	02P	Day	Wet			ANGLE	SS	NS	Fail to obey other control
* (6) 2.54	✓	11252011	4 Injured	10A	Day	Dry			ANGLE	SL	uu	Fail to yield right-of-way
* (7) 2.54	✓	04162012	Property	09A	Day	Dry			ANGLE	WS	NS	Fail to obey stop sign
* (8) 2.54		09202012	1 Injured	05P	Day	Dry			PED	WL	--	Fail to yield right-of-way

Fixed Object: 01 = Bridge 02 = Building 03 = Culvert/Ditch 04 = Curb 05 = Guardrail/Barrier 06 = Embankment 07 = Fence
08 = Light Pole 09 = Sign Post 10 = Other Pole 11 = Tree/Shrubbery 12 = Construction Barrier 13 = Crash Attenuator


6
2
3
4
7
1
5
8
©2010 Google
Imagery Date: 10/12/2012
1988
38°58'07.59" N 77°08'21.16" W elev 152 ft
Eye alt 732 ft