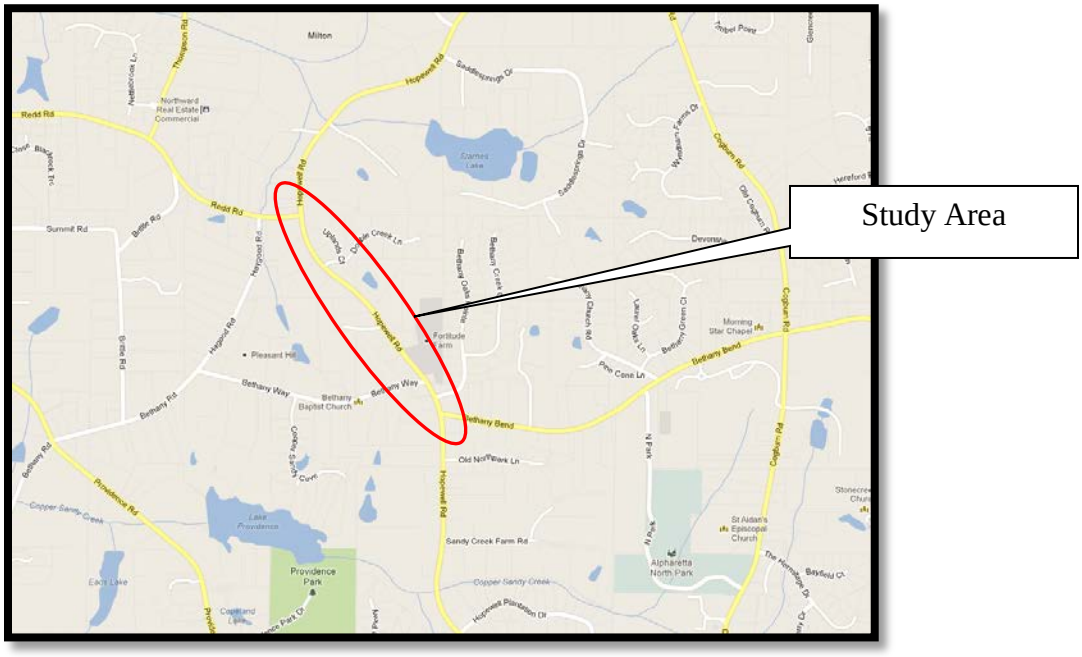
IMPROVEMENT SCENARIOS REPORT

For

Hopewell Road with Bethany Bend, Bethany Way, Bethany Oaks Pointe, and Redd Road Intersections

City of Milton, Georgia



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INTRODUCTION

Gresham, Smith and Partners (GS&P) has prepared a improvement scenarios report for the intersections of Hopewell Road with Bethany Bend, Bethany Way, Bethany Oaks Pointe, and Redd Road in Milton, GA. The purpose of the project is to develop cost effective enhancements to address the known safety and operational deficiencies at the study intersections. The study intersections are is located in the central part of the City of Milton. Figure 1 shows the location and vicinity of the study intersections

This improvement scenarios report evaluates the existing level of service at the study intersections and also the future level of service, accounting for the anticipated traffic growth at the intersections. Based on the projected future level of service, several intersection improvement alternatives were identified and analyzed as part of this improvement scenarios report. Each alternative was evaluated based on estimated project cost, improvement to the intersection level of service, and congestion/mobility benefit.

This improvement scenarios report has been prepared in accordance with the following standards:

- *Manual on Uniform Traffic Control Devices (MUTCD),* 2009 Edition, FHWA.
- *A Policy on Geometric Design of Highways and Streets,* 2011 Edition, AASHTO.
- *Highway Capacity Manual 2010,* Transportation Research Board.
- *Trip Generation*, 8th Edition, Institute of Transportation Engineers.

Report Outline

The documentation in this report is structured as noted below:

- Existing (Year 2013) traffic conditions at the study intersection.

- Future traffic analysis based on two analysis years - 2015 and 2035. Traffic volumes on the study area roadways were forecasted for each of these years. Increases in traffic related to the projected attendance increases at Cambridge High School and Kings Ridge Christian School were also accounted for.

- Future "No-Build" level of service analysis to determine future capacity deficiencies.

- Recommended improvements to Hopewell Road with Bethany Bend, Bethany Way, Bethany Oaks Pointe, and Redd Road study intersections.

- Future level of service analysis and a benefit-cost analysis was conducted to analyze the benefits and impacts of the proposed intersection improvements.

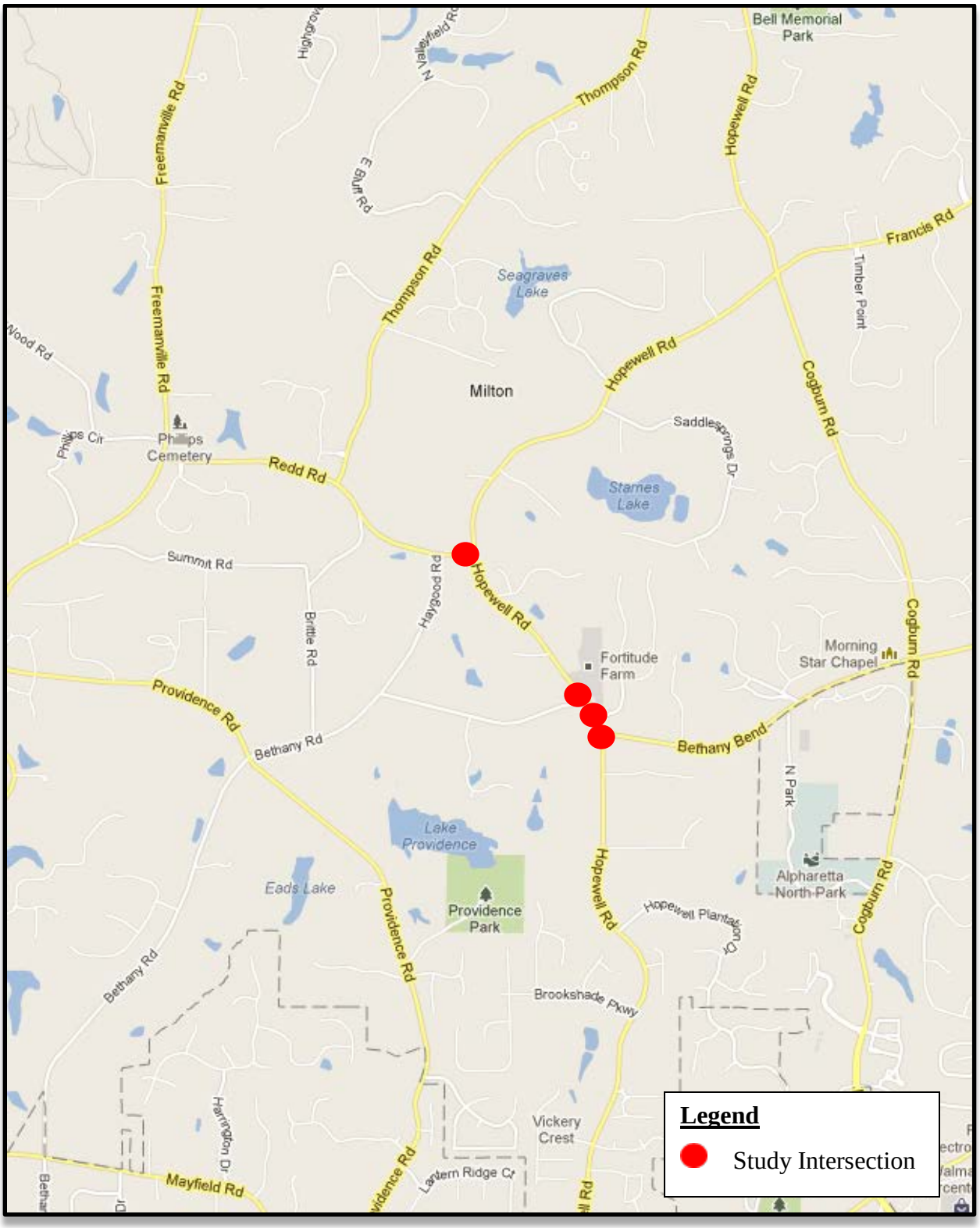

Figure 1. Intersection Locations and Vicinity

SECTION II - EXISTING CONDITIONS

INTERSECTION CONDITIONS AND ADJACENT LAND USE

As stated previously, the following intersections were analyzed as part of this improvement scenarios report:

1. Hopewell Rd/Redd Rd
2. Hopewell Rd/Bethany Way
3. Hopewell Rd/Bethany Oaks Pointe
4. Hopewell Rd/Bethany Bend

Hopewell Road traverses through the intersections as a through movement from the roughly south to north direction. Bethany Bend and Bethany Oaks Pointe tee into Hopewell Road with stop control from the east side while Bethany Way and Redd Road tee into Hopewell Road with stop control from the west side. Hopewell Road serves as a vital north-south link for the City and traverses an area of primarily upscale residential development and equestrian farms. Bethany Bend is utilized as a link from Milton to Johns Creek and provides access to the commercial district and SR 400 in south Milton. Several schools, including the recently opened Cambridge High School and Kings Ridge Christian School, are located off of Bethany Bend or are in close proximity. Bethany Way and Redd Road function as collector roadways that predominately feed traffic to and from Hopewell Road. Bethany Oaks Pointe is a local street that provides the sole access to the Bethany Oaks subdivision.

TRANSPORTATION FACILITIES

The following provides a description of the existing street system near the study intersections including classifications and characteristics.

Hopewell Road is a two-lane, undivided Urban Collector roadway and is a north-south oriented roadway in the study area. In the vicinity of the study area, the posted speed limit on Hopewell Road is 45 mph.

Bethany Bend is a two-lane, undivided Urban Collector roadway and is an east-west oriented roadway in the study area. In the vicinity of the study area, the posted speed limit on Bethany Bend is 45 mph.

Bethany Oaks Pointe is a two-lane, undivided Urban Local roadway and is the access roadway to the Bethany Oaks subdivision. In the vicinity of the study area, Bethany Oaks Pointe is an east-west oriented roadway and the posted speed limit on is 25 mph.

Bethany Way is a two-lane, undivided Urban Collector roadway and is an east-west oriented roadway in the study area. In the vicinity of the study area, the posted speed limit on Bethany Way is 45 mph.

Redd Road is a two-lane, undivided Urban Collector roadway and is an east-west oriented roadway in the study area. In the vicinity of the study area, the posted speed limit on Redd Road

is 45 mph.

The ***Hopewell Road/Redd Road*** intersection is a stop sign controlled intersection with a stop sign on the eastbound Redd Road approach. The ***Hopewell Road/Bethany Way*** intersection is a stop sign controlled intersection with a stop sign on the eastbound Bethany Way approach. The ***Hopewell Road/Bethany Oaks Pointe*** intersection is a stop sign controlled intersection with a stop sign on the westbound Bethany Oaks Pointe approach. The ***Hopewell Road//Bethany Bend*** intersection is a stop sign controlled intersection with a stop sign on the westbound Bethany Bend approach.

The existing lane configurations and traffic control at the study area intersections are shown in Figure 2.

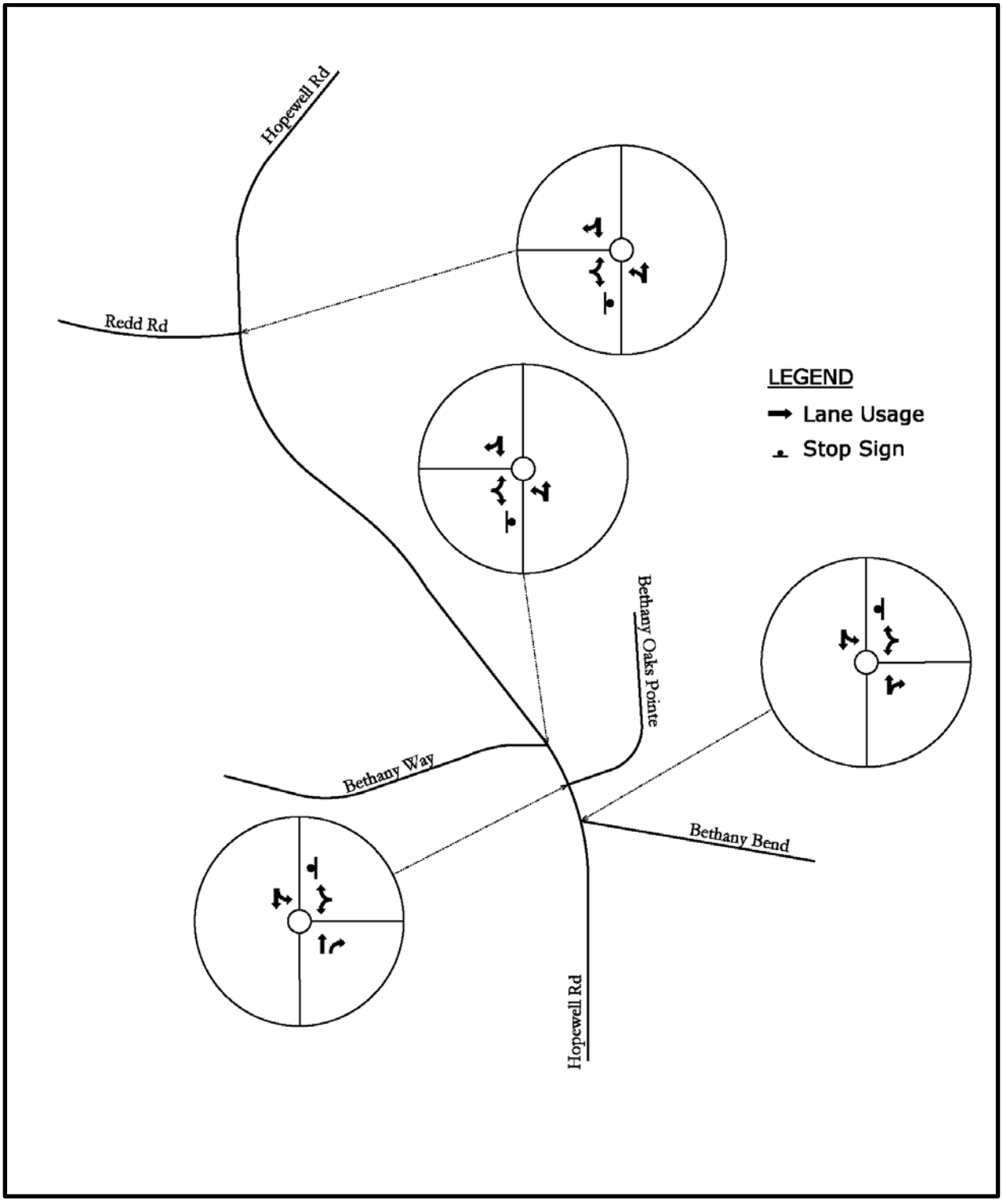

Figure 2. Existing Lane Configurations and Traffic Control

EXISTING TRAFFIC VOLUMES

Existing (Year 2013) A.M. and P.M. peak hour traffic volumes at the study intersections and 24 hour bi-directional volumes along study area roadways were collected by National Data & Surveying Services on Tuesday February 12, 2013 and are presented in Figure 3. The raw traffic count worksheets are provided in Appendix A.

EXISTING INTERSECTION LEVELS OF SERVICE

Based on the existing lane configurations and traffic control shown in Figure 2 and the existing traffic volumes presented in Figure 3, peak hour traffic operations were analyzed at the study intersections using the methodologies outlined in the 2010 Highway Capacity Manual (HCM) and utilizing the *Synchro 8.0* software program.

According to the HCM, there are six levels of service (LOS) by which the operational performance of an intersection may be described. These levels of service range between LOS "A" which indicates a relatively free-flowing condition and LOS "F" which indicates operational breakdown. LOS "D/E" is generally considered the minimum acceptable LOS in urban areas at signalized intersections.

The results of the intersection levels of service analysis for the Year 2013 existing conditions are summarized in Table 1. As shown in Table 1, none of the study area intersections operate at a level of service (LOS) D or better in the AM and PM peak hours except for the Hopewell Road/Bethany Way intersection in the PM peak hour and the Hopewell Road/Bethany Oaks Pointe intersection in the AM peak hour. Please note that the level of service provided for unsignalized intersections is for the worst movement. A LOS F at an unsignalized intersection does not necessarily indicate that a traffic signal is needed. The levels of service worksheets for the 2013 Existing Year condition are provided in Appendix B.

Table 1. Year 2013 Existing Intersection Levels of Service

	Year 2013 Existing (Unsignalized)	
Intersection/Approach	**AM Peak (LOS/Delay)**	**PM Peak (LOS/Delay)**
Hopewell Road / Redd Road	F/ 63.8s	F/ >100s
Hopewell Road / Bethany Way	E/ 41.5s	B/ 14.0s
Hopewell Road / Bethany Oaks Pointe	D/ 28.2s	E/ 35.2s
Hopewell Road / Bethany Bend	F/ 70.1s	F/ >100s

Note: (1) Level of service provided for unsignalized is for the worst movement.

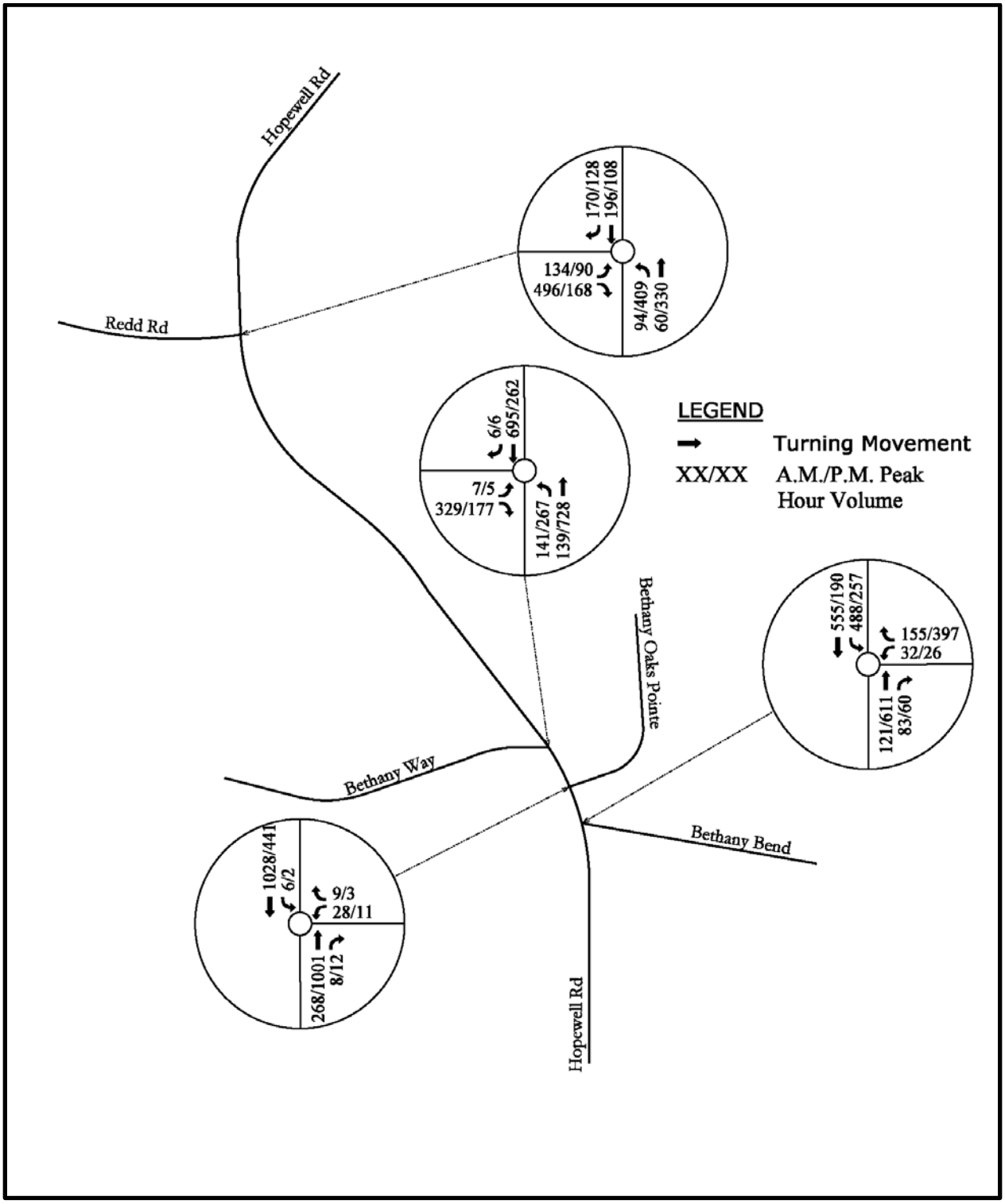

Figure 3. Year 2013 Existing AM and PM Peak Hour Traffic Volumes

NON-MOTORIZED TRANSPORTATION

There is currently a sidewalk on the east side of Hopewell Road north of Bethany Oaks Pointe for 50 feet and along the east side of Hopewell Road from Bethany Oaks Pointe to Bethany Bend. There are currently no bike lanes in the vicinity of the study intersection.

According to the Milton Trail Plan, the City has outlined a proposed trail network for the use of pedestrian and equestrians. A 10-foot wide gravel trail is shown in the Trail Plan as a shorter term project on the south side of Bethany Bend and Bethany Way as well as on the west side of Hopewell Road between Bethany Bend and Bethany Way. Further, a 10-foot wide gravel trail is also shown along Hopewell Road south of Bethany Bend towards Alpharetta as a longer term project.

ON-STREET PARKING

In the vicinity of the study intersections, there was no on-street parking observed or expected in the study area.

CRASH ANALYSIS

Crash data along the section of Hopewell Road within the study area was obtained from the City of Milton for the period between January 1, 2010 and December 31, 2012. The crash data summarized by location and type for the section of Hopewell Road is provided in Table 2.

A detailed analysis of the crashes was undertaken to determine the type of crashes along this section of roadway. The type of crash by location was summarized to determine crash patterns. As shown in Table 2, there were 23 total crashes in this section of roadway over the three (3) year period (2010 - 2012). The majority of the crashes recorded were “Rear-End” type, which accounted for about 39% of the total number of crashes. About 35% of the total number of crashes was found to be “Angle” crashes and 22% of crashes were found to be “Object” crashes, where the vehicle departed the roadway and crashed into a fixed object, such as a tree or utility pole.

Table 2. Crashes by Location and Type - Years 2010 thru 2012

Roadway	Location	Angle	Rear End	Object	Animal	Total
Hopewell Road	North of Redd Road	2	0	0	0	2
Hopewell Road	At Redd Road	0	3	0	0	3
Hopewell Road	Redd Road to Bethany Way	4	2	1	0	7
Hopewell Road	At Bethany Way	1	1	1	0	3
Hopewell Road	At Bethany Oak Point	0	1	0	0	1
Hopewell Road	At Bethany Bend	0	0	1	0	1
Bethany Way	At Hopewell Road	0	0	2	0	2
Bethany Bend	At Hopewell Road	0	0	0	1	1
Redd Road	At Hopewell Road	1	2	0	0	3
Total		**8**	**9**	**5**	**1**	**23**
Percent		**35%**	**39%**	**22%**	**4%**	

SECTION III - FUTURE CONDITIONS

PROPOSED INTERSECTION ALTERNATIVES

In order to alleviate the existing and future operational deficiencies at the study intersections, several different improvement alternatives were evaluated. Intersection improvements included in the City of Milton Comprehensive Transportation Plan were also reviewed.

The following alternatives were evaluated at the study intersections and each alternative is discussed in the following sections:

- Bethany Bend and Bethany Way: Roundabouts
- Bethany Bend and Bethany Way: Stop Sign Control
- Bethany Bend and Bethany Way: Traffic Signal Control
- Redd Road: Roundabout
- Redd Road: Stop Sign Control

Bethany Bend and Bethany Way: Roundabouts – This alternative includes two different roundabout concepts. The first concept alternative includes constructing roundabouts with crosswalks at the Hopewell Road/Bethany Bend and Hopewell Road/Bethany Way intersections. The second concept alternative constructs a single roundabout with crosswalks at Hopewell Road /Bethany Oaks Pointe and intersection improvements at the Hopewell Road/Bethany Bend and Hopewell Road/Bethany Way intersections.

A sketch of the first roundabout concept is shown in Figure 4a. As shown in Figure 4a, bypass lanes with turn bays are provided for all right turns at both roundabouts. Based on discussions with the City of Milton, it was decided that a median break along Hopewell Road at Bethany Oaks Pointe is operationally undesirable and was not included. The Bethany Oaks Pointe intersection would become a right-in/right out. Therefore, vehicles traveling southbound on Hopewell Road wanting to turn left onto Bethany Oaks Pointe would have to circulate around the Hopewell Road/Bethany Bend roundabout and head north on Hopewell Road and make a right onto Bethany Oaks Pointe. Vehicles exiting Bethany Oaks Pointe wanting to turn left onto Hopewell Road to head south would turn have to turn right onto Hopewell Road and circulate around the Hopewell Road/Bethany Way roundabout and head south on Hopewell Road.

Figure 4b shows a sketch of the second roundabout concept. As shown in Figure 4b, the roundabout has two lanes in the northbound and southbound direction. The approaches at Bethany Way and Bethany Bend will be restricted to prohibit left-out movements to improve the overall traffic flow. At the Hopewell Road/Bethany Way intersection the east bound left turn movement will be prohibited and motorists wanting to go north onto Hopewell Road will instead make a right turn maneuver at the Hopewell Road/Bethany Way intersection and a U-turn maneuver at the Hopewell Road/ Bethany Oaks Pointe intersection. In a similar fashion, the west bound left turn movement will be prohibited and motorists wanting to go south onto Hopewell Road will instead make a right turn maneuver at the Hopewell Road/Bethany Bend intersection and a U-turn maneuver at the Hopewell Road/ Bethany Oaks Pointe intersection. This operational changes at the Hopewell Road/Bethany Bend and Hopewell Road/Bethany Way intersections not only improves the overall network traffic flow but also improves the safety at

these intersections by reducing the conflicts at these intersection.

Bethany Bend and Bethany Way: Stop Sign Control – This alternative includes turn lane improvements at the Bethany Bend, Bethany Oaks Pointe and Bethany Way intersections with Hopewell Road. A conceptual sketch of this alternative is shown in Figure 5. As shown in Figure 5, turn lanes are provided for all turning movements at the Hopewell Road/Bethany Bend and Hopewell Road/Bethany Bend intersections. At the Hopewell Road/Bethany Oaks Point intersection, a southbound left turn lane from Hopewell Road is provided. In this alternative, the stop sign control will remain as existing, on Bethany Bend, Bethany Oaks Pointe and Bethany Way intersections.

Bethany Bend and Bethany Way: Traffic Signal Control – This alternative includes the same turn lane improvements included in the stop sign control alternative but adds a traffic signal at the Hopewell Road/Bethany Bend intersection. A conceptual sketch of this alternative is shown in Figure 6. This case was also studied where traffic signals were added at both the Hopewell Road/Bethany Way and Hopewell Road/Bethany Bend intersections.

Redd Road: Roundabout – This alternative includes constructing a roundabout with crosswalks at the Hopewell Road/Redd Road intersection. A conceptual sketch of this alternative is shown in Figure 7. As shown in Figure 7, an eastbound right turn bypass lane and with a turn bay is provided on Redd Road. The south leg of the intersection on Hopewell Road has a northbound left turn bay and northbound through lane that is separate from the left turns in the roundabout.

Redd Road: Stop Sign Control – This alternative includes turn lane improvements at the Hopewell Road/Redd Road intersection. A conceptual sketch of this alternative is shown in Figure 8. As shown in Figure 8, turn lanes are provided for all turning movements at the Hopewell Road/Redd Road intersection. In this alternative, the stop sign control will remain on Redd Road only.

In addition to the alternatives detailed above, there were several other alternatives brought up at the City Council meeting on the 8th of August 2013. These are listed below along with the reason why these alternatives were not studied further as part of this analysis:

1. Three-Way Stop Sign Control: Installing stop sign control on all approaches including Hopewell road will result in increased delays and vehicle queues. This would also have a potential negative impact on overall safety of the intersections due to driver frustrations caused due to the increased delays.
2. One Roundabout at Hopewell Road/ Bethany Bend intersection only: This would not solve the capacity issues at the Hopewell Road/ Bethany Way intersection, which would then result in the queues from the Bethany Way intersection to back into the roundabout at the Bethany Bend intersection. The close proximity of these two intersections require improvements to both intersections for safe and acceptable operations of the traffic network.
3. One Roundabout at Hopewell Road/ Bethany Bend intersection with turn lanes at the Hopewell Road/ Bethany Way intersection: The operational problems at both intersections are very similar in nature. Though turn lane improvements at the Hopewell

Road/ Bethany Way intersection would be adequate in the 2015 Opening Year conditions, for the 2035 Design Year conditions further improvements (roundabout/ traffic signal) would be required at the Hopewell Road/ Bethany Way intersection to adequately serve the expected traffic.

4. Relocate Bethany Oaks Pointe to intersect Bethany Bend: This would be much more expensive than the studied alternatives.
5. Relocate Bethany Way to line up with Bethany Bend: This would also be much more expensive than the studied intersections.

SIGNAL WARRANT ANALYSIS

In order to determine if any of the study intersections are a candidate for signalization for the Year 2013 or 2015 "Opening Year", a signal warrant analysis was performed at the intersections. For this signal warrant analysis, two methods were used to determine if a traffic signal is warranted:

a) Minor side street volume versus the major street volume
b) Major street left turn volume versus major street thru volume

The standard signal warrants are contained in the *Manual of Uniform Traffic Control Devices* (MUTCD). The following three MUTCD warrants are relevant to this analysis:

- Warrant 1 – Eight-Hour Vehicular Volume: This warrant is intended to be applied under one of three conditions. The first condition (Warrant 1A) is based on minimum vehicular volume in which a large volume of intersecting traffic is the principal reason to consider signalization. The second condition (Warrant 1B) is based on interruption of continuous traffic in which the traffic on the major street is so heavy that the intersecting street traffic suffers excessive delays or conflicts. The third condition (Warrant 1C) is the combination of the first two conditions.

- Warrant 2 – Four-Hour Vehicular Volume: This warrant is intended to be applied where cross traffic to the major street is the primary consideration for installing a traffic signal.

- Warrant 3 – Peak Hour: This warrant is intended for use at a location where traffic conditions are such that in the peak hour(s) of an average day, the minor street approach suffers significant delay when entering or crossing the major street.

The warrant analysis based on the minor side street volume versus the major street volume did not meet any warrants. The results of the signal warrant analysis based on the major street left turn volume versus major street thru volume are summarized in Table 3 and Table 4 and are detailed in Appendix C.

As shown in Table 3 and Table 4, the Hopewell Road/Bethany Way and Hopewell Road/Bethany Bend intersections meet only the peak hour warrant for the Year 2013 and 2015 "Opening Year".

Table 3. Results of the Signal Warrant Analysis for Year 2013 Existing

Intersection	Eight Hour			Four Hour	Peak Hour
	Condition A	Condition B	Condition C		
Hopewell Road / Redd Road	No (0)	No (0)	No (0)	No (0)	No (0)
Hopewell Road / Bethany Way	No (2)	No (2)	No (2)	No (2)	Yes (1)
Hopewell Road / Bethany Oaks Pointe	No (0)	No (0)	No (0)	No (0)	No (0)
Hopewell Road / Bethany Bend	No (3)	No (1)	No (2)	No (3)	Yes (1)

Note: Yes/No tells if the warrant is met and the values tell the number of hours the warrant is met.

Table 4. Results of the Signal Warrant Analysis for 2015 "Opening Year"

Intersection	Eight Hour			Four Hour	Peak Hour
	Condition A	Condition B	Condition C		
Hopewell Road / Redd Road	No (0)	No (0)	No (0)	No (0)	No (0)
Hopewell Road / Bethany Way	No (3)	No (2)	No (2)	No (2)	Yes (2)
Hopewell Road / Bethany Oaks Pointe	No (0)	No (0)	No (0)	No (0)	No (0)
Hopewell Road / Bethany Bend	No (3)	No (1)	No (3)	No (3)	Yes (3)

Note: Yes/No tells if the warrant is met and the values tell the number of hours the warrant is met.

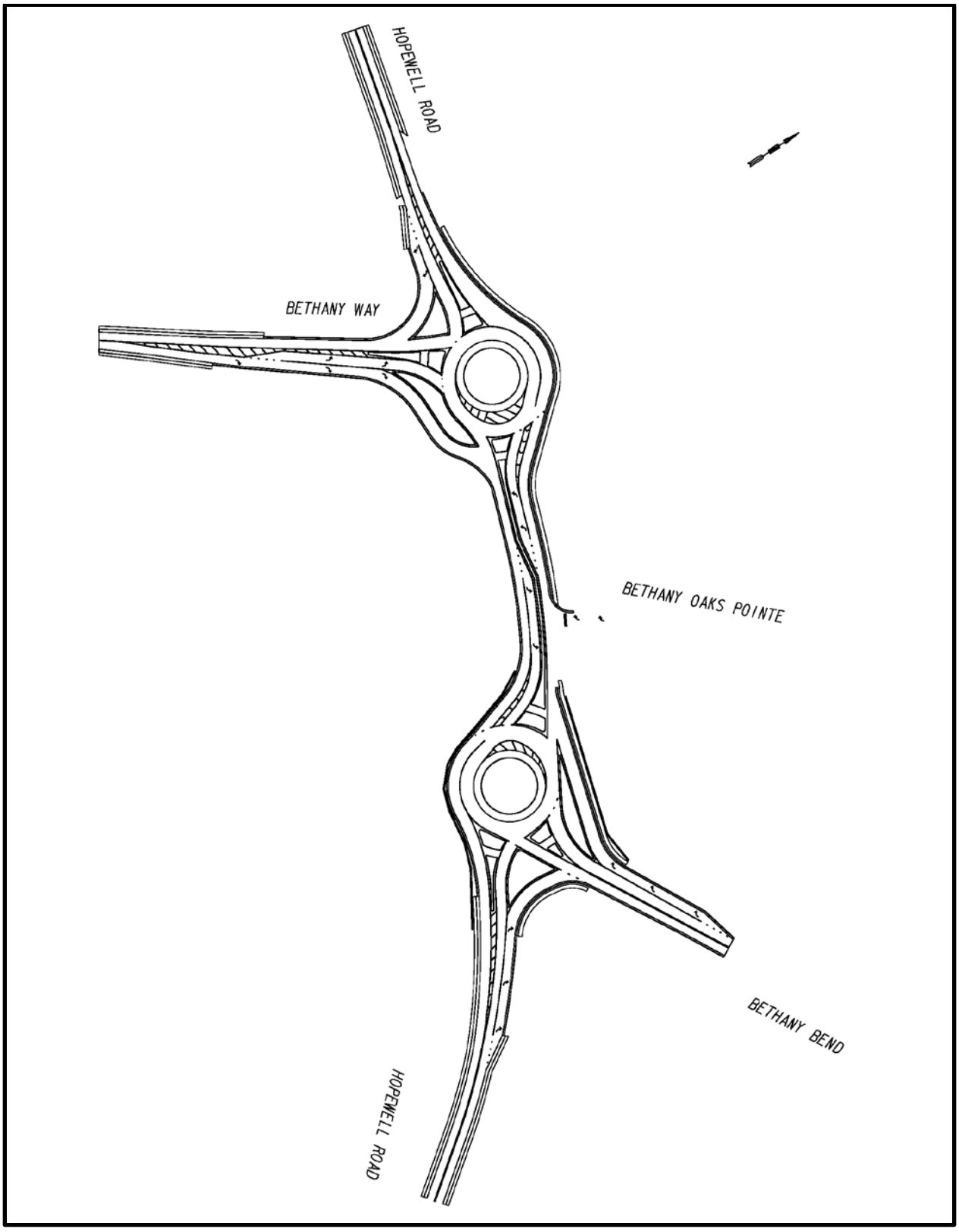

Figure 4a. Bethany Bend & Bethany Way: Roundabouts Improvement Sketch – Concept A

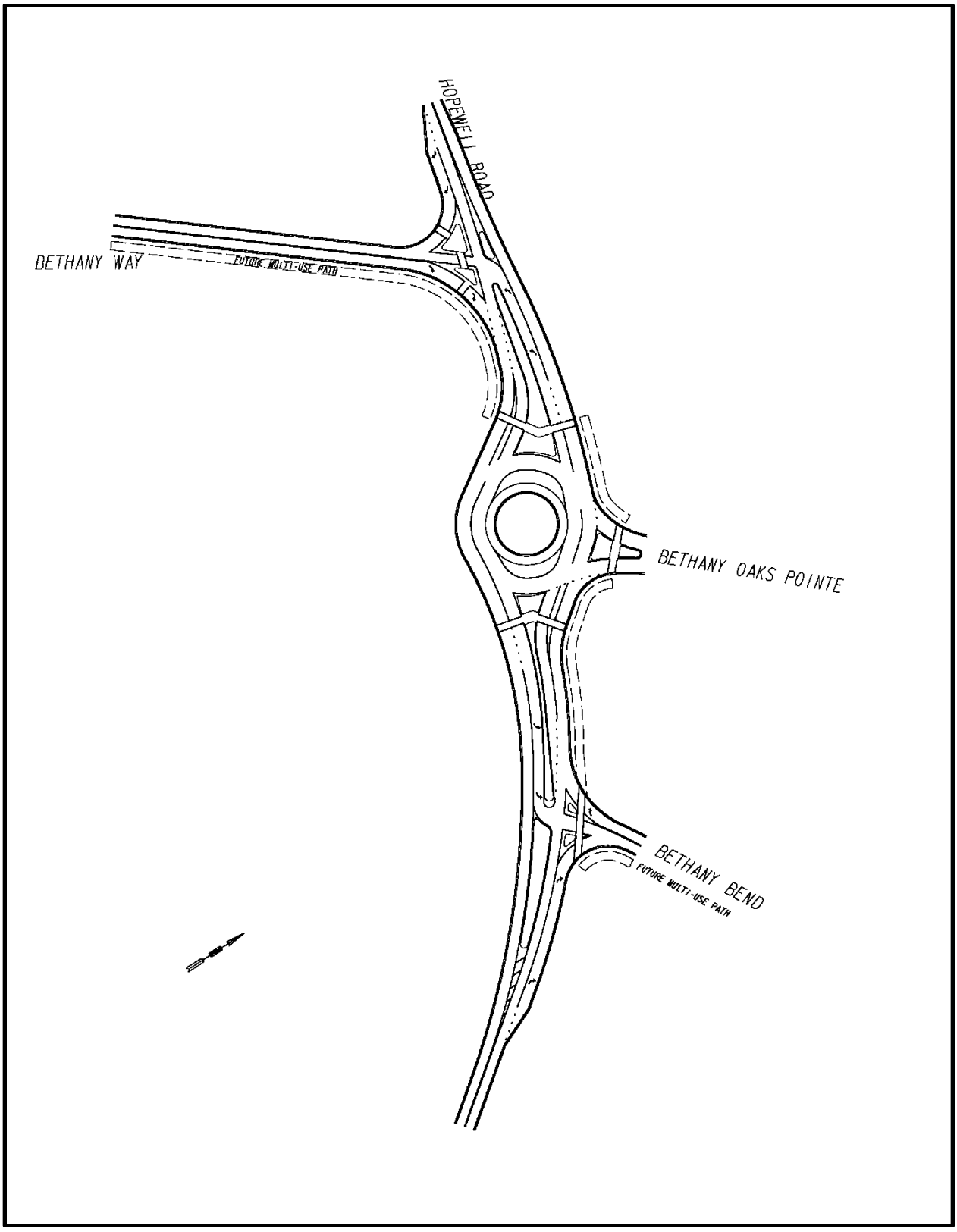

Figure 5b. Bethany Bend & Bethany Way: Roundabouts Improvement Sketch – Concept B

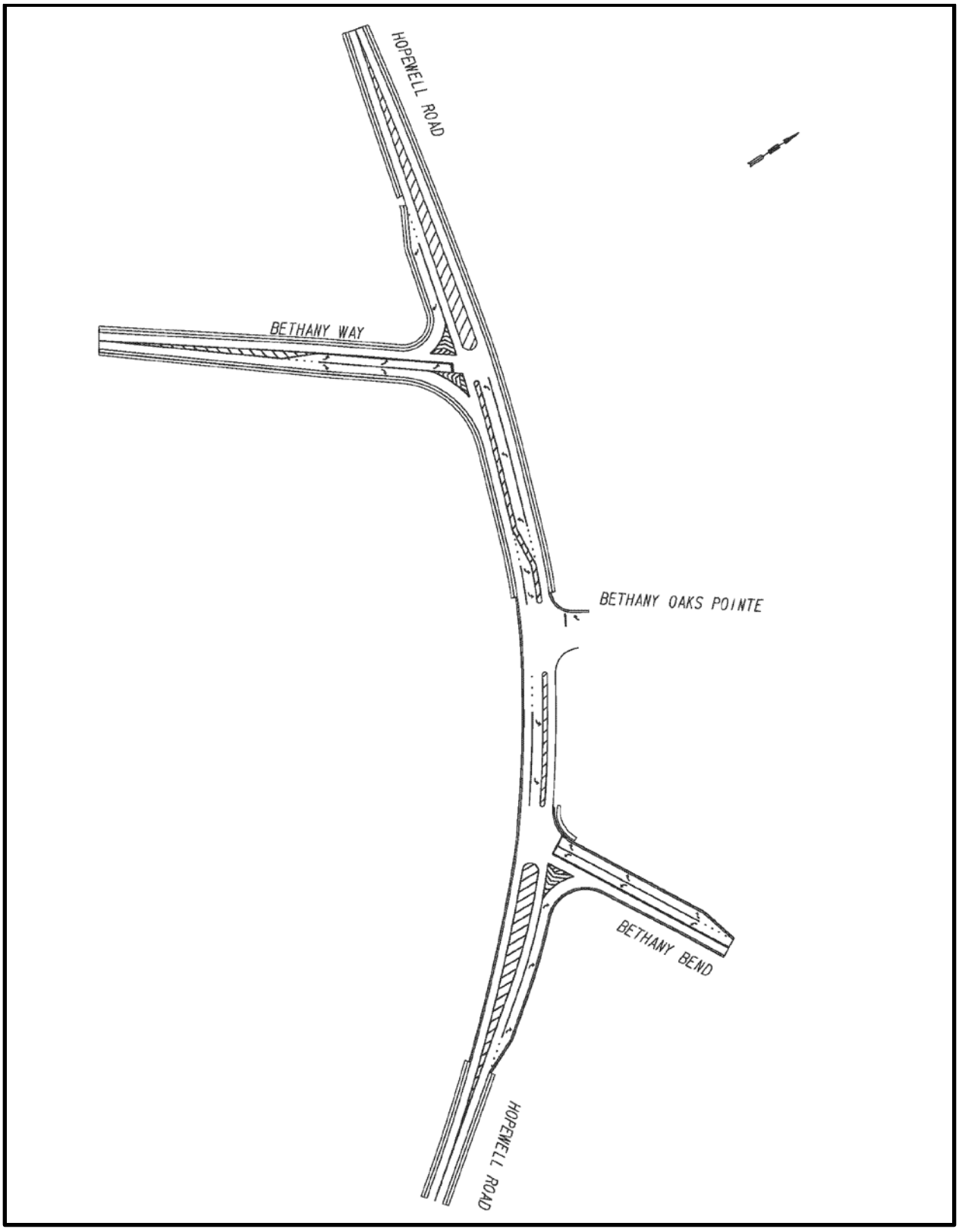

Figure 6. Bethany Bend and Bethany Way: Stop Sign Control Improvement Sketch

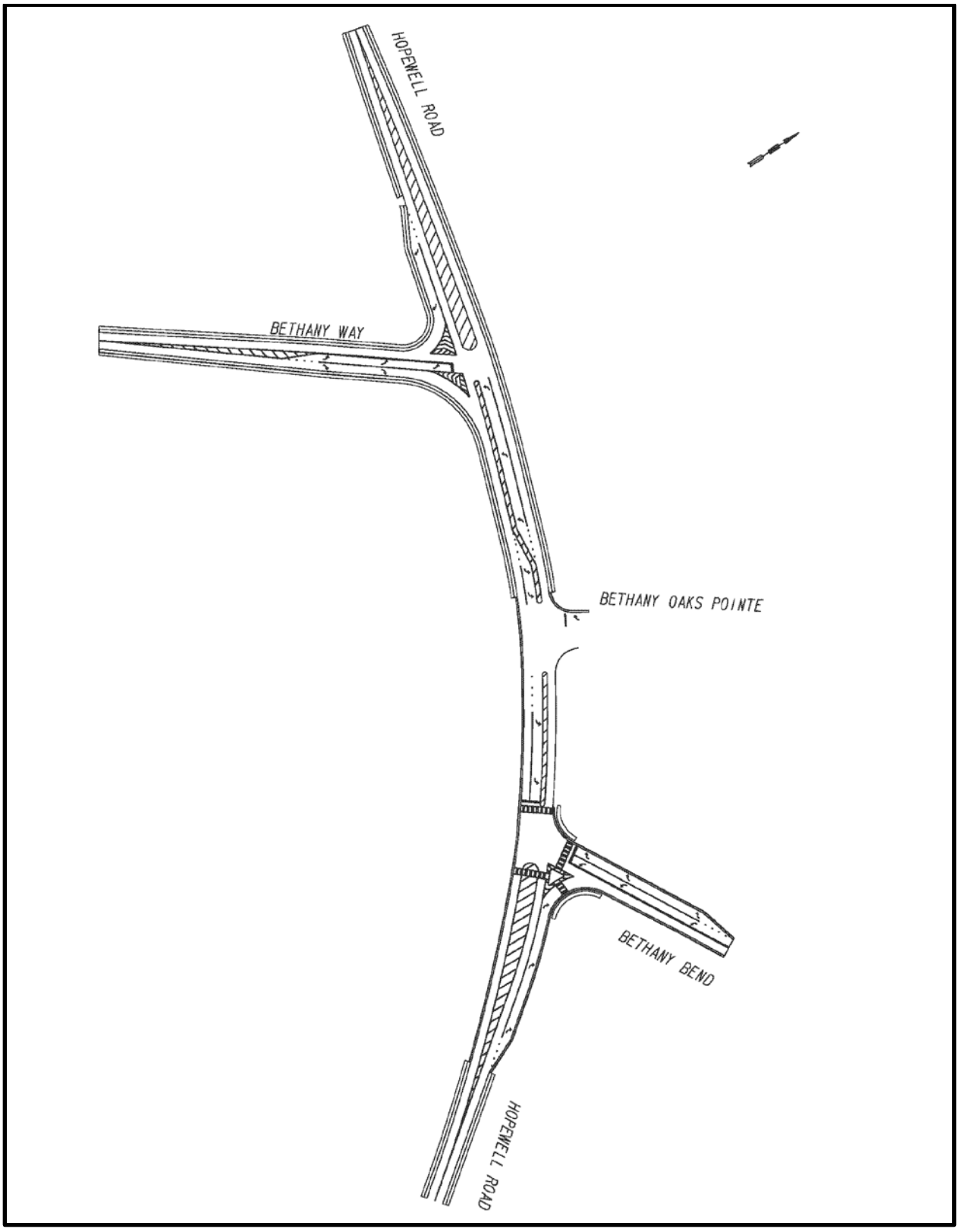

Figure 7. Bethany Bend and Bethany Way: Traffic Signal Control Improvement Sketch

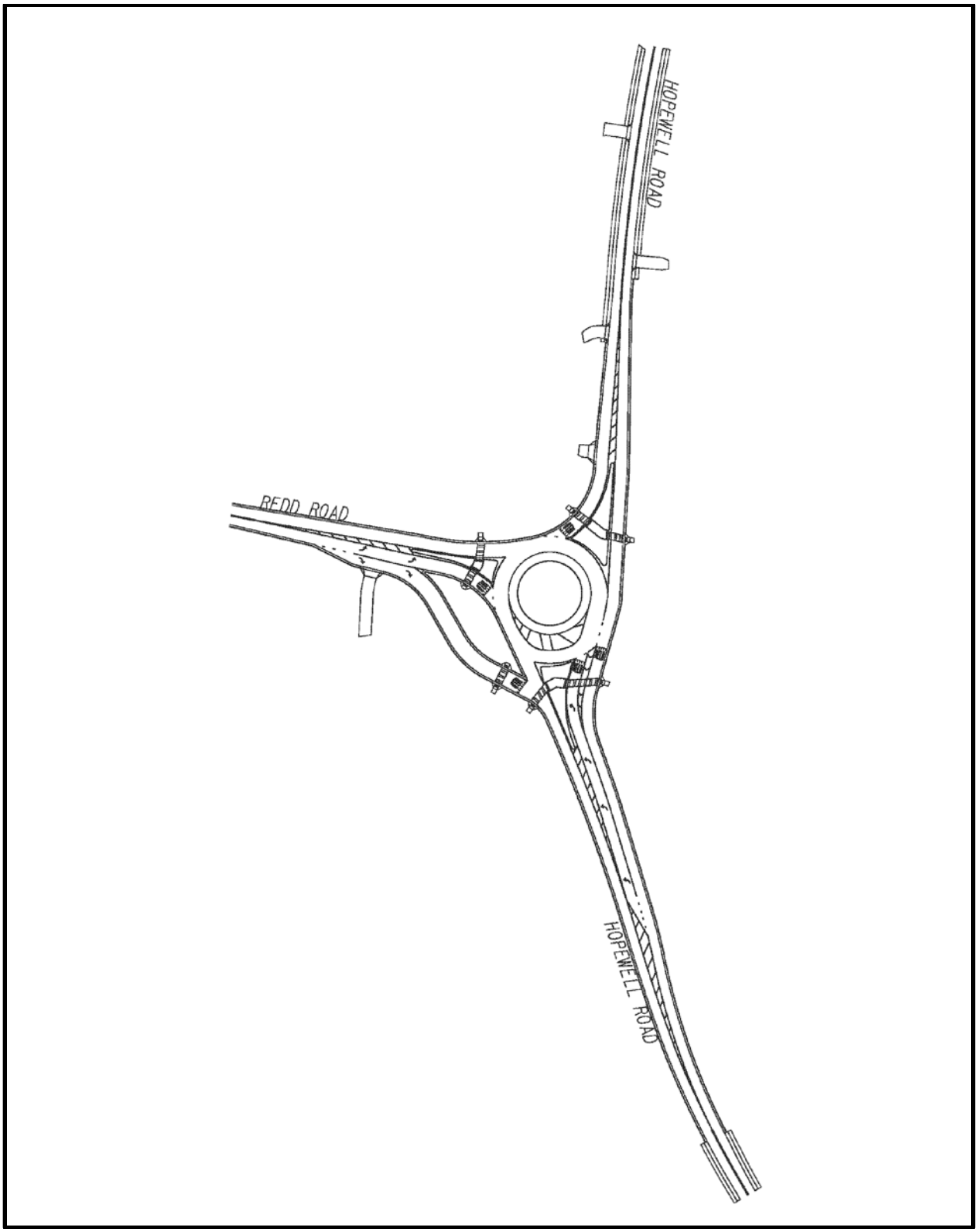

Figure 8. Redd Road: Roundabout Improvement Sketch

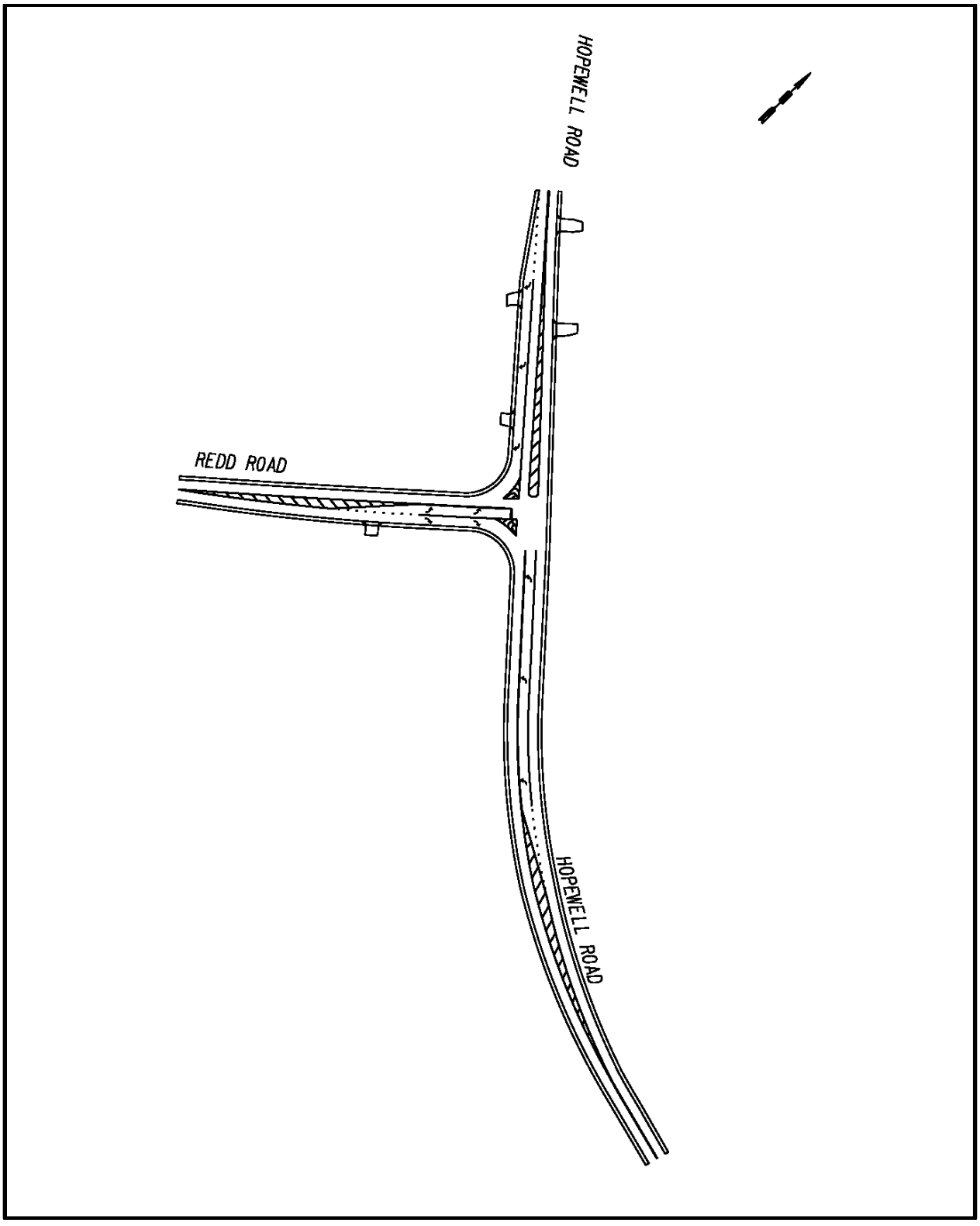

Figure 9. Redd Road: Stop Sign Control Improvement Sketch

ANALYSIS METHODOLOGY

The future traffic operational conditions of the study intersections were based on two years – 2015 "Opening Year" and 2035 "Design Year". This traffic analysis was undertaken as follows:

- Years 2015 "Opening Year" and 2035 "Design Year" were chosen as the analysis years for the future traffic operational analysis of the study intersection. The 2015 and 2035 intersection traffic volumes were derived using a 1.47 percent background growth rate on the study area roadways. Increases in traffic related to the projected attendance increases at Cambridge High School and Kings Ridge Christian School were also accounted for.

- The 2015 and 2035 "No Build" condition levels of service without any improvements at the intersections were calculated to determine future level of service deficiencies.

- The 2015 and 2035 "With Improvements" condition levels of service were calculated to determine the benefits and impacts of each of the potential improvement alternatives.

A detailed discussion of the methodology summarized above and the analysis results are contained in the remainder of this section.

2015 AND 2035 "ANALYSIS YEARS" TRAFFIC VOLUMES

Based on input from the City of Milton, years 2015 "Opening Year" and 2035 "Design Year" were chosen as the analysis years for the future traffic operational analysis at the study area intersections.

The first step was to determine the 2015 "Opening Year" and 2035 "Design Year" background traffic volumes. The traffic generated by the build out of Cambridge High School and Kings Ridge Christian School was then added to the calculated background volumes to determine the total 2015 "Opening Year" and 2035 "Design Year" traffic volumes.

The historical traffic volumes presented in Table 5 indicate that traffic growth in the study area is approximately 1.47 percent. This factor was derived by computing the annual growth rate for the traffic volumes between 2006 and 2011 at five GDOT traffic count stations near the study area and averaging the percent growth at the five count stations. The 1.47 percent annual growth in used in calculating the 2015 "Opening Year" and 2035 "Design Year" traffic volumes is to account for annual increases to the traffic volumes that happen due to other planned developments in the region.

Table 5. Historical ADT Volumes Near Study Area

Year	Bethany Bend East of Hopewell Rd (TC Station 0836)	Bethany Way West of Hopewell Rd (TC Station 0834)	Hagood Rd North of Bethany Way (TC Station 0820)	Hopewell Rd North of Bethany Way (TC Station 0831)	Hopewell Rd North of Redd Rd (TC Station 0822)
2006	6150	4610	2550	11250	6110
2011	6640	4350	3480	8090	8530
Growth	490	-260	930	-3160	2420
Percent Growth	1.55%	-1.15%	6.42%	-6.38%	6.90%
Average Growth	**1.47 %**				

The 2015 "Opening Year" and 2035 "Design Year" traffic volumes were derived using a 1.47 percent annual growth rate on the study area roadways.

The following formula was used for the traffic projections to derive 2015 "Opening Year" and 2035 "Design Year" traffic volumes:

$$F = P\,(1+i)^n$$

Where:

F = Projected traffic, vehicles per hour (2015 or 2035 peak hour traffic volumes)
P = Existing peak hour traffic volume, vehicles per hour
i = growth rate per year = 1.47 percent (0.0147)
n = number of years in projection, 2 for 2015 and 22 for 2035

Based on discussions with the City of Milton and with Cambridge High School and Kings Ridge Christian School, it was determined the student enrollment is around 57% of capacity. To account for the additional traffic generated when the school populations reaches 100% in the future, the amount of trips and the distribution of those trips through the study intersections had to be determined. The estimated number of trips generated by the school's enrollment reaching capacity was determined by reviewing the trip generation information from the Traffic Impact Study for High School Completion for Kings Ridge Christian School and the Traffic Impact Study for Cambridge High School. Based on these traffic impact studies, the additional trips generated by the schools are shown in Table 6.

Table 6. Trip Generation Expected from School Enrollment Increasing

	AM Peak			**PM Peak**		
School	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Cambridge High School	35	11	46	8	23	31
Kings Ridge Christian School	165	40	205	76	50	126

The trip generation shown is Table 6 was distributed to the study area intersections based on trip distributions determined by reviewing existing traffic counts, existing traffic patterns and the previously mentioned traffic impact studies prepared for the schools.

The traffic generated by the school enrollment increases and the background growth were combined to determine the 2015 "Opening Year" and 2035 "Design Year" A.M. and P.M. peak hour traffic volumes at the study area intersections and these are shown in Figure 9 and Figure 10 respectively.

2015 AND 2035 "ANALYSIS YEARS" NO BUILD INTERSECTION LEVELS OF SERVICE

Based on the 2015 "Opening Year" and 2035 "Design Year" traffic volumes and the existing lane configurations and traffic control, levels of service were calculated for the 2015 and 2035 "No Build" condition using design hour volumes and are presented in Table 7.

Table 7. 2015 and 2035 No Build Condition Intersection Levels of Service

	2015 "Opening Year" No Build (Unsignalized)		2035 "Design Year" No Build (Unsignalized)	
Intersection/Approach	**AM Peak (LOS/Delay)**	**PM Peak (LOS/Delay)**	**AM Peak (LOS/Delay)**	**PM Peak (LOS/Delay)**
Hopewell Road / Redd Road	F/ >100s	F/ >100s	F/ >100s	F/ >100s
Hopewell Road / Bethany Way	F/ >100s	C/ 16.6s	F/ >100s	F/ 58.0s
Hopewell Road / Bethany Oaks Pointe	F/ 50.7s	E/ 49.5s	F/ >100s	F/ >100s
Hopewell Road / Bethany Bend	F/ >100s	F/ >100s	F/ >100s	F/ >100s

Note: (1) Level of service provided for unsignalized is for the worst approach.

As shown in Table 7 for the 2015 "Opening Year" No Build Scenario, all of the study area intersections operate a LOS F in the AM and PM peak hours except for Hopewell Road/Bethany Way in the PM peak hour and Hopewell Road/Bethany Oaks Pointe in the PM peak hour.

As shown in Table 7 for the 2035 "Design Year" No Build Scenario, all of the study area intersections operate a LOS F in the AM and PM peak hours.

The LOS worksheets for the 2015 "Opening Year" and 2035 "Design Year" scenario are provided in the Appendix D.

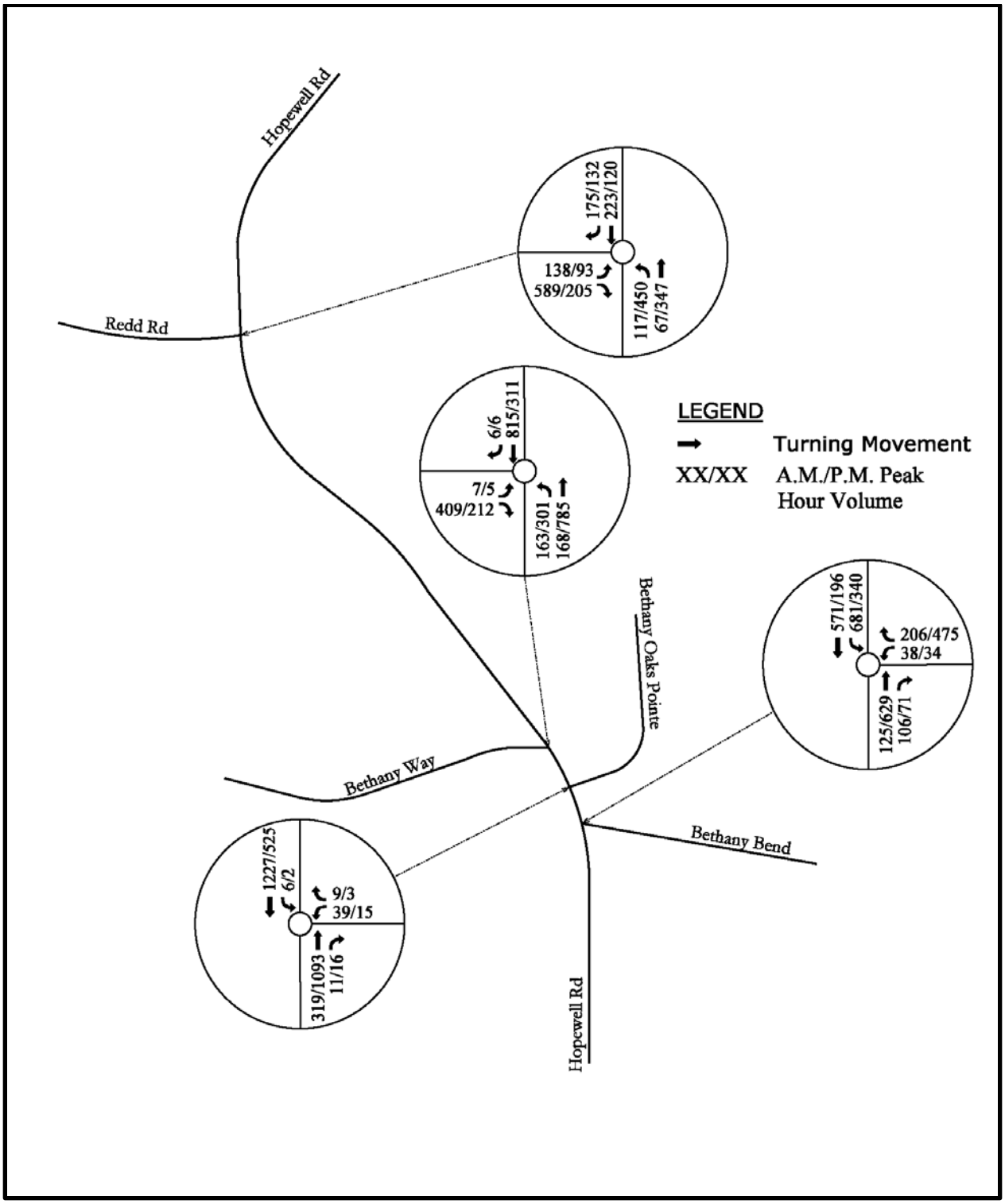

Figure 10. 2015 "Opening Year" Peak Hour Traffic Volumes

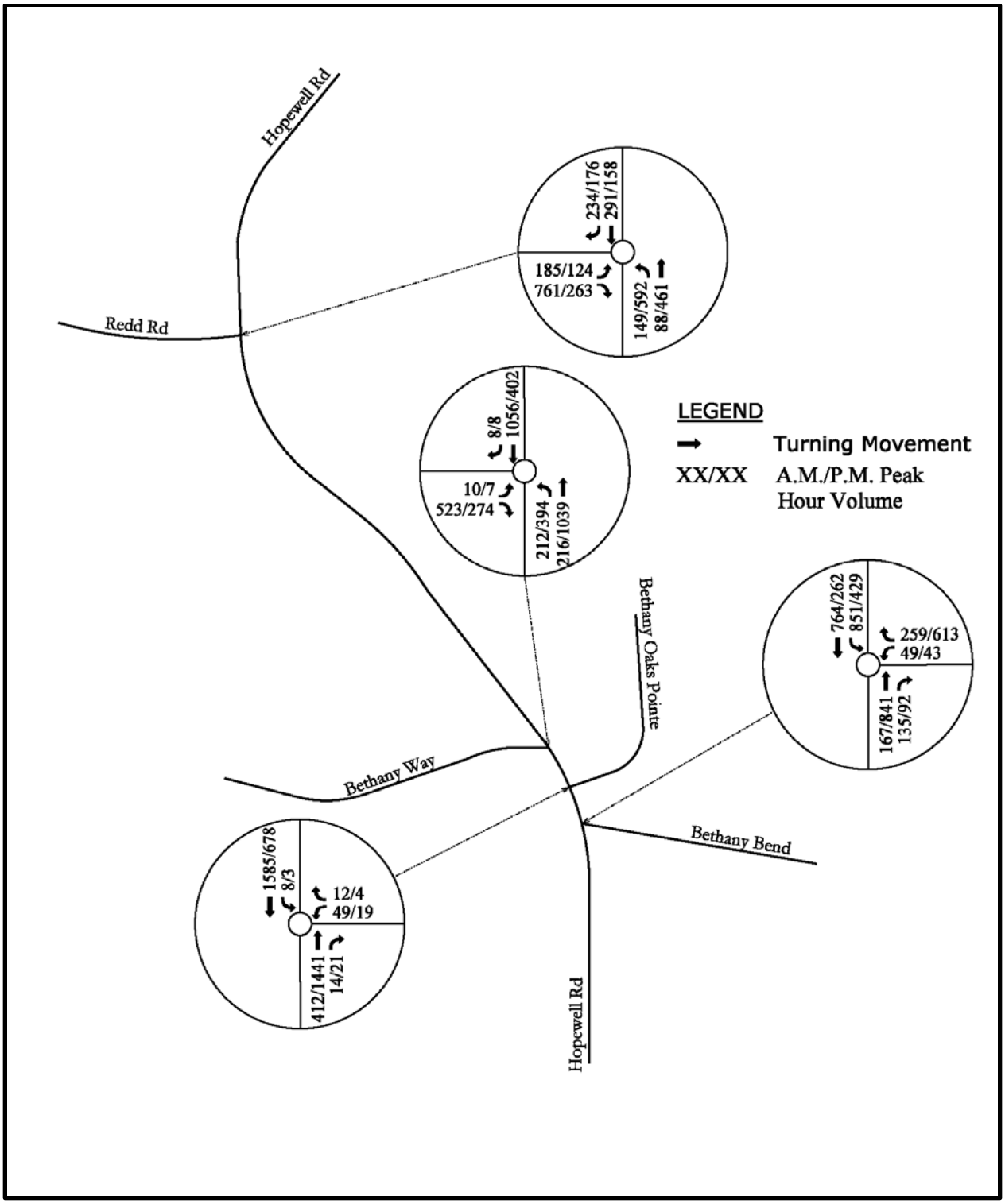

Figure 11. 2035 "Design Year" Peak Hour Traffic Volumes

INTERSECTION LEVELS OF SERVICE FOR THE PROPOSED ALTERNATIVES

In order to determine the impact of the different alternatives, levels of service (LOS) were calculated at each study intersection. Since the alternatives discussed previously consisted of a roundabout, turn lane improvements with stop sign control or turn lane improvements with traffic signal control, the LOS was calculated at each intersection with these improvement alternatives.

The LOS for each intersection, analysis year and alternative are presented in Table 8. The LOS worksheets for the 2015 and 2035 Build Conditions for the different alternatives are provided in the Appendix D.

Table 8. 2015 and 2035 Build Condition Intersection Levels of Service

	2015 "Opening Year"							
	Roundabout: Concept A		**Roundabout: Concept B**		**Turn Lane Improvements (Stop Sign Control)**		**Turn Lane Improvements (Signal Control)**	
Intersection	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**
Hopewell Rd / Redd Rd	A/ 8.4s	A/ 7.3s	NA	NA	C/ 21.7s	F/ 66.2s	NA	NA
Hopewell Rd / Bethany Way	A/ 6.3s	A/ 5.8s	C/ 19.9s	B/ 10.8s	F/ >100s	B/14.3s	C/ 21.4s	A/ 6.1s
Hopewell Rd / Bethany Oaks Pointe	B/ 10.5s	C/ 22.4s	B/ 13.2s	A/ 5.6s	E/ 49.1s	E/ 48.2s	E/ 49.1s	E/ 48.2s
Hopewell Rd / Bethany Bend	A/ 6.3s	A/ 6.2s	B/ 9.4s	C/18.2s	F/ >100s	F/ >100s	A/ 6.3s	B/ 16.0s
	2035 "Design Year"							
	Roundabout: Concept A		**Roundabout: Concept B**		**Turn Lane Improvements (Stop Sign Control)**		**Turn Lane Improvements (Signal Control)**	
Intersection	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**	**AM Pk (LOS/ Delay)**	**PM Pk (LOS/ Delay)**
Hopewell Rd / Redd Rd	B/ 13.1s	B/ 10.4s	NA	NA	F/ 72.5s	F/ >100s	NA	NA
Hopewell Rd / Bethany Way	B/ 12.1s	A/ 8.0s	E/38.1s	B/ 12.2s	F/ >100s	C/ 23.1s	E/ 58.8s	A/ 6.9s
Hopewell Rd / Bethany Oaks Pointe	B/ 11.5s	E/ 37.9s	B/ 14.5s	A/ 9.4s	F/ >100s	F/ >100s	F/ >100s	F/ >100s
Hopewell Rd / Bethany Bend	A/ 8.6s	B/ 14.5s	A/9.8s	D/34.0s	F/ >100s	F/ >100s	A/ 8.6s	D/ 46.4s

Note: (1) Level of service for signalized intersections is for the entire intersection; for unsignalized intersections the level of service provided is for the worst approach.

As shown in Table 8 for the 2015 "Opening Year", all study intersections with a roundabout alternative operate at a LOS A in the AM and PM peak hours. In 2015 with the turn lane improvements and stop sign control, none of the study intersections operate a LOS D or better

except for Hopewell Road/Redd Road in the AM peak hour and Hopewell Road/Bethany Way in the PM peak hour. In 2015 with turn lane improvements and a traffic signal at Hopewell Road/Bethany Bend, the intersection operates at a LOS A in the AM peak hour and a LOS B in the PM peak hour.

As shown in Table 8 for the 2035 "Design Year", all study intersections with a roundabout alternative operate at a LOS B or better in the AM and PM peak hours. In 2035 with the turn lane improvements and stop sign control, all of the study intersections operate at a LOS F in the AM and PM peak hours. In 2035 with turn lane improvements and a traffic signal at Hopewell Road/Bethany Bend, the intersection operates at a LOS B in the AM peak hour and a LOS D in the PM peak hour.

PRELIMINARY PROJECT COST ESTIMATES FOR THE PROPOSED ALTERNATIVES

Construction costs were estimated for the proposed alternatives discussed previously. The construction costs include the cost for utilities construction/relocation, right-of-way and business displacement, construction costs and also the 20 year maintenance cost of the intersections. The estimated total construction costs for each of the proposed improvement alternatives are summarized in Table 9. As shown in Table 9, the roundabout scenarios have the highest estimated project cost and the traditional intersection improvements with stop sign control have the lowest estimated project cost. Detailed preliminary project cost estimates for each alternative can be found in Appendix E.

Table 9. Preliminary Project Cost Estimates for the Proposed Alternatives

Alternative	Estimated Project Cost
Bethany Bend and Bethany Way: Roundabouts Concept A	$ 2,750,000
Bethany Bend and Bethany Way: Roundabouts Concept B	$ 1,370,000
Bethany Bend and Bethany Way: Stop Sign Control	$ 1,150,000
Bethany Bend and Bethany Way: Traffic Signal Control	$ 1,720,000
Redd Road: Roundabout	$ 1,060,000
Redd Road: Stop Sign Control	$ 530,000

BENEFIT-COST ANALYSIS FOR THE PROPOSED ALTERNATIVES

The anticipated congestion benefit and the estimated total project costs associated with all of the intersection improvement alternatives were analyzed as part of this traffic operations analysis. The anticipated congestion benefit was based on methodology developed by the Georgia Department of Transportation (GDOT).

The benefits based on congestion mitigation were quantified based on travel time and fuel savings for both passenger vehicles and trucks over the 20 year design life of the proposed

improvement. The savings in travel time and fuel anticipated for each alternative were compared to the same anticipated for the "No Build" condition to arrive at the benefits for each alternative. The benefit-cost ratio for each of the improvement alternatives were then developed based on these benefits and the costs associated with each of those alternatives. A summary of this is shown in Table 10. The benefit-cost worksheets based on travel time and fuel savings are provided in Appendix F.

Table 10. Congestion Based Benefit-Cost Ratios for the Proposed Alternatives

Alternative	Preliminary Cost	20 Year Congestion Benefit	Benefit to Cost Ratio
Bethany Bend and Bethany Way: Roundabouts Concept A	$ 2,750,000	$ 105,608,000	38.4
Bethany Bend and Bethany Way: Roundabouts Concept B	$ 1,370,000	$ 54,542,000	39.8
Bethany Bend and Bethany Way: Stop Sign Control	$ 1,150,000	$ 13,311,000	11.6
Bethany Bend and Bethany Way: Traffic Signal Control	$ 1,720,000	$ 56,603,000	32.9
Redd Road: Roundabout	$ 1,060,000	$ 19,984,000	18.9
Redd Road: Stop Sign Control	$ 530,000	$ 13,560,000	25.6

As shown in Table 10 for the Bethany Bend and Bethany Way Alternatives, the roundabouts and the signal control option have higher benefit-cost ratio compared to the stop sign control options. For the Redd Road Alternatives, the traditional turn lane improvements with stop sign control have the highest benefit-cost ratio. However, the benefit-cost ratios between the different alternatives at each intersection location are relatively comparable to each other.

CONCLUSIONS

Several alternatives were evaluated at the study intersections including roundabouts, turn lane improvements with stop sign control, and turn lane improvements with traffic signal control. A signal warrant analysis was performed at the study intersections. No warrants were met at the Hopewell Road/Bethany Oaks Pointe and Hopewell Road/Redd Road intersections for the Year 2013 and 2015 "Opening Year" conditions. Only the peak hour warrant was met at the Hopewell Road/Bethany Way and Hopewell Road/Bethany Bend intersections for the Year 2013 and 2015 "Opening Year". A traffic signal is not recommended at the Hopewell Road/Bethany Way and Hopewell Road/Bethany Bend intersections as only the peak hour warrants are met. Installing a traffic signal based on the conditions analyzed would result in increased delays. These intersections should be monitored in the future to determine when the eight-hour warrants are met to be candidates for signalization.

In the 2015 "Opening Year" No Build Scenario, all of the study area intersections operate a LOS F in the AM and PM peak hours except for Hopewell Road/Bethany Way in the PM peak hour and Hopewell Road/Bethany Oaks Pointe in the PM peak hour. In the 2035 "Design Year" No

Build Scenario, all of the study area intersections operate a LOS F in the AM and PM peak hours.

In the 2015 "Opening Year" Build Scenario, all study intersections with a roundabout alternative operate at a LOS A in the AM and PM peak hours. In 2015 with the turn lane improvements and stop sign control, none of the study intersections operate a LOS D or better except for Hopewell Road/Redd Road in the AM peak hour and Hopewell Road/Bethany Way in the PM peak hour. In 2015 with turn lane improvements and a traffic signal at Hopewell Road/Bethany Bend, the intersection operates at a LOS A in the AM peak hour and a LOS B in the PM peak hour.

In the 2035 "Design Year" Build Scenario, all study intersections with a roundabout alternative operate at a LOS B or better in the AM and PM peak hours. In 2035 with the turn lane improvements and stop sign control, all of the study intersections operate at a LOS F in the AM and PM peak hours. In 2035 with turn lane improvements and a traffic signal at Hopewell Road/Bethany Bend, the intersection operates at a LOS B in the AM peak hour and a LOS D in the PM peak hour.

The roundabout intersection improvements have the highest estimated project cost and the traditional intersection improvements with stop sign control have the lowest estimated project cost.

For the Bethany Bend and Bethany Way Alternatives, the roundabouts and the signal control option have higher benefit-cost ratio compared to the stop sign control options. For the Redd Road Alternatives, the traditional turn lane improvements with stop sign control have the highest benefit-cost ratio.

PUBLIC OUTREACH AND COMMENTS

In conjunction with this improvement scenarios report study, a public review of the alternatives was conducted on July 7, 2013 at 6 PM to receive comments on the concepts. The concepts and simulations of traffic operations were available on the City website for public review prior to the public meeting. There were opportunities to comment online or at the meeting. The City of Milton received 77 comments and these are included in Appendix G.

RECOMMENDATIONS

After evaluating the different proposed concept improvement scenarios proposed for the study area intersections and their anticipated benefits, costs, impacts, and drawbacks, GS&P recommends the implementation of the improved turn lane alternative with the possible future addition of a traffic signal at Bethany Bend and/or Bethany Way intersections. For the Hopewell Road at Redd Road intersection, the implementation of the dual lane roundabout alternative is recommended.

While the two dual lane roundabouts with raised median or the single dual lane roundabout at Bethany Oaks Pointe alternatives have better design year levels of service and other potential operational improvement benefits, they also have significant property impacts, greater

construction costs, limited access control on the side roads, and, supported by input from the public outreach, have lane configurations that would be confusing to unfamiliar drivers.

The improved turn lane alternative offers the best trade-off of improved operations with the lowest estimated initial costs (half that of the two dual lane roundabouts with raised median) with the least property impacts. Further, this option allows full access from Bethany Bend/Way/Oaks Pointe and was received favorably from the public outreach.

The installation of the improved turn lane alternative allows for a potential, relatively simple addition of a traffic signal at Bethany Bend and/or Bethany Way intersections in the future. A traffic signal is not recommended at the Hopewell Road/Bethany Way and Hopewell Road/Bethany Bend intersections currently (based on the Year 2013 and 2015 "Opening Year" conditions analyses) as only the peak hour warrants are met. Installing a traffic signal based on the conditions analyzed would result in increased delays. These intersections should be monitored in the future once the improved turn lanes are constructed to determine when the eight-hour warrants are met to be candidates for signalization. Another contributing factor for a traffic signal would be the construction of the planned multi-use trail along Bethany Bend and Bethany Way as a traffic signal would allow for a protected pedestrian/equestrian crossing over Hopewell Road.

A partial dual lane roundabout at the intersection of Hopewell Road at Redd Road significantly improves the intersection's operations, particularly in the 2035 design year, versus the addition of turn lanes. While a roundabout at this location does not have quite as large of a benefit-cost ratio as the turn lane alternative and has slightly more impacts, this is based on only a $500,000 difference. Unlike the Hopewell Road at Bethany Bend/ Way/Oaks Pointe intersections, the anticipated traffic volumes do not indicate that the turn lane alternatives could be upgraded with the traffic signal at a future date. Further, the impacts from the roundabout alternative are largely concentrated on an open, unimproved portion of a single parcel whereas the turn lane alternative impacts are distributed between several developed parcels. In addition to the enhanced levels of service, a roundabout intersection at this location offers the best geometric improvement to remedy the current poor northbound horizontal sight distance on Hopewell Road in advance of the intersection as well as some traffic calming benefits for Hopewell Road. Unlike the more complex roundabout alternatives for Hopewell Road at Bethany Bend/ Way/Oaks Pointe, the Hopewell Road at Redd Road intersection is a standalone 'tee' configuration, so the lane should assignments should be easily understood by unfamiliar motorists.

APPENDIX A

EXISTING TRAFFIC COUNTS

APPENDIX B

EXISTING INTERSECTION LEVEL OF SERVICE WORKSHEETS

APPENDIX C

TRAFFIC SIGNAL WARRANT ANALYSIS WORKSHEETS

APPENDIX D

2015 AND 2035 INTERSECTION LEVEL OF SERVICE WORKSHEETS

APPENDIX E

CONSTRUCTION COSTS ESTIMATES FOR PROPOSED ALTERNATIVES

APPENDIX F

BENEFIT-COST RATIO WORKSHEETS

APPENDIX G

PUBLIC OUTREACH FINDINGS