TRANSPORTATION ANALYSIS

Prepared For

Cherokee County Board of Commissioners

BELLS FERRY ROAD CORRIDOR STUDY

CHEROKEE COUNTY, GA

November 23, 2020

ENGINEERING WILBURN

Design • Install • Maintain

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CONTENTS

LIST OF FIGURES

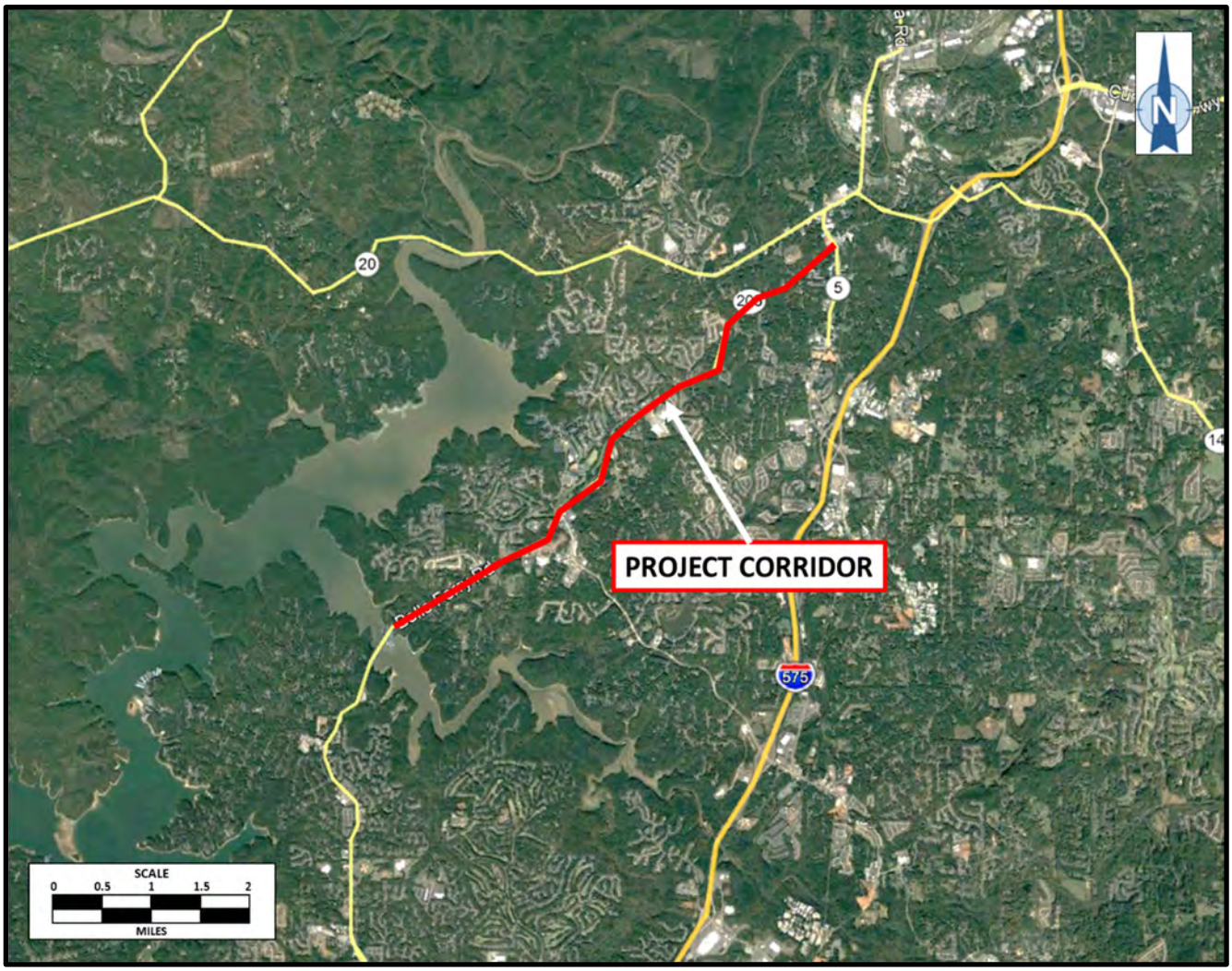
LIST OF TABLES

INTRODUCTION

The purpose of this report is to identify short-term, mid-term and long-term improvements to the Bells Ferry Road (BFR) Corridor such as intersection and sight distance improvements, proposals to improve school traffic circulation, and the potential for road widening. The proposed project extends from Wooten Drive north to Marietta Highway. The study corridor is located in Cherokee County and is approximately 5.6 miles in length.

BFR is classified as a minor arterial for its entire length. The posted speed limit is 45 mph along the corridor. Figure 1 shows the BFR location of the corridor.

Figure 1: PROJECT LOCATION MAP

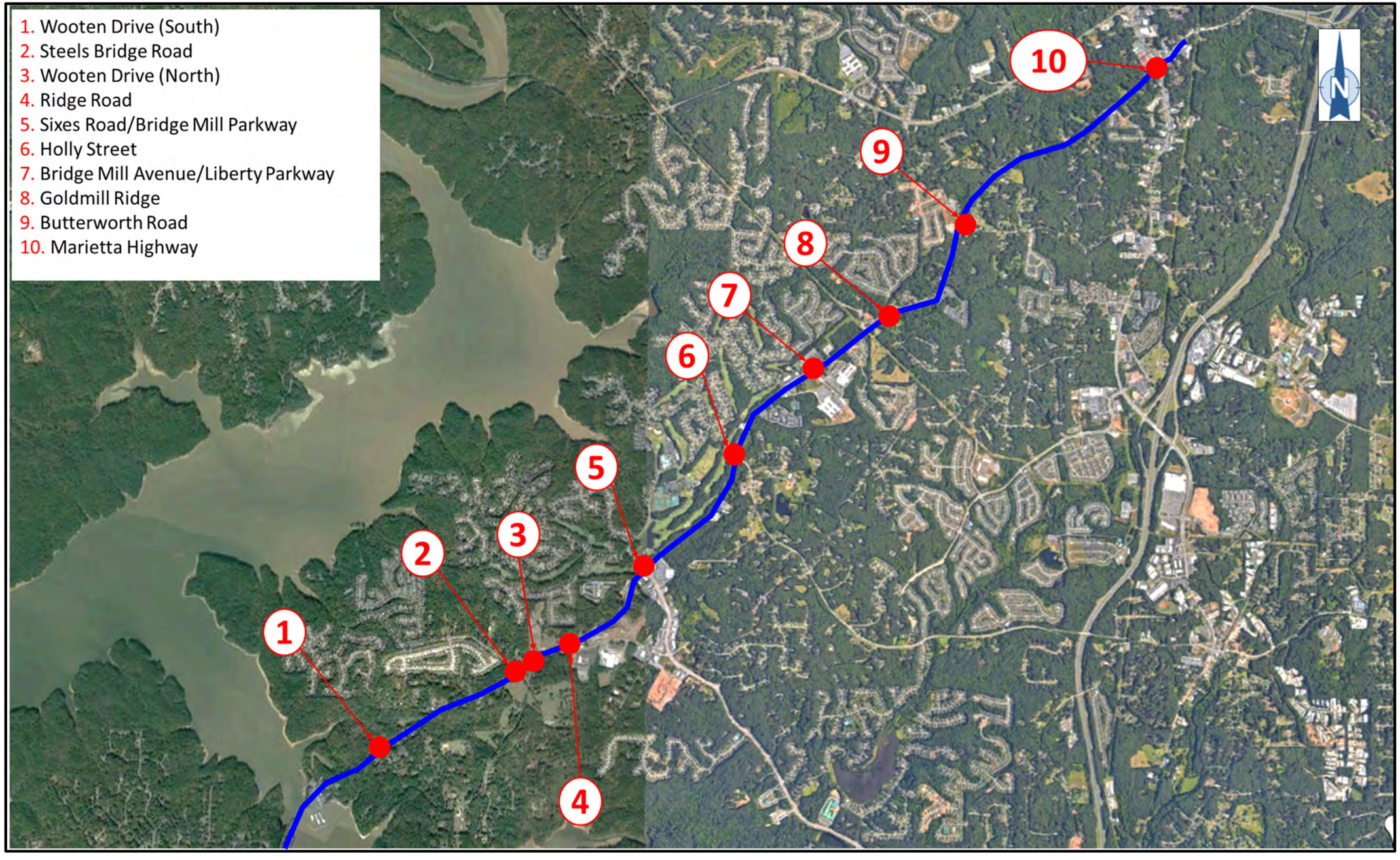


STUDY AREA

These study intersections are shown in Figure 2 on the following page. This key map provides study intersections and study intersection numbers. The study intersections, identified by road names and by study intersection number, are as follows:

1. BFR & Wooten Drive (South)
2. BFR & Steels Bridge Road
3. BFR & Wooten Drive (North)
4. BFR & Ridge Road
5. BFR & Sixes Road/Bridge Mill Parkway
6. BFR & Holly Street
7. BFR & Bridge Mill Avenue/Liberty Road
8. BFR & Goldmill Ridge
9. BFR & Butterworth Road
10. BFR & Marietta Highway

Figure 2: STUDY AREA MAP



EXISTING CONDITIONS

A field visit and preliminary research was conducted to inventory the existing conditions along the study corridor, including functional classification, geometry, traffic control, traffic volumes and characteristics.

FIELD VISIT

A field visit was conducted on Wednesday, August 12, 2020 by Wilburn Engineering staff. The following summarizes during the field visit, the full Field Inspection Report can be found in Appendix A:

- There are several locations, including side street approaches, that suffer from a deficiency of sight distance. In most cases this is due to horizontal or vertical curvature and sometimes both.
- One such location is at the Little River Marina that sits at the bottom of a curve that has both horizontal and vertical elements. This has led to several crashes due to the poor sight distance.
- Cherokee County officials indicted to Wilburn Engineering a location near the intersection of BFR and Steels Bridge Road that potentially has issues. While the Steels Bridge Road approach at the intersection does meet sight distance, there is a vertical curve south of the intersection that does limit sight line for all drivers approaching in either direction.
- Liberty Elementary School observations:
    - Cars began queuing for student drop-off starting at 7:00 AM and dissapted by 7:30 AM.
    - During the Afternoon School Pick-up extended back several hundred feet on BFR.
    - The queue during the Afternoon School Pick-up cleared up by 2:30 PM (15 minutes after school let out).
- Freedom Middle School observations:
    - During the Afternoon School Pick-up extended back several hundred feet on BFR.
    - The queue during the Afternoon School Pick-up cleared up by 4:20 PM (20 minutes after school let out).

FUNCTIONAL CLASSIFICATION

Table 1, on the following page, lists the GDOT functional classification of each roadway along the study corridor.

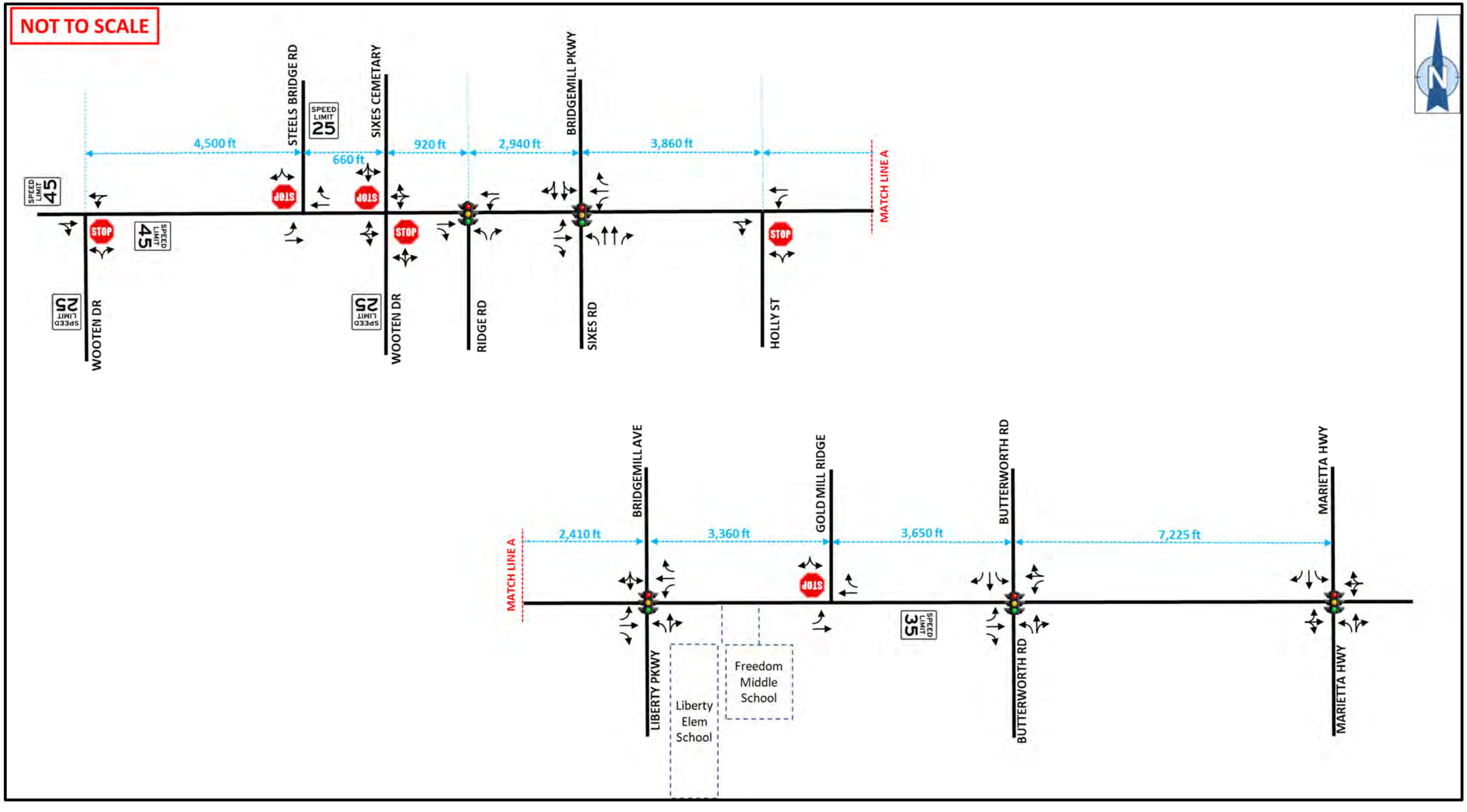
Table 1: GDOT FUNCTIONAL CLASSIFICATION TABLE

ROAD NAME	TYPE OF FACILITY	RURAL/ URBAN	STATE ROUTE?
Wooten Drive (South)	Local Road	Urban	N/A
Steels Bridge Road	Local Road	Urban	N/A
Wooten Drive (North)	Local Road	Urban	N/A
Ridge Road	Major Collector	Urban	N/A
Sixes Road/ Bridge Mill Parkway	Local Road	Urban	N/A
Holly Street	Major Collector	Urban	N/A
Bridge Mill Parkway/ Liberty Parkway	Local Road	Urban	N/A
Goldmill Ridge	Local Road	Urban	N/A
Butteworth Road	Major Collector	Urban	N/A
Marietta Highway	Minor Arterial	Urban	SR 5

GEOMETRY AND TRAFFIC CONTROL

The existing geometry and traffic control are shown in Figure 3 below.

Figure 3: EXISTING CONDITIONS



TURNING MOVEMENT VOLUMES

Turning movement counts (TMC's) were conducted in August of 2020. Six-hour TMCs were collected at all intersections. The established AM and PM Peak Hours along the corridor are 7:00 AM to 8:00 AM, 2:00 PM to 3:00 PM and 4:30 PM to 5:30 PM. The Traffic Count Map is provided in Appendix B. The turning movement counts are included in Appendix C. The count number on each sheet corresponds to the location identified in the count map.

DAILY VOLUMES

Forty-eight-hour traffic counts were collected in August of 2020. Forty-eight-hour counts, including 3 vehicle classification counts, were collected at different points along BFR. The forty-eight-hour data is included in Appendix D.

An excel spreadsheet was developed to convert the 48-hour existing Average Daily Traffic (ADT's) to Annual Average Daily Traffic (AADT's). The ADT locations were adjusted using the 2019 daily and monthly factors provided by the GDOT. ADT to AADT conversion charts are provided in Appendix E.

The existing traffic diagrams are provided in Appendix F. AADT's have been balanced and rounded up to the nearest 25.

RELATED ROADWAY PROJECTS IN THE STUDY AREA

From the Atlanta Regions Plan RTP Project List

- P.I. 0013526 (CH-010A2) – Bells Ferry Road Widening – This project proposes to widen BFR from 2 to 4 lanes with a raised median and curb and gutter for a length of 2.3 miles. The project also proposes a 5-foot sidewalk on the west side of BFR, and a 10-foot mixed use path on the opposite side. This improvement is proposed between the intersections of South Fork Way and Victoria Road.

- P.I. 0013525 (CH-010B) – Bells Ferry Road Bridge Replacement and Approach – From the ARC description page, "This project is a bridge replacement at Bells Ferry Road north of Little River. The bridge will be upgraded with a two-lane deck." This project proposes to construct a new two-lane bridge and shift the alignment of the road to the north, to improve the sight distance of the existing curve that exists with both horizontal and vertical curvature. The project is proposed to let in 2023 and open in 2026. In order to outline improvements that will coincide with the new bridge, 2026 was chosen as the base year for this Traffic Data Report.

A separate bridge from P.I. 0013525, is planned for the future though it does not have a P.I. number. This bridge will also be a two-lane bridge built alongside the new bridge from P.I. 0013525, with the intention being utilized when Bells Ferry Road is widened to four lanes.

SAFETY EVALUATION

CRASH HISTORY

Crash data for the study corridor was obtained from the Georgia Electronic Accident Reporting System (GEARS). Table 2 and Table 3 summarize the crash data for the segment of BFR from Wooten Drive (South) to Marietta Highway. The most recent complete five-year period of available data is shown. The complete crash data is provided in Appendix G.

Table 2: CRASH DATA SUMMARY, WOOTEN DRIVE TO MARIETTA HWY

YEAR	TOTAL CRASHES	INJURY CRASHES /INJURIES	FATALITIES	COLLISION w/ OTHER VEHICLE				COLLISION w/ ANIMAL OR STRUCTURE
				RIGHT ANGLE	HEAD ON	REAR END	SIDE-SWIPE	
2015	110	27/37	0	31	6	38	11	24
2016	123	34/47	0	24	3	47	8	41
2017	126	24/43	0	27	1	52	9	37
2018	111	33/56	0	33	5	41	8	24
2019	122	21/43	0	35	3	48	13	23
TOTAL	**592**	**139/226**	**0**	**150**	**18**	**226**	**49**	**149**

The crash history along the corridor indicates that rear end collisions were the most common type of crashes, accounting for approximately 38% of the collisions for the past five years.

CRASH RATE CALCULATIONS

Crash rates were calculated for the BFR study corridor using the following equation:

$$Crash\ Rate\ = \#\ crashes/(\frac{L * ADT * 365}{100{,}000{,}000})$$

Where;
L = length of section in miles
ADT = Average daily volume

Table 3 summarizes the crash rates along the corridor from Wooten Drive to Marietta Highway. The table shows the rates for all crashes, injuries, and fatalities, and compares each to the statewide averages (SWA) for like facilities.

The analysis year volumes were developed by first locating the highest volume counted on this section of the corridor for this study in 2020 then reducing this volume by the no-build growth rate of 1.0% per year.

Table 3: CRASH RATE SUMMARY, WOOTEN DR TO MARIETTA HWY

YEAR	ADT	ALL CRASHES			INJURIES			FATALITIES		
		FREQ	PROJECT[1]	SWA	FREQ	PROJECT[1]	SWA	FREQ	PROJECT[1]	SWA
2015	12025	110	448	637	27	110	156	0	0	1.68
2016	12150	123	495	655	34	137	156	0	0	1.53
2017	12275	126	502	623	24	96	153	0	0	1.35
2018	12400	111	438	540	33	130	134	0	0	1.34
2019	12525	122	477	N/A	21	80	N/A	0	0	N/A

SWA=Statewide Average Crash Rate for like facility

[1] Crash rates calculated based on the number of crashes per 100 million vehicle miles traveled

All of the annual crash rates for this section of the BFR corridor are below statewide averages for total crashes and injury crashes. There were no fatalities reported for this section of the corridor during the most recent five-year period. The rates for 2019 were not available at the time of this report.

REQUIRED SIGHT DISTANCE

For vehicles turning left from a unsignalized minor street approach onto BFR, the required time to cross opposing lanes of traffic is as follows:

$$t = 7.5s + (0.5s) * (n)$$

$$t = 7.5\ seconds$$

Where n = number of lanes (more than one) to cross

The left turning drivers should have enough sight distance to see opposing vehicles approaching at the speed limit or the 85^{th} percentile speed, whichever is greater, to prevent a collision during the time they are crossing the intersection. The required sight distance based on the posted speed limit is as follows:

The required minimum sight distance for minor street left turns:

$$SD = (7.5s) * (45mph) * (1.47)$$

$$SD \approx 500\ feet$$

SIGHT DISTANCE

A few different locations on BFR were noted to have sight distance issues. The locations include the following:

- Holly Street - has an embankment and a horizontal/vertical curve when looking to the right (north).
- Wooten Drive (South) - has limited sight distance looking to the right (north) due to the road going downhill along with a telephone pole, a fence, and trees.
- Steels Bridge Road - has sufficient sight distance, but there is a vertical curve that crests looking right (south) that can cause concern to drivers, especially with speeding.
- Wooten Drive (North) - needs to have maintenance for removing vegetation looking both left (south) and right (north).
- Marina - looking north is restricted by the horizontal/vertical curve along with trees/vegetation. If the vegetation is cleared, the hill would still cause issues. There may be a speeding issue with southbound traffic, as there is a speed detection sign in place that does not seem to be active.

TRAFFIC PROJECTION METHODOLOGY

The methodology used to estimate future traffic growth included the examination of Cherokee County census data, historic trends from the GDOT count stations, and data from the GDOT statewide travel demand model.

CENSUS DATA

Cherokee County's comprehensive plans most recent population was developed in 2018. The estimated census data is shown in Table 4.

Table 4: CENSUS DATA: CHEROKEE COUNTY COMPREHENSIVE PLAN

YEAR	POPULATION	% CHANGE	% CHANGE PER YEAR
2017	247,573	-	-
2040	392,411	58.5%	2.02%

Source: Cherokee County Community Plan 2018

According to the comprehensive plan data, Cherokee County will experience an increase of 58.5% (or 2.02% per year) between 2017 and 2040.

The most recent Cherokee County population data from the Atlanta Regional Commission (ARC) was developed in 2015 and is shown in Table 5.

Table 5: CENSUS DATA: ATLANTA REGIONAL COMMISSION

CHEROKEE COUNTY			
YEAR	POPULATION	% CHANGE	% CHANGE PER YEAR
2015	233,231	-	-
2040	392,411	68.3	2.1%

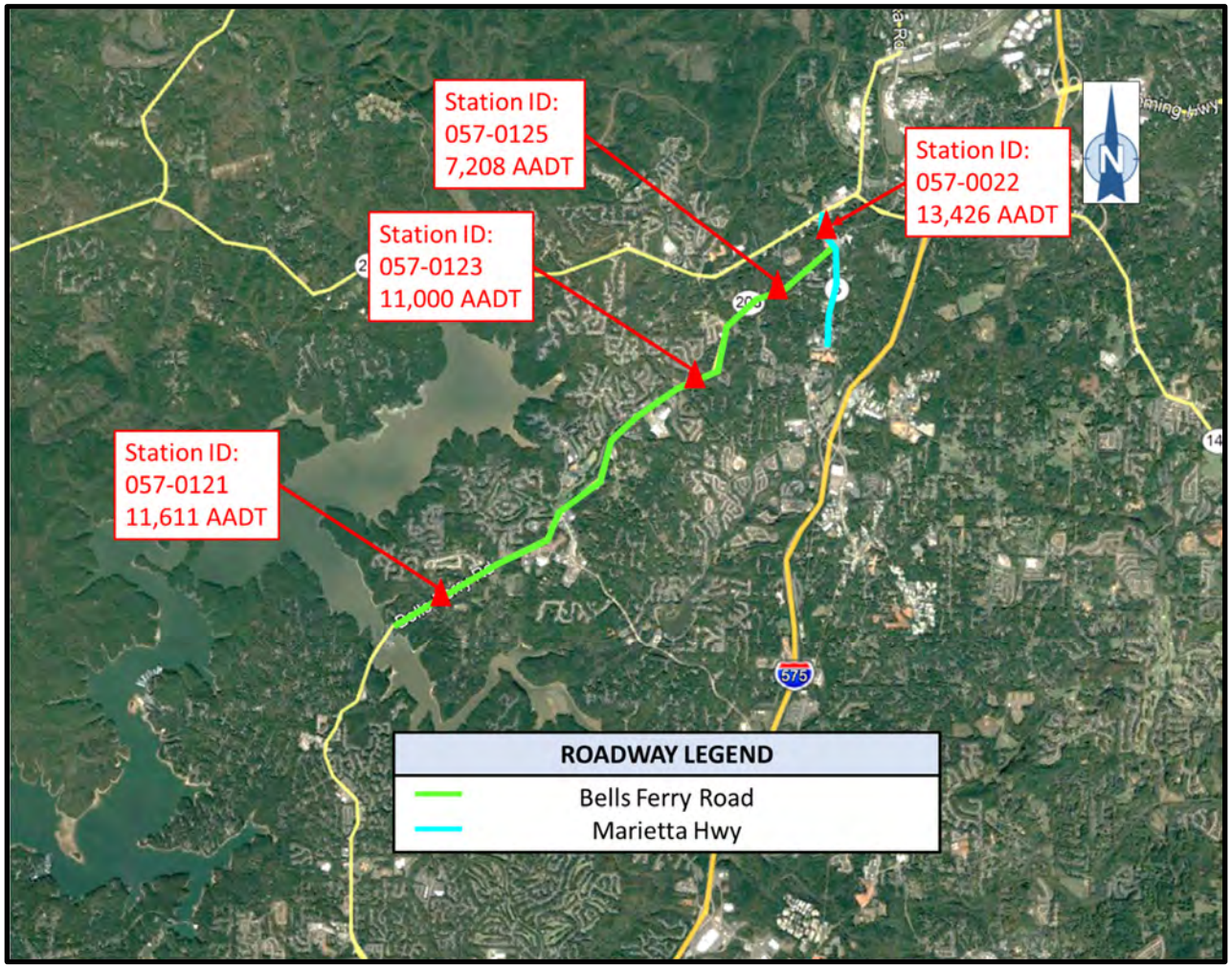
Source: Atlanta Regional Commission, Forecast 2040: Cherokee County

According to the ARC data, the population will see an increase of 68.3% (or 2.1% per year) between 2015 and 2040.

HISTORIC TRAFFIC DATA

The GDOT maintains multiple annual traffic count stations in the vicinity of the project. This data was used to establish historic growth rates. The count stations shown in Figure 4 were used.

Figure 5: GDOT COUNT STATIONS



Historic data reported by the GDOT for each of the count stations can be found in Appendix H.

Table 6 summarizes the average annual daily traffic (AADT) reported by the GDOT for each of the years from 2010 to 2020.

Table 6: HISTORIC TRAFFIC DATA

Year	GDOT Count Station 057-0121	GDOT Count Station 057-0123	GDOT Count Station 057-0125	GDOT Count Station 057-0022
2010	10202	10400*	6820*	13301
2011	8660*	10100*	5812	11500*
2012	8510*	11673	5230*	11300*
2013	8450*	10400*	5200*	11200*
2014	11324	10400*	5200*	13511
2015	11100*	11200*	6247	13300*
2016	11500*	11600*	5470*	13700*
2017	12200*	12300*	5790*	14500*
2018	11611	12300*	7208	13426
2019	10700*	12368	5780*	14600*
2020	10800*	11000	7320*	-

Source: GDOT Geocounts Database System

*Estimated counts not used in trend analysis.

TREND ANALYSIS

Figures 5 and 6, on the following pages, show graphs of the historic AADT as reported by the GDOT. A trend line is shown for each count station. Gaps in the graphs represent years for which data was estimated, which are not used in the analysis, per GDOT policy.

Figure 5: 5-YEAR TREND LINES FOR GDOT COUNT STATIONS

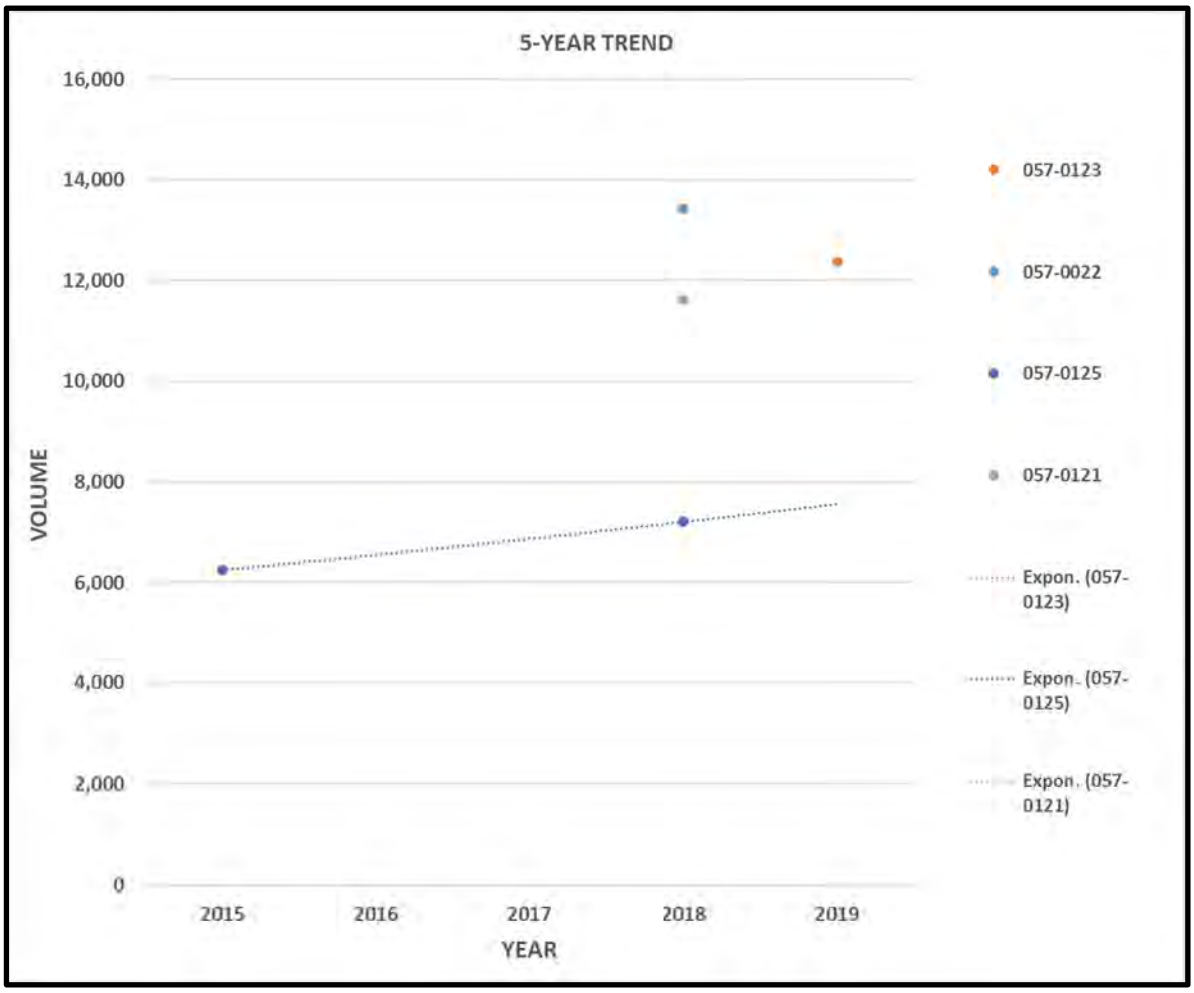
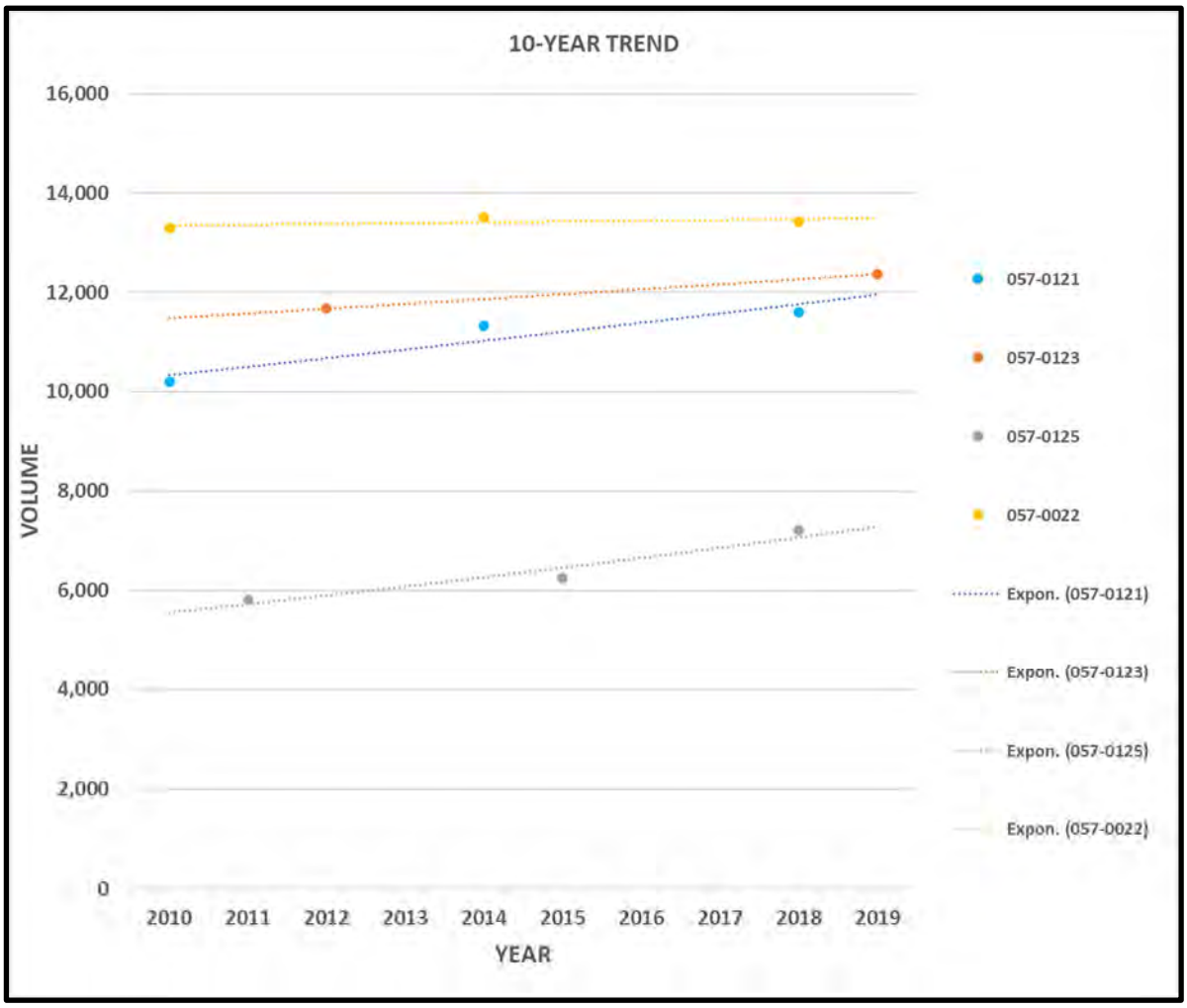


Figure 6: 10-YEAR TREND LINES FOR GDOT COUNT STATIONS



Growth rates were developed based on the 5-year and 10-year analyses of count station data shown above. Table 7 shows the resulting trend rates.

Table 7: TREND ANALYSIS FOR COUNT STATION DATA

GDOT Count Stations	5-year	10-year
057-0121	0.50%	1.30%
057-0123	-2.32%	0.58%
057-0125	2.90%	2.18%
057-0022	-0.13%	0.09%
Blended Trend Rates from Count Stations	0.5%**	0.88%

Note: Rates are calculated based on annual compounding.

**Trend was negative, assumed minimum 0.5%

TRAVEL DEMAND MODEL

The forecasts from the Atlanta Regional Commission (ARC) statewide travel demand model are provided in Table 8. The models are 2020, 2040, 2050 Build and 2050 No-Build. Model data was not provided for the 2020 or 2040 No-Build Scenario.

Table 8: ARC TRAVEL DEMAND MODEL FORECASTS

Model Year	BFR – NORTH OF RCC MEMORIAL BRIDGE	BFR – NORTH OF SIXES ROAD	BFR – SOUTH OF BUTTERWORTH ROAD	BFR – NORTH OF MARIETTA HWY
2020 Base	12,900	10,200	9,700	13,100
2040 Build	14,500	13,200	12,400	15,100
2050 Build	15,600	13,900	13,300	16,200
2050 No-Build	14,675	13,539	13,921	15,851

Source: Atlanta Regional Commission, Forecast 2050

Growth rates were established by conducting trend analysis between 2020, 2050 Build, and 2050 No-Build model data. Table 9 shows the resulting trend rates.

Table 9: TREND ANALYSIS FOR MODEL DATA

TREND METHOD	BFR – NORTH OF RCC MEMORIAL BRIDGE	BFR – NORTH OF SIXES ROAD	BFR – SOUTH OF BUTTERWORTH ROAD	BFR – NORTH OF MARIETTA HWY
2020 - 2050 Build	0.64	1.04	1.06	0.71
2020 - 2050 No-Build	0.43	0.95	1.21	0.64

Note: Rates are calculated based on annual compounding.
* = Poplar Road interchange not included in this TDM

NO-BUILD V. BUILD GROWTH RATES

The Cherokee County Community Plan (2018) identified that growth is expected throughout the county. The community plan shows a population increase of 58.5% (2.02% per year) from 2017-2040. Population data was also obtained from the ARC. The most recent data provided by the ARC was developed in 2015. The population forecast for Cherokee County shows a population increase of 68.3% (2.1% per year) from 2015-2040.

Historical data obtained from several GDOT count stations along Bells Ferry Road were also examined. From the count stations the 5-year and 10-year growths were determined to be 0.5% and 0.88%, respectively.

Finally, Travel Demand Models (TDM) provided by ARC were evaluated. The provided models compare the time period of 2020 to 2050 under build and no-build conditions. The 2050 build and no-build models show the traffic on Bells Ferry Road growing at a similar rate. Therefore, it was determined that grow rate for the two conditions should be the same.

After examining the historical data, the census data, and the ARC models the growth rates were established as follows:

- No-Build = Build:
    - 2020 to 2026 Base Year – 1.0%
    - 2026 Base Year to 2046 Design Year – 1.0%

GROWTH FACTORS

Growth factors were established by applying the growth factor equation, shown below, to the growth rates listed above.

$$Future\ Volume = Present\ Volume\ (1 + r)^n$$

The growth factors were established by applying the growth rates. The 2026 projections were calculated using n=6, taken as the time period between Existing Year (2020) and Base Year (2026). The 2046 projections were calculated using n=20, taken as the time period between Base Year (2026) and Design Year (2046). The growth factors calculated to be used for the project are provided in Table 10.

Table 10: GROWTH FACTORS

CONDITION	BASE YEAR 2026	DESIGN YEAR 2046
No-Build Build	1.06	1.22

The Base Year growth factors will be applied to the existing volumes to develop the projected volumes for the Base Year. The Design Year growth factors will be applied to the Base Year volumes to develop the projected volumes for the Design Year.

TRAFFIC PROJECTIONS

The traffic projection methodology presented in the previous pages was used to develop the projected No-Build and Build traffic for all analysis years.

The diagrams for total forecasted volumes are provided in Appendix I.

Cherokee County approved the Traffic Forecasting Report on September 11, 2020.

CAPACITY ANALYSIS

Existing and projected conditions were evaluated using capacity analysis techniques described in the *Highway Capacity Manual, Special Report 209*, published by the Transportation Research Board, 2010. The *Synchro Program* (Version 10) from Trafficware was used to facilitate the analysis. The HCM level of service (LOS) definitions for signalized, roundabouts, and stop controlled intersections are summarized in Table 11.

Table 11: LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	DELAY PER VEHICLE (SECONDS)		
	SIGNALIZED INTERSECTIONS	STOP-CONTROLLED INTERSECTIONS	ROUNDABOUTS
A	≤10.0	≤10.0	≤10.0
B	10.1 to 20.0	10.1 to 15.0	10.1 to 20.0
C	20.1 to 35.0	15.1 to 25.0	20.1 to 35.0
D	35.1 to 55.0	25.1 to 35.0	35.1 to 50.0
E	55.1 to 80.0	35.1 to 50.0	>50.0
F	>80.0	>50.0	

EXISTING CONDITIONS

The study intersections were first evaluated using the existing geometry, traffic control, traffic volumes, and traffic signal timings. The results of the capacity analysis for existing conditions are summarized on the following pages in Table 12 (for signalized intersections), and Table 13 (for unsignalized intersections). For each condition, the LOS is shown followed parenthetically by the average delay per vehicle, in seconds. Capacity analysis reports for existing conditions are included in Appendix J.

The intersections are labeled numerically in the following tables and correspond to how the intersections were counted and are numbered from west to east.

Table 12: CAPACITY ANALYSIS – EXISTING CONDITIONS, SIGNALIZED

	INTERSECTION	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
4	BFR & Ridge Road	B (10.6)	B (10.4)	B (13.4)
5	BFR & Bridge Mill Parkway/Sixes Road	B (19.0)	B (17.4)	B (17.6)
7	BFR & Bridge Mill Avenue/Liberty Road	B (18.5)	B (15.8)	B (12.8)
9	BFR & Butterworth Road	C (23.8)	C (23.9)	C (29.5)
10	BFR & Marietta Highway	B (10.6)	A (9.1)	A (9.9)

BFR = Bells Ferry Road

The capacity analysis results indicate acceptable operations at all signalized intersections under existing conditions.

Table 13: CAPACITY ANALYSIS – EXISTING CONDITIONS, UNSIGNALIZED

INTERSECTION		APPROACH-MOVEMENT	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
1	BFR & Wooten Drive (South)	NB-T	--	--	--
		NB-R	--	--	--
		SB-L	A (9.0)	A (8.3)	A (8.7)
		SB-T	--	--	--
		WB-L/R	C (16.5)	B (13.4)	C (18.0)
2	BFR & Steels Bridge Road	NB-L	A (8.5)	A (8.4)	A (9.0)
		NB-T	--	--	--
		SB-T	--	--	--
		SB-R	--	--	--
		EB-L	D (29.0)	C (21.6)	**E (36.1)**
		EB-R	B (11.5)	B (10.7)	B (12.0)
3	BFR & Wooten Drive (North)	NB-L/T/R	A (8.3)	--	A (8.9)
		SB-L/T/R	A (8.6)	A (8.5)	A (8.9)
		EB-L/T/R	D (25.2)	+	+
		WB-L/T/R	B (14.5)	B (11.6)	C (18.9)
6	BFR & Holly Street	NB-T/R	--	--	--
		SB-L	A (8.8)	A (9.0)	A (9.3)
		SB-T	--	--	--
		WB-L/R	C (20.7)	C (22.5)	C (23.8)
8	BFR & Gold Mill Ridge	NB-L	A (8.4)	A (8.3)	A (8.5)
		NB-T	--	--	--
		SB-T	--	--	--
		SB-R	--	--	--
		EB-L/R	C (23.2)	B (14.7)	C (23.3)

"--" = delay for movement was A(0.0)
"+" = volume for movement was 0
BFR = Bells Ferry Road

The capacity analysis results indicate that only one of the stop-controlled study intersections under existing conditions has a movement currently experiencing unacceptable LOS in the PM peak hour. The remaining four intersections are currently operating with an acceptable amount of delay for all peak hours.

PROJECTED CONDITIONS

This section includes an evaluation of all study intersections under projected conditions for the Base (2026) and Design (2046) Years.

Geometry and Traffic Control

The study intersections were evaluated under the following geometric and traffic control conditions including:

- Existing intersection and segment geometry
- Approved projected Base Year and Design Year traffic volumes

The results of the capacity analysis for projected no-build conditions are summarized on the following pages in Table 14 (for signalized intersections) and Table 15 (for unsignalized intersections). For each condition, the LOS is shown followed parenthetically by the average delay per vehicle, in seconds. Capacity analysis reports for no-build conditions are included in Appendix K.

Table 14: CAPACITY ANALYSIS – PROJECTED CONDITIONS – EXISTING GEOMETRICS, SIGNALIZED

INTERSECTION		BASE (2026)			DESIGN (2046)		
		AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
4	BFR & Ridge Road	B (11.0)	B (10.6)	B (13.9)	B (12.3)	B (11.8)	B (16.7)
5	BFR & Bridge Mill Parkway/Sixes Road	B (19.8)	B (17.8)	B (18.1)	C (25.1)	C (20.3)	C (20.4)
7	BFR & Bridge Mill Avenue/Liberty Road	C (20.1)	B (17.2)	B (13.1)	D (36.6)	C (26.8)	B (15.0)
9	BFR & Butterworth Road	C (24.7)	C (24.3)	C (31.6)	C (30.2)	C (27.4)	D (45.8)
10	BFR & Marietta Highway	B (11.1)	A (9.4)	B (10.1)	B (13.0)	B (10.5)	B (12.1)

The capacity analysis results indicate each of the five signalized intersection are expected to experience acceptable levels of delay in the Design Year for each of the peak hours under projected conditions.

Table 15: CAPACITY ANALYSIS – PROJECTED CONDITIONS – EXISTING GEOMETRICS, UNSIGNALIZED

INTERSECTION		APPROACH-MOVEMENT	BASE (2026)			DESIGN (2046)		
			AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
1	BFR & Wooten Drive (South)	NB-T	--	--	--	--	--	--
		NB-R	--	--	--	--	--	--
		SB-L	A (9.1)	A (8.3)	A (8.8)	A (9.6)	A (8.7)	A (9.3)
		SB-T	--	--	--	--	--	--
		WB-L/R	C (17.3)	B (13.9)	C (18.9)	C (21.9)	C (16.1)	C (24.6)
2	BFR & Steels Bridge Road	NB-L	A (8.6)	A (8.5)	A (9.2)	A (9.0)	A (8.9)	A (9.9)
		NB-T	--	--	--	--	--	--
		SB-T	--	--	--	--	--	--
		SB-R	--	--	--	--	--	--
		EB-L	D (34.4)	C (23.8)	**E (42.2)**	**F (107.3)**	**E (40.1)**	**F (123.7)**
		EB-R	B (11.8)	B (10.9)	B (12.3)	B (13.3)	B (11.7)	B (14.0)
3	BFR & Wooten Drive (North)	NB-L/T/R	A (8.4)	--	A (9.1)	A (8.7)	--	A (9.7)
		SB-L/T/R	A (8.7)	A (8.6)	A (9.1)	A (9.1)	A (9.1)	A (9.6)
		EB-L/T/R	D (27.4)	+	+	**E (40.1)**	+	+
		WB-L/T/R	C (15.2)	B (11.9)	C (20.3)	C (18.3)	B (13.2)	D (27.0)
6	BFR & Holly Street	NB-T/R	--	--	--	--	--	--
		SB-L	A (8.9)	A (9.1)	A (9.5)	A (9.5)	A (9.8)	B (10.4)
		SB-T	--	--	--	--	--	--
		WB-L/R	C (23.1)	D (25.1)	D (26.9)	**E (48.1)**	**F (59.3)**	**F (61.8)**
8	BFR & Gold Mill Ridge	NB-L	A (8.5)	A (8.4)	A (8.6)	A (8.8)	A (8.7)	A (9.1)
		NB-T	--	--	--	--	--	--
		SB-T	--	--	--	--	--	--
		SB-R	--	--	--	--	--	--
		EB-L/R	D (33.5)	C (16.0)	D (28.2)	**F (181.0)**	D (25.6)	**F (115.0)**

"--" = delay for movement was A(0.0)
"+" = volume for movement was 0

The capacity analysis results indicate that by the Design Year, all but one of the stop-controlled intersections will have at least one movement experiencing unacceptable delay during at least one peak hour under projected conditions.

Improvement Conditions (with 4 Lane only)

The expected volume of BFR in the Base Year (2026) will not reach the volume threshold for a four-lane roadway section (approximately 15,000 VPD), however by the Design Year (2046) a large portion of the corridor will meet or exceed that threshold or be near it. In order to approximate when the volume threshold is expected to be crossed interpolation between 2026 and 2046 was used. It was determined that by 2039 certain parts of the corridor would exceed 15,000 vehicles per day. Due to this, the study intersections were analyzed with BFR under four-lane roadway conditions with the Design Year volumes. For this analysis, no other improvements were added besides the road widening.

The results of the capacity analysis for projected conditions with no improvements except for BFR being a four-lane roadway are summarized on the following pages in Table 16 (for signalized intersections), and Table 17 (for unsignalized intersections). For each condition, the Level of Service is shown followed parenthetically by the average delay per vehicle, in seconds. Capacity analysis reports for this condition are included in Appendix L.

Table 16: CAPACITY ANALYSIS – 4-LANE BFR CONDITIONS, SIGNALIZED

INTERSECTION		DESIGN (2046)		
		AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
4	BFR & Ridge Road	B (11.0)	B (10.5)	B (14.1)
5	BFR & Bridge Mill Parkway/Sixes Road	C (21.9)	B (18.5)	B (18.4)
7	BFR & Bridge Mill Avenue/Liberty Road	C (21.4)	B (14.4)	B (12.5)
9	BFR & Butterworth Road	C (26.7)	C (24.6)	C (30.2)
10	BFR & Marietta Highway	B (10.4)	A (9.8)	B (10.9)

The capacity analysis results indicate each of the five signalized intersection are expected to experience acceptable levels of delay in the Design Year for each of the peak hours with BFR as a four-lane roadway.

Table 17: CAPACITY ANALYSIS – 4-LANE BFR CONDITIONS, UNSIGNALIZED

INTERSECTION		APPROACH-MOVEMENT	DESIGN (2046)		
			AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
1	BFR & Wooten Drive (South)	NB-T	--	--	--
		NB-R	--	--	--
		SB-L	B (10.1)	A (8.7)	A (9.3)
		SB-T	--	--	--
		WB-L/R	C (16.6)	B (13.1)	C (18.0)
2	BFR & Steels Bridge Road	NB-L	A (9.1)	A (8.9)	A (9.9)
		NB-T	--	--	--
		SB-T	--	--	--
		SB-R	--	--	--
		EB-L	**F (50.5)**	D (27.0)	**F (56.2)**
		EB-R	B (10.8)	B (10.0)	B (10.9)
3	BFR & Wooten Drive (North)	NB-L/T/R	A (8.7)	--	A (9.7)
		SB-L/T/R	A (9.1)	A (9.1)	A (9.6)
		EB-L/T/R	D (25.5)	+	+
		WB-L/T/R	B (13.6)	B (10.6)	C (17.2)
6	BFR & Holly Street	NB-T/R	--	--	--
		SB-L	A (9.6)	A (9.9)	B (10.5)
		SB-T	--	--	--
		WB-L/R	C (24.2)	D (31.1)	D (30.1)
8	BFR & Gold Mill Ridge	NB-L	A (8.9)	A (8.8)	A (9.2)
		NB-T	--	--	--
		SB-T	--	--	--
		SB-R	--	--	--
		EB-L/R	**F (50.6)**	C (18.9)	**E (43.3)**

"--" = delay for movement was A(0.0)
"+" = volume for movement was 0

The capacity analysis results indicate LOS improvements to each of the study intersections associated with the four-lane widening of BFR in the Design Year. However, the intersections of BFR and Steels Bridge Road and BFR and Gold Mill Ridge are projected to operate at LOS E or worse in the AM and PM peak hours.

INTERSECTION IMPROVEMENTS – SHORT-TERM, MID-TERM, LONG-TERM

With BFR not projected to reach four-lane volumes threshold until 2039, along with a few intersections still experiencing high levels of delay under the four-lane conditions, this section explores the improvements that can be made to each of the study intersections before and after the widening of BFR may take place.

For each of the intersections, improvements were considered under the following time frames:

- Short-term (≤3 years) – improvements that can implemented to immediately affect operations, safety, or both.
- Mid-term (≤6 years) – improvements that can be planned for near future incorporation into the corridor.
- Long-term (6+ years) – improvements that address how the corridor and intersection need to function long term.

If the short-term or mid-term improvements were found to establish and maintain acceptable operation through the Design Year, additional improvements were not evaluated.

BFR and Wooten Drive (South)

Operational improvements were not deemed necessary as this intersection is projected to have low volumes through the Design Year. The movements of this intersection are projected to operate acceptably regardless of the BFR roadway section design.

However, during the site visit a sight distance issue was observed. The protocol for measuring for sight distance requires the investigator to take the measurement six feet from the stop bar to emulate where a driver is positioned. The photo below illustrates the view from this location.

Figure 7: SIGHT LINE FROM WOOTEN DRIVE (SOUTH)

As shown in the picture the sight distance is obstructed due to a telephone pole, a hill due to an upgrade, a private fence, and a private sign. Due to these obstructions, a separate measurement was taken from directly on top of the stop bar. The distance measured from this location was 350 feet, which was ultimately limited by horizontal curvature on BFR.

As previously stated, the minimum required sight necessary for side street left turns from an unsignalized side street is approximately 500 feet. A Short-Term improvement for this intersection would be to remove the obstructions on the Northeast corner of the intersection to improve the sight distance to approximately 350 feet.

BFR and Steels Bridge Road

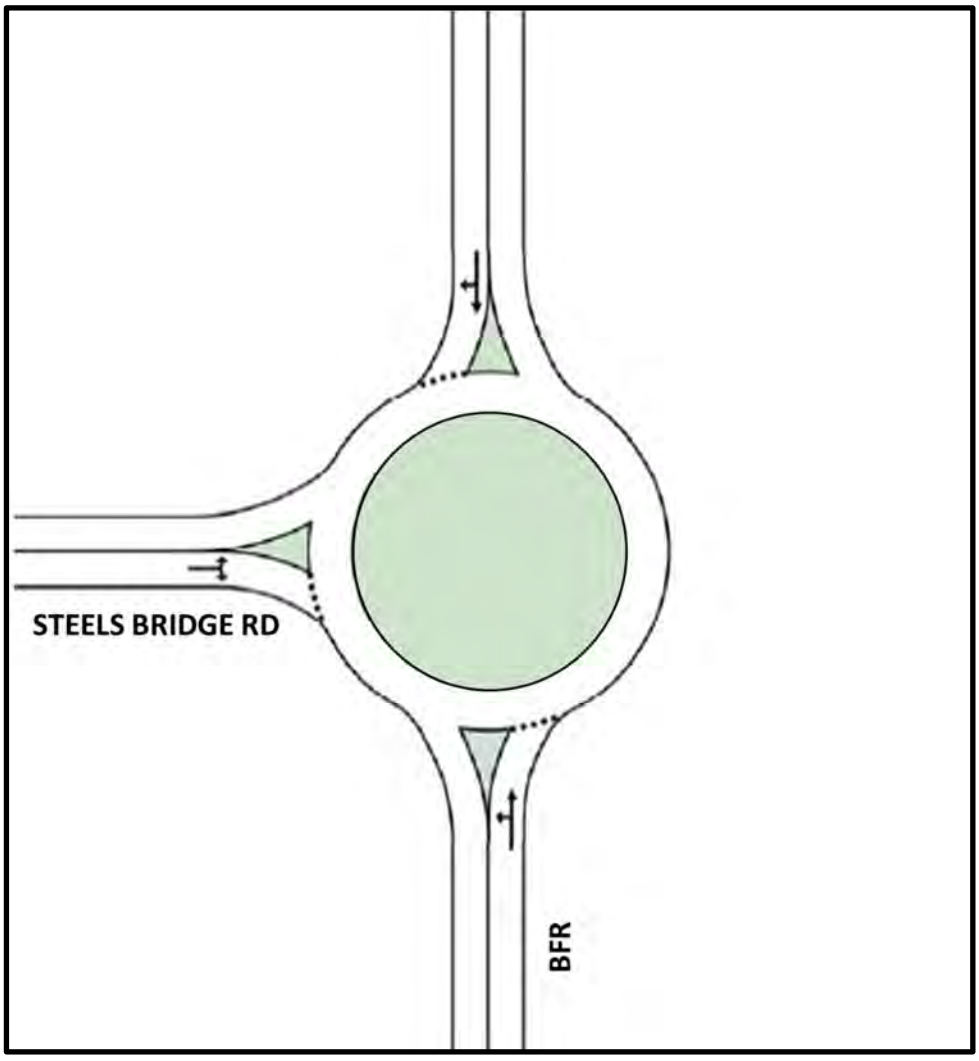
No Short-Term improvements were deemed necessary at Steels Bridge Road due to:

- The side street approach of Steels Bridge Road currently has a movement operating at LOS E, however this is only for a single peak hour (PM).
- During the same peak hour, the largest observed queue was four cars.
- No sight distance issues were observed at this intersection during the site visit.

By 2026, it is expected that the AM Peak Hour will be near the threshold of LOS E (35 $\geq$ seconds of delay), while the delay in the PM is expected to continue growing. Because of this a Mid-term improvement was explored that could be employed before 2026.

Taking into account the volume of each of the approaches and the location of the intersection, a single lane-roundabout was evaluated beginning with the 2026 volumes. The initial layout of the roundabout evaluated through capacity analysis is illustrated in Figure 8.

Figure 8: SINGLE-LANE ROUNDABOUT



Capacity analysis results for the single lane roundabout with the 2026 volumes are shown in Table 18.

Table 18: CAPACITY ANALYSIS – STEELS BRIDGE ROUNDABOUT – 2026

APPROACH (ROAD)	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
NB (BFR)	A (2.7)	A (2.6)	A (4.0)
SB (BFR)	A (2.8)	A (2.8)	A (5.1)
EB (STEELS BRIDGE)	A (1.4)	A (0.6)	A (0.8)

The results indicate the under roundabout control that LOS A can be expected for each approach in all peak hours.

In order to determine the lifetime of this improvement the single lane roundabout was then evaluated using the 2046 volumes.

Table 19: CAPACITY ANALYSIS – STEELS BRIDGE ROUNDABOUT – 2046

APPROACH (ROAD)	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
NB (BFR)	B (10.6)	A (9.2)	B (11.8)
SB (BFR)	A (8.2)	A (8.7)	B (12.7)
EB (STEELS BRIDGE)	B (11.1)	A (7.6)	A (9.0)

The results indicate that a single lane roundabout control is expected to operate acceptably to the Design Year of 2046. This analysis illustrates the that minimum lifetime of effectiveness for the single lane roundabout at 20 years.

Finally, while the analysis proves that a single-lane roundabout will operate acceptably until the Design year, it should be constructed in such a way if BFR is widened to a four-lane, the single-lane can be reconfigured into a multilane roundabout.

An additional benefit to the installation of a roundabout is the speed reduction to a corridor that one can provide. An area that could benefit from a speed reduction is the vertical curve that crests at approximately 600 feet south of the Steels Bridge Road intersection. The curve presents a sight obstruction that prevents drivers on BFR from seeing each other until the top of crest is reached. Figure 9 shows the crest from both approaches.

Figure 9: VERTICAL CURVE SOUTH OF STEELS BRIDGE ROAD

As shown in the above Figure, the crest of the curve presents a challenge to drivers, particularly in the southbound direction. This curve exhibits a potential unsafe condition for drivers, especially those that may be traveling at speeds higher than the posted speed limit. Flattening out this vertical curve is a proposed Mid-term improvement.

Depending on which improvement is installed first, the installation of a single lane roundabout at Steels Bridge Road could also improve conditions at this vertical curve until it is flattened, by reducing the travel speeds on BFR.

BFR and Wooten Drive (North)

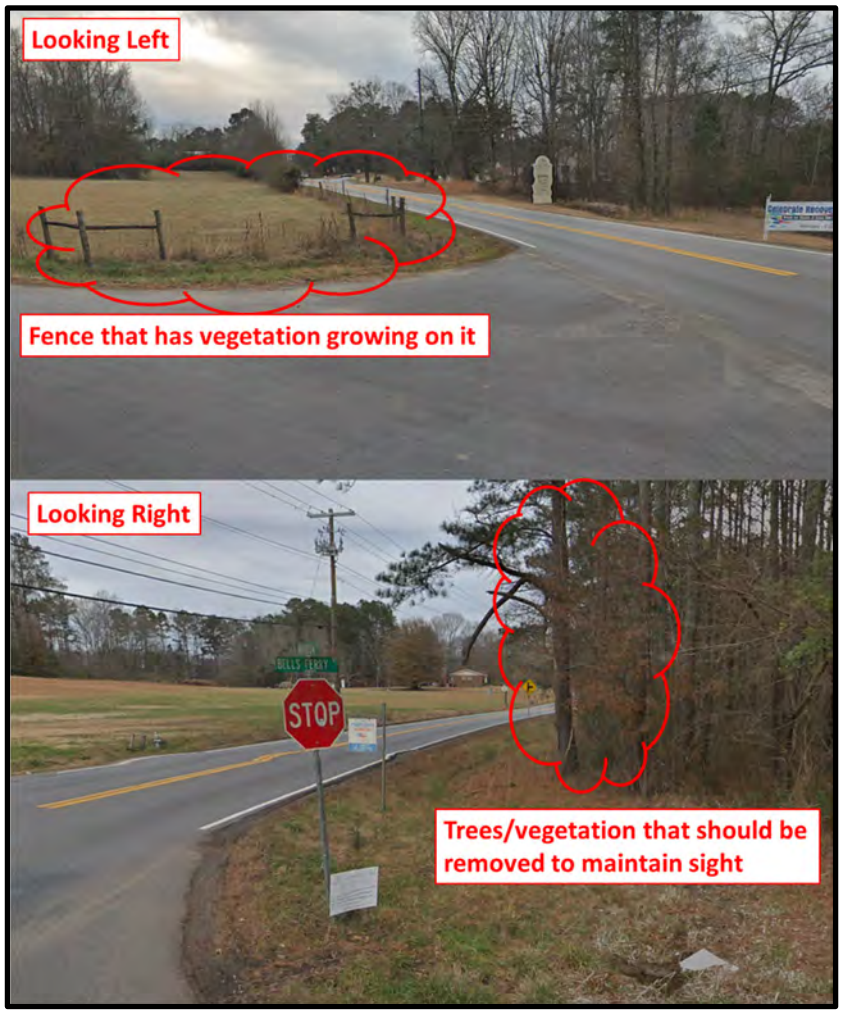
Two improvements were considered for this intersection: 1 Short-Term and 1 Mid-Term. These improvements were considered separately i.e. implementation of one or the other, not both.

The Short-Term Improvements for this intersection were found to be:

- Addition of a left turn lane for the southbound approach. Warranted by GDOT volume requirements. Minimum full width storage 235 feet.
- Addition of a right turn lane for the westbound approach. Approximately 80% of the volume is making a right turn movement at this intersection.
- Improve sight distance for the westbound approach looking left. Sight distance was limited to 69 feet due a private fence that has vegetation growing on it. With the fence moved and vegetation maintained the sight distance would meet the minimum required for the BFR corridor.
- Maintain vegetation at westbound approach looking right to maintain sight distance. Sight distance was measured at more than 500 feet, which meets the required minimum. However, if the vegetation is not maintained then the sight distance could decrease.

Figure 10 illustrates the items that limit sight distance or have the potential to do so.

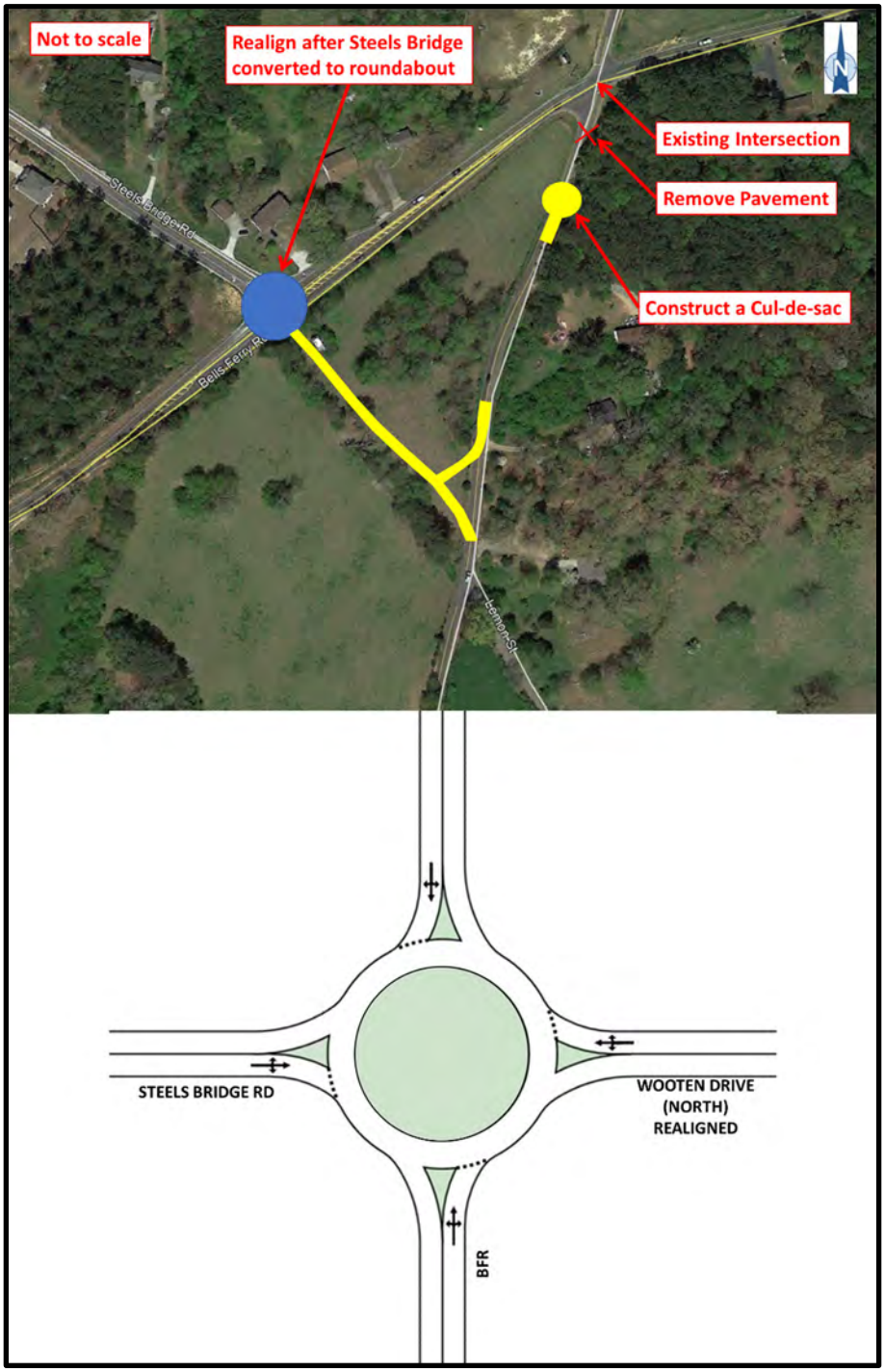
Figure 10: SIGHT LINE FROM WOOTEN DRIVE (NORTH)



The Mid-term Impprovement for this intersection.

- Cul-de-sac the existing Wooten Drive (North) and realign the road to intersect the Steels Bridge Road intersection if the roundabout is constructed. Figure 11 illustrates this improvement.

Figure 11: POTENTIAL WOOTEN DRIVE (NORTH) REALIGNMENT



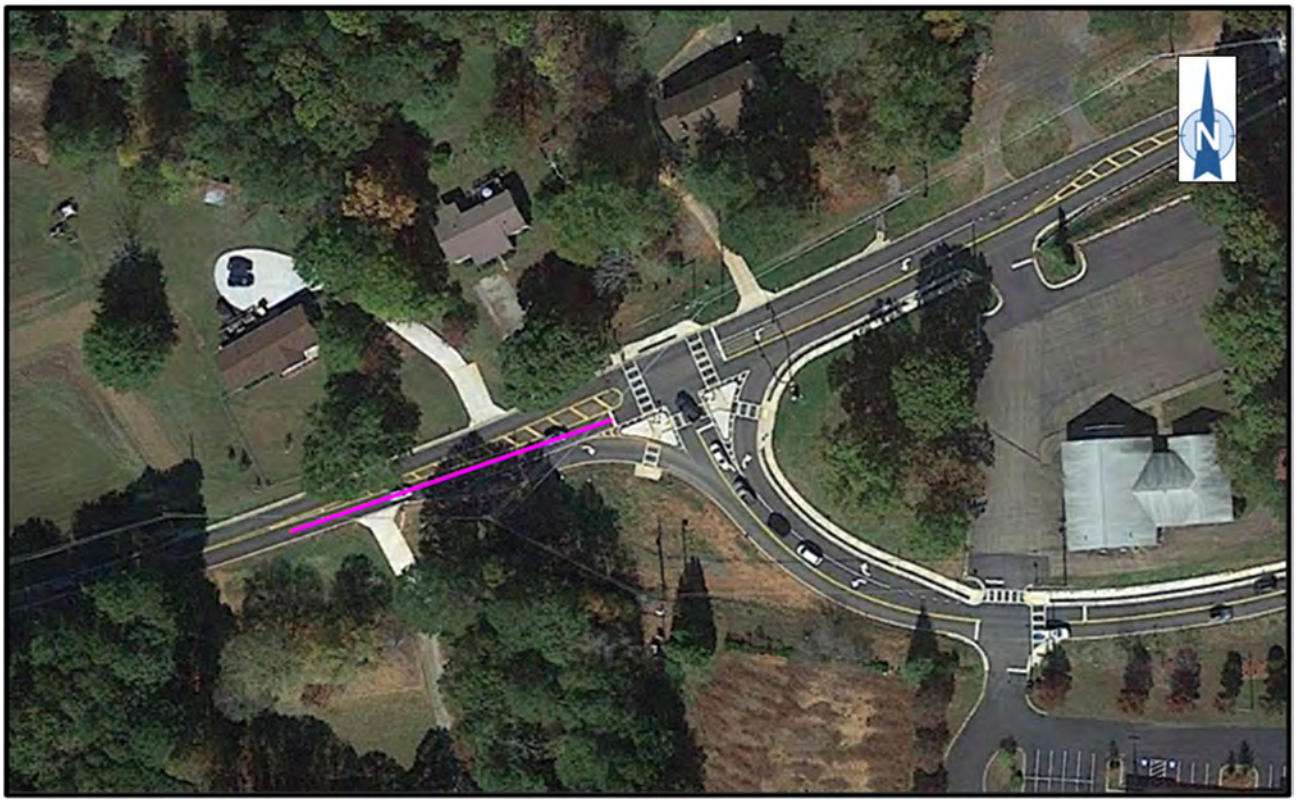
BFR and Ridge Road

Operational improvements were not deemed necessary as this intersection is projected operate at LOS B through the Design Year, regardless of whether BFR is a two-lane or four-lane. Safety improvements were also deemed not necessary as there has only been a single crash at this intersection in the past five years according to the Georgia Electronic Accident Reporting System (GEARS).

Two potential Short-Term improvements that could be implemented are:

- The adjustment of the existing signal timing which would improve the LOS for the signal/approaches.
- Extension of the Northbound right turn lane. The longest queue observed during the site visit for the Northbound through lane was 9 vehicles that equates to 225 feet (shown in Figure 12 by the pink line). Currently the right turn lane is only approximately 75 feet, because of this a 9-car queue leads to the right turn lane being starved as any drivers that want to make a right turn cannot until the queue is cleared.

Figure 12: OBSERVED NORTHBOUND QUEUE



The minimum length according to GDOT for a right turn on a 45-mph road is 175 feet, but in the case of this intersection the minimum full width storage for the right should be 225 feet due to the observed queue. Extension of the right turn lane may be difficult due to the private driveway of a resident that currently sits at the end of the right turn lane taper.

BFR and Sixes Road/Bridgemill Parkway

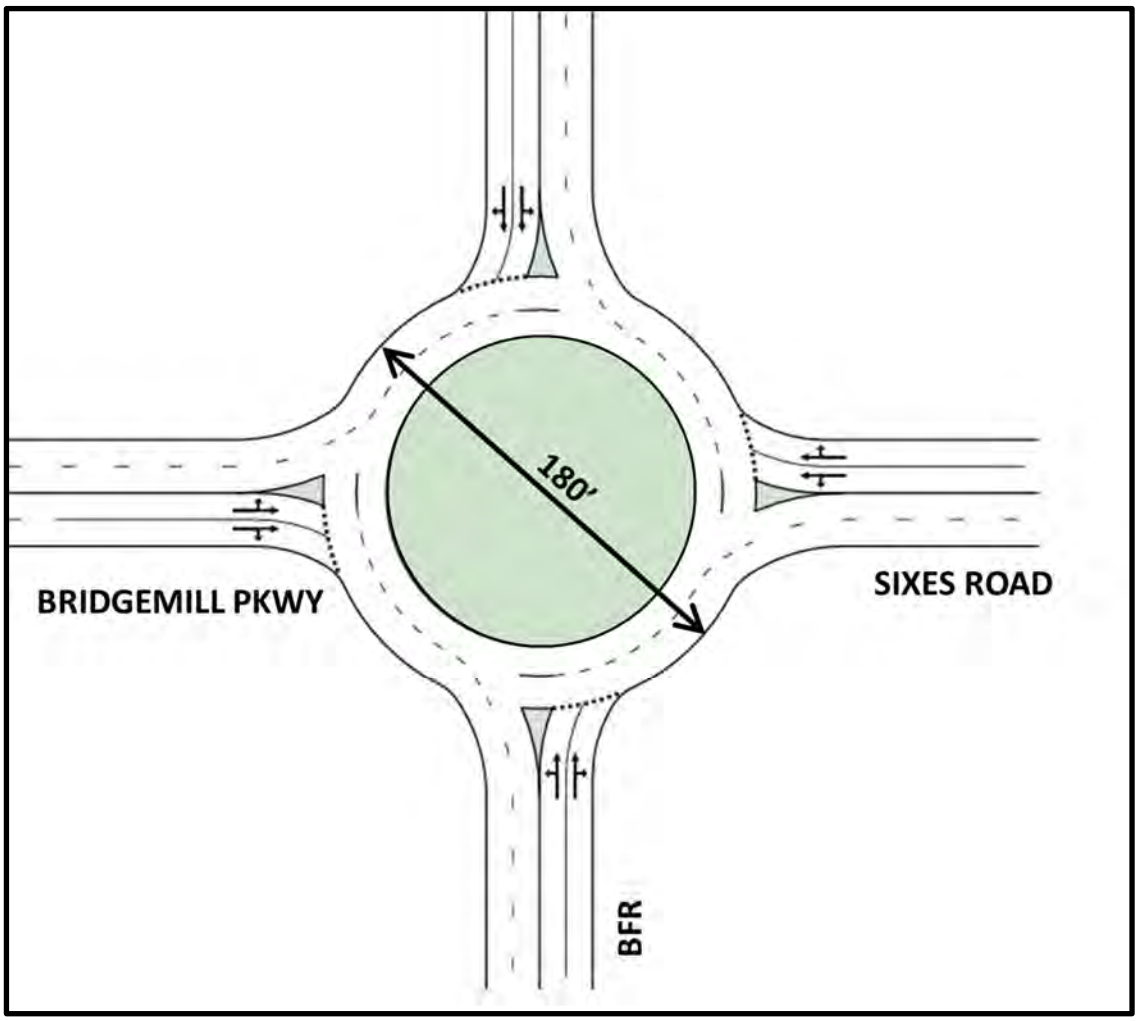
Short-Term Improvements for this intersection were found to be:

- Addition of a left turn lane for the eastbound approach (Bridgemill Parkway). Warranted by GDOT daily volume requirements. Minimum full width storage 135 feet.
- Adjustments to the existing signal timing to improve the LOS of the intersection and individual approaches.

Two options were explored for Long term Improvement(s) at this intersection:

1. Leave the intersections signalized and add a dual left turn lane configuration that is warranted when a peak left turn volume is greater than 300. The southbound left turning volume is currently 335 vehicles in the AM. The longest queue observed during the site visit was 8 cars also during the AM. The current storage length of the single left turn is sufficient to handle this queue and the movement is operating acceptably, though as the volume continues to grow a second left may be necessary.
2. Reconfigure the intersection into a multilane roundabout after widening BFR. Figure 13 illustrates the layout of the roundabout.

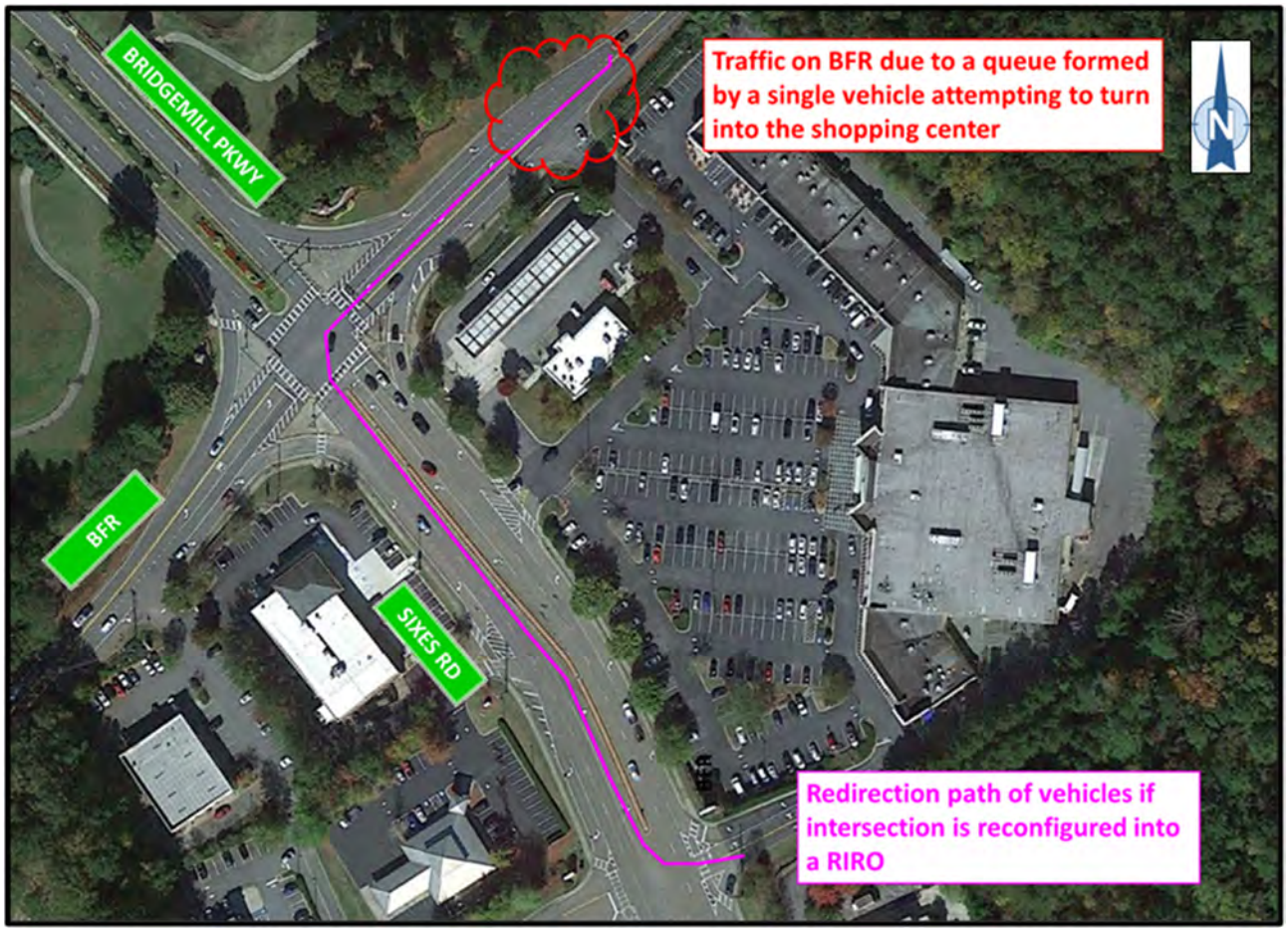
Figure 13: BRIDGEMILL/SIXES LONG TERM IMPROVEMENT CONCEPT (OPTION 2)



Other improvements to consider – Sixes Road/Bridgemill Pkwy

While driving the corridor as a part of the site visit, a queue of 7 vehicles, which was preventing traffic to proceed along BFR, was seen at the location illustrated in Figure 14. This queue was due a vehicle attempting to make a left turn into the shopping center located on the northeast corner of the intersection. Until BFR is widening to a four-lane and a left turn lane can be provided, it is recommended that this driveway be reconstructed into a Right-in/Right-out. This will prevent traffic from being stopped on BFR due to single car.

Figure 14: OBSERVED DRIVEWAY QUEUE BLOCKING BFR TRAFFIC



BFR and Holly Street

Short-Term Improvements for this intersection were found to be:

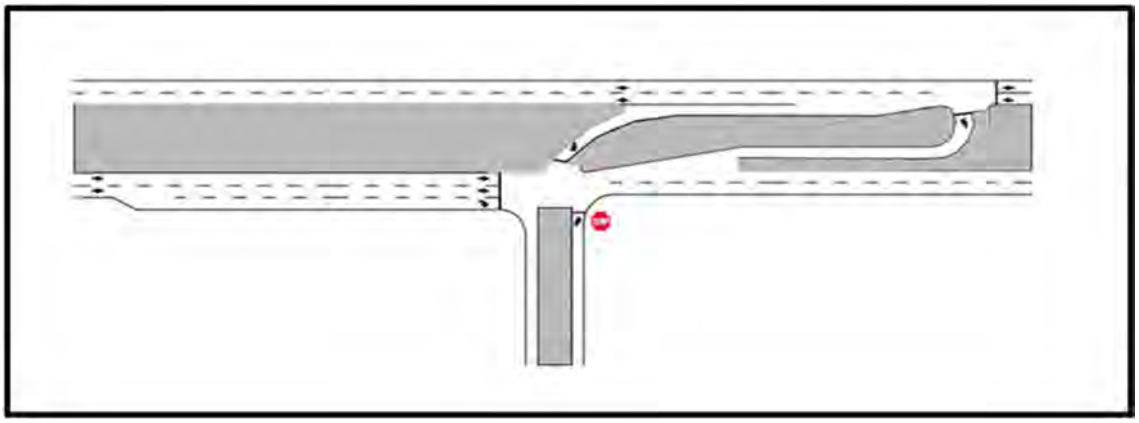
- Addition of a right turn lane for the northbound approach on BFR. Warranted by GDOT daily volume requirements. Minimum full width storage 175 feet.
- Addition of a right turn lane for the westbound approach on Holly Street. Warranted by GDOT daily volume requirements. Minimum full width storage 175 feet.
    - Approximately 75% of vehicles turning onto BFR from Holly Street are turning right.
    - The longest queue for the minor street approach was observed to 15 cars. This was due to a single vehicle making a left turn movement, while the other 14 were making a right turn.
    - The addition of a right turn lane would prevent the heavier movement (right turn) from being held up due a single vehicle.
- Improve sight distance for the westbound approach looking right.
    - The current sight distance looking right was measured at approximately 300 feet.
    - The Holly Street intersection is located at the beginning of a horizontal and vertical curve that extends in the northbound direction. This curve is a factor in limiting sight distance.
    - There is also on embankment on the northeast corner that contributes to the shortened sight distance.
    - Due to curvature of the road the minimum 500 feet is most likely unobtainable. However, if the embankment is cut back/smoothed out then it is believed a minimum of 100 feet of sight distance would be added.
    - Figure 15 illustrates the view from 6 feet behind the stop bar where the sight distance was measured from.

Figure 15: HOLLY STREET APPROACH LOOKING RIGHT

Two options were explored for Long-term Improvement(s) at this intersection. Both improvements are dependent on BFR being widened:

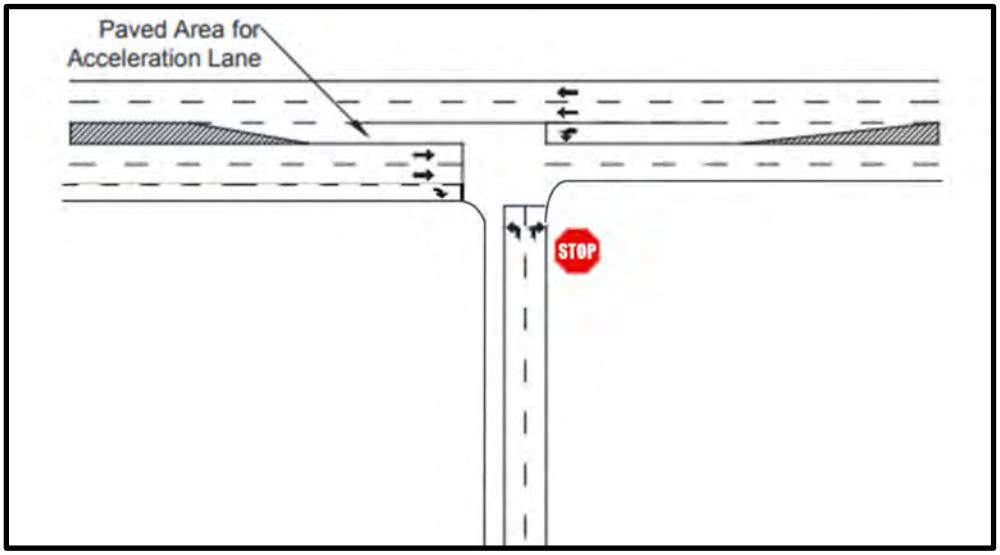
1. Reconfigure the Holly Street intersection into a Restricted Crossing U-Turn (RCUT) intersection, as show in Figure 16 below.
    - According to the FHWA, an RCUT "differs from a conventional intersection by eliminating the left-turn and through movements from cross street approaches…….the RCUT intersection requires drivers to turn right onto the main road and then make a U-turn maneuver at a one-way median opening at least 400 feet after the intersection.
    - RCUT are typically installed when the left/through volume(s) are low in comparison to the right turning volume. This makes Holly Street a prime candidate for reconfiguration.

Figure 16: TYPICAL CONFIGURATION FOR RCUT INTERSECTION



2. Reconfigure the Holly Street intersection into an unsignalized High-T intersection, as shown in Figure 17 below.
    - According the FHWA, a High-T "allows main line through traffic to pass through an intersection without stopping, while also eliminating conflicting vehicle movements.
    - Side street left turning traffic is provided a minimum 800-foot merge/acceleration lane.

Figure 17: TYPICAL CONFIGURATION FOR HIGH-T INTERSECTION

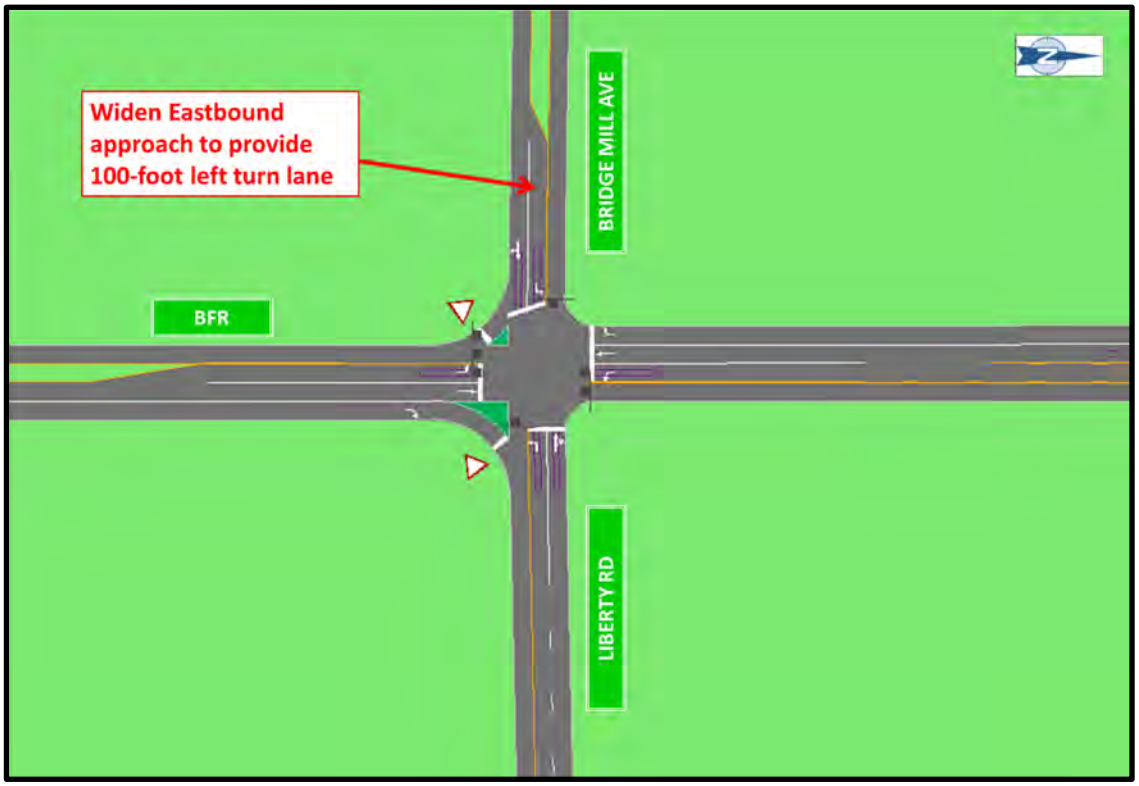


BFR and Bridge Mill Avenue

Short-Term Improvements for this intersection were found to be:

- Addition of a left turn lane for the eastbound approach. Warranted by GDOT daily volume requirements. Minimum full storage 100 feet. The turn lane was shortened due to the limited distance between the intersection and the driveway for the Bridgemill shopping center.
- Upgrade the existing-five-section signal heads for the northbound and southbound left turn lanes to four-section Flashing Yellow Arrow (FYA) signal heads.
- Adjustments to the existing signal timing to improve the LOS of the intersection and individual approaches.
- Figure 18 illustrates the listed improvements.

Figure 18: BRIDGE MILL AVE/LIBERTY ROAD



No Mid or Long-term improvements were proposed for this intersection due to capacity analysis indicating acceptable operation through 2046 regardless of the BFR roadway section.

However, while the signal does/is expected to operate acceptably this intersection serves as an entrance to the Liberty Elementary School and experiences high traffic during the AM Peak Hour and during early afternoon due to parent drop-off/pick-up of the children attending this school.

Other improvements to consider – Liberty Elementary and Freedom Middle

The intersection of BFR and Liberty Road also serves as an entrance for the Liberty Elementary School (LES), while Freedom Middle School (FMS) has an entrance approximately 1500 feet north of the signalized intersection. There is a third point of access between these two that is for bus drop-off/pick-up only.

While the signal is expected to operate acceptably at the BFR and Liberty Road, it experiences high traffic during the AM Peak Hour and during early afternoon due to parent drop-off/pick-up of the children attending this school. The same is true for the entrance for Freedom Middle School. During the site visit, the following queues due to parent traffic were observed spilling out onto BFR:

- Liberty Elementary School
    - North: 6 cars or 150 feet
    - South: 24 cars or 600 feet
- Freedom Middle School
    - North: 21 cars or 525 feet
    - South: 33 cars or 825 feet

The queuing for each school does not affect the other as they have different start times in the AM and let-out times in the PM.

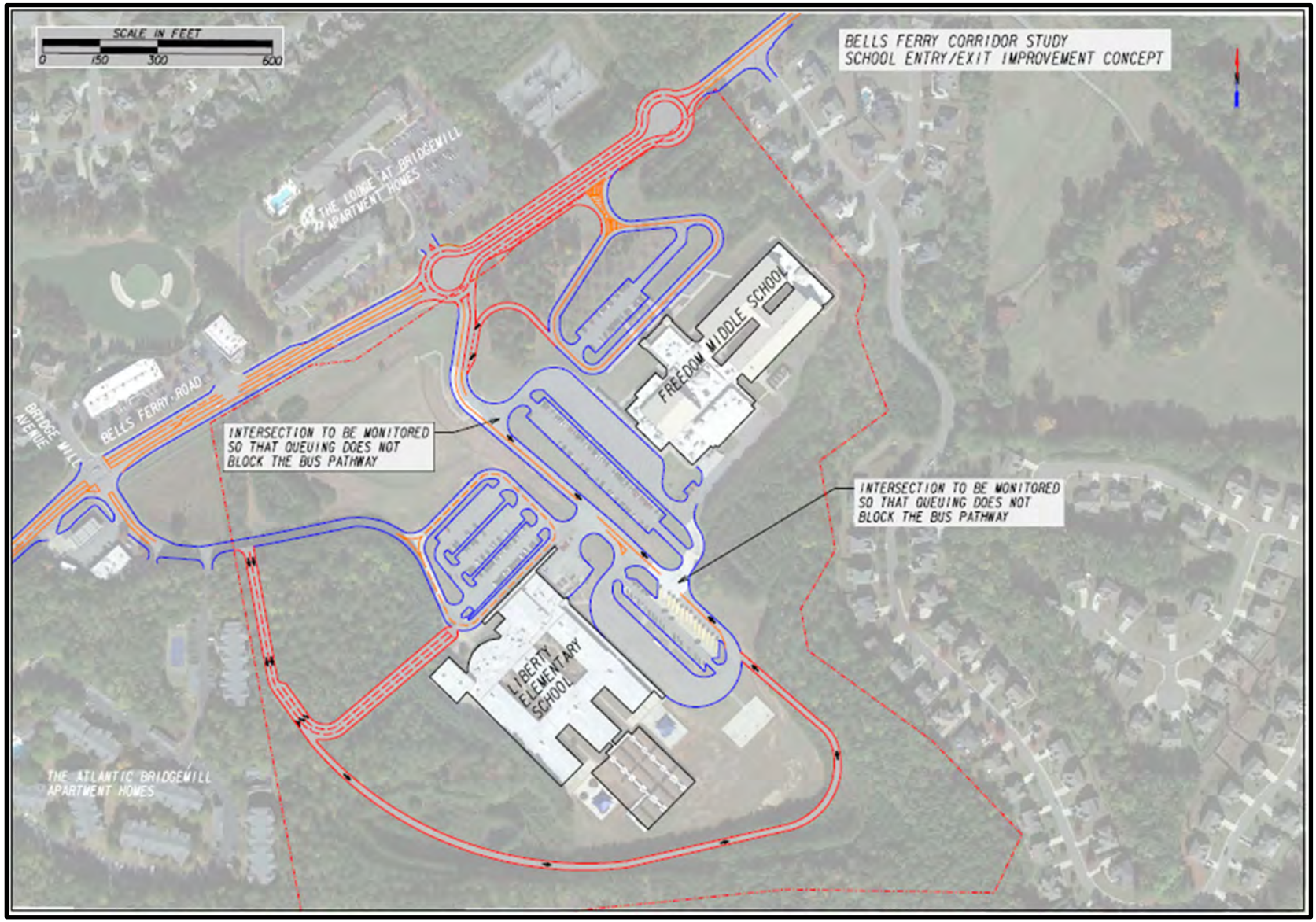
Finally, for both Freedom Middle School's driveway as well as the driveway dedicated for the bus traffic, there was a person on BFR directing traffic to help vehicles/buses leave the school grounds.

In an effort to improve this area, a concept was developed in order to address two issues:

1. Remove the parent queues off BFR completely for both schools
2. Eliminate the need for a person at the unsignalized intersections to direct traffic

With these two issues in mind, the concept on the following page, shown in Figure 19, was developed.

Figure 19: SCHOOL IMPROVEMENT CONCEPT



BFR and Gold Mill Ridge

No Short-Term improvements were deemed necessary at Steels Bridge Road due to:

- The side street approach of Gold Mill Ridge is currently operating acceptably in all peak hours.
- The largest observed queue was four cars. This was only observed once during a single peak hour (AM).
- No sight distance issues were discovered at this intersection during the site visit.

By 2026, it is expected that the AM and PM Peak Hours will be near the threshold of LOS E (35 $\geq$ seconds of delay). Because of this a Mid-term improvement was explored that could be employed before 2026.

The single lane roundabout was evaluated first with the 2026 volumes.

Table 20: CAPACITY ANALYSIS – GOLD MILL ROUNDABOUT – 2026

APPROACH (ROAD)	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
NB (BFR)	B (11.7)	A (8.5)	B (12.1)
SB (BFR)	A (7.3)	A (7.6)	B (10.5)
EB (GOLD MILL)	A (4.2)	A (8.0)	A (8.9)

The results indicate the under roundabout control that LOS B or better can be expected for each approach in all peak hours.

In order to determine the lifetime of this improvement the single lane roundabout was then evaluated using the 2046 volumes.

Table 21: CAPACITY ANALYSIS – GOLD MILL ROUNDABOUT – 2046

APPROACH (ROAD)	AM PEAK HOUR	MD PEAK HOUR	PM PEAK HOUR
NB (BFR)	C (15.3)	A (9.8)	B (12.4)
SB (BFR)	A (8.1)	A (8.7)	B (10.9)
EB (GOLD MILL)	B (10.9)	A (8.0)	A (9.2)

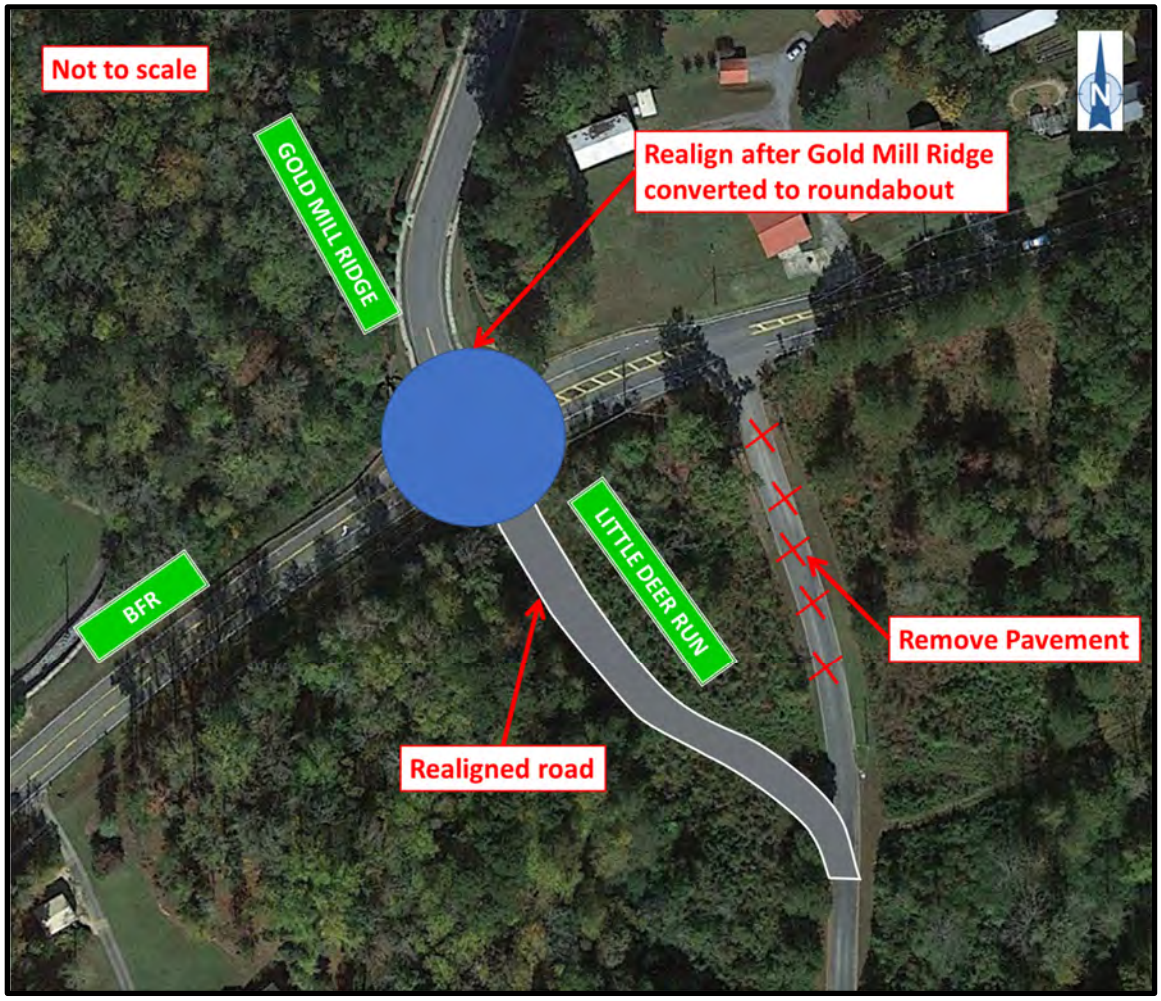
The results indicate that a single lane roundabout control is expected to operate acceptably to the Design Year of 2046. This analysis illustrates the that minimum lifetime of effectiveness for the single lane roundabout at 20 years.

While the analysis proves that a single-lane roundabout will operate acceptably until the Design year, it should be constructed in such a way that if BFR is widened to a four-lane the single-lane can be reconfigured into a multilane roundabout.

Other improvements to consider – Gold Mill Ridge

Constructing the roundabout at the Gold Mill Ridge intersection would present an opportunity to transition two separate intersections into one. Little Deer Run intersects BFR approximately 200 feet north of Gold Mill Ridge and serves as the sole entry and exit for a small residential neighborhood under minor street stop control. Figure 20 illustrates a concept sketch of how Little Deer Run could be rerouted to become the fourth leg of the Gold Mill Ridge intersection.

Figure 20: LITTLE DEER RUN REALIGNMENT

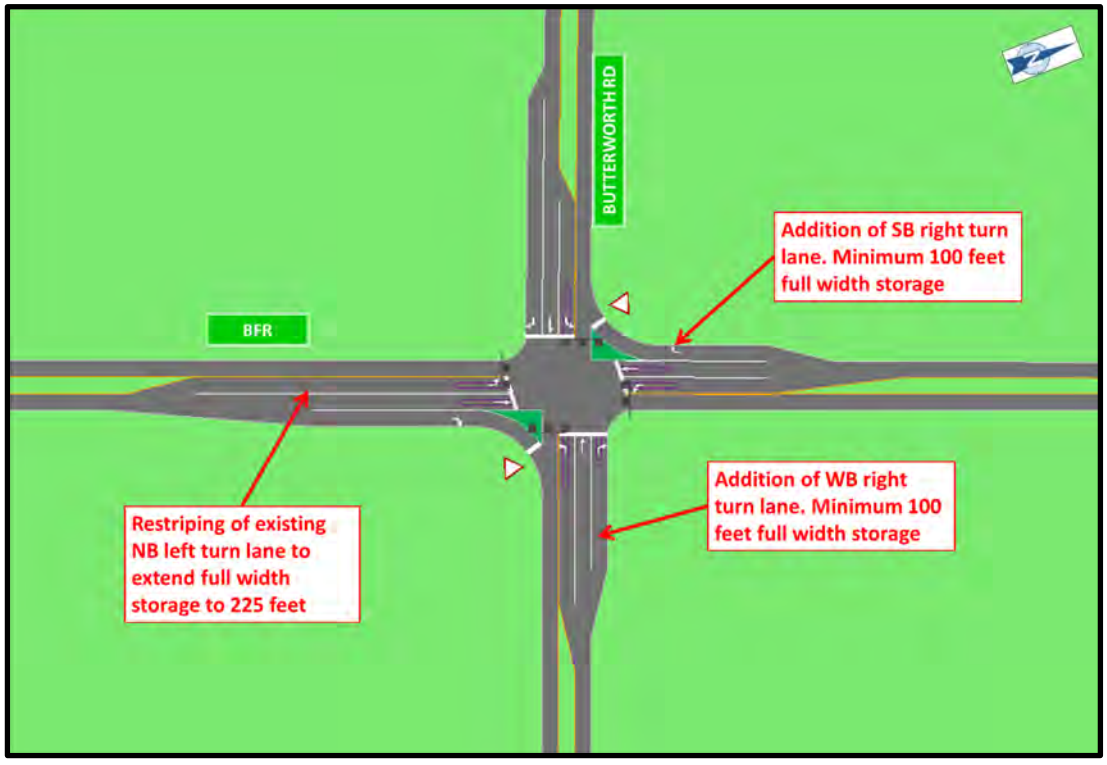


BFR and Butterworth Road

Short-Term Improvements for this intersection were found to be:

- Addition of a right turn lane for the southbound approach. Warranted by GDOT daily volume requirements.
    - Minimum full width storage 100 feet (speed limit is 35 mph after Gold Mill Ridge).
- Addition of a right turn lane for the westbound approach (Butterworth Road). Warranted by GDOT daily volume.
    - Minimum full width storage 100 feet (speed limit is 35 mph after Gold Mill Ridge).
- Restripe the Northbound left turn lane to provide 225 feet of full width storage.
    - Current full width is approximately 160 feet, which is the minimum required by GDOT on a 35-mph roadway.
    - Largest queue observed in this turn lane was 9 cars, which equates to 225 feet.
    - Due to the proximity of an existing gas station driveway the longest the left turn can be without obstructing the driveway and have a taper is 225 feet.
- Upgrade the existing-five-section signal heads for the left turn lanes to four-section Flashing Yellow Arrow (FYA) signal heads.
- Adjustments to the existing signal timing to improve the LOS of the intersection and individual approaches.
- Figure 21 illustrates a concept of these improvements.

Figure 21: SHORT-TERM IMPROVEMENTS – BUTTERWORTH ROAD



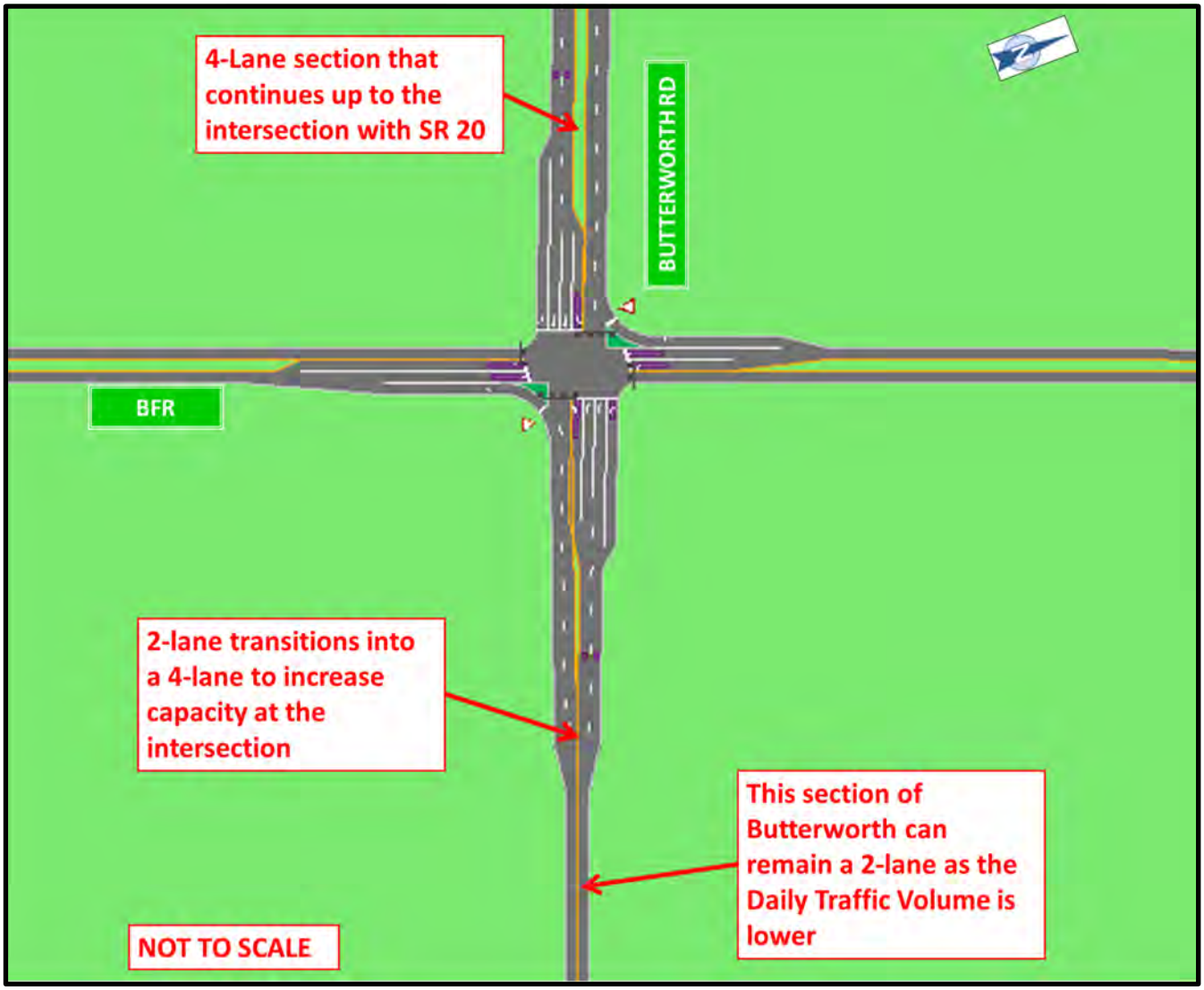
Two options were explored for Long-term Improvement(s) at this intersection.

1. Leave intersection signalized.
2. Convert intersection into a multi-lane roundabout after BFR 4-laned.

Other improvements to consider – Butterworth Road

Consider widening Butterworth Road into a four-lane section between BFR and SR 20. The current AADT on Butterworth Road West of BFR is 15,000 vehicles, which is the approximate threshold for a two-lane to four-lane conversion. Butterworth Road is being utilized as a high volume cut through road for traffic going to and from SR 20 and SR 5, with more of the traffic headed west to SR 20. The additional lanes will not only add capacity to Butterworth Road, but will also improve the operation of the BFR and Butterworth Road intersection. A concept of the widening at the Butterworth Road intersection is shown in Figure 22. The Short-Term improvements are also included in the figure.

Figure 22: OTHER IMPROVEMENTS – WIDEN BUTTERWORTH ROAD



BFR and Marietta Highway

This intersection is expected to operate acceptably through 2046 under existing conditions and with the limited space surrounding the intersection only a few Short-Term Improvements for this intersection were considered:

- Adjustments to the existing signal timing to improve the LOS of the intersection and individual approaches.
- Addition of FYA signal heads for the Marietta Highway approaches.

The table below summarizes the alternatives considered and the time periods for which they were considered.

Table 22: INTERSECTION IMPROVEMENTS SUMMARY

Intersection/Area		Short-Term Improvement(s)	Mid-Term Improvement(s)	Long Term Improvement(s)
Bells Ferry Road Corridor		-----	-----	Widen corridor to four-lanes from the Marina to the Butterworth Intersection
BFR & Wooten Drive (South)		Improvement of sight distance looking north	-----	-----
BFR & Steels Bridge Road		-----	Construct a single-lane roundabout (inscribed diameter 180')	Restripe the single-lane into multi-lane when BFR is widened to a Four-lane
BFR & Wooten Drive (North)	1)	Addition of southbound left turn lane; Addition of westbound right turn lane; Improve sight distance	-----	-----
	2)	-----	Cul-de-sac the existing Wooten Drive and realign road to intersect roundabout at Steels Bridge Road intersection	
BFR & Ridge Road		Adjustment of existing signal timing; Extension of northbound right turn lane	-----	-----
BFR & Sixes Road/ Bridgemill Parkway	1)	Addition of a eastbound left turn lane with 3-section FYA indication; Adjustment of existing signal timing	-----	Leave intersection signalized and reconstruct the southbound left turn movement to be a dual left
	2)			Construct a multilane roundabout while widening BFR (180 feet inscribed diameter)
BFR & Holly Street	1)	Addition of a northbound right turn lane; Addition of a westbound right turn lane; Improve sight distance looking north	-----	Convert intersection into an Unsignalized Restricted Crossing U-turn intersection
	2)			Convert intersection into a High-T intersection
BFR & Bridge Mill Ave/ Liberty Road		Addition of an eastbound left turn lane; Upgrade the existing 5-section signal heads to 4-section FYAs; Signal Timing	-----	-----
BFR & Gold Mill Ridge		-----	Construct a single-lane roundabout (inscribed diameter 180')	-----
BFR & Butterworth Road	1)	Addition of a southbound right turn lane; Addition of a westbound right turn lane; Extend northbound left turn lane by striping; Upgrade existing 5-section signal heads to 4-section FYAs; Signal Timing Adjustment	-----	Leave intersection signalized
	2)			Construct a multilane roundabout while widening BFR (180 feet inscribed diameter)
BFR & Marietta Highway		Addition of FYA signal heads for the Marietta Highway approaches; Signal Timing Adjustment	-----	-----
Other Improvements to Consider				
Marina		Cut back trees/vegetation to improve sight distance until BFR is realigned	-----	-----
The Market at Bridgemill driveway on BFR		Convert intersection into a RIRO	-----	-----
Liberty Elementary School/ Freedom Middle School		-----	Construct extra storage space for the parent queueing; convert the unsignalized driveways to multilane roundabouts with a four-lane section between them	-----
BFR & Butterworth Road		-----	Widen Butterworth Road into a four-lane roadway between BFR and SR 20	-----

BENEFIT-COST ANALYSIS

In an effort to determine the feasibility of some of the proposed improvement alternatives a Benefit/Cost Analysis was performed on the alternatives that were deemed optimal for each intersection. To complete this process three pieces of information were necessary:

1. Estimated Travel Time Savings Benefits associated with the alternative
2. Estimated Crash Savings Benefits
3. Estimated Cost of the Alternative

1) **Travel Time Savings** – This process uses the delay reduction experienced per vehicle comparing the proposed alternative to the "existing condition". For example, under existing conditions the delay was 10 seconds per affected vehicle and it was reduced to 6 seconds with the alternative installed, then the delay reduction per vehicle would be 4 seconds. Using this process, the delay reductions for the AM, Midday, and PM Peaks were converted into Hours Saved per Work Year. Finally, the Hours Saved per Work Year is multiplied by the Average Hourly Earnings found for Cherokee County to convert this into Annual Travel Time Savings.

2) **Crash Savings Benefits** – These were developed by using a process outlined in the Highway Safety Manual (HSM) in order to put a cost to the crashes that would be prevented by the alternative based on the Crash Reduction Factors (CRF), from Crash Clearinghouse, associated with the proposed alternatives. Comprehensive Crash Costs were provided via a 2016 update by the FHWA and per the process outlined these national costs first must be adjusted to state level costs costs based on per capita income (PCI). According to the 2016 update Georgia's PCI compared to national average is 0.844. Finally, the 2016 costs must be brought to current values. The year of 2019 was used to avoid affects by the Coronavirus. The table below illustrates the 2016 FHWA costs, the 2016 Georgia adjusted costs, and the 2019 Georgia costs.

Table 23: COMPREHENSIVE CRASH COSTS

	CRASH SEVERITY	2016 FHWA	2016 GEORGIA	2019 GEORGIA
K	Fatal Crash	$11,295,402	$9,533,319	$10,435,754
A	Suspected Serious Injury Crash	$654,967	$552,792	$604,229
B	Suspected Minor Injury Crash	$198,492	$167,527	$182,694
C	Possible Injury Crash	$125,742	$106,126	$115,694
O	Property Damage Only	$11,906	$10,049	$10,702

The 2019 Georgia costs were applied to the amount of crashes found to be correctable based on the alternative chosen. The number of crashes was then multiplied by the appropriate cost. For all injuries sustained in a crash the cost for crash severity 'B' was used. Because the crash data was collected for the past five years at each intersection, the total cost found was divided by 5 to convert it into annual cost savings.

3) **Cost of the Alternative** – The estimated cost of the chosen alternative at each intersection was developed by Heath & Linebeck Engineers Inc. Using the costs provided, the Total Annual Costs, for the Design Life of each alternative (26 years), were determined through the following equation:

$$AC = P(\frac{A}{P}i, n)$$

Where P = Estimated Cost
A/P = Cash Flow Equivalent Factors based on i and n
i = Time Value of Money based on Federal Interest Rate
n = Life of Project

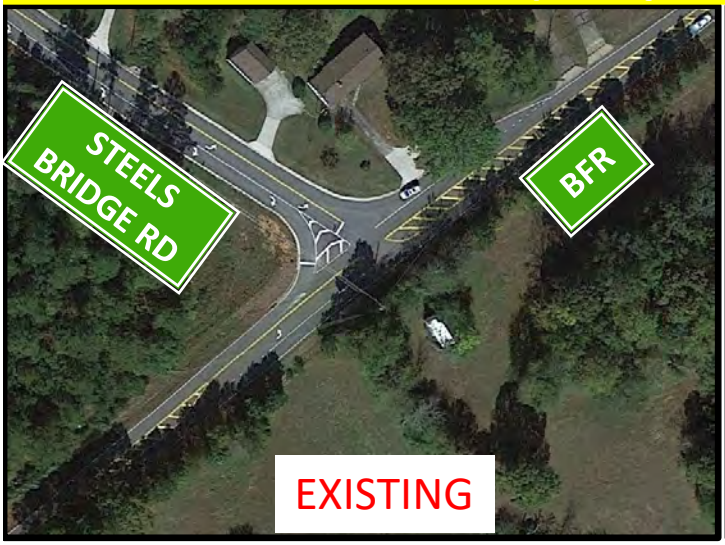
After each of the three pieces of information were determined for each intersection a Benefit/Cost was produced for the alternative:

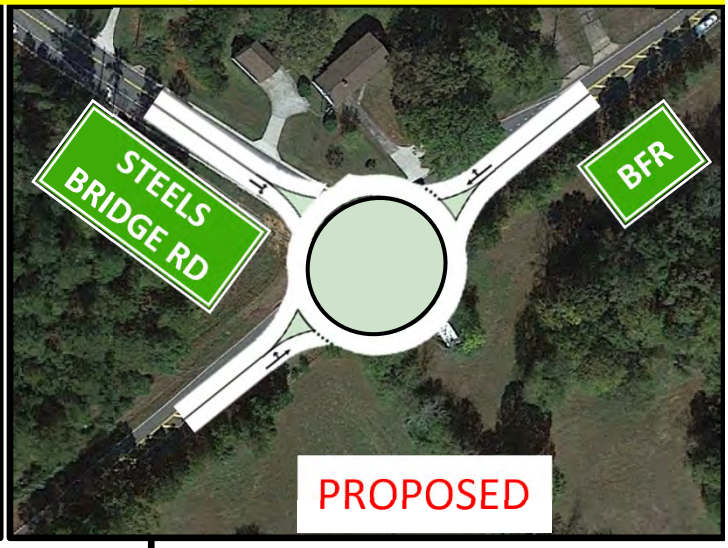
$$BC\ Ratio = \frac{Travel\ Time\ Savings + Crash\ Savings}{Cost\ of\ the\ Alternative}$$

The following pages illustrate the process outlined to determine a B/C Ratio for each applicable proposed alternative.

The estimated total cost for the each of the evaluated alternatives is included in Appendix M.

BFR AT STEELS BRIDGE ROAD
(Completed 2026)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	29.9	16.3	36.1
Vehicles at Approach	260	140	160
Total Delay Reduction per Hour	2.160	0.634	1.604
Hours Saved through Workday	6.478	1.268	4.813
Hours Saved per Day	12.560		
Hours Saved per Work Year (260)	3265.46		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$86,339.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 32%
All Inj/Fat = 71%

Total Correctable Crashes = 13
PDO Crashes = 8
Total Injuries = 8

Type	PDO	Inj/Fat
Total	8	8
Reduced	3	6
Cost Per	$10,701.83	$182,693.67
Total $	$32,105	$1,096,162

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$32,105+\$1,096,162}{5}$

Annual Crash Savings = **$225,653.00**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $3,663,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$3,663,000\ (0.0497)$$

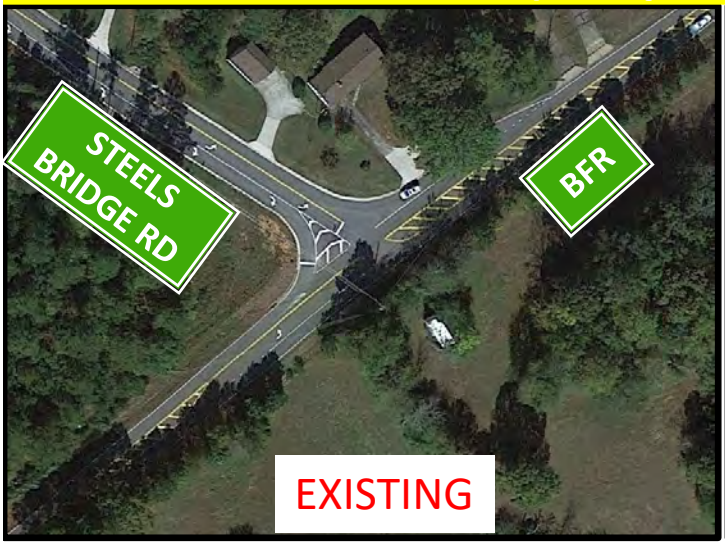
$$AC = \$182,051.00$$

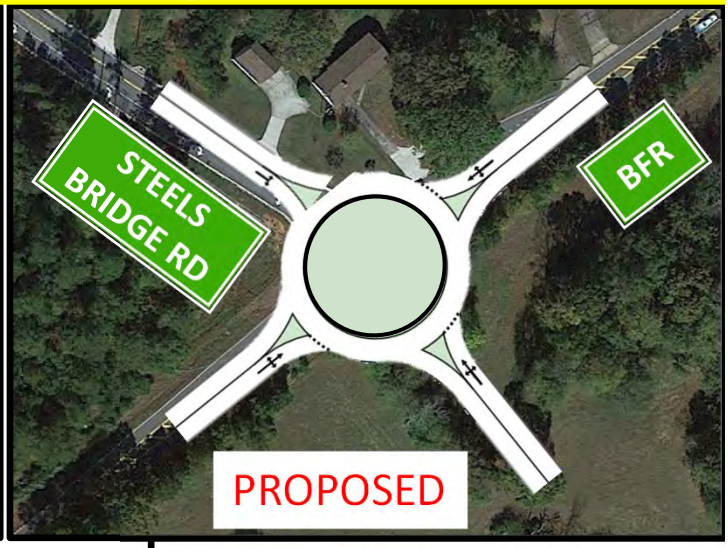
FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$86,339 + \$225,653)}{\$182,051}$$

B/C for alternative = 1.71

BFR AT WOOTEN DRIVE (NORTH)
(Completed 2026)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	7.5	5.1	10.9
Vehicles at Approach	35	25	30
Total Delay Reduction per Hour	0.073	0.035	0.091
Hours Saved through Workday	0.219	0.071	0.273
Hours Saved per Day	0.562		
Hours Saved per Work Year (260)	146.142		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$3,864.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 32%
All Inj/Fat = 71%

Total Correctable Crashes = 13
PDO Crashes = 8
Total Injuries = 8

Type	PDO	Inj/Fat
Total	3	6
Reduced	1	4
Cost Per	$10,701.83	$182,693.67
Total $	$10,702	$730,775

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$10,702+\$730,775}{5}$

Annual Crash Savings = **$148,295.00**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $817,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$817,000\ (0.0497)$$

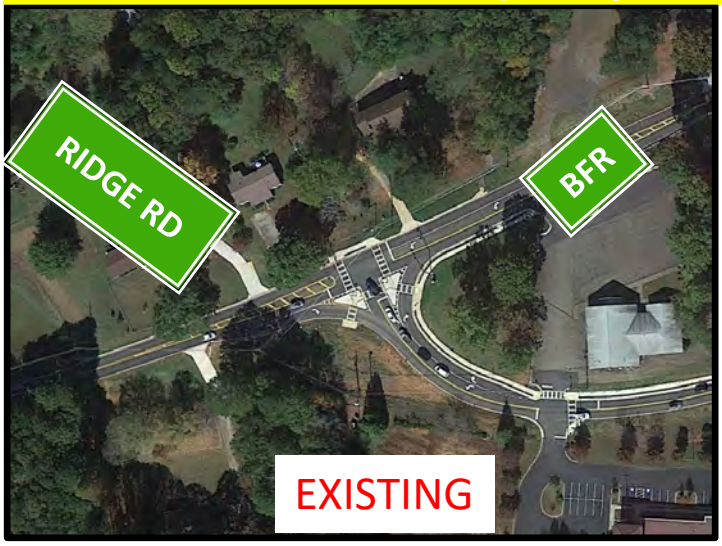
$$AC = \$40,605.00$$

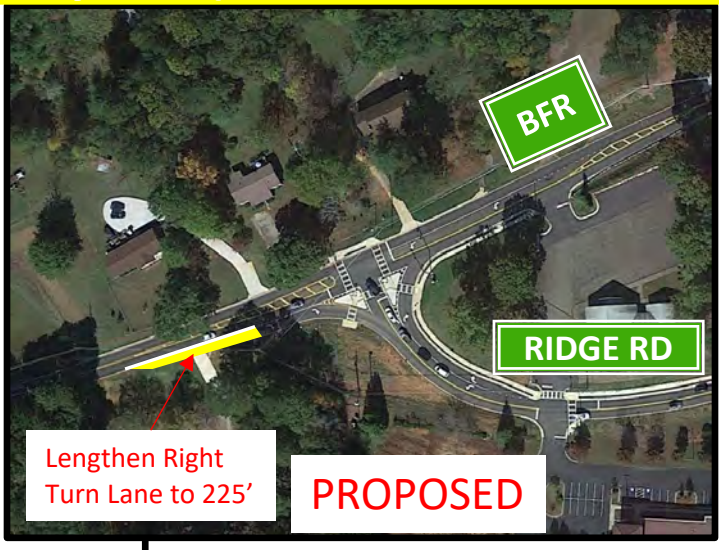
FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$3,864 + \$148,295)}{\$40,605}$$

B/C for alternative = 3.75

BFR AT RIDGE ROAD
(Completed by 2023)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	1.6	2.1	11.3
Vehicles at Approach	695	630	805
Total Delay Reduction per Hour	0.309	0.368	2.527
Hours Saved through Workday	0.927	0.735	7.580
Hours Saved per Day	9.242		
Hours Saved per Work Year (260)	2402.94		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$63,534.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 14%
All Inj/Fat = 9%

Total Correctable Crashes = 0
PDO Crashes = 0
Total Injuries = 0

Type	PDO	Inj/Fat
Total	0	0
Reduced	0	0
Cost Per	$10,701.83	$182,693.67
Total $	$0	$0

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$0+\$0}{5}$

Annual Crash Savings = **$0.00**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $222,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$222{,}000\ (0.0497)$$

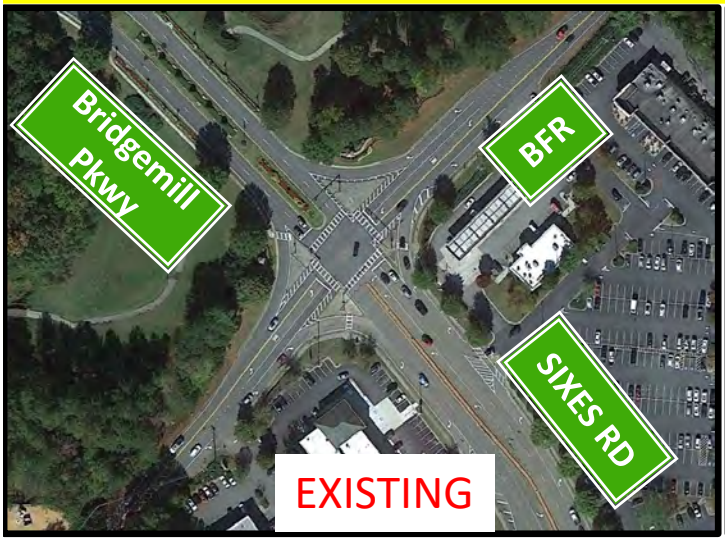
$$AC = \$11{,}033.00$$

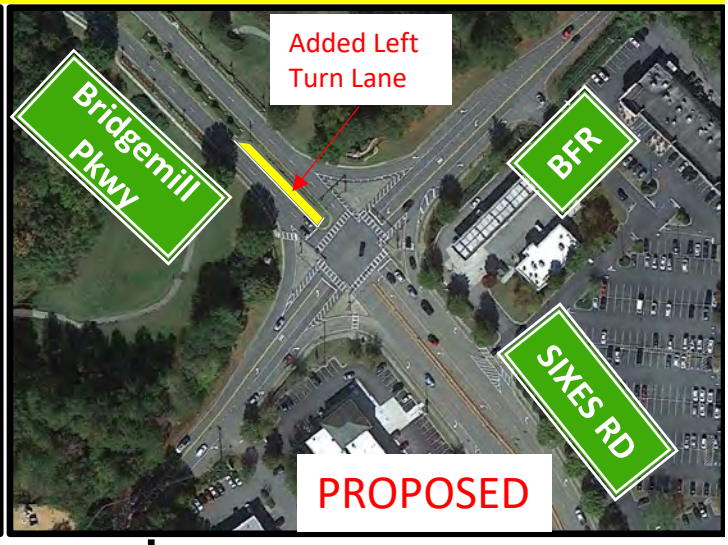
FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$63{,}534 + \$0)}{\$11{,}033}$$

B/C for alternative = 5.76

BFR AT SIXES ROAD/BRIDGEMILL PARKWAY
(Completed 2023)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	1.3	0.3	0.4
Vehicles at Intersection	1505	1550	1790
Total Delay Reduction per Hour	0.543	0.129	0.199
Hours Saved through Workday	1.630	0.258	0.597
Hours Saved per Day	2.485		
Hours Saved per Work Year (260)	646.208		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$17,086.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 19%
All Inj/Fat = 17%

Total Correctable Crashes w/ WBL = 14
PDO Crashes = 11
Total Injuries = 5

Type	PDO	Inj/Fat
Total	11	5
Reduced	2	1
Cost Per	$10,701.83	$182,693.67
Total $	$21,404	$182,694

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$21,404+\$182,694}{5}$

Annual Crash Savings = **$\$40,820.00$**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $40,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$78,000\ (0.0497)$$

$$AC = \$3,877.00$$

FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$17,086 + \$40,820)}{\$3,877}$$

B/C for alternative = 14.94

BFR AT HOLLY STREET
(Completed 2023)

BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	5.9	6.4	7.3
Vehicles at Approach	145	130	145
Total Delay Reduction per Hour	0.238	0.231	0.294
Hours Saved through Workday	0.713	0.462	0.882
Hours Saved per Day	2.057		
Hours Saved per Work Year (260)	534.88		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$14,143.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 14%
All Inj/Fat = 9%

Total Correctable Crashes = 3
PDO Crashes = 3
Total Injuries = 0

Type	PDO	Inj/Fat
Total	3	0
Reduced	1	0
Cost Per	$10,701.83	$182,693.67
Total $	$10,702	$0

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$10{,}702+\$0}{5}$

Annual Crash Savings = **$2,140.00**

ESTIMATED COST

$AC = P(\frac{A}{P}\ i, n)$

P = $643,000
i = 2.00%
n = 26
A/P = 0.0497

$AC = \$643{,}000\ (0.0497)$

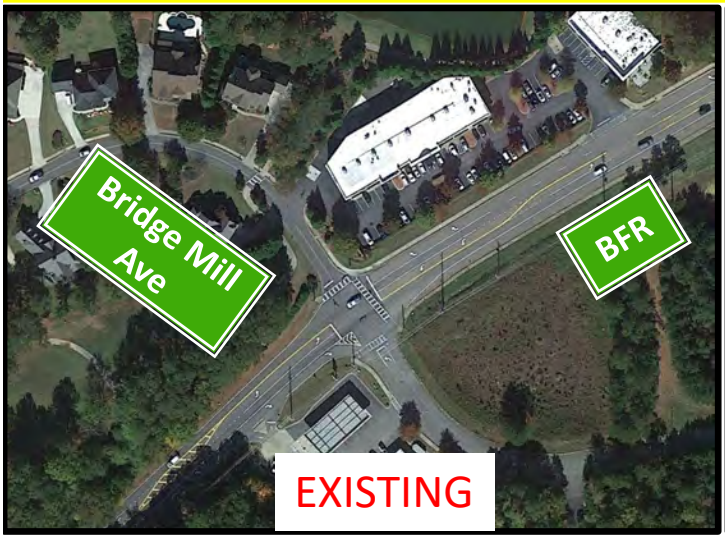
$AC =$ **$31,957.00**

FINAL BENEFIT/COST

B/C Ratio = $\frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$14{,}143 + \$2{,}140)}{\$31{,}957}$

B/C for alternative = 0.51

BFR AT BRIDGE MILL AVE
(Completed 2023)



BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	5.3	3.1	2.8
Vehicles at Approach	270	140	145
Total Delay Reduction per Hour	0.398	0.121	0.113
Hours Saved through Workday	1.193	0.241	0.338
Hours Saved per Day	1.772		
Hours Saved per Work Year (260)	460.710		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$12,182.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 19%
All Inj/Fat = 17%

Total Correctable Crashes = 3
PDO Crashes = 3
Total Injuries = 0

Type	PDO	Inj/Fat
Total	3	0
Reduced	1	0
Cost Per	$10,701.83	$182,693.67
Total $	$10,702	$0

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$10{,}702+\$0}{5}$

Annual Crash Savings = **$2,140.00**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $443,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$443{,}000\ (0.0497)$$

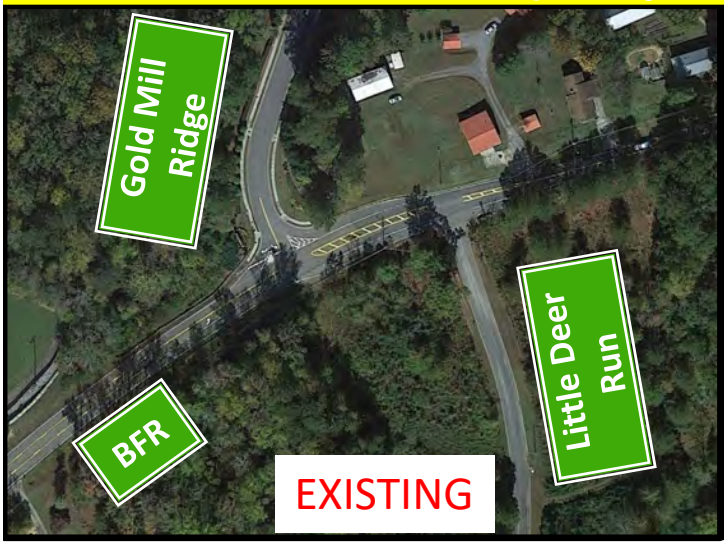
$$AC = \$22{,}017.00$$

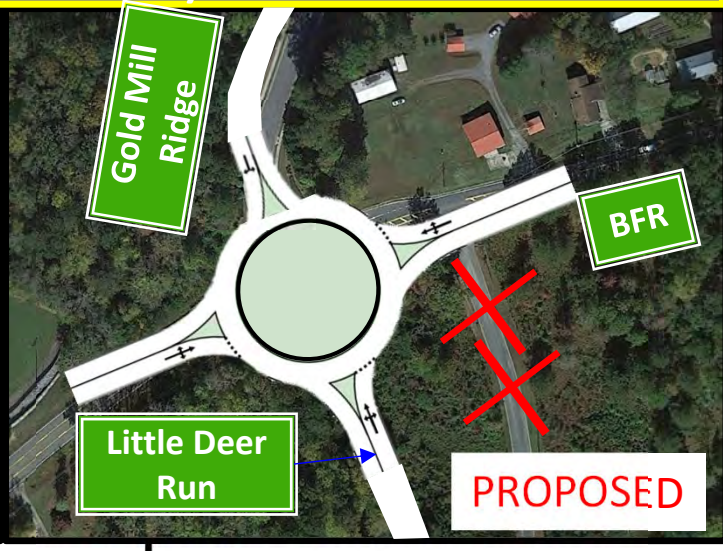
FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$12{,}182 + \$2{,}140)}{\$22{,}017}$$

B/C for alternative = 0.65

BFR AT GOLD MILL RIDGE
(Completed 2026)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	41.6	12.2	35.6
Vehicles at Approach	285	150	175
Total Delay Reduction per Hour	3.293	0.508	1.731
Hours Saved through Workday	9.880	1.017	5.192
Hours Saved per Day	16.088		
Hours Saved per Work Year (260)	4182.967		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$110,598.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 32%
All Inj/Fat = 71%

Total Correctable Crashes = 13
PDO Crashes = 8
Total Injuries = 8

Type	PDO	Inj/Fat
Total	12	8
Reduced	4	6
Cost Per	$10,701.83	$182,693.67
Total $	$42,807	$1,096,162

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$42,807+\$1,096,162}{5}$

Annual Crash Savings = **$227,794.00**

ESTIMATED COST

$$AC = P(\frac{A}{P}\ i, n)$$

P = $3,128,000
i = 2.00%
n = 26
A/P = 0.0497

$$AC = \$3,128,000\ (0.0497)$$

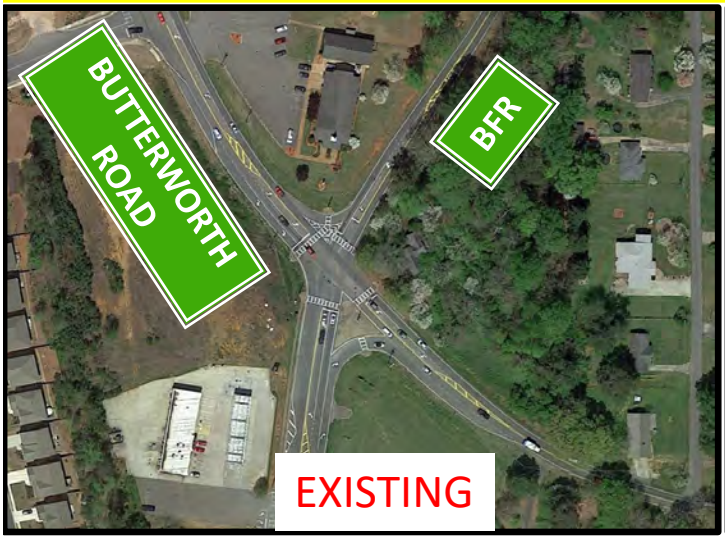
$$AC = \$155,462.00$$

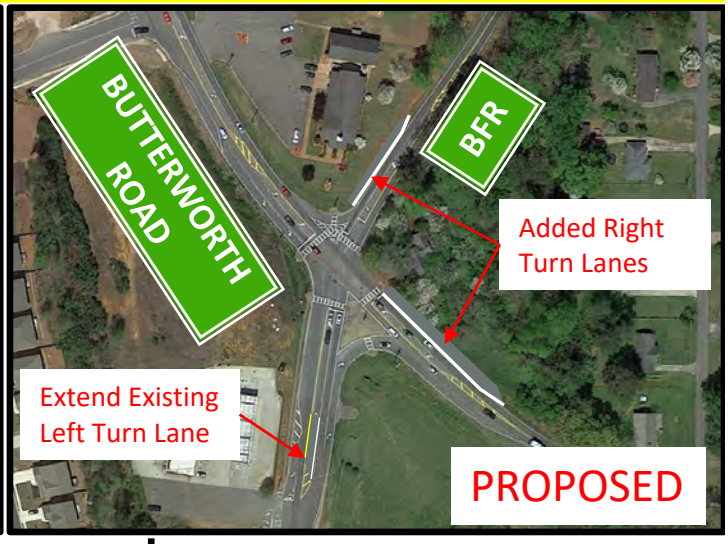
FINAL BENEFIT/COST

$$\text{B/C Ratio} = \frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$110,598 + \$227,794)}{\$155,462}$$

B/C for alternative = 2.18

BFR AT BUTTERWORTH ROAD
(Completed 2023)





BENEFITS

Estimated Delay Reduction

	AM	MD	PM
Delay Reduction per Vehicle	2.0	2.5	5.0
Vehicles at Intersection	1780	1525	2120
Total Delay Reduction per Hour	0.989	1.059	2.944
Hours Saved through Workday	2.967	2.118	8.833
Hours Saved per Day	13.918		
Hours Saved per Work Year (260)	3618.69		
Cherokee County Avg Hrly Earnings	$26.44 per hour		
Total Travel Time Savings (rounded to nearest $)	**$95,678.00**		

Crash Reduction

Roundabout Crash Reduction %'s

All PDO's = 14%
All Inj/Fat = 9%

Total Correctable Crashes = 1
PDO Crashes = 1
Total Injuries = 0

Type	PDO	Inj/Fat
Total	1	0
Reduced	0	0
Cost Per	$10,701.83	$182,693.67
Total $	$0	$0

Annual Crash Savings= $\frac{Total\ Crash\ Reduction}{\#\ of\ Years}$

Annual Crash Savings = $\frac{\$0+\$0}{5}$

Annual Crash Savings = **$0.00**

ESTIMATED COST

$AC = P(\frac{A}{P}\ i, n)$

P = $741,000
i = 2.00%
n = 26
A/P = 0.0497

$AC = \$741{,}000\ (0.0497)$

$AC =$ **$36,828.00**

FINAL BENEFIT/COST

B/C Ratio = $\frac{Total\ Annual\ Benefits}{Total\ Annual\ Costs} = \frac{(\$95{,}678 + \$0)}{\$36{,}828}$

B/C for alternative = 2.60

Table 24 below illustrates the reduction in delay with the alternative implemented.

Table 24: CAPACITY ANALYSIS – DELAY REDUCTION COMPARISON

INTERSECTION	ANALYSIS TYPE	BY BASE YEAR (2026)					
		AM		MID		PM	
		W/O Alt	W Alt	W/O Alt	W Alt	W/O Alt	W Alt
Steels Bridge Road	Approach	**E (39.0)**	A (9.1)	C (22.8)	A (6.5)	**E (43.5)**	A (7.4)
Wooten Drive (North)	Approach	B (13.6)	A (6.1)	B (10.6)	A (5.5)	C (17.2)	A (6.3)
Ridge Road	Approach	B (10.7)	A (9.1)	B (10.1)	A (8.0)	C (23.3)	B (12.0)
Sixes Road/Bridgemill Parkway	Intersection	B (19.8)	B (18.5)	B (17.8)	B (17.5)	B (18.1)	B (17.7)
Holly Street	Approach	C (23.1)	C (17.2)	D (25.1)	C (18.7)	D (26.9)	C (19.6)
Bridge Mill Avenue	Approach	C (28.3)	C (23.0)	C (29.4)	C (26.3)	C (24.0)	C (21.2)
Gold Mill Ridge	Approach	**F (50.6)**	A (9.0)	C (18.9)	A (6.7)	**E (43.3)**	A (7.7)
Butterworth Road	Intersection	C (24.7)	C (22.7)	C (24.3)	C (21.8)	C (31.6)	C (26.6)

The table shows decreased delay for each intersection that an alternative was evaluated. Operational improvements were not evaluated at the intersections of Wooten Drive (South) or Marietta Highway as they are expected operate acceptably under current geometric conditions. These capacity analysis results can be found in Appendix N.

SUMMARY OF FINDINGS

- There are two GDOT P.I. numbered projects in the vicinity of the Bells Ferry Road study corridor and a third project that is expected in the future. The P.I. projects are 0013526 and 0013525, which are the widening of 2.3 miles for BFR south of the marina and the construction of a new two-lane bridge, respectively. The third project is the construction of a second new bridge that would be utilized when/if BFR is widened north of the marina.
- During the field visit multiple queues were observed originating from both Liberty Elementary School and Freedom Middle School. The queues extended from the parent drop-off points within school property, out onto BFR. The longest observed on BFR queue for Liberty was 600 feet and 825 feet for Freedom.
- Both schools have different start and let-out times so the queueing experienced by each school does not affect the other.
- The BFR corridor is experiencing crash rates between Wooten Drive (South) and Marietta Highway that are lower than the state-wide averages for the years analyzed. No fatalities were found through this portion of the corridor for the years analyzed.
- Traffic in the study area and the surrounding regions is expected to grow at a rate of 1.0% per year under No-Build Conditions and Build Conditions.
- Under Existing Conditions, the following study intersections have at least one movement/approach operating with a level of service ‘E’ or worse during one or both peak hours:
  2. Steels Bridge Road
- Under Projected Conditions with no geometric improvements, the signalized intersections are expected to continue operate acceptably through the Base Year (2026) and Design Year (2046).
- Under Projected Conditions with no geometric improvements, the following unsignalized intersections within the study area are expected to have at least one movement that experiences a level of service ‘E’ or worse by Base (2026) or Design (2046):
  2. Steels Bridge Road
  3. Wooten Drive (North)
  6. Holly Street
  8. Gold Mill Ridge
- It was determined, through interpolation, by using the 2026 volumes that portions of the corridor would begin to reach 15,000 vehicles per day by 2039. For this reason, the 2046 volumes were evaluated under the condition that BFR would be consists of four lanes at this point.
- Under Projected Conditions with the only improvement being the widening of BFR, the signalized intersections are expected to continue to operate acceptably through the Base Year (2026) and Design Year (2046).

- Under Projected Conditions with the only improvement being the widening of BFR, the following unsignalized intersections are expected to have at least one movement that experiences a level of service 'E' or worse by Design (2046):
  2. Steels Bridge Road
  8. Gold Mill Ridge

- Short-Term (≤3 years), Mid-Term (≤6 years), and Long-Term (6+ years) improvement alternatives were considered for each of the study intersections.

- The alternatives were then narrowed down to the optimal for each intersection, on which a Benefit/Cost analysis was developed. The intersections, the chosen alternative and its B/C Ratio is summarized below:

2. Steels Bridge Road	Construction of a single-lane roundabout that can be transitioned into a multpg 58i-lane after BFR is widened	1.71
3. Wooten Drive (North)	Realignment of road to become the 4th leg of the Steels Bridge Road intersection after the installation of the roundabout	3.75
4. Ridge Road	Lengthening of the northbound right turn lane	5.76
5. Sixes Road/Bridgemill Parkway	Addition of a dedicated westbound left turn lane and optimized signal timing	14.94
6. Holly Street	Addition of northbound and westbound right turn lanes	0.51
7. Bridge Mill Avenue	Addition of a dedicated westbound left turn lane	0.65
8. Gold Mill Ridge	Construction of a single-lane roundabout that can be transitioned into a multi-lane after BFR is widened; Realignment of Little Deer Run to become 4th leg of intersection	2.18
9. Butterworth Road	Addition of southbound and eastbound right turn lanes and the extension of the existing northbound left turn lane and optimizing signal timing	2.6

- Capacity Analysis of each of the evaluated alternatives indicates that each of the alternatives would result in decreased delay per vehicle compared to existing geometric conditions.

- Operational improvements for Wooten Drive (South) and Marietta Highway were evaluated due to the expected acceptable operation through the Design Year (2046).

- Other improvements that were found to consider were:
  - Converting the Market at Bridgemill Driveway on BFR to a RIRO
  - Implementation of the school concept to eliminate the parental queueing onto BFR
  - Widening of Butterworth Road into a four-lane from SR 20 though its intersection with BFR

RECOMMENDATIONS

This section contains two sets of recommendations. The set on this page are recommendations based off the B-C Analysis, while the following page contains recommendations based on the evaluations of the study and general improvements to consider for the corridor.

Based on the B-C Analysis, implementation of the following improvements is recommended (by intersection):

2. Steels Bridge Road
    - Construction of a single-lane roundabout (180-foot inscribed diameter) that can be transitioned into a multi-lane after BFR is widened – Constructed by 2026.

3. Wooten Drive (North)
    - Realignment of the road to become the 4th leg of the Steels Bridge Road intersection after the installation of the roundabout – Constructed by 2026.
    - Cul-de-sac original roadway alignment.

4. Ridge Road
    - Lengthening of the northbound right turn lane from the existing 75 feet to 225 feet – Constructed by 2023.

5. Sixes Road/Bridgemill Parkway
    - Addition of a dedicated 150-foot westbound left turn lane with a three-section FYA – Constructed by 2023.
    - Optimize signal timing

6. Holly Street
    - Addition of a 175-foot full width storage northbound right turn lane – Constructed by 2023.
    - Addition of a 175-foot full width storage westbound right turn lane – Constructed by 2023.
    - Sight Distance improvements – completed by 2026.

7. Bridge Mill Avenue
    - Addition of a dedicated 100-foot westbound left turn lane – constructed by 2023.

8. Gold Mill Ridge
    - Construction of a single-lane roundabout (180-foot inscribed diameter) that can be transitioned into a multi-lane after BFR is widened – Constructed by 2026.
    - Realignment of Little Deer Run to become 4th leg of intersection – Constructed by 2026

9. Butterworth Road
    - Addition of a 150-foot full width storage southbound right turn lane – Constructed by 2023.
    - Addition of a 150-foot full width storage westbound right turn lane – Constructed by 2023
    - Restripe the existing northbound left turn lane to provide 225 feet of full width storage – Constructed by 2023
    - Optimize signal timing

Other recommendations based on the evaluations of this study are:

- The Bells Ferry Road corridor should be widened to a four-lane roadway section by the year 2039. The widening should take place from the marina to the intersection of Butterworth Road.
- Improving the sight distance at the intersection of Wooten Drive (South) (intersection #1) by cutting back the vegetation and removing existing obstructions.
- Conversion of the existing full access driveway for the Market at Bridgemill on BFR to a RIRO to prevent the traffic on BFR from being obstructed by a single car.
- Adjustments to the existing signal timing of the Marietta Highway (#10) intersection, along with addition of 3-section FYA for the Marietta Highway approaches.

Considerations should also be given to the following:

- Providing extra roadway on school grounds in an effort to remove all of the queueing due to parents picking up and dropping off their children at Liberty Elementary and Freedom Middle Schools.
- A study for the potential widening of Butterworth Road to a four-lane section. The current AADT west of the BFT is 15,000 vehicles per day. Butterworth Road is being utilized as a high volume cut through road for traffic going to and from SR 20 and SR 5, with most of the traffic destined for SR 20. The addition of lanes would not add capacity to this section of Butterworth Road, but it would also add capacity to the intersection with BFR and lead to better operation.