# Section 3A:

# Bent Creek Road Corridor

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## INTRODUCTION

This section documents the results of traffic operations evaluations for the Bent Creek Road Corridor from E. Glenn Avenue to Hamilton Road in Auburn, Alabama. The intersections analyzed in this corridor include:

- Bent Creek Road at E. Glenn Avenue
- Bent Creek Road at Auburn Exchange Drive
- Bent Creek Road at I-85 Southbound Ramps
- Bent Creek Road at I-85 Northbound Ramps
- Bent Creek Road at Hamilton Road

The locations of the study intersections along the Bent Creek Road Corridor are illustrated in **Figure 1**. To accomplish the traffic operations evaluations for the Bent Creek Road Corridor, the following tasks were undertaken:

- existing peak hour turning movement counts were conducted for the study intersections;
- daily traffic counts were conducted on Bent Creek Road;
- drive times were collected for the morning and afternoon commuter peak periods;
- observations of traffic operations were conducted during peak periods;
- capacity analyses were conducted for the study intersections;
- segment capacity analysis was conducted for Bent Creek Road;
- current traffic operational deficiencies were identified;
- projections for ten (10) year growth in traffic through the corridor were developed; and
- geometric and traffic control improvements were developed for the study intersections to address traffic operational and safety deficiencies for existing and projected ten (10) year conditions.

Sources of information used in this section include: The City of Auburn, Alabama; the Institute of Transportation Engineers; American Association of State Highway and Transportation Officials; the Manual on Uniform Traffic Control Devices; the Transportation Research Board; and the files and field reconnaissance efforts of Skipper Consulting, Inc.

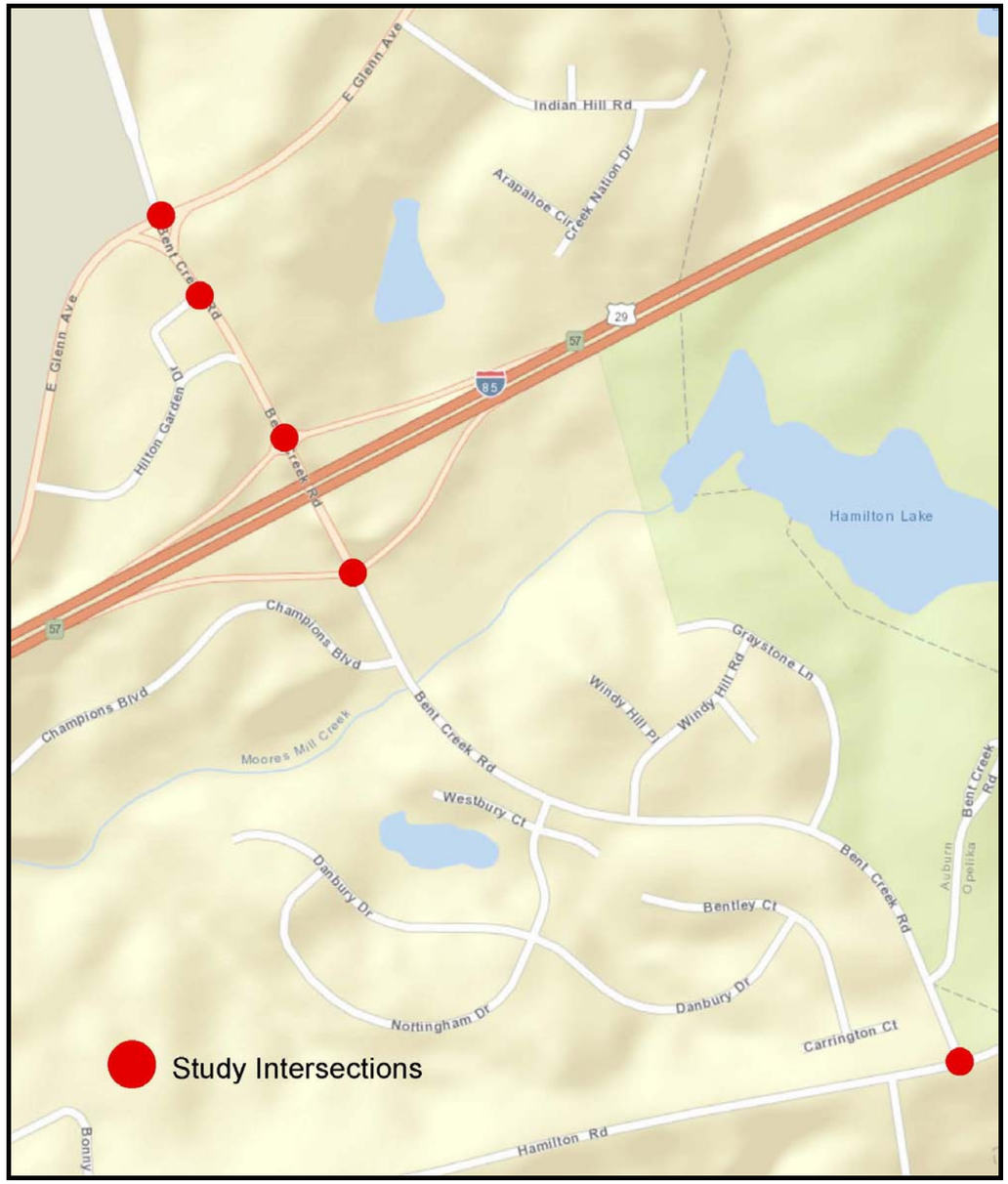



**Figure 1**

**Bent Creek Road Corridor and Study Intersections**

## BACKGROUND INFORMATION

### Study Area Roadways

Bent Creek Road is a minor arterial roadway from E. Glenn Avenue to Hamilton Road. From E. Glenn Avenue south through the Interstate 85 ramp intersections Bent Creek Road provides access to various retail and commercial land uses as well as access to Interstate 85. To the south of Interstate 85 to Hamilton Road, Bent Creek Road provides access to primarily residential land uses. Bent Creek Road is approximately 1.2 miles in length. Characteristics of the roadways within the Bent Creek Road Corridor are summarized in **Table 1**.

**Table 1 - Corridor Roadway Characteristics**

| Roadway | Parking | # of Lanes | Travel Direction | Travel Speeds (mph) | Classification |
|---|---|---|---|---|---|
| Bent Creek Road (E. Glenn Ave to I-85 NB Ramps) | None | 4-6 | North/South | 35 | Minor Arterial |
| Bent Creek Road (I-85 to Hamilton Road) | None | 2 | North/South | 35 | Minor Arterial |
| E. Glenn Avenue | None | 5 | East/West | 45 | Minor Arterial |
| Auburn Exchange Drive (East of Bent Creek Rd) | None | 5 | East/West | 25 | Local Street |
| Auburn Exchange Drive (West of Bent Creek Rd) | None | 2 | East/West | 25 | Local Street |
| Interstate 85 | None | 4 | North/South | 70 | Interstate/ Freeway |
| Hamilton Road | None | 2 | East/West | 45 | Minor Arterial |

### Peak Hour Traffic Counts

Morning (7:00-9:00 am) and afternoon (4:00-6:00 pm) peak hour turning movement counts were conducted along the Bent Creek Road Corridor at study intersections during the months of October and November 2016. Traffic count data utilized for the analyses of these intersections is summarized in **Figure 2**.

### Peak Period Observations

Observations of traffic operations were conducted within the Bent Creek Corridor during the morning and afternoon peak periods. The following items were noted in these observations:

- Some conflict during peak periods of traffic flow were observed between the free-flow right-turning vehicles from E. Glenn Avenue onto southbound Bent Creek Road and left-turning vehicles from westbound E. Glenn Avenue attempting to access the right-turn lane at Auburn Exchange. This conflict was not a constant occurrence but did cause some turbulence when it occurred.
- Some conflict was noted during peak periods of traffic flow due to vehicles utilizing the lane add from Hilton Garden Drive onto southbound Bent Creek Parkway and vehicles travelling southbound on Bent Creek Road attempting to turn right onto southbound I-85. Although the right-turn from Hilton Garden Drive is signed with "Yield" control, often vehicles were observed making this movement as a free-flow. This conflict was not a constant occurrence but did cause some turbulence when it occurred.

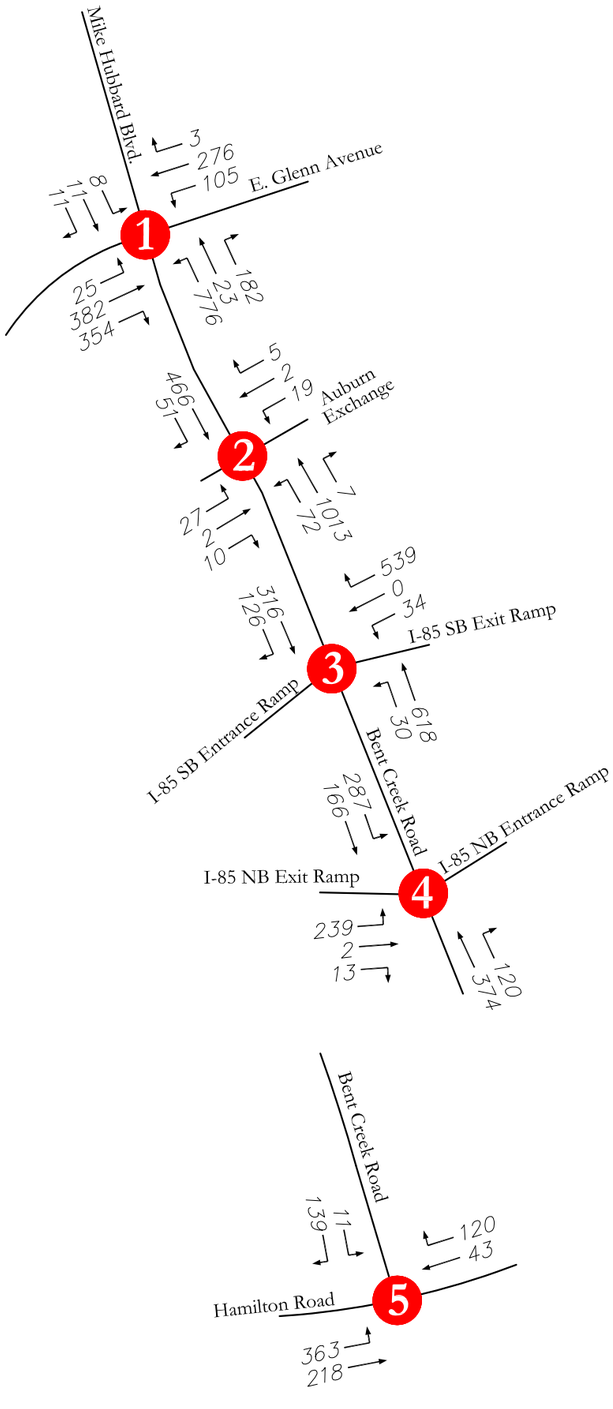
## EXISTING CONDITIONS ANALYSES

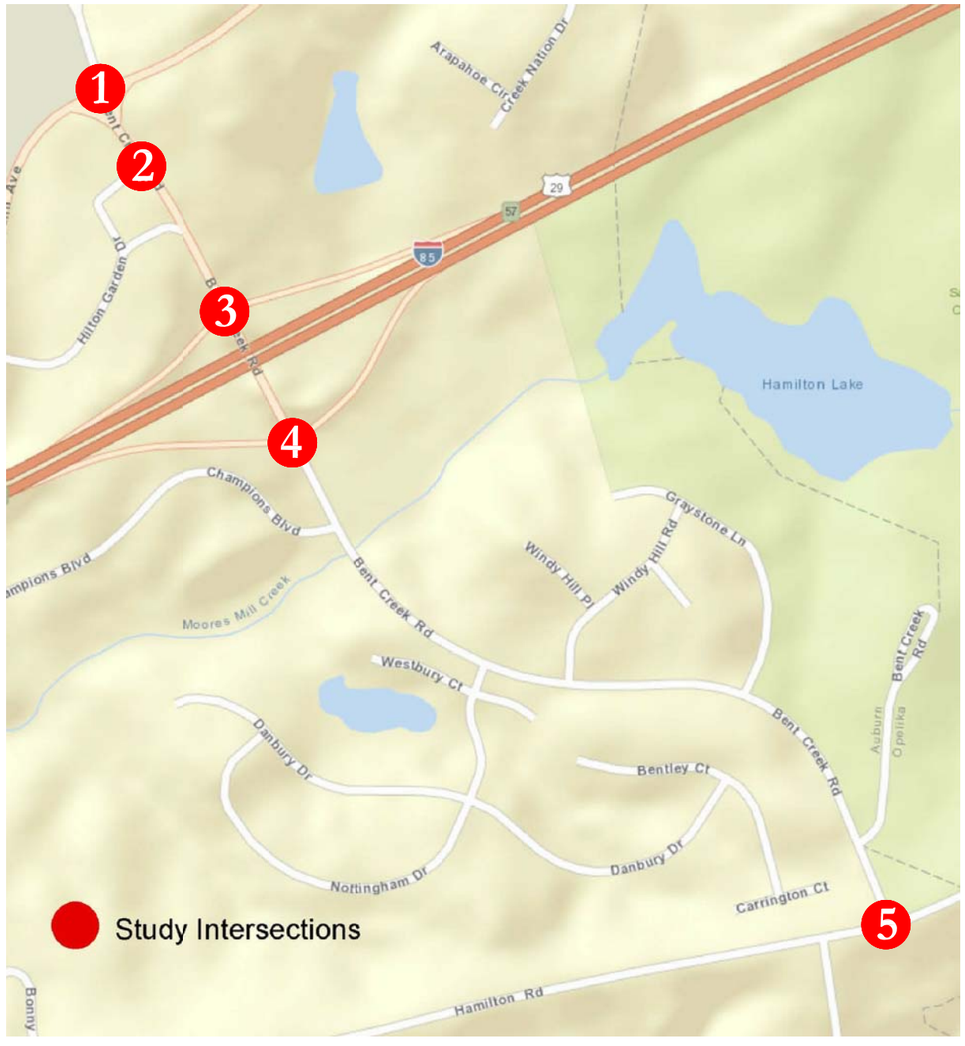
### Existing Intersection Capacity Analysis

Capacity analyses for peak hour conditions at the study intersections along the Bent Creek Road Corridor were conducted for the morning and afternoon peak hour periods using methods outlined in the *Highway Capacity Manual, 2010*. According to methods of the *Highway Capacity Manual*, capacity is expressed as levels of service ranging from "A" (best) through "F" (worst). In general, a level of service "C" is considered desirable while a level of service "D" is considered acceptable during peak hour operations. Results of these capacity analyses for existing conditions are summarized in **Table 2**.

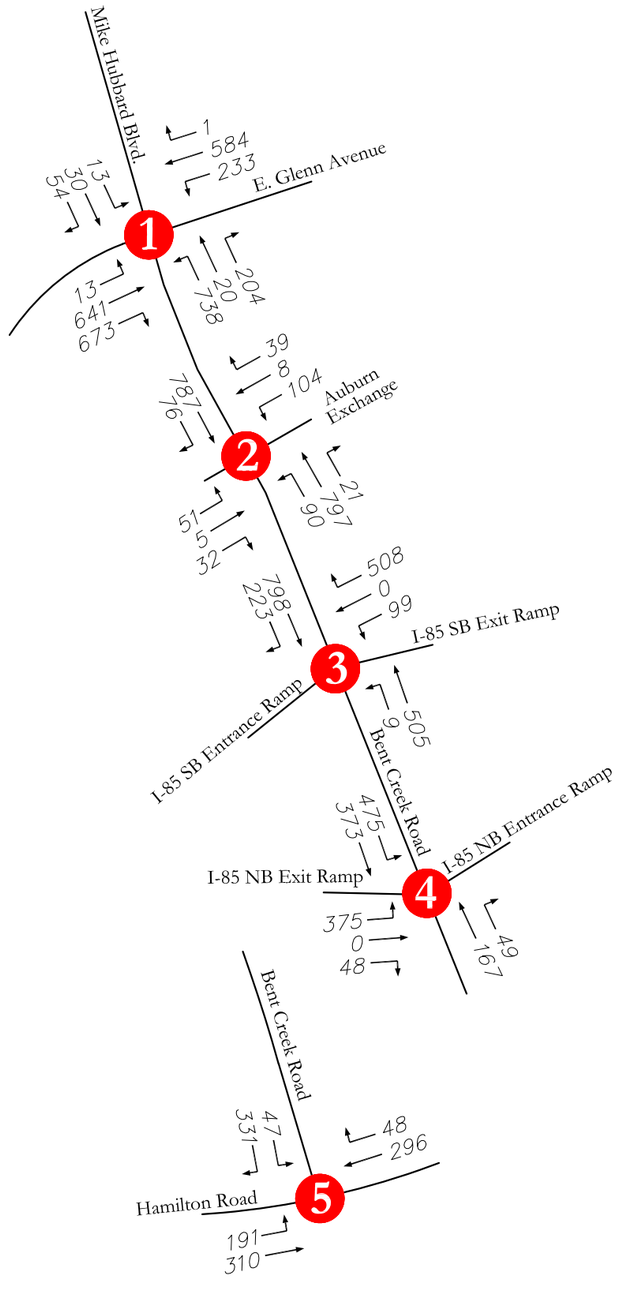
As shown in **Table 2**, all study intersections evaluated along the Bent Creek Road Corridor operate at acceptable levels of service for both peak periods tested.

## AM Peak Hour Traffic Volumes




## PM Peak Hour Traffic Volumes




SKIPPER CONSULTING INC

North

Graphic Scale: 1"-100'

# Figure 2
## Bent Creek Road
## Existing Peak Hour Volumes

Bent Creek Road
Auburn, Alabama

October 2018

1103-013

### Table 2 - Existing Intersection Levels of Service

| Intersection (traffic control) | Approach | Movement/ Lane Group | Level of Service | |
|---|---|---|---|---|
| | | | A.M. Peak Hour | P.M. Peak Hour |
| Bent Creek Road at E. Glenn Avenue (traffic signal) | EB E. Glenn Avenue. | Left | C | C |
| | | Through | C | C |
| | | Right | - | - |
| | WB E. Glenn Avenue. | Left | C | C |
| | | Through | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | C | D |
| | | Through | B | C |
| | | Right | - | - |
| | SB Mike Hubbard Boulevard | Left | C | D |
| | | Through | C | D |
| | | Right | C | D |
| | **Overall LOS** | | **C** | **C** |
| Bent Creek Road at Auburn Exchange Drive (traffic signal) | EB Auburn Exchange Dr. | Left | B | B |
| | | Through/Right | B | B |
| | WB Auburn Exchange Dr. | Left | B | C |
| | | Through | B | B |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | | Right | - | - |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Southbound Ramps (traffic signal) | I-85 SB Ramps | Left | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Northbound Ramps (traffic signal) | I-85 NB Ramps | Left | B | B |
| | | Right | - | - |
| | NB Bent Creek Road | Through/Right | B | B |
| | SB Bent Creek Road | Left | B | B |
| | | Through | B | A |
| | **Overall LOS** | | **B** | **B** |
| Bent Creek Road at Hamilton Road (traffic signal) | EB Hamilton Road | Left | A | B |
| | | Through | A | A |
| | WB Hamilton Road | Through/Right | B | C |
| | SB Bent Creek Road | Left | B | B |
| | | Right | C | D |
| | **Overall LOS** | | **B** | **C** |

### Existing Roadway Segment Capacity Analysis

Roadway segment capacity analyses for daily traffic conditions along the Bent Creek Road Corridor were performed using the daily capacity and level of service chart obtained from the Alabama Department of Transportation. The daily traffic count on Bent Creek Road was conducted just south of E. Glenn Avenue. This section of Bent Creek Road is three (3) northbound lanes and two (2) southbound lanes. To develop levels of service based upon the Daily Capacity and Level of Service Chart, included in **Table 3**, two-way capacity was divided in half to develop one-way capacity for this segment. For northbound Bent Creek Road, the daily capacity for a six-lane divided arterial was utilized and the daily capacity for a four-lane divided arterial was utilized for southbound Bent Creek Road. Levels of service for the daily roadway segment capacity analysis conducted for Bent Creek Road is summarized in **Table 4**.

### Table 3 – Daily Capacity and Level of Service Chart

| Functional Classification | Number of Lanes | Maximum Daily Flow Rate Related to Level of Service | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F |
| Freeway | 4 | 23,800 | 34,000 | 42,160 | 51,000 | 68,000 | >68,000 |
| | 6 | 35,700 | 51,000 | 63,240 | 76,500 | 102,000 | >102,000 |
| | 8 | 47,600 | 68,000 | 84,320 | 102,000 | 136,000 | >136,000 |
| | 10 | 59,500 | 85,000 | 105,400 | 127,500 | 170,000 | >170,000 |
| Expressway | 4 | 17,500 | 25,000 | 31,000 | 37,500 | 50,000 | >50,000 |
| | 6 | 26,250 | 37,500 | 46,500 | 56,250 | 75,000 | >75,000 |
| | 8 | 35,000 | 50,000 | 62,000 | 75,000 | 100,000 | >100,000 |
| Arterial (Divided) | 2 | 7,700 | 11,000 | 13,640 | 16,500 | 22,000 | >22,000 |
| | 4 | 11,865 | 16,950 | 21,018 | 25,425 | 33,900 | >33,900 |
| | 6 | 17,500 | 25,000 | 31,000 | 37,500 | 50,000 | >50,000 |
| | 8 | 25,760 | 36,800 | 45,632 | 55,200 | 73,600 | >73,600 |
| Arterial (Undivided) | 2 | 6,230 | 8,900 | 11,036 | 13,350 | 17,800 | >17,800 |
| | 4 | 10,850 | 15,500 | 19,220 | 23,250 | 31,000 | >31,000 |
| | 6 | 16,030 | 22,900 | 28,396 | 34,350 | 45,800 | >45,800 |
| | 8 | 22,085 | 31,550 | 39,122 | 47,325 | 63,100 | >63,100 |
| Collector (Divided) | 2 | 7,280 | 10,400 | 12,896 | 15,600 | 20,800 | >20,800 |
| | 4 | 9,975 | 14,250 | 17,670 | 21,375 | 28,500 | >28,500 |
| | 6 | 14,700 | 21,000 | 26,040 | 31,500 | 42,000 | >42,000 |
| Collector (Undivided) | 2 | 5,810 | 8,300 | 10,292 | 12,450 | 16,600 | >16,600 |
| | 4 | 9,170 | 13,100 | 16,244 | 19,650 | 26,200 | >26,200 |
| | 6 | 13,545 | 19,350 | 23,994 | 29,025 | 38,700 | >38,700 |

**Table 4 – Existing Roadway Segment Levels of Service**

| Segment Description | Two-Way Daily Volume | Travel Direction | Directional Daily Volume | Number of Lanes | Roadway LOS by Segment |
|---|---|---|---|---|---|
| South of E. Glenn Avenue | 20,874 | Northbound | 11,909 | 3 | B |
| | | Southbound | 8,965 | 2 | C |

### Right-Turn Lane Warrant Evaluations

Existing peak hour traffic volumes were compared with the turn lane warrant criteria outlined in the National Cooperative Highway Research Program (NCHRP) Report 457 *Evaluating Intersection Improvements: An Engineering Study Guide*, published by the Transportation Research Board. For evaluation purposes, the posted speed limit was utilized for roadways. Evaluations were conducted for the following approaches:

- Northbound Bent Creek Road at I-85 NB Ramps
- Westbound Hamilton Road at Bent Creek Road

The results of these comparisons indicate:

- Northbound Bent Creek Road at I-85 Northbound Ramps – During both the morning and afternoon peak hours, existing traffic volumes are not sufficient to meet the criteria for a right-turn lane.
- Westbound Hamilton Road at Bent Creek Road – During both the morning and afternoon peak hours, existing traffic volumes are not sufficient to meet the criteria for a right-turn lane.

### Intersection Crash Evaluation

Skipper Consulting, Inc. performed a citywide crash study for intersections and roadway segments maintained by the City of Auburn. The results of this crash study have been documented in a separate bound report. The citywide crash study included the study intersections along Bent Creek Road. Screening procedures and crash analyses were conducted to determine any locations that are worthy of safety-based roadway improvements. The crash analyses indicated that none of the study intersections within the Bent Creek Road corridor fell within the screening limits as low, moderate, or high priority locations.

### Travel Time

GPS-based Travel time runs were performed on Bent Creek Road between E. Glenn Avenue and Hamilton Road. The roadway segment is approximately 1.24 miles with typical distances for the travel time runs of approximately 1.28 miles. Travel time runs were performed during the a.m., midday, and p.m. peak periods of traffic flow on February 20, 2018, March 27 & 29, 2018, and April 4 & 23, 2018. Six runs were performed in each direction during each period. The results of the travel time runs are shown in **Table 5**.

**Table 5 – Existing Travel Time Runs**

| AM Peak | | | | Midday Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Dir. | Elapsed Time | Avg. Speed | Start Time | Dir. | Elapsed Time | Avg. Speed | Start Time | Dir. | Elapsed Time | Avg. Speed |
| 7:00 | SB | 2:48 | 28.9 | 11:00 | SB | 3:14 | 24.8 | 4:00 | SB | 2:48 | 28.8 |
| 7:04 | NB | 2:39 | 29.6 | 11:04 | NB | 3:44 | 21.2 | 4:04 | NB | 3:20 | 23.9 |
| 7:08 | SB | 3:14 | 25.7 | 11:08 | SB | 3:10 | 25.5 | 4:07 | SB | 3:07 | 26.5 |
| 7:12 | NB | 2:31 | 32.0 | 11:12 | NB | 3:08 | 25.4 | 4:11 | NB | 2:46 | 29.7 |
| 7:15 | SB | 4:23 | 18.4 | 11:16 | SB | 2:38 | 30.1 | 4:14 | SB | 2:52 | 28.7 |
| 7:20 | NB | 2:21 | 34.5 | 11:20 | NB | 2:40 | 30.7 | 4:18 | NB | 3:43 | 21.3 |
| 7:23 | SB | 3:36 | 22.7 | 11:23 | SB | 3:33 | 23.2 | 4:22 | SB | 4:10 | 20.1 |
| 7:27 | NB | 3:45 | 21.3 | 11:27 | NB | 2:45 | 29.1 | 4:27 | NB | 3:24 | 23.6 |
| 7:32 | SB | 2:33 | 32.8 | 11:31 | SB | 3:34 | 22.8 | 4:30 | SB | 4:06 | 19.8 |
| 7:35 | NB | 3:10 | 25.1 | 11:35 | NB | 3:21 | 23.6 | 4:35 | NB | 2:33 | 31.4 |
| 7:39 | SB | 4:06 | 19.7 | 11:39 | SB | 3:16 | 24.6 | 4:39 | SB | 3:26 | 23.1 |
| 7:44 | NB | 2:55 | 27.4 | 11:43 | NB | 2:28 | 32.6 | 4:44 | NB | 2:57 | 27.3 |

## EXISTING CONDITIONS ANALYSES WITH IMPROVEMENTS

### Recommended Improvements

Roadway and traffic control improvements have been developed to help address capacity deficiencies identified in the capacity analyses conducted or traffic operational issues observed during peak periods along the Bent Creek Road corridor. The following outlines the recommended improvements for existing conditions along Bent Creek Road.

E. Glenn Avenue Signal System

The Bent Creek Road at E. Glenn Avenue intersection is recommended to be included within the system on E. Glenn Avenue.

Bent Creek Road at E. Glenn Avenue

Recommended improvements have been developed for implementation along Bent Creek Road as summarized in the following:

- Modify eastbound E. Glenn Avenue to lessen the radius of the right-turn lane onto Bent Creek Road and install a "Yield" sign to address weaving and turbulence that occurs between the free-flow right-turn movement and conflicting vehicles attempting to turn right into Auburn Exchange.
- Modify the striping for the southbound right-turn lane from Mike Hubbard Boulevard to provide channelization and "Yield" sign control.
- Extend the left-turn lane storage on northbound Bent Creek Road.

Bent Creek Road at Hilton Garden Drive

Presently, Hilton Garden Drive is controlled by a "Yield" sign at Bent Creek Road with a lane add onto southbound Bent Creek Road. It is recommended the lane add be physically restricted (modify the raised curb and gutter) to enforce the "Yield" condition. This curb and gutter modification would eliminate the lane add and result in providing a more traditional right-turn lane of approximately 350 feet approaching the I-85 SB Ramps. The physical restriction of the lane add would help to eliminate current conflicts associates with weaving within this segment of Bent Creek Road.

**Figure 3** illustrates the improvements for Bent Creek Road from E. Glenn Ave. to I-85 SB Ramps.

### Existing Intersection Capacity Analysis with Improvements

Capacity analyses for peak hour conditions at the study intersections along the Bent Creek Road Corridor were conducted assuming improvements for existing conditions would be in place. Capacity analyses were conducted using methods outlined in the *Highway Capacity Manual, 2010*. Results of these capacity analyses are summarized in **Table 6**.

As shown in **Table 6**, all study intersections evaluated along the Bent Creek Road Corridor operate at acceptable overall levels of service for both peak periods evaluated. It should be noted that implementation of coordinated signal system timings on E. Glenn Avenue could cause increased delay for some of the minor movements and/or lane groups. **Table 6** indicates that the southbound left-turn and through movements from Mike Hubbard Boulevard would operate at levels of service "E" during both the morning and afternoon peak hours. This would be a result of cycle length requirements for a coordinated signal system along E. Glenn Avenue and not reflective of deficient capacity for the movements.


SKIPPER CONSULTING INC

Legend

Required Pavement

Required Raised Island

North

Graphic Scale: 1"-100'

# Figure 3
## E. Glenn Ave. to I-85 SB Ramps Recommended Improvements

Bent Creek Road
Auburn, Alabama

October 2018

1103-013

**Table 6 – Existing Intersection Levels of Service w/Improvements**

| Intersection (traffic control) | Approach | Movement/ Lane Group | Level of Service A.M. Peak Hour | Level of Service P.M. Peak Hour |
|---|---|---|---|---|
| Bent Creek Road at E. Glenn Avenue (traffic signal) | EB E. Glenn Avenue. | Left | B | C |
| | | Through | C | C |
| | | Right | - | - |
| | WB E. Glenn Avenue. | Left | B | C |
| | | Through | C | A |
| | | Right | - | - |
| | NB Bent Creek Road | Left | D | D |
| | | Through | D | D |
| | | Right | - | - |
| | SB Mike Hubbard Boulevard | Left | E | E |
| | | Through | E | E |
| | | Right | - | - |
| | **Overall LOS** | | **D** | **C** |
| Bent Creek Road at Auburn Exchange Drive (traffic signal) | EB Auburn Exchange Dr. | Left | B | B |
| | | Through/Right | B | B |
| | WB Auburn Exchange Dr. | Left | B | C |
| | | Through | B | B |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | | Right | - | - |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Southbound Ramps (traffic signal) | I-85 SB Ramps | Left | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Northbound Ramps (traffic signal) | I-85 NB Ramps | Left | B | B |
| | | Right | - | - |
| | NB Bent Creek Road | Through/Right | B | B |
| | SB Bent Creek Road | Left | B | B |
| | | Through | B | A |
| | **Overall LOS** | | **B** | **B** |
| Bent Creek Road at Hamilton Road (traffic signal) | EB Hamilton Road | Left | A | B |
| | | Through | A | A |
| | WB Hamilton Road | Through/Right | B | C |
| | SB Bent Creek Road | Left | B | B |
| | | Right | C | D |
| | **Overall LOS** | | **B** | **C** |

## PROJECTED TRAFFIC GROWTH

Growth rates were calculated for the study roadways based on historical traffic volumes and growth trends. The historical growth rate calculated for roadways in the vicinity of Bent Creek Road was 2.6% per year. The annual growth rate was applied for a ten (10) year period to result in an overall growth rate of 26% percent for study area traffic volumes. Existing peak hour traffic volumes were increased 26% to reflect ten (10) year projected traffic volumes for the Bent Creek Road corridor.

Analyses were conducted utilizing projected peak hour traffic volumes for the study area roadways and intersection to assess traffic operations within the corridor. Capacity deficiencies were identified for projected conditions to aid in development of potential roadway and traffic control improvements within the corridor to address capacity and traffic operations.

## ANALYSES WITH PROJECTED TRAFFIC GROWTH

Analyses conducted for this scenario assumes projected traffic volumes for ten (10) years would be in place and the improvements recommended for existing conditions (previously introduced and illustrated in **Figure 4**) would also be in place.

### Intersection Capacity Analysis with Projected Traffic Growth

Capacity analyses for projected ten (10) year peak hour conditions were conducted for the study intersections along the Bent Creek Road Corridor assuming existing recommended improvements would be in place. Capacity analyses were conducted using methods outlined in the *Highway Capacity Manual, 2010*. Results of these capacity analyses are summarized in **Table 7**.

As shown in **Table 7**, all study intersections evaluated along the Bent Creek Road Corridor operate with overall acceptable levels of service for both peak periods evaluated. At Bent Creek Road and E. Glenn Avenue, the Mike Hubbard Boulevard left-turn and through movements would operate at levels of service “E” as well as the westbound left-turn from E. Glenn Avenue. This is primarily due to cycle length requirements for the coordinated signal system on E. Glenn Avenue and not deficient capacity.

### Table 7 - Intersection Levels of Service w/Projected Traffic Growth

| Intersection (traffic control) | Approach | Movement/ Lane Group | Level of Service | |
|---|---|---|---|---|
| | | | A.M. Peak Hour | P.M. Peak Hour |
| Bent Creek Road at E. Glenn Avenue (traffic signal) | EB E. Glenn Avenue. | Left | C | C |
| | | Through | C | D |
| | | Right | - | - |
| | WB E. Glenn Avenue. | Left | C | E |
| | | Through | A | A |
| | | Right | - | - |
| | NB Bent Creek Road | Left | D | E |
| | | Through | C | C |
| | | Right | - | - |
| | SB Mike Hubbard Boulevard | Left | E | E |
| | | Through | E | E |
| | | Right | - | - |
| | **Overall LOS** | | **D** | **D** |
| Bent Creek Road at Auburn Exchange Drive (traffic signal) | EB Auburn Exchange Dr. | Left | C | C |
| | | Through/Right | C | C |
| | WB Auburn Exchange Dr. | Left | C | C |
| | | Through | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | | Right | - | - |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Southbound Ramps (traffic signal) | I-85 SB Ramps | Left | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Northbound Ramps (traffic signal) | I-85 NB Ramps | Left | C | C |
| | | Right | C | C |
| | NB Bent Creek Road | Through/Right | B | C |
| | SB Bent Creek Road | Left | C | C |
| | | Through | A | A |
| | **Overall LOS** | | **B** | **B** |
| Bent Creek Road at Hamilton Road (traffic signal) | EB Hamilton Road | Left | A | B |
| | | Through | A | A |
| | WB Hamilton Road | Through/Right | B | C |
| | SB Bent Creek Road | Left | B | B |
| | | Right | A | D |
| | **Overall LOS** | | **A** | **C** |

### Roadway Segment Capacity Analysis with Projected Traffic Growth

Roadway segment capacity analyses for future daily traffic conditions on Bent Creek Road were performed using the daily capacity and level of service chart obtained from the Alabama Department of Transportation. Levels of service for the daily roadway segment capacity analysis conducted for Bent Creek Road are summarized in **Table 8**.

### Table 8 – Future Roadway Segment Levels of Service

| Segment Description | Two-Way Projected Daily Volume | Travel Direction | Directional Daily Volume Projection | Number of Lanes | Roadway LOS by Segment |
|---|---|---|---|---|---|
| South of E. Glenn Avenue | 26,300 | Northbound | 15,000 | 3 | C |
| | | Southbound | 11,300 | 2 | D |

### Right-Turn Lane Warrant Evaluations with Projected Traffic Growth

Projected peak hour traffic volumes were compared with the turn lane warrant criteria outlined in the National Cooperative Highway Research Program (NCHRP) Report 457 *Evaluating Intersection Improvements: An Engineering Study Guide*, published by the Transportation Research Board. As with existing conditions, the posted speed limit was utilized for right-turn lane evaluations for northbound Bent Creek Road at I-85 NB Ramps and westbound Hamilton Road at Bent Creek Road.

The results of these comparisons for projected traffic conditions indicate:

- Northbound Bent Creek Road at I-85 Northbound Ramps – During both the morning and afternoon peak hours, projected peak hour traffic volumes would not be sufficient to meet the criteria for a right-turn lane.
- Westbound Hamilton Road at Bent Creek Road – During the afternoon peak hour, project peak hour traffic volumes would be sufficient to meet the criteria for a right-turn lane on Hamilton Road. As such, a right-turn lane is recommended.

## RECOMMENDED IMPROVEMENTS WITH PROJECTED TRAFFIC GROWTH

Based upon the analyses and evaluations conducted for the Bent Creek Road Corridor for existing conditions and projected ten (10) year conditions, recommendations are made to help improve traffic operations along the corridor at study intersections and to address any capacity or safety deficiencies identified. These improvements are in addition to the improvements recommended for existing conditions. For reference, improvements recommended as part of existing conditions are included and noted in the following descriptions.

E. Glenn Avenue Signal System

As a part of the existing conditions analyses, it was recommended the Bent Creek Road intersection be included as part of the signal system on E. Glenn Avenue.

Bent Creek Road at E. Glenn Avenue

The following outlines the recommendations for existing conditions:

- Modify eastbound E. Glenn Avenue to lessen the radius of the right-turn lane onto Bent Creek Road and install a "Yield" sign to address weaving and turbulence that occurs between the free-flow right-turn movement and conflicting vehicles attempting to turn right into Auburn Exchange.
- Modify the striping for the southbound right-turn lane from Mike Hubbard Boulevard to provide channelization and "Yield" sign control.
- Extend the left-turn lane storage on northbound Bent Creek Road.

The following outlines additional improvements developed for the Bent Creek Road at E. Glenn Avenue intersection to address traffic conditions anticipated with projected ten (10) year traffic growth.

- Restripe westbound E. Glenn Avenue to provide space for offset left-turn lanes.
- Widen the departure of westbound E. Glenn Avenue to accommodate required lane shifts for the offset left-turn lanes on E. Glenn Avenue.

Widening E. Glenn Avenue to provide offset left-turn lanes has been recommended to help address safety concerns for the movement.

Bent Creek Road at Hilton Garden Drive

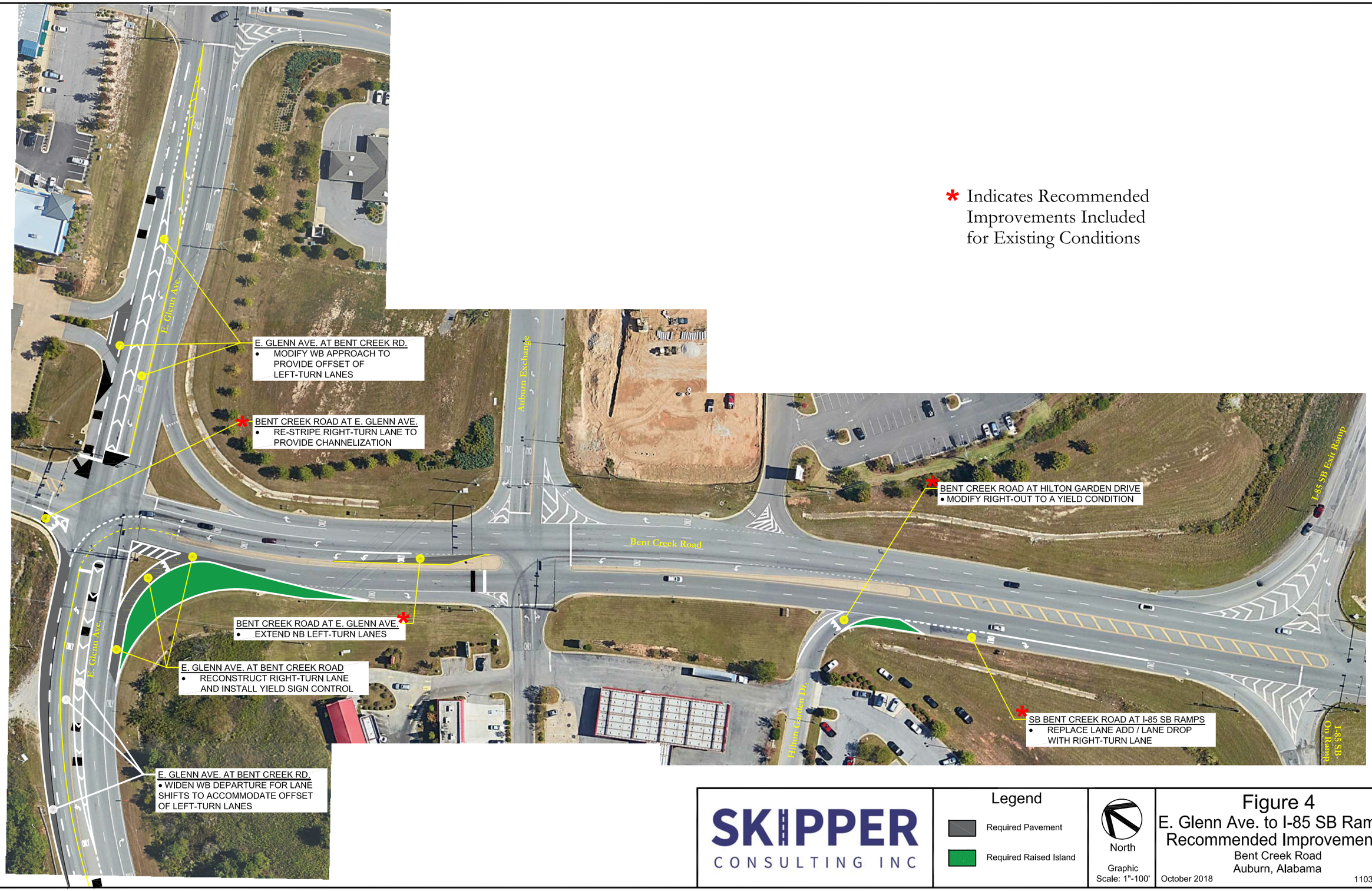
As noted for existing conditions, it is recommended the lane add from Hilton Garden Drive be physically restricted (modify the raised curb and gutter) to enforce the "Yield" condition. This curb and gutter modification would eliminate the lane add and result in providing a more traditional right-turn lane of approximately 350 feet approaching the I-85 SB Ramps. The physical restriction of the lane add would eliminate help to weaving within this segment of Bent Creek Road.

Bent Creek Road at Hamilton Road

The following improvements are recommended at the Bent Creek Road and Hamilton Road intersection:

- A right-turn lane is recommended for construction on westbound Hamilton Road approaching Bent Creek Road to accommodate projected traffic volumes.
- Modify signal phasing to provide for the southbound Bent Creek Road right-turn movement to operate with permissive plus overlap phasing.

Improvements developed to address traffic conditions anticipated with ten (10) years of projected traffic growth are illustrated in **Figure 4** and **Figure 5**.




* Indicates Recommended Improvements Included for Existing Conditions

SKIPPER CONSULTING INC

Legend

- Required Pavement
- Required Raised Island

North

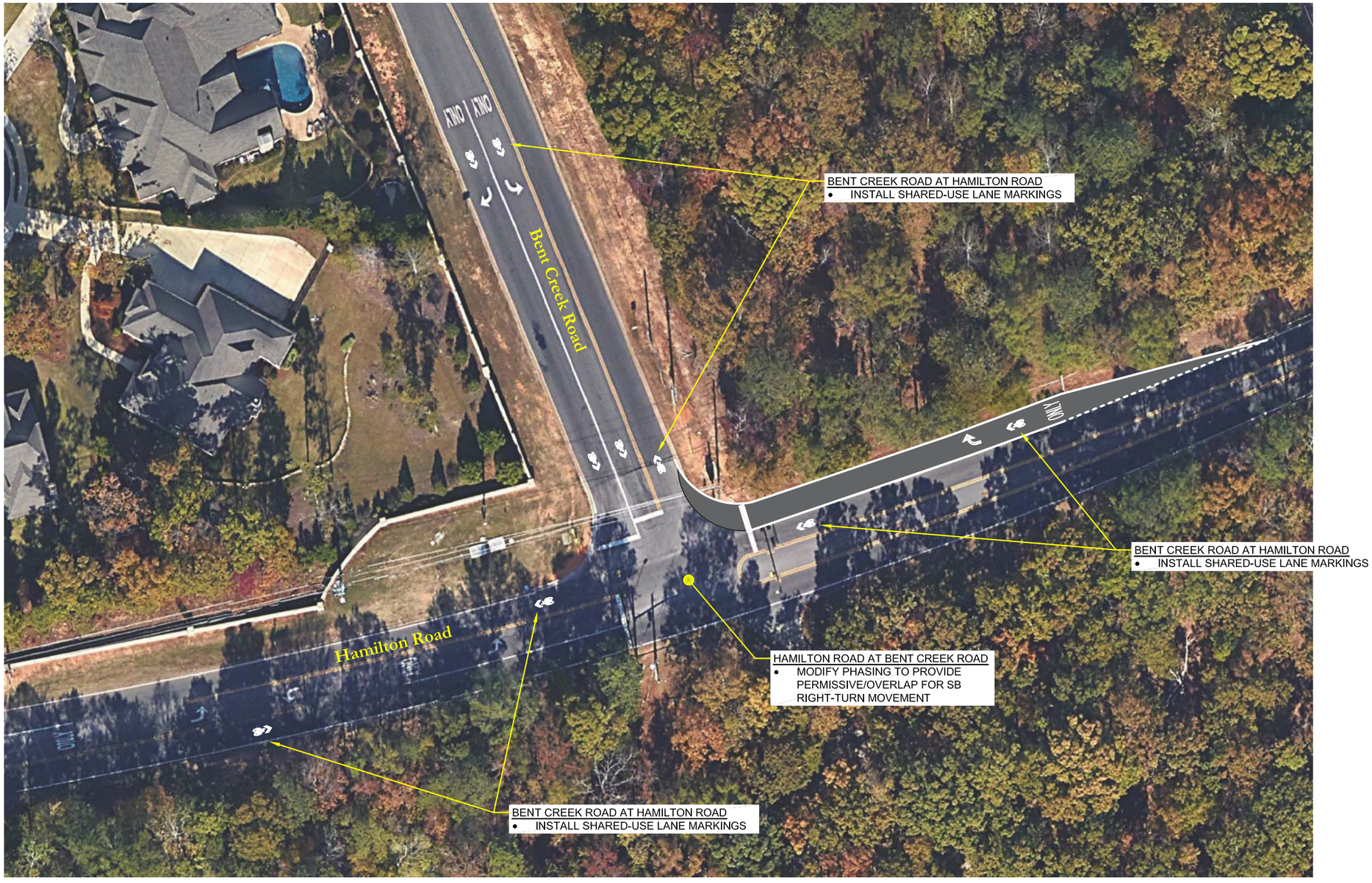
Graphic Scale: 1"-100'

# Figure 4
## E. Glenn Ave. to I-85 SB Ramps Recommended Improvements

Bent Creek Road
Auburn, Alabama

October 2018

1103-013




SKIPPER CONSULTING INC

Legend

Required Pavement

North

Graphic Scale: 1"-50'

# Figure 5
## Bent Creek Road at Hamilton Road
Bent Creek Road
Auburn, Alabama

February 2019

1103-013

## ANALYSES W/RECOMMENDED IMPROVEMENTS & PROJECTED TRAFFIC GROWTH

### Intersection Capacity Analysis with Improvements and Projected Traffic Growth

Capacity analyses were conducted for the study intersections assuming recommended improvements (outlined above and illustrated in **Figure 4** and **Figure 5**) and projected ten (10) traffic volumes would be in place. Capacity analyses were conducted using methods of the *Highway Capacity Manual*, as previously introduced. **Table 9** provides a summary of the levels of service for study intersections with recommended improvements and projected ten (10) traffic volumes in place.

**Table 9** indicates each of the study intersections would operate with overall levels of service "D" or better with the recommended improvements and projected traffic volumes in place. The Bent Creek Road at E. Glenn Avenue intersection is expected to have some movements/lane groups operating at levels of service "E" during peak periods. The movements/lane groups expected to operate at less than level of service "D" are primarily side street movements and/or main street left-turn movements. This is due to the green time requirements for the coordinated signal system on E. Glenn Avenue coupled with the heavy left-turn volumes on northbound Bent Creek Parkway and westbound E. Glenn Avenue.

With the recommended improvements in place at Bent Creek Road and E. Glenn Avenue, additional left-turn storage for the westbound E. Glenn Avenue left-turn lane would be provided. Additionally, sight lines would be improved for the E. Glenn Avenue left-turn movements which would help to improve the safety of these movements during the permissive portion of the left-turn phases.

**Table 9 - Intersection LOS with Improvements and Projected Traffic**

| Intersection (traffic control) | Approach | Movement/ Lane Group | Level of Service | |
|---|---|---|---|---|
| | | | A.M. Peak Hour | P.M. Peak Hour |
| Bent Creek Road at E. Glenn Avenue (traffic signal) | EB E. Glenn Avenue. | Left | C | C |
| | | Through | C | D |
| | | Right | - | - |
| | WB E. Glenn Avenue. | Left | C | E |
| | | Through | A | A |
| | | Right | | |
| | NB Bent Creek Road | Left | D | E |
| | | Through | C | C |
| | | Right | - | - |
| | SB Mike Hubbard Boulevard | Left | E | E |
| | | Through | E | E |
| | | Right | - | - |
| | **Overall LOS** | | **D** | **D** |
| Bent Creek Road at Auburn Exchange Drive (traffic signal) | EB Auburn Exchange Dr. | Left | C | C |
| | | Through/Right | C | C |
| | WB Auburn Exchange Dr. | Left | C | C |
| | | Through | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | | Right | - | - |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Southbound Ramps (traffic signal) | I-85 SB Ramps | Left | C | C |
| | | Right | - | - |
| | NB Bent Creek Road | Left | A | A |
| | | Through | A | A |
| | SB Bent Creek Road | Through | A | A |
| | | Right | - | - |
| | **Overall LOS** | | **A** | **A** |
| Bent Creek Road at I-85 Northbound Ramps (traffic signal) | I-85 NB Ramps | Left | C | C |
| | | Right | C | C |
| | NB Bent Creek Road | Through/Right | B | C |
| | SB Bent Creek Road | Left | C | C |
| | | Through | A | A |
| | **Overall LOS** | | **B** | **B** |
| Bent Creek Road at Hamilton Road (traffic signal) | EB Hamilton Road | Left | A | B |
| | | Through | A | A |
| | WB Hamilton Road | Through | B | C |
| | | Right | B | B |
| | SB Bent Creek Road | Left | B | B |
| | | Right | A | C |
| | **Overall LOS** | | **A** | **B** |

### Alternate Improvements for Bent Creek Road at E. Glenn Avenue

Alternate improvements have been developed for the Bent Creek Road at E. Glenn Avenue intersection. The alternate improvements were developed as an option should the westbound left-turn movement on E. Glenn Avenue need additional storage and/or crash rates increase to a point which additional measures need to be taken. As noted previously, the recommended improvements for this intersection provide additional left-turn lane storage and improve sight lines with the offset left-turn lanes on E. Glenn Avenue to help improve safety of the permissive left-turn movements. Should traffic patterns change, or traffic growth exceed projections, the alternate improvements provides an option to address these potential issues for the westbound left-turn movement on E. Glenn Avenue. The alternate improvements for Bent Creek Road at E. Glenn Avenue, illustrated in **Figure 6**, include:

- Restriping westbound E. Glenn Avenue to provide dual left-turn lanes.
- Widening/restriping the departure lanes on westbound E. Glenn Avenue to accommodate required lane shifts for the dual westbound left-turn lanes.
- Modify signal phasing to provide protected only left-turn phasing for eastbound and westbound E. Glenn Avenue.

The alternate improvements could be implemented with restriping on E. Glenn Avenue as the widening included in the recommended improvements would be sufficient to accommodate the alternate improvements.

### Intersection Capacity Analysis with Alternate Improvements and Projected Traffic Growth

Capacity analyses were conducted for Bent Creek Road and E. Glenn Avenue intersection assuming alternate improvements (outlined above and illustrated in **Figure 6**) and projected ten (10) traffic volumes would be in place. Capacity analyses were conducted using methods of the *Highway Capacity Manual*, as previously introduced. **Table 10** provides a summary of the levels of service for study intersections with recommended improvements and projected ten (10) traffic volumes in place.

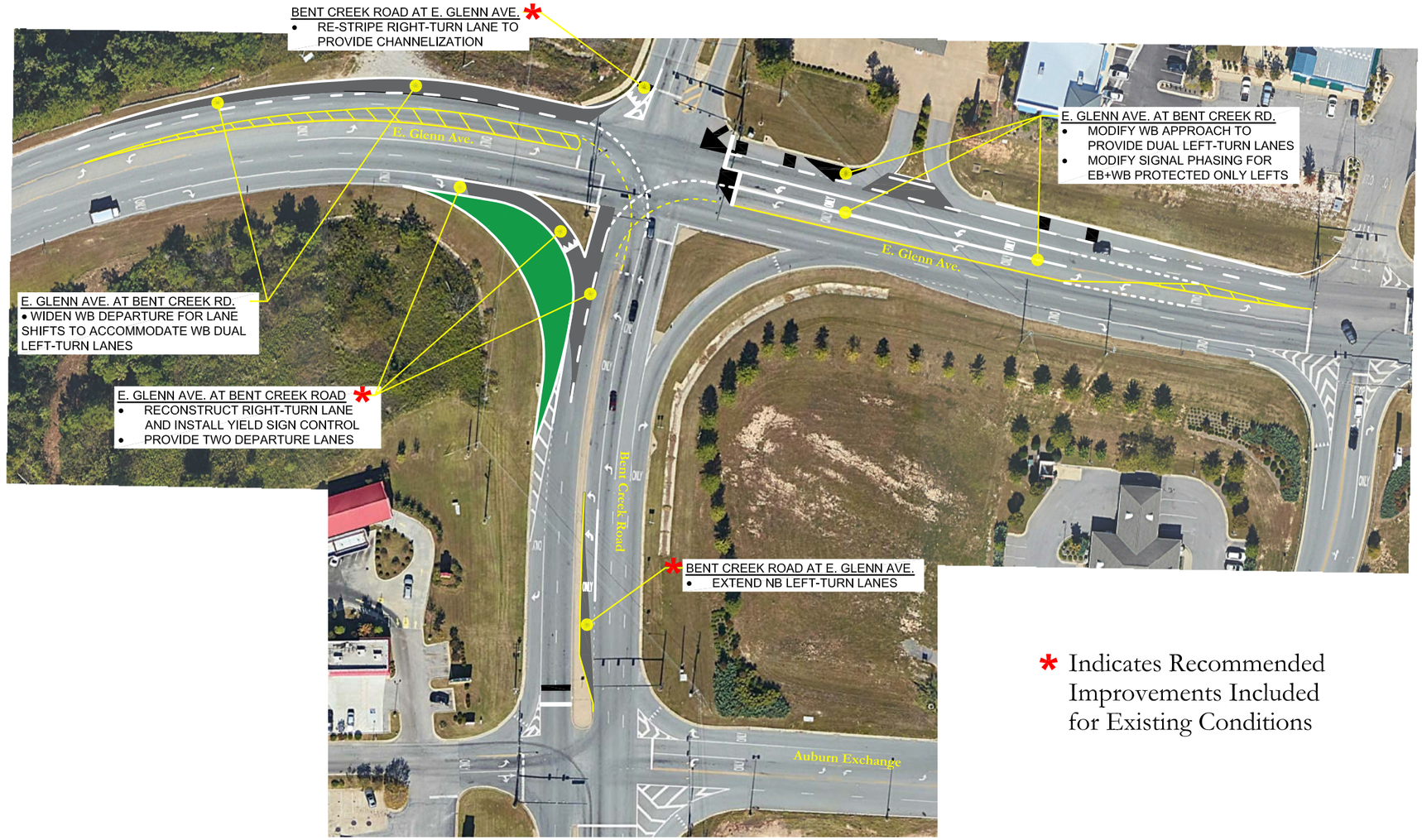
**Table 10** indicates various movements/lane groups operating at levels of service "E" or "F" during peak periods. The movements/lane groups expected to operate less than level of service "D" are primarily side street left-turn and through movements and/or main street left-turn movements. This is due to the green time requirements for the coordinated signal system on E. Glenn Avenue coupled with the heavy left-turn movements on northbound Bent Creek Parkway and westbound E. Glenn Avenue. In general, these levels of service do not reflect deficient capacity but rather increased delay resulting from longer cycle lengths and green time demand of the primary movements within the intersection.

**Table 10 – Bent Creek Rd. at E. Glenn Ave. LOS w/Alt. Improvements and Projected Traffic**

| Intersection (traffic control) | Approach | Movement/Lane Group | Level of Service | |
|---|---|---|---|---|
| | | | A.M. Peak Hour | P.M. Peak Hour |
| Bent Creek Road at E. Glenn Avenue (traffic signal) | EB E. Glenn Avenue. | Left | F | F |
| | | Through | C | D |
| | | Right | - | - |
| | WB E. Glenn Avenue. | Left | E | E |
| | | Through | A | A |
| | | Right | | |
| | NB Bent Creek Road | Left | D | E |
| | | Through | C | C |
| | | Right | - | - |
| | SB Mike Hubbard Boulevard | Left | E | E |
| | | Through | E | E |
| | | Right | - | - |
| | **Overall LOS** | | **D** | **D** |

With construction of the dual left-turn lanes for the westbound approach of E. Glenn Avenue, additional storage would be provided for the left-turn movement on westbound E. Glenn Avenue and protected only left-turn phasing would be implemented which would remove the permissive left-turn movement. With protected only left-turn phasing, the conflict between the eastbound through movement and the westbound left-turn movement would be significantly reduced. Additionally, with protected only left-turn phasing on E. Glenn Avenue, increased delay for the eastbound left-turn movement would result. The increase in delay for the eastbound left-turn movement would result from cycle length requirements and not capacity deficiency.

Should left-turn queueing exceed available storage and/or crash experience for the westbound left-turn on E. Glenn Avenue become an issue as traffic volumes increase, the alternate improvements for Bent Creek Road at E. Glenn Avenue would be an option for implementation. The alternate improvements option could be implemented with restriping of E. Glenn Avenue as the widening provided with the offset left-turn lanes in the recommended improvements (illustrated previously in




* Indicates Recommended Improvements Included for Existing Conditions

SKIPPER CONSULTING INC

Legend

Required Pavement

Required Raised Island

North

Graphic Scale: 1"-100'

# Figure 6
## Bent Creek Rd. at E. Glenn Ave. Alternate Improvements

Bent Creek Road
Auburn, Alabama

October 2018

1103-013

**Figure 4**) would be sufficient to accommodate the required widths for the dual westbound left-turn lanes and the departure lanes on westbound E. Glenn Avenue.

Potential long-term improvements would be required to provide levels of service “D” or better at the Bent Creek Road and E. Glenn Avenue intersection for all major movements. Such improvements would potentially include widening E. Glenn Avenue to provide three through lanes in each direction through Bent Creek Road, triple left-turns on northbound Bent Creek Road, and dual left-turn lanes on westbound E. Glenn Avenue. Other potential options would include elimination of signal phases by restricting minor movements within the intersection.

Due to the findings of this study and other corridor studies which include intersections on the Glenn Avenue corridor, it is recommended that the City of Auburn undertake a separate study to determine long-term improvement requirements for the entire Glenn Avenue corridor. This study should include determining the number of travel lanes, appropriate pedestrian and bicycle provisions, right-of-way requirements, overall cost estimates, and potential funding sources.