



Interoffice Memorandum

**AGENDA ITEM**

DATE: May 25, 2022

TO: Mayor Jerry L. Demings  
-AND-  
County Commissioners

FROM: Jon V. Weiss, P.E., Director  
Planning, Environmental, and Development Services Department

CONTACT PERSON: **Renzo Nastasi, AICP, Manager  
Transportation Planning  
(407) 836-8072**

SUBJECT: June 21, 2022 – Discussion Item  
Orange Avenue/Gatlin Avenue/Holden Avenue  
Intersection Analysis Study

Orange County has completed the Final Report Intersection Analysis at Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue ("Study") at the request of the City of Edgewood. The analysis assessed a series of potential improvements ranging from short-term operational improvements to longer-term major reconfiguration of the intersections at Orange Avenue, Gatlin Avenue, and Holden Avenue. Several of the major intersection reconfigurations of the long-term alternatives identified and evaluated in the Study are currently unfunded and will result in significant impacts to Cypress Grove Park should they be approved to proceed. The potential scenarios regarding both the short-term and long-term improvements, including the associated impacts to Cypress Grove Park and community, were presented to the public at a community meeting held on March 1, 2022.

In regards to the "interim" improvements, Orange County has coordinated the implementation of the project with the Florida Department of Transportation (FDOT), and those are referenced in the Memorandum of Understanding (MOU). The MOU confirms FDOT's support for the interim improvements and outlines the distinct obligations and responsibilities of both FDOT and the County.

If you have any questions, please contact me at 407-836-8072.

**ACTION REQUESTED: Approval and execution of Memorandum of Understanding regarding a Traffic Operations Project at the intersection of Orange Avenue and Holden Avenue by and between Orange County and the State of Florida Department of Transportation: authorization to proceed with the short-term improvements; and direction to staff on long-term improvements including selection of a preferred alternative (if any) and project delivery option. District 3**

JVW/RN/ep

**MEMORANDUM OF UNDERSTANDING**  
**REGARDING A TRAFFIC OPERATIONS PROJECT**  
**AT THE INTERSECTION OF**  
**ORANGE AVENUE AND HOLDEN AVENUE**

This **MEMORANDUM OF UNDERSTANDING** ("MOU"), effective as of the latest date of execution (the "Effective Date"), is entered into by and between **ORANGE COUNTY**, a charter county and political subdivision of the State of Florida ("County"), whose address is P.O. Box 1393, Orlando, Florida 32802-1393, and the **STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION**, an executive agency of the State of Florida ("Department"), whose address is 719 South Woodland Boulevard, DeLand, FL 32720-6834 . The County and the Department may be referred to herein individually as a "Party" and jointly as the "Parties."

**RECITALS**

**WHEREAS**, Orange Avenue is a road under the Department's jurisdiction, and Holden Avenue is a road under the County's jurisdiction;

**WHEREAS**, the Parties wish to complete a Traffic Operations minor project at the intersection of Orange Avenue and Holden Avenue, limited to re-striping, travel lane reconfiguration, and modifying traffic signals and the timing of signals ("Project"); and

**WHEREAS**, each Party will have separate and distinct obligations and responsibilities under the Project, as described below.

**NOW, THEREFORE**, for and in consideration of these premises, the mutual agreement of the Parties hereto, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties hereby agree as follows regarding the Project:

1. **Recitals.** The foregoing recitals are true and correct, and are hereby incorporated and made a part of this MOU by this reference.

2. **County's Obligation and Responsibility.**

a. At its sole cost and expense, the County shall re-stripe Holden Avenue, at the intersection of Orange Avenue and Holden Avenue, at the west approach of the intersection, from an exclusive left lane and a shared through/right turn lane to a shared left/through lane and an exclusive right turn lane.

b. The Department shall issue a permit to the County for the re-striping of the subject approach of Holden Avenue as it will affect the operations at the intersection along Orange Avenue.

3. **Department's Obligation and Responsibility.**

At its sole cost and expense, the Department, which owns, operates and maintains the traffic signals at the intersection Orange Avenue and Holden Avenue, shall make all necessary traffic signal modifications at the intersection of Orange Avenue and Holden Avenue, including making traffic signal head modifications, which include removal of the two three-section signal heads and replacing them with two five-section signal heads, and re-timing traffic signals with an overlap phase between the northbound left and eastbound right turn movements, all to accommodate geometric changes at the Holden Avenue eastbound approach to the intersection.

4. **Timing of the Work.**

The Department and the County agree that all of the work described in Paragraphs 2 and 3 hereinabove must be undertaken and completed at the same time and that there cannot be any delay by either Party. The Parties shall assure that there is a coordination of effort as both of their

responsibilities and obligations set forth herein. The Parties agree that this Project shall be completed not later than 180 days after the effective date of the MOU.

**IN WITNESS WHEREOF**, the Parties, intending to be legally bound, have executed this Memorandum of Understanding by their respective duly authorized representatives as of the dates indicated below their respective signatures.

**“COUNTY”**

**ORANGE COUNTY, FLORIDA**

By: Board of County Commissioners

By: \_\_\_\_\_  
Jerry L. Demings  
Orange County Mayor

Date: \_\_\_\_\_, 2022

ATTEST: Phil Diamond, CPA, County Comptroller  
As Clerk of the Board of County Commissioners

By: \_\_\_\_\_  
Deputy Clerk

Print Name: \_\_\_\_\_

**“DEPARTMENT”**

**STATE OF FLORIDA, DEPARTMENT OF TRANSPORTATION**

By: \_\_\_\_\_ [Seal]  
Name  
Title

Date: \_\_\_\_\_, 2022

ATTEST: \_\_\_\_\_ [Seal]  
Executive Secretary

Legal Review

By: \_\_\_\_\_  
Legal Counsel



INTERSECTION ANALYSIS AT

# Orange Avenue at Gatlin Avenue

and

# Orange Avenue at Holden Avenue

March 2022



**March 2022**

**Intersection Analysis Study for  
Orange Avenue at Gatlin Avenue &  
Orange Avenue at Holden Avenue**

**Prepared for:**



**Prepared by:**



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## **1 INTRODUCTION**

Vanasse Hangen Brustlin, Inc (VHB) was retained by Orange County to conduct an Intersection Analysis Study for the intersections of Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue. The objective of the study is to develop alternative intersection designs and identify other improvements to alleviate current and anticipated operational and safety issues within the study limits. The study area is shown in **Figure 1**. In addition to the study intersections of Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue, **Figure 1** also shows the Lake Gatlin Road because a potential future improvement will utilize this road. The current work effort is a continuation of the recently submitted study "Intersection Analysis for Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue", dated March 2021 (previous study).

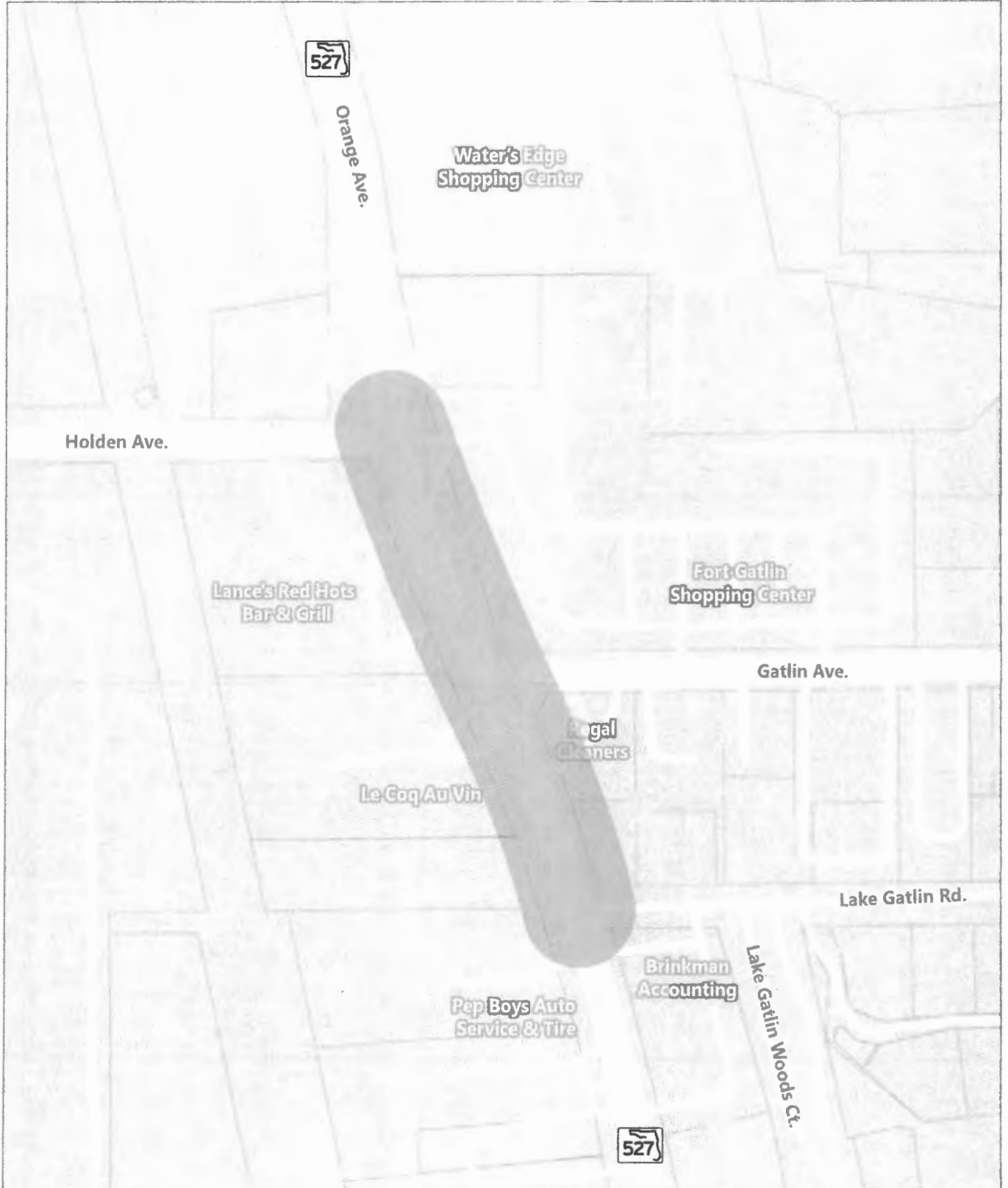
Orange Avenue is an urban principal arterial with regional importance and connects the City of Edgewood and Downtown Orlando. Under the existing conditions, the congestion and associated delay are due to the existing offset intersection configuration, heavy turning traffic from/to Orange Avenue to side streets (Holden Avenue and Gatlin Avenue) and limited existing left-turn storage lengths along Orange Avenue.

Under the current conditions, the queue for the northbound left turn movement at Orange Avenue and Holden Avenue exceeds the available storage length and spills into the northbound through lane south of Gatlin Avenue. Excessive queues are also observed along Holden Avenue (for the eastbound approach) and Gatlin Avenue (for the westbound approach). The other movements are observed to operate with minimum impact during both AM and PM peak hours.

The two signalized study intersections are approximately 350-feet apart from each other. The SunRail crossing on Holden Avenue (Florida Department of Transportation [FDOT] Railroad Crossing No. 622311), located approximately 300-feet west of Orange Avenue, also contributes to the intersection delays during the morning and afternoon peak hours. Based on the existing published SunRail schedule, there are a total of four crossings (two trains each for the northbound and southbound routes) during both the morning (7-8 AM) and afternoon (5-6 PM) peak hours at the study location.

The distribution service center for Boise Cascade Building Materials is also located on Holden Avenue approximately 700-feet west of Orange Avenue. This distribution service center provides access for heavy trucks to/from Holden Avenue.

The purpose of this memorandum is to present the previous studies review, existing (2019) turning movement counts (TMCs) and future (2025 and 2040) turning movement volumes (TMVs), existing travel patterns (origin-destination [OD] data) at the study intersections, historical crash analysis for ten years, future operational analysis summaries for the existing conditions, short-term and long-term alternatives, and safety evaluation of the future alternatives. The objective of this study is to develop design concepts for the long-term alternatives and benefit-cost (B/C) ratios using operational benefits and planning-level cost estimates.



 Location



**Figure 1**

**Location Map**  
 Intersection Analysis for Orange Avenue/Holden Avenue & Orange Avenue/Gatlin Avenue

## **2 PREVIOUS STUDIES REVIEW**

Per discussions with the City of Edgewood, the study intersections have been the subject of previous studies dating back to 1973. This section presents a review of previous studies and recommendations related to the study intersections. Following is a summary of the historical timeline of previous/related studies and/or meetings.

- **1973:** Orange County Board of County Commission Meeting Minutes, December 11, 1973 – Orange County Board of County Commissioners (BCC) discussed the widening of Holden Avenue from Rio Grande Avenue to Orange Avenue.
- **1988:** Orange County Board of County Commission Meeting Minutes, April 18, 1988 – the BCC discussed right-of-way (ROW) reservation and Preliminary Engineering Study for widening Holden Avenue from Orange Blossom Trail to Orange Avenue. The realignment of Holden Avenue with Gatlin Avenue was part of the Preliminary Engineering Study.
- **1999:** Orange County Roadway Corridor Analysis for Holden improvements.
- **2001:** City of Edgewood Community Master Plan – the Master Plan included alternatives for realigning the Holden Avenue and Gatlin Avenue intersections at SR 527/Orange Avenue.
- **2009:** Qualitative Assessment for SR 527 at Gatlin and Holden Avenue Study #1, Work Order #52, July 2009 – the assessment included a series of short-term geometric improvements at Orange Avenue and Gatlin/Holden Avenues.
- **2010:** Orange County SYNCHRO Analysis – this analysis compared 2010 existing conditions with proposed intersection modifications at Orange Avenue and Holden/Gatlin Avenues.
- **2015:** Conceptual Design Study, SR 527 (Orange Avenue) from Gatlin Avenue to Holden Avenue (FPID 433648-1-32-01), March 2015 – this study included a series of design recommendations for the SR 527 corridor and at the intersections of Holden Avenue and Gatlin Avenue.



- **2017:** The Orange Avenue Corridor Master Plan Summary was prepared by Kittelson and Associates in August 2017 (relevant pages are included in Appendix A of this report). The study was initiated by MetroPlan Orlando and the City of Edgewood to establish Orange Avenue (SR 527) as a livable and walkable multi-modal urban thoroughfare. This study establishes a corridor vision and identifies implementation actions to address network efficiency, safety, and livability within the context of future transportation needs.
- **2018:** FDOT Signal Timing Report, SR 527 from Office Court to Drennen Road, May 2018 – this study summarizes the signal retiming efforts for 12 intersections along SR 527, from Office Court to Drennen Road. It was recommended that the detections at the intersection of Holden Avenue/Orange Avenue be further investigated.
- **2019:** Orange County Realignment Concept Plan review comments – this document includes a review of the Orange Avenue-Holden Avenue-Gatlin Avenue Intersection Realignment Concept Plan.
- **2021:** MetroPlan Orlando, Orlando Urban Area FY 2026/27 – 2034/35 Prioritized Project List (Adopted July 7, 2021) – The Orange Avenue corridor from Holden Avenue to Gatlin Avenue is identified for safety improvements totaling \$10.5 million. Based on the information provided by the City, this project is a result of a recommendation by Orange County to the City of Edgewood to seek funding for the realignment of Holden Avenue with Gatlin Avenue.

**Appendix A** includes more detailed summaries of the available documents listed above. The summary of previous studies includes applicable recommendations to address the traffic operations at the study locations, and alternatives that were proposed in those studies.

### **3 EXISTING CONDITIONS**

#### **3.1 Existing (2019) Traffic Volumes**

Due to the ongoing COVID-19 pandemic, the year 2019 traffic volumes were forecasted using TMCs from recently completed studies. FDOT District 5 performed signal retiming on Orange Avenue in 2018 with TMCs collected in the field in October 2017. The 8-hour TMCs for the study intersections of Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue obtained from this signal retiming report are included in **Appendix B**. Please note that growth rates referred to in this report are simple growth rates.

To develop the year 2019 TMCs from the year 2017 TMCs, a growth rate was calculated using Bureau of Economic and Business Research (BEBR) estimates and historical traffic trends. The summary is provided below.

1. Based on BEBR estimates for Orange County, an annual growth rate of 2.7% was observed between 2017 and 2019 population estimates. An annual growth rate of 2.1% was observed between 2017 and 2019 population estimates for the City of Orlando (see **Table 1**).

**Table 1: BEBR Population Estimates**

Year	Orange County	City of Orlando
<b>2017</b>	1,313,880	279,789
<b>2018</b>	1,349,597	285,099
<b>2019</b>	1,386,080	291,800
<b>Growth Rate</b>	<b>2.8%</b>	<b>2.1%</b>

2. The historical count (2017 – 2019) information obtained from 2019 Florida Traffic Online (FTO) for Cosites #750175 and #750537 on Orange Avenue and historical count (2017 – 2019) information obtained from Orange County for Station#187 on Holden Avenue and Station # 323 on Gatlin Avenue are summarized in **Table 2**.
3. **An annual growth rate of 2.8% is recommended to forecast the 2019 TMCs.** This growth rate depicts the average growth rates derived from the historical traffic counts

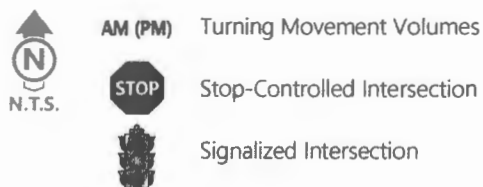
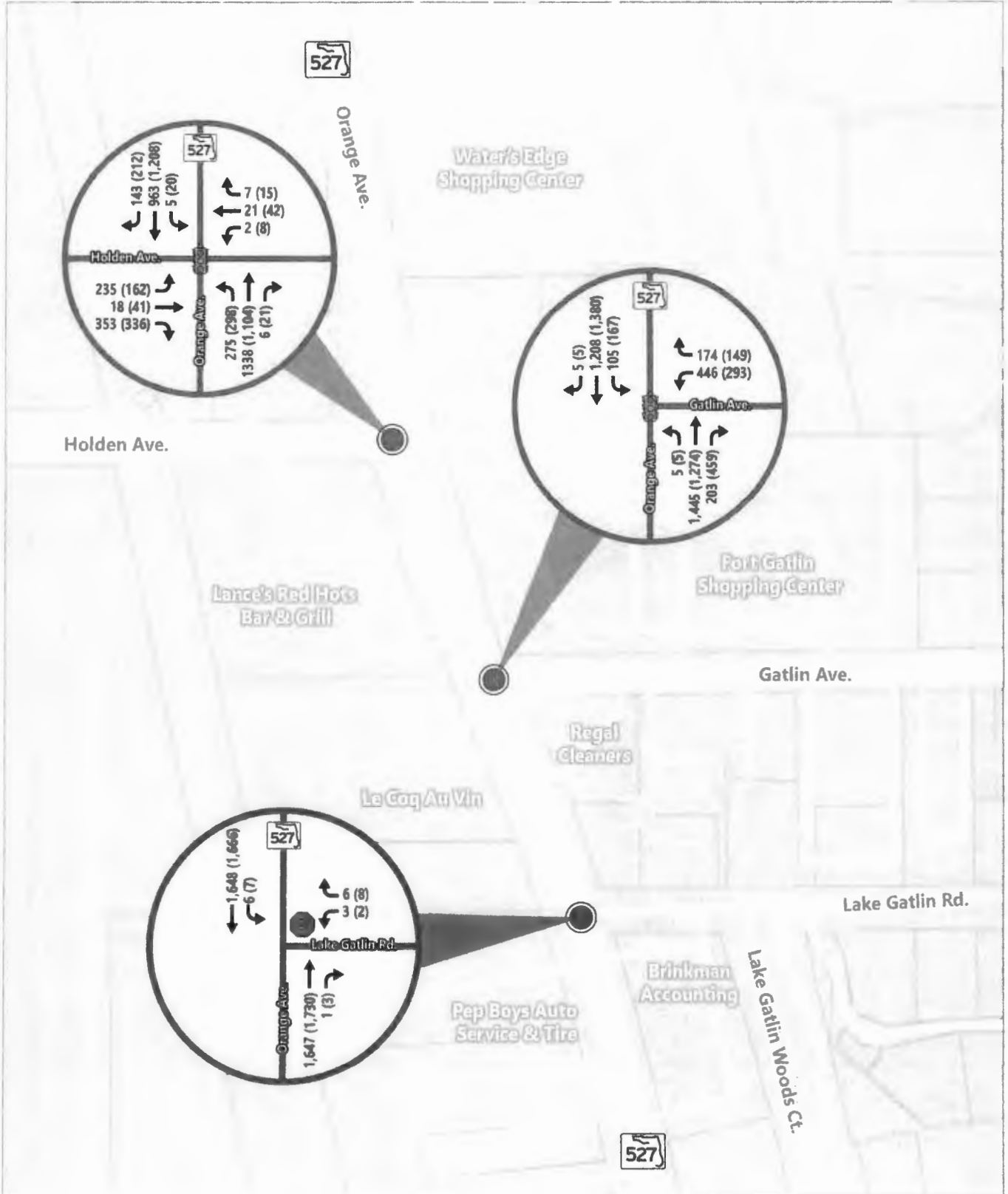
(2017-2019) and BEBR population estimates for the City of Orlando (2017-2019) and Orange County (2017-2019).

**Table 2: Historical Traffic Trends Summary**

Year	Orange Avenue north of Holden Avenue (Cosite 750175)	Orange Avenue south of Gatlin Avenue (Cosite 750537)	Holden Avenue west of Orange Avenue (Station – 187)	Gatlin Avenue east of Orange Avenue (Station – 323)
<b>2017</b>	36,439	42,000	16,000	8,559
<b>2018</b>	37,064	43,000	17,140	8,711
<b>2019</b>	38,138	44,500	17,335	9,307
<b>Annual Growth Rate</b>	<b>2.3%</b>	<b>3.0%</b>	<b>4.2%</b>	<b>4.4%</b>

**Figure 2** shows the year 2019 estimated TMVs for the study intersections. The following observations are noted from the estimated year 2019 TMVs.

- The eastbound right turning and northbound left turning movements are heavy during both AM and PM peak hours at the intersection of Orange Avenue and Holden Avenue.
- The westbound left turning movement in the AM peak hour and northbound right turning movement in the PM peak hour are heavy at the intersection of Orange Avenue and Gatlin Avenue.
- Northbound is the predominant peak direction in the AM peak hour along Orange Avenue, which shifts to southbound in the PM peak hour.



**Figure 2**  
**Year 2019 Estimated Turning Movement Volumes**  
 Intersection Analysis for Orange Avenue/  
 Holden Avenue & Orange Ave/Gatlin Avenue

### 3.2 OD Study

An OD study was performed at study intersections in September 2020 to understand the percentage of vehicles completing the following two travel patterns. These percentages were eventually used to determine the eastbound and westbound through movements in the future Holden Avenue Realignment alternatives. The OD results are included in **Appendix C**.

- Turning westbound right at Orange Avenue and Gatlin Avenue and immediately turning northbound left at Orange Avenue and Holden Avenue.
- Turning eastbound right at Orange Avenue and Holden Avenue and immediately turning southbound left at Orange Avenue and Gatlin Avenue.

**Figure 3** depicts the existing OD patterns between the study intersections. Based on the OD study, it was determined that

- Approximately 30% of eastbound right turning traffic at Orange Avenue and Holden Avenue intersection immediately turns southbound left turn onto Gatlin Avenue, depicted as a blue line in **Figure 3**.
- Approximately 70% of westbound right turning traffic at Orange Avenue & Gatlin Avenue intersection immediately turn northbound left turn onto Holden Avenue, depicted by the red line in **Figure 3**.

**Figure 3: Field-Collected OD Patterns**



## **4 HISTORICAL CRASH ANALYSIS**

The latest available ten years of crash data within the study area from July 1, 2011 to June 30, 2021 were provided by Orange County. A total of 517 crashes were reported within the study area, including the intersections of Orange Avenue with Gatlin Avenue, Holden Avenue, and Lake Gatlin Road. 235 of the crashes occurred at the Holden Avenue intersection, 249 occurred at the Gatlin Avenue intersection, and the remaining 33 crashes occurred at the Lake Gatlin Road intersection. The crashes were analyzed to identify possible crash patterns within the study area.

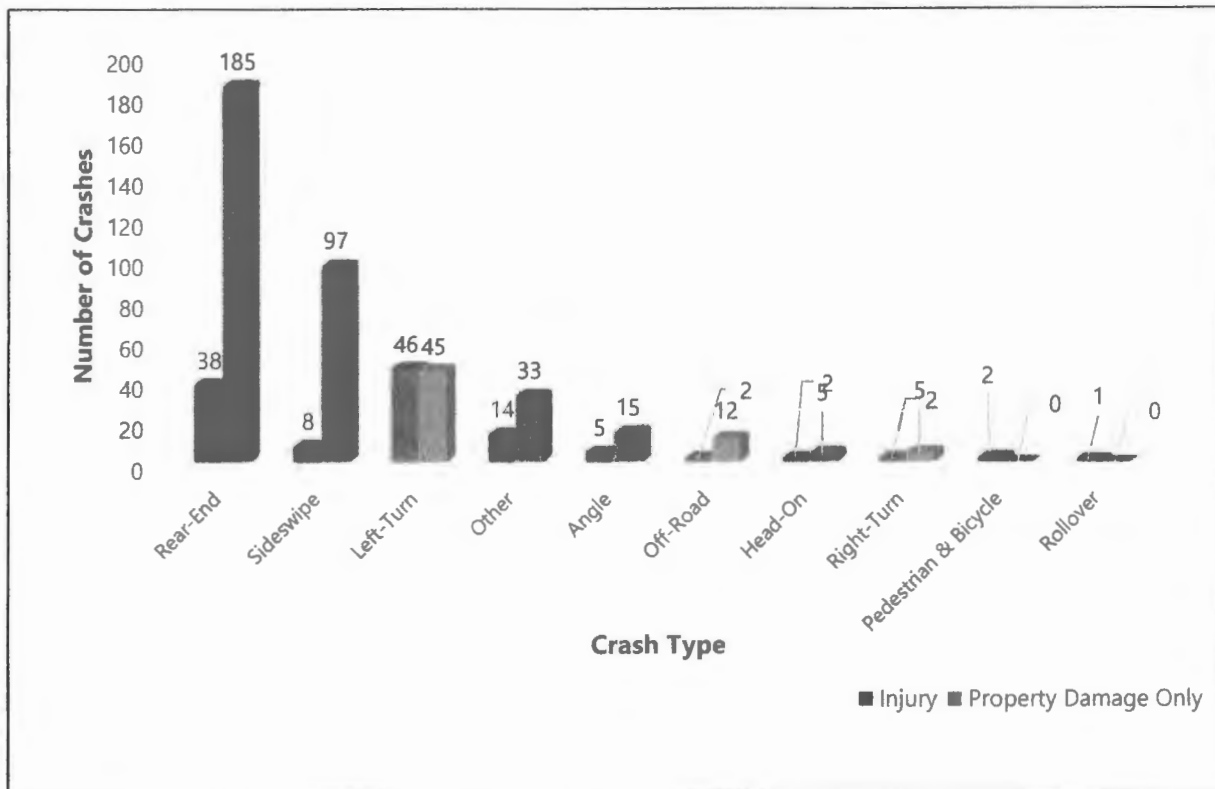
As for the severity, injuries accounted for 23% of the crashes while the remaining crashes resulted in property damage only. No fatalities were recorded in the ten-year study period. A low occurrence of pedestrian or bicyclist crashes was recorded with only one of each reported out of 517 crashes. The major crash types were rear-end accounting for 43% of crashes, sideswipe for 20% of crashes, and left-turn for 18% of crashes. Five crashes involved alcohol and one involved drug usage. **Figure 4** illustrates a heat map of the crashes over the ten-year period for the study area. The heat map is based on the location details provided within the crash data source (Signal Four Analytics) and is approximate. The heat map helps to visually identify a cluster of crashes within the study area and was prepared using the ArcGIS Maps for PowerBI tool.

**Figure 4: Crash Heat Map of the Study Area (2011-2021)**



**Figure 5** describes all 517 crashes by type and severity. The following sections describe the crash characteristics by intersection and include an overview of pedestrian and cyclist crashes. The raw crash data is included in **Appendix D**.

**Figure 5: Crashes Summary by Type and Severity for the Study Area (2011-2021)**



## 4.1 Crash Summary by Intersection

### 4.1.1 Orange Avenue and Holden Avenue

In total, 235 crashes were recorded within the influence area of the intersection of Orange Avenue and Holden Avenue. The predominant crash types were rear-end (110), left-turn (38), and sideswipe (38) crashes. Both pedestrian and bicycle crashes occurred within the area of this intersection. Of the 235 total crashes at this intersection, 54 resulted in injury with the remaining 181 causing property damage only. The majority of the crashes occurred in dry pavement conditions (200) and daylight (178) conditions. Alcohol and drugs played a role in three (3) crashes.

**Table 3** describes the crash circumstances by year.

**Table 3: Crash Summary – Orange Avenue and Holden Avenue**

Crash Type	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	Proportion
<b>Crash Type</b>														
Rear-End		0	7	9	15	15	18	11	9	14	8	4	110	47%
Head-On		0	1	0	0	0	1	0	1	0	0	0	3	1%
Sideswipe		0	2	5	5	3	6	5	6	3	3	0	38	16%
Angle		1	0	1	1	0	2	1	2	0	1	1	10	4%
Left-Turn		2	1	0	4	3	6	4	6	7	2	3	38	16%
Right-Turn		0	0	0	1	0	0	0	1	0	0	0	2	1%
Off-Road		0	0	0	0	1	0	1	0	4	0	1	7	3%
Pedestrian & Bicycle		0	0	1	0	0	0	0	0	0	1	0	2	1%
Other		0	1	2	6	1	7	1	1	2	4	0	25	11%
<b>Total</b>		<b>3</b>	<b>12</b>	<b>18</b>	<b>32</b>	<b>23</b>	<b>40</b>	<b>23</b>	<b>26</b>	<b>30</b>	<b>19</b>	<b>9</b>	<b>235</b>	<b>100%</b>
<b>Crash Severity</b>														
Injury		1	0	4	6	5	8	4	8	8	6	4	54	23%
Property Damage Only		2	12	14	26	18	32	19	18	22	13	5	181	77%
<b>Total</b>		<b>3</b>	<b>12</b>	<b>18</b>	<b>32</b>	<b>23</b>	<b>40</b>	<b>23</b>	<b>26</b>	<b>30</b>	<b>19</b>	<b>9</b>	<b>235</b>	<b>100%</b>
<b>Pavement Condition</b>														
Wet		0	1	6	10	2	8	1	0	4	2	1	35	15%
Dry		3	11	12	22	21	32	22	26	26	17	8	200	85%
<b>Total</b>		<b>3</b>	<b>12</b>	<b>18</b>	<b>32</b>	<b>23</b>	<b>40</b>	<b>23</b>	<b>26</b>	<b>30</b>	<b>19</b>	<b>9</b>	<b>235</b>	<b>100%</b>
<b>Light Condition</b>														
Daylight		3	10	15	21	21	28	16	20	22	15	7	178	76%
Dusk		0	0	0	2	0	1	1	0	2	1	1	8	3%
Dawn		0	0	0	0	0	1	1	0	0	0	0	2	1%
Dark		0	2	3	9	2	10	5	6	6	3	1	47	20%
<b>Total</b>		<b>3</b>	<b>12</b>	<b>18</b>	<b>32</b>	<b>23</b>	<b>40</b>	<b>23</b>	<b>26</b>	<b>30</b>	<b>19</b>	<b>9</b>	<b>235</b>	<b>100%</b>

Note: The crash period is from July 1, 2011 to June 30, 2021, the years 2011 and 2021 are not full

#### 4.1.2 Orange Avenue and Gatlin Avenue

249 of the 517 total crashes were recorded at the adjacent intersection of Orange Avenue and Gatlin Avenue. The crash types included 98 rear-end, 61 sideswipe, 50 left-turn, and 19 other crashes. Of the 249 crashes, 60 resulted in injury while 189 resulted in property damage only. Conditions were dry for 217 crashes and in daylight for 200 crashes. There were no pedestrian or bicycle-related crashes, while alcohol was a factor accounting for three of the crashes. **Table 4** describes the crash circumstances by year.



**Table 4: Crash Summary – Orange Avenue and Gatlin Avenue**

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	Proportion
<b>Crash Type</b>													
<b>Rear End</b>	1	12	13	9	11	12	18	9	7	4	2	<b>98</b>	39%
<b>Head On</b>	0	0	0	0	1	1	0	0	0	0	0	<b>2</b>	1%
<b>Sideswipe</b>	1	6	6	6	8	10	6	4	10	3	1	<b>61</b>	24%
<b>Roll Over</b>	0	0	0	0	0	0	0	1	0	0	0	<b>1</b>	1%
<b>Angle</b>	0	1	0	0	2	1	1	0	0	1	0	<b>6</b>	2%
<b>Left Turn</b>	1	8	1	4	3	3	2	8	13	1	6	<b>50</b>	20%
<b>Right Turn</b>	0	0	0	0	1	0	2	0	0	1	1	<b>5</b>	2%
<b>Off Road</b>	0	0	0	1	0	0	0	1	2	1	2	<b>7</b>	3%
<b>Other</b>	0	3	0	4	2	3	5	0	1	1	0	<b>19</b>	8%
<b>Total</b>	<b>3</b>	<b>30</b>	<b>20</b>	<b>24</b>	<b>28</b>	<b>30</b>	<b>34</b>	<b>23</b>	<b>33</b>	<b>12</b>	<b>12</b>	<b>249</b>	100%
<b>Crash Severity</b>													
<b>Injury</b>	1	9	5	7	3	6	4	9	8	2	6	<b>60</b>	24%
<b>Property Damage Only</b>	2	21	15	17	25	24	30	14	25	10	6	<b>189</b>	76%
<b>Total</b>	<b>3</b>	<b>30</b>	<b>20</b>	<b>24</b>	<b>28</b>	<b>30</b>	<b>34</b>	<b>23</b>	<b>33</b>	<b>12</b>	<b>12</b>	<b>249</b>	100%
<b>Pavement Condition</b>													
<b>Wet</b>	0	2	5	6	4	5	2	2	4	0	2	<b>32</b>	13%
<b>Dry</b>	3	28	15	18	24	25	32	21	29	12	10	<b>217</b>	87%
<b>Total</b>	<b>3</b>	<b>30</b>	<b>20</b>	<b>24</b>	<b>28</b>	<b>30</b>	<b>34</b>	<b>23</b>	<b>33</b>	<b>12</b>	<b>12</b>	<b>249</b>	100%
<b>Light Condition</b>													
<b>Daylight</b>	2	25	18	24	25	27	21	15	25	9	9	<b>200</b>	80%
<b>Dusk</b>	0	1	0	0	0	1	3	0	1	1	0	<b>7</b>	3%
<b>Dawn</b>	0	0	0	0	0	0	0	1	0	0	0	<b>1</b>	1%
<b>Dark</b>	1	4	2	0	3	2	10	7	7	2	3	<b>41</b>	16%
<b>Total</b>	<b>3</b>	<b>30</b>	<b>20</b>	<b>24</b>	<b>28</b>	<b>30</b>	<b>34</b>	<b>23</b>	<b>33</b>	<b>12</b>	<b>12</b>	<b>249</b>	100%

Note: The crash period is from July 1, 2011 to June 30, 2021, the years 2011 and 2021 are not full

#### 4.1.3 Orange Avenue and Lake Gatlin Road

Of the 517 total crashes, 33 were reported at the intersection of Orange Avenue and Lake Gatlin Road. These crashes included 15 rear-end, six sideswipe, and four angle crashes. Six of the crashes resulted in injury, while the remaining 27 crashes caused property damage only. 26 of the crashes occurred in dry conditions and 29 of them occurred in daylight.

There were no pedestrian or bicycle-related crashes at this intersection and there were also no drug or alcohol-related incidents. The following **Table 5** describes the circumstances by year.

**Table 5: Crash Summary – Orange Avenue and Lake Gatlin Road**

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	Proportion
<b>Crash Type</b>													
<b>Rear End</b>	0	1	1	1	2	5	1	1	3	0	0	<b>15</b>	45%
<b>Head On</b>	0	0	0	0	1	0	1	0	0	0	0	<b>2</b>	6%
<b>Sideswipe</b>	0	0	0	0	1	0	1	1	2	0	1	<b>6</b>	18%
<b>Angle</b>	0	0	0	0	0	2	0	0	1	1	0	<b>4</b>	12%
<b>Left Turn</b>	0	0	0	0	1	0	1	1	0	0	0	<b>3</b>	9%
<b>Other</b>	0	0	0	0	0	0	1	0	1	1	0	<b>3</b>	9%
<b>Total</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>33</b>	100%
<b>Crash Severity</b>													
<b>Injury</b>	0	0	0	0	2	2	0	0	1	1	0	<b>6</b>	18%
<b>Property Damage Only</b>	0	1	1	1	3	5	5	3	6	1	1	<b>27</b>	82%
<b>Total</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>33</b>	100%
<b>Pavement Condition</b>													
<b>Wet</b>	0	0	0	0	2	1	1	0	3	0	0	<b>7</b>	21%
<b>Dry</b>	0	1	1	1	3	6	4	3	4	2	1	<b>26</b>	79%
<b>Total</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>33</b>	100%
<b>Light Condition</b>													
<b>Daylight</b>	0	1	1	1	5	7	4	2	6	2	0	<b>29</b>	88%
<b>Dusk</b>	0	0	0	0	0	0	0	0	1	0	0	<b>1</b>	3%
<b>Dawn</b>	0	0	0	0	0	0	0	1	0	0	0	<b>1</b>	3%
<b>Dark</b>	0	0	0	0	0	0	1	0	0	0	1	<b>2</b>	6%
<b>Total</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>33</b>	100%

*Note: The crash period is from July 1, 2011 to June 30, 2021, the years 2011 and 2021 are not full*

## 4.2 Overview of Pedestrian and Bicycle Crashes

A total of two bicycle and pedestrian-related crashes occurred during the study period, neither of which resulted in a fatality. One pedestrian crash was recorded at the study intersection of Orange Avenue and Holden Avenue, resulting in injury. One bicycle crash at the intersection of Orange Avenue and Holden Avenue resulted in injury. Of these two, the pedestrian crash occurred in 2013,

while the bicycle crash occurred in 2020. The following **Table 6** describes the crash circumstances in chronological order:

**Table 6: Pedestrian and Cyclist Crash Summary**

Condition	Vehicle Orientation	Location	Description
<b>Crash #83295366</b>			
<b>Dry/ Daytime</b>	Westbound	East of railroad	A vehicle traveling westbound along Holden Avenue struck a roadway worker holding a stop sign in the middle of the roadway between the railroad and intersection with Orange Avenue. The worker was transported to the hospital.
<b>Crash #83855964</b>			
<b>Dry/ Dark-Lighted</b>	Northbound	In intersection	A vehicle turning left from northbound Orange Avenue onto Holden Avenue struck a bicycle traveling southbound along Orange Avenue within the intersection. The vehicle entered the intersection with a flashing yellow signal. The bicyclist was transported to the hospital.

### 4.3 Historical Crash Patterns

Based on the crash conditions and types at the three intersections, the following patterns are noted at the study intersections:

- The low number of pedestrian and bicycle-related (two) crashes over a ten-year crash period is most likely because of the minimal pedestrian/bicycle activity at the study intersections.
- The proportion (of the total number) of crashes is approximately equal at the two main study intersections (Orange Avenue at Holden Avenue – 46% and Orange Avenue at Gatlin Avenue – 48%). A significant portion of these crashes was the result of rear-end crashes which are typical of the stop-and-go traffic at signalized intersections.
- Rear-end, left-turn, and sideswipe crashes were the most common crash types at all three intersections. Of these major crash types, around half of the left-turn crashes resulted in injuries, underscoring the severity associated with left-turn crashes.

## 5 FUTURE TRAFFIC

The development of 2040 future traffic projections for the study corridors requires the examination of historical growth, proposed development levels within the corridor vicinity, and a basic understanding of local traffic circulation patterns and travel characteristics of the corridor. As such, the following sources were used to derive reasonable future traffic forecasts for the study corridor. All growth rates referred to in this section are linear annual rates unless otherwise stated.

1. **Travel Demand Model:** The latest adopted Central Florida Regional Planning Model (CFRPM) version 6.1 was used in the traffic forecasting process (**Table 7**).
2. **Historical Traffic Trends Analysis:** Historical traffic trends (linear growth) analysis based on least squares regression analysis was conducted for the study roadways using traffic data from 2017 FTO (**Table 8**).
3. **Population Projections:** The population estimates from BEBR, Florida Population Studies, Bulletin 180 were used (**Table 9**).
4. **Programmed and Planned Improvements:** Based on the latest adopted MetroPlan Orlando 2045 Metropolitan Transportation Plan (MTP) adopted on 12/9/2020 and revised on 12/8/2021, and Transportation Improvement Program (TIP) adopted on 7/7/2021, there are no capacity improvements projects along Orange Avenue in the vicinity of the study area. As such, CFRPM version 6.1 confirms the same along Orange Avenue, Holden Avenue, and Gatlin Avenue near the study area.

**Table 7: CFRPM Model Growth Rate Summary**

Location	2010	2040	Growth Rate
Orange Avenue, north of Holden Avenue	39,779	44,803	0.4%
Orange Avenue b/w Holden Avenue & Gatlin Avenue	44,141	49,852	0.4%
Orange Avenue, south of Gatlin Avenue	43,007	49,546	0.5%
Holden Avenue, west of Orange Avenue	15,977	18,153	0.5%
Gatlin Avenue, east of Orange Avenue	13,792	16,797	0.7%
<b>Average</b>	<b>0.5%</b>		

**Table 8: Historical Traffic Trends Summary**

Station	2019 AADT (Actual)	2040 AADT (Trends)	Growth Rate	R <sup>2</sup> Value
Orange Avenue, north of Holden Avenue	38,138	40,800	0.33%	53.23%
Orange Avenue, south of Gatlin Avenue	44,500	52,700	0.88%	70.42%
Holden Avenue, west of Orange Avenue	17,335	30,900	3.73%	97.17%
Gatlin Avenue, east of Orange Avenue	9,307	14,100	2.45%	70.71%

**Table 9: Population Analysis Summary - Orange County**

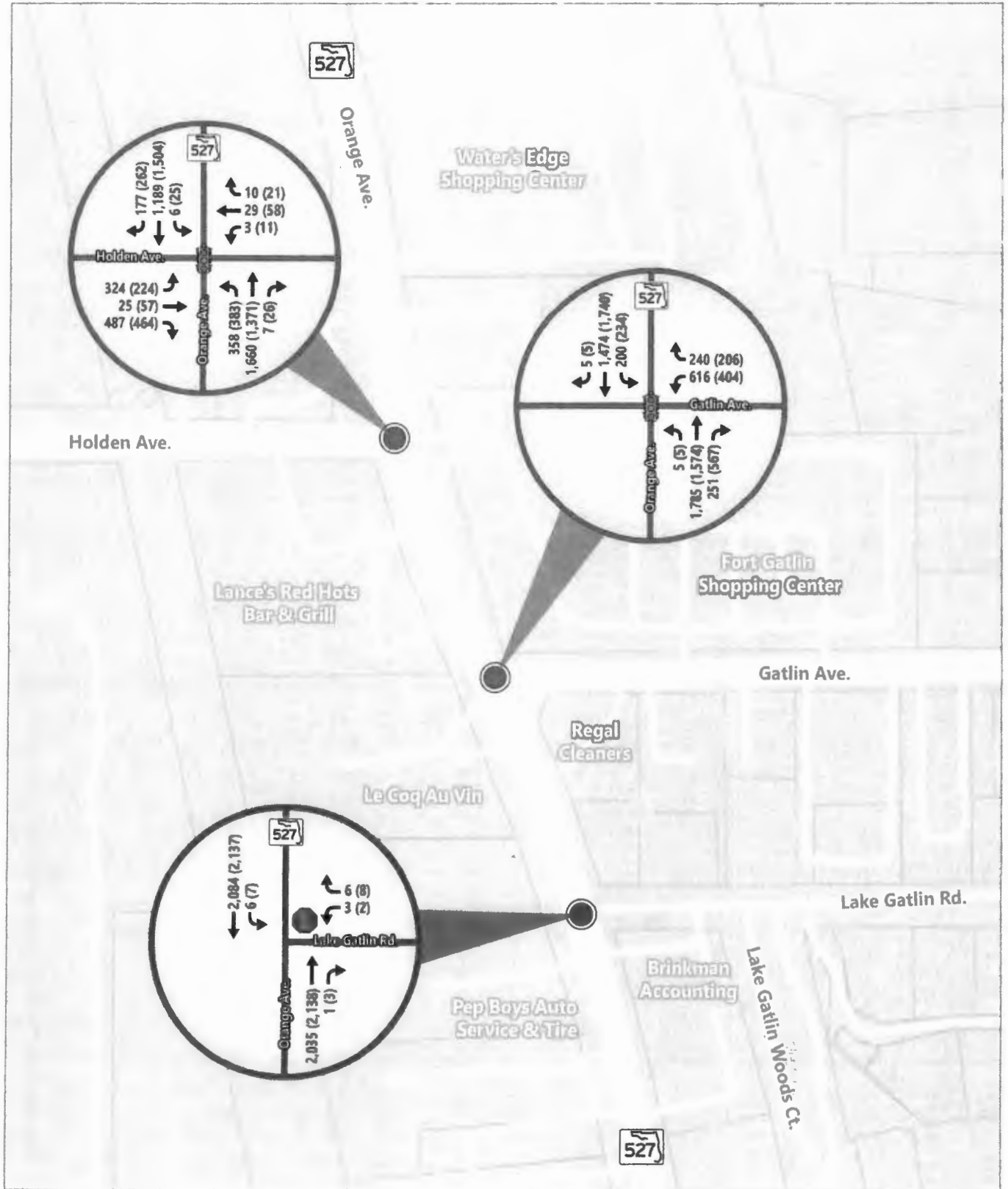
Projection Type	2019 Estimate	2040 Projection	Growth Rate
BEBR Low Projection	1,386,080	1,584,300	0.68%
BEBR Medium Projection	1,386,080	1,888,700	1.73%
BEBR High Projection	1,386,080	2,188,600	2.76%

## 5.1 Recommended Growth Rates

Based on the above-mentioned growth rates from various sources, input from the County, and the fact that the study roadways will not be widened by 2040, the following recommended growth rates are used to derive the year 2040 TMVs at the study intersections:

- **A growth rate of 1.12%** (average of model-based growth rates for Orange Avenue [0.50%] and BEBR medium projection-based growth rate [1.73%]) is used for Orange Avenue.
- **A growth rate of 1.81%** (average of model-based growth rates for Holden Avenue and Gatlin Avenue [0.60%], trends-based growth rates for Holden Avenue and Gatlin Avenue [3.09%], and BEBR medium projection-based growth rate [1.73%]) is used for Holden Avenue and Gatlin Avenue.

The supporting documents including CFRPM 6.1 model plots, historical trends spreadsheets, and BEBR population estimates are included in **Appendix E**. **Figure 6** depicts forecasted 2040 AM and PM TMVs for the No-Build alternative.



- AM (PM) Turning Movement Volumes
- STOP Stop-Controlled Intersection
- Signalized Intersection



Figure 6

Future Year 2040 No Build Turning Movement Volumes Intersection Analysis for Orange Avenue/Holden Avenue & Orange Ave/Gatlin Avenue

## **6 CONSIDERED ALTERNATIVES**

Based on the input received from Orange County and the City of Edgewood, and a preliminary evaluation of the study needs and objectives, traffic data, and anticipated traffic operational efficiency and safety improvements, one short-term and three long-term alternatives are evaluated in this study. Also, a Stage 1 Intersection Control Evaluation (ICE) was conducted to evaluate a range of viable long-term traffic control options (including the existing signal configuration) for the study intersections of Orange Avenue at Holden Avenue and Orange Avenue at Gatlin Avenue.

### **6.1 Short-term Alternative**

A short-term alternative is evaluated that can be built in the field before construction funding can be secured for the long-term alternative. The short-term alternative was evaluated for the year 2025 and is based on the improvements suggested by the County. **Figure 7** shows the year 2025 AM and PM TMVs for the study intersections derived using growth rates described in Section 5.2. Please refer to the next section for details on the short-term alternative improvements.

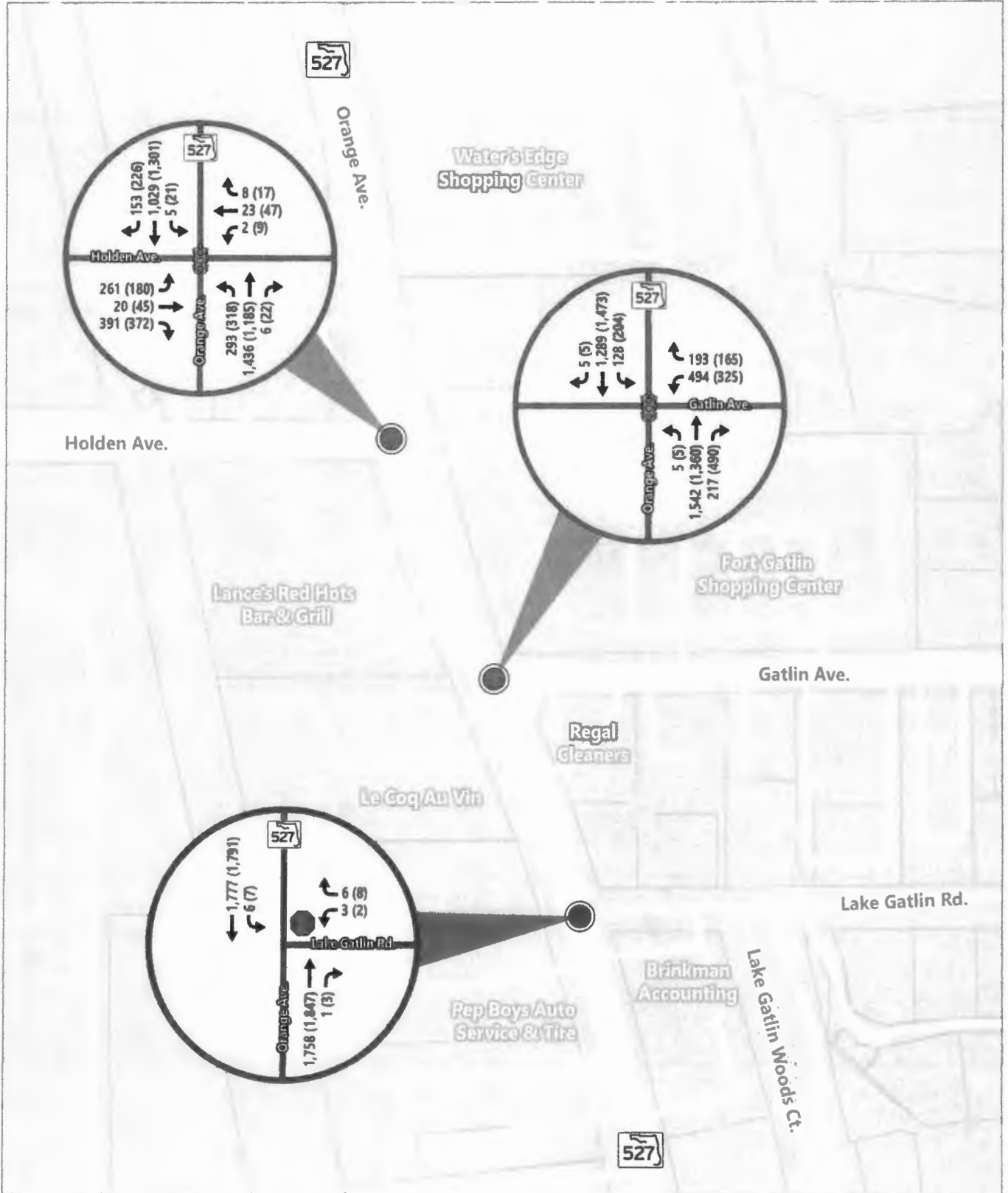
### **6.2 Long-term Alternatives**

#### **6.2.1 ICE (Stage 1) Summary**

As part of the initial screening for reasonable long-term alternatives, a Stage 1 ICE was conducted at the two study intersections.

- Orange Avenue and Holden Avenue
- Orange Avenue and Gatlin Avenue

The purpose of the ICE Analysis is to determine viable candidates for intersection control based on capacity, safety, and geometric constraints. As part of this process, FDOT modified Capacity Analysis at Junctions (CAP-X) and Safety Performance for ICE (SPICE) tools were used to identify the first set of potential alternatives at the study intersections that can accommodate 2040 volumes.



AM (PM) Turning Movement Volumes



Stop-Controlled Intersection



Signalized Intersection



Figure 7

**Future Year 2025  
Turning Movement Volumes -  
Short-term Alternative**  
Intersection Analysis for Orange  
Avenue/Holden Avenue & Orange  
Avenue/Gatlin Avenue



The existing issues because of the offset intersection configuration and previously evaluated future long-term alternatives were taken into consideration in the ICE process.

#### *6.2.1.1 Data Sources*

The intersection geometry, existing and future AADTs, and future (2040) turning movement volumes were used in the ICE process. For this purpose, existing year (2019), opening year (2025), and design year (2045) AADTs were used based on the recommended growth rates discussed in Section 5.2. For the ICE, in cases where the AADT along a roadway differed on either side of the intersection, the larger AADT was used to keep the analysis conservative. Truck factors for the intersection approaches were based on the FTO for Orange Avenue, Holden Avenue, Gatlin Avenue.

#### *6.2.1.2 Analysis*

##### **Orange Avenue and Holden Avenue**

For the Stage 1 ICE of this intersection, the options for viable control strategies are limited due to the proximity of the intersection at Orange Avenue and Gatlin Avenue and ROW needs on Orange Avenue and existing operational issues. The following control strategies were evaluated:

- Signalized Intersection
- Roundabout
- Quadrant Roadway Intersection (QRI)

A QRI is chosen as one of the alternatives because it meets the study objectives, does not require two-lane U-turns on Orange Avenue, and is consistent with the stakeholder input. As mentioned before, each control strategy was evaluated for capacity and multimodal performance using the CAP-X tool and for safety using the SPICE tool. The results of the analysis are shown in the table below.

**Table 10: ICE Stage 1 Summary – Orange Avenue and Holden Avenue**

Control Strategy	Capacity (v/c)		Multimodal Score	SPICE Ranking*
	2040 AM	2040 PM		
Signalized Intersection	0.73	0.79	4.8	2
Roundabout	1.10	1.33	5.6	1
Quadrant Roadway	0.58	0.62	4.4	-

*Note: SPICE ranking is not considered because the future AADT for Orange Avenue is outside of Safety Performance Function (SPF) development range for a roundabout and not available for a QRI*

As shown in the table, the roundabout does not meet the projected capacity needs of the intersection. Based on the results of the capacity and safety analysis, both the Signalized Intersection and the Quadrant Roadway can accommodate projected traffic volumes. Therefore, the QRI is the preferred option given that it is consistent with the previously evaluated long-term alternatives (which are discussed in the next section).

**Orange Avenue and Gatlin Avenue**

For the Stage 1 ICE of this intersection, the options for viable control strategies are limited due to the proximity of the intersection at Orange Avenue and Gatlin Avenue and ROW needs on Orange Avenue and existing operational issues. The following control strategies were evaluated:

- Signalized Intersection
- Roundabout
- QRI

A QRI is chosen as one of the alternatives because it meets the study objectives, does not require two-lane U-turns on Orange Avenue, and is consistent with the stakeholder input. Again, each control strategy was evaluated for capacity and multimodal performance using the CAP-X tool and for safety using the SPICE tool. The results of the analysis are shown in the table below.

As shown in the table, the roundabout does not meet the projected capacity needs of the intersection. Based on the results of the capacity and safety analysis, both the Signalized Intersection and the Quadrant Roadway can accommodate projected traffic volumes. Therefore, the QRI is the preferred option given that it is consistent with the previously evaluated long-term alternatives (which are discussed in the next section).

**Table 11: ICE Stage 1 Summary – Orange Avenue and Gatlin Avenue**

Control Strategy	Capacity (v/c)		Multimodal Score	SPICE Ranking*
	2040 AM	2040 PM		
Signalized Intersection	0.84	0.74	4.8	2
Roundabout	2.58	1.38	5.6	1
Quadrant Roadway	0.77	0.70	4.4	-

*Note: SPICE ranking is not considered because the future AADT for Orange Avenue is outside of Safety Performance Function (SPF) development range for a roundabout and not available for a QRI*

The supporting documentation for the ICE Stage 1 is provided in **Appendix F**.

### **6.2.2 Long-term Options**

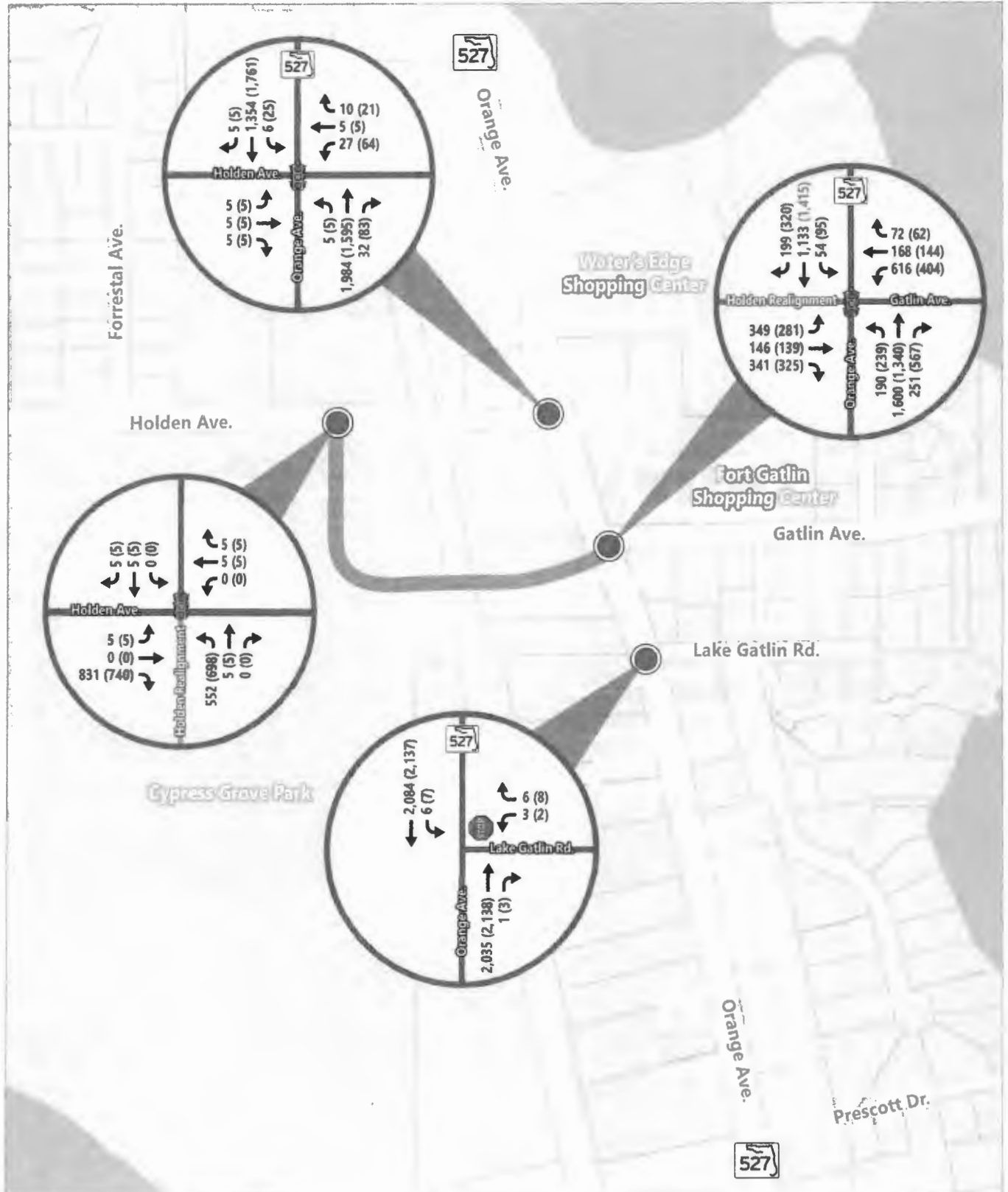
Three long-term alternatives are evaluated for this study for the year 2040 traffic conditions as described below:

- **Holden Avenue Realignment/Gatlin Avenue Extension Alternative with 1 Rail Crossing (Future Alternative 1):** This alternative was developed based on the input from the County and City, and the assumption that the existing rail crossing along Holden Avenue will be closed to support the opening of the new rail crossing along realigned Holden Avenue. As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection. The realignment is anticipated to help mitigate the existing and anticipated congestion and associated delay at the offset intersections. It should be noted the term “Holden Avenue Realignment” is used interchangeably with the term “Gatlin Avenue Extension”.
- **Holden Avenue Realignment/Gatlin Avenue Extension Alternative with 2 Rail Crossings (Future Alternative 2):** This alternative was developed based on the input from the County and City, and the assumption that the existing rail crossing along Holden Avenue will stay open along with the new rail crossing along realigned Holden Avenue. The existing rail crossing along Fairlane Avenue must be closed to support the opening of the new rail crossing along realigned Holden Avenue. As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection like the Future Alternative 1. However, traffic will be circulated

using both the existing Holden Avenue and Holden Avenue Realignment to minimize ROW impacts and provide improved operational LOS.

- **Quadrant Intersection Alternative using Lake Gatlin Road (Future Alternative 3):** This alternative proposes to use Lake Gatlin Road for the movements between Orange Avenue and Gatlin Avenue. The main idea is to eliminate the existing southbound left turn lane at Orange Avenue and Gatlin Avenue intersection and instead use Lake Gatlin Road for this movement. This will help provide two northbound left turn lanes and improve signal efficiency at the intersection of Orange Avenue. Besides, a portion of the westbound left and northbound right turn movements that currently use the intersection at Orange Avenue and Gatlin Avenue will use Orange Avenue and Lake Gatlin Road intersection.

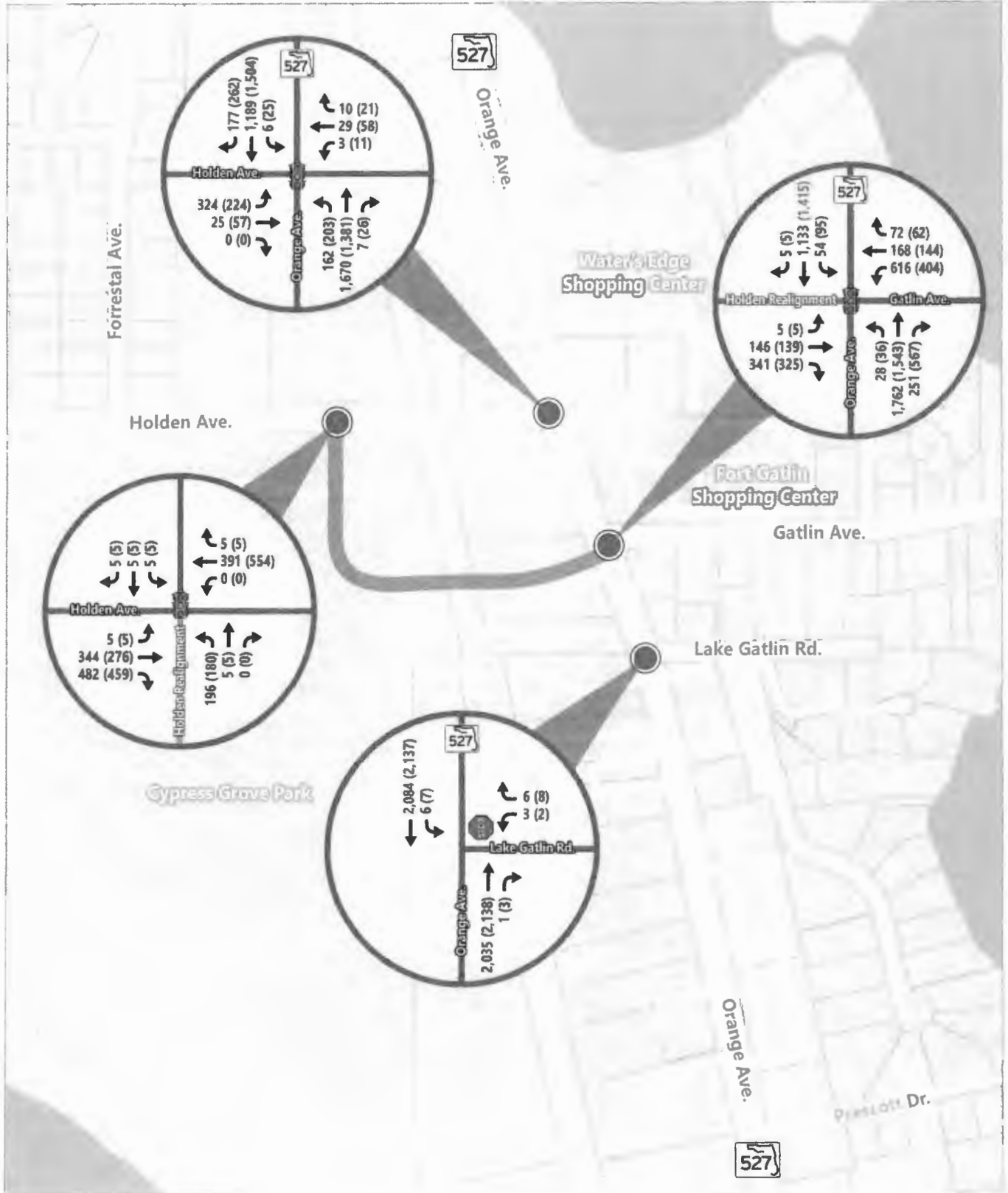
**Figures 8 through 10** show the year 2040 AM and PM TMVs for Future Alternatives 1, 2, 3, respectively. These volumes are derived using the 2040 volumes shown in **Figure 6** and results of the OD Study (Section 3) and rerouting them to satisfy the assumptions of each of the future alternatives. For minor local movements, a volume of five vehicles is used. Please refer to the next section for details on the long-term alternatives' improvements.



- AM (PM)** Turning Movement Volumes
- Stop-Controlled Intersection
- Signalized Intersection
- Holden Ave. Realignment



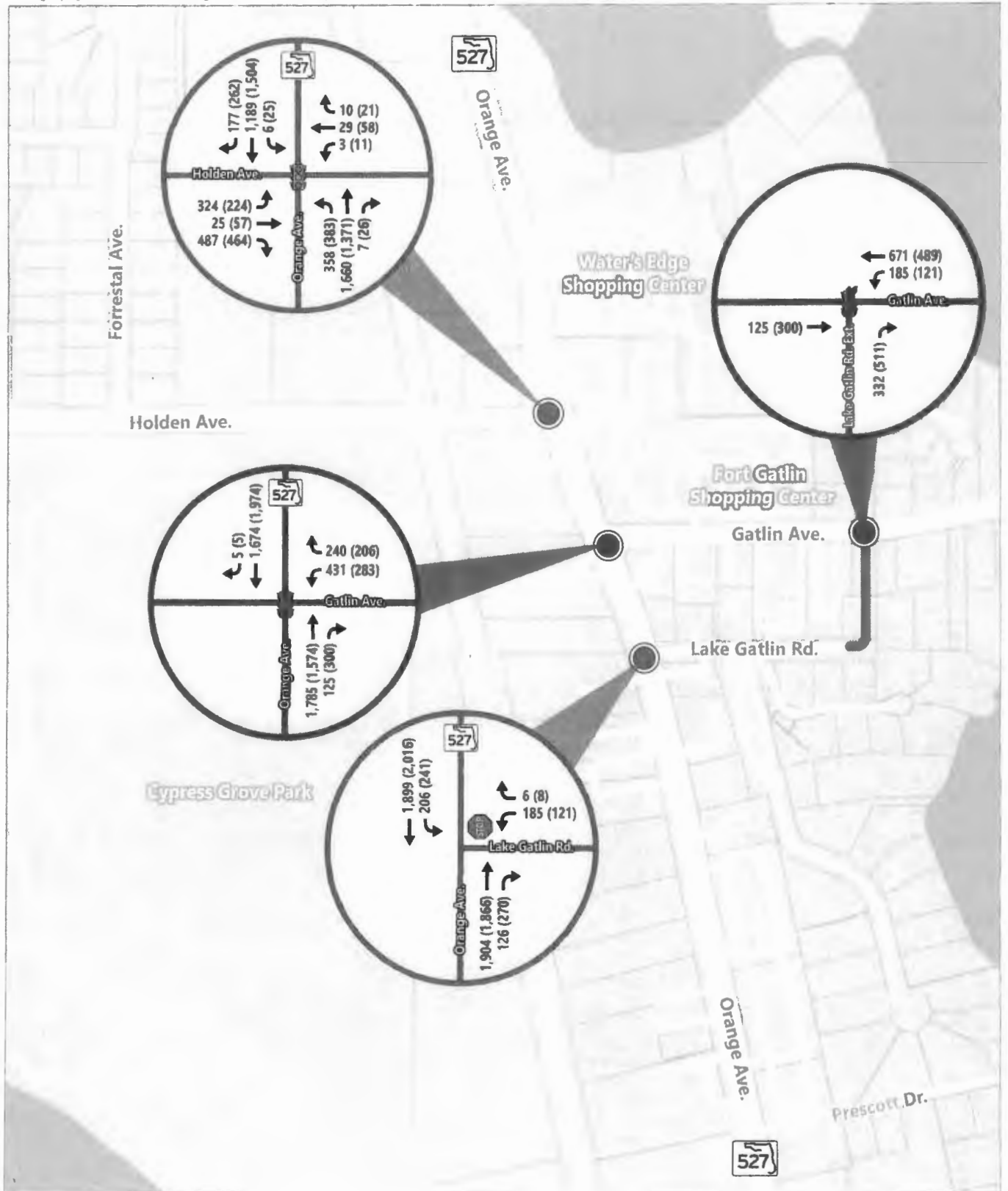
**Figure 4**  
**Year 2040 Long-term Future Alternative 1 Turning Movement Volumes**  
 Intersection Analysis for Orange Avenue/Holden Avenue & Orange Ave/Gatlin Avenue



- AM (PM) Turning Movement Volumes
- Stop-Controlled Intersection
- Signalized Intersection
- Holden Ave. Realignment



**Figure 9**  
**Year 2040 Long-term Future**  
**Alternative 2 Turning Movement**  
**Volumes**  
 Intersection Analysis for Orange Avenue/Holden Avenue & Orange Ave/Gatlin Avenue



- AM (PM) Turning Movement Volumes
- STOP Stop-Controlled Intersection
- Signalized Intersection
- Lake Gatlin Rd. Extension



Figure 10

**Year 2040 Long-term Future Alternative 3 Turning Movement Volumes**

Intersection Analysis for Orange Avenue/Holden Avenue & Orange Avenue/Gatlin Avenue

## **6.3 Assessment of the Proposed Holden Avenue Realignment**

### **6.3.1 Project Basic Survey Services**

VHB performed a topographic survey for the proposed realignment route. The survey mapped the intersection of Orange Avenue and Gatlin Avenue to include 200 feet east along Gatlin Avenue and 200 feet north and south along Orange Avenue. Additional coverage extended 25 feet outside of the ROW. VHB also mapped the proposed realignment route and obtained topographic data for a 100 feet wide swath as it runs west from Orange Avenue and then northerly to the connection with Holden Avenue where VHB mapped Holden Avenue 100 feet east and west of the proposed connection. Topographic data were obtained within the Holden Avenue ROW and extended 25 feet outside of it. The survey was accomplished through on-the-ground measurements and was performed and documented following the Standards of Practice as established for Surveyors and Mappers within Florida's Administrative Code, Chapter 5J-17.050, .051, .052, and .053.

### **6.3.2 Project Basic Drainage Analysis**

#### **Existing Conditions**

The project lies within the Lake Jessamine Sub-Basin of the Boggy Creek Basin. The overall project is within the St. Johns River Water Management District (SJRWMD). According to the Natural Resource Conservation Service (NRCS), the soils within the project limits are classified as follows: Tavares Fine Sand-Urban Land Complex (48) and Urban Land (50). The Tavares Fine Sand is moderately well-drained with a depth to the high-water table of approximately 3.5 to 6.0 feet. According to the Orange County Flood Insurance Rate Map (FIRM) Panels 12095C0410F and 12095C0430, both dated September 25, 2009, the project is not within a 100-year floodplain. Therefore, no floodplain impacts are anticipated. It should be noted there are existing permits for Cypress Grove Park (27401-1, -2, and -3). The existing stormwater system for the park consists of dry retention ponds.

#### **Proposed Conditions**

For future conditions (long-term alternatives), Future Alternative 1 was considered to keep the preliminary drainage analysis conservative. In the proposed condition, the stormwater runoff will be collected and conveyed to a proposed stormwater pond via a closed storm sewer system.



Curb inlets will be placed along the roadway to collect stormwater runoff from the roadway. Given the soil conditions and based on information from Cypress Grove Park, it appears the proposed pond would be a dry retention system. The overall project is approximately 4.23 acres in size based on the conceptual right of way width that varies from 30' to 87'. Approximately 1.93 acres is impervious, and 2.31 acres is pervious. The required treatment volume (assuming an on-line dry retention pond) is approximately 0.35 acre-feet. The estimated pond size would be approximately 0.98 acres. This assumes a depth of approximately 3 feet. These numbers are preliminary and are subject to change once the project moves to design and additional data are available. For example, detailed geotechnical information will determine whether the stormwater pond is wet detention or a dry retention pond.

#### **SJRWMD Permitting**

Given the nature of the project, it is anticipated the project would require an Individual Environmental Resource Permit (ERP) from the SJRWMD. As the project continues toward design, it should be confirmed through a pre-application meeting with representatives of the SJRWMD. The stormwater computations are provided in **Appendix H**.

## **6.4 Preliminary Roadway Design**

Please note that the basic survey services and drainage analysis were conducted for Future Alternatives 1 and 2 only. Anticipated impacts of the proposed long-term alternatives (Future Alternatives 1, 2, and 3) and on the adjacent properties including Cypress Grove Park and Railroad (located west of Orange Avenue) are determined. This study utilized The American Association of State Highway and Transportation Officials' (AASHTO's) Chapter 5.3 "Local Streets in Urban Areas" for Holden Avenue and Lake Gatlin Road as the basis for horizontal design criteria supplemented with standards the City may have or want to incorporate into the proposed alignment. The latest Florida Department of Transportation [FDOT] Design Manual (FDM) was utilized for Orange Avenue.

The design speed is not currently set, but given the existing constraints, the design will initially begin with 25 mph for Lake Gatlin Road under Alternative 3.

For the alternatives which require Holden Avenue widening, it was assumed that the roadway widening will be allowed through the railroad crossing. The vertical design was not performed since this assignment was not surveyed. Additionally, Future Alternatives 1 and 2 were revisited to accommodate the required storage lengths for the turn lanes on the eastbound approach (which may require widening through the proposed/existing rail crossings). The design concepts for the future alternatives are provided in **Appendix G**.

#### **6.4.1 Impacts to the Cypress Grove Park**

The Orange County Parks and Recreation Division identified the following impacts to the acreage and functionality of Cypress Grove Park for Future Alternative 1. This alternative was used to determine the worst-case impacts to the park.

- The park will lose approximately four acres of wooded park land.
- The road and retention pond would be located in the front northeast corner of the park and impact around 60 trees including Live Oaks which provide a buffer to the park from the road. This tree canopy helps lessen heat island effects and protects wildlife habitat.
- The irrigation well serving 28 irrigation zones will need to be relocated within the park.
- Approximately 1,250 Linear Feet (LF) of decorative aluminum fencing will need to be relocated along with the concrete walking exercise loop.
- The walking loop will be reduced in length by 135 LF from approximately 835 LF to 700 LF. Relocating the walking loop will reduce the multi-purpose field area which would displace sports activities and reduce overflow parking for events.

### **6.5 Railroad and Project Coordination**

As part of the previous study (and included in this report), the team coordinated with the stakeholders including Orange County, City of Edgewood, FDOT (District 5 and Central Office Railroad coordinators), SunRail, and Central Florida Rail Corridor.

The primary intent of these coordination efforts was to make everyone aware of the study, determine the feasibility of adding a new railroad crossing south of the existing Holden Avenue railroad crossing (crossing #622311), and discuss future alternatives and analysis results. The memorandum describing these activities is provided in **Appendix I**.

## **7 TRAFFIC OPERATIONAL ANALYSIS**

Synchro 11 was used to perform the LOS operational analyses at the study intersections for the existing (2019), short-term (2025), and long-term (2040) conditions. Also, the year 2030 intersection analyses were conducted (but not summarized in the report) for B/C analysis (which is described in the next section). Since new intersections are added in the long-term alternatives, both intersection and network-wide measures of effectiveness (MOEs) are provided for an accurate comparison of the future alternatives. The Synchro outputs for all the analysis years are provided in **Appendix J**.

### **7.1 Existing (2019) Conditions**

The year 2019 AM and PM peak hour TMVs (**Figure 3**) along with existing intersection geometry (**Figure 11**) and signal timings were used in the intersection LOS analysis. A summary of the existing LOS analysis for the study intersections is included in **Table 12**.

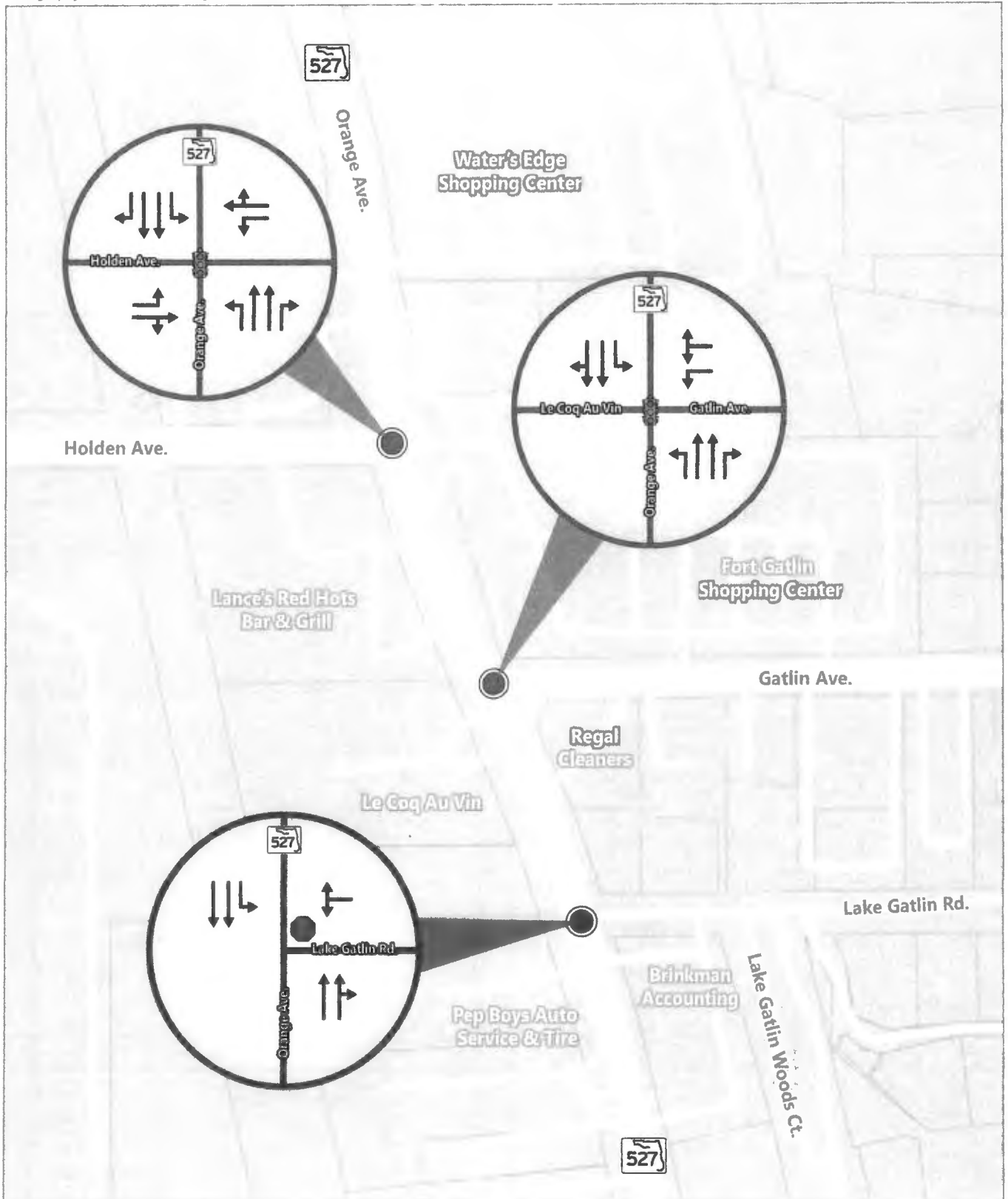
As shown in **Table 12**, the following are noted:

- Both the study intersections operate at overall LOS D or better in the existing conditions. The most likely reason is the very low delays for the heavy northbound and southbound through movements along Orange Avenue at both study intersections.
- As observed in the field, the following movements operate at LOS F in the existing conditions:
  - Eastbound left turn (AM and PM) and northbound left turn (PM) at Orange Avenue and Holden Avenue.
  - Westbound left turn (PM) at Orange Avenue and Gatlin Avenue.
- Under the current conditions, the queue for the northbound left turn movement at Orange Avenue and Holden Avenue exceeds the available storage length and spills into the northbound through lane south of Gatlin Avenue. Excessive queues are also observed along Holden Avenue (for the eastbound approach) and Gatlin Avenue (for the westbound approach). The other movements are observed to operate with minimum impact during both AM and PM peak hours.

**Table 12: Existing Year 2019 AM & PM Peak Hour Intersection Analysis Summary**

Study Intersection	Movement	2019 AM Peak		2019 PM Peak	
		Delay	LOS	Delay	LOS
Orange Avenue & Holden Avenue	EBL	140.1	F	146.5	F
	EBT	25.0	C	57.3	E
	EBR	25.0	C	0.0	A
	WBL	67.0	E	82.2	F
	WBT	61.6	E	76.3	E
	WBR	61.6	E	76.3	E
	NBL	56.7	E	103.6	F
	NBT	2.7	A	4.1	A
	NBR	0.0	A	0.0	A
	SBL	11.4	B	10.9	B
	SBT	33.4	C	40.1	D
	SBR	2.0	A	8.2	A
	<b>Overall</b>	<b>28.5</b>	<b>C</b>	<b>39.3</b>	<b>D</b>
Orange Avenue & Gatlin Avenue	WBL	75.8	E	93.2	F
	WBT	42.5	D	36.4	D
	WBR	42.5	D	36.4	D
	NBL	11.6	B	8.0	A
	NBT	34.0	C	22.6	C
	NBR	8.6	A	7.1	A
	SBL	42.3	D	20.2	C
	SBT	26.3	C	11.2	B
	SBR	26.3	C	11.2	B
	<b>Overall</b>	<b>34.7</b>	<b>C</b>	<b>21.5</b>	<b>C</b>

Note: Red highlighted text shows LOS F



**Figure 11**

**Existing Intersection Geometry**  
Intersection Analysis for Orange Avenue/Holden Avenue & Orange Avenue/Gatlin Avenue

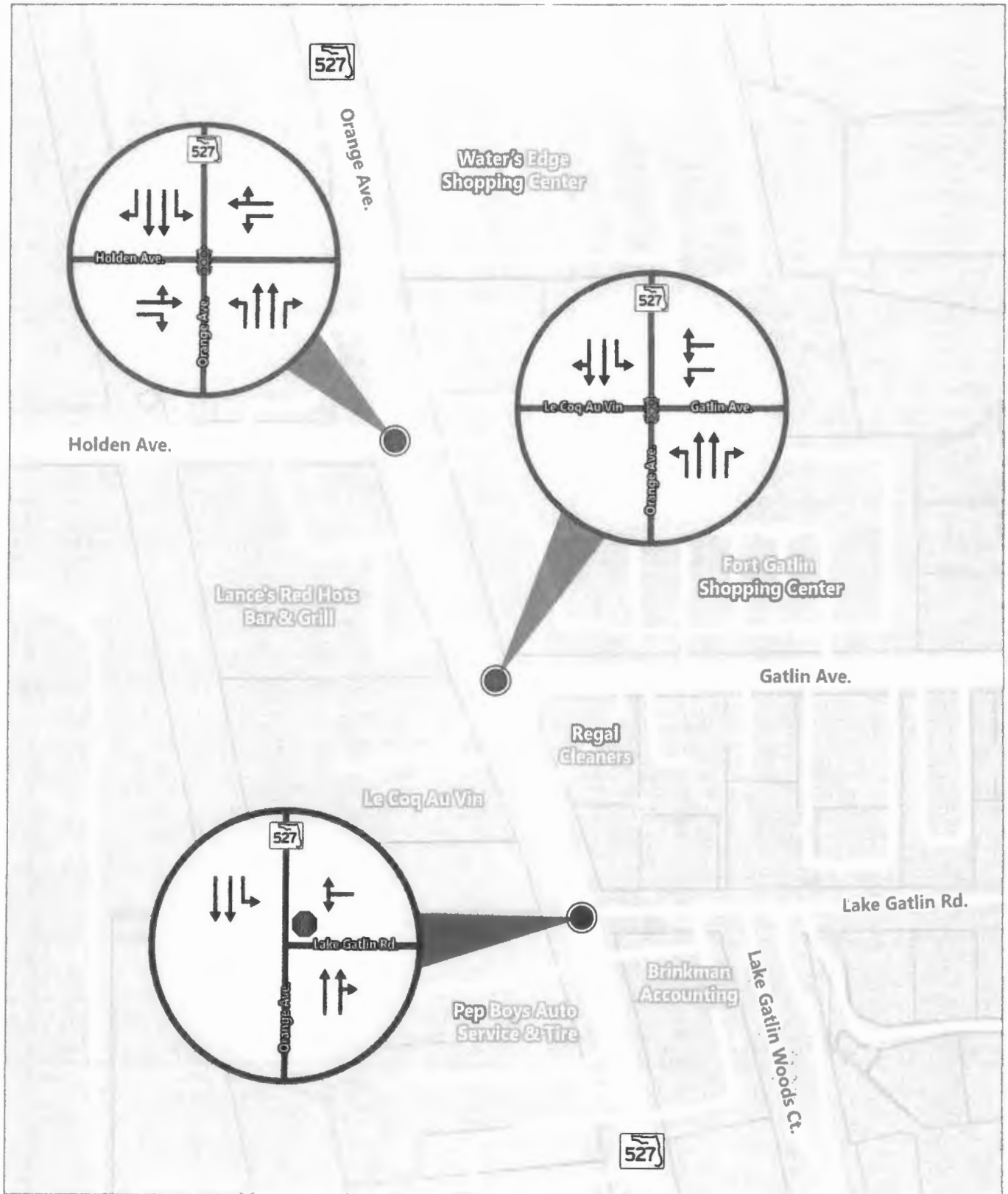
## 7.2 Short-term (2025) Conditions

As described in Section 6.1, a short-term alternative is evaluated that can be built in the field before construction funding can be secured for the long-term alternative. For this study, the short-term alternative is evaluated for the year 2025 and is based on the improvements suggested by the County and signal timings provided by FDOT. The following improvements are considered at the intersection of Orange Avenue and Holden Avenue for the short-term alternative.

- Modify the existing exclusive eastbound left turn only lane to a shared through-left turn lane and the existing shared through-right turn lane to a right turn only lane.
- Introduce an overlap between the eastbound right turn and northbound left turn movements.

**Figure 12** shows the intersection geometry for the short-term alternative. The year 2025 AM and PM peak hour turning movement volumes (**Figure 7**) along with short-term intersection geometry were used in the intersection LOS analysis. The signal timings are optimized using Synchro software. A summary of the year 2025 LOS analysis for the No-Build and Short-term alternatives is included in **Table 13**. **Figure 13** illustrates the improvement in overall intersection delay in the short-term alternative compared to the No-Build alternative. The following are noted from **Table 13** and **Figure 13**:

- The overall intersection delay at both the study intersections has reduced in the short-term alternative compared to the No-Build alternative because of the following:
  - The lane repurposing modification of the eastbound approach at Orange Avenue and Holden Avenue will help provide efficient use of the green time and thereby reduce the delay for the critical eastbound left and through movements.
  - There was a reduction in delay for the other critical movement (northbound left turn) at Orange Avenue and Holden Avenue in the PM peak hour because of the short-term alternative improvements.
  - The intersection cycle length and split optimization have also caused an improvement in the overall delay ranging from 3-18% at the study intersections.



**Figure 12**  
**Short-term Alternative Intersection Geometry**  
 Intersection Analysis for Orange Avenue/Holden Avenue & Orange Avenue/Gatlin Avenue

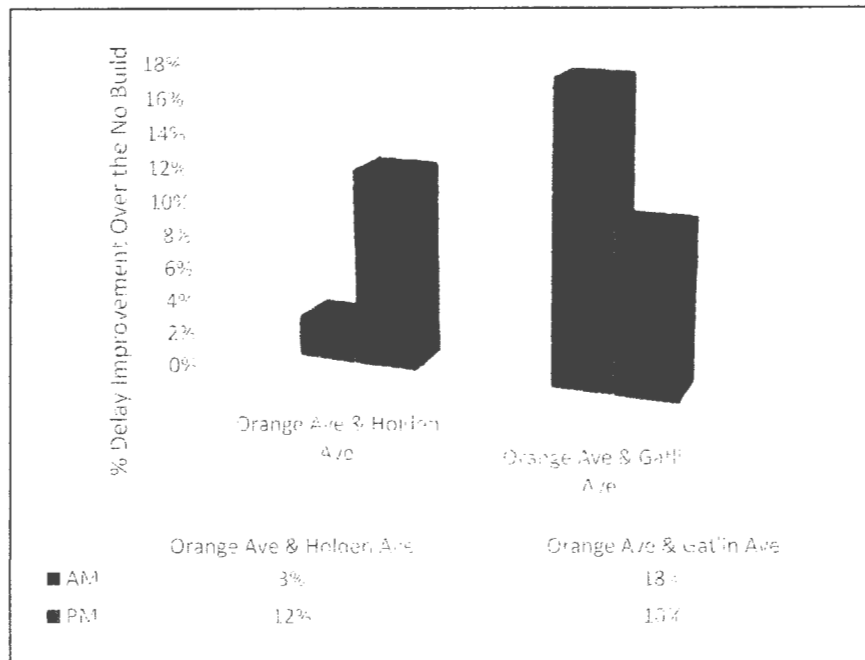


**Table 13: Year 2025 AM & PM Peak Hour Intersection Analysis Summary for the Short-term Alternative**

Study Intersection	Movement	AM Peak				PM Peak			
		No-Build		Build		No-Build		Build	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Orange Avenue & Holden Avenue	EBL	178.8	F	69.4	E	145.0	F	94.2	F
	EBT	37.0	D	69.4	E	67.4	E	94.2	F
	EBR	37.0	D	21.5	C	67.4	E	27.8	C
	WBL	67.0	E	66.0	E	82.3	F	86.7	F
	WBT	61.7	E	60.2	E	73.2	E	87.0	F
	WBR	61.7	E	60.2	E	73.2	E	87.0	F
	NBL	70.2	E	106.7	F	168.1	F	88.0	F
	NBT	3.6	A	4.0	A	4.5	A	6.9	A
	NBR	0.0	A	0.0	A	0.0	A	0.0	A
	SBL	11.6	B	25.6	C	11.2	B	19.3	B
	SBT	38.0	D	56.8	E	43.5	D	61.9	E
	SBR	2.8	A	3.4	A	9.2	A	7.2	A
	<b>Overall</b>	<b>35.7</b>	<b>D</b>	<b>34.8</b>	<b>C</b>	<b>47.4</b>	<b>D</b>	<b>41.8</b>	<b>D</b>
Orange Avenue & Gatlin Avenue	WBL	78.0	E	66.4	E	95.1	F	87.9	F
	WBT	43.6	D	37.3	D	38.8	D	51.7	D
	WBR	43.6	D	37.3	D	0.0	A	51.7	D
	NBL	12.0	B	21.0	C	8.8	A	8.4	A
	NBT	43.3	D	42.2	D	29.6	C	27.3	C
	NBR	10.0	A	3.0	A	9.8	A	2.3	A
	SBL	57.1	E	43.1	D	44.8	D	44.9	D
	SBT	33.0	C	19.5	B	12.2	B	9.3	A
	SBR	33.0	C	19.5	B	0.0	A	9.3	A
<b>Overall</b>	<b>41.6</b>	<b>D</b>	<b>34.2</b>	<b>C</b>	<b>26.3</b>	<b>C</b>	<b>23.7</b>	<b>C</b>	

Note: Red highlighted text shows LOS F

**Figure 13: Percent Intersection Delay Improvement in the Short-term Alternative over the No-Build Alternative**



### **7.2.1 Year of Failure Analysis for the Short-term Alternative**

A planning-level year of failure analysis was conducted for the study area to determine a period for which the short-term improvements will provide the target LOS “D” at all the study intersections. For this analysis, the following assumptions are used:

- Since the study intersections are along Orange Avenue (which is a State roadway), the corresponding target LOS “D” is used.
- The overall intersection LOS (delay) is used.
- The critical intersection of Orange Avenue and Holden Avenue (which has an overall intersection delay of 41.8 (LOS D) in the year 2025 PM peak hour) for the PM peak hour is used.
- The volumes were increased incrementally to test the future conditions after the year 2025.

**Based on this analysis, the short-term improvements are anticipated to provide an overall LOS “D” at the study intersections till the year 2035.** The year 2035 PM peak hour results are provided in **Appendix J**.

However, it should be noted the certain individual intersection movements will still operate at LOS "F", even though the overall intersection stands at LOS "D" through the year 2035.

### **7.3 Long-term Alternatives**

As described in Section 6.2, three long-term alternatives are evaluated for this study for the year 2040 traffic conditions. A No-Build alternative is also evaluated for comparison purposes. The No-Build alternative for the year 2040 will keep the existing roadway and intersection configuration within the study limits but incorporate the improvements from the short-term alternative at the intersection of Orange Avenue and Holden Avenue. This section provides the operational analysis results for each of these long-term alternatives. Per the approved scope, this study has developed design concepts for all future alternatives. The design for Future Alternatives 1 and 2 was based on the field survey results. The field survey results helped establish the boundaries of the proposed corridor and lay out a proper railroad crossing. The survey also helped identify modifications needed for Cypress Grove Park.

#### **7.3.1 Holden Avenue Realignment/Gatlin Avenue Extension Alternative with 1 Rail Crossing (Future Alternative 1)**

As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection and the existing rail crossing along Holden Avenue will be closed to support the opening of the new rail crossing along realigned Holden Avenue. The design concept is shown in **Figure 14**. As shown in this concept, the existing signal at Orange Avenue and Holden Avenue will still be operational, albeit for the local movements on Holden Avenue and Business Center east of Orange Avenue. However, a new signal at Holden Avenue and Holden Avenue Realignment/Distribution Service Center Driveway (Boise Cascade Building Materials) will be introduced. Also, since the existing rail crossing along Holden Avenue will be closed, there will not be through movements along Holden Avenue between this new signal and Orange Avenue. All the current movements that occur at Orange Avenue and Holden Avenue intersection will instead use Orange Avenue at Holden Avenue Realignment/Gatlin Avenue (new plus intersection).

Figure 14: Design Concept – Future Alternative 1



### **Potential Roadway Impacts**

The following impacts are anticipated within the study limits in this alternative.

- Additional ROW will be needed on Orange Avenue between Holden Avenue and Lake Gatlin Road to accommodate the exclusive southbound right turn lane and an additional northbound left turn lane at the new plus intersection.
- Additional ROW will be needed through Cypress Grove Park for the Holden Avenue Realignment. The existing parcels in the northwest and southwest corners of the new plus intersection will also be impacted.
- Around 10 parcels (including the Cypress Grove Park) are anticipated to be impacted in this alternative.
- Gatlin Avenue will need to be widened to provide additional turn lane improvements.

#### **7.3.2 Holden Avenue Realignment/Gatlin Avenue Extension Alternative with 2 Rail Crossings (Future Alternative 2)**

As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection. Under this alternative, the existing rail crossing on Holden Avenue will stay open along with the new rail crossing on the realigned Holden Avenue. The design concept is shown in **Figure 15**.

As shown in this figure, a new signal at Holden Avenue and Holden Avenue Realignment/Distribution Service Center Driveway (Boise Cascade Building Materials) will be introduced. Unlike Future Alternative 1, both the existing signal at Orange Avenue and Holden Avenue and the new plus intersection will be used to circulate the traffic for an efficient design. The following important changes are proposed:

- Much of the northbound left turn movement will still occur at Orange Avenue at Holden Avenue. A small portion of this movement will use the northbound left turn lane at the new plus intersection. For this study, it was assumed that 85% of the northbound left turning traffic will use the signal at Orange Avenue and Holden Avenue, and the remaining 15% will use the new plus intersection.

- The eastbound left turn will still occur at Orange Avenue at Holden Avenue
- The eastbound right turn movement will occur at the new plus intersection
- Since most of the eastbound right turn movement will now occur at the new plus intersection, the eastbound approach is modified to an exclusive left turn lane and a shared left-through-right turn lane.
- The following movements will use the eastbound and westbound through lanes at the new plus intersection:
  - Eastbound right turn from Holden Avenue onto Orange Avenue and an immediate southbound left turn from Orange Avenue onto Gatlin Avenue will now use the eastbound through lane
  - Westbound right turn from Gatlin Avenue onto Orange Avenue and an immediate northbound left turn onto Holden Avenue from Orange Avenue will now use the westbound through lane

The main advantage of this alternative (compared to Future Alternative 1) is the efficiency of traffic circulation and a smaller intersection footprint at the new plus intersection.

**Potential Roadway Impacts**

The following impacts are anticipated within the study limits in this alternative.

- Additional ROW needs on Orange Avenue within the study limits are not anticipated.
- Additional ROW will be needed through Cypress Grove Park for the Holden Avenue Realignment. The existing parcels in the northwest and southwest corners of the Orange Avenue and Holden Avenue Realignment/Gatlin Avenue intersection will also be impacted.
- Around 7 parcels (including the Cypress Grove Park) are anticipated to be impacted in this alternative.
- Gatlin Avenue will need to be widened to provide additional turn lane improvements.

Figure 15: Design Concept – Future Alternative 2



### **7.3.3 Quadrant Intersection Alternative using Lake Gatlin Road (Future Alternative 3):**

This alternative proposes to use Lake Gatlin Road for the movements between Orange Avenue and Gatlin Avenue. The existing southbound left turn lane at Orange Avenue and Gatlin Avenue intersection will be eliminated and Lake Gatlin Road will instead be used for this movement. The design concept is shown in **Figure 16**.

The following should be noted for this alternative:

- The southbound left turn movement at Orange Avenue at Gatlin Avenue will be eliminated and will have to use Lake Gatlin Road. For this change to occur, new signals at Orange Avenue and Lake Gatlin Road and Gatlin Avenue, and Lake Gatlin Road Extension will have to be introduced.
- The northbound left turn into Le Coq Au Vin Restaurant must be eliminated for signal efficiency.
- Two northbound left turn lanes at Orange Avenue and Holden Avenue are included since the southbound left turn movement at Orange Avenue at Gatlin Avenue will be eliminated. However, for this to occur, two westbound receiving lanes must be provided along Holden Avenue which requires widening through the railroad crossing on Holden Avenue. Besides, the eastbound approach must be widened to accommodate the proposed turn lane improvements Orange Avenue and Holden Avenue intersection.
- The existing northbound right turn and westbound left turn movements at Orange Avenue and Gatlin Avenue are assumed to be distributed to the new signal at Orange Avenue and Lake Gatlin Road. For this study, it was assumed that 70% of the westbound left turning traffic will use the signal at Orange Avenue and Gatlin Avenue, and the remaining 30% will use the new signal at Orange Avenue and Lake Gatlin Road. Also, it was assumed that 50% of the northbound right turning traffic will use the signal at Orange Avenue and Gatlin Avenue, and the remaining 50% will use the new signal at Orange Avenue and Lake Gatlin Road.



**Figure 16: Design Concept - Future Alternative 3**



### **Potential Roadway Impacts**

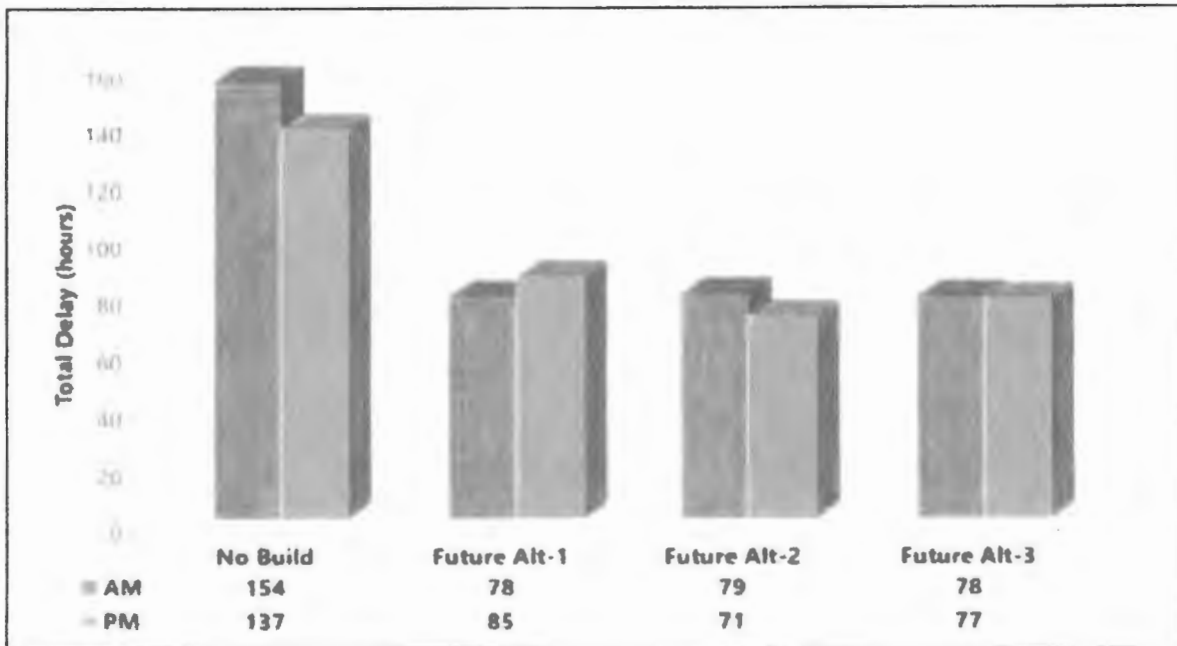
The following impacts are anticipated within the study limits in this alternative.

- Additional ROW is anticipated on Orange Avenue south of Lake Gatlin Road to provide an exclusive northbound right turn lane.
- Additional ROW will be needed in the southeast quadrant of Orange Avenue and Gatlin Avenue intersection to extend the existing Lake Gatlin Road to Gatlin Avenue.
- Around 14 parcels are anticipated to be impacted in this alternative.
- Holden Avenue will need to be widened in both directions to accommodate the turn lane improvements in the eastbound approach and provide two receiving lanes for the northbound left turn lane at Orange Avenue and Holden Avenue intersection.
- Gatlin Avenue will need to be widened to provide additional turn lane improvements.

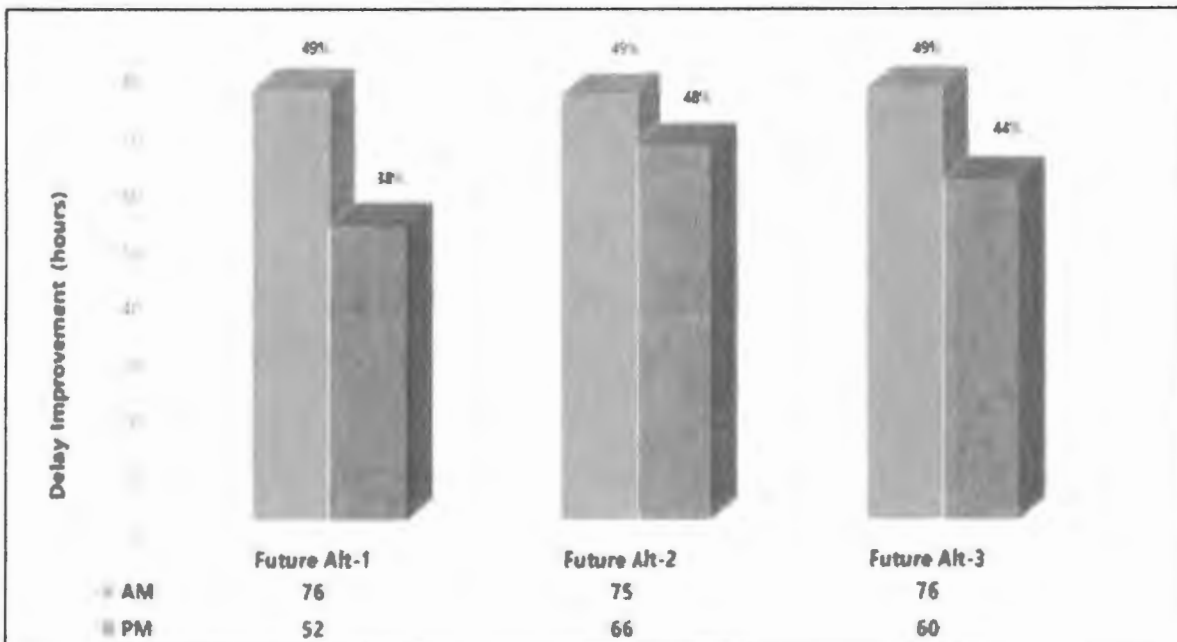
#### **7.3.4 Operational Analysis Summary**

The year 2040 AM and PM peak hour turning movement volumes along with proposed intersection geometries were used in the intersection LOS analysis. The signal timings are optimized using Synchro software. **Figures 17 and 18** illustrate the networkwide delays for each of the future alternatives and the delay improvement for each of the build alternatives over the No-Build alternative, respectively. A summary of the year 2040 LOS analysis for the No-Build and the three long-term alternatives is included in **Table 14**. Since all the long-term alternatives introduce either one or two new signals, network-wide MOEs are provided in **Table 15** for an apples-to-apples comparison.

**Figure 17: Networkwide Delays for the Future Alternatives**



**Figure 18: Networkwide Delay Improvement in the Long-term Alternatives over the No-Build Alternative**



The following conclusions are noted based on **Table 15 and Figure 17**.

- All the Build long-term alternatives show that all the study intersections operate within LOS "D" or better condition.
- All the long-term alternatives show significant improvement in both the networkwide MOEs as well as individual movement delays over the No-Build alternative.
- In the year 2040 AM peak hour, all the build alternatives provide a comparable reduction in total delay. Future Alternative 2 provides the highest delay reduction in the PM peak hour. The same is true regarding the performance index for future alternatives.

**Table 14: Year 2040 AM & PM Peak Hour Intersection Analysis Summary for the Long-term Alternatives**

Study Intersection	AM Peak									PM Peak						
	No Build		Holden Ave Realignment with 1 Rail Crossing (Future Alt-1)		Holden Ave Realignment with 2 Rail Crossings (Future Alt-2)		Quadrant Intersection using Lake Gatlin Rd (Future Alt-3)		No Build		Holden Ave Realignment with 1 Rail Crossing (Future Alt-1)		Holden Ave Realignment with 2 Rail Crossings (Future Alt-2)		Quadrant Intersection using Lake Gatlin Rd (Future Alt-3)	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Orange Ave & Holden Ave	59.9	E	5.5	A	19.5	B	24.9	C	69.3	E	8.1	A	26.7	C	27.1	C
Orange Ave & Gatlin Ave	64.7	E	47.9	D	44.3	D	12.4	B	39.8	D	47.4	D	29.9	C	9.1	A
Holden Ave & Holden Ave Realignment			12.8	B	8.7	A					15.4	B	8.6	A		
Orange Ave & Lake Gatlin Rd							26.4	C							21.6	C
Gatlin Ave & Lake Gatlin Rd							4.8	A							13.2	B

*Notes:*

- 1) Blank cells indicate that the movement does not exist in the corresponding alternative.
- 2) Synchro-based overall intersection LOS and delay are shown.

**Table 15: Year 2040 AM & PM Peak Hour Networkwide MOE Summary for the Long-term Alternatives**

Network MOE	AM				PM			
	No-Build	Holden Avenue Realignment with 1 Rail Crossing (Future Alt-1)	Holden Avenue Realignment with 2 Rail Crossings (Future Alt-2)	Quadrant Intersection using Lake Gatlin Road (Future Alt-3)	No-Build	Holden Avenue Realignment with 1 Rail Crossing (Future Alt-1)	Holden Avenue Realignment with 2 Rail Crossings (Future Alt-2)	Quadrant Intersection using Lake Gatlin Road (Future Alt-3)
<b>Total Delay (hour)</b>	154	78	79	78	137	85	71	77
<b>Vehicle Stops</b>	5,022	5,087	4,909	6,033	5,253	5,185	5,477	5,951
<b>Average Speed (mph)</b>	9	15	14	15	10	15	16	16
<b>Fuel Consumed (gallons)</b>	222	172	168	183	217	183	173	186
<b>Performance Index (PI)</b>	<b>168</b>	<b>93</b>	<b>93</b>	<b>95</b>	<b>152</b>	<b>99</b>	<b>86</b>	<b>93</b>

Notes:

- 1) PI is defined as  $[(D*1) + (St*10)]/3600$ , where D = Total Delay (seconds) and St = Vehicle Stops
- 2) The lower the PI, the better the operational efficiency.

## **8 B/C ANALYSIS**

A B/C analysis was performed for the short- and long-term alternatives based on traffic operational benefits derived using delay savings and planning-level cost estimates. For the short-term alternative, benefits are calculated for 10 years between 2021 and 2030 (included). For the long-term alternatives, the benefits are calculated between 2030 and 2050 (improvements will last for 20 years based on FDOT guidance). Initially, benefits are calculated for the years 2025, 2030, and 2040 conditions. Then the benefits for the other years are interpolated (extrapolated) using the appropriate values.

### **8.1 Traffic Operational Benefits**

To estimate the operational benefits of the proposed intersection improvements, Synchro reported networkwide total delay (vehicle-hours) values are used. The benefits are defined in terms of annualized cost savings associated with a reduction in the total delay values. The benefits are calculated for six hours (3 AM and 3 PM hours) in a day and 300 days in a year accounting for reduced benefits anticipated due to lower traffic volumes during the off-peak hours and weekends. The latest value of delay time per hour (\$20.17) for the year 2020 was obtained from "The Mobility Data for Orlando" published by Texas A&M University.

### **8.2 Improvement Construction Costs**

The estimated costs of the proposed improvements separated by each Build alternative were determined for this study. The estimated cost for the short-term alternative is based on FDOT 12-month moving statewide average unit prices for the period between June 1, 2020 and May 31, 2021. A signal retiming cost of \$8,000 was also added to the short-term alternative cost. The estimated costs for the long-term alternatives are based on FDOT Long Range Estimating (LRE) System. Please note that ROW costs are not estimated for the long-term alternatives.

**Table 16** summarizes the B/C analysis for the study alternatives. The analysis yields a high B/C ratio of 44.7 for the short-term alternative because of the low-cost improvements. The analysis yields B/C ratios of 12.1, 17.3, and 16.8 for the long-term alternatives. The calculated B/C ratio for each of the build alternatives (short- and long-term) indicates that the anticipated benefits

outweigh the estimated costs for the proposed modification, with benefits derived through reduced costs associated with lower delay. Other benefits such as reduced fuel consumption and improved safety were not considered in the analysis. The operational annual user benefits calculations and improvement costs are provided in **Appendix K**. As illustrated in **Table 16**, Future Alternative 2 provides the best B/C ratio.

**Table 16: B/C Analysis Summary**

Network Alternative	Estimated Cost	B/C Ratio
<b>Short-term Alternative</b>	\$24,000	<b>44.7</b>
<b>Long-term Alternatives</b>		
<b>Future Alternative 1</b>	\$3,741,739	<b>12.1</b>
<b>Future Alternative 2</b>	\$2,888,699	<b>17.3</b>
<b>Future Alternative 3</b>	\$2,863,435	<b>16.8</b>

*Notes:*

- 1) The service life was kept at 10 years for the short-term alternative and 20 years for the long-term alternatives*
- 2) Traffic operational annual user benefits (derived using total delay savings) are calculated for 20 years with 300 days in a year and with 3 hours each of AM and PM peak periods in a day*
- 3) The value of delay time per hour is based on "The mobility data for Orlando" published by Texas A&M University*
- 4) Estimated construction cost does not include right-of-way estimate*



## **9 HSM PREDICTIVE SAFETY ANALYSIS**

Since SPICE and Crash modification factors (CMFs) from the CMF Clearinghouse are not available for a QRI or the hybrid QRI options (Future Alternatives) that are discussed in this study, predictive safety analysis is used to forecast changes in safety outcomes between the No-Build and Future alternatives for the long-term conditions. In addition, crash reduction percentages from the CMF Clearinghouse, FHWA, Handbook of Road Safety Measures, and FDOT are also discussed for individual safety improvements not accounted for in the basic predictive analysis.

A Highway Safety Manual (HSM) Safety analysis was conducted using the HSM worksheet for Urban and Suburban Arterials for the No-Build and Future Alternatives 1, 2, and 3 using predictive crash methods to quantify and compare the potential future crashes under these scenarios. The predictive method can account for several intersection and roadway segment improvements, like turn lane additions at intersections, incorporation of raised medians, right turn on red restrictions, left turn phasing at signals, signalization, intersection, and corridor lighting. The associated calculations and supporting documentation are presented in **Appendix L**.

The No-Build alternative is expected to have around 373 crashes over a 20-year period. Based on predictive safety analysis, the long-term build alternatives are anticipated to reduce the crashes compared to the No-Build alternative.

- Future Alternative 1 is expected to have around 278 total crashes and therefore reduce the total number of crashes within the study area by approximately 95 crashes over a 20-year period.
- Future Alternative 2 is expected to have around 284 total crashes and therefore reduce the total number of crashes within the study area by approximately 89 crashes over a 20-year period.
- Future Alternative 3 is expected to have around 345 total crashes and therefore reduce the total number of crashes within the study area by approximately 28 crashes over a 20-year period.
- Future Alternatives 1 and 2 have a similar crash reduction compared to the No-Build alternative. Future Alternative 3 is anticipated to lower the number of crashes compared to the No-Build alternative; however, this reduction is much less than the crash reduction anticipated for Future Alternatives 1 or 2.

## **9.1 Safety Benefits of Other Countermeasures**

The following list provides a summary of the possible crash reduction percentages and qualitative discussion for individual safety improvements that can be applied in the Build alternatives (some of which are not accounted for in the basic predictive analysis).

- Permissive to protected left turns are anticipated to result in:
  - 6% reduction in all crash types (source: CMFclearinghouse.org).
- Although a specific crash reduction factor is not available for a QRI, it has six fewer conflict points than a traditional intersection.
- All the Future Build alternatives will help improve signal coordination because the movements are simpler compared to the No-Build alternative. As such several studies have shown both safety and operational benefits of improved signal coordination.
- Enhanced roadway/intersection lighting:
  - Installation of lighting at intersections has been linked to a 38% reduction in dark condition crashes and a 42-59% reduction in vehicle/pedestrian crashes under dark conditions (source: Handbook of Road Safety Measures).
- High friction surface treatments:
  - Increased Pavement Friction is one of twenty of FHWA's proven safety countermeasures. The application of this treatment has been linked to a 52% reduction in wet road crashes and a 24% reduction in curve-related crashes.
- Tightened intersection corners (where feasible) will reduce vehicle turning speeds and therefore improve pedestrian and bicycle safety.
- In the information guide for signalized intersections published by FHWA, the addition of turn (left or right) lanes is identified as one of the treatments for vehicle movements at intersections to address an overrepresentation of rear-end collisions under congested conditions and excessive queuing and/or delay for one (or more) approach movements. Extension of turn lanes is also widely used for the same purposes. Based on the crash

reduction factors published by FDOT, the extension and addition of turn lanes have the following safety benefits:

- Exclusive right turn lane: 11% reduction (all crash types)
- Additional left turn lane: 4% reduction (all crash types)
- Extend storage: 11% reduction (all crash types)

## **10 STUDY CONCLUSIONS**

The objective of the study is to develop alternative intersection designs and identify other improvements to alleviate current and anticipated operational and safety issues at the study intersections of Orange Avenue at Gatlin Avenue and Orange Avenue at Holden Avenue. Under the existing conditions, the congestion and associated delay are due to the existing offset intersection configuration, heavy turning traffic from/to Orange Avenue to side streets (Holden Avenue and Gatlin Avenue) and limited existing turn lane storage lengths along Orange Avenue and side streets. The queue for the northbound left turn movement at Orange Avenue and Holden Avenue exceeds the available storage length and spills into the northbound through lane south of Gatlin Avenue. Excessive queues are also observed along Holden Avenue (for the eastbound approach) and Gatlin Avenue (for the westbound approach). The other movements are observed to operate with minimum impact during both AM and PM peak hours.

Based on the input received from Orange County and the City of Edgewood, and an evaluation of the study needs and objectives, traffic data, and anticipated traffic operational efficiency and safety improvements, this study evaluated one short- and three long-term alternatives.

### **10.1 Short-term Alternative**

- A short-term alternative is evaluated that can be built in the field before construction funding can be secured for the long-term alternative. The short-term alternative was evaluated for the year 2025 and is based on the improvements suggested by the County and signal timings provided by FDOT.
  - Modify the existing exclusive eastbound left turn only lane to a shared through-left turn lane and the existing shared through-right turn lane to a right turn only lane.
  - Introduce an overlap between the eastbound right turn and northbound left turn movements.
  - Modify signal timings to provide an extra phase within a cycle for the northbound left turning movement at Orange Avenue and Holden Avenue

- A year of failure analysis was conducted for short-term improvements to determine the period for which these improvements will provide the target LOS "D" at all the study intersections. **Based on this analysis, the short-term improvements are anticipated to provide an overall LOS "D" (not individual movements) at the study intersections till the year 2035.**
- The B/C analysis yielded a high ratio of 44.7 for this alternative because of the low-cost improvements. The calculated B/C ratio indicates that the anticipated benefits outweigh the estimated costs for the proposed modification, with benefits derived through reduced costs associated with lower delay.

## 10.2 Long-term Alternatives

Three long-term alternatives are evaluated for this study for the year 2040 traffic conditions as described below:

- **Holden Avenue Realignment Alternative with 1 Rail Crossing (Future Alternative 1):**  
This alternative was developed based on the input from the County and City, and the assumption that the existing rail crossing along Holden Avenue will be closed to support the opening of a new rail crossing along realigned Holden Avenue. As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection. The realignment is anticipated to help mitigate the existing and anticipated congestion and associated delay at the offset intersections.
- **Holden Avenue Realignment Alternative with 2 Rail Crossings (Future Alternative 2):**  
This alternative was developed based on the input from the County and City, and the assumption that the existing rail crossing along Holden Avenue will stay open along with the new rail crossing along realigned Holden Avenue. An existing rail crossing at a different location (e.g., along Fairlane Avenue) must be closed to support the opening of the new rail crossing along realigned Holden Avenue. As part of this alternative, Holden Avenue will be realigned to form a plus intersection at the existing Orange Avenue and Gatlin Avenue intersection like the Future Alternative 1. However, the traffic will be circulated

using both the existing Holden Avenue and Holden Avenue Realignment to minimize ROW impacts and provide improved operational LOS.

- **Quadrant Intersection Alternative using Lake Gatlin Road (Future Alternative 3):** This alternative proposes to use Lake Gatlin Road for the movements between Orange Avenue and Gatlin Avenue. The main idea is to eliminate the existing southbound left turn lane at Orange- Avenue and Gatlin Avenue intersection and instead use Lake Gatlin Road for this movement. This will help provide two northbound left turn lanes and improve signal efficiency at the intersection of Orange Avenue. Besides, a portion of the westbound left and northbound right turn movements that currently use the intersection at Orange Avenue and Gatlin Avenue will use Orange Avenue and Lake Gatlin Road intersection.

The following **Table 17** provides the summary for these three long-term alternatives. As shown in **Table 17**, Future Alternative 2 has the best operational efficiency (based on 2040 analysis results) and B/C ratio compared to the other alternatives.

In addition to providing operational benefits, all the three long-term alternatives are anticipated to provide safety benefits (see Section 9) with a reduced number of crashes compared to the No-Build alternative. However, Future Alternatives 1 and 2 have a similar crash reduction compared to the No-Build alternative. Future Alternative 3 is anticipated to lower the number of crashes compared to the No-Build alternative; however, this reduction is much less than the crash reduction anticipated for Future Alternatives 1 or 2. Future Alternatives 1, 2, and 3 are expected to have approximately 25%, 24%, and 8% less crashes, respectively compared to the No-Build alternative.

**Table 17: Long-term Alternatives Summary**

Network Alternative	Year 2040 Performance Index (PI) [AM/PM /Average]	B/C Ratio	Safety Benefit (20-year Period) compared to No-Build Alternative	Potential Roadway Impacts
Holden Avenue Realignment with 1 Rail Crossing (Future Alt-1)	93/99/96	12.1	Expected to have around 25% less crashes	<ul style="list-style-type: none"> <li>• Anticipated on Orange Avenue (between Holden Avenue and Lake Gatlin Road) and the side streets and through Cypress Grove Park (located south of Holden Avenue and west of Orange Avenue)</li> <li>• Will impact around 10 parcels including Cypress Grove Park</li> <li>• Will need a four-lane typical section on Holden Avenue Realignment</li> <li>• A new railroad crossing must be provided, but the existing one can be closed</li> <li>• Will add 1 new signal</li> </ul>
Holden Avenue Realignment with 2 Rail Crossings (Future Alt-2)	93/86/90	17.3	Expected to have around 24% less crashes	<ul style="list-style-type: none"> <li>• Not anticipated on Orange Avenue, but anticipated on the side streets and through Cypress Grove Park (located south of Holden Avenue and west of Orange Avenue)</li> <li>• Will impact around 7 parcels including Cypress Grove Park</li> <li>• A new railroad crossing must be provided, but the existing one cannot be closed</li> <li>• To meet FDOT guidelines for railroad crossings, an existing railroad crossing at a different location must be closed</li> <li>• Will add 1 new signal</li> </ul>
Quadrant Intersection using Lake Gatlin Road (Future Alt-3)	95/93/94	16.8	Expected to have around 8% less crashes	<ul style="list-style-type: none"> <li>• Anticipated on Orange Avenue (south of Lake Gatlin Road), side streets, and the southeast quadrant of Orange Avenue and Gatlin Avenue intersection (for the extension of Lake Gatlin Road to Gatlin Avenue)</li> <li>• Will impact around 14 parcels</li> <li>• Will not need closing or opening of railroad crossings</li> <li>• Will need roadway widening on Holden Avenue through the railroad crossing to accommodate the receiving lanes for the recommended dual NB lefts at Orange Avenue and Holden Avenue intersection (WB) and turn lane improvements (EB)</li> <li>• Will add 2 new signals</li> </ul>

Note: 1) Estimated construction cost does not include right-of-way estimate

## **11 STAKEHOLDER COORDINATION**

As part of the stakeholder coordination effort, a community meeting was held on Tuesday, March 1, 2022, for this study. The intent of this community meeting was to receive public feedback on the proposed alternatives that were evaluated in this study. The community meeting summary along with the presentation slides used in this meeting are provided in **Appendix M**.