



# SR 406 CONCEPT DEVELOPMENT AND EVALUATION

Florida Department of Transportation  
District 5  
FM#: 436187-1-12-01



Future Conditions Report  
March 2018



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# 1

## Introduction

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### 1.1 Purpose of Technical Memorandum

The purpose of this Future Conditions Summary is to develop the projected future traffic demand on SR 406 (Garden Street), and identify potential capacity deficiencies and additional needs for the corridor through 2040. This technical memorandum will include the methodology and forecast of future travel demands for SR 406 (Garden Street) from the North Area Adult Education Center (NAAEC) to Indian River Avenue in Titusville, Florida. The latest available development and growth projections have been compiled to create an accurate depiction of the future traffic demand. These future traffic projections are used by this study to influence, improve and validate potential improvement strategies identified through the rigorous study and public engagement during the Corridor Planning Study. These traffic projections have been used to analyze the no-build and build alternatives described in this report.

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### 1.2 Project Background and Purpose

In January 2015, the Florida Department of Transportation began a Corridor Planning Study for SR 406 (Garden Street) from the North Area Adult Education Center (NAAEC) to US 1 NB (Washington Avenue) in Titusville, Florida. A Corridor Planning Study is an evaluation of safety, environmental and geometric concerns along a transportation corridor where needs, possible improvement options and planning level cost estimates are identified. The purpose of the study was to develop a multimodal vision, rather than a model-driven vision, to determine how best to meet the needs of the current and future end users of the corridor. Multimodal corridor projects are essential to network efficiency, safety, and livability within the context of future transportation needs.

This project was requested by the City of Titusville to coordinate the development of a future vision for the SR 406 (Garden Street) corridor that will establish a multimodal approach to addressing future transportation needs. The Corridor Planning Study involved a community-based evaluation to determine how best to meet the needs of current and future users. It then established a long-term plan to guide the evolution of the corridor that appropriately balances land use and transportation planning initiatives. This project was coordinated with local and regional agency partners, such as the Space Coast Transportation Planning Organization (SCTPO), Brevard County, the City of Titusville, Space Coast Area Transit (SCAT), Titusville Community Redevelopment Area (CRA) and Florida East Coast (FEC) Railway to develop a context-sensitive approach. As part of the analysis, previous studies, improvement plans, as well as an inventory of existing traffic, pedestrian and bicycle, and transit conditions and facilities were evaluated. This process combined planning and engineering

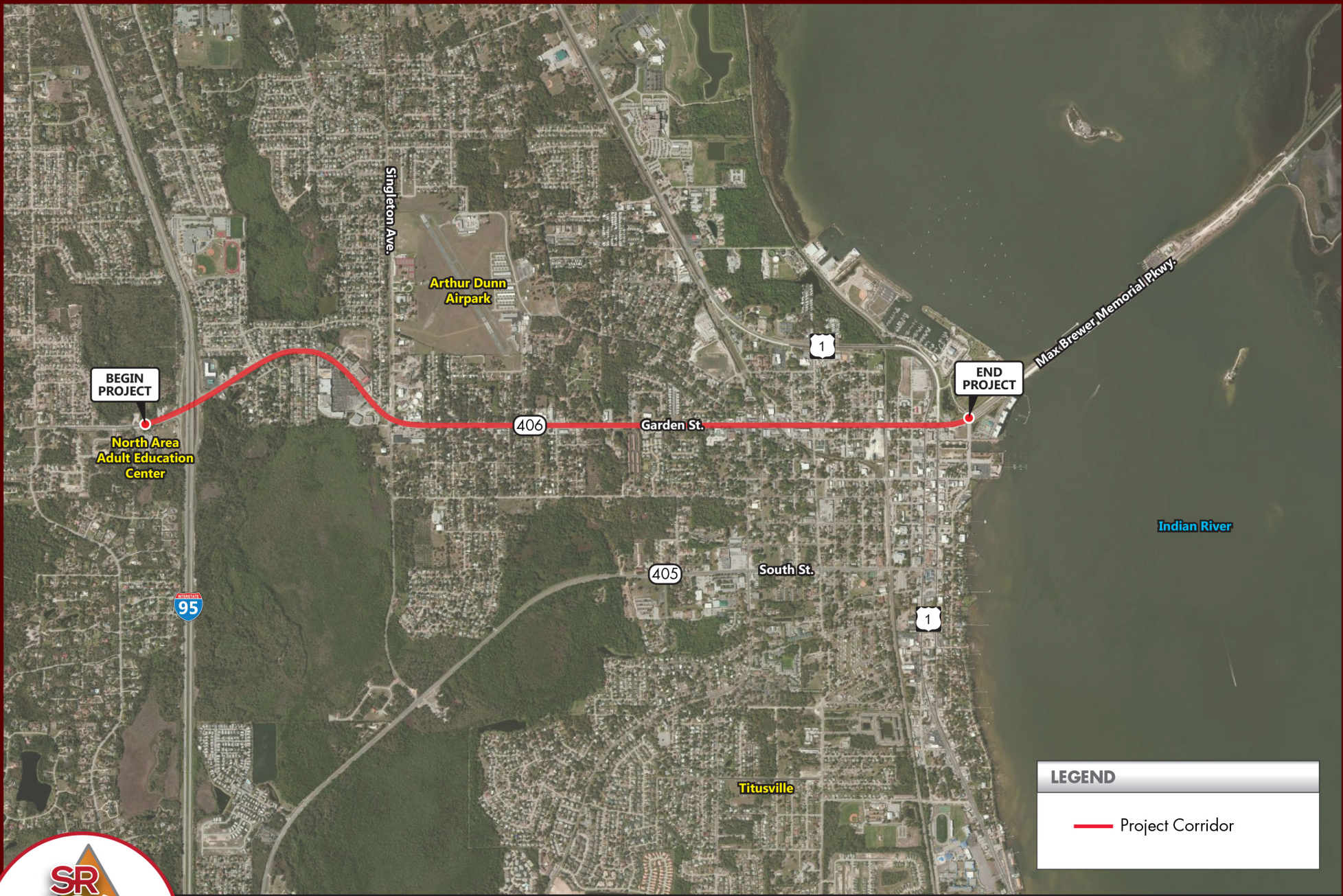




efforts to develop a range of potential improvement strategies. The Corridor Planning Study concluded in September 2016.

In July 2017, the project process continued with the start of the Concept Development and Evaluation Study. This study builds upon what was started in the Corridor Planning Study by further evaluating the alternatives identified, creating concept plans, and identifying and evaluating impacts. The eastern study limit was extended to Indian River Avenue, Figure 1 illustrates the current study area. This study will continue the public and stakeholder involvement effort that was previously established by continuing to engage the Project Visioning Team throughout the process as well as holding a public meeting to receive local input.





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**FIGURE 1**  
 Study Area Location Map



# 2

## Existing Conditions

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### 2.1 Roadway and Intersection Characteristics

The SR 406 (Garden Street) study area consists of an approximately 3-mile long segment spanning from the NAAEC, just west of I-95 to Indian River Avenue within the City of Titusville in Brevard County, Florida. The study area corridor can be characterized as an urbanized, 4-lane divided section with primarily residential and commercial development throughout the study area. Based on the FDOT Context Classification Guidance, this corridor is classified as a C-4 Urban General.

SR 406 (Garden Street) from the NAAEC to US 1 NB (Washington Avenue) is classified as an “urban principal arterial other” and owned and maintained by the Florida Department of Transportation. It’s roadway ID is 70002000. The study area extends the entire length of the state maintained length from mile post (MP) 0 to MP 2.949. The roadway ID for the section of SR 406 (Garden Street) from US 1 NB (Washington Avenue) to Indian River Avenue is 70160001. This section of roadway is within MP 0 to 0.332 and is owned by FDOT but considered “active off the State Highway System (SHS)”.

The posted speed limit on SR 406 (Garden Street) from the NAAEC to east of Maiden Lane is 40 mph, and it transitions to 30 mph for the remainder of the corridor to US 1 NB (Washington Avenue). The posted speed from US 1 NB (Washington Avenue) to Indian River Avenue is 30 mph.

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### 2.2 Existing Operational Analysis

Existing 2017 operational analysis was conducted to determine the Level of Service (LOS) for the roadway segments and the study area intersections. Peak hour peak direction volumes along the different segments were compared against the latest Generalized Peak Hour Directional Service Volumes Tables from the 2012 FDOT Quality/Level of Service Handbook to obtain the arterial LOS. The LOS for the study area intersections were determined using the procedures as outlined in the Transportation Research Board’s (TRB) – Highway Capacity Manual (HCM 2010) using Synchro Software (version 9.0).



### 2.2.1 Roadway Operational Analysis

According to FDOT, SR 406 (Garden Street) in the study area is classified as an “urban principal arterial other” and has an adopted LOS “D”. The generalized peak hour directional service volumes for the LOS letters “A” through “F” were obtained from the 2012 FDOT Quality/Level of Service Handbook and compared with volumes collected from the 24-hour bi-directional tube counts after seasonal and axle adjustments were applied to create average annual daily traffic for SR 406 (Garden Street) in the study area. A summary of the LOS analysis for the study roadways is included in Table 1.

**Table 1: Existing Roadway Level of Service**

Roadway/Segment	Daily		AM Peak			PM Peak		
	AADT	LOS	Volume	Peak Direction	LOS	Volume	Peak Direction	LOS
<b>SR 406 (Garden Street)</b>								
North Area Adult Education Center to I-95	7,300	D	390	EB	C	390	WB	C
I-95 to Singleton Avenue	16,000	C	680	EB	C	690	WB	C
Singleton Avenue to Park Avenue	16,000	C	660	EB	C	760	WB	C
Park Avenue to Palm Avenue	14,000	C	610	EB	C	750	EB	C
Palm Avenue to US 1 SB (Hopkins Avenue)	10,000	C	390	EB	C	470	WB	C
US 1 Southbound to US 1 NB (Washington Avenue)	9,900	C	440	EB	C	600	WB	C
US 1 NB (Washington Avenue) to Indian River Avenue	7,000	C	600	EB	C	680	EB	C

2012 FDOT Quality/Level of Service Handbook Tables  
AM and PM Peak Volumes and LOS are based off of Peak Direction  
AADT = Data Collected \* Seasonal Factor (1.06) \* Axle Factor (0.99)

As shown in Table 1, the SR 406 (Garden Street) corridor currently operates within acceptable LOS standards.

### 2.2.2 Intersection Operational Analysis

According to the HCM 2010, for signalized intersections, an average control delay per vehicle from 55 seconds up to 80 seconds is considered to be a LOS E condition. Beyond 80 seconds is considered to be a LOS F condition. A summary of the LOS analysis for the study intersections is included in Table 2.





**Table 2: 2017 Intersection Level of Service**

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
SR 406 (Garden Street)/I-95 SB Ramps	Signalized	11.0	B	8.8	A
SR 406 (Garden Street)/I-95 NB Ramps	Signalized	12.3	B	13.0	B
SR 406 (Garden Street)/Singleton Avenue	Signalized	27.4	C	33.4	C
SR 406 (Garden Street)/Park Avenue	Signalized	16.9	B	16.4	B
SR 406 (Garden Street)/Palm Avenue	Signalized	3.4	A	4.6	A
SR 406 (Garden Street)/US 1 SB (Hopkins Avenue)	Signalized	13.0	B	13.0	B
SR 406 (Garden Street)/US 1 NB (Washington Avenue)	Signalized	8.8	A	9.9	A

As seen in Table 2, all study area intersection and roadway segments currently operate under acceptable level of service conditions during the AM and PM peak hours.



# 3

## Future Traffic Development

### 3.1 Future Land Use

The Future Land Uses (FLUs) assigned to the study area, Figure 2, are generally consistent with the existing land uses along, and adjacent to the corridor.

All of the land adjacent to the eastern half of the corridor is designated as Downtown Mixed-Use., with a maximum density of 20 dwelling units per acre and a maximum intensity of 5.0 Floor Area Ratio (FAR). The Downtown Mixed-Use FLU was established by the City of Titusville to “pursue the renewal of Downtown Titusville as the center of professional, governmental, financial and unique retail and redevelop blighted areas.” Towards the western terminus, the primary land use transitions to commercial designations, with maximum intensities of 1.0 FAR. Other land uses adjacent to the study area consist of Educational, Residential and Public, which includes the Arthur Dunn Airpark.

The majority of the land that is near, but not adjacent to the study area is designated as residential. Most of the land is shown as Residential-Low, which allows a maximum of 5 dwelling units per acre. Residential neighborhoods allowing 10 and 15 dwelling units per acre also exist in close proximity to the study area.

The land south of the eastern portion of the study area near the SR 406 (Garden Street)/US 1 intersection, is designated as Industrial and Urban Mixed Use. The Industrial FLU provides for a maximum intensity of 1.0 FAR, and is intended to be master planned to share infrastructure and to be clustered in limited areas for the purpose of maximizing employment centers and convenient access. The Urban Mixed-Use FLU allows a maximum density of 15 dwelling units per acre and a maximum intensity of 1.0 FAR.

### 3.2 Planned Improvements

There are several planned improvements for the study area.

- The Space Coast Transportation Planning Organization (SCTPO) 2040 Long Range Transportation Plan (LRTP) identifies a sharrow and ‘Bike May Use Full Lane’ (BMUFL) signage from Park Avenue to US 1 SB (Hopkins Avenue) along SR 406 (Garden Street).



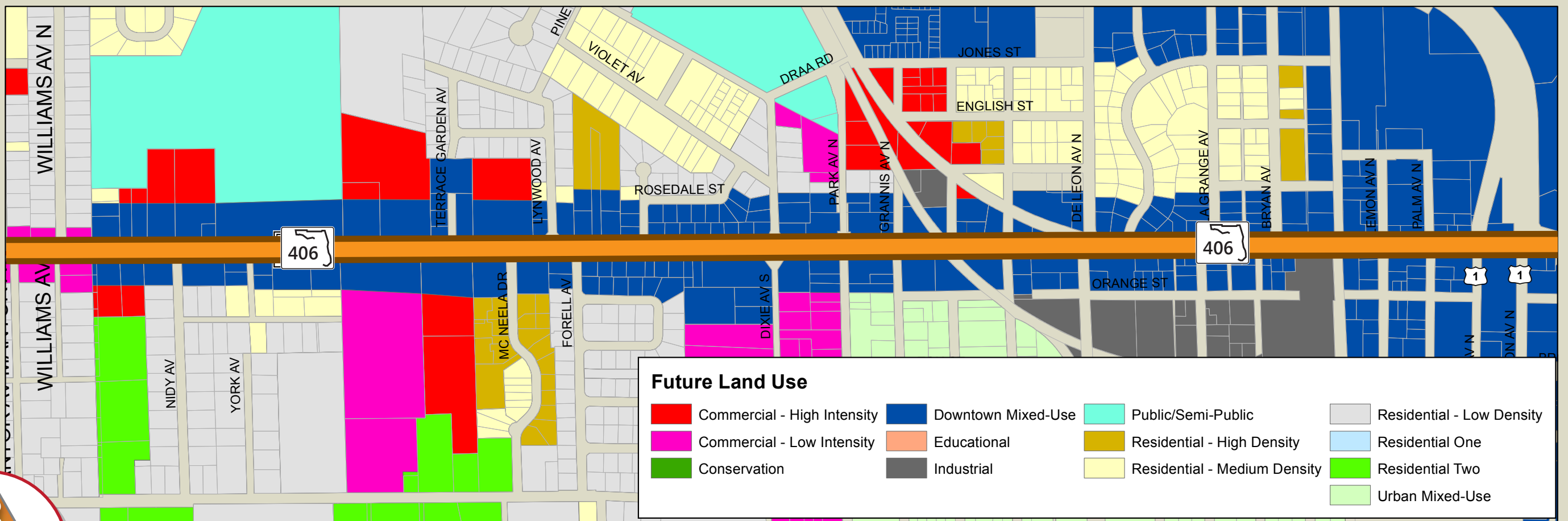
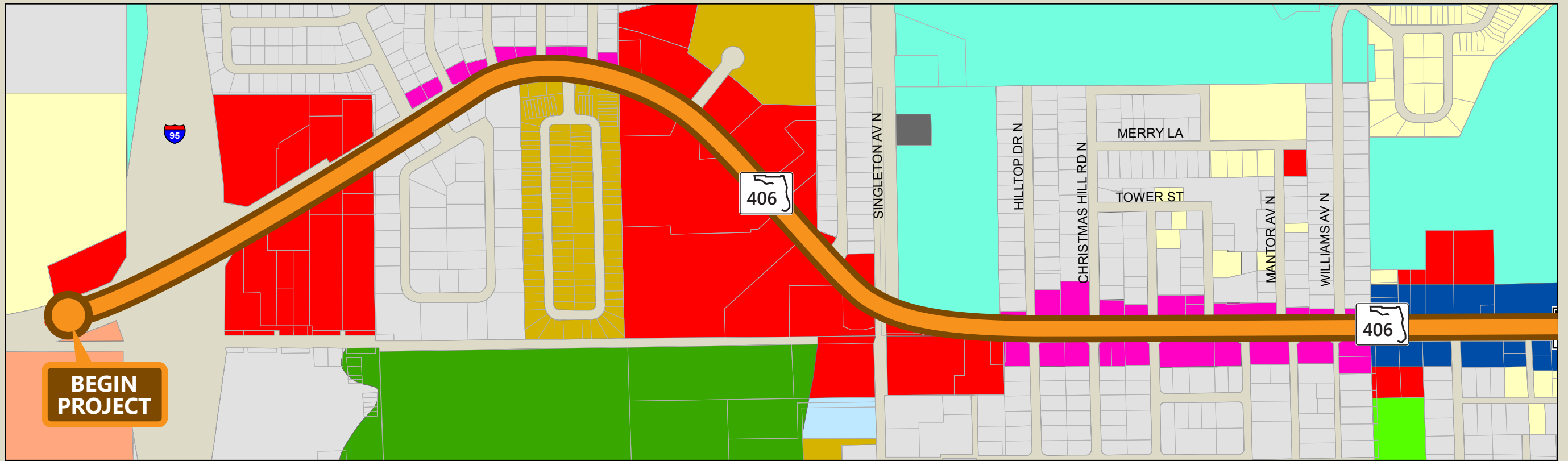


- An off road shared use path along US 1 was identified between Dairy Road and SR 406 (Garden Street).
- A resurfacing is funded for construction in FY 2019 for SR 406 (Garden Street) from East of Petty Circle to US 1 NB (Washington Avenue).
- The SCTPO identifies a project to install a Designated Bike Lane on SR 406 (Garden Street) from 600' west of Park Avenue to US 1 NB (Washington Avenue). Funding is currently not available for this improvement.

No other planned roadway improvement projects were identified within the study area, therefore, the existing intersection and lane geometry identified were utilized for the 2040 future conditions analysis.

A safety study was performed at the intersection of SR 406 (Garden Street) and US 1 one-way pair intersections in February 2017 to evaluate the operations and safety of the intersections. Due to the high angle crash history, many short- and mid-term improvements were recommended to help reduce crashes along the corridor. Combining both intersections into one with an elongated roundabout was identified as a long-term improvement. This was considered long-term due to the significant right of way required for this enhancement.





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**FIGURE 2**  
 Future Land Use Map

### 3.3 Model Validation

The CFRPM 6.1 year 2016 subarea model validation was performed to most accurately reflect 2016 traffic conditions inside the study area. This validation helped to create a better forecast of future traffic. The model refinement was performed by fine-tuning the network using the guidelines identified in “FSUTMS-Cube Framework Phase II Model Calibration and Validation Standards – Final Report, October 2, 2008”. Validation methods used include volume-over-count ratio and percent error by facility type and by volume group for the study area.

Table 3 shows the percent deviation error by facility type. The percent deviation is defined as (year 2016 model assignment in AADT – year 2016 ground count in AADT) / (year 2016 ground count in AADT).

**Table 3: Volume-Over-Count Ratio and Percent Error by Facility Type**

	FDOT Standards			
	Acceptable	Preferable	Before	After
Freeway (FT1X,FT8X,FT9X)	+/- 7%	+/- 6%	-37.79%	9.81%
Divided Arterial (FT2X)	+/- 15%	+/- 10%	-27.58%	-10.06%
Undivided Arterial (FT3X)	+/- 15%	+/- 10%	-44.80%	3.93%
Collector (FT 4X)	+/- 25%	+/- 20%	-40.54%	-4.04%
OneWay (FT 6X)	+/- 25%	+/- 20%	-20.67%	-5.75%
Ramp (FT 7X)			30.58%	11.54%

\*text in red indicates out of acceptable range

In addition, the percent deviation error by volume group performed for the study area is shown in Table 4. The results of this validation method show the model is in preferable range of standards.

**Table 4: Volume-Over-Count Ratio and Percent Error by Volume Group**

Statistic	FDOT Standards			
	Acceptable	Preferable	Before	After
LT 10,000 Volume	50%	25%	-21.71%	-1.46%
10,000-30,000	30%	20%	-27.62%	-8.34%
30,000-50,000	25%	15%	37.79%	9.81%
50,000-65,000	20%	10%	N/A	N/A
65,000-75,000	15%	10%	N/A	N/A
GT 75,000	10%	5%	N/A	N/A

\*text in red indicates out of acceptable range

The percent Root Mean Square Error (RMSE) for the study area is another aggregate measure to validate the model against the ground counts gathered within the study area. The RMSE for the study area comprising of 25 roadway links is 3.32% and usually can be ± 35% to 45%. This validates that the adjusted network accurately represents the ground counts within the study area. Table 5 provides an overview of the RMSE output within the study area.





**Table 5: RSME Model Validation**

Volume Group	% RMSE	Acceptable % RMSE	Preferable % RMSE
1-5,000:	8.82%	100%	45%
5,000-10,000:	3.03%	45%	35%
10,000-15,000:	5.07%	35%	27%
15,000- 20,000:	N/A	30%	25%
20,000- 30,000:	12.29%	27%	15%
30,000- 50,000:	9.09%	25%	15%
50,000- 60,000:	N/A	20%	10%
60,000+:	N/A	19%	10%
<b>Areawide</b>	<b>3.32%</b>	<b>45%</b>	<b>35%</b>

Based on the validation efforts performed, the model is considered acceptable for use in estimating future travel demand within the study area. The validation adjustments were carried over to the year 2040 model to achieve optimal results.

Recent coordination with the Project Visioning Team and City of Titusville staff revealed several planned developments within the study area that were not included in the original adopted 2040 model. The developments were included in the updated year 2040 model to account for additional traffic that will be generated within the study area. The following lists those planned developments:

- Housing development with 170 single family homes northwest of I-95 at SR 406 interchange. These were added to TAZ 2925.
- Gas station on the northwest quadrant of US 1 Southbound at SR 406 intersection, added to TAZ 2934.
- A 120,000 SF shopping center was assumed for the area northwest of US 1 Southbound at SR 406 intersection. Although this development information is not certain, a higher traffic demanding land use was assumed for this location to make a conservative analysis of future traffic. This land use was added to TAZ 2934.

### 3.4 Growth Projections and Assumptions

In order to determine an acceptable growth rate for the SR 406 (Garden Street) study area, growth projections from various available sources were considered. This included the latest year Central Florida Regional Planning Model, Version 6.1 (CFRPM 6.1) released in 2016, FDOT historical Annual Average Daily Traffic (AADT) growth trends, and Brevard County population projections from the Bureau of Economic and Business Research (BEBR) Volume 51, Bulletin 180 (January 2018). The



trends analysis sheet and model output files are provided in Appendix C. Table 6 below presents the comparison of resulting growth rates.

**Table 6: Growth Rate Comparison**

<b>Growth Method</b>	<b>Growth Rate</b>
<b>Historic Trends Analysis</b>	-1.34%
<b>Model Growth Analysis</b>	0.81%
<b>BEBR Growth Analysis</b>	
Brevard County Medium	0.90%
Brevard County High	1.69%
<b>Growth Rate Used</b>	<b>0.85%</b>

The historic growth trends were not applied due to the r-squared values being less than 75% and being a negative value as illustrated in Table 6. The model growth analysis identified an annual growth rate of 0.81%. Accounting for future development, planned roadway improvements, as well as historic growth rates, the model is considered to be the most detailed predictor of future traffic growth. Specifically, the model applied for this analysis included aggressive development estimates. For a conservative analysis of growth, this rate was averaged with BEBR’s Brevard County medium projected growth rate of 0.90% annually. The average of BEBR medium growth and CFRPM model is 0.85%, which is the rate used for analysis of future traffic growth along the corridor.



# 4

## No-Build Scenario

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### 4.1 2040 No-Build Operational Analysis

Future 2040 operational analysis was conducted to determine the LOS for the roadway segments and the study area intersections in a no-build scenario. Future Traffic volumes were project by using preferred growth rate and growing existing traffic to the future year. The future level of service was determined by using the 2012 FDOT Quality/Level of Service tables, similar to the existing conditions analysis.

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#### 4.1.1 2040 No-Build Projected Roadway Operations

According to FDOT, the study corridor is classified as an “urban principal arterial other” and has an adopted LOS “D”. The generalized peak hour directional service volumes for the LOS letters “A” through “F” were obtained from Table 7 of the 2012 FDOT Quality/Level of Service Handbook and compared with projected 2040 volumes calculated using the 2017 existing volumes with the previously-identified 0.85% annual growth factor applied. The 2040 projected roadway operations are provided in Table 7 and Figure 3 for daily, AM peak hour, and PM peak hour.

**Table 7: 2040 Projected Roadway Level of Service: No-Build**

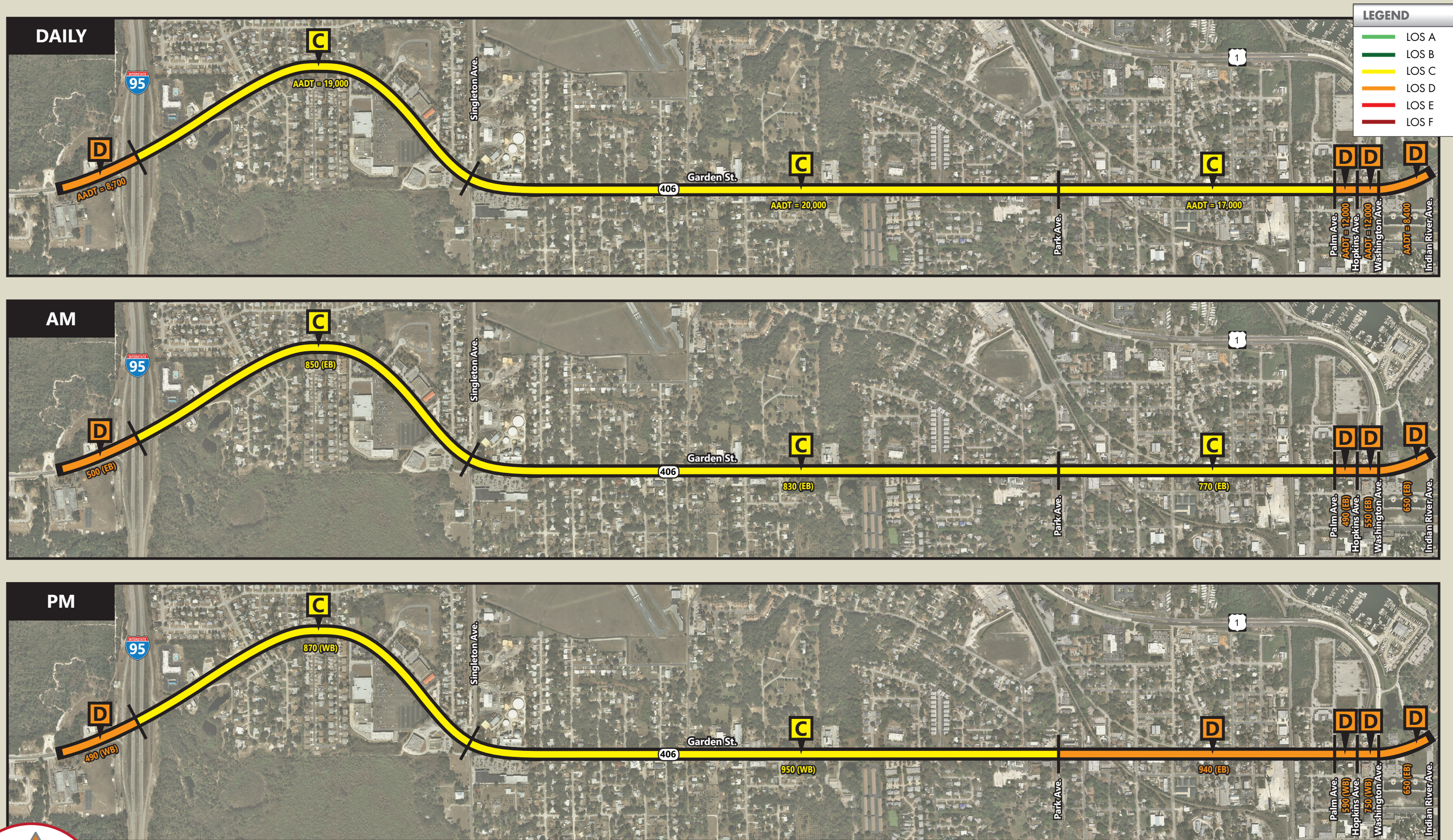
Roadway/Segment	Daily		AM Peak		PM Peak			
	AADT	LOS	Volume	Peak Direction.	LOS	Volume	Peak Direction	LOS
<b>SR 406 (Garden Street)</b>								
North Area Adult Education Center to I-95	8,700	D	500	EB	D	490	WB	D
I-95 to Singleton Avenue	19,000	C	850	EB	C	870	WB	C
Singleton Avenue to Park Avenue	20,000	C	830	EB	C	950	WB	C
Park Avenue to Palm Avenue	17,000	C	770	EB	C	940	EB	D
Palm Avenue to US 1 SB (Hopkins Avenue)	12,000	D	490	EB	D	590	WB	D
US 1 Southbound to US 1 NB (Washington Avenue)	12,000	D	550	EB	D	750	WB	D
US 1 NB (Washington Avenue) to Indian River Avenue	8,400	D	650	EB	D	650	EB	D

*2012 FDOT Quality/Level of Service Handbook Tables  
AADT = Data Collected \* Seasonal Factor (1.06) \* Axle Factor (0.98) (if need)*

As shown in Table 7, the SR 406 corridor currently operates within acceptable LOS standards.







**LEGEND**

- LOS A
- LOS B
- LOS C
- LOS D
- LOS E
- LOS F



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**FIGURE 3**  
 2040 Projected Roadway Volumes and Operations





### 4.1.2 2040 No-Build Projected Intersection Operations

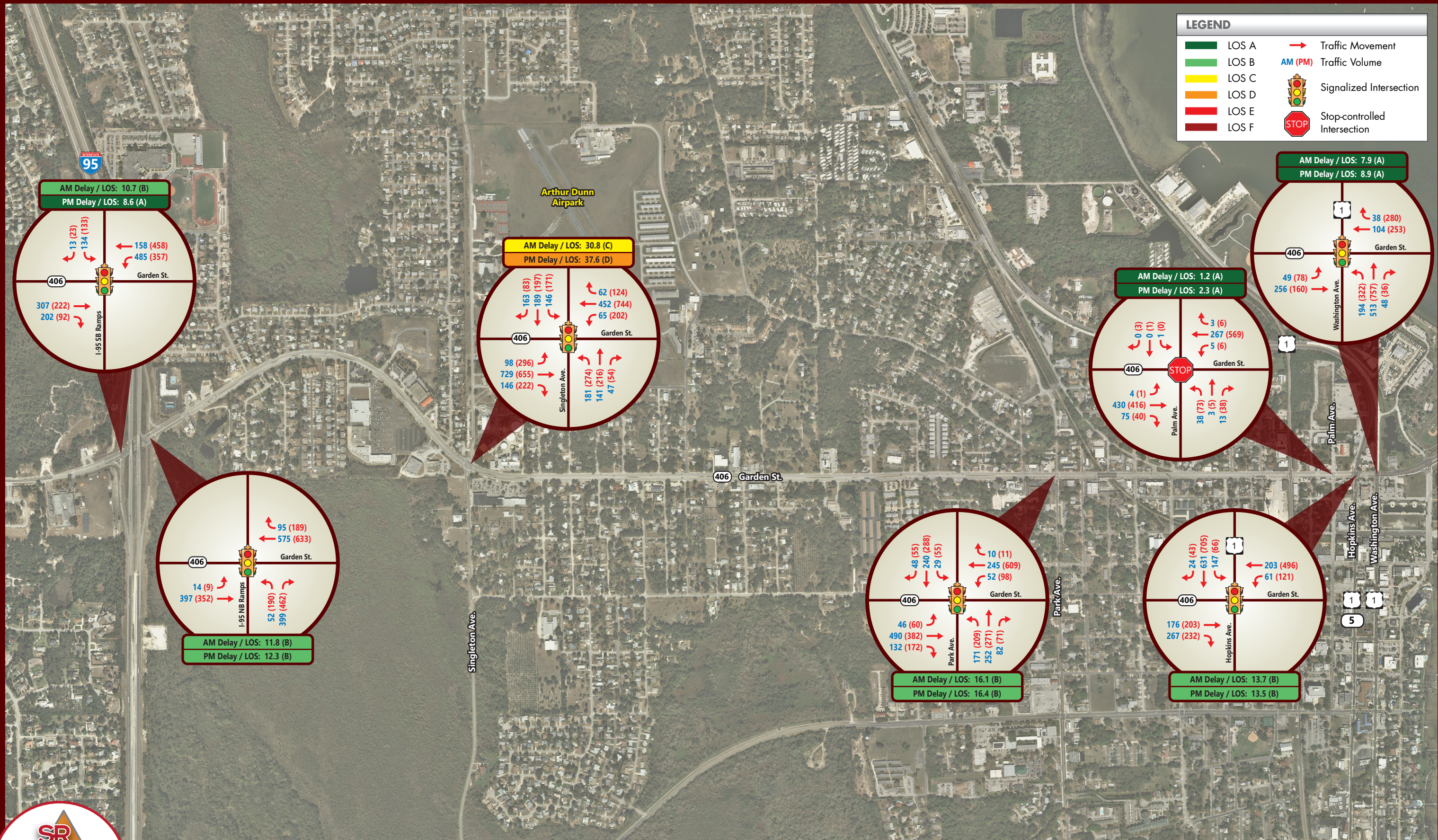
According to the HCM 2010, for signalized intersections, and average control delay per vehicle from 55 seconds up to 80 seconds is considered to be a LOS E condition. Beyond 80 seconds is considered to be a LOS F condition. A summary of the 2040 projected intersection operations for all study area intersections is provided in Table 8 for the AM and PM peak hours. The signal timings were optimized under the assumption that signal timings will be regularly maintained through 2040. Future volume analysis sheets are located in Appendix A.

**Table 8: 2040 Projected Intersection Level of Service: No-Build**

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
SR 406 (Garden Street)/I-95 SB Ramps	Signalized	10.7	B	8.6	A
SR 406 (Garden Street)/I-95 NB Ramps	Signalized	11.8	B	12.3	B
SR 406 (Garden Street)/Singleton Avenue	Signalized	30.8	C	37.6	D
SR 406 (Garden Street)/Park Avenue	Signalized	16.1	B	16.4	B
SR 406 (Garden Street)/Palm Avenue	Un-Signalized	1.2	A	2.3	A
SR 406 (Garden Street)/US 1 SB (Hopkins Avenue)	Signalized	13.7	B	13.5	B
SR 406 (Garden Street)/US 1 NB (Washington Avenue)	Signalized	7.9	A	8.9	A

As presented in Table 8 above, all of the study area intersections are anticipated to operate at acceptable LOS in 2040. The 2040 study area intersection operations are presented in Figure 4 for the AM and PM peak hours. Synchro reports are located in Appendix B.





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**FIGURE 4**  
 2040 Projected No Build Intersection Volumes and Operations





# 5

## 2040 Build Conditions Analysis

Beyond the no-build scenario, the project is considering two build conditions alternatives. Both scenarios propose keeping SR 406 (Garden Street) as four lanes west of Singleton Avenue to I-95. A roundabout is proposed at the Singleton Avenue intersection. The two build scenarios diverge between Singleton Avenue and Dixie Avenue. Between Singleton Avenue and Dixie Avenue, the first build alternative proposes a two-lane road diet with improved pedestrian and bicycle amenities. For this same section, Build Scenario #2 proposes keeping four travel lanes, while taking some of the unnecessarily wide 20-foot travel lanes to use for bike lanes. The existing signal at Palm Avenue does not meet signal warrant criteria for existing or future traffic and is planned for removal with the currently funded resurfacing project.

Future 2040 operational analysis was conducted to determine the LOS for the roadway segments and the study area intersections in both build scenarios. The same methodology used for determining 2040 Future No-Build LOS was applied to the 2040 Future build scenarios.

The build scenarios for SR 406 (Garden Street) was developed during the Corridor Planning Study process with extensive feedback from stakeholders at Project Visioning Team meetings, public meetings and discussions with public officials.

Several potential improvement strategies were identified in the Corridor Planning Study process that are used in this future condition analysis. Because of the acceptable no-build LOS for the roadways, many of the improvement strategies are focused on safety instead of capacity. Improvements include crosswalk enhancements, pavement markings and intersection improvements, a roundabout at SR 406 (Garden Street) and Singleton Avenue, the addition of bike lanes and a road diet.

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### 5.1 2040 Build Scenario #1 Operational Analysis

For Build Scenario #1, because of higher traffic volumes and the ability to provide sufficient capacity for incident management purposes the section from I-95 to Singleton will remain in its existing 4-lane configuration.

At the Singleton Avenue intersection, a roundabout is proposed as shown in Figure 5. A roundabout at this intersection is anticipated to improve current safety conditions by reducing severe intersection crashes and promoting slower speeds as traffic enters downtown Titusville from the west. This roundabout can also serve as a gateway feature for the City of Titusville.



From Singleton Avenue to Dixie Avenue a two-lane road diet is proposed for Build Scenario #1, as shown in Figure 6. Travel lanes are proposed to be reduced to 11-feet to add seven-foot buffered bikes lanes, six-foot sidewalks as well as a 32-foot raised median and six-foot utility strips on either side.

From Dixie Avenue to Indian River Avenue a 3-lane road diet is proposed, as shown in Figure 7. This scenario provides two 11-foot travel lanes with a continuous, bi-directional left turn lane in the center. This road diet capitalizes on the available capacity that this corridor offers and repurposes it to provide buffered bike lanes and wider sidewalks. Also, the signal at Palm Avenue is planned to be removed with the currently funded resurfacing project. The intersection doesn't meet signal warrant criteria for existing or future traffic.

**Figure 5: Singleton Avenue Roundabout**

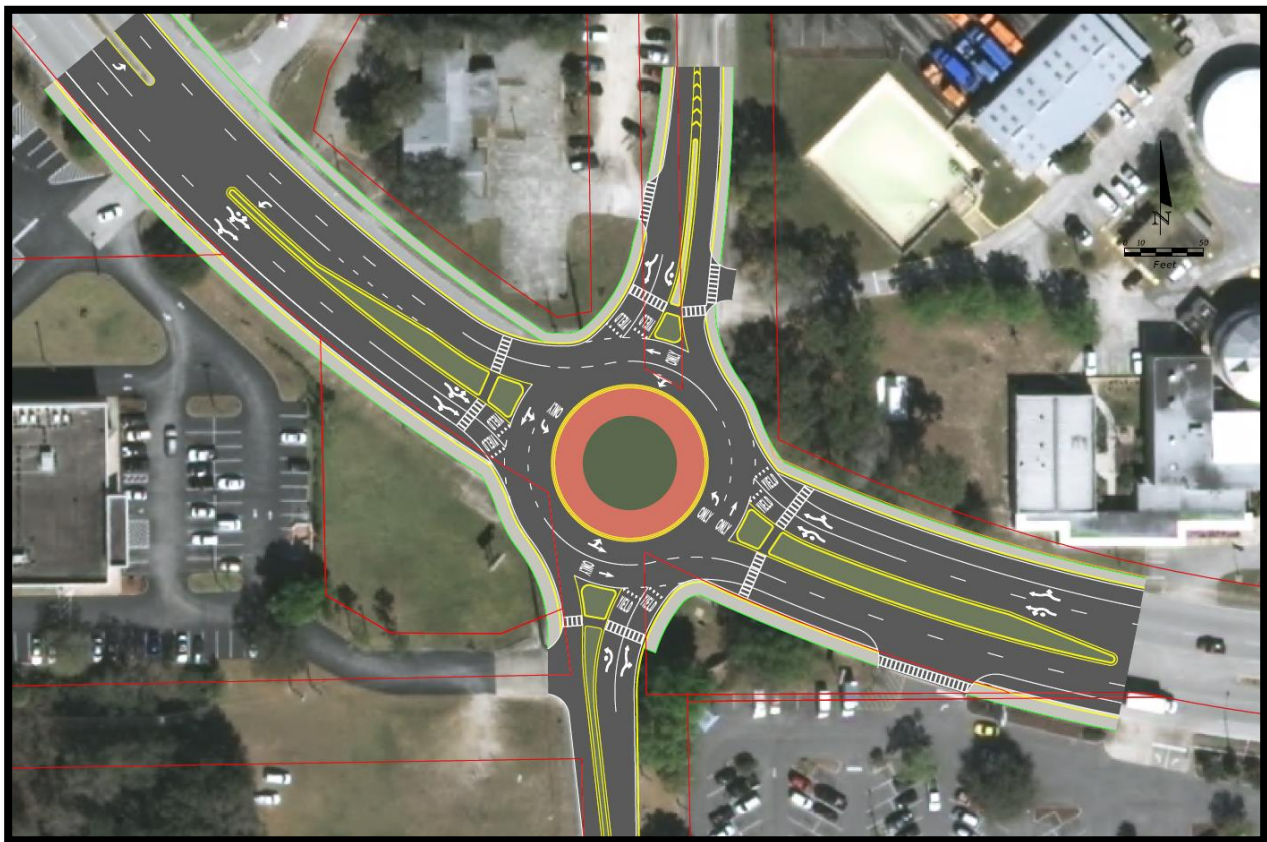




Figure 6: Road Diet Singleton Avenue to Dixie Avenue

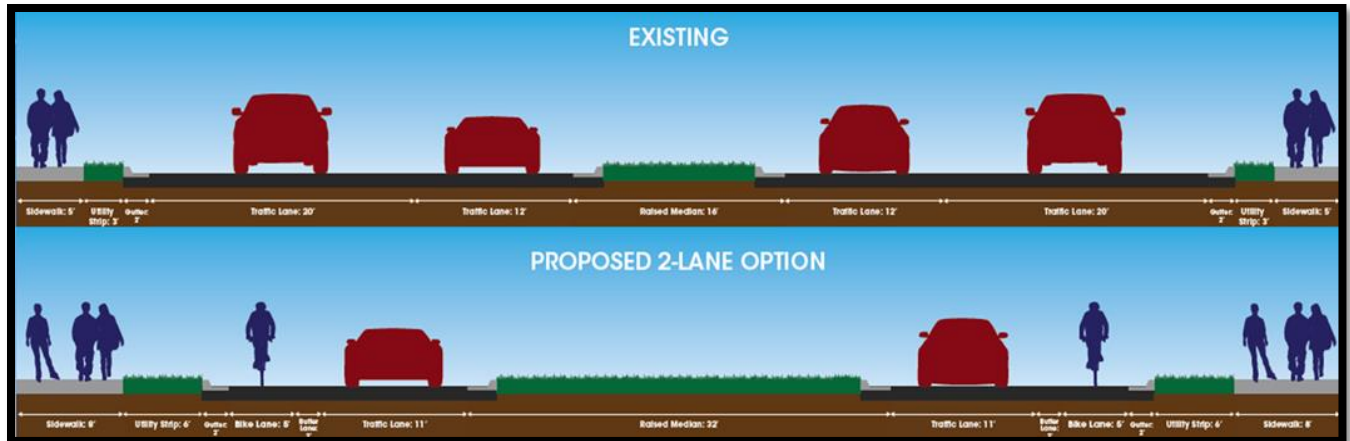
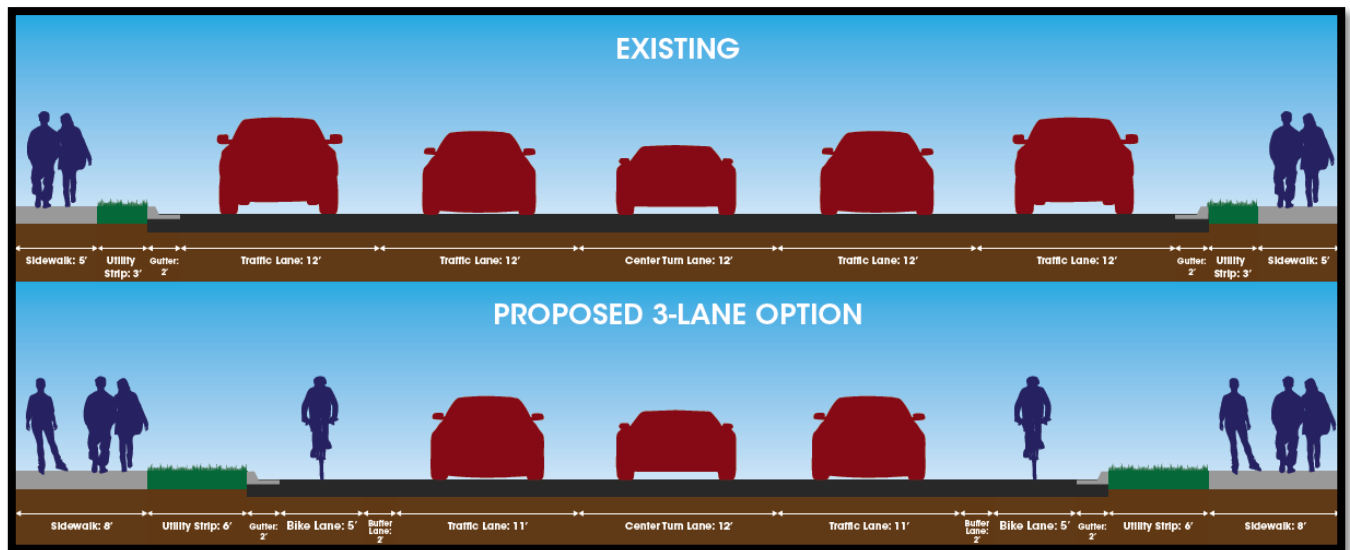


Figure 7: Road Diet Dixie Avenue to Indian River Avenue



### 5.1.1 2040 Build Scenario #1 Projected Roadway Operations

Build Scenario #1 assumes that no traffic is diverted away from the corridor due to lane reduction, so the same volumes will be used and compared against the No-Build and Build Scenario #2. This scenario reduces through lanes from Singleton Avenue to Indian River Avenue. The generalized peak hour directional service volumes for the LOS letters “A” through “F” were obtained from Table 7 of the 2012 FDOT Quality/Level of Service Handbook and compared with projected 2040 volumes calculated using the 2017 existing volumes with the previously-identified 0.85% annual growth factor applied. The 2040 projected roadway operations are provided in Table 9 and Figure 8 for daily, AM peak hour, and PM peak hour.

**Table 9: 2040 Projected Roadway Level of Service: Build Scenario #1**

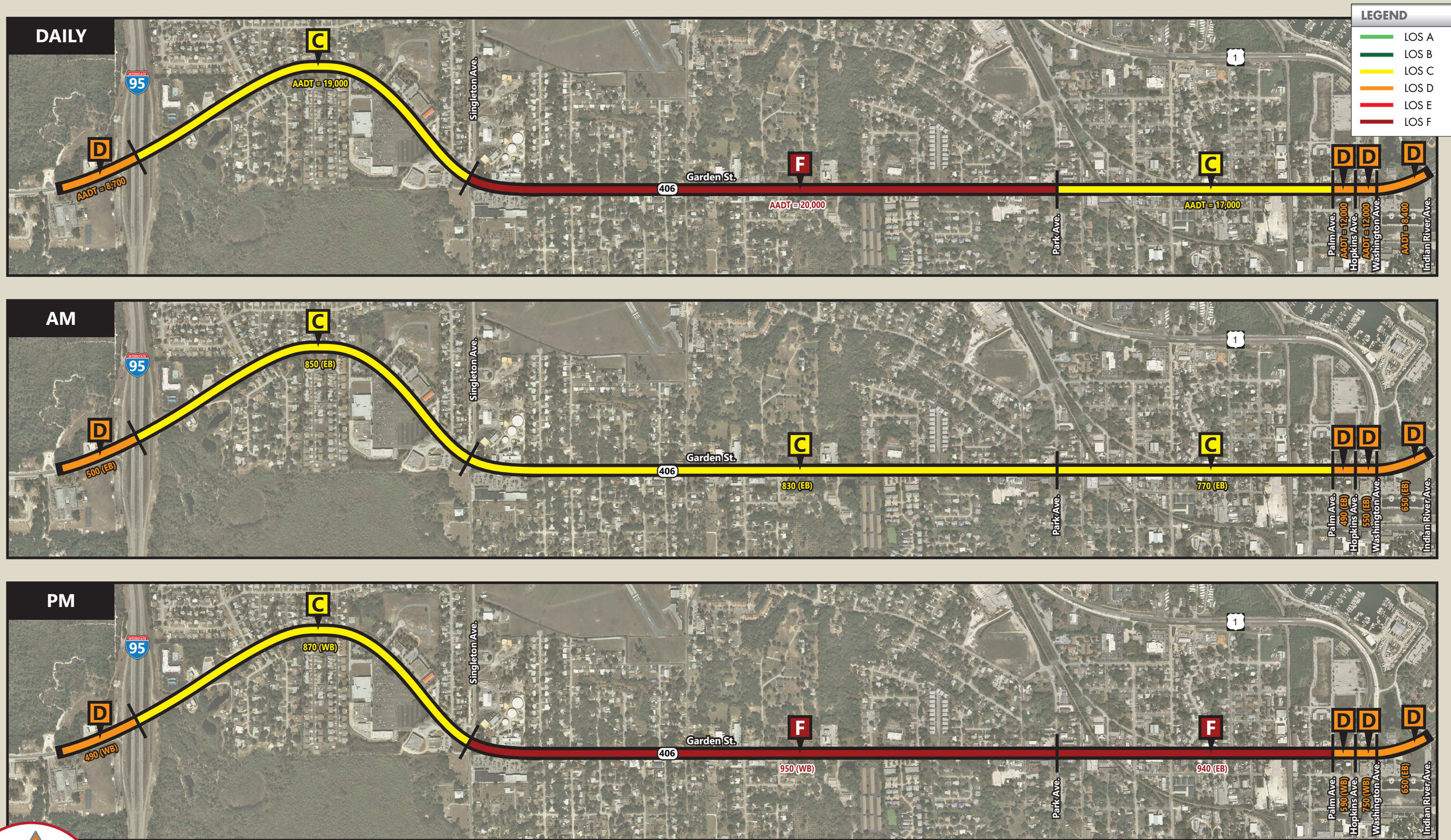
Roadway/Segment	Daily		AM Peak		PM Peak			
	AADT	LOS	Volume	Peak Direction	LOS	Volume	Peak Direction	LOS
<b>SR 406 (Garden Street)</b>								
North Area Adult Education Center to I-95	8,700	D	500	EB	D	490	WB	D
I-95 to Singleton Avenue	19,000	C	850	EB	C	870	WB	C
Singleton Avenue to Park Avenue	20,000	F	830	EB	C	950	WB	F
Park Avenue to Palm Avenue	17,000	C	770	EB	C	940	EB	F
Palm Avenue to US 1 SB (Hopkins Avenue)	12,000	D	490	EB	D	590	WB	D
US 1 Southbound to US 1 NB (Washington Avenue)	12,000	D	550	EB	D	750	WB	D
US 1 NB (Washington Avenue) to Indian River Avenue	8,400	D	650	EB	D	650	EB	D

*2012 FDOT Quality/Level of Service Handbook Tables*

*AADT = Data Collected \* Seasonal Factor (1.06) \* Axle Factor (0.98) (if need)*

As shown in Table 9, the Build Scenario #1 SR 406 corridor is anticipated to operate within acceptable LOS standards in YR 2040 with the exception of Singleton Avenue to Park Avenue daily and Singleton Avenue to Palm Avenue during the PM peak hour.





**LEGEND**

- LOS A
- LOS B
- LOS C
- LOS D
- LOS E
- LOS F



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 NORTH AREA ADULT EDUCATION CENTER TO INDIAN RIVER AVENUE



**FIGURE 8**  
 Build Scenario #1 2040 Projected Roadway Volumes and Operations



### 5.1.2 2040 Build Scenario #1 Projected Intersection Operations

According to the HCM 2010, for signalized intersections, and average control delay per vehicle from 55 seconds up to 80 seconds is considered to be a LOS E condition. Beyond 80 seconds is considered to be a LOS F condition. A summary of the 2040 projected intersection operations for all study area intersections is provided in Table 10 for the AM and PM peak hours. The signal timings were optimized under the assumption that signal timings will be regularly maintained through 2040. SR 406 at Singleton Avenue was analyzed as both a signalized intersection and a roundabout. The 2040 project intersection operations are presented in Figure 9 for the AM and PM peak hours. Analysis output sheets for the roadway operations are provided in the Appendix A.

**Table 10: 2040 Projected Intersection Level of Service: Build Scenario #1**

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
SR 406 (Garden Street)/I-95 SB Ramps	Signalized	11.5	B	9.1	A
SR 406 (Garden Street)/I-95 NB Ramps	Signalized	12.4	B	13.4	B
SR 406 (Garden Street)/Singleton Avenue	Signalized	16.8	B	23.7	C
	Roundabout	9.9	A	22.5	C
SR 406 (Garden Street)/Park Avenue	Signalized	21.0	C	30.0	C
SR 406 (Garden Street)/Palm Avenue	Un-Signalized	1.3	A	3.8	A
SR 406 (Garden Street)/US 1 SB (Hopkins Avenue)	Signalized	18.3	B	17.4	B
SR 406 (Garden Street)/US 1 NB (Washington Avenue)	Signalized	8.8	A	10.9	B

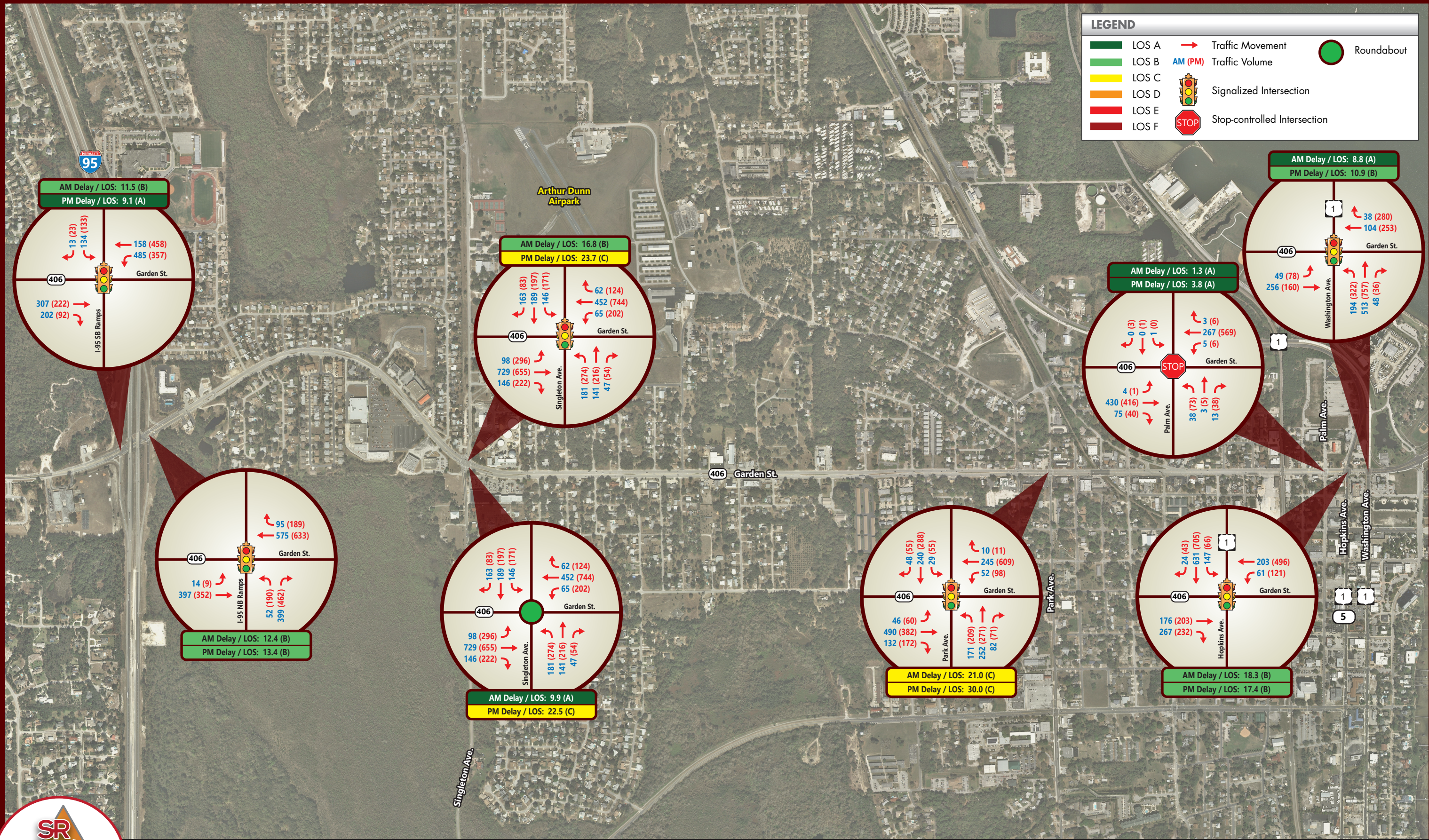
As presented in Table 10 above, all of the study area intersections are anticipated to operate at acceptable LOS in 2040 under Build Scenario #1. The lane reduction for this alternative happens at the intersection of SR 406 and Singleton Avenue in the signalized scenario. For the roundabout scenario, the lane reduction starts east of the intersection since the roundabout needs two lanes eastbound and westbound in order to operation sufficiently. The 2040 projected intersection operations are presented in Figure 9 for the AM and PM peak hours. Synchro reports are provided in Appendix B.





**LEGEND**

- LOS A (Green)
- LOS B (Light Green)
- LOS C (Yellow)
- LOS D (Orange)
- LOS E (Red)
- LOS F (Dark Red)
- Traffic Movement (Red Arrow)
- AM (PM) Traffic Volume (Blue/Red Arrow)
- Signalized Intersection (Traffic Light Icon)
- Stop-controlled Intersection (Stop Sign Icon)
- Roundabout (Green Circle)



## SR 406 Concept Development & Evaluation

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**FIGURE 9**  
Build Scenario #1 2040 Projected Intersection Volumes and Operations





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## 5.2 2040 Build Scenario #2 Operational Analysis

For Build Scenario #2, because of higher traffic volumes and the ability to provide sufficient capacity for incident management purposes the section from I-95 to Singleton Avenue will remain in its existing 4-lane configuration.

At the Singleton Avenue intersection, a roundabout is proposed as described in Section 5.1. A roundabout at this intersection is anticipated to improve current safety conditions by reducing severe intersection crashes and promoting slower speeds as traffic enters downtown Titusville from the west. This roundabout can also serve as a gateway feature for the City of Titusville.

From Singleton Avenue to Dixie Avenue the 4-lane section will remain the same. However, the existing outside parking lane will be converted to 7-foot buffered bike lanes and the median will be widened to the standard 22 feet.

From Dixie Avenue to Indian River Avenue a 3-lane road diet is proposed as described in Section 5.1. This alternative will provide two 11-foot travel lanes with a continuous, bi-directional left center turn lane. This road diet will capitalize on the available capacity that this corridor offers and repurposes it to provide buffered bike lanes and wider sidewalks. Also, the signal at Palm Avenue is planned to be removed with the currently funded resurfacing project. The intersection doesn't meet signal warrant criteria for existing or future traffic.



### 5.2.1 2040 Build Scenario #2 Projected Roadway Operations

This scenario reduces lanes from Dixie Avenue to Indian River Avenue. The generalized peak hour directional service volumes for the LOS letters “A” through “F” were obtained from Table 7 of the 2012 FDOT Quality/Level of Service Handbook and compared with projected 2040 volumes calculated using the 2017 existing volumes with the previously-identified .85% annual growth factor applied. The 2040 projected roadway operations are provided in Table 11 and Figure 10 for daily, AM peak hour, and PM peak hour.

**Table 11: 2040 Projected Roadway Level of Service: Build Scenario #2**

Roadway/Segment	Daily		AM Peak			PM Peak		
	AADT	LOS	Volume	Peak Direction	LOS	Volume	Peak Direction	LOS
<b>SR 406 (Garden Street)</b>								
North Area Adult Education Center to I-95	8,700	D	500	EB	D	490	WB	D
I-95 to Singleton Avenue	19,000	C	850	EB	C	870	WB	C
Singleton Avenue to Dixie Avenue	20,000	C	830	EB	C	950	WB	C
Dixie Avenue to Park Avenue	20,000	F	830	EB	C	950	WB	F
Park Avenue to Palm Avenue	17,000	D	770	EB	C	940	EB	F
Palm Avenue to US 1 SB (Hopkins Avenue)	12,000	D	490	EB	D	590	WB	D
US 1 Southbound to US 1 NB (Washington Avenue)	12,000	D	550	EB	D	750	WB	D
US 1 NB (Washington Avenue) to Indian River Avenue	8,400	D	650	EB	D	650	EB	D

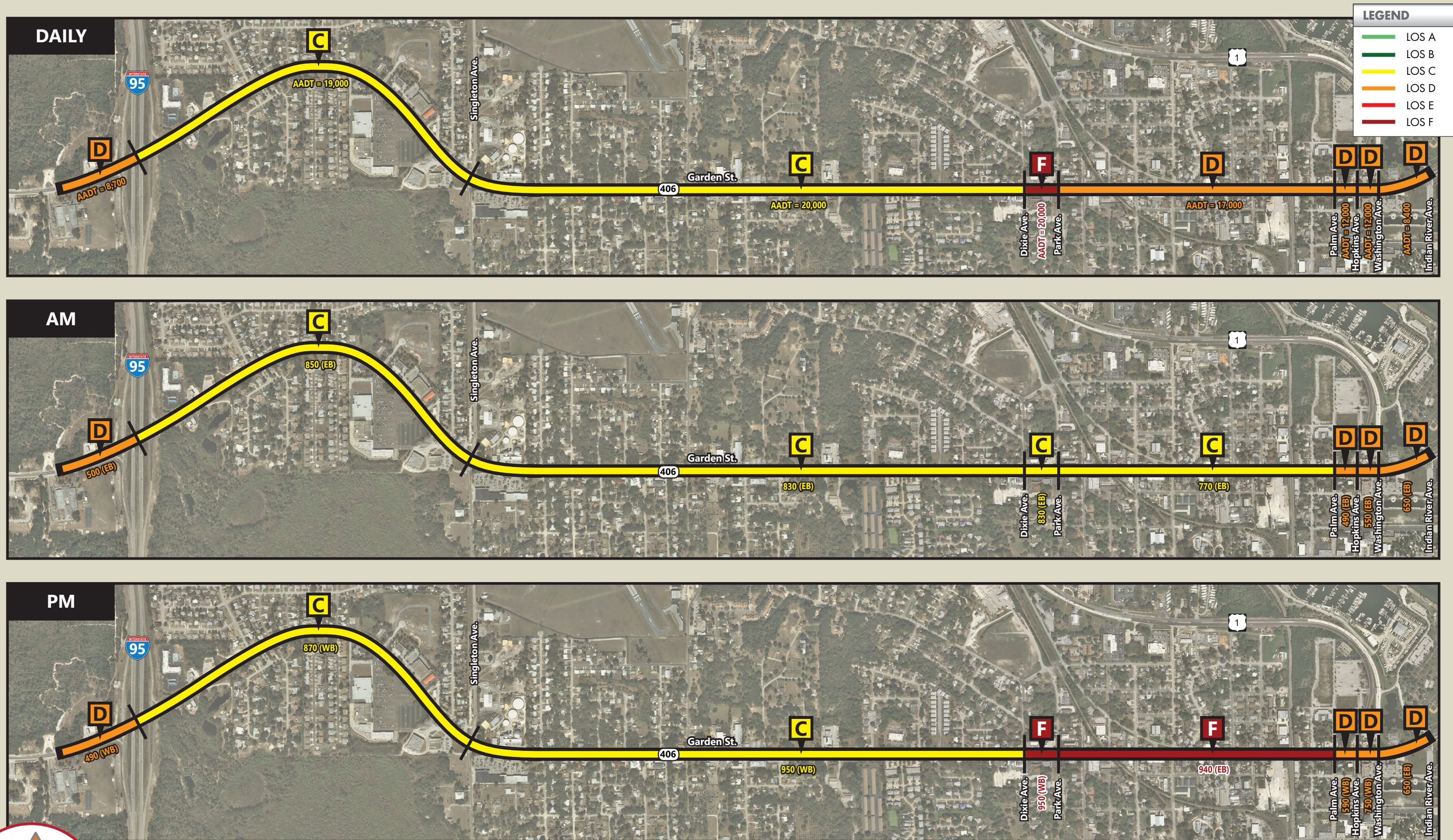
*2012 FDOT Quality/Level of Service Handbook Tables*

*AADT = Data Collected \* Seasonal Factor (1.06) \* Axle Factor (0.98) (if need)*

As shown in Table 11, the SR 406 corridor currently operates within acceptable LOS standards with the exception of the short segment between Dixie Avenue and Park Avenue, approximately 368 feet long, in the daily and PM peak hour as well as the segment between Park Avenue and Palm Avenue in the PM peak hour.







**LEGEND**

- LOS A
- LOS B
- LOS C
- LOS D
- LOS E
- LOS F



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**FIGURE 10**  
 Build Scenario #2 2040 Projected Roadway Volumes and Operations





### 5.2.2 2040 Build Scenario #2 Projected Intersection Operations

According to the HCM 2010, for signalized intersections, and average control delay per vehicle from 55 seconds up to 80 seconds is considered to be a LOS E condition. Beyond 80 seconds is considered to be a LOS F condition. A summary of the 2040 projected intersection operations for all study area intersections is provided in Table 12 for the AM and PM peak hours. The signal timings were optimized under the assumption that signal timings will be regularly maintained through 2040. Analysis output sheets for the roadway operations are attached.

**Table 12: 2040 Projected Intersection Level of Service: Build Scenario #2**

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
SR 406 (Garden Street)/I-95 SB Ramps	Signalized	10.8	B	8.9	A
SR 406 (Garden Street)/I-95 NB Ramps	Signalized	11.9	B	13.0	B
SR 406 (Garden Street)/Singleton Avenue	Signalized	19.6	B	29.7	C
	Roundabout	9.9	A	22.5	C
SR 406 (Garden Street)/Park Avenue	Signalized	29.2	C	39.6	D
SR 406 (Garden Street)/Palm Avenue	Un-Signalized	1.3	A	3.8	A
SR 406 (Garden Street)/US 1 SB (Hopkins Avenue)	Signalized	24.5	C	25.1	C
SR 406 (Garden Street)/US 1 NB (Washington Avenue)	Signalized	21.1	C	28.5	C

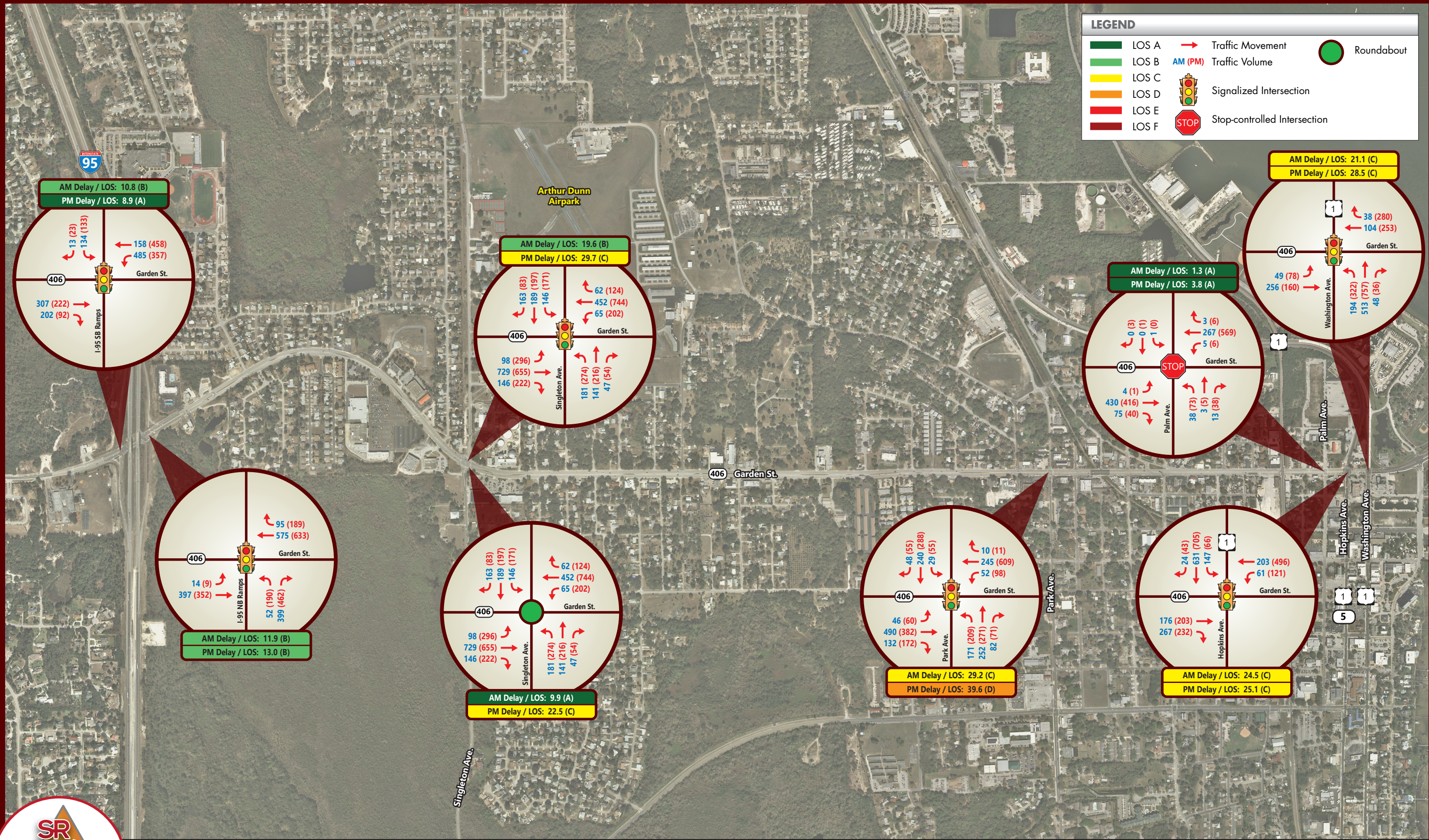
As presented in Table 12 above, all of the study area intersections are anticipated to operate at acceptable LOS in 2040. The 2040 projected intersection operations are presented in Figure 11 for the AM and PM peak hours. Synchro Output sheet are provided in Appendix B.





**LEGEND**

- LOS A (Green)
- LOS B (Light Green)
- LOS C (Yellow)
- LOS D (Orange)
- LOS E (Red)
- LOS F (Dark Red)
- Traffic Movement (Red Arrow)
- AM (PM) Traffic Volume (Blue/Red Text)
 (PM)
- Signalized Intersection (Traffic Light Icon)
- Stop-controlled Intersection (Stop Sign Icon)
- Roundabout (Green Circle)



**SR 406 Concept Development & Evaluation**  
 NORTH AREA ADULT EDUCATION CENTER TO INDIAN RIVER AVENUE



**FIGURE 11**  
 Build Scenario #2 2040 Projected Intersection Volumes and Operations



# 6

## Conclusions and Recommendations

Based on analysis performed to determine the 2040 projected volumes and operations of SR 406 (Garden Street) within the study area, the no-build demonstrates that there are no anticipated roadway capacity or intersection operational issues. This allowed the build scenarios to focus on improving safety and creating a multi-modal friendly environment.

The future conditions analysis for build scenario #1 operates at acceptable level of service with the exception of Singleton Avenue to Park Ave from a daily perspective. The segment between Singleton Avenue to Palm Avenue is anticipated to operate adversely during peak times. The intersections in this scenario are projected to operate acceptably in the future conditions. Build scenario #2 operates at acceptable levels of service except for the segment from Dixie Avenue to Palm Avenue in the daily analysis. The segment from Dixie Avenue to Palm Avenue is anticipated to operate adversely in the PM peak hours.

The Road Diet allows for the addition of multimodal features including buffered bike lanes, widened sidewalks, planting strips, and improved bus stop facilities by repurposing the existing configurations within the roadway right-of-way. This pedestrian and bicycle friendly typical section supports the aesthetic character of the area desired by local stakeholders and the community. The Road Diet also encourages slower speeds, ultimately providing a safer corridor.

For Build Scenario #1, implementing a road diet between the segment of Singleton Avenue and Dixie Avenue could create a bottleneck in traffic in this segment. Also, these changes would require moving the curbs and median making this a high cost option. Since the goals and objectives to improve multi-modal mobility can be satisfied with a 4-lane option within the existing roadway right-of-way and without moving the curb, this scenario becomes less viable.

Build Scenario #2 experiences traffic concerns from Dixie Avenue to Park Avenue spanning a distance of 368 feet. According to the intersection operations at Park Avenue, the intersection will operate sufficiently. There are opportunities to mitigate these issues with in the extra room created by the road diet

The future conditions analysis for the two-lane roundabout proposed at the Singleton Avenue intersection also shows to operate at acceptable LOS in the 2040 future conditions. The addition of the roundabout is anticipated to improve safety at the intersection and provides an opportunity for aesthetic treatments including a gateway feature into the City of Titusville, as desired by local stakeholders.

