



# US 1 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 US 1, and identify potential capacity deficiencies and additional needs for the corridor through 2040. This technical memorandum will include the methodology and forecast of future traffic conditions for US 1 from Laurel Place to Indian River Avenue. The latest available development and growth projections have been compiled to create an accurate picture of 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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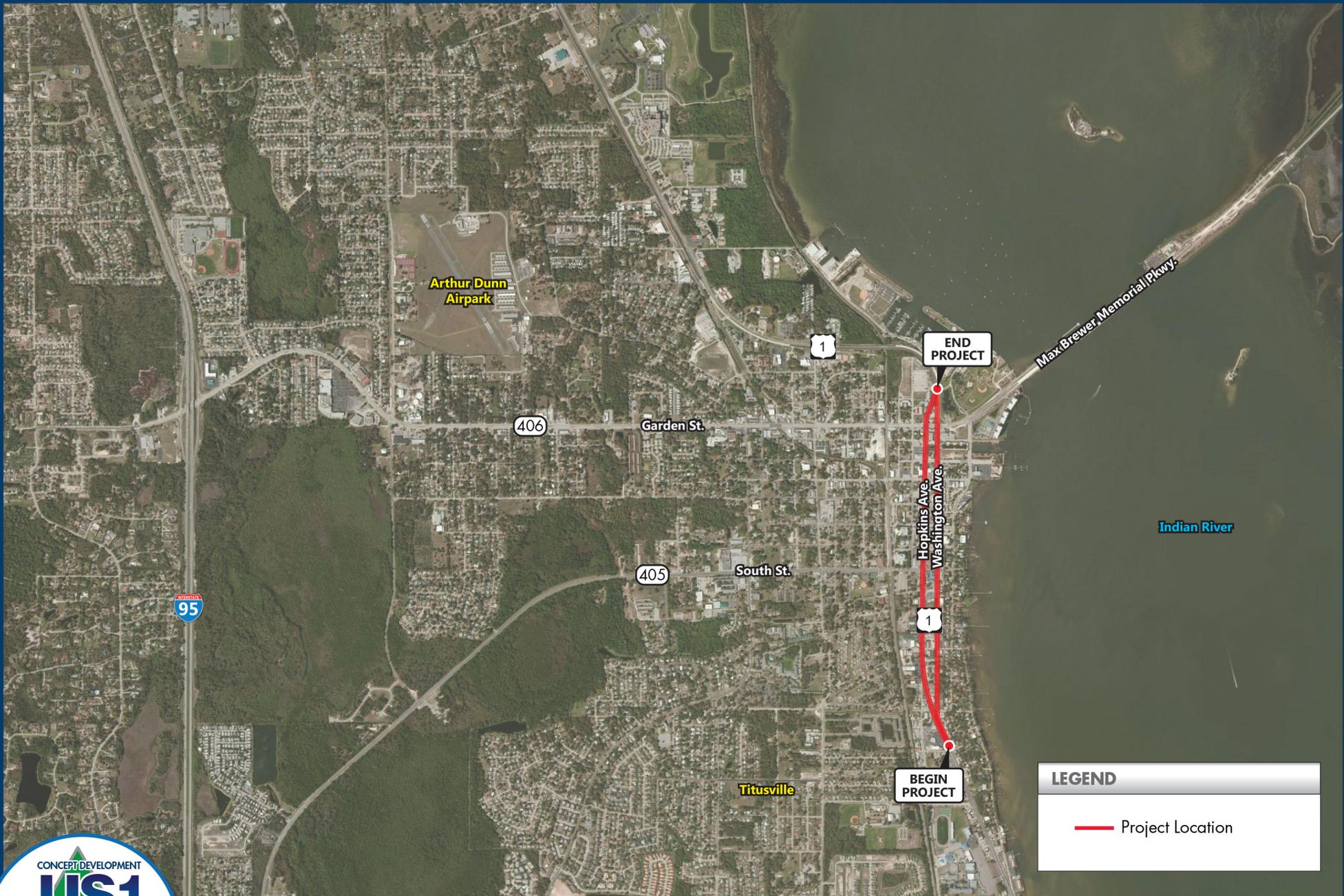
### 1.2 Project Background and Purpose

In January 2015, FDOT began a Corridor Planning Study on US 1 (including both Washington Avenue and Hopkins Avenue as one-way pairs) from Laurel Place to Indian River Avenue in Titusville, Florida. Figure 1 illustrates the study area. 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 US 1 corridor that will establish a multimodal approach to addressing future transportation needs. The 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. US 1 has been the subject of various previous planning studies

and improvement efforts. Several development and planning goals have been identified and implemented to create a more walkable urban environment for the downtown Titusville business district. 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 continues what was started in the Corridor Planning Study by further evaluating the alternatives identified, creating concept plans, and identifying and evaluating impacts. This study will continue the public and agency 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.



# US 1 Concept Development & Evaluation

LAUREL PLACE TO INDIAN RIVER AVENUE



**FIGURE 1**  
Study Area Location Map

# 2

## Existing Conditions

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### 2.1 Roadway and Intersection Characteristics

The US 1 study area consists of approximately 1.25-mile, one-way pair section (Hopkins Avenue and Washington Avenue) of US 1 within the City of Titusville in Brevard County, Florida. The study area begins at Laurel Place and extends north to Indian River Avenue, which encompasses the entire one-way pair section through downtown Titusville. The study area corridor can be characterized as an urbanized two-lane roadway, in an area of predominantly retail and service land uses. Based on the FDOT Context Classification Guidance, this corridor is classified as a C-4 Urban General, except where development is densest between South St. (SR 405) and Broad Street, this section is classified as C-5 Urban Center.

US 1 from Laurel Place to Indian River Avenue is classified as an “urban principal arterial other”. There are two predominate typical sections of the corridor; a four-lane bidirectional segment from Laurel Place to Grace Street; and a two-lane, one-way pair segment from Grace Street to Indian River Avenue. The posted speed limit varies along US 1; from south of the study area to north of Laurel Place the posted speed limit is 45 miles per hour (MPH), immediately north of Laurel Place to south of SR 405 it transitions to 40 MPH, from south of SR 405 to north of SR 406 the posted speed is 30 MPH, and transitions to 35 MPH south of Indian River Avenue.

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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, 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 volumes collected from the 24-Hour bi-directional tube counts. 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 (Peak Direction)		PM Peak (Peak Direction)	
	AADT	LOS	Volume	LOS	Volume	LOS
<b>US 1</b>						
Laurel Place to Grace Street	23,000	C	880 (NB)	C	1000 (NB)	C
<b>US 1 SB (Hopkins Avenue)</b>						
Grace Street to SR 405 (South Street)	12,000	C	800	C	920	C
SR 405 (South Street) to SR 406 (Garden Street)	12,000	D	850	C	860	C
SR 406 (Garden Street) to Indian River Avenue	8,900	D	630	C	690	C
<b>US 1 NB (Washington Avenue)</b>						
Grace Street to SR 405 (South Street)	12,000	C	840	C	940	C
SR 405 (South Street) to SR 406 (Garden Street)	12,000	D	840	C	980	D
SR 406 (Garden Street) to Indian River Avenue	8,300	C	580	C	700	C
<b>Grace Street</b>						
West of US 1 SB (Hopkins Avenue)	1,600	C	60 (WB)	C	210 (WB)	C
East of US 1 NB (Washington Avenue)	490	C	20 (WB)	C	35 (WB)	C

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

As shown in Table 1, all the segments within the US 1 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
US 1/Grace Street	Signalized	5.2	A	5.5	A
US 1 NB (Washington Avenue)/SR 406 (Garden Street)	Signalized	8.8	A	9.9	A
US 1 SB (Hopkins Avenue)/SR 406 (Garden Street)	Signalized	14.4	B	13.6	B

As seen in Table 2, all study area intersections currently operate under acceptable LOS conditions during the AM and PM peak hours.

# 3

## Future Traffic Development

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### 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.

Along the study corridor, the Downtown Mixed-Use district extends to Indian River Avenue east of US 1. Further east, between Indian River Avenue and the Indian River, the majority of the land is designated as Residential Medium. Medium density residential lands are permitted for a maximum density of 10 dwelling units per acre, and are intended to consider existing and proposed land uses during development to ensure compatibility with surrounding uses.

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### 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 north of SR 406 (Garden Street) to SR 405 (South Street) along US 1.
- ITS Improvements were identified along US 1 from SR 406 (Garden Street) to SR 405 (South Street) with an estimated cost of \$1.3 Million.
- 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).

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



### 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  $\pm$  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 US 1 study area, traffic 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 and Appendix D. 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>	-1.17%
<b>Model Growth Analysis</b>	0.65%
<b>BEBR Growth Analysis</b>	
Brevard County Medium	0.90%
Brevard County High	1.69%
<b>Average Growth Rate (used)</b>	<b>0.77%</b>

The historic growth trends were not applied due to the negative value and the R-squared value of the historical counts were not above 75% illustrating volatility in the volumes as illustrated in Table 6. The model growth analysis identified a growth rate of 0.65%. Taking into account 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 to reflect development anticipated in the near future. For a conservative analysis of growth, this rate was averaged with BEBR’s medium projected growth rate. The average of these two models is 0.77%, 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 projected by using the preferred growth rate and growing the existing traffic to the future year. Similar to the existing conditions analysis, future LOS was determined by using the 2012 FDOT Quality/Level of Service tables and HCM 2010 guidelines for roadway and intersection operations, respectively.

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

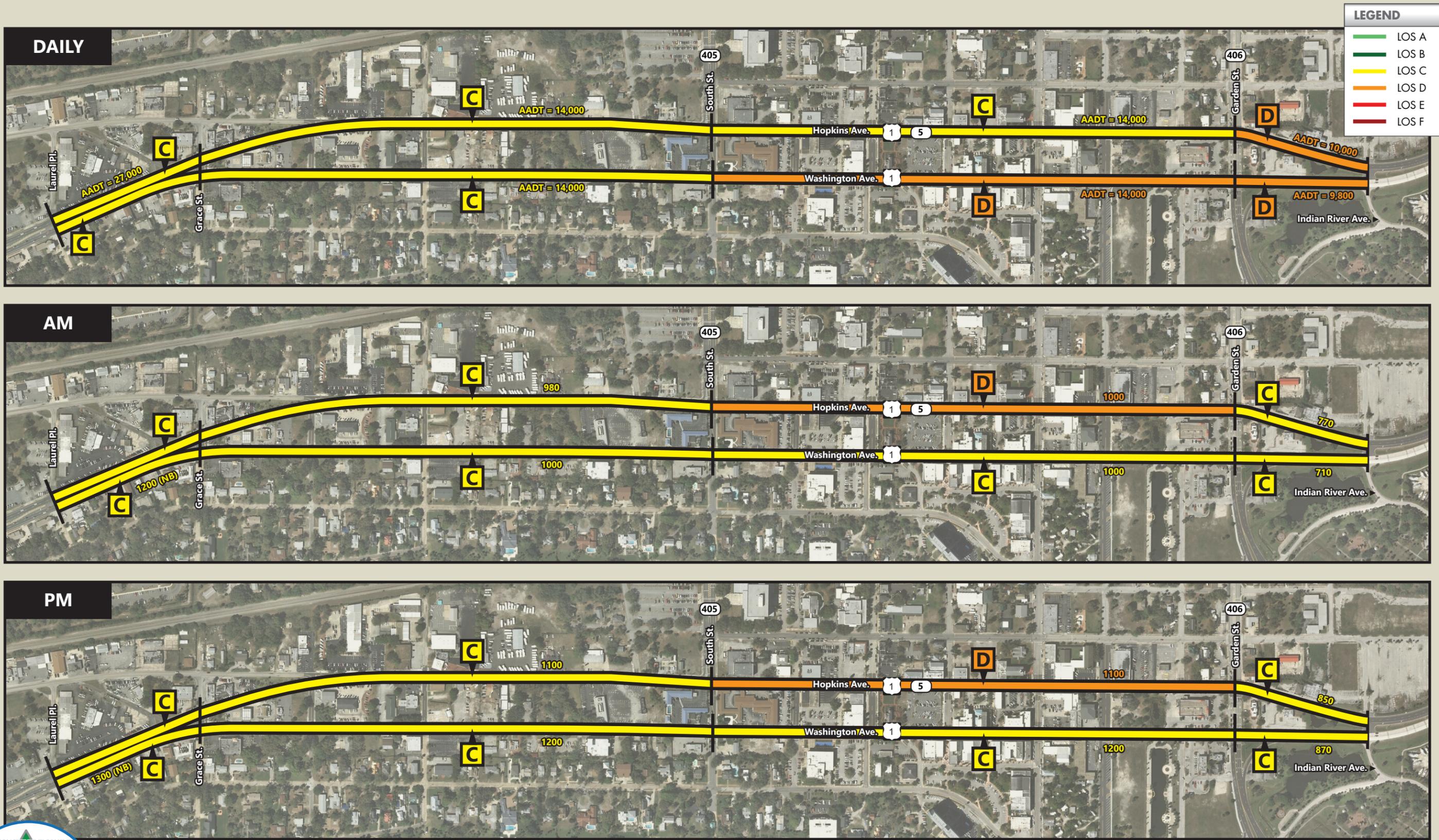
According to FDOT, the study corridor is classified as an “urban principal arterial other” and has an adopted LOS “D”. The generalized peak hour directional service volumes for the LOS letters “A” through “F” were obtained from Table 7 of the 2012 FDOT Quality/Level of Service Handbook and compared with projected 2040 volumes calculated using the 2017 existing volumes with the previously-identified 0.77% 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. Future volume analysis sheets are located in Appendix A.

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

Roadway/Segment	Daily		AM Peak (Peak Direction)		PM Peak (Peak Direction)	
	AADT	LOS	Volume	LOS	Volume	LOS
<b>US 1</b>						
Laurel Place to Grace Street	27,000	C	1,200 (NB)	C	1,300	C
<b>US 1 SB (Hopkins Avenue)</b>						
Grace Street to SR 405 (South Street)	14,000	C	980	C	1,100	C
SR 405 (South Street) to SR 406 (Garden Street)	14,000	C	1,000	D	1,100	D
SR 406 (Garden Street) to Indian River Avenue	10,000	D	770	C	850	C
<b>US 1 NB (Washington Avenue)</b>						
Grace Street to SR 405 (South Street)	14,000	C	1,000	C	1,200	C
SR 405 (South Street) to SR 406 (Garden Street)	14,000	D	1,000	C	1,200	C
SR 406 (Garden Street) to Indian River Avenue	9,800	D	710	C	870	C

*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 US 1 corridor is projected to operate within acceptable LOS standards in No-Build condition of YR 2040.



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LAUREL PLACE TO INDIAN RIVER AVENUE



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

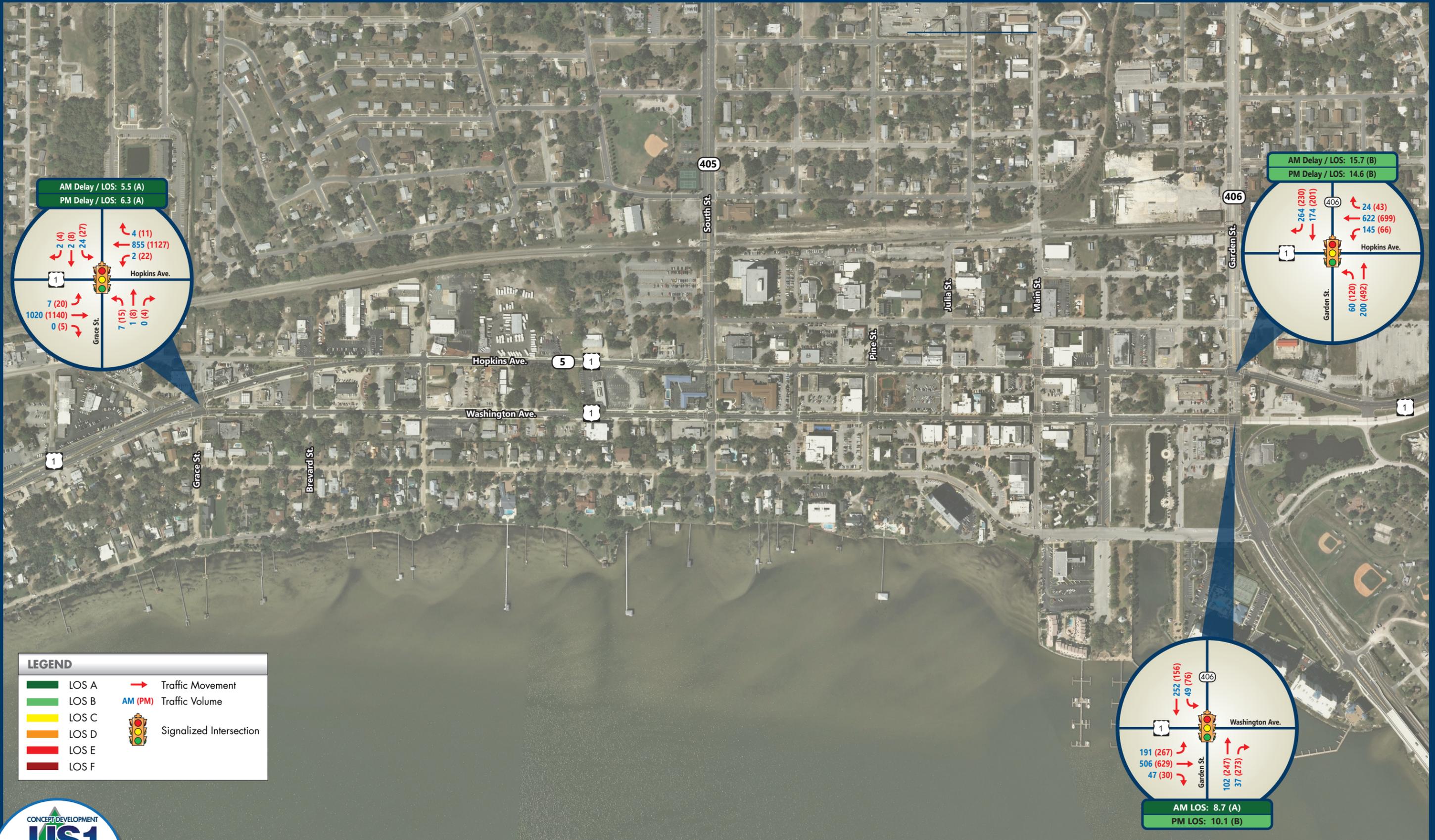
#### 4.1.2 2040 No-Build Projected Intersection Operations

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.

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

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
US 1/Grace Street	Signalized	5.5	A	6.3	A
US 1 NB (Washington Avenue)/SR 406 (Garden Street)	Signalized	8.7	A	10.1	B
US 1 SB (Hopkins Avenue)/SR 406 (Garden Street)	Signalized	15.7	B	14.6	B

As presented in Table 8 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 4 for the AM and PM peak hours. Synchro reports are located in Appendix B.



# US 1 Concept Development & Evaluation

LAUREL PLACE TO INDIAN RIVER AVENUE



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

# 5

## 2040 Build Conditions Analysis

There is one proposed build scenario for the US 1 corridor. The main features of this build scenario are roundabouts at Grace Street and SR 406 (Garden Street). Both serve as a safety improvement for downtown Titusville. The roundabout at SR 406 (Garden Street) offers a unique solution for the removal of the two existing signals in order to address high crash rates currently experienced. In addition to the roundabouts are crosswalk enhancements, pavement markings and other pedestrian focused enhancements.

### 5.1 2040 Build Scenario Operational Analysis

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

The build scenario for US 1 was developed throughout the Corridor Planning Study process with extensive feedback from stakeholders during Project Visioning Team meetings, public meetings and discussions with local public officials.

Several potential improvement strategies were identified during 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. Improvement include crosswalk enhancements, pavement markings and intersection improvements, including roundabouts where US 1 intersects Grace Street and SR 406 (Garden Street).

The proposed Grace Street roundabout is visualized in Figure 5. It seeks to provide improved safety and encourage slower speeds as traffic enters downtown Titusville from the south. This roundabout could also serve as a gateway feature for the City of Titusville.

The proposed roundabout at US 1 and SR 406 (Garden Street) is visualized in Figure 6. It provides the opportunity to remove the two signals at SR 406 (Garden Street) and both US 1 Southbound (Hopkins Avenue) and US 1 Northbound (Washington Avenue). From 2011 to 2015, the segments that include these two intersections produced an average crash rate of 11.75, compared with a statewide average crash rate of 9.40. With the high crash rates currently experienced at this one-way pair intersection, this combined roundabout seeks to improve safety.

**Figure 5: Grace Street Roundabout**



**Figure 6: US 1 and SR 406 (Garden Street) Roundabout**



### 5.1.1 2040 Build Scenario Projected Roadway Operations

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 roadway volumes. The 2040 roadway volumes were calculated using the 2017 existing roadway volumes with the previously-identified 0.77% annual growth factor applied. The 2040 projected roadway operations are provided in Table 9 for daily, AM peak hour, and PM peak hour. Future volume analysis sheets are located in Appendix A.

**Table 9: 2040 Projected Roadway Level of Service: Build**

Roadway/Segment	Daily		AM Peak (Peak Direction)		PM Peak (Peak Direction)	
	AADT	LOS	Volume	LOS	Volume	LOS
<b>US 1 (2-Way Section)</b>						
Laurel Place to Grace Street	27,000	C	1,200 (NB)	C	1,300	C
<b>US 1 SB (Hopkins Avenue) (One Way)</b>						
Grace Street to SR 405	14,000	C	980	C	1,100	C
SR 405 to SR 406	14,000	C	1,000	D	1,100	D
SR 406 to Indian River Avenue	10,000	D	770	C	850	C
<b>US 1 NB (Washington Avenue) (One Way)</b>						
Grace Street to SR 405	14,000	C	1,000	C	1,200	C
SR 405 to SR 406	14,000	D	1,000	C	1,200	C
SR 406 to Indian River Avenue	9,800	D	710	C	870	C

*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 US 1 Build condition is projected to operate within acceptable LOS standards in YR 2040.

### 5.1.2 2040 Build Scenario 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.

**Table 10: 2040 Projected Intersection Level of Service: Build**

Intersection	Control	AM Peak		PM Peak	
		Delay	LOS	Delay	LOS
US 1/Grace Street	Roundabout	5.6	A	6.8	A
US 1 NB (Washington Avenue)/SR 406 (Garden Street)	Roundabout	6.4	A	9.9	A
US 1 SB (Hopkins Avenue)/SR 406 (Garden Street)	Roundabout	7.4	A	10.5	B

As presented in Table 10 above, all of the study area intersections are anticipated to operate at acceptable LOS levels in 2040. The 2040 projected intersection operations are presented in Figure 7 for the AM and PM peak hours. Synchro reports are located in Appendix B.



# US 1 Concept Development & Evaluation

LAUREL PLACE TO INDIAN RIVER AVENUE



**FIGURE 7**  
2040 Projected Build Scenario Intersection Volumes and Operations

# 6

## Conclusions and Recommendations

Based on analysis performed to determine the 2040 projected volumes and operations of US 1 within the study area, the no-build demonstrates that there are no anticipated roadway capacity or intersection operational issues. This allowed the build scenario to focus on improving safety and creating a multi-modal friendly environment.

The two roundabouts proposed in the build scenario are anticipated to operate at similar or better conditions in the 2040 future year when compared to the no-build scenario. These roundabouts also provide the benefit of improving safety, encouraging slower speeds, and providing opportunities for aesthetic treatments including a gateway feature into the downtown Titusville area, as desired by local stakeholders.

The two signalized intersections at SR 406 (Garden Street) and the US 1 one-way pairs (US 1 Southbound and US 1 Northbound) currently experience high crash rates. The proposed SR 406 and US 1 roundabout provides a unique solution that removes two existing signals and combines the two intersections into one roundabout. This combined roundabout seeks to improve safety while maintaining acceptable operations.

In addition to the two roundabouts proposed for the build scenario, there are several crosswalk enhancements, pavement markings, and other pedestrian focused improvements proposed. These improvements are expected to enhance the user experience for all modes using the study corridor and are not anticipated to cause operational issues.

The two roundabouts are recommended to be moved forward into the roundabout evaluation process and concept development to vet safety, right of way, and design characteristics.