CORRIDOR PLANNING STUDY FINAL REPORT

SR 507 (Babcock Street) Corridor Planning Study

From CR 516 (Palm Bay Road) to US 192 (New Haven Avenue)
FM 439858-1

Brevard County, Florida

Prepared For:
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719 South Woodland Boulevard
DeLand, FL 32720

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1. INTRODUCTION

The Florida Department of Transportation (FDOT) District Five is conducting a Corridor Planning Study to evaluate the future needs of SR 507 (Babcock Street) - from CR 516 (Palm Bay Road) to US 192 (New Haven Avenue) in Brevard County. The purpose of the Corridor Planning Study is to develop and evaluate alternatives to accommodate future projected traffic demand and improved bicycle, pedestrian, and transit connectivity. As part of the Corridor Planning Study, a Future Conditions Summary has been prepared. The scope of this Corridor Planning Study Final Report includes:

- Review relevant traffic projections from other studies, local and regional growth trends, and LRTP future year model projections;
- Identify and review future land use changes;
- Review planned and programmed improvements to roadway, pedestrian, bicycle and transit facilities;
- Utilizing readily available model outputs and/or a trends analysis with assumed growth rates, conduct a sensitivity analysis to identify a reasonable growth rate projection within the study area during the design year (anticipated to be 2045);
- Perform a no build operational analysis with future traffic volumes to identify deficiencies at key intersections and roadway segments; and
- Utilizing the results of the initial operational analysis, identify potential intersection and segment improvements that could be considered to facilitate vehicular, pedestrian, bicycle, and transit operations along the corridor.

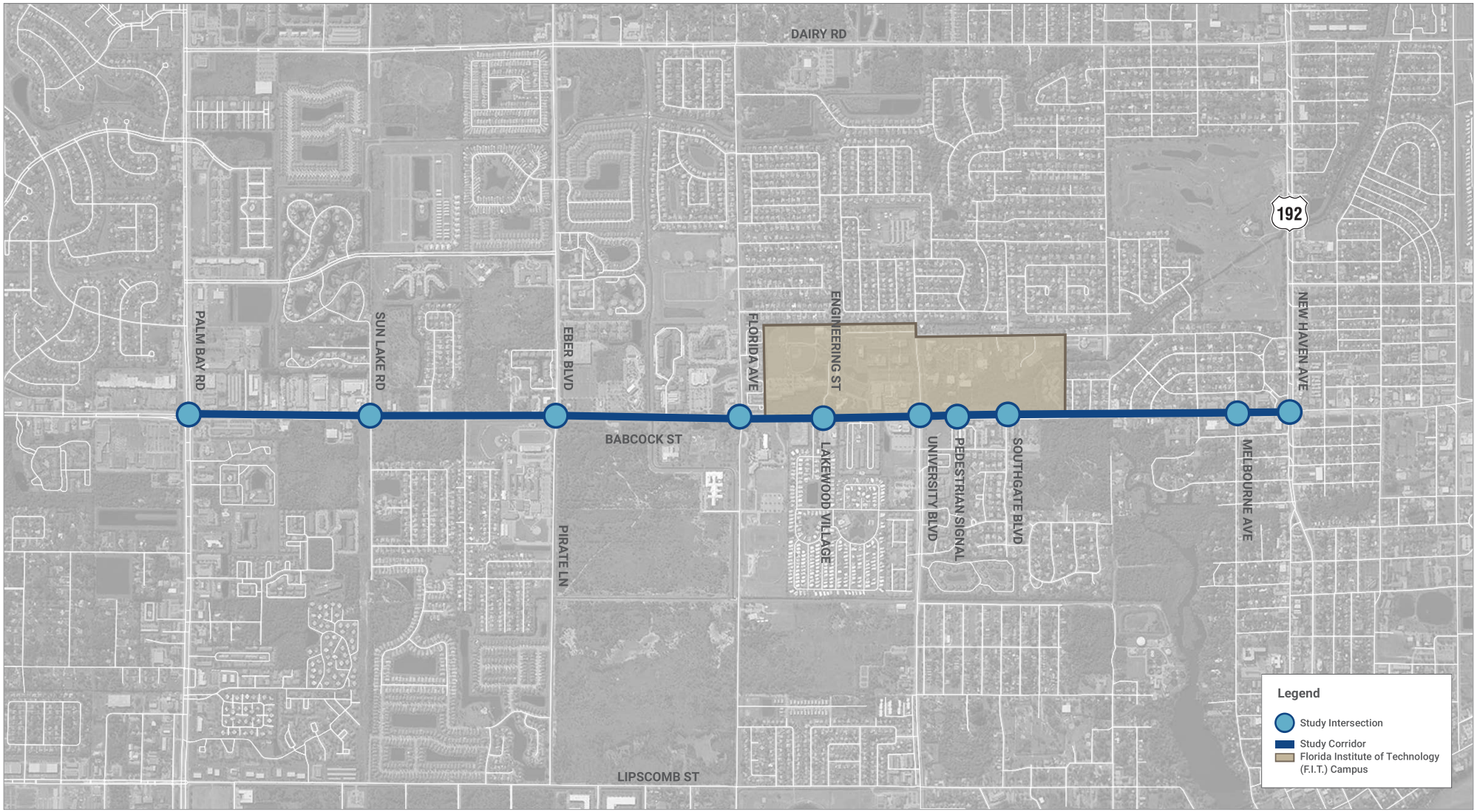
The remainder of this document reviews the future traffic projects and no build operations analysis for the Babcock Street study corridor.

1.1 Project Location

The Babcock Street study corridor is displayed in **Figure 1**. Babcock Street from Palm Bay Road to US 192 is classified as an urban principal arterial, oriented south to north in Brevard County. The three-mile corridor is mostly developed with a mix of uses.

- The southern part of the corridor from Palm Bay Road to Pirate Lane/Eber Boulevard has mostly commercial and light industrial uses with some residential as well as Palm Bay High School.
- The middle of the corridor from Pirate Lane/Eber Boulevard to University Boulevard is largely made up of Florida Institute of Technology (FIT) facilities and housing with some commercial and residential uses.
- The northern part of the corridor from University Boulevard to US 192 is made up of residential and commercial uses with some FIT facilities.

Due to the presence of FIT along the corridor, student activity is prevalent and is expected to impact the needs and influence eventual multimodal recommendations from this study.



Babcock Street Corridor Planning Study

FIGURE 1 | **Study Corridor**

2. PURPOSE AND NEED

Identifying the purpose of the study corridor and the needs of its users is critical to understanding the facility's function and how to prepare it to continue to meet the users' needs into the future. The following section describes the specific purpose and needs of the Babcock Street corridor to facilitate discussion of what future solutions should entail.

2.1 Corridor Purpose

The Babcock Street corridor has a variety of purposes in the study area, as summarized below:

- North-south regional connection providing access between the City of Palm Bay and the City of Melbourne.
- North-south sub-regional connection providing motorized access between Palm Bay Road and US 192.
- Local connection providing motorized access to residences, schools, and businesses in collaboration with the local street network.
- Multimodal connector providing non-motorized access between local uses.

2.2 Corridor Needs

The needs of the corridor have been developed through careful consideration of the corridor's purpose(s), direct feedback from the corridor's stakeholders and users, and data-driven analysis of the existing and future conditions. In the Existing Conditions Report, the corridor issues were preliminarily identified through the existing conditions analysis and stakeholder feedback. Those were further refined through the future conditions analysis of the No Build scenario and interaction with the Project Visioning Team. The needs are important indicators of how different users rely on the facility and must be considered in future corridor improvements. The user needs identified in the Babcock Street corridor are described on the following page.

Motorists

- Corridor Safety – Motorists need a roadway that allows safe travel between destinations
- Intersection Safety – Motorists need intersections that facilitate safe connections between roadways
- Intersection Congestion – Motorists need a reliable roadway that allows effective travel

Bicyclists

- Safe, Continuous Facility – Bicycle users need a safe and continuous bicycle facility along Babcock Street
- Access between Uses – Bicycle users need to safely access land uses along and across Babcock Street

Pedestrians

- Safe, Continuous Facility – Pedestrian users need a safe and continuous pedestrian facility travel along Babcock Street
- Access between Uses – Pedestrian users need to safely access land uses along and across Babcock Street

Transit

- Accessibility – Transit riders need a system that allows safe and easy access between modes

2.3 Performance Measures

When defining the purpose and needs of the corridor, it is important to identify performance measures to be able to evaluate how well a proposed improvement meets the identified needs. **Table 1** summarizes the performance measures.

Table 1: Performance Measures

User	Facility Needs	Performance Measures
Motorists		
	Corridor Safety	Crash Frequency/Severity Number of Conflict Points Number of Uncontrolled Median Openings Speed Differential
	Intersection Safety	Crash Frequency/Severity Number of Conflict Points
	Intersection Congestion	Intersection Volume/Capacity Ratio Intersection Delay
Bicyclists		
	Safe, Continuous Facility	Continuity (linear feet) Comfort Level
	Access between Uses	Number of Controlled Crossing Opportunities Distance between Crossings Percent of Corridor with Design Speed of 35 MPH or less
Pedestrians		
	Safe, Continuous Facility	Continuous Sidewalk (linear feet) Comfort Level
	Access between Uses	Number of Controlled Crossing Opportunities Distance between Crossings Average Crossing Distance Number of Spot Medians or Refuge Islands Percent of Corridor with Design Speed of 35 MPH or less
Accessibility		
	Accessibility	Percentage of ADA Compliant Stops Pedestrian Crossings within Vicinity of Transit Stops

3. TRAFFIC

Traffic volumes were developed for a future Design Year (2045) to be used in the future conditions operational analysis. This section presents the future-year traffic volumes and the process by which they were developed.

3.1 Methodology

Annual growth rates were selected based upon a comparison of model growth, historical volume trends, and projected area-wide population growth. Future intersection turning movements were forecasted by applying the selected growth rates to existing (2017) segment and (2018) intersection turning movement volumes. Growth rates were selected and applied along the Babcock Street corridor for the following segments:

- Palm Bay Road to Florida Avenue
- Florida Avenue to University Boulevard
- University Boulevard to US 192

3.2 Historical AADT Trends

Historical Annual Average Daily Traffic (AADT) data was obtained from the Space Coast TPO (SCTPO) website and reviewed. Historical trends were evaluated using FDOT standard spreadsheets for linear trend analysis. Evaluations were conducted for five segments along the study corridor.

The historical annual growth rates along Babcock Street range between 0.09 to 1.09 percent. The R^2 values are below 40 percent, indicating the historical data does not have a strong linear fit. Linear growth rates show a negative trend between 2011-2015 along the corridor followed by a positive trend from 2015 onwards. The traffic volumes and finalized growth rates at these locations are summarized in **Table 2**. The historical AADT reports and the historic trend analyses are included in **Appendix A**.

Table 2: SCTPO Historical AADT Trends

Year	Palm Bay Rd to Eber Blvd	Eber Blvd to Florida Ave	Florida Ave to University Blvd	University Blvd to Melbourne Ave	Melbourne Ave to US 192
2017	33,100	35,900	37,700	34,600	31,800
2016	32,700	36,100	36,300	33,800	30,000
2015	29,400	34,200	35,700	32,000	27,200
2014	29,700	31,200	33,600	28,600	25,300
2013	29,700	31,300	33,800	30,600	27,800
2012	30,000	31,800	34,200	31,400	29,400
2011	30,500	32,600	34,900	32,300	29,100
2010	30,500	32,300	34,900	31,400	29,200
2009	31,400	33,300	34,200	32,300	28,500
2008	27,900	30,500	32,900	31,400	27,400
2007	31,600	32,800	34,800	32,200	28,500
2006	33,200	-	36,000	32,800	29,600
Annual Linear Growth Rate	0.09%	1.09%	0.45%	0.20%	0.22%
R^2 Value	0.37%	36.84%	17.96%	1.89%	1.60%

Source: SCTPO Traffic Count Database

3.3 Model Volume Growth

The currently adopted version of the Central Florida Regional Planning Model (CFRPM) v6.1 with a base year 2010 and forecast year 2040 was utilized to estimate model volume growth. As documented in the Existing Conditions Summary, future land uses adjacent to the study corridor were reviewed, and socioeconomic data within the model were reviewed and compared to the land uses summarized in the Existing Conditions Summary. The socioeconomic data from the model was comparable to anticipated future land uses, thus no adjustments were made to the adopted model. The horizon year scenario utilized the cost-feasible long-range transportation plan (LRTP) network. A sub-area model validation was not completed as part of this study.

Project AADT volume growth from the model was calculated and compared to the existing (2017) AADTs. Model plots showing the 2010 and 2040 peak season weekday average daily traffic (PSWADT) volumes are provided in **Appendix A**. The 2010 and 2040 PSWADT values were converted to AADTs using the model output conversion factor (MOCF) of 0.93, obtained from Florida Traffic Online. The resulting annual growth projected by the CFRPM is summarized in **Table 3**.

Table 3: CFRPM Model Growth Summary

Roadway Segment	Existing (2017) AADT	Model Growth	
		AADT per Year	Annual Growth Rate
Palm Bay Road to Eber Boulevard	33,143	35	0.10%
Eber Boulevard to Florida Avenue	35,862	46	0.13%
Florida Avenue to University Boulevard	37,697	86	0.23%
University Boulevard to Melbourne Avenue	34,588	55	0.16%
Melbourne Avenue to US 192	31,778	93	0.29%

Projected growth from the model is 0.10 percent to 0.29 percent per year, which falls within the range of growth produced by the historical trends.

3.4 Population Projections

Population projections for Brevard County were obtained from the University of Florida's Bureau of Business and Economic Research (BEBR). The BEBR projections show an estimate for 2017 and projections for 2020 to 2045. The low, medium, and high projections for Brevard County in 2045 (the Design Year) are summarized in **Table 4**. Population growth rates for Brevard County range from approximately 0.27 percent (low) to 1.66 percent (high) per year. BEBR population study data is provided in **Appendix A**.

Table 4: BEBR Population Growth Projections (Brevard County)

Estimation	2017 Estimate	2045 Projection	Annual Growth Rate, Growth/Year (%)
Low	575,211	617,900	1,525 (0.27%)
Medium		711,100	4,853 (0.84%)
High		842,000	9,528 (1.66%)

BEBR Volume 51, Bulletin 180, January 2018

These population projections account for countywide population data and do not necessarily reflect expected population growth in sub-areas of the County (e.g., City of Melbourne) or traffic growth on specific roadways. It is useful in reviewing reasonableness of growth rates obtained from other sources such as travel demand models or historical AADT data.

3.5 Selection of Applied Growth Rates

After evaluation, little growth is anticipated from the travel demand model – which accounts for land use changes, and the historical trends are generally in line with model forecasts. Based upon the evaluation of the historical trends, model growth, and the range of population forecasts, the study team, along with the Project Visioning Team (PVT) members, concluded that the applied linear growth rates summarized in **Table 5** will provide reasonable forecasts for the study corridor. The selected growth rates consist of the average annual growth from historical trends and model forecasts on the corridor, and generally align with the low-end population growth projections for Brevard County.

Table 5: Selected Annual Growth Rates

Roadway Segment	Existing (2017) AADT	Selected Annual Growth	
		AADT	Rate
Palm Bay Road to Eber Boulevard	33,143	110	0.3%
Eber Boulevard to Florida Avenue	35,862		
Florida Avenue to University Boulevard	37,697	120	0.3%
University Boulevard to Melbourne Avenue	34,588	70	0.2%
Melbourne Avenue to US 192	31,778		

For the purposes of this planning study, the design year (2045) AADT forecasts and intersection turning volume forecasts were estimated by simply applying the growth rate to the existing volumes. The design year (2045) AADT forecasts and intersection turning volume forecasts are illustrated in **Figure 2**, **Figure 3**, and **Figure 4**.

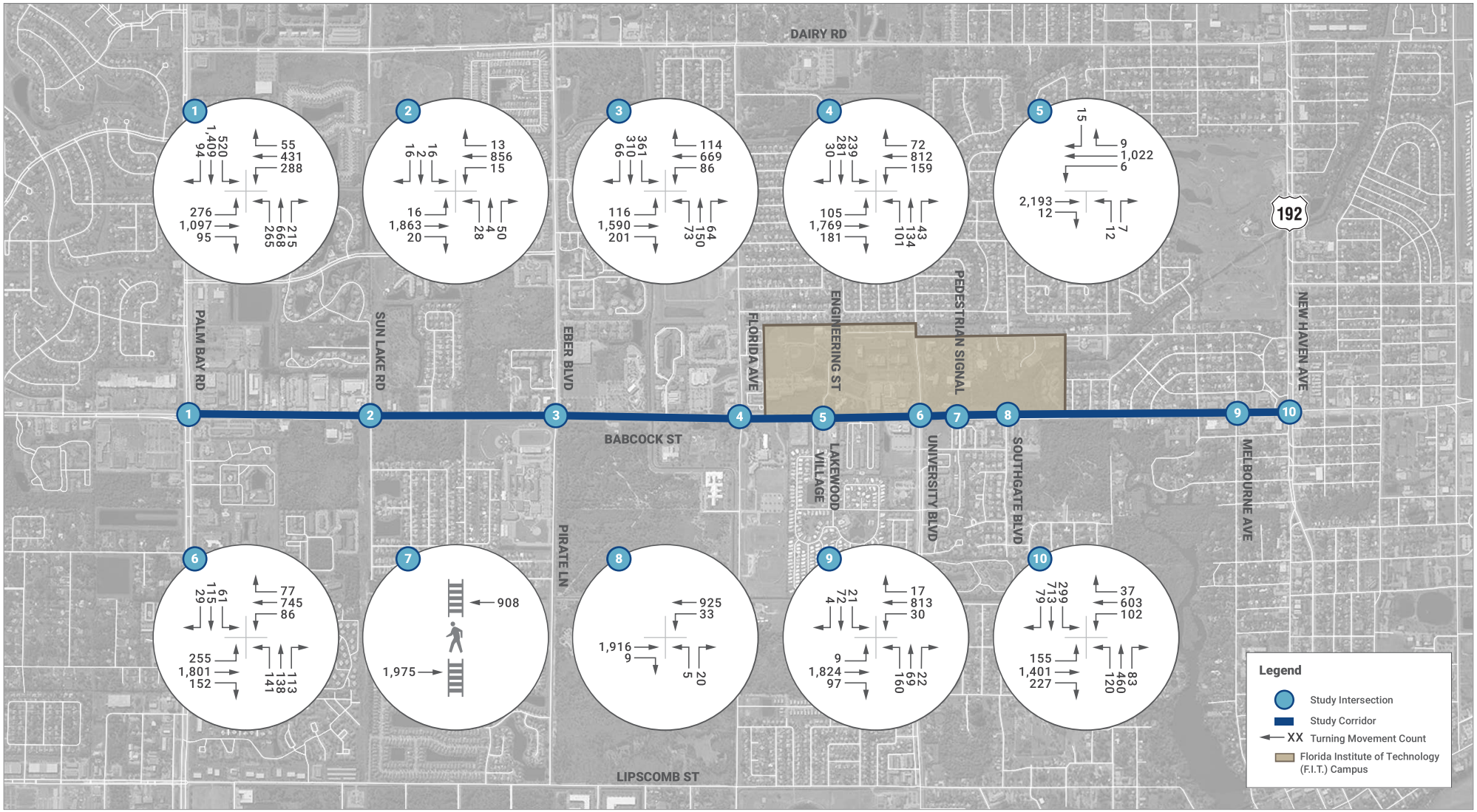


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FIGURE 2 | **2045 AM Peak Hour Intersection Volumes**

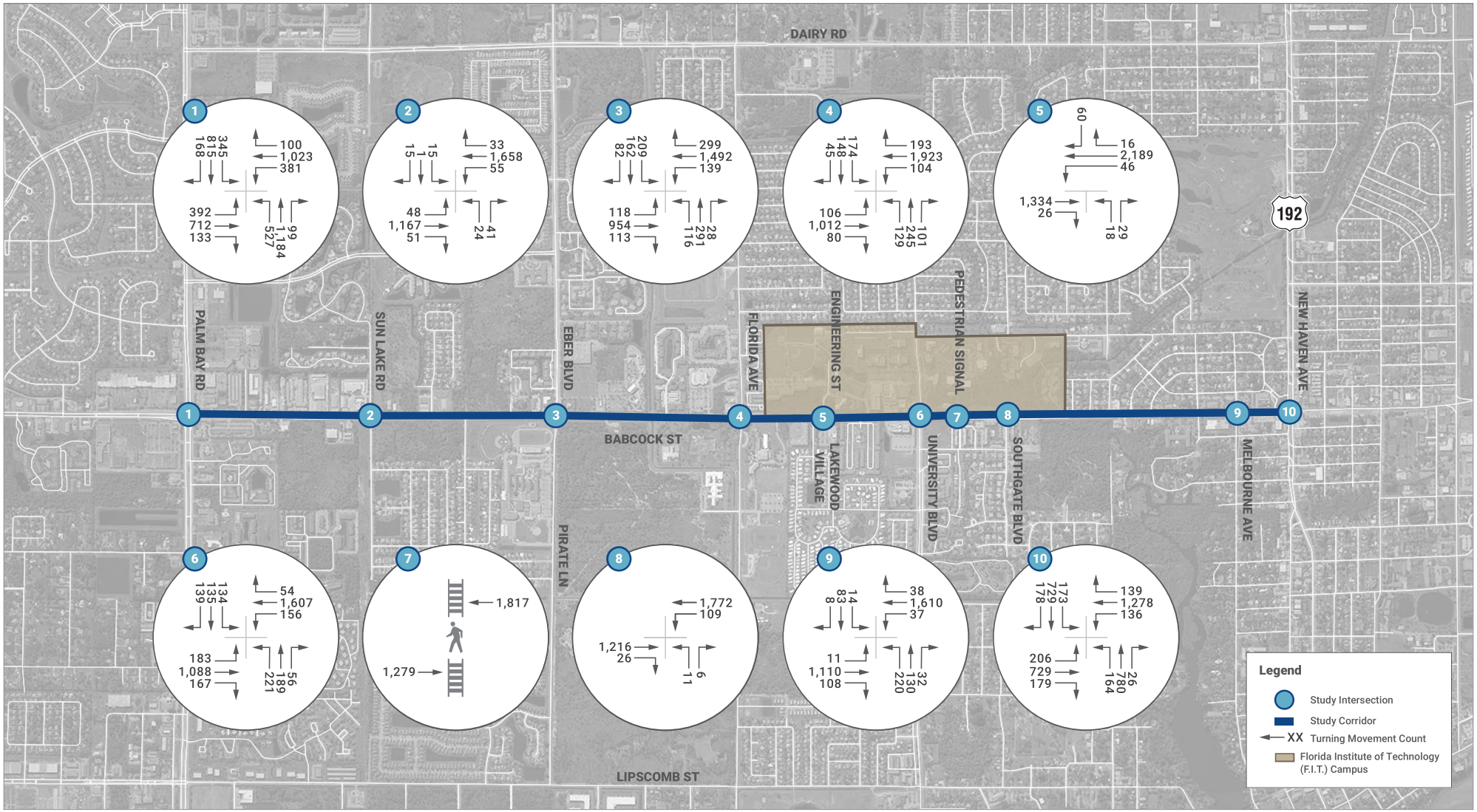

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FIGURE 3 | **2045 PM Peak Hour Intersection Volumes**

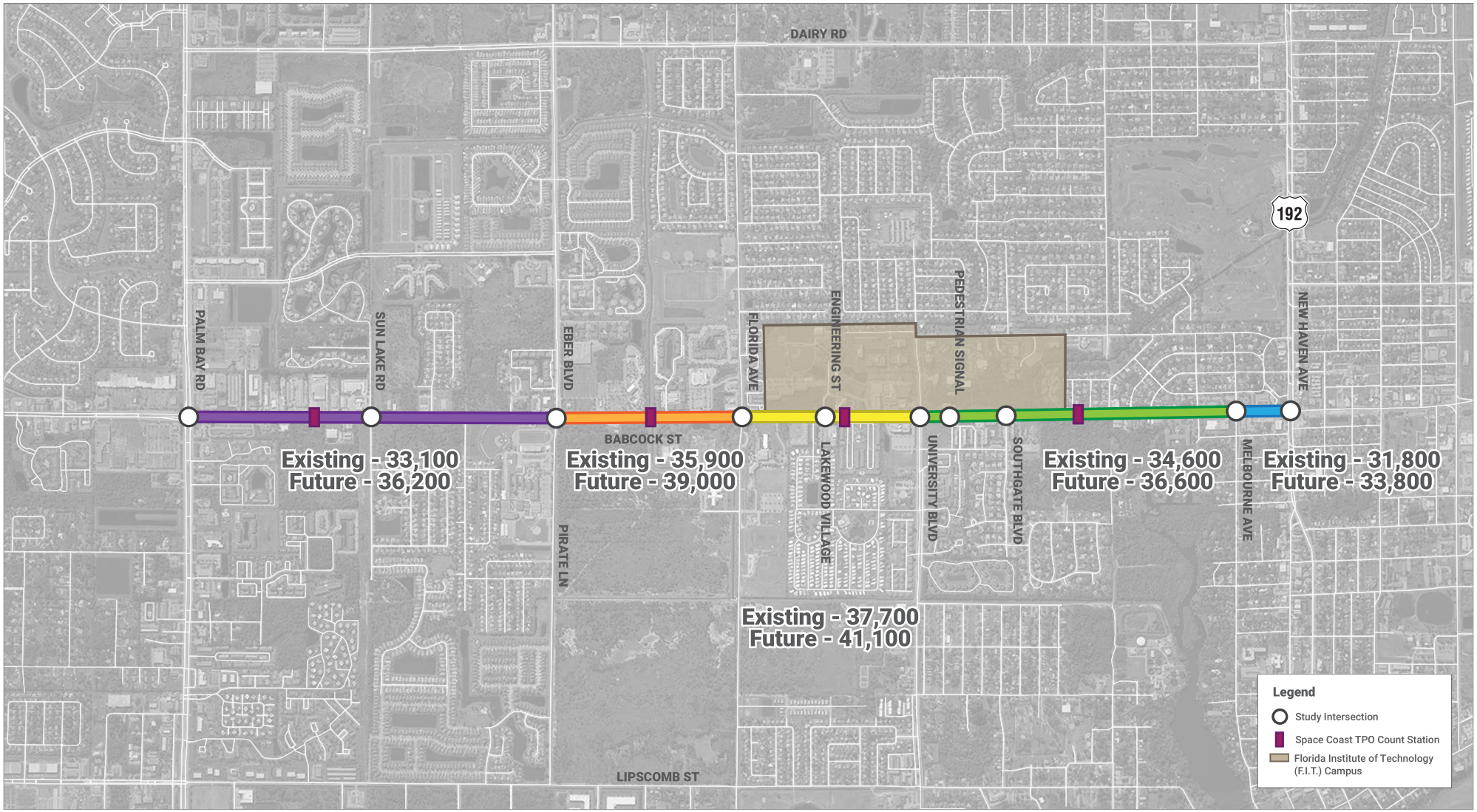

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FIGURE 4 | **Existing 2017 and Future 2045 Annual Average Daily Traffic**

4. NO BUILD ANALYSIS

An operations analysis was completed using Highway Capacity Manual (HCM) methodologies to evaluate future operational conditions on the study corridor and intersections under the No Build scenario.

4.1 Roadway and Intersection Characteristics

The existing roadway facility and intersection characteristics will continue under the No Build scenario. Intersection traffic control and geometric lane configurations for the No Build scenario are illustrated in **Figure 5**.

4.2 Multimodal Traffic Operations

A traffic operations analysis was completed for the design year using Highway Capacity Manual (HCM) methodologies to evaluate future operational conditions on the study corridor and intersections.

Roadway Segment Operations

A Level of Service (LOS) evaluation based on the Generalized FDOT Tables was performed to identify operational performance along the Babcock Street study corridor. An evaluation of the future LOS along Babcock Street was performed by comparing segment AADTs versus the LOS volume threshold from the FDOT Generalized LOS Tables found in the 2020 FDOT Quality/LOS Handbook. The FDOT LOS standard and volume thresholds are consistent from the Existing Conditions Report. The roadway segment analyses are summarized in **Table 6**. In the future (2045) No Build scenario, the Babcock Street segments are anticipated to meet FDOT's LOS target.

Table 6: 2045 Roadway Segment Analysis (No Build)

Segment	FDOT LOS Target	Daily Service Volume	Existing (2017)		No Build (2045)	
			AADT	LOS	AADT	LOS
Palm Bay Road to Pirate Lane/ Eber Boulevard	D	39,800	33,100	C	36,200	C
Pirate Lane/Eber Boulevard to Florida Avenue	D	39,800	35,900	C	39,000	D
Florida Avenue to University Boulevard	D	41,800	37,700	C	41,100	D
University Boulevard to Southgate Boulevard	D	39,800	34,600	C	36,600	C
Southgate Boulevard to Melbourne Avenue	D	39,800	34,600	C	36,600	C
Melbourne Avenue to US 192	D	34,000	31,800	D	33,800	D

**Source: 2020 FDOT Quality/LOS Handbook Tables*

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FIGURE 5 | **No Build Study Intersection Characteristics**

Multimodal LOS analyses were also completed as summarized in **Table 7**. This analysis evaluated the bicycle, pedestrian, and transit LOS along the corridor utilizing the multimodal LOS thresholds from the FDOT Generalized LOS Tables.

Table 7: 2045 Pedestrian and Bicycle LOS Analysis – (No Build)

Segment	AADT	Bike Lane Coverage	Bicycle LOS Score	Sidewalk Coverage	Pedestrian LOS Score	Transit LOS
Palm Bay Road to Pirate Lane/ Eber Boulevard	36,200	25%	E	88%	E	F
Pirate Lane/Eber Boulevard to Florida Avenue	39,000	0%	E	100%	E	F
Florida Avenue to University Boulevard	41,100	0%	F	100%	E	D
University Boulevard to Southgate Boulevard	36,600	0%	E	100%	E	D
Southgate Boulevard to Melbourne Avenue	36,600	0%	E	100%	E	D
Melbourne Avenue to US 192	33,800	100%	C	100%	D	D

**Source: 2020 FDOT Quality/LOS Handbook Tables*

The bicycle LOS is E from Palm Bay Road to Florida Avenue and from University Boulevard to Melbourne Avenue and LOS F from Florida Avenue to University Boulevard in the future No Build condition due to facility gaps and high vehicle volumes. The Pedestrian LOS is E from Palm Bay Road to Melbourne Avenue. The transit LOS is F from Palm Bay Road to Florida Avenue due to lack of transit service. A map of the existing transit routes is provided in Figure 21 of the Existing Conditions Report.

Peak Hour Intersection Operations

The future (2045) intersection operating conditions were evaluated for the weekday AM and PM peak hour traffic volume conditions in the No Build scenario. Signal timing improvements (signal splits and coordination offset updates) were made to the existing timings. No changes to the overall cycle lengths were made except at Palm Bay Road. The intersection LOS was analyzed using HCM methodologies, as implemented by Synchro Version 10.1. Detailed HCM output reports are provided in **Appendix B**. **Table 8** summarizes the peak hour intersection operations. For the signalized intersections, average delay and LOS are presented for each approach and for the overall intersection. For the unsignalized intersections, average delay and LOS are presented for the controlled approaches and for the critical movement on uncontrolled approaches. The volume-to-capacity (v/c) ratios are reported for the critical movement on each approach. The controlled approaches and uncontrolled critical movements operate at LOS D or better, with the following exceptions:

- **Babcock Street at Palm Bay Road**: The overall intersection operates at LOS E with an average delay of 75 seconds in the AM peak hour and LOS F with an average delay of 85 seconds in the PM peak hour.
    - In the AM peak hour, the northbound approach operates at LOS F with and average delay of 90 seconds. The eastbound, westbound, and southbound approaches operate at LOS E with average delays of 55-80 seconds.

Table 8: 2045 Intersection Operations Analysis – (No Build)

Intersection	Measure	AM Peak Hour					PM Peak Hour				
		EB	WB	NB	SB	Overall	EB	WB	NB	SB	Overall
Babcock Street at Palm Bay Road	Delay (LOS)	76.8 (E)	56.8 (E)	91.2 (F)	78.3 (E)	76.7 (E)	49.4 (D)	114.5 (F)	93.8 (F)	73.5 (E)	**84.9 (F)**
	v/c ratio	1.15	0.87	1.16	0.95	-	0.50	1.31	1.11	0.93	-
Babcock Street at Sun Lake Road*	Delay (LOS)	>150.0 (F)	>150.0 (F)	8.3 (A)	13.3 (B)	-	>150.0 (F)	>150.0 (F)	11.6 (B)	9.3 (A)	-
	v/c ratio	0.72	2.13	0.01	0.03	-	1.23	1.20	0.08	0.06	-
Babcock Street at Eber Boulevard/Pirate Lane	Delay (LOS)	89.9 (F)	60.0 (E)	62.3 (E)	9.6 (A)	**55.4 (E)**	64.5 (E)	76.9 (E)	41.1 (D)	13.8 (B)	**34.5 (C)**
	v/c ratio	1.05	0.50	0.99	0.68	-	0.84	0.90	0.86	1.01	-
Babcock Street at Florida Avenue	Delay (LOS)	119.0 (F)	77.9 (E)	53.7 (D)	12.8 (B)	**53.7 (D)**	88.7 (F)	78.6 (E)	34.3 (C)	44.6 (D)	**49.3 (D)**
	v/c ratio	1.13	0.75	1.03	0.77	-	1.00	0.93	0.62	1.09	-
Babcock Street at Lakewood Village Place*	Delay (LOS)	-	>150.0 (F)	-	20.7 (C)	-	-	23.1 (C)	-	12.9 (B)	-
	v/c ratio	-	0.92	-	0.03	-	-	0.14	-	0.09	-
Babcock Street at Engineering Street*	Delay (LOS)	10.7 (B)	-	-	-	-	40.8 (E)	-	-	-	-
	v/c ratio	0.02	-	-	-	-	0.38	-	-	-	-
Babcock Street at University Boulevard	Delay (LOS)	67.0 (E)	96.5 (F)	34.3 (C)	13.7 (B)	**37.6 (D)**	61.5 (E)	74.2 (E)	60.5 (E)	53.4 (D)	**59.0 (E)**
	v/c ratio	0.41	1.03	0.89	0.66	-	0.45	0.85	0.94	1.04	-
Babcock Street at Pedestrian Signal	Delay (LOS)	-	-	0.4 (A)	0.2 (A)	**0.3 (A)**	-	-	0.2 (A)	0.5 (A)	**0.4 (A)**
	v/c ratio	-	-	0.56	0.26	-	-	-	0.36	0.51	-
Babcock Street at Southgate Boulevard	Delay (LOS)	-	96.1 (F)	18.1 (B)	6.6 (A)	**15.0 (B)**	-	90.0 (F)	17.9 (B)	11.7 (B)	**14.6 (B)**
	v/c ratio	-	0.61	0.74	0.34	-	-	0.37	0.53	0.66	-
Babcock Street at Melbourne Ave	Delay (LOS)	82.8 (F)	89.0 (F)	36.9 (D)	11.7 (B)	**35.6 (D)**	85.4 (F)	84.0 (F)	13.9 (B)	15.1 (B)	**24.6 (C)**
	v/c ratio	0.63	0.80	0.89	0.33	-	0.73	0.83	0.49	0.65	-
Babcock Street at US 192	Delay (LOS)	68.8 (E)	61.1 (E)	48.5 (D)	48.5 (D)	**55.7 (E)**	67.7 (E)	67.2 (E)	44.2 (D)	55.3 (E)	**58.0 (E)**
	v/c ratio	0.85	0.58	0.91	0.78	-	0.81	0.81	0.84	0.89	-

**Stop Controlled Intersection*

***Average delays (seconds) and LOS reported for approach on controlled approaches or critical movement on uncontrolled approaches. Volume-to-capacity (v/c) ratios reported for critical movement on all approaches.*

  - In the PM peak hour, the westbound and northbound approaches operate at LOS F with average delays of 95-115 seconds. The southbound approach operates at LOS E with an average delay of 75 seconds.

- **Babcock Street at Sun Lake Road (stop-controlled)**: The eastbound and westbound approaches operate at LOS F with average delays exceeding 150 seconds in the AM and PM peak hours.
- **Babcock Street at Eber Boulevard/Pirate Lane**: The overall intersection operates at LOS E in the AM peak hour.
  - In the AM peak hour, the eastbound approach operates at LOS F with an average delay of 90 seconds. The westbound and northbound approaches operate at LOS E with average delays of 60-65 seconds.
  - In the PM peak hour, the eastbound and westbound approaches operate at LOS E with average delays of 65-75 seconds.
- **Babcock street at Florida Avenue**:
  - In the AM peak hour, the eastbound approach operates at LOS F with an average delay of 120 seconds. The westbound approach operates at LOS E with an average delay of 80 seconds.
  - In the PM peak hour, the eastbound approach operates at LOS F with an average delay of 90 seconds. The westbound approach operates at LOS E with average delays of 80 seconds.
- **Babcock Street at Lakewood Village Place (stop-controlled)**: The westbound approach operates at LOS F with an average delay exceeding 150 seconds in the AM peak hour.
- **Babcock Street at Engineering Street (stop-controlled)**: The eastbound approach operates at LOS E with an average delay of 40 seconds in the PM peak hour.
- **Babcock Street at University Boulevard**: The overall intersection operates at LOS E in the PM peak hour.
  - In the AM peak hour, the westbound approach operates at LOS F with an average delay of 95 seconds and the eastbound approach operates at LOS E with an average delay of 65 seconds.
  - In the PM peak hour, the eastbound, westbound, and northbound approaches operate at LOS E with average delays of 60-75 seconds.
- **Babcock Street at Southgate Boulevard**: The westbound approach operates at LOS F with average delays of 90-95 seconds in the AM and PM peak hours.
- **Babcock Street at Melbourne Avenue**: The eastbound and westbound approaches operate at LOS F with average delays of 85-90 seconds in the AM and PM peak hours.
- **Babcock Street at US 192**: The overall intersection operates at LOS E in the AM and PM peak hour.
  - In the AM peak hour, the eastbound and westbound approaches operate at LOS E with average delays of 60-70 seconds.
  - In the PM peak hour, the eastbound, westbound, and southbound approaches operate at LOS E with average delays of 55-70 seconds.

4.3 No Build Analysis Summary

The findings of the No Build analysis are summarized as follows:

- The Babcock Street segments are anticipated to meet FDOT's LOS target (D) in the design year (2045).
- The bicycle LOS is F along Babcock Street from Florida Avenue to University Boulevard, and LOS E from Palm Bay Road to Florida Avenue and from University Boulevard to Melbourne Avenue due to lack of bicycle facilities and the high volume of traffic in the future No Build condition.
- The pedestrian LOS is E from Palm Bay Road to Melbourne Avenue due to the high volume of traffic adjacent to the sidewalks in the future No Build condition.
- Peak hour operations are expected to degrade to LOS F in the design year on one or more approaches during the peak hour(s) at Palm Bay Road, Sun Lake Road, Eber Boulevard/Pirate Lane, Florida Avenue, Lakewood Village Place, University Boulevard, Southgate Boulevard, and Melbourne Avenue.

5. ALTERNATIVES ANALYSIS AND DEVELOPMENT

Project alternatives for Babcock Street were developed based upon the project purpose and need.

5.1 Design Criteria

As discussed in the next section, a suburban 40 mile per hour (MPH) typical section is being considered for Babcock Street from Palm Bay Road to Florida Avenue with a 30 MPH typical section from Florida Avenue to US 192. The FDOT Design Manual (FDM) provides design criteria for Florida state roadways. The design control list and current design criteria for a 40 MPH typical section are listed in **Table 9** and **Table 10**. The design control list and current design criteria for a 30 MPH typical section are listed in

Table 11 and **Table 12**.

Table 9: Design Control List

Design Control		Palm Bay Road to Florida Avenue – Suburban Typical Section	Source
General Criteria	Functional Class	Principal Arterial	FDM Table 200.2.1
	Context Classification	C3C – Suburban Commercial	FDM Table 200.4.1
	Proposed Access Management Classification	5	FDM Table 201.4.2
	Design/Posted Speed	40	FDM Table 201.5.1
	Design Year	2045	Planning Study Documentation
	Travel Lanes	4	Existing
	Facility within Urban Boundary	Yes	Florida Urban Area Buffer Maps
	Stormwater Management Facilities	Closed	Existing

Source: 2020 FDOT Design Manual (FDM)

Table 10: Design Standards List for Typical Sections

Design Control		Palm Bay Road to Florida Avenue – Suburban Typical Section	Source
Typical Section Element	Typical Section Type	Suburban	Existing
	Lane Widths	11 ft.	FDM Table 210.2.1
	Median Width (ft) (min)	22 ft.	FDM Table 210.3.1
	Outside Shoulder Width (Full/Paved) (ft.)	15.5 ft./8 ft.	FDM Table 210.4.1
	Inside Shoulder Width (Full/Paved) (ft.)	15.5 ft./8 ft.	FDM Table 210.4.1
	Curb & Gutter Type	Type E, F	FDM Section 210.5
	Sidewalk Width (ft.)	6 ft.	FDM Table 222.1.1
	Bicycle Lane Width	7 ft. buffered	FDM Section 223.2.1.1
	Shared Use Path Width	12 ft.	FDM Section 224.4
	Clear Zone	18 ft.	FDM Table 215.2.1

Source: 2020 FDOT Design Manual (FDM)

Table 11: Design Control List

Design Control		Florida Avenue to US 192 – Suburban Typical Section	Source
General Criteria	Functional Class	Principal Arterial	FDM Table 200.2.1
	Context Classification	C3R – Florida Avenue to Panther Place and South of Vida Way to Edgewood Drive C4 – Panther Place to University Boulevard and Edgewood Drive to US 192 C3C – University Boulevard to South of Vida Way	FDM Table 200.4.1
	Proposed Access Management Classification	5	FDM Table 201.4.2
	Design/Posted Speed	30	FDM Table 201.5.1
	Design Year	2045	Planning Study Documentation
	Travel Lanes	4	Existing
	Facility within Urban Boundary	Yes	Florida Urban Area Buffer Maps
	Stormwater Management Facilities	Closed	Existing

Source: 2020 FDOT Design Manual (FDM)

Table 12: Design Standards List for Typical Sections

Design Control		Florida Avenue to US 192 – Suburban Typical Section	Source
Typical Section Element	Typical Section Type	Suburban	Existing
	Lane Widths	10 ft.	FDM Table 210.2.1
	Median Width (ft) (min)	C3 – 22 ft. C4 – 15.5 ft.	FDM Table 210.3.1
	Outside Shoulder Width (Full/Paved) (ft.)	15.5 ft./8 ft.	FDM Table 210.4.1
	Inside Shoulder Width (Full/Paved) (ft.)	15.5 ft./8 ft.	FDM Table 210.4.1
	Curb & Gutter Type	Type E, F	FDM Section 210.5
	Sidewalk Width (ft.)	6 ft.	FDM Table 222.1.1
	Bicycle Lane Width	7 ft. buffered	FDM Section 223.2.1.1
	Shared Use Path Width	12 ft.	FDM Section 224.4
	Clear Zone	12 ft.	FDM Table 215.2.1

Source: 2020 FDOT Design Manual (FDM)

5.2 Access Management

The existing access management classification for Babcock Street is Class 5 throughout the study limits. For Class 5 roadways with posted speeds of 45 MPH or less, the following standards are provided in Rule 14-97 of the Florida Administrative Code (FAC):

- Median: Restrictive
- Full Median Opening Spacing Standard: 2,640 feet
- Directional Median Opening Spacing Standard: 1,320 feet
- Signal Spacing: 2,640 feet

Each median opening and intersection along the corridor was evaluated against the access management standards, as summarized in **Table 13**. Most median openings along the corridor do not meet the spacing standards, and the 0.45-mile segment from Vida Way to Melbourne Avenue does not have a restrictive median. Implementing consistent access management can improve corridor safety by eliminating unnecessary conflicts, improving driver expectancy, and controlling vehicular speeds. **Table 13** includes a summary of proposed actions to implement consistent access management throughout the study corridor, and these proposed changes are illustrated in **Figure 6**.

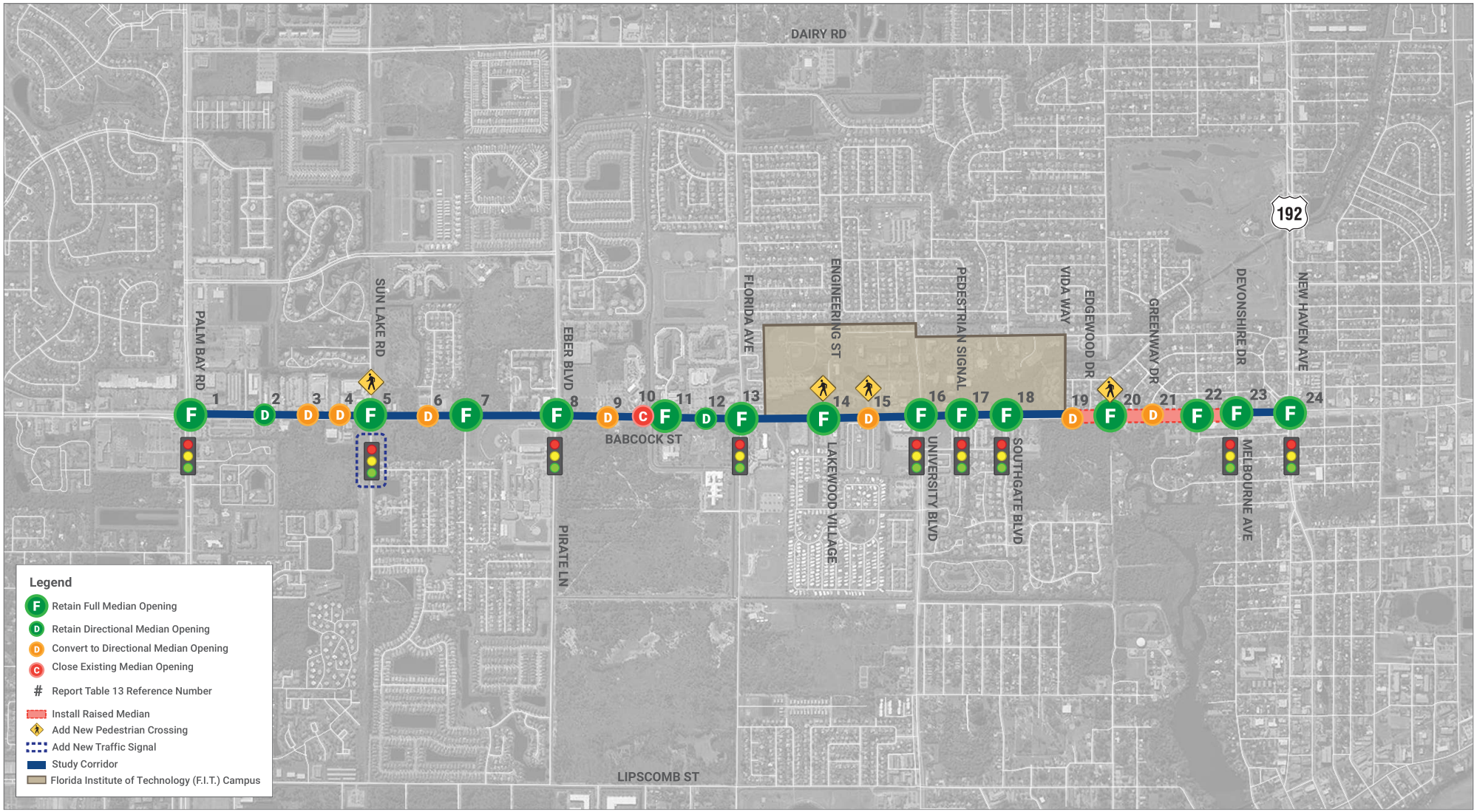
Table 13: Access Management Summary

Cross-Street	Median / Opening	Reference Number	Dir	Traffic Control	Spacing (ft)*	Comment	Proposed Action
Palm Bay Road	Full	1		Signal			
	Restricted				1,250		
	Directional	2	Bi				Tighten up median nose - leave directional in place
	Restricted				**500**		
	Full	3	NB			T-int, no SB U-turn lane	Convert to NB Directional
	Restricted				**410**		
	Full	4	SB			No NBLT lane	Convert to SB Directional
	Restricted				**450**		
Sun Lake Road	Full	5		TWSC			
	Restricted				**840**		
Cinnamon Lake Cir	Full	6	NB	TWSC		T-int, no SB U-turn lane	Convert to NB Directional
	Restricted				**530**		
Crown Blvd	Full	7	SB	TWSC		T-int, no NB U-turn lane	Leave in place
	Restricted				1,310		
Eber Blvd/Pirate Ln	Full	8		Signal			
	Restricted				**720**		
	Full	9	NB			No SBLT lane	Convert to NB Directional
	Restricted				**545**		
	Full	10	NB			No SBLT lane, NBLT lane to closed driveway	Close this opening
	Restricted				**310**		
Misty Oak Drive	Full	11		TWSC		Short NBLT lane	Extend the NB left-turn lane
	Restricted				**575**		
	Directional	12	NB				Leave in place
	Restricted				**510**		
Florida Ave	Full	13		Signal			
	Restricted				**1,025**		
Villagewood Place	Full	14	SB	TWSC		T-int, no NB U-turn lane	Line up with Engineering St, install NB LT lane - provide a protected pedestrian crossing
	Restricted				**680**		
	Full	15	SB			T-int, no NB U-turn lane	Line up with Panther Place, install NB LT lane - provide a protected pedestrian crossing
	Restricted				**845**		
University Blvd	Full	16		Signal			
	Restricted				**865**		
	Full	17	NB			T-int, no SB U-turn lane	Leave in place
	Restricted				**385**		
Southgate Blvd	Full	18	SB	Signal		T-int, no NB U-turn lane	
	Restricted				**935**		
Vida Way	Full	19	NB	TWSC		T-int, no SB U-turn lane	Convert to NB Directional
	Unrestricted				**260**		Install restrictive median

Table 13: Access Management Summary (continued)

Cross-Street	Median / Opening	Reference Number	Dir	Traffic Control	Spacing (ft)*	Comment	Proposed Action
Rosevere Way				TWSC			Close this opening
	Unrestricted				**275**		Install restrictive median
Edgewood Drive		20		TWSC		Provides Network Connection	Convert to Full Median Opening
	Unrestricted				**295**		Install restrictive median and provide pedestrian crossing
Colonial Drive				TWSC			Close this opening
	Unrestricted				**300**		Install restrictive median
Greenway Drive		21		TWSC			Convert to Bi-Directional Median Opening (let SBLT line up with business driveway)
	Unrestricted				670		Install restrictive median
Devonshire Drive		22		TWSC		Provides Network Connection	Convert to Full Median Opening
	Unrestricted				**555**		Install restrictive median
Melbourne Avenue	Full	23		Signal			
	Restricted				**780**		
US 192	Full	24		Signal			

*Note: A **Bolded** spacing denotes a median opening spacing exceeding a 10% difference from the spacing standard.



Babcock Street Corridor Planning Study

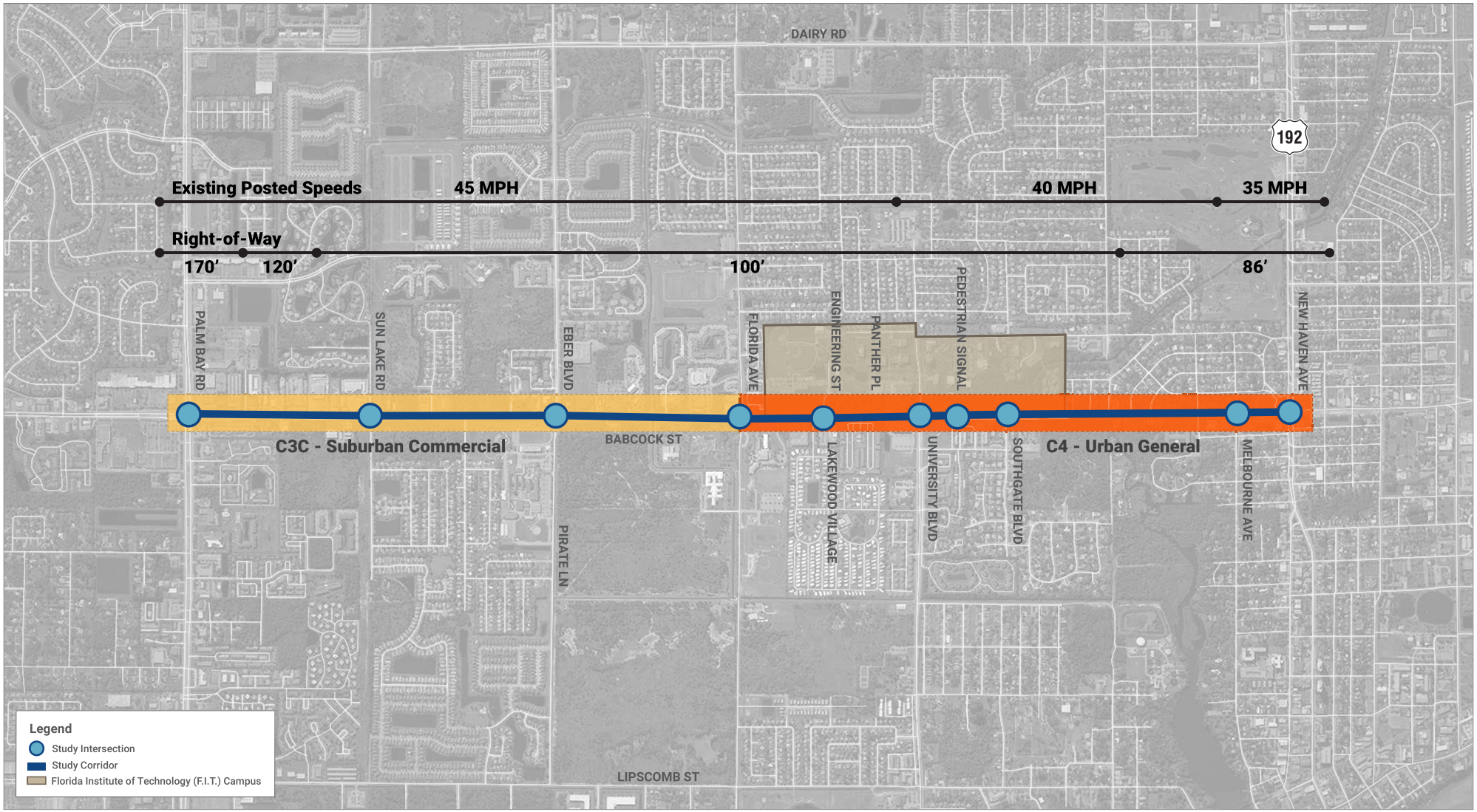
FIGURE 6 | **Access Management Improvements**

5.3 Pedestrian and Bicycle Connectivity

To meet the multimodal connectivity needs of the corridor as specified in this Study, sidewalk gaps will be filled in the future conditions and a continuous bicycle facility will be specified for the planned Resurfacing, Restoration, and Rehabilitation (RRR) project and long-term alternatives. Currently, there is a sidewalk gap on the corridor between Palm Bay Road and Sun Lake Road on the east side of Babcock Street. The bicycle facilities for the future conditions include a combination of shared use path and two-way cycle track throughout the corridor. The facility alternatives are supported by other elements such as a buffer between the facility and the travel lane, street trees, and transit pads to enhance connectivity on the corridor.

The type of facilities proposed for different segments along the corridor are informed by the existing context classification, existing posted speed, ROW, and peak crosswalk volumes. As shown in **Figure 7**, the existing content classification for the corridor is C3C Suburban Commercial from Palm Bay Road to Florida Avenue and C4 Urban General from Florida Avenue to New Haven Avenue, and the posted speed decreases from 45 MPH to 40 MPH at Panther Place and again to 35 MPH approaching Melbourne Avenue. Similarly, the right-of-way (according to the most readily-available data) decreases from 170’ to 86’ from Palm Bay Road to New Haven Avenue as shown in **Figure 7**.

Figure 8 demonstrates the AM and PM peak pedestrian and bicycle activity at the study intersections along the corridor, with the highest AM activity at Eber Boulevard, Florida Avenue, and Pedestrian Signal by the FIT campus main entrance. In the PM, the highest activity is concentrated by the FIT campus main entrance, University Boulevard, and Pedestrian Signal north of University Boulevard. Overlaying all these elements provided the basis for the pedestrian and bicycle facility alternatives for the short-term and long-term, as summarized in **Figure 9**.



Babcock Street Corridor Planning Study

FIGURE 7 | **Context Classification, Right-of-Way, and Posted Speeds**

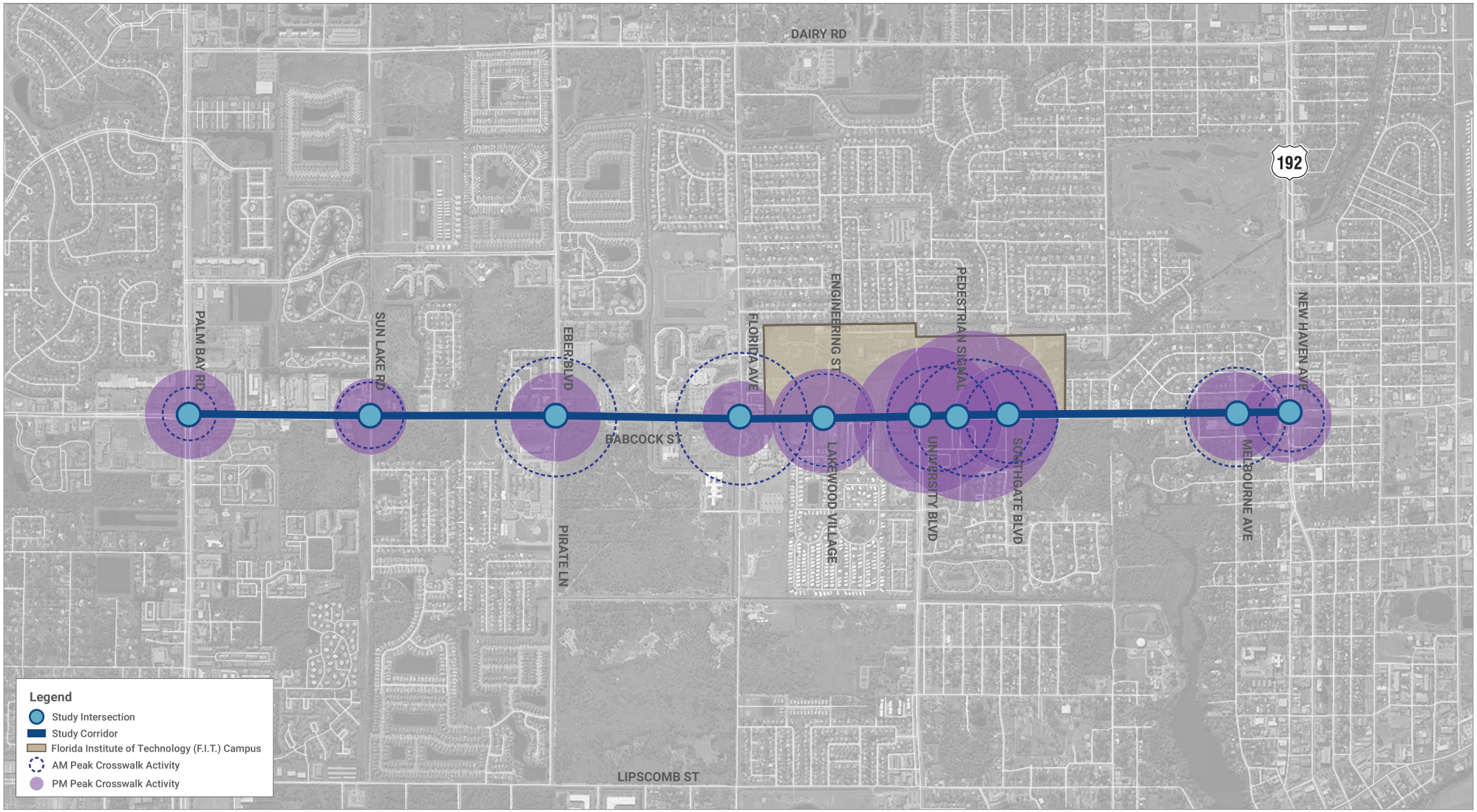


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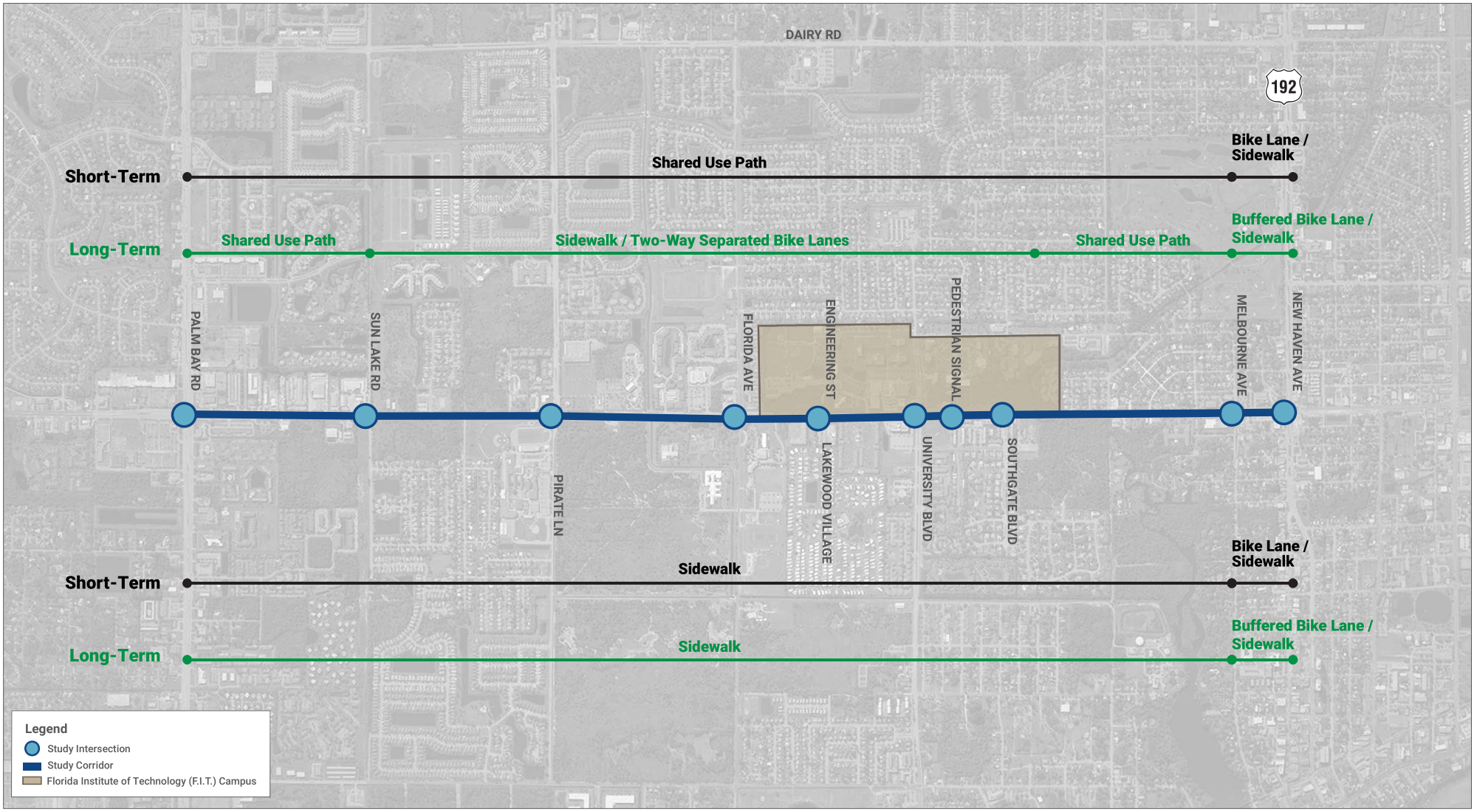
FIGURE 8 | **Pedestrian and Bicycle Activity**



Babcock Street Corridor Planning Study

FIGURE 9 | **Short-Term and Long-Term Pedestrian and Bicycle Facility Alternatives**

Typical Section Alternatives

Typical section alternatives were developed for the existing conditions and short- and long-term conditions based on the characteristics described above. This section describes the bicycle and pedestrian facility alternatives for the following segments:

- Palm Bay Road to Sun Lake Road
- Sun Lake Road to Florida Avenue
- Florida Avenue to Crane Creek Bridge
- Crane Creek Bridge
- Crane Creek Bridge to Melbourne Avenue
- Melbourne Avenue to New Haven Avenue

Figure 10 through **Figure 15** illustrates the proposed short-term and long-term typical section alternatives for Babcock Street. The short-term improvements are recommended to be included along with the potential RRR project while the long-term improvements would be completed as part of future projects.

Figure 10 illustrates the first set of alternatives on the existing 170’ ROW that varies. There is no sidewalk facility on the east side of the road, which is recommended to be completed as part of the short-term alternative. New sidewalk is added in the existing greenspace to close the sidewalk gap and the sidewalk on the west side of the road is widened to 10’ using the existing greenspace/drainage swale between the sidewalk and the travel lane. In the long-term, the 10’ sidewalk on the west side of the road is expanded to a 12’ shared use path as the drainage and utilities allow.

North of Sun Lake Road to Florida Avenue, seen in **Figure 11**, the existing ROW varies from 90’ to 115’ and the existing typical section shows a 98’ ROW with an 8’ sidewalk on the west side, 11.5 travel lanes and a 5’ sidewalk on the east side of the road. This typical section will remain the same in the short-term. In the long-term, the 8’ sidewalk on the west side surrounded by grassed areas becomes a 6’ sidewalk adjacent to an 8’ two-way cycle track, separated by a 2’ buffer. The utility poles in the grassed area between the travel lanes and the sidewalk on the west side of the road are relocated to the outside of the sidewalk in long-term. The travel lane width remains the same, as does the typical section on the east side of the road.

From Florida Avenue to Crane Creek Bridge, the ROW varies from 90’ to 115’ with the typical section ROW at 100’. In the existing condition, the travel lanes are 12’ and there is an 8’ sidewalk on the west side of the road with an 8’ grassed area between the sidewalk and the travel lane in which utility poles are located. A 5’ sidewalk separated from the travel lane by a 5’ grasses area exists in the east side of the road. In the short-term, the travel lanes are reduced to 10.5’ and a 3’ striped buffer separates the travel lanes and the outside curb on both sides of the road. Where there are currently utility poles, trees are included as a local option between the utility pole siting and the sidewalk is expanded to a 10’ shared use path by using the existing grassed area to the west. In the long-term, the 10’ shared use path on the west side of the road becomes a 6’ sidewalk with an 8’ two-way cycle track separated by a

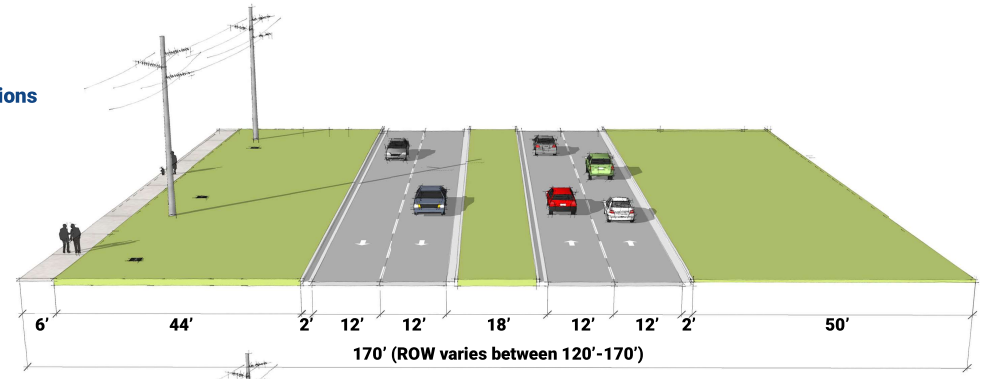
2’ buffer. The utility poles are relocated west of the sidewalk in the grassed area, consistent with the relocated utility poles west of the sidewalk, as shown in **Figure 12**.

Figure 13 shows Crane Creek Bridge has an existing known ROW of 84’ with 11.5’ travel lanes, a 6’ sidewalk on the west side of the road with a 2’ railing and 4’ shoulder between the sidewalk and travel lane. There is a 5’ sidewalk with a 2’ railing on the outside of the sidewalk on the east side of the road. In the short-term and long-term, the travel lanes are reduced to 10.5’, the 6’ sidewalk expands to 12’ shared use path with only an outside barrier of 2’ and a curb of 2’ between the shared use path and the travel lane. The 5’ sidewalk on the east side of the road is expanded to 9’.

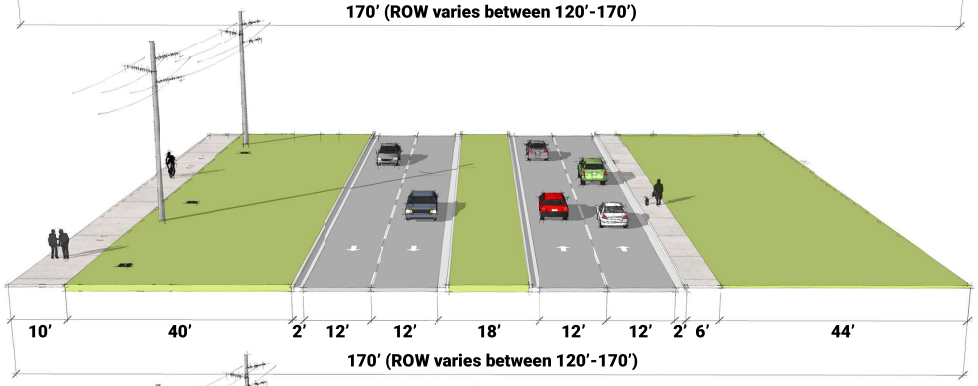
From Crane Creek Bridge the Melbourne Drive, the existing ROW varies from 80’ to 105’, with a width of 86’ as the typical, shown in **Figure 14**. The existing 12’ lanes are reduced to 10.5’ in the short-term and long-term. In the short-term and long-term, the bi-directional median becomes a raised concrete median, and a 3’ striped buffer creates horizontal separation between the travel lanes and the pedestrian facilities on both sides of the road. On the west side of the road, existing 8’ sidewalk becomes a 10’ shared use path utilizing the existing grassed area surrounding it.

For the northernmost segment of the corridor, from Melbourne Avenue to New Haven Avenue, the existing ROW is 100’, as shown in **Figure 15**. Currently and into the short-term, the travel lanes are 12’ and the right-turn lane is 11’. There is an 18’ raised concrete median and 4’ bike lanes in each direction. The existing sidewalk is 6’ on the west side and 5’ on the east side. In the long-term, the travel lanes (except for the turn lane) are reduced to 10.5’ and the bike lanes are expanded to 5’ with a 2’ buffer separation from the travel lanes. The sidewalk widths on both sides of the road remain the same as in the existing condition.

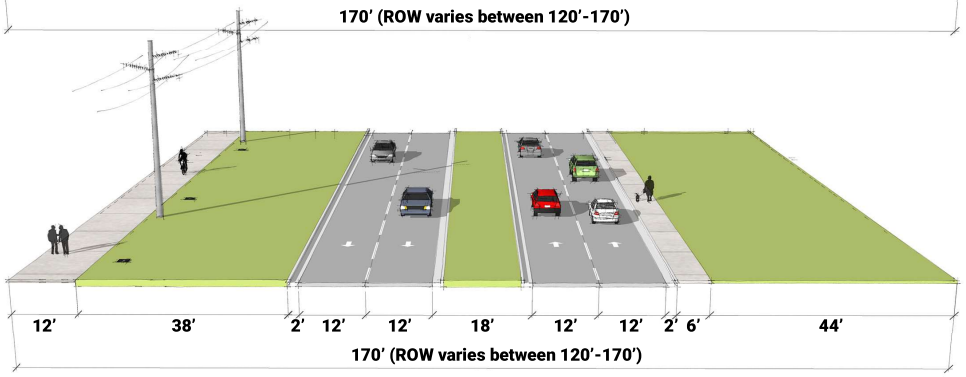
Existing Conditions

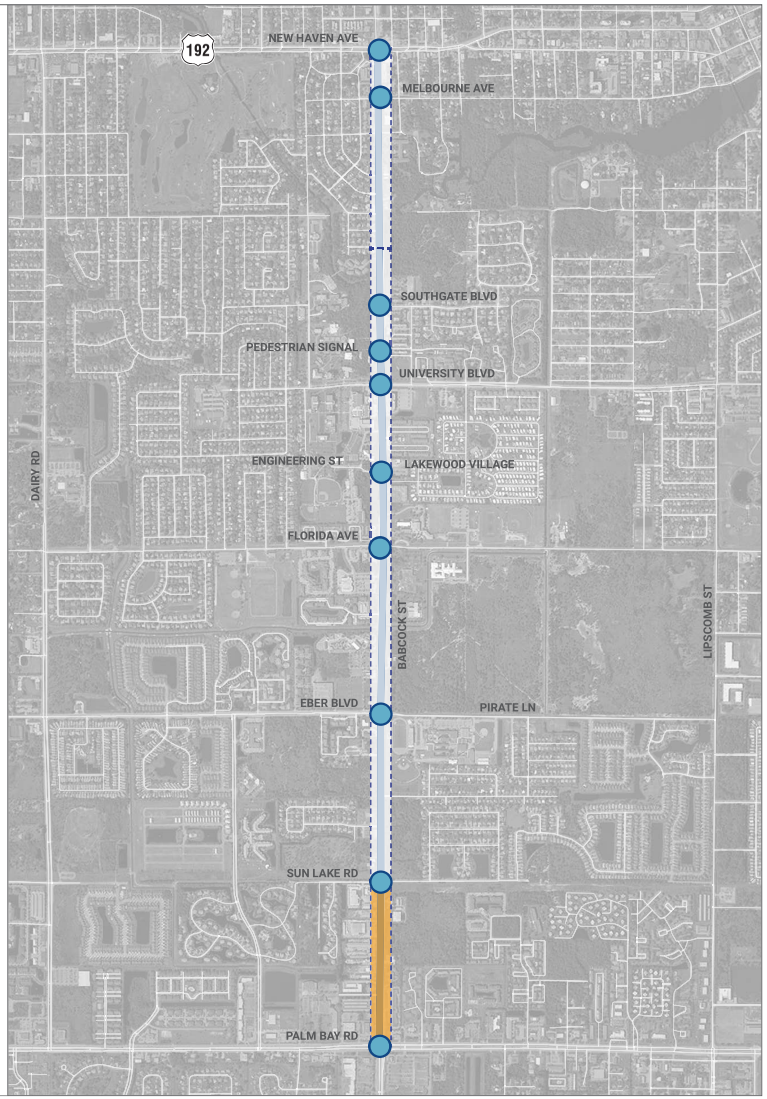


Short-Term



Long-Term



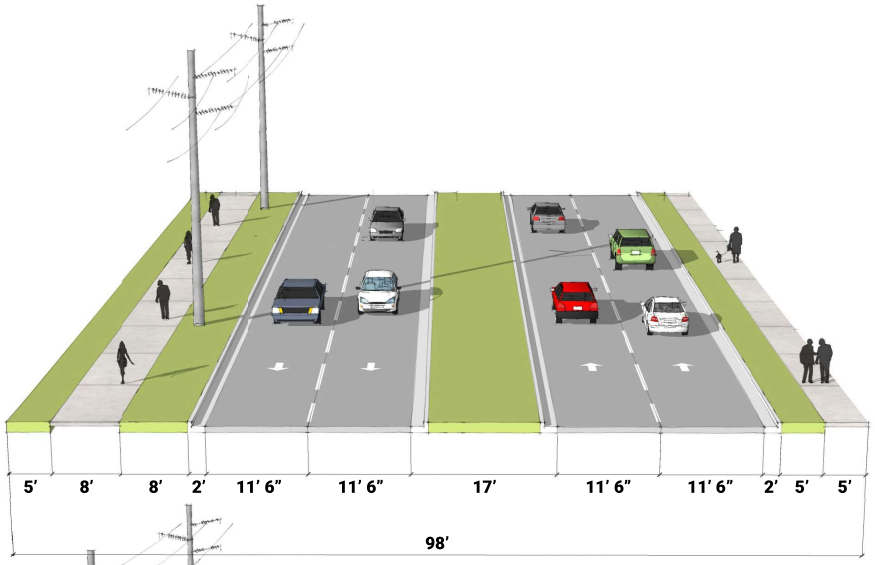


Not to Scale North

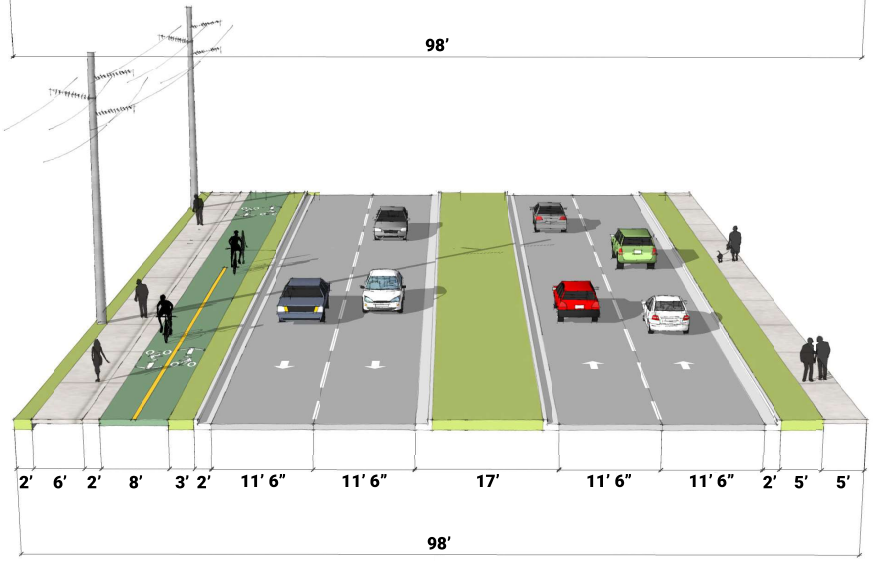
Babcock Street Corridor Planning Study

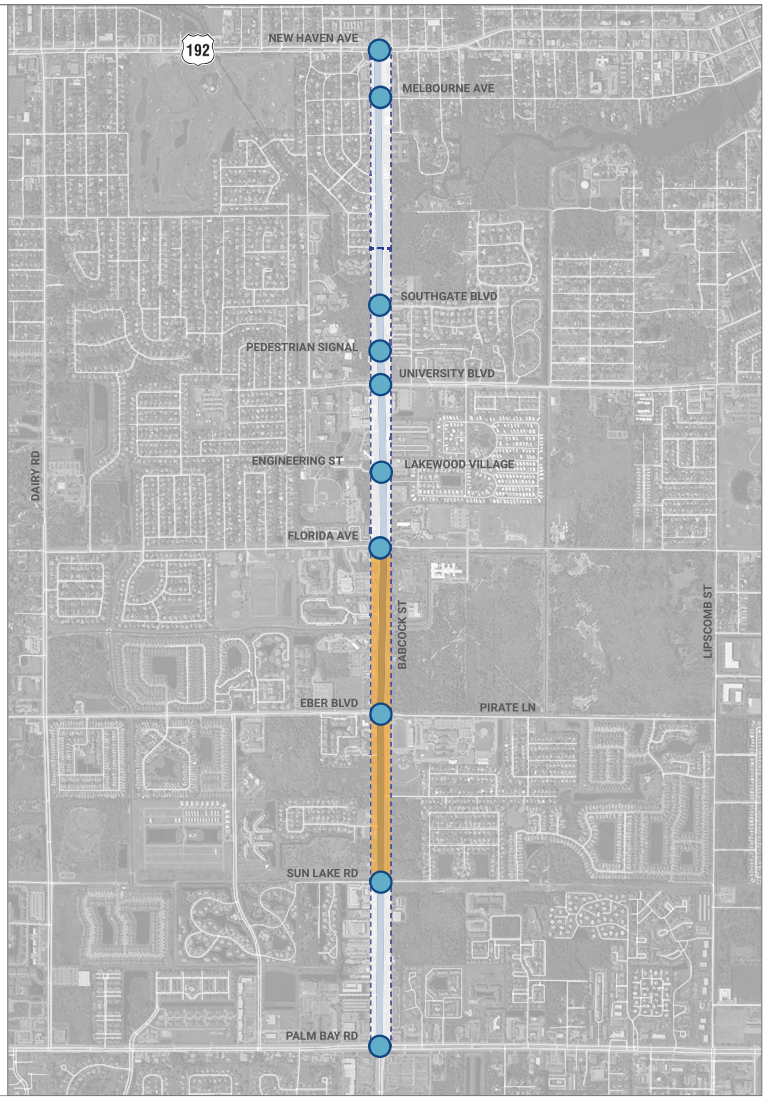
FIGURE 10 | **Palm Bay Road to Sun Lake Road Typical Section**

Existing Condition & Short-Term



Long -Term



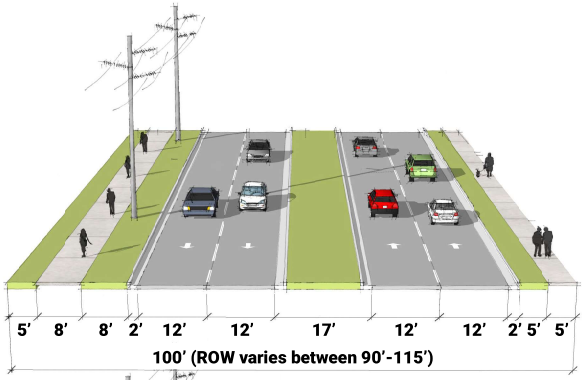


Not to Scale North

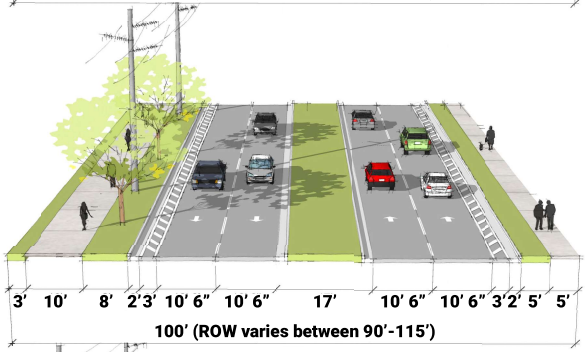
Babcock Street Corridor Planning Study

FIGURE 11 | **Sun Lake Road to Florida Avenue Typical Section**

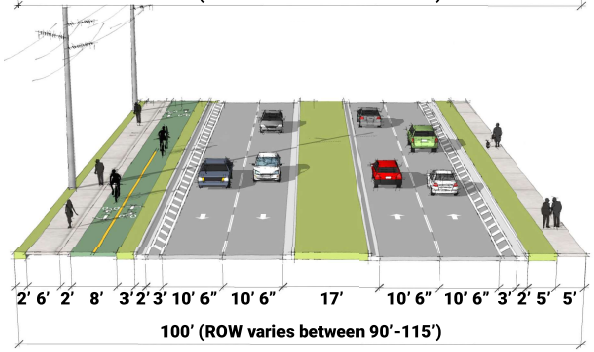
Existing Conditions

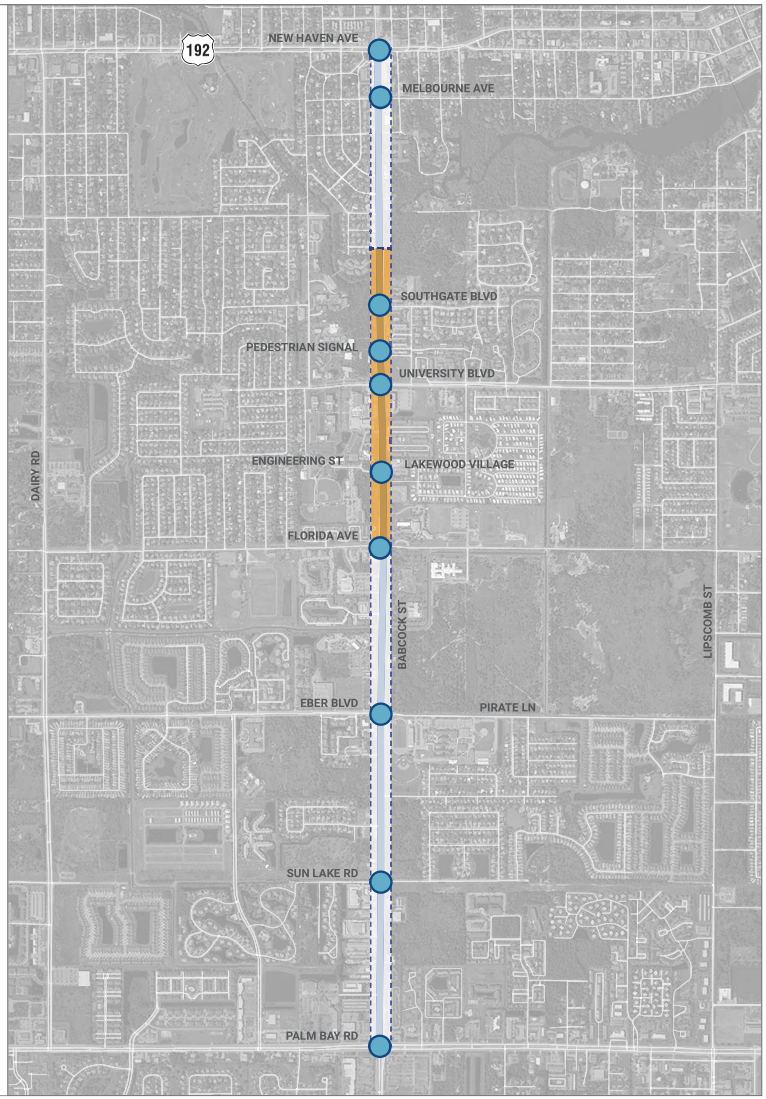


Short-Term



Long-Term



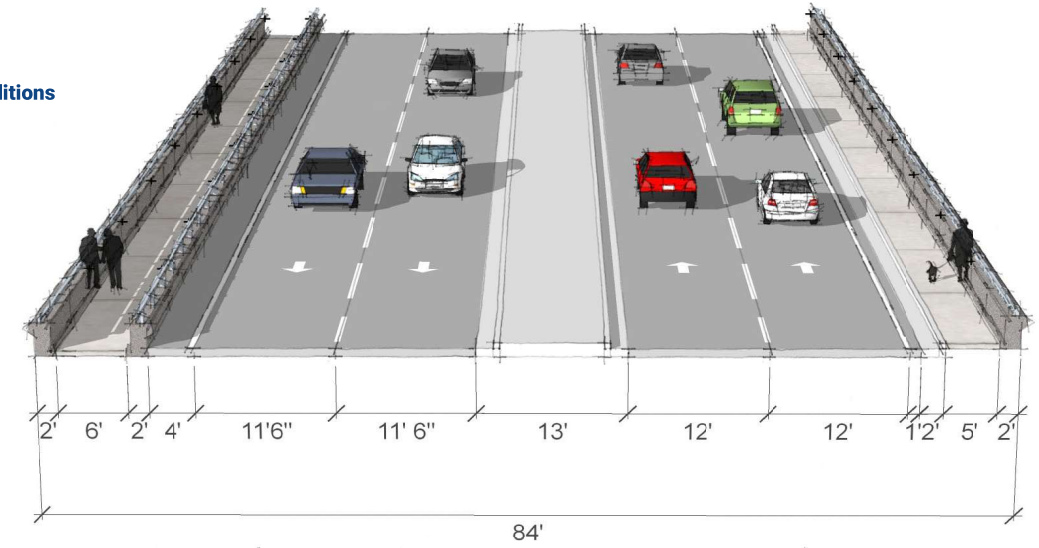


Not to Scale North

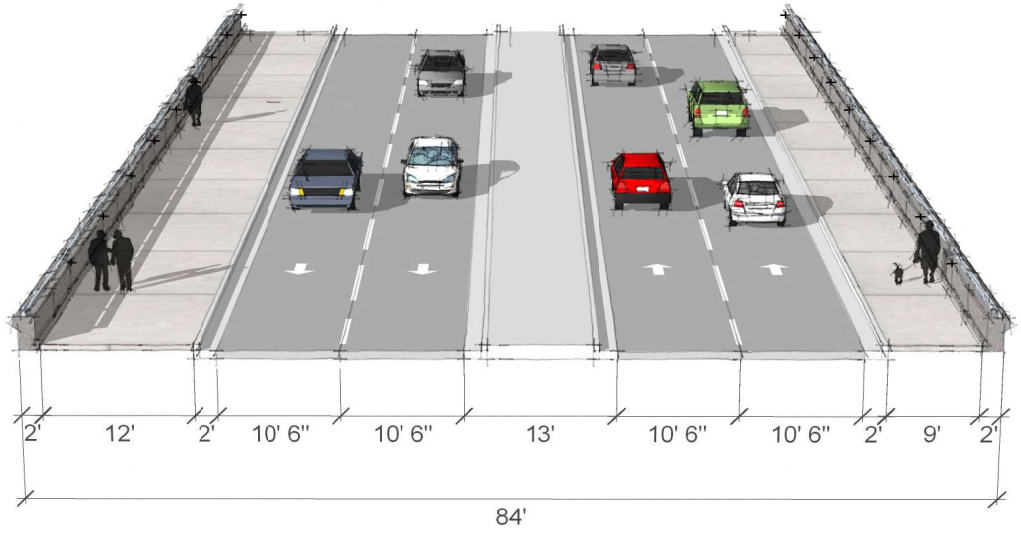
Babcock Street Corridor Planning Study

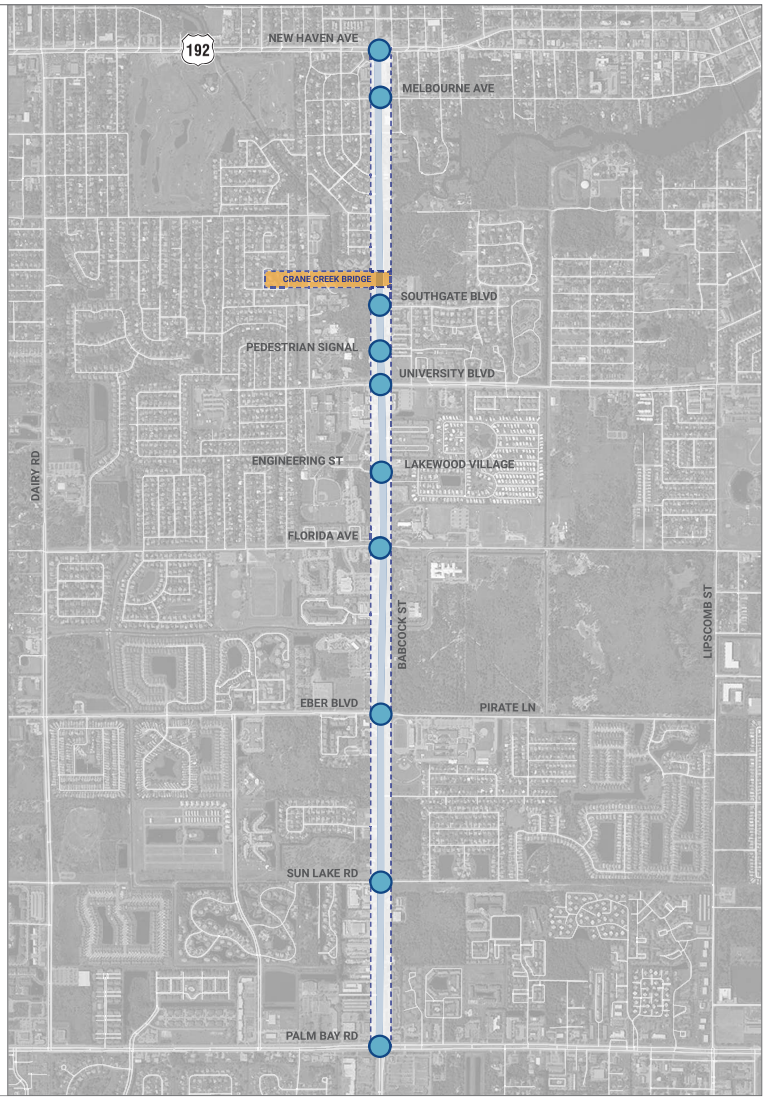
FIGURE 12 | **Florida Avenue to Crane Creek Bridge Typical Section**

Existing Conditions



Short-Term & Long-Term





Not to Scale North

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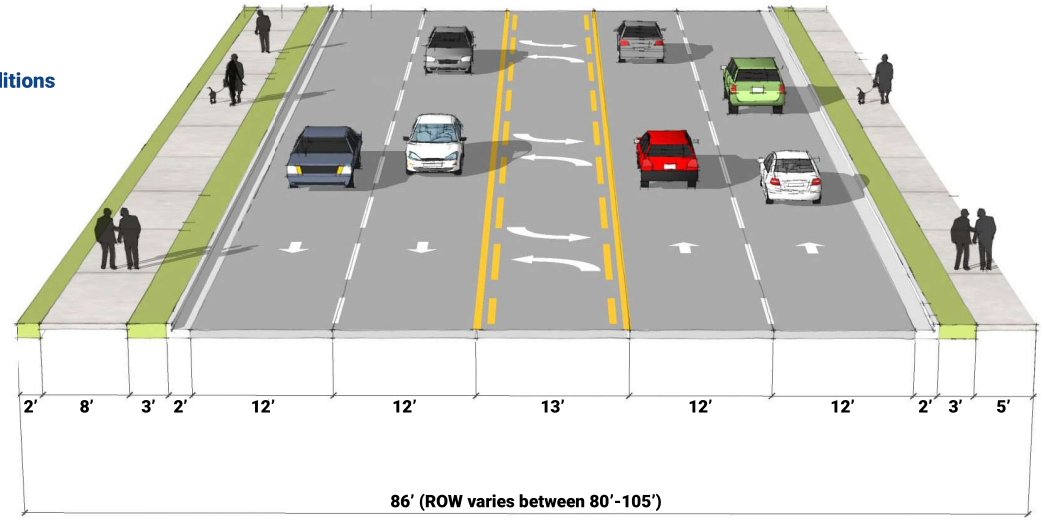
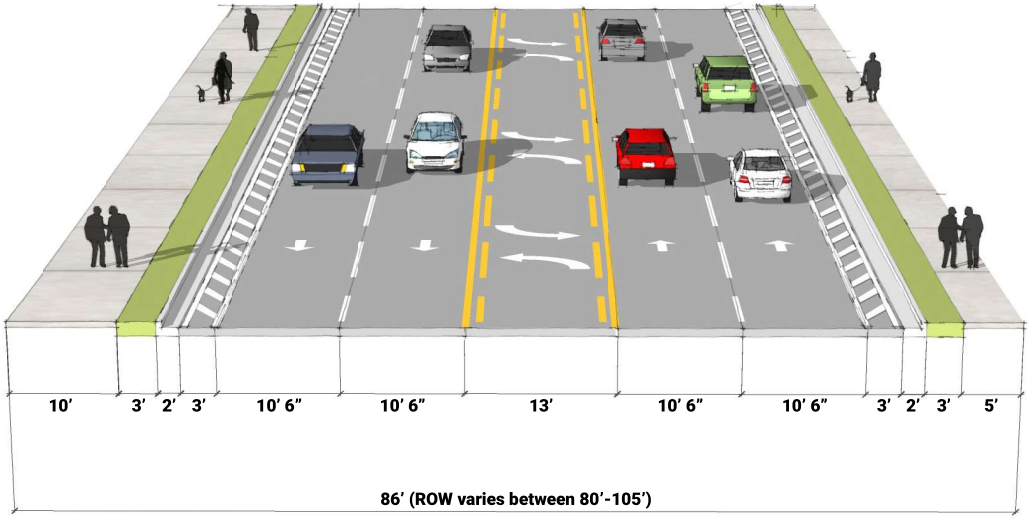
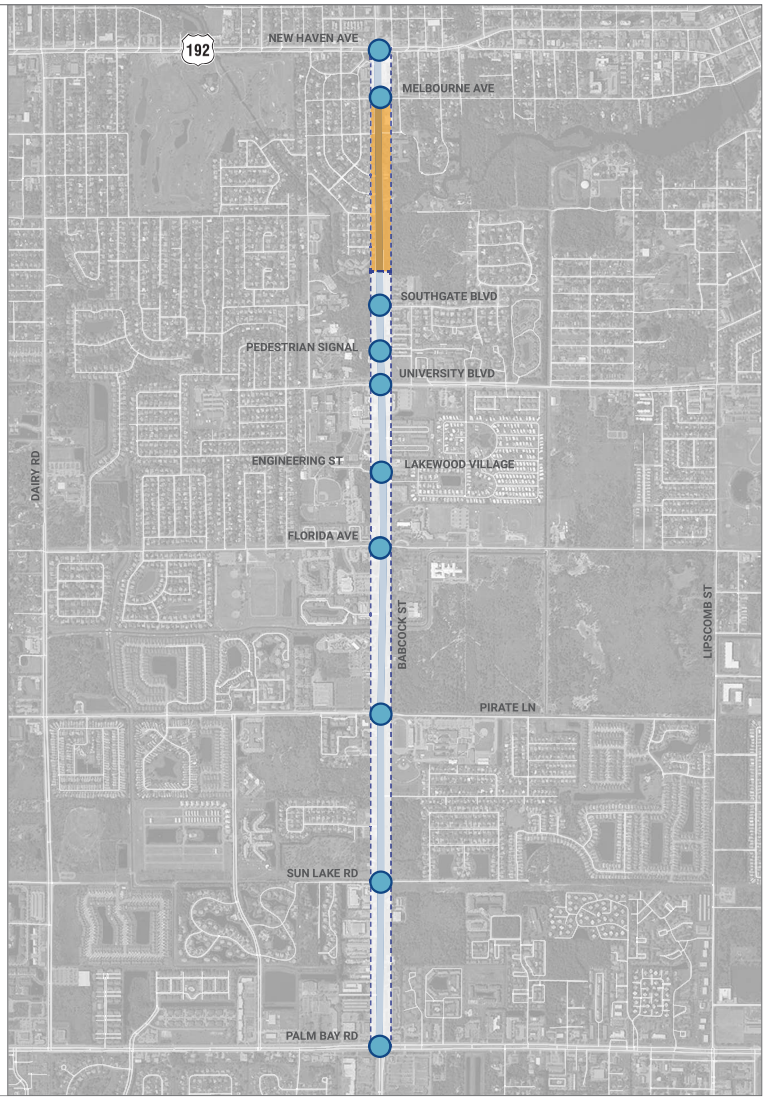
FIGURE 13 | **Crane Creek Bridge Typical Section**

Existing Conditions



Short-Term & Long-Term





Not to Scale North

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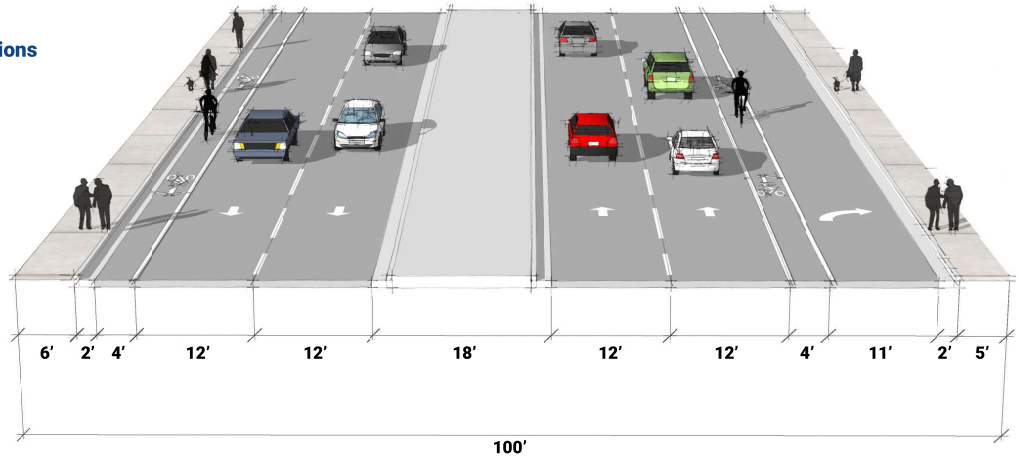
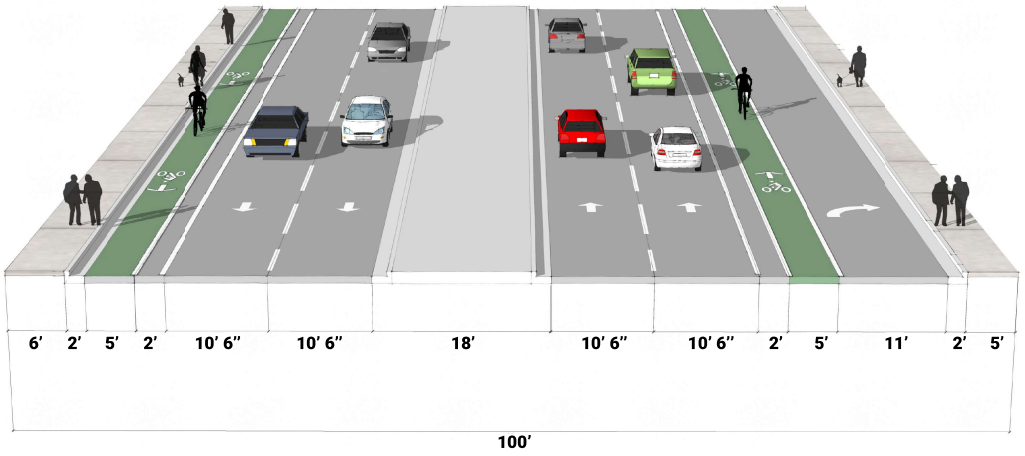
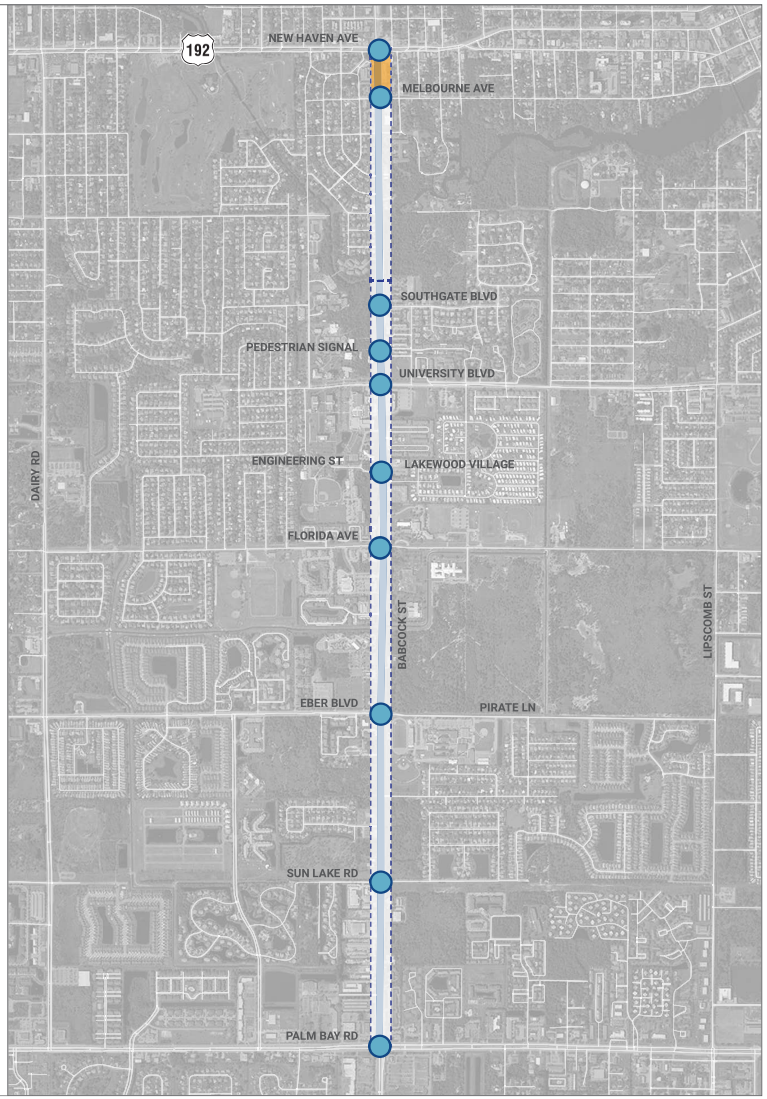
FIGURE 14 | **Crane Creek Bridge to Melbourne Drive Typical Section**

Existing Conditions & Short-Term



Long-Term





Not to Scale North

Babcock Street Corridor Planning Study

FIGURE 15 | **Melbourne Avenue to New Haven Avenue Typical Section**

Multimodal Traffic Operations

A LOS evaluation based on the 2020 FDOT Quality/LOS Handbook was performed to identify operational performance along the Babcock Street study corridor. An evaluation of the future LOS along Babcock Street was performed by comparing segment AADTs versus the LOS volume threshold from the FDOT Generalized LOS Tables found in the 2020 FDOT Quality/LOS Handbook. The FDOT LOS standard and volume thresholds are consistent from the Existing Conditions Report. The roadway segment analyses are summarized in **Table 14**. In the future (2045) Build scenario, the Babcock Street segments are anticipated to operate the same as in the No Build scenario and continue to meet FDOT's LOS target or Brevard County's LOS standard.

Table 14: 2045 Roadway Segment Analysis (Build)

Segment	FDOT LOS Target	Daily Service Volume	No Build (2045)		Build (2045)	
			AADT	LOS	AADT	LOS
Palm Bay Road to Pirate Lane/ Eber Boulevard	D	39,800	36,200	C	36,200	C
Pirate Lane/Eber Boulevard to Florida Avenue	D	39,800	39,000	D	39,000	D
Florida Avenue to University Boulevard	D	41,800	41,100	D	41,100	D
University Boulevard to Southgate Boulevard	D	39,800	36,600	C	36,600	C
Southgate Boulevard to Melbourne Avenue	D	39,800	36,600	C	36,600	C
Melbourne Avenue to US 192	D	34,000	33,800	D	33,800	D

**Source: 2020 FDOT Quality/LOS Handbook Tables*

A Multimodal LOS analysis was completed based on the FDOT Generalized LOS Tables as summarized in **Table 15**. This analysis evaluated the future (2045) Build scenario bicycle, pedestrian, and transit LOS along the corridor utilizing the multimodal LOS thresholds from the FDOT Generalized LOS Tables.

Table 15: 2045 Pedestrian and Bicycle LOS Analysis – (Build)

Segment	AADT	Bike Lane Coverage	Bicycle LOS Score	Sidewalk Coverage	Pedestrian LOS Score	Transit LOS
Palm Bay Road to Pirate Lane/ Eber Boulevard	36,200	100%	C	100%	E	F
Pirate Lane/Eber Boulevard to Florida Avenue	39,000	100%	C	100%	E	F
Florida Avenue to University Boulevard	41,100	100%	D	100%	E	D
University Boulevard to Southgate Boulevard	36,600	100%	C	100%	E	D
Southgate Boulevard to Melbourne Avenue	36,600	100%	C	100%	E	D
Melbourne Avenue to US 192	33,800	100%	C	100%	D	D

**Source: 2020 FDOT Quality/LOS Handbook Tables*

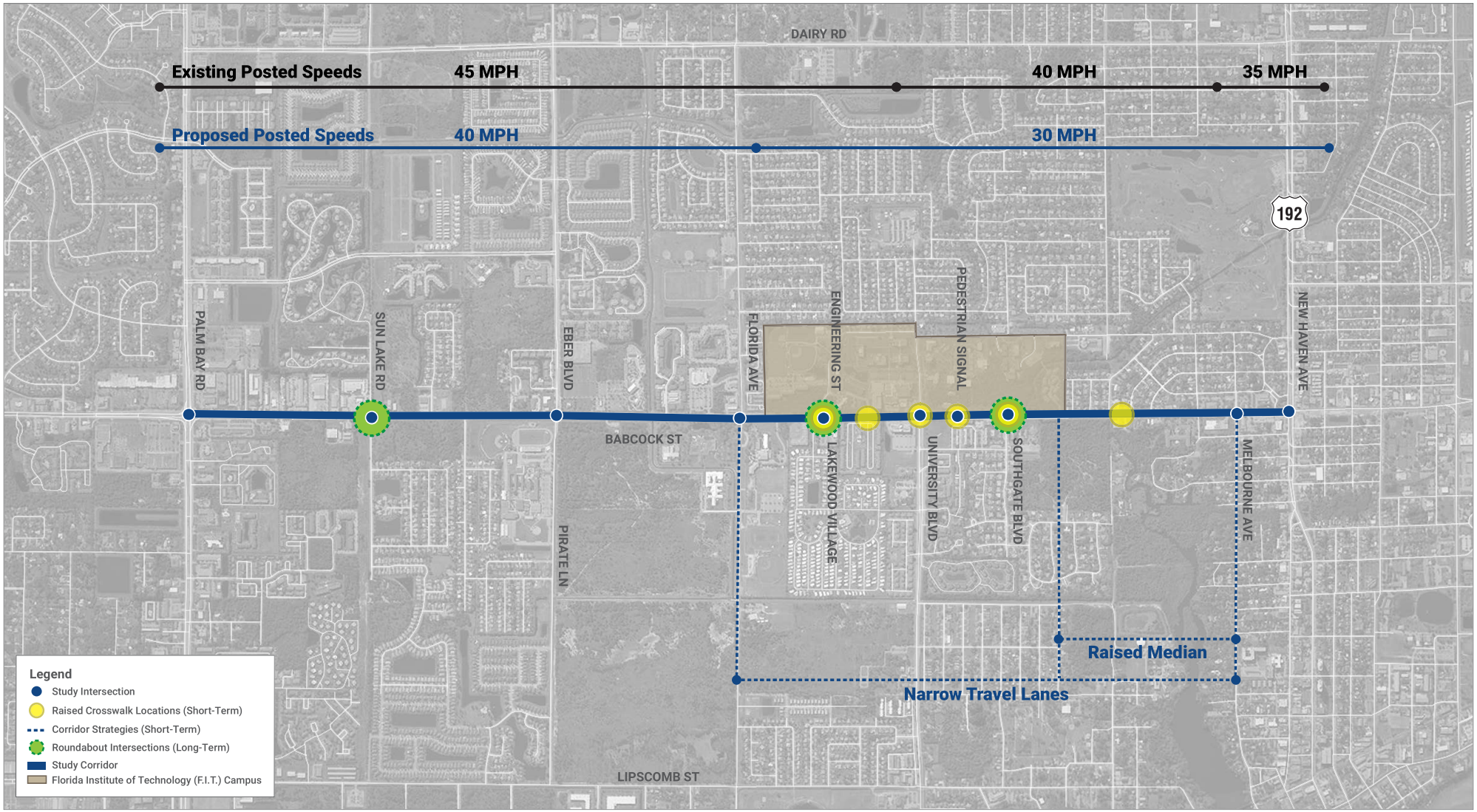
The bicycle LOS is D or better on all segments. The pedestrian LOS is E from Palm Bay Road to Melbourne Avenue due to high vehicular volumes. The transit LOS is F from Palm Bay Road to Florida Avenue due to lack of transit service.

5.4 Speed Management

The following speed management strategies were proposed to improve safety for all users:

- Palm Bay Road to Florida Avenue
    - Reduce the target speed to 40 mph
    - Access management improvements
    - Install curb on south side to fill in sidewalk gap
- Florida Avenue to US 192
    - Reduce the target speed to 30 mph
    - Narrow travel lanes to 10.5 feet
        - Incorporate chicanes for horizontal deflection
    - Install raised median from Vida Way to Melbourne Avenue
    - Install raised crosswalks
    - Introduce enclosure with street trees

The proposed speed management improvements are illustrated in **Figure 16**.



Babcock Street Corridor Planning Study

FIGURE 16 | **Speed Management Strategies**

5.5 Intersection / TSM&O Alternatives

Intersection operations and improvement options were considered separately for each study intersection. To address some of the issues and opportunities identified for the Babcock Street corridor, the following TSMO improvements may be considered to improve safety and mobility on the corridor:

- **Signal Retiming –** The study evaluated signal timing optimization, including splits, cycle length, and offsets. Right-turn overlap phasing was evaluated for the northbound approach at US 192.
- **Turn Lanes** – The study evaluated turn lane improvements at six study intersections. The **Turn Lane Improvements** section provides detailed discussion and analysis for these potential improvements.
- **Roundabouts –** The study evaluated roundabouts at five study intersections. The **Roundabout Intersections** section provides detailed discussion and analysis for these potential improvements.
- **Innovative Intersection Treatments** – The study conducted an Intersection Control Evaluation (ICE) analysis at the US 192 and Palm Bay Road intersections. The **Intersection Control Evaluation** section provides detailed discussion and analysis for these potential improvements.

Signal Timing and Turn Lane Improvements

Intersection improvements including signal cycle length adjustments and turn lane improvements were considered at several intersections. The cycle length at each signalized intersection was adjusted to 160 seconds in the AM peak hour and 140 seconds in the PM peak hour, with the exception of a half cycle at Southgate Boulevard and Palm Bay Road remaining at 180 seconds in both peak hours. The intersection LOS was analyzed using HCM methodologies as implemented by Synchro Version 10.1. A summary comparison of the 2045 No Build and 2045 Build peak hour intersection operations is provided in **Table 16** and **Table 17**. Detailed HCM Build output reports are provided in **Appendix C.** The following improvements were evaluated:

- Babcock Street and Eber Boulevard/Pirate Lane
    - Added second eastbound left-turn lane and adjusted signal timing
- Babcock Street and Florida Avenue
    - Added second eastbound left-turn lane and adjusted signal timing
- Babcock Street and University Boulevard
    - Added second westbound left-turn lane and adjusted signal timing
- Babcock Street and Southgate Boulevard
    - Signal timing adjustments only
- Babcock Street and Melbourne Avenue
    - Signal timing adjustments only
- Babcock Street and US 192
    - Signal timing adjustments only

Each approach operates at LOS D or better, with the following exceptions:

- **Babcock Street at Eber Boulevard/Pirate Lane**:
    - In the AM peak hour, the eastbound and westbound approaches operate at LOS E with a average delays of 55-70 seconds.
    - In the PM peak hour, the westbound approach operates at LOS E with an average delay of 60 seconds.
- **Babcock street at Florida Avenue**: The overall intersection operates at LOS E in the PM peak hour.
    - In the AM peak hour, the eastbound and westbound approaches operate at LOS E with average delays of 70-75 seconds.
    - In the PM peak hour, the westbound and southbound approaches operate at LOS E with average delays of 70-75 seconds.
- **Babcock Street at University Boulevard**: The overall intersection operates at LOS E in the PM peak hour.
    - In the AM peak hour, the eastbound and westbound approaches operate at LOS E with average delays of 60-65 seconds.
    - In the PM peak hour, the southbound approach operates at LOS E with an average delay of 70 seconds.
- **Babcock Street at Melbourne Avenue**: The eastbound and westbound approaches operate at LOS E with average delays of 70-80 seconds in the AM and PM peak hours.
- **Babcock Street at US 192**: The overall intersection operates at LOS E in the PM peak hour.
    - In the AM peak hour, the eastbound and westbound approaches operate at LOS E with average delays of 55-60 seconds.
    - In the PM peak hour, the westbound and southbound approaches operate at LOS E with average delays of 60-70 seconds.

Table 16: 2045 AM Peak Hour Intersection Operations Analysis – (Build)

Intersection	Measure	AM Peak Hour									
		Eastbound		Westbound		Northbound		Southbound		Overall	
		No Build	Build	No Build	Build	No Build	Build	No Build	Build	No Build	Build
Babcock Street at Eber Boulevard/Pirate Lane	Delay (LOS)	89.9 (F)	70.9 (E)	60.0 (E)	57.2 (E)	62.3 (E)	45.6 (D)	9.6 (A)	7.6 (A)	**55.4 (E)**	**42.7 (D)**
	v/c ratio	1.05	0.86	0.50	0.56	0.99	0.93	0.68	0.51	-	-
Babcock Street at Florida Avenue	Delay (LOS)	119.0 (F)	73.1 (E)	77.9 (E)	71.0 (E)	53.7 (D)	54.0 (D)	12.8 (B)	24.4 (C)	**53.7 (D)**	**50.0 (D)**
	v/c ratio	1.13	0.89	0.75	0.77	1.03	1.02	0.77	0.81	-	-
Babcock Street at University Boulevard	Delay (LOS)	67.0 (E)	62.5 (E)	96.5 (F)	59.1 (E)	34.3 (C)	34.9 (C)	13.7 (B)	42.0 (D)	**37.6 (D)**	**40.7 (D)**
	v/c ratio	0.41	0.4	1.03	0.52	0.89	0.9	0.66	0.66	-	-
Babcock Street at Southgate Boulevard	Delay (LOS)	-	-	96.1 (F)	44.6 (D)	18.1 (B)	12.1 (B)	6.6 (A)	2.7 (A)	**15.0 (B)**	**9.3 (A)**
	v/c ratio	-	-	0.61	0.46	0.74	0.77	0.34	0.33	-	-
Babcock Street at Melbourne Avenue	Delay (LOS)	82.8 (F)	77.6 (E)	89.0 (F)	78.8 (E)	36.9 (D)	45.7 (D)	11.7 (B)	12.0 (B)	**35.6 (D)**	**40.1 (D)**
	v/c ratio	0.63	0.61	0.8	0.79	0.89	0.95	0.33	0.33	-	-
Babcock Street at US 192	Delay (LOS)	68.8 (E)	62.4 (E)	61.1 (E)	57.1 (E)	48.5 (D)	52.0 (D)	48.5 (D)	48.1 (D)	**55.7 (E)**	**54.8 (D)**
	v/c ratio	0.85	0.85	0.58	0.66	0.91	0.96	0.78	0.78	-	-

Table 17: 2045 PM Peak Hour Intersection Operations Analysis – (Build)

Intersection	Measure	AM Peak Hour									
		Eastbound		Westbound		Northbound		Southbound		Overall	
		No Build	Build	No Build	Build	No Build	Build	No Build	Build	No Build	Build
Babcock Street at Eber Boulevard/Pirate Lane	Delay (LOS)	64.5 (E)	53.6 (D)	76.9 (E)	61.7 (E)	41.1 (D)	29.7 (C)	13.8 (B)	6.6 (A)	**34.5 (C)**	**24.7 (C)**
	v/c ratio	0.84	0.69	0.90	0.85	0.86	0.62	1.01	0.97	-	-
Babcock Street at Florida Avenue	Delay (LOS)	88.7 (F)	47.7 (D)	78.6 (E)	68.5 (E)	34.3 (C)	30.1 (C)	44.6 (D)	76.7 (E)	**49.3 (D)**	**60.2 (E)**
	v/c ratio	1.00	0.64	0.93	0.92	0.62	0.63	1.09	1.09	-	-
Babcock Street at University Boulevard	Delay (LOS)	61.5 (E)	48.2 (D)	74.2 (E)	49.5 (D)	60.5 (E)	49.7 (D)	53.4 (D)	71.8 (E)	**59.0 (E)**	**59.2 (E)**
	v/c ratio	0.45	0.5	0.85	0.56	0.94	0.95	1.04	0.99	-	-
Babcock Street at Southgate Boulevard	Delay (LOS)	-	-	82.8 (F)	38.2 (D)	0.7 (A)	11.6 (B)	0.7 (A)	5.2 (A)	**1.1 (A)**	**7.9 (A)**
	v/c ratio	-	-	0.24	0.3	0.44	0.59	0.55	0.65	-	-
Babcock Street at Melbourne Avenue	Delay (LOS)	85.4 (F)	70.1 (E)	84.0 (F)	75.8 (E)	13.9 (B)	28.3 (C)	15.1 (B)	15.5 (B)	**24.6 (C)**	**28.6 (C)**
	v/c ratio	0.73	0.7	0.83	0.82	0.49	0.66	0.65	0.68	-	-
Babcock Street at US 192	Delay (LOS)	67.7 (E)	53.7 (D)	67.2 (E)	58.6 (E)	44.2 (D)	45.0 (D)	55.3 (E)	69.4 (E)	**58.0 (E)**	**57.8 (E)**
	v/c ratio	0.81	0.87	0.81	0.9	0.84	0.93	0.89	1.02	-	-

Roundabout Intersections

A series of roundabout configurations were evaluated for five Babcock Street intersections at Sun Lake Road, Florida Avenue, Engineering Street / Lakewood Village Place, University Boulevard, and Southgate Boulevard, and the preferred roundabout configurations were evaluated against a traditional signal for each intersection using FDOT's Intersection Control Evaluation (ICE) process.

Alternative Roundabout Configurations

Intersection operational analyses were conducted for the AM and PM peak hours using future (2045) intersection volumes. The analysis was conducted using the methodologies of the *Highway Capacity Manual, 6th Edition* (HCM6) as implemented by the *Highway Capacity Software, v.7* (HCS7). Detailed HCS7 output reports are provided in **Appendix C**, and **Table 18** and **Table 19** summarize the peak hour intersection operations. The following roundabout configurations were evaluated:

- Babcock Street at Sun Lake Road
    - **A partial 2-lane roundabout** was evaluated to maintain 2-lane entries and exits for Babcock Street traffic. This configuration operates adequately in the future year (2045) peak hours.
- Babcock Street at Florida Avenue
    - **A partial 2-lane roundabout** was evaluated to maintain 2-lane entries and exits for Babcock Street traffic. However, a partial 2-lane roundabout would be over capacity in the future year (2045) with volume-to-capacity (v/c) ratios exceeding 1.0 in the AM and PM peak hours.
    - **A full 2-lane roundabout** was evaluated to provide additional capacity. However, a full 2-lane roundabout would be over capacity in the future year (2045) with v/c ratios exceeding 1.0 in the AM and PM peak hours.
- Babcock Street at Engineering Street/Lakewood Village Place
    - **A partial 2-lane roundabout** was evaluated to maintain 2-lane entries and exits for Babcock Street traffic. This configuration operates adequately in the future year (2045) peak hours.
- Babcock Street at University Boulevard
    - **A partial 2-lane roundabout** was evaluated to maintain 2-lane entries and exits for Babcock Street traffic. However, a partial 2-lane roundabout would be over capacity in the future year (2045) with volume-to-capacity (v/c) ratios exceeding 1.0 in the AM and PM peak hours.
    - **A full 2-lane roundabout** was evaluated to provide additional capacity. However, a full 2-lane roundabout would be over capacity in the future year (2045) with v/c ratios exceeding 1.0 in the AM and PM peak hours.

- Babcock Street at Southgate Boulevard
    - **A partial 2-lane roundabout** was evaluated to maintain 2-lane entries and exits for Babcock Street traffic. This configuration operates adequately in the future year (2045) peak hours.

The full 2-lane roundabout alternatives at Babcock Street and Florida Avenue and Babcock Street and University Boulevard are over capacity in the future year (2045) in both peak hours. A roundabout is not feasible at these locations and did not move forward into concept development. The partial 2-lane roundabout alternatives at Babcock Street and Sun Lake Road, Babcock Street and Engineering Street / Lakewood Village Place, and Babcock Street and Southgate Boulevard operate adequately in both peak hours of the future year (2045). Partial 2-lane roundabouts are feasible at these locations and concepts were prepared for each intersection. The following section outlines the concept development of partial 2-lane roundabouts.

Table 18: 2045 AM Peak Hour Intersection Operations Analysis – (Roundabout)

Intersection	Measure	AM Peak Hour														
		Eastbound			Westbound			Northbound			Southbound			Overall		
		No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build
Babcock Street at Sun Lake Road	Delay (LOS)	>150.0 (F)	6.6 (A)	-	>150.0 (F)	21.9 (C)	-	8.3 (A)	12.8 (B)	-	13.3 (B)	5.8 (A)	-	-	**10.9 (A)**	-
	v/c ratio	0.72	0.06	-	2.13	0.32	-	0.01	0.75	-	0.03	0.36	-	-	-	-
Babcock Street at Florida Avenue	Delay (LOS)	119.0 (F)	67.3 (F)	17.4 (C)	77.9 (E)	>150.0 (F)	56.2 (F)	53.7 (D)	>150.0 (F)	>150.0 (F)	12.8 (B)	10.2 (B)	10.4 (B)	**53.7 (D)**	**131.2 (F)**	**115.1 (F)**
	v/c ratio	1.13	1.01	0.54	0.75	1.27	0.73	1.03	1.47	1.41	0.77	0.56	0.54	-	-	-
Babcock Street at Engineering Street / Lakewood Village Place	Delay (LOS)	10.7 (B)	7.1 (A)	-	>150.0 (F)	19.1 (C)	-	-	16.4 (C)	-	20.7 (C)	6.2 (A)	-	-	**13.1 (B)**	-
	v/c ratio	0.02	0.03	-	0.92	0.09	-	-	0.84	-	0.03	0.4	-	-	-	-
Babcock Street at University Boulevard	Delay (LOS)	67.0 (E)	11.2 (B)	8.9 (A)	96.5 (F)	>150.0 (F)	109.7 (F)	34.3 (C)	54.0 (F)	56.9 (F)	13.7 (B)	12.1 (B)	12.2 (B)	**37.6 (D)**	**78.9 (F)**	**48.9 (E)**
	v/c ratio	0.41	0.35	0.19	1.03	1.79	1.03	0.89	1.08	1.06	0.66	0.57	0.56	-	-	-
Babcock Street at Southgate Boulevard	Delay (LOS)	-	-	-	96.1 (F)	15.2 (C)	-	18.1 (B)	12.8 (B)	-	6.6 (A)	5.8 (A)	-	**15.0 (B)**	**10.5 (B)**	-
	v/c ratio	-	-	-	0.61	0.09	-	0.74	0.76	-	0.34	0.37	-	-	-	-

Table 19: 2045 PM Peak Hour Intersection Operations Analysis – (Roundabout)

Intersection	Measure	PM Peak Hour														
		Eastbound			Westbound			Northbound			Southbound			Overall		
		No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build	No Build	2x1 Build	2x2 Build
Babcock Street at Sun Lake Road	Delay (LOS)	>150.0 (F)	13.5 (B)	-	>150.0 (F)	9.2 (A)	-	11.6 (B)	7.9 (A)	-	9.3 (A)	11.4 (B)	-	-	**10.0 (A)**	-
	v/c ratio	1.23	0.1	-	1.2	0.13	-	0.08	0.52	-	0.06	0.7	-	-	-	-
Babcock Street at Florida Avenue	Delay (LOS)	88.7 (F)	>150.0 (F)	102.1 (F)	78.6 (E)	86.1 (F)	21.7 (C)	34.3 (C)	14.0 (B)	14.3 (B)	44.6 (D)	134.9 (F)	139.0 (F)	**49.3 (D)**	**116.7 (F)**	**87.7 (F)**
	v/c ratio	1.00	1.72	0.99	0.93	1.05	0.57	0.62	0.68	0.67	1.09	1.31	1.27	-	-	-
Babcock Street at Engineering Street / Lakewood Village Place	Delay (LOS)	40.8 (E)	26.1 (D)	-	23.1 (C)	9.8 (A)	-	-	8.1 (A)	-	12.9 (B)	17.6 (C)	-	-	**14.1 (B)**	-
	v/c ratio	0.38	0.29	-	0.14	0.11	-	-	0.54	-	0.09	0.86	-	-	-	-
Babcock Street at University Boulevard	Delay (LOS)	61.5 (E)	>150.0 (F)	77.0 (F)	74.2 (E)	113.3 (F)	25.6 (D)	60.5 (E)	19.4 (C)	19.7 (C)	53.4 (D)	94.5 (F)	95.7 (F)	59.0 (E)	**93.5 (F)**	**59.5 (F)**
	v/c ratio	0.45	1.61	0.92	0.85	1.12	0.61	0.94	0.81	0.79	1.04	1.19	1.15	-	-	-
Babcock Street at Southgate Boulevard	Delay (LOS)	-	-	-	90.0 (F)	8.2 (A)	-	17.9 (B)	8.0 (A)	-	11.7 (B)	11.3 (B)	-	**14.6 (B)**	**10.0 (A)**	-
	v/c ratio	-	-	-	0.37	0.04	-	0.53	0.52	-	0.66	0.72	-	-	-	-

Roundabout Design Considerations

Concepts were developed for the three roundabout intersections as illustrated in **Figure 17**, **Figure 18**, and **Figure 19**. Each concept was developed in accordance with the design principles outlined in NCHRP Report 672, *Roundabouts: An Informational Guide – 2nd Edition*. These concepts represent one possible option for the roundabout horizontal geometry.

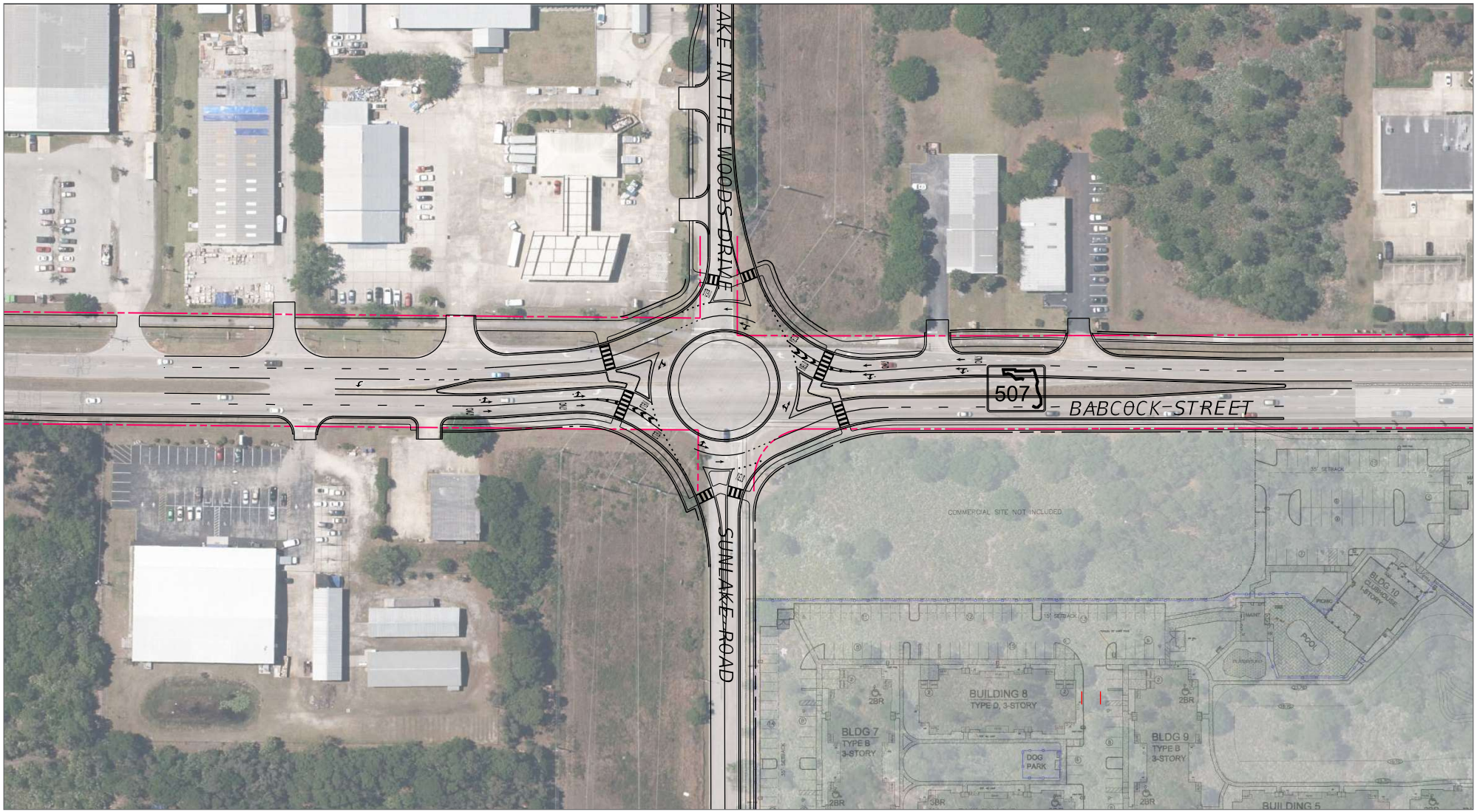
Roundabout design is based upon a set of fundamental principles which guide the design process. These principles include: (1) achieving speed control at entry, (2) providing appropriate lane numbers and arrangements, (3) appropriately aligning the natural path of vehicles, (4) accommodating the design vehicle, (5) accommodating non-motorized users, and (6) providing adequate sight distance and visibility. Alternative sizes, shapes, placement, and approach alignments may also be acceptable provided they result in a design that meets these fundamental principles.

The features shown in the concept design, and discussed below, were developed based upon an iterative process to balance the various roundabout design principles with impacts to adjacent properties:

- **Speed Control**
  Reduced vehicle speeds entering the intersection is one of the fundamental design criteria for roundabouts. The designs were developed based upon the fastest path criteria from *NCHRP Report 672*. The design concepts were developed to maintain fastest path speeds entering the roundabout of 30 mph or less for each of the two-lane approaches (assuming drivers ignore all lane lines) and 25 mph or less for single-lane approaches.

- **Design Vehicle**
  The conceptual roundabout designs were developed to accommodate a WB-62FL design vehicle for all turn movements. The concept was set up as a “Case 2” design where the design vehicle stays within lane through the entry but may encroach slightly into the adjacent lane within the circulatory roadway. The Case 2 design allows for impacts to adjacent properties to be minimized while still allowing for side-by-side navigation with a WB-62FL tractor-trailer and a passenger vehicle.

- **Pedestrian and Bicycles**
  Appropriate pedestrian crossing treatments are included across each leg of each intersection. A 10-foot shared use path around each intersection is used to connect the crossing locations. Roundabout splitter island lengths and widths are designed to provide space for appropriately sized pedestrian refuges. RRFBs or PHBs are recommended at two-lane crossings to provide extra crossing protection for path users. Raised crossings may also be used to provided further speed control.

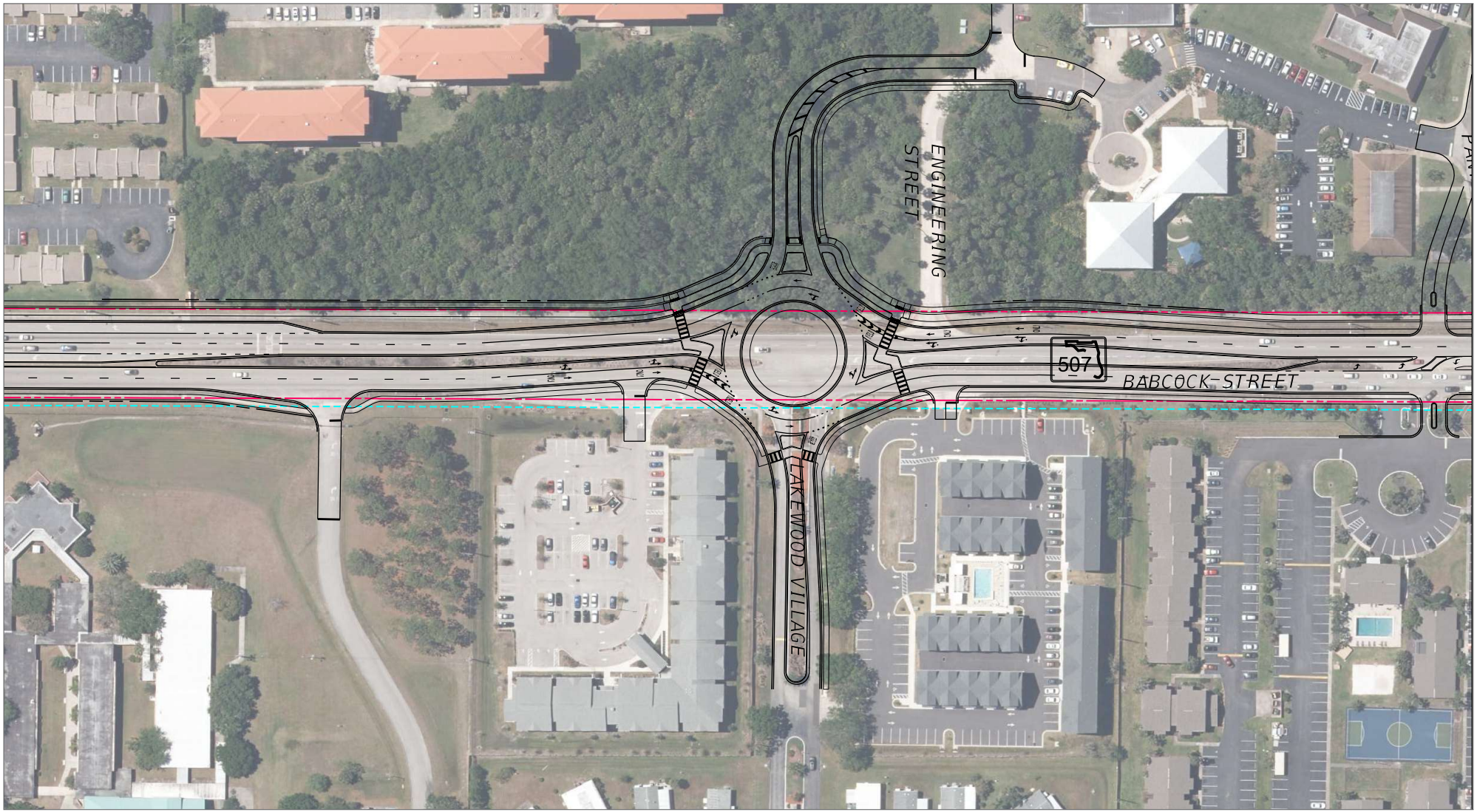


Not to Scale

North

Babcock Street Corridor Planning Study

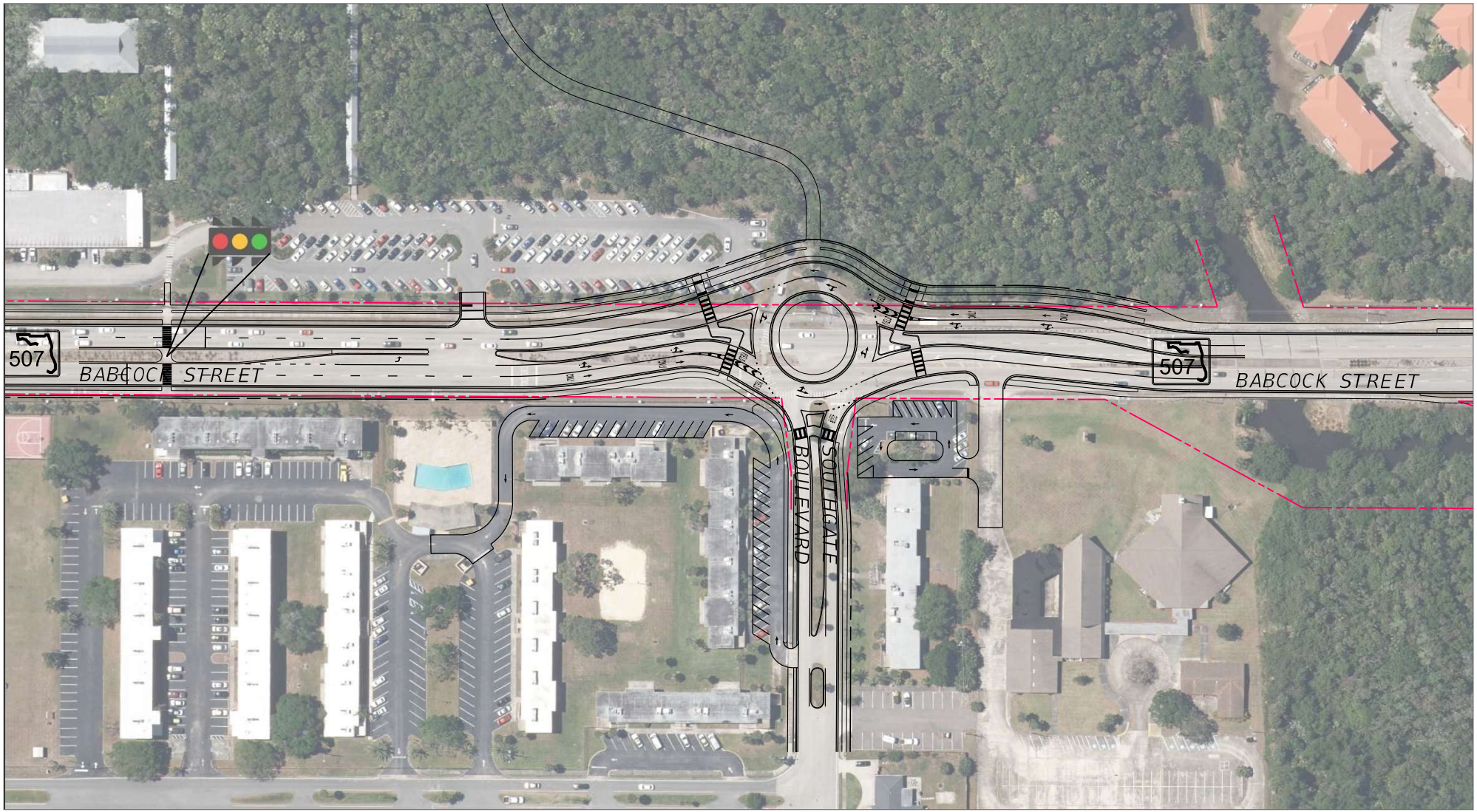
FIGURE 17 | **Babcock Street at Sun Lake Road – Roundabout Concept**



Not to Scale

North

FIGURE 18 | **Babcock Street at Engineering Street / Lakewood Village Place – Roundabout Concept**



Not to Scale

North

FIGURE 19 | **Babcock Street at Southgate Boulevard Roundabout Concept**

Intersection Control Evaluation

Intersection control evaluations (ICE) were conducted for the proposed roundabout intersections utilizing the ICE Forms and ICE Tools from FDOT's website. FDOT's ICE process is a performance-based procedure that quantitatively evaluates several intersection control scenarios (alternatives) and ranks them based upon their operational and safety performance. The preferred roundabout configuration was compared to traditional signal control for three intersections. For the benefit-cost analyses, basic cost assumptions included $2M for the Sun Lake Road roundabout and the Engineering Street/Lakewood Village Place roundabout and $1.5M for the Southgate Boulevard roundabout. A brief summary of the operational and safety performance is provided below:

Babcock Street at Sun Lake Road

- **Operational**: based upon the findings of the intersection analysis, the partial 2-lane roundabout is expected to have similar delay to the existing two-way stop control, with delays expected to increase slightly by 0 to 5 seconds during the peak hours.
- **Safety**: based upon the findings of the SPICE analysis, the roundabout is expected to experience an increase of 108 crashes – including 5 fatal and injury crashes – over the project's lifecycle.
- **Mobility**: there is a mile gap between Palm Bay Road and Eber Boulevard/Pirate Lane with no east-west pedestrian crossings. A roundabout at Sun Lake Road would provide an opportunity for a pedestrian crossing on all intersection approaches.

Babcock Street at Engineering Street/Lakewood Village Place

- **Operational**: based upon the findings of the intersection analysis, the partial 2-lane roundabout is expected to have similar delay to the existing two-way stop control, with delays expected to increase slightly by 10 to 15 seconds during the peak hours.
- **Safety**: based upon the findings of the SPICE analysis, the roundabout is expected to experience an increase of 192 crashes – including 15 fatal and injury crashes – over the project's lifecycle.
- **Mobility**: there is a half mile gap in front of Florida Institute of Technology, between Florida Avenue and University Boulevard, with no east-west pedestrian crossings. A roundabout at Engineering Street/Lakewood Village Place would provide an opportunity for a pedestrian crossing on all intersection approaches.

Babcock Street at Southgate Boulevard

- **Operational**: based upon the findings of the intersection analysis, the partial 2-lane roundabout is expected to have similar delay to the existing traffic signal control, with delays expected to decrease slightly by 5 seconds during the peak hours.
- **Safety**: based upon the findings of the SPICE analysis, the roundabout is expected to experience an increase of 56 crashes, but a decrease of 13 fatal and injury crashes over the project's lifecycle.
- **Mobility**: pedestrian crossings at Southgate Boulevard connect student housing with a trail connecting to Florida Institute of Technology.

Additional benefits that roundabout intersections provide are opportunities to beautify the corridor with community features and contribute to the following overall project goals:

- **Speed Management**: the roundabouts will help control speeds within this suburban residential and school campus context.
- **Access Management**: the roundabouts facilitate the adjacent access management improvements by providing U-turn opportunities on the corridor.

The operational and safety comparisons of the No Build to the PDLT and PMUT intersection alternatives is summarized in **Table 20**, **Table 21**, and **Table 22**, respectively. Detailed HCM output reports and other supporting documentation of the ICE analysis, including CAP-X and SPICE tool results, are included in **Appendix D**.

Table 20: Babcock Street at Sun Lake Road – ICE Performance Summary

Configuration		Operational Performance					Delay B/C Ratio	Safety Performance				Safety B/C Ratio	Overall B/C Ratio
		Measure	Opening Year (2025)		Design Year (2045)			Measure	Opening Year (2025)	Design Year (2045)	Total Project Life Cycle		
			AM Peak	PM Peak	AM Peak	PM Peak							
	Two-Way Stop	Delay (LOS)	9.9 (A)	8.3 (A)	14.0 (B)	8.5 (A)	-	Total Crashes	6.83	7.24	147.7	-	-
								Fatal & Injury Crashes	1.97	2.1	42.7		
	Roundabout	Delay (LOS)	9.7 (A)	9.1 (A)	10.9 (B)	10.0 (A)	**< 0**	Total Crashes	11.76	12.56	255.27	**< 0**	**<0**
								Fatal & Injury Crashes	2.18	2.35	47.6		

Table 21: Babcock Street at Engineering Street/Lakewood Village – ICE Performance Summary

Configuration		Operational Performance					Delay B/C Ratio	Safety Performance				Safety B/C Ratio	Overall B/C Ratio
		Measure	Opening Year (2025)		Design Year (2045)			Measure	Opening Year (2025)	Design Year (2045)	Total Project Life Cycle		
			AM Peak	PM Peak	AM Peak	PM Peak							
	Two-Way Stop	Delay (LOS)	2.3 (A)	1.0 (A)	2.3 (A)	1.1 (A)	-	Total Crashes	4.60	4.87	99.48	-	-
								Fatal & Injury Crashes	1.86	1.99	40.41		
	Roundabout	Delay (LOS)	11.4 (B)	12.2 (B)	13.1 (B)	14.1 (B)	**< 0**	Total Crashes	13.49	14.31	291.92	**< 0**	**< 0**
								Fatal & Injury Crashes	2.54	2.71	55.13		

Table 22: Babcock Street at Southgate Boulevard – ICE Performance Summary

Configuration		Operational Performance					Delay B/C Ratio	Safety Performance				Safety B/C Ratio	Overall B/C Ratio
		Measure	Opening Year (2025)		Design Year (2045)			Measure	Opening Year (2025)	Design Year (2045)	Total Project Life Cycle		
			AM Peak	PM Peak	AM Peak	PM Peak							
	Signal	Delay (LOS)	15.7 (B)	14.4 (B)	15.0 (B)	14.6 (B)	-	Total Crashes	6.43	6.93	140.23	-	-
								Fatal & Injury Crashes	2.38	2.53	51.52		
	Roundabout	Delay (LOS)	9.8 (A)	9.4 (A)	10.5 (B)	10.0 (A)	**3.04**	Total Crashes	9.05	9.63	196.18	**1.46**	**4.50**
								Fatal & Injury Crashes	1.77	1.90	38.52		

Babcock Street at US 192

Two additional intersections were identified for Intersection Control Evaluation (ICE). The intersection of Babcock Street at US 192 and Babcock Street at Palm Bay Road were identified as operating at LOS E or F in the future year (2045) AM and PM peak hours. As noted previously in the No Build analysis, the intersection of Babcock Street at US 192 is projected to operate near capacity at LOS E with average delays of 55-60 seconds in the AM and PM peak hours. Multiple approaches operate at LOS E in both the AM and PM peak hours. The intersection of Babcock Street at Palm Bay Road is projected to operate over capacity at LOS E in the AM peak hour and LOS F in the PM peak hour with average delays of 75-85 seconds. The northbound approach operates at LOS F in AM peak hour and the westbound and northbound approaches operate at LOS F in the PM peak hour.

The intersections of Babcock Street at US 192 and Babcock Street at Palm Bay Road were identified as high crash locations. There were 195 total crashes at the intersection of Babcock Street and US 192 from 2012-2016 – including 38 crashes (19 percent) resulting in injury and 21 crashes (11 percent) resulting from a left-turn, angle, or head-on collision. The intersection's safety ratio ranged from 1.07 to 2.84, indicating it had higher crash rates than similar intersections in Florida over the study period. There were 478 total crashes at the intersection of Babcock Street and Palm Bay Road from 2012-2016 – including 100 crashes (21 percent) resulting in injury and 40 crashes (8 percent) resulting from a left-turn, angle, or head-on collision. The intersection's safety ratio ranged from 2.04 to 3.76 over the study period.

An intersection control evaluation (ICE) was conducted at both intersections using the ICE Forms and ICE Tools from FDOT's website (https://www.fdot.gov/traffic/trafficservices/intersection-operations.shtm). FDOT's ICE process is a performance-based procedure that quantitatively evaluates several intersection control scenarios (alternatives) and ranks them based upon their operational and safety performance.

A Stage 1 evaluation was conducted for Babcock Street at US 192. The Stage 1 results showed the No Build alternative (traffic signal) operates with a V/C ratio under 0.75 in both the AM and PM peak hours. Although other alternatives operate well in the Stage 1 analysis, the No Build will have the lowest cost. Additional signal timing improvements are recommended to improve the operational results of the No Build alternative.

Babcock Street at Palm Bay Road

A Stage 1 evaluation was conducted for Babcock Street at Palm Bay Road. Based upon the Stage 1 results, the No Build alternative (traffic signal), full Displaced Left-Turn (DLT), partial Displaced Left-Turn (PDLT), and Partial Median U-turn (PMUT) alternatives were advanced to Stage 2 for further analysis.

During the Stage 2 analysis it was concluded that the PDLT would operate adequately and so the DLT was not carried forward into concept development. The PDLT and PMUT intersection alternatives are summarized as follows:

Partial (East-West) Displaced Left-Turn

- Eastbound left-turn volumes are projected to exceed 500 vehicles in the AM peak hour and 300 vehicles in the PM peak hour. Westbound left-turn volumes are projected to exceed 250 vehicles in the AM peak hour and 500 vehicles in the PM peak hour.

- Displacing the eastbound and westbound left-turns allows the eastbound and westbound left-turn volumes to be served in the same phase as the eastbound and westbound through volume.

- Additional movements associated with displacing the eastbound and westbound left-turns can occur concurrently at the new intersections, located on Palm Bay Road approximately 600 feet west and 900 feet east of Babcock Street. The following benefits are expected from the proposed modification:

    - **Operational**: the need for three-to-four phases to serve the Palm Bay Road movements is reduced to two phases, improving the efficiency of the signal and opening up additional capacity to serve all approaches. Based upon the findings of the intersection analysis, ***average intersection delays are expected to decrease by 20 to 40 seconds during the peak hours***.

    - **Safety**: the elimination of the eastbound and westbound left-turn conflicts at the intersection is expected to result in a decrease in crash frequency – particularly left-turn and angle crashes – and crash severity. Based upon the findings of the SPICE analysis, ***a reduction of 185 crashes – including 37 fatal and injury crashes – may be expected over the project's lifecycle***.

Partial (North-South) Median U-Turn

- Northbound left-turn volumes are projected to be 250 to 400 vehicles in the AM and PM peak hours. These volumes conflict with the southbound through volumes – 400 to 1,000 vehicles in the AM and PM peak hours. The southbound left-turn volumes are projected to be 250 to 400 vehicles in the AM and PM peak hours. These volumes conflict with the northbound through volumes – 700 to 1,000 vehicles in the AM and PM peak hours.

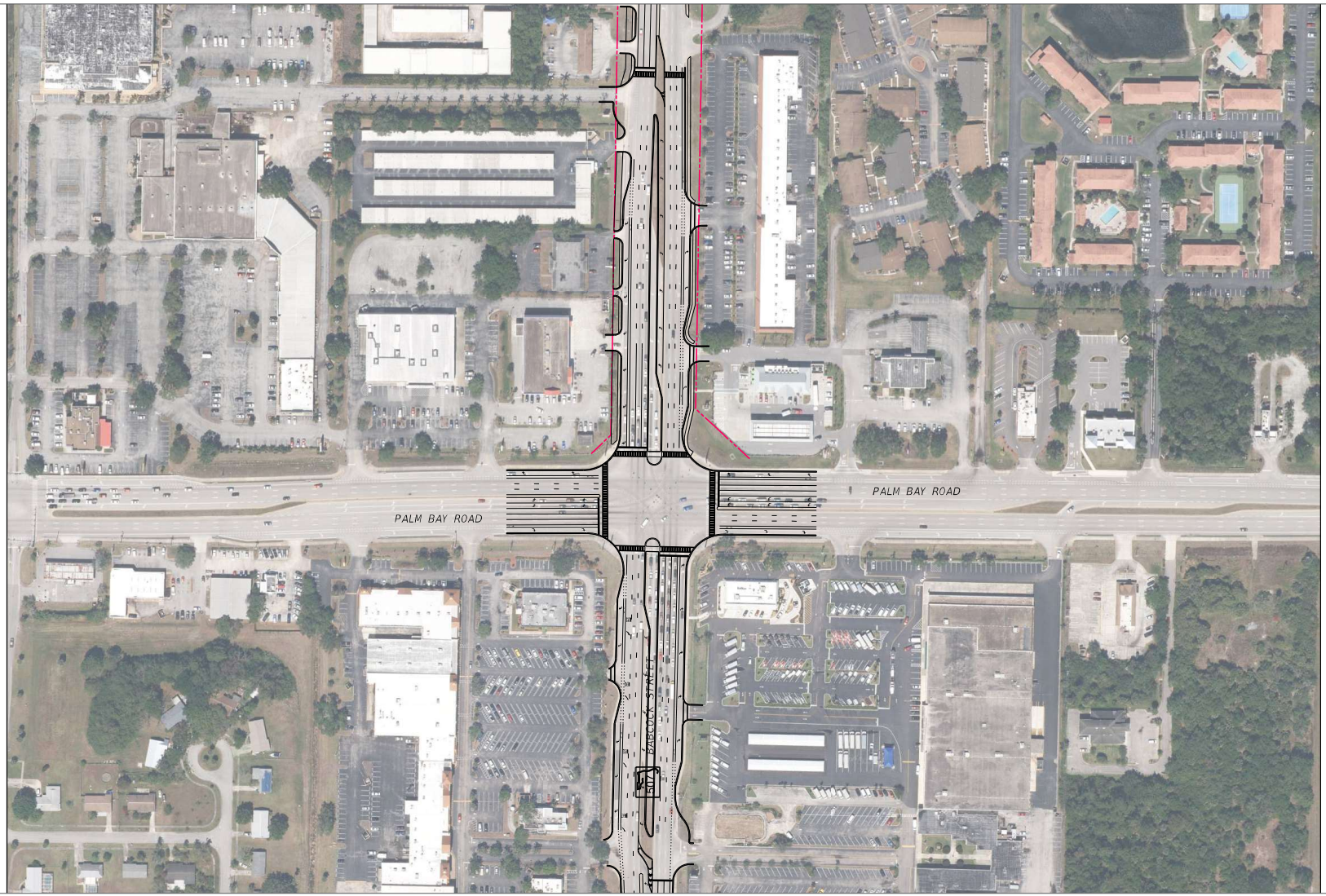
- Requiring the northbound and southbound left-turns to proceed through the intersection and make a U-turn, followed by a right-turn at the intersection, eliminates the conflict with the through vehicles and reduces the need for a northbound and southbound left-turn phase at the signal.

- Additional movements associated with U-turning the northbound and southbound left-turns can occur concurrently at the new intersections, located approximately 800 feet north and 700 feet south of Palm Bay Road. The following benefits are expected from the proposed modification:

    - **Operational**: the need for three-to-four phases to serve the Babcock Street movements is reduced to two phases, improving the efficiency of the signal and opening up additional capacity to serve all approaches. Based upon the findings of the intersection analysis, ***average intersection delays are expected to decrease by 10 to 25 seconds during the peak hours***.

- **Safety**: the elimination of the northbound and southbound left-turn conflicts at the intersection is expected to result in a decrease in crash frequency – particularly left-turn and angle crashes – and crash severity. Based upon the findings of the SPICE analysis, ***a reduction of 231 crashes – including 92 fatal and injury crashes – may be expected over the project's lifecycle***.

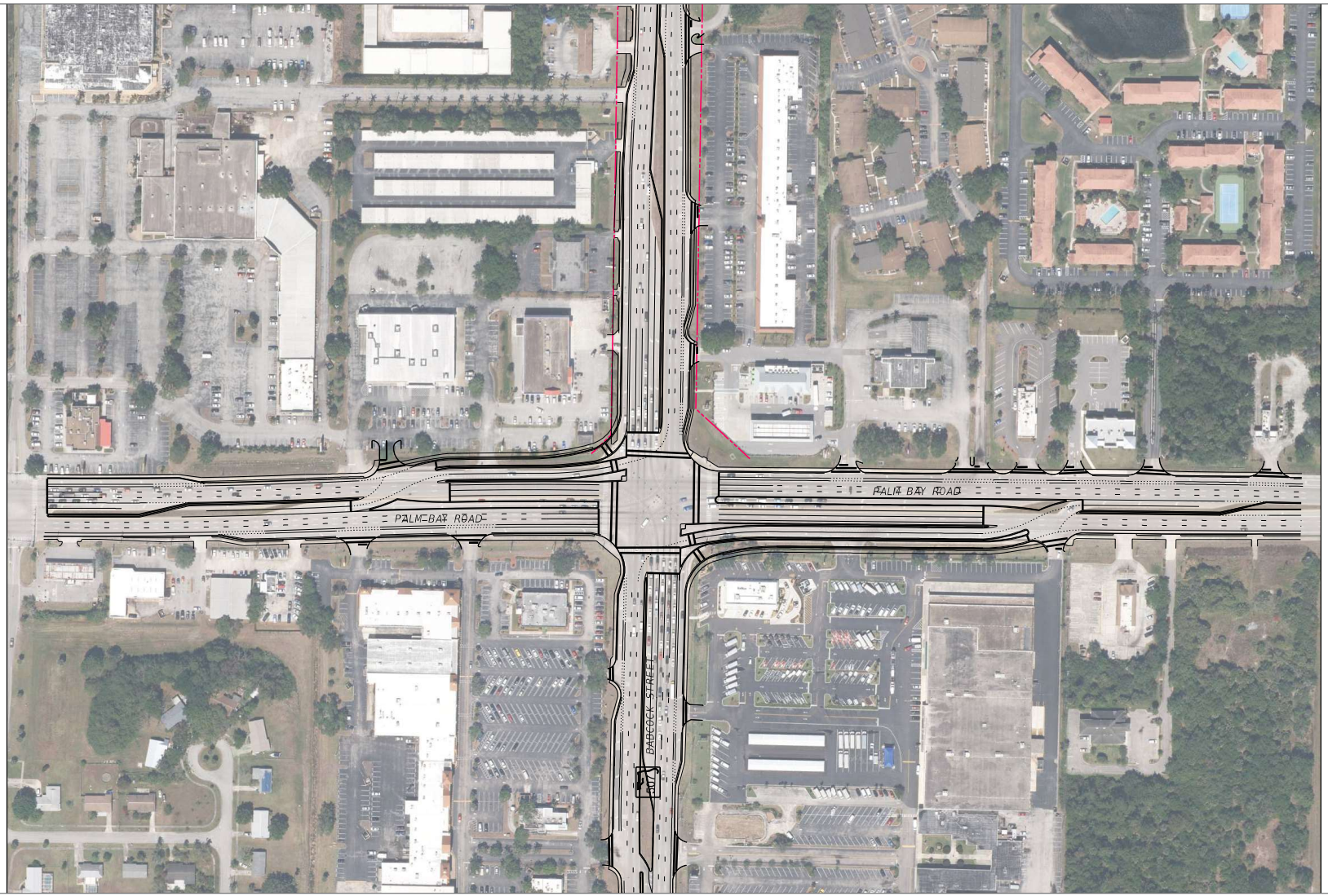
Concepts of the PDLT and PMUT alternatives are illustrated in **Figure 20** and **Figure 21**. The operational and safety comparison of the No Build to the PDLT and PMUT intersection alternatives is summarized in **Table 23**. Detailed HCM output reports and other supporting documentation of the ICE analysis, including CAP-X and SPICE tool results, are included in **Appendix D**.



Not to Scale

North

FIGURE 20 | **Babcock Street at Palm Bay Road – Partial Median U-Turn Concept**



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North

FIGURE 21 | **Babcock Street at Palm Bay Road – Partial Displaced Left-Turn Concept**

Table 23: Babcock Street at Palm Bay Road – ICE Operational Performance Summary

Configuration		Operational Performance					Delay B/C Ratio	Safety Performance				Safety B/C Ratio	Overall B/C Ratio
		Measure	Opening Year (2025)		Design Year (2045)			Measure	Opening Year (2025)	Design Year (2045)	Total Project Life Cycle		
			AM Peak	PM Peak	AM Peak	PM Peak							
	No Build	Delay (LOS)	78.6 (E)	83.0 (F)	76.7 (E)	84.9 (F)	-	Total Crashes	72.29	74.50	1,541.31	-	-
								Fatal & Injury Crashes	14.31	14.80	305.60		
	PMUT	Delay (LOS)	63.9 (E)	61.1 (E)	65.3 (E)	61.2 (E)	**30.59**	Total Crashes	61.44	63.32	1,310.12	**11.25**	**41.83**
								Fatal & Injury Crashes	10.01	10.36	213.92		
	PDLT	Delay (LOS)	45.2 (D)	45.3 (D)	55.6 (E)	46.7 (D)	**20.99**	Total Crashes	63.61	65.56	1,356.36	**3.26**	**24.26**
								Fatal & Injury Crashes	12.59	13.02	268.93		
	DLT	Delay (LOS)	32.7 (C)	33.7 (C)	33.3 (C)	33.9 (C)	**23.82**	Total Crashes	63.61	65.56	1,356.36	**2.14**	**25.95**
								Fatal & Injury Crashes	12.59	13.02	268.93		

Build Intersection Summary

Intersection improvements were evaluated at each study intersection. **Table 24** provides a summary of the intersection operations for each improvement evaluated. Intersection traffic control and geometric lane configurations for the Build scenario are illustrated in **Figure 22**. The following lists the short-term and long-term improvements proposed for each study intersection:

Babcock Street at Palm Bay Road:

- Signal timing improvements (short-term)
- Partial Median U-Turn (long-term)

Babcock Street at Sun Lake Road:

- Partial two-lane roundabout (long-term)

Babcock Street at Eber Boulevard/Pirate Lane:

- Signal timing improvements (short-term)
- Additional eastbound left-turn lane (long-term)

Babcock Street at Florida Avenue:

- Signal timing improvements (short-term)
- Additional eastbound left-turn lane (long-term)

Babcock Street at Engineering Street/Lakewood Village Place:

- Partial two-lane roundabout (long-term)

Babcock Street at University Boulevard:

- Signal timing improvements (short-term)
- Additional westbound left-turn lane (long-term)

Babcock Street at Southgate Boulevard:

- Signal timing improvements (short-term)
- Partial two-lane roundabout (long-term)

Babcock Street at Melbourne Avenue:

- Signal timing improvements (short-term)

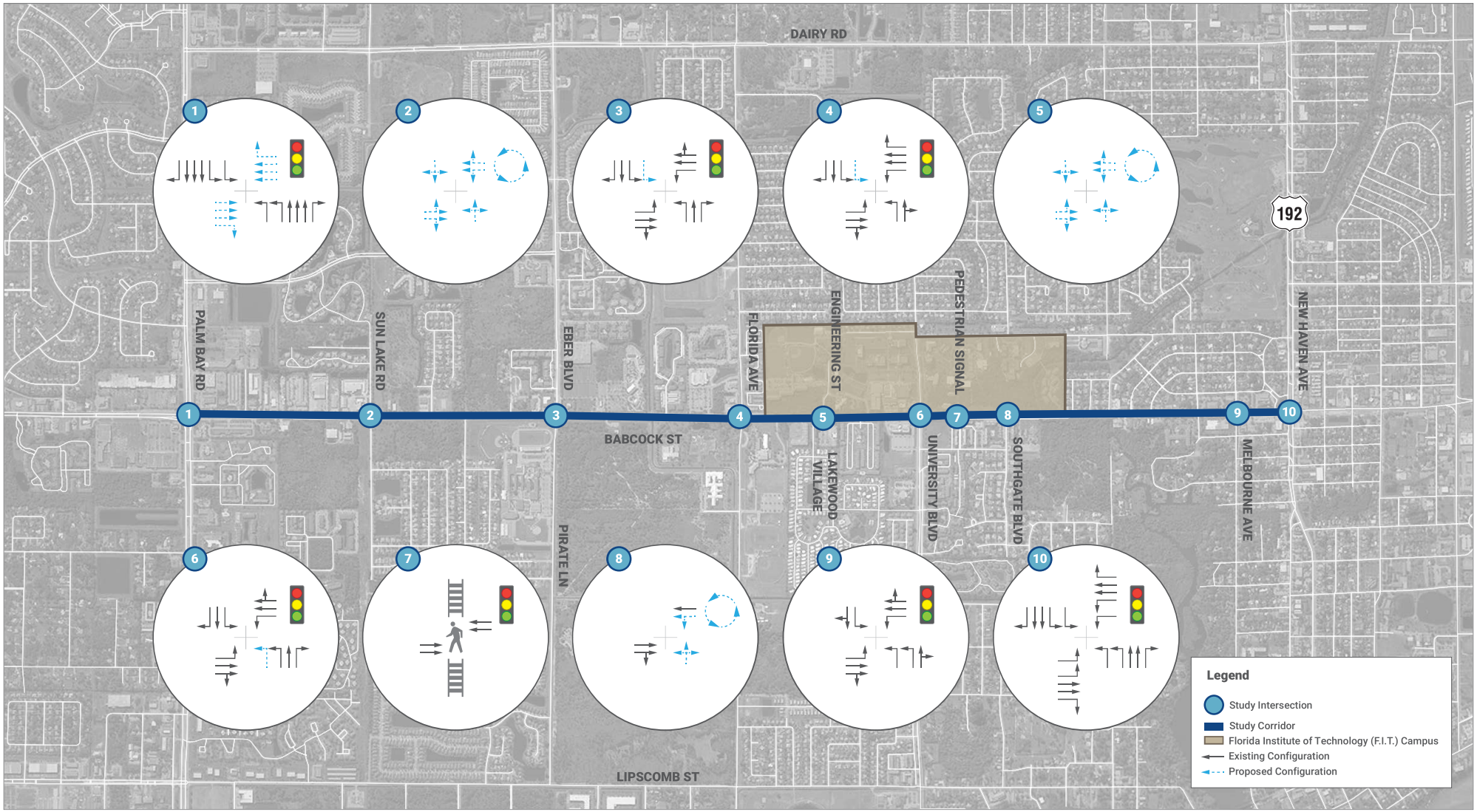
Babcock Street at US 192:

- Signal timing improvements (short-term)

Table 24: 2045 Intersection Operations Analysis Comparison

Intersection	Configuration		Measure	AM Peak Hour					PM Peak Hour				
				EB	WB	NB	SB	Overall	EB	WB	NB	SB	Overall
Babcock Street at Palm Bay Road		No Build	Delay (LOS)	76.8 (E)	56.8 (E)	91.2 (F)	78.3 (E)	76.7 (E)	49.4 (D)	114.5 (F)	93.8 (F)	73.5 (E)	84.9 (F)
			v/c ratio	1.15	0.87	1.16	0.95	-	0.5	1.31	1.11	0.93	-
		PMUT	Delay (LOS)	-	-	-	-	65.3 (E)	-	-	-	-	61.2 (E)
			v/c ratio	-	-	-	-	-	-	-	-	-	-
		PDLT	Delay (LOS)	-	-	-	-	55.6 (E)	-	-	-	-	46.7 (D)
			v/c ratio	-	-	-	-	-	-	-	-	-	-
		DLT	Delay (LOS)	-	-	-	-	33.3 (C)	-	-	-	-	33.9 (C)
			v/c ratio	-	-	-	-	-	-	-	-	-	-
Babcock Street at Sun Lake Road		No Build	Delay (LOS)	>150.0 (F)	>150.0 (F)	8.3 (A)	13.3 (B)	-	>150.0 (F)	>150.0 (F)	11.6 (B)	9.3 (A)	-
			v/c ratio	0.72	2.13	0.01	0.03	-	1.23	1.2	0.08	0.06	-
		Partial 2-Lane Roundabout	Delay (LOS)	6.6 (A)	21.9 (C)	12.8 (B)	5.8 (A)	10.9 (A)	13.5 (B)	9.2 (A)	7.9 (A)	11.4 (B)	10.0 (A)
			v/c ratio	0.06	0.32	0.75	0.36	-	0.1	0.13	0.52	0.7	-
Babcock Street at Eber Boulevard/Pirate Lane		No Build	Delay (LOS)	89.9 (F)	60.0 (E)	62.3 (E)	9.6 (A)	55.4 (E)	64.5 (E)	76.9 (E)	41.1 (D)	13.8 (B)	34.5 (C)
			v/c ratio	1.05	0.5	0.99	0.68	-	0.84	0.9	0.86	1.01	-
		2nd EB LT Lane	Delay (LOS)	70.9 (E)	57.2 (E)	45.6 (D)	7.6 (A)	42.7 (D)	53.6 (D)	61.7 (E)	29.7 (C)	6.6 (A)	24.7 (C)
			v/c ratio	0.86	0.56	0.93	0.51	-	0.69	0.85	0.62	0.97	-
Babcock Street at Florida Avenue		No Build	Delay (LOS)	119.0 (F)	77.9 (E)	53.7 (D)	12.8 (B)	53.7 (D)	88.7 (F)	78.6 (E)	34.3 (C)	44.6 (D)	49.3 (D)
			v/c ratio	1.13	0.75	1.03	0.77	-	1.00	0.93	0.62	1.09	-
		2nd EB LT Lane	Delay (LOS)	73.1 (E)	71.0 (E)	54.0 (D)	24.4 (C)	50.0 (D)	47.7 (D)	68.5 (E)	30.1 (C)	76.7 (E)	60.2 (E)
			v/c ratio	0.89	0.77	1.02	0.81	-	0.64	0.92	0.63	1.09	-
		Full 2-Lane Roundabout	Delay (LOS)	17.4 (C)	56.2 (F)	>150.0 (F)	10.4 (B)	115.1 (F)	102.1 (F)	21.7 (C)	14.3 (B)	139.0 (F)	87.7 (F)
			v/c ratio	0.54	0.73	1.41	0.54	-	0.99	0.57	0.67	1.27	-
Babcock Street at Engineering Street/Lakewood Village Place		No Build	Delay (LOS)	10.7 (B)	>150.0 (F)	-	20.7 (C)	-	40.8 (E)	23.1 (C)	-	12.9 (B)	-
			v/c ratio	0.02	0.92	-	0.03	-	0.38	0.14	-	0.09	-
		Partial 2-Lane Roundabout	Delay (LOS)	7.1 (A)	19.1 (C)	16.4 (C)	6.2 (A)	13.1 (B)	26.1 (D)	9.8 (A)	8.1 (A)	17.6 (C)	14.1 (B)
			v/c ratio	0.03	0.09	0.84	0.4	-	0.29	0.11	0.54	0.86	-
Babcock Street at University Boulevard		No Build	Delay (LOS)	67.0 (E)	96.5 (F)	34.3 (C)	13.7 (B)	37.6 (D)	61.5 (E)	74.2 (E)	60.5 (E)	53.4 (D)	59.0 (E)
			v/c ratio	0.41	1.03	0.89	0.66	-	0.45	0.85	0.94	1.04	-
		2nd WB LT Lane	Delay (LOS)	62.5 (E)	59.1 (E)	34.9 (C)	42.0 (D)	40.7 (D)	48.2 (D)	49.5 (D)	49.7 (D)	71.8 (E)	59.2 (E)
			v/c ratio	0.4	0.52	0.9	0.66	-	0.5	0.56	0.95	0.99	-
		Full 2-Lane Roundabout	Delay (LOS)	8.9 (A)	109.7 (F)	56.9 (F)	12.2 (B)	48.9 (E)	77.0 (F)	25.6 (D)	19.7 (C)	95.7 (F)	59.5 (F)
			v/c ratio	0.19	1.03	1.06	0.56	-	0.92	0.61	0.79	1.15	-
Babcock Street at Southgate Boulevard		No Build	Delay (LOS)	-	96.1 (F)	18.1 (B)	6.6 (A)	15.0 (B)	-	90.0 (F)	17.9 (B)	11.7 (B)	14.6 (B)
			v/c ratio	-	0.61	0.74	0.34	-	-	0.37	0.53	0.66	-
		Cycle Length	Delay (LOS)	-	44.6 (D)	12.1 (B)	2.7 (A)	9.3 (A)	-	38.2 (D)	11.6 (B)	5.2 (A)	7.9 (A)
			v/c ratio	-	0.46	0.77	0.33	-	-	0.3	0.59	0.65	-
		Partial 2-Lane Roundabout	Delay (LOS)	-	15.2 (C)	12.8 (B)	5.8 (A)	10.5 (B)	-	8.2 (A)	8.0 (A)	11.3 (B)	10.0 (A)
			v/c ratio	-	0.09	0.76	0.37	-	-	0.04	0.52	0.72	-
Babcock Street at Melbourne Ave		No Build	Delay (LOS)	82.8 (F)	89.0 (F)	36.9 (D)	11.7 (B)	35.6 (D)	85.4 (F)	84.0 (F)	13.9 (B)	15.1 (B)	24.6 (C)
			v/c ratio	0.63	0.8	0.89	0.33	-	0.73	0.83	0.49	0.65	-
		Cycle Length	Delay (LOS)	77.6 (E)	78.8 (E)	45.7 (D)	12.0 (B)	40.1 (D)	70.1 (E)	75.8 (E)	28.3 (C)	15.5 (B)	28.6 (C)
			v/c ratio	0.61	0.79	0.95	0.33	-	0.7	0.82	0.66	0.68	-
Babcock Street at US 192		No Build	Delay (LOS)	68.8 (E)	61.1 (E)	48.5 (D)	48.5 (D)	55.7 (E)	67.7 (E)	67.2 (E)	44.2 (D)	55.3 (E)	58.0 (E)
			v/c ratio	0.85	0.58	0.91	0.78	-	0.81	0.81	0.84	0.89	-
		Cycle Length	Delay (LOS)	62.4 (E)	57.1 (E)	52.0 (D)	48.1 (D)	54.8 (D)	53.7 (D)	58.6 (E)	45.0 (D)	69.4 (E)	57.8 (E)
			v/c ratio	0.85	0.66	0.96	0.78	-	0.87	0.9	0.93	1.02	-

**Average delays (seconds) and LOS reported for approach on controlled approaches or critical movement on uncontrolled approaches. Volume-to-capacity (v/c) ratios reported for critical movement on all approaches.*
Note: The Highway Capacity Manual 2010 uses similar delay criteria for LOS on stop-control and roundabout intersections, but different delay criteria are used for LOS at signalized intersections.



Babcock Street Corridor Planning Study

FIGURE 22 | **Build Study Intersection Characteristics**

5.6 Alternatives Analysis Summary

A series of improvements were identified and evaluated to meet the needs of corridor motorists, bicyclists, pedestrians, and transit users.

- Speed management strategies – such as reducing posted speeds, narrowing lane widths, and introducing horizontal deflection and enclosure – were identified to reduce vehicular speeds on the corridor and improve safety for all users.
- Access management improvements – such as median opening modifications, aligning intersections, and adding new pedestrian crossings and raised medians – were identified to improve safety and increase vehicular and pedestrian/bicycle access to FIT.
- Pedestrian and bicycle facility alternatives – such as filling sidewalk gaps, constructing shared use paths, and two-way separated bicycle lanes – were identified to improve pedestrian and bicycle access and safety throughout the corridor.
- TSM&O alternatives – such as signal timing modifications, new turns lanes, and conversion to roundabout or median U-turn intersections – were identified at the intersection level to improve intersection operations and safety throughout the corridor.

The proposed improvements are evaluated against the purpose and need performance measures in **Table 25**. With the exception of the shared use path and the two-way cycle track (shown as A vs. B in the table), the proposed improvements build upon each other to further enhance the goals of each strategy/project. The identified project elements can be implemented in groups or move forward independently based upon the available funding, expected impacts, and opportunities created by other ongoing / planned projects. The implementation strategy for the proposed improvements are discussed in the next section.

Table 25: Proposed Improvements Evaluation Matrix

Mode	Needs	Performance Measures	Speed Management: Narrow Travel Lanes	Speed Management: Chicanes	Speed Management: Install Curb with Sidewalk	Speed Management: Street Trees	Speed Management: Raised Crosswalks	Access Management: New Raised Median	Access Management: Modify Median Openings	Access Management: Intersection Alignment	Access Management: Transit Pads	Ped & Bike Connectivity: Fill Sidewalk Gaps	Ped & Bike Connectivity: A: Shared Use Path	Ped & Bike Connectivity: B: 2-Way Cycle Track	Intersection Strategies: Signal Timing	Intersection Strategies: Turn Lanes	Intersection Strategies: Roundabouts	Intersection Strategies: Innovative Intersections
	Corridor Safety	Crash frequency/severity																
		Number of conflict points																
		Number of uncontrolled median openings																
		Speed differential																
	Intersection Safety	Crash frequency/severity																
		Number of conflict points																
	Intersection Congestion	Intersection delay and volume / capacity ratio																
		Corridor travel time																
	Safe, Continuous Facility	Continuity (linear feet)																
		Number of conflict points																
		Comfort level																
	Access Between Uses	Number of controlled crossing opportunities																
		Distance between crossings																
		Reducing target speed to 35 mph or less																
	Safe, Continuous Facility	Continuous sidewalk (linear feet)																
		Number of conflict points																
		Comfort level																
	Access Between Uses	Number of controlled crossing opportunities																
		Distance between crossings																
		Average crossing distance																
		Number of spot medians or refuge islands																
		Reducing target speed to 35 mph or less																
	Accessibility	Percentage of ADA Compliant Stops																
		Pedestrian crossings within vicinity of transit stops																
	Constructability	ROW Impacts																
		Utility Impacts																
		Drainage Impacts																
	Cost		$	$	$	$	$	$$	$$	$$$	$	$	$$	$$	$	$$	$$$	$$$

Negative Impact — Positive Impact

6. IMPLEMENTATION STRATEGY

FDOT is scoping an upcoming Resurfacing, Restoration, and Rehabilitation (RRR) project anticipated for 2023. The project limits include Babcock Street from Palm Bay Road to Melbourne Avenue – covering the majority of the study corridor. The implementation strategy for the corridor's proposed improvements have been divided into two phases:

1. Short-term alternatives that address the immediate multimodal needs of the corridor and can be constructed with a future resurfacing project, and
2. Long-term alternatives requiring further project development and may be constructed in groups or standalone as part of other future projects.

6.1 Short-Term Alternatives

The following short-term alternatives address the multimodal needs and performance measures set out for this project as previously shown in **Table 25**:

- Narrow travel lanes
- Chicanes
- Access management improvements
- Raised crosswalks
- Shared use path (where viable)
- Widen sidewalk on Cranes Creek Bridge
- Fill sidewalk gaps
- Transit ADA pads

The purpose and location of the above improvements were presented in detail in Section 5, and a concept plan illustrating the above improvements with FDOT's other RRR improvements is provided in **Appendix E**.

6.2 Long-Term Alternatives

For the long-term, alternatives further address the multimodal safety, connectivity, and access needs of the corridor into the future. Additionally, the long-term alternatives require the collaboration of the Florida Institute of Technology (FIT) and the Cities of Palm Bay and Melbourne, particularly in determining the maintenance of landscaping opportunities that serve as speed management strategies to address safety on the corridor. The long-term alternatives include the following:

- Turn lane improvements at Eber Boulevard, Florida Avenue, and University Boulevard
- Roundabout intersections at Sun Lake Road, Engineering Street, and Southgate Boulevard
- Partial Median U-Turn (PMUT) intersection at Palm Bay Road
- Landscaping opportunities to introduce enclosure throughout the corridor
- Shared use path (where not previously addressed by the RRR project)
- Two-way cycle track along the west side from Sun Lake Road to Cranes Creek Bridge
- 7’ buffered bicycle lane from Melbourne Avenue to US 192

The purpose and location of the above improvements were presented in detail in Section 5, and a concept plan illustrating the above long-term improvements is provided in **Appendix E**.

7. PUBLIC INVOLVEMENT

The Babcock Street (SR 507) Corridor Planning Study was conducted around key public involvement milestone events designed to solicit meaningful input from the corridor stakeholders on:

- Who the user groups are and where they are travelling to/from along the Corridor;
- What the existing and future needs are along the Corridor;
- Goals and objectives of the study; and
- Issues and challenges related to all modes moving along and across Babcock Street.

7.1 Summary of Public Involvement

The overall purpose of the public outreach for the corridor study was to have continuous communication and feedback between the Study Team and corridor constituents. The public outreach activities were designed to share information as well as receive continuous input on evolving ideas related to the study. The specific objectives of the public involvement activities included:

- ***Early and continuous engagement:*** The Study Team engaged elected officials, agencies, stakeholders, and the public early and regularly throughout the project's key milestones.

- ***Engagement through various channels and opportunities:*** The Study Team implemented various ways of community engagement, from traditional large-scale meetings to small-group stakeholder meetings. The Study Team also leveraged existing channels of communication with the FDOT and with partner agencies including Space Coast Transportation Planning Agency (SCTPO), the City of Palm Bay, the City of Melbourne, and Space Coast Area Transit in sharing project information and receiving community input.

- ***Engage a diverse group of community members:*** The Study Team provided opportunities for interacting with the Corridor's diverse stakeholders and users, including residents, property owners, students, and educational institutions.

7.2 Project Visioning Team

The collaboration between the Department and key stakeholders included the establishment of a Project Visioning Team (PVT), comprised of agency staff from various units of the Department (planning, traffic operations), the SCTPO, the City of Palm Bay, the City of Melbourne, Brevard County, Space Coast Area Transit, and representatives from Brevard County Schools, Florida Institute of Technology, and Melbourne Central Catholic High School. This group met four times over the course of the study to act as a sounding board for preliminary findings and ideas, and vet potential alternatives before they are presented to the FDOT management and the broader community.

7.3 Small Group Meetings

Early in the study process, key local stakeholders were identified to gain better input on corridor needs from different perspectives, including property owners, major employers, large institutions (schools and churches), community and civic organizations, and neighborhood homeowners' associations within the corridor. Community stakeholders were engaged through emails, phone calls, and conversations at the public involvement meetings.

7.4 Public Meetings

The visioning phase of the study included a Public Involvement Kick-Off Meeting to review the corridor planning process and study objectives, and issues and opportunities identified from stakeholder interviews and data collection and analysis, and to begin to brainstorm ideas for solutions to address the opportunities and challenges. The workshop was conducted on April 17, 2019 as an open house format at Melbourne City Hall.

The final phase of the study (alternatives development and selection) included an Alternatives Development Public Meeting to present and receive feedback on the alternative strategies. The second public meeting was conducted on May 18, 2021 as a hybrid meeting, with an in-person option at Melbourne City Hall and a virtual option utilizing the GoToWebinar platform.

7.5 SCTPO Meetings

After the final public meeting and PVT meeting, the project team presented the recommendations of the corridor planning study to the SCTPO. The project team presented to the Technical Advisory Committee (TAC), the Citizens Advisory Committee (CAC), and the Governing Board during SCTPO's regularly scheduled meetings on September 8-9, 2021.

8. NEXT STEPS

A future conditions analysis was conducted for Babcock Street Corridor Planning Study to evaluate the future needs of Babcock Street from Palm Bay Road to New Haven Avenue. The findings and conclusions of the analysis are summarized as follows.

No Build Analysis

- Based upon project traffic growth, the Babcock Street segments are anticipated to meet FDOT's LOS target (D) in the design year (2045).
- The bicycle and pedestrian LOS is E from Palm Bay Road to Florida Avenue and from University Boulevard to Melbourne Avenue and LOS F from Florida Avenue to University Boulevard due to facility gaps and high vehicle volumes.
- Peak hour operations are expected to degrade to LOS F in the design year on one or more approaches during the peak hour(s) at Palm Bay Road, Sun Lake Road, Eber Boulevard/Pirate Lane, Florida Avenue, Lakewood Village Place, University Boulevard, Southgate Boulevard, and Melbourne Avenue.

Purpose and Need

The user Needs identified of the Babcock Street corridor are described as follows:

Motorists

- Corridor Safety – Motorists need a roadway that allows safe travel between destinations
- Intersection Safety – Motorists need intersections that facilitate safe connections between roadways
- Intersection Congestion – Motorists need a reliable roadway that allows effective travel

Bicyclists

- Safe, Continuous Facility – Bicycle users need a safe and continuous bicycle facility along Babcock Street
- Access between Uses – Bicycle users need to safely access land uses along and across Babcock Street

Pedestrians

- Safe, Continuous Facility – Pedestrian users need a safe and continuous pedestrian facility travel along Babcock Street
- Access between Uses – Pedestrian users need to safely access land uses along and across Babcock Street

Transit

- Accessibility – Transit riders need a system that allows safe and easy access between modes

Alternatives Development and Analysis

A series of improvements were identified and evaluated to meet the needs of corridor motorists, bicyclists, pedestrians, and transit users.

- Speed management strategies – such as reducing posted speeds, narrowing lane widths, and introducing horizontal deflection and enclosure – were identified to reduce vehicular speeds on the corridor and improve safety for all users.
- Access management improvements – such as median opening modifications, aligning intersections, and adding new pedestrian crossings and raised medians – were identified to improve safety and increase vehicular and pedestrian/bicycle access to FIT.
- Pedestrian and bicycle facility alternatives – such as filling sidewalk gaps, constructing shared use paths, and two-way separated bicycle lanes – were identified to improve pedestrian and bicycle access and safety throughout the corridor.
- TSM&O alternatives – such as signal timing modifications, new turns lanes, and conversion to roundabout or median U-turn intersections – were identified at the intersection level to improve intersection operations and safety throughout the corridor.

8.1 Recommendations

It is recommended the following short-term improvements be incorporated into the upcoming RRR project on Babcock Street, as illustrated in the concept plan in **Appendix E**:

- Narrow travel lanes
- Chicanes
- Access management improvements
- Raised crosswalks
- Shared use path (where viable)
- Widen sidewalk on Cranes Creek Bridge
- Fill sidewalk gaps
- Transit ADA pads

The following long-term improvements are recommended for additional project development and coordination with Florida Institute of Technology (FIT) and the local partners:

- Turn lane improvements at Eber Boulevard, Florida Avenue, and University Boulevard
- Roundabout intersections at Sun Lake Road, Engineering Street, and Southgate Boulevard
- Partial Median U-Turn (PMUT) intersection at Palm Bay Road
- Landscaping opportunities to introduce enclosure throughout the corridor
- Shared use path (where not previously addressed by the RRR project)
- Two-way cycle track along the west side from Sun Lake Road to Cranes Creek Bridge
- 7’ buffered bicycle lane from Melbourne Avenue to US 192

A concept plan illustrating the above long-term improvements is provided in **Appendix E**.