INTERCHANGE OPERATIONAL ANALYSIS REPORT

I-4/SR 400 at SR 528 (Beachline Expressway)

Orange County, Florida

Financial Project ID: 448915-1
Roadway ID: 75280000

Prepared For:
FLORIDA DEPARTMENT OF TRANSPORTATION
DISTRICT FIVE

February 2023

Interchange Operational Analysis Report (IOAR)

I-4 at SR 528 (Beachline Expressway) IOAR

448915-1

Florida Department of Transportation

Determination of Safety, Operational and Engineering Acceptability

Acceptance of this document indicates successful completion of the review and determination of safety, operational and engineering acceptability of the Interchange Access Request. Approval of the access request is contingent upon compliance with applicable Federal requirements, specifically the National Environmental Policy Act (NEPA) or Department's Project Development and Environment (PD&E) Procedures. Completion of the NEPA/PD&E process is considered approval of the project location design concept described in the environmental document.

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Central Office — Date

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: 2/23/2023

FM Number: 448915-1

Project Title: I-4 at SR 528 (Beachline Expressway) Interchange Operational Analysis Report

District: Five

Requestor: Megan Owens Phone: 386/943-5140

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Document Type: ☐ MLOU ☐ IJR ☐ IMR ☒ IOAR ☐ OTHER___________________________

Status of Document (Only complete documents will be submitted for review; however, depending on the complexity of the project, interim reviews may be submitted as agreed upon in the MLOU)

IOAR Document

Quality Control (QC) Statement

This document has been prepared following FDOT Procedure Topic No. 525-030-160 (New or Modified Interchanges) and complies with the FHWA two policy requirements. Appropriate District level quality control reviews have been conducted and all comments and issues have been resolved to their satisfaction. A record of all comments and responses provided during QC review is available in the project file or Electronic Review Comments (ERC) system.

Requestor DocuSigned by: Megan Owens 8B3FF13A9ADF453... Date: 02/23/2023 | 3:59 PM EST

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Melissa McKinney

CERTIFICATION

BY

KITTELSON & ASSOCIATES, INC.

Financial Project ID: 448915-1

Roadway ID: 75280000

I, Michael P. Eagle, Florida P.E. Number 86645, have prepared and reviewed the Design Traffic for the above referenced FLORIDA DEPARTMENT OF TRANSPORTATION project. I have specifically followed the "Project Traffic Forecasting Procedure" as adopted by the Florida Department of Transportation. Based on traffic count information, general data sources, and other pertinent information, the Design Traffic has been prepared using current traffic engineering, transportation planning, and Florida Department of Transportation practices and procedures.

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MICHAEL P. EAGLE
LICENSE
No. 86645
★ ★ ★
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Michael P. Eagle, P.E., on February 23, 2023. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Michael P. Eagle, P.E. #86645

Michael P Eagle

Digitally signed by Michael P Eagle
Date: 2023.02.23 14:47:04 -05'00'

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1. EXECUTIVE SUMMARY

The Florida Department of Transportation (FDOT) District Five has prepared an Interchange Operational Analysis Report (IOAR) for the proposed improvements at the I-4 (SR 400) and SR 528 (locally known as Beachline Expressway) interchange. The proposed improvement includes the widening of the existing single lane off-ramp from I-4 westbound to eastbound SR 528 to two-lanes. The interchange improvements are funded for construction in fiscal year 2023 (FM #448915-1).

The purpose of this IOAR is to document the potential safety and operational impacts of the proposed interchange modification being proposed as part of the I-4 and SR 528 improvements. The findings of the operational and safety analysis and the FHWA Policy Point discussion are summarized as follows:

Purpose and Need

- **Purpose:** The purpose of this project is to improve safety and traffic operations at the I-4 and SR 528 interchange. Improvements to the operation and safety of the I-4 and SR 528 interchange will better accommodate future population increases, improve mobility, and support economic growth.
- **Need:** The need for the project has been documented in previous analyses of the interchange (described in detail in the Introduction) which showed failing operations of the westbound I-4 off ramp to SR 528. The need for the project is also demonstrated by the projections of future population and employment growth in the region indicating that travel demand will continue to increase well into the future. Without the improvements, congestion is expected to occur on the westbound I-4 off ramp resulting in failing conditions which will impact the operations of I-4. The 2026 peak hour projections indicate that capacity of the single lane ramp will be exceeded (v/c ratio greater than 1.0) during both peak hours. Queue spillback onto the mainline I-4 is expected to occur in the future without widening the ramp to two lanes, resulting in a significant safety risk along the westbound I-4 mainline lanes.

Future Traffic Operations

- The microsimulation analysis shows an improvement in travel time along I-4 westbound:
  - The end-to-end travel time along I-4 westbound is expected to improve by approximately 3 to 6 percent during the future year peak hours.
  - The travel time along I-4 westbound to the end of the AOI along eastbound SR 528 is expected to improve by up to 9 percent with the proposed ramp widening at the I-4 westbound off-ramp to eastbound SR 528 during the future year peak hours.
- The microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.
- Network-wide performance metrics such as average delay, average speed, and total delay are better in the Build when compared to the No-Build for each analysis year analyzed.

Future Safety Performance

- The projected traffic volume along the I-4 westbound off-ramp to eastbound SR 528 is expected to exceed the capacity of a single lane ramp. In an unconstrained network, it would be expected that there would be queue spillback onto the I-4 westbound mainline lanes due to this ramp capacity issue. It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent).
- The widening of the I-4 westbound off-ramp to eastbound SR 528 will provide adequate capacity to accommodate the project traffic demand along the ramp which would mitigate the potential for queue spillback onto the I-4 mainlines and minimize the high-speed differential crash potential along I-4 westbound. The proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.

FHWA Policy Points

The proposed improvements satisfy FHWA's Two Policy Point Requirements included in the May 22, 2017, update to "Policy on Access to the Interstate System".

- Policy Point 1: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).
    - Policy Point 1: The safety and operational analyses conducted as part of this IOAR have concluded that the proposed interchange improvements improve traffic operations and mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.

- The microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.
- As described in this IOAR, the proposed action of widening of the I-4 westbound off-ramp to eastbound SR 528 from a single lane ramp to a dual lane ramp safely and efficiently collects, distributes, and accommodates the traffic anticipated to use the improvements.
- It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent). The proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.
- As noted in the Future Operational Analysis sections, the analyses confirmed that capacity improvements such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 to address mainline bottlenecks within the AOI. These improvements will be evaluated as funding becomes available. At this time, the FDOT is using a phased approach to implement improvement projects as construction funding is identified.

- Policy Point 2: The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.
    - Policy Point 2: The proposed improvements will maintain full access between I-4 and SR 528. All traffic movements are being provided.

The interchange improvements evaluated as part of the Build scenario fulfill the project's purpose and need and satisfy the FHWA Policy Points.

2. GENERAL PROJECT INFORMATION

2.1. Introduction

The Interstate 4 (I-4) at SR 528 (locally known as Beachline Expressway) interchange is a system interchange. The interchange is the western terminus of SR 528 and is located between the interchanges of I-4 with SR 535 and Central Florida Parkway to the south and Sand Lake Road (SR 482) to the north. The interchange is located within Orange County. **Figure 1** shows the project location.

In October 2015, the I-4 and SR 528 Interchange Interim Improvements Interchange Operational Analysis Report (IOAR) requested by Florida's Turnpike Enterprise (FTE) received a Determination of Engineering and Operational Acceptability from the Federal Highway Administration (FHWA). The IOAR documented the need for the widening of the SR 528 westbound ramps to both eastbound and westbound I-4 to two lanes. This project has been constructed and is operational and resulted in all interchange ramps being two lanes except for the westbound I-4 off-ramp to SR 528. The IOAR identified the need to widen the westbound I-4 off-ramp to SR 528 to two lanes.

The I-4 Beyond the Ultimate (BtU) South Section Systems Access Modification Report (SAMR) received a determination of Engineering and Operational Acceptability on May 9, 2017 from FHWA. At this time, it is not known when additional funding will become available to expand the southern limits of the I-4 BtU project. The Florida Department of Transportation (FDOT) District 5 has initiated the evaluation of additional opportunities that maintain the purpose and need from the previously approved I-4 BtU Project Development & Environment (PD&E) Study as well as consider operational needs, construction costs, and constructability. These opportunities include reviewing the elements in the previously approved concept such as typical section, managed lane separation type, and use of the rail corridor.

The first projects to be constructed in the I-4 BtU South Section are the interim I-4/Daryl Carter Parkway interchange (FM# 441113-3), the I-4/Sand Lake Road interchange modification (FM# 444315-3), and the I-4/SR 535 interchange modification (FM# 448914-1). The I-4/Sand Lake Road IMR (received an Affirmative Determination of Safety, Operational, and Engineering Acceptability from FHWA in December 2021) also identified the need to widen the westbound I-4 off-ramp to SR 528.

The I-4 westbound express lane "Tube" project will also be constructed as part of the Daryl Carter Parkway, Sand Lake Road, and SR 535 interchange projects as previously mentioned. A single westbound express lane will be extended from the end of the I-4 Ultimate project to west of SR 536. The "Tube" project is expected to be delivered as part of the following three projects:

- G/W FM# 444315-3: The portion of the "Tube" from west of SR 482 (Sand Lake Road) to west of Central Florida Parkway will be designed and constructed as part of the Sand Lake Road Interchange Design Build project.
- FM# 441113-3: The portion of the "Tube" from west of Central Florida Parkway to west of Daryl Carter Parkway will be designed and constructed as part of the Daryl Carter Parkway

project. The current construction plans for the Daryl Carter Parkway interchange are at the Phase IV level, but a Plans Update will be required to incorporate the WB Express Lanes through the limits of this project. This task is being included as a Supplemental Agreement to the original contract.

- G/W FM# 449771-1: The portion of the "Tube" from west of Daryl Carter Parkway to west of SR 536 will be designed and constructed as part of the SR 535 interchange Design Build project (FM# 448914-1).

The express lane extension included in the Sand Lake Road interchange project will not be open to traffic until the entirety of the "Tube" to west of the SR 536 interchange is constructed as part of other projects.

The roadway identification number for the portion of I-4 included in this project is 75280000, beginning from the SR 535 interchange to the south (MP 68.107) and ending at SR 482 interchange to the north (MP 74.607). The roadway identification number for the portion of the SR 528 mainline included in the project is 75471000 which begins at I-4 (MP 0.00) and ends east of I-Drive (MP 1.30).

A Methodology Letter of Understanding (MLOU) was prepared and approved in July 2022, prior to the initiation of this study and is included in **Appendix A**.

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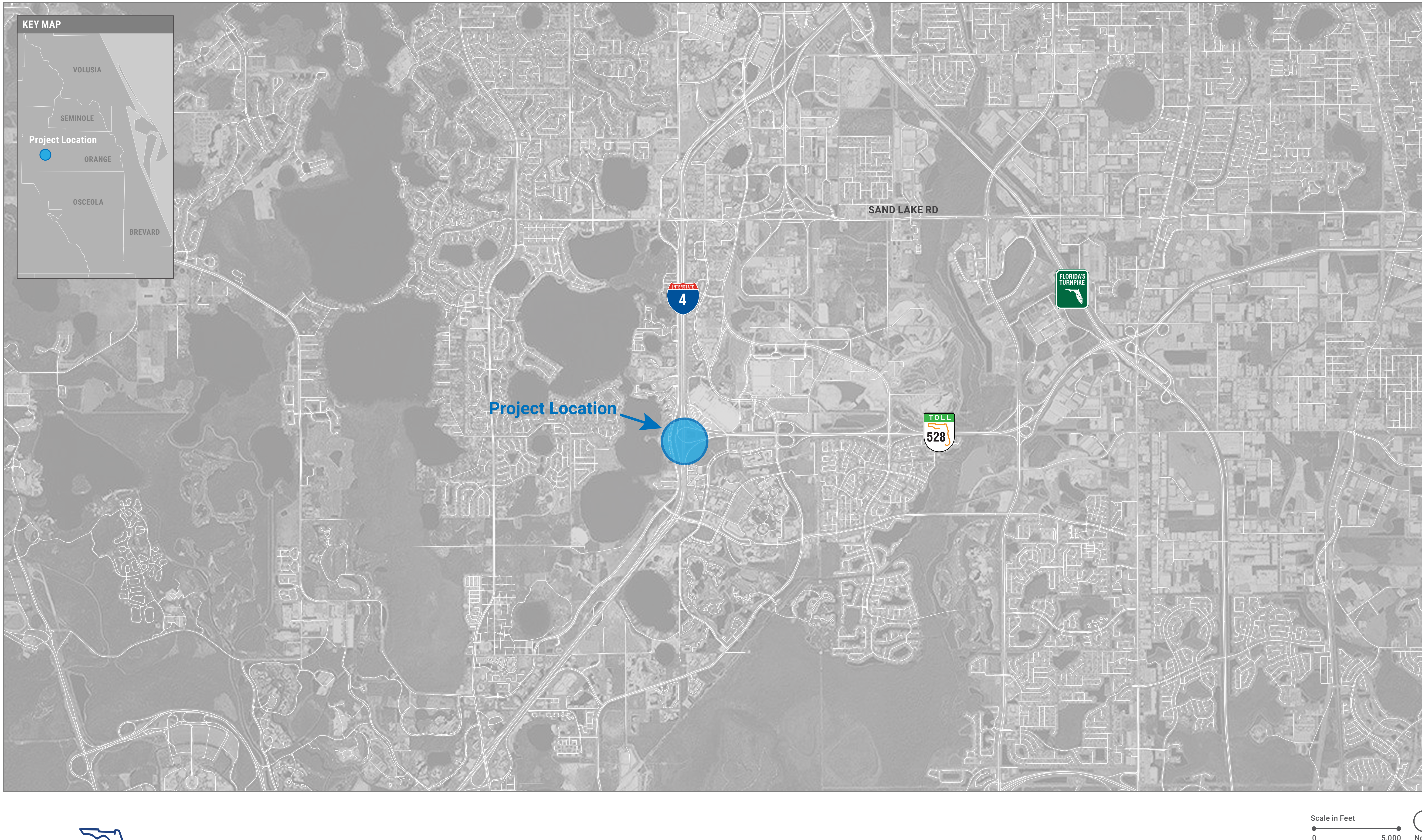

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I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 1 | **Project Location**

2.2. Purpose and Need Statement

The purpose of this project is to improve safety and traffic operations at the I-4 and SR 528 interchange. Improvements to the operation and safety of the I-4 and SR 528 interchange area will improve mobility and support economic growth.

The purpose of this interchange access request (IAR) is to document the potential safety and operational impacts of the interchange modifications being proposed as part of the I-4 and SR 528 interchange improvement project.

The need for the project has been documented in previous analyses of the interchange (as described in the Introduction) which showed failing operations of the westbound I-4 off-ramp to SR 528. The need for the project is also shown by the projections of future population and employment growth in the region indicating that travel demand will continue to increase well into the future. Without the improvements, congestion is expected to occur on the westbound I-4 off-ramp resulting in failing conditions which will impact the operations of I-4. The volume to capacity (v/c) ratio along the study ramp is expected to exceed 1.0 (overcapacity) based on the 2026 AM and PM traffic projections prepared by Florida's Turnpike Enterprise (2,330 and 2,150 vehicles in the 2026 AM and PM peak hours, respectively) and the capacity of a single lane ramp (assuming approximately 1,800 vehicles per hour). The v/c ratio is expected to increase/worsen as traffic demands increase. Queue spillback onto the mainline I-4 is expected to occur in the future without widening the ramp to two lanes, resulting in a significant safety risk along the westbound I-4 mainline lanes.

2.3. Analysis Years

Traffic operations are analyzed and reported in this IOAR for the existing year (2022) as well as the following future years:

- Opening year – 2026
- Design year – 2036

2022 field collected data was used for the existing year analyses documented in this IOAR.

2.4. Area of Influence

The study interchange's area of influence is illustrated in **Figure 2**. The following key facilities were evaluated in this IOAR:

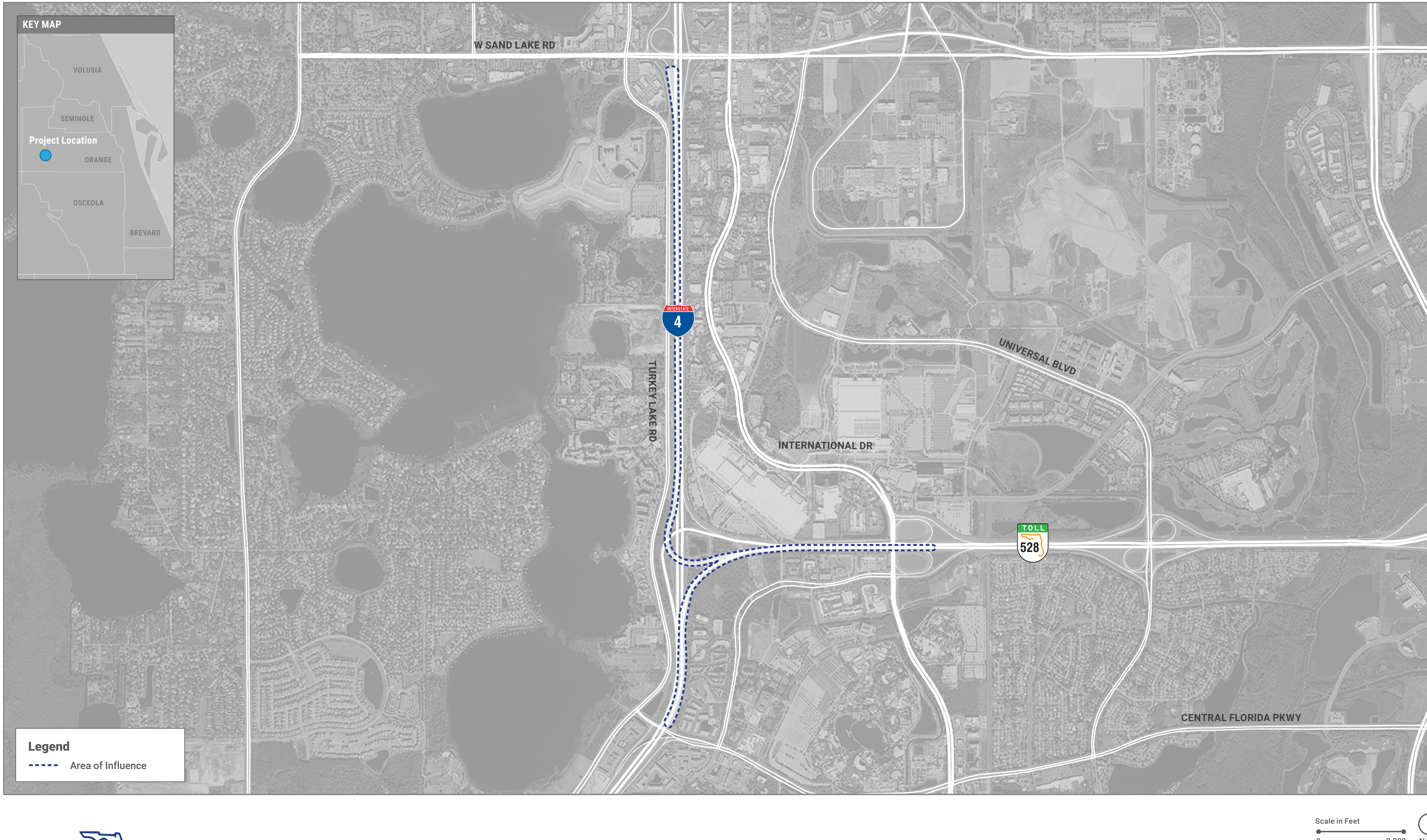
<u>Freeway Mainline</u>

- I-4 westbound, east of the Sand Lake Road on-ramp
- I-4 westbound, between the Sand Lake Road on-ramp and the I-4 westbound off-ramp to SR 528
- I-4 eastbound, west of SR 528
- SR 528 eastbound, between I-4 and the International Drive off-ramp from SR 528 eastbound

<u>Ramps</u>

- I-4 westbound on-ramp from eastbound Sand Lake Road
- I-4 westbound off-ramp to SR 528
  - This proposed two-lane ramp will tie into existing pavement along eastbound SR 528 (currently striped out).
- I-4 eastbound off-ramp to SR 528
- SR 528 eastbound off-ramp to International Drive

A deceleration lane will be added to the I-4 westbound mainline as part of this off-ramp widening project. The proposed ramp widening will not impact westbound SR 528 operations.



FDOT I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 2 | **Area of Influence**

2.5. Level of Service (LOS) Targets

The Level of Service performance target for the study facility was determined per the State Highway System, Policy No. 000-525-006c, effective April 19, 2017, is consistent with the approved MLOU, and is shown below:

- I-4 and SR 528 Mainline and Ramps: LOS D

It is understood that the LOS that is extracted from VISSIM analyses is estimated and should not be compared directly against Highway Capacity Manual (HCM) LOS results. The estimated LOS from VISSIM reported in this IOAR is noted as "estimated" in the analysis sections of this report. Consistent with guidance in the 2021 FDOT Traffic Analysis Handbook, HCM results were not conducted or reported as part of this IOAR since microsimulation analyses were conducted.

2.6. Funding Plan and Schedule

Funding for this project is included in the FDOT Five Year Work Program (FM# 448915-1). The following is the anticipated funding plan and schedule for this project.

- Design – Ongoing, completion by March 2023
- Design-Bid-Build RFP Advertisement – April 2023
- Construction Letting – June 2023

3. DATA COLLECTION

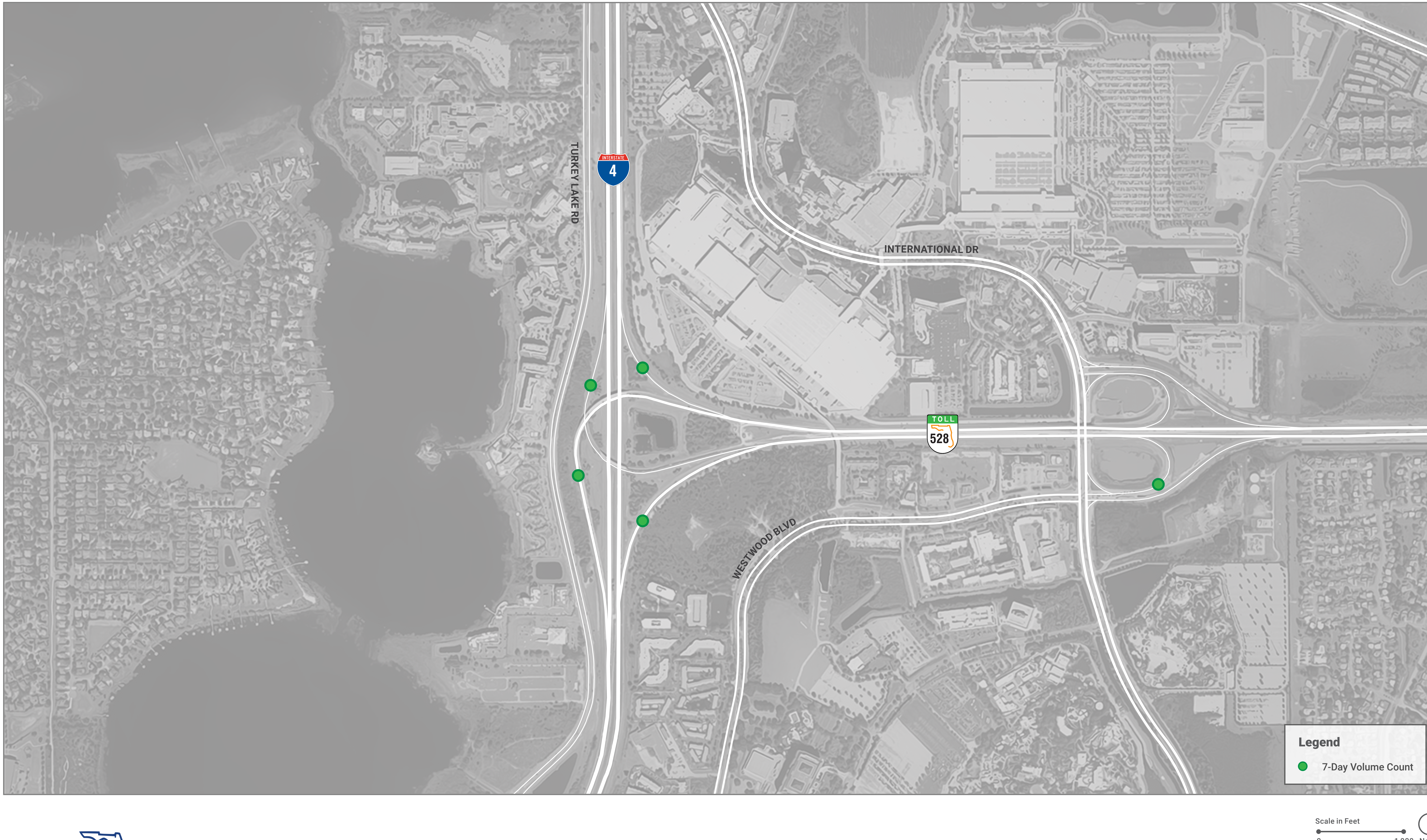
3.1. Traffic Data

Seven-day, field collected traffic volume data was collected by Florida's Turnpike Enterprise (FTE) in 2022 at the I-4 at SR 528 ramps and the SR 528 eastbound off-ramp to International Drive. Forty-eight hour (48-hour) field collected vehicular classification data was collected by FDOT District 5 along the Sand Lake to I-4 westbound ramp. I-4 mainline data was provided by FDOT Central Office at the telemetered site 750130 (I-4 between SR 528 and Sand Lake Road). This data was provided to the project team for this IOAR and used in the analyses.

The 2022 field data collection locations used in this IOAR are illustrated in **Figure 3**. The following summarizes the FDOT traffic count station locations within the AOI:

- I-4 westbound on-ramp from Sand Lake Road (FDOT Site 752020)
- I-4 westbound off-ramp to SR 528 (FDOT Site 977500)
- I-4 eastbound off-ramp to SR 528 (FDOT Site 977515)
- SR 528 between I-4 and International Drive (FDOT Site 970533)
- SR 528 eastbound off-ramp to International Drive (FDOT Site 977517)

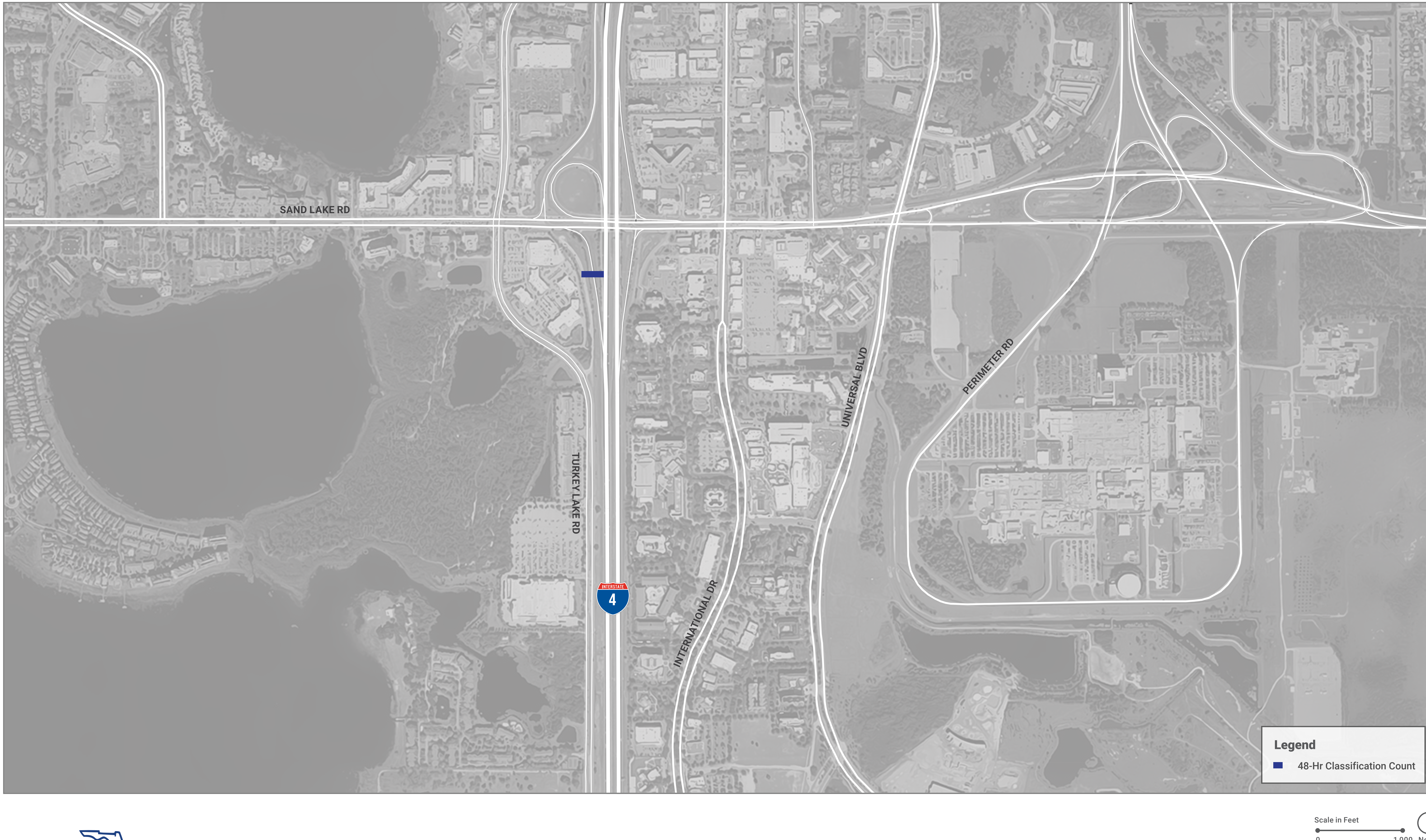
The existing raw field collected AM and PM peak hour volumes are summarized in **Appendix B**.



I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 3 | **Data Collection Locations**

(1 of 2)



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I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 3 | **Data Collection Locations**

(2 of 2)

3.2. Planned and Programmed Projects

The FDOT Five Year Work Program and Metroplan Long Range Transportation Plan (LRTP) 2045 were reviewed to identify planned and programmed projects along I-4 in the vicinity of the study location.

3.2.1. Planned Projects

- I-4 from W CR 532 to W of SR 528; ultimate configuration for general use and managed lanes. (Metroplan LRTP).
- I-4 from W of SR 528 to Kirkman Road; ultimate configuration for general use and managed lanes.

3.2.2. Programmed Projects

- I-4 at Sand Lake Road Interchange Improvements (FM #444315-1)
- I-4 at Daryl Carter Parkway Interim Interchange Improvements (FM #441113-3)
- I-4 at SR 535 Interchange Improvements (FM #448914-1)
- I-4 Westbound Express Lane “Tube” (G/W FM #444315-3, FM# 441113-3, and G/W FM# 449771-1)

4. EXISTING CONDITIONS

The following section summarizes the existing roadway characteristics, existing traffic characteristics, existing operational analysis results, and the historical safety analysis.

4.1. Existing Roadway Characteristics

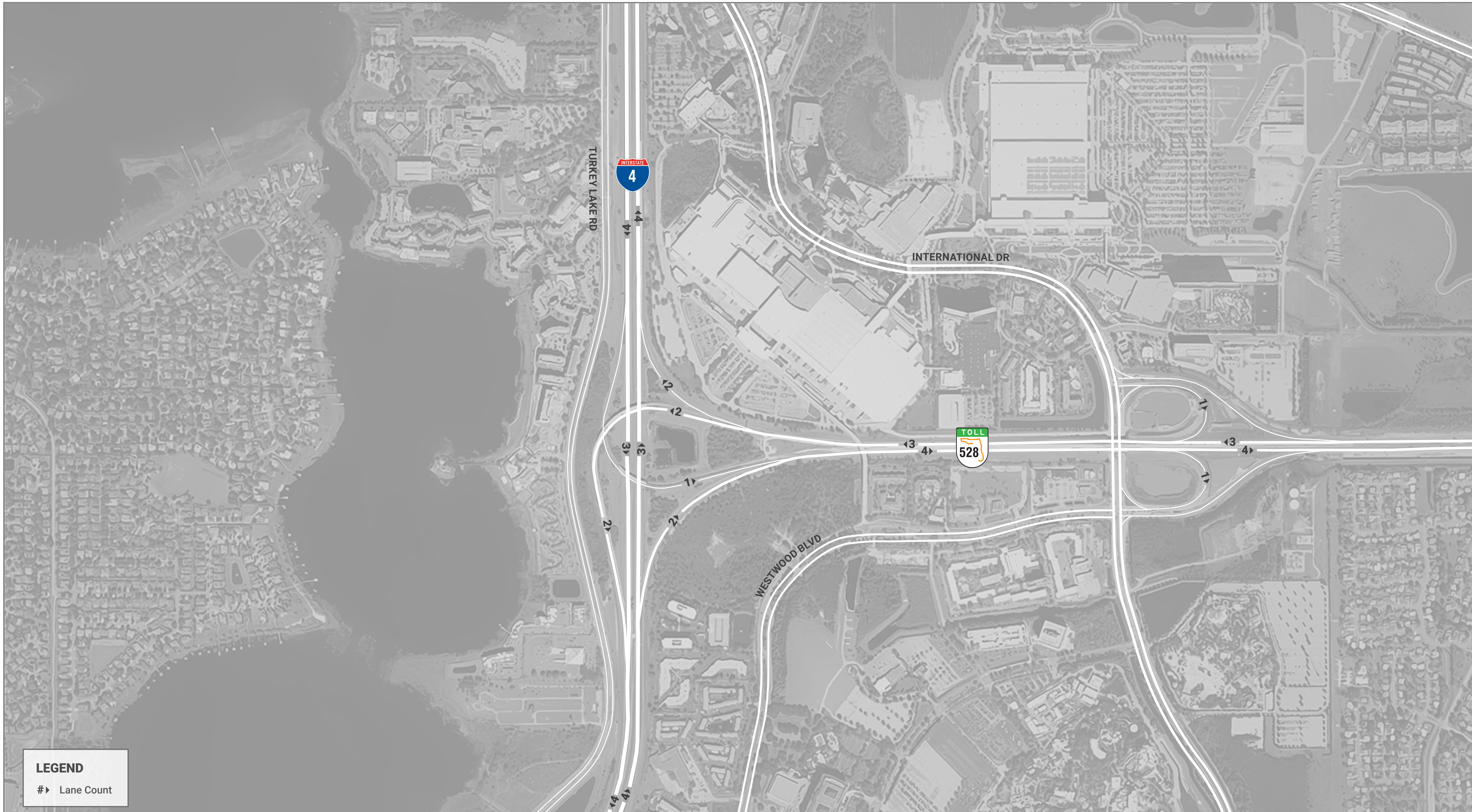
Roadway segment characteristics, including road names, area type, roadway type, FDOT access classification, number of lanes, and posted speed limit were reviewed using Straight Line Diagrams (SLDs), aerial photography, and the FDOT Open Data Hub. **Table 1** summarizes existing characteristics for the roadways in the study area. The Straight-Line Diagrams are provided in **Appendix C**.

The I-4 at SR 528 (locally known as Beachline Expressway) interchange is a system interchange. The system interchange is the western terminus of SR 528. All existing I-4 at SR 528 on- and off-ramps are two-lanes except for the westbound I-4 off-ramp to SR 528 eastbound, which provides one lane.

SR 528 is a seven-lane (three-lanes westbound and four-lanes eastbound), limited access, east-west facility. Land uses within the study area generally consist of retail, restaurant, and hotel uses. The Orange County Convention Center is located northeast of the interchange and the Westgate Lakes Resort & Spa exists west of the interchange. The existing lane configurations along the I-4 and SR 528 mainlines within the AOI, as well as, at the study on-ramp and off-ramp gore points are illustrated in **Figure 4**.

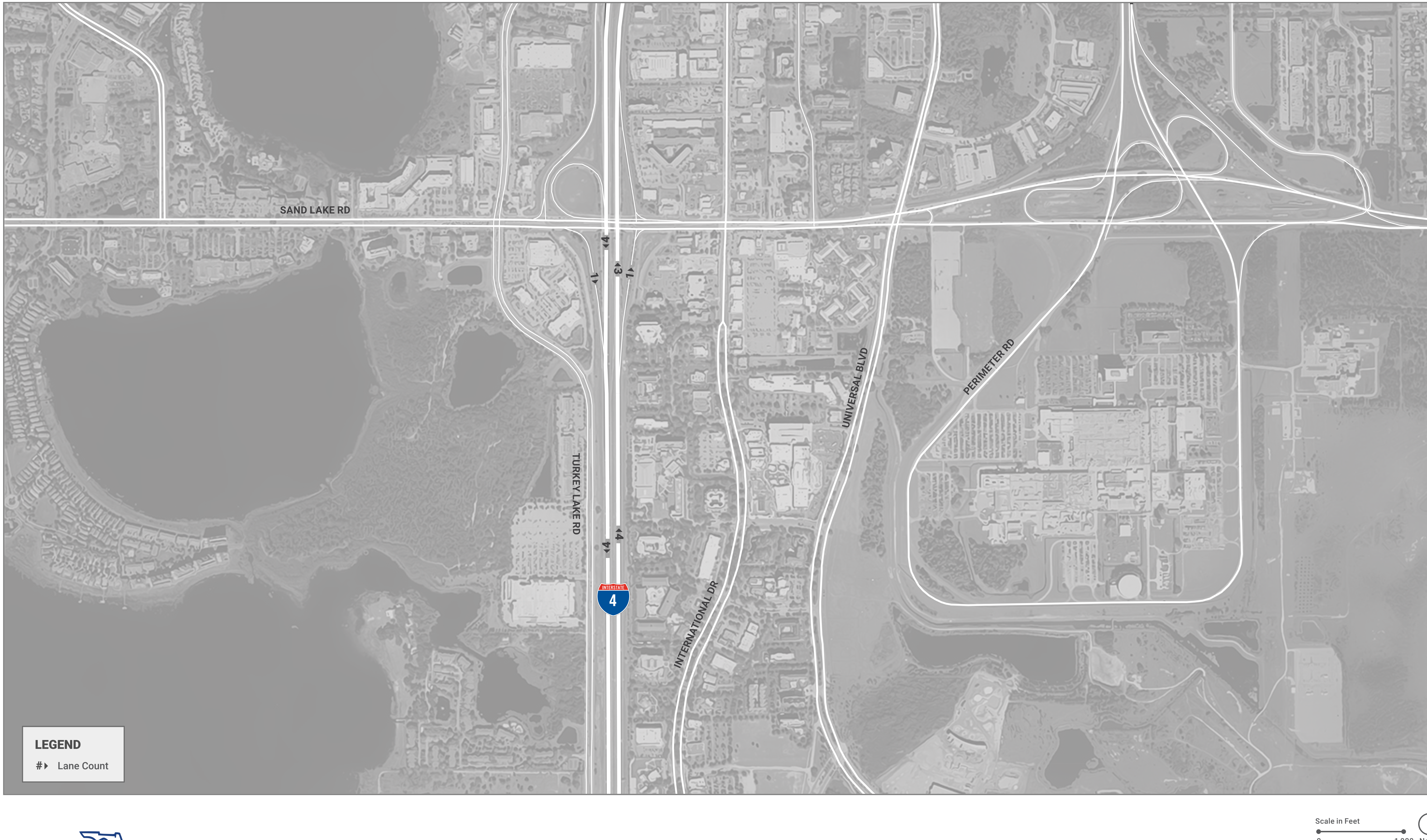
Table 1: Existing Roadway Characteristics

Characteristic	Roadway Segment	
	I-4	SR 528 (Beachline Expressway)
FDOT Roadway ID	75280000	75471000
Location (Milepost)	5.530 – 8.065	0.000 – 0.986
Functional Classification	Urban Principal Arterial - Interstate	Urban Principal Arterial - Expressway
SIS Designation	SIS	SIS
Speed Limit	60 mph	65 mph
Lane Width	12 ft	12 ft
Shoulder Width	12 ft paved outside and 12 ft inside	6 -12 ft shoulder
Median	65 ft vegetation median	Jersey Barrier
FDOT Access Classification	1	1
Curb and Gutter	None	None
Sidewalks	None	None
Bike Lanes	None	None
Street Lighting	Present	Present
Surrounding Land Uses	Commercial	Commercial/Residential



I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 4 | **Existing (2022) Lane Configurations**



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I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 4 | **Existing (2022) Lane Configurations**

(2 of 2)

4.2. Existing Traffic Characteristics

The following section summarizes the existing traffic characteristics including the estimation of system peak hours and existing traffic volumes/adjustments.

4.2.1. Existing System Peak Hours

The 2022 field collected data was reviewed to determine a system peak hour for the purposes of balancing counts and evaluating a consistent peak hour for the operational analyses (freeway and microsimulation). The total ramp volumes along each study ramp where 2022 field data was collected were summed for the entire study area for each 15-minute bin collected. The 15-minute bins were summed together to determine the max total network hourly volume for each period collected. The resulting system peak hours are as follows and are summarized in **Table 2**:

- AM Peak Hour: 7:30 AM – 8:30 AM
- PM Peak Hour: 5:00 PM – 6:00 PM

4.2.2. Existing Traffic Volumes

The collected vehicle classification and volume counts were adjusted using a seasonal adjustment factor obtained from the 2019 Florida Traffic Online (pre-COVID) to estimate 2022 average daily traffic (ADTs) volumes and Annual Average Daily Traffic (AADTs). The volume counts were adjusted using both seasonal factors and axle adjustment factors obtained from the 2019 Florida Traffic Online. The raw ADTs, seasonal factors, and resulting 2022 AADTs collected for the study roadway segments are summarized in **Table 3**. The peak season factor category and axle correction factor reports are provided in **Appendix D**. The 2019 seasonal and axle correction factor reports were used as these are the most recent reports that are not impacted by the COVID-19 pandemic. The 2022 AADTs within the study area are illustrated in **Figure 5**.

I-4 mainline existing (2022) volumes were referenced from the telemetered site (Site 750130). This telemetered mainline site was selected as the anchor point location within the AOI. Peak hour and AADTs were balanced directionally and summed for the bi-directional AADTs along the mainline.

The seasonally adjusted and balanced volumes used in the existing conditions analysis for the AM and PM peak hours are illustrated in **Figure 6**.

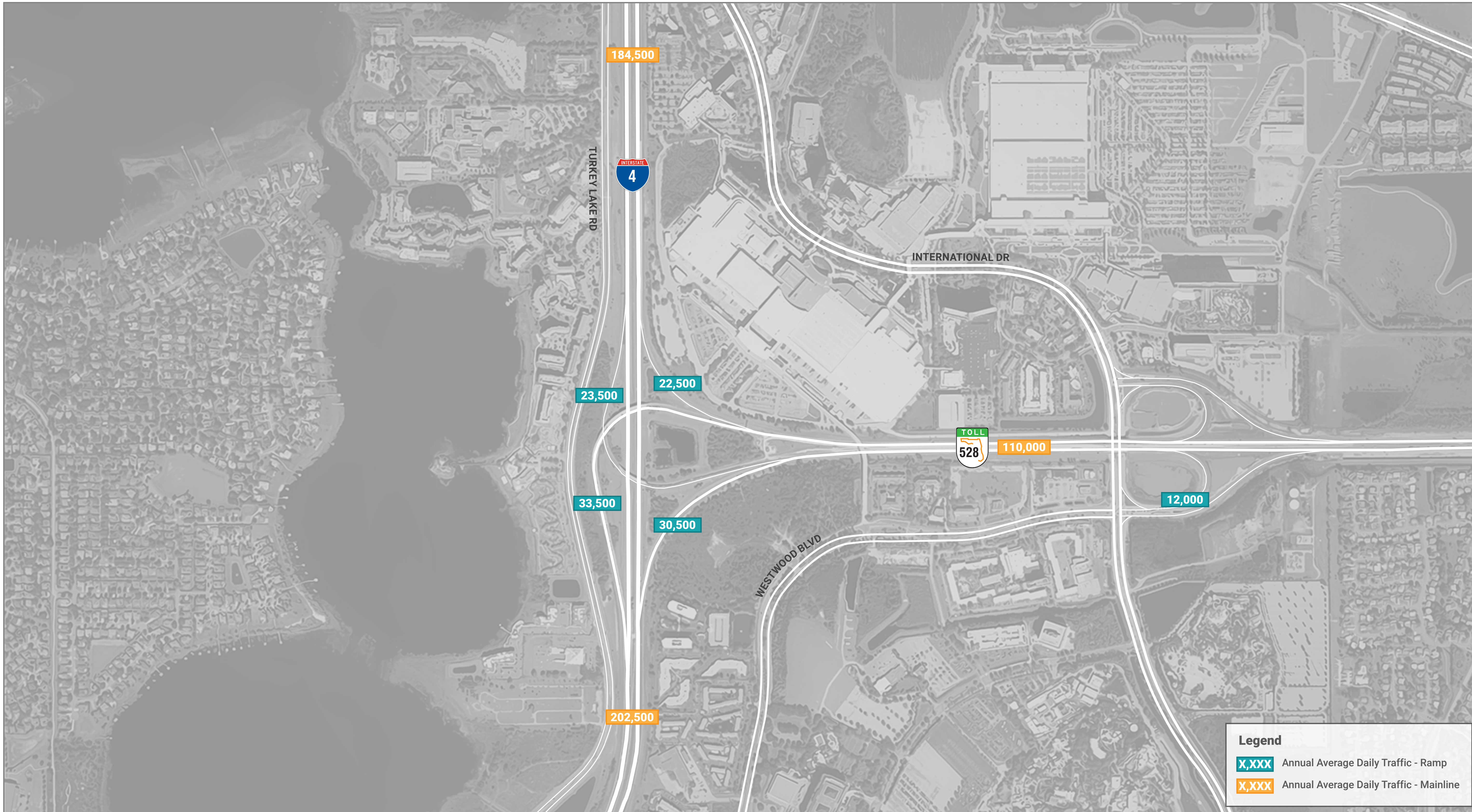
Table 2: Existing (2022) System Peak Hour Summary

AM Peak				PM Peak			
End time	Total Network Volume	Total Hourly Network Volume	Peak Hour	End time	Total Network Volume	Total Hourly Network Volume	Peak Hour
6:15 AM	1,348			3:15 PM	1,814		
6:30 AM	1,509			3:30 PM	1,839		
6:45 AM	1,723			3:45 PM	1,853		
7:00 AM	1,754	6,334	6:00AM - 7:00AM	4:00 PM	1,880	7,386	3:00PM - 4:00PM
7:15 AM	1,762	6,748	6:15AM - 7:15AM	4:15 PM	1,916	7,488	3:15PM - 4:15PM
7:30 AM	2,061	7,300	6:30AM - 7:30AM	4:30 PM	1,884	7,533	3:30PM - 4:30PM
7:45 AM	2,258	7,835	6:45AM - 7:45AM	4:45 PM	1,938	7,618	3:45PM - 4:45PM
8:00 AM	2,253	8,334	7:00AM - 8:00AM	5:00 PM	1,944	7,682	4:00PM - 5:00PM
8:15 AM	2,135	8,707	7:15AM - 8:15AM	5:15 PM	1,984	7,750	4:15PM - 5:15PM
8:30 AM	2,191	**8,837**	**7:30AM - 8:30AM**	5:30 PM	2,047	7,913	4:30PM - 5:30PM
8:45 AM	2,212	8,791	7:45AM - 8:45AM	5:45 PM	2,008	7,983	4:45PM - 5:45PM
9:00 AM	2,184	8,722	8:00AM - 9:00AM	6:00 PM	2,005	**8,044**	**5:00PM - 6:00PM**
9:15 AM	1,995	8,582	8:15AM - 9:15AM	6:15 PM	1,855	7,915	5:15PM - 6:15PM
9:30 AM	1,899	8,290	8:30AM - 9:30AM	6:30 PM	1,764	7,632	5:30PM - 6:30PM
9:45 AM	1,902	7,980	8:45AM - 9:45AM	6:45 PM	1,592	7,216	5:45PM - 6:45PM
10:00 AM	1,833	7,629	9:00AM - 10:00AM	7:00 PM	1,528	6,739	6:00PM - 7:00PM

Table 3: Existing (2022) Daily Volumes

Roadway	Count Date Range (2022)	Count Type	Day 1	Day 2	Day 3	ADT	Seasonal Adj. Factor	Axle Correction Factor	AADT
I-4 WB Off-Ramp to EB SR 528*	3/22 – 3/24	Volume	24,862	25,221	24,079	24,721	0.97	0.99	23,500
I-4 WB On-Ramp from WB SR 528*	3/22 – 3/24	Volume	34,235	35,238	35,354	34,942	0.97	0.99	33,500
I-4 EB Off-Ramp to EB SR 528*	5/9 – 5/11	Volume	30,774	31,552	31,420	31,249	0.98	0.99	30,500
I-4 EB On-Ramp from WB SR 528*	3/22 – 3/24	Volume	23,860	23,708	23,001	23,523	0.97	0.99	22,500
Sand Lake Rd EB On-Ramp to I-4 WB	8/31 – 9/1	Class	6,452	6,616	-	6,534	1.02	-	6,700
SR 528 EB Off-Ramp to International Dr*	3/22 – 3/24	Volume	12,143	12,759	12,916	12,606	0.97	0.99	12,000

***Note:** Data from the weekdays (Tuesday, Wednesday, and Thursday) are summarized.



FDOT **I-4 at SR 528 Interchange Operational Analysis Report**

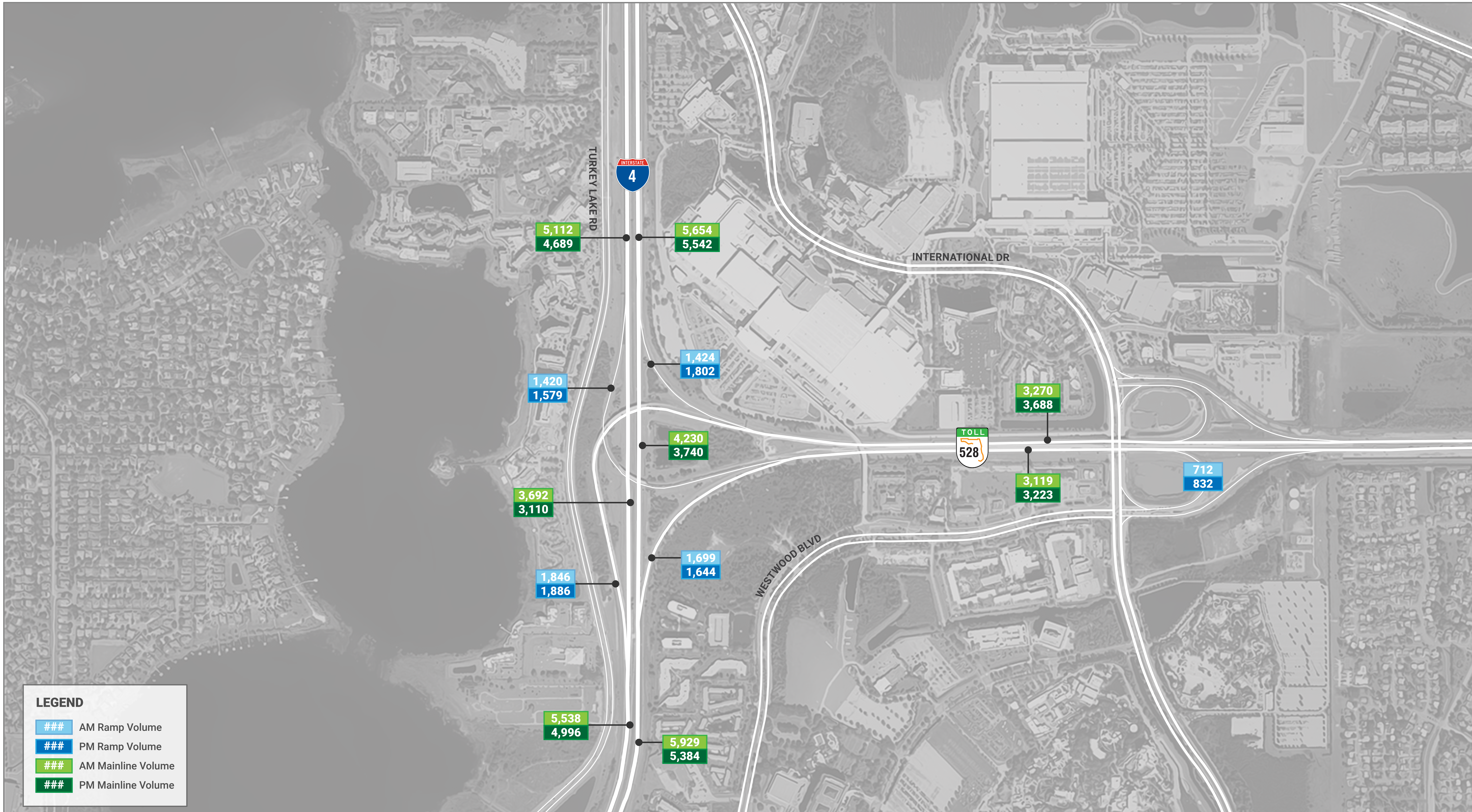
FIGURE 5 | **Existing (2022) Annual Average Daily Traffic**

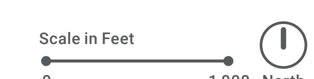
(1 of 2)

FDOT I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 5 | **Existing (2022) Annual Average Daily Traffic**

(2 of 2)

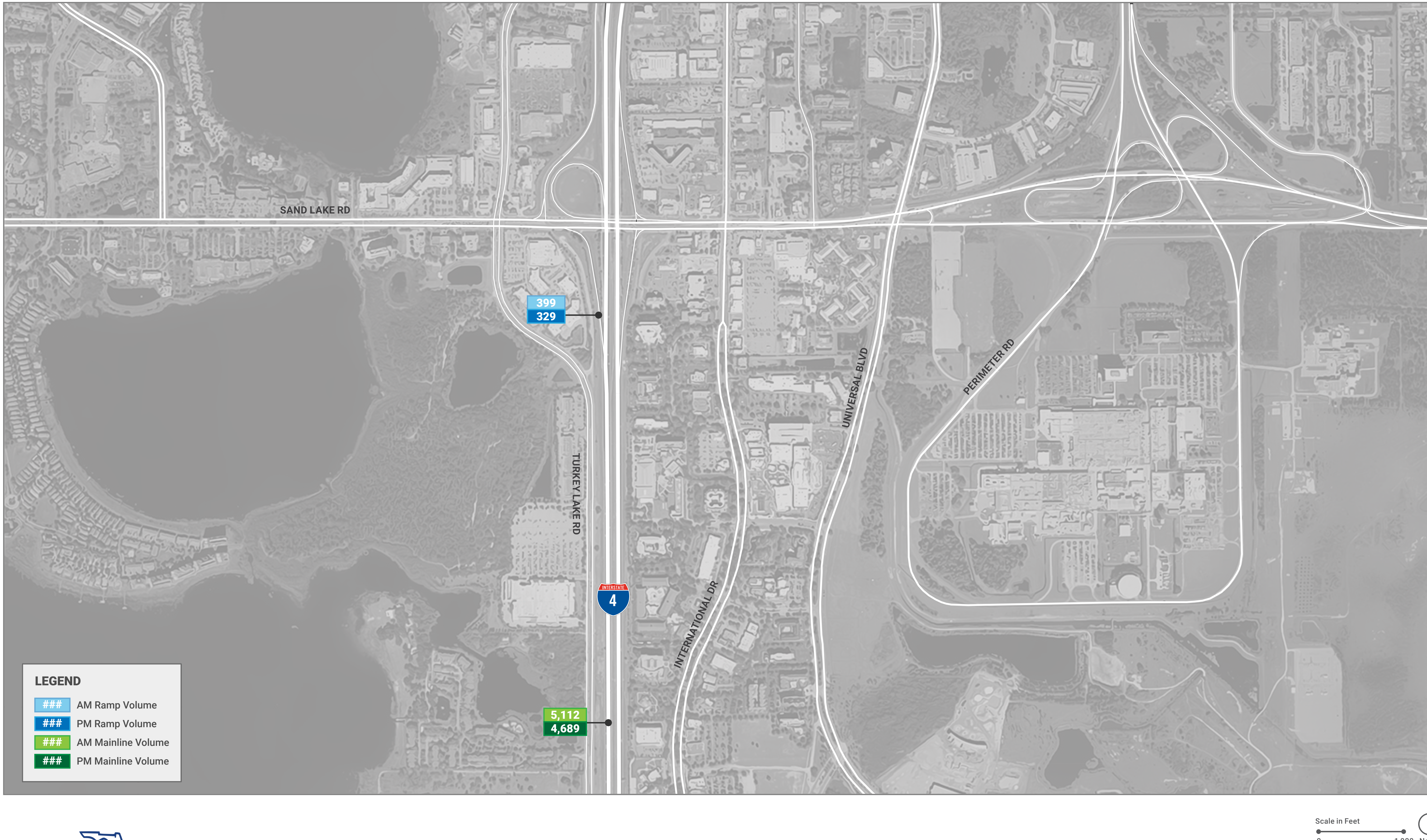




FDOT

I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 6 | **Existing (2022) Peak Hour Volumes**



I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 6 | **Existing (2022) Peak Hour Volumes**

(2 of 2)

4.3. Existing Traffic Operational Analysis

Based on the approved Methodology Letter of Understanding (MLOU), microsimulation was the primary analysis method of the study facilities within the AOI. Microsimulation models for this study were developed using VISSIM (PTV Software) version 2022 to evaluate the existing conditions of the freeways and ramps within the AOI.

4.3.1. Data Sources

The following summarizes the data sources utilized for the existing (2022) microsimulation models.

4.3.1.1. Traffic Data

The 2022 peak hour traffic volumes illustrated previously in **Figure 6** were utilized as part of the existing year microsimulation models. **Section 4.2** summarizes the existing (2022) traffic characteristics in further detail.

4.3.1.2. Speed and Travel Time Data

Speed and travel time data were obtained in March 2022 (consistent with the field data collection efforts for majority of the SR 528 ramps). The data was obtained via the Federal Highway Administration (FHWA) National Performance Management Research Data Set (NPMRDS). In general, the dataset consists of speeds and travel times for 15-minute intervals at traffic message channel (TMC) segments along the freeway (I-4) and SR 528. The 15-minute speed data is created by measuring speeds for all vehicles traveling along a TMC segment and averaging them into 15-minute bins. The TMCs were manually matched with the VISSIM model, and the data points potentially impacted by incidents and severe weather were removed from the dataset. A set of “typical” conditions was then developed using averaged recurring weekday speeds.

4.3.2. Model Development

The following section summarizes the VISSIM model development for this project including model geometry, driver behaviors, routing, speed control, vehicle inputs, vehicle compositions, conflict management, and traffic control.

4.3.2.1. Model Geometry

The network within the area of influence was developed as part of the VISSIM model. Model links and connectors were made to fit the latest aerial imagery from the FDOT Aerial Photo Look Up System (APLUS) within VISSIM.

Connector lengths were generally minimized to allow most calculations during validation to occur on the links. Also, overlaps between links and connectors were avoided where appropriate. Links along curves were adjusted by creating a spline from the beginning to the end of the curve. The shapes of the links and connectors were coded so that if the model is run with aerial imagery in the background and the network made invisible, the simulation will show vehicles running smoothly on the aerial image's roadway network.

4.3.2.2. Driver Behavior

The following list includes the behavior assumptions included in the models:

- Wiedemann 74 driving behaviors were used for all freeway off-ramps within the model.
- Wiedemann 99 driving behaviors were used for the freeway segments within the model.
- Wiedemann 99 driving behaviors were used for all freeway on-ramps within the model.

4.3.2.3. Routing Decisions

Origin-Destination data was provided by the FTE for the development of the Origin-Destination (OD) routes that were used in the microsimulation peak hour analyses. The AM and PM O-D percentages from the I-4/SR 528 ramps to the International Drive off-ramp were used and are included for reference in **Appendix E**. It is important to note that the OD data provided starts at the I-4 off-ramps to SR 528 and do not include the split for the traffic that comes from Sand Lake Road or I-4 westbound/eastbound. An assumption of 100% traffic from Sand Land Road going through on I-4 westbound was made and represents the worst traffic operational condition, i.e., all of traffic from Sand Lake Road has to merge to continue on the I-4 westbound mainline. This assumption was carried into the future conditions.

4.3.2.4. Speed Control

The following summarizes the various speed control elements coded into the models including desired speed distributions, desired speed decisions, and reduced speed areas.

Desired Speed Distributions

Speed distributions were based on existing speed data where data is available. For I-4 and SR 528, speed data from NPMRDS was reviewed to estimate free-flow speeds along the study corridor.

Desired Speed Decisions

Vehicle inputs were coded with vehicle compositions with defined speed distributions where possible; otherwise, speed decisions were placed at each entrance to the model. These were placed so the vehicles change speeds as soon as they are on the link with each new anticipated speed. Desired speed decisions were placed along off-ramps just downstream of the freeway diverge and along the on-ramps, downstream of the connector from the arterial to the ramp.

4.3.2.5. Vehicle Inputs

Vehicle inputs for each link going into the network were developed through the volume development process. The process provides the peak hour volumes for both AM and PM. The peak period (AM and PM) traffic demand profiles were developed based on field data and used to convert the peak hour volume into peak period demand (3-hour period for both AM and PM) with 15-min analysis intervals. Finally, the vehicle inputs were included for each 15-minute analysis period within each 3-hour analysis, as well as a 15-minute warm-up period so that the peaking characteristics during the simulation period was accurately modeled. The volume profiles used for each of the vehicle inputs are included in **Appendix E**.

4.3.2.6. Vehicle Compositions

The North America Default vehicle fleet vehicle compositions were obtained from the PTV website and assumed for the VISSIM models used in this study. Existing conditions heavy vehicle data along I-4 and SR 528 were assumed in this study based on classification data documented in the approved I-4 at Sand Lake Road IMR and 2021 FTO data, consistent with the DHT values included in the traffic factors table in the approved MLOU. The truck percentage assumptions are summarized in in **Table 4**.

Table 4: Truck Percentages

Roadway Segment	DHT	Source
I-4	4.5%	I-4 at Sand Lake Road IMR
Sand Lake Road Ramp to I-4 WB	1.1%	I-4 at Sand Lake Road IMR
SR 528	6.3%	2021 Florida Traffic Online
SR 528 Ramps	6.3%	2021 Florida Traffic Online

4.3.3. Simulation Parameters

This section summarizes the simulation parameters used in the simulation models including simulation resolution, network warm/up periods, and the simulation run time.

4.3.3.1. Simulation Resolution

The simulation resolution is the number of times the position of a vehicle will be calculated within one simulated second (ranging from 1 to 20). The input parameter of one will result in the vehicles moving once per simulation second while an input parameter of 10 will result in the position of the vehicle being calculated 10 times per simulation second, thus making vehicles move more smoothly throughout the network. The higher the simulation resolution, the more realistic the behavior and interactions of vehicles is. The change of simulation speed is inversely proportional to the number of time steps. A value of 10 was used on all models to balance realism and model run times and is consistent with FDOT Traffic Analysis Handbook (May 2021) recommendations. This value is consistent between the existing and future analyses.

4.3.3.2. Network Warm-Up Period/Cool-Down Period

A warm-up period of 15 minutes (900 seconds) was used prior to the analysis period to allow for the model to populate with a sufficient number of vehicles to better represent field conditions. This warm-up period is consistent with the agreed upon methodology described in the approved MLOU. The measures of effectiveness (MOEs) are not reported for the warm-up period. A 15-minute cooldown period was also included after the analysis period. This cool-down period is consistent with the agreed upon methodology described in the approved MLOU. Similar to the warm-up period, MOEs were not reported for the cooldown period.

4.3.3.3. Simulation Run Time

Simulation runs were conducted for each AM and PM three-hour peak period in addition to a 15-min warm-up period. The peak period times and corresponding peak hour times are as follows:

- AM Peak Period: 6:30 – 9:30 AM
- AM Peak Hour: 7:30 – 8:30 AM
- PM Peak Period: 4:00 – 7:00 PM
- PM Peak Hour: 5:00 – 6:00 PM

Analysis of each time period extends for 900 seconds (15 minutes). The existing conditions and future conditions simulation run times are consistent between models.

4.3.4. Model Calibration

VISSIM models were developed and calibrated to 2022 existing average peak hour conditions. FDOT Traffic Analysis Handbook (May 2021) guidance was used for the development of the project VISSIM models. Calibration parameters developed as part of the validation efforts for each of the existing condition models are carried forward to the future conditions models.

4.3.4.1. Calibration Parameters

This section describes the calibration parameters assumed in this study.

Driver Behaviors

Four driver behaviors, Urban (motorized), Freeway (free lane selection), Freeway Ramps, and Advanced Merge were used throughout the model. Advanced Merge is only applied to the end of the acceleration lanes for the merge segments from Sand Lake Road to I-4 westbound and from westbound SR 528 to I-4 eastbound. Urban (motorized) using the Wiedemann 74 model as the car following model, was used for all off-ramps. The off-ramps in the network use the default car following parameters of Wiedemann 74. Car following model, Wiedemann 99, was used for all freeways and on-ramps. The adjusted parameters of car flowing models of the freeway driver behaviors are summarized in **Table 5** and the adjusted parameters of lane change of the driver behaviors are summarized in **Table 6**. For the Urban (motorized), the parameter "number of interaction objects" was increased to "4". For the Urban (motorized) behavior, the maximum look ahead distance was increased to 1,000 ft. All the parameters are within the acceptable range shown in Table 7-12 of the FDOT Traffic Analysis Handbook.

Table 5: Parameters of Car Following Model

Category	CC0 (Standstill Distance)	CC1 (Gap Time)	CC2 (Following Distance Oscillation
(default)	4.92 ft	0.9 s	13.12 ft
Freeway (Free Lane Selection)	4.92 ft	1.10 s	13.12 ft
Advanced Merge	4.92 ft	1.10s	13.12 ft
Freeway Ramps	4.92 ft	1.25 s	13.12 ft

Table 6: Parameters of Lane Change

Category	Safety Distance Reduction Factor	Cooperative Lane Change	Max Deceleration for Cooperative Braking
(default)	0.6	Checked	-9.84 ft/s^2
Freeway (Free Lane Selection)	0.6	Checked	-9.84 ft/s^2
Advanced Merge	0.6	Checked	-9.84 ft/s^2
Freeway Ramps	0.6	Checked	-18.00 ft/s^2
Urban	0.4	Checked	-9.84 ft/s^2

(Unlisted parameters are left as defaults)

Lane Change Distance

The default value of 656.32 feet (200 meters) was adjusted for lane change distance throughout the model. In general, this distance was increased to half a mile (2,640 feet) or quarter a mile (1,320 feet) for freeway merge or diverge connectors. Other connectors may have adjusted lane change distance based on observed model behavior. These lane change distances can impact the lane utilization of upstream links and were refined as needed based on field data, local knowledge of travel patterns, and engineering judgement.

4.3.4.2. Calibration Targets

The calibration of the existing AM and PM models target the thresholds indicated in the FDOT Traffic Analysis Handbook for the volumes as well as mainline travel times. **Table 7** summarizes the calibration criteria and acceptable targets as documented in FDOT Traffic Analysis Handbook and assumed in this study. These criteria and thresholds are consistent with those described and approved in the MLOU document.

Table 7: Calibration Criteria and Acceptance Targets

Measure	Criteria	Calibration Acceptance Targets
Volume	**Hourly Flows, Model Versus Observed**	
	Individual Link Flows, vehicles per hour (vph)	
	Within 100 vph, for Flow < 700 vph Within 15%, for 700 vph < Flow < 2700 vph Within 400 vph, for Flow > 2700 vph Simulated and measured link volumes have a GEH value <5	> 85% of cases
	Sum of All Link Flows	Within 5% of sum of all link counts GEH < 5
Speed	Modeled average link speeds within ±10 mph of field measured speed	> 85% cases
Travel Time	Model Versus Observed Travel Time	within ±1 minute for routes with observed travel times less than seven (7) minutes and within ±15% for routes with observed travel times greater than seven (7) minutes

***Note:** GEH is an empirical formula expressed as $\sqrt{2*(M-C)2/(M+C)}$ where M is the simulation model volume and C is the field counted volume.

Link Flow Calibration

Field count locations were modeled as data collection points in VISSIM. The model volumes at these data collection points were compared with the field counts. Each data collection point was separated into the appropriate volume category based on the field volume. The number in each category and the calibration results are shown in **Table 8** and **Table 9**. As summarized in the tables, each of the volume categories meet the calibration targets during the AM and PM peak hours. Detailed results are included in **Appendix E** for reference.

Table 8: AM Link Volume Calibration Results

Volume Category	Number of segments	Number of segments in calibration	Percent Passing	Meets Calibration?
Within 100 vph, for Flow < 700 vph	1	1	100%	**Yes (>85%)**
Within 15%, for 700 vph < Flow < 2700 vph	6	6	100%	**Yes (>85%)**
Within 400 vph, for Flow > 2700 vph	10	10	100%	**Yes (>85%)**

Table 9: PM Link Volume Calibration Results

Volume Category	Number of segments	Number of segments in calibration	Percent Passing	Meets Calibration?
Within 100 vph, for Flow < 700 vph	1	1	100%	**Yes (>85%)**
Within 15%, for 700 vph < Flow < 2700 vph	6	6	100%	**Yes (>85%)**
Within 400 vph, for Flow > 2700 vph	10	10	100%	**Yes (>85%)**

The calibration of "Sum of all link flows" was based on the sum of the data collection points above. The results for this calibration parameter are shown in **Table 10** and meet the calibration targets during both peak hours.

Table 10: Sum of all Link Flow Calibration Results

Scenario	Field Volume	Simulation Volume	Percent Difference	GEH*	Meets Calibration?
AM	54,411	54,353	-0.1%	0.25	**Yes (<5%, <5)**
PM	52,346	52,312	-0.1%	0.15	**Yes (<5%, <5)**

Speed Calibration

Average segment speed (calculated by travel time measurements) were compared with the speed measurements of corresponding TMCs from NPMRDS. The calibration results are summarized in **Table 11** and each of the speed observations in the model meet the calibration targets during both the 2022 AM and PM peak hours. Detailed results are included in **Appendix E** for reference.

As suggested by the field data, there is congestion on I-4 westbound during both the AM and PM peak hours within the AOI of this study. The congestion on I-4 westbound is a result of the downstream bottleneck at the Central Florida Parkway merge onto I-4 westbound, which falls outside the limits of the approved AOI. Artificial bottlenecks were developed to simulate the observed congestion conditions by adjusting desired speed decisions at select location(s), which is consistent with guidance recommended by latest FDOT Traffic Analysis Handbook (Section 7.3.9) for this situation. It should be noted that these artificial bottlenecks will be removed from the future No-Build and Build scenarios because the construction of the Daryl Carter Parkway interchange (FM# 441113-1) is programmed for construction in FY 2022 and is expected to relocate this merge and remove traffic from I-4 by providing a new access point along I-4.

Table 11: Speed Calibration

Scenario	# Obs.	# Obs. within ±10 mph	Percent Passing	Meets Calibration?
AM	48	48	100%	**Yes (>85%)**
PM	48	48	100%	**Yes (>85%)**

Travel Time Calibration

Travel times along the I-4 corridor (end to end within the AOI) and along both I-4 and SR 528 (end to end within the AOI) were measured in VISSIM and compared with field measurements. NPMRDS data was obtained for individual Traffic Message Channel (TMC) and measurements were used for both the I-4 and SR 528 corridors. The corridor travel time measurements were calculated by aggregating the corresponding TMCs. The corridor travel time measurements were compared to the VISSIM results and analyzed according to the criteria in **Table 7**. For both the 2022 AM and PM peak hours, each of the corridor travel time measurements measured within the AOI meet the calibration criteria as shown in **Table 12** and **Table 13**.

Table 12: Corridor Travel Time Calibration Results (AM Peak Hour)

Corridor	Direction	Time	Travel Time* (HERE)	Travel Time* (VISSIM)	Difference*	Target	Meets Target?
I-4	WB	7:30	164	162	-2	+/-60	**Yes**
		7:45	175	163	-13	+/-60	**Yes**
		8:00	179	162	-17	+/-60	**Yes**
		8:15	186	163	-24	+/-60	**Yes**
	EB	7:30	145	156	10	+/-60	**Yes**
		7:45	147	156	9	+/-60	**Yes**
		8:00	150	156	6	+/-60	**Yes**
		8:15	154	155	2	+/-60	**Yes**
I-4 to SR 528	WB	7:30	173	174	2	+/-60	**Yes**
		7:45	178	174	-4	+/-60	**Yes**
		8:00	179	174	-4	+/-60	**Yes**
		8:15	183	174	-9	+/-60	**Yes**
	EB	7:30	85	91	6	+/-60	**Yes**
		7:45	85	91	7	+/-60	**Yes**
		8:00	85	91	6	+/-60	**Yes**
		8:15	85	90	5	+/-60	**Yes**
SR 528 to I-4	WB	7:30	143	133	-10	+/-60	**Yes**
		7:45	144	133	-11	+/-60	**Yes**
		8:00	146	132	-14	+/-60	**Yes**
		8:15	151	132	-19	+/-60	**Yes**
	EB	7:30	132	160	28	+/-60	**Yes**
		7:45	135	160	25	+/-60	**Yes**
		8:00	137	160	22	+/-60	**Yes**
		8:15	139	160	20	+/-60	**Yes**
Total Observations					24		
Observations within Target					24		
Observations within Target / Total					100%	> 85%	**Yes**

***Note:** Travel time is reported in seconds

Table 13: Corridor Travel Time Calibration Results (PM Peak Hour)

Corridor	Direction	Time	Travel Time* (HERE)	Travel Time* (VISSIM)	Difference*	Target	Meets Target?
I-4	WB	17:00	311	297	-14	+/-60	**Yes**
		17:15	326	297	-28	+/-60	**Yes**
		17:30	303	297	-6	+/-60	**Yes**
		17:45	290	297	7	+/-60	**Yes**
	EB	17:00	171	154	-17	+/-60	**Yes**
		17:15	172	155	-17	+/-60	**Yes**
		17:30	172	154	-18	+/-60	**Yes**
		17:45	168	154	-14	+/-60	**Yes**
I-4 to SR 528	WB	17:00	236	246	10	+/-60	**Yes**
		17:15	244	248	3	+/-60	**Yes**
		17:30	231	248	17	+/-60	**Yes**
		17:45	234	248	14	+/-60	**Yes**
	EB	17:00	90	90	0	+/-60	**Yes**
		17:15	93	90	-3	+/-60	**Yes**
		17:30	94	90	-4	+/-60	**Yes**
		17:45	93	90	-2	+/-60	**Yes**
SR 528 to I-4	WB	17:00	170	179	9	+/-60	**Yes**
		17:15	170	180	10	+/-60	**Yes**
		17:30	163	181	18	+/-60	**Yes**
		17:45	160	178	18	+/-60	**Yes**
	EB	17:00	193	159	-34	+/-60	**Yes**
		17:15	192	160	-32	+/-60	**Yes**
		17:30	179	160	-19	+/-60	**Yes**
		17:45	164	159	-5	+/-60	**Yes**
Total Observations					24		
Observations within Target					24		
Observations within Target / Total					100%	> 85%	**Yes**

***Note:** Travel time is reported in seconds

4.3.4.3. Number of Runs

VISSIM simulations were run multiple times with different random seeds to capture the impact of the stochastic nature of the model on the results. Ten (10) simulation runs were performed first with different random seed numbers. After the ten simulation runs, the adequacy of the number of runs was assessed using the following equation:

$$n = \left(\frac{s * t_{\alpha/2}}{\mu * \varepsilon}\right)^2$$

Where:

n is the required number of simulation runs

s is the standard deviation of the system performance measure (such as total traffic volume) based on previously conduced simulation runs.

$t_{\alpha/2}$ is the critical value of a two-sided Student's t-statistic at the confidence level of α and n-*1* degrees of freedom. An α of 5% is typical.

μ is the mean of the system performance measure

ε is the tolerable error, specified as a fraction of μ. A 10% error is desired.

In the equation above, the system performance measure used is the "average delay time per vehicles (sec), all vehicle types" for the peak hour period through vehicle network performance. With 10 runs and an alpha of 5%, the critical t value is approximately 2.262. A 10% tolerable error was used. shows the minimum required number of runs for each scenario. Detailed calculations are shown in **Appendix E**. This calculation shows the minimum number of runs for both the AM and PM models are less than three runs; however, it is standard practice to use no fewer than ten runs. Ten runs were used for each scenario.

4.3.4.4. Visual Error Checking

Upon development of each model, a visual inspection of the model was completed to check the coding of each network element (conflict areas, reduced speeds, lane changing, etc.). Adjustments due to this review were completed prior to the calibration summarized previously.

4.3.5. Existing Conditions Results

A variety of measures were collected to summarize traffic operations throughout the simulation model consistent with the performance measures listed in the approved MLOU.

- Network-wide performance, such as total travel time, total delay time, vehicle-miles of travel, latent volume, and latent delay were summarized. The results are summarized in **Section 4.3.5.1**.

- Speed and density measures were collected on freeway links in 1,500 ft and fifteen-minute increments. These results are presented in contour diagrams for the I-4 corridor (eastbound and westbound) in **Section 4.3.5.2**.

4.3.5.1. Network-wide Statistics

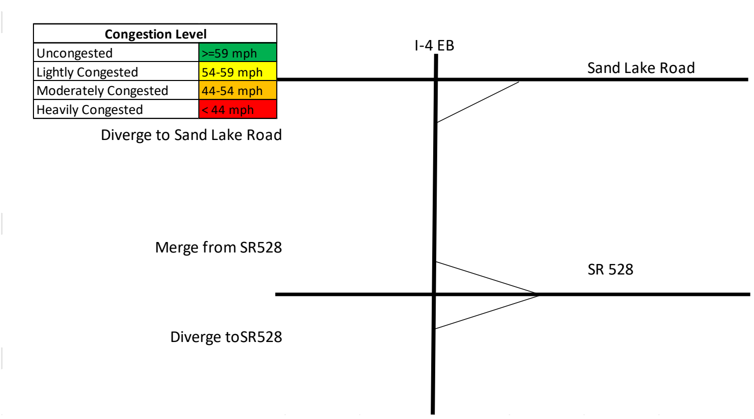
Network-wide statistics for the AM and PM peak hour are shown in **Table 14**. The average network delay per vehicle is estimated to be 6.0 seconds during the AM peak hour and 12.3 seconds during the PM peak hour. The average network speed is estimated to be 53.9 miles-per-hour during the AM peak hour and 41.3 miles-per-hour during the PM peak hour.

Table 14: Network-wide Statistics – 2022 AM and PM Peak Hour

Network-wide Statistics	AM Peak Hour	PM Peak Hour
Average Delay (sec)	6.0	12.3
Average Speed (mph)	53.9	41.3
Total Delay (hr)	25.2	50.4
Active Vehicles (at end of peak hour)	779	978
Vehicles Arrived (during peak hour)	14,286	13,744
Total peak hour vehicles (Active + Arrived)	15,065	14,722
Latent Demand (at end of peak hour)	0	1
Latent Delay (hr)	0.32	0.27

4.3.5.2. Link Evaluation on I-4 Corridor

Speed and density results for the I-4 study corridor from Sand Lake Road to SR 528 are shown in **Figure 7**, **Figure 8**, **Figure 9**, and **Figure 10**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook.



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
59	59	59	58	59	59	59	59
59	59	59	58	59	59	59	59
59	59	59	58	59	59	59	59
57	57	56	56	57	57	57	56
58	58	58	58	58	58	58	58
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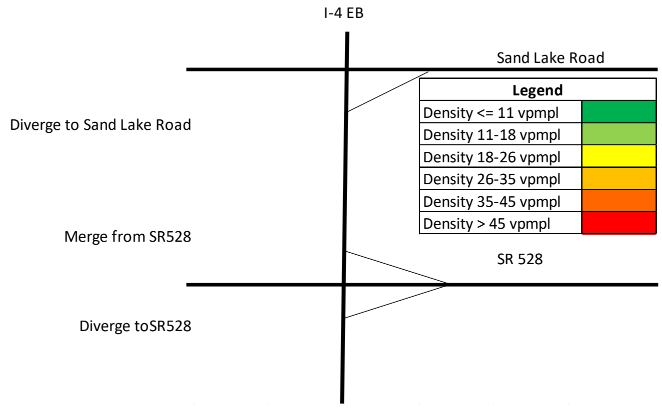
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59
58	58	58	58	58	58	58	58
53	53	53	54	56	55	56	55
58	58	59	59	59	59	59	59
59	59	59	59	59	59	59	59
59	59	59	59	59	59	59	59

Figure 7: 2022 AM and PM I-4 Eastbound Speed Contours

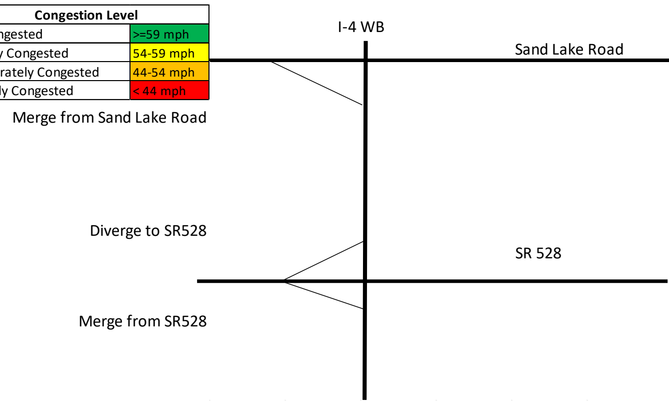


Legend	
Density <= 11 vpmpl	(dark green)
Density 11-18 vpmpl	(light green)
Density 18-26 vpmpl	(yellow)
Density 26-35 vpmpl	(orange)
Density 35-45 vpmpl	(dark orange)
Density > 45 vpmpl	(red)

AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
26	26	25	26	25	26	25	26
26	26	25	26	25	26	25	26
26	26	25	26	25	26	25	26
25	25	25	25	24	25	24	25
25	25	24	24	23	24	24	24
25	25	24	24	23	24	24	24
25	25	24	24	23	24	24	24
24	24	23	24	23	24	24	24
20	20	19	19	19	19	19	19
24	24	23	24	21	22	21	21
24	24	23	24	21	21	21	21
25	25	24	24	21	22	21	22
29	28	27	27	24	25	24	25
26	26	25	25	23	23	23	23
26	26	24	25	23	23	23	23
26	26	24	25	22	23	23	23

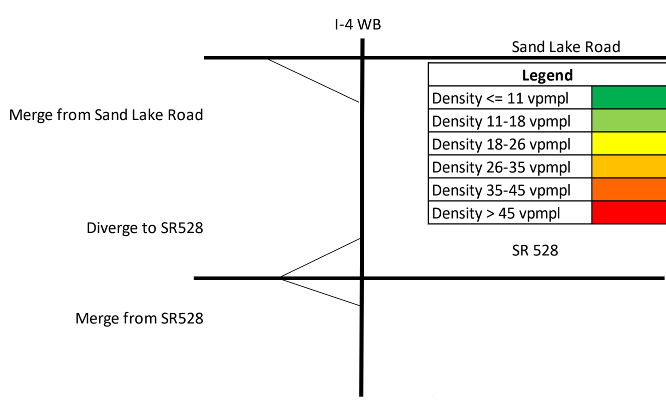
Figure 8: 2022 AM and PM I-4 Eastbound Density Contours

Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
59	59	59	59	60	59	59	59
59	59	59	59	60	59	59	59
59	59	59	59	39	39	39	39
59	59	59	59	34	34	34	34
59	59	59	59	33	33	33	33
59	59	59	59	33	33	33	33
58	58	58	58	32	32	32	33
57	57	57	57	32	32	32	32
59	59	59	59	29	28	29	29
59	59	59	59	28	28	28	28
59	59	59	59	28	28	28	28
40	39	40	40	23	22	22	23
39	38	39	39	23	23	23	23
38	38	38	38	22	22	22	22
38	38	38	38	22	22	22	23

Figure 9: 2022 AM and PM I-4 Westbound Speed Contours



Legend	
Density <= 11 vpmpl	(dark green)
Density 11-18 vpmpl	(light green)
Density 18-26 vpmpl	(yellow)
Density 26-35 vpmpl	(orange)
Density 35-45 vpmpl	(dark orange)
Density > 45 vpmpl	(red)

AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
20	20	19	20	18	19	18	18
20	20	19	20	18	19	18	18
18	18	17	17	24	25	24	24
22	22	21	21	34	36	35	35
22	22	21	22	35	36	36	35
22	22	21	22	35	36	36	36
22	22	21	22	35	37	36	36
23	23	22	22	35	37	37	36
21	21	20	21	36	37	36	36
21	21	20	21	36	38	36	37
21	22	20	21	36	38	37	37
28	29	27	27	44	45	44	44
36	37	35	35	54	56	55	55
37	37	35	36	55	56	56	55
36	37	35	36	55	56	56	55

Figure 10: 2022 AM and PM I-4 Westbound Density Contours

4.4. Historical Crash Analysis

A safety analysis was conducted to support this IOAR. Crash records were obtained for I-4 from just east of the Central Florida Parkway interchange to just west of the Sand Lake Road interchange for the five-year period of 2017 through 2021 and partial 2022 (January 1 to November 30, 2022) from FDOT's Crash Analysis Reporting (CAR) Online, the FDOT State Safety Office Geographic Information System (SSOGis), and the University of Florida's Signal Four (S4) crash database.

This section summarizes the I-4 eastbound, I-4 westbound, I-4/SR 528 interchange ramps, and SR 528 frequency/crash rate statistics based on the safety analysis performed. The roadway segment study limit mileposts can be seen in **Table 15**. A more detailed summary of the 2017 to 2021 and partial 2022 crash data set in tabular and graphical format is also provided in **Appendix F**. It is important to note that the 2020 crash data may have been impacted by the COVID-19 pandemic. Caution should be used in drawing conclusions using the 2020 data.

Table 15: Roadway Segment Mileposts

Location	Begin Milepost	End Milepost	Roadway ID	Length	Notes	County
I-4 Eastbound	5.552	6.018	75280000	0.466	Begin: AOI Starting Point East of Central Florida Parkway End: Gore point for I-4 EB Off Ramp to SR 528 EB	Orange
I-4 Westbound	8.252	6.483	75280000	1.769	Begin: AOI Starting Point West of Sand Lake Road End: I-4 WB Off Ramp to SR 528 EB	Orange
SR 528	0.000	1.300	75471000	1.300	Begin: End of I-4 Ramps End: East of International Drive	Orange

4.4.1. I-4 Eastbound Crash Frequency Statistics

Figure 11 displays a summary of crash frequency by year along with their respective severity for the study period along I-4 eastbound. There were a total of 105 reported crashes during this period, 37 of which (35 percent) resulted in 89 injuries. As displayed in **Figure 11**, the crashes per year along the corridor generally decreased between 2017 (21 crashes) and 2019 (13 crashes) but saw an increase in crashes between 2019 and 2022 (21 crashes).

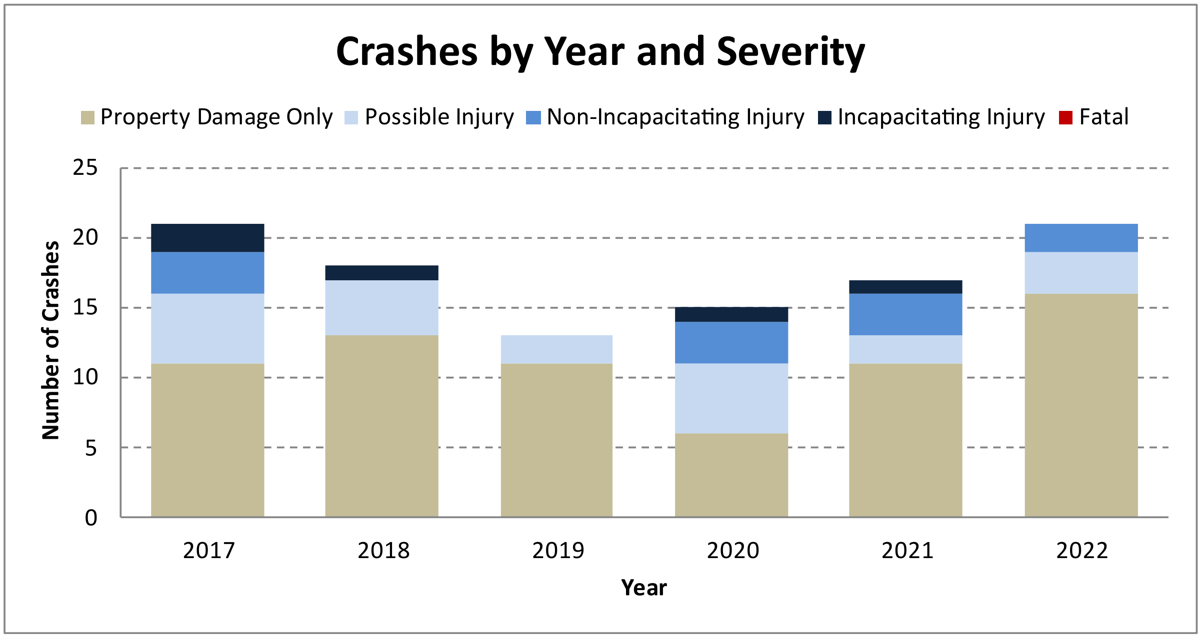


Figure 11: Crashes per Year (I-4 Eastbound)

Figure 12 displays the crashes along I-4 eastbound by type and severity for the study period. The highest crash type observed was rear end, comprising 47 percent of the total crashes. Sideswipe (32 percent) and fixed object/run-off road (seven percent) were the second and third highest crash types. Rear end and sideswipe accounted for 70 percent of the injury crashes.

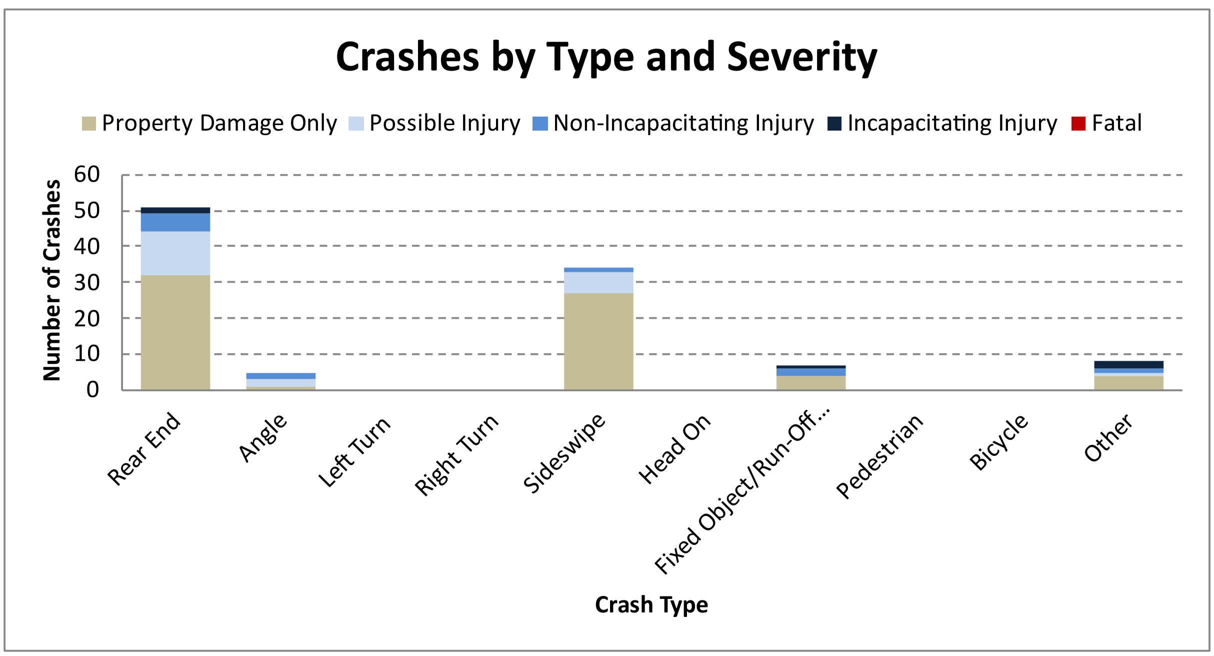


Figure 12: Crashes by Type and Severity (I-4 Eastbound)

4.4.2. I-4 Westbound Crash Frequency Statistics

Figure 13 displays a summary of crash frequency by year along with their respective severity for the study period along I-4 westbound. There were a total of 406 reported crashes, 142 of which (35 percent) resulted in 379 injuries and one of which resulted in a fatality. As displayed in **Figure 13**, the crashes per year along the corridor ranged between 78 and 94 crashes pre-COVID (2017-2019) but an approximate 56 percent reduction in crashes was observed in 2020 largely due to the travel restrictions during COVID. Post-COVID crash frequency in 2021 and 2022 is still approximately 31 percent lower than pre-COVID levels.

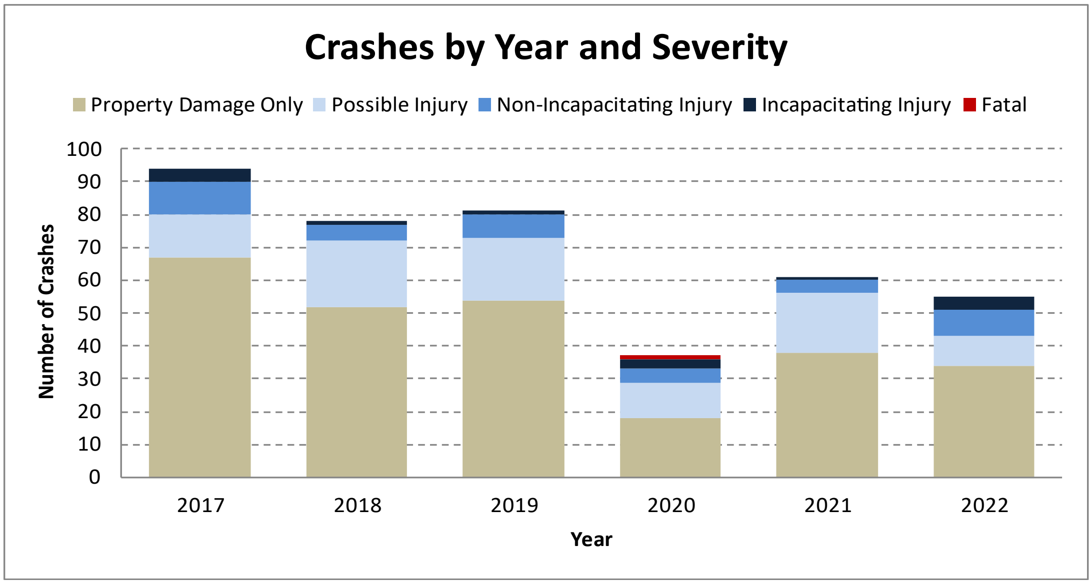


Figure 13: Crashes per Year (I-4 Westbound)

Figure 14 displays the crashes along I-4 westbound by type and severity for the study period. The highest crash type observed was rear end, comprising 66 percent of the total crashes. Sideswipe (21 percent) and fixed object/run-off road (five percent) were the second and third highest crash types. Rear end and sideswipe accounted for 83 percent of the injury crashes. As noted above, one fatal rear end crash occurred during the study period along I-4 westbound. This crash is reviewed in more detail in **Section 4.4.5**.

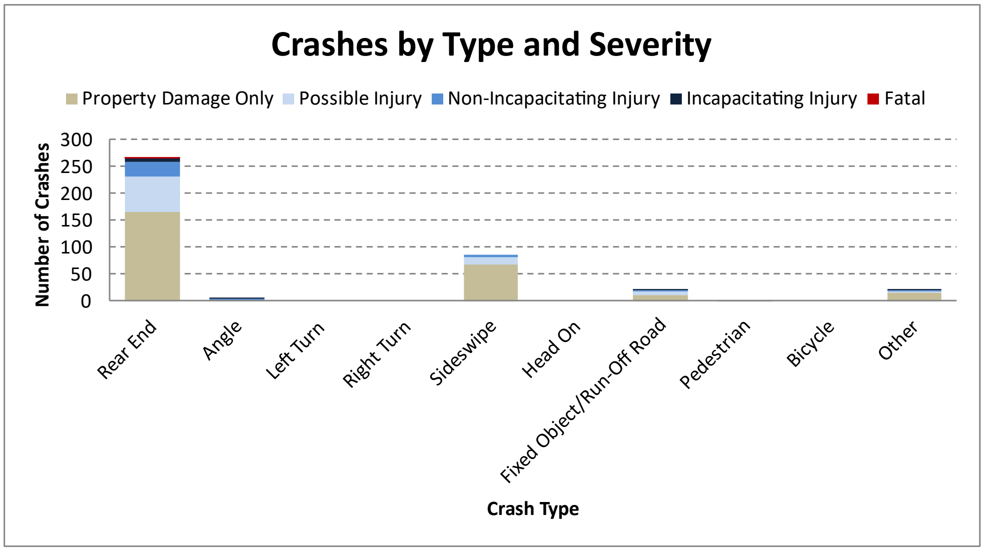


Figure 14: Crashes by Type and Severity (I-4 Westbound)

4.4.3. SR 528 Crash Frequency Statistics

Figure 15 displays a summary of crash frequency by year along with their respective severity for the study period along SR 528. There was a total of 233 reported crashes during this period, 69 of which (35 percent) resulted in 131 injuries. As displayed in **Figure 15**, the crashes per year along the corridor have generally decreased from 2017 (65 crashes) to 2021 (10 crashes) with 2018 being the highest crash year (77 crashes). As with the I-4 westbound data, the drop in reported crashes observed in 2020 is largely due to the travel restrictions during COVID. The widening of SR 528 from four to eight lanes in this area was also completed in 2019 and might have had an impact in the higher numbers of reported crashes between 2017 and 2019.

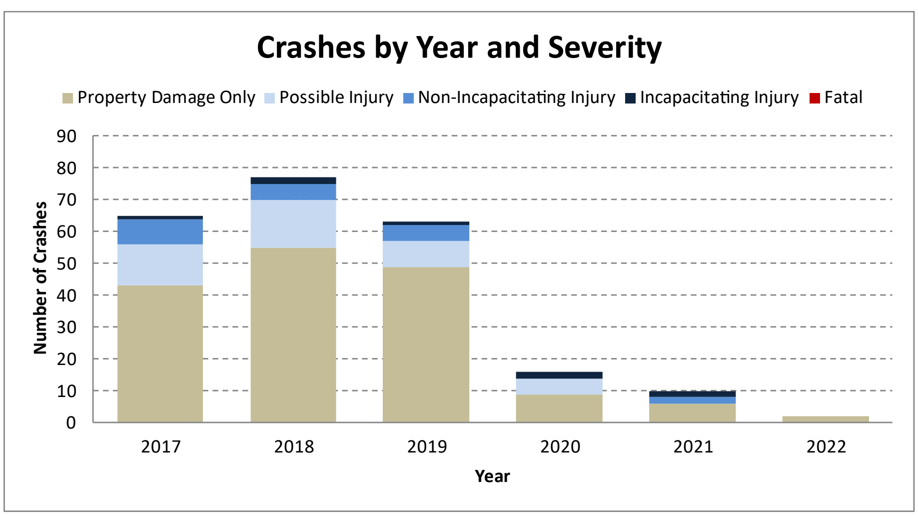


Figure 15: Crashes per Year (SR 528)

Figure 16 displays the crashes along SR 528 by type and severity for the study period. The highest crash type observed was rear end, comprising 59 percent of the total crashes. Sideswipe (12 percent) and fixed object/run-off road (10 percent) were the second and third highest crash types. Rear end and sideswipe accounted for 72 percent of the injury crashes, and no fatal crashes were observed along SR 528 in the study period.

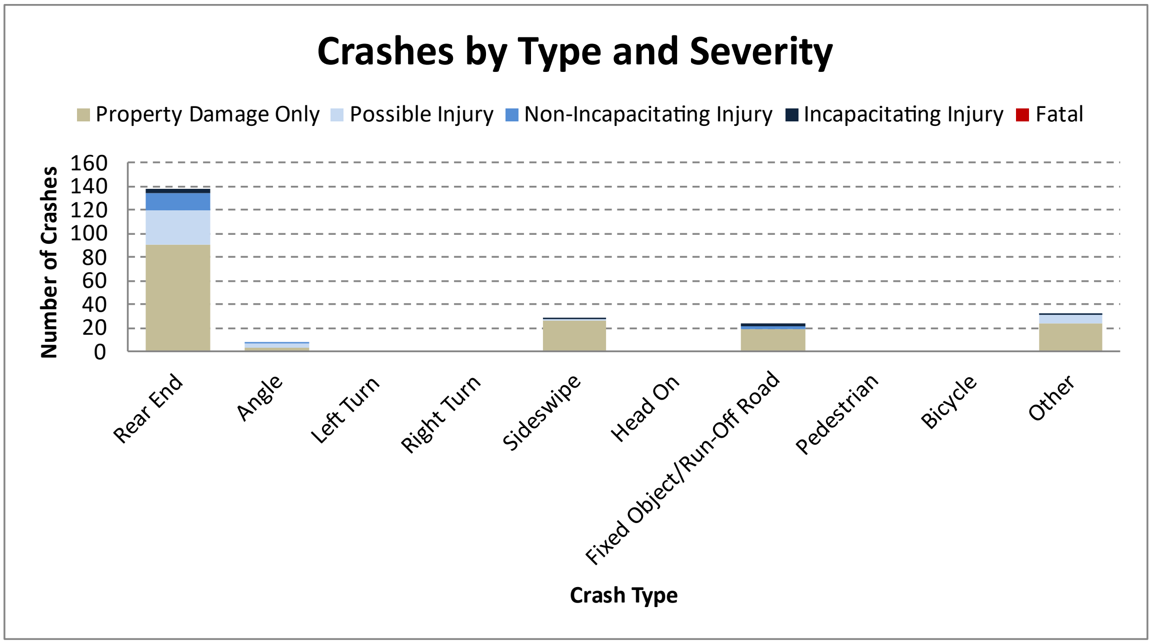


Figure 16: Crashes by Type and Severity (SR 528)

4.4.4. I-4/SR 528 Interchange Ramp Crash Statistics

In addition to the I-4 and SR 528 freeway segments, interchange ramp crashes were summarized for the I-4 eastbound and westbound off-ramps to SR 528 eastbound. There was a total of 62 reported crashes across both ramps, 16 of which (26 percent) resulted in 36 injuries, and no fatal crashes. **Figure 17** displays the crashes for the I-4 off-ramps to SR 528 by type and severity for the study period. The highest crash type observed was rear end, comprising 39 percent of the total crashes. Sideswipe (36 percent) and fixed object/run-off road (11 percent) were the second and third highest crash types. Rear end and sideswipe accounted for 75 percent of the injury crashes.

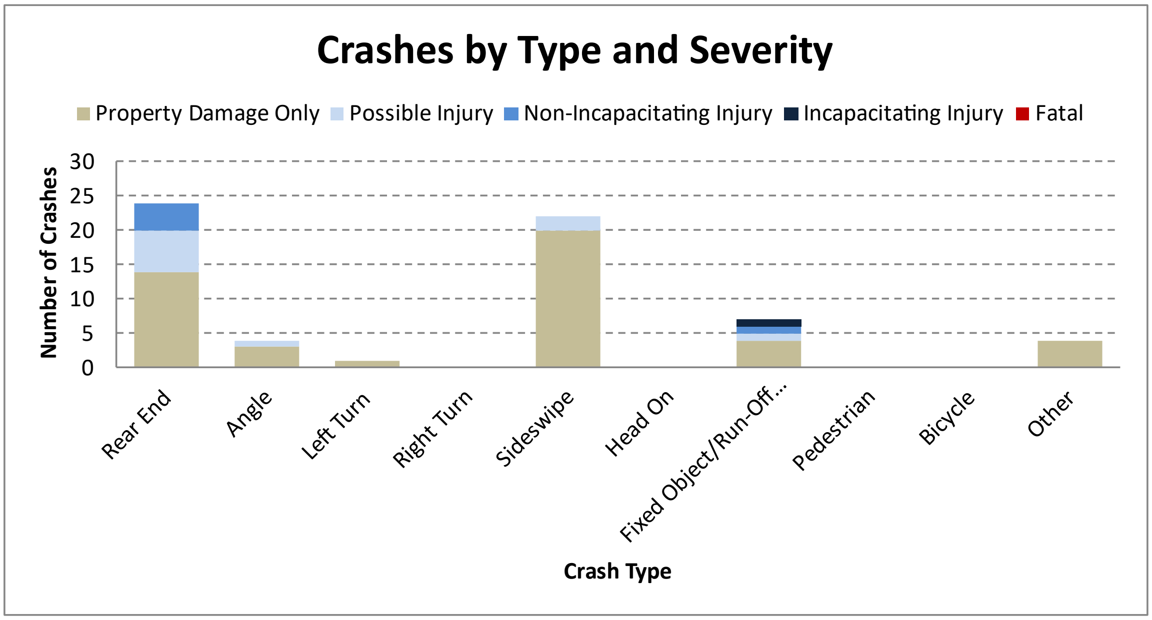


Figure 17: Crashes by Type and Severity (I-4 Off-Ramps to SR 528 Eastbound)

4.4.5. Fatal Crash Review

On July 22, 2020, at 11:04 PM, a fatal rear-end crash involving four vehicles occurred on I-4 westbound within the study limits. The crash resulted in one fatality and two non-incapacitating injuries. The crash occurred during dark-lighted and dry roadway conditions. Vehicle 1 struck Vehicle 2 from behind, as Vehicle 2 was slowing down to pull onto the inside shoulder to assist the disabled Vehicle 3. Vehicle 2 overturned and ejected the driver, collided into Vehicles 3 and 4, and eventually came to a final stop blocking I-4 westbound lanes. Vehicle 1 came to a rest in the grass median. The driver of Vehicle 2 was pronounced deceased at the hospital.

4.4.6. Contributing Factors

As discussed in the previous sections, rear-end was the highest crash type for the I-4 eastbound (49 percent), I-4 westbound (66 percent), and SR 528 freeway segments (59 percent). Sideswipe was the second highest crash type for each of the three freeway segments as well (I-4 eastbound – 32 percent; I-4 westbound – 21 percent; and SR 528 – 12 percent). These two crash types combined for 605 of the 744 total crashes in the study area (81 percent). Potential contributing factors relating to these two crash types in an urban freeway setting are discussed below:

- Rear-end –
  - Reoccurring congestion related to AM and PM peak hour traffic volumes;
  - Non-reoccurring congestion related to crashes, disabled vehicles, etc.; and

    - Merge/diverge areas throughout the interchange where vehicles traveling at different speeds are interacting (particularly near the Sand Lake Road on-ramp to I-4 westbound and the I-4 eastbound off-ramp to SR 528 eastbound).
- Sideswipe –
    - Merge/diverge areas throughout the interchange where vehicles needing to make lane change movements are occurring (particularly near the Sand Lake Road on-ramp to I-4 westbound and the I-4 eastbound off-ramp to SR 528 eastbound);
    - When a vehicle needs to change lanes to avoid a disabled vehicle, crash, construction, or emergency vehicle on the shoulder, etc.; and
    - When a vehicle makes a sudden lane change in recurring or non-recurring congestion.

4.4.7. Crash Rate Analysis

A crash rate analysis was performed for the I-4 eastbound, I-4 westbound, and SR 528 freeway segments noted in the previous sections. Note that as 2020-2022 average crash rates are not yet available, crash rate analyses were limited to 2017 through 2019 data. A crash rate analysis was not performed for the ramps because no statewide average crash rates are available for ramps.

Actual crash rates, expressed as number of crashes per million vehicle miles traveled (MVMT), were calculated from the total number of crashes in a year, AADT, and the length of the freeway segment based on the equation below:

Actual Crash Rate = (Number of crashes per year x 1,000,000) / (ADT x 365 x segment length)

Volume data was obtained from the Florida Traffic Online website for each freeway segment and is provided in **Appendix G**. The calculated actual crash rates were compared to the critical crash rate to find the safety ratio for of the three freeway segments within the area of influence. The critical crash rate is calculated using the Statewide average crash rates for similar facilities based on the equation[1] below:

Critical Crash Rate = Statewide Average Crash Rate + (K Factor x SQRT {Statewide Average Crash Rate / Vehicle Exposure}) – (1 / {2 x Vehicle Exposure})

Vehicle Exposure = (ADT x 365 x Segment Length) / 1,000,000

Safety Ratio = Actual Crash Rate / Critical Crash Rate

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[1] Critical Crash Rate Equation derived from the State Safety Office Frequently Asked Questions document, pages 2 and https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/safety/11a-safetyengineering/crash-data/frequently-asked-questions-(update2019).pdf?sfvrsn=e0384b8d_2

The facility types and statewide average crash rates for study corridor segments are summarized in **Table 16**. **Table 17** provides a crash rate and safety ratio summary for I-4 eastbound, I-4 westbound, and SR 528. The detailed crash rate analysis for each of the I-4 segments and SR 528 can be found in **Appendix G**.

Table 16: Facility Types and Statewide Average Crash Rates

Facility Type	Year			
	2017	2018	2019	4-Year Statewide Average
I-4 – Urban Interstate	1.038	0.980	0.956	0.991
SR 528 – Toll Road Urban	0.780	0.804	0.743	0.767

Table 17: Crash Rates and Safety Ratios

Freeway Segment	3 Year Actual Crash Rate	3 Year Critical Crash Rate	Safety Ratio
I-4 Eastbound from Central Florida Parkway to SR 528	1.046	1.766	0.592
I-4 Westbound from Sand Lake Road Interchange to SR 528	**1.422**	**1.408**	**1.009**
SR 528 from I-4 Ramps to International Drive	**1.595**	**1.207**	**1.322**

Bold Rows display roadway segments with crash rates higher than rates of similar facilities.

The crash rate on the I-4 eastbound freeway segment west of SR 528 had a crash rate lower than the average crash rate for similar facilities, but both the I-4 westbound freeway segment east of SR 528 and the SR 528 freeway segment had crash rates higher than the average crash rates for similar facilities.

5. FUTURE TRAFFIC DEVELOPMENT

5.1. Recommended Design Traffic Factors

The procedures contained in FDOT's *2019 Project Traffic Forecasting Handbook* result in initial estimates of future daily traffic volumes that would occur during the average day of the year. Several factors are then used to convert from daily volumes to the "design hour" volumes used for analysis. This section of the IOAR documents pertinent data used for selecting the traffic factors to be applied in preparing the design hour volumes. These factors are important as they play a role in determining the appropriate number of lanes along a facility or design features such as pavement thicknesses. Key traffic factors include: K-factor, D-factor, and T-factor, which are further described as follows.

In general terms, the K-factor is the percentage of the daily traffic volume that occurs during the peak hour of the day. Specifically, the K-factor is used to convert an Annual Average Daily Traffic (AADT) volume into a two-way design hour volume (DHV) for a given roadway segment. The FDOT has implemented standardized K-factors to be used in traffic forecasting statewide. The Standard K-factor is dependent upon the area type and facility type for a given project. A standard K-factor of 9.0% is typically used for most urban arterials. This means that nine percent of the daily traffic occurs in the design hour.

The D-factor represents the percentage of traffic traveling in each direction along a roadway segment during the design hour. For example, a D-Factor of 60 percent would represent 60 percent of the traffic traveling in the peak direction and the remaining 40 percent of traffic traveling in the opposite direction. By applying a D-factor to the previously developed two-way design hour volume, the directional design hourly volumes (DDHVs) are calculated for a given roadway segment. These segment DDHVs for each leg of an intersection are then utilized in developing design hour intersection volumes.

The ratio of passenger vehicles and larger trucks is also important in the analysis and design of roadway improvements. T-factors identify the percentage of truck traffic utilizing the roadway during the design hour (DHT) as well as over the entire typical day (T_{24}).

The recommended design traffic factors used in this IOAR are summarized in **Table 18** and are consistent with those listed in the approved MLOU included in **Appendix A**).

Table 18: Recommended Design Traffic Factors

Roadway	K	D	T	DHT
I-4	9.0	52.0	8.9	4.5
Sand Lake Road Ramp to I-4 WB	9.0	100.0	2.1	1.1
SR 528	8.5	52.0	12.6	6.3
SR 528 Ramps	8.5	52.0	12.6	6.3

6. TRAFFIC FORECASTING

The following section summarizes the traffic forecasting for the future AADTs and peak hour volumes for this IOAR. The projections developed followed the accepted methodologies as described in the FDOT Project Traffic Forecasting Handbook.

6.1. Volume Projections Along I-4 and the Sand Lake Road to I-4 Westbound On-Ramp

As noted in the approved MLOU, the traffic forecasts from the approved Sand Lake Road IMR were referenced where appropriate (e.g., Sand Lake Road on-ramp to I-4 westbound, I-4 westbound Express Lane “Tube”, and I-4 mainline between SR 528 and Sand Lake Road). The I-4 at Sand Lake Road IMR received an affirmative determination of safety, operational, and engineering (SO&E) acceptability from FHWA in December 2021. The excerpts from the approved Sand Lake Road IMR are included in **Appendix H** for reference. Both 2026 and 2036 AADTs and peak hour volumes were referenced.

6.2. Volume Projections at the I-4/SR 528 Ramps and SR 528 Eastbound to International Drive Off-Ramp

As noted in the approved MLOU, the traffic forecasts for each of the four I-4/SR 528 ramps and the SR 528 eastbound to International Drive off-ramp were developed by the Florida’s Turnpike Enterprise and provided to FDOT District Five for use in this IOAR. Both 2025 and 2035 AADT and peak hour forecasts were provided and are included in **Appendix I**. Volumes along these ramps were interpolated for the Opening Year (2026) and extrapolated for the Design Year (2036).

6.3. Volume Adjustments/Balancing

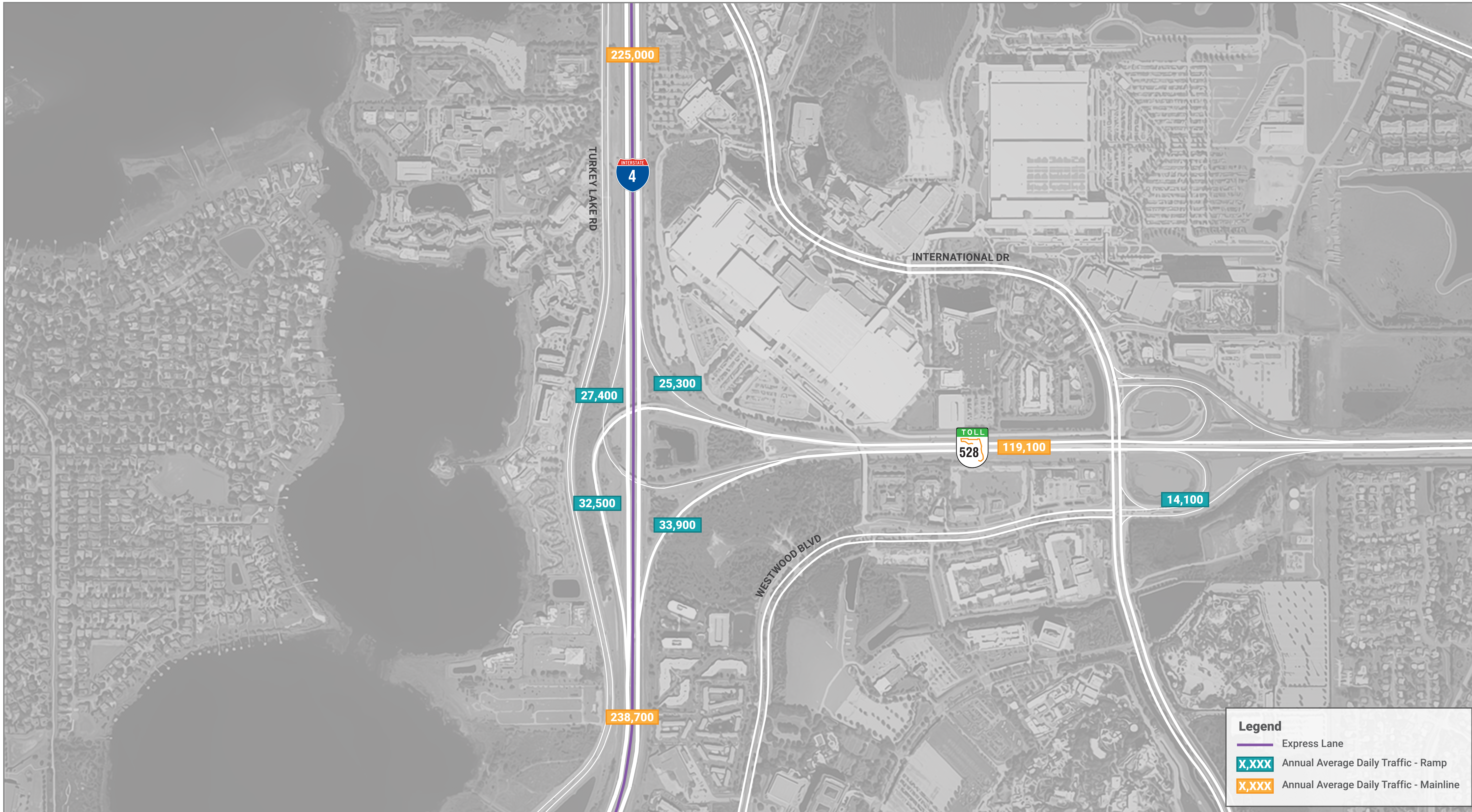
Volumes along the mainline of I-4 were balanced using an anchor point along the facility as described previously (I-4 between SR 528 and Sand Lake Road). The forecasted volumes along I-4 were anchored at this point and the downstream and upstream mainline values were calculated as ramp volumes exited or entered the mainline. This methodology is consistent between the No-Build and Build scenarios.

One set of AADTs were developed for the Opening Year (2026) and Design Year (2036) AADTs and are summarized in the following figure sets:

- 2026 No-Build and Build AADT – **Figure 18**
- 2036 No-Build and Build AADT – **Figure 19**

One set of peak hour volumes were developed for each of the Opening Year (2026) and Design Year (2036) AM and PM peak hours. The balanced volumes are illustrated in the following figure sets:

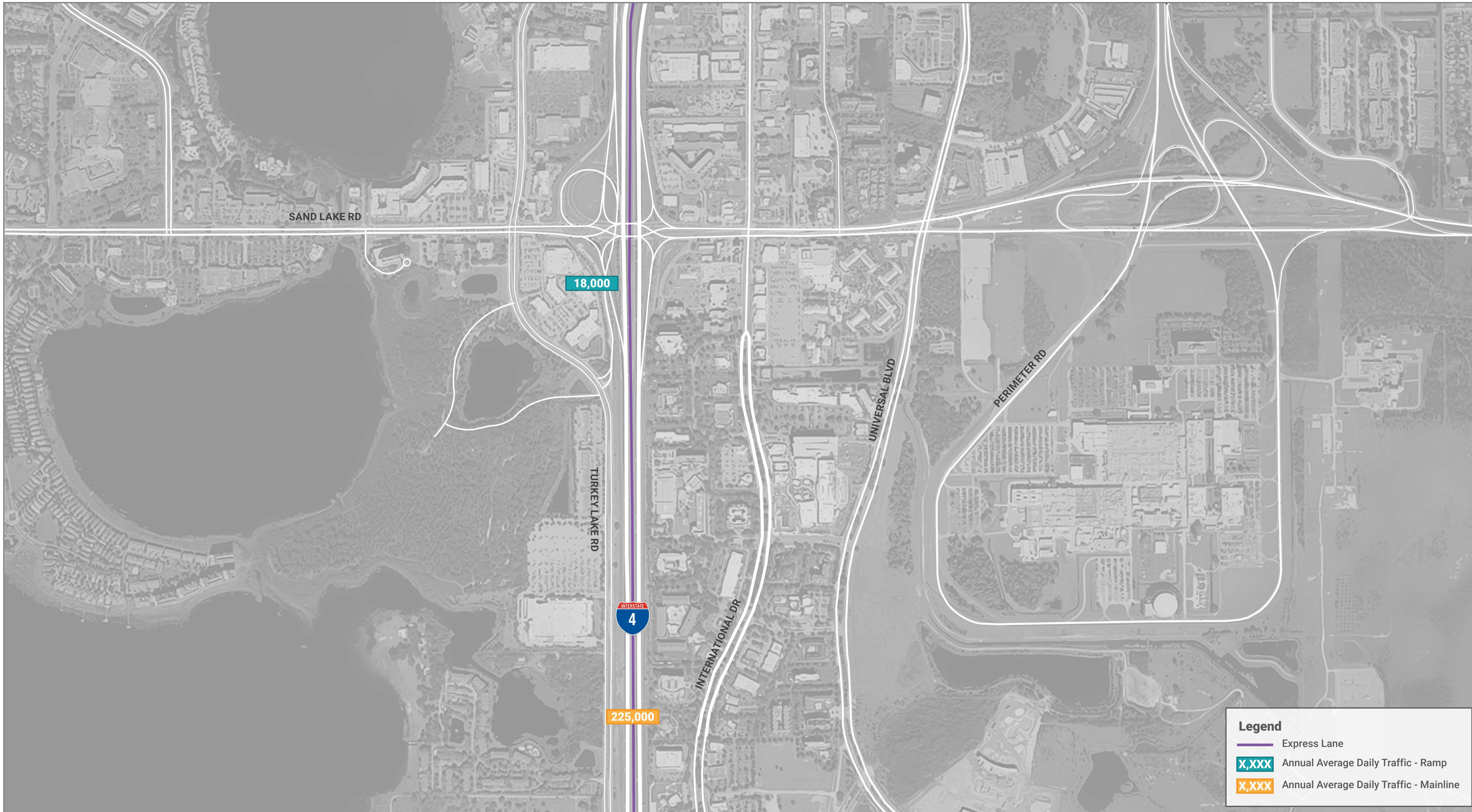
- 2026 No-Build and Build Peak Hour Volumes – **Figure 20**
- 2036 No-Build and Build Peak Hour Volumes – **Figure 21**



FDOT **I-4 at SR 528 Interchange Operational Analysis Report**

FIGURE 18 | **2026 No-Build and Build Annual Average Daily Traffic**

(1 of 2)

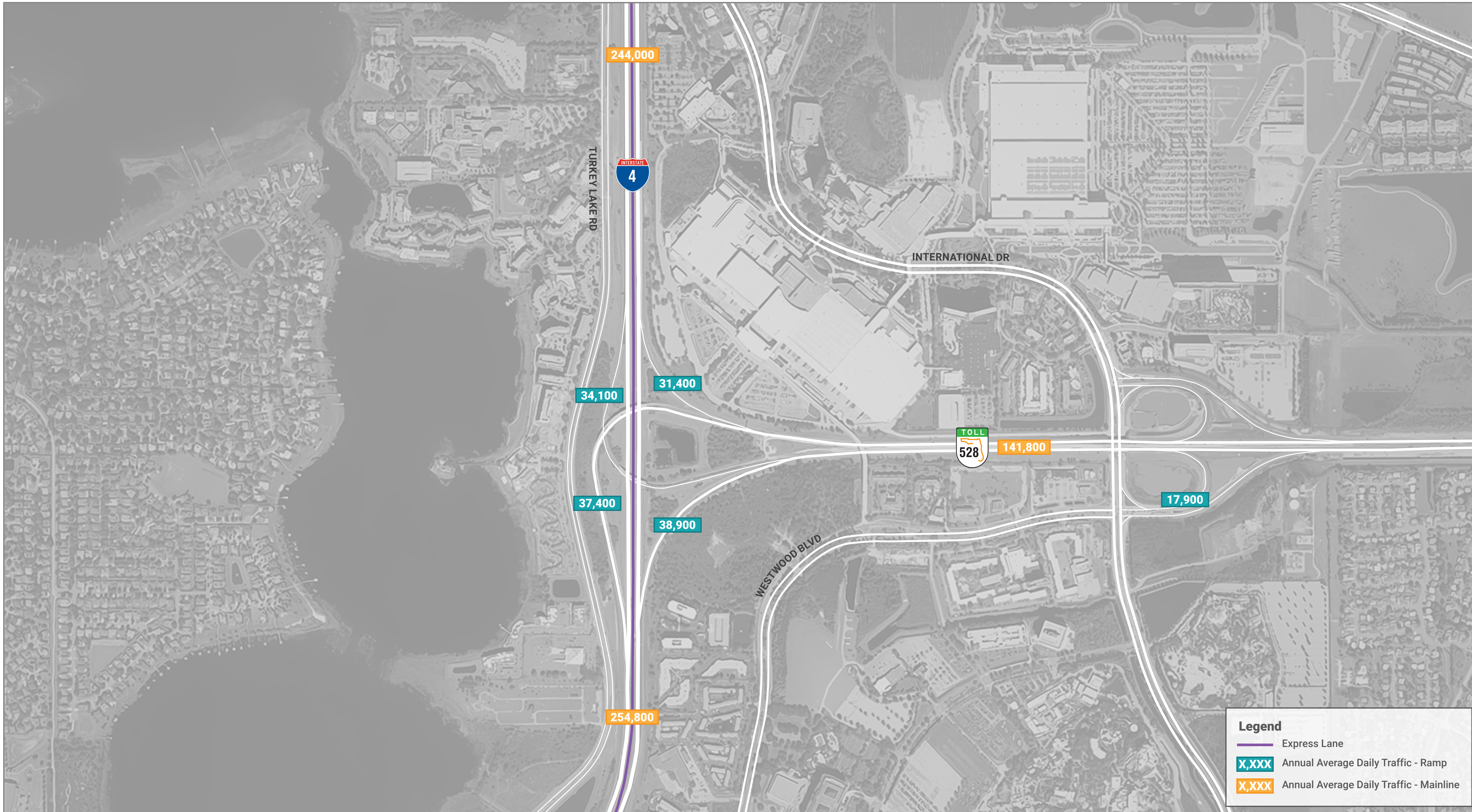


FDOT

I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 18 | **2026 No-Build and Build Annual Average Daily Traffic**

(2 of 2)



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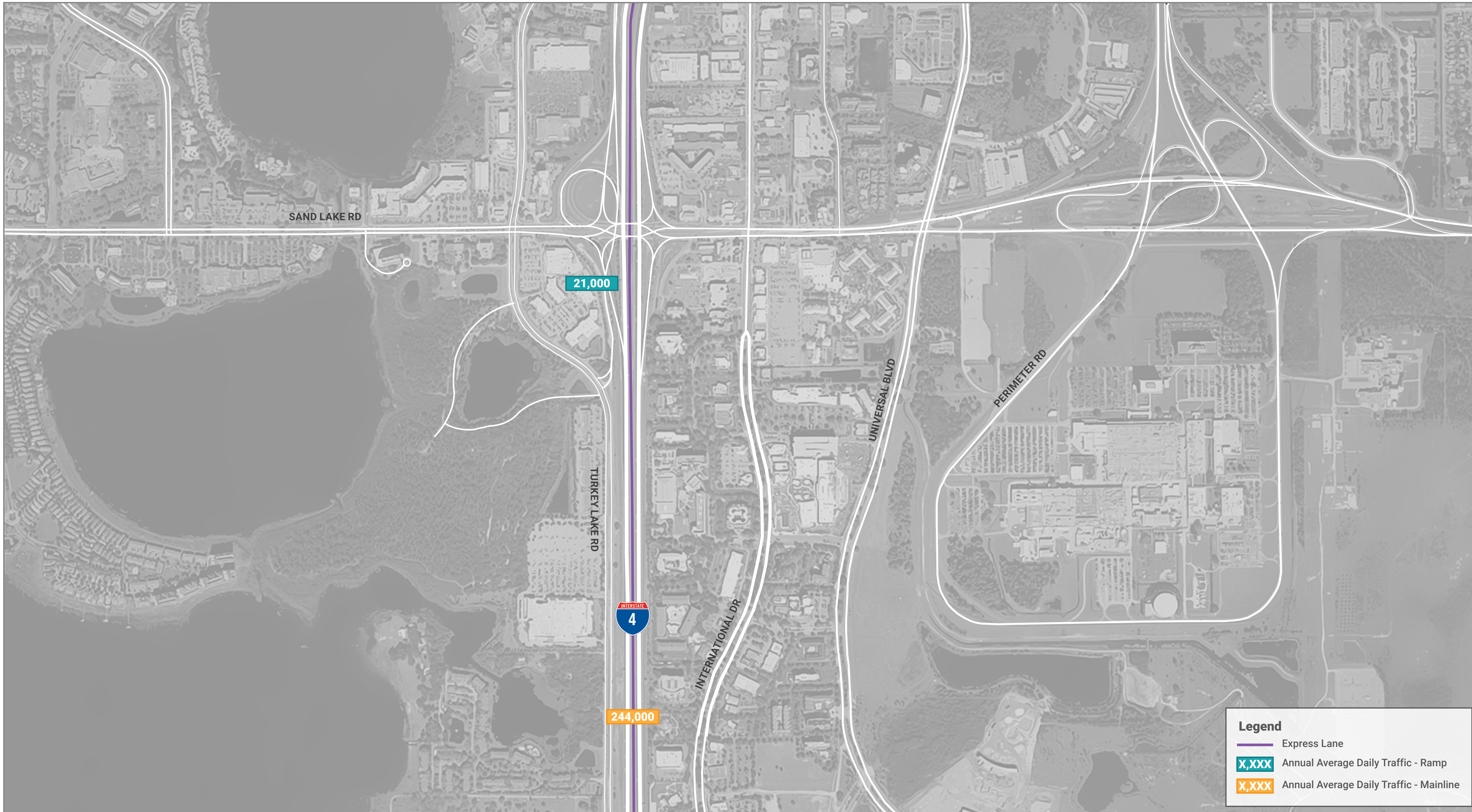
I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 19 | **2036 No-Build and Build Annual Average Daily Traffic**

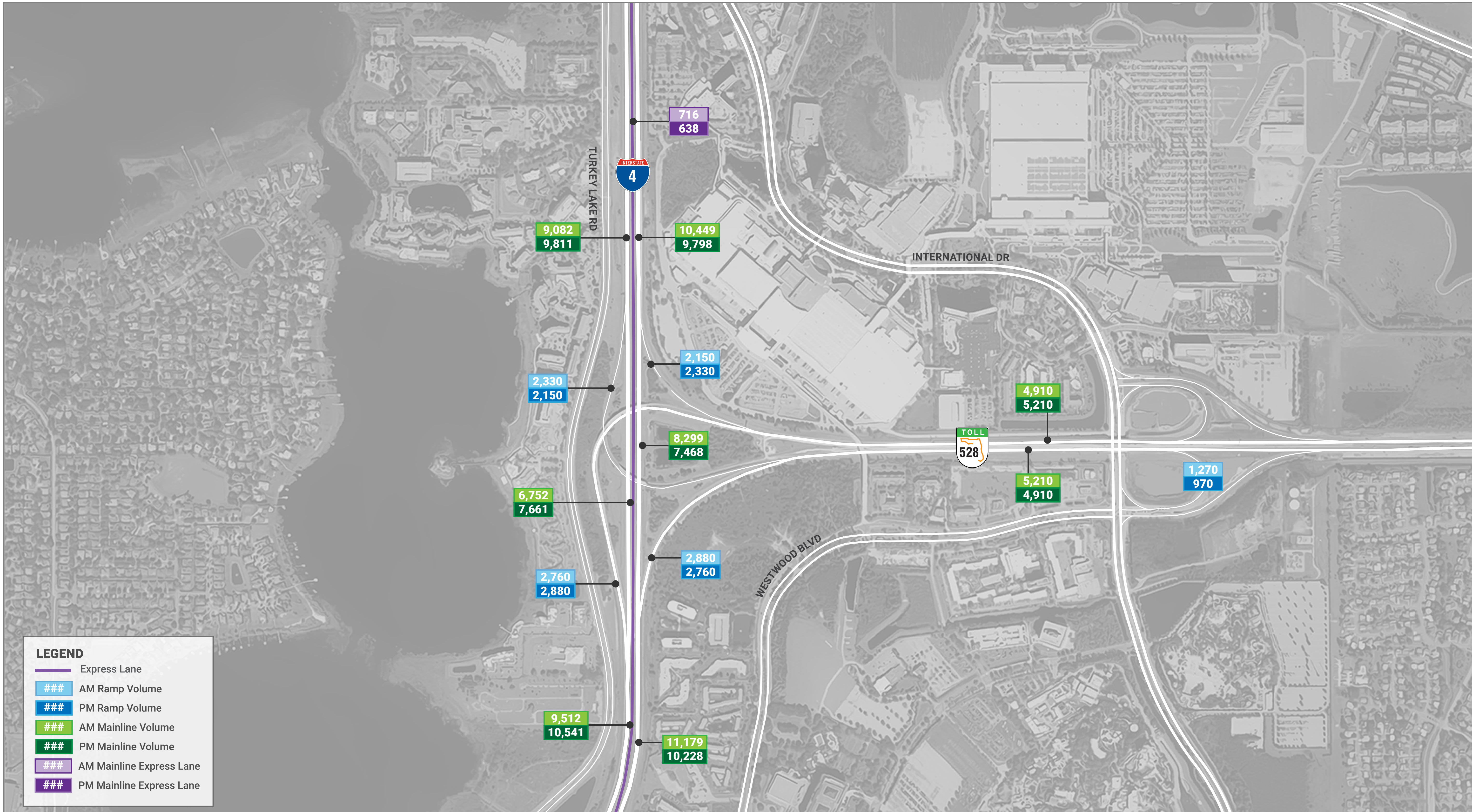
(1 of 2)



FDOT **I-4 at SR 528 Interchange Operational Analysis Report**

FIGURE 19 | **2036 No-Build and Build Annual Average Daily Traffic**

(2 of 2)



Scale in Feet 0 1,000 North

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I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 20 | **2026 No-Build and Build Peak Hour Volumes**

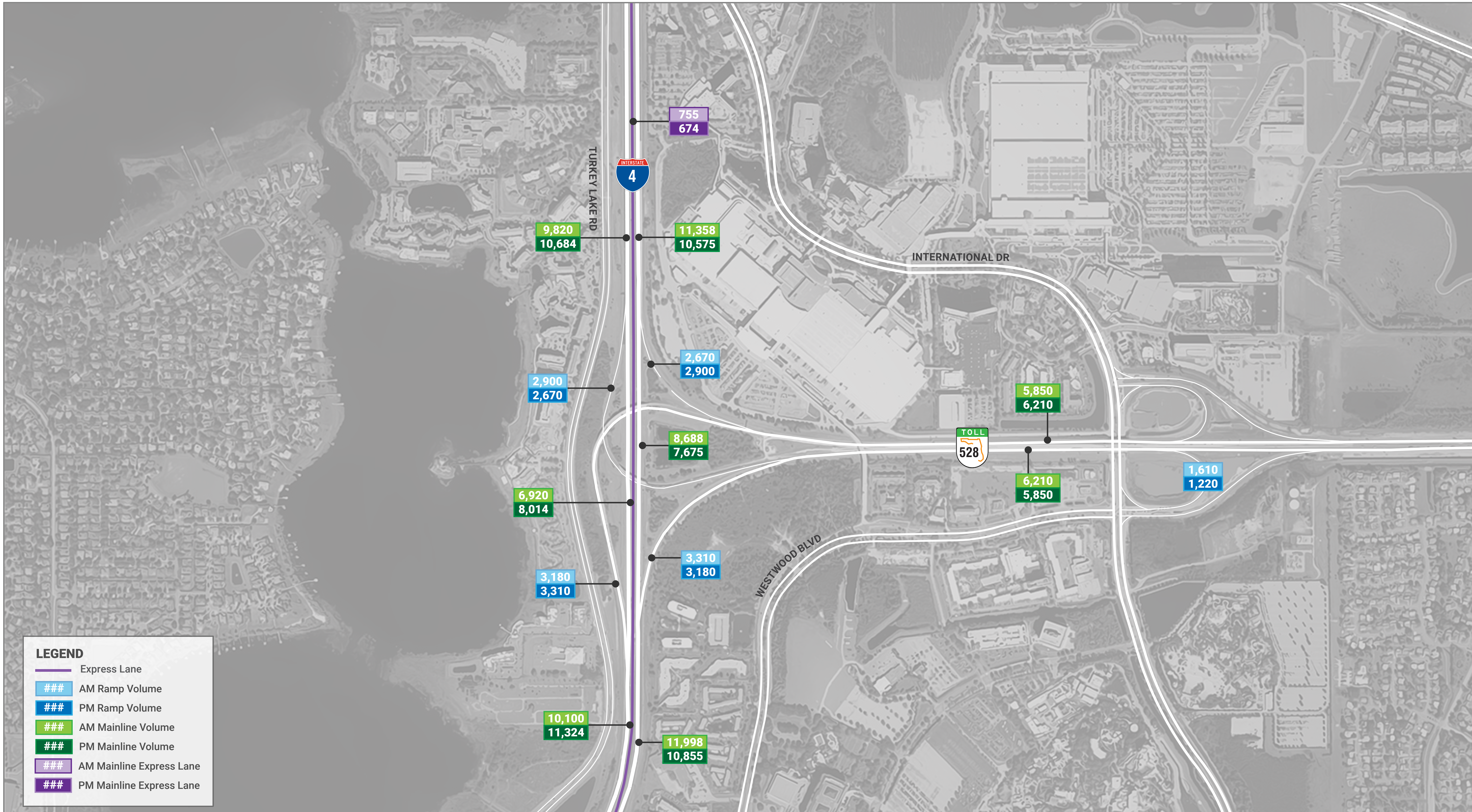
(1 of 2)

FDOT

I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 20 | **2026 No-Build and Build Peak Hour Volumes**

(2 of 2)



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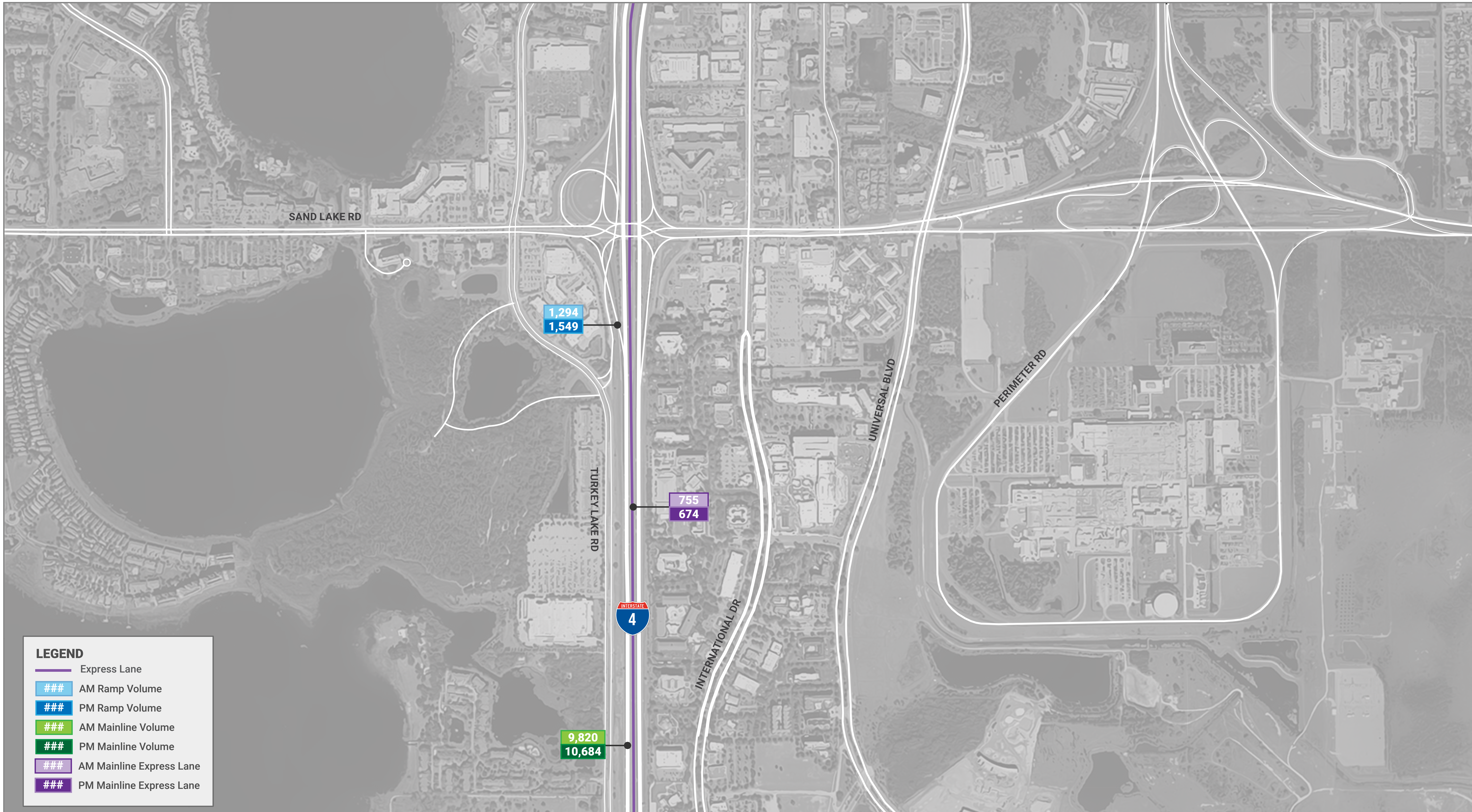
I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 21 | **2036 No-Build and Build Peak Hour Volumes**

(1 of 2)



Scale in Feet 0 1,000 North

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I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 21 | **2036 No-Build and Build Peak Hour Volumes**

(2 of 2)

7. FUTURE (NO-BUILD) OPERATIONAL ANALYSIS

The following sections summarize the future No-Build operational analysis results for both the AM and PM peak hours of the future years (2026 and 2036).

7.1. Future No-Build Geometry

As noted previously, the Sand Lake Road and I-4 westbound express lane "Tube" improvements are moving forward (Design-Build procurement complete). A summary of the geometric changes for the No-Build condition in this IOAR are described below. The future No-Build lane configurations along the I-4 mainline, the SR 528 mainline, and at the gore points for each study on- and off-ramp are illustrated in **Figure 22**.

- I-4 at Sand Lake Road interchange improvements (FM# 444315-3)
    - Conversion of the existing partial cloverleaf interchange to a diverging diamond interchange (DDI)
- Extension of the westbound I-4 Ultimate express lanes to west of Sand Lake Road (FM# 444315-3)
    - Extension of two barrier separated express lanes through the Sand Lake Road interchange area.
- I-4 westbound express lane "Tube" (G/W FM# 444315-3, FM# 441113-3, and G/W FM# 449771-1)
    - Transition to one buffer separated express lane from the end of the Sand Lake Road interchange area through the limits of the SR 528 interchange.
- Interim I-4 at Daryl Carter Parkway interchange (FM# 441113-3)
    - Interim diverging diamond interchange
        - Ramps to/from I-4 eastbound and from I-4 westbound only
    - New westbound C-D system for I-4 westbound off-ramp to Daryl Carter Parkway and I-4 westbound on-ramp from Central Florida Parkway.
    - It is important to note that this new interim interchange is outside the AOI of this IOAR.

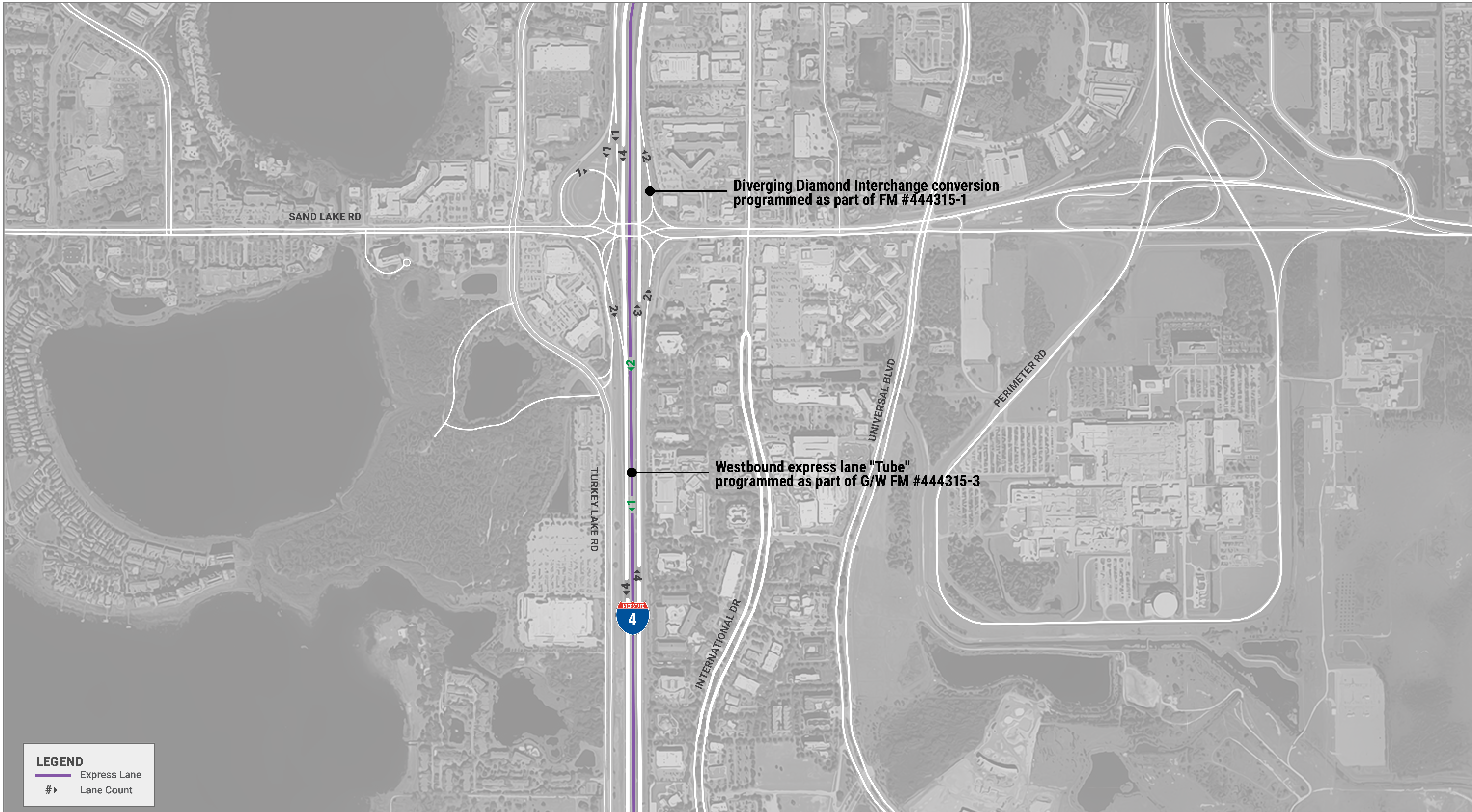
Scale in Feet 0 1,000 North

FDOT

I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 22 | **No-Build Lane Configurations**

(1 of 2)



I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 22 | **No-Build Lane Configurations**

(2 of 2)

7.2. Future No-Build Microsimulation Evaluation

The following section summarizes the Opening Year (2026) and Design Year (2036) No-Build AM and PM peak hour microsimulation analysis conducted using PTV VISSIM software.

7.2.1. Model Development and Assumptions

The future year microsimulation models were developed based on the existing (2022) microsimulation models, which were calibrated/validated against field measurements. Per the approved MLOU, link variables, parameters, and driver behavior settings in future scenarios were kept the same as the existing models.

The geometric assumptions for the future year are described in **Section 7.1** and are illustrated for 2026 and 2036 No-Build conditions in **Figure 22**.

7.2.2. Routes and Demand Volumes

The same O-D percentages provided by FTE for use in the existing conditions models were used for the future year No-Build AM and PM microsimulation models.

7.2.3. VISSIM Simulation Parameters

Ten simulation runs were conducted for each of the future year peak period models for the No-Build scenario. The peak period (AM and PM) traffic demand profile, as previously provided in **Appendix E**, was applied to convert the peak hour volume forecasts into 15-min analysis intervals. The vehicle inputs were developed for each 15-minute analysis period within the peak period, as well as a 15-minute warm-up period and 15-minute cool-down period.

7.2.4. VISSIM Analysis Results

The following measures were collected to summarize traffic operations throughout the simulation model:

- Network-wide performance including average delay, average speed, total delay time, latent volume, and latent delay.
- Speed and density on the freeway links within the AOI in 15-minute increments.
- Average travel time.

The following summarizes the various performance measures and the observations of the models. It is important to note that the results reported are for the AM and PM peak hours only which is consistent with the approved MLOU.

Capacity Constraints and Impacts to the Network

Latent demand along I-4 is prevalent in each of the future year simulation models evaluated because the projected demands significantly exceed the capacity of I-4. The simulation model does not have the ability to load the network as the headways are not low enough to achieve those demands. In addition, extending the length of the network won't mitigate this since the traffic was metered at the entry points. As such, significant demand was metered along the westbound and eastbound approach entries of I-4 within the microsimulation models and was unable to enter the network. The simulation confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4.

No-Build Network Performance Results

Network wide statistics for the 2026 and 2036 AM and PM peak hour are summarized in **Table 19** and **Table 20**, respectively. Significant latent demand and latent delay were observed in each of the future year peak hours, indicating a need for additional capacity along I-4. Average delays, speeds, and total delay at a network level are all expected to worsen as demands increase in each of the future analysis years.

Table 19: VISSIM Network-wide Statistics – Opening Year (2026) No-Build Peak Hours

Network-wide Statistics	No-Build 2026 AM Peak Hour	No-Build 2026 PM Peak Hour
Average Delay (sec)	192	236
Average Speed (mph)	28	24
Total Delay (hr)	1,084	1,299
Active Vehicles (at end of peak hour)	2,163	2,228
Vehicles Arrived (during peak hour)	18,181	17,602
Total Peak Hour Vehicles (Active + Arrived)	20,344	19,830
Latent Demand (at end of peak hour)	10,193	15,136
Latent Delay (hr)	6,523	11,005

Table 20: VISSIM Network-wide Statistics – Design Year (2036) No-Build Peak Hours

Network-wide Statistics	No-Build 2036 AM Peak Hour	No-Build 2036 PM Peak Hour
Average Delay (sec)	184	188
Average Speed (mph)	28	28
Total Delay (hr)	1,058	1,067
Active Vehicles (at end of peak hour)	2,086	2,061
Vehicles Arrived (during peak hour)	18,653	18,433
Total Peak Hour Vehicles (Active + Arrived)	20,739	20,494
Latent Demand (at end of peak hour)	14,315	19,333
Latent Delay (hr)	9,624	14,400

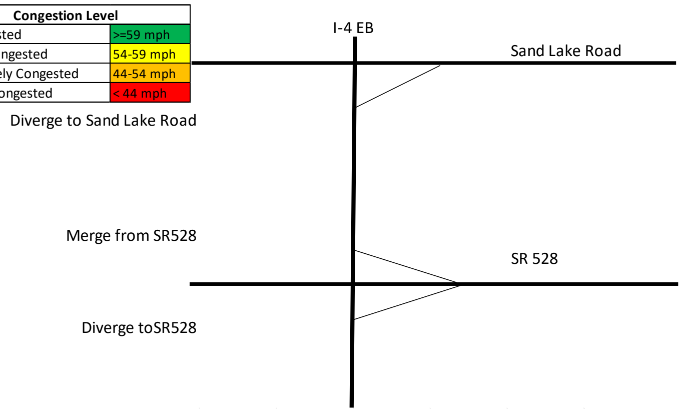
No Build VISSIM Link Evaluation Results

Future year peak hour speed contours for the I-4 study corridor between SR 528 and Sand Lake Road are shown in **Figure 23** to **Figure 26**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook. The density contours along I-4 eastbound and westbound for the future years are illustrated in **Figure 27** through **Figure 30**.

As suggested by the speed and density contours, significant demand was metered during AM and PM peak hours at the I-4 entry points into the microsimulation models for both I-4 eastbound and westbound. During the future year AM peak hours, the main bottleneck along I-4 eastbound occurs at the diverge segment to Sand Lake Road, which resulted in a significant queue along I-4 mainline.

During the 2026 PM peak hour, the major bottleneck within the AOI is at the I-4 westbound merge segment from SR 528 (**Figure 24**). During the Design Year (2036), the contours suggest that the I-4 westbound bottleneck is mitigated/improved (**Figure 26**). However, this is due to metering of traffic demand from westbound SR 528 upstream observed in the microsimulation model and as a result, the total traffic volume at this bottleneck along I-4 in Design Year is actually less than the volume in the Opening Year (2026).

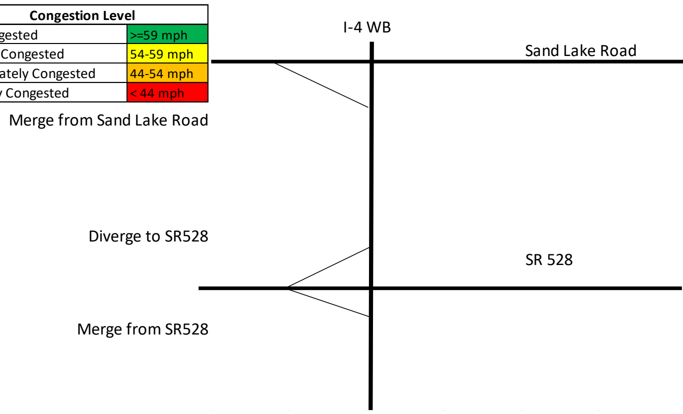
Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
53	53	53	54	56	57	57	56
53	53	53	54	56	57	57	56
53	53	53	54	56	57	57	56
27	28	29	30	41	47	46	46
24	25	28	29	40	47	47	48
22	23	27	27	43	49	49	51
28	25	26	28	45	51	51	52
40	29	30	34	49	52	53	54
45	35	33	33	50	54	53	56
49	39	36	34	53	57	55	58
53	45	43	37	56	57	58	58
52	52	50	44	55	54	54	55
29	26	26	23	29	24	26	28
21	19	19	18	20	18	19	20
20	19	18	18	19	18	19	19
20	18	18	17	19	17	18	19

Figure 23: 2026 No-Build AM and PM I-4 EB Speed Contours

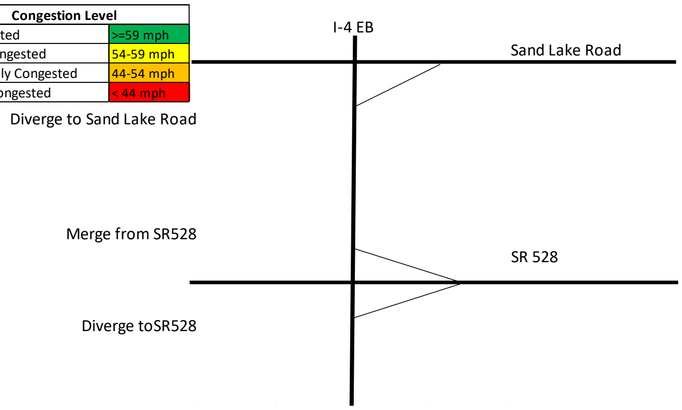
Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
15	15	15	15	15	14	14	14
15	15	15	15	15	14	14	14
14	14	14	14	12	11	10	10
14	14	14	14	13	13	13	13
14	14	14	14	14	14	13	14
50	50	50	50	40	38	30	29
55	55	56	56	39	32	26	25
50	51	51	49	36	30	29	28
58	56	56	58	30	27	25	24
58	53	49	52	28	26	23	23
52	44	37	37	24	24	22	23
33	27	24	24	16	16	16	16
54	53	53	53	52	52	52	52
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58

Figure 24: 2026 No-Build AM and PM I-4 WB Speed Contours

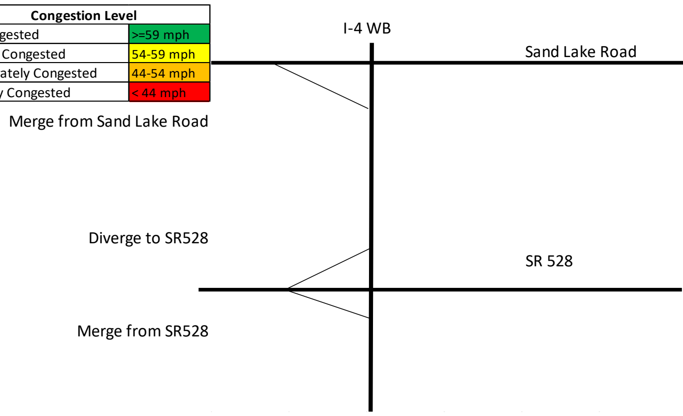
Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
54	53	53	54	55	55	55	55
54	53	53	54	55	55	55	55
54	53	53	54	55	55	55	55
33	26	27	29	36	40	40	37
30	23	23	25	36	41	41	38
31	25	21	24	39	45	44	41
37	32	24	23	46	47	46	44
45	37	27	25	47	47	47	46
44	38	28	23	44	44	44	43
48	44	38	34	48	49	50	48
52	47	47	46	49	51	52	53
54	52	52	49	50	50	55	53
28	27	24	24	25	24	31	30
20	20	18	18	18	17	20	21
19	19	18	18	18	17	19	20
18	18	17	17	17	17	18	19

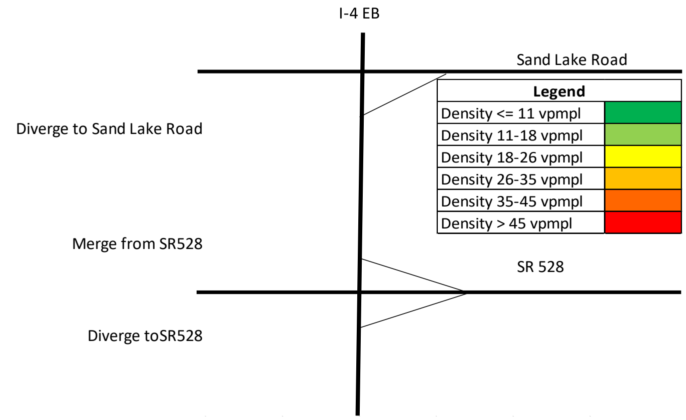
Figure 25: 2036 No-Build AM and PM I-4 EB Speed Contours

Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



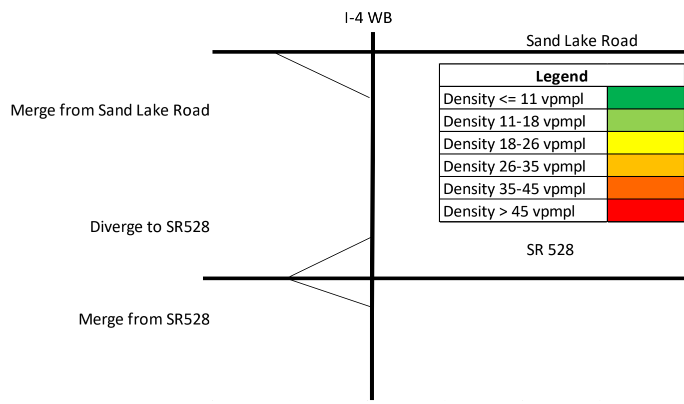
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
14	13	13	14	13	14	14	14
14	13	13	14	13	14	14	14
10	10	10	10	10	10	10	10
13	13	13	13	13	14	14	13
14	14	14	14	14	15	14	14
45	44	47	50	50	50	50	50
42	43	47	53	56	56	56	57
42	46	46	47	52	50	54	53
58	58	58	58	56	57	57	58
58	58	58	58	55	53	53	54
58	58	58	58	52	47	42	45
50	48	50	46	36	34	33	29
57	57	57	56	55	55	54	54
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58

Figure 26: 2036 No-Build AM and PM I-4 WB Speed Contours



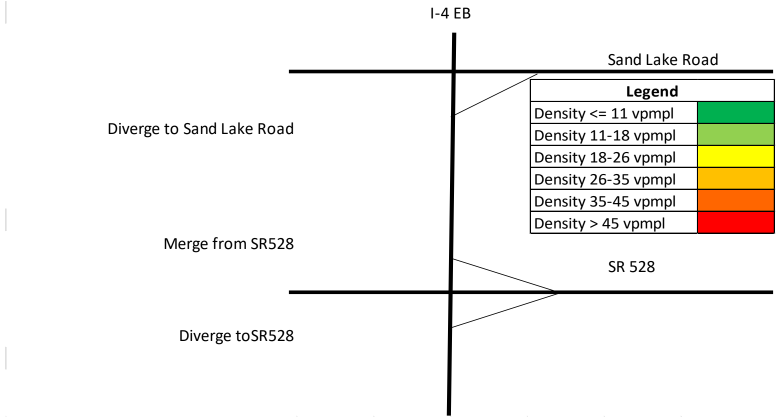
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
36	36	34	34	33	31	31	32
36	36	34	34	33	31	31	32
36	36	34	34	33	31	31	32
62	60	61	59	43	36	36	38
72	69	68	66	48	37	39	37
77	75	74	72	48	38	39	36
67	75	76	71	45	38	37	35
50	69	67	64	40	34	33	32
39	53	57	58	30	23	26	23
40	54	57	64	34	28	30	28
36	42	46	53	30	27	28	28
35	32	35	40	30	29	29	30
59	65	65	72	60	68	65	62
83	86	88	90	86	89	87	85
85	88	89	90	88	90	89	87
87	92	92	94	90	94	93	90

Figure 27: 2026 No-Build AM and PM I-4 EB Density Contours



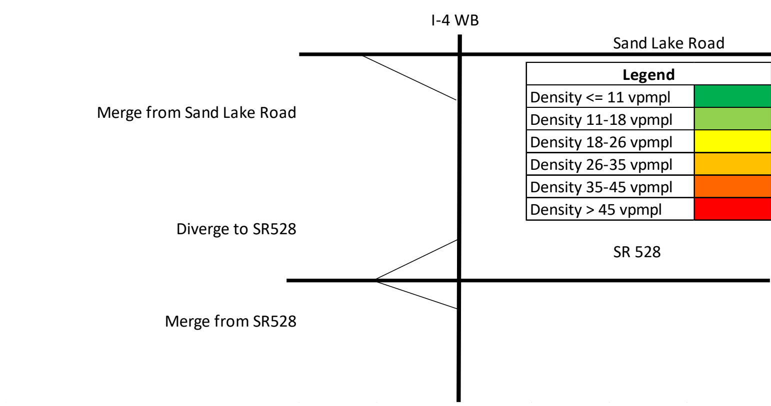
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
99	99	99	99	102	103	104	104
99	99	99	99	102	103	104	104
84	83	82	82	101	108	114	115
104	104	104	104	106	106	107	107
99	100	98	100	100	101	103	102
35	35	35	35	47	51	61	63
33	32	32	32	53	62	72	72
36	35	35	37	54	61	63	63
30	32	32	31	69	74	77	78
31	36	39	35	72	76	81	80
35	44	55	53	78	78	82	80
52	66	75	76	90	91	90	90
35	36	35	35	35	35	35	35
33	33	32	32	32	32	32	32
33	33	32	32	31	32	32	32

Figure 28: 2026 No-Build AM and PM I-4 WB Density Contours



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
35	34	35	35	33	32	33	33
35	34	35	35	33	32	33	33
35	34	35	35	33	32	33	33
54	65	63	59	48	45	46	49
61	73	72	69	51	46	48	50
64	73	79	76	49	45	47	51
54	64	77	80	45	45	46	49
47	55	72	74	43	44	45	45
41	52	66	69	43	41	41	45
40	46	52	55	40	38	39	40
34	38	37	41	38	35	34	34
30	32	31	35	32	31	29	31
62	62	69	69	68	70	57	58
86	85	89	89	89	91	84	83
88	86	90	91	90	93	87	85
91	91	93	95	94	96	91	89

Figure 29: 2036 No-Build AM and PM I-4 EB Density Contours



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
106	107	106	105	106	105	104	106
106	107	106	105	106	105	104	106
115	118	118	119	121	119	121	122
105	105	105	105	105	103	105	105
99	99	100	99	99	99	99	100
40	41	37	36	35	36	35	35
44	44	39	34	31	32	31	31
42	38	38	38	34	35	33	34
29	29	29	29	32	32	32	31
28	29	29	29	36	37	37	35
28	29	29	29	38	44	50	43
30	32	30	33	54	55	60	65
33	34	33	34	35	35	35	35
32	33	32	33	33	33	33	33
32	33	32	32	32	33	33	32

Figure 30: 2036 No-Build AM and PM I-4 WB Density Contours

The density and speed of the SR 528 eastbound segment between I-4 and International Drive are summarized in **Table 21** and **Table 22**. According to the segment density, this segment is operating at LOS B and the travel speed is nearly at free-flow speed (i.e., 65 mph), which suggests congestion is not expected to be present within this segment in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.

Table 21: Density and Speed of SR 528 Eastbound Segment – No-Build AM Peak Hours

Time Period	2026 No-Build AM		2036 No-Build AM	
	Density*	Speed	Density*	Speed
7:30	13.9	63	15.1	63
7:45	13.4	63	14.8	63
8:00	13.5	63	14.6	63
8:15	13.3	63	14.6	63

***Note:** LOS B = Density between 11-18 veh/mile/lane

Table 22: Density and Speed of SR 528 Eastbound Segment –No-Build PM Peak Hours

Time Period	2026 No-Build PM		2036 No-Build PM	
	Density*	Speed	Density*	Speed
17:00	12.9	63	14.1	63
17:15	12.3	63	13.9	63
17:30	12.6	63	14.4	63
17:45	12.7	63	14.3	63

***Note:** LOS B = Density between 11-18 veh/mile/lane

A detailed traffic demand and simulated volume comparison for each of the study roadway segments during the peak hours is summarized in **Appendix J**.

No-Build VISSIM Travel Time Results

Travel time markers were coded into the network to measure the trip travel time along the I-4 mainline and from I-4 to SR 528 (end-to-end routes within the microsimulation models). **Table 23** and **Table 24** summarize the travel time performance of different routes within the AOI for the 2026 and 2036 peak hours. The start/end markers of each route are shown in **Appendix J**.

The travel time results suggest that traffic along both I-4 eastbound and westbound will experience significant delay, which is consistent with general observations of the No-Build VISSIM models. The travel times along the corridors listed in the tables are expected to be approximately two to three times longer than the average free-flow travel time during the AM and PM peak hours, respectively.

It is important to note that there are instances where the travel time decreases in the Design Year (2036) versus the Opening Year (2026), and these are due to the upstream metering/capacity constraints as previously described.

Table 23: VISSIM Corridor Travel Time Results – Opening Year (2026) No-Build Peak Hours

Travel Time Measurement	No-Build 2026 AM Peak Hour (min)	No-Build 2026 PM Peak Hour (min)
I-4 WB	4.6	6.5
I-4 EB	5.3	3.8
I-4 WB to SR 528	4.3	5.0
I-4 EB to SR 528	2.4	2.4

*Note: The average free-flow travel time along the I-4 (end-to-end within the study limits) is approximately 2.3 min, the average free-flow travel time from I-4 WB to SR 528 (end-to-end within the study limits) is approximately 2.5 min and the average free-flow travel time from I-4 EB to SR 528 (end-to-end within the study limits) is approximately 1.4 min based on HERE data.

Table 24: VISSIM Corridor Travel Time Results – Design Year (2036) No-Build Peak Hours

Travel Time Measurement	No-Build 2036 AM Peak Hour (min)	No-Build 2036 PM Peak Hour (min)
I-4 WB	4.7	4.8
I-4 EB	5.1	4.2
I-4 WB to SR 528	4.6	4.1
I-4 EB to SR 528	2.4	2.4

*Note: The average free-flow travel time along the I-4 (end-to-end within the study limits) is approximately 2.3 min, the average free-flow travel time from I-4 WB to SR 528 (end-to-end within the study limits) is approximately 2.5 min and the average free-flow travel time from I-4 EB to SR 528 (end-to-end within the study limits) is approximately 1.4 min based on HERE data.

7.3. Future No-Build Operational Summary

Based on the operational analyses conducted for the future year No-Build AM and PM peak hours, the VISSIM results show severe congestion along I-4 due to the capacity constraints on the mainline and the results are impacted by upstream metering impacts. The volume to capacity (v/c) ratio along the study ramp is expected to exceed 1.0 (overcapacity) based on the 2026 AM and PM traffic projections prepared by Florida's Turnpike Enterprise (2,330 and 2,150 vehicles in the 2026 AM and PM peak hours, respectively) and the capacity of a single lane ramp (assuming approximately 1,800 vehicles per hour). The v/c ratio is expected to increase/worsen as traffic demands increase.

The following summarizes the key findings from the future year No-Build simulation analyses. The simulation analysis resulted in severe latent demand and capacity constraints on the I-4 mainline continuing to reinforce the need for capacity improvements along I-4, such as those identified in the I-4 BtU South Section SAMR and PD&E Study.

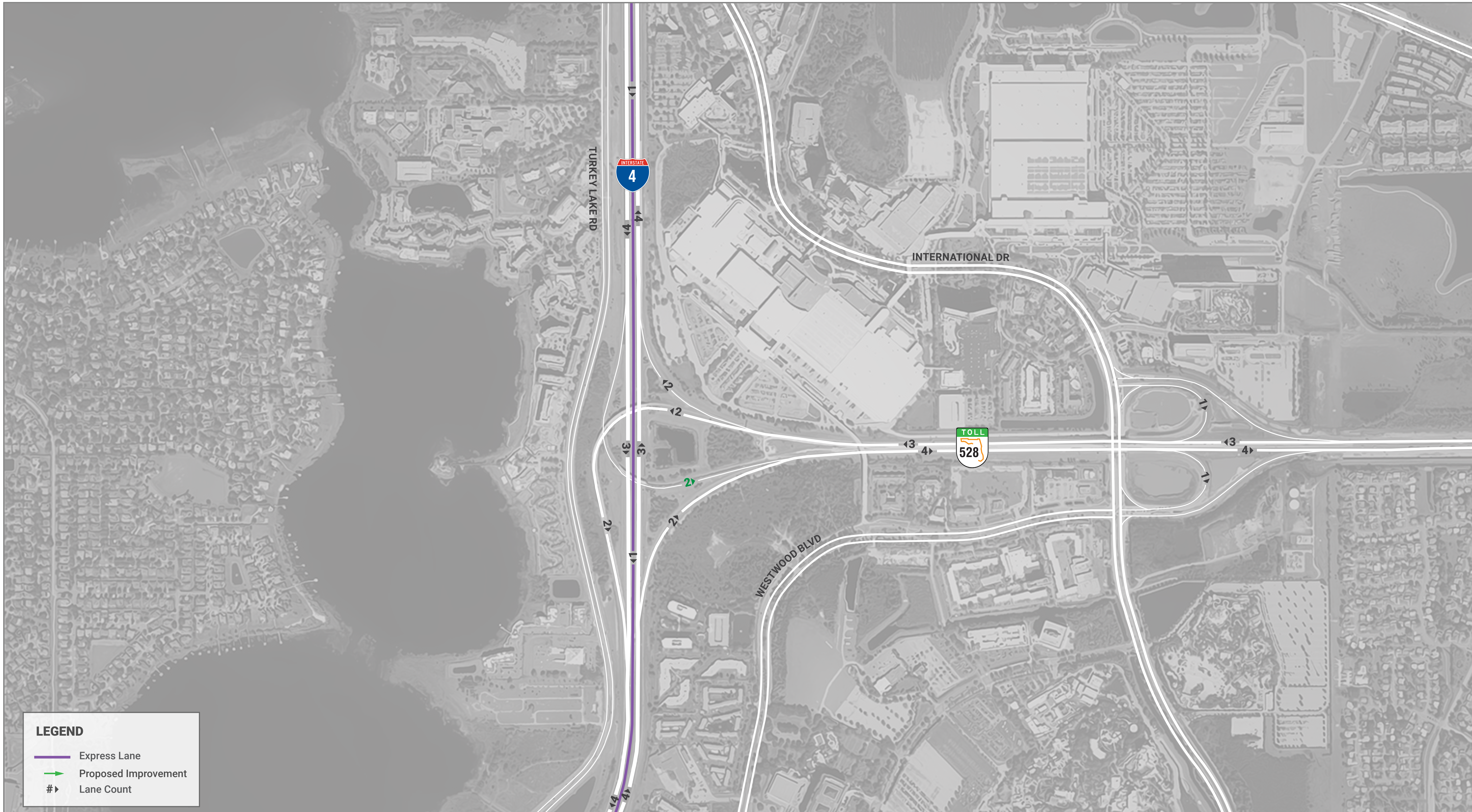
- The capacity constraints and metering impact along I-4 westbound upstream of the SR 528 interchange mask the expected impact of the additional capacity needs for the I-4 westbound off-ramp to SR 528 eastbound movement. If these upstream impacts were not present, it is expected that there would be queue spillback onto the I-4 westbound mainline lanes from the single-lane off-ramp.
- The link evaluation results show several bottlenecks along I-4 westbound including the merge from Sand Lake Road during the future year AM peak hours and the merge from SR 528 westbound during the future year AM and PM peak hours.
- The link evaluation results show a major bottleneck along I-4 eastbound at the diverge to Sand Lake Road during the future year peak hours.
- The travel time results suggest that traffic along both I-4 eastbound and westbound will experience significant delays.
    - The end-to-end travel times along the I-4 westbound and eastbound are expected to be approximately two to three times longer than the average free-flow travel time during the future AM and PM peak hours.

8. FUTURE (BUILD) OPERATIONAL ANALYSIS

The following section summarizes the future Build operational analysis results for the freeway evaluations for both the AM and PM peak hours of the future years (2026 and 2036).

8.1. Future Build Improvements

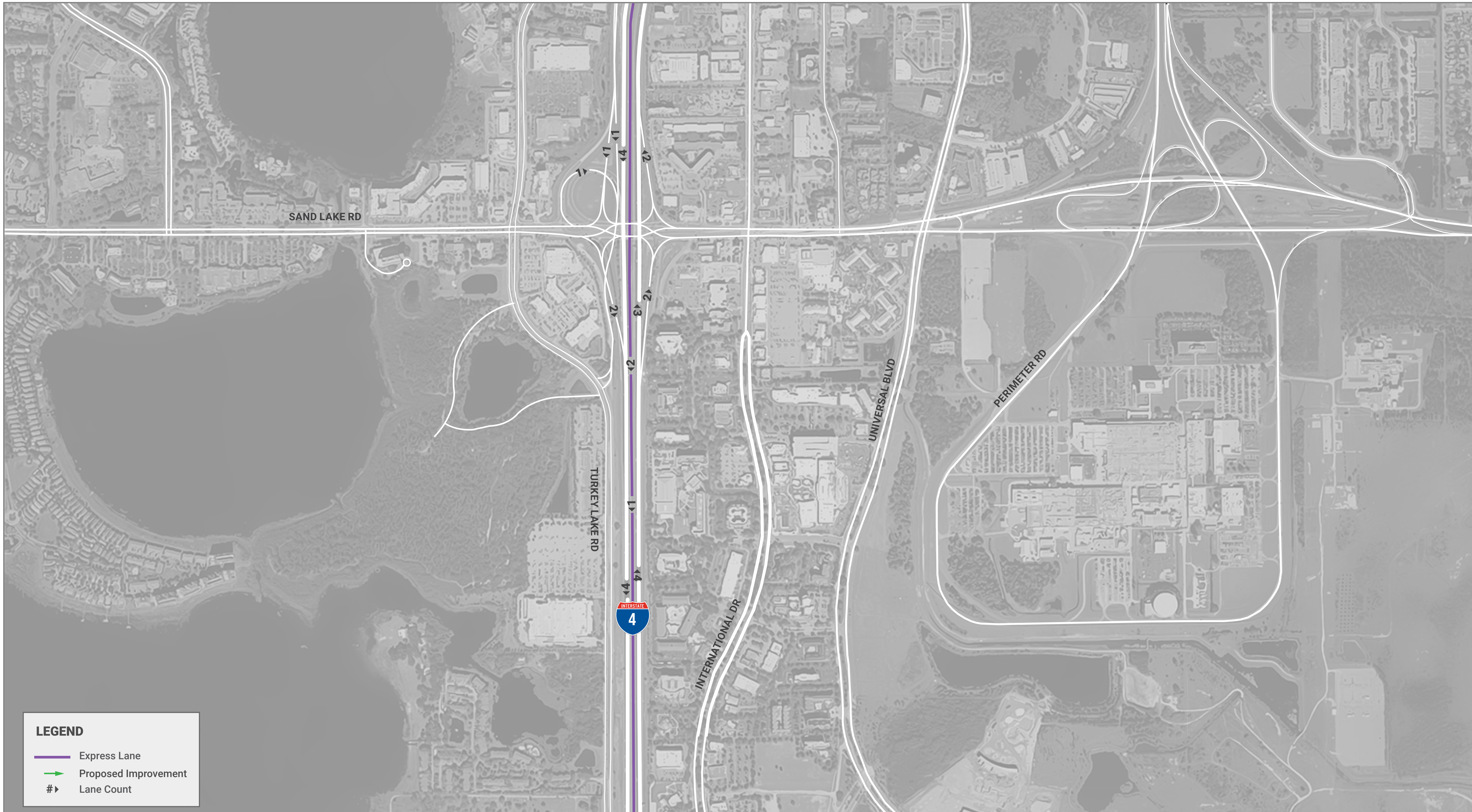
In addition to the No-Build improvements listed in **Section 7.1**, the Build condition will include widening of the westbound I-4 off-ramp to eastbound SR 528 from a single lane at the gore point to two lanes at the gore point. The future Build lane configuration at the gore points for each on-ramp and off-ramp are illustrated for 2026 and 2036 Build conditions in **Figure 31**. Exhibits showing the off-ramp improvement are included in **Appendix L** (Typical Section Package) and **Appendix M** (Signing and Pavement Marking Plan).



I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 31 | **Build Lane Configurations**

(1 of 2)



Scale in Feet
0
1,000
North

FDOT

I-4 at SR 528 Interchange Operational Analysis Report

FIGURE 31 | **Build Lane Configurations**

(2 of 2)

8.2. Future Build Microsimulation Evaluation

The following section summarizes the Opening Year (2026) and Design Year (2036) Build AM and PM peak hour microsimulation analysis conducted using PTV VISSIM software.

8.2.1. Model Development and Assumptions

In addition to the geometric modifications made within the No-Build models as described in **Section 7.2.1**, the interchange modifications described in **Section 8.1** were incorporated into the Build microsimulation models.

8.2.2. Routes and Demand Volumes

The same O-D routes for the No-Build scenario were used for the O-D routes as part of the future year Build VISSIM models.

8.2.3. VISSIM Simulation Parameters

For consistency with the future year No-Build VISSIM models, ten simulation runs were conducted for the future year Build scenarios. The simulation results summarized in this section are representative of the peak hour simulation models.

8.2.4. VISSIM Analysis Results

The future year Build VISSIM models were evaluated using the same performance measures as the No-Build VISSIM analysis including network performance, freeway link evaluations, and corridor travel time results. The following summarizes the various performance measures and the observations in the models. Consistent with the No-Build results summarized in **Section 7.3**, the results reported in this section are for the AM and PM peak hours only.

Capacity Constraints and Impacts to the Network

As no improvements are proposed along the I-4 mainline as part of this project, the capacity constraints along I-4 in the Build scenarios are consistent with what was observed in the No-Build models. Both I-4 westbound and eastbound are the primary driver of the latent demand observed within the microsimulation models. As such, significant demand was metered along the westbound and eastbound approach entries of I-4 within the microsimulation models and was unable to enter the network. The simulation confirmed that capacity improvements, such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4.

Build Network Performance Results

Network-wide statistics for the 2026 and 2036 AM and PM peak hours are summarized in **Table 25** and **Table 26**, respectively. Similar to No-Build models, significant latent demand and latent delay were still observed in each of the peak hours at the I-4 entry points into the microsimulation models. Each of the performance metrics such as average delay, average speed, and total delay are better in the Build when compared to the No-Build during each of the future year peak hours.

Table 25: VISSIM Network-wide Statistics – Opening Year (2026) Build Peak Hours

Network-wide Statistics	Build 2026 AM Peak Hour	Build 2026 PM Peak Hour
Average Delay (sec)	180	226
Average Speed (mph)	29	25
Total Delay (hr)	1,022	1,231
Active Vehicles (at end of peak hour)	2,117	2,116
Vehicles Arrived (during peak hour)	18,316	17,584
Total Peak Hour Vehicles (Active + Arrived)	20,433	19,700
Latent Demand (at end of peak hour)	10,088	15,408
Latent Delay (hr)	6,498	11,170

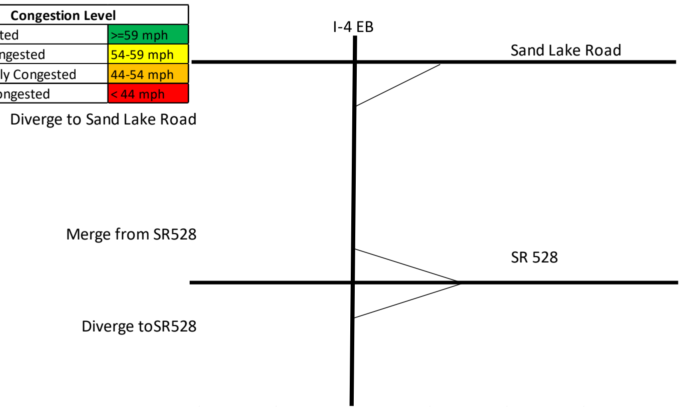
Table 26: VISSIM Network-wide Statistics – Design Year (2036) Build Peak Hours

Network-wide Statistics	Build 2036 AM Peak Hour	Build 2036 PM Peak Hour
Average Delay (sec)	177	185
Average Speed (mph)	29	28
Total Delay (hr)	1,018	1,041
Active Vehicles (at end of peak hour)	2,048	2,005
Vehicles Arrived (during peak hour)	18,627	18,252
Total Peak Hour Vehicles (Active + Arrived)	20,675	20,257
Latent Demand (at end of peak hour)	14,332	19,647
Latent Delay (hr)	9,631	14,590

Build VISSIM Link Evaluation Results

Speed contours for the I-4 study corridor during the future year weekday AM and PM peak hours between SR 528 and Sand Lake Road are shown in **Figure 32** through **Figure 35**. The speed contours utilize the congestion level thresholds in Table 9-12 of the latest FDOT Traffic Analysis Handbook published in May 2021. The density contours along I-4 eastbound and westbound for the future years are illustrated in **Figure 36** through **Figure 39**. The bottlenecks/capacity constraints are in the same locations as the No-Build scenario as previously illustrated and discussed in **Section 7.2.4**.

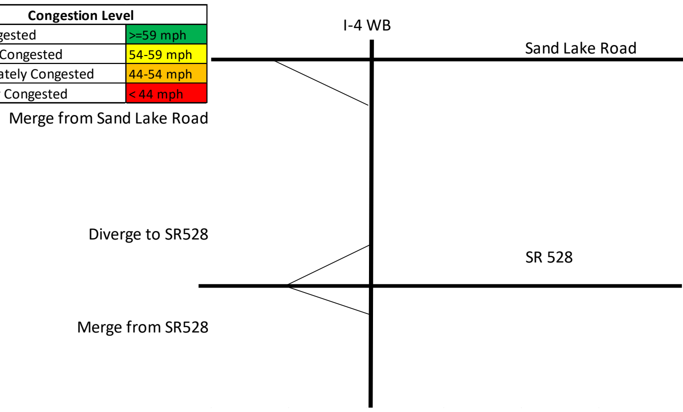
Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



AM Peak (7:30 – 8:30)					PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15		17:00	17:15	17:30	17:45
53	53	53	53		56	56	57	56
53	53	53	53		56	56	57	56
53	53	53	53		56	56	57	56
27	28	27	29		43	45	48	43
24	24	25	25		44	46	50	44
22	23	24	24		50	51	53	50
28	25	24	26		53	54	57	55
40	29	30	29		55	55	59	58
45	34	31	31		53	55	57	57
49	39	36	35		54	58	58	58
53	44	42	41		54	58	58	58
52	49	48	45		52	54	54	55
29	26	24	23		26	23	24	30
21	19	18	18		19	18	18	20
20	19	18	18		18	17	18	20
20	18	17	17		18	17	17	19

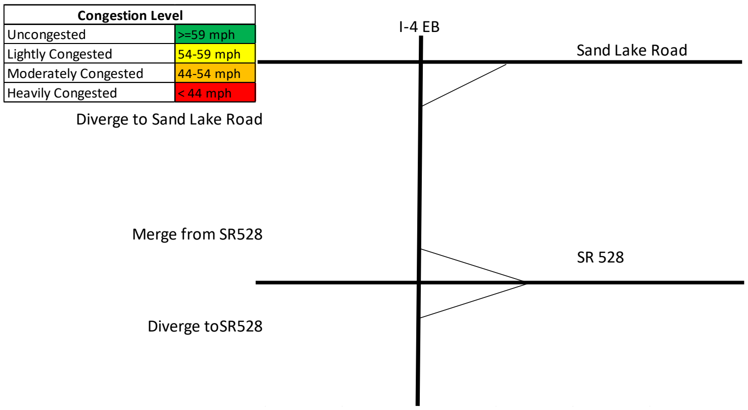
Figure 32: 2026 Build AM and PM I-4 EB Speed Contours

Congestion Level	
Uncongested	>=59 mph
Lightly Congested	54-59 mph
Moderately Congested	44-54 mph
Heavily Congested	< 44 mph



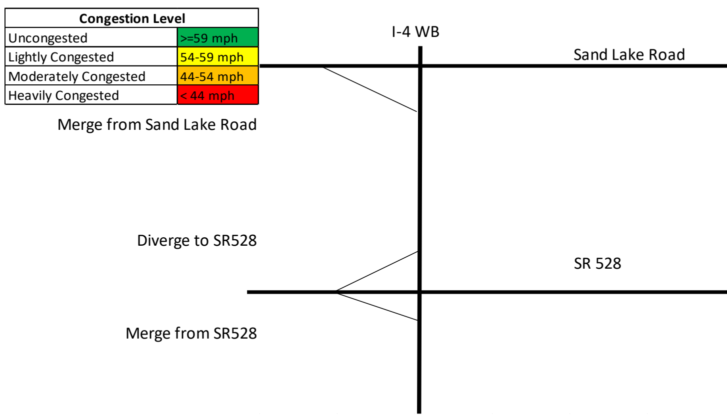
AM Peak (7:30 – 8:30)					PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15		17:00	17:15	17:30	17:45
16	15	16	15		15	14	13	14
16	15	16	15		15	14	13	14
14	14	14	14		17	17	16	17
14	14	14	14		16	15	14	15
15	15	15	14		15	14	13	14
51	51	50	51		32	27	24	28
55	56	56	56		29	24	25	25
57	56	57	57		30	28	28	29
59	59	59	58		25	23	23	24
58	58	56	58		23	23	23	23
56	52	49	51		22	22	23	23
41	34	32	32		16	16	16	16
55	54	54	54		52	52	52	52
58	58	58	58		58	58	58	58
58	58	58	58		58	58	58	58

Figure 33: 2026 Build AM and PM I-4 WB Speed Contours



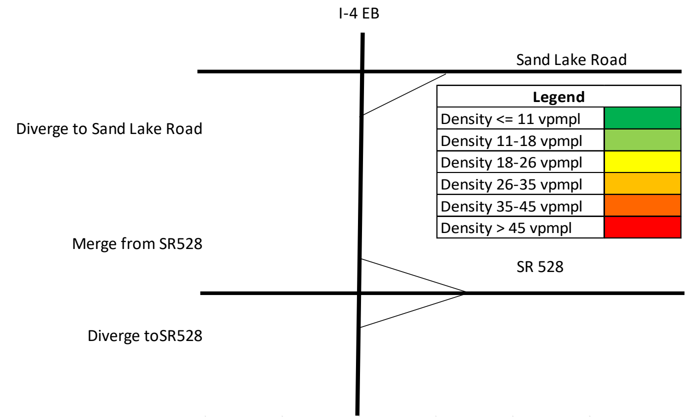
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
54	53	53	54	55	56	55	56
54	53	53	54	55	56	55	56
54	53	53	54	55	56	55	56
33	26	27	29	36	42	41	41
30	23	23	25	37	42	41	42
31	25	21	24	39	43	44	45
37	32	24	23	43	43	46	47
45	37	27	25	44	45	47	48
44	38	28	23	41	45	46	45
48	44	38	34	48	49	50	50
52	47	47	46	52	52	52	54
54	52	52	49	52	52	54	53
28	27	24	24	26	24	31	31
20	20	18	18	18	18	21	21
19	19	18	18	18	17	20	20
18	18	17	17	17	17	19	20

Figure 34: 2036 Build AM and PM I-4 EB Speed Contours



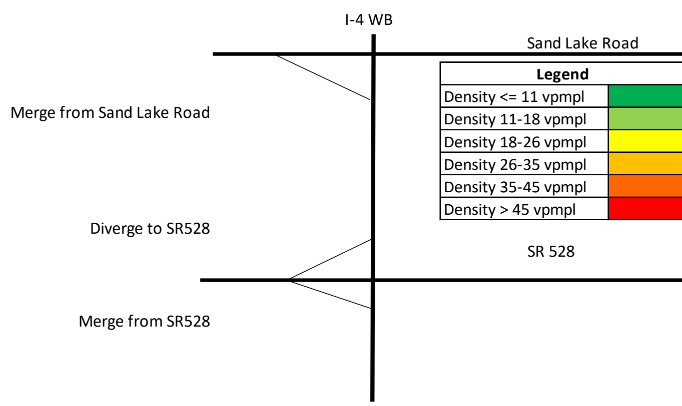
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
14	14	14	14	13	13	13	13
14	14	14	14	13	13	13	13
10	10	10	10	15	15	15	15
13	14	14	14	16	16	16	16
14	15	14	14	16	15	15	16
50	50	50	50	50	50	50	50
55	55	55	55	54	54	53	53
57	57	57	57	54	54	51	51
59	59	59	59	53	50	48	47
58	58	58	58	48	48	43	38
58	58	58	58	39	41	35	34
50	48	52	50	28	27	24	24
57	57	58	57	54	53	53	53
58	58	58	58	58	58	58	58
58	58	58	58	58	58	58	58

Figure 35: 2036 Build AM and PM I-4 WB Speed Contours



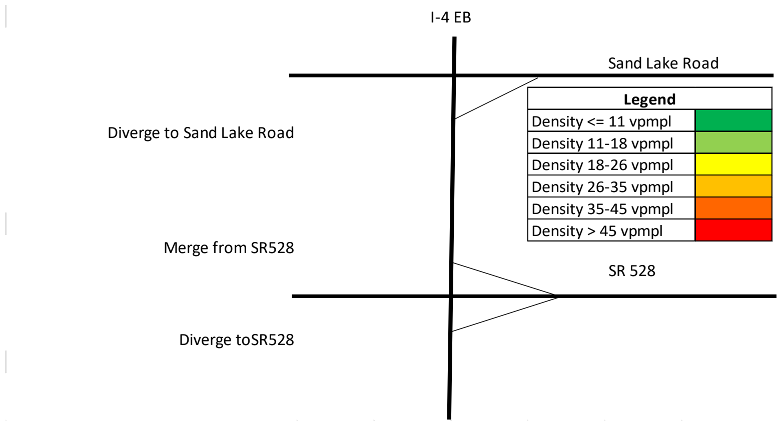
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
36	36	35	34	33	31	31	33
36	36	35	34	33	31	31	33
36	36	35	34	33	31	31	33
62	61	64	61	41	38	35	40
72	71	72	70	40	38	35	40
77	76	78	75	36	35	33	36
67	75	78	75	34	33	28	32
50	69	66	68	33	31	26	28
39	56	61	63	27	23	22	23
40	55	57	60	34	27	27	28
36	43	47	50	33	26	27	28
35	34	37	40	33	28	29	30
59	65	68	70	65	72	69	59
83	86	89	89	87	90	89	84
85	88	91	90	89	92	91	86
87	92	94	94	92	96	95	89

Figure 36: 2026 Build AM and PM I-4 EB Density Contours



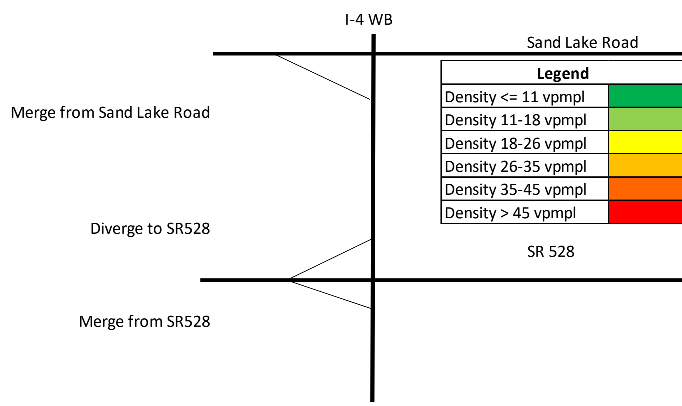
AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
97	98	96	98	101	103	105	102
97	98	96	98	101	103	105	102
83	83	82	83	68	69	72	69
102	102	102	103	90	93	97	92
97	98	97	98	97	100	105	100
35	35	35	35	58	65	71	64
32	32	32	31	65	71	70	70
25	25	25	25	48	49	50	48
30	31	30	30	76	79	79	78
30	31	31	30	79	80	81	79
31	37	38	36	81	81	81	80
42	55	60	61	90	91	90	91
35	36	35	35	35	35	35	35
34	34	32	32	32	32	32	32
34	33	32	32	32	32	32	32

Figure 37: 2026 Build AM and PM I-4 WB Density Contours



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
35	34	35	35	33	32	33	32
35	34	35	35	33	32	33	32
35	34	35	35	33	32	33	32
54	65	63	59	49	43	45	43
61	73	72	69	50	46	47	44
64	73	79	76	51	49	47	44
54	64	77	80	49	49	46	44
47	55	72	74	48	45	43	43
41	52	66	69	44	37	40	41
40	46	52	55	37	37	40	37
34	38	37	41	33	34	34	34
30	32	31	35	30	30	30	31
62	62	69	69	68	69	56	57
86	85	89	89	89	91	83	82
88	86	90	91	90	93	86	85
91	91	93	95	94	96	90	88

Figure 38: 2036 Build AM and PM I-4 EB Density Contours



AM Peak (7:30 – 8:30)				PM Peak (17:00 – 18:00)			
7:30	7:45	8:00	8:15	17:00	17:15	17:30	17:45
104	104	104	102	106	107	106	105
104	104	104	102	106	107	106	105
114	119	115	114	80	81	79	80
104	102	101	102	91	89	90	88
99	96	97	97	95	92	93	91
34	35	35	35	35	35	35	35
31	32	32	32	31	32	32	31
24	25	25	25	33	35	34	34
28	29	29	29	31	32	36	32
28	29	29	29	31	34	46	40
28	29	29	29	47	49	60	58
30	32	29	30	66	72	72	71
32	33	33	33	35	35	35	34
32	33	33	32	32	32	33	32
32	33	33	32	32	32	32	32

Figure 39: 2036 Build AM and PM I-4 WB Density Contours

The density and speed along the eastbound SR 528 segment between I-4 and International Drive are summarized in **Table 27** and **Table 28** for the 2026 and 2036 peak hours, respectively. Similar to the No-Build scenario, congestion was not observed along this segment. According to the segment density, this segment is operating at LOS B and the travel speed is nearly at free-flow speed (i.e., 65 mph), which suggests congestion is not expected to be present within this segment in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.

Table 27: Density and Speed of SR 528 Eastbound Segment – Build AM Peak Hours

Time Period	2026 Build AM		2036 Build AM	
	Density*	Speed	Density*	Speed
7:30	13.9	63	15.2	63
7:45	13.3	63	14.8	63
8:00	13.5	63	14.4	63
8:15	13.2	64	14.4	63

***Note:** LOS B = Density between 11-18 veh/mile/lane

Table 28: Density and Speed of SR 528 Eastbound Segment – Build PM Peak Hours

Time Period	2026 Build PM		2036 Build PM	
	Density*	Speed	Density*	Speed
17:00	12.6	64	14.0	63
17:15	12.1	64	13.7	63
17:30	12.4	64	14.2	63
17:45	12.7	64	14.2	63

***Note:** LOS B = Density between 11-18 veh/mile/lane

A detailed traffic demand and simulated volume comparison for each of the study roadway segments during the peak hours is summarized in **Appendix J**.

Build VISSIM Travel Time Results

Travel time markers were coded into the network to measure the trip travel time along the I-4 mainline and from I-4 to SR 528 (end to end routes within the microsimulation models). These travel time routes are consistent with those measured in the No-Build scenario to allow for a direct comparison between the scenarios (included in **Section 9.2**). The travel time results for the 2026 and 2036 Build peak hours are summarized in **Table 29** and **Table 30**, respectively. The start/end markers of each route are included in **Appendix J** for reference.

Table 29: VISSIM Corridor Travel Time Results – Opening Year (2026) Build Peak Hours

Travel Time Measurement	Build 2026 AM Peak Hour (min)	Build 2026 PM Peak Hour (min)
I-4 WB	4.3	6.3
I-4 EB	5.3	3.7
I-4 WB to SR 528	4.2	4.7
I-4 EB to SR 528	2.4	2.4

*Note: The average free-flow travel time along the I-4 (end-to-end within the study limits) is approximately 2.3 min, the average free-flow travel time from I-4 WB to SR 528 (end-to-end within the study limits) is approximately 2.5 min and the average free-flow travel time from I-4 EB to SR 528 (end-to-end within the study limits) is approximately 1.4 min based on HERE data.

Table 30: VISSIM Corridor Travel Time Results – Design Year (2036) Build Peak Hours

Travel Time Measurement	Build 2036 AM Peak Hour (min)	Build 2036 PM Peak Hour (min)
I-4 WB	4.5	4.6
I-4 EB	5.1	4.2
I-4 WB to SR 528	4.2	4.1
I-4 EB to SR 528	2.4	2.3

*Note: The average free-flow travel time along the I-4 (end-to-end within the study limits) is approximately 2.3 min, the average free-flow travel time from I-4 WB to SR 528 (end-to-end within the study limits) is approximately 2.5 min and the average free-flow travel time from I-4 EB to SR 528 (end-to-end within the study limits) is approximately 1.4 min based on HERE data.

As summarized in **Table 29** and **Table 30**, each of the specific O-D routes along I-4 westbound (end to end) are expected to see benefits ranging between 2 and 6 percent during the future year peak hours. The travel times along I-4 eastbound (end to end) are not expected to be impacted by the improvements proposed as part of this project.

It is important to note that there are instances where the travel time decreases in the Design Year (2036) versus the Opening Year (2026), and these are due to the upstream metering/capacity constraints as previously described.

8.3. Future Build Operational Summary

Based on the operational analyses conducted for the future year Build AM and PM peak hours, the VISSIM results show severe congestion along I-4 due to the capacity constraints on the mainline and the results are impacted by upstream metering impacts (same as the No-Build scenario). The following summarizes the key findings from the future year Build simulation analyses.

- Like the No-Build, the Build simulation analysis resulted in severe latent demand and capacity constraints on the I-4 mainline continuing to reinforce the need for capacity improvements along I-4, such as those identified in the I-4 BtU South Section SAMR and PD&E Study.
- Consistent with the No-Build scenario, the Build link evaluation results show several bottlenecks along I-4 westbound including the merge from Sand Lake Road during the future year AM peak hours and the SR 528 westbound during the future year AM and PM peak hours.
- The link evaluation results show a major bottleneck along I-4 eastbound at the diverge to Sand Lake Road during the future year peak hours.
- The speed and density results for eastbound SR 528 between I-4 and International Drive show that congestion is not expected to be present within this segment in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.
- The end-to-end travel times along I-4 westbound are expected to improve by approximately 3 to 6 percent during the future year peak hours with the Build improvements.
- The travel time along I-4 westbound to the end of the AOI along eastbound SR 528 is expected to improve by up to 9 percent with the proposed ramp widening at the I-4 westbound off-ramp to eastbound SR 528 during the future year peak hours.
- The travel times along I-4 eastbound are not impacted by improvements proposed as part of this project.

9. NO-BUILD AND BUILD MICROSIMULATION COMPARATIVE SUMMARY

The future year (2026 and 2036) VISSIM microsimulation results for the No-Build and Build scenarios are summarized and directly compared in this section. The comparisons include network-wide performance and travel time metrics.

9.1. Network Performance Comparison

As shown in **Table 31** and **Table 32**, the Build scenarios generally provide better network performance when compared to the No-Build scenario in each of the future year peak hours. Each of the performance metrics such as average delay, average speed, and total delay are better in the Build when compared to the No-Build (values bolded in green in the following tables) during each of the future year peak hours. The percent difference between the Build and No-Build results are also presented in the tables for reference.

It should be noted that the average delay in year 2026 is higher than that in year 2036 because more traffic demand was metered at vehicle entry points in year 2036, which then resulted in more latent delay in year 2036. The total of traveling delay and latent delay are increased from 2026 to 2036 as the traffic demand increased as expected. There are some instances during the future year peak hours where the latent demand and latent delay is slightly higher in the Build versus the No-Build; however, the differences are less than 2% and can be considered negligible and within the tolerance of the stochastic nature of simulation models.

Table 31: Network Performance Comparison (2026 No-Build and Build)

Time Period	Scenario	Average Delay (seconds)	Average Speed (mph)	Total Delay (hr)	Latent Demand (veh)	Latent Delay (hr)	Vehicles Arrived
AM	No-Build	192	27.7	1,084	10,193	6,523	18,181
	Build	**180**	**28.7**	**1,022**	**10,088**	**6,498**	**18,316**
	Difference	-6%	4%	-6%	-1%	0%	1%
PM	No-Build	236	24.5	1,299	15,136	11,005	17,602
	Build	**226**	**25.2**	**1,231**	15,408	11,170	17,584
	Difference	-4%	3%	-5%	2%	2%	0%

Table 32: Network Performance Comparison (2036 No-Build and Build)

Time Period	Scenario	Average Delay (seconds)	Average Speed (mph)	Total Delay (hr)	Latent Demand (veh)	Latent Delay (hr)	Vehicles Arrived
AM	No-Build	184	28.2	1,058	14,315	9,624	18,653
	Build	**177**	**28.8**	**1,018**	14,332	9,631	18,627
	Difference	-3%	2%	-4%	0%	0%	0%
PM	No-Build	188	28.0	1,067	19,333	14,400	18,433
	Build	**185**	**28.2**	**1,041**	19,647	14,590	18,252
	Difference	-1%	1%	-2%	1%	1%	-1%

9.2. Travel Time Comparison

As summarized in **Table 33** and **Table 34**, the travel times along I-4 westbound have improved in the Build scenario versus the No-Build scenario. The end-to-end travel time along I-4 westbound are expected to improve by approximately 3 to 6 percent during the future year peak hours. The travel time along I-4 westbound to the end of the AOI along eastbound SR 528 is expected to improve by up to 9 percent with the proposed ramp widening at the I-4 westbound off-ramp to eastbound SR 528 during the future year peak hours. As expected, the travel times along I-4 eastbound are not impacted by improvements proposed as part of this project.

Table 33: Travel Time Comparison (2026 No-Build and Build)

Time Period	Travel Time Measurement	Travel Time NB (min)	Travel Time Build (min)	Difference (Build vs. NB)
AM	I-4 WB	4.6	4.3	**-6%**
	I-4 EB	5.3	5.3	0%
	I-4 WB to SR 528	4.3	4.2	**-2%**
	I-4 EB to SR 528	2.4	2.4	0%
PM	I-4 WB	6.5	6.3	**-3%**
	I-4 EB	3.8	3.7	**-2%**
	I-4 WB to SR 528	5.0	4.7	**-7%**
	I-4 EB to SR 528	2.4	2.4	0%

Table 34: Travel Time Comparison (2036 No-Build and Build)

Time Period	Travel Time Measurement	Travel Time NB (min)	Travel Time Build (min)	Difference (Build vs. NB)
AM	I-4 WB	4.7	4.5	**-5%**
	I-4 EB	5.1	5.1	0%
	I-4 WB to SR 528	4.6	4.2	**-9%**
	I-4 EB to SR 528	2.4	2.4	0%
PM	I-4 WB	4.8	4.6	**-6%**
	I-4 EB	4.2	4.2	0%
	I-4 WB to SR 528	4.1	4.0	**-1%**
	I-4 EB to SR 528	2.4	2.3	**-1%**

10. COMPARATIVE SAFETY ANALYSIS

The purpose of the comparative safety analysis was to determine the safety impacts of reconfiguring the I-4 westbound to SR 528 eastbound interchange ramp from one lane (No-Build) to two lanes (Build). To determine these impacts, a predicted crash frequency analysis was performed utilizing the Enhanced Interchange Safety Analysis Tool (ISATe) Build 06.10 – Modified to Include Present Worth Analysis. A qualitative analysis was also performed for the proposed improvements.

10.1. Quantitative Ramp Analysis

Table 35 provides the results of the ISATe analysis for the I-4 westbound to SR 528 eastbound interchange ramp.

Table 35: No-Build vs Build ISATe Predicted Crash Frequency Results

Scenario/ Feature	Predicted Fatal Crashes	Predicted Injury Crashes	Predicted Property Damage Only Crashes	Total Predicted Crashes	Total Present Value
No-Build – Ramp	0.6	31.9	34.5	67.0	$7,790,000
Build – Ramp	0.8	42.0	56.9	99.7	$10,550,000
Difference – Build minus No-Build	***0.2***	***10.1***	***22.4***	***32.7***	***$2,760,000***

Note: Some values in **Table 35** will not sum due to rounding from the ISATe output spreadsheets.

The results of the analysis show the Build configuration is predicted to experience more injury and property damage only (PDO) crashes over the 10-year life cycle of the project. The Build configuration is showing a $2,760,000 increase in total present value over the No-Build, primarily due to the predicted increase in injury and PDO crashes. The total present value was calculated for each alternative by applying the KABCO comprehensive crash costs from FDM Table 122.6.2 to the predicted crash severity distributions. This calculation is performed in ISATe.

A contributing factor to the predicted crash increase for the Build condition is the overall ramp length increase. The Build condition 2-lane ramp is approximately 600' longer than the No-Build ramp, which directly contributes to approximately 11 more total predicted crashes over the 10-year life cycle (approximately 33% of the total predicted crash increase).

While the Build configuration is showing an increase in crashes, it is common to see 2-lane ramps with a higher crash frequency than a single lane ramp. A 2-lane ramp will introduce lane change crashes which are not present for single lane ramps. The Final Report for NCHRP 17-45 Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges found that on average, 2-lane ramps will experience a higher crash frequency than single lane ramps. From page 233 of the Final Report: "The trend lines…also indicate that crash frequency is lower on urban ramps and C-D roads with one lane, relative to those with two lanes…They also indicate that a single-lane urban C-D road segment has about 50 percent fewer crashes than a two-lane urban C-D road segment. …this trend is due to a significant increase in multiple-vehicle crashes on two-lane entrance ramps and C-D roads, relative to those on single-lane ramps and C-D roads."

Limitations exist with the current Highway Safety Manual (HSM) methodologies and tools when it comes to quantitatively analyzing the proposed improvements evaluated in this study. For example, the analysis does not quantify the negative safety impact and expected increase in crashes that occur due to spillback from the single lane ramp onto the mainline. It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. **Appendix K** provides the inputs and outputs of the qualitative safety analysis.

10.2. Qualitative Safety Analysis

Limitations exist with the current Highway Safety Manual (HSM) methodologies and Enhanced Interchange Safety Analysis Tool (ISATe) when it comes to quantitatively analyzing the proposed improvements evaluated in this study. The Crash Modification Factor (CMF) Clearinghouse was also reviewed but no potentially applicable CMFs were found for the specific improvements proposed. A qualitative safety analysis was conducted to highlight the safety benefits that can be expected with the proposed improvements and provide a full picture of safety impacts proposed as part of this project.

The projected traffic volume along the I-4 westbound off-ramp to eastbound SR 528 is expected to exceed the capacity of a single lane ramp. In an unconstrained network, it would be expected that there would be queue spillback onto the I-4 westbound mainline lanes due to this ramp capacity issue. It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent).

The widening of the I-4 westbound off-ramp to eastbound SR 528 will provide adequate capacity to accommodate the project traffic demand along the ramp which would mitigate the potential for queue spillback onto the I-4 mainlines and minimize the high-speed differential crash potential along I-4 westbound. The proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.

With the new two-lane off-ramp to SR 528, vehicles in the far left lane will have to weave across two lanes to access the International Drive exit ramp. The current HSM methodologies cannot analyze this type of weaving configuration, but the microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours. Therefore, safety is not anticipated to be negatively impacted along this segment of SR 528 due to the weaving maneuver.

10.3. Comparative Safety Analysis Summary

The following bullets summarize the comparative safety analysis of the Build improvements for the I-4 westbound to SR 528 eastbound ramp:

- Quantitative Safety Summary –
  - The Build configuration is predicted to experience more injury and property damage only (PDO) crashes over the 10-year life cycle of the project.
  - The Build condition 2-lane ramp is approximately 600’ longer than the No-Build ramp, which directly contributes to approximately 11 more total predicted crashes over the 10-year life cycle (approximately 33% of the total predicted crash increase).
  - It is also common to see 2-lane ramps with a higher crash frequency than a single lane ramp based on research presented in NCHRP 17-45 Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges. It is expected that the quantitative tools available for use would also show an increase in crashes for a two-lane ramp versus a single lane ramp based on the current safety methodologies.
- Qualitative Safety Summary – Limitations exist with the current HSM methodologies and ISATe in regard to the following issues:
  - It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent). The proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.
  - With the new two lane ramp to SR 528, vehicles in the far left lane will have to weave across two lanes to access the International Drive exit ramp. Current HSM methodologies cannot analyze this type of weaving configuration but the microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours. Therefore, safety is not anticipated to be negatively impacted along this segment of SR 528 due to the weaving maneuver.

11. OTHER CONSIDERATIONS

11.1. Conceptual Signing and Pavement Marking Plan

The conceptual signing and pavement marking plan for this project is included in **Appendix M**.

11.2. Access Management Coordination

The access management plan within the area of influence will not be changed by the proposed improvements to the interchange.

11.3. Environmental Considerations

The approved I-4 BtU PD&E Study covering the South Section that received approval on 8/24/17 will be re-evaluated to support the proposed alternative. It is expected that the proposed alternative will have the same or fewer environmental impacts as the 2017 Approved Build alternative due to the reduced project limits.

11.4. Design Variations and Exception

Three design variations and one design exception are anticipated for the proposed build condition. The design variations and exception have been submitted to FDOT for review and the provided comments are being addressed. Approval is expected on the variations and exception prior to letting of this project. The following describes the anticipated variations and exception:

- **Design Speed Design Variation**: The Florida Design Manual (FDM) requires a 50 mph design speed for the proposed system-to-system ramp, however the exiting horizontal curve requires a 45 mph design speed as documented by a safety study conducted by the FDOT State Materials Office. The American Association of State Highway Officials (AASHTO) Greenbook allows for a 45 mph design speed for the proposed horizontal curve. Approval of a design variation to use 45 mph as the design speed has been requested.
- **Horizontal Alignment/Curve Radius Design Variation**: The horizontal curve through the existing ramp bridge over I-4 has a curve radius below the FDM requirement needed for a 45 mph design speed. The proposed curve radius meets AASHTO and approval of a design variation to use the lower curve radius has been requested.
- **Shoulder Width and Shoulder Cross Slope Design Variation**: The proposed ramp has been designed to provide a wider left shoulder than right shoulder resulting in reversed shoulder widths. This design choice is proposed to improve horizontal stopping sight distance (SSD). The design proposes a segment where the right-hand shoulder is six-feet wide (with concrete barrier) which is less than the eight-foot width required in the FDM. The design also proposes a right shoulder slope matching the superelevated lane’s cross slope.

- **Horizontal SSD Design Exception**: The left-hand shoulder through the bridge is ten-feet wide and the left-hand side's traffic railing is a sight obstruction that provides less than the FDM/AASHTO required stopping sight distance (SSD), however, the proposed design would improve the existing horizontal SSD while meeting vertical SSD requirements. Since the existing bridge over I-4 is currently in good condition and the objective of this project is to keep and widen the existing bridge, the existing design speed and horizontal curve provided by the bridge control the proposed design and approval of a design exception has been requested.

12. FEDERAL HIGHWAY ADMINISTRATION (FHWA) POLICY POINTS

The Federal Highway Administration (FHWA) regulates the addition and modification of access points along the interstate system. On May 22, 2017, FHWA issued an updated Policy on Access to the Interstate, which now includes two policy points that must be addressed before a new interchange or modification of access points to the interstate is approved. The following summarizes how the I-4 at SR 528 interchange modification fulfills each requirement.

12.1. Policy Point 1

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The microsimulation (VISSIM) analysis of the Build scenario shows an improvement in networkwide performance metrics such as average delay, average speed, and total network delay. The microsimulation analysis also shows an improvement in travel time along I-4 westbound:

- The end-to-end travel time along I-4 westbound is expected to improve by approximately 3 to 6 percent during the future year peak hours.
- The travel time along I-4 westbound to the end of the AOI along eastbound SR 528 is expected to improve by up to 9 percent with the proposed ramp widening at the I-4 westbound off-ramp to eastbound SR 528 during the future year peak hours.

The microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.

Limitations exist with the current Highway Safety Manual (HSM) methodologies and Enhanced Interchange Safety Analysis Tool (ISATe) when it comes to quantitatively analyzing the proposed improvements evaluated in this study. The Crash Modification Factor (CMF) Clearinghouse was also reviewed but no potentially applicable CMFs were found for the specific improvements proposed. A qualitative safety analysis was conducted to highlight the safety benefits that can be expected with the proposed improvements and provide a full picture of safety impacts proposed as part of this project.

The projected traffic volume along the I-4 westbound off-ramp to eastbound SR 528 is expected to exceed the capacity of a single lane ramp. In an unconstrained network, it would be expected that there would be queue spillback onto the I-4 westbound mainline lanes due to this ramp capacity issue. It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent).

The widening of the I-4 westbound off-ramp to eastbound SR 528 will provide adequate capacity to accommodate the project traffic demand along the ramp which would mitigate the potential for queue spillback onto the I-4 mainlines and minimize the high-speed differential crash potential along I-4 westbound. The proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.

The safety and operational analyses conducted as part of this IOAR have concluded that the proposed interchange improvements improve traffic operations and mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes. As described in this IOAR, the proposed action of widening of the I-4 westbound off-ramp to eastbound SR 528 from a single lane ramp to a dual lane ramp safely and efficiently collects, distributes, and accommodates the traffic anticipated to use the improvements.

As noted in the Future Operational Analysis sections, the analyses confirmed that capacity improvements such as those identified in the I-4 BtU South Section SAMR and PD&E Study, are needed along I-4 to address mainline bottlenecks within the AOI and will be evaluated as funding becomes available. At this time, the FDOT is using a phased approach to implement improvement projects as construction funding is identified.

12.1. Policy Point 2

The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by

the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

The existing interchange is a system interchange and the western terminus of SR 528. The existing interchange provides full access to all traffic movements on the connecting limited access facility (SR 528) and the proposed improvement will maintain full access to all traffic movements.

13. CONCLUSIONS

The FDOT District Five has prepared an IOAR for the proposed interchange improvements at the I-4 and SR 528 interchange. The proposed improvement includes the widening of the existing single lane off-ramp from I-4 westbound to eastbound SR 528 to two-lanes. The interchange improvements are funded for construction in fiscal year 2023 (FM #448915-1).

The purpose of this IOAR is to document the potential safety and operational impacts of the proposed interchange modifications being proposed as part of the I-4 and SR 528 interchange improvements. The findings of the operational and safety analysis are summarized as follows:

Future Traffic Operations

- The microsimulation analysis shows an improvement in travel time along I-4 westbound:
    - The end-to-end travel time along I-4 westbound is expected to improve by approximately 3 to 6 percent during the future year peak hours.
    - The travel time along I-4 westbound to the end of the AOI along eastbound SR 528 is expected to improve by up to 9 percent with the proposed ramp widening at the I-4 westbound off-ramp to eastbound SR 528 during the future year peak hours.
- The microsimulation analysis of the Build scenario shows that the eastbound segment of SR 528 between I-4 and International Drive is not expected to be congested based on the speed and density results in the future year peak hours and therefore, will not negatively impact the I-4 eastbound or westbound mainline lanes.
- Network-wide performance metrics such as average delay, average speed, and total delay are better in the Build when compared to the No-Build for each analysis year analyzed.

Future Safety Performance

- The findings of the qualitative safety analysis are that the proposed ramp widening would mitigate the potential for high-speed differential rear end, sideswipe, and run off the road crashes due to the spillback onto the I-4 westbound mainline lanes that can reasonably be expected if the proposed improvements were not in place.
- The projected traffic volume along the I-4 westbound off-ramp to eastbound SR 528 is expected to exceed the capacity of a single lane ramp. In an unconstrained network, it would be expected that there would be queue spillback onto the I-4 westbound mainline lanes due to this ramp capacity issue. It is known through observation that having slow moving or stopped vehicles on the mainline creates significant speed differentials and increases the occurrence of crashes. This was found to be true in the I-4 westbound crash data east of the SR 528 off-ramp, where 375 of the 406 crashes were either rear-end, sideswipe, or run off the road related (92 percent).
- The widening of the I-4 westbound off-ramp to eastbound SR 528 will provide adequate capacity to accommodate the project traffic demand along the ramp which would mitigate the potential for queue spillback onto the I-4 mainlines and minimize the high-speed differential crash potential along I-4 westbound. The proposed ramp widening would mitigate the potential for high-speed

differential rear end, sideswipe, and run off the road crashes due to eliminated spillback onto the I-4 westbound mainline lanes.

The interchange improvements evaluated as part of the Build scenario fulfill the project's purpose and need and satisfy the FHWA Policy Points.

Appendix A – MLOU

Appendix B – Raw Count Data

Volume Counts

Classification Counts

Appendix C – Straight-Line Diagrams

Appendix D – Seasonal Factor and Axle Correction Factors

Appendix E – Summary of VISSIM Validation Results

Appendix F – Crash Data Tables and Graphs

Appendix G – Crash Rate Analysis

Appendix H – I-4 at Sand Lake Road IMR Future Volumes Excerpts

Appendix I – Traffic Projections from FTE

Appendix J – Future Year VISSIM Demand Profiles, Travel Time Measurements, and Demand/Simulated Volumes

Appendix K – Future Safety Results

Appendix L – I-4 at SR 528 Typical Section Package

Appendix M – I-4 at SR 528 Signing and Pavement Marking Plan