I-4 at CR 532 / SR 429
Systems Interchange Modification Report (SIMR)

Financial ID Numbers: 444187-1 & 444329-1

May, 2020

FDOT

Final
I-4/CR 532/SR 429 Systems Interchange Modification Report (SIMR)

Financial Project IDs: 444187-1 & 444329-1

Prepared for:

Florida Department of Transportation – District 5

5/8/2020

Systems Interchange Modification Report (SIMR)

I-4/CR 532/SR 429 SIMR

FPID #s: 444187-1 & 444329-1

Florida Department of Transportation

Determination of Engineering and Operational Acceptability

Acceptance of this document indicates successful completion of the review and determination of engineering and operational 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.

Requestor	DocuSigned by: Jason Learned CE87B8000017491... Jason Learned District Five Project Manager	5/11/2020 | 7:39 AM ED Date
Interchange Review Coordinator	DocuSigned by: Suraj Pamulapati FE89B6447E1043B... Suraj Pamulapati District Five	5/11/2020 | 8:46 AM ED Date
Interchange Review Coordinator	DocuSigned by: Carol Scott 3B837E2255B94F2... Carol Scott Turnpike	5/11/2020 | 9:38 AM ED Date
Interchange Review Coordinator	DocuSigned by: Christopher Simpson E637C3142BAD4D3... Christopher Simpson District One	5/11/2020 | 10:01 AM E Date
Systems Management Administrator	DocuSigned by: Jenna Bowman 9AD03E6A337F401... Jenna Bowman, PE Systems Implementation Office – Central Office	5/11/2020 | 10:44 AM E Date
Federal Highway Administration	DocuSigned by: Chad Thompson 4203ECE57D2A4A3... Chad Thompson Acting Associate Division Administrator	5/13/2020 | 7:56 AM ED Date

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: 5/8/2020

FM Number: 444187-1 & 444329-1

Project Title: I-4/CR 532/SR 429 Systems Interchange Modification Report (SIMR)

District: Five

Requestor: Jason Learned Phone: 386-943-5320

District IRC: Suraj Pamulapati Phone: 386-943-5378

Document Type: ☐ MLOU ☐ IJR ☐ IMR ☐ IOAR ☒ OTHER SIMR

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)

Final SIMR

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: Jason Learned CE87B8000017491... Date: 5/11/2020 | 7:39 AM EDT

Jason Learned

IRC DocuSigned by: Suraj Pamulapati FE89B6447E1043B... Date: 5/11/2020 | 8:46 AM EDT

Suraj Pamulapati

Quality Control Checklist and Review Log
Interchange Access Request Proposals

Project Name: I-4 /CR 532/SR 429 SIMR

FDOT Project Manager:
Jason Learned

FPID No. 444187-1 & 444329-1

IRC:
Suraj Pamulapati

No.	ITEM	READY FOR REVIEW	
		CHECKED BY	DATE
1	**Travel Demand Forecasting**		
	Has the latest version of approved model been used? Have all adjustments been made per FDOT guidelines and MLOU and reviewed?		
	Have the traffic factors been reviewed and checked to make sure K, D, and T factors are reasonable?		
	Did the project traffic development follow FDOT Traffic Forecasting Handbook and MLOU?		
	Have existing and future traffic volumes been checked for reasonableness?		
2	**Operational Analysis**		
	Are the inputs into traffic software correct?		
	Has the validation/calibration of microsimulation been properly documented?		
	Are operational analysis results reasonable?		
3	**Safety Analysis**		
	Has appropriate safety analysis been performed to quantify impacts of the recommended improvements?	P. Rajashekar	**5/8/2020**
4	**Concept Design**		
	Does the proposed design meet minimum design standards?		
	Have the exceptions and variations, if any, been justified?		
5	**Conceptual Signing Plan**		
	Has a conceptual signing plan been reviewed, checked to make sure it can be signed and meets MUTCD?		
6	**FHWA's Two Policy Points**		
	Does the proposal satisfy FHWA's policy points?	P. Rajashekar	**5/1/2020**
7	**Report Review**		
	Has the report been reviewed for grammatical and editorial errors?	Balaji Ambikapathy	**5/1/2020**

Quality Control Checklist and Review Log
Interchange Access Request Proposals

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FDOT Project Manager:
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FPID No. 444187-1 & 444329-1

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	Have the exceptions and variations, if any, been justified?		**2/20/20**
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	Has a conceptual signing plan been reviewed, checked to make sure it can be signed and meets MUTCD?		**4/30/20**
6	**FHWA's Two Policy Points**		
	Does the proposal satisfy FHWA's policy points?		
7	**Report Review**		
	Has the report been reviewed for grammatical and editorial errors?		

Quality Control Checklist and Review Log
Interchange Access Request Proposals

Project Name: **I-4 /CR 532/SR 429 SIMR**

FDOT Project Manager:
Jason Learned

FPID No. **444187-1 & 444329-1**

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Interchange Access Request Proposals

Project Name: I-4 /CR 532/SR 429 SIMR

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FPID No. 444187-1 & 444329-1

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	Have the traffic factors been reviewed and checked to make sure K, D, and T factors are reasonable?		11/26/19
	Did the project traffic development follow FDOT Traffic Forecasting Handbook and MLOU?		11/26/19
	Have existing and future traffic volumes been checked for reasonableness?		11/26/19
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	Has the report been reviewed for grammatical and editorial errors?		

PROFESSIONAL ENGINEER CERTIFICATE

Financial Project IDs: 444187-1 & 444329-1

Project: I-4/CR 532/SR 429 SIMR

County: Osceola

FDOT District: Five

I, Babuji Ambikapathy, Florida P.E. Number 50689, have prepared and reviewed the I-4/CR 532/SR 429 SIMR. I have specifically followed the guidelines as adopted by the Florida Department of Transportation, FDOT Policy No. 000-525-015-h, and FDOT Procedure No. 525-030-160-i. Based on traffic count information, general data sources, and other pertinent information, the SIMR has been prepared using current traffic engineering, transportation planning, and Florida Department of Transportation practices and procedures.

SIGNATURE: _____

Name: Babuji Ambikapathy, P.E., AICP

P.E. No.: 50689

Firm: Vanasse Hangen Brustlin, Inc.
225 East Robinson Street, Suite 300,
Orlando, FL 32801

Date: 05/08/2020

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Executive Summary

Introduction

This SIMR for the I-4 interchanges between County Road (CR) 532 and State Road (SR) 429 in Osceola County covers the documentation requirements agreed upon in the approved Methodology Letter of Understanding (MLOU). This report provides existing conditions data, future traffic forecasts, and the operational analysis for the existing (2018), opening year (2022), mid-design year (2032) and design year (2042) conditions.

The study segment was previously evaluated as part of the I-4 Beyond the Ultimate (BtU) South Section Systems Access Modification Report (SAMR) that received a determination of Safety, Operational and Engineering (SO&E) Acceptability on May 9, 2017 from the Federal Highway Administration (FHWA). The SAMR identified a series of improvement recommendations for the interchanges and I-4 mainline, however, these improvements are not scheduled until the mid-2040s and interim improvements identified as part of this SIMR are advanced by Florida Department of Transportation (FDOT) and Osceola County in response to concerns brought forth by area residents and businesses through local agencies. The project location map is shown in **Figure A**.

Purpose and Need

Rapid growth in residential, commercial/retail, and industrial development within ChampionsGate and Poinciana over the last several years has resulted in a significant increase in travel demand and traffic impacts (daily recurring congestion) on I-4 within the vicinity of the CR 532 and SR 429 interchanges. The existing congestion along I-4 that spans across multiple interchanges is tied to unique traffic patterns within the study area with overlapping traditional morning and evening work-based trips and tourist trips generated by the nearby Disney attractions and new development within the study area.

Under the existing conditions, traffic routinely backs up along eastbound I-4 from CR 532 eastbound on ramp merge to US 27 in the morning peak period and backs up along westbound I-4 from the CR 532 westbound off ramp diverge to US 192 in the afternoon peak period. The interchange at I-4 and SR 429 also regularly experiences backups on the ramps to and from I-4 (west of SR 429). Operational deficiencies that occur within the I-4 and CR 532 interchange area combined with a short weaving distance between the I-4 at CR 532 and I-4 at SR 429 interchanges create major bottlenecks near the study area that cause recurring daily congestion on the I-4 mainline. The lack of adequate capacity to accommodate the existing traffic demand is most prevalent with the westbound off ramp and the eastbound on ramp at the I-4 and CR 532 interchange.

\\vhb\gbl\proj\Orlando\62954.34 I4 SR429 IOAR\Graphics\FIGURES\AI

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Figure A

Project Location Map
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

The capacity-constrained conditions that currently exist create congested conditions and adverse impacts to the I-4 mainline, SR 429 mainline and ramps, and CR 532 cross-street operations. These conditions are anticipated to worsen in the future as more development occurs within the study area. Given the extent of congestion along I-4, major capacity improvements such as I-4 widening to 10 lanes (as proposed in the I-4 BtU project) and CR 532 widening to six lanes are needed to appropriately alleviate the severe existing and anticipated future congestion issues. However, there is an urgent need to alleviate the adverse traffic conditions that currently impact the operations as well as safety of all road users within the study area.

As such, the primary purpose of this SIMR is to identify interim solution to improve traffic operations, reduce congestion, and enhance safety at the study interchanges, until the approved concept for the I-4 BtU along with widening of CR 532 can be funded and implemented. Identified Interim Improvements

Figure B illustrates the proposed interim improvements (and the corresponding financial project numbers) based on information provided by FDOT. The DDI improvement at the I-4 and CR 532 interchange is being coordinated through a Joint Participation Agreement (JPA) with Osceola County and with local developers to facilitate congestion relief in the near term. Additionally, the Department is seeking to advance funding for the interchange improvements through the SIS Quick Fix program and work with MetroPlan Orlando to leverage Surface Transportation Program (SU) funds for urban areas of population over 200,000. The auxiliary lanes project along I-4 between CR 532 and SR 429, and SR 429 improvements will be completed jointly by Florida's Turnpike Enterprise (FTE) and FDOT.

Per the approved MLOU, this SIMR evaluated a No Build alternative and a Build alternative as noted below:

- **No Build Alternative**: This alternative maintains the existing configuration along I-4 and CR 532 and SR 429.
- **Build Alternative:** The build condition includes the following interim improvements:
    - Diverging Diamond Interchange (DDI) at the I-4 and CR 532 interchange (FPID #444187-1).
    - Widening the existing westbound off ramp and eastbound on ramp at I-4 and CR 532 to two lanes (FPID #444329-1). Please note that widening the existing eastbound on ramp from CR 532 to I-4 to two lanes was not identified in the MLOU, as amended in September 2019. The decision to widen the I-4 eastbound on-ramp from CR 532 was made during the operational analysis effort, and additional information in this regard is provided in Section 4.1.1 of this SIMR.
    - Adding an auxiliary lane in each direction along I-4 between the CR 532 and SR 429 ramps (FPID #444329-1).
    - Widening the existing ramps to two lanes, from eastbound I-4 to northbound SR 429 and southbound SR 429 to westbound I-4 (FPID #444329-1).

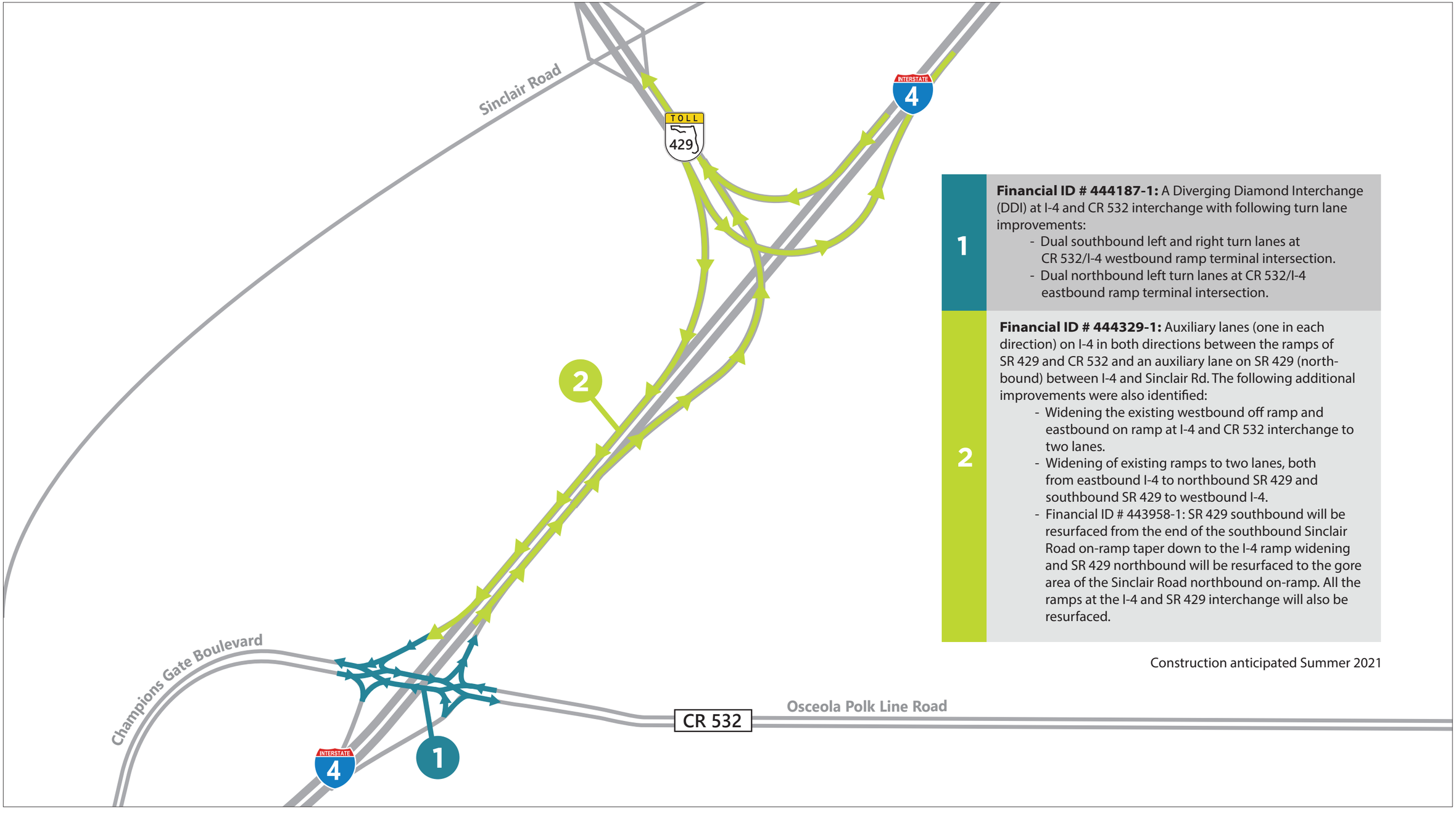
- Widening SR 429 in the northbound direction to add an auxiliary lane to the outside, to the Sinclair Road interchange (FPID #444329-1).

A signal at CR 532 and Kemp Road intersection is considered in both the No Build and Build alternatives, which will be in place by opening year 2022 based on discussion with Osceola County. In addition, based on coordination between FDOT and Osceola County, the northbound left turn and through movements at the intersection of CR 532 and S Goodman Road are restricted to improve safety and operations under the Build alternative.

The proposed interim improvements will achieve this study objective as illustrated below:

- Improve operational and safety deficiencies with innovative interim improvements and without the need to widen CR 532, SR 429 and I-4
- Mitigate traffic bottleneck at the interchange of I-4 and CR 532
- Extend operational life of the study area "with limited Strategic Intermodal System (SIS) Quick Fix Funds"
- The auxiliary lanes along I-4 between CR 532 and SR 429 ramps will provide added capacity between the interchanges and increase the available distance for entering traffic (from the proposed two-lane ramps – eastbound on ramp from CR 532 to I-4 eastbound and southbound SR 429 on ramp to I-4 westbound) to merge with the I-4 mainline,
- The interchange at I-4 and CR 532 modification will alleviate the existing recurring traffic congestion along CR 532 and queueing on the westbound off ramp, and improve the safety characteristics for all road users, and
- The widening of existing ramps from I-4 eastbound to northbound SR 429 and widening of SR 429 northbound to add an auxiliary lane up to the Sinclair Road interchange will help flush traffic away from the I-4 mainline at a faster rate.

In conclusion, short term improvements that can be constructed quickly without significant project costs and without need for acquiring right-of-way are identified as part of this SIMR. There are no funds available to build other improvements currently.



1

Financial ID # 444187-1: A Diverging Diamond Interchange (DDI) at I-4 and CR 532 interchange with following turn lane improvements:

- Dual southbound left and right turn lanes at CR 532/I-4 westbound ramp terminal intersection.
- Dual northbound left turn lanes at CR 532/I-4 eastbound ramp terminal intersection.

2

Financial ID # 444329-1: Auxiliary lanes (one in each direction) on I-4 in both directions between the ramps of SR 429 and CR 532 and an auxiliary lane on SR 429 (northbound) between I-4 and Sinclair Rd. The following additional improvements were also identified:

- Widening the existing westbound off ramp and eastbound on ramp at I-4 and CR 532 interchange to two lanes.
- Widening of existing ramps to two lanes, both from eastbound I-4 to northbound SR 429 and southbound SR 429 to westbound I-4.
- Financial ID # 443958-1: SR 429 southbound will be resurfaced from the end of the southbound Sinclair Road on-ramp taper down to the I-4 ramp widening and SR 429 northbound will be resurfaced to the gore area of the Sinclair Road northbound on-ramp. All the ramps at the I-4 and SR 429 interchange will also be resurfaced.

Construction anticipated Summer 2021

N

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FDOT

Figure B

Proposed Interim Improvements &
Financial Project IDs
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

FDOT's Commitment to Improving I-4 Operations

This SIMR established that beyond year 2032, additional major capacity improvements including those shown in the I-4 BtU and CR 532 widening are needed to provide improved levels of service within the study area. As such, FDOT realizes the need for further improvements along I-4 as well as the interchanges in the vicinity of the study area and will be ready in case funding becomes available for advancement of the proposed I-4 BtU improvements. Below is the list of activities programmed and planned for I-4 in the study area:

- Interim improvements for this area are programmed in collaboration with the local agencies.
- I-4 BtU is included as a planned improvement in the latest SIS Long Range Cost Feasible FY 2029-2045 (FY 2036-2040)
- I-4 Florida's Regional Advanced Mobility Elements (FRAME) study
    - This study, currently underway, is a regional, intercity integrated corridor management (ICM) project running from the Central Business District in Tampa to the southwest side of Orlando at the Florida Turnpike.
    - It will add Connected Vehicle (CV) devices to inform the public on congestion along I-4 and provide alternatives.
- Furthermore, in support of the continued commitment to long term I-4 BtU improvements in this area, FDOT has completed the following:
    - Completed the concept design plans and right-of-way maps
    - Began acquisition of parcels in this segment
    - Is in the process of obtaining environmental permits

Compliance with FHWA Policy Points

As demonstrated in the study analysis results, the proposed interim improvements including the I-4 at CR 532 interchange modification, addition of auxiliary lanes along I-4 between CR 532 and SR 429, and widening of existing critical ramps at the study interchanges (I-4 at CR 532 and I-4 at SR 429 interchanges) will provide immediate and near-term relief from the recurring traffic congestion within the study area, and will improve safety for all road users. The two policy points per the FHWA Requirements and Guidelines were examined and addressed in this SIMR as stated below:

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.*

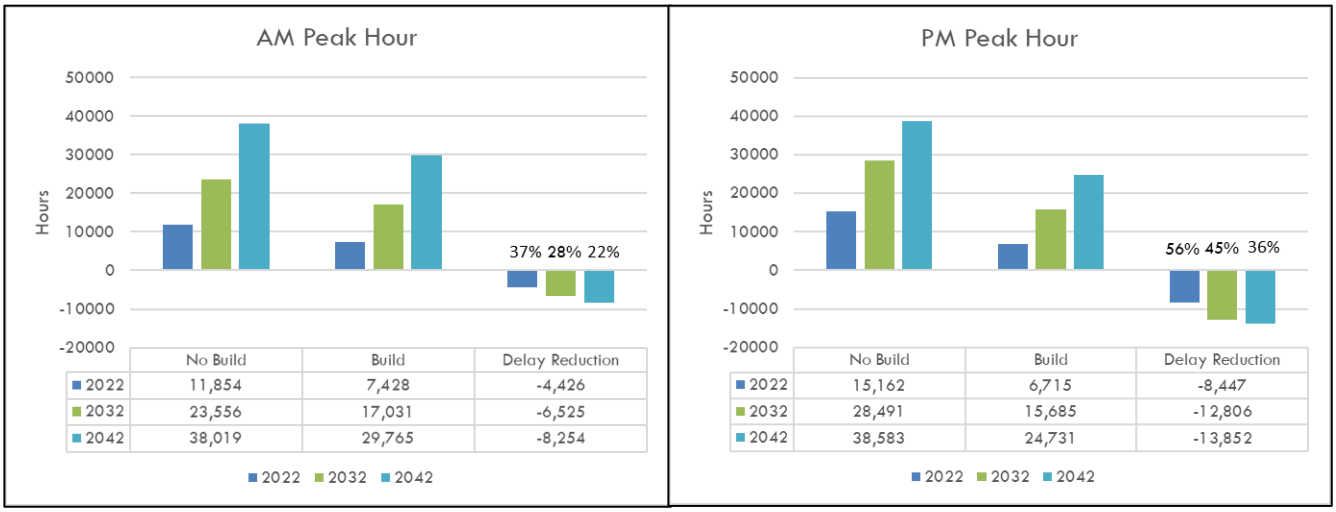
Response:

Operational Analysis

A detailed traffic operational analysis for the existing year (2018), opening year (2022), mid-design year (2032) and design year (2042) conditions was conducted for this SIMR within the area of influence. Key performance measures from microsimulation (VISSIM) analysis including networkwide metrics, freeway travel times, speeds, densities and LOS, arterial travel times, intersection LOS and delays, and off ramp queues are used in this SIMR. Since existing congestion spans across multiple interchanges and time periods, non-traditional Measures of Effectiveness (MOEs) including unmet demand (termed as blocked vehicles in this report), processed vehicles (network-wide and segment-based) and blocked vehicle queues (upstream of the network entry points) were also used in this SIMR to identify the true benefits of the Build alternative, instead of individual segment MOEs for I-4. Based on the operational analysis conducted for this SIMR, the following high-level operational analysis observations are made, and detailed results are provided in the Future Operational Analysis section (Section 4.2) of this report:

- **General Observations**
  - The Build alternative provides benefits (compared to the No Build alternative) within the study area through 2042 as evidenced from the MOEs including overall network performance, average speeds and number of vehicles processed along I-4 and CR 532.
  - Given the extent of congestion and interim nature of the Build alternative, it is not anticipated that the proposed improvement along I-4 (auxiliary lanes on both sides of I-4 between CR 532 and SR 429) will provide capacity comparable to a full through lane. Therefore, I-4 will continue to have oversaturated conditions through the design year 2042 conditions. However, as described below, substantial benefits in several performance metrics are observed, especially for 2022 and 2032 traffic conditions.
- **VISSIM Networkwide Performance Results**
  - The Build alternative provides better operational efficiency with reduced networkwide travel time, delay time and latent delay time compared to the No Build alternative, especially for 2022 and 2032 traffic conditions. The AM peak hour delay reduction ranges between 22% and 37%, while the PM peak hour delay reduction ranges between 36% and 56%. The Build alternative provides more benefits in the PM peak hour compared to the AM peak hour (see **Figure C**).
  - The Build alternative provides higher speeds and lower average delays for vehicles within the study area compared to the No Build alternative.
  - The Build alternative processes a greater number of vehicles and has lower latent demand compared to the No Build alternative.

Figure C: Total Delay Plus Latent Delay (hours) Summary



- **Freeway Operational Results**

Under the Build alternative, average speed, simulated volume and density improved in the westbound direction for both the AM and PM peak hours and eastbound direction for the PM peak hour.

It should be noted that due to the unique nature of the study area and interim nature of the Build improvements, worse LOS conditions are observed for certain I-4 segments under the Build alternative compared to the No Build alternative. The following list provides the reasons for these conditions and justification that shows the true benefits of the Build alternative:

- Because of the proposed improvements under the Build alternative, a higher number of vehicles are processed on I-4 between CR 532 and SR 429, and therefore this segment shows more congestion (or worse LOS) compared to the No Build alternative. Based on a supplemental 2032 AM peak hour HCS freeway analysis using the same projected demand for the two study alternatives, this segment is shown to operate at LOS E under the Build alternative and at LOS F under the No Build alternative.
- Under the Build alternative, I-4 westbound between CR 532 and US 27 during the PM peak hour for 2022 and 2032 shows more congestion (or worse LOS) compared to the No Build alternative, because the Improvements upstream of this segment resulted in a higher throughput and consequently a higher density along I-4 westbound in this segment. For instance, a throughput improvement of approximately 36% on I-4 westbound between CR 532 and US 27 in 2032 PM peak hour is noted under the Build alternative.

- Blocked vehicle queues on I-4 is another non-traditional MOE to gauge the benefit of the Build alternative. For example, when compared to the Build alternative, the No Build alternative will have an approximately three-mile longer queue in the AM peak hour, and an approximately six-mile longer queue in the PM peak hour on I-4 eastbound west of US 27 and on I-4 westbound east of SR 417/World Drive, respectively.

- **Travel Time Results**
  - Based on input from FDOT, travel times in vehicle-hours are calculated for vehicles inside and outside (blocked vehicles) the network for I-4 and CR 532.
  - **I-4:** Build alternative travel time results along I-4, in general, show improvements in both directions when compared to the No Build alternative with the inclusion of blocked vehicles. The travel time savings are more significant in the PM peak hour compared to the AM peak hour (see **Figure D**).
  - **CR 532:** The total travel time (vehicle-hours) saving along CR 532 in the Build alternative is significantly more when compared to the No Build Alternative in all analysis years (See **Figure E**).
- **CR 532 Intersection Performance Results**
  - The ramp terminal intersections are estimated to operate at a significantly improved LOS D or better through 2032 under the Build alternative compared to the No Build alternative. Under the Build alternative, there is a significant improvement with all intersections operating at LOS E or better in 2022 AM and PM peak hours.
  - Cumulative intersection delays (sum of overall study intersection delays) under the Build alternative show more than 60% improvement in 2022 (AM and PM peak hours) and more than 45% (PM peak hour) improvement in 2032 versus the No Build alternative, which indicates noticeably improved traffic conditions in the Build alternative (see **Figure F**).

Figure D: I-4 Total Travel Time (veh-hours) Summary

Figure E: CR 532 Total Travel Time (veh-hours) Summary

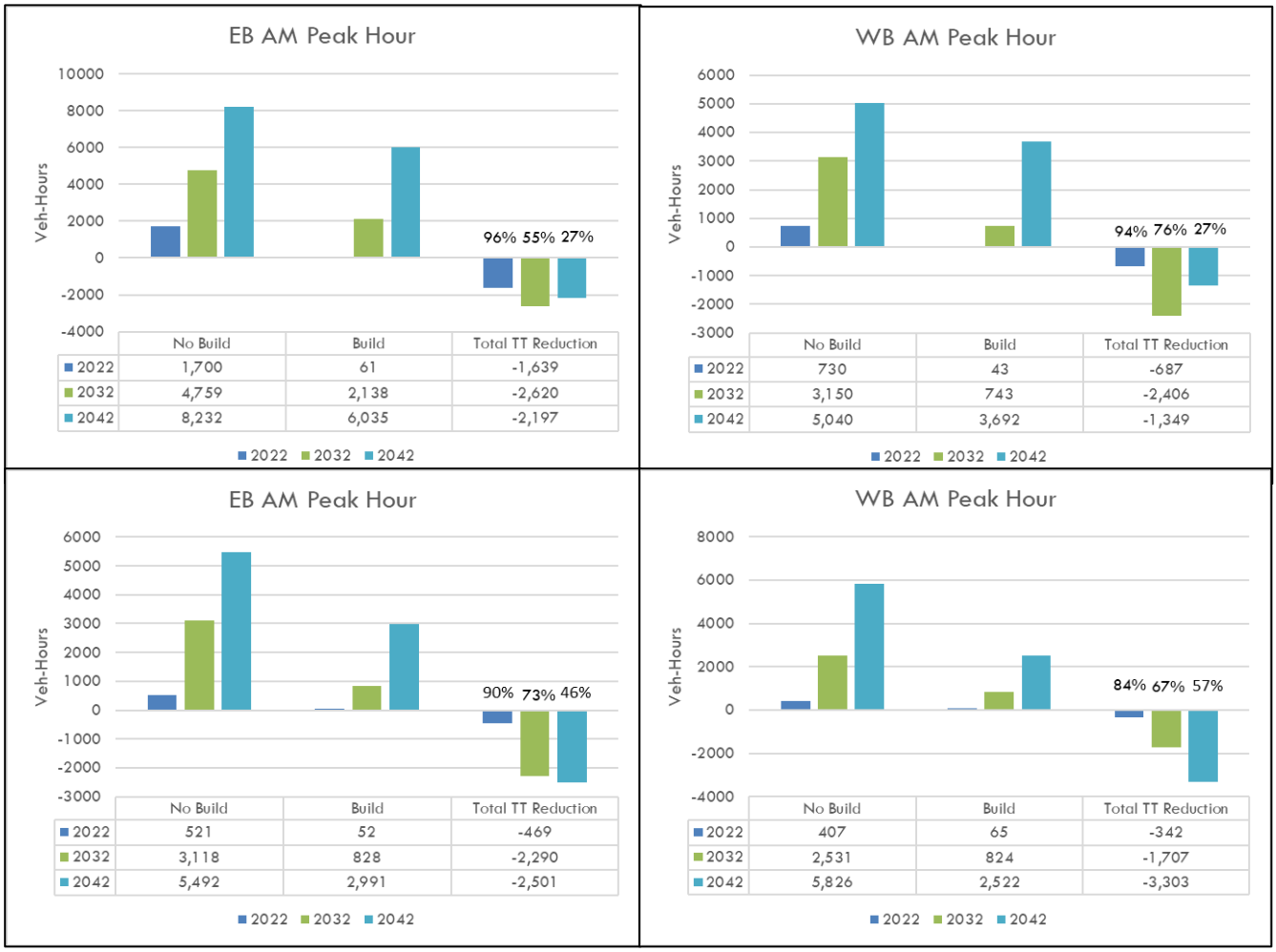
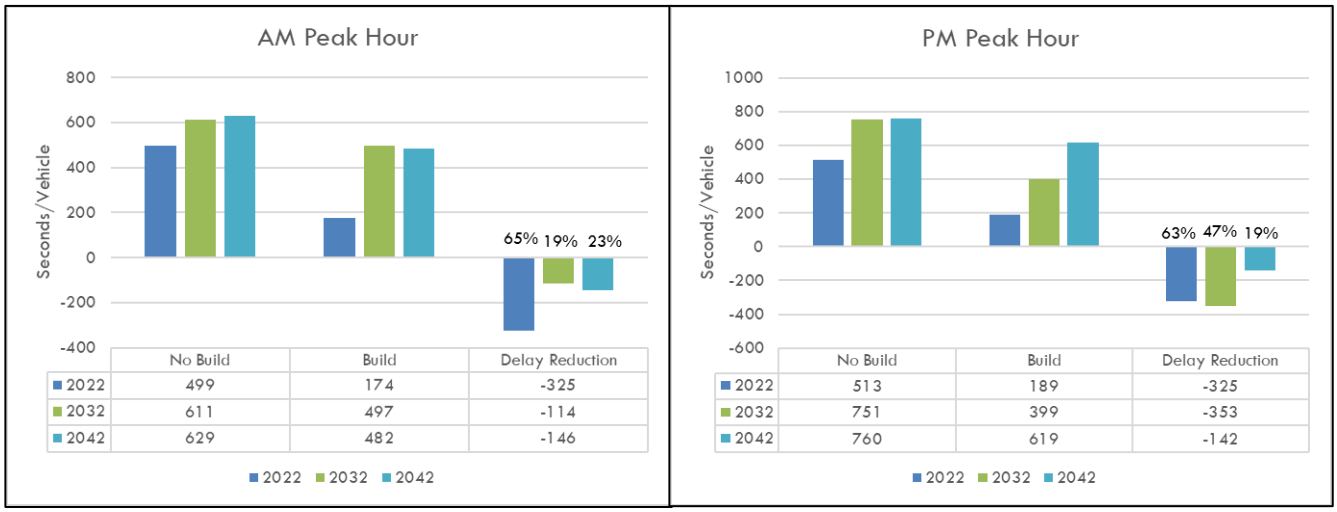


Figure F: Cumulative Intersection Delay (seconds/vehicle) Summary for CR 532



- **CR 532 Off Ramp Queue Results**
    - As part of the Build alternative, the proposed off ramp improvements at both I-4 eastbound and westbound ramp terminals will help avoid queue backups from the ramp terminals to the freeway mainline during the peak hours through design year 2042. Similarly, capacity improvements for the westbound off ramp from I-4 at the CR 532 interchange, the off ramp from eastbound I-4 to northbound SR 429 in combination with an auxiliary lane along northbound SR 429 from I-4 to Sinclair Road will help divert traffic away from I-4 mainline at a faster rate during the peak hours. **The operational analysis for the Build alternative shows that the ramp queues will not backup onto I-4 mainline through the design year 2042.**

Based on the above mentioned key performance results, benefits are seen in the Build alternative in the AM and PM peak hours for 2022 and 2032. However, based on networkwide metrics and cumulative intersection delays, the Build alternative will begin to fail after 2032 indicating additional improvements are warranted in the study area beyond 2032.

Safety Analysis

The Build option provides improved safety benefits over the No Build alternative. Based on safety analysis and information contained in the Crash Modification Factor (CMF) Clearinghouse, the Build alternative is anticipated to:

- **Reduce the number of crashes by approximately 23 crashes per year,** and therefore **save $4,164,900 in total crash costs (fatal, injuries and property damage only) per year** compared to the No Build alternative.
- Reduce freeway crashes by 20% because of the proposed addition of auxiliary lanes (one in each direction) on I-4 between CR 532 and SR 429
- Reduce interchange related crashes by approximately 40% because of the proposed conversion of the existing diamond configuration to a DDI at the interchange of I-4 and CR 532.

Conceptual Signing Plan

A conceptual signing plan is developed (**Figure 29**) for the proposed interchange modification alternative. Modifications to the existing roadway signs were evaluated in conjunction with the proposed modifications to ensure that a proper signing plan is implemented within the study area.

Policy Point 2: *The proposed access connects to a public road only and will provide for all traffic movements.*

Response:

Full access interchange conditions, as offered by the existing interchanges at I-4 and CR 532 as well as at I-4 and SR 429, will remain with the proposed modification improvements. In addition, this project will achieve benefits to the transportation system with no adverse impact to the public. The proposed improvements have been, and will continue to be, coordinated with the public and local government agencies. The design of the proposed improvements will follow the applicable FHWA and FDOT design standards.

1 Introduction

In support of FPID's 444187-1 and 444329-1, FDOT District Five (applicant) is conducting a SIMR to evaluate interim improvements at the interchanges of I-4 at CR 532 and I-4 at SR 429 and I-4 mainline between these two interchanges.

This SIMR documents the requirements and summarizes the results of the operational evaluations for the study interchanges in Osceola County, and was developed in accordance with FDOT Policy No. 000-525-015-h: Approval of New or Modified Access to Limited Access Highways on the State Highway System (SHS) and FDOT Procedure No. 525-030-160-i: New or Modified Interchanges. It should be noted that FDOT Procedure No. 525-030-160-i was recently updated by the FDOT Systems Implementation Office, as of January 2018, to incorporate the recent change in policy by FHWA on access to the Interstate System.

The portion of the I-4 mainline included in the project is in Osceola County Roadway ID #92130000, which begins south of the CR 532 interchange at Milepost 0.000 and ends at the Orange County Line at Milepost 7.885. The I-4 at CR 532 interchange, Milepost 0.2, and I-4 at SR 429 interchange, Milepost 2.0 of the project are in Section #92130000 in Osceola County. CR 532 is a four-lane, divided arterial, from Ronald Reagan Parkway (west of I-4) to Lake Wilson Road (east of I-4). CR 532 is the primary connecting roadway within the interchange area of influence for I-4 traffic to and from the Four Corners region, and for local traffic between Polk, Osceola and Orange Counties. SR 429 is a four-lane tolled expressway that provides connectivity to I-4 in the south and SR 46 at Sorrento in Lake County to the north. I-4, a six-lane divided freeway, is part of the Strategic Intermodal System (SIS) and classified as an urban principal arterial within the study area. **Figure 1** depicts the project location of the subject interchanges.

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Figure 1

Project Location Map
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

1.1 Description of Project

I-4 is an east-west interstate highway spanning approximately 133-miles, from I-275 in Tampa to I-95 in Daytona Beach. I-4 has three 12-foot lanes in each direction in the vicinity of the study area (between CR 532 interchange and SR 429 interchange). The posted speed is 65 mph within the study limits. CR 532 is a four-lane, divided arterial, from Ronald Reagan Parkway (west of I-4) to Lake Wilson Road (east of I-4) with speed limit of 35 mph. CR 532 is the primary connecting roadway within the interchange area of influence for I-4 traffic to and from the Four Corners region, and for local traffic between Polk, Osceola and Orange Counties. SR 429 is an urban principal arterial expressway that provides connectivity to I-4 in the south and SR 46 at Sorrento in Lake County to the north. SR 429 is a tolled, high-speed (posted speed is 70 mph), limited access facility. Robust development growth in residential, commercial/retail, and industrial development within ChampionsGate and Poinciana over the last several years has resulted in a significant increase in travel demand and traffic impacts (daily recurring congestion) on I-4 within the vicinity of the CR 532 interchange and the SR 429 interchange.

The study interchanges have been evaluated as part of the Interstate 4 (I-4) Beyond the Ultimate (BtU) South Section Systems Access Modification Report (SAMR) that received a determination of Safety, Operational and Engineering (SO&E) Acceptability on May 9, 2017 from FHWA. A series of improvement recommendations were identified for the interchange and I-4 mainline, however, the timeline for advancing the BtU improvements is still uncertain.

The goal of the subject Interchange Access Request (IAR) is to identify a solution to address the immediate capacity needs to provide near and immediate-term relief within the study area. This report also includes a conceptual signing plan for the proposed Build alternative based on modifications that are required for the existing roadway signs to ensure that a proper signing plan is implemented within the study area.

1.2 Purpose and Need

Under the existing conditions, the interchange at I-4 and SR 429 routinely experiences backups on the ramps to and from I-4 (west of SR 429). This is due to bottlenecks and congestion along I-4 and at I-4 and the CR 532 interchange just over one mile further to the west. Operational deficiencies that occur within the I-4 and CR 532 interchange area and the short weaving distance between I-4 at CR 532 and I-4 at SR 429 interchanges are the major bottlenecks near the study area that cause recurring daily congestion on the I-4 mainline. In the morning peak period, traffic backs up along eastbound I-4 from CR 532 eastbound on ramp merge to US 27. In the afternoon peak period, traffic backs up along westbound I-4 from the CR 532 westbound off ramp diverge to US 192.

The lack of adequate capacity to accommodate the existing traffic demand is most prevalent with the westbound off ramp and the eastbound on ramp at the I-4 and CR 532 interchange. The capacity-constrained conditions that currently exist create congested conditions and adverse impacts to the I-4 mainline, SR 429 mainline and ramps and CR 532 cross-street operations and are anticipated to worsen in the future as more development occurs within the study area. The primary purpose of the SIMR is to identify an interim solution to improve traffic operations, reduce congestion, and enhance safety within the study area until the approved concept for the I-4 BtU along with the widening of CR 532 can be funded and implemented in the future. The proposed interim improvements include:

- DDI at the I-4 and CR 532 interchange
- Widening the existing westbound off ramp and eastbound on ramp at I-4 and CR 532 to two lanes.
- Adding an auxiliary lane in each direction along I-4 between the CR 532 and SR 429 ramps.
- Widening the existing ramps to two lanes, from eastbound I-4 to northbound SR 429 and southbound SR 429 to westbound I-4.
- Widening SR 429 in the northbound direction to add an auxiliary lane to the outside up to the Sinclair Road interchange.

Please note that widening the existing eastbound on ramp from CR 532 to I-4 to two lanes was not identified in the MLOU, as amended in September 2019. The decision to widen this ramp was made during the operational analysis effort, and additional information in this regard is provided in Section 4 of this SIMR. The proposed improvements will support the study purpose as illustrated below:

- The auxiliary lanes along I-4 between the CR 532 and SR 429 ramps will provide added capacity between the interchanges and increase the available distance for entering traffic (from the proposed two-lane ramps – eastbound on ramp from CR 532 to I-4 eastbound and southbound SR 429 on ramp to I-4 westbound) to merge with the I-4 mainline,
- The interchange at I-4 and CR 532 modification will alleviate the existing recurring traffic congestion along CR 532 and will eliminate the westbound off ramp queue back-up onto the I-4 mainline and improve the safety characteristics for all road users, and
- The widening of existing ramps from I-4 eastbound to northbound SR 429 and widening of SR 429 northbound to add an auxiliary lane to the Sinclair Road interchange will help flush traffic away from the I-4 mainline at a faster rate.

The preparation of the subject SIMR to improve operations and safety within the study area is an integral part of the continuing effort to advance the SIS development process with scheduling of future phases as necessary.

The recommended alternative, supported by the SIMR, is consistent with the goals of providing safe and efficient travel, facilitating interstate and regional commerce, and the movement of people, freight and goods.

1.3 Methodology

The methodology used for the development of this SIMR is based on the MLOU submitted by FDOT District Five to the FDOT SIO and FHWA. The MLOU (dated September 2019) describes the preparation of the SIMR for the I-4 at CR 532 and I-4 at SR 429 interchanges in Osceola County, and was developed in accordance with the FDOT Policy No 000-525-015-h and FDOT Procedure 525-030-160-i. A copy of the signed MLOU document is included as **Appendix A.**

1.4 Area of Influence

The area of influence as shown in **Figure 2,** includes the following:

Mainline Freeway/Expressway:

- I-4 between SR 429 and World Drive
- I-4 between CR 532 and SR 429
- I-4 between US 27 and CR 532
- SR 429 between Sinclair Road and I-4

Ramps:

- I-4 WB on ramp from World Drive/SR 417
- I-4 EB off ramp to World Drive/SR 417
- Ramps at I-4 and SR 429
- Ramps at I-4 and CR 532
- I-4 EB on ramp from US 27
- I-4 WB off ramp to US 27
- SR 429 NB off ramp to Sinclair Road
- SR 429 SB on ramp from Sinclair Road

Intersections along CR 532:

- Kemp Road
- I-4 EB Ramps
- I-4 WB Ramps
- South Goodman Road (S Goodman Road)
- Legends Boulevard
- Masters Boulevard

1.5 Analysis Years

Future traffic forecasts were developed using the Central Florida Regional Planning Model (CFRPM) version 6.2 for the following years.

Traffic Forecasting

- Base year 2015
- Horizon year 2045

The following analysis years are used in this study.

Traffic Operational Analysis

- Existing year 2018
- Opening year 2022
- Interim year(s) 2032
- Design year 2042

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Area of Influence

Study Intersections

FDOT

Figure 2

Area of Influence Map
I-4/CR 532/SR 429 Systems Interchange Modification Report (SIMR)

2 Existing Conditions

This section documents the existing (2018) conditions within the study area, including existing traffic volumes, transportation network, and traffic operations for the I-4 and SR 429 mainlines, ramps and CR 532.

2.1 Traffic Count Information

The following traffic count program summarizes the location and type of counts collected in support of this SIMR:

- A forty-eight (48) hour vehicle classification count was conducted during August 21-23, 2018 at the following location:
  - CR 532 between Masters Boulevard and Legends Boulevard
- Forty-eight (48) hour volume counts were conducted during August 21-23, 2018 at the following locations:
  - CR 532, west of Masters Boulevard
  - Masters Boulevard, north of CR 532
  - Legends Boulevard, north of CR 532
  - Legends Boulevard, south of CR 532
  - CR 532, between Legends Boulevard and S Goodman Road
  - S Goodman Road, south of CR 532
  - S Goodman Road, north of CR 532
  - I-4 WB off ramp to CR 532
  - I-4 WB on ramp from CR 532
  - I-4 EB off ramp to CR 532
  - I-4 EB on ramp from CR 532
  - CR 532, east of I-4 EB Ramps
  - I-4 WB off ramp to US 27
  - I-4 EB on ramp from US 27
  - I-4 EB off ramp to SR 429
  - I-4 WB on ramp from SR 429

- Forty-eight (48) hour volume counts were conducted during July 9-11, 2019 at the following locations:
  - I-4 EB off ramp to World Drive/SR 417
  - I-4 WB on ramp from World Drive
  - I-4 WB on ramp from SR 417
- Six hour turning movement counts were conducted between 7-10 AM and 3-6 PM on July 11, 2018 at the following locations:
  - CR 532 at Kemp Road
  - CR 532 at I-4 EB Ramps
  - CR 532 at I-4 WB Ramps
  - CR 532 at S Goodman Road
  - CR 532 at Legends Boulevard
  - CR 532 at Masters Boulevard
- The travel time data and average speed data was collected for the following segments:
  - I-4 Mainline between US 27 and CR 532
  - I-4 Mainline between SR 429 and CR 532
  - SR 429 Mainline between I-4 and Sinclair Road
  - CR 532 between Ronald Reagan Parkway and Lake Wilson Road
- Field visits were conducted to collect information on existing geometry, storage lengths, traffic signal heads, and to determine/verify signal phasing information, such as protected/permitted left-turn operation, Right-Turn-On-Red (RTOR) restrictions, and phase overlaps, etc.
- Existing traffic counts at all I-4 and SR 429 ramps, and southbound off ramp and northbound on ramp at SR 429 and Sinclair Road interchange were provided by FTE.

Copies of all traffic count data are provided in **Appendix B**. Year 2017 FDOT axle and seasonal adjustment factors for Osceola County are provided in **Appendix C**.

2.2 Existing Geometry

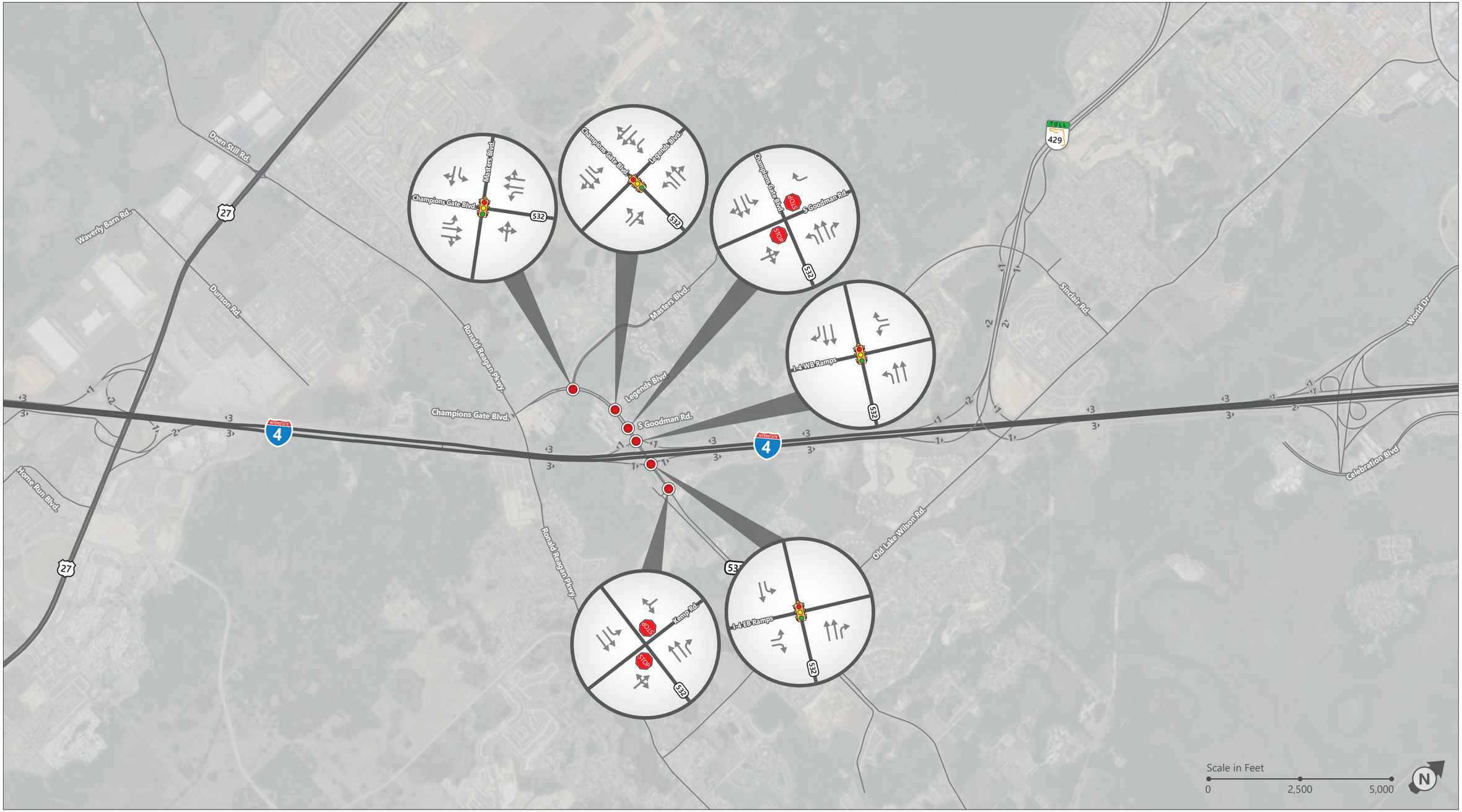
Figure 3 provides the existing intersection geometry for all the intersections evaluated in this study. The year 2018 intersection geometry information was obtained and verified based on field visits and aerial photographs. The existing geometry plays a vital role in assessing the intersection LOS. LOS is a qualitative measure of how efficiently a roadway or intersection operates. LOS A represents the highest traffic flow quality, while LOS E represents traffic flow at capacity. LOS F represents forced flow congested conditions. LOS B, C, and D represent a gradual degradation in traffic flow quality before reaching capacity.

The existing geometry was considered as one of the factors in determining potential intersection improvements to accommodate the travel demand. Please note that the NB approach at the intersection of CR 532 and Kemp Road is used by a Church and volumes were not recorded at the time when a TMC was collected at this location.

2.3 Existing Traffic Volumes and Turning Movement Counts

Traffic count information, 48-Hour volume counts and 48-Hour classification counts, were collected and used to develop existing traffic characteristics for the project corridor and the intersecting side streets. The truck factor for each movement for the peak condition was used in the existing intersection analysis. Turning movement counts were collected during the peak periods of 7:00-10:00 AM and 3:00-6:00 PM to capture peak hours for all the study roadways including the I-4 mainline, CR 532 and SR 429. Please refer to Section 2.1 for information on dates when these counts were collected.

It should be noted that balanced study area peak hour volumes were derived based on the morning (9:00 AM to 10:00 AM) and afternoon (4:00 PM to 5:00 PM) peak hour traffic conditions within the study area. Ramp volumes were derived from the turning movement counts conducted at the I-4 and CR 532 ramp terminals. The mainline volumes along I-4 were derived from Florida Transportation Information (FTI) counts. The turning movement counts were checked for reasonableness and balanced. Raw data for the 48-Hour volume counts, 48-Hour classification counts and year 2018 AM and PM peak hour turning movement volumes collected at the study intersections are available in **Appendix B**. The adjusted year 2018 AM and PM peak hour turning movement volumes for the study area are shown in **Figure 4**.



Lane Geometry

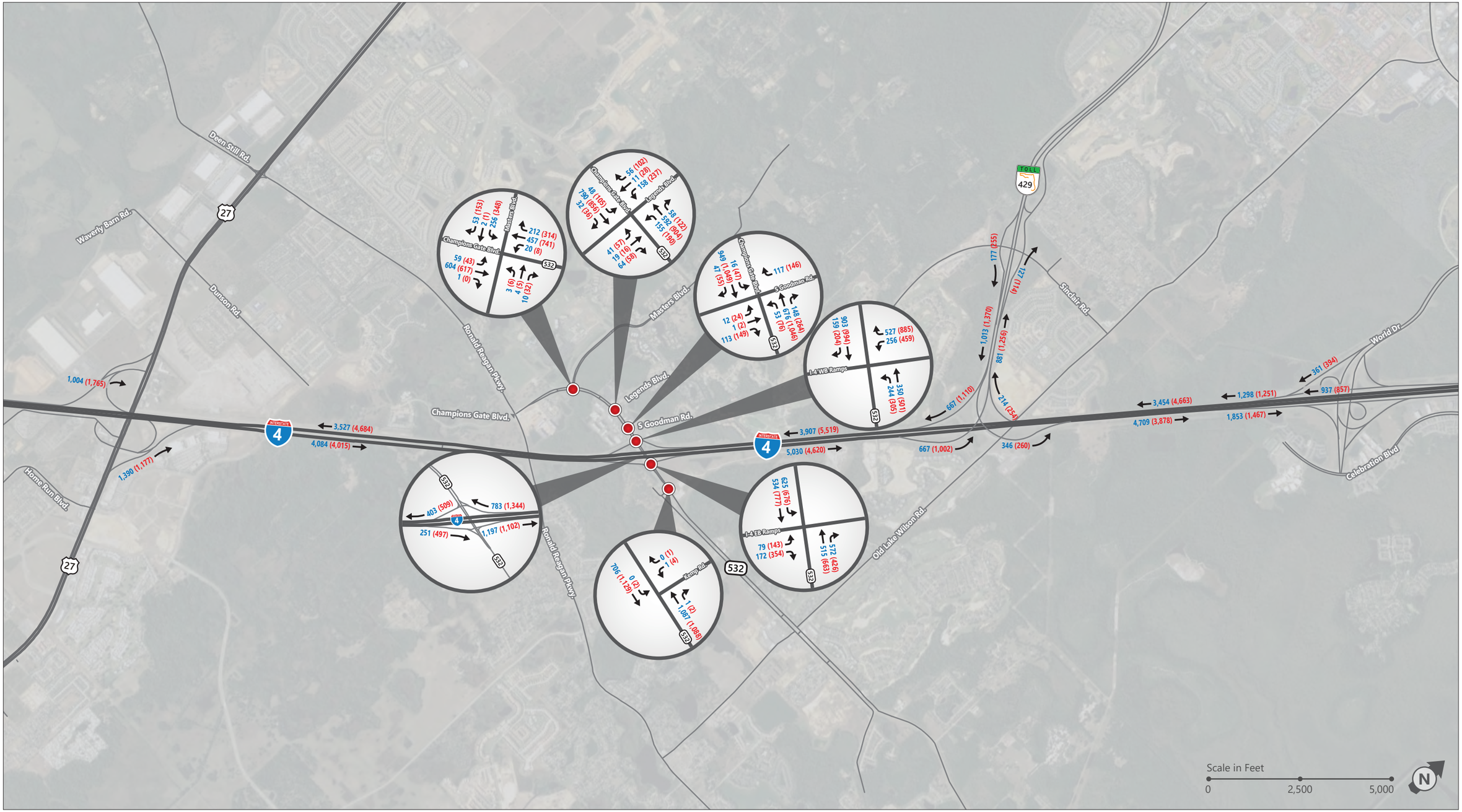
Number of Lanes

Stop-Controlled Intersection

Signalized Intersection

Figure 3

Existing Year 2018 Geometry
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)



→ Traffic Movement

AM (PM) Peak Hour Traffic Volumes

Figure 4

Existing Year 2018 Peak Hour
Turning Movement Volumes
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

2.4 Year 2018 Traffic Operational Analysis

An existing conditions traffic operational analysis was performed using the calibrated VISSIM (version 10) microsimulation software, Synchro and Highway Capacity Software (HCS) 7. Synchro was used to optimize signal timings and evaluate the study intersections along CR 532. HCS 7 was used to evaluate freeway segments including basic, merge/diverge and weave. VISSIM was used to conduct arterial, intersection and freeway (basic, merge/diverge and weave) analyses. Due to prevailing and anticipated future oversaturated conditions, Highway Capacity Manual (HCM) based tools including Synchro and HCS have methodology limitations and do not provide meaningful results for such traffic conditions. For this SIMR (based on FDOT input), all study conclusions are based on calibrated VISSIM analysis. Traffic operational results and output reports from Synchro and HCS 7 are included in **Appendix D** for reference only.

The detailed information on existing conditions VISSIM model development and calibration steps are provided in the Calibration Report included in **Appendix E**. The VISSIM model includes intersections and freeways identified in the area of influence. VISSIM models were constructed and calibrated to 2018 AM and PM period conditions. The 2018 VISSIM model was developed in VISSIM version 10 for a 4-hour period each for AM (7:00 – 11:00 AM) and PM (3:00 - 7:00 PM) peak periods with 1-hour seeding time. The morning peak hour corresponds to the period between 9:00 AM and 10:00 AM, and the PM peak hour corresponds to the period between 4:00 PM and 5:00 PM. The *FHWA Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software* and *2014 FDOT Traffic Analysis Handbook* were used as guidelines for the development of VISSIM models.

VISSIM output is based on the average data from 10 simulation runs. Per the approved MLOU, the following Measures of Effectiveness (MOEs) are used to assess existing traffic conditions:

- **Freeway Evaluation**: Simulated volume, simulated speed, simulated density, demand volume and estimated LOS based on density.
- **Intersection Evaluation**: Overall intersection delay and off ramp approach queues. Detailed intersection movement delay and queues are included in **Appendix E**.

Additionally, travel time results along I-4 and CR 532 and blocked vehicles (or unserved vehicles) for I-4 and CR 532 vehicle inputs are summarized from VISSIM.

2.4.1 Existing Freeway Analysis

The VISSIM link evaluation results for I-4 and SR 429 are graphically depicted in a lane schematic format for AM and PM peak hours in **Figures 5 and 6**. Simulated speed, simulated volume, simulated density and estimated LOS are summarized along with demand volume in the lane schematic figures.

It should be noted that LOS resulted from microsimulation analysis cannot be directly compared to HCM based LOS, since microsimulation based LOS is calculated for vehicles per hour per lane (vphpl) while HCM LOS is based on passenger cars per hour per lane (pcphpl).

Additionally, microsimulation analysis does not require PHF input. HCM and microsimulation tools also differ on the way they treat random arrivals in the traffic stream. HCM utilizes an analytical procedure to account for random arrival effects, while microsimulation tools use statistical distributions to account for randomness in the traffic stream. However, LOS is estimated from the HCM LOS criteria shown in **Table 1** for comparison purposes.

Table 1: Freeway Segments HCM Sixth Edition LOS Criteria

LOS	Basic (HCM Exhibit 12-15)	Merge/Diverge (HCM Exhibit 12-15)	Weaving (HCM Exhibit 12-15)
A	≤ 11	≤ 10	0-10
B	> 11-18	> 10-20	> 10-20
C	> 18-26	> 20-28	> 20-28
D	> 26-35	> 28-35	> 28-35
E	> 35-45	> 35 >	35-43
F	Demand exceeds capacity or density >45	Demand exceeds capacity	Demand exceeds capacity or density >43

The lane schematics (**Figures 5 and 6)** indicate the following:

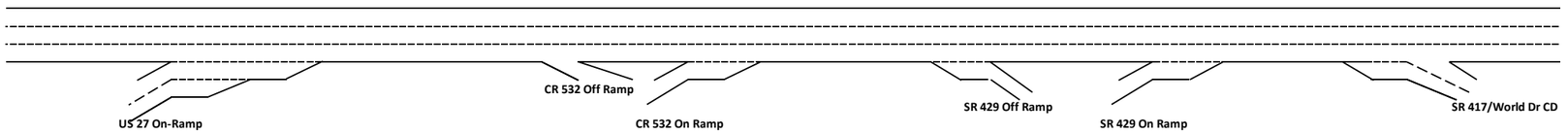
- Based on simulated speed and density, the I-4 eastbound segment from east of the US 27 on ramp to the CR 532 on ramp merge in the morning peak period, and the westbound segment from east of CR 532 off ramp to east of SR 417/World Drive in the afternoon peak period are severely congested. These congested areas are consistent with observed field conditions. The eastbound on ramp merge from CR 532 to I-4 is observed to be the bottleneck in the morning peak period, and a combination of westbound on ramp merge from SR 429, short distance between SR 429 and CR 532 and westbound off ramp diverge to CR 532 is the bottleneck in the afternoon peak period.

- The I-4 westbound on ramp from southbound SR 429 fail in the PM peak hour.

- Peak hour demand and simulated values are comparable indicating a well calibrated model. The detailed volume Geoffrey E. Havers (GEH) Statistics are provided in VISSIM Calibration report included in **Appendix E**.

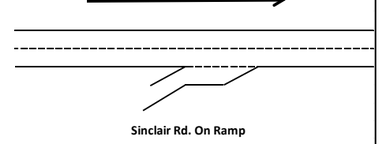
Figure 5: Freeway Lane Schematic - Existing Year 2018 Eastbound Direction (Peak Hour)

2018 Existing AM Eastbound Direction

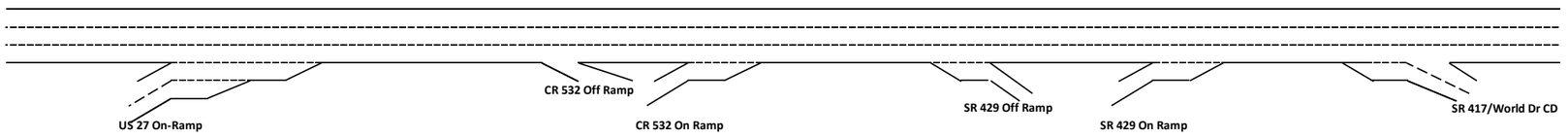


Link #	34	70	72	71	4	2	35	36	9	6	47	15	37	38	27	28	49	21	22
	BASIC	MERGE	MERGE	BASIC	DIVERGE	BASIC	MERGE	BASIC	BASIC	BASIC	DIVERGE	BASIC	MERGE	BASIC	DIVERGE	BASIC			B
# of Lanes	3	5	4	3	3	3	4	3	3	3	4	3	4	3	4	3	2	3	2
Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	904	1,717	918	556	6,273	531	2,784	1,843	5,324	15,276	532	1,174
Simulated Speed (mph)	66	24	14	19	20	16	13	35	56	60	63	68	59	61	64	70	71	70	69
Demand Volume (veh/h)	2,694	4,084	4,084	4,084	4,084	3,833	5,030	5,030	5,030	5,030	5,030	4,363	4,709	4,709	4,709	2,856	836	1,013	1,013
Simulated Volume (veh/h)	2,701	4,145	4,200	4,235	4,231	3,971	5,072	5,073	5,075	5,076	5,068	4,398	4,744	4,750	4,755	2,874	841	1,019	1,022
Simulated Density (veh/ln/mi)	14	52	85	75	70	82	99	48	30	28	20	22	20	26	19	14	6	5	7
Estimated LOS (Density based)	B	F	F	F	F	F	F	F	D	D	C	C	C	C	B	B	A	A	A

2018 Existing AM SR 429 Southbound Direction

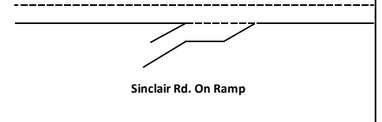


2018 Existing PM Eastbound Direction



Simulated Speed (mph)	71	63	69	68	56	66	61	55	62	65	64	69	67	67	67	71	70	33	25
Demand Volume (veh/h)	2,898	4,015	4,015	4,015	4,015	3,518	4,620	4,620				3,618	3,878	3,878	3,878	2,411	1,115	1,370	1,370
Simulated Volume (veh/h)	2,834	4,008	4,005	4,004	4,006	3,510	4,551	4,549	4,542	4,539	4,529	3,569	3,838	3,833	3,837	2,387	1,111	1,384	1,419
Simulated Density (veh/ln/mi)	13	13	15	20	24	18	19	28	24	24	23	17	14	19	14	11	8	17	31
Estimated LOS (Density based)	B	B	B	C	C	B	B	D	C	C	C	B	B	C	B	B	A	B	D

2018 Existing PM SR 429 Southbound Direction

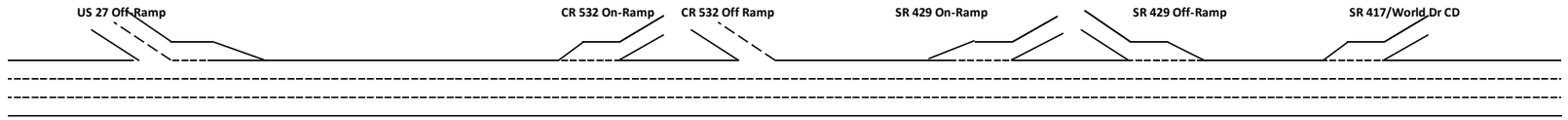


Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

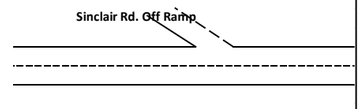
Figure 6: Freeway Lane Schematic - Existing Year 2018 Westbound Direction (Peak Hour)

2018 Existing AM Westbound Direction

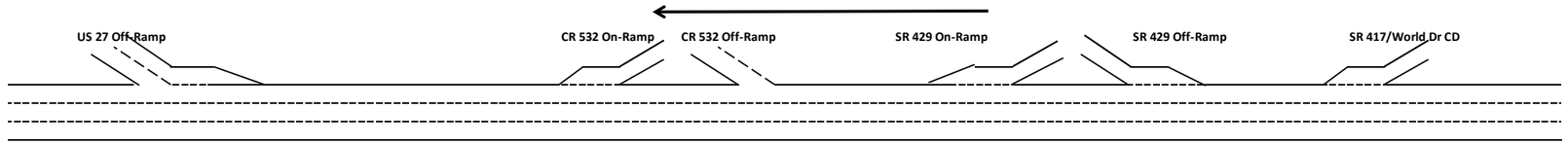


Link #	74	75	5	45	44	76	11	7	42	41	40	48	68	39	24
	BASIC	DIVERGE	BASIC	BASIC	MERGE	BASIC	DIVERGE	BASIC	MERGE	BASIC	DIVERGE	BASIC	MERGE	BASIC	B MD MD
# of Lanes	3	4	3	3	4	3	3	3	4	3	4	3	4	3	2
Distance (ft.)	5,695	1,345	11,282	1,113	378	3,016	1,636	2,765	937	4,519	784	4,195	492	30,327	3,270
Simulated Speed (mph)	71	66	70	68	65	70	67	69	68	70	69	69	63	72	66
Demand Volume (veh/h)	2523	3527	3527	3527	3527	3124	3907	3907	3907	3240	3454	3454	3454	2156	754 881
Simulated Volume (veh/h)	2,512	3,503	3,506	3,506	3,498	3,139	3,934	3,936	3,938	3,255	3,454	3,462	3,461	2,157	810
Simulated Density (veh/ln/mi)	12	13	17	17	13	15	20	19	15	15	12	17	14	10	6
Estimated LOS (Density based)	B	B	B	B	B	B	B	C	B	B	B	B	B	A	A

2018 Existing AM SR 429 Northbound Direction

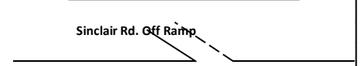


2018 Existing PM Westbound Direction



Simulated Speed (mph)	71	64	69	65	61	63	31	26	21	13	14	15	12	19	66
Demand Volume (veh/h)	2919	4684	4684	4684	4684	4175	5519	5519	5519	4409	4663	4663	4663	3412	1142 1256
Simulated Volume (veh/h)	2,759	4,404	4,407	4,416	4,404	3,921	5,144	5,141	5,142	3,944	4,163	4,167	4,156	3,340	1,127
Simulated Density (veh/ln/mi)	13	17	21	23	18	21	55	67	62	101	76	96	88	61	9
Estimated LOS (Density based)	B	B	C	C	B	C	F	F	F	F	F	F	F	F	A

2018 Existing PM SR 429 Northbound Direction



Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

2.4.2 Blocked Vehicles

An important measure of effectiveness for the study area is the number of vehicles that remain outside the network or blocked vehicles due to congestion within the study area. This is indicative of how much of the demand the model is unable to process due to the oversaturated conditions. Consistent with *Section 7.5 of the 2014 FDOT Traffic Analysis Handbook,* spatial and temporal limits are extended to address unmet demand during existing conditions calibration. Based on discussion with FDOT, spatially, the vehicle input segment for CR 532 was extended over a mile and the vehicle input segment for I-4 was extended several miles in both eastbound and westbound directions. Temporally, the analysis time period was extended from three to four hours. Spatial and temporal limit expansion resulted in zero blocked vehicles during calibration.

2.4.3 Existing Travel Time Results

Travel times along CR 532 and I-4 were used as a calibration parameter and results from the calibrated model are summarized in **Table 2**. Based on results shown in **Table 2**, the following observations can be made:

- I-4:
  - The eastbound direction is peak direction in the morning, and it takes approximately 15 minutes to travel seven miles.
  - The westbound direction is peak direction in the afternoon, and it takes approximately six minutes to travel five miles.

- CR 532:
  - The morning is the peak hour for both eastbound and westbound direction and it takes approximately six minutes to traverse 1.3 miles along CR 532 roadway.

Table 2: Peak Hour Travel Times (minutes) for Study Segments

Direction	Roadway Segment	Distance (miles)	Travel Time (minutes)	
			AM	PM
I-4 EB	West of US 27 on ramp	2.9	2.7	2.4
	US 27 on ramp to CR 532 off ramp	2.2	7.7	2.0
	CR 532 off ramp to CR 532 on ramp	0.8	3.0	0.7
	CR 532 on ramp to SR 429 off ramp	0.9	1.4	0.9
	I-4 EB Total	**6.8**	**14.8**	**6.0**
I-4 WB	SR 429 on ramp to CR 532 off ramp	1.1	1.0	2.5
	CR 532 off ramp to CR 532 on ramp	0.6	0.5	0.6
	CR 532 on ramp to US 27 off ramp	2.7	2.3	2.4
	US 27 off ramp to End	1.1	0.9	0.9
	I-4 WB Total	**5.5**	**4.7**	**6.4**
CR 532 EB	Ronald Reagan Parkway to Masters Boulevard	0.4	0.7	0.7
	Masters Boulevard to Legends Boulevard	0.3	1.5	1.0
	Legends Boulevard to S Goodman Road	0.1	1.0	0.8
	S Goodman Road to I-4 WB Ramps	0.1	1.2	1.3
	I-4 WB Ramps to I-4 EB Ramps	0.1	1.1	0.4
	I-4 EB Ramps to Kemp Road	0.2	0.4	0.3
	CR 532 EB Total	**1.2**	**5.9**	**4.5**
CR 532 WB	Kemp Road to I-4 EB Ramps	0.2	2.9	1.3
	I-4 EB Ramps to I-4 WB Ramps	0.1	0.4	0.4
	I-4 WB Ramps to S Goodman Road	0.1	0.2	0.2
	S Goodman Road to Legends Boulevard	0.1	0.4	0.6
	Legends Boulevard to Masters Boulevard	0.3	0.8	0.9
	Masters Boulevard to Ronald Reagan Parkway	0.4	0.9	0.9
	CR 532 WB Total	**1.2**	**5.6**	**4.2**

2.4.4 Existing Intersection Analysis

The calibrated VISSIM model was also used to analyze intersection performance along CR 532. **Table 3** summarizes the overall intersection LOS for the peak hour from VISSIM. The detailed outputs by movement delay, LOS and queue lengths are included in **Appendix E.** Node evaluation output from VISSIM represents an estimated LOS based on HCM metrics.

Table 3: Existing Year 2018 VISSIM Intersection Delay & LOS Analysis Summary

Study Intersections	Control Type	AM Peak Hour		PM Peak Hour	
		Delay (seconds)	Estimated LOS	Delay (seconds)	Estimated LOS
CR 532 @ Masters Boulevard	Signal	14.4	B	16.1	B
CR 532 @ Legends Boulevard	Signal	39.5	D	27.5	C
CR 532 @ S Goodman Road	Stop	26.5	D	17.5	C
CR 532 @ I-4 WB Ramps	Signal	30.7	C	48.3	D
CR 532 @ I-4 EB Ramps	Signal	105.8	F	18.7	B
CR 532 @ Kemp Road	Stop	87.0	F	0.9	A

Note: Overall intersection delay is reported for both stop controlled and signalized intersections

VISSIM node evaluation results indicate the following conditions at the study intersections.

- The intersections of CR 532 at the I-4 Eastbound Ramps and CR 532 at Kemp Road operate at LOS F in the AM peak hour.
- All the study intersections along CR 532 operate at target LOS E or better in the PM peak hour. However, the intersection at the CR 532 and I-4 Westbound Ramps operates at near capacity.

2.4.5 Off Ramp Queue Summary

The off ramp approach queues from VISSIM node evaluation are summarized in **Table 4** for both AM and PM peak hours for ramp intersections. Queue results from VISSIM are compared with available storage and the queue results indicate that the CR 532 Westbound off ramp queue extends available storage in the PM peak hour. Detailed individual movement queues for all study intersections are summarized **in Appendix E**.

Table 4: Off Ramp Queue Summary at I-4 and CR 532 Interchange

Movement	Available Storage (feet)	Simulated Max Queue (feet)	
		AM	PM
I-4 Westbound Off Ramp	1,950	468	>1,950*
I-4 Eastbound Off Ramp	1,600	165	300

*Note: Off ramp queue extends available storage and backs onto I-4 mainline

3 Traffic Forecast Development

This section discusses the development of traffic forecasts used in the future year operational analyses. The future year volumes were developed using the CFRPM version 6.2. Based on the approved MLOU, future peak hour traffic volumes were developed for the study area in 2022, 2032, and 2042.

As part of the effort to develop future volume forecasts to support the future year analysis, the historical traffic growth, population-based growth rates, model-based growth rates, and characteristics of the nearby land uses were reviewed. Model derived growth rates were selected as the basis for projecting year 2042 daily traffic volumes. Future intersection turning movements were projected using the accepted methodologies from the FDOT's 2014 Project Traffic Forecasting Handbook.

3.1 Subarea Model Development

A subarea model using FDOT's CFRPM v6.2 was developed for use in this SIMR. The subarea model calibration and validation followed the procedures outlined in FDOT's 2014 Project Traffic Forecasting Handbook and Florida Standard Urban Transportation Model Structure (FSUTMS) Model Calibration and Validation Standards. A future year (2045) subarea model scenario was then developed based on the calibration efforts to obtain future year volume forecasts. A review of the subarea validated model (documentation provided separately) was also completed. The subarea validation report and details of this review are provided in **Appendix F**.

3.2 Future Traffic Development

3.2.1 Recommended Design Traffic Factors

The MLOU defined design traffic factors based on a review of historical data presented in the 2017 Florida Traffic Online and 2018 data from field collected counts. This study utilized the design traffic factors defined in the MLOU and summarized in **Table 5**. These traffic factors fall within the recommended ranges identified in the Project Traffic Forecasting Handbook and Procedure (525-030-120). The directional factor, D, along each study segment was selected based upon a review of the 2018 field collected data. The recommended D factors for each segment are included in **Appendix G**.

Table 5: Recommended K, D, T24, and DHT Values

Roadway	K	D	T_{24}	DHT
I-4	0.08	53.00	13.7	6.9
CR 532	0.09	+	6.2	4.5
SR 429	0.105	55.65	14.1	7.0
Side Streets	0.09	+	#	#

Notes:
1. # These factors are based on existing counts.
2. + D factor varies along each study segment.
3. Traffic factors for I-4 and CR 532 were sourced from the 2017 Florida Traffic Online. Traffic factors for SR 429 were provided by FTE.
4. A K factor of 8.00 is proposed for I-4 based on the guidance set forth in FDOT's Traffic Forecasting Handbook.

3.2.2 Traffic Forecasting

Historic Growth Rates

Historical AADTs were obtained from the 2017 FDOT Florida Traffic Online. FTE provided the historical AADT information along the I-4 and SR 429 and SR 429 and Sinclair Road ramps. Historic growth rates were evaluated using FDOT standard spreadsheets for linear trend analysis. Evaluations were conducted for 16 FDOT count locations within the study area. **Table 6** shows a summary of the historical AADT data along with the linear historical growth rates and respective R^2 values at each station. FDOT Site 16-0111 along I-4 has a historical linear growth rate of 4.75 percent with a 90 percent R^2 value. Generally, only growth rates with an R^2 value greater than or equal to 75 percent should be considered when determining growth factors with historical trends. Historical growth rates along the CR 532 ramps range between 0.93 and 4.60 percent. The FDOT Historical AADT reports and trends analyses for each count station are provided in **Appendix G**.

Table 6: Historical AADTs and Historical Growth Rates

Year	I-4 EB on ramp from NB US 27	I-4 EB on ramp from SB US 27	I-4 WB off ramp to US 27	I-4 between US 27 and CR 532	I-4 WB off ramp to CR 532	I-4 EB on ramp from CR 532	I-4 EB off ramp to CR 532	I-4 WB on ramp from CR 532	CR 532 between Masters Boulevard and Legends Boulevard	Masters Boulevard north of CR 532	S Goodman Road north of CR 532	I-4 EB off ramp to SR 429	I-4 WB on ramp from SR 429	I-4 WB on ramp from World Drive	I-4 WB on ramp from SR 417	I-4 EB off ramp to World Drive
	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site	FDOT Site
	16-7131	16-7132	16-7128	16-0111	92-2002	92-2001	16-7081	16-7082	92-8034	92-8037	92-8079	97-9001	97-9004	92-2009	92-8316	92-8000
2017	16,000	2,900	19,500	131,000	11,500	11,000	5,300	6,000	18,600	6,100	2,500	9,000	9,000	5,400	16,000	25,500
2016	15,500	2,800	18,500	126,000	11,000	10,500	5,100	5,700	17,900	5,900	1,300	7,600	7,600	7,000	12,500	12,000
2015	14,500	2,700	17,500	110,500	10,500	9,800	4,800	5,400	17,300	5,800	1,300	6,600	6,600	4,900	11,000	11,500
2014	14,000	2,600	16,500	110,500	10,500	9,500	4,600	5,100	16,900	5,600	1,300	5,500	5,500	4,400	9,700	10,000
2013	14,000	3,200	16,000	105,500	9,800	8,800	4,700	5,200	15,000	3,600	1,500	4,600	4,600	4,400	9,900	10,000
2012	13,500	3,100	15,500	103,000	9,800	8,800	4,600	5,100	14,900	3,600	1,500	4,200	4,200	4,300	8,500	8,100
2011	13,500	3,100	15,500	95,500	9,700	6,000	4,600	5,100	14,900	3,600	-	4,100	4,100	3,900	8,000	8,400
2010	-	-	-	99,000	9,200	8,300	4,900	5,300	-	-	-	-	-	5,600	7,000	12,000
2009	-	-	-	95,500	9,400	8,200	4,800	5,200	-	-	-	-	-	5,600	12,300	23,500
2008	-	-	-	100,500	10,000	9,200	4,700	5,100	-	-	-	-	-	5,200	16,700	19,500
2007	-	-	-	100,000	7,300	7,100	4,700	5,000	-	-	-	-	-	8,200	16,700	33,500
2006	-	-	-	88,000	6,700	6,300	4,600	4,900	-	-	-	-	-	6,700	11,700	20,500
2005	-	-	-	77,500	7,700	7,500	4,500	4,800	-	-	-	-	-	4,000	11,100	16,500
2004	-	-	-	81,500	-	-	-	-	-	-	-	-	-	3,800	11,700	15,600
2003	-	-	-	77,500	-	-	-	-	-	-	-	-	-	3,800	10,200	14,100
2002	-	-	-	67,000	-	-	-	-	-	-	-	-	-	-		
Annual Linear Growth Rate	3.31%	-2.15%	4.70%	4.75%	4.33%	4.60%	0.93%	1.39%	4.86%	14.71%	9.23%	25.00%	25.00%	-0.44%	3.81%	-0.98%
R^2	90.00%	33.45%	93.66%	89.61%	79.99%	60.72%	42.83%	69.06%	92.44%	82.91%	25.30%	94.11%	94.11%	0.78%	4.18%	0.41%

3.3 Bureau of Business and Economic Research (BEBR) Growth Rates

The University of Florida's BEBR projections (Volume 51, Bulletin 180, January 2018) were obtained for Osceola and Polk County. The BEBR projections show an estimate for 2017 and projections for 2020 to 2040. The low, medium, and high projections for 2040 are summarized in **Table 7**. Growth rates range from approximately 0.73 percent to 5.10 percent. BEBR population study data is included in **Appendix G**.

Table 7: BEBR Population based Growth Rates

County and Estimation	2017 Estimate	2040 Projection	Linear Annual Growth Rate, Growth/Year (%)
Osceola County			
Low	337,614	480,600	6,217 (1.84%)
Medium		606,200	11,678 (3.46%)
High		733,400	17,208 (5.10%)
Polk County			
Low	661,645	772,000	4,798 (0.73%)
Medium		906,100	10,628 (1.61%)
High		1,064,000	17,494 (2.64%)

Note: Volume 51, Bulletin 180, January 2018

It is important to note that the BEBR data accounts for countywide data and does not necessarily reflect expected growth on specific roadways or sub-areas of the County. It is useful in reviewing reasonableness of growth rates obtained from other sources such as travel demand models or historical AADT data.

3.4 CFRPM v6.2 Model Growth rates

The subarea validated CFRPM v6.2 with base year 2015 and forecast year 2045 was utilized to estimate volume growth. A sub-area validation was completed as part of this task work order as previously described. The peak season weekday average daily traffic (PSWADT) volumes were converted to model AADTs using the appropriate model output conversion factors (MOCF) for Osceola and Polk County. The model growth rates along the segments within the area of influence are summarized in **Table 8**. Base year and horizon year model plots are included in **Appendix G**.

Upon a review of the base year and horizon year models, it was noted that the model loads volume to CR 532 between Masters Boulevard and I-4 through three centroid connectors and two roadway links representatives of Masters Boulevard and S Goodman Road as illustrated in **Figure 7**.

The model's representation of the roadway does not reflect all connections to CR 532 from the north and south in this area. Therefore, a model screenline analysis north and south of CR 532 between Masters Boulevard and I-4 was used to identify model growth along the minor streets in this area. The screen lines used within this study parallel CR 532 and bisect Masters Boulevard, S Goodman Road and the centroid connector to the north and bisect the two centroid connectors to the south. An example of the calculations is also provided in **Appendix G**.

Figure 7: Example of Screenline Analysis to the North and South of CR 532

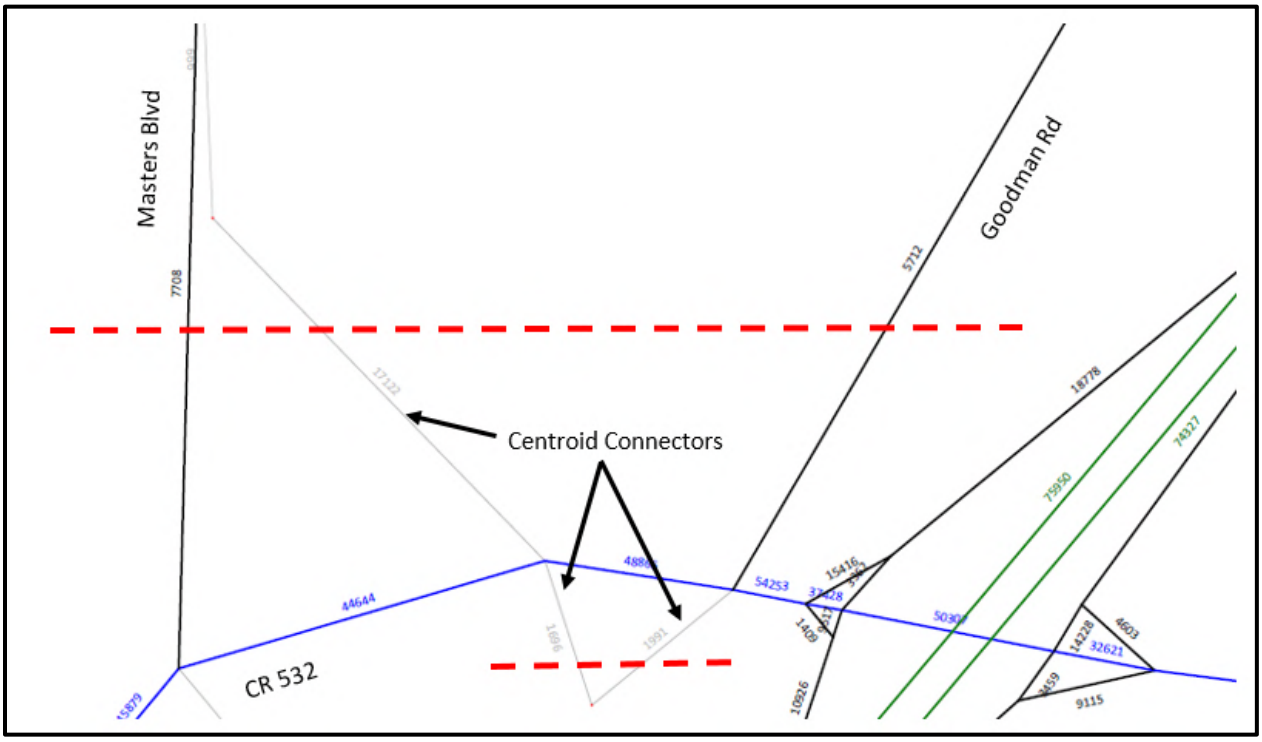


Table 8: Validated CFRPM v6.2 Model Growth Rates

Roadway Segment	2015 Base Year AADT	2045 Forecast Year AADT	Annual Volume Growth	Linear Annual Model Growth Rate (%)
CR 532 west of Masters Boulevard	13,402	44,961	1,052	7.85%
Masters Boulevard north of CR 532	7,589	15,219	254	3.35%
Masters Boulevard south of CR 532	6,509	6,975	16	0.24%
CR 532 between Masters Boulevard and Legends Boulevard	15,285	43,751	949	6.21%
Legends Boulevard north of CR 532	4,111	8,244	138	3.35%
Legends Boulevard south of CR 532	1,297	1,569	9	0.70%
CR 532 between Legends Boulevard and S Goodman Rd	19,712	47,889	939	4.76%
S Goodman Road north of CR 532	3,225	6,468	108	3.35%
S Goodman Road south of CR 532	1,689	2,044	12	0.70%
I-4 WB off ramp to CR 532	10,455	18,402	265	2.53%
I-4 WB on ramp from CR 532	5,609	10,707	170	3.03%
I-4 EB off ramp to CR 532	5,055	12,322	242	4.79%
I-4 EB on ramp from CR 532	9,511	18,454	298	3.13%
CR 532 east of I-4 Ramps	25,450	45,412	665	2.61%
I-4 WB off ramp to US 27	16,993	27,309	344	2.02%
I-4 EB on ramp from US 27	17,241	25,861	287	1.67%
I-4 WB on ramp from SR 429	4,588	9,960	179	3.90%
I-4 EB off ramp to SR 429	4,678	11,489	227	4.85%
I-4 between CR 532 and US 27	106,912	163,349	1,881	1.76%
I-4 between CR 532 and SR 429	120,762	184,128	2,112	1.75%
I-4 east of SR 429	114,222	177,497	2,109	1.85%

Note: A MOCF of 0.98 (Osceola) and 0.94 (Polk) was used to convert the PSWADT volumes to model AADTs

3.5 Recommended Growth Rates and AADTs

Recommended growth rates were determined based on an evaluation of historic, BEBR, and model growth rates. After a comprehensive review of the historic growth rates, population growth rates, and the model growth rates, the model growth per year along each segment was applied to CR 532, and each of the I-4 ramps at US 27 and CR 532, and along the I-4 mainline segment east of US 27. The traffic volumes along the remaining I-4 mainline segments were estimated by balancing along the network using the I-4 mainline segment volume east of US 27. It should also be noted that the future volumes on the I-4 ramps at World Drive/SR 417 were estimated using the existing traffic split between I-4 mainline segment and World Drive/SR 417 ramps. The growth along the I-4 and SR 429 ramps and SR 429 and Sinclair Road was coordinated with FTE for consistency along their facility.

The applied linear growth rates, the AADT growth per year, and the forecast AADTs/DDHVs are summarized in **Table 9**. The forecasted AADTs, along with the existing AADT are depicted in **Figure 8**.

To maintain the existing peak hour proportionality (consistent with existing travel patterns) for each ramp pair (e.g. I-4 westbound off ramp to CR 532 and I-4 eastbound on ramp from CR 532), the existing volumes for each ramp pair were summed to determine a "D factor".

The future AADTs for each ramp pair were added together and then Standard K and the resulting D factor was applied to estimate the future peak hour ramp volumes. This ensures the appropriate directionality between the two ramps is achieved during the peak hour while still capturing the growth at the daily level (Application of Standard K and D factor to the Design Year AADT). Example calculations are included in **Appendix G**. This approach was done for each ramp pair at the US 27 and CR 532 interchanges within the study limits.

Table 9: Future Traffic Forecasts

Roadway Segment	Annual Volume Growth	2018 AADT	Future AADT			AM Peak Hour Future DDHV			PM Peak Hour Future DDHV		
			2022	2032	2042	2022	2032	2042	2022	2032	2042
CR 532 west of Masters Boulevard	1,052	18,000	22,000	33,000	43,000	984	1,586	2,188	1,160	1,706	2,252
Masters Boulevard north of CR 532	254	12,000	13,000	16,000	18,000	425	653	883	597	810	1,024
CR 532 between Masters Boulevard and Legends Boulevard	949	26,000	30,000	39,000	49,000	1,232	1,885	2,538	1,321	1,833	2,344
Legends Boulevard north of CR 532#	-	#	#	#	#	273	368	464	447	590	733
Legends Boulevard south of CR 532#	-	#	#	#	#	198	213	227	249	266	282
CR 532 between Legends Boulevard and S Goodman Rd	939	30,000	34,000	43,000	53,000	1,406	2,118	2,830	1,470	1,984	2,534
S Goodman Road north of CR 532	108	5,100	5,500	6,600	7,700	213	317	420	349	409	468
S Goodman Road south of CR 532	12	4,300	4,300	4,500	4,600	151	179	220	165	193	222
I-4 WB off ramp to CR 532	265	15,000	16,000	19,000	21,000	995	1,252	1,510	1,530	1,830	2,131
I-4 WB on ramp from CR 532	170	5,400	6,100	7,800	9,500	569	898	1,227	657	852	1,048
I-4 EB off ramp to CR 532	242	5,900	6,900	9,300	12,000	401	593	786	627	826	1,024
I-4 EB on ramp from CR 532	298	13,000	14,000	17,000	20,000	1,449	1,880	2,311	1,293	1,526	1,760
CR 532 east of I-4 Ramps	665	34,000	37,000	43,000	50,000	1,490	2,116	2,743	1,514	2,023	2,545
I-4 WB off ramp to US 27	344	23,000	24,000	28,000	31,000	1,812	2,076	2,302	2,592	2,970	3,294
I-4 EB on ramp from US 27	287	23,000	24,000	27,000	30,000	2,508	2,874	3,188	1,728	1,980	2,196
I-4 WB on ramp from SR 429	677	10,000	13,000	19,000	26,000	1,401	2,237	2,991	1,334	1,948	2,424
I-4 EB off ramp to SR 429	955	10,000	14,000	23,000	33,000	1,334	1,948	2,424	1,451	2,337	2,991
I-4 WB off ramp to SR 429	196	2,900	3,700	5,600	7,600	363	735	1,106	451	945	1,438
I-4 EB on ramp from SR 429	277	2,900	4,000	6,800	9,200	528	983	1,438	401	754	1,106
SR 429 SB on ramp from Sinclair Road	250	2,300	3,900	6,200	8,300	226	348	470	302	419	535
SR 429 NB off ramp to Sinclair Road	250	2,300	3,900	6,200	8,300	195	365	535	173	322	470
I-4 between CR 532 and US 27	1,881	137,000	145,000	163,000	182,000	6,148	6,911	7,717	6,148	6,911	7,717
I-4 between CR 532 and SR 429	*	*	*	*	*	7,196	8,198	9,242	7,021	7,889	8,800
I-4 east of SR 429	*	*	*	*	*	6,390	7,233	8,256	6,138	6,886	7,814

Notes: AADTs rounded based on rounding guidelines in Section 1.8 of the 2014 Project Traffic Forecasting Handbook.
- Tube counts collected unreasonably low volumes when compared to the TMCs and were not used for estimating AADTs or for forecasting.
The approach/departures from the peak hour TMCs were grown to estimate future DDHVs.
* The existing and future DDHVs were estimated by balancing along the I-4 network

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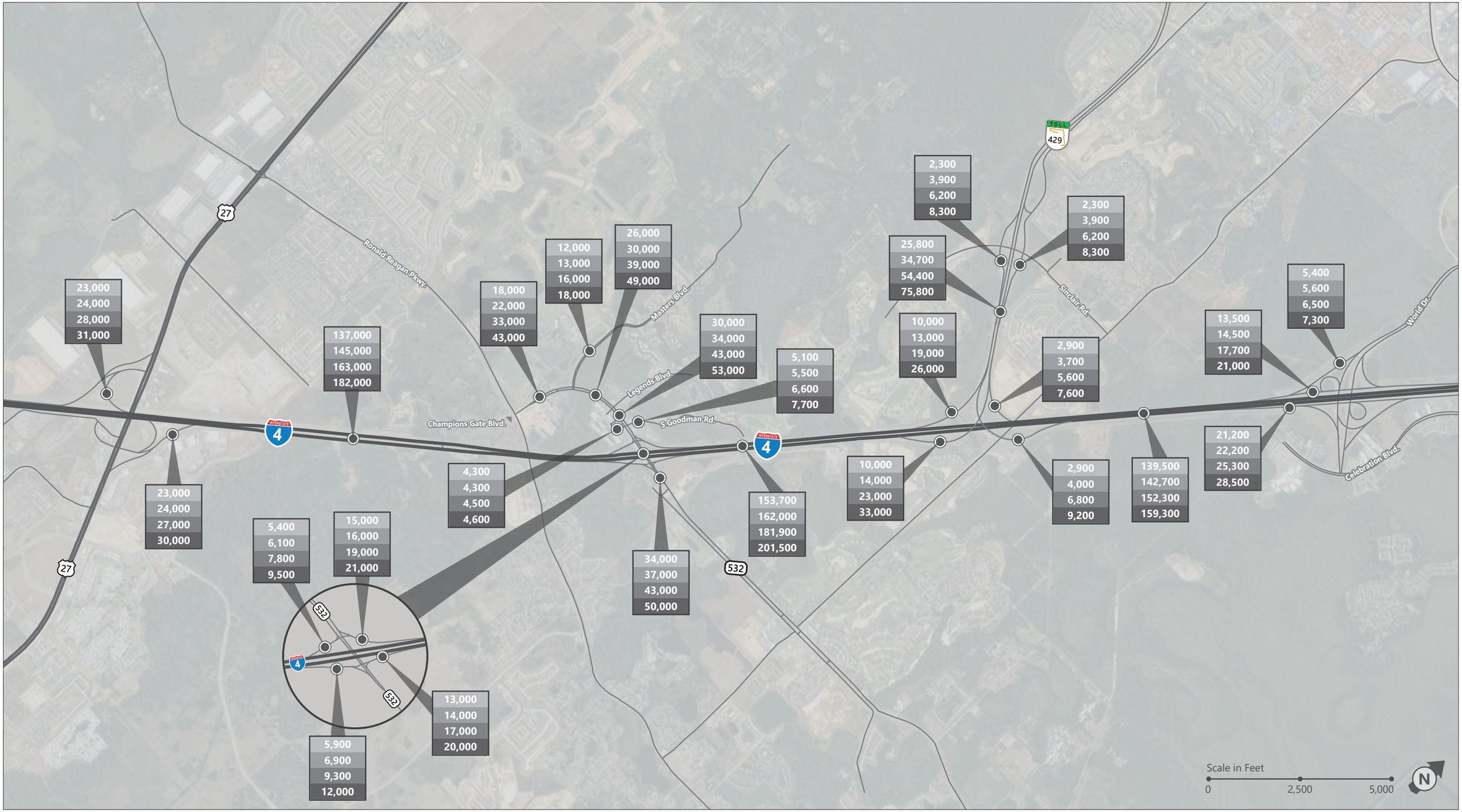

00,000 2018 (Existing) AADT
00,000 2022 AADT
00,000 2032 AADT
00,000 2042 AADT

Figure 8

Existing and Future Year Annual Average Daily Traffic (AADT)
I-4/CR 532/SR 429 Systems Interchange Modification Report (SIMR)

3.6 Development of Future Turning Movement Volumes

A methodology that follows the iterative, growth-factoring procedures described in the NCHRP Report 765 was used to convert future segment DDHVs into intersection turning movement volumes for the 2042 AM and PM peak hours. The NCHRP Report 765 is an update to the NCHRP Report 255 (published in 1982), which is a method consistent with the acceptable tools described in FDOT's 2014 Project Traffic Forecasting Handbook. The inputs and raw outputs from the forecasting spreadsheet are included in **Appendix G**.

The build-out PM peak hour intersection volumes (entering and exiting) associated with the Blackwater Crossings Development, 7-11, and Reunion Village Development were added to the existing volumes at the intersection of CR 532 and Kemp Road. The project trips included in the Traffic Impact Analysis (TIA) for each development were only developed for the future PM peak hour. These PM peak hour project trips were also converted to AM volumes using a reciprocal movement methodology. For example, southbound right-turn movements in the PM peak hour were assumed to be equal to eastbound left-turn movements in the AM peak hour. The PM peak hour project trips and resulting AM reciprocal movements are provided **in Appendix G**.

The 2022 and 2032 AM and PM peak hour intersection turning movement volumes were estimated by interpolating between 2018 and 2042 as indicated in the MLOU. The 2022, 2032, and 2042 design hour intersection turning movement volumes are summarized in **Figures 9** through **11**.

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→ Traffic Movement

AM (PM) Peak Hour Traffic Volumes

Figure 9

Opening Year 2022 Peak Hour
Turning Movement Volumes
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

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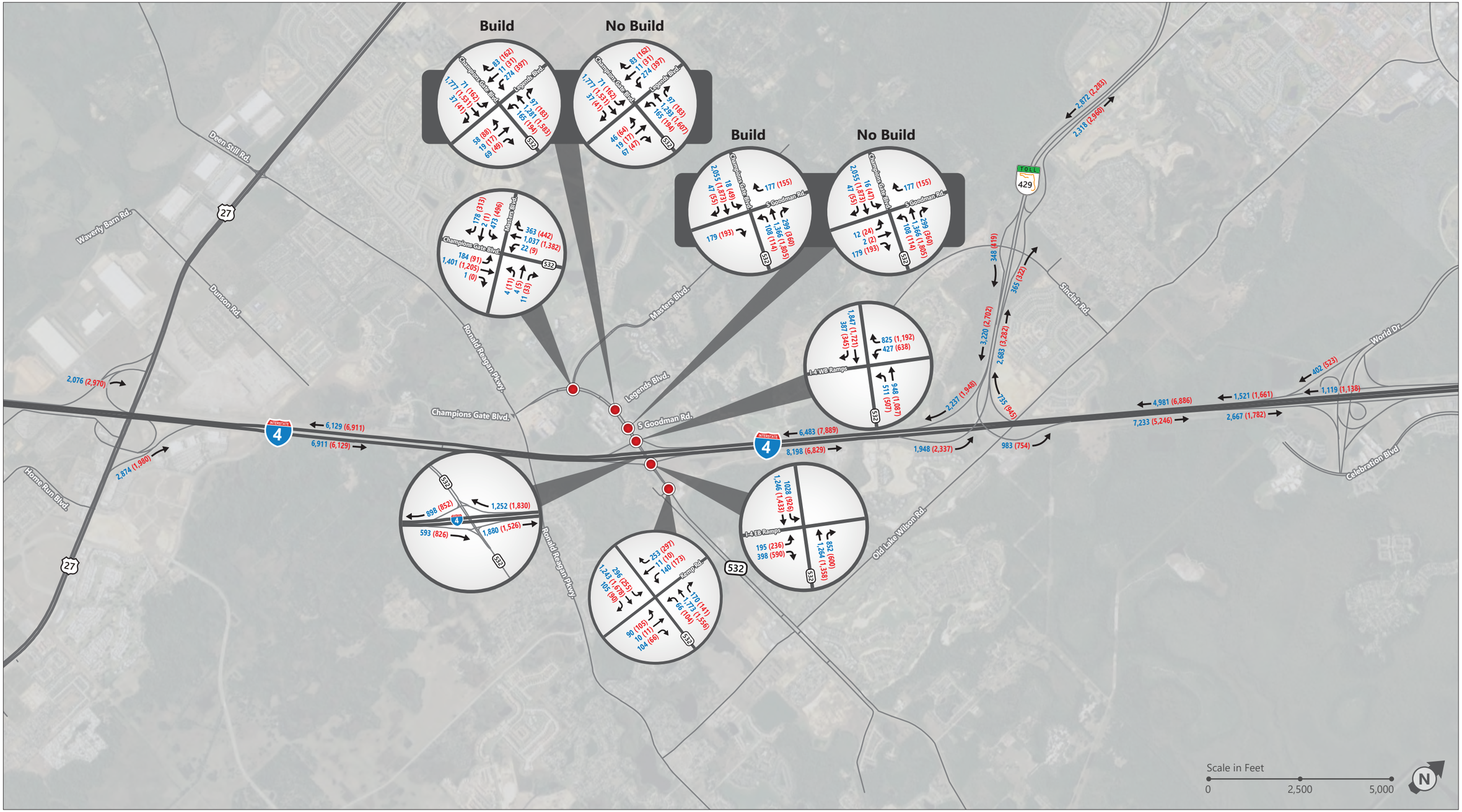

→ Traffic Movement

AM (PM) Peak Hour Traffic Volumes

Figure 10

Interim Year 2032 Peak Hour
Turning Movement Volumes
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

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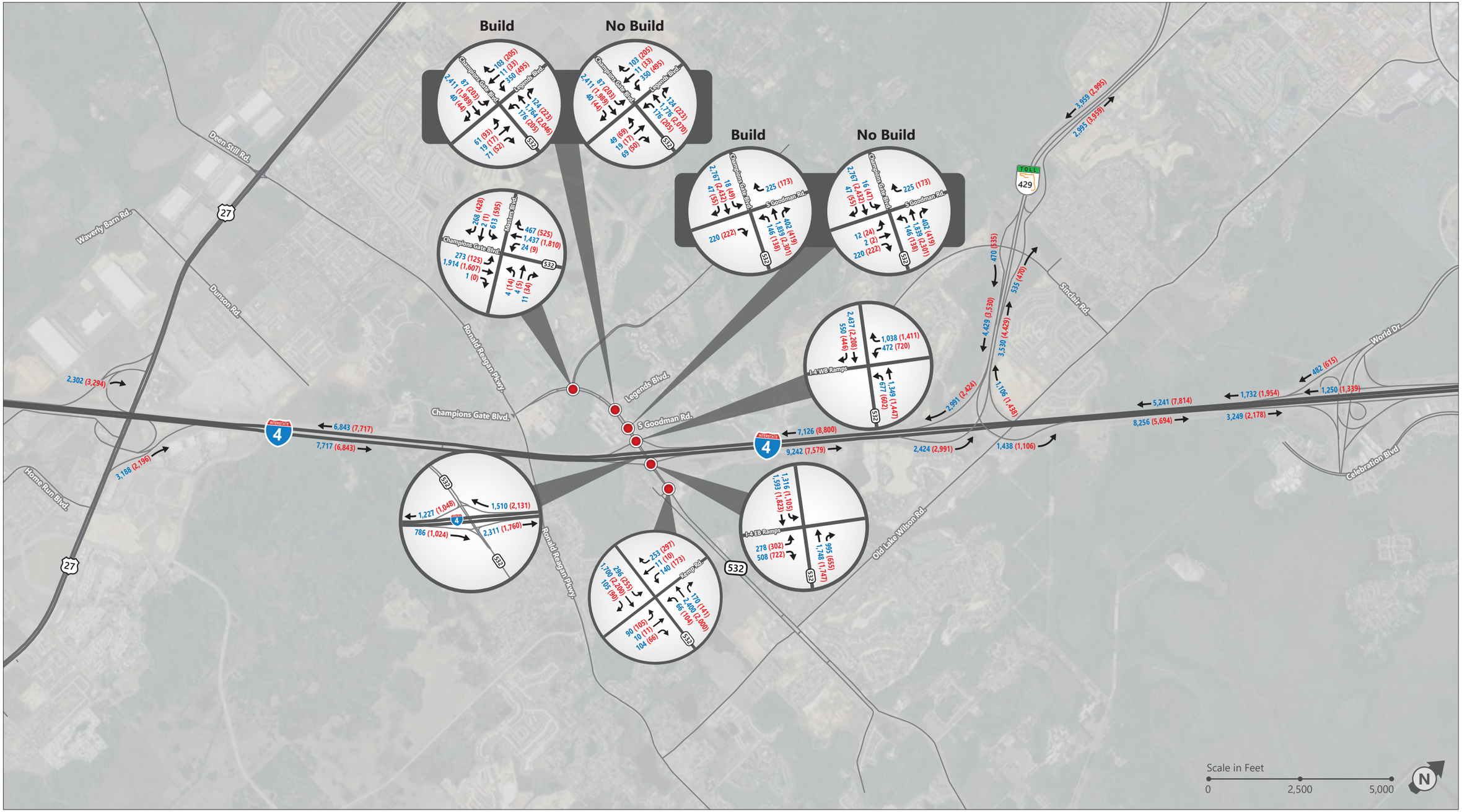


→ Traffic Movement

AM (PM) Peak Hour Traffic Volumes

Figure 11

Design Year 2042 Peak Hour
Turning Movement Volumes
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

4 Future Operational Analysis

This section describes the alternatives evaluated for the study area as well as results of the traffic operational analysis.

4.1 Analysis Alternatives

A No Build alternative and a Build alternative are evaluated in this SIMR. The No Build alternative maintains the existing roadway and intersection configuration within the AOI. However, a signal at CR 532 and Kemp Road intersection is considered in both the No Build and Build alternatives, which will be in place by opening year 2022 based on discussion with Osceola County. The signal is approved by the County and funded by the Developer to support the traffic volumes generated by the nearby development (Blackwater Crossings Development, 7-11, and Reunion Village Development).

Please note that there are no committed improvements (other than the proposed Build alternative improvements) within the AOI. A Build alternative as described below is evaluated.

4.1.1 Build Alternative

Based on the existing and anticipated future operational deficiencies, the following improvements are evaluated as part of the Build alternative:

- DDI at the I-4 and CR 532 interchange (FPID #444187-1).
- Widening the existing westbound off ramp and eastbound on ramp at I-4 and CR 532 to two lanes (FPID #444329-1).
- Adding an auxiliary lane in each direction along I-4 between CR 532 and SR 429 ramps (FPID #444329-1).
- Widening the existing ramps to two lanes, from eastbound I-4 to northbound SR 429 and southbound SR 429 to westbound I-4 (FPID #444329-1).
- Widening SR 429 in the northbound direction to add an auxiliary lane to the outside up to the Sinclair Road interchange (FPID #444329-1).

Please note that widening the existing eastbound on ramp from CR 532 to I-4 to two lanes was not identified in the MLOU, as amended in September 2019. The decision to widen the I-4 eastbound on-ramp from CR 532 was made during the operational analysis effort. Based on the one lane scenario for the I-4 eastbound on- ramp from CR 532, the 2032 AM peak period operational analysis showed that the on-ramp was at-

capacity (around 1,900 vph by 2032) and adversely impacted CR 532 arterial and I-4 westbound operations. In this condition, the eastbound queue on CR 532 extended from the I-4 EB Ramp Terminal to west of the I-4 WB Ramp Terminal, and consequently caused the queue on the I-4 westbound off ramp to CR 532 to back up to the mainline adversely affecting the I-4 westbound mainline operations. This information was not available during preparation of the MLOU Amendment. A graphic illustrating the above mentioned traffic operational issues is included in **Appendix H** of this SIMR. This graphic is a snapshot of the average speed metric from VISSIM for the 2032 AM peak hour condition.

In addition, based on coordination between FDOT and Osceola County, the northbound left turn and through movements at the intersection of CR 532 and S Goodman Road are restricted to improve safety and operations under the Build alternative. The Build geometry figure is shown in **Figure 12**. A conceptual layout is presented in **Appendix H**.

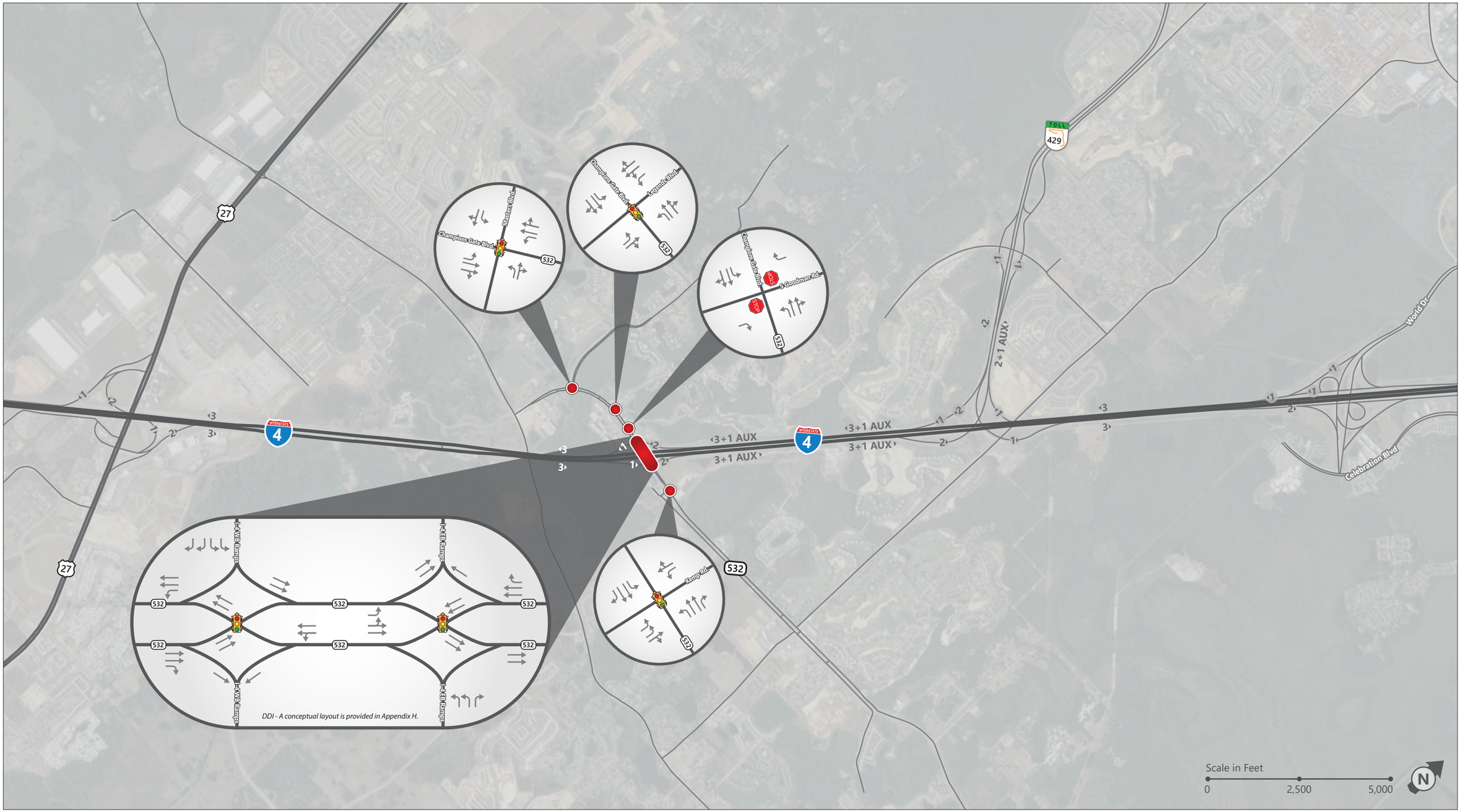
The Build alternative included relevant Transportation Systems Management & Operations (TSM&O) alternatives such as traffic signal optimization, additional turn lanes, and auxiliary lane additions. FDOT provided the intersection clearance times at the proposed DDI in the Build alternative. Please note that a DDI interchange configuration was proposed at the study interchange as part of the I-4 BtU project. The I-4 BtU concept is provided as part of the MLOU in **Appendix A** for reference. Other alternatives were evaluated in the I-4 BtU PD&E and it was decided that the DDI was the best solution. A DDI is anticipated to be retrofitted for low cost without modifying the existing bridge structure and without acquiring new right-of-way.

4.1.2 TSM&O Alternative

Per the MLOU, a standalone TSM&O alternative is not evaluated in this SIMR. However, as mentioned in the above section, applicable TSM&O strategies are incorporated in the Build alternative. These strategies include:

- Adding an additional eastbound left turn lane at the I-4 and CR 532 EB Ramp Terminal
- Capacity improvements at the I-4 off ramps (eastbound and westbound) to CR 532
    - Additional left turn at the I-4 eastbound off ramp to CR 532
    - Additional left and right turn lanes at the I-4 westbound off ramp to CR 532
- Signal optimization along CR 532
- Adding auxiliary lanes for the following segments:
    - I-4 between CR 532 and SR 429 in both directions
    - SR 429 northbound between I-4 and Sinclair Road

\\vhb\gbl\proj\Orlando\62954.34 I4 SR429 IOAR\Graphics\FIGURES\AI



Lane Geometry

Number of Lanes

Stop-Controlled Intersection

Signalized Intersection

Figure 12

Build Geometry
I-4/CR 532/SR 429 Systems Interchange
Modification Report (SIMR)

4.2 Future Traffic Operational Analysis

Future conditions traffic operational analysis was performed using VISSIM (version 10) microsimulation software, Synchro and HCS 7. Synchro was used to optimize signal timings and evaluate the study intersections along CR 532. HCS 7 was used to evaluate freeway segments including basic, merge/diverge and weave. VISSIM was used to conduct arterial, intersection and freeway (basic, merge/diverge and weave) analyses. As mentioned in Section 2.4 for existing conditions, HCM based tools including Synchro and HCS have methodology limitations due to prevailing and anticipated future oversaturated conditions within the study area. Therefore, only VISSIM based traffic operational results are discussed in this section. Traffic operational results and outputs from Synchro and HCS 7 are included in **Appendix I** for reference.

A detailed VISSIM microsimulation analysis was performed for the No Build and Build alternatives for the future analysis years of 2022, 2032 and 2042 for both AM and PM peak periods. The future year models were developed following methodologies previously adopted by the calibrated VISSIM model for existing (2018) conditions. The future year models included all improvements described in Section 4.1.1.

Consistent with calibrated VISSIM models, the average of 10 random seed runs was used to assess the output to account for the stochasticity of the microsimulation model. The microsimulation model results in this section are summarized only for the peak hour of both peak periods and detailed summaries are reported in **Appendix J**.

The following MOEs were used to assess future traffic conditions for both the No Build and Build conditions:

- **Network Wide Performance**: Average speed, total delay time, average delay, number of arrived vehicles, latent delay time and latent vehicles.
- **Freeway Evaluation**: Lane schematics for I-4 depicting simulated volume, demand volume, simulated speed, simulated density and estimated LOS based on density.
- **Intersection Evaluation**: Overall Intersection delay and Off ramp approach queues. Detailed intersection movement delay and queues are included in **Appendix J**.

Additionally, travel time results along I-4 and CR 532 and blocked vehicles for I-4 and CR 532 vehicle inputs are summarized from VISSIM.

4.2.1 Networkwide Performance Results

A network performance evaluation is an important statistic as it provides the relative number of vehicles that are being processed and the extent of latent demand in the study area. Peak hour network wide statistics are summarized for the AM and PM peak periods in **Table 10** for the No Build and Build alternatives.

The network performance results are summarized below:

- Overall, significant benefits are seen in the Build alternative compared to the No Build alternative for both AM and PM peak hours.
- Latent demand improves in all Build scenarios indicating improved conditions with higher traffic flow in the Build alternative.
- The increase in average speed and number of arrived vehicles, and decrease in latent delay time, total delay time, average delay and latent vehicles indicate improvement in congestion in the study area under the Build alternative.
- As seen in **Table 10**, certain discrepancies such has a higher total delay in 2032 when compared to 2042 during the AM peak hour can be explained with the inclusion of latent vehicle delay. This MOE consistently increases with time. The total delay plus the latent delay for 2042 AM peak hour (29,765 hours) is significantly higher than 2032 AM peak hour (17,031 hours).
- Under the No Build alternative, network wide MOEs including average delay, total travel time and number of arrived vehicles are comparable between 2032 and 2042, but the number of latent vehicles and latent delays have significantly increased starting from 2022.
- While the network performance results show substantial improvements in the Build versus No Build alternative, the differences between the Build alternative in 2032 and 2042 are comparable. This indicates that the system is anticipated to reach capacity by 2032 with the proposed Build alternative improvements.

Table 10: Networkwide Performance Summary

AM Peak Hour									
Parameter	**Network Performance**						**Percent Improvement from No Build**		
	Year 2022		**Year 2032**		**Year 2042**		**2022**	**2032**	**2042**
	No Build	**Build**	**No Build**	**Build**	**No Build**	**Build**			
Average Speed (mph)	18	26	18	20	16	19	44%	11%	19%
Total Delay Time (hr)	4,688	2,750	4,657	4,484	5,201	4,459	41%	4%	14%
Avg Delay (hr)	0.23	0.14	0.22	0.20	0.24	0.19	39%	9%	21%
Number of Arrived Vehicles	13,730	15,202	14,526	16,370	14,343	16,675	11%	13%	16%
Latent Delay Time (hr)	7,166	4,678	18,899	12,547	32,818	25,307	35%	34%	23%
Latent Vehicles	8,809	5,715	22,163	14,873	38,177	29,481	35%	33%	23%
Total Delay + Latent Delay (hr)	**11,854**	**7,428**	**23,556**	**17,031**	**38,019**	**29,765**	**37%**	**28%**	**22%**

PM Peak Hour									
Parameter	**Network Performance**						**Percent Improvement from No Build**		
	Year 2022		**Year 2032**		**Year 2042**		**2022**	**2032**	**2042**
	No Build	**Build**	**No Build**	**Build**	**No Build**	**Build**			
Average Speed (mph)	11	22	10	16	9	16	100%	60%	78%
Total Delay Time (hr)	7,442	3,980	7,939	6,180	8,490	5,960	47%	22%	30%
Avg Delay (hr)	0.33	0.18	0.35	0.24	0.38	0.24	45%	31%	37%
Number of Arrived Vehicles	13,418	16,344	13,061	17,022	12,642	17,047	22%	30%	35%
Latent Delay Time (hr)	7,721	2,735	20,552	9,505	30,093	18,772	65%	54%	38%
Latent Vehicles	9,686	3,356	24,974	11,666	35,955	22,487	65%	53%	37%
Total Delay + Latent Delay (hr)	**15,162**	**6,715**	**28,491**	**15,685**	**38,583**	**24,731**	**56%**	**45%**	**36%**

4.2.2 Freeway Operational Results

The VISSIM link evaluation results for I-4 and SR 429 are graphically depicted in a lane schematic format for both eastbound and westbound directions for AM and PM peak hours in **Figures 13 through 24**. Simulated speed, simulated volume, simulated density and estimated LOS are summarized along with demand volume in the lane schematic figures. The freeway segments shown in these lane schematic figures represent basic and merge/diverge and weave segments. Under the No Build alternative, only basic and merge/diverge segments are present, while the Build alternative includes a weave segment on I-4 (both directions) between CR 532 and SR 429 and on SR 429 northbound between I-4 and Sinclair Road. As discussed in Section 2.4.1, it should be noted that LOS estimated directly from VISSIM based density cannot be compared to HCM based LOS criteria (see table 1 in Section 2.4). However, the LOS (estimated from the HCM LOS criteria) is provided in the lane schematic figures for comparison purposes.

Figures 13 through 24 and **Table 11** indicate the following:

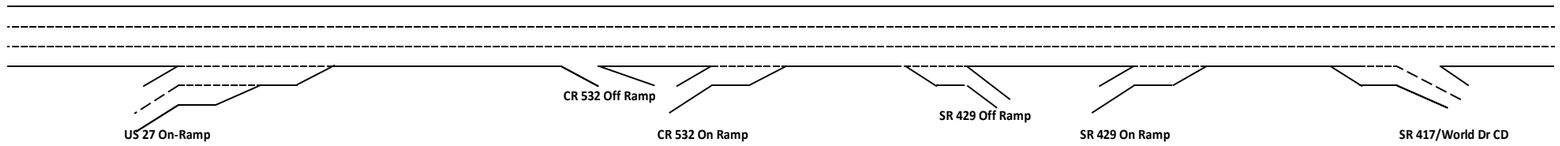
- Blocked vehicles, as discussed in section 2.4.2, are also summarized for I-4 along with other freeway MOEs for both the No Build and Build alternatives. Blocked vehicles were obtained from VISSIM error files showing number of vehicles that remained outside the network for each vehicle input for each simulation run. Only I-4 eastbound and westbound blocked vehicles are summarized for Build and No Build alternatives. Generally, the Build alternative processes more vehicles when compared to the No Build alternative. Additionally, this improvement is significant in the afternoon peak hour when compared to morning peak hour in the Build alternative. This is further discussed in Section 4.2.3.
- For I-4, average speed, volume, and density in the Build alternative improves in the westbound direction for both AM and PM peak hours and in the eastbound direction for the PM peak hour.
- Furthermore, the No Build alternative models have a large number of blocked vehicles in all years for I-4. During 2022, 2032 and 2042 AM peak hour 636 (23%), 1,328 (22%) and 2,440 (23%) additional vehicles, respectively, are processed under the Build alternative compared to the No Build alternative.
- For SR 429 between Sinclair Road and I-4, the Build alternative shows improvement in simulated volume, density and average speed compared to the No Build alternative through design year 2042.

- Under the Build alternative, I-4 eastbound between CR 532 and SR 429 during the AM peak hour shows more congestion compared to the No Build alternative because a higher number of vehicles are processed along I-4 in this segment due to the proposed improvements under the Build alternative. Based on a supplemental 2032 AM peak hour HCS freeway analysis using the same projected demand for the two study alternatives, this segment is shown to operate at LOS E under the Build alternative and at LOS F under the No Build alternative.
- Under the Build alternative, I-4 westbound between CR 532 and US 27 during the PM peak hour shows more congestion compared to the No Build alternative because of the following reason:
    - Improvements upstream of this segment resulted in a higher throughput and consequently a higher density along I-4 westbound in this segment under the Build alternative. For instance, a throughput improvement of approximately 36% on I-4 westbound between CR 532 and US 27 in 2032 PM peak hour is noted under the Build alternative.

Figure 13: Freeway Lane Schematic – Year 2022 AM Peak Hour Eastbound Direction (Peak Hour)

2022 No Build AM I-4 Eastbound Direction

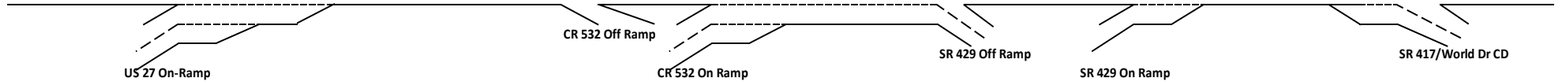
2022 No Build AM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	3,540	556	6,273	531	2,784	1,843	5,324	15,276	532	1,174
Simulated Speed (mph)	6	7	10	18	21	16	13	50	62	68	57	62	65	70	6	7	10
Demand Volume (veh/h)	3,640	6,148	6,148	6,148	6,148	5,747	7,196	7,196	7,196	5,862	6,390	6,390	6,390	4,304	1,703	1,929	1,929
Simulated Volume (veh/h)	2,624	4,172	4,183	4,180	4,182	3,907	4,977	4,974	4,970	4,058	4,572	4,570	4,565	3,062	1,597	1,807	1,811
Simulated Density (veh/ln/mi)	148	119	108	78	68	81	94	33	20	20	20	25	17	15	135	92	87
Estimated LOS (Density based)	F	F	F	F	F	F	F	D	B	C	C	C	B	B	F	F	F

2022 Build AM I-4 Eastbound Direction

2022 Build AM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	3,256	777	4,817	6,256	531	2,784	1,843	5,324	15,276	532	1,174
Simulated Speed (mph)	5	7	9	17	18	15	12	17	20	20	53	63	70	71	67	62
Demand Volume (veh/h)	3,640	6,148	6,148	6,148	6,148	5,747	7,196	7,196	5,862	6,390	6,390	6,390	4,304	1,703	1,929	1,929
Simulated Volume (veh/h)	2,490	4,107	4,108	4,114	4,117	3,854	5,317	5,347	4,391	4,974	4,976	4,977	3,355	1,716	1,951	1,961
Simulated Density (veh/ln/mi)	152	121	109	81	76	86	90	81	72	62	31	20	16	12	10	16
Estimated LOS (Density based)	F	F	F	F	F	F	F	F	F	F	D	B	B	B	A	B

Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

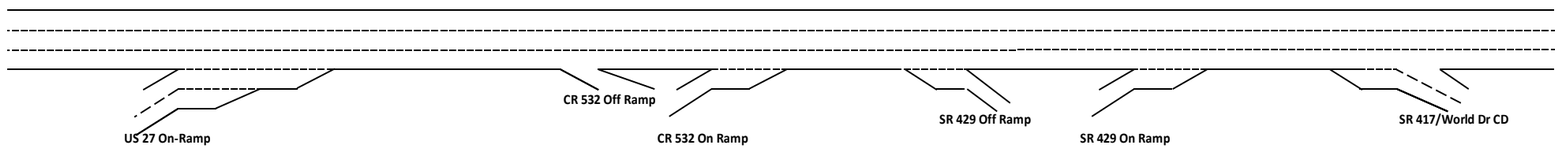
	No-Build	Build	Additional Vehicles processed in Build	
I-4 EB Blocked Vehicles	2823	2187	637	23%

Note: I-4 EB between CR 532 and SR 429 shows more congestion (or worse LOS) under the Build alternative compared to No Build alternative because of the location of the proposed Build improvements and a higher number of processed vehicles in this I-4 segment under the Build alternative (see Section 4.2.2 for more information)

Figure 14: Freeway Lane Schematic – Year 2022 PM Peak Hour Eastbound Direction (Peak Hour)

2022 No Build PM I-4 Eastbound Direction

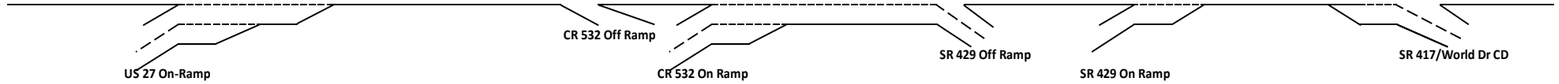
2022 No Build PM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	3,540	556	6,273	531	2,784	1,843	5,324	6,273	531	2,784
Simulated Speed (mph)	6	7	10	18	22	17	14	51	62	69	64	66	67	71	9	4	8
Demand Volume (veh/h)	3,724	5,452	5,452	5,452	5,452	4,825	6,118	6,118	6,118	4,667	5,068	5,068	5,068	3,433	1,433	1,735	1,735
Simulated Volume (veh/h)	2,603	4,169	4,166	4,169	4,167	3,684	4,736	4,739	4,734	3,636	3,980	3,978	3,976	2,682	1,337	1,525	1,534
Simulated Density (veh/ln/mi)	149	120	109	78	62	70	83	31	19	18	15	20	15	13	75	116	100
LOS (Density based)	F	F	F	F	F	F	F	D	B	B	B	C	B	B	F	F	F

2022 Build PM I-4 Eastbound Direction

2022 Build PM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	3,256	777	4,817		6,256	531	2,784	1,843	5,324	6,256	531	2,784
Simulated Speed (mph)	9	9	13	28	33	61	65	65		67	56	61	65	70	71	68	65
Demand Volume (veh/h)	3,724	5,452	5,452	5,452	5,452	4,825	6,118	6,118		4,667	5,068	5,068	5,068	3,433	1,433	1,735	1,735
Simulated Volume (veh/h)	3,221	4,813	4,820	4,820	4,824	4,261	5,509	5,506		4,200	4,600	4,600	4,601	3,103	1,436	1,740	1,747
Simulated Density (veh/ln/mi)	117	103	95	57	49	23	17	21		21	21	25	18	15	10	9	13
LOS (Density based)	F	F	F	F	F	C	B	C		C	C	C	B	B	A	A	B

Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

	No-Build	Build	Additional Vehicles processed in Build	
I-4 EB Blocked Vehicles	3103	2001	1102	36%

Figure 15: Freeway Lane Schematic – Year 2022 AM Peak Hour Westbound Direction (Peak Hour)

2022 No Build AM I-4 Westbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Distance (ft.)	5,695	1,345	11,282	1,113	378	3,016	1,636	3,312	937	4,519	784	4,195	492	30,327
Simulated Speed (mph)	70	62	68	64	61	66	50	51	26	16	17	19	18	70
Demand Volume (veh/h)	3640	5452	5452	5452	5452	4883	5878	5878	5878	4477	4840	4840	4840	3400
Simulated Volume (veh/h)	3,371	5,077	5,082	5,081	5,072	4,671	5,621	5,585	5,620	4,322	4,655	4,684	4,685	3,402
Simulated Density (veh/ln/mi)	16	20	25	27	21	24	38	37	55	91	69	82	64	16
Estimated LOS (Density based)	B	C	C	C	C	C	E	E	F	F	F	F	F	B

2022 No Build AM SR 429 Northbound Direction

Sinclair Rd. Off Ramp

Distance (ft.)	3,270	
Simulated Speed (mph)	66	
Demand Volume (veh/h)	1502	1697
Simulated Volume (veh/h)	1,188	
Simulated Density (veh/ln/mi)	9	
Estimated LOS (Density based)	A	

2022 Build AM I-4 Westbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Distance (ft.)	5,695	1,345	11,282	1,113	378	2,963	5,304	342	4,766	784	4,195	492	30,327
Simulated Speed (mph)	70	60	67	60	55	67	64	63	69	67	64	50	71
Demand Volume (veh/h)	3640	5452	5452	5452	5452	4883	5878	5878	4477	4840	4840	4840	3400
Simulated Volume (veh/h)	3,671	5,533	5,527	5,520	5,507	4,945	5,934	5,905	4,487	4,842	4,858	4,862	3,402
Simulated Density (veh/ln/mi)	18	23	27	31	25	25	23	19	22	18	25	24	16
Estimated LOS (Density based)	B	C	D	D	C	C	C	B	C	B	C	C	B

2022 Build AM SR 429 Northbound Direction

Sinclair Rd. Off Ramp

Distance (ft.)	3,270	
Simulated Speed (mph)	67	
Demand Volume (veh/h)	1502	1697
Simulated Volume (veh/h)	1,270	
Simulated Density (veh/ln/mi)	10	
Estimated LOS (Density based)	A	

	No-Build	Build	Additional Vehicles processed in Build
I-4 WB Blocked Vehicles	0	0	0 -

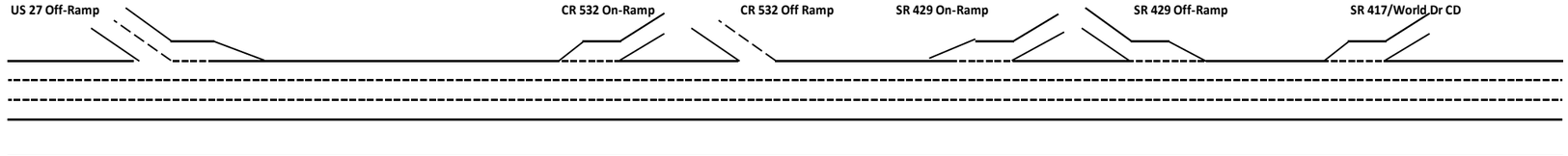
Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

Figure 16: Freeway Lane Schematic – Year 2022 PM Peak Hour Westbound Direction (Peak Hour)

2022 No Build PM I-4 Westbound Direction

2022 No Build PM SR 429 Northbound Direction

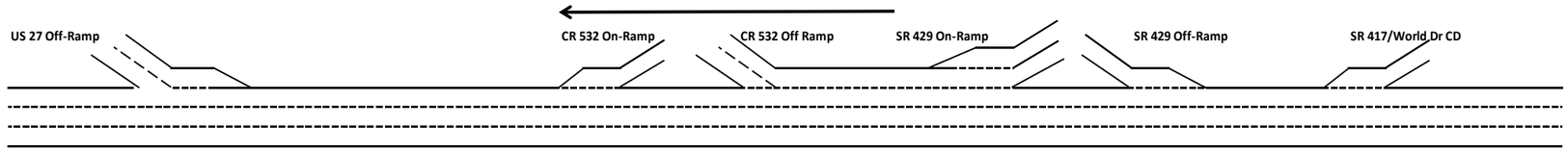


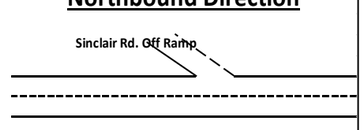
Distance (ft.)	5,695	1,345	11,282	1,113	378	3,016	1,636	3,312	937	4,519	784	4,195	492	30,327
Simulated Speed (mph)	71	63	68	64	60	63	27	23	19	12	13	14	12	7
Demand Volume (veh/h)	3,556	6,148	6,148	6,148	6,148	5,491	7,021	7,021	7,021	5,687	6,138	6,138	6,138	4,770
Simulated Volume (veh/h)	2,559	4,409	4,403	4,399	4,387	3,861	4,940	4,918	4,948	3,778	4,053	4,061	4,064	3,088
Simulated Density (veh/ln/mi)	12	17	22	23	18	20	61	71	65	107	80	99	88	141
Estimated LOS (Density based)	B	B	C	C	B	C	F	F	F	F	F	F	F	F

Distance (ft.)	3,270
Simulated Speed (mph)	66
Demand Volume (veh/h)	1729 | 1902
Simulated Volume (veh/h)	1,325
Simulated Density (veh/ln/mi)	10
Estimated LOS (Density based)	A

2022 Build PM I-4 Westbound Direction

2022 Build PM SR 429 Northbound Direction





Distance (ft.)	5,695	1,345	11,282	1,113	378	2,963	5,304	342	4,766	784	4,195	492	30,327	
Simulated Speed (mph)	70	58	49	54	48	63	61	62	67	65	58	20	12	
Demand Volume (veh/h)	3,556	6,148	6,148	6,148	6,148	5,491	7,021	7,021	5,687	6,138	6,138	6,138	4,770	
Simulated Volume (veh/h)	3,277	5,652	5,670	5,677	5,660	5,054	6,443	6,403	5,068	5,451	5,463	5,466	4,273	
Simulated Density (veh/ln/mi)	16	24	42	37	32	29	27	21	25	21	32	69	115	
Estimated LOS (Density based)	A	B	D	C	B	C	B	A	B	B	C	D	F	

Distance (ft.)	3,270
Simulated Speed (mph)	66
Demand Volume (veh/h)	1729 | 1902
Simulated Volume (veh/h)	1,599
Simulated Density (veh/ln/mi)	12
Estimated LOS (Density based)	B

Legend

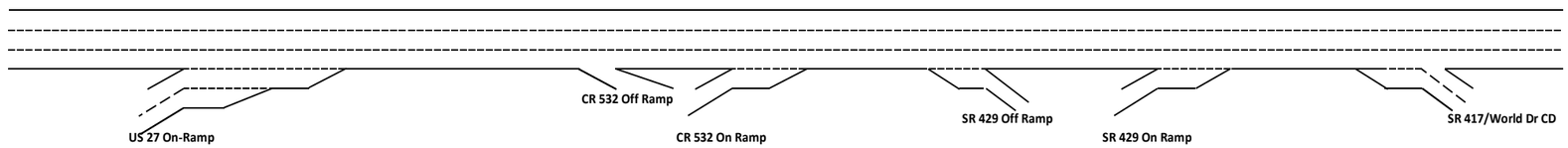
LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

	No-Build	Build	Additional Vehicles processed in Build	
I-4 WB Blocked Vehicles	6695	4261	2433	36%

Note: I-4 WB between CR 532 and US 27 shows more congestion (or worse LOS) under the Build alternative compared to No Build alternative because the proposed Build improvements upstream of this segment increases the number of processed vehicles in this segment under the Build alternative (see Section 4.2.2 for more information)

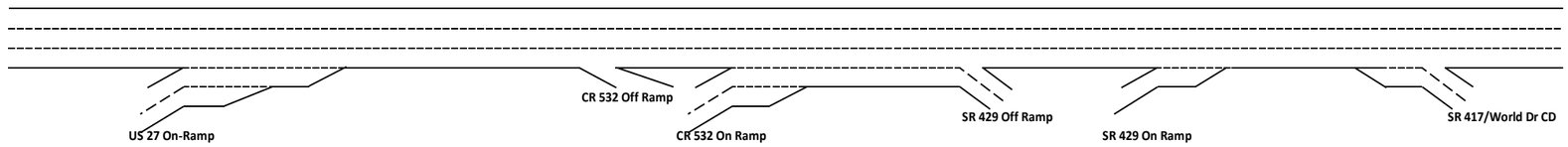
Figure 17: Freeway Lane Schematic – Year 2032 AM Peak Hour Eastbound Direction (Peak Hour)

2032 No Build AM I-4 Eastbound Direction



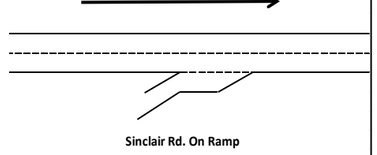
Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	3,540	556	6,273	531	2,784	1,843	5,324	15,276	532	1,174
Simulated Speed (mph)	6	7	9	16	20	16	14	51	61	69	59	63	66	70	5	6	11
Demand Volume (veh/h)	4,037	6,911	6,911	6,911	6,911	6,318	8,198	8,198	8,198	6,250	7,233	7,233	7,233	4,566	2,872	3,220	3,220
Simulated Volume (veh/h)	2,520	4,020	4,027	4,036	4,037	3,687	4,789	4,787	4,779	3,661	4,229	4,225	4,221	2,665	1,513	1,863	1,878
Simulated Density (veh/ln/mi)	150	123	111	82	67	78	86	31	19	18	18	22	16	13	160	98	82
Estimated LOS (Density based)	F	F	F	F	F	F	F	D	B	B	B	C	B	B	F	F	F

2032 Build AM I-4 Eastbound Direction

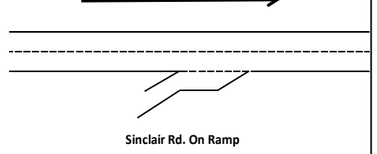


Distance (ft.)	15,579	809	1,546	7,790	1,500	3,256	777	4,817		6,256	531	2,784	1,843	5,324	15,276	532	1,174
Simulated Speed (mph)	6	7	10	18	20	15	12	16		17	15	53	63	70	9	15	36
Demand Volume (veh/h)	4,037	6,911	6,911	6,911	6,911	6,318	8,198	8,198		6,250	7,233	7,233	7,233	4,566	2,872	3,220	3,220
Simulated Volume (veh/h)	2,537	4,234	4,230	4,240	4,247	3,887	5,329	5,339		4,093	4,951	4,949	4,945	3,094	2,419	2,780	2,790
Simulated Density (veh/ln/mi)	152	118	109	77	71	84	92	81		83	83	31	20	15	128	61	39
Estimated LOS (Density based)	F	F	F	F	F	F	F	F		F	F	D	B	B	F	F	E

2032 No Build AM SR 429 Southbound Direction



2032 Build AM SR 429 Southbound Direction



	No-Build	Build	Additional Vehicles processed in Build	
I-4 EB Blocked Vehicles	6037	4708	1328	22%

Legend

LOS (Density based)
A, B, C & D
E
F

Speeds (mph)
20 and below
20 - 30
30 - 45
45 - 55
55 and above

Volume (vph)
5000 and above
5000 - 4000
4000 - 3000
below 3000

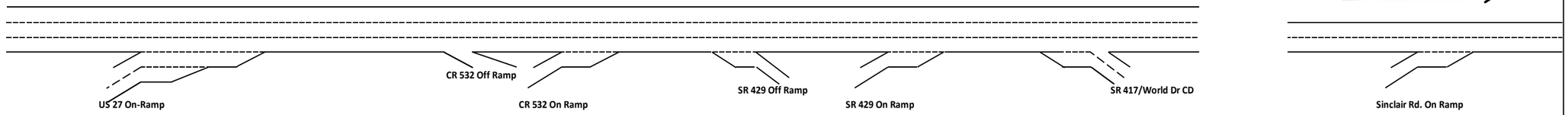
Estimated Density (veh/ln/mi)
90 and above
90 - 70
70 - 50
50 - 35
below 35

Note: I-4 EB between CR 532 and SR 429 shows more congestion (or worse LOS) under the Build alternative compared to No Build alternative because of the location of the proposed Build improvements and a higher number of processed vehicles in this I-4 segment under the Build alternative (see Section 4.2.2 for more information)

Figure 18: Freeway Lane Schematic – Year 2032 PM Peak Hour Eastbound Direction (Peak Hour)

2032 No Build PM I-4 Eastbound Direction

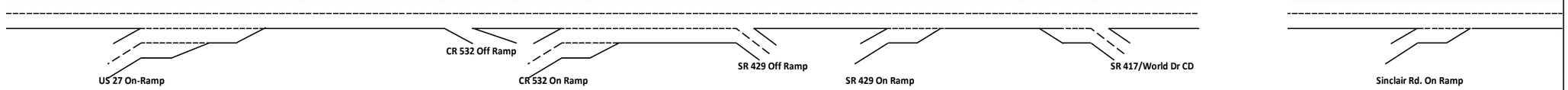
2032 No Build PM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	3,540	556	6,273	531	2,784	1,843	5,324	6,273	531	2,784
Simulated Speed (mph)	5	6	8	13	18	20	16	54	57	70	66	68	68	71	3	4	8
Demand Volume (veh/h)	4,149	6,129	6,129	6,129	6,129	5,303	6,829	6,829	6,829	4,492	5,246	5,246	5,246	3,464	2,283	2,702	2,702
Simulated Volume (veh/h)	2,289	3,646	3,649	3,647	3,650	3,149	4,073	4,072	4,066	2,702	3,141	3,143	3,141	2,067	1,147	1,559	1,561
Simulated Density (veh/ln/mi)	157	128	120	93	68	53	62	25	18	13	12	15	11	10	174	128	98
Estimated LOS (Density based)	F	F	F	F	F	F	F	C	B	B	B	B	B	A	F	F	F

2032 Build PM I-4 Eastbound Direction

2032 Build PM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	3,256	777	4,817		6,256	531	2,784	1,843	5,324	6,256	531	2,784
Simulated Speed (mph)	7	8	12	24	29	61	66	66		69	56	63	66	71	16	12	26
Demand Volume (veh/h)	4,149	6,129	6,129	6,129	6,129	5,303	6,829	6,829		4,492	5,246	5,246	5,246	3,464	2,283	2,702	2,702
Simulated Volume (veh/h)	2,870	4,575	4,579	4,583	4,573	3,950	5,208	5,221		3,452	4,167	4,163	4,162	2,737	2,208	2,574	2,578
Simulated Density (veh/ln/mi)	143	113	99	65	54	22	16	20		17	19	22	16	13	71	73	52
Estimated LOS (Density based)	F	F	F	F	F	C	B	B		B	B	C	B	B	F	F	F

Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

	No-Build	Build	Additional Vehicles processed in Build	
I-4 EB Blocked Vehicles	6682	4140	2541	38%

Figure 19: Freeway Lane Schematic – Year 2032 AM Peak Hour Westbound Direction (Peak Hour)

2032 No Build AM I-4 Westbound Direction

2032 No Build AM SR 429 Northbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Sinclair Rd. Off Ramp

Distance (ft.)	5,695	1,345	11,282	1,113	378	3,016	1,636	3,312	937	4,519	784	4,195	492	30,327	3,270
Simulated Speed (mph)	70	63	68	63	60	66	50	50	26	40	66	63	47	71	65
Demand Volume (veh/h)	4,053	6,129	6,129	6,129	6,129	5,231	6,483	6,483	6,483	4,246	4,981	4,981	4,981	3,460	2,318 / 2,683
Simulated Volume (veh/h)	3,347	5,062	5,060	5,059	5,049	4,543	5,395	5,561	5,591	4,254	4,970	4,982	4,984	3,462	1,718
Simulated Density (veh/ln/mi)	16	20	25	27	21	23	38	38	53	38	19	26	27	16	13
Estimated LOS (Density based)	B	C	C	C	C	C	E	E	F	E	B	D	C	B	B

2032 Build AM I-4 Westbound Direction

2032 Build AM SR 429 Northbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Sinclair Rd. Off Ramp

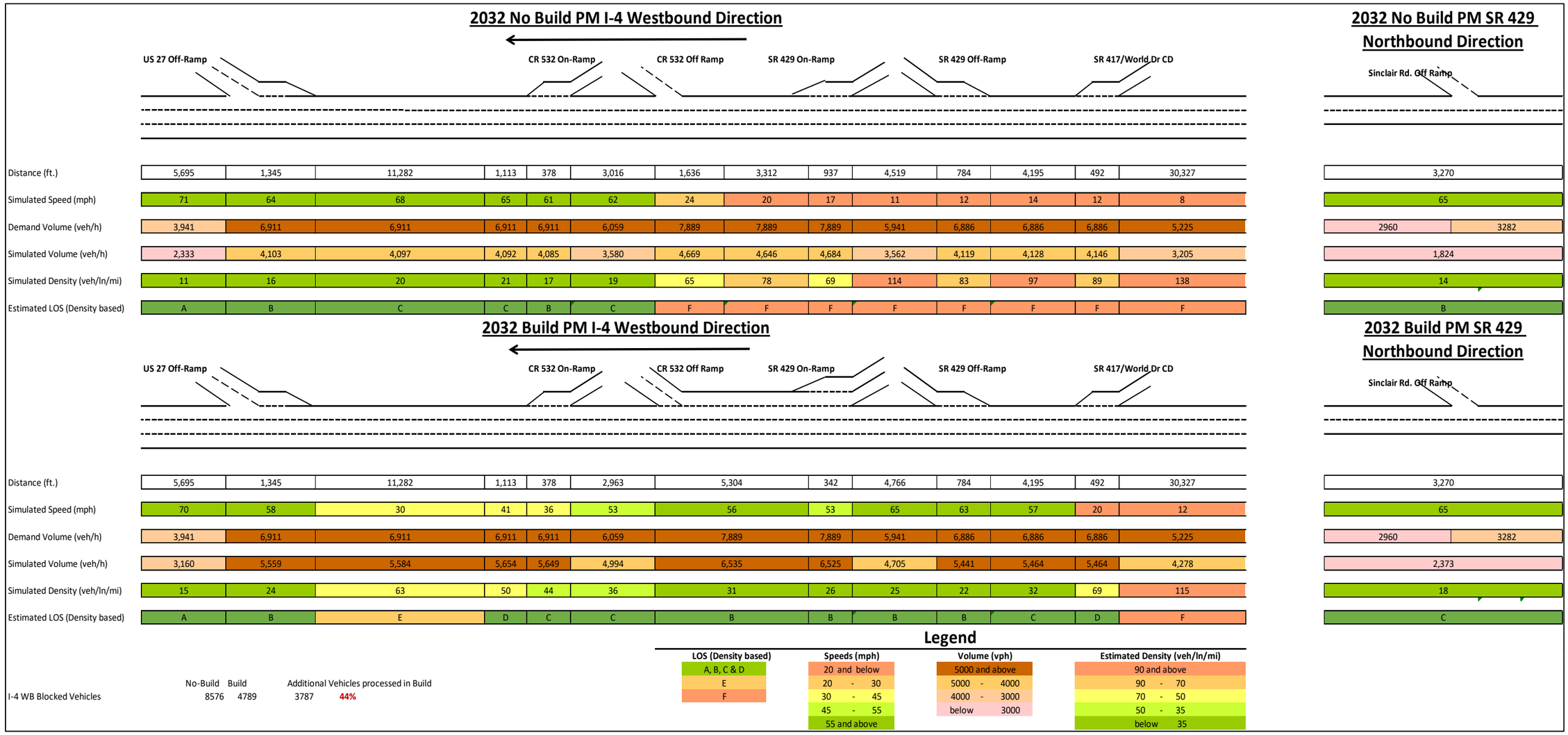
Distance (ft.)	5,695	1,345	11,282	1,113	378	2,963	5,304	342	4,766	784	4,195	492	30,327	3,270
Simulated Speed (mph)	70	60	67	57	55	67	62	56	69	67	64	55	71	67
Demand Volume (veh/h)	4,053	6,129	6,129	6,129	6,129	5,231	6,483	6,483	4,246	4,981	4,981	4,981	3,460	2,318 / 2,683
Simulated Volume (veh/h)	3,758	5,696	5,707	5,681	5,665	5,002	6,184	6,176	4,264	4,958	4,988	4,980	3,458	1,796
Simulated Density (veh/ln/mi)	18	24	28	33	26	25	25	22	21	19	26	23	16	14
Estimated LOS (Density based)	B	B	C	C	B	B	B	A	B	A	B	B	A	B

I-4 WB Blocked Vehicles — No-Build: 0 | Build: 0 | Additional Vehicles processed in Build: 0

Legend

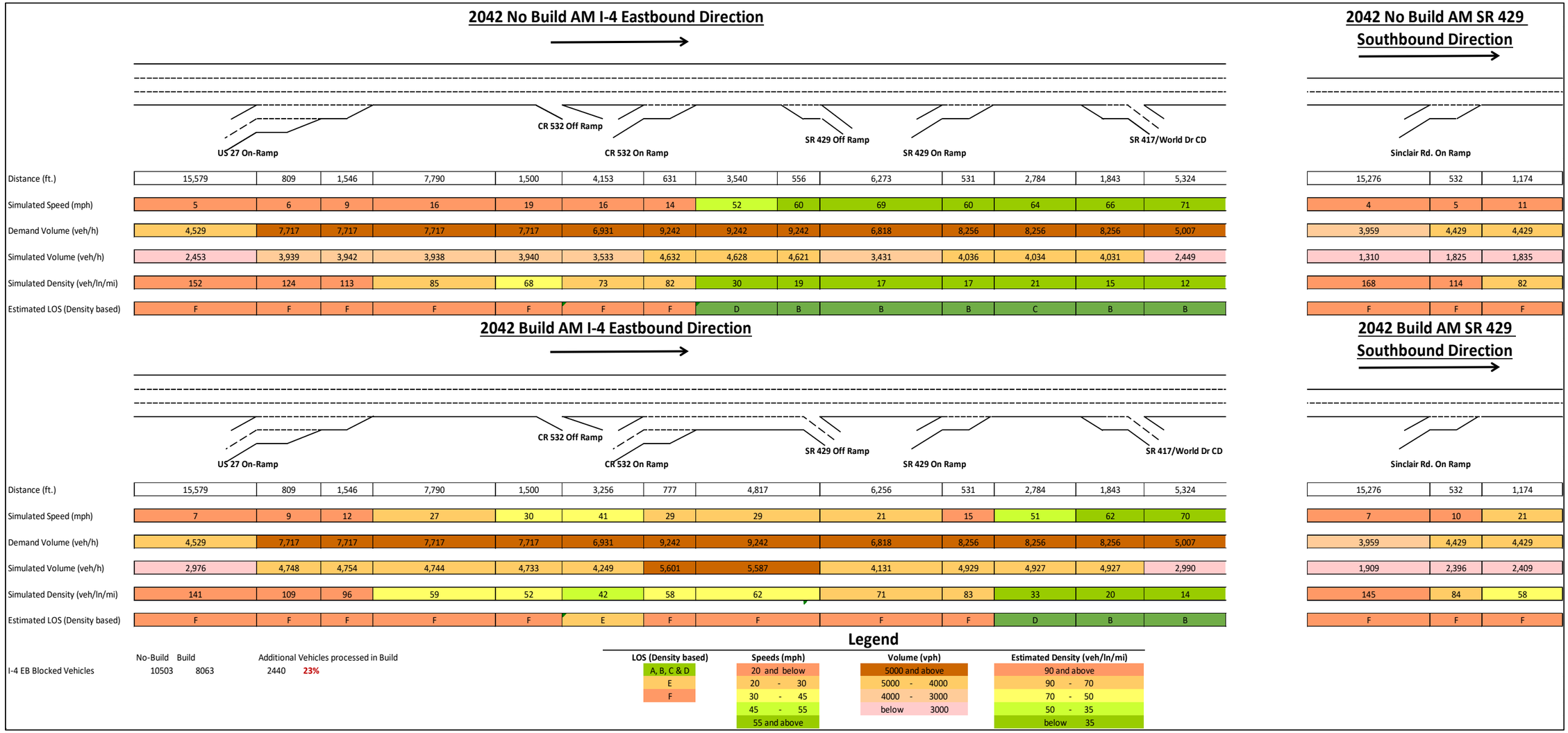
LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

Figure 20: Freeway Lane Schematic – Year 2032 PM Peak Hour Westbound Direction (Peak Hour)



Note: I-4 WB between CR 532 and US 27 shows more congestion (or worse LOS) under the Build alternative compared to No Build alternative because the proposed Build improvements upstream of this segment increases the number of processed vehicles in this segment under the Build alternative (see Section 4.2.2 for more information)

Figure 21: Freeway Lane Schematic – Year 2042 AM Peak Hour Eastbound Direction (Peak Hour)

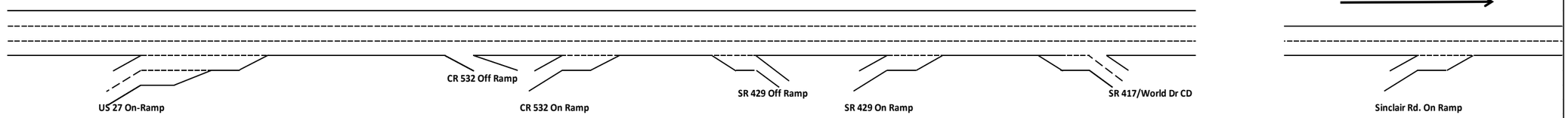


Note: I-4 EB between CR 532 and SR 429 shows more congestion (or worse LOS) under the Build alternative compared to No Build alternative because of the location of the proposed Build improvements and a higher number of processed vehicles in this I-4 segment under the Build alternative (see Section 4.2.2 for more information)

Figure 22: Freeway Lane Schematic – Year 2042 PM Peak Hour Eastbound Direction (Peak Hour)

2042 No Build PM I-4 Eastbound Direction

2042 No Build PM SR 429 Southbound Direction



Distance (ft.)	15,579	809	1,546	7,790	1,500	4,153	631	3,540	556	6,273	531	2,784	1,843	5,324	6,273	531	2,784
Simulated Speed (mph)	4	5	7	11	16	22	17	55	51	70	67	69	69	71	3	3	8
Demand Volume (veh/h)	4,647	6,843	6,843	6,843	6,843	5,819	7,579	7,579	7,579	4,588	5,694	5,694	5,694	3,516	2,995	3,530	3,530
Simulated Volume (veh/h)	2,148	3,397	3,399	3,380	3,368	2,861	3,720	3,723	3,716	2,265	2,729	2,730	2,733	1,688	947	1,494	1,494
Simulated Density (veh/ln/mi)	159	135	125	101	72	44	55	22	18	11	10	13	10	8	182	147	100
Estimated LOS (Density based)	F	F	F	F	F	E	F	C	B	A	B	B	A	A	F	F	F

2042 Build PM I-4 Eastbound Direction

2042 Build PM SR 429 Southbound Direction

Distance (ft.)	15,579	809	1,546	7,790	1,500	3,256	777	4,817	6,256	531	2,784	1,843	5,324	6,256	531	2,784
Simulated Speed (mph)	6	8	11	21	27	61	67	66	70	60	65	67	71	8	12	35
Demand Volume (veh/h)	4,647	6,843	6,843	6,843	6,843	5,819	7,579	7,579	4,588	5,694	5,694	5,694	3,516	2,995	3,530	3,530
Simulated Volume (veh/h)	2,760	4,432	4,431	4,435	4,445	3,777	4,874	4,884	2,972	3,813	3,809	3,805	2,343	2,177	2,716	2,724
Simulated Density (veh/ln/mi)	145	115	102	70	55	21	15	18	14	16	19	14	11	135	74	39
Estimated LOS (Density based)	F	F	F	F	F	C	B	B	B	B	C	B	B	F	F	E

Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

	No-Build	Build	Additional Vehicles processed in Build	
I-4 EB Blocked Vehicles	9802	7005	2797	29%

Figure 23: Freeway Lane Schematic – Year 2042 AM Peak Hour Westbound Direction (Peak Hour)

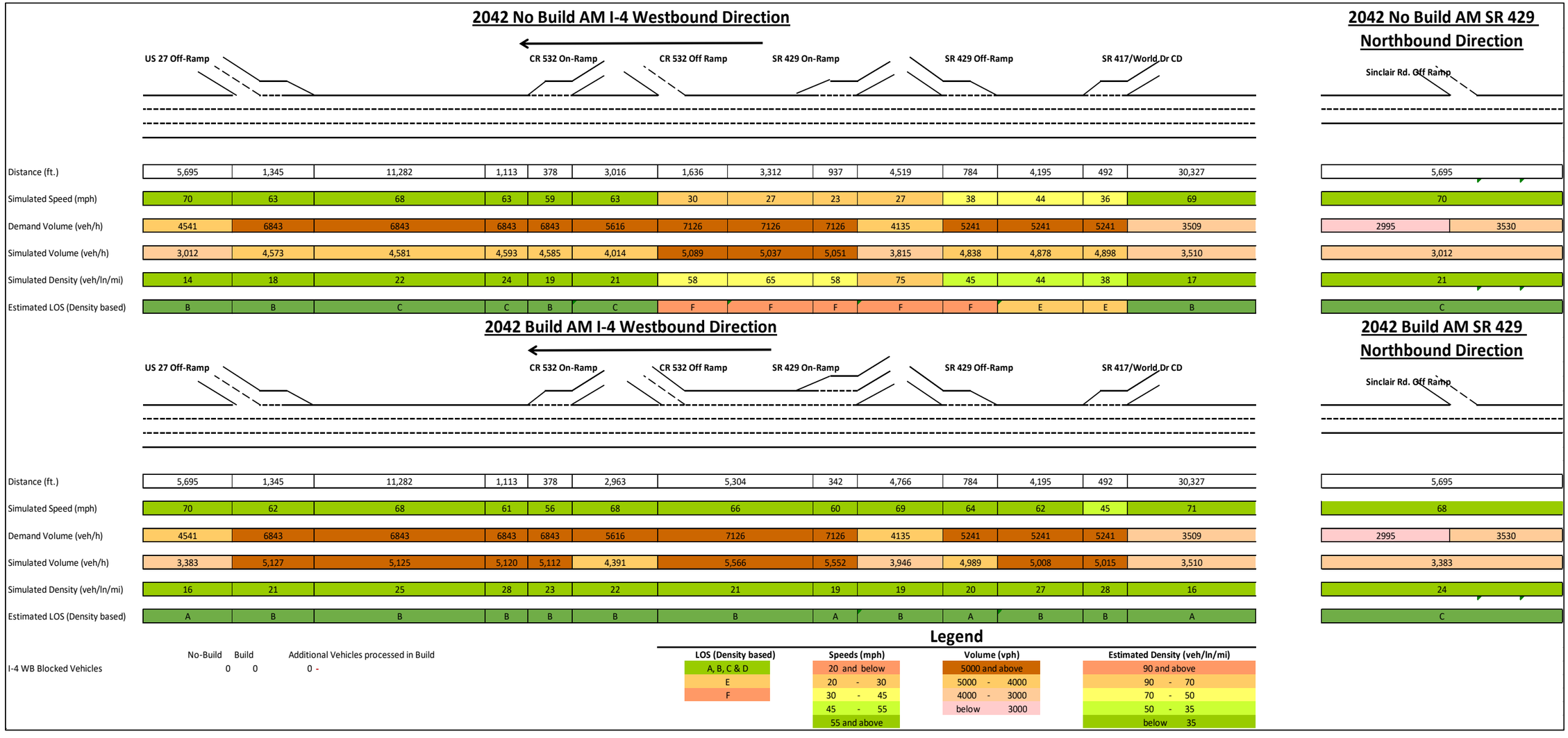


Figure 24: Freeway Lane Schematic – Year 2042 PM Peak Hour Westbound Direction (Peak Hour)

2042 No Build PM I-4 Westbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Distance (ft.)	5,695	1,345	11,282	1,113	378	3,016	1,636	3,312	937	4,519	784	4,195	492	30,327
Simulated Speed (mph)	71	64	69	66	61	62	20	16	14	9	11	13	11	7
Demand Volume (veh/h)	4,423	7,717	7,717	7,717	7,717	6,669	8,800	8,800	8,800	6,376	7,814	7,814	7,814	5,860
Simulated Volume (veh/h)	2,157	3,753	3,763	3,765	3,758	3,262	4,301	4,264	4,271	3,214	3,920	3,910	3,908	3,015
Simulated Density (veh/ln/mi)	10	15	18	19	15	17	72	89	74	121	90	102	93	143
Estimated LOS (Density based)	A	B	C	B	B	B	F	F	F	F	F	F	F	F

2042 No Build PM SR 429 Northbound Direction

Sinclair Rd. Off Ramp

Distance (ft.)	5,695	
Simulated Speed (mph)	71	
Demand Volume (veh/h)	3959	4429
Simulated Volume (veh/h)	2,157	
Simulated Density (veh/ln/mi)	15	
Estimated LOS (Density based)	B	

2042 Build PM I-4 Westbound Direction

US 27 Off-Ramp | CR 532 On-Ramp | CR 532 Off Ramp | SR 429 On-Ramp | SR 429 Off-Ramp | SR 417/World Dr CD

Distance (ft.)	5,695	1,345	11,282	1,113	378	2,963	5,304	342	4,766	784	4,195	492	30,327
Simulated Speed (mph)	70	60	61	61	57	68	63	58	68	63	57	20	12
Demand Volume (veh/h)	4,423	7,717	7,717	7,717	7,717	6,669	8,800	8,800	6,376	7,814	7,814	7,814	5,860
Simulated Volume (veh/h)	3,103	5,445	5,449	5,455	5,445	4,799	6,326	6,307	4,462	5,439	5,455	5,458	4,281
Simulated Density (veh/ln/mi)	15	23	30	30	24	24	25	22	22	22	32	68	115
Estimated LOS (Density based)	A	B	C	C	B	B	B	A	B	B	C	D	F

2042 Build PM SR 429 Northbound Direction

Sinclair Rd. Off Ramp

Distance (ft.)	5,695	
Simulated Speed (mph)	70	
Demand Volume (veh/h)	3959	4429
Simulated Volume (veh/h)	3,103	
Simulated Density (veh/ln/mi)	22	
Estimated LOS (Density based)	C	

	No-Build	Build	Additional Vehicles processed in Build	
I-4 WB Blocked Vehicles	9501	5154	4348	46%

Legend

LOS (Density based)	Speeds (mph)	Volume (vph)	Estimated Density (veh/ln/mi)
A, B, C & D	20 and below	5000 and above	90 and above
E	20 - 30	5000 - 4000	90 - 70
F	30 - 45	4000 - 3000	70 - 50
	45 - 55	below 3000	50 - 35
	55 and above		below 35

4.2.3 Blocked Vehicles

As discussed in Section 2.4.2, an important measure of effectiveness for the study area is the number of vehicles that remain outside the network (or blocked vehicles) due to congestion within the study area. This is indicative of how much of the demand the model is unable to process due to oversaturated conditions. Also, as discussed in Section 2.4.2, and consistent with *2014 FDOT Traffic Analysis Handbook (Section 7.5)*, spatial and temporal limits are extended to address unmet demand during existing conditions calibration. With an anticipated increase in traffic demand between existing and future years, blocked vehicles were observed in the future simulation models that maintained the existing VISSIM model spatial and temporal limits. However, these limits could not be further extended (more than what was done for existing models) because of study constraints and because of the interim nature of the proposed Build improvements. Therefore, based on input from FDOT, blocked vehicles and total travel time that account for blocked vehicles are also used to illustrate the benefits of the Build alternative in the future conditions. The number of blocked vehicles is summarized for CR 532 and I-4 vehicle inputs in **Table 11**. The following observations can be made from **Table 11**:

- Number of blocked vehicles in the No Build alternative increases between 2022 and 2042 for I-4 and CR 532.
- The Build alternative follows a similar pattern (as the No Build alternative) for I-4 and CR 532, but with lower number of blocked vehicles compared to the No Build alternative. This indicates an improvement in traffic operations within the study area.
- Blocked vehicles are not observed for I-4 westbound direction in the AM peak hour in both Build and No Build alternatives.
- Substantial improvement (in number of vehicles processed) is observed in 2022 and 2032 (both AM and PM peak hours) for CR 532. Under the Build alternative, the number of blocked vehicles is zero in 2022, while a substantial improvement (56% to 79%) is observed in blocked vehicle reduction in 2032 in both AM and PM peak hours.

The benefits of the Build alternative are also specified through the measurement of blocked vehicle queues that form at the network entry points in VISSIM models (**see Table 11C**). Below are some examples based on the number of blocked vehicles reported by VISSIM for 2032:

- I-4 eastbound west of US 27 will have an approximately three-mile longer queue in the AM peak hour
- I-4 westbound east of SR 417/World Drive will have an approximately six-mile longer queue in the PM peak hour

Table 11A: Blocked Vehicles & Queues for I-4 Vehicle Inputs

Input Direction	2022		2032		2042		Percent decrease in Blocked Vehicles in Build Compared to No Build		
	No Build	Build	No Build	Build	No Build	Build	2022	2032	2042
AM Peak Hour									
I-4 EB	2,823	2,187	6,037	4,708	10,503	8,063	23%	22%	23%
I-4 WB	0	0	0	0	0	0	-	-	-
PM Peak Hour									
I-4 EB	3,103	2,001	6,682	4,140	9,802	7,005	36%	38%	29%
I-4 WB	6,695	4,261	8,576	4,789	9,501	5,154	36%	44%	46%

Table 11B: Blocked Vehicles & Queues for CR 532 Vehicle Inputs

Input Direction	2022		2032		2042		Percent decrease in Blocked Vehicles in Build Compared to No Build		
	No Build	Build	No Build	Build	No Build	Build	2022	2032	2042
AM Peak Hour									
CR 532 EB	1,579	0	4,551	1,986	8,062	6,033	100%	56%	25%
CR 532 WB	693	0	3,096	660	4,949	3,591	100%	79%	27%
PM Peak Hour									
CR 532 EB	390	0	2,887	655	5,254	2,987	100%	77%	43%
CR 532 WB	331	0	2,431	702	5,746	2,407	100%	71%	58%

Table 11C: Blocked Vehicle Queue Reduction for I-4 and CR 532

Roadway/Direction	Queue (mile) Reduction at the Network Entry Points in Build Compared to No Build		
	2022	2032	2042
AM Peak Hour			
I-4 EB	1	3	4
I-4 WB	-	-	-
CR 532 EB	2	5	3
CR 532 WB	1	5	2
PM Peak Hour			
I-4 EB	2	4	4
I-4 WB	4	6	7
CR 532 EB	1	4	4
CR 532 WB	1	3	5

4.2.4 Travel Time Results

VISSIM microsimulation models are used to produce travel times along the I-4 and CR 532 segments for 2022, 2032 and 2042 analysis years.

For a fair comparison of travel time between alternatives, a total travel time (in vehicle hours) is estimated for all vehicles entering from I-4 and CR 532 including vehicles in the network and blocked vehicles. The travel time for vehicles within the network was obtained from VISSIM travel time evaluation for CR 532 and I-4 segments separately. The delay for the blocked vehicles was calculated using the methodology provided in the Section 7.5 of the *2014 FDOT Traffic Analysis Handbook*. First, the blocked vehicles for I-4 and CR 532 were obtained from VISSIM error files (also summarized in **Table 11**) and then delay was calculated for the peak hour for those vehicles. The total travel time results for I-4 and CR 532 are summarized in **Tables 12** and **13**.

Tables 12 and **13** indicate that the total travel time (vehicle-hours) for vehicles entering from I-4 and CR 532 inputs in the Build alternative is significantly less when compared to the No Build Alternative in all analysis years.

Table 12: Peak Hour Travel Times (vehicle-hours) for I-4 segments

Direction	Roadway Segment	2022		2032		2042	
		No Build	Build	No Build	Build	No Build	Build
AM Peak Hour							
I-4 EB	West of US 27 on to US 27 on	1,298	1,323	1,335	1,292	1,344	1,225
	US 27 on to CR 532 Off	621	650	648	592	662	503
	CR 532 Off to CR 532 On	194	207	187	188	175	108
	CR 532 On to SR 429 Off	88	232	76	207	70	158
	I-4 EB Total (veh-hours)	2,201	2,411	2,246	2,279	2,251	1,994
	Total Travel Time (veh-hours) *	**5,024**	**4,598**	**8,282**	**6,987**	**12,754**	**10,056**
I-4 WB	SR 429 on to CR 532 Off	141	97	143	101	218	89
	CR 532 Off to CR 532 On	43	45	42	44	40	39
	CR 532 On to US 27 Off	203	226	202	230	182	206
	US 27 off to End	53	58	53	58	47	53
	I-4 WB Total (veh-hours)	440	426	439	434	487	388
	Total Travel Time (veh-hours) *	**440**	**426**	**439**	**434**	**487**	**388**
PM Peak Hour							
I-4 EB	West of US 27 on to US 27 on	1,215	862	1,331	1,248	1,414	1,264
	US 27 on to CR 532 Off	619	484	713	535	760	570
	CR 532 Off to CR 532 On	169	54	129	50	106	47
	CR 532 On to SR 429 Off	74	59	48	47	38	40
	I-4 EB Total (veh-hours)	2,078	1,459	2,221	1,880	2,319	1,922
	Total Travel Time (veh-hours) *	**5,181**	**3,459**	**8,903**	**6,020**	**12,120**	**8,926**
I-4 WB	SR 429 on to CR 532 Off	232	112	254	128	287	105
	CR 532 Off to CR 532 On	39	52	36	65	33	43
	CR 532 On to US 27 Off	176	322	163	466	148	242
	US 27 off to End	40	52	36	50	34	49
	I-4 WB Total (veh-hours)	487	538	489	708	502	439
	Total Travel Time (veh-hours) *	**7,182**	**4,799**	**9,065**	**5,497**	**10,004**	**5,593**

* Total Travel Time includes travel time for all vehicles including vehicles in the network and blocked vehicles.

Table 13: Peak Hour Travel Times (vehicle-hours) for CR 532 Segments

Direction	Roadway Segment	2022		2032		2042	
		No Build	Build	No Build	Build	No Build	Build
AM Peak Hour							
CR 532 EB	Ronald Reagan Parkway to Masters Boulevard	58	12	107	61	92	47
	Masters Boulevard to Legends Boulevard	28	7	43	29	28	26
	Legends Boulevard to S Goodman Road	12	12	24	23	21	23
	S Goodman Road to I-4 WB Ramps	14	4	22	6	21	6
	I-4 WB Ramps to I-4 EB Ramps	2	6	3	6	3	8
	I-4 EB Ramps to Kemp Road	6	19	8	27	6	31
	CR 532 EB Total (veh-hours)	121	61	208	152	171	140
	Total Travel Time (veh-hours) *	**1,700**	**61**	**4,759**	**2,138**	**8,232**	**6,035**
CR 532 WB	Kemp Road to I-4 EB Ramps	14	11	20	34	47	30
	I-4 EB Ramps to I-4 WB Ramps	2	9	3	12	3	13
	I-4 WB Ramps to S Goodman Road	1	2	1	3	2	3
	S Goodman Road to Legends Boulevard	5	5	8	9	12	13
	Legends Boulevard to Masters Boulevard	7	8	10	13	15	26
	Masters Boulevard to Ronald Reagan Parkway	8	9	11	13	13	15
	CR 532 WB Total (veh-hours)	37	43	53	83	92	101
	Total Travel Time (veh-hours) *	**730**	**43**	**3,150**	**743**	**5,040**	**3,692**
PM Peak Hour							
CR 532 EB	Ronald Reagan Parkway to Masters Boulevard	40	10	135	62	143	136
	Masters Boulevard to Legends Boulevard	38	6	42	38	44	60
	Legends Boulevard to S Goodman Road	22	7	19	28	17	21
	S Goodman Road to I-4 WB Ramps	25	18	24	25	24	27
	I-4 WB Ramps to I-4 EB Ramps	2	4	3	7	3	8
	I-4 EB Ramps to Kemp Road	5	7	7	12	7	8
	CR 532 EB Total (veh-hours)	131	52	231	172	238	261
	Total Travel Time (veh-hours) *	**521**	**52**	**3,118**	**828**	**5,492**	**2,991**
CR 532 WB	Kemp Road to I-4 EB Ramps	42	19	52	28	38	43
	I-4 EB Ramps to I-4 WB Ramps	3	9	3	15	3	13
	I-4 WB Ramps to S Goodman Road	1	2	2	5	2	6
	S Goodman Road to Legends Boulevard	7	10	10	10	8	17
	Legends Boulevard to Masters Boulevard	11	11	20	23	13	18
	Masters Boulevard to Ronald Reagan Parkway	11	12	13	41	15	18
	CR 532 WB Total (veh-hours)	75	65	100	122	80	115
	Total Travel Time (veh-hours) *	**407**	**65**	**2,531**	**824**	**5,826**	**2,522**

* Total Travel Time includes travel time for all vehicles including vehicles in the network and blocked vehicles.

4.2.5 CR 532 Intersection Performance Results

Table 14 summarizes the overall intersection LOS and delay for the peak hour for analysis years 2022, 2032 and 2042. The detailed projected demand and simulated vehicles, vehicle delays and queues by movement for each analysis hour are reported in **Appendix J.**

The following observations are made from the intersection performance results:

- The ramps are anticipated to operate at a significantly improved LOS D or better through 2032 under the Build alternative compared to the No Build alternative. The ramp terminals operating at a better LOS under the Build alternative will help with improved I-4 westbound mainline operations (especially in the PM peak period) and a higher number of processed vehicles on I-4 in both eastbound and westbound directions.
- Under the Build alternative, there is a significant improvement with all intersections operating at LOS E or better in 2022 AM and PM peak hours.
- When considering the cumulative delay (sum of all study intersection delays), the Build alternative shows more than 60% improvement in 2022 (AM and PM peak hours) and more than 45% (PM peak hour) improvement in 2032. This shows the noticeably improved traffic conditions in the Build alternative compared to the No Build alternative.
- The following counterintuitive conclusions are observed from the intersection delay results:
    - Under both the No Build and Build alternatives, in some cases (i.e., CR 532 and Masters Boulevard), there is slight reduction in delay in 2042 when compared to 2032 conditions, but these values are comparable. This is because of the higher number of blocked vehicles (or a smaller number of vehicles processed through the intersection) in 2042 when compared to 2032.
    - In some cases, within the same year (i.e., CR 532 and I-4 westbound ramps), the intersection delay under the No Build alternative is lower than the Build alternative. This is because of the additional number of vehicles being processed at these intersections under the Build alternative compared to the No Build alternative. Furthermore, considering the oversaturated traffic conditions and number of blocked vehicles along CR 532 in the future conditions, especially in 2032 and 2042 (comparing both No Build and Build alternatives), the cumulative intersection delay better describes the study results. The cumulative delay generally increases between years and the No Build alternative delay is generally higher than the Build alternative delay.

- The cumulative delays along CR 532 illustrate that year 2032 is the year of failure. Under both the No Build (AM and PM peak hours) and Build (AM peak hour) alternatives, cumulative delays for 2032 and 2042 are very comparable indicating the proposed improvements reach capacity in 2032.

Table 14: VISSIM Intersection Results Summary

AM Peak Hour																
Study Intersection	**Control**	**Year 2022**				**Year 2032**				**Year 2042**				**Percentage Improvement in Build Delay Compared to No Build Delay**		
	Type	**No Build**		**Build**		**No Build**		**Build**		**No Build**		**Build**				
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**2022**	**2032**	**2042**
CR 532 @ Masters Boulevard	Signal	123.6	F	17.2	B	172.4	F	192.8	F	162.7	F	190.4	F	86%	-12%	-17%
CR 532 @ Legends Boulevard	Signal	118.3	F	23.8	C	206.6	F	96.2	F	166.1	F	93.1	F	80%	53%	44%
CR 532 @ S Goodman Road	Stop	27.6	D	5.3	A	44.8	E	36.4	E	37.3	E	30.5	D	81%	19%	18%
CR 532 @ I-4 WB Ramps	Signal	32.5	C	29.9	C	37.0	D	39.1	D	58.8	E	42.8	D	8%	-6%	27%
CR 532 @ I-4 EB Ramps	Signal	64.7	E	26.2	C	66.2	E	52.3	D	74.6	E	40.5	D	60%	21%	46%
CR 532 @ Kemp Road	Signal	132.4	F	72.1	E	83.8	F	79.8	E	129.3	F	85.2	F	46%	5%	34%
Cumulative Delay		**499.1**	**-**	**174.5**	**-**	**610.6**	**-**	**496.6**	**-**	**628.8**	**-**	**482.5**	**-**	**65%**	**19%**	**23%**

PM Peak Hour																
Study Intersection	**Control**	**Year 2022**				**Year 2032**				**Year 2042**				**Percentage Improvement in Build Delay Compared to No Build Delay**		
	Type	**No Build**		**Build**		**No Build**		**Build**		**No Build**		**Build**				
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**2022**	**2032**	**2042**
CR 532 @ Masters Boulevard	Signal	88.2	F	24.7	C	278.4	F	98.1	F	269.1	F	215.4	F	72%	65%	20%
CR 532 @ Legends Boulevard	Signal	110.6	F	26.5	C	144.7	F	92.3	F	179.4	F	157.2	F	76%	36%	12%
CR 532 @ S Goodman Road	Stop	45.9	E	7.4	A	45.1	E	31.9	D	47.2	E	38.0	E	84%	29%	19%
CR 532 @ I-4 WB Ramps	Signal	68.2	E	39.8	D	68.3	E	44.6	D	70.8	E	61.7	E	42%	35%	13%
CR 532 @ I-4 EB Ramps	Signal	74.6	E	31.4	C	81.4	F	51.4	D	76.5	E	58.4	E	58%	37%	24%
CR 532 @ Kemp Road	Signal	126.0	F	58.6	E	133.7	F	80.5	F	117.5	F	87.9	F	53%	40%	25%
Cumulative Delay		**513.5**	**-**	**188.6**	**-**	**751.4**	**-**	**398.7**	**-**	**760.5**	**-**	**618.6**	**-**	**63%**	**47%**	**19%**

Notes:
1. LOS is an estimated LOS using HCM 6th delay thresholds.
2. Average delay (hour) is obtained from VISSIM network performance results and is reported in sec/veh.
3. Within a same alternative (No Build or Build), 2042 intersection delay is lower than 2032 because of higher number of blocked vehicles in 2042 compared to 2032 (ex: CR 532 at Masters Boulevard under No Build).
4. In 2032 AM Masters Boulevard No Build processes 2,148 vehicles whereas Build alternative processes 2,637 vehicles. This is a 23% increase.
5. In 2042 AM Masters Boulevard No Build processes 2,414 vehicles whereas Build alternative processes 2,836 vehicles. This is an 18% increase.
6. In 2032 AM I-4 WB Ramps No Build processes 3,188 vehicles whereas Build alternative processes 3,947 vehicles. This is a 24% increase.
7. Overall intersection delay is reported for both stop controlled and signalized intersections.

4.2.6 CR 532 Off Ramp Queue Results

Maximum queue results from the VISSIM intersection node evaluation are summarized in **Table 15** for the peak hour for analysis years 2022, 2032 and 2042. As indicated in **Table 15**, queues will not backup to I-4 mainline in all analysis years under the Build alternative. Individual movement queues for all other movements are provided in **Appendix J.**

Table 15: Off Ramp Available Storage and Maximum Queue Length Results at I-4 and CR 532 Interchange

AM Peak Hour								
Location	**Available Storage Length (feet)**		**2022 Maximum Queue Length (feet)**		**2032 Maximum Queue Length (feet)**		**2042 Maximum Queue Length (feet)**	
	No Build	**Build**	**No Build**	**Build**	**No Build**	**Build**	**No Build**	**Build**
I-4 WB off ramp	1,950	1,125	1,225	300	1,175	400	>1,950	475
I-4 EB off ramp	1,600	1,700	150	75	225	125	591	175

PM Peak Hour								
Location	**Available Storage Length (feet)**		**2022 Maximum Queue Length (feet)**		**2032 Maximum Queue Length (feet)**		**2042 Maximum Queue Length (feet)**	
	No Build	**Build**	**No Build**	**Build**	**No Build**	**Build**	**No Build**	**Build**
I-4 WB off ramp	1,950	1,125	>1,950	575	>1,950	650	>1,950	1,350
I-4 EB off ramp	1,600	1,700	650	275	850	350	1,225	400

Notes:
1. WB off ramp queue at I-4 and CR 532 backs up onto I-4 mainline for 2042 AM peak hour and for 2022, 2032, and 2042 PM peak hours under the No Build alternative.
2. WB off ramp queue at I-4 and CR 532 is not anticipated to back up onto I-4 mainline under the Build alternative (2022, 2032 and 2042 peak hours).

4.2.7 Anticipated Year of Failure

- In summary, the Build alternative provides benefits within the study area through 2032 as evidenced from the performance measures. Overall, benefits are seen in the Build alternative in the AM and PM peak hours for 2022 and 2032. While the 2042 Build alternative shows improvement when compared to the No Build alternative, it is evident from networkwide metrics and cumulative intersection delays that the Build alternative will begin to fail after 2032 indicating additional improvements are warranted in the study area beyond 2032.

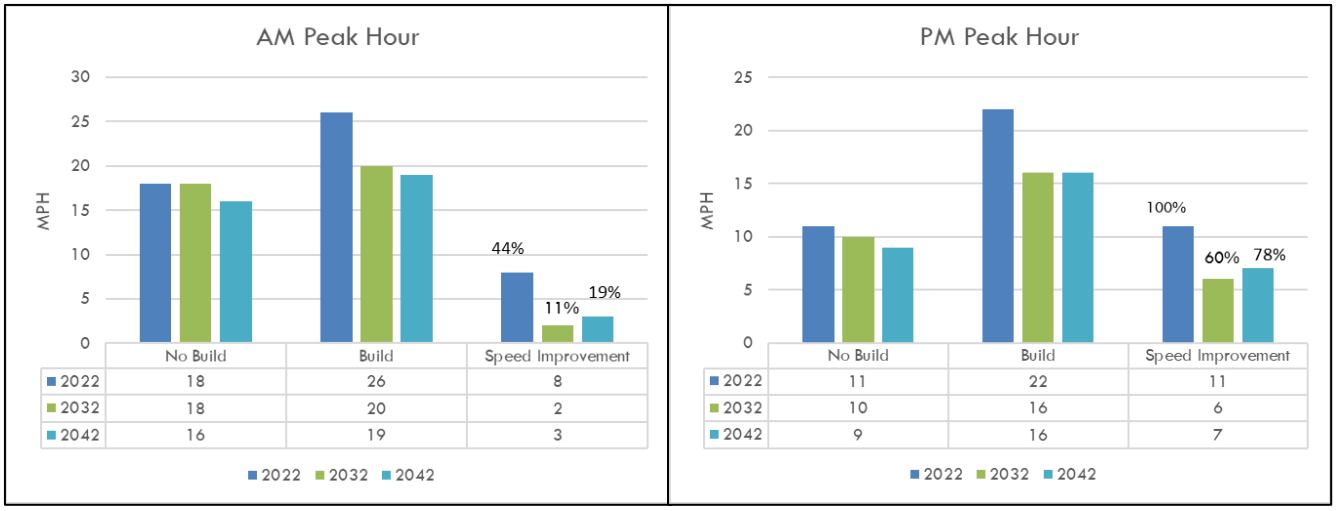
- Under the Build alternative, networkwide MOEs including average delay, total travel time and number of arrived vehicles have significant differences between 2022 and 2032, but 2032 and 2042 values are comparable. In addition, under both No Build (AM and PM peak hours) and Build (AM peak hour) alternatives, cumulative delays for 2032 and 2042 are very comparable, indicating the proposed improvements reach capacity by 2032.

4.2.8 Operational Results Summary

The traffic operational analysis was performed for the future analysis years for both No Build and Build alternatives. A brief summary of the microsimulation analysis results is provided below.

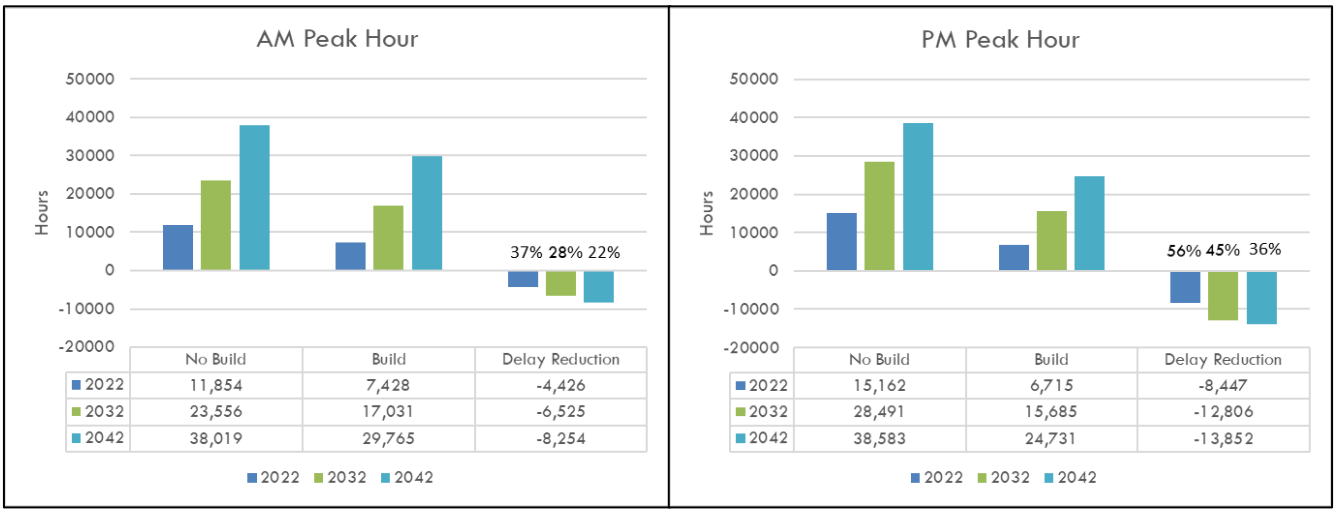
- **Networkwide Performance:** The network performance results indicate an improvement in average speed, total delay and average delay times, number of arrived vehicles, latent delay and latent demand under the Build alternative (compared to the No Build alternative). **Figure 25** shows the improvement in travel speeds within the study area in the Build alternative.

Figure 25: Networkwide Average Speed (mph) Summary



Similarly, under the Build alternative, there is significant reduction in the total delay plus latent delay compared to the No Build alternative as shown in **Figure 26.**

Figure 26: Networkwide Total Delay Plus Latent Delay (hours) Summary

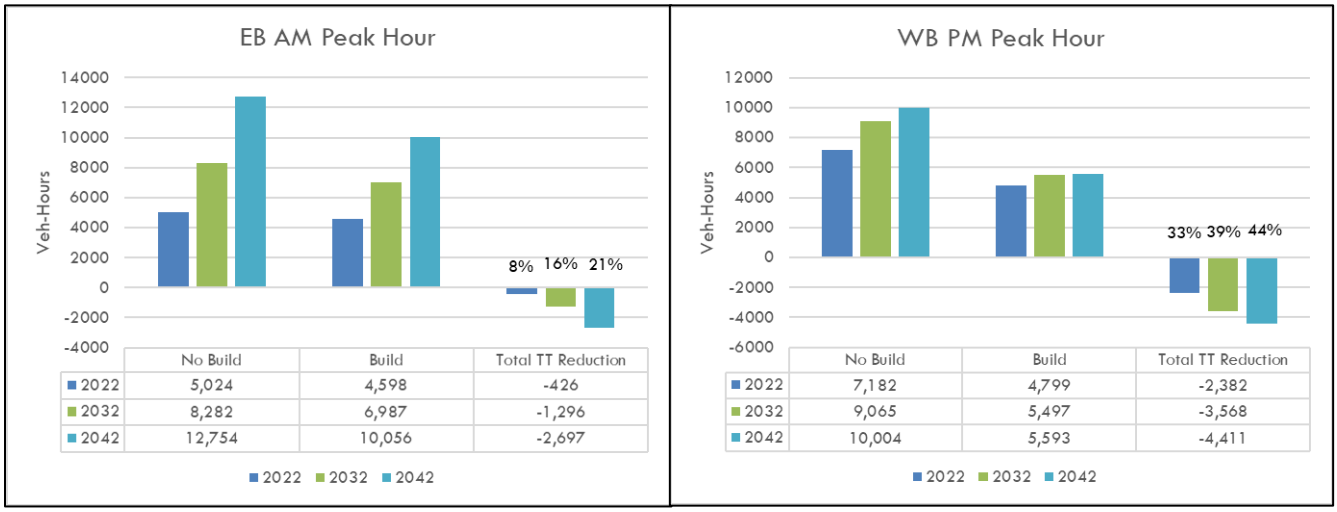


	No Build	Build	Delay Reduction
2022	11,854	7,428	-4,426
2032	23,556	17,031	-6,525
2042	38,019	29,765	-8,254

	No Build	Build	Delay Reduction
2022	15,162	6,715	-8,447
2032	28,491	15,685	-12,806
2042	38,583	24,731	-13,852

- **Travel Times:** Build alternative travel time results along I-4, in general, show improvements in both directions when compared to No Build alternative with the inclusion of blocked vehicles. The travel time savings are more significant in the PM peak hour compared to the AM peak hour.

Figure 27: I-4 Total Travel Time (vehicle-hours) Summary



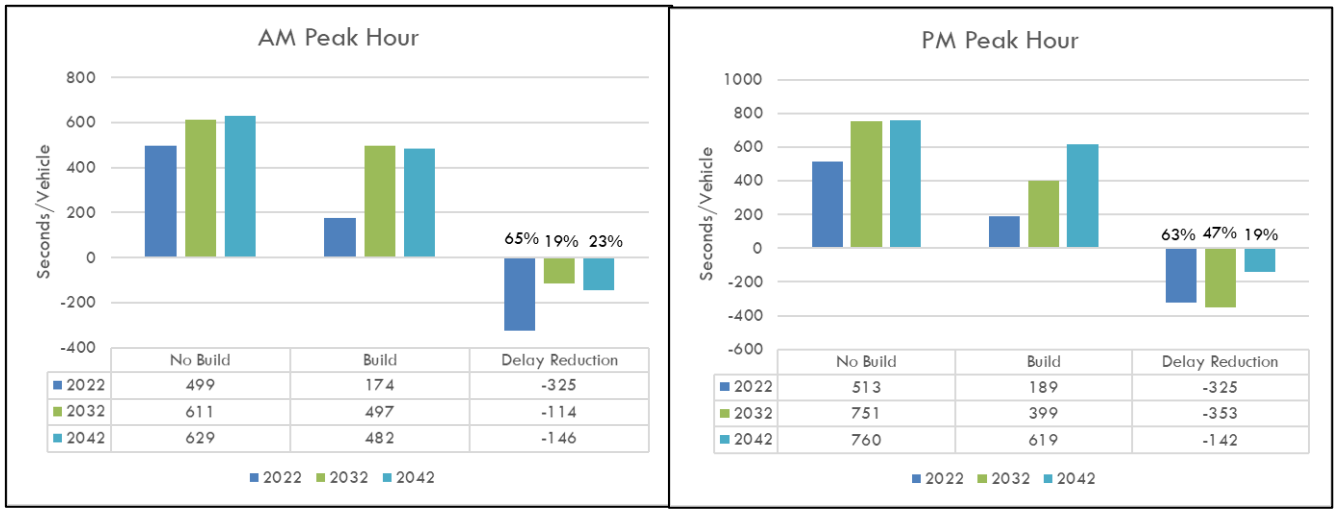
	No Build	Build	Total TT Reduction
2022	5,024	4,598	-426
2032	8,282	6,987	-1,296
2042	12,754	10,056	-2,697

	No Build	Build	Total TT Reduction
2022	7,182	4,799	-2,382
2032	9,065	5,497	-3,568
2042	10,004	5,593	-4,411

Figure 27 shows the total travel time in the peak direction for AM (eastbound) and PM (westbound) peak periods along I-4. This is reported in vehicle-hours and includes the blocked vehicles in the calculation.

- **Intersection Analysis:** The intersection analysis results indicate a significant improvement in traffic operations along CR 532 in Build compared to the No Build in 2022. Even though LOS remains largely unchanged from No Build to Build in 2032 and 2042, overall delays for most intersections have improved under the Build alternative. Moreover, the ramp terminals operate within the target LOS E by 2032 under the Build alternative, which will improve I-4 mainline operations as well. **Figure 28** shows improvement in terms of cumulative delay (including blocked vehicle delay) under the Build alternative when compared to the No Build alternative.

Figure 28: Cumulative Delay for Study Intersections (seconds/vehicle)



- 2042 Build alternative shows improvement in key performance measures compared to the No Build alternative. However, it is evident from networkwide metrics and cumulative intersection delays that the Build alternative will begin to fail after 2032 indicating additional improvements are warranted in the study area beyond 2032.

5 Safety (Crash) Analysis

The proposed improvements are likely to have a positive impact on crash occurrence. As part of this study a safety analysis was conducted based on the required procedures and methodology for a SIMR per the FDOT SIO Interchange Access Request Users Guide (IARUG) dated January 2018 that follows the criteria contained in the Highway Safety Manual (HSM). The safety analysis was based on the following methodology:

- Identifying the Crash Type & Crash Severity
- Calculation of Crash Rates
- Description of Existing Crash Trends
- Development of Safety Performance Functions (SPF's)
- Development of Empirical Bayes Method
- Application of Crash Reduction Estimations (CRF's)
- Crash Reduction Benefit

5.1 Existing Crash Data Information

Crash statistics along I-4 and CR 532 were obtained from the Signal Four Analytics and FDOT Crash Analysis Reporting System (CARS) database based on the latest available five years of crash data (from January 1, 2012 to December 31, 2016). **Table 16** summarizes the crashes (by severity and conditions) for the freeway mainline, ramp merge/diverge areas, and ramp terminal intersections based on the segmentation process utilized for this SIMR. The specific segmentation process used for this study is shown below:

- I-4 Freeway Segment between US 27 & CR 532
- Eastbound I-4 Diverge to CR 532
- Eastbound I-4 and CR 532 Ramp Terminal
- Eastbound I-4 Merge from CR 532
- Eastbound I-4 Freeway Segment (between CR 532 & SR 429)
- Eastbound I-4 Diverge to SR 429
- Eastbound I-4 Merge from SR 429
- I-4 Freeway Segment (between SR 429 and World Drive/SR 417)
- Westbound I-4 Diverge to SR 429
- Westbound I-4 Merge from SR 429
- Westbound I-4 Diverge to CR 532
- Westbound I-4 and CR 532 Ramp Terminal
- Westbound I-4 Merge from CR 532
- SR 429 between I-4 and Sinclair Road

Table 16: Crash Summary by Severity & Conditions (Jan 2012-Dec 2016)

Crash Segment	Crash Severity & Conditions									
	Total	**Fatal**	**Injury**	**Property Damage Only**	**Daylight**	**Dark without Light**	**Dusk**	**Dawn**	**Dry**	**Wet**
I-4 between US 27 & CR 532	242	2	77	163	145	79	10	7	155	87
I-4 between CR 532 & SR 429	121	0	39	82	75	32	8	6	93	28
I-4 between SR 429 & World Dr	88	0	25	63	59	22	5	2	66	22
SR 429 between Sinclair Rd & I-4	2	0	0	2	1	1	0	0	2	0
EB I-4 Diverge to CR 532	33	2	3	28	23	10	0	0	26	7
EB I-4 Merge from CR 532	17	0	3	14	15	0	1	1	17	0
WB I-4 Diverge to CR 532	19	0	2	17	12	6	1	0	12	7
WB I-4 Merge from CR 532	11	1	1	9	5	6	0	0	5	6
EB I-4 Diverge to SR 429	14	0	7	7	7	5	1	1	8	6
EB I-4 Merge from SR 429	12	0	5	7	7	5	0	0	9	3
WB I-4 Diverge to SR 429	32	0	11	21	25	5	2	0	25	7
WB I-4 Merge from SR 429	23	0	7	16	15	4	3	1	15	8
I-4 at CR 532 EB Ramp Terminal	74	0	36	38	56	15	1	2	60	13
I-4 at CR 532 WB Ramp Terminal	149	0	53	96	105	40	4	0	134	15
Total	**837**	**5**	**269**	**563**	**550**	**230**	**36**	**20**	**627**	**209**
Percent of Total		**0.6%**	**32.1%**	**67.3%**	**65.7%**	**27.5%**	**4.3%**	**2.4%**	**74.9%**	**25.0%**

As shown in **Table 16**, a total of 837 crashes occurred during the five (5) year analysis period from January 2012 to December 2016. Out of the 837 total crashes there were 5 fatal crashes, 269 injury crashes and 563 property damage only crashes. A total of 550 crashes occurred during the daylight hours and 230 crashes were reported to have occurred during dark conditions (at night, dawn and dusk). In addition, a total of 627 crashes occurred during dry roadway conditions with the remaining 209 occurring during wet conditions.

Over this five-year time period, a total of 74 crashes occurred at the eastbound ramp terminal intersection and 149 crashes occurred at the westbound ramp terminal intersection. No fatalities were reported at these ramp terminal intersections between the year 2012 and year 2016.

5.2 Crash Summary by Crash Type

Table 17 shows the summary of the crashes by crash types. Per the summary, Rear End crashes accounted for the predominant crash type (about 46.7%) within the study area, followed by Sideswipe (14.5%), Left Turn (about 12.2%), Other (12.1%), and Off Road (about 8.7%) crashes.

Table 17: 5 Year Crash Summary by Type

Crash Segment	Crash Type											Total
	Rear End	Head On	Sideswipe	Roll Over	Angle	Left Turn	Right Turn	Off Road	Pedestrian & Bicycle	Animal	Other	
I-4 between US 27 & CR 532	99	0	47	20	0	1	0	32	1	1	41	242
I-4 between CR 532 & SR 429	67	0	30	4	0	1	0	5	0	1	13	121
I-4 between SR 429 & World Dr	58	0	9	1	0	1	0	11	0	0	8	88
SR 429 between I-4 & Sinclair Rd	0	0	1	0	0	0	0	0	0	1	0	2
EB I-4 Diverge to CR 532	16	1	8	0	0	1	0	7	0	0	0	33
EB I-4 Merge from CR 532	8	0	4	0	1	1	0	0	0	0	3	17
WB I-4 Diverge to CR 532	11	0	3	0	1	1	0	1	0	0	2	19
WB I-4 Merge from CR 532	4	0	1	1	0	1	0	2	0	0	2	11
EB I-4 Diverge to SR 429	6	0	1	0	0	1	0	1	0	0	5	14
EB I-4 Merge from SR 429	5	0	1	0	0	0	0	3	0	0	3	12
WB I-4 Diverge to SR 429	20	0	1	0	0	1	0	5	0	0	5	32
WB I-4 Merge from SR 429	15	0	5	1	0	1	0	1	0	0	0	23
I-4 at CR 532 EB Ramp Terminal	47	0	2	0	0	18	0	0	0	0	7	74
I-4 at CR 532 WB Ramp Terminal	35	0	8	0	15	74	0	5	0	0	12	149
Total	**391**	**1**	**121**	**27**	**17**	**102**	**0**	**73**	**1**	**3**	**101**	**837**
Percentage of Total	**46.7%**	**0.1%**	**14.5%**	**3.2%**	**2.0%**	**12.2%**	**0.0%**	**8.7%**	**0.1%**	**0.4%**	**12.1%**	**100%**

5.3 Crash Frequency & Crash Rate Development

Based on the required procedures and methodology for a SIMR per the FDOT SIO, crash rates and frequencies along the area of influence were developed based on the five (5) year crash information. **Table 18** summarizes the crash frequency and rates for each safety analysis segmentation for the study area.

The crash rates for the mainline segments are expressed as the number of crashes per million vehicle-miles traveled, the crash rates for the intersections are expressed as number of crashes per million entering vehicles. The following equations were utilized to develop the crash frequency and crash rates for this study:

$$Crash\ Rate\ of\ Segment = \frac{Total\ Number\ of\ Crashes\ x\ 1{,}000{,}000}{AADT\ x\ 365\ x\ Number\ of\ Years\ x\ Length\ of\ Roadway\ Segment}$$

$$Crash\ Rate\ of\ Intersections = \frac{Total\ Number\ of\ Crashes\ x\ 1{,}000{,}000}{AADT\ x\ 365\ x\ Number\ of\ Years}$$

5.3.1 Crash Rate Comparison

In addition to developing the five-year existing crash rates, a comparison of these actual crash rates with the FDOT statewide crash rates was conducted based on the most current FDOT CAR reporting database. For I-4, all the freeway segments have lower crash rates compared to the FDOT statewide crash rate of 0.924.

The eastbound ramp terminal, with an existing crash rate of 1.042, has a lower crash rate than the FDOT statewide crash rate at 1.51. The westbound ramp terminal, with an existing crash rate of 1.775, has a higher crash rate than the FDOT statewide crash rate at 1.51. Note that for the merge and diverge segments, based on discussions with FDOT Central Office (Crash Records and Research Department), FDOT does not provide crash rate statistics for merging and diverging segments.

Table 18: 5 Year Crash Frequency & Rate Summary

Crash Segment	Crash Frequency & Rate					
	Severity	No. of Crashes	Daily Volume	Segment Length (miles)	Total Crash Frequency	Total Crash Rate
I-4 between US 27 & CR 532	Total	242	137,000	2.00	48.40	0.48
	FI	79				
	PDO	163				
I-4 between CR 532 & SR 429	Total	121	153,700	0.81	24.20	0.53
	FI	39				
	PDO	82				
I-4 between SR 429 & World Dr	Total	88	139,500	0.83	17.60	0.41
	FI	25				
	PDO	63				
SR 429 between I-4 and Sinclair Rd	Total	2	25,800	0.34	0.40	0.12
	FI	0				
	PDO	2				
EB I-4 Diverge to CR 532	Total	33	68,500	0.09	6.60	2.79
	FI	5				
	PDO	28				
EB I-4 Merge from CR 532	Total	17	76,900	0.11	3.40	1.14
	FI	3				
	PDO	14				
WB I-4 Diverge to CR 532	Total	19	76,900	0.09	3.80	1.43
	FI	2				
	PDO	17				
WB I-4 Merge from CR 532	Total	11	68,500	0.13	2.20	0.66
	FI	2				
	PDO	9				
EB I-4 Diverge to SR 429	Total	14	76,900	0.12	2.80	0.81
	FI	7				
	PDO	7				
EB I-4 Merge from SR 429	Total	12	69,800	0.14	2.40	0.69
	FI	5				
	PDO	7				
WB I-4 Diverge to SR 429	Total	32	69,800	0.19	6.40	1.30
	FI	11				
	PDO	21				
WB I-4 Merge from SR 429	Total	23	76,900	0.11	4.60	1.52
	FI	7				
	PDO	16				
I-4 at CR 532 EB Ramp Terminal	Total	74	38,900	-NA-	14.80	1.04
	FI	36				
	PDO	38				
I-4 at CR 532 WB Ramp Terminal	Total	149	46,000	-NA-	29.80	1.77
	FI	53				
	PDO	96				

5.5 Safety Performance Functions

SPFs are crash equations used to predict or calculate the expected number of crashes per year at a specific study roadway segment, ramp terminals and merge and diverge areas. These SPF factors are only required for specific roadway improvement alternatives being considered and have an available CMF to show the effectiveness of the subject improvement. For this study, the Build alternative includes converting the existing diamond interchange to a DDI, adding auxiliary lanes along I-4 between CR 532 and SR 429, and adding auxiliary lane along northbound SR 429 between I-4 and Sinclair Road. Therefore, SPFs were developed for the I-4 and CR 532 interchange ramp terminals, I-4 freeway segment between CR 532 and SR 429, and the SR 429 segment between I-4 and Sinclair Road.

Calculating the SPF factors for each facility crash type has four primary steps. These four steps utilized for this SIMR study are summarized below:

1. Developing the Base Equation
2. Developing the SPF factors to be used in the Base Equation
3. Balancing the Fatal-Injury Crashes and Property Damage Only Crashes
4. Distribution of the appropriate Crash Severity or Crash Type

Table 19 summarizes the SPF's expected crashes for the No Build Condition. **Appendix K** contains the safety performance analysis worksheets and crash data utilized for this study.

Table 19: Safety Performance Function Expected Crash Summary

Study Segmentation	SPF No Build Summary		
	Fatal-Injury Crashes	Property Damage Only Crashes	Total Expected Crashes
I-4 between CR 532 and SR 429	7.62	18.67	26.29
SR 429 between I-4 and Sinclair Road	0.42	0.59	1.01
I-4 at CR 532 EB Ramp Terminal	5.51	10.08	15.59
I-4 at CR 532 WB Ramp Terminal	6.54	13.97	20.51

5.6 Empirical Bayes Method

Another step in the safety analysis is developing the expected crash frequency by the Empirical Bayes Method. This analysis method combines the Predicted Crash Frequency with the Observed Crash Frequency to obtain the Expected Crash Frequency. This method of analysis is implemented to improve the statistical reliability of developing the future expected crash frequency.

Table 20 summarizes the Empirical Bayes analysis summary utilized for this study for the appropriate segments. **Appendix K** contains the Empirical Bayes Method analysis worksheets and crash data utilized for this study.

Table 20: Empirical Bayes Method Analysis Summary

Crash Segmentation	Predicted Crash Totals		Observed Frequency		Expected Crash Frequency	
	FI	PDO	FI	PDO	FI	PDO
I-4 between CR 532 and SR 429	7.62	18.67	7.80	16.40	8.01	17.54
SR 429 between I-4 and Sinclair Road	0.42	0.59	0.00	0.40	0.36	0.55
I-4 at CR 532 EB Ramp Terminal	5.51	10.08	7.20	7.60	6.70	7.91
I-4 at CR 532 WB Ramp Terminal	6.54	13.97	10.60	19.20	9.54	18.71
Total	**20.09**	**43.31**	**25.60**	**43.60**	**24.61**	**44.71**

5.7 Crash Reduction Estimation

One of the last steps in evaluating whether the improvements provide a safety benefit is developing the crash reduction estimates based on the proposed study area improvements. For this study, the Build alternative includes converting the existing diamond interchange to a DDI, adding auxiliary lanes along I-4 between CR 532 and SR 429, and adding an auxiliary lane along northbound SR 429 between I-4 and Sinclair Road.

The first step in developing the crash reduction estimates is to determine the CMFs for the proposed alternative. Appropriate CMFs from the Crash Modification Factors Clearinghouse (CMF Clearinghouse) database are available for 1) converting a diamond interchange to a DDI and 2) adding auxiliary lanes between ramps. CMFs are currently not available for other improvements considered in the Build alternative.

Based on the CMF Clearinghouse database, the CMF to convert a diamond interchange to DDI is 0.592, and the CMF to add auxiliary lanes between ramps is 0.800. **Table 21** summarizes the crash reduction estimations in comparison to the No Build alternative for this study. **Appendix K** contains the crash data and crash reduction analysis worksheets utilized for this study.

Table 21: Crash Reduction Estimation for Build Alternative in Comparison to the No Build Alternative

Parameter	Crash Severity	Crash Segment				Total
		I-4 from CR 532 to SR 429	SR 429 from I-4 to Sinclair Rd	I-4 at CR 532 EB Ramp Terminal	I-4 at CR 532 WB Ramp Terminal	
Expected Crash Frequency (No Build)	Fatal Injury	8.01	0.36	6.70	9.54	**24.61**
	PDO	17.54	0.55	7.91	18.71	**44.71**
	Total	**25.55**	**0.91**	**14.61**	**28.25**	**69.32**
CMF	Fatal Injury	0.80	0.80	0.60*	0.60*	**-**
	PDO	0.80	0.80	0.60*	0.60*	**-**
Proposed Condition Expected Crash Frequency (Build)	Fatal Injury	6.41	0.29	3.97	5.65	**16.32**
	PDO	14.03	0.44	4.68	11.08	**30.23**
	Total	**20.44**	**0.73**	**8.65**	**16.73**	**46.55**

Note: The actual CMF (0.592) was used in the crash reduction calculation, but is rounded to 0.60 in this Table

5.8 Crash Reduction Benefit

The final step in the safety analysis is to estimate a crash reduction benefit in dollars. This process utilizes Empirical Bayes Method crash predictions and an assigned dollar amount to prevented crashes. The crash costs are developed using the procedure suggested in the latest Interchange Access Request Safety Procedure Webinar presented by SIO. The analysis follows this procedure, but using the latest costs found in the latest [2019 Edition] Florida Design Manual (FDM) Table 122.6.2, and fatal (K), severe injury (A), moderate injury (B), minor injury (C) and property damage only (O) [KABCO] distribution based on FDM and HSM crash costs.

For this study the following dollar amounts are used to develop the crash reduction benefit.

- Assigned Dollar Amount to Crash
    - 450,000 for Fatal/Injury Crash
    - 30,000 for Property Damage Only Crash

Table 22 summarizes the crash reduction benefit for the Build alternative in comparison to the No Build alternative.

Table 22: Crash Reduction Benefit

Build Alternative	Fatal-Injury Crashes	Property Damage Only Crashes	Total
Total Crash Reduction	8.29	14.48	**22.77 (~23)**
Total Crash Cost	$450,000	$30,000	**$480,000**
Total Crash Reduction Cost	**$3,730,500**	**$434,400**	**$4,164,900**

In summary, based on the safety analysis, the proposed Build alternative is anticipated to have a reduction in crash cost per year by $4,164,900 with an overall total reduction of approximately 23 crashes. **Appendix K** contains the crash data utilized for this study.

6 Funding Plan

The I-4 at CR 532 interchange modification (Financial Project# 444187-1) and I-4 auxiliary lanes to/from SR 429 (Financial Project# 444329-1) projects are identified in the latest FDOT Work Program as illustrated in **Table 23**.

Table 23: FDOT Work Program

Project Description	Financial ID#	Activity
I-4 at CR 532 Interim Interchange Modification	444187-1	FY20 Design - Local Agreement Osceola County - $1M FY21 Construction - $8.4M
I-4 Auxiliary Lanes to/from SR 429	444329-1	FY20 Design - $2.8M FY22 Construction – $22.5M

The ultimate improvements to modify the interchange of I-4 at CR 532 and I-4 mainline are identified in MetroPlan Orlando's Long-Range Transportation Plan (LRTP) Cost Feasible Plan and the FDOT SIS Cost Feasible Plan. However, these improvements are not scheduled until the mid-2040s and interim improvements were advanced by FDOT in response to concerns brought forth by area residents and businesses.

The DDI improvement at the I-4 and CR 532 interchange is being coordinated through a Joint Participation Agreement (JPA) with Osceola County and with local developers to facilitate congestion relief in the near term. The estimated construction cost of the DDI improvement is $8.4 million to implement a diverging diamond on CR 532 and other turn lane improvements within the constraints of the existing bridge structure. Additionally, the Department is seeking to advance funding for the interchange improvements through the SIS Quick Fix program and work with MetroPlan Orlando to leverage Surface Transportation Program (SU) funds for urban areas of population over 200,000. The auxiliary lanes project along I-4 between CR 532 and SR 429, and SR 429 improvements will be completed jointly by Florida's Turnpike Enterprise (FTE) and FDOT.

This SIMR established that beyond year 2032, additional major capacity improvements including those shown in the I-4 BtU and CR 532 widening are needed to provide improved levels of service within the study area. As such, FDOT realizes the need for further improvements along I-4 as well as the interchanges in the vicinity of the study area and will be ready in case funding becomes available for advancement of the proposed I-4 BtU improvements.

Below is the list of activities programmed and planned for I-4 in the study area:

- Interim improvements for this area as mentioned above in collaboration with the local agencies.
- I-4 BtU is included as a planned improvement in the latest SIS Long Range Cost Feasible FY 2029-2045 (FY 2036-2040)
- I-4 Florida's Regional Advanced Mobility Elements (FRAME) study
    - This study, currently underway, is a regional, intercity integrated corridor management (ICM) project running from the Central Business District in Tampa to the southwest side of Orlando at the Florida Turnpike.
    - It will add Connected Vehicle (CV) devices to inform the public on congestion along I-4 and provide alternatives.
- Furthermore, in support of the continued commitment to long term I-4 BtU improvements in this area, FDOT has completed the following:
    - Completed the concept design plans and right-of-way maps
    - Began acquisition of parcels in this segment
    - Is in the process of obtaining environmental permits

7 Environmental Impacts & Design Exceptions

There are no significant environmental considerations and/or factors located within the anticipated area of influence or impact area of the proposal that could influence the outcome of the selection process in comparing the Build and No Build alternatives. The implementation of the Build alternative will not result in negative environmental impacts.

The proposed Build alternative is not likely to result in environmental impacts that extend beyond those already documented for the proposed I-4 BtU configuration.

The approved I-4 BtU PD&E Study covering the study area received Location Design Concept Acceptance (LDCA) or NEPA approval on 6/12/2017. The status of this approval, and potential effects with the recommendations stemming from the subject SIMR, will be documented as appropriate, in conjunction with this request through a separate Environmental Reevaluation in accordance with state and federal requirements.

The Environmental Resource Permit (ERP) Application to the South Florida Water Management District (SFWMD) and Individual Section 404 Dredge and Fill Permit Application to the U.S. Army Corps of Engineers (USACE) will be submitted prior to final design plans.

Please note that design exceptions and variations are not anticipated at this time.

8 Conceptual Signing Plan

The purpose of this section is to provide a preliminary signing plan based on the proposed alternative design modifications. Modifications to the existing roadway signs were evaluated in conjunction with the proposed interchange modifications to ensure that a proper signing plan is implemented at the interchange. A schematic of the proposed conceptual signing plan showing their locations is provided in **Figure 29** for the proposed alternative. The conceptual signing plan is based on the requirements described in Chapter 2D, and Chapter 2E through section 2H of the 2009 Manual on Uniform Traffic Control Devices (MUTCD).

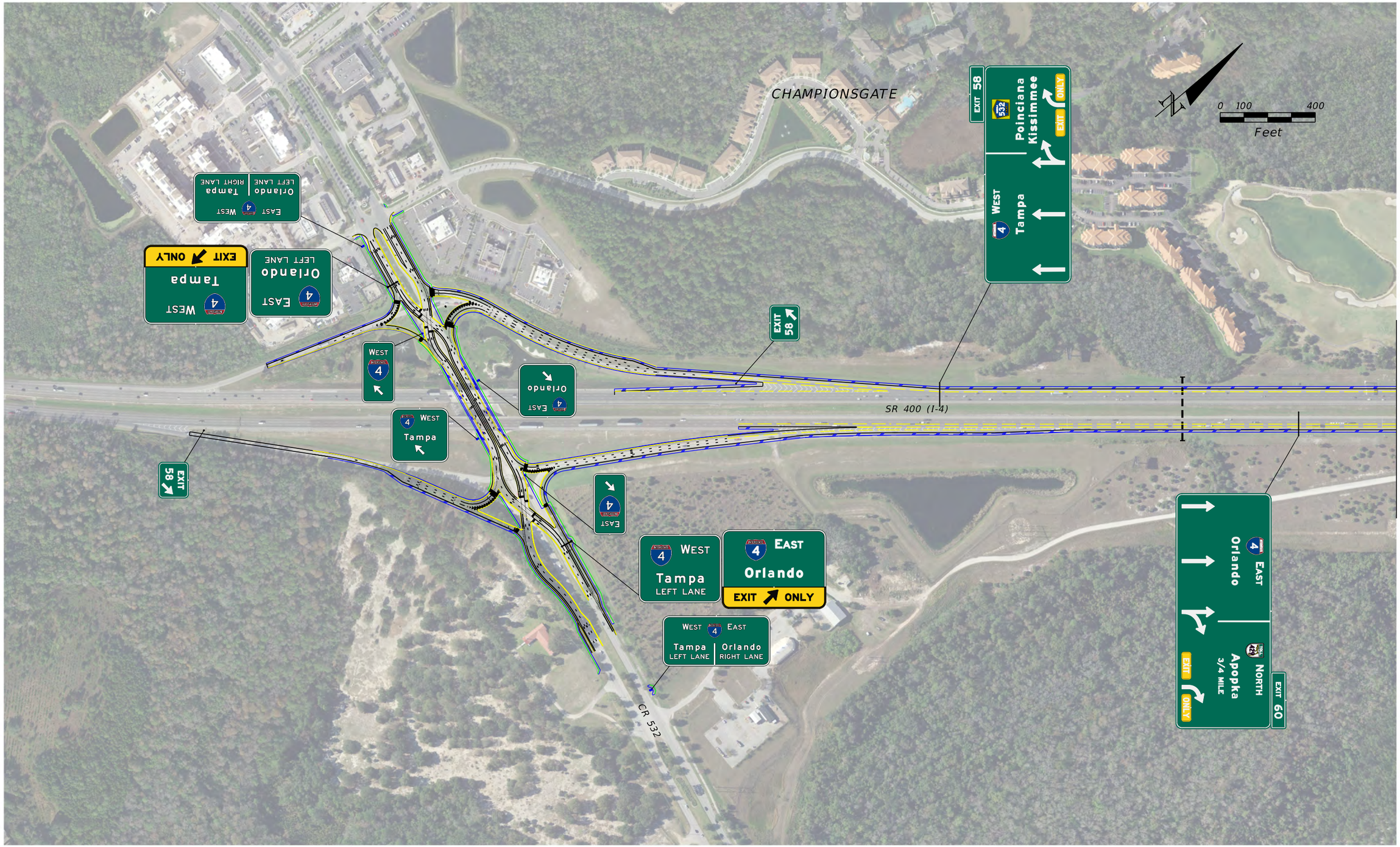


FIGURE 29

REVISIONS						
DATE	DESCRIPTION	DATE	DESCRIPTION			

VANASSE HANGEN BRUSTLIN, INC.
225. E. ROBINSON STREET
ORLANDO, FL 32801
CERTIFICATE OF AUTHORIZATION 3932

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 400	OSCEOLA	N/A

CONCEPTUAL SIGNING PLAN
(BUILD ALTERNATIVE)

SHEET NO.
1 OF 4

$USER$ $DATE$ $TIME$ $MODELNAME$ $FILE$

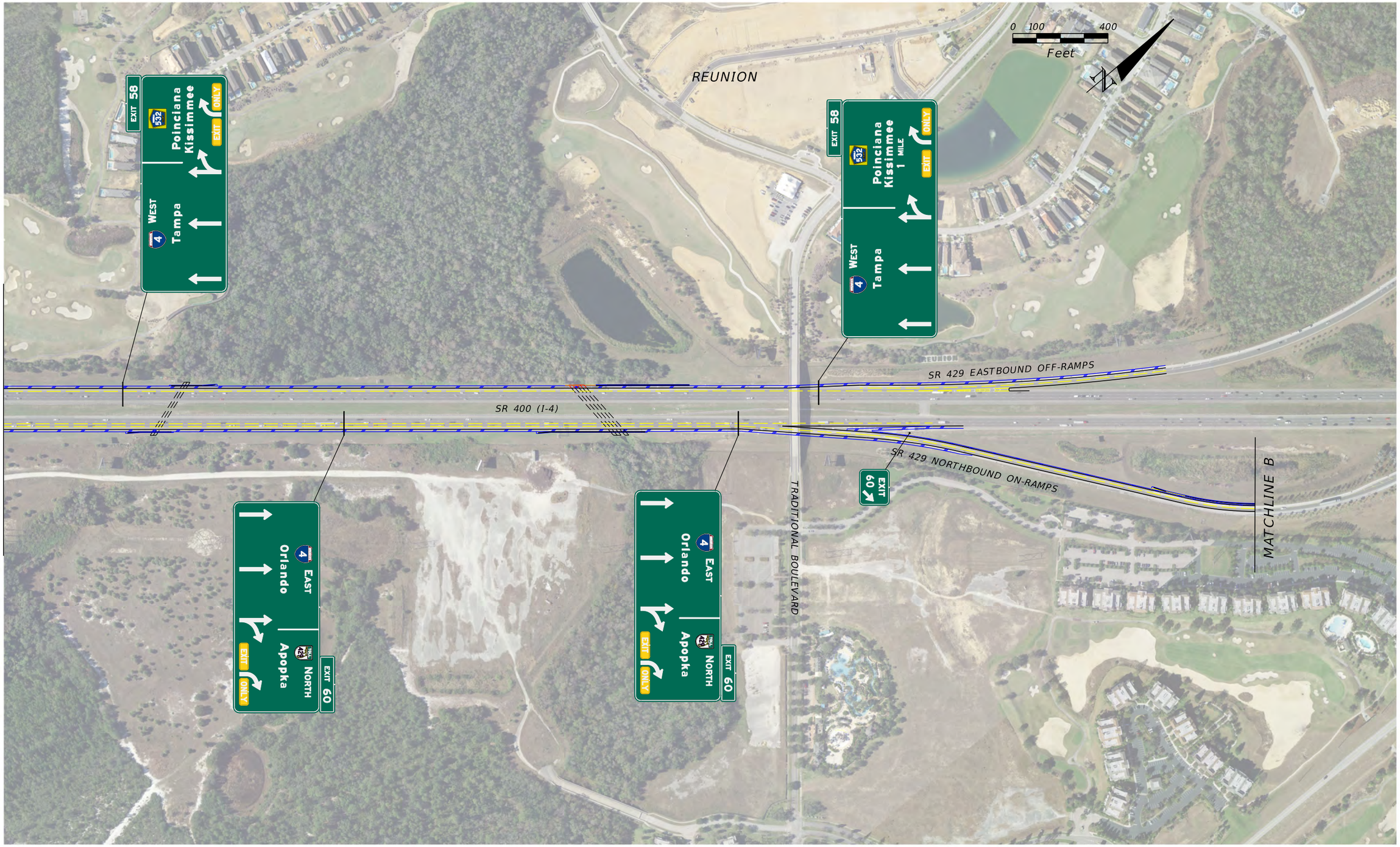


FIGURE 29

REVISIONS				VANASSE HANGEN BRUSTLIN, INC. 225. E. ROBINSON STREET ORLANDO, FL 32801 CERTIFICATE OF AUTHORIZATION 3932	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CONCEPTUAL SIGNING PLAN (BUILD ALTERNATIVE)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		2 OF 4
					SR 400	OSCEOLA	N/A		

$USER$ $DATE$ $TIME$ $MODELNAME$ $FILE$

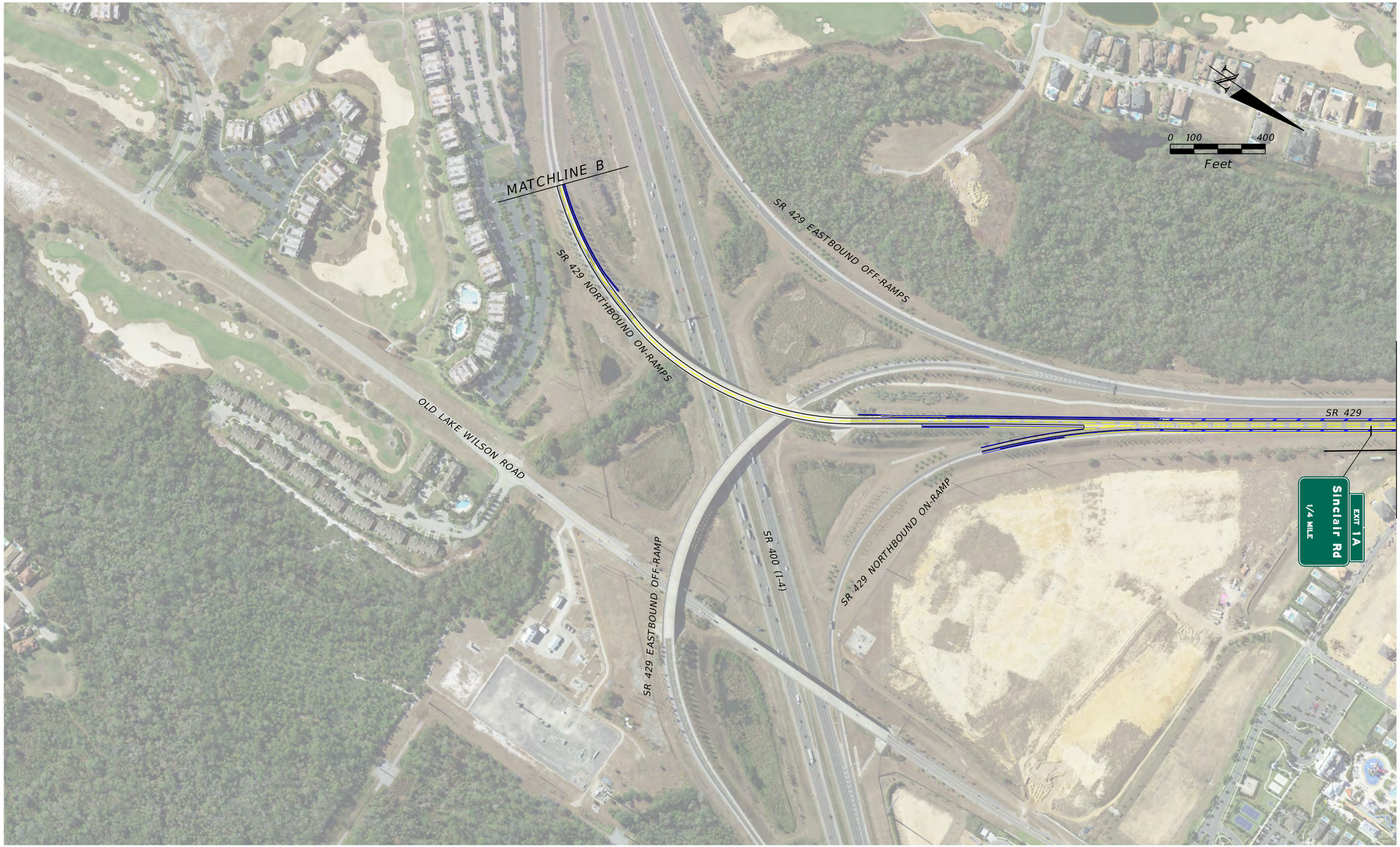


FIGURE 29

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

VANASSE HANGEN BRUSTLIN, INC.
225. E. ROBINSON STREET
ORLANDO, FL 32801
CERTIFICATE OF AUTHORIZATION 3932

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 400	OSCEOLA	N/A

CONCEPTUAL SIGNING PLAN (BUILD ALTERNATIVE)

SHEET NO. 3 OF 4

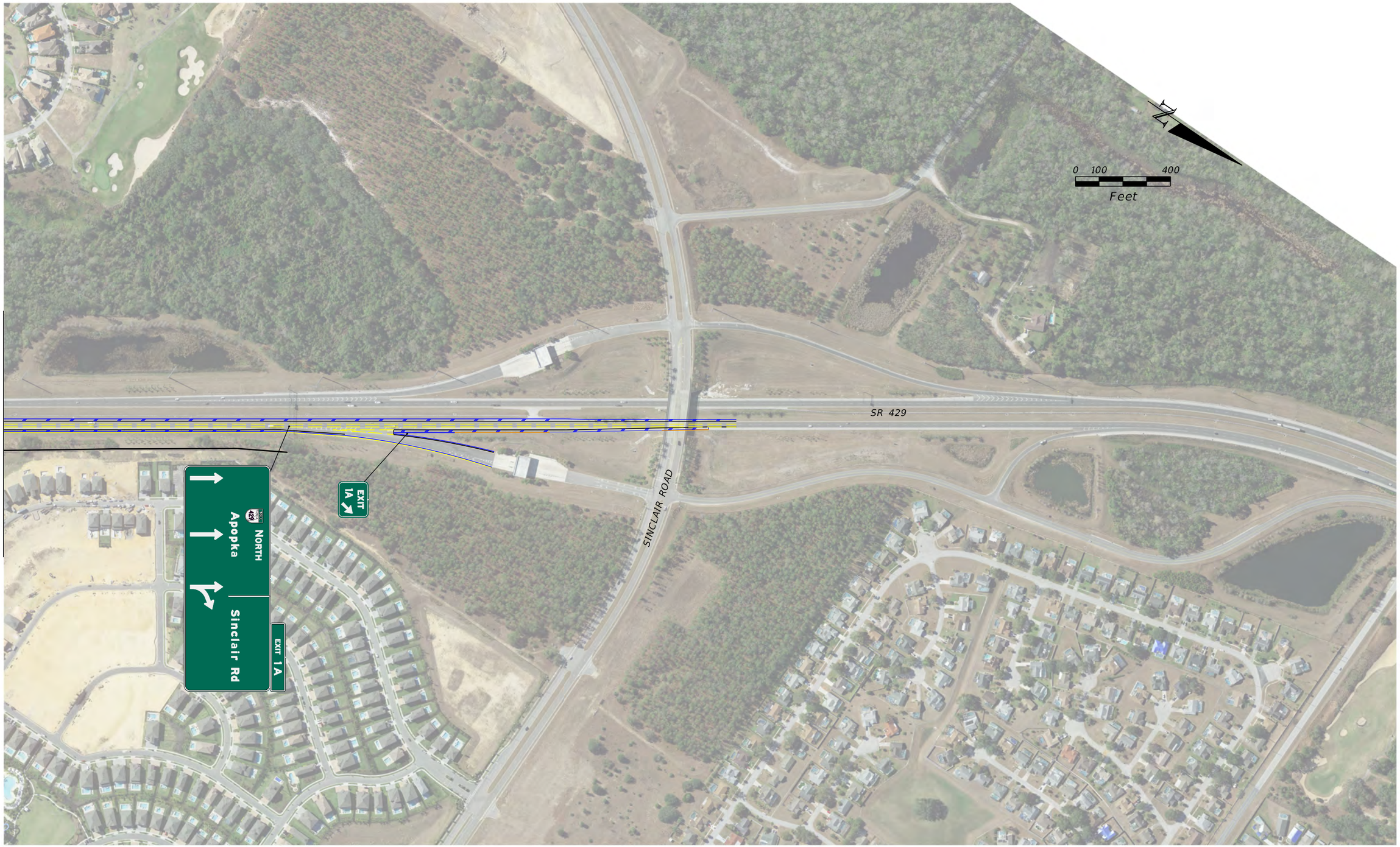


FIGURE 29

REVISIONS				VANASSE HANGEN BRUSTLIN, INC. 225. E. ROBINSON STREET ORLANDO, FL 32801 CERTIFICATE OF AUTHORIZATION 3932	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CONCEPTUAL SIGNING PLAN (BUILD ALTERNATIVE)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					SR 400	OSCEOLA	N/A		4 OF 4

$USER$ $DATE$ $TIME$ $MODELNAME$ $FILE$

9 Access Management Plan

The purpose of this section is to state the requirements for an access management plan as part of the proposed I-4 and CR 532 interchange modification under the Build alternative. Based on input from FDOT and the County, the existing access management plan within the study corridor and area of influence will include the following change:

- The currently allowed northbound left turn and through movements at the intersection of CR 532 and S Goodman Road will be restricted as part of the proposed interim improvements.

10 Qualifying Provisions

FHWA Requirements and Guidelines state that the following two policy points and criteria be examined and addressed in the SIMR documentation:

10.1 Policy Point 1

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)).*

10.1.1 Operational Analysis

Under the existing conditions, traffic routinely backs up along eastbound I-4 from CR 532 eastbound on ramp merge to US 27 in the morning peak period and backs up along westbound I-4 from the CR 532 westbound off ramp diverge to US 192 in the afternoon peak period. The interchange at I-4 and SR 429 also regularly experiences backups on the ramp to and from I-4 (west of SR 429). Operational deficiencies that occur within the I-4 at CR 532 interchange area combined with a short distance between the I-4 at CR 532 and I-4 at SR 429 interchanges create major bottlenecks near the study area that cause recurring daily congestion on the I-4 mainline.

The lack of adequate capacity to accommodate the existing traffic demand is most prevalent with the westbound off ramp and the eastbound on ramp at the I-4 and CR 532 interchange. The capacity-constrained conditions that currently exist create congested conditions and adverse impacts to the I-4 mainline, SR 429 mainline and ramps, and CR 532 cross-street operations are anticipated to worsen in the future as more development occurs within the study area.

There is an urgent need to alleviate the adverse traffic conditions that currently impact the operations as well as the safety of all road users within the study area. **As such, the primary purpose of this SIMR is to identify interim solution to improve traffic operations, reduce congestion, and enhance safety at the study interchanges, until the approved concept for the I-4 BtU along with widening of CR 532 can be funded and implemented. Additionally, proposed improvements extend the operational life of the study area with interim improvements that can be built "with limited SIS Quick Fix Funds".**

A detailed traffic operational analysis for the existing year (2018), opening year (2022), mid-design year (2032) and design year (2042) conditions was conducted for this SIMR within the area of influence. Key performance measures from microsimulation (VISSIM) analysis including networkwide metrics, freeway travel times, speeds, densities and LOS, arterial travel times, intersection LOS and delays, and off ramp queues are used in this SIMR. Since existing congestion spans across multiple interchanges and time periods, non-traditional Measures of Effectiveness (MOEs) including unmet demand (termed as blocked vehicles in this report), processed vehicles (network-wide and segment-based) and blocked vehicle queues (upstream of the network entry points) were also used in this SIMR to identify the true benefits of the Build alternative, instead of individual segment MOEs for the study roadways.

Based on the operational analysis conducted for this SIMR, the following high-level operational analysis observations are made, and detailed results are provided in the Future Operational Analysis section (Section 4.2) of this report.

- **General Observations**
  - The Build alternative provides benefits (compared to the No Build alternative) within the study area through 2042 as evidenced from the MOEs including overall network performance, average speeds and number of vehicles processed along I-4 and CR 532.
  - Given the extent of congestion and interim nature of the Build alternative, it is not anticipated that the proposed improvement along I-4 (auxiliary lanes on both sides of I-4 between CR 532 and SR 429) will provide capacity comparable to a full through lane. Therefore, I-4 will continue to have oversaturated conditions through the design year 2042 conditions. However, as

described below, substantial benefits in several performance metrics are observed, especially for 2022 and 2032 traffic conditions.

- **VISSIM Networkwide Performance Results**
  - The Build alternative provides better operational efficiency with reduced networkwide travel time, delay time and latent delay time compared to the No Build alternative, especially for 2022 and 2032 traffic conditions. The AM peak hour delay reduction ranges between 22% and 37%, while the PM peak hour delay reduction ranges between 36% and 56%. The Build alternative provides more benefits in the PM peak hour compared to the AM peak hour.
  - The Build alternative provides higher speeds and lower average delays for vehicles within the study area compared to the No Build alternative.
  - The Build alternative processes a greater number of vehicles and has lower latent demand compared to the No Build alternative.
- **Freeway Operational Results**
  - Under the Build alternative, average speed, simulated volume and density improved in the westbound direction for both the AM and PM peak hours and eastbound direction for the PM peak hour.
  - It should be noted that due to the unique nature of the study area and interim nature of the Build improvements, worse LOS conditions are observed for certain I-4 segments under the Build alternative compared to the No Build alternative. The following list provides the reasons for these conditions and justification that shows the true benefits of the Build alternative:
    - Because of the proposed improvements under the Build alternative, a higher number of vehicles are processed on I-4 between CR 532 and SR 429, and therefore this segment shows more congestion (or worse LOS) compared to the No Build alternative. Based on a supplemental 2032 AM peak hour HCS freeway analysis using the same projected demand for the two study alternatives, this segment is shown to operate at LOS E under the Build alternative and at LOS F under the No Build alternative.
    - Under the Build alternative, I-4 westbound between CR 532 and US 27 during the PM peak hour for 2022 and 2032 shows more congestion (or worse LOS) compared to the No Build alternative, because the Improvements upstream of this segment resulted in a higher throughput and consequently a higher density along I-4 westbound in this segment. For instance, a throughput improvement of approximately 36% on I-4 westbound between CR 532 and US 27 in 2032 PM peak hour is noted under the Build alternative.

  - Blocked vehicle queues on I-4 is another non-traditional MOE to gauge the benefit of the Build alternative. For example, when compared to the Build alternative, the No Build alternative will have an approximately three-mile longer queue in the AM peak hour, and an approximately six-mile longer queue in the PM peak hour on I-4 eastbound west of US 27 and on I-4 westbound east of SR 417/World Drive, respectively.

- **Travel Time Results**
  - Based on input from FDOT, travel times in vehicle-hours are calculated for vehicles inside and outside (blocked vehicles) the network for I-4 and CR 532.
  - **I-4:** Build alternative travel time results along I-4, in general, show improvements in both directions when compared to the No Build alternative with the inclusion of blocked vehicles. The travel time savings are more significant in the PM peak hour compared to the AM peak hour.
  - **CR 532:** The total travel time (vehicle-hours) saving along CR 532 in the Build alternative is significantly more when compared to the No Build Alternative in all analysis years.
- **CR 532 Intersection Performance Results**
  - The ramp terminal intersections are estimated to operate at a significantly improved LOS D or better through 2032 under the Build alternative compared to the No Build alternative. Under the Build alternative, there is a significant improvement with all intersections operating at LOS E or better in 2022 AM and PM peak hours.
  - Cumulative intersection delays (sum of overall study intersection delays) under the Build alternative show more than 60% improvement in 2022 (AM and PM peak hours) and more than 45% (PM peak hour) improvement in 2032 versus the No Build alternative, which indicates noticeably improved traffic conditions in the Build alternative.
- **CR 532 Off Ramp Queue Results**
  - As part of the Build alternative, the proposed off ramp improvements at both I-4 eastbound and westbound ramp terminals will help avoid queue backups from the ramp terminals to the freeway mainline during the peak hours through design year 2042. Similarly, capacity improvements for the westbound off ramp from I-4 at the CR 532 interchange, the off ramp from eastbound I-4 to northbound SR 429 in combination with an auxiliary lane along northbound SR 429 from I-4 to Sinclair Road will help divert traffic away from I-4 mainline at a faster rate during the peak hours. **The operational analysis for the Build alternative shows that the ramp queues will not backup onto I-4 mainline through the design year 2042.**

Based on the above-mentioned key performance results, benefits are seen in the Build alternative in the AM and PM peak hours for 2022 and 2032. However, based on networkwide metrics and cumulative intersection delays, the Build alternative will begin to fail after 2032 indicating additional improvements are warranted in the study area beyond 2032.

10.1.2 Safety Analysis

The Build option provides improved safety benefits over the No Build alternative. Based on safety analysis, the Build alternative is anticipated to reduce number of crashes by approximately 23 crashes per year, and therefore save $4,164,900 in total crash cost (fatal, injuries and property damage only) per year compared to the No Build alternative.

10.1.3 Conceptual Signing Plan

A conceptual signing plan is developed (**Figure 29**) for the proposed interchange modification alternative. Modifications to the existing roadway signs were evaluated in conjunction with the proposed modifications to ensure that a proper signing plan is implemented within the study area.

10.2 Policy Point 2

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.*

Full access interchange conditions, as offered by the existing interchanges at I-4 and CR 532 as well as I-4 and SR 429, will remain with the proposed modification improvements. In addition, this project will achieve benefits to the transportation system with no adverse impact to the public. The proposed improvements have been, and will continue to be, coordinated with the public and local government agencies. The design of the proposed improvements will follow the applicable FHWA and FDOT design standards.

10.3 Recommendation

The results for the future analysis years indicate that the proposed improvements under the Build alternative provide operational as well as safety benefits to the study area. The Build alternative offers significant benefits in terms of increased average speeds, improved travel times, reduced queues at the I-4 and CR 532 interchange, and higher traffic flows through the year 2032 traffic conditions. As such, this SIMR recommends that the proposed short-term improvements be implemented to provide immediate and near-term congestion relief to the study area. Beyond 2032, additional capacity improvements within the study area including widening I-4 mainline as well as CR 532 are needed to accommodate anticipated future traffic volumes.

11 Appendices

Appendix A: Methodology Letter of Understanding (MLOU)

Appendix B: Existing Traffic Count Information

Appendix C: FDOT Seasonal & Axle Factors

Appendix D: Existing Conditions HCS and Synchro Outputs

Appendix E: Existing Conditions VISSIM Calibration Report

Appendix F: SubArea Model Validation & Traffic Forecasting Report

Appendix G: Traffic Forecasts – Supporting Documents

Appendix H: 2032 AM Average Speed Plot (1-lane I-4 EB On-Ramp) & Design Concept Layouts – Build Alternative

Appendix I: Future Conditions HCS & Synchro Outputs

Appendix J: Future Conditions VISSIM Output

Appendix K: Crash Data Information / Safety Analysis Worksheets