System Interchange Modification Report

SR 9/I-95 @ SR 842/Broward Boulevard (Broward Boulevard from West of SW 24th Avenue to East of NW/SW 18th Avenue) Project Development & Environment (PD&E) Study

Efficient Transportation Decision Making (ETDM) No.: 14226

Broward County, Florida
Financial Project ID Number: 435513-1-22-02

Prepared for:
Florida Department of Transportation, District Four
3400 West Commercial Boulevard
Fort Lauderdale, FL 33309

February 2019

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being or have been carried out by FDOT pursuant to 23 U.S.C. §327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.

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SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: December 19, 2018

FM Number: 435513-1-22-02

Project Title: I-95 at Broward Boulevard Systems Interchange Modification Report

District: District Four

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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)

Systems Interchange Modification Report

Quality Control (QC) Statement

This document has been prepared following FDOT Procedure Topic No. 525-030-260 (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 _____ Date: _____
[Anson Sonnett, PE]

IRC _____ Date: _____
[Cesar Martinez, PE]

System Interchange Modification Report(SIMR)

I-95 at Broward Boulevard

Systems Interchange Modification Report

FPID: 435513-1-22-02

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.

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Executive Summary

The I-95 corridor is a significant component of the Strategic Intermodal System (SIS) and provides a key transportation element in linking the major ports, airports, and railways that handle Florida's passenger and freight traffic. Within the study area, I-95 is a ten-lane facility comprised of four General Purpose Lanes in each direction and one Special Use Lane in each direction. The 95 Express 3A-1 project is under construction within the Study Limits that will result in conversion of the single HOV lane in each direction to dual Express Lanes in each direction, maintaining the General Purpose and Auxiliary Lanes the same as they are today. There are numerous access ramps within the study limits and at the interchange itself. The interchange of I-95 at SR 842/Broward Boulevard is located between the Sunrise Boulevard interchange (one mile to the north) and the Davie Boulevard interchange (one mile to the south). The interchange of I-95 at Sunrise Boulevard is located approximately 2.16 miles south of the I-95 at Oakland Park Boulevard interchange. The I-95 at SR 842/Broward Boulevard interchange is currently a Tight Urban Diamond Interchange with a flyover ramp from SR 842/Broward Boulevard eastbound to the I-95 northbound entrance ramp. The I-95 at Sunrise Boulevard interchange is a modified partial cloverleaf interchange with one loop ramp in the northeast quadrant. The South Florida Rail Corridor (SFRC)/CSX Railroad is adjacent to and runs parallel along the west side of I-95 in this area.

SR 842/Broward Boulevard and Sunrise Boulevard are six-lane urban divided roadways with a raised median within the vicinity of the I-95 Interchange. The SR 842/Broward Boulevard interchange provides the main entryway to the downtown Fort Lauderdale Central Business District from I-95 and the east-west connection between US 1 and SR 817/University Drive in the City of Plantation.

SR 842/Broward Boulevard interchange is the main entryway to downtown Fort Lauderdale. There are a number of transit options on Broward Boulevard and at the I-95/Broward Boulevard interchange that provide direct service and transfer connections along both corridors. These include passenger rail service (Tri-Rail and Amtrak) and bus service (Broward County Transit (BCT), Sun Trolley, 95 Express Bus, and the Tri-Rail Commuter Connector). There is a Park-and-Ride lot located within the interchange area with designated parking for Amtrak, Tri-Rail and general purpose, including car pools and 95 Express Bus. Access to the Park-and-Ride lots is provided via Broward Boulevard and I-95. Ingress from eastbound Broward Boulevard is provided via a right-turn lane at SW 22nd Avenue/SW 1st Street. Ingress from westbound Broward Boulevard is provided via a right-turn lane at NW 22nd Avenue. Egress to westbound Broward Boulevard is provided via the intersection with NW 22nd Avenue, requiring drivers coming from the south to circulate through the northern parking areas. Egress to eastbound Broward Boulevard is provided via SW 22nd Avenue/SW 1st Street.

Currently, northbound ingress to I-95 from Broward Boulevard is provided by a single-lane access ramp from westbound Broward Boulevard at the eastern terminal intersection and a single-lane flyover from eastbound Broward Boulevard west of the western terminal intersection. Egress to Broward Boulevard from northbound I-95 is provided by a ramp, which is part of the northbound CD road ramp system, that was recently reconstructed to include triple right-turn lanes for traffic heading eastbound on Broward Boulevard and double left-turn lanes for traffic heading westbound on Broward Boulevard. Additional ingress and egress to I-95 is provided through the Park-and-Ride lot. For both directions of travel along

I-95 ingress and egress is provided by single-lane ramps that cross over the southbound lanes of I-95 and connect with the Special Use Lanes located in the center of I-95.

E.1 Background

Broward Boulevard's elevation over I-95 creates vertical access challenges for transit users, bicyclists and pedestrians looking to connect with the transit services available in the Park-and-Ride and Transit Station area northwest and southwest of the interchange. As a result of these challenges and due to its location as the entryway to downtown Fort Lauderdale, this interchange has been the subject of a variety of studies including the City of Fort Lauderdale's Gateway Vision and FDOT's Broward Boulevard Transit Corridor Study. In 2010, the I-95 at Broward Boulevard Interchange Operational Analysis Report (IOAR) identified the need to improve the southbound exit ramp.

FDOT District Four completed a Corridor Traffic Analysis Report (CTAR) for the 95 Express Phase 3 project in November 2014. The CTAR demonstrated the engineering and operational acceptance of the proposed expansion of the I-95 express lanes system from Stirling Road in Broward County to Linton Boulevard in Palm Beach County.

The Interchange Master Plan (IMP) for Broward County which addressed the traffic and safety issues at the 16 interchanges along I-95, including the adjacent Sunrise Boulevard interchange, was completed in February 2016. Subsequently, an Interchange Concept Development Report (ICDR) was prepared to evaluate the specific issues associated with the current interchange configuration and a concept plan was developed to improve traffic operations at the Sunrise Boulevard interchange. The ICDR recommended improvements for the west ramp terminal intersection of Sunrise Boulevard, and did not include the Broward Boulevard Interchange because that was left to the future Project Development & Environment (PD&E) Study that is the subject of this I-95 at Broward Boulevard Systems Interchange Modification Report (SIMR).

Due to the potential impact of the Woodlawn Cemetery located on the southeast quadrant of the I-95 at Sunrise Boulevard interchange, the improvements for the Sunrise Boulevard Interchange were addressed for the west ramp terminal intersection only. The east side of the interchange would be included in the I-95 at Broward Boulevard interchange PD&E study for feasibility study only, and the west side of the interchange would advance directly to the design phase since the improvements identified in the ICDR did not require a PD&E study. The IOAR documenting the traffic analysis was completed for the I-95 at Sunrise Boulevard west ramp terminal and recommended design concepts to improve the operation of the I-95 southbound ramps and the ramp terminal on the west side of the interchange. The east ramp terminal intersection of I-95 at Sunrise Boulevard was addressed using a feasibility review technical memorandum as an off-shoot of the I-95 at Broward Boulevard PD&E Study. This Technical Memorandum is included as an **Appendix B** to this SIMR.

E.2 Purpose and Need

Following the safety, operational and engineering (SO&E) acceptability of the CTAR study, FDOT is currently implementing Phase 3 of the 95 Express Lanes continuing 29 miles north from Stirling Road in

Broward County to Linton Boulevard in Palm Beach County. The 95 Express Phase 3A project will convert the existing HOV lane to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes. The resulting typical section becomes a 12-lane facility comprised of four General Purpose Lanes and two Special Use Lanes in each direction. Currently, single-lane HOV ramps from I-95 provide access to the Park-and-Ride lot located within the I-95 at Broward Boulevard interchange area. This Park-and-Ride lot includes parking spaces for Amtrak, Tri-Rail and general purpose, including car pools and 95 Express Bus. Access to the Park-and-Ride lots is provided via Broward Boulevard and HOV ramps from I-95 sometimes require drivers coming from the south to circulate through the northern parking areas. As a result of these challenges, improved connections between the I-95 Express Lanes and Broward Boulevard service interchange ramps, as well as the surrounding intermodal facilities, are desired and are the basis of the PD&E Study.

The primary purpose of the I-95 at Broward Boulevard PD&E Study is to improve traffic flow to and from I-95 and along Broward Boulevard; to improve connectivity between the 95 Express Lanes and Broward Boulevard; and to improve intermodal connectivity. Detailed purpose and need for the I-95 at Broward Boulevard Interchange PD&E Study is documented in **Section 1**. The primary need for this I-95 at Broward Boulevard PD&E Study is to enhance system linkage and modal interrelationships at the I-95 at Broward Boulevard interchange. Secondary purpose and need considerations include Capacity, Safety, Transportation Demand, Social Demands, Economic Development, and Emergency Evacuation.

This I-95 at Broward Boulevard Systems Interchange Modification Report (SIMR) documents the travel demand modeling, traffic forecasting, and operational analysis for the Build Alternative that includes proposed modifications as part of the I-95 at Broward Boulevard PD&E study and adjacent Sunrise Boulevard east ramp terminal intersection. Therefore, the purpose of the SIMR is to provide the required technical documentation for obtaining safety, operational and engineering (SO&E) acceptability of the proposed modifications.

E.3 Methodology

A Methodology Letter of Understanding (MLOU) was developed and approved by the Florida Department of Transportation (FDOT) District Four Interchange Review Committee (DIRC) and the FDOT Central Office in August 2018 for the I-95 at Broward Boulevard SIMR. This MLOU was a revision to the original I-95 at Broward Boulevard Interchange Modification Report (IMR) MLOU approved in February 2017. When the original IMR MLOU was developed, the I-95 at Broward Boulevard PD&E Study scope of work included a standalone Feasibility Study for the northbound ramp terminal intersection (east intersection) of the I-95 at Sunrise Boulevard interchange. This Feasibility Study was focused on determining operational improvements needed only at the Sunrise Boulevard east terminal ramp intersection and the recommendation was not expected to be part of the IMR. The recommendation from the Feasibility Study did not include any environmental impacts. Therefore, FDOT District Four decided to include the Sunrise Boulevard east ramp terminal improvements along with the original IMR SO&E request and reclassify the IAR to an SIMR. SIMR MLOU also incorporates changes to the Federal Highway Administration's (FHWA) Interstate Access Policy (dated May 22, 2017). Based on the revised FHWA policy changes, the IAR addresses following two policy points in the SIMR documentation and the remaining six of eight FHWA policy points to be addressed in the NEPA documentation:

- Policy Point 1: The proposal does not adversely impact operations or safety of the existing freeway.
- Policy Point 2: A full interchange with all traffic movements at a public road is provided.

The MLOU established guidelines for traffic forecasting, traffic operational and safety analyses. The Southeast Florida Regional Planning Model (SERPM), Version 7.062 was used for travel forecasting. Traffic simulation software (PTV's VISSIM) was chosen for the traffic operational analysis for analysis years 2016 (Existing Year), 2020 (Opening Year) and 2040 (Design Year). A detailed methodology for traffic forecasting, traffic operational and safety analyses is presented in **Section 2**. The original IMR MLOU and the SIMR MLOU for the I-95 at Broward Boulevard are included in **Appendix A**.

E.4 SIMR Alternatives

The area of influence for the I-95 at Broward Boulevard SIMR includes the SR 9/I-95 mainline from south of Davie Boulevard to north of Sunrise Boulevard and the interchanges at Davie Boulevard, Broward Boulevard and Sunrise Boulevard The area of influence along cross-street arterials are discussed in detail in **Section 2.2**. As discussed in the approved MLOU, the SIMR will evaluate the No-Build Alternative and the Build Alternative within the area of influence. The Build Alternative was developed from several geometric alternatives. The SIMR No-Build and Build Alternatives are described below:

No-Build Alternative:

- The ongoing 95 Express Phase 3A project which will convert the existing HOV lane to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes.
- Recently approved Interchange Operational Analysis Report (IOAR) improvements for the I-95 at Sunrise Boulevard west ramp terminal intersection. The approved IOAR improvement converts the existing west terminal off-ramp (single lane right turn and dual lane left turns) to triple right turns and triple left turns. The IOAR approved improvement is currently under design phase and is scheduled for construction (FM # 435514-1) in the year 2020.

Build Alternative

In addition to the No-Build, the Build Alternative includes following proposed improvements and they are depicted in **Figure E-1**, **Figure E-2** and **Figure E-3**:

1. 95 Express Ingress-Egress Connections with Broward Boulevard Interchange: As discussed in the Purpose and Need Section, the primary purpose of the I-95 at Broward Boulevard PD&E Study is to improve traffic flow to and from I-95 and along Broward Boulevard; to improve connectivity between the I-95 Express Lanes and Broward Boulevard; and to improve intermodal connectivity. The Broward Boulevard interchange recommended Build Alternative 2B satisfies the purpose and need. The ingress and egress braided ramps connecting I-95 express lanes are listed below and graphically depicted in **Figure E-1**.

- In the southbound egress direction, the proposed improvements include a braided ramp over the southbound I-95 General Use Lanes with a connection to the west ramp terminal intersection of the Broward Boulevard service interchange to provide egress from 95 Express near NW 6th Street/Sistrunk Boulevard.
- Similarly in the southbound ingress direction, there is a braided ramp over the southbound I-95 General Use Lanes located just south of Broward Boulevard that provides ingress access for the westbound traffic on Broward Boulevard. This elevated braided ramp provides direct access via the west ramp terminal intersection of the Broward Boulevard service interchange. The inside westbound left-turn at the west ramp terminal intersection feeds directly into the southbound express lane ramp and does not require drivers to weave through the General Use Lanes.
- To access Southbound (SB) 95 Express from eastbound Broward Boulevard, motorists use SW 1st Street, from SW 22nd Avenue, to access the legacy HOV SB entrance ramp at the south side of the Park and Ride Lot just south of Broward Boulevard. Along SW 1st Street, the residential road of SW 22nd Ave is closed. The stop-controlled intersection at SW 21st Terrace and the signalized intersection immediately east of that are converted to a single roundabout.
- For the northbound direction, egress from 95 Express near Davie Boulevard is proposed through the use of a braided ramp over the northbound I-95 General Use Lanes with a connection to the northbound CD road ramp system that terminates at the east terminal intersection of the Broward Boulevard service interchange. This elevated braided ramp provides eastbound and westbound Broward Boulevard access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.
- Ingress from the Broward Boulevard service interchange to the northbound 95 Express lanes is proposed through a braided ramp over the northbound I-95 General Use Lanes in the vicinity of NW 6th Street/Sistrunk Boulevard. This elevated braided ramp provides direct access between Broward Boulevard and the northbound Express Lanes, using the existing eastbound to northbound flyover, and westbound to northbound ramp, for access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.

2. I-95 at Broward Boulevard Interchange: The Broward Boulevard Interchange recommended Modified Displaced Left Turn Alternative, the Build Alternative 2B. The Modified Displaced Left Turn Interchange alternative provides for the displacement of the northbound exit ramp onto a new roadway (bridge structure) that is on the south of Broward Boulevard over I-95, and runs south of and parallel to the eastbound Broward Boulevard through lanes. The northbound ramp left-turn traffic is then transitioned on to the westbound Broward Boulevard roadway at the west ramp terminal intersection. There are three westbound left-turn lanes at the west ramp terminal intersection. The inner left-turn lane is a buffer left turn lane to provide direct connect to southbound 95 Express and the outer two left-turn lanes are for general use that feed to the southbound I-95 and the C-D road. These improvements are illustrated in **Figure E-2**.

3. I-95 at Sunrise Boulevard East Terminal Ramp Intersection: The Signalized Loop Ramp and Extended Eastbound Merge to NW 17th Avenue (Alternative 3A) for the Sunrise Boulevard east terminal ramp intersection. This alternative modifies both the northbound to eastbound ramp and the northbound to westbound ramp. The northbound to eastbound merge distance is increased to 500 feet, terminating just west of NW 17th Avenue. The northbound to westbound loop ramp is realigned to stop at the signal serving the I-95 northbound entrance. The loop ramp is modified to provide two-lane and three-lane section storage approaching the signal. These improvements are illustrated in **Figure E-3**.

Traffic operational analysis results for all geometric alternatives considered are discussed in **Section 5.3**. Additionally, three Park-and-Ride Alternatives were developed to address vehicular and pedestrian circulation through the lots. Each alternative provides additional sidewalk throughout the northern parking areas, identifies crosswalks, and proposes a canopy for the sidewalks connecting the train station to the newly created area underneath the expanded Broward Boulevard bridge structure. The development of Park-and-Ride Alternatives are discussed in detail in Preliminary Engineering Report (PER). Traffic operational analysis results for SIMR alternatives (No-Build and Build) are summarized in **Section 6**. The Safety evaluation of the Build Alternatives is presented in **Section 6**. The demonstration of operational and safety benefits are discussed in the Federal Highway Administration's policy requirements later in this section.


842
SW 24TH AVE
NW 24TH AVE
SW 22ND AVE
NW 22ND AVE
SW 1ST ST
SW 21ST TERR
TRANSIT PLATFORM AREA
EXISTING MEDIAN P&R/TRANSIT
STAION RAMPS TO REMAIN
EXISTING MEDIAN P&R/TRANSIT
STAION RAMPS TO REMAIN
ENTRANCE RAMP TO REMAIN
SB EXPRESS LANES INGRESS
EXIT RAMP TO REMAIN
ENTRANCE RAMP TO REMAIN
SW 18TH AVE
NW 18TH AVE
NORTH FORK NEW RIVER
SW 22ND AVE
SW 21ST TERR
DAVIE BLVD
SW 18TH AVE
NB EXPRESS LANES EGRESS
NB GENERAL PURPOSE
LANES EGRESS
95
95
NW 22ND AVE
NW 21ST TERR
SB EXPRESS LANES EGRESS
NB EXPRESS LANES INGRESS
NW 6TH STREET
NW 20TH AVE
NW 19TH AVE
SUNRISE BLVD

Figure E-2 | I-95 at Broward Boulevard Interchange – Alternative 2B (Modified Displaced Left)

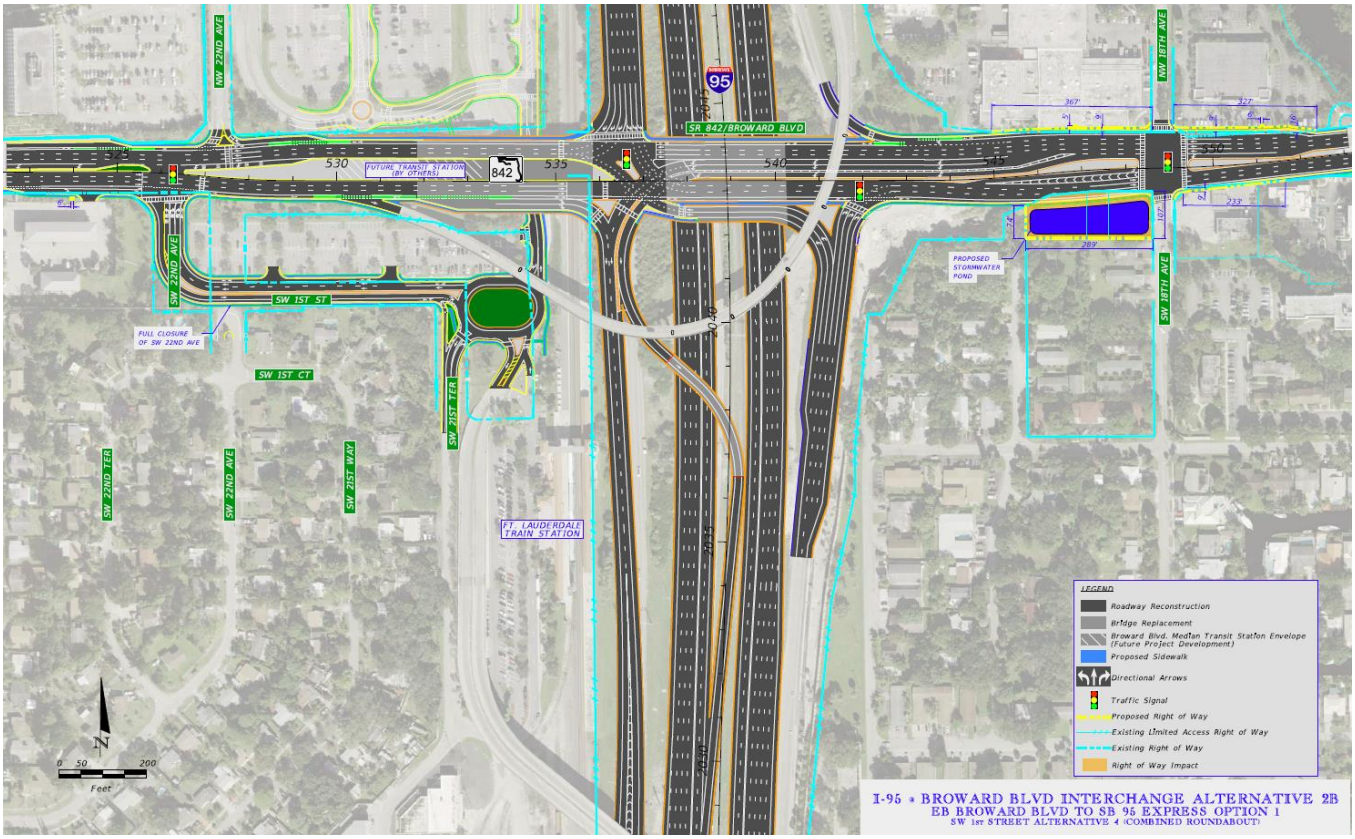
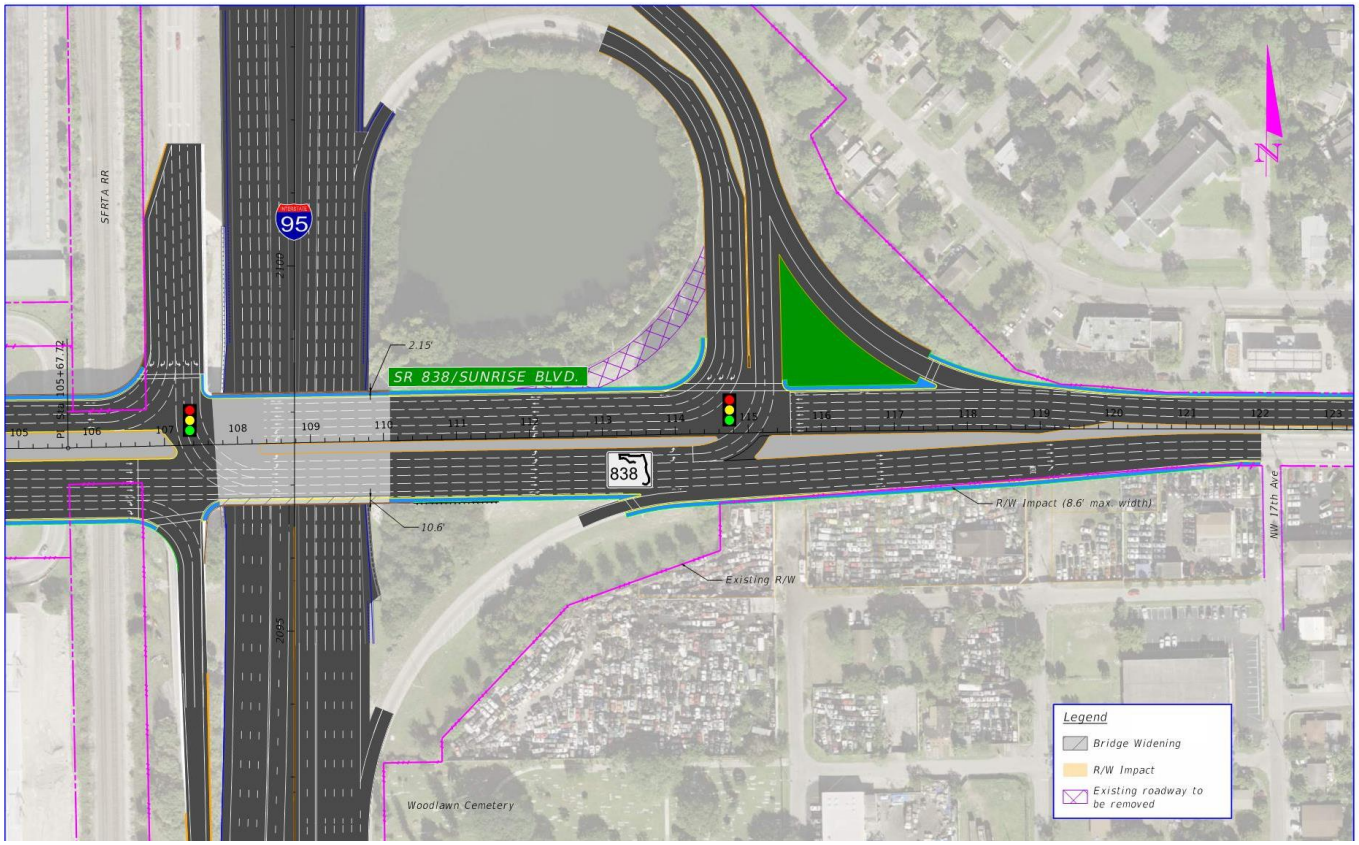


Figure E-3 | I-95 at Sunrise Boulevard Interchange – Alternative 3A (Signalized Loop Ramp and Extend Eastbound Merge to NW 17th Ave)



E.5 Compliance with FHWA General Requirements

The FHWA Policy on Access to the Interstate System provides the requirements for the justification and documentation necessary to substantiate any proposed changes in access to the Interstate System. The policy is published under the Federal Register, Volume 74, Number 43743, dated May 22, 2017. The responses provided herein for each of the two policy statements demonstrate compliance with these requirements and justification for the proposed Systems Interchange Modification Report (SIMR) in support of the I-95 at Broward Boulevard Interchange PD&E Study in Broward County, Florida.

Policy:

It is in the national interest to preserve and enhance the Interstate System to meet the needs of the 21st Century by assuring that it provides the highest level of service in terms of safety and mobility. Full control of access along the interstate mainline and ramps, along with control of access on the crossroad at interchanges, is critical to providing such service. Therefore, FHWA's decision to approve new or revised access points to the Interstate System under Title 23, United States Code (U.S.C.), Section 111, must be supported by substantiated information justifying and documenting that decision. The FHWA's

decision to approve a request is dependent on the proposal satisfying and documenting the following requirements.

Point #1: Proposal does not adversely impact operational safety of the existing freeway

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)).

Response:

Operations Analysis

The I-95 at Broward Boulevard SIMR consists of existing interchanges that are being modified and the I-95 Express Phase 3A project that will convert the existing HOV lane to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes to better accommodate the future traffic demands in the region. An in-depth traffic operational analysis for the Existing Year (2016), Opening Year (2020) and Design Year (2040) conditions was conducted to study the impacts of the Build Alternative within the area of influence. Analyses were conducted for the mainline, express lanes, and intersections at the ramp terminals and crossroads.

Several performance measures were used to compare the operations of the existing system under No-Build and Build conditions. Key measures included freeway speeds, intersection delays, and queues. Based on the operational analysis conducted for the SIMR, the following high level operational analysis observations were made and detailed results are provided in **Section 6**.

<u>I-95 Mainline and Express Lanes</u>

- **Figure E-4** through **Figure E-11** summarize freeway speeds for 2040 No-Build and Build Alternatives and freeway speeds for the 2020 are depicted in **Section 6**.
- I-95 northbound mainline and express lanes are operating at or near free flow speed during the AM and PM peak periods for both the No-Build and Build Alternatives in 2020 and 2040 conditions.

- I-95 southbound mainline and express lanes are operating at or near free flow speed during the AM peak period for both the No-Build and Build Alternatives in 2020 and 2040 conditions.
- I-95 southbound mainline in the No-Build Alternative during the PM peak period experiences congestion along the segment between Broward Boulevard and Sunrise Boulevard due to the weaving between interchanges and due to the Broward Boulevard southbound off-ramp queuing back to I-95. Upstream of the Broward Boulevard southbound off-ramp, speeds between 20 mph and 40 mph were observed in the PM peak hour. Downstream of the Broward Boulevard southbound off-ramp, vehicles escape the congested area and operating speeds at or near free flow speed were observed until reaching the Davie interchange area.
- With the addition of the direct connects to Broward Boulevard, I-95 southbound in the Build Alternative is operating at or near free flow speed during the PM peak period the 2040 Alternative.

Intersection Analysis

- The following intersections projected to operate at LOS F during the AM and/or PM peak period under the 2040 No-Build scenario are now projected to operate at LOS E or better under the Build scenario:
  - Sunrise Boulevard at NW 24th Avenue, I-95 Southbound Ramp*, NW 16th Avenue, and NW 15th Avenue
  - Broward Boulevard at NW 27th Avenue, I-95 Northbound Ramp, and NW 15th Avenue

  *Note the Sunrise Boulevard I-95 Southbound Ramp is failing due to arterial delay, not off-ramp delay.

Exit Ramp Queues

- The 95th percentile queues for exit ramp movements were calculated
- The following ramp terminal movements projected to exceed available storage during the AM and/or PM peak period under the No-Build scenario are now project to accommodate queues under the Build scenario:
  - Sunrise Boulevard Northbound Off-Ramp
  - Broward Boulevard Southbound and Northbound Off-Ramp

It is expected that the Build Alternative will not have a significant adverse impact on the traffic operations of the freeway system or on the local street network.

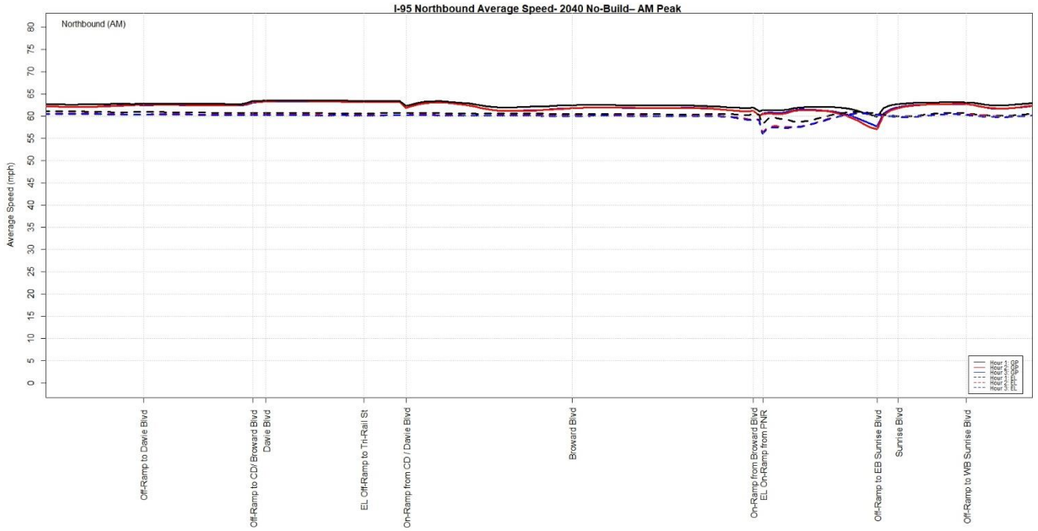


Figure E-4 | 2040 No-Build Northbound Average Speed for AM Peak Period

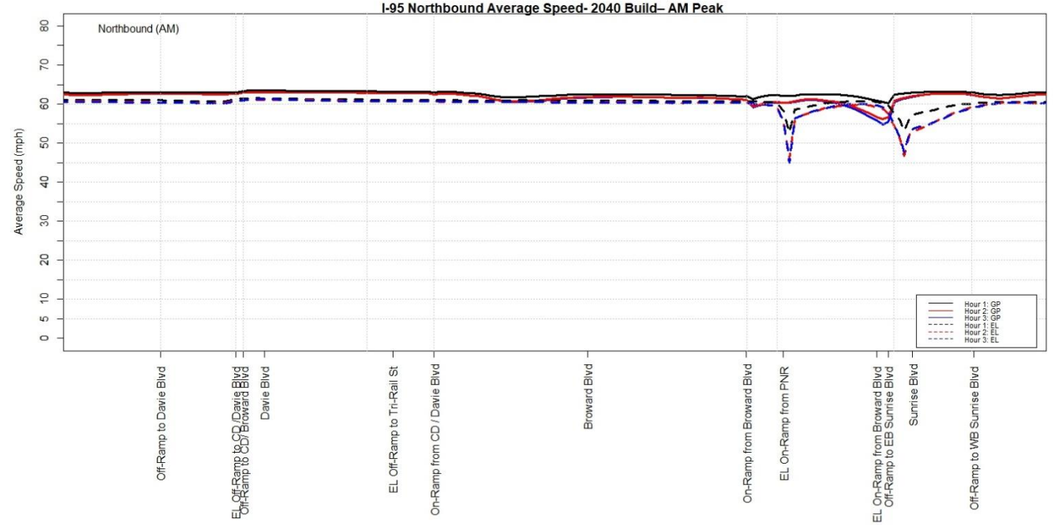


Figure E-5 | 2040 Build Northbound Average Speed for AM Peak Period

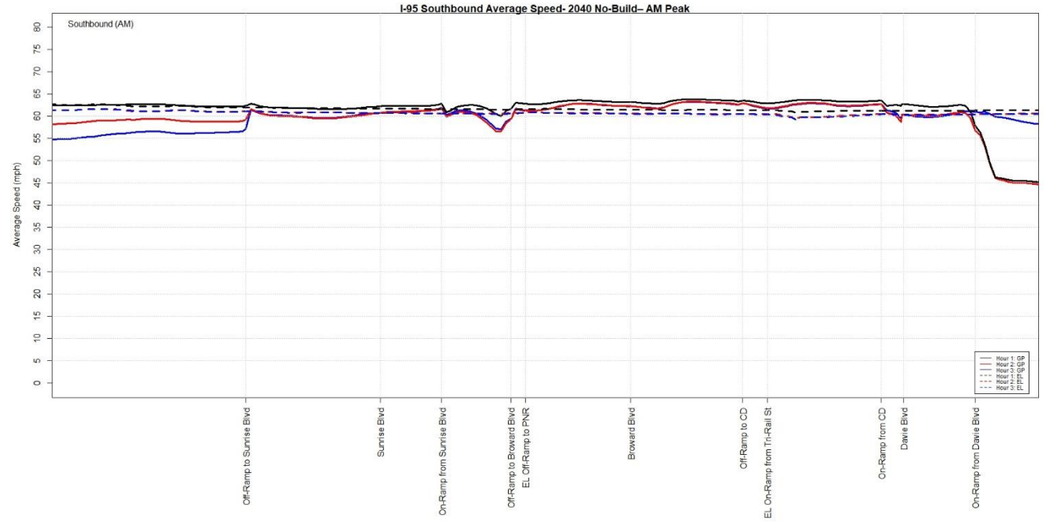


Figure E-6 | 2040 No-Build Southbound Average Speed for AM Peak Period

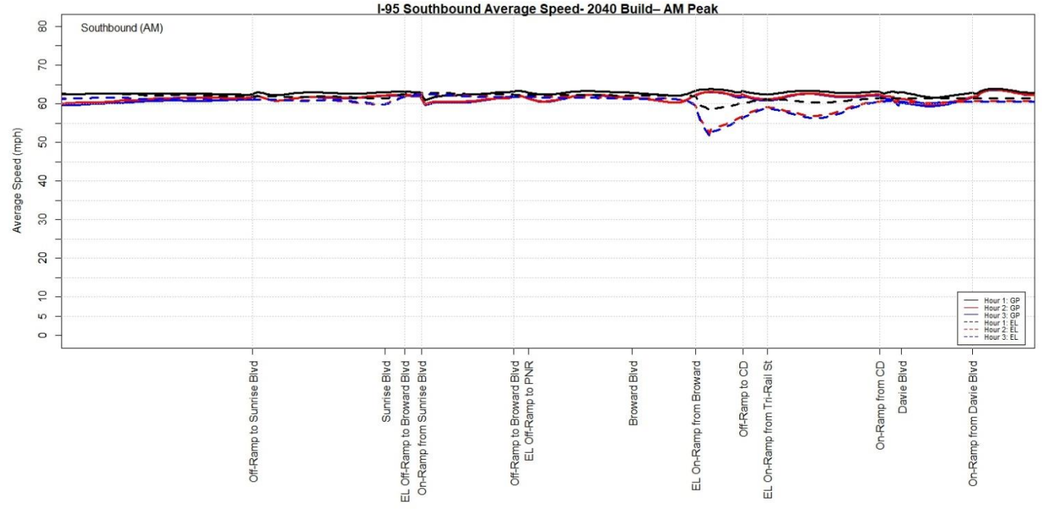


Figure E-7 | 2040 Build Southbound Average Speed for AM Peak Period

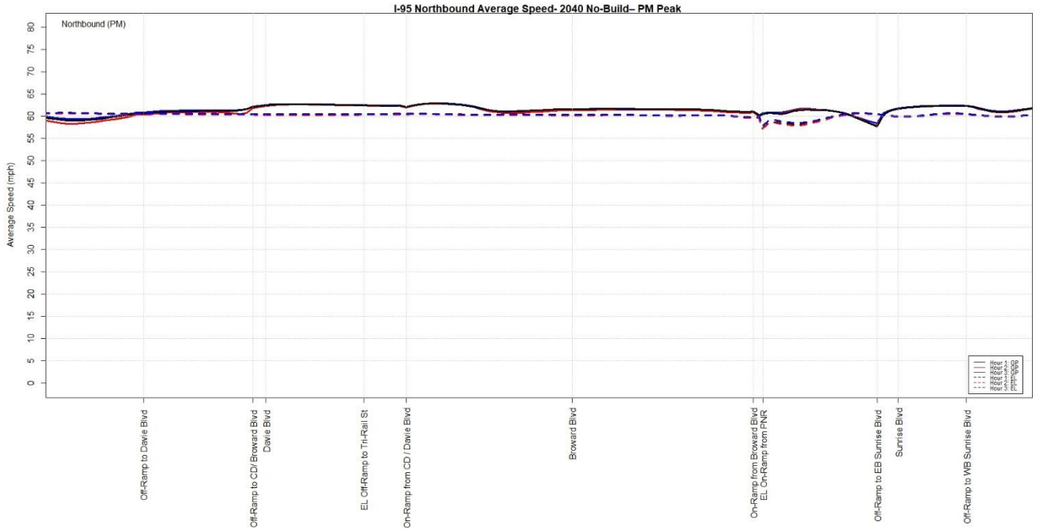


Figure E-8 | 2040 No-Build Northbound Average Speed for PM Peak Period

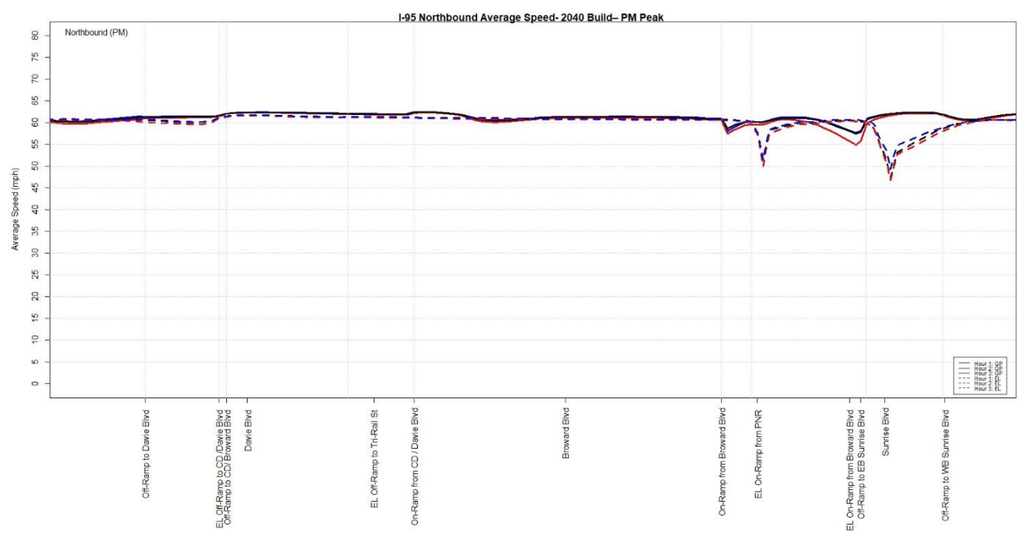


Figure E-9 | 2040 Build Northbound Average Speed for PM Peak Period

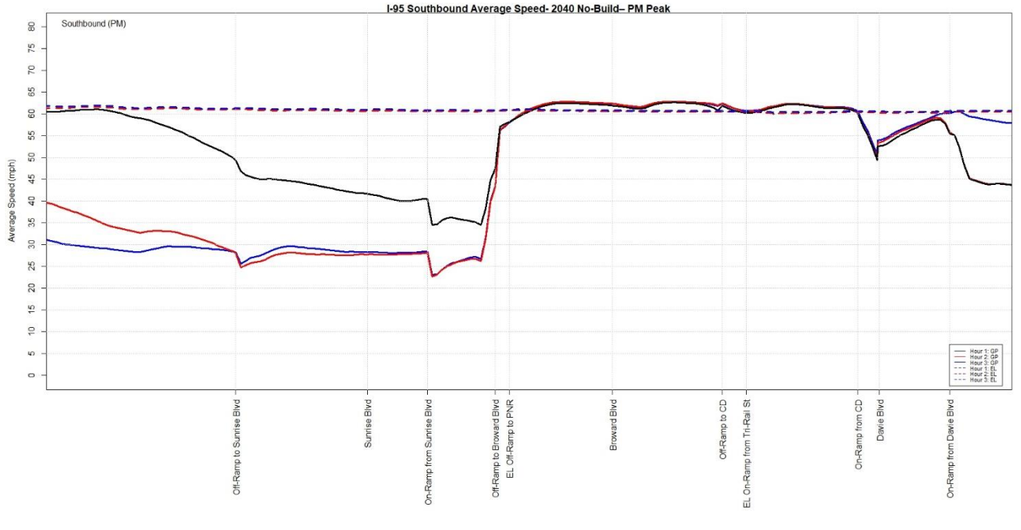


Figure E-10 | 2040 No-Build Southbound Average Speed for PM Peak Period

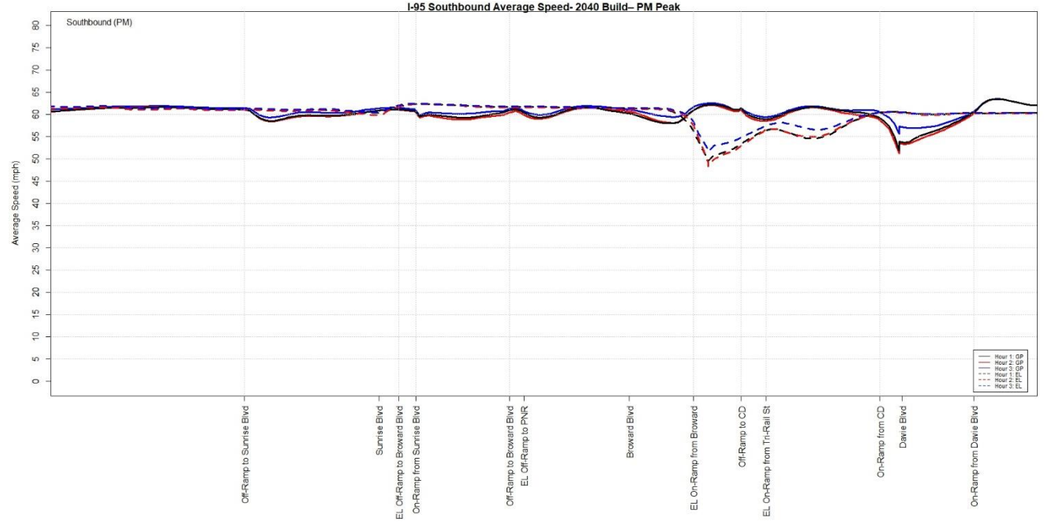


Figure E-11 | 2040 Build Southbound Average Speed for PM Peak Period

Safety Analysis

Rear-end crashes are the most predominant crash type within the region and indicative of congested roadway conditions. **Table E-1** summarizes the locations and potential countermeasures to address safety concerns. The conceptual design plans were developed in accordance with the FDOT's Design Standards and Plans Preparation Manual and FHWA's Policy on Geometric Design of Highways and Streets. Adherence to these standards will facilitate safe and efficient traffic operations along the corridor. The improvements proposed will increase capacity along the mainline and at the interchanges. These capacity improvements will correspondingly improve traffic flow and reduce congestion-related crashes along the corridor.

It is expected that the Build Alternative will not have a significant adverse impact on the safety of the freeway system.

Table E-1 | Potential Safety Countermeasures

Location	Issue	Predominant Crash Type	Countermeasures
I-95 from Davie Boulevard to Sunrise Boulevard	Crash rate higher than statewide average crash rate and higher than the district average crash rate.	Rear end and sideswipe crashes.	Additional capacity expected to improve traffic flow and reduce congestion related crashes
Broward Boulevard from SW 27 Avenue to NW 15 Avenue	Crash rate was higher than statewide average crash rate in the year 2011 through 2014 and higher than the district average crash rate in the year 2013 and 2014.	Rear end, angle, and sideswipe crashes	The Modified Displaced Left Turn (MDLT) concept for the Broward Boulevard interchange reduces total number of conflict points from 32 (for a conventional intersection) to 30 (for a DLT intersection with left-turn crossovers on the mainline approaches). expected to improve traffic The MDLT concept expected to improve traffic flow and reduce congestion related crashes
Sunrise Boulevard from NW 24 Avenue to NW 15 Avenue	Crash rate was higher than statewide average crash rate and higher than the district average crash rate.	Rear end, angle, and sideswipe crashes	Intersection improvements at ramp terminals reduce congestion and occurrences of rear end crashes.

Conceptual Signing Plan

A draft conceptual signing plan has been prepared as part of the I-95 at Broward Boulevard Interchange PD&E Study. The draft signing plan is included in **Appendix I**.

Point #2: A full interchange with all traffic movements at a public road is provided

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)).

I-95 is a public facility and all interchanges within the area of influence provide full access. The interchange improvements will occur at the I-95 at Broward Boulevard and Sunrise Boulevard east terminal ramp intersection. All basic movements are currently provided at I-95 at Broward Boulevard and Sunrise Boulevard interchanges. The proposed improvements at the I-95 at Broward Boulevard and Sunrise Boulevard interchanges will continue to provide full access.

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1.0 Introduction

The Florida Department of Transportation (FDOT), District Four, is conducting a Project Development and Environment (PD&E) Study at the I-95 and Broward Boulevard interchange. The primary purpose for this PD&E study is to enhance connectivity and modal interrelationships at the I-95 at Broward Boulevard interchange. The project is also intended to increase capacity and improve safety in the vicinity, including access to I-95 and the arterial intersections. Additionally, the Department has conducted a standalone feasibility review for the I-95 at Sunrise Boulevard interchange, focusing on operational improvements needed at the east ramp terminal intersection. This Feasibility Study was completed in June 2017 and did not include any environmental impacts. FDOT District Four (the applicant) would like to include Sunrise Boulevard east terminal ramp improvements in the Systems Interchange Modification Report (SIMR). Therefore, a SIMR is being prepared in support of the PD&E Study to document the evaluation of the proposed modifications for the I-95 at Broward Boulevard interchange and for the Sunrise Boulevard east ramp terminal intersection. **Figure 1-1** shows the SIMR project location and AOI.

This SIMR documents the travel demand modeling, traffic forecasting, and operational analysis for the Build Alternative that includes proposed modifications at the I-95 at Broward Boulevard PD&E study and adjacent Sunrise Boulevard northbound ramp terminal intersection. Therefore, the purpose of the SIMR is to provide the required technical documentation for obtaining safety, operational and engineering (SO&E) acceptability of the proposed modifications as part of the I-95 at Broward Boulevard PD&E study.

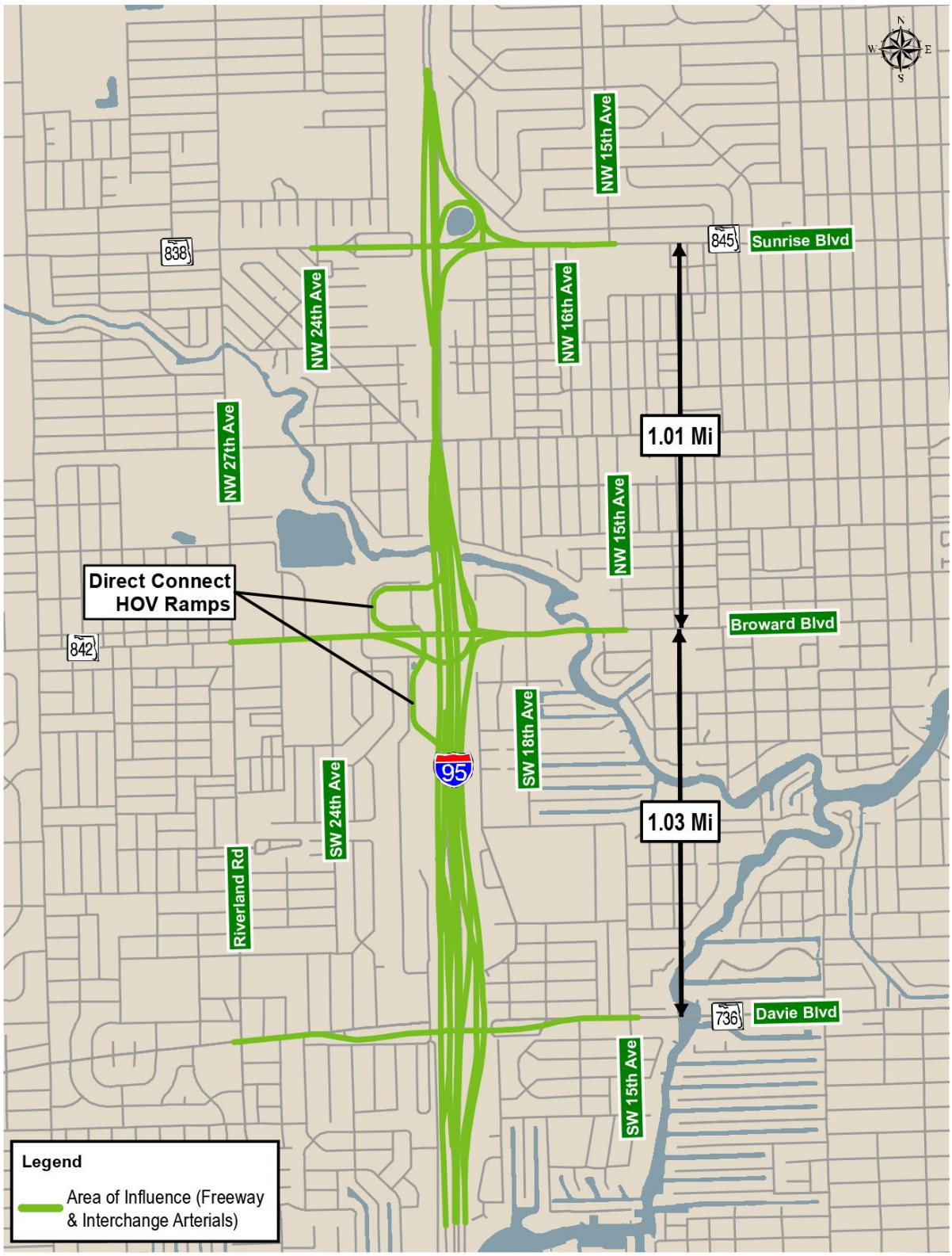
1.1 Background

The Broward Boulevard interchange has been the subject of several studies over recent years. In 2010, the I-95 at Broward Boulevard Interchange Operational Analysis Report (IOAR) identified the need to improve the southbound exit ramp.

FDOT District Four completed a Corridor Traffic Analysis Report (CTAR) for the 95 Express Phase 3 project in November 2014. The CTAR demonstrated the engineering and operational acceptance of the proposed expansion of the I-95 express lanes system from Stirling Road in Broward County to Linton Boulevard in Palm Beach County.

The Interchange Master Plan (IMP) for Broward County which addressed the traffic and safety issues at the 16 interchanges along I-95, including the Sunrise Boulevard interchange was completed in February 2016. Subsequently, an Interchange Concept Development Report (ICDR) was prepared to evaluate the specific issues associated with the current interchange configuration and a concept plan was developed to improve traffic operations at the Sunrise Boulevard interchange. The ICDR recommended improvements for the west ramp terminal intersection of Sunrise Boulevard, and did not include the Broward Boulevard interchange because that was left to the future PD&E Study that is the subject of this SIMR. Due to the potential impact of the Woodlawn Cemetery located on the southeast quadrant of the I-95 at Sunrise Boulevard interchange, the improvements for the Sunrise Boulevard interchange were addressed for the west ramp terminal intersection only. The east side of the interchange would be

Figure 1-1: Project Location and Area of Influence



included in the I-95 at Broward Boulevard Interchange PD&E Study for feasibility study only, and the west side of the interchange would advance directly to the design phase since the improvements identified in the ICDR did not require a PD&E study. The IOAR documenting the traffic analysis was completed for the I-95 at Sunrise Boulevard west ramp terminal and recommended design concepts to improve the operation of the I-95 southbound ramps and the ramp terminal on the west side of the interchange. The east ramp terminal intersection of I-95 at Sunrise Boulevard was addressed using a feasibility review technical memorandum as an off-shoot of the I-95 at Broward Boulevard PD&E Study. This Technical Memorandum is included as an **Appendix B** to this SIMR.

1.2 Purpose and Need

The primary purpose of I-95 at Broward Boulevard Interchange PD&E Study is to improve traffic flow to and from I-95 and along Broward Boulevard; to improve connectivity between the 95 Express Lanes and Broward Boulevard; and to improve intermodal connectivity. Improved connections between the 95 Express Lanes and Broward Boulevard, as well as the surrounding intermodal facilities, are desired. The primary need for the Broward Boulevard Interchange PD&E Study is to enhance system linkage and modal interrelationships at the I-95 at Broward Boulevard interchange.

Secondary purpose and need considerations are described in the following sections that include Capacity, Safety, Transportation Demand, Social Demands, Economic Development, and Emergency Evacuation.

1.2.1 System Linkage

Broward Boulevard is a state road (SR 842) that provides the main entryway to the downtown Fort Lauderdale Central Business District from I-95 and the east-west connection between US 1 and SR 817/University Drive in the City of Plantation. Broward Boulevard continues west toward SR 823/Flamingo Road as a county road. The section of Broward Boulevard from I-95 to NE 3rd Avenue is part of the state's Strategic Intermodal System (SIS), which consists of high-priority transportation facilities and services of statewide and interregional significance. I-95 north and south of Broward Boulevard is also a SIS facility and serves as the primary north-south interstate facility that links all major cities along the Atlantic Seaboard and is one of the most important transportation systems in southeast Florida. These SIS facilities are critical to the movement of people and goods in Florida, and their function is considered to be vital to Florida's economic competitiveness.

1.2.2 Modal Interrelationships

Transit services along Broward Boulevard are currently experiencing recurring congestion that reduces vehicle speeds, increases operating costs, and makes scheduling of buses from a system level challenging. There are a number of transit options on Broward Boulevard that provide direct service and transfer connections along the corridor. These include passenger rail service (Tri-Rail and Amtrak) and bus service (Broward County Transit, Breeze, Sun Trolley, 95 Express Bus by Miami-Dade Transit, Tri-

Rail Shuttle and Tri-Rail NW Community Link). The operation of these services is vital to the mobility of the entire corridor.

The desired geometric and operational improvements to the Broward Boulevard interchange and surrounding transit facilities will reduce bus travel times, improve intermodal connectivity, and improve access to bus stops and transfers. One of the key aspects of the improvements to Broward Boulevard include a median transit station over the Park and Ride Lot, west of the SFRC, for connectivity between transit services at-grade both north and south of Broward Boulevard, and potential future premium transit service on Broward Boulevard E/W. The 95 Express Bus service is desired to access Broward Boulevard more effectively from the 95 Express Lanes and the existing Park-and-Ride lots. Functionality of the I-95 median ramps and Park-and-Ride lot network is to be improved for the intermodal services within the interchange area.

1.2.3 Capacity

Within the project limits, I-95 will operate at Level of Service (LOS) F. Broward Boulevard within the project limits also will operate at LOS F. Without improvements, the traffic will continue to operate well below acceptable LOS standards into the future. The 95 Express Phase 3 improvements will help improve the mainline I-95 corridor LOS by adding one travel lane in each direction in the form of an Express Lane, managing congestion along I-95. The improvements proposed as part of the interchange project will be developed to complement the 95 Express Lanes improvements by enhancing existing connectivity within the Park-and-Ride lots, improving existing I-95 at Broward Boulevard terminal intersections, and providing improved Express Lane access to Broward Boulevard.

1.2.4 Safety

The comprehensive improvements to the interchange and surrounding transit facilities will improve the interaction between the different modes of transportation in the vicinity. The improvements are to include safe connections for pedestrians using transit services, circulation of traffic within the Park-and-Ride lot network, and access between the Express Lanes and Broward Boulevard. Additionally, the capacity improvements will aid in reducing the number of crashes within the project limits.

1.2.5 Transportation Demand

The Broward Boulevard Interchange Project PD&E Study is included in the Broward Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP) for Fiscal Years (FY) 2015-2019 and the FDOT Work Program FY 2015-2019.

Broward MPO's 2035 Long Range Transportation Plan (LRTP) included improvements to all I-95 interchanges in Broward County under Illustrative Roadway Projects. Illustrative projects are those that cannot be included in the Cost Feasible Plan due to financial constraints but would be included in a future approved TIP. The MPO's 2040 LRTP, Commitment 2040, adopted by reference the Strategic Intermodal System 2040 Cost Feasible Plan, which includes modifications to the I-95 at Broward Boulevard interchange in the first five years.

1.2.6 Social Demands and Economic Development

Social and economic demands on the I-95 corridor will continue to increase as population and employment increase. The Broward MPO 2035 LRTP predicted that the population would grow from 1.7 million in 2005 to 2.3 million by 2035, an increase of 29 percent. Jobs were predicted to increase from 0.7 million to 1 million during the same time period, an increase of 37 percent. Commitment 2040 revised the growth projections to 1.9 million persons and 0.8 million jobs by 2040. These numbers reflect growth rates of 13.4 percent for population and 10.4 percent for jobs by 2040. These numbers, however, only account for the projected growth in Broward County and do not reflect the number of commuters from adjacent areas who may use this interchange to access jobs.

1.2.7 Emergency Evacuation

The project is anticipated to improve emergency evacuation capabilities by enhancing connectivity and accessibility to major arterials designated on the state evacuation route. I-95 serves as part of the emergency evacuation route network designated by the Florida Division of Emergency Management and Broward County. Broward Boulevard moves traffic from the east and west to I-95. I-95 is critical in facilitating traffic during emergency evacuation periods as it connects to other major arterials and highways of the state evacuation route network (i.e., I-595 and Florida's Turnpike).

While the Broward Boulevard PD&E Study evaluates system linkage and modal interrelationships at the I-95 at Broward Boulevard interchange, the purpose of this Systems Interchange Modification Report (SIMR) is to seek safety, operational and engineering (SO&E) acceptability of the proposed modifications for the Interstate 95 (I-95) at Broward Boulevard interchange and for Sunrise Boulevard northbound ramp terminal intersection.

2.0 Methodology

2.1 Overview

A Methodology Letter of Understanding (MLOU) was developed and approved by the Florida Department of Transportation (FDOT) District Four Interchange Review Committee (DIRC) and the FDOT Central Office in August 2018 for this I-95 at Broward Boulevard SIMR. This MLOU was a revision to the original I-95 at Broward Boulevard IMR MLOU approved in February 2017. When the original IMR MLOU was developed, the I-95 at Broward Boulevard PD&E Study scope of work included a standalone Feasibility Study for the northbound ramp terminal intersection (east intersection) of the I-95 at Sunrise Boulevard interchange. This Feasibility Study was focused on determining operational improvements needed at only the Sunrise Boulevard east terminal ramp intersection and the recommendation was not expected to be part of the IMR for the I-95 at Broward Boulevard PD&E Study. The recommendation from the Feasibility Study did not include any environmental impacts. Therefore, FDOT District Four decided to include the Sunrise Boulevard east ramp terminal improvements along with the original IMR SO&E request and reclassify the IAR to an SIMR. SIMR MLOU also incorporates changes to the Federal Highway Administration's (FHWA) Interstate Access Policy (dated May 22, 2017). The IMR MLOU and the SIMR MLOU for the I-95 at Broward Boulevard are included in **Appendix A**.

2.2 Area of Influence

The area of influence included SR 9/I-95 mainline, from south of Davie Boulevard to north of Sunrise Boulevard. Along crossroads, the area of influence extended from each study interchange ramp terminal intersection to the nearest adjacent signalized intersection to the east and west of the ramp terminal intersection. **Figure 1-1** shows the project location and AOI. The cross street roadway limits and the intersections that were analyzed in the SIMR are identified below.

Along the Arterials

There are 16 signalized intersections under consideration within the area of influence along the arterials. These intersections are listed below:

1. Davie Blvd. at Riverland Road
2. Davie Blvd. at I-95 SB Off-ramp terminal
3. Davie Blvd. at I-95 NB Off-ramp terminal
4. Davie Blvd. at SW 15th Avenue
5. Broward Blvd. at SW 27th Avenue
6. Broward Blvd. at SW 24th Avenue
7. Broward Blvd. at NW/SW 22th Avenue
8. Broward Blvd. at I-95 SB Off-ramp terminal including the WB to NB fly-over
9. Broward Blvd. at I-95 NB Off-ramp terminal including the WB to NB fly-over
10. Broward Blvd. at SW 18th Avenue
11. Broward Blvd. at NW 15th Avenue
12. Sunrise Blvd. at NW 24th Avenue
13. Sunrise Blvd. at I-95 SB Off-ramp terminal

14. Sunrise Blvd. at I-95 NB Off-ramp terminal
15. Sunrise Blvd. at NW 15th Avenue
16. Sunrise Blvd. at NW 16th Avenue

There are additional intersections under consideration within the area of influence. These intersections are listed below:

1. Broward Blvd. at NW 25th Avenue (proposed signal for Wal-Mart)
2. Direct connect ramps from existing HOV lanes to the Park-and-Ride lot (North of Broward Blvd.)
3. Direct connect ramps from existing HOV lanes to the Park-and-Ride lot (South of Broward Blvd.)
4. SW 1st Street at 22nd Avenue (U)
5. SW 1st Street at SW 21st Terrace (U)
6. SW 1st Street at On/Off Ramps Terminal Intersection

2.3 Analysis Years

The years used for the travel demand forecasting are:

- Base Year: 2010
- Horizon Year: 2040

The forecasting of the traffic volumes is based on the Southeast Regional Planning Model, Version 7.0 (SERPM 7.0). The years used for the traffic operational analysis are:

- Existing Year: 2016
- Opening Year: 2020
- Design Year: 2040

2.4 Considered Alternatives

Traffic operational analyses were performed for No Build and Build Alternatives in the SIMR. FDOT is currently implementing Phase 3 of the 95 Express Lanes continuing 29 miles north from Stirling Road in Broward County to Linton Boulevard in Palm Beach County. The 95 Express Phase 3A project will convert the existing HOV lane to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes. The resulting typical section becomes a 12-lane facility comprised of 4 General Purpose Lanes and 2 Special Use Lanes in each direction. Additionally, FDOT has recently completed an IOAR for the I-95 at Sunrise Boulevard west ramp terminal intersection. The IOAR recommended design concept improves traffic operations for the I-95 southbound ramps and the ramp terminal on the west side of the Sunrise Boulevard interchange. Therefore, the No-Build Alternative will include aforementioned projects and are briefly listed below.

- 95 Express Phase 3A project which is currently under construction.
- The Sunrise Boulevard Interchange Operational Analysis (IOAR) west terminal intersection improvements. The approved IOAR improvement converts the existing west terminal off-ramp

(single lane right turn and dual lane left turns) to triple right turns and triple left turns. The IOAR approved improvement is currently under design phase and is scheduled for construction (FM # 435514-1) in the year 2020.

The Build Alternative includes an I-95 at Broward Boulevard PD&E study recommended concept for the Broward Boulevard interchange accommodating ingress and egress braided ramps for the on-going 95 Phase 3 project and the Sunrise Boulevard east terminal intersection recommended concept.

1. 95 Express Ingress-Egress Connections with Broward Boulevard Interchange: As discussed in the Purpose and Needs Section, the primary purpose of the I-95 at Broward Boulevard PD&E Study is to improve traffic flow to and from I-95 and along Broward Boulevard; to improve connectivity between the I-95 Express Lanes and Broward Boulevard; and to improve intermodal connectivity. The challenge was to utilizing legacy HOV ramps to connect to 95 Express Phase 3A and integrating with the Broward Boulevard interchange recommended alternative: Build Alternative 2B.

   The ingress and egress braided ramps connecting I-95 express lanes are listed below**.**

   - In the southbound egress direction, the proposed improvements include a braided ramp over the southbound I-95 General Use Lanes with a connection to the west ramp terminal intersection of the Broward Boulevard service interchange to provide egress from 95 Express near NW 6th Street/Sistrunk Boulevard.
   - Similarly in the southbound ingress direction, there is a braided ramp over the southbound I-95 General Use Lanes located just south of Broward Boulevard that provides ingress access for the westbound traffic on Broward Boulevard. This elevated braided ramp provides direct access via the west ramp terminal intersection of the Broward Boulevard service interchange. The westbound left-turn at the west ramp terminal intersection feeds directly into the southbound express lane ramp and does not require drivers to weave through the General Use Lanes.
   - To access Southbound (SB) 95 Express from eastbound Broward Boulevard, motorists use SW 1st Street, from SW 22nd Avenue, to access the legacy HOV SB entrance ramp at the south side of the Park and Ride Lot just south of Broward Boulevard. Along SW 1st Street, the residential road of SW 22nd Ave is closed. The stop-controlled intersection at SW 21st Terrace and the signalized intersection immediately east of that are converted to a single roundabout.
   - For the northbound direction, egress from 95 Express near Davie Boulevard is proposed through the use of a braided ramp over the northbound I-95 General Use Lanes with a connection to the northbound CD road ramp system that terminates at the east terminal intersection of the Broward Boulevard service interchange. This elevated braided ramp provides eastbound and westbound Broward Boulevard access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.
   - Ingress from the Broward Boulevard service interchange to the northbound 95 Express lanes is proposed through a braided ramp over the northbound I-95 General Use Lanes in the vicinity of NW 6th Street/Sistrunk Boulevard. This elevated braided ramp provides

direct access between Broward Boulevard and the northbound Express Lanes, using the existing eastbound to northbound flyover, and westbound to northbound ramp, for access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.

2. I-95 at Broward Boulevard Interchange: The Broward Boulevard interchange recommended Modified Displaced Left Turn Alternative, the Build Alternative 2B. The Modified Displaced Left Turn Interchange Alternative provides for the displacement of the northbound exit ramp onto a new roadway (bridge structure) that is on the south of Broward Boulevard over I-95, and runs south of and parallel to the eastbound Broward Boulevard through lanes. The northbound ramp left-turn traffic is then transitioned on to the westbound Broward Boulevard roadway at the west ramp terminal intersection. There are three westbound left-turn lanes at the west ramp terminal intersection. The inner left-turn lane is a buffer left-turn lane to provide direct connect to southbound 95 Express and the outer two left-turn lanes are for general use that feed to the southbound I-95 and the C-D road.

3. I-95 at Sunrise Boulevard east terminal ramp intersection: The Signalized Loop Ramp and Extended Eastbound Merge to NW 17th Avenue (Build Alternative 3A) for the Sunrise Boulevard east terminal ramp intersection. This alternative modifies both the northbound to eastbound ramp and the northbound to westbound ramp. The northbound to eastbound merge distance is increased to 500 feet, terminating just west of NW 17th Avenue. The northbound to westbound loop ramp is realigned to stop at the signal serving the I-95 northbound entrance. The loop ramp is modified to provide two-lane and three-lane section storage approaching the signal.

2.5 Analysis Approach

2.5.1 Travel Demand Forecasting

The Southeast Florida Regional Planning Model (SERPM), Version 7.062 was used for travel forecasting since it was the latest version of the SERPM model available at the beginning of this project. SERPM 7.062 is an Activity-Based Model (ABM) that simulates both household-level and person-level travel choices including intra-household interactions with household members. SERPM 7.062 model is validated to Year 2010 conditions and includes a future year 2040 scenario based on the adopted Cost Feasible plans from Miami-Dade MPO, Broward MPO, and Palm Beach MPO. It is approved for transportation engineering and planning studies by the Regional Transportation Technical Advisory Committee - Modeling Subcommittee (RTTAC-MS) in South Florida. The RTTAC-MS comprises representatives from FDOT District 4, District 6, and the three MPOs in South Florida.

The AADTs were developed based on existing traffic counts and growth factors. The growth factors were determined from 2010 and 2040 model volumes, historical traffic counts, and socioeconomic growth in the study area. The AADT, Standard K factor, D factor, together with existing turning movements, were used as input into the TMTool application to calculate future year turning movements.

2.5.2 Traffic Operational Analysis

Traffic simulation software (PTV's VISSIM) was chosen for the analysis. The Federal Highway Administration's (FHWA's) Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, 2014 FDOT Traffic Analysis Handbook and 2011 Oregon Department of Transportation (ODOT) Protocol for VISSIM Simulation were used as a guideline for the development of the project VISSIM models.

Three-hour AM and PM peak-period analyses were conducted using 15-minute flow rates with microsimulation for the existing year (2016), opening year (2020), and design year (2040). A 30-minute seeding period will be used, based on a lower percentage of the counted volumes. VISSIM models were developed and calibrated to existing year. The calibration of the existing AM and PM models were based on the thresholds including traffic volume, travel time, speed and queue lengths as indicated in the FDOT Traffic Analysis Handbook Table 7-7 Classical Model Calibration Targets. Calibration parameters from the existing year VISSIM models were carried forward to the future year VISSIM models.

The Measures of Effectiveness (MOE) assessed from the VISSIM models include the following:

- Intersection Node Evaluation: Volume, delay, and max queue length for the study area intersections for all movements.
- Link Evaluation Segments: Volume and Speed information for General Use Lanes, Express Lanes and access points within the study area. A temporal and spatial volume and speed profile will be provided.
- Network-Wide Output: Total travel time, total delay time, average delay time, vehicle-miles of travel, latent volume and latent delay.

2.5.3 Safety Analysis

The safety analysis was performed for the past five years (2011 – 2015) for the study intersections and roadway segments. The safety analysis will document crash rate, crash patterns, crash types, and their contributing causes for existing conditions within the area of influence.

3.0 Existing Conditions

The Interchange of I-95 at Broward Boulevard is located in central Broward County in the City of Fort Lauderdale, between the Sunrise Boulevard interchange (one mile to the north) and the Davie Boulevard interchange (one mile to the south). The interchange provides the main entryway to the downtown Fort Lauderdale Central Business District from I-95 and the east-west connection between US 1 and SR 817/University Drive in the City of Plantation.

The South Florida Rail Corridor (SFRC)/CSX Railroad is adjacent to and runs parallel along the west side of I-95 in this area. The I-95 at Broward Boulevard (SR 842) (Roadway Segment 86006000) interchange is located at milepost 10.201 of I-95 (Roadway Segment 86070000) on the west edge of the Fort Lauderdale city limits. It is approximately 1.0 mile south of the I-95 at Sunrise Boulevard (SR 838) (Roadway Segment 86110000) interchange and 1.42 miles north of the I-95 at Davie Boulevard (SR 736) (Roadway Segment 86210000) interchange.

SR 842/Broward Boulevard and Sunrise Boulevard are six-lane urban divided roadways with raised medians within the vicinity of the I-95 Interchange. The SR 842/Broward Boulevard interchange provides the main entryway to the downtown Fort Lauderdale Central Business District from I-95 and the east-west connection between US 1 and SR 817/University Drive in the City of Plantation.

3.1 Existing Transportation Network

I-95 is the primary north-south interstate facility that links all major cities along the Atlantic Seaboard and is one of the most important transportation systems in southeast Florida. I-95 is one of two major expressways, Florida's Turnpike being the other, that connect the major employment centers and residential areas within the South Florida tri-county area. I-95 is part of the State's Strategic Intermodal System (SIS) and the National Highway System (NHS). In addition, I-95 is designated as an evacuation route along the east coast of Florida.

I-95 within the project area is a ten-lane facility with four general purpose travel lanes and one high occupancy vehicle (HOV) lane in each direction. I-95 has a posted speed limit near the Broward Boulevard interchange of 65 mph.

The Broward Boulevard interchange is a diamond interchange. Broward Boulevard is a six-lane east-west arterial thorough Broward County and the City of Fort Lauderdale. Within the project limits, Broward Boulevard is functionally classified as a Divided Urban Principal Arterial with a posted speed limit of 40 mph. Broward Boulevard from I-95 to NE 3rd Avenue is a designated Strategic Intermodal System (SIS) Connector providing access to the Greyhound Bus Station located just east of NW 2nd Avenue in Fort Lauderdale. The Broward Boulevard interchange currently provides direct connect HOV access with a southbound entrance ramp from Broward Boulevard onto I-95, and a northbound exit ramp from I-95 to Broward Boulevard.

The Sunrise Boulevard interchange is currently a modified partial cloverleaf interchange with one loop ramp on the NE quadrant located on the west edge of the Fort Lauderdale city limits. Sunrise Boulevard is classified as a six-lane divided Urban Principal Arterial with a posted speed limit of 40 mph.

The Davie Boulevard interchange is currently a diamond interchange. Within the project limits, Davie Boulevard is functionally classified as a four-lane divided State Minor Arterial with a posted speed limit of 40 mph.

The collector distributor (C-D) system currently exists south of the Broward Boulevard interchange. The southbound C-D originates after one of the two lanes from the southbound on-ramp terminal splits and forms a southbound C-D. The northbound C-D terminates at southbound off-ramp. The northbound off-ramp is a two-lane facility with one lane ramp coming from the northbound C-D and another lane ramp from the I-95 general purpose lanes. Both southbound and northbound C-Ds provide access to Davie Boulevard and I-595 interchanges.

3.2 Data Collection

The traffic data including traffic volume counts, the intersection turning movement volumes, I-95 collector-distributor (C-D) ramps, origin-destination (O-D) data and data for microsimulation were collected in September and October 2016. The signal timing plans for signalized intersections were obtained from Broward County. The Park-and-Ride lot usage inventory was conducted in October 2016. Detailed data collection information and referenced documents are included in **Appendix C**.

3.2.1 Traffic Data

Traffic count data was collected for the intersections for three consecutive weekdays (Tuesday, Wednesday, and Thursday) in September and October 2016. The traffic data includes 72-hour approach/departure traffic volume counts, the intersection turning movement volumes from 6:00 am to 9:00 am during AM peak period and from 4:00 pm to 7:00 pm during PM peak period for the following intersections:

1. Davie Boulevard at SW 27th Avenue
2. Davie Boulevard at I-95 Southbound Ramps
3. Davie Boulevard at I-95 Northbound Ramps
4. Davie Boulevard at SW 15th Avenue
5. Broward Boulevard at NW 27th Avenue
6. Broward Boulevard at NW 25th Terrace
7. Broward Boulevard at NW 24th Avenue
8. Broward Boulevard at NW 22nd Avenue
9. Broward Boulevard at I-95 Southbound Ramps
10. Broward Boulevard at I-95 Northbound Ramps
11. Broward Boulevard at NW 18th Avenue
12. Broward Boulevard at NW 15th Avenue
13. SW 1st Street at SW 22nd Avenue
14. SW 1st Street at SW 21st Terrace
15. SW 1st Street at Access Road at Tri-Rail Station

The turning movement counts and approach/departure counts along Sunrise Boulevard were conducted in October 2015 as part of the efforts for the I-95 at Sunrise Boulevard Interchange Operational Analysis Report (IOAR) study. Traffic counts for I-95 C-D ramps were also collected for the study. The 72-hour traffic volumes were collected for the following locations:

1. I-595 westbound Off-Ramp to I-95 northbound
2. I-595 eastbound Off-Ramp to I-95 northbound
3. I-595 eastbound/westbound Off-Ramp to I-95 northbound north of SR 84
4. I-595 eastbound/westbound Off-Ramp to I-95 northbound south of Davie Boulevard
5. I-95 northbound Off-Ramp to Broward Boulevard
6. I-595 northbound connection to Broward Boulevard
7. I-95 southbound Off-Ramp to I-595 / Davie Boulevard
8. Broward Boulevard connection to I-95 southbound
9. I-95 southbound Off-Ramp to I-595 south of Davie Boulevard Off Ramp
10. Davie Boulevard connection to I-95 southbound
11. I-95 southbound Ramp to I-595 south of Davie Boulevard
12. I-95 southbound to I-595 eastbound

Reasonableness checks were performed for traffic count data. Traffic count data were compared with FTI data and also approach counts were compared with the intersection turning movement counts.

3.2.2 Origin Destination Data

To better understand the travel pattern in and around the study area and support the PD&E Study origin-destination (O-D) data was collected using the BlueTOAD Bluetooth equipment. The BlueTOAD devices were deployed in a number of selected locations to capture vehicles passing through these locations by detecting anonymous MAC addresses. The wireless identification number is used to connect Bluetooth signals between mobile devices and vehicles. The origin-destination data collection was performed on three consecutive weekdays from Tuesday, October 25, 2016 to Thursday, October 27, 2016. The BlueTOAD devices were installed at the following locations:

1. SW 21st Terrace at HOV Ramp
2. SW 1st Street at HOV Ramp
3. Sunrise Boulevard east of I-95
4. I-595 Express east of I-95
5. Davie Boulevard east of I-95
6. Sunrise Boulevard west of I-95
7. I-95 north of Sunrise Boulevard
8. Davie Boulevard west of I-95
9. Broward Boulevard at NW 22nd Avenue
10. Broward Boulevard east of I-95
11. I-595 Express west of I-95
12. I-95 north of I-595 Express

Bluetooth O-D data was supplemented with StreetLight O-D data.

3.2.3 Microsimulation Data

Additional data collection including off-peak spot speeds, peak hour speeds, and travel times on I-95 and arterials, and approach queues and saturation flows at the ramp terminals and key study area intersections for calibration purposes in microsimulation (VISSIM).

- Saturation Flow Rates: Vehicle headways and start-up lost time were collected for each approach at key intersections to calibrate driver behavior at the signals. Saturation flow rate data was collected for six hours on a typical weekday (Tuesday, Wednesday, or Thursday) at the study locations. The saturation flow rate data was collected on a typical weekday between October 25, 2016 (Tuesday) and October 27, 2016 (Thursday), and on January 3, 2017 from 6:00 AM to 9:00 AM, and 4:00 PM to 7:00 PM on all approaches at the study intersections. The saturation flow rate data was collected at the following locations:
  - Broward Boulevard at NW 24th Avenue
  - Broward Boulevard at I-95 Southbound Ramps
  - Broward Boulevard at I-95 Northbound Ramps
  - Broward Boulevard at NW 15th Avenue
  - Davie Boulevard at I-95 Northbound Ramps
  - Sunrise Boulevard at I-95 Northbound Ramps
- Queue data: Collected for six hours on three consecutive weekdays (Tuesday, Wednesday, and Thursday). The six-hour queue data was collected from 6:00 AM to 9:00 AM, and from 4:00 PM to 7:00 PM on all approaches at the study intersections. At the intersections along Broward Boulevard, the queue data was collected from September 20, 2016 through September 22, 2016. At the intersections along Davie Boulevard and Sunrise Boulevard, the queue data was collected from October 11, 2016 through October 13, 2016.
- Travel Time Data: Seven travel time runs were collected using GPS loggers during the morning peak period from 7:00 AM to 9:00 AM and the afternoon peak period from 4:00 PM to 6:00 PM for both directions of the I-95 mainline and arterials for the entire segments within the area of influence. The travel time data was collected from October 11, 2016 (Tuesday) through October 13, 2016 (Thursday). The travel time runs were collected on the following segments for comparing Vissim model results to field conditions:
  - I-95 from north of I-595 to north of Sunrise Boulevard
  - Sunrise Boulevard between NW 24th Avenue and NW 15th Avenue
  - Broward Boulevard between NW 27th Avenue and NW 15th Avenue
  - Davie Boulevard between Riverland Avenue and SW 15th Avenue
- Off-Peak Speed Data: Off-peak spot speed data was collected between 9:00 PM and 11:00 PM. The spot speed study was performed on I-95 at the Broward Boulevard interchange. The off-peak spot speed data was collected from October 11, 2016 (Tuesday) through October 13, 2016 (Thursday).
- Peak Period Speed Data: Peak hour speed data on I-95 was obtained from RITIS. RITIS maintains all FDOT District Four detector data in addition to several other FDOT Districts.

Speed data is primarily used to develop speed-contour plots, but after reviewing the RITIS data it was determined that the speeds did not correlate with the field collected travel times on I-95. Congestion scans available on the RITIS website indicate that speeds along this segment of I-95 vary significantly from one day to the next and that incidents are commonplace. Due to these factors, the calibration of I-95 did not use spot speeds and instead relied on travel times and visual observations of known bottlenecks and other congested areas.

3.2.4 Crash Data

The crash data for the five most recent years (from January 2011 to December 2015) was obtained from the FDOT's Crash Analysis Reporting System (CARS).

3.3 Existing Traffic Operational Analysis

Traffic operational analyses were conducted for existing conditions using VISSIM 9.00-08, a widely-used, behavior-based multi-purpose traffic microsimulation program. VISSIM tracks individual vehicle movements and interactions more realistically than typical HCM methods and quantifies the performance of individual movements and overall delays and queue lengths for freeways, ramps, and intersections.

3.3.1 Existing Traffic

The three-day traffic data including turning movement counts, approach/departure counts, I-95 C-D ramps were averaged, seasonally adjusted using seasonal factors using 2015 FTI DVD and balanced. Based on the turning movement volumes, 7:30 AM to 8:30 AM was selected as the AM peak Hour and 5:00 PM to 6:00 PM was selected as PM peak hour for the study area. The balanced 2016 AM and PM peak hour turning movement volumes, intersection geometry and number of lanes are depicted in **Figure 3-1** through **Figure 3-3**.

3.3.2 VISSIM Model Development and Calibration

VISSIM models were constructed and calibrated to 2016 Existing Conditions. The Federal Highway Administration's (FHWA) Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, 2014 FDOT Traffic Analysis Handbook and 2011 Oregon Department of Transportation (ODOT) Protocol for VISSIM Simulation were used as guidelines for the development of VISSIM models.

The development of the VISSIM models and the calibration process are documented in detail in the SR 9/I-95 at Broward Boulevard from West of SW 24th Avenue to East of NW/SW 18th Avenue VISSIM Model Development and Calibration Report dated August 9, 2017 and is included in **Appendix D**.

The VISSIM model was utilized to evaluate traffic operations for the Existing Year (2016) Conditions. All simulation output is based on the average data from ten simulation runs. Consistent with the approved MLOU, the Measures of Effectiveness (MOEs) that were assessed from the simulation analysis include the following:

- Intersection Node Evaluation: Volume, delay, and maximum queue length for the study area intersections for all movements.
- Link Evaluation Segments: Volume and Speed information for General Use Lanes, Express Lanes and access points within the study area. Temporal and spatial volume and speed profiles will be provided.
- Network-Wide Output: Total travel time, total delay time, latent volume and latent delay.

Figure 3-1 | Existing Traffic for I -95 at Davie Blvd Interchange

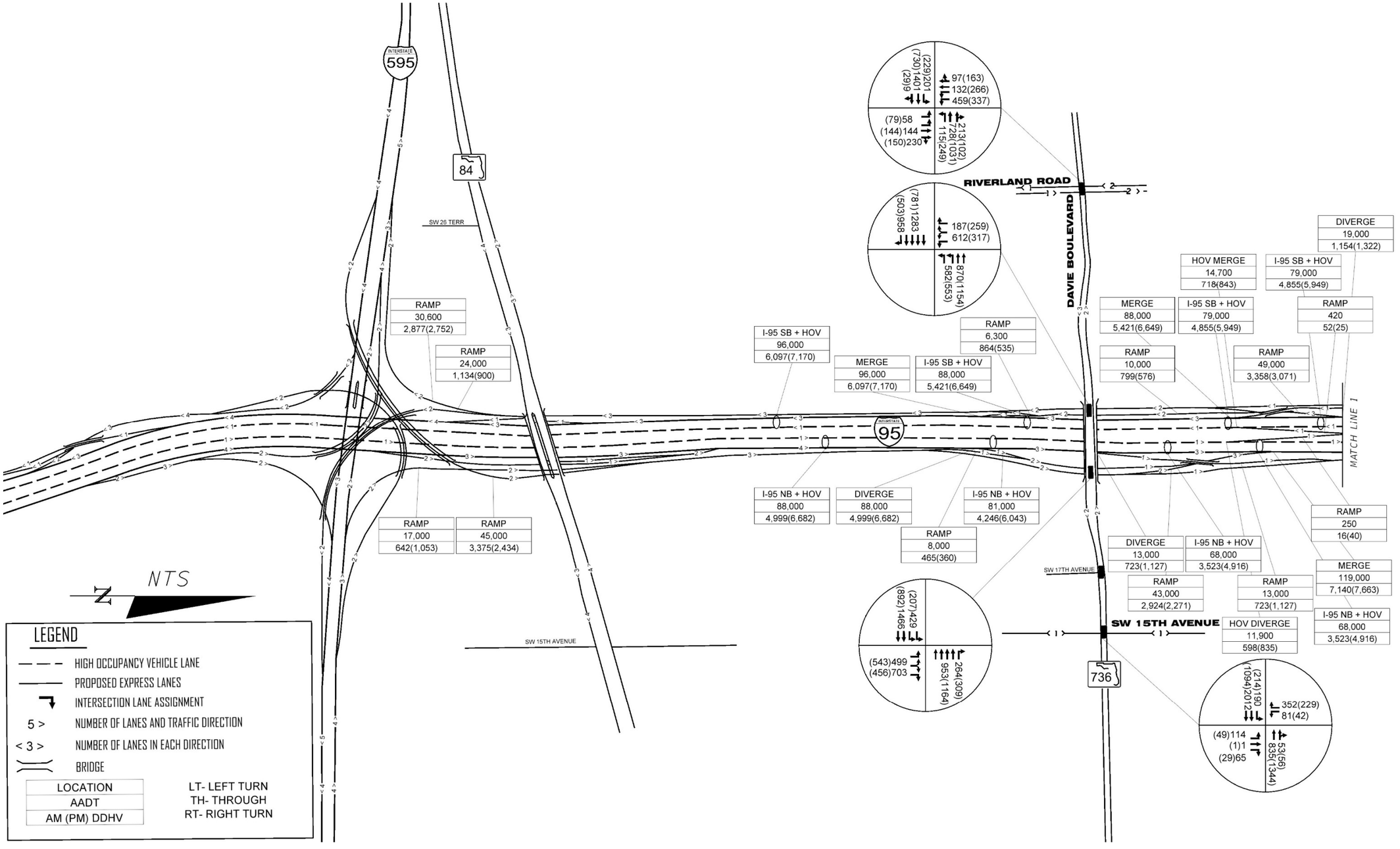


Figure 3-2 | Existing Traffic for I -95 at Broward Blvd Interchange

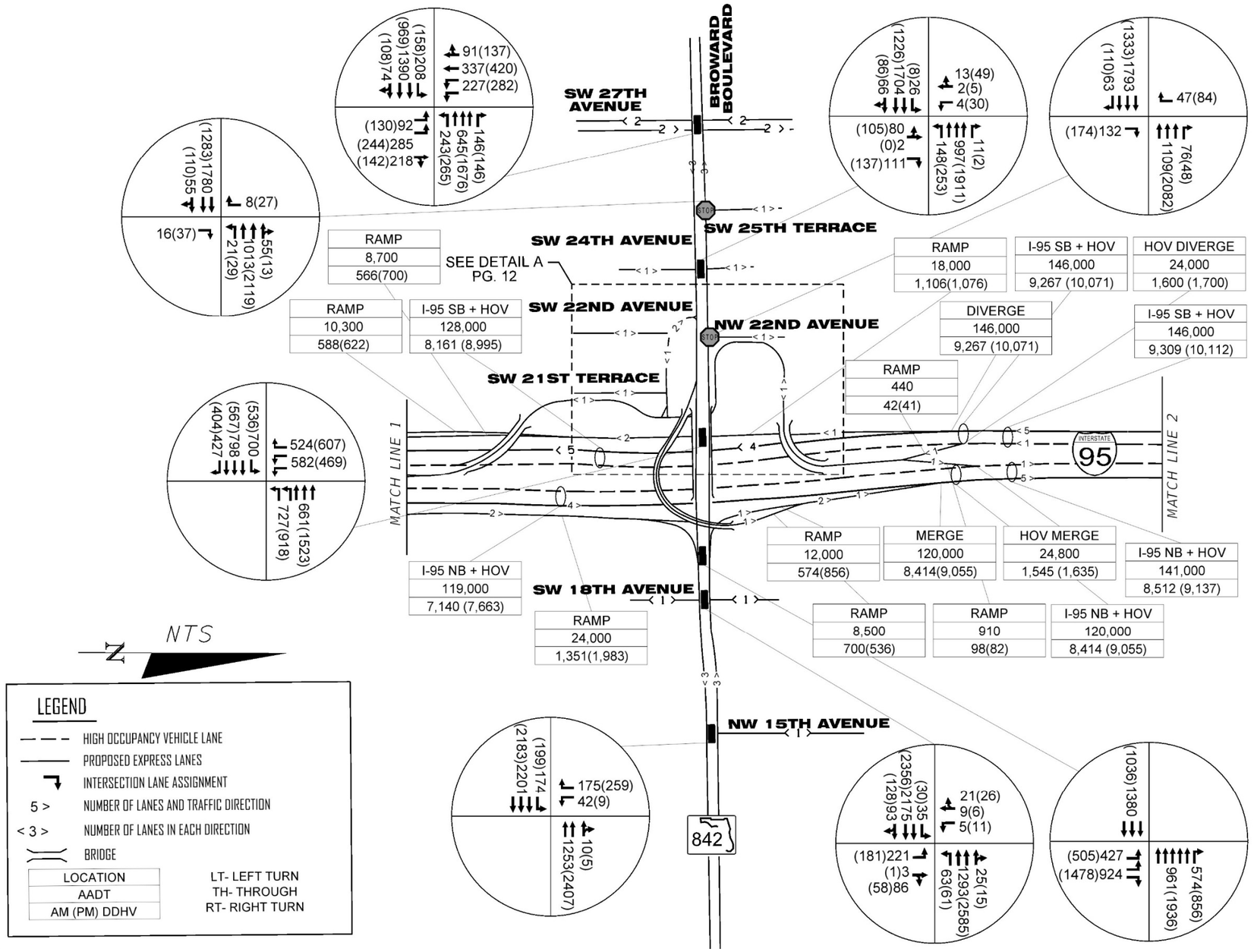
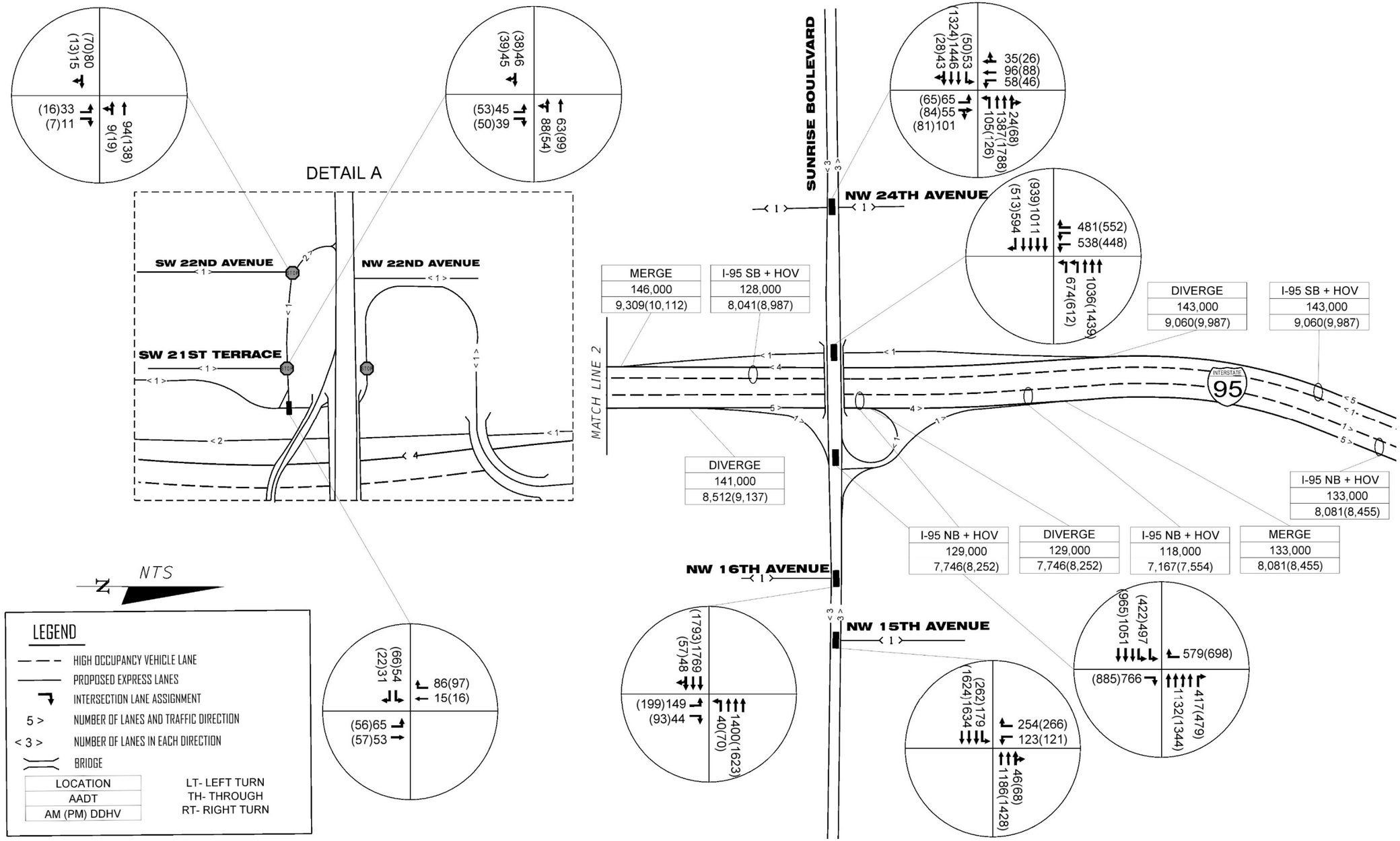


Figure 3-3 | Existing Traffic for I -95 at Sunrise Blvd Interchange



3.3.3 Intersection Node Evaluation

Node Evaluation output from VISSIM represents intersection evaluation for the study intersections. An estimated Level of Service (LOS) based on Highway Capacity Manual metrics for both AM and PM peak-hour is summarized in **Table 3-1** and **Table 3-2**. The signal timing plans and detailed output for the Node Evaluation analysis showing volume, delay, and max queue length for the study area intersections for all movements are included in **Appendix E.**

The results of intersection analyses indicate that all the intersections are performing at D or better with the exception of the Davie Boulevard and Riverland Road intersection which is operating at LOS E in the AM peak hour.

Table 3-1 | Intersection Node Evaluation Summary - Existing AM Peak Hour

Interchange	Signalized Intersection	Existing AM	
		Delay (sec)	Estimated LOS
Sunrise Blvd	NW 24th Ave	27.3	C
	I-95 SB Ramp	37.6	D
	I-95 NB Ramp	21.5	C
	NW 16th Ave	10.3	B
	NW 15th Ave	18.3	B
Broward Blvd	NW 27th Ave	34.1	C
	SW 24th Ave	7.9	A
	SW 22nd Ave	7.1	A
	I-95 SB Ramp	36.0	D
	I-95 NB Ramp	12.6	B
	SW 18th Ave / NW 18th Ave	22.5	C
	NW 15th Ave	5.3	A
PNR	SW 21th T	18.6	B
Davie Blvd	Riverland Dr	65.2	E
	I-95 SB Ramp	10.4	B
	I-95 NB Ramp	26.3	C
	SW 15th Ave	46.8	D

Table 3-2 | Intersection Node Evaluation Summary - Existing PM Peak Hour

Interchange	Signalized Intersection	Existing PM	
		Delay (sec)	Estimated LOS
Sunrise Blvd	NW 24th Ave	30.9	C
	I-95 SB Ramp	32.7	C
	I-95 NB Ramp	17.8	B
	NW 16th Ave	13.6	B
	NW 15th Ave	21.7	C
Broward Blvd	NW 27th Ave	35.5	D
	SW 24th Ave	7.1	A
	SW 22nd Ave	9.5	A
	I-95 SB Ramp	24.5	C
	I-95 NB Ramp	22.1	C
	SW 18th Ave / NW 18th Ave	15.6	B
	NW 15th Ave	5.7	A
PNR	SW 21th T	18.8	B
Davie Blvd	Riverland Dr.	38.1	D
	I-95 SB Ramp	5.2	A
	I-95 NB Ramp	20.6	C
	SW 15th Ave	20.8	C

3.3.4 Ramp Terminal Queues

In addition to max queues, 95th percentile queues were calculated for the off-ramp movements within the study area. Results are presented in **Table 3-3** and show that available storage is not exceeded in existing conditions.

Table 3-3 | Ramp Queue Summary - Existing AM and PM Peak Hour

Interchange	Signalized Intersection	Existing	
		AM	PM
		95th Queue' (Storage')	
Sunrise Blvd	SB Off-Ramp	198 (1,200)	383 (1,200)
	NB Off-Ramp	0 (500)	0 (960)
Broward Blvd	SB Off-Ramp	500 (1,400)	405 (1,400)
	NB Off-Ramp	409 (4,600)	654 (4,600)
Davie Blvd	SB Off-Ramp	348 (1,800)	192 (1,800)
	NB Off-Ramp	568 (1,500)	291 (1,500)

3.3.5 Link Evaluation

The VISSIM micro-simulation models were used to produce volume and speed profiles along the I-95 general purpose (GP) lanes for freeway operations for both the AM and PM peak hours using link evaluation. Average volume and average speed profiles provide a good representation of the traffic flow along the corridor. **Figure 3-4** through **Figure 3-11** depict the average speed and volumes profiles along the corridor for the existing condition.

The results of link evaluation indicate the following:

- I-95 northbound is operating at or near free flow speed during the AM and PM peak periods.
- I-95 southbound experiences significant congestion near Broward Boulevard and Sunrise Boulevard due to the weaving segment between interchanges. Speeds between 20 mph and 30 mph were observed in both the AM and PM peak periods. Slow operating speeds extend well beyond Sunrise Boulevard in the PM peak period.
- I-95 southbound experiences significant congestion south of I-595 as well, with reduced operating speeds that extend to Davie Boulevard.

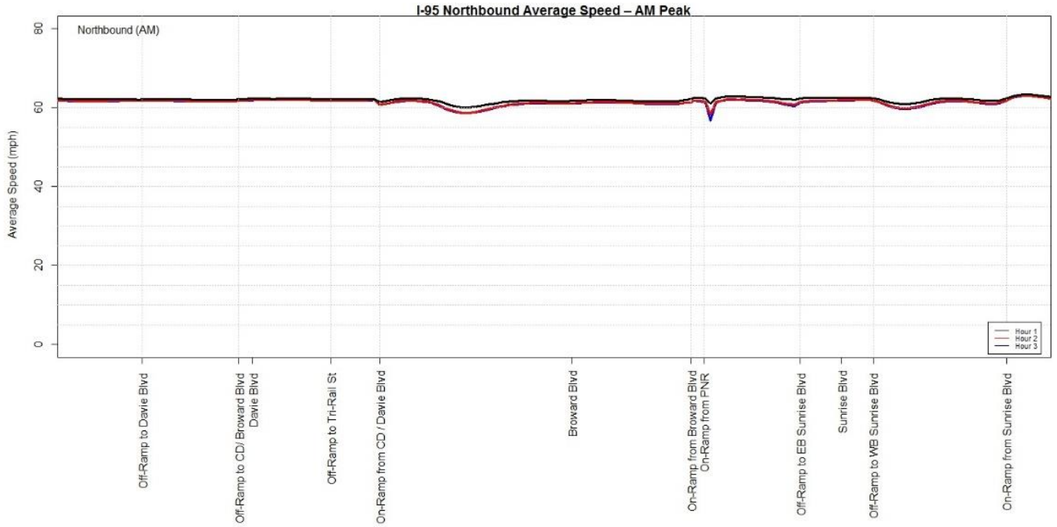


Figure 3-4 | Existing Northbound Average Speed for AM Peak Hour

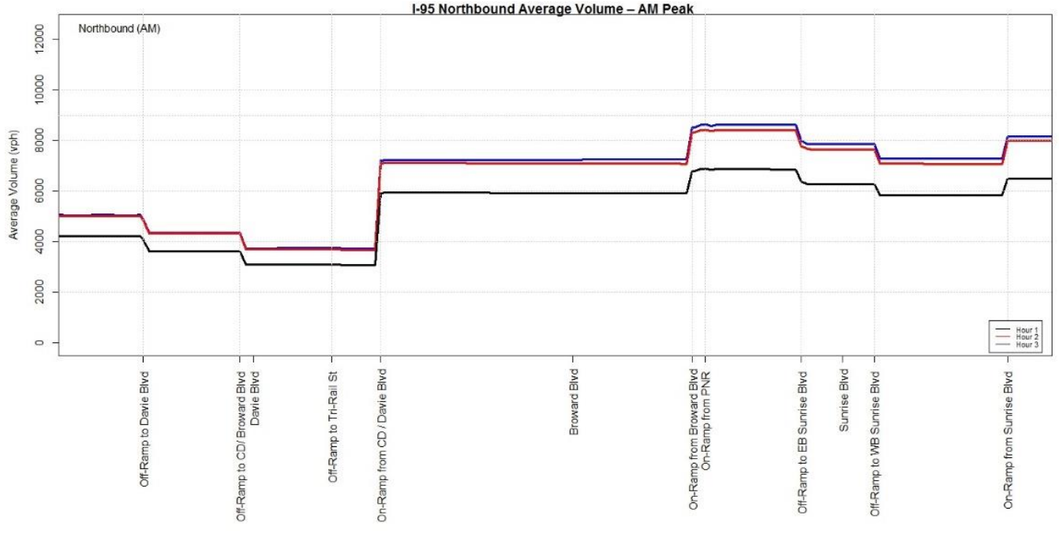


Figure 3-5 | Existing Northbound Volume Profiles for AM Peak Hour

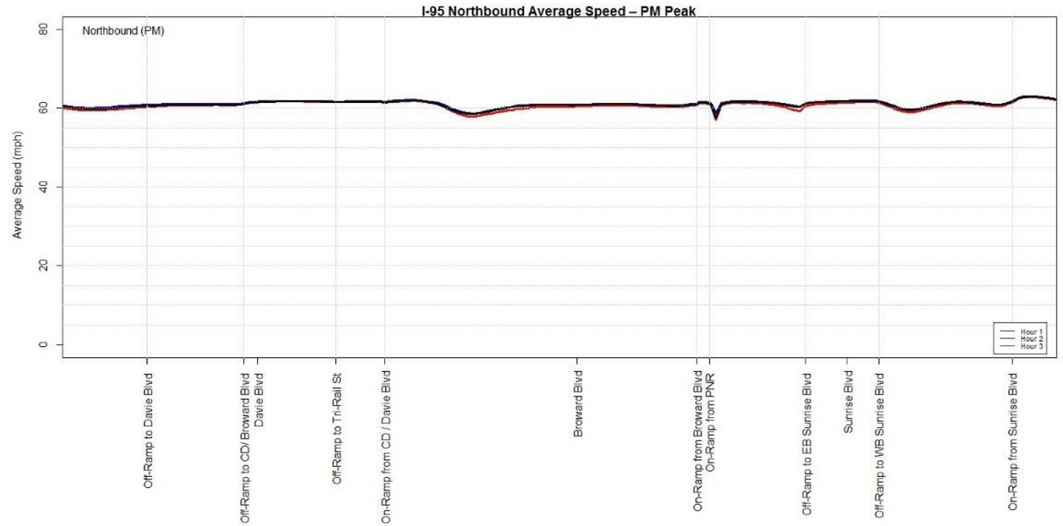


Figure 3-6 | Existing Northbound Average Speed for PM Peak Hour

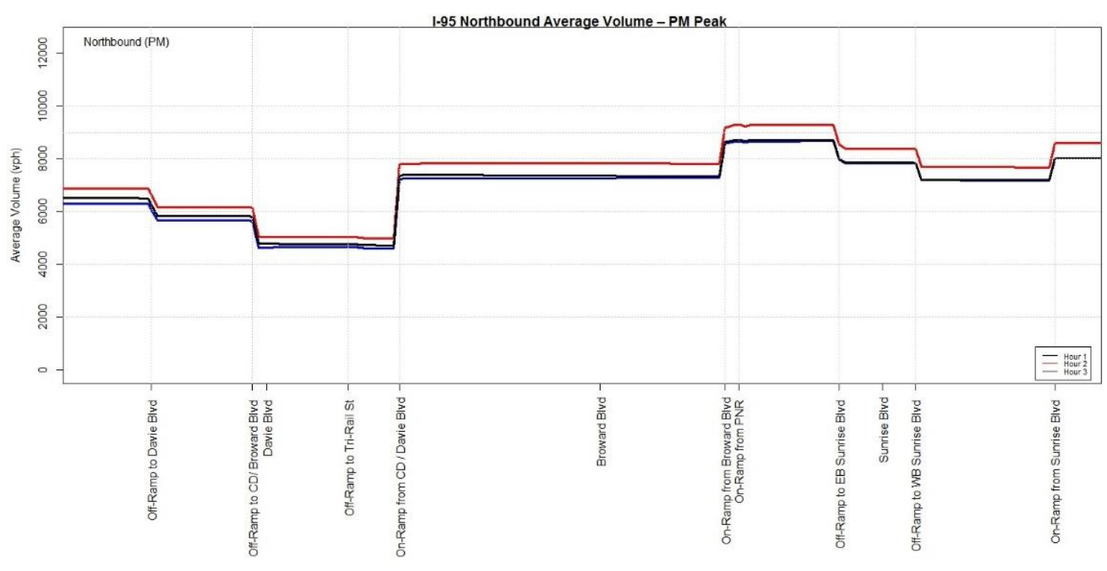


Figure 3-7 | Existing Northbound Volume Profiles for PM Peak Hour

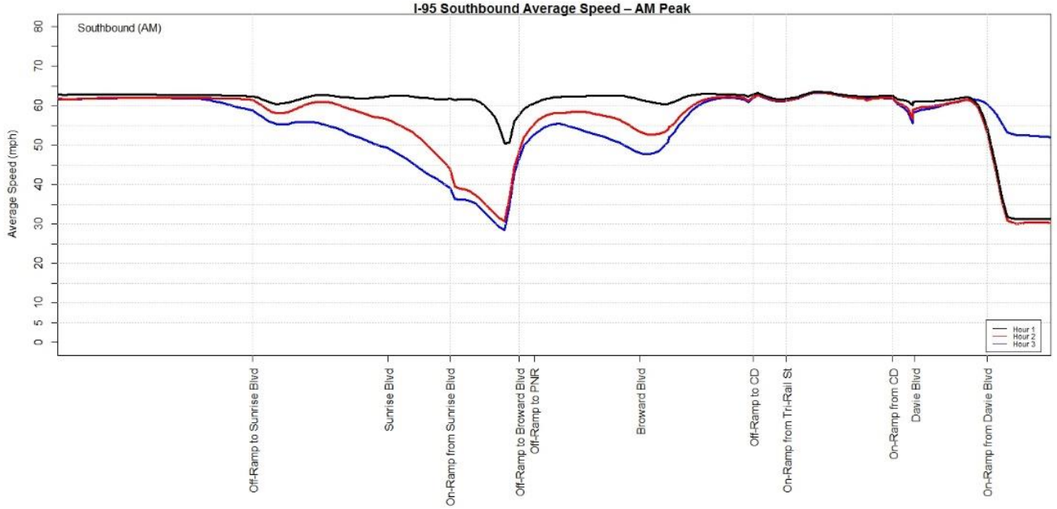


Figure 3-8 | Existing Southbound Average Speed Profiles for AM Peak Hour

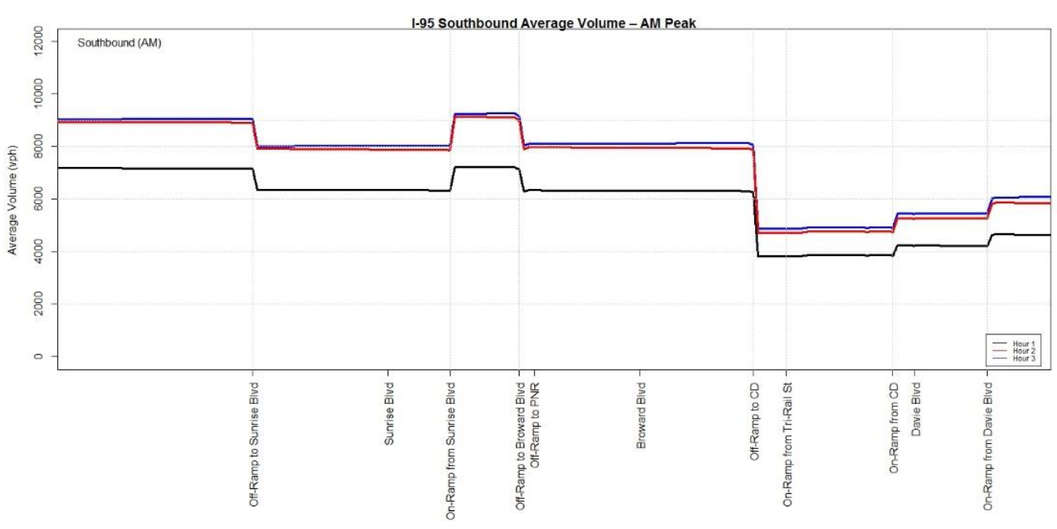


Figure 3-9 | Existing Southbound Volume Profiles for AM Peak Hour

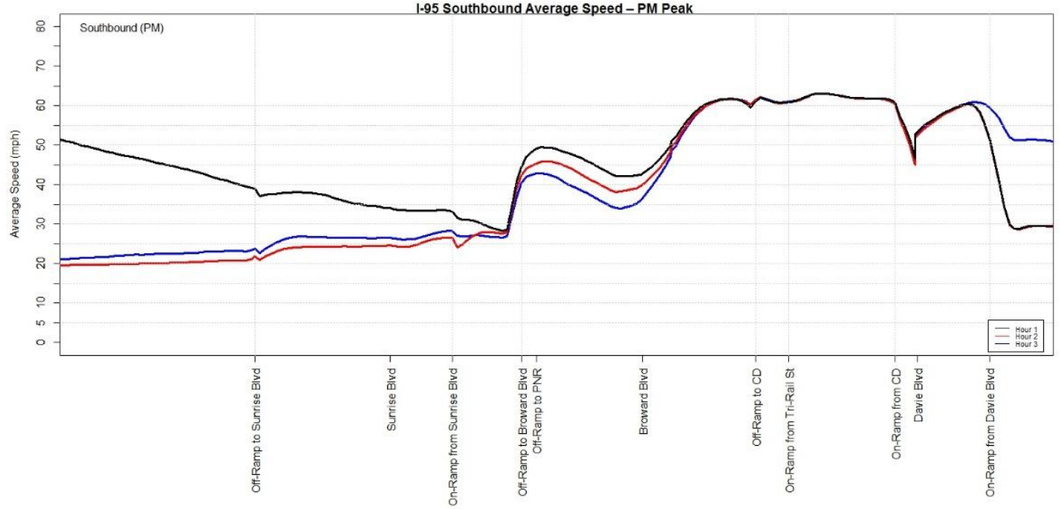


Figure 3-10 | Existing Southbound Average Speed Profiles for PM Peak Hour

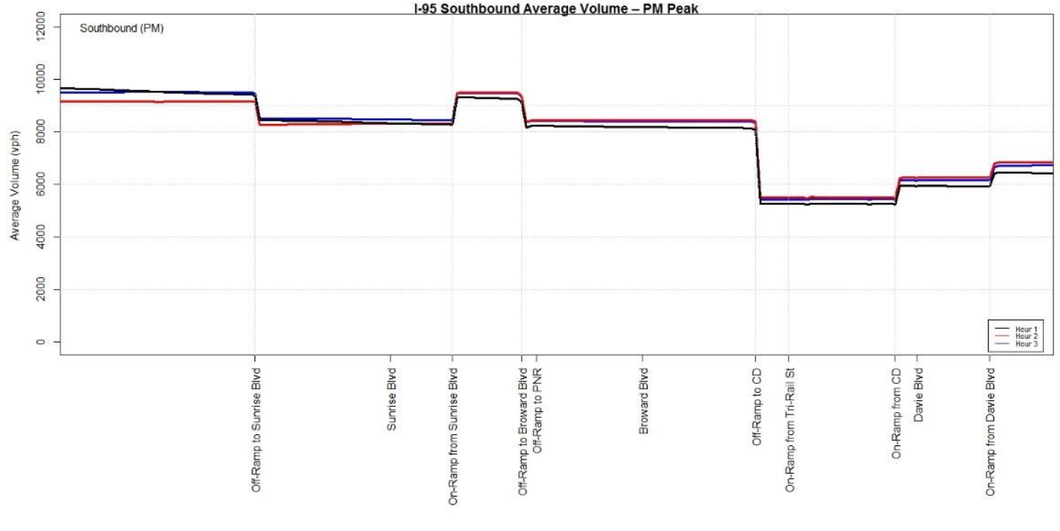


Figure 3-11 | Existing Southbound Volume Profiles for PM Peak Hour

3.4 Safety Analysis

The crash data for five most recent years (from January 2011 to December 2015) along I-95 from Davie Boulevard to Sunrise Boulevard, Broward Boulevard from NW 27th Avenue to NW 15th Avenue, Davie Boulevard from Riverland Road to SW 15th Avenue, Sunrise Boulevard from NW 24th Avenue to NW 15th Avenue and ramps at the I-95 interchanges of Broward Boulevard were obtained from the FDOT's Crash Analysis Reporting System (CARS). The detailed crash analysis is included in the **Appendix C**. The following is a summary of findings based on the review of crash data.

I-95 from Davie Boulevard to Sunrise Boulevard

The crash data for five most recent years (from January 2011 to December 2015) along I-95 from Davie Boulevard to Sunrise Boulevard (Section 86070000, MP 8.714 to MP 11.858) was downloaded from the FDOT's Crash Analysis Reporting System (CARS). The following is a summary of findings based on the review of crash data.

- A total of 1,868 crashes were reported during the referenced five-year period with 273 crashes in 2011, 333 crashes in 2012, 422 crashes in 2013, 466 crashes in 2014 and 374 crashes in 2015.
- Based on crash severity, of the 1,868 crashes reported, 746 (40%) were injury type crashes and 1,116 (60%) were property damage only crashes. There were 6 fatal crashes reported during the referenced five-year period that occurred within the study segment.
- There were 871 rear end crashes, 365 sideswipe crashes, 234 fixed object crashes, 92 angle crashes, 81 non-collisions, 65 non-fixed object collisions, 9 pedestrian crashes, and 151 other crashes.
- The study segment was identified as part of high crash segments and included high crash intersections on the Department's high crash listings for all referenced five years.
- The crash rate of the study segment was higher than statewide average crash rate and higher than the district average crash rate for all the referenced five years.

Broward Boulevard from NW 27th Avenue to NW 15th Avenue

The crash data for five most recent years (from January 2011 to December 2015) along Broward Boulevard from west of NW 27th Avenue to east of NW 15th Avenue (Section 86006000, MP 4.573 to MP 5.697) was downloaded from the FDOT's Crash Analysis Reporting System (CARS). The following is a summary of findings based on the review of crash data.

- A total of 568 crashes were reported during the referenced five-year period with 68 crashes in 2011, 86 crashes in 2012, 152 crashes in 2013, 194 crashes in 2014 and 68 crashes in 2015.
- Based on crash severity of the 568 crashes reported, 207 (36%) were injury type crashes and 360 (63%) were property damage only crashes. There was one fatal crash reported in 2012 within the study segment.
- There were 290 rear end crashes, 86 angle crashes, 49 sideswipe crashes, 20 pedestrian crashes, 17 left turn crashes, 12 fixed object crashes, 11 bicycle crashes, 11 non-collisions,

9 non-fixed object collisions, 4 right turn crashes, 3 backed into crashes, 1 head on crash and 5 other crashes.

- Based on the Department's high crash listings (2010-2014), the study segment was identified as a part of high crash segments for the year 2011, 2013 and 2014; and it included high crash intersections for the year 2010, 2012, 2013 and 2014.
- Based on the Department's pedestrian and bicycle hot spot lists that the Traffic Operations Office has developed, the subject segment is within top 25 pedestrian and bicycle crash clusters identified based on pedestrian and bicycle crashes (2009 to 2013).
- The crash rate of the study segment was higher than statewide average crash rate in the year 2011 through 2014 and higher than the district average crash rate in the year 2013 and 2014.

Davie Boulevard from Riverland Road to NW 15th Avenue

The crash data for five most recent years (from January 2011 to December 2015) along Davie Boulevard from west of NW Riverland Road to east of NW 15th Avenue (Section 86006000, MP 1.436 to MP 2.547) was downloaded from the FDOT's Crash Analysis Reporting System (CARS). The following is a summary of findings based on the review of crash data.

- A total of 578 crashes were reported during the referenced five-year period with 64 crashes in 2011, 78 crashes in 2012, 142 crashes in 2013, 189 crashes in 2014 and 105 crashes in 2015.
- Based on crash severity of the 578 crashes reported, 221 (38%) were injury type crashes and 353 (61%) were property damage only crashes. There were two fatal crashes reported in 2012 and two fatal crashes reported in 2014 within the study segment.
- There were 82 rear end crashes, 28 angle crashes, 13 sideswipe crashes, 7 fixed object crashes, 4 pedestrian crashes, 1 right turn crash, 1 non-fixed object collision, 1 non-collision and 15 other crashes.
- Based on the Department's high crash listings (2010-2014), the study segment was identified as a part of high crash segments; and it included high crash intersections for all referenced five years.
- Based on the Department's pedestrian and bicycle hot spot lists that the Traffic Operations Office has developed, the subject segment is within top 25 bicycle crash clusters identified based on pedestrian and bicycle crashes (2009 to 2013).
- The crash rate of the study segment was higher than statewide average crash rate and higher than the district average crash rate for all the referenced five years.

Sunrise Boulevard from NW 24th Avenue to NW 15th Avenue

The crash data for five most recent years (from January 2011 to December 2015) along Sunrise Boulevard from west of NW 24th Avenue to east of NW 15th Avenue (Section 86110000, MP 4.936 to MP 5.342) was downloaded from the FDOT's Crash Analysis Reporting System (CARS). The following is a summary of findings based on the review of crash data.

- A total of 740 crashes were reported during the referenced five-year period with 94 crashes in 2011, 122 crashes in 2012, 188 crashes in 2013, 222 crashes in 2014 and 114 crashes in 2015.

- Based on crash severity of the 740 crashes reported, 283 (38%) were injury type crashes and 454 (61%) were property damage only crashes. There was one fatal crash reported in 2013 and two fatal crashes reported in 2015 within the study segment.
- There were 374 rear end crashes, 127 angle crashes, 66 sideswipe crashes, 33 left turn crashes, 23 fixed object crashes, 16 pedestrian crashes, 14 non-collisions, 10 bicycle crashes, 7 non-fixed object collisions, 3 backed into crashes, 1 right turn crash, 1 head on crash and 65 other crashes.
- Based on the Department's high crash listings (2010-2014), the study segment was identified as a part of a high crash segment; and it included a high crash intersection for all referenced five years.
- Based on the Department's pedestrian and bicycle hot spot lists that the Traffic Operations Office has developed, the subject segment is within top 25 bicycle crash clusters identified based on pedestrian and bicycle crashes (2009 to 2013).
- The crash rate of the study segment was higher than statewide average crash rate and higher than the district average crash rate for all the referenced five years.

4.0 Future Traffic Forecasts

This section discusses the development of traffic forecasts used in the future year operational analyses. The future year volumes were developed using the Southeast Florida Regional Planning Model (SERPM). Based on the approved MLOU, future peak hour traffic volumes were developed for 2020 and 2040.

4.1 Travel Demand Model

The SERPM version 7.062 travel demand model was selected for use in the study. The SERPM travel demand model is based on the CT-RAMP (Coordinated Travel Regional Activity-Based Modeling Platform) family of Activity-Based Models (ABM). The SERPM version 7.062 contains model data sets for the base year of 2010 and a year 2040 Cost Feasible network.

4.2 No-Build 2020 and 2040 Peak Hour Traffic Development

Various traffic forecasting methodologies were evaluated and appropriate growth rates were developed from historical AADTs and SERPM model volumes. After reviewing growth rates from the various traffic forecasting methodologies and considering the residential land use north and south of the study corridor, a compound growth factor of 0.58% was applied to Broward Boulevard. A compound growth factor of 0.50% was applied to Davie Boulevard, all other cross streets, I-95 and the C-D ramps.

The existing peak-to-daily ratios were calculated based on actual field data. The future K factors for AM and PM peak periods were increased to 9.0% (standard K) for the segment with the higher K factor. Other future design year K factors were also adjusted, while maintaining the same differences between the field K factor and the higher K factor at each intersection. The future D factors were adjusted to the range between 50.8% and 67.1%, as recommended in FDOT's 2014 Project Traffic Forecasting Handbook.

AADT volumes from the recently completed I-95 at Sunrise Boulevard Interchange Operational Analysis Report (IOAR) study were used as control totals and the rest of the AADTs for the I-95 mainline were developed by adding or subtracting ramp AADT volumes from the Broward Boulevard or Davie Boulevard interchanges. AADT volumes for 2020 and 2040 were developed in a similar manner. Since traffic counts were not collected for I-95, data from sources such as the 2015 Florida Traffic Information DVD, I-95 ITS detector data, and the I-95 at Broward Boulevard Interchange Concept Development Report (CDR) was obtained and checked for consistency, accuracy, and reasonableness of estimated AADT volumes. Existing Year 2016 AADTs and Future Year 2020 and 2040 AADTs are displayed in **Figure 4-1** through **Figure 4-3.**

Peak hour traffic volumes were estimated using FDOT District 4 TMTOOL (Version 2.0) with the AADT volumes and the design factors. Adjustments were made to ensure volumes are balanced throughout the corridor. AM and PM peak hour traffic volumes are displayed in **Figure 4-4** through **Figure 4-9.**

Figure 4-1 | Forecasted AADT for I-95 at Davie Interchange

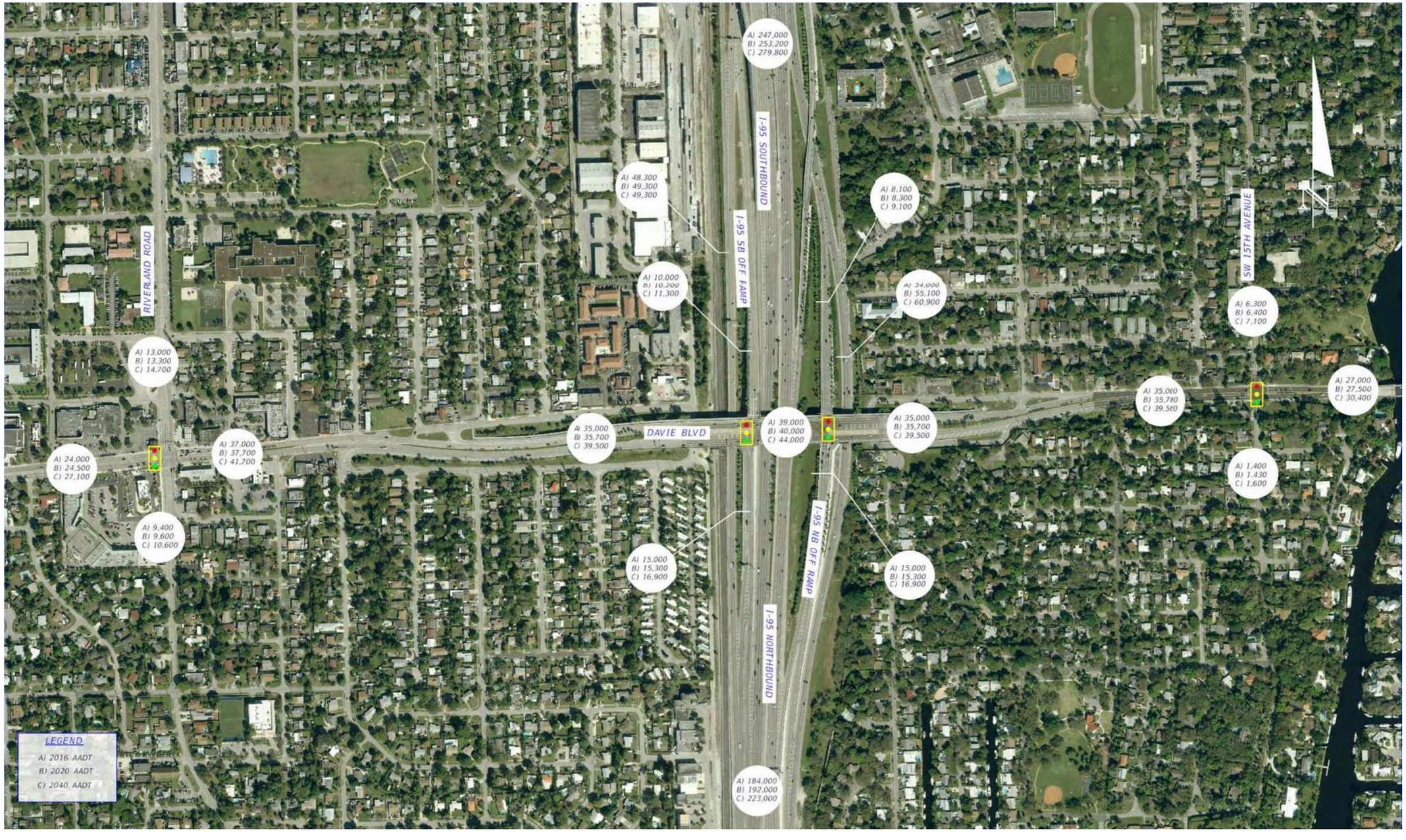


Figure 4-2 | Forecasted AADT for I-95 at Broward Blvd Interchange

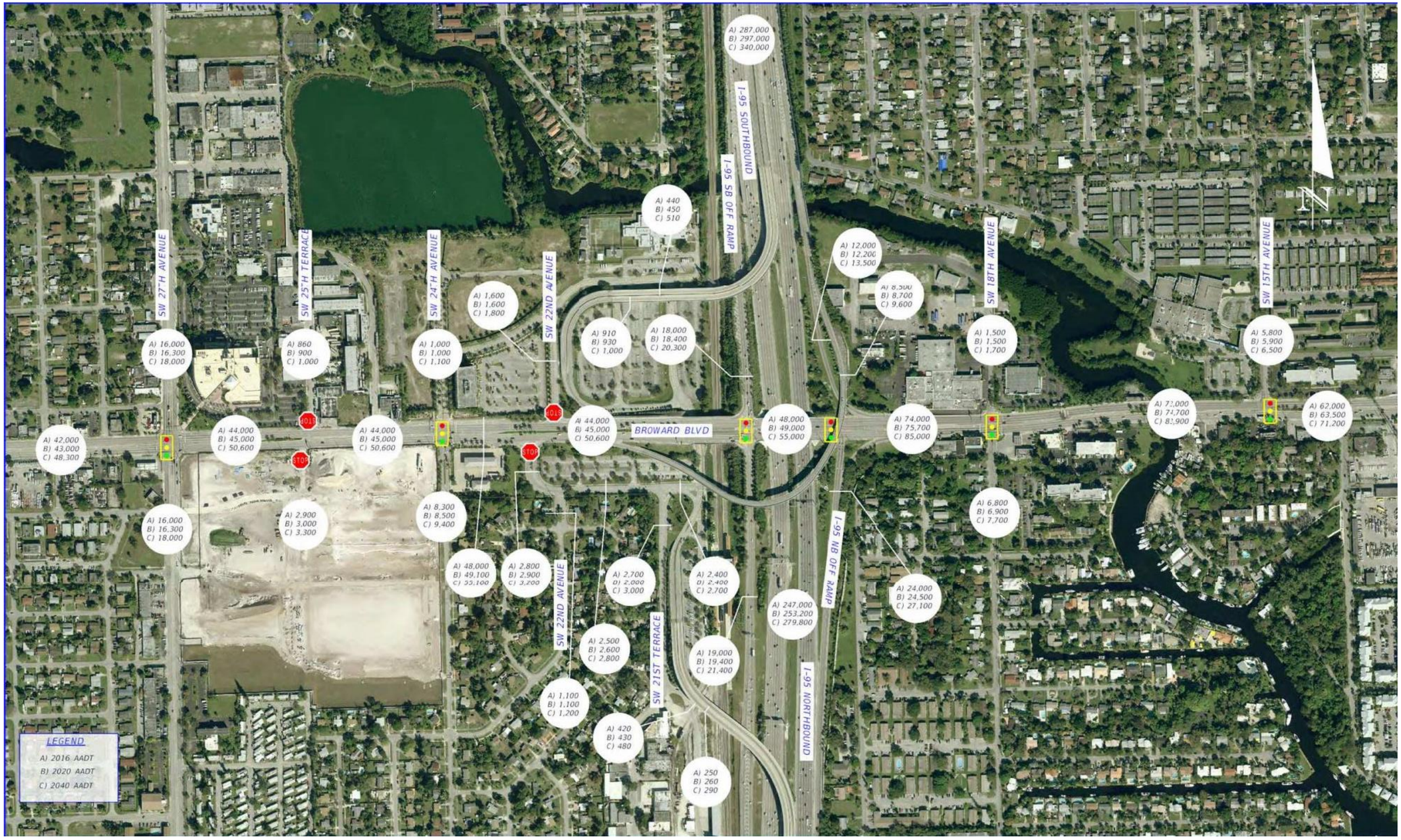


Figure 4-3 | Forecasted AADT for I-95 at Sunrise Blvd Interchange

Figure 4-4 | 2020 No-Build Peak Hour Traffic Volumes for I -95 at Davie Blvd Interchange

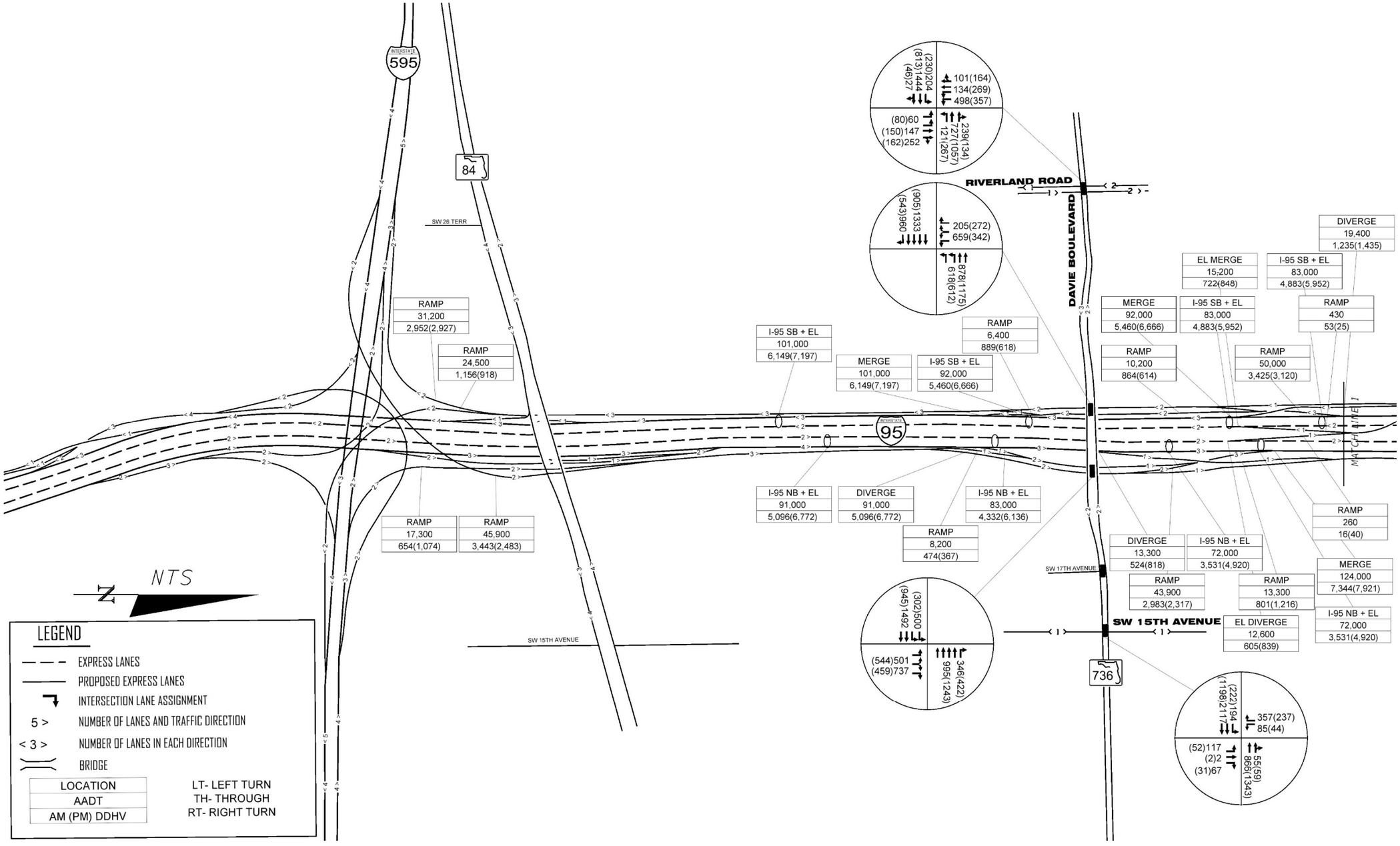


Figure 4-5 | 2020 No-Build Peak Hour Traffic Volumes for I -95 at Broward Blvd Interchange

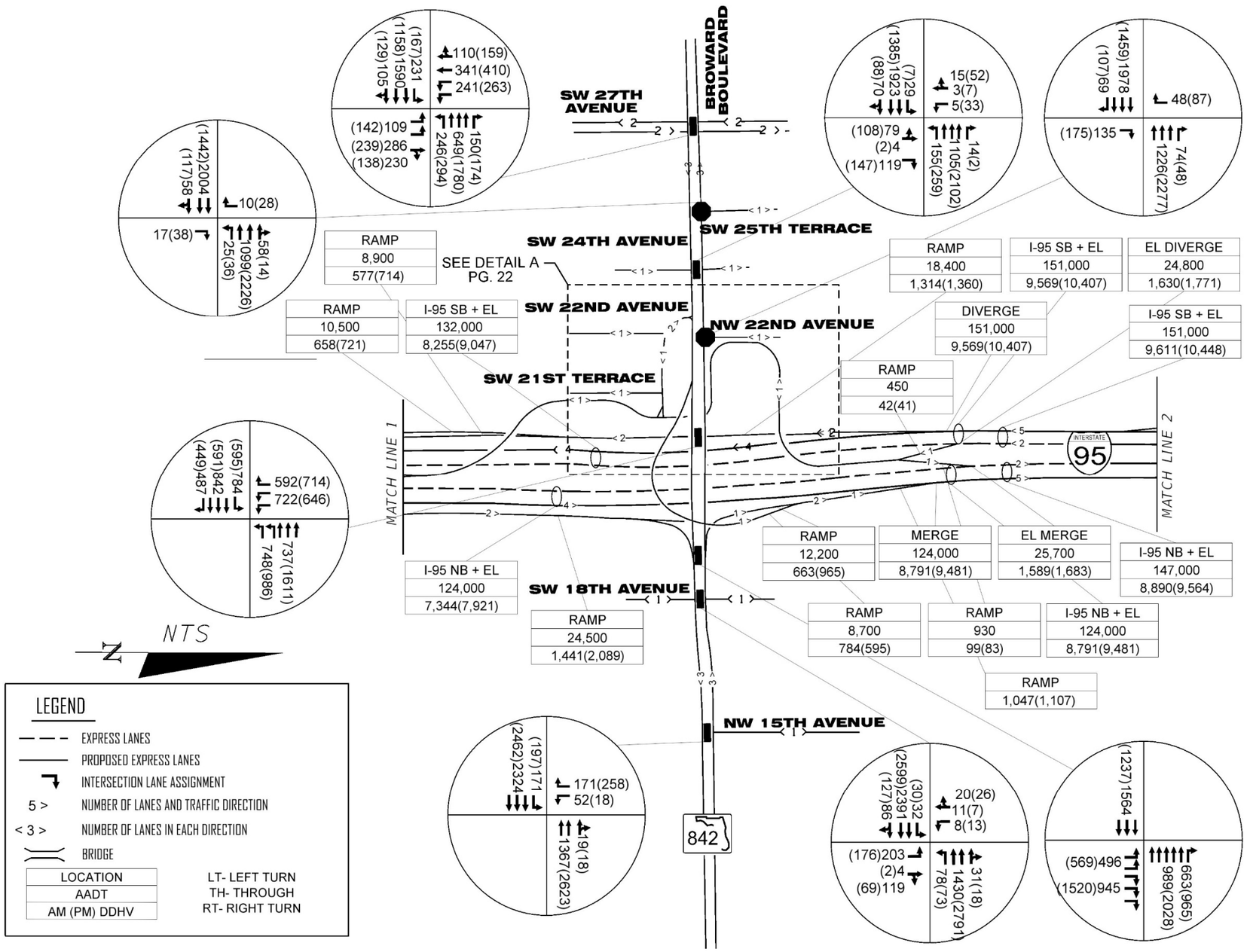


Figure 4-6 | 2020 No-Build Peak Hour Traffic Volumes for I -95 at Sunrise Blvd Interchange

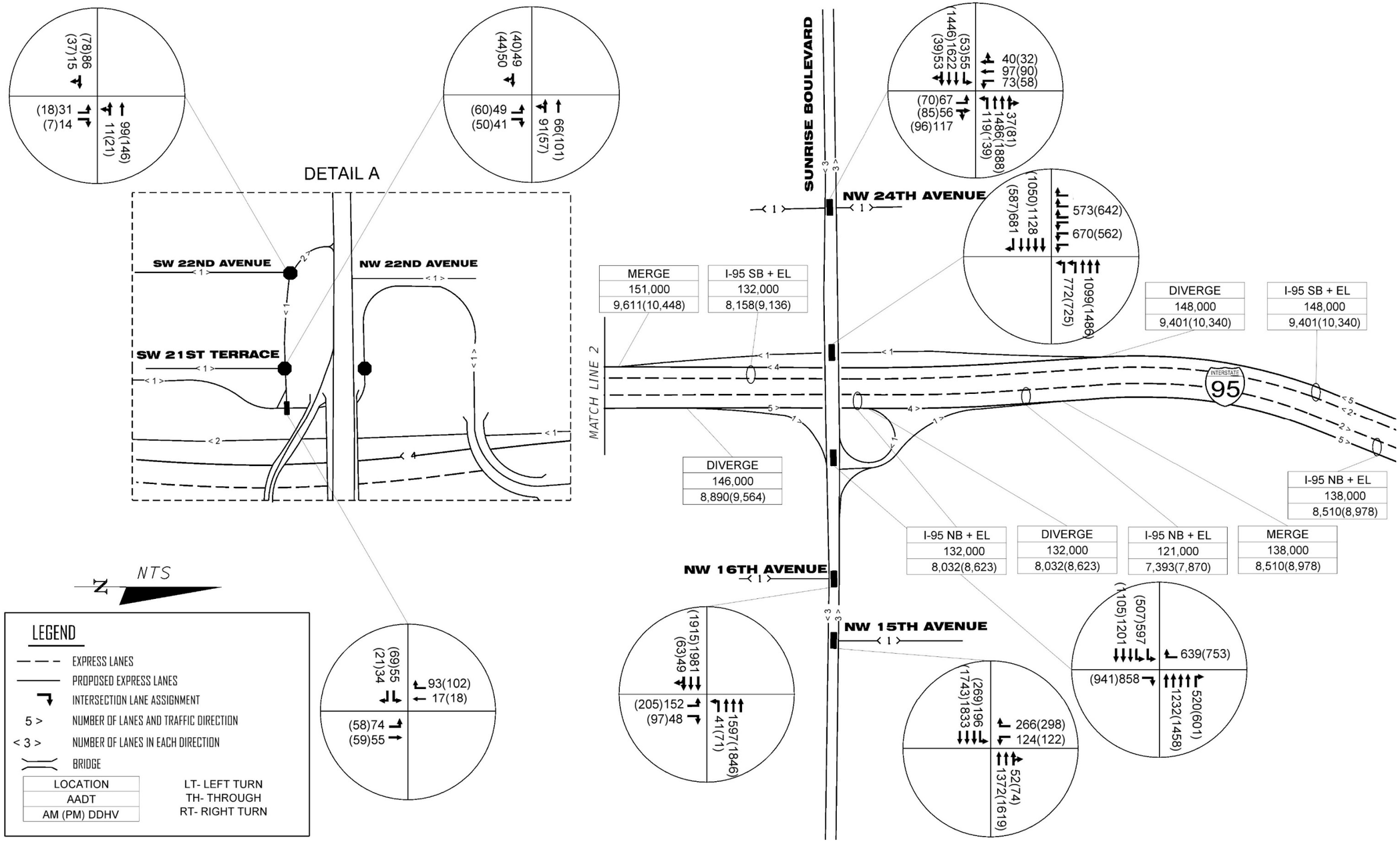


Figure 4-7 | 2040 No-Build Peak Hour Traffic Volumes for I -95 at Davie Blvd Interchange

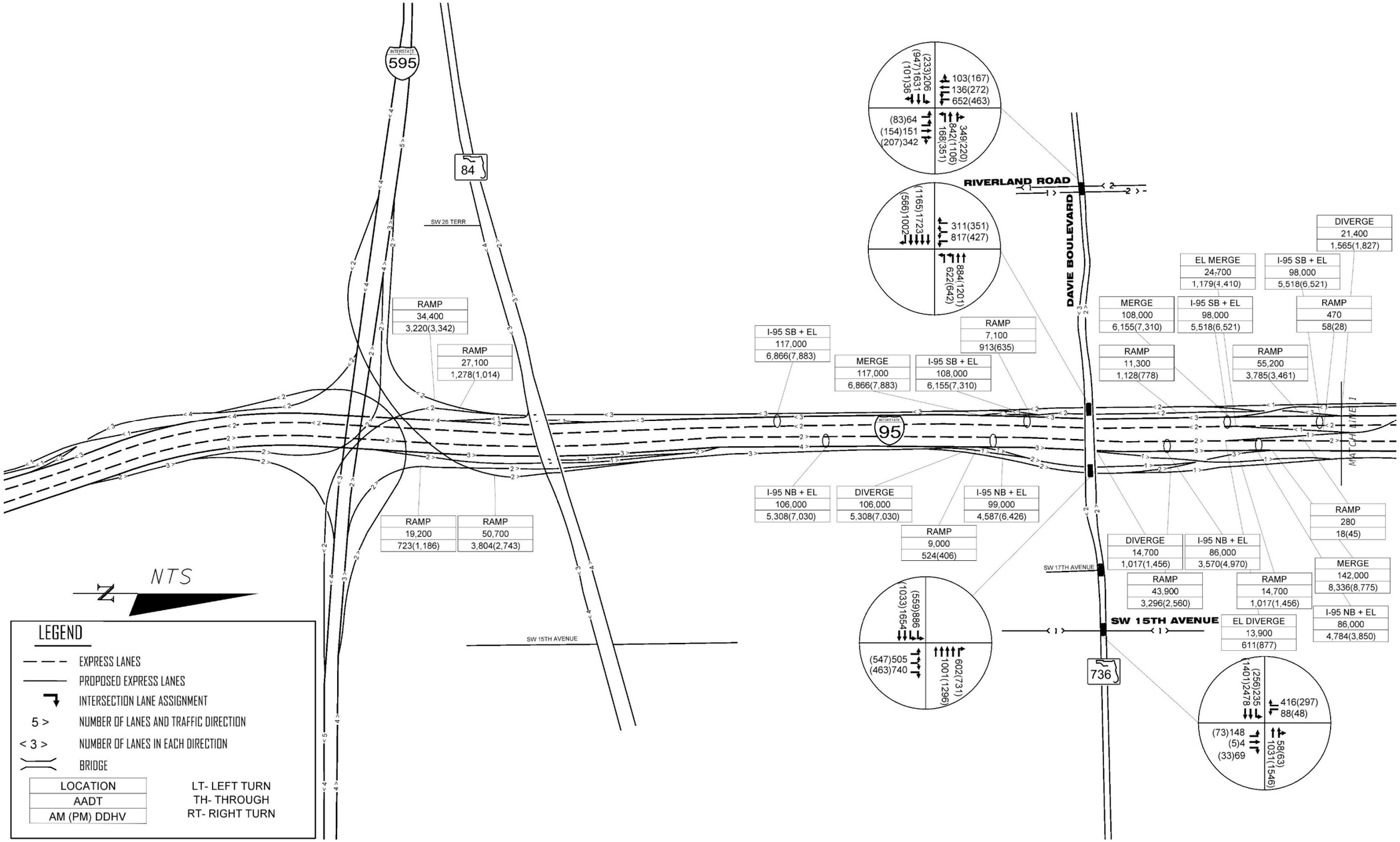


Figure 4-8 | 2040 No-Build Peak Hour Traffic Volumes for I -95 at Broward Blvd Interchange

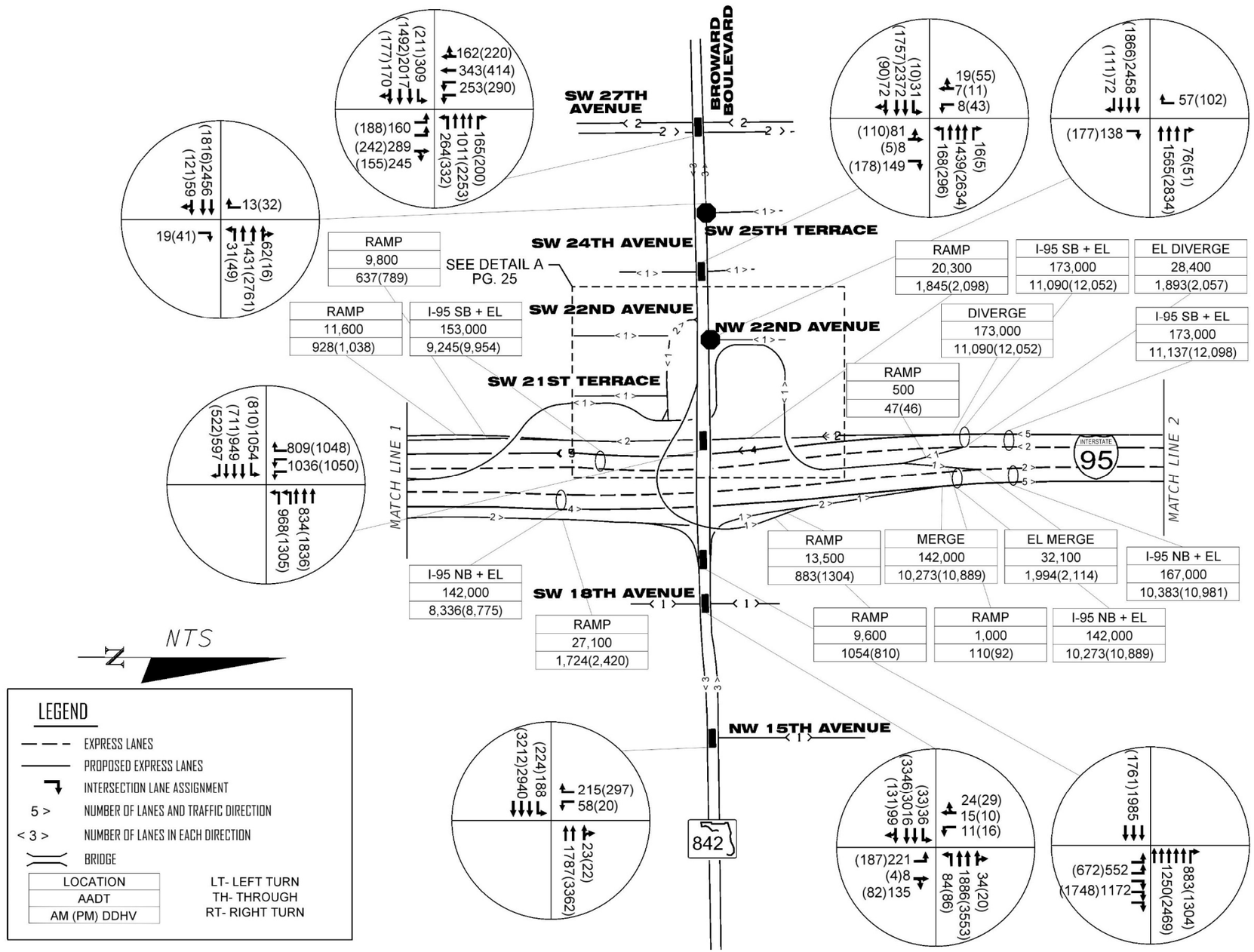
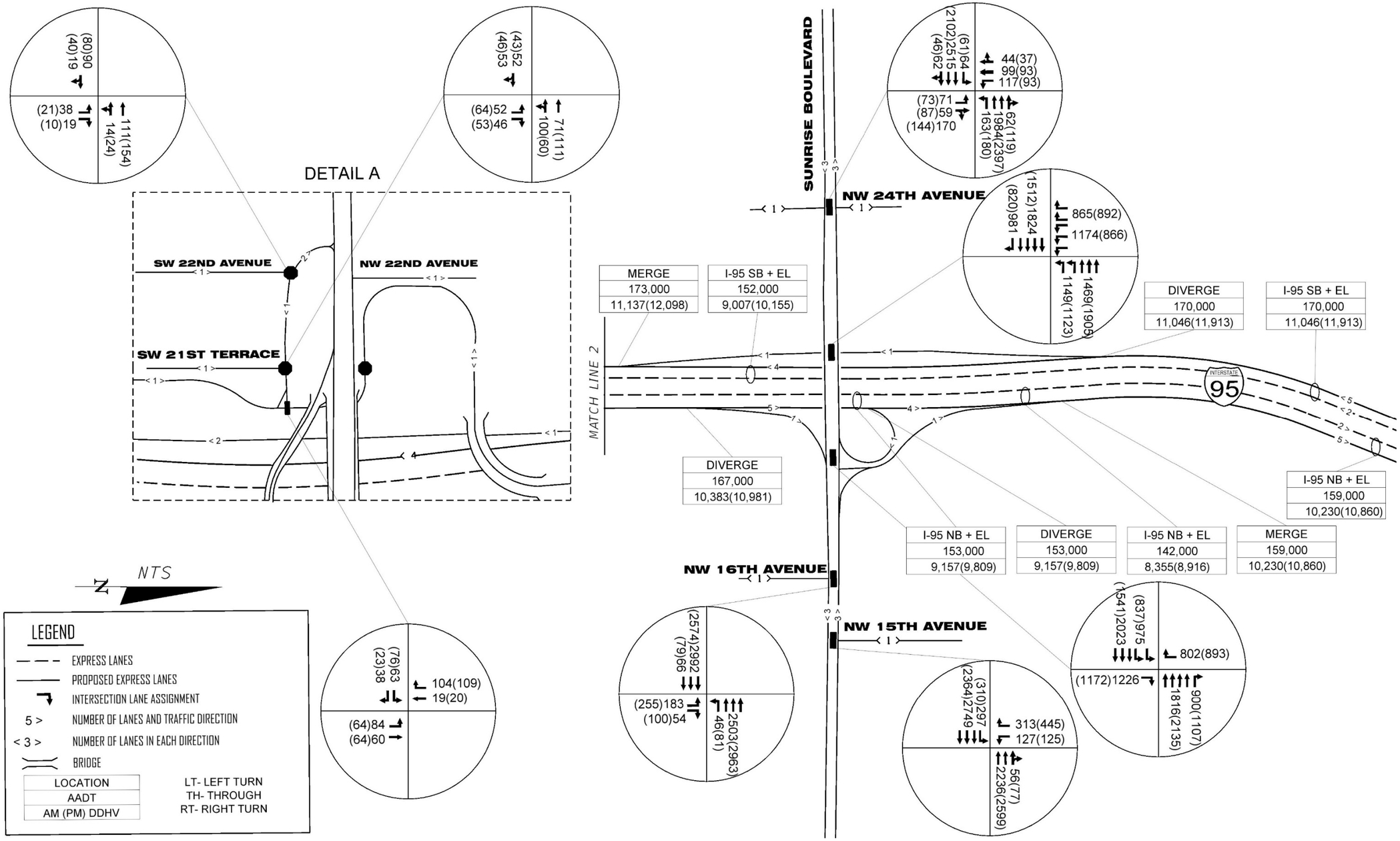


Figure 4-9 | | 2040 No-Build Peak Hour Traffic Volumes for I -95 at Sunrise Blvd Interchange



4.3 Build 2020 and 2040 Peak Hour Traffic Development

Traffic volumes developed for the No-Build Alternative (as discussed in **Section 4.2**) were used to determine the traffic volumes for the Build Alternative. The No-Build traffic volumes were redistributed to establish traffic volumes for the Build Alternative. The Build Alternative includes following changes when compared to the No-Build Alternative.

- Broward Boulevard interchange and Sunrise Boulevard interchanges were reconfigured based on the recommendations from the alternative analysis. Additional information regarding the recommended alternative is provided in **Chapter 5**. The No-Build traffic volumes were redistributed to establish traffic volumes for the reconfigured movements.
- In addition, the Build Alternative for the Broward Boulevard interchange includes direct connect ramps between the 95 Express Lanes and Broward Boulevard. SERPM model was utilized to determine the ramp split percentages between direct connects and the service ramps. These split percentages were applied to the No-Build traffic volumes for the service ramps to obtain traffic volumes for the Broward Boulevard direct connect ramp volumes in the Build Alternative. Split percentages are provided in **Table 4-1**.

Table 4-1 | SERPM Model Traffic Split Percentages for Broward Blvd Direct Connects

AM Peak Period				
Direct Connect Location	Direction	EL Split	GP Split	Comments
South of Broward Blvd	Southbound On-Ramp	43%	57%	% of traffic entering into the SB EL lanes from Broward
	Northbound Off-Ramp	35%	65%	% of I-95 traffic exiting to Broward from NB EL lanes
North of Broward Blvd	Southbound Off-Ramp	28%	72%	% of traffic exiting to Broward from SB EL lanes
	Northbound On-Ramp	26%	74%	% of traffic entering into NB EL lanes from Broward
PM Peak Period				
Direct Connect Location	Direction	EL Split	GP Split	Comments
South of Broward Blvd	Southbound On-Ramp	51%	49%	% of traffic entering into the SB EL lanes from Broward
	Northbound Off-Ramp	33%	67%	% of I-95 traffic exiting to Broward from NB EL lanes
North of Broward Blvd	Southbound Off-Ramp	23%	77%	% of traffic exiting to Broward from SB EL lanes
	Northbound On-Ramp	29%	71%	% of traffic entering into NB EL lanes from Broward

The 2020 and 2040 peak hour volumes for the Build Alternative are illustrated in **Figure 4-10** through **Figure 4-15**.

Figure 4-10 | 2020 Build Peak Hour Traffic Volumes for I -95 at Davie Blvd Interchange

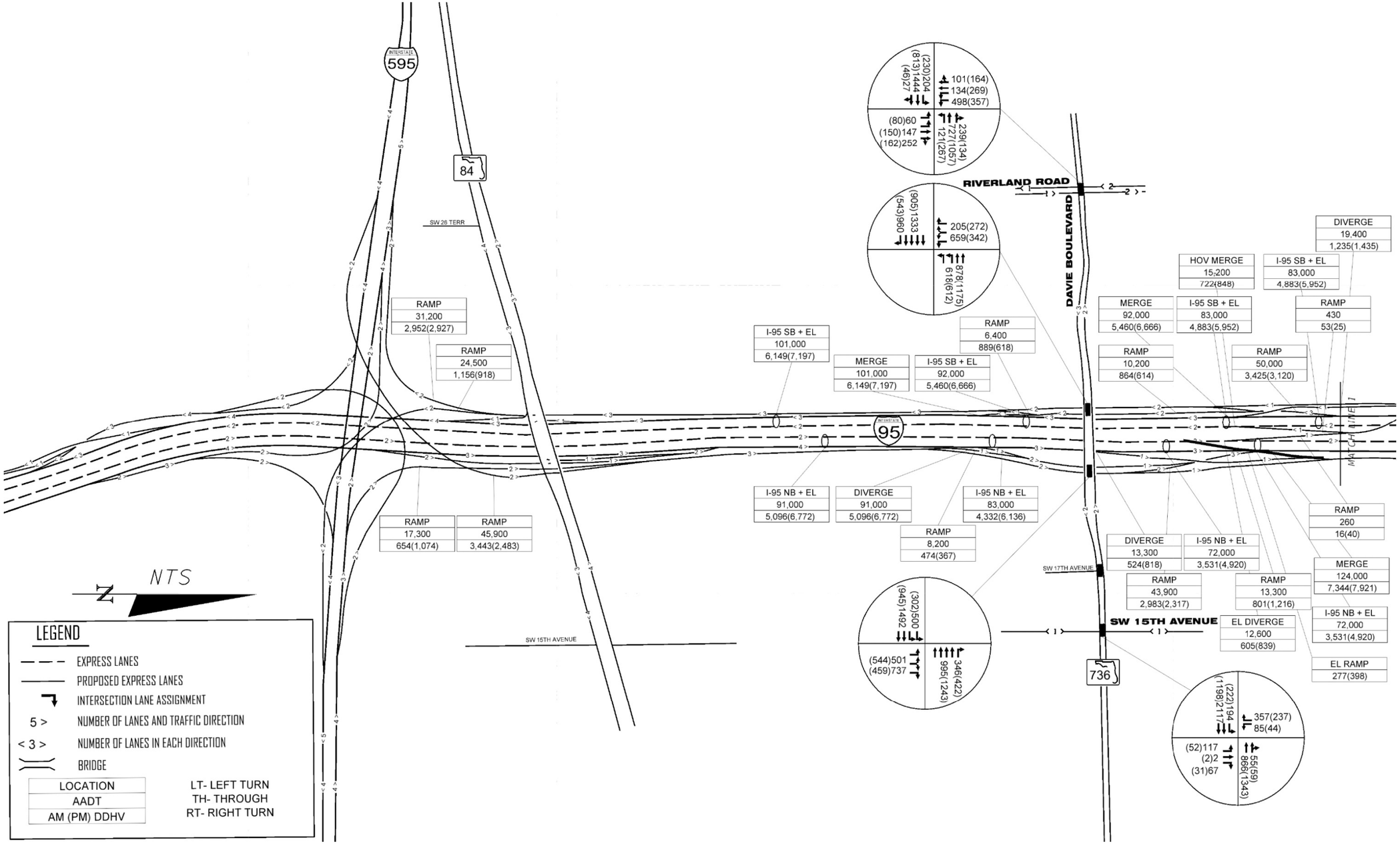


Figure 4-11 | 2020 Build Peak Hour Traffic Volumes for I -95 at Broward Blvd Interchange

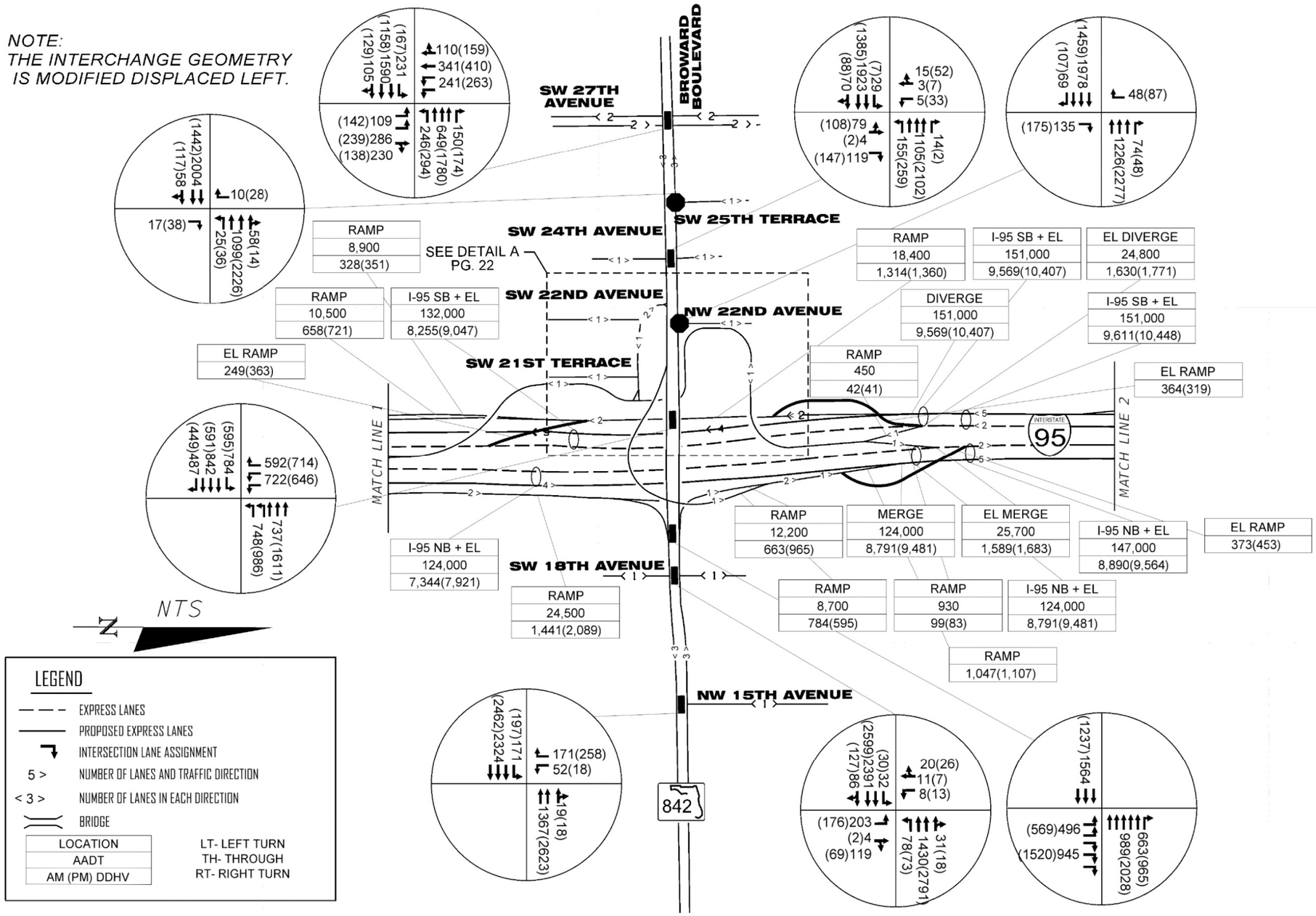


Figure 4-12 | 2020 Build Peak Hour Traffic Volumes for I -95 at Sunrise Blvd Interchange

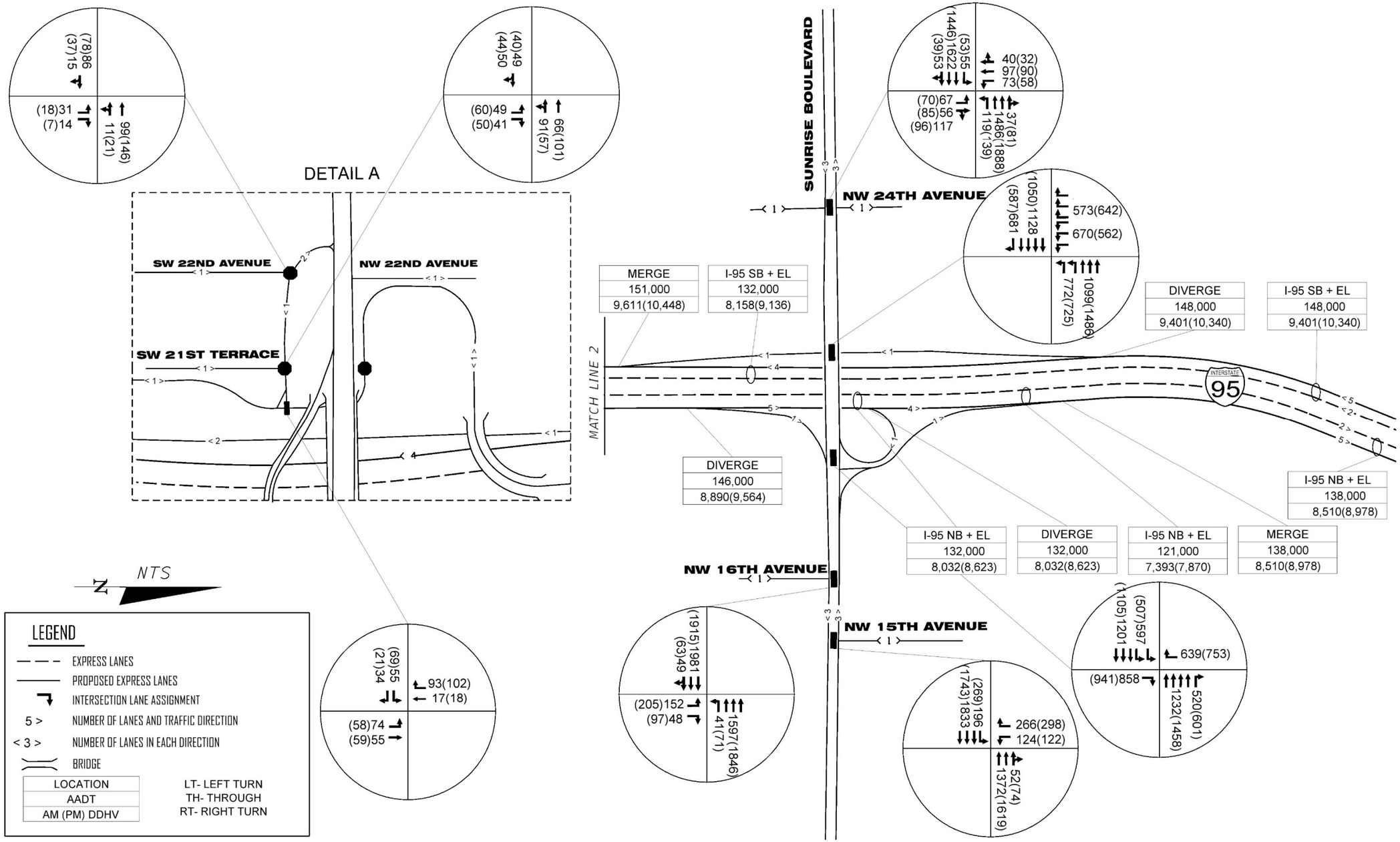


Figure 4-13 | 2040 Build Peak Hour Traffic Volumes for I -95 at Davie Blvd Interchange

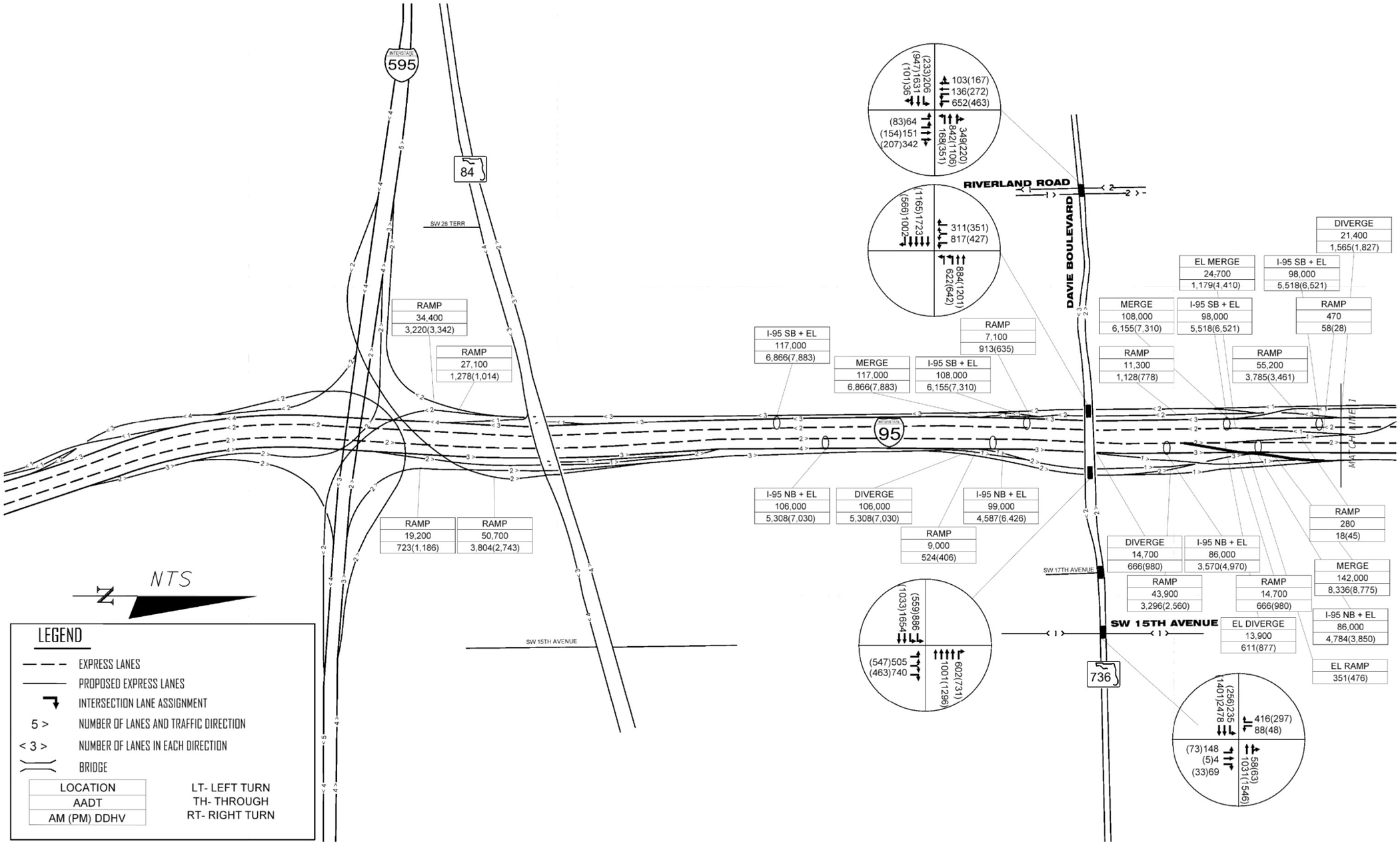


Figure 4-14 | 2040 Build Peak Hour Traffic Volumes for I -95 at Broward Blvd Interchange

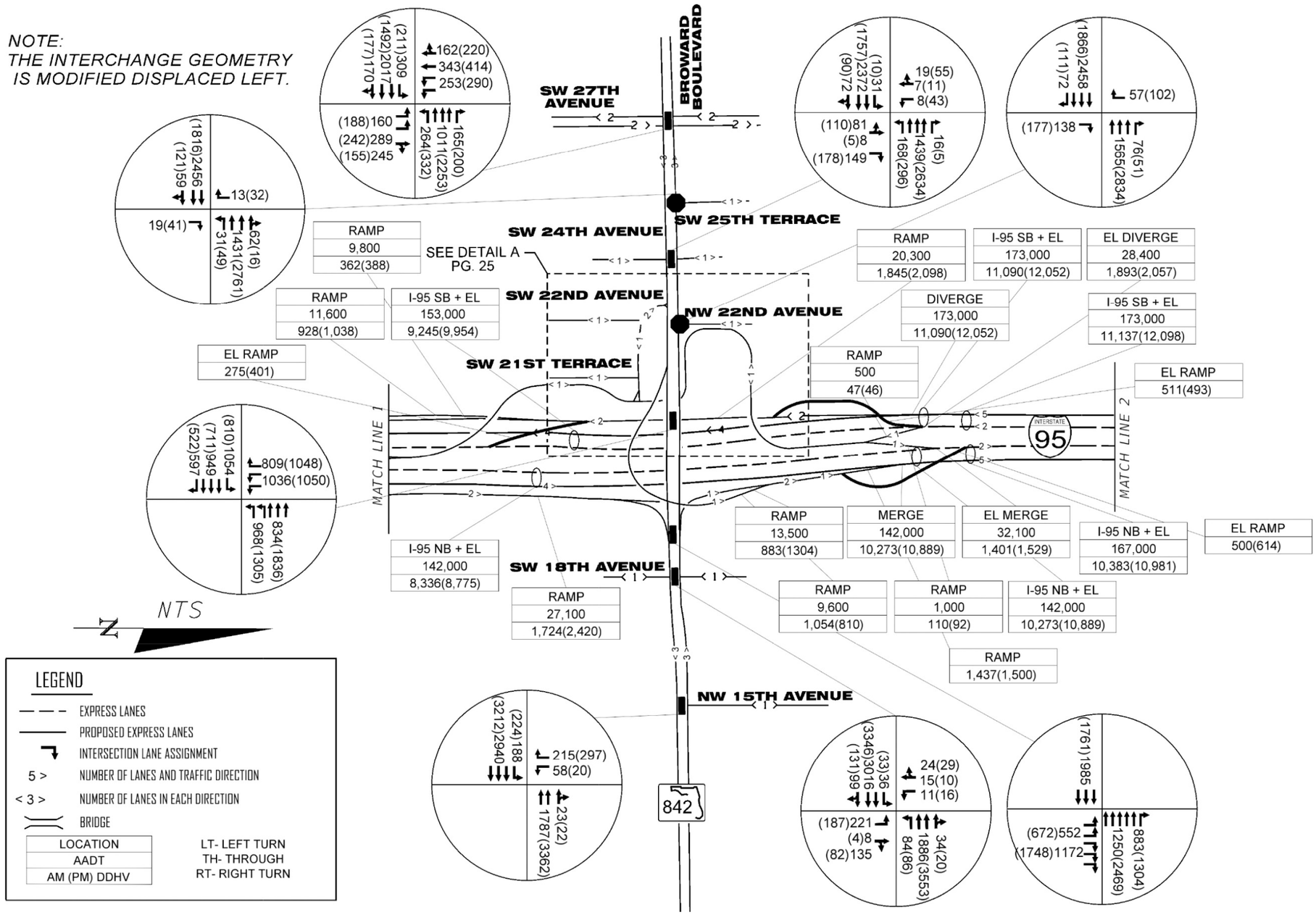
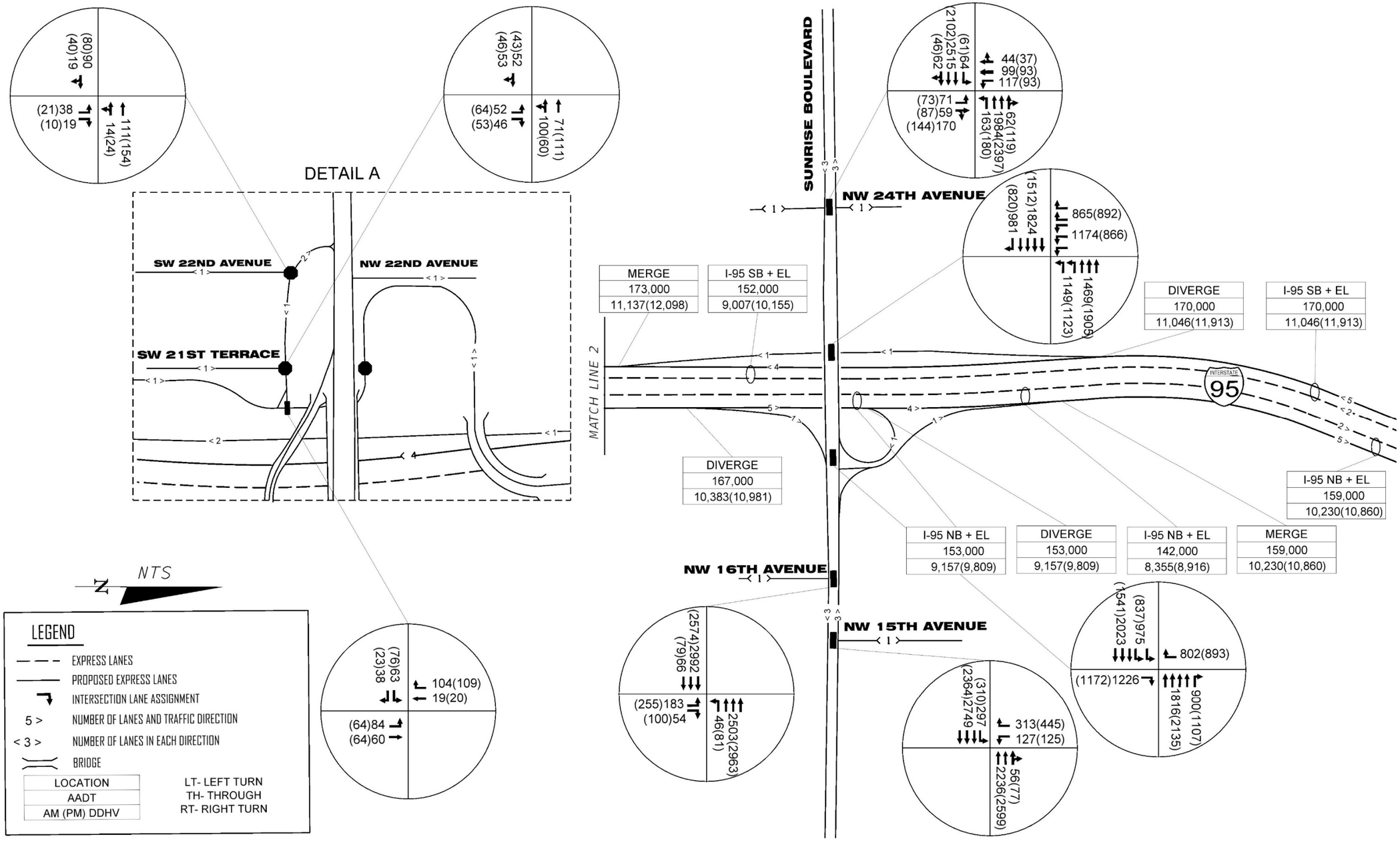


Figure 4-15 | 2040 Build Peak Hour Traffic Volumes for I -95 at Sunrise Blvd Interchange



5.0 Considered Alternatives

5.1 No-Build Alternative

I-95 in the study area is a ten-lane facility with four general purpose travel lanes and one HOV lane in each direction. Within the study limits, and at the interchange itself, there are numerous access ramps. The Florida Department of Transportation (FDOT) is currently implementing Phase 3 of the 95 Express Lanes continuing 29 miles north from Stirling Road in Broward County to Linton Boulevard in Palm Beach County. The 95 Express Phase 3A project will convert the existing HOV lane in each direction to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes. The resulting typical section becomes a 12-lane facility comprised of 4 General Purpose Lanes and 2 Special Use Lanes in each direction. The No-Build Alternative includes the 95 Express 3A-1 for the I-95 mainline and the IOAR approved improvement for the Sunrise Boulevard west terminal ramp intersection.

5.2 Build Alternative

In addition to the No-Build Alternative, the Build Alternative includes improvements for the Mainline I-95, I-95 at Broward Boulevard interchange and the I-95 at Sunrise Boulevard east terminal ramp intersection; they are listed below.

- The ingress and egress braided ramps connecting I-95 express lanes and the Broward Boulevard Alternative 2B.
- The Modified Displaced Left Turn (Alternative 2B) for Broward Boulevard interchange.
- The Signalized Loop Ramp and Extend Eastbound Merge to NW 17th Avenue (Alternative 3A) for the Sunrise Boulevard east terminal ramp intersection.

The following section summarizes the considered alternatives and selection of the recommended alternative. Additional information on the selection of recommended alternatives is included in the Preliminary Engineering Report conducted as part of the PD&E Study.

5.3 Build Alternative Development

Several geometric improvement alternatives were considered for improving traffic operations and safety near the I-95 at Broward Boulevard interchange and the Sunrise Boulevard east ramp terminal intersection.

5.3.1 Mainline I-95 Build Alternative

The proposed improvements to the mainline account for the programmed implementation of 95 Express, which adds one additional Special Use Lane in each direction and modifies the use of these lanes to include managed toll lanes. The resulting typical section becomes a 12-lane facility comprised of four General Purpose Lanes and two Special Use Lanes in each direction.

The primary proposed improvements for the mainline, which are shown in **Figure 5-1**, are for the new ramps providing ingress and egress to the 95 Express lanes.

- In the southbound egress direction, the proposed improvements include a braided ramp over the southbound I-95 General Use Lanes with a connection to the west ramp terminal intersection of the Broward Boulevard service interchange to provide egress from 95 Express near NW 6th Street/Sistrunk Boulevard.
- Similarly in the southbound ingress direction, there is a braided ramp over the southbound I-95 General Use Lanes located just south of Broward Boulevard that provides ingress access for the westbound traffic on Broward Boulevard. This elevated braided ramp provides direct access via the west ramp terminal intersection of the Broward Boulevard service interchange. The westbound left-turn at the west ramp terminal intersection feeds directly into the southbound express lane ramp and does not require drivers to weave through the General Use Lanes.
- To access Southbound (SB) 95 Express from eastbound Broward Boulevard, motorists use SW 1st Street, from SW 22nd Avenue, to access the legacy HOV SB entrance ramp at the south side of the Park and Ride Lot just south of Broward Boulevard. Along SW 1st Street, the residential road of SW 22nd Ave is closed. The stop-controlled intersection at SW 21st Terrace and the signalized intersection immediately east of that are converted to a single roundabout.
- For the northbound direction, egress from 95 Express near Davie Boulevard is proposed through the use of a braided ramp over the northbound I-95 General Use Lanes with a connection to the northbound CD road ramp system that terminates at the east terminal intersection of the Broward Boulevard service interchange. This elevated braided ramp provides eastbound and westbound Broward Boulevard access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.
- Ingress from the Broward Boulevard service interchange to the northbound 95 Express lanes is proposed through a braided ramp over the northbound I-95 General Use Lanes in the vicinity of NW 6th Street/Sistrunk Boulevard. This elevated braided ramp provides direct access between Broward Boulevard and the northbound Express Lanes, using the existing eastbound to northbound flyover, and westbound to northbound ramp, for access to northbound 95 Express without requiring drivers to weave through the General Use Lanes.

842
SW 24TH AVE
NW 24TH AVE
SW 22ND AVE
NW 22ND AVE
SW 1ST ST
SW 21ST TERR
SW 22ND AVE
SW 21ST TERR
TRANSIT PLATFORM AREA
EXISTING MEDIAN P&R/TRANSIT
STAION RAMPS TO REMAIN
EXISTING MEDIAN P&R/TRANSIT
STAION RAMPS TO REMAIN
ENTRANCE RAMP TO REMAIN
SB EXPRESS LANES INGRESS
NB EXPRESS LANES EGRESS
95
NB GENERAL PURPOSE
LANES EGRESS
EXIT RAMP TO REMAIN
ENTRANCE RAMP TO REMAIN
DAVIE BLVD
SW 18TH AVE
SW 18TH AVE
NW 18TH AVE
NORTH FORK NEW RIVER
NW 22ND AVE
NW 21ST TERR
SB EXPRESS LANES EGRESS
95
NB EXPRESS LANES INGRESS
NW 6TH STREET
NW 20TH AVE
NW 19TH AVE
SUNRISE BLVD

5.3.2 Broward Boulevard Interchange Alternatives

Several alternatives were considered for the traffic operational analysis of the Broward Boulevard interchange: The proposed interchange alternatives include:

- Alternative 1 – Tight Diamond,
- Alternative 2A – Displaced Left Turn
- Alternative 2B – Modified Displaced Left Turn
- Alternative 3 – Diverging Diamond (DDI)

5.3.2.1 Alternative 1 – Tight Diamond

The Tight Diamond Interchange is a compressed version of the diamond interchange designed to accommodate right-of-way constraints. The interchange consists of two closely spaced signalized intersections at the crossing of the ramp terminals. The key operational aspect of a Tight Diamond Interchange is signal coordination to ensure efficient progression of traffic and minimum storage of vehicles between the terminals. The existing interchange is a Tight Diamond Interchange and this alternative will improve the existing operation through the addition of turn lanes at the ramp terminal locations and optimization of the intersection signal timings. Specifically, one additional left-turn lane is proposed for southbound ingress from Broward Boulevard to I-95 resulting in triple left-turn lanes for traffic traveling westbound. An additional right-turn lane is also proposed, resulting in double right-turn lanes for eastbound traffic on Broward Boulevard There are no proposed improvements to the northbound ingress ramps from Broward Boulevard These improvements are illustrated in **Figure 5-2**.

5.3.2.2 Alternative 2A – Displaced Left

The Displaced Left Turn Interchange is also known as the Continuous Flow Interchange. The main geometric feature of the Displaced Left Turn Interchange is the removal of left-turn movements from the main intersection to an upstream signalized location to reduce the number of traffic signal phases and conflict points. For this alternative the westbound left-turn movements are displaced at the east ramp terminal intersection to a new roadway that is south and runs parallel to the eastbound through lanes where it combines with the displaced left-turn lanes from the northbound ramp. This configuration enables the westbound left-turn lanes to execute the left turn simultaneously with the westbound through traffic and under a different signal phase also transition the traffic from the northbound ramp on to the westbound at the west ramp terminal intersection. This proposed alternative increases the number of right-turn lanes for the southbound ingress to I-95 from eastbound Broward Boulevard, resulting in dual right-turn lanes. Although displaced as previously described, the left-turn lanes for southbound ingress remain as dual left-turn lanes as is currently provided. These improvements are illustrated in **Figure 5-3**

Figure 5-2 | I-95 at Broward Boulevard Interchange – Alternative 1 (Tight Diamond)

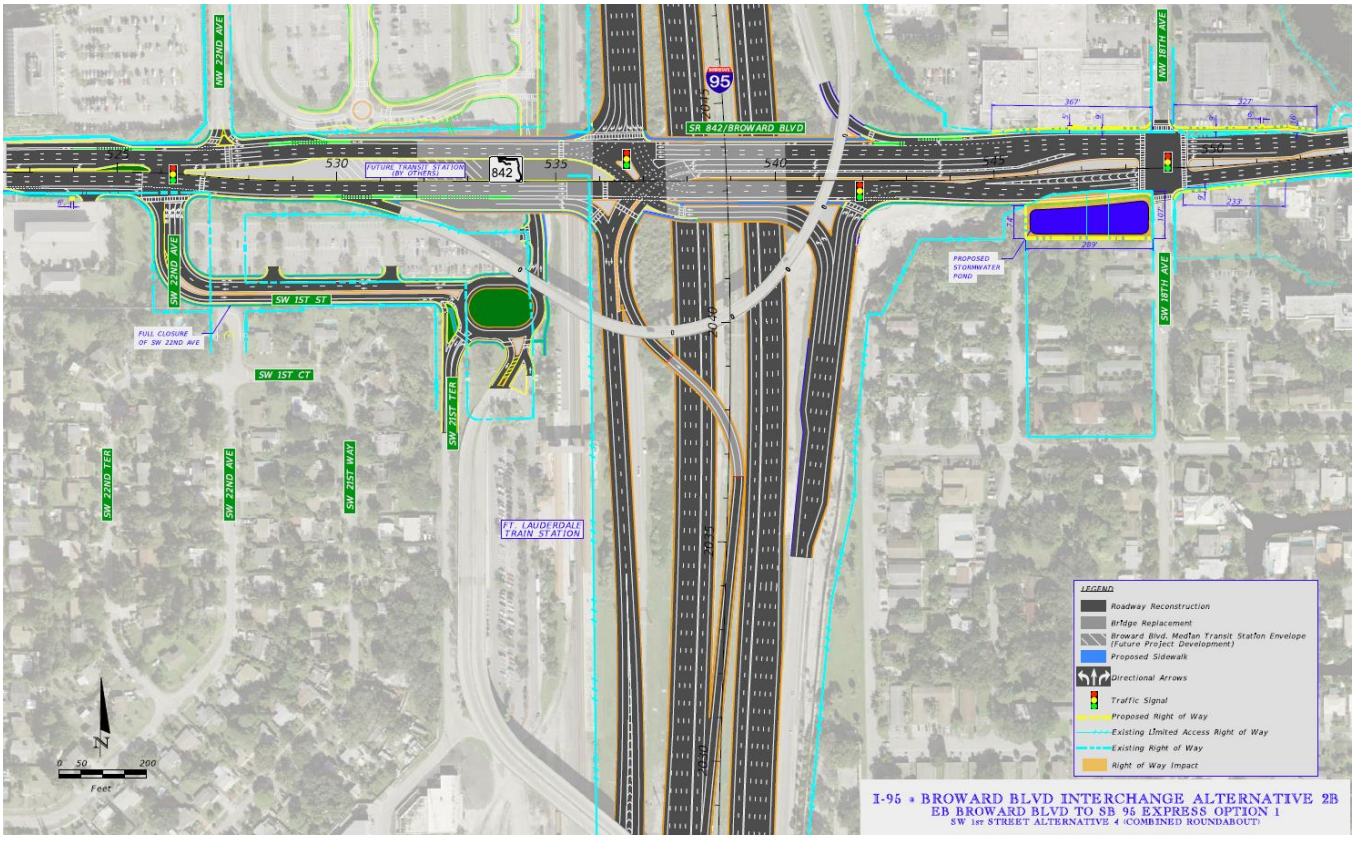
Figure 5-3 | I-95 at Broward Boulevard Interchange – Alternative 2A (Displaced Left)

5.3.2.3 Alternative 2B – Modified Displaced Left

The Modified Displaced Left Turn Interchange alternative provides for the displacement of the northbound exit ramp onto a new roadway (bridge structure) that is on the south of Broward Boulevard over I-95, and runs south of and parallel to the eastbound Broward Boulevard through lanes. The northbound ramp left-turn traffic is then transitioned on to the westbound Broward Boulevard roadway at the west ramp terminal intersection.

This alternative differs from Alternative 2A in that there are three westbound left-turn lanes at the west ramp terminal intersection. The inner left-turn lane is a barrier separated direct connect to 95 Express and the outer two left-turn lanes are for general use that feed to the southbound C-D road. Note the eastbound traffic destined to the southbound 95 Express lanes cannot use the eastbound right turn at the ramp terminal; the traffic must use legacy ramps. This design separates the westbound express lane traffic from the westbound C-D road traffic and eliminates the short weave between the westbound left-turn and the eastbound right-turn on the C-D. **Figure 5-4** illustrates the Modified Displaced Left-Turn Alternative. Alternatives for the eastbound to southbound express lane traffic are provided in **Section 5.3.5**.

Figure 5-4 | I-95 at Broward Boulevard Interchange – Alternative 2B (Modified Displaced Left)



5.3.2.4 Alternative 3 – DDI

The Diverging Diamond Interchange (DDI) eliminates the need for left-turning vehicles to cross the paths of approaching through vehicles. By shifting cross street traffic to the left side of the street between the signalized crossover intersections, vehicles on the crossroad making a left turn on to or off of ramps do not conflict with vehicles approaching from the other directions.

5.3.2.5 Broward Boulevard Interchange Recommended Alternative

A separate AM and PM peak hour intersection analysis for the study area intersections was completed in VISSIM for the study intersections along Broward Boulevard using Broward Boulevard only VISSIM models; the intersection delay and LOS summary is shown in **Table 5-1**. The queue summary is shown in **Table 5-2**.

During the development of interchange alternatives, Alternative 3 (DDI) was eliminated due to geometric constraints (inability to maintain 45 MPH for the main eastbound-westbound movement). Therefore, an operational analysis was not conducted for this alternative.

The No-Build Alternative is not recommended because both ramp terminal intersections are anticipated to fail in 2040 with high delays resulting in LOS E or worse and off-ramp queues spilling back to I-95. Alternative 1, the TUDI, was not recommended because the I-95 southbound ramp terminal is anticipated to operate at LOS E and exceed ramp storage in the PM peak. The TUDI alternative at the I-95 southbound ramp terminal intersection has three off-ramp right-turn lanes, three off-ramp left-turn lanes, three westbound left-turn lanes, and two eastbound right-turn lanes. Because the number of lanes for each turning movement was maximized yet still unable to meet acceptable operational results, the TUDI alternative was discarded as viable option. Alternative 2A accommodates all exit ramp queues but still fails to achieve an LOS of D or better at the I-95 northbound ramp terminal intersection. Shifting the westbound left from the southbound ramp terminal intersection to the northbound ramp terminal intersection introduces a high volume movement that must still compete with the eastbound through movement for green time, thus resulting in high delays. Further, the westbound left-turn movement produced queues spilling over from the available storage bay. Alternative 2B accommodates all exit ramp queues and achieves LOS D or better at both ramp terminal intersections. Alternative 2B operationally outperforms the other considered alternatives and efficiently moves the future traffic demand through the interchange.

Based on the intersection operational analyses, Alternative 2B, the Modified Displaced Left, provides better operations when compared to the other alternatives. Alternative 2B was selected as the Broward Boulevard Interchange Recommended Alternative. The signal operating plan for the recommended alternative can be found in **Appendix F**.

Table 5-1 | 2040 I-95 at Broward Blvd Delay and LOS Results Comparison

AM Peak								
Signalized Intersection	No-Build		ALT 1 TUDI		ALT 2A Displaced Left		ALT 2B Modified Displaced Left	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
I-95 SB Ramp Terminal	45.3	D	56.3	E	27.9	C	43.8	D
I-95 NB Ramp Terminal	27.0	C	48.2	D	54.8	D	15.0	B
PM Peak								
Signalized Intersection			ALT 1		ALT 2A		ALT 2B	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
I-95 SB Ramp Terminal	67.0	E	68.4	E	32.4	C	45.2	D
I-95 NB Ramp Terminal	54.9	D	50.1	D	91.5	F	15.9	B

Table 5-2 | 2040 I-95 at Broward Blvd Ramp Queue Results Comparison

AM Peak				
Signalized Intersection	No-Build	ALT 1 TUDI	ALT 2A Displaced Left	ALT 2B Modified Displaced Left
	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')
I-95 SB Ramp Terminal	716 (1,400)	755 (1,400)	355 (1,400)	407 (1,400)
I-95 NB Ramp Terminal	567 (4,600)	2,212 (4,600)	412 (4,600)	495 (4,600)
PM Peak				
Signalized Intersection	No-Build	ALT 1	ALT 2A	ALT 2B
	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')
I-95 SB Ramp Terminal	3,779 (1,400)	2,208 (1,400)	372 (1,400)	650 (1,400)
I-95 NB Ramp Terminal	4,203 (4,600)	2,573 (4,600)	1,411 (4,600)	586 (4,600)

5.3.3 Broward Boulevard Eastbound to Southbound 95 Express Alternatives

In the recommended Broward Boulevard Build Alternative (Build Alternative 2B), there is a barrier separation on the southbound C-D road (SW 20th Terrace) that restricts Broward Boulevard eastbound right-turn traffic from entering the express lanes via the new braid. Thus, the eastbound traffic on Broward Boulevard destined to the I-95 southbound express lanes must use an alternative route. The SW 1st Street Alternatives (Option 1) and the Flyover Alternative (Option 2) was developed to accommodate the future year traffic and facilitate a functional route for Broward Boulevard eastbound to southbound express lane traffic. The total volume of eastbound motorists seeking access to southbound 95 Express in 2040 is 258 vehicles in the AM peak and 267 vehicles in the PM peak.

5.3.3.1 Option 1 – Broward Boulevard EB to SB Express Lane Traffic via SW 1st Street

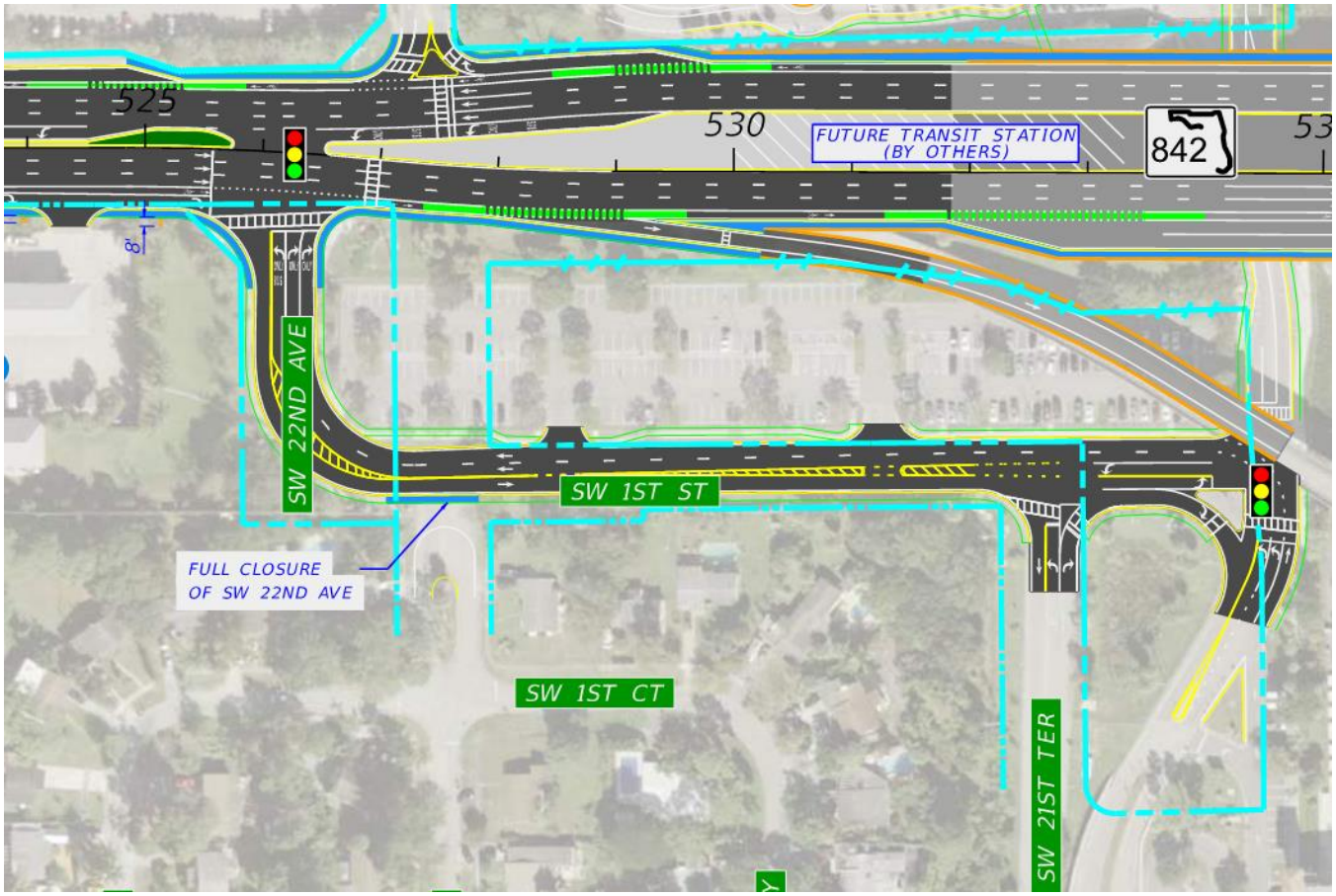
In this option, the eastbound to southbound express lane traffic must continue to use the legacy ramps via SW 1st Street. On SW 1st Street, there is an existing stop control intersection at SW 21st Terrace and an existing signal approximately 200 feet east of SW 21st Terrace at the Park and Ride Access Road. A traffic analysis was conducted to evaluate different control types at those two intersections. Four alternatives with different control types were developed. To be conservative and consistent in analysis, all alternatives (including No-Build) assume the residential road SW 22nd Avenue is closed to SW 1st Street. The four alternatives evaluated are:

- Alternative 1 – No-Build
- Alternative 2 – T-Intersection at SW 21st Terrace and Roundabout at Access Road
- Alternative 3 – Double Roundabout
- Alternative 4 – Combined Roundabout

Alternative 1 – No-Build

This alternative assumes the existing geometry on SW 1st Street. The westbound direction is maintained as two lanes and the eastbound direction is maintained as one lane to SW 21st Terrace where it then becomes a left-turn and a right-turn lane. The No-Build Alternative is illustrated in **Figure 5-5**.

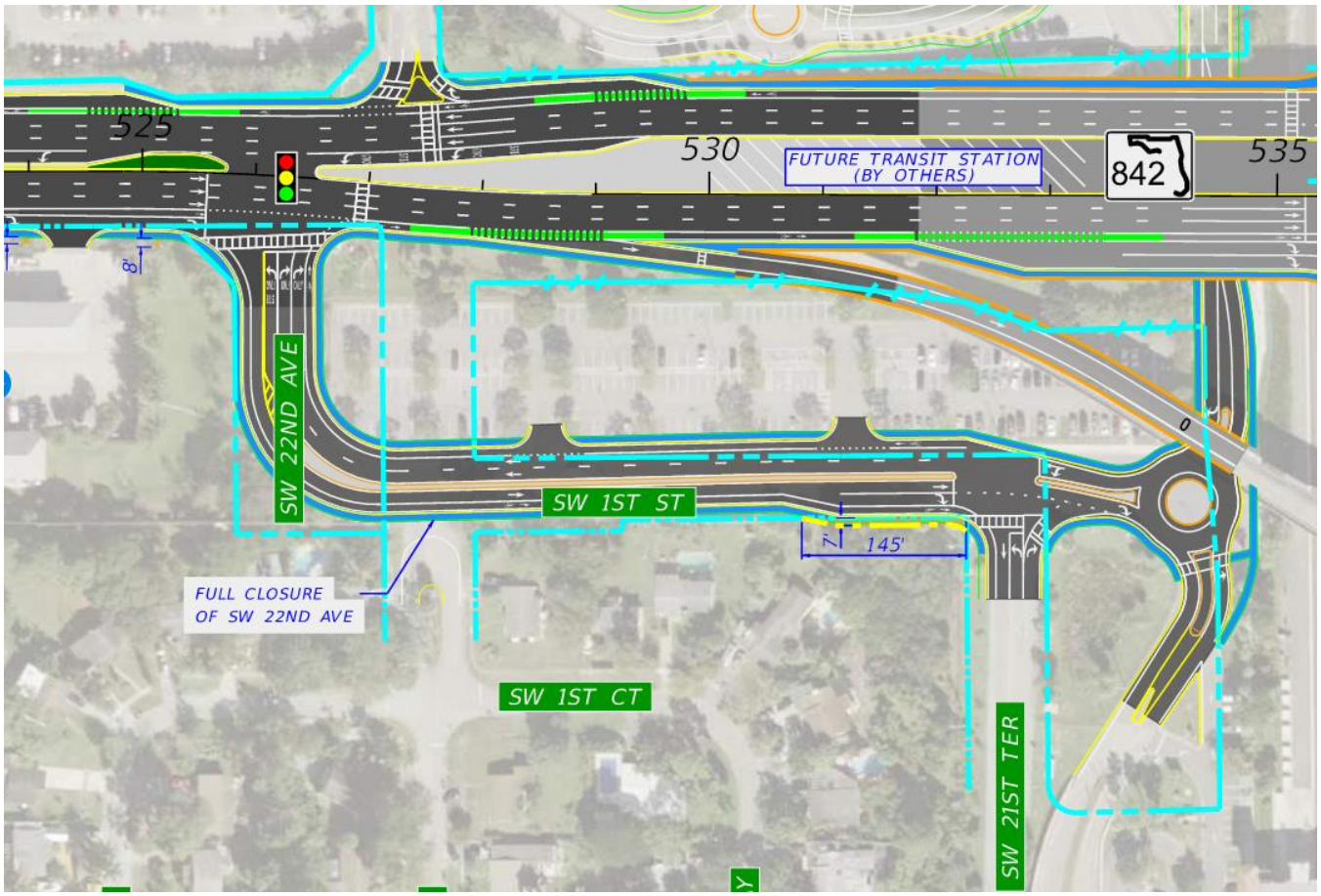
Figure 5-5 | SW 1st Street Alternative 1 – No-Build



Alternative 2 – T-Intersection and Roundabout

This alternative keeps the SW 21st Terrace intersection as stop control but converts the east signalized intersection to a single-lane roundabout. The eastbound section on SW 1st Street between SW 21st Terrace and the roundabout is reduced to one lane to facilitate a single-lane roundabout entry. The eastbound direction maintains one lane from SW 22nd Avenue to SW 21st Terrace and the westbound direction maintains two lanes from SW 21st Terrace to SW 22nd Avenue. There is also an eastbound right-turn lane added on SW 1st St for vehicles to access SW 21st Terrace. To construct the right-turn bypass lane, right-of-way is required. These improvements are illustrated in **Figure 5-6**.

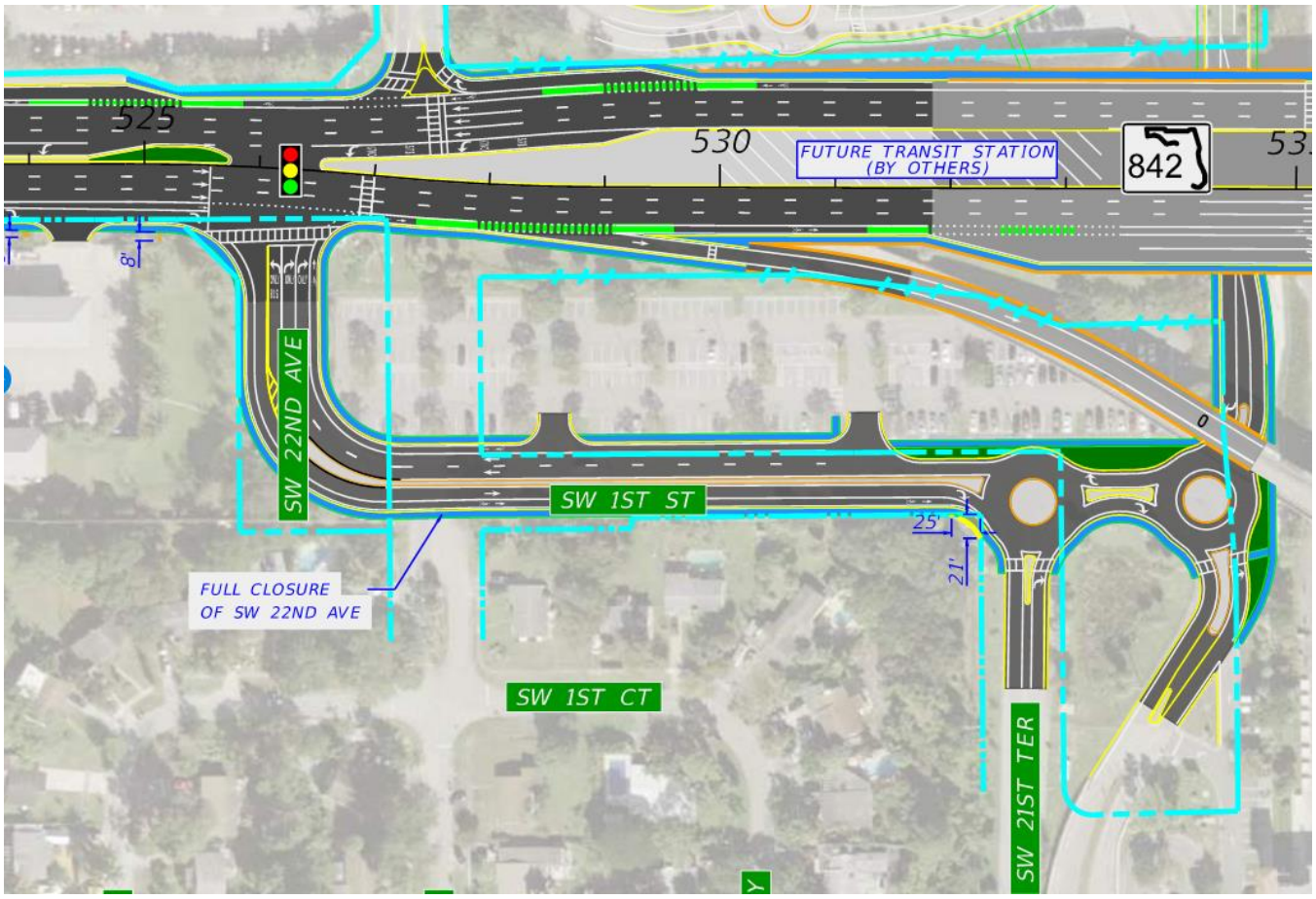
Figure 5-6 | SW 1st Street Alternative 2 – T-Intersection and Roundabout



Alternative 3 – Double Roundabout

This alternative converts the intersection of SW 21st Terrace and the existing east signalized intersection to single-lane roundabouts. The section of SW 1st Street between the two junctions is reduced to one lane in each direction to facilitate single-lane roundabout entries. The eastbound direction maintains one lane from SW 22nd Avenue to SW 21st Terrace and the westbound direction maintains two lanes from SW 21st Terrace to SW 22nd Avenue. These improvements are illustrated in **Figure 5-7**.

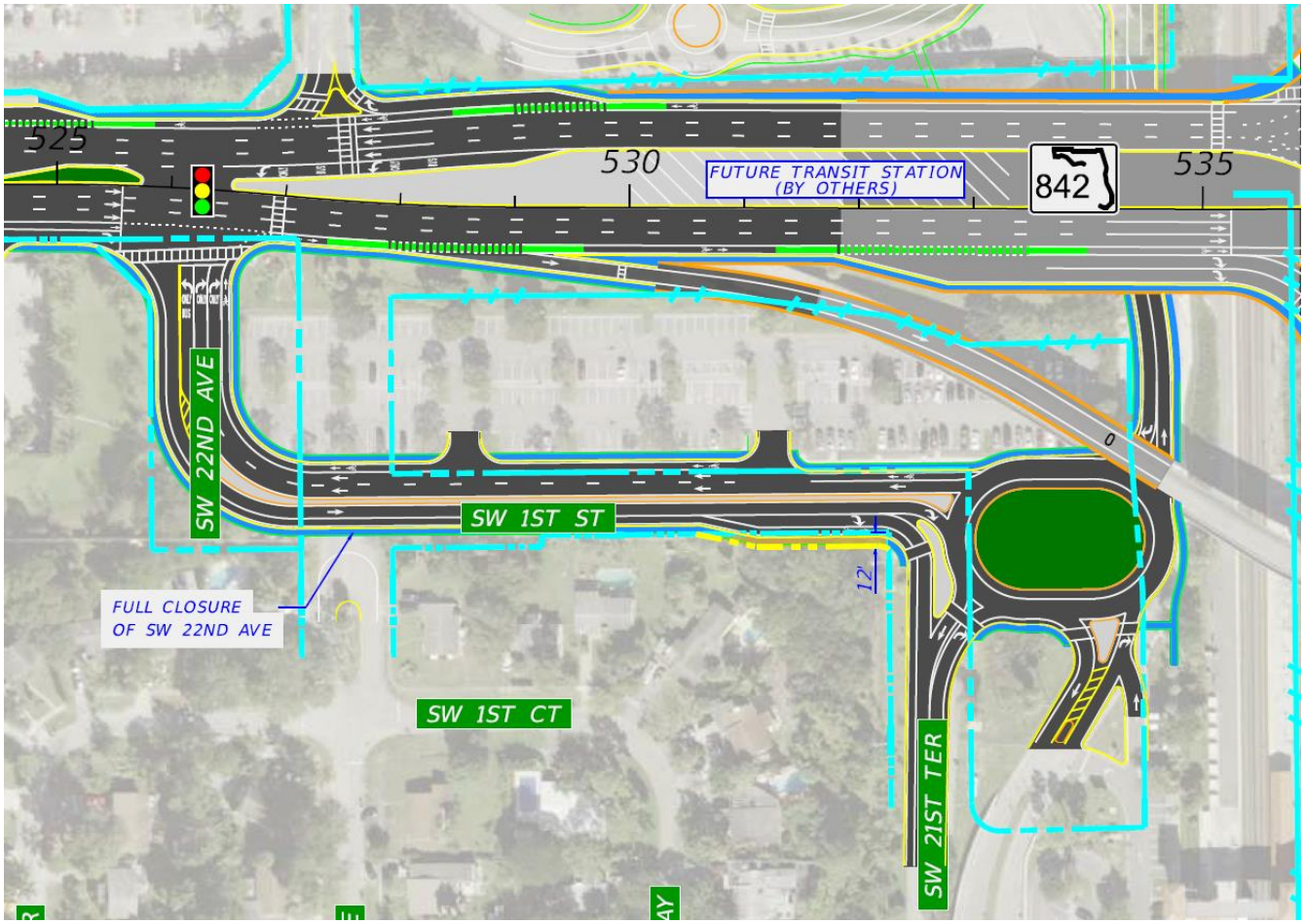
Figure 5-7 | SW 1st Street Alternative 3 – Double Roundabout



Alternative 4 – Combined Roundabout

This alternative combines the intersection of SW 21st Terrace and the existing east signalized intersection into one roundabout. This design eliminates the need for two roundabouts (described in Alternative 3) by bringing all approach movements from the two intersections into a single roundabout. The roundabout is designed to accommodate transit vehicles exiting the Park and Ride lot. There is also an eastbound right-turn bypass lane added on SW 1st St for vehicles to access SW 21st Terrace without entering the roundabout, which provides less impedance to eastbound vehicles destined for southbound 95 Express. To construct the right-turn bypass lane, right-of way is required. These improvements are illustrated in **Figure 5-8**.

Figure 5-8 | SW 1st Street Alternative 4 – Combined Roundabout



SW 1st Street Recommended Alternative

A separate AM and PM peak hour intersection analysis was completed in SYNCHRO and SIDRA for the study intersections along SW 1st Street. The intersection delay and LOS summary is shown in **Table 5-3** and the queue summary is shown in **Table 5-4**. SYNCHRO and SIDRA reports can be found in **Appendix F**.

Results show that all three alternatives yield favorable delay and queue results. Intersection delays are all LOS C or better and movement queues are all accommodated in the available storage. Geometrical constrains, ROW, environmental factors, and impacts to communities should be considered in choosing the recommended alternative. Based on the operational results alone, Alternative 4 (combined roundabout) provides the best operational results and minimizes conflict points.

Table 5-3 | 2040 SW 1st Street Alternatives Delay and LOS Results Comparison

AM Peak												
	ALT 1			*ALT 2*			*ALT 3*			*ALT 4*		
SW 1st St Intersection	*No-Build*			*T-Intersection & Roundabout*			*Double Roundabout*			*Combined Roundabout*		
	Control	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**
SW 21st Terr	Stop	15.7*	C	Stop	15.4*	C	Roundabout	3.5	A	Roundabout	4.9	A
PnR Access Rd	Signal	10.6	B	Roundabout	3.3	A	Roundabout	3.3	A			
PM Peak												
SW 1st St Intersection	*ALT 1*			*ALT 2*			*ALT 3*			*ALT 4*		
	Control	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**	**Control**	**Delay (s)**	**LOS**
SW 21st Terr	Stop	14.4*	B	Stop	14.6*	B	Roundabout	3.1	A	Roundabout	5.0	A
PnR Access Rd	Signal	10.3	B	Roundabout	3.2	A	Roundabout	3.2	A			

*worst movement reported

Table 5-4 | 2040 SW 1st St Alternatives Queue Result Comparison

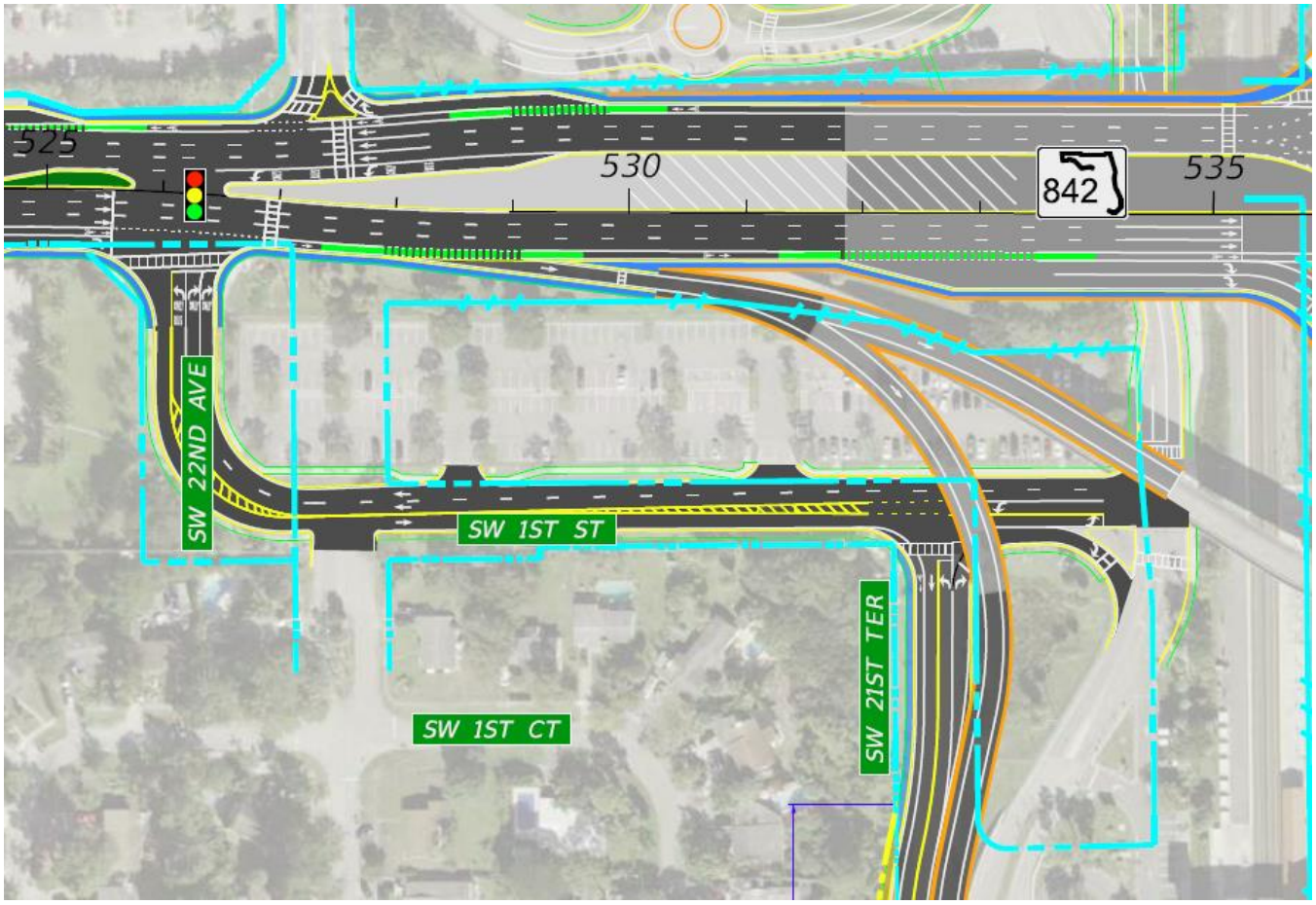
AM Peak									
SW 1st St Intersection	Movement	*ALT 1*		*ALT 2*		*ALT 3*		*ALT 4*	
		No-Build		*T-Intersection & Roundabout*		*Dual Roundabouts*		*Combined Roundabout*	
		Control	95th Queue' (Storage')	Control	95th Queue' (Storage')	Control	95th Queue' (Storage')	Control	95th Queue' (Storage')
SW 21st Terr	EBT	Stop	-	Stop	-	Roundabout	41 (970)	Roundabout	27 (970)
	EBR		-		-				4 (175)
	WBL		8 (110)		8 (110)		17 (60)		--
	WBT		-		-				
	NBL		13 (500+)		13 (500+)		12 (500+)		14 (500+)
	NBR		5 (275)		5 (175)				
PnR Access Rd	EBL	Signal	46 (110)	Roundabout	38 (60)	Roundabout	38 (60)		--
	EBR		54 (125)						
	NBL		31 (100)		13 (500+)		13 (500+)		18 (500+)
	NBR		19 (500+)						
	SBT		15 (375)		11 (375)		11 (375)		12 (375)
	SBR		25 (50)						

PM Peak									
SW 1st St Intersection	Movement	*ALT 1*		*ALT 2*		*ALT 3*		*ALT 4*	
		Control	95th Queue' (Storage')	Control	95th Queue' (Storage')	Control	95th Queue' (Storage')	Control	95th Queue' (Storage')
SW 21st Terr	EBT	Stop	-	Stop	-	Roundabout	39 (970)	Roundabout	27 (970)
	EBR		-		-				3 (175)
	WBL		8 (110)		8 (110)		17 (60)		--
	WBT		-		-				
	NBL		13 (500+)		13 (500+)		14 (500+)		17 (500+)
	NBR		5 (275)		5 (175)				
PnR Access Rd	EBL	Signal	54 (110)	Roundabout	38 (60)	Roundabout	38 (60)		--
	EBR		53 (125)						
	NBL		26 (100)		11 (500+)		11 (500+)		16 (500+)
	NBR		20 (500+)						
	SBT		15 (375)		12 (375)		12 (375)		13 (375)
	SBR		25 (50)						

5.3.3.2 Option 2 – Broward Boulevard EB to SB Express Lane Traffic via Flyover

In this option, the eastbound to southbound express lane traffic uses a spur ramp off of the existing eastbound to northbound ramp. Vehicles exit to the spur ramp and then merge into the existing southbound legacy ramp approximately 1,100 feet downstream. To construct the flyover, right-of-way on the west side on SW 21st Terrace is required. In this option, there are no modifications to SW 1st Street. **Figure 5-9** illustrates the flyover.

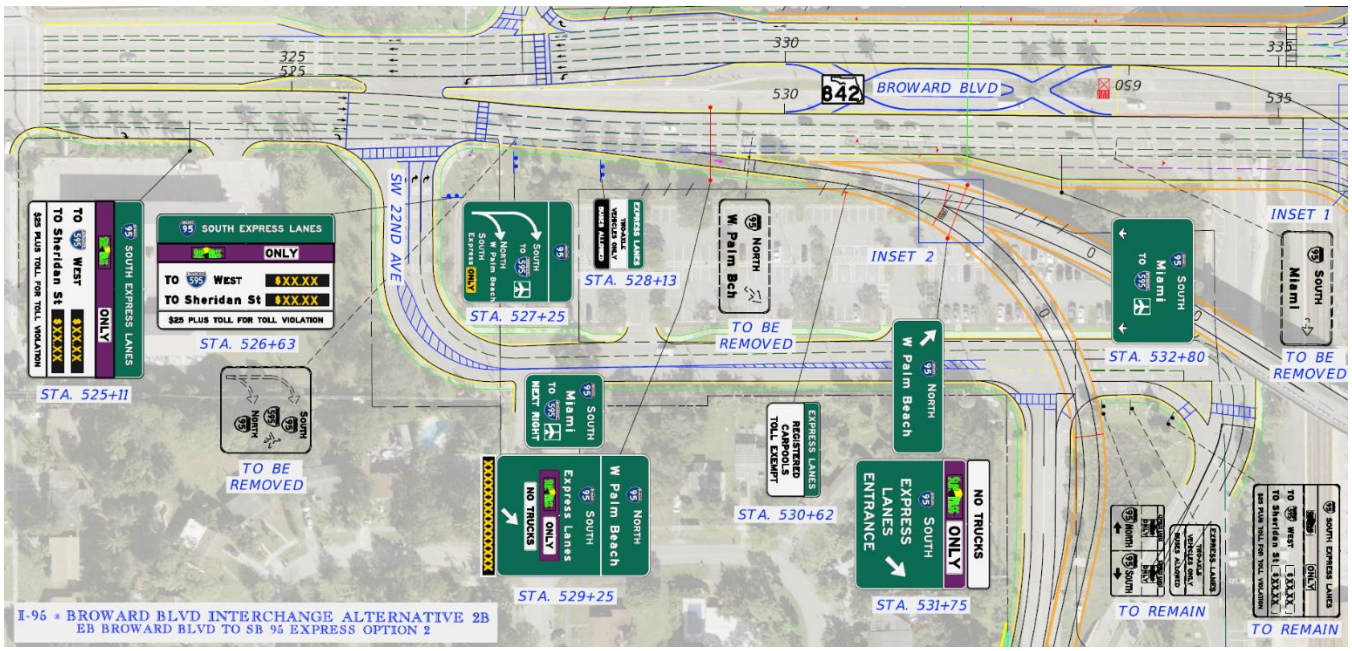
Figure 5-9 | EB to SB 95 Express Option 2 (via Flyover)



5.3.3.3 Overall Recommendation

Of the two options for Broward Boulevard eastbound to southbound express lane traffic, Option 1 (via SW 1st Street) is recommended. After discussion with District Four, it was agreed that the flyover would not be pursed as an option due to signing complexity. A sample of the signing plan for the flyover is provided in **Figure 5-10**. Therefore, the option via SW 1st Street is recommended since it maintains the eastbound to southbound express lane traffic pattern from existing conditions and still provides acceptable operations.

Figure 5-10 | EB to SB 95 Express Option 2 (via Flyover) Signing Plan



5.3.4 Broward Boulevard Park and Ride Lot / Transit Station Alternatives

Three park and ride alternatives were developed to address vehicular and pedestrian circulation through the lots. Each alternative provides additional sidewalk throughout the northern parking areas, identifies crosswalks, and proposes a canopy for the sidewalks connecting the train station to the newly created area underneath the expanded Broward Boulevard bridge structure. The development of park and ride alternatives are discussed in detail in Preliminary Engineering Report (PER).

5.3.5 Sunrise Boulevard East Terminal Ramp Intersection Alternatives

As discussed in earlier sections, FDOT conducted a standalone feasibility study during the Broward Boulevard PD&E Study for the I-95 at Sunrise Boulevard east terminal ramp intersection focusing on geometric and operational improvements needed at the east ramp terminal intersection. Four interchange alternatives were considered for the Sunrise Boulevard east terminal ramp intersection. A description of the alternatives is provided below.

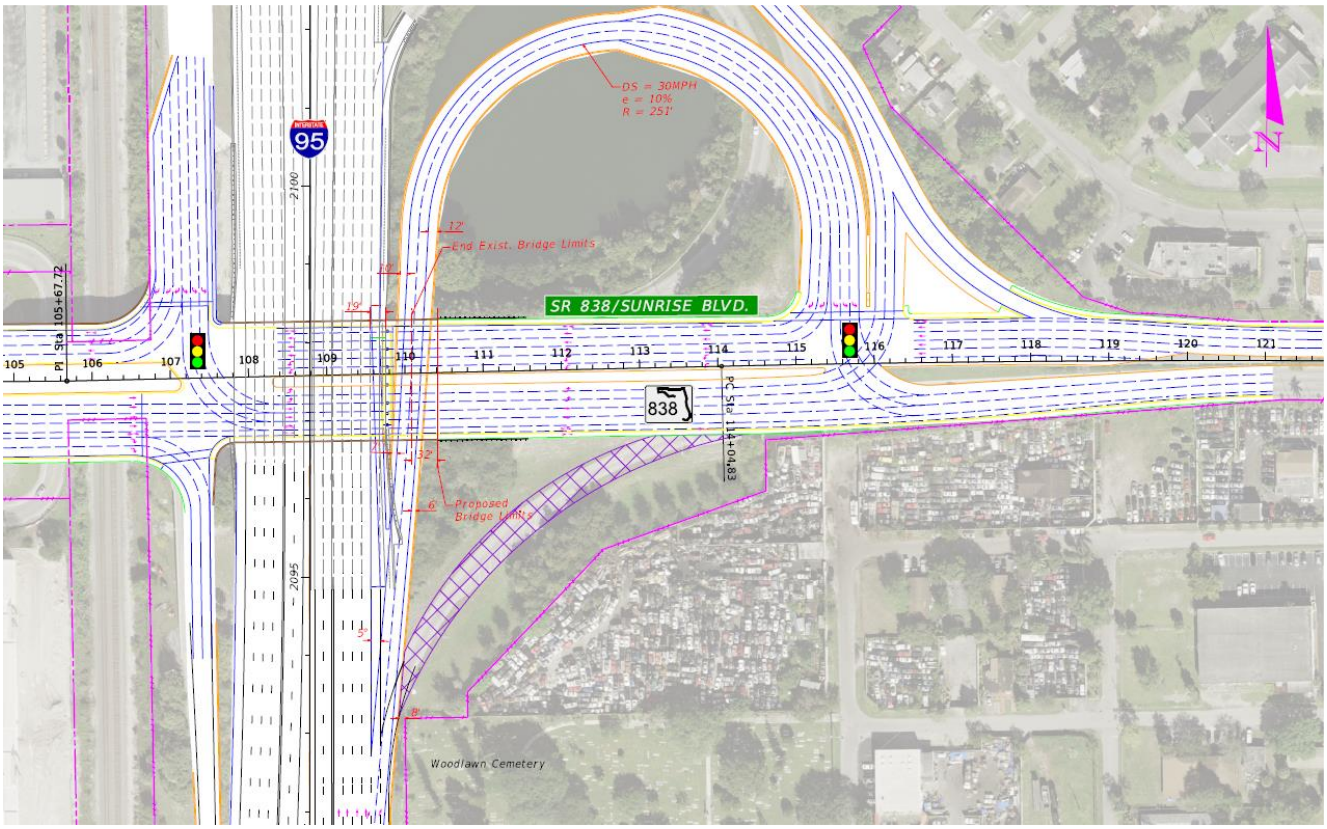
5.3.5.1 Alternative 1 – Dual Lane Off-Ramp Alternative

This alternative includes eliminating the existing northbound to eastbound off-ramp movement and placing it on the loop ramp in the northeast quadrant of the interchange. The loop ramp is widened to the inside to provide a two-lane loop ramp and the existing east ramp terminal signal is modified to serve the ramp. This alternative changes the existing signal from a two-phase signal to a three-phase signal. Additionally, the existing free-flow right movement is removed and the southbound right movement is protected by the southbound left and the eastbound left. The existing bridge eastern bridge piers are directly adjacent to the existing single exit lane off-ramp. Therefore, the widening of the existing northbound to westbound ramp will require reconstruction of the eastern half of the Sunrise Boulevard

Bridge over I-95 northbound. This alternative simplifies the Sunrise Boulevard interchange configuration by reducing the number of northbound off-ramp access points from two to one. It also increases the ramp spacing between the northbound Broward Boulevard on ramp and the northbound Sunrise Boulevard off-ramp from ~2,970 feet to ~3,940 feet. This approximate 970 foot increase in distance will benefit the weaving movement between the two interchanges.

In order for the east terminal intersection to operate at an acceptable level of service, the westbound to southbound dual left-turn lane needs to be extended through the east terminal intersection and the eastbound to northbound dual left-turn lane should be extended to the west terminal intersection. Full dual left-turn lanes are made possible by realigning the westbound through lanes and shifting them north to use the existing northbound to westbound auxiliary merge lane which is no longer needed since this movement is controlled by the east terminal signal. Realigning the westbound travel lanes will allow the westbound dual left-turn lanes to be developed sooner, providing the required storage at the east terminal. Without providing approximately 850 feet of storage for the westbound dual left-turn lanes prior to the east terminal, this alternative is sensitive to queue spillback, impacting the westbound through lanes and the traffic operations at the Sunrise Boulevard and NW 16th Avenue signalized intersection. **Figure 5-11** shows the configuration of the Dual Lane Off-Ramp Alternative.

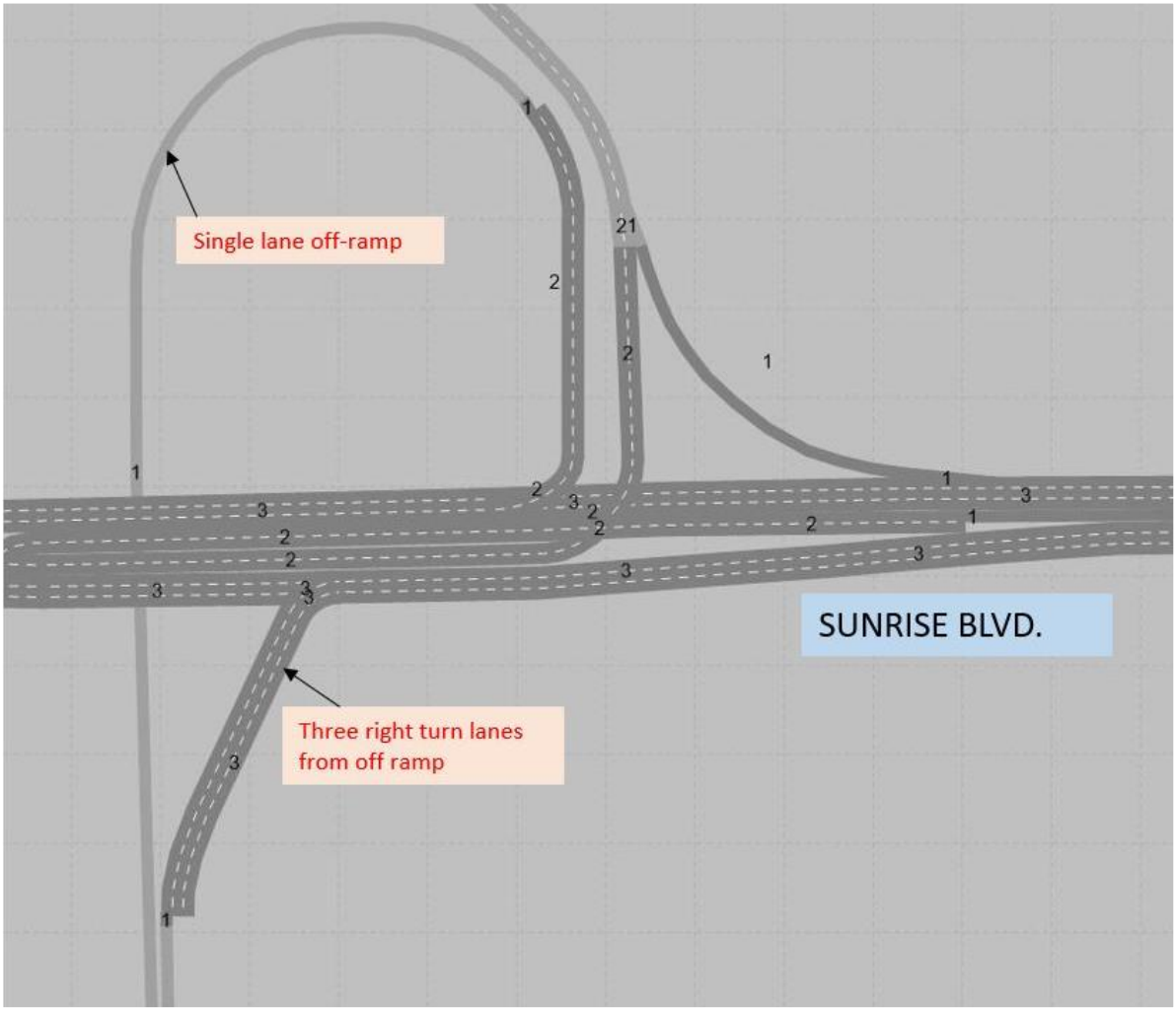
Figure 5-11 | I-95 at Sunrise Boulevard Interchange – Alternative 1 (Dual Lane Off-Ramp Alternative)



5.3.5.2 Alternative 2 – Partial Diamond with Single Lane Off-Ramp

This alternative modifies the alignment of the northbound to eastbound free-flow exit ramp to a tight diamond configuration. The realigned ramp would terminate at a new two-phase signal serving the eastbound through movement and the northbound right movement. The existing single loop ramp remains but the northbound to westbound free-flow right is modified to stop at the two-phase signal serving the northbound entrance ramp. The two-phase signal allows the southbound right turns to run concurrently with the eastbound left. It should be noted that in this alternative, the two signals located at the east terminal would operate on separate two-phase controllers, serving westbound and eastbound traffic independently. This alternative would require full reconstruction of the northbound to eastbound exit ramp being cautious not to impact the Woodlawn Cemetery. **Figure 5-12** shows the configuration of Partial Diamond with Single Lane Loop Alternative.

Figure 5-12 | I-95 at Sunrise Boulevard Interchange – Alternative 2 (Partial Diamond with Single Lane Off-Ramp)

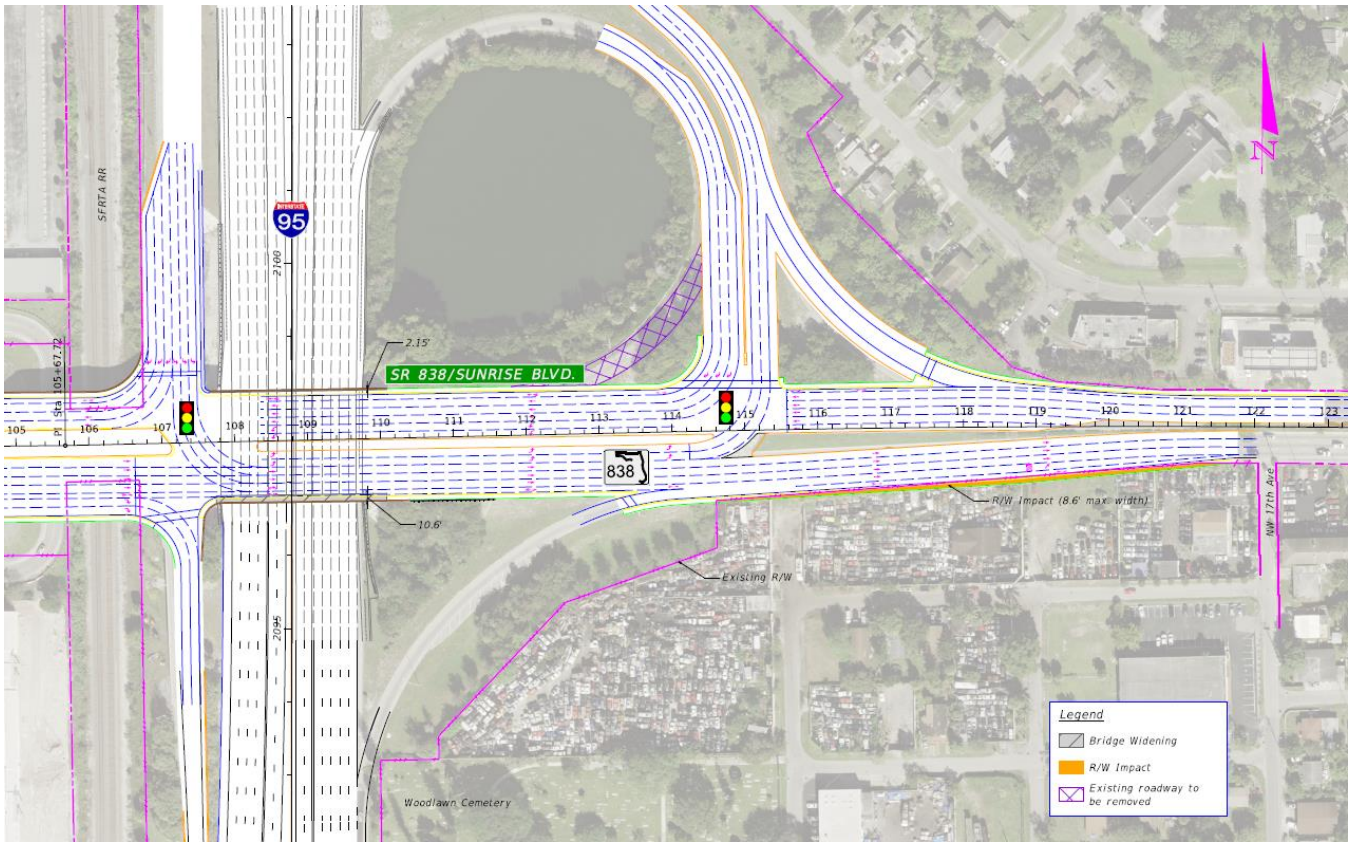


5.3.5.3 Alternative 3A – Signalized Loop Ramp and Extend Eastbound Merge to NW 17th Ave

This alternative modifies the both the northbound to eastbound ramp and the northbound to westbound ramp. The northbound the eastbound free-flow exit ramp is maintained, however the four-lane section merge distance is increased to 500 feet, terminating just west of NW 17th Avenue. This merge extension requires minimal right-of-way acquisition in the southeast quadrant. The northbound to westbound ramp movement is realigned to stop at the two-phase signal serving the northbound entrance ramp. The existing single loop ramp remains but is modified to open up to a two-lane section and then a three-lane section for exit ramp storage. The two-phase signal allows the southbound right turns to run concurrently with the eastbound left. This modification also allows for pedestrian accommodation at the signal.

Similar to Alternative 1, in order for the east terminal intersection to operate at an acceptable level, the westbound to southbound dual left turn lane needs to be extended through the east terminal intersection and the eastbound to northbound dual left turn lane should be extended to the west terminal intersection. **Figure 5-13** shows the configuration of Alternative 3.

Figure 5-13 | I-95 at Sunrise Boulevard Interchange – Alternative 3A (Signalized Loop Ramp and Extend Eastbound Merge to NW 17th Ave)

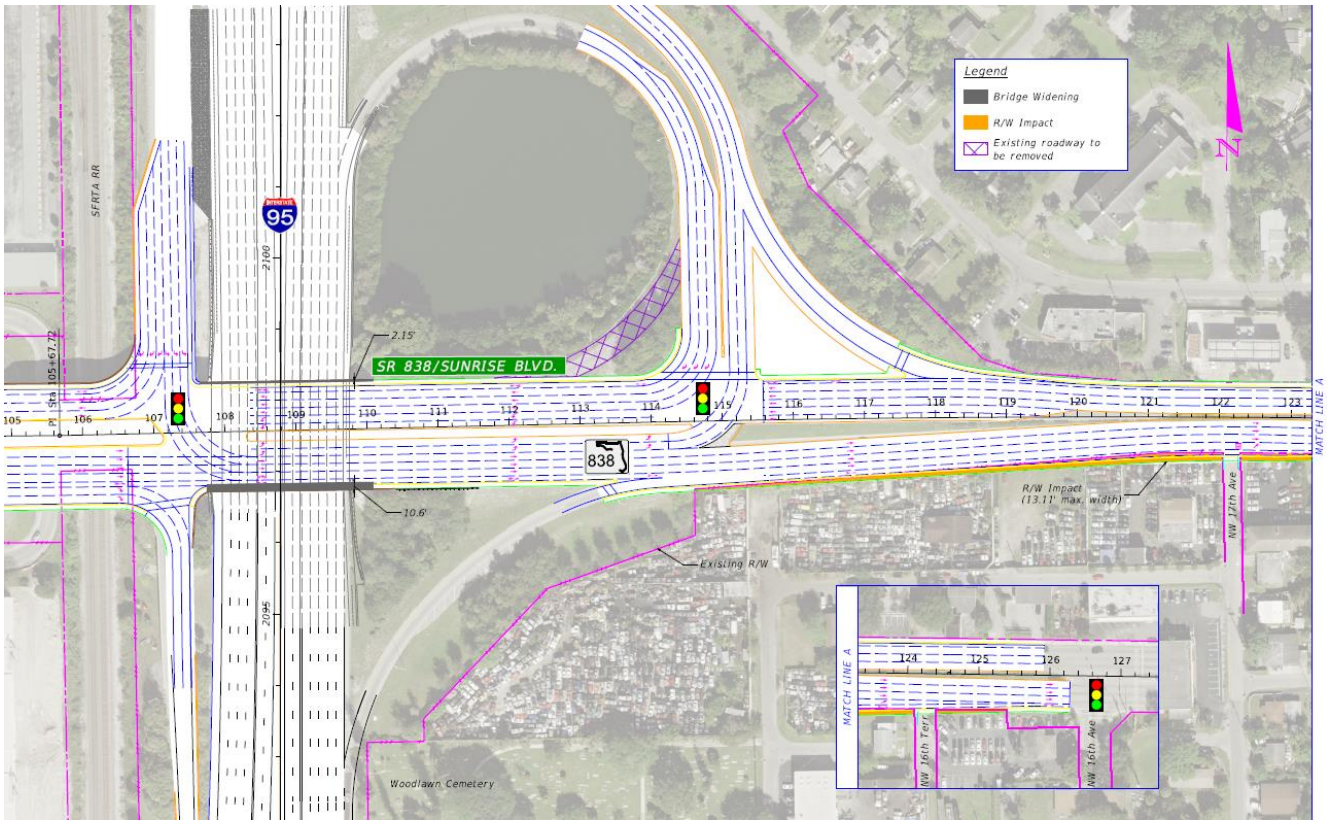


5.3.5.4 Alternative 3B – Signalized Loop Ramp and Extend Eastbound Merge to NW 16th Avenue

This alternative modifies the both the northbound to eastbound ramp and the northbound to westbound ramp. The northbound the eastbound free-flow exit ramp is maintained, however the four-lane section merge distance is increased to ~1,050 feet, terminating just west of NW 16th Avenue. This merge extension requires right-of-way acquisition in the southeast quadrant. Compared to Alternative 3A, this option provides more lane usability for the off-ramp traffic by allowing the traffic to use the full ~1,050 feet of distance available from the free-flow lane. The northbound to westbound ramp movement is realigned to stop at the two-phase signal serving the northbound entrance ramp. The existing single loop ramp remains but is modified to open up to a two-lane section and then a three-lane section for exit ramp storage. The two-phase signal allows the southbound right turns to run concurrently with the eastbound left. This modification also allows for pedestrian accommodation at the signal.

Similar to Alternative 1, in order for the east terminal intersection to operate at an acceptable level, the westbound to southbound dual left-turn lane needs to be extended through the east terminal intersection and the eastbound to northbound dual left-turn lane should be extended to the west terminal intersection. **Figure 5-14** shows the configuration of Alternative 3B.

Figure 5-14 | I-95 at Sunrise Boulevard Interchange – Alternative 3B (Signalized Loop Ramp and Extend Eastbound Merge to NW 16th Ave)

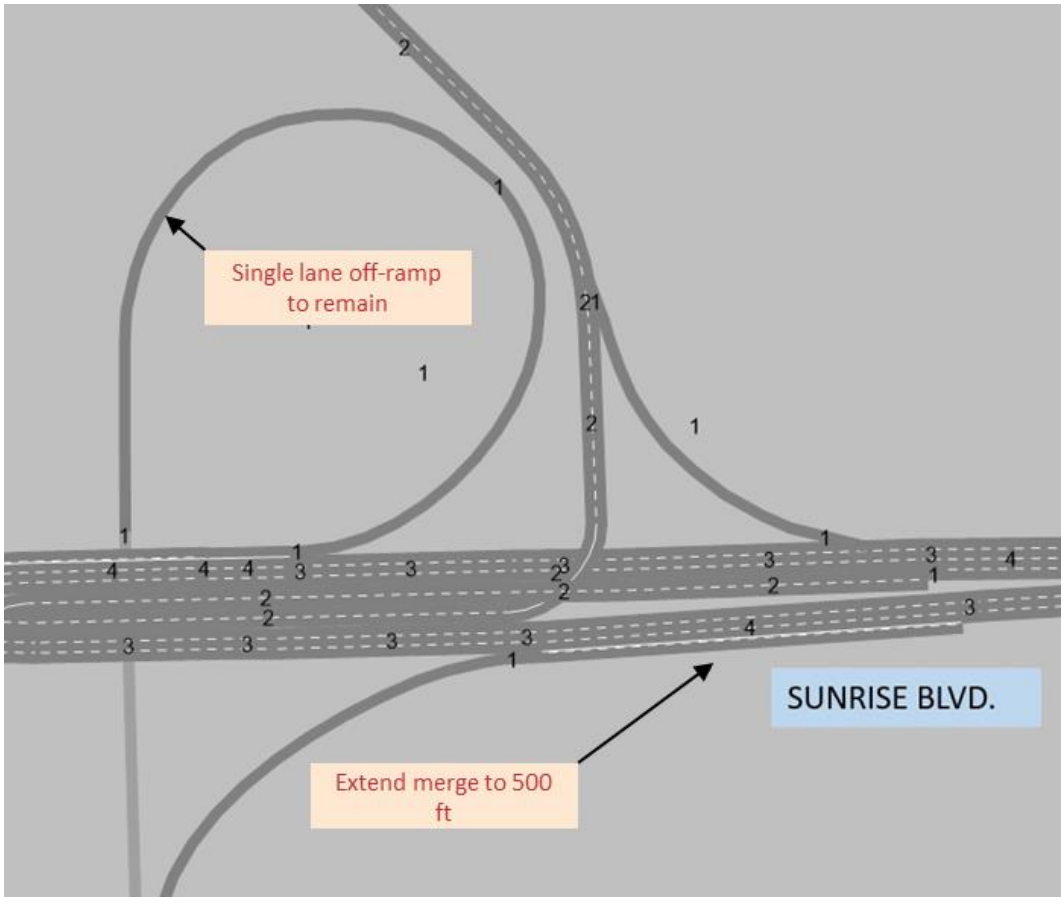


5.3.5.5 Alternative 4 – Extend Eastbound Merge to NW 17th Avenue

This alternative modifies only the northbound to eastbound ramp. The northbound to eastbound free-flow exit ramp is maintained, however the four-lane section merge distance is increased to 500 feet, terminating just west of NW 17th Avenue. This merge extension requires minimal right-of-way acquisition in the southeast quadrant.

Similar to Alternative 1, in order for the east terminal intersection to operate at an acceptable level, the westbound to southbound dual left-turn lane needs to be extended through the east terminal intersection and the eastbound to northbound dual left-turn lane should be extended to the west terminal intersection. Since the existing northbound to westbound free-flow movement is maintained in this alternative, the dual left turn modifications would require widening of the existing bridge. **Figure 5-15** shows the configuration of Build Alternative 4.

Figure 5-15 | I-95 at Sunrise Boulevard Interchange – Alternative 4 (Extend Eastbound Merge to NW 17th Ave)



5.3.5.6 Sunrise Boulevard East Terminal Ramp Intersection Recommended Alternative

A separate AM and PM peak period intersection analysis for the study area intersections was completed in VISSIM for the build alternatives. In order to replicate field conditions, the AM VISSIM models included the Sunland Park Academy school zone located on Sunrise Boulevard, approximately 1,100 feet east of southbound ramp terminal intersection. The intersection delay and LOS summary is shown in **Table 5-5** and the queue summary is presented in **Table 5-6**. Note results for Alternative 2 and Alternative 4 are taken from models that do not include the school zone on Sunrise Boulevard. These alternatives were removed from consideration before the school zone was modeled on Sunrise Boulevard and therefore time was not spent rerunning alternatives already proven unfeasible. Alternative 2 was removed from consideration because the northbound off-ramp queued back to I-95 and exceeded available storage by over double the length of the off-ramp. Alternative 4 was removed from consideration after conversation with FDOT at a District Interchange Review Coordination (DIRC) Meeting. During the discussion, it was agreed that the loop ramp should be signalized to improve pedestrian safety. Alternative 4 does not signalize that loop ramp and was therefore eliminated as a viable alternative. Based on the operational analysis, the recommended improvement is Alternative 3A – Signalized Loop Ramp and Extend Eastbound Merge to NW 17th Avenue.

Alternative 3A accommodates all exit ramp queues and improves pedestrian access on the north side of the interchange by signalizing the existing free-flow loop ramp movement. Alternatives 1 and 2 are not recommended since there are maximum queues for the exit ramps that exceed the available storage. Alternative 3B is not recommended because the additional merge distance does not provide any additional benefit; the operational results for Alternatives 3A and 3B are similar and Alternative 3A requires less right-of-way. Alternative 4 was discarded from consideration because it does not signalize the existing free-flow loop ramp. Alternative 3A is determined to provide the greatest benefit to travelers in operations and safety.

Table 5-5 | 2040 I-95 at Sunrise Blvd East Ramp Terminal Intersection Delay and LOS Results Comparison

AM Peak												
Signalized Intersection	No-Build		ALT 1		ALT 2		ALT 3A		ALT 3B		ALT 4	
			Dual Lane Loop Ramp		Partial Diamond with Single Lane Ramp		Signalize Loop Ramp and Extend Eastbound Merge to NW 17th Ave		Signalize Loop Ramp and Extend Eastbound Merge to NW 16th Ave		Extend Eastbound Merge to NW 17th Ave	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
I-95 SB Ramp Terminal	53.3	D	46.1	D	38.0	D	54.7	D	53.0	D	30.0	C
I-95 NB Ramp Terminal	47.6	D	55.4	E	25.5	C	24.2	C	23.6	C	8.9	A
PM Peak												
Signalized Intersection	No-Build		ALT 1		ALT 2		ALT 3A		ALT 3B		ALT 4	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
I-95 SB Ramp Terminal	104.0	F	36.7	D	33.4	C	37.3	D	37.4	D	36.5	D
I-95 NB Ramp Terminal	79.8	E	50.6	D	33.0	C	15.3	B	14.8	B	10.5	B

Table 5-6 | 2040 I-95 at Sunrise Blvd East Ramp Terminal Intersection Ramp Queue Results Comparison

AM Peak							
Signalized Intersection	Ramp Movement	No-Build	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4
		Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')
I-95 SB Ramp Terminal	SB	724 (1,200)	499 (1,200)	514 (1,200)	559 (1,200)	528 (1,200)	352 (1,200)
I-95 NB Ramp Terminal	NB to EB	649 (500)	1,947 (1,500)	1,274 (400)	0 (500)	0 (900)	37 (500)
	NB to WB	0 (1,420)		515 (960)	246 (960)	275 (960)	0 (1,420)
PM Peak							
Signalized Intersection	Ramp Movement	No-Build	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4
		Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')	Max Queue' (Storage')
I-95 SB Ramp Terminal	SB	499 (1,200)	305 (1200)	400 (1,200)	412 (1,200)	398 (1,200)	397 (1,200)
I-95 NB Ramp Terminal	NB to EB	36 (500)	516 (1,500)	964 (400)	20 (500)	0 (900)	0 (400)
	NB to WB	0 (1,420)		739 (960)	291 (960)	316 (960)	309 (1,420)

6.0 SIMR Alternatives Analysis

This section documents the future conditions operations analysis for the area of influence and compares traffic operations of the No-Build Alternative against the Build Alternative for the SIMR. A VISSIM micro-simulation analysis was performed to evaluate the effects of the proposed improvements in the study area for the opening year (2020) and the design year (2040).

6.1 Simulation Model Development

As discussed in **Section 3.3.2**, VISSIM models for this study were developed and calibrated for AM peak hour and PM peak hour for the 2016 traffic conditions. The calibrated existing models were used to develop the Opening Year 2020 and the Design Year 2040 VISSIM models. Calibration parameters from the existing conditions VISSIM models were carried forward to future models. The geometry of the No-Build and the Build were constructed by tracing the roadway network over the proposed design files. Existing signal timings were coded in the VISSIM models as a starting point and then optimized for both alternatives. Similar to existing conditions, inputs for both AM and PM peak hours included a 1-hour shoulder period before the peak hour and a 1-hour shoulder period after the peak hour. A 30-minute seeding period was used prior to the start of the first shoulder hour. The shoulder hours were developed by factors established in the calibrated existing models. VISUM T-Flow Fuzzy was again utilized to synthesize the Origin-Destination (OD) matrices. Existing OD matrices were utilized as seed matrices to generate ODs for 2020 and 2040 conditions. The OD matrices and routes imported from the VISUM T-Flow Fuzzy process were utilized for vehicle routing in all simulation models. Vehicle routing was coded using static routes in the entire model including the managed lane facilities. Vehicle inputs for express lanes were set to 3,300 vph for two lanes and percentage splits, determined in **Table 4-1**, were used to split the Broward Boulevard direct connect on and off-ramp volumes into general purpose and express lane routes.

6.2 Network Performance Results

A network performance evaluation is an important statistic as it provides the relative number of vehicles that are being served and extent of the latent demand of the study area. Network wide statistics are summarized for the AM and PM peak periods in **Table 6-1** through **Table 6-4** for No-Build and Build Alternatives.

The network analyses indicate the No-Build Alternative has capacity constraints; therefore, some demand cannot enter the network, resulting in latent demand and latent delay. The numbers of latent demand and latent delay are good indicators of the overall network congestion. The Build Alternative shows significantly less latent demand and latent delay compared to the No-Build, indicating less network congestion in the Build Alternative primarily in the 2040 Build Alternative for PM Peak Hour.

In terms of network travel time and network delay, the 2040 Build Alternative for the PM Peak Hour shows an approximate 37 percent reduction in total travel time and a 73 percent reduction in total delay time compared to the 2040 No-Build Alternative for the PM Peak Hour.

Table 6-1 | Network Wide Performance Summary

Parameter	AM Peak Hour					
	2020			2040		
	No-Build	Build	% Change	No-Build	Build	% Change
Total Travel Time (hr)	2,829	2,750	3%	4,566	3,661	20%
Total Delay Time (hr)	550	514	7%	1,973	997	49%
Average Delay Time (sec/veh)	56	51	8%	169	83	51%
Latent Delay Time (hr)	2	1	27%	252	96	62%
Vehicles Left the Network	32,925	33,431	-2%	36,636	39,474	-8%
Latent Demand (veh)	5	1	72%	959	220	77%
Parameter	**PM Peak Hour**					
	2020			2040		
	No-Build	Build	% Change	No-Build	Build	% Change
Total Travel Time (hr)	3,148	3,017	4%	6,051	3,834	37%
Total Delay Time (hr)	603	525	13%	3,316	887	73%
Average Delay Time (sec/veh)	55	48	14%	261	68	74%
Latent Delay Time (hr)	0	0	0%	1,499	2	100%
Vehicles Left the Network	36,422	36,937	-1%	39,291	43,541	-11%
Latent Demand (veh)	0	0	0%	2,982	1	100%

6.3 Freeway Link Evaluation Results

The VISSIM micro-simulation models were used to produce volume and speed profiles along the I-95 general purpose (GP) lanes, and express lanes for freeway operations for both the AM and PM peak hours. Average volume and average speed profiles provide a good representation of the traffic flow along the corridor.

6.3.1 2020 Operational Results

Figure 6-1 through **Figure 6-16** depict the average speed and volumes profiles along the I-95 corridor for the Opening Year 2020 condition. The results of the link evaluation indicate the following:

- I-95 northbound is operating at or near free flow speed during the AM and PM peak periods for both the No-Build and Build Alternatives.
- I-95 southbound is operating at or near free flow speed during the AM and PM peak periods for both the No-Build and Build Alternatives.

6.3.2 2040 Operational Results

Figure 6-17 through **Figure 6-32** depict the average speed and volumes profiles along the I-95 corridor for the Design Year 2040 condition. The results of the link evaluation indicate the following:

- I-95 northbound is operating at or near free flow speed during the AM and PM peak periods for both the No-Build and Build Alternatives.

- I-95 southbound is operating at or near free flow speed during the AM peak period for both the No-Build and Build Alternatives.
- I-95 southbound mainline in the No-Build Alternative during the PM peak period experiences congestion along the segment between Broward Boulevard and Sunrise Boulevard due to the weaving between interchanges and due to the Broward Boulevard southbound off-ramp queuing back to I-95. Upstream of the Broward Boulevard southbound off-ramp, speeds between 20 mph and 40 mph were observed in the PM peak hour. Downstream of the Broward Boulevard southbound off-ramp, vehicles escape the congested area and operating speeds at or near free flow speed were observed until reaching the Davie interchange area.
- With the addition of the direct connects to Broward Boulevard, I-95 southbound in the Build Alternative is operating at or near free flow speed during the PM peak period.

Freeway operations results show that the I-95 mainline and Express Lanes are expected to be un-congested in future conditions with the Phase 3 95 Express Lanes. These results are consistent with the operational results provided for the 95 Express Phase 3 results included in **Appendix G**.

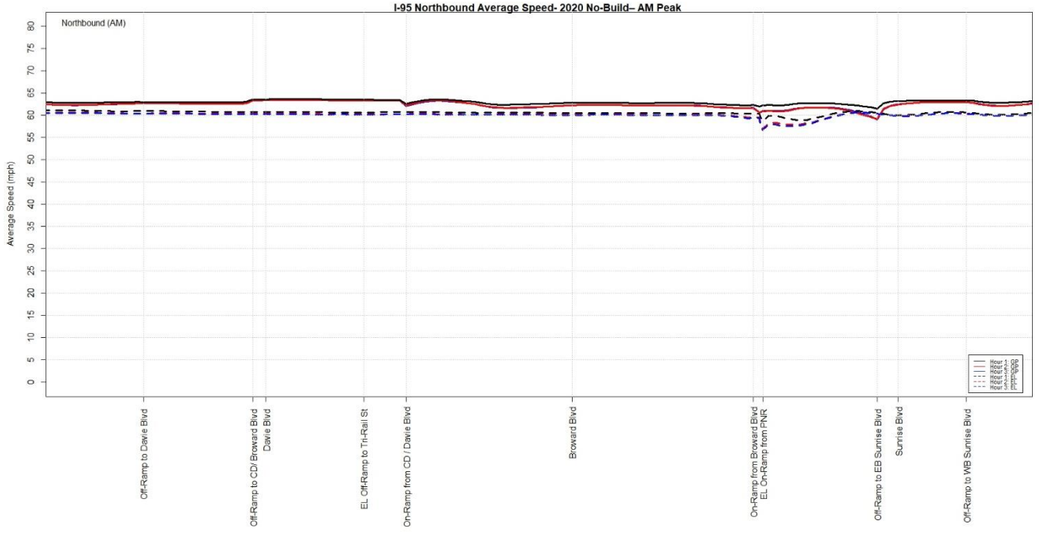


Figure 6-1 | 2020 No-Build Northbound Average Speed for AM Peak Period

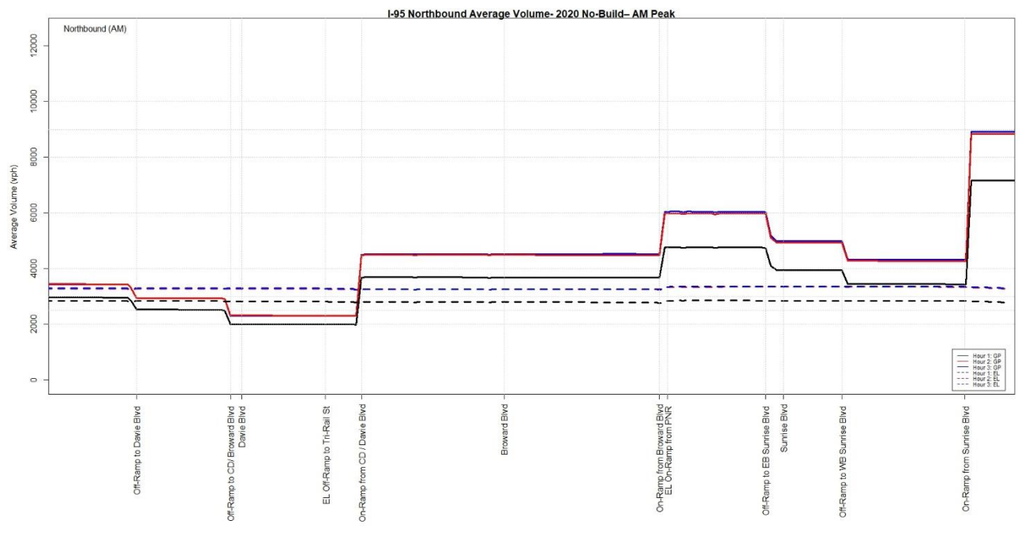


Figure 6-2 | 2020 No-Build Northbound Volume Profiles for AM Peak Period

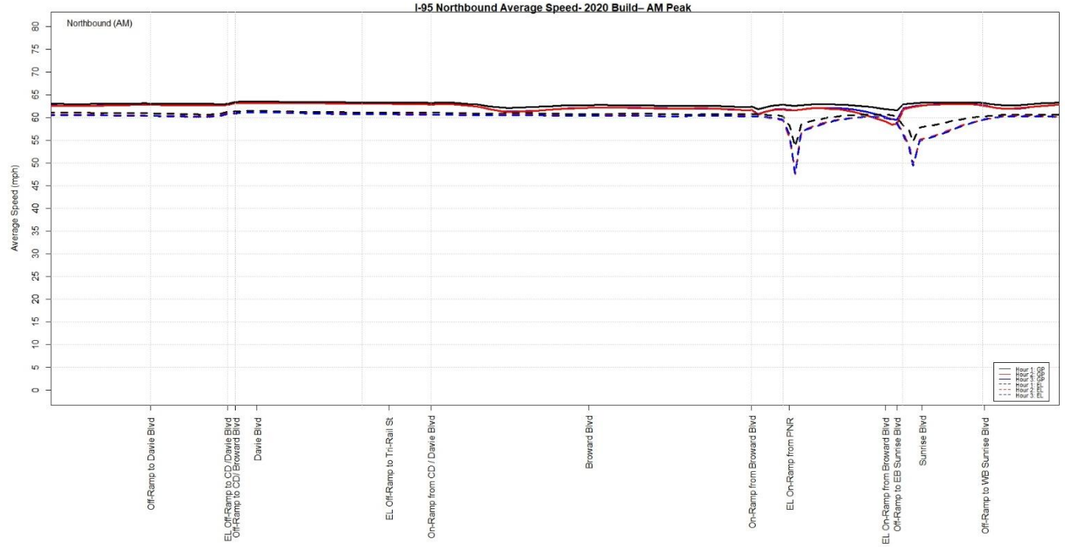


Figure 6-3 | 2020 Build Northbound Average Speed for AM Peak Period

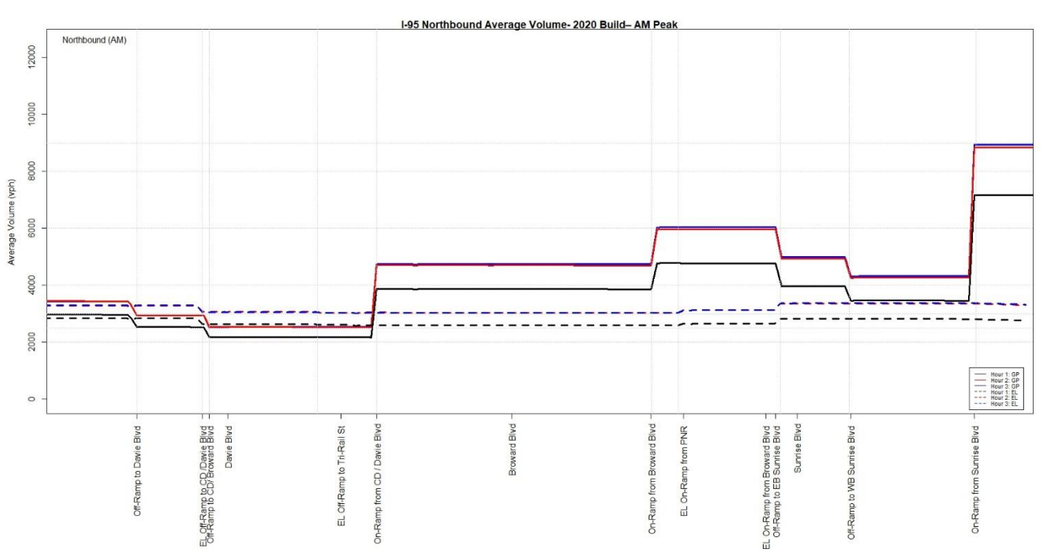


Figure 6-4 | 2020 Build Northbound Volume Profiles for AM Peak Period

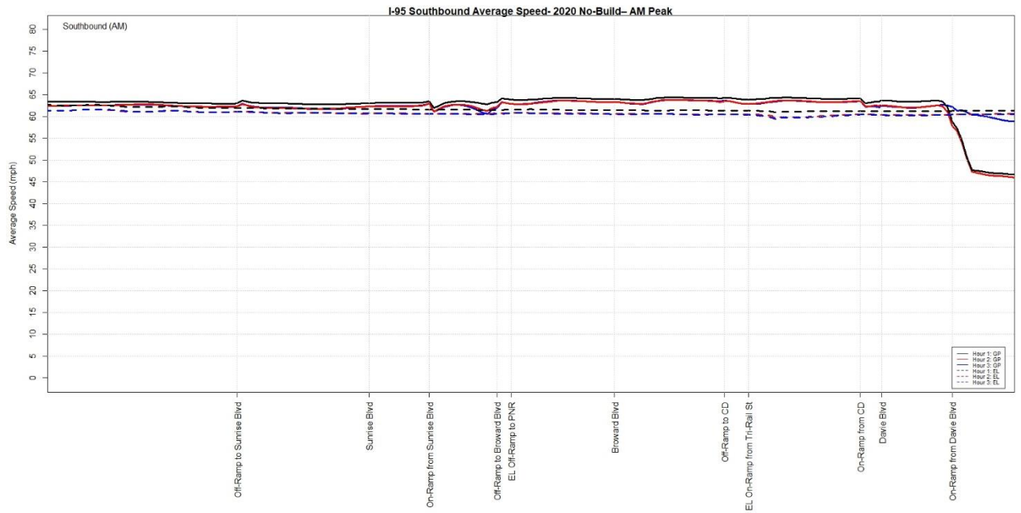


Figure 6-5 | 2020 No-Build Southbound Average Speed for AM Peak Period

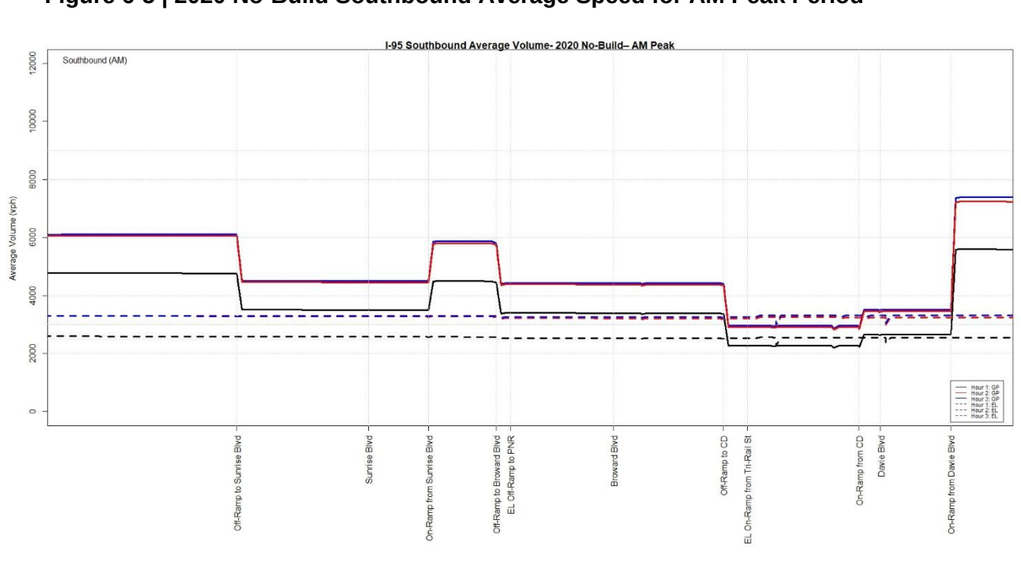


Figure 6-6 | 2020 No-Build Southbound Volume Profiles for AM Peak Period

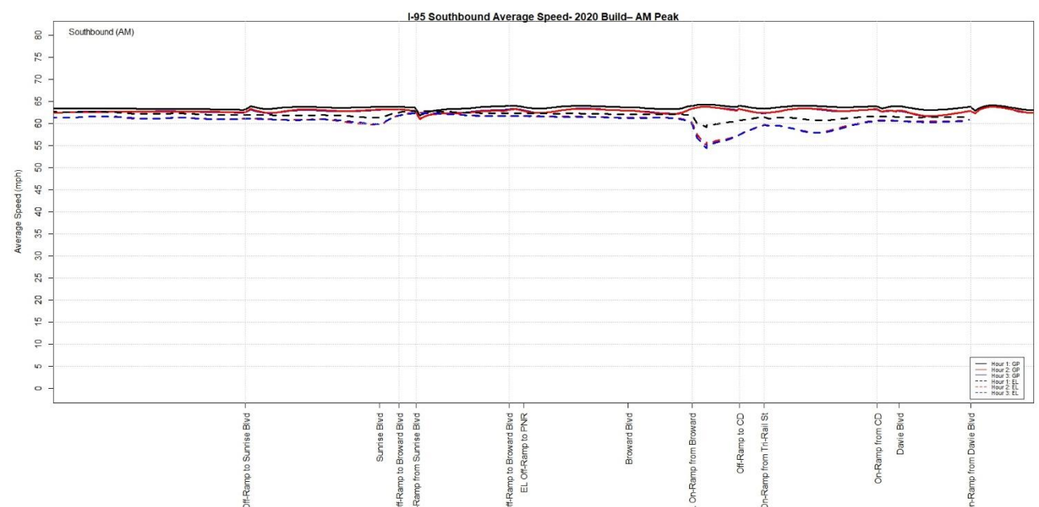


Figure 6-7 | 2020 Build Southbound Average Speed for AM Peak Period

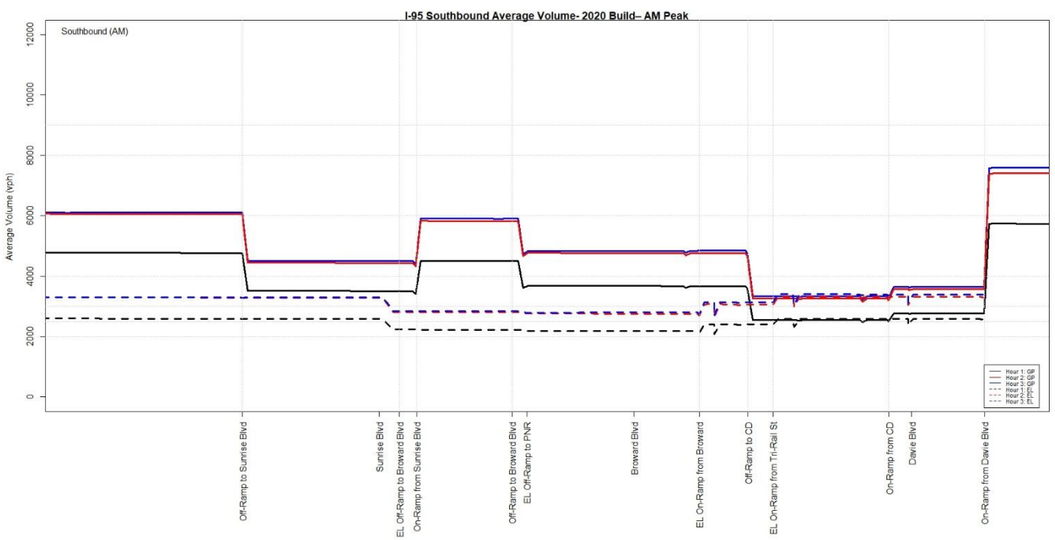


Figure 6-8 | 2020 Build Southbound Volume Profiles for AM Peak Period

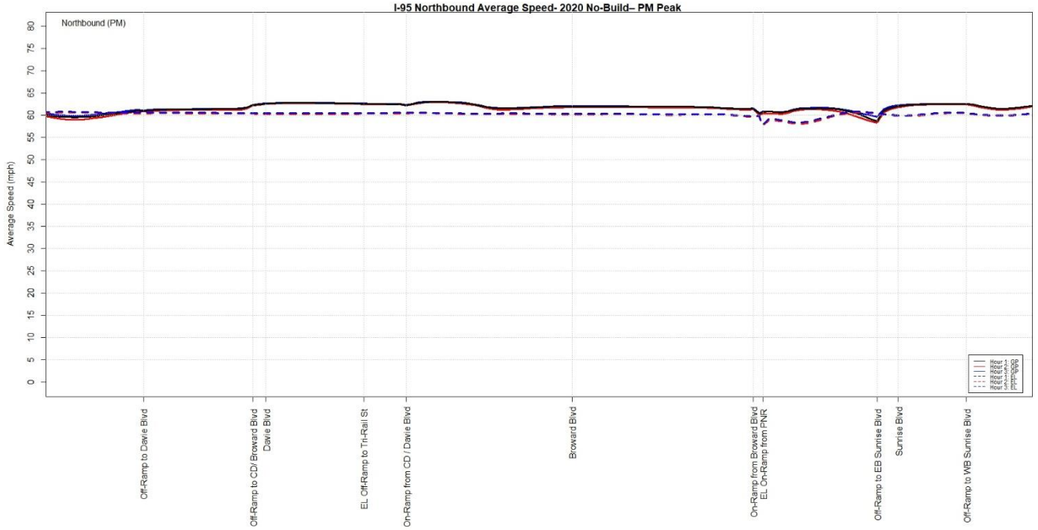


Figure 6-9 | 2020 No-Build Northbound Average Speed for PM Peak Period

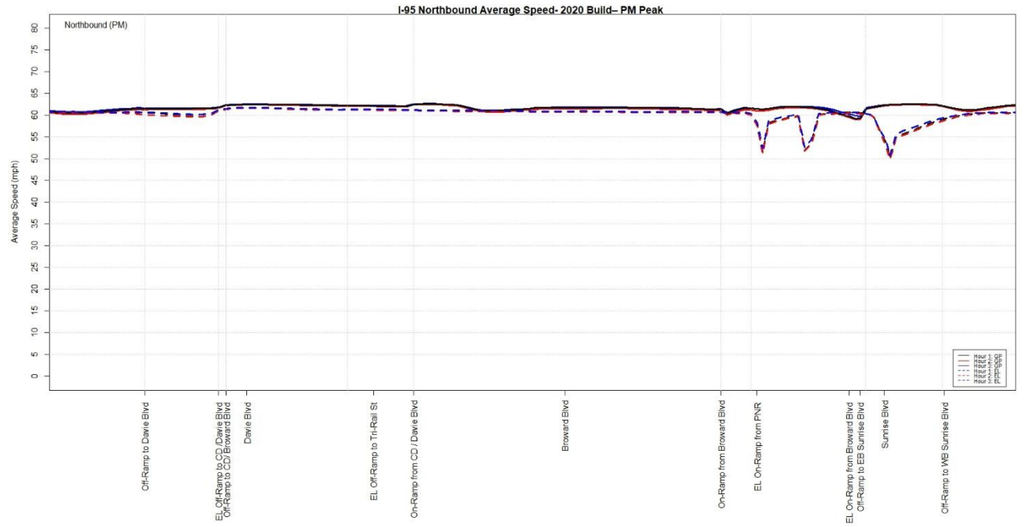


Figure 6-11 | 2020 Build Northbound Average Speed for PM Peak Period

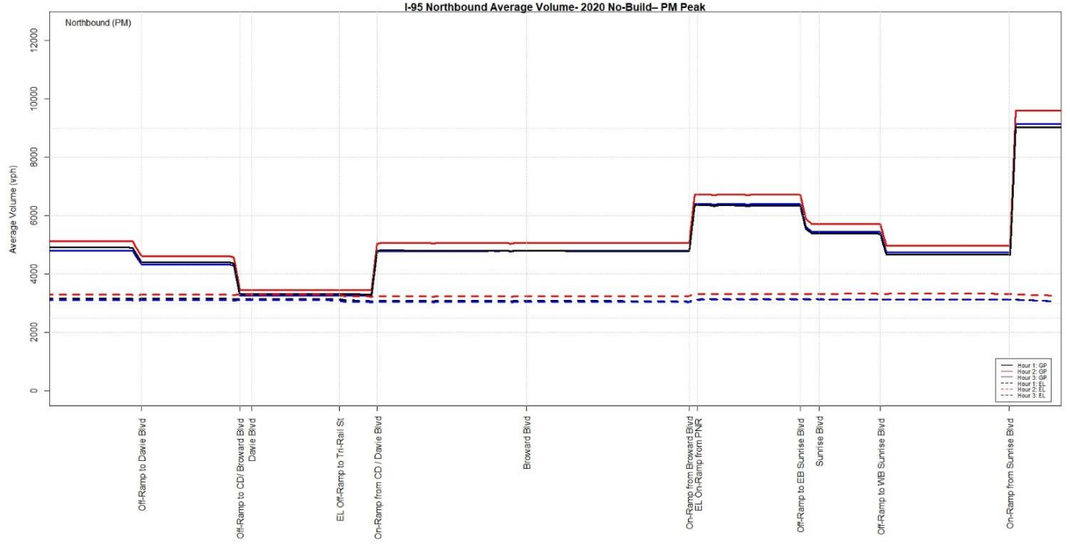


Figure 6-10 | 2020 No-Build Northbound Volume Profiles for PM Peak Period

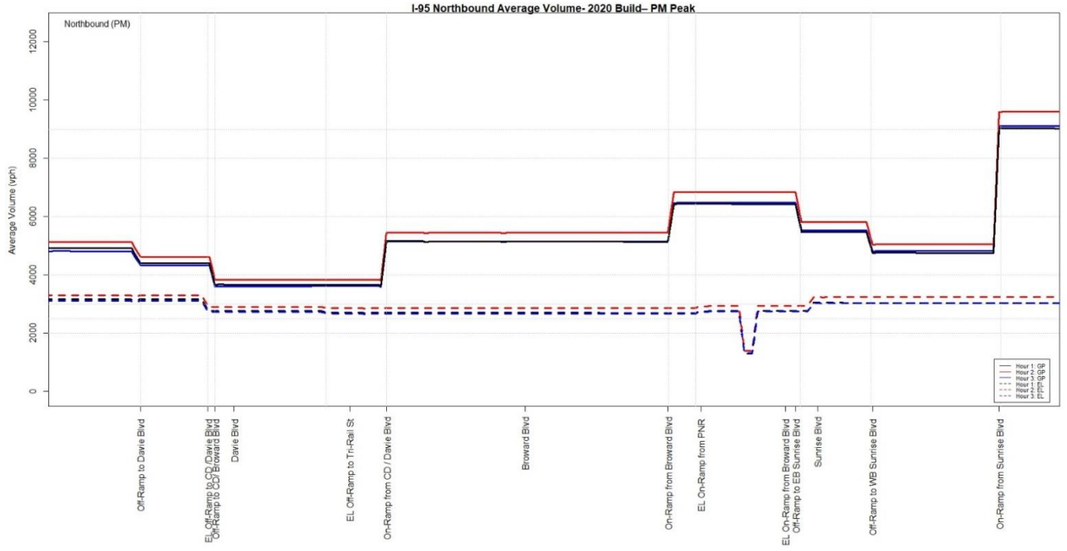


Figure 6-12 | 2020 Build Northbound Volume Profiles for PM Peak Period

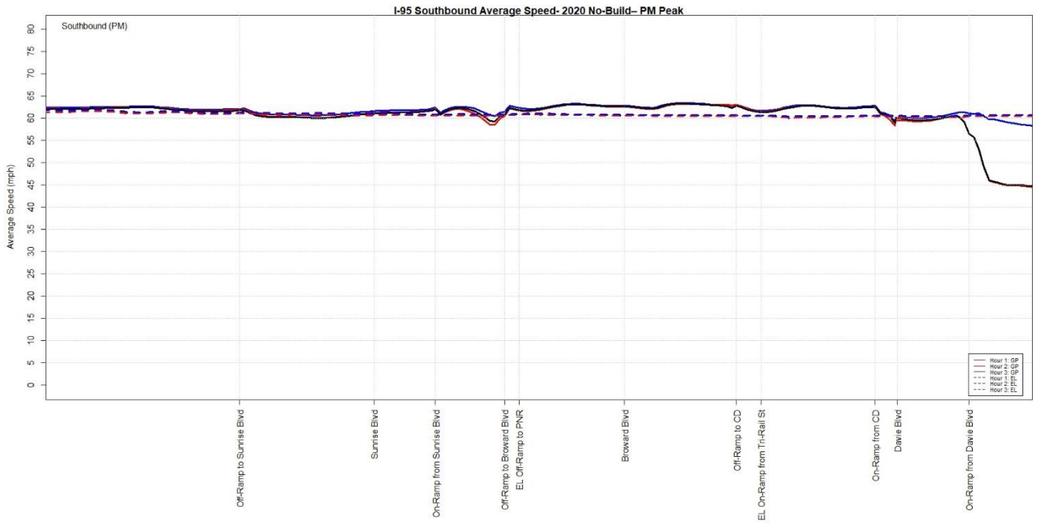


Figure 6-13 | 2020 No-Build Southbound Average Speed for PM Peak Period

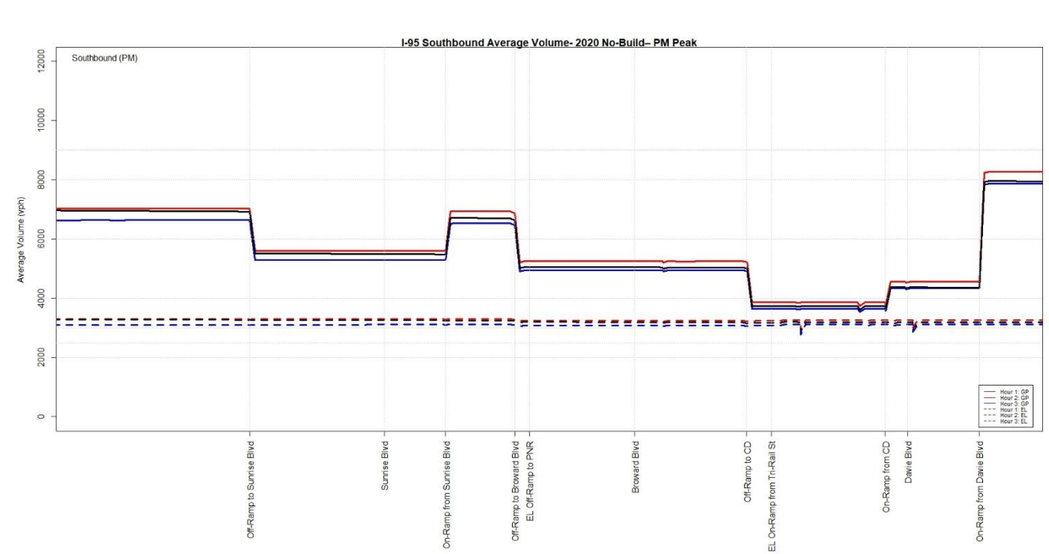


Figure 6-14 | 2020 No-Build Southbound Volume Profiles for PM Peak Period

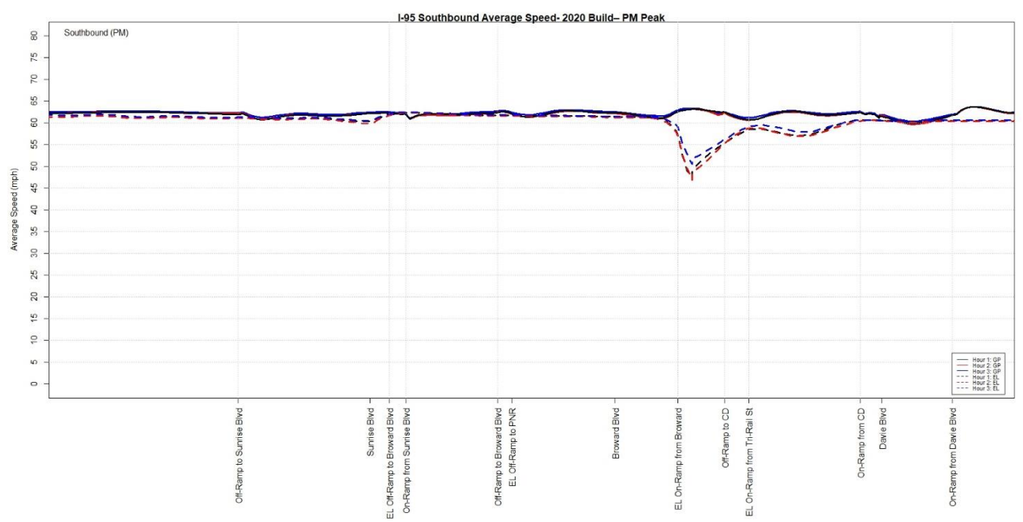


Figure 6-15 | 2020 Build Southbound Average Speed for PM Peak Period

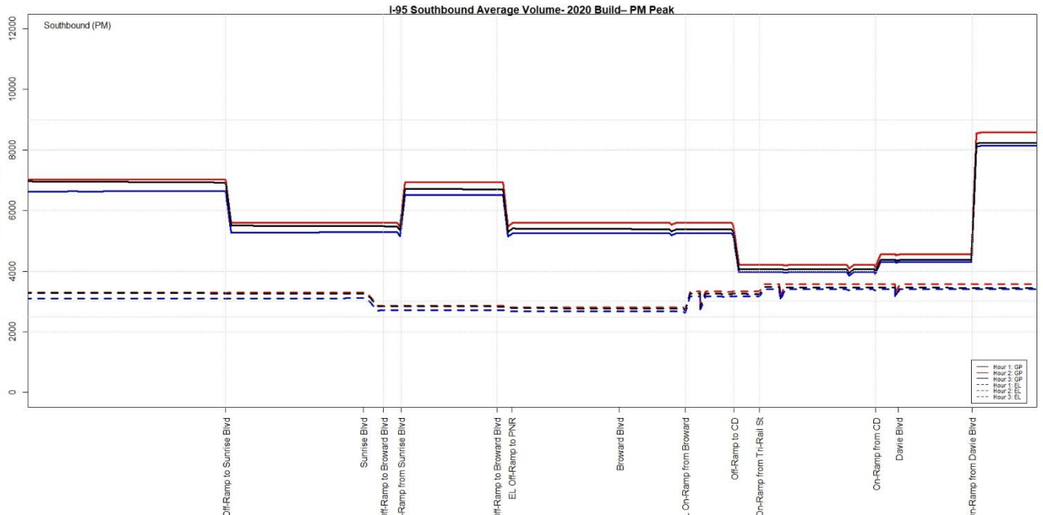


Figure 6-16 | 2020 Build Southbound Volume Profiles for PM Peak Period

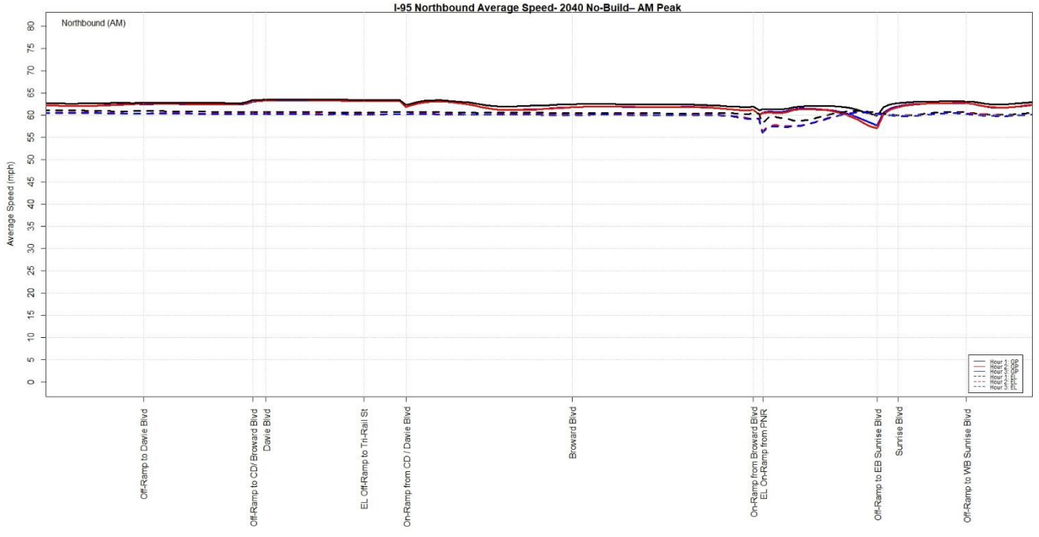


Figure 6-17 | 2040 No-Build Northbound Average Speed for AM Peak Period

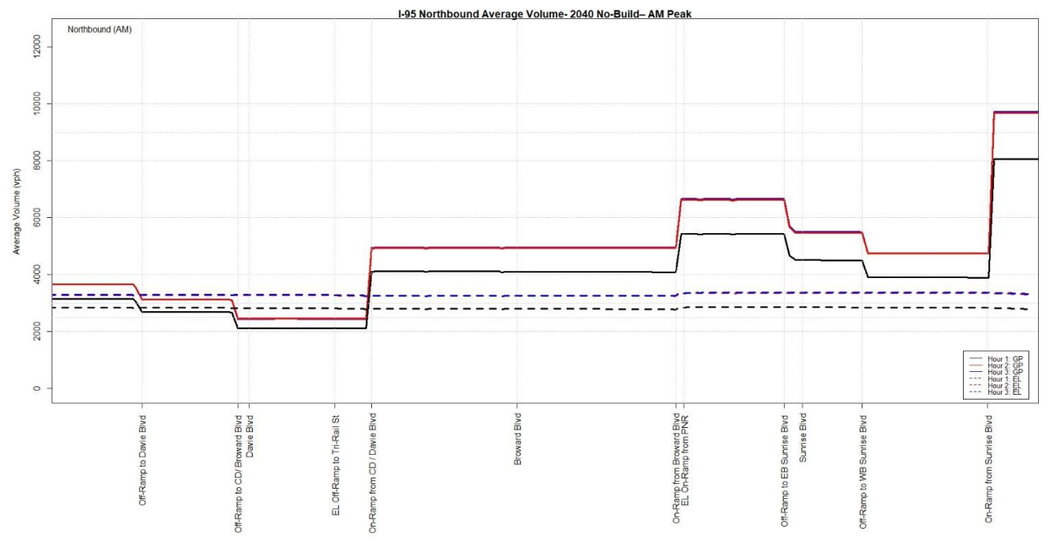


Figure 6-18 | 2040 No-Build Northbound Volume Profiles for AM Peak Period

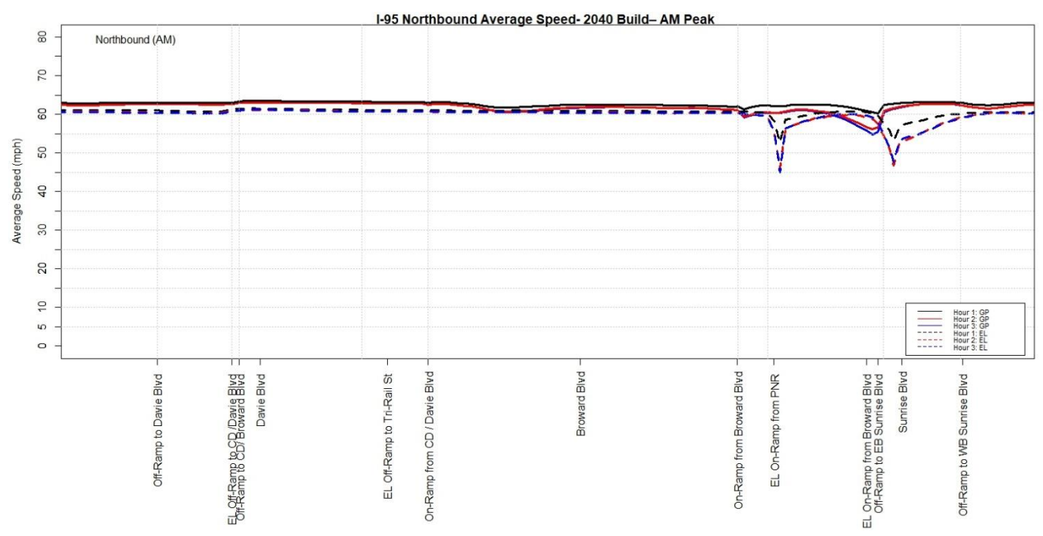


Figure 6-19 | 2040 Build Northbound Average Speed for AM Peak Period

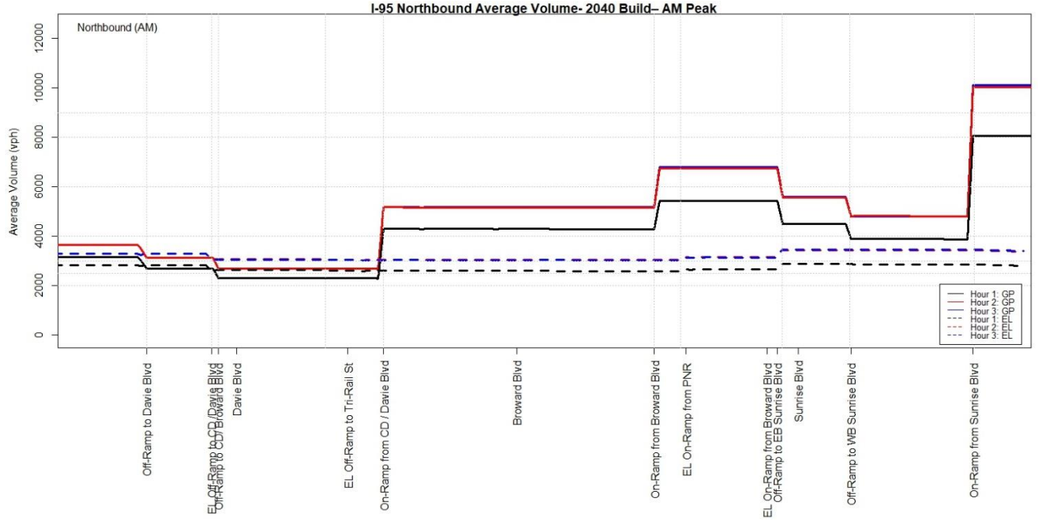


Figure 6-20 | 2040 Build Northbound Volume Profiles for AM Peak Period

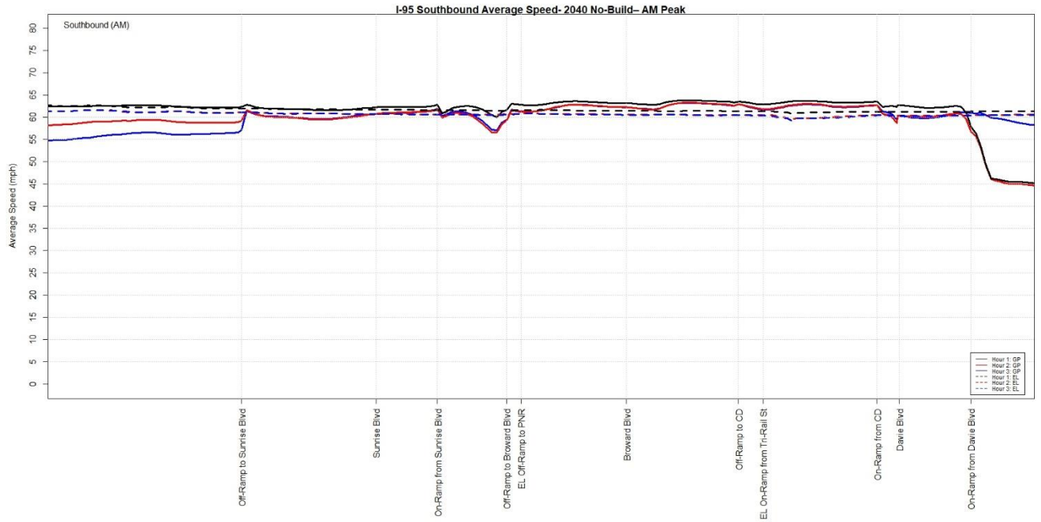


Figure 6-21 | 2040 No-Build Southbound Average Speed for AM Peak Period

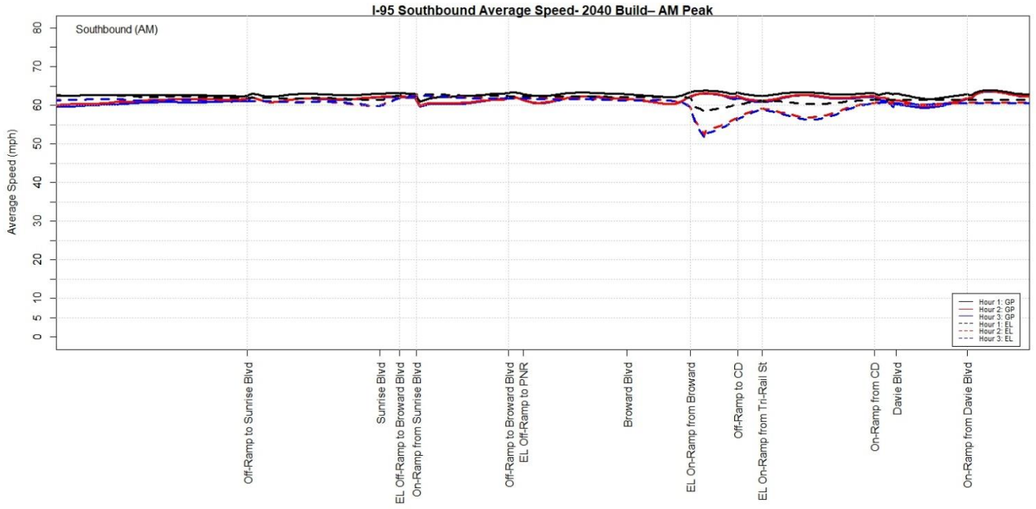


Figure 6-23 | 2040 Build Southbound Average Speed for AM Peak Period

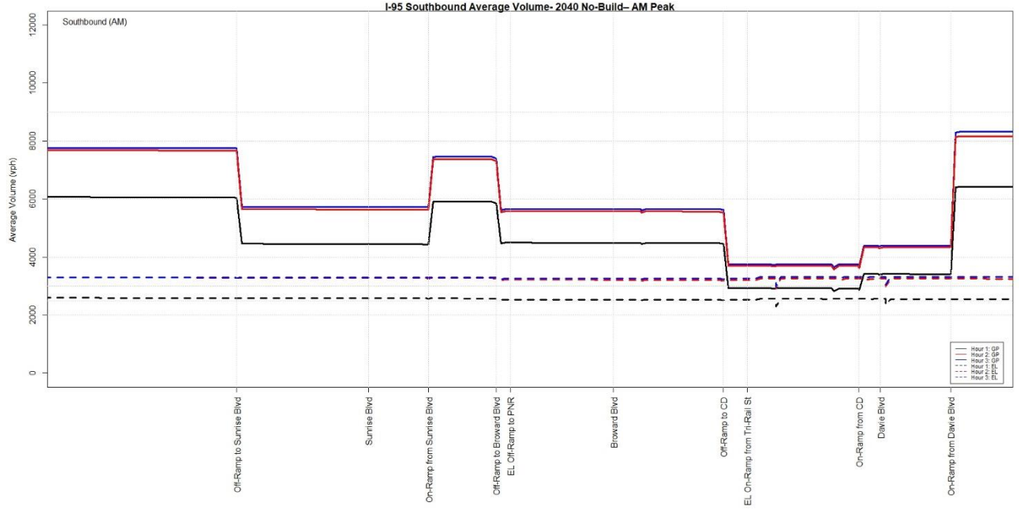


Figure 6-22 | 2040 No-Build Southbound Volume Profiles for AM Peak Period

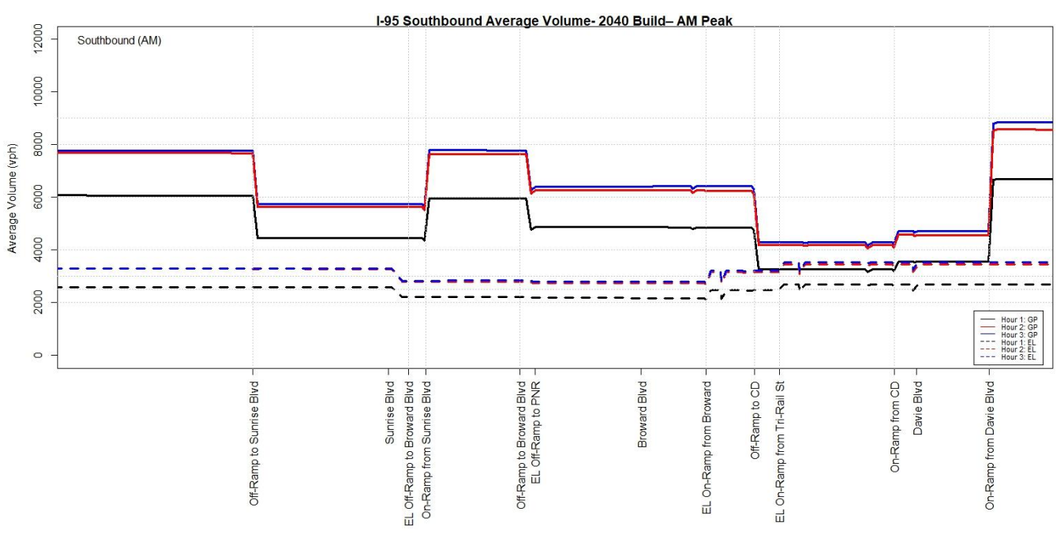


Figure 6-24 | 2040 Build Southbound Volume Profiles for AM Peak Period

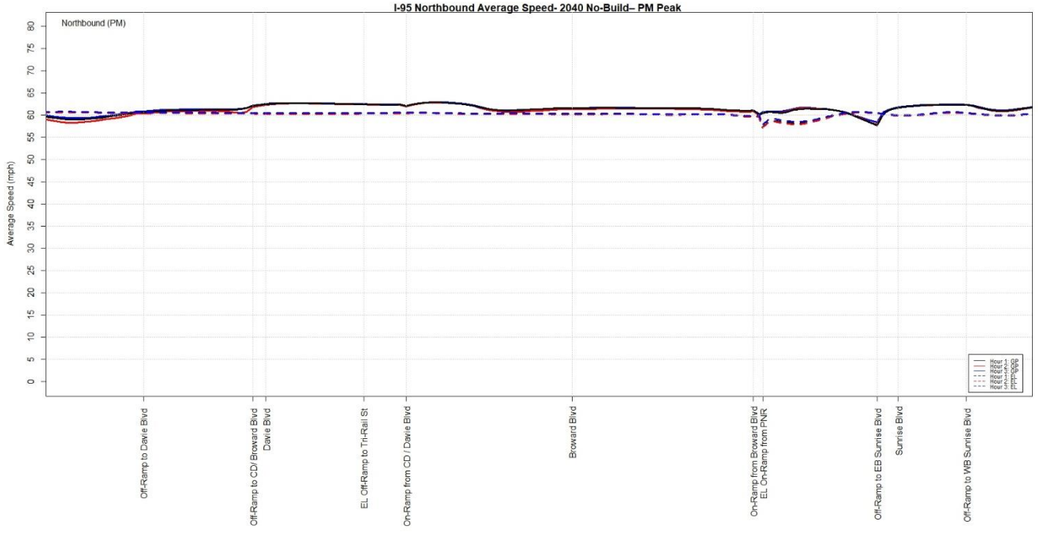


Figure 6-25 | 2040 No-Build Northbound Average Speed for PM Peak Period

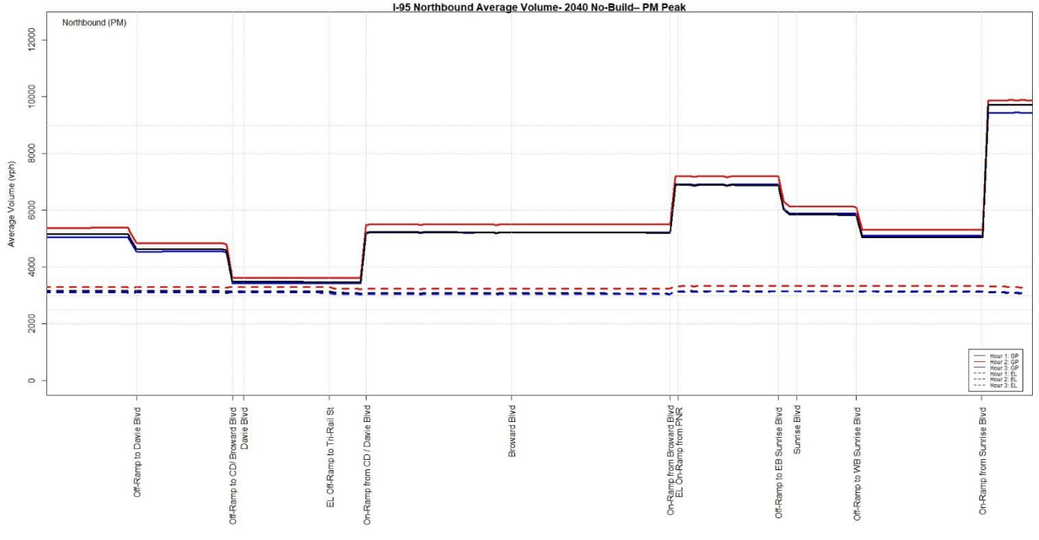


Figure 6-26 | 2040 No-Build Northbound Volume Profiles for PM Peak Period

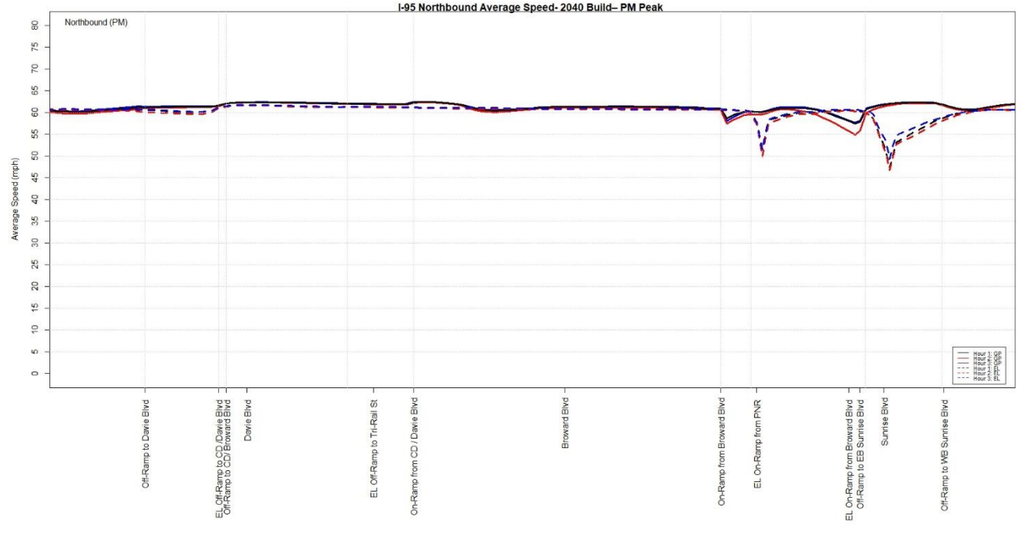


Figure 6-27 | 2040 Build Northbound Average Speed for PM Peak Period

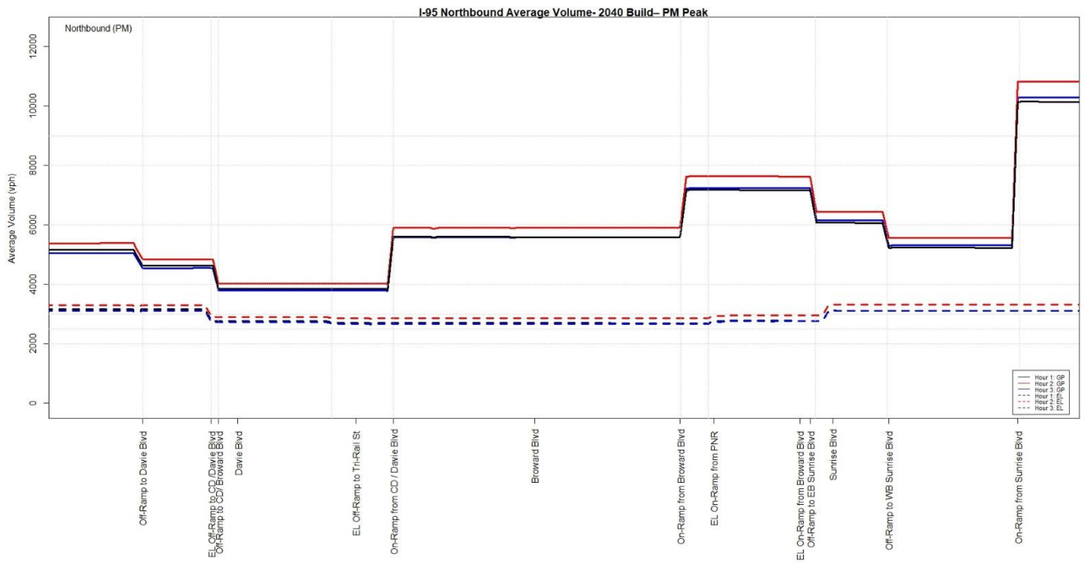


Figure 6-28 | 2040 Build Northbound Volume Profiles for PM Peak Period

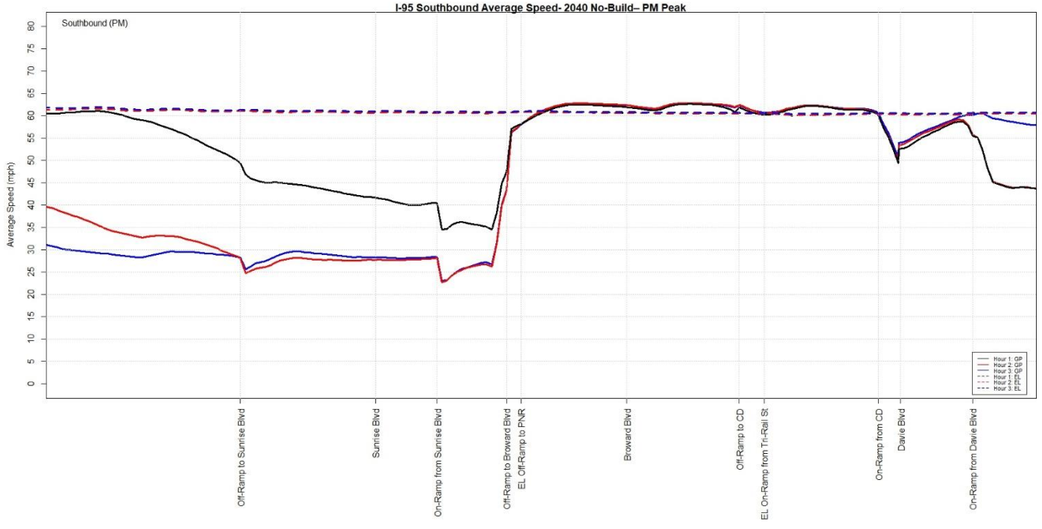


Figure 6-29 | 2040 No-Build Southbound Average Speed for PM Peak Period

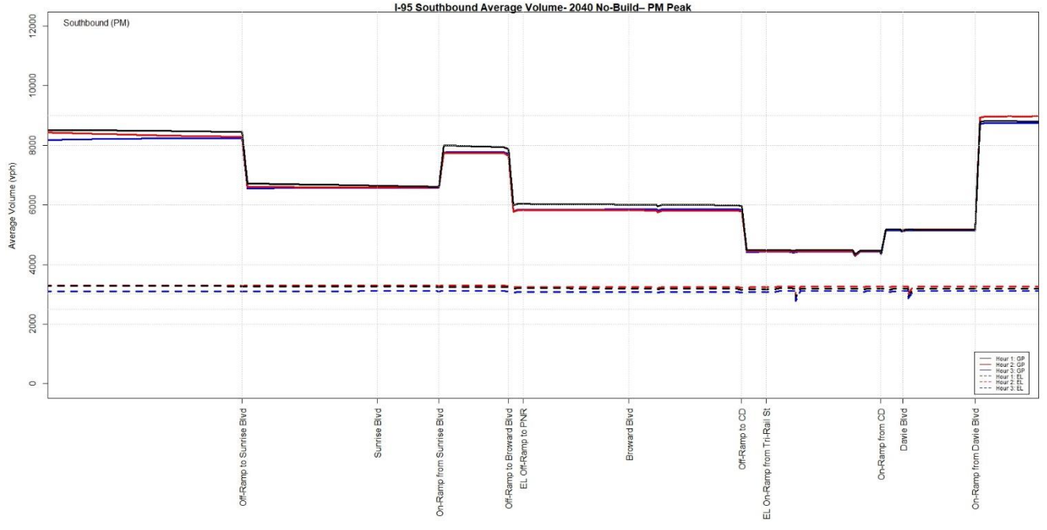


Figure 6-30 | 2040 No-Build Southbound Volume Profiles for PM Peak Period

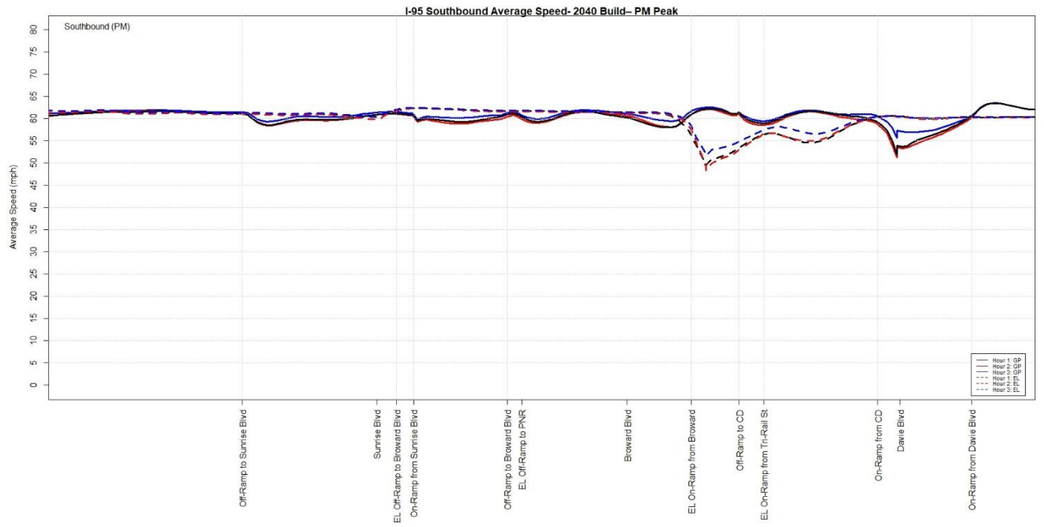


Figure 6-31 | 2040 Build Southbound Average Speed for PM Peak Period

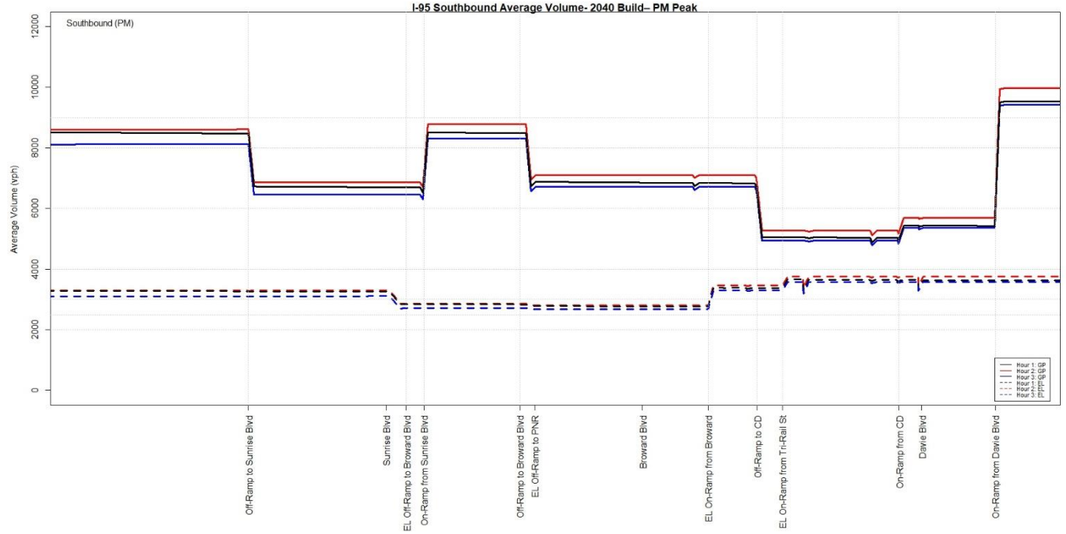


Figure 6-32 | 2040 Build Southbound Volume Profiles for PM Peak Period

6.4 Intersection Node Evaluation Results

The VISSIM micro-simulation models were also used to analyze the intersection delay and LOS for No-Build and Build alternatives. In this analysis, the LOS is computed from the microsimulation analysis and is therefore reported as an "estimated LOS." Results are presented in **Table 6-2** and **Table 6-2**.

- The following intersections projected to operate at LOS F during the AM and/or PM peak period under the 2040 No-Build scenario are now projected to operate at LOS E or better under the Build scenario:
  - Sunrise Boulevard at NW 24th Avenue, I-95 Southbound Ramp*, NW 16th Avenue, and NW 15th Avenue
  - Broward Boulevard at NW 27th Avenue, I-95 Northbound Ramp, and NW 15th Avenue

*Note the Sunrise Boulevard I-95 Southbound Ramp is failing due to arterial delay, not off-ramp delay.

The detailed output for the Node Evaluation analysis showing volume, delay, and max queue length for the study area intersections for all movements are included in **Appendix H.**

Table 6-2 | 2020 Intersection Node Evaluation Summary

Interchange	Signalized Intersection	AM				PM			
		No-Build		Build		No-Build		Build	
		Delay	Estimated LOS	Delay	Estimated LOS	Delay	Estimated LOS	Delay	Estimated LOS
Sunrise Blvd	NW 24th Ave	19.0	B	22.6	C	29.2	C	26.1	C
	I-95 SB Ramp	30.9	C	36.2	D	28.9	C	31.2	C
	I-95 NB Ramp	15.9	B	11.1	B	7.9	A	11.2	B
	NW 16 Ave	12.4	B	6.3	A	12.7	B	8.0	A
	NW 15 Ave	12.1	B	4.5	A	18.6	B	9.4	A
Broward Blvd	NW 27 Ave	37.4	D	36.4	D	36.2	D	35.8	D
	SW 24 Ave	19.0	B	10.4	B	11.5	B	7.6	A
	SW 22 Ave	7.1	A	6.2	A	8.6	A	7.5	A
	I-95 SB Ramp	31.0	C	43.4	D	29.8	C	41.7	D
	I-95 NB Ramp	24.5	C	12.4	B	32.9	C	12.6	B
	SW/NW 18 Ave	17.4	B	14.9	B	23.6	C	13.8	B
	NW 15 Ave	3.5	A	3.5	A	15.6	B	10.2	B
PnR	SW 21 T	19.6	B	3.9	A	17.6	B	3.9	A
Davie Blvd	Riverland Dr	66.7	E	65.5	E	37.2	D	36.9	D
	I-95 SB Ramp	25.5	C	25.2	C	17.2	B	19.1	B
	I-95 NB Ramp	24.6	C	24.4	C	21.0	C	23.5	C
	SW 15 Ave	18.6	B	18.7	B	12.2	B	12.7	B

Table 6-3 | 2040 Intersection Node Evaluation Summary

Interchange	Signalized Intersection	AM				PM			
		No-Build		Build		No-Build		Build	
		Delay	Estimated LOS	Delay	Estimated LOS	Delay	Estimated LOS	Delay	Estimated LOS
Sunrise Blvd	NW 24th Ave	91.9	F	61.7	E	110.4	F	33.7	C
	I-95 SB Ramp	78.1	E	51.9	D	98.7	F	39.5	D
	I-95 NB Ramp	48.5	D	21.9	C	77.9	E	15.0	B
	NW 16 Ave	47.7	D	8.7	A	105.7	F	11.0	B
	NW 15 Ave	76.5	E	7.0	A	218.6	F	25.0	C
Broward Blvd	NW 27 Ave	98.8	F	59.7	E	49.5	D	48.0	D
	SW 24 Ave	48.7	D	15.2	B	23.5	C	10.2	B
	SW 22 Ave	11.0	B	6.7	A	11.6	B	8.9	A
	I-95 SB Ramp	36.1	D	44.2	D	53.5	D	43.1	D
	I-95 NB Ramp	108.1	F	15.0	B	55.5	E	16.0	B
	SW/NW 18 Ave	26.0	C	18.7	B	43.7	D	16.4	B
	NW 15 Ave	8.1	A	4.7	A	99.3	F	27.2	C
PnR	SW 21 T	20.0	C	4.4	A	18.4	B	3.8	A
Davie Blvd	Riverland Dr	110.8	F	115.3	F	48.5	D	51.8	D
	I-95 SB Ramp	30.3	C	43.4	D	18.6	B	21.3	C
	I-95 NB Ramp	45.3	D	52.8	D	26.6	C	29.8	C
	SW 15 Ave	31.6	C	33.7	C	21.7	C	23.2	C

6.5 Ramp Intersection Queue Results

In addition to max queues, 95th percentile queues were calculated for the off-ramp movements within the study area. In 2040 No-Build, the southbound and northbound off-ramp at the Broward Boulevard interchange is anticipated to exceed storage and the northbound off-ramp at Sunrise Boulevard is anticipated to exceed storage. In the 2040 Build scenario, all ramp queues are accommodated in the available storage. Results are presented in **Table 6-4** and **Table 6-5**.

Table 6-4 | 2020 Exit Ramp 95th Percentile Queue Summary

Interchange	Signalized Intersection	AM		PM	
		No-Build	Build	No-Build	Build
		95th Queue' (Storage')	95th Queue' (Storage')	95th Queue' (Storage')	95th Queue' (Storage')
Sunrise Blvd	SB Off-Ramp	246 (1,200)	352 (1,200)	272 (1,200)	339 (1,200)
	NB Off-Ramp	4 (500)	268 (960)	7 (500)	312 (960)
Broward Blvd	SB Off-Ramp	668 (1,400)	424 (1,400)	809 (1,400)	450 (1,400)
	NB Off-Ramp	584 (4,600)	462 (4,600)	864 (4,600)	594 (4,600)
Davie Blvd	SB Off-Ramp	315 (1,800)	327 (1,800)	216 (1,800)	226 (1,800)
	NB Off-Ramp	391 (1,500)	395 (1,500)	324 (1,500)	354 (1,500)

Table 6-5 | 2040 Exit Ramp 95th Percentile Queue Summary

Interchange	Signalized Intersection	AM		PM	
		No-Build	Build	No-Build	Build
		95th Queue' (Storage')	95th Queue' (Storage')	95th Queue' (Storage')	95th Queue' (Storage')
Sunrise Blvd	SB Off-Ramp	419 (1,200)	663 (1,200)	446 (1,200)	583 (1,200)
	NB Off-Ramp	3,624 (500)	284 (960)	20 (500)	331 (960)
Broward Blvd	SB Off-Ramp	1,151 (1,400)	523 (1,400)	5,000+ (1,400)	542 (1,400)
	NB Off-Ramp	5,000+ (4,600)	558 (4,600)	4,076 (4,600)	702 (4,600)
Davie Blvd	SB Off-Ramp	477 (1,800)	1,239 (1,800)	211 (1,800)	288 (1,800)
	NB Off-Ramp	579 (1,500)	1,173 (1,500)	406 (1,500)	505 (1,500)

6.6 Safety Analysis and Counter Measures

The safety analysis was conducted within the study area for five most recent years (from January 2011 to December 2015) crash frequency and crash rates are summarized in **Section 3.5**. Based on the existing conditions crash analysis, predominant crash types are rear-end, angle and sideswipe collisions in those areas. Typically, these crash types are associated with traffic congestion.

6.6.1 Countermeasures

The conceptual design plans for I-95 mainline and Broward Boulevard interchange improvements were developed in accordance with the FDOT's Design Standards and Plans Preparation Manual and FHWA's Policy on Geometric Design of Highways and Streets. Adherence to these standards will facilitate safe and efficient traffic operations along the corridor. As discussed in previous **Section 3.5** of the report, a large portion of the crashes experienced within the study area were associated with congested traffic conditions. In addition, it was determined that several high crash spots/segments along the corridor were concentrated at or near the interchanges. The improvements proposed will increase capacity along the mainline and at the interchanges. These capacity improvements will correspondingly improve traffic flow and reduce congestion related crashes along the corridor. **Table 6-6** summarizes specific countermeasures by location.

Table 6-6 | Potential Safety Countermeasures

Location	Issue	Predominant Crash Type	Countermeasures
I-95 from Davie Boulevard to Sunrise Boulevard	Crash rate higher than statewide average crash rate and higher than the district average crash rate.	Rear end and sideswipe crashes.	Additional capacity expected to improve traffic flow and reduce congestion related crashes
Broward Boulevard from SW 27 Avenue to NW 15 Avenue	Crash rate was higher than statewide average crash rate in the year 2011 through 2014 and higher than the district average crash rate in the year 2013 and 2014.	Rear end, angle, and sideswipe crashes	The Modified Displaced Left Turn (MDLT) concept for the Broward Boulevard interchange reduces total number of conflict points from 32 (for a conventional intersection) to 30 (for a DLT intersection with left-turn crossovers on the mainline approaches). expected to improve traffic The MDLT concept expected to improve traffic flow and reduce congestion related crashes
Sunrise Boulevard from NW 24 Avenue to NW 15 Avenue	Crash rate was higher than statewide average crash rate and higher than the district average crash rate.	Rear end, angle, and sideswipe crashes	Intersection improvements at ramp terminals reduce congestion and occurrences of rear end crashes.

7.0 Other Considerations

7.1 Consistency with Other Plans/Projects

The Broward Boulevard Interchange Project PD&E Study is included in the Broward Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP) for Fiscal Years (FY) 2017-2021 and the FDOT Work Program FY 2019-2023, the FDOT State TIP FY 2016-2020, and the FDOT SIS Five Year Plan FY 2019-2023 for Environmental Mitigation and Right-of-Way in Phase in FY 2021 and 2022.

Broward MPO's 2035 Long Range Transportation Plan (LRTP) included improvements to all I-95 interchanges in Broward County under Illustrative Roadway Projects. Illustrative projects are those that cannot be included in the Cost Feasible Plan due to financial constraints but would be included in a future approved TIP. The MPO's 2040 LRTP, Commitment 2040, adopted by reference the Strategic Intermodal System 2040 Cost Feasible Plan, which includes modifications to the I-95 at Broward Boulevard interchange in the first five years.

The proposed improvements are consistent with ongoing I-95 Express Lanes Phase 3 project. This I-95 Express Phase 3A project will convert the existing HOV lane in each direction to dual Express Lanes in each direction and modify the use of these lanes to include managed toll lanes.

7.2 Design Exceptions and Variations

All the Recommended Build Alternatives proposed modifications are designed with the ultimate goal to meet current standards for federal-aid projects and conform to AASHTO design standards, but some design exceptions and variations are unavoidable considering the vicinity and project needs.

7.2.1 Design Variations

Design variations necessary for the recommended alternative, both along I-95 and Broward Boulevard include the following:

I-95:

- Design Speed
  - Variation required as per 2018 FDM Table 201.4.1 regarding design speed of SIS facilities on the State Highway System
- Shoulder Width
  - Variation required for substandard shoulder width along I-95 mainline (recommended alternative)
- Lane Width
  - Variation required due to 11' Express Lanes
- Horizontal Curve Lengths (Mainline and ramps)
  - Variation required due to minimum horizontal curve length is not met along Ingress/Egress ramps

- Ramp Entrance Acceleration Length (Ramps C)
- Border Width
  - Variation required due to 94’ border width is not met
- Escape Lanes
  - Variation required due to spacing constraints not allowing for escape lanes at proposed egress ramps

Broward Boulevard:

- Horizontal Curve Length
  - Variation required due to minimum horizontal curve length is not met
- Bicycle Lane Width
  - Variation required due to 7’ bicycle lanes transitioning down to 4’ to match existing east of NW 18th Street and stay within the right-of-way
- Border Width
  - Variation required due to 12’ border width is not met
- Median Width
  - Variation required due to 22’ minimum median width is not met

7.2.2 Design Exceptions

I-95:

- Lane Width
  - Exception, as constructed by I-95 Express phase 3A-1
- Shoulder Width
  - Exception, as constructed by I-95 Express phase 3A-1

7.3 Conceptual Signing Plan

Conceptual signing and marking plans in accordance with FHWA guidelines were prepared for the Recommended Build Alternatives and are provided in **Appendix I**. The signing plans provided in the SIMR are conceptual in nature and will be subject to final design for construction. The purpose of the signing plans provided are to demonstrate their ability to provide adequate advance signing and directions to drivers entering and/or exiting the study interchanges under the proposed Build Alternative improvements.

7.4 Project Schedule

The PD&E Study for the I-95 at Broward Boulevard interchange improvements is currently in progress. Public Hearing is scheduled in March 2019. Funding is in the currently adopted Five-Year Work Program as listed below.

- 435513-1: I-95 @ SR 842/Broward Blvd. Interchange Improvements PD&E, PE and Environmental - FY 2017 through FY 2021

8.0 Conclusion and Recommendations

The primary purpose of I-95 at Broward Boulevard Interchange PD&E Study is to improve traffic flow to and from I-95 and along Broward Boulevard; to improve connectivity between the 95 Express Lanes and Broward Boulevard; and to improve intermodal connectivity. Improved connections between the 95 Express Lanes and Broward Boulevard, as well as the surrounding intermodal facilities, are desired. The primary need for Broward Boulevard PD&E Study is to enhance system linkage and modal interrelationships at the I-95 at Broward Boulevard interchange.

While the intermodal connectivity improvements between the transit options on Broward Boulevard and the Park and Ride and Tri-Rail/Amtrak stations are discussed in detail in the PER, the I-95 at Broward Boulevard SIMR documents the traffic flow improvements to and from I-95 and along Broward Boulevard interchange.

The I-95 at Broward Boulevard SIMR provides documentation for the travel demand modeling, traffic forecasting, and operational analysis for the I-95 at Broward Boulevard PD&E Study and adjacent Sunrise Boulevard northbound ramp terminal intersection. The operational and safety analysis demonstrates that modifications proposed at the I-95 Broward Boulevard interchange and Sunrise Boulevard east terminal ramp intersection improves the operation of the I-95 mainline, express lane system, ramps, ramp junction intersections, and cross-street intersections when compared to the No-Build scenario. Safety is expected to be improved or not degrade as compared to the No-Build Alternative.

Based on the evaluations of the No-Build and Build Alternative, the Build Alternative performs better than the No-Build Alternative and is the Recommended Alternative. The Build Alternative includes following recommended improvements for the I-95 at Broward Boulevard interchange and the I-95 at Sunrise Boulevard east ramp terminal intersection in addition to the on-going I-95 Phase 3 improvements along the I-95 mainline:

- The Modified Displaced Left turn (Alternative 2B) for Broward Boulevard interchange.
- The ingress and egress braided ramps connecting I-95 express lanes and the Broward Boulevard Build interchange (Alternative 2B) for I-95.
- The Signalized Loop Ramp and Extended Eastbound Merge to NW 17th Avenue (Alternative 3A) for the Sunrise Boulevard east terminal ramp intersection.

With this submittal, the FDOT is seeking safety, operational and engineering (SO&E) acceptability of the Build Alternative.

APPENDIX

{Appendices are provided in a separate zip file electronically}

Appendix A – MLOUs

Appendix B – Sunrise Boulevard East Terminal Intersection Feasibility

Appendix C – Data Collection, Traffic Forecasting, and Safety Analysis

Appendix D – VISSIM Model Development and Calibration Report

Appendix E – Existing VISSIM Outputs

Appendix F – Alternative Analysis Vissim and Outputs

Appendix G – 95 Express Phase 3 Operational Results

Appendix H – 2020 and 2040 VISSIM Detailed Node Evaluation Results

Appendix I – Conceptual Signage Plan