INTERCHANGE OPERATIONAL ANALYSIS REPORT (IOAR)

SR 9/I-95 at SR 16

St. Johns County, Florida

FPID: 434615-2

April 2020

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Prepared for:

Florida Department of Transportation - District Two
St. Johns County, Florida

April 2020

Interchange Operational Analysis Report (IOAR)

For I-95 at SR 16 Interchange

FPID: 434615-2

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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Federal Highway Administration	N/A (Programmatic)	*Date*

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: April 9, 2020

FM Number: 434615-2

Project Title: I-95 at SR 16 Interchange Operational Analysis Report (IOAR)

District: District 2

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

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

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

Requestor [signature] Date: 4/10/2020

David Tyler, P.E.
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IRC [signature] Date: 4/10/2020

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PROFESSIONAL ENGINEER CERTIFICATE

I hereby certify that I am a registered professional engineer in the State of Florida practicing with BW Engineers and Planners, Inc., a Florida corporation authorized under the provisions of Section 471.023, Florida Statutes, to offer engineering services to the public through a Professional Engineer, duly licensed under Chapter 471, Florida Statutes, by the State of Florida Board of Professional Engineers and I have prepared or approved the evaluation, findings, opinions, conclusions or technical advice hereby reported for:

PROJECT: I-95 at SR 16 Interchange Operational Analysis Report (IOAR)

LOCATION: St. Johns County, FL

FINANCIAL PROJECT ID: 434615-2

This report includes a summary of data collection effort, traffic analysis, discussion of preferred alternative and summary of conclusions. I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering and planning as applied through professional judgement and experience.

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Signature: ____________________

Date: 2/7/2020

EXECUTIVE SUMMARY

The purpose of this study is to determine enhancements that can be programmed to improve traffic spillback onto I-95, interchange operations and safety by reducing congestion at the I-95 at SR 16 interchange location. Improvements are aimed at increasing the efficiency of I-95, SR 16 and the interchange ramps. The primary need of the project is to improve future traffic conditions thereby improving safety at the interchange. The interchange of I-95 at SR 16 is a diamond interchange providing full access. It is an important component of the Strategic Intermodal System (SIS) providing access to the City of St. Augustine.

If no improvements are made to the interchange, traffic operations and safety within the interchange area will continue to deteriorate as traffic volumes increase.

The Methodology Letter of Understanding (MLOU) was prepared in April 2018 to document the methodology for the analysis and evaluation of this IOAR. The primary basis for traffic projections in this Interchange Operational Analysis Report (IOAR) are the 2014 field traffic counts obtained from the I-95 Express Phase 1 – From International Golf Parkway to I-295 Systems Interchange Operational Analysis Report(SIMR), FDOT Traffic Online (FTO) 2017 and the latest version of Northeast Regional Planning Model-Activity Based version 3 (NERPM-AB3) with base year 2010 and horizon year 2040. The analysis years for this study include Existing Year 2018, Opening Year 2023 and Design Year 2043. The operational analysis for this study was performed using the Highway Capacity Software (HCS 7) and Synchro 10. All operational analysis followed the guidelines of the Highway Capacity Manual (HCM) 6^{th} Edition.

Two alternatives were evaluated to address the purpose and needs identified for this project and presented in this IOAR. These include the No-Build Alternative and the Build Alternative. Transportation Systems Management and Operations (TSM&O) improvements were considered and include implementation of non-capacity improvements to improve traffic flow within the project area. The Build Alternative developed for this IOAR incorporates TSM&O improvements. The alternatives analyzed include:

- No-Build Alternative – This alternative includes the existing configuration plus all programmed improvements with future traffic.
- Build Alternative – This alternative includes widening the SR 16 roadway from 4 lanes to 6 lanes with curb, gutter and sidewalk improvements between the interchange ramp

terminals. This Build Alternative also includes extending left turn movements for eastbound and westbound approaches along SR 16 past the off-ramp terminal intersections and accommodating them via U-Turn. This allows off-ramp left turn to the arterial and arterial left turn to the on-ramp to be processed during the same signal phase.

As part of this study, an existing crash analysis was performed. The data provided from FDOT State Safety Office Map Based Query Tool (SSOGis) shows along I-95 and SR 16 rear end crashes and angle crashes are the most prominent crashes within the project area. The Recommended Build Alternative shows improved traffic operations and safety within the project study area due to reduction in congestion and improved geometric design.

Based on the evaluations of the No-Build and Build Alternatives, the recommended alternative, for approval in this study, is the Build Alternative. The recommended alternative will incorporate viable TSM&O improvements and will be developed further in the next phase.

This IOAR has been developed in accordance with the FDOT Policy No. 000-525-015: Approval of New or Modified Access to Highways on the State Highway System (SHS), FDOT Procedure No. 525-030-160: New or Modified Interchanges, Interchange Access Request User's Guide (IARUG) and the FDOT Traffic Forecasting Handbook (Procedure No. 525-030-120).

E.1 Compliance with FHWA General Requirements

The following requirements serve as the primary decision criteria used in approval of interchange modification projects. Responses to each of the FHWA 2 policy points are provided to show that the proposed modification for the I-95 at SR 16 interchange is viable based on the conceptual analysis performed to date.

E.1.1 FHWA Policy Point 1

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, 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 (23 CFR 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)).*

An in-depth operational and safety analysis was conducted to study the impacts of the proposed improvements at the I-95 at SR 16 interchange. Several performance measures were used to compare the operations of the existing system under No-Build and Build conditions. Key measures included freeway densities, intersection delays, 95th percentile queue lengths and safety under existing and proposed conditions.

From an operational perspective in the Design Year 2043 under No-Build Alternative, operational and safety deficiencies will exist. The intersections along SR 16 at Toms Road, I-95 Southbound On/Off Ramps and Outlet Mall Boulevard will operate at LOS E or worse in the PM peak hour. These deficiencies are attributed to the insufficient capacity at all three intersections. At the I-95 southbound ramp terminal intersection, queues are longer than the available storage in the eastbound and westbound directions in 2043 under the No-Build.

The Build Alternative for this study performs substantially better than the No-Build Alternative for all future years. The proposed interchange improvements provide additional capacity for the heavy left turn volumes as well as for the arterial through volumes. By implementing these improvements, the study intersections of I-95 at SR 16 will operate at acceptable LOS C or better in both AM and PM peak hour. SR 16 arterial will also benefit from the increase in number of through lanes and improved ramp terminal intersections configuration which allows off ramp left turn to arterial and from arterial left turn to on ramp movements to be processed through the intersection together, resulting in lower intersection delay when traveling through the proposed interchange.

The safety analysis performed for this study indicated a total of 443 crashes occurred within the project area, of which 341 of the total crashes occurred on the project segment SR 16 from 2012 to 2016. The predominant crash types that occurred within the study area were rear end and angled collisions. Crashes of these types are typically attributed to congestion along the interstate, arterials and interchange ramps.

With the improved operations under the Build Alternative, it is anticipated to enhance safety within the project area. A predictive safety analysis was performed for the study area where improvements are to be implemented. Based on the safety analysis, it is predicted that a reduction of 10.13 crashes will occur annually due to the recommended improvements.

Overall, the Build Alternative provides significantly better traffic operations and enhanced safety when compared to the No-Build Alternative.

In conclusion, the comparison of the No-Build and Build alternatives show that the proposed interchange improvements provide enhanced operation and safety conditions. The proposed modifications in the build alternative are not anticipated to have a negative impact on operations or safety of the I-95 mainline or the adjacent interchanges.

E.1.2 FHWA Policy Point 2

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

The proposed improvements to the I-95 at SR 16 interchange and adjacent intersections will provide full access and cater to all traffic movements from SR 16 to and from I-95. The proposed modifications are designed to meet current standards for federal-aid projects on the interstate system and conform to American Association of State Highway and Transportation Officials (AASHTO) and the FDOT design standards.

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1. INTRODUCTION

The interchange of I-95 with SR 16 is located in St. Johns County, Florida. The interchange provides primary access to commuters as well as trucks to shopping districts and the City of St. Augustine. The Florida Department of Transportation (FDOT) District Two is conducting an interchange study to evaluate improvements for the interchange of I-95 and SR 16. This Interchange Operational Analysis Report (IOAR) evaluated alternatives to improve traffic operations and safety at this critical interchange in St. Johns County. The existing I-95 and SR 16 interchange is a diamond type configuration. SR 16 is a four lane Divided Rural Principal Arterial Other and I-95 is classified as Rural Principal Arterial Interstate. The Methodology Letter of Understanding (MLOU) was prepared summarizing and documenting all methodology agreements reached between the Requestor, FDOT's District 2 Interchange Review Team and FDOT Central Office. The MLOU was prepared considering this study will be an Interchange Modification Report (IMR) as the type and extent of the required improvements was unknown during preparation of the MLOU. The signed MLOU is provided in **Appendix A**.

1.1 Background

The interchange of I-95 at SR 16 is an important component of the Strategic Intermodal System (SIS) and it provides access to the City of St. Augustine. This IOAR proposes ultimate improvements to enhance the movement of people and goods at the interchange. SR 16 is currently a four lane roadway east and west of I-95, and I-95 is currently a six lane roadway within the project limits.

The project is included in the North Florida Transportation Planning Organization (TPO) Transportation Improvement Program (TIP) for Fiscal Years 2019/2020 through 2023/2024.

This IOAR is seeking approval from the Chief Engineer and FDOT Central Office for the proposed improvements to the access point of I-95 at SR 16 in St. Johns County. This IOAR has been developed in accordance with FDOT Policy No. 000-525-015: Approval of New or Modified Access to Limited Access Highways on the Strategic Highway System (SHS), FDOT Procedure No. 525-030-160: New or Modified Interchanges, 2018 Interchange Access Request User's Guide (IARUG) and the 2014 FDOT Traffic Forecasting Handbook (Procedure No. 525-030-120).

1.2 Purpose and Need

The purpose of this study is to complete an IOAR to determine what improvements can be programmed to improve traffic spillback onto I-95, interchange operations, reduce congestion and improve safety at this interchange location. Improvements are aimed at increasing the efficiency of I-95 at SR 16 interchange and SR 16.

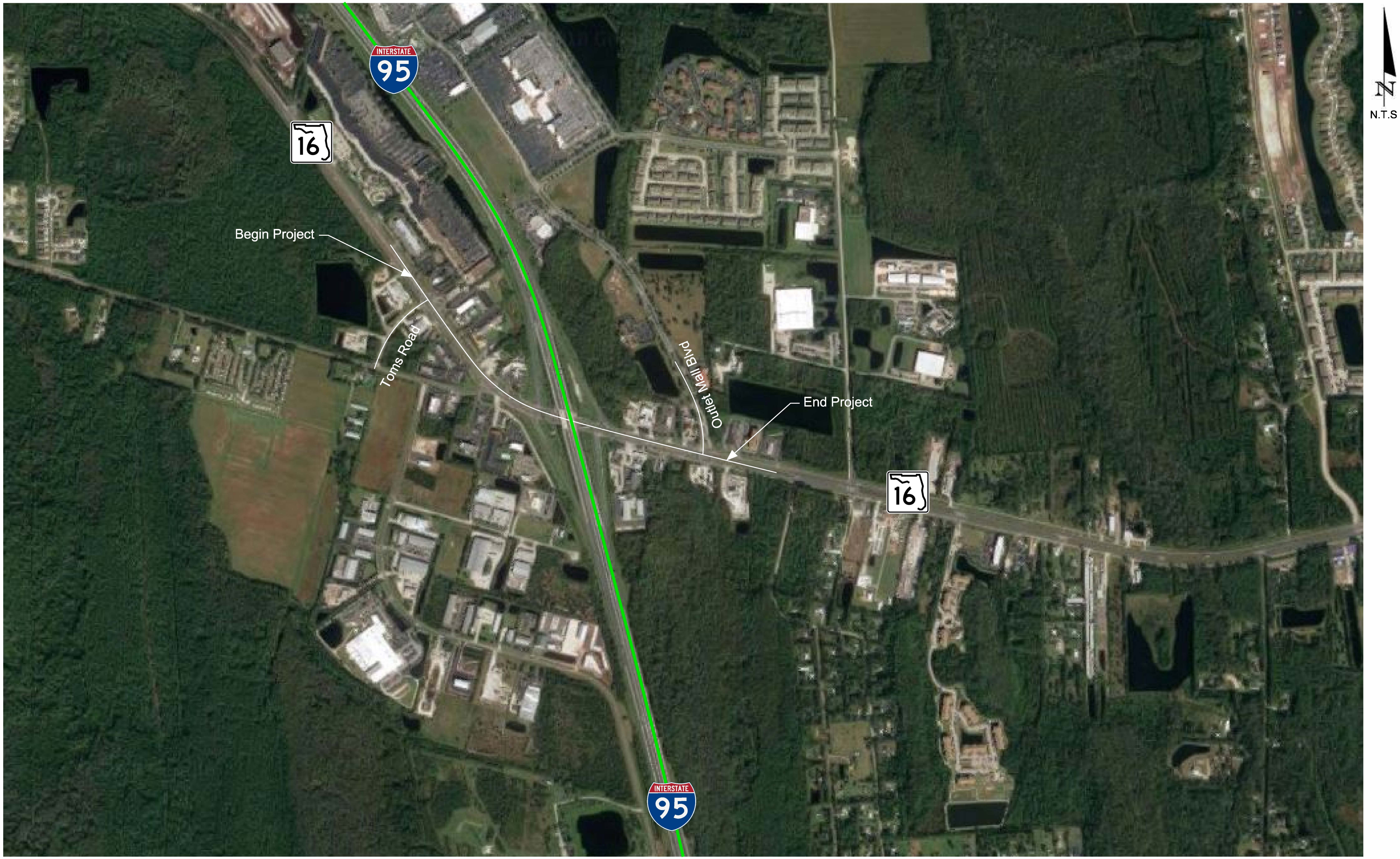
The primary need of the project is to improve existing and future traffic conditions thereby improving safety at the interchange. The interchange of I-95 at SR 16 is a diamond interchange providing full access. It is an important component of the SIS providing access to the City of St. Augustine. Recent traffic projections completed in the region, identified increased traffic congestion and potential operational deficiencies in the vicinity of the study interchange. Currently, I-95 south of SR 16 is carrying approximately an annual average daily traffic (AADT) of 83,000 vehicles and I-95 north of SR 16 is carrying an approximate AADT of 87,800. By year 2043, the AADT along I-95 is expected to increase to 109,800 vehicles daily south of SR 16 and 118,200 vehicles daily north of SR 16. The interchange serves two outlet malls on both sides of the interstate and other establishments in the area. The SR 16 northbound on and southbound off ramps to and from I-95 carries 10,200 vehicles daily which is anticipated to exceed 13,700 AADT by year 2043. The SR 16 northbound off and southbound on ramps to and from I-95 carries 7,800 vehicles daily which is anticipated to exceed 9,500 AADT by year 2043. With this increase in traffic along I-95 and the ramps and the increase in development around the SR 16 interchange, the operating conditions at this interchange is expected to deteriorate.

The available crash data collected from the FDOT State Safety Office Map Based Query Tool (SSOGis) for the years 2012 through 2016 reveal that a total of 443 crashes occurred within the project area, of which 224 (49%) were rear-end crashes and 94 (21%) were angle crashes. These types of crashes can be attributed to the heavy levels of congestion within the project area. A large number (327) of the total crashes occurred on the project segment SR 16, resulting in 318 injuries and one fatality. The remaining crashes include those that occurred on the I-95 on/off-ramps.

If no operational and safety improvements are made within the interchange area, conditions will become progressively worse as traffic volumes continue to increase, thereby, deteriorating access of the interchange.

1.3 Project Location

The subject interchange is located in St. Johns County, along I-95 at Milepost 20.400, Section number 78080000. I-95 at SR 16 interchange is located between I-95 at International Golf Parkway interchange to the north and I-95 at SR 207 interchange to the south. SR 16 is approximately 5.7 miles south of International Golf Parkway and 6.7 miles north of SR 207. The project location and the study area are shown in **Figure 1-1**. The adjacent interchanges are not included within the area of influence as they are more than 5 miles from the study interchange and will not be impacted.



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I-95 / SR 16
Interchange Operational Analysis Report

Project Location and Study Area Map

Figure 1-1

2. METHODOLOGY

2.1. Overview

The Methodology Letter of Understanding (MLOU) was prepared in April 2018 to document the methodology for the analysis and evaluation of this IOAR. The MLOU was prepared considering this study will be an Interchange Modification Report (IMR) as the type and extent of the required improvements was unknown during preparation of the MLOU. A copy of the signed MLOU is provided in **Appendix A**. The following sections summarize the methodology set forth in the MLOU.

The methodology used for travel demand forecasting and development of design hour traffic is consistent with the 2014 FDOT Project Traffic Forecasting Handbook. The primary basis for traffic projections are 2014 traffic counts obtained from the I-95 Express Phase 1 – From International Golf Parkway to I-295 Systems Interchange Modification Report (SIMR), 2017 FDOT Traffic Online (FTO) and the Northeast Regional Planning Model-Activity Based version 3 (NERPM-AB3) with the base year 2010 and horizon year 2040.

2.2. Analysis Years

The following study years are established for this IOAR:

Traffic Operational Analysis

- Existing Year: 2018
- Opening Year: 2023
- Design Year: 2043

2.3. Area of Influence

The area of influence (AOI) for the IOAR includes the study interchange of I-95 and SR 16 located in St. Johns County. Along I-95, the nearest interchanges of International Golf Parkway and SR 207 are 5.6 and 6.7 miles to the north and south, respectively. These interchanges are not included within the area of influence as they are more than 5 miles from the study interchange and will not be impacted.

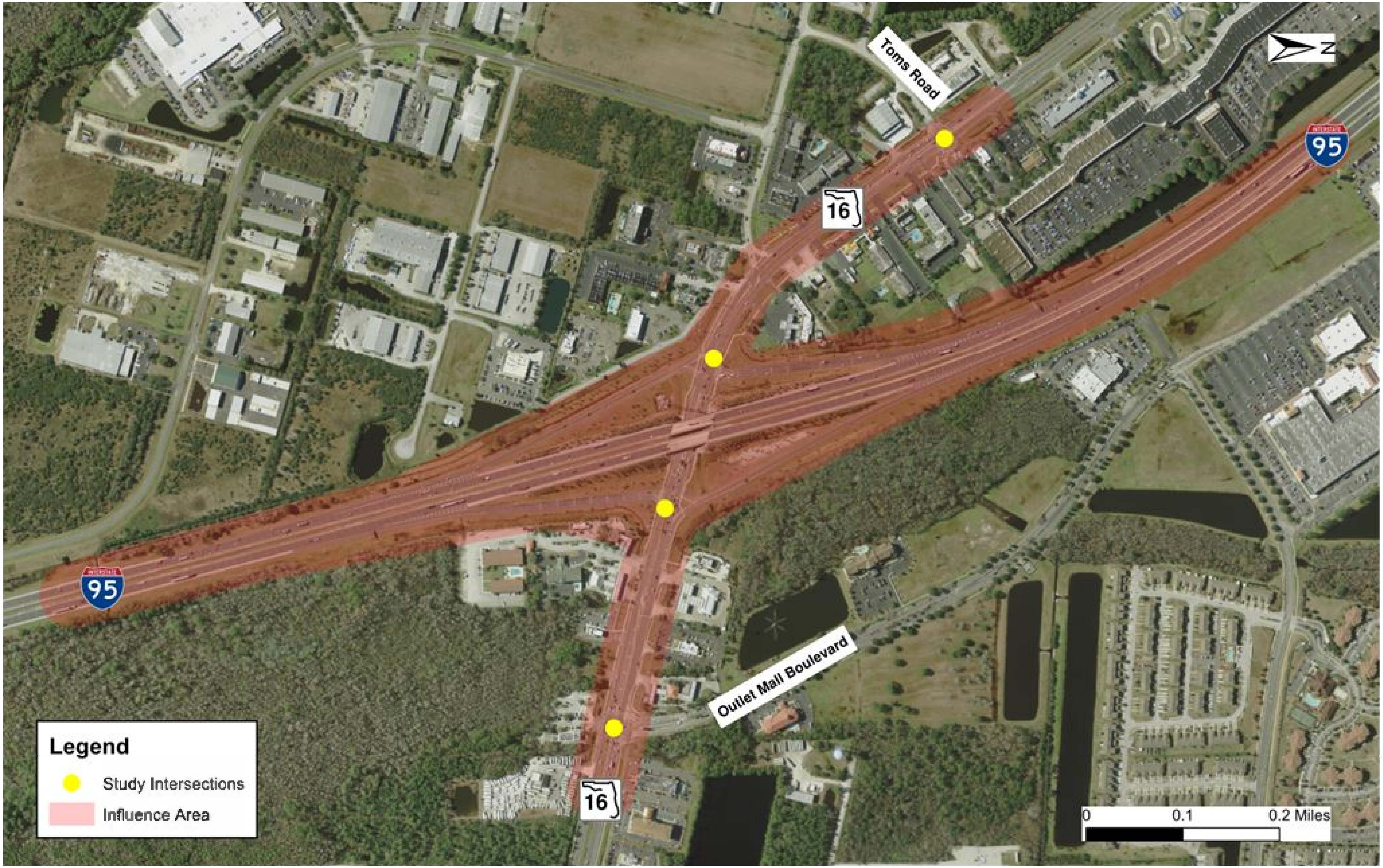
The major study corridor is SR 16:

- SR 16 is a 4 lane divided Rural Principal Arterial Other west and east of I-95. The speed limit within the study limits to the east and west of I-95 is 45 miles per hour.

The area of influence also includes signalized intersections along SR 16. The intersections and traffic impacts analyzed within the area of influence are listed below:

- Intersections
  - SR 16 at Toms Road
  - SR 16 at Southbound Interchange Ramps
  - SR 16 at Northbound Interchange Ramps
  - SR 16 at Outlet Mall Boulevard
- Mainline through movements
  - I-95
- Ramp merge and diverge junctions
  - I-95 at SR 16 Northbound On/Off-Ramps
  - I-95 at SR 16 Southbound On/Off-Ramps

The area of influence is shown in **Figure 2-1**.



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Area of Influence

Figure 2-1

2.4. Data Collection

The analysis conducted for this IOAR is based on a combination of data that includes recently approved projects and additional data available from FDOT. The data sources within the project study area included:

- I-95 Express Phase 1 – From International Golf Parkway to I-295 Systems Interchange Modification Report (SIMR), approved in 2016 referred as I-95 Express Phase 1 SIMR in this report. This Existing Year of analysis for this project was 2014 and The Design Year 2040.
- Existing Traffic Data from 2017 FTO
- Land Use Data from the Florida Geographic Data Library (FGDL)
- Existing Plan, Programs and Project Lists from FDOT and St. Johns County

2.5. Base Traffic Data and Traffic Factors

The primary sources of the traffic data for this IOAR were obtained from the I-95 Express Phase 1 SIMR and 2017 FTO. I-95 mainline and ramps counts from 2017 FTO were counted in July 2017. The intersection turning movement counts for the I-95 Express Phase 1 SIMR were collected in May 2014 (Tuesday through Thursday). The I-95 Express Phase 1 SIMR is provided in **Appendix B.**

Information from the 2017 FTO was used to obtain the mainline and ramps traffic data. Reasonableness checks were made with the I-95 Express Phase 1 SIMR. A compound growth rate of 2% was then applied to determine the Existing Year 2018 I-95 mainline and ramp volumes. The arterial approach volumes obtained from the I-95 Express Phase 1 SIMR were grown and the peak hour volumes between study area intersections were balanced by holding the ramp volumes constant. Adjustments were made if necessary, to ensure that turning movement volumes at ramp terminals sum to the peak hour ramp volumes. The existing traffic volumes from 2017 FTO used are provided in **Appendix B**.

The factors used for design traffic analysis include the T_{Daily} percentage, Design Hour Truck (DHT) percentage and Peak Hour Factor (PHF). The Standard K factor and D factors were not used to develop the DDHV for this study.

- The T_{Daily} factor is the adjusted, annual daily percentage of truck traffic.
- The DHT percentage is calculated as one half of the daily truck percentage.

- The PHF is applied to convert hourly flow to peak 15-minute flow rate for capacity analysis.

The traffic factors from the MLOU are recommended for use in this IOAR are presented in **Table 2-1**.

Table 2-1: Summary of Traffic Factors

Roadway	T_{daily}	DHT	PHF
I-95 S of SR 16	8.6%	4.3%	0.95
I-95 N of SR 16	8.6%	4.3%	0.95
SR 16	2.7%	1.4%	0.95

Source: 2017 FDOT FTO

2.6. Selected Travel Demand Model

2.6.1 Northeast Regional Planning Model-Activity Based

The NERPM-AB3 model with base year of 2010 and horizon year of 2040 was available at the initiation of this study and reviewed for the study area. Year 2010 and 2040 volumes were obtained from the model and compared with the I-95 Express Phase 1 SIMR volumes to determine adjustments required to forecast the Design Year 2043 volumes for this project. No modifications or validation of the travel demand model was performed as part of this IOAR. The model was validated for the I-95 Express Phase 1 SIMR and validation was not needed for this IOAR. The traffic development methodology is discussed in detail in Section 5.

2.7. LOS Criteria

FDOT Topic No. 000-525-006 provides LOS targets for the State Highway System (SHS). The term LOS is defined as the system of six designated ranges from “A” (best) to “F” (worst) used to evaluate roadway facility performance. The I-95 at SR 16 interchange is located in the rural area, but due to the shopping and high traffic to the city of St. Augustine, it is analyzed with Urban LOS target. The FDOT minimum acceptable operating LOS targets as detailed in the MLOU were used for this IOAR. The LOS targets for major roadways analyzed in this IOAR are summarized below:

- I-95 Interstate Mainline: LOS D
- Ramps Merge/Diverge: LOS D
- Signalized Intersections: LOS D

2.8. Analysis Procedures

The analysis procedure was conducted using the most recent versions of the Highway Capacity Software (HCS) and Synchro. Analysis of I-95 system and SR 16 arterial, including the mainline, interchange ramps and intersections were based on criteria and policies detailed in the FDOT Traffic Analysis Handbook, March 2014 Edition.

Microsimulation analysis using VISSIM was not performed considering the type of recommended improvements in this IOAR. The recommended improvements such as addition of turn lanes at intersections were analyzed using Synchro.

2.8.1 HCS and Synchro Analysis Procedure

Freeway merge/diverge operational analysis was conducted utilizing Highway Capacity Software (HCS 7). Intersection capacity analysis was conducted using Synchro 10.0 software.

The HCM methodology and Synchro 10.0 are generally classified as a series of analytical procedures (flow rate variables) that produce deterministic results (no randomness). Each transportation facility (freeway mainline, freeway ramp, signalized intersection, etc.) is analyzed using a unique methodology, which is performed independent of other adjacent facilities. The discussion of HCS and Synchro analysis is documented in subsequent sections for the Existing Year 2018, Opening Year 2023 and the Design Year 2043.

2.9. Alternatives Considered

The following scenarios were considered for this project:

- Existing Year 2018 – AM and PM peak hours
- No-Build Alternative –Design Year 2043 AM and PM peak hours
- Build Alternative –Design Year 2043 AM and PM peak hours

3. EXISTING CONDITIONS

The following section provides a discussion and evaluation of the existing conditions within the area of influence. This discussion includes existing land use data, transportation systems data, existing traffic data and existing operating and safety conditions.

3.1 Existing Land Use

The interchange falls within St. Johns County. According to the Florida Department of Transportation (FDOT) District Two Generalized Land Use Map, the area is primarily retail and industrial.

The existing land uses within the area of influence are shown in **Figure 3-1**.

3.2 Existing Transportation Network

3.2.1 Existing Roadway Network

The existing transportation network within the area of influence consists of a 6 lane interstate highway with an interchange at SR 16. **Table 3-1** summarizes the functional classification and number of lanes for I-95, SR 16 and local roads within the project area of influence.

Table 3-1: Functional Classification of Area Roadways

Roadway	Functional Classification	Number of Lanes
I-95	Rural Principal Arterial - Interstate	6
SR 16	Rural Principal Arterial	4
Toms Road	Rural Local Road	2
Outlet Mall Boulevard	Rural Local Road	4

I-95 – I-95 within the study area is a six lane north-south Rural Principal Arterial Interstate providing three GUL in each direction. The median within this section is approximately 20 feet with guardrail barrier throughout the length of the study area. Interchanges within the area of influence along I-95 is at SR 16. The posted speed limit along I-95 is 70 mph.

SR 16 – SR 16 is a Rural Principal Arterial consisting of two lanes in each direction with grassy and raised medians dividing the roadway. SR 16 serves primary commercials and retail properties within the area of influence. The posted speed limit along SR 16 is 45 mph.

3.2.2 Alternative Transportation Modes

The Sunshine Bus Company, St. Johns County's public transit system utilizes the roadways within the project area for one public transit route listed below:

- Purple line serving SR 16 Outlet Malls and the Avenue Mall areas.

3.2.3 Existing Interchanges

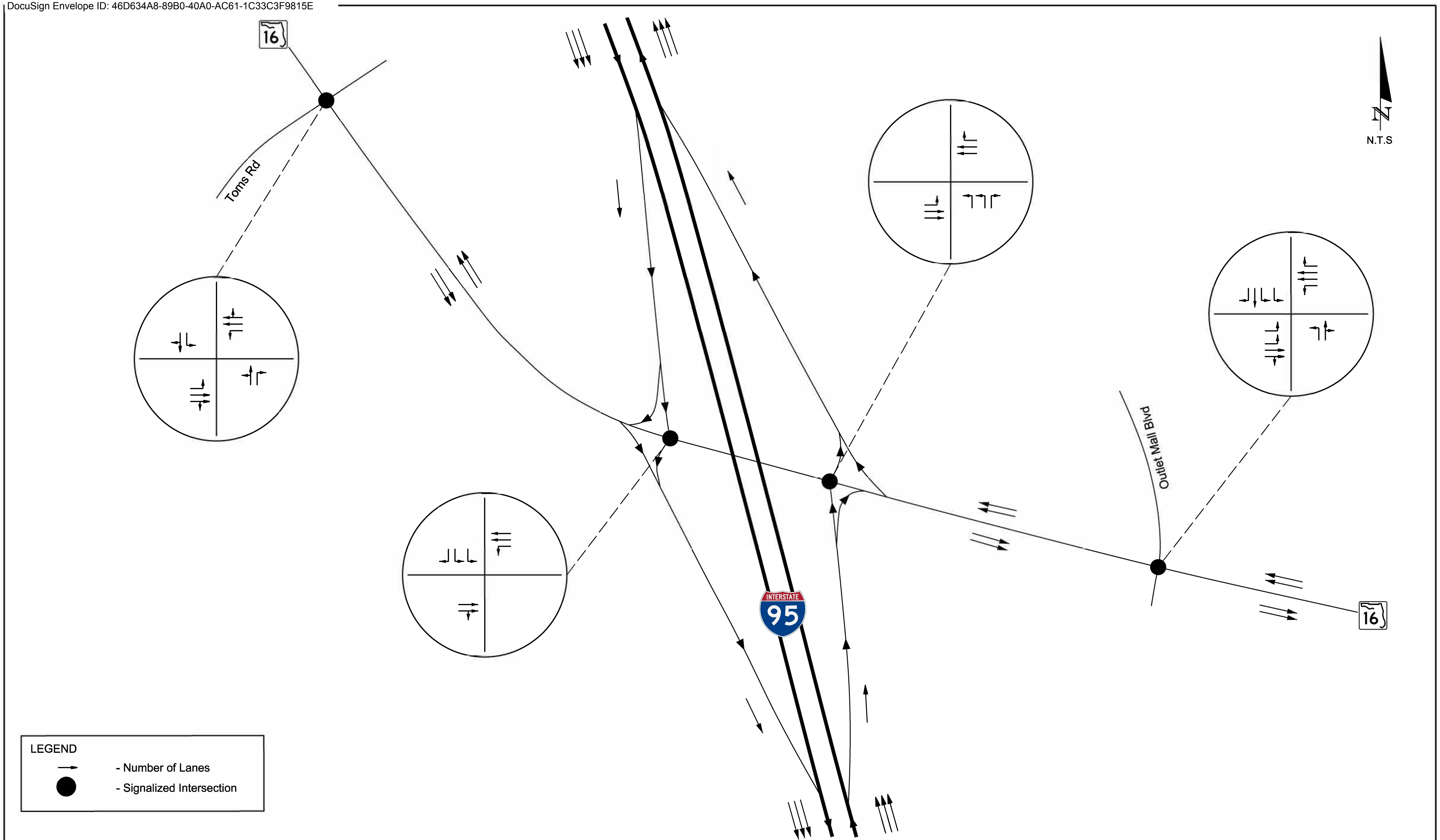
I-95 at SR 16 is the only interchange within the study area. This study interchange is a full diamond interchange and the existing lane configuration is provided in **Figure 3-2**.

FDOT

I-95 / SR 16
Interchange Operational
Analysis Report

Existing Land Use

Figure 3-1



I-95 / SR 16
Interchange Operational Analysis Report

Existing Year 2018 Lane Configuration

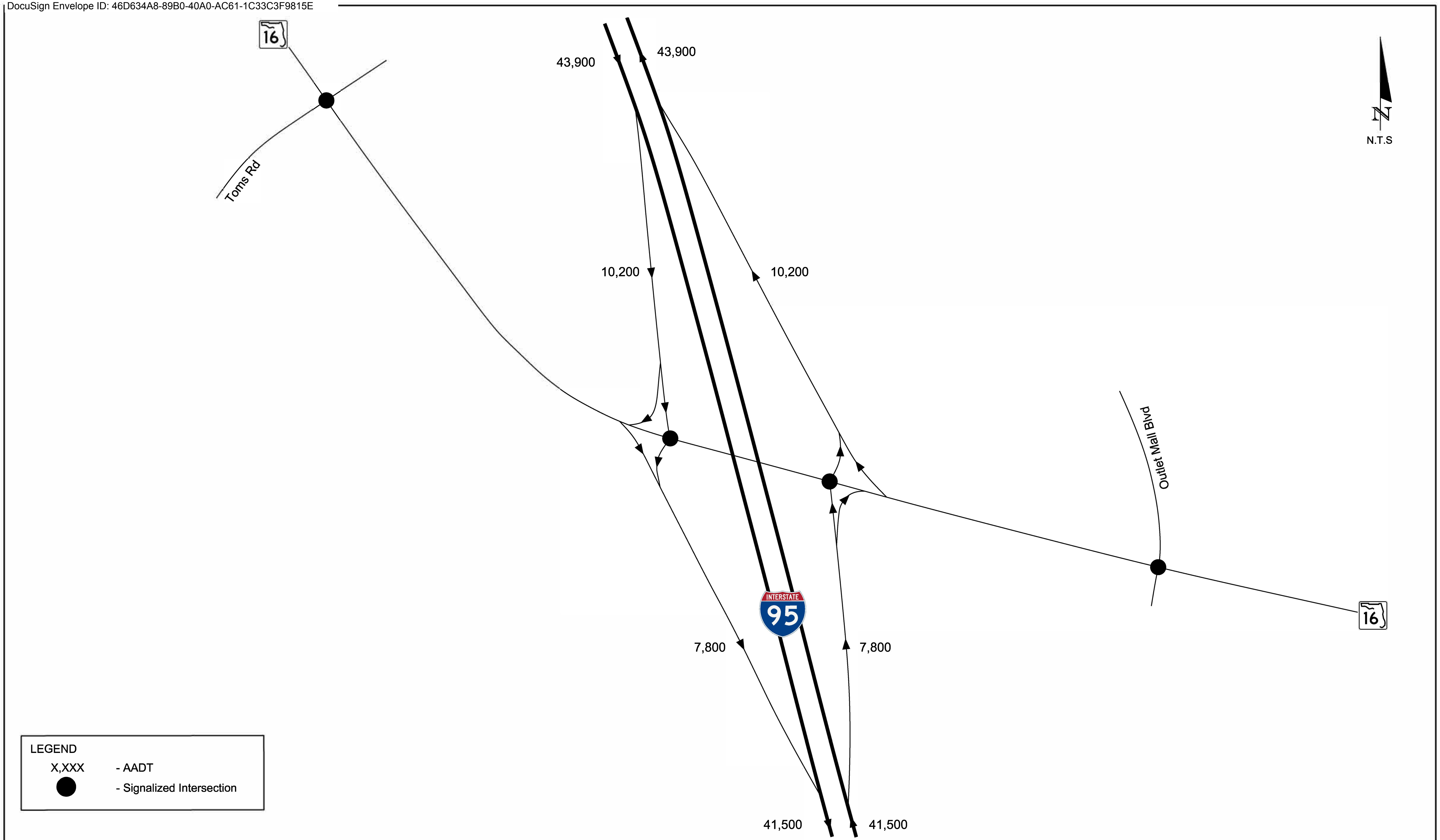
Figure 3-2

3.3 Existing Operational Performance

This section summarizes the existing traffic and operational analysis performed within the area of influence to assess the mobility conditions. This facility accommodates interstate and regional mobility for commuter and freight traffic.

3.3.1 Existing Traffic Data

The existing traffic data was obtained from the I-95 Express Phase I SIMR as discussed in **Section 2.4**. AADTs along I-95 and ramps were adjusted and rounded to attain a balanced flow. The Existing Year 2018 AADTs are depicted in **Figure 3-3**.



FDOT

I-95 / SR 16
Interchange Operational Analysis Report

Existing Year 2018 Annual Average Daily Traffic (AADT)
Mainline and Ramps

Figure
3-3

3.3.2 HCM Based Operational Analysis

A detailed operational analysis for the Existing Year 2018 was performed for individual roadway elements, i.e., mainline segments, ramp junctions and study intersections.

HCS 7 was used for the operational analysis of mainline segments and ramps. Synchro 10.0 was used for the analysis of study intersections. VISSIM analysis was not performed as it was not needed for the type of recommended improvements. Synchro is adequate to analyze the addition of turn lanes at intersections. **Figure 3-4** illustrates the peak hour volumes utilized for the Existing Year 2018 HCS and Synchro analysis. Additional information on the existing conditions analysis is provided in **Appendix C**.

HCS Analysis

The Existing Year 2018 HCS analysis results are summarized in **Table 3-2**. The results of the operational analysis show that in both AM and PM peak hours all the mainline segments operate at an acceptable LOS of C or better.

Table 3-2: Existing Year 2018 HCS Analysis Summary

Segment	Analysis Type	AM Peak Hour			PM Peak Hour		
		Volume	Density[1]	LOS	Volume	Density[1]	LOS
I-95 NB South of SR 16	Basic Segment	2,910	14.5	B	2,470	12.3	B
I-95 NB to SR 16 Off-Ramp	Diverge	2,291	20.5	C	1,826	18.1	B
I-95 NB from SR 16 On-Ramp	Merge	2,291	20.2	C	1,826	17.3	B
I-95 NB North of SR 16	Basic Segment	3,079	15.4	B	2,550	12.7	B
I-95 SB North of SR 16	Basic Segment	2,141	10.6	A	3,373	16.8	B
I-95 SB to SR 16 Off-Ramp	Diverge	1,534	17.8	B	2,489	25.4	C
I-95 SB from SR 16 On-Ramp	Merge	1,534	13.5	B	2,489	20.7	C
I-95 SB South of SR 16	Basic Segment	2,039	10.1	A	3,281	16.3	B

1. Density = passenger cars/mile/lane

Intersection Analysis

The Existing Year 2018 intersection analysis results are summarized in **Table 3-3**. All the study intersections are signalized and were analyzed using field signal timing and phasing plans for AM and PM peak hours. No signal optimization was performed when analyzing Existing Year 2018 conditions. In Existing Year 2018, all intersections within the study area operate at acceptable LOS D or better. However, few minor street movements within the study intersections operate at LOS F. These movements are listed below:

SR 16 at I-95 SB On/Off- Ramp

- Eastbound Through/Right (PM peak hours)
- Westbound Left (PM peak hour)

SR 16 at Outlet Mall Boulevard

- Southbound Right (PM peak hour)

Table 3-3: Existing Year 2018 Intersection Analysis Summary

Intersection	Intersection Approach				Overall Intersection	
	Approach	Movement	Delay (sec)	LOS	Delay (sec)	LOS
			AM (PM)	AM (PM)	AM (PM)	AM (PM)
Toms Road & SR 16	Eastbound	Left	6.0 (14.1)	A (B)	12.9 (26.1)	B (C)
		Through/Right	15.3 (29.3)	B (C)		
	Westbound	Left	9.2 (16.5)	A (B)		
		Through/Right	6.2 (21.3)	A (C)		
	Northbound	Left/Through	61.0 (70.2)	E (E)		
		Right	1.1 (10.4)	A (B)		
	Southbound	Left	36.9 (43.5)	D (D)		
		Through/Right	26.6 (18.0)	C (B)		
SR 16 at I-95 SB On/Off Ramps	Eastbound	Through/Right	33.7 (86.1)	C (F)	29.6 (50.2)	C (D)
	Westbound	Left	39.8 (80.9)	D (F)		
		Through	11.2 (13.7)	B (B)		
	Southbound	Left	50.7 (43.5)	D (D)		
		Right	8.4 (16.4)	A (B)		
SR 16 at I-95 NB On/Off Ramps	Eastbound	Left	16.3 (30.3)	B (C)	21.0 (19.0)	C (B)
		Through	22.0 (11.3)	C (B)		
	Westbound	Through	27.9 (20.3)	C (C)		
		Right	3.7 (0.2)	A (A)		
	Northbound	Left	29.8 (49.7)	C (D)		
		Right	33.0 (36.1)	C (D)		
SR 16 & Outlet Mall Boulevard	Eastbound	Left	63.2 (59.2)	E (E)	20.4 (42.1)	C (D)
		Through/Right	11.5 (10.8)	B (B)		
	Westbound	Left	50.8 (45.5)	D (D)		
		Through	23.1 (38.3)	C (D)		
		Right	2.2 (1.1)	A (A)		
	Northbound	Left	49.3 (78.6)	D (E)		
		Through/Right	29.6 (24.1)	C (C)		
	Southbound	Left	56.6 (45.1)	E (D)		
		Through	44.3 (40.6)	D (D)		
		Right	12.9 (130.0)	B (F)		

In the existing year, the 95th Percentile queue lengths exceed the storage available at the following intersection approaches:

- Southbound left turn at SR 16 at Toms Road (PM Peak hour)
- Eastbound through at SR 16 at I-95 Southbound On/Off-Ramps (AM and PM peak hour)

- Westbound left turn at SR 16 at I-95 Southbound On/Off-Ramps (PM peak hour)
- Northbound left at SR 16 at Outlet Mall Boulevard (PM peak hour)
- Southbound right at SR 16 at Outlet Mall Boulevard (PM peak hour)

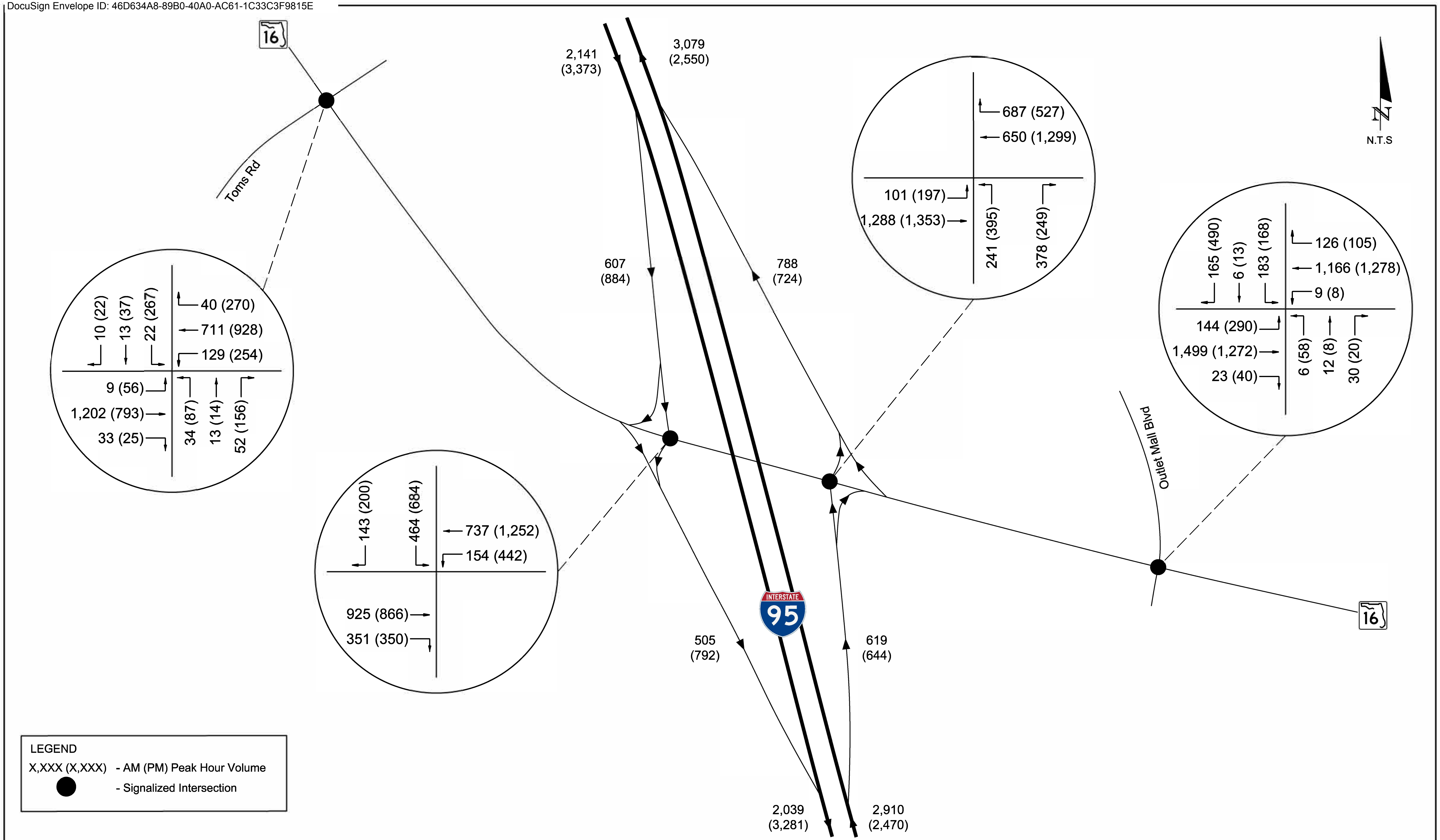
The queue lengths obtained from the analysis generally match with the field observations during the peak hours.

Table 3-4 summarizes the queue analysis for Existing Year 2018.

Table 3-4: 95th Intersection Percentile Queue Length Summary – Existing Year 2018

Intersection	Time Period	95th Percentile Queue Length (feet)											
		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
SR 16 at Toms Road	AM Peak	7	454	--	43	287	--	--	75	0	36	32	--
	PM Peak	37	320	--	#190	#565	--	--	#143	49	217	46	--
	Available Storage (feet)	420		--	420	1,200	--	--		150	50	350	--
SR 16 at I-95 SB On/Off Ramps	AM Peak	--	593	--	119	148	--	--	--	--	219	--	52
	PM Peak	--	#653	--	#501	388	--	--	--	--	281	--	110
	Available Storage (feet)	--	520	--	275	450	0	--	--	--	1,400		1,400
SR 16 at I-95 NB On/Off Ramps	AM Peak	m59	324	--	--	169	120	109	--	#355	--	--	--
	PM Peak	m103	m192	--	--	m238	m0	181	--	#195	--	--	--
	Available Storage (feet)	230	450	--	--	1,000	830	1,300	--	1,300	--	--	--
SR 16 & Outlet Mall Boulevard	AM Peak	m87	675	--	23	428	23	18	45	--	#140	17	66
	PM Peak	m#156	375	--	20	#554	9	#103	32	--	91	27	#499
	Available Storage (feet)	425	1,000	--	280	1,335	1,050	75	75	--	1,000	1,000	230

95th percentile volume exceeds capacity, queue may be longer
m: Volume for 95th percentile queue is metered by upstream signal
Available storage for ramps includes ramp length



FDOT

I-95 / SR 16

Interchange Operational Analysis Report

Existing Year 2018 Peak Hour Volumes
Mainline, Ramps and Intersections

Figure
3-4

3.3.3 Crash and Safety Information

Vehicular crash data along I-95, SR 16 and at the interchange ramps were obtained from the FDOT State Safety Office Map Based Query Tool (SSOGis). SSOGis is a database maintained annually by FDOT for crashes reported along state highway facilities. The database provides information on various characteristics associated with each crash including collision type, severity, weather conditions, road surface conditions and date/time information. The crash data was collected for the most recent five years available (2012-2016). The crashes were analyzed to make an assessment of safety conditions along I-95, SR 16 and at the interchange ramps within the project limits. The existing crash analysis performed for the IOAR is consistent with the methods outlined in the Highway Safety Manual (HSM). In this section, the existing crash analysis will be broken down between I-95, SR 16 and the interchange ramps. The raw crash data is provided in **Appendix D**.

The existing crashes were first segmented based on arterial, freeway and ramp segmentation outlined in Chapters 12, 18 and 19 of the HSM. After segmenting I-95, SR 16 and the interchange ramps, the crash frequency and crash rate were calculated for each segment. The 'Average Crash Rate Method' of crash analysis, based on segment length, AADT and number of crashes occurred, was used for calculating actual crash rate for the roadway segments. The actual crash rate for the study corridors from year 2012 to 2016 was compared with the statewide average crash rate for the same type of facility. I-95, SR 16 and the interchange ramps all have crash rates that are higher than the statewide average.

I-95

The crash analysis results reveal that there was a total of 94 crashes on I-95 within the project area during the five study years (2012-2016). Of these 94 crashes, front to rear (rear end) crashes were the most common type of crash accounting for 32% of total crashes followed by sideswipe crashes accounting for 25% of total crashes. There were 65 total injuries and 1 fatality. The average crash rate for the I-95 mainline segments is higher than the statewide average crash rate for similar interstate facilities. Summaries of the crash analysis are provided in **Figure 3-5, Table 3-5 and Table 3-8**.

Figure 3-5: I-95 Crash Types (2012-2016)

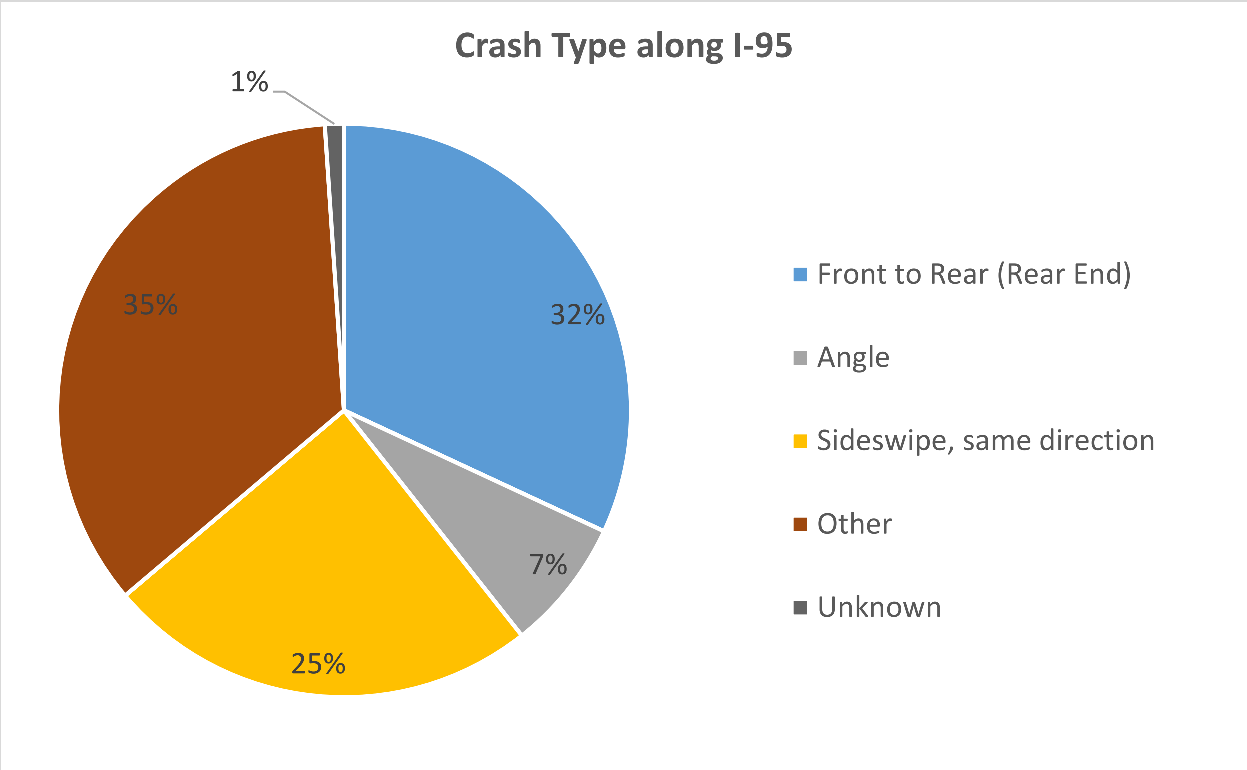


Table 3-5: I-95 Severity Summary (2012 to 2016)

Injury Type	2012	2013	2014	2015	2016	Total	Percent of Total
Number of Property Damage Only Crashes	10	11	10	16	18	65	69%
Number of Crashes with Injuries	7	5	5	2	9	28	30%
Number of Crashes with Fatalities	0	0	0	0	1	1	1%
Total	17	16	15	18	28	94	100%
Number of Injuries	15	19	7	4	20	65	
Number of Fatalities	0	0	0	0	1	1	

SR 16

The crash analysis results reveal that there was a total of 327 crashes on SR 16 within the project area during the five study years (2012-2016). Of these 327 crashes, rear end crashes were the most common type of crash accounting for 54% of total crashes followed by angle crashes accounting for 26% of total crashes. There were 318 total injuries and 1 fatality. The average crash rate for most of SR 16 is higher than the statewide average crash rate for similar facilities. Summaries of the crash analysis are provided in **Figure 3-6, Table 3-6 and Table 3-8**.

Figure 3-6: SR 16 Crash Types (2012-2016)

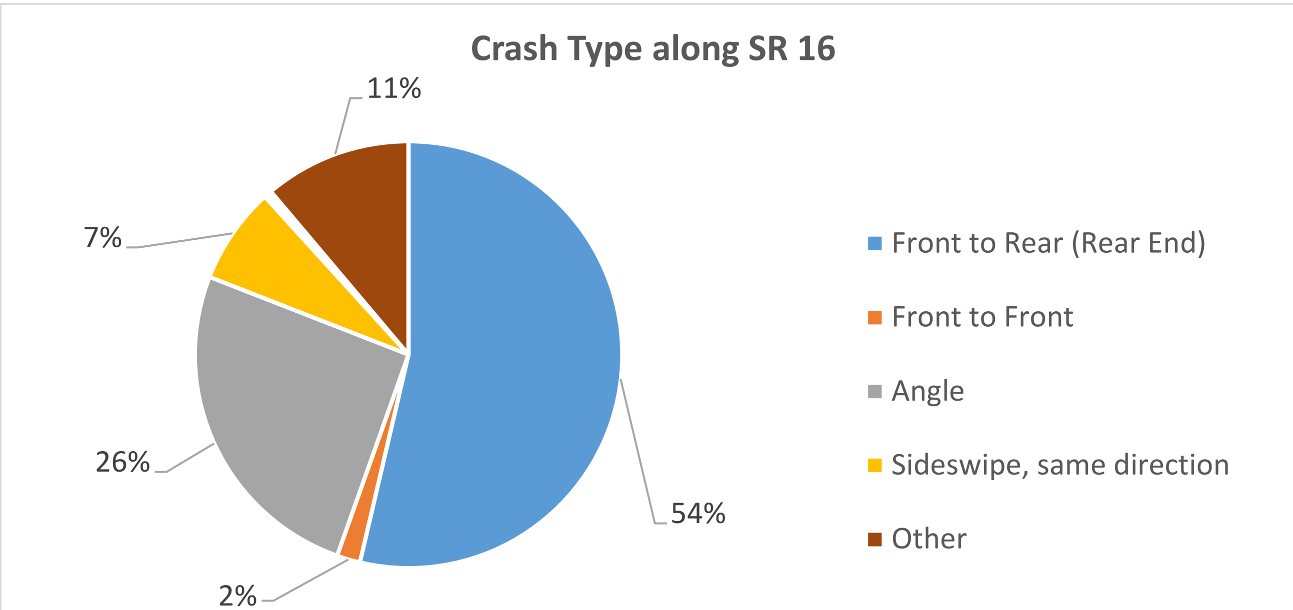


Table 3-6: SR 16 Severity Summary (2012 to 2016)

Injury Type	2012	2013	2014	2015	2016	Total	Percent of Total
Number of Property Damage Only Crashes	30	28	31	32	45	166	51%
Number of Crashes with Injuries	31	23	34	31	41	160	49%
Number of Crashes with Fatalities	0	1	0	0	0	1	0%
Total	61	54	68	65	86	327	100%
Number of Injuries	64	48	70	54	82	318	
Number of Fatalities	0	1	0	0	0	1	

Interchange Ramps

The crash analysis results reveal that there was a total of 22 crashes on the interchange ramps within the project area during the five study years (2012-2016). Of these 22 crashes, rear end crashes were the most common type of crash accounting for 50% of total crashes followed by sideswipe crashes accounting for 14% of total crashes. There were 29 total injuries and no fatalities. The average crash rate could not be compared to the statewide average crash rate for like facilities because it was not available. The crash rates on the interchange ramps ranges from 0.8 to 1.9. Summaries of the crash analysis are provided in **Figure 3-7, Table 3-7 and Table 3-8**.

Figure 3-7: Interchange Ramps Crash Types (2012-2016)

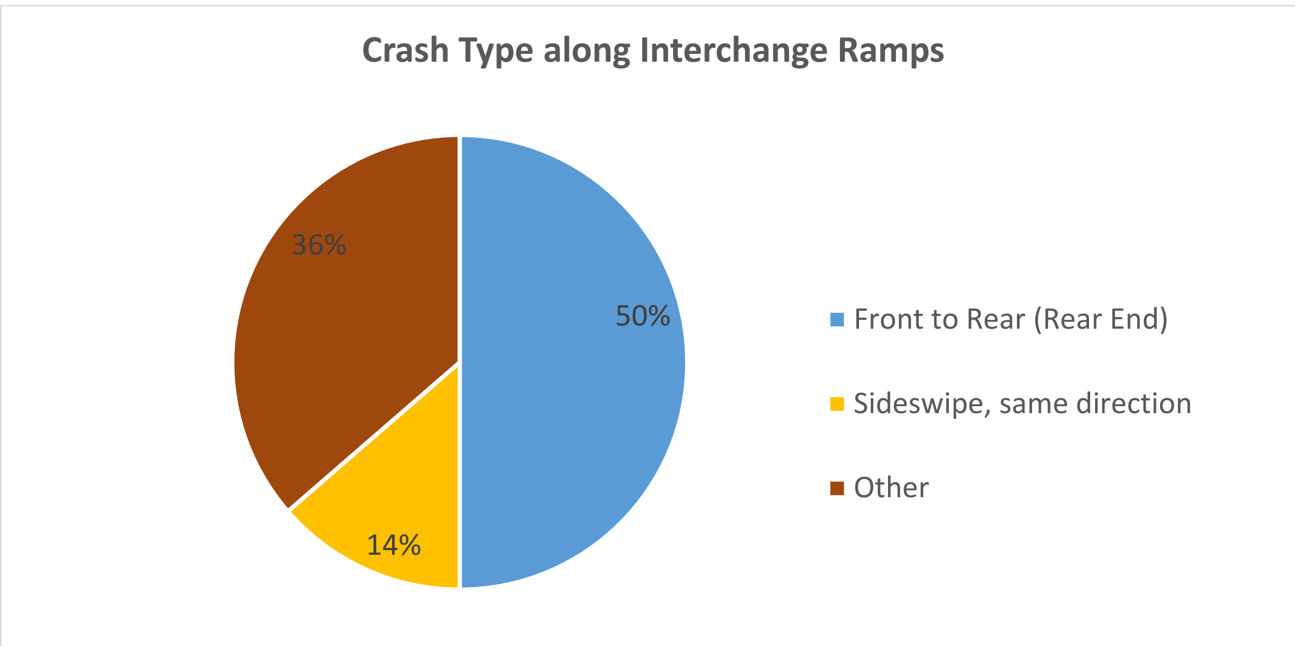


Table 3-7: Interchange Ramps Severity Summary (2012 to 2016)

Injury Type	2012	2013	2014	2015	2016	Total	Percent of Total
Number of Property Damage Only Crashes	4	0	6	1	2	13	59%
Number of Crashes with Injuries	2	3	3	1	0	9	41%
Number of Crashes with Fatalities	0	0	0	0	0	0	0%
Total	6	3	9	2	2	22	100%
Number of Injuries	8	11	9	1	0	29	
Number of Fatalities	0	0	0	0	0	0	

Table 3-8 further summarizes the existing crash data and provides the crash frequency and rate at each of the study corridors and ramps.

Table 3-8: Existing Crash Summary (2012 to 2016)

Location	Number of Crashes	Daily Entering (AADT)	Length (miles)	Crash Frequency (crashes/year)	Crash Rate (crashes/million miles traveled)	Statewide Average Crash Rate
I-95 SB Diverge Area to SR 16	11	69864	0.076	2.2	1.1	0.389
I-95 SB Off Ramp	8	8063	0.280	1.6	1.9	*
I-95 SB Segment Between On & Off Ramp	22	66886	0.660	4.4	0.3	0.389
I-95 SB On Ramp	3	5967	0.330	0.6	0.8	*
I-95 SB Merge Area to SR 16	0	-	0.114	-	-	0.389
I-95 NB Diverge to SR 16	2	64000	0.038	0.4	0.5	0.389
I-95 NB Off Ramp	4	5925	0.240	0.8	1.5	0
I-95 NB Segment Between On & Off Ramp	39	67244	0.660	7.8	0.5	0.389
I-95 NB On Ramp	7	7986	0.380	1.4	1.3	*
I-95 NB Merge Area to SR 16	20	71675	0.095	4	1.6	0.389
SR 16 at Toms Road	30	21290	N/A	6	0.8	0.596
SR 16 - Toms Road to CR 208	28	21211	0.170	5.6	4.3	0.596
SR 16 at CR 208	33	23474	N/A	6.6	0.8	0.596
SR 16 at I-95 SB Ramp Terminal	73	24147	N/A	14.6	1.7	0.596
SR 16 at I-95 NB Ramp Terminal	79	20125	N/A	15.8	2.2	0.596
SR 16 at Outlet Mall Blvd	84	33155	N/A	16.8	1.4	0.596

*Statewide average crash rate not available

3.4 Consistency with Master Plans, LRTP and DRIs

This IOAR considers all programmed and planned roadway improvements in the area. These capacity improvements are consistent with those specified in the regional transportation plans including the following:

- North Florida TPO Year 2040 Long-Range Transportation Plan (LRTP)
- North Florida TPO Transportation Improvement Program (TIP)
- FDOT's SIS Second Five Year Plan

- FDOT Five-Year Work Program
- Local Government Comprehensive Plans
- I-95 Phase I SIMR

4. NEED

The SR 16 interchange with I-95 is an important component of the SIS in St. Johns County, Florida and provides access to the City of St. Augustine. The objective of the IOAR is to propose improvements that will provide a safer and more operationally efficient interchange.

Operational Performance

The I-95 at SR 16 interchange ramps and intersections operate at an acceptable LOS D or better during the AM and PM peak hours in Existing Year 2018. However, traffic congestion and long delays are experienced by some movements at the study intersections during the PM peak hour. At the SR 16 and I-95 SB ramp terminal, the eastbound through/right and westbound left operates at LOS F in the Existing Year 2018. Travel demand forecasts indicate that the study area is expected to experience substantial traffic growth in future years. Based on the anticipated growth in traffic, operating conditions at the interchange and the study intersections will further deteriorate. The SR 16 at I-95 SB ramp terminal intersection will operate at LOS F during the PM peak hour in Design Year 2043. The proposed project will address these concerns by increasing capacity at the interchange and providing acceptable operating conditions through the Design Year (2043).

Transportation Capacity

An increase in demand on I-95 and SR 16 interchange is anticipated in future due to growth in St. Johns County. As a result, additional traffic demand on I-95 and at the interchange will need to be addressed. **Table 4-1** summarizes the anticipated growth within the study area.

Table 4-1: Forecasted Growth in Traffic Volumes

Segment	Existing (2018)	Design (2043)
I-95		
North of SR 16	87,800	118,200
South of SR 16	83,000	109,800
I-95 Ramps		
Northbound off-ramp	7,800	9,500
Northbound on-ramp	10,200	13,700
Southbound on-ramp	7,800	9,500
Southbound off-ramp	10,200	13,700

The study area also has a high volume of heavy trucks along I-95. For the purpose of this study, it was assumed that trucks would increase proportionally with overall traffic volumes. I-95 experiences 8.6% daily truck percentage to the south and north of SR 16. The vehicular traffic and truck volume will increase and result in further deteriorated conditions. The proposed project will support the anticipated traffic growth within the vicinity.

Safety

The crash analysis results reveal that there is a total of 341 crashes on SR 16 within the project area during the five study years 2012 to 2016. Predominant crash pattern experienced within the study area include rear-end crashes (54%) and angle crashes (26%) indicating congestion and long queues at the intersections. If no improvements are made within the project limits, queues on the I-95 off-ramps could progressively become worse, increasing traffic spillback onto I-95 mainline, crash risk and deteriorating the access to and from I-95 for users. The proposed project will implement geometric improvements and provide additional capacity that will assist in alleviating these safety concerns within the project limits.

Emergency Evacuation

I-95 and SR 16 corridors serve as part of the emergency evacuation route network designated by the Florida Division of Emergency Management and St. Johns County. This interchange is critical in facilitating traffic flow during emergency evacuation periods.

5. FUTURE TRAFFIC FORECASTS

The travel demand modeling and future year AADT forecasts for this study were obtained from the I-95 Phase I SIMR. A growth rate was then applied to develop traffic forecasts for the opening and design years of this IOAR. A summary of the future transportation network and future traffic volume forecasting is discussed in this section.

5.1. Future Land Use

Land use within the study area of influence is projected to remain the same as existing with predominantly mixed use district land use.

5.2. Future Transportation Network

The North Florida TPO for St. Johns County plays a critical role in addressing regional transportation issues, convening stakeholders, and identifying the long-term transportation needs within St. Johns County. It also serves as the coordinating forum for all the local governments for matters relating to the maintenance and development of the county's transportation network. Together they establish long-term planning goals and objectives, set priorities and identify the agency with responsibility for funding and implementing needed transportation improvements.

5.3. Travel Demand Forecasting/Development of AADTs

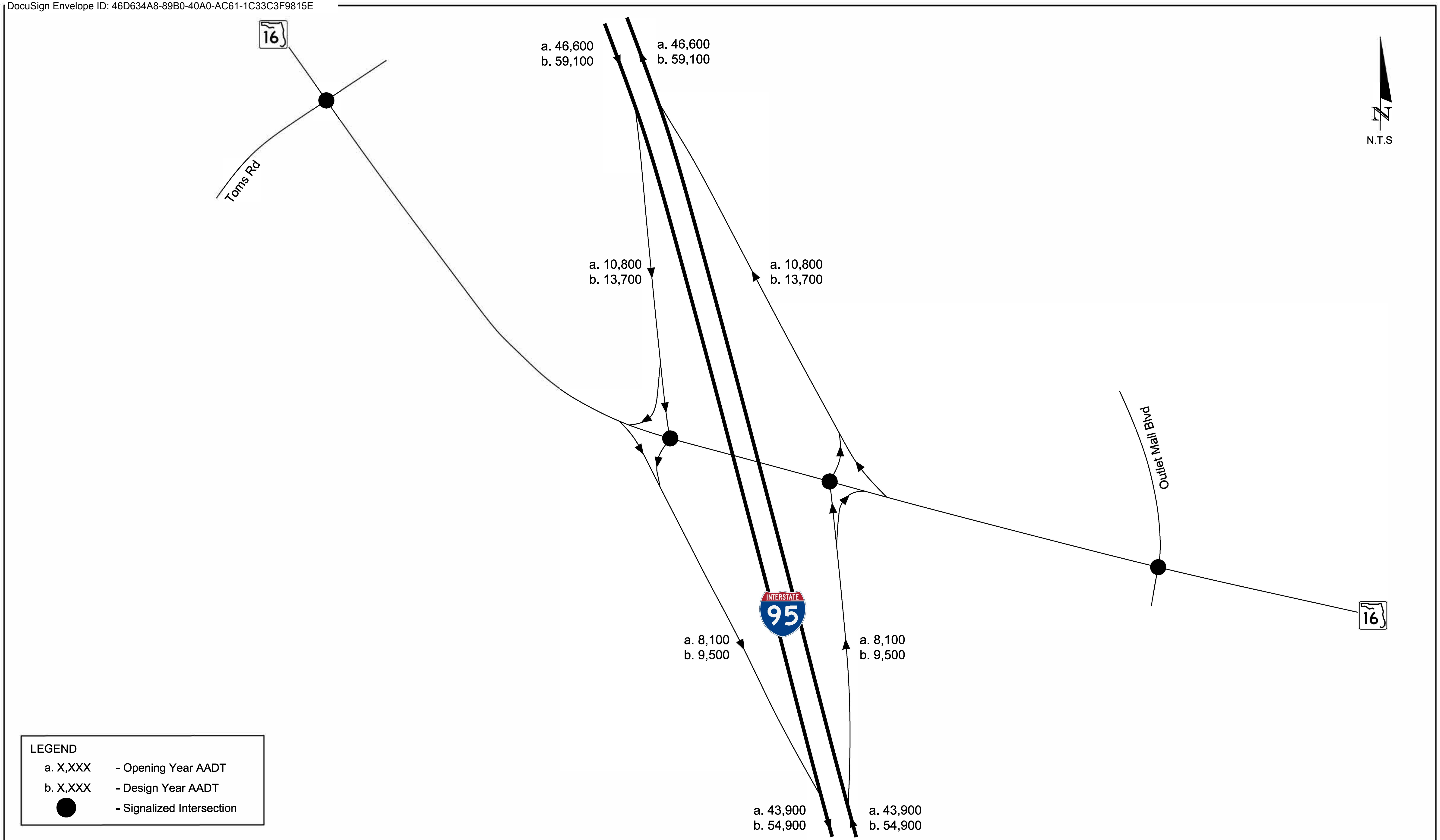
The methodology used to develop the future years 2023 and 2043 AADT is described in this Section. The same approach was used to estimate the DDHVs in this IOAR.

Development of future year traffic volumes for this study involved applying a compounded growth rate to the I-95 Express Phase I SIMR AADTs. Growth trends were determined from the 2010 and 2040 NERPM-AB3 AADT forecast volumes and historic volumes from the FTO since the completion of the I-95 Express Phase I SIMR. The minimum compound growth rate was then developed for the study area by comparing the growth between NERPM-AB3 projected volumes and the historical AADTs on all roadway links in the study area. The I-95 Express Phase I SIMR Design Year 2040 traffic volumes were adjusted to reflect the growth trends in St. Johns County. No new traffic forecasts or model runs was performed as part of this IOAR. The Design Year 2043 AADT volumes were developed by applying 1% compound growth rate on the adjusted I-95 Express Phase I SIMR volumes. This growth rate is reflective of the anticipated growth in the region and is different from the growth rate utilized to develop Existing Year 2018 peak hour volumes. A 2% growth rate was used to develop the Existing Year 2018 volumes based on traffic trends and data obtained from FTO. The Opening Year 2023 AADT volumes were developed by interpolation using 2018 AADT and recommended 2043 AADT volumes.

The No-Build AADTs for the Opening Year 2023 and the Design Year 2043 are presented in **Figure 5-1**.

5.4. Development of DDHV Volumes

Future year Directional Design Hour Volumes (DDHVs) for Opening Year 2023 and Design Year 2043 were developed in an equivalent manner as the AADTs. The I-95 Express Phase I SIMR Design Year 2040 traffic volumes were adjusted to reflect the growth trends in St. Johns County. The Design Year 2043 DDHVs were developed by applying 1% compound growth rate on the adjusted I-95 Express Phase I SIMR volumes. The developed peak hour volumes were balanced along the freeway mainlines as well as between ramps and arterial intersections. The final future year volumes were checked for reasonableness.



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I-95 / SR 16
Interchange Operational Analysis Report

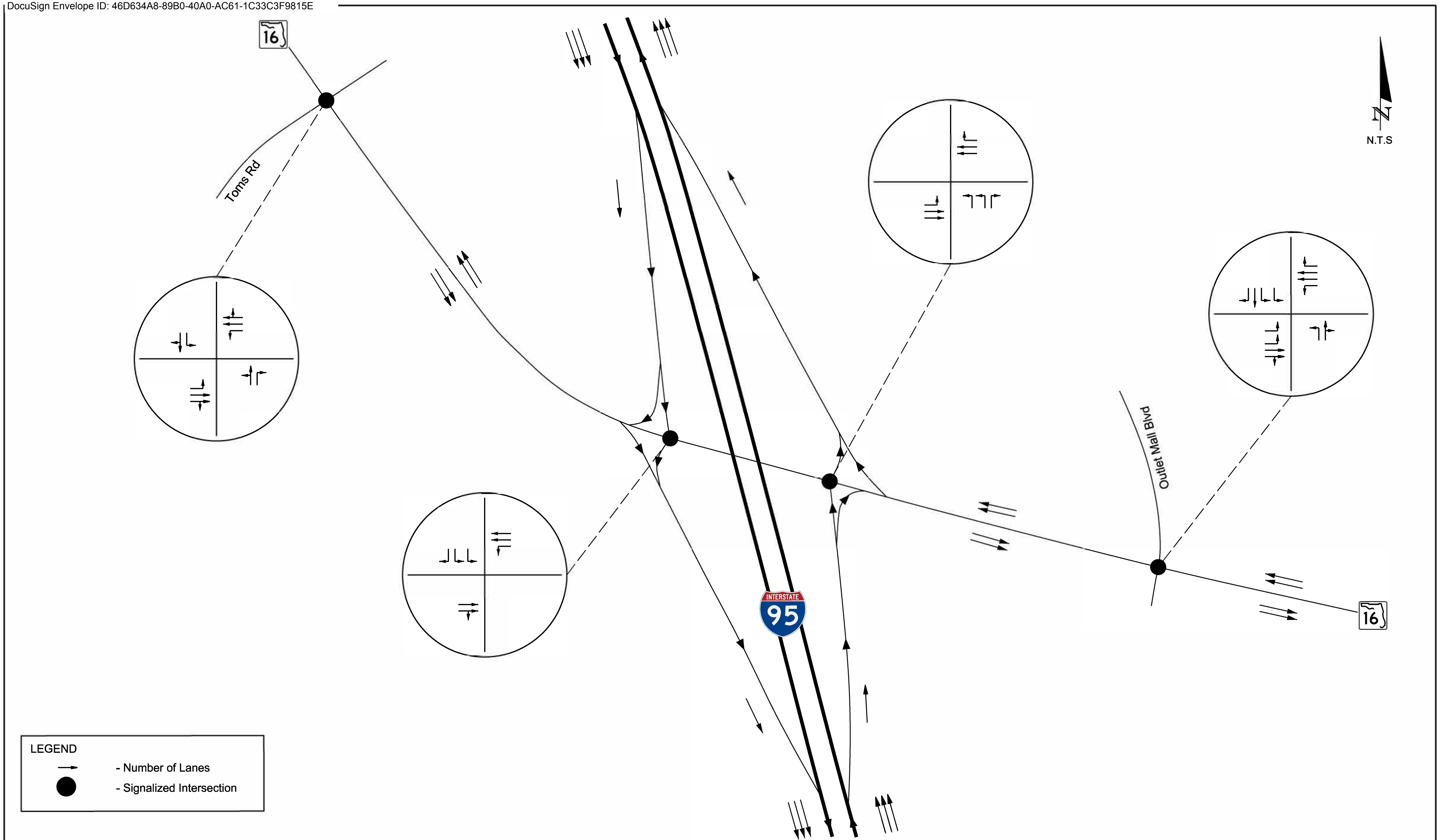
Opening Year 2023 and Design 2043 No-Build Alternative Annual Average Daily Traffic (AADT)
Mainline and Ramps

Figure
5-1

6. NO-BUILD CONDITIONS

This section documents the future conditions within the I-95 at SR 16 interchange study area of influence for the No-Build Alternative. The No-Build Alternative assumes the existing plus committed roadway network. The analysis years considered under the No-Build Alternative are Opening Year 2023 and Design Year 2043. The operational analysis includes the future year peak hour traffic forecasts for the area of influence. The primary objective of this analysis was to establish the No-Build operational conditions along I-95 and at the study interchange and intersections.

The No-Build lane configuration is provided in **Figure 6-1**.



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I-95 / SR 16

Interchange Operational Analysis Report

No-Build Alternative Lane Configuration

Figure 6-1

6.1. Individual Element No-Build Operational Analysis

An individual element operational analysis was conducted for the No-Build Alternative using HCM methodologies. HCS 7 was used to perform capacity analysis for the freeway and ramps merge/diverge segments. Synchro 10 was used to analyze the study intersections. The results of this detailed analysis are presented in the following sections. **Figure 6-2** and **Figure 6-3** illustrate the peak hour volumes utilized for the Opening Year 2023 and Design Year 2043 No-Build Alternative HCS and Synchro analysis respectively. Additional information on the No-Build Alternative analysis is provided in **Appendix E**.

6.1.1 2023 No-Build Analysis

HCS Analysis

The Opening Year 2023 No-Build HCS analysis is summarized in **Table 6-1**. The results of the HCS operational analysis show that all the mainline segments operate at an acceptable LOS in both AM and PM peak hours.

Table 6-1: Opening Year 2023 No-Build HCS Analysis Summary

Segment	Analysis Type	AM Peak Hour			PM Peak Hour		
		Volume	Density[1]	LOS	Volume	Density[1]	LOS
I-95 NB South of SR 16	Basic Segment	3,180	15.8	B	2,790	13.9	B
I-95 NB to SR 16 Off-Ramp	Diverge	2,540	22.0	C	2,130	19.9	B
I-95 NB from SR 16 On-Ramp	Merge	2,540	22.0	C	2,130	19.2	B
I-95 NB North of SR 16	Basic Segment	3,400	17.1	B	2,890	14.4	B
I-95 SB North of SR 16	Basic Segment	2,530	12.7	B	3,750	19.0	C
I-95 SB to SR 16 Off-Ramp	Diverge	1,890	20.2	C	2,800	27.4	C
I-95 SB from SR 16 On-Ramp	Merge	1,890	15.6	B	2,800	22.5	C
I-95 SB South of SR 16	Basic Segment	2,430	12.1	B	3,630	18.2	C

1. Density = passenger cars/mile/lane

Intersection Analysis

The Opening Year 2023 No-Build intersection analysis results are summarized in **Table 6-2**. In Opening Year 2023, all the intersections within the study area operate at LOS D or better in the AM peak hour and all the movements operate at LOS E or better. In Opening Year 2023, two intersections within the study area operate at LOS E in the PM peak hour: 1) SR 16 at I-95 Southbound On/Off-Ramps and 2) Outlet Mall Boulevard intersection. There are several individual movements at these intersections operating at LOS F in the PM peak hour. The movements are listed below:

SR 16 and I-95 Southbound On/Off-Ramps

- Eastbound Through/Right
- Westbound left turn
- Southbound left turn

SR 16 and Outlet Mall Boulevard

- Northbound left turn
- Southbound right turn

Table 6-2: Opening Year 2023 No-Build Intersection Analysis Summary

Intersection	Intersection Approach				Overall Intersection	
	Approach	Movement	Delay (sec)	LOS	Delay (sec)	LOS
			AM (PM)	AM (PM)	AM (PM)	AM (PM)
SR 16 at Toms Road	Eastbound	Left	6.5 (15.2)	A (B)	20.8 (30.8)	C (C)
		Through/Right	20.4 (28.3)	C (C)		
	Westbound	Left	29.0 (49.0)	C (D)		
		Through/Right	17.4 (24.0)	B (C)		
	Northbound	Through/Left	69.5 (66.2)	E (E)		
		Right	2.0 (11.8)	A (B)		
	Southbound	Left	37.8 (55.0)	D (D)		
		Through/Right	23.6 (23.7)	C (C)		
SR 16 at I-95 SB On/Off Ramps	Eastbound	Through/Right	58.0 (89.1)	E (F)	38.6 (65.9)	D (E)
	Westbound	Left	24.5 (144.3)	C (F)		
		Through	2.8 (11.2)	A (B)		
	Southbound	Left	53.8 (87.7)	D (F)		
		Right	8.6 (28.7)	A (C)		
SR 16 at I-95 NB On/Off Ramps	Eastbound	Left	12.0 (31.5)	B (C)	26.3 (26.5)	C (C)
		Through	28.0 (20.6)	C (C)		
	Westbound	Through	38.6 (31.2)	D (C)		
		Right	4.0 (0.1)	A (A)		
	Northbound	Left	33.2 (54.5)	C (D)		
		Right	39.3 (44.8)	D (D)		
SR 16 & Outlet Mall Boulevard	Eastbound	Left	53.0 (64.3)	D (E)	25.6 (58.8)	C (E)
		Through/Right	21.5 (16.0)	C (B)		
	Westbound	Left	51.7 (57.1)	D (E)		
		Through	24.2 (41.4)	C (D)		
		Right	2.5 (2.2)	A (A)		
	Northbound	Left	51.3 (198.2)	D (F)		
		Through/Right	29.8 (30.0)	C (C)		
	Southbound	Left	69.4 (70.1)	E (E)		
		Through	46.9 (50.3)	D (D)		
		Right	14.4 (216.2)	B (F)		

In the Opening Year 2023 No-Build Alternative, the 95th Percentile queue length exceeds available storage at the following intersection approaches:

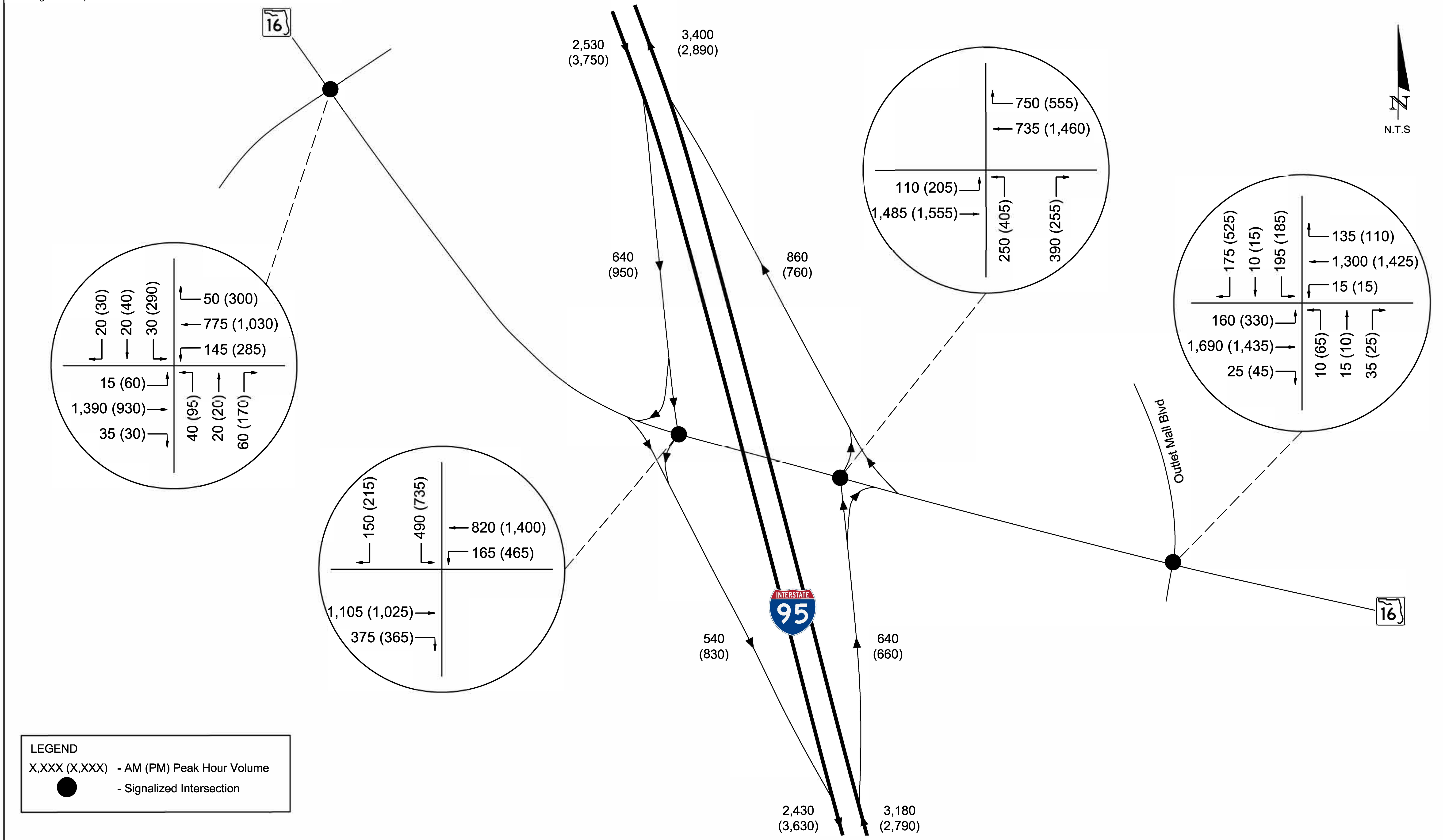
- Southbound left turn at SR 16 at Toms Road (PM peak hour)
- Eastbound through at SR 16 at I-95 Southbound On/Off-Ramps (AM and PM peak hour)
- Westbound left turn at SR 16 at I-95 Southbound On/Off-Ramps (PM peak hour)
- Eastbound through at SR 16 I-95 Northbound On/Off-Ramps (AM and PM peak hour)
- Northbound left at SR 16 at Outlet Mall Boulevard (PM peak hour)
- Southbound right at SR 16 at Outlet Mall Boulevard (PM peak hour)

Table 6-3 summarizes the queue analysis for Opening Year 2023 No-Build Alternative.

Table 6-3: 95th Percentile Queue Length Summary – Opening Year 2023 No-Build Alternative

Intersection	Time Period	95th Percentile Queue Length (feet)											
		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
SR 16 at Toms Road	AM Peak	10	595	--	124	220	--	--	#94	0	46	43	--
	PM Peak	30	337	--	#260	615	--	--	#225	70	#418	70	--
	Available Storage (feet)	420		--	420	1,200	--	--		150	50	350	--
SR 16 at I-95 SB On/Off Ramps	AM Peak	--	#672	--	109	77	--	--	--	--	238	--	54
	PM Peak	--	#755	--	m#606	272	--	--	--	--	#455	--	171
	Available Storage (feet)	--	520	--	275	450	0	--	--	--	1,400		1,400
SR 16 at I-95 NB On/Off Ramps	AM Peak	m32	577	--	--	255	203	127	--	#470	--	--	--
	PM Peak	m107	m511	--	--	m430	m0	208	--	219	--	--	--
	Available Storage (feet)	230	450	--	--	1,000	830	1,300	--	1,300	--	--	--
SR 16 & Outlet Mall Boulevard	AM Peak	m80	#842	--	34	513	28	26	50	--	#151	26	69
	PM Peak	175	751	--	35	#721	22	#162	48	--	#130	34	#603
	Available Storage (feet)	425	1,000	--	280	1,335	1,050	75	75	--	1,300	3,000	200

95th percentile volume exceeds capacity, queue may be longer
m: Volume for 95th percentile queue is metered by upstream signal
Available storage for ramps includes ramp length



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I-95 / SR 16
Interchange Operational Analysis Report

Opening Year 2023 No-Build Alternative Peak Hour Volumes
Mainline, Ramps and Intersections

Figure 6-2

6.1.2 2043 No-Build Analysis

HCS Analysis

The Design Year 2043 No-Build HCS analysis is summarized in **Table 6-4**. The results of the operational analysis show that all the segments along I-95 Northbound and Southbound operate at acceptable LOS D or better in AM peak hour. In the PM peak hour, the diverge segment from I-95 Southbound to SR 16 operates at LOS E. All the remaining segments operate at acceptable LOS D or better.

Table 6-4: Design Year 2043 No-Build HCS Analysis Summary

Segment	Analysis Type	AM Peak Hour			PM Peak Hour		
		Volume	Density[1]	LOS	Volume	Density[1]	LOS
I-95 NB South of SR 16	Basic Segment	4,570	24.1	C	4,600	24.3	C
I-95 NB to SR 16 Off-Ramp	Diverge	3,840	29.2	D	3,870	29.3	D
I-95 NB from SR 16 On-Ramp	Merge	3,840	31.3	D	3,870	29.1	D
I-95 NB North of SR 16	Basic Segment	5,040	27.7	D	4,770	25.6	C
I-95 SB North of SR 16	Basic Segment	4,960	27.1	D	5,750	34.4	D
I-95 SB to SR 16 Off-Ramp	Diverge	4,180	32.9	D	4,450	37.2	E
I-95 SB from SR 16 On-Ramp	Merge	4,180	28.8	D	4,450	32.2	D
I-95 SB South of SR 16	Basic Segment	4,910	26.6	D	5,440	31.2	D

1. Density = passenger cars/mile/lane

Intersection Analysis

The Design Year 2043 No-Build intersection analysis results are summarized in **Table 6-5**. In Design Year 2043, the results indicate several operational deficiencies along SR 16 within the study area. The following intersections will operate at LOS E or worse by year 2043:

- SR 16 at Toms Road (PM peak hour)
- SR 16 at I-95 SB On/Off-Ramps (AM and PM peak hour)
- SR 16 at Outlet Mall Boulevard (PM peak hour)

There are several individual movements at these intersections that will operate at LOS F. These movements are listed below:

SR 16 at Toms Road

- Westbound left turn (PM peak hour)
- Northbound through/left turn (AM and PM peak hours)
- Southbound left turn (PM peak hours)

SR 16 at I-95 Southbound On/Off-Ramps

- Eastbound through/right (AM and PM peak hours)
- Westbound left turn (AM and PM peak hour)
- Southbound left turn (PM peak hour)

SR 16 at I-95 Northbound On/Off-Ramps

- Eastbound left turn (PM peak hour)

SR 16 at Outlet Mall Boulevard

- Westbound through (PM peak hour)
- Northbound left turn (PM peak hour)
- Southbound left turn (PM peak hour)
- Southbound right turn (PM peak hour)

Table 6-5: Design Year 2043 No-Build Intersection Analysis Summary

Intersection	Intersection Approach				Overall Intersection	
	Approach	Movement	Delay (sec)	LOS	Delay (sec)	LOS
			AM (PM)	AM (PM)	AM (PM)	AM (PM)
SR 16 at Toms Road	Eastbound	Left	6.5 (22.0)	A (C)	31.5 (67.3)	C (E)
		Through/Right	40.0 (43.7)	D (D)		
	Westbound	Left	42.5 (113.8)	D (F)		
		Through/Right	12.5 (61.9)	B (E)		
	Northbound	Through/Left	85.2 (202.0)	F (F)		
		Right	2.8 (20.2)	A (C)		
	Southbound	Left	39.7 (111.9)	D (F)		
		Through/Right	26.6 (23.7)	C (C)		
SR 16 at I-95 SB On/Off Ramps	Eastbound	Through/Right	86.2 (161.1)	F (F)	61.3 (117.4)	E (F)
	Westbound	Left	85.6 (283.1)	F (F)		
		Through	5.0 (12.4)	A (B)		
	Southbound	Left	79.8 (167.9)	E (F)		
		Right	14.2 (36.6)	B (D)		
SR 16 at I-95 NB On/Off Ramps	Eastbound	Left	18.0 (100.6)	B (F)	30.3 (49.5)	C (D)
		Through	28.8 (52.4)	C (D)		
	Westbound	Through	43.7 (48.2)	D (D)		
		Right	10.4 (0.1)	B (A)		
	Northbound	Left	33.0 (73.8)	C (E)		
		Right	58.4 (68.2)	E (E)		
SR 16 & Outlet Mall Boulevard	Eastbound	Left	55.3 (74.2)	E (E)	46.5 (117.6)	D (F)
		Through/Right	41.7 (32.9)	D (C)		
	Westbound	Left	51.7 (57.1)	D (E)		
		Through	57.9 (138.1)	E (F)		
		Right	2.9 (3.5)	A (A)		
	Northbound	Left	53.1 (276.5)	D (F)		
		Through/Right	25.8 (29.7)	C (C)		
	Southbound	Left	68.9 (81.0)	E (F)		
		Through	46.0 (49.3)	D (D)		
		Right	12.3 (355.3)	B (F)		

In the Design Year 2043, the 95th Percentile queue length exceeds the storage at the following intersection approaches:

- Westbound left turn at SR 16 at Toms Road (PM peak hour)
- Southbound left turn at SR 16 at Toms Road (AM and PM peak hour)
- Eastbound through at SR 16 at I-95 Southbound On/Off-Ramps (AM and PM peak hour)
- Westbound left turn at SR 16 at I-95 Southbound On/Off-Ramps (AM and PM peak hour)
- Eastbound through at SR 16 at Outlet Mall Boulevard (AM and PM peak hour)

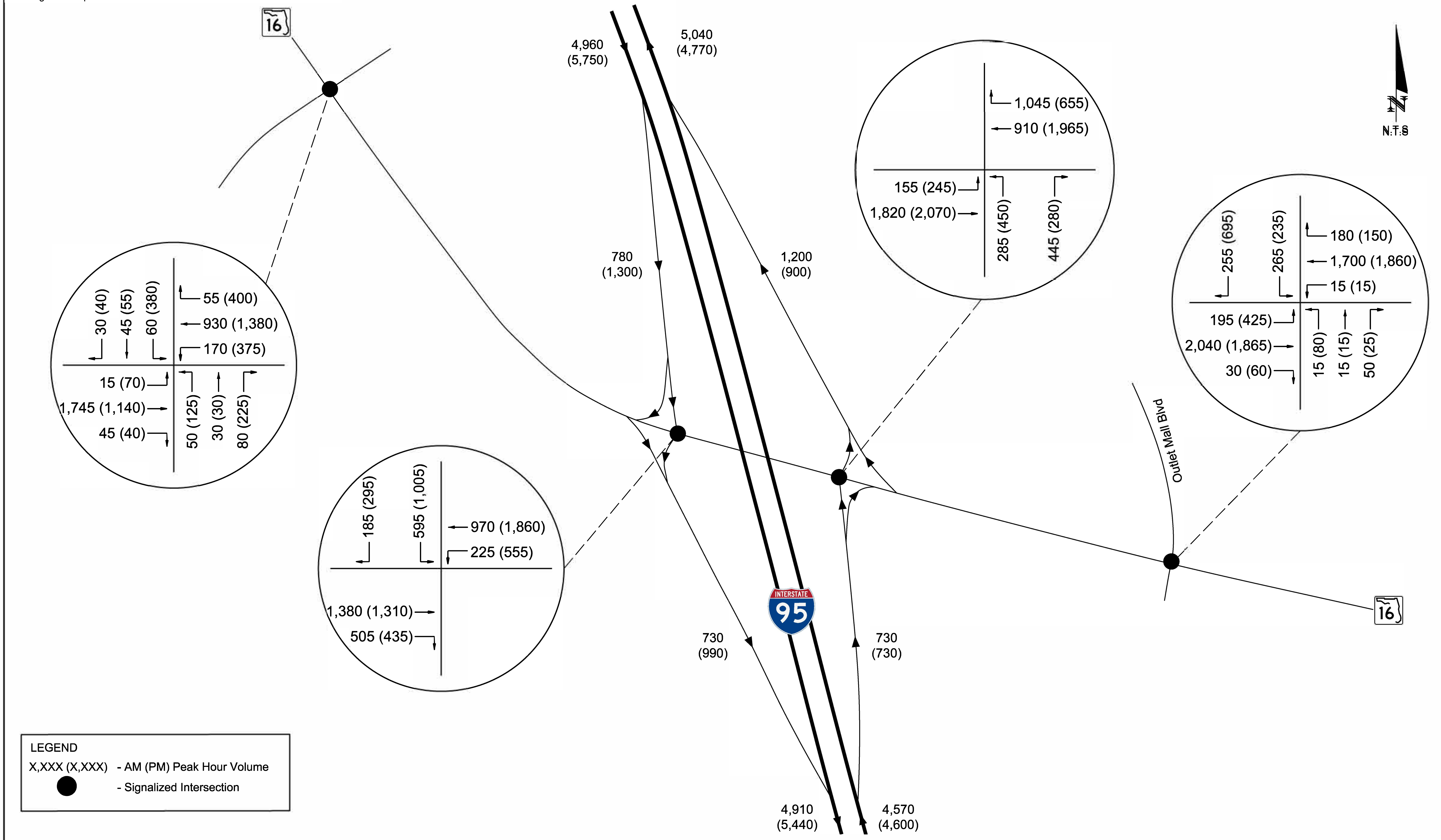
- Northbound left at SR 16 at Outlet Mall Boulevard (PM peak hour)
- Southbound right at SR 16 at Outlet Mall Boulevard (PM peak hour)

Table 6-6 summarizes the queue analysis for Design Year 2043 No-Build Alternative

Table 6-6: 95th Percentile Queue Length Summary – Design Year 2043 No-Build Alternative

Intersection	Time Period	95th Percentile Queue Length (feet)											
		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
SR 16 at Toms Road	AM Peak	10	#891	--	#167	392	--	--	#141	0	76	72	--
	PM Peak	50	#581	--	m#422	#1,051	--	--	#298	103	#541	85	--
	Available Storage (feet)	420		--	420	1,200	--	--		150	50	350	--
SR 16 at I-95 SB On/Off Ramps	AM Peak	--	m#903	--	#282	100	--	--	--	--	#348	--	89
	PM Peak	--	m#1,035	--	m#607	m165	--	--	--	--	#663	--	257
	Available Storage (feet)	--	520	--	275	450	0	--	--	--	1,400		1,400
SR 16 at I-95 NB On/Off Ramps	AM Peak	m46	m352	--	--	m251	m188	123	--	#450	--	--	--
	PM Peak	m91	m88	--	--	m542	m0	#284	--	#328	--	--	--
	Available Storage (feet)	230	450	--	--	1,000	830	1,300	--	1,300	--	--	--
SR 16 & Outlet Mall Boulevard	AM Peak	m86	#1,121	--	34	#862	37	33	54	--	#208	33	80
	PM Peak	m#245	#1,115	--	35	#1,121	38	#192	47	--	#172	34	#860
	Available Storage (feet)	425	1,000	--	280	1,335	1,050	75	75	--	1,300	3,000	200

95th percentile volume exceeds capacity, queue may be longer
m: Volume for 95th percentile queue is metered by upstream signal
Available storage for ramps includes ramp length



FDOT *I-95 / SR 16 Interchange Operational Analysis Report*	Design Year 2043 No-Build Alternative Peak Hour Volumes Mainline, Ramps and Intersections	Figure 6-3

7. ALTERNATIVES

As part of this of this IOAR, the following alternatives have been analyzed:

- No-Build Alternative
- Build Alternative

7.1. No-Build Alternative

The No-Build alternative provides a baseline for comparison to all study alternatives. This alternative represents the existing physical and operational conditions within the area of influence including all planned and programmed roadway improvements over the course of the analysis years. Since the basis for any interchange proposal is based on a comparison of the No-Build and Build Alternatives, identification of the network that is considered in the No-Build Alternative in each analysis year is required.

The No-Build alternative considered the existing configuration plus any programmed improvement with future traffic. The No-Build Alternative does not satisfy the objectives of this project. The operational analysis results for the No-Build Alternative are provided in **Section 6**.

7.2. TSM&O Improvements

The TSM&O approach includes implementation of low-cost improvements to the existing transportation network that improve traffic flow, manage congestion and maximize highway operations. Intelligent Transportation Systems (ITS), multimodal applications and adjusting signal phasing and timing are TSM&O strategies commonly used to maximize transportation infrastructure utilization. Such improvements are often less costly and require little to no right-of-way compared to physical expansion of the transportation network.

The TSM&O improvements considered for SR 16 included optimized signal timing and phasing plans and used coordinated signal timings with offsets, cycle lengths and splits optimized for the study area intersections. These improvements are included in the Build Alternative analysis.

7.3. Build Alternatives

Three (3) Build Alternatives were considered for the study interchange. These alternatives are listed below:

- Diverging Diamond Interchange (DDI) – A DDI concept was developed for the study interchange of I-95 at SR 16. Based on preliminary evaluation and cost of this alternative it was eliminated and not included in the IOAR.
- Diamond Interchange with addition of turn lanes – This alternative evaluated the existing diamond configuration with additional turn lanes at the ramp terminal intersections to achieve the acceptable LOS target.
- Diamond Interchange with addition of turn lanes and U turns – This alternative further refined the diamond interchange with addition of turn lanes by providing U-turn movements for left turns at the ramp terminal intersections. The Diamond Interchange with addition of turn lanes and U turns alternative was evaluated as the recommended alternative in this IOAR and is discussed in detail below in the Build Alternative Section.

All viable TSM&O improvements were also implemented in the Build Alternative.

7.3.1 Build Alternative

The Build Alternative looks at improvements within the study area. The following are the major improvements for the Build Alternative:

- Widening the SR 16 roadway from four lanes to six lanes with curb, gutter and sidewalk improvements from western ramp terminal to the eastern ramp terminal.

- Diamond Interchange with Left Turns along SR 16 accommodated as U-Turns

    - Extending left turn movement for eastbound approach past the northbound off-ramp terminal and bringing it back at the northbound on-ramp terminal via U-Turn. This allows northbound off-ramp left turn to SR 16 westbound movement and from SR 16 eastbound left turn to I-95 northbound on ramp movements to process during the same signal phase.

    - Extending left turn movement for westbound approach past the southbound off-ramp terminal and bringing it back at the southbound on-ramp terminal via U-Turn. This allows southbound off-ramp left turn to SR 16 eastbound movement and from

SR 16 westbound left turn to I-95 southbound on ramp movements to process during the same signal phase.

- Widening the left turn movement from westbound approach at I-95 southbound ramp terminal from one lane to two lanes.

Toms Road Phase II Concept modifications at SR 16 and Toms Road intersection were also incorporated in the Build Alternative Analysis. These improvements are listed below:

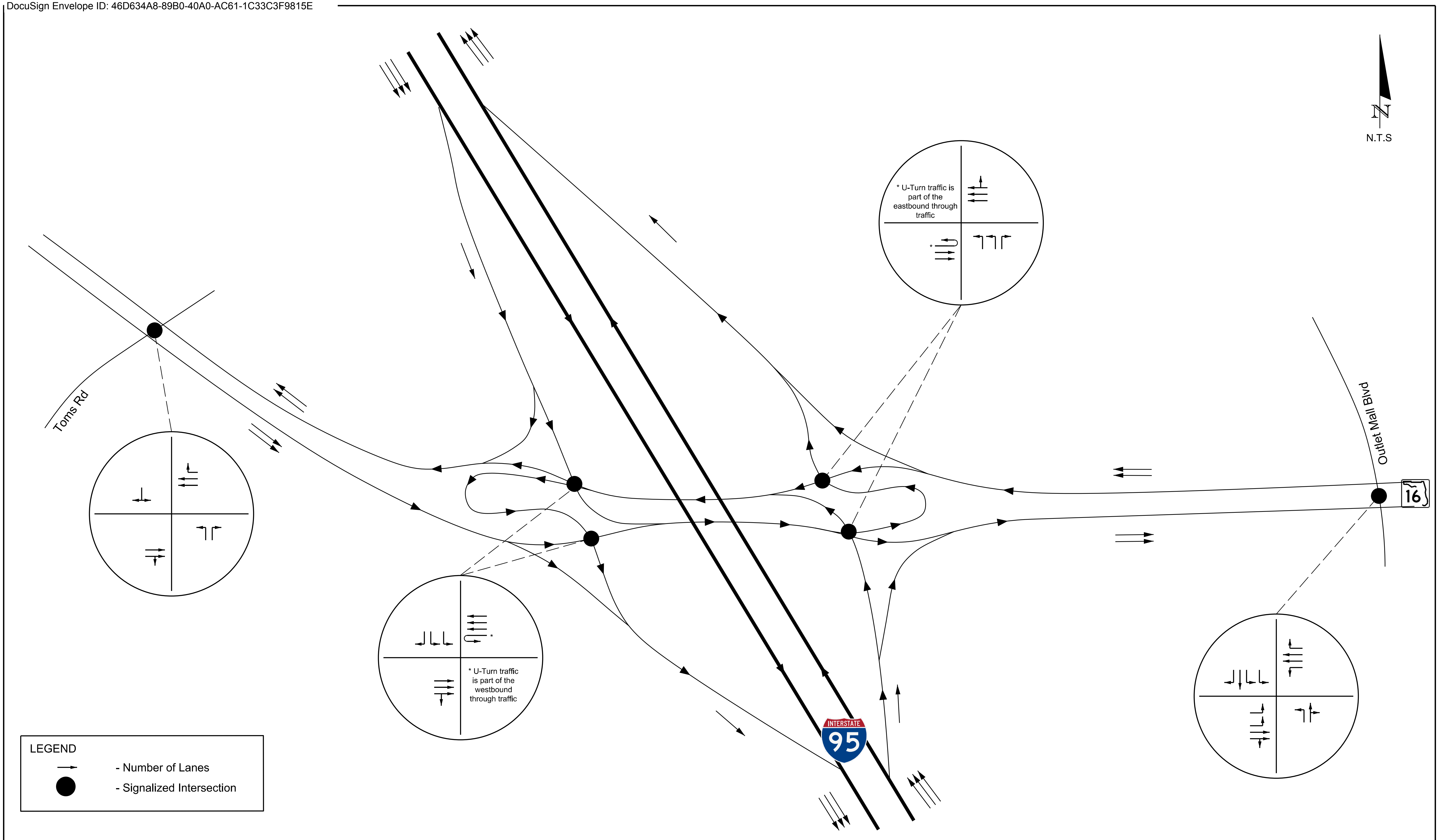
- Eliminating through movement from the Northbound and Southbound approaches.
- Eliminating left turn movement from the Eastbound and Westbound approaches.

Build Alternative interchange lane configuration is shown in **Figure 7-1** and the Build Alternative interchange concept figures are included in **Appendix F**.

7.4. Build Design Traffic

The Build Alternative design traffic for Opening Year 2023 and Design Year 2043 required redistribution of traffic based on the new design. The SR 16 at Toms Road through movements from the Northbound and Southbound approaches and left turn movement from the Eastbound and Westbound approaches were redistributed.

The Build Alternative AADTs for 2023 and 2043 are presented in **Figure 7-2**.



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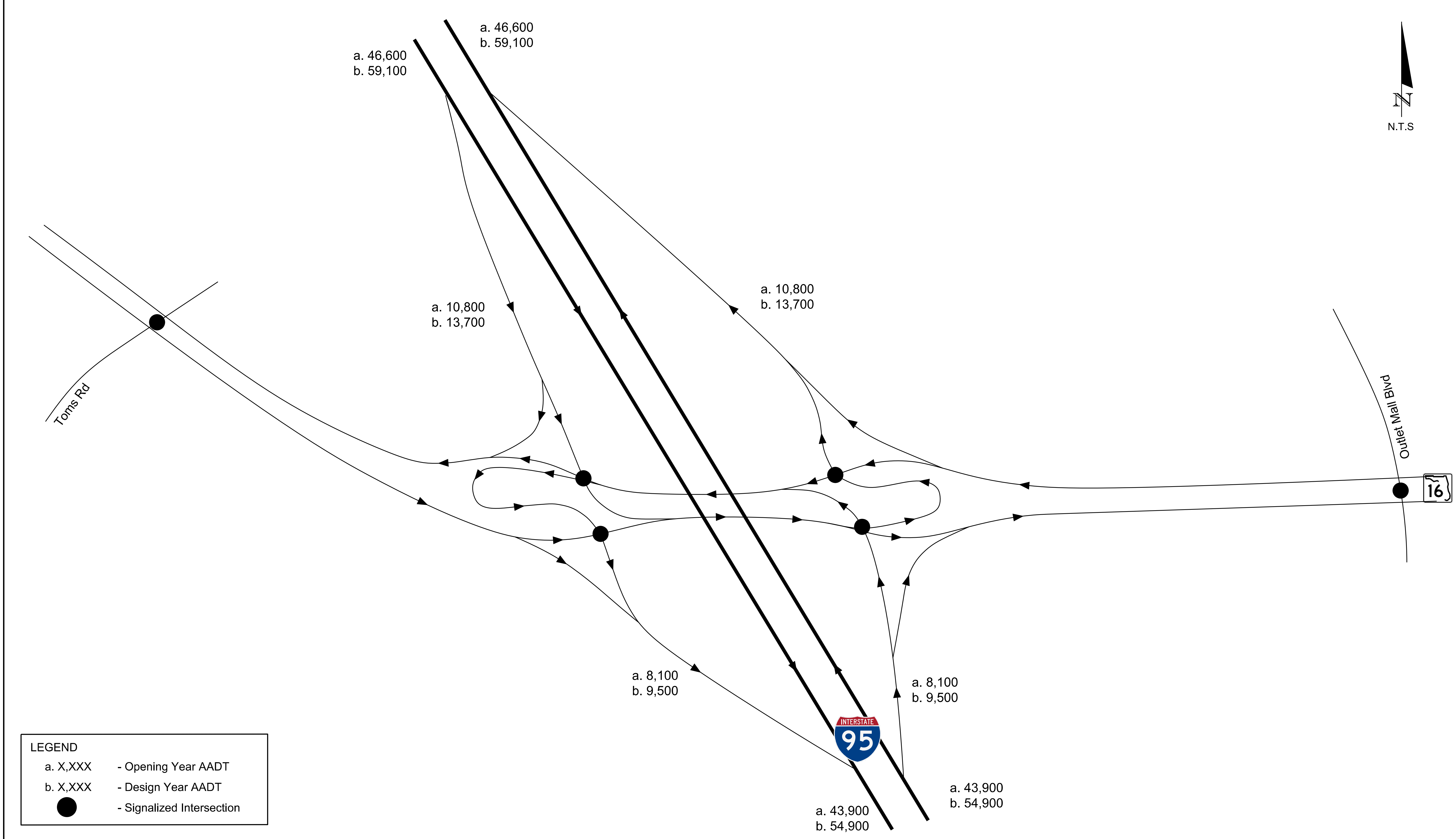
Build Alternative Lane Configuration

Figure 7-1



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Opening Year 2023 and Design Year 2043 Build Alternative Annual Average Daily Traffic (AADT)
Mainline and Ramps

Figure
7-2

8. EVALUATION OF ALTERNATIVES

This section discusses the analysis of alternatives based on engineering, safety and financial factors. The No-Build Alternative was evaluated in **Section 6**; the Build Alternative is analyzed in this section. A comparison of the No-Build and the Build Alternative is provided in this section. The evaluation criteria are described as follows:

- Conformance with Regional and State Transportation Plans
- Compliance with FHWA Requirements
- Traffic Operational Performance
- Safety
- Achievement of Objectives

8.1 Conformance with Local, Regional and State Transportation Plans

The improvements proposed in the IOAR for the Build Alternatives are consistent with improvement plans incorporated in the TPO's TIP.

8.2 Compliance with Policies and Engineering Standards

The design criteria for this project are based on design parameters outlined in the FDOT Florida Design Manual (FDM), the FDOT Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways and AASHTO's A Policy on Geometric Design of Highway and Streets published in 2011.

8.3 HCM Based Individual Element Build Operational Analysis

An individual element operational analysis was conducted for the Build Alternative. The LOS for individual freeway elements was determined using HCS 7. Ramp analysis was performed by calculating the merge/diverge areas density and LOS. Synchro 10 was used to analyze the study intersections. The results of this detailed analysis are presented in the following sections. **Figure 8-1** and **Figure 8-2** illustrate the peak hour volumes utilized for the Opening Year 2023 and Design Year 2043 Build Alternative HCS and Synchro analysis respectively. Additional information on the Build Alternative analysis is provided in **Appendix G**.

8.4 Build Alternative Operational Analysis

The Build Alternative evaluated for the SR 16 interchange along I-95 and is described in detail in **Section 7.3**.

The No-Build Alternative Operational analysis presented in **Section 6.1** of this IOAR, demonstrated that failing conditions are expected within the study area by Design Year 2043 if no infrastructure improvements are considered. To address these operational deficiencies, a design option was developed and evaluated for the SR 16 interchange. The Build Alternative performed operational analysis for the interchange using HCM procedures and is discussed in the sections below.

It should be noted that the proposed improvements did not include any design modification to I-95 mainline and merge/diverge areas. Therefore, HCS operational analysis for the Build Alternative is similar to the No-Build Alternative. Also, the Build Alternative did not include any improvements at the SR 16 and Outlet Mall Boulevard intersection as they are not in the scope of this IOAR. The lane configuration and results for this intersection are same as No-Build. FDOT plans to evaluate improvements at this intersection under a separate project in future. Microsimulation analysis using VISSIM was not performed considering the type of recommended improvements in this IOAR. The recommended improvements such as addition of turn lanes at the intersections were analyzed using Synchro.

8.4.1 2023 Build Analysis

HCS Analysis

The Opening Year 2023 Build Alternative HCS analysis is summarized in **Table 8-1**. The results of the HCS operational analysis show that all the mainline segments operate at an acceptable LOS in both AM and PM peak hours.

Table 8-1: Opening Year 2023 Build Alternative HCS Analysis Summary

Segment	Analysis Type	AM Peak Hour			PM Peak Hour		
		Volume	Density[1]	LOS	Volume	Density[1]	LOS
I-95 NB South of SR 16	Basic Segment	3,180	15.8	B	2,790	13.9	B
I-95 NB to SR 16 Off-Ramp	Diverge	2,540	22.0	C	2,130	19.9	B
I-95 NB from SR 16 On-Ramp	Merge	2,540	22.0	C	2,130	19.2	B
I-95 NB North of SR 16	Basic Segment	3,400	17.1	B	2,890	14.4	B
I-95 SB North of SR 16	Basic Segment	2,530	12.7	B	3,750	19.0	C
I-95 SB to SR 16 Off-Ramp	Diverge	1,890	20.2	C	2,800	27.4	C
I-95 SB from SR 16 On-Ramp	Merge	1,890	15.6	B	2,800	22.5	C
I-95 SB South of SR 16	Basic Segment	2,430	12.1	B	3,630	18.2	C

1. Density = passenger cars/mile/lane

Intersection Analysis

The Opening Year 2023 Build intersection analysis results are summarized in **Table 8-2**. The Build Alternative did not include any improvements at the SR 16 and Outlet Mall Boulevard intersection. The lane configuration and results for this intersection are same as No-Build. All the intersections within the project area operate at acceptable LOS C or better in both AM and PM peak hours. No operational issues are observed at any of these intersections in the Opening Year 2023 Build Alternative.

Table 8-2: Opening Year 2023 Build Alternative Intersection Analysis Summary

Intersection	Intersection Approach				Overall Intersection	
	Approach	Movement	Delay (sec)	LOS	Delay (sec)	LOS
			AM (PM)	AM (PM)	AM (PM)	AM (PM)
SR 16 at Toms Road	Eastbound	Through/Right	5.5 (13.1)	A (B)	5.6 (11.3)	A (B)
	Westbound	Through	1.4 (2.3)	A (A)		
		Right	0.1 (0.4)	A (A)		
	Northbound	Left	43.5 (25.8)	D (C)		
		Right	12.6 (11.7)	B (B)		
	Southbound	Left/Right	22.1 (36.3)	C (D)		
SR 16 at I-95 SB Off Ramps	Eastbound	Right	0 (0.1)	A (A)	9.9 (15.6)	A (B)
	Westbound	Through	8.1 (20.3)	A (C)		
	Southbound	Through	16.3 (14.7)	B (B)		
		Right	11 (10.7)	B (B)		
SR 16 at I-95 SB On Ramps	Eastbound	Through	19 (27.8)	B (C)	12.7 (16.0)	B (B)
		Right	4.4 (9.1)	A (A)		
	Southbound	Left	1.3 (1.5)	A (A)		
		Through[1]	23.4 (18.3)	C (B)		
SR 16 at I-95 NB Off Ramps	Eastbound	Through	11.4 (16.4)	B (B)	13.5 (15.2)	B (B)
	Westbound	Right	0.1 (0.1)	A (A)		
	Northbound	Through	20.8 (19.9)	C (B)		
		Right	21.1 (11.4)	C (B)		
SR 16 at I-95 NB On Ramps	Westbound	Through	13.4 (29.5)	B (C)	15.8 (28.0)	B (C)
		Right	16.5 (24.5)	B (C)		
	Northbound	Left	1.1 (1.2)	A (A)		
		Through[2]	61.6 (79.7)	E (E)		

Note: 1 Operational analysis result for the westbound to I-95 southbound on ramp U-turn movement

2 Operational analysis result for the eastbound to I-95 northbound on ramp U-turn movement

In the Opening Year 2023 Build Alternative, the 95th Percentile queue length exceeds the storage at the following intersection approaches:

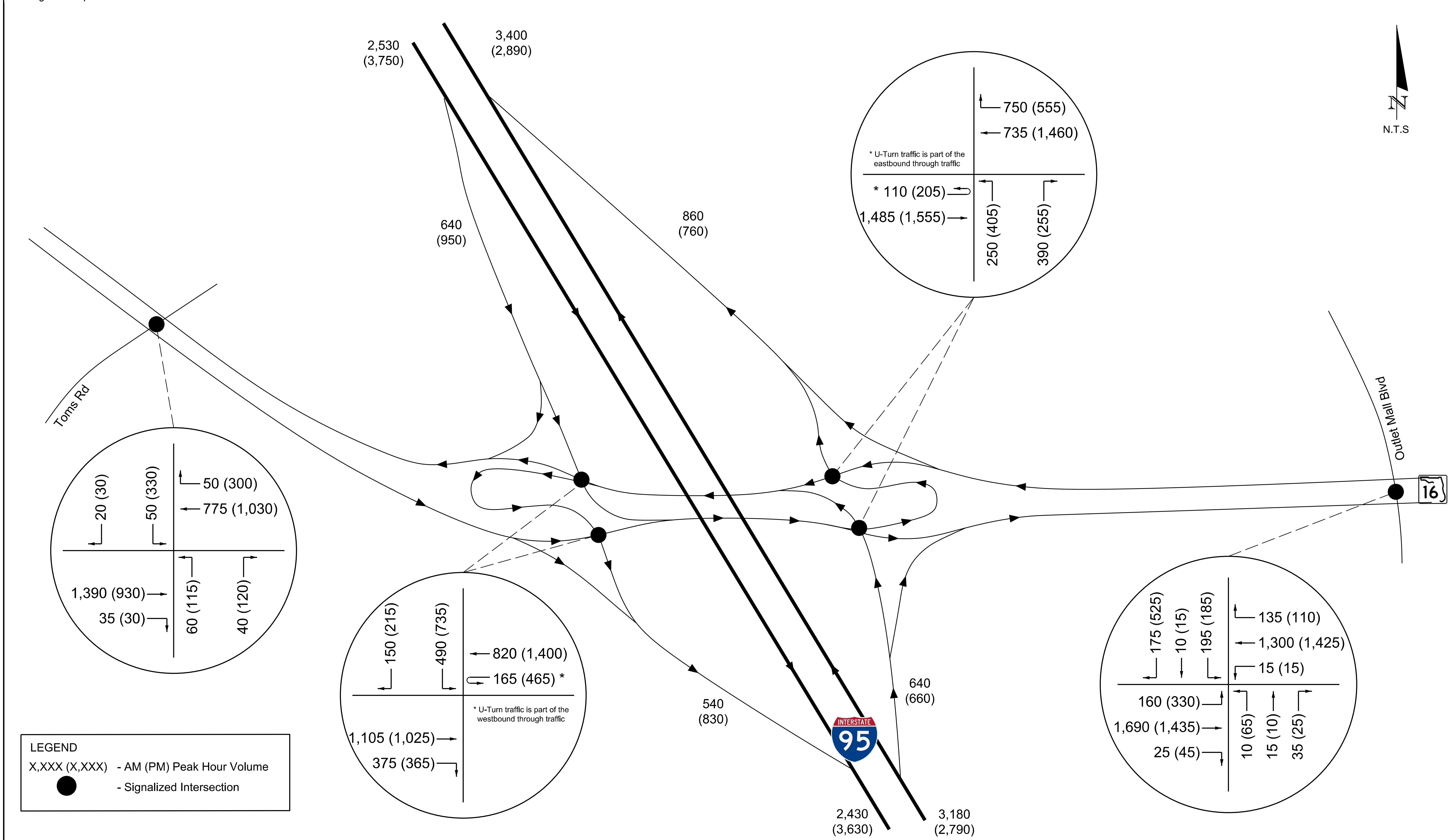
- Westbound right turn SR 16 at I-95 Northbound On Ramps (AM and PM peak hour)

Table 8-3 summarizes the queue analysis for Opening Year 2023 Build Alternative.

Table 8-3 95th Percentile Queue Length Summary – Opening Year 2023 Build Alternative

Intersection	Time Period	95th Percentile Queue Length (feet)											
		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
SR 16 at Toms Road	AM Peak	--	238	--	--	10	0	71	--	26	53	--	--
	PM Peak	--	267	--	--	m21	m0	87	--	57	242	--	--
	Available Storage (feet)	--	2,200	--	--	1,200	400	420	--	150	350	--	--
SR 16 at I-95 SB Off Ramps	AM Peak	--	--	0	--	58	--	--	--	--	--	131	73
	PM Peak	--	--	m0	--	#241	--	--	--	--	--	182	98
	Available Storage (feet)	--	--	250	--	450	--	--	--	--	--	1,400	1,400
SR 16 at I-95 SB On Ramps	AM Peak	--	236	42	--	--	--	--	--	--	0	77	--
	PM Peak	--	261	82	--	--	--	--	--	--	0	183	--
	Available Storage (feet)	--	520	200	--	--	--	--	--	--	--	250	--
SR 16 at I-95 NB Off Ramps	AM Peak	--	158	--	--	--	m0	--	83	230	--	--	--
	PM Peak	--	266	--	--	--	m0	--	123	111	--	--	--
	Available Storage (feet)	--	450	--	--	--	225	--	1,300	1,300	--	--	--
SR 16 at I-95 NB On Ramps	AM Peak	--	--	--	--	159	460	0	87	--	--	--	--
	PM Peak	--	--	--	--	354	347	0	170	--	--	--	--
	Available Storage (feet)	--	--	--	--	1,000	200	--	225	--	--	--	--

95th percentile volume exceeds capacity, queue may be longer
m: Volume for 95th percentile queue is metered by upstream signal
Available storage for ramps includes ramp length



FDOT

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Opening Year 2023 Build Alternative Peak Hour Volumes
Mainline, Ramps and Intersections

Figure 8-1

8.4.2 2043 Build Analysis

HCS Analysis

The Design Year 2043 Build HCS analysis is summarized in **Table 8-4**. The results of the operational analysis show that all the segments along I-95 Northbound and Southbound operate at acceptable LOS D or better in AM peak hour. In the PM peak hour, the diverge segment from I-95 Southbound to SR 16 operates at LOS E similar to the No-Build condition. All the remaining segments operate at acceptable LOS D or better.

Table 8-4: Design Year 2043 Build Alternative HCS Analysis Summary

Segment	Analysis Type	AM Peak Hour			PM Peak Hour		
		Volume	Density[1]	LOS	Volume	Density[1]	LOS
I-95 NB South of SR 16	Basic Segment	4,570	24.1	C	4,600	24.3	C
I-95 NB to SR 16 Off-Ramp	Diverge	3,840	29.2	D	3,870	29.3	D
I-95 NB from SR 16 On-Ramp	Merge	3,840	31.3	D	3,870	29.1	D
I-95 NB North of SR 16	Basic Segment	5,040	27.7	D	4,770	25.6	C
I-95 SB North of SR 16	Basic Segment	4,960	27.1	D	5,750	34.4	D
I-95 SB to SR 16 Off-Ramp	Diverge	4,180	32.9	D	4,450	37.2	E
I-95 SB from SR 16 On-Ramp	Merge	4,180	28.8	D	4,450	32.2	D
I-95 SB South of SR 16	Basic Segment	4,910	26.6	D	5,440	31.2	D

1. Density = passenger cars/mile/lane

Intersection Analysis

The Design Year 2043 Build intersection analysis results are summarized in **Table 8-5.** The Build Alternative did not include any improvements at the SR 16 and Outlet Mall Boulevard intersection. The lane configuration and results for this intersection are same as No-Build. In Design Year 2043, all the intersections within the project operate at acceptable LOS C or better in both AM and PM peak hours. No operational issues are observed at any of these intersections in the Design Year 2043 Build Alternative. All individual movements operate acceptably in Design Year 2043 under the Build Alternative versus the No-Build condition that had several failing movements.

Table 8-5: Design Year 2043 Build Alternative Intersection Analysis Summary

Intersection	Intersection Approach				Overall Intersection	
	Approach	Movement	Delay (sec) AM (PM)	LOS AM (PM)	Delay (sec) AM (PM)	LOS AM (PM)
SR 16 at Toms Road	Eastbound	Through/Right	8.6 (15.7)	A (B)	9.1 (15.4)	A (B)
	Westbound	Through	1.5 (5.1)	A (A)		
		Right	0.1 (0.4)	A (A)		
	Northbound	Left	49.4 (26.7)	D (C)		
		Right	20.4 (17.7)	C (B)		
	Southbound	Left/Right	43 (53.0)	D (D)		
SR 16 at I-95 SB Off Ramps	Eastbound	Right	0.1 (0.1)	A (A)	14.1 (27.1)	B (C)
	Westbound	Through	15 (37.1)	B (D)		
	Southbound	Through	17.9 (21.5)	B (C)		
		Right	13.2 (15.8)	B (B)		
SR 16 at I-95 SB On Ramps	Eastbound	Through	23.3 (23.4)	C (C)	15.7 (14.0)	B (B)
		Right	10.9 (7.4)	B (A)		
	Southbound	Left	5.7 (8.6)	A (A)		
		Through[1]	6.4 (6.8)	A (A)		
SR 16 at I-95 NB Off Ramps	Eastbound	Through	17.4 (20.3)	B (C)	18.1 (18.9)	B (B)
	Westbound	Right	0.1 (0.1)	A (A)		
	Northbound	Through	21.6 (24.4)	C (C)		
		Right	25.4 (15.6)	C (B)		
SR 16 at I-95 NB On Ramps	Westbound	Through	7.9 (25.4)	A (C)	22.0 (20.3)	C (C)
		Right	41.5 (20.1)	D (C)		
	Northbound	Left	2.2 (4.0)	A (A)		
		Through[2]	9.7 (10.4)	A (B)		

Note: 1 Operational analysis result for the westbound to I-95 southbound on ramp U-turn movement

2 Operational analysis result for the eastbound to I-95 northbound on ramp U-turn movement

In the Design Year 2043, the 95th Percentile queue length exceeds the storage at the following intersection approaches:

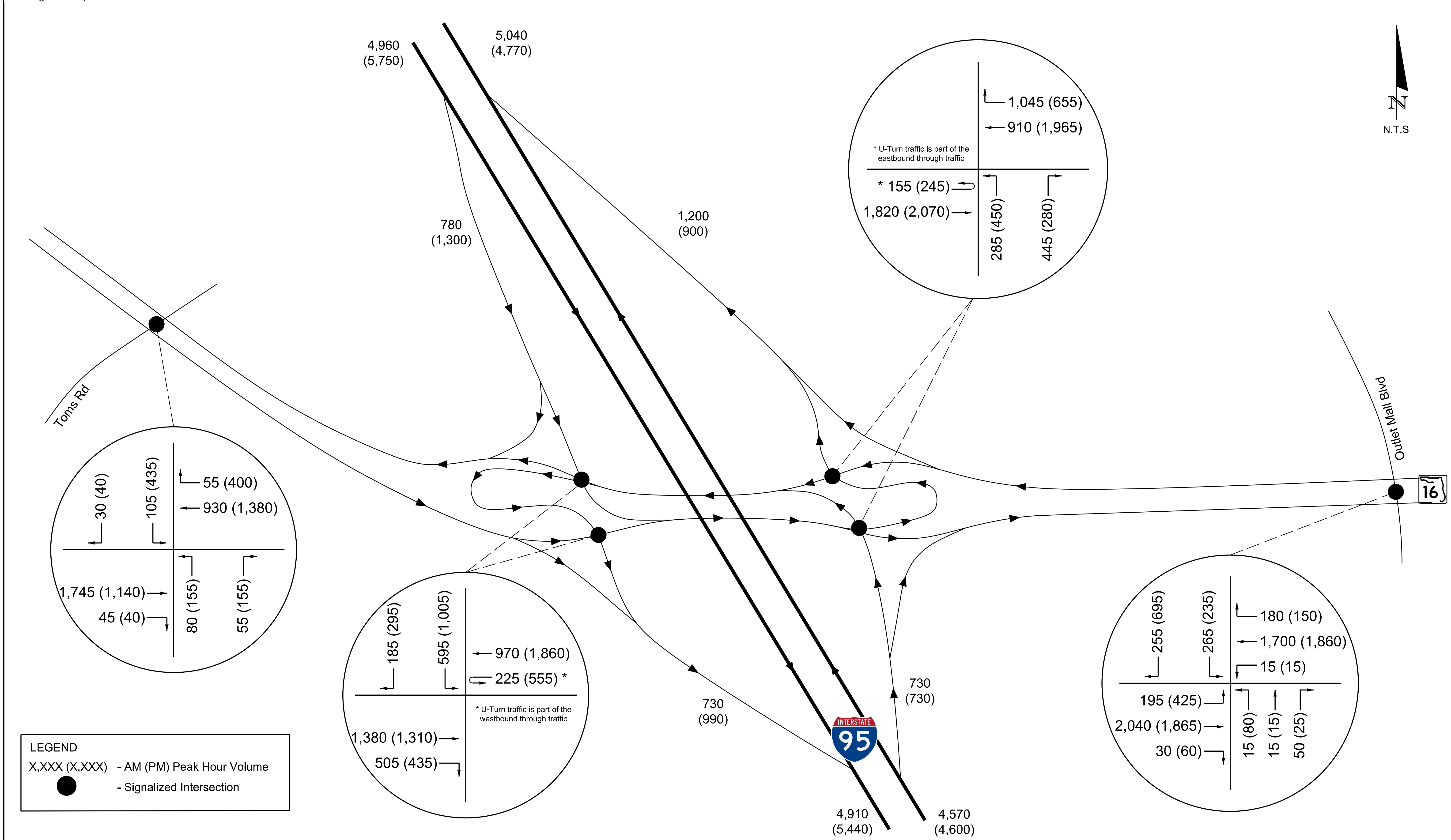
- Westbound through at SR 16 at I-95 Southbound Off Ramp (PM Peak Hour)
- Eastbound right turn at SR 16 at I-95 Southbound On Ramp (AM Peak Hour)
- Westbound right turn at SR 16 at I-95 Northbound On Ramp (AM and PM Peak Hour)

Table 8-6 summarizes the queue analysis for Design Year 2043 Build Alternative.

Table 8-6: 95th Percentile Queue Length Summary – Design Year 2043 Build Alternative

Intersection	Time Period	95th Percentile Queue Length (feet)											
		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
SR 16 at Toms Road	AM Peak	--	388	--	--	27	m0	97	--	45	122	--	--
	PM Peak	--	367	--	--	m460	m7	111	--	90	344	--	--
	Available Storage (feet)	--	2,200	--	--	1,200	400	420	--	150	350	--	--
SR 16 at I-95 SB Off Ramps	AM Peak	--	--	0	--	104	--	--	--	--	--	173	101
	PM Peak	--	--	m0	--	#512	--	--	--	--	--	305	162
	Available Storage (feet)	--	--	250	--	450	--	--	--	--	--	1,400	1,400
SR 16 at I-95 SB On Ramps	AM Peak	--	347	270	--	--	--	--	--	--	53	26	--
	PM Peak	--	285	76	--	--	--	--	--	--	101	58	--
	Available Storage (feet)	--	520	200	--	--	--	--	--	--	--	250	--
SR 16 at I-95 NB Off Ramps	AM Peak	--	265	--	--	--	m0	--	98	306	--	--	--
	PM Peak	--	#360	--	--	--	m0	--	151	143	--	--	--
	Available Storage (feet)	--	450	--	--	--	225	--	1,300	1,300	--	--	--
SR 16 at I-95 NB On Ramps	AM Peak	--	--	--	--	60	#316	12	45	--	--	--	--
	PM Peak	--	--	--	--	m453	m360	28	63	--	--	--	--
	Available Storage (feet)	--	--	--	--	1,000	200	--	225	--	--	--	--

95th percentile volume exceeds capacity, queue may be longer
m: Volume for 95th percentile queue is metered by upstream signal
Available storage for ramps includes ramp length



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Design Year 2043 Build Alternative Peak Hour Volumes
Mainline, Ramps and Intersections

Figure
8-2

8.5 Safety

A quantitative safety analysis was also performed to determine if the study alternative addressed the existing safety concerns. The safety analysis performed follows the guidelines in the 2018 IARUG. The safety analysis was performed using Crash Modification Factors (CMFs) from the CMF Clearinghouse funding by FHWA.

Table 8-7, presented below, shows the reduction in crashes based on the Build Alternative for SR 16 from CR 208 to the I-95 at SR 16 northbound ramp terminal intersection. These crash frequencies were then used to determine the safety impact of the proposed improvements. Of the proposed improvements, widening SR 16 from four to six lanes and converting a yield signal control to signalized control have known CMFs. The safety benefits of some other improvements must be looked at qualitatively. For example, the type of operational improvement being implemented at the SR 16 at Toms Road intersection cannot be analyzed using the HSM and the FHWA Clearinghouse. The elimination of left turn movements at this intersection is expected to improve safety and reduce rear-end and angle crashes. Also, the U-turns provided at the ramp terminal intersections cannot be analyzed using HSM and the FHWA Clearinghouse, but the elimination of left turns improves operations and is expected to reduce the sideswipe crashes.

The CMFs used to quantify the benefits of the project include:

- Clearinghouse CMF 7924: Increase from 4 lanes to 6 lanes = 0.85
- Clearinghouse CMF 2554: Convert from yield signal control to signalized control = 0.64.

It should be noted that CMF 2554 is implemented at the ramp terminals only and applied to the off-ramps' right turn crashes only.

By implementing the proposed modifications, a total crash reduction of 10.13 crashes a year is expected. The CMF Clearinghouse summary reports are provided in **Appendix H**.

Table 8-7: Reduced Crashes Based on the Build Alternative

Location	Existing Number of Crashes	Crash Frequency (crashes/year)	CMF	Reduction in Crashes Annually
SR 16 - Toms Road to CR 208	28	5.6	0.85	0.84
SR 16 at CR 208	33	6.6	0.85	0.99
SR 16 at I-95 SB Ramp Terminal	32	6.4	0.85	0.96
SR 16 at I-95 NB Ramp Terminal	31	6.2	0.85	0.93
SR 16 at I-95 SB Ramp Terminal Right Turns	41	8.2	0.64	2.95
SR 16 at I-95 NB Ramp Terminal Right Turns	48	9.6	0.64	3.46
Total	213	42.6		10.13

8.6 Alternatives Comparison

The No-Build Alternative and the Build Alternative were compared and a summary is provided in the sections below.

8.6.1 Operational Comparison

This section compares the mainline, merge/diverge and intersections traffic operational performance of the No-Build and Build Alternatives.

The No-Build Alternative intersections of SR 16 at Toms Road, I-95 Southbound On/Off-Ramps and I-95 Northbound On/Off-Ramps do not operate at an acceptable LOS and individual movements operate at LOS F. The traffic operations at these intersections improve with the implementation of the Build Alternative and will operate at LOS C or better.

8.6.2 Cost Estimation

A cost estimation was performed for Build Alternative. The Build Alternative cost estimates are shown in **Table 8-8.** The total project cost for the Build Alternative is $9,139,519.76. The FDOT Long Range Estimating (LRE) is provided in **Appendix I**.

Table 8-8 Build Alternatives Long Range Estimates

Cost	Build Alternative
Roadway Construction (LRE Cost)	$7,311,615.81
Engineering/Design (10% Construction)	$731,161.58
CEI (15% Construction)	$1,096,742.37
Total Project Cost	$9,139,519.76

8.7 Recommended Alternative

The No-Build Alternative will not accommodate the travel demand at the I-95 at SR 16 interchange. In the Design Year 2043, significant operational deficiencies exist. Three out of four study area intersections operate at unacceptable LOS in the Design Year 2043 No-Build Alternative. These operational deficiencies are associated with high arterial through and left-turn volume at the SR 16 ramp terminal intersection and insufficient capacity at the ramp terminal and at the Outlet Mall Boulevard intersections. Congestion from the insufficient capacity at these intersections extend to the I-95 southbound off ramp and spills back onto southbound mainline affecting freeway operations. These also affected the operations at the northbound off ramp and Toms Road intersection.

The Build Alternative for this study performs substantially better than the No-Build Alternative for all future years. The proposed interchange improvements provide additional capacity for the eastbound and westbound through volumes and better operations by reconfiguration of the signal phasing. SR 16 arterial will benefit from the increase in number of through lanes and improved ramp terminal intersection configuration resulting in lower intersection delay. These improvements help process traffic travelling to and from the interchange. SR 16 at Outlet Mall Boulevard intersection operate similar to the No-Build Alternative. SR 16 at Outlet Mall Boulevard intersection improvements are not included in the scope of this IOAR and FDOT plans to evaluate improvements at this intersection under a separate project in future.

A predicted quantitative safety analysis was also performed to determine if the Build Alternative addressed the existing safety concerns. Based on the proposed improvements, crashes are expected to reduce by 10.13 crashes per year.

Considering all the findings described in the IOAR, the Build Alternative is recommended as the Preferred Alternative for approval in this study. A final comparison of the No-Build and Build Alternatives is provided in **Table 8-9**.

Table 8-9: Alternatives Evaluation Summary

Evaluation Factors		No-Build	Build Alternative
ENGINEERING	Meets Purpose and Need	No	Yes
	Improves Safety	No	Yes
	Meets 2043 LOS Target	No	Yes
	Improves SIS Connectivity	No	Yes
	Meets Geometric Design Criteria	Yes	Yes
COST	Construction	$0	$9.1M

8.8 Conceptual Signing Plan

A conceptual signing plan was prepared for the recommended alternative. **Appendix J** presents the conceptual signing plan for proposed modifications within the area of influence.

8.9 Design Exceptions and Variations

Implementation of the proposed improvements will not require any design exceptions or variations.

9. JUSTIFICATION

The proposed improvements at the SR 16 interchange with I-95 are consistent with the requirements set by the FHWA Access to the Interstate System Policy dated May 22, 2017 and by FDOT Procedure No. 525-030-160. The roadway enhancements in this IOAR will provide traffic relief, thereby enhance safety within the area of influence. The I-95 at SR 16 interchange will operate at an acceptable LOS through the Design Year 2043.

9.1 Compliance with FHWA General Requirements

The following requirements serve as the primary decision criteria used in approval of interchange modification projects. Responses to each of the FHWA 2 policy points are provided to show that the proposed modification for the I-95 at SR 16 interchange is viable based on the conceptual analysis performed to date.

9.1.1 FHWA Policy Point 1

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, 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 (23 CFR 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)).

An in-depth operational and safety analysis was conducted to study the impacts of the proposed improvements at the I-95 and SR 16 interchange. Several performance measures were used to compare the operations of the existing system under No-Build and Build conditions. Key measures included freeway densities, intersection delays, 95th percentile queue lengths and safety under existing and proposed conditions.

From an operational perspective in the Design Year 2043 under No-Build Alternative, operational and safety deficiencies will exist. The intersections along SR 16 at Toms Road, I-95 Southbound On/Off Ramps and Outlet Mall Boulevard will operate at LOS E or worse in the PM peak hour. These deficiencies are attributed to the insufficient capacity at all three intersections. At the I-95 southbound ramp terminal intersection, queues are longer than the available storage in the eastbound and westbound directions in 2043 under the No-Build.

The Build Alternative for this study performs substantially better than the No-Build Alternative for all future years. The proposed interchange improvements provide additional capacity for the heavy left turn volumes as well as for the arterial through volumes. By implementing these improvements, the study intersections of I-95 at SR 16 will operate at acceptable LOS C or better in both AM and PM peak hour. SR 16 arterial will also benefit from the increase in number of through lanes and improved ramp terminal intersections configuration which allows off ramp left turn to arterial and from arterial left turn to on ramp movements to be processed through the intersection together, resulting in lower intersection delay when traveling through the proposed interchange.

The safety analysis performed for this study indicated a total of 443 crashes occurred within the project area, of which 341 of the total crashes occurred on the project segment SR 16 from 2012 to 2016. The predominant crash types that occurred within the study area were rear end and angled collisions. Crashes of these types are typically attributed to congestion along the interstate, arterials and interchange ramps.

With the improved operations under the Build Alternative, it is anticipated to enhance safety within the project area. A predictive safety analysis was performed for the study area where improvements are to be implemented. Based on the safety analysis, it is predicted that a reduction of 10.13 crashes will occur annually due to the recommended improvements.

Overall, the Build Alternative provides significantly better traffic operations and enhanced safety when compared to the No-Build Alternative.

In conclusion, the comparison of the No-Build and Build alternatives show that the proposed interchange improvements provide enhanced operation and safety conditions. The proposed modifications in the build alternative are not anticipated to have a negative impact on operations or safety of the I-95 mainline or the adjacent interchanges.

9.1.2 FHWA Policy Point 2

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

The proposed improvements to the I-95 at SR 16 interchange and adjacent intersections will provide full access and cater to all traffic movements from SR 16 to and from I-95. The proposed modifications are designed to meet current standards for federal-aid projects on the interstate system and conform to American Association of State Highway and Transportation Officials (AASHTO) and the FDOT design.

10. CONCEPTUAL FUNDING PLAN/CONSTRUCTION SCHEDULE

The improvements proposed as part of the Build Alternative at the I-95 at SR 16 interchange are performed under the Programmatic Agreement with FHWA. Therefore, FDOT Central Office will conduct necessary review and assessment of the justification for the proposed improvements. This project is included in the (2019-2024) FDOT Five Year Work Program. This project is also included in the North Florida Transportation Planning Organization (North Florida TPO) Transportation Improvement Program (TIP) adopted in June 2019 for Fiscal Year 2019/2020 to 2023/2024.

List of Appendices

Appendix A	Methodology Letter of Understanding
Appendix B	Existing Traffic Volume, Existing signal Timing, and I-95 Express Phase 1 SIMR from International Golf Parkway to I-295
Appendix C	Existing Year 2018 HCS and Synchro Outputs
Appendix D	Raw Crash Data
Appendix E	No-Build Opening Year 2023 and Design Year 2043 HCS and Synchro Outputs
Appendix F	Build Alternative Concept Design
Appendix G	Build Alternative Opening Year 2023 and Design Year 2043 HCS and Synchro Output
Appendix H	Safety Analysis
Appendix I	FDOT Long Range Cost Estimating
Appendix J	Build Alternative Conceptual Signing Plan