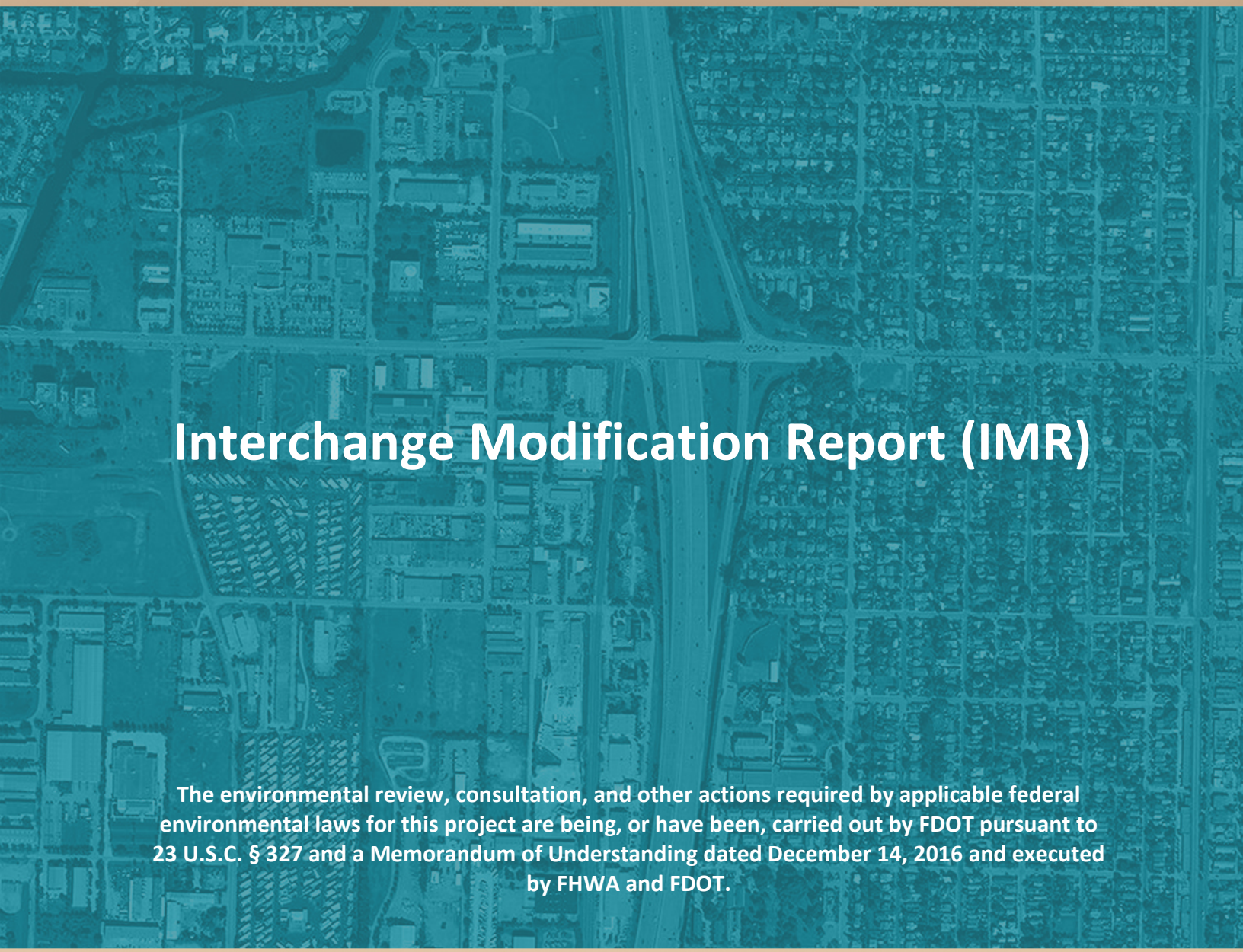
I-95 (SR 9) at 10th Avenue North
PD&E Study



Interchange Modification Report (IMR)

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

Palm Beach County, Florida

Financial Project Number: 412733-1-22-02 **ETDM**

Number: 14337

Federal Aid No.: D417-077-B

Florida Department of Transportation District Four

January 2021

FDOT

District 4

Interchange Modification Report (IMR)

PD&E Study: SR 9/I-95 at 10th Avenue North
Palm Beach County, Florida

ETDM No.: 14337
Financial Project ID: 412733-1-22-02
Federal Aid No.: D417-077-B

Prepared for

Florida Department of Transportation (FDOT)
District 4

January 2021

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

Interchange Modification Report (IMR)

PD&E Study: SR 9/I-95 at 10th Avenue North

Palm Beach County, Florida

Financial Project ID: 412733-1-22-02

Florida Department of Transportation

Determination of Safety, Operational and Engineering Acceptability

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

Requestor	DocuSigned by: Humberto Arrieta F20CB13C158648D...	2/2/2021 | 1:38 PM EST
	Humberto Arrieta Consultant Management/ Project Manager	Date
Interchange Review Coordinator	DocuSigned by: Cesar Martinez DC7B7B72D0BD4A2...	2/2/2021 | 1:47 PM EST
	Cesar Martinez, PE District Four	Date
Systems Management Administrator	DocuSigned by: Jenna Bowman 4AD03E6A337F4C1...	2/10/2021 | 9:51 AM EST
	Jenna Bowman, PE Systems Implementation Office – Central Office	Date
State Chief Engineer	DocuSigned by: 022E6284290B41A...	2/10/2021 | 2:59 PM EST
	Will Watts, P.E. Central Office	Date

SYSTEMS IMPLEMENTATION OFFICE

QUALITY CONTROL CERTIFICATION FOR INTERCHANGE ACCESS REQUEST SUBMITTAL

Submittal Date: 1/28/2021

FM Number: 412733-1-22-02

Project Title: SR 9/I-95 at 10th Avenue North Project Development & Environment (PD&E) Study

District: Four

Requestor: Humberto Arrieta, PE Phone: (954) 777-4152

District IRC: Cesar Martinez, P.E. Phone: 954/777-4653

Document Type: ☐ MLOU ☐ IJR ☒ IMR ☐ IOAR ☐ OTHER (Specify)

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: DocuSigned by: Humberto Arrieta F20CB13C158048D... Date: 2/2/2021 | 1:38 PM EST

Humberto Arrieta, PE
Consultant Management/Project Manager

IRC: DocuSigned by: Cesar Martinez DC7B7D72D0BD4A2... Date: 2/2/2021 | 1:47 PM EST

Cesar Martinez, PE
District 4 Project Development Manager

PROFESSIONAL ENGINEER CERTIFICATE

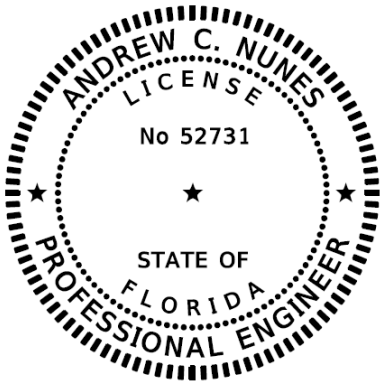
I hereby certify that I am a registered professional engineer in the State of Florida practicing with American Consulting Professionals, LLC., a Florida corporation authorized under the provisions of Section 471.023, Florida Statutes, to offer engineering services to the public through a Professional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

PROJECT: SR 9/I-95 at 10th Avenue North Project Development & Environment (PD&E) Study

LOCATION: Palm Beach County, FL

FINANCIAL PROJECT ID: 412733-1-22-02

This report includes a summary of data collection efforts, traffic analyses, discussion of the 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.



THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY:

Andrew C Nunes
2021.01.28 17:05:26 -05'00'

ON THE DATE ADJACENT TO THE SEAL

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

AMERICAN CONSULTING PROFESSIONALS, LLC
2041 VISTA PARKWAY, SUITE 101
WEST PALM BEACH, FL 33411
PHONE: (561) 253-9550 FAX: (561) 253-9551
Andrew C. Nunes, P.E. NO. 52731

EXECUTIVE SUMMARY

The purpose of the project is to improve the local and regional transportation network while simultaneously providing enhanced multimodal interrelationships at the I-95 and 10th Avenue North interchange. Further consideration for the need of this project includes improving capacity and transportation demand, improving safety through design year and also enhancing emergency evacuation and response times. The project aims at improving the capacity and mobility through the study interchange as traffic increases, thereby increasing the amount of congestion due to the anticipated increase in the population of Palm Beach County from 1,471,150 in 2017 (US Census) to 1,715,300 in 2040 (US Census), representing an increase of 17% approximately.

According to the Future Land Use Plan for the City of Lake Worth Beach, the area will mainly remain residential with mixed-used and high-density residential and pockets of public and pubic recreating open space. As the population of the City and the County continues to increase, traffic will continue to grow, thereby, increasing the amount of congestion.

The *Interchange Concept Development Report for I-95 (SR 9) Interchange at 10th Avenue North, Palm Beach County, dated June 2014*, shows that if no improvements are made in the study interchange, it is forecasted that by 2045, for AM and PM peak hour, the southbound and northbound ramps intersections will be operating at a level of service (LOS) of D and F respectively. Therefore, long-term interchange improvements are needed to maintain acceptable level of service through the study area, thereby, reduce delays, travel time and provide more mobility to the residents and commuters in this area along 10th Avenue North which provides east-west access in the City of Lake Worth Beach and Palm Beach County.

The proposed interchange improvements will also address pedestrian and bicycle modes and will ensure that the project corridor continues to meet mobility and safety goals as travel demands continue to grow.

The existing configuration of the existing study interchange is a tight-diamond urban interchange (TUDI), with 10th Avenue North carried on structure over I-95. In the vicinity of the 10th Avenue North interchange, I-95 is a ten-lane divided interstate freeway providing four general purpose lanes and one High Occupancy Vehicle (HOV) lane in each direction. There is one auxiliary (AUX) lane northbound and southbound between 10th Aveune North and Forest Hill Boulevard. There are two AUX lanes northbound and one AUX lane southbound between 6th Aveune South and 10th Aveune North.

The South Florida Rail Corridor (SFRC)/CSX runs parallel and immediately to the west of I-95. 10th Avenue also spans over the rail line on separate structure from the I-95 crossing. The 10th Avenue North roadway is a four-lane divided urban minor arterial near the I-95 interchange. The adjacent signalized intersections located east and west of the interchange are Barnett Drive (west), and at “A” Street (east). Barnett Drive, and A Street are all two-lane undivided city collectors that run north-

south adjacent to the interchange. A project location map which identifies the study limits and area of influence is provided in **Figure 1-1**.

A Methodology Letter of Understanding (MLOU) was prepared to document the methodology for the analysis and evaluation of this Interchange Modification Report (IMR). The MLOU was approved by the Florida Department of Transportation (FDOT) District 4 Interchange Review Coordinator (IRC), and FDOT Central Office in November 2019. The primary basis for traffic projections in this IMR are existing field traffic counts and the latest version of Southeast Regional Planning Model V7.062 (SERPM 7.062) with base year 2010 and horizon year 2040. The analysis years for this study include Existing Year 2019, Opening Year 2025, and Design Year 2045. The operational analysis for this study was performed using the Highway Capacity Software (HCS Version 7.7) and Synchro Version 10.0. All operational analysis followed the guidelines of the *Highway Capacity Manual 6th Edition* (HCM 6).

Several alternatives were evaluated to address the purpose and needs identified for this project. First level of screening eliminated some alternatives and second level screening and based on discussions with the FDOT only two build alternatives were considered for further evaluation. The two Build Alternatives evaluated in this IMR are Build Alternative 1 (TUDI) and Build Alternative 2 (Diverging Diamond Interchange (DDI)). The Build Alternative's primary proposed design improvements for evaluation include alternative interchange configurations, widening of ramps, and adding turn lanes along 10th Avenue North to improve signalized intersection operations. Multi-modal accommodations, including buffered bicycle lanes and six-foot sidewalks are provided for each direction of travel on the 10th Avenue North approaches to the interchange.

This IMR has been developed in accordance with the FDOT Policy Statement 000-525-015: Approval of New or Modified Access to Limited Access Highways on the State Highway System, FDOT Procedure Topic 525-030-160: New or Modified Interchanges adding or modifying interchange access to limited access facilities on Florida's SHS, Interchange Access Request User's Guide, and the FDOT Procedure Topic 525-030-120 Project Traffic Forecasting.

The findings of the overall engineering and environmental evaluation for this project will be documented in the *Type 2 Categorical Exclusion* and *Preliminary Engineering Report* for this Project Development and Environment (PD&E) study.

Compliance with Federal Highway Administration (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 10th Avenue North interchange is viable based on the conceptual analysis performed to date.

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, and ramp intersections with crossroad) or on the

local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

An in-depth operational and safety analysis was conducted to study the impacts of the proposed improvements. Several performance measures were used to compare the operations of the existing system under No-Action and Build conditions. Key measures included freeway densities, ramp V/C ratios, intersection delays, level of service and 95th percentile queue lengths for existing and proposed conditions.

From an operational perspective, the traffic analysis performed for the signalized intersections indicated that the ramp terminal signalized intersections will operate at an overall LOS F during the peak periods by Design Year 2045 if no improvements are built. Adjacent intersections are also operating at a LOS F by the year 2045. A substantial number of failing movements at the ramp terminal and adjacent intersections will occur. Significant queuing will also be observed at the ramp terminal and adjacent intersections.

The safety analysis performed for this study indicated a total of 434 crashes occurred along I-95 and 198 crashes occurred along 10th Avenue North within the study area from 2014 to 2018. The predominant crash types that occurred within the study area were rear end collisions and sideswipe collisions. Crashes of these types are typically attributed to the congested conditions along the arterial and interchange ramps and terminals.

The Recommended Build Alternative 2 is a reconfiguration to a DDI. This alternative performs substantially better than the No-Action Alternative for all future year scenarios particularly for the 10th Avenue North interchange ramp terminals, which is the primary focus for this study. The ramp terminal intersections will operate at LOS D or better compared to the No-Action that will operate at a LOS F in the Design Year. The traffic analysis results also indicate that all the approaches for ramp terminal and adjacent intersections will operate at acceptable LOS during both the AM and PM peak periods for the 2045 design years.

With the improved operations under Build Alternative 2, it is anticipated to enhance safety along both I-95 and 10th Avenue North will improve due to the significant reduction in delays and improved

mobility. The DDI and adjacent intersection improvements proposed along 10th Avenue North will provide better signal operations reducing congestion and queue lengths, thereby improving safety. According to the *FHWA Diverging Diamond Interchange Informational Guide* from August 2014, DDIs not only reduced total number of crashes at the interchange but also left turn crashes and injury crashes.

Using the Highway Safety Manual (HSM) predictive crash methodology, the number of crashes expected for the segments and intersections under existing conditions was modeled at 46.170 and the number of crashes expected for the segments and intersections under the No-Action condition for 2045 was 48.539. Considering the 2045 Build Alternative 2, the expected number of crashes under proposed future conditions dropped from 48.539 to 47.696, a further decrease of 1.75%. While the expected crashes for Build Alternative 1 would be 48.991.

A cost comparison was performed for the two Build Alternatives by approximating construction and right-of-way cost for both alternatives. The cost comparison shown in Section 8.7.3 show that Alternative 2 is the more economical alternative. A benefit-cost analysis, also prepared as part of the study, indicated that Build Alternative 2 has a higher benefit-cost ratio (5.80) than Build Alternative 1 (1.71). The primary crash reduction factor of Build Alternative 2 is approximately two and half times more than Build Alternative 1 resulting in a much larger safety benefit for Build Alternative 2.

Overall, the Recommended Build Alternative 2 provides significantly better traffic operations and enhanced safety when compared to the No-Action Alternative.

A conceptual signing plan has been developed for the Recommended Build Alternative 2 showing signage requirements for the proposed improvements and the interchange.

In conclusion, the comparison of the No-Action and Build alternatives show that the proposed Interchange improvements would provide for better and safer operating conditions. The proposed capacity improvements in the build alternatives are not anticipated to have a negative impact on operations or safety of I-95 mainline or the adjacent interchanges. The proposed capacity improvements along 10th Avenue North, within the study area, would likely have positive impacts on the operation of the 10th Avenue North interchange, with no potential for spillbacks from the 10th Avenue North interchange ramps on to Interstate 95.

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 or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding

signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

As with the existing conditions, the proposed improvements to the I-95 at 10th Avenue North interchange and adjacent intersections will provide full access and cater to all traffic movements from 10th Avenue North 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 and Transportation Officials (AASHTO) and the FDOT design standards. The 10th Avenue North roadway is a public road under the jurisdiction of Palm Beach County (west of I-95) and City of Lake Worth Beach (east of I-95).

Table of Contents

List of Figures and Tables

Figures

Tables

Appendices

SECTION 1 INTRODUCTION

The Florida Department of Transportation (FDOT), District Four, is conducting a Project Development and Environment (PD&E) Study that proposes improvements to SR 9/I-95 at 10th Avenue Interchange from west of Barnett Drive to east of North A Street. This Interchange Modification Report (IMR) contains detailed information that fulfills the purpose and need for the project.

1.1 PROJECT BACKGROUND

The Interchange of I-95 at 10th Avenue North is located in central Palm Beach County in the City of Lake Worth Beach. The interchange is situated between adjacent interchanges at Forest Hill Boulevard (1.90 miles to the north) and 6th Avenue South (1.28 miles to the south). The South Florida Rail Corridor (SFRC)/ CSX Railroad run parallel along the west side of I-95 in this area and crosses below an elevated section of 10th Avenue North. The study area for the 10th Avenue North interchange improvements includes 10th Avenue North from west of Barnett Drive to east of North A Street and 0.5 miles south and north of the 10th Avenue North interchange along I-95. Refer to **Figure 1-1** for project location and area of influence map.

10th Avenue North is currently a four lane divided urban minor arterial with a raised landscape median to the east and west of the I-95 interchange. 10th Avenue North over I-95 is divided with one dedicated westbound left-turn lane and two dedicated eastbound left-turn lanes, and two through lanes in each direction across the overpass bridge (total of 7 lanes). The left turn lanes access on-ramps to I-95. Adjacent signalized intersections relative to the I-95 interchange are located at Barnett Drive (west), and at North A Street (east). Barnett Drive and North A Street are two-lane undivided city collectors.

I-95 is a ten-lane divided interstate freeway on the Strategic Intermodal System (SIS) that features four general purpose lanes and one high occupancy vehicle (HOV) lane in each direction. The study interchange is configured as a typical TUDI. Off-ramps operate as two-lane off-ramps that transition into a three-lane approach at the northbound ramp intersection with 10th Avenue North and a four-lane approach at the southbound ramp intersection with 10th Avenue North. Shoulders are provided on the outside of the on- and off-ramps. There is one auxiliary (AUX) lane northbound and southbound between 10th Aveune North and Forest Hill Boulevard. There are two AUX lanes northbound and one AUX lane southbound between 6th Aveune South and 10th Aveune North.

Previously, an *Interchange Concept Development Report for I-95 (SR 9) Interchange at 10th Avenue North, Palm Beach County,* dated June 2014, documented improvements that were proposed at the subject interchange. These improvements are discussed in detail in **Section 7, Considered Alternatives.**

The project is included in the Palm Beach Transportation Planning Agency (TPA) Year 2045 Long Range Transportation Plan (LRTP), Palm Beach TPA Transportation Improvement Program (TIP), Local Government Comprehensive Plans and Port of Palm Beach Master Plan.

Figure 1-1 Project Location and Area of Influence

1.2 PROJECT DESCRIPTION

This *IMR* is being prepared to seek approval from FDOT Central Office for the Applicant, FDOT District 4, for the proposed improvements to the access point of I-95 at 10th Avenue North in Palm Beach County. This IMR has been developed in accordance with the FDOT Policy Statement 000-525-015: *Approval of New or Modified Access to Limited Access Highways on the State Highway System (SHS)*, FDOT Procedure Topic 525-030-160: *New or Modified Interchanges adding or modifying interchange access. to limited access facilities on Florida's SHS, Interchange Access Request User's Guide (IARUG), and the FDOT Procedure Topic 525-030-120 Project Traffic Forecasting.*

The findings of the overall engineering and environmental evaluation for this project will be documented in the Type 2 Categorical Exclusion and Preliminary Engineering Report for this PD&E study.

The proposed improvements will include operational and safety improvements to the Interchange. The project will also include improvements to sidewalks, ADA ramps, guide signs, and designated bicycle lanes.

This IMR will document the existing and future conditions in the study area, the analysis of future conditions, ramps and merge/diverge junctions between the interstate mainline and the interchange within the project limits including 10th Avenue North northbound and southbound ramps, Barnett Drive and North A Street intersections.

1.3 PURPOSE AND NEED

The purpose of the project is to improve the local and regional transportation network while simultaneously providing enhanced multimodal interrelationships at the I-95 and 10th Avenue North interchange. Further consideration for the need of this project includes improving capacity and transportation demand, improving safety through design year and also enhancing emergency evacuation and response times. The project aims at improving the capacity and mobility through the study interchange as traffic increases, thereby increasing the amount of congestion due to the anticipated increase in the population of Palm Beach County from 1,471,150 in 2017 to 1,715,300 in 2040 (*Source: 2019 PBC Population Allocation Model, PAPA, Building/Zoning Divisions*), representing an increase of 17% approximately.

According to the Future Land Use Plan for the City of Lake Worth Beach, the area will mainly remain residential with mixed-used and high-density residential and pockets of public and pubic recreating open space. As the population of the City and the County continues to increase, traffic will continue to grow, thereby, increasing the amount of congestion.

The *Interchange Concept Development Report for I-95 (SR 9) Interchange at 10th Avenue North*, *Palm Beach County,* dated June 2014, showed that if no improvements are made in the study interchange, it is forecasted that by 2040, for AM and PM peak hours the southbound ramps intersection along 10th Avenue North will be operating at a LOS of D and the northbound ramps intersection will be operating at a LOS of F. Therefore, long-term interchange improvements are needed to maintain

acceptable level of service through the study area, thereby, reduce delays, travel time and provide more mobility to the residents and commuters in this area along 10th Avenue North which provides east-west access in the City of Lake Worth Beach and Palm Beach County.

The proposed interchange improvements will also address pedestrian and bicycle modes and will ensure that the project corridor continues to meet mobility and safety goals as travel demands continue to grow.

The 10th Avenue North interchange with I-95 is an important component of the FDOT's SIS in Palm Beach County and provides a key transportation element. This interchange is an important connection for commuters and freight traffic in the region.

The goal of this project is to improve traffic operations at the study interchange through implementation of operational and capacity improvements that will maintain and improve mobility, improve safety, support existing and future development and enhance emergency evacuation and response times.

The need for the project is based on the following factors:

- Transportation Capacity
- Safety

1.3.1 TRANSPORTATION CAPACITY

An increase in demand on I-95 and 10th Avenue North interchange is anticipated in future due to planned growth in the area. As a result, additional traffic demand on major arterials within the study area will need to be addressed. **Table 1-1** summarizes the anticipated traffic volume increase within the study area.

Table 1-1 Forecasted Growth in Daily Traffic Volumes

Segment	Existing (2019)	Opening (2025)	Design (2045)
I-95 South of 10th Avenue North	231,700	240,000	267,000
I-95 North of 10th Avenue North	237,300	246,000	275,000
10th Avenue North West of I-95	45,700	47,000	52,000
10th Avenue North East of I-95	35,700	36,500	40,000

1.3.2 SAFETY

The Moving Ahead for Progress in the 21st Century Act, MAP-21, established national performance goals for Federal highway programs including:

- Safety - to achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- System Reliability – to improve the efficiency of the surface transportation system.

If no operational and safety improvements are made within the project limits, traffic operations within the interchange area will progressively become worse, potentially increasing the number and severity of crashes, and deteriorating the access to and from I-95 for users.

Emergency Evacuation and Response Times

Based on Palm Beach County's Evacuation Routes and Zones Map, 10th Avenue North is classified as an evacuation route from I-95 to US 1. As designated evacuation facilities, these roadways are critical in facilitating traffic flow during emergency evacuation periods. 10th Avenue North is an east-west corridor in eastern Palm Beach County providing linkage between I-95 and Jog Road.

SECTION 2 METHODOLOGY

A Methodology Letter of Understanding (MLOU) was prepared to document the methodology for the analysis and evaluation of this IMR. The MLOU was approved by the FDOT District 4 Interchange Review Coordinator (IRC), and FDOT Central Office in November 2019. The MLOU outlined the criteria, assumptions, processes, analyses, and documentation requirements for the project. A signed copy of the MLOU is included in **Appendix A**.

2.1 TRAVEL DEMAND FORECASTING

The methodology used for travel demand forecasting and development of design hour traffic is consistent with the FDOT *Project Traffic Forecasting Handbook*. The primary basis for traffic projections in this IMR are existing field traffic counts and the latest version of South East Regional Planning Model 7.062 (SERPM 7.062) with base year 2010 and horizon year 2040. The annual average daily traffic (AADT) volumes and traffic data collection provided by FDOT was previously performed in the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report* dated December 21, 2017. The design hour volumes for the I-95 mainline, ramps, 10th Avenue North corridor and intersections were developed in the *Traffic Forecasting Memorandum*, dated May 2020. *The Traffic Forecasting Memorandum* is included in **Appendix B**. The operational analysis for this study was performed using the Highway Capacity Software (HCS) version 7.7 and SYNCHRO version 10.0. All operational analysis followed the guidelines of the Highway Capacity Manual 6th Edition (HCM 6).

2.2 AREA OF INFLUENCE

The Area of Influence (AOI) of the proposed study of the interchange along I-95 extends from merge/diverge areas south of Forest Hill Boulevard to merge/diverge areas north of 6th Avenue South. The logical termini for the interchange analyses are defined by the adjacent intersection of Barnett Drive to the west of I-95 and the North A Street intersection located east of I-95. Refer to **Figure 1-1**.

The existing freeway mainline segments and the interchange ramps that are located within the I-95 AOI are as follows:

Along I-95:

Freeway mainline segments include -

- I-95 northbound – North of Northbound On Ramp from 10th Avenue North
- I-95 southbound – North of Southbound Off Ramp to 10th Avenue North
- I-95 northbound – South of Northbound Off Ramp to 10th Avenue North
- I-95 southbound – South of Southbound On Ramp from 10th Avenue North

Ramp merge/diverge junctions include -

- I-95 Northbound Off Ramp to Forest Hill Boulevard

- I-95 Southbound On Ramp from Forest Hill Boulevard
- I-95 Northbound Off Ramp to 10th Avenue North
- I-95 Northbound On Ramp from 10th Avenue North
- I-95 Southbound Off Ramp to 10th Avenue North
- I-95 Southbound On Ramp from 10th Avenue North
- I-95 Southbound Off Ramp to 6th Avenue South
- I-95 Northbound On Ramp from 6th Avenue e South

The intersections along 10th Avenue North included within the AOI that will be analyzed are listed below:

- 10th Avenue North at Barnett Drive
- 10th Avenue North at I-95 Southbound ramp terminal
- 10th Avenue North at I-95 Northbound ramp terminal
- 10th Avenue North at North A Street

2.3 ANALYSIS YEARS

The *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report,* dated December 21, 2017 used a base year of 2010 and a horizon year of 2040.

The years to be used for the traffic operational analysis are as follows:

- Existing year: 2019
- Opening year: 2025
- Design year: 2045

The forecasted AADTs for this study's Opening Year (2025) and Design Year (2045) were based on these volumes and existing turning movement proportions. The existing and future AADTs from this report are included in **Appendix B**.

2.4 DATA COLLECTION

The sources for data within this project study area will include, but not limited to:

- "I-95 (SR 9) Interchange at 10th Avenue North Interchange Concept Development (ICD) Report" dated June 2014 (06/14 ICD Report)
- "*Traffic Forecasting Memo* dated May 2020 (included in **Appendix B**)
- FDOT Traffic Online (FTO)
- FDOT Roadway Characteristic Inventory (RCI)
- FDOT Crash Analysis Reporting System (CAR Online)
- Signal Four Analytics (University of Florida)
- Palm Beach TPA

- Palm Beach County Traffic and Engineering Division
- Field data collection

2.4.1 Traffic Factors

Traffic factors used for the development of design hour traffic volumes include the K factor, Directional Distribution (D), Daily Truck (T_{24}), Design Hour Truck (T_{Peak}) and peak hour factors (PHF).

The Design Hour Truck percentage is calculated as one half of the daily truck percentage. The recommended K, D and T24 factors for the freeway, ramps and arterial within the study area were documented in the approved *MLOU* which is included in **Appendix A,** updated in the *Traffic Forecasting Memo* provided in **Appendix B,** and listed below in **Table 2-1**.

Table 2-1 Traffic Factors

Roadway	K (1) (in %)	D (2) (in %)	T_{24} (in %)	T_{peak} (4) (in %)	PHF (5)
I-95	8.0	60.1	7.3 (2)	3.7	0.95
Ramps	8.0	100.0	4.0	2.0	0.95
10th Ave North east and west of I-95	9.0	59.9	6.5 (3)	3.3	0.95

Notes:
(1) Large urbanized areas with Core Freeways. Figure 2.4; page 2-33 2014 FDOT *Project Traffic Forecasting* Handbook.
(2) Based on 5-year historical data average for FDOT Count Stations.
(3) Based on 2018 FTO Online PTMS, site number site number 932199 (I-95), sites 934031, 934032, 934033 and 934034 (10th Avenue N Ramps) and site 930171 (10th Avenue N).
(4) $T_{peak} = T_{24} / 2$
(5) For existing and future conditions traffic analysis, PHF of 0.95 is being recommended as all the traffic volumes are being generated using TMTool utilizing existing turning movement proportion instead of using actual count data.

All the traffic count information obtained from 2017 FTO is included in **Appendix B**.

2.4.2 Transportation System Data

The following transportation system data was collected to describe the existing roadway conditions within the study area:

- Geometric conditions such as lane widths, lane designations, storage length, and intersection configurations
- Access management class 1 and the existing 10th Avenue roadway is an off-system roadway and is not classified by FDOT
- Traffic control devices such as traffic signal phasing / timing, signs and traffic signal equipment
- Posted and design speed

- Bicycle / pedestrian facilities, transit services including stop locations and possible park-and-ride locations

2.4.3 Existing And Historical Traffic Data

The *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report* dated December 21, 2017 contained 2017 counts and forecasted volumes for years 2025, 2035 and 2045. No significant growth occurred in the area between the years of 2017 and 2019. Therefore, in accordance with the MLOU, included in **Appendix A**, for this study 2019 traffic counts were determined for use by interpolation between the 2017 traffic counts and 2025 traffic forecasts.

Intersection turning movement counts (TMCs) were collected for 6 hours (6 to 9 AM and 4 to 7 PM) during three weekdays at the following locations:

- 10th Avenue North at Barnett Drive
- 10th Avenue North at I-95 SB ramp terminal
- 10th Avenue North at I-95 NB ramp terminal
- 10th Avenue North at North A Street

Bi-directional 72-hour vehicle classification counts were collected at the following locations:

- I-95 SB on-ramp from Forest Hill Boulevard
- I-95 NB off-ramp to Forest Hill Boulevard
- I-95 SB off-ramp to 10th Avenue North
- I-95 SB on-ramp from 10th Avenue North
- I-95 NB off-ramp to 10th Avenue North
- I-95 NB on-ramp from 10th Avenue North
- 10th Avenue North east of Barnett Drive
- 10th Avenue North west of North A Street
- I-95 SB off-ramp to 6th Avenue South
- I-95 NB on-ramp from 6th Avenue South

Bi-directional 72-hour vehicle approach counts were also collected at the following locations:

- Barnett Drive north of 10th Avenue North
- Barnett Drive south of 10th Avenue North
- 10th Avenue North west of Barnett Drive
- 10th Avenue North west of I-95 SB Ramps
- 10th Avenue North east of I-95 NB Ramps
- North A Street north of 10th Avenue North
- North A Street south of 10th Avenue North
- 10th Avenue North east of North A Street

The existing traffic volume information from the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report* dated December 21, 2017 is included in **Appendix B**.

2.4.4 Environmental Data

The data collected for and documentation of the potential for environmental impacts or no impacts will be noted for the following categories.

- Wetlands / Surface Waters (**Section 3.5.1**)
- Socio-Cultural features (**Section 3.5.2**)
- Historic Resources (**Section 3.5.3**)
- Parks and Recreation (**Section 3.5.4**)
- Threatened and Endangered Species (**Section 3.5.5**)
- Floodplains and Drainage (**Section 3.5.6**)
- Hazardous Material and Contamination impact (**Section 3.5.8**)
- Noise (**Section 3.5.9**)

2.4.5 Planned and Programmed Projects

A review of planned and programmed transportation projects in the vicinity of the I-95 at 10th Avenue North interchange was conducted using the latest versions of the documents indicated below. Projects that are fully funded and programmed for implementation will be incorporated in the alternatives analyses as applicable.

- FDOT SIS Funding Strategy / Five Year Plan
- FDOT District 4 Adopted 5-Year Work Program
- Palm Beach TPA adopted Cost Feasible 2045 LRTP
- City of Lake Worth Beach most recently adopted Capital Improvement Program (CIP)

2.5 CONSIDERED ALTERNATIVES

The following were evaluated for this project:

- Existing Year 2019 – AM and PM peak hours
- No-Action Alternative – Opening Year 2025 and Design Year 2045 – AM and PM peak hours
- Build Alternative 1 (TUDI) – Opening Year 2025 and Design Year 2045 – AM and PM peak hours
- Build Alternative 2 (DDI) – Opening Year 2025 and Design Year 2045 – AM and PM peak hours

The conceptual layouts for the build alternatives are included in **Appendix D**.

2.6 TRAFFIC OPERATIONAL ANALYSIS

The years to be used for the traffic operational analysis are as follows:

Existing year: 2019

Opening year: 2025

Design year: 2045

The analyses of a No-Action Alternative and the Build Alternatives were performed for the Opening Year 2025 and the Design Year 2045.

The traffic volumes for the opening and design years were interpolated or extrapolated based on the traffic forecasting information included in *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report,* dated December 21, 2017.

Details of types of Traffic Operational Analysis such as procedures, measures of effectiveness, and software used are provided in the following sections.

2.6.1 Existing Area Type/Traffic Conditions

The existing area type and traffic conditions are documented below in **Table 2-2**.

Table 2-2 Existing Area Type and Traffic Conditions

Area Type	Conditions	
	Under Saturated	Saturated
Rural	-	-
Urban Area/Transitioning Area	-	X

Traffic operational analyses for the AM and PM peak hours was conducted to document the existing year 2019 levels of service within the AOI. The results of the 2019 analysis was summarized in tabular format and presented in **Section 3.3.3**. The existing analysis was based on 2019 AM and PM traffic volumes interpolated between 2017 and 2020 AADT and design hour volumes derived using 2017 turning volume proportion provided in the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report,* dated December 21, 2017. Existing signal timing and cycle lengths were provided from Palm Beach County and used in the traffic operational evaluation.

2.6.2 Traffic Analysis Software Used

The HCM 6 methodology using HCS 7.7 and SYNCHRO 10.0 software were utilized for the operational analysis as indicated below in the **Table 2-3**. The HCM methodology results for the 10th Avenue North signalized intersections were reported from SYNCHRO signal timing analysis.

Table 2-3 Traffic Analysis Software

Software		System Component					
		Freeway				Crossroad	
Name	Version	Basic Segment	Weaving	Ramp Merge	Ramp Diverge	Arterials	Intersections
HCS HCM 6	7.7	X	X	X	X	-	-
SYNCHRO	10.0	-	-	-	-	X	X
SimTraffic	-	-	-	-	-	-	-
Corsim	-	-	-	-	-	-	-
Vissim	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-

2.6.3 Calibration Methodology

Traffic Volume data, queuing, visual observations made during field visits along with existing signal timings provided by the maintaining agency were used in the calibration of existing SYNCHRO models. These calibrated SYNCHRO models were used to analyze the opening and design year conditions.

2.6.4 Selection of Measures of Effectiveness (MOE)

The FDOT's Level of Service (LOS) requirements for the State Highway System are defined in the Department's *Policy 000-525-006-c* effective April 19, 2017 and detailed in the *2020 Quality/Level of Service Handbook*. The study area is located in an Urbanized Area. The LOS target that will be used for the I-95, 10th Avenue North and the interchange is LOS D (urban).

The following measures of effectiveness (MOE) will be used for the operational analysis:

- Ramp terminals and intersections – Queue length, delay and LOS
- Arterial segments – Speed (mph), and LOS
- Freeway ramps (merge and diverge) – density in passenger car per mile per lane (pc/mi/ln), and LOS
- Freeway segments – density (pc/mi/ln), and LOS

2.6.5 Safety Analysis

An in-depth safety analysis was conducted to study the impacts of the proposed improvements. Several performance measures were used to compare the operations of the existing system under No-Action and Build conditions. As part of the PD&E study, a crash review for the most recent five-year period (2014-2018) and safety analysis in accordance with the Highway Safety Manual (AASHTO, 2010).

Crash data was collected from the FDOT CAR Online and Signal Four Analytics for the most recent five-year period (2014 - 2018). This crash data was summarized by crash types, severity, weather/lighting conditions and time-of-day along with a safety analysis to identify high crash segments and locations. The crash analysis separately identified the number of crashes that occurred at I-95 and 10th Avenue North interchange. Safety performance of the no-action and the build alternatives was evaluated using the Highway Safety Manual (HSM). The safety analysis performed for this study indicated a total of 434 crashes occurred along I-95 and 198 crashes occurred along 10th Avenue North within the study area. Along 10th Avenue North zero (0) fatal crashes were reported and 2 fatal crashes were reported for the I-95 segment within the study area. The predominant crash types that occurred within the study area were rear end collisions, angle collisions, and sideswipe collisions. Crashes of these types are typically attributed to the congested conditions along the arterial and interchange ramps and terminals.

The safety and crash analysis for this study is documented in the *Safety Analysis I-95/SR 9 at 10th Avenue North Interchange Report*, dated June 2020 (see **Appendix C**). The report used the "Urban and Suburban Arterials" procedures identified in Part C, Chapter 12 of the HSM.

SECTION 3 EXISTING CONDITIONS

The following section provides a discussion and evaluation of the existing conditions within the AOI. This discussion includes existing land use data, transportation systems data, existing traffic data, known environmental constraints, and existing operating conditions.

3.1 EXISTING LAND USE

This project lies within the City of Lake Worth Beach in Palm Beach County, Florida. The project limits are not within the City of Lake Worth Beach Community Redevelopment Area. The information on the land use in the study area was extracted from FDOT Efficient Transportation Decision Making (ETDM) Preliminary Programming Summary Report, Project # 14337 – I-95 (SR 9) at 10th Avenue North Interchange Modification dated February 5, 2018.

The project study area is surrounded by residential, light industrial, institutional, open land, and roads and highways. Northeast and Southeast quadrants of the study area are comprised of residential neighborhoods. The neighborhoods are unnamed, however, within the neighborhoods are several condominium and apartment complexes. Northwest and Southwest quadrants are mostly commercial and office buildings. There are no parks within the 500-foot buffer, however, there are two (2) parks within the 1,320-foot buffer: Sunset Ridge Park and 3rd Avenue Park.

The Palm Beach County Future Land Use Map shows the following future land uses: commercial, office, tourism, marina; industrial, extractive, transportation; mixed use, activity center, urban village; public/semi-public, governmental, institutional; recreation/open space; residential high more than residential medium and greater than 12 dwelling units; residential medium more than residential low and less than 13 dwelling units; and unknown information not available.

The existing land use for the AOI is shown in **Figure 3-1**.

The Palm Beach County Land Use Map shows the following land uses: commercial, office, industrial, transportation, mixed use, education, activity center, urban village, and residential.

3.2 EXSITING TRANSPORTATION NETWORK

3.2.1 Existing Roadway Network

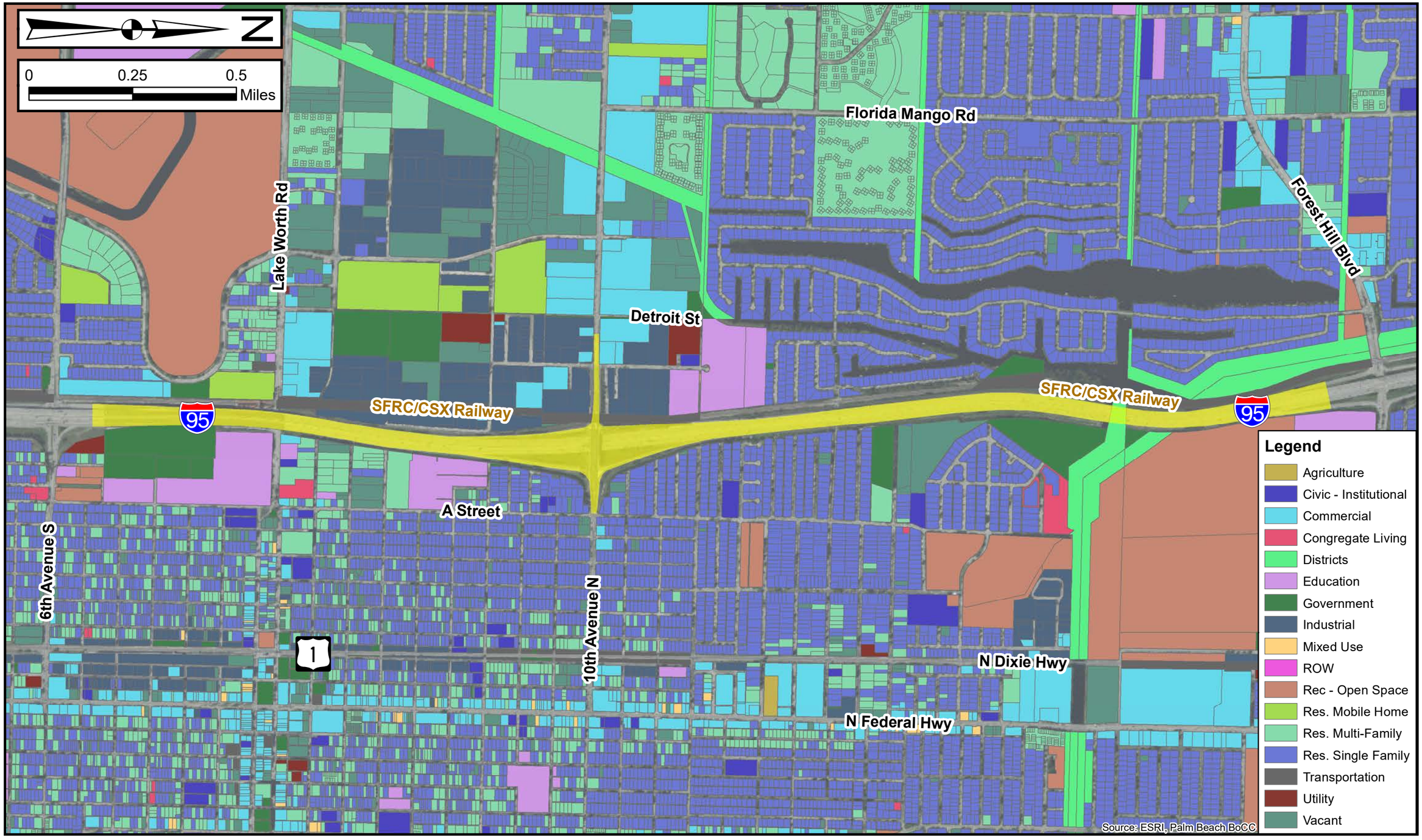
The existing I-95 roadway transportation network, south of 10th Avenue North consists of 7 lanes northbound (1 High Occupancy Vehicle Lanes (HOV) lane, 4 General Use Lanes (GUL) and 2 Auxiliary Lanes (AUX)) and 6 lanes southbound (1 HOV, 4 GUL and 1 AUX). North of 10th Avenue North, I-95 consists of 6 lanes northbound (1 HOV, 4 GUL and 1 AUX) and 6 lanes southbound (1 HOV, 4 GUL and 1 AUX).

The adjacent I-95 interchanges are located at 6th Avenue South to the south of 10th Avenue North and Forest Hill Boulevard to the north of 10th Avenue North.

10th Avenue North is currently a four lane divided urban minor arterial with a raised landscape median, curb, gutter, and attached sidewalk from Barnett Drive to North A Street. 10th Avenue North over the I-95 overpass has one dedicated westbound left-turn lane accessing I-95 SB on ramp and dual eastbound left-turn lanes access I-95 NB on ramp, and two through lanes in each direction of travel.

3.2.2 Functional Classification

The FDOT classifies roadways according to the nature and character of their uses. I-95 is a ten- lane divided interstate freeway and is designated as a SIS highway corridor owned by FDOT. 10th Avenue North is a four-lane divided urban minor arterial with a raised median to the east and west of the I-95 interchange. Adjacent accessible signalized intersections relative to the I-95 interchange are located at Barnett Drive (west) and at North A Street (east). Barnett Drive and North A Street are two-lane undivided city collectors.



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

I-95/SR 9 Interchange at 10th Avenue
Project Development and Environment Study
FPID No.: 412733-1
ETDM No.: 14337

Title:

EXISTING LAND USE MAP

Figure:

3-1

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3.2.3 Access Management

The existing I-95 roadway is classified by FDOT as Access Class 1. The existing 10th Avenue North roadway is an off system roadway and is not classified by FDOT for access management standards.

3.2.4 Typical Sections

I-95 is a ten-lane divided interstate freeway that features four general purpose lanes and one HOV lane in each direction. 10th Avenue North over the I-95 overpass is divided with one dedicated left-turn lane along the westbound direction and two left-turn lanes eastbound to access I-95 NB & SB ramps, and two through lanes in each direction of travel. Travel lanes are 12 ft wide along 10th Avenue within the project limits.

10th Avenue North design and posted speed limits for the roadway within the project limits are as follows:

- Posted: 40 miles per hour (west of interchange) 35 miles per hour (east of interchange)
- Design: 45 miles per hour (west of interchange) 35 miles per hour (east of interchange)

10th Ave North has varying right-of-way width within the project limits with minimum being 80 feet and maximum being 411 feet. Right-of-way ranges from 81 feet to 121 feet between east of Detroit Street to west of Barnett Drive; 175 feet to 207 feet between east of Barnett Drive to west of I-95; 125 feet to 411 feet between east of I-95 and west of A street; and 80 feet to 103 feet between A street and B Street.

3.2.5 Pedestrian and Bicycle Facilities

I-95 at 10th Avenue North interchange accommodates east-west sidewalks and bicycle lanes on the north and south sides of 10th Avenue North, from Barnett Drive to A Street.

Bike lane width varies between 5 and 6 ft and 6ft sidewalk is present along both sides of 10th Avenue.

3.2.6 Transit

The South Florida Regional Transportation Authority (SFRTA) provides regional transit service via the Tri-Rail for the South Florida Counties of Broward, Miami-Dade and Palm Beach. The Lake Worth Tri-Rail Station is located south of Lake Worth Road, less than 1 mile south of the I-95 & 10th Avenue North interchange. The station provides approximately 217 parking spaces and also provides park-and-ride designated areas. The Lake Worth Tri-Rail station is accessed by Palm Beach County Transit (Palm Tran) Routes 61 and 62. 10th Avenue North is served by Palm Tran Route 61. Currently there are no bus stops within the study limits on 10th Avenue North.

3.2.7 Existing Interchanges

The Interchange of I-95 at 10th Avenue North is located in central Palm Beach County in the City of Lake Worth Beach, between Forest Hill Boulevard (1.90 miles to the north) and 6th Avenue South (1.28 miles to the south) interchanges.

The existing lane configuration is provided in **Figure 3-2**.

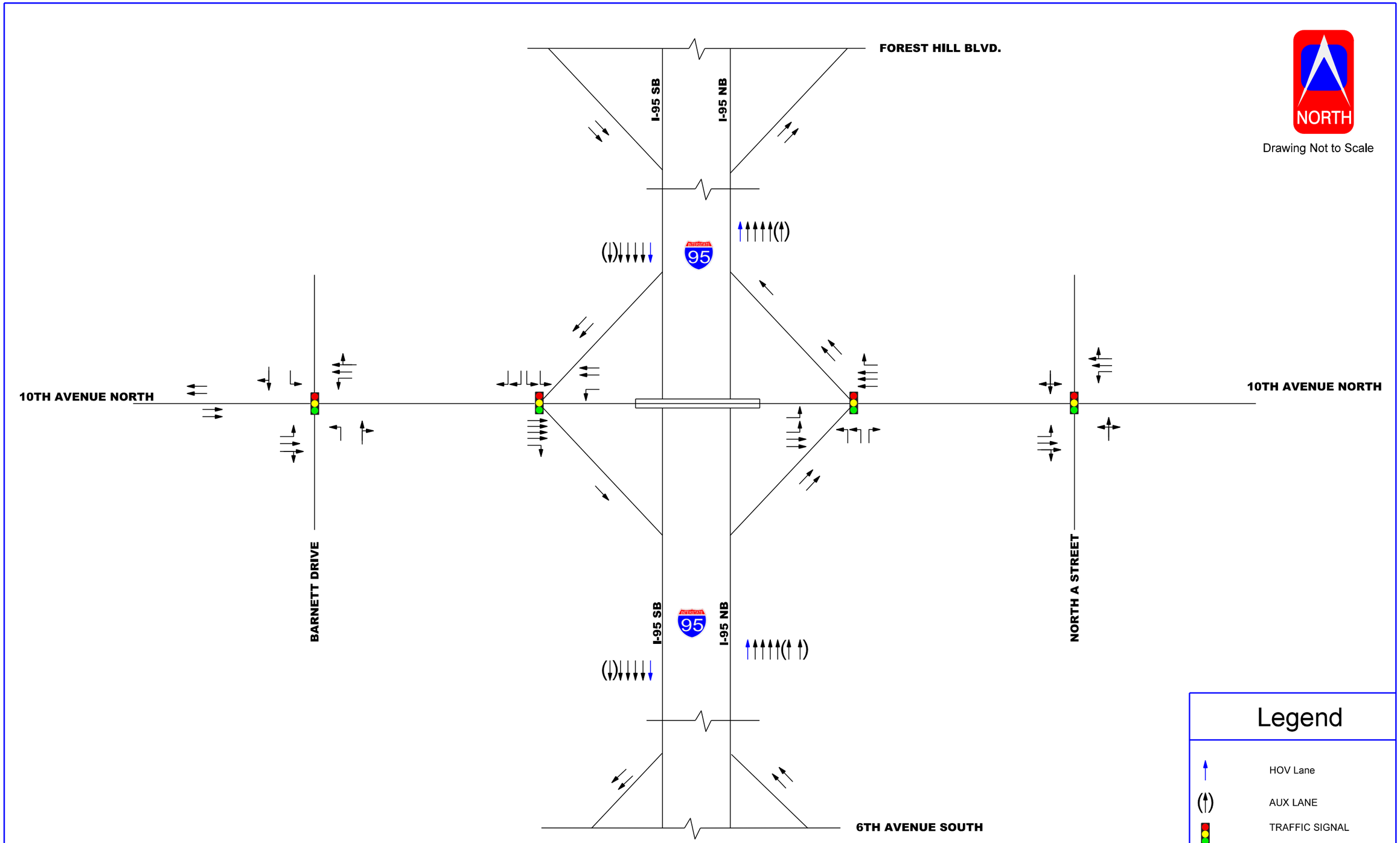
3.2.8 Interchange Ramps

The current interchange configuration is an urban tight diamond with coordinated signalized intersections spaced approximately 540 feet apart on 10th Avenue North at the I-95 ramp terminals. The I-95 southbound off ramp transitions from two lanes to four lanes at the intersection with 10th Avenue North with two dedicated right turns (westbound) and two dedicated left turns (eastbound) provided at the signal. The I-95 northbound off ramp transitions from two lanes to 3 lanes along the ramp proper, and provides dual lefts and a single right turn lane the signal with 10th Avenue. In the current configuration, storage lengths for turn lanes at the off ramps are not sufficient and often spill back on to I-95.

All ramps have minimum 12ft wide travel lanes and appropriate shoulder widths.

The posted speed limits for the roadway within the project limits are as follows:

- I-95 off ramps: 35 miles per hour (advisory)
- I-95 off ramps: 35 miles per hour (design)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 3-2
Existing Year 2019 Lane Configuration

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3.3 EXISTING ENVIRONMENTAL CONSIDERATIONS

The proposed improvements are anticipated to result in the following potential environmental impacts (or no impacts) as noted in the sections below. A complete environmental impact analysis will be included in the *Type 2 Categorical Exclusion* document prepared as part of this PD&E Study.

3.3.1 Wetlands / Surface Waters

No wetland impacts are anticipated by the proposed improvements. There are potential surface waters and ditches in the project limits. A discussion of the resources and impacts will be documented in the *Natural Resources Evaluation*. **Figure 3-3** depicts the wetlands and surface waters within the AOI.

3.3.2 Socio-Cultural features

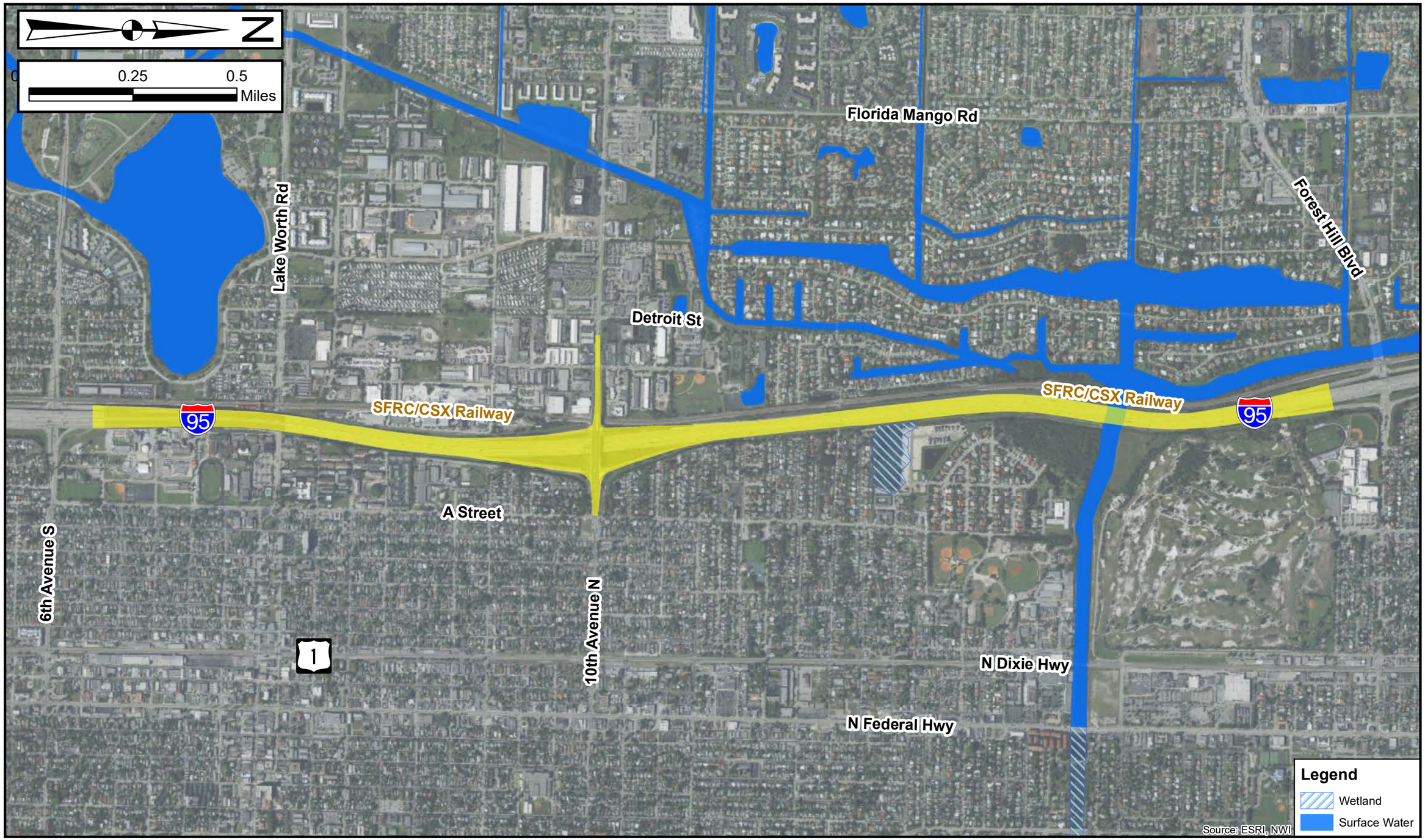
There are several community services near the project limits including schools, fire stations, and churches. A review of the Environmental Protection Agency's (EPA) EJScreen Tool, the majority of the population within a quarter mile of the project limits is comprised of minority populations, much of which does not speak English well or at all. There are also a large percentage of low income households within a quarter mile of the project limits that will require civil rights and environmental justice considerations to be accounted for in prior to implementing the improvements. Some residential and commercial relocation may be required*. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations*, signed by the President on February 11, 1994, directs federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law. Potential impacts will be documented in the *Sociocultural Effects Evaluation* for this PD&E study. This project is being developed in accordance with the Civil Rights Act of 1964 as amended by the Civil Rights Act of 1968.

3.3.3 Historic Resourcecs

The Seaboard Air Line Railroad (now the SFRC/CSX Railroad) is potentially eligible for the National Register of Historic Places (NRHP); however, there was insufficient information to make the determination by the State Historic Preservation Office (SHPO). In addition, there are two structures within 300 feet of the proposed improvements that are potentially fifty years or older that may require further assessment. The structures have not been evaluated by the SHPO. An evaluation will be conducted pursuant to 36 CFR Part 800, Section 106 of the National Historic Preservation Act. **Figure 3-4** depicts the resources map of civic, historic, park, contamination, impact potential and cultural resources within the AOI.

3.3.4 Parks and Recreation

There are no parks nor recreation facilities in close proximity to the project limits. No impacts anticipated by proposed improvements.



Florida Department of Transportation District Four 3400 West Commercial Boulevard Fort Lauderdale, FL 33309	**I-95/SR 9 Interchange at 10th Avenue** Project Development and Environment Study FPID No.: 412733-1 ETDM No.: 14337	Title: **ENVIRONMENTAL RESOURCES MAP (WETLANDS)**	Figure: **3-3**

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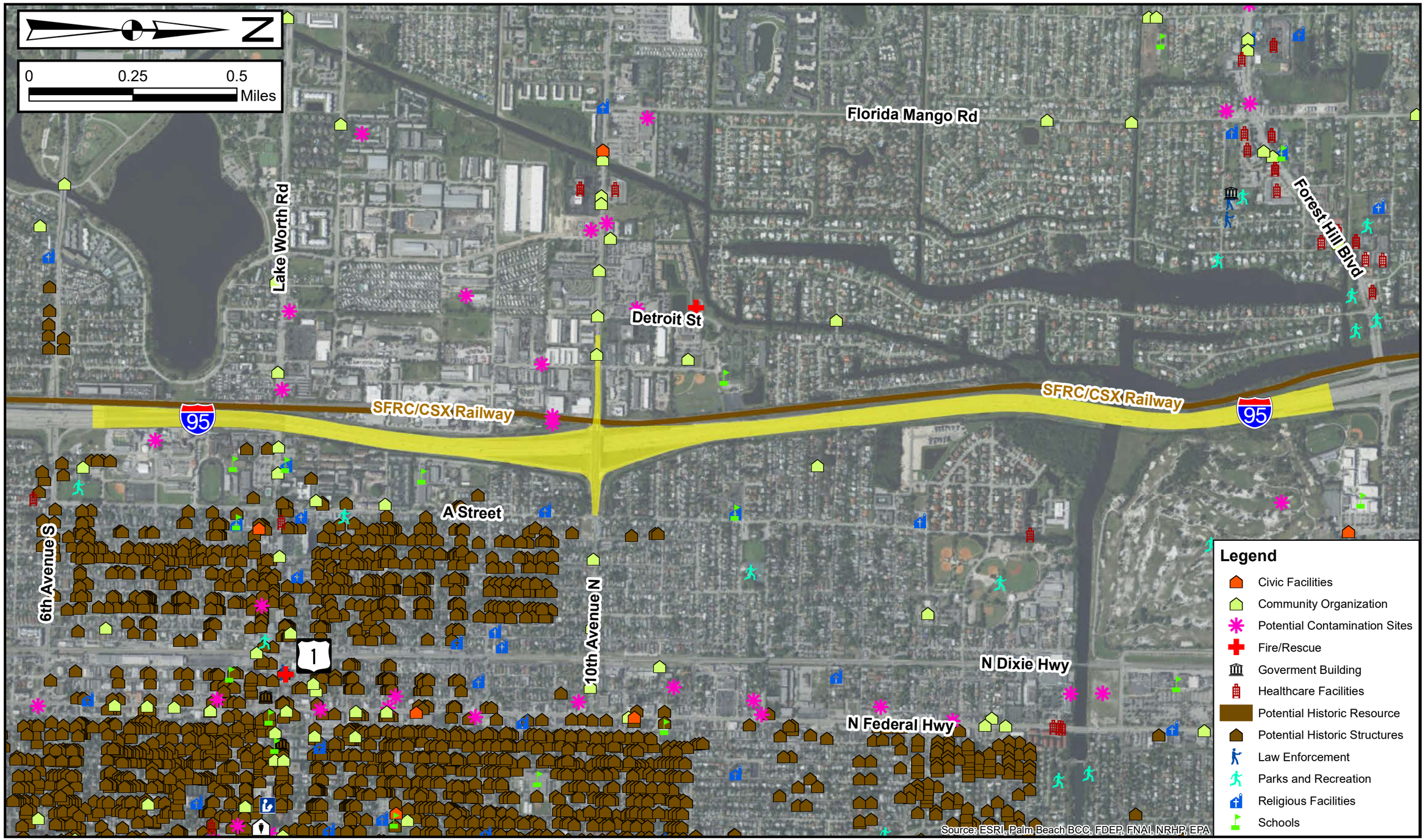

Florida Department of Transportation
District Four
3400 West Commercial Boulevard
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I-95/SR 9 Interchange at 10th Avenue
Project Development and Environment Study
FPID No.: 412733-1
ETDM No.: 14337

Title: **ENVIRONMENTAL RESOURCES MAP (SOCIAL, CULTURAL AND CONTAMINATION)**

Figure: **3-4**

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3.3.5 Threatened and Endangered Species

Due to the urban nature of the corridor, natural environment that would support listed species is limited. The project is within United States Fish and Wildlife Service (USFWS) Consultation Areas for the Florida scrub-jay (Aphelocoma oerulescens), West Indian manatee (Trichechus manatus) and Atlantic Coast Plants, and within the USFWS core foraging area (CFA) of four wood stork (Mycteria americana) colonies: 619220 PBC SWA, Ballen Isles, Lox NC- 4, and Wakodahatchee. Also, occurrences of least terns (Sternula antillarum) were documented northwest of the 10th Avenue North interchange in 1987 and occurrences of gopher tortoises (Gopherus polyphemus) and gopher frogs (Rana capito) were documented in the southeast quadrant of the interchange in 1989. Least terns are known to nest on tar and gravel roofs and on spoil piles left exposed during construction. Gopher tortoises are typically found in dry sandy habitats but may dig burrows along road shoulders. Gopher frogs are rare and may live in gopher tortoise burrows that are near shallow, seasonally inundated ponds. Suitable habitat for the least tern, Florida scrub-jay, wood stork, manatee and gopher frog does not exist within the project area and habitat for gopher tortoises is marginal; therefore, impacts to these species from the improvements are not anticipated. A discussion of the resources and impacts will be documented in the *Natural Resources Evaluation* for this PD&E study.

3.3.6 Floodplains and Drainage

The interchange is located outside of the 100-year floodplain. No impacts anticipated by proposed improvements.

3.3.7 Air Quality

This project is located within Palm Beach County, which is in attainment of the National Ambient Air Quality Standards and no adverse impacts are anticipated to air quality through this project.

3.3.8 Hazardous Material and Contamination Impact

Based on a review of the Florida Department of Environmental Protection (FDEP) GIS data, the FDEP contamination locator map, and the FDEP OCULUS database, several potential hazardous material sites were identified within the vicinity of the I-95/10th Avenue North Interchange. There are 18 potential storage tank contamination monitoring (STCM) sites. In addition, there are numerous other potentially contaminated facilities within a quarter mile of the proposed I-95/10th Avenue North interchange improvements, including brownfields and solid waste facilities. In addition, the CSX railroad is likely a source of contamination. Additional file review or field reconnaissance would be required to determine the potential and severity of hazardous material and contamination impacts based on the proposed improvements to these sites. **Figure 3-4** shows adjacent potential sites. A *Contamination Screen Evaluation Report* will be prepared for this PD&E study.

3.3.9 Noise

Noise sensitive sites identified adjacent to the interchange include single family residences on the east side of I-95, several schools, doctors' offices, and churches. Currently, there are sound barriers along

the I-95 northbound on- and off-ramps which run along the SFRC/CSX railroad lines. There are currently no sound barriers along the I-95 southbound on- and off-ramps. Noise analysis will be conducted during the PD&E study for the recommended alternative and documented in the *Noise Study Report*.

3.4 CONSISTENCY WITH OTHER PLANS/PROJECTS

The proposed improvements will maintain consistency with the following:

- FDOT SIS Funding Strategy / Five Year Plan.
- FDOT District 4 Adopted 5-Year Work Program
- Palm Beach TPA FY 2021-2025 TIP
- Palm Beach TPA adopted Cost Feasible 2045 LRTP
- City of Lake Worth Beach most recently adopted CIP

Where the proposed improvements are inconsistent with the above referenced plans/ programs, steps to bring the plan into consistency will be developed.

SECTION 4 EXISTING OPERATIONAL ANALYSIS AND SAFETY ANALYSIS

4.1 EXISTING OPERATIONAL ANALYSIS

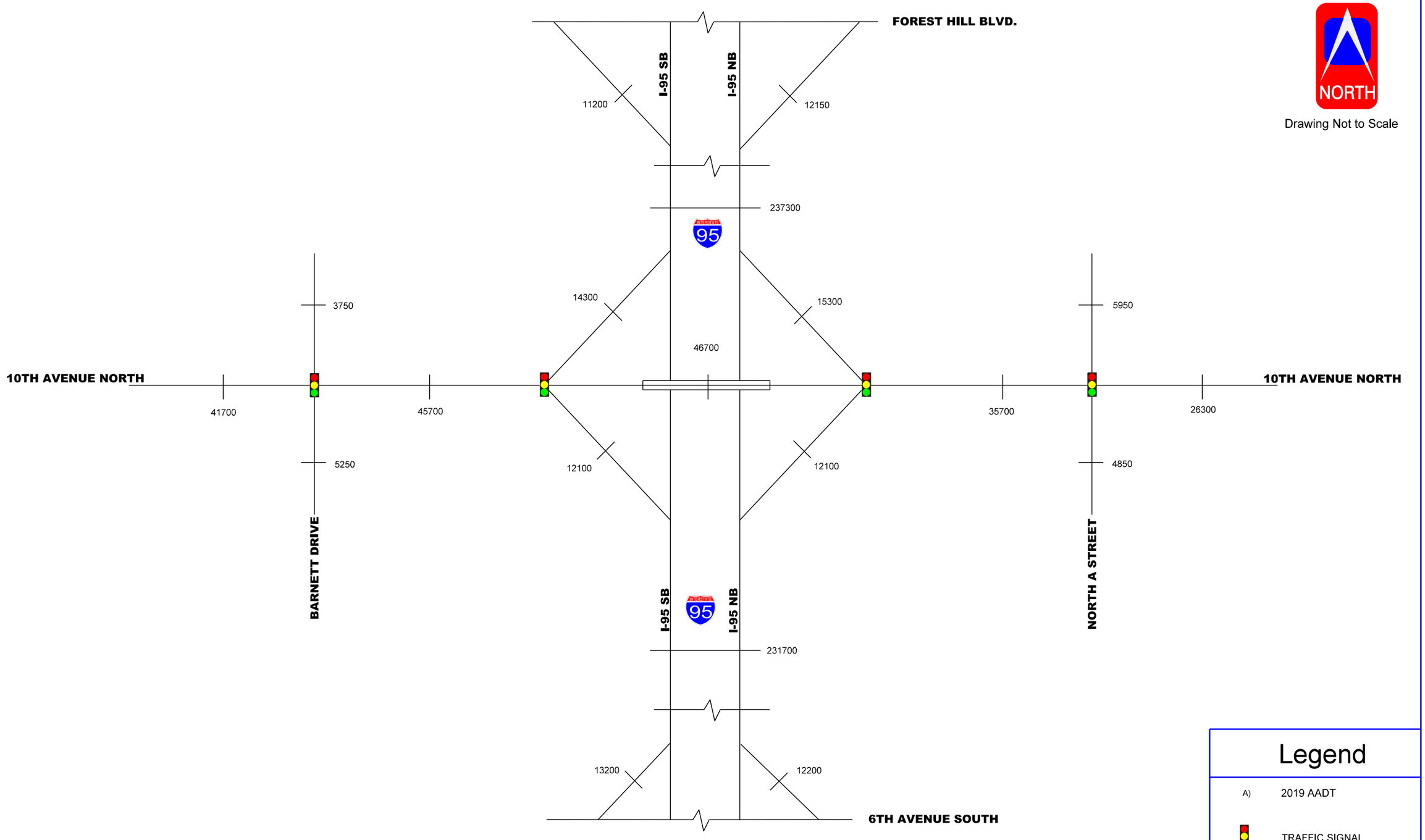
This section summarizes the existing traffic and operational analysis performed within the AOI to assess the mobility conditions. This facility accommodates interstate and regional mobility for commuter and freight traffic.

4.1.1 Existing Traffic Data

The existing traffic data collection provided by FDOT was previously performed in the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report,* dated December 21, 2017 and shown in **Appendix B**. No significant growth occurred in the area. Therefore, for this study 2019 traffic counts were determined for use by interpolation between 2017 traffic counts and 2025 traffic forecasted volumes. AADTs along I-95, 6th Avenue South, 10th Avenue North, and Forest Hill Boulevard were adjusted to attain a balanced flow and depicted in **Figure 4-1**.

4.1.2 Turning Movement Counts

Intersection turning movement counts (TMCs) were collected for 6 hours (6 to 9 AM and 4 to 7 PM) during three weekdays at the locations outlined in **Section 2.4.3** of this report. These are depicted in the **Figure 4-2.**



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(FPID: 412733-1-22-02)

Figure 4-1
Existing Year 2019 Annual Average Daily Traffic (AADT) Volumes

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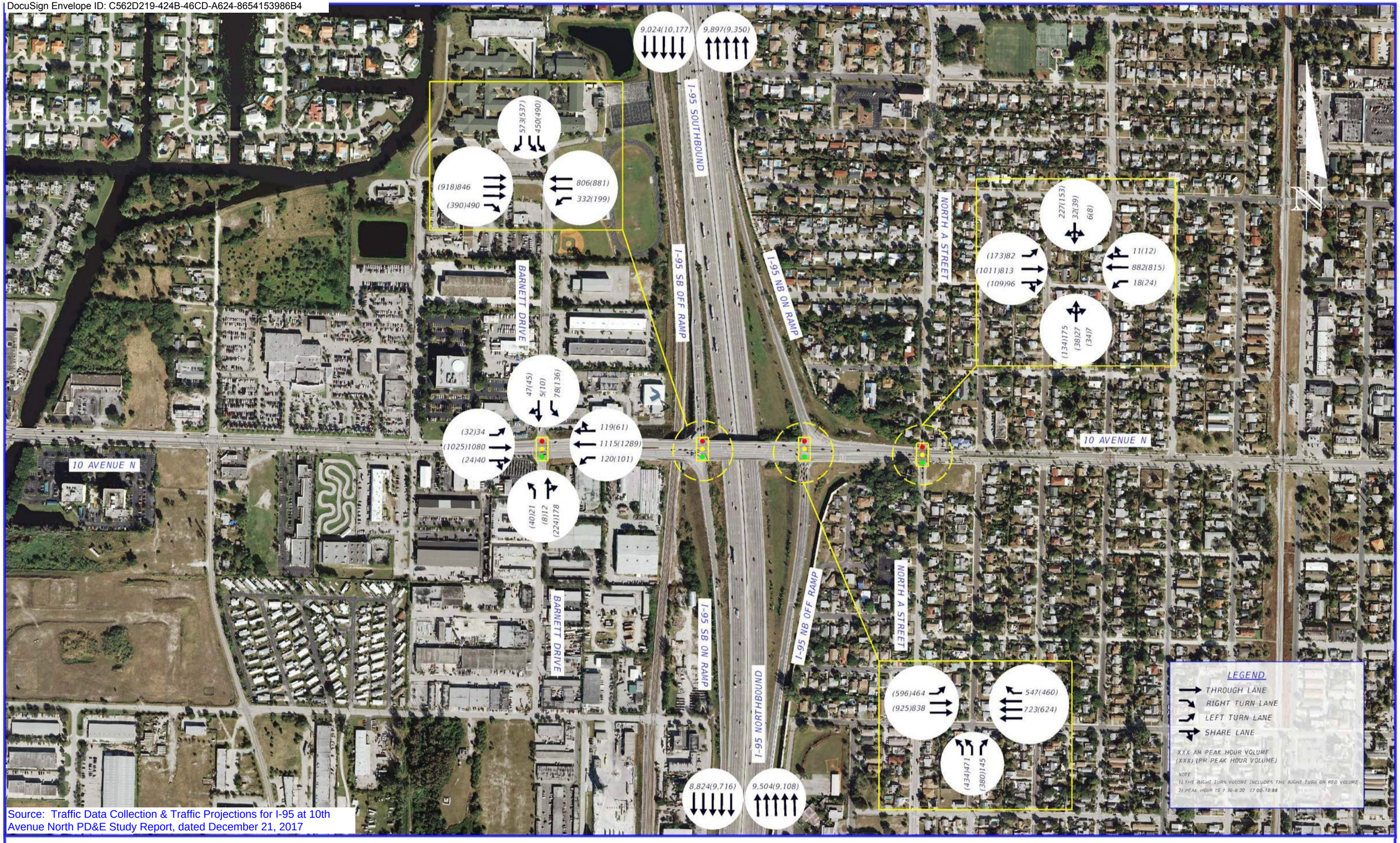

Source: Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report, dated December 21, 2017

FIGURE 4-2 2017 INTERSECTION TURNING MOVEMENT COUNTS AT 10 AVENUE N

4.1.3 Operational Analysis

A detailed operational analysis for the Existing Year 2019 was performed for the mainline segments, ramp junctions, and study intersections along 10th Avenue North.

HCS Version 7.7 was used for the operational analysis of mainline segments and ramps. SYNCHRO 10.0 was used for the analysis of study intersections along 10th Avenue North. Documentation for the Existing Conditions analysis is provided in **Appendix E**. SYNCHRO 10 results were reported for all of the intersection analysis to be consistent between different alternatives, as HCS methodology does not support clustered intersections in Alternative 2.

4.1.3.1 Mainline Analysis

The Existing Year 2019 mainline analysis results are summarized in **Table 4-1**. The results of the operational analysis show that all the mainline segments operate at an acceptable LOS D or better except for the segments and peak hours highlighted in the table.

Table 4-1 2019 Mainline Capacity Analysis Summary

Freeway Segment	Direction	Number of Lanes[3]	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 - S of 10th Ave N	NB	7 (1HOV+4GUL+2AUX)	11,029	28.3	D	0.76	7,507	18.7	B	0.52
	SB	6 (1HOV+4GUL+1AUX)	7,509	21.8	C	0.61	10,797	34.4	D	0.87
I-95 - N of 10th Ave N	NB	6 (1HOV+4GUL+1AUX)	11,427	38.1	E	0.92	7,726	22.5	C	0.62
	SB	6 (1HOV+4GUL+1AUX)	7,689	22.3	C	0.62	11,295	37.2	E	0.91

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane
3. HOV = High Occupancy Vehicle Lane; GUL = General Use Lane; AUX = Auxiliary Lane

4.1.3.2 Ramp Junction Analysis

The Existing Year 2019 ramp junction analysis results are summarized in **Table 4-2**. The results of the operational analysis show that 10th Avenue North northbound on-ramp and 6th Avenue South northbound on-ramp operate at an unacceptable LOS for the AM peak period and the 10th Avenue North southbound on-ramp operates at an unacceptable LOS for the PM peak period. These ramp merge/diverge areas could be experiencing unacceptable LOS and high density levels due to mainline segments meeting capacity targets. In **Section 4.1.4** the eastbound right turn at the 10th Avenue North and I-95 southbound ramps were observed backing up past the provided turn lane storage.

Table 4-2 Existing Year (2019) Ramp Junction Analysis Summary

Freeway Segment	Direction	Analysis Type	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 at 10th Ave North	NB Off	Diverge	629	21.5	C	0.16	819	10.5	B	0.21
	NB On	Merge	1,027	31.9	**F**	0.27	1,038	21.0	C	0.27
	SB Off	Diverge	1,041	10.9	B	0.27	1,063	21.5	C	0.28
	SB On	Merge	861	19.5	B	0.23	565	27.7	**F**	0.15
I-95 at 6th Avenue South	NB On	Merge	976	30.3	**F**	0.26	976	20.1	C	0.26
	SB Off	Diverge	1,056	10.6	B	0.28	1,056	20.0	B	0.28
I-95 at Forest Hill Blvd.	NB Off	Diverge	972	21.7	C	0.25	972	10.7	B	0.25
	SB On	Merge	896	10.8	B	0.23	896	21.5	C	0.23

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Note: All existing on and off ramps are 2 lane ramps.

4.1.3.3 Weaving Analysis

Along the mainline, the I-95 segments between 6th Avenue South, 10th Avenue North and Forest Hill Boulevard contain AUX lanes. With these AUX lanes between the 3 interchanges, it is possible that weaving could occur. Referring to the *HCM* Equation 13-4 the values of VR (volume ratio) for all four ramps at the 10th Avenue N interchange require less than a mile of weaving length. Considering that both adjacent interchanges are at least a mile from the 10th Avenue North interchange, a weaving analysis is not required. Hence a weaving analysis was not performed.

4.1.3.4 Intersection Analysis

The Existing Year 2019 intersection analysis results are summarized in **Table 4-3.** The intersections along 10th Avenue North within the project limits were analyzed using 2019 peak hour volumes, existing signal timing and phasing plans provided from Palm Beach County (**Appendix E**). In discussing with Palm Beach County Traffic, a 160 seconds cycle length is used for all intersections along the 10th Avenue corridor. Hence, no signal optimization was performed when modeling Existing Year 2019 conditions in SYNCHRO software in order to keep timings consistent with the adjacent coordinated system. Results indicate that the overall intersection delay exceeds the acceptable LOS D, for the 10th Avenue North and I-95 Northbound ramp intersection for the AM peak period. **Figure 4-3** illustrates the Existing Year (2019) peak hour turning movement volumes for the intersections. SYNCHRO 10 results were reported for all of the intersection analysis to be consistent between different alternatives, as HCS methodology does not support clustered intersections in Alternative 2. **Figure 4-4** depicts the calculated delay (in seconds) and LOS for all the intersections, approaches and individual

movements for the AM and PM peak hours. The approaches that are currently operating below acceptable LOS are highlighted in **Table 4-3** and in **Figure 4-5.**

Table 4-3 Existing Year (2019) Intersection Analysis Summary

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	22.8	16.2	83.2	82.9	26.5
		LOS	C	B	F	F	C
	PM	Delay[1]	43.4	39.6	92.2	83.9	48.8
		LOS	D	D	F	F	D
10th Avenue North at I-95 SB ramps	AM	Delay[1]	41.6	6.7	-	49.7	32.2
		LOS	D	A	-	D	C
	PM	Delay[1]	35.9	3.8	-	52.7	31.1
		LOS	D	A	-	D	C
10th Avenue North at I-95 NB ramps	AM	Delay[1]	0.5	139.7	65.4	-	68.8
		LOS	A	F	E	-	E
	PM	Delay[1]	0.9	82.4	98.7	-	49.9
		LOS	A	F	F	-	D
10th Avenue North at A Street	AM	Delay[1]	41.4	32.6	68.9	47.1	41.1
		LOS	D	C	E	D	D
	PM	Delay[1]	47.4	38.6	52.8	43.2	44.7
		LOS	D	D	D	D	D

[1] Delay (Secs/Veh)

Table 4-4 summarizes the 95th percentile queue length analysis for the Existing Year 2019. The approaches with required storage length higher than existing storage length are highlighted in the table. At the I-95 northbound ramp intersection the northbound right queue exceeds provided storage for the PM peak period and the westbound right exceeds storage in both peak periods. At the I-95 southbound ramp intersection the eastbound right queue exceeds the provided storage in both peak periods. The 10th Avenue North and Barnett Drive intersections have the westbound and southbound left queues exceeding provided storage in both peak periods.

4.1.3.5 Arterial Analysis

Peak hour volumes were analyzed along the 10th Avenue corridor between Barnett Drive and North A Street for the existing arterial analysis. The results arterial LOS for eastbound and westbound obtained from SYNCHRO software are summarized in **Table 4-5 and Table 4-6.** Several of the arterial segments operate at unacceptable LOS and are highlighted in the tables. Arterial LOS was not improved through signal cycle offsets or optimization since provided signal timings from the county was utilized in the Existing Conditions Analysis.

Table 4-4 Existing Year (2019) 95th Percentile Queue Length Summary

Intersection	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	79	633	-	182	420	-	49	274	-	144	94	-
	PM	#86	730	-	#196	740	-	91	#396	-	#250	89	-
	Storage	125	721	-	125	825	-	75	513	-	80	453	-
10th Avenue North at I-95 SB ramps	AM	-	388	664	m14	m60	-	-	-	-	322	-	303
	PM	-	497	460	m0	36	-	-	-	-	#396	-	282
	Storage	-	825	250	508	508	-	-	-	-	540	-	540
10th Avenue North at I-95 NB ramps	AM	0	0	-	-	#557	#1090	323	-	226	-	-	-
	PM	0	0	-	-	451	#805	296	-	#685	-	-	-
	Storage	508	508	-	-	571	200	1462	-	550	-	-	-
10th Avenue North at A Street	AM	158	395	-	33	472	-	-	#360	-	-	339	-
	PM	m260	m513	-	47	465	-	-	291	-	-	247	-
	Storage	265	571	-	120	578	-	-	475	-	-	414	-

(#) = 95 Percentile Volume exceeds capacity

(m) = Volume for 95th percentile queue is metered by upstream signal

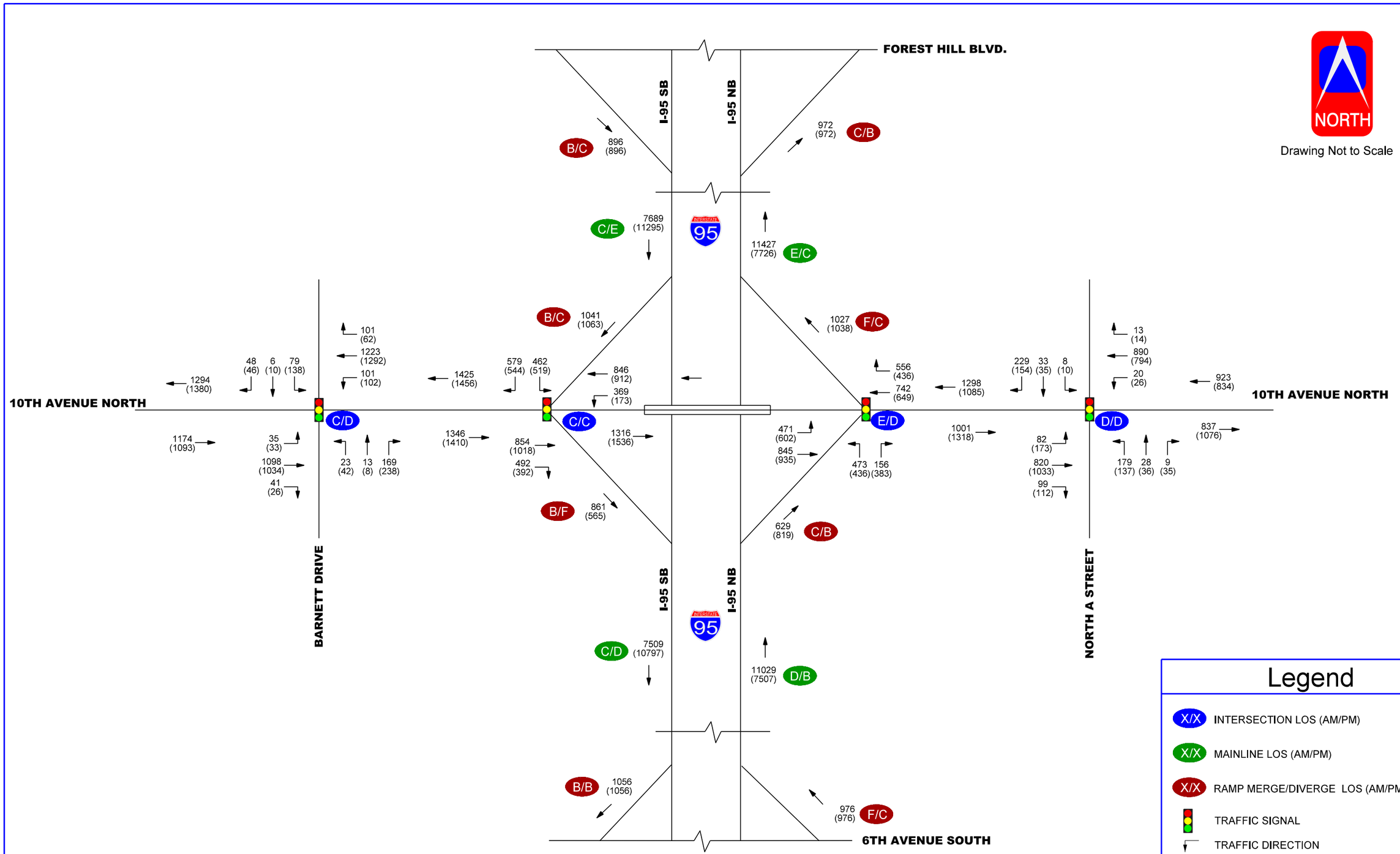

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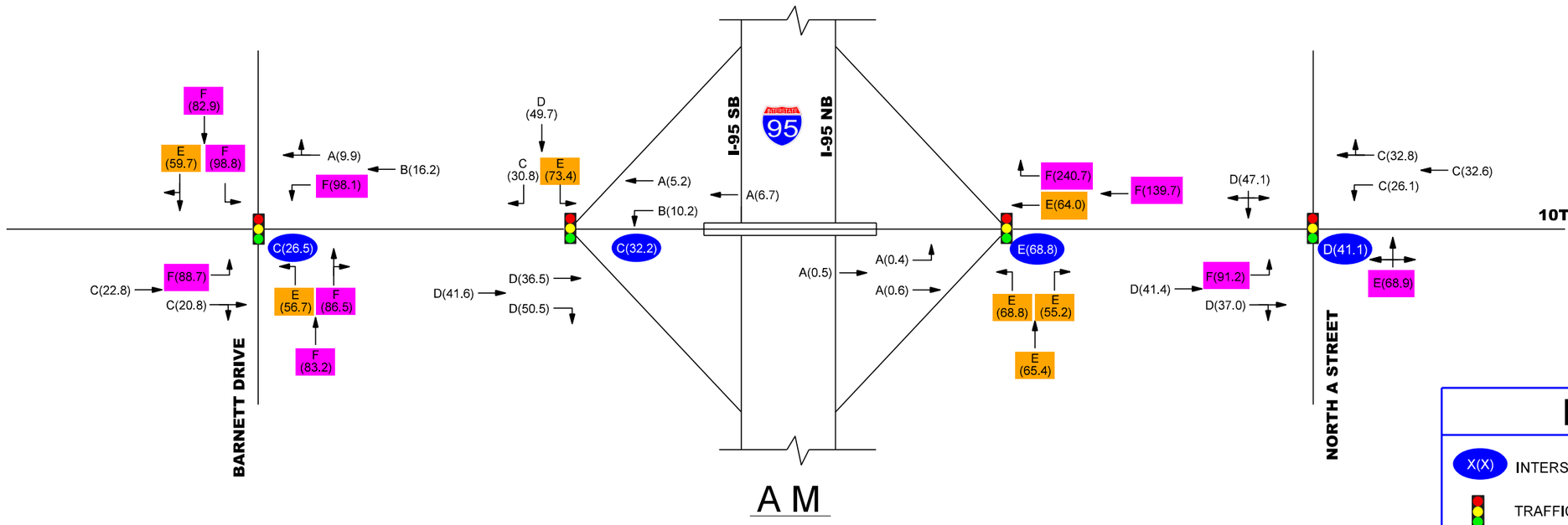
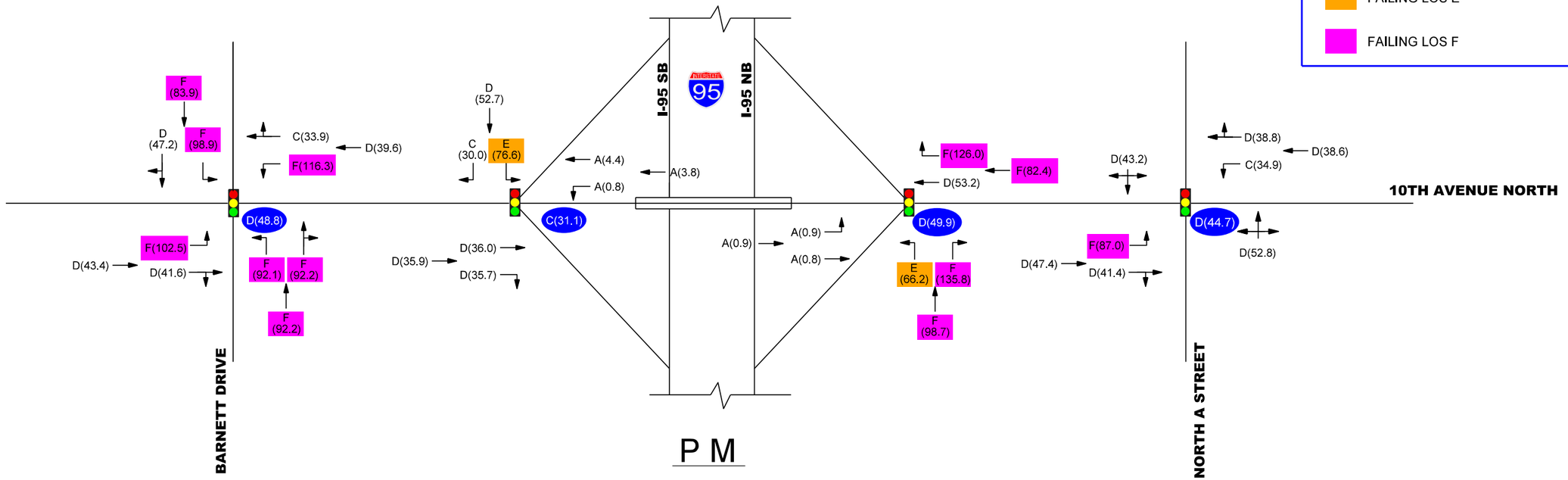
Figure 4-3
Existing Year (2019) Peak Hour Traffic Volumes And Level of Service (LOS)





SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 4-4
Existing Year 2019 No Action Alternative
Peak Hour Level of Service (LOS) and Delay (In Seconds)

Table 4-5 Existing Year (2019) AM Arterial Level of Service

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	36.5	13.5	E	31.6	7.7	E
I95 SB Off Ramp	56.0	10.0	**F**	20.8	4.8	**F**
I95 NB On Ramp	12.3	28.2	B	81.8	16.7	C
North A St	50.2	7.8	**F**	50.9	17.8	C
Total	155.0	11.5	**F**	185.1	9.1	D

Table 4-6 Existing Year (2019) PM Arterial Level of Service

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	57.3	8.6	**F**	54.7	10.3	D
I95 SB Off Ramp	55.5	10.1	**F**	19.8	17.5	C
I95 NB On Ramp	12.4	27.9	C	71.0	5.5	**F**
North A St	54.4	7.2	**F**	56.9	6.9	**F**
Total	179.6	10.0	**F**	202.4	8.4	E

4.1.4 Field Observations

A field review was conducted on January 14, 2020 to try and confirm complaints made by residents and officials from the City of Lake Worth Beach regarding traffic backing up between the westbound to northbound movement to I-95 and A Street. During the field review the observer spoke with one of the school crossing guards during the morning rush hour (am peak). The crossing guard mentioned that the afternoon rush hour (pm peak) is worse than the am peak based on the number of school children that need to cross the signalized intersections between the westbound to northbound movement to I-95 and A Street. The crossing guard also mentioned that they would call the City of Lake Worth Beach to complain about the signal timing. The following is a list of our observations from the field review from 3:30 PM to 4:30 PM regarding traffic movements:

4.1.4.1 Barnett Drive

- School children were observed walking on both sides of 10th Avenue North.

- School children bicycling the wrong way on eastbound bike lanes along 10th Avenue North.
- Westbound vehicles were backed up from traffic signal at Detroit Street.
- Northbound approach is green and westbound traffic backs up onto the railroad bridge.
- Eastbound approach was observed to have traffic backed up to Detroit Street.
- Southbound approach was observed to have 15 vehicles waiting.
- Westbound approach was backed up from Detroit Street to the railroad bridge.
- Westbound left turn lane was full and the queue was encroaching into the westbound through lanes.
- Vehicles making the southbound left movement were observed waiting for the northbound right turning movement.

4.1.4.2 North "A" Street Intersection

- Eastbound left turn traffic backed up when northbound left movement was moving (observed 10 cars in the left turn bay).
- Eastbound left turn traffic cleared on protected movement (green arrow) during signal cycle.
- Westbound approach lanes observed to have 15 cars in each lane waiting while northbound left and eastbound left movement were green. The westbound approach did clear during green time.
- The southbound and northbound approach had 10 vehicles stopped while eastbound and westbound approaches had the green time. The northbound approach was not able to clear during the signal cycle green time for the approach.

4.1.4.3 NB On and Off Ramp From I-95 (East Signal)

- Westbound through and right turn movements experienced a red light even though there was no eastbound left movement occurring
- Westbound through traffic backup went over to A Street prior to movement receiving the green at the On-Ramp intersection.
- Westbound through movement at the northbound On-Ramp intersection did not clear when the northbound light at A Street turned green.

4.1.4.4 SB On and Off Ramp From I-95 (West Signal)

- Eastbound right turn traffic backup exceeded the turn lane bay length.
- Eastbound through traffic back up went beyond the Barnett Drive intersection.

- Westbound through traffic at Barnett Drive backed up even as the westbound through movement over the I-95 Bridge had a red light. When the westbound through movement over the I-95 bridge turned green, there was no room for them to go in the receiving lanes.
- Vehicles trying to make the southbound right movement from the off-ramp were not able to turn right due to congestion on the receiving approach.

4.2 CRASH AND SAFETY INFORMATION

4.2.1 Crash Data

A five-year (2014 through 2018) crash data summary for 10th Avenue North between Detroit Street and North A Street (Roadway IDs # 93507500 & 93507501) and I-95/SR 9 from 6th Avenue South to Forest Hill Boulevard (Roadway ID # 93220000) were provided by FDOT District 4 obtained from Signal Four Analytics records and CAR Online data. The two sets of data were compared to ensure no duplicated crashes were counted. A *Safety Analysis I-95/SR 9 at 10th Avenue North Interchange Report*, dated June 2020 (see **Appendix C**) was prepared for this PD&E study. A summary of the observed crashes for 10th Avenue North, I-95, ramp segments and terminals are shown in **Table 4-7** & **Table 4-8**.

Table 4-7 Crash Summary for 10th Avenue North (2014-2018)

Year	Rear end	Sideswipe	Left turn	Right Turn	Angle	Head on	Others	Total
2014	17	0	1	1	6	0	3	28
2015	20	0	2	1	13	2	5	43
2016	25	0	6	0	8	4	5	48
2017	14	6	1	1	1	5	2	30
2018	25	11	6	1	0	1	5	49
Total	101	17	16	4	28	12	20	198
%	*51%	9%	8%	2%	*14%	6%	*10%	

* Predominant crash patterns

Year	Day	Night	Total
2014	18	10	28
2015	31	12	43
2016	34	14	48
2017	18	12	30
2018	36	13	49
Total	137	61	198
%	69.19%	30.81%	

* Night crashes exceeds statewide average (29%)

Year	Dry	Wet	Total
2014	24	4	28
2015	34	9	43
2016	41	7	48
2017	27	3	30
2018	45	4	49
Total	171	27	198
%	86.36%	13.64%	

* Wet Weather crashes less than statewide average (16%)

Table 4-8 Crash Summary for SR 9/I-95 (2014-2018)

Year	Rear end	Sideswipe	Left turn	Right Turn	Angle	Head on	Others	Total
2014	71	0	9	0	14	0	2	96
2015	67	0	5	0	10	6	0	88
2016	76	1	7	0	11	4	0	99
2017	20	11	1	0	2	0	21	55
2018	38	16	3	0	5	0	34	96
Total	272	28	25	0	42	10	57	434
%	62.5%	6.4 %	5.7%	0%	9.7%	2.3%	13.1%	

Year	Day	Night	Total
2014	66	30	96
2015	69	19	88
2016	66	33	99
2017	35	20	55
2018	64	32	96
Total	300	134	434
%	69.1%	30.9%	

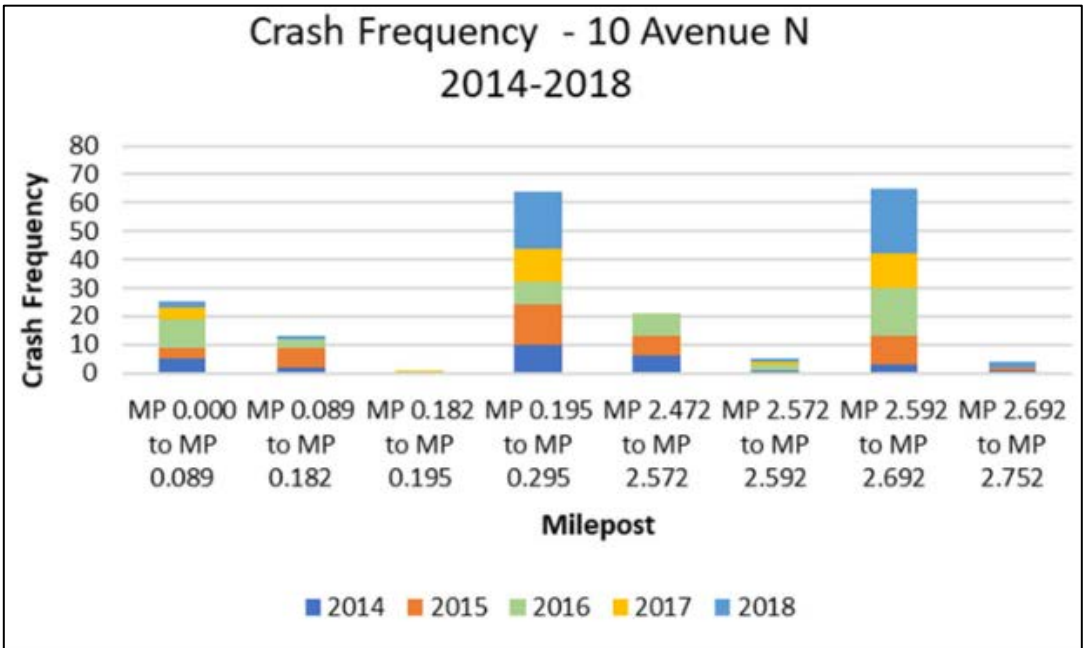
Year	Dry	Wet	Total
2014	52	44	96
2015	50	38	88
2016	53	46	99
2017	41	14	55
2018	70	26	96
Total	266	168	434
%	61.3%	38.7%	

Crash data for the 10th Avenue North segment shows a total of 198 crashes and for I-95 segment shows a total of 434 crashes. Rear end collisions are leading the crash type with 51% for 10th Avenue North and 63% for I-95, followed by angle collisions for both corridors as second predominant type of crash with 14% and 10%, respectively. The predominant crash patterns are indicative of congested conditions approaching the closely spaced intersections, which are also enduring peak hour traffic volumes exceeding capacity and thereby safety concerns.

I-95 /SR 9 is under high crash segment location from MP 21.3 to 21.9 is as per 2017 High Crash Segment list by FDOT.

Crash hotspot locations were identified in the analysis conducted along 10th Avenue North to determine specific segments or intersections with high crash frequencies. **Figure 4-5** shows the crash safety hotspots. 10th Avenue North at Barnett Drive (MP 2.592 to MP 2.692) and 10th Avenue North at A Street (MP 0.195 to MP 0.295) have more than 60 crashes in the span of 5 years. 10th Avenue North at I 95 ramp (MP 0.000 to MP 0.089) and 10th Avenue North at Detroit St have more than 20 crashes in the span of 5 years. All these locations could be considered high crash locations when compared to statewide crash averages for similar roadway facility types.

Figure 4-5 Crash Frequency



HSM Segmentation - Existing			
Name	**Limits**		**Length**
Intersection 1	10th Ave N @ Detroit St	MP 2.472 to MP 2.572	250' on each leg
Segment 1A	Between Intersection 1 and Intersection 2	MP 2.572 to MP 2.592	106'
Intersection 2	10th Ave N @ Barnett Dr	MP 2.592 to MP 2.692	250' on each leg
Segment 1B	Between Intersection 2 and Intersection 3	MP 2.692 to MP 2.752	317'
Intersection 3	10th Ave N @ I95 SB ON/OFF Ramp	MP 0.000 to MP 0.089	250' on each leg
Intersection 4	10th Ave N @ I95 NB ON/OFF Ramp	MP 0.089 to MP 0.182	250' on each leg
Segment 2	Between Intersection 4 and Intersection 5	MP 0.182 to MP 0.195	106'
Intersection 5	10th Ave N @ A St	MP 0.195 to MP 0.295	250' on each leg

Two (2) fatal crashes were identified on SR 9/I 95 during the five-year study period. Both fatal crashes were rear end collisions. The report also found that implementing traffic improvement to provide less delay, reduction in congestion and improved geometric design to prevent crashes would assist in improving safety of the interchange.

SECTION 5 FUTURE TRAFFIC FORECASTS

The AADTs development for this project was included in the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report*, dated December 21, 2017. Using the AADTs developed, a *Traffic Forecasting Memorandum* was completed for this project and presents details on future design hour volume development. These reports are provided in **Appendix B**. A summary of the future transportation network and future traffic volume forecasting is discussed in this section.

5.1 FUTURE LAND USE

The Palm Beach County Future Land Use Map shows the following land uses: commercial, office, industrial, transportation, mixed use, education, activity center, urban village, and residential. Future land use is consistent with the currently adopted land use plans and is shown on **Figure 5-1**.

5.2 FUTURE TRANSPORTATION NETWORK

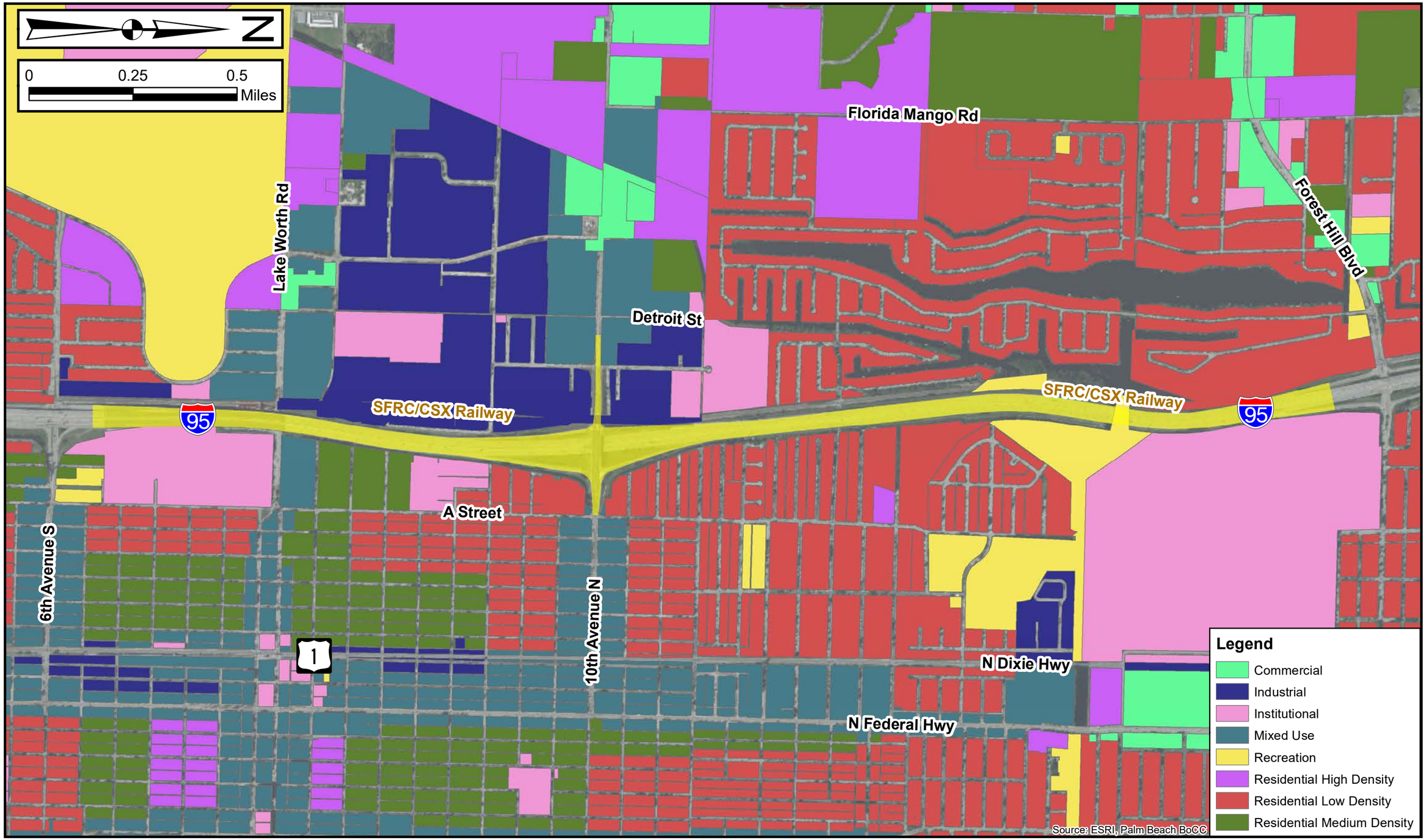
The TPA for Palm Beach County plays a critical role in addressing regional transportation issues, convening stakeholders, and identifying the long-term transportation needs within Palm Beach County. It also serves as the coordinating forum for all the local governments for matters relating to the maintenance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

The Palm Beach TPA 2040 LRTP Desire Plan shows managed lanes on I-95 from Broward County Line to Martin County Line; and, the Cost Feasible Plan shows the managed lanes on I-95 from Broward County Line to Linton Boulevard and from Indiantown Road to Martin County Line; however, no other County or local agency roadway projects, included privately funded, were identified within the interchange immediate vicinity. In addition, the managed lanes are reflected in the FDOT Tentative Work Program for PD&E in Fiscal Year 2024 (Financial Management No. 444202-2).

5.3 TRAVEL DEMAND FORECASTING/DEVELOPMENT OF AADT'S

Forecasts of future AADT traffic volumes were previously developed from information obtained from the *Traffic Data Collection & Traffic Projections for I-95 at 10th Avenue North PD&E Study Report*, dated December 21, 2017 and provided in **Appendix B**. The AADT volumes remained consistent between the alternatives. The AADTs for 2025 and 2045 are presented in **Figure 5-2**. **Section 5.3.1** details how the DDHVs were developed.

Furthermore, the methodology used for project traffic forecasting is documented in the MLOU and provided in **Appendix A**. A *Traffic Forecasting Memorandum*, May 2020, included in **Appendix B**, outlines the procedures used to develop traffic volumes for Existing Year 2019 and forecasted years 2025 and 2045.



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

I-95/SR 9 Interchange at 10th Avenue
Project Development and Environment Study
FPID No.: 412733-1
ETDM No.: 14337

Title:

FUTURE LAND USE MAP

Figure:

5-1

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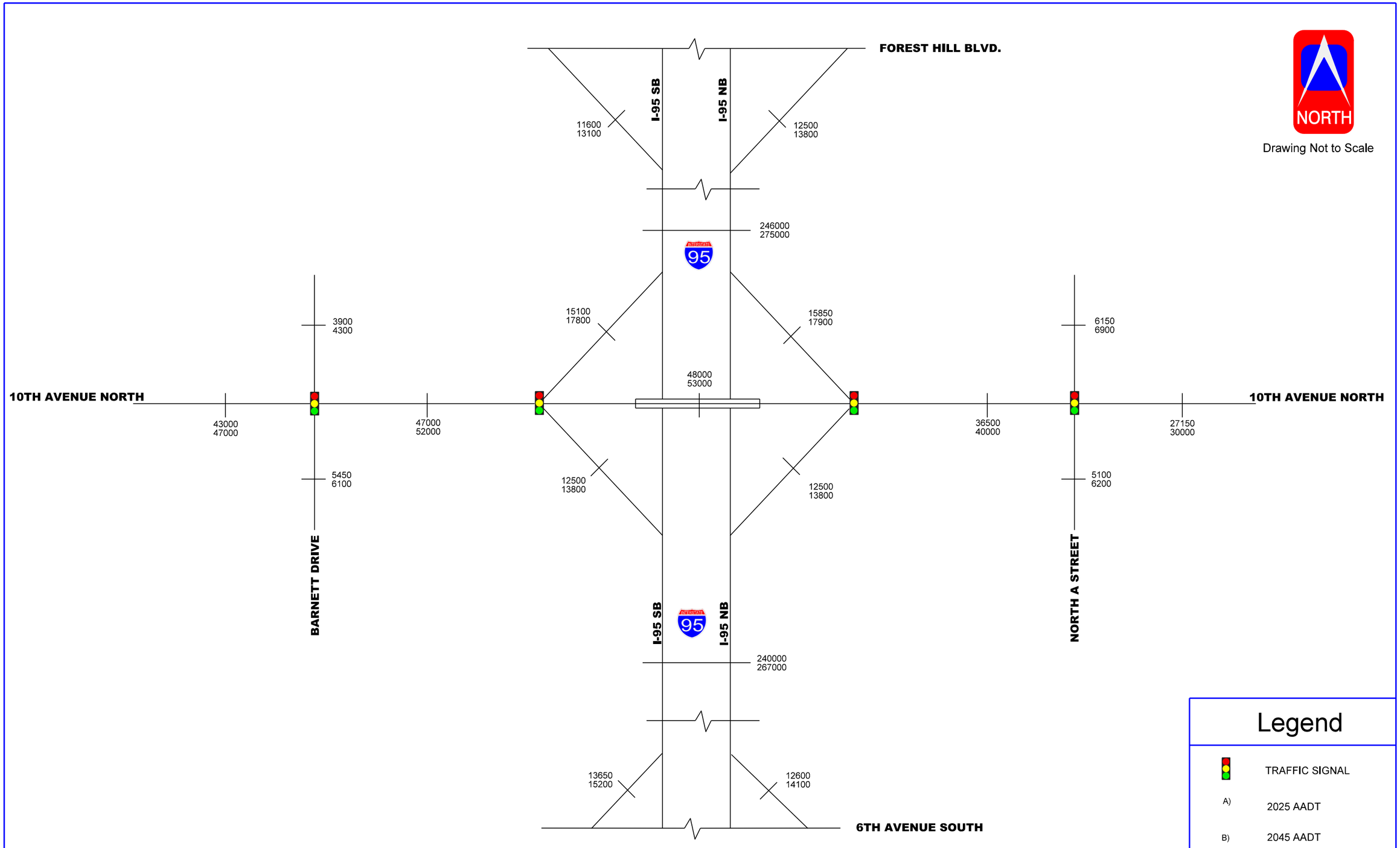

SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 5-2
Future Years Annual Average Daily Traffic (AADT) Volumes

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5.3.1 Development of DDHV Volumes

The Opening Year 2025 and Design Year 2045 DDHVs were developed using K and D factors along with the FDOT's TMTool. The No-Action 2025 and 2045 future year I-95 mainline, ramps and 10th Avenue North Signalized (four) intersections DDHVs were estimated by applying the study K and D factors. The K and D factors presented in **Section 2.4.1** were entered in the TMTool for Design Year 2045. The Opening Year 2025 volumes were developed by interpolation between Existing Year 2019 and Design Year 2045.

High Occupancy Vehicle (HOV) lanes were accounted for in all mainline ramp analysis. The percentage of HOV lanes compared to the total traffic on I-95 was provided via the FDOT District 4 *I-95 Master Plan Study*. The HOV percentage was different depending on the direction and peak hour. In the AM Peak Hour, the southbound HOV percentage was between 15-18%, and in the northbound direction, it was between 12-14%. In the PM Peak Hour, the southbound HOV percentage was between 11-14%, and in the northbound direction, it was 13%. The General Use Lane (GUL) volume was calculated by subtracting the calculated HOV lane volume from the total volume. This methodology was also applied to the mainline volumes between the ramps at the interchanges.

The mainline, ramp and intersections DDHVs were then balanced and checked for reasonableness and shown on **Figure 5-3** for Opening year 2025 and **Figure 5-4** for Design Year 2045.

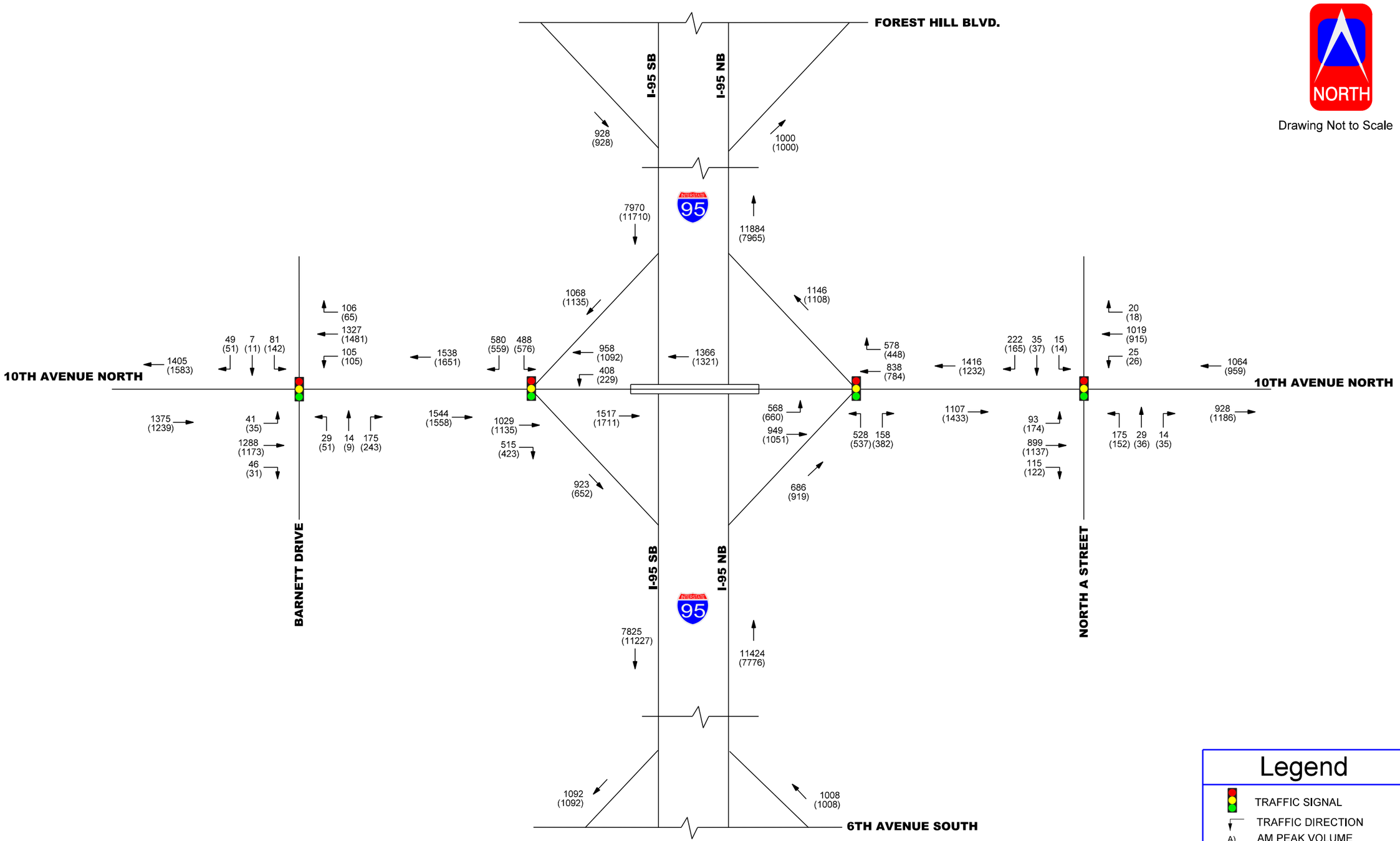

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Figure 5-3
Opening Year 2025 No Action Alternative
Peak Hour Volumes

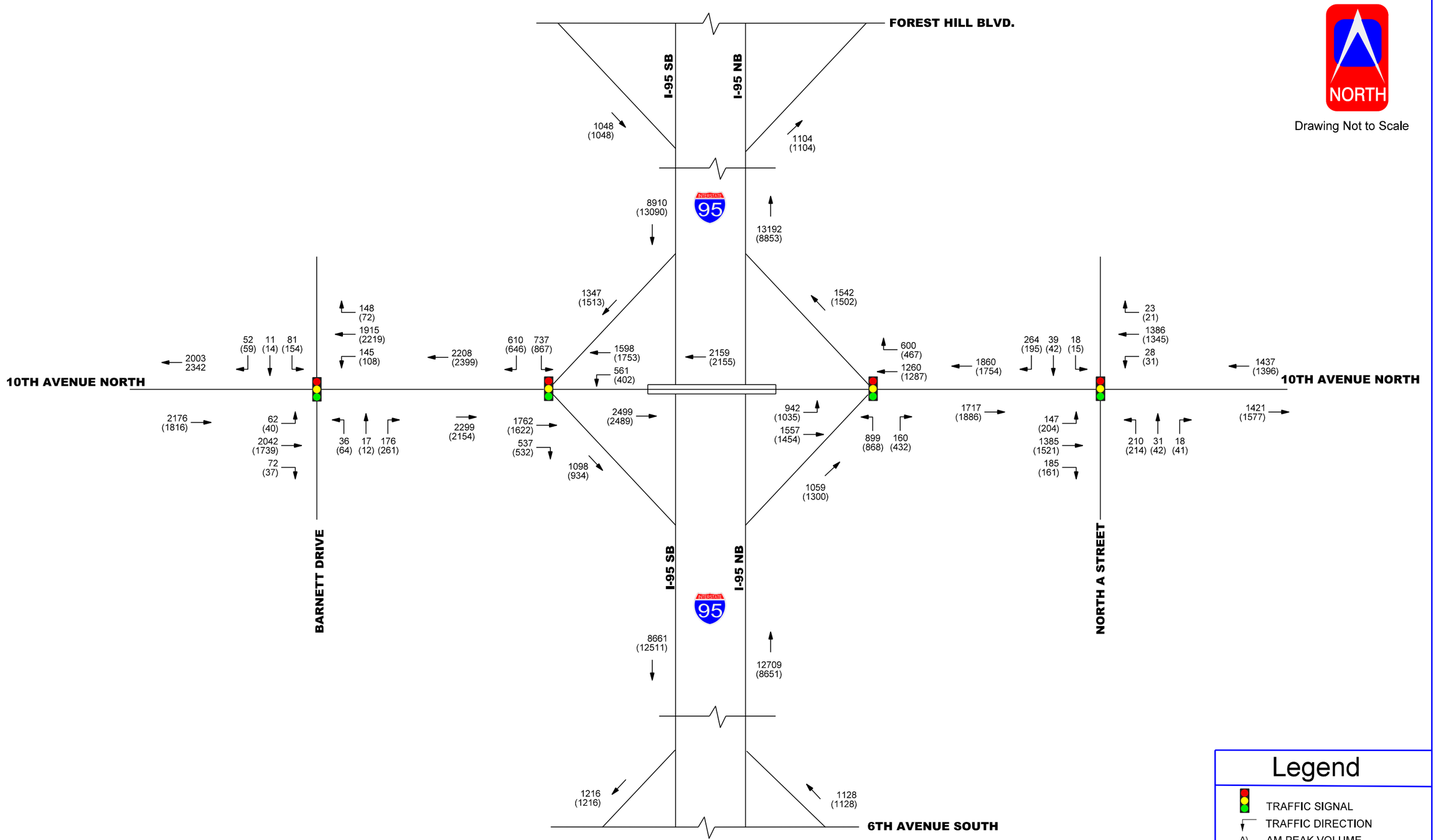

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Figure 5-4
Design Year 2045 No Action Alternative
Peak Hour Volumes

SECTION 6 NO-ACTION CONDITIONS

This section documents the future conditions within the I-95 at 10th Avenue North interchange modification study AOI for the No-Action Alternative. The No-Action Alternative assumes the existing plus committed roadway network. At this time, there are no committed roadway projects, so, the No-Action will match existing geometric lane configuration. The analysis years considered under the No-Action Alternative are Opening Year 2025 and Design Year 2045 as shown in the **Table 6-1**. The operational analysis includes the future year peak hour traffic forecasts for the AOI. The primary objective of this analysis was to establish the No-Action operational conditions along I-95 and at the study interchange and the signalized intersections.

Table 6-1 Recommended Years of Analysis

Alternatives	Years of Analysis			
	Existing (2019)	Opening (2025)	Interim (N/A)	Design (2045)
Existing Configuration	X	-	-	-
No Action Alternative	-	X	-	X
Build Alternative 1	-	X	-	X
Build Alternative 2	-	X	-	X

The No-Action lane configuration is provided in **Figure 6-1**. **Figure 5-3** and **Figure 5-4,** provided in Section 5.0 of this report, provided the future year No-Action DDHVs for 2025 and 2045 respectively.

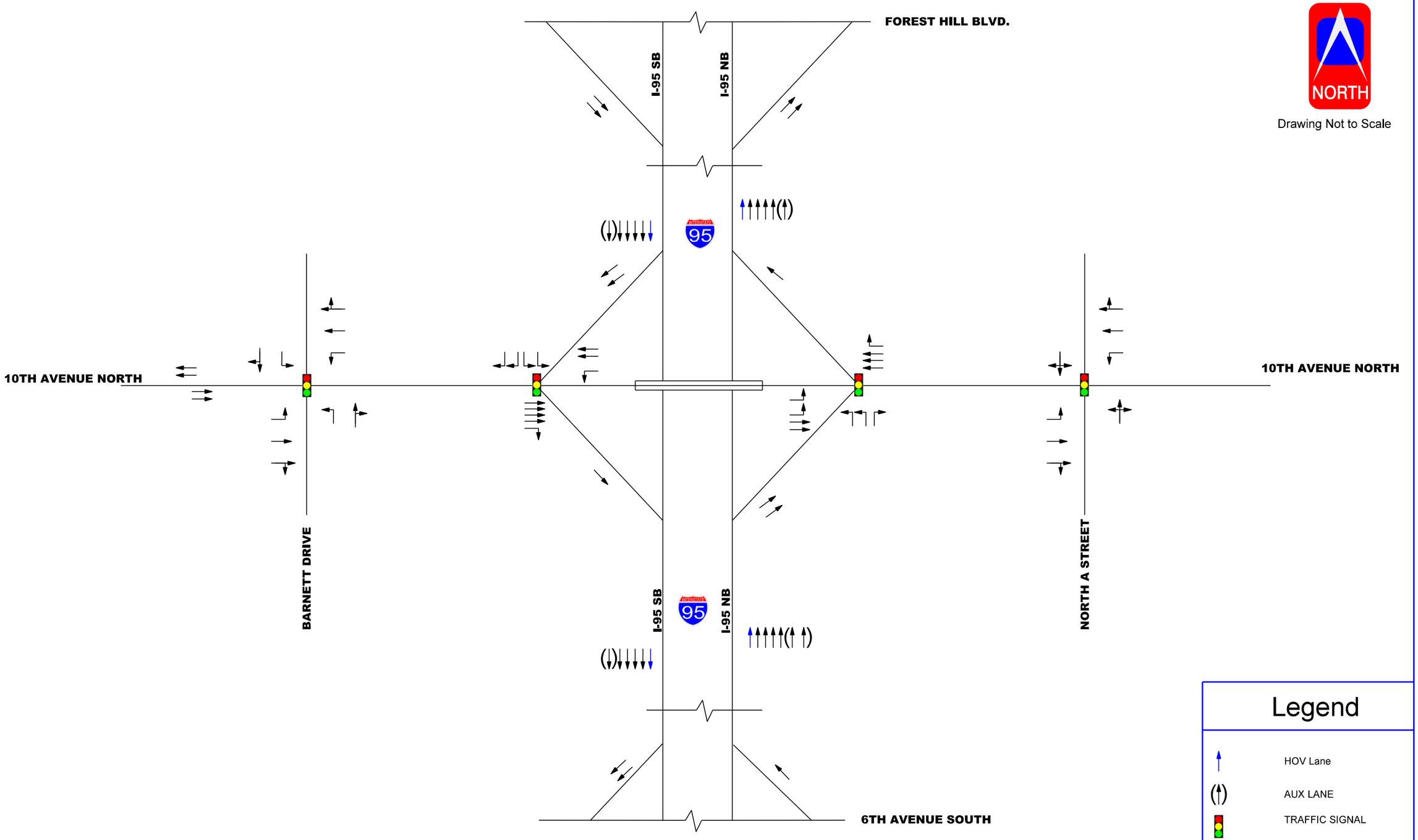
6.1 INDIVIDUAL ELEMENT NO-ACTION OPERATIONAL ANALYSIS

An individual element operational analysis was conducted for the No-Action Alternative using HCM 6 methodology and HCS 7 was used to perform a capacity analysis for the mainline segments and ramps. SYNCHRO 10.0 was used to analyze the study intersections along 10th Avenue North. The results of this detailed analysis are presented in the following sections. Documentation for the No-Action Alternative analysis is provided in **Appendix F**.

6.1.1 2025 No-Action Analysis

6.1.1.1 Mainline Analysis

The Opening Year 2025 No-Action mainline analysis results are summarized in **Table 6-2**. The results of the operational analysis show that I-95 mainline segment south of 10th Avenue North would operate at LOS E (capacity) and not acceptable LOS for the southbound direction in the 2025 PM peak hour. The I-95 mainline segment north of 10th Avenue North would operate at LOS E (capacity) and not acceptable LOS for the northbound direction in the AM peak period and southbound direction in the PM peak hour.



SR 9/I-95 at 10th Avenue North PD&E
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Figure 6-1
No Action Lane Configuration

Table 6-2 Opening Year (2025) No Action Mainline Capacity Analysis

Freeway Segment	Direction	Number of GUL Lanes+Aux lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95- S of 10th Ave N	NB	7 (1HOV+4GUL+2AUX)	11,424	29.7	D	0.79	7,776	19.4	C	0.54
	SB	6 (1HOV+4GUL+1AUX)	7,825	22.7	C	0.63	11,227	36.9	E*	0.91
I-95 - N of 10th Ave N	NB	6 (1HOV+4GUL+1AUX)	11,884	41.2	E*	0.96	7,965	23.2	C	0.64
	SB	6 (1HOV+4GUL+1AUX)	7,970	23.2	C	0.64	11,710	40.0	E*	0.95

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Source – See Appendix F for Software Input/Output, results.

* - Improving LOS to D or better along I-95 is out of the scope of this project

6.1.1.2 Ramp Analysis

The Opening Year 2025 No-Action ramp analysis results are summarized in **Table 6-3**. The results of the operational analysis show that not all study ramps merge/diverge at an acceptable LOS. **Figure 6-4** illustrates the peak hour volumes, and LOS results.

Table 6-3 Opening Year (2025) No Action Ramp Capacity Analysis

Freeway Segment	Direction	Analysis Type	Number of lanes	AM Peak Hour				PM Peak Hour			
				Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 at 10th Ave N	NB Off	Diverge	2	686	23.7	C	0.18	919	11.0	B	0.24
	NB On	Merge	2	1,146	35.0	**F**	0.30	1,108	21.9	C	0.29
	SB Off	Diverge	2	1,068	11.5	B	0.28	1,135	23.8	**F**	0.30
	SB On	Merge	2	923	20.2	C	0.24	652	29.7	**F**	0.17
I-95 at 6th Avenue South	NB On	Merge	2	1,008	31.8	**F**	0.27	1,008	20.9	C	0.27
	SB Off	Diverge	2	1,092	11.4	B	0.29	1,092	21.2	C	0.29
I-95 at Forest Hill Blvd.	NB Off	Diverge	2	1,000	24.7	C	0.26	1,000	11.3	B	0.26
	SB On	Merge	2	928	11.6	B	0.24	928	24.0	C	0.24

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Source – See Appendix F for Software Input/Output, results.

6.1.1.3 Weaving Analysis

Along the mainline, the I-95 northbound and southbound segments between 10th Avenue North and adjacent interchanges do include auxiliary lanes. With these auxiliary lanes, it is possible that weaving could occur. Referring to the *HCM* Equation 13-4 the values of VR (volume ratio) for all four ramps at

the 10th Avenue North interchange require less than a mile of weaving length. Considering that both adjacent interchanges are at least a mile from the 10th Avenue North interchange, a weaving analysis is not required. Hence a weaving analysis was not performed.

6.1.1.4 Intersection Analysis

Peak hour volumes were analyzed at the signalized intersections along 10th Avenue North, for the opening Year 2025 No-Action intersection analysis. The results (approach and intersection delay and LOS) obtained from SYNCHRO software are summarized in **Table 6-4.** SYNCHRO 10 results were reported for all of the intersection analysis to be consistent between different alternatives, as HCS methodology does not support clustered intersections in Alternative 2. In the Opening Year 2025, the overall intersections and several approaches would operate at unacceptable LOS and are highlighted in the **Table 6-4.**

Table 6-4 Opening Year (2025) No Action Intersection Analysis

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	27.1	16.5	82.4	83.8	28.2
		LOS	C	B	F	F	C
	PM	Delay[1]	50.7	50.4	94.0	84.0	56.4
		LOS	D	D	F	F	E
10th Avenue North at I-95 SB ramps	AM	Delay[1]	40.3	11.4	-	51.3	33.3
		LOS	D	B	-	D	C
	PM	Delay[1]	35.1	8.4	-	64.3	34.6
		LOS	D	A	-	E	C
10th Avenue North at I-95 NB ramps	AM	Delay[1]	0.7	169.1	70.0	-	79.7
		LOS	A	F	E	-	E
	PM	Delay[1]	1.1	103.1	100.4	-	57.3
		LOS	A	F	F	-	E
10th Avenue North at A Street	AM	Delay[1]	40.0	36.2	68.6	47.5	41.6
		LOS	C	C	E	D	D
	PM	Delay[1]	46.4	41.4	57.2	44.2	45.4
		LOS	D	D	E	D	D

1. Delay (Secs/Veh)

Source – See Appendix F for Software Input/Output, results.

Table 6-5 summarizes the 95th percentile queue length analysis for the Opening Year 2025 No-Action. In the Opening Year 2025, the existing storage accommodates the 95th Percentile queue at all intersection approaches except the movements highlighted in **Table 6-5**. At the I-95 northbound ramp intersection the northbound right queue is expected to exceed provided storage for the PM peak period.

Figure 6-2 illustrates the peak hour volume and LOS. **Figure 6-3** illustrates the AM and PM peak hour LOS and Delay (in seconds) results.

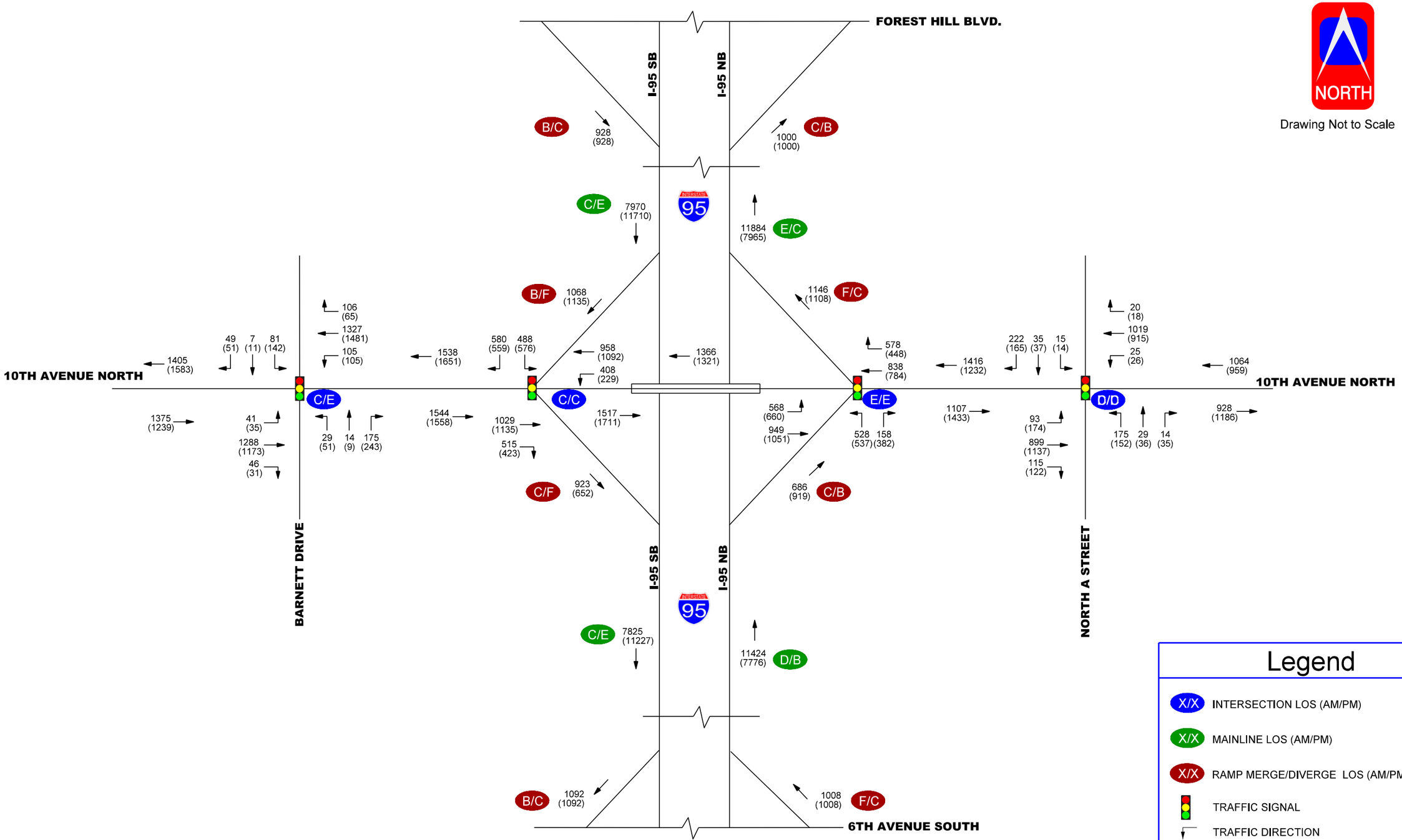
Table 6-5 Opening Year (2025) No Action 95th Percentile Queue Length Summary

Intersection	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	89	845	-	m184	524	-	59	282	-	147	96	-
	PM	#92	#942	-	m#174	#1053	-	#107	#409	-	#261	97	-
	Storage	125	721	-	125	825	-	75	513	-	80	453	-
10th Avenue North at I-95 SB ramps	AM	-	419	#719	m0	m74	-	-	-	-	#359	-	305
	PM	-	613	m543	m0	m76	-	-	-	-	#466	-	290
	Storage	-	825	250	508	508	-	-	-	-	540	-	540
10th Avenue North at I-95 NB ramps	AM	0	0	-	-	#679	#1143	#364	-	228	-	-	-
	PM	0	m13	-	-	#616	#839	#382	-	#681	-	-	-
	Storage	508	508	-	-	571	200	1462	-	550	-	-	-
10th Avenue North at A Street	AM	176	411	-	40	580	-	-	#363	-	-	343	-
	PM	m264	m564	-	49	559	-	-	323	-	-	269	-
	Storage	265	571	-	120	578	-	-	475	-	-	414	-

(#) = 95th Percentile Volume exceeds capacity

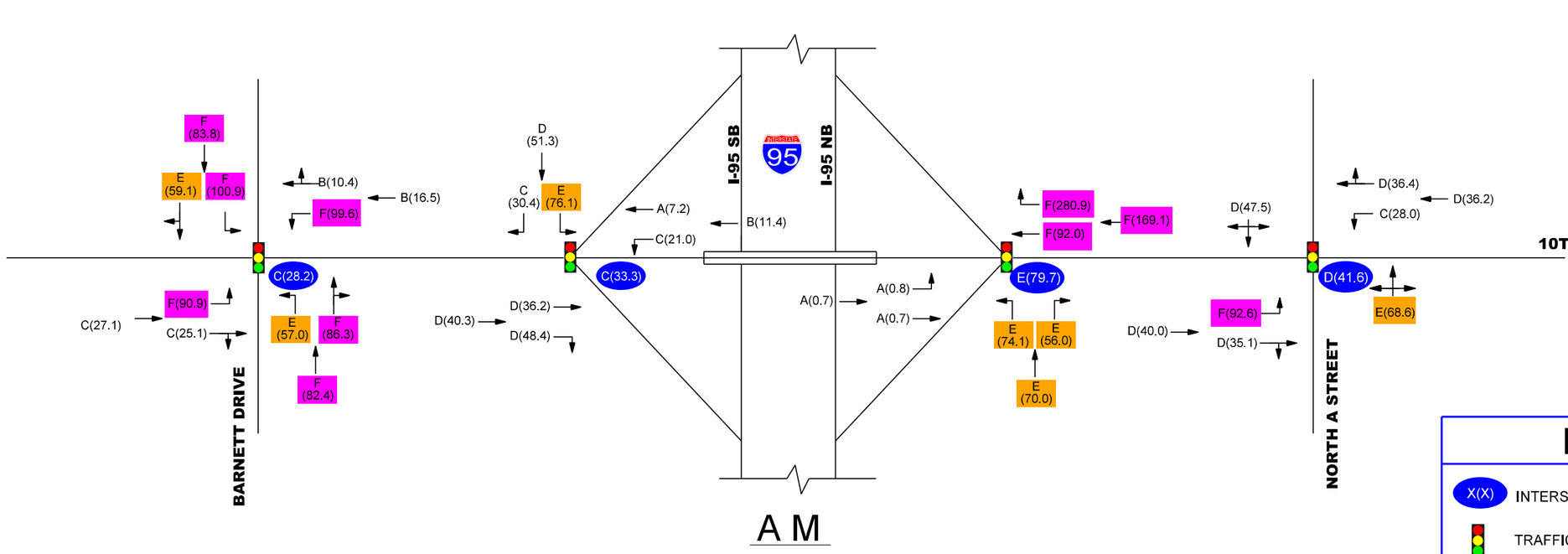
Source – See Appendix F for Software Input/Output, results.

(m) = Volume for 95th percentile queue is metered by upstream signal



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 6-2
Opening Year 2025 No Action Alternative
Peak Hour Volumes and Level of Service (LOS)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 6-3
Opening Year 2025 No Action Alternative
Peak Hour Level of Service (LOS) and Delay (in Seconds)

6.1.1.5 Arterial Analysis

Peak hour volumes were analyzed along the 10th Avenue North corridor between Barnett Drive and North A Street for the opening Year 2025 No-Action arterial analysis. The results arterial LOS for Eastbound and Westbound obtained from SYNCHRO software are summarized in **Table 6-6 and Table 6-7.** In the Opening Year 2025, several of the arterial segments would operate at unacceptable LOS and are highlighted in the tables.

Table 6-6 Opening Year (2025) AM Arterial Level of Service – No Action

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	40.8	12.0	**F**	32	17.6	C
I95 SB Off Ramp	55.7	10.1	**F**	22.4	15.5	C
I95 NB On Ramp	12.3	28.2	B	109.8	3.5	**F**
North A St	48.4	8.0	**F**	54.5	7.2	E
Total	157.2	11.4	**F**	218.7	7.7	E

Table 6-7 Opening Year (2025) PM Arterial Level of Service – No Action

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	64.8	7.6	**F**	36.1	9.7	D
I95 SB Off Ramp	55.1	10.2	**F**	6.8	15.3	C
I95 NB On Ramp	12.7	27.3	C	76.4	4.1	**F**
North A St	54.0	7.2	**F**	41.6	6.6	**F**
Total	186.6	9.6	**F**	160.9	7.2	E

6.1.2 2045 No-Action Analysis

6.1.2.1 Mainline Analysis

The Design Year 2045 No-Action mainline analysis results are summarized in **Table 6-8**. The results of the operational analysis show that not all the mainline segments operate at an acceptable LOS D or better in both the 2045 AM and PM peak hours. The I-95 segment north of 10th Avenue North are

expected to operate at a LOS F for the northbound direction in the AM peak hour and southbound direction in the PM peak hour.

Table 6-8 Design Year (2045) No Action Mainline Capacity Analysis

Freeway Segment	Direction	Number of GUL Lanes+Aux lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 - S of 10th Ave N	NB	7 (1HOV+4GUL+2AUX)	12,709	35.0	D	0.88	8,651	21.5	C	0.60
	SB	6 (1HOV+4GUL+1AUX)	8,861	25.4	C	0.70	12,511	-	F*	1.01
I-95 - N of 10th Ave N	NB	6 (1HOV+4GUL+1AUX)	13,192	-	F*	1.07	8,853	26.1	D	0.72
	SB	6 (1HOV+4GUL+1AUX)	8,910	26.2	D	0.72	13,090	-	F*	1.06

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Source – See Appendix F for Software Input/Output, results.

* Improving LOS to D or better along Interstate 95 is out of the scope of this project.

6.1.2.2 Ramp Analysis

The Design Year 2045 No-Action ramp analysis results are summarized in **Table 6-9**. The results of the operational analysis show that several study ramps have merge and diverge operations that operate at an unacceptable LOS F. **Figure 6-4** illustrates the peak hour volumes and ramp analysis results for the Design Year 2045 No-Action ramp analysis. All the ramps either fail in the AM or PM peak period. A future PD&E study (FM# 4442021) will be conducted for the I-95 mainline in this area that will evaluate proposed managed lanes that could improve mainline, ramp merge and ramp diverge LOS.

Table 6-9 Design Year (2045) No Action Ramp Capacity Analysis

Freeway Segment	Direction	Number of lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 at 10th Ave N	NB Off	2	1,059	30.4	F	0.27	1,300	13.8	B	0.33
	NB On	2	1,542	45.9	F	0.41	1,502	25.9	C	0.40
	SB Off	2	1,347	14.7	B	0.36	1,513	31.3	F	0.40
	SB On	2	1,098	23.2	C	0.29	934	40.5	F	0.25
I-95 at 6th Avenue South	NB On	2	1,128	42.1	F	0.30	1,128	23.4	C	0.30
	SB Off	2	1,216	13.6	B	0.32	1,216	29.5	F	0.32
I-95 at Forest Hill Blvd.	NB Off	2	1,104	33.6	F	0.28	1,104	13.7	B	0.28
	SB On	2	1,048	14.0	B	0.27	1,048	33.3	F	0.27

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Source – See Appendix F for Software Input/Output, results.

6.1.2.3 Weaving Analysis

Along the mainline, the I-95 northbound segment between 10th Avenue North and Forest Hill Boulevard does include an auxiliary lane. With this auxiliary lane, it is possible that weaving could occur. However, referring to Equation 13-4 of the *HCM*, the values of VR (volume ratio) for all four ramps at the 10th Avenue North interchange requires less than a mile of weaving length. Considering that both adjacent I-95 interchanges are at least a mile from the 10th Avenue North interchange, a weaving analysis is not required. According to this equation there is sufficient distance to make a single lane change for motorists accessing I-95, or motorists diverging to exit I-95. Hence a weaving analysis was not performed.

6.1.2.4 Intersection Analysis

The Design Year 2045 No-Action intersection analysis results are summarized in **Table 6-10.** In the Design Year 2045, the overall intersections and individual movements that would not operate at acceptable LOS are highlighted in the **Table 6-10.** All intersections for the Design Year 2045 No-Action Alternative are expected to operate at a failing LOS for both peak periods except for the intersection at A Street.

Table 6-10 Design Year (2045) No Action Intersection Analysis

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	121.8	60.8	81.6	82.9	90.4
		LOS	F	E	F	F	F
	PM	Delay[1]	193.7	185.9	99.1	88.6	178.1
		LOS	F	F	F	F	F
10th Avenue North at I-95 SB ramps	AM	Delay[1]	114.5	69.6	-	120.2	99.1
		LOS	F	E	-	F	F
	PM	Delay[1]	79.6	94.5	-	177.0	110.4
		LOS	E	F	-	F	F
10th Avenue North at I-95 NB ramps	AM	Delay[1]	7.3	308.6	216.1	-	151.5
		LOS	A	F	F	-	F
	PM	Delay[1]	7.2	278.3	208.1	-	140.1
		LOS	A	F	F	-	F
10th Avenue North at A Street	AM	Delay[1]	41.2	62.7	119.7	51.2	55.8
		LOS	D	E	F	D	E
	PM	Delay[1]	54.1	79.4	100.4	46.2	66.4
		LOS	D	E	F	D	E

1. Delay (Secs/Veh) Source – See Appendix F for Software Input/Output, results.

Table 6-11 summarizes the 95th percentile queue length analysis for the Design Year 2045 No-Action. In the Design Year 2045, the existing turn lane storage accommodates the 95th Percentile queue at all intersection approaches, except the movements highlighted in the **Table 6-11**. The westbound right queue at the northbound on-ramp intersection is expected to exceed storage for both peak periods

along 10th Avenue North. The eastbound right queue at the southbound on-ramp intersection is expected to exceed storage for both peak periods. The northbound off-ramp is expected to have the northbound right queue exceed the existing 550 feet of storage in the PM peak period. The southbound left movement at the southbound off-ramp is expected to exceed existing provided storage in both peak periods.

Figure 6-4 illustrates Peak Hour Volumes and Level of Service and **Figure 6-5** illustrates peak hour LOS and Delay (in seconds) results.

6.1.2.5 Arterial Analysis

Peak hour volumes were analyzed along the 10th Avenue North corridor between Barnett Drive and North A Street for the opening Year 2045 No-Action arterial analysis. The results of arterial LOS for Eastbound and Westbound obtained from SYNCHRO software are summarized in **Table 6-12 and Table 6-13.** In the Opening Year 2045, several of the arterial segments would operate at unacceptable LOS and are highlighted in the tables. Almost all of the 10th Avenue North segments are expected to operate at failing LOS for the PM peak period except for the eastbound segment at I-95 northbound on-Ramp.

Table 6-11 Design Year (2045) No Action 95th Percentile Queue Length Summary

Intersection	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	122	#1972	-	m171	m#1151	-	68	287	-	147	106	-
	PM	#110	#1708	-	m124	m#1539	-	#148	#463	-	#294	111	-
	Storage	125	721	-	125	825	-	75	513	-	80	453	-
10th Avenue North at I-95 SB ramps	AM	-	m#863	m324	m0	m82	-	-	-	-	#663	-	323
	PM	-	m689	m346	m0	m78	-	-	-	-	#819	-	346
	Storage	-	825	250	508	508	-	-	-	-	540	-	540
10th Avenue North at I-95 NB ramps	AM	m0	m0	-	-	m#1094	m#1003	#820	-	230	-	-	-
	PM	m0	m35	-	-	m#1073	m#646	#784	-	#804	-	-	-
	Storage	508	508	-	-	571	200	1462	-	550	-	-	-
10th Avenue North at A Street	AM	252	634	-	#75	#1054	-	-	#502	-	-	414	-
	PM	m299	m888	-	#104	#1087	-	-	#535	-	-	315	-
	Storage	265	571	-	120	578	-	-	475	-	-	414	-

(#) = 95th Percentile Volume exceeds capacity

(m) = Volume for 95th percentile queue is metered by upstream signal

Source – See Appendix F for Software Input/Output, results.

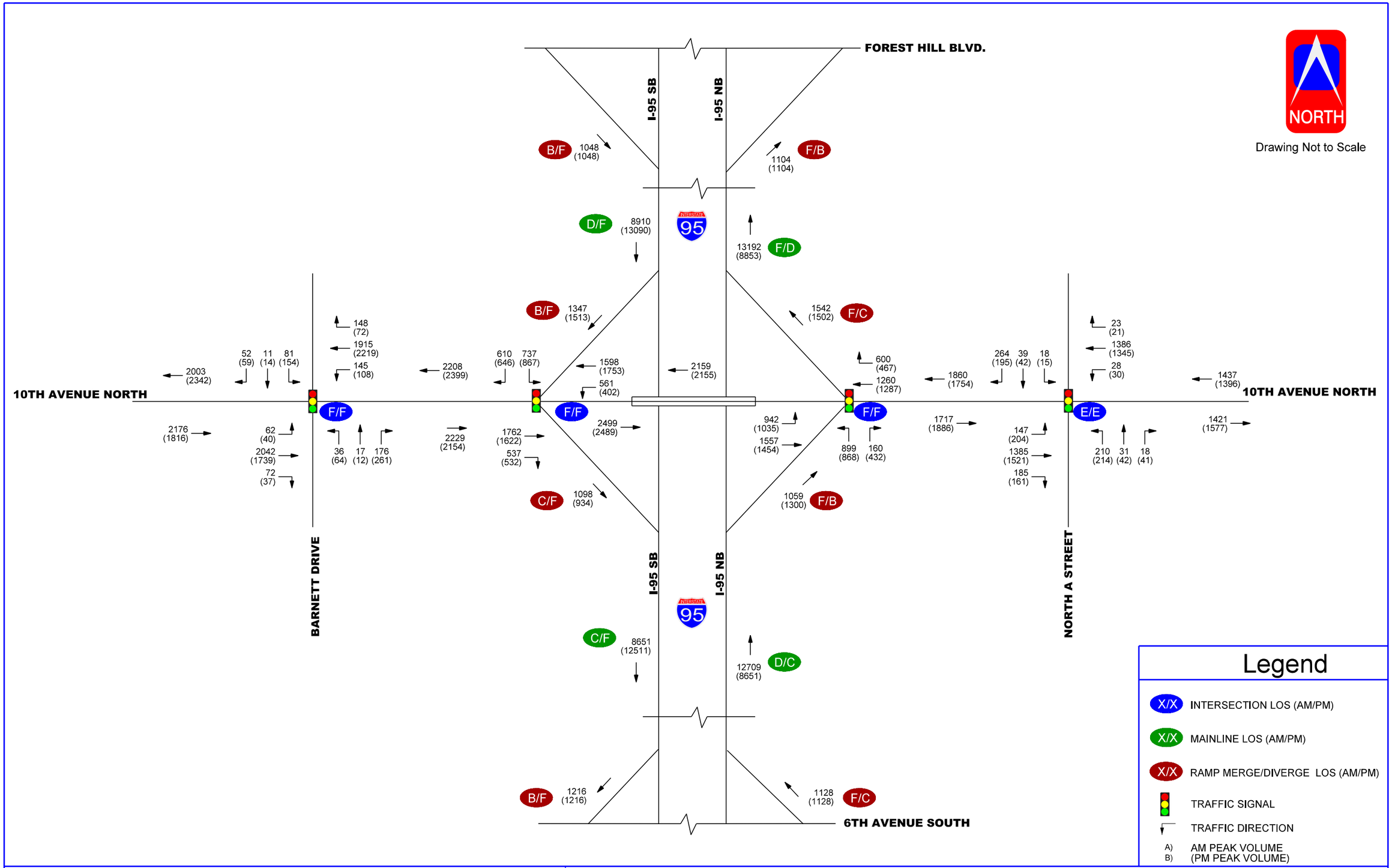


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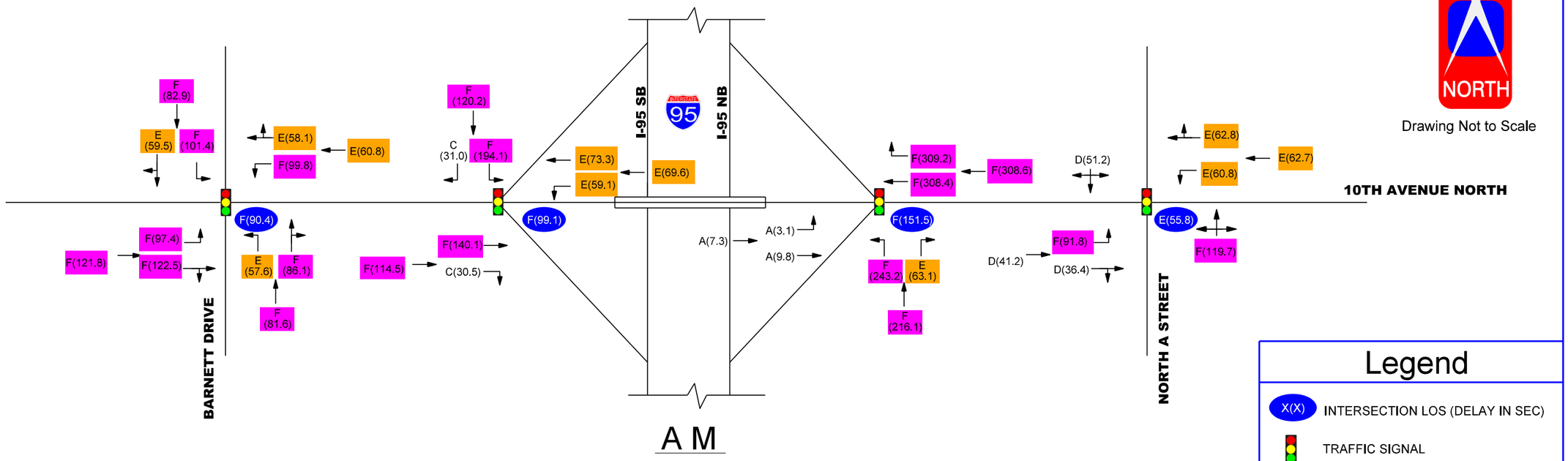
Figure 6-4
Design Year 2045 No Action Alternative
Peak Hour Volumes and Level of Service (LOS)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 6-5
Design Year 2045 No Action Alternative
Peak Hour Level of Service (LOS) and Delay (in Seconds)

Table 6-12 Design Year (2045) AM Arterial Level of Service – No Action

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	138.2	3.6	F	40.8	13.8	C
I95 SB Off Ramp	159.6	3.5	F	80.8	4.3	F
I95 NB On Ramp	14	24.7	C	324.5	1.2	F
North A St	49.5	7.9	F	80.9	4.9	F
Total	361.3	5.0	F	527.0	3.2	F

Table 6-13 Design Year (2045) PM Arterial Level of Service – No Action

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	211.1	2.3	F	209.0	2.7	F
I95 SB Off Ramp	115.4	4.9	F	118.0	2.9	F
I95 NB On Ramp	16.3	21.2	D	334.7	1.2	F
North A St	65.5	5.9	F	92.4	4.3	F
Total	408.3	4.4	F	754.1	2.2	F

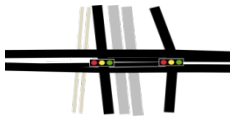
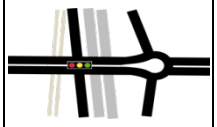
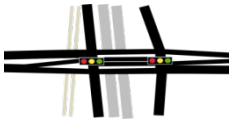
SECTION 7 CONSIDERED ALTERNATIVES

This section of the I-95 at 10th Avenue North IMR process will include the development and evaluation of alternatives for the study interchange within the previously-defined AOI. It is anticipated that up to two Build alternatives including the recommended alternative from the *Interchange Concept Development Report for I-95 (SR 9) Interchange at 10th Avenue North, Palm Beach County* dated June 2014 will be analyzed, in addition to the No-Action alternative as shown below. Multiple alternatives were developed based on safety, mobility, value and fatal flaw analysis. After a first level screening (**Table 7-1**) four alternatives were presented to FDOT at the DIRC meeting. Based on second level screening (**Table 7-2**) and input from FDOT, Roundabout and Contraflow alternatives were discarded and enhanced diamond (Tight Urban Diamond Interchange) and Diverging Diamond Interchange were considered for further evaluation. The Build alternatives will be further refined based on the results of the traffic operational and safety analyses. The Build alternatives analyzed in this study have concept plans included in **Appendix D**.

Table 7-1 First Level Screening of Alternatives

TYPE OF INTERCHANGE	Operations	Safety	Cost/ Impact	Peds/ Bikes
Enhanced Diamond	Baseline >= LOS D	Baseline	Baseline	Baseline
SPUI	Similar	Similar	Worse	Worse
Contraflow	Similar	Slight Better	Similar	Similar
DDI	Similar	Better	Similar	Slight Better
Continuous Flow Interchange	Similar	Similar	Worse	Similar
Roundabout Terminals	Similar	Better	Similar/Worse	Slight Better
Superstreet Interchange	Similar	Worse	Similar	Similar
Cloverleaf configs.	Similar	Slight Better	Severe	Worse
Flyovers	Similar	Better	Severe	Worse

Table 7-2 Second Level Screening of Alternatives

I-95 at 10th Avenue North EVALUATION CRITERIA	No Build	 Option 1 (Concept Reports)	 Option 2 (Roundabout)	 Option 3 (Diverging Diamond)	 Option 4 (Contra Flow Lefts)
Traffic Operation (LOS)	D/D : F/F	C/D: C/C	C/A : B/C	A/B : C/D	C/C: C/D
Safety	Poor	Improve	Significant	Significant	Improve
Natural Environmental	None	Minimal	Minimal	Minimal	Minimal
Contamination	None	Moderate	Moderate	Moderate	Moderate
Historic / Archaeological	None	Minimal	Minimal	Minimal	Minimal
Structures	None	Minimal	Minimal	Minimal	Minimal
Property Impacts	None	Moderate	Substantial	Moderate	Moderate
Relocation	None	Minimal	Moderate	Minimal	Minimal
Noise	None	Minimal	Minimal	Minimal	Minimal
Maintenance of Traffic	None	Substantial	Substantial	Substantial	Substantial
Utilities and Railroad	None	Moderate	Moderate	Moderate	Moderate
Estimated Cost (R/W Not Included)	None	Moderate $14.5 M	Moderate $12.9 M	Moderate $14.2 M	Moderate $12.6 M

7.1 NO-ACTION ALTERNATIVE

The No-Action Alternative describes the conditions that will exist in the design year of 2045, if no improvements are considered. It assumes that all other projects included in the cost feasible 2040 Long- Range Transportation Plan (LRTP) and other work programs in the area where funding has been committed will be built in the design year. The No-Action Alternative includes the recently completed FDOT interim improvements at the I-95 and 10th Avenue North interchange. The Palm Beach TPA 2040 Long Range Transportation Plan (LRTP) Desire Plan shows managed lanes on I-95 from Broward County Line to Martin County Line; and the Cost Feasible Plan shows the managed lanes on I-95 from Broward County Line to Linton Boulevard and from Indiantown Road to Martin County Line; however, no other County or local agency roadway projects, including privately funded, were identified within the interchange in the immediate vicinity. In addition, the managed lanes are reflected in the FDOT Tentative Work Program for PD&E in Fiscal Year 2024 (Financial Management No. 444202-2). The operational analysis results for the No-Action Alternative are provided in **Section 6**.

Two Build Alternatives were developed and evaluated in this IMR. The two alternatives are discussed in detail below.

All the build alternatives will take into consideration the potential I-95 managed lanes.

7.2 BUILD ALTERNATIVE 1 – TIGHT URBAN DIAMOND INTERCHANGE (TUDI)

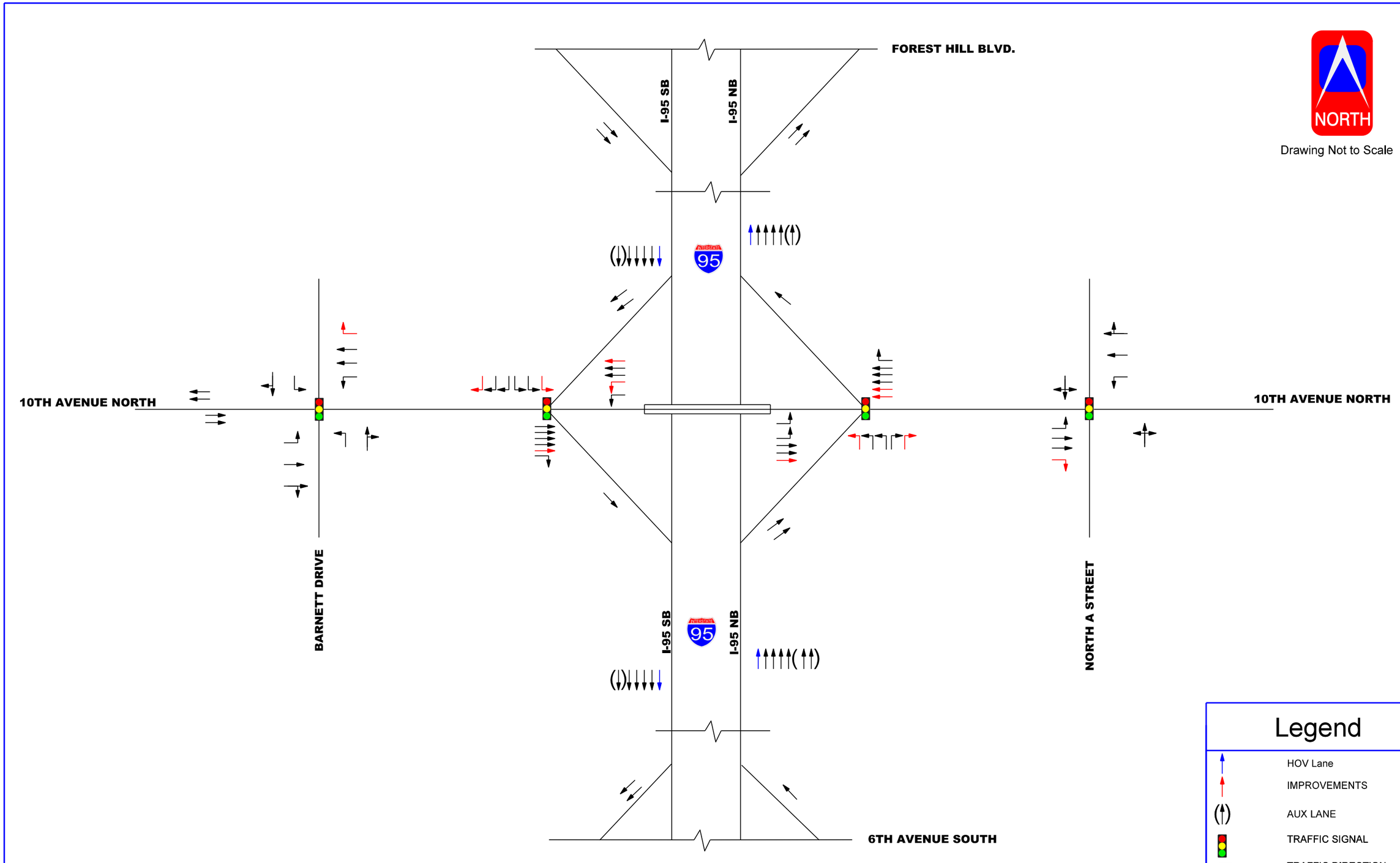
Build Alternative 1 is the Conceptual Development Alternative (the CDA) developed in the *I-95 (SR 9) Interchange at 10th Avenue North Interchange Concept Development Report dated June 2014 (06/14 ICD Report)* for TUDI.

The lane configuration for Build Alternative 1 is shown in **Figure 7-1**.

7.3 BUILD ALTERNATIVE 2 – DIVERGING DIAMOND INTERCHANGE (DDI)

Build Alternative 2 proposes a DDI at the interchange of I-95 and 10th Avenue North without bridge replacement. The MLOU (provided in **Appendix A**) presents Build Alternative 3 which proposes a DDI interchange with a bridge replacement over 10th Avenue North. This alternative was dropped during the PD&E process due to high cost and construction impacts of replacing the bridge.

The lane configuration for Build Alternative 2 is shown in **Figure 7-2**.



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-1
Build Alternative 1 (TUDI) Lane Configuration

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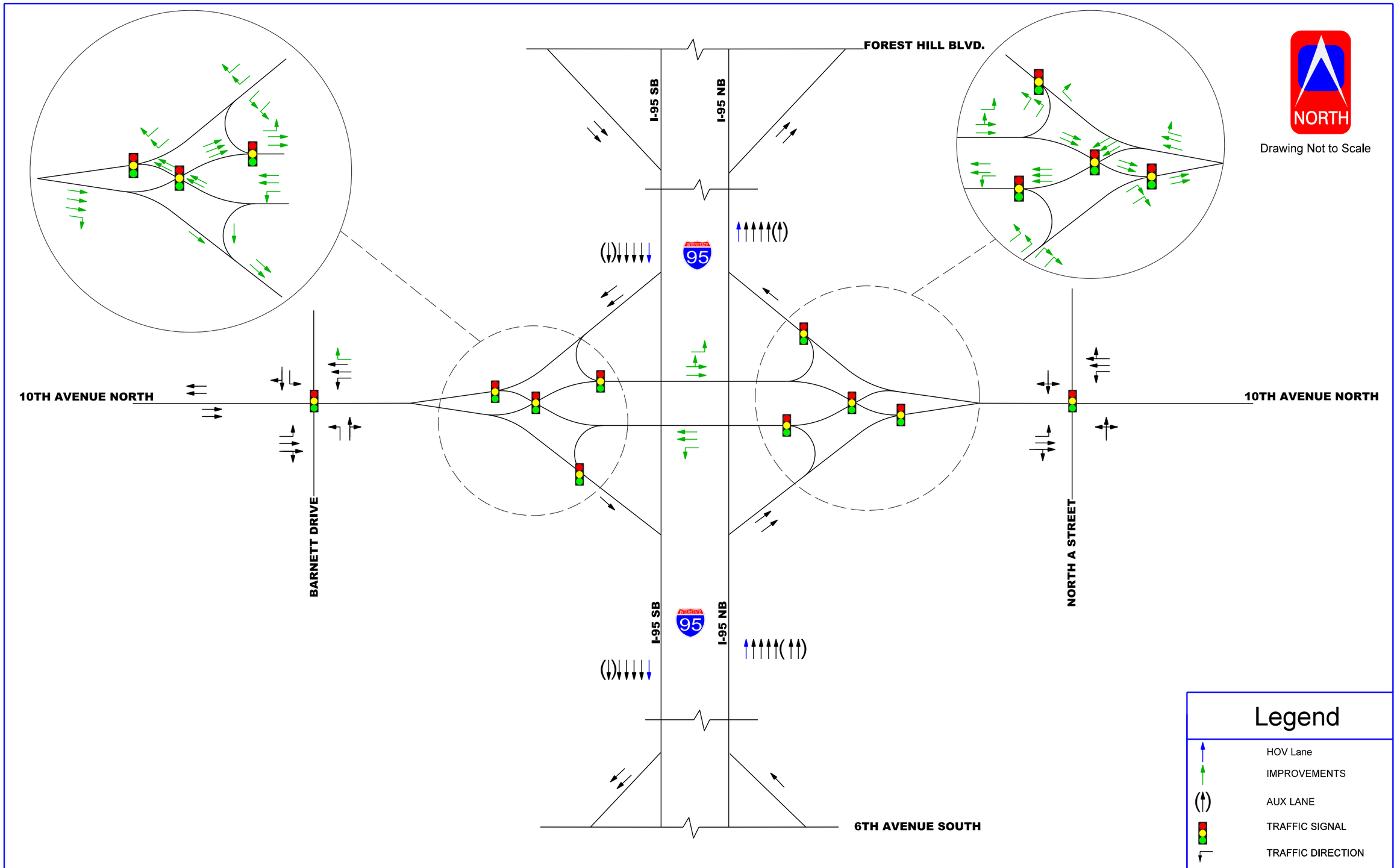
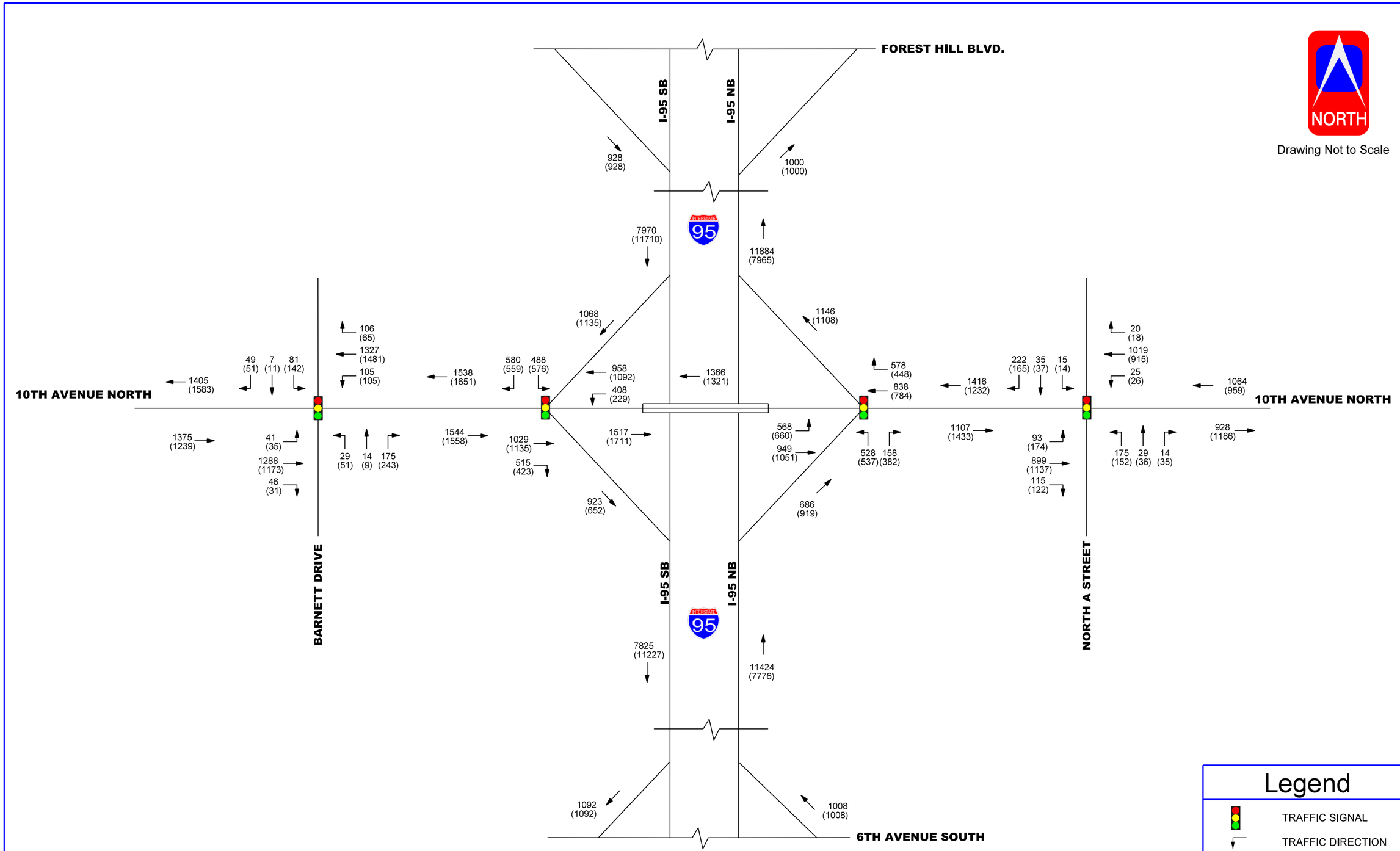


SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-2
Build Alternative 2 (DDI) Lane Configuration

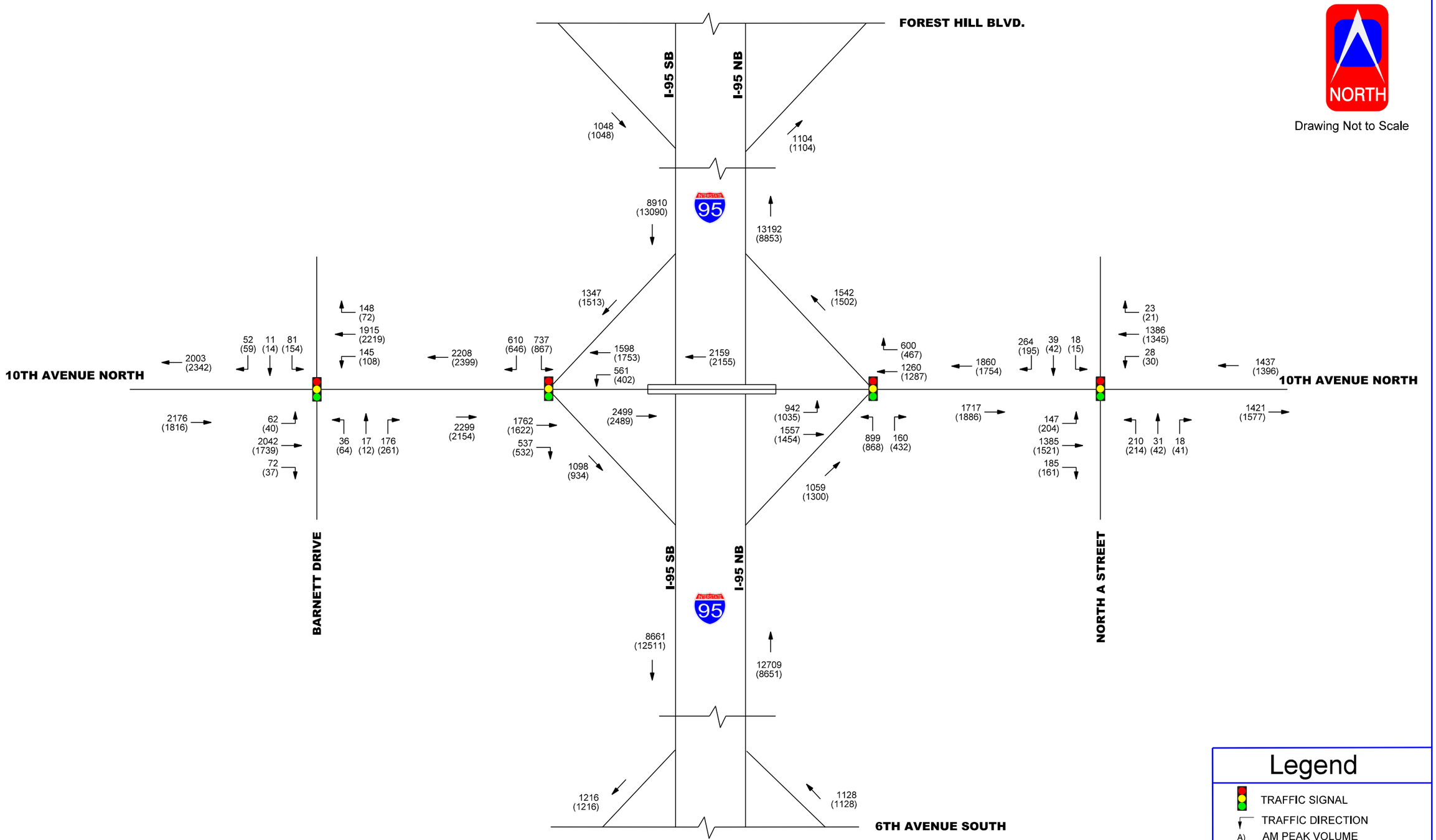
7.4 BUILD DESIGN TRAFFIC

The Build Alternatives Design traffic for Opening Year 2025 and Design Year 2045 were developed by keeping the same volumes for the freeway, ramps and peak hour turning movement volumes at the intersections as the No-Action traffic. Opening Year and Design Year Build Alternatives AM and PM peak hour volumes are shown in **Figure 7-3** and **Figure 7-4** for Alternative 1 (TUDI) and **Figure 7-5** and **Figure 7-6** for Alternative 2 (DDI).



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-3
Opening Year 2025 Build Alternative 1 (TUDI) Peak Hour Volumes



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-4
Design Year 2045 Build Alternative 1 (TUDI) Peak Hour Volumes

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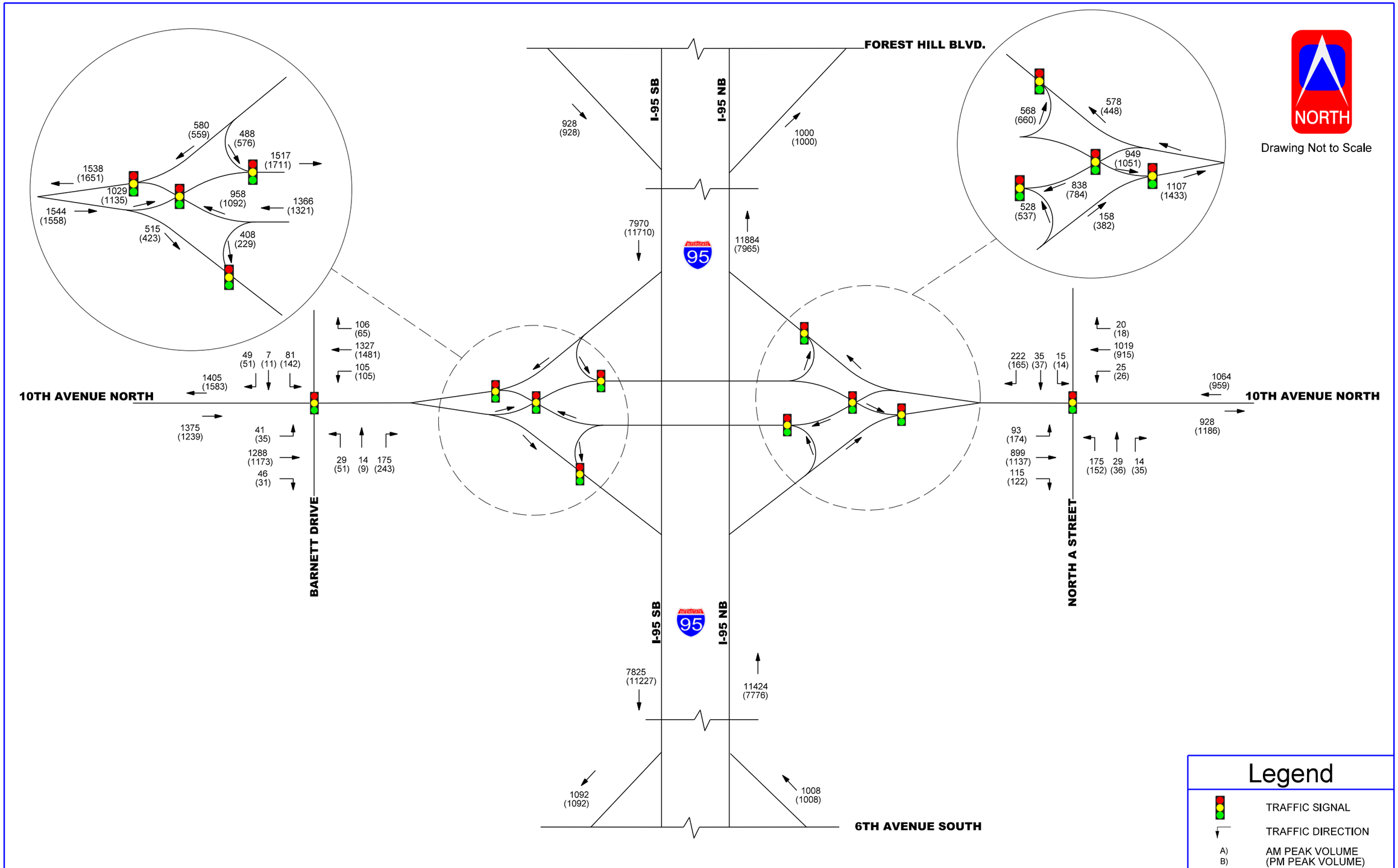
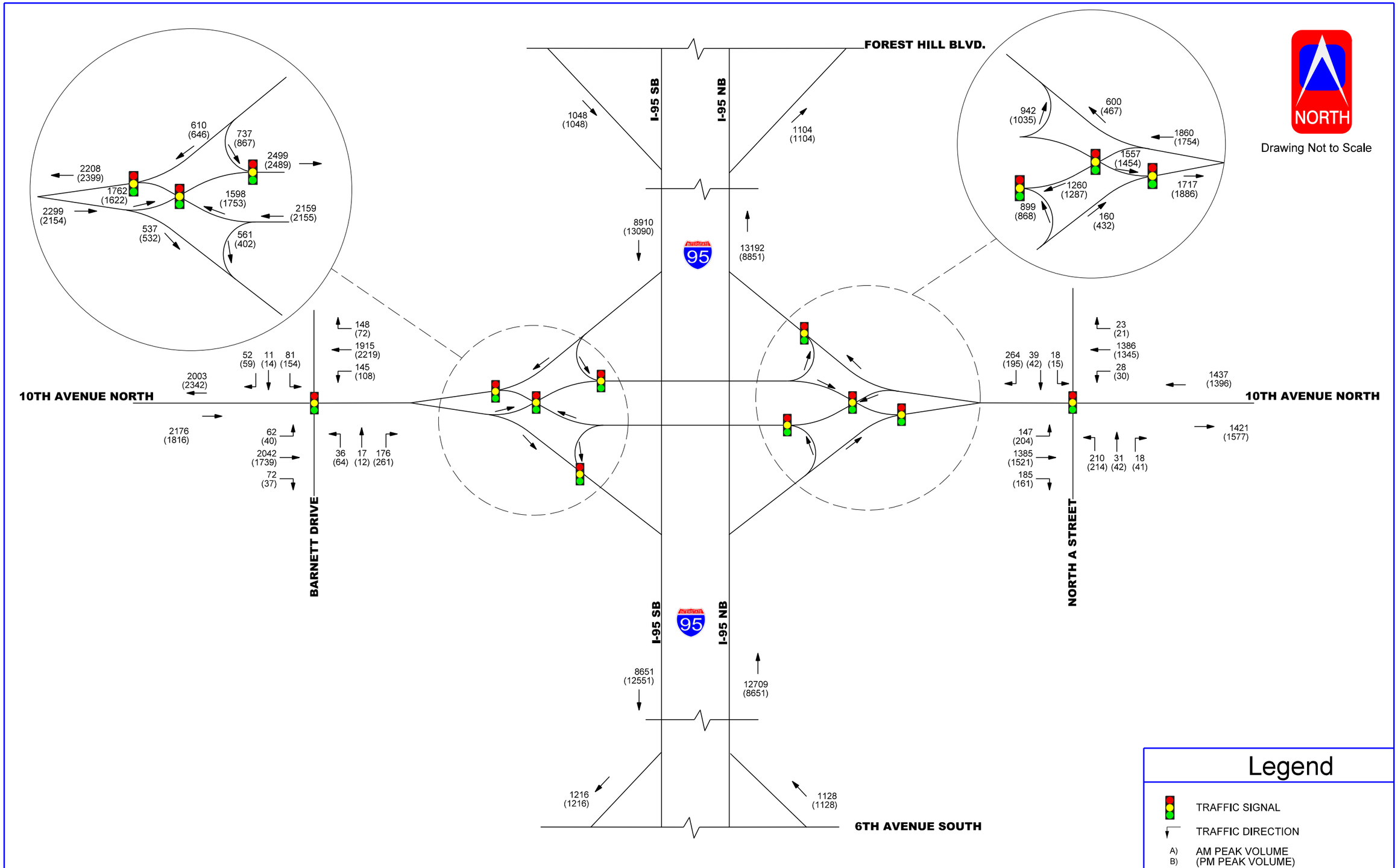


SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-5
Opening Year 2025 Build Alternative 2 (DDI) Peak Hour Volumes



Legend

- TRAFFIC SIGNAL
- TRAFFIC DIRECTION
- A) AM PEAK VOLUME
- B) (PM PEAK VOLUME)

SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 7-6
Design Year 2045 Build Alternative 2 (DDI) Peak Hour Volumes

SECTION 8 ALTERNATIVES EVALUATION

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

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

8.1 CONFORMANCE WITH LOCAL, REGIONAL, AND STATE TRANSPORTATION PLANS

The improvements proposed in the IMR for the Build Alternatives are consistent with improvement plans incorporated in Florida's Strategic Intermodal System (SIS), 2040 Long Range Cost Feasible Plan and the Statewide Transportation Improvement Program (STIP). The proposed improvements are also consistent with the current 2045 Cost Feasible Long Range Transportation Plan (LRTP), adopted by Palm Beach TPA. The improvements are also incorporated in the TPA's Transportation Improvement Program (TIP) and the City of Lake Worth Beach most recently adopted Capital Improvement Program (CIP).

8.2 COMPLIANCE WITH POLICIES AND ENGINEERING STANDARDS

The design criteria for this project is based on design parameters outlined in the 2020 FDOT Design Manual (FDM), the FDOT Standard Plans for Road and Bridge Construction, Manual on Uniform Traffic Control Devices (MUTCD), and AASHTO's A Policy on Geometric Design of Highway and Streets published in 2019.

8.3 HCM BASED INDIVIDUAL ELEMENT BUILD OPERATIONAL ANALYSIS

An individual element operational analysis was conducted for the Build Alternatives using SYNCHRO's HCM 6 methodology for intersections and HCS 7 was used to perform a capacity analysis for the mainline segments and ramps. SYNCHRO 10.0 was used to analyze the study intersections. There are no geometric changes to the I-95 mainline or ramps within the study area. The Opening Year 2025 and Design Year 2045 Build Alternatives freeway and ramp analysis is the same as the No-Action alternative. The results of this detailed analysis are presented in the following sections. Documentation for the Build Alternative analysis is provided in **Appendix G** and **Appendix H.**

8.4 BUILD ALTERNATIVES OPERATIONAL ANALYSIS

8.4.1 2025 Build Analysis

8.4.1.1 Mainline Analysis

The Opening Year 2025 Build mainline analysis results are summarized in **Table 8-1**. The results of the operational analysis show that I-95 mainline segment south of 10th Avenue North would operate at LOS E (capacity) and not acceptable LOS for the southbound direction in the 2025 PM peak hour. The I-95 mainline segment north of 10th Avenue North would operate at LOS E (capacity) and not acceptable LOS for the northbound direction in the AM peak period and southbound direction in the PM peak hour. **Figure 8-1** and **Figure 8-2** illustrate the peak hour volumes and LOS results for the Opening Year 2025 Build Alternative analysis.

Table 8-1 Opening Year (2025) Mainline Capacity Analysis

Freeway Segment	Direction	Number of GUL Lanes + Aux lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 S of 10th Ave North	NB	7 (1HOV+4GUL+2AUX)	11,424	29.7	D	0.79	7,776	19.4	B	0.54
	SB	6 (1HOV+4GUL+1AUX)	7,825	22.7	C	0.63	11,227	36.9	E*	0.91
I-95 N of 10th Ave North	NB	6 (1HOV+4GUL+1AUX)	11,884	41.2	E*	0.96	7,965	23.2	C	0.64
	SB	6 (1HOV+4GUL+1AUX)	7,970	23.2	C	0.64	11,710	40.0	E*	0.95

Source - See Appendix G for Software Input/Output, results.

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

* - Improving LOS to D or better along I-95 is out of the scope of this project

8.4.1.2 Ramp Analysis

The Opening Year 2025 Build ramp analysis results are summarized in **Table 8-2**. The results of the operational analysis show that not all study ramps merge/diverge at an acceptable LOS. **Figure 8-2** illustrates the peak hour volumes and LOS for the Opening Year 2025 Build Alternative analysis for the ramp merge/diverge analysis. In the PM peak period the I-95 southbound off-ramp and on-ramp at the 10th Avenue North interchange are expected to operate at failing LOS. In the AM peak period the 10th Avenue North and the 6th Avenue South northbound on-ramps are expected to operate at failing LOS. The unacceptable LOS results for the ramp merge and diverge could be attributed to the poor LOS on the mainline segments.

Table 8-2 Opening Year (2025) Ramp Capacity Analysis

Freeway Segment	Direction	Number of lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95- at 10th Ave N	NB Off	2	686	23.7	C	0.18	919	11	B	0.24
	NB On	2	1,146	35.0	F*	0.30	1,108	21.9	C	0.29
	SB Off	2	1,068	11.5	B	0.28	1,135	23.8	F*	0.30
	SB On	2	923	20.2	C	0.24	652	29.7	F*	0.17
I-95 at 6th Avenue South	NB On	2	1,008	31.8	F*	0.27	1,008	20.9	C	0.27
	SB Off	2	1,092	11.4	B	0.29	1,092	21.2	C	0.29
I-95 at Forest Hill Blvd.	NB Off	2	1,000	24.7	C	0.26	1,000	11.3	B	0.26
	SB On	2	928	11.6	B	0.24	928	24.0	C	0.24

1. Volume = Veh/ Hr
2. Density = passenger cars/mile/lane

Source - See Appendix G for Software Input/Output, results

* - Improving LOS to D or better along I-95 is out of the scope of this project

8.4.1.3 Weaving Analysis

Along the mainline, the I-95 northbound segment between 10th Avenue North and Forest Hill Boulevard does include an AUX lane. With this aux lane, it is possible that weaving could occur. However, referring to Equation 13-4 of the *HCM*, the values of VR (volume ratio) for all four ramps at the 10th Avenue North interchange requires less than a mile of weaving length. Considering that both adjacent I-95 interchanges are at least a mile from the 10th Avenue North interchange, a weaving analysis is not required. According to this equation there is sufficient distance to make a single lane change for motorists accessing I-95, or motorists diverging to exit I-95. Hence a weaving analysis was not performed.

8.4.1.4 Intersection Analysis

Two Build alternatives were analyzed using SYNCHRO signal timing software with optimized settings. Alternative 1 is a Tight Urban Diamond Interchange (TUDI), and Alternative 2 is a Diverging Diamond Interchange (DDI). Based on coordination with Palm Beach County Traffic Signal department, proposed signals at Barnett Drive and North A St, for both alternatives are timed for 160 second cycle lengths to match the overall 10th Avenue North corridor beyond west of Barnett Drive and east of North A St. However, at the northbound and southbound on and off-ramps were changed to 80 second cycles for the DDI Alternative. This provided optimal results for this alternative while it was not optimal for the TUDI Alternative. The proposed signal cycle lengths were coordinated with Palm Beach County and the County concurred with this approach.

The Opening Year 2025 Build intersection analysis results are summarized in **Table 8-3** and **Table 8-4.** The overall delay would operate at acceptable LOS D or better at all study intersections. Some approaches would operate below acceptable LOS in the TUDI alternative and are highlighted in **Table**

8-3. The southbound approach for the intersection of 10th Avenue North and Barnett Drive is expected to operate at failing LOS for the PM peak period for Build Alternative 2 as shown in **Table 8-4. Figure 8-1** and **Figure 8-2** illustrate the peak hour volumes and LOS results for the 2025 Build alternatives. **Figure 8-3** and **Figure 8-4** illustrate the peak hour LOS and Delay results for the 2025 Build alternatives SYNCHRO outputs are included in **Appendix G** and **Appendix H** for Build Alternatives 1 and 2 respectively.

Table 8-3 Opening Year (2025) Alternative 1 (TUDI) Build Intersection Analysis

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	20.6	4.9	33.5	52.2	15.4
		LOS	C	A	C	D	B
	PM	Delay[1]	24.9	7.9	37.7	57.9	19.8
		LOS	C	A	D	E	B
10th Avenue North at I-95 SB ramps	AM	Delay[1]	26.6	13.2	-	66.3	32.7
		LOS	C	B	-	E	C
	PM	Delay[1]	33.2	9.8	-	66.0	34.7
		LOS	C	A	-	E	C
10th Avenue North at I-95 NB ramps	AM	Delay[1]	13.2	46.9	75.5	-	38.2
		LOS	B	D	E	-	D
	PM	Delay[1]	20.3	61.1	69.9	-	45.1
		LOS	C	E	E	-	D
10th Avenue North at A Street	AM	Delay[1]	22.5	38.2	71.9	61.2	36.8
		LOS	C	D	E	E	D
	PM	Delay[1]	5.1	39.6	74.9	63.0	26.7
		LOS	A	D	E	E	C

1. Delay (Secs/Veh)

Source - See Appendix G for Software Input/Output, results.

Table 8-5 and **Table 8-6** summarizes the 95th percentile queue length analysis obtained from SYNCHRO for the Design Year 2025 for Build Alternatives 1 and 2. Those movements whose lane geometry currently does not accommodate the 95th percentile queue are highlighted yellow in the table.

In Alternative 1 the westbound right turn is expected to exceed provided storage in the AM and PM peak period at the 10th Avenue North and I-95 northbound ramp intersection. The westbound through movement at Barnett Drive is expected to exceed provided storage in both peak periods and back-up to the east adjacent intersection. The eastbound right turn movement is expected to exceed provided storage in the AM and PM peak period at the 10th Avenue North and I-95 southbound ramp intersection. No off-ramp queues are expected to back-up to the I-95 mainline. All other movements that will exceed the provided storage are highlighted in **Table 8-5**.

In Alternative 2 the westbound through movement at Barnett Drive is expected to exceed provided storage in both peak periods and back-up to the east adjacent intersection. No off-ramp queues are

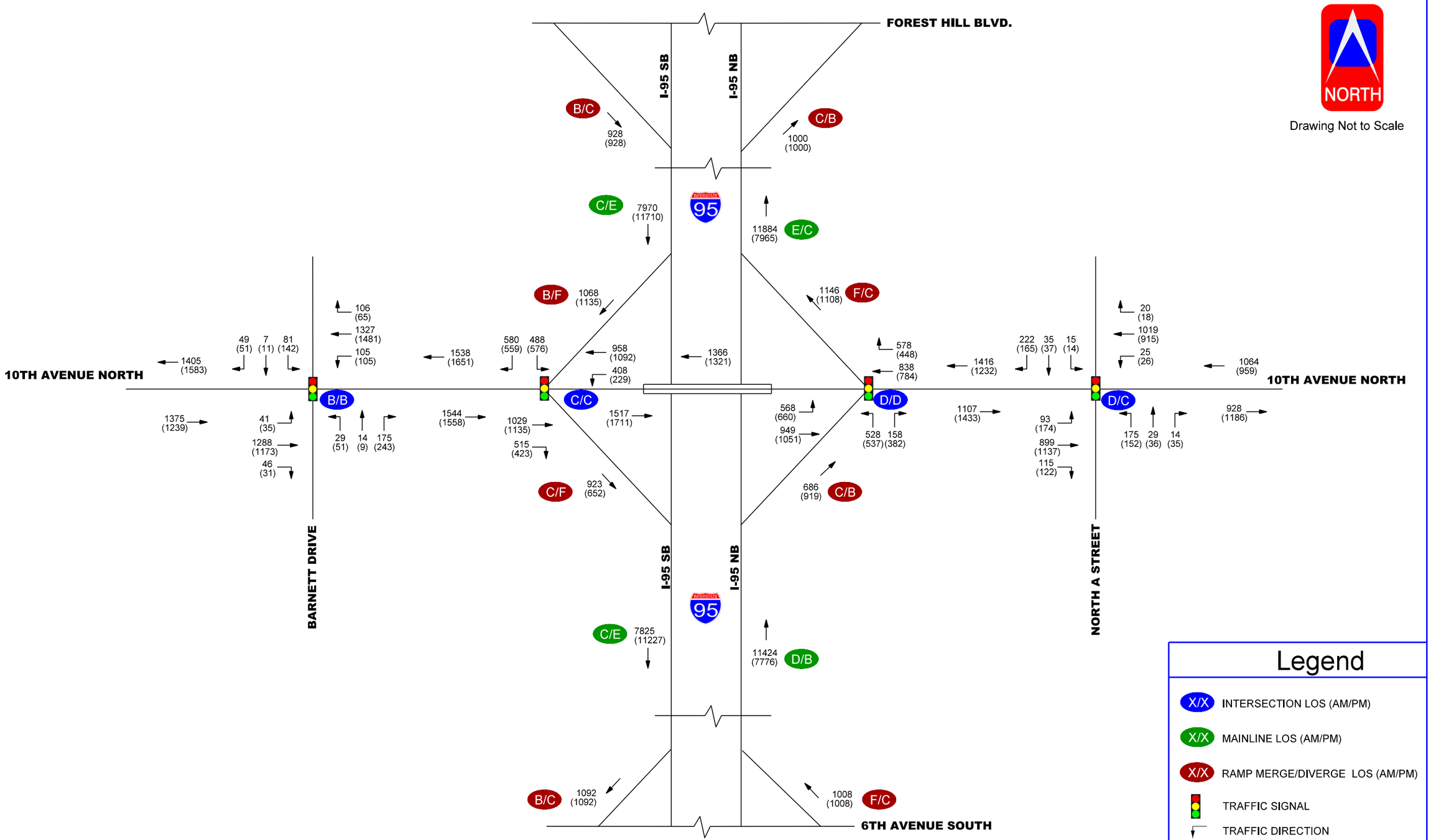
expected to back-up to the I-95 mainline. All other movements that will exceed the provided storage are highlighted in **Table 8-6**.

Table 8-4 Opening Year (2025) Alternative 2 (DDI) Build Intersection Analysis

*Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	12.6	11.0	35.5	52.0	15.0
		LOS	B	B	D	D	B
	PM	Delay[1]	15.0	10.0	52.6	72.2	19.4
		LOS	B	B	D	E	B
10th Avenue North at I-95 SB Off Ramp to WB	AM	Delay[1]	-	0.3	-	4.5	1.9
		LOS	-	A	-	A	A
	PM	Delay[1]	-	0.4	-	6.3	2.4
		LOS	-	A	-	A	A
10th Avenue North at Crossover (West of I-95)	AM	Delay[1]	29.5	16.8	-	-	24.6
		LOS	C	B	-	-	C
	PM	Delay[1]	22.4	15.8	-	-	19.7
		LOS	C	B	-	-	B
10th Avenue North at I-95 SB Off Ramp to EB	AM	Delay[1]	0.2	-	-	17.2	5.6
		LOS	A	-	-	B	A
	PM	Delay[1]	0.2	-	-	17.9	6.2
		LOS	A	-	-	B	A
10th Avenue North at I-95 NB Off Ramp to WB	AM	Delay[1]	-	1.3	14.6	-	6.4
		LOS	-	A	B	-	A
	PM	Delay[1]	-	1.2	14.0	-	6.4
		LOS	-	A	B	-	A
10th Avenue North at Crossover (East of I-95)	AM	Delay[1]	33.9	16.7	-	-	27.0
		LOS	C	B	-	-	C
	PM	Delay[1]	33.3	15.8	-	-	25.2
		LOS	C	B	-	-	C
10th Avenue North at I-95 NB Off Ramp to EB	AM	Delay[1]	0.2	-	0.2	-	0.2
		LOS	A	-	A	-	A
	PM	Delay[1]	0.3	-	1.5	-	0.6
		LOS	A	-	A	-	A
10th Avenue North at A Street	AM	Delay[1]	25.2	46.1	31.5	40.6	35.7
		LOS	C	D	C	D	D
	PM	Delay[1]	31.8	48.4	29.6	38.3	37.8
		LOS	C	D	C	D	D

[1] Delay (Secs/Veh) Source - See Appendix H for Software Input/Output, results

* Intersection includes Signalized Locations within the DDI, at the I-95-10th Avenue North Interchange Ramps.

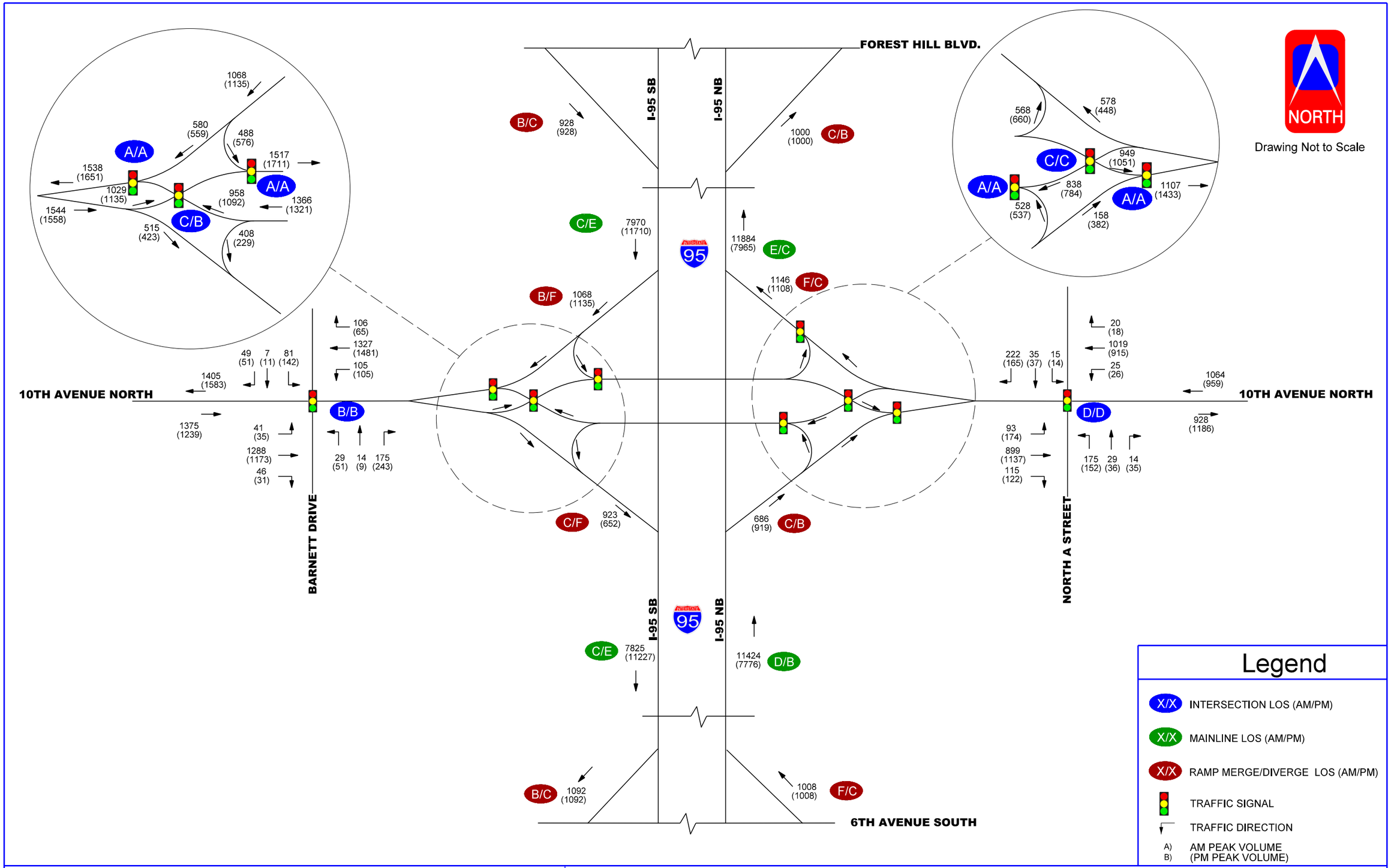


Legend

- X/X — INTERSECTION LOS (AM/PM)
- X/X — MAINLINE LOS (AM/PM)
- X/X — RAMP MERGE/DIVERGE LOS (AM/PM)
- TRAFFIC SIGNAL
- TRAFFIC DIRECTION
- A) AM PEAK VOLUME
  B) (PM PEAK VOLUME)

SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-1
Opening Year 2025 Build Alternative 1 (TUDI)
Peak Hour Volumes and Level of Service (LOS)

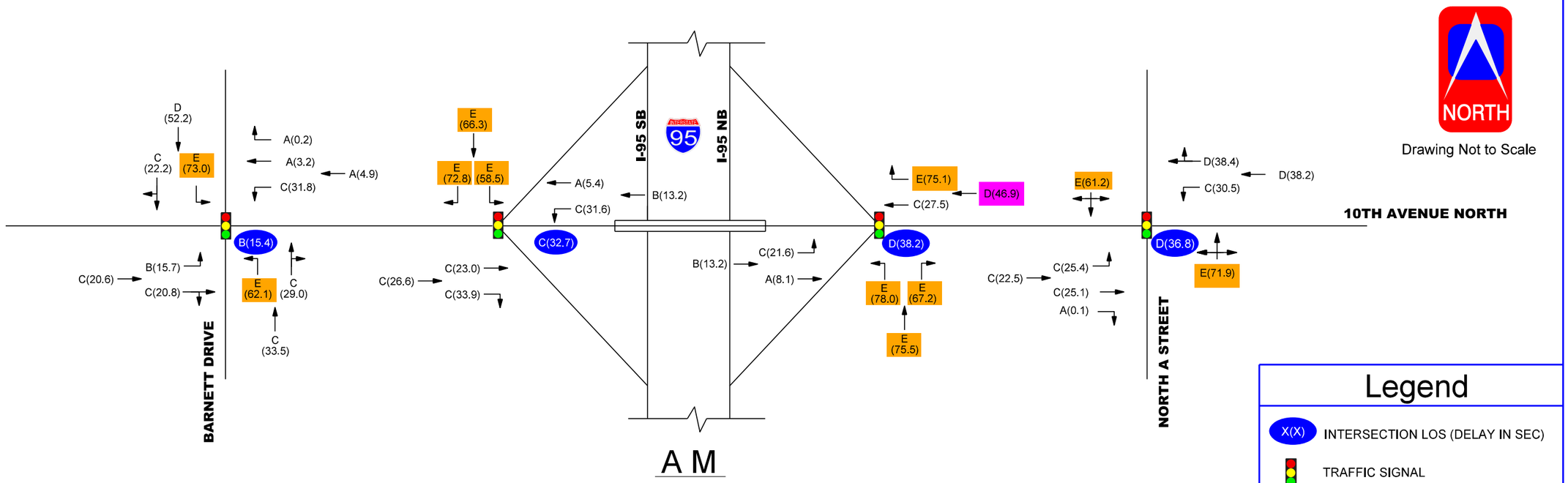


Legend

- X/X — INTERSECTION LOS (AM/PM)
- X/X — MAINLINE LOS (AM/PM)
- X/X — RAMP MERGE/DIVERGE LOS (AM/PM)
- TRAFFIC SIGNAL
- TRAFFIC DIRECTION
- A) AM PEAK VOLUME
  B) (PM PEAK VOLUME)

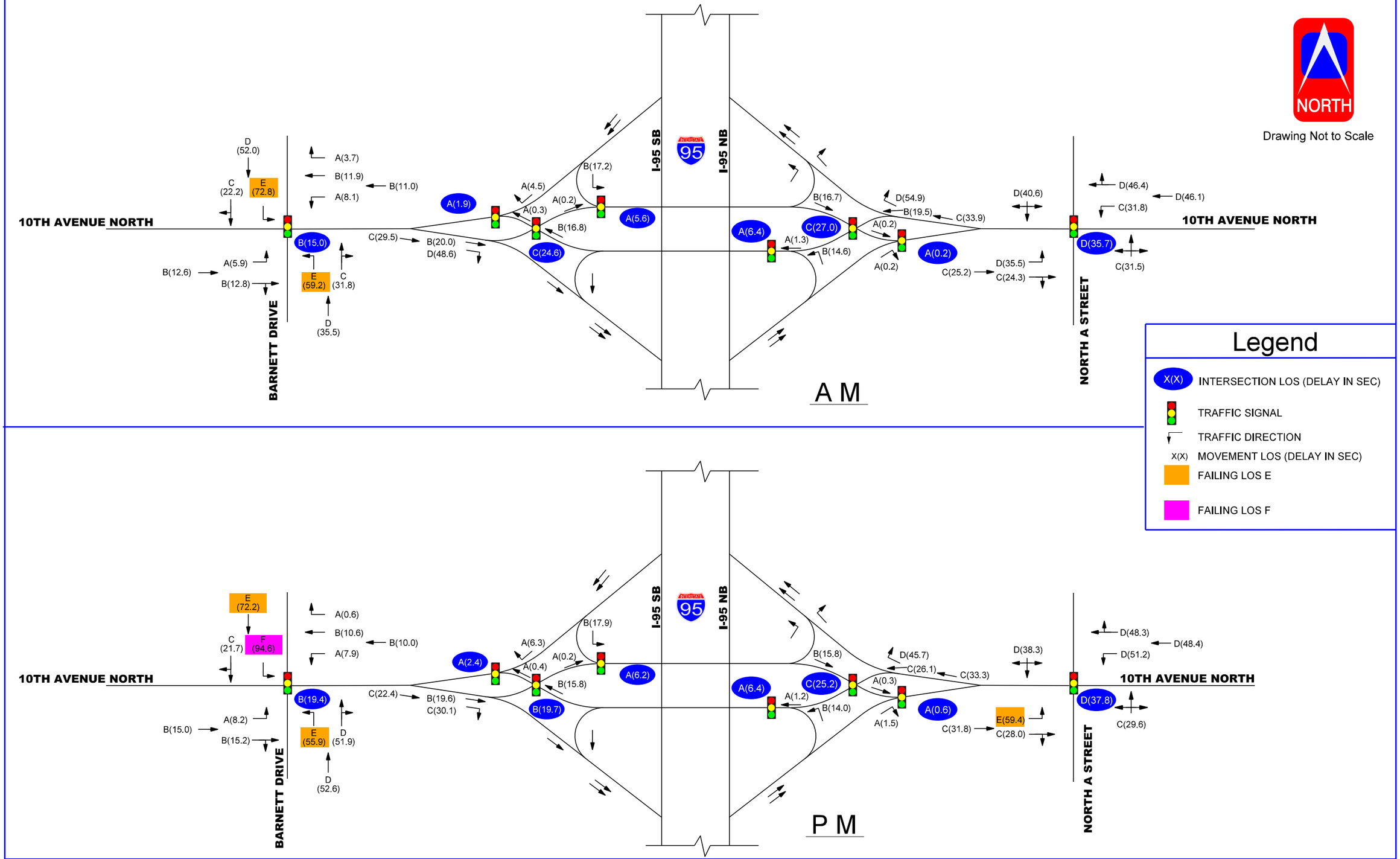
SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-2
Opening Year 2025 Build Alternative 2 (DDI)
Peak Hour Volumes and Level of Service (LOS)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-3
Opening Year 2025 Build Alternative 1 (TUDI)
Peak Hour Level of Service (LOS) and Delay (in Seconds)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-4
Opening Year 2025 Build Alternative 2 (DDI)
Peak Hour Level of Service (LOS) and Delay (In Seconds)

Table 8-5 Opening Year (2025) Build Alternative 1, 95th Percentile Queue Lengths

Intersection	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	39	775	-	m74	34	m0	59	99	-	129	52	-
	PM	40	761	-	m98	301	m7	81	144	-	193	55	-
	Storage	300	634	-	250	838	250	75	332	-	100	451	-
10th Avenue North at I-95 SB ramps	AM	-	244	591	93	61	-	-	-	-	208	-	328
	PM	-	327	443	17	275	-	-	-	-	245	-	313
	Storage	475	838	250	385	385	-	-	-	-	540	-	540
10th Avenue North at I-95 NB ramps	AM	327	145	-	-	208	689	248	-	135	-	-	-
	PM	255	406	-	-	287	617	234	-	294	-	-	-
	Storage	25	385	-	-	522	450	550	-	550	-	-	-
10th Avenue North at A Street	AM	92	426	0	43	626	-	-	328	-	-	274	-
	PM	m122	55	m0	53	554	-	-	332	-	-	233	-
	Storage	200	602	200	120	920	-	-	475	-	-	414	-

(#) = 95 Percentile Volume exceeds capacity

Source - See Appendix G for Software Input/Output, results.

(m) = Volume for 95th percentile queue is metered by upstream signal

Table 8-6 Opening Year (2025) Build Alternative 2, 95th Percentile Queue Lengths

Intersection*	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	22	498	-	52	447	50	59	109	-	129	52	-
	PM	21	445	-	38	550	2	88	#221	-	#215	59	-
	Storage	100	750	-	100	330	100	100	320	-	100	502	-
10th Avenue North at I-95 SB Off Ramp to WB	AM	-	-	-	-	0	-	-	-	-	-	53	-
	PM	-	-	-	-	0	-	-	-	-	-	68	-
	Storage	-	-	-	-	112	-	-	-	-	-	274	-
10th Avenue North at Crossover (West of I-95)	AM	-	284	#620	-	181	-	-	-	-	-	-	-
	PM	-	215	m354	-	`182	-	-	-	-	-	-	-
	Storage	-	325	325	-	194	-	-	-	-	-	-	-
10th Avenue North at I-95 SB Off Ramp to EB	AM	-	0	-	-	-	-	-	-	-	-	126	-
	PM	-	0	-	-	-	-	-	-	-	-	150	-
	Storage	-	182	-	-	-	-	-	-	-	-	130	-
10th Avenue North at I-95 NB Off Ramp to WB	AM	-	-	-	-	5	-	132	-	-	-	-	-
	PM	-	-	-	-	3	-	122	-	-	-	-	-
	Storage	-	-	-	-	141	-	176	-	-	-	-	-
10th Avenue North at Crossover (East of I-95)	AM	-	234	-	-	229	-	-	-	-	-	-	-
	PM	-	255	-	-	268	-	-	-	-	-	-	-
	Storage	-	180	-	-	148	-	-	-	-	-	-	-
10th Avenue North at I-95 NB Off Ramp to EB	AM	-	0	-	-	-	-	-	0	-	-	-	-
	PM	-	0	-	-	-	-	-	17	-	-	-	-
	Storage	-	147	-	-	-	-	-	207	-	-	-	-
10th Avenue North at A Street	AM	105	348	-	39	544	-	-	253	-	-	270	-
	PM	212	447	-	53	505	-	-	248	-	-	221	-
	Storage	220	339	-	250	620	-	-	801	-	-	792	-

(#) = 95 Percentile Volume exceeds capacity

Source - See Appendix H for Software Input/Output, results.

(m) = Volume for 95th percentile queue is metered by upstream signal

* Intersection includes Signalized Locations within the DDI, at the I-95-10th Avenue North Interchange Ramps.

8.4.1.5 Arterial Analysis

Peak hour volumes were analyzed along the 10th Avenue North corridor between Barnett Drive and North A Street for the Opening Year 2025 Alternative 1 and 2 arterial analysis. The results of arterial LOS for eastbound and westbound obtained from SYNCHRO software are summarized in **Table 8-7, Table 8-8, Table 8-9** and **Table 8-10.** In the opening Year 2025, few of the arterial segments would operate at unacceptable LOS and are highlighted in the tables**.** Offsets for intersection signal timing were optimize to try to improve the arterial LOS but were limited in order to not hinder the overall intersection LOS. Not all segments are able to reach acceptable LOS without degrading the overall intersection LOS. For arterial segments that are less than 0.5 miles, SYNCHRO has limitations and calculates running time based on FHWA research that shows longer running times on networks with short segments. This will cause longer travel times and lower LOS than using the free flow speeds. It should be noted that all signalized intersection operations meet the LOS D criteria for both alternative for the Opening Year 2025.

Table 8-7 Opening Year (2025) AM Arterial Level of Service - Build Alternative 1

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	35.4	12.9	D	23.2	24.6	B
I95 SB Off Ramp	45.2	12.6	D	16.3	19.5	C
I95 NB On Ramp	22.4	14.2	C	42.9	9.6	**F**
North A St	42.8	9.6	D	60.7	10.3	E
Total	145.8	12.0	D	143.1	13.5	E

Table 8-8 Opening Year (2025) PM Arterial Level of Service - Build Alternative 1

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	38.9	11.3	**F**	27.1	21.1	C
I95 SB Off Ramp	51.5	11.1	**F**	21.3	14.9	D
I95 NB On Ramp	35.0	9.1	**F**	65.8	6.2	**F**
North A St	18.0	22.8	C	61.8	10.2	E
Total	143.4	12.1	**F**	176.0	10.9	E

Table 8-9 Opening Year (2025) AM Arterial Level of Service - Build Alternative 2

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	27.2	16.6	E	28.5	12.9	D
I95 SB Off Ramp	4.0	27.1	C	4.1	20.8	B
I95 NB On Ramp	20.2	5.0	**F**	32.0	8.5	E
North A St	33.6	8.1	**F**	70.8	9.5	D
Total	85.0	11.0	**F**	135.4	10.3	D

Table 8-10 Opening Year (2025) PM Arterial Level of Service - Build Alternative 2

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	30.1	15.5	C	27.3	13.5	C
I95 SB Off Ramp	5.2	20.8	B	4.3	19.8	B
I95 NB On Ramp	20.5	5.0	**F**	38.2	6.9	**F**
North A St	40.8	7.0	**F**	72.7	9.3	D
Total	96.6	9.9	D	142.5	9.8	D

8.4.2 2045 Build Analysis

8.4.2.1 Mainline Analysis

The Design Year 2045 Build mainline analysis results are summarized in **Table 8-11**. The results of the operational analysis show that not all the mainline segments operate at an acceptable LOS in both the 2045 AM and PM peak hours. Segments that would fail to operate at acceptable LOS are documented in **Table 8-11**. Segments that are expected to operate at a failing LOS include I-95 south of 10th Avenue North southbound in the PM peak period, I-95 north of 10th Avenue northbound in the AM peak period and southbound in the PM peak hour. Any proposed geometrical improvements to enhance capacity along the mainline is outside the scope of this PD&E. A future PD&E study (FM# 444202-1) will be conducted for the I-95 mainline in this area that will evaluate proposed managed lanes that could improve mainline, ramp merge and ramp diverge LOS. **Figure 8-5** and **Figure 8-6** illustrate the peak hour volumes and LOS results for the 2045 Build alternatives.

Table 8-11 Design Year (2045) Mainline Capacity Analysis

Freeway Segment	Direction	Number of GUL Lanes + Aux lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95 - S of 10th Ave N	NB	7	12,709	35.0	D	0.88	8,651	21.5	C	0.60
	SB	6	8,861	25.4	C	0.70	12,511	-	**F***	1.01
I-95 - N of 10th Ave N	NB	6	13,192	-	**F***	1.07	8,853	26.1	D	0.72
	SB	6	8,910	26.2	D	0.72	13,090	-	**F***	1.06

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

Source - See Appendix F for Software Input/Output, results.

* Improving LOS to D or better along Interstate 95 is out of the scope of this project.

8.4.2.2 Ramp Analysis

The Design Year 2045 Build ramp merge/diverge analysis results are summarized in **Table 8-12**. The results of the operational analysis show that not all study ramps merge/diverge at an acceptable LOS. **Figure 8-5** and **Figure 8-6** Illustrate the peak hour volumes and LOS. The V/C ratios provided in **Table 8-12** show adequate capacity on the ramp roadways. Any proposed geometrical improvements to enhance ramp merge/diverge operations along the mainline is outside the scope of this PD&E. A future PD&E study (FM# 444202-1) will be conducted for the I-95 mainline in this area that will evaluate proposed managed lanes that could improve mainline, ramp merge and ramp diverge LOS.

Table 8-12 Design Year (2045) Ramp Capacity Analysis

Freeway Segment	Direction	Number of lanes	AM Peak Hour				PM Peak Hour			
			Volume[1]	Density[2]	LOS	V/C	Volume[1]	Density[2]	LOS	V/C
I-95- at 10th Ave N	NB Off	2	1,059	30.4	**F***	0.27	1,300	13.8	B	0.33
	NB On	2	1,542	45.9	**F***	0.41	1,502	25.9	C	0.40
	SB Off	2	1,347	14.7	B	0.36	1,513	31.3	**F***	0.40
	SB On	2	1,098	23.2	C	0.29	934	40.5	**F***	0.25
I-95 at 6th Ave S	NB On	2	1,128	42.1	**F***	0.30	1,128	23.4	C	0.30
	SB Off	2	1,216	13.6	B	0.32	1,216	29.5	**F***	0.32
I-95 at Forest Hill Blvd	NB Off	2	1,104	33.6	**F***	0.28	1,104	13.7	B	0.28
	SB On	2	1,048	14.0	B	0.27	1,048	33.3	**F***	0.27

1. Volume = Veh/Hr
2. Density = passenger cars/mile/lane

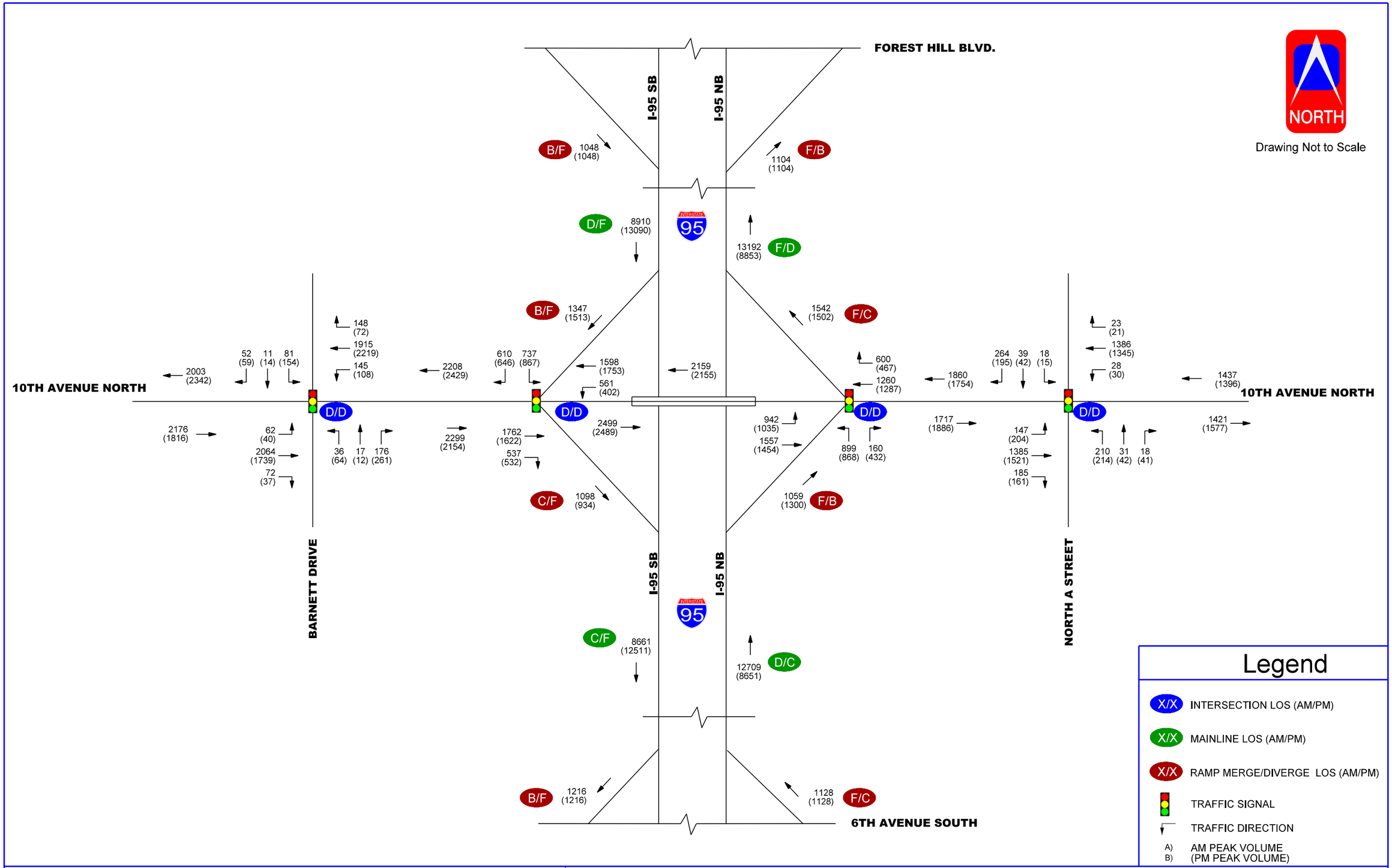
Source - See Appendix F for Software Input/Output, results.

* - Improving LOS to D or better along I-95 is out of the scope of this project

8.4.2.3 Weaving Analysis

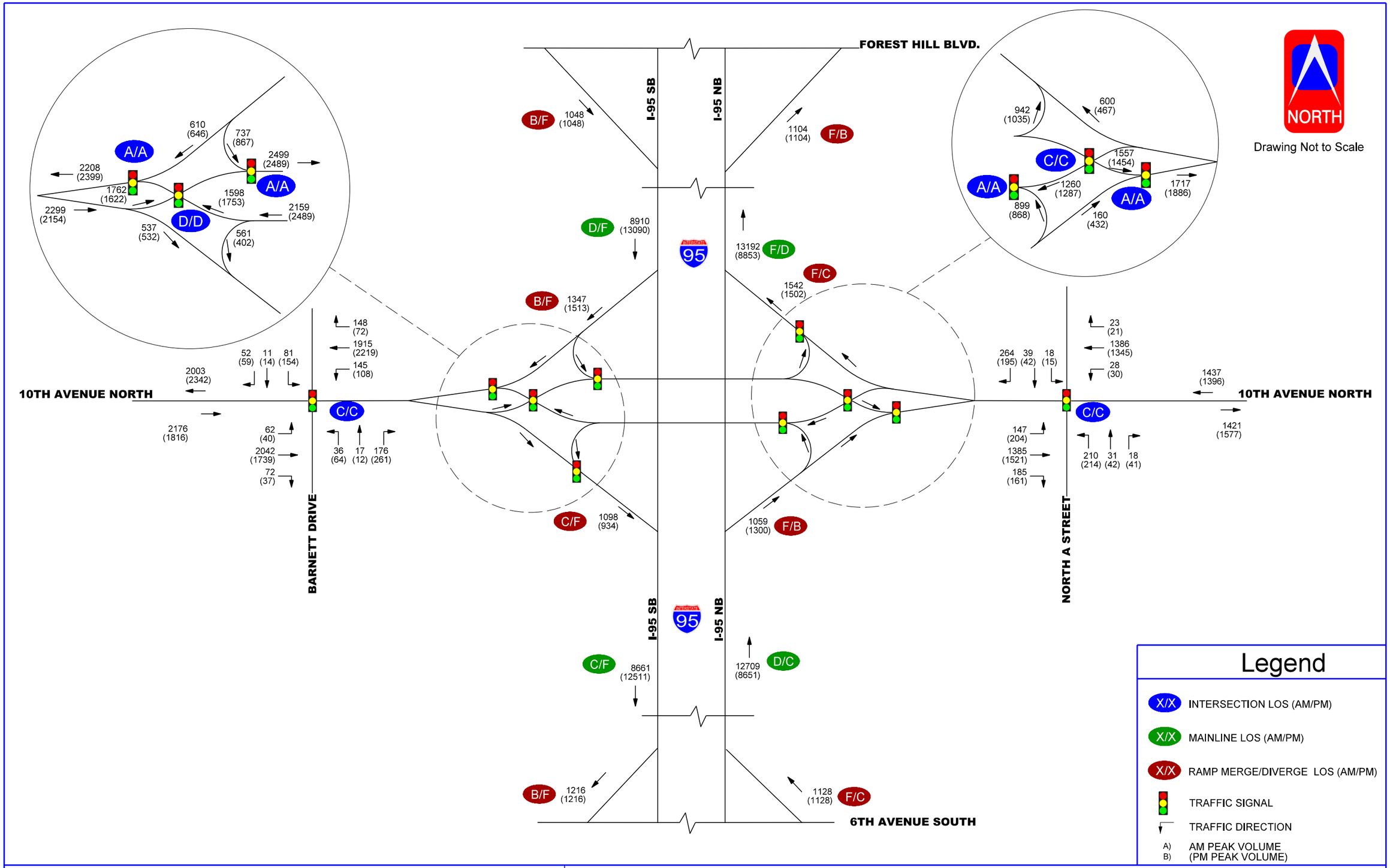
Along the mainline, the I-95 northbound segment between 10th Avenue North and Forest Hill Boulevard does include an AUX lane. With this aux lane, it is possible that weaving could occur.

However, referring to Equation 13-4 of the *HCM*, the values of VR (volume ratio) for all four ramps at the 10th Avenue North interchange requires less than a mile of weaving length. Considering that both adjacent I-95 interchanges are at least a mile from the 10th Avenue North interchange, a weaving analysis is not required. According to this equation there is sufficient distance to make a single lane change for motorists accessing I-95, or motorists diverging to exit I-95. Hence a weaving analysis was not performed.



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-5
Design Year 2045 Build Alternative 1 (TUDI)
Peak Hour Volumes and Level of Service (LOS)



Legend

- X/X — INTERSECTION LOS (AM/PM)
- X/X — MAINLINE LOS (AM/PM)
- X/X — RAMP MERGE/DIVERGE LOS (AM/PM)
- TRAFFIC SIGNAL
- TRAFFIC DIRECTION
- A) AM PEAK VOLUME
  B) (PM PEAK VOLUME)

SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-6
Design Year 2045 Build Alternative 2 (DDI)
Peak Hour Volumes and Level of Service (LOS)

8.4.2.4 Intersection Analysis

Two Build alternatives were analyzed using SYNCHRO signal timing software with optimized settings. Alternative 1 is a Tight Urban Diamond Interchange (TUDI), and Alternative 2 is a Diverging Diamond Interchange (DDI). Based on the analysis, the DDI performs substantially better than the TUDI. The Design Year 2045 Build intersection analysis results for Alternatives 1 and 2 are summarized in **Table 8-13** and **Table 8-14.**

Cycle length was coordinated at all four signalized intersections, based on coordination/approval with Palm Beach County Traffic. In the SYNCHRO evaluation, 160 second cycle length was utilized at Barnett Drive and A Street intersections. Whereas at the I-95 Ramp Signals, optimized cycle length of 80 seconds was used (half cycle). The overall intersection delay would operate at acceptable LOS D or better at all study intersections. Some approaches would operate below acceptable LOS in the TUDI alternative and are highlighted in **Table 8-13. Figure 8-5** and **Figure 8-6** illustrate the peak hour volumes and LOS results for the 2045 Build alternatives. **Figure 8-7** and **Figure 8-8** illustrate the peak hour LOS and Delay results for the 2045 Build alternatives.

Alternative 2 has only 2 failing (LOS E or F) approaches compared to 15 failing approaches for Alternative 1. In Alternative 2, the east-west movements would operate at LOS C, and overall intersection at acceptable LOS D. SYNCHRO analysis evaluated additional lane improvements to the side streets which resulted in minor delay reductions, that did not justify the higher costs of adding lanes. SYNCHRO output is provided in **Appendix G** and **Appendix H** for Alternatives 1 and 2 respectively.

Table 8-13 Design Year (2045) Build Alternative 1 (TUDI) Build Intersection Analysis

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	59.4	10.3	84.9	93.4	38.9
		LOS	E	B	**F**	**F**	D
	PM	Delay[1]	41.4	31.6	122.3	108.7	45.4
		LOS	D	C	**F**	**F**	D
10th Avenue North at I-95 SB ramps	AM	Delay[1]	46.0	15.4	-	71.6	40.6
		LOS	D	B	-	E	D
	PM	Delay[1]	32.2	41.9	-	85.7	49.7
		LOS	C	D	-	**F**	D
10th Avenue North at I-95 NB ramps	AM	Delay[1]	15.9	42.0	97.7	-	40.8
		LOS	B	D	**F**	-	D
	PM	Delay[1]	3.1	54.4	82.0	-	37.8
		LOS	A	D	**F**	-	D
10th Avenue North at A Street	AM	Delay[1]	15.5	58.8	90.3	68.8	41.9
		LOS	B	E	**F**	E	D
	PM	Delay[1]	32.7	59.2	124.3	68.1	51.8
		LOS	C	E	**F**	E	D

1. Delay (Secs/Veh)

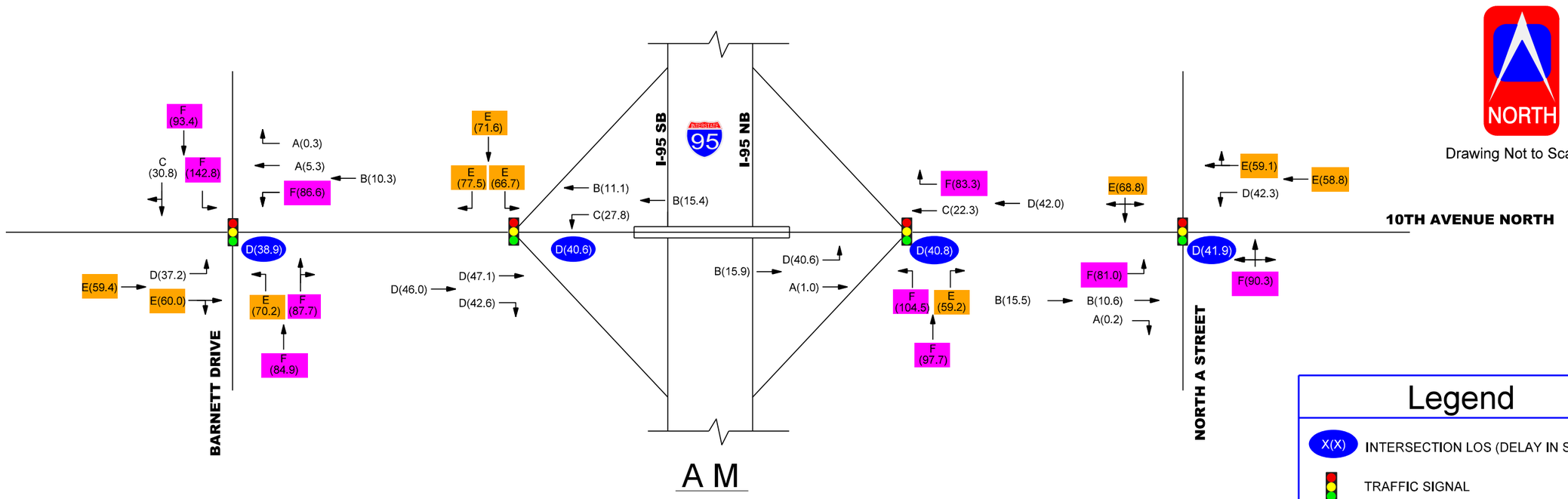
Source - See Appendix G for Software Input/Output, results.

Table 8-14 Design Year (2045) Build Alternative 2 (DDI) Build Intersection Analysis

Intersection	Peak Period	Approach	EB	WB	NB	SB	Overall
10th Avenue North at Barnett Drive	AM	Delay[1]	33.8	16.5	42.3	52.6	26.7
		LOS	C	B	D	D	C
	PM	Delay[1]	29.5	29.0	64.3	93.2	34.7
		LOS	C	C	E	**F**	C
10th Avenue North at I-95 SB Off Ramp to WB	AM	Delay[1]	-	1.3	-	12.8	4.5
		LOS	-	A	-	B	A
	PM	Delay[1]	-	1.4	-	18.8	6.1
		LOS	-	A	-	B	A
10th Avenue North at Crossover (West of I-95)	AM	Delay[1]	25.9	52.8	-	-	37.0
		LOS	C	D	-	-	D
	PM	Delay[1]	34.6	40.6	-	-	37.3
		LOS	C	D	-	-	D
10th Avenue North at I-95 SB Off Ramp to EB	AM	Delay[1]	0.3	-	-	23.7	7.2
		LOS	A	-	-	C	A
	PM	Delay[1]	0.4	-	-	21.4	7.7
		LOS	A	-	-	C	A
10th Avenue North at I-95 NB Off Ramp to WB	AM	Delay[1]	-	5.1	16.3	-	9.8
		LOS	-	A	B	-	A
	PM	Delay[1]	-	4.3	17.5	-	9.6
		LOS	-	A	B	-	A
10th Avenue North at Crossover (East of I-95)	AM	Delay[1]	28.4	30.3	-	-	29.3
		LOS	C	C	-	-	C
	PM	Delay[1]	27.2	29.4	-	-	28.2
		LOS	C	C	-	-	C
10th Avenue North at I-95 NB Off Ramp to EB	AM	Delay[1]	0.9	-	1.2	-	1.0
		LOS	A	-	A	-	A
	PM	Delay[1]	0.7	-	7.2	-	2.2
		LOS	A	-	A	-	A
10th Avenue North at A Street	AM	Delay[1]	23.0	37.1	46.9	50.9	32.5
		LOS	C	D	D	D	C
	PM	Delay[1]	23.3	34.2	53.3	44.5	31.0
		LOS	C	C	D	D	C

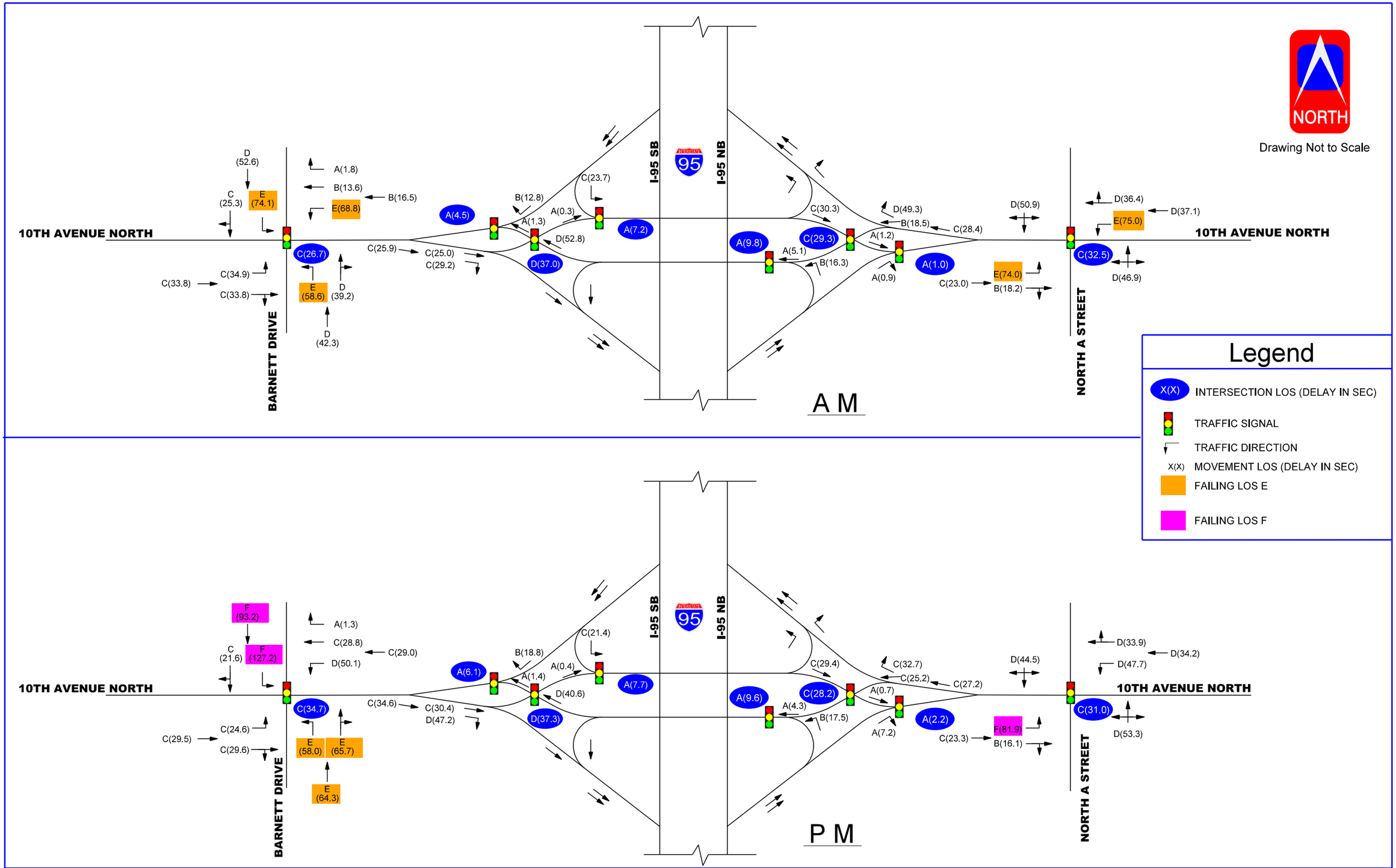
1. Delay (Secs/Veh) Source - See Appendix H for Software Input/Output, results.

* Intersection includes Signalized Locations within the DDI, at the I-95-10th Avenue North Interchange Ramps.



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-7
Design Year 2045 Build Alternative 1 (TUDI)
Peak Hour Level of Service (LOS) and Delay (in Seconds)



SR 9/I-95 at 10th Avenue North PD&E
(FPID: 412733-1-22-02)

Figure 8-8
Design Year 2045 Build Alternative 2 (DDI)
Peak Hour Level of Service (LOS) and Delay (In Seconds)

Table 8-15 and **Table 8-16** includes the 95th percentile queue length analysis for the Design Year 2045 for Build Alternatives 1 and 2. In the Design Year 2045, the existing storage lane lengths would accommodate the 95th percentile queues at all intersection approaches except the lane movements highlighted in the **Table 8-15** and **Table 8-16.** Where recommendations are included, 95th percentile queue lengths were utilized from the SYNCHRO software results to compute the required storage lengths, so there is no spillback into the through lanes or spillback into the adjacent closely spaced intersection. The total storage length for the left and right turn lanes were computed by adding the Deceleration Distance (L) (based on posted speed limit of 45 MPH) to the 95th percentile queue length, as required by *FDOT Standard Plans for Road Construction FY 2020-21 Index 711-001*.

For both Build Alternatives no queues for the interchange off-ramps are expected to queue back to the interstate mainline in Design Year 2045.

8.4.2.5 Arterial Analysis

Peak hour volumes were analyzed along the 10th Avenue North corridor between Barnett Drive and North A Street for the Design Year 2045 Alternative 1 and Alternative 2 arterial analysis. The results of arterial LOS for eastbound and westbound obtained from SYNCHRO software are summarized in **Tables 8-17, 8-18, 8-19 and 8-20.** In the Design Year 2045, few of the arterial segments would operate at unacceptable LOS and are highlighted in the tables. The reason for the potential failures along 10th Avenue North, is that the four closely spaced intersections between Barnett Drive and A Street (including the I-95 ramp signals), combined with higher traffic volumes (2045) during the peak hours would experience constrained flow conditions temporarily, when traffic flows towards the interstate during AM peak period and from the interstate towards 10th Avenue North during PM peak period. For arterial segments that are less than 0.5 miles, SYNCHRO has limitations and calculates running time based on FHWA research that shows longer running times on networks with short segments. This will cause longer travel times and lower LOS than using the free flow speeds.

The intersection signal offsets and approach green times along 10th Avenue North have been optimize to attain the best LOS for both the arterial and overall intersection. Any further mitigation to the arterial LOS would require additional east-west through lanes, and widening improvements that would be expensive and not justified. Widening 10th Avenue North to achieve acceptable LOS on the arterial is not a viable alternative due to constricted right of way and adjacent businesses. If 10th Avenue North was widened further, large opposition from the public is expected.

Table 8-15 Design Year (2045) Build Alternative 1 (TUDI) 95th Percentile Queue Lengths

Intersection	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	70	#1641	-	m#237	63	m0	75	#268	-	#165	66	-
	PM	36	#1305	-	m#161	m#1512	m3	105	#473	-	#297	66	-
	Storage	300	634	-	250	838	250	75	332	-	100	451	-
10th Avenue North at I-95 SB ramps	AM	--	m748	m595	377	m244	-	-	-	-	325	-	#367
	PM	--	m598	m505	m284	799	-	-	-	-	#423	-	#423
	Storage	475	838	250	385	385	-	-	-	-	540	-	540
10th Avenue North at I-95 NB ramps	AM	m#442	m10	-	-	m237	m#804	#472	-	130	-	-	-
	PM	34	m0	-	-	m389	m#647	385	-	331	-	-	-
	Storage	25	385	-	-	522	450	550	-	550	-	-	-
10th Avenue North at A Street	AM	#266	370	0	55	#961	-	-	#445	-	-	#374	-
	PM	m#368	929	m41	#103	#984	-	-	#551	-	-	280	-
	Storage	200	602	200	120	920	-	-	475	-	-	414	-

(#) = 95 Percentile Volume exceeds capacity

Source - See Appendix G for Software Input/Output, results.

(m) = Volume for 95th percentile queue is metered by upstream signal

Table 8-16 Design Year (2045) Build Alternative 2 (DDI) 95th Percentile Queue Lengths

Intersection*	Peak Period	95th Percentile Queue Length (Feet)											
		EB			WB			NB			SB		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
10th Avenue North at Barnett Drive	AM	74	#1413	-	#227	760	31	68	134	-	129	62	-
	PM	39	936	-	125	#1445	m13	106	#308	-	#273	66	-
	Storage	100	750	-	256	500	256	100	320	-	100	502	-
10th Avenue North at I-95 SB Off Ramp to WB	AM	-	-	-	-	m0	-	-	-	-	-	134	-
	PM	-	-	-	-	m0	-	-	-	-	-	174	-
	Storage	-	-	-	-	112	-	-	-	-	-	640	-
10th Avenue North at Crossover (West of I-95)	AM	-	m419	m354	-	#607	-	-	-	-	-	-	-
	PM	-	m414	m#471	-	#620							
	Storage	-	525	640	-	389	-	-	-	-	-	-	-
10th Avenue North at I-95 SB Off Ramp to EB	AM	-	0	-	-	-	-	-	-	-	-	219	-
	PM	-	0	-	-	-	-	-	-	-	-	244	-
	Storage	-	182	-	-	-	-	-	-	-	-	400	-
10th Avenue North at I-95 NB Off Ramp to WB	AM	-	-	-	-	16	-	219	-	-	-	-	-
	PM	-	-	-	-	26	-	215	-	-	-	-	-
	Storage	-	-	-	-	141	-	427	-	-	-	-	-
10th Avenue North at Crossover (East of I-95)	AM	-	#530	-	-	231		-	-	-	-	-	-
	PM	-	417	-	-	357	-	-	-	-	-	-	-
	Storage	-	360	-	-	436		-	-	-	-	-	-
10th Avenue North at I-95 NB Off Ramp to EB	AM	-	m0	-	-	-	-	-	9	-	-	-	-
	PM	-	0	-	-	-	-	-	66	-	-	-	-
	Storage	-	147	-	-	-	-	-	378	-	-	-	-
10th Avenue North at A Street	AM	#195	580	-	#81	698	-	-	341	-	-	332	-
	PM	#303	565	-	63	663	-	-	402	-	-	270	-
	Storage	220	339	-	250	620	-	-	801	-	-	792	-

(#) = 95 Percentile Volume exceeds capacity

Source - See Appendix H for Software Input/Output, results.

(m) = Volume for 95th percentile queue is metered by upstream signal

* Intersection includes Signalized Locations within the DDI, at the I-95-10th Avenue North Interchange Ramps

Table 8-17 Design Year (2045) AM Arterial Level of Service – Build Alternative 1

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	71.7	6.0	F	75.4	8.3	F
I95 SB Off Ramp	64.8	8.8	F	37.7	10.9	E
I95 NB On Ramp	11.7	27.1	C	21.2	15.0	D
North A St	24.9	16.5	E	25.6	22.3	C
Total	173.1	10.0	F	159.9	12.0	E

Table 8-18 Design Year (2045) PM Arterial Level of Service - Build Alternative 1

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	54.7	7.9	F	74.8	8.4	F
I95 SB Off Ramp	51.5	11.1	F	54.8	7.5	F
I95 NB On Ramp	11.4	27.8	C	27.5	11.5	F
North A St	36.4	11.3	F	49.9	11.5	F
Total	154.0	11.2	F	207.0	9.3	F

Table 8-19 Design Year (2045) AM Arterial Level of Service - Build Alternative 2

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	45.3	8.0	F	30.2	12.2	D
I95 SB Off Ramp	4.1	26.4	C	5.1	16.7	C
I95 NB On Ramp	33.8	3.0	F	31.2	8.9	E
North A St	27.9	10.2	F	60.8	11.1	D
Total	111.1	7.7	F	127.3	11.0	D

Table 8-20 Design Year (2045) PM Arterial Level of Service – Build Alternative 2

Cross Streets	Eastbound			Westbound		
	Travel Time (s)	Speed (mph)	LOS	Travel Time (s)	Speed (mph)	LOS
Barnett Dr	41.1	8.8	**F**	44.1	8.4	E
I95 SB Off Ramp	4.2	25.8	C	5.2	16.4	C
I95 NB On Ramp	32.9	3.1	**F**	37.0	6.9	**F**
North A St	25.6	11.1	**F**	58.3	11.6	D
Total	103.8	8.2	**F**	144.6	9.6	D

8.5 PEDESTRIAN AND BICYCLE ACCOMMODATIONS

Throughout the project corridor, the Recommended Alternative will include improved and upgraded facilities to enhance safety and accommodations for pedestrians and bicyclists. A visual of the proposed facilities can be seen in **Appendix D**. These facilities include:

- Dedicated 7' buffered bike lanes and 5' key holes between through and right turn lane
- Continuous sidewalks will be included along 10th Avenue North, with the proposed DDI Alternative and tie in with existing sidewalks at the project limits
- Pedestrian crossings with special emphasis pavement crosswalk markings at signalized intersections
- Lake Worth Middle School located in the NW Quadrant, would likely benefit from a proposed east-west pedestrian bridge installed over Interstate 95 for students commuting to the School from the residential neighborhoods located east of Interstate 95. The pedestrian bridge could be installed just north of the 10th Avenue corridor and connect to the existing 10th Avenue sidewalks on either sides of Interstate 95. It was observed that the school peak (start and end times) doesn't coincide with the street peak. A pedestrian bridge would separate pedestrian/bike flows from motorized traffic and enhance safety. Traffic signal operations would benefit with no disruption from pedestrian signal push button activations
- Another less inexpensive alternative to a pedestrian bridge, is to expand the existing sidewalk running east-west along south side of 10th Avenue North. The expansion could likely include a shared use path to accommodate bikes and pedestrians

8.6 SAFETY

Safety Analysis and crash cost estimates for 10th Avenue North was conducted in accordance with the Highway Safety Manual (HSM) for existing conditions and future No-Action and Build 2045 scenarios and documented in the *Safety Analysis I-95/SR 9 at 10th Avenue North Interchange Report*, dated August 2020 (see **Appendix C**).

The safety analysis along 10th Avenue North was performed for the adjacent accessible signalized intersection from Detroit Street to A Street. To facilitate analyses using HSM procedures, the corridor was divided into three segments and five signalized intersections. Intersection limits were defined using estimated AOI procedures and where there are traffic volume changes and configuration.

Analyses were conducted using spreadsheets developed under the Transportation Research Board's National Cooperative Research Program (NCHRP) Project Number 17-38.

The FDOT crash data (years 2014 through 2018) evaluated in **Section 3.4** and HSM analysis included in **Appendix C** showed that the crash rates along I-95 and 10th Avenue North within the AOI are lower than the statewide averages, and it is not on the high crash list. Crash data for the 10th Avenue North within project limits, shows that a total of 198 crashes occurred. For I-95 mainline from 6th Avenue ramp terminals (located north of 10th Avenue North Interchange) to Forest Hill Boulevard ramp

terminals (located south of Forest Hill Boulevard Interchange), a total of 434 crashes occurred. Rear end collisions are leading the crash pattern type with 51.0 % for 10th Avenue North and 62.5 % for I-95 mainline, followed by Angle collision for both corridors as second predominant type of crash with 14.14 % and 9.7% respectively. From a safety perspective, the recommendations of this study will not have a negative impact on Interstate 95. However, the capacity improvement recommendations along 10th Avenue North, would have a positive impact in terms of geometrical capacity improvements, which would likely help improve in decrease in crashes. These dominant crash patterns are associated with urban congestion along major arterials and intersections.

Two build alternatives (TUDI, DDI) were evaluated for safety analysis. Alternative 2 (DDI) is the best option because it reduces vehicle-to-vehicle conflict points, eliminates many of the most severe crash types and it has better overall performance, reducing delay. The DDI can accommodate twice the left turn traffic as the conventional design. DDI helps travelers to save time and provides safer vehicular movements, safer movements for pedestrians and bikes. The DDI and adjacent intersection improvements proposed along 10th Avenue North will likely improve signal progression with the proposed optimized signal timings and result in efficiently improving traffic flow and reducing congestion, and reducing potential crashes. Safety is also enhanced with the proposed geometry of the DDI, which would likely result in reducing predominant crash patterns with less number of conflict points. The DDI provides a reduction from 10 to 2 crossing conflicts compared to the TUDI. A total of 14 conflict points which includes merging diverging and crossing movements, thereby alleviating potential for left turn and injury crashes. **Table 8-21** summarizes the potential countermeasures identified for the study area crash patterns in **Section 3.4** and identifies the Build Alternatives that would address them.

A HSM predictive safety analysis was performed for this study. The analysis found the number of crashes expected for the segments and intersections under existing conditions to be 46.170 and the number of crashes expected for the segments and intersections under proposed future No-Action conditions for Design Year 2045 to be 48.539. Considering Build Alternative 2 (DDI) for Design Year 2045, the expected number of crashes under proposed future conditions dropped from 48.539 to 47.696, a further decrease of 1.75%. While the expected crashes for Build Alternative 1 (TUDI) would be 48.991. Societal costs of crashes were calculated from tables above and resulted in a decrease from $8,947,811.53 (2045 No-Action) to $8,792,410.61 (2045 Build Alternative 2) for a net benefit of $ 155,400.92. The details of the individual segment and intersection calculations for the No-Action and Build Alternatives is provided in **Appendix C**.

Table 8-21 Potential Countermeasures Addressed by Build Alternatives

Crash Type	Potential Countermeasures	Build Alternatives
Rear End	Improve signal visibility (e.g. replace signal bulbs, install advanced warning signs/flashers, etc.)	This should be coordinated with Palm Beach County Traffic Division and incorporated into the recommended alternative during the design phase
	Improve roadway surface	This will be incorporated into the recommended alternative during the design phase
	Modify signal timing patterns (e.g. phasing, all red and clearance interval timings, etc.)	All Build Alternatives
Angle	Improve signal visibility (e.g. replace signal bulbs, install advanced warning signs/flashers, etc.)	This should be coordinated with Palm Beach County Traffic Division and incorporated into the recommended alternative during the design phase
	Increase capacity and enhance intersection operations	All Build Alternatives
Nighttime Crashes	Safety Enhancement - Replace existing high pressure sodium lighting along corridor and intersections (new reconstruction criteria-enhanced light levels) with LED per FDM Table 231.2.1	This will be incorporated into the recommended alternative during the design phase

8.7 COMPARISON OF BUILD ALTERNATIVES

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

8.7.1 Planning And Environmental Comparison

This section provides a comparison of planning and environmental impacts associated with the No-Action, and Build Alternatives. The modified interchange will provide better and safer traffic operations leading to better roadway connectivity.

The Build Alternatives are in conformance with the Palm Beach County TPA. The No-Action Alternative is not in conformance with these plans.

The No-Action Alternative will have no environmental impacts. Special considerations were taken in developing and evaluating the Build Alternatives to avoid and minimize the environmental impacts associated with this project to the maximum extent possible.

The Build Alternative 1 will have an impact on 1 parcel at the SW quadrant of 10th Ave N and North A St. It will require Right-of-way corner clip to tie-in to existing sidewalk at this quadrant.

The Build Alternatives will have no impacts to the air quality, schools and churches, noise receptors or historical/archeological sites within the vicinity of the I-95 at 10th Avenue North study interchange. **Table 8-22** shows the environmental comparison for each of the Alternatives.

Table 8-22 Environmental Comparison of Alternatives

Item	No-Action	Build Alternative 1 (TUDI)	Build Alternative 2 (DDI)
Number of Parcels Affected	0	1	0
Residential	0	1	0
Commercial	0	0	0
Vacant	0	0	0
Improves Air Quality	No	Yes	Yes
Potential Changes to Noise Receptors/Barriers	No	Yes	Yes
Wetland Impacts	No	No	No
Wildlife and Habitat	No	No	No
Archaeological/Historical Sites	No	No	No
Parks/Recreation/Schools	No	No	No
Contamination Sites (high/medium/low)	No	Low	Low

8.7.2 Operational Comparison

This section compares the mainline, ramp, merge/diverge, and intersections traffic operational performance of the No-Action and Build Alternatives. There were two build alternatives that were analyzed. In order to address the concerns at the interchange and adjacent intersections, the two Build Alternatives were developed. Build Alternative 2 operates at considerably better than Build Alternative 1 in terms of LOS and has only 2 failing approaches compared to 16 approaches as shown in **Table 8-9** and **Table 8-10** in the Design Year 2045. **Table 8-23** shows the operational comparison for the Alternatives .

Table 8-23 Build Alternatives Traffic Operational Comparison

	No-Action	Alternative 1 – TUDI	Alternative 2 - DDI
2045 AM	All intersections (overall intersection LOS) fail	8 approaches and 14 movements with unacceptable LOS	0 approaches and 5 movements with unacceptable LOS
2045 PM	3 intersections (overall intersection LOS) fail	7 approaches and 14 movements with unacceptable LOS	2 approaches and 4 movements with unacceptable LOS

8.7.3 Cost Comparison

A cost comparison was performed for the two Build Alternatives. Long Range Estimates (LRE) construction costs are provided in **Appendix I**. Based on the Build Alternatives results shown in **Table 8-24**, Alternative 2 is the more economical alternative. The total project cost for Alternative 1 is $8.33 M and Alternative 2 is $6.7 M.

Table 8-24 Build Alternatives Costs Comparison

Cost	Build Alternative 1 (TUDI)	Build Alternative 2 (DDI)
Construction (LRE Cost)	$8.3 M	$6.7 M
Right-of-Way Acquisition	$0.03 M	$0
Total Project Cost	$8.33 M	$6.7 M

Benefit Cost (B/C) Analyses were conducted for both alternatives (TUDI and DDI) by using

FDOT benefit cost analysis tool. B/C analysis (see **Appendix C**) provides the ratio of benefits to the cost spent for the proposed improvements. Benefits and costs were analyzed for Arterial and Ramp Terminal for both alternatives. The benefit cost ratio is shown in **Table 8-25**. The Crash Reduction factors (CRF) for calculating the B/C were obtaining from FHWA CMF Clearing House. Alternative # 2, has a larger Benefit Cost Ratio when compared to Alternative # 1.

Table 8-25 Build Alternatives Benefit Cost Ratio Comparison

	Build Alternative 1 (TUDI)	Build Alternative 2 (DDI)
Benefit (Annual)	$1,074,947.04	$2,861,339.29
Costs (Annual)	$626,824.00	$493,120.00
Benefit Cost Ratio	1.71	5.80

8.8 RECOMMENDED ALTERNATIVE

Per the SYNCHRO Signal Timing software analysis, the No-Action Alternative would not accommodate the future travel demand along 10th Avenue North signalized intersections within AOI. In the Design Year 2045, at the ramp terminal signalized intersections, if no improvements are made, both signals would operate at unacceptable LOS F in the AM Peak Hour. In order to make it operate at an acceptable LOS D or better, capacity improvements would be necessary. The proposed capacity improvements to 10th Avenue North signalized intersections within the area of influence for the two Build Alternatives would make them operate at acceptable LOS levels and benefit the operations and enhance safety for both the interstate and the arterial, 10th Avenue North

Build Alternatives 1 and 2, would provide better operations compared to the No-Action Alternative through Design Year 2045 with the proposed capacity improvements and would make the signalized intersections operate at acceptable overall LOS D or better. Build Alternatives 1 and 2, do not have any adverse environmental and residential impacts.

From a traffic operations standpoint, Build Alternative 2 (DDI) in Design Year 2045, would operate at better levels of service with lesser delay when compared to Alternative 1 (TUDI), since there are less number of conflict points between opposing traffic movements. Build Alternative 2, would also be a safer alternative with potential for reduced number of crashes, reduced congestion and additional savings in delay and travel time, with lesser emissions and improvement in air quality.

In narrowing down to the Recommended Alternatives evaluation, Build Alternative 2 performs better operationally and is less expensive than Build Alternative 1, and hence the Recommended Alternative for approval.

A final comparison of the No-Action and Build Alternatives is provided in **Table 8-26**.

8.9 CONCEPTUAL SIGNING PLAN

A conceptual signing plan was prepared for the recommended Alternative. **Figure 8-9** presents the conceptual signing plan for proposed Build Alternative 2.

8.10 DESIGN EXCEPTIONS AND VARIATIONS

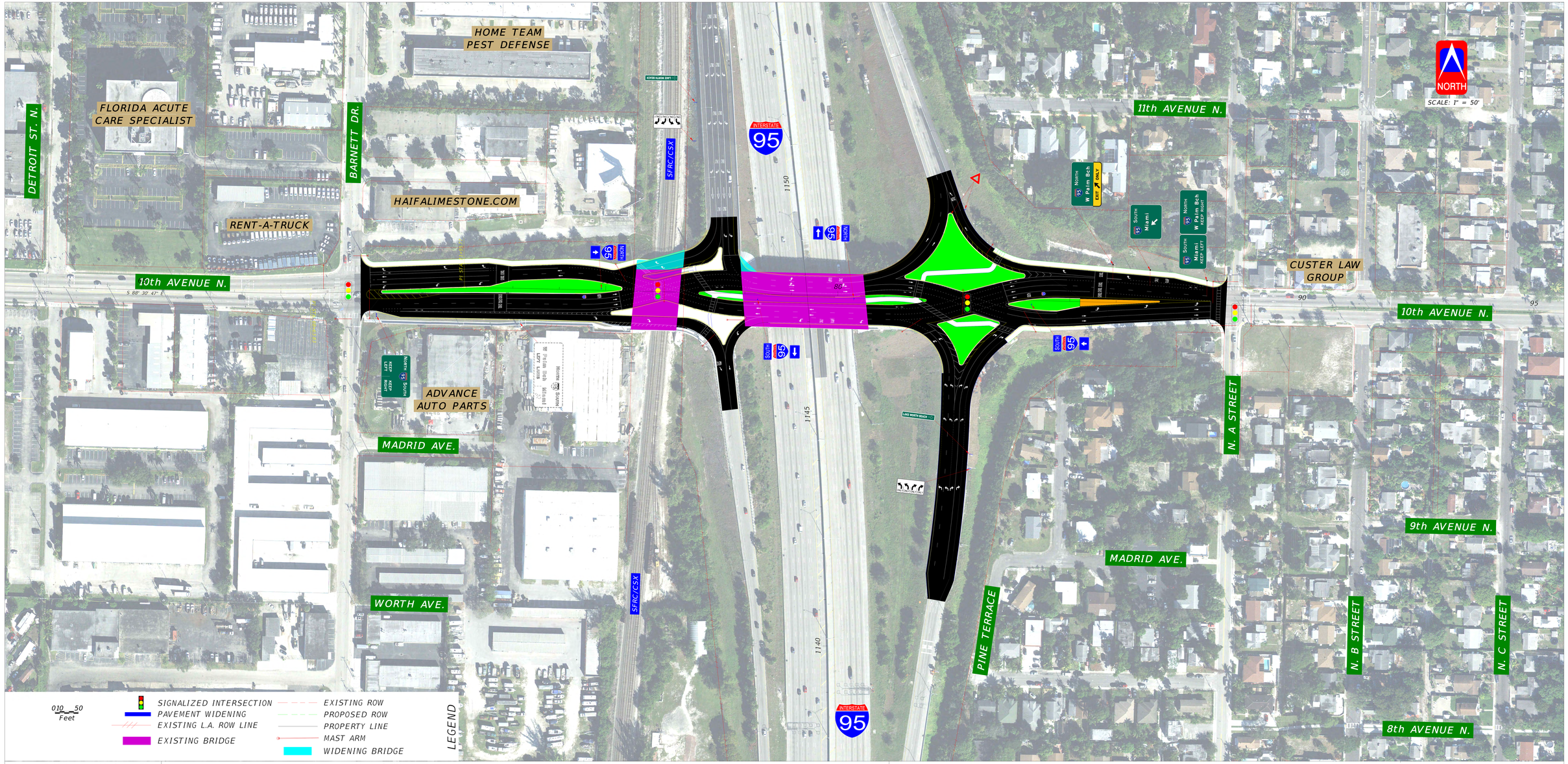
The following variations to FDOT, AASHTO or FHWA rules, policies, standards, criteria or procedures have been identified:

- Design Exceptions are required for vertical clearance for the 10th Avenue North Bridges over South Florida Rail Corridor (SFRC) that is less than 24.25’ and for the10th Avenue North Bridge over I-95 that is 16’±.
- A Design Variation is required for border width for the I-95 ramps.
- A Design Variation is required for horizontal clearance measured from the centerline of the outside SFRC railroad track to the existing bridge support structures.

All the exceptions or variations that arise during the process of conceptual development of the preferred alternative will be coordinated with FDOT and will be processed per FHWA and FDOT standards.

Table 8-26 Alternatives Evaluation Summary

Evaluation Factors		No-Action	Build Alternative 1 (TUDI)	Build Alternative 2 (DDI)
ENGINEERING	Meets Purpose and Need	No	Yes	Better than Alt 1
	Improves Safety	No	Yes	Better than Alt 1
	Meets 2045 LOS Target	No	Yes	Yes
	Improves SIS Connectivity	No	Some	Some
	Meets Geometric Design Criteria	Yes	Yes	Yes
	Right-of-Way Impacts (Parcels)	0	1	0
ENVIRONMENTAL	Improves Air Quality	No	Yes	Yes
	Potential Changes to Noise Receptors/Barriers	No	Yes	Yes
	Wetland Impacts	No	No	No
	Wildlife and Habitat	No	No	No
	Archaeological/Historical Sites	No	No	No
	Parks/Recreation/Schools	No	No	No
	Contamination Sites (high/medium/low)	No	Low	Low
COST	Construction	$0	$8.3M	$6.7M
	Right-of-Way	$0	$0.03	$0



FDOT

SR 9/I-95 at 10th Avenue North PD&E

(FPID: 412733-1-22-02)

Conc

SECTION 9 JUSTIFICATION

The proposed improvements at the I-95 and 10th Avenue North interchange are consistent with the requirements set by the FHWA Access to the Interstate System Policy dated May 22, 2017 and by FDOT Procedure Topic 525-030-160: New or Modified Interchanges adding or modifying interchange access to limited access facilities on Florida's SHS. The roadway enhancements in this IMR will provide traffic relief, thereby enhance safety within the area of influence. The interchange at I-95 and 10th Avenue North will operate at an acceptable LOS through the Design Year 2045.

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 10th Avenue North 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, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

An in-depth operational and safety analysis was conducted to study the impacts of the proposed improvements. Several performance measures were used to compare the operations of the existing system under No-Action and Build conditions. Key measures included freeway densities, ramp V/C ratios, intersection delays, level of service and 95th percentile queue lengths for existing and proposed conditions.

From an operational perspective, the traffic analysis performed for the signalized intersections indicated that the ramp terminal signalized intersections will operate at an overall LOS F during the

peak periods by Design Year 2045 if no improvements are done. Adjacent intersections are also operating at a LOS F (Barnett Dr) and LOS E (A St) by the year 2045, and a substantial number of failing movements at the ramp terminal and adjacent intersections will occur. Significant queuing will also be observed at the ramp terminal and adjacent intersections.

The safety analysis performed for this study indicated a total of 434 crashes occurred along I-95 and 198 crashes occurred along 10th Avenue North within the study area from 2014 to 2018. The predominant crash types that occurred within the study area were rear end collisions and sideswipe collisions. Crashes of these types are typically attributed to the congested conditions along the arterial and interchange ramps and terminals.

The Recommended Build Alternative 2 (DDI) for this study performs substantially better than the No-Action Alternative for all future year scenarios particularly for the 10th Avenue North interchange ramp terminals, which is the primary focus for this study. The ramp terminal intersections will operate at LOS D or better compared to the No-Action that will operate at a LOS F in the Design Year. The traffic analysis results also indicate that all the approaches for ramp terminal and adjacent intersections will operate at acceptable LOS during both the AM and PM peak periods for the 2040 design year. For the 10th Avenue North ramp terminal intersections, the southbound and northbound ramps will experience 54% reduction in delay compared to the No-Action Alternative during the AM Peak Hour.

With the improved operations under Build Alternative 2 (DDI), it is anticipated to enhance safety along both I-95 and 10th Avenue North will improve due to the significant reduction in delays and improved mobility. The DDI and adjacent intersection improvements proposed along 10th Avenue North will provide better signal operations reducing congestion and queue lengths, thereby improving safety. According to the FHWA *Diverging Diamond Interchange Informational Guide* from August 2014, DDIs not only reduced total number of crashes at the interchange but also left turn crashes and injury crashes.

Overall, the Recommended Build Alternative 2 (DDI) provides significantly better traffic operations and enhanced safety when compared to the No-Action Alternative.

A conceptual signing plan has been developed for the Recommended Build Alternative 2 showing signage requirements for the proposed improvements and the interchange.

In conclusion, the comparison of the No-Action and Build alternatives show that the proposed Interchange improvements provide better and safer operating conditions. The proposed modifications in the build alternative are not anticipated to have a negative impact on operations or safety of 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 or high occupancy vehicle and high occupancy toll lanes)

or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

The proposed improvements to the I-95 at 10th Avenue North interchange and adjacent intersections will provide full access and cater to all traffic movements from 10th Avenue North 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 and Transportation Officials (AASHTO) and the FDOT design standards.

SECTION 10 FUNDING PLAN & SCHEDULE

The improvements proposed as part of Build Alternative 2 at the I-95 and 10th Avenue North 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 funded for design in Fiscal Year (FY) 2021 in FDOT's STIP report as Financial Project Identification Number (FPID) 412733-1. The funding for project phases in FDOT's STIP for FY 2020 – FY 2023 is shown in **Table 10-1.** The Construction Phase is planned to occur after 2024 and is currently unfunded.

Table 10-1 Funding for FIN 412733-1 - SR 9/I-95 at 10th Avenue North Improvements

Fiscal Year	Less Than 2021	2021	2022	2023	Greater Than 2024
Highways PD&E	***(Ongoing)***				
Amount:	$1,450,449				
Highways/Preliminary Engineering					
Amount:		$1,891,421			
Highways/Right of Way					
Amount:				$6,245,802	
Highways/Environmental					
Amount:			$20,000		
Highways/Construction					
Amount					$22,722,836
Item Total:	**$1,450,449**	**$1,891,421**	**$20,000**	**$6,245,802**	**$22,722,836**

The project schedule is as follows:

- Draft IMR submittal: May 2020
- Final IMR submittal: December 2020
- Alternatives Workshop: October 2020
- Public Hearing: January 2021
- LDCA: June 2021
- Design: Funded for 2021
- Construction: Unfunded

APPENDICES

APPENDIX A

Methodology Letter of Understanding

APPENDIX B

Traffic Forecasting Memorandum

APPENDIX C

Safety Analysis I-95/SR 9 at 10th Avenue North

Interchange Report

APPENDIX D

Build Alternatives Concept Figures

APPENDIX E

Existing Year 2019 HCS and Synchro Outputs

APPENDIX F

No-Action Opening Year 2025 and Design Year 2045

HCS and Synchro Outputs

APPENDIX G

Build Alternative 1 Opening Year 2025 and Design Year 2045 HCS and Synchro Outputs

APPENDIX H

Build Alternative 2 Opening Year 2025 and Design Year 2045 HCS and Synchro Outputs

APPENDIX I

Long Range Estimates