2015

Quality/Level of Service Training

Planning Level Analysis

June 2015

Centennial FDOT 1915 ★ 2015

INTRODUCTION

Introductions

- Martin Guttenplan
- Andrew Young
- Nathan Hicks
- Lisa Colmenares

INTRODUCTION

Housekeeping

- Questions—ask lots of them at any time!
  - Acronyms – ask if you do not understand them

Restrooms

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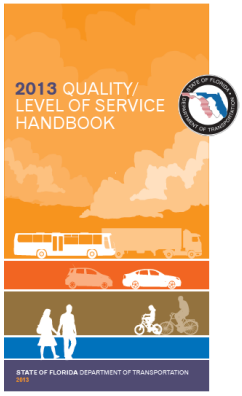
INTRODUCTION

www.dot.state.fl.us/planning/systems/programs/sm/los/



Download PDF of Q/LOS Handbook

www.dot.state.fl.us/planning/systems/programs/SM/los/pdfs/2013%20QLOS%20Handbook.pdf

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INTRODUCTION

Overview of Course Material

1. Traffic Concepts and Key Variables Affecting Level of Service (LOS)
2. Data Sources
3. Generalized Service Volume Tables
4. LOSPLAN
5. Monroe St. Video Data & QLOS Analysis
6. Freeway Analysis
7. Applications of QLOS & Wrap-Up

Notice the Page Curls

INTRODUCTION

Agenda – Day One

8:30 AM	**1** Introductions and Key Concepts	Andrew
9:00 AM	**2** Input Variables	Andrew
9:40 AM	**3** Data Sources	Nathan
◄ 10:10 AM Break		
10:25 AM	**4** Generalized Service Volume Tables	Nathan
11:00 AM	**5** Introduction to LOSPLAN	Martin
◄ 11:45 AM Lunch		
1:00 PM	**6** HIGHPLAN	Martin
1:30 PM	**7** ARTPLAN Introduction	Martin
◄ 2:15 PM Break		
2:30 PM	**8** ARTPLAN – Intermediate & Multimodal	Martin
◄ 4:30 PM Adjourn		

INTRODUCTION

Agenda – Day Two

8:30 AM	**9** Multimodal LOS Review	Martin
9:00 AM	**10** ARTPLAN – Bus Analysis	Martin
9:40 AM	**11** Monroe Street Video Data Collection	Martin
◄ 10:10 AM Break		
10:25 AM	**12** Monroe Street ARTPLAN analysis	Martin
◄ 11:45 AM Lunch		
1:00 PM	**13** FREEPLAN – Freeway analysis	Martin
◄ 2:30 PM Break		
2:45 PM	**14** Future Year Analysis, LOS Applications	Martin
4:00 PM	**15** Wrap-Up	Martin
◄ 4:30 PM Adjourn		

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INTRODUCTION

Course Objectives

- Move from understanding basic traffic concepts to hands-on capacity and quality of service analysis
- Gain proficiency in planning analysis
- Gain proficiency in multimodal QOS
- Understand the factors that have the greatest impact on the results
- Identify key differences between LOSPLAN and other tools

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INTRODUCTION

Quality/Level of Service

Introduction and Key Concepts

Agenda Item 1

- Name
- Agency
- Experience with Q/LOS

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INTRODUCTION

FDOT Mission Statement

The department will provide a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity and preserves the quality of our environment and communities.

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INTRODUCTION

Importance of Mobility

"Ensuring mobility for people and goods is transportation's most essential function."

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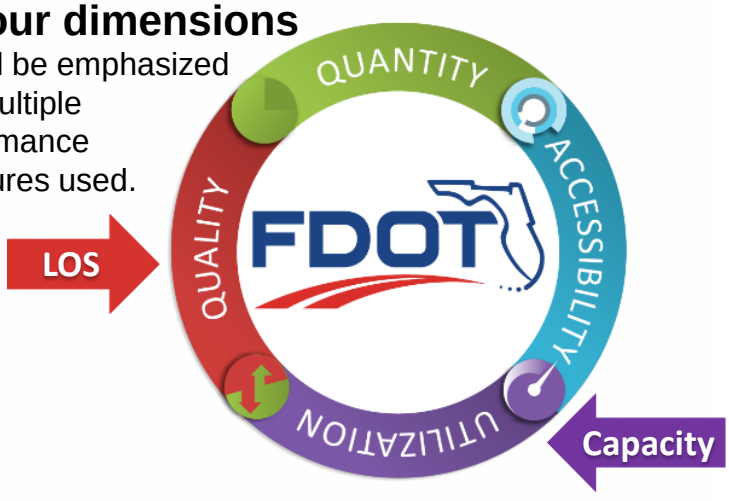
INTRODUCTION

4 Dimensions of Mobility

To adequately address mobility,
all four dimensions
should be emphasized and multiple performance measures used.



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INTRODUCTION

Concepts Apply to All Modes

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INTRODUCTION

Quality of Service and Capacity Analyses

LOS **Quality of service and capacity analyses are at the heart of "ensuring mobility of people and goods."** **Capacity**

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INTRODUCTION

Five Important Definitions

Quality of Service

Level of Service

Highway

Multimodal

Capacity

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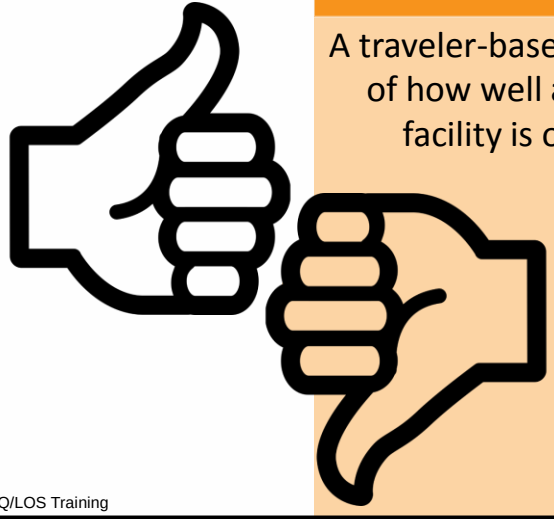
INTRODUCTION

Five Important Definitions

Quality of Service

A traveler-based assessment of how well a service or facility is operating



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INTRODUCTION

Five Important Definitions

LOS A-F should not be thought of as school grades.

Level of Service

A quantitative stratification of the "quality of service" of a service or facility into six letter grade levels with "A" describing the highest quality and "F" describing the lowest quality

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INTRODUCTION

Five Important Definitions

Highway

Roadway with all transportation facilities (e.g., lanes, bus pull-outs, paved shoulders, sidewalks, signals) within the right of way

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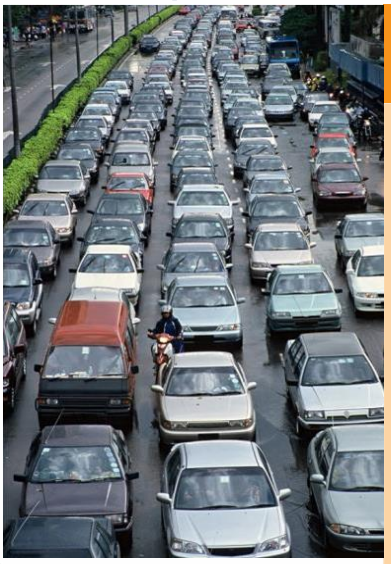
INTRODUCTION

Five Important Definitions



Capacity

The maximum number of vehicles that can pass a point during a specified time period under prevailing roadway, traffic, and control conditions

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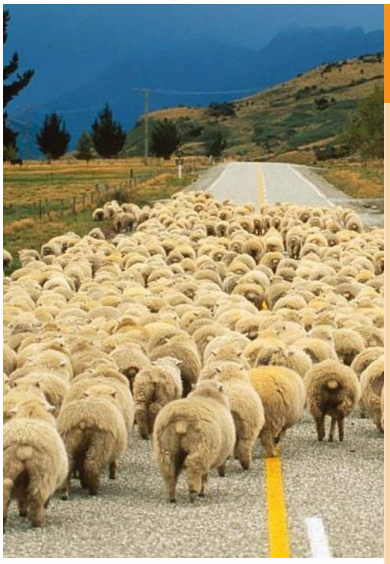
INTRODUCTION

Five Important Definitions



Capacity

The maximum number of vehicles that can pass a point during a specified time period under prevailing roadway, traffic, and control conditions

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INTRODUCTION

Five Important Definitions

Multimodal

More than one highway mode (auto, bicycle, bus, pedestrian, truck)

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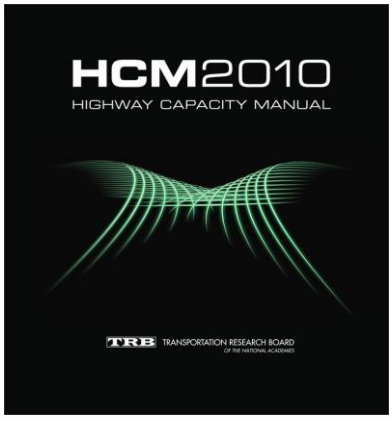
INTRODUCTION

TRB's Highway Capacity Manual is **"The National Document"**



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INTRODUCTION

Positive Aspects and Limitations of the HCM

- Benchmark for highway quality of service and capacity analyses
- Consensus of expert opinion

- Too detailed / not detailed enough
- Does not cover other important mobility issues
  - Travel demand (Quantity)
  - Land use

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INTRODUCTION

Types of Analyses

Planning

- Default values for nearly all of the model inputs
- Limited data requirements, general results

Operational

- All or nearly all of the required model inputs
- More data, more precise results

Design

- To establish the detailed physical features

This course will focus on planning-level analysis

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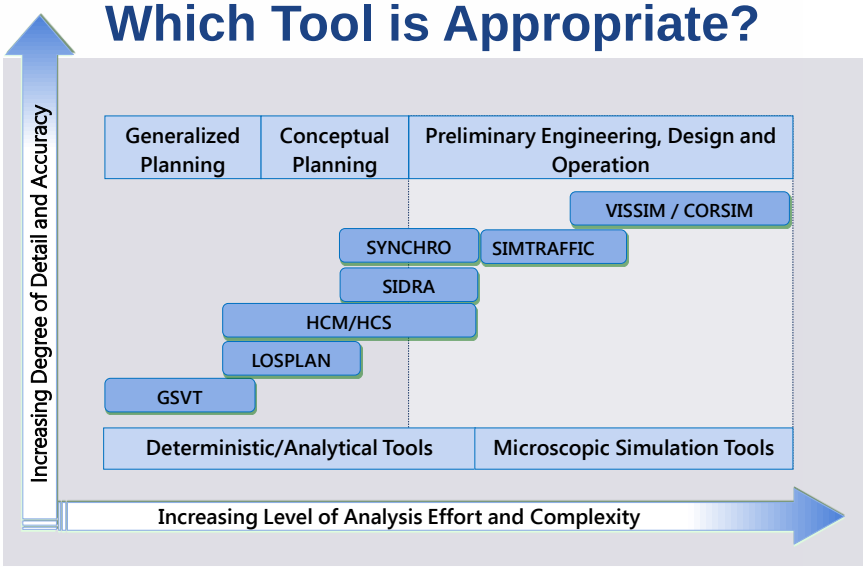
INTRODUCTION

Which Tool is Appropriate?



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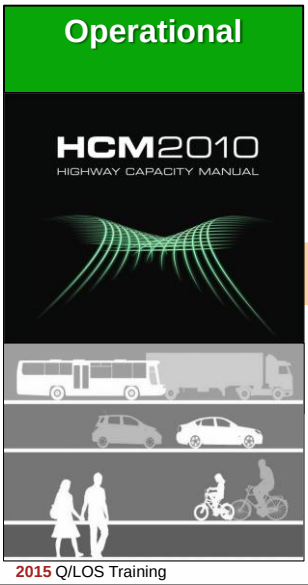
Traffic Analysis Handbook 21

INTRODUCTION

LOS - Operational, Conceptual and Generalized Planning Techniques

Operational

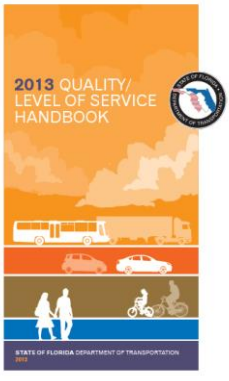


TCQSM

BLOS

PLOS

Conceptual and Generalized Planning



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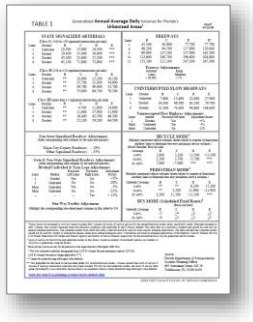
INTRODUCTION

LOS Planning Analysis Tools

Q/LOS Handbook

Conceptual Software

Generalized Planning Tables



27 http://www.dot.state.fl.us/planning/systems/programs/sm/los/default.shtm

INTRODUCTION

LOS and Capacity

LOS	Automobile	Bicycle	Pedestrian	Bus
A/B				 >4 buses/hour
C/D				 2 to 4 buses/hour
E/F				 ≤ 1 bus/hour

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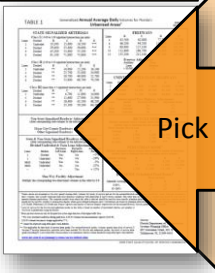
INTRODUCTION

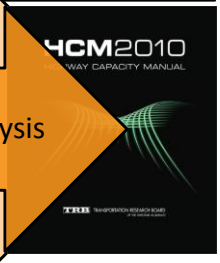
FDOT Guidance on Applying Capacity and LOS Tools

Conceptual and Generalized Planning

Decide on type of analysis

Operational





Pick the right capacity/LOS tool for analysis

Keep inputs comparable to the analysis and tool

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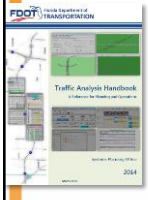
INTRODUCTION



Traffic Analysis Handbook

Table 4-2 Traffic Analysis Software by System Element

Facility	Level of Analysis	Project Need	Performance MOE	Recommended Software
Limited Access	Generalized Planning	Determining a need for additional capacity	LOS	GSVT, LOSPLAN
	Conceptual Planning	Determining number of lanes	LOS	LOSPLAN, HCS
	Preliminary Engineering and Design	Determining how the facility will operate	LOS, density, speed, Travel time	HCS CORSIM, VISSIM
	Operational	Determining how well the facility operates	LOS, density, speed, Travel time	HCS CORSIM, VISSIM
Interchanges	Conceptual Planning	Determining capacity of the weaving segment	Flow rate, LOS	HCS
	Preliminary Engineering and Design	Determining capacity of the weaving segment or ramp merge/diverge	Density, speed, LOS	HCS
		Evaluating effect of a queue backup from the ramp terminal to the weaving operation	Queue length	SYNCHRO, VISSIM, CORSIM
		Analyzing weaving from ramp terminal to the nearest signalized intersection	Speed, density	VISSIM/CORSIM
		Evaluating the operation of the entire interchange	Density, speed,	SYNCHRO, CORSI, VISSIM
	Operational	Evaluating weaving operation	LOS, density	HCS, SYNCHRO, VISSIM, CORSIM
Urban Arterials	Generalized Planning	Determining a need for additional capacity	LOS	GSVT, LOSPLAN
	Conceptual Planning	Determining number of lanes	LOS	LOSPLAN, HCM/HCS
	Preliminary Engineering and Design	Determining how the facility will operate	Speed	HCS
		Optimizing signals	Control delay, queue, V/C ratio	SYNCHRO/SIMTRAFFIC

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INTRODUCTION

Types of Roadways

Arterials

Freeways

Highways

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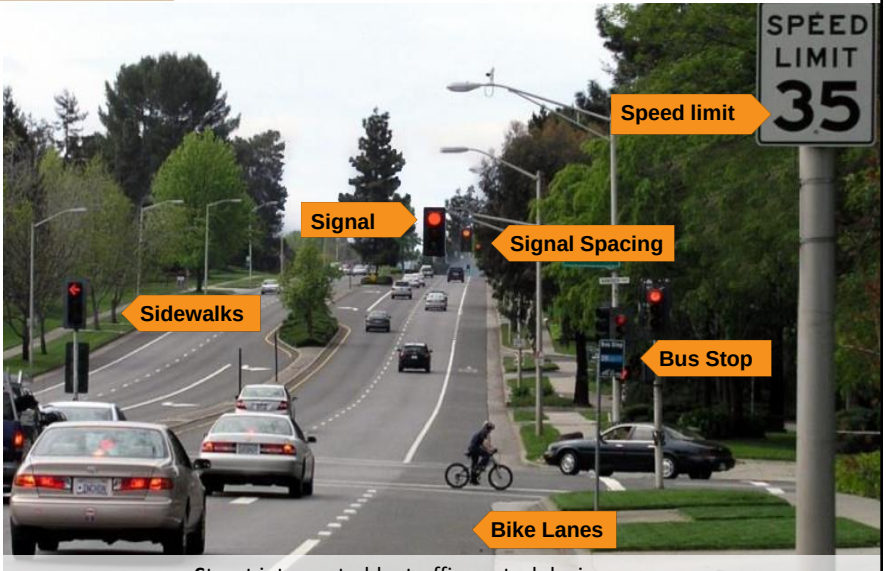
INTRODUCTION

Arterial (Types of Roadways)



Street interrupted by traffic control devices *(e.g. signals, STOP signs, or YIELD signs)*
Average signalized intersection spacing less than or equal to two miles

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INTRODUCTION

Freeway (Types of Roadways)

A fully access-controlled, divided highway with a minimum of two lanes (and typically more) in each direction

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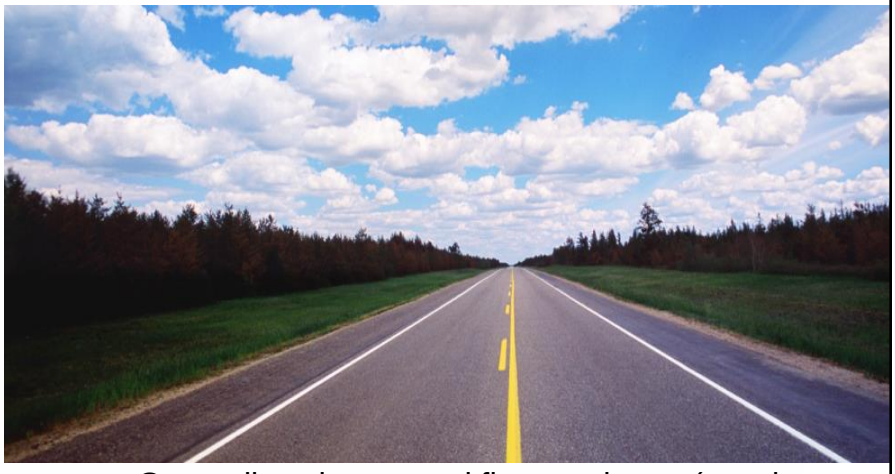
INTRODUCTION

Highway (Types of Roadways)

Uninterrupted Flow Highway Rural Two Lane



Generally uninterrupted flow roadways (may have driveways and isolated traffic signals) which may be further categorized as two-lane or multilane

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INTRODUCTION

Highway (Types of Roadways)

Uninterrupted Flow Highway Multilane Rural

Average signalized intersection spacing greater than two miles and are not freeways

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INTRODUCTION

Highway System Structure

Generalized HCM Highway System Structure

Point		A boundary between links, usually a signalized intersection
Link		A length of roadway between two points
Segment		A portion of roadway extending from one point to another
Section		A length of roadway consisting of groups of segments having common characteristics
Facility		A length of roadway consisting of points and segments having different characteristics

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INTRODUCTION

Highway System Structure (Types of Roadways)

Segmentation

Section	A length of roadway consisting of groups of segments having common characteristics
Facility	A length of roadway consisting of points and segments having different characteristics

This is based on:

- Driver perception
- Highway system structure

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INTRODUCTION

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INPUT VARIABLES

ROADWAY
TRAFFIC
CONTROL

Input Variables

Agenda Item 2

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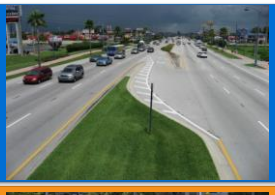
INPUT VARIABLES

Affecting LOS and Capacity



Roadway variables

Traffic variables

Control variables

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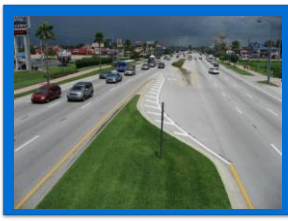
INPUT VARIABLES

Key Factors Affecting LOS and Capacity



Roadway variables

- Area Type
- Laneage
- Turn lanes
- Sidewalks
- Bicycle lanes

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INPUT VARIABLES

Key Factors Affecting LOS and Capacity

Traffic variables

- Daily/Hourly aspects
- Directional aspects
- Bus frequency

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INPUT VARIABLES

Key Factors Affecting LOS and Capacity

Control variables

- Control Type
- Green time
- Cycle length

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INPUT VARIABLES

Key Factors Which Highly Influence Results

- Avoid using defaults with these factors

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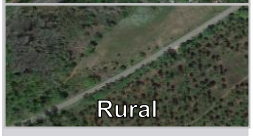
INPUT VARIABLES

Key Factors Which Highly Influence Results

Area Type



Auto

- Number of lanes
- Left turn lanes
- AADT
- K
- D
- Signal spacing
- g/C

Multimodal

- Paved shoulder/ bicycle lane
- Sidewalk
- Bus frequency

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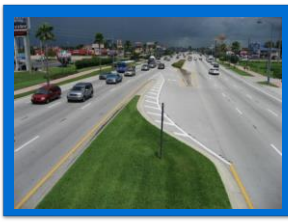
ROADWAY

Key Factors Affecting LOS and Capacity



Roadway variables

- Area Type
- Laneage
- Turn lanes
- Sidewalks
- Bicycle lanes

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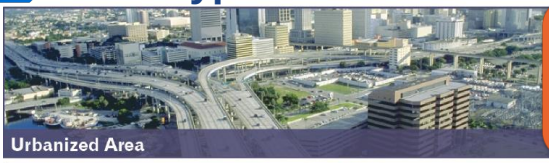
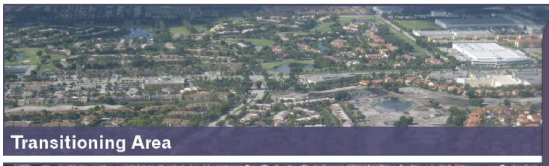
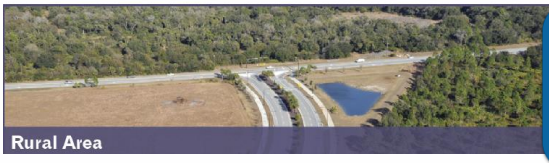
ROADWAY **Area Type**







Large Urbanized
1,000,000+

Other Urbanized
50,000 - 1,000,000

Transitioning
Urban fringe, urbanized within 20 years

Urban
5,000 – 50,000

Rural Developed
< 5,000 with dev.

Rural Undeveloped
Little to no dev.

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ROADWAY **Area Type**

Large Urbanized

- 1,000,000+ population
- Covered by MPOs

1. Ft. Lauderdale
2. Jacksonville
3. Miami
4. Orlando
5. St. Petersburg
6. Tampa
7. West Palm Beach

Other Urbanized

- Population: 50,000 - 1,000,000
- Covered by MPOs other than those overseeing large urbanized areas

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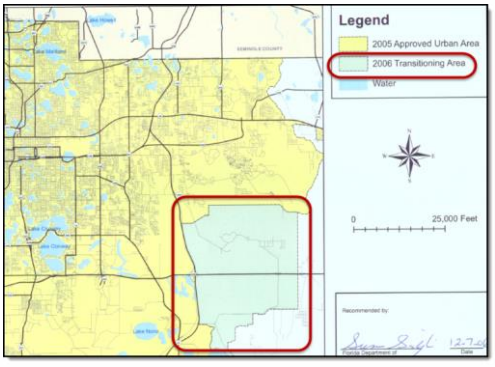
ROADWAY

Area Type



Example Transitioning Area from Metro Plan Orlando

Transitioning

- Area outside of, but contiguous to, an urbanized area
- Expected to be urbanized or urban within the next 20 years based on growth characteristics

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ROADWAY

Area Type

Urban

- Areas with populations between 5,000 - 50,000 and not an urbanized area

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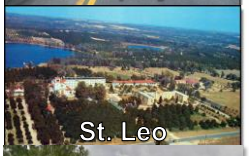
ROADWAY

Area Type



Rural Developed

- Population less than 5,000
- Exhibit some development, such as small cities

Rural Undeveloped

- Contain little to no development

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ROADWAY

Number of Through Lanes

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ROADWAY

Exclusive Turn Lanes

Turn lanes from which a turning-movement must be made, designated by solid line striping

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ROADWAY

Median

A separating barrier between opposing directions of traffic

- **Restrictive**
  – A raised or grassed area at least 10’ wide

- **Non-restrictive**
  – A painted at-grade area at least 10’ wide
  - “Undivided” refers to no median
  - “Divided” can include either a restrictive or non-restrictive median

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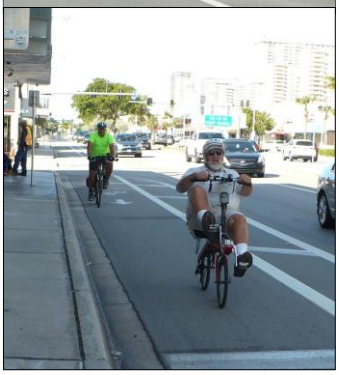
ROADWAY

Bicycles



Paved Shoulder / Bicycle Lane

- A bicycling area typically four feet wide or greater and separated from the outer motorized vehicle through lane by a solid pavement marking

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ROADWAY

Pedestrians

Sidewalk

- Paved walkway at the side of a roadway, typically 5 feet in width **(on the directional side of the arterial being analyzed)**

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TRAFFIC

Key Factors Affecting LOS and Capacity

Traffic variables

- Daily/Hourly aspects
- Directional aspects
- Bus frequency

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TRAFFIC

Annual Average Daily Traffic

Total traffic volume in both directions on a highway segment for one year divided by the number of days in a year

AADT

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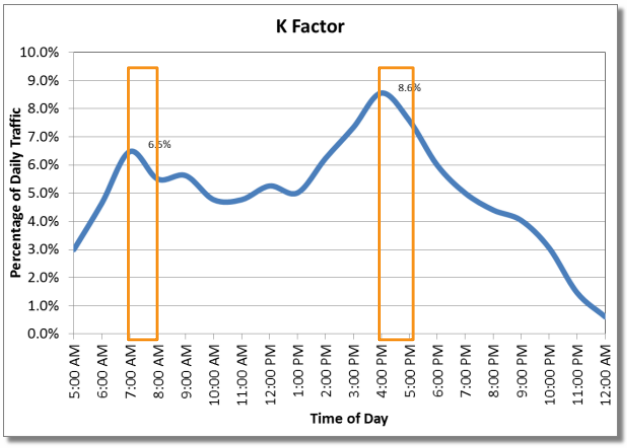
Most used of all traffic parameters

TRAFFIC

K-factor

The proportion of AADT that occurs during the peak hour



Morning Peak:
.065*10000= 650

Evening Peak:
.086*10000= 860

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TRAFFIC

K-factor

Standard K

- FDOT policy sets the K-factor as a fixed parameter rather than a variable
- It is set based on area type and facility type

Standard K-Factor						
Roadway Type	Urbanized		Transitioning/Urban		Rural	
	Large	Other	Transitioning	Urban	Developed	Undeveloped
Arterials	0.08-0.09	0.09	0.09	0.09	0.095	
Freeways	0.08-0.09	0.09	0.09	0.09	0.095	
Highways	0.08-0.09	0.09	0.09	0.105	0.105	

*Core freeways have a lower K-factor

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TRAFFIC

D-factor

The proportion of traffic moving in the peak direction of travel on a given roadway during the peak hour

WB

EB

- The minimum allowable D-factor is **0.51** for all area types
- The D-factor has a sensitivity such that a 1% increase in D-factor produces a 2% decrease in allowable daily service volume

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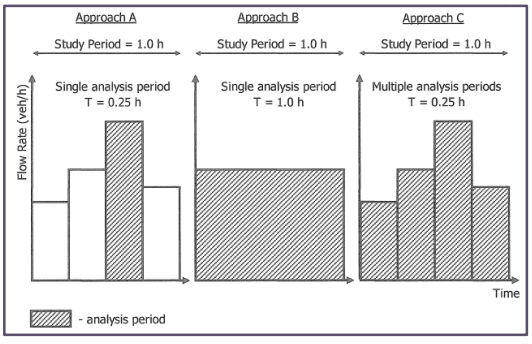
TRAFFIC

Peak Hour Factor (PHF)

A measure of traffic demand fluctuation within the analysis hour.



1.0

FDOT recommends using a PHF of 1.0 for all planning level analyses

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TRAFFIC

Percent (%) Heavy Vehicles

The percent of trucks and other heavy vehicles with more than four wheels touching the pavement during normal operation.

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TRAFFIC

Local Adjustment Factor

Drivers exiting Florida's Turnpike see two signs for International Drive.

Accounts for driver aggression, hurriedness, and familiarity with the facility. It reflects lower capacities for different area types.

*Input in FREEPLAN and HIGPLAN

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TRAFFIC

Bus Frequency

- The number of scheduled fixed route buses which can stop on a given roadway segment in one direction of flow in a one-hour time period.
- Express buses with no potential of stopping along a roadway are not included.

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CONTROL

Key Factors Affecting LOS and Capacity

Control variables

- Control Type
- Green time
- Cycle length

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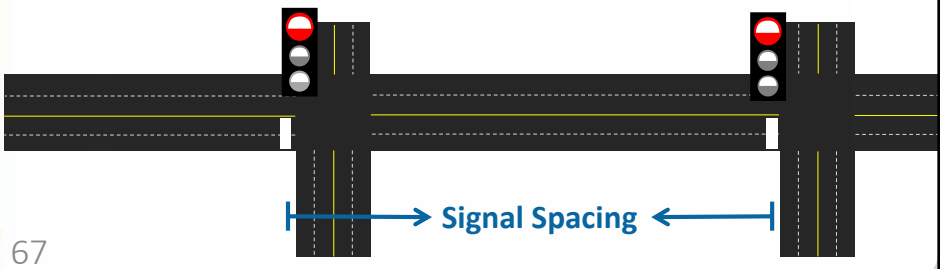
CONTROL

Number of Signalized Intersections

Signal Spacing

- The distance between consecutive traffic signals along a facility, measured from stop bar to stop bar in the direction of analysis



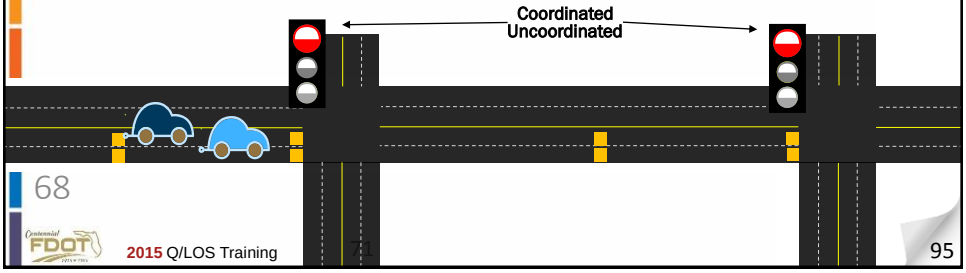
67

2015 Q/LOS Training 92

CONTROL

Arrival Type

- A generalized categorization of the quality of progression between signalized intersections, ranging from 1 to 6
- Uncoordinated signals are represented by arrival type 3, and coordinated signals are represented by arrival type 4 or higher



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2015 Q/LOS Training 95

CONTROL

Signal Type

- **Pretimed**
  - Uses a preset sequence of phase times with no use of vehicle detection
- **Coordinated Actuated**
  - Uses a fixed cycle length while the amount of green time for the main street through phase varies, utilizing unused time from the minor phases.
- **Fully Actuated**
  - Uses vehicle detection for all signal phases on both the main and side street approaches

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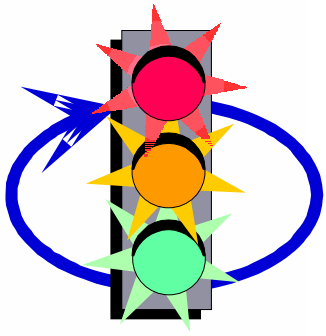
CONTROL

Cycle Length

- **The total time for the signal to complete one complete sequence of indications**



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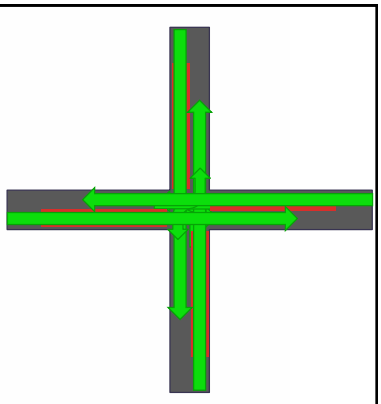
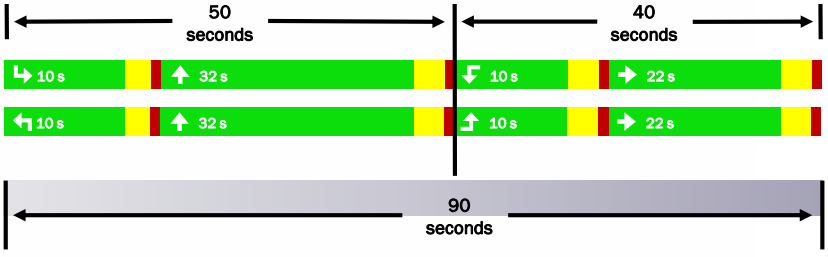
CONTROL

Cycle Length

- The amount of time (in seconds) that is provided to service all movements at a signalized intersection





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CONTROL

Green Time

- **Green Time**
  - the amount of time within a given phase during which the green indication is present (G)

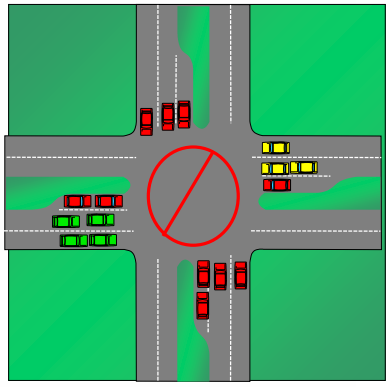
72

2015 Q/LOS Training

CONTROL

Basic Signal Operations Terms

- **Lost Time -** The amount of time during which the intersection is not used effectively. (L). Default is 4 seconds per movement.



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CONTROL

Basic Signal Operations Terms

Effective Green Ratio (g/C)

- The ratio of the effective green time of a phase to the cycle length

Indicates the proportion of the cycle length that traffic may move through the intersection for a particular movement

Pretimed Signals	Actuated Signals
g/C ≈ G/C	g/C ≈ (G+4)/C

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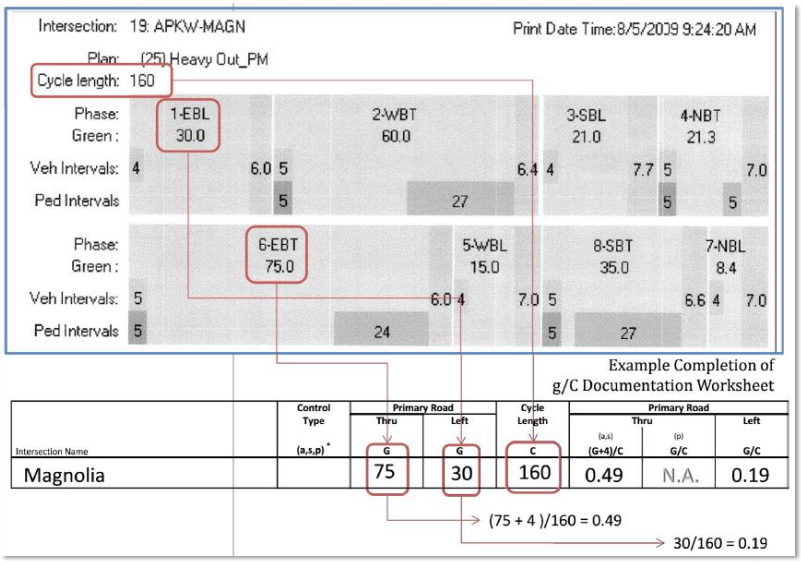
CONTROL

Signal Timing



Example Completion of g/C Documentation Worksheet

Intersection Name	Control Type (a,s,p)*	Primary Road Thru G	Primary Road Left G	Cycle Length C	Primary Road Thru (a,s) (G+4)/C	Primary Road Thru (p) G/C	Primary Road Left G/C
Magnolia		75	30	160	0.49	N.A.	0.19

(75 + 4)/160 = 0.49

30/160 = 0.19

- **Through g/C**
- **Left g/C**

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2015 Q/LOS Training

100

CONTROL

Left-Turn Phasing

- **Protected turn** – Green arrow
- **Permissive turn** – Green ball (or flashing yellow arrow) where left turns have to yield to oncoming traffic
- **Protected + Permissive turn** – Starts as green arrow, changes to green ball (or vice versa)

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2015 Q/LOS Training

INPUT VARIABLES

ROADWAY

TRAFFIC

CONTROL

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2015 Q/LOS Training

Data Sources

Agenda Item 3

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2015 Q/LOS Training

Data Sources

The goal of this segment of training is to successfully locate the key input parameters for a given roadway

using free sources

Florida Traffic Online
http://www2.dot.state.fl.us/FloridaTrafficOnline/viewer.html

Florida Transportation Information DVD

Google

Google Maps / Google Earth

Road Characteristics Inventory
http://www.dot.state.fl.us/planning/statistics/gis/

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Data Sources

Most Important Variables - Reminder

Area Type	Auto	Multimodal
	 ▪ Number of lanes ▪ Left turn lanes ▪ AADT ▪ K ▪ D ▪ Signal spacing ▪ g/C	 ▪ Paved shoulder/ bicycle Lane ▪ Sidewalk ▪ Bus frequency

80

Data Sources

Area Type

- **Transitioning areas** are adjacent and contiguous to an urbanized area and may become urbanized in the next 20 years based on growth characteristics
- **Urban areas** are developed cities that are not within contiguous to an urbanized area, and have a population between 5,000-50,000

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Data Sources

Area Type

If the population is less than 5,000:

- View the area on an aerial software (Google Maps or Earth)
- If there is little or no development present, the area type is **rural undeveloped**
- If the area appears to be developed with residential or commercial developments, the area type is **rural developed**

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Data Sources

Area Type

1. Ask District LOS Coordinator - particularly for transitioning area
2. If available, obtain area type GIS data
3. Determine if your study roadway is within the urbanized boundary of an MPO
4. If within MPO but outside the urbanized boundary, confirm location using this interactive MPO/Urban area map (http://transport.cfgis.org/). Turn on Urban areas 2012 and MPO Boundaries under RCI 2012 and Jurisdictional Boundaries, found under the base data tab

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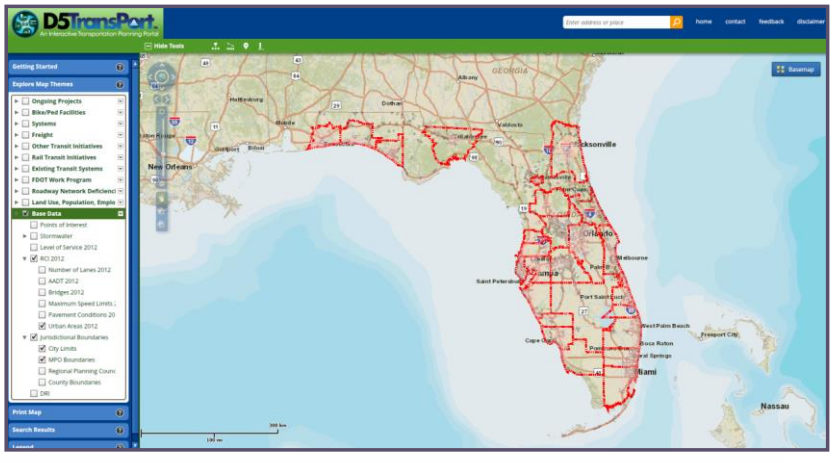
Data Sources

Area Type (TransPort)

Example: Mahan Dr. & Dempsey Mayo Rd. (Tallahassee)

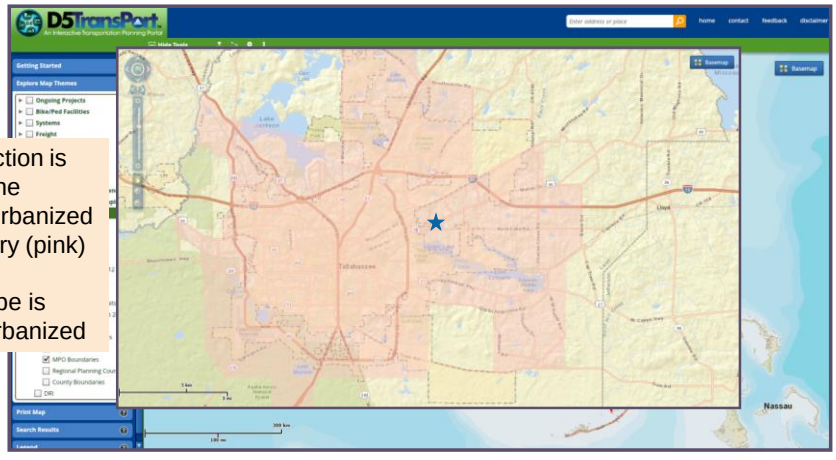


84

Data Sources

Area Type (TransPort)

Example: Mahan Dr. & Dempsey Mayo Rd. (Tallahassee)



Intersection is within the urban/urbanized boundary (pink)

Area type is other urbanized

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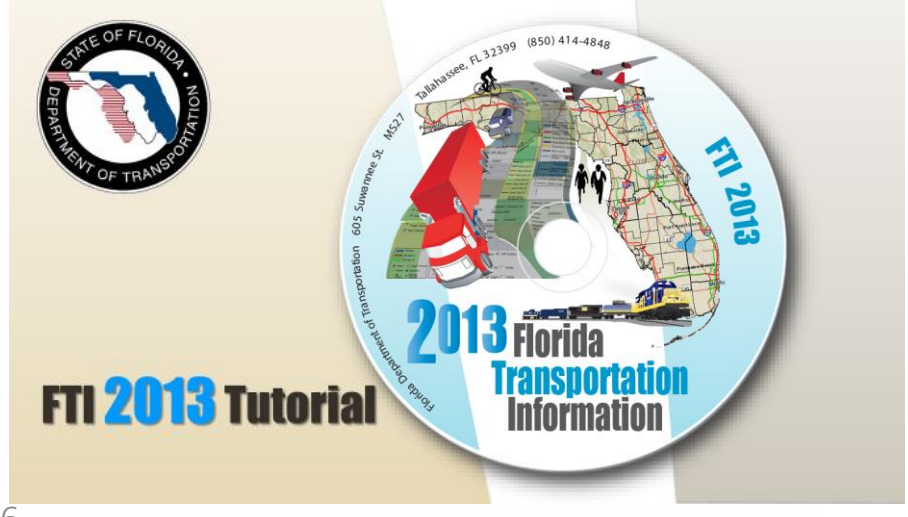
Florida Transportation Information (FTI) video



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Florida Transportation Information DVD

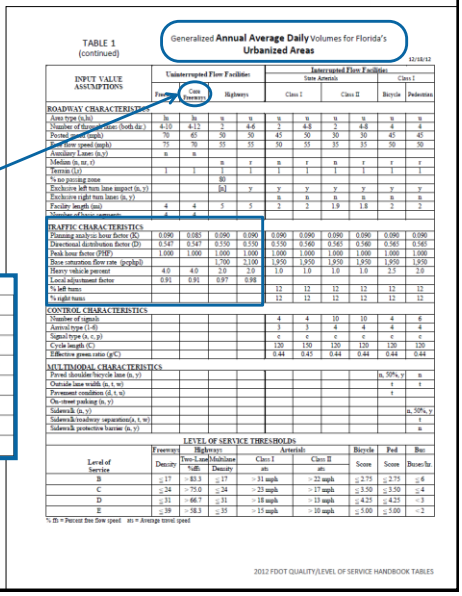
87

Data Sources

Percent Heavy Vehicles *(From back of GSVTs)*

Example for a core freeway in an urbanized area

TRAFFIC CHARACTERISTICS				
Planning analysis hour factor (K)	0.090	0.085	0.090	0.090
Directional distribution factor (D)	0.547	0.547	0.550	0.550
Peak hour factor (PHF)	1.000	1.000	1.000	1.000
Base saturation flow rate (pcphpl)			1,700	2,100
Heavy vehicle percent	4.0	4.0	2.0	2.0
Local adjustment factor	0.91	0.91	0.97	0.98
% left turns				
% right turns				



88

% Heavy Vehicles = 4.0

Data Sources

Example 1

Find the following parameters for Interstate I-4 in Orlando (D5) between Princeton St and Par St:

- Area Type
- Peak Direction
- AADT
- K-Factor
- D-Factor
- % Heavy Vehicles

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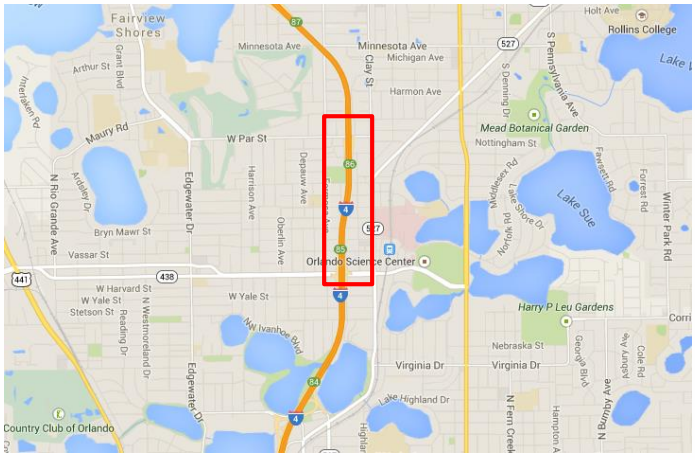
Data Sources

Example 1

Area Type



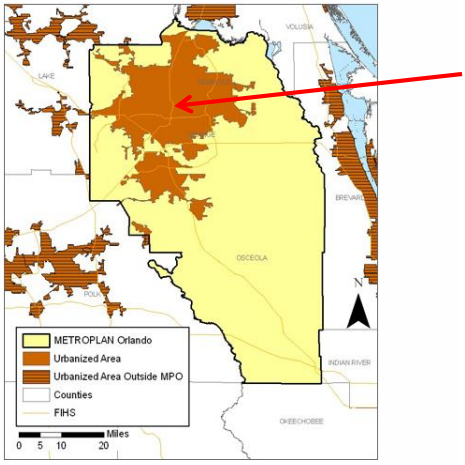
90

Data Sources

Example 1

Area Type

- The study roadway is in Orlando, FL:



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Data Sources

Example 1

Area Type

- The study roadway (I-4) is within the urbanized area of the map

→ **Orlando is classified as an urbanized area**

Side note: Orlando is one of the 7 urbanized areas the State of Florida considers a "Large Urbanized" area

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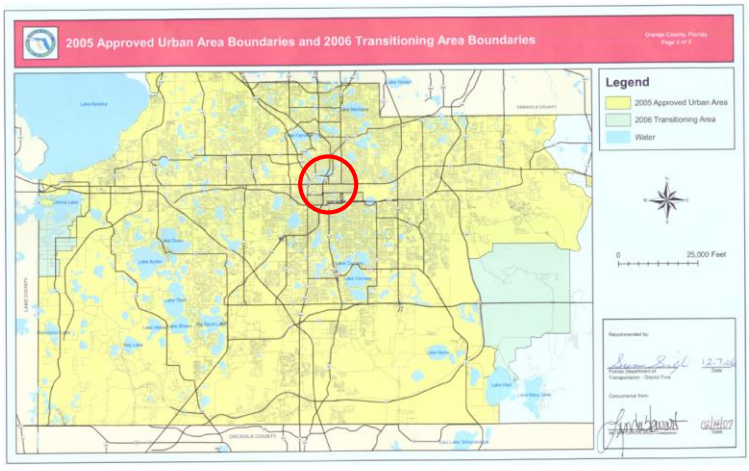
Data Sources

Example 1

District 5 Urban/Transitioning Area Maps



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2015 Q/LOS Training

Data Sources

Example 1

Determine:

- AADT
- K-Factor
- D-Factor
- Peak Direction
- % Heavy Vehicles

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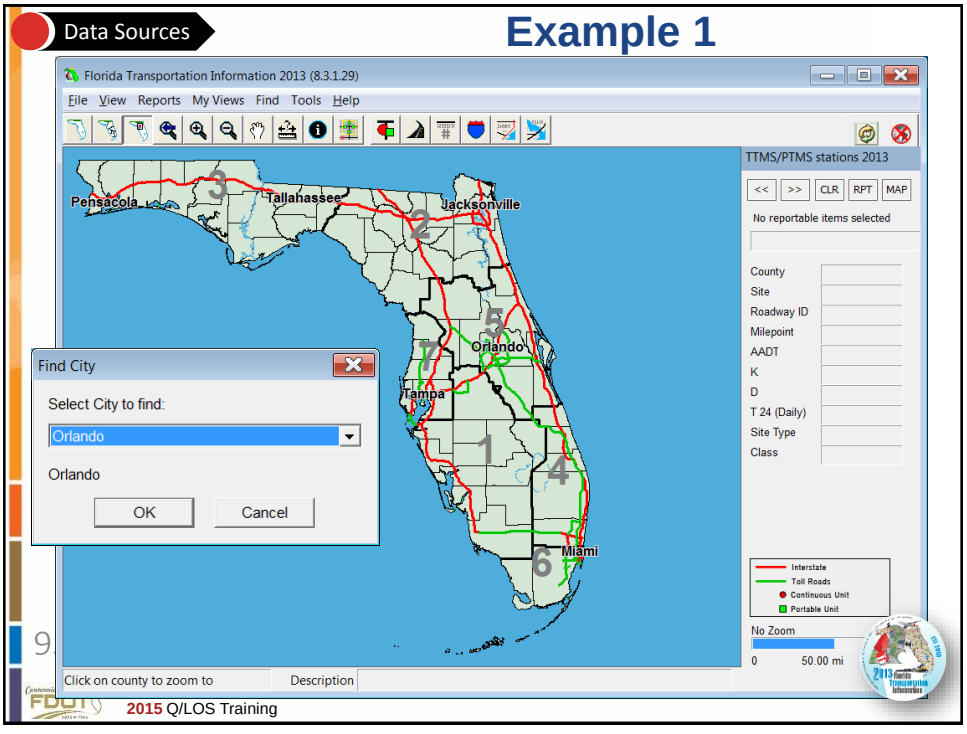
2015 Q/LOS Training

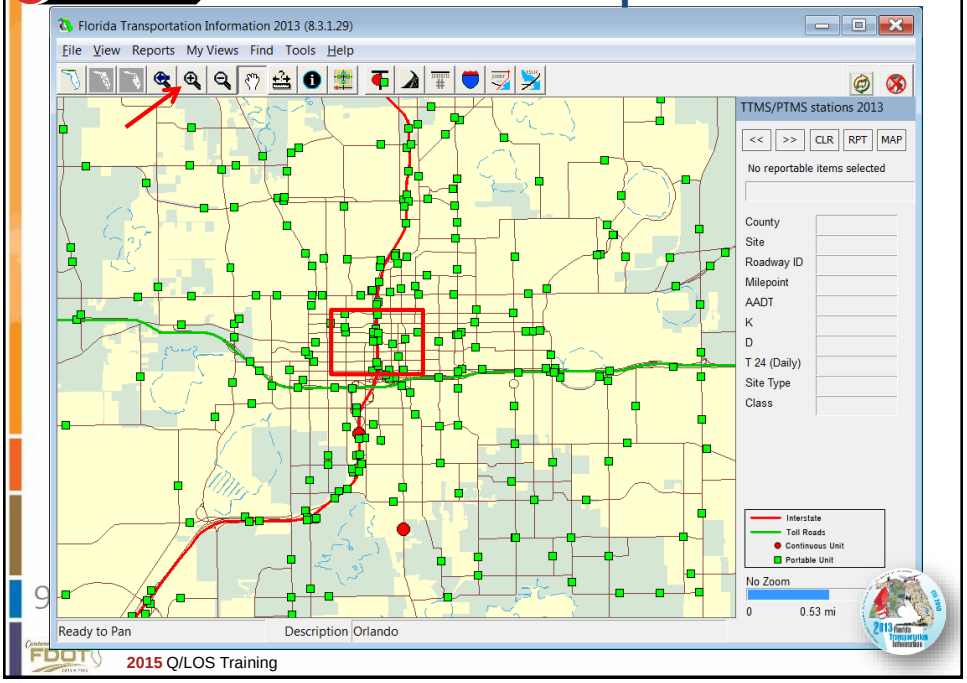
Data Sources

Example 1



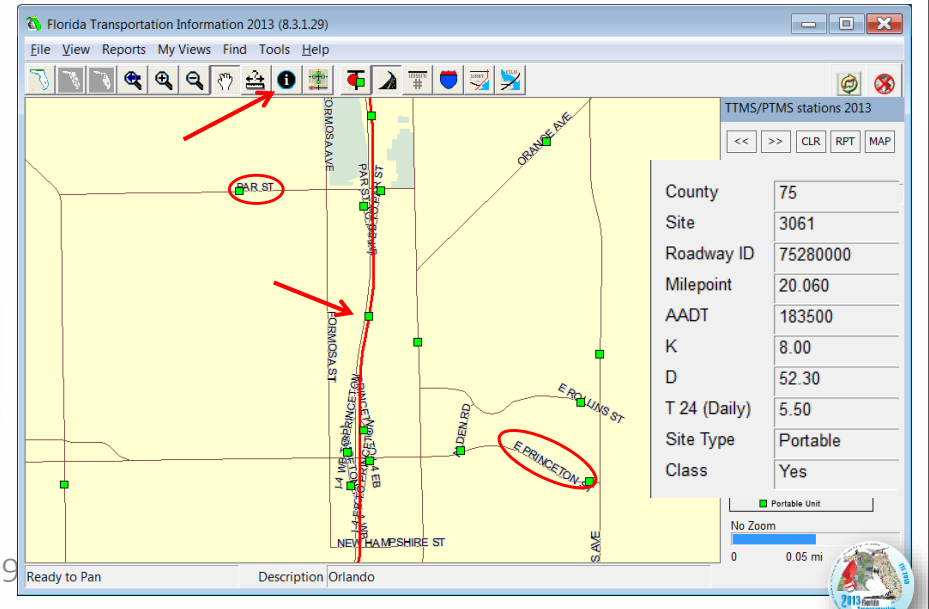
Data Sources

Example 1



Data Sources

Example 1



Data Sources

Example 1

TrafficInfo -- Report Print Preview

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Florida Department of Transportation
Transportation Statistics Office
2013 Historical AADT Report

County: 75 - ORANGE

Site: 3061 - ON I-4, 0.121 MI. NE OF SR-438 (UCLP)

Year	AADT	Direction 1	Direction 2	*K Factor	D Factor
2013	183500 C	E 84500	W 99000	8.00	52.30
2012	196000 C	E 97500	W 98500	8.00	51.80
2011	168000 S	E 85000	W 83000	8.00	53.10
2010	164000 F	E 83000	W 81000	7.77	53.41
2009	159500 C	E 80500	W 79000	8.65	52.77
2008	182500 C	E 92500	W 90000	8.20	
2007	209000 C	E 103000	W 106000	7.89	

Data Sources

Example 1

TRAFFIC CHARACTERISTICS				
Planning analysis hour factor (K)	0.090	0.085	0.090	0.090
Directional distribution factor (D)	0.547	0.547	0.550	0.550
Peak hour factor (PHF)	1.000	1.000	1.000	1.000
Base saturation flow rate (pcphpl)			1,700	2,100
Heavy vehicle percent	4.0	4.0	2.0	2.0
Local adjustment factor	0.91	0.91	0.97	0.98
% left turns				
% right turns				

% Heavy Vehicles = 4.0

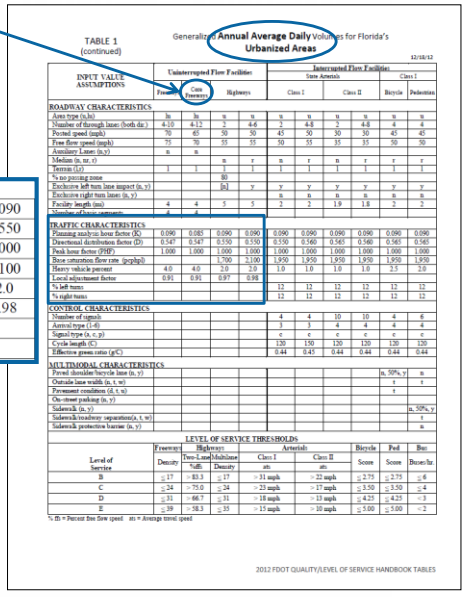


TABLE 1 (continued)

Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

12/10/12

INPUT VALUE ASSUMPTIONS	Uninterrupted Flow Facilities: Freeways	Uninterrupted Flow Facilities: Highways	Interrupted Flow Facilities: State Arterials Class I	Interrupted Flow Facilities: State Arterials Class II	Interrupted Flow Facilities: Class I Bicycle	Interrupted Flow Facilities: Class I Pedestrian
ROADWAY CHARACTERISTICS						
Area type (u,b)	b	b	u	u	u	u
Number of through lanes (both dir.)	4-10	4-12	2	4-6	2	4-8	2	4-8	4	4
Posted speed (mph)	70	65	50	50	45	50	30	30	45	45
Free flow speed (mph)	75	70	55	55	50	55	35	35	50	50
Auxiliary Lanes (n, y)	n	n								
Median (n, nr, r)			n	r	n	r	n	r	r	r
Terrain (LT)	1	1	1	1	1	1	1	1	1	1
% no passing zone			80							
Exclusive left turn lane impact (n, y)			[a]	y	y	y	y	y	y	y
Exclusive right turn lanes (n, y)					n	n	n	n	n	n
Facility length (mi)	4	4	5	5	2	2	1.9	1.8	2	2
Number of basic segments	4	4								
TRAFFIC CHARACTERISTICS										
Planning analysis hour factor (K)	0.090	0.085	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Directional distribution factor (D)	0.547	0.547	0.550	0.550	0.550	0.560	0.565	0.560	0.565	0.565
Peak hour factor (PHF)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Base saturation flow rate (pcphpl)			1,700	2,100	1,950	1,950	1,950	1,950	1,950	1,950
Heavy vehicle percent	4.0	4.0	2.0	2.0	1.0	1.0	1.0	1.0	2.5	2.0
Local adjustment factor	0.91	0.91	0.97	0.98						
% left turns					12	12	12	12	12	12
% right turns					12	12	12	12	12	12
CONTROL CHARACTERISTICS										
Number of signals					4	4	10	10	4	6
Arrival type (1-6)					3	3	4	4	4	4
Signal type (a, c, p)					c	c	c	c	c	c
Cycle length (C)					120	150	120	120	120	120
Effective green ratio (g/C)					0.44	0.45	0.44	0.44	0.44	0.44
MULTIMODAL CHARACTERISTICS										
Paved shoulder/bicycle lane (n, y)									n, 50%, y	n
Outside lane width (n, t, w)									t	t
Pavement condition (d, t, u)									t	
On-street parking (n, y)										
Sidewalk (n, y)										n, 50%, y
Sidewalk/roadway separation(n, t, w)										t
Sidewalk protective barrier (n, y)										n

LEVEL OF SERVICE THRESHOLDS

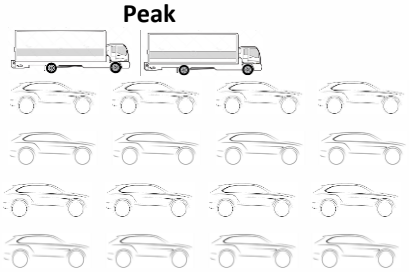
Level of Service	Freeways: Density	Highways: Two-Lane %ffs	Highways: Multilane Density	Arterials: Class I atr	Arterials: Class II atr	Bicycle: Score	Ped: Score	Bus: Buses/hr.
B	≤ 17	> 83.3	≤ 17	> 31 mph	> 22 mph	≤ 2.75	≤ 2.75	≤ 6
C	≤ 24	> 75.0	≤ 24	> 23 mph	> 17 mph	≤ 3.50	≤ 3.50	≤ 4
D	≤ 31	> 66.7	≤ 31	> 18 mph	> 13 mph	≤ 4.25	≤ 4.25	< 3
E	≤ 39	> 58.3	≤ 35	> 15 mph	> 10 mph	≤ 5.00	≤ 5.00	< 2

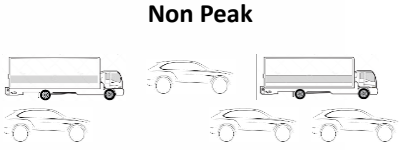
*: ffs = Percent free flow speed atr = Average travel speed

2012 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK TABLES

Why do we recommend ½ of daily trucks?

- During Peak Hour
  - More passenger vehicles
  - Same or slightly fewer trucks





Data Sources

Example 1

Answers

- Area Type = _____
- AADT = _____
- K-Factor = _____
- D-Factor = _____
- Peak Direction = _____
- % Heavy Vehicles = _____

101

Data Sources

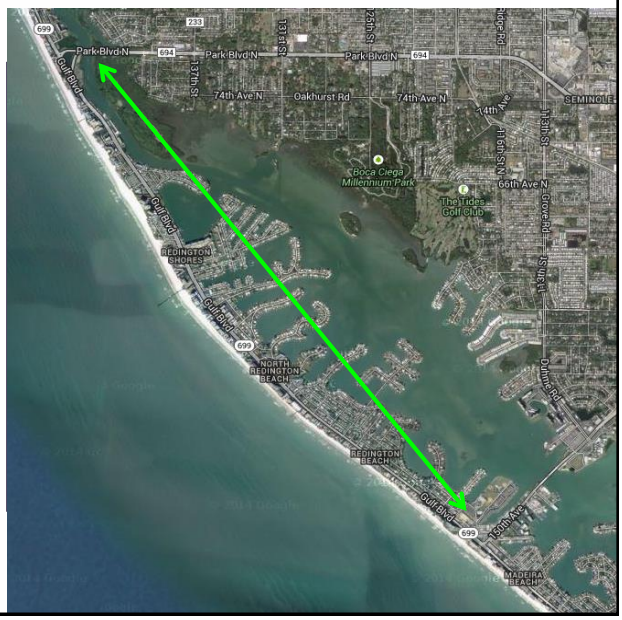
Workshop 1

SR 699

- Between Park Blvd and SR 666
- Redington Beach (D7 – north of Madera Beach)

Identify:

- Area Type
- AADT, K-Factor, D-Factor
- Peak Direction
- % Heavy Vehicles



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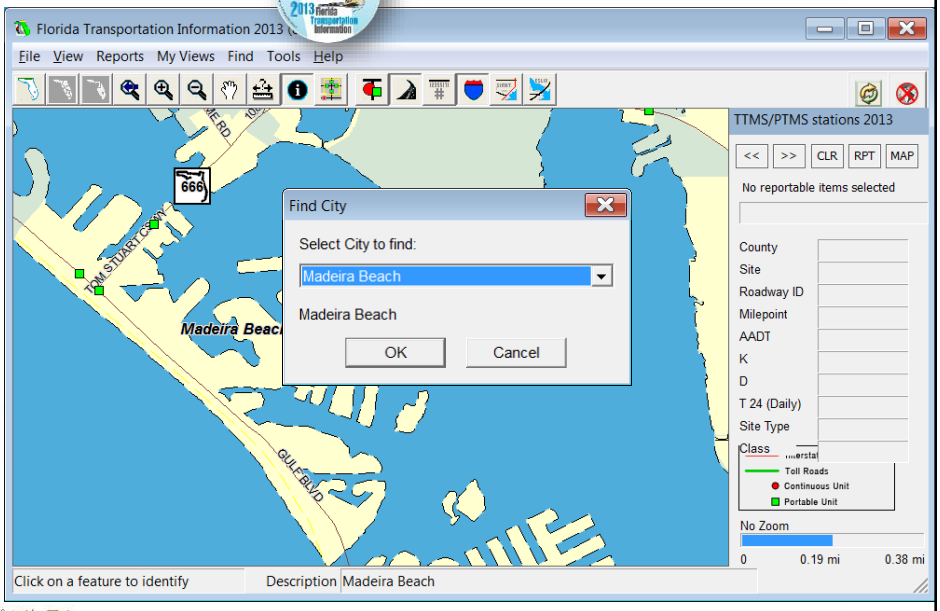
Data Sources

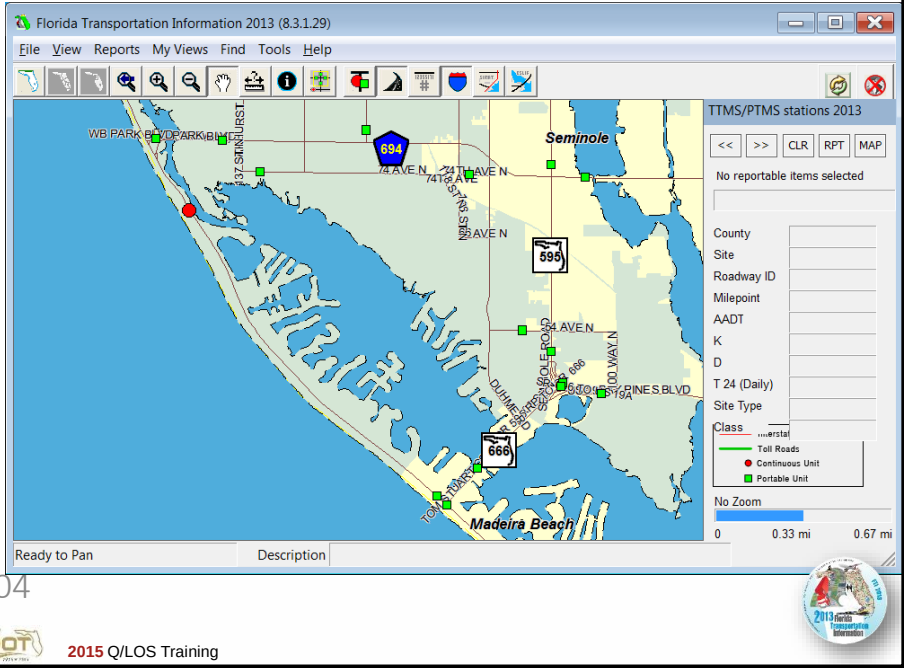
Workshop 1



2015 Q/LOS Training

Data Sources

Workshop 1



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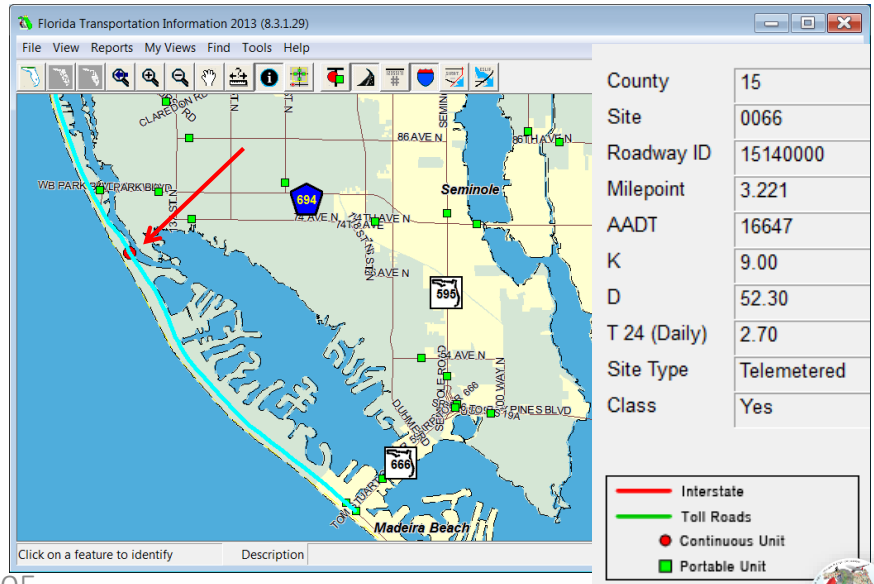
2015 Q/LOS Training

Data Sources

Workshop 1



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Data Sources

Workshop 1

TrafficInfo -- Report Print Preview

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Florida Department of Transportation
Transportation Statistics Office
2013 Historical AADT Report

County: 15 - PINELLAS

Site: 0066 - SR-699(GULF BLVD),110' N OF 183 AVE W,PINELLAS CO.

Year	AADT	Direction 1	Direction 2	*K Factor	D Factor
2013	16647 C	N 8475	S 8172	9.00	52.30
2012	16868 C	N 8550	S 8318	9.00	52.30
2011	16693 C	N 8461	S 8232	9.00	53.00
2010	17247 C	N 8756	S 8491	10.72	54.73
2009	16700 C	N 8461	S 8239	10.72	54.73
2008	16302 C	N 8247	S 8055	10.68	52.60
2007	17677 C	N 8943	S 8734	10.11	59.91

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Data Sources

Workshop 1

Answers

- Area Type = _____
- AADT = _____
- K-Factor = _____
- D-Factor = _____
- Peak Direction = _____
- % Heavy Vehicles = _____

107

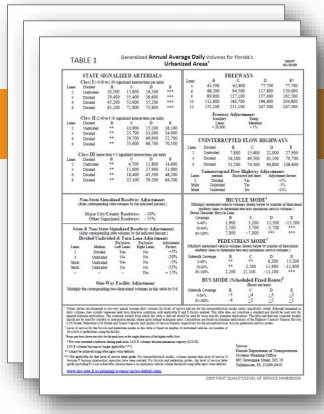
Format of the Training Modules

- Explain the program's uses
- Identify strengths and limitations
- Identify when other tools should be used
- Required inputs
- Example problem(s)
  - Sensitivity example
- Workshops

108

Generalized Service Volume Tables

Generalized Service Volume Tables



Agenda Item 4

Generalized Service Volume Tables

Generalized Service Volume Tables

- Provide a rough estimate of capacity and LOS
- Use the same rules as LOSPLAN software and the Q/LOS Handbook
- FDOT supported and statewide acceptable for **PLANNING** only

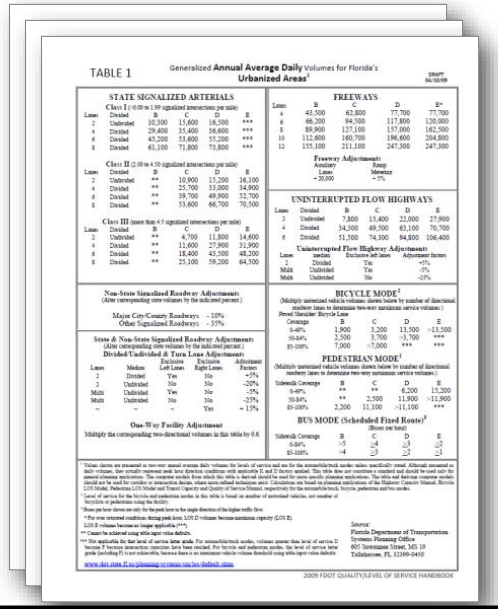


TABLE 1

Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**[1]

DRAFT 04/10/09

STATE SIGNALIZED ARTERIALS

Class I (≥ 0.00 to 1.99 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	10,300	15,600	16,500	***
4	Divided	29,400	35,400	36,600	***
6	Divided	45,200	53,600	55,200	***
8	Divided	61,100	71,800	73,800	***

Class II (2.00 to 4.59 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	**	10,900	15,200	16,100
4	Divided	**	25,700	33,200	34,900
6	Divided	**	39,700	49,900	52,700
8	Divided	**	53,600	66,700	70,500

Class III (more than 4.5 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	**	4,700	11,800	14,600
4	Divided	**	11,600	27,900	31,900
6	Divided	**	18,400	43,500	48,200
8	Divided	**	25,100	59,200	64,500

Non-State Signalized Roadway Adjustment:
(Alter corresponding state volumes by the indicated percent.)

Major City/County Roadways: - 10%
Other Signalized Roadways: - 35%

State & Non-State Signalized Roadway Adjustment:
(Alter corresponding state volumes by the indicated percent.)

Divided/Undivided & Turn Lanes Adjustment:

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	-5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
--	--	--	Yes	+ 15%

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6.

FREEWAYS

Lanes	B	C	D	E*
4	43,500	62,800	77,700	77,700
6	66,200	94,500	117,800	120,000
8	89,900	127,100	157,000	162,500
10	112,600	160,700	196,600	204,800
12	135,100	211,100	247,300	247,300

Freeway Adjustments:

Auxiliary Lanes	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	B	C	D	E
2	Undivided	7,800	15,400	22,000	27,900
4	Divided	34,100	49,500	63,100	70,700
6	Divided	51,500	74,300	94,800	106,400

Uninterrupted Flow Highway Adjustment:

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

BICYCLE MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way motorized service volumes.)

Paved Shoulder/Bicycle Lane Coverage

	B	C	D	E
0-49%	1,900	3,200	13,500	-13,500
50-84%	2,500	3,700	>3,700	***
85-100%	7,000	>7,000	***	***

PEDESTRIAN MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way motorized service volumes.)

Sidewalk Coverage

	B	C	D	E
0-49%	**	**	6,200	15,200
50-84%	**	2,500	11,900	-11,900
85-100%	2,200	11,100	>11,100	***

BUS MODE (Scheduled Fixed Route)[3]
(Buses per hour)

Sidewalk Coverage

	B	C	D	E
0-84%	>3	>4	>3	>3
85-100%	>4	>3	>2	>3

* Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically noted. Although presented as daily volumes, they actually represent peak hour direction conditions with applicable K and D factors applied. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The tables and data base computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual, Service LOS Models, Federal LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

Buses per hour shown are only for the peak hour in the single direction of the higher traffic flow.

* Pre-over saturated conditions: during peak hour, LOS D volumes become maximum capacity (LOS E).
LOS E volumes become no longer applicable (***).

** Cannot be achieved using table input value defaults.

*** Not applicable for that level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not vulnerable, because there is no maximum vehicle volume threshold using table input value defaults.

Source:
Florida Department of Transportation
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450

www.dot.state.fl.us/planning/systems/sm/los/default.shtm

2009 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK

Generalized Service Volume Tables

Generalized Service Volume Tables

Provide **estimates** of maximum service volumes for various Florida roadway types

Represent **average** roadway conditions for the state

Allow analysts to **quickly** and easily estimate LOS from volumes and estimate capacity

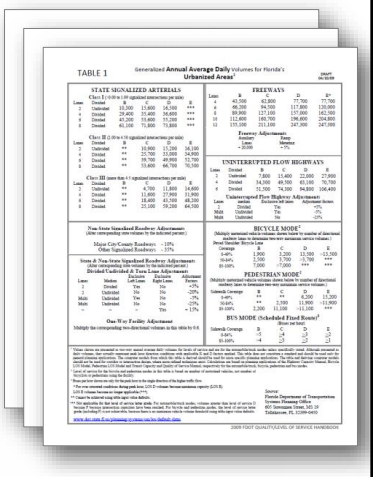


TABLE 1

Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**[1]

STATE SIGNALIZED ARTERIALS

FREEWAYS

UNINTERRUPTED FLOW HIGHWAYS

BICYCLE MODE[2]

PEDESTRIAN MODE[2]

BUS MODE (Scheduled Fixed Route)[2]

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Generalized Service Volume Tables

Generalized Service Volume Tables

Limitations

Results are rough estimates

Simplified planning level assumptions are made, therefore the tables must not be used for actual design or operation of facilities

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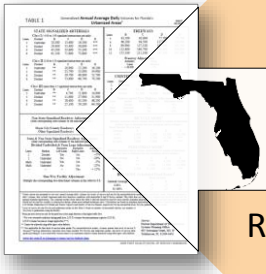
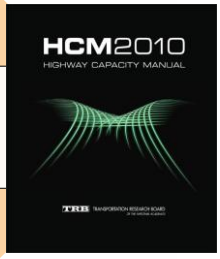
Generalized Service Volume Tables



Assumptions

Reflect typical conditions on Florida roadways



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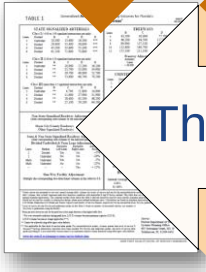
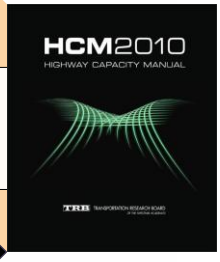
Rural freeways based on UF Research



- Two class system
- Average travel speed

Threshold Differences

Percent base free flow speed



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Generalized Service Volume Tables

LOS Thresholds

Urbanized and Transitioning/Urban

LEVEL OF SERVICE THRESHOLDS

Level of Service	Freeways	Highways		Arterials		Bicycle	Ped	Bus
	Density	Two-Lane %ffs	Multilane Density	Class I ats	Class II ats	Score	Score	Buses/hr.
B	≤ 17	> 83.3	≤ 17	> 31 mph	> 22 mph	≤ 2.75	≤ 2.75	≤ 6
C	≤ 24	> 75.0	≤ 24	> 23 mph	> 17 mph	≤ 3.50	≤ 3.50	≤ 4
D	≤ 31	> 66.7	≤ 31	> 18 mph	> 13 mph	≤ 4.25	≤ 4.25	< 3
E	≤ 39	> 58.3	≤ 35	> 15 mph	> 10 mph	≤ 5.00	≤ 5.00	< 2

% ffs = Percent free flow speed ats = Average travel speed

Rural

LEVEL OF SERVICE THRESHOLDS

Level of Service	Freeways	Highways				
		Two-Lane ru		Two-Lane rd	Multilane ru	Multilane rd
	Density	%tsf	ats	%ffs	Density	Density
B	≤ 14	≤ 50	≤ 55	> 83.3	≤ 14	≤ 14
C	≤ 22	≤ 65	≤ 50	> 75.0	≤ 22	≤ 22
D	≤ 29	≤ 80	≤ 45	> 66.7	≤ 29	≤ 29
E	≤ 36	> 80	≤ 40	> 58.3	≤ 34	≤ 34

Level of Service	Arterials	Bicycle	Pedestrian
	Major City/Co.(ats)	Score	Score
B	> 31 mph	≤ 2.75	≤ 2.75
C	> 23 mph	≤ 3.50	≤ 3.50
D	> 18 mph	≤ 4.25	≤ 4.25
E	> 15 mph	≤ 5.00	≤ 5.00

%tsf = Percent time spent following %ffs = Percent of free flow speed ats = Average travel speed ru = Rural undeveloped rd = Rural developed

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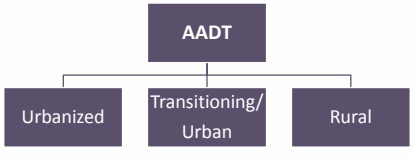
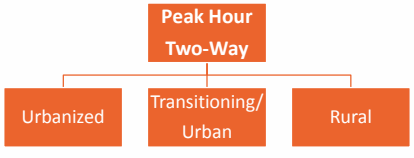
Generalized Service Volume Tables

Table Format

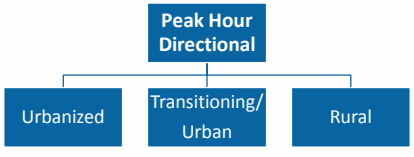
Tables 1-3



Tables 4-6



Tables 7-9



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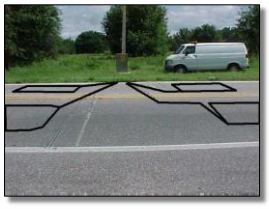
Generalized Service Volume Tables

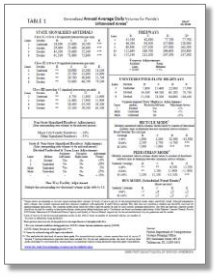
How the Tables Were Developed

Collect Traffic Data → Calculate Values → Publish Tables

From roadways around the state



Using LOSPLAN and generalized assumed values for variables



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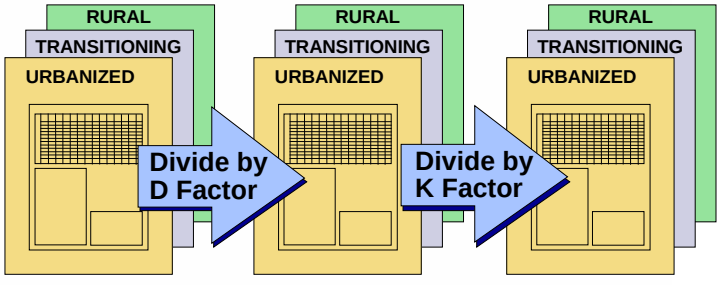
Organization of the Tables

Peak Hour Directional Volumes

Two-Way Peak Hour Volumes

Two-Way AADT Volumes



The sets of Generalized Tables are internally consistent; all are based on peak hour peak direction analysis

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Generalized Service Volume Tables

Most Important Generalized Assumptions

Standard K	Peak Hour Factor (PHF) = 1.0	Directional Distribution Factor (D)
• Urbanized and Transitioning Area Standard K = 0.09 • *except* core freeways = 0.085 • Rural Area Standard K = 0.095 • *except* rural freeways = 0.105		• Ranges from .547 for urbanized freeways to .555 in rural areas • Ranges from .57 for transitioning arterials to .55 elsewhere.

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Generalized Service Volume Tables

Table Footnote Abbreviations

Level of Service	Arterials Major City/Co.(ats)	Bicycle Score	Pedestrian Score
B	> 31 mph	≤ 2.75	≤ 2.75
C	> 23 mph	≤ 3.50	≤ 3.50
D	> 18 mph	≤ 4.25	≤ 4.25
E	> 15 mph	≤ 5.00	≤ 5.00

%tsf = Percent time spent following | %ffs = Percent of free flow speed | ats = Average travel speed | ru = Rural undeveloped | rd = Rural developed

% tsf = Percent time spent following

% ffs = Percent of free flow speed

ats = Average travel speed

ru = Rural undeveloped

rd = Rural developed

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Generalized Service Volume Tables

Table Footnote Abbreviations

Level of Service	Arterials Major City/Co.(ats)
B	> 31 mph
C	> 23 mph
D	> 18 mph
E	> 15 mph

% tsf = Percent time spent following

% ffs = Percent of free flow speed

ats = Average travel speed

ru = Rural undeveloped

rd = Rural developed

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Generalized Service Volume Tables

Table Footnote Abbreviations

Bicycle Score	Pedestrian Score
≤ 2.75	≤ 2.75
≤ 3.50	≤ 3.50
≤ 4.25	≤ 4.25
≤ 5.00	≤ 5.00

% tsf = Percent time spent following

% ffs = Percent of free flow speed

ats = Average travel speed

ru = Rural undeveloped

rd = Rural developed

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Generalized Service Volume Tables

Roadway Variables

Num. of Lanes (both dir.) 2 — Left Turn/Blockage Impact

Terrain Level — Median

Posted Speed 55 — Passing Lanes

Free-Flow Speed 60 — Passing Lane Length 0.0

Segment Length 10.0 — % No Passing Zones 20

Traffic Variables

AADT 7000 — Peak Dir. Hr. Vol. 366

K factor (%) 9.5 — Off-peak Dir. Hr. Vol. 295

D factor (%) 55.0 — % Heavy Vehicles 5.0

PHF 1.000

For the variables highlighted in blue, local value

TABLE 3 (continued)
Generalized **Annual Average Daily** Volumes for Florida's
Rural Undeveloped Areas and
Developed Areas Less Than 5,000 Population

INPUT VALUE ASSUMPTIONS	Uninterrupted Flow Facilities: Freeways	Uninterrupted Flow Facilities: Highways				Interrupted Flow Facilities: Arterials		Bicycle		Pedestrian
ROADWAY CHARACTERISTICS										
Area type (ru, rd)	rural	ru	ru	rd	rd	rd	rd	ru	rd	rd
Number of through lanes (both dir.)	4-8	2	4-6	2	4-6	2	4-6	4	4	2
Posted speed (mph)	70	55	65	50	55	45	45	55	45	45
Free flow speed (mph)	75	60	70	55	60	50	50	60	50	50
Auxiliary lanes (n,y)	n									
Median (n, nr, r)		n	r	n	r	n	r	r	r	n
Terrain (l,r)	1	1	1	1	1	1	1	1	1	1
% no passing zone		20		60						
Exclusive left turn lanes (n, y)		[n]	y	[n]	y	y	y	y	y	y
Exclusive right turn lanes (n, y)						n	n	n	n	n
Facility length (mi)	14	10	10	5	5	1.9	2.2	4	2	2
Number of basic segments	4									
TRAFFIC CHARACTERISTICS										
Planning analysis hour factor (K)	0.105	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095
Directional distribution factor (D)	0.555	0.550	0.550	0.550	0.550	0.550	0.550	0.570	0.570	0.550
Peak hour factor (PHF)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Base saturation flow rate (pcphpl)		1,700	2,300	1,700	2,100	1,910	1,910	1,910	1,910	1,910
Heavy vehicle percent	12.0	5.0	12.0	4.0	4.0	3.0	3.0	6.0	3.5	3.0
Local adjustment factor	0.84	0.88	0.73	0.97	0.82					
% left turns						12	12		12	12
% right turns						12	12		12	12
CONTROL CHARACTERISTICS										
Number of signals						5	6	2	4	4
Arrival type (1-6)						3	3	3	3	3
Signal type (a, c, y)						c	c	a	a	a
Cycle length (C)						90	90	60	90	90
Effective green ratio (g/C)						0.44	0.44	0.37	0.44	0.44

INPUT VALUE ASSUMPTIONS	Uninterrupted Flow Facilities: Freeways	Highways			
ROADWAY CHARACTERISTICS		Rural Undeveloped			
Area type (ru, rd)	rural	ru	ru	rd	rd
Number of through lanes (both dir.)	4-8	2	4-6	2	4-6
Posted speed (mph)	70	55	65	50	55
Free flow speed (mph)	75	60	70	55	60
Auxiliary lanes (n,y)	n				
Median (n, nr, r)		n	r	n	r
Terrain (l,r)	1	1	1	1	1
% no passing zone		20		60	
Exclusive left turn lanes (n, y)		[n]	y	[n]	y
Exclusive right turn lanes (n, y)					
Facility length (mi)	14	10	10	5	5
Number of basic segments	4				

Generalized Service Volume Tables

Service Volumes From **HIGH**PLAN

Lanes	Annual Average Daily Traffic				
	A	B	C	D	E
2	2600	4700	8400	14300	28600

TABLE 3
Generalized **Annual Average Daily** Volumes for Florida's
Rural Undeveloped Areas and
Developed Areas Less Than 5,000 Population

INTERRUPTED FLOW FACILITIES — UNINTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Lanes	Median	B	C	D	E
2	Undivided	*	12,900	14,200	**
4	Divided	*	29,300	30,400	**
6	Divided	*	45,200	45,800	**

FREEWAYS

Lanes	B	C	D	E
4	28,800	43,000	52,300	60,000
6	43,000	64,000	78,300	92,500
8	57,500	85,400	104,400	123,500

Non-State Signalized Roadway Adjustments
(Alter corresponding raw volumes by the indicated percent.)
Non-State Signalized Roadways ±10%

Freeway Adjustments
Auxiliary Lanes
Present in Both Directions ± 20,000

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6

UNINTERRUPTED FLOW HIGHWAYS
Rural Undeveloped

Lanes	Median	B	C	D	E
2	Undivided	4,700	8,400	14,300	28,600
4	Divided	25,700	40,300	51,000	57,900
6	Divided	38,800	60,400	76,700	86,800

Developed Areas

Lanes	Median	B	C	D	E
2	Undivided	8,700	16,400	23,100	31,500
4	Divided	25,900	40,700	52,400	59,600

0-49% * * 2,100 9,200
50-84% * 1,500 8,400 14,900
85-100% 3,600 10,200 16,700 >19,200

Source: Florida Department of Transportation, Systems Planning Office
www.dot.state.fl.us/planning/systems/sm/los/default.shtm

2012 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK TABLES

UNINTERRUPTED FLOW HIGHWAYS

Rural Undeveloped

Lanes	Median	B	C	D	E
2	Undivided	4,700	8,400	14,300	28,600
4	Divided	25,700	40,300	51,000	57,900
6	Divided	38,800	60,400	76,700	86,800

Generalized Service Volume Tables

Asterisks on the Tables

TABLE 1 Urb

INTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	16,800	17,700	**
4	Divided	*	37,900	39,800	**
6	Divided	*	58,400	59,900	**
8	Divided	*	78,800	80,100	**

* Cannot be achieved using table input value defaults.

** Not applicable for that level of service letter grade. For the automobile mode, volumes greater than level of service D become F because intersection capacities have been reached. For the bicycle mode, the level of service letter grade (including F) is not achievable because there is no maximum vehicle volume threshold using table input value defaults.

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Generalized Service Volume Tables

Process for Using Tables

Determine time period of traffic volumes

- Annual Average Daily
- Peak Hour Two-Way
- Peak Hour Directional

Determine area type

- Urbanized
- Transitioning/ Urban
- Rural
  - Developed
  - Undeveloped

Determine mode

- Automobile
- Bicycle
- Pedestrian
- Bus

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Generalized Service Volume Tables

Process for Using Tables

Automobile Mode

Key Variables

- Facility Type
- Number and type of lanes

Bicycle Mode

Key Variables

- Paved shoulder/ bicycle lane coverage
- Number of motorized vehicles

Pedestrian Mode

Key Variables

- Sidewalk coverage
- Number of motorized vehicles

Bus Mode

Key Variables

- Bus frequency
- Sidewalk coverage

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Generalized Service Volume Tables

Example 1.A

Determine the max. service volume for LOS E:

- In terms of AADT
- In a core urbanized area
- For a 8-lane freeway

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2015 Q/LOS Training

I-4 Through Orlando, FL

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Generalized Service Volume Tables

Example 1.A

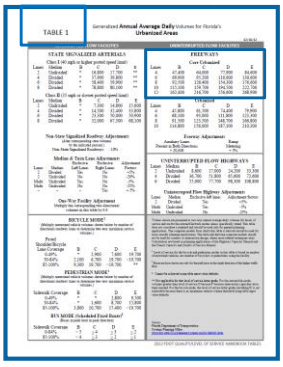
Determine the max. service volume for LOS E:

- In terms of AADT
- In a core urbanized area
- For a 8-lane freeway

FREEWAYS

Core Urbanized

Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900



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Generalized Service Volume Tables

Freeways

FREEWAYS				
Core Urbanized				
Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900
Urbanized				
Lanes	B	C	D	E
4	45,800	61,500	74,400	79,900
6	68,100	93,000	111,800	123,300
8	91,500	123,500	148,700	166,800
10	114,800	156,000	187,100	210,300

Freeway Adjustments	
Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

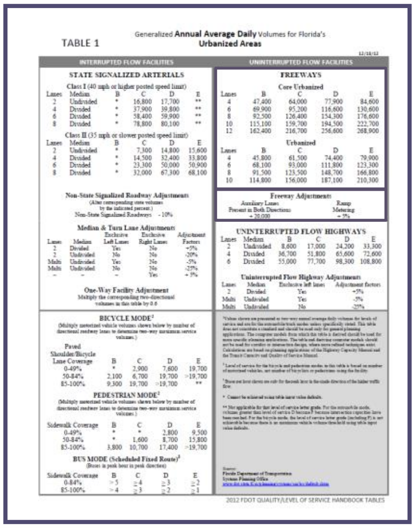
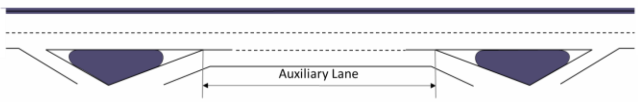


TABLE 1
Generalized Annual Average Daily Volumes for Florida's Urbanized Areas



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Generalized Service Volume Tables

Example 1.B

Determine the max. service volume for LOS E:

- In terms of AADT
- In a core urbanized area
- For a 8-lane freeway
- Auxiliary lanes in both directions

FREEWAYS				
Core Urbanized				
Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900

Freeway Adjustments	
Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

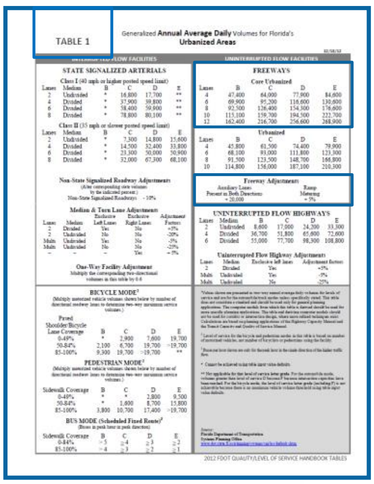
TABLE 1
Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

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Generalized Service Volume Tables

Example 2.A

Determine the auto LOS:

- In terms of peak hour directional volumes
- In a rural undeveloped area
- For an uninterrupted flow highway with:
  - 2 lanes (one in each direction)
  - No median/undivided
  - No passing lanes
  - Peak hour directional volume is 440

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Generalized Service Volume Tables

Example 2.A

Determine the auto LOS:

- In terms of peak hour directional volumes
- In a rural undeveloped area
- For an uninterrupted flow highway with:
  - 2 lanes (one in each direction)
  - No median/undivided
  - No passing lanes
  - Peak hour directional volume is 450

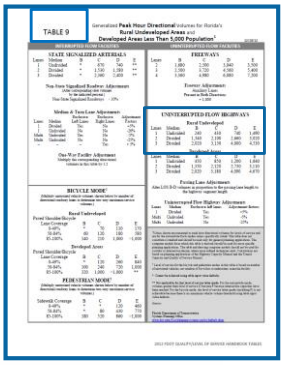
TABLE 9

UNINTERRUPTED FLOW HIGHWAYS

Rural Undeveloped

Lanes	Median	B	C	D	E
1	Undivided	240	430	740	1,490
2	Divided	1,340	2,100	2,660	3,020
3	Divided	2,020	3,150	4,000	4,530

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Generalized Service Volume Tables

Example 2.B

Determine the auto LOS:

- In terms of peak hour directional volumes
- In a rural undeveloped area
- For an uninterrupted flow highway with:
  - 2 lanes (one in each direction)
  - 20% passing lane
  - No median/undivided
  - Peak hour directional volume is 450

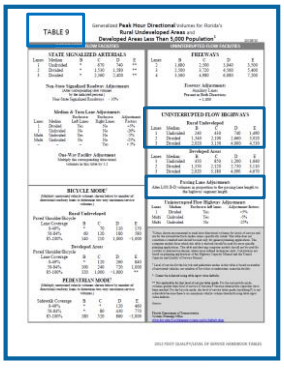
TABLE 9

UNINTERRUPTED FLOW HIGHWAYS

Rural Undeveloped

Lanes	Median	B	C	D	E
1	Undivided	240	430	740	1,490
2	Divided	1,340	2,100	2,660	3,020
3	Divided	2,020	3,150	4,000	4,530

Passing Lane Adjustments
Alter LOS B-D volumes in proportion to the passing lane length to the highway segment length

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Generalized Service Volume Tables

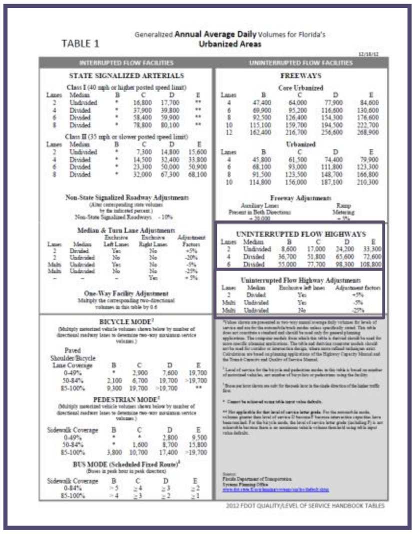
Uninterrupted Flow Highways

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,600	17,000	24,200	33,300
4	Divided	36,700	51,800	65,600	72,600
6	Divided	55,000	77,700	98,300	108,800

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%



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2015 Q/LOS Training

Generalized Service Volume Tables

Other Adjustments

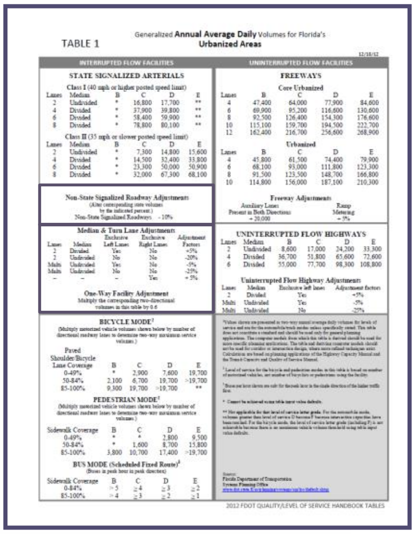
- Non-State Signalized Roadways
- Divided/ Undivided
- Turn Lanes
- One-Way

Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes
by the indicated percent.)
Non-State Signalized Roadways - 10%

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment
Multiply the corresponding two-directional
volumes in this table by 0.6



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Adjustments for State and Non-State Signalized Roadways

2015 Q/LOS Training

Generalized Service Volume Tables

Example 3

Determine the auto LOS:

- In terms of peak hour directional volumes
- In an urban/transitioning area
- For a non-state signalized roadway with:
  - 45 mph speed limit
  - 6 lanes (3 in each direction)
  - Peak hour directional volume of 2,500

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Generalized Service Volume Tables

Example 3

Determine the auto LOS:

- In terms of peak hour directional volumes
- In an urban/transitioning area
- For a non-state signalized roadway with:
  - 45 mph speed limit
  - 6 lanes (3 in each direction)
  - Peak hour directional volume of 2,500

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
1	Undivided	*	710	800	**
2	Divided	*	1,740	1,820	**
3	Divided	*	2,670	2,740	**

Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes by the indicated percent.)
Non-State Signalized Roadways - 10%

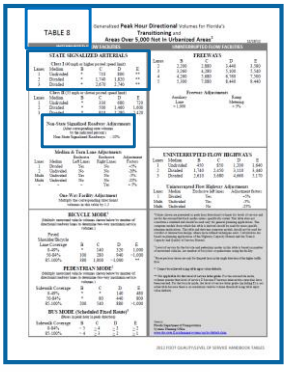
TABLE 8

STATE SIGNALIZED ARTERIALS

FREEWAYS

UNINTERRUPTED FLOW HIGHWAYS

BICYCLE MODE

PEDESTRIAN MODE

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Generalized Service Volume Tables

Multimodal LOS

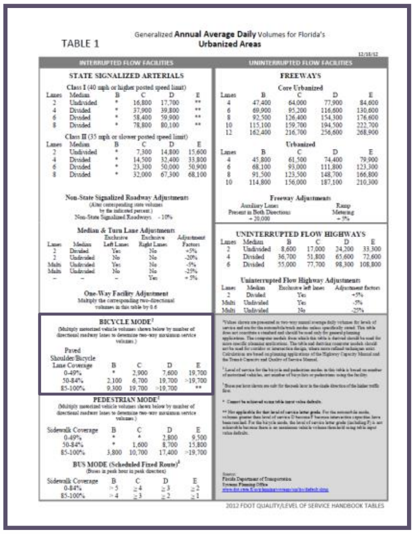

TABLE 1

Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**

12/18/12

INTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	16,800	17,700	**
4	Divided	*	37,900	39,800	**
6	Divided	*	58,400	59,900	**
8	Divided	*	78,800	80,100	**

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	7,300	14,800	15,600
4	Divided	*	14,500	32,400	33,800
6	Divided	*	23,300	50,000	50,900
8	Divided	*	32,000	67,300	68,100

Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes by the indicated percent.)
Non-State Signalized Roadways - 10%

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6

BICYCLE MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/Bicycle Lane Coverage	B	C	D	E
0-49%	*	2,900	7,600	19,700
50-84%	2,100	6,700	19,700	>19,700
85-100%	9,300	19,700	>19,700	**

PEDESTRIAN MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	*	*	2,800	9,500
50-84%	*	1,600	8,700	15,800
85-100%	3,800	10,700	17,400	>19,700

BUS MODE (Scheduled Fixed Route)[3]
(Buses in peak hour in peak direction)

Sidewalk Coverage	B	C	D	E
0-84%	> 5	≥ 4	≥ 3	≥ 2
85-100%	> 4	≥ 3	≥ 2	≥ 1

UNINTERRUPTED FLOW FACILITIES

FREEWAYS

Core Urbanized

Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900

Urbanized

Lanes	B	C	D	E
4	45,800	61,500	74,400	79,900
6	68,100	93,000	111,800	123,300
8	91,500	123,500	148,700	166,800
10	114,800	156,000	187,100	210,300

Freeway Adjustments

Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,600	17,000	24,200	33,300
4	Divided	36,700	51,800	65,600	72,600
6	Divided	55,000	77,700	98,300	108,800

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

Source:
Florida Department of Transportation
Systems Planning Office

2012 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK TABLES

Bicycle Mode

Based on:

- Paved shoulder/bicycle lane coverage
- Number of motorized vehicles

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Generalized Service Volume Tables

Multimodal LOS

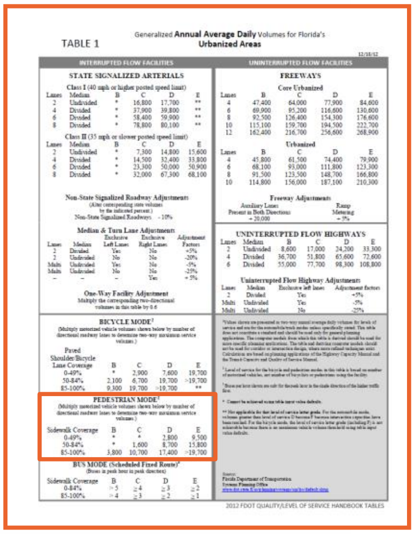

TABLE 1

Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

(Same table as reproduced above for slide 141, with the Pedestrian Mode section highlighted.)

Pedestrian Mode

Based on:

- Sidewalk coverage
- Number of motorized vehicles

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Generalized Service Volume Tables

Multimodal LOS

Bus Mode

Based on:

- Bus frequency
- Sidewalk coverage

TABLE 1

Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**

12/18/12

INTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	16,800	17,700	**
4	Divided	*	37,900	39,800	**
6	Divided	*	58,400	59,900	**
8	Divided	*	78,800	80,100	**

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	7,300	14,800	15,600
4	Divided	*	14,500	32,400	33,800
6	Divided	*	23,300	50,000	50,900
8	Divided	*	32,000	67,300	68,100

Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes by the indicated percent.)
Non-State Signalized Roadways - 10%

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6

BICYCLE MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/Bicycle Lane Coverage	B	C	D	E
0-49%	*	2,900	7,600	19,700
50-84%	2,100	6,700	19,700	>19,700
85-100%	9,300	19,700	>19,700	**

PEDESTRIAN MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	*	*	2,800	9,500
50-84%	*	1,600	8,700	15,800
85-100%	3,800	10,700	17,400	>19,700

BUS MODE (Scheduled Fixed Route)[3]
(Buses in peak hour in peak direction)

Sidewalk Coverage	B	C	D	E
0-84%	> 5	≥ 4	≥ 3	≥ 2
85-100%	> 4	≥ 3	≥ 2	≥ 1

UNINTERRUPTED FLOW FACILITIES

FREEWAYS

Core Urbanized

Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900

Urbanized

Lanes	B	C	D	E
4	45,800	61,500	74,400	79,900
6	68,100	93,000	111,800	123,300
8	91,500	123,500	148,700	166,800
10	114,800	156,000	187,100	210,300

Freeway Adjustments

Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,600	17,000	24,200	33,300
4	Divided	36,700	51,800	65,600	72,600
6	Divided	55,000	77,700	98,300	108,800

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

Source:
Florida Department of Transportation
Systems Planning Office

2012 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK TABLES

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2015 Q/LOS Training

Generalized Service Volume Tables

Example 4

Determine the bicycle, pedestrian, and bus LOS:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with:
  - 2 lanes
  - AADT=13,000
  - 3 buses/hour
  - 90% bike lane coverage
  - 40% sidewalk coverage

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2015 Q/LOS Training

Generalized Service Volume Tables

Example 4.A

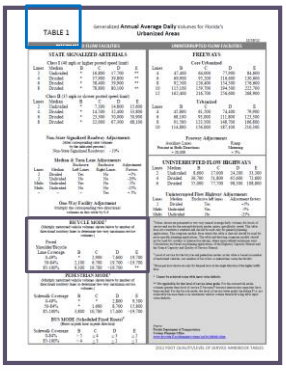
Determine the bicycle LOS:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with:
  - 2 lanes
  - AADT=13,000
  - 3 buses/hour
  - 90% bike lane coverage
  - 40% sidewalk coverage

BICYCLE MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/Bicycle Lane Coverage	B	C	D	E
0-49%	*	2,900	7,600	19,700
50-84%	2,100	6,700	19,700	>19,700
85-100%	9,300	19,700	>19,700	**



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Generalized Service Volume Tables

Example 4.B

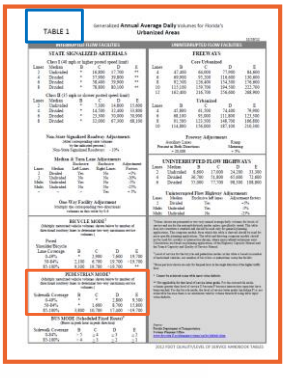
Determine the pedestrian LOS:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with:
  - 2 lanes
  - AADT=13,000
  - 3 buses/hour
  - 90% bike lane coverage
  - 40% sidewalk coverage

PEDESTRIAN MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	*	*	2,800	9,500
50-84%	*	1,600	8,700	15,800
85-100%	3,800	10,700	17,400	>19,700



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Generalized Service Volume Tables

Example 4.C

Determine the bus LOS:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with:
  - 2 lanes
  - AADT=13,000
  - 3 buses/hour
  - 90% bike lane coverage
  - 40% sidewalk coverage

BUS MODE (Scheduled Fixed Route)[3]
(Buses in peak hour in peak direction)

Sidewalk Coverage	B	C	D	E
0-84%	> 5	≥ 4	≥ 3	≥ 2
85-100%	> 4	≥ 3	≥ 2	≥ 1

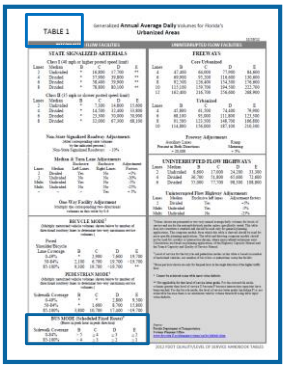
TABLE 1
Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

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Generalized Service Volume Tables

Example 5

Determine the auto LOS:

- In terms of AADT
- In an urban/transitioning area (pop. 12,000)
- For an undivided state arterial with:
  - 30 mph speed limit
  - 2 lanes
  - 6,000 AADT
  - No left turn lanes

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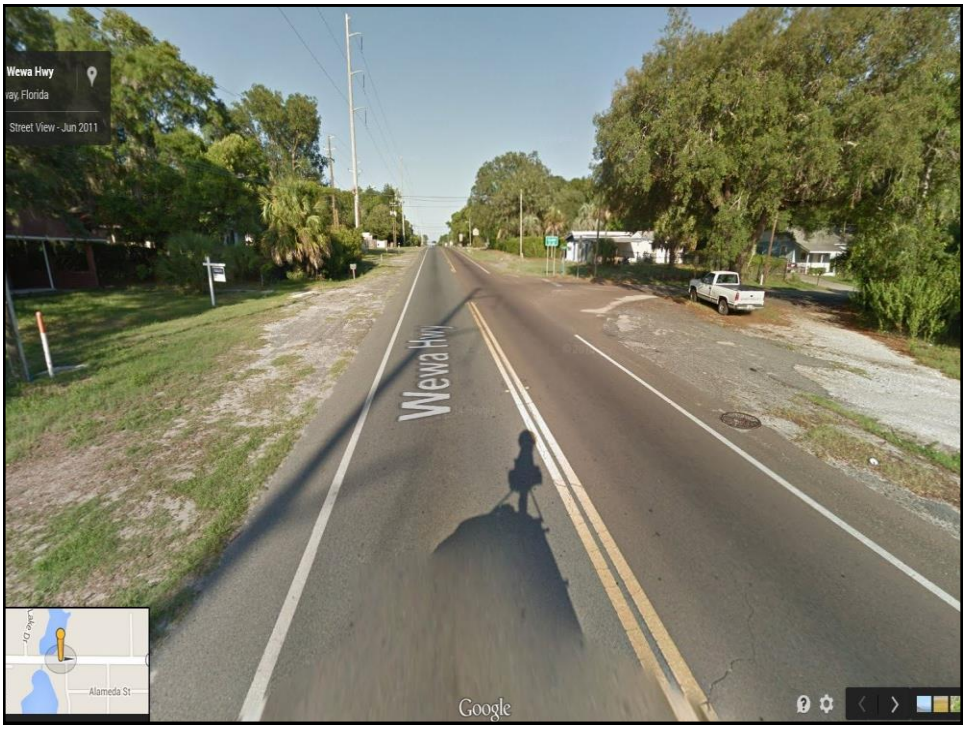

Generalized Service Volume Tables

Example 5

Determine the auto LOS:

- In terms of AADT
- In an urban/transitioning area (pop. 12,000)
- For an undivided state arterial with:
  - 30 mph speed limit
  - No left turn lanes
  - 2 lanes
  - 6,000 AADT

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	6,500	13,300	14,200
4	Divided	*	9,900	28,800	31,600
6	Divided	*	16,000	44,900	47,600

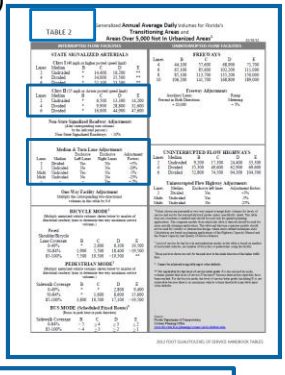
TABLE 2

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

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2015 Q/LOS Training

Generalized Service Volume Tables

Example 6

Determine the auto LOS:

- In terms of AADT
- In an urban/transitioning area
- For a state signalized arterial with:
  - 4 lanes
  - No median
  - 35 mph speed limit
  - Exclusive left turn lanes
  - AADT of 28,000

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Generalized Service Volume Tables

Example 6

Determine the auto LOS:

- In terms of AADT
- In an urban/transitioning area
- For a state signalized arterial with:
  - 4 lanes
  - No median
  - 35 mph speed limit
  - Exclusive left turn lanes
  - AADT of 28,000

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	6,500	13,300	14,200
4	Divided	*	9,900	28,800	31,600
6	Divided	*	16,000	44,900	47,600

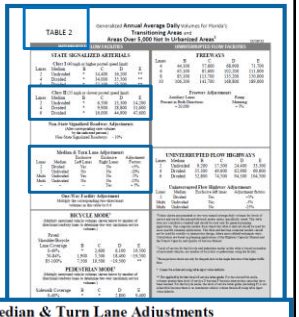
TABLE 2

Generalized Annual Average Daily Volumes for Florida's Transitioning Areas and Areas Over 5,000 Not in Urbanized Areas

STATE SIGNALIZED ARTERIALS

FREEWAYS

UNINTERRUPTED FLOW HIGHWAYS

Median & Turn Lane Adjustment

BICYCLE MODE

PEDESTRIAN MODE

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
—	—	—	Yes	+ 5%

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2015 Q/LOS Training

Generalized Service Volume Tables

Example 7

Determine the max. service volume for LOS E:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with
  - One-way
  - 30 mph speed limit
  - 2 lanes in travel direction

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Generalized Service Volume Tables

Example 7

Determine the max. service volume for LOS E:

- In terms of AADT
- In an urbanized area
- For a state signalized arterial with
  - One-way
  - 30 mph speed limit
  - 2 lanes in travel direction

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	7,300	14,800	15,600
4	Divided	*	14,500	32,400	33,800
6	Divided	*	23,300	50,000	50,900
8	Divided	*	32,000	67,300	68,100

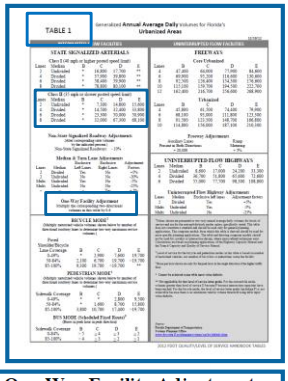
TABLE 1

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6

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2015 Q/LOS Training

Generalized Service Volume Tables

Local Government can Create Own Tables

- Lookup table for local system
- Lee County

Lee County
Generalized Peak Hour Directional Service Volumes
Urbanized Areas

Sept. 2013 c:\input4

Uninterrupted Flow Highway
Level of Service

Lane	Divided	A	B	C	D	E
1	Undivided	120	420	840	1,190	1,640
2	Divided	1,060	1,810	2,560	3,240	3,590
3	Divided	1,600	2,720	3,840	4,860	5,380

Arterials
Class I (40 mph or higher posted speed limit)
Level of Service

Lane	Divided	A	B	C	D	E
1	Undivided	*	140	800	860	860
2	Divided	*	260	1,840	1,960	1,960
3	Divided	*	410	2,840	2,940	2,940
4	Divided	*	550	3,840	3,940	3,940

Class II (35 mph or slower posted speed limit)
Level of Service

Lane	Divided	A	B	C	D	E
1	Undivided	*	*	330	710	780
2	Divided	*	*	710	1,590	1,660
3	Divided	*	*	1,150	2,450	2,500
4	Divided	*	*	1,580	3,310	3,340

Controlled Access Facilities
Level of Service

Lane	Divided	A	B	C	D	E
1	Undivided	*	160	880	940	940
2	Divided	*	270	1,970	2,100	2,100
3	Divided	*	430	3,050	3,180	3,180

Collectors
Level of Service

Lane	Divided	A	B	C	D	E
1	Undivided	*	*	310	670	740
1	Divided	*	*	330	710	780
2	Undivided	*	*	740	1,460	1,460
2	Divided	*	*	780	1,530	1,530

Note: the service volumes for I-75 (freeway), bicycle mode, pedestrian mode, and bus mode should be from FDOT's most current version of LOS Handbook.

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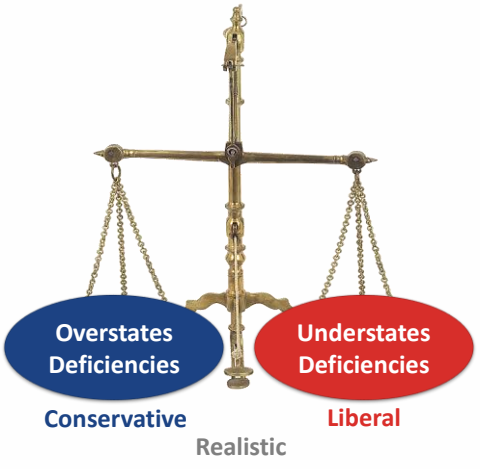
Generalized Service Volume Tables

The Tables Are Not Biased



Theoretically, **50%** of roads have higher service volumes while **50%** have lower service volumes

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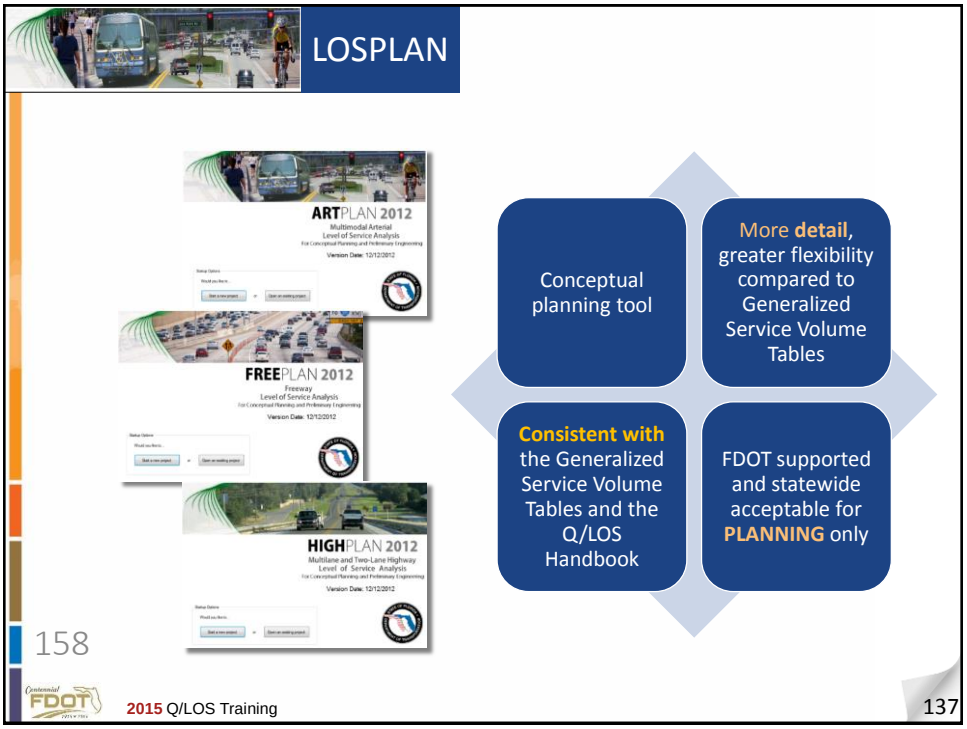
LOSPLAN
HIGHPLAN 2012
Multilane and Two-Lane Highway
Level of Service Analysis
For Conceptual Planning and Preliminary Engineering
Version Date: 12/12/2012
FREEPLAN 2012
Freeway
Level of Service Analysis
For Conceptual Planning and Preliminary Engineering
Version Date: 12/12/2012
Agenda Item 5
ARTPLAN 2012
Multimodal Arterial
Level of Service Analysis
For Conceptual Planning and Preliminary Engineering
Version Date: 12/12/2012
157
2015 Q/LOS Training


LOSPLAN
ARTPLAN 2012
FREEPLAN 2012
HIGHPLAN 2012
Conceptual planning tool
More detail, greater flexibility compared to Generalized Service Volume Tables
Consistent with the Generalized Service Volume Tables and the Q/LOS Handbook
FDOT supported and statewide acceptable for PLANNING only
158
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137

LOSPLAN

Capabilities

- Allows for planning-level multimodal LOS and capacity analysis with minimal input requirements
- Allows "what if" comparisons showing the interactions of modes upon each other
- Provides facility specific service volume tables for auto, bike, pedestrian, and bus based on model inputs

159

LOSPLAN

Limitations

Although considered good generalized and conceptual planning tools

The software programs are not detailed enough for PD&E traffic analysis, final design, or operational analysis work, and should not be used for those purposes

160

Key Differences Between Other Tools

ARTPLAN

- Requires significantly fewer inputs than other tools such as HCS, TRANSYT-7F, and CORSIM
- Uses average travel speed rather than percent base free flow speed as the primary service measure

NUMBER OF INPUTS COMPARISON:

Input	HCS Streets 2010	ARTPLAN
Turning Movements/Volume	12	3
Signal Timing Parameters	75+	5

161

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Key Differences Between Other Tools

HIGHPLAN

- Uses two classes of two-lane highways rather than three, as HCS uses
- Uses a modified version of the multilane speed-flow curves developed for the HCM, extending beyond the 60 mph maximum
- Approximately the same number of inputs as HCS, but simplified approximation of free flow speed

162

2015 Q/LOS Training 146

Key Differences Between Other Tools

FREEPLAN

- Includes extensions to the HCM methodology for planning purposes
- Relies on revised density thresholds differing from the HCM density thresholds
- Basic segments in FREEPLAN require 9 inputs as opposed to 11 in HCS facilities

163

LOSPLAN

DEFINITIONS

Study Period – The time frame for which the traffic demand on the roadway is being studied

- LOSPLAN offers three options for the study period:
  - *Standard K*
    – Florida's Standard K-factor based on area type and facility type
  - K_{other}
    – A study period other than that represented by Florida's Standard K-Factor
  - *Dir Hr Demand Vol*
    – Allows the analyst to enter directional hourly demand volumes

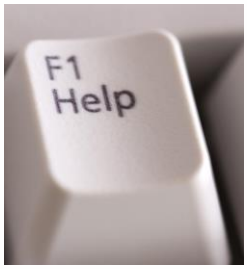
Provide documentation if using K_{other} or *Dir Hr Demand Vol*

164

LOSPLAN

Documentation

- Help feature – context sensitive
- F1 Key



Full details of the analysis methodologies contained in the LOSPLAN programs can be found in the computations documentation at: www.losplan.net

165

HIGHPLAN 2012

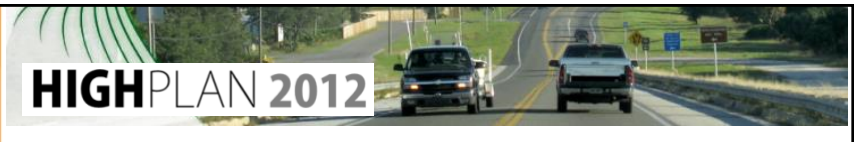
Agenda Item 6

166

Uses

- Roadways with average signalized intersection spacing greater than 2 - 3 miles
- Can perform three types of highway analysis:
  - Two-Lane Segment
  - Multilane Segment
  - Two-Lane Facility

167



Strengths

- Requires only basic geometry and volume information for LOS estimation
- Incorporates Florida specific adjustments

Limitations

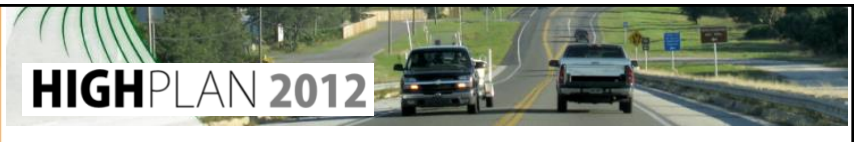
- Only supports analysis of multilane segments, not multilane facilities
- Not capable of non-automobile LOS evaluation

168

When to use other tools

- When conducting operational or design level analysis
- Multimodal analysis

169



Number of Lanes

- Number of through lanes in both directions for the entire roadway cross-section; exclude left turn lanes and center two-way left turn lanes.

170

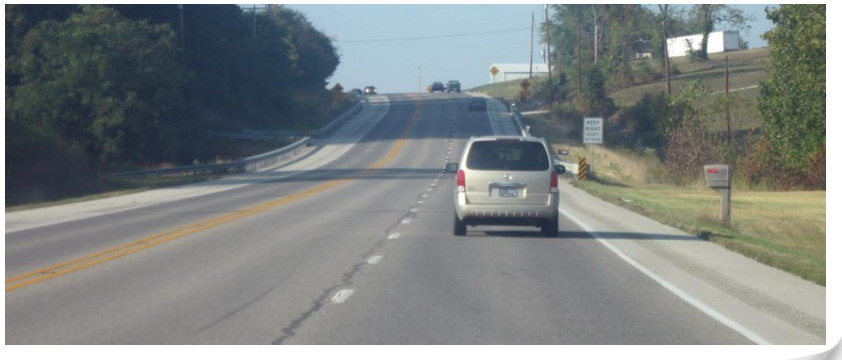
Percent No Passing Zones

- Percent of a two-lane highway where passing is prohibited in the analysis direction

171

Passing Lane

- Short lane (approximately 1 mile) added to provide passing opportunities in one direction of travel on a two-lane highway



172

Example 1 *Two-Lane Segment*

SR 24 between US 19/US 98 & SR 500, near Gainesville

- Rural undeveloped area type
- EB peak direction
- 45 mph posted speed limit
- 11.3 mile segment
- 4% no passing zones
- No median

AADT	D-Factor	% Heavy Vehicles	Local Adjustment Factor
1,200	55.3	5.0	0.84

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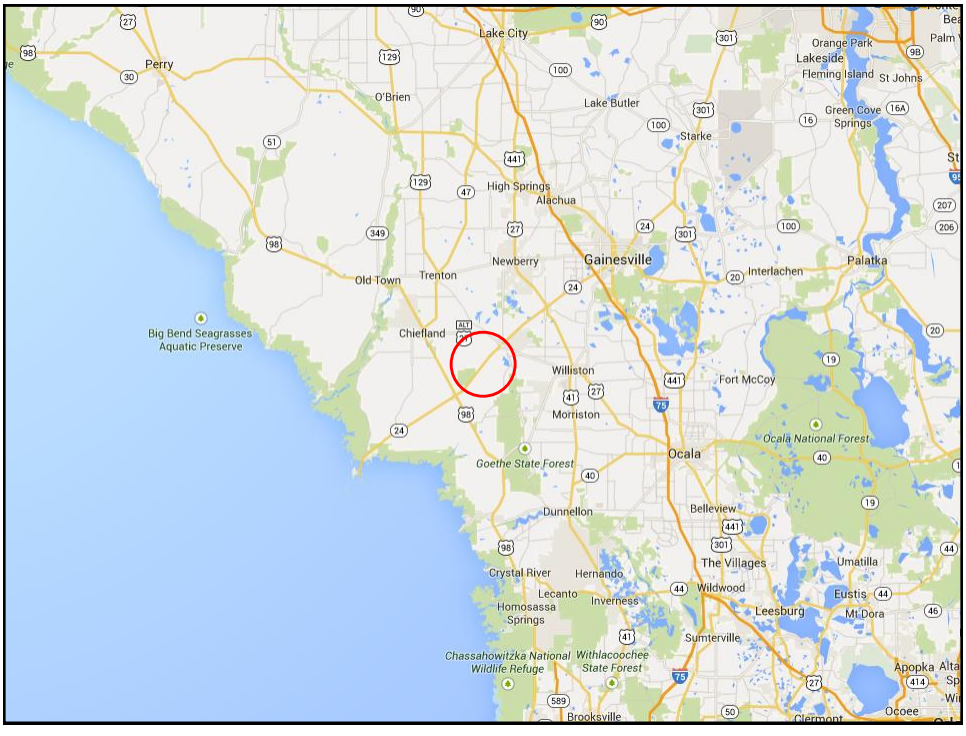

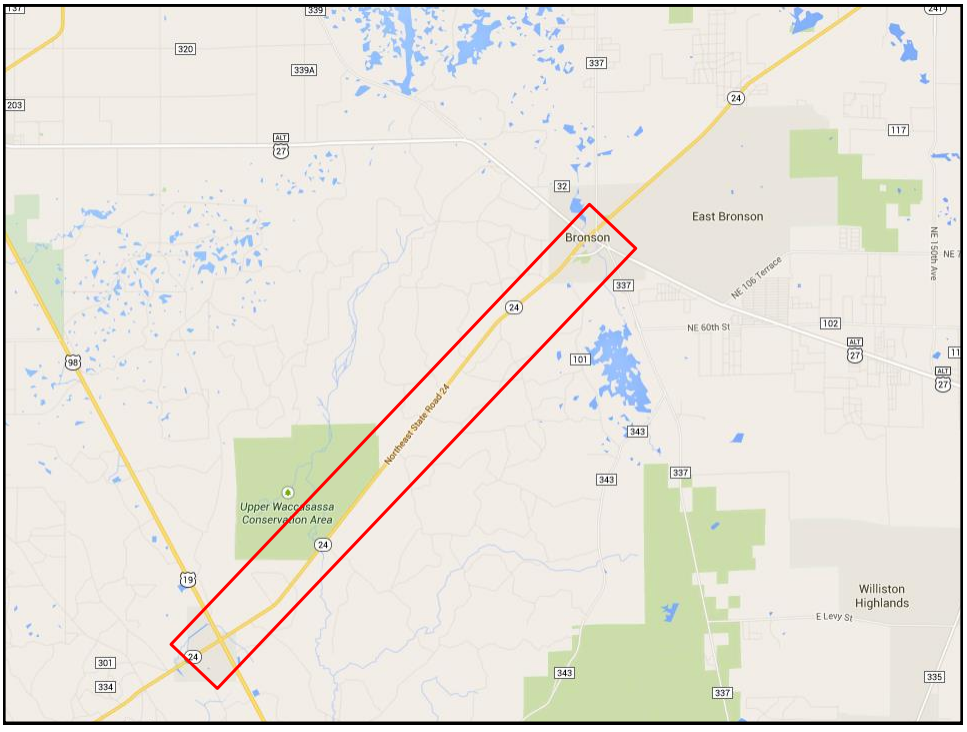
Bronson
East Bronson
Northeast State Road 24
Upper Waccasassa Conservation Area
Williston Highlands
NE 60th St
E Levy St


FL-24
Florida
Street View - May 2011
FL-24

Example 1 *Two-Lane Segment*

SR 24 between US 19/US 98 & SR 500, near Gainesville

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- 4% no passing zones
- No median

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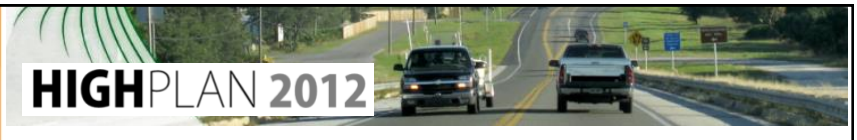
177



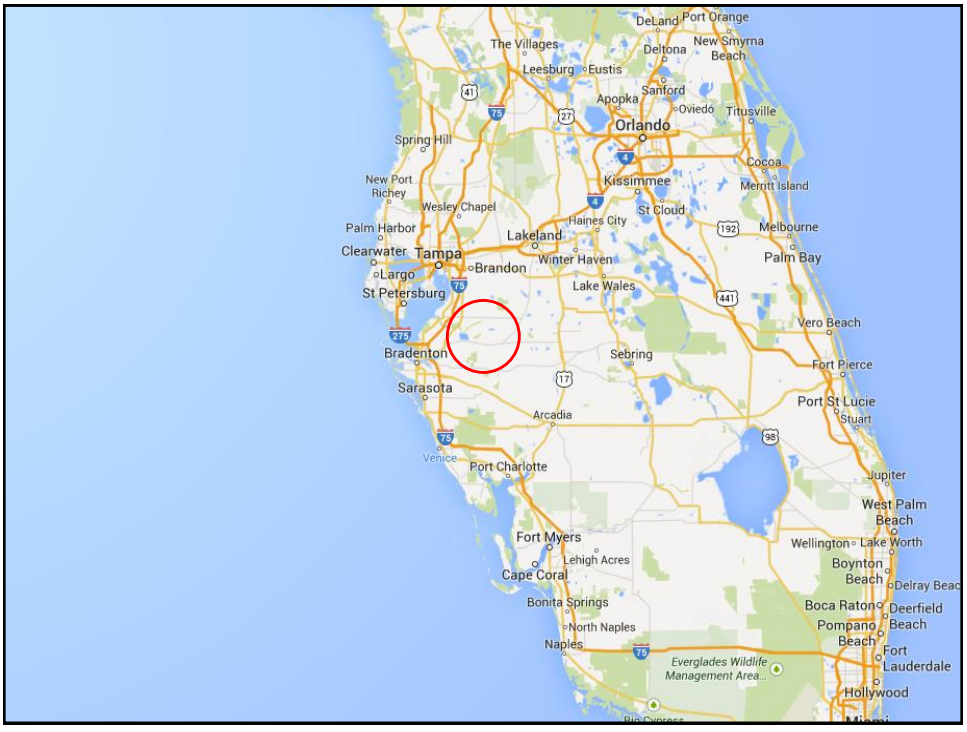
Workshop 1 *Two-Lane Segment*

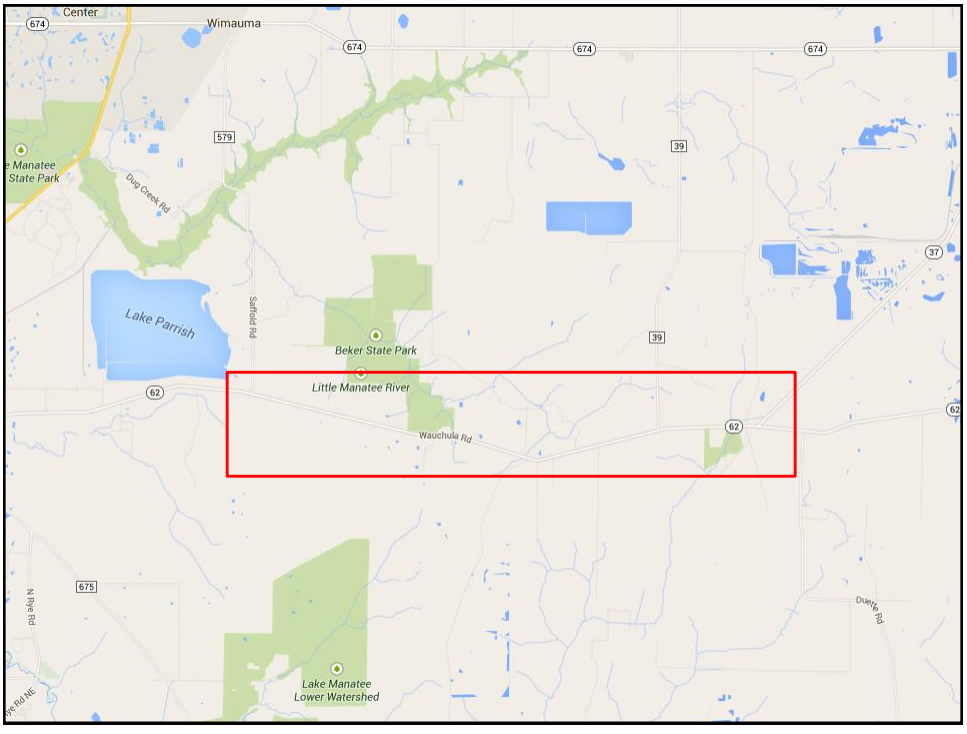
SR 62 between Saffold Rd & SR 37, Parrish/Wauchula

- Rural undeveloped area type
- EB peak direction
- 60 mph posted speed limit
- 10.9 mile segment
- 11% no passing zones
- No median

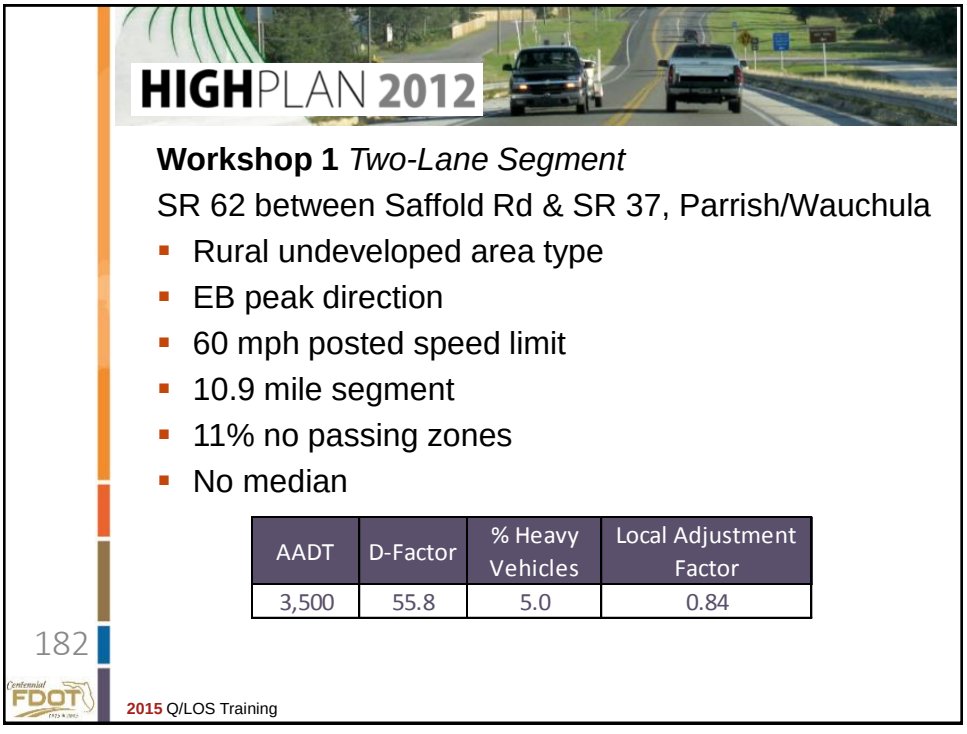
AADT	D-Factor	% Heavy Vehicles	Local Adjustment Factor
3,500	55.8	5.0	0.84

178


DeLand
Port Orange
New Smyrna Beach
Deltona
The Villages
Leesburg
Eustis
Sanford
Apopka
Oviedo
Titusville
Orlando
Spring Hill
Cocoa
Merritt Island
Kissimmee
New Port Richey
Wesley Chapel
St Cloud
Haines City
Palm Harbor
Lakeland
Melbourne
Clearwater
Tampa
Winter Haven
Palm Bay
Brandon
Largo
Lake Wales
St Petersburg
Vero Beach
Bradenton
Sebring
Fort Pierce
Sarasota
Port St Lucie
Arcadia
Stuart
Venice
Port Charlotte
Jupiter
West Palm Beach
Fort Myers
Wellington
Lake Worth
Lehigh Acres
Boynton Beach
Cape Coral
Delray Beach
Bonita Springs
Boca Raton
Deerfield Beach
North Naples
Pompano Beach
Naples
Fort Lauderdale
Everglades Wildlife Management Area
Hollywood


Center
Wimauma
Manatee State Park
Dug Creek Rd
Lake Parrish
Safford Rd
Beker State Park
Little Manatee River
Wauchula Rd
N Pine Rd
Lake Manatee Lower Watershed


FL-62


HIGHPLAN 2012
Workshop 1 Two-Lane Segment
SR 62 between Saffold Rd & SR 37, Parrish/Wauchula
Rural undeveloped area type
EB peak direction
60 mph posted speed limit
10.9 mile segment
11% no passing zones
No median
AADT
D-Factor
% Heavy Vehicles
Local Adjustment Factor
3,500
55.8
5.0
0.84
182
2015 Q/LOS Training

Workshop 2 *Multilane Segment*

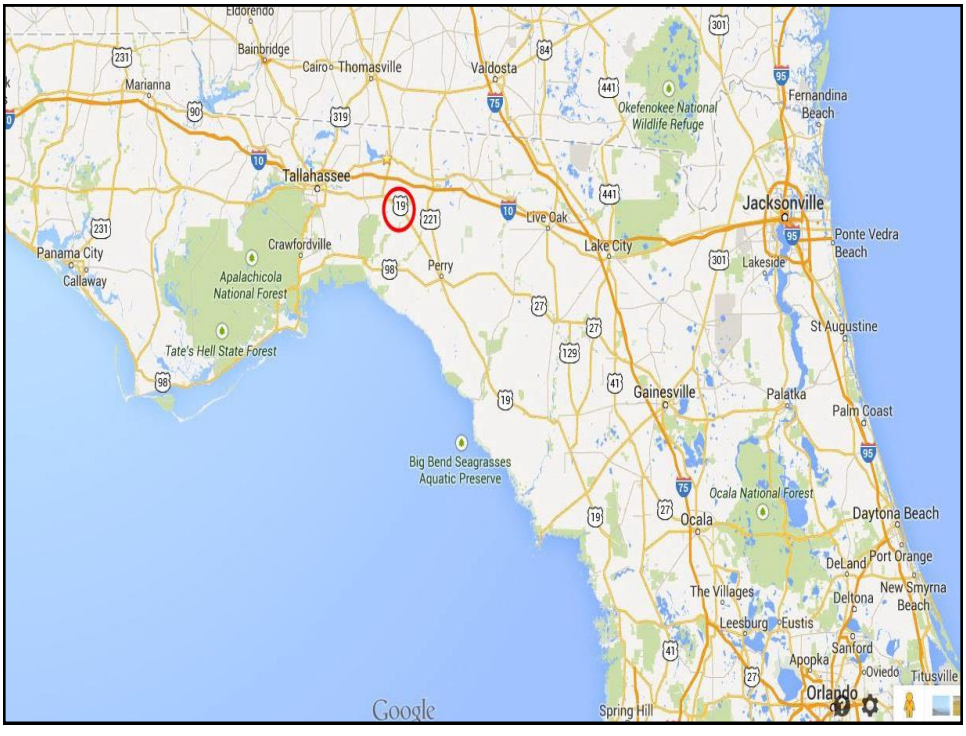
US 19/27 between Avalon Rd & CR 14, Lamont

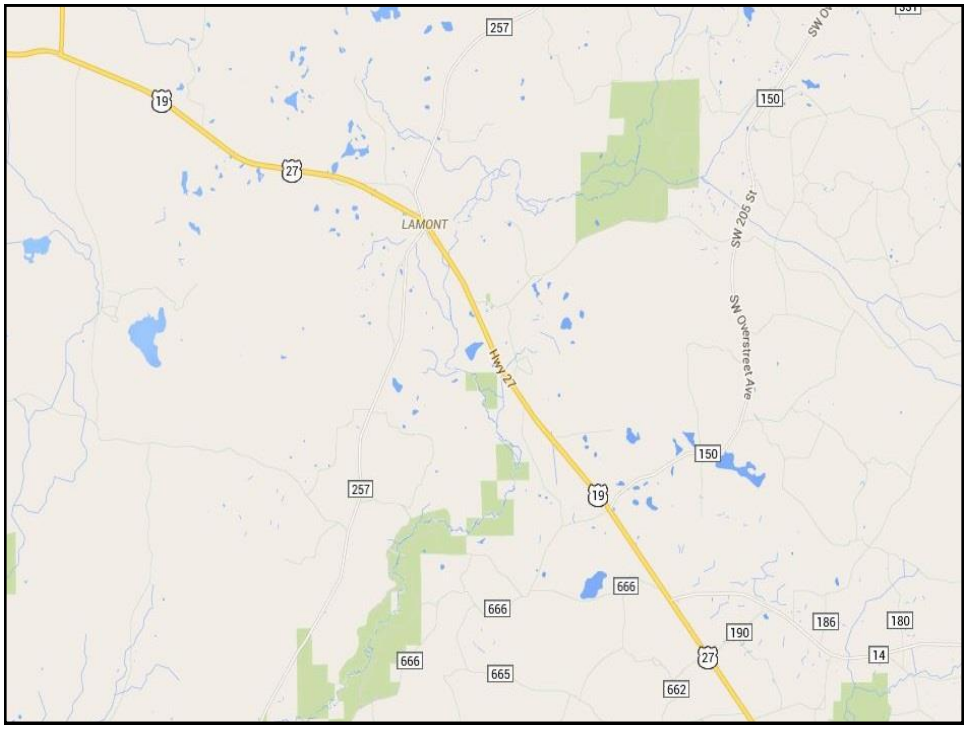
- Rural undeveloped area type
- NB peak direction
- 4-lane highway
- 65 mph posted speed limit
- 12.6 mile segment
- Median present

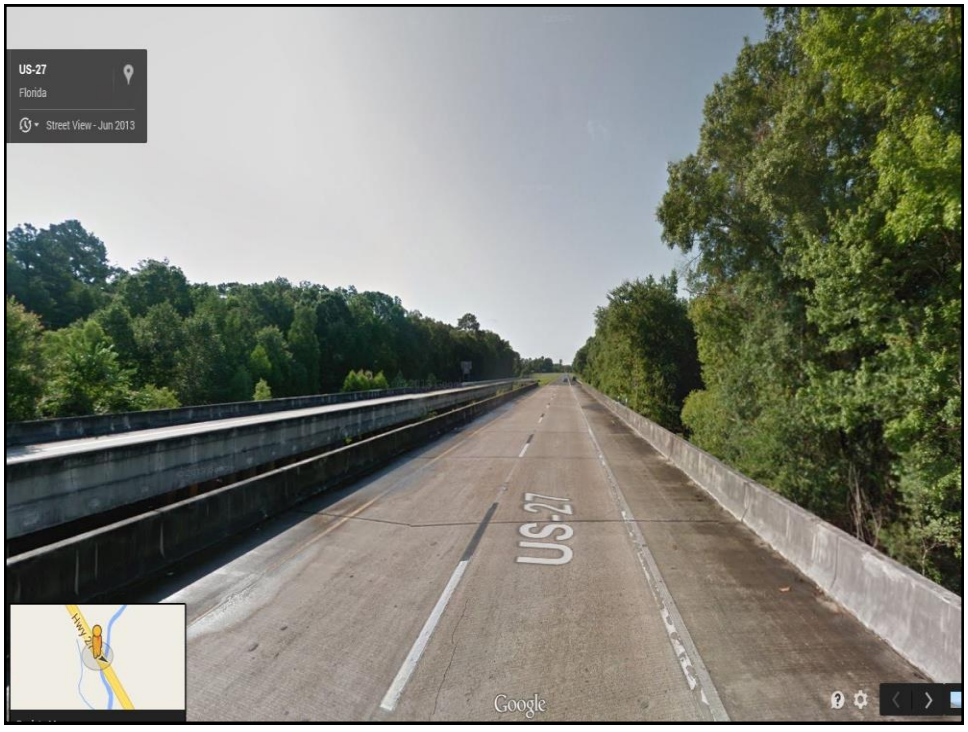
AADT	D-Factor	% Heavy Vehicles	Local Adjustment Factor
5,056	55.8	12.0	0.76

183

2015 Q/LOS Training




257
19
27
LAMONT
150
SW 205 St
SW Overstreet Ave
Hwy 27
150
257
19
666
666
190
186
180
14
27
666
665
662


US-27
Florida
Street View - Jun 2013
US-27
Hwy 27
Google

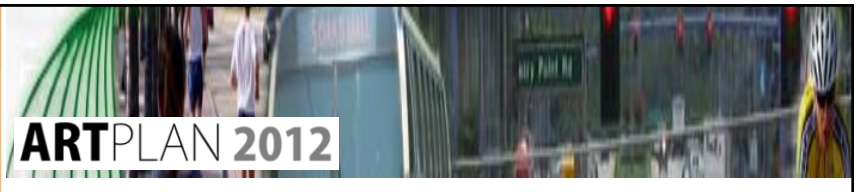
Workshop 2 *Multilane Segment*

US 19/27 between Avalon Rd & CR 14, Lamont

- Rural undeveloped area type
- NB peak direction
- 4-lane highway
- 65 mph posted speed limit
- 12.6 mile segment
- Median present

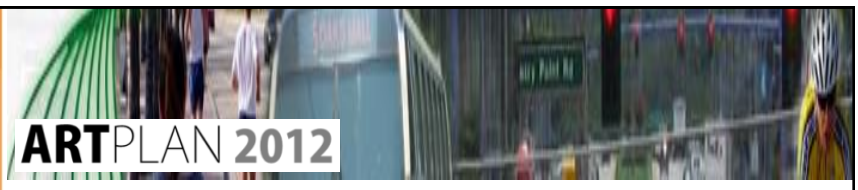
AADT	D-Factor	% Heavy Vehicles	Local Adjustment Factor
5,056	55.8	12.0	0.76

187



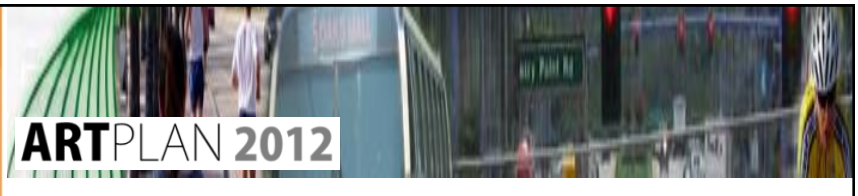
Agenda Item 7

188



Uses

- Can perform three types of arterial analysis:
  - Single Intersection
  - Segments
  - Facilities
- Provides LOS for four modes:
  - Auto
  - Bicycle
  - Pedestrian
  - Bus



Strengths

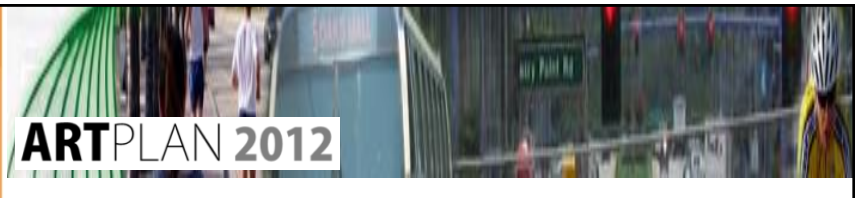
- Much fewer inputs than HCS Streets
- Input data is easy to obtain
- Provides multimodal analysis with limited required information

Multimodal Analysis

Input	HCS Streets 2010	ARTPLAN
Pedestrian Parameters	76	16
Bicycle Parameters	42	6
Bus Parameters	24	4

Number of Pedestrian/Bicycle/Bus Inputs

191

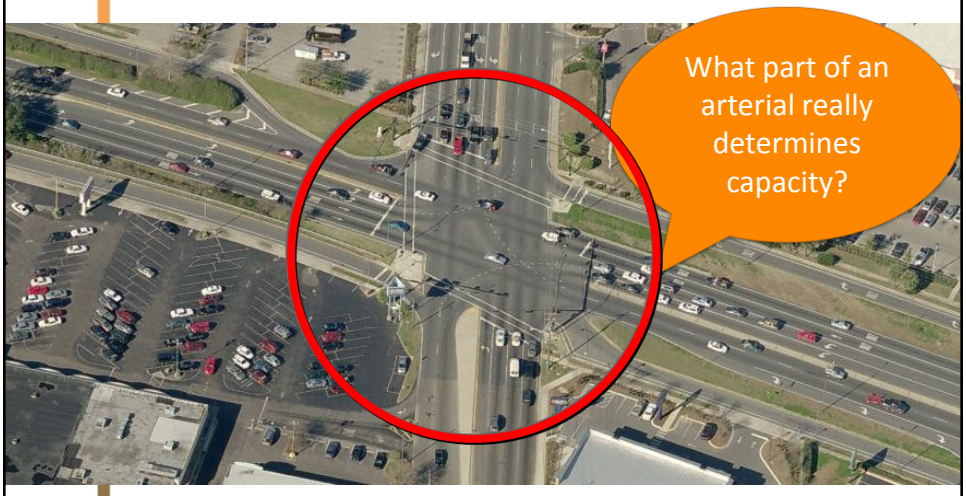


- **Roadway Class**
  - **Class 1 –** Arterials with a posted speed of **40 mph** or greater

  - **Class 2 –** Arterials with a posted speed of **35 mph** or less

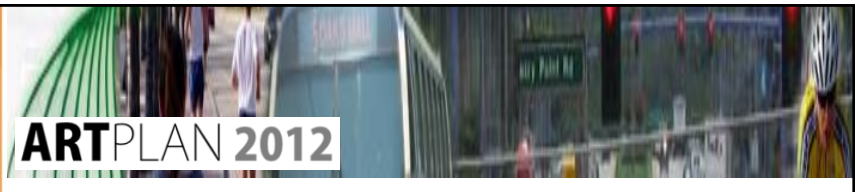
192

Importance of Signalized Intersections



Getting signalized intersection data correct is critical for capacity and LOS analyses

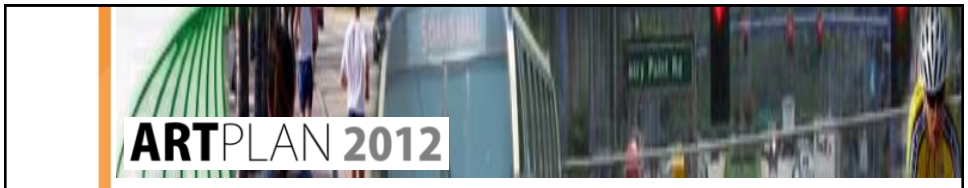
193



Number of through lanes

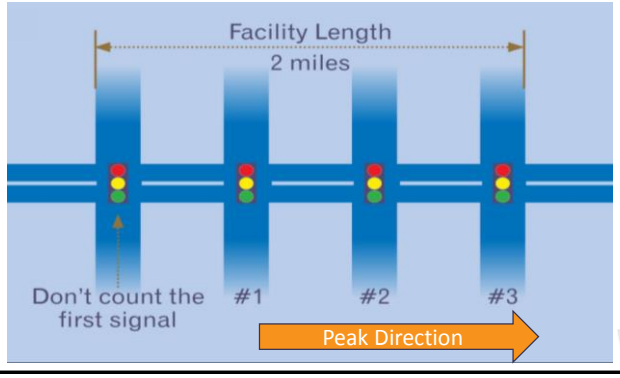
- In ARTPLAN and FREEPLAN, the number of through lanes in the analysis direction is an input

194



Number of Signalized Intersections

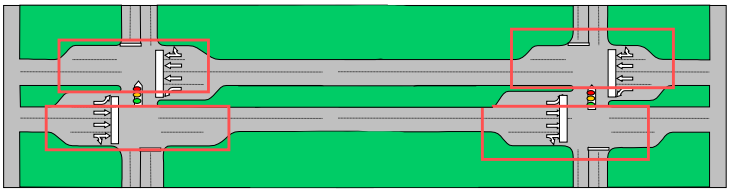
- Only one intersection at the ends of the facility should be counted



195

Number of Through Lanes

- Arterials
  - Counted at signalized intersections,
  - Through and shared-right-turn lanes



Add-on / Drop-off lanes must be of reasonable lengths

- Freeways – Counted "mid-block"

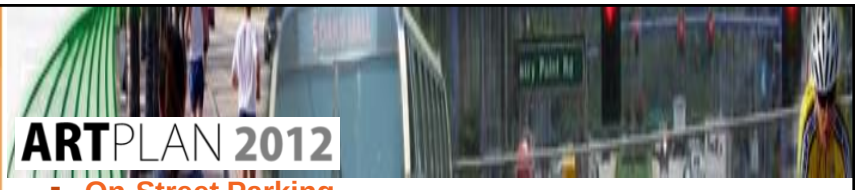
196

ROADWAY

Turn Lanes

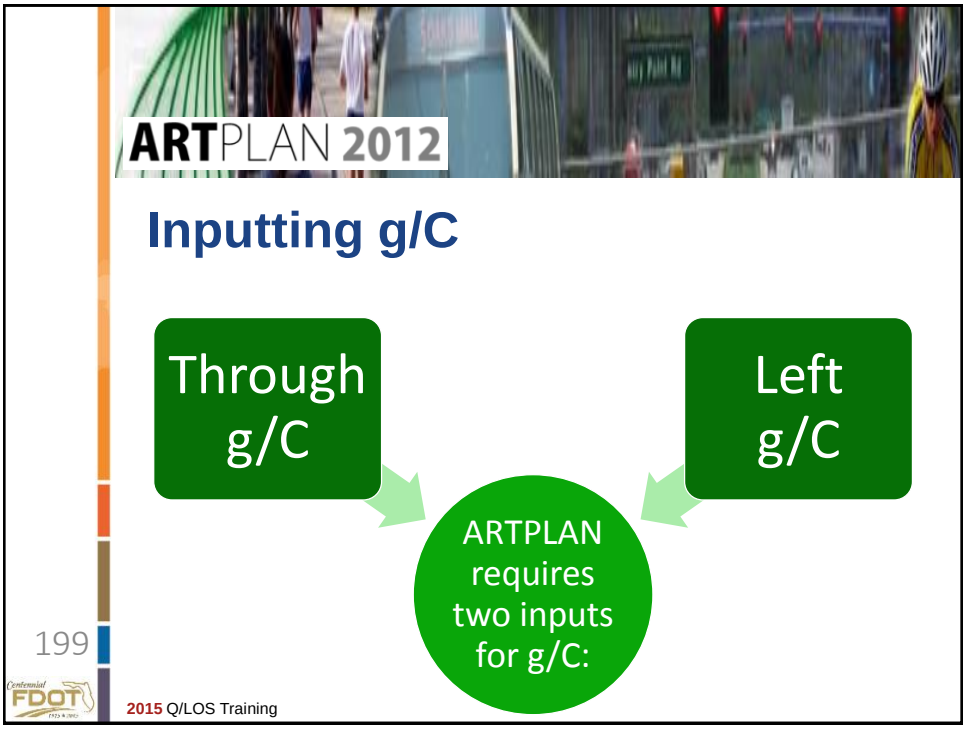
- **Number of Left/Right Turn Only Lanes**
- **Percent Left/Right Turns –** percentage of vehicles performing a left or right-turning movement on the approach to a signalized intersection
- **Total Left Turn Storage –** The total amount of storage length in feet for exclusive left turn lanes

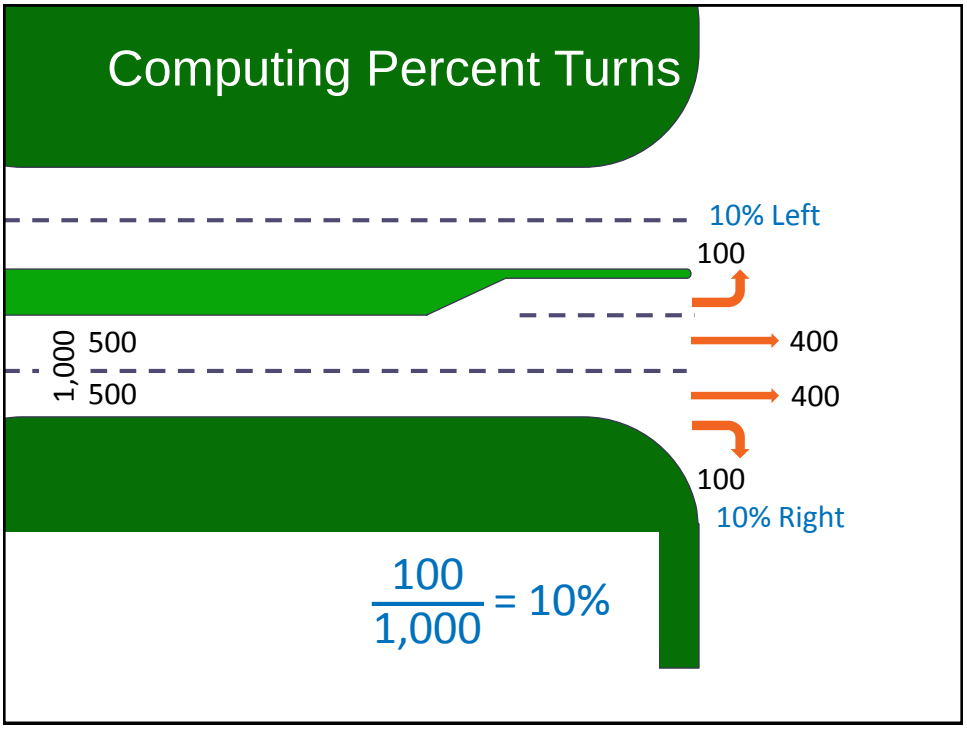
197



- **On-Street Parking**
  - Impacts both link running time as well as bicycle and pedestrian LOS
- **Parking Activity**
  - **Low**
  - **Medium**
  - **High**

198


ARTPLAN 2012
Inputting g/C
Through g/C
Left g/C
ARTPLAN requires two inputs for g/C:
199
2015 Q/LOS Training


Computing Percent Turns
10% Left
100
500
400
1,000
500
400
100
10% Right
100 / 1,000 = 10%

ARTPLAN 2012

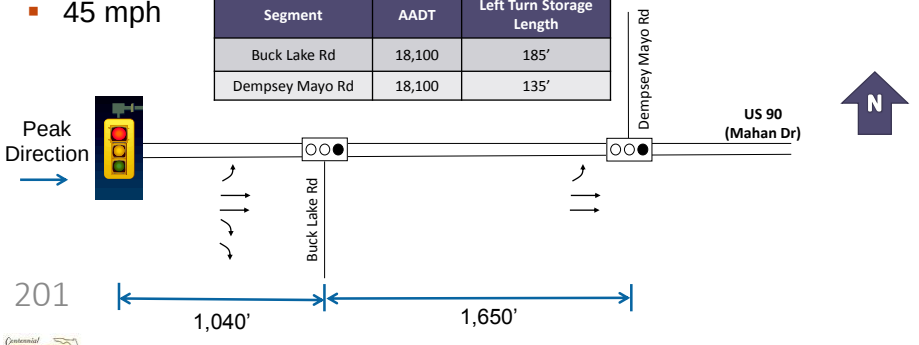
Example 1 *Planning-Level Inputs, Auto Only*

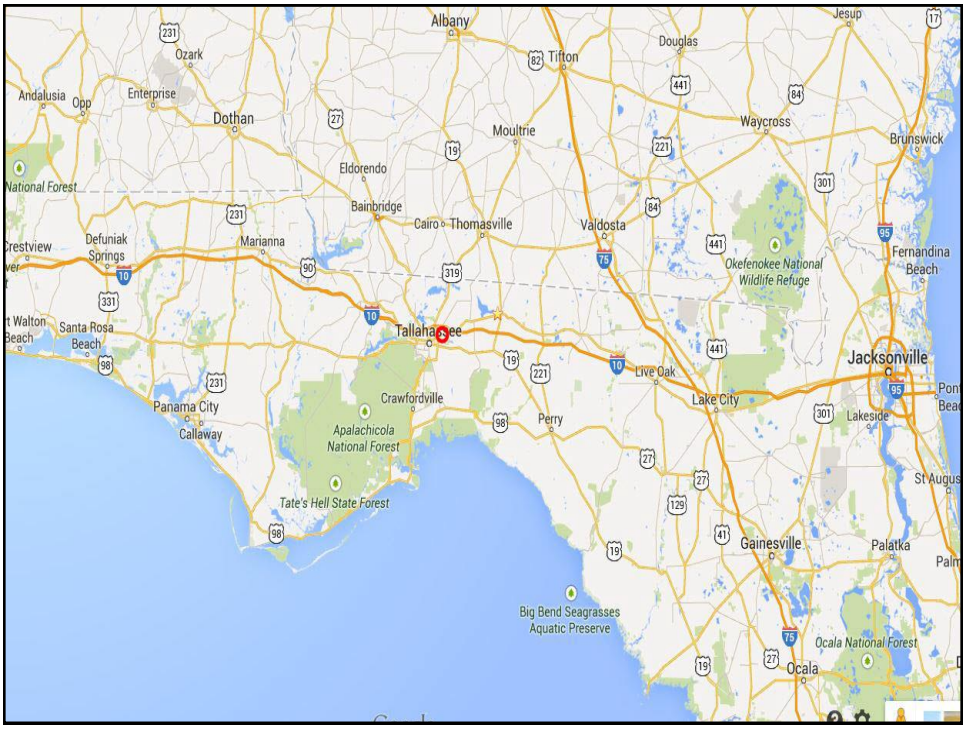
Mahan Drive and Dempsey Mayo Road, Tallahassee

- Fully actuated signal, protected only phasing
- Percent turns (L = 5%)
- Restrictive median
- 45 mph

D-Factor	% Hvy Vhcls
71.3	1.0

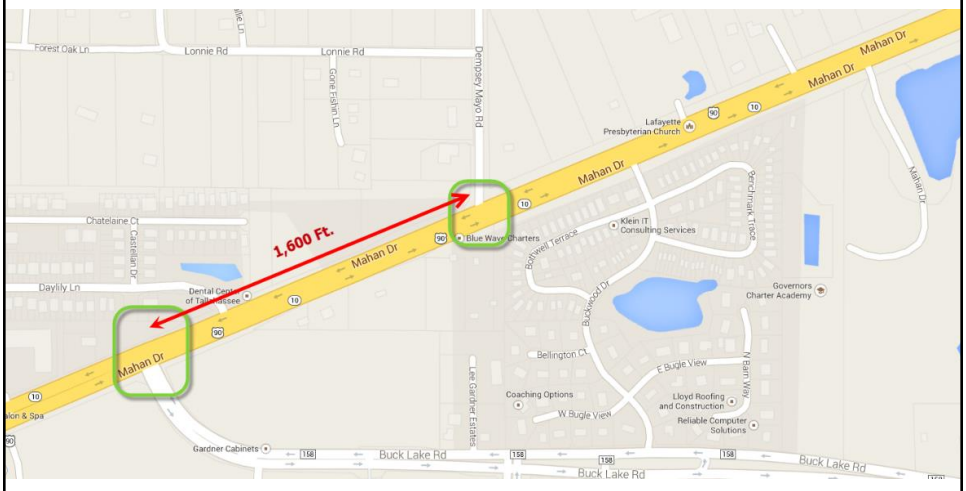
Segment	AADT	Left Turn Storage Length
Buck Lake Rd	18,100	185’
Dempsey Mayo Rd	18,100	135’





ARTPLAN

Example #1 *Planning-Level Inputs, Auto Only*
Mahan Drive and Dempsey Mayo Road, Tallahassee



ARTPLAN 2012

Example 1 *Planning-Level Inputs, Auto Only*

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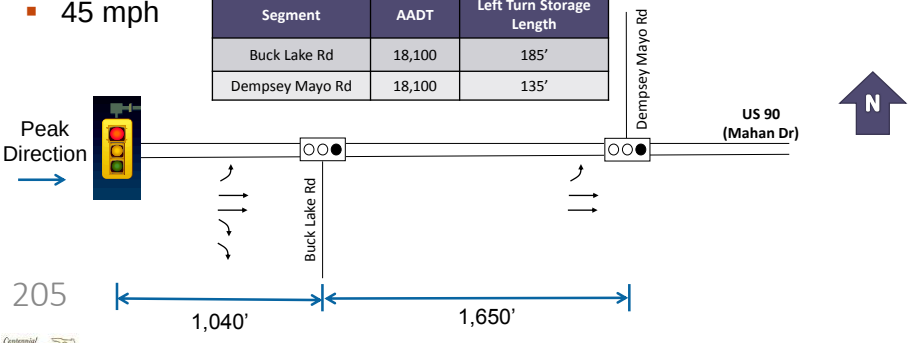


2015 Q/LOS Training

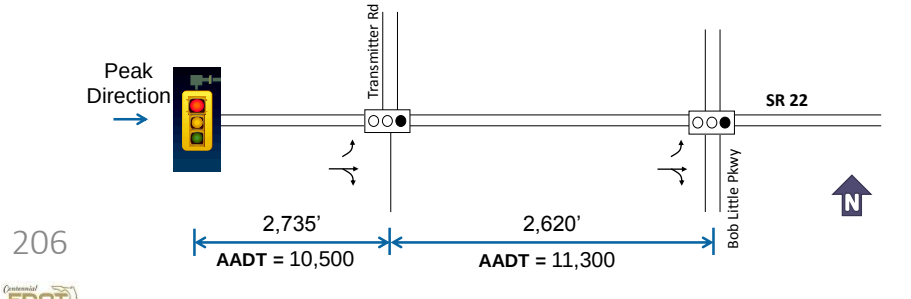
ARTPLAN 2012

Workshop 1 *Planning-Level Inputs, Auto Only*

SR 22 between Transmitter Rd & Bob Little Rd

- Fully actuated signal, protected lefts only
- Posted speed = 45 mph
- No median

Segment	AADT	Left Turn Storage Length
Transmitter Rd	10,500	325’
Bob Little Pkwy	11,300	125’



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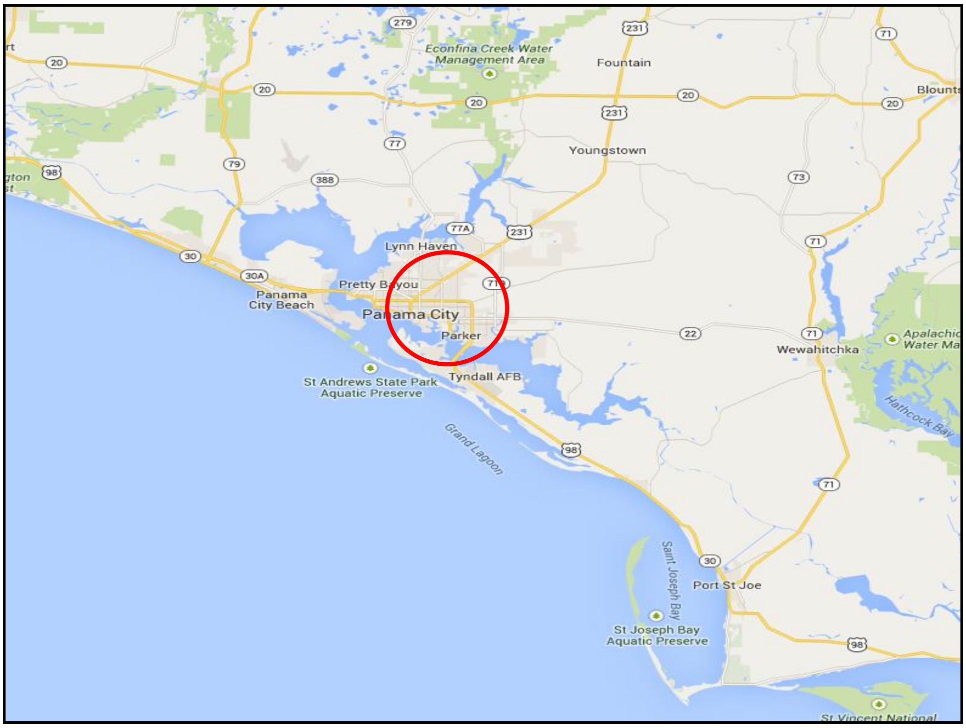
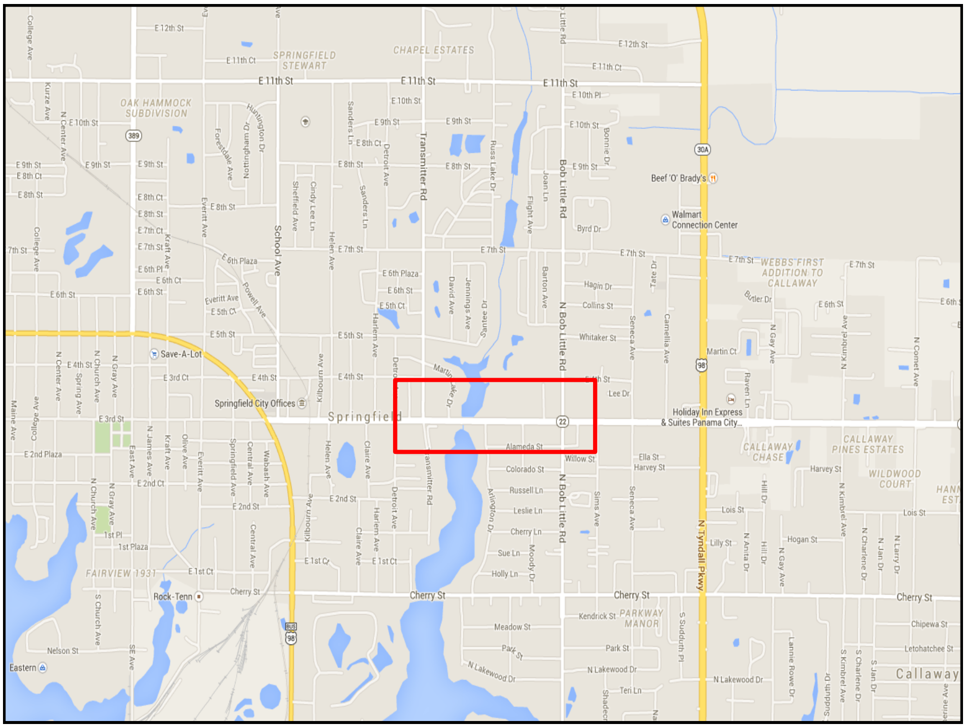

Econfina Creek Water Management Area
Fountain
Youngstown
Lynn Haven
Pretty Bayou
Panama City Beach
Panama City
Parker
Tyndall AFB
St Andrews State Park Aquatic Preserve
Grand Lagoon
Wewahitchka
Hathcock Bay
Saint Joseph Bay
Port St Joe
St Joseph Bay Aquatic Preserve


SPRINGFIELD STEWART
CHAPEL ESTATES
OAK HAMMOCK SUBDIVISION
E 11th St
Transmitter Rd
Bob Little Rd
N Bob Little Rd
School Ave
Beef 'O' Brady's
Walmart Connection Center
WEBBS FIRST ADDITION TO CALLAWAY
Save-A-Lot
Springfield City Offices
Springfield
Holiday Inn Express & Suites Panama City
CALLAWAY CHASE
CALLAWAY PINES ESTATES
WILDWOOD COURT
N Tyndall Pkwy
FAIRVIEW 1931
Rock-Tenn
Cherry St
PARKWAY MANOR
Callaway

ARTPLAN 2012

Workshop 1 *Planning-Level Inputs, Auto Only*

SR 22 between Transmitter Rd & Bob Little Rd

- Fully actuated signal, protected lefts only
- Posted speed = 45 mph
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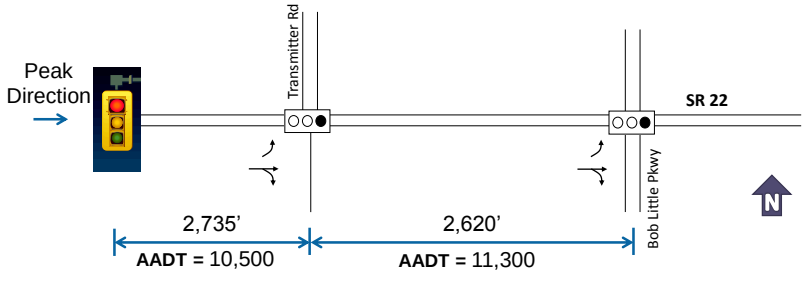
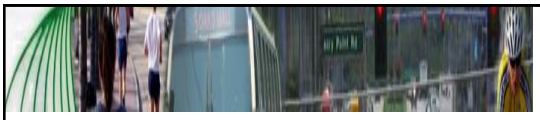


210

2015 Q/LOS Training



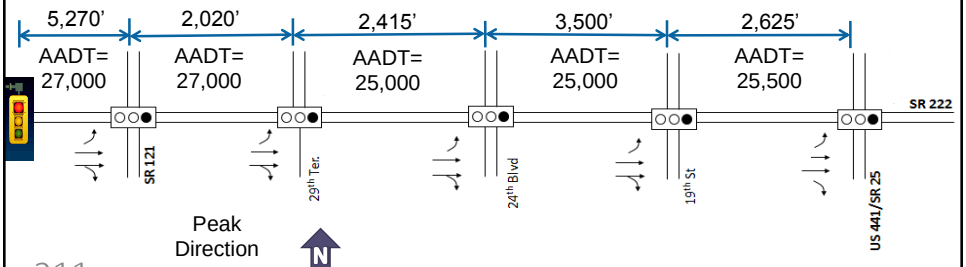
ARTPLAN 2012

Workshop 2 *Planning-Level Inputs, Auto Only*

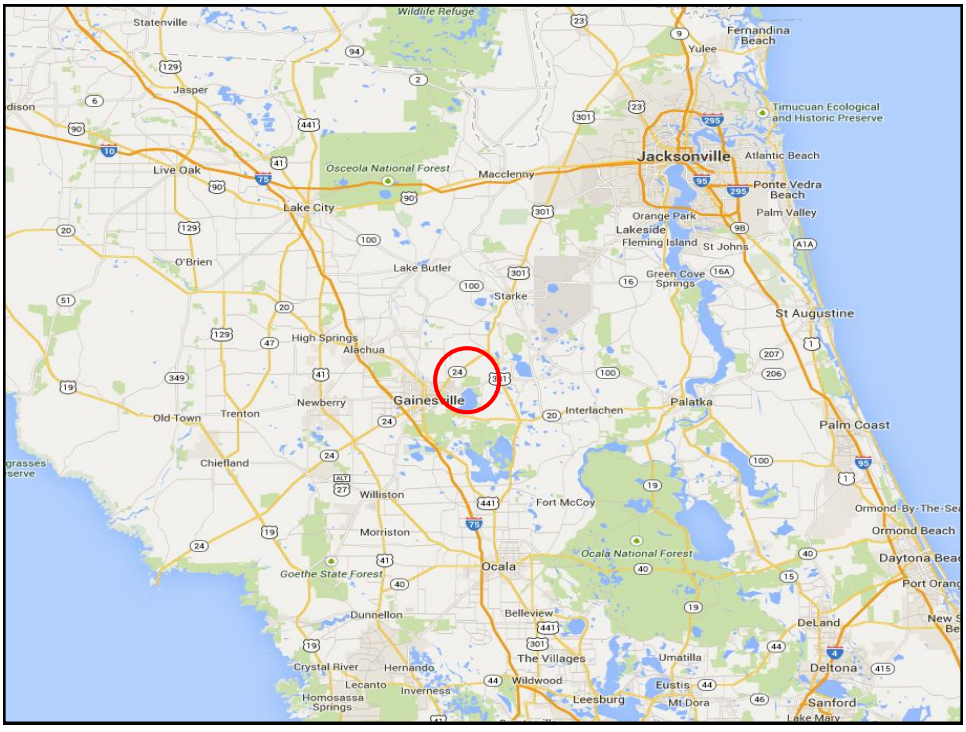
SR 222 between SR 121& US 441/SR 441

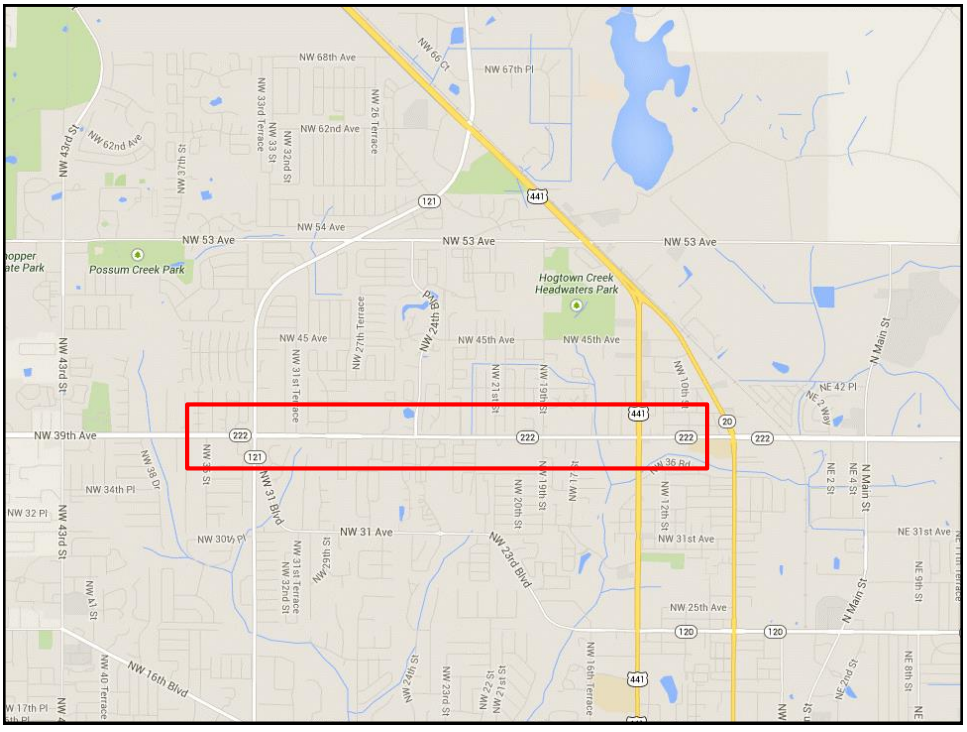
- Coordinated/actuated
- Posted speed = 45 mph
- Bounded by major intersections on each end
- Non-restrictive median

Segment	% Left Turns	% Right Turns	Left Turn Storage
SR 121	12	12	510’
29th Terr.	5	5	150’
24th Blvd.	5	5	175’
19th St.	5	5	150’
US 441	10	12	135’



211

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NW 67th Pl
NW 66 Ct
NW 62nd Ave
NW 62nd Ave
NW 53 Ave
NW 53 Ave
NW 53 Ave
NW 54 Ave
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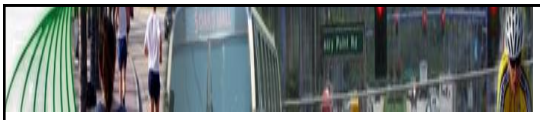
Hogtown Creek Headwaters Park
NW 45 Ave
NW 45th Ave
NW 45th Ave
NW 39th Ave
NW 34th Pl
NW 31 Ave
NW 31st Ave
NW 25th Ave
NE 42 Pl
NE 31st Ave
N Main St
NW 16th Blvd
NW 43rd St
NW 31 Blvd
NW 23rd Blvd
121
441
222
20
120


NW 39th Ave
Street View - May 2011
NW 39th Ave
Google



ARTPLAN 2012

Workshop 2 *Planning-Level Inputs, Auto Only*

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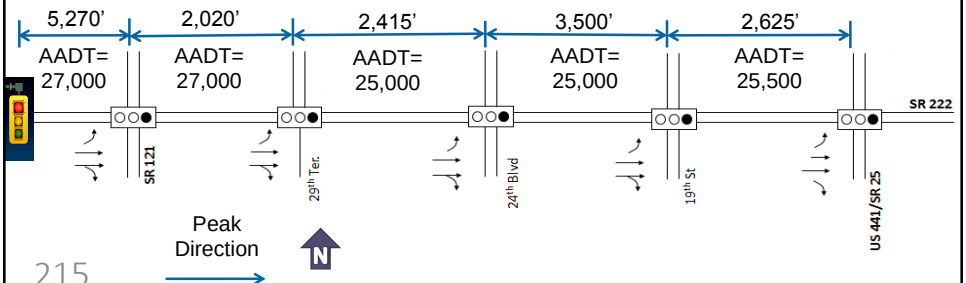
29th Terr.	5	5	150’
24th Blvd.	5	5	175’
19th St.	5	5	150’
US 441	10	12	135’



215

ARTPLAN 2012

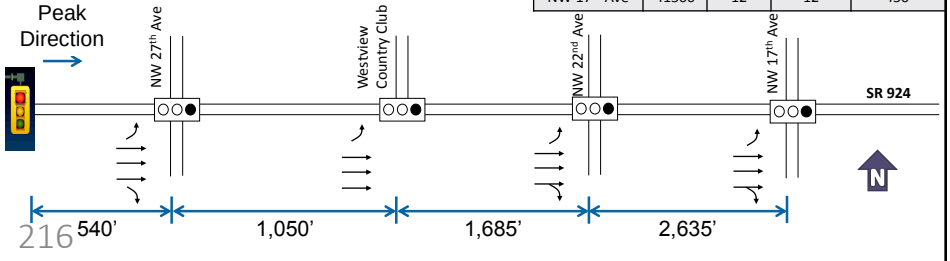
Save data file for multimodal analysis in next unit

Workshop 3 *Known Inputs & Multimodal Analysis*

State Route 924 between NW 27th Ave & NW 17th Ave, Miami

- Non-restrictive median west of 27th Ave
- 40 mph posted speed limit

Segment	AADT	% Left Turns	% Right Turns	Left Turn Storage
NW 27th Ave	41500	8	12	195’
Westview CC	41500	5	0	155’
NW 22nd Ave	41500	5	12	185’
NW 17th Ave	41500	12	12	450’



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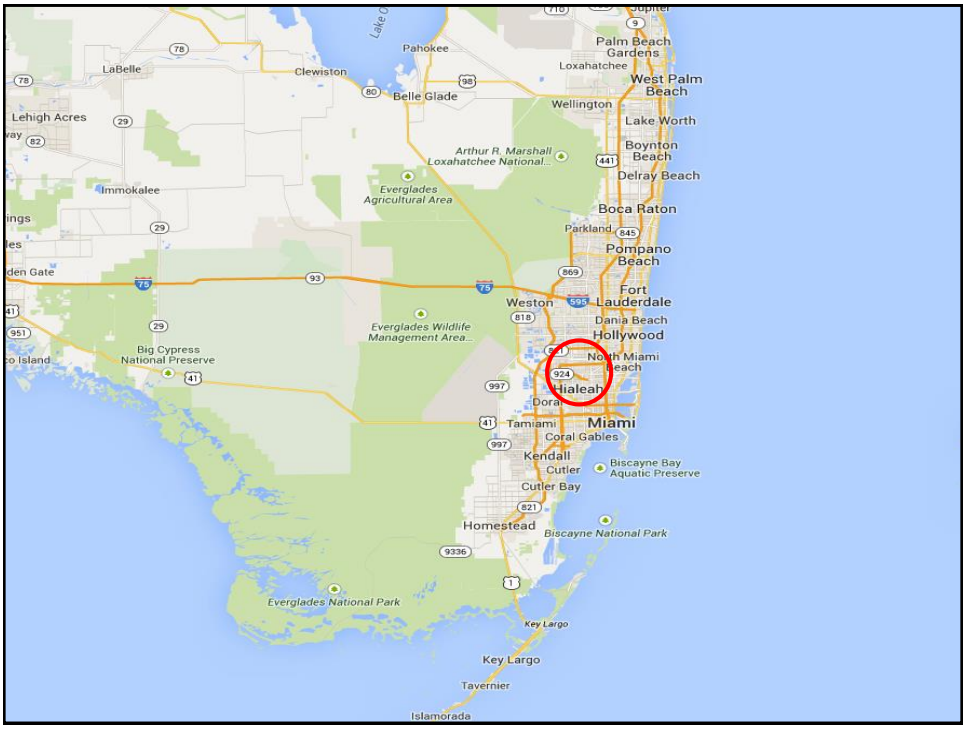
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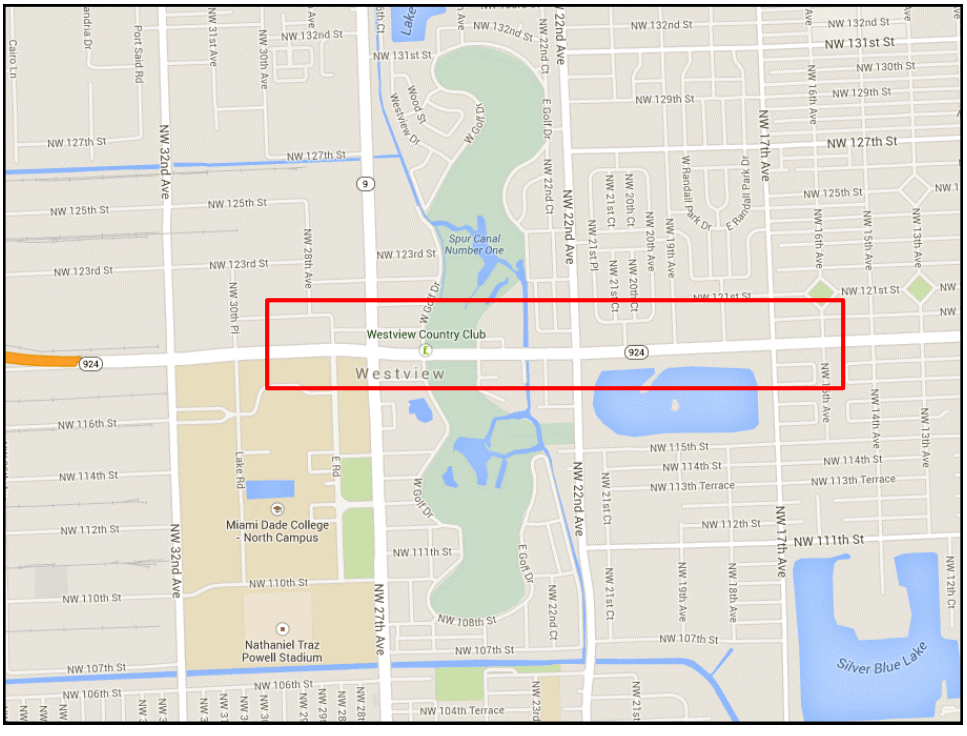
Loxahatchee
West Palm Beach
Wellington
Lake Worth
Boynton Beach
Delray Beach
Boca Raton
Parkland
Pompano Beach
Fort Lauderdale
Weston
Dania Beach
Hollywood
North Miami Beach
Hialeah
Doral
Tamiami
Miami
Coral Gables
Kendall
Cutler
Cutler Bay
Homestead
Biscayne Bay Aquatic Preserve
Biscayne National Park
Everglades National Park
Key Largo
Tavernier
Islamorada
Pahokee
Clewiston
Belle Glade
LaBelle
Lehigh Acres
Immokalee
Arthur R. Marshall Loxahatchee National...
Everglades Agricultural Area
Everglades Wildlife Management Area...
Big Cypress National Preserve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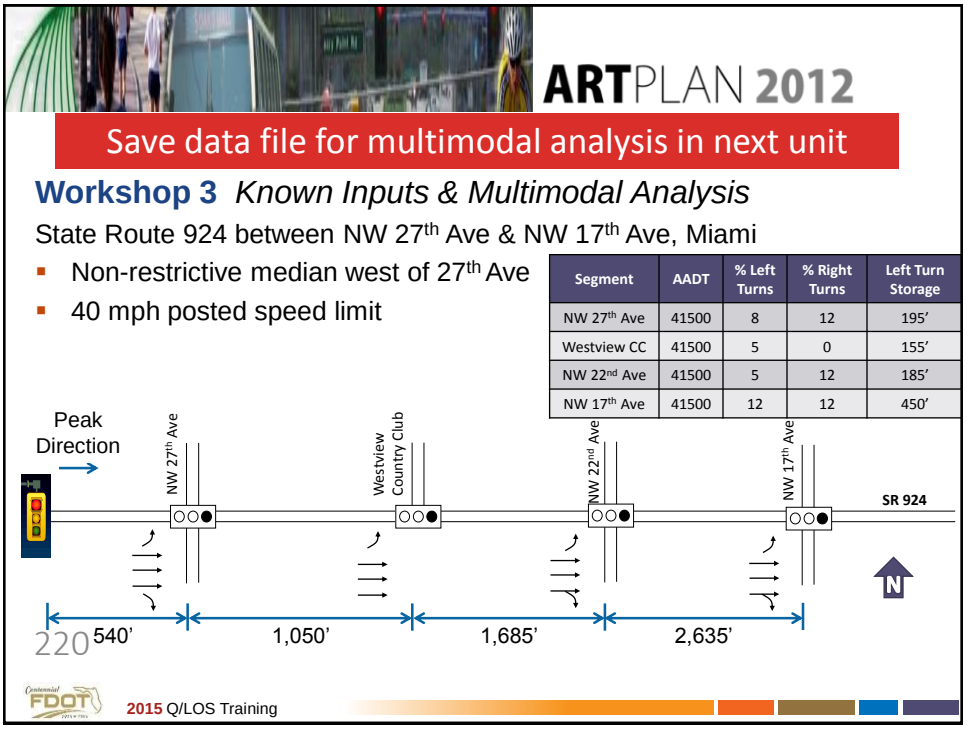
NW 131st St
NW 130th St
NW 129th St
NW 127th St
NW 125th St
NW 123rd St
NW 32nd Ave
NW 22nd Ave
NW 17th Ave
Spur Canal Number One
Westview Country Club
Westview
924
NW 116th St
NW 114th St
NW 112th St
NW 111th St
NW 110th St
NW 108th St
NW 107th St
NW 106th St
NW 104th Terrace
NW 27th Ave
NW 115th St
NW 113th Terrace
Miami Dade College - North Campus
Nathaniel Traz Powell Stadium
Silver Blue Lake


NW 119th St
Westview, Florida
Street View - May 2014
Westview Country Club
W 119th St
Westview
NW 119th
Google


ARTPLAN 2012
Save data file for multimodal analysis in next unit
Workshop 3 Known Inputs & Multimodal Analysis
State Route 924 between NW 27th Ave & NW 17th Ave, Miami
Non-restrictive median west of 27th Ave
40 mph posted speed limit
Segment | AADT | % Left Turns | % Right Turns | Left Turn Storage
NW 27th Ave | 41500 | 8 | 12 | 195'
Westview CC | 41500 | 5 | 0 | 155'
NW 22nd Ave | 41500 | 5 | 12 | 185'
NW 17th Ave | 41500 | 12 | 12 | 450'
Peak Direction
NW 27th Ave
Westview Country Club
NW 22nd Ave
NW 17th Ave
SR 924
N
220
540'
1,050'
1,685'
2,635'
2015 Q/LOS Training

MULTIMODAL LOS

Agenda Item 8

Is the purpose of the roadway to serve automobiles or people?

223

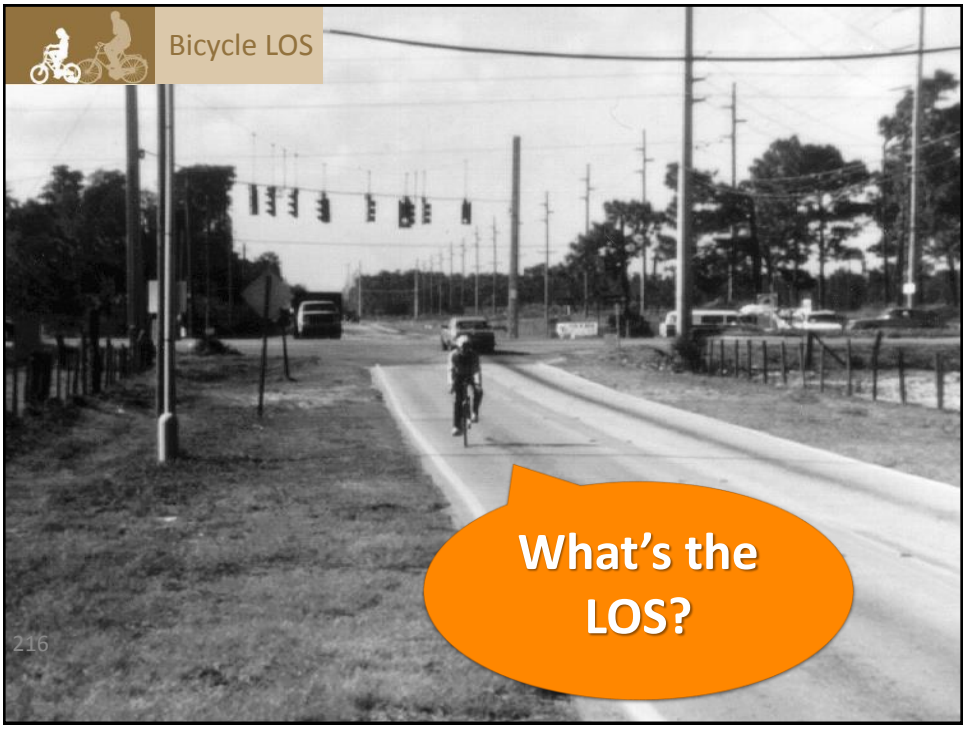
Mode	Automobile	Bicycle	Pedestrian	Bus
Major Inputs	Volume and Lanes	Bicycle Lane	Sidewalk	Bus Frequency
	Volume and Lanes			
	Other Traffic and Roadway Characteristics			
	Arterial Running Speed			
	Arterial Running Time		Sidewalk	
	Control Characteristics			
	Control Delay			
Service Measure	Average Travel Speed	Bicycle LOS Score	Pedestrian LOS Score	Adjusted Bus Frequency
LOS Determinator	HCM LOS Criteria	HCM LOS Criteria	HCM LOS Criteria	TCQSM LOS Crteria

139

Bicycle/Pedestrian/Bus Level of Service Analyses

225

Bicycle LOS



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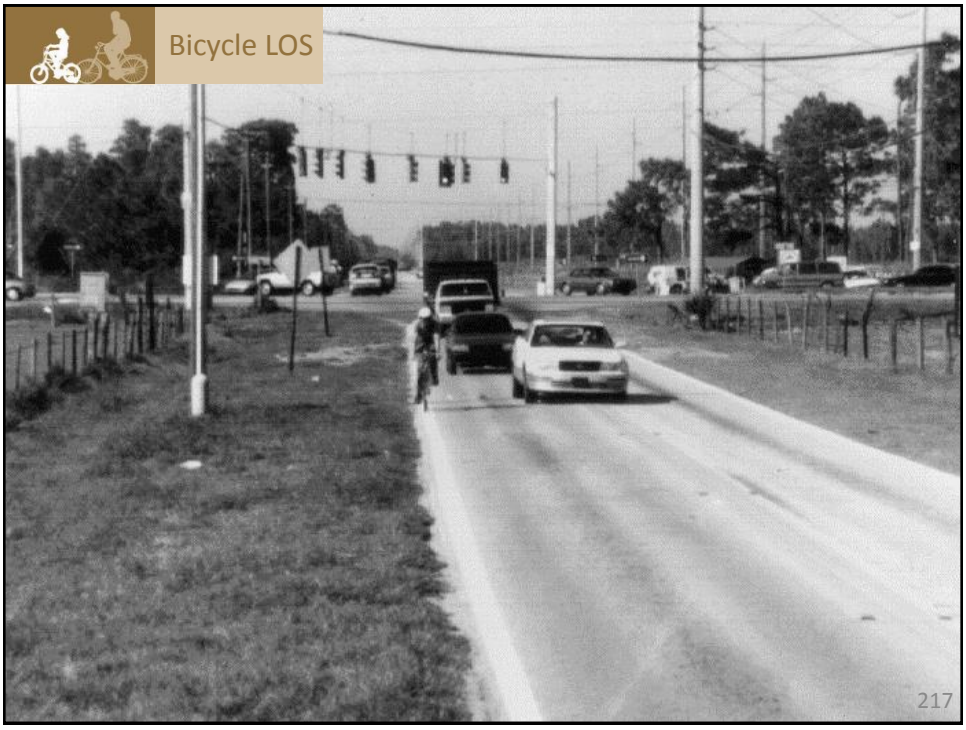
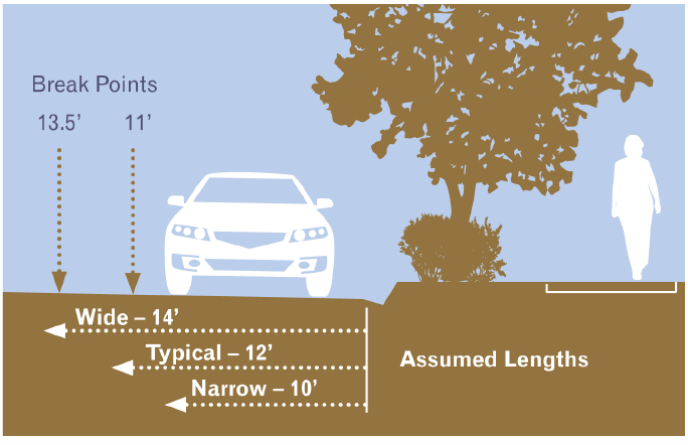

Bicycle LOS
217


Bicycle LOS
228

Bicycle LOS

Bicycle LOS

- **Outside Lane Width** - Width, in feet, of a roadway's outside motorized vehicle through lane, not including the gutter



230

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Bicycle LOS

- **Paved Shoulder / Bicycle Lane –** A bicycling area at least three feet wide* and separated from the outer motorized vehicle through lane by a solid pavement marking

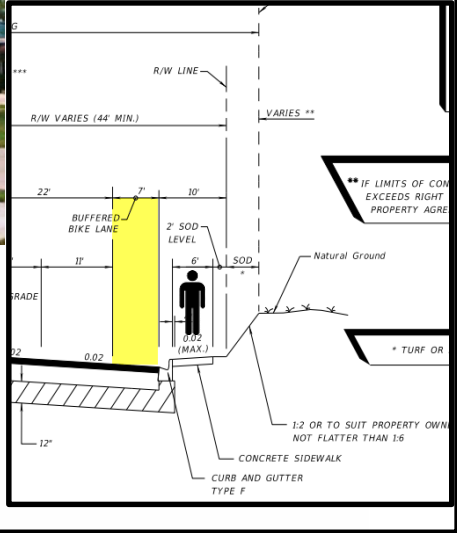
* ARTPLAN assumes a width of 5' if selected

231

Andy Hamilton, PBIC

7 ft. Bike Lane

Gainesville, FL



232

Bicycle LOS

- **Pavement Condition** - classification of the roadway surface where bicycling usually occurs
  - **Desirable** - new or recently resurfaced
  - **Typical** - light gray color, the surface appears worn, and may have some cracks; however, the ride for the bicyclist is fairly smooth
  - **Undesirable** - noticeable cracks, broken pavement, or ruts

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Bicycle LOS

- **Side Path** - Off-street dedicated bicycle and pedestrian path (ARTPLAN analyzes bicycles only)
- **Side Path Separation** - distance between the side path and the outside edge of the roadway

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Bicycle LOS

235

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Bicycle LOS

- Developed in Tampa in 1996
- Now applied to more than 200,000 miles throughout U.S.
- Published by TRB (# 1578)

A/B

C/D

E/F

236

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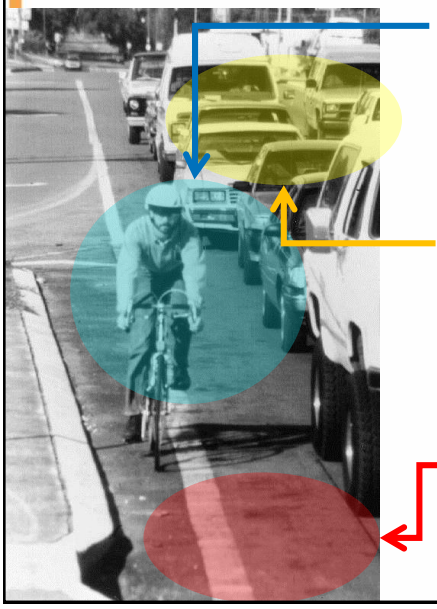
Bicycle LOS

Factors Affecting Bicycling Quality of Service



- Proximity of bicyclists to motorized vehicles
  - Paved shoulder
  - Bicycle lane
- Motorized vehicle
  - Volume
  - Speed
  - Type
- Pavement condition
- On-street parking

Bicycle LOS

$$BLOS = 0.507\ ln(Vol_{15}/L) + 0.199SP_t\ (1 + 10.38HV)^2 + 7.066(1/PR_5)^2 - 0.005(W_e)^2 + 0.760$$

Where:

BLOS	=	Bicycle level of service score
ln	=	Natural log
Vol_{15}	=	Volume of directional motorized vehicles in the peak 15 minute time period
L	=	Total number of directional thru lanes
SP_t	=	Effective speed factor = 1.1199 ln(SPp - 20) + 0.8103
SP_p	=	Posted speed limit (a surrogate for average running speed)
HV	=	percentage of heavy vehicles
PR_5	=	FHWA's five point pavement surface condition rating
W_e	=	Average effective width of outside thru lane

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2015 Q/LOS Training

Bicycle LOS

LOS	Score
A	≤ 2.0
B	≤ 2.75
C	≤ 3.5
D	≤ 4.25
E	≤ 5.0
F	> 5.0

HCM 2010 Exhibit 17-4
LOS Criteria: Bicycle Mode

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Bicycle LOS

Conceptual Planning Level of Analysis

- Input factors
  - **Paved shoulder/bicycle lane (y/n)**
  - Outside lane width
  - Traffic volume
  - Motorized vehicle speed
  - Motorized vehicle mix
  - Pavement condition

Bicycle LOS is an integrated module in ARTPLAN

240

Bicycle LOS

Is the Bicycle Lane/Paved Shoulder at least 3 feet?

Bicycle LOS

Outside Lane Width

12 Feet – (Typical)

242

Bicycle LOS

Pavement Condition

Desirable | Typical | Undesirable

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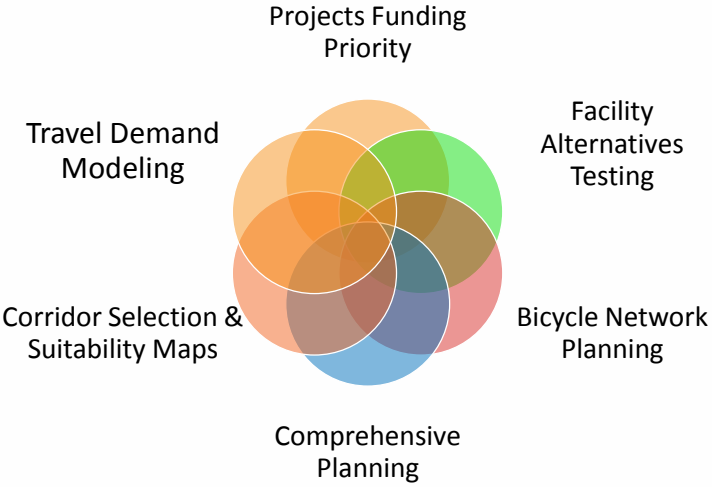
2015 Q/LOS Training

Bicycle LOS

Potential Applications of Bicycle LOS



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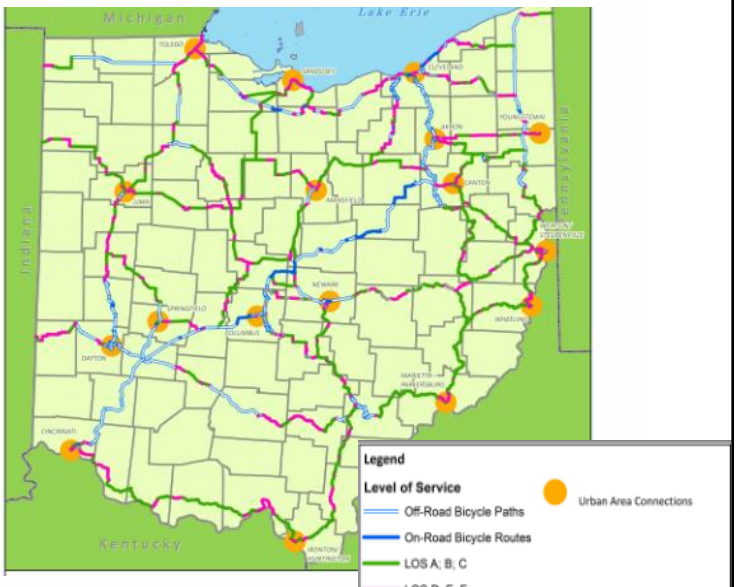
2015 Q/LOS Training

Bicycle LOS

Ohio Bicycle Trunk Routes

Criteria

- Shoulder Width
- Lane width
- Pavement conditions
- Speed limits
- Car and truck volumes
- Existing bike facilities



Bicycle LOS

ARTPLAN: Bicycle LOS Example

Instructions

Open a new ARTPLAN file and input the variables on the following slide

Bicycle LOS

What is the Bike LOS?

LOS =

What is the Bike LOS if a bike lane were added?

LOS =

If the speed limit were changed to 25 mph (no bike lane)?

LOS =

Example 1

- Area type: Large Urbanized
  - Class 2 arterial
- ARTPLAN defaults
- 3 Signals, 2 segments
- Through g/C: .44
- Facility: 4-lane divided
- K Factor: .09
- D Factor: .55
- AADT: 30,000
- Bike lanes : None

Pedestrian LOS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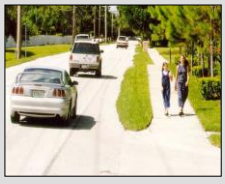
Pedestrian LOS

Factors Affecting Pedestrian Quality of Service

- Presence of a sidewalk
- Lateral separation of pedestrians and motorized vehicles
  - Includes presence of barriers and buffers, i.e. parked cars, trees
- Motorized vehicle
  - Volume
  - Speed



249

2015 Q/LOS Training

Pedestrian LOS

Input Variables

- **Sidewalk** - paved walkway at the side of a roadway, typically 5 feet in width (on the directional side of the arterial being analyzed)

- **Sidewalk Protective Barrier** - Physical barriers of at least 3' high and spacing of 20' or less that separate pedestrians from vehicles, such as planted trees and on-street parking.

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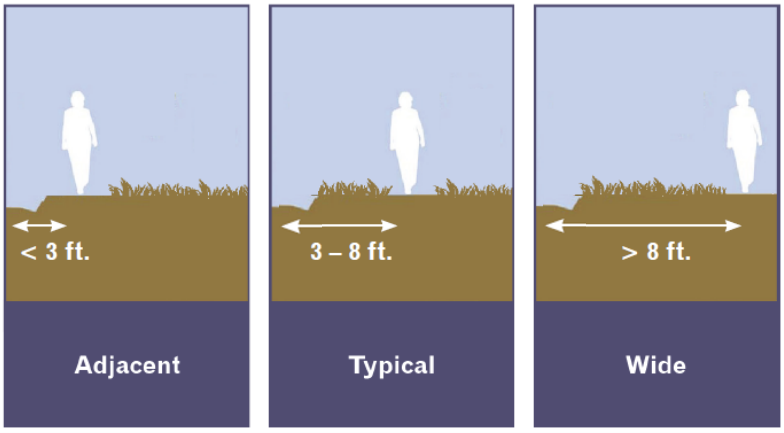
2015 Q/LOS Training

Pedestrian LOS

Input Variables

- **Sidewalk/Roadway Separation**
  - lateral distance in feet from the outside edge of pavement (before the gutter pan) to the inside edge of the sidewalk



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2015 Q/LOS Training

Pedestrian LOS

- Model developed in 2000 from FDOT sponsored research in Pensacola

A/B

C/D

E/F

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2015 Q/LOS Training

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Pedestrian LOS

$$\text{Ped LOS} = -1.2276\, ln(W_{ol} + W_l + f_p \times \%OSP + f_b \times W_b + f_{sw} \times W_s) + 0.0091(Vol_{15}/L) + 0.004SPD^2 + 6.0468$$

Where:

PLOS	=	Pedestrian level of service score
ln	=	Natural log
W_{ol}	=	Width of outside lane
W_l	=	Width of shoulder or bicycle lane
f_p	=	On-street parking effect coefficient (=0.20)
%OSP	=	Percent of segment with occupied on-street parking
f_b	=	Buffer area barrier coefficient (=5.37 for trees spaced 20 feet on center)
W_b	=	Buffer width (distance between edge of pavement and sidewalk, feet)
fs_w	=	Sidewalk presence coefficient (= 6 – 0.3Ws)
W_s	=	Width of sidewalk
Vol_{15}	=	Volume of motorized vehicles in the peak 15 minute period
L	=	Total number of directional thru lanes
SPD	=	Average running speed of motorized vehicles traffic (mi/hr)

253

Pedestrian LOS

LOS	Score
A	≤ 2.0
B	≤ 2.75
C	≤ 3.5
D	≤ 4.25
E	≤ 5.0
F	> 5.0

HCM 2010 Exhibit 17-3
LOS Criteria: Pedestrian Mode

254

Pedestrian LOS

- Input factors
  - **Sidewalk (y/n)**
  - Sidewalk/roadway separation
  - Sidewalk/roadway separation barrier
  - Traffic volume
  - Motorized vehicle speed

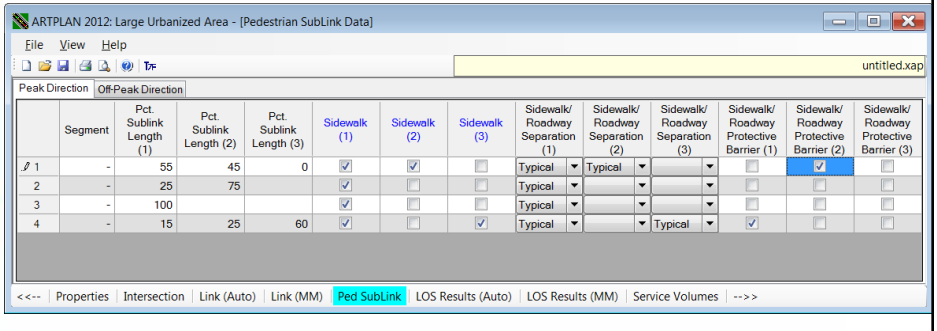
Pedestrian LOS is an integrated module in ARTPLAN

255

Pedestrian LOS

Pedestrian Sub Link Screen

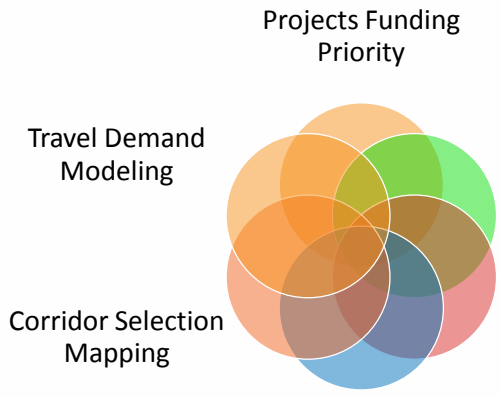
- Allows for coding changes in sidewalks along a segment



256

Pedestrian LOS

Potential Applications



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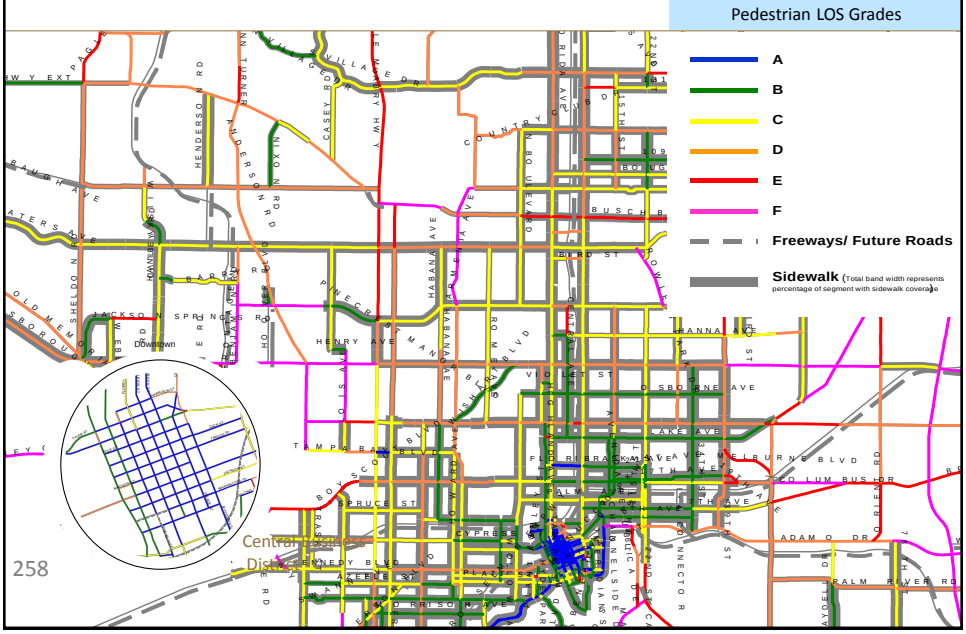
2015 Q/LOS Training

Pedestrian LOS

City of Tampa

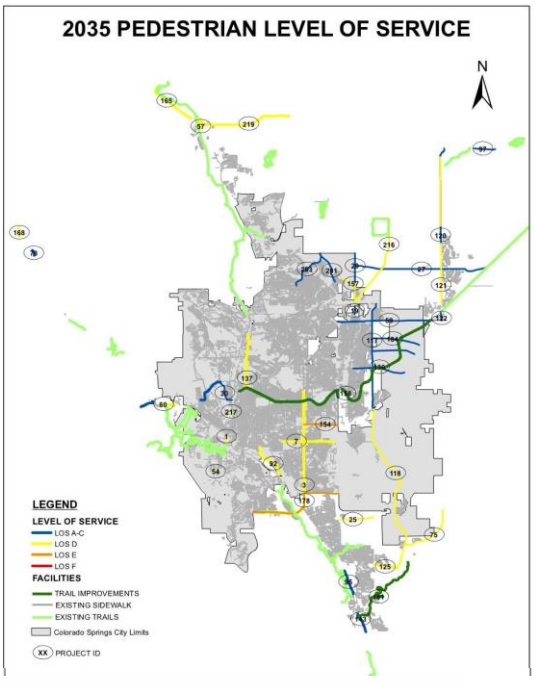


258

Pedestrian LOS

Colorado Springs MPO LRTP Networks

- PLOS changes from 2005 to 2035 model roadway network



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Pedestrian LOS

ARTPLAN: Pedestrian LOS Example

Instructions

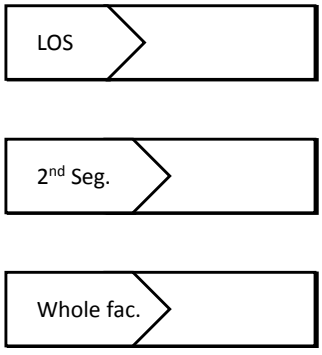
Open a new ARTPLAN file and input the variables on the following slide

260

Pedestrian LOS

Example 1

- **What is the pedestrian LOS?**
- **What is the pedestrian LOS if a sidewalk with typical separation were added to the**
  - **2nd segment only?**
  - **Whole facility?**



- Area type: Large Urbanized
- Opening ARTPLAN defaults
- Facility:
  - Class 2 arterial
- Number of Signals: 3
- Through g/C: .44
- 4-lane divided
- K Factor: .09
- D Factor: .565
- AADT of 34,000
- Sidewalk : None

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Agenda – Day Two

8:30 AM	**9** Multimodal LOS Review	Martin
9:00 AM	**10** ARTPLAN – Bus Analysis	Martin
9:40 AM	**11** Monroe Street Video Data Collection	Martin
◄ 10:10 AM Break		
10:25 AM	**12** Monroe Street ARTPLAN analysis	Martin
◄ 11:45 AM Lunch		
1:00 PM	**13** FREEPLAN – Freeway analysis	Martin
◄ 2:30 PM Break		
2:45 PM	**14** Future Year Analysis, LOS Applications	Martin
4:00 PM	**15** Wrap-Up	Martin
◄ 4:30 PM Adjourn		

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ARTPLAN – Bus Analysis

Agenda Item 10

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2015 Q/LOS Training

Bus LOS

A/B

C/D

E/F

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2015 Q/LOS Training

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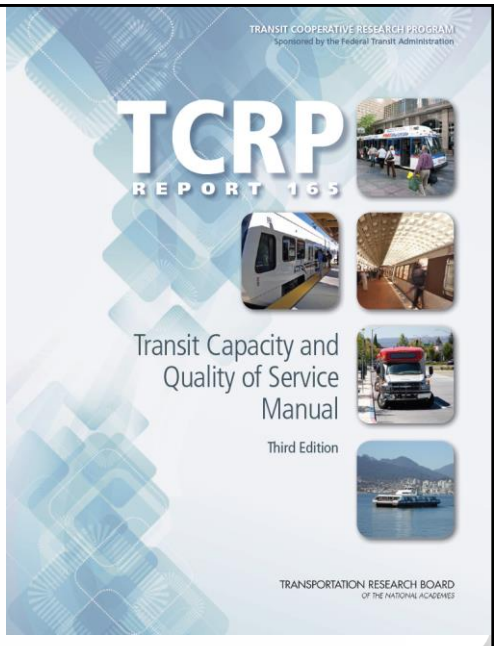
Bus LOS



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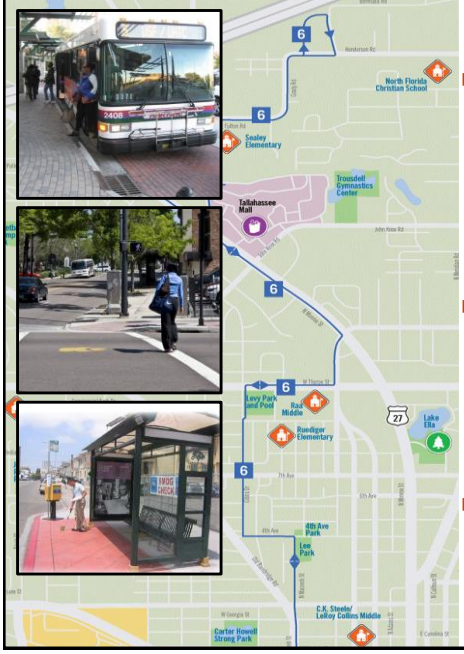
2015 Q/LOS Training 42

Bus LOS



Key Factors Affecting Transit QOS

- Availability (bus frequency)
  - Passenger loading
- Pedestrian LOS (accessibility)
  - Mid-block crossing difficulty
- Bus Stop Amenities

110

Bus LOS

Conceptual Planning

- Performance measure
  - Adjusted bus frequency
- Input factors
  - Bus frequency
  - Passenger Loading
  - Bus stop type and amenities
  - Pedestrian access factors
    - Pedestrian LOS (calculated within ARTPLAN)
    - Crossing difficulty (calculated within ARTPLAN)

Bus LOS is an integrated module in ARTPLAN

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Bus LOS

Headways

Level of Service	Adjusted Service Frequency (Vehicles/hour)	Headway (minutes)	Comments
A	>6.0	<10	Passengers do not need schedules
B	4.01 to 6.0	10 to 14	Frequent service, passengers consult schedules
C	3.0 to 4.0	15 to 20	Maximum desirable time to wait if transit vehicle missed
D	2.0 to 2.99	21 to 30	Service unattractive to choice riders
E	1.0 to 1.99	31 to 60	Service available during hour
F	<1.0	>60	Service unattractive to all riders

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Bus LOS

Bus Frequency Adjustments

Pedestrian LOS	Adjustment Factor
Pedestrian LOS A	1.15
Pedestrian LOS B	1.10
Pedestrian LOS C	1.05
Pedestrian LOS D	1.00
Pedestrian LOS E	0.80
Pedestrian LOS F	0.55

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Bus LOS

Input Variables

- Bus Stop Amenities
  - **Excellent** – Shelter and bench
  - **Good** – Shelter, no bench
  - **Fair** – Bench, no shelter
  - **Poor** – No bench or shelter

- Bus Stop Type
  - **Typical** – Dwell time approximately 15 s
  - **Major** – Dwell time approximately 35 s

Bus Stop Amenities	Adjustment Factor
Excellent	1.1
Good	1.0
Fair	1.0
Poor	0.9

270

Bus LOS

Input Variables

- Passenger Load Factor
  - Passengers divided by seats (0 - 300%)

Passenger Load Factor	Adjustment Factor
<30%	1.05
<70%	1.00
≤100%	0.95
>100%	0.85

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Bus LOS

Example 1

- Area type: Large Urbanized
- Opening ARTPLAN defaults
- Facility:
  - 4-lane divided Class 1 arterial
- AADT of 34,000
- K Factor: .09
- D Factor: .565
- Number of Signals: 4
- Through g/C: .45
- Bus frequency: 3
- Bus Stop Amenities: Excellent
- Speed = 45mph

What is Bus LOS?

LOS =

272

Bus LOS

Workshop 4.A

With inputs from Bus LOS Example #1 and the following bus inputs: What is the Bus Level of Service for each segment and the facility as a whole?

	From	To	Buses/Hr in peak direction	Existence of Sidewalk	Passenger Load	Stop Amenities
Freq. =	Easy	First	3	Yes	50%	Excellent
Freq. =	First	Second	2	Yes	60%	Excellent
Freq. =	Second	Third	2	No	60%	Excellent
Freq. =	Third	Mulberry	1	No	75%	Excellent

273

2015 Q/LOS Training

Overall LOS =

Bus LOS

Workshop 4.B

With inputs from Bus LOS Example #1 and the following bus inputs: What is the Bus Level of Service for each segment and the facility as a whole?

	From	To	Buses/Hr in peak direction	Existence of Sidewalk	Passenger Load	Stop Amenities
Freq. =	Easy	First	2	Yes	110%	Excellent
Freq. =	First	Second	2	Yes	80%	Excellent
Freq. =	Second	Third	2	No	80%	Excellent
Freq. =	Third	Mulberry	2	No	110%	Excellent

274

2015 Q/LOS Training

Overall LOS =

Bus LOS

Workshop 4.C

With inputs from Bus LOS Example #1 and the following bus inputs: What is the Bus Level of Service for each segment and the facility as a whole?

	From	To	Buses/Hr in peak direction	Existence of Sidewalk	Passenger Load	Stop Amenities
Freq. =	Easy	First	3	Yes	50%	Excellent
Freq. =	First	Second	2	Yes	60%	Good
Freq. =	Second	Third	2	No	60%	Fair
Freq. =	Third	Mulberry	1	No	75%	Poor

Overall LOS =

Bus LOS

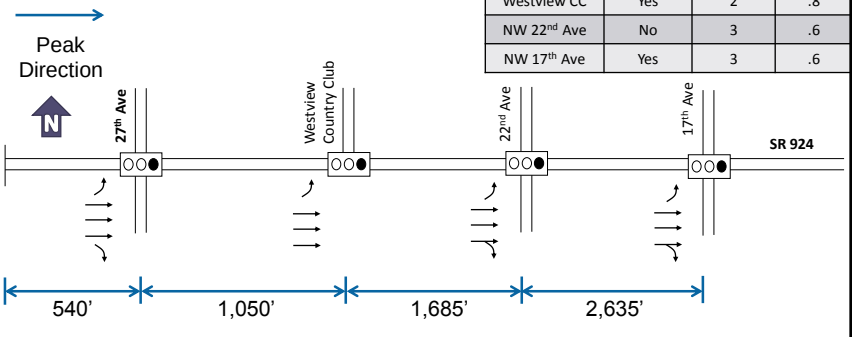
Use data file saved from Workshop 3 in ARTPLAN unit for the following Workshop 5

Workshop 5 *Known Inputs & Multimodal Analysis*

State Route 924 between 27th Ave & 17th Ave, Miami

- Non-restrictive median west of 27th Ave
- 40 mph posted speed limit

Segment	Sidewalk	Buses per hour	Load Factor
NW 27th Ave	Yes	2	.8
Westview CC	Yes	2	.8
NW 22nd Ave	No	3	.6
NW 17th Ave	Yes	3	.6



Bus LOS

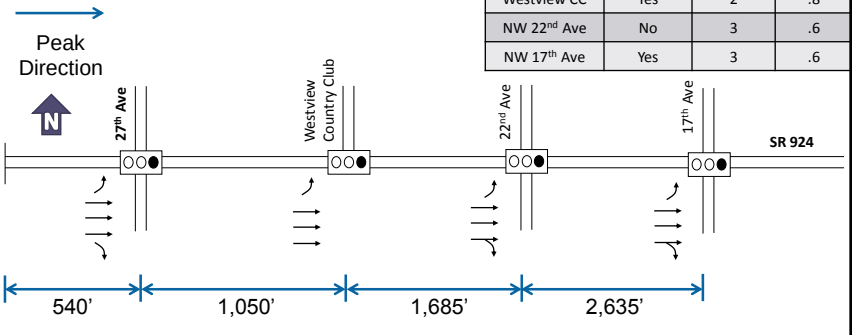
Use data file saved from Workshop 3 in ARTPLAN unit for the following Workshop 5

Workshop 5 *Known Inputs & Multimodal Analysis*

State Route 924 between 27th Ave & 17th Ave, Miami

- Non-restrictive median west of 27th Ave
- 40 mph posted speed limit

Segment	Sidewalk	Buses per hour	Load Factor
NW 27th Ave	Yes	2	.8
Westview CC	Yes	2	.8
NW 22nd Ave	No	3	.6
NW 17th Ave	Yes	3	.6



279

2015 Q/LOS Training

Monroe Street data collection

Agenda 11

280

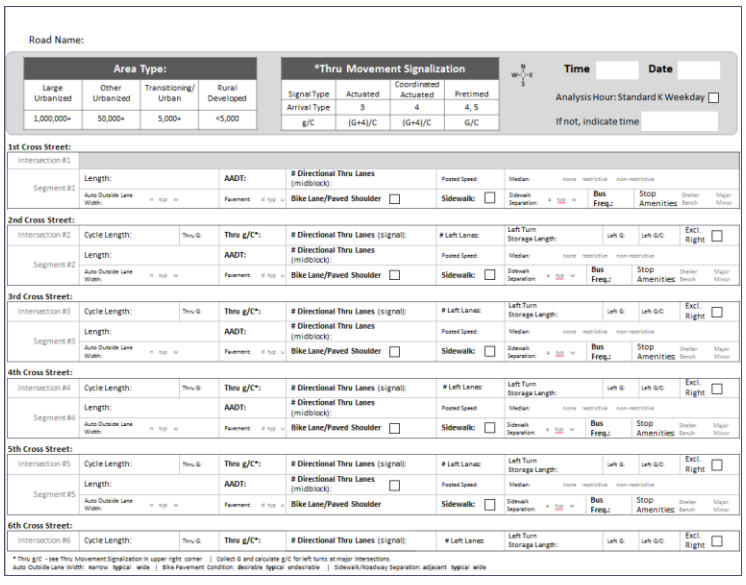
2015 Q/LOS Training

Table Workshop

North Monroe

281

Data Collection Sheet



Road Name:

Area Type:			
Large Urbanized	Other Urbanized	Transitioning/ Urban	Rural Developed
1,000,000+	50,000+	5,000+	<5,000

*Thru Movement Signalization			
Signal Type	Actuated	Coordinated Actuated	Pretimed
Arrival Type	3	4	4, 5
g/C	(G+4)/C	(G+4)/C	G/C

Time Date

Analysis Hour: Standard K Weekday ☐

If not, indicate time

1st Cross Street:

Intersection #1

Segment #1 — Length: | AADT: | # Directional Thru Lanes (midblock): | Posted Speed: | Median: none restrictive non-restrictive | Auto Outside Lane Width: n typ w | Pavement: d typ u | Bike Lane/Paved Shoulder ☐ | Sidewalk: ☐ | Sidewalk Separation: n typ w | Bus Freq.: | Stop Amenities: Shelter Bench Major Minor

2nd Cross Street:

Intersection #2 — Cycle Length: | Thru G: | Thru g/C*: | # Directional Thru Lanes (signal): | # Left Lanes: | Left Turn Storage Length: | Left G: | Left G/C: | Excl. Right ☐

Segment #2 — Length: | AADT: | # Directional Thru Lanes (midblock): | Posted Speed: | Median: none restrictive non-restrictive | Auto Outside Lane Width: n typ w | Pavement: d typ u | Bike Lane/Paved Shoulder ☐ | Sidewalk: ☐ | Sidewalk Separation: n typ w | Bus Freq.: | Stop Amenities: Shelter Bench Major Minor

3rd Cross Street:

Intersection #3 — Cycle Length: | Thru G: | Thru g/C*: | # Directional Thru Lanes (signal): | # Left Lanes: | Left Turn Storage Length: | Left G: | Left G/C: | Excl. Right ☐

Segment #3 — Length: | AADT: | # Directional Thru Lanes (midblock): | Posted Speed: | Median: none restrictive non-restrictive | Auto Outside Lane Width: n typ w | Pavement: d typ u | Bike Lane/Paved Shoulder ☐ | Sidewalk: ☐ | Sidewalk Separation: n typ w | Bus Freq.: | Stop Amenities: Shelter Bench Major Minor

4th Cross Street:

Intersection #4 — Cycle Length: | Thru G: | Thru g/C*: | # Directional Thru Lanes (signal): | # Left Lanes: | Left Turn Storage Length: | Left G: | Left G/C: | Excl. Right ☐

Segment #4 — Length: | AADT: | # Directional Thru Lanes (midblock): | Posted Speed: | Median: none restrictive non-restrictive | Auto Outside Lane Width: n typ w | Pavement: d typ u | Bike Lane/Paved Shoulder ☐ | Sidewalk: ☐ | Sidewalk Separation: n typ w | Bus Freq.: | Stop Amenities: Shelter Bench Major Minor

5th Cross Street:

Intersection #5 — Cycle Length: | Thru G: | Thru g/C*: | # Directional Thru Lanes (signal): | # Left Lanes: | Left Turn Storage Length: | Left G: | Left G/C: | Excl. Right ☐

Segment #5 — Length: | AADT: | # Directional Thru Lanes (midblock): ☐ | Posted Speed: | Median: none restrictive non-restrictive | Auto Outside Lane Width: n typ w | Pavement: d typ u | Bike Lane/Paved Shoulder | Sidewalk: ☐ | Sidewalk Separation: n typ w | Bus Freq.: | Stop Amenities: Shelter Bench Major Minor

6th Cross Street:

Intersection #6 — Cycle Length: | Thru G: | Thru g/C*: | # Directional Thru Lanes (signal): | # Left Lanes: | Left Turn Storage Length: | Left G: | Left G/C: | Excl. Right ☐

* Thru g/C - see Thru Movement Signalization in upper right corner | Collect G and calculate g/C for left turns at major intersections.
Auto Outside Lane Width: narrow typical wide | Bike Pavement Condition: desirable typical undesirable | Sidewalk/Roadway Separation: adjacent typical wide

282

Monroe Street ARTPLAN ANALYSIS

AGENDA ITEM 12

283

Freeway Capacity and LOS Analysis

AGENDA ITEM 13

284

- Strengths
  - Requires only basic geometry and volume information for LOS estimation
  - Includes extensions of HCM methodology for planning use
  - Incorporates Florida specific adjustments

285

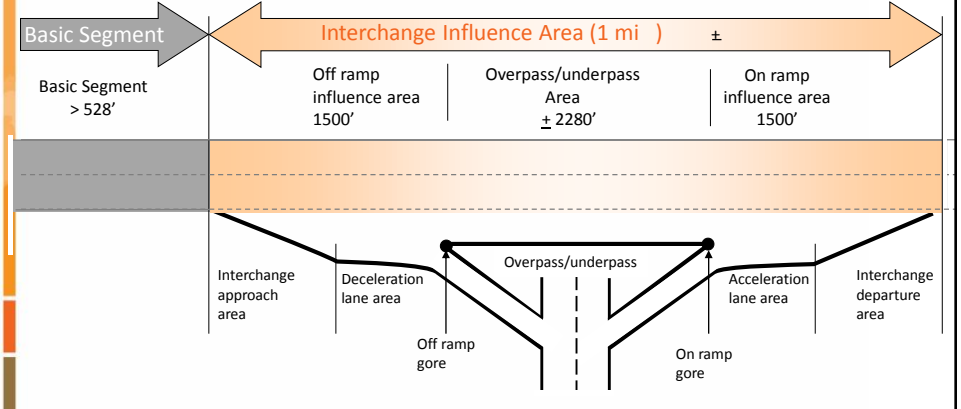
When to use other tools

- When conducting operational or design level analysis

286

- **Point**
  - Off ramp gore
- **Subsegment**
  - Off ramp influence area
  - Overpass/underpass
  - On ramp influence area
- **Segment**
  - Basic
  - Interchange influence area
- **Section**
  - Basic segment + next interchange influence area
- **Facility**
  - Combination of segments/sections

287



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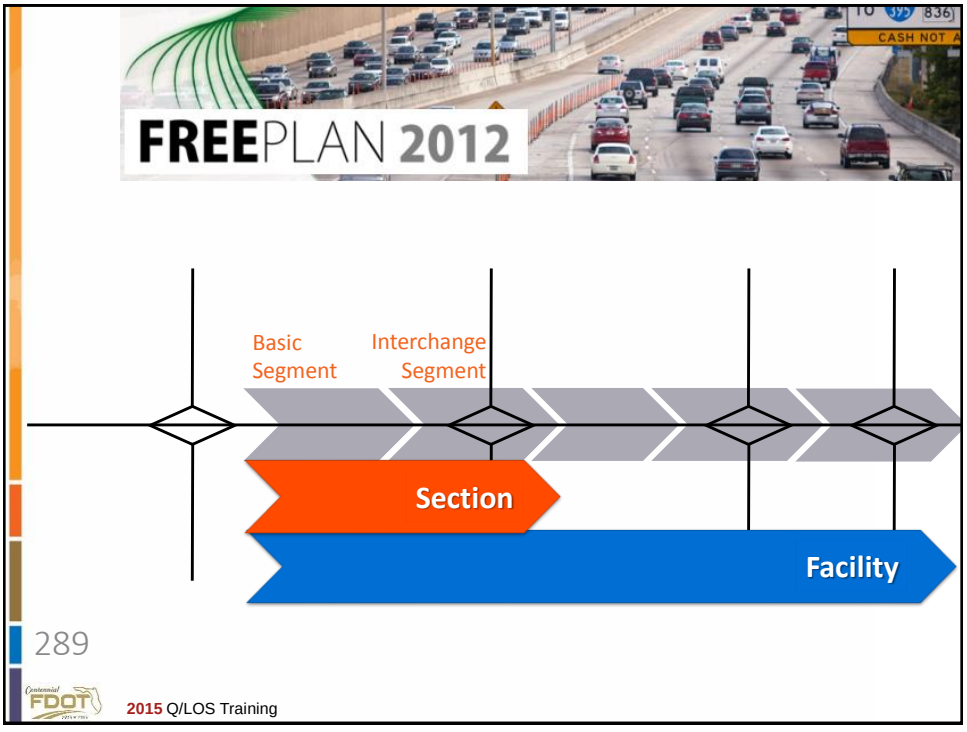
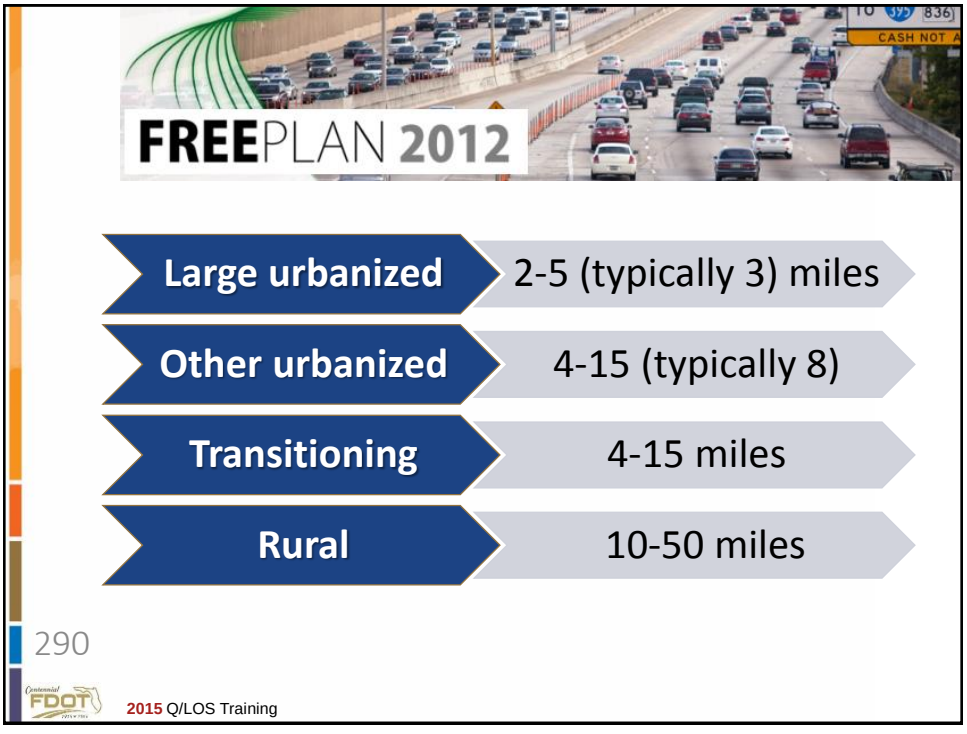

FREEPLAN 2012
Basic Segment
Interchange Segment
Section
Facility
289
2015 Q/LOS Training


FREEPLAN 2012
Large urbanized
2-5 (typically 3) miles
Other urbanized
4-15 (typically 8)
Transitioning
4-15 miles
Rural
10-50 miles
290
2015 Q/LOS Training

Freeway Level of Service Analysis

291

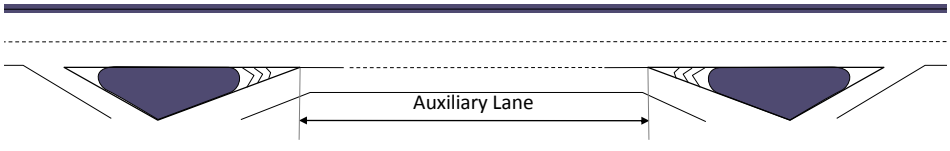
Developed for planning applications	Directly applicable to Florida
• Calculates LOS for design concept and scope • Determines maximum service volumes • Identifies "hot spots"	• Matches well with Florida freeway capacities • Warnings if values are out of line

HCM Based

292

- **Freeway operational features**
  - Auxiliary lanes
  - Extensions of ramp acceleration and deceleration lanes
  - Ramp metering
  - Ramp terminal capacity check

293



Auxiliary Lane

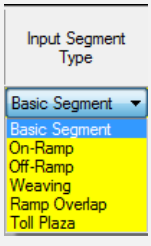
294

1. **Provide facility characteristics** → Roadway → Traffic → Especially key input variables
2. **Provide segment characteristics** → Segment types → Ramp traffic / information (if desired) → Ramp capacity check (if desired)
3. **Compute LOS** → Analyze "hot spots" (if desired)
4. **Compute service volume table**

295

Segment Types

1. Basic
2. On-Ramp
3. Off-Ramp
4. Ramp Overlap
5. Weaving
6. Toll Plaza



Segment Length

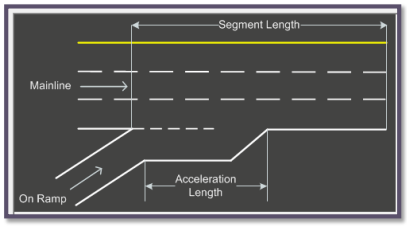
Default Segments	Length (in feet)
Basic Segment	5280
On-Ramp Segment	1500
Off-Ramp Segment	1500
Ramp Overlap Segment	500
Weaving Segment	3000
Toll Plaza Segment	3000

Default Values

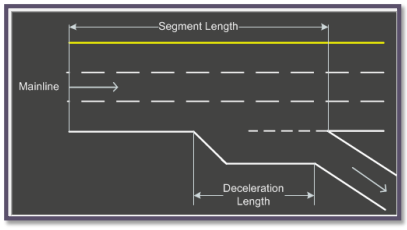
29

FREEPLAN Definitions

- **Acceleration Length –** Measured from on-ramp gore to the end of the taper; Typically 1,000’



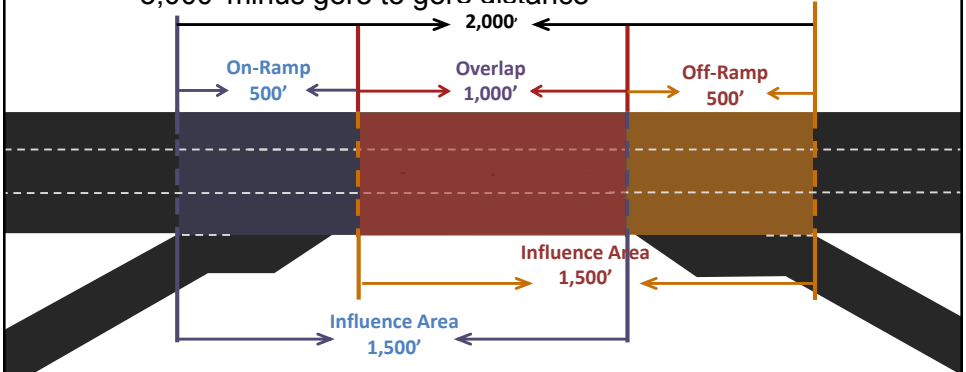
- **Deceleration Length –** Measured from beginning of taper to off-ramp gore; typically 450’



297

FREEPLAN Definitions

- **Ramp Overlap** - occurs when the influence area of an on-ramp and the influence area of an off-ramp extend into one another, creating an overlap in the influence areas; typically 3,000’ minus gore to gore distance



298

FREEPLAN Definitions

- **Ramp Metering –** used to control the flow of vehicles entering the freeway from on-ramps, in an effort to reduce the turbulence in the merge area and delay the onset of a potential breakdown.

299

FREEPLAN

Example 1

Basic/Ramps/Ramp Overlap

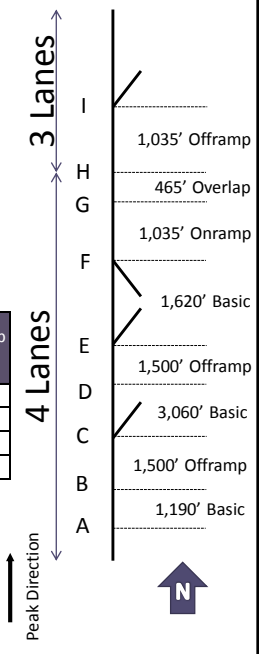
I-4 between Princeton St & Lee Rd, Orlando

- Large urbanized area type
- Core freeway – K-factor of 8.0 (K_{other})
- 50 mph posted speed limit

Segment	Segment Name	Type	Ramp Demand	# of Ramp Lanes	Ramp % Heavy Vehicles	Acc/Dec Length [ft]	Ramp FFS
2	B-C	Off-Ramp	486	1	4.0	740	40
4	D-E	Off-Ramp	720	1	4.0	600	40
6	F-G	On-Ramp	486	1	4.0	600	40
8	H-I	Off-Ramp	945	1	4.0	1,500	40

D-Factor	% Heavy Vehicles	Local Adjustment Factor
51.8	4.0	0.98

138,250 AADT



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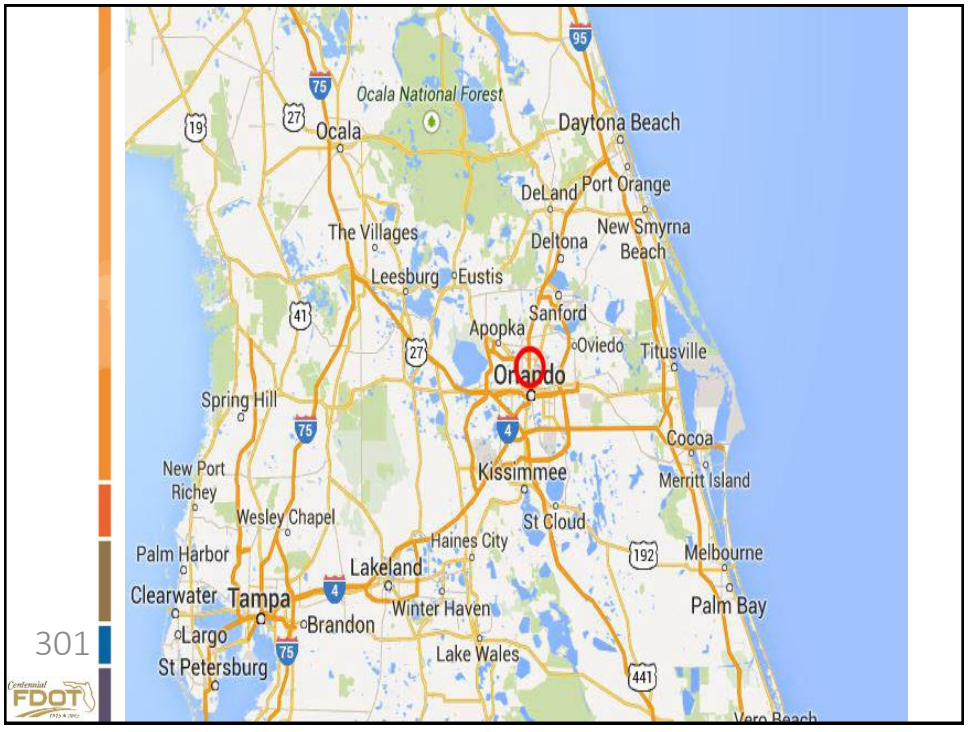
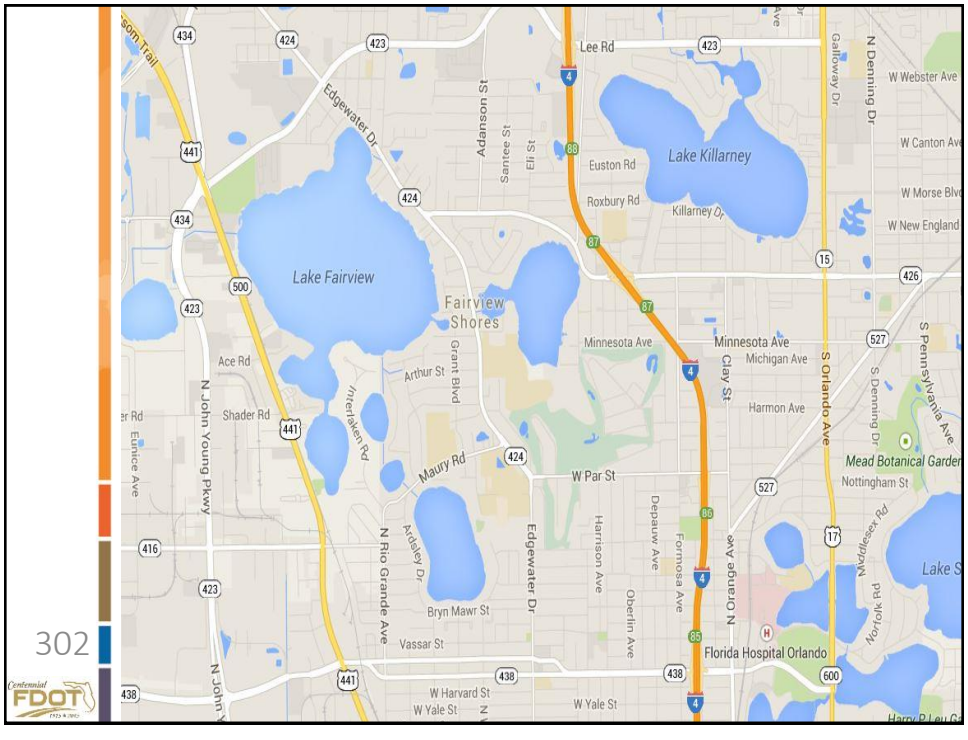
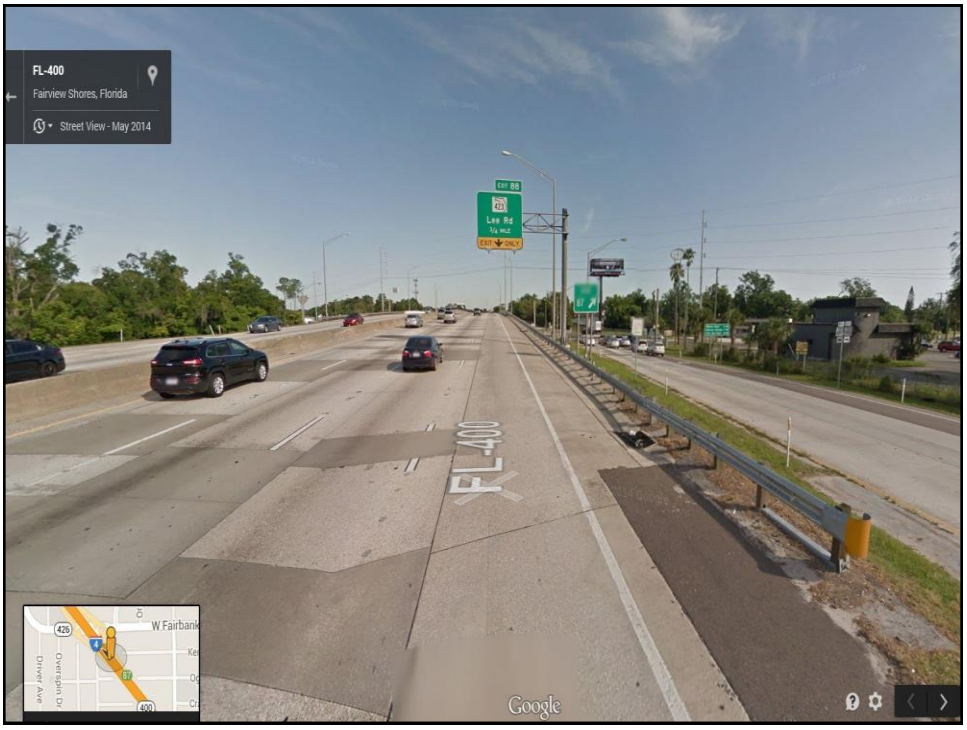
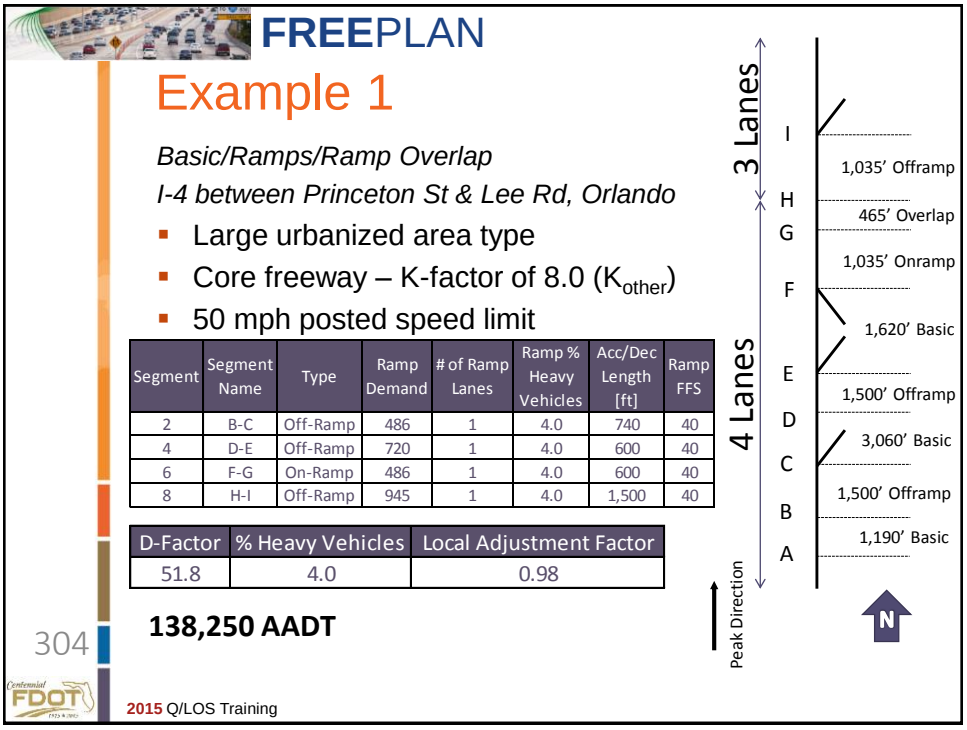

Ocala National Forest
Ocala
Daytona Beach
DeLand
Port Orange
The Villages
Deltona
New Smyrna Beach
Leesburg
Eustis
Sanford
Apopka
Oviedo
Titusville
Orlando
Spring Hill
Cocoa
Kissimmee
New Port Richey
Merritt Island
Wesley Chapel
St Cloud
Haines City
Palm Harbor
Lakeland
Melbourne
Clearwater
Tampa
Winter Haven
Palm Bay
Brandon
Largo
Lake Wales
St Petersburg
Vero Beach

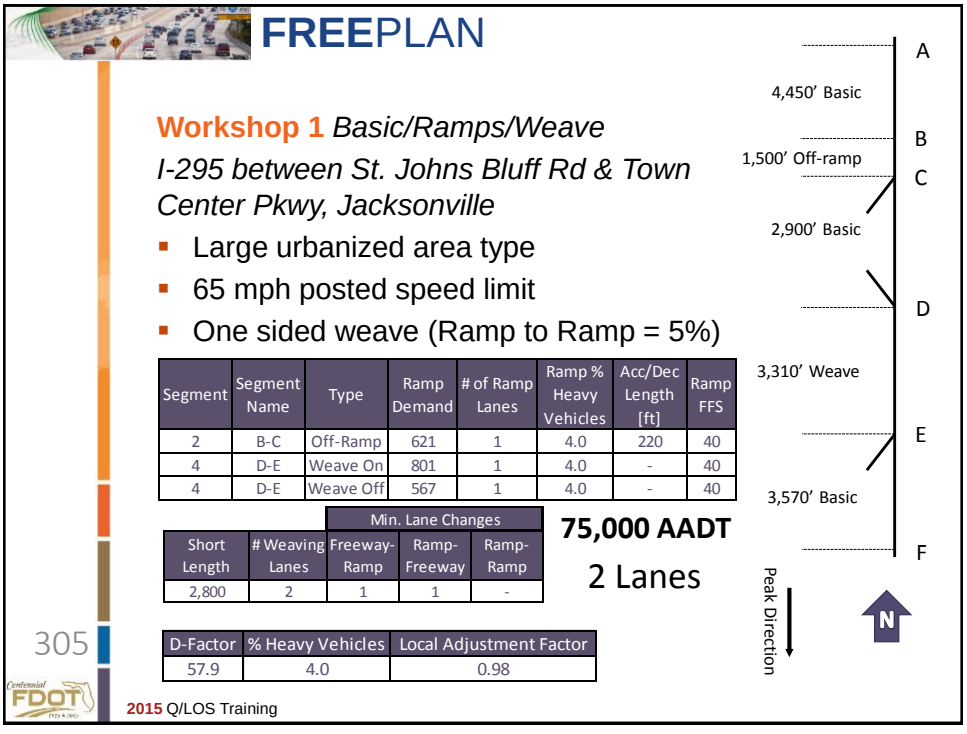
301

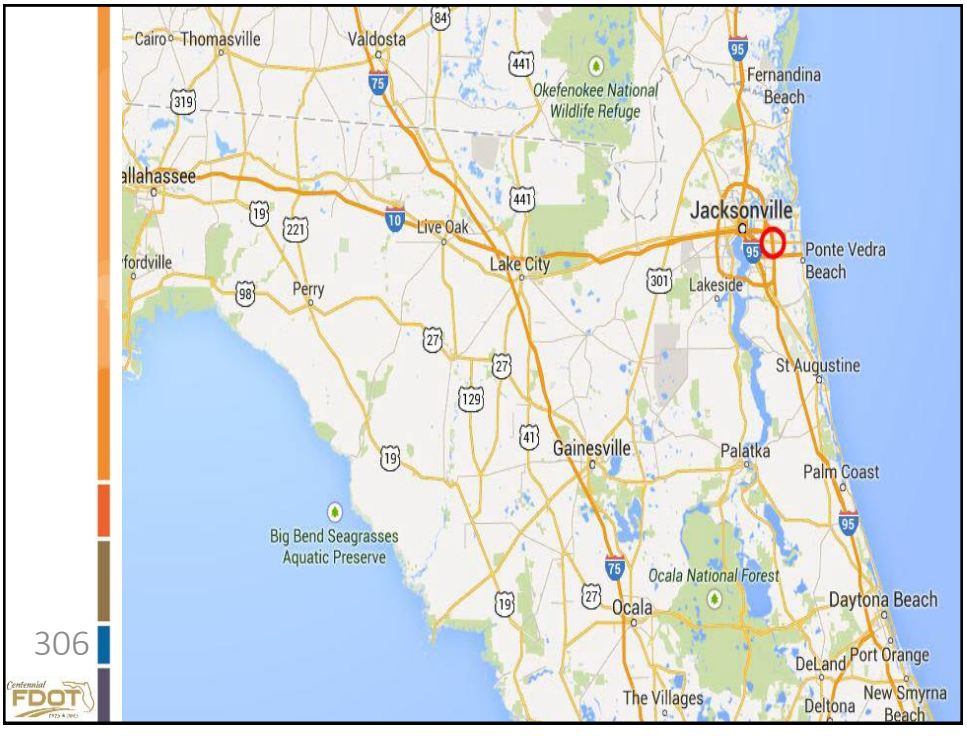

Lee Rd
Edgewater Dr
Adanson St
Lake Killarney
Euston Rd
Roxbury Rd
W Webster Ave
W Canton Ave
W Morse Blvd
W New England
Lake Fairview
Fairview Shores
Minnesota Ave
Michigan Ave
Ace Rd
Arthur St
Grant Blvd
Clay St
Harmon Ave
S Orlando Ave
S Pennsylvania Ave
Shader Rd
N John Young Pkwy
Interlaken Rd
Maury Rd
W Par St
Nottingham St
Mead Botanical Garden
N Rio Grande Ave
Bryn Mawr St
Vassar St
Harrison Ave
Oberlin Ave
Formosa Ave
Orange Ave N
Florida Hospital Orlando
W Harvard St
W Yale St

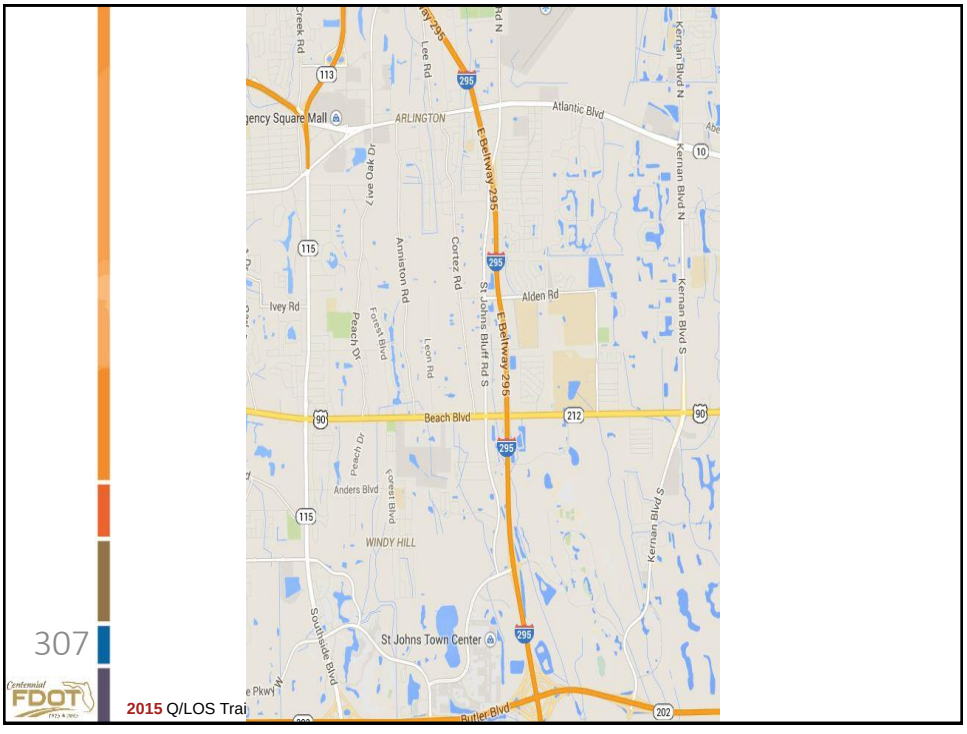
302


FL-400
Fairview Shores, Florida
Street View - May 2014
Lee Rd
FL-400
Google

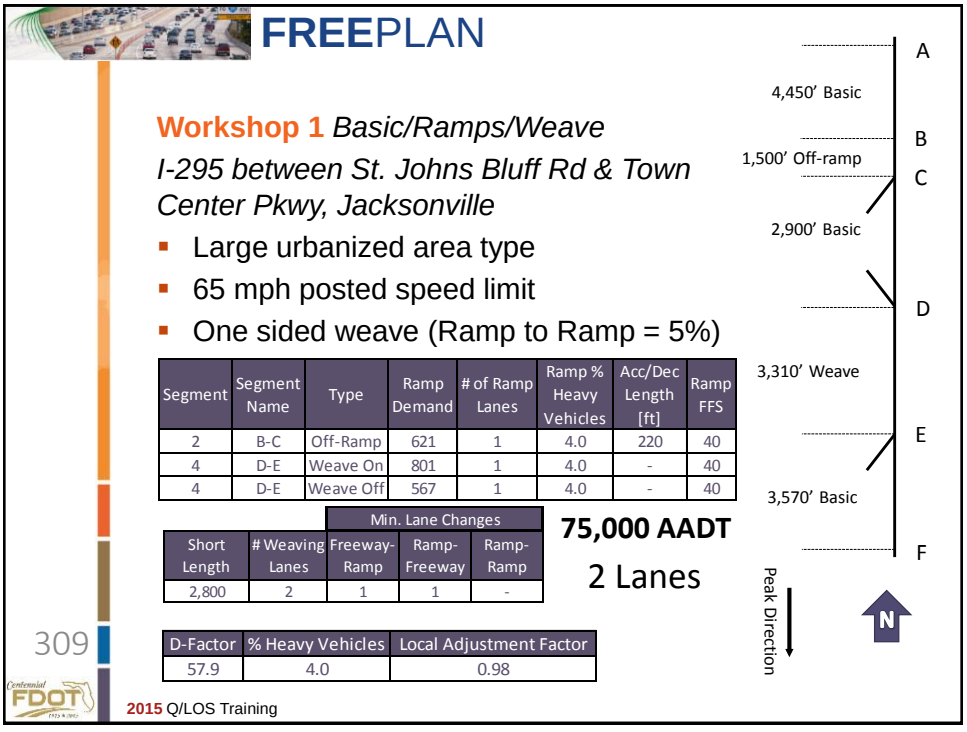

FREEPLAN
Example 1
Basic/Ramps/Ramp Overlap
I-4 between Princeton St & Lee Rd, Orlando
Large urbanized area type
Core freeway – K-factor of 8.0 (K_{other})
50 mph posted speed limit
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 486 | 1 | 4.0 | 740 | 40
4 | D-E | Off-Ramp | 720 | 1 | 4.0 | 600 | 40
6 | F-G | On-Ramp | 486 | 1 | 4.0 | 600 | 40
8 | H-I | Off-Ramp | 945 | 1 | 4.0 | 1,500 | 40
D-Factor | % Heavy Vehicles | Local Adjustment Factor
51.8 | 4.0 | 0.98
138,250 AADT
3 Lanes
4 Lanes
I
H
G
F
E
D
C
B
A
1,035' Offramp
465' Overlap
1,035' Onramp
1,620' Basic
1,500' Offramp
3,060' Basic
1,500' Offramp
1,190' Basic
Peak Direction
N
304
2015 Q/LOS Training


FREEPLAN
Workshop 1 Basic/Ramps/Weave
I-295 between St. Johns Bluff Rd & Town Center Pkwy, Jacksonville
Large urbanized area type
65 mph posted speed limit
One sided weave (Ramp to Ramp = 5%)
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 621 | 1 | 4.0 | 220 | 40
4 | D-E | Weave On | 801 | 1 | 4.0 | - | 40
4 | D-E | Weave Off | 567 | 1 | 4.0 | - | 40
Min. Lane Changes
Short Length | # Weaving Lanes | Freeway-Ramp | Ramp-Freeway | Ramp-Ramp
2,800 | 2 | 1 | 1 | -
75,000 AADT
2 Lanes
D-Factor | % Heavy Vehicles | Local Adjustment Factor
57.9 | 4.0 | 0.98
A
4,450' Basic
B
1,500' Off-ramp
C
2,900' Basic
D
3,310' Weave
E
3,570' Basic
F
Peak Direction
N
305
2015 Q/LOS Training


Cairo
Thomasville
Valdosta
Okefenokee National Wildlife Refuge
Fernandina Beach
allahassee
Live Oak
Jacksonville
Ponte Vedra Beach
Lake City
Lakeside
Perry
St Augustine
Gainesville
Palatka
Palm Coast
Big Bend Seagrasses Aquatic Preserve
Ocala National Forest
Ocala
Daytona Beach
DeLand
Port Orange
The Villages
Deltona
New Smyrna Beach
306


307
2015 Q/LOS Trai
Atlantic Blvd
ARLINGTON
E Beltway 295
Alden Rd
Beach Blvd
St Johns Town Center
WINDY HILL
Kernan Blvd N
Kernan Blvd S
Cortez Rd
Ivey Rd
Anders Blvd
Southside Blvd
Butler Blvd


Street View - Jul 2014
Google


FREEPLAN
Workshop 1 Basic/Ramps/Weave
I-295 between St. Johns Bluff Rd & Town Center Pkwy, Jacksonville
Large urbanized area type
65 mph posted speed limit
One sided weave (Ramp to Ramp = 5%)
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 621 | 1 | 4.0 | 220 | 40
4 | D-E | Weave On | 801 | 1 | 4.0 | - | 40
4 | D-E | Weave Off | 567 | 1 | 4.0 | - | 40
Min. Lane Changes
Short Length | # Weaving Lanes | Freeway-Ramp | Ramp-Freeway | Ramp-Ramp
2,800 | 2 | 1 | 1 | -
75,000 AADT
2 Lanes
D-Factor | % Heavy Vehicles | Local Adjustment Factor
57.9 | 4.0 | 0.98
A
4,450' Basic
B
1,500' Off-ramp
C
2,900' Basic
D
3,310' Weave
E
3,570' Basic
F
Peak Direction
N
309
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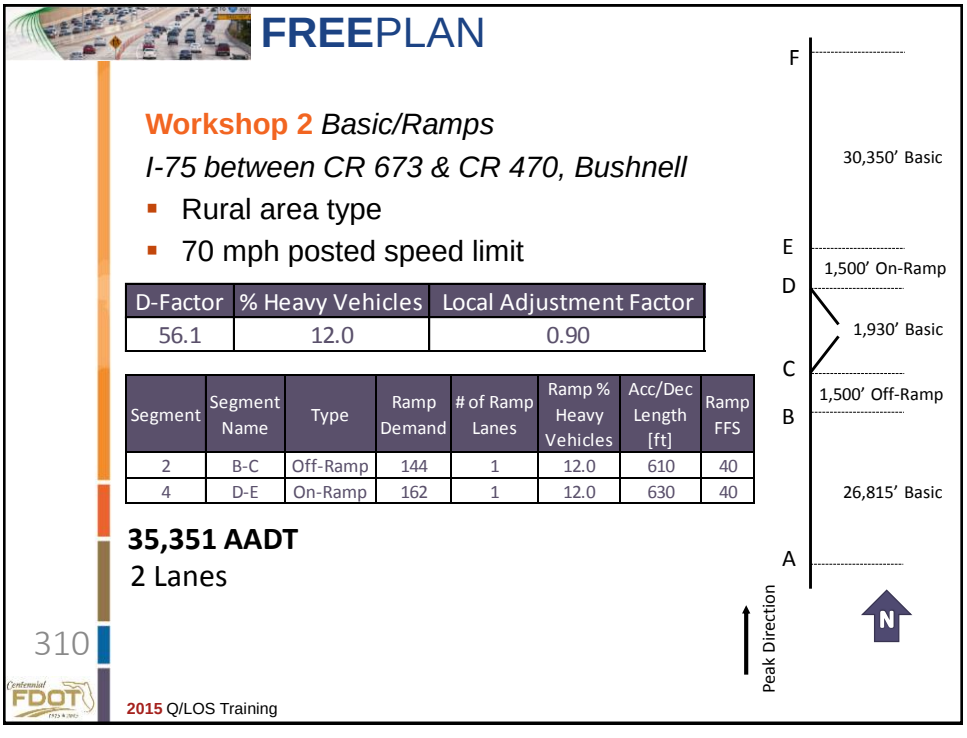
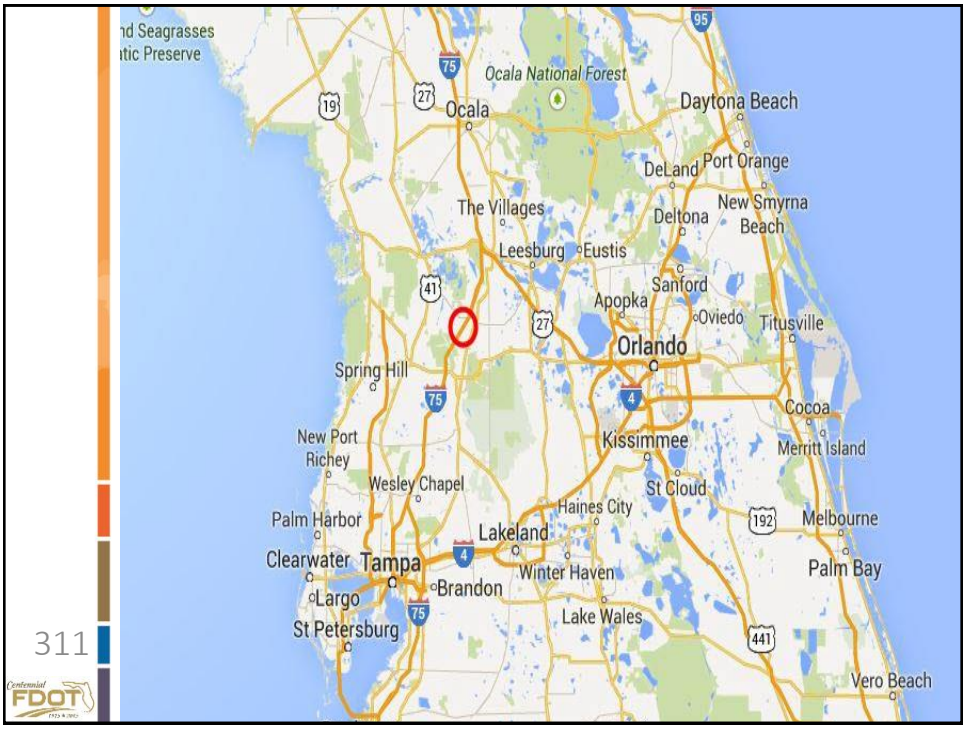
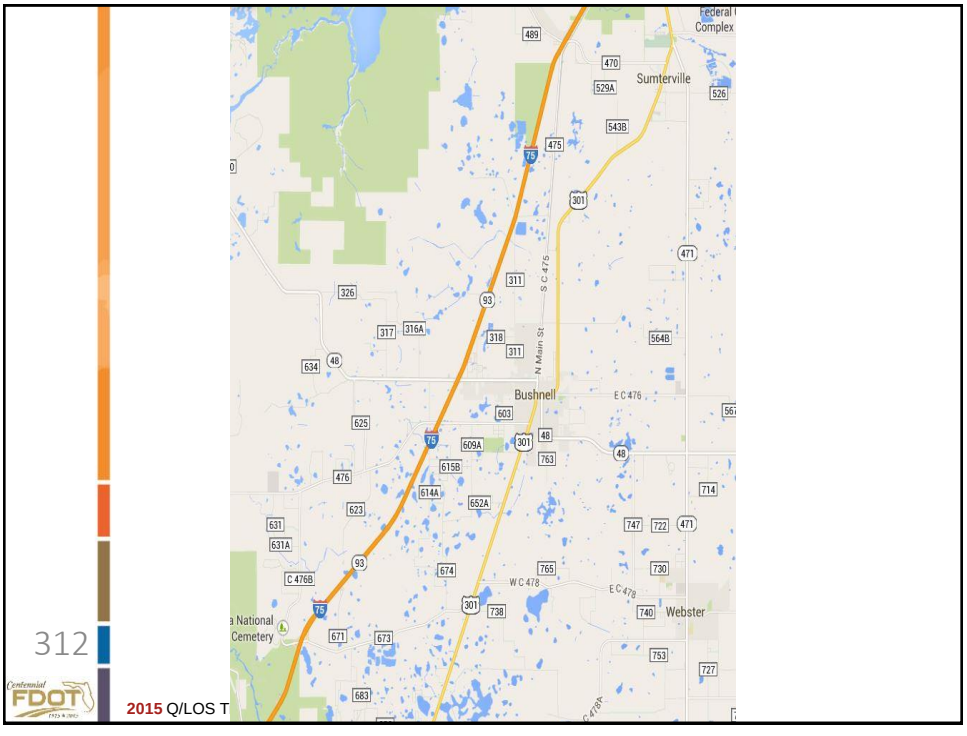

FREEPLAN
Workshop 2 Basic/Ramps
I-75 between CR 673 & CR 470, Bushnell
Rural area type
70 mph posted speed limit
D-Factor | % Heavy Vehicles | Local Adjustment Factor
56.1 | 12.0 | 0.90
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 144 | 1 | 12.0 | 610 | 40
4 | D-E | On-Ramp | 162 | 1 | 12.0 | 630 | 40
35,351 AADT
2 Lanes
F
30,350' Basic
E
1,500' On-Ramp
D
1,930' Basic
C
1,500' Off-Ramp
B
26,815' Basic
A
Peak Direction
N
310
2015 Q/LOS Training


Ocala National Forest
Ocala
Daytona Beach
DeLand
Port Orange
New Smyrna Beach
Deltona
The Villages
Leesburg
Eustis
Sanford
Apopka
Oviedo
Titusville
Orlando
Spring Hill
Cocoa
Kissimmee
Merritt Island
New Port Richey
Wesley Chapel
St Cloud
Haines City
Palm Harbor
Lakeland
Melbourne
Clearwater
Tampa
Winter Haven
Palm Bay
Largo
Brandon
Lake Wales
St Petersburg
Vero Beach
311


Sumterville
Bushnell
Webster
312
2015 Q/LOS T

FREEPLAN

Workshop 2 *Basic/Ramps*

I-75 between CR 673 & CR 470, Bushnell

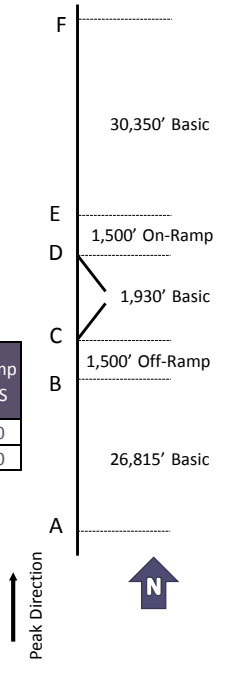
- Rural area type
- 70 mph posted speed limit

D-Factor	% Heavy Vehicles	Local Adjustment Factor
56.1	12.0	0.90

Segment	Segment Name	Type	Ramp Demand	# of Ramp Lanes	Ramp % Heavy Vehicles	Acc/Dec Length [ft]	Ramp FFS
2	B-C	Off-Ramp	144	1	12.0	610	40
4	D-E	On-Ramp	162	1	12.0	630	40

35,351 AADT

2 Lanes



314

FREEPLAN

Workshop 3 *Basic/Ramps*

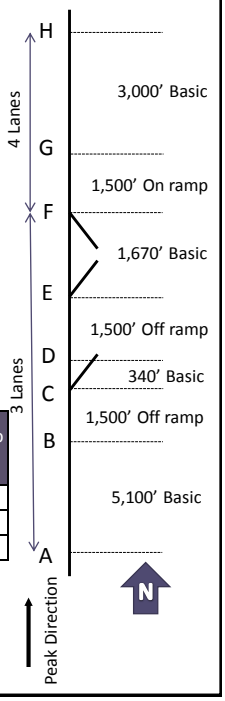
I-95 between FL 104 & FL 102, Jacksonville

- Large urbanized area type
- 70 mph posted speed limit

D-Factor	% Heavy Vehicles	Local Adjustment Factor
54.5	4.0	0.98

Segment	Segment Name	Type	Ramp Demand	# of Ramp Lanes	Ramp % Heavy Vehicles	Acc/Dec Length [ft]	Ramp FFS
2	B-C	Off-Ramp	387	1	4.0	260	45
4	D-E	Off-Ramp	234	1	4.0	830	45
6	F-G	On-Ramp	828	2	4.0	975	45

72,500 AADT



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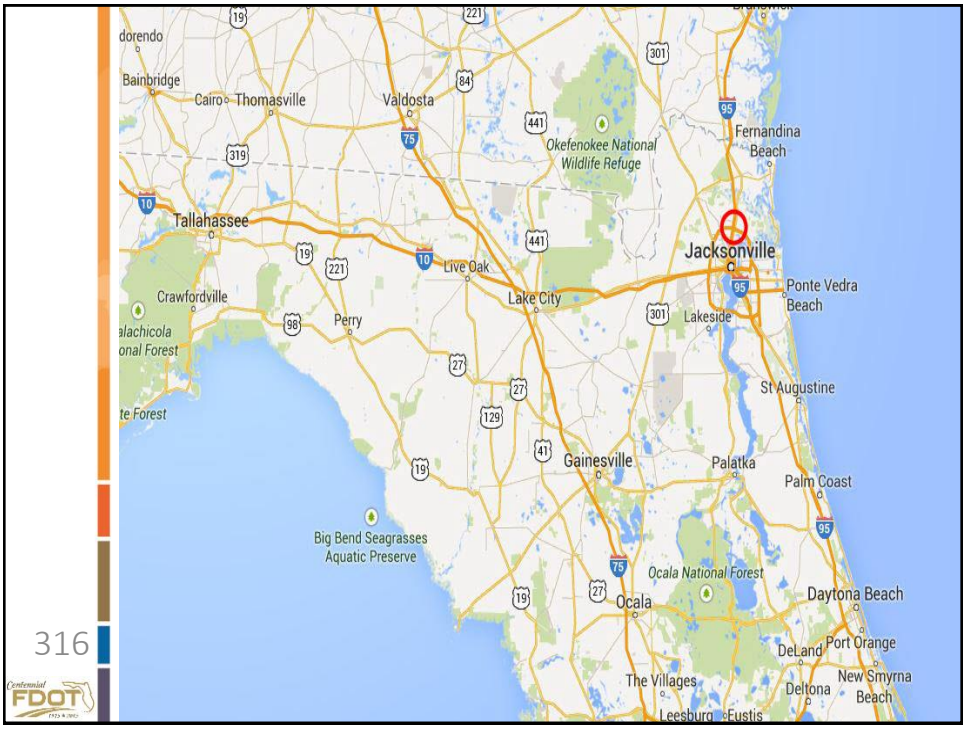

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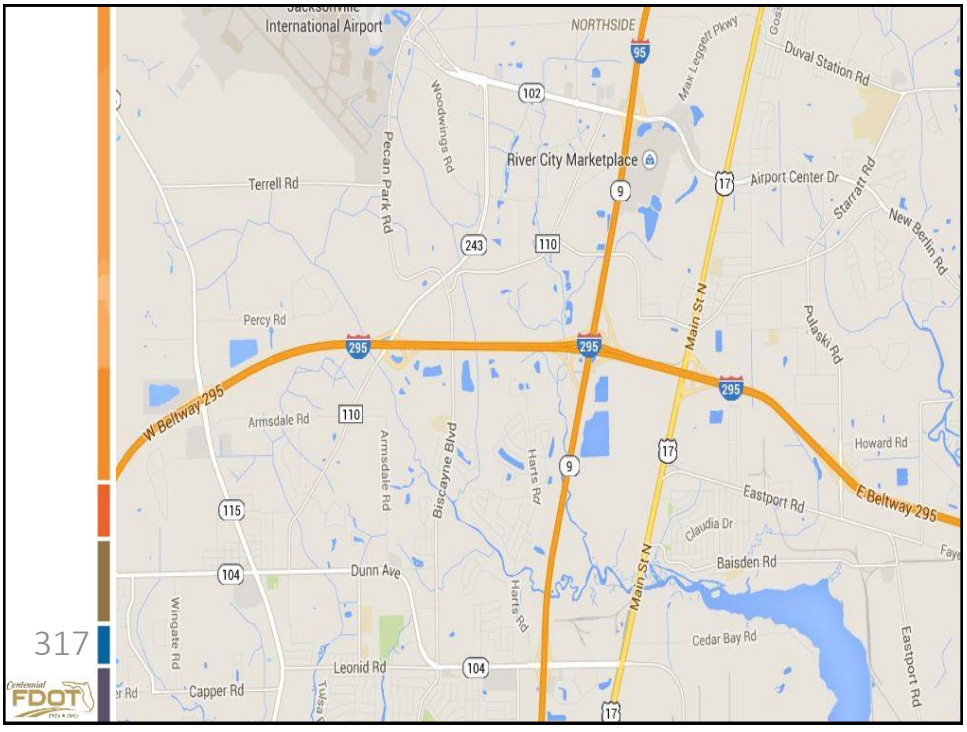
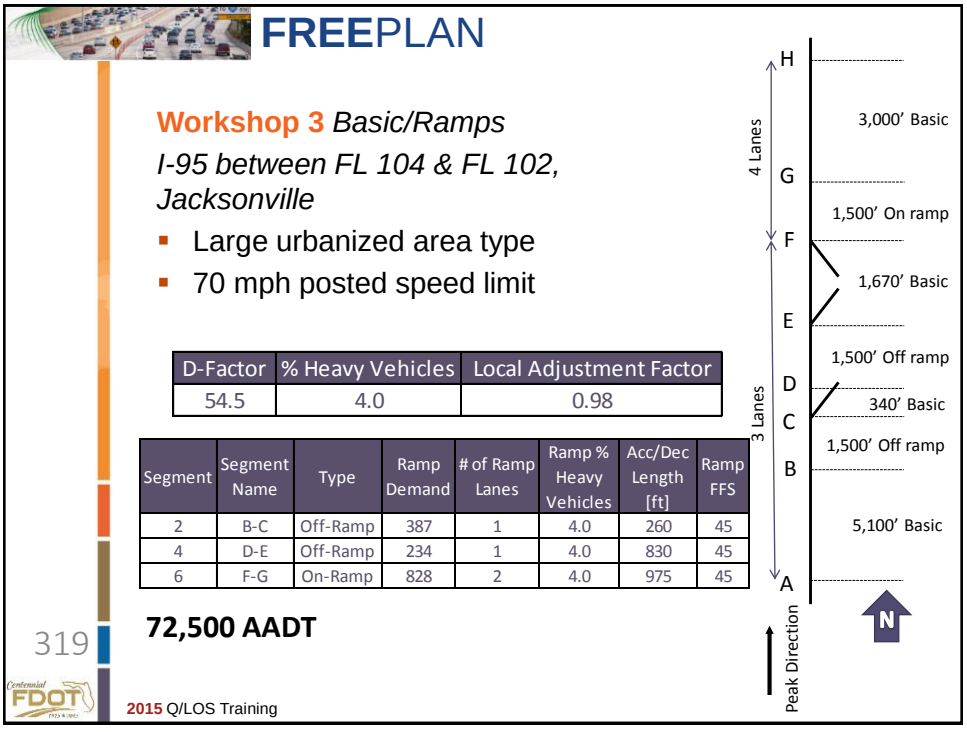
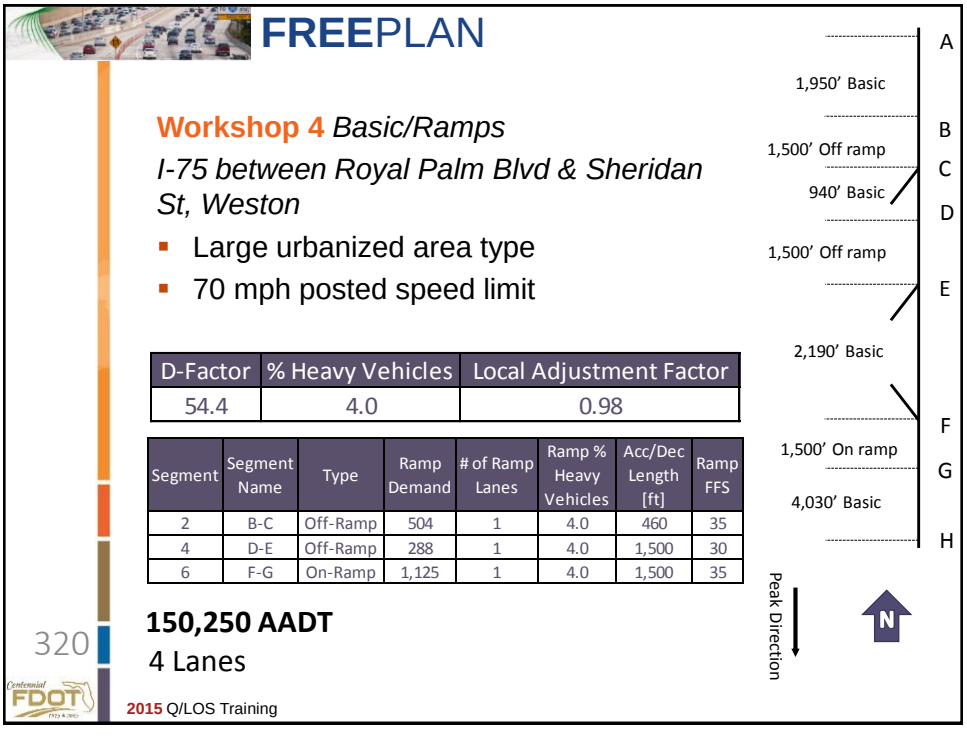
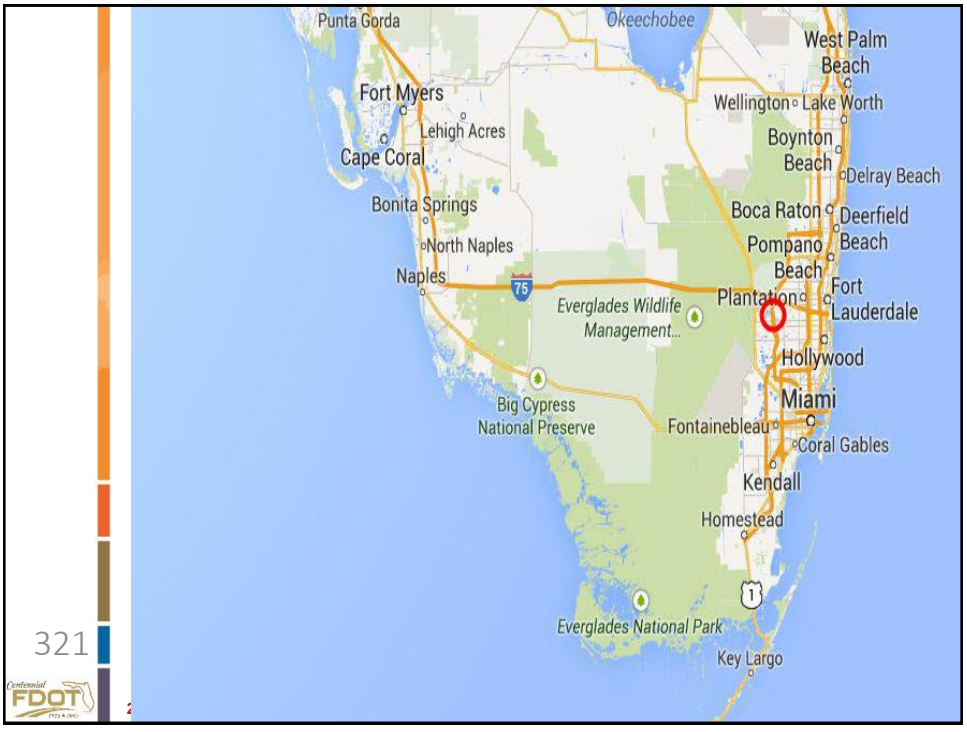

International Airport
NORTHSIDE
Max Leggett Pkwy
Duval Station Rd
Woodwings Rd
Pecan Park Rd
Terrell Rd
River City Marketplace
Airport Center Dr
Starratt Rd
New Berlin Rd
Percy Rd
Main St N
Pulaski Rd
W Beltway 295
Armsdale Rd
Biscayne Blvd
Harts Rd
Howard Rd
Eastport Rd
E Beltway 295
Claudia Dr
Baisden Rd
Dunn Ave
Wingate Rd
Cedar Bay Rd
Leonid Rd
Capper Rd
317

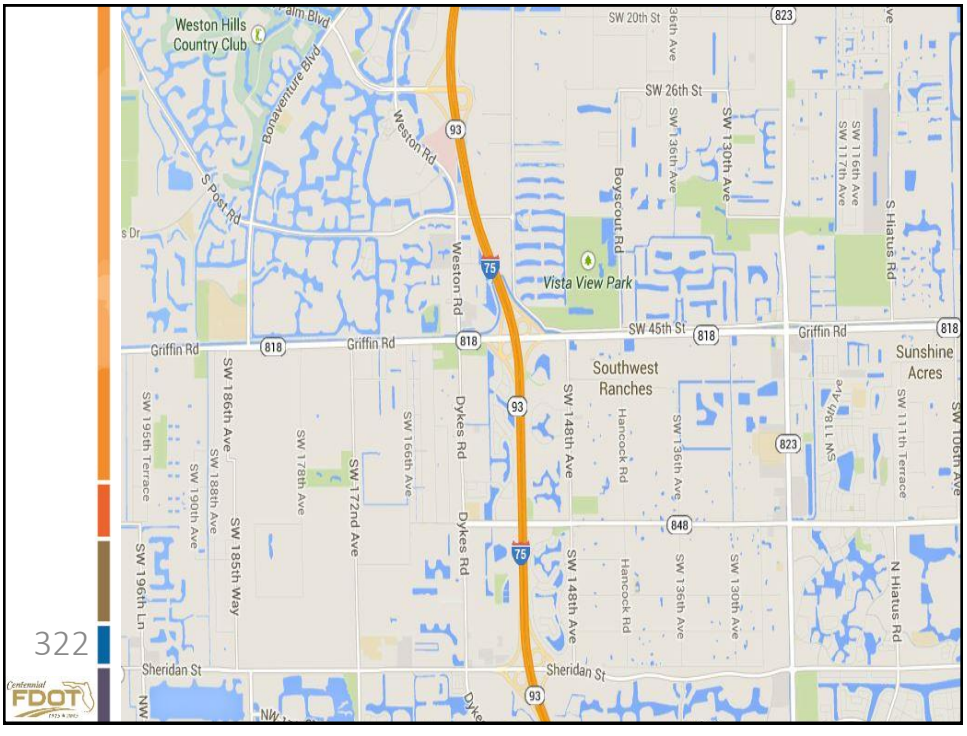

I-95
Jacksonville, Florida
Street View - Aug 2014
I-95
Google


FREEPLAN
Workshop 3 Basic/Ramps
I-95 between FL 104 & FL 102, Jacksonville
Large urbanized area type
70 mph posted speed limit
D-Factor | % Heavy Vehicles | Local Adjustment Factor
54.5 | 4.0 | 0.98
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 387 | 1 | 4.0 | 260 | 45
4 | D-E | Off-Ramp | 234 | 1 | 4.0 | 830 | 45
6 | F-G | On-Ramp | 828 | 2 | 4.0 | 975 | 45
72,500 AADT
319
2015 Q/LOS Training
4 Lanes
3 Lanes
H
G
F
E
D
C
B
A
3,000' Basic
1,500' On ramp
1,670' Basic
1,500' Off ramp
340' Basic
1,500' Off ramp
5,100' Basic
N
Peak Direction


FREEPLAN
Workshop 4 Basic/Ramps
I-75 between Royal Palm Blvd & Sheridan St, Weston
Large urbanized area type
70 mph posted speed limit
D-Factor | % Heavy Vehicles | Local Adjustment Factor
54.4 | 4.0 | 0.98
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 504 | 1 | 4.0 | 460 | 35
4 | D-E | Off-Ramp | 288 | 1 | 4.0 | 1,500 | 30
6 | F-G | On-Ramp | 1,125 | 1 | 4.0 | 1,500 | 35
150,250 AADT
4 Lanes
320
2015 Q/LOS Training
A
1,950' Basic
B
1,500' Off ramp
C
940' Basic
D
1,500' Off ramp
E
2,190' Basic
F
1,500' On ramp
G
4,030' Basic
H
N
Peak Direction

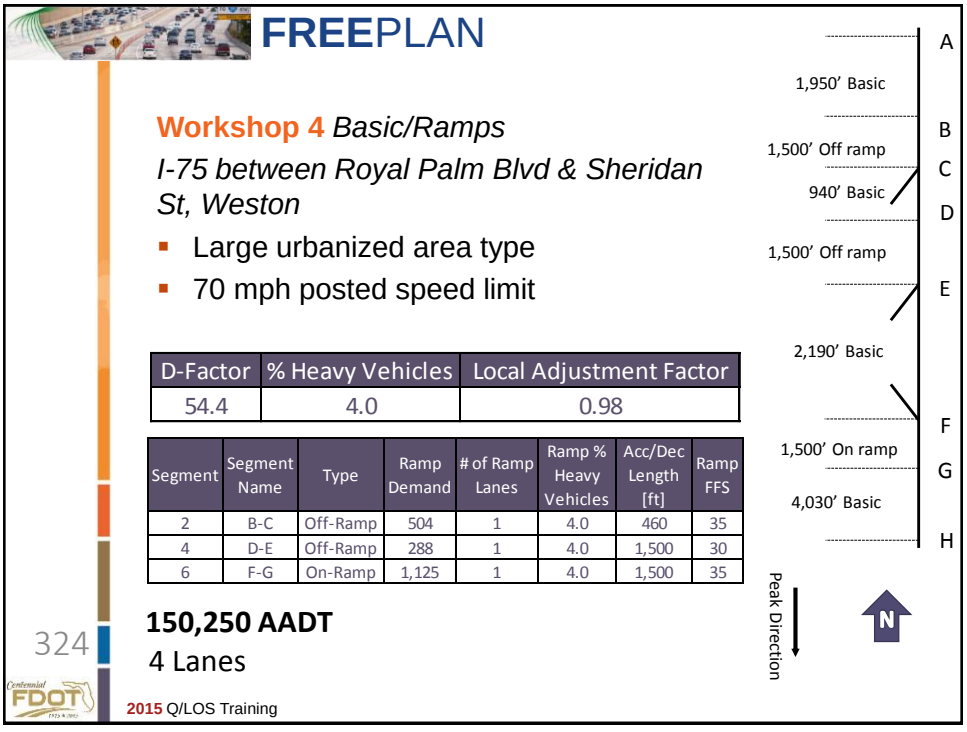

Punta Gorda
Okeechobee
West Palm Beach
Fort Myers
Wellington
Lake Worth
Lehigh Acres
Cape Coral
Boynton Beach
Delray Beach
Bonita Springs
Boca Raton
Deerfield Beach
North Naples
Pompano Beach
Naples
75
Everglades Wildlife Management...
Plantation
Fort Lauderdale
Hollywood
Miami
Big Cypress National Preserve
Fontainebleau
Coral Gables
Kendall
Homestead
1
Everglades National Park
Key Largo

321


Weston Hills Country Club
Bonaventure Blvd
SW 20th St
823
SW 26th St
Weston Rd
93
S Post Rd
Boyscout Rd
SW 130th Ave
SW 136th Ave
SW 117th Ave
SW 116th Ave
S Hiatus Rd
75
Vista View Park
SW 45th St
818
Griffin Rd
Southwest Ranches
Sunshine Acres
SW 186th Ave
SW 195th Terrace
SW 188th Ave
SW 190th Ave
SW 178th Ave
SW 172nd Ave
SW 166th Ave
Dykes Rd
SW 148th Ave
Hancock Rd
SW 111th Terrace
848
SW 185th Way
SW 196th Ln
Sheridan St

322


Florida
Street View - Mar 2014
FL-93
Google


FREEPLAN
Workshop 4 Basic/Ramps
I-75 between Royal Palm Blvd & Sheridan St, Weston
Large urbanized area type
70 mph posted speed limit
D-Factor | % Heavy Vehicles | Local Adjustment Factor
54.4 | 4.0 | 0.98
Segment | Segment Name | Type | Ramp Demand | # of Ramp Lanes | Ramp % Heavy Vehicles | Acc/Dec Length [ft] | Ramp FFS
2 | B-C | Off-Ramp | 504 | 1 | 4.0 | 460 | 35
4 | D-E | Off-Ramp | 288 | 1 | 4.0 | 1,500 | 30
6 | F-G | On-Ramp | 1,125 | 1 | 4.0 | 1,500 | 35
150,250 AADT
4 Lanes
A
1,950' Basic
B
1,500' Off ramp
C
940' Basic
D
1,500' Off ramp
E
2,190' Basic
F
1,500' On ramp
G
4,030' Basic
H
Peak Direction
N
324
2015 Q/LOS Training

Applications

AGENDA ITEM 14

LOS APPLICATIONS

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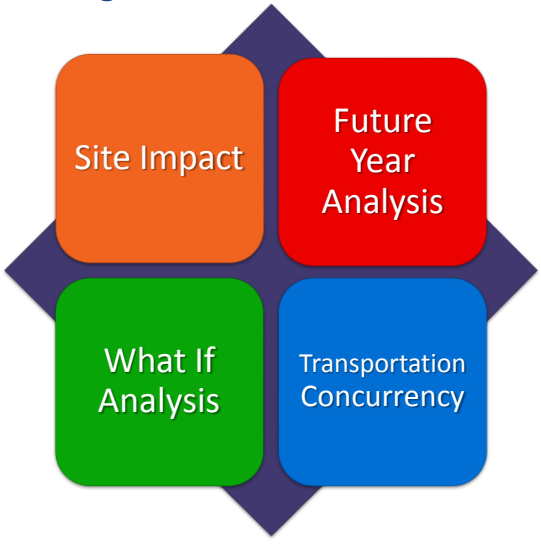
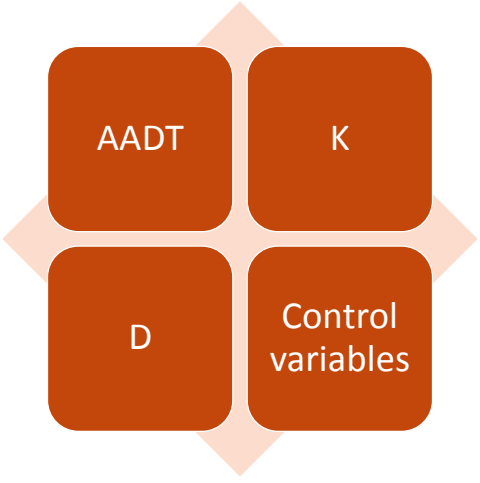
Planning Uses of LOS Techniques



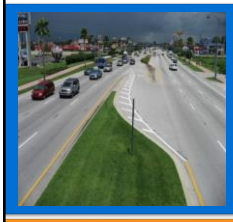
328

Future Year Analysis



329

Future Year Analysis



Roadway variables

Traffic variables

Control variables

Conditions change – what should we do?

Good Assumptions = Good Results

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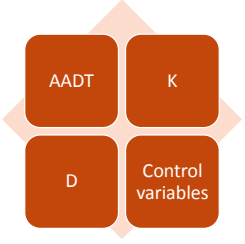
Future Year Analysis

Refer to QLOS Handbook and District LOS Coordinators

- General rules of thumb
  - Area type remains the same unless development enters new phase
  - Through g/C typically goes down to .40 at major intersections
  - Signal density usually increases



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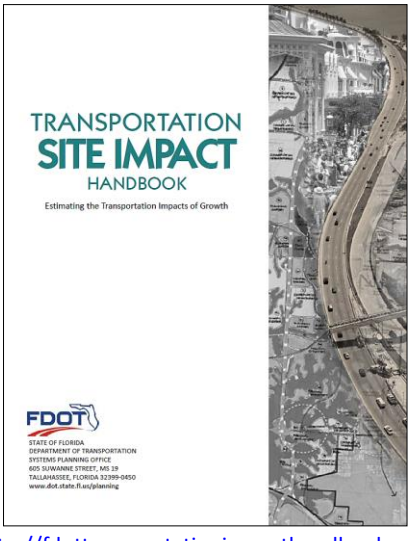
Transportation Impact Handbook



http://fdottransportationimpacthandbook.com/

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Transportation Impact Handbook Website

HOME

Welcome to the FDOT Transportation Site Impact Handbook Site!

We are proud to announce the 2014 update to the Transportation Site Impact Handbook!

We've renamed the document to Transportation **Site Impact** Handbook to help differentiate between other traffic analysis guides.

TSIH_April_201404.pdf

The Florida Department of Transportation (FDOT) has developed these guidelines to assist FDOT staff in their review of developments. While this handbook is primarily for FDOT staff, it is available to local governments and other transportation partners in an effort to communicate the FDOT's guidance for reviewing various documents.

The purpose of this document is to guide the professional through the current generally accepted professional practice. This should assist in making better decisions for the study of the transportation impacts of new developments.

OPEN HANDBOOK CURRENT VERSION April 4, 2014

We recommend saving the handbook to your computer. The hyperlinks will open documents in a separate browser window, allowing you to easily toggle between the Handbook and the resources.

The purpose of this document is to guide the professional through the current generally accepted professional practice. It should also help the professional understand the existing statutes, rules, and policies of FDOT. However, unless a rule, statute, or standard is referenced, the material inside is to be used for guidance by professionals. This should assist in making better decisions for the study of the transportation impacts of new developments.

This website structure was updated 4/08/2014

333

Maximum Acceptable Capacity Volumes

- Values higher than the following slides are seldom seen in Florida
- Values should be demand volumes
- Values should be based on an hourly analysis
- Supporting documentation should be provided

334

Maximum Acceptable Capacity Volumes for Arterials

Large urbanized	1,000 vehicles per hour per lane (vphpl)
Other urbanized	950 vphpl
Transitioning	920 vphpl
Urban	920 vphpl
Rural	850 vphpl

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Maximum Acceptable Capacity Volumes for Freeways

Large urbanized	2,100 vphpl (1900 vphpl if oversaturated)
Other urbanized	2,000 vphpl (1900 vphpl if oversaturated)
Transitioning	1,900 vphpl
Urban	1,800 vphpl
Rural	1,800 vphpl

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Maximum Acceptable Capacity Volumes for Highways

Two-lane	**Developed** 1,600 vphpl	**Undeveloped** 1,500 vphpl
Multilane	**Developed** 1,850 vphpl	**Undeveloped** 1,600 vphpl

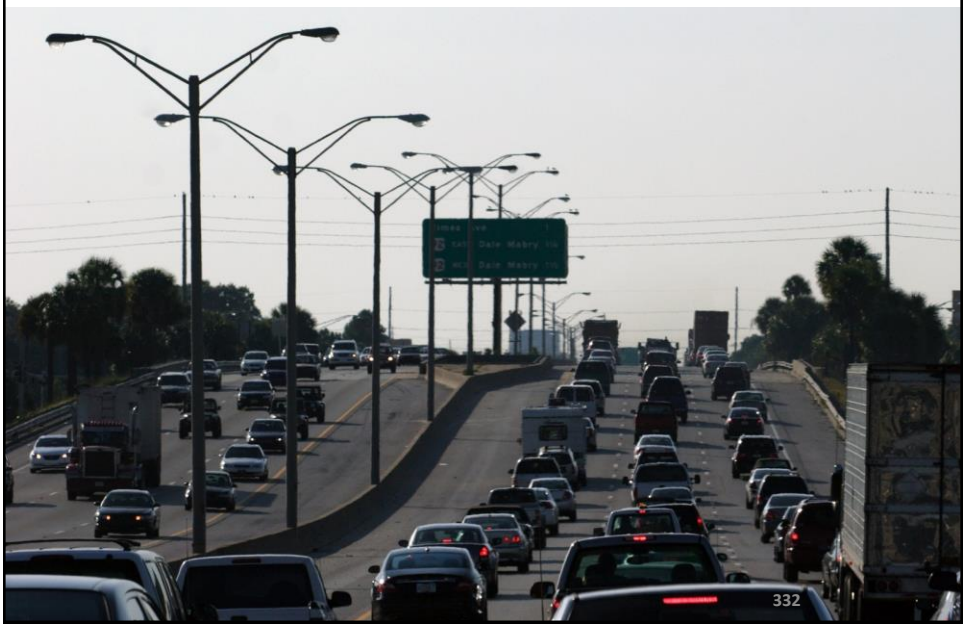
337

Precursor to HCM Analysis

- LOSPLAN or Generalized Tables screening.
  - If facilities show problems then a more detailed analysis can follow

338

SIS Deficiencies/Priorities



Performance Measures Using LOS

- Map 21
  - % Travel Meeting LOS Criteria (peak hour, peak period, daily)
- FDOT Mobility Performance Measures
  - Average Travel Speed
  - % Miles Severely Congested
  - Pedestrian LOS
  - Bicycle LOS

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WRAP-UP

AGENDA ITEM 15

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Course Objectives

- Move from understanding basic traffic concepts to hands-on capacity and quality of service analysis
- Gain proficiency in planning analysis
- Gain proficiency in multimodal QOS
- Understand the factors that have the greatest impact on the results
- Identify key differences between LOSPLAN and other tools

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Wrap-Up

- What did you learn that was particularly useful?
- Do you have any suggestions for improving the training course?
- Please complete your evaluation form!

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Wrap-Up

Contact Information

Andrew Young
Andrew.Young@dot.state.fl.us
(850) 414-4582

Nathan Hicks
HicksNA@cdmsmith.com
(850) 414-4755

Martin Guttenplan
GuttenplanME@cdmsmith.com
(850) 386-9528

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