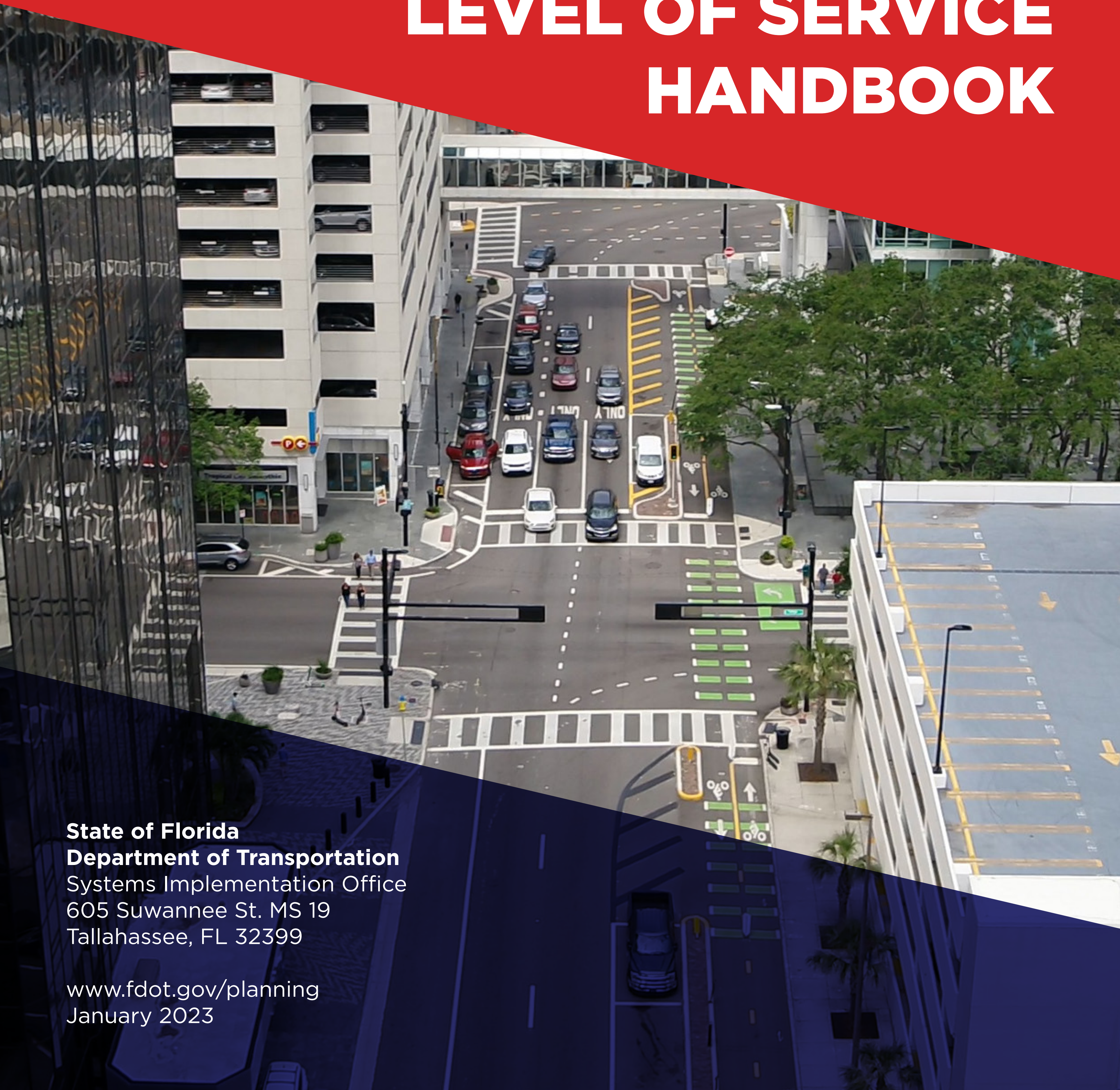
2023 MULTIMODAL QUALITY/ LEVEL OF SERVICE HANDBOOK



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List of Abbreviations

AADT	Annual average daily traffic
ADT	Average daily traffic
BLTS	Bicycle level of traffic stress
C	Cycle length
C1	Context classification natural
C2	Context classification rural
C2T	Context classification rural town
C3C	Context classification suburban commercial
C3R	Context classification suburban residential
C4	Context classification urban general
C5	Context classification urban center
C6	Context classification urban core
CAF	Capacity adjustment factor
D	Directional distribution factor
DDHV	Directional design hourly volume
DHV	Design hourly volume
FDM	*FDOT Design Manual*
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FTO	Florida Traffic Online
g	Effective green time
g/C	Effective green ratio
GSVT	Generalized Service Volume Tables
HCM	*Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis*

HCS	Highway Capacity Software
HCS7	Highway Capacity Software 7.9.6
ITE	The Institute of Transportation Engineers
K	K factor
K100	100th highest volume hour of the year
K5–6pm	The 5–6 p.m. weekday volume to AADT
Kam	Average a.m. peak weekday volume to AADT
Knoon	The noon weekday volume to AADT
Kp/d	The highest hourly volume to daily volume
Kpm	Average p.m. weekday peak volume to AADT
LAF	Local adjustment factor
LOS	Level of service
LRTP	Long range transportation plan
LTS	Level of traffic stress
MMTD	Multimodal transportation district
MPA	Metropolitan planning area
MPO	Metropolitan planning organization
n	No median
nr	Non-restrictive median
pcphpl	Passenger cars per hour per lane
PD&E	Project development and environment
PLTS	Pedestrian level of traffic stress
PSWADT	Peak season weekday average daily traffic
PTF Handbook	*FDOT's Project Traffic Forecasting Handbook*
PTSF	Percent time spent following
Q/LOS	Quality/level of service
Q/LOS Handbook	*2023 Multimodal Quality/Level of Service Handbook*
r	Restrictive median

RCI	Roadway Characteristics Inventory
SAF	Speed adjustment factor
SIO	Systems Implementation Office
T	Truck factor
TCQSM	*Transit Capacity and Quality of Service Manual*
TDA	Transportation Data and Analytics Office
TPO	Transportation planning organization
vph	Vehicles per hour
vphpl	Vehicles per hour per lane

1 | Introduction

The *2023 Multimodal Quality/Level of Service Handbook (Q/LOS Handbook)* is intended to be used by engineers, planners, and decision-makers to evaluate roadway users' quality/level of service (Q/LOS) at generalized planning levels. This edition of the Q/LOS Handbook is updated and reorganized. It provides a foundation for high-quality, consistent level of service (LOS) analyses and review in the state of Florida. It incorporates new analytical techniques from the Transportation Research Board's *Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis (HCM)*. It also introduces level of traffic stress (LTS) for evaluating bicycle and pedestrian quality of service. With these professionally accepted techniques, analysts can evaluate roadways from a multimodal perspective, which results in better multimodal decisions for projects in generalized planning phases.

Generalized planning is most appropriate when precise results are not required, for systemwide or areawide analysis, or for future long-range estimates. Florida's Generalized Service Volume Tables (GSVT) at the end of this handbook are the primary tools for conducting generalized planning. This edition of the Q/LOS Handbook includes reorganized and updated GSVTs. The freeway GSVTs are organized by area type. The highway and arterial GSVTs are organized by context classification. The motorized vehicle GSVTs have been updated to be consistent with the *HCM Sixth Edition* methodology. LTS is used for arterials to measure bicycle and pedestrian quality of service. For more, see the LTS flow charts in **Appendix B**.

The GSVTs are based on the *HCM Sixth Edition* and Florida roadway, traffic, control characteristics and multimodal data. This handbook presents the simplified assumptions and input variables used to develop the GSVTs. The resulting tables are valid in Florida.

This handbook outlines the accepted methodologies used to determine the inputs for the GSVTs. For motorized vehicles these inputs include roadway segmentation, roadway type, area type or context classification, and existing motorized vehicle demand. For pedestrians and bicyclists, this includes facility type and width, number of travel lanes, posted speed, separation from motor vehicles, motorized vehicle volumes, and land use characteristics.

FDOT will provide technical assistance and training as needed for use of the Q/LOS process. For additional resources, see the FDOT Systems Implementation Office (SIO) website at https://www.fdot.gov/planning/systems/. **Initial contact should be made with FDOT District and Florida's Turnpike Enterprise Q/LOS contact.** This document and other resources are available online at the FDOT SIO website at Quality/Level of Service (fdot.gov).

For updates and questions regarding this handbook, contact:

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1.1 Purpose and Scope

The Q/LOS Handbook can be used to analyze and review a traveler's experience at a generalized planning level. Quality of service is a traveler-based perception of how well a transportation service or facility operates. Quality of service measures assess multimodal service inside the roadway environment (essentially inside the right of way). The Q/LOS Handbook focuses on HCM based LOS to measure motorized vehicle quality of service and LTS to measure bicycle and pedestrian quality of service. This handbook presents the GSVTs and LTS at the generalized planning level and provides specific instructions on how to use the GSVTs and the LTS flow charts.

The Q/LOS Handbook evaluates comfort for vehicles based on arterial average motorized vehicle travel speeds and freeway density. For people walking and biking, this handbook evaluates comfort based on roadway characteristics mid-block. This handbook does not cover the overall quality of the trip experience, which depends on a variety of factors, including aesthetics, safety, connectivity, and other measures.

1.2 What's New in This Version of the Q/LOS Handbook?

This edition of the Q/LOS Handbook includes reorganized and updated GSVTs. The following key changes were made to the methodology provided in this handbook:

- The highway and arterial GSVTs, previously based on area type, were updated to be based on FDOT context classification.
- The arterial inputs were fully redeveloped based on context classifications. This includes new values for turning percentages, segment lengths, and effective green ratio (g/C).
- Freeway, highway, and arterial GSVTs have been updated to be consistent with the HCM Sixth Edition methodology.
- The GSVT inputs for freeways are generally consistent between the 2020 and 2023 versions; however, some were updated to maintain internal consistency. Examples of inputs that were updated to maintain internal consistency include weaving length, short distance, and weaving ratio.
- Bicycle and pedestrian LTS methodologies were developed for arterial roadways.
- Transit LOS was removed. The transit LOS was based on FDOT LOSPLAN program, which is no longer supported by FDOT. FDOT will work with partners to develop a transit

quality of service measure for future editions. In the meantime, *Transit Capacity and Quality of Service Manual* *(TCQSM)* procedures should be used.

The updated tables can be found in **Appendix B**.

1.3 Travel Modes

The *HCM* defines four major travel modes: motorized vehicle, pedestrian, bicycle, and transit. Each mode includes a unique set of characteristics that define a traveler's experience during a trip. It is important to consider each perspective when analyzing a multimodal facility. This handbook address quality of service for motorized vehicles, pedestrians, and bicyclists. The *HCM* is used in this handbook to determine motorized vehicle LOS, while LTS is used to determine bicycle and pedestrian QOS.

1.3.1 Motorized Vehicle

Motorized vehicles include passenger cars, light duty trucks, vans, buses, recreational vehicles, and motorcycles. Because each motor vehicle type has a unique set of operational characteristics, the percentage of each motor vehicle type within a traffic stream affects the facility's capacity. For example, trucks, buses, and recreational vehicles have lower acceleration and deceleration rates than standard passenger cars. Therefore, larger percentages of trucks, buses, and recreational vehicles can reduce a highway's capacity.

Five major elements that affect LOS for motorized vehicles are addressed in this handbook: facility type, area type or roadway classification, roadway characteristics, traffic characteristics, and control characteristics. Other factors can affect operating conditions, such as pavement type and condition, time of day, and weather. Driver conditions, such as fatigue, health, and driving under the influence of drugs and alcohol, can also affect operating conditions. This handbook assumes base conditions that include good weather, good visibility, good pavement conditions, and unimpaired drivers driving on dry pavement during daylight hours. **Figure 1** provides an example of motorized vehicle LOS for arterials.

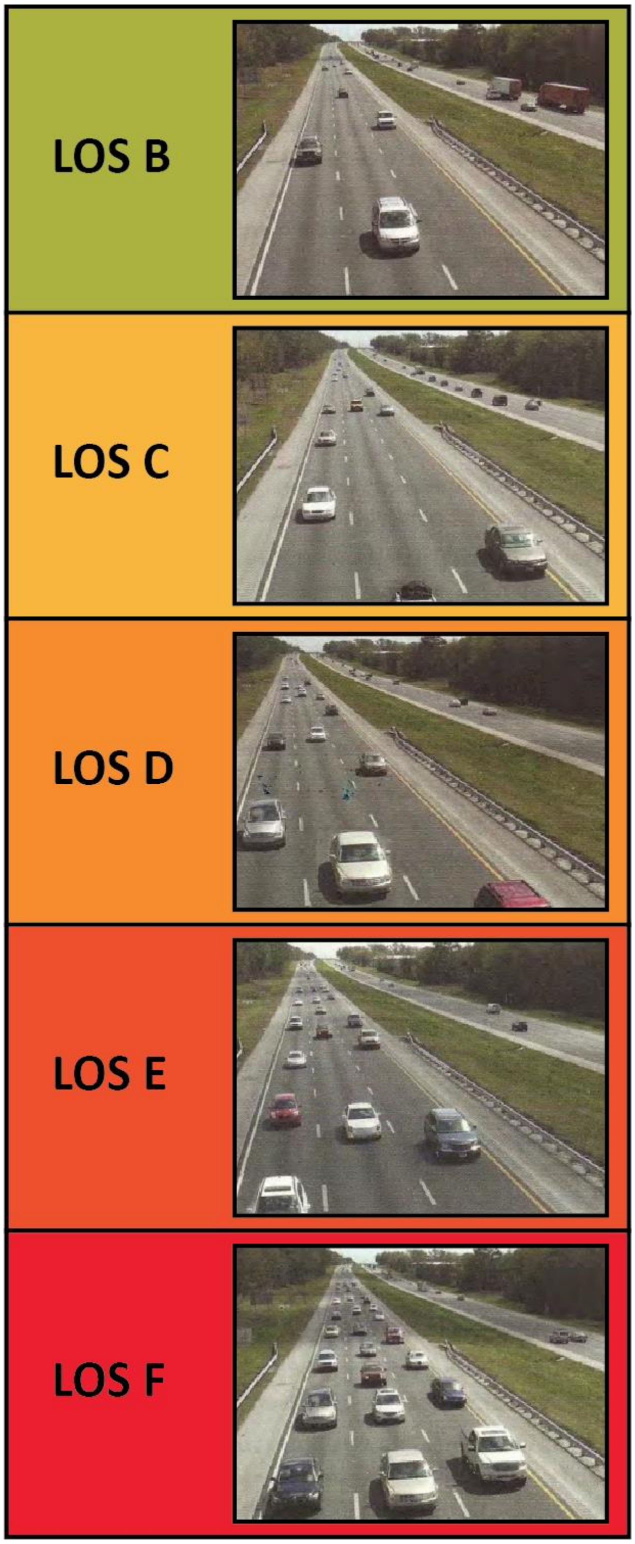


Figure 1: Examples of Motorized Vehicle LOS for Arterials[1]

1.3.2 Pedestrian

Walking is an important part of our transportation system. Many trips include at least one portion in which the traveler is a pedestrian. This is particularly important for transit trips, where discomfort while walking to the transit stop or from the transit stop to the final destination may impact future transit use. People have a range of abilities when it comes to walking and perceiving their environment. Children and older adults walk slower than the average adult. Children cannot gage vehicular travel speeds as well as the average adult. People with visual or physical disabilities can be greatly impacted by surface conditions.

Elements that affect pedestrian experience include delay and facility attributes. Delay at intersections can be quantified and analyzed. Delay created by out-of-direction travel can also be quantified. Facility attributes include the clear width of the sidewalk, sidewalk continuity, pavement conditions, grade, separation from vehicular travel lanes, physical barriers from vehicular travel, vehicular volumes, heavy vehicle presence, number of travel lanes, lighting, shade, and network connectivity. Other factors that contribute to the overall walking experience are less easily quantified, including safety, security, and built form. When determining pedestrian quality of service, this handbook accounts for users' perception and some facility attributes for walking along a road.

1.3.3 Bicycle

Bicycles are used to make a variety of trips, including trips for recreation, commuting, and errands. Bicyclists vary in their riding ability. Cycling is a learned skill, and aptitude and interest vary. The National Household Travel Survey (NHTS) showed that average commute trip length for people walking was 1.19 miles, with a speed of 3.15 miles per hour (mph)[2]. The average bicycle trip was 2.3 miles and approximately 19 minutes[3]. Because bicycle trips are typically longer than walking trips, bicycles can help extend the accessible service market area for transit.

Elements that affect a bicyclists' experience can be summarized by delay and facility attributes. Delay can include intersection delay and out-of-direction travel. Facility attributes that impact cyclist comfort include facility type and width, pavement conditions, grade, separation from vehicular travel lanes, physical barriers from vehicular travel, vehicular volumes, heavy vehicle presence, number of travel lanes, lighting, and network connectivity. When determining bicycle

[1] Principals of Highway Engineering and Traffic Analysis. Fred L. Mannering and Scott S. Washburn.
[2] Summary of Travel Trends, 2017 National Household Trave Survey. U.S. Department of Transportation. Federal Highway Administration.
[3] Walking and Bicycling in the United States. The Who, What, Where, and Why. J. Richard Kuzmyak and Jennifer Dill.

quality of service, this handbook accounts for some facility attributes when bicycling along a road.

1.3.4 Transit

Unlike other modes, transit is influenced by both service frequency and facility characteristics. Once constructed, infrastructure for driving, biking, or walking is always available. Transit service, on the other hand, is only available along designated routes during certain times. Factors that contribute to the overall comfort and quality of service for transit riders include travel times, service times, service frequency, reliability, directness of route, amenities at transit stops, and connection to sidewalks and bicycle facilities. Because transit riders typically walk or bike to and from transit stops on either end of their trip, the quality of the walking and biking experience at the beginning or end of a trip may be just as important to the transit passenger as the actual transit experience.

1.4 Q/LOS Principles

Safety and mobility for people and goods remains transportation's most essential function and part of FDOT's mission. There are four dimensions of mobility:

- Quality of travel: how satisfied travelers are with a facility or service
- Quantity of travel: how much travelers use a facility or service
- Accessibility: how easily travelers can engage in desired activities
- Capacity utilization: quantity of operations relative to capacity

This handbook focuses primarily on quality of travel, followed by capacity utilization. It does not address quantity of travel or accessibility.

Quality of service is based on users' perception of how well a transportation service or facility operates. Motorized vehicle LOS quantifies quality of service into six letter grades. For bicyclists and pedestrians, LTS quantifies quality of service into four numerical categories. These schemes help traffic engineers and transportation planners explain operating conditions, needs, and design concepts to the public and elected officials. FDOT's LOS targets are defined in FDOT Policy Topic No. 000-525-006 and discussed in **Chapter 10**.

1.4.1 Common Q/LOS Misconceptions

There are three misconceptions about Q/LOS that commonly arise:

Misconception: Q/LOS is directly related to all other dimensions of mobility.

Although Q/LOS is frequently related to the other dimensions of mobility, this does not hold true for all cases. Q/LOS for motorized vehicles is usually linked to how many other vehicles are on the road; however, this is not always the best measure of mobility. For example, arterial speeds are more closely tied to signalization conditions than the number of vehicles on the roadway. A four-lane arterial may have a higher Q/LOS grade—despite having twice the volume of another arterial—due to efficient signal progression.

For transit riders, pedestrians, and bicyclists, there is often an even weaker relationship between total demand and Q/LOS. For most situations in Florida, the total number of bicyclists and pedestrians on a facility has very little, if any, impact on Q/LOS. Similarly, bus frequency is typically far more important to transit riders than how many people are on a bus.

Misconception: Q/LOS is the best tool for prioritizing projects.

In some cases, particularly for non-motorized vehicle modes, many considerations should be considered when prioritizing projects or investments, such as total potential demand, safety, equity, sustainability, and economic development. This handbook addresses Q/LOS and does not address methods of determining overall demand, safety, or mode splits. Other tools, such as logit models or demand models, are more appropriate for these types of analyses.

Misconception: LOS A–F grades are comparable to American school letter grades.

The most common misconception about LOS is that the A through F categories are comparable to school letter grades. For motorized vehicles, LOS A is most likely not a desirable goal from a transportation or societal perspective. LOS A in a peak travel hour could indicate inefficient use of limited funding. It is simply not cost-effective to design state roadways to operate at LOS A during the peak hour. Expanding the facility to accommodate LOS A also leaves the facility open to excessive speeds in the off-peak, which could create safety concerns.

LOS F represents a failing condition during the analysis period, but there are other factors to consider when LOS reaches this level. LOS F means either travel demand exceeds capacity during the analysis period and the roadway is operating in oversaturated conditions or that another undesirable condition exists. LOS standards for vehicles are visualized in **Figure 1**.

1.5 What Are the Generalized Service Volume Tables and Level of Traffic Stress Flow Charts?

FDOT's GSVTs and the LTS flow charts are the primary analysis tools for conducting a generalized-planning analysis. Each GSVT provides generalized peak hour directional, peak hour two-way, and annual average daily traffic (AADT) maximum service volumes for a given LOS by roadway type and land use or context classification. The LTS flow charts provide a methodology to determine bicycle and pedestrian LTS based on roadway and traffic characteristics.

The GSVTs are not capacity tables. Whereas maximum service volume is the highest number of vehicles for a given LOS, capacity is the maximum number of vehicles or people who can pass a point during a specified time under prevailing roadway, traffic, and signal characteristics. Many of the LOS E service volumes in the hourly directional tables represent the capacity for an average roadway, but in general, most of the values do not reflect a specific roadway's capacity. Consider the daily tables. Roadway capacities for the day far exceed the volumes shown in the daily tables. All roadways are underutilized in most hours of the day, and many congested roads will have demand volumes higher than the highest volumes shown in the daily tables. This disparity occurs because traffic is backed up for more than one analysis period.

Arterial LOS E service volumes do not represent capacity. **The primary criterion for LOS on arterials is average travel speed, not roadway capacity.** The average travel speed along arterials is influenced by many control characteristics (such as progression and cycle length) and not just the capacity of signalized intersections.

1.6 When to Use the Generalized Service Volume Tables and Level of Traffic Stress Flow Charts

The primary intent of this handbook is to assist engineers, planners, and decision-makers in the planning and design of roadways and in the evaluation of roadway users' Q/LOS at generalized planning levels. Generalized planning includes a range of high-level analysis, such as initial problem identification (e.g., deficiency and needs analyses and geographic influence areas), statewide analyses (e.g., statewide calculation of delay), and future year analyses (e.g., 10 or more years planning horizon). Florida's GSVTs provided at the end of this handbook are the primary tools for conducting this type of planning analysis in Florida and are most appropriately used when precise results are not required.

Example applications of the GSVTs and LTS flow charts include:

- Generalized comprehensive plan amendment analyses
- State Highway System (SHS) deficiencies and needs
- Statewide mobility performance measure reporting
- Areawide baseline capacity (such as MPO boundaries) and service volume values for travel-demand forecasting models
- Areawide influence areas for major developments (such as impact areas)
- Future-year analyses, which have 10- to 25-year planning horizons (such as strategic intermodal system [SIS] needs plans and MPO long range transportation plans [LRTPs])
- Baseline capacity and service volumes for concurrency management systems
- High level screening of alternatives
- Sketch planning studies

Florida's GSVTs are not meant for detail analysis application.

1.7 How to Use the Generalized Service Volume Tables and Level of Traffic Stress Flow Charts

To begin determining quality of service, the analyst must first determine the appropriate analysis tool (see **Chapter 2**). If the GSVTs and LTS flow charts are the appropriate analysis tools, the analyst must determine the inputs needed to interpret the motorized vehicle LOS using the GSVTs: roadway type, area type or context classification, and segmentation (see **Chapter 3**). Analysts must determine the appropriate analysis year (existing or future) and the motorized vehicle demand volumes for that year (see **Chapter 3**). Analysts compare the appropriate motorized vehicle demand volumes for the study segment (peak hour directional, peak hour, or AADT) to the generalized service volumes.

If conducting an analysis for motorized vehicles on a particular road, as compared to an areawide analysis, analysts may also need to determine roadway, traffic, and control characteristics that apply to the analysis year. It may be necessary to apply adjustment factors to the generalized service volumes presented in the tables (see **Chapters 5-7**). Analysts then compare the appropriate motorized vehicle demand volumes for the study segment (peak hour directional, peak hour, or AADT) to the GSVTs as determined once the relevant adjustment factors are applied.

Analysts may determine the pedestrian or bicycle LTS by following the approach shown in the LTS flow charts included in **Appendix B**. The analysis inputs are presented in **Chapter 8**. Bicycle and pedestrian LTS are weakest link analyses, meaning that LTS scores are calculated separately for each side of the road, and the higher (more stressful) score is assigned as the overall score for the segment. The analyst should apply the same analysis year, context classification, roadway characteristics, and traffic characteristics used for the motor vehicle analysis to the bicycle and pedestrian LTS analysis.

2 | Traffic Analysis Tools

There are many methods for computing quality of service. The GSVTs can be used for generalized planning level analysis. Other operational analysis tools are more complex and precise but may be time-intensive and costly. This chapter presents a range of motorized vehicle traffic, pedestrian, bicycle, and transit analysis tools so the analyst may determine the best tool for their project.

2.1 Motorized Vehicle Traffic Analysis Tools

Figure 2 provides a list of some motorized vehicle traffic analysis tools organized by accuracy and complexity. In selecting the appropriate tools, tradeoffs among study purposes (such as generalized planning application or signal timing application); accuracy and precision of results (such as variability in data for current year analyses or variability in future year analyses); and data preparation effort (such as use of existing statewide traffic data or use of direct field measurements) should be considered. Refer to the FDOT Traffic Analysis Handbook (FDOT Systems Implementation Office) for additional tools and guidance in selecting the appropriate analysis tool.

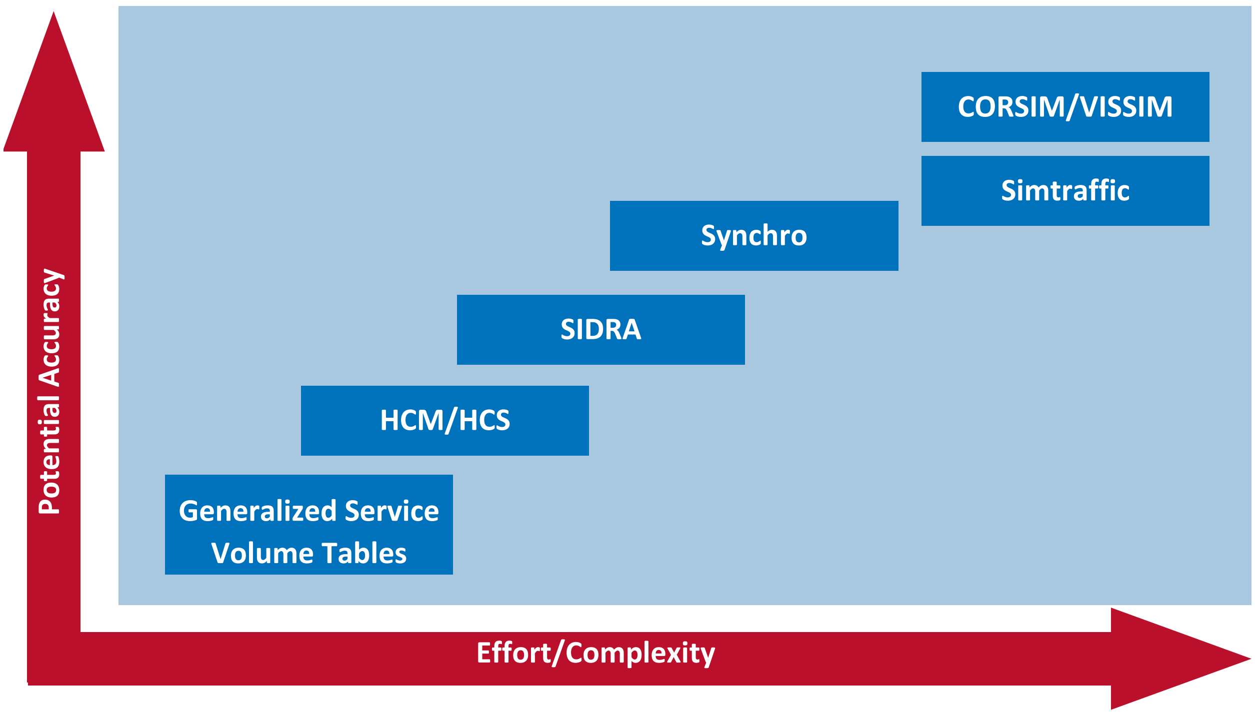


Figure 2: Traffic Analysis Tools

2.1.1 Highway Capacity Manual

For motorized vehicles, the *Highway Capacity Manual* (*HCM)* is the most widely recognized and accepted analysis tool.

2.1.1.1 Facility Types

The *HCM* defines two primary facility types: uninterrupted flow and interrupted flow.

Uninterrupted flow facilities do not have fixed causes of delay or interruption external to the traffic stream, such as signals or stop signs. Non-tolled freeways represent the purest form of uninterrupted flow because there are no fixed interruptions to traffic flow and facility access is limited to ramp locations. Multilane and two-lane highways operate under uninterrupted flow in long segments between points of fixed interruption (such as at signalized intersections or stop signs). It is often necessary to examine points of fixed interruption using interrupted flow methodologies.

Interrupted flow facilities have fixed causes of periodic delay or interruption to the traffic stream, such as traffic signals or stop signs, with average spacing less than or equal to two miles. Traffic flow patterns on interrupted flow facilities are caused by vehicle interactions with the facility's geometric characteristics, the traffic control used at intersections, and the frequency of facility access points. Traffic signals allow designated movements to occur only during portions of the signal cycle, and therefore affect flow and capacity because the facility is not available for continuous use. Traffic signals also create vehicle platoons that travel along a facility as a group. By contrast, roundabouts, and all-way stop-controlled intersections discharge vehicles more randomly, creating periodic and sometimes small gaps in traffic at downstream locations.

2.1.1.2 Capacity

The HCM defines capacity as the maximum sustainable hourly flow rate at which persons or vehicles can be expected to traverse a point or a uniform section of a lane or roadway during a given time under prevailing roadway, environmental, traffic, and control conditions. Capacity is not the absolute maximum flow rate observed at a facility; instead, capacity is the flow rate that can be achieved repeatedly for peak periods of sufficient demand. Prevailing roadway, traffic, and control conditions impact capacity. These conditions should be relatively uniform for any analyzed segment or facility. Base conditions assume optimum circumstances, including good weather, dry pavement conditions, users who are familiar with the system, and no impediments to traffic flow. In most cases, prevailing conditions differ from base conditions (for example, there are trucks in the traffic stream and rolling terrain). As a result, the computations of capacity, service flow rate, and LOS include an adjustment to capacity under base conditions.

Capacity on uninterrupted and interrupted flow facilities can be measured in passenger cars per hour per lane (pcphpl) or vehicles per hour per lane (vphpl), depending on analysis type or system element.

2.1.1.3 Free-Flow Speed

Free-flow speed is the average speed under low-volume conditions and is not delayed by traffic controls, such as signalized intersections. The free-flow speed for freeways and highways can be calculated using the methodology presented in Chapter 12 of the *HCM*. For arterials, free-flow speed is calculated according to Chapter 18 of the *HCM*.

2.1.1.4 Base Free-Flow Speed

Base free-flow speed is the potential free-flow speed based only on the highway's horizontal and vertical alignments. Base free-flow speed is not impaired by lane widths or control characteristics. On arterials, the base free-flow speed is defined by the free-flow speed on longer segments, base free-flow speed can be calculated using s *HCM* equation 18-3.

$$S_{fo} = S_{calib} + S_0 + f_{cs} + f_A + f_{pk}$$

where

S_{fo} = base free-flow speed (mi/h),

S_{calib} = base free-flow speed calibration factor (mi/h),

S_0 = speed constant (mi/h),

f_{CS} = adjustment for cross section (mi/h),

f_A = adjustment for access points (mi/h), and

f_{pk} = adjustment for on-street parking (mi/h).

See the *HCM* for more information on the adjustment factors to the base free-flow speed equation.

This handbook primarily relies on and reports capacity values based on the interrupted flow concept of capacity, with base free-flow speed considered a roadway characteristic input. **Based on a general assumption used in the *HCM*, base free-flow speed is assumed to be 5 mph above the posted speed in this handbook.**

2.1.1.5 Motorized Vehicle LOS

The *HCM* uses a quantitative stratification of the quality of service to represent the comfort a typical traveler experiences on a facility in six letter-grade levels, with A describing the highest quality and F describing the lowest quality. LOS for a freeway facility is based on density. For two-lane highways, both average speed and delay experienced (measured as percent time spent following (PTSF)) are used to measure comfort for motorists. For arterials, LOS thresholds are based on the comparison of average travel speed (including stops at intersections) to the base free-flow speed. For arterials, the LOS D threshold range is between 40% and 50% of the base free-flow speed and the LOS E threshold range is between 30% and 40% of the base free-flow speed.

2.2 Transit Quality of Service

Two nationally recognized methods for evaluating transit quality of service include the HCM methodology and the *TCQSM*. The HCM methodology is based on the NCHRP Report 616—Multimodal Level of Service Analysis for Urban Streets (2008). The HCM methodology was based on national traveler response data to changes in transit service quality. HCM LOS consists of three main model components:

- Access to transit, which is based on the pedestrian link LOS.
- Frequency of transit.
- Perceived travel time rate, which includes bus travel speed, bus stop amenities, excess wait time due to bus arrival time compared to scheduled time, and on-board crowding.

The TCQSM LOS measures are based on surveys that identified transit service factors important to traveler perceptions. It is designed to represent comfort along the entire trip. The LOS E/F thresholds identify undesirable service from a passenger standpoint, and the other thresholds represent points at which a noticeable change in service quality occurs (for example, when no more seats are left). TCQSM measures include service frequency, hours of service, service coverage, transit travel time versus auto travel time, passenger loading, and reliability. One significant exhibit in the TCQSM is a table for urban scheduled transit service based on service frequency. **Table 1** replicates this TCQSM table.

Table 1: Urban Scheduled Transit Service Based on Service Frequency from the *TCQSM*

Level of Service	Service Frequency (vehicles/hour)	Headway (minutes)	Comments
A	>6	<10	Passengers don’t need schedules
B	5-6	10-14	Frequent service, passengers consult schedules
C	3-4	15-20	Maximum desirable time to wait if transit vehicle missed
D	2	21-30	Service unattractive to choice riders
E	1	31-60	Service available during hour
F	<1	>60	Service unattractive to all riders

A specific transit quality of service measure is not included in Florida's Generalized Service Volume Tables. FDOT will work with partners to develop a transit quality of service measure for future editions.

2.3 Bicycle and Pedestrian Quality of Service

There are several ways to evaluate bicycle and pedestrian quality of travel. The state of the practice for bicycle and pedestrian planning and design is evolving quickly as the transportation industry focuses more resources on economic development, sustainability, safety, and public health. Many factors influence cyclists and pedestrian comfort and should be considered when planning or designing a road or a network. Such factors include presence of steep or long climbs, pavement condition, presence of heavy vehicles, width of travel lanes, driveway density, absence of lighting, skewed railroad crossings, drainage grates, curbside conditions (such as rutting or litter/gravel in the roadway), facilities at the intersections, width of intersection crossings, delay time at intersections, network connectivity, neighborhood crime, and noise.

This handbook uses LTS to evaluate the quality of travel for people walking and biking. LTS as applied in this handbook only address comfort traveling along a facility as it relates to facility type, width, and continuity; vehicular posted speeds; vehicular volumes; and separation from traffic. It does not address the impacts of intersection design or delay, crossing frequency, or number of driveways. The scale is defined by the type of user that finds the facility comfortable.

2.3.1 Bicycle Level of Traffic Stress

Bicycle level of traffic stress (BLTS) is a performance measure that quantifies the amount of discomfort that people feel when they bicycle close to traffic (see **Figure 3**). The methodology was developed in 2012 by the Mineta Transportation Institute at San Jose State University[4].

BLTS designates the quality of service in to four categories:

- BLTS 1: The level that most children can use confidently.
- BLTS 2: The level that will be tolerated by most adults.
- BLTS 3: The level tolerated by confident cyclists who still prefer having their own dedicated space for riding.
- BLTS 4: The level tolerated only by those with limited route or mode choice or cycling enthusiasts that choose to ride under stressful conditions.

[4] Low-Stress Bicycling and Network Connectivity. Maaza Mekuria, Peter Furth, & Hilary Nixon.

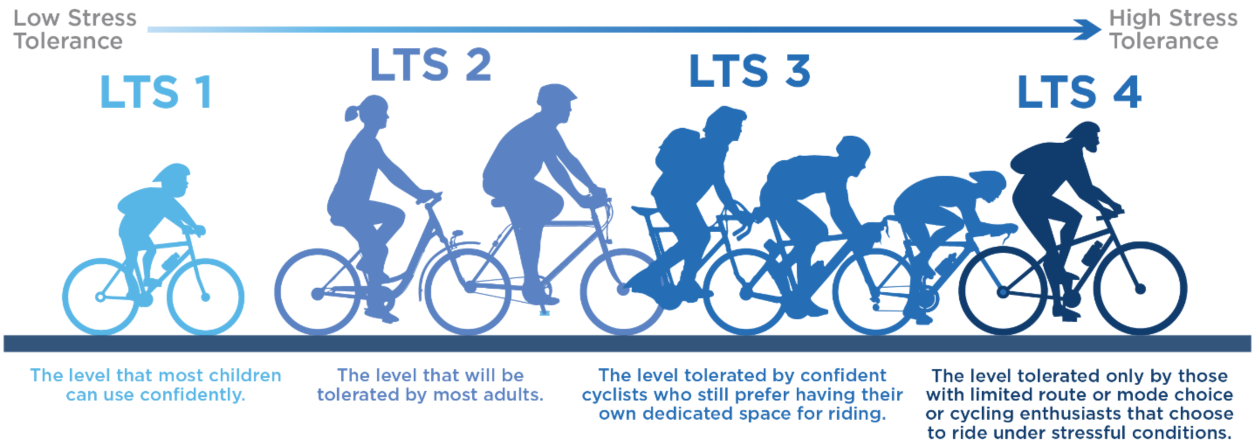


Figure 3: Bicycle Level of Traffic Stress

BLTS applies to bicycle facilities on the SHS within the right of way. BLTS uses the following characteristics to assess bicyclists' perceptions of the roadway environment:

- Bicycle facility type
- Bicycle facility width
- Posted speed
- Separation from traffic
- AADT

2.3.2 Pedestrian Level of Traffic Stress

Pedestrian level of traffic stress (PLTS) is a performance measure that quantifies the amount of discomfort that people feel when they walk along a road within the roadway right of way (see **Figure 4**).

PLTS designates the quality of service in to four categories:

- PLTS 1: The level suitable for all users including teenagers traveling alone, the elderly, and people using a wheeled mobility device. People feel safe and comfortable on the pedestrian facility and all users are willing to use the pedestrian facility.
- PLTS 2: The level where all users are able to use the facility and most users are willing to use the facility.
- PLTS 3: The level where some users are willing to use this facility, but others may only use the facility when there are limited route and mode choices available.
- PLTS 4: The facility is difficult or impassible by a wheeled mobility device or users with other limitations in their movement and most likely used by users with limited route and mode choice.

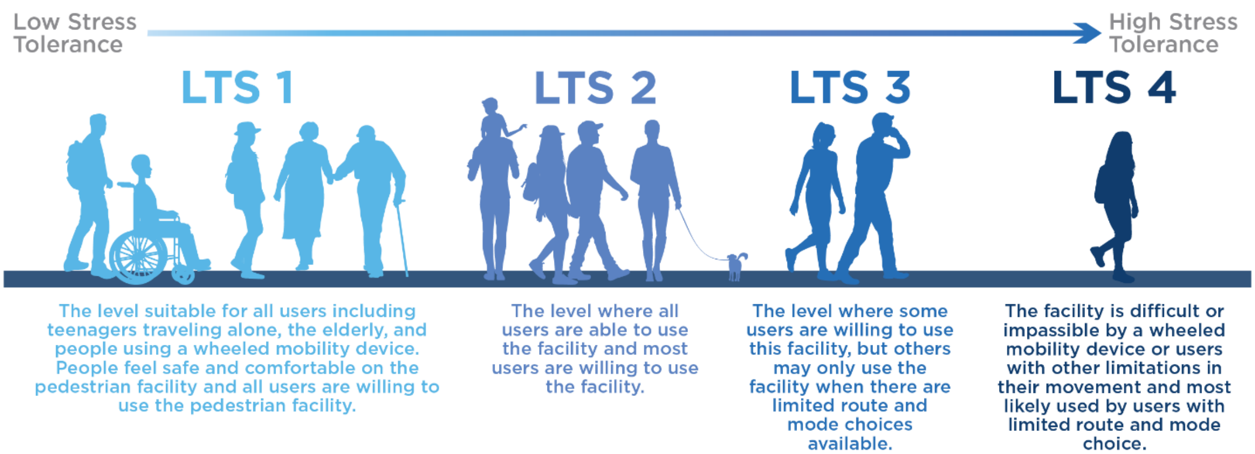


Figure 4: Pedestrian Level of Traffic Stress

PLTS uses six characteristics to assess pedestrians' perceptions of the roadway or nearby roadside environment:

- Existence of a sidewalk
- Sidewalk continuity
- Sidewalk width
- Posted speed
- Lateral separation of pedestrians from vehicular travel lanes
- Presence of vertical separation

3 | Analysis Inputs

To apply the motorized vehicle Generalized Service Volume Tables, the analyst must determine the segmentation, roadway type, land use context, and existing or future motorized vehicle volumes. This chapter outlines the methodology for determining these inputs.

3.1 Roadway Type

In alignment with *HCM* terminology, this handbook is based on three major roadway types:

- Freeways
- Uninterrupted flow highways
- Arterials (interrupted flow facilities)

3.1.1 Freeways

Freeways are multilane, divided facilities with at least two lanes for exclusive use of traffic in each direction and full control of ingress and egress.

3.1.2 Uninterrupted Flow Highways

Uninterrupted flow highways are non-freeway facilities which have isolated driveways and average signalized intersection spacing greater than two miles. Because of the significantly different operating characteristics, these types of roadways are frequently further distinguished as two-lane highways and multilane highways.

3.1.3 Arterials

Interrupted flow facilities have fixed causes of periodic delay or interruption to the traffic stream (such as traffic signals or stop signs) with average spacing less than or equal to two miles. In this handbook, signalized arterials are the predominant type of interrupted flow roadway. Signalized non-state owned roadways, but not local streets, are included in this category. This handbook refers to all fixed causes of interruption to the traffic stream, including stop signs or other control types, to be signalized intersections. However, when using the GSVTs, all intersections included in the analysis should be signalized, as stop signs and other control types that impact arterial traffic are not considered.

3.2 Land Use Context

3.2.1 Area Types

This handbook uses four broad area types for freeways and highways (see **Figure 5**):

- Core urbanized: Areas with a population of 1,000,000 or more.
- Urbanized: Other urbanized areas with a population of 50,000 or more.
- Transitioning: Transitioning from rural into urbanized areas.
- Rural: Areas with a population of less than 5,000.

Figure 5: Area Types

FDOT District LOS Coordinators should be consulted for applicable boundaries within their districts.

3.2.1.1 Core Urbanized and Urbanized Areas

Core urbanized and urbanized areas have defined, approved boundaries which encompasses the entire census-defined urbanized area as well as the surrounding geographic area agreed on by FDOT, Federal Highway Administration (FHWA), and the local metropolitan planning organization (MPO) or transportation planning organization (TPO). A census-defined urbanized area boundary consists of a central core and the adjacent densely settled area that combined has a population of 50,000 or more.

Core urbanized areas include MPO areas in Fort Lauderdale, Jacksonville, Miami, Orlando, St. Petersburg, Tampa, and West Palm Beach.

3.2.1.2 Transitioning Areas

Transitioning areas are fringe areas that exhibit characteristics between rural and urbanized. Transitioning areas are anticipated to become urbanized or urban in the next 20 years.

A metropolitan planning area (MPA) is the boundary in which the transportation planning process must be carried out. The MPA is made up of the census-defined urbanized area, plus the contiguous or transitioning area expected to become urbanized within the next 20 to 25 years. Frequently, the MPA is used for the transitioning area adjacent to an FHWA Urbanized Area (adjusted census-defined urbanized area boundary). In practice, most MPOs have not delineated those contiguous or transitioning areas, and many of the MPAs extend to remote rural areas of counties. When the MPO does not identify these transitioning areas or areas adjacent to urban (but not urbanized) areas, FDOT districts, in cooperation with local governments, may delineate transitioning areas for LOS purposes.

Keeping the boundaries relatively consistent over time encourages understanding by all potential parties. Transitioning area boundaries should be reviewed and adjusted during the census cycle update, consistent with the setting of the FHWA Urbanized Area boundaries. Transitioning area boundaries can also be reviewed when updating long-range transportation plans. The FDOT District LOS Coordinators should be consulted for transitioning boundaries within their districts. Boundaries for transitioning areas should be based on the location of major roadways or interchanges to avoid portions of freeway changing from transitioning to urbanized or rural between interchanges. When aligning the transitioning area boundary with major roads is impractical, arterials should have the same designation between major roadways and not change midblock.

3.2.1.3 Rural Areas

Generally, rural areas are areas with a population less than 5,000 and not immediately adjacent to core urbanized, urbanized, or transitioning areas.

For more information on designating urban boundaries, reference the FDOT Urban Boundary and Functional Classification Handbook (FDOT Urban Boundary and Functional Classification Update Process).

3.2.1.4 Context Classification

FDOT categorizes non-limited access roadways (highways and arterials) in one of eight context classifications (see **Figure 6**).

- C1—Natural roadways are in lands surrounded by nature or wilderness that is in permanent preservation.
- C2—Rural refers to sparsely settled lands that may include agricultural land mixed with grassland, woodland, or wetlands.
- C2T—Rural Town represents small concentrations of developed areas immediately surrounded by rural and natural areas.
- C3R—Suburban Residential classification is mostly in areas where housing is located immediately adjacent to the road and organized in large blocks with a disconnected or sparse roadway network.
- C3C—Suburban Commercial has mostly non-residential uses with large building footprints and large parking lots along the road. C3C also has large blocks and a disconnected or sparse roadway network.
- C4—Urban General has a mix of uses in one- to three-story buildings set in small blocks within a well-connected roadway network. C4s can extend long distances.
- C5—Urban Center has mixed uses within small blocks in one- to five-story buildings with a well-connected roadway network typically concentrated around a few blocks or within an identified civic or economic center of a community, town, or city.
- C6—Urban Core describes roads located in areas with the highest densities and building heights. C6 roadways are within FDOT-classified Core Urbanized Areas (defined as having a population greater than one million).

C1 and C2 roadways are highway facilities and have similar operations. For more on context classification, see the *FDOT Context Classification Guide* (FDOT Context Based Solutions).

The Generalized Service Volume Tables for highways and arterials are organized by context classification rather than area type. This more stratified set of tables better represents varied conditions across the state.

Figure 6: FDOT Context Classification

3.3 Segmentation

To properly apply the GSVTs, analysts should segment roadways into appropriate lengths. Lengths that are too short may not adequately capture traffic flow characteristics. Vehicles will not achieve the same average running speed on a short segment as over a longer one. Delays and average travel speeds on segments that are too short will be influenced in large part by the signal control delay. Furthermore, setting lengths that are too short will create results that do not conform to the concept of motorized vehicle LOS, which is based on the drivers' perception of roadway operation. Such results also may not show where proposed development traffic may have the greatest impact.

Conversely, setting lengths too long may dilute the impact of hot spots by averaging them into other portions that operate better.

FDOT District LOS Coordinators are primarily responsible for segmenting the SHS for LOS purposes. FDOT Central Office may combine smaller segmentation lengths of a facility for statewide reporting and other purposes.

In general, the segmentation of roadways for facility analyses should be based on the following considerations:

- Area type boundaries
- Context classification
- Highway system structure (including facility type, number of lanes, and bicycle facility type)
- AADT
- Major intersections or interchanges

Local government agencies often segment roadways at their own jurisdictional boundaries, regardless of the appropriate facility length and logical termini considerations described above.

Jurisdictional boundaries by themselves are usually inappropriate termini for analyzing capacity and LOS. Local governments should consult with FDOT District LOS Coordinators for applicable segmentation within local jurisdictional boundaries.

There may be small lengths of roadways (such as about six miles for freeways or three miles for non-freeways) between area types or adjacent to an area type that should be combined into one area type or another. These situations typically occur with adjacent interchanges or in transitioning areas. When these circumstances occur, FDOT districts can adjust area type boundaries or designate a roadway with a certain area type.

3.3.1 Freeway Segmentation

For freeway facility analyses, interchanges should serve as segmentation points. In the event that the number of lanes changes between interchanges, the freeway should be broken into multiple segments between those interchanges.

3.3.2 Uninterrupted Flow Highway Segmentation

For highway facilities (C1 or C2), it is generally recommended that the segment lengths be at least two miles long and use major intersecting roadways as logical breaks. If the number of lanes change between interchanges or major intersecting roads, the highway should be broken into multiple segments between those intersections.

3.3.3 Arterial Segmentation

For Suburban Commercial—C3C or Suburban Residential—C3R it is generally recommended that the segment lengths be at least two miles long. Shorter segments may be appropriate in C2T—Rural Town; C4—Urban General; C5 —Urban Center; and C6—Urban Core context classifications. Major intersecting arterials provide logical segment breaks. Changes in context classification should also provide segment breaks.

When evaluating an arterial section or facility’s LOS for planning purposes, analysts should set a roadway’s beginning and ending points at signalized intersections. For special cases, analysts can use the following guidance:

- Interchanges, on and off ramps, along an arterial: at a generalized planning level, it is generally appropriate to apply segmentation at an unsignalized interchange. Analysts should exercise caution when evaluating signalized interchanges, as geometric conditions can significantly impact operations and are not considered in the GSVTs analysis.
- Boundaries, especially urbanized area boundaries: for a planning-level analysis where a signalized intersection lies two miles beyond an area type boundary or less, practitioners should extend the analysis to the next signalized intersection. For example,

if a signalized intersection lies one mile beyond the existing urbanized area boundary in a transitioning area, the analyst should consider that signalized intersection and the one mile of transitioning area as part of an urbanized area.

3.3.4 Impact of Segmentation on LOS

On interrupted flow facilities, there is generally limited impact to travel speed mid-segment, so most of the travel speed reduction is caused by delay at signalized intersections. Because this delay is averaged across a segment's length, longer segments result in higher average travel speeds, even with the same intersection delay. This impact should be considered when moving from a GSVT analysis to a more detailed analysis. If field segment lengths are significantly different than those assumed by the GSVTs, LOS may change significantly.

3.4 Motorized Vehicle Volume and Travel Demand

Motorized vehicle traffic volume is the number of motorized vehicles passing a point on a transportation facility during a specified time. Typically, motorized vehicle traffic volumes are an input to motorized vehicle capacity and LOS analyses. Motorized vehicle traffic volume sources include:

- FDOT's Florida Traffic Online web application Florida Traffic Online (state.fl.us)
- Travel demand forecasting models
- The Institute of Transportation Engineers' (ITE) *Trip Generation Manual*

The following sources offer guidance on traffic forecasting and analysis:

- FDOT's Project Traffic Forecasting Handbook (*PTF Handbook*) (FDOT Systems Implementation Office)
- FDOT's *Traffic Analysis Handbook* (FDOT Systems Implementation Office)
- The Transportation Research Board of the National Academies of Science's *HCM, Sixth Edition*

Motorized vehicle capacity and LOS analyses can misuse measured motorized vehicle traffic volumes on congested facilities by assuming observations and measurements of traffic conditions as they currently exist reflect the totality of motorized vehicle traffic demand. However, current observations on congested facilities reflect capacity constraints that may prevent motorized vehicles from accessing a desired segment of the system during a particular time rather than motorized vehicle traffic demand. This is important to consider when collecting traffic data at an oversaturated intersection, where the traffic volume that can be processed through a traffic signal is what is often measured in the field. But when traffic volumes approach roadway capacity, the intersection may experience long vehicle queues. The length of the vehicle queue upstream of a traffic signal cannot be processed in the analysis period but is a more accurate measure of traffic demand during a particular time at the intersection. When analysts question whether they should use measured motorized vehicle traffic volumes or demand volumes for capacity and LOS analyses, they should use demand volumes by including the vehicle queue.

GSVTs are not applicable above capacity. In the case where motorized vehicle traffic demand exceeds capacity during a particular time, consider using one of the other analysis tools presented in **Figure 2**.

3.4.1 Annual Average Daily Traffic

AADT is the total volume of motorized vehicle traffic on a highway or roadway segment for one year divided by the number of days in the year. Most planning applications use AADT volumes. Determining AADT values is a separate process and distinct from capacity and LOS analyses. FDOT routinely provides AADT values for state roads.

AADT values are easily mistaken for two other traffic counts that are used to estimate AADT: average daily traffic (ADT) and peak season weekday average daily traffic (PSWADT).

ADT is the total traffic volume during a given time (more than a day but less than a year) divided by the number of days in that time. ADT is generated from a short-term traffic count and can be used to estimate AADT. When using ADT to estimate AADT, analysts should ensure that ADT counts reflect normal traffic conditions. Counts taken during holidays, long weekends, or events such as professional sports games or concerts will not reflect normal traffic conditions.

PSWADT represents typical weekday traffic during the peak season. Typically, these numbers are generated by travel demand forecasting planning models, such as the Florida Standard Urban Transportation Model Structure (FSUTMS). Like ADT, PSWADT counts can be converted to AADT using an adjustment factor.

There are two count-adjustment factors used to calculate AADT: axle correction factors and seasonal adjustment factors. Axle correction factors compensate for an axle counter's tendency to count more vehicles than are present. For example, an axle counter would show a count of two after a four-axle truck ran over the sensor, even though only one vehicle was present. Seasonal adjustment factors compensate for traffic variations over the course of a year. The peak season is the 13 consecutive weeks with the highest volumes. Peak season weeks will have the lowest seasonal adjustment factors. Weeks with the lowest volumes will have the highest seasonal adjustment factors.

The following equation calculates AADT using short-term traffic counts adjusted by axle correction factors and seasonal adjustment factors:

$$\textbf{AADT} = (\textbf{short term traffic count}) \times (\textbf{seasonal adjustment factor}) \times (\textbf{axle correction factor})$$

FDOT operates two types of traffic monitoring programs:

- Continuous monitoring at selected locations using permanently installed equipment
- Coverage counts at many temporary or short-term sites using portable equipment

Further information about the traffic monitoring programs can be found in FDOT's *PTF Handbook*.

3.4.2 Use Average AADT

Volumes in the GSVTs should be considered as average volumes for the facility under analysis.

Consider a four (4)-mile facility with five segments and AADT counts of 23,000; 22,000; 25,000; 23,000; and 27,000. In this case, the analyst should apply the average value 24,000 to the tables to determine LOS.

Using average AADT works well unless one segment has a widely disparate value, in which case a median value may be more appropriate. In the above example, if the first value was 10,000, the user should disregard that value and use the median value (23,000) instead or consider developing new segmentation.

For the arterial analysis used in developing the GSVTs for this handbook, volumes along the arterial were analyzed as being consistent for the entire corridor. To achieve consistent volumes, the number of vehicles that turned from the side streets onto the mainline was assumed to be equal to the number of vehicles that turned off the mainline onto the side streets.

3.4.3 Define the Through Movement

The service volumes in the GSVTs are based on the approach volume of the roadway (left turning, through, and right turning traffic are added together).

In this handbook, the through movement is defined as the traffic stream with the greatest number of vehicles passing directly through a point. While this movement is typically the straight ahead movement, the right or left turn can sometimes qualify as the through movement. When the turning movement has the greatest number of vehicles (more than the straight ahead), it is recommended to consider the turning movement as the through movement. See **Figures 7–9** for additional details.

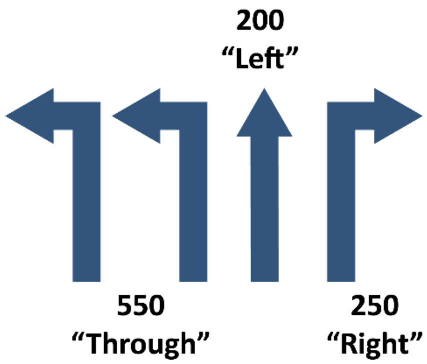


Figure 7: Predominant Turning Movement

In **Figure 7**, the predominant movement is the left-turning movement; the 550 vehicles turning left should be considered the through movement. The 200 vehicles going straight ahead should be treated as left-turning vehicles with 20% left turns from an exclusive left-turn lane. The resulting equation would look like this:

$$\frac{\mathbf{200}}{(\mathbf{550}\ +\ \mathbf{200}\ +\ \mathbf{250})}\ =\ \mathbf{20\%}$$

The 250 vehicles turning right should be treated normally, with 25% right turns from an exclusive right-turn lane. The resulting equation would look like this:

$$\frac{\mathbf{250}}{(\mathbf{550}\ +\ \mathbf{200}\ +\ \mathbf{250})}\ =\ \mathbf{25\%}$$

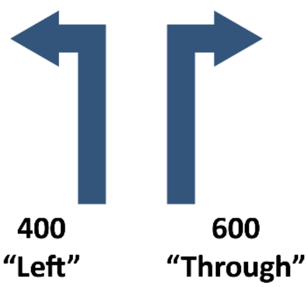


Figure 8: Through Movement at T Intersection with Exclusive Lanes

In **Figure 8,** all vehicles are turning from exclusive turn lanes at a T intersection. The 600 vehicles turning right is the predominant movement and should be considered the through movement. The 400 vehicles turning left should be treated normally, with 40% left-turns from an exclusive left-turn lane. The resulting equation would look like this:

$$\frac{\mathbf{400}}{(\mathbf{400}\ +\ \mathbf{600})}\ =\ \mathbf{40\%}$$

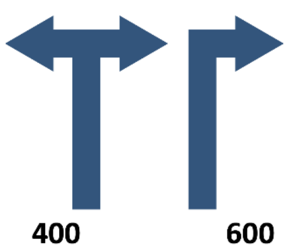


Figure 9: Through Movement at T Intersection with Shared Lanes

In **Figure 9**, another T intersection has a shared left/right lane in addition to the predominant movement served by the exclusive right lane. Normally, a shared left/through lane does not have the same capacity as a through lane because opposing vehicles block permitted left turns for the main movement. However, in this case, there is no opposing movement, and the capacity of this shared lane is virtually the same as a typical through lane. In this situation, an analyst should assume one through lane and one shared through lane with 20% left turns. The resulting equation would look like this:

$$\frac{\mathbf{200}}{(\mathbf{200}\ +\ \mathbf{200}\ +\ \mathbf{600})}\ =\ \mathbf{20\%}$$

3.4.4 Future Year Analyses

Traffic and development conditions change on roadways over time. This raises questions about what input values, analysis tools, and LOS targets to use for capacity and LOS analyses in future years. In transportation planning, analysis years and planning horizons differ greatly. For the purposes of this handbook, future or long term means 10 or more years from the current year, and current or short term means less than 10 years from the current year. For more specific applications and more detailed guidance, analysts should consult FDOT District LOS Coordinators.

For future year analyses, analysts should consider changes in roadway, traffic, and control characteristics as well as changes in land use and multimodal facilities. For example, existing conditions in a transitioning area may have infrequent signalization. However, as development occurs, the area may have more signalized intersections, which will need to be accounted for in future-year capacity and LOS analyses.

Changes in traffic and control characteristics are discussed in the following sections. For further guidance on future-year traffic development and analyses, refer to FDOT's *PTF Handbook* and *Traffic Analysis Handbook*. For more information on how to determine future context classification, refer to the FDOT Context Classification Guide (FDOT Context Based Solutions).

3.4.5 Changes in Motorized Vehicle Travel Demand

Analysts typically use historical growth trends and the state's travel demand forecasting models for long-term traffic projections. Analysts and reviewers of capacity and LOS analyses must agree on future AADT values to use in projections. (For additional information, see FDOT's *PTF Handbook*).

For site-impact analyses, analysts typically present volumes in terms of trips generated by the site rather than roadway-specific AADT, Standard K factors, and D factors. Analysts typically use ITE's *Trip Generation Handbook* to determine trip generation for site impact analyses. However, analysts should consult FDOT for supplemental material. In all cases, analysts should take care to ensure final values are compatible with statewide Standard K and D factors.

3.4.6 Changes in Traffic Characteristics

Measured K factor values often drop as areas become more developed for two reasons:

1. More urban situations typically do not have highly volatile volumes, such as what occurs with holiday traffic in rural areas. Generally, more developed areas have frequent, recurring volumes, such as weekday commuter traffic.
2. As congestion develops, peak travel hour traffic spread occurs.

For future-year generalized planning analyses, this handbook uses a Directional Distribution Factor (D) factor of 0.55 for all area and facility types. For long-term analyses, analysts may need to lower the factor. Analysts should refer to the D factors and their acceptable ranges in the FDOT *PTF Handbook*.

For future-year generalized planning analyses, analysts should use the traffic characteristics (Standard K and peak hour factor [PHF] values) for the future years' assumed area, context classification, and facility types (see **Chapter 6**).

3.4.7 Change in Control Characteristics

Generalized planning analyses have long made future traffic and roadway projections. For signalized roadways, these analyses must address control characteristics in the short and long terms. Typically, the two most important control variables are the through movement g/C and signal density.

3.4.7.1 Through Movement g/C

Determining current and future g/Cs for a roadway is complicated, and analysts must use good judgment. Analysts should use HCM analysis tools, which incorporate a signal timing optimization tool, to estimate future g/C. Optimization determines the required signal timing parameters to process through traffic movements on the major street while simultaneously minimizing the delay to minor street approaches.

3.4.7.2 Signal Density

Additional traffic signals are frequently installed as areas grow. More signals significantly affect arterial operations and LOS. For both short and long-term analyses, analysts should consider the probability of new traffic signals, especially those predicted based on proposed new developments. In the absence of specific development plans or intersecting traffic volume cross-product signalization criteria, analysts should use general guidance in the FDOT *Access Management Guidebook* (FDOT Access Management) for future year signal density/signal spacing.

This handbook does not advise on future signal locations in rural areas because of the wide variety of circumstances along generally uninterrupted flow highways in these contexts. However, analysts should consider the possibility of new signalized intersections. Signal density is important for LOS on state-owned roadways; thus, Highway Capacity Software 7.9.6 (for site impact applications, the number of new signals should be reviewed and approved by the FDOT district prior to use in an analysis.

4 | Development of the Generalized Service Volume Tables

This chapter outlines how the Highway Capacity Software 7.9.6 (HCS7) modules were used to obtain the service volume thresholds included in the GSVTs. The chapter also outlines the simplifying assumptions used to develop the tables, appropriate adjustment factors, and the limitations of the tables.

4.1 How Were the Generalized Service Volume Tables Developed?

All three sets of service volumes are internally consistent. All table service volume thresholds are based on the Standard K factors, D factors, and PHFs listed in **Chapter 6** of this handbook. **All service volumes and resulting tables are first calculated for the peak hour in the peak direction.** The peak hour two-way values are obtained by dividing the peak hour peak-direction service volumes by the D factor. The daily volumes are obtained by dividing the peak hour two-way service volumes by the K factor. Peak hour directional and peak hour two-way service volumes are rounded to the nearest 10 vehicles. Daily service volumes are rounded to the nearest 100 vehicles. Any motorized vehicle volume greater than the maximum service volume shown for a given number of lanes would drop the LOS to the next letter grade.

4.1.1 Freeway LOS

For freeways, the HCS7 freeway facilities module was used to obtain the service volume thresholds. The motorized vehicle volume was incrementally increased until the demand flow rate to the mean speed of the traffic stream produced an average facility density that was approximately equal to the LOS B threshold. The volume level at which this occurs is the service volume for LOS B. The volume (i.e., LOS B service volume) was then incrementally increased by 10 vph until the average facility density was approximately equal to the LOS C threshold speed. This process was repeated for LOS D and E. If at any point during this process the volume-to-capacity (v/c) ratio exceeded 1.0 for the full hour, the calculation stops. The traffic characteristics and other inputs, such as the capacity adjustment factor (CAF) and speed adjustment factor (SAF), used in these analyses are discussed in **Chapter 6** of this handbook and listed on the back of the GSVTs.

4.1.2 Highways LOS

For multilane uninterrupted flow highways, the HCS7's multilane highways procedure was used to obtain the service volume thresholds. The analysis started with a volume of 10 vehicles per hour (vph) and then calculated density. If the density was below the LOS B threshold density, the volume was incrementally increased by 10 vph. This process was repeated until the average density was approximately equal to the LOS B threshold. The volume level at which this occurs is then the service volume for LOS B. The volume (i.e., LOS B service volume) was then increased by 10 vph until the average facility density approximately equaled the LOS C threshold density. This process was repeated for LOS D and E. If at any point during this process the v/c ratio exceeded 1.0 for the full hour, the calculation stopped. The traffic factors and other inputs, such as CAF and SAF, used in these analyses are discussed in **Chapter 6** of this handbook and listed on the back of the GSVTs.

For two-lane uninterrupted flow highways, the computational process is similar to the process followed for multilane uninterrupted flow highways. The HCS7's two-lane highways module depends on highway class (I, II, or III; see Glossary for two-lane highway class). The traffic factors and other inputs used in the analyses are discussed in **Chapters 5-7** of this handbook and listed on the back of the GSVTs.

4.1.3 Arterial LOS

For arterials, the HCS7 streets facilities module was used to obtain the service volume thresholds. For the motorized vehicle mode, arterial analyses started with a volume of 100 vph and then calculated the v/c ratio at each intersection. Then, the speed on each segment was calculated, which accounts for the signal delay and the overall average facility speed. The average speed was checked against the average speed criterion for LOS B. If the speed was above the LOS B threshold, the volume was increased by either 50 vph (if the difference in the actual speed and LOS threshold speed was large) or 10 vph (if the difference in actual speed and LOS threshold speed was small). This process was repeated until the average facility speed was approximately equal to the LOS B threshold. The volume level at which this occurred is documented as the service volume for LOS B. The volume (i.e., LOS B service volume) was then incrementally increased by 10 vph until the average facility speed was approximately equal to the LOS C threshold speed. This process was repeated for LOS D and E. Once the maximum service volume is reached, the next LOS grade is F. For example, in Generalized Service Volume Table 4 for C2T—Rural Town (arterials), if demand volumes are greater than the LOS D threshold, then LOS is F. If the volume is at the LOS D threshold, the LOS is D. Essentially, LOS E does not exist.

4.2 HCM Methodology Simplifying Assumptions

Planning-level analyses make extensive use of default values and simplified assumptions to the operational models on which they are based. This handbook uses multiple simplifying assumptions to develop the GSVTs.

4.2.1 Default Inputs

In developing the Generalized Service Volume Tables most default input characteristics represent statewide averages. Some of the input characteristics used are summarized on the back of the GSVTs and in **Chapters 5-7**.

4.2.2 Queue Spillback

This handbook assumes that turning movements do not back up into adjacent through lanes. It assumes that there is adequate storage for turning vehicles on arterials and for vehicles exiting freeways. This is also assumed for some two-lane uninterrupted flow highways in which mid-block turning movements may affect capacity. Off- and on-ramp movements along freeways are also handled in a general way and are assumed to be adequately accommodated. Most importantly, it is assumed that movements at off-ramps do not back up into the through lanes of the freeway.

The planning techniques found in this handbook are not appropriate where mainline turning movements are not adequately accommodated. In these cases, users should select a different analysis tool identified in **Figure 2**.

4.3 Service Volume Adjustment Factors

Each GSVT provides generalized peak hour directional, peak hour two-way, and AADT maximum service volumes for a given LOS by roadway type and land use or context classification. Roadway characteristics that vary significantly from the average may require analysis to apply adjustment factors to the service volumes presented in the table. Common adjustment factors are listed below and are also presented on the back of the GSVTs.

4.3.1 No Left-Turn Lane Adjustment Factor

Exclusive left-turn lanes may only be used by vehicles turning left. The length of these lanes should accommodate turning demand, so that left-turning traffic is able to either enter the turn lanes behind through queues or be stored in the turn lane to ensure the through-lane traffic is not blocked. In developing the GSVTs, when a left-turn lane is present, it is assumed that ample storage is provided, and therefore storage length does not affect the delay or speed results.

When there are no left-turn lanes, a shared lane exists, which is included in the number of through lanes. The tables assume that left-turn lanes are available. When analyzing arterials without left-turn lanes, analysts should only use the GSVTs for the most basic analyses. The tables include a 25% reduction factor for use in very basic analyses. However, research indicates that the true reduction value is highly dependent on the distribution of traffic volumes among all movements; a constant reduction factor, as used in the tables, will not be accurate.

4.3.2 Exclusive Right-Turn Lanes Adjustment Factor

Exclusive right-turn lanes may only be used by vehicles turning right. In developing the GSVTs, when a right-turn lane is present, it is assumed that the length of these lanes is sufficient to allow for free flow of the through movement, and therefore storage length does not affect the delay or speed results.

The GSVTs assume a non-exclusive (or shared) right-turn lane, except in cases with one lane in each direction where an exclusive right lane was assumed as a work-around to an HCM methodology limitation. The tables include adjustment factors for the presence of right-turn lanes that must be manually applied to service volumes.

4.3.3 One-Way Facility Adjustment Factor

The GSVTs have a factor for accounting for how one-way streets affect service volumes. Because the GSVTs treat each facility of a one-way pair separately, the volumes in the daily and hourly two-way tables should be multiplied by 0.6 and the volumes in the hourly directional tables should be multiplied by 1.2 to obtain the correct service volume and LOS per direction of a one-way pair.

4.3.4 Auxiliary Lane Adjustment Factor

Freeway auxiliary lanes (lanes that connect on- and off-ramps) usually have significant capacity and LOS benefits. The values contained in the tables indicate their importance in a general way. To apply the values, add the volume shown in the freeway adjustment to the maximum service volume shown in the table.

4.3.5 Ramp Metering Adjustment Factor

Freeway ramp metering can smooth out traffic demand entering a freeway during peak travel times. This benefit is reflected by increasing the service volumes shown on the tables by 5%.

4.3.6 Non-State-Owned Signalized Roadways Adjustment Factor

The primary purpose of this handbook is to compute LOS for state-owned facilities. However, the GSVTs are reasonably well suited for local governments evaluating roads in their jurisdictions. The only types of roadways not addressed in the tables are unsignalized local streets and unpaved roads.

Roadways being operated and maintained by different governmental entities has no effect on roadway capacity or LOS. **However, because they have lower green times at signalized intersections, non-state-owned roadways generally have lower capacities and service volumes than state-owned facilities.** The GSVTs contain a 10% adjustment factor for non-State-owned roadways.

The *HCM* LOS criteria address arterials rather than collectors or local streets. Local governments may decide how to analyze collectors and local streets.

Uninterrupted flow facilities are analyzed the same, regardless of whether they are State-owned facilities or not.

4.3.7 Examples of How to Apply Adjustment Factors

A C2T two-lane one-way non-State-owned signalized arterial facility with an exclusive right-turn lane will have an adjusted peak hour directional LOS C threshold of 1290. This is calculated using the C2T Arterial GSVTs based on the LOS C threshold for a two-lane state-owned signalized arterial facility classified as C2T with an exclusive left-turn lane, which is 1,140. To calculate the specific LOS C threshold for the example roadway, all applicable adjustment factors must be accounted for. The LOS C threshold must be adjusted by 1.2 for one-way facilities (20% more capacity for one-way facilities), 1.05 for exclusive right-turn lanes (5% more capacity for exclusive right-turn lanes), and 0.90 for non-state-owned signalized roadway adjustments (10% less capacity due to different control characteristics). Applying these adjustment factors to the base threshold of 1,640 gives an adjusted peak hour directional LOS C threshold of 1,293 (1,140 × 1.20 × 1.05 × 0.90), which would be rounded to 1,290.

4.4 Generalized Service Volume Tables Limitations

Although they are a good generalized-planning tool, the GSVTs do not provide sufficient detail for project development and environment (PD&E) traffic analysis, final design, or operational analysis work, and should not be used for those purposes. It is entirely possible that no single roadway has the exact values for all the roadway, traffic, or control characteristics used in the GSVTs.

The GSVTs are based on the *HCM* urban streets facility methodology, which examines multiple intersections. The arterial GSVTs generally assume a consistent set of contiguous intersections without any significant variance between side street demand at each intersection. The arterial GSVTs will not provide proper results at bottleneck intersections where side street demand is high.

Most planning applications begin with AADT volumes given as an input or end with AADT as a calculated output. The tables' generalized daily service volumes depict the AADT based on a standard peak hour in the peak direction. Some local and regional entities have adopted two-direction peak hour standards. In this case, the GSVTs may underestimate the LOS service volumes

The GSVTs cannot be relied upon when approaching LOS E and LOS F thresholds, because of operational fluctuations at these thresholds. In these situations, analysts should perform more detailed analyses.

The techniques to determine LOS for an arterial found in this handbook are not appropriate for turning movements that are not adequately accommodated in the available storage. Although the arterial analysis includes all vehicles on the arterial, this handbook focuses on the vehicles making through movements rather than turning movements. For example, this handbook only includes the green time for the through movement. A penalty of 25% is used if there are no left-turn lanes at signalized intersections.

Because the GSVTs use default values, higher and lower Q/LOS letter grades for motorized vehicles than what is shown in the tables may not be achieved, even with extremely low or extremely high traffic volumes. Higher letter grades cannot be achieved primarily because the control characteristics will not allow vehicles to attain relatively high average travel speeds. The tables have footnotes to reflect this unachievable concept. Lower Q/LOS letter grades are not achieved primarily because the control characteristics do not allow enough vehicles to pass through an intersection in an hour. If vehicles could get through the intersection, they could obtain the applicable LOS speed threshold, but there is not enough capacity at the intersection to let them through.

5 | Roadway Characteristics

This chapter outlines key roadway characteristics used in the GSVTs.

5.1 Number of Through Lanes

The number of through lanes is a critical variable for analyzing a roadway's capacity and LOS. In this handbook, emphasis is placed on through lanes, or lanes that directly accommodate through traffic.

Usually, roadways are described by the total number of through lanes in both directions. However, this handbook bases analyses upon a single peak direction. For example, an LOS analysis for a six-lane freeway is based on three lanes and uses the higher directional traffic volume.

5.1.1 Number of Through Lanes for Freeways

On freeways, the number of lanes is counted at the basic segment or between interchanges. The number of lanes does not include auxiliary lanes on freeways.

5.1.2 Number of Through Lanes for Highways

On two-lane highways in rural areas, LOS is largely determined by the ability to pass other vehicles. For highway facilities with uninterrupted flow, the number of lanes is counted at the basic segment or midblock. For example, a two-lane highway that widens to four lanes at major intersections should be considered to have two lanes. The number of lanes does not include passing lanes on two-lane highways.

5.1.3 Number of Through Lanes for Arterials

Because signalized intersections are the primary limiting factor for an arterial's capacity, this handbook emphasizes intersection characteristics more than midblock characteristics. Generally, midblock segment capacity far exceeds that of major intersections, and significant delays rarely occur midblock. Therefore, when using the GSVTs, analysts should determine the number of lanes for arterials and other interrupted flow facilities at major intersections rather than midblock.

When using the GSVTs, the number of through lanes on a facility is typically determined by the through and shared through/right-turn lanes at major intersections. Consider **Figure 10**, which shows a roadway that has midblock segments with four lanes (two lanes in each direction). The roadway's major intersections each have six lanes, with two through and one shared through/right add/drop lane with tapers adequate for safe merging. Here, minor signalized intersections have green times heavily weighted to the major urban street so that they do not significantly delay through traffic. In cases like this, it is often acceptable to disregard the number of lanes at minor intersections and instead use the number of the lanes at major intersections. So for the purposes of determining LOS, this facility has six lanes.

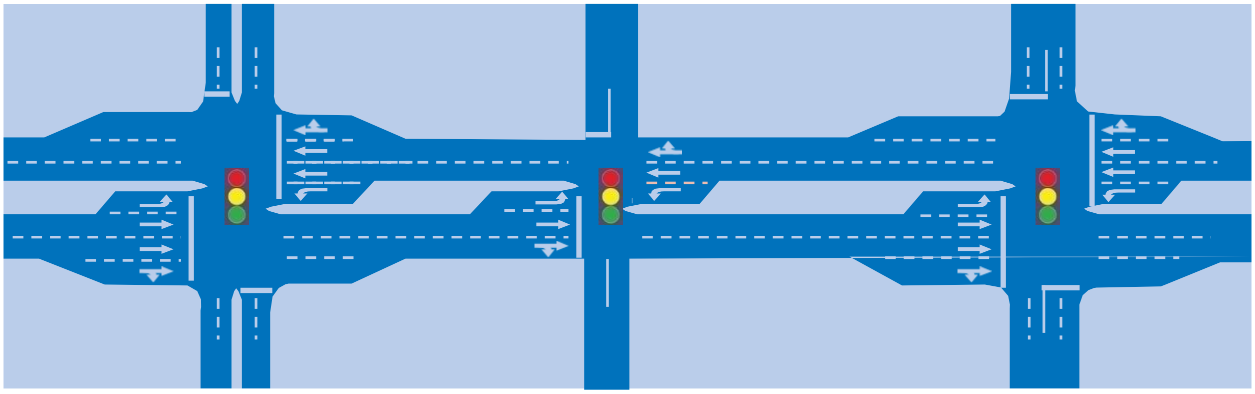


Figure 10: Example of Determining Lane Count when Minor Signalized Intersections Have Green Times Heavily Weighted to the Major Urban Street

Add/drop lanes may be included in the number of lanes. Because site-specific characteristics (such as intensity and type of land use, driver behavior, and speed) can dramatically affect the viability of add/drop lanes as through lanes, each approach should be examined on a case-by-case basis. Analysts should carefully review all pertinent characteristics during peak travel conditions prior to adjusting the number of through lanes. Analysts should consult with their FDOT District LOS Coordinators prior to any through lane adjustment. The following guidelines only help estimate capacity, and this process should never be used to design or redesign an expanded intersection.

For the add/drop lanes to be included as a full lane in the number of lanes, two conditions should be met:

1. The add/drop lanes must each be at least 800 feet long, and
2. Combined, the add/drop lanes must be at least 1,760 feet long.

If the add/drop lanes are at least 0.33 mile long (divided about equally between approach and departure and exclusive of tapers and cross-street width, as represented by A+B in **Figure 7**), it may be reasonable to consider adding 0.5 lane. For example, in **Figure 11**, if A is 1,000 feet and B is 1,000 feet, then the intersection approach effectively has 2.5 through lanes.

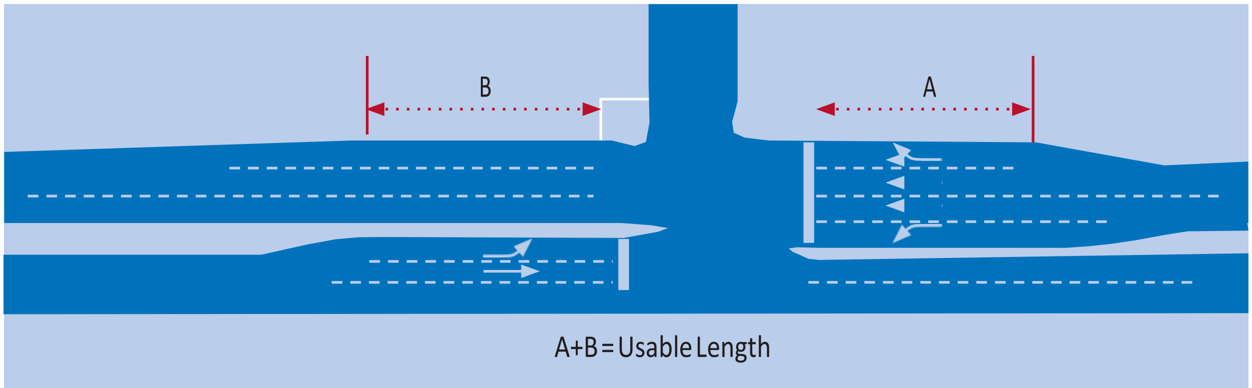


Figure 11: Length of Add and Drop Lanes

When continuous two-way left-turn lanes are present, also known as non-restrictive medians, arterials are often described as having an odd number of lanes. However, this assessment is inappropriate for service volume and LOS analyses. Because the continuous two-way left-turn lane does not accommodate through vehicles, the arterial is better characterized as having an even number of lanes with a non-restrictive median.

5.2 Posted Speed

Posted speed is the maximum speed at which vehicles are legally allowed to travel on a roadway segment.

5.3 Median Type

This handbook classifies medians in three ways:

- Restrictive median (r)
- Non-restrictive median (nr)
- No median (n)

A restrictive median is a raised or grassed area normally at least 10 feet wide that separates opposing midblock traffic lanes and includes left-turn lanes.

A non-restrictive median is a painted, at-grade area normally at least 10 feet wide that separates opposing midblock traffic lanes. For arterials, non-restrictive medians accommodate midblock left-turning vehicles exiting from through lanes. Under this definition, continuous two-way left-turn lanes are considered non-restrictive medians.

For the purpose of evaluating general service volumes and LOS, when restrictive or non-restrictive medians are less than 10 feet wide, the roadway is considered to have no median.

The HCM uses the access point methodology to handle delay due to mid-segment turns. Field knowledge is required for the access point adjustment factor because access points can vary dramatically. This adjustment was not applied to the GSVTs, and there is no generalized adjustment factor for median type or mid-segment turns.

5.4 Base Free-Flow Speed

Base free-flow speed is the potential free-flow speed based only on the road's horizontal and vertical alignment, not including the impacts of lane widths, lateral clearances, median types, or access points. Based on a general assumption used in the HCM, base free-flow speed is assumed to be 5 mph above the posted speed in this handbook.

5.5 Auxiliary Lanes

Freeway auxiliary lanes (lanes that connect on- and off-ramps) usually have significant capacity and LOS benefits. The freeway GSVTs assume auxiliary lanes are not present. If auxiliary lanes are present, the analyst should add the volume shown in the freeway adjustment to the maximum service volume shown in the table.

5.6 Lane Width

For freeways and highways, the GSVTs assume 12-foot lanes. For arterials, the GSVTs assume the lane widths permitted for the context classification based on the design speed (FDM section 210.2) shown in the roadway characteristics on the back of the GSVTs, assuming the design speed and posted speed are the same.

5.7 Signal Spacing

On arterials, the cumulative effect of numerous traffic signals, lack of green time, and lack of effective signal progression negatively impacts motorized vehicle LOS. To account for this influence, the GSVTs consider signal spacing when determining motorized vehicle LOS on highways and arterials. For each context classification, average signal spacing and average standard deviation of facility segment lengths were set using an analysis of sample Florida arterials. While this approach may be acceptable for an areawide analysis, analysts should measure precise distances between signalized intersections when an individual roadway is analyzed at the corridor planning level.

The distance between signalized intersections is required to determine a roadway's specific service volumes. Because individual intersection delays are averaged over segment length, longer segments generally result in higher motorized vehicle LOS.

Roadway and traffic characteristics change over time. New signals will likely be added as areas develop and become more urbanized. As a result, analyses of future conditions LOS must consider future roadway and signal characteristics and future context classification.

Arterial segments should begin and end at signalized intersections. In unusual situations when this strategy is not applicable (for instances, where there are lane drops or ramp junctions), analysts should not count the unsignalized terminus as a signalized intersection when using the GSVTs.

Typically, analysts should only consider fixed, periodic interruptions when determining the number of signals. Only one intersection at the ends of the facility should be counted. Draw bridges, at-grade railroad crossings, school zones, pedestrian crossings, and median openings should not be counted. There may be exceptions to these guidelines, depending on site-specific conditions or desired analysis.

6 | Traffic Characteristics

This chapter outlines key traffic characteristics used in the GSVTs. LOS analysis evaluates conditions for the most congested through movement during the most congested time period(s). It is for this reason that the most fundamental tables in the GSVTs are the hourly directional tables. The GSVTs include LOS tables for peak hour directional, peak hour two-way, and AADT. AADT tables are created by dividing the peak hour directional values by the D and K factors. Since AADT is usually used for planning purposes, determining D and K factors is critical for planning-level capacity and LOS analyses because of the need to convert AADT to peak hour directional volumes.

6.1 K Factor

The K factor is the ratio of traffic volume in the study hour to AADT. In the past, FDOT used a variety of study hours and K factors depending on application. Common K factors included the 30th highest volume hour of the year (K30); the 100th highest volume hour of the year (K100); the highest hourly volume to daily volume (Kp/d); the 5–6 p.m. weekday volume to AADT (K5–6pm); the average p.m. weekday peak volume to AADT (Kpm); the average a.m. peak weekday volume to AADT (Kam); and the average noon weekday volume to AADT (Knoon).

Today, Florida uses Standard K as the primary planning-analysis hour factor. The value of Standard K is set based on area and facility type and used during the planning phase through the design phase of the project development process. FDOT developed a two (2) point Standard K factor range for the context classifications from which a value can be chosen for the project. Unless noted otherwise, all references in this handbook to "study hour" or "K factor" refer to Standard K.

The Standard K factor is used to convert peak hour two-way volume to AADT and vice versa. On freeways in the seven largest urbanized areas in Florida—Fort Lauderdale, Jacksonville, Miami, Orlando, St. Petersburg, Tampa, and West Palm Beach—Standard K represents the peak study period. Standard K factors for planning and design analysis do not directly apply to the Florida Turnpike, other toll roads, and managed lanes. For more information on K factors, refer to FDOT's *PTF Handbook*.

Recommended Standard K factor ranges can be found in FDOT's *PTF Handbook*. Analysts must refer to FDOT's *PTF Handbook* when setting appropriate K factors for projects. **The K factor generally decreases as an area becomes more urbanized and high traffic volumes are spread out over longer time periods.**

Previously, generalized service volume thresholds for core urbanized area were determined by applying a different K factor to the urbanized design hourly volume (DHV) thresholds. After careful consideration, it was noted that additional factors such as speed and ramp density should be considered when analyzing core urbanized areas. As a result, new DHV, directional design hourly volume (DDHV), and AADT thresholds were developed for core urbanized areas based on a separate analysis from the urbanized area thresholds.

The K factors used to develop the GSVTs for freeways and highways are consistent with FDOT's *PTF Handbook* (see **Table 2**).

Table 2: Standard K Factors for Freeways

Area Type	Recommended Standard K Factor Range
Rural	8.5% - 10.5%
Urban	7.5% - 9.5%
Urban Core	7.0% - 9.0%

The K factors used to develop the GSVTs for arterials align with FDOT's *PTF Handbook* (see **Table 3**).

Table 3: Standard K Factors for Arterials and Highways

Context Classification	Recommended Standard K Factor Range
C1 – Natural	8.5% - 10.5%
C2 – Rural	8.5% - 10.5%
C2T – Rural Town	8.5% - 10.5%
C3C – Suburban Commercial	7.5% - 9.5%
C3R – Suburban Residential	7.5% - 9.5%
C4 – Urban General	7.5% - 9.5%
C5 – Urban Center	7.0% - 9.0%
C6 – Urban Core	7.0% - 9.0%

The K factors for all state roads are available on the FDOT Florida Traffic Online (FTO) web application managed by FDOT's Transportation Data and Analytics (TDA) Office.

6.2 Peak Hour Directional Distribution Factor (D)

The D factor is the proportion of a peak hour's total volume that occurs in the higher volume direction.

The preferred approach for obtaining D factor data is from the Florida Traffic Online web application, which provides a D factor for all state roads. The web application reports the average of measured D factors for the 200th highest hour from nearby and comparable roadway sites. The statewide minimum acceptable D factor is 0.51; however, this is not the default value and should only be used in an LOS analysis if adequate justification is provided for the specific roadway. The GSVTs for all facility and area types use a D factor of 0.55. This approach ensures statewide consistency and reasonably accurate results at a low cost. For additional guidance and recommended D factor ranges, see FDOT's *PTF Handbook*.

6.3 Peak Hour Factor (PHF)

The PHF compares the traffic volume during the busiest 15-minutes of the peak hour with the total volume during the peak hour.

The following equation calculates PHF:

$$\mathbf{PHF} = \frac{(\mathbf{Peak\ hour\ volume})}{\mathbf{4\ \times\ peak\ 15\ minute\ volume}}$$

Freeway motorized vehicular service volumes were developed using freeway PHF based on area type (see **Table 4**).

Table 4: Freeway Peak Hour Factor (PHF)

Area Type	Peak Hour Factor
Core Urbanized and Urbanized Areas	0.95
Transitioning	0.92
Rural	0.88

The GSVTs for highways and arterials use PHF values aligned with the HCM, Sixth Edition and FDOT's *PTF Handbook*. Each context classification has a PHF (see **Table 5**):

Table 5: Highway and Arterial Peak Hour Factor (PHF)

Context Classification	Peak Hour Factor
C1 – Natural	0.88
C2 – Rural	0.92
C2T – Rural Town	0.95
C3C – Suburban Commercial	0.95
C3R – Suburban Residential	0.92
C4 – Urban General	0.95
C5 – Urban Center	0.95
C6 – Urban Core	0.95

For more information on PHF, refer to FDOT's *PTF Handbook*.

6.4 Base Saturation Flow Rate

Base saturation flow rate is the maximum steady flow rate, expressed in pcphpl, at which passenger cars can cross a point on interrupted flow roadways. Base saturation flow rate is not the same as capacity, which describes how many vehicles a roadway can reasonably accommodate.

To describe the maximum steady flow of an interrupted flow roadway, the HCM uses base saturation flow rate for arterials. For uninterrupted flow roadways, the HCM uses capacity or base capacity. Florida's freeways and highways have set base capacities and Florida's arterials have set base saturation flow rates (see **Table 6** and **Table 7**).

Table 6: Base Capacity for Freeways and Highways

Facility Type	Base Capacity (pcphpl)
Basic Freeway (70 mph free-flow speed)	2,400
Uninterrupted Flow Multilane Highway (60 mph free-flow speed)	2,200
Uninterrupted Flow Two-Lane Highway	1,700

Table 7: Base Saturation Flow Rates for Arterials

Facility Type	Base Saturation Flow Rates (pcphpl)
C3C, C3R, C4, C5, and C6 and Other Interrupted Flow Facilities (assuming 100% green time)	1,950
C2T — Rural Town	1,700

6.5 Heavy Vehicle Percentage

The FHWA's standardized vehicle classification system considers vehicles larger than a pickup truck as heavy vehicles. Vehicles with more than four wheels or a classification group of four or higher are also considered heavy vehicles. Truck factor (T) is the percentage of heavy vehicles in a given day. To be consistent with *HCM* terminology and clarify the transportation industry's use of truck, this handbook uses the phrase "heavy vehicle percentage" instead.

Heavy vehicle percentage varies by time of day, day of week, roadway type, and adjacent land uses. Operational characteristics of heavy vehicles also vary by heavy vehicle type and whether the vehicles are operating on an uncongested freeway or interrupted flow facilities. Heavy vehicle type and speed also impact the blast effect felt by bicyclists. For example, a relatively small delivery truck will create a smaller blast effect compared to a fully loaded 18-wheel semi-truck.

The heavy vehicle percentage assumed by facility type, area type, and context classification is provided on the back of the GSVTs.

6.6 Speed and Capacity Adjustment Factors

In the HCM, Sixth Edition, the speed adjustment factor and capacity adjustment factor replaced the local adjustment factor (LAF). In the past, LAF adjusted capacity to account for driver aggression, hurriedness, and familiarity with the facility.

The speed adjustment factor (SAF) adjusts the speed of a facility based on several environmental conditions, including weather. The SAF can also be used to calibrate estimated free-flow speed for local conditions or other effects that reduce free-flow speed.

The capacity adjustment factor (CAF) adjusts the capacity of a facility for capacity-reducing situations—such as construction and maintenance activities, adverse weather, traffic incidents, and vehicle breakdowns—or to match field measurements.

Both the SAF and CAF adjust for driver familiarity or unfamiliarity with a facility and calibrate a roadway to existing conditions. The GSVTs for all analyses and area types use a SAF of 0.975 and a CAF of 0.968. These values are derived from the *HCM, Sixth Edition*.

7 | Signalized Intersection Control Characteristics

This chapter outlines key signalized intersection control characteristics used in the GSVTs. Control characteristics account for the impact of signalized intersections on motorized vehicle capacity on interrupted flow facilities, unless otherwise noted. For uninterrupted flow facilities, such as freeways and highways, analysts can readily derive LOS from motorized vehicle volumes and roadway capacity. In these cases, control characteristics do not apply.

For signalized roadways (interrupted flow facilities), volume and capacity will not be sufficient to determine the LOS. Instead, the analyst will need to consider signal characteristics, including:

- Number of signals
- Arrival type
- Cycle length
- Effective green ratio (g/C)

The GSVTs use default control characteristics that represent typical conditions on Florida roadways for each context classification. The default control characteristics—along with the roadway and traffic characteristics assumed in the creation of each table—can be found at the back of the GSVTs. The GSVTs uses default characteristics for the signal spacing, arrival type, signal type, cycle length, major through effective g/C, and exclusive left-turn effective green ratio. If default values vary significantly, the analyst should consult the *HCM*.

Some characteristics have a greater effect on results than others. **Table 8** indicates how motorized vehicle service volumes are sensitive to different control characteristics.

Table 8: Sensitivity of Control Characteristics on Service Volumes

Control Characteristics	Service Volumes Sensitivity
Arrival Type	High
Signal Type	Low
Signal Spacing	High
Cycle Length (C)	Medium
Through Effective Green Ratio (g/C)	High
Exclusive Left Effective Green Ratio	Medium

Analysts should conduct field visits to collect traffic data and other data needed for analyses. Up-to-date aerial or satellite imagery may be sufficient for most data entry items.

7.1 Arrival Type

Arrival type describes the quality of signal progression. The HCM, Sixth Edition defines six arrival types, as shown in **Table 9**. Type 1 represents the worst progression quality, and Type 6 represents the best.

Table 9: HCM, Sixth Edition Signal Progression Types

Arrival Type	Description of Flow
Type 1	Worst progression quality
Type 2	Unfavorable progression
Type 3	Uncoordinated operation, or random arrivals; appropriate for actuated signals
Type 4	Favorable progression; FDOT's default for coordinated signal systems
Type 5	Highly favorable progression
Type 6	Exceptional progression; may be appropriate when progression design strongly favors the peak direction of travel and all signals are coordinated for the facility's length

One-way facilities tend to have better quality progression than two-way facilities. Analysts should not assume that good progression in one direction implies good progression in the other. If favorable progression has been established for the peak direction only, off-peak speeds can be lower, even with less traffic volume.

A higher level of progression may also be appropriate around freeway interchanges, where signals are typically highly coordinated.

Arrival type may vary significantly from one signal to the next, even in coordinated signal systems. Actuated-coordinated signals have different green times, with breaks between groups of coordinated signals.

The HCM's urban streets facility procedure does not use arrival type for major street movements; instead, it estimates the percent arrivals on green directly. The GSVTs assign signal offset values to represent typical signal coordination for each context classification, given idealized scenario constraints.

7.2 Signal Type

Signal type indicates the degree to which the signal's cycle length, phase plan, and phase times are preset or actuated. There are three main signal types:

- Actuated

- Actuated-coordinated
- Pre-timed

Because modern traffic signals can handle multiple settings and vary by time of day, a traffic signal's type can change during a day to best meet traffic demands.

7.2.1 Actuated

Actuated signals (sometimes called fully-actuated signals) use vehicle detection for all signal phases on main and side street approaches. Each phase is subject to a minimum and maximum green time, and some phases may be skipped if there is no demand for that phase. The length of the green time observed in the field typically depends on vehicular demand for the phase. When there is little demand, a relatively short green time will be allocated to the phase. When there is significant demand, a relatively long green time will be allocated (depending on the maximum green time for that phase). Minimum and maximum green times for each phase can be changed by entering new values into the traffic signal controller.

Because phases can be skipped, and the amount of green time for each phase generally depends on demand, the cycle length can vary substantially from cycle to cycle. However, during periods of heavy vehicular demand, when all phases consistently reach their maximum values, cycle length can seem fixed. Actuated signal operations are most frequently used when the signalized intersection is isolated or when there is a desire to minimize delay without concern for progression.

7.2.2 Actuated-Coordinated

A subset of actuated control, actuated-coordinated control typically has fixed cycle length and varied green time for the main street through phase. The varied green time consists of a minimum green time plus any unused time from minor phases. When all the signals along a facility hold the main street green in this manner, vehicle platoons can move relatively unimpeded along the main street, with decent progression. Actuated-coordinated signal operations are typically used in Florida's urbanized areas, especially during peak travel times. This type of operation often offers the best balance of capacity and progression for main street through movements.

7.2.3 Pre-timed

Pre-timed signals repeat a set sequence of phase times and do not use vehicle detection. Regardless of vehicular demand, each phase is green for a fixed period, and none of the phases can be skipped. As a result, the signal has a fixed cycle length. Where there is a pedestrian signal, the pre-timed signal green time includes time allotted to the pedestrian signal. This signal type is most frequently used in downtown areas (C5 and C6) with high signal density, or when there is a need to maximize progression but no need to maximize capacity for the through movement.

7.3 Cycle Length (C)

Cycle length (C) is the total time it takes a signal to complete a sequence of signal indications for all traffic movements. The GSVTs for arterials use cycle lengths based on representative cycle lengths for each context classification. Principal arterials and roadways at or near capacity during peak periods typically have the longest cycle lengths because these facilities need to provide a high level of mobility for through movements on the mainline. Shorter cycle lengths are typically used for less saturated conditions, such as in rural areas and where better access and service is needed for all directions. The cycle lengths used to develop the GSVTs can be found on the back of each table.

7.4 Through Effective Green Ratio (g/C)

The through effective g/C is the through movement's effective green time (g) divided by the signal cycle length (C). The through effective green time is the time during which the signal is effectively green. It is the sum of actual green time plus the yellow minus the applicable lost times.

Along with the number of through lanes, g/C is one of the most important factors for determining a roadway's through movement capacity at any given intersection and for the motorized vehicle travel lanes as a whole. Many analysts mistakenly ignore g/C because it varies from intersection to intersection along an arterial and because it varies by time of day. Ignoring g/C undermines any arterial LOS analysis at the generalized planning level.

A review of g/C ratios at sample intersections for each context classification revealed that g/C ratios vary widely. To account for such variation, analysts should acquire actual signal timing information for each study.

Analysts should determine g/C in current year analyses by using the traffic operations agency's signal timing plan for the p.m. peak hour (typically 5–6 p.m.) for each signalized intersection. This consistent and cost-effective approach provides reasonable accuracy. Analysts should be aware that signal timing plans come in many forms, use different notations, and are not designed to directly determine g/C. The operating agency can often help interpret output values.

If the signal is actuated, where the speed limit is below 35 mph the analyst should use (G + 4) for the through movement effective green time. This calculation assumes the typical yellow-plus-red time of four seconds as additional time allocated to the through movement as a result of unused time from other movements. Where the speed limit exceeds 35 mph, the analyst should assume the yellow phase is four seconds, and the all-red phase is an additional two seconds; therefore, the analyst should use (G + 6) for the through movement effective green time.

If the signal is pre-timed, the analyst should use the g/C for the through movement. However, in these cases, it would be better to analyze the signal with the *HCM*, as its phase duration model more accurately estimates unused time.

The GSVTs estimate g/C using a small sample of statewide signals across each context classification. Due to the great variation of g/C across the state, analysts should use real signal timings rather than table input parameters when conducting corridor planning studies. For future analyses, common *HCM*-based software tools provide signal optimization engines that suggest signal timing values.

8 | Multimodal Characteristics

This chapter discusses the multimodal characteristic used in the GSTVs to determine bicycle and pedestrian LTS. Multimodal characteristics include:

- Bicycle facility type
- Bicycle facility width
- Sidewalk continuity
- Sidewalk width
- Separation from motorized vehicle travel lanes
- Land use

8.1 Bicycle Facility Type

There are many types of bicycle facilities:

- Bicycle lanes: Bicycle lanes are one-way facilities and carry bicycle traffic in the same direction as adjacent motorized vehicle traffic. These facilities use a bicycle symbol pavement marking to designate a portion of a curbed roadway for the exclusive use of bicyclists. Bicycle lanes can be used on curbed roadways with a design speed less than or equal to 45 mph.
- Marked shoulders: This facility is a paved shoulder that has the helmeted bicyclist symbol and bicycle lane arrow pavement markings. Paved shoulders should only be marked when all of the following criteria are met: (1) The road's design speed is less than or equal to 45 mph, (2) the shoulder width is greater than or equal to 5 feet, (3) the facility is in a C4, C5, or C6 context classification or within a C3 context classification when sufficient demand is demonstrated, and (4) no shared use path is present along corridor.
- Paved shoulders: Part of the roadway, these facilities are contiguous with the travel way and accommodate errant vehicles, stopped vehicles, bicycle traffic, and emergency use. To serve as a bicycle facility, a paved shoulder must be at least 4 feet wide.
- Separated bicycle lanes: These facilities are one-way or two-way bicycle lanes that are adjacent to and physically separated from the vehicular travel lane by tubular markers, islands, on-street parking, or rigid barriers.
- Shared use paths: These facilities are paved pathways with a minimum width of 10 feet (eight feet for short segments in constrained conditions) that are physically separated from motorized vehicular traffic by either a four-foot clear space or a barrier. Shared use paths are either within the highway right of way or in an independent right-of-way. A

shared use path may substitute for a bicycle lane on roads with a design speed of 35 mph or greater.
Urban Side Paths: A category of shared use paths, urban side paths may be used in C2T, C4, C5 and C6 context classifications where the design speed of the adjacent roadway is 35 mph or less.

Optional pavement markings used to indicate a shared environment for bicycles and motor vehicles, sharrows, are not bicycle facilities. They serve to provide guidance to bicyclists to "command the lane" which discourages motorists from passing too closely. FDOT permits sharrows on roads with a posted speed less than or equal to 35 mph where it is not practical to provide a bicycle facility, and any of the following conditions exist: (1) with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle. (2) to fill a gap in an otherwise continuous bicycle facility, generally for a short distance. (3) as part of an approved temporary traffic control plan, see FDM 240.

For additional information on the definition and design of bicycle facilities, see the *FDOT Design Manual (FDM)*.

8.2 Sidewalks

A sidewalk is a continuous concrete pedestrian walkway as depicted in FDOT Standard Plans Index 522-001.

8.2.1 Sidewalk Continuity

Analysts should use good judgement to determine whether a continuous sidewalk is present. Due to the length of the segments used in the Q/LOS Handbook, segments with short sidewalk gaps may be considered to have continuous sidewalk if:

- The gap represents less than 90% of the segment length, and
- The gap does not occur within 600 feet of a bus stop, and
- The gap does not occur within 600 feet of a pedestrian generator (such as a school, park, convenience store, or shopping center)

8.2.2 Sidewalk Width and Separation from Motorized Vehicle Lanes

Separation is defined as the lateral distance from the outside edge of the motorized vehicle travel lane and the sidewalk. It can include bicycle lanes, unmarked shoulder, landscape and furnishing zone, parking, bicycle racks, parklets, or utility strips. Curb and gutter are not included in the separation width.

When sidewalk widths and/or separation vary along a segment, analysts should calculate the weighted average of the sidewalk widths and/or the separation width. In doing so, they can consider the width of the sidewalk up to 6 feet to apply to the sidewalk, and the additional pavement area to apply to the separation space if there is no additional separation between the sidewalk and the vehicular travel lane.

For example, consider a segment with 500 feet of four-foot sidewalk and no separation; 500 feet of eight-foot sidewalk with no separation; and 500 feet of six-foot sidewalk with two feet of separation. The analysts would calculate sidewalk width and separation width using the equations below:

$$\boldsymbol{Sidewalk\ Width = \frac{(4 \times 500) + (6 \times 500) + (6 \times 500)}{(500 + 500 + 500)} = 5\ feet}$$

$$\boldsymbol{Separation\ Width = \frac{(0 \times 500) + (2 \times 500) + (2 \times 500)}{(500 + 500 + 500)} = 1.33\ feet}$$

8.3 Land Use

When considering land use for the BLTS analysis in the GSVTs, analysts should use existing land use maps from local governments or conduct a visual assessment. Land use should include the predominant land use immediately adjacent to the roadway but does not consider land uses a half block or more away from the roadway.

8.4 Data Sources

The most appropriate data source for determining BLTS and PLTS depends on the scale of analysis. FDOT's Roadway Characteristics Inventory (RCI)[5] provides data organized by features and characteristics. The following RCI features can be used as inputs to determine BLTS and PLTS:

- Feature 126 – Preliminary Context Class: Denotes the preliminary Context Classification assigned by the district to each roadway segment. For final context classification to be used at the project level, contact the District Complete Streets Coordinator. The Preliminary Context Classification contained in RCI is sufficient for research and general information purposes. The context classification denotes the criteria for roadway design elements for safer streets that promote safety, economic development, and quality of life.

[5] RCI is available for all FDOT employees and can be granted for non FDOT personnel. For questions on accessing RCI please contact the Transportation Data Analytics Office at TDA_DataSupport@dot.state.fl.us.

- Feature 212—Through Lanes: Records the total number of through lanes for a roadway side. For a divided roadway, there will be two values, one for the left side and one for the right side.
- Feature 214—Outside Shoulders: Denotes the type and width of outside shoulders located adjacent to outside travel lanes. Outside shoulders accommodate stopped vehicles, bicycle traffic, and emergency use.
- Feature 216—Bike Lanes/Pedestrian Sidewalk: Records the limits of bicycle lanes and bicycle slots (also called bicycle keyhole lanes), sidewalk barrier codes; shared use path width and separation (offset distance), sidewalk width and separation (offset distance), and sidewalk barrier codes. This feature denotes whether a bicycle lane is designated, buffered, or colored. Sharrows are also noted in this feature. For this feature, sidewalk barriers include physical barriers that separate motorized vehicle lanes from sidewalks or shared use paths. Barriers come in many forms, including areas for vehicular parking, physical traffic barriers, guardrail, and trees.
- Feature 217—Sidewalks: Notes the width of sidewalk adjacent to the roadway and the length from the beginning and ending mile points.
- Feature 311—Speed Limits: Provides information on the posted speed.
- Feature 313—Parking Restrictions: Records the limits of parking restriction times and type of parking (curb, angle, or none).
- Feature 413—Landscape Area: Includes ornamental bushes, shrubs, flowers, and plants.

For more information, refer to the FDOT RCI Handbook (FDOT RCI). When possible, analysts should corroborate data using mapping programs such as ArcMap or ArcGIS Pro and Google Maps or Google Earth Pro, or through field reviews.

8.5 Weakest Link Analysis

For both BLTS and PLTS, scores are calculated separately for each side of the road, and the higher (more stressful) value is assigned as the overall score for the segment.

9 | Maximum Capacity Volumes

Using motorized vehicle capacity and LOS analyses (appropriately and inappropriately) has resulted in projected capacities that exceed normal capacity ranges found on Florida facilities. There are several reasons for this disparity. To aid analysts and reviewers on which capacity values are normally acceptable, FDOT has adopted a set of general guidelines. The values provided below are based on site-specific freeway studies and counts, as well as on maximum acceptable g/C for arterials.

9.1 Freeways

According to the HCM, the maximum per-lane approach capacity at 70 mph free-flow speed is 2,400 pcphpl for freeway facilities and segments.

Freeway operational measures, such as ramp metering, may result in higher volumes. Ramp metering could have up to a 5% improvement on capacity.

9.2 Highways

According to the HCM, the maximum per-lane approach capacity for highway segments (C1 and C2) are as follows:

- Two-lane: 1,700 pcphpl
- Multilane (60 mph free-flow speed): 2,200 pcphpl

9.3 Arterials

Saturation flow rate, as defined by the HCM, is the equivalent hourly rate at which vehicles can traverse an intersection approach under prevailing conditions in vehicles per hour of green or vehicles per hour of green per lane, assuming the green signal is available at all times. Through movement capacity is simply the saturation flow rate multiplied by g/C. To calculate an approach capacity, analysts must add the left- and right-turn volumes to the through movement capacity.

The maximum per-lane capacity for arterials are measured in vphpl (see **Table 10**). Per-lane capacity decreases as more lanes are added. In some cases, maximum-acceptable per-lane approach volume for a single lane is more than 40% higher than the maximum-acceptable per-lane approach volume for four lanes. Therefore, the maximum per-lane capacity provided in **Table 10** may overestimate the capacity of a roadway if the per lane capacity is simply multiplied by the number of lanes.

Table 10: Maximum Per-lane Arterial Capacity

Area Type	Maximum Per-lane Arterial Capacity (vphpl)
C2T - Rural Town	940
C3C - Suburban Commercial	1,040
C3R – Suburban Residential	1,040
C4 – Urban General	1,100
C5 – Urban Center	1,100
C6 – Urban Core	1,040

10 | Florida's LOS Policy

FDOT aims to plan, design, and operate the SHS at an acceptable LOS for the traveling public. LOS targets are consistent with FDOT's Policy on Level of Service Targets for the SHS, Topic No. 000-525-006. The policy outlines the motorized vehicle LOS target for urbanized areas and outside urbanized areas. The motorized vehicle-mode LOS targets for the SHS during peak travel hours are LOS D in urbanized areas and LOS C outside of urbanized areas. FDOT shall work with local governments to establish appropriate LTS targets for multimodal mobility and system design. The targets shall be responsive to all users according to context, roadway function, network design, and user safety.

10.1 Support of Local Government Transportation LOS Policies

Local governments can, but are not required, to extend concurrency requirements to transportation facilities. If concurrency is applied to transportation facilities, the local government comprehensive plan must provide the principles, guidelines, standards, and strategies, including adopted levels of service to guide its application. (F.S. 163.3180[5(a)]). Local governments are encouraged to develop tools and techniques to complement the application of transportation concurrency such as:

- Adoption of long-term strategies to facilitate development patterns that support multimodal solutions, including urban design, and appropriate land use mixes, including intensity and density.
- Adoption of an areawide LOS not dependent on any single road segment function.
- Exempting or discounting impacts of locally desired development, such as development in urban areas, redevelopment, job creation, and mixed use on the transportation system.
- Assigning secondary priority to vehicle mobility and primary priority to ensuring a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit.
- Establishing multimodal LOS standards that rely primarily on nonvehicular modes of transportation where existing or planned community design will provide adequate level of mobility.
- Reducing impact fees or local access fees to promote development within urban areas, multimodal transportation districts, and a balance of mixed-use development in certain areas or districts, or for affordable or workforce housing.

Several policy tools have been used to support multimodal mobility and infill development as concurrency legislation evolved over time. Some of these include multimodal transportation districts (MMTD), transportation concurrency exception areas, and mobility fees.

MMTD can be established under local government comprehensive plans in areas delineated on the future land use map for which the local comprehensive plan assigns secondary priority to vehicle mobility and primary priority to assuring a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit. Local governments can establish multimodal LOS standards that rely primarily on nonvehicular modes of transportation within the district and use impact fees to promote community design that supports multimodal travel.

Transportation concurrency exception areas apply land use and transportation strategies to support and fund mobility within the exception area, including alternative modes of transportation. Transportation concurrency exceptions can be adopted in urban centers where one of the following conditions is met:

- Transportation cannot be effectively managed, and mobility cannot be improved solely through the expansion of roadway capacity,
- The expansion of roadway capacity is not physically or financially possible,
- A range of transportation alternatives is essential to satisfy mobility needs, reduce congestion, and achieve healthy, vibrant centers.

Local governments can also use mobility fees to promote multimodal transportation infrastructure. A mobility fee is a transportation system charge on development that allows local governments to assess the proportionate cost of transportation improvements needed to serve the demand generated by development projects[6]. A mobility fee allows funds to be spent on roadways, transit facilities and capital expenditures, and bicycle and pedestrian infrastructure.

FDOT promotes lower acceptable motorized vehicle travel speeds for longer durations in facility planning, design, and operations in areas where local governments support and invest in a multimodal transportation system through their comprehensive plan, land development regulations, and other policies.

[6] *A Guidebook: Using Moblity Fees to Fund Transportation Improvements*. The Florida Department of Transportation. November 2016.

Appendix A: Glossary

Acceleration lane	A freeway lane extending from the on-ramp gore to where its taper ends.
Accessibility	The dimension of mobility that addresses the ease in which travelers can engage in desired activities.
Actuated control	All approaches to the signalized intersection have vehicle detectors, with each phase subject to a minimum and maximum green time, and some phases may be skipped if no vehicle is detected. Same as actuated and fully-actuated control.
Actuated-coordinated control	The fixed-cycle signal control of an intersection in which the through movement on the designated main roadway gets the unused green time from side movements because of limited or no vehicle activation from side movements. Same as coordinated-actuated.
Add /drop lanes	The roadway lanes added before an intersection and dropped after the intersection. Same as expanded intersections.
Adjusted saturation flow rate	In the Q/LOS Handbook, the base saturation flow rate times the effect of many roadway variables and traffic variables.
Adjustment factor	In the Generalized Service Volume Tables: additive or multiplicative factors to adjust service volumes.
All-way stop control	An intersection with a stop sign at all approaches.
Annual average daily traffic (AADT)	The volume passing a point or segment of a roadway in both directions for one year, divided by the number of days in the year.
Areawide analysis	An evaluation within a geographic boundary.
Arrival type	A general categorization of the quality of signal progression.

Arterial	A signalized roadway that primarily serves through-traffic and provides access to abutting properties as a secondary function, having signal spacings of two miles or less and turning movements at intersections that usually do not exceed 20 percent (%) of the total traffic.
Auxiliary lane	An additional lane on a freeway connecting an on-ramp of one interchange to the off-ramp of the downstream interchange.
Average daily traffic (ADT)	The total traffic volume during a given period in whole days (greater than one day and less than one year) divided by the number of days in that time period. (AASHTO).
Average travel speed	The facility length divided by the average travel time of all vehicles traversing the facility, including all stopped delay times.
Axle correction factors	The factor developed to adjust axle counts into vehicle counts. ACF is developed from classification counts by dividing the total number of vehicles counted by the total number of axles on these vehicles.
Base conditions	The best possible conditions (e.g. good weather, good and dry pavement conditions, and familiar users) in terms of capacity for a given type of facility. Assumes typical, unimpaired drivers driving on dry pavement during daylight hours.
Base saturation flow rate	The maximum steady flow rate, expressed in passenger cars per hour per lane, at which passenger cars can cross a point on interrupted flow roadways.
Basic segment	In the Q/LOS Handbook, the length of a freeway in which operations are unaffected by interchanges. Same as basic freeway segment.
Basic two-lane highway segment	A highway segment upstream of the intersection influence area and downstream of the affected downstream highway segment, and thus not affected by signalized intersections.

Bicycle lane	A portion of a curbed roadway designated for the exclusive use of bicyclists.
Bicycle level of traffic stress (BLTS)	Level of traffic stress (LTS) is an approach that quantifies the amount of discomfort that people feel when they bicycle close to traffic. The methodology was developed in 2012 by the Mineta Transportation Institute and San Jose State University.
Capacity	The maximum sustainable hourly flow rate at which persons or vehicles can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions. (HCM 6th Edition). As typically used in the Q/LOS Handbook, the maximum number of vehicles that can pass a point in one hour under prevailing roadway, traffic and control conditions.
Capacity adjustment factor	An adjustment factor used in the HCS7 freeways and multilane highways module to adjust the capacity of a facility for reduced capacity situations or to match field measurements. The capacity can be reduced to represent incident situations, such as construction and maintenance activities, adverse weather, traffic incidents, and vehicle breakdowns.
Capacity constrained	A condition in which traffic demand exceeds the capacity of a roadway.
Capacity utilization	The dimension of mobility that addresses the quantity of operations relative to capacity.
Collector	A roadway providing land access and traffic circulation with residential, commercial and industrial areas.
Concurrency	A systematic process utilized by local governments to ensure new development does not occur unless adequate infrastructure is in place to support growth.

Context classification	A classification assigned to a roadway that broadly identifies the various built environments in Florida, based on existing or future land use characteristics, development patterns, and the roadway connectivity of an area.
Control delay	The component of delay that results when a signal causes traffic to reduce speed or stop.
Control conditions	The signal control characteristics in effect for a segment, including the type, phasing and timing.
Core freeways	A conceptual term defining a freeway (major, through, non-toll) routed into or through a large urbanized area's core area (central business districts), such as Interstate 4 in Orlando). The Standard K value may change as it passes through. FDOT has adopted lower K values for these freeways to represent a peak period, as opposed to a peak hour analysis. The lower K values affect daily service volumes only in the Generalized Service Volume Tables.
Core urbanized area	A Metropolitan Planning Organization urbanized area greater than 1 million in population; in Florida, these seven areas consist of the following central cities: Fort Lauderdale, Jacksonville, Miami, Orlando, St. Petersburg, Tampa, and West Palm Beach.
Critical signalized intersection	The signalized intersection with the lowest volume-to-capacity ratio (v/c), typically the one with the lowest effective green ratio (g/C) for the through movement. Same as critical signalized intersection.
Cycle length (C)	The time it takes a traffic signal to go through one complete sequence of signal indications.
Daily service volume	The maximum total daily volumes in both directions that can be sustained in each segment without violating the criteria for a given LOS in the peak direction in the peak hour under prevailing roadway, traffic, and control conditions.

Deceleration lane	A freeway lane extending from the taper to the off-ramp gore.
Delay	The additional travel time experienced by a traveler.
Demand	The number of persons or vehicles desiring service on a roadway. Same as demand traffic.
Density	The number of vehicles, averaged over time, occupying a given length of lane or roadway; usually expressed as vehicles per mile or vehicles per mile per lane.
Design hourly volume (DHV)	The traffic volume expected to use a highway segment during the design hour of the design year. The DHV is related to AADT by the “K” factor.
Directional distribution factor (D)	The percentage of the total, two-way peak hour traffic that occurs in the peak direction.
Effective green ratio (g/C)	Typically in the Q/LOS Handbook, the ratio of the effective green time (g) for the through movement at a signal intersection to its cycle length (C).
Effective green time	The time allocated for the through movement to proceed; calculated as the through movement green plus yellow plus all-red indication times less the lost time.
Exclusive left-turn storage length	The total amount of storage length, in feet, for exclusive left-turn lanes.
Exclusive right-turn lanes	A storage area designated to only accommodate right-turning vehicles.
Exclusive turn lane	A storage area designated to only accommodate left- or right-turning vehicles; in the Q/LOS Handbook, the turn lane must be long enough to accommodate enough turning vehicles to allow the free flow of the through movement.
Five-lane section	A roadway with four through lanes, two in each direction, separated by a two-way left turn lane; in the Generalized Service Volume Tables, a five-lane section is treated as a roadway with four lanes and a median.

Flow rate	In the Q/LOS Handbook, the equivalent hourly rate at which vehicles pass a point on a roadway for a 15-minute period.
Free flow speed	In the Q/LOS Handbook, the average speed of vehicles under low-flow traffic conditions and not under the influence of signals, stop signs, or other fixed causes of interruption, generally assumed to be 5 mph over the posted speed limit.
Freeway	A fully access-controlled, divided highway with a minimum of two lanes (and frequently more) in each direction (HCM Sixth Edition).
Freeway segment	In the Q/LOS Handbook, a basic segment, interchange or toll plaza.
FSUTMS	A standard modeling structure used in Florida for travel-demand forecasting approved by FDOT Model Task Force.
Functional classification	The assignment of roads into systems according to the character of service they provide in relation to the total road network.
Generalized Service Volume Tables	Maximum service volumes based on average roadway, traffic, and control variables for the area type or context classification presented in tabular form. Same as generalized tables.
Generalized planning	A broad type of planning application that includes statewide analyses, initial problem identification, and future year analyses. In the Q/LOS Handbook, typically performed by using the Generalized Tables.
Gore	The point located immediately between the left edge of a ramp pavement and the right edge of the roadway pavement at a merge or diverge area.
Headway	The time, in seconds, between two successive vehicles as they pass a point on a roadway.
Heavy vehicle	An FHWA vehicle classification of 4 or higher; essentially, vehicles with more than 4 wheels touching the pavement during normal operation.
Heavy vehicle factor	The adjustment factor for heavy vehicles.

Heavy vehicle percent	The percentage of heavy vehicles in the traffic stream.
Highway capacity analysis	An examination of the maximum of vehicles or persons that can reasonably be expected to pass a point on a roadway during a specified time under prevailing roadway, traffic, and control conditions. Same as capacity analysis.
Highway Capacity Manual	A publication of the Transportation Research Board of the National Academies of Science that provides concepts, guidelines, and computational procedures to determine the capacity and quality of service for various highway facilities.
Interchange	In the Q/LOS Handbook, the influence area associated with the off-ramp influence area, overpass/underpass, and on-ramp influence area of a connection to a freeway. Same as freeway interchange influence area.
Interrupted flow	A category of roadways characterized by signals, stop signs, or other fixed causes of periodic delay or interruption to the traffic stream, with average spacing less than or equal to 2.0 miles.
Intersection influence area	In the Q/LOS Handbook, a segment of an uninterrupted flow highway influenced by an isolated intersection.
Interval	A period of time in which all traffic signal indications remain constant.
Isolated intersection	An intersection occurring along an uninterrupted flow highway.
Lateral clearance	Clearance distance from edges of outside lanes to fixed obstructions.
K factor	The proportion of AADT that occurs during the peak hour.
Level of service (LOS)	A quantitative stratification of a performance measure or measures that represent quality of service, measured on an A-F scale, with LOS A representing the best operating conditions from the traveler's perspective and LOS F the worst. (HCM Sixth Edition)

Level of service targets	The same as the statewide minimum LOS targets for the State Highway System.
Level of traffic stress (LTS)	LTS measures quality of service for pedestrian and bicyclists. The scale is defined by the type of user that finds the facility comfortable.
Limited access (LA)	A street or highway especially designed for through traffic and over, from, or to which owners or occupants of abutting land or other persons have no right or easement, or only a limited right or easement, of access, light, air, or view by reason of the fact that their property abuts upon such limited access facility or for any other reason. Such highways or streets may be parkways from which trucks, buses, and other commercial vehicles are excluded; or they may be freeways open to use by all customary forms of street and highway traffic
Load factor	The ratio of passengers actually carried to the total passenger capacity of a bus.
Local adjustment factor (LAF)	In the 2013 Q/LOS Handbook, an adjustment factor FDOT used to adjust base saturation flow rates or base capacities to better match actual Florida traffic volumes; mostly consisted of a driver population factor and an area type factor.
Maximum service volume	The highest number of vehicles for a given LOS.
Marked shoulder	A paved shoulder that has the Helmeted Bicyclist Symbol and Bicycle Lane Arrow pavement markings.
Median	In the Q/LOS Handbook, areas at least 10 feet wide that are restrictive or non-restrictive, which separate opposing-direction midblock traffic lanes and, on arterials, contain turn lanes that allow left-turning vehicles to exit from the through traffic lanes.
Median type	A classification of roadway medians as restrictive, non-restrictive, or no median.

Midblock	In the Q/LOS Handbook, the part of a roadway between two signalized intersections.
Mobility	The movement of people and goods.
Mode	A method of travel; in the Q/LOS Handbook, either motorized vehicle, bus, bicycle, or pedestrian.
Motorized vehicle mode	A method of travel by automobile, light duty truck, van, bus, recreational vehicle, or motorcycle.
Metropolitan/Transportation Planning Organization (MPO/TPO)	An organization made up of local elected and appointed officials responsible for the development and coordination of transportation plans and programs, in cooperation with the state for metropolitan area containing 50,000 or more residents.
Multilane highway	A nonfreeway roadway with two or more lanes in each direction and, although occasional interruptions to flow at signalized intersections may exist, is generally uninterrupted flow.
Multimodal	In the Q/LOS Handbook, more than one mode.
Multimodal Transportation District (MMTD)	An area in which secondary priority is given to vehicle mobility, and primary priority is given to ensure a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit.
No passing zone	In the Q/LOS Handbook, a segment of a two-lane highway along which passing is prohibited in the analysis direction.
No median (n)	No separation is provided between opposing midblock traffic lanes. For the purpose of evaluating general service volumes and LOS, when restrictive or non-restrictive medians are less than 10 feet wide, the roadway is considered to have no median.
Non-restrictive median (nr)	A painted, at-grade area separating opposing midblock traffic lanes.
Non-State signalized roadway	A signalized roadway not on the State Highway System.

Number of effective lanes	In terms of capacity, the equivalent number of through lanes. Typically, the number is expressed as a fraction (e.g., 2.7) to reflect the partial beneficial effects of freeway auxiliary lanes or arterial add-on/drop-off lanes.
Number of through lanes	The number of lanes relevant to an analysis of a roadway's LOS. For arterials: • Usually at the signalized intersection, not midblock • Usually through and shared right-turn lanes • Maybe a fractional number reflecting add /drop lanes or other special lane utilization considerations • Using the Generalized Service Volume Tables, the number at major signalized intersections For freeways and uninterrupted flow highways: • Does not include auxiliary lanes between two points • Usually the predominant number of through lanes between interchanges or major intersections
Off-peak	The course of the lower flow of traffic. A time not representing a peak hour.
Off-ramp influence area	The geographic limits affecting the capacity of a freeway associated with traffic exiting a freeway. Same as diverge area.
On-ramp influence area	The geographic limits affecting the capacity of a freeway associated with traffic entering a freeway. Same as merge area.
One-way	A type of roadway in which vehicles are allowed to move in only one direction.
Operational analysis	A detailed analysis of a roadway's present or future LOS, as opposed to a generalized planning.

Other urbanized area	A Metropolitan Planning Organization urbanized area with less than 1 million in population.
Oversaturated	A traffic condition in which demand exceeds capacity.
Passenger load factors	Factors used to determine the adjusted bus frequency value by applying a factor commensurate to the level of passenger crowding.
Passing lane	A lane added to provide passing opportunities in one direction of travel on a two-lane highway. Two-way left-turn lanes are not considered passing lanes.
Paved shoulder/bicycle lane	The portion of the roadway contiguous with the travel way for accommodation of errant vehicles, stopped vehicles, bicycle traffic, and emergency use. A paved shoulder must be a minimum width of four feet to serve as a bicycle facility.
Peak direction	The course of the higher flow of traffic.
Peak hour	In the Q/LOS Handbook, a one-hour time with high volume.
Peak hour factor	The ratio of the hourly volume to the peak 15-minute flow rate for that hour; specifically, hourly volume/(4 x peak 15-minute volume).
Peak period	A multi-hour analysis period with high volume; peak periods rather than peak hours are typically used for the analysis of core freeways or roadways within a Multimodal Transportation District.
Peak season	The 13 consecutive weeks with the highest daily volumes for an area.
Peak season weekday average daily traffic (PSWADT)	The average weekday traffic during the peak season. Most FSUTMS traffic assignment volumes represent PSWADT projections for the roads represented in the model network. For Project Traffic Forecasting Reports, the PSWADT should be converted to AADT using a MOCF.

Pedestrian	An individual traveling on foot and other non-motorized modes such as skateboards, scooters and both motorized and non-motorized wheelchairs.
Pedestrian/sidewalk/roadway separation	The lateral distance, in feet, from the outer edge of the vehicular travel lane to where a pedestrian travels on a sidewalk.
Pedestrian level of traffic stress (PLTS)	Pedestrian level of traffic stress (PLTS) is an approach that quantifies the amount of discomfort that people feel when they walk along a road within the right of way.
Percent time spent following (PTSF)	The average percent of total travel time that vehicles must travel in platoons behind slower vehicles because of the inability to pass on a two-lane highway.
Performance measure	A qualitative or quantitative factor used to evaluate a particular aspect of travel quality.
Person flow	The capacity on uninterrupted and interrupted flow facilities, defined in terms of persons per hour.
Phase	The part of a traffic signal's cycle allocated to any combination of traffic movements receiving the right of way simultaneously during one or more intervals.
Planning horizon	A time period, typically 20 years, applicable to the analysis of a project, roadway or service.
Platoon	A group of vehicles traveling together as a group, either voluntarily or involuntarily because of signal control, geometrics, or other factors.
Point	A boundary between links. In the Q/LOS Handbook, usually a signalized intersection, but maybe other places where modal users enter, leave, or cross a facility, or roadway characteristics change.
Posted speed	The maximum speed at which vehicles are legally allowed to travel over a roadway segment.

Pre-timed control	Traffic signal control in which the cycle length, phase plan, and phase times are preset and repeated continuously, according to a preset plan.
Prevailing conditions	Existing circumstances that primarily include roadway, traffic, and control conditions, but may also include weather, construction, incidents, lighting, and area type.
Principal arterial	A signalized roadway that primarily serves through traffic between centers of metropolitan areas and provides a high degree of mobility. In the Q/LOS Handbook, principal arterials have approximately one signal every half mile and a posted speed limit of 50 mph.
Project development and environment study (PD&E)	FDOT's procedure for complying with the National Environmental Policy Act (NEPA) of 1969, Title 42 U.S.C. section 4321, et seq. and describes FDOT's environmental review process.
Quality of service	A traveler-based perception of how well a service or facility is operating.
Quality/level of service (Q/LOS)	A traveler-based perception of how well a transportation service or facility operates. Quality of service measures assess multimodal service inside the roadway environment (essentially inside the right of way). A combination of the broad quality of service and more detailed LOS and LTS concepts.
Queue spillback	When a link's queue of vehicles extends to upstream links.
Ramp overlap segment	The length for which the upstream on-ramp influence area and the downstream off-ramp influence area overlap.
Restrictive median (r)	A raised or grassed area that restricts crossing movements.
Roadway	A general categorization of an open way for persons and vehicles to traverse; in theQ/LOS Handbook, it encompasses streets, arterials, freeways, highways, and other facilities.

Roadway Characteristics	The parameters associated with the physical design and posted speed of the roadway.
Rolling terrain	A combination of horizontal and vertical alignments causing heavy vehicles to reduce their running speeds substantially below that of passenger cars, but not to operate at crawl speeds for a significant amount of time.
Route	As used in the TCQSM, a designated, specified path to which a bus is assigned.
Route segment	As used in the TCQSM, a portion of a bus route ranging from two stops to the entire length of the route.
Running speed	The distance a vehicle travels divided by the travel time the vehicle is in motion.
Rural area	In the Generalized Service Volume Tables, areas that are not core urbanized areas, urbanized areas, or transitioning areas.
Scheduled fixed route	In the Q/LOS Handbook, bus service provided on a repetitive, fixed-schedule basis along a specific route, with buses stopping to pick up and deliver passengers to specific locations.
Seasonal adjustment factor	Parameters used to adjust base counts which consider traffic fluctuations by day of the week and month of the year. The Seasonal Factor used in Florida is determined by interpolating between the Monthly Seasonal Factors for two consecutive months.
Section	A group of consecutive segments that have similar roadway characteristics, traffic characteristics and, as appropriate, control characteristics for a mode of travel. A characteristic describing laneage (e.g., three-lane section, five-lane section, seven-lane section).
Segment	A portion of a facility defined by two boundary points; usually the length of roadway from one signalized intersection to the next signalized intersection.
Separated bicycle lane	One-way or two-way bicycle lanes that are adjacent to and physically separated from the vehicular travel lane by tubular markers, islands, on-street parking, or rigid barriers.

Service measure	A specific performance measure used to assign a LOS to a set of operating conditions for a transportation facility or service.
Service volume	Maximum service volumes based on roadway, traffic and control variables.
Service volume table	Maximum service volumes based on roadway, traffic and control variables and presented in tabular form.
Seven-lane section	A roadway with six through lanes, three in each direction separated by a two-way left-turn lane; in the Generalized Service Volume Tables, a seven-lane section is treated as a roadway with six lanes and a median.
Shared lane	A roadway lane shared by two or three traffic movements; in Florida, a shared lane usually serves through and right-turning traffic movements.
Shared lane markings or sharrows	Optional pavement markings used to indicate a shared environment for bicycles and motor vehicles.
Shared use path	Paved facilities with minimum width of ten feet, or eight feet for short segments in constrained conditions, physically separated from motorized vehicular traffic by four foot clear space on either side or barrier and are either within the highway right of way or an independent right of way. A shared use path may substitute for a bicycle lane on roads with a design speed of 35 mph or greater.
Sidewalk	A continuous concrete pedestrian walkway as depicted in FDOT Standard Plans Index 522-001.
Sidewalk/roadway protective barrier	Physical barriers separating pedestrians on sidewalks or cyclist in a bicycle facility and vehicles.
Sidewalk/roadway separation	The lateral distance in feet from the outside edge of the vehicular travel lane to the inside edge of the sidewalk.

Signal	In the Q/LOS Handbook, a traffic control device regulating the flow of traffic with green, yellow, and red indications. A traffic control device that routinely stops vehicles during the study period; excluded from this definition are flashing yellow lights, railroad crossings, draw bridges, yield signs, and other control devices.
Signal density	The number of signals intersections per mile.
Signal type	The kind of traffic signal (actuated, pre-timed or coordinated-actuated) with respect to the way its cycle length, phase plan, and phase times are operated.
Signalized intersection	A place where two roadways cross and have a signal controlling traffic movements.
Signalized intersection spacing	The distance between signalized intersections.
Simple average	An average that gives equal weight to each component.
Speed	In the Q/LOS Handbook, the same as average travel speed, unless specifically noted.
Speed adjustment factor (SAF)	An adjustment factor in HCS 7's freeways and multilane highways module, used to adjust the speed of a facility to account for the effects of adverse weather and construction work zones. The SAF also may be used to calibrate estimates of free-flow speed for local conditions or other effects that contribute to a reduction in free-flow speed.
Standard K	A factor used to convert AADT to a peak hour volume. Standard K values are statewide fixed parameters that depend on the general area types (location) and facility types (roadway characteristics). Multiple Standard K Factors may be assigned depending on the area type/facility type and applied statewide.
State Highway System	All roadways that FDOT operates and maintains; the State Highway System consists of the Florida Intrastate Highway System and other state roads.

Stochastic	A description of a type of model that incorporates variability and uncertainty into analysis.
Strategic Intermodal System	A statewide network of high-priority transportation facilities, including the State's largest and most significant airports, spaceports, deep water seaports, freight rail terminals, passenger rail and intercity bus terminals, rail corridors, waterways, and highways. These facilities represent the State's primary means for moving people and freight between Florida's diverse regions, as well as between Florida and other states and nations.
Termini	In the Q/LOS Handbook, the beginning and endpoints of a facility.
Three-lane section	A roadway with two through lanes separated by a two-way left-turn lane. In the Generalized Service Volume Tables, a three-lane section is treated as a roadway with two lanes and a median. An exclusive passing lane on a two-lane highway is not considered a three-lane section.
Threshold	The breakpoints between LOS differentiations.
Threshold delay	The additional travel time represented by the difference between the time associated with a roadway's generally accepted speed (LOS D threshold in urbanized areas and LOS C threshold in nonurbanized areas) and average travel speed. Same as LOS threshold delay.
Through movement	In the Q/LOS Handbook, the traffic stream with the greatest number of vehicles passing directly through a point. Typically, this is the straight-ahead movement, but occasionally it may be a turning movement.

Two-lane highway class	The categories of two-lane highways; two-lane highways are primarily grouped by area type. Class I are the major intercity routes where motorists expect to travel at relatively high speeds. Class II are access routes to Class I where motorists do not necessarily expect to travel at high speeds. Class III serve moderately developed areas, and may pass through small towns, where local traffic often mixes with through traffic. Same as class.
Traffic demand	The number of vehicles with drivers who desire to traverse a particular highway during a specified time.
Traffic volume	The number of vehicles passing a point on a highway during a specified time.
Transit	In the Q/LOS Handbook, the same as bus.
Transit Capacity and Quality of Service Manual (TCQSM)	The document and operational methodology from which the Q/LOS. Handbook's bus Q/LOS analyses are based.
Transitioning area	An area adjacent to an urbanized area that exhibits characteristics between rural and urbanized/urban and will be urbanized in the next 20 years.
Transportation planning boundaries	Precisely defined lines that delineate geographic areas. These boundaries are used throughout transportation planning in Florida. Their mapping is described in Urban Boundaries and Functional Classification of Roadways FDOT's Procedure Topic No. 525-020-311.
Travel time	The average time spent by vehicles traversing a roadway.
Two-lane highway	A roadway with one lane in each direction on which passing maneuvers must be made in the opposing lane and, although occasional interruptions to flow at signalized intersections may exist, is generally uninterrupted flow.
Two-way	Movement allowed in either direction.

Two-way left-turn lane	A lane that simultaneously serves left-turning vehicles traveling in opposite directions. Same as continuous left-turn lane.
Two-way stop control	The type of traffic control at an intersection where drivers on the minor street, or a driver turning left from the major street, wait for a gap in major-street traffic to complete a maneuver.
Undivided	As used in the Generalized Service Volume Tables, a roadway with no median.
Uninterrupted flow	A category of roadway not characterized by signals, stop signs, or other fixed causes of periodic delay or interruption to traffic stream.
Uninterrupted flow highway	A nonfreeway roadway that generally has uninterrupted flow, with average signalized intersection spacing of greater than 2.0 miles; a two-lane highway or a multilane highway.
Urban side path	A category of shared use paths that may be used in C2T, C4, C5 and C6 context classifications where the design speed of the adjacent roadway is 35 mph or less.
Urbanized area	An area within a Metropolitan Planning Organization's (MPO) designated urbanized area boundary. The minimum population for an urbanized area is 50,000 people. Based on the census, any area the U.S. Bureau of Census designates as urbanized, together with any surrounding geographical area agreed on by the FDOT, the relevant MPO, and the FHWA, commonly called the FHWA Urbanized Area Boundary.
Volume-to-capacity ratio	Either the ratio of demand volume to capacity or the ratio of service flow volume to capacity, depending on the particular problem situation.
Weaving distance	A length of freeway over which traffic streams across paths through lane-changing maneuvers. Same as weaving segment.

Weighted effective green ratio	In the Q/LOS Handbook, the average of the critical intersection’s through effective green ratio and the average of all the other signalized intersections’ through effective green ratios along the arterial facility

Appendix B: Florida's Generalized Service Volume Tables

Limited Access

Freeway Generalized Service Volume Tables

(Core Urbanized)

Peak Hour Directional

	B	C	D	E
2 Lane	2,400	3,170	3,970	4,150
3 Lane	3,390	4,600	5,810	6,130
4 Lane	4,340	6,060	7,700	8,170
5 Lane	5,480	7,450	9,680	10,390
6 Lane	6,630	9,220	11,520	12,760

Peak Hour Two-Way

	B	C	D	E
4 Lane	4,360	5,760	7,220	7,550
6 Lane	6,160	8,360	10,560	11,150
8 Lane	7,890	11,020	14,000	14,850
10 Lane	9,960	13,550	17,600	18,890
12 Lane	12,050	16,760	20,950	23,200

AADT

	B	C	D	E
4 Lane	51,300	67,800	84,900	88,800
6 Lane	72,500	98,400	124,200	131,200
8 Lane	92,800	129,600	164,700	174,700
10 Lane	117,200	159,400	207,100	222,200
12 Lane	141,800	197,200	246,500	272,900

(Urbanized)

Peak Hour Directional

	B	C	D	E
2 Lane	2,500	3,300	4,070	4,240
3 Lane	3,570	4,900	6,080	6,360
4 Lane	4,720	6,500	8,090	8,490
5 Lane	5,790	8,020	10,020	10,610

Peak Hour Two-Way

	B	C	D	E
4 Lane	4,550	6,000	7,400	7,710
6 Lane	6,490	8,910	11,050	11,560
8 Lane	8,580	11,820	14,710	15,440
10 Lane	10,530	14,580	18,220	19,290

AADT

	B	C	D	E
4 Lane	50,600	66,700	82,200	85,700
6 Lane	72,100	99,000	122,800	128,400
8 Lane	95,300	131,300	163,400	171,600
10 Lane	117,000	162,000	202,400	214,300

(Transitioning)

Peak Hour Directional

	B	C	D	E
2 Lane	2,430	3,180	3,790	3,910
3 Lane	3,520	4,670	5,610	5,870
4 Lane	4,630	6,170	7,440	7,830
5 Lane	5,690	7,640	9,220	9,800

Peak Hour Two-Way

	B	C	D	E
4 Lane	4,420	5,780	6,890	7,110
6 Lane	6,400	8,490	10,200	10,670
8 Lane	8,420	11,220	13,530	14,240
10 Lane	10,350	13,890	16,760	17,820

AADT

	B	C	D	E
4 Lane	45,100	59,000	70,300	72,600
6 Lane	65,300	86,600	104,100	108,900
8 Lane	85,900	114,500	138,100	145,300
10 Lane	105,600	141,700	171,000	181,800

(Rural)

Peak Hour Directional

	B	C	D	E
2 Lane	2,010	2,770	3,270	3,650
3 Lane	2,820	3,990	4,770	5,470
4 Lane	3,630	5,220	6,260	7,300

Peak Hour Two-Way

	B	C	D	E
4 Lane	3,650	5,040	5,950	6,640
6 Lane	5,130	7,250	8,670	9,950
8 Lane	6,600	9,490	11,380	13,270

AADT

	B	C	D	E
4 Lane	34,800	48,000	56,700	63,200
6 Lane	48,900	69,000	82,600	94,800
8 Lane	62,900	90,400	108,400	126,400

Adjustment Factors

Peak Hour Directional:
Auxiliary Lanes Present in Analysis Direction Adjustment: +1,000
Ramp Metering Present Adjustment: Multiply by 1.05

Peak Hour Two-Way:
Auxiliary Lanes Present in Analysis Direction Adjustment: +1,800
Ramp Metering Present Adjustment: Multiply by 1.05

AADT:
Auxiliary Lanes Present in Analysis Direction Adjustment: +20,000
Ramp Metering Present Adjustment: Multiply by 1.05

This table does not constitute a standard and should be used only for general planning applications. The table should not be used for corridor or intersection design, where more refined techniques exist.

Limited Access

Input Parameters

Roadway Characteristics

	Core Urbanized	Urbanized	Transitioning	Rural
Number of Lanes (one direction)	2-6	2.5	2-5	2-4
Posted Speed (mph)	65	70	70	70
Auxiliary Lanes	No	No	No	No
Lane Width (feet)	12	12	12	12
Total Ramp Density (ramps/mile)	1.33	2.67	0.50	0.17
Facility Length (miles)	3	3	6	18
Terrain	Level	Level	Level	Level

Traffic Characteristics

	Core Urbanized	Urbanized	Transitioning	Rural
Planning Analysis Hour Factor (K)	0.085	0.090	0.098	0.105
Directional Distribution Factor (D)	0.55	0.55	0.55	0.55
Peak Hour Factor (PHF)	0.95	0.95	0.92	0.88
Base Free Flow Speed (mph)	70	75	75	75
Heavy Vehicle Percent (%)	4%	4%	9%	12%
Speed Adjustment Factor (SAF)	0.975	0.975	0.975	0.975
Capacity Adjustment Factor (CAF)	0.968	0.968	0.968	0.968

C1 & C2

Motor Vehicle Highway Generalized Service Volume Tables

(C1-Natural & C2-Rural)

Peak Hour Directional

	B	C	D	E
1 Lane	240	430	730	1,490
2 Lane	1,670	2,390	2,910	3,340
3 Lane	2,510	3,570	4,370	5,010

Peak Hour Two-Way

	B	C	D	E
2 Lane	440	780	1,330	2,710
4 Lane	3,040	4,350	5,290	6,070
6 Lane	4,560	6,490	7,950	9,110

AADT

	B	C	D	E
2 Lane	4,600	8,200	14,000	28,500
4 Lane	32,000	45,800	55,700	63,900
6 Lane	48,000	68,300	83,700	95,900

Adjustment Factors

2 Lane Divided Roadway with Exclusive Left Turn Adjustment: Multiply by 1.05
Multilane Undivided Highway with Exclusive Left Turn Adjustment: Multiply by 0.95
Multilane Undivided Highway without Exclusive Left Turn Adjustment:: Multiply by 0.75

This table does not constitute a standard and should be used only for general planning applications. The table should not be used for corridor or intersection design, where more refined techniques exist.

C1 & C2

Input Parameters

Roadway Characteristics

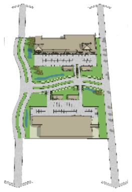
	C1	C2
Number of Lanes (one direction)	1	2-3
Posted Speed (mph)	55	55
Base Free Flow Speed (mph)	60	60
Median Type	Undivided	Divided
Shoulder Width (feet)	3	6
Lane Width (feet)	12	12
% No Passing Zone	20%	
Access-Point Density (access/mile)	2	2
Terrain	Level	Level

Traffic Characteristics

	C1	C2
Planning Analysis Hour Factor (K)	0.095	0.095
Directional Distribution Factor (D)	0.55	0.55
Peak Hour Factor (PHF)	0.88	0.88
Heavy Vehicle Percent (%)	5%	10%
Speed Adjustment Factor (SAF)	0.975	0.975
Capacity Adjustment Factor (CAF)	0.968	0.968

C3C & C3R

Motor Vehicle Arterial Generalized Service Volume Tables



(C3C-Suburban Commercial)

Peak Hour Directional

	B	C	D	E
1 Lane	*	760	1,070	**
2 Lane	*	1,520	1,810	**
3 Lane	*	2,360	2,680	**
4 Lane	*	3,170	3,180	**

Peak Hour Two-Way

	B	C	D	E
2 Lane	*	1,380	1,950	**
4 Lane	*	2,760	3,290	**
6 Lane	*	4,290	4,870	**
8 Lane	*	5,760	5,780	**

AADT

	B	C	D	E
2 Lane	*	15,300	21,700	**
4 Lane	*	30,700	36,600	**
6 Lane	*	47,700	54,100	**
8 Lane	*	64,000	64,200	**

(C3R-Suburban Residential)

	B	C	D	E
1 Lane	*	970	1,110	**
2 Lane	*	1,700	1,850	**
3 Lane	*	2,620	2,730	**

	B	C	D	E
2 Lane	*	1,760	2,020	**
4 Lane	*	3,090	3,360	**
6 Lane	*	4,760	4,960	**

	B	C	D	E
2 Lane	*	19,600	22,400	**
4 Lane	*	34,300	37,300	**
6 Lane	*	52,900	55,100	**

Adjustment Factors

The peak hour directional service volumes should be adjust by multiplying by 1.2 for one-way facilities
The AADT service volumes should be adjusted by multiplying 0.6 for one way facilities 2 Lane Divided Roadway with an Exclusive Left Turn Lane(s): Multiply by 1.05
2 lane Undivided Roadway with No Exclusive Left Turn Lane(s): Multiply by 0.80
Exclusive right turn lane(s): Multiply by 1.05
Multilane Undivided Roadway with an Exclusive Left Turn Lane(s): Multiply by 0.95
Multilane Roadway with No Exclusive Left Turn Lane(s): Multiply by 0.75
Non-State Signalized Roadway: Multiply by 0.90

This table does not constitute a standard and should be used only for general planning applications. The table should not be used for corridor or intersection design, where more refined techniques exist.
* 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.

C3C & C3R

Input Parameters

Roadway Characteristics

	C3C	C3R
Number of Lanes (one direction)	1-4	1-3
Posted Speed (mph)	45	45
Facility Length (miles)	3.98	2.57

Traffic Characteristics

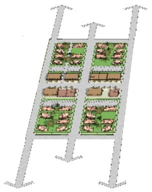
	C3C		C3R	
Planning Analysis Hour Factor (K)	0.09		0.09	
Directional Distribution Factor (D)	0.55		0.55	
Peak Hour Factor (PHF)	0.95		0.92	
Base Saturation Flow Rate	1,950		1,950	
Heavy Vehicle Percent (%)	4		4	
Lane Width	12		12	
Median Type	Non Restrictive (1 lane)	Restrictive (2,3,4 lanes)	Non Restrictive (1 lane)	Restrictive (2,3 lanes)
Roadway Edge Type	Curbed		Flush	
On-Street Parking	None		None	

Control Characteristics

	C3C		C3R
Cycle Length	160		190
Major Street Through g/c	0.5 (1,2,3 lanes)	0.45 (4 lanes)	0.5
Yellow Change Interval	5.1		5.1
Red Change Interval	2		2
Number of Signals	10		5

C2T, C4, C5, & C6

Motor Vehicle Arterial Generalized Service Volume Tables



(C2T-Rural Town)

Peak Hour Directional

	B	C	D	E
1 Lane	*	720	940	**
2 Lane	*	1,140	1,640	**
3 Lane	*	2,120	2,510	**

Peak Hour Two-Way

	B	C	D	E
2 Lane	*	1,310	1,710	**
4 Lane	*	2,070	2,980	**
6 Lane	*	3,850	4,560	**

AADT

	B	C	D	E
2 Lane	*	13,800	18,000	**
4 Lane	*	21,800	31,400	**
6 Lane	*	40,500	48,000	**

(C4-Urban General)

	B	C	D	E
1 Lane	*	*	870	1,190
2 Lane	*	1,210	1,790	2,020
3 Lane	*	2,210	2,810	2,990
4 Lane	*	2,590	3,310	3,510

	B	C	D	E
2 Lane	*	*	1,580	2,160
4 Lane	*	2,200	3,250	3,670
6 Lane	*	4,020	5,110	5,440
8 Lane	*	4,710	6,020	6,380

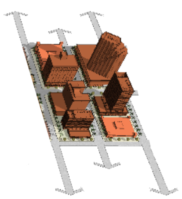
	B	C	D	E
2 Lane	*	*	17,600	24,000
4 Lane	*	24,400	36,100	40,800
6 Lane	*	44,700	56,800	60,400
8 Lane	*	52,300	66,900	70,900

(C5-Urban Center)

	B	C	D	E
1 Lane	*	*	690	1,080
2 Lane	*	1,290	1,900	2,130
3 Lane	*	1,410	2,670	3,110
4 Lane	*	2,910	3,560	3,640

	B	C	D	E
2 Lane	*	*	1,250	1,960
4 Lane	*	2,350	3,450	3,870
6 Lane	*	2,560	4,850	5,650
8 Lane	*	5,290	6,470	6,620

	B	C	D	E
2 Lane	*	*	13,900	21,800
4 Lane	*	26,100	38,300	43,000
6 Lane	*	28,400	53,900	62,800
8 Lane	*	58,800	71,900	73,600



(C6-Urban Core)

	B	C	D	E
1 Lane	*	***	790	1,030
2 Lane	*	***	1,490	1,920
3 Lane	*	***	2,730	2,940
4 Lane	*	***	3,250	3,490

	B	C	D	E
2 Lane	*	***	1,440	1,870
4 Lane	*	***	2,710	3,490
6 Lane	*	***	4,960	5,350
8 Lane	*	***	5,910	6,350

	B	C	D	E
2 Lane	*	***	16,000	20,800
4 Lane	*	***	30,100	38,800
6 Lane	*	***	55,100	59,400
8 Lane	*	***	65,700	70,600

Adjustment Factors

The peak hour directional service volumes should be adjust by multiplying by 1.2 for one-way facilities
The AADT service volumes should be adjusted by multiplying 0.6 for one way facilities 2 Lane Divided Roadway with an Exclusive Left Turn Lane(s): Multiply by 1.05
2 lane Undivided Roadway with No Exclusive Left Turn Lane(s): Multiply by 0.80

Exclusive right turn lane(s): Multiply by 1.05
Multilane Undivided Roadway with an Exclusive Left Turn Lane(s): Multiply by 0.95
Multilane Roadway with No Exclusive Left Turn Lane(s): Multiply by 0.75
Non-State Signalized Roadway: Multiply by 0.90

This table does not constitute a standard and should be used only for general planning applications. The table should not be used for corridor or intersection design, where more refined techniques exist.
*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.
***LOS C thresholds are not applicable for C6 as C6 roadway facilities are neither planned nor designed to achieve automobile LOS C.

C2T, C4, C5, & C6

Motor Vehicle Arterial Generalized Service Volume Tables

Input Parameters

Roadway Characteristics

	C2T	C4	C5	C6
Number of Lanes (one direction)	1-3	1-4	1-4	1-4
Posted Speed (mph)	40	45	35	30
Facility Length (miles)	0.78	1.83	1.18	0.74
Number of Signals	4	9	9	7

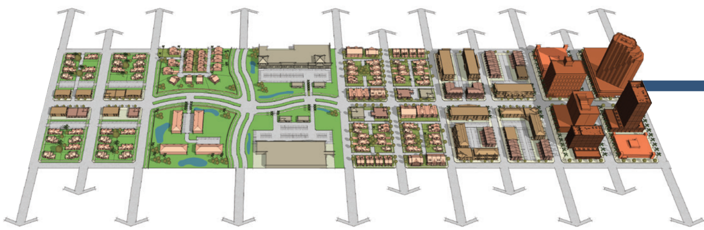
Traffic Characteristics

	C2T	C4	C5	C6
Planning Analysis Hour Factor (K)	0.095	0.09	0.09	0.09
Directional Distribution Factor (D)	0.55	0.55	0.55	0.55
Peak Hour Factor (PHF)	0.92	0.95	0.95	0.95
Base Saturation Flow Rate	1,700	1,950	1,950	1,950
Heavy Vehicle Percent (%)	5	3	2	2
Lane Width	11	11	10	10
Median Type	Non Restrictive	Non Restrictive	Non Restrictive	Non Restrictive
Roadway Edge Type	Curb	Curb	Curb	Curb
On-Street Parking	50%	100%	100%	100%

Signal Characteristics

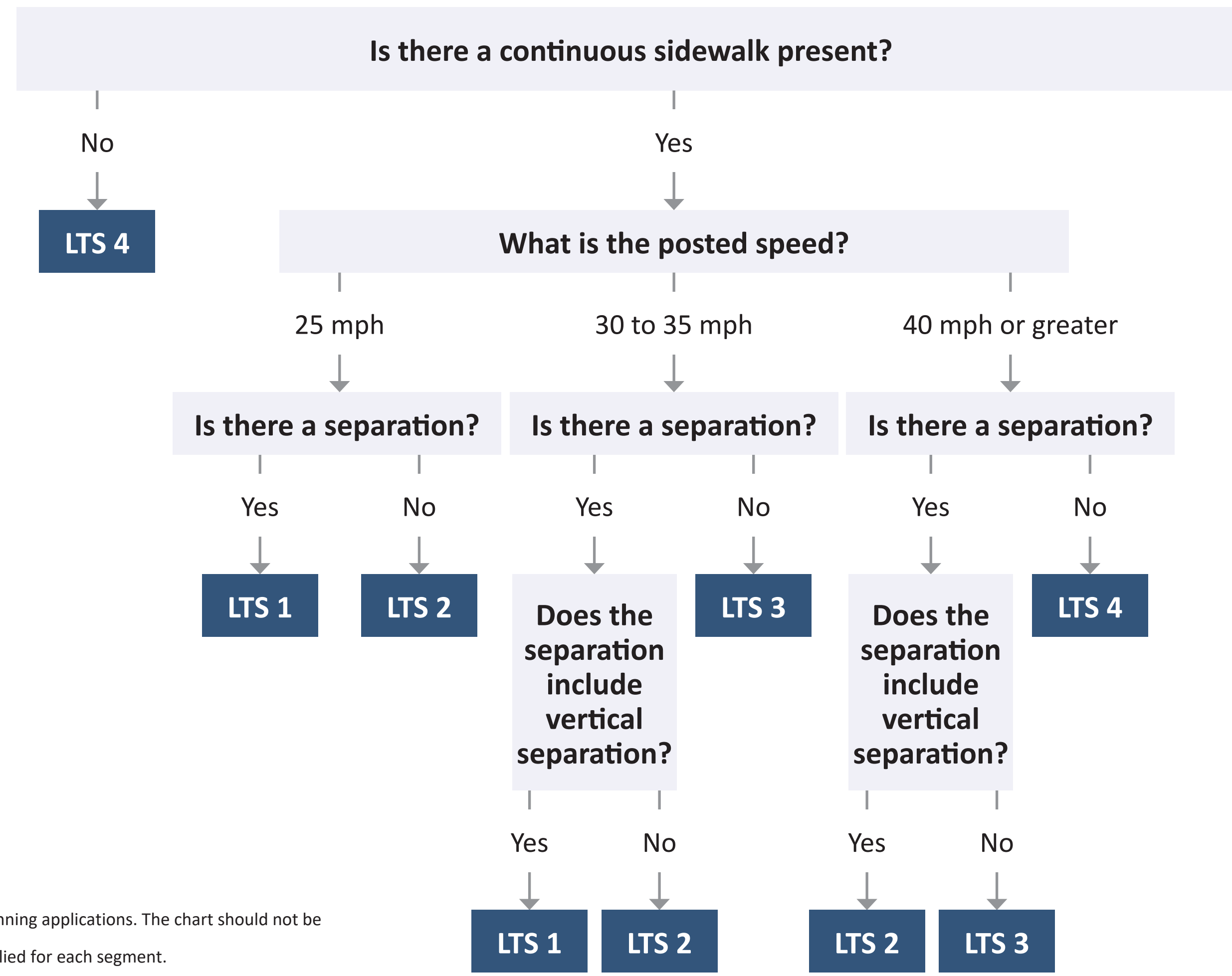
	C2T	C4		C5		C6	
Cycle Length	90	170		150		120	
Major Street Through g/c	0.47	0.52 (1,2,3 lanes)	0.47 (4 lanes)	0.55 (1,2,3 lanes)	0.48 (4 lanes)	0.52 (1,2,3 lanes)	0.46 (4 lanes)
Yellow Change Interval	4.4	4.8		4		3.7	
Red Change Interval	2	2		2		2	

Appendix C: Florida's Pedestrian and Bicycle Level of Traffic Stress Flow Charts

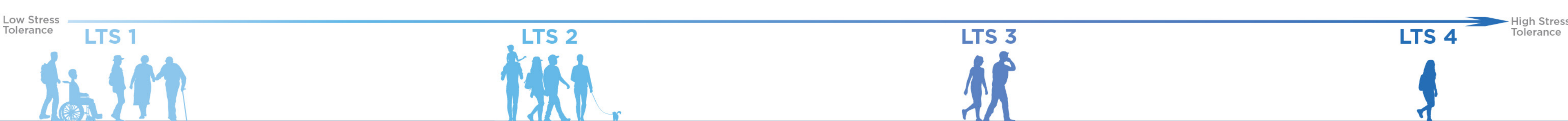


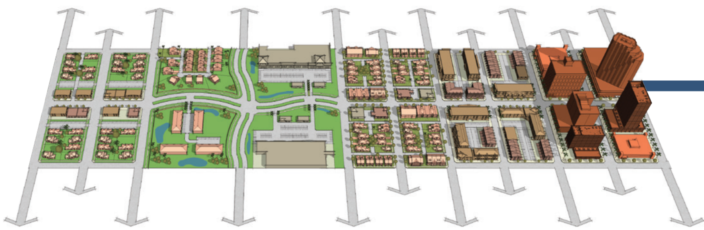
Pedestrian Level of Traffic Stress Flow Chart

C2T, C3C, C3R, C4, C5, & C6



Notes:
1) This chart does not constitute a standard and should be used only for general planning applications. The chart should not be used for corridor or intersection design, where more refined techniques exist.
2) This analysis is conducted for each side of the road and the worst side PLTS is applied for each segment.
3) If the sidewalk width is less than or equal to 5 feet, the PLTS deteriorates by 1.
4) Separation is defined by space between the outside vehicular travel lane and sidewalk and can include bicycle lanes, unmarked shoulders, street furniture, vertical separation, landscaping, or utility strips. Vertical separation in the separation includes tubular markers, islands, on-street parking, rigid barriers, and landscaping.
5) Sidewalk space over 6 feet can be evaluated as part of the separation.





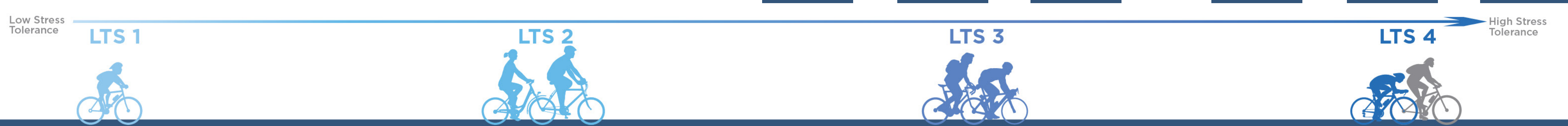
Bicycle Level of Traffic Stress Flow Chart to use When Bicycle Facility is Present

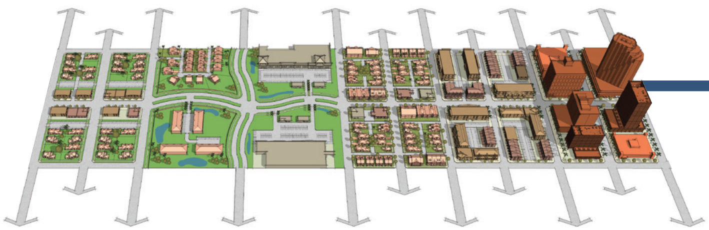
C2T, C3C, C3R, C4, C5, & C6

What kind of bicycle facility is present?

- Separated Bicycle Lane, Shared Use Path, or Urban Side Path → **LTS 1**
- Bicycle Lane, Marked Shoulder, or Paved Shoulder → **Is the posted speed 40 mph or more?**
  - Yes → **LTS 4**
  - No → **Is the AADT less than or equal to 7,000?**
    - Yes → **LTS 1**
    - No → **Is the posted speed 35 mph?**
      - Yes → **Is there a buffered bicycle lane?**
        - Yes → **LTS 2**
        - No → **LTS 3**
      - No → **Is the bicycle facility next to on-street parking?**
        - Yes → **Width of the bicycle lane and separation**
          - Greater than or equal to 7′ → **LTS 1**
          - 5′ or 6′ → **LTS 2**
          - 4′ → **LTS 3**
        - No → **Width of the bicycle lane**
          - Greater than or equal to 6′ → **LTS 1**
          - 5′ → **LTS 2**
          - 4′ → **LTS 3**
- Sharrow or None → **Use bicycle level of traffic stress assessment for when bicycle facility is not present**

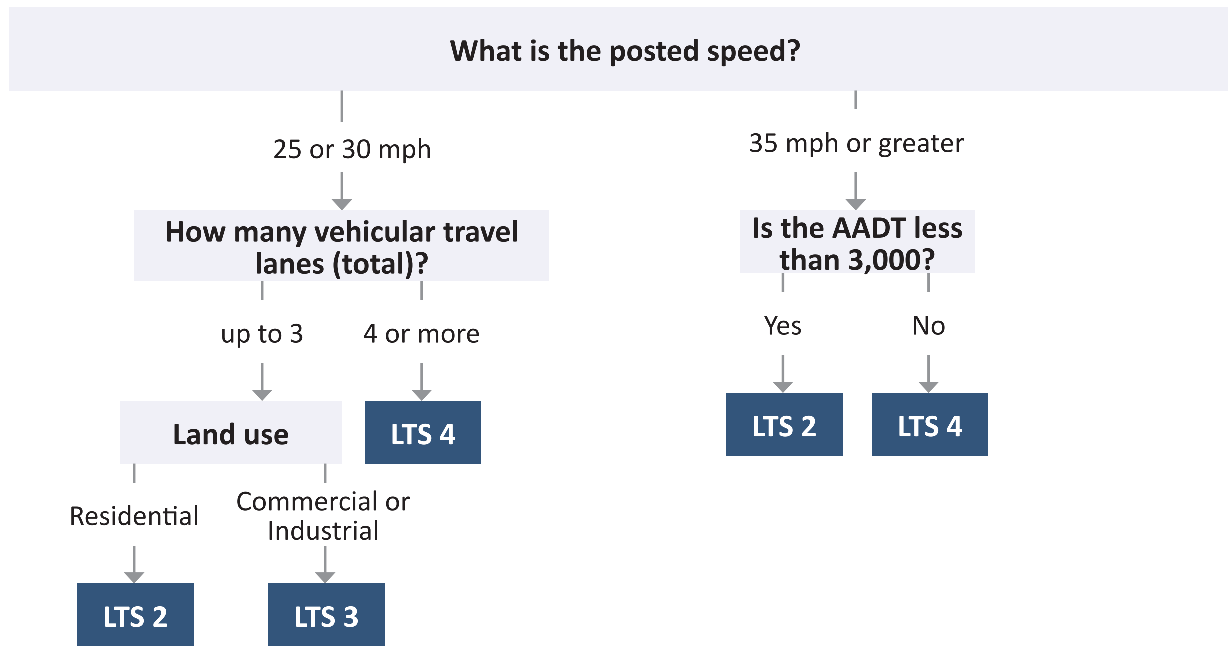
Notes:
1) This chart does not constitute a standard and should be used only for general planning applications. The chart should not be used for corridor or intersection design, where more refined techniques exist.
2) If there is both a separated bicycle lane, shared use path or urban side path and a bicycle lane, marked shoulder, or paved shoulder, evaluate the facility as having a shared use path





Bicycle Level of Traffic Stress Flow Chart to use When No Bicycle Facility is Present or When There are Sharrows Present

C2T, C3C, C3R, C4, C5, & C6



Notes:
1) This chart does not constitute a standard and should be used only for general planning applications. The chart should not be used for corridor or intersection design, where more refined techniques exist.