2002

Quality/Level of Service

HANDBOOK

State of Florida
Department of Transportation
2002

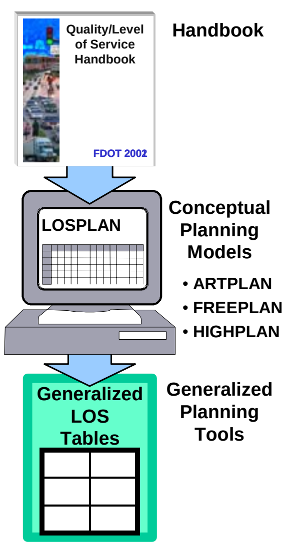
Florida Department of Transportation
Office of the State Transportation Planner
Systems Planning Office
605 Suwannee Street, Mail Station 19
Tallahassee, FL 32399-0450

http://www11.myflorida.com/planning/systems/sm/los/default.htm

EXECUTIVE SUMMARY

Handbook used for roadway planning and preliminary engineering analyses

This Handbook successfully combines the nation's leading automobile, bicycle, pedestrian, and bus evaluation techniques into a common analysis process.



This Quality/Level of Service Handbook and its accompanying software are intended to be used by engineers, planners, and decision-makers in the development and review of roadway users' quality/level of service (Q/LOS) at planning and preliminary engineering levels. This Handbook provides tools to quantify multimodal transportation service inside the roadway environment (essentially inside the right-of-way).

These updated methods provide the first successful multimodal approach unifying the nation's leading automobile, bicycle, pedestrian and bus Q/LOS evaluation techniques into a common transportation analysis at facility and segment levels. With these professionally accepted techniques, analysts can now easily evaluate roadways from a multimodal perspective, which result in better multimodal decisions for projects in planning and preliminary engineering phases.

Two levels of analysis are included in this Handbook: (1) "generalized" planning and (2) "conceptual" planning. Generalized planning makes extensive use of statewide default values and is intended for broad applications such as statewide analyses, initial problem identification, and future year analyses. Conceptual planning is increasingly more detailed and accurate than generalized planning, but does not involve comprehensive operational analyses.

Generalized planning is most appropriate when a quick, "in the ball park" determination of LOS is needed. Florida's Generalized Tables found in this Handbook are the primary tools for conducting this type of planning analysis. The default values used for the Generalized Tables have been extensively researched and represent the most appropriate statewide values.

Conceptual planning is best suited for obtaining a solid determination of the LOS of a facility. Examples of conceptual planning are preliminary engineering applications, such as determining the design concept and scope for a facility (e.g., 4 through lanes with a raised median and bicycle lane), conducting alternatives analyses (e.g., 4 through lanes undivided versus 2 through lanes with a two-way left turn lane), and determining needs when a generalized planning approach is simply not accurate enough. Florida's LOS software (LOSPLAN), which includes ARTPLAN, FREEPLAN, and HIGHPLAN, is the easy to use tool for conducting these types of evaluations.

Implementation schedule

The techniques contained in this Handbook and the accompanying software are to be implemented immediately. After September 1, 2002, FDOT will not accept analyses using methods, techniques, volumes, or generalized tables from previous versions of this Handbook.

Handbook changes

Multimodal perspective includes bicycles, pedestrians, and buses as well as automobiles.

New freeway facility planning technique and updated software

The most significant difference in this Handbook from previous editions is the multimodal perspective. In addition to traditional "highway" (automobile and truck) LOS analysis, state-of-the-art techniques are now provided allowing a simultaneous evaluation of the LOS for bicyclists, pedestrians, and buses. Although LOS techniques are provided for each roadway mode, FDOT recommends against combining their LOS into one overall roadway LOS. Other significant changes include a new freeway facility planning technique and completely updated software.

Analytical methodologies for automobiles, bicycles, pedestrians, and buses.

The updated methodologies are planning and preliminary engineering applications from the following primary resource documents and analytical techniques using actual Florida roadway, traffic and signalization data:

- 2000 Highway Capacity Manual (HCM2000) methodologies for automobiles and trucks;
- 1999 Transit Capacity and Quality of Service Manual (TCQSM) for buses;
- Bicycle LOS Model, the most used technique in the U.S. to evaluate LOS for bicyclists; and
- Pedestrian LOS Model, the most advanced technique in the U.S. to evaluate LOS for pedestrians.

Florida's LOS standards

Also included are Florida's Statewide Minimum LOS Standards for the State Highway System. These standards are required for use on Florida Intrastate Highway System (FIHS) routes.

User feedback

Comments and suggestions are welcome.

In order to make future editions of this Handbook and accompanying software even better, FDOT welcomes your review comments and suggestions. Chapter 8 contains a user survey and a software "bug" report form.

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1 INTRODUCTION

1.1 PURPOSE/APPLICATIONS

Handbook uses

This Handbook and its accompanying software are intended to be used by engineers, planners, and decision-makers in the development and review of transportation quality/level of service (Q/LOS) on roadways at planning and preliminary engineering levels.

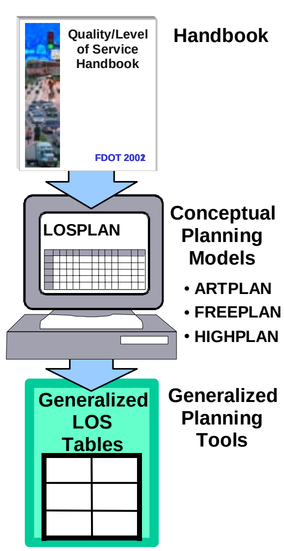
Quality of service defined

Quality of service (QOS) is a traveler-based perception of how well a transportation service or facility operates.

Level of service defined

Level of service (LOS) is a quantitative stratification of quality of service into six letter grade levels. It provides planning and preliminary engineering tools to address multimodal service inside the roadway environment (essentially inside the right-of-way).

These updated methods provide the first successful multimodal approach unifying the nation's leading automobile, bicycle, pedestrian and bus Q/LOS evaluation techniques into a common transportation analysis at the facility and segment levels. With these professionally accepted techniques, analysts can now easily evaluate roadways from a multimodal perspective, which result in better multimodal decisions for projects in the planning and preliminary engineering phases.



Two levels of analysis are included in this Handbook: (1) "generalized" planning and (2) "conceptual" planning. Generalized planning makes extensive use of statewide default values and is intended for broad applications such as statewide analyses, initial problem identification, and future year analyses. Conceptual planning is increasingly more detailed than generalized planning, but does not involve comprehensive operational analyses.

Generalized planning is most appropriate when a quick, "in the ball park" determination of LOS is needed. Florida's Generalized Tables found in this Handbook are the primary tools for conducting this type of planning analysis. The default values used for the Generalized Tables have been extensively researched and represent the most appropriate statewide values.

Conceptual planning is best suited for obtaining a solid determination of the LOS of a facility. As used in this Handbook, conceptual planning is synonymous with preliminary engineering. Preliminary engineering analyses are performed to support decisions related to design concept and scope, such as need for improvement, design controls and standards, traffic, alternative alignment, preliminary design, and conceptual design plans. Examples of conceptual planning include preliminary engineering applications such deciding on a design concept and scope for a facility (e.g., 4 through lanes with a raised median and bicycle lane), conducting alternatives analyses (e.g., 4 through lanes undivided versus 2 through lanes with a two-way left turn lane), and determining needs when a generalized planning approach is simply not accurate enough. Florida's LOS planning software (LOSPLAN) which includes ARTPLAN, FREEPLAN, and HIGHPLAN is the easy to use tool for conducting these types of evaluations.

Handbook does not contain tools for operational analyses or design

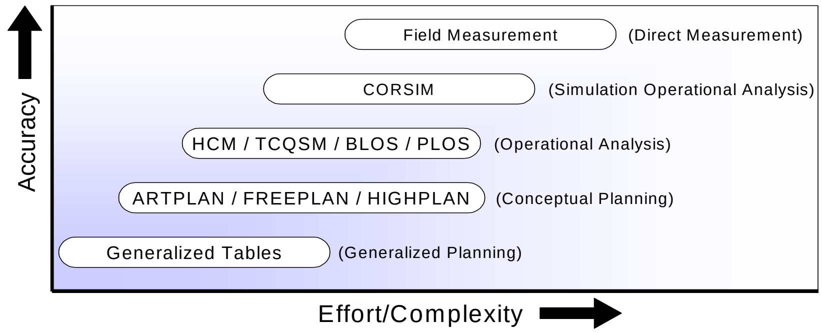
While operational analyses, such as intersection signal timing and interchange justification reports, are sometimes conducted at the planning level, the Handbook does not contain the necessary tools for these types of detailed evaluations. As a planning document, the precision of operational, design, or pavement documents such as the AASHTO Policy on Geometric Design for Highways and Streets or FDOT's Plans Preparation Manual is not included. For example, this Handbook's simplifying planning level assumptions are applied to vehicle turning movements, lane widths, bicycle striping, sidewalk widths, bus stops and many other transportation characteristics. Therefore, it must not be used for actual design or operation of facilities or services where more appropriate resource documents and/or analysis methods are available.

Hierarchy of evaluation tools

There are many methods for computing LOS, which form a hierarchy ranging from the Generalized Tables (the simplest to use but least accurate) to full field measurement (very precise, but in most cases too time consuming and costly). Figure 1-1 provides an overview of analysis levels and evaluation tools. In selecting the appropriate tools, the tradeoff between the data preparation effort and the accuracy of the results should be considered carefully.

Figure 1 – 1

LEVEL OF SERVICE ANALYSES AND EVALUATION TOOLS



Significant changes in the Handbook

The most significant difference in this Handbook from previous editions is the multimodal perspective. In addition to traditional "highway" (automobile and truck) LOS analysis, state-of-the-art techniques are now provided to simultaneously evaluate the LOS for bicyclists, pedestrians, and buses (scheduled fixed route) on roadways. Other significant changes include a new freeway facility planning technique and completely updated software.

Primary resource documents and methodologies

The updated methodologies in this Handbook are planning and preliminary engineering applications from the following primary resource documents and analytical techniques using actual Florida roadway, traffic and signalization data:

- 2000 Highway Capacity Manual (HCM2000) methodologies for automobiles and trucks;
- 1999 Transit Capacity and Quality of Service Manual (TCQSM) for buses;
- Bicycle LOS Model, the most used technique in the U.S. to evaluate LOS for bicyclists; and
- Pedestrian LOS Model, the most advanced technique in the U.S. to evaluate LOS for pedestrians.

Extensions of these operational techniques are presented in Section 2.6.

FDOT's LOS standards

Also included are Florida's Statewide Minimum LOS Standards for the State Highway System. These standards are required for use on Florida Intrastate Highway System (FIHS) routes.

Implementation date

The techniques contained in this Handbook and the accompanying software are to be implemented immediately. After September 1, 2002, FDOT will not accept analyses using methods, techniques, volumes, or generalized tables from previous versions of this Handbook.

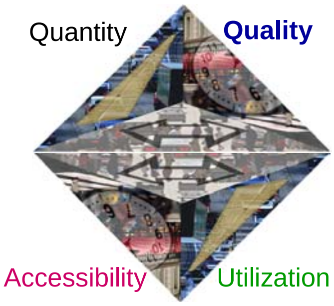
1.2

QUALITY AND LEVEL OF SERVICE (Q/LOS) CONCEPTS

Importance of mobility

Providing mobility for people and goods is transportation's most essential function. There are four dimensions of mobility which include:

Dimensions of mobility



- Quality of travel – traveler satisfaction with a facility or service;
- Quantity of travel – magnitude of use of a facility or service;
- Accessibility – ease in which travelers can engage in desired activities; and
- Utilization – quantity of operations with respect to capacity.

Quality of Service (QOS)

This Handbook focuses on the important quality dimension of mobility (the movement of people and goods). Quality of service (QOS) is a user (traveler) based perception of how well a transportation service or facility operates. In other words, how do existing and potential travelers perceive the overall quality of service provided to them?

Level of Service (LOS)

Level of service (LOS) is a quantitative stratification of quality of service. While it is desirable to have an understanding of the overall quality of service provided by a transportation facility or service, transportation analysts for a long time desired to "quantify" this quality of service assessment by travelers. Beginning in 1965, the Highway Capacity Manual (HCM) divided highway quality of service into six letter grades, "A" through "F," with "A" being the best and "F" being the worst. With the "A" through "F" LOS scheme, traffic engineers were much better able to explain to the general public and elected officials operating and design concepts of highways. The LOS letter scheme caught on so well that it is now used throughout the United States in transportation, as well as other fields. Nevertheless, it is important to note that LOS is simply a quantitative breakdown from transportation users' perspectives of transportation QOS. LOS reflects the quality of service as measured by a scale of user satisfaction and is applicable to each of the following modes that use roadways: automobiles, trucks, bicycles, pedestrians, and buses.

QOS & LOS issues addressed in this Q/LOS Handbook

Because this Handbook deals with the overall quality of user satisfaction and its quantitative breakdown, it is labeled as the Quality/Level of Service Handbook. Specifically, it deals with both the quality of service (QOS) and the level of service (LOS) roadways provide to roadway users (i.e., automobile and truck drivers, bicyclists, pedestrians and bus riders) inside the roadway environment and provides planning tools to assist transportation planners and engineers address these issues.

QOS & LOS issues not addressed in this Q/LOS Handbook

This Handbook does not deal with the overall "quality of trip experience" such as neighborhood safety and appearance, and social and aesthetic amenities that transportation planners and engineers do not directly affect. Furthermore, Q/LOS analysis does not address all the important dimensions of mobility. Frequently QOS is closely linked and directly related to the other dimensions of mobility (quantity, accessibility and utilization), but not always.

QOS Misconceptions

There are three major common misconceptions of the relationship between QOS and LOS. These include: (1) the relationship between quality and other dimensions of mobility; (2) LOS is applicable to only to automobile analysis while QOS is related to the non-automobile modes and (3) Q/LOS analysis is sufficient to assess traffic impacts.

Quality is only one dimension of mobility.

The first common misconception exists on the relationship between the quality and the other dimensions of mobility. Frequently they are related, but not necessarily. For example, Q/LOS for automobile drivers is usually closely linked to how many other motorized vehicles are on the road. However, even for automobile drivers, that relationship is not perfect.

Arterial speeds are more closely tied to signalization conditions than the number of other motorized vehicles on the roadway. A higher quality LOS grade may exist on a 4-lane arterial with twice the volume of another arterial because of better signal progression. For the non-automobile modes there is usually an even smaller relationship between how many other similar modal users there are on the facility and the corresponding Q/LOS. In fact, the relationship is weak, except in limited cases. For example, for most situations in Florida, bicycle and pedestrian Q/LOS has little relationship to the number of other bicyclists and pedestrians on a facility; other factors are more important. Similarly, in most of Florida bus frequency is usually much more important to potential transit users than how many people are on the bus.

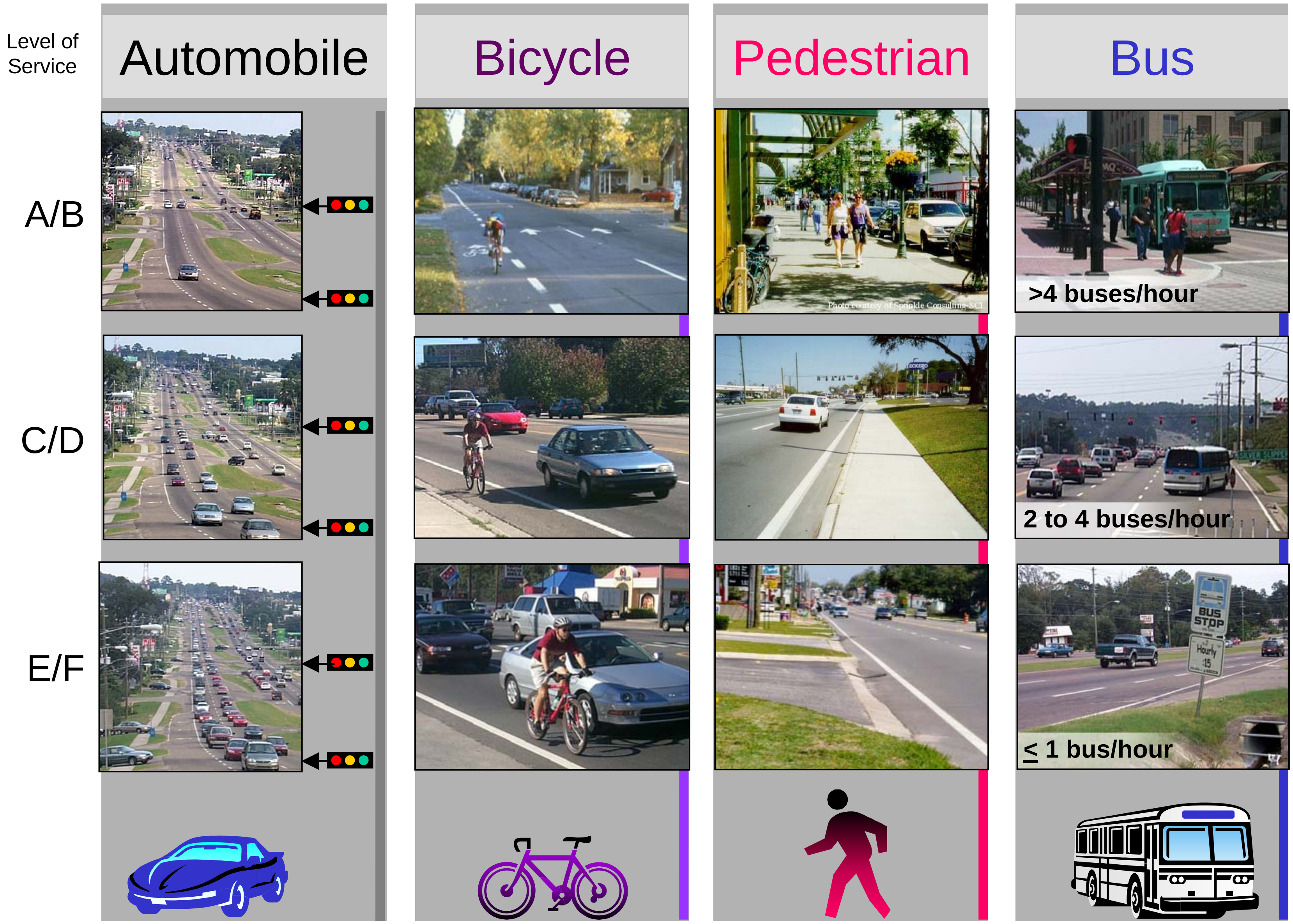
Quality is being addressed not quantity.

Again, it is important to note that quality and quantity are two distinct dimensions of mobility and may or may not be directly correlated. Frequently, especially for the non-automobile modes, an analysis addressing the quantity (demand) of potential users is more important in the decision making process than the quality of service provided to the users. However, this Handbook only addresses the Q/LOS to transportation users and not the demand aspects, including such topics as: if a bicycle lane is built, how many bicyclists will use the facility?, or how many automobile trips will be diverted to bicycling trips? Other tools, such as logit models, are more appropriate for those types of analyses.

The concepts of quality of service and level of service apply to all modes.

The second common misconception is that LOS applies only to automobiles and QOS applies to the other modes; automobile analysis is more “quantitative” while analysis of the other modes is “softer” or more “qualitative”. As described later, the bicycle, pedestrian and transit techniques are as quantitative and rigorously developed and tested as those for automobiles and trucks. The techniques developed for this Handbook assess only the quality of the actual trip itself, which transportation professionals can directly affect, and not the overall “quality of the trip experience.” The LOS for each mode for urban roadways is illustrated in Figure 1-2.

Figure 1 - 2
EXAMPLES OF LEVEL OF SERVICE BY MODE FOR URBAN ROADWAYS



Q/LOS analysis is not sufficient to assess development impacts.

The third common misconception is that Q/LOS analysis is sufficient to assess impacts from proposed developments and mitigation effects. Consider the following two examples in which utilization, one of the four dimensions of mobility, should also be considered: (1) level of service standards and maximum service volumes and (2) capacity at a specific signalized intersection.

(1) Suppose that a local government has level of service standard of D for a 4-lane arterial and the corresponding maximum hourly directional volume that can be served is 1,580 (the value that appears for a Class IV arterial in the Generalized Tables). The roadway's current volume is 1,400; thus, 180 vehicles could be added and remain within the standard. However, by changing two inputs not directly associated with capacity (i.e., signal type to pretimed and arrival type to 6 from the Generalized Tables default assumptions), the maximum service volume becomes 1,690. Additional vehicles added by development may or may not meet community criteria based upon the inputs used in the analysis.

(2) Suppose that the existing condition at a signalized intersection has a volume to capacity ratio of 0.75, but the signalization is so poor that the LOS is D. A development is proposed which would increase the volume to capacity ratio of the intersection to 0.95, but improved timing and coordination of the existing signalization system could keep the intersection operating at a LOS D. In this situation 80 percent of the remaining capacity (0.20 out of 0.25) is used by a development while adhering to a LOS D criterion.

Clearly, both Q/LOS and utilization (volume to maximum service volume ratio or volume to capacity ratio) criteria are appropriate to determine development impacts.

LOS across Modes

LOS grades are not comparable across modes.

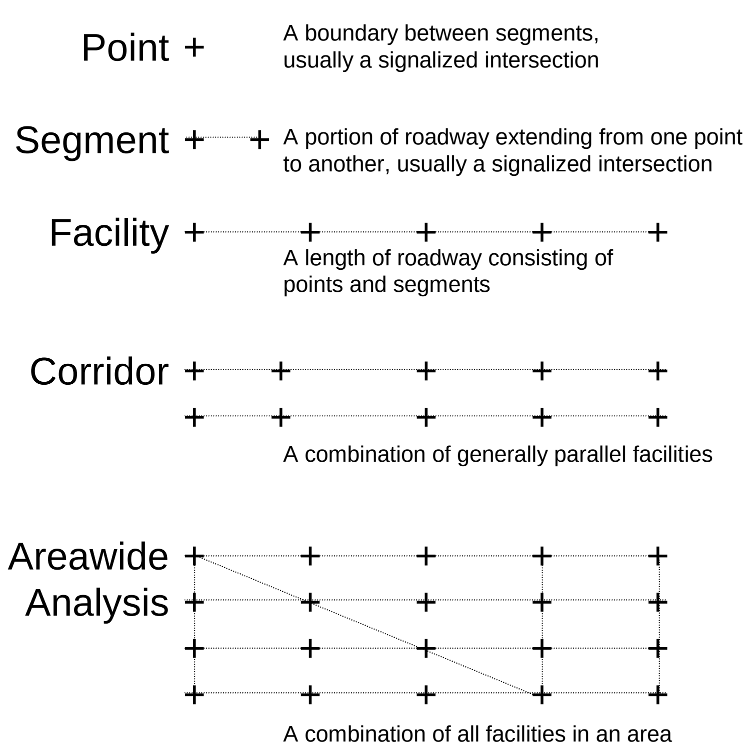
Although each of methodologies for automobiles/trucks, bicycles, pedestrians, and buses make use of the LOS A-F scales, the meaning of A-F is probably not consistent across the modes. Transportation professionals widely consider LOS D for the automobile mode as "acceptable," or as a design level in urbanized areas. Committees of transportation professionals, with common understanding of the LOS grading scale, collectively developed the LOS thresholds for the automobile and bus modes. Conversely, members of the general public whose understanding of LOS D more closely correlates to the school grading system, determined the derivation of the bicycle and pedestrian LOS thresholds. Thus, LOS D does not have a common meaning across modes and represents a worse condition for the bicycle and pedestrian modes than the automobile and bus modes. FDOT and its research team evaluated and considered various methods to make the LOS thresholds more consistent across modes, but found no scientific basis to adjust individual mode's LOS scales. Users should be cautious about comparing the same LOS letter grade across modes.

Users should be cautious about comparing LOS grades across modes.

1.3 TRANSPORTATION SYSTEM STRUCTURE

FDOT's Q/LOS techniques generally incorporate the primary highway system structure of the HCM, consisting of points, segments, facilities, corridors and areas, although the HCM occasionally includes other structural units (e.g., section). A generalized characterization of the HCM structure is shown in Figure 1-3.

Figure 1 – 3
GENERALIZED HCM2000 HIGHWAY SYSTEM STRUCTURE



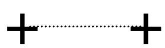
This Handbook's analytical techniques focus on the facility.

The analysis techniques contained in this Handbook and accompanying software are focused at the facility level. Points and segments are the primary building blocks of facilities and these techniques frequently evaluate level of service analyses at those levels. Depending on the mode or facility type being analyzed, it is sometimes useful to use roadway sub-segments and sections. Although future editions of this Handbook will likely include corridor and areawide analysis methods, they are currently beyond the scope of this Handbook. Points, segments, facilities, sub-segments and sections are discussed further below.

Point

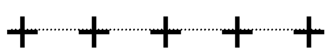
- A point is a boundary between segments. In broad terms, points are where modal users enter, leave, or cross a facility, or where roadway characteristics change. In most applications of this Handbook, points are signalized intersections. Other points may include freeway gores, unsignalized intersections, area boundaries, bicycle lane terminals, sidewalk terminals, pedestrian mid-block crossings, and bus stops.

Segment



- A segment is a portion of a facility defined by two end points. Segments are the primary building blocks of facility analyses. For arterials and other signalized roadways, segments generally extend from one signalized intersection to the next signalized intersection. However, for bicycle, pedestrian, and bus analyses, other segmentation may also be appropriate. For example, if buses leave a roadway before a signalized intersection, it may be desirable to make a segment break reflecting where the buses leave the arterial.

Facility

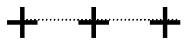


- A facility is a length of roadway composed of points and segments. Facility analysis is the focus of this Handbook and accompanying software. Guidance on length and facility termini is found in Section 3.4. For example, in most urbanized situations, freeway lengths should be at least 5 miles and arterial lengths at least 2 miles, and would be bounded by intersecting principal arterials or freeways.

Sub-segment

- A sub-segment is a further breakdown of a segment. Although segments are the primary building blocks of facility analyses, at times it is desirable to subdivide them into smaller units. For example, pedestrian conditions frequently vary between signalized intersections (e.g., discontinuous sidewalks, sidewalk proximity to roadways) and it is desirable to analyze these conditions. However, the entire roadway analysis for other modes should not be based on these special conditions.

Section



- A section is a grouping of consecutive segments that have the similar roadway, traffic, and, as appropriate, control characteristics for a mode of travel. Although the term occasionally is used in the HCM and provides some minor analytical benefit, it also adds some confusion and complexity. Because of the potential for confusion, this Handbook downplays the use of the term.

Transit system structure

Bicycle & pedestrian structure

Difficulty in developing an integrated structure

Because the system structure is different for each mode, an integrated multimodal approach becomes more difficult. The transit system structure of the Transit Capacity and Quality of Service Manual (TCQSM) consists of transit stops, route segments, and system. The two national document system structures (HCM2000, TCQSM) are conceptually equivalent when comparing points and transit stops, and areawide and system. Route segments are portions of a transit route where, in general, bus service is provided at constant headways. The Bicycle and Pedestrian LOS Models are based on segments in which roadway characteristics are the same. Usually these segments are not consistent in length with either roadway “segments” or bus “segments”. After discussions with the primary authors of the operational models for each of the four modes, a consensus was reached that for multimodal analyses of highways, the system structure presented on the previous page works best.

Caution about highway facility types and varying LOS service measures

Even within the HCM2000 highway system structure, occasional inconsistencies can arise when determining the level of service of a roadway because of different service measures being applied. For example, if percent time spent following another vehicle is used as the service measure to evaluate the level of service on an uninterrupted flow two-lane road, with certain input assumptions such as adding a traffic signal (or even multiple signals), the reported level of service may improve. This improvement occurs because the service measure for a signalized intersection is based on control delay and the service measure for roadways with multiple signals is average travel speed. Thus, anomalies are possible when changing from one facility type to another.

1.4

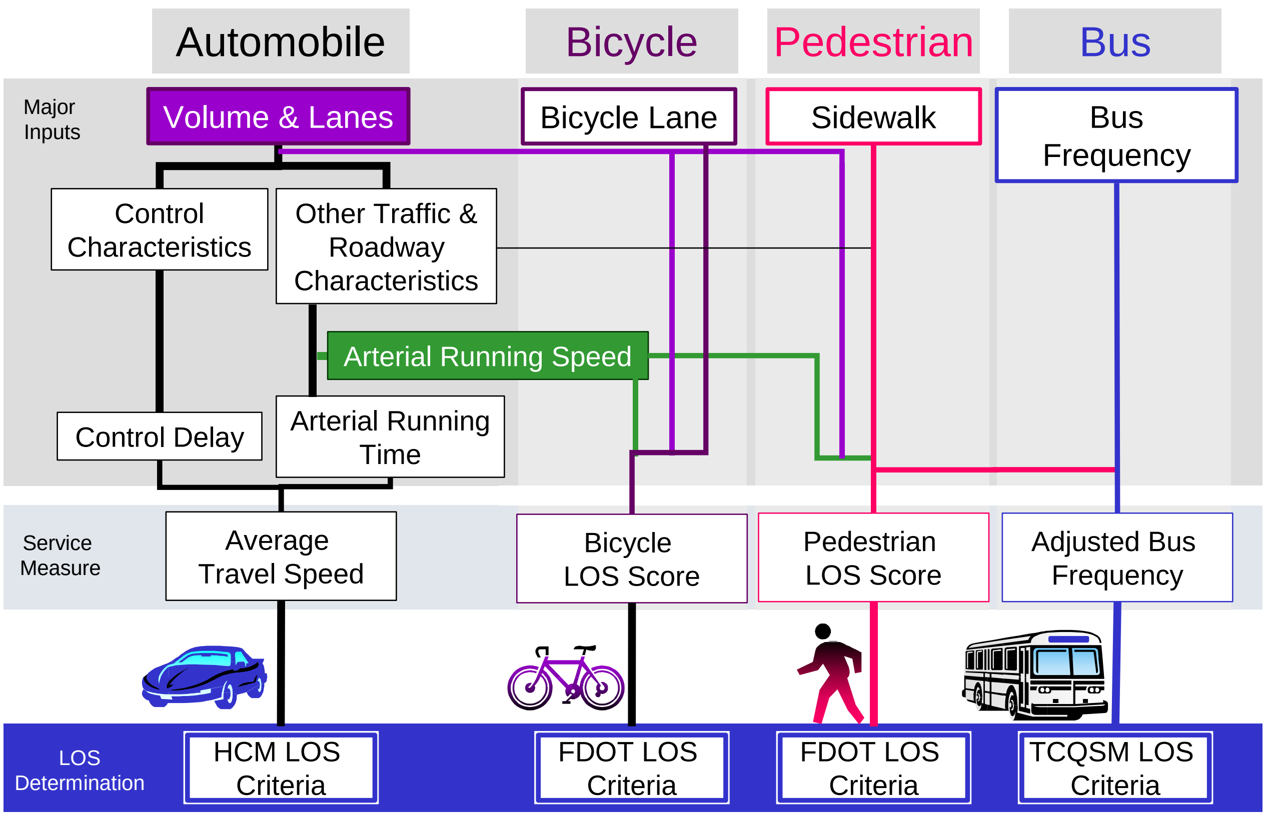
MULTIMODAL STRUCTURE

Quality of service improvements in one mode may have positive, neutral or negative effects on other modes.

Perhaps the most significant technical advancement in this Handbook is linking and simultaneous LOS calculation of the primary highway modes: automobiles, trucks, bicycles pedestrians and buses. As quality of service of one mode improves, it may have a positive, neutral or negative effect on the other modes. For example, as running speed of automobiles increases, the LOS may improve for automobiles, but the LOS for bicyclists may decrease. Figure 1-4 provides an overview of how the modes and their levels of service are linked in FDOT's multimodal arterial planning software program, ARTPLAN.

Figure 1 – 4

SIMPLIFIED MULTIMODAL FLOW CHART



The LOS for each mode is linked to the LOS of other modes.

As shown in Figure 1-4, the vehicular volume and number of lanes significantly affect the automobile, bicycle and pedestrian levels of service. Other roadway and traffic variables, plus control (signalization) variables, determine the automobile LOS. The motorized vehicle running speed (calculated as part of the automobile LOS) is also an important determinant of bicycle and pedestrian LOS. Together with the presence of bicycle lanes and sidewalks, motorized vehicles volume and speed are the main determinants of bicycle and pedestrian LOS. Bus LOS is primarily determined by bus frequency, but is also affected by pedestrian LOS. In summary, all the highway modes are linked together.

FDOT does not recommend combining the LOS for each of the modes into one overall roadway LOS.

Noteworthy, FDOT does not recommend combining the LOS for each of the modes into one overall LOS for a roadway for many reasons. Four major cautions about combining the LOS for each of the modes into one overall LOS grade exist.

Cautions about a combined multimodal LOS for roadways

The first concern is there is no professionally accepted or scientifically valid technique for combining the LOS for the various modes.

The second concern is the issue of applying a weight to each of the modes. Various scenarios exist of weighting the modes equally, by relative importance, policy goals or other criteria. For example, it would be inappropriate to average the LOS for bicycles and pedestrians equally with that of automobiles and trucks on freeways. However, simply weighting each of the modes by the number of users would, in most cases, result in using the LOS for the automobile.

The third issue is the functional classification/purposes of roadways. For example, pedestrian considerations should have greater importance on local streets serving schools than on highways serving freight transfer facilities.

The last major concern is that the purpose and travel patterns of each of the modes are generally distinct. Combining the level of service of each mode is like mixing “apples and oranges”.

1.5 MAJOR REVISIONS TO THIS EDITION OF THE HANDBOOK

Major revisions have been made to this Handbook compared to the 1998 edition due to:

- The desire and need to address multimodal considerations;
- A completely revised HCM;
- A new freeway facility planning methodology;
- The desire for executable software instead of spreadsheet-based software;
- Updates of Florida traffic characteristics; and
- Comments and suggestions resulting from user experience with previous editions.

Multimodal perspective

The most significant difference in this Handbook from previous editions is its multimodal perspective. In addition to traditional "highway" (automobile and truck) LOS analysis, state-of-the-art techniques are now provided to simultaneously evaluate the LOS for bicyclists, pedestrians, and buses (scheduled fixed route) on roadways. Automobiles and trucks are combined into one LOS category. Applying the Q/LOS concept to bicyclists, pedestrians, and buses is a relatively new concept. For potential users of the Q/LOS concept for these modes, it is important to realize that LOS does not imply a degree of congestion (as generally inferred to automobile users); it is simply a measure of user satisfaction for that mode along the roadway.

There is no "roadway LOS"; a roadway is not a user.

There is a separate LOS for each roadway mode.

A new and important concept in this Handbook is that a roadway does not have a single LOS. Historically, a "roadway's LOS" was indicative of the LOS for automobile drivers, generally the predominant users of a roadway. "Roadway LOS" is commonly used in the literature and in transportation language. Nevertheless, LOS is a measure of **user** satisfaction; a roadway is not a user, and therefore, has no LOS. For any given roadway there is a separate LOS for automobile/truck, bicycle, pedestrian, and bus modes. When using the term "roadway LOS" it should be in context for a given mode.

Freeway LOS

The changes in the computational methodology presented in this edition will naturally change the numerical results of the LOS computations compared to previous editions. The most dramatic change will be the calculation of freeway LOS service volumes.

Freeway LOS thresholds for levels A-D have increased substantially.

The HCM2000 features a new freeway chapter and basic freeway segment LOS threshold criteria have changed dramatically. Whereas LOS E volumes are nearly comparable, most of the other thresholds have been increased. Handbook users should examine the new FREEPLAN (freeway planning) software. The HCM2000 also has a new two-lane uninterrupted flow chapter with a new methodology. Handbook users should review the new HIGHPLAN (highway planning) software for two-lane and multilane uninterrupted flow analyses.

1.6 ANTICIPATED FUTURE APPLICATIONS OF Q/LOS HANDBOOK

Considerable research and project-related work is ongoing and will likely be incorporated into the next edition of this Q/LOS Handbook. Presently, software patches are expected to be released approximately by September 2002. The next edition of the Handbook and accompanying software is anticipated in 2005 and should include most of items discussed in this section as well as others.

Software patches to be provided

The ARTPLAN, FREEPLAN, and HIGHPLAN software programs accompanying this Handbook were completely redone. Although FDOT is comfortable with the current level of performance and reliability of the programs, as with any new software release, it is expected that some "bugs" will be discovered once the programs experience extensive use. Therefore, FDOT intends to provide major "bug" fix updates, such as calculation errors, as soon as possible after discovery, and minor "bug" fix updates, as well as recommended enhancements, by September 2002. FDOT does not plan to provide any major changes to the software prior to 2005.

Point multimodal LOS analyses

The bicycle, pedestrian and bus methodologies contained in this Handbook are primarily based on segment analyses; they don't give much emphasis to quality of service at points (i.e., signalized intersections, bus stops). Obviously, bicyclists and pedestrians not only evaluate a roadway's quality of service mid-block, but also at intersections. Similarly, the quality of bus stops is important to bus users.

Incorporating point LOS analyses will also involve a substantial change to ARTPLAN or possibly result in a new SIGPLAN software program.

Corridor multimodal LOS analyses

Frequently, a traveler is less concerned about the quality of service offered by a particular facility than service in a corridor that may be served by more than one facility. Because there may be multiple facility types (e.g., a freeway and an arterial), modal options, traveling purposes (i.e., traveling along a corridor, crossing a corridor), and traveling lengths (e.g., automobiles traveling the whole length while pedestrians travel relatively short distances of the corridor), numerous performance measures become relevant.

It is expected that facility analyses contained in this Handbook and in ARTPLAN will form the basis of the new corridor analysis technique. Incorporating corridor LOS techniques will likely involve the development of a new CORPLAN software program.

Areawide multimodal LOS

Florida's Urban Infill and Redevelopment Act of 1999 established the need for consideration of multimodal transportation districts. These are designated areas in which secondary priority is given to vehicle mobility and primary priority is given to assuring a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit. Such districts also must incorporate community design features that will reduce the number of automobile trips or vehicle miles of travel and will support an integrated, multimodal transportation system.

Because of the numerous purposes of an areawide analysis and design elements that are not strictly transportation-related, numerous performance measures become relevant. Incorporating areawide LOS analyses could also involve the development of a new AREAPLAN software program. The methodology will be released prior to 2005.

Transit LOS analysis

At the conceptual planning level, the methodology contained in this Handbook (i.e., ARTPLAN) makes use of bus frequency as the primary determinant of bus LOS; however, it also includes pedestrian LOS, pedestrian crossing difficulty, obstacles to bus stops, and bus span of service. These factors may need refining and there is also a desire to include bus stop considerations and load factors.

Suggestions for other revisions

Users of this Handbook and accompanying software are encouraged to complete the User Survey in Section 8.1. The last portion of the survey contains a list of possible topics to be addressed in the future.

2 PRIMARY Q/LOS EVALUATION TECHNIQUES

2.1 2000 HIGHWAY CAPACITY MANUAL (HCM2000)

Clearly, the HCM is the foremost recognized and accepted analysis tool for automobile/truck capacity and quality/level of service analysis. FDOT's LOS Handbook and software are nationally recognized as the leading planning application of HCM for the evaluation of automobile/truck LOS. This 2002 edition contains the latest updates found in the HCM2000, with the exception of the two-lane uninterrupted flow highway chapter. Testing of the new two-lane methodology and LOS thresholds indicates results that would pose significant problems for applications to roadways in Florida (discussed further in Section 2.6). Therefore, FDOT is continuing to use the HCM1997 thresholds in rural undeveloped areas until further research is conducted, and has developed a new class of two-lane highways in developed areas.

2.2 BICYCLE LOS MODEL

For bicycle Q/LOS, the FDOT has concluded that the Bicycle LOS Model, developed by Sprinkle Consulting Inc. (SCI), is the best analytical methodology. It is technically sound, superior for Florida applications compared with other approaches including the one appearing in the HCM, and has been successfully applied to over 100,000 miles of roadways in the U.S (including Florida) and Canada. Because it is an operational model, FDOT, in cooperation with the model developers, have made some simplifying assumptions for incorporation into this Handbook and accompanying software.

In the Bicycle LOS Model, bicycle levels of service are based on five variables with relative importance (T statistic) ordered in the following list:

- average effective width of the outside through lane,
- motorized vehicle volumes,
- motorized vehicle speeds,
- heavy vehicle (truck) volumes, and
- pavement condition.

Average effective width is largely determined by the width of the outside travel lane and striping for bicyclists, but also includes other factors such as the effects of street parking and drainage grates. Each of the variables is weighted by coefficients derived by stepwise regression modeling importance. A numerical LOS score, generally ranging from 0.5 to 6.5, is determined and stratified to a LOS letter grade. Thus, unlike the determination of automobile LOS in the HCM2000, in which there is usually only one service measure (e.g., average travel speed), bicycle LOS is determined based on multiple factors. In the Bicycle LOS Model, bicycle levels of service are determined using the following equation and then applying the level of service thresholds (see Table 2-1) to the calculated scores.

Bicycle LOS Model equation

The Bicycle LOS Model is based on the following equation:

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

Where:

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

Where:

$W_e = W_v$ - (10ft x %OSP) Where $W_1 = 0$

$W_e = W_v + W_1$(1 - 2x %OSP) Where $W_1 > 0$ & $W_{ps} = 0$

$W_e = W_v + W_1$ - 2 (10 x %OSP) Where $W_1 > 0$ & $W_{ps} > 0$ and a bicycle lane exists

Where:

- W_t = total width of outside lane (and shoulder) pavement
- %OSP = percentage of segment with occupied on-street parking
- W_1 = width of paving between the outside lane stripe and the edge of pavement
- W_{ps} = width of pavement striped for on-street parking
- W_v = Effective width as a function of traffic volume

Where:

$W_v = W_t$ if AADT > 4,000 veh/day
$W_v = W_t(2-(0.00025 \times AADT))$ if AADT $\leq$ 4,000 veh/day, and if the street/road is undivided and striped

Table 2 – 1
BICYCLE AND PEDESTRIAN LEVEL OF SERVICE CATEGORIES

Level of Service	Score
A	$\leq$ 1.5
B	> 1.5 and $\leq$ 2.5
C	> 2.5 and $\leq$ 3.5
D	> 3.5 and $\leq$ 4.5
E	> 4.5 and $\leq$ 5.5
F	> 5.5

Many Bicycle LOS Model mathematical terms are also HCM2000 motorized vehicle terms.

Noteworthy, many of the factors in the Bicycle LOS Model equation are also used to determine automobile LOS in the HCM2000 methodology, and are either logarithmic or exponential functions. Logarithmic and exponential functions make the importance of the variables differ significantly depending on the precise value. For example, the bicycle LOS drops dramatically as motorized vehicle volumes initially rise, but then tends to deteriorate more slowly at higher volumes. Another example is the effect of motorized vehicle speed. At low speeds, the variable is not as significant in determining bicycle LOS, but at higher speeds it plays an ever increasing role.

Bicycle LOS Model is not applicable to off-street facilities.

Bicycle Q/LOS is based on bicyclists' perceptions in the roadway environment, specifically on the roadway cross section. The model is not applicable to off-street facilities, such as shared use paths or sidewalks. Analysts are encouraged to use discretion when assigning a bicycle LOS to a roadway when shared use paths exist. For example, if an outstanding path with few intersection conflicts (e.g. Pinellas Trail, a facility along a causeway) exists immediately adjacent to a roadway whose on-street bicycle LOS is D, it is appropriate for the analyst to acknowledge a better quality of service for bicyclists than ARTPLAN produces.

2.3

PEDESTRIAN LOS MODEL

For pedestrian Q/LOS, the FDOT has developed the Pedestrian LOS Model as the best analytical methodology. It is technically sound, superior to the approach appearing in the HCM, and has been successfully applied to cities in Florida and the U.S. Because it is an operational model, FDOT, in cooperation with the model developers, have made some simplifying assumptions for incorporation into this Handbook and accompanying software.

In the Pedestrian LOS Model, pedestrian levels of service are based on four variables with relative importance (T statistic) ordered in the following list:

- existence of a sidewalk,
- lateral separation of pedestrians from motorized vehicles,
- motorized vehicle volumes, and
- motorized vehicle speeds.

Pedestrian LOS Model equation

Each of the variables is weighted by relative importance (determined by stepwise regression modeling): A numerical LOS score, generally ranging from 0.5 to 6.5, is determined along with the corresponding LOS letter grade. Thus, like the bicycle LOS approach (but unlike the automobile approach), pedestrian LOS is determined based on multiple factors.

In developing the Pedestrian LOS Model, the researchers, under contract with FDOT, conducted step-wise regression analyses using 1315 real-time observations from a research effort conducted in 2000 in Pensacola. In the Pedestrian LOS Model, pedestrian levels of service are determined using the following equation and then applying level of service thresholds (see Table 2-1) to the calculated scores.

$$PLOS = -1.2276 \ln (W_{ol} + W_l + f_p \times \%OSP + f_b \times W_b + f_{sw} \times W_s) + 0.0091 (Vol_{15}/L) + 0.0004\ SPD^2 + 6.0468$$

Where:

PLOS	= Pedestrian level of service score
ln	= Natural log
W_{ol}	= Width of outside lane
W_l	= Width of shoulder or bicycle lane
f_p	= On-street parking effect coefficient (=0.20)
%OSP	= Percent of segment with on-street parking

f_b	= Buffer area barrier coefficient (=5.37 for trees spaced 20 feet on center)
W_b	= Buffer width (distance between edge of pavement and sidewalk, feet)
f_{sw}	= Sidewalk presence coefficient (= 6 – 0.3W_s)
W_s	= Width of sidewalk
Vol_{15}	= Volume of motorized vehicles in the peak 15 minute period
L	= Total number of directional through lanes
SPD	= Average running speed of motorized vehicles traffic (mi/hr)

Pedestrian LOS Model is applicable to nearby shared use paths.

Many of the terms in the Pedestrian LOS Model equation are also used to determine automobile LOS in the HCM methodology and bicycle LOS in the Bicycle LOS Model. The logarithmic and exponential functions make the importance of the variables differ significantly depending on the precise value.

Pedestrian Q/LOS is based on pedestrians' perceptions in the roadway or nearby roadside environment – either along the roadway lanes, on a sidewalk or nearby shared use path, or on a nearby exclusive pedestrian facility. Applying the model to pedestrian facilities significantly greater than 100 feet from a roadway may exceed the validated range of the model.

2.4 TRANSIT CAPACITY AND QUALITY OF SERVICE MANUAL (TCQSM)

The Transportation Research Board's 1999 Transit Capacity and Quality of Service Manual (TCQSM) addresses many forms of transit. Part 5 of the TCQSM deals specifically with QOS and includes LOS thresholds. Transit related text in the HCM2000 comes from applicable text in the TCQSM dealing with transit operating on roadways. As used in this Handbook, "transit" or "bus" is limited to scheduled fixed route bus transit. The TCQSM techniques, supplemented by FDOT's Transit Level of Service (TLOS) software, should be used to evaluate bus Q/LOS at an operational level.

Service frequency LOS thresholds

One of the most significant exhibits in the TCQSM is the table for urban scheduled transit service based on service frequency. In essence, Table 2-2 replicates the TCQSM table.

Table 2 – 2
SERVICE FREQUENCY LOS THRESHOLDS

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

2.5 SIMPLIFYING ASSUMPTIONS TO PRIMARY Q/LOS EVALUATION TECHNIQUES

Planning level analyses make extensive use of default values and simplifying assumptions to the operational models on which they are based. This section discusses the major simplifying assumptions used in this Handbook and accompanying software. Extensions to, or variations from, the operational methodologies are presented in the next section.

Use of averages

This Handbook makes extensive use of averages. For generalized planning (Generalized Tables), most of the default input variables represent well researched statewide averages. Similarly, for generalized planning, simple averages are recommended. For example, if an arterial facility has daily volumes of 20,000, 25,000 and 24,000, it is recommended the average of 23,000 be used. However, users should be cautious of outlying values and use some judgment when applying simple averages. In the above example, if the first value were only 10,000, the user may want to disregard that value or use the median value (i.e., 24,000). Previous editions of this Handbook recommended extensive use of median values, but for simplification, this edition is recommending the use of averages with a word of caution given to users.

For facility analyses at the conceptual planning level for automobiles and buses, LOS determinations use an average weighted by segment lengths. For example, in determining average travel speed of automobiles on arterials or freeways, the length of the segments is considered. For bus analyses, if 2 buses serve 1 mile of a facility, and 1 bus serves 3 miles of the facility, the weighted average for bus frequency for the 4-mile facility is 1.25 ([2x1 + 1x3]/4).

Exceptions to averages

Two explicit exceptions exist to the simple average or weighted average by distance: (1) treatment of the effective green ratio (g/C) in the Generalized Tables and (2) evaluation of bicycle and pedestrian LOS accounting for segments providing poor service to bicyclists and pedestrians.

Weighted effective green time

For generalized planning use a weighted effective green ratio.

For conceptual planning use actual effective green ratios.

Clearly, the amount of green time that traffic movements receive at signalized intersections is one of the most significant variables in automobile Q/LOS and capacity analyses. A major simplifying assumption, essential to the development of the Generalized Tables, is the selection of a single effective green ratio (g/C) for all the intersections of the arterial. A fundamental question arises as to what green time value to assume, given that intersections frequently have widely varying green times. The average green time through movements receive along the arterial, or the green time at the critical intersection where the greatest delay is likely to occur, or some other value could be used. FDOT has determined that for generalized planning analyses, the “weighted effective green ratio” yielded the closest results to actual conditions. The weighted effective g/C of an arterial is the average of the critical intersection through g/C and the average of the other intersections’ through g/C’s. Essentially, the worst intersection is given equal weight to all the other intersections combined. For conceptual planning, there is rarely a need to use weighted effective green ratios. The weighted g/C approach is probably only needed when it is desired to develop a generalized table.

Bicycle and pedestrian LOS weighting

To determine bicycle and pedestrian LOS for a facility, FDOT used a similar approach by weighting the worst LOS segment with the average of all the other segments. For example, if an arterial has 1 segment with a pedestrian LOS score of 5.2 (LOS E) and the average score for the other 5 segments is 2.8 (LOS C), then the weighted pedestrian LOS score is 4.0 ([5.2+2.8]/2), which is LOS D. If a simple average was used, the pedestrian LOS score would be 3.2 ([5x2.8+5.2]/6), which is LOS C. Essentially, FDOT is taking the position that bicyclists and pedestrians do not simply evaluate a roadway by either its average conditions or its worst condition, but rather a combination of both.

Simplifying Assumptions to the HCM2000

Most significant planning assumption is that mainline non-through movements are adequately accommodated.

Probably the most significant planning assumption is that mainline non-through movements are adequately accommodated. As used in this Handbook, the through movement is defined as the traffic stream with the greatest number of vehicles passing directly through a point. Typically, that movement is straight ahead, but occasionally the "through" movement is a right or left turning movement, with the straight ahead movement being considered a non-through movement. Most analyses of through movements in the HCM2000 are relatively straightforward. Complications arise with the treatment of turning/merging movements, especially for signalized intersections and arterials. By handling non-through arterial movements (i.e., turns from the arterial, side street movements) in a general way, Q/LOS analyses are greatly simplified.

Emphasis on through movement

Although the arterial analysis in this Handbook includes all vehicles on the arterial, it focuses on the through movement. For example, only the green time for the through movement is included and penalties are assigned if there are no left turn lanes at signalized intersections and no medians exist mid-block. Similarly, off and on ramp movements along freeways are handled in a general way and are assumed to be adequately accommodated. Most importantly, it is assumed that off ramp movements do not back up on the through lanes of the freeway. Where mainline non-through movements are not adequately accommodated, the planning techniques found in this Handbook and accompanying software are not appropriate.

Capacity and free flow speed

For HCM2000 analyses of uninterrupted flow facilities, capacity is set in terms of passenger cars per hour per lane. Free flow speed is estimated based on other variables such as percent heavy vehicles, driver population, median type and lateral clearance. In the HCM2000, those variables affect free flow speed, not capacity.

For consistency this Handbook assumes all roadway, traffic and control variables are capacity adjustments, not free flow speed adjustments.

Free flow speed is assumed to be 5 mph over the posted speed.

For HCM2000 analyses of interrupted flow facilities, capacity represents the maximum number of vehicles that can pass a point during a specified time period under prevailing roadway, traffic, and control (signalization) conditions. Variables affect capacity, not free flow speed. This capacity approach also predominates in the traffic engineering literature and general understanding. Largely for consistency, this Handbook and accompanying software primarily rely on and report capacity values based on the interrupted flow concept of capacity, with free flow speed being considered a roadway variable input. For planning purposes, the assumed free flow speed is 5 mph over the posted speed limit (although in the software analysts may override this planning assumption). Regardless, ARTPLAN, FREEPLAN and HIGHPLAN software all follow the HCM2000 calculation processes.

Simplifying Assumptions to the Bicycle LOS Model

To reduce the complexity of the Bicycle LOS Model, simplifying assumptions have been made in FDOT's software (ARTPLAN) and the Generalized Tables. In the software three input variables have been simplified and include:

- Existence of paved shoulder/bicycle lane – width of these facilities are assigned default values;
- Outside lane width – the outside travel lane for motorized vehicles is categorized as wide, typical, or narrow with default values assigned;
- Pavement condition – the surface on which bicyclists ride is categorized as desirable, typical, or undesirable with default values assigned.

These variables are discussed in detail in Section 3.4. For a generalized planning analysis using the Generalized Tables, the process is simplified further by only requiring the analyst to use the existence of a paved shoulder/bicycle lane and the number of motorized vehicles, which are the two most important variables in the Bicycle LOS Model.

Simplifying Assumptions to the Pedestrian LOS Model

To reduce the complexity of the Pedestrian LOS Model, simplifying assumptions have been made in FDOT's software (ARTPLAN) and the Generalized Tables. In the software four input variables have been simplified and are discussed in Section 3.4. These variables include:

- Sidewalk/roadway separation – the lateral distance from the sidewalk to the outside travel lane is categorized as adjacent, typical, or wide with default values assigned;
- Existence of sidewalk/roadway protective barrier – on-street parking, trees and other such barriers are treated in a general way with a multiplicative factor applied to the sidewalk/roadway separation distance;
- Outside lane width – the outside travel lane for motorized vehicles is categorized as wide, typical, or narrow with default values assigned; and
- Existence of paved shoulder/bicycle lane – widths of these facilities are set at a default value.

For a generalized planning analysis using the Generalized Tables, the process is simplified further by only requiring the analyst to use the existence of sidewalks and the number of motorized vehicles, which are the two most important variables in the Pedestrian LOS Model.

Simplifying Assumptions to the TCQSM

For transit analysis planning purposes, the most significant assumption is that bus frequency is the single most important factor in determining the Q/LOS to transit users along a transit route segment or roadway facility. FDOT, in cooperation with the TCQSM authors and others, has incorporated that concept. Certainly, LOS varies for bus riders inside a bus along a facility, but in the determination of bus LOS along a transit route segment or roadway facility, the existence or availability of buses is usually the more relevant performance measure.

2.6 PLANNING EXTENSIONS TO PRIMARY Q/LOS RESOURCE TECHNIQUES

In general, the methodologies used in this Handbook are consistent with those found in the 2000 Highway Capacity Manual (HCM2000), the Transit Capacity and Quality of Service Manual (TCQSM), and the Bicycle and Pedestrian LOS Models. However, three circumstances result in some deviation from those methodologies. First, all four methodologies are detailed operational models and none of those sources is complete for planning applications. Thus, FDOT needed to develop some planning applications of the methodologies. In all cases, the extensions or variations were coordinated with leaders of those source documents to be as consistent as possible with the methodologies. Second, frequently techniques in this Handbook are being developed simultaneously, or in advance of published updates of the operational methodologies and documents. Leaders of those sources are seriously considering incorporating FDOT's planning applications in subsequent updates. Third, there is the need to address specific aspects not found in those source documents.

The extensions appear below.

Extensions to the HCM2000

Freeway planning

The HCM2000 contains a new chapter on freeway facilities. It is a detailed operational methodology combining the analyses of basic freeway segments, weaving areas, off ramp areas and on ramp areas. The new chapter neither contains any guidance or examples for planning applications, nor does it include any LOS threshold criteria. Because of these limitations, FDOT contracted with Polytechnic University to jointly develop a freeway facility planning application.

Major features of FREEPLAN

Major features of FDOT's freeway planning application and software (FREEPLAN) are:

- Use of the HCM2000 as the primary resource document for the methodology;
- Concentration on the through vehicle, while being sensitive to the analysis of other vehicles on the freeway and on segments of the freeway;
- Use of four freeway classes based primarily on interchange spacing, which is very similar to the use of four arterial classes largely based on signalized intersection spacing in the HCM2000;
- The approach is structured towards combining segments (e.g., interchange areas, toll plaza influence areas), rather than combining point analyses (e.g., ramps);
- LOS thresholds based on the density criteria found in the basic freeway segment chapter of the HCM2000;
- Capacity reductions in interchange areas;
- Use of a "local adjustment factor" (driver population factor), based primarily on freeway class and location; and
- The resulting volumes match well with actual Florida traffic counts.

Base saturation flow rates for interchange influence areas

Within interchange influence areas, the base saturation flow rate for the two outside lanes are reduced by:

- 200 passenger cars per hour per lane for off ramp influence area;
- 100 passenger cars per hour per lane for on ramp influence area; and
- 50 passenger cars per hour per lane between the off ramp and on ramp influence areas.

Although similar reductions for ramp areas appeared in drafts of the HCM2000, the wording was not included in the final version. FDOT has included the reductions because (1) they are logical, (2) recent national research by the developers (May, et. al.) of the HCM2000 freeway facility chapter has indicated the HCM2000 values are 4 to 10 percent too high (applying the reductions virtually eliminates that bias), and (3) applying the reductions result in an extremely good fit with actual Florida freeway volumes.

Consistency with measured freeway volumes

With regard to actual Florida traffic volumes, these volumes seldom exceed 2100 vehicles per lane per hour in urbanized areas and 1750 vehicles per hour per lane in rural areas. By applying the interchange capacity reductions, and the statewide defaults for the peak hour factor, heavy vehicle percentage, and "local adjustment factor," the calculated volumes match very well with actual volumes.

Freeway LOS thresholds

HCM LOS thresholds have changed considerably.

Concerning the application of LOS thresholds, FDOT uses the basic freeway segment criteria found in the HCM2000 for the whole facility. For users of previous editions of this Handbook and accompanying software, this reflects no change in approach. However, it should be noted that the thresholds found in the HCM2000 have changed considerably, resulting in significant maximum service volume changes for LOS A through D.

Freeway auxiliary lanes

Auxiliary lanes are additional lanes on freeways that connect on ramps and off ramps of adjacent interchanges. FDOT's FREEPLAN software addresses these auxiliary lanes based on three approximate distances. If the length of the auxiliary lanes is less than 2500 feet, they are analyzed using weaving analysis procedures found in the HCM2000. If the lanes are greater than 3000 feet in length, they are considered as full lanes for capacity purposes. If the auxiliary lanes are between 2500 and 3000 feet in length, they are considered as adding an extra half lane of capacity.

Treating interchanges as segments

Freeways are considered by FDOT to have two primary segments. These primary segments are:

- A basic segment, which is the length of a freeway where operations are unaffected by interchanges.
- An interchange, which is the influence area associated with the off ramp influence area, overpass/underpass, and on ramp influence area.

With this type of system structure, freeways are primarily broken down into segments affected by interchanges and those that are not. Conceptually, and for presentations to the public, this breakdown is more feasible than the HCM2000 structure in which the off ramp and on ramp influence areas and the overpass/underpass are treated as distinct segments. Analytically, there is no difference in these two freeway structures.

Uninterrupted flow highway facility and segment analyses

The multilane and two-lane highway chapters of the HCM2000 are more reflective of segment analyses than facility analyses; the assumption is no significant impact of major intersections along these roadways. For example, in the HCM2000, the comparable chapter to the multilane highway chapter is the basic freeway segment chapter, rather than the freeway facility chapter. Because FDOT's generalized and conceptual planning tools are primarily facility analysis techniques, an approach was needed to convert the segment results to facility results. The chosen approach was based on the freeway interchange approach, in which the capacity is reduced by a maximum of 200 passenger cars per hour per lane, or approximately 10 percent of capacity.

Reduction factor for uninterrupted flow highway analyses

Applying a 10 percent reduction to uninterrupted flow highway analyses generates more realistic values. If the reduction were not made, uninterrupted flow highway facility service volumes would be unrealistically higher than freeway facility values. Service volumes for two-lane and multilane highways in FDOT's Generalized Tables reflect this facility approach concept.

Use of segment analysis in HIGHPLAN

FDOT's conceptual planning uninterrupted flow highway software (HIGHPLAN) defaults to a facility analysis, but the user has the option to select a segment analysis if that type of analysis is more appropriate. An example of the appropriate segment analysis approach is when isolated intersections are accounted for directly. FDOT recommends the use of the segment analysis type in HIGHPLAN for the uninterrupted flow segments of the highway and the "signal" selection under roadway class in ARTPLAN for 0.25 miles on each side of the signalized intersection. An example of this approach is contained in Section 3.4.

Treatment of isolated intersections

Two-lane uninterrupted flow highway analyses

For two-lane uninterrupted flow highways FDOT will continue to use HCM1997 LOS thresholds in rural undeveloped areas.

FDOT's procedures make use of " percent of free flow speed" as the service measure for two-lane uninterrupted flow highways in developed areas.

The HCM2000 includes a new two-lane uninterrupted flow chapter that contains a new analysis technique, revised performance measures, new LOS thresholds, and a new capacity value. Testing of the new chapter indicates results that would pose significant problems to users in Florida. For example, the new Class I LOS thresholds would result in over a 50% reduction in service volumes for LOS C (FDOT's planning minimum LOS standard for two-lane highways). In setting project priorities and reporting to the Legislature on highway deficiencies, such a "paper" change, as opposed to actual change in operating conditions on the highways, is deemed too significant for FDOT to implement without further analysis, review, research and discussions with the HCM oversight committee. Therefore, FDOT will continue to use the HCM1997 LOS thresholds in rural, undeveloped areas until those activities are completed. In comparing calculated service volumes to values in previous editions of this Handbook, keeping the HCM1997 LOS thresholds results in only minor changes in the Generalized Tables, or generated from the conceptual planning software (HIGHPLAN) for these types of facilities in rural undeveloped areas. HIGHPLAN also defaults to the HCM1997 thresholds for two-lane uninterrupted flow facility analyses in undeveloped areas.

FDOT and University of Florida researchers have developed a distinct class of two-lane uninterrupted flow facilities in developed areas, such as small towns, along coastal roads, or in urban situations. FDOT assumes that the most relevant service measure for motorists on two-lane highways in developed areas is to maintain a "reasonable" speed, rather than a measure of the ability to pass found in the HCM2000. Drivers in a small, developed area, which is posted at 55 mph, would primarily like to travel near that speed. Similarly, along a beach road posted at 45 mph, or in a community posted at 40 mph, drivers probably accept that they need to slow down and are quite satisfied to proceed through these areas close to those speeds. At the national level, a research paper has been submitted to the HCM oversight committee and the FDOT approach is being investigated. Compared to previous Handbook editions, the FDOT approach results in relatively minor changes in service volume calculations which appear in the Generalized Tables, or are generated from the conceptual planning software (HIGHPLAN) for these types of facilities in developed areas.

Passing lanes

To assess the beneficial effects of passing lanes on two-lane highways, the analysis tools are based on the distance between passing lanes and the assumption that the passing lanes are 1 mile in length. When analyzing two-lane highways in rural undeveloped areas, HIGHPLAN alters the LOS v/c criteria by multiplying the original v/c criteria by the ratio of the percent time spent following without the passing lanes to the percent time spent following with the passing lanes. The passing lane adjustments found in the Generalized Tables are based on this HIGHPLAN approach and a typical value is applied across LOS A-D thresholds. In developed areas, HIGHPLAN evaluates the benefit of passing lanes directly, based on the percent of free flow speed.

Directional Analysis

The HCM2000 allows the analysis of two-lane uninterrupted highways both for a single direction and bi-directionally. Consistent with all the other analyses found in this Handbook and software, analyses are based on a single direction. Also, all applicable terms (e.g., percent no passing zones) pertain to the analysis direction.

Arterial planning

Mid-block running speeds

The segment running time calculations in the HCM2000 do not include traffic volume as a variable. Based on research conducted for FDOT, changes to the HCM exhibit were approved by the national subcommittee overseeing the chapter, but unfortunately due to time considerations, were not included in the HCM2000. This research effort and resulting equation is included in this Handbook and accompanying software. Specifically, FDOT's running speeds include traffic volume as a variable and better reflects *through* vehicle running speeds, as opposed to the total mix of through and turning vehicles.

LOS for other signalized roadways

The HCM2000 LOS measure of effectiveness and thresholds for urban streets are essentially for arterials. LOS is based on their average travel speed. Generally, on major non-state roadways, motorists also evaluate quality based on average travel speed. However, most local streets are not signalized and some have only one signal for the purpose of allowing motorists access to an arterial. The HCM2000 does not provide LOS criteria for these streets. It is generally assumed that the LOS for local unsignalized roadways is acceptable. However, for roads that have one signalized intersection, the methodology in this Handbook recommends that the HCM2000 intersection LOS criteria (delay at the intersection) be used to set the LOS for those roadways. In using this procedure, these facilities are being evaluated by delay at the signal and not the average travel speed of the roadway. In FDOT's Generalized Tables, these roadways are labeled "other signalized roadways". Previous editions of FDOT's software included a program called SIG-TAB to evaluate these "other signalized roadways". To simplify and reduce the number of software programs, these facilities can now be evaluated using ARTPLAN by selecting "signal" under roadway class.

Add/drop lanes (expanded intersections)

The HCM2000 does not directly address the situation where lanes that carry through traffic are added before a signalized intersection and dropped after the intersection. The add/drop lane (or expanded intersection) will contribute to intersection capacity, but probably not to the extent of a full through lane. Guidance on this topic is provided in Section 3.4.

Rural LOS criteria

The LOS service thresholds found in the HCM2000 are primarily determined by urbanized area conditions. For example, the maximum control delay at a signalized intersection for LOS D is 55 seconds. While that value may be reasonable based on user perception in an urbanized area, in a small town, or at an isolated intersection on a rural highway, that delay would surely be considered F. To overcome this difference in user perception, FDOT has adopted different control delay criteria in rural undeveloped and rural developed areas. The criteria are one-half, rounded up, of the urbanized area criteria. For arterials in rural developed areas, arterial Class I LOS thresholds apply. These revised LOS criteria are directly imbedded in FDOT's rural undeveloped and rural developed Generalized Tables and software. The LOS criteria appear on the back of the tables.

Local adjustment factor

FDOT recommends use of a "local adjustment factor" when calculating LOS or service volumes. Statewide default values for peak hour conditions appear on the back of Generalized Tables for varying freeway classes and area types. If an analysis is for an off peak hour, values, even in urbanized situations, should be no higher than 0.95. For users of previous editions of this Handbook and accompanying software, there is minimal effect of using the "local adjustment factor," as it was already indirectly incorporated into the calculation techniques.

Extensions to the Bicycle LOS Model

One extension was made to the Bicycle LOS Model to meet Florida's needs: calculation of bicycle LOS at a facility level as opposed to a segment level. The Bicycle LOS Model was developed and calibrated at a roadway segment level. From the beginning of FDOT's planning LOS program, facilities (e.g., 4

Facility LOS

miles of an arterial or freeway) not segments or points (e.g., signalized intersections) have been emphasized. For example, the Generalized Tables are applicable for automobile/truck LOS at a facility level, not for a given segment or intersection/interchange along those facilities.

Continuity of paved shoulders/bicycle lanes is important to bicyclists.

For consistency, a method was needed to aggregate the individual segment bicycle analyses into a facility analysis. The aggregation method is especially important when one considers the continuity of a paved shoulder/bicycle lane existence over some segments, but not over the whole facility. Portions of a facility may offer reasonably good quality of service, but other portions may be so poor that many bicyclists are discouraged from riding on the facility altogether.

Facility approach in Generalized Tables

The Generalized Tables use three broad ranges of the percent of paved shoulder/bicycle lane coverage. If a facility has less than 50% coverage, it is treated as having no paved shoulder/bicycle lane coverage. If it has from 50-84% coverage, it is actually evaluated as if it has 50% coverage. If a facility has a wide outside lane over its whole length, it may also be considered as having between 50-84% paved shoulder/bicycle lane coverage when using the Generalized Tables. If a facility has from 85-100% coverage, it is evaluated as having a paved shoulder/bicycle lane over its full length.

Facility approach at a conceptual level

At the conceptual level, each segment is weighted by its distance and the severity of its bicycle LOS score to determine the facility LOS for bicyclists. Specifically, the bicycle LOS for a facility is given by the following equation:

$$BLOS_f = (\sum\ d_1(b_1)^2 + \ldots\ d_n(b_n)^2)/(\ \sum\ d_1(b_1) + \ldots\ d_n(b_n))$$

Where:
$BLOS_f$ = Bicycle level of service for the facility
d_1 = Length of the first segment
b_1 = Bicycle level of service score for the first segment
d_n = Length of the last segment
b_n = Bicycle level of service score for the last segment

The equation represents a weighting combination of distance and LOS score severity, primarily reflecting paved shoulder/bicycle lane continuity.

Number of heavy vehicles

Bicyclists are affected by the windblast effect of heavy vehicles. To bicyclists, it is primarily the number of heavy vehicles that is important, not the percentage of heavy vehicles. In developing the Bicycle LOS Model, the percent of heavy vehicles proved to be a useful factor largely because traffic and heavy vehicle volumes were in typical ranges. When traffic or heavy vehicle volumes are extremely low or high, distortions in the results from using the percent of heavy vehicles may occur. Working with the developers of the Bicycle LOS Model, FDOT developed some calculation techniques in ARTPLAN to better account for the number of heavy vehicles, as opposed to strictly the percent of heavy vehicles in these atypical ranges.

Extensions to the Pedestrian LOS Model

Facility LOS

One extension to the Pedestrian LOS Model to meet Florida's needs was made: calculation of pedestrian LOS at facility level as opposed to a segment level. The Pedestrian LOS Model was developed and calibrated at a roadway segment level. From the beginning of FDOT's planning LOS program, facilities (e.g., 4 miles of an arterial or freeway) not segments or points (e.g., signalized intersections) have been emphasized. For example, the Generalized Tables are applicable for automobile/truck LOS at a facility level, not for a given segment or intersection/interchange along those facilities.

Continuity of sidewalks is important to pedestrians.

For consistency, a method was needed to aggregate the individual segment pedestrian analyses into a facility analysis. The aggregation method is especially important when the continuity of sidewalk existence over some segments, but not over the whole facility, is considered. Portions of facility may offer reasonably good quality of service, but other portions may be so poor that many pedestrians are discouraged from walking along the facility altogether.

Facility approach in Generalized Tables

The generalized level the Generalized Tables use three broad ranges of the percent of sidewalk coverage. If a facility has less than 50% coverage, it is treated as having no sidewalk coverage. If it has from 50-84% coverage, it is evaluated as if it has 50% coverage. If a facility has from 85-100% coverage, it is evaluated as having a sidewalk over its full length.

Facility approach at a conceptual level

At the conceptual level, each segment is weighted by its distance and the severity of its pedestrian LOS score to determine the facility LOS for pedestrians. Specifically, the pedestrian LOS for a facility is given by the following equation:

$$PLOS_f = (\sum \ d_1(p_1)^2 + \ldots d_n(p_n)^2)/(\sum \ d_1(p_1) + \ldots d_n(p_n))$$

Where:

$PLOS_f$ = Pedestrian level of service for the facility
d_1 = Length of the first segment
p_1 = Pedestrian level of service score for the first segment
d_n = Length of the last segment
p_n = Pedestrian level of service score for the last segment

The equation represents a weighting combination of distance and LOS score severity, primarily reflecting sidewalk continuity.

Extensions to the TCQSM

Pedestrian access to buses

Although pedestrian access to transit is recognized as important in the TCQSM, it did not provide guidance on how to incorporate pedestrian aspects. The methodology in this Handbook makes use of pedestrian considerations as the second most important determinant of bus LOS along a transit route segment or facility. The Generalized Tables use sidewalk coverage along a facility as the factor for pedestrian access to transit. At the conceptual planning level and built into FDOT's software (ARTPLAN), three important pedestrian considerations are included to determine an "adjusted bus frequency" and bus LOS. These considerations are: pedestrian LOS, pedestrian crossing difficulty, and obstacles to bus stops. Favorable pedestrian conditions have multiplicative factors greater than 1.0 and unfavorable conditions have values less than 1.0 and are applied to bus frequency to determine the "adjusted bus frequency".

Pedestrian LOS as a factor to bus LOS

Pedestrian LOS is determined by the methodology contained in this Handbook and accompanying software (ARTPLAN). The pedestrian LOS factors as they relate to bus LOS are shown in Table 2-3.

Table 2 – 3
PEDESTRIAN LOS ADJUSTMENT FACTORS ON BUS LOS

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

Pedestrian crossing difficulty as an adjustment factor to bus LOS

When catching a bus, transit users frequently have to cross a road. Crossing difficulty is increased largely based on three broad factors: traffic signal density, crossing length, and motorized vehicle volume. It is more difficult to cross under lower signal densities than higher densities. For example, it is relatively harder to cross a Class I arterial with few signalized intersections than a Class IV arterial with closely spaced signalized intersections. Mid-block crossing difficulty increases with road width and lack of pedestrian refuges (i.e., restrictive (raised) medians). Mid-block crossing difficulty also increases as the number of motorized vehicles increase, which results in fewer gaps. These three broad factors and others, such as motorized vehicle speed, are interrelated. To account for crossing difficulty in a general way, FDOT's conceptual planning approach includes the factors in Table 2-4, which are applied to help determine an "adjusted bus frequency". Relatively favorable conditions have a 1.05 factor, typical conditions a 1.0 factor, and relatively unfavorable conditions have a 0.80 factor.

Table 2 – 4

ROADWAY CROSSING ADJUSTMENT FACTORS

Conditions that must be met:				Crossing Adjustment Factor
Arterial Class	Median	Number of Mid-Block Through Lanes	Automobile LOS	
I	All situations	2	A or B	1.05
II	All situations	2	A, B or C	
III	All situations	<=4	A or B	
IV	All situations	<=4	All levels of service	
I	None or Nonrestrictive	>=4	B, C, D, E or F	0.80
	Restrictive	>=8	All levels of service	
II	None or Nonrestrictive	>=4	C, D, E or F	
	Restrictive	>=8	All levels of service	
III	None or Nonrestrictive	>=4	D, E, or F	
	Restrictive	>=8	All levels of service	
All cases not included in conditions for factor 1.05 and 0.80 =				1.00

Obstacles between sidewalks and bus stops as a factor to bus LOS

In some suburban situations, obstacles exist between sidewalks and bus stops. Examples of such physical barriers are swales and fences. When such obstacles occur, FDOT's conceptual analysis incorporates a 0.90 factor.

Bus span of service as a factor to bus LOS

The methodologies contained in this Handbook are based on hourly analyses. Frequently in planning applications, these hourly analyses are reported on a daily basis. For example, the motorized vehicle volumes appearing in the daily Generalized Tables are based on a peak hour analysis, but are converted to Annual Average Daily Traffic (AADT) for reporting purposes. When reporting bus LOS on a daily basis, FDOT's conceptual planning methodology incorporates the bus span of service concept found in the TCQSM. Adjustment factors were developed to address that, regardless of the bus frequency during the analysis hour, users can either benefit from extended hours, or be adversely affected if only very limited service is provided. FDOT's factors for adjusting hourly frequency are inserted into the TCQSM's span of service exhibit in Table 2-5.

Table 2 – 5
BUS SPAN OF SERVICE ADJUSTMENT FACTORS

Level of Service	Hours of Service per Day	FDOT Adjustment Factor	Comments
A	19-24	1.15	Night or owl service provided
B	17-18	1.05	Late evening service provided
C	14-16	1.0	Early evening service provided
D	12-13	0.90	Daytime service provided
E	4-11	0.75	Peak hour service/limited mid-day service
F	0-3	0.55	Very limited or no service

Factors used to determine an adjusted bus frequency

In summary, FDOT's conceptual planning methodology allows the adjustment of bus frequency with four factors: pedestrian LOS, pedestrian crossing difficulty, obstacles between sidewalks and bus stops, and bus span of service.

Reporting bus LOS

The TCQSM structure for Q/LOS analysis consists of points (e.g., bus stops), route segments and system. It does not include a "facility" analysis. Nevertheless, since the focus of this Handbook and accompanying software is at the facility level, a method of aggregating segment level bus frequency to a facility level is needed. FDOT recommends the following procedure. At the conceptual level, ARTPLAN shows the LOS for each roadway segment and for the facility as a whole, based on bus frequency weighted by the distance of the segment lengths. At the generalized level, a simple average, with no weighting by distance, is acceptable. For example, if on a 3-mile facility, 4 buses serve the first 2 miles and 2 buses serve the last mile, then using a value of 3 buses [(4+2)/2] is acceptable for a generalized level analysis, while a value of 3.3 buses [(4*2+2*1)/3] should be used for a conceptual planning analysis.

3 INPUT VARIABLES

Florida's Generalized Level of Service Volume Tables and the conceptual planning software that produces them are based on the 2000 edition of the Highway Capacity Manual (HCM2000), Transit Capacity and Quality Service Manual (TCQSM), Pedestrian LOS Model, Bicycle LOS Model, and Florida roadway, traffic, and control (signalization) data. The resulting tables and programs are valid in Florida, and their use for general and conceptual planning and preliminary engineering applications is encouraged by FDOT. Since it is recognized that traffic characteristics vary within Florida and that roadway, traffic, and control characteristics vary by road, the Generalized Tables are not adequate for all analysis needs. Therefore, to either recognize these variations or to analyze specific roadways, a description of input variables needed to use the LOS software is provided in this chapter.

Generalized Tables frequently are not sufficient to analyze specific roadways.

Each variable is defined and discussed in this chapter. Depending upon the roadway and mode being analyzed, the variables may or may not be applicable. Input requirements needed to use the various computational tools are provided in Table 3-1.

3.1 INPUT VARIABLE TYPES

Quality/level of service analyses are based on three types of characteristics: roadway, traffic, and control (signalization).

General roadway variables

Roadway variables include:

- Area type
- Number of through lanes
- Roadway class
- Posted speed
- Free flow speed
- Length
- Interchange spacing
- Median type
- Left turn lanes
- Terrain
- Percent no passing zone
- Passing lanes

Unique bicycle/pedestrian/bus roadway variables

Roadway variables specifically related to bicycle, pedestrian and bus considerations include:

- Paved shoulder/bicycle lane
- Outside lane width
- Pavement condition
- Sidewalk
- Sidewalk/roadway separation
- Sidewalk/roadway protective barrier
- Obstacle to bus stop

Input requirements

Table 3 – 1
INPUT REQUIREMENTS

	Input Variable	Generalized Tables	ART PLAN	FREE PLAN	HIGHPLAN 2-Lane	HIGHPLAN Multilane
ROADWAY	Area Type	R	F	F	F	F
	Number of Through Lanes	R	S	S	F	F
	Roadway Class	R	F	F	-	F
	Posted Speed	D	S	S	F	F
	Free Flow Speed	D	S	S	F	F
	Length	D	S	S	F	F
	Interchange Spacing	R	-	F	-	-
	Median Type	D	F	-	F	-
	Left Turn Lanes	D	F	-	F	F
	Terrain	D	D	S	F	F
	Percent No Passing	D	-	-	-	F
	Percent Exclusive Passing Lanes	D	-	-	-	F
	Paved Shoulder/Bicycle Lane	R	F	-	-	-
	Outside Lane Width	D	F	-	-	-
	Pavement Condition	D	F	-	-	-
	Sidewalk	R	F	-	-	-
	Sidewalk/Roadway Separation	D	F	-	-	-
	Sidewalk/Roadway Protective Barrier	D	F	-	-	-
	Obstacle to Bus Stop	D	F	-	-	-
TRAFFIC	Annual Average Daily Traffic (AADT)	R	S	S	F	F
	Planning Analysis Hour Factor, K	D	F	F	F	F
	Directional Distribution Factor, D	D	F	F	F	F
	Peak Hour Factor, PHF	D	F	F	F	F
	Base Saturation Flow Rate/Capacity	D	F	F	F	F
	Percent Heavy Vehicles	D	F	S	F	F
	Local Adjustment Factor	D	F	F	F	F
	Percent Turns from Exclusive Turn Lanes	D	S	-	-	-
	Bus Frequency	R	F	-	-	-
	Bus Span of Service	D	F	-	-	-
CONTROL	Signalized Intersection Spacing	R	F	-	-	-
	Arrival Type	D	S	-	-	-
	Signal Type	D	F	-	-	-
	Cycle Length, C	D	S	-	-	-
	Effective Green Ratio, g/C	D*	S	-	-	-

LEGEND

R	**R**equired table input	**S**	**S**egment/point specific
D	**D**efault cannot be altered	**-**	Not applicable
F	**F**acility specific	*****	Weighted g/C ratio

Traffic variables

Traffic variables include:

- Annual average daily traffic (AADT)
- Planning analysis hour factor (K)
- Directional distribution factor (D)
- Peak hour factor (PHF)
- Base saturation flow rate/capacity
- Percent heavy vehicles
- Local adjustment factor
- Percent turns from exclusive turn lanes
- Bus frequency
- Bus span of service

Control (signalization) variables

Control variables include:

- Signalized intersection spacing
- Arrival type
- Signal type
- Cycle length I
- Effective green ratio (g/C)

3.2 RELATIVE IMPORTANCE OF INPUT VARIABLE

The effects that individual variables have on the computational process vary. Table 3-2 indicates the sensitivity of the variables.

Most Important Variables

Ten variables have a significant impact on calculated volumes in an LOS analysis along an urban arterial. At a minimum, these variables should be evaluated and appropriate changes made for a conceptual planning (ARTPLAN) analysis. These variables are:

Variables for which default values should not be used in a conceptual planning level analysis

- Number of through lanes
- Left turn lanes
- Paved shoulder/bicycle lane/outside lane width
- Sidewalk
- Average annual daily traffic (AADT)
- Planning analysis hour factor (K)
- Directional distribution factor (D)
- Bus frequency
- Signalized intersection spacing
- Effective green ratio (g/C)

The first three variables are applicable to all roadway and modal analyses. The others are more modal specific. Of the ten variables, it is likely that only the K, D and g/C will require more field data than just a drive through survey of the facility. In addition, serious consideration should be given to calculating the percent turns from exclusive lanes at one or two key intersections in conjunction with collecting the K and D data. As discussed in Section 3.5, the K and D calculation procedures (also percent turns from exclusive lanes if desired) should be calculated based on 3-day field counts (i.e., a 72-hour consecutive count taken within the time frame of Monday afternoon through Friday morning) in urbanized, transitioning and urban areas. Calculations for rural areas should be based on 7-day counts. Collection of g/C data is discussed in Section 3.6.

Sensitivity of variables

Table 3 – 2

SENSITIVITY OF VARIABLES ON SERVICE VOLUMES

	Roadway/Traffic/Control Variables	Sensitivity on Service Volumes
ROADWAY	Number of through lanes	high
	Left turn lanes/medians	high
	Paved shoulder/bicycle lane/outside lane width	high
	Existence of sidewalk	high
	Roadway class	medium
	Posted/free flow speed	medium
	Sidewalk/roadway separation	medium
	Roadway protective barrier	medium
	Length	low
	Terrain/no passing zone/passing lanes	low
	Pavement condition	low
	Obstacle to bus stop	low
TRAFFIC	Planning analysis hour factor (K)	high
	Directional distribution factor (D)	high
	Percent turns from exclusive turn lanes	high
	Bus frequency	high
	Saturation flow rate/capacity/percent heavy vehicles/local adjustment factor	medium
	Peak hour factor (PHF)	low
	Bus span of service	low
CONTROL	Signalized intersection spacing	high
	Effective green ratio (g/C)	high
	Arrival type	medium
	Cycle length (C)	medium
	Signal type	low

Refine all the important variables when moving from a generalized to a conceptual analysis.

In general, analysts should not selectively choose from these variables when moving from a generalized planning analysis to a conceptual planning analysis. For example, it is usually inappropriate to use only refined K and D factors to a roadway without also addressing the other important variables. The level of precision should stay relatively constant across these variables. By applying only one or two of these variables, a level of LOS accuracy is implied, but probably not appropriate, given the lack in precision of the other variables. Furthermore, the default values in the Generalized Tables are representative of statewide averages and one or more variables can be selectively chosen to help improve a desired outcome while ignoring the other factors.

Be sensitive to falsely implied precision.

Avoid mixing generalized and conceptual evaluation techniques.

Similarly FDOT does not regard the mixing of different evaluation techniques as an acceptable practice. For example, if ARTPLAN is being used in a local government comprehensive plan, it should generally be used for all arterials and the Generalized Tables should not be used except as an initial low cost screening tool to determine if roadways may be operating at or below LOS standards.

Multimodal preliminary engineering studies, at a minimum, must use the prescribed ten variables, and typically will use most of the traffic, roadway, and signalization variables.

3.3 FIELD DATA COLLECTION

When developing values for the variables, the following should be taken into account:

Current/same time period

- All acquired data used to develop factors should be current and from the same time period. Data collected previously should be approved by the responsible agency prior to its use.

15-minute intervals

- Traffic count data should be obtained at 15-minute intervals when estimating K and D.

3-day minimum count

- 3-day counts (i.e., a 72-hour consecutive count taken within the time frame of Monday afternoon through Friday morning) in urbanized areas and 7-day counts elsewhere should be collected for deriving the estimated K, D and PHF. Exceptions, resulting in a different number of counts or time periods, may be based on unique generators, such as shopping centers or recreation traffic. Exceptions should be approved by FDOT district planning offices.

K, D and PHF considerations.

- If a continuous count station is directly applicable to a roadway, the K, D and PHF data should be used instead of the 3-day count data. Under heavily congested conditions, traffic will back up on the roadway affecting this data. The determination of K, D and PHF should be under demand conditions and if those conditions are not met, consideration should be given to altering these factors. Minimum and maximum acceptable values for these factors are presented in Section 3.5.

Count locations

- When possible, traffic counters should be placed at "mid-block" locations and away from the influence of driveways or side streets. If data on turning movements is desired, additional counters should be placed appropriately. Note that the percentage of turns from exclusive turn lanes is taken from the factored (K, D, PHF) mid-block segment. Counts should be collected in both directions.

Segment length

- The length of an arterial being analyzed, which may comprise several segments, should be at least 1 mile in downtown areas and at least 2 miles in other areas. In general, arterial length should be increased rather than decreased, if there is any uncertainty. To obtain a reasonable sample of average conditions, at least one count station should be used for each facility. Major intersections are the components normally used in defining facility length. If the single station does not obtain a representative sample of traffic, more stations should be included.

Seasonal data

- If significant changes in trip characteristics, such as volumes, take place during peak and off peak seasons, it is preferable to obtain traffic data during both of these seasons. By obtaining this data, a more valid judgment about traffic variables can be made. Seasonal adjustment factors are available from FDOT district offices.

Axle adjustments

- A need for axle adjustments may also exist. See FDOT's "Project Traffic Forecasting Procedure" (Topic 525-030-120-g) and the "Project Traffic Forecasting Handbook" for more information.

Travel time studies for LOS planning applications are not recommended.

FDOT does not recommend the use of travel time studies for LOS planning applications. Travel time studies have the advantage of being real world data; however, their use in assigning LOS for a facility is limited for three major reasons: (1) cost and variability of results, (2) application to a specific time period, and (3) use for future year analyses. Variability from run to run usually dictates large sample sizes. For example, a 1-mile facility may require 40 runs to achieve a 2 mph confidence bound above or below the actual average travel speed. A plus or minus 1 mph confidence bound would require considerably more runs and expense. Most of the analyses in this Handbook are based on the demand traffic for the 100^{th} highest traffic hour of the year, and there is no easy way to replicate that hour without an exorbitant number of runs. Even with good travel time studies, there is no agreed upon approach using the HCM2000 as a base to project speeds into the future. Although FDOT is not recommending travel time studies at this time, they can be used if the District FDOT and all agencies required to use the results of the studies agreed on the methodology, the limitations and uses of the results.

Data Collection Sheet

Analysts may find the following data collection sheet useful.

Arterial Data Collection Sheet

1. Arterial Name:										
2. Direction:										
3. Study Period:										
4. Area Type:										
5. Class:										
6. Segment	1	2	3	4	5	6	7	8	9	10
7. From:										
8. To:										
9. Length:										
10. Lanes:										
11. Posted Speed:										
12. Left Turn Lanes:										
13. AADT:										
14. K*										
15. D*										
16. g/C:										
17. % Sidewalk:										
18. Paved Shoulder/ Bicycle Lane/Outside Lane Width:										
19. Buses/Hour:										
20. Other**										

* Determine at a facility level, not at segment level.

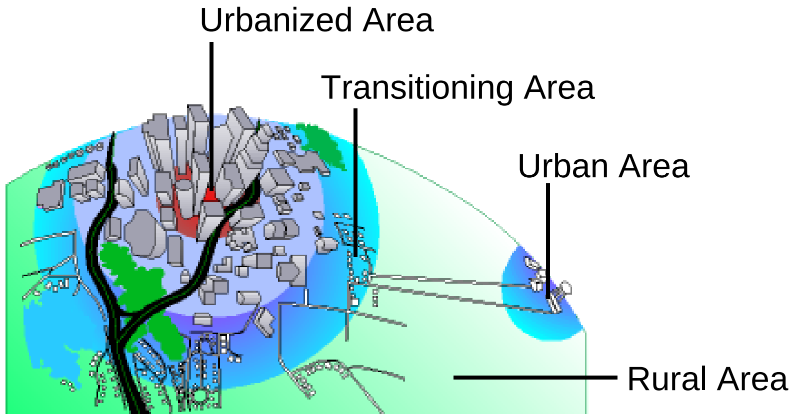
** Generally, defaults are recommended for other input values in the Q/LOS Handbook. Collection of data (e.g., percent turns from exclusive turn lanes at selected intersections) may be appropriate for an individual facility.

3.4 ROADWAY VARIABLES

The LOS analyses concentrate on through movements. Concentrating on through movements and making some simplifying assumptions can overcome much of the complexity of LOS analysis, especially along arterials.

Area Type

Three broad area type groups are used in this Handbook and accompanying software:



- Urbanized areas;
- Transitioning/Urban areas (transitioning into urbanized areas or areas over 5,000 population not in urbanized areas); and
- Rural areas (rural undeveloped areas and cities or developed areas less than 5,000 population).

The area types in the Generalized Tables and software match well with FDOT's LOS standards; however, a few points are noteworthy.

Urbanized areas

Urbanized areas are defined by the Federal Highway Administration (FHWA) approved boundary, which encompasses the entire Census Urbanized Area, as well as a surrounding geographic area as agreed upon by FDOT, FHWA and the Metropolitan Planning Organization (MPO). The minimum population for an urbanized area is 50,000.

For use in the Generalized Tables and software, all urbanized areas are included, regardless of size. However, some of the roadway groupings are distinguished by whether an urbanized area is over or less than 750,000 population. Currently, the over 750,000 groupings only apply to the Ft. Lauderdale, Miami, Jacksonville, Tampa, Orlando, West Palm Beach and St. Petersburg urbanized areas.

Transitioning/Urban areas

Transitioning/urban areas actually consist of two distinct areas: 1) areas that are adjacent to urbanized areas and anticipated to become parts of urbanized areas, and 2) areas of over 5,000 population not in urbanized areas. However, because their traffic characteristics are similar, they are treated under one grouping. Transitioning areas are outside of, but contiguous to, urbanized areas with which they are expected to be included within the next 20 years.

Transitioning areas are always adjacent to urbanized areas.

They are not smaller cities expected to become distinct urbanized areas in future years.

Transitioning areas are defined as those areas within MPO-designated planning boundaries, but outside FHWA urbanized boundaries. As used here, transitioning areas are only found adjacent to urbanized areas and are not isolated small cities that are expected to meet urbanized area thresholds in the future. Transitioning areas are "fringe" areas that exhibit characteristics between rural and urbanized characteristics. These boundaries are established through the transportation planning process of MPOs. Over time, these boundaries may change as MPOs update their plans. FDOT's MPO Administration Manual (Topic #525-010-025a) contains additional guidance and is currently being updated.

Be sure to note the difference between urbanized and urban area types.

Boundaries for cities over 5,000 population and not in urbanized areas are primarily set by existing city limits and must be agreed upon by FDOT, the local government and FHWA. However, the 5,000 population threshold is primarily a surrogate for areas that exhibit urban traffic characteristics. In situations where a city has less than 5,000 population (e.g., 3,000), but the surrounding area has more than 5,000 population (e.g., 10,000), and the city has an urban character, then it is reasonable to use the over 5,000 population classification in the Generalized Tables and "urban" (Transitioning/Urban) classification in the software.

Other situations exist where an area has over 5,000 population (e.g., 10,000) and yet, the area is more characteristic of a "rural developed area." In this situation, it is reasonable to use the developed area less than 5,000 population sections of Generalized Tables 4-3, 4-6, and 4-9, and the "rural developed" classification in the software. In both of these situations, FDOT district planning offices, after consultation with the central office, should make a determination as to the appropriate table to use. FDOT's MPO Administration Manual (Topic #525-010-025-a) contains additional guidance.

Rural areas

The “Rural” designation actually consist of two types of areas: “rural undeveloped” and “rural developed” with small populations. Generally, the cities or developed areas portion of the Generalized Tables should be applied to non-urban areas with a population of at least 500. This portion of the table also should be generally applied to non-urban coastal roads.

NOTE: the “rural undeveloped area” in Tables 4-3, 4-6, and 4-9 corresponds to the “rural area” in the LOS standards (Table 6-1). The “cities or developed areas less than 5,000 population” portion of Tables 4-3, 4-6, and 4-9 corresponds to different LOS standards under the “communities” category in Table 6-1.

As Florida’s population grows, area types may change for a specific location or roadway in future years. FDOT’s district offices should be consulted if analysts believe different area types are appropriate for a future study period.

Number of Through Lanes

In general, the total number of through lanes in both directions are used to describe roadways. However, this Handbook bases analyses upon a single direction, as is a traffic engineering evaluation. As an example, a LOS analysis for a 6-lane freeway is based upon 3 lanes, using the higher directional traffic volume. Similarly, a LOS analysis for a 4-lane arterial, then would be based upon 2 lanes. When using FDOT’s software, the sum of the directional number of through lanes should be entered to describe the roadway facility. When calculating LOS, the software will automatically take one-half of the total number of through lanes, unless overridden by the analyst.

Arterials

For arterials, the number of through lanes is calculated at intersections, not mid-block.

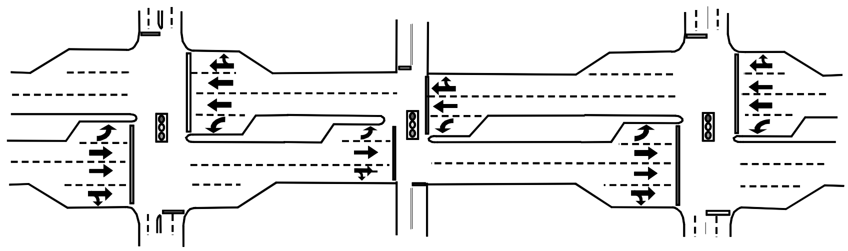
An important aspect of this Handbook is the methodology for determining an arterial’s “number of through lanes”. Since the ultimate result of the LOS analysis is a facility estimation of LOS, and it is widely recognized that signalized intersections are the arterial’s primary capacity constraint, it is appropriate to place more emphasis on the intersections’ characteristics than mid-block characteristics. Generally, most mid-block segments have capacities far exceeding those of major intersections and it is rare for significant delays to occur mid-block. By weighting the effects of intersections more heavily, a more accurate aggregate estimation is possible.

Generalized planning

When using the Generalized Tables, the number of through lanes on a facility is typically determined by the through and shared through/right lanes at major intersections rather than mid-block.

In the illustration below, the mid-block segments have 4 lanes, with 2 lanes in each direction. The major intersections each have 6 lanes, with 2 through and 1 shared through/right add/drop lane with tapers adequate for safe merging. In this illustration, as in many cases, minor signalized intersections have green times so heavily weighted to the arterial that they do not cause significant delays to through traffic. When this is the case, it is *sometimes* acceptable to disregard the number of lanes at these minor intersections; instead, the determination should be based on the lanes at major intersections. So in terms of LOS, this particular facility has 6 lanes.

For generalized planning this road should be considered as 6-laned due to expanded major intersections.



Through lanes accommodate the greatest traffic movement.

Typically, lanes that go straight ahead are considered the through lanes; however, occasionally more vehicles turn in a certain direction than go straight ahead. Under those circumstances, the lanes accommodating the turning movement should be considered the "through" lanes. As an example, if 50 percent of the vehicles are turning left, 25 percent are going straight ahead, and 25 percent are turning right, then the lanes accommodating the left turning movement should be considered the through lanes.

Conceptual planning

Analysis of add/drop lanes (expanded intersections)

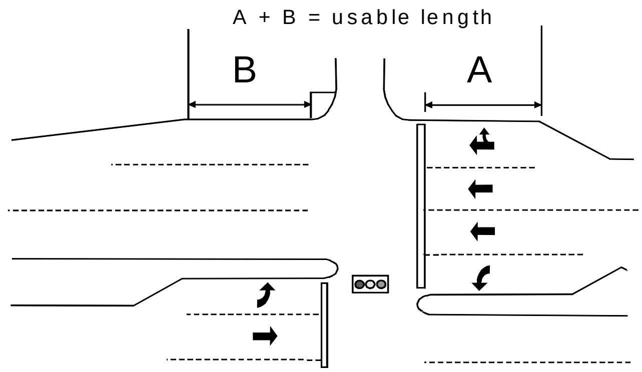
At a conceptual planning level, it is appropriate to evaluate in more detail the effects of add/drop lanes. When lanes that carry through traffic are added before the intersection and dropped after the intersection, the add/drop lane, or expanded intersection, will contribute to intersection capacity, but probably not to the extent of a full through lane.

Caution in application of add/drop lanes

Site-specific characteristics (e.g., intensity and type of land use, driver behavior, speed, etc.) can dramatically affect the viability of add/drop pairs as through lanes; therefore, each application should be examined on a case-by-case manner. Analysts are strongly cautioned to review all pertinent characteristics prior to adjusting the number of through lanes used. The reviews should be conducted during peak travel conditions. Analysts are encouraged to consult with FDOT district personnel prior to application of this concept. The following guidelines are offered as a capacity estimating tool only. This process should never be used for the design or redesign of an expanded intersection.

Add/drop lanes

- If the add/drop pair is less than one-third mile (1760 feet) then no additional capacity is assumed.
- If the add/drop pair is at least one-third mile (1760 feet – roughly divided equally between approach and departure and exclusive of tapers and cross-street width, i.e., A + B in the accompanying diagram), it may be reasonable to consider an additional one-half lane for capacity purposes. For example, in the accompanying diagram if A = 1000’ and B = 1000’, then it would be reasonable to consider that the intersection approach has 2.5 effective through lanes.



Uninterrupted flow facilities

For uninterrupted flow facilities the number of lanes is calculated “mid-block”.

For uninterrupted flow facilities, the number of lanes is the basic segment or mid-block laneage, which is a different approach than is used for arterials. Thus, for example, a 4-lane highway, which is widened to 6 lanes at major intersections, should be considered a 4-lane highway

Freeway auxiliary lanes

An auxiliary lane on a freeway connects an on ramp to the next downstream off ramp and is less than 3000 feet from gore to gore (1500 feet being the influence area of both the on ramp and the off ramp). For planning purposes, if a lane extends more than 3000 feet from an on ramp to an off ramp (i.e., gore to gore), then it is acceptable to consider the full length, including the ramp influence area, as having an additional through lane. For planning purposes, when a through lane is added to or dropped from, a freeway, the lane is assumed to extend from or terminate at the gore.

Roadway Class

Roadway class is a categorization of arterials, freeways, and two-lane highways involving signalized intersection/interchange spacing, free flow speed, and location.

Arterials

General characteristics of arterial classes are:

Class I – Arterials in non-rural areas with speed limits of at least 45 mph and a signal density of less than 2 signals per mile, or arterials in rural developed areas.
Class II – Arterials with speed limits of 35 to 45 mph and a signal density from 2 to 4.5 signals per mile.
Class III – Arterials with speed limits of 30 to 40 mph and a signal density of at least 4.5 signals per mile.
Class IV – Arterials in the downtowns of core cities in urbanized areas over 750,000.

Freeways

General characteristics of freeway classes in Florida are:

Class I – Freeways facilities with average interchange spacing of at least 6 miles, posted speeds of 70 mph, and located in rural areas.
Class II – Freeways facilities with average interchange spacing of 3 to 6 miles, posted speeds of 65 to 70 mph, and located at or near urban fringes.
Class III – Freeways facilities with average interchange spacing of 2 to 3 miles, posted speeds from 55 to 70 mph, and located in urbanized areas.
Class IV – Freeway facilities with average interchange spacing less than 2 miles, posted speeds of approximately 55 mph, and located in or near downtown areas.

Two-Lane Highways

Directly imbedded in the Generalized Tables and HIGHPLAN are 2 classes of two-lane highways.

Class III – Two-lane highways in developed areas in which percent of free flow speed is used as the service measure.
Class IV – Two-lane highways in rural undeveloped areas in which volume to capacity ratios from the HCM1997 are used as the service measure.

(Classes I and II are HCM2000 classifications that are not currently being used by FDOT.)

Posted Speed

Posted speed is the posted speed limit.

Free Flow Speed

Posted speed + 5 mph

Free flow speed is the average speed of vehicles not operating under the influence of speed reduction conditions. In general, free flow is the speed under low flow conditions and not influenced by control conditions, such as signalized intersections. The assumption used in this Handbook is that the free flow speed is 5 mph above the posted speed. As an example, if an arterial is posted 40 mph, the default free flow speed used in this Handbook and accompanying software is 45 mph; however, if a more accurate free flow speed is available, it should be used.

Roadway Lengths

In order to use the Generalized Tables or compute LOS using one of the conceptual planning models, it is necessary to determine facility lengths and, as appropriate, segment lengths. Note, that in previous editions of this Handbook, the term "section" was used instead of "facility". "Facility" is now being used to be consistent with nomenclature in the HCM2000.

Arterials

For an arterial facility analysis, the general recommendation is that the facility be at least 2 miles in length in order to use the service measure of average travel speed. Major intersecting arterials frequently serve as logical breaks in segmenting the arterial facility. In downtown areas, the general recommended length is at least 1 mile.

Freeways

For urbanized freeway facility analyses, the general recommendation is that the freeway facility length be between 3 and 8 miles in downtown areas, and between 5 and 12 miles elsewhere. For rural freeway analyses, the length is expected to be considerably longer. For example, I-75 across the Everglades extends for 87 miles.

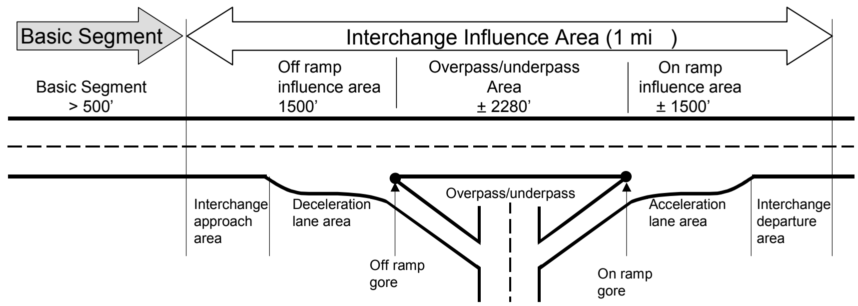
Freeway segments

Interchange influence areas

The planning and preliminary engineering analysis facility method makes use of two freeway segments: interchange influence areas and basic segments. As illustrated below, a typical interchange influence area is 1 mile in length and consists of an off ramp influence area 1500 feet long, an overpass/underpass area 2280 feet in length, and an on ramp influence area 1500 feet long. For most interchanges, this interchange influence area is approximately 1 mile in length centered on the midpoint of the crossing facility. The actual length of an interchange influence may vary from a typical 1-mile length, depending upon the type of interchange and ramp geometry.

Basic segments

Parts of freeways outside these interchange influence areas are basic freeway segments. Their lengths vary significantly based on interchange locations, but should be at least 500 feet in length.

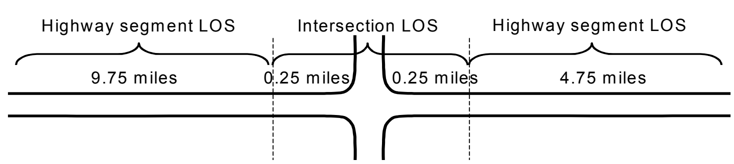


Two-lane and multilane highways

The analysis length of uninterrupted flow two-lane and multilane highway facilities varies considerably (e.g., 2 to 60 miles), and may or may not include interrupted flow conditions (e.g., signalized intersections, stop signs). Any given uninterrupted segment should be greater than 2 miles. Segments with spacings greater than 3 miles between interrupted flow conditions should be considered uninterrupted. Between 2- and 3-mile spacings, analysts have the discretion to group the segment into an uninterrupted facility or into an interrupted facility.

Isolated intersections

On many uninterrupted flow highways, there are isolated interrupted flow conditions. For a generalized planning analysis these isolated cases are already considered in the generalized tables. For a preliminary engineering analysis FDOT recommends breaking the facility into uninterrupted and interrupted flow segments. The interrupted flow intersection segments, "intersection influence areas," extend 0.5 miles in length centered on the midpoint of the crossing facility. The LOS for this influence area is determined by the intersection LOS. For example, if a two-lane highway facility extends 15 miles with an isolated intersection at the 10-mile point: (1) the LOS for the first 9.75 miles would be based on the two-lane highway segment LOS, (2) the 0.5 mile intersection influence area would be based on the LOS for that intersection, and (3) the last 4.75 miles would be based on the two-lane highway segment LOS.



Termini

This part of the Handbook provides guidelines on the development of facility lengths. The beginning and end of each facility is referred to as the termini. The factors considered in selecting the appropriate termini for a roadway facility relate to various analysis considerations. For example, the Generalized Tables are based on a particular number of lanes, so a change in the number of lanes on a roadway is usually a good terminus for a facility. Other logical termini may be signalized intersections or geographical barriers. Likewise, area boundaries, such as the urban, transitioning and rural designations, form desirable facility termini.

Summary of guidance on length and termini

No precise guidelines can be given on the proper termini or length of reasonable freeway and arterial facilities. However, the following general length for freeways and arterial facilities are suggested:

Freeways
- at least 3 miles in downtown areas
- at least 5 miles in other parts of urbanized areas
- at least 10 miles in rural areas

Arterials
- at least 1 mile in downtown areas
- at least 2 miles in other areas

Termini
- intersecting principal arterials or freeways
- from the urban(ized) boundary to the first intersecting principal arterial
- changes in the number of through lanes
- when traffic volumes vary significantly from one area to another, especially if the variation is associated with changes in adjacent land uses, signalization characteristics, or peak directions
- from city limit to city limit in cities under 5,000 population.

Median Type

As used in this document, medians may be classified in one of three ways:

- restrictive median (r),
- non-restrictive median (nr), and
- no median (n).

A restrictive median is a raised or grassed area at least 10 feet in width separating opposing mid-block traffic lanes and includes left turn lanes.

A non-restrictive median is a painted at-grade area at least 10 feet in width separating opposing mid-block traffic lanes, and for arterials, allows mid-block left-turning vehicles to exit from through lanes. Continuous two-way left turn lanes are considered as a non-restrictive median under this definition. Situations in which restrictive or non-restrictive medians are less than 10 feet wide are considered as having no median.

Median factor

Although a median factor does not exist in the HCM2000, FDOT included it to account for a lowering of mid-block average travel speeds when no median is present. From the aspect of getting left-turning vehicles out of the traffic stream, the difference between a restrictive and a non-restrictive median is relatively inconsequential. Thus, in determining automobile/truck LOS, restrictive and non-restrictive medians are treated the same.

Median consideration for determining pedestrian crossing difficulty in bus LOS analysis

From a pedestrian point of view, there is a significant difference between non-restrictive medians and restrictive medians. Restrictive medians give pedestrians a much safer mid-block crossing. Thus, this type of median is a consideration in determining the "pedestrian crossing" factor that enters the transit LOS analysis.

Pedestrian refuges

A pedestrian refuge is a raised or grassed area at least 5 feet but less than 10 feet in width, separating opposing mid-block traffic lanes, and allowing pedestrians to cross the roadway more safely and comfortably. From a pedestrian point of view, a pedestrian refuge has nearly the same benefit as a restrictive median. From the aspect of pedestrian crossing difficulty, the difference between a restrictive median and pedestrian refuge is relatively small; therefore, in determining "pedestrian crossing difficulty," the two may be treated the same. Pedestrian refuges are occasionally seen along beach roads or other roads where development is almost exclusively on one side of the road.

Because pedestrian refuges do not appear frequently in Florida, FDOT's LOS software does not include them as a distinct category. If an analyst wants to evaluate the effects of a pedestrian refuge, it should be treated as a restricted median for transit analysis, but as no median for automobile/truck analysis.

As presented above, the differentiation of median types becomes relevant as pedestrians cross roadways mid-block. Depending upon the application, FDOT's software provides different median options: restrictive I, non-restrictive (nr), and no median (n) in ARTPLAN; yes (y) and no (n) in HIGHPLAN.

Left Turn Lanes

Left turn lanes are storage areas designated to exclusively accommodate left turning vehicles. The length of these lanes must be able to accommodate turning demand such that left turn traffic (1) is able to enter the turn lanes behind through queues, or (2) can be stored in the turn lane to ensure the through lane traffic is not blocked. The HCM2000 offers guidelines on this subject. When left turn lanes are not present, a shared lane exists.

Use of Generalized Tables and ARTPLAN when analyzing arterials without left turn lanes is discouraged

The use of the Generalized Tables and ARTPLAN when analyzing arterials without left turn bays is discouraged in all but the most basic analyses. If used, the Generalized Tables have intuitive factors, which have been approved by the Level of Service Task Team but are not contained in the HCM2000, to adjust for the lack of left turn lanes. To account for the absence of left turns lanes, adjustment factors, found in the lower right corner of the tables, must be manually applied to the service volumes contained in the table. Likewise, if an ARTPLAN analysis is performed, the resulting service volume is internally reduced by the same factor. However, the user is cautioned that research indicates that the true value of the reduction is highly dependent on the distribution of traffic volumes among all the various movements, and a constant reduction factor, as used in the tables and ARTPLAN, is not accurate.

Exclusive right turn lanes

Exclusive right turn lanes are storage areas designated to accommodate only right turning vehicles. Other than the sheer volume of right turning vehicles, right turning vehicles generally do not significantly affect the operations of signalized intersections. Although no special provision is made for exclusive right turn lanes in FDOT's conceptual planning software (i.e., ARTPLAN), the LOS benefits of exclusive right turn lanes can be accounted for by increasing the traffic input variable "percent turns from exclusive turn lanes".

Terrain

Terrain is a general classification used for analyses in lieu of specific grades. Level terrain is a combination of horizontal and vertical alignments that permits heavy vehicles to maintain approximately the same speed as passenger cars, usually short grades of no more than 1 to 2 percent. Although level terrain may be assumed throughout most of Florida, the software allows the use of rolling terrain. Rolling terrain is a combination of horizontal and vertical alignments causing heavy vehicles to reduce their speed substantially below that of passenger cars, but not to operate at crawl speeds for a significant amount of time.

Percent No Passing Zone

Percent no passing zone refers to the percent of a two-lane, two-way highway where passing is prohibited in the analysis direction. The Generalized Tables assume 20 percent no passing for these roads in rural undeveloped areas.

Passing Lanes

Passing lanes improve the operation of two-lane highways, but do not affect their capacities.

Passing lanes generally result in higher percentages of no passing zones.

A passing lane is a lane added to improve passing opportunities in one direction of travel on a two-lane highway. Continuous two-way left turn lanes are not considered exclusive passing lanes.

Passing lanes do not affect the capacity of a two-lane highway because the capacity is constrained by the segments that do not have passing lanes. However, the operation of two-lane highways is improved with the addition of passing lanes. In the rural undeveloped portions of the Generalized Tables, the benefit of passing lanes is handled as an adjustment to the service volumes for LOS A through D and varies by the spacing of the lanes. When analyzing two-lane highways in rural undeveloped areas, HIGHPLAN alters the LOS v/c criteria by multiplying the original v/c criteria by the ratio of the percent time spent following without the passing lanes to the percent time spent following with the passing lanes. In developed areas, HIGHPLAN evaluates the benefit of passing lanes directly based on the percent of free flow speed. When analyzing the potential of passing lanes, analysts should routinely alter the percent no passing zone value as well, because passing lanes generally result in higher percentages of no passing zones.

Roadway variables specifically related to bicycle, pedestrian and bus considerations are presented below.

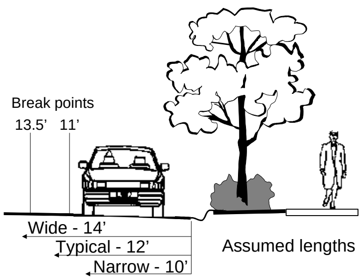
Paved Shoulder/Bicycle Lane

As used in this Handbook, a bicycle lane is a designated or undesignated (paved shoulder) portion of a roadway for bicycles adjacent to motorized vehicle lanes. Painted lines separate paved shoulders/bicycle lanes from motorized vehicle lanes.

The dimensions indicated below are for planning analyses and not for design purposes. A designated bicycle lane is usually 4 to 5 feet in width and has a bicycle logo and a directional arrow painted on it. An undesignated bicycle lane is usually 4 feet in width and does not contain a bicycle logo. To be considered a paved shoulder/bicycle lane, at least 3 feet of paved shoulder must exist outside the painted line. For facilities with striped shoulders between 1 and 3 feet, they should be considered to have wide outside lane widths. In ARTPLAN the assumed width of paved shoulders/bicycle lanes is 5 feet.

Outside Lane Width

As used in this Handbook, outside lane width is the width, in feet, of a roadway's outside motorized vehicle through lane. The lane width does not include the gutter. This factor is usually important in the determination of a roadway's bicycle LOS. The majority of the State Highway System lane widths are 12 feet. Many local roads and some state highways have 14 foot outside lanes; these are sometimes referred to as "wide curb lanes". Many other local roads and some state facilities have outside lane widths less than 12 feet.



The dimensions indicated below are for planning analyses and not for design purposes.

- Wide – greater than or equal to 13.5 feet, with 14 feet being the assumed value in ARTPLAN;
- Typical – greater than or equal to 11 feet and less than 13.5 feet, with 12 being the assumed value in ARTPLAN; and
- Narrow – less than 11 feet, with 10 feet being the assumed value in ARTPLAN.

To allow multimodal LOS alternatives analysis, ARTPLAN assumes that if the outside lane width is 12 feet or greater, the inside lane(s) is 12 feet; and if the outside lane is less than 12 feet the inside lane (s) is the same as the outside lane.

Pavement Condition

Used only for bicycle LOS analysis

Pavement condition relates to where bicyclists, not motorized vehicles, would ride.

Pavement condition is a general classification of the roadway surface where bicycling usually occurs, and is not necessarily that which drivers of motorized vehicles experience. This variable is used only for bicycle LOS analysis. Three general classifications are used: desirable, typical and undesirable. These general classifications are used in lieu of detailed pavement surface grades found in the operational model on which this planning technique is based.

Desirable pavement condition is new or recently resurfaced pavement. The pavement still maintains a dark black color, is free of cracks, and rides smoothly.

Typical pavement condition is the most common type of pavement condition of Florida's roadways. Generally, the pavement has a light gray color, the surface appears worn, and may have some cracks; however, the ride for the bicyclist and motorist is fairly smooth.

Undesirable pavement condition consists of pavement with noticeable cracks, broken pavement and/or ruts in it. There may be existing or partially filled potholes, or it may have drainage grates hazardous to bicycles. Alternatively, even though the roadway surface is typical or desirable, if the bicycle riding surface contains loose dirt/gravel or debris, then it would also be considered undesirable.

In general, FDOT recommends the use of a “typical” pavement condition for most analyses, especially those involving future years.

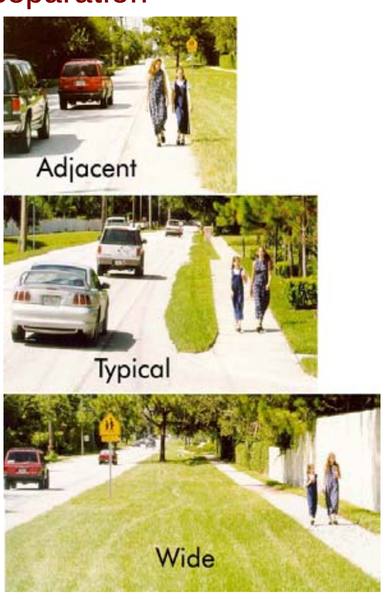
For analysts familiar with FHWA’s PAVECON factors, “desirable” would equate to a 4.5 or 5.0 rating; “typical” would equate to 3.0 to 4.0 ratings, and “undesirable” would equate to 2.5 or less. The ARTPLAN software assumes a 4.5 rating for desirable, 3.5 for typical, and 2.5 for undesirable.

Sidewalk

Sidewalks are paved walkways for pedestrians, not paved roadway shoulders.

As used in this Handbook, a sidewalk is a paved walkway for pedestrians at the side of a roadway. They are assumed to be 5 feet in width. Paved roadway shoulders are not considered sidewalks.

Sidewalk/Roadway Separation



Since LOS analyses are directional, the existence of a sidewalk is based on the directional side of the arterial being analyzed. Sidewalk/roadway separation is the lateral distance in feet from the outside edge of pavement to the inside edge of the sidewalk.

As used in this Handbook sidewalk/roadway separation is classified in three ways:

Adjacent – less than or equal to 3.0 feet,
Typical – greater than 3.0 feet and less than or equal to 8.0
Wide – greater than 8.0 feet.

In general, pedestrians tend to walk towards the outer half of sidewalks, away from traffic. ARTPLAN makes the assumption that pedestrians walk 4 feet from the inside edge of the sidewalk.

Based on the above sidewalk/roadway separation ranges, the assumed ARTPLAN separation distances for pedestrians walking on sidewalks (pedestrian/sidewalk/roadway separation) are:

Pedestrian/roadway separation distances

Pedestrian/Sidewalk/Roadway Separation Distances	Sidewalk/Roadway Separation Classification
6 feet	Adjacent
10 feet	Typical
15 feet	Wide

Frequently, in downtown situations, sidewalks extend at least 8 feet from the curb. In situations where there are no tree plantings or other sidewalk/roadway protective barrier, these sidewalks should be classified as “adjacent’. In situations where there are tree plantings, or some other barrier between where people walk and the outside edge of the travel lane, these sidewalks should be considered as having “typical” separation.

In situations where on-street parking and sidewalks both exist, the sidewalk/roadway separation should be considered “wide,” regardless of how close the sidewalk is to the edge of pavement. Essentially, on-street parking adds approximately 8 additional feet between pedestrians and motorized vehicles.

Sidewalk/Roadway Protective Barrier

In many urban situations, there are physical barriers separating motorized vehicles and pedestrians. Primary examples include planted trees and on-street parking. In the Pedestrian LOS Model, from which this planning application is based, each of these barriers has a separate impact on pedestrian LOS; however, as used in this Handbook, these barriers are consolidated into one overall protective barrier factor. In ARTPLAN, the analyst simply states whether the barrier exists or not. ARTPLAN assumes that these barriers have the equivalent of a 1.5-fold impact on sidewalk/roadway separation. For example, if a row of trees exists along a roadway in which the sidewalk/roadway separation is typical (sidewalk distance from the outside edge of pavement is 6 feet), then the effect of the trees is the equivalent separation distance of 9 feet from the edge of the outside lane.

Obstacle to Bus Stop

An obstacle to bus stop refers to a situation where there is a physical barrier such as a swale, fence or guard rail between the sidewalk and the bus stop (i.e., boarding area). This is a factor

related to transit LOS, not pedestrian LOS. The presence of a sidewalk and pedestrian level of service does not indicate the existence of a physical obstacle between a bus stop and a sidewalk. The explicit inclusion of this obstacle to the bus stop addresses directly the ease of pedestrian access to transit. If an obstacle exists, a multiplicative factor of 0.90 is applied in FDOT's ARTPLAN program.

3.5 TRAFFIC VARIABLES

Volume and Annual Average Daily Traffic (AADT)

Traffic volume is the most basic of all traffic parameters and is generally defined as the number of vehicles passing a point on a highway during a specified time period. Traffic volumes typically are developed separately from, and provided for, Q/LOS analyses.

Traffic volume and traffic demand

Volume is the parameter most often used to quantify traffic demand; however, the relationship between traffic demand and traffic volume is not a simple one. Traffic demand is the number of vehicles that desire to traverse a particular highway during a specified time period. While traffic demand expresses a desire, traffic volume represents actual measurement.

Traffic studies result in the observation and measurement of conditions as they presently exist. Current observations neither indicate what will be in the future, nor do they reflect constraints in the existing highway system that may prevent vehicles from accessing a desired segment of the system at any given point in time. Thus, even current volumes may not accurately reflect current demand where such constraints exist. Observed volumes on congested facilities are more a reflection of capacity constraints than of true demand. The impact of bottlenecks, alternative routes, latent travel demand, and future growth further complicate the relationship between traffic volume and traffic demand.

Demand versus measured volumes

For convenience, the Generalized Tables are presented in terms of “volumes”; however, they more accurately reflect “demand”. As used in this Handbook, “volume” generally represents “demand”. Because of the complexities of determining traffic demand, “measured volumes” are used to approximate demand; however, if a question arises as to the appropriateness of using “measured volumes” or “demand volumes,” it is clear “demand volumes” are to be used.

Annual Average Daily Traffic (AADT)

Annual average daily traffic (AADT) is the total volume on a highway segment for one year divided by the number of days in the year. Planning applications usually work with daily volumes and FDOT routinely provides AADT values for state roads.

AADT relationship to average daily traffic (ADT)

AADT values are easy to confuse with two other traffic count numbers that are used to estimate AADT. The average daily traffic (ADT) is the total traffic volume during a given time period, more than a day and less than a year, divided by the number of days in that time period. ADT is generated from a short-term traffic count and can be used to estimate AADT. Ensuring that ADT counts are reflective of the normal average traffic is an important consideration when using them to estimate the annual traffic (AADT) on the roadways. Traffic taken during a 4-day holiday, long weekend, or Saturday night when 50,000 to 70,000 football fans gather is not a normal occurrence.

Peak Season Weekday Average Daily Traffic (PSWADT)

Peak Season Weekday Average Daily Traffic (PSWADT) numbers are normally generated by travel demand forecasting planning models, such as FSUTMS. Like ADT, they can be converted to AADT by an adjustment factor.

FDOT monitoring programs

FDOT operates two types of traffic monitoring programs: (1) continuous monitoring at selected locations using permanently installed equipment, and (2) coverage counts at many temporary sites using portable equipment. Permanent counters that continuously monitor traffic are referred to as telemetry traffic monitoring sites (TTMS), and are sometimes called permanent traffic recorders (PTR). They are permanently placed at specific locations throughout the state to record the distribution and variation of traffic flow by hour of the day, day of the week, and month of the year, from year to year. Coverage counters at temporary sites are called portable traffic monitoring site (PTMS) counters. Short duration traffic surveys, usually 24-48 hours, are collected using portable equipment at 5,000 – 6,000 locations, from one to four times a year. These PTMS surveys are used to provide the volume estimates for each segment of highway on the State Highway System.

Traffic adjustment factors

Axle corrections and seasonal adjustment

Two count adjustment factors are used to calculate AADT. The first, axle correction factors, are used to compensate for an axle counter’s tendency to count more vehicles than are actually present. An axle counter, for example, would show a count of two when a 4-axle truck runs over the sensor, even though only one vehicle is present. The second, seasonal adjustment factors, have been developed to adjust for the variation in traffic over the course of a year. The peak season is the 13 consecutive weeks with the highest volumes. The weekly seasonal factors for those weeks will be the lowest and the factors will be the highest for the weeks with the lowest volumes. The seasonal factor is used as follows: AADT = short term vehicle count * seasonal factor.

When developing service volume tables, AADT is not needed as an input.

As noted above, AADT is a basic traffic parameter for determining the level of service for motorized vehicles along a roadway. However, a frequent application is to determine what is the maximum AADT for a given level of service. When this is the desired outcome, AADT becomes the output shown in service volume tables, instead of an input variable. When using the software to generate a service volume table, the AADT on the facility data screen may be ignored and the initial default value need not be altered.

Planning Analysis Hour Factor (K)

The Planning Analysis Hour Factor, or K Factor, is the ratio of the traffic volume in the study hour to the annual average daily traffic (AADT). There are numerous potential study hours and K factors depending upon the applications. Frequently used K factors include the 30th highest volume hour of the year (K_{30}), 100th highest volume hour of the year (K_{100}), highest hourly volume to daily volume ($K_{p/d}$), 5-6 p.m. weekday volume to AADT ($K_{5\text{-}6pm}$), average p.m. weekday peak volume to AADT (K_{pm}), average a.m. peak weekday volume to AADT (K_{am}), and noon weekday volume to AADT (K_{noon}). In general, K factors are used for peak hour traffic analyses, but analyses can also be based on low volume conditions, such as the analysis of truck travel in early morning hours. Roadway, traffic and control conditions vary considerably during the day, potentially affecting capacity values and service volume thresholds. A few of the most commonly used K factors are briefly discussed below.

K_{100} is Florida's primary planning analysis hour factor.

For planning purposes, the primary planning analysis hour factor used in Florida is the K_{100}, which is the ratio for the 100th highest traffic volume hour of the year to the AADT. The 100th highest traffic hour of the year is used in FDOT's LOS rule (see Section 6.1) and is the hour that the daily Generalized Tables are based. Unless otherwise noted, all references in this Handbook to an hour or K factor are the 100th highest hour or K_{100}. The accompanying software are valid for use for any hour of analysis.

In developed areas, the 100th highest volume hour of the year is representative of a typical weekday peak traffic hour during the peak travel season. In Florida's developed areas, the peak hour usually occurs in the late afternoon for most state roads. Thus, in developed areas of the state, the 100th highest hour of the year is representative of the typical "rush" hour during the peak traffic season.

The K_{100} factor is used to convert a peak hour volume to an AADT and vice-versa. The K_{100} factors used in the Generalized Tables (see Table 3-3) were obtained from unconstrained, continuous count stations throughout the state. Actual 100th highest hourly volumes and AADTs were used to determine the K_{100}s.

Table 3 – 3
STATEWIDE AVERAGE K_{100}S

	Urbanized	Transitioning/ Urban	Rural Developed	Rural Undeveloped
Freeways	9.3 & 9.7%*	10.0%	10.4%	10.4%
Highways	9.5%	9.6%	9.7%	9.8%
Arterials	9.5%	9.6%	9.7%	N.A.

**9.3% applies to Class IV freeways and 9.7% applies to other freeways.*

As volume increases, the peak period becomes longer, thus decreasing the K factor.

The K factor generally drops as an area becomes more urbanized and high traffic volumes are spread out over longer time periods. If adequate documentation is provided, FDOT would consider somewhat lower K factor values for urbanized areas than appear in the Generalized Tables.

K_{100} is not a peak to daily ratio.

The K_{100} factor is not a peak to daily ratio. A peak to daily ratio is usually determined by obtaining hourly traffic counts for a day and dividing by the measured daily volume. In the Florida professional community, peak to daily ratios are frequently used as K factors. In most cases, especially in urbanized areas, peak to daily ratios are lower than K factors. Whereas, a K factor relates to the whole year, a one-day peak to daily ratio only accounts for traffic variability in one day. Traffic volumes derived from FSUTMS or other UTPS type travel demand forecasting models are in terms of peak season weekday average daily traffic (PSWADT).

Calculating K_{100}

For a conceptual planning analysis, FDOT recommends calculating roadway specific K_{100} factors based on 3-day counts (i.e., a 72-hour consecutive count taken within the time frame of Monday afternoon through Friday morning) in urbanized, transitioning and urban areas, and 7-day counts in rural areas. The approach makes use of FDOT's seasonal factors for weekday traffic counts and peak to daily ratios. The first step is to obtain appropriate seasonal factors (SF) for the project or area for the most recent three years. This data is available from the FDOT district planning offices. The seasonal factor may be for the county, a nearby count station or from some other source.

Step 1: Determine the average seasonal factor (SF_{avg}) for the 13 highest consecutive weeks of the year. FDOT's Peak Season Factor Report includes this value, also known as the Model Output Conversion Factor or MOCF. This procedure should be done for each of the three most recent years. Take the average of those three average values. For example, the value may be 0.90 in 1998, 0.89 in 1999 and 0.88 in 2000 and the resultant 3-year average SF_{avg} would be 0.89.

Step 2: Determine the average peak to daily ratio (peak hour volume ÷ daily volume) for the 72-hour count as illustrated below:

Measured Day	Peak Hour	Daily Volume	Peak Hour Volume	Peak to Daily Ratio
1/22	4-5 PM	21,000	1700	0.081
1/23	5-6 PM	22,000	1800	0.082
1/24	5-6 PM	22,000	1900	0.086
Averages	NA	21,667	NA	0.083

Step 3: The estimated K_{100} is then the average peak to daily ratio divided by the average adjusted seasonal factor. Using the example shown above:

Step 1: 3-year average of SF_{adj} = 0.89;
Step 2: average peak to daily ratio = 0.083
Step 3: calculated K_{100} = 0.083 / 0.89= 0.093.

Limitation of calculated K_{100} use – minimum acceptable K_{100}

It should be noted that the K_{100} calculation process described above makes use of measured traffic volumes, not necessarily more appropriate demand traffic volumes. The estimated demand traffic K_{100} should be used rather than the measured K_{100}. The minimum K_{100} values FDOT will accept are presented in Table 3-4. If the estimation process above yields a number lower than in Table 3-4, the roadway(s) probably exhibits capacity constraints and is currently not accommodating demand traffic volumes. Under this situation, FDOT may accept values as low as, but not lower than, those in Table 3-4.

Table 3 – 4

MINIMUM ACCEPTABLE K_{100}s

	Urbanized	Transitioning/ Urban	Rural Developed	Rural Undeveloped
Freeways	8.5%	9.0%	9.0%	9.0%
Multilane Highways	9.0%	9.0%	9.0%	9.0%
Two-Lane Highways	9.0%	9.0%	9.0%	9.0%
Arterials	9.0%	9.0%	9.0%	N.A.

Other K factors

K_{30} is frequently used in design.

$K_{5\text{-}6PM}$ is frequently used in reporting mobility.

K_{30} is used by FDOT for design purposes. It is the proportion of the AADT occurring during the 30th highest hour of the design year and is commonly known as the Design Hour Factor.

The greatest amount of total highway (automobile, bicycle, bus, pedestrian, and truck) trips occur between 5 and 6 p.m. While that hour is not necessarily the highest hour for each of those modes, collectively it is the highest. $K_{5\text{-}6pm}$ for weekdays is useful to assess the state's travel and capacity under peak conditions. FDOT's statewide reporting of mobility performance measures to the Legislature and others is based on that time period.

Directional Distribution Factor (D)

The D, or Directional Distribution Factor, is used in converting AADT to directional peak traffic. The peak hour D factor is the proportion of an hour's total volume occurring in the higher volume direction.

The statewide recommended default D factor is 0.55. The D factor was remarkably consistent across different roadway types and periods of analysis (K_{30}, K_{100}, $K_{5\text{-}6pm}$), ranging from 0.53 to 0.57.

For a peak hour analysis (e.g., K_{100}), the minimum acceptable D factor is 0.52. That assumes 52% of unconstrained peak hour traffic is traveling in one direction. If a roadway's traffic is constrained, the D will drop. Consideration should be given to raising the D from the process illustrated below if a roadway is constrained.

Calculating D

For a conceptual planning analysis, FDOT recommends calculating roadway specific D factors. To calculate the D from a 3- (or 7-) day count, calculate the average of the daily peak hour Ds. The process illustrated below shows how to obtain the estimated D from a 3-day count.

CALCULATING D

Measured Day	Peak Hour	Peak Hour Volume	Predominate Direction Peak Volume	Opposite Direction Peak Volume	D
1/22	4-5 PM	1,700	884	816	0.520
1/23	5-6 PM	1,800	1,152	648	0.640
1/24	5-6 PM	1,900	1,102	798	0.580
Sums	NA	5,400	3,138	2,262	NA
Averages	NA	1,800	1,046	754	0.580

Calculated D = (0.520 + 0.640 + 0.580)/ 3 = 0.580.

Peak Hour Factor (PHF)

The PHF or Peak Hour Factor is the hourly volume divided by the peak 15-minute rate of flow within the peak hour; specifically

PHF = hourly volume ÷ (4 * peak 15-minute volume)

All service volumes in this Handbook are for an hour; however, consideration of subhour traffic peaks may also become important. The most notable example is on freeways. If traffic demand on a freeway exceeds its capacity, the operation of the freeway breaks down. Subsequently, the freeway queue discharge rate is lower than the maximum flow rate under non-breakdown conditions. Another example is that, although FDOT's Generalized Tables and arterial planning model (ARTPLAN) account for queues building up and dissipating over an hour, good arterial progression becomes irrelevant in oversaturated conditions.

The maximum PHF normally accepted by FDOT is 0.95. However, if adequate justification is provided by the applicant that a higher PHF is appropriate and represents an unconstrained situation, FDOT may accept a somewhat higher value.

Calculating PHF

For a conceptual planning analysis, FDOT considers the calculation of PHF as optional because it is usually not one of the most important LOS input variables. However, when gathering data to calculate the K and D factors, PHF can be easily derived. To calculate the PHF from a 3- (or 7-) day count, calculate the average PHF from the 3 highest measured peak hour volumes. The process shown below is an example of obtaining the estimated PHF from a 3-day count.

CALCULATING PHF

Measured Day	Peak Hour	Peak Hour Volumes	15 Minute Volumes				Peak Hour Factor
			1st	2nd	3rd	4th	
1/22	4-5 PM	1700	400	400	450	450	0.944
1/23	5-6 PM	1800	400	500	450	450	0.900
1/24	5-6 PM	1900	450	500	500	450	0.950
Average	NA	NA	NA	NA	NA	NA	0.931

Calculated PHF = 0.931

If a roadway's traffic is constrained, the PHF will generally increase. Thus, consideration should be given to lowering the PHF if a roadway is constrained.

Base Saturation Flow Rate/Capacity

The HCM2000 uses the term base saturation flow rate for interrupted flow roadways and capacity, or base capacity, for uninterrupted flow roadways to describe the maximum steady flow. This rate is expressed in passenger cars per hour per lane (pcphpl), at which passenger cars can cross a point on given types of roadways. The base saturation flow rates/capacities for Florida's roadway facilities are shown below.

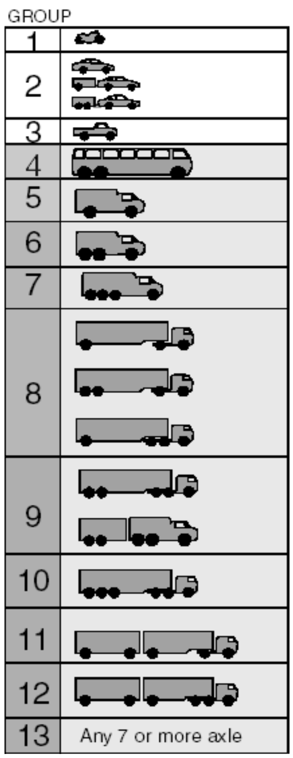
- Arterials and other interrupted flow facilities – 1,900 pcphpl (assuming 100 percent green time)
- Basic freeway segment (70 mph posted speed) – 2,400 pcphpl
- Freeway interchange influence areas (70 mph posted speed) –
  - 2,200 pcphpl for the two outside lanes for the off ramp influence area
  - 2,300 pcphpl for the two outside lanes for the on ramp influence area
  - 2,350 pcphpl for the two outside lanes for the overpass underpass area
  - 2,400 pcphpl for additional inside lanes
- Uninterrupted flow multilane highway segments – 2,200 pcphpl
- Uninterrupted flow two-lane highway segments – 1,700 pcphpl

Adjusted saturation flow rate

Previous editions of this Handbook made use of the term "adjusted saturation flow rate" as an input value instead of base saturation flow rate. Essentially, it accounted for the effects of the driver population factor, heavy vehicles, and other adjustment factors on the base saturation flow rate. However, primarily related to the greater emphasis on truck movements, those factors are now broken into two broad categories: (1) heavy vehicle percent and (2) "local adjustment factor". To aid users understanding the impacts of many of the roadway and traffic variables, the terms "adjusted saturation flow rate" and "adjusted capacity" appear in the current conceptual planning software as outputs.

Percent Heavy Vehicles

Heavy vehicles have more than four wheels.



FHWA has a vehicle classification scheme in which vehicles larger than a pick-up truck, which includes vehicles with more than four wheels or classification group 4 or higher, are considered heavy vehicles. The percentage of these heavy vehicles in a given hour is frequently referred to as a truck factor (T). However, to be more consistent with HCM2000 terminology and to overcome some definitional problems with the common understanding of the meaning of a "truck," this Handbook uses the term "heavy vehicle" and makes use of the percent of heavy vehicles (classification group 4 or higher) in a given hour.

The heavy vehicle percentage varies dramatically by time of day, day of week, roadway type, and by adjacent land uses. Operational characteristics of heavy vehicles also vary dramatically by type of heavy vehicle (e.g., a relatively small delivery truck versus a fully loaded 18-wheel semi-truck) and whether they are operating on an uncongested freeway or on signalized roadways. The "blast" effect of heavy vehicles on bicyclists also varies significantly based on the type and speed of heavy vehicles. Until proposed research is conducted in Florida, the HCM2000 heavy vehicle factors are utilized.

Statewide heavy vehicle percents by selected areas, roadway types, and analysis hours are shown in Table 3-5. Other statewide heavy vehicle percent defaults for the 100th highest hour (K_{100}) appear on the back of the Generalized Tables.

Heavy vehicle percents

Table 3 – 5

HEAVY VEHICLE PERCENTS BY PLANNING ANALYSIS HOURS

Area	Roadway	K_{30}	K_{100}	$K_{5\text{-}6pm}$
Urbanized	Class III Freeway	6.0%	6.0%	6.0%
	Class IV Freeway	4.0%	4.0%	4.0%
	Uninterrupted Highway	2.0%	2.0%	2.0%
	Class I & II Arterials	2.0%	2.0%	2.0%
	Class III & IV Arterials	1.5%	1.5%	1.5%
	Major City/County Roadways	1.5%	1.5%	1.5%
	Other Signalized Roadways	1.0%	1.0%	1.0%
Transitioning/Urban	Freeway	6.0%	9.0%	12.0%
Rural	Freeway	5.0%	9.0%	14.0%
	Uninterrupted Multilane Highway	5.0%	9.0%	14.0%
	Uninterrupted Two-Lane Highway	4.0%	5.0%	6.0%

Local Adjustment Factor (Driver Population Factor)

The local adjustment factor is used by FDOT to adjust base saturation flow rates and base capacities to better match actual Florida traffic volumes. It consists of the driver population factor and a combination of other factors, such as area type. Driver population is a parameter that accounts for driver characteristics and their effects on traffic. Historically, most HCM chapters assume drivers are commuters and drive aggressively. The fact that not all drivers are as aggressive as commuters is recognized, and allows the use of a driver population factor. Throughout Florida are many tourists unfamiliar with roads and most driving actually occurs during non-peak hours where driver purposes are different. Under these conditions, saturation flow rates should be expected to drop. Research in Florida by the University of South Florida for FDOT indicates that this drop in saturation flow is up to 15 percent.

An example of another factor found in the HCM2000 is the "area" factor associated with signalized intersections. Essentially, the HCM recognizes lower saturation flow rates at signalized intersections in central business districts (CBD) than elsewhere. Even this CBD factor may be thought of as a "local" factor. To keep the analyses at a planning level, rather than treating each of the many HCM2000 factors separately, FDOT has simply grouped them into the "local adjustment factor".

The local adjustment factor values used by FDOT to develop the Generalized Tables appear on the back of those tables.

Percent Turns from Exclusive Turn Lanes

FDOT's planning tools assume there is no blockage of through lanes by turning vehicles.

"Percent turns from exclusive turn lanes" is the percent of vehicles performing left or right turning movements at signalized intersections from lanes solely dedicated to turning movements. Most of the complicated aspects of the HCM2000 chapter on signalized intersections deal with accommodating left turn movements. The Generalized Tables and ARTPLAN assume that left turns are adequately accommodated; there is no backing up of left turning traffic into through lanes. If this assumption cannot be made, results obtained from the planning analysis tools are doubtful. Primarily for that reason the tables and programs must not be used for intersection design or traffic operations work.

Exclusive right turn lanes

Where a right turn lane of sufficient length exists, it is proper to add the percent of right turns to the percent of left turns, assuming the existence of a left turn lane, to determine the percent turns from exclusive lanes.

The automobile LOS methodology described in this Handbook applies the HCM procedures to the through traffic at each signalized intersection. For planning purposes, it is assumed that the turning movements are accommodated by the signal timing plan. Turning movement adjustments are made internally, based on the user-specified value of percent turns from exclusive lanes.

Turning volumes are added to the through volumes in determining the overall service volumes shown in the Generalized Tables and computed by ARTPLAN. Conversely, the turning volumes must be subtracted from the overall demand volumes for purposes of computing arterial through-traffic delay by ARTPLAN.

Calculating percent turns from exclusive turn lanes

The accuracy of LOS calculations may be highly dependent on the percent turns from exclusive turn lanes. In most cases, it is of moderate importance, but at some key intersections it may be one of the most significant variables. While FDOT does not routinely suggest acquiring percent turns from exclusive turn lanes, serious consideration should be given to acquiring the data at key intersections. If the percent turns at key intersections are obtained in the field, a 10 percent value, assuming an exclusive left turn lane and no exclusive right turn lane, may be assumed for the other intersections in an ARTPLAN analysis. If the percentage of turns from exclusive turn lanes is acquired, the data acquisition can be tied into the 3-day field counts used to determine the K and D factors. The process is illustrated below.

CALCULATING % TURNS FROM EXCLUSIVE TURN LANES

Measured Day	Peak Hour	Signalized Intersection	Total Peak Hr. Predominant Approach Vol.	Exclusive Lane Volume	% Turns from Exclusive Turn Lanes A	B
1/22	4-5 PM	A	884	130	14.7%	
		B	900	150		16.7%
1/23	5-6 PM	A	1152	150	13.0%	
		B	1150	150		13.0%
1/24	5-6 PM	A	1102	150	13.6%	
		B	1090	160		14.7%
Totals	NA	A	3,138	430	13.7%	
	NA	B	3,140	460		14.6%

Bus Frequency

As used in this Handbook, bus frequency refers to the number of scheduled fixed route buses which have a potential to stop on a given roadway segment in one direction of flow in a one hour time period. Express buses with no potential of stopping along a roadway are not included.

Bus Span of Service

Bus span of service refers to the number of hours in a day of scheduled fixed route bus service. This factor becomes relevant when reporting on a daily basis. Although the Generalized LOS Tables are based on hourly directional values, span of service becomes a relevant factor for any given hour if the transit service is not available for the return, or originating, trip. In the following table, the LOS letter grade, hours of service thresholds, and comments were obtained from the TCQSM. The factors are FDOT's and are applied as multiplicative factors in ARTPLAN daily analyses of buses.

Table 3 – 6
IMPACT OF BUS SPAN SERVICE – DAILY REPORTING

Hours of Service Per Day	LOS	Factor	Comments
19-24	A	1.15	Night or owl service provided
17-18	B	1.05	Late evening service provided
14-16	C	1.00	Early evening service provide
12-13	D	0.90	Daytime serviced provided
4-11	E	0.75	Peak hour service/limited midday service
0-3	F	0.55	Very limited or no service

3.6 CONTROL VARIABLES

In general, control variables refer to roadway or area traffic controls and regulations in effect for a roadway segment, including the type, phasing, and timing of traffic signals, stop signs, lane use and turn controls, and other similar measures. Control variables refer to those regularly occurring at signalized intersections, unless otherwise noted.

Signalized Intersection Spacing

For uninterrupted flow facilities, such as freeways and rural highways, LOS can readily be derived from the volume of vehicles and roadway capacity. For signalized roadways, control conditions must also be considered. Traditional volume to capacity ratios (v/c) are simply not adequate to determine LOS for these signalized roadways and the effects of the traffic signals must also be included.

Importance of signalized intersections

Frequently, it is the cumulative effect of numerous traffic signals, lack of green time, and lack of good progression that lower the LOS of arterials. A major feature of FDOT's Generalized Tables is the importance of the number of signalized intersections on the determination of LOS.

The distance between signalized intersections is required to determine specific service volumes for a roadway. FDOT's Generalized Tables use signalized intersections per mile as a variable and assume uniform spacing. While this spacing may be acceptable for an areawide analysis, precise distances between signalized intersections should be determined when an individual roadway is being analyzed at a conceptual level.

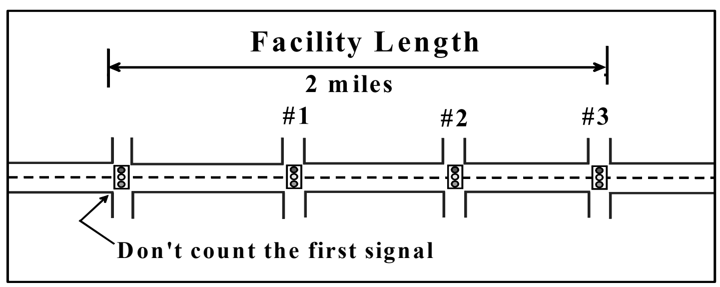
Future conditions

Generally, over time, roadway and traffic characteristics change. The number of signalized intersections per mile is frequently the most significant change. As development takes place and an area urbanizes, the number of signals is likely to increase. The LOS analysis for the future should take into account changes in roadway and signalization characteristics.

Determining number of signalized intersections per mile

When determining the number of signalized intersections per mile, to avoid double counting, the signalized intersections at the ends of the facility should not both be counted. In general, FDOT recommends not counting the roadway's first signalized intersection and counting the last one.

Count the last intersection, but not the first.



For example, often in southeast Florida, principal arterials are spaced 1 mile apart with other signalized intersections between them. In this situation, only one of the signalized intersections at the end of the roadway, plus the signals in between should be counted when determining the number of signalized intersections per mile. In general, the first intersection in the peak flow direction would not be counted and the last one would be included. Alternatively, the number of signalized intersections per mile can be considered as the number of roadway segments between signalized intersections within the appropriate distance. Do not count the signal at the end of a facility as one-half of a signal.

Two-way and all-way stop control guidance

When using the Generalized Tables, an intersection with a stop sign for the through movement is considered a "signalized intersection" for all roadway types, except "other signalized roadways". The intersection must be signalized to be considered an "other signalized roadway". The following guidelines are offered when applying ARTPLAN to two-way and all-way stop control conditions on arterials:

- **For two-way stop control** in which the arterial traffic is stopped by a stop sign or flashing red light, the equivalent cycle length should be assumed to be 30 seconds with actuated control and arrival type 3. The effective green time ratio, g/C should be computed as:

$$g/C = 1 - (1400/V_c)$$

Where V_c = the sum of the cross street hourly volumes.

- **For all-way stop control** where both the arterial and cross street are stopped, the equivalent cycle length should be set at 15 seconds with actuated control and arrival type 3. The effective g/C ratio should be estimated as:

$$g/C = (15(V_{AH} / V_{CH}) - 3) / 15$$

Where V_{AH} = the arterial volume in the heaviest direction
And V_{CH} = the cross street volume in the heaviest direction

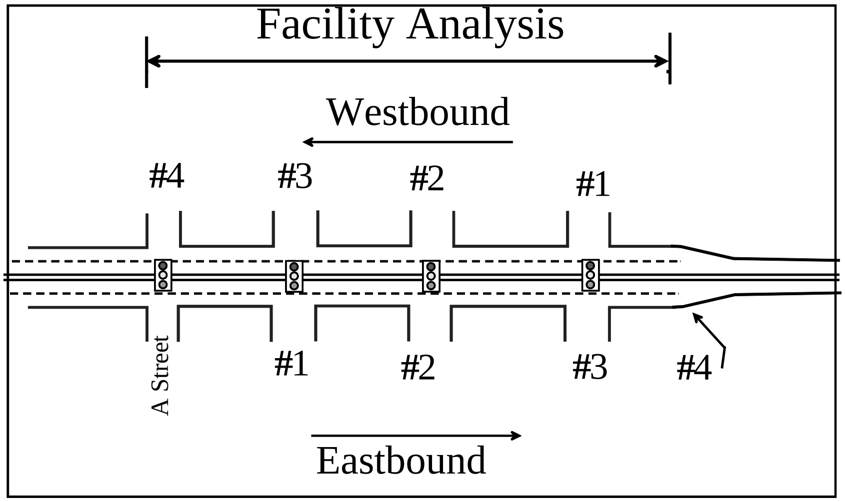
These g/C values are subject to minimum and maximum values of 0.3 and 0.7, respectively.

If the approximations suggested above indicate that the intersection in question would operate beyond its capacity, then a more detailed analysis should be conducted using the HCM2000 Chapter 17 methodology for analyzing two-way or all-way stop control.

Arterials terminating where there is no intersection

When determining the number of signalized intersections for LOS calculation using the Generalized Tables, an arterial facility that ends where there is no intersection (e.g., lane drops, ramp junctions), should be treated as if the terminal is a signalized intersection with a g/C ratio of 1.00.

For example, a four-lane arterial leads eastward out of an urbanized area. The western terminal is A Street. There are 3 signalized intersections east of A Street. However, the analysis extends 1 mile past the last signal as a four-lane road. At that point, the road tapers and becomes a two-lane facility.



This roadway should be analyzed by counting the arterial facility terminus as a signal, which means there would be 4 signalized intersections along the arterial. In an ARTPLAN analysis, the g/C of the eastbound term terminus (#4) is assumed to be 1.00. It should be noted that if analyzed westbound and counting the downstream signals, there are 4, since the western terminus is signalized.

Arrival Type

Quality of progression

Arrival type is a general categorization of quality of signal progression. The HCM defines six arrival types, with 1 representing the worst progression quality and 6 representing the best. Uncoordinated operation, or random arrivals, is represented by 3 and is appropriate for actuated signals. Arrival type 4 is FDOT's default for coordinated signal systems. More favorable progression (5 or 6) for a Class III or IV facility may be appropriate when progression design strongly favors the peak direction of travel, signals are pretimed, and all the signals are linked for the length of the facility. One-way facilities tend to have better quality progression than two-way facilities. Arrival type also may vary significantly from one signal to the next, even in coordinated signal systems. Semiactuated signals have varying g/C ratios and there are breaks between groups of coordinated signals.

A good arrival type in one direction may result in a low arrival type in the other.

The assumption of very good progression in one direction implies that a lower progression quality probably prevails in the other direction. With a relatively even directional distribution, the off peak direction speeds could be lower than the arterial LOS if favorable progression has been established for the peak direction.

Signal Type

The signal type indicates the degree to which a traffic signal's cycle length, phase plan, and phase times are preset or actuated. The types are:

- Actuated – all approaches to the signalized intersection have vehicle detectors. Each phase is subject to a minimum and maximum green time and some phases may be "skipped" if no vehicle is detected.

- Semiactuated – vehicle detectors are only located on the minor street. The signal is set such that the green is always on the major street unless a vehicle is detected on the minor street.

- Pretimed – the signal times out a preset sequence of phases in repetitive order. Each phase has a fixed green time and change interval that is repeated in each cycle. Cycle length is constant.

Generalized Tables assumptions

In the General Tables, actuated signals are assumed when the number of signalized intersections per mile is less than 2. Semiactuated signals are assumed when the number of signalized intersections per mile is at least 2.

Cycle Length (C)

C or cycle length is the total time for a signal to complete a sequence of signal indications for all traffic movements. For actuated and possibly semiactuated signals, the cycle length may vary depending on side street traffic. Usually these signals have a maximum cycle length, assuming the maximum time is allocated for each phase. As used in the Generalized Tables, the cycle length represents this maximum cycle length.

Effective Green Ratio

g/C is one of the most important variables in determining LOS and capacity of arterials.

$$g/C = \frac{G + Y + R - l_1 - l_2}{C}$$

Clearly the amount of green time that traffic movements receive at signalized intersections is one of the most significant variables in Q/LOS and capacity analyses. The g/C (effective green time to signal cycle length) ratio, as it pertains to arterial analysis in this Handbook, is the ratio of the time at signalized intersections allocated only for the through traffic movement divided by the cycle length. Effective green time (g) is composed of the sum of the time of the circular green (G), yellow (Y) and all red (R) signal indications minus the sum of the start-up (l_1) and clearance (l_2) lost times. Start-up lost time is the additional time consumed by the first few vehicles in a queue at a signalized intersection because of the need to react to the initiation of the green indication and to accelerate. Clearance lost time is the time between signal phases during which an intersection is not used by any traffic. The default assumption used is that the sum of the start-up and clearance lost times is 4 seconds per phase.

Calculating g/C

For a conceptual planning analysis, FDOT recommends obtaining actual g/C ratios for each intersection from field studies conducted for the applicable through movement during the study hour. For major intersections, the g/C ratio should be obtained for 5 cycles and then averaged for each major intersection. For non-major intersections, 3 cycles should be sufficient to determine applicable g/C's. Again, to determine g/C correctly, add the time of the circular green light plus the circular yellow plus the circular all red for the through movement phase, then subtract 4 seconds for lost time of the phase, and then divide by the cycle length.

Weighted g/C for generalized planning analyses

Generalized planning analyses use only one g/C for all intersections.

A major advantage of ARTPLAN over the Generalized Tables is that it accounts for the g/C of each intersection rather than assuming one g/C value for all intersections. Nevertheless, a major simplifying assumption was essential for the development of the Generalized Tables. The following discussion outlines the approach used; however, it should be noted to develop the weighted g/C approach discussed below, the g/C's for all the intersections are needed. Rather than determining the weighted g/C, it would be more desirable to simply enter them directly into ARTPLAN for conceptual planning analyses.

Weighting the g/C allows the aggregation of data from multiple signals.

$$(g/C)_W = \frac{(g/C)_c + \left(\sum \frac{(g/C)_1 + \ldots + (g/C)_n - (g/C)_c}{n-1}\right)}{2}$$

A fundamental technical question is what green time value to assume for arterials in the Generalized Tables. Should it represent the average green time that through movements receive along the arterial, or should it be the green time that the through movement receives at the critical intersection where the greatest delay is likely to occur, or should it be some other value? The concept of "weighted effective green time ratio" was created for this purpose. An arterial's weighted g/C ($(g/C)_w$) is the average of the critical signalized intersections through g/C ($(g/C)_c$) and the average of all the other signalized intersections' through g/C's along the arterial facility. For example, if over a 4-mile principal arterial the lowest through g/C is 0.4 and the average through g/C for the other intersections is 0.6, then the weighted g/C is 0.5. The weighted g/C takes into account the adverse impact of the critical intersection and the overall quality of flow for the arterial length.

This weighted approach has been found to be a reasonable, simplifying assumption. Under typical traffic, roadway and control conditions, the "weighted g/C" approach yield speeds within 2 mph of entering actual g/C ratios for each intersection. In general, the approach slightly overestimates speeds when the number of signalized intersections per mile is greater than 2.5 and slightly underestimates speeds when the number of signalized intersections per mile is less than 2.5.

Determining the critical signalized intersection

The critical intersection is the signalized intersection with the highest volume to capacity ratio (v/c), and is typically the intersection with the lowest g/C. In determining the critical intersection along an arterial, the analyst is cautioned about strictly using g/C ratios from intersections with different numbers of through lanes. Because of the difference in the number of lanes, the green time needed to accommodate the through trips would likely be different. For example, Arterial A has 4 intersections. Intersections 1, 2 and 3 have two through lanes. Intersection 4 has 3 through lanes, which continue for more than 1,500 feet. Thus, keeping g/C constant more vehicles can pass through Intersection 4 because of the additional lane. So the g/C for Intersection 4 may be lowered below that of the other intersections, but its capacity could still be higher because of the additional lane.

4 GENERALIZED PLANNING ANALYSIS
(Generalized Level of Service Volume Tables)

4.1 INTRODUCTION

Applications

Generalized planning is a broad type of planning application such as statewide analyses, initial problem identification, and future year analyses. Generalized planning is applicable when the desire is for a quick, "in the ball park" estimate of LOS, and makes extensive use of default values. Florida's Generalized Tables found in this Handbook are the major analysis tool in conducting this type of planning analysis.

Because FDOT's Generalized Level of Service Tables (Tables 4-1 through 4-9) make extensive use of statewide default data, use of the tables generally should be limited to:

- statewide or regionwide analyses where consistency in approach is more important than accuracy on any given roadway,
- as a screening device for initial problem identification,
- analyses of future years where roadway, traffic and signalization characteristics are uncertain,
- quick LOS estimates, and
- use by lay people with little transportation analysis experience.

Caution in applying tables

Perhaps no single roadway has all the default input values of the tables.

FDOT's Generalized Tables are based on nationally accepted techniques.

It is quite possible that no single roadway has the exact values for all the roadway, traffic and control variables used in the Generalized Tables. The tables must be applied with care to roadway facilities and in the determination of the LOS grade.

The automobile/truck parts of the Generalized Tables were developed based on the definitions and methodology of the HCM2000. The values shown in the Generalized Tables for bicycles, pedestrians and buses are based on the latest national and state research for those modes. Nationally, for bus analyses, the Transit Capacity and Quality of Service Manual (TCQSM) is the comparable document to the HCM2000. FDOT has found the newly developed Bicycle and Pedestrian LOS Models to be the most appropriate for those modes. Besides their positive technical merits, these models have become the leading techniques used in the U.S. Noteworthy, the bicycle, pedestrian and bus techniques being used are as technically sound as the HCM2000 techniques. The Generalized Tables are believed to be the most thoroughly researched and state-of-the-art generalized service volume tables in use nationwide.

The tables were developed from data collected around the state.

FDOT personnel conducted numerous traffic and signalization studies and developed values to reflect average conditions in Florida. Daily and directional data were derived from FDOT's continuous traffic count stations throughout Florida. Signal timing data were obtained from analyses of traffic signal timings in Miami, Tampa, Tallahassee, Gainesville, DeLand and Lake City. FDOT's intent has been to develop the most realistic numbers based on actual roadway, traffic and control data. Bicycle, pedestrian and bus components of the tables were developed through a significant research project with the University of Florida and the developers of the TCQSM and Bicycle LOS and Pedestrian LOS Models. Major bicycle data and calibration was conducted in Tampa and major pedestrian data and calibration was conducted in Pensacola. All roadway, traffic and control default values, as well as LOS thresholds, appear on the back of the Generalized Tables.

Maximum service volumes

The Generalized Tables present maximum service volumes, which is the highest number of vehicles for a given level of service. Any number greater than the value shown in a table for a roadway with a given number of lanes would drop the level of service to the next letter grade. For example, if the volume shown in a table for a 4-lane arterial at LOS C is 26,000 then 26,100 would represent LOS D. Some special aspects to the tables exist and are discussed in Section 4.5.

Types of areas

Florida's Generalized Tables consist of five area types grouped into three tables:

- urbanized areas;
- areas transitioning into urbanized areas, or cities over 5,000 population not in urbanized areas; and
- rural undeveloped areas, or cities and developed areas less than 5,000 population.

Daily tables

Peak hour two-way tables

Most planning and preliminary engineering applications begin with annual average daily traffic (AADT) volumes given as an input, or end with AADT as a calculated output. Therefore, the Generalized Daily Tables shown in Tables 4-1 through 4-3, depict the AADT based on the 100th highest traffic hour of the year. Some local and regional entities have adopted two-direction peak hour standards. Table 4-4 through 4-6 provide generalized peak hour two-way volumes. Generalized Peak Hour Directional Tables (Tables 4-7 through 4-9) are provided because traffic engineering analyses are conducted on an hourly or subhourly directional basis. These hourly directional tables may be viewed as the most fundamental of the tables because the two-way tables are simply the peak hour directional values divided by the directional distribution factor (D), and the daily tables are simply the peak hour directional values divided by both the D factor and the planning analysis hour factor (K).

Peak hour directional tables

All tables are based on peak hour directional variables.

All three sets of tables are internally consistent. More specifically, all of the volumes are based on the higher directional flow of traffic for the 100^{th} highest hour of the year and account for traffic fluctuations within the hour. The 100^{th} highest hour is approximately equivalent to the typical peak hour of a day during a peak season in a developed area. Again, it is stressed that the daily, peak hour two-way, and peak hour directional tables are internally consistent, and are based on the same time period and directional flow of traffic.

The tables are not capacity tables.

The Generalized Level of Service Volume Tables should not be referred to as capacity tables. In general, the values shown are the maximum service volumes for a given level of service based on roadway, traffic and control conditions during the peak hour in the peak travel direction. Many of the LOS E maximum service volumes in the hourly directional tables also represent the capacity of the roadway, but in general, most of the values do not reflect a roadway's capacity. A clear case of not representing capacity values is the "daily" tables. Roadway capacities for the day far exceed the volumes shown in the daily tables. All roadways are under utilized in the early morning hours and many heavily congested roads will have volumes higher than the highest volumes shown in the daily tables because traffic is backed up for more than a 1 hour period.

4.2 Florida's Generalized Daily Level of Service Volume Tables

Florida's Generalized Daily Level of Service Volume Tables

Urbanized Areas
Transitioning and Urban Areas
Rural Undeveloped and Rural Developed Areas

4.3 Florida's Generalized Peak Hour Two-Way Level of Service Volume Tables

Florida's Generalized Peak Hour Two-Way Level of Service Volume Tables

Urbanized Areas
Transitioning and Urban Areas
Rural Undeveloped and Rural Developed Areas

4.4 Florida's Generalized Peak Hour Directional Level of Service Volume Tables

Florida's Generalized Peak Hour Two-Way Level of Service Volume Tables

Urbanized Areas
Transitioning and Urban Areas
Rural Undeveloped and Rural Developed Areas

TABLE 4 - 1
GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	2,000	7,000	13,800	19,600	27,000
4	Divided	20,400	33,000	47,800	61,800	70,200
6	Divided	30,500	49,500	71,600	92,700	105,400

STATE TWO-WAY ARTERIALS

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

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	4,200	13,800	16,400	16,900
4	Divided	4,800	29,300	34,700	35,700	***
6	Divided	7,300	44,700	52,100	53,500	***
8	Divided	9,400	58,000	66,100	67,800	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	1,900	11,200	15,400	16,300
4	Divided	**	4,100	26,000	32,700	34,500
6	Divided	**	6,500	40,300	49,200	51,800
8	Divided	**	8,500	53,300	63,800	67,000

Class III (more than 4.5 signalized intersections per mile and not within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	5,300	12,600	15,500
4	Divided	**	**	12,400	28,900	32,800
6	Divided	**	**	19,500	44,700	49,300
8	Divided	**	**	25,800	58,700	63,800

Class IV (more than 4.5 signalized intersections per mile and within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	5,200	13,700	15,000
4	Divided	**	**	12,300	30,300	31,700
6	Divided	**	**	19,100	45,800	47,600
8	Divided	**	**	25,900	59,900	62,200

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	9,100	14,600	15,600
4	Divided	**	**	21,400	31,100	32,900
6	Divided	**	**	33,400	46,800	49,300

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	4,800	10,000	12,600
4	Divided	**	**	11,100	21,700	25,200

Source: Florida Department of Transportation 02/22/02
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Interchange spacing ≥ 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
4	23,800	39,600	55,200	67,100	74,600
6	36,900	61,100	85,300	103,600	115,300
8	49,900	82,700	115,300	140,200	156,000
10	63,000	104,200	145,500	176,900	196,400
12	75,900	125,800	175,500	213,500	237,100

Interchange spacing < 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
4	22,000	36,000	52,000	67,200	76,500
6	34,800	56,500	81,700	105,800	120,200
8	47,500	77,000	111,400	144,300	163,900
10	60,200	97,500	141,200	182,600	207,600
12	72,900	118,100	170,900	221,100	251,200

BICYCLE MODE

(**Note**: Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	3,200	13,800	>13,800
50-84%	**	2,500	4,100	>4,100	***
85-100%	3,100	7,200	>7,200	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	6,400	15,500
50-84%	**	**	**	9,900	19,000
85-100%	**	2,200	11,300	>11,300	***

BUS MODE (Scheduled Fixed Route)

(Buses per hour)

(**Note:** Buses per hour shown are only for the **peak hour** in the **single direction** of the higher traffic flow.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-84%	**	>5	≥4	≥3	≥2
85-100%	>6	>4	≥3	≥2	≥1

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED
(alter corresponding volume by the indicated percent)

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

ONE-WAY FACILITIES

Decrease corresponding two-directional volumes in this table by 40% to obtain the equivalent one directional volume for one-way facilities.

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are two-way annual average daily volumes (based on K_{100} factors) for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

**Cannot be achieved using table input value defaults.

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

TABLE 4 - 1 (continued)

GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S

Urbanized Areas

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES			
	Freeways		Highways	
ROADWAY CHARACATERISTICS	Class III	Class IV		
Number of through lanes	4 - 12	4 - 12	2	4 - 6
Posted speed (mph)	65	55	50	50
Free flow speed (mph)	70	60	55	55
Basic segment length (mi)	1.5	0		
Interchange spacing per mile	2.5	1		
Median (n,y)			n	y
Left turn lanes (n,y)			y	y
Terrain (r,l)	l	l	l	l
% no passing zone			80	
Passing lanes (n,y)			n	
TRAFFIC CHARACTERISTICS				
Planning analysis hour factor (K)	0.097	0.093	0.095	0.095
Directional distribution factor (D)	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.95	0.925	0.925
Base capacity (pcphpl)			1700	2100
Heavy vehicle percent	6.0	4.0	2.0	2.0
Local adjustment factor	0.98	1.00	1.0	1.0

	INTERRUPTED FLOW FACILITIES																	
	State Arterials												Non-State Roadways			Bicycle	Pedestrian	Bus
ROADWAY CHARACTERISTICS	Class I			Class II			Class III			Class IV			Major City/County		Other Signalized	Class II	Class II	
Number of through lanes	2	4 - 6	8	2	4 – 6	8	2	4 - 6	8	2	4 – 6	8	2	4 - 6	2 - 4	4	4	
Posted speed (mph)	45	50	50	45	45	45	35	35	35	30	30	30	45	45		40	40	
Free flow speed (mph)	50	55	55	50	50	50	40	40	40	35	35	35	50	50		45	45	
Median type (n,nr,r)	N	r	r	n	r	r	n	r	r	n	r	r	n	r		r	r	
Left turn lanes (n,y)	Y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
Paved shoulder/bicycle lane (n,y)																n,50%,y	n	
Outside lane width (n,t,w)																t	t	
Pavement condition (u,t,d)																t		
Sidewalk (n,y)																	n,50%,y	n,y
Sidewalk/roadway separation (a,t,w)																	t	
Sidewalk/roadway protective barrier (n,y)																	n	
Obstacle to bus stop (n,y)																		n
TRAFFIC CHARACTERISTICS																		
Planning analysis hour factor (K)	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	
Peak hour factor (PHF)	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Heavy vehicle percent	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.0	2.0	2.0	
Local adjustment factor	1.0	1.0	0.95	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.98	0.98	0.95	0.98	0.98	
% turns from exclusive turn lanes	12	12	12	12	12	12	12	12	12	12	12	12	14	14	16	12	12	
Bus span of service																		15
CONTROL CHARACTERISTICS																		
Signalized intersections per mile	1.5	1.0	1.0	3.0	3.0	3.0	5.0	5.0	5.0	8.0	8.0	8.0	3.0	3.0		3.0	3.0	
Arrival type (1-6)	3	3	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	
Signal type (a,s,f)	a	a	a	s	s	s	s	s	s	s	s	s	s	s	s	s	s	
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44	

LEVEL OF SERVICE THRESHOLDS

	Freeways				Highways			State Two-Way Arterials				Non-State Roadways		Bicycle	Pedestrian	Bus
Level of	Class III		Class IV		Two-Lane	Multilane		Class I	Class II	Class III	Class IV	Major City/County	Other Signalized			
Service	v/c	Density	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	ATS	Control Delay	Score	Score	Buses per hr.
A	≤ 0.32	≤ 11	≤ 0.29	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 25 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5	> 6
B	≤ 0.53	≤ 18	≤ 0.47	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 19 mph	> 28 mph	≤ 20 sec	≤2.5	≤ 2.5	> 4
C	≤ 0.74	≤ 26	≤ 0.68	≤ 26	> 0.750	≤ 0.68	≤ 26	> 21 mph	> 22 mph	> 18 mph	> 13 mph	> 22 mph	≤ 35 sec	≤3.5	≤ 3.5	≥ 3
D	≤ 0.90	≤ 35	≤ 0.88	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 9 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5	≥ 2
E	≤ 1.00	≤ 45	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 7 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5	≥ 1
F	> 1.00	> 45	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 7 mph	≤ 13 mph	> 80 sec	> 5.5	> 5.5	< 1

v/c = Demand to Capacity Ratio % FFS = Percent Free Flow Speed ATS = Average Travel Speed 02/22/02

TABLE 4 – 2
GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	2,100	6,900	12,900	18,200	24,900
4	Divided	18,600	30,200	43,600	56,500	64,200
6	Divided	27,900	45,200	65,500	84,700	96,200

STATE TWO-WAY ARTERIALS

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

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	4,000	13,100	15,500	16,300
4	Divided	4,600	27,900	32,800	34,200	***
6	Divided	6,900	42,800	49,300	51,400	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	10,500	14,500	15,300
4	Divided	**	3,700	24,400	30,600	32,200
6	Divided	**	6,000	38,000	46,100	48,400

Class III (more than 4.5 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	5,000	11,800	14,600
4	Divided	**	**	11,700	27,200	30,800
6	Divided	**	**	18,400	42,100	46,300

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	7,000	13,600	14,600
4	Divided	**	**	16,400	29,300	30,900
6	Divided	**	**	25,700	44,100	46,400

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	4,400	9,400	12,000
4	Divided	**	**	10,300	20,200	24,000

Source: Florida Department of Transportation 02/22/02
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	23,500	38,700	52,500	62,200	69,100
6	36,400	59,800	81,100	96,000	106,700
8	49,100	80,900	109,600	129,800	144,400
10	61,800	101,800	138,400	163,800	182,000

BICYCLE MODE

(**Note:** Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	1,900	3,300	13,600	>13,600
50-84%	**	2,500	4,000	>4,000	***
85-100%	3,200	7,100	>7,100	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometric at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine two-way maximum service volumes.)

% Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	6,300	15,400
50-84%	**	**	**	9,800	18,800
85-100%	**	2,200	11,200	>11,200	***

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED

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

ONE-WAY FACILITIES

Decrease corresponding two-directional volumes in this table by 40% to obtain the equivalent one directional volume for one-way facilities.

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are two-way annual average daily volumes (based on K_{100} factors) for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.

**Cannot be achieved using table input value defaults.

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

TABLE 4 - 2 (continued)

GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES		
	Freeways	**Highways**	
ROADWAY CHARACATERISTICS	**Class II**		
Number of through lanes	4 - 10	2	4 - 6
Posted speed (mph)	70	50	50
Free flow speed (mph)	75	55	55
Basic segment length (mi)	3		
Interchange spacing per mile	4		
Median (n,y)		n	y
Left turn lanes (n,y)		y	y
Terrain (r,l)	l	l	l
% no passing		60	
Passing lanes (n,y)		n	
TRAFFIC CHARACTERISTICS			
Planning analysis hour factor (K)	0.100	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.910	0.910
Base capacity (pcphpl)		1700	2100
Heavy vehicle percent	9.0	4.0	4.0
Local adjustment factor	0.95	0.95	0.95

	INTERRUPTED FLOW FACILITIES										
	State Arterials						**Non-State Roadways**			**Bicycle**	**Pedestrian**
ROADWAY CHARACTERISTICS	**Class I**		**Class II**		**Class III**		**Major City/County**		**Other Signalized**	**Class II**	**Class II**
Number of through lanes	2	4 - 6	2	4 - 6	2	4 - 6	2	4 - 6	2 - 4	4	4
Posted speed (mph)	45	50	45	45	35	35	40	40		40	40
Free flow speed (mph)	50	55	50	50	40	40	45	45		45	45
Median type (n,nr,r)	n	r	n	r	n	r	n	r		r	r
Left turn lanes (n,y)	y	y	y	y	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n,y)										n,50%,y	n
Outside lane width (n,t,w)										t	t
Pavement condition (u,t,d)										t	
Sidewalk (n,y)											n,50%,y
Sidewalk/roadway separation (a,t,w)											t
Sidewalk/roadway protective barrier (n,y)											n
TRAFFIC CHARACTERISTICS											
Planning analysis hour factor (K)	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Heavy vehicle percent	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Local adjustment factor	0.98	0.98	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.95	0.95
% turns from exclusive turn lanes	12	12	12	12	12	12	14	14	16	12	12
CONTROL CHARACTERISTICS											
Signalized intersections per mile	1.5	1.0	3.0	3.0	5.0	5.0	3.0	3.0		3.0	3.0
Arrival type (1-6)	3	3	4	4	4	4	4	4	3	4	4
Signal type (a,s,f)	a	a	s	s	s	s	s	s	s	s	s
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		**Highways**			**State Two-Way Arterials**			**Non-State Roadways**		**Bicycle**	**Pedestrian**
Level of	Class II		Two-Lane	Multilane		Class I	Class II	Class III	Major City/County	Other Signalized		
Service	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 28 mph	≤ 20 sec	≤2.5	≤ 2.5
C	≤ 0.76	≤ 26	> 0.750	≤ 0.68	≤ 26	> 27 mph	> 22 mph	> 18 mph	> 22 mph	≤ 35 sec	≤3.5	≤ 3.5
D	≤ 0.90	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 13 mph	> 80 sec	>5.5	> 5.5

v/c = Demand to Capacity Ratio   % FFS = Percent Free Flow Speed   ATS = Average Travel Speed

TABLE 4 – 3
GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION*

RURAL UNDEVELOPED AREAS

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	21,300	35,300	47,900	56,600	63,000
6	33,100	54,300	73,900	87,400	97,200
8	44,700	73,600	100,000	118,400	131,400

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	2,600	5,300	8,600	13,800	22,300
4	Divided	17,500	28,600	40,800	52,400	58,300
6	Divided	26,200	42,800	61,200	78,600	87,400

PASSING LANE ADJUSTMENTS
(alter corresponding two-lane LOS A-D volumes indicated percent)

Passing Lane Spacing	Adjustment Factors
5 mi.	+25%
10 mi.	+10%

ISOLATED SIGNALIZED INTERSECTIONS

Lanes	A	B	C	D	E
	Level of Service				
2	**	1,900	8,000	10,700	12,100
4	**	2,900	17,400	23,000	25,200
6	**	4,500	27,100	35,500	43,100

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 55 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by directional roadway lanes to determine maximum service volume.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
0-49%	**	**	**	**	6,200
50-84%	**	**	**	**	17,600
85-100%	**	**	3,900	>3,900	***

CITIES OR RURAL DEVELOPED AREAS LESS THAN 5000

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	21,300	35,300	47,900	56,600	63,000
6	33,100	54,300	73,900	87,400	97,200
8	44,700	73,600	100,000	118,400	131,400

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	2,500	7,200	12,700	17,300	23,500
4	Divided	17,800	28,900	41,800	54,100	61,500
6	Divided	26,800	43,300	62,700	81,200	92,200

INTERRUPTED FLOW ARTERIALS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	2,200	11,000	13,900	14,900
4	Divided	**	5,300	25,500	29,400	31,200
6	Divided	**	8,400	39,400	44,200	46,800

NON-STATE SIGNALIZED ROADWAYS

(signalized intersection analysis)

Lanes	A	B	C	D	E
	Level of Service				
2	**	**	1,900	7,600	10,100

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 45 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	2,800	6,900	>6,900
50-84%	**	2,100	3,500	>3,500	***
85-100%	2,800	4,000	>4,000	***	***

PEDESTRIAN MODE

(Note: Level of service for the pedestrian mode in this table is based on roadway geometric at 45 mph posted speed and traffic conditions, not number of pedestrian using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	4,400	14,200
50-84%	**	**	**	8,000	18,000
85-100%	**	**	9,400	>9,400	***

02/22/02

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

http://www11.myflorida.com/planning/systems/sm/los/default.htm

NON-FREEWAY AND SIGNALIZED INTERSECTION ANALYSES DIVIDED/UNDIVIDED ADJUSTMENTS

(alter corresponding volumes by the indicated percent)

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

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are two-way annual average daily volumes (based on K_{100} factors) for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.
**Cannot be achieved using table input value defaults.
***Not applicable for the level of service letter grade. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 - 3 (continued)
GENERALIZED ANNUAL AVERAGE DAILY VOLUMES FOR FLORIDA'S
RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION
INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES				
	Freeways	Highways			
ROADWAY CHARACTERISTICS	Class I				
Area type (ru,rd)		ru	ru	rd	rd
Number of through lanes	4 – 8	2	4 - 6	2	4 - 6
Posted speed (mph)	70	55	55	50	50
Free flow speed (mph)	75	60	60	55	55
Facility length (mi)	7				
Basic segment length (mi)	6				
Interchange spacing per mile	7				
Median (n,y)		n	y	n	y
Left turn lanes (n,y)		y	y	y	y
Terrain (r,l)	l	l	l	l	l
% no passing zone		20		40	
Passing lanes (n,y)		n		n	
TRAFFIC CHARACTERISTICS					
Planning analysis hour factor (K)	0.104	0.098	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.88	0.88	0.895	0.895
Base capacity (pcphpl)		1700	2200	1700	2100
Heavy vehicle percent	9.0	5.0	9.0	4.0	4.0
Local adjustment factor	0.90	0.90	0.90	0.92	0.92

	INTERRUPTED FLOW FACILITIES						
	Isolated Signalized Intersections	Arterials		Non-State Signalized	Bicycle		Pedestrian
ROADWAY CHARACTERISTICS		Class I			Class I		Class I
Area type (ru,rd)	ru	rd	rd	rd	ru	rd	rd
Number of through lanes	2 – 6	2	4 – 6	2	2	2	2
Posted speed (mph)		45	45		55	45	45
Free flow speed (mph)		50	50		60	50	50
Median type (n,nr,r)		n	r		n	n	n
Left turns lanes (n,y)	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n.y)					n,50%,y	n,50%,y	n
Outside lane width (n,t,w)					t	t	t
Pavement condition (u,t,d)					t	t	
Sidewalk (n,y)							n,50%,y
Sidewalk roadway separation (a,t,w)							t
Sidewalk roadway protective barrier (n,y)							n
TRAFFIC CHARACTERISTICS							
Planning analysis hour factor (K)	0.098	0.097	0.097	0.097	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.88	0.895	0.895	0.895	0.88	0.895	0.895
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1700	1900	1900
Heavy vehicle percent	5.0	3.0	3.0	1.5	6.0	3.0	3.0
Local adjustment factor	0.90	0.92	0.92	0.92	0.90	0.92	0.92
% turns from exclusive turn lanes	12	12	12	25	0	12	12
CONTROL CHARACTERISTICS							
Signalized intersections per mile		2.0	2.0		0.5	2.0	2.0
Arrival type (1-6)	3	3	3	3	3	3	3
Signal type (a,s,f)	a	s	s	s	a	s	s
Cycle length (C)	60	90	90	60	60	90	90
Effective green ratio (g/C)	0.44	0.44	0.44	0.31	0.44	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		Highways						Isolated Intersections	Arterials	Non-State Signalized Roadways	Bicycle	Pedestrian
Level of Service	Class I v/c	Density	Two-Lane ru v/c	Two-Lane rd % FFS	Multilane ru v/c	Density	Multilane rd v/c	Density	Control Delay	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	≤ 0.12	> 0.917	≤ 0.30	≤ 11	≥ 0.29	≤ 11	≤ 5 sec	> 42 mph	≤ 5 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	≤ 0.24	> 0.833	≤ 0.49	≤ 18	≥ 0.47	≤ 18	≤10 sec	> 34 mph	≤ 10 sec	≤ 2.5	≤ 2.5
C	≤ 0.76	≤ 26	≤ 0.39	> 0.750	≤ 0.70	≤ 26	≥ 0.68	≤ 26	≤ 15 sec	> 27 mph	≤ 15 sec	≤ 3.5	≤ 3.5
D	≤ 0.90	≤ 35	≤ 0.62	> 0.667	≤ 0.90	≤ 35	≥ 0.88	≤ 35	≤ 20 sec	> 21 mph	≤ 20 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	≤ 1.00	> 0.583	≤ 1.00	≤ 40	≥ 1.00	≤ 41	≤ 40 sec	> 16 mph	≤ 40 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 1.00	≤ 0.583	> 1.00	> 40	< 1.00	> 41	> 40 sec	≤ 16 mph	> 40 sec	> 5.5	> 5.5

v/c = Demand to Capacity Ratio % FFS = Percent Free Flow Speed ATS = Average Travel Speed ru = Rural Undeveloped rd = Rural Developed

TABLE 4 - 4
GENERALIZED PEAK HOUR TWO-WAY VOLUMES FOR FLORIDA'S URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	180	620	1,210	1,720	2,370
4	Divided	1,940	3,140	4,540	5,870	6,670
6	Divided	2,900	4,700	6,800	8,810	10,010

STATE TWO-WAY ARTERIALS

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

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	400	1,310	1,560	1,610
4	Divided	460	2,780	3,300	3,390	***
6	Divided	700	4,240	4,950	5,080	***
8	Divided	890	5,510	6,280	6,440	***

Class II (2.00 to 4.50 signalized intersections per mile)

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	180	1,070	1,460	1,550
4	Divided	**	390	2,470	3,110	3,270
6	Divided	**	620	3,830	4,680	4,920
8	Divided	**	800	5,060	6,060	6,360

Class III (more than 4.5 signalized intersections per mile and not within primary city central business district of an urbanized area over 750,000)

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	**	500	1,200	1,470
4	Divided	**	**	1,180	2,750	3,120
6	Divided	**	**	1,850	4,240	4,690
8	Divided	**	**	2,450	5,580	6,060

Class IV (more than 4.5 signalized intersections per mile and within primary city central business district of an urbanized area over 750,000)

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	**	490	1,310	1,420
4	Divided	**	**	1,170	2,880	3,010
6	Divided	**	**	1,810	4,350	4,520
8	Divided	**	**	2,460	5,690	5,910

NON-STATE ROADWAYS

Major City/County Roadways

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	**	870	1,390	1,480
4	Divided	**	**	2,030	2,950	3,120
6	Divided	**	**	3,170	4,450	4,690

Other Signalized Roadways
(signalized intersection analysis)

Level of Service

Lanes	Divided	A	B	C	D	E
2	Undivided	**	**	450	950	1,200
4	Divided	**	**	1,050	2,070	2,400

Source: Florida Department of Transportation, Systems Planning Office, 605 Suwannee Street, MS 19, Tallahassee, FL 32399-0450 — 02/22/02
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Interchange spacing ≥ 2 mi. apart

Level of Service

Lanes	A	B	C	D	E
4	2,310	3,840	5,350	6,510	7,240
6	3,580	5,930	8,270	10,050	11,180
8	4,840	8,020	11,180	13,600	15,130
10	6,110	10,110	14,110	17,160	19,050
12	7,360	12,200	17,020	20,710	23,000

Interchange spacing < 2 mi. apart

Level of Service

Lanes	A	B	C	D	E
4	2,050	3,350	4,840	6,250	7,110
6	3,240	5,250	7,600	9,840	11,180
8	4,420	7,160	10,360	13,420	15,240
10	5,600	9,070	13,130	16,980	19,310
12	6,780	10,980	15,890	20,560	23,360

BICYCLE MODE

(**Note**: Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Level of Service

Paved Shoulder Bicycle Lane Coverage	A	B	C	D	E
0-49%	**	**	310	1,310	>1,310
50-84%	**	240	390	>390	***
85-100%	300	680	>680	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Level of Service

Sidewalk Coverage	A	B	C	D	E
0-49%	**	**	**	600	1,480
50-84%	**	**	**	940	1,800
85-100%	**	210	1,080	>1,080	***

BUS MODE (Scheduled Fixed Route)

(Buses per hour)

(**Note:** Buses per hour shown are only for the **peak hour** in the **single direction** of higher traffic flow.)

Level of Service

Sidewalk Coverage	A	B	C	D	E
0-84%	**	>5	≥4	≥3	≥2
85-100%	>6	>4	≥3	≥2	≥1

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED
(alter corresponding volume by the indicated percent)

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

ONE-WAY FACILITIES

Decrease corresponding two-directional volumes in this table by 40% to obtain the equivalent one directional volume for one-way facilities.

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are hourly two-way volumes for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. To convert to annual average daily traffic volumes, these volumes must be divided by an appropriate K factor. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.
**Cannot be achieved using table input value defaults.
***Not applicable for that level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 - 4 (continued)
GENERALIZED PEAK HOUR TWO-WAY VOLUMES FOR FLORIDA'S
Urbanized Areas
INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES			
	Freeways		Highways	
ROADWAY CHARACATERISTICS				
Number of through lanes	4 - 12	4 - 12	2	4 - 6
Posted speed (mph)	65	55	50	50
Free flow speed (mph)	70	60	55	55
Basic segment length (mi)	1.5	0		
Interchange spacing per mile	2.5	1		
Median (n,y)			n	y
Left turn lanes (n,y)			y	y
Terrain (r,l)	l	l	l	l
% no passing zone			80	
Passing lanes (n,y)			n	
TRAFFIC CHARACTERISTICS				
Planning analysis hour factor (K)	0.097	0.093	0.095	0.095
Directional distribution factor (D)	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.95	0.925	0.925
Base capacity (pcphpl)			1700	2100
Heavy vehicle percent	6.0	4.0	2.0	2.0
Local adjustment factor	0.98	1.00	1.0	1.0

	INTERRUPTED FLOW FACILITIES																	
	State Arterials												Non-State Roadways			Bicycle	Pedestrian	Bus
ROADWAY CHARACTERISTICS	Class I			Class II			Class III			Class IV			Major City/County		Other Signalized	Class II	Class II	
Number of through lanes	2	4 - 6	8	2	4 – 6	8	2	4 - 6	8	2	4 – 6	8	2	4 - 6	2 - 4	4	4	
Posted speed (mph)	45	50	50	45	45	45	35	35	35	30	30	30	45	45		40	40	
Free flow speed (mph)	50	55	55	50	50	50	40	40	40	35	35	35	50	50		45	45	
Median type (n,nr,r)	n	r	r	n	r	r	n	r	r	n	r	r	n	r		r	r	
Left turn lanes (n,y)	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
Paved shoulder/bicycle lane (n,y)																n,50%,y	n	
Outside lane width (n,t,w)																t	t	
Pavement condition (u,t,d)																t		
Sidewalk (n,y)																	n,50%,y	n,y
Sidewalk/roadway separation (a,t,w)																	t	
Sidewalk/roadway protective barrier (n,y)																	n	
Obstacle to bus stop (n,y)																		n
TRAFFIC CHARACTERISTICS																		
Planning analysis hour factor (K)	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	
Peak hour factor (PHF)	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Heavy vehicle percent	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.0	2.0	2.0	
Local adjustment factor	1.0	1.0	0.95	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.98	0.98	0.95	0.98	0.98	
% turns from exclusive turn lanes	12	12	12	12	12	12	12	12	12	12	12	12	14	14	16	12	12	
Bus span of service																		15
CONTROL CHARACTERISTICS																		
Signalized intersections per mile	1.5	1.0	1.0	3.0	3.0	3.0	5.0	5.0	5.0	8.0	8.0	8.0	3.0	3.0		3.0	3.0	
Arrival type (1-6)	3	3	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	
Signal type (a,s,f)	a	a	a	s	s	s	s	s	s	s	s	s	s	s	s	s	s	
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44	

LEVEL OF SERVICE THRESHOLDS

	Freeways				Highways			State Two-Way Arterials				Non-State Roadways		Bicycle	Pedestrian	Bus
Level of	Class III		Class IV		Two-Lane	Multilane		Class I	Class II	Class III	Class IV	Major City/County	Other Signalized			
Service	v/c	Density	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	ATS	Control Delay	Score	Score	Buses per hr.
A	≤ 0.32	≤ 11	≤ 0.29	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 25 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5	> 6
B	≤ 0.53	≤ 18	≤ 0.47	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 19 mph	> 28 mph	≤ 20 sec	≤2.5	≤ 2.5	>4
C	≤ 0.74	≤ 26	≤ 0.68	≤ 26	> 0.750	≤ 0.68	≤ 26	> 21 mph	> 22 mph	> 18 mph	> 13 mph	> 22 mph	≤ 35 sec	≤3.5	≤ 3.5	≥ 3
D	≤ 0.90	≤ 35	≤ 0.88	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 9 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5	≥ 2
E	≤ 1.00	≤ 45	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 7 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5	≥ 1
F	> 1.00	> 45	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 7 mph	≤ 13 mph	> 80 sec	> 5.5	> 5.5	< 1

v/c = Demand to Capacity Ratio % FFS = Percent Free Flow Speed ATS = Average Travel Speed

02/22/02

TABLE 4 – 5
GENERALIZED PEAK HOUR TWO-WAY VOLUMES FOR FLORIDA'S AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	180	600	1,130	1,590	2,180
4	Divided	1,790	2,900	4,190	5,420	6,160
6	Divided	2,680	4,340	6,280	8,130	9,240

STATE TWO-WAY ARTERIALS

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

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	390	1,260	1,490	1,560
4	Divided	440	2,680	3,150	3,290	***
6	Divided	670	4,110	4,730	4,930	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	1,010	1,390	1,470
4	Divided	**	360	2,340	2,940	3,090
6	Divided	**	580	3,640	4,420	4,650

Class III (more than 4.5 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	480	1,130	1,400
4	Divided	**	**	1,130	2,610	2,960
6	Divided	**	**	1,770	4,040	4,450

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	670	1,300	1,400
4	Divided	**	**	1,570	2,810	2,970
6	Divided	**	**	2,470	4,230	4,460

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	430	900	1,150
4	Divided	**	**	990	1,940	2,300

Source: Florida Department of Transportation 02/22/02
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	2,350	3,870	5,250	6,220	6,910
6	3,640	5,980	8,110	9,600	10,670
8	4,910	8,090	10,960	12,980	14,440
10	6,180	10,180	13,840	16,380	18,200

BICYCLE MODE

(**Note:** Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	180	310	1,310	>1,310
50-84%	**	240	390	>390	***
85-100%	310	680	>680	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometric at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	600	1,480
50-84%	**	**	**	940	1,800
85-100%	**	210	1,080	>1,080	***

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED

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

ONE-WAY FACILITIES

Decrease corresponding two-directional volumes in this table by 40% to obtain the equivalent one directional volume for one-way facilities.

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are hourly two-way volumes for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.
**Cannot be achieved using table input value defaults.
***Not applicable for the level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 – 5 (continued)
GENERALIZED PEAK HOUR TWO-WAY VOLUMES FOR FLORIDA'S
AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES		
	Freeways	Highways	
ROADWAY CHARACATERISTICS	Class II		
Number of through lanes	4 - 10	2	4 - 6
Posted speed (mph)	70	50	50
Free flow speed (mph)	75	55	55
Basic segment length (mi)	3		
Interchange spacing per mile	4		
Median (n,y)		n	y
Left turn lanes (n,y)		y	y
Terrain (r,l)	l	l	l
% no passing		60	
TRAFFIC CHARACTERISTICS			
Planning analysis hour factor (K)	0.100	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.910	0.910
Base capacity (pcphpl)		1700	2100
Heavy vehicle percent	9.0	4.0	4.0
Local adjustment factor	0.95	0.95	0.95

	INTERRUPTED FLOW FACILITIES										
	State Arterials						Non-State Roadways			Bicycle	Pedestrian
ROADWAY CHARACTERISTICS	Class I		Class II		Class III		Major City/County		Other Signalized	Class II	Class II
Number of through lanes	2	4 - 6	2	4 - 6	2	4 - 6	2	4 - 6	2 - 4	4	4
Posted speed (mph)	45	50	45	45	35	35	40	40		40	40
Free flow speed (mph)	50	55	50	50	40	40	45	45		45	45
Median type (n,nr,r)	n	r	n	r	n	r	n	r		r	r
Left turn lanes (n,y)	y	y	y	y	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n,y)										n,50%,y	n
Outside lane width (n,t,w)										t	t
Pavement condition (u,t,d)										t	
Sidewalk (n,y)											n,50%,y
Sidewalk/roadway separation (a,t,w)											t
Sidewalk/roadway protective barrier (n,y)											n
TRAFFIC CHARACTERISTICS											
Planning analysis hour factor (K)	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Heavy vehicle percent	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Local adjustment factor	0.98	0.98	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.95	0.95
% turns from exclusive turn lanes	12	12	12	12	12	12	14	14	16	12	12
CONTROL CHARACTERISTICS											
Signalized intersections per mile	1.5	1.0	3.0	3.0	5.0	5.0	3.0	3.0		3.0	3.0
Arrival type (1-6)	3	3	4	4	4	4	4	4	3	4	4
Signal type (a,s,f)	a	a	s	s	s	s	s	s	s	s	s
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		Highways			State Two-Way Arterials			Non-State Roadways		Bicycle	Pedestrian
Level of	Class II		Two-Lane	Multilane		Class I	Class II	Class III	Major City/County	Other Signalized		
Service	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 28 mph	≤ 20 sec	≤2.5	≤ 2.5
C	≤ 0.76	≤ 26	> 0.750	≤ 0.68	≤ 26	> 27 mph	> 22 mph	> 18 mph	> 22 mph	≤ 35 sec	≤3.5	≤ 3.5
D	≤ 0.90	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 13 mph	> 80 sec	>5.5	> 5.5

v/c = Demand to Capacity Ratio   % FFS = Percent Free Flow Speed   ATS = Average Travel Speed

TABLE 4 – 6
GENERALIZED PEAK HOUR TWO-WAY VOLUMES FOR FLORIDA'S RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION*

RURAL UNDEVELOPED AREAS

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	2,200	3,670	4,980	5,890	6,550
6	3,440	5,650	7,690	9,090	10,110
8	4,650	7,650	10,400	12,310	13,670

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	220	460	740	1,190	1,920
4	Divided	1,710	2,800	4,000	5,140	5,710
6	Divided	2,570	4,200	6,000	7,710	8,560

PASSING LANE ADJUSTMENTS
(alter corresponding two-lane LOS A-D volumes indicated percent)

Passing Lane Spacing	Adjustment Factors
5 mi.	+25%
10 mi.	+10%

ISOLATED SIGNALIZED INTERSECTIONS

Lanes	A	B	C	D	E
	Level of Service				
2	**	180	780	1,050	1,190
4	**	290	1,700	2,250	2,470
6	**	440	2,660	3,480	4,220

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 55 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by directional roadway lanes to determine maximum service volume.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
0-49%	**	**	**	**	610
50-84%	**	**	**	**	1,720
85-100%	**	**	390	>390	***

CITIES OR RURAL DEVELOPED AREAS LESS THAN 5000

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
4	2,220	3,670	4,980	5,890	6,550
6	3,440	5,650	7,690	9,090	10,110
8	4,650	7,650	10,400	12,310	13,670

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	220	630	1,100	1,500	2,040
4	Divided	1,730	2,800	4,060	5,250	5,960
6	Divided	2,600	4,200	6,080	7,870	8,940

INTERRUPTED FLOW ARTERIALS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	210	1,070	1,350	1,450
4	Divided	**	520	2,470	2,850	3,020
6	Divided	**	810	3,820	4,290	4,540

NON-STATE SIGNALIZED ROADWAYS
(signalized intersection analysis)

Lanes	A	B	C	D	E
	Level of Service				
2	**	**	180	740	980

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 45 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	270	670	>670
50-84%	**	200	340	>340	***
85-100%	280	390	>390	***	***

PEDESTRIAN MODE

(Note: Level of service for the pedestrian mode in this table is based on roadway geometric at 45 mph posted speed and traffic conditions, not number of pedestrian using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	430	1,370
50-84%	**	**	**	780	1,750
85-100%	**	**	920	>920	***

02/22/02

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

http://www11.myflorida.com/planning/systems/sm/los/default.htm

NON-FREEWAY AND SIGNALIZED INTERSECTION ANALYSES DIVIDED/UNDIVIDED ADJUSTMENTS
(alter corresponding volumes by the indicated percent)

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

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are two-way annual average daily volumes (based on K_{100} factors) for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.
**Cannot be achieved using table input value defaults.
***Not applicable for the level of service letter grade. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 - 6 (continued)

GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES				
		Highways			
ROADWAY CHARACTERISTICS	**Freeways**				
Area type (ru,rd)	**Class I**	ru	ru	rd	rd
Number of through lanes	4 - 8	2	4 – 6	2	4 - 6
Posted speed (mph)	70	55	55	50	50
Free flow speed (mph)	75	60	60	55	55
Facility length (mi)	7				
Basic segment length (mi)	6				
Interchange spacing per mile	7				
Median (n,y)		n	y	n	y
Left turn lanes (n,y)		y	y	y	y
Terrain (r,l)	l	l	l	l	l
% no passing zone		20		40	
Passing lanes (n,y)		n		n	
TRAFFIC CHARACTERISTICS					
Planning analysis hour factor (K)	0.104	0.098	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.88	0.88	0.895	0.895
Base capacity (pcphpl)		1700	2200	1700	2100
Heavy vehicle percent	9.0	5.0	9.0	4.0	4.0
Local adjustment factor	0.90	0.90	0.90	0.92	0.92

	INTERRUPTED FLOW FACILITIES						
	Isolated Signalized Intersections	**Arterials**		**Non-State Signalized**	**Bicycle**		**Pedestrian**
ROADWAY CHARACTERISTICS		**Class I**			**Class I**		**Class I**
Area type (ru,rd)	ru	rd	rd	rd	ru	rd	rd
Number of through lanes	2 – 6	2	4 – 6	2	2	2	2
Posted speed (mph)		45	45		55	45	45
Free flow speed (mph)		50	50		60	50	50
Median type (n,nr,r)		n	r		n	n	n
Left turns lanes (n,y)	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n.y)					n,50%,y	n,50%,y	n
Outside lane width (n,t,w)					t	t	t
Pavement condition (u,t,d)					t	t	
Sidewalk (n,y)							n,50%,y
Sidewalk roadway separation (a,t,w)							t
Sidewalk roadway protective barrier (n,y)							n
TRAFFIC CHARACTERISTICS							
Planning analysis hour factor (K)	0.098	0.097	0.097	0.097	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.88	0.895	0.895	0.895	0.88	0.895	0.895
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1700	1900	1900
Heavy vehicle percent	5.0	3.0	3.0	1.5	6.0	3.0	3.0
Local adjustment factor	0.90	0.92	0.92	0.92	0.90	0.92	0.92
% turns from exclusive turn lanes	12	12	12	25	0	12	12
CONTROL CHARACTERISTICS							
Signalized intersections per mile		2.0	2.0		0.5	2.0	2.0
Arrival type (1-6)	3	3	3	3	3	3	3
Signal type (a,s,f)	a	s	s	s	a	s	s
Cycle length (C)	60	90	90	60	60	90	90
Effective green ratio (g/C)	0.44	0.44	0.44	0.31	0.44	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		**Highways**						**Isolated Intersections**	**Arterials**	**Non-State Signalized Roadways**	**Bicycle**	**Pedestrian**
Level of	Class I		Two-Lane ru	Two-Lane rd	Multilane ru		Multilane rd						
Service	v/c	Density	v/c	% FFS	v/c	Density	v/c	Density	Control Delay	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	≤ 0.12	> 0.917	≤ 0.30	≤ 11	≥ 0.29	≤ 11	≤ 5 sec	> 42 mph	≤ 5 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	≤ 0.24	> 0.833	≤ 0.49	≤ 18	≥ 0.47	≤ 18	≤10 sec	> 34 mph	≤ 10 sec	≤ 2.5	≤ 2.5
C	≤ 0.76	≤ 26	≤ 0.39	> 0.750	≤ 0.70	≤ 26	≥ 0.68	≤ 26	≤ 15 sec	> 27 mph	≤ 15 sec	≤ 3.5	≤ 3.5
D	≤ 0.90	≤ 35	≤ 0.62	> 0.667	≤ 0.90	≤ 35	≥ 0.88	≤ 35	≤ 20 sec	> 21 mph	≤ 20 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	≤ 1.00	> 0.583	≤ 1.00	≤ 40	≥ 1.00	≤ 41	≤ 40 sec	> 16 mph	≤ 40 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 1.00	≤ 0.583	> 1.00	> 40	< 1.00	> 41	> 40 sec	≤ 16 mph	> 40 sec	> 5.5	> 5.5

v/c = Demand to Capacity Ratio % FFS = Percent Free Flow Speed ATS = Average Travel Speed ru = Rural Undeveloped rd = Rural Developed 02/22/02

TABLE 4 - 7
GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	100	340	670	950	1,300
2	Divided	1,060	1,720	2,500	3,230	3,670
3	Divided	1,600	2,590	3,740	4,840	5,500

STATE TWO-WAY ARTERIALS

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

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	220	720	860	890
2	Divided	250	1,530	1,810	1,860	***
3	Divided	380	2,330	2,720	2,790	***
4	Divided	490	3,030	3,460	3,540	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	100	590	810	850
2	Divided	**	220	1,360	1,710	1,800
3	Divided	**	340	2,110	2,570	2,710
4	Divided	**	440	2,790	3,330	3,500

Class III (more than 4.5 signalized intersections per mile and not within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	280	660	810
2	Divided	**	**	650	1,510	1,720
3	Divided	**	**	1,020	2,330	2,580
4	Divided	**	**	1,350	3,070	3,330

Class IV (more than 4.5 signalized intersections per mile and within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	270	720	780
2	Divided	**	**	650	1,580	1,660
3	Divided	**	**	1,000	2,390	2,490
4	Divided	**	**	1,350	3,130	3,250

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	480	760	810
2	Divided	**	**	1,120	1,620	1,720
3	Divided	**	**	1,740	2,450	2,580

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	250	530	660
2	Divided	**	**	580	1,140	1,320

Source: Florida Department of Transportation 02/22/02
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Interchange spacing ≥ 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
2	1,270	2,110	2,940	3,580	3,980
3	1,970	3,260	4,550	5,530	6,150
4	2,660	4,410	6,150	7,480	8,320
5	3,360	5,560	7,760	9,440	10,480
6	4,050	6,710	9,360	11,390	12,650

Interchange spacing < 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
2	1,130	1,840	2,660	3,440	3,910
3	1,780	2,890	4,180	5,410	6,150
4	2,340	3,940	5,700	7,380	8,380
5	3,080	4,990	7,220	9,340	10,620
6	3,730	6,040	8,740	11,310	12,850

BICYCLE MODE

(**Note**: Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	170	720	>720
50-84%	**	130	210	>210	***
85-100%	160	380	>380	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not the number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	330	810
50-84%	**	**	**	520	990
85-100%	**	120	590	>590	***

BUS MODE (Scheduled Fixed Route)
(Buses per hour)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-84%	**	>5	≥4	≥3	≥2
85-100%	>6	>4	≥3	≥2	≥1

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED
(alter corresponding volumes by the indicated percent)

Lanes	Median	Left Turns Lanes	Adjustment Factors
1	Divided	Yes	+5%
1	Undivided	No	-20%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

ONE WAY FACILITIES
Increase corresponding volume 20%

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are hourly directional volumes for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. To convert to annual average daily traffic volumes, these. volumes must be divided by appropriate D and K factors. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.
**Cannot be achieved using table input value defaults.
***Not applicable for that level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 – 7 (CONTINUED)
GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S URBANIZED AREAS

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES			
	Freeways		Highways	
ROADWAY CHARACATERISTICS	**Class III**	**Class IV**		
Number of directional through lanes	2 - 6	2 - 6	1	2 - 3
Posted speed (mph)	65	55	50	50
Free flow speed (mph)	70	60	55	55
Basic segment length (mi)	1.5	0		
Interchange spacing per mile	2.5	1		
Median (n,y)			n	y
Left turn lanes (n,y)			y	y
Terrain (r,l)	l	l	l	l
% no passing zone			80	
Passing lanes (n,y)			n	
TRAFFIC CHARACTERISTICS				
Planning analysis hour factor (K)	0.097	0.093	0.095	0.095
Directional distribution factor (D)	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.95	0.925	0.925
Base capacity (pcphpl)			1700	2100
Heavy vehicle percent	6.0	4.0	2.0	2.0
Local adjustment factor	0.98	1.00	1.0	1.0

	INTERRUPTED FLOW FACILITIES																	
	State Arterials												Non-State Roadways			Bicycle	Pedestrian	Bus
ROADWAY CHARACTERISTICS	**Class I**			**Class II**			**Class III**			**Class IV**			**Major City/County**		**Other Signalized**	**Class II**	**Class II**	
Number of directional through lanes	1	2 - 3	4	1	2-3	4	1	2 - 3	4	1	2 - 3	4	1	2 - 3	1-2	2	2	
Posted speed (mph)	45	50	50	45	45	45	34	35	35	30	30	30	45	45		40	40	
Free flow speed (mph)	50	55	55	50	50	50	40	40	35	35	35	35	50	50		45	45	
Median type (n,nr,r)	n	r	r	n	r	r	n	r	r	n	r	r	n	r		r	r	
Left turn lanes (n,y)	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
Paved shoulder/bicycle lane (n,y)																n,50%,y	n	
Outside lane width (n,t,w)																t	t	
Pavement condition (u,t,d)																t		
Sidewalk (n,y)																	n,50%,y	n,y
Sidewalk/roadway separation (a,t,w)																	t	
Sidewalk/roadway protective barrier (n,y)																	n	
Obstacle to bus stop (n,y)																		n
TRAFFIC CHARACTERISTICS																		
Planning analysis hour factor (K)	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	
Peak hour factor (PHF)	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Heavy vehicle percent	2.0	2.0	2.0	2.0	2.0	2.0	1.5	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.0	2.0	2.0	
Local adjustment factor	1.0	1.0	0.95	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.98	0.98	0.95	0.98	0.98	
% turns from exclusive turn lanes	12	12	12	12	12	12	12	12	12	12	12	12	14	14	16	12	12	
Bus span of service																		15
CONTROL CHARACTERISTICS																		
Signalized intersections per mile	1.5	1.0	1.0	3.0	3.0	3.0	5.0	5.0	5.0	8.0	8.0	8.0	3.0	3.0		3.0	3.0	
Arrival type (1-6)	3	3	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	
Signal type (a,s,f)	a	a	a	s	s	s	s	s	s	s	s	s	s	s	s	s	s	
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44	

LEVEL OF SERVICE THRESHOLDS

	Freeways				Highways			State Two-Way Arterials				Non-State Roadways		Bicycle	Pedestrian	Bus
Level of	Class III		Class IV		Two-Lane	Multilane		Class I	Class II	Class III	Class IV	Major City/County	Other Signalized			
Service	v/c	Density	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	ATS	Control Delay	Score	Score	Buses per hr.
A	≤ 0.32	≤ 11	≤ 0.29	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 25 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5	> 6
B	≤ 0.53	≤ 18	≤ 0.47	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 19 mph	> 28 mph	≤ 20 sec	≤ 2.5	≤ 2.5	>4
C	≤ 0.74	≤ 26	≤ 0.68	≤ 26	> 0.750	≤ 0.68	≤ 26	> 27 mph	> 22 mph	> 18 mph	> 13 mph	> 22 mph	≤ 35 sec	≤ 3.5	≤ 3.5	≥ 3
D	≤ 0.90	≤ 35	≤ 0.88	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 9 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5	≥ 2
E	≤ 1.00	≤ 45	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 7 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5	≥ 1
F	> 1.00	> 45	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 7 mph	≤ 13 mph	> 80 sec	> 5.5	> 5.5	< 1

v/c = Demand to Capacity Ratio   % FFS = Percent Free Flow Speed   ATS = Average Travel Speed

TABLE 4 – 8

GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	100	330	620	870	1,200
2	Divided	980	1,590	2,300	2,980	3,390
3	Divided	1,470	2,390	3,460	4,470	5,080

STATE TWO-WAY ARTERIALS

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

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	210	690	820	860
2	Divided	240	1,470	1,730	1,810	***
3	Divided	370	2,260	2,600	2,710	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	560	760	810
2	Divided	**	200	1,290	1,620	1,700
3	Divided	**	320	2,000	2,430	2,560

Class III (more than 4.5 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	260	620	770
2	Divided	**	**	620	1,440	1,630
3	Divided	**	**	970	2,220	2,450

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	370	720	770
2	Divided	**	**	870	1,550	1,630
3	Divided	**	**	1,360	2,330	2,450

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	**	230	490	630
2	Divided	**	**	540	1,070	1,270

Source: Florida Department of Transportation 02/22/02
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www11.myflorida.com/planning/systems/sm/los/default.htm

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
2	1,290	2,130	2,890	3,420	3,800
3	2,000	3,290	4,460	5,280	5,870
4	2,700	4,450	6,030	7,140	7,940
5	3,400	5,600	7,610	9,010	10,010

BICYCLE MODE

(**Note:** Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	100	170	720	>720
50-84%	**	130	210	>210	***
85-100%	170	380	>380	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometric at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	330	810
50-84%	**	**	**	520	990
85-100%	**	120	590	>590	***

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

DIVIDED/UNDIVIDED

Lanes	Median	Left Turn Lanes	Adjustment Factors
1	Divided	Yes	+5%
1	Undivided	No	-20%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

ONE-WAY FACILITIES

Increase corresponding volume 20%.

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are hourly two-way volumes for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.
**Cannot be achieved using table input value defaults.
***Not applicable for the level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 - 8 (continued)

GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S AREAS TRANSITIONING INTO URBANIZED AREAS OR AREAS OVER 5,000 NOT IN URBANIZED AREAS

INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES		
	Freeways	**Highways**	
ROADWAY CHARACATERISTICS	**Class II**		
Number of directional through lanes	2 - 5	1	2 - 3
Posted speed (mph)	70	50	50
Free flow speed (mph)	75	55	55
Basic segment length (mi)	3		
Interchange spacing per mile	4		
Median (n,y)		n	y
Left turn lanes (n,y)		y	y
Terrain (r,l)	l	l	l
% no passing		60	
Passing lanes (n,y)		n	
TRAFFIC CHARACTERISTICS			
Planning analysis hour factor (K)	0.100	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.910	0.910
Base capacity (pcphpl)		1700	2100
Heavy vehicle percent	9.0	4.0	4.0
Local adjustment factor	0.95	0.95	0.95

	INTERRUPTED FLOW FACILITIES										
	State Arterials						**Non-State Roadways**			**Bicycle**	**Pedestrian**
ROADWAY CHARACTERISTICS	**Class I**		**Class II**	**Class III**			**Major City/County**		**Other Signalized**	**Class II**	**Class II**
Number of directional through lanes	1	2 - 3	1	2 - 3	1	2 – 3	1	2 – 3	1 – 2	2	2
Posted speed (mph)	45	50	45	45	35	35	40	40		40	40
Free flow speed (mph)	50	55	50	50	40	40	45	45		45	45
Median type (n,nr,r)	n	r	n	r	n	r	n	r		r	r
Left turn lanes (n,y)	y	y	y	y	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n,y)										n,50%,y	n
Outside lane width (n,t,w)										t	t
Pavement condition (u,t,d)										t	
Sidewalk (n,y)											n,50%,y
Sidewalk/roadway separation (a,t,w)											t
Sidewalk/roadway protective barrier (n,y)											n
TRAFFIC CHARACTERISTICS											
Planning analysis hour factor (K)	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910	0.910
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Heavy vehicle percent	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Local adjustment factor	0.98	0.98	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.95	0.95
% turns from exclusive turn lanes	12	12	12	12	12	12	14	14	16	12	12
CONTROL CHARACTERISTICS											
Signalized intersections per mile	1.5	1.0	3.0	3.0	5.0	5.0	3.0	3.0		3.0	3.0
Arrival type (1-6)	3	3	4	4	4	4	4	4	3	4	4
Signal type (a,s,f)	a	a	s	s	s	s	s	s	s	s	s
Cycle length (C)	120	120	120	120	120	120	120	120	120	120	120
Effective green ratio (g/C)	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.41	0.31	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		**Highways**			**State Two-Way Arterials**			**Non-State Roadways**		**Bicycle**	**Pedestrian**
Level of	Class II		Two-Lane	Multilane		Class I	Class II	Class III	Major City/County	Other Signalized		
Service	v/c	Density	% FFS	v/c	Density	ATS	ATS	ATS	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	> 0.917	≤ 0.29	≤ 11	> 42 mph	> 35 mph	> 30 mph	> 35 mph	≤ 10 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	> 0.833	≤ 0.47	≤ 18	> 34 mph	> 28 mph	> 24 mph	> 28 mph	≤ 20 sec	≤2.5	≤ 2.5
C	≤ 0.76	≤ 26	> 0.750	≤ 0.68	≤ 26	> 27 mph	> 22 mph	> 18 mph	> 22 mph	≤ 35 sec	≤3.5	≤ 3.5
D	≤ 0.90	≤ 35	> 0.667	≤ 0.88	≤ 35	> 21 mph	> 17 mph	> 14 mph	> 17 mph	≤ 55 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	> 0.583	≤1.00	≤ 41	> 16 mph	> 13 mph	> 10 mph	> 13 mph	≤ 80 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 0.583	>1.00	> 41	≤ 16 mph	≤ 13 mph	≤ 10 mph	≤ 13 mph	> 80 sec	>5.5	> 5.5

v/c = Demand to Capacity Ratio   % FFS = Percent Free Flow Speed   ATS = Average Travel Speed

02/22/02

TABLE 4 – 9
GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION*

RURAL UNDEVELOPED AREAS

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
2	1,220	2,020	2,740	3,240	3,600
3	1,890	3,110	4,230	5,000	5,560
4	2,560	4,210	5,720	6,770	7,520

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	120	250	410	650	1,060
2	Divided	940	1,540	2,200	2,830	3,140
3	Divided	1,410	2,310	3,330	4,240	4,710

PASSING LANE ADJUSTMENTS
(alter corresponding two-lane LOS A-D volumes indicated percent)

Passing Lane Spacing	Adjustment Factors
5 mi.	+25%
10 mi.	+10%

ISOLATED SIGNALIZED INTERSECTIONS

Lanes	A	B	C	D	E
	Level of Service				
1	**	100	430	580	650
2	**	160	940	1,240	1,360
3	**	240	1,460	1,910	2,320

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 55 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by directional roadway lanes to determine maximum service volume.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
0-49%	**	**	**	**	340
50-84%	**	**	**	**	950
85-100%	**	**	210	>210	***

CITIES OR RURAL DEVELOPED AREAS LESS THAN 5000

FREEWAYS

Lanes	A	B	C	D	E
	Level of Service				
2	1,220	2,020	2,740	3,240	3,600
3	1,890	3,110	4,230	5,000	5,560
4	2,560	4,210	5,720	6,770	7,520

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	120	350	600	820	1,120
2	Divided	950	1,540	2,230	2,890	3,280
3	Divided	1,430	2,310	3,350	4,330	4,920

INTERRUPTED FLOW ARTERIALS

Lanes	Divided	A	B	C	D	E
		Level of Service				
1	Undivided	**	120	590	740	800
2	Divided	**	290	1,360	1,570	1,660
3	Divided	**	450	2,100	2,360	2,500

NON-STATE SIGNALIZED ROADWAYS
(signalized intersection analysis)

Lanes	A	B	C	D	E
	Level of Service				
1	**	**	100	410	540

BICYCLE MODE

(Note: Level of service for the bicycle mode in this table is based on roadway geometrics at 45 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	150	370	>370
50-84%	**	110	180	930	>930
85-100%	150	210	>210	***	***

PEDESTRIAN MODE

(Note: Level of service for the pedestrian mode in this table is based on roadway geometric at 45 mph posted speed and traffic conditions, not number of pedestrian using the facility.) (Multiply motorized vehicle volumes shown by number of directional roadway lanes to determine maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	240	760
50-84%	**	**	**	430	960
85-100%	**	**	500	>500	***

02/22/02

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

http://www11.myflorida.com/planning/systems/sm/los/default.htm

NON-FREEWAY AND SIGNALIZED INTERSECTION ANALYSES DIVIDED/UNDIVIDED ADJUSTMENTS
(alter corresponding volumes by the indicated percent)

Lanes	Median	Left Turn Lanes	Adjustment Factors
1	Divided	Yes	+5%
1	Undivided	No	-20%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

*This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Values shown are two-way annual average daily volumes (based on K_{100} factors) for levels of service and are for the automobile/truck modes unless specifically stated. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. The table's input value defaults and level of service criteria appear on the following page. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, and Pedestrian LOS Model, respectively for the automobile/truck, bicycle and pedestrian modes.
**Cannot be achieved using table input value defaults.
***Not applicable for the level of service letter grade. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

TABLE 4 - 9 (continued)
GENERALIZED PEAK HOUR DIRECTIONAL VOLUMES FOR FLORIDA'S RURAL UNDEVELOPED AREAS AND CITIES OR DEVELOPED AREAS LESS THAN 5,000 POPULATION
INPUT VALUE ASSUMPTIONS

	UNINTERRUPTED FLOW FACILITIES				
	Freeways	**Highways**			
ROADWAY CHARACTERISTICS	**Class I**				
Area type (ru,rd)		ru	ru	rd	rd
Number of directional through lanes	2 - 4	1	2-3	1	2-3
Posted speed (mph)	70	55	55	50	50
Free flow speed (mph)	75	60	60	55	55
Facility length (mi)	7				
Basic segment length (mi)	6				
Interchange spacing per mile	7				
Median (n,y)		n	y	n	y
Left turn lanes (n,y)		y	y	y	y
Terrain (r,l)	l	l	l	l	l
% no passing zone		20		40	
Passing lanes (n,y)		n		n	
TRAFFIC CHARACTERISTICS					
Planning analysis hour factor (K)	0.104	0.098	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.95	0.88	0.88	0.895	0.895
Base capacity (pcphpl)		1700	2200	1700	2100
Heavy vehicle percent	9.0	5.0	9.0	4.0	4.0
Local adjustment factor	0.90	0.90	0.90	0.92	0.92

	INTERRUPTED FLOW FACILITIES						
	Isolated Signalized Intersections	**Arterials**		**Non-State Signalized**	**Bicycle**		**Pedestrian**
ROADWAY CHARACTERISTICS		**Class I**			**Class I**		**Class I**
Area type (ru,rd)	ru	rd	rd	rd	ru	rd	rd
Number of directional through lanes	1 - 3	1	2 - 3	1	1	1	1
Posted speed (mph)		45	45		55	45	45
Free flow speed (mph)		50	50		60	50	50
Median type (n,nr,r)		n	r		n	n	n
Left turns lanes (n,y)	y	y	y	y	y	y	y
Paved shoulder/bicycle lane (n.y)					n,50%,y	n,50%,y	n
Outside lane width (n,t,w)					t	t	t
Pavement condition (u,t,d)					t	t	
Sidewalk (n,y)							n,50%,y
Sidewalk roadway separation (a,t,w)							t
Sidewalk roadway protective barrier (n,y)							n
TRAFFIC CHARACTERISTICS							
Planning analysis hour factor (K)	0.098	0.097	0.097	0.097	0.098	0.097	0.097
Directional distribution factor (D)	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Peak hour factor (PHF)	0.88	0.895	0.895	0.895	0.88	0.895	0.895
Base saturation flow rate (pcphpl)	1900	1900	1900	1900	1700	1900	1900
Heavy vehicle percent	5.0	3.0	3.0	1.5	6.0	3.0	3.0
Local adjustment factor	0.90	0.92	0.92	0.92	0.90	0.92	0.92
% turns from exclusive turn lanes	12	12	12	25	0	12	12
CONTROL CHARACTERISTICS							
Signalized intersections per mile		2.0	2.0		0.5	2.0	2.0
Arrival type (1-6)	3	3	3	3	3	3	3
Signal type (a,s,f)	a	s	s	s	a	s	s
Cycle length (C)	60	90	90	60	60	90	90
Effective green ratio (g/C)	0.44	0.44	0.44	0.31	0.44	0.44	0.44

LEVEL OF SERVICE THRESHOLDS

	Freeways		**Highways**						**Isolated Intersections**	**Arterials**	**Non-State Signalized Roadways**	**Bicycle**	**Pedestrian**
Level of	Class I		Two-Lane ru	Two-Lane rd	Multilane ru		Multilane rd						
Service	v/c	Density	v/c	% FFS	v/c	Density	v/c	Density	Control Delay	ATS	Control Delay	Score	Score
A	≤ 0.34	≤ 11	≤ 0.12	> 0.917	≤ 0.30	≤ 11	≥ 0.29	≤ 11	≤ 5 sec	> 42 mph	≤ 5 sec	≤ 1.5	≤ 1.5
B	≤ 0.56	≤ 18	≤ 0.24	> 0.833	≤ 0.49	≤ 18	≥ 0.47	≤ 18	≤10 sec	> 34 mph	≤ 10 sec	≤ 2.5	≤ 2.5
C	≤ 0.76	≤ 26	≤ 0.39	> 0.750	≤ 0.70	≤ 26	≥ 0.68	≤ 26	≤ 15 sec	> 27 mph	≤ 15 sec	≤ 3.5	≤ 3.5
D	≤ 0.90	≤ 35	≤ 0.62	> 0.667	≤ 0.90	≤ 35	≥ 0.88	≤ 35	≤ 20 sec	> 21 mph	≤ 20 sec	≤ 4.5	≤ 4.5
E	≤ 1.00	≤ 45	≤ 1.00	> 0.583	≤ 1.00	≤ 40	≥ 1.00	≤ 41	≤ 40 sec	> 16 mph	≤ 40 sec	≤ 5.5	≤ 5.5
F	> 1.00	> 45	≤ 1.00	≤ 0.583	> 1.00	> 40	< 1.00	> 41	> 40 sec	≤ 16 mph	> 40 sec	> 5.5	> 5.5

v/c = Demand to Capacity Ratio   % FFS = Percent Free Flow Speed   ATS = Average Travel Speed   ru = Rural Undeveloped   rd = Rural Developed

02/22/02

4.5

SPECIAL ASPECTS OF THE GENERALIZED TABLES

Varying Traffic Volumes along a Facility

The volumes in the Generalized Tables should be considered as average volumes over the facility under analysis. For example, if a 4-mile facility has AADT counts of 23,000, 22,000, 25,000, 23,000, and 27,000 for segments over its length, FDOT recommends the use of the average value 24,000 for comparison to the tables to determine the LOS. (Note: In previous editions, FDOT recommended the use of the median value of 23,000; however, for simplicity and greater consistency, FDOT is now recommending the use of the average.) Use of the average volume works reasonably well unless there is one segment that has a widely disparate value, in which case a median value may be more appropriate.

Mid-Block Considerations

The number of lanes for an arterial is determined at major intersections, not mid-block.

In general, Q/LOS analyses for interrupted flow facilities primarily center on the signalized intersections. The majority of motorist aggravation, generally attributable to delays, occurs at signalized intersections on arterials. Therefore, when using the Generalized Tables, the number of lanes for arterials and other interrupted flow facilities should be determined at major intersections, rather than mid-block.

For uninterrupted flow facilities and non-automobile modes, travelers place a greater emphasis on mid-block considerations. For example, on two-lane highways in rural undeveloped areas, LOS is largely determined by the ability to pass. For freeways, most travelers are concerned about the operation of the whole facility and not the operation of particular interchanges. For bicycle and pedestrian movements, the Bicycle LOS and Pedestrian LOS Models are calibrated for mid-block conditions. For bus LOS, the emphasis is on the ability to get on the bus over the length of facility with less importance placed on intersections. Therefore, in general, the number of lanes for these situations concentrate on mid-block considerations.

Non-State Roadways

The primary purpose of this Handbook is to compute the LOS for state facilities. However, because the techniques have great potential use by local governments, the Generalized Tables and software also have been structured for their needs. The Generalized Tables are reasonably well suited to local governments who desire to use them to evaluate roads under local jurisdiction. A feature of the urbanized and transitioning/urban Generalized Tables is that two types of non-state roadways are addressed: major city/county roadways and other signalized roadways.

Major city/county roadways

Major city/county roadways are streets not on the State Highway System that would be classified as an arterial roadway on a city/county major thoroughfare plan or similar planning document. These roadways have roadway, traffic and control characteristics similar to state roads classified as urban minor arterials.

Although state arterials are divided into five types (Classes I-IV and uninterrupted flow) in the Generalized Tables to primarily account for the effects of signalization density, space was only provided for one "grouping" of non-state roads that act like arterials. A medium density of signalized intersections, which is 3 signalized intersections per mile, is assumed. A practical alternative generalized planning approach to using the single set of values in the Generalized Tables for those types of facilities, and to better account for signal density, is to apply a 5 percent reduction in the corresponding state values. The reason for this reduction is that these roads resemble state minor arterials, as opposed to state principal arterials, whose default values predominate in the Generalized Tables.

Other signalized roadways

A signalized roadway not on the State Highway System and also considered by the local government not to be a major city/county roadway is considered an "other signalized roadway". Because these two types of roadways are not on the State Highway System, local governments should primarily make the determination of whether the roads are considered major facilities. The role of FDOT would generally be advisory.

Evaluating collectors

The HCM2000 LOS criteria address arterials, rather than collectors or local streets. FDOT considers it appropriate for local governments to decide whether to analyze collectors as "major city/county roadways" or "other signalized roadways."

Non-state rural roadways

Uninterrupted flow facilities in areas with less than 5,000 population are analyzed the same, regardless of whether they are state facilities or not. Where non-state roads are signalized, volumes are provided in Tables 4-3, 4-6 and 4-9.

In the rural undeveloped portion of Tables 4-3, 4-6 and 4-9, it should be noted that non-state roadways should be treated as two-lane uninterrupted highways.

Unachievable Levels of Service

Higher quality levels of service for the automobile, bicycle and pedestrian modes may not be achieved, even with extremely low traffic volumes given the default values use in the Generalized Tables. In the case of automobiles, the higher quality levels of service cannot be achieved primarily because the control, or signalization, characteristics simply will not allow vehicles to attain relatively high average travel speeds. In the case of bicycles and pedestrians, it is primarily caused by the lack of facilities serving those modes. The "**" symbol and corresponding footnote reflect this "unachievable" concept. The "unachievable" concept and "**" symbol also apply to service volume tables generated in ARTPLAN.

Not Applicable Levels of Service

Lower quality levels of service for the automobile, bicycle and pedestrian modes may not be applicable, even with extremely high traffic volumes given the default values used in the Generalized Tables. In the case of automobiles, the lower quality levels of service are not applicable primarily because the control characteristics simply 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 pass through.

In the case of bicycles and pedestrians, it is primarily caused by the existence of facilities adequately serving those modes. For example, if a sidewalk exists, it is very difficult to establish a set of conditions in which the LOS to the pedestrian is F.

Essentially, once the maximum service volume is reached, the next LOS grade is F. For example, in Table 3-1 for multilane Class I arterials, if demand volumes are greater than the LOS D threshold, then the LOS is F, and if the volume is at the LOS D threshold, the LOS is D; essentially LOS E does not exist. The "***" symbol and corresponding footnote reflect this "not applicable" concept. The "not applicable" concept and "***" symbol also apply to service volume tables generated in ARTPLAN.

Bicycle LOS and Motorized Vehicle Thresholds

Bicycle lanes and motorized vehicles primarily determine bicycle LOS, not the number of bicyclists.

The bicycle portions of the Generalized Tables make primary use of the two most important factors in determining the LOS for bicyclists: the existence of paved shoulders/bicycle lanes and motorized vehicle volumes. It is important to note that the volumes shown in the tables are not the number of bicyclists; rather they are the number of motorized vehicles in the outside lane. Unlike automobile LOS that is highly dependent on the number of other motorized vehicles on the roadway, bicycle LOS is not determined by how many other bicyclists are on road; rather, it is primarily determined by the bicycle accommodations on the roadway and volume of motorized vehicles. Default values are assumed for the other important factors such as speed of motorized vehicles, outside lane width, and pavement conditions, in establishing the bicycle LOS thresholds.

Three broad ranges of paved shoulder/bicycle lane percent coverage are provided: 0-49%, 50-84%, and 85-100%. The position reflected in the tables is that if a bicycle lane exists for less than 50% of the roadway facility, then no benefit is given to bicyclists. The interpretation of the 85-100% coverage is that a bicycle lane exists for the whole facility. Bicycle lane coverage of 50-84% is treated as if a bicycle lane exists over 50% of the facility. If a facility has a wide outside lane, the 50-84% category may be used because the benefit of a wide outside lane is approximately equal to 50% bicycle lane coverage. If the roadway does not have a wide outside lane over its whole length, no bicycle accommodation credit should be given.

The other factor used in the Generalized Tables is the volume of motorized vehicles in the outside lane. For analysis purposes, motorized vehicle volumes are assumed to be equally spread across the number of directional roadway lanes. Unlike the automobile entries on the table, in which the number of lanes is an entry into the tables, a step of multiplying the motorized volume by the number of lanes is needed in order to use the volume (hourly directional, hourly non-directional, or daily) of motorized vehicles. For example, in Table 4-7, the LOS C threshold for 0% bicycle lane coverage is 170 vehicles for the outside lane. If the roadway has 4 lanes, then the 170 vehicles would be multiplied by 2 (number of directional lanes) in order to determine the maximum volume of motorized vehicles for bicycle LOS C in one direction of flow. The additional step was included to simplify the appearance of the tables and to save space.

Pedestrian LOS and Motorized Vehicle Thresholds

Sidewalks and motorized vehicles primarily determine pedestrian LOS, not the number of pedestrians.

The pedestrian portions of the Generalized Tables make primary use of the two most important factors in determining the LOS for pedestrians: the existence of a sidewalk and motorized vehicle volumes. It is important to note that the volumes shown in the tables are not the number of pedestrians; rather, they are the number of motorized vehicles in the outside lane. Unlike automobile LOS that is highly dependent on the number of other motorized vehicles on the roadway, pedestrian LOS is not determined by how many other pedestrians use the facility; rather, it is primarily determined by the presence of sidewalks and the volume of motorized vehicles. Default values are assumed for the other important factors, such as sidewalk/roadway separation, sidewalk/roadway protective barrier, and speed of motorized vehicles, in establishing the pedestrian LOS thresholds.

Three broad ranges of sidewalk coverage are provided: 0-49%, 50-84%, 85–100%. The position reflected in the tables is that if a sidewalk exists in the peak direction of traffic flow for less than 50% of the roadway facility, then no benefit is given to pedestrians. The interpretation of the 85-100% coverage is that a sidewalk exists for the whole facility. Sidewalk coverage of 50-84% is treated as if the facility has 50% coverage.

The other factor used in these tables is the volume of motorized vehicles in the outside lane. For analysis purposes, motorized vehicle volumes are assumed to be equally spread across the number of directional roadway lanes. Unlike the automobile entries on the table, in which the number of lanes is an entry into the tables, a step of multiplying the motorized volume by the number of lanes is needed in order to use the volume (hourly directional, hourly non-directional, or daily) of motorized vehicles. For example, in Table 4-7, the LOS C threshold for 100% sidewalk coverage is 590 vehicles for the outside lane. If the roadway has 4 lanes, then the 590 vehicles would be multiplied by 2 (number of directional lanes) in order to determine the maximum volume of motorized vehicles for pedestrian LOS C in one direction of flow. The additional step was included to simplify the appearance of the tables and to save space.

Sidewalk on only one side of a roadway

All of the techniques contained in this Handbook and accompanying software are based on a directional analysis. For example, in the case of evaluating the automobile LOS on arterials, the LOS is for the peak directional flow, and the off peak direction could have a higher, lower, or the same LOS. This directional technique results in some unique perspectives when evaluating pedestrian LOS. Unlike facilities (and buses) for the other modes, sidewalks, whether on one side or both sides of a road, serve pedestrians in both directions. Furthermore, analysts should be especially careful when using the Generalized Tables for determining pedestrian LOS when there is a sidewalk only on one side of the roadway. Because all the Generalized Tables are based on peak hour directional analyses, pedestrian LOS based on the tables should be considered applicable only to the direction of the peak flow of traffic. When using the tables, there is typically a difference of two LOS grades if the sidewalk is, or is not, on the same side of roadway as the peak flow of traffic. Generally, having sidewalks on both sides of arterials in developed areas is considered desirable; yet, the Generalized Tables do not adequately reflect that concept.

A two LOS grade difference is typical if the sidewalk is or is not on the same side as the peak traffic flow.

Bus LOS and Hourly Directional Bus Frequency

Bus frequency and pedestrian accessibility determine bus LOS.

The bus portions of the Generalized Tables are primarily dependent on bus frequency, which is the number of scheduled fixed route buses that have a potential to stop in a given segment in the peak direction of flow in a 1 hour time period. That measure is supplemented by pedestrian accessibility. In the Generalized Tables, pedestrian accessibility is represented by three broad ranges of sidewalk coverage.

Unique aspects of bus values in tables

Volumes shown are the number of buses per hour in the peak direction.

There are three unique aspects of bus mode entries of the Generalized Tables. First, it is important to note that the volumes shown in the tables are the number of buses per hour. Unlike automobile, bicycle and pedestrian LOS thresholds, the bus mode LOS thresholds are not related to the number of motorized vehicles on the roadway. Second, regardless of the table used, all numbers are shown in terms of buses per hour only for the peak hour in the single direction of higher traffic flow. Thus, even in the daily urbanized table (Table 4-1), the threshold values shown are still in terms of peak hour directional buses. Third, the daily urbanized table (Table 4-1) is the only table that incorporates the daily variable of bus span of service and excludes a planning analysis hour factor (K) and a directional distribution factor (D). Span of service becomes relevant when reporting on a daily basis because availability of transit becomes important if a passenger cannot use a bus for the return, or originating, trip.

Median and Left Turn Lane Adjustments

For simplicity, the Generalized Tables have intuitive factors that have been approved by the Level of Service Task Team, but not contained in the HCM2000, for the effects of mid-block medians and left turn lanes at intersections on motorized vehicles. A median has the effect of changing the adjusted saturation flow rate or service volume by 5 percent. In Florida, most two-lane roadways do not have a median (e.g., a two-way left turn lane), so the tables assume no median for those facilities. However, if there is a median, appropriate volumes should be increased 5 percent. Most multilane arterials and highways in Florida have medians, so the tables are set up to assume medians for those facilities. However, if there is no median, appropriate volumes should be decreased 5 percent. Also in Florida, most roadways have left turn lanes at nearly all streets except those with very low volumes. If a roadway does not have left turn lanes at major intersections, the service volume should be lowered 20 percent. The cumulative effects of medians and left turn lanes from typical occurrences are shown in the Generalized Tables.

One-Way Facilities

For simplicity, the Generalized Tables have an intuitive factor that has been approved by the Level of Service Task Team, but not contained in the HCM2000, for the effects of one-way streets on motorized vehicles. Essentially, one-way pairs are assumed to have a 20 percent higher service volumes than corresponding two-way roadways with the same number of lanes. However, the Generalized Tables treat each facility of a one-way pair as a separate facility. Thus, when using the hourly directional tables (4–7 through 4-9), appropriate volumes should be increased by 20 percent, while when using the daily or two-way directional tables (4-1 through 4-6), a 40 percent reduction should be applied to the values shown. This latter situation is the equivalent of halving the number of lanes and adding 20 percent to the service volume.

For example, if using Table 4-7 for an hourly directional analysis of a one-way facility with 3 lanes and 3 signalized intersections per mile, then the corresponding 6-lane two-way Class II arterial service volumes would be increased 20 percent. For a LOS D, this would correspond to 3,080 (e.g., 1.2* 2,570) vehicles per hour. On the other hand, if Table 4-1 for a daily analysis is being used to evaluate the same facility, a 40 percent reduction should be applied (e.g., 0.6*49,200 = 29,500).

4.6

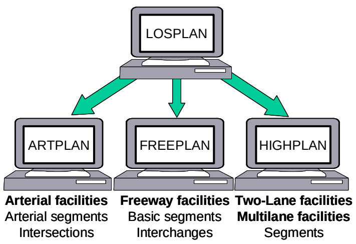
EXAMPLE PROBLEMS

By September 2002, FDOT intends to have example problems dealing with the generalized tables posted on its website:

http://www11.myflorida.com/planning/systems/sm/los/default.htm

5 CONCEPTUAL PLANNING ANALYSIS (LOS Calculating Software)

5.1 INTRODUCTION



Conceptual planning is a type of planning or preliminary engineering application detailed enough to reach a decision on design concept and scope (e.g., 4 through lanes with a raised median), conducting alternatives analyses (e.g., 4 through lanes undivided versus 2 through lanes with a two-way left turn lane), and performing other technical analyses. Conceptual planning is applicable when there is a desire for a good determination of the LOS of a facility without doing detailed, comprehensive operational analyses, and for determining needs when a generalized planning evaluation is simply not accurate enough. Florida's LOS planning software, which includes ARTPLAN, FREEPLAN, and HIGHPLAN, is the major tool in conducting this type of analysis. Although considered outstanding planning and preliminary engineering tools, the software programs are not detailed enough for final design or operational analysis work and should not be used for those purposes.

In general, the software is based on the HCM2000 techniques, with ARTPLAN also based on the Transit Capacity and Quality of Service Manual (TCQSM), Bicycle LOS Model, and Pedestrian LOS Model. Simplifying assumptions and planning extensions to these primary Q/LOS evaluation techniques are presented in Sections 2.5 and 2.6.

Users of previous versions of this Handbook and accompanying software should note that FDOT has reduced the number of software programs from eight to three, while at the same time has expanded the analytical capabilities of the programs. ARTPLAN has been broadened to include the bicycle, pedestrian, and bus modes. FREEPLAN and HIGHPLAN include the direct calculation of LOS, as well as being able to generate service volume tables. Previously, FDOT had "TAB" programs such as FREETAB, that generated service volume tables. This table-generating feature is now directly incorporated into the facility planning analyses found in ARTPLAN, FREEPLAN and HIGHPLAN.

Self executing programs

Previous versions of FDOT's software required a spreadsheet program to operate, and these new programs are stand-alone, executable programs. The programs are Windows-based and were developed with the Visual Basic 6.0 development environment. This new development effort has allowed the implementation of several new features, such as toolbar buttons, pull down menus, form access tabs, specially formatted output reports, and context-sensitive help.

Access to programs

Windows 2000 and NT operating systems also implemented more advanced security features over previous versions. One security feature is the implementation of creating subordinate user accounts to the administrator account, which allows the administrator to restrict access to certain parts of the hard drive. If a computer user has limited access to the hard drive under a logon account, the system administrator may need to install the programs.

Minimum requirements

The minimum requirements for running ARTPLAN, as well as the other PLAN programs are the following:

- Pentium class processor (133 MHz or above)
- 32 MB RAM
- 10 MB of available hard drive space
- Monitor capable of displaying 800x600 resolution
- Windows 95 or higher
- Internet Explorer 5.0 or higher

After the installation process, an ARTPLAN, FREEPLAN or HIGHPLAN icon should be present under "Programs" folder of the "Start" menu. Select this icon to launch the program.

Printing results

Printing operations utilize a new technique that takes advantage of the capabilities of Microsoft's Internet Explorer. For the printing capabilities to work properly within the programs, a version 5.0 or higher of Internet Explorer must be installed. Internet Explorer is distributed freely by Microsoft, and if the version 5.0 or higher is not installed, the most recent version may be downloaded from:

www.microsoft.com/windows/ie/default.asp, or contact their computer support personnel.

Although FDOT is comfortable with the current level of performance and reliability of the programs, as with any new software release, it is expected that some "bugs" will be

Reporting software bugs

discovered once the programs experience extensive use. A software "bug" report form is included in Section 8.2. Software users are encouraged to report any "bugs" to the FDOT personnel listed on the form.

Software patches

FDOT intends to provide major "bug" fix updates, such as calculation errors, soon after they discovered, and minor "bug" fix updates, as well as recommended enhancements, by September 2002. FDOT does not plan to provide any major changes to the software prior to 2005.

New statewide defaults automatically appear when changes are made to area types and classes.

When opening a program, a base situation with a set of defaults will appear. For example, when FREEPLAN is opened, a Class III facility in an urbanized area and its statewide defaults appears. For the benefit of users, the programs have been structured so that changing area types and roadway classes will automatically call up a new set of statewide defaults. For example, if the analysis changes from an urbanized Class II arterial to a rural developed Class I facility, a new set of defaults reflecting that area and roadway type will automatically appear.

Calculation results: LOS and service volume tables

The three software programs (ARTPLAN, FREEPLAN, HIGHPLAN) have two major LOS calculating features. First, each calculates the LOS for the facility being analyzed and also shows the calculated service measure (e.g., average travel speed, adjusted bus frequency) or score (e.g., bicycle LOS score). Second, each calculates three service volume tables: hourly volumes in the peak direction, hourly volumes in both directions, and annual average daily traffic volumes. It should be noted that all the service volume tables are actually based on the hourly volumes in the peak direction, with the other two tables presented in a different form for the benefit of users who work on an hourly two-way or daily basis.

Screen layout

In general the programs have:

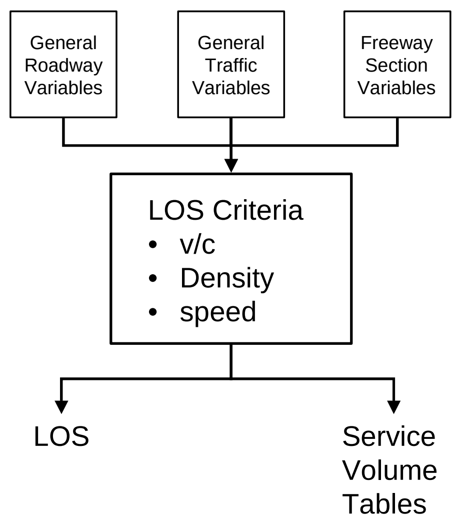
- an opening screen,
- a general facility data input screen in which inputs applicable to the whole facility are placed or statewide defaults are assumed,
- a segment data input screen in which inputs applicable to each segment are placed or facility-wide data are assumed,
- a LOS results screen in which LOS results for the facility and each segment are shown, and
- a service volume table screen in which maximum service volume tables based on the previous input values are shown.

Depending upon the complexity of the specific programs, some screens may be combined (e.g., HIGHPLAN combines the input and LOS results screens) and some screens may be expanded (e.g., ARTPLAN includes a pedestrian sub-segment screen). Tool buttons and tabs allow the analyst to proceed from one screen to another.

Calculation process

The programs use facility specific roadway, traffic and, in the case of ARTPLAN, control or signalization data. The programs apply the HCM2000/TCQSM/BLOS/PLOS calculation techniques to determine the LOS. The calculation processes are illustrated in Figure 5-1, with FREEPLAN used in the example.

Figure 5 – 1
FREEWAY LOS AND SERVICE VOLUME CALCULATION PROCESS



Calculating service volumes

To develop service volume tables, the LOS calculation must be performed immediately prior to the service volume table calculation.

Volumes are outputs instead of inputs when developing service volume tables.

In general, the process of calculating maximum service volumes is to use all inputs, except for AADT, K, and D to determine LOS, the applicable service measure criteria, and then calculate volume instead of LOS. In other words, rather than solving for the LOS criterion given volume, the programs solve for volume given the LOS criterion. When using the software to generate a service volume table, the AADT on the facility data screen is ignored and the initial value shown on the facility data screen need not be altered.

When the general facility data screen appears, a typical set of default values appear for each of the programs. In general, selection of the appropriate area type and roadway class will cause a new set of statewide defaults to appear more specific to the roadway being analyzed, saving time in entering inputs. However, these defaults may be changed as necessary.

Automatic calculations

In general, the programs automatically calculate results upon entering input data. In situations where this is not the case, the results are presented in the following sections under the applicable program.

Getting help

Each of the programs has a complete Help feature. For ARTPLAN and HIGHPLAN, context sensitive help can be obtained by pressing the F1 key. A help topic will pop up corresponding to where the cursor is located. Additional help information can also be found under the Help dropdown menu found on the on the menu bar. For FREEPLAN, context sensitive help can be obtained by clicking on the question mark sign next to a data input item.

If additional help is needed, contact the applicable FDOT district or central office person listed in Chapter 7.

5.2 ARTPLAN

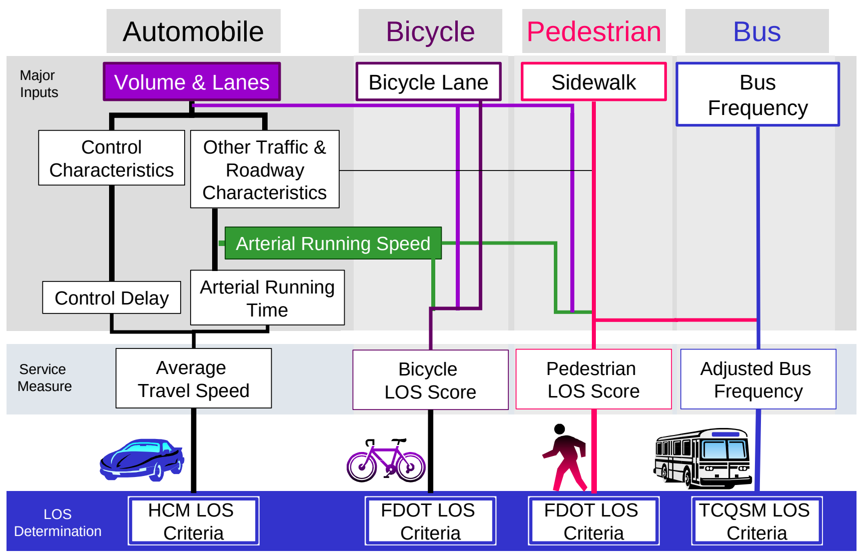
ARTPLAN, designed for arterial planning, is FDOT's conceptual planning software for signalized roadways. For the automobile mode, ARTPLAN is primarily used to analyze signalized roadways in which average travel speed is the service measure used to determine LOS. It is widely recognized as the primary planning software program implementing the HCM2000 urban streets methodology (HCM2000 Chapter 15). For the automobile mode, it may also be used for a simplified LOS analysis of the through movement at a signalized intersection. For the bicycle mode, ARTPLAN is the conceptual planning application of the Bicycle LOS Model methodology applied to roadway sections and facilities. For the pedestrian mode, ARTPLAN is the conceptual planning application of the Pedestrian LOS Model methodology applied to roadway segments and facilities. For the bus mode, ARTPLAN is the conceptual planning application of the TCQSM methodology applied to bus route segments and roadway facilities.

ARTPLAN is now multimodal in structure.

ARTPLAN is multimodal in structure with the facility's roadway, traffic and control characteristics calculated simultaneously to determine the LOS for the automobile, bicycle, pedestrian and bus modes. As quality of service of one mode improves, a positive, neutral or negative effect on the other modes may occur. For example, as running speed of automobiles increases, the LOS may improve for automobiles, but the LOS for bicyclists may decrease. Figure 5-2 provides an overview of how the modes and their levels of service are linked.

Figure 5 – 2

SIMPLIFIED MULTIMODAL FLOW CHART



As shown in the figure, the vehicular volume and number of lanes significantly affect the automobile, bicycle and pedestrian levels of service. Other roadway and traffic variables, plus control or signalization variables, determine the automobile LOS. The motorized vehicle running speed, which is calculated as part of the automobile LOS, is also an important determinant of bicycle and pedestrian LOS. Together with the presence of bicycle lanes and sidewalks, motorized vehicle volume and speed are the main determinants of bicycle and pedestrian LOS. Bus LOS is primarily determined by bus frequency, but is also largely tied to pedestrian LOS.

LOS is calculated for each mode and not combined.

Noteworthy, ARTPLAN does not combine the LOS for each of the modes into one overall LOS for the facility because there is no professionally acceptable or scientifically valid technique for combining the LOS (see Section 1.4).

Special aspects about operating ARTPLAN

Tip: Start a new file after every LOS determination.

Some special aspects about operating ARTPLAN are listed below:

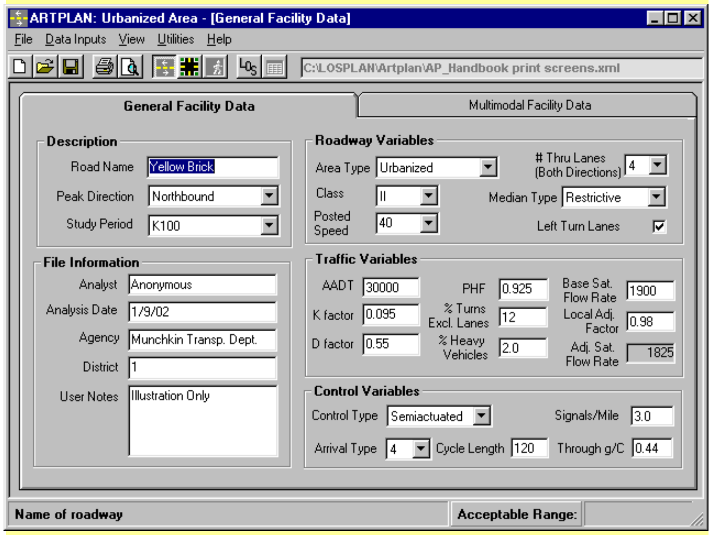
- Analysts are encouraged to start a new file after every LOS determination. When conducting multiple ARTPLAN runs, the facility data information in the segment data and multimodal segment data screens were not frequently restored/applied. After making the first LOS analysis, changes made in the facility data screens are not automatically transferred to the segment data screens. The restore/apply buttons provide that capability, but analysts must remember to activate the feature.
- To input multimodal segment data by segments, analysts must select each respective segment appearing on the left side of the multimodal segment data screen;
- To input pedestrian sub-segment data, analysts must select the pedestrian button on the tool bar in order to toggle to the multimodal segment data screen; and
- Up to 3 pedestrian sub-segments are allowed for a given roadway segment. The percent of the segment's length of each sub-segment is entered. The program assumes there are no sub-segments, so 100% appears until the analyst changes the value.

ARTPLAN input and output screens

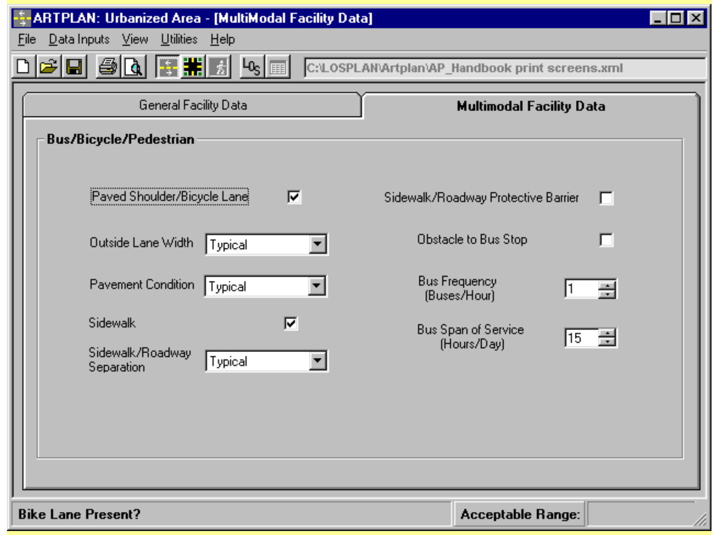
ARTPLAN input and output screens appear in Figures 5-3 and 5-4.

Figure 5 – 3
ARTPLAN INPUT SCREENS

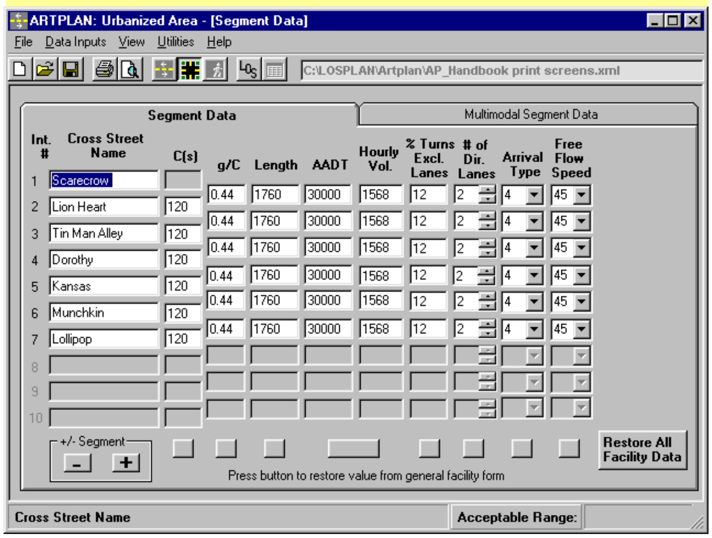
General Facility Data



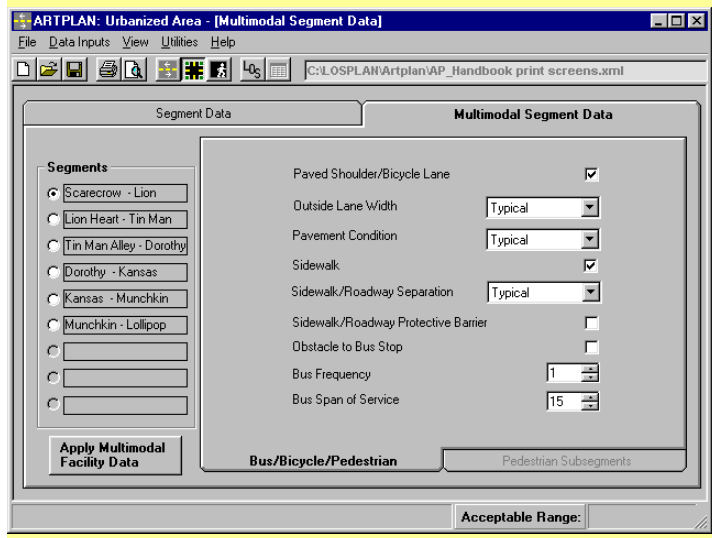
Multimodal Facility Data



General Segment Data



Multimodal Segment Data



Pedestrian Sub-segment Data

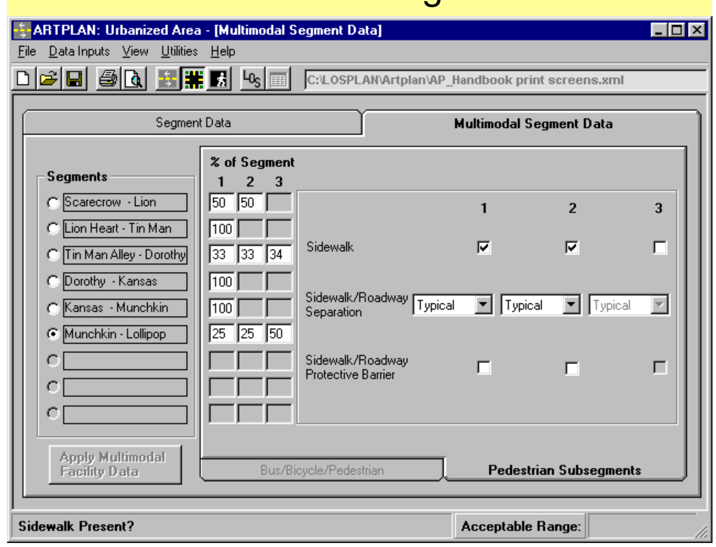
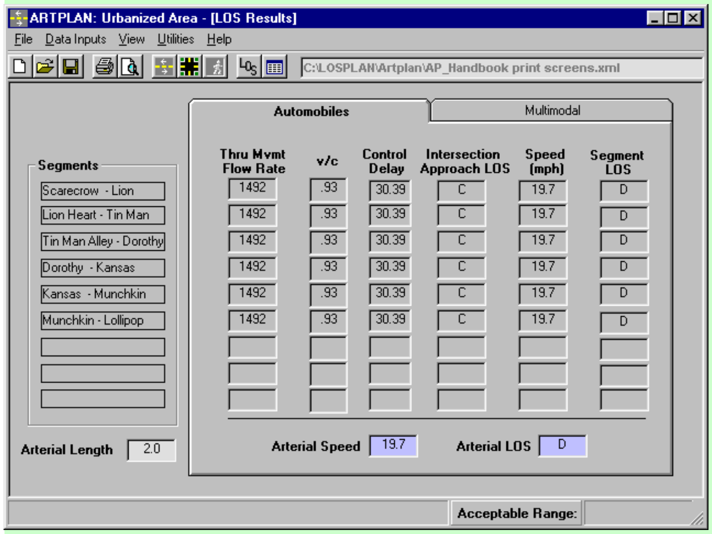
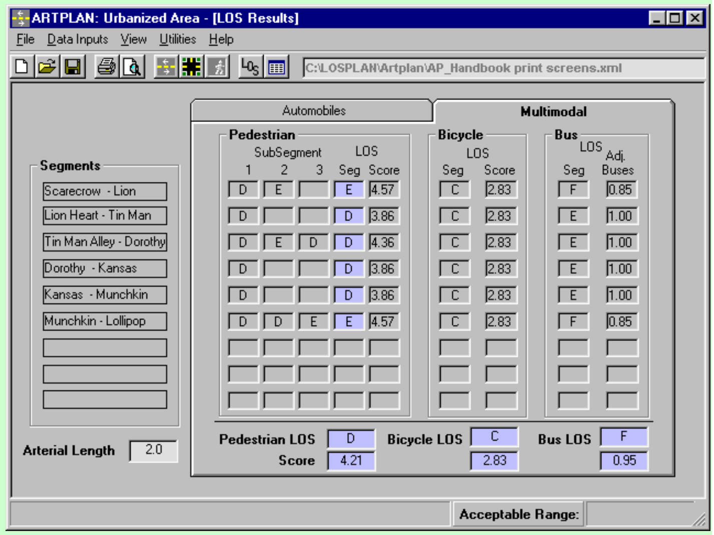


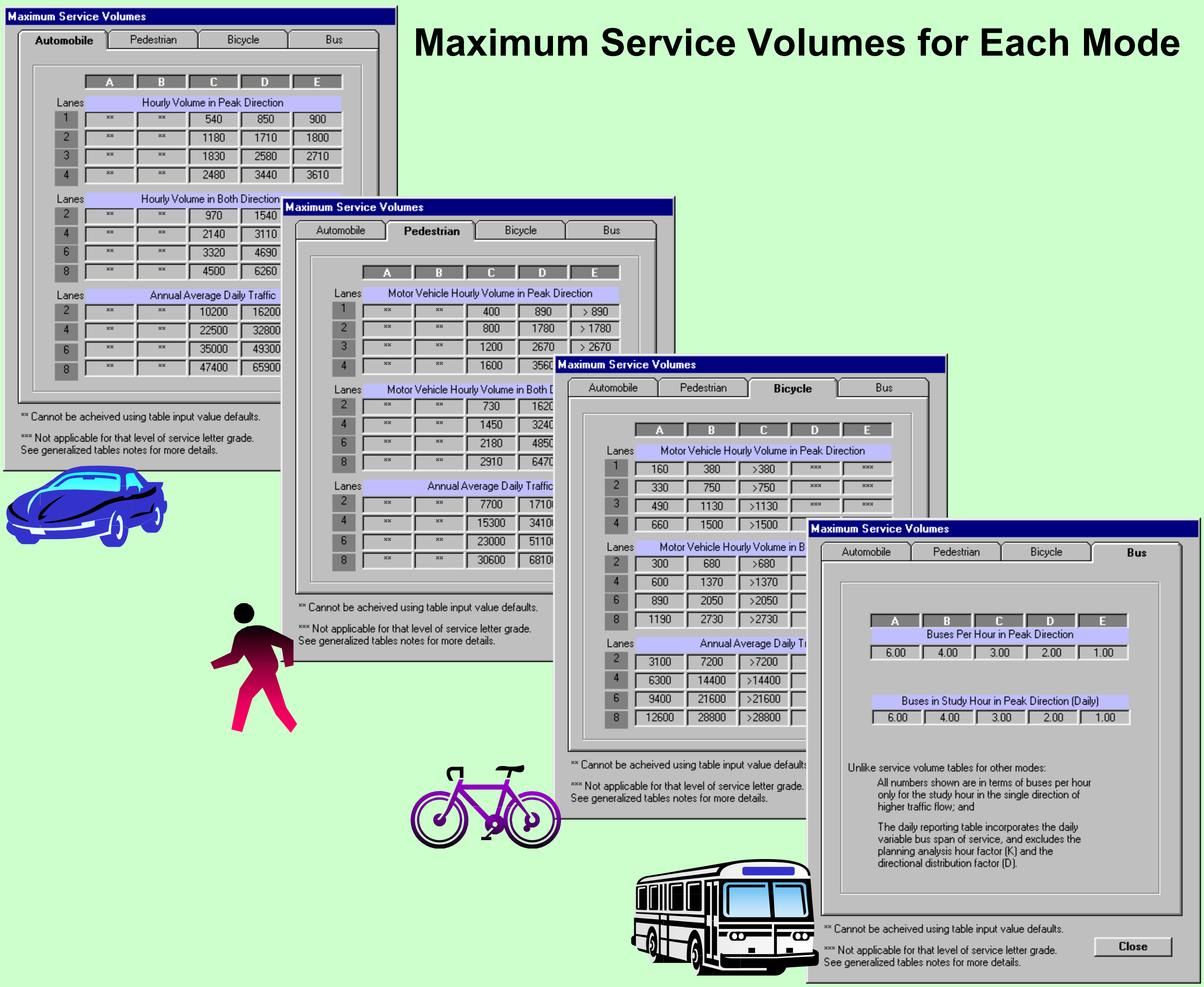
Figure 5 – 4
ARTPLAN OUTPUT SCREENS

Level of Service for Each Mode





Maximum Service Volumes for Each Mode



5.3

FREEPLAN

FREEPLAN was developed specifically for planning applications.

FREEPLAN, designed for freeway planning, is FDOT's conceptual planning software for freeways, multilane divided roadways with at least two lanes for exclusive use of traffic in each direction and full control of ingress and egress.

FREEPLAN features

Major features of FDOT's freeway planning application and software (FREEPLAN) are:

- Use of the HCM2000 (Chapter 22) as the primary resource document for the methodology, such that the FREEPLAN methodology should "not be inconsistent" with the HCM2000, but, as appropriate, extend the HCM2000 for planning purposes;
- Concentration on the through vehicle while being sensitive to the analysis of other vehicles on the freeway and on segments of the freeway;
- Use of four freeway classes based primarily on interchange spacing, which is very similar in approach to the HCM's use of four arterial classes largely based on signalized intersection spacing;
- Rather than combining point analyses (e.g., ramps), the approach is structured towards combining segments (e.g., interchange areas, toll plaza influence areas);
- LOS thresholds based on the density criteria from the HCM2000's basic freeway segment chapter;
- Capacity reductions in interchange areas;
- Use of a "local adjustment factor" or driver population factor based primarily on freeway class and location; and
- Resulting volumes matching reasonably well with actual Florida traffic counts.

Special aspects about operating FREEPLAN

Some special aspects about operating FREEPLAN are listed below:

- The interchange influence area consists of the length from the off ramp gore to on ramp gore, plus 1,500 feet extending from each gore. As a default, the typical interchange influence area is 1 mile consisting of 1,500 feet prior to the off ramp gore, 2,280 feet from gore to gore, and 1,500 feet past the on ramp gore; and
- Basic segment influence areas are the same as the basic segment length.

- If the gore to gore length between interchanges is less than 3,000 feet, a button appears on the far left of the segment input data screen which allows an analysis of auxiliary lanes. Auxiliary lanes generally less than 2,500 feet are analyzed using the HCM2000 weaving section methodology. In general, from 2,500 feet to 3,000 feet the lanes are considered to add an additional half lane of capacity. Beyond 3,000 feet the lanes are considered a full lane. If the analyst chooses an auxiliary lane for all the available segments of the freeway facility, FREEPLAN assumes their benefits extend to the interchanges at the beginning and ending of the facility. (Also see Section 3.4 on freeway auxiliary lanes).

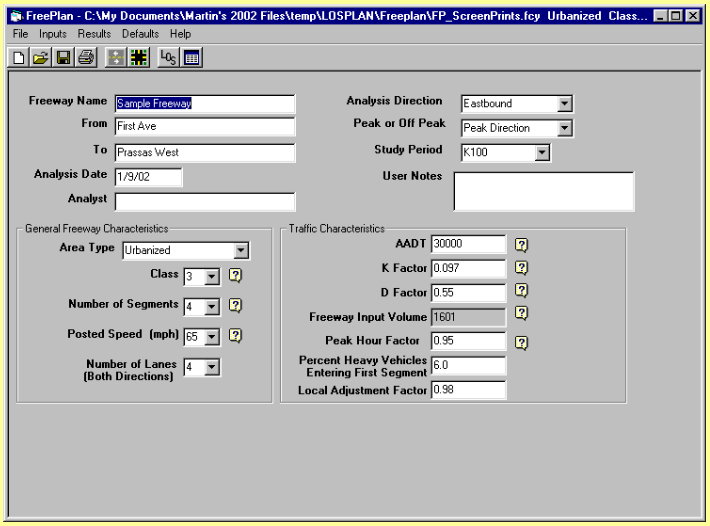
FREEPLAN input and output screens

FREEPLAN input and output screens appear in Figure 5-5.

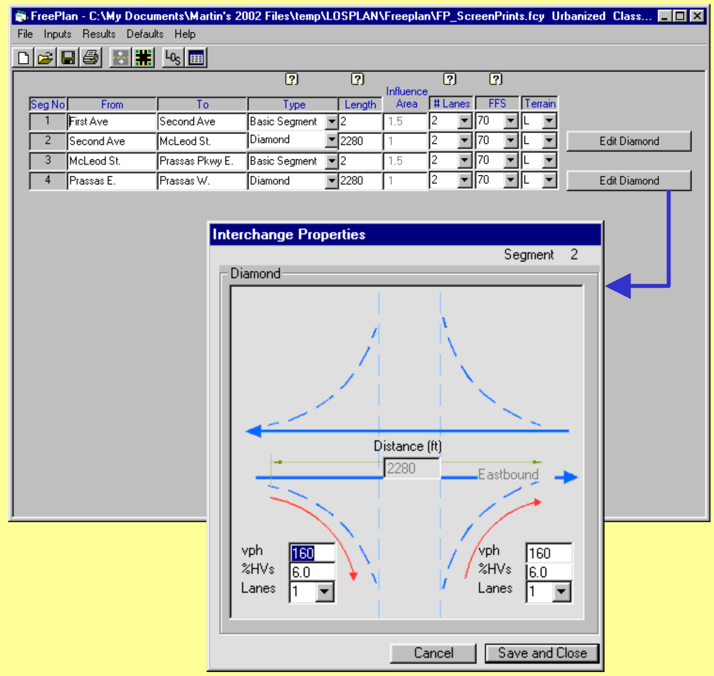
Figure 5 – 5
FREEPLAN INPUT AND OUTPUT SCREEENS

Input Screens

Facility Data

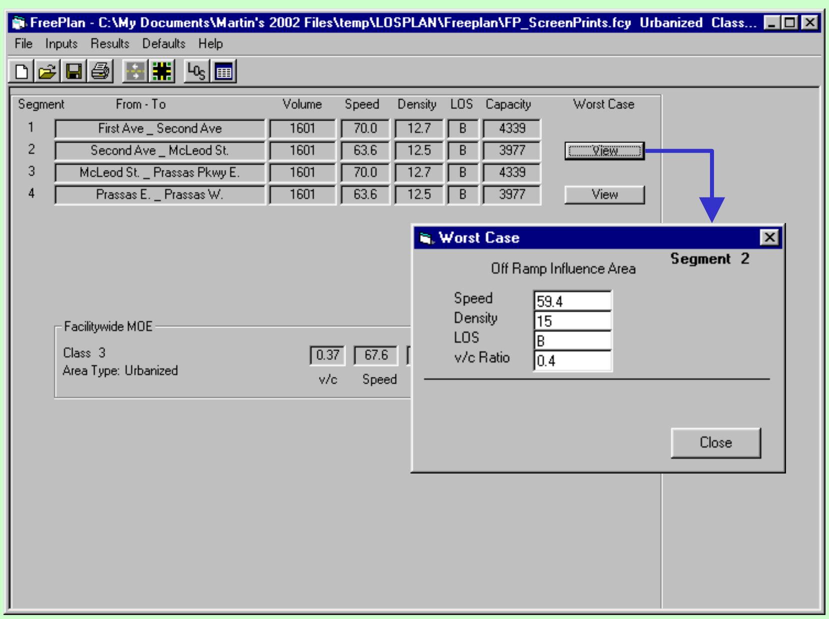


Segment Data

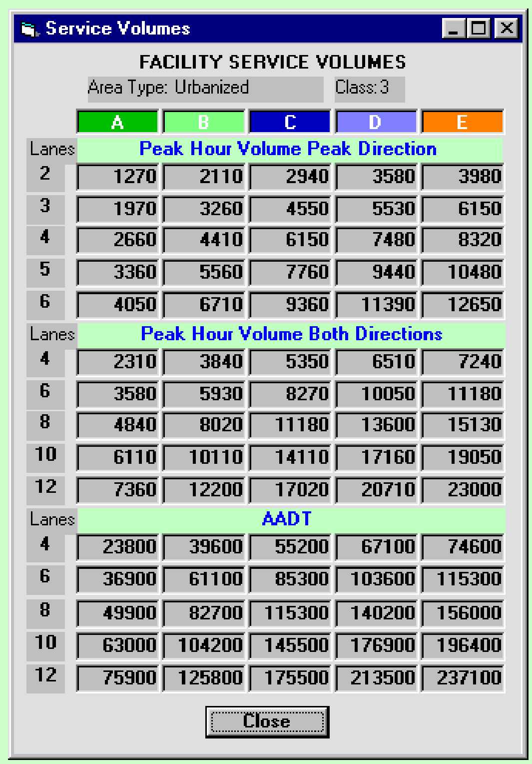


Output Screens

Level of Service



Service Volume Table



Service Volumes

FACILITY SERVICE VOLUMES

Area Type: Urbanized Class: 3

Lanes	A	B	C	D	E
	Peak Hour Volume Peak Direction				
2	1270	2110	2940	3580	3980
3	1970	3260	4550	5530	6150
4	2660	4410	6150	7480	8320
5	3360	5560	7760	9440	10480
6	4050	6710	9360	11390	12650
Lanes	**Peak Hour Volume Both Directions**				
4	2310	3840	5350	6510	7240
6	3580	5930	8270	10050	11180
8	4840	8020	11180	13600	15130
10	6110	10110	14110	17160	19050
12	7360	12200	17020	20710	23000
Lanes	**AADT**				
4	23800	39600	55200	67100	74600
6	36900	61100	85300	103600	115300
8	49900	82700	115300	140200	156000
10	63000	104200	145500	176900	196400
12	75900	125800	175500	213500	237100

Close

5.4 HIGHPLAN

HIGHPLAN, designed for uninterrupted flow highway planning, is FDOT's conceptual planning software for two-lane and multilane uninterrupted flow highways with points of access not fully controlled.

Special aspects about HIGHPLAN

Special aspects of HIGHPLAN are:

Two-lane or multilane selection

- Selection of the number of two-directional lanes determines whether the facility will be analyzed as a two-lane or a multilane highway. The selection of either choice makes some variables irrelevant, such as % no passing zone for multilane highways.

Facility or segment analysis selection

- Either a facility analysis or a segment analysis may be selected from the "analysis type" option. Both the two-lane and multilane analyses of the HCM2000 should be viewed as "segment" analyses more than "facility" analyses, because signalized intersections at termini are not included. This aspect becomes especially important when comparing multilane LOS results and service volume tables with those of freeways. Freeway analyses include the capacity and LOS influences of interchanges, while a straight application of the HCM multilane chapter does not include any significant termini effects. In other words, results from the HCM2000 multilane analyses should be compared to the HCM2000 freeway basic segment analyses, rather than the HCM2000 freeway facility analyses.

  To overcome this comparability problem, HIGHPLAN includes an analysis type option of facility or segment. The facility option lowers service volumes 10 percent. The segment option uses HCM2000 base capacity values and generates a segment analysis.

Two-lane highway LOS thresholds

- Embedded in the two-lane highway portion of HIGHPLAN are two different classes of two-lane highways, one for rural undeveloped areas and one for developed areas. The HCM2000 has a new two-lane analysis technique, revised performance measures, new LOS thresholds, and a new capacity value. Testing of the new chapter indicates results that would pose significant problems to users in Florida, both in undeveloped and developed areas. FDOT and University of Florida researchers have raised these concerns to the committee overseeing the HCM, and as concerns are resolved, future updates to HIGHPLAN are anticipated.

"v/c" is used in rural undeveloped areas.

- In rural undeveloped areas, HIGHPLAN uses the HCM2000 analysis technique and new capacity value, but retains the HCM1997 v/c values as the LOS thresholds. The net result for users of previous editions of FDOT's planning software is minimal change in LOS determinations or service volumes.

Percent of free flow speed is used in developed areas to determine LOS.

- In developed areas (urbanized, transitioning/urban, rural developed area types), HIGHPLAN uses the HCM2000 analysis technique and new capacity value, but implements LOS thresholds based on percent of free flow speed. FDOT's position is that the most relevant service measure for motorists on two-lane highways in developed areas is to maintain a "reasonable" speed, instead of the HCM2000's primary service measure of percent time spent following. Drivers in developed areas primarily base their LOS on how close they're going relative to their free flow speeds and not so much based on the ability to pass.

All performance measures are shown.

- After pressing the LOS calculation button, near the bottom of HIGHPLAN's facility data and LOS screen, the results are shown with four performance measures. HIGHPLAN highlights the v/c ratio for analyses in rural undeveloped areas and percent free flow speed in developed areas because they are the service measures used to determine LOS. Nevertheless, v/c, percent of free flow speed, as well as the HCM2000's performance measures percent time spent following and average travel speed are presented for a broader understanding of conditions along two-lane highways under all types of conditions

Bicycle, pedestrian and bus analyses along uninterrupted flow highways should be based on ARTPLAN.

- When conducting a bicycle, pedestrian, or bus LOS analysis along an uninterrupted flow highway, ARTPLAN should be used instead of HIGHPLAN. In its present form, HIGHPLAN only addresses the LOS of motorized vehicles. Primarily by using very low signal densities, ARTPLAN can approximate multimodal results as if HIGHPLAN had multimodal features. The bicycle service volumes in the rural undeveloped portions of Tables 4-3, 4-6 and 4-9 were generated in that manner.

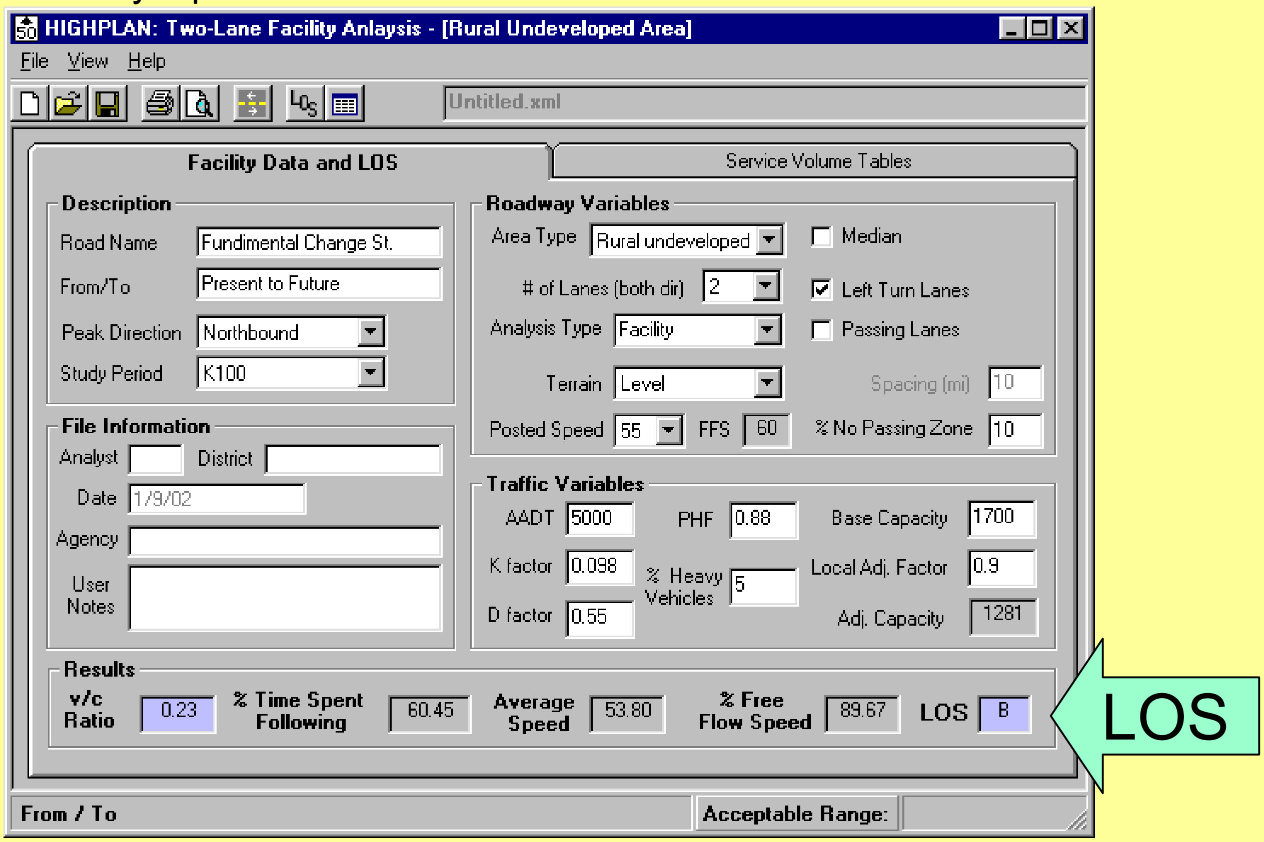
HIGHPLAN input and output screens

HIGHPLAN input and output screens appear in Figure 5-6.

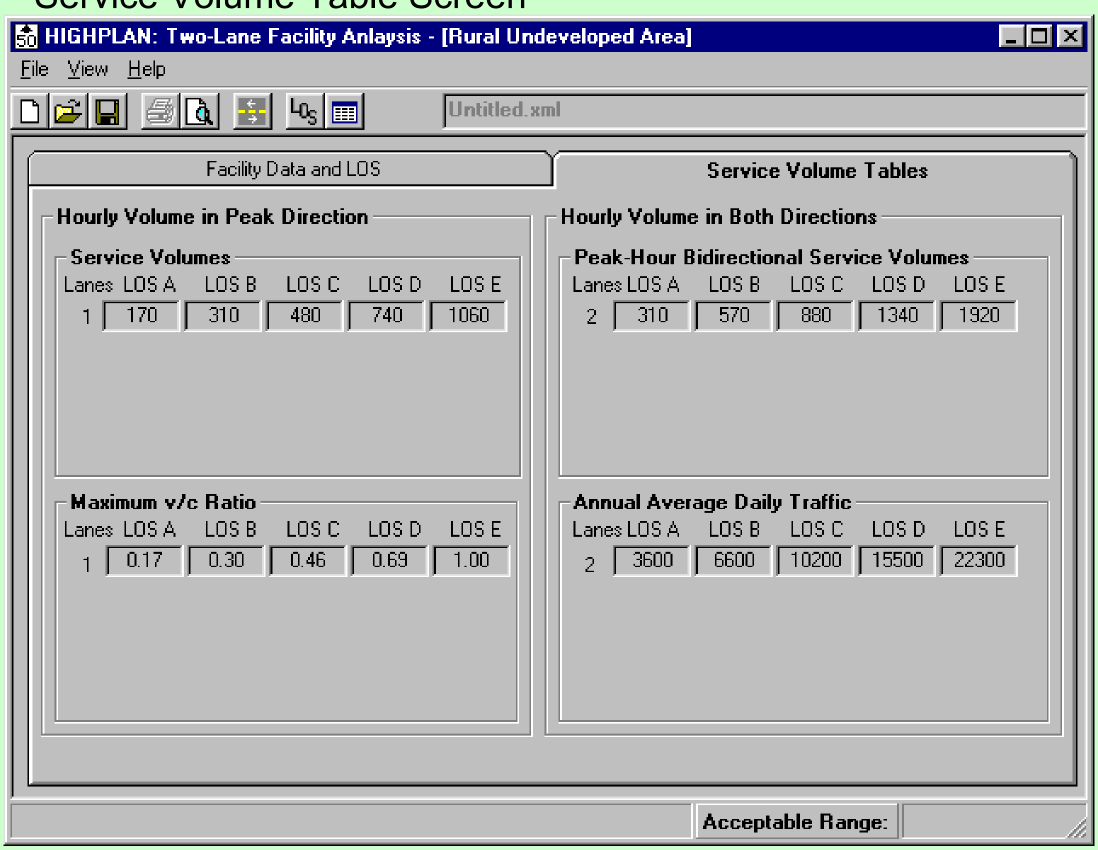
Figure 5 – 6

HIGHPLAN INPUT AND OUTPUT SCREENS

Facility Input Data and LOS Screen



Service Volume Table Screen



5.5 SPECIAL CONSIDERATIONS

Off Peak Directional Analyses

Users are cautioned about making off peak directional analyses with the tools and software provided in this Handbook. All analyses are based on an hourly peak directional analysis. Therefore, it is incorrect to directly apply results to the off peak direction. For example, the service volumes produced for one direction are likely not applicable in the other direction. Nevertheless, if used carefully, the current programs can be used for hourly off peak directional analyses, but inputs have to be carefully addressed both to “fool the program” (e.g., lowering the AADT to use an off peak D less than 0.50) and to obtain realistic inputs (e.g., good progression in the peak direction probably implies that progression is not good in the off peak direction; sidewalk on one side of the facility, but not the other).

Previous editions of ARTPLAN had the direct capability of analyzing off peak directional LOS. In the interest of having the new ARTPLAN, FREEPLAN and HIGHPLAN programs available in a timely fashion, the current set of programs do not feature off peak directional analyses. It is hoped that by September 2002, the programs will be updated to include the option of off peak directional analyses.

5.6 EXAMPLE PROBLEMS

By September 2002, FDOT intends to have example conceptual planning analysis problems posted on its website:

http://www11.myflorida.com/planning/systems/sm/los/default.htm

6 FLORIDA'S PLANNING LEVEL OF SERVICE STANDARDS

Rule Chapter 14-94

FDOT's Statewide Minimum Level of Service Standards for the State Highway System were adopted by Administrative Rule in 1992 (Rule Chapter No. 14-94) and are shown in Table 6-1.

The area and roadway types in the level of service standards match well with FDOT's Generalized Tables appearing in Chapter 4 of this Handbook; however, subtleties exist on delineation of areas. The first part of Section 3.4 of this Handbook addresses area types.

The indicated levels of service designate the lowest quality operating conditions acceptable for the 100th highest volume hour of the year, from the present through the planning horizon, generally up to 20 years. The 100th highest hour approximates the typical weekday peak hour during the peak season in developed areas. Thus, it can be thought of as the typical drive during "rush" hour in an area's peak season.

6.1 APPLICABILITY OF STANDARDS

Applicable to FDOT planning

The standards are to be applied to FDOT's planning activities. The level of service standards in this Handbook are based on the 100th highest hour for planning purposes. The 30th highest hour, or design hour, remains effective for design purposes and must be used in the review of new or modified interchanges on limited access facilities.

Applicable to Florida Intrastate Highways

Florida Statutes, 163.1380(10), require local governments to adopt the level of service standards for the Florida Intrastate Highway System (FIHS). Local governments establish the adopted level of service standard on all non-FIHS roadways in their comprehensive plans. These standards can differ from FIHS and FDOT's recommended standards.

6.2 CONCEPTS OF UNDERLYING STANDARDS

The standards include the following major concepts:

- the different level of importance of the Florida Intrastate Highway System and other state roads,
- the different roles (i.e., mobility versus access) provided by state facilities (i.e., Florida Intrastate Highway System versus other state roads),
- the direct correlation between urban size and acceptance of some highway congestion as a tradeoff for other urban amenities,
- urban infill as a desirable objective,
- the presence of infrastructure concurrent with the impact of development,
- local flexibility in setting standards in and around Transportation Concurrency Management Areas and Transportation Concurrency Exception Areas,
- recognition of the interaction between highways and exclusive transit systems serving commuters,
- recognition that many state facilities are constrained because they cannot be expanded because of physical or policy barriers, and
- recognition that the operation of many state facilities do not meet the standards and are not programmed for improvement in FDOT's 5-Year Work Program.

6.3 EXAMPLE PROBLEMS

By September 2002, FDOT intends to have example problems dealing with its level of service standards posted on its website:

http://www11.myflorida.com/planning/systems/sm/los/default.htm

Table 6 – 1
STATEWIDE MINIMUM LEVEL OF SERVICE STANDARDS FOR THE STATE HIGHWAY SYSTEM[1]

	Rural Areas[2]	Transitioning Urbanized Areas[3], Urban Areas[4], or Communities[5]	Urbanized Areas[6] under 500,000	Urbanized Areas over 500,000	Roadways Parallel to Exclusive Transit Facilities[7]	Inside Transportation Concurrency Management Areas[8]	Constrained[9] and Backlogged[10] Roadways
Intrastate[11]							
Limited Access Highway (Freeway)[12]	B	C	C(D)	D(E)	D(E)	D(E)	Maintain[15]
Controlled Access Highway[13]	B	C	C	D	E	E	Maintain
OTHER STATE ROADS[14]							
Other Multilane	B	C	D	D	E	*[16]	Maintain
Two-Lane	C	C	D	D	E	*	Maintain

Level of service standards inside of parentheses apply to general use lanes only when exclusive through lanes exist.

1. The indicated **levels of service** designate lowest quality operations for the 100th highest volume hour of the year in the predominant traffic flow direction from the present through a 20-year planning horizon. The 100th highest hour approximates the typical peak hour during the peak season. Definitions and measurement criteria used for minimum level of service standards are based on the most recent updates of the Transportation Research Board Highway Capacity Manual "Special Report 209". All level of service evaluations are to be based on "Special Report 209," or a methodology which has been accepted by FDOT as having comparable reliability.

2. **Rural areas** are areas not included in a transportation concurrency management area, an urbanized area, a transitioning urbanized area, an urban area or a community.

3. **Transitioning urbanized areas** are the areas outside urbanized areas, but within the MPO Planning Boundaries. These areas are planned to be included within the urbanized areas within the next 20 years.

4. **Urban Areas** are places with a population of at least 5,000 and are not included in urbanized areas. The applicable boundary encompasses the 1990 urban area as well as the surrounding geographical area as agreed upon by FDOT, local government, and Federal Highway Administration (FHWA). The boundaries are commonly called FHWA Urban Area Boundaries and include areas expected to have medium density development before the next decennial census.

5. **Communities** are incorporated places outside urban and urbanized areas, or unincorporated developed areas having 500 population or more identified by local governments in their local government comprehensive plans and located outside of urban or urbanized areas.

6. **Urbanized areas** are the 1990 urbanized areas designated by the U.S. Bureau of Census as well as the surrounding geographical areas as agreed upon by the FDOT, Metropolitan Planning Organization (MPO), and Federal Highway Administration (FHWA), commonly called FHWA Urbanized Area Boundaries. The over or under 500,000 classifications distinguish urbanized areas with a population over or under 500,000 based on the 1990 U.S. Census.

7. **Roadways parallel to exclusive transit facilities** are roads generally parallel to and within one-half mile of a physically separated rail or roadway lane reserved for multi-passenger use by rail cars or buses serving large volumes of home/work trips during peak travel hours. Exclusive transit facilities do not include downtown people movers, or high occupancy vehicle lanes unless physically separated from other travel lanes.

8. **Transportation Concurrency Management Areas** are geographically compact areas designated in local government comprehensive plans where intensive development exists or is planned in a manner that will ensure an adequate level of mobility and further the achievement of identified important state planning goals and policies, including discouraging the proliferation of urban sprawl, encouraging the revitalization of existing

downtowns and designated redevelopment areas protecting natural resources, protecting historic resources, maximizing the efficient use of existing public facilities, and promoting public transit, bicycling, walking and other alternatives to the single occupant automobile. Transportation concurrency management areas may be established in a comprehensive plan in accordance with Rule 9J-5, Florida Administrative Code.

9. **Constrained roadways** are roads on the State Highway System which FDOT has determined will not be expanded by the addition of two or more through lanes because of physical, environmental or policy constraints. Physical constraints primarily occur when intensive land use development is immediately adjacent to roads, thus making expansion costs prohibitive. Environmental and policy constraints primarily occur when decisions are made not to expand a road based on environmental, historical, archaeological, aesthetic or social impact considerations.

10. **Backlogged roadways** are roads on the State Highway System operating at a level of service below the minimum level of service standards, not programmed for construction in the first three years of FDOT's adopted work program or the five year schedule of improvements contained in a local government's capital improvements element, and not constrained.

11. **Intrastate** means the Florida Intrastate Highway System (FIHS) which comprises a statewide network of limited and controlled access highways. The primary function of the system is for high speed and high volume traffic movements within the state. Access to abutting land is subordinate to this function and such access must be prohibited or highly regulated. Highways included as part of this system are designated in the Florida Transportation Plan. **General use lanes** are intrastate roadway lanes not exclusively designated for long distance high speed travel. In urbanized areas general use lanes include high occupancy vehicle lanes not physically separated from other travel lanes. **Exclusive through lanes** are roadway lanes exclusively designated for intrastate travel, which are physically separated from general use lanes and to which access is highly regulated. These lanes may be used for high occupancy vehicles and express buses during peak hours if the level of service standards can be maintained.

12. **Limited access highways (freeways)** are multilane divided highways having a minimum of two lanes for exclusive use of traffic in each direction and full control of ingress and egress; this includes freeways and all fully controlled access roadways.

13. **Controlled access highways** are non-limited access arterial facilities where access connections, median openings and traffic signals are highly regulated. The standards shown are the ultimate standards to be achieved for controlled access facilities on the Florida Intrastate Highway System (FIHS) within a 20 year period. For rural two-lane FIHS facilities, the standard is "C" until such time as the facility is improved to four or more lanes when the "B" standard would apply. Signalized intersections are to be minimized on these facilities within 20 years making an uninterrupted flow standard generally applicable. Controlled access facilities on the FIHS currently not meeting the ultimate standards shall be allowed to remain on the FIHS with a "maintain" status.

14. **Other state roads** are roads on the State Highway System which are not part of the Florida Intrastate Highway System.

15. **Maintain** means continuing operating conditions at a level such that significant degradation does not occur based on conditions existing at the time of local government comprehensive plan adoption. For roadways in rural areas, transitioning urbanized areas, urban areas or communities, significant degradation means (1) an increase in average annual daily traffic volume of 5 percent above the maximum service volume, or (2) a reduction in operating speed for the peak direction in the 100^{th} highest hour of 5 percent below the speed of the adopted LOS standard. For roadways in urbanized areas, for roadways parallel to exclusive transit facilities, or for intrastate roadways in transportation concurrency management areas, significant degradation means (1) an increase in average annual daily traffic volume of 10 percent above the maximum service volume, or (2) a reduction in operating speed for the peak direction in the 100^{th} highest hour of 10 percent below the speed of the adopted LOS standard. For other state roads in transportation concurrency management areas, significant degradation means that amount defined in the transportation mobility element. For constrained roadways meeting or exceeding the level of service standards, "maintain" does not apply until the roadway is operating below the applicable minimum level of service standard.

16. * means the level of service standard will be set in a transportation mobility element that meets the requirements of Rule 9J-5.

7 Sources For Additional Information

Initial contacts should be made with FDOT district planning personnel.

FDOT welcomes questions and comments on the content and concepts of this Handbook and accompanying software. FDOT can provide assistance in interpretations, answering questions, providing advice, and training. Initial contacts should be made with FDOT district planning personnel.

District Contacts

District 1 – Bartow
Mike Tako
(941) 519-2395
michael.tako@dot.state.fl.us

District 2 – Jacksonville Urban Office
Lea Gabbay
(904) 360-5647
lea.gabbay@dot.state.fl.us

District 3 – Chipley
Jerry Campbell
(850) 638-0250
jerry.campbell@dot.state.fl.us

District 4 – Ft. Lauderdale
John Krane
(954) 777-4354
john.krane@dot.state.fl.us

District 5 – Orlando Urban Office
Dawn Bisplinghoff
(407) 482-7879
dawn.bisplinghoff@dot.state.fl.us

District 6 – Miami
Chris Dube
(305) 377-5888
chris.dube@dot.state.fl.us

District 7 – Tampa
Waddah Farah
(813) 975-6440
waddah.farah@dot.state.fl.us

District 8 – Turnpike District
Joey Gordon
(387) 532-3999
joey.gordon@dot.state.fl.us

For **Central Office** coordination contact:

Gina Bonyani about software,
gina.bonyani@dot.state.fl.us
(850) 414-4707

Kurt Eichin about boundaries,
kurt.eichin@dot.state.fl.us
(850) 414-4818

Martin Guttenplan about multimodal analysis,
LOS standards and training,
martin.guttenplan@dot.state.fl.us
(850) 414-4906

Doug McLeod about management related items,
douglas.mcleod@dot.state.fl.us
(850) 414-4932

FDOT's Q/LOS Website

Also, see the Florida Department of Transportation's planning website at:

http://www11.myflorida.com/planning/systems/sm/los/default.htm

8 USER FEEDBACK

USER SURVEY

To: Users of the 2002 Quality/Level of Service Handbook

From: Doug McLeod, Quality/Level of Service Manager

Subject: User Evaluation and Feedback Request

This completely updated Quality/Level of Service Handbook and accompanying software represents a significant advancement in unifying the nation's leading automobile, bicycle, pedestrian and bus quality/level of service (Q/LOS) techniques into an easy to use, multimodal analysis approach. It also contains a new freeway facility planning technique and completely updated software. FDOT sincerely hopes the Handbook and software proves useful in addressing the needs of our thousands of users throughout state and nation.

To make the Handbook and accompanying software even better, we welcome user feedback. Your feedback is welcome in any form; however, to provide some structure for your response we have prepared a list of items. We would appreciate your rating these items from your perspective. Please circle the letter grade from A to F for each of the items, with A being the highest rating and F the lowest. Feel free to leave a response blank if it is not applicable to you.

You may e-mail, mail or fax your responses to me at:

Doug McLeod
Florida Department of Transportation
Systems Planning Office
605 Suwannee St. MS-19
Tallahassee, FL 32399-0450
douglas.mcleod@dot.state.fl.us
Fax: (850) 921-6361

Topics

1) General	
a) Multimodal approach	< high low >
Including non-automobile techniques is desirable.	A B C D E F
Approach is easy to use.	A B C D E F
b) Applicability to planning	
Techniques are useful.	A B C D E F
c) Applicability to preliminary engineering	
Techniques are useful.	A B C D E F
d) Details of computational procedures	
Generalized Tables are easy to use.	A B C D E F
The LOS software programs are easy to use.	A B C D E F
Other comments	

2) Handbook	< high low >
a) The Handbook is useful.	A B C D E F
b) The Handbook is well organized.	A B C D E F
c) The Handbook reads easily.	A B C D E F
Other comments	
3) Generalized Tables	
a) The Generalized Tables are useful.	A B C D E F
b) Service volumes	
How accurate are the service volumes? 1=extremely high 2=high 3=about right 4=low 5=extremely low	
i) Freeway (automobile/truck modes)	1 2 3 4 5
ii) Highway (automobile/truck modes)	1 2 3 4 5
iii) Arterial (automobile/truck modes)	1 2 3 4 5
iv) Bicycle mode	1 2 3 4 5
v) Pedestrian mode	1 2 3 4 5
vi) Bus mode	1 2 3 4 5
Other comments	
4) Software	
a) General	
i) The software is useful.	A B C D E F
ii) The software is easy to use.	A B C D E F
Other comments	
b) ARTPLAN	
i) ARTPLAN is useful.	A B C D E F
ii) ARTPLAN is easy to use.	A B C D E F
Other comments	
c) FREEPLAN	
i) FREEPLAN is useful.	A B C D E F
ii) FREEPLAN is easy to use.	A B C D E F
Other comments	
d) HIGHPLAN	
i) HIGHPLAN is useful.	A B C D E F
ii) HIGHPLAN is easy to use.	A B C D E F
Other comments	

5) Future topics to be addressed	
a) Areawide analyses	< high low >
i) Urbanized area networks (better address applicability to travel demand forecasting models)	A B C D E F
ii) Subarea analyses (develop techniques and software to address such areas as multimodal transportation districts)	A B C D E F
b) Batch mode updating (develop a technique for multiple runs of roadways)	A B C D E F
c) Bicycle and pedestrian LOS for exclusive facilities (develop a technique to evaluate bicycle and pedestrian LOS for off road facilities)	A B C D E F
d) Bus LOS on the bus (include load factor in the evaluation of bus LOS)	A B C D E F
e) Corridor analyses (develop techniques and software to address LOS along a corridor rather than along specific facilities)	A B C D E F
f) Driver population factor in rural areas (conduct research to better define appropriate values)	A B C D E F
g) Freeways	
i) Interchange ramp terminals (develop a technique to evaluate the impacts of ramp terminals and ramps)	A B C D E F
ii) Special use lanes (develop a technique to evaluate the LOS and capacity of special use lanes)	A B C D E F
iii) Toll plazas (develop a technique to evaluate the LOS at toll booths)	A B C D E F
h) Multimodal analyses	
i) Assessing LOS equally across modes (e.g., LOS D probably means OK for automobiles, but poor for pedestrians)	A B C D E F
ii) Latent demand for bicyclists and pedestrians (develop a technique that addresses demand volumes of bicyclists and pedestrians)	A B C D E F
iii) Tradeoff analysis (develop a technique to evaluate tradeoffs between modes)	A B C D E F
i) Point analysis	
i) Bicycle (develop a technique to evaluate the bicycle LOS at signalized intersections and other points)	A B C D E F
ii) Bus (develop a technique to evaluate the bus LOS at bus stops and other points)	A B C D E F
iii) Pedestrian (develop a technique to evaluate the pedestrian LOS at signalized intersections and other points)	A B C D E F
j) Roundabouts (refine ARTPLAN to include roundabouts)	A B C D E F
k) Saturation flow by number of lanes (this possibly will allow better differentiation in the capacities of 2, 4, 6, 8 and 10-lane roadways)	A B C D E F
l) Truck LOS and capacity (address how LOS should be determined for trucks and develop passenger car equivalency factors for Florida)	A B C D E F
m) Uninterrupted flow highways	
i) Refine FDOT's classes of two-lane highways (readdress how to better bring FDOT's LOS analyses in rural undeveloped areas closer to the HCM2000 method)	A B C D E F
ii) Develop a facility method (include isolated intersections and multiple segments into an overall facility approach)	A B C D E F
n) Other comments	

SOFTWARE ‘BUG” REPORT FORM

Describe the program “bug” you are experiencing:

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<u>System Properties:</u> (detail of the specific computer system that you are using):

Operating System (e.g., Windows 95, 98, 2000, NT 3.51/4.0, XP): ______________________

Internet Explorer Version: ______________

CPU and speed (e.g., Intel Pentium II, 333 MHz, 500 MHz): ________________

Megabytes of Ram (computer memory, not hard drive storage): ____________

General Software Problems	Bicycle, Pedestrian and Bus software problems
Contact: Gina Bonyani Department of Transportation Systems Planning Office 605 Suwannee Street, MS 19 Tallahassee, FL 32399-0450 (850) 414-4707 Suncom: 994-4707 Fax: (850) 921-6361	**Contact:** Martin Guttenplan Department of Transportation Systems Planning Office 605 Suwannee Street, MS 19 Tallahassee, FL 32399-0450 (850) 414-4906 Suncom: 994-4906 Fax: (850) 921-6361

Click here to find a word

9 GLOSSARY

Notes: Italicized words and phrases are defined in this glossary. Most terms are incorporated in the conceptual planning software "help" files.

Acceptable range – The limits of input values for use in FDOT's *conceptual planning software*.

Accessibility – The dimension of *mobility* that addresses the ease in which travelers can engage in desired activities.

Accuracy – The degree of a measure's conformity to a true value.

Actuated – Same as *actuated control*.

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.

Add/drop lanes – Roadway lanes that are added before an intersection and dropped after the intersection.

Adjacent – In this Handbook a categorization of *sidewalk/roadway separation* less than or equal to 3.0 feet.

Adjusted bus frequency – In this Handbook the *bus frequency* times *adjustment factors* that account for pedestrian level of service, *pedestrian crossing difficulty*, *obstacles to bus stops*, and *span of service*.

Adjusted capacity – In this Handbook the *base capacity* times the effect of many *roadway variables* and *traffic variables*.

Adjusted frequency – Same as *adjusted bus frequency*.

Adjusted saturation flow rate – In this Handbook the *base saturation flow rate* times the effect of many *roadway variables* and *traffic variables*.

Adjustment factor –

1) In the *software* a multiplicative factor applied to the *base saturation flow rate* to represent a prevailing condition.
2) In ARTPLAN a multiplicative factor applied to the *bus frequency* to determine *adjusted bus frequency*.
3) In the *Generalized Tables* additive factors for the existence of *medians*, *left turn lanes*, or *one-way* considerations on *interrupted flow* facilities.

All way stop control – An intersection with stop sign at all approaches.

Analysis type – In *HIGHPLAN* a choice between a *facility* analysis or a *segment* analysis.

Annual average daily traffic – The volume passing a point or segment of a roadway in both directions for 1 year divided by the number of days in the year.

Approach – The set of lanes comprising one leg of an intersection or interchange.

Approach delay – The sum of stopped-time *delay* and the time lost in decelerating to a stop and accelerating to a steady speed.

Area type – In this Handbook a general categorization of an extent of surface based primarily on the degree of urbanization.

Areawide analysis – An evaluation within a geographic boundary.

Arrival type – A general categorization of the quality of signal progression.

Arterial –

1) A signalized roadway that primarily serves through traffic with signal intersection spacing of 2.0 miles or less.
2) A state facility that is not on *freeway*.
3) A type of roadway based on FDOT functional classification.

ARTPLAN – FDOT's *arterial* planning software for calculating *level of service* and *service volume tables* for *interrupted flow* roadways.

ATS – Same as *average travel speed*.

Auto – Same as *automobile*.

Automobile –

1) A motorized vehicle with 4 or less wheels touching the pavement during normal operation.
2) Motorized vehicles, excluding *buses*.

Average daily traffic – The total traffic volume during a given time period (more than a day and less than a year) divided by the number of days in that time period.

Average travel speed – The facility length divided by the average travel time of all *vehicles* traversing the facility, including all stopped *delay* times.

Auxiliary lane – An additional lane on a freeway to connect an on ramp and an off ramp.

Base capacity – Same as *base saturation flow rate* for *uninterrupted flow* roadways.

Base conditions – The best possible characteristic in terms of capacity for a given type of facility.

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 this Handbook the length of a *freeway* in which operations are unaffected by interchanges.

Bicycle – A mode of travel with two wheels in tandem, propelled by human power.

Bicycle lane – In this Handbook a *designated* or *undesignated* portion of roadway for bicycles adjacent to motorized vehicle lanes.

Bicycle LOS Model – The *operational methodology* from which this Handbook's bicycle *quality/level of service* analyses are based.

Bicycle level of service score – A numerical value calculated by the *Bicycle LOS Model* that corresponds to a bicycle *level of service*.

BLOS – 1) Same as *Bicycle LOS Model*

2) Same as *bicycle level of service score*.

Boundaries – In this Handbook the geographical limits associated with *FDOT's Statewide Minimum Level of Service Standards for the State Highway System* or its *MPO* Administrative Manual.

Bus – In this Handbook a self-propelled, rubber-tired roadway vehicle designed to carry a substantial number of passengers and traveling on a *scheduled fixed route*.

Bus frequency – The number of *buses* which have a potential to stop on a given *segment* in one direction of flow in a one hour time period.

Bus span of service – The number of hours in a day of *bus* service along a *route segment.*

Bus stop – An area where *bus* passengers wait for, board, alight, and transfer.

Capacity –
1) The maximum number of vehicles or persons that can pass a *point* on a roadway during a specified time period (usually 1 hour) under prevailing *roadway*, *traffic*, and *control* conditions.
2) Same as *base capacity* or base *saturation flow* rate.

Capacity constrained – A condition in which traffic *demand* exceeds the *capacity* of a roadway.

Class – Same as *roadway class*.

Clearance lost time – The portion of the time between traffic signal *phases* during which an intersection is not used by any traffic *movement*, in seconds.

Collector – A roadway providing land access and traffic circulation with residential, commercial and industrial areas.

Community – In this Handbook outside of an urban or urbanized area, an incorporated place or a developed but unincorporated area with a population of 500 or more identified in the appropriate *local government comprehensive plan.*

Conceptual planning – A type of *planning application* detailed enough to reach a decision on design concept and scope, conducting alternatives analyses, and performing other technical analyses; in this Handbook typically performed by use of accompanying planning *software*.

Concurrency – A systematic process utilized by local governments to ensure that new development does not occur unless adequate infrastructure is in place to support growth.

Constrained – Same as capacity constrained.

Constrained roadway – A roadway on the *State Highway System* that FDOT will not expand by 2 or more through lanes because of physical, environmental, or policy constraints.

Continuous left turn lane – Same as *two-way left-turn lane*.

Control –
(1) A variable or characteristic typically associated with a traffic *signal.*
(2) A variable or characteristic associated with a stop sign, yield sign, flashing device and other similar measures.

Control characteristics – Same as control.

Control delay – The component of *delay* that results when a *signal* causes traffic to reduce speed or to stop.

Control variables – Parameters associated with roadway *controls.*

Controlled access highway – A non-*limited access highway* whose access connections, *median* openings, and traffic *signals* are highly regulated.

Corridor – A set of essentially parallel transportation facilities for moving people and goods between two points.

Critical intersection – *Same as critical signalized intersection.*

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*.

Cycle length (C) – The time it takes a traffic signal to go through one complete sequence of signal *indications*.

D factor – Same as *directional distribution factor*.

Daily tables – In this Handbook, *Service Volume Tables* presented in terms of *annual average daily traffic*.

Delay – The additional travel time experienced by a traveler.

Demand – The number of persons or vehicles desiring service on a *roadway*.

Demand traffic – Same as demand.

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 hour factor – In this Handbook the proportion of *annual average daily traffic* occurring during the 30th highest hour of the design year.

Designated – A type of *bicycle lane* at least 5 feet in width and having a bicycle logo and a direction arrow painted on it.

Desirable – In this Handbook a categorization of *pavement condition* that is new or recently resurfaced pavement.

Developed areas – 1) All areas not *rural undeveloped.*

2) Same as *rural developed areas.*

Development of regional impact (DRI) – A development which, because of its character, magnitude, or location, would substantially affect the health, safety, or welfare of citizens of more than one county in Florida, as defined in Section 380.06(1), Florida Statutes, implemented by Rule 9J-2, Florida Administrative Code, and coordinated by the regional planning agency.

Directional distribution factor (D) – The proportion of an hour's total *volume* occurring in the higher volume direction.

Diverge area – Same as *off ramp influence area*.

Divided – As used in the *Generalized Tables*, a roadway with a *median*.

Driver population – A *traffic variable* included as part of the *local adjustment factor* that describes driver familiarity with a roadway and accounts for such differences in driving habits as those between commuters and other drivers.

Driver population factor – The *factor* associated with *driver population.*

Dual left-turn lanes – Two lanes designated exclusively for left turns at a signalized intersection.

Effective green ratio (g/C) – In this 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 (g) – 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 lanes – Same as *left turn lanes*.

Exclusive right turn lanes – Storage area designated to only accommodate right turning vehicles.

Exclusive through lane – Any Intrastate highway lane that is designated exclusively for intrastate travel, is physically separated from any *general-use* lane, and the access to which is highway regulated. These lanes may be used for *high occupancy vehicles* (HOVs), and express buses during peak travel hours if the level of service standards can be maintained.

Exclusive turn lane – A storage area designated to only accommodate left or right turning vehicles; in this Handbook the turn lane must be long enough to accommodate enough turning vehicles to allow the free flow of the *through movement*.

Expanded intersections – Same as *add/drop lanes*.

Facility – 1) A length of *roadway* composed of *points* and *segments*.

2) A generic term including *points*, *segments* or *roadways*.

Factor – A value by which a given quantity is multiplied, divided, added or subtracted in order to indicate a difference in measurement.

FDOT – Florida Department of Transportation.

FHWA – Federal Highway Administration.

Five-lane section – A roadway with 4 through lanes, 2 in each direction separated by a *two-way left-turn lane*; in the *Generalized Tables*, a five-lane section is treated as a roadway with 4 lanes and a *median*.

Florida Intrastate Highway System (FIHS) – An interconnected statewide system of *limited access* facilities and *controlled access* facilities developed and managed by FDOT to meet standards and criteria established for the FIHS. It is part of the *State Highway System*, and is developed for high-speed and high-volume traffic movements. The FIHS also accommodates high occupancy vehicles (HOVs), express bus transit and in some *corridors*, interregional, and high-speed intercity passenger rail service. Access to abutting land is subordinate to movement of traffic and such access must be prohibited or highly regulated.

Flow rate – In this Handbook the equivalent hourly rate at which vehicles pass a point on a roadway for a 15-minute time period.

Free flow speed (FFS) – In this Handbook the average speed of vehicles not under the influence of speed reduction conditions, generally assumed to be 5 mph over the *posted speed* limit.

FREEPLAN – FDOT's *freeway* planning software for calculating *level of service* and *service volume tables*.

Freeway – A multilane, divided highway with at least 2 lanes for exclusive use of traffic in each direction and full control of ingress and egress.

Freeway interchange influence area – Same as *interchange*.

Fully actuated control – Same as *actuated control*.

Functional classification – The assignment of roads into systems according to the character of service they provide in relation to the total road network.

g/C – Same as *effective green ratio*.

Generalized Level of Service Volume Tables – *Maximum service volumes* based on areawide *roadway*, *traffic* and *control* variables and presented in tabular form.

Generalized planning – A broad type of *planning application* such as statewide analyses, initial problem identification, and future year analyses; in this Handbook typically performed by use of the *Generalized Tables*.

Generalized Tables – Same as *Generalized Level of Service Volume Tables*.

General-use lane – Any Intrastate highway lane not exclusively designated for long distance, high-speed travel. In urbanized areas these lanes include high occupancy vehicle (HOV) lanes that are not physically separated from other travel lanes.

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*.

Green time (G) – The duration in seconds of the green *indication* for a given movement at a signalized intersection.

Growth management concepts – The ideas necessary for use in careful planning for urban growth so as to responsibly balance the growth of the infrastructure required to support a community's residential and commercial growth with the protection of its natural systems (land, air, water).

Guideline – Based on FDOT's Standard Operating System (Topic No: 025-020-002-d), a recommended process intended to provide efficiency and uniformity to the implementation of policies, procedures, and standards; a guideline is intended to provide general program direction with maximum flexibility.

Handbook – Based on FDOT's Standard Operating System (Topic No: 025-020-002-d), technical instructions or techniques used to assist or train users in performing specific functions.

HCM2000 – The Transportation Research Board 2000 manual and *operational methodology* from which this Handbook's automobile *quality/level of service* analyses are based.

Heavy vehicle – A vehicle with more than 4 wheels touching the pavement during normal operation.

Heavy vehicle factor (HV) – The *adjustment factor* for *heavy vehicles*.

High-occupancy vehicle (HOV) lane – A *freeway* lane reserved for the use of vehicles with a preset minimum number occupants; such vehicles often include buses, taxis, and carpools.

HIGHPLAN – FDOT's software for calculating levels of service and *service volume tables* for *two-lane highways* and *multilane highways*.

Highway – 1) An *uninterrupted flow roadway* that is not a *freeway*.

2) A generic term meaning the same as *roadway*.

3) A *roadway* with all the transportation elements within the right-of-way.

Highway Capacity Manual (HCM) – The Transportation Research Board document on highway capacity and quality of service.

Highway mode – In this Handbook either *automobile*, *bicycle*, *bus*, *pedestrian* or *truck*.

HIGHPLAN – FDOT's *uninterrupted flow highway* planning software for calculating *level of service* and *service volume tables*.

Highway system structure – Same as *transportation system structure*.

Indication – In this Handbook, the green, yellow or red appearance of a *signal* to a motorist.

Interchange – In this Handbook the influence area associated with the *off ramp influence area*, overpass/underpass, and *on ramp influence area* of a connection to a *freeway*.

Interchange influence area – Same as *interchange*.

Interchange spacing – The distance between the centerlines of freeway interchanges.

Interrupted flow – A category of roadways characterized by signals, stop signs or other fixed causes of periodic delay or interruption to the traffic stream.

Intersection – The same as *signalized intersection*, unless specifically noted.

Intersection influence area – In this 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.

Intrastate highways – Highways on the *Florida Intrastate Highway System (FIHS).*

Isolated intersection – An *intersection* occurring along an *uninterrupted flow highway*.

K factor – Same as *planning analysis hour factor*.

K_{100} – The ratio of the 100th highest traffic volume hour of the year to the *annual average daily traffic*.

Lanes – Same as *number of through lanes,* unless specifically noted.

Lateral clearance – Clearance distance from edges of outside lanes to fixed obstructions.

Left turn lanes – In this Handbook storage areas designated to only accommodate left turning vehicles; a left turn lane must be long enough to accommodate enough left turning vehicles to allow the free flow of the *through movement*.

Level of service (LOS) – A quantitative stratification of the *quality of service* of a service or facility intosixletter grade levels with “A” describing the highest quality and “F” describing the lowest quality; a discrete stratification of a *quality of service* continuum.

Level of Service Standards – Same as *Statewide Minimum Level of Service Standards for the State Highway System*.

Level terrain – A combination of horizontal and vertical alignments that permits *heavy vehicles* to maintain approximately the same running speed as passenger cars; this generally includes short grades of no more than 1 to 2 percent.

Limited access highway – Same as *freeway*.

Link – Same as *segment*; for *quality/level of service* analyses this term is discouraged for use.

Load factor – The ratio of passengers actually carried to the total passenger capacity of a *bus*.

Local adjustment factor – In this Handbook an *adjustment factor* FDOT uses to adjust *base saturation flow rates* or *base capacities* to better match actual Florida traffic *volumes*; mostly consists of a *driver population factor* and an *area type* factor.

Local Government Comprehensive Plan (LGCP) – Any county or municipal plan that meets the requirements of subsections 163.3177 and 163.3178 of the Florida Statues.

LOS – Same as *level of service*.

LOS standards – Same as *Statewide Minimum Level of Service Standards for the State Highway System*.

Lost time – Time during which a *signalized intersection* is not used by any movement; clearance lost time plus start up lost time.

Maintain – Continuing operating conditions at a level that prevents significant degradation.

Major city/county roadway – A roadway not on the *State Highway System* whose *roadway*, *traffic* and *control* characteristics are similar to those classified as state minor arterials.

Maximum acceptable value – The highest value for a *traffic variable* FDOT will accept when developing, reviewing or approving a LOS analysis.

Maximum service volume – The highest number of *vehicles* for a given *level of service*.

Measure of effectiveness – A quantitative parameter indicating the performance of a transportation *facility* or service.

Median – 1) Areas at least 10 feet wide that are *restrictive* or *non-restrictive* that separate opposing-direction mid-block traffic lanes and that, on arterials, contain turn lanes that allow left turning vehicles to exit from the through traffic lanes.

2) A mathematical measure of central tendency in which the value selected in an ordered set of values below and above which there is an equal number of values.

Median factor – A *factor* by which a *service volume* is multiplied to account for the effects of the existence of a *median*.

Median type – A classification of roadway *medians* as *restrictive*, *non-restrictive*, or no median.

Merge area – Same as *on ramp influence area*.

Mid-block – In this Handbook the part of a roadway between two *signalized intersections*.

Minimum acceptable speed – In this Handbook the lowest *average travel speed* criterion for a given level of service as applied to Class III *two-lane highways*.

Minimum acceptable value – The lowest value for a *traffic variable* FDOT will accept when developing, reviewing or approving a LOS analysis.

Mobility – The movement of people and goods.

Mode – A method of travel; in this Handbook a *highway mode.*

Motorized mode – A method of travel by *automobile*, *bus* or *truck*.

Motorized vehicle – Same as *vehicle*.

Movement – 1) A flow of *vehicles* in a given direction

2) A flow of *vehicles* or people in a given direction.

MPO – Metropolitan Planning Organization.

Multilane – Having more than one through lane in the analysis direction.

Multilane highway – A non-*freeway* roadway with 2 or more lanes in each direction and, although occasional interruptions to flow at *signalized intersections* may exist, is generally *uninterrupted flow*.

Multimodal – In this Handbook more than one highway *mode*.

Multimodal transportation district – An area in which secondary priority is given to *vehicle* mobility and primary priority is given to assuring a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit (F.S. 163.3180(15)).

Narrow – In this Handbook a categorization of *outside lane width* less 11.0 feet.

No passing zone – In this Handbook a segment of a two-lane highway along which passing is prohibited in the analysis direction.

Non-restrictive median – A type of *median* (i.e., painted) that provides no pedestrian refuge.

Non-state roadway – A roadway not on the *State Highway System.*

Not Achievable – In this Handbook a situation in which a given level of service can not be obtained because of the roadway, traffic and control variables and level of service thresholds used.

Not Applicable – In this Handbook a situation in which a given level of service is not relevant because of the roadway, traffic and control variables and level of service thresholds used.

Number of through lanes – The number of lanes relevant to an analysis of a roadway's level of service.

- Usually two-directional (the *software* will convert to one direction for analysis purposes).
- For *arterials:*
  - usually at the *signalized intersection*, not mid-block.
  - usually through and shared-right-turn lanes.
  - may be a fractional number reflecting *add/drop lanes* or other special lane utilization considerations.
  - using the *Generalized Tables* the number at major *signalized intersections*.
- For *freeways* and *uninterrupted flow highways*:
  - does not include *auxiliary lanes* between 2 points.
  - usually the predominant number of through lanes between 2 points.

Obstacle to bus stop – A physical barrier between a *sidewalk* and a *bus stop*.

Off peak – 1) The course of the lower flow of traffic.

2) A time period not representing a *peak hour*.

Off ramp influence area – The geographic limits affecting the *capacity* of a freeway associated with traffic exiting a freeway.

On ramp influence area – The geographic limits affecting the *capacity* of a freeway associated with traffic entering a freeway.

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 level of service, as opposed to a *generalized planning* analysis or *conceptual planning* analysis.

Operational model – In this Handbook the use of the full methodologies contained in the 2000 *Highway Capacity Manual*, *Bicycle LOS Model*, *Pedestrian LOS Model*, *Transit Capacity and Quality of Service Manual* or other source to conduct an *operational analysis*.

Other signalized roadway – A signalized roadway not on the *State Highway System* and also considered by the local government of jurisdiction not to be a *major city/county roadway*.

Other state roads – Roads on the *State Highway System*, which are not part of the *Florida Intrastate Highway System.*

Outside lane – A roadway's motorized vehicle through lane closest to the edge of pavement.

Outside lane width – In this Handbook the width in feet of a roadway's motorized vehicle through lane closest to the edge of pavement.

Passing lane – A lane added to improve 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 – In this Handbook pavement at least 3 feet in width separated by a solid pavement marking from the outside motorized vehicle through lane to the edge of pavement.

Pavement condition – In this Handbook the general classification of the roadway surface where bicycling generally occurs.

Peak direction – The course of the higher flow of traffic.

Peak hour – In this Handbook a 1 hour time period with high *volume*.

Peak hour factor (PHF) – 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 season – The 13 consecutive weeks with the highest daily *volumes* for an area.

Peak Season Weekday Average Daily Traffic – The *average daily traffic* for Monday through Friday during the *peak season.*

Peak to daily ratio – The ratio of the highest 1 hour *volume* of a day to the daily volume.

Pedestrian – An individual traveling on foot.

Pedestrian accessibility – In this Handbook the ease in which a *pedestrian* can reach a bus stop.

Pedestrian crossing difficulty – In this Handbook a generalization of how hard it is for a *pedestrian* to go from one side of a roadway to the other side.

Pedestrian LOS Model – The *operational methodology* from which this Handbook's pedestrian *quality/level of service* analyses are based.

Pedestrian level of service score – A numerical value calculated by the *Pedestrian LOS Model* that corresponds to a pedestrian *level of service*.

Pedestrian refuge – In this Handbook a raised or grassed area at least 5 feet but less than 10 feet in width that separates opposing mid-block traffic lanes, and allows pedestrians to cross a roadway.

Pedestrian/Sidewalk/Roadway separation – The lateral distance in feet from the outer edge of pavement to where a *pedestrian* walks on a sidewalk.

Percent free flow speed – The percentage of *vehicle average travel speed* to *free flow speed*.

%FFS – Same as *percent free flow speed*.

Percent no passing zone– In this Handbook the percentage of a *two-lane highway* along which passing is prohibited in the analysis direction.

Percent time spent following – The average percent of total *travel time* that *vehicles* must travel in *platoons* behind slower vehicles due to inability to pass on a *two-lane highway*.

Percent turns from exclusive turn lanes – The percent of vehicles traveling in one direction that turn left, right, or both left and right from an *exclusive turn lane(s)*.

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*.

PHF – Same as *peak hour factor*.

Planning analysis hour factor (K) – The ratio of the *traffic volume* in the *study hour* to the *annual average daily traffic*.

Planning application – In this Handbook the use of default values and simplifying assumptions to an *operational model* to address a roadway's present or future *level of service*.

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.

PLOS – 1) Same as *Pedestrian LOS Model*.

2) Same as *pedestrian level of service score*.

Point – A boundary between *segments*; in this Handbook usually a signalized intersection, but may be other places where modal users enter, leave, or cross a facility, or roadway characteristics change.

Posted speed – The maximum seed at which *vehicles* are legally allowed to travel over a roadway *segment*.

Precision – The range of accurate and acceptable numerical answers.

Preliminary engineering – Engineering analyses performed to support decisions related to design concept and scope, e.g., need for improvement, design controls and standards, traffic, alternative alignment, preliminary design, conceptual design plans.

Pretimed – Same as *pretimed control*.

Pretimed control – Traffic signal control in which the cycle length, phase plan, and phase times are preset and repeated continuously according to a preset plan.

QOS – Same as *quality of service*.

Quality of service (QOS) – A user based perception of how well a service or facility is operating.

Quality of travel – The dimension of *mobility* that addresses traveler satisfaction with a facility or service.

Quality/level of service (Q/LOS) – A combination of the broad *quality of service* and more detailed *level of service* concepts.

Quantity of travel – The dimension of *mobility* that addresses the magnitude of use of a facility or service.

Restrictive median – A type of *median* that is not painted (e.g., grassed, raised).

Roadway – A general categorization of an open way for persons and vehicles to traverse; in this Handbook it encompasses streets, arterials, freeways, highways and other facilities.

Roadway characteristics – Same as *roadway variables*.

Roadway class – Categories of *arterials, freeways*, and *two-lane highways*; *arterial*s are primarily grouped by *signal density*; *freeways* are primarily grouped by *interchange spacing*; *two-lane highways* are primarily grouped by *area type*.

Roadway variables – Parameters associated with *roadways*.

Rolling terrain – A combination of horizontal and vertical alignments causing *heavy vehicles* to reduce their running speed substantially below that of passenger cars, but not to operate at crawl speeds for a significant amount of time.

Route – As used in the Transit Capacity and Quality of Service Manual, a designated, specified path to which a bus is assigned.

Route segment – As used in the Transit Capacity and Quality of Service Manual, a portion of a bus *route* ranging from 2 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.

Running time – The portion of *travel time* during which a *vehicle* is in motion.

Rural – Same as *rural area*.

Rural area – 1) In the *Generalized Tables* and *software,* areas that are not *urbanized areas*, *transitioning areas*, or *urban areas*.

2) In FDOT's *Statewide Minimum Level of Service Standards for the State Highway System,* areas not included in *transportation concurrency management areas*, *urbanized areas*, *transitioning areas*, *urban areas*, or *communities*.

Rural developed areas – Portions of *rural areas* that are generally cities and other population areas with less than 5000 population or along coastal roadways.

Rural undeveloped areas – Portions of *rural areas* with no or minimal population.

Scheduled fixed route – In this 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 factor – A *factor* used to adjust for the variation in traffic over the course of a year.

Section –

(1) A grouping of consecutive *segments* that have similar *roadway characteristics*, *traffic characteristics* and, as appropriate, *control characteristics* for a *mode* of travel.

(2) A characteristic describing laneage (i.e., *three-lane section*, *five-lane section*, *seven-lane section*).

(3) A portion of this Handbook.

Segment – A portion of a facility defined by 2 end *points*; usually the length of roadway from one *signalized intersection* to the next signalized intersection.

Semiactuated – Same as *semiactuated control*.

Semiactuated control – 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.

Service measure – A specific performance measure used to assign a level of service to a set of operating conditions for a transportation facility or service.

Service volume – Same as *maximum service volume*.

Service Volume Table – *Maximum service volumes* based on *roadway, traffic* and *control variables* and presented in tabular form.

Seven-lane section – A roadway with 6 through lanes, 3 in each direction separated by a *two-way left-turn lane*; in the *Generalized Tables*, a seven-lane section is treated as a roadway with 6 lanes and a *median.*

Shared lane – A roadway lane shared by 2 or 3 traffic movements; in Florida a shared lane usually serves through and right turning traffic movements.

Sidewalk – A paved walkway for pedestrians at the side of a roadway.

Sidewalk/roadway protective barrier – Physical barriers separating pedestrians on *sidewalks* and motorized vehicles.

Sidewalk/roadway separation – The lateral distance in feet from the outside edge of pavement to the inside edge of the *sidewalk*.

Signal – In this Handbook:

(1) A traffic *control* device regulating the flow of traffic with green, yellow and red *indications*.

(2) 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 *signalized intersections* per mile.

Signal type – The kind of traffic signal (*actuated*, *pretimed* or *semiactuated*) with respect to the way its *cycle length*, *phase* plan, and phase times are operated.

Signalization characteristics – Same as *control*.

Signalized intersection – A place where 2 roadways cross and have a *signal* controlling traffic *movements*.

Signalized intersection spacing – The distance between *signalized intersections*.

Software – FDOT's *ARTPLAN*, *FREEPLAN*, and *HIGHPLAN conceptual planning* computer programs.

Span of service – Same as *bus span of service*.

Speed – In this Handbook the same as *average travel speed*, unless specifically noted.

Speed limit – Same as *posted speed*.

Standard – A Florida Department of Transportation formally established criterion for a specific or special activity to achieve a desired level of quality.

Standards – Same as *Statewide Minimum Level of Service Standards for the State Highway System*.

Start-up lost time – The additional time consumed by the first few vehicles in a queue at a signalized intersection because of the need to react to the initiation of the green *indication* and to accelerate.

State Highway System (SHS) – All roadways that the Florida Department of Transportation operates and maintains; the State Highway System consists of the *Florida Intrastate Highway System* and *other state roads*.

Statewide Minimum Level of Service Standards for the State Highway System – FDOT's Rule Chapter No. 14-94 to be used in the planning and operation of the *State Highway System*.

Study hour – An hour period on which to base *quality/level of service* analyses of a facility or service.

Study period –

(1) Same as study hour.

(2) A length in time including a future year of analysis.

Sub-segment – A further breakdown of *segments*; in this Handbook primarily used for pedestrian level of service analysis where pedestrian roadway elements change between signalized intersections.

System – A group of facilities or services forming a network.

Termini – In this Handbook the beginning and end points of a *facility*.

Terrain – A general classification used for analyses in lieu of specific grades.

Three-lane section – A roadway with 2 through lanes separated by a *two-way left-turn lane*; in the *Generalized Tables*, a three-lane section is treated as a roadway with 2 lanes and a *median*; an *exclusive passing lane* on a *two-lane highway* is not considered a three-lane section.

Threshold – The breakpoints between level of service differentiations.

Through g/C – Same as *effective green ratio*.

Through lanes – Same as *number of through lanes.*

Through movement – In this Handbook the traffic stream with the greatest number of vehicles passing directly through a *point.*

Traffic – A characteristic associated with the flow of vehicles.

Traffic characteristics – Same as *traffic variables*.

Traffic variables – Parameters associated with *traffic*.

Transit – In this Handbook, the same as *bus*.

Transit Capacity and Quality of Service Manual (TCQSM) – The document and *operational methodology* from which this Handbook's *bus quality/level of service* analyses are based.

Transit system structure – The Transit Capacity and Quality of Service Manual's analytical methodology of transit stops, route segments, and system.

Transitioning – (1) In the text of this Handbook, the same as *transitioning area*.

(2) In the software of this Handbook, the same as *transitioning/urban*.

Transitioning area – An area within *MPO* designated planning boundaries, but outside *FHWA* urbanized boundaries.

Transitioning/urban – The grouping of *transitioning areas* and *urban areas* into one analysis category in the *Generalized Tables* and *software.*

Transportation Concurrency Management Area (TCMA) – A geographically compact area designated in a *local government comprehensive plan* where intensive development exists, or is planned, so as to ensure adequate *mobility* and further the achievement of identified important state planning goals and policies, including discouraging the proliferation of urban sprawl, encouraging the revitalization of an existing downtown and any designated redevelopment area, protecting natural resources, protecting historic resources, maximizing the efficient use of existing public facilities, and promoting public transit, bicycling, walking, and other alternatives to the single-occupant automobile. A transportation concurrency management area may be established in a comprehensive plan in accordance with Rule 9J-5.0057, F.A.C.

Transportation planning boundaries – Precisely defined lines that delineate geographic areas. These boundaries are used throughout transportation planning in Florida; their mapping is described in FDOT's Procedure Topic Number 525-010-024b.

Transportation system structure – In this Handbook the 2000 Highway Capacity Manual's analytical methodology of *points*, *segments*, *facilities*, *corridors*, and *areawide analysis*.

Travel time – The average time spent by *vehicles* traversing a *roadway*.

Truck – In this Handbook the same as *heavy vehicle*.

Truck factor (T) – In this Handbook the same as *heavy vehicle factor (HV)*.

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.

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.

Typical – In this Handbook a categorization of:

(1) *outside lane width* greater than or equal to 11.0 feet and less than 13.5 feet.

(2) *pavement condition* of most of Florida's roadways.

(3) *sidewalk/roadway separation* greater than 3.0 feet and less than or equal to 8.0 feet.

Undesignated – A type of *bicycle lane* usually at least 4 feet in width and does not contain a bicycle logo.

Undesirable – In this Handbook a categorization of *pavement condition* with noticeable cracks and/or ruts in it.

Undivided – As used in the *Generalized 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 the traffic stream.

Uninterrupted flow highway – A non-*freeway* roadway that generally has *uninterrupted flow*; a *two-lane highway* or a *multilane highway*.

Urban area – (1) A place with a population of between 5,000 and 50,000 and not in an urbanized area. The applicable boundary includes the Census's urban area and the surrounding geographical area agreed upon by the FDOT, the local government, and the Federal Highway Administration (FHWA). The boundaries are commonly called FHWA Urban Area Boundaries and include those areas expected to develop medium density before the next decennial census.

(2) A general characterization of places where people live and work.

Urban infill – A land development strategy aimed at directing higher density residential and mixed-use development to available sites in developed areas to maximize the use of adequate existing infrastructure; often considered an alternative to low density land development.

Urbanized area – Based on the Census, any area the U.S. Bureau of Census designates as urbanized, together with any surrounding geographical area agreed upon by the FDOT, the relevant Metropolitan Planning Organization (MPO), and the Federal Highway Administration (FHWA), commonly called the FHWA Urbanized Area Boundary. The minimum population for an urbanized area is 50,000.

Utilization – The dimension of *mobility* that addresses the quantity of operations with respect to *capacity*.

v/c – The ratio of *demand flow rate* to *capacity* of a *signalized intersection*, *segment* or *facility*.

Vehicle – In this Handbook, a *motorized mode* of transportation, unless specifically noted.

Volume – In this Handbook usually the number of *vehicles,* and occasionally persons, passing a point on a roadway during a specified time period, often 1 hour; a volume may be measured or estimated, either of which could be a *constrained* value or a hypothetical *demand volume*.

Weighted effective green ratio – In this Handbook the average of the *critical intersection's* through *g/C* and the average of all the other signalized intersections' through g/C's along the arterial facility.

Weighted g/C – Same as weighted effective green ratio.

Wide – In this Handbook a categorization of:

(1) *outside lane width* greater than or equal to 13.5 feet.

(2) *sidewalk/roadway separation* greater than 8.0 feet.

Worst case – In this Handbook for:

(1) *arterials*, the *critical intersection*.

(2) *freeways*, usually the *off ramp influence area* of an interchange.

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