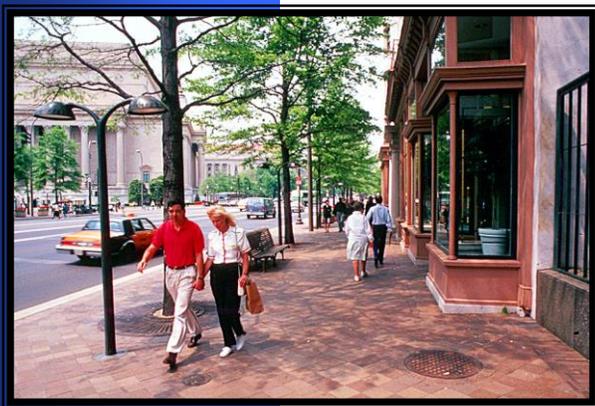


# Multimodal Transportation Districts and Areawide Quality of Service Handbook



Systems Planning Office  
Florida Department of Transportation  
<http://www.dot.state.fl.us/planning/systems/sm/los/default.htm>

# **Multimodal Transportation Districts and Areawide Quality of Service Handbook**

*Systems Planning Office  
Florida Department of Transportation*

*The Florida Department of Transportation Systems Planning Office  
gratefully acknowledges the NJ Transit Authority document “Planning for  
Transit-Friendly Land Use: A Handbook for New Jersey Communities”  
used in the preparation of this document.*

**November, 2003**

# TABLE OF CONTENTS

<b>Executive Summary</b>	<b>4</b>
<b>Chapter 1: Introduction and Background</b>	<b>7</b>
1.1 Growth Management in Florida	
1.2 Purpose of Handbook	
<b>Chapter 2: Basic Criteria and Procedures for the Designation of a Multimodal Transportation District</b>	<b>11</b>
2.1 Basic Criteria for a Multimodal Transportation District	
2.2 Steps in the Evaluation Process	
<b>Chapter 3: Complementary Mix of Land Uses</b>	<b>17</b>
3.1 Basic Criteria for Complementary Mix of Land Uses	
3.2 Summary	
<b>Chapter 4: Appropriate Density and Intensity of Land Uses</b>	<b>25</b>
4.1 Appropriate Densities and Intensities of Land Uses	
4.2 Organization of Land Uses Promoting a Central Core	
4.3 Appropriate Organization of Land Uses Along Corridors	
4.4 Summary	
<b>Chapter 5: Network Connectivity</b>	<b>29</b>
5.1 Proper Pattern of Roadways	
5.2 Connectivity Index	
5.3 Convenient Connections Between Modes	
5.4 Connections to Regional Intermodal Facilities	
<b>Chapter 6: Quality/Level of Service in Multimodal Transportation Districts</b>	<b>42</b>
6.1 Levels of Service Standards	
6.2 Level of Service Techniques for Pedestrians, Bicycles, Transit and Automobiles	
6.3 Determining the Areawide Quality/Level of Service	
6.4 Summary	
<b>Chapter 7: Final Evaluation of Multimodal Transportation Districts</b>	<b>52</b>
<b>Chapter 8: Application of Analysis of Multimodal Transportation Districts</b>	<b>54</b>

## Appendices

<b>Appendix A:</b> Glossary of Terms	<b>67</b>
<b>Appendix B:</b> Transit Oriented Design Principles	<b>69</b>
<b>Appendix C:</b> Annotated Bibliography	<b>75</b>
<b>Appendix D:</b> Gainesville Case Study	<b>76</b>

## List of Tables

<b>Table 1. Characteristics of Development Appropriate for Multimodal Transportation Districts</b>	<b>19</b>
<b>Table 2. Characteristics of Development Not Suited for Multimodal Transportation Districts</b>	<b>20</b>
<b>Table 3. Land Use Compatibility Matrix</b>	<b>21</b>
<b>Table 4. Land Uses Promoting Transit and Pedestrian Usage in Mixed-Use Areas</b>	<b>22</b>
<b>Table 5. Recommended Maximum Separations of Land Uses Based on Trip Purpose</b>	<b>24</b>
<b>Table 6. Desirable Densities and Intensities for Multimodal Transportation Districts</b>	<b>25</b>
<b>Table 7. Recommended Minimum LOS Standards for Multimodal Transportation Districts</b>	<b>43</b>
<b>Table 8. Pedestrian and Bicycle LOS Thresholds</b>	<b>44</b>
<b>Table 9. Availability Measures: Transit Stops Headway LOS</b>	<b>45</b>
<b>Table 10. Availability Measures: Route Segments Hours of Service LOS</b>	<b>45</b>
<b>Table 11. Transit Route Segment Hours of Service Adjustment Factor</b>	<b>46</b>
<b>Table 12. Pedestrian LOS Adjustment Factor</b>	<b>46</b>
<b>Table 13. Comparison of Average Modal LOS(QOS) and LOS Based on Percentage of Households and Employment within Service Area</b>	<b>51</b>
<b>Table 14. Example of Areawide QOS Adjustment</b>	<b>51</b>
<b>Table 15. Total Population, Employment, &amp; Jobs: Population</b>	<b>56</b>
<b>Table 16. Preferred Ratio of Uses</b>	<b>57</b>
<b>Table 17. Density and Intensity of Land Use: DeLand</b>	<b>61</b>
<b>Table 18. DeLand Connectivity Indices</b>	<b>65</b>

## List of Figures

Figure 1. Simplified Flowchart of Multimodal LOS Determinations	10
Figure 2. Land Uses and Multimodal Compatibility	23
Figure 3. Organization of Land Uses That Promote a Central Core	26
Figure 4. Recommended Intensities of Land Uses Along Corridors	27
Figure 5. Proper Pattern of Streets:	30
Figure 6. Example of Proper Pattern of Streets for Central Core and to Promote Pedestrian and Transit Activity	31
Figure 7. Street Patterns Promoting Pedestrian and Transit Activity	32
Figure 8. Pedestrian Connectivity Index	34
Figure 9. Bicycle Connectivity Index	35
Figure 10. Transit/Automobile Connectivity Index	36
Figure 11. Successful Integration of Transportation, Urban Design and Land Use in an Urban Center: Portland, Oregon	38
Figure 12. Successful Integration of Transportation, Urban Design and Land Use in a Regional Center: Miami Beach, Florida	39
Figure 13. Successful Integration of Transportation, Urban Design and Land Use in a Traditional Town or Village: DeLand, Florida	39
Figure 14. Area Not Suited for Multimodal Transportation District: Southpoint, Jacksonville, Florida	40
Figure 15. Example of Determining Areawide Quality of Service	49
Figure 16. District Boundaries	54
Figure 17. Land Use Ratios: Downtown vs. Hub & District at Large	58
Figure 18. Corridor Organization of Land Uses	59
Figure 19. Comparison of Corridor Organization of Land Uses	60
Figure 20. Residential and Non-Residential Property	61
Figure 21. Pedestrian Level of Service	62
Figure 22. Bicycle Level Of Service	63
Figure 23. Existing Transit Service	64

# Executive Summary

The State of Florida is one of the fastest growing states in the country, as well as one of the most visited. Presently, there are approximately 15 million residents and the State enjoys over 50 million visitors each year. By the year 2025, the population of Florida is expected to be over 20 million.

In order to accommodate the number of people and still maintain the resources that make the State so attractive to both residents and visitors, steps to manage growth and development were implemented through the Urban Infill and Redevelopment Act of 1999 (HB 17, Third Engrossed), also known as the "Growth Management Act" (F.S.163.3180). The encouragement of the use of alternative transportation modes to the automobile was included in this act through the establishment of multimodal transportation districts and multimodal areawide level-of-service (LOS), which are critical components in the assessment of multimodal transportation districts. The ease of access and safety for alternative mode users must be addressed and supported within the multimodal environment.

## **Purpose of the Handbook**

Guidelines are provided in this Handbook for local governments to achieve the successful designation of a multimodal transportation district. This designation also provides local governments with an additional approach in meeting concurrency requirements mandated by legislative statute. The techniques outlined in the Handbook provide a guide for enhancing existing development and/or redevelopment efforts. It also provides a template for good planning for new and future development with the integration of transportation and land use and the incorporation of urban design techniques that contribute to sustainable development.

## **Goals of a Multimodal Transportation District**

The goal of a multimodal transportation district is to facilitate the use of multiple modes of transportation, leading to a reduction in automobile use and vehicle miles traveled. The designation of such districts recognizes the inherent, integral relationship between transportation, land use and urban design and the degree that these elements affect the other.

## **Designation**

Potential districts are proposed for designation by local governments and the evaluation of the proposal is through a cooperative effort by the Florida Department of Transportation (FDOT) and the Florida Department of Community Affairs. The Department of Community Affairs (DCA) ultimately approves the needed changes to the local comprehensive plan necessary for district establishment.

A good candidate district has a mix of mutually supporting land uses, good multimodal access and connectivity, an interconnected transportation network and the provision of alternative modes of transportation to the automobile. Due to the general type of growth and development that has occurred and dependence on the automobile as primary mode of transportation, areas desiring district designation may encounter some difficulty in meeting the basic criteria for a multimodal transportation district. While there are certain elements needed for designation, many of the guidelines are recommendations and not rigid standards or thresholds. For those areas desiring designation, but not

meeting the minimum suggested standards, this Handbook functions as an excellent tool for planning and focusing future development that will meet the multimodal transportation district criteria in the future.

### **Development Tracks for Multimodal Transportation District**

There are two developmental tracks for potential multimodal districts. The first is a proposed district in an already developed area, such as the central core area of a municipality. This type of district would focus on the enhancement of existing elements and qualities and guiding redevelopment and infill opportunities.

The second type of potential district is a totally new development generally located outside of the traditional municipal area. In order to qualify as multimodal districts, new developments need both the incorporation of the necessary elements, such as connectivity and friendliness to modes of transportation other than the automobile. In addition, new greenfield type developments need an emphasis on regional connectivity to the existing centralized areas of development.

### **Multimodal Transportation District Criteria**

A multimodal transportation district should be supported by community design features that provide an adequate level of multimodal mobility and accessibility within the district. The legislation prescribes that local governments must demonstrate through the use of professionally accepted multimodal analysis using levels of service criteria, that adequate levels of mobility for all modes of transportation are provided. The following criteria for district designation were developed to meet this requirement and focus on both land use and transportation. For proposed districts that may not meet the needed minimum criteria for designation, a definitive commitment to meeting these criteria, shown in the local comprehensive plan and capital improvement program, is necessary.

#### Land Use:

- Inclusion of complimentary land uses which promote alternative mode usage, including medium/high density residential
- Appropriate densities and intensities of development to support transit
- Appropriate organization of land uses, focusing on central core and multimodal supportive development along major corridors
- Recommended minimum 5,000 in residential population, and 2 to 1 population to jobs ratio

#### Interconnected Street System:

- Adequate levels of service for all modes
- Appropriate numbers of connections within the street network
- Connected pedestrian and bicycle network
- Convenient modal connections
- Convenient connections to regional transportation

#### Design:

- Adequate access for pedestrians and cyclists to transit
- Transit oriented development within the area
- Shorter block length providing easier access and better quality pedestrian environment

**Additional Considerations:**

- Special considerations given to schools and their multimodal needs to provide a safe, amenable environment for students
- Reduction in vehicle mile of travel within the district
- Determination of impacts on any FIHS facility

**Implementation and Monitoring:**

- Designation occurs through DCA approval with technical assistance by FDOT
- Appropriate changes made to local comprehensive plan and any needed amendments to local ordinances and codes
- Monitoring to ensure proposed development occurs as planned

**Process Steps for Assessing Potential Multimodal Districts**

There are a series of steps that lead through the process of assessing the potential of multimodal transportation districts. These steps evaluate both the land use and transportation elements to gauge the success and viability of a potential district. The general steps found in the process of assessing potential districts are listed below, including the applicable chapters.

- *Assess scale of development.*
  - Chapter 2
- *Analyze land use mix and organization.*
  - Chapters 3 and 4
- *Analyze network connectivity.*
  - Chapter 5
- *Define modal network.*
  - Chapter 6
- *Areawide Quality/Level of Service analysis.*
  - Chapter 6
- *Final evaluation of proposed multimodal transportation district.*
  - Chapter 7

## CHAPTER 1

# Introduction and Background

### 1.1 Growth Management in Florida

The State of Florida is one of the fastest growing states in the country, as well as one of the most visited. Presently, there are approximately 15 million residents and the State enjoys over 50 million visitors each year. By the year 2025, the population of Florida is expected to be over 20 million.

Even though the State embarked on an ambitious growth management program in 1985 to help guide growth, ensure mobility and preserve the State's natural beauty, runaway growth and development continues. A part of this growth management act includes *concurrency*, requiring that transportation and other infrastructure be available concurrent with the impact of development.

Active congestion management systems (CMS) were established in all 25 Metropolitan Planning Organizations (MPO's) and growth management legislation was continually "tweaked" to allow for urban infill and development where infrastructure was already in place. Throughout this process, local government agencies were involved.

To aid in measuring and managing mobility, Florida Department of Transportation (FDOT) embarked on a Mobility Performance Measure program. Dimensions of mobility were specified as well as modal options, and areas of coverage, such as statewide and local. When this statewide program was presented to the MPO's and local governments, there was little interest from them in collecting generalized data at a local level in order to have a statewide picture. Instead, the request was for better performance measures and tools to use at a local planning level to assess mobility of automobiles, transit, pedestrians and bicycles.

In the first round of CMS plans submitted to FDOT in 1997, only 7 of the 25 MPO's had performance measures for the non-automobile modes. This was the case even though all of the CMS plans had reference to these modes in the strategies sections of their plans.

In 1998, the Florida Legislature created the Transportation and Land Use Study Committee (TALUS). Among its charges was to provide recommendations to improve: community design; transportation concurrency and level of service; land use impacts used to assess transportation needs; and the roles of MPO's, local governments and regional planning councils in addressing these areas. (*Transportation and Land Use Study Committee Report, 1999*)

Utilizing some of the TALUS committee recommendations, the Legislature developed and passed the Urban Infill and Redevelopment Act of 1999 (HB 17, Third Engrossed), which amended the "Growth Management Act" (F.S.163.3180). Encouragement of the use of alternative transportation modes to the automobile through the establishment of multimodal transportation districts (MMTDs) was included in this act. The applicable portion of the legislation addressing multimodal planning and policy goals is shown below.

- (15)(a) *Multimodal transportation districts may be established under a local government comprehensive plan in areas delineated on the future land use map for which the local comprehensive plan assigns secondary priority to vehicle mobility and primary priority to assuring a safe, comfortable, and attractive pedestrian environment, with convenient interconnection to transit. Such districts 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.*
- (b) *Community design elements of such a district include: a complementary mix and range of land uses, including educational, recreational, and cultural uses; interconnected networks of streets designed to encourage walking and bicycling, with traffic-calming where desirable; appropriate densities and intensities of use within walking distance of transit stops; daily activities within walking distance of residences, allowing independence to persons who do not drive; public uses, streets, and squares that are safe, comfortable, and attractive for the pedestrian, with adjoining buildings open to the street and with parking not interfering with pedestrian, transit, automobile, and truck travel modes.*
- (c) *Local governments may establish multimodal level of service standards that rely primarily on non-vehicular modes of transportation within the district, when justified by an analysis demonstrating that the existing and planned community design will provide an adequate level of mobility within the district based upon professionally accepted multimodal level of service methodologies. The analysis must take into consideration the impact on the Florida Intrastate Highway System (FIHS). The analysis must also demonstrate that the capital improvements required to promote community design are financially feasible over the development or redevelopment timeframe for the district and that community design features within the district provide convenient interconnection for a multimodal transportation system. Local governments may issue development permits in reliance upon all planned community design capital improvements that are financially feasible over the development or redevelopment timeframe for the district, without regard to the period of time between development or redevelopment and the schedule construction of the capital improvements. A determination of financial feasibility shall be based upon currently available funding or funding sources that could reasonably be expected to become available over the planning period.*
- (d) *Local governments may reduce impact fees or local access fees for development within multimodal transportation districts based on the reduction of vehicle trips per household or vehicle miles of travel expected from the development pattern planned for the district.*

As can be seen from this legislation, two primary characteristics of the multimodal transportation districts are defined. The first characteristic is that a district should include the community design standards and mixed land use that ensure a good pedestrian environment and mobility, with convenient connections to transit. The second characteristic is that the concurrency determinations within a district should be based on multimodal performance measures that consider all of the available modes of transportation.

The legislation, shown below, also defined the need for the development of a multimodal level-of-service (LOS), which is a critical component in the assessment of these potential districts.

(1)(b) Local governments shall use professionally accepted techniques for measuring level of service for automobiles, bicycles, pedestrians, transit, and trucks. These techniques may be used to evaluate increased accessibility by multiple modes and reductions in vehicle miles of travel in an area or zone. The Department of Transportation shall develop methodologies to assist local governments in implementing this multimodal level of service analysis. The Department of Community Affairs and the Department of Transportation shall provide technical assistance to local governments in applying these methodologies.

This legislation directed FDOT to develop methods for measuring performance of various modes and assist local governments in setting minimum standards for each of the modes in order to manage growth. FDOT then embarked on an ambitious research program to conduct Multimodal LOS analysis. The product of this research program is the *Quality/Level of Service Handbook* and software, as well as this handbook.

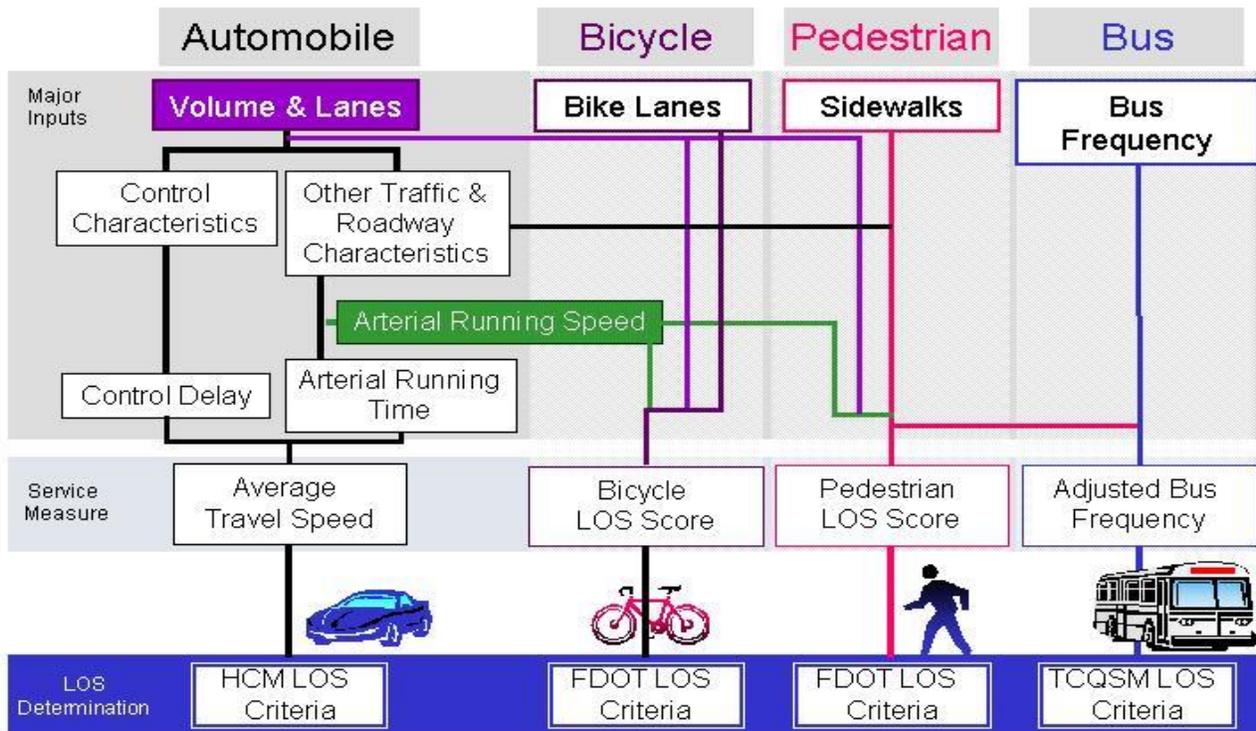
### **Florida's Multimodal LOS Approach**

Though there is a dynamic linkage between the modes, each mode has a discrete LOS output. FDOT chose not to create an index that produces a single LOS grade for all modes combined on a single roadway. A single grade could mask the effects of the lesser-used modes, negating the effort of a multimodal analysis.

For the bicycle and pedestrian modes, ARTPLAN is the conceptual planning application of the BLOS and PLOS methodology applied to roadway sections and facilities. For the bus mode, ARTPLAN is the conceptual planning application of the *Transit Capacity and Quality of Service Manual (TCQSM)* methodology applied to bus route sections and roadway facilities

The updated ARTPLAN is multimodal in structure with the facility's roadway, traffic and signalization characteristics calculated simultaneously to determine the LOS for the automobile, bicycle, pedestrian and bus modes. As quality of service of one mode improves that 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 provides an overview of how the modes and their levels of service are linked.

**Figure 1. Simplified Flowchart of Multimodal LOS Determinations**



**1.2 Purpose of Handbook**

Guidelines are provided in this Handbook for local governments to achieve the successful designation of a multimodal transportation district. These techniques provide a guide for enhancing existing development and/or redevelopment efforts. It also provides a template for good planning for new and future development with the integration of transportation and land use and the incorporation of urban design techniques that contribute to sustainable development. With the implementation of these techniques, a local government could “grow” a multimodal district in an area not currently suited for designation. In addition, the designation of a multimodal transportation district provides an avenue for local governments in meeting the concurrency mandated through legislation.

This Handbook is primarily designed to assist local governments in the identification and design of multimodal transportation districts. Other interested groups that participate in local and regional planning and development activities may also find the information contained in the Handbook helpful. These groups could include volunteer civic or chamber of commerce committees, regional planning councils, consultants, and private developers.

## CHAPTER 2

# Basic Criteria and Procedures for the Designation of Multimodal Transportation Districts

### **Goal of Multimodal Transportation Districts**

The goal of a multimodal transportation district is to facilitate the use of multiple modes of transportation, leading to a reduction in automobile use and vehicle miles traveled. Local governments may designate a multimodal transportation district by amending the comprehensive plan to show the district on a future land use map. The designation of such districts recognizes the inherent, integral relationship between transportation, land use, and urban design and the degree that these elements affect the other.

### **Designation**

This transportation-land use relationship is evident in the process for designation of a multimodal transportation district. Potential districts are proposed for designation by local governments and the evaluation of the proposal is through a cooperative effort by the Florida Department of Transportation (FDOT) and the Florida Department of Community Affairs. The Department of Community Affairs (DCA) ultimately approves the needed changes to the local comprehensive plan necessary for district establishment. DCA will also monitor the progress of multimodal transportation districts through the periodic comprehensive plan review and additionally, in the case of new development, through the periodic review process for large developments.

### **Guidelines**

The guidelines contained in the Handbook provide local government with the template for a successful multimodal district. These guidelines are also used in assessing the success of a district by FDOT and DCA. A good candidate district has a mix of mutually supporting land uses, good urban design, good multimodal access and connectivity, an interconnected transportation network and the provision of alternative modes of transportation to the automobile. Conversely, an area containing a single land use, a transportation network containing a large number of cul-de-sacs, few accommodations for pedestrians and bicycles and no transit service would be a poor candidate. Due to the general type of growth and development that has occurred, and the potential difficulty in meeting some of the criteria, the guidelines for establishing multimodal transportation districts may be difficult for proposed districts to meet. These criteria may be used as a planning tool for future development that is more suitable to a multimodal district. If a local government requests a designation and does not meet the minimum criteria, designation can be applied based on a commitment to appropriate future development that will meet the requirements must be in place through the comprehensive plan and the capital improvements program.

### **Two Development Tracks**

There are two developmental tracks for potential multimodal districts. The first is a proposed district in an existing area, such as the central core area of a municipality. This type of district would focus on the enhancement of existing elements and qualities and guiding redevelopment and infill opportunities. The second type of potential district

is a proposed development located outside of the traditional municipal area. In order to qualify as multimodal districts, new developments need both the incorporation of the necessary elements, such as connectivity and friendliness to modes of transportation other than the automobile, and the connectivity to the areas of existing development.

## **2.1 Basic Criteria for a Multimodal Transportation District**

A multimodal transportation district should be supported by community design features that provide an adequate level of multimodal mobility and accessibility within the district. Community design elements needed for establishing a multimodal transportation district include:

- Provision of a complementary mix of land uses, including residential, educational, recreational, and cultural uses
- Provision of an interconnected network of streets designed to encourage walking and bicycling use with traffic calming where desirable
- Provision of appropriate densities and intensities of land uses within walking distance of transit stops
- Provision of daily activities within walking distance of residences; public infrastructure that is safe, comfortable, and attractive for pedestrians; adjoining buildings open to the street; and parking facilities structured to avoid conflict with pedestrian, transit, automobile, and truck travel.
- Provision of transit service within the designated area, or a definitive commitment to the provision of transit. This definitive commitment should be found in local planning documents and in the approved capital improvements program. For new developments, transit connectivity to the major urban area must also be included, or a definitive commitment for transit connections, again evident in both planning documents and the approved capital improvement program.

The legislation prescribes that local government agencies must demonstrate through the use of professionally accepted multimodal analysis using levels of service criteria, adequate levels of mobility for all modes of transportation are provided. To meet this requirement, the following recommendations for designating an area as a multimodal transportation district include:

### **1. Complementary Mix of Land Uses (See Chapter 3)**

A complementary mix of land uses requires that a multimodal transportation district:

- Be of sufficient size to support various uses and transportation alternatives
- Contain a variety of land uses, including both employment and residential
- Include land uses promoting pedestrian, bicycle and transit use

### **2. Appropriate Density and Intensity of Land Uses (See Chapter 4)**

The multimodal transportation district must contain an appropriate density and intensity of land uses to support multimodal transportation use. The land uses should have:

- Sufficient densities to demonstrate transit ridership
- Sufficient intensities in and around central cores
- Sufficient intensities along major transit corridors

### **3. Network Connectivity** (See Chapter 5)

Network connectivity requires a multimodal transportation district to provide:

- Adequate levels of service for bicyclists, pedestrians and transit
- Appropriate numbers of connections within the street network
- Connected pedestrian, bicycle and transit network
- Convenient modal connections
- Convenient connections to regional transportation

### **4. Design**

The design and development of a multimodal transportation district should incorporate those elements both providing for, and encouraging the use of, alternative transportation modes. Almost every trip begins with walking, regardless of the ultimate transportation mode chosen for the trip. The design of the area should provide a pleasant environment conducive to the continuation of a trip utilizing some form of transportation other than the automobile.

Design features that promote transit/pedestrian/bicycle activity include adequate pedestrian/bicycle connections with transit stations and stops, which facilitate, encourage and support transit use. Transit oriented design principles, which facilitate and encourage the use of transit and pedestrian activities, include the following elements:

- Transit stations or stops are a visible point of identity for the neighborhood district and community
- Access to the transit station or stop is along clear, direct and convenient routes
- Continuous and safe pedestrian access is provided with sidewalks and pathways
- Access to transit stations or stops includes good accommodations for bicycles, including storage
- Transit stops or stations are safe, comfortable places
- Transit stations or stops provide direct or reasonable access to major attractions and destinations
- A mix of land uses are available promoting pedestrian, bicycle and transit usage and encouraging off-peak pedestrian activity and transit use
- Buildings and services are located adjacent to the sidewalk
- The transit stations and stops are accessible in accordance with the Americans with Disabilities Act of 1990
- An active, visually pleasing, interesting, and safe environment
- Adequate parking is provided with direct access to major transit stations or park-and-ride services

While adequate parking with direct access to the transit system is needed, care must be taken not to provide an excess of parking. An abundance of convenient and cheap parking encourages, rather than discourages, the use of the private automobile instead of other transportation modes. It is also important that urban design and aesthetics be considered in the provision of parking. A "sea of asphalt" parking lot is not conducive to a pleasant walking environment, nor does it visually enhance the streetscape. The ideal location for adequate parking is on the edge or outside of the proposed district.

A list of reference materials offering guidelines and recommendations for the design of transit friendly development can be found in Appendix C.

Another important feature contributing to the quality of the pedestrian environment is block length. Shorter blocks provide more stopping points for automobiles, allowing for easier pedestrian crossings. The shorter block design also allows for numerous route options, providing more overall connectivity. Consideration should also be given to the provision of truck access to businesses for freight deliveries.

## **5. Additional Considerations**

The following criteria should also be included for the designation of a multimodal transportation district:

- Special consideration given to schools and their multimodal needs to provide a safe, accessible environment for students
- Reduction in vehicle-miles traveled

### ***Consideration of Schools***

Schools can play a key role in a multimodal transportation district. Daycare/Preschool facilities and K-12 schools are land uses with very high pedestrian, bicycle and transit potential. Because of the special safety needs associated with younger walkers, bicyclists and bus riders, the planning and design of facilities should receive special attention.

FDOT is empowered by legislation to administer a *Safe Paths to School Program*. This program could provide special funding for transportation and safety improvements for students in and around schools. Improvements can include sidewalks, paths, and bicycle/pedestrian/transit connections, as well as appropriate traffic safety projects that help in difficult street crossings and improvements in drop off areas to reduce conflicts. The *Safe Paths to School Program* is augmented by local *Safe Ways to School Programs* that are implemented locally through specific schools or school districts.

Generally, the service area for walking and bicycling for most schools is a 2-mile radius. This distance is based on the standard distance requirement for the provision of school bus transportation for students. Special consideration of pedestrian and bicycle LOS in the school zone is recommended for multimodal districts, with a LOS B or better for pedestrian and bicycle modes along major access routes to schools.

Colleges and universities are also land uses with very high pedestrian, bicycle and transit potential. While the considerations needed for the very young may not be necessary within these areas, provisions for, and access to, good, safe pedestrian, bicycle and transit facilities should be provided.

### ***Reduction in Vehicle-Miles Traveled***

The reduction of vehicle miles of travel (VMT) within multimodal transportation districts is also discussed in the legislation. Through the proper planning of the district, consistent with the other criteria and standards outlined in this Handbook, a reduction in vehicle-miles traveled is anticipated when compared to other types of typical development.

Recent research conducted in Florida indicates that for mixed-use developments, with a ratio of jobs to population greater than 0.5, an internal capture rate of 35 percent or greater can be expected (Ewing, "Analysis of Internal Capture Rates in Mixed Use Developments in Florida, 2000). Based on past experiences, this internal capture of trips for multimodal transportation districts is somewhat optimistic. In order to

realistically project the internal capture for a multimodal transportation district, the procedures found in the *Trip Generation Handbook, Chapter 7 "Multi Use Development"* should be followed. Because of past projections not meeting the actual internal capture of trips, care should be taken with the factors utilized in the process. However, the 35% internal capture rate for trips does provide a target or goal for a district, but is not a required minimum standard or requirement for designation.

## **6. Implementation and Monitoring**

In order to be considered as a multimodal transportation district, the interested local government contacts DCA to discuss designation. A technical evaluation of the proposed district will be performed and is a cooperative effort between FDOT and DCA, again emphasizing the interrelationship between land use, urban design and transportation.

Actual district designation requires a change in the local comprehensive plan, and possibly new or amended local ordinances specific to the needs of each local government. The change concerning district designation is made in the comprehensive plan and is submitted to, and subject to approval by DCA. In the case of designation for new development, local government should ensure that the future development is built out according to the proposals meeting the designation criteria.

Additional monitoring of these designated districts will be accomplished in a biennial review through a cooperative effort between DCA, local governments and necessary technical assistance provided by FDOT. These biennial reviews and reports also provide the opportunity for pertinent information about the districts and the process to be applied to future proposals throughout the state.

### ***Institutional Mechanisms***

In order to implement multimodal transportation districts successfully, the planning, development and redevelopment of land must be appropriately guided. The consideration of these districts should become an integral part of the land use and transportation planning practice in the state. Current Florida Statutes allows priority consideration of projects supporting public transportation as follows:

*Rule 9J-5.0055(7) Concurrency Exception – For Projects That Promote Public Transportation. The purpose of this flexible concurrency option is to reduce the adverse impact transportation concurrency may have on the promotion of public transportation, including goals and policies of the state comprehensive plan. Local governments may exempt projects that promote public transportation as defined in Section 163.3164(28), F.S., by establishing in the local comprehensive plan, guidelines and/or policies for the granting of such exceptions. Those guidelines must demonstrate by supporting data and analysis that consideration has been given to the impact of the projects on the Florida Intrastate Highway System. The guidelines must establish how a project will qualify as a project that promotes public transportation.*

*Section 163.3164(28) F.S. "Projects that promote public transportation" means projects that directly affect the provision of public transit, including transit terminals, transit lines and routes, separate lanes for the exclusive use of public transit services, transit stops (shelters and stations), office buildings or projects that include fixed-rail or transit terminals as part of the building, and projects which are transit-oriented and designed to complement reasonably proximate planned or existing facilities.*

To implement the guidelines provided in this Handbook, the required comprehensive plans of local governments should include policy guidance supporting transit-oriented design in multimodal transportation districts. Local development ordinances may also need to be adopted by local governments to ensure the support for multimodal transportation through transit-oriented design elements, and to implement the policy guidance in the comprehensive plan.

Local governments also need to work in conjunction with other local entities. The logical boundaries of a proposed district may cross political jurisdictions, resulting in the need for intergovernmental cooperation. A coordinated effort is also needed with the transit operators and any other locally involved agencies or groups. Intergovernmental cooperation is also needed on the local and state level. Another important aspect of the formation of a multimodal transportation district is public involvement. Citizens and stakeholders should be fully informed and involved in the process.

## **2.2 Steps in the Evaluation Process**

There are a series of steps that lead through the process of assessing the potential of multimodal transportation districts. These steps evaluate both the land use and transportation elements to gauge the success and viability of a potential district. The steps for assessing potential districts are listed below.

- *Assess scale of development.*
  - Chapter 2
- *Analyze land use mix and organization.*
  - Chapters 3 and 4
- *Analyze network connectivity.*
  - Chapter 5
- *Define modal network.*
  - Chapter 6
- *Areawide Quality/Level of Service analysis.*
  - Chapter 6
- *Final evaluation of proposed multimodal transportation district.*
  - Chapter 7

## CHAPTER 3

# Complementary Mix of Land Uses

### 3.1 Basic Criteria for Complementary Mix of Land Uses

The effective organization and mix of land uses can help reduce the number of automobile trips, which leads to a reduction of other auto related needs, such as parking, and promotes pedestrian/bicycle/transit activity. Three basic criteria are used to determine if a complementary mix of land uses is provided. These criteria include:

- Appropriate scale of development
- Complementary mix of land uses
- Transit and pedestrian friendly design

#### Appropriate Scale of Development

Multimodal transportation districts should include an area of sufficient size to promote, encourage and sustain pedestrian, bicycle and transit usage. The organization of land uses within a multimodal district should also be compact. This type of land use organization, which mirrors that of transit oriented developments, makes the use of alternative modes of transportation feasible and best supports the goals of a district. The recommendations for designating a district include:

- Minimum residential population of 5,000  
(Source: *Developed from Planning for Transit Friendly Land Use, NJ Transit*)
- Minimum 2 to 1 ratio of population to jobs  
(Source: *Developed from Planning for Transit Friendly Land Use, NJ Transit*)
- Provision of scheduled transit service

Although there is not a minimum size standard, it is important that a prospective district achieve the critical mass necessary to promote, encourage, and sustain pedestrian, bicycle, and transit usage. The minimum area should be of sufficient size to attain the levels of activity, intensity and density necessary to sustain multimodal transportation systems. Conversely, the maximum area of a district is dictated by the organization of the land use and transportation system and the ability of the area to sustain multimodal transportation options.

#### Complementary Mix of Land Uses

The area proposed for district designation should contain an appropriate mix of land uses that promote multimodal transportation. The Urban Land Institute (*Mixed Use Development Handbook*, Dean Schwanke, 1987) defines mixed-use developments through the following standards:

- Three or more significant land uses, such as retail, office, residential, hotel/motel, entertainment, cultural, recreational, that are mutually supporting
- Physical and functional integration of project components, including connected and continuous pedestrian facilities

An important component in the success of a multimodal district is the presence of residential uses within the overall land use mix. Areas with the most potential as multimodal districts, and attaining the goals of sustained usage of alternative modes,

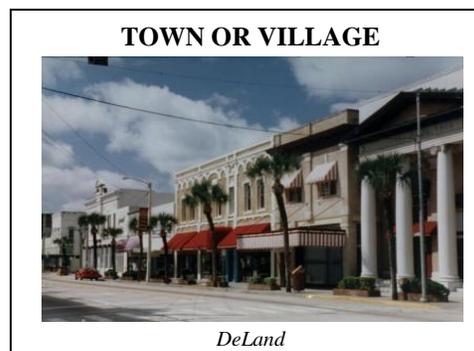
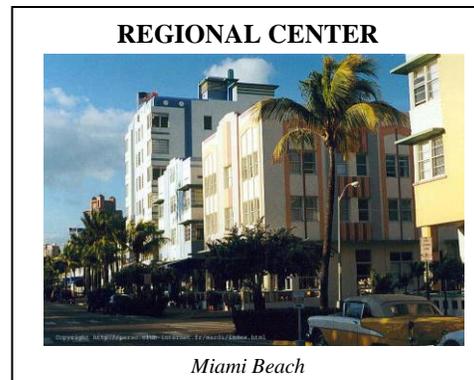
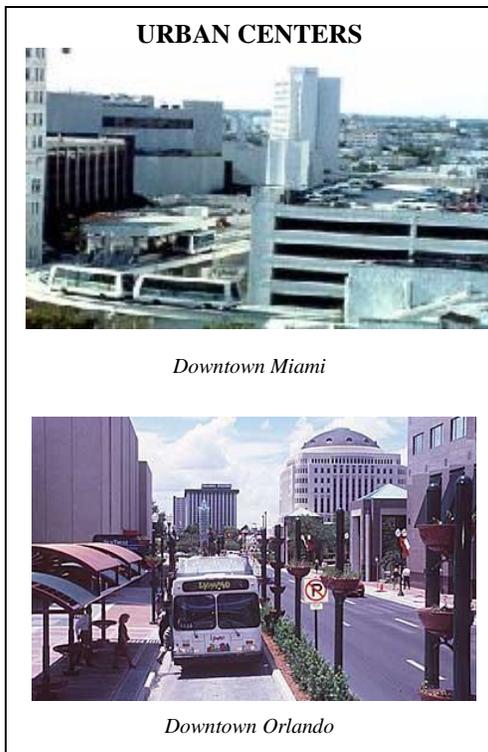
occurs when there is a wide variety of compatible land uses, including a solid residential base. For example, if there are fewer than three land uses without residential, or if the area is dominated by residential, the potential for functioning as a multimodal district is low.

**Transit and Pedestrian Friendly Design**

The types of areas suitable for multimodal transportation districts can encompass urban centers, regional centers or traditional towns and villages. Single use developments and isolated park and ride/transit stations are generally not appropriate candidates for multimodal transportation districts. However, if alternative modes of transportation are provided, including transit service, within the proposed district, as well to the major urban center in the area, these types of developments may qualify. It is essential that multimodal transportation linkages exist both internally and from the isolated development to the central community. The types of areas suitable for multimodal designation are shown in Table 1. Area types generally not well suited for multimodal transportation district designation are shown in Table 2. These tables were adapted from *Planning for Transit Friendly Land Use, NJ Transit, 1994*.

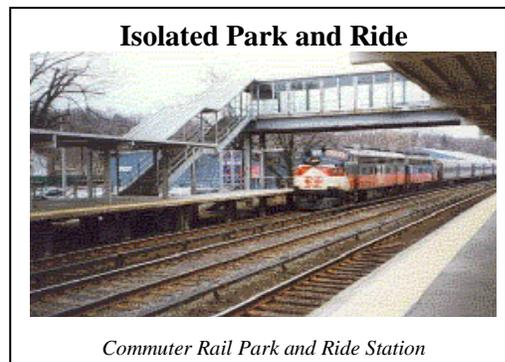
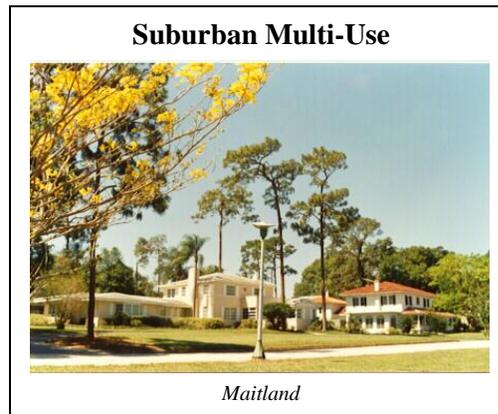
**Table 1. Characteristics of Development Appropriate for Multimodal Transportation Districts**

<p><b>Urban Center</b> (Ex: Miami, Downtown Orlando)</p>	<p><b>Regional Center</b> (Ex: Miami Beach)</p>	<p><b>Traditional Town or Village</b> (Ex: DeLand)</p>
<p>Intense Development and Major Employment Supported By Residential and Retail</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Population &gt;50,000</li> <li>• Jobs &gt; 50,000</li> <li>• Jobs: Dwelling Units, 1:1</li> <li>• Area: 10 square miles</li> <li>• Compact Core of Community &amp; Commercial Services</li> <li>• Pedestrian Orientation</li> <li>• High Density</li> <li>• Mix of Land Uses</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• Multiple Modes of Transit</li> <li>• Walking is Significant</li> <li>• Parking Provided, but Limited</li> <li>• Significant Amenities</li> <li>• Dense Network of Narrow Local Streets Plus Arterial Roadways</li> </ul>	<p>Significant Area of Development Smaller Than Urban Center</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Population: 25,000 - 50,000</li> <li>• Jobs &gt; 5,000</li> <li>• Jobs: Dwelling Units: 1:1</li> <li>• Area: 5 square miles</li> <li>• Compact Core of Community and Commercial Services</li> <li>• Pedestrian Orientation</li> <li>• Mid to High Density</li> <li>• Mix of Land Uses</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• Multiple Transit Services Available</li> <li>• Walking is Significant</li> <li>• Parking Provided, but Limited</li> <li>• Significant Amenities</li> </ul>	<p>Communities Organized Around a Focal Point With Sense of Community Identify</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Population &lt; 25,000</li> <li>• Jobs &lt; 5,000</li> <li>• Area: 2 square miles</li> <li>• Compact Core of Community Services</li> <li>• Pedestrian Orientation</li> <li>• Mid Density</li> <li>• Mix of Land Uses</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• May Have Bus</li> <li>• Walking is Significant</li> <li>• Parking is Provided</li> <li>• Significant Amenities</li> </ul>



**Table 2. Characteristics of Development Not Suited for Multimodal Transportation Districts**

<p><b>Single Use District</b> (Ex: Southpoint -Jacksonville)</p>	<p><b>Suburban Multi-Use</b> (Ex: Hathaway Maitland -Orlando)</p>	<p><b>Isolated Park and Ride</b> (Ex: Golden Glades Park &amp; Ride)</p>
<p>Area With One Land Use Such As Residential or Office or Industrial</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• No Central Core</li> <li>• Mid to Low Density</li> <li>• Dominated by One Land Use</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• May Have Bus</li> <li>• Walking Access is Limited</li> <li>• Parking Provided</li> <li>• Few Amenities</li> </ul>	<p>Suburban Area With No Central Focus and A Mix of Land Uses</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• No Central Core</li> <li>• Low Density</li> <li>• May Have a Mix of Land Use</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• May Have a Bus</li> <li>• Walking Access is Limited</li> <li>• Parking Provided</li> <li>• Few Amenities</li> <li>• Required to Drive to Transit</li> </ul>	<p>Isolated Park and Ride or Transit Stations Without a Mix of Supporting Land Uses or Pedestrian Access</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Isolated Station and Parking</li> <li>• Mid to Low Density</li> <li>• May Have Mix of Land Use But Poorly Organized</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>• May Have Bus</li> <li>• Walking Access is Limited</li> <li>• Parking Provided, May Include Park and Ride</li> <li>• Required to Drive to Regional Transit</li> </ul>



The mix of complementary land uses within a multimodal transportation district is also an important element. This mix provides amenities that attract pedestrians, bicyclists and transit users. The *significant* land uses suitable for multimodal transportation districts include office, regional retail, recreation, educational, cultural, institutional, hospital, and high/medium density residential. *Supporting* land uses include commercial uses such as hotels, theaters, restaurants, health clubs, day care, convenience retail, specialty retail, or light industrial and manufacturing.

The Land Use Compatibility Matrix found in Table 3 depicts the significant and supporting land uses generally appropriate for a multimodal transportation district. The more diverse the mixture of land uses within a district, the greater the potential for multimodal trip making.

**Table 3. Land Use Compatibility Matrix**

	Urban Center	Regional Center	Town or Village
<b>Office</b>			
Center Office	◆	◆	◆
Suburban Office	—	—	◆
Local Services	◇	◇	◇
Medical Office	◇	◇	◇
<b>Commercial</b>			
Hotels	◇	◇	◇
Theaters	◇	◇	◇
Restaurants	◇	◇	◇
Local Shopping Centers	◇	◇	◆
Regional Shopping Centers	◆	◆	—
Convenience Retail	◇	◇	◇
Specialty Shopping	◇	◇	◆
Hospitals	◆	◆	◆
Day Care	◇	◇	◇
<b>Recreational</b>	◆	◆	◆
<b>Cultural</b>	◆	◆	◆
<b>Schools and Colleges</b>	◆	◆	◆
<b>Governmental/Institutional</b>	◆	◆	◆
<b>Light Industrial/Manufacturing</b>	◇	◇	◇
<b>Residential</b>			
0-7 Units per Acre	—	◇	◇
8-15 Units per Acre	◇	◆	◆
16-24 Units per Acre	◆	◆	◆
24+ Units per Acre	◆	◆	◆

◆ Significant Use, Highly Desirable  
 ◇ Supporting Use, Contributing

Source: Adapted from *Planning for Transit Friendly Land Use*, NJTransit, 1994

**3. Land Uses That Promote Walking and Transit Use**

In addition to an appropriate mix of compatible land uses, the urban form, or organization and pattern of land uses should promote transit, bicycle and pedestrian travel. This design, which includes good intermodal connections, is critical in sustaining multimodal usage and achieving the full potential of the district. The activity resulting from a constant level of transit, pedestrian and bicycling activity promotes a safe, pleasurable experience for the traveler.

“The inclusion of varied uses within an otherwise residential environment appears to be a necessary precondition for pedestrian street activity. This is for several reasons. A blend of non-residential and residential uses places trip attractions within walking distance of people’s homes; people are much more likely to walk when they have some place specific and nearby to go.

Other pedestrian-friendly qualities ascribed to mixed-use development include: architectural variety and visual interest; street security; and a greater sense of community when residents have places outside home and work to casually interact.

Two kinds of accessibility between land uses are important. Proximity of activities to one’s place of residence – so called residential accessibility affects the length, mode and the frequency of home-based trips. A second type of accessibility is destination accessibility – the proximity of activities to one another. Destination accessibility affects the travelers' ability to link trips efficiently into tours or, better still, complete more than one activity at a single stop. In either case, activity centers should be placed no more than ¼ mile from housing if walking is to be a serious mode of travel. “

*-Pedestrian and Transit Friendly Design, FDOT, 1996*

Table 4 summarizes the land uses that promote pedestrian and transit usage by time of day. Off-peak usage is important in promoting the needed level of activity to create a safe and vital pedestrian environment. The mix and organization of the land uses are central to supporting and encouraging multimodalism both in the peak and off-peak hours.

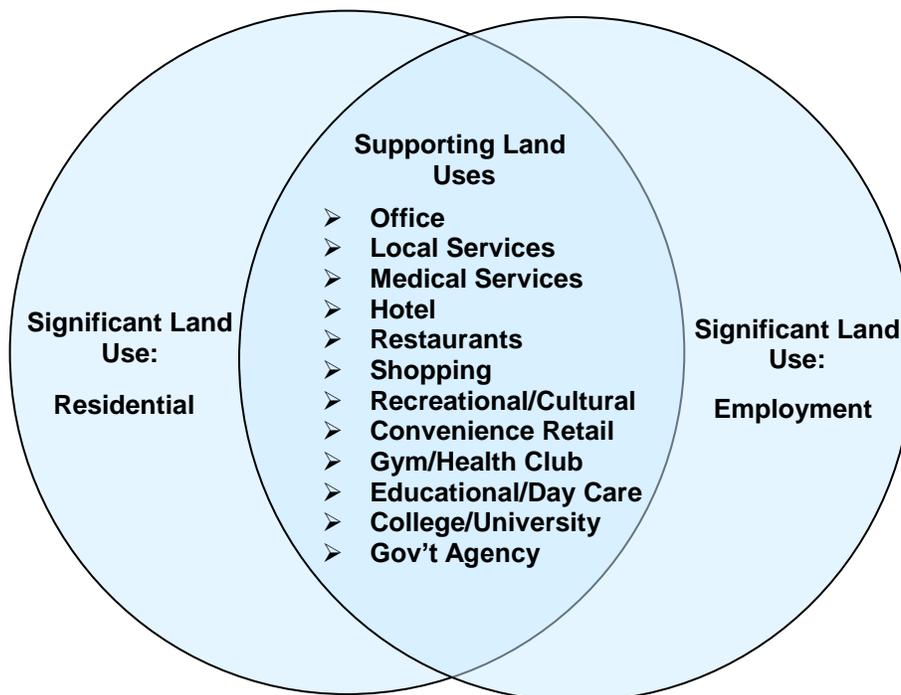
**Table 4. Land Uses Promoting Transit and Pedestrian Usage in Mixed-Use Areas**

Land Use	Peak	Off-Peak
High Density Residential	X	X
Commercial/Office	X	
Destination Retail		X
Convenience Retail	X	X
Entertainment		X
Institutional	X	X
Day Care	X	
School	X	
Grocery Stores	X	X
Restaurants	X	X

Source: Adapted from *Planning for Transit Friendly Land Use, NJTransit, 1994*, and *Pedestrian and Transit Friendly Design, FDOT, 1996*.

A complementary mixture of land uses is critical to encouraging and sustaining multimodalism. In conjunction with this mix of land uses, modal choices must provide convenient and efficient transportation service, allowing the user to remain within a comfort zone of activity, travel time, perception of safety, and pleasantness of the trip. The land uses necessary for multimodal interaction are employment and residential. The residential and employment need to be supported by other land uses which are contributing factors to multimodal interaction. Figure 2 illustrates the necessary and supporting land uses that are compatible with and support multimodal usage in a district. As shown in the diagram, the supporting uses can also function as employment centers.

**Figure 2. Land Uses and Multimodal Compatibility**



In addition to providing the appropriate mix of land uses, the separation of these land uses should be addressed. Acceptable walk trip lengths are dependent upon several variables, including the trip purpose, quality of the pedestrian environment, and age and ability of the pedestrian. Tabulations from the 1990 National Personal Transportation Survey reported in *Pedestrian and Transit Friendly Design, FDOT, 1996*, show that median travel times and walking distances for shopping, social/recreational, and other trip purposes can be used to assess the desirable distances between land uses serving these trips. Table 5 summarizes these results and can be used as a guide in determining the recommended separation of land uses with potential interactions.

**Table 5. Recommended Maximum Separations of Land Uses Based on Trip Purpose**

Trip Purpose	Maximum Trip Length Walking Mode	Maximum Trip Length Walking Mode
Home-Based Shopping	0.25 - 0.5 miles	5 - 10 minutes
Home-Based-Social/Recreational	0.5 – 1.0 miles	10 - 20 minutes
Home-Based Work	1.0 – 1.25 miles	20 - 25 minutes

Adapted from *Pedestrian and Transit Friendly Design*, FDOT, 1996.

The maximum walk trip lengths for home-based work and social/recreational purposes are more flexible than those shown for shopping. These trip lengths are applicable to the typical urban area and are not indicative of special areas, such as high tourist areas, which may demonstrate acceptance of much longer trips. This information is useful in providing guidance for designing new developments that are potential multimodal districts, as well as for assessing the potential success of districts located in existing developments.

**3.2 Summary**

This section provides guidance in determining if an area contains the complementary mix of land uses needed to promote multimodal transportation. The area should be of sufficient scale to sustain pedestrian, bicycle and transit use and contain an appropriate mix of land uses. Recommendations include at least three *significant* land use types, one of which is residential, should be provided for an area designated as a multimodal transportation district. In addition, the recommended land uses should promote walking, bicycling and transit usage within the district. Adequate connections for pedestrians and bicyclists to transit stops are extremely important in promoting the use of alternative modes of transportation and are critical to the success of any transit system.

**CHAPTER 4**

# Appropriate Density and Intensity of Land Uses

The appropriate density, intensity and organization of land uses are as important as the mix of land uses in maximizing the multimodal potential of any area. The proper coordination of these land use elements with the modes of transportation ensures the success of designated multimodal transportation districts. Land uses within a proposed multimodal district should be appropriately distributed to help define viable transit centers and community cores and to support the bicycle, pedestrian and transit use.

## 4.1 Appropriate Densities and Intensities of Land Uses

Land use density is a critical element of a multimodal transportation district. The densities necessary for sustaining a multimodal transportation district should be sufficient to support bus transit along major corridors and to provide the opportunity for vital and active pedestrian and bicycle usage. The desirable levels of residential densities and commercial intensities for an area to support the designation as a multimodal transportation district are summarized in Table 6. In determining these densities, areas that are not available for development, such as parks and golf courses, should be excluded from the analysis. It is important in the assessment of districts to also recognize and define future development possibilities within district boundaries that could increase the area's multimodal potential and make a district viable.

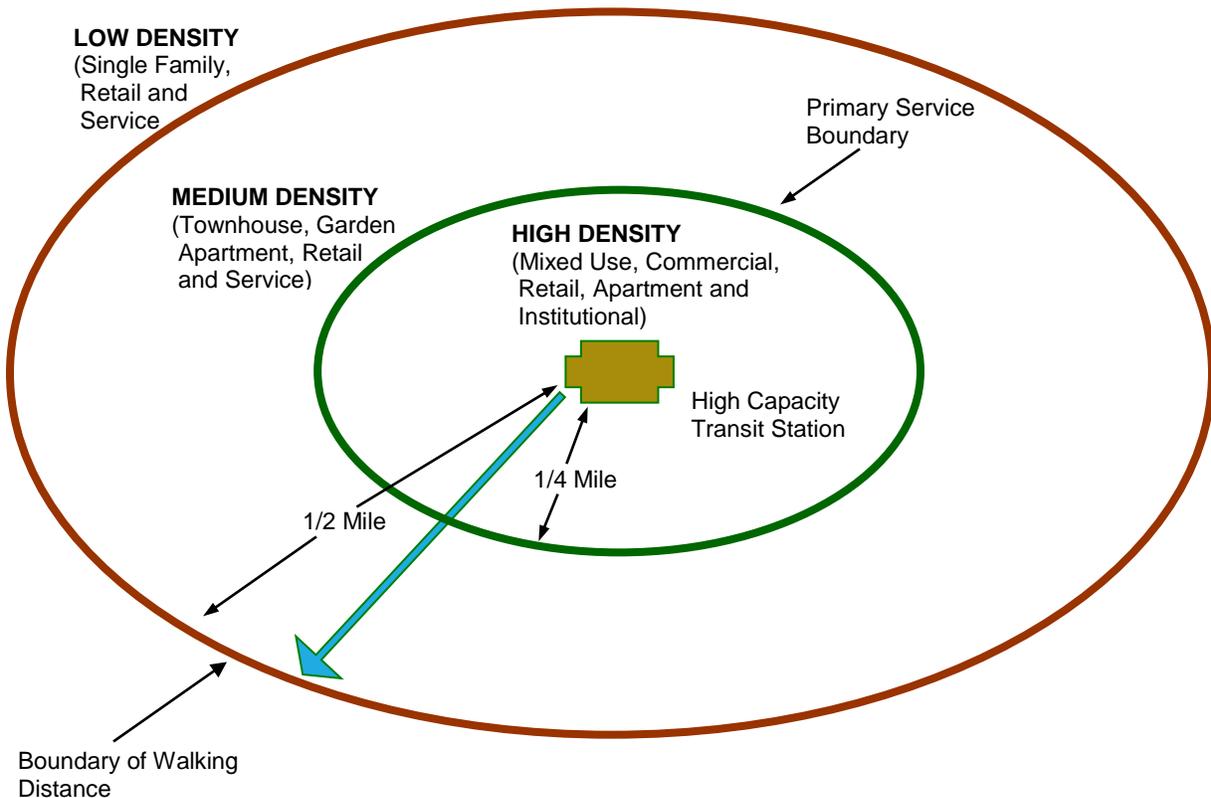
**Table 6. Desirable Densities and Intensities for Multimodal Transportation Districts**

Residential Land Use (units per acre)	Commercial Land Use (employees per acre)	Multimodal Potential and Transportation Compatibility
1 - 3	1 – 39	Poor.
4 - 6	40 - 59	Marginal multimodal potential, but possibilities for success exist.
7 - 14	60 - 99	Good multimodal potential. Densities support bus transit service.
15 +	100 +	High multimodal potential. Densities support light-rail and other high capacity transit service.

Source: *Planning for Transit Friendly Land Use, NJ Transit, 1994*

## 4.2 Organization of Land Uses Promoting a Central Core

Providing a central core of community services is a characteristic of the major land use typically needed for Multimodal Transportation Districts. A strong central core within a community or urban center is the ideal land use organization for providing the vitality and sustainability of land uses and pedestrian activity necessary for a multimodal transportation district. Figure 3 provides an illustration of the principals of transportation and land use location around the central core.

**Figure 3. Organization of Land Uses That Promote a Central Core**

The intensity of land uses should provide denser development within the primary service area for this central core, which should include transit service. The primary service area bound by a radius of  $\frac{1}{4}$  mile should include a mixture of land uses including commercial, residential and retail. Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile, which is considered the practical limit for walking access, densities may decline but mixed use including residential, retail and community facilities is encouraged. Beyond the  $\frac{1}{2}$  mile walking boundary, lower densities are permitted. This pattern of land use intensity promotes a logical organization and a compatible mix of land uses that promotes multimodal usage.

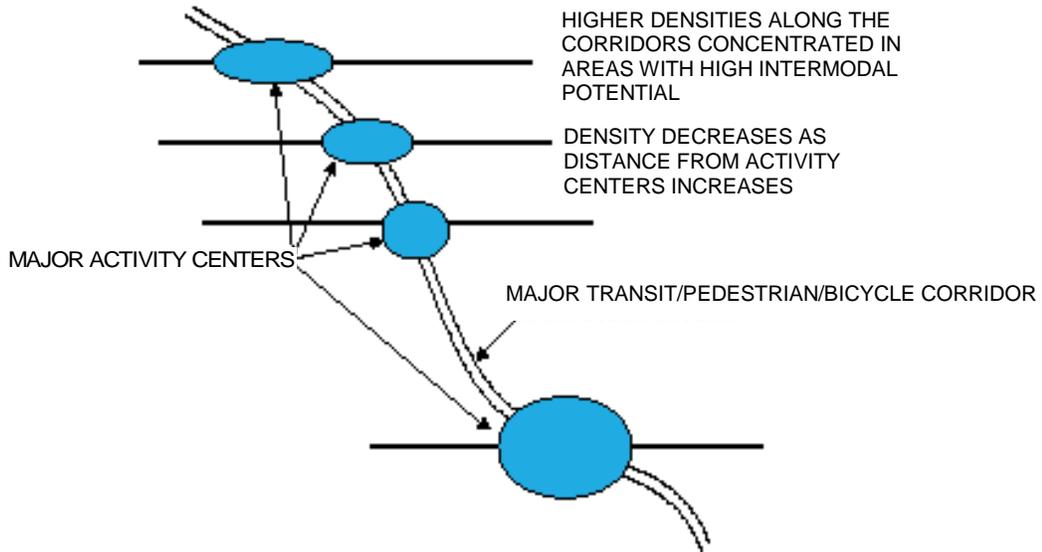
While this land use organizational structure is ideal, there are other development patterns that can support a successful multimodal district. This pattern is evidenced in the Gainesville Case Study, which had a land use organizational structure that was not concentric. The Gainesville Case Study can be found in Appendix D. The key element is a density of development providing primary services, whether the activity core is located centrally, or in some other organizational form. If a multimodal district was designed and then built, the land use organization would be concentric. However, if the multimodal districts are being overlaid onto existing development, the pattern may not fit the ideal of a concentric core. The fact that the development organization is not concentric should not preclude the designation of a district if the criteria can be met.

### 4.3 Appropriate Organization of Land Uses Along Corridors

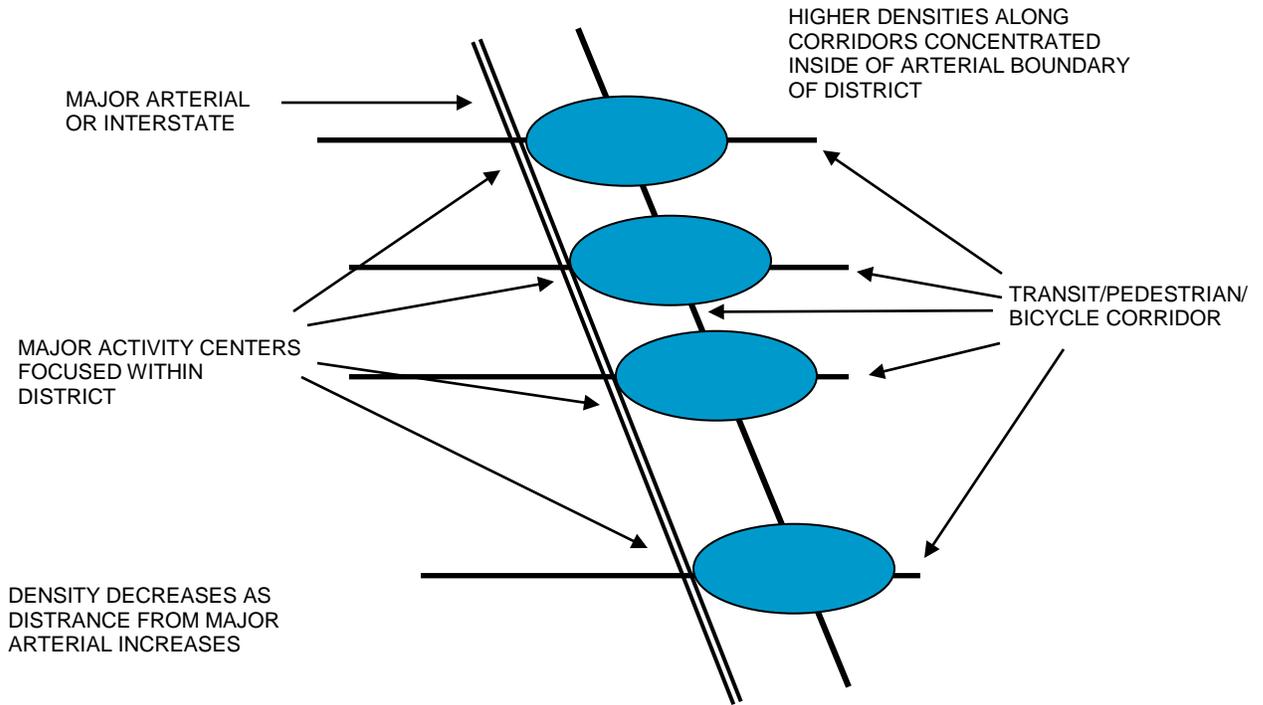
Along the major corridors, or principal arterials, within a proposed district, land uses should be distributed in such a way that the densities and intensities promote transit usage. Higher density land uses, such as commercial offices, multifamily residential, and institutions should be located within walking distances to activity centers along the major route. These activity centers are best located at key crossings of perpendicular routes, which are generally minor arterials or collectors, or transit service routes. The densities along the perpendicular facilities to the major route should decrease as distance from the major route increases. This strategy will promote transit use and access or intermodal transfer facilities.

However, in some cases, the organization of land uses may be focused on only one side of a major arterial. This scenario could occur when a multimodal district is bounded by a major traffic mover. In this type of configuration, the land uses that promote transit usage would be focused within the district and on one side of the major arterial. These concepts are illustrated in Figure 4.

**Figure 4. Recommended Intensities of Land Uses Along Corridors**



### Recommended Intensities of Land Uses Along Corridors: Major Arterial Boundary



#### 4.4 Summary

The appropriate density and intensity of land uses is important in the promotion of multimodal transportation. The recommendations for residential density and commercial intensity levels, as well as the appropriate organization of these land uses around the central core and along major corridors are also an important element of a multimodal transportation districts.

## CHAPTER 5

# Network Connectivity

An interconnected, multimodal transportation network designed to meet the needs of the transportation user, as well as to encourage and facilitate walking, bicycling and transit usage, is essential for a multimodal transportation district. This transportation network must provide a convenient, connected transportation system within the district, connectivity between modes and to regional intermodal facilities, as well as minimum desirable levels of service for bicyclists, pedestrians and transit riders.

### 5.1 Proper Pattern of Roadways

The street pattern should promote efficient and continuous circulation that maximizes the efficiency of transit usage and provides the greatest accessibility for pedestrians and bicyclists. Networks that have meandering, serpentine streets with numerous termini or cul-de-sacs limit opportunities for transit and pedestrian usage.

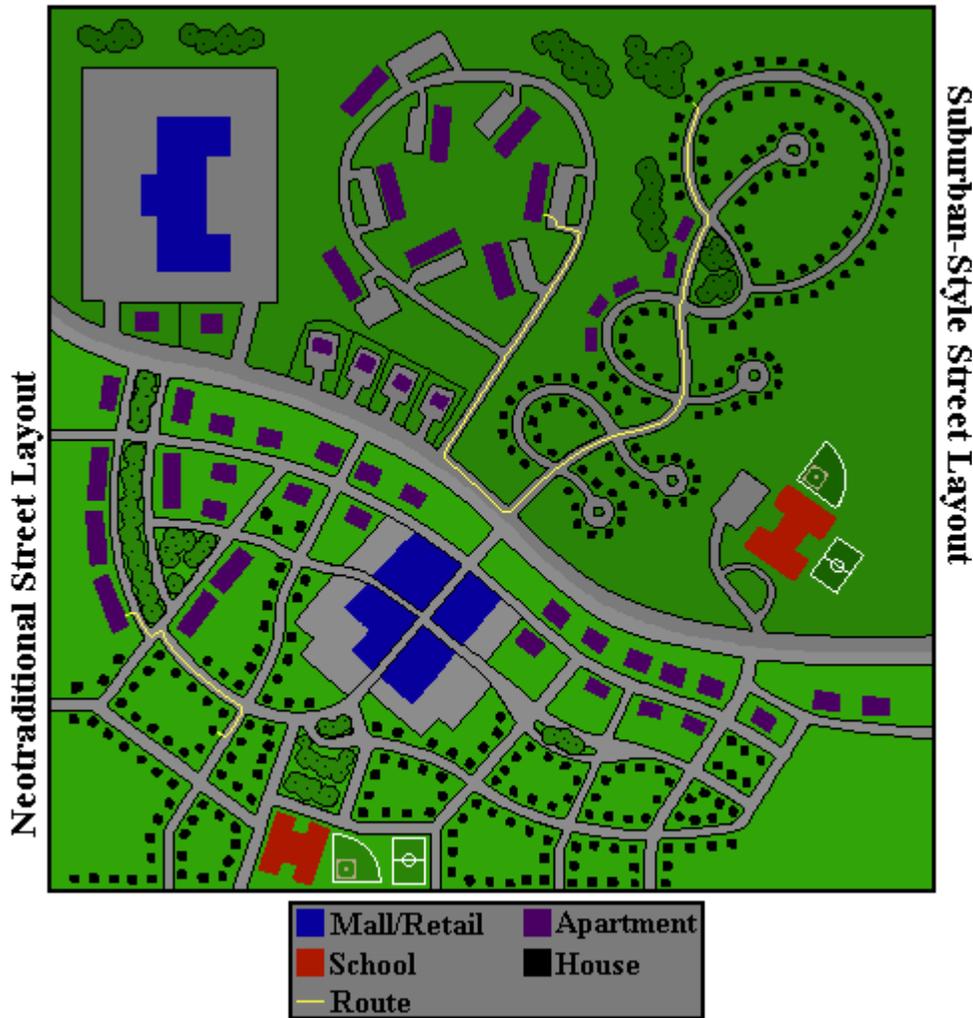
A properly organized street network promotes continuous systems for pedestrians, bicyclists and automobiles. Transit stations and stops should be located within walking distances of activity centers and the access routes for pedestrians and bicycles to transit should be as direct as possible. Street systems should support pedestrian usage by providing continuous sidewalks, shade tree canopies or covered walkways, and traffic buffers and separations wherever possible. While arterial roadways should provide greater mobility to automobiles and transit, amenities should also be provided to support transit station accessibility and pedestrian and bicycle usage, including protection at major roadway crossings.

Freeways and other major highways promote and support automobile and truck mobility, but safe environments should be provided for bicyclists and pedestrians wherever possible and allowable. Safety and ease of crossing major automobile and truck routes for pedestrians and bicyclists should be a priority.

The street pattern should also provide good access to a community focal point or urban core that provides basic services such as a government center, transit station or town square. The basic concept of the hierarchy and proper pattern of roadways is shown in Figures 5 and 6, with photos illustrating these basic concepts shown in Figure 7.

**Figure 5. Proper Pattern of Streets:**

Neotraditional vs. Conventional Suburban Style

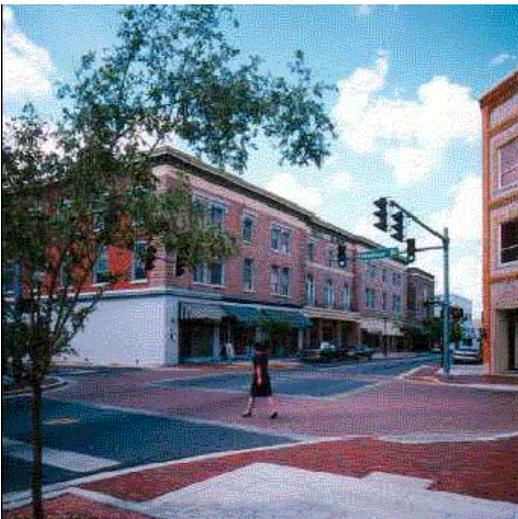


A conventional suburban-style street layout has a system of streets with feeder, collector and arterial streets. This system has very poor street connectivity, as all traffic is funneled onto the arterial street. As a result, only one possible (and often longer) route exists for most trips, creating congestion on the arterial street and making it impractical to walk anywhere. A neotraditional street layout has a high degree of street connectivity. Many more possible and more direct routes are available for any given trip, and traffic is spread out over the entire street network, reducing congestion. If shopping is centrally located within a neotraditional neighborhood, it becomes possible for shoppers to walk to the store. A centrally located school not only makes it possible for kids to walk to school, but also makes school athletic and playground equipment easily reached by the members of the neighborhood in the evening and on the weekends.

Source: *Concepts Sketchbook: Street Connectivity*, Oregon Department of Land Conservation and Development, 2001



Figure 7. Street Patterns Promoting Pedestrian and Transit Activity



Photos courtesy of Walkable Communities, Inc.

## **5.2 Connectivity Index**

A connectivity index for each of the modes should be applied to measure how well the street pattern is organized. There are several methodologies available to measure the connectivity of the modal networks. These connectivity indices include the accepted link-node methodology, as well as some that are currently being researched and under development. After the application of these various methodologies within case studies, the polygon methodology, which is currently being tested and updated by the Department of Urban and Regional Planning at the University of Florida, was chosen as a sketch planning method for evaluating multimodal districts.

This polygon methodology was chosen for the simplicity of application. In applying this connectivity methodology, the modal network is identified. Once the network has been identified, the number of polygons contained within that network is counted. Based on an evaluation of communities exhibiting excellent connectivity, a minimum of 50 polygons per square mile is considered to be an acceptable level of connectivity for a proposed district (See Figures 10-13).

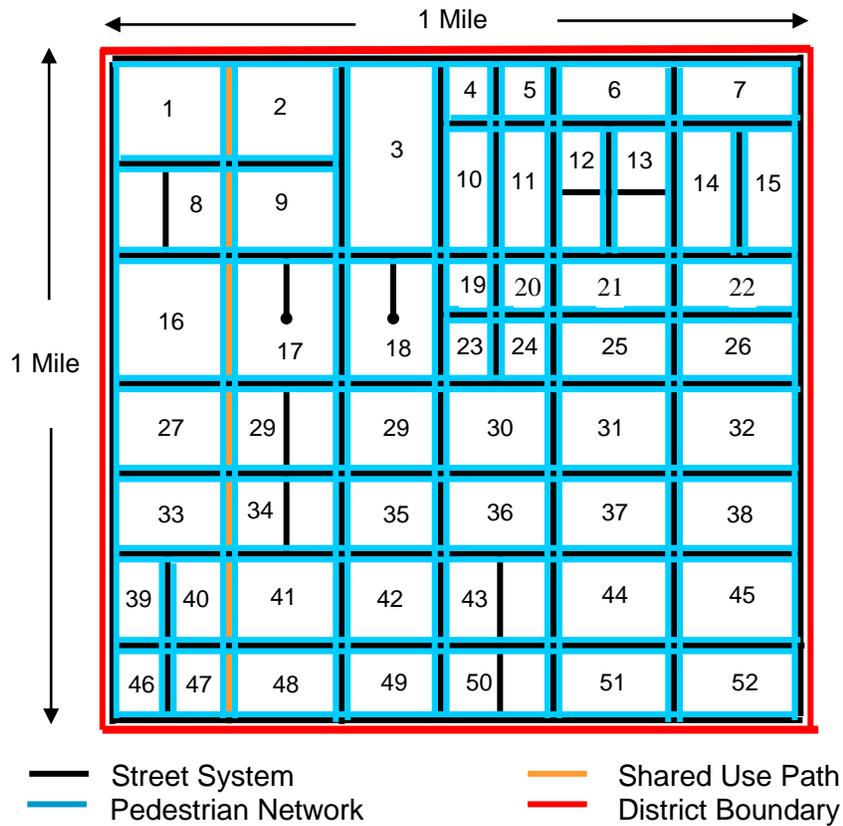
### **Modal Connectivity**

Good pedestrian connectivity is a key component of a multimodal transportation district. This connectivity is critical for transit access and for providing the shortest walking distances to destinations. The pedestrian connectivity, measured through the polygon methodology, identifies all pedestrian facilities, including shared use paths. Also included are cul-de-sac connections. After defining the network, polygons are drawn over the complete network. The higher the number of closed polygons, the greater the connectivity. Presently, the number of closed polygons is recommended to be 50 or higher per square mile for good connectivity.

This polygon methodology is also used as a measure for bicycle, transit and automobile connectivity. Each modal network is defined and polygons drawn over the complete network. The defined network for transit and automobile is the same. The defined bicycle network includes the automobile/transit network, as well as any shared use paths and cul-de-sac connections. With the emphasis on modes of transportation other than the automobile within multimodal districts, if the pedestrian connectivity index is higher than 50, the automobile connectivity index can be correspondingly lower than 50.

Figure 8 shows an example of the polygon methodology for measuring pedestrian connectivity.

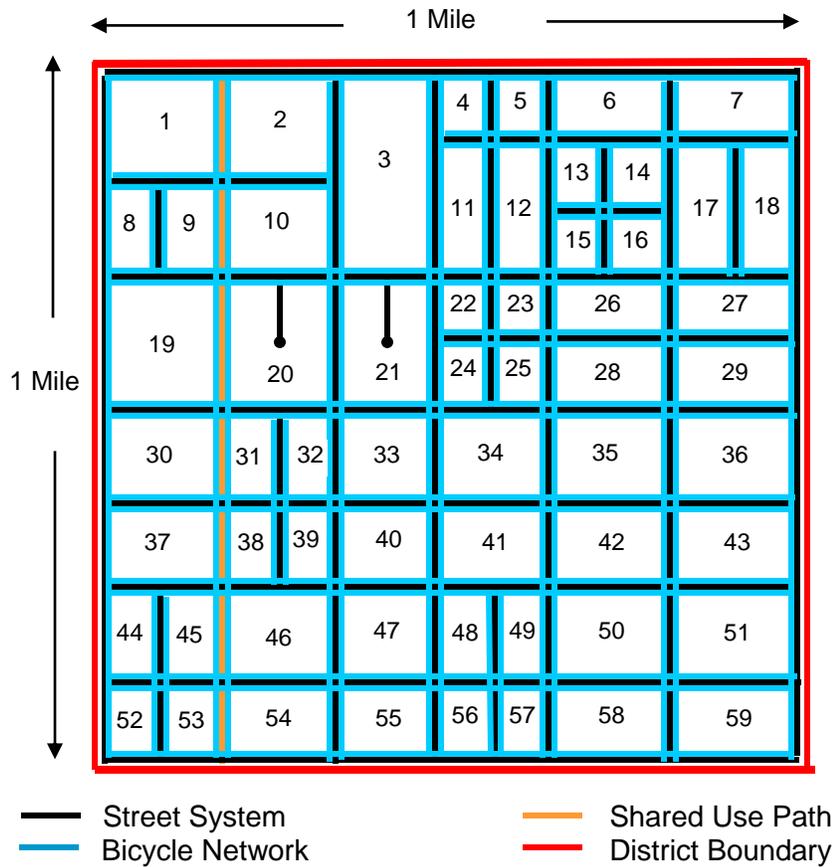
**Figure 8. Pedestrian Connectivity Index**



The blue lines depict the pedestrian network. To determine the connectivity index, the closed polygons shown by the blue lines are counted. This example has a good pedestrian connectivity with 52 polygons.

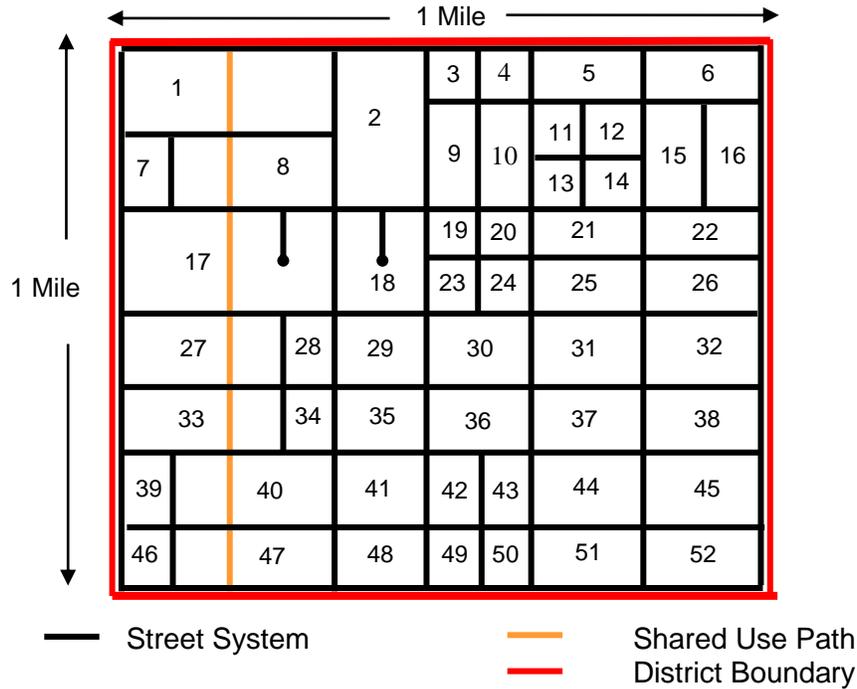
The bicycle network and connectivity index is shown in Figure 9. The bicycle network consists of the street network and any shared use paths and cul-de-sac connections. The blue lines in this figure detail the bicycle network. The bicycle index has 59 polygons per square mile, which exceeds the recommended number of 50 acceptable for good connectivity.

**Figure 9. Bicycle Connectivity Index**



The transit/automobile connectivity index is shown in Figure 10. This network consists of the street system within the district and the blue lines depict the number of closed polygons. The transit/automobile index contains 52 polygons per square mile, which exceeds the recommended number of 50 acceptable for good connectivity.

**Figure 10. Transit/Automobile Connectivity Index**



As can be seen in these examples, areas with grid street patterns exhibit a high connectivity index. As the grid pattern becomes more compact with shorter block sizes, the connectivity index rises. These types of areas will have the most potential as a multimodal transportation district and can be found in large urban centers, regional centers, or smaller towns or villages.

Portland, Oregon, a large urban center, exhibits a very dense grid street pattern shown in Figure 11. This type of street pattern is extremely appropriate for a multimodal transportation district, with a very high level of connectivity for transit, automobile, and bicycle modes of transportation. The number of polygons on the transit/automobile network within an approximately 2 square mile area of Portland is very high, at 867. The pedestrian connectivity index is also high due to the emphasis placed on the transit system in the area. These urban design and transportation characteristics both encourage and sustain the densities and intensities of land uses necessary for a successful multimodal transportation district. Another example of a large urban center is the downtown area of Orlando, Florida. A map of downtown Orlando and images of the urban design, land use and transportation characteristics that should be present in a multimodal transportation district are also seen in Figure 11. The automobile/transit network in the Orlando area exhibits good connectivity, containing 162 polygons in approximately 2 square miles.

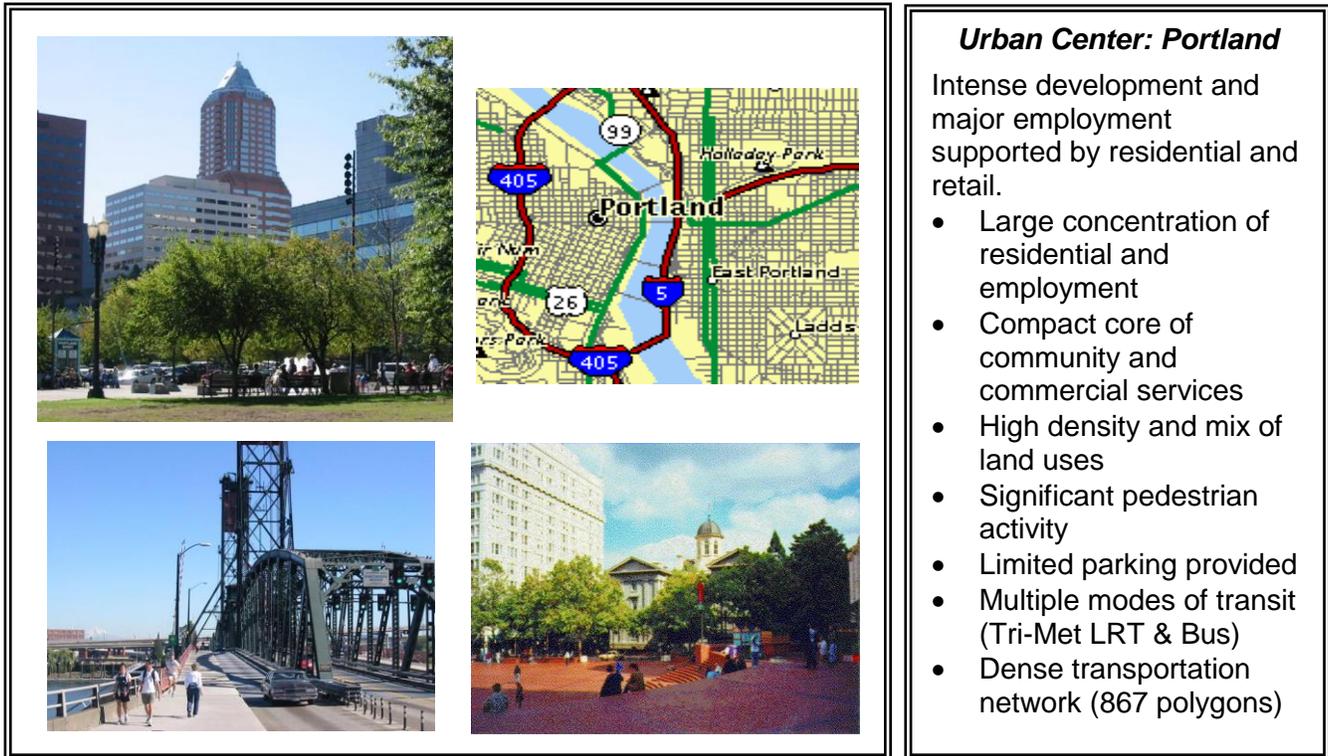
A regional center is a significant area of development smaller than the urban center and can also be well suited for a multimodal transportation district. An example of a regional center with the needed combination of street pattern and connectivity and land use is Miami Beach, Florida. The street pattern that provides connectivity can be seen in the map in Figure 12 and contains 183 polygons in approximately 2 square miles. The

organization of land uses which supports multimodal usage is also shown in Figure 12.

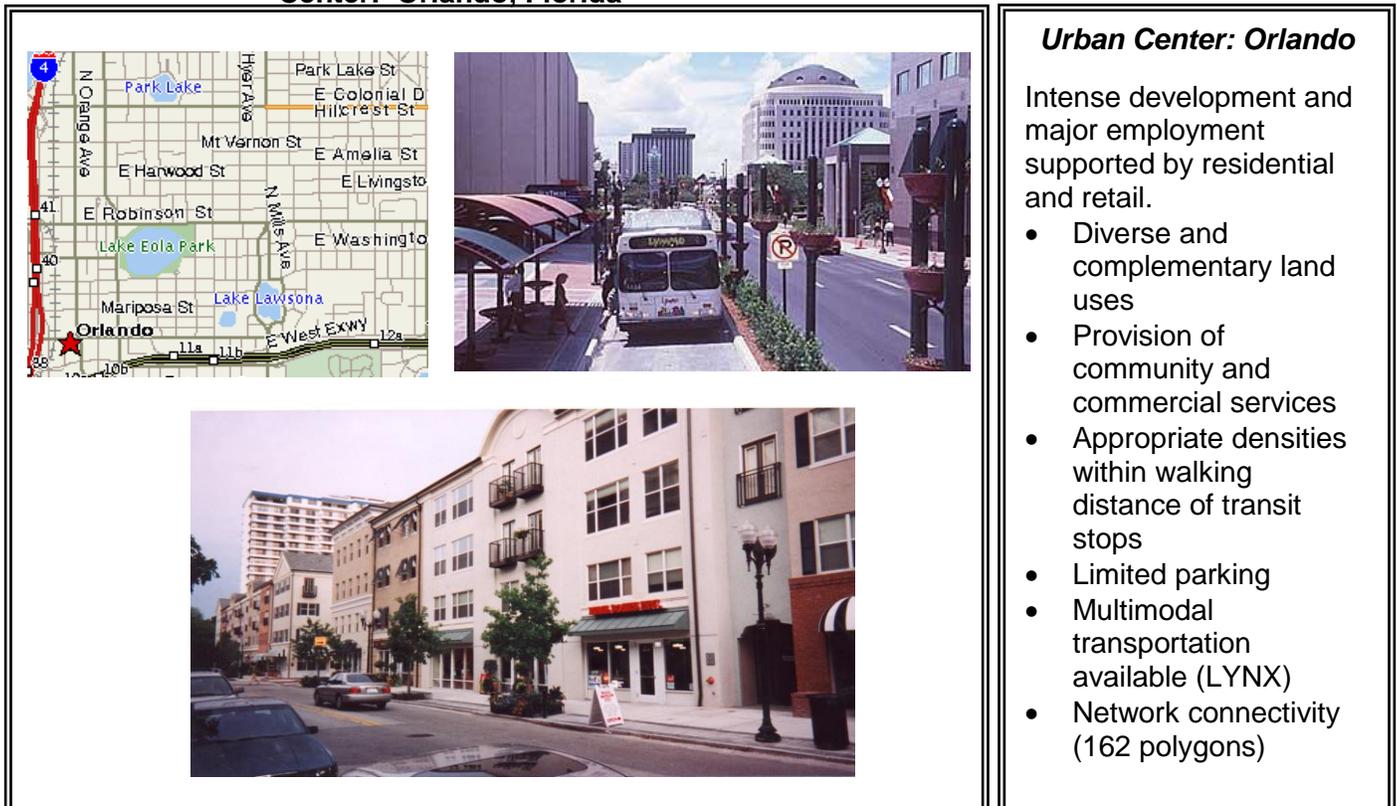
A traditional town or village, which is a community organized around a focal point with a strong sense of community may also be suitable for a multimodal transportation district. An example of this type of development is found in Figure 13, showing a map and images of DeLand, Florida. The area of DeLand that is shown is approximately 4 square miles in size and also exhibits the needed connectivity, with 353 polygons contained within the automobile/transit network.

An example of an area that is not suited to a multimodal transportation district is the Southpoint area located in Jacksonville, Florida shown in Figure 14. This single use area, roughly 2 square miles in size, is comprised primarily of offices and associated uses such as hotels and restaurants. Transit availability is limited and access to transit stops is very poor. There are few pedestrian facilities and very little connectivity within the modal networks, with a total of 14 polygons contained within the automobile/transit network. Parking is readily available and the parking facilities generally fall into the “sea of asphalt” category.

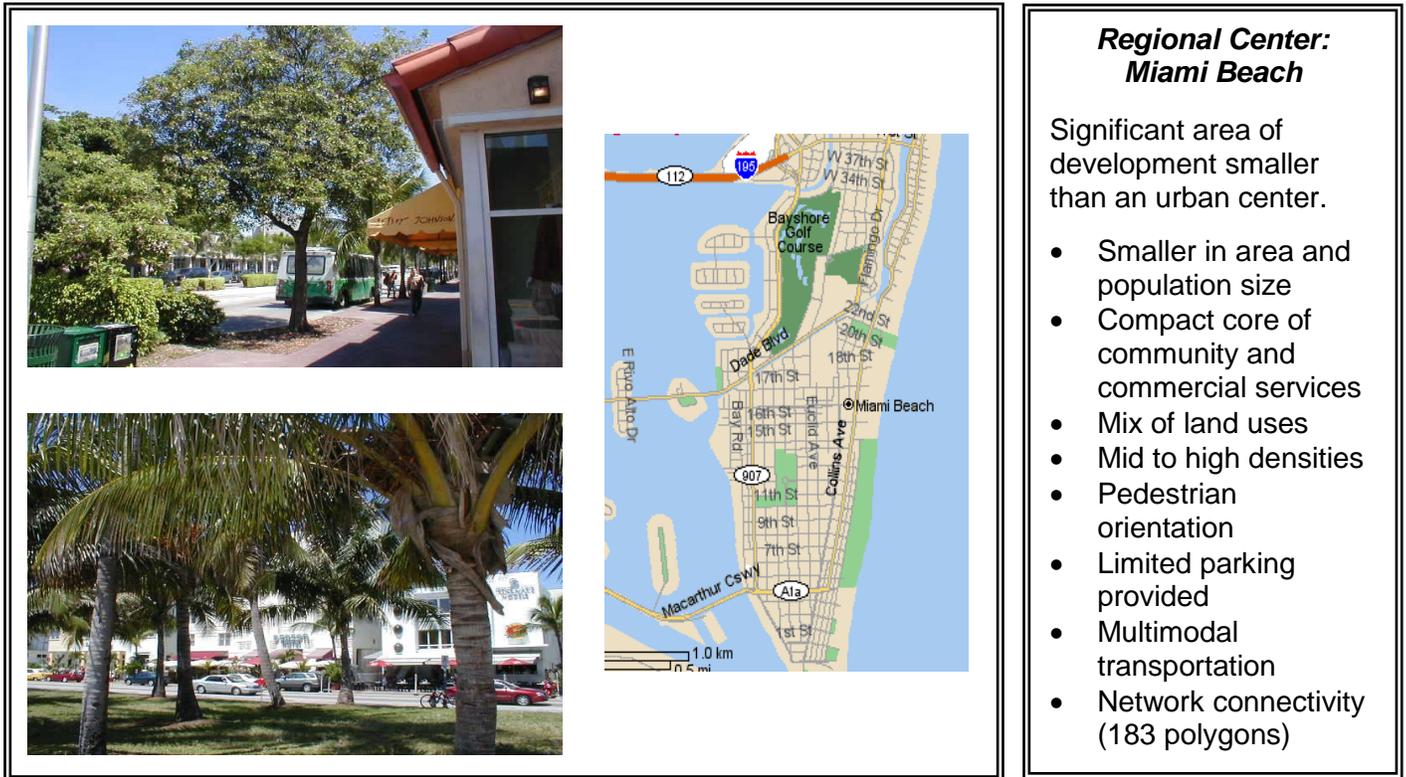
**Figure 11. Successful Integration of Transportation, Urban Design and Land Use in an Urban Center: Portland, Oregon**



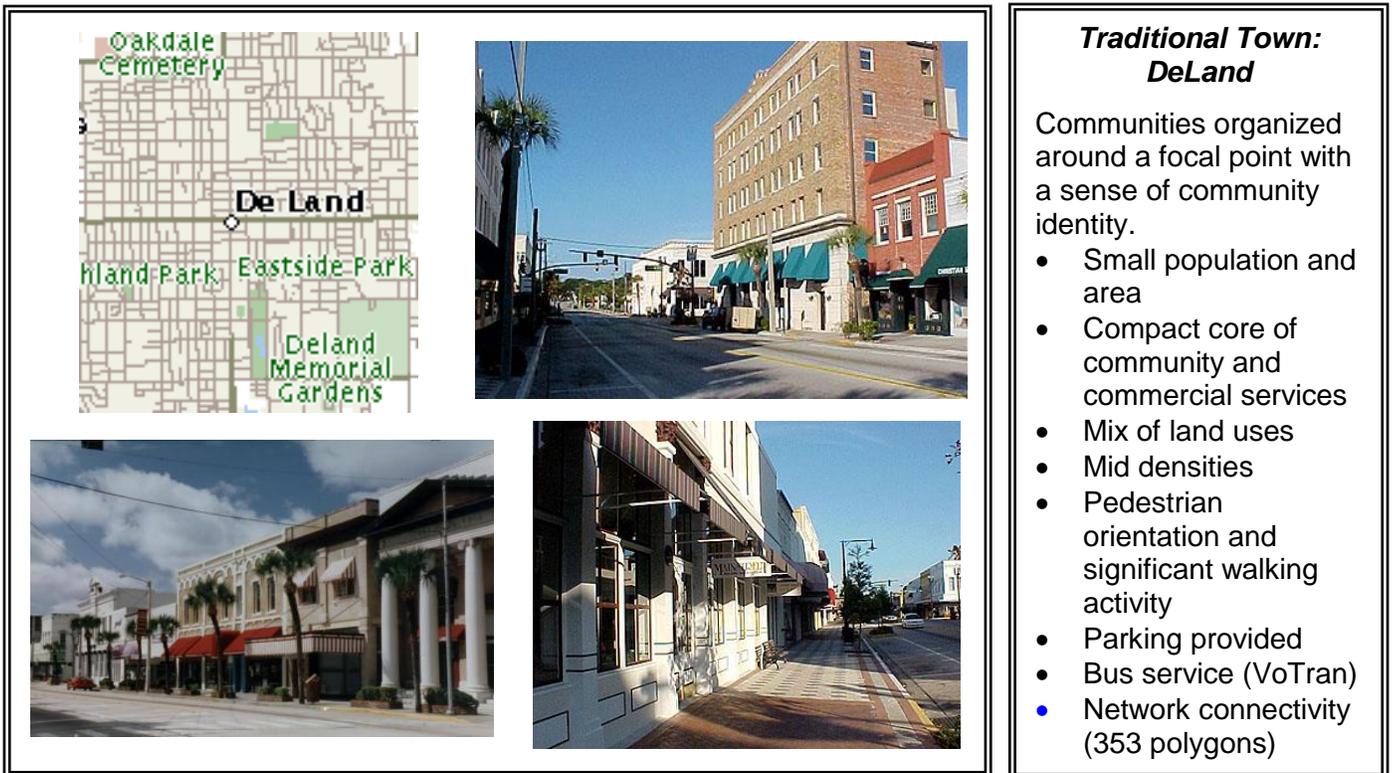
**Successful Integration of Transportation, Urban Design and Land Use in an Urban Center: Orlando, Florida**



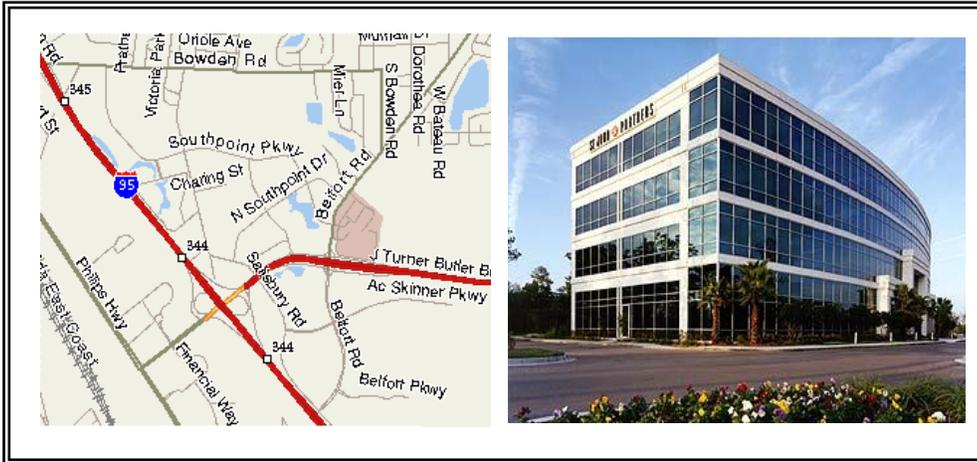
**Figure 12. Successful Integration of Transportation, Urban Design and Land Use in a Regional Center: Miami Beach, Florida**



**Figure 13. Successful Integration of Transportation, Urban Design and Land Use in a Traditional Town or Village: DeLand, Florida**



**Figure 14. Area Not Suited for Multimodal Transportation District: Southpoint, Jacksonville, Florida**



**Single Use District:  
Southpoint**

Area with one land use such as residential or office or industrial.

- Dominated by one land use
- No central core of activities and services
- Mid to low densities
- Limited pedestrian access and little walking activity
- Large amounts of Available parking
- May have bus service
- Poor connectivity (14 polygons)

**5.3 Convenient Connections Between Modes**

In order for multimodal transportation districts to be successful, easy connections between modes must be provided, with particular attention to bicycle and pedestrian access to transit stops. For pedestrians, short walking distances, usually ranging between one-quarter and one-half mile, with easy access and connections to other modes are of primary concern. In addition to network connections to transit stops, major stops should provide an adequate level of amenities. Examples of such amenities include benches, weather protection, system information and maps, trash bins and bicycle storage. Accommodations for bicycles to be carried on the transit vehicle are also a very important aspect of the necessary intermodal connections within a district.

Adequate mid-block crossings and handicapped access should also be provided to transit stops and are another important element in encouraging and sustaining the use of alternatives to the automobile.

**5.4 Connections to Regional Intermodal Facilities**

A multimodal district should have connectivity to regional and intercity multimodal transportation facilities and services. These types of linkages include direct access to regional bus services, express bus service, regional rail service, regional greenway and trail systems, the Florida Intrastate Highway System (FIHS), and regional aviation facilities.

Isolated areas that do not provide linkages to regional transit service or other multimodal facilities are not considered suitable for designation as a multimodal transportation district. Because of the diversity and unique needs of any particular district, no quantitative assessments of these regional intermodal connections are included, but a qualitative assessment should be made to determine if viable links to regional transportation systems are provided.

## CHAPTER 6

# Level of Service in Multimodal Transportation Districts

## 6.1 Level of Service Standards

In addition to convenient connections within the network and between modes, the network must also provide a desirable minimum level of service for bicycles, pedestrians, and transit. Level of service is a term that is commonly used in the analysis of highway systems. This term has been used interchangeably with quality of service and performance measurement. According to the *Transit Capacity and Quality of Service Manual* (Transportation Research Board, 1999), the terms are defined as:

- *Level of Service (LOS)* - the system of six designated ranges of values for a particular aspect of service, graded from "A" (best) to "F" (worst) based on a user's perception.
- *Quality of Service* - the overall measures or perceived performance of service from the user's point of view.
- *Performance Measure/Measures of Effectiveness* - a quantitative or qualitative factor used to evaluate a particular aspect of service.

Performance measures, or measures of effectiveness, are defined based on an understanding of the user's perceptions of the quality of service. Analytical techniques can be used to estimate these performance measures, or they can be measured directly in the field. The results of the analysis or measurement produce quantifiable results that can be stratified into ranges from 'A' (best) to 'F' (worst).

When evaluating multimodal transportation districts, the LOS for pedestrians, bicyclists and transit are the critical components in the assessment. The comfort and safety of those using modes of travel other than the automobile and the access provided to these alternative modes must be addressed and supported in the successful multimodal environment. The task may be complex, because some design elements supporting high pedestrian LOS, such as on-street parking, can adversely affect the LOS of other modes. This can be an important element, particularly if a proposed district contains a route designated as part of the Florida Intrastate Highway System (FIHS). In the case of FIHS routes, the minimum LOS standard is established by the FDOT. For other streets and highways, the LOS requirements are identified in the local government comprehensive plan (LGCP).

Table 7 includes recommended modal LOS standards for multimodal transportation districts and correlates the standards with the two basic scenarios of transit oriented development and bicycle and pedestrian oriented development.

**Table 7. Recommended Minimum LOS Standards for Multimodal Transportation Districts**

	<b>Pedestrian</b>	<b>Transit</b>	<b>Bicycle</b>	<b>Automobile</b>
Transit-oriented	C	C	D	FIHS/LGCP
Non-motorized oriented	C	D	C	FIHS/LGCP

In addition to the recommended minimum LOS standards contained in Table 7, there are also suggested performance measures that a district should strive to meet by the end of the planning period at full build-out. This performance target for the pedestrian and bicycle networks is for 80% of all facilities contained in those networks function at LOS C or better. For the transit network, all parcels within ¼ mile of a transit stop should be served by pedestrian facilities operating at LOS C or better. Another target performance measure for transit is that 80% of the employees and the dwelling units in a district will be located within ½ mile of a transit stop.

## 6.2 Level of Service Techniques for Pedestrians, Bicyclists, Transit and Automobiles

The Florida Department of Transportation is currently leading the nation in the development of quality of service, level of service and performance measures for multimodal transportation. The following is a summary of the basic methodologies that are currently in the FDOT Multimodal Quality/Level of Service Handbook. These techniques are consistent with national practices documented in the 2000 edition of the *Highway Capacity Manual* and the *Transit Capacity and Quality of Service Manual* when appropriate.

### Pedestrian Level of Service

The Florida Department of Transportation recently adopted a method for determining the quality level of service for pedestrians along facilities. The Pedestrian LOS Model measures the performance of a roadway with respect to pedestrians' primary perception of safety and comfort. The factors that are considered in the model include:

- Lateral separation elements between the pedestrian and motor vehicle traffic, such as:
  - Presence of sidewalk
  - Buffers between sidewalk and motor vehicle travel lanes, such as grass strips
  - Presence of protective barriers, such as trees or swales within the buffer area, or on-street parking
  - Width of outside travel lanes and bicycle lanes
- Motor vehicle traffic volume
- Motor vehicle speed

Each of these factors is weighted within the model by relative importance. This weighting has been validated by a statistically significant sample. A numerical score is computed and then converted to a level of service letter grade based on the numerical scale. The equation for determining Pedestrian Level of Service (Ped LOS) can be found in FDOT's 2002 *Quality/Level of Service Handbook*. Table 8 contains the

numerical thresholds for pedestrian level of service and the corresponding letter grade

**Table 8. Pedestrian and Bicycle LOS Thresholds**

<b>LEVEL OF SERVICE</b>	<b>SCORE</b>
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	$> 5.5$

Source: FDOT, *Quality/Level of Service Handbook*, 2002

Because motorized traffic is an important factor in the model, it is designed for use on those pedestrian facilities located within reasonable proximity to roadways. Additional research is underway by FDOT to assess other types of pedestrian facilities. On an interim basis, the pedestrian LOS methods provided in the 2000 edition of the *Highway Capacity Manual (HCM)* may be employed to evaluate the pedestrian LOS of pedestrian malls and shared use paths that are widely separated from the roadside environment.

For pedestrian facilities that are crowded, a combination of the FDOT and the 2000 edition of the *HCM* methods is possible. The FDOT model appropriately measures pedestrian satisfaction with the walking environment during un-crowded pedestrian conditions. The *HCM* may be better suited for facilities providing an adequate walking environment that are very heavily used. When using the two methods in combination, both the FDOT quality of service and the *HCM* level of service should be determined and the worse outcome utilized.

### **Bicycle Level of Service**

The Florida Department of Transportation recently adopted a method for determining the quality/level of service for bicyclists. This model measures the performance of a roadway with respect to bicyclists' perception of quality, which appears to be based primarily on safety and comfort. Bicycle level of service along a roadway segment depends on a numeric score that considers the effect of a number of factors on the bicycle mode of travel. These factors include:

- Total width of pavement
- Traffic volume in the outside lane
- Motor vehicle speed
- Percentage and number of trucks
- Pavement surface condition
- Availability of a designated bike lane or paved shoulder.

Each of these factors is weighted within the model by relative importance. This weighting has been validated by a statistically significant sample. A numerical score is computed and then converted to a level of service letter grade based on the numerical scale. The equation for determining Bicycle Level of Service (BikeLOS) can be found in FDOT's 2002 *Quality/Level of Service Handbook*.

The thresholds used to classify the bicycle level of service into different categories are the same as those in the pedestrian model documented in Table 8.

### Transit Level of Service

A transit level of service model, based on the Transit Capacity and Quality of Service Manual (TCQSM), used to determine the level of service for transit riders along route segments was also recently adopted by FDOT. The method evaluates the riders' perception of the quality of the bus route segment. Various factors that affect the user's perception of service are weighted and then used to calculate a numeric score for the frequency of service. This numeric score is translated into a level of service letter grade based on threshold values. A planning level model is incorporated into the 2002 version of ARTPLAN, which is the software used for computing multimodal arterial level of service at a conceptual planning level. This software is available from FDOT. Table 9, shown below, measures the level of service of the transit service frequency, based on the number of transit vehicles per hour.

**Table 9. Availability Measures: Transit Stops Headway LOS**

BUS LOS	HEADWAY (min)	FREQUENCY (bus/hr)	COMMENTS
A	<10	>6	No schedule needed
B	10-14	5-6	Frequent service; consult schedules
C	15-20	3-4	Maximum desirable time to wait
D	21-30	2	Service unattractive to choice users
E	31-60	1	Service available during hour
F	>60	<1	Service unattractive to all users

Source: FDOT, *Quality/Level of Service Handbook, 2002*

Table 10 provides the level of service based on transit availability, measured by the hours of service.

**Table 10. Availability Measures: Route Segments Hours of Service LOS**

BUS LOS	HOURS PER DAY	TYPE OF SERVICE PROVIDED
A	19-24	Night or owl service
B	17-18	Late evening service
C	14-16	Early evening service
D	12-13	Daytime service
E	4-11	Peak hour/limited midday
F	0-3	Very limited/no service

Source: *Transit Capacity and Quality of Service Manual, 1999*

The method addresses the LOS provided by fixed route bus transit service only. LOS techniques for fixed guideway transit services such as MetroRail in Miami, or the Automated Skyway Express in Jacksonville are not available from FDOT at this time, however, techniques are available in the *TCQSM*. The factors used in the study to assess the quality of fixed route bus transit along a route segment are as follows:

- Transit service frequency
- Pedestrian level of service
- Transit hours of service (span of service)

- Obstacles between sidewalks and bus stops
- Pedestrian crossing difficulty

The transit span of service, pedestrian level of service, presence of obstacles between sidewalks and bus stops, and crossing difficulty are calculated by using adjustment factors on transit frequencies. The transit adjustment factors based on hours of service per day are shown in Tables 11.

**Table 11. Transit Route Segment Hours of Service Adjustment Factor**

HOURS OF SERVICE PER DAY	ADJUSTMENT FACTOR
19-24	1.15
17-18	1.05
14-16	1.0
12-13	0.90
4-11	0.75
0-3	0.55

Source: FDOT, Quality/Level of Service Handbook, 2002

Crossing difficulty is proportional to traffic volumes and crossing length, and indirectly proportional to the number of signalized intersections per mile. Alternatives for these factors can be arterial class, number of lanes to cross, and automobile level of service.

The crossing difficulty factors based on the above-mentioned variables range from 1.05 to 0.80 and represent an extremely favorable or unfavorable crossing condition. A default value of 1.00 is used for all other cases. The pedestrian LOS adjustment factors are shown in Table 12.

**Table 12. Pedestrian LOS Adjustment Factor**

PEDESTRIAN LOS	ADJUSTMENT FACTOR
A	1.15
B	1.10
C	1.00
D	0.90
E	0.75
F	0.55

Source: FDOT, Quality/Level of Service Handbook, 2002

There are other transit programs, such as commuter assistance programs, that are important parts of the overall transit service picture. However, these programs are beyond the scope of the current Q/LOS methodology, but it should be recognized that the transit level of service and connectivity is enhanced by their existence.

**Automobile Level of Service**

The key element of a Multimodal Transportation District is the focus on non-automobile modes of transportation and the support and facilitation of their use. While automobile level of service analysis is a consideration in the multimodal district concept, the level of service score is not a major factor unless the facility analyzed is a part of the Florida

Intrastate Highway System (FIHS). Facilities included on the FIHS have the primary responsibility of moving statewide and regional traffic in the most efficient and effective manner. The goal for these facilities differs significantly from the goals of an MMTD and therefore should be excluded from the designated district area if at all possible. However, if the potential district boundaries are such that an FIHS facility must be included, the minimum level of service standard is established by the Florida Department of Transportation.

Special attention should be given on all facilities to ensure good, safe access for pedestrians and cyclists to any transit stops, as well as frequent and safe crossings. The recommended number of crossings providing the needed connectivity is a minimum of two crossings per mile. The safe access and crossings for non-automobile modes where needed on these types of facilities ensures the candidate multimodal transportation district meets the overall goal of promoting non-automobile modes of transportation, as well as providing for the needs of those using motorized transportation.

Detailed descriptions of the software, techniques, and tools available for computing level of service for various modes and facilities can be found in FDOT's *Quality/Level of Service Handbook*.

### **6.3 Determining the Areawide QOS**

In keeping with the committee recommendations and the legislation (F.S.163.3180), FDOT has developed a methodology for the technical evaluation of potential Multimodal Transportation Districts (MMTDs). This methodology integrates techniques for assessing both the land use and the transportation components needed for a successful district. The land use evaluation criteria discussed in earlier chapters include the mix of land uses, the density, intensity and organization of land use, and appropriate community design elements. The transportation criteria include the use of level of service performance measures, network connectivity, and regional connections.

Every potential MMTD is composed of a network of facilities serving bicyclists, pedestrians, transit and motorists. Within this network, the transportation facilities exhibit an operational hierarchy in which certain modes are preferred. For example, freeways provide a high level of mobility for motorists, but pedestrian and bicycle usage is generally prohibited, and conversely a pedestrian friendly downtown business district with many signals and a 25 mph speed limit, provides poor mobility for intercity truck traffic. Determining an LOS, by mode, for the potential district, is based on defining the appropriate facilities, mobility within those facilities and the accessibility to potential users.

#### **Areawide Multimodal QOS Methodology**

The methodology for determining the areawide quality of service consists of a series of steps, which include:

➤ ***Define major modal facilities.***

Identify the primary facilities that serve each mode within the area. The identification of these facilities defines each modal network, which may be different for modes or may

overlap on certain facilities. Each mode should be considered independently in defining the facilities. The following criteria are used in the definition of the modal network.

- Roadways classified as arterials, and freeways or toll roads are included.
- Neighborhood streets or shared use paths that serve attractions are considered as the major pedestrian and bicycle facilities.
- Major bicycle facilities typically have lower vehicular speeds of 35 mph or less.
- Transit facilities are based on the location of bus routes and it is essential to include pedestrian access to transit stops.

➤ ***Establish user service areas by mode.***

There are generally accepted standards of the practical distances that pedestrians, bicyclists and transit riders are willing to travel. The user ranges for the typical pedestrian and transit user is  $\frac{1}{4}$  mile and for the bicycle mode the typical distance is  $\frac{1}{2}$  mile. This  $\frac{1}{2}$  mile is applicable to typical riders for home-based social and other non-work trips. These distances are used to establish the service areas for each facility. A “buffer zone” or service area line is drawn on each side of the facility.

➤ ***Determine the percentage of households and employment within the user service area by modal facility.***

This data can often be found in a development master plan or sector plan. If these types of plans containing specific data are unavailable, census tract level or traffic zone level information can be used to estimate the percent of population and households.

➤ ***Determine the LOS for each mode on each facility.***

FDOT's 2000 version of ARTPLAN, the software used for computing multimodal arterial level of service at a conceptual planning level, is utilized for assessing the LOS for the different modes on each facility. While all of the facilities on each defined modal network are used in the connectivity analysis, the LOS analysis is conducted only on those facilities that are classified as connectors and above, or are major bicycle/pedestrian through routes.

➤ ***Determine each modal LOS or Quality of Service (QOS) within the district***

The modal LOS or QOS is determined as a length weighted average, by facility.

➤ ***Compare the Quality of Service for each mode with the LOS based on the percentage of households and employment located within the user service area.***

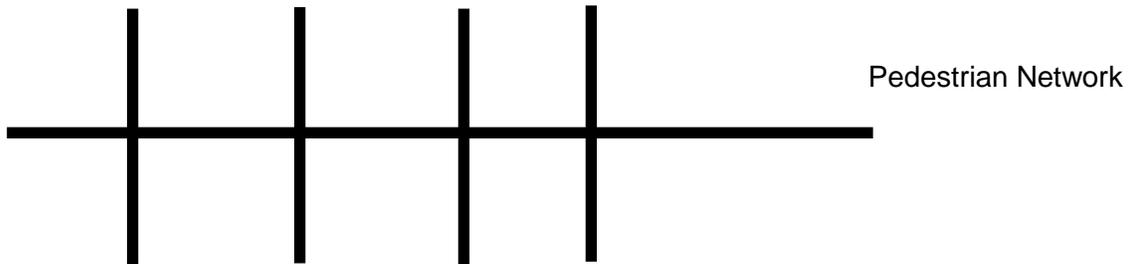
The areawide QOS is determined by comparing the average modal QOS with the LOS based on the percentage of households and employment located within the user service area. The LOS based on households and employment measures the multimodal potential within the user service area. The higher the percentage of households and employment located within a service area, the higher the multimodal potential, and the average modal QOS is adjusted to reflect that potential.

➤ ***Report the adjusted areawide QOS for each mode.***

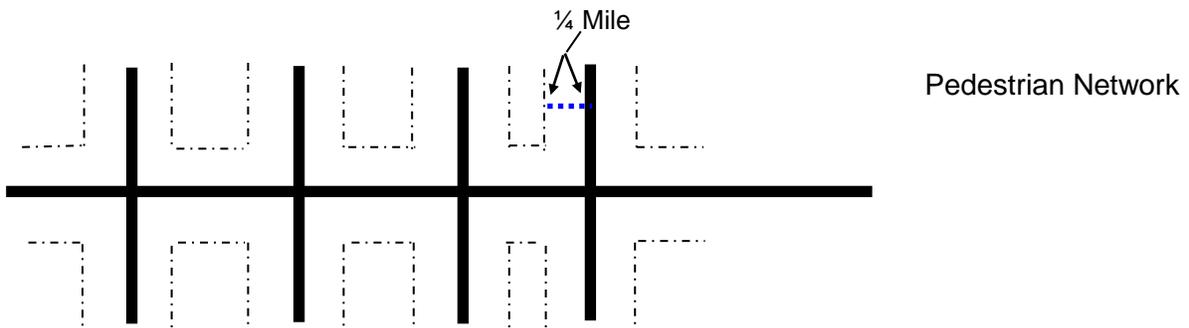
Figure 15 contains a graphic example of the steps in determining the areawide Quality of Service. Table 13, shown below, contains the comparison modal QOS and LOS based on the percentage of households and employment. Table 14 contains an example of the adjustment to the areawide QOS.

**Figure 15. Example of Determining Areawide Quality of Service**

**Define the major modal facilities.**



**Establish user service areas by mode.**

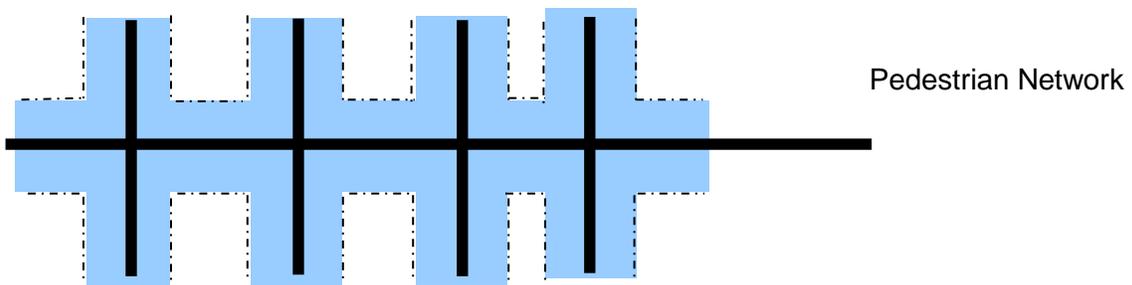


**Determine the percentage of households and employment within the user service area by modal facility.**

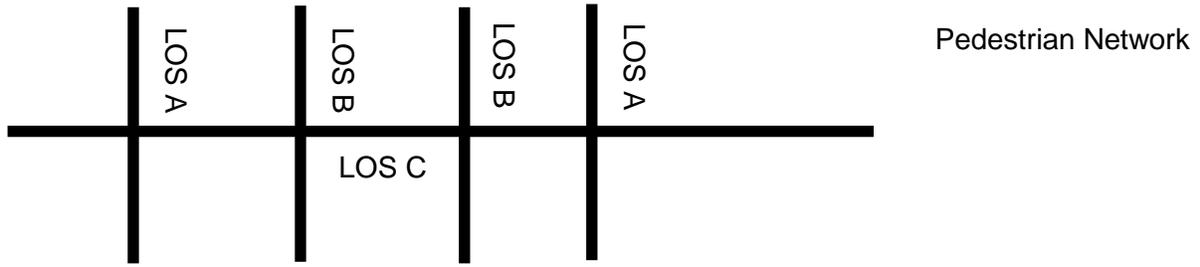
Total Employment in District: 100  
Total Households in District: 100

Total Employment in Defined Service Area: 50  
Total Households in Defined Service Area: 50

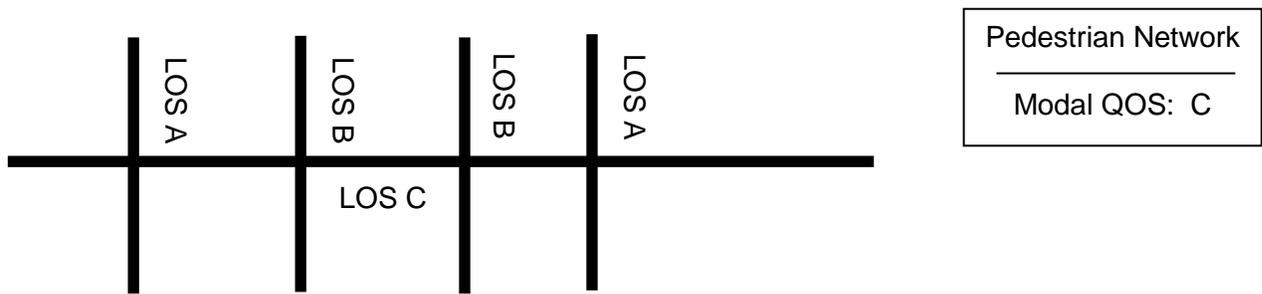
Percentage of Employment in Defined Service Area: 50%  
Percentage of Households in Defined Service Area: 50%



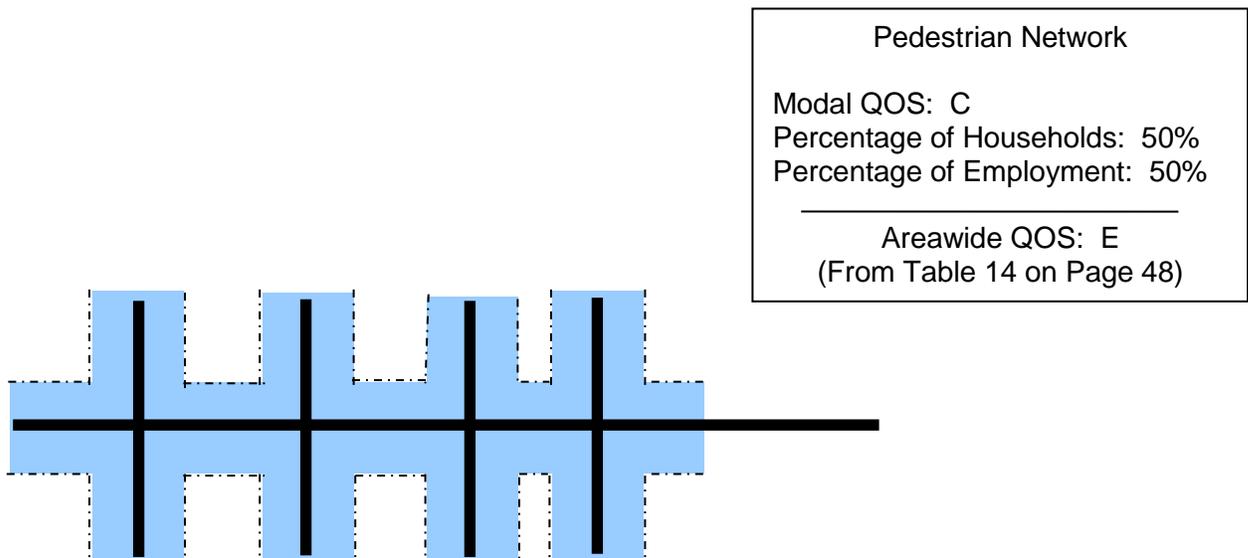
**Determine the LOS for each mode on each facility.**



**Determine each modal LOS or QOS**



**Compare the modal QOS with the LOS based on the percentage of households and employment located within the user service area to determine the areawide quality of service.**



**Table 13. Comparison of Modal QOS and LOS Based on Percentage of Households and Employment within Service Area**

% Households and Jobs Within Service Area	Areawide Quality of Service
90% - 99%	Modal QOS or LOS A, whichever is worse
80% - 89%	Modal QOS or LOS B, whichever is worse
70% - 79%	Modal QOS or LOS C, whichever is worse
60% - 69%	Modal QOS or LOS D, whichever is worse
50% - 59%	Modal QOS or LOS E, whichever is worse
1% - 49%	LOS F

**Table 14. Example of Areawide QOS Adjustment**

Modal QOS	C
% Households and Jobs Within Service Area	94%
Areawide QOS	C, not A
Modal QOS	C
% Households and Jobs Within Service Area	54%
Areawide QOS	E, not C

**6.4 Summary**

In summary, the facilities within the potential district serving each mode are identified. A user service area for each of these facilities is then determined based on the accepted typical distances that users are willing to travel. The percentage of households and employment are then computed within these service areas. This calculation is most easily accomplished utilizing a Geographic Information System (GIS), if possible. The LOS of each facility is determined. A length-weighted average LOS for each mode is then calculated, resulting in a modal quality of service. This modal QOS is adjusted for the multimodal potential, which is based on the percentage of households and employment contained within the service areas. This adjustment provides the final areawide Quality of Service. This approach described above assumes that adequate modal connections to the major facilities are provided, which for pedestrians, bicyclists and transit, is LOS of D or better.

**CHAPTER 7****Final Evaluation of Multimodal  
Transportation Districts**

As stated earlier, the goal of a multimodal transportation district is to facilitate and promote the use of multiple modes of transportation. This goal is accomplished through the appropriate design features, land use, network connectivity and development patterns which support and promote the use of modes of transportation other than the automobile. By going through the described steps for assessing a proposed multimodal transportation district, the viability of the proposed district can be determined. This determination is the final step in the overall process.

The steps in the process provide the information needed to determine if a proposed multimodal transportation district is a viable candidate. A proposed district should meet the indicators which detail the minimum standards needed for a successful district. The contra-indicators are also listed to detail what is not acceptable for a successful multimodal transportation district. Table 16, shown on the following page, is a checklist that depicts these indicators and contra-indicators for a successful district.

The indicators are the minimum standards necessary for designation. Again, due to development patterns over the years, many areas may find meeting these standards difficult. However, if a commitment, found in the comprehensive plan and capital improvement program, for directing future development and implementing policies that will enable the thresholds to be met in the future, district designation is possible without meeting all of the minimum criteria.

**Multimodal Transportation District Checklist**

<b>Criteria for a Multimodal Transportation District</b>	<b>Indicators for a Successful District</b>	<b>Contra-Indicators for a District</b>
Appropriate Scale of Development	<ul style="list-style-type: none"> <li>• Min. Residential Pop: 5,000</li> <li>• Minimum Population/Jobs Ratio: 2 to 1</li> <li>• Provision of scheduled transit</li> </ul>	<ul style="list-style-type: none"> <li>• Size of District too small or too large to support appropriate intensities and densities</li> <li>• No transit service</li> </ul>
Complementary Mix of Land Uses	<ul style="list-style-type: none"> <li>• 3 or more significant land uses</li> <li>• Physical integration of components</li> </ul>	<ul style="list-style-type: none"> <li>• Single Land Use</li> </ul>
Land Uses Promoting Multimodal Usage	<ul style="list-style-type: none"> <li>• Land uses that are mutually supporting</li> </ul>	<ul style="list-style-type: none"> <li>• Single Land Use</li> </ul>
Acceptable Separation of Land Uses	<ul style="list-style-type: none"> <li>• Different land uses are located within the typically acceptable range for walking (1/4 to 1/2 mile)</li> </ul>	<ul style="list-style-type: none"> <li>• Land uses spaced too far apart for typical pedestrian comfort</li> </ul>
Appropriate Densities and Intensities of Land Uses	<ul style="list-style-type: none"> <li>• Minimum of 4 residential units per acre for marginal potential</li> <li>• Minimum of 40 employees per acre for marginal potential</li> </ul>	<ul style="list-style-type: none"> <li>• Less than minimum residential units per acre and minimum employees per acre</li> </ul>
Appropriate Organization of Land Uses	<ul style="list-style-type: none"> <li>• Core area of activities and services</li> <li>• Activity centers along corridors concentrated at key intersections promoting transit usage</li> </ul>	<ul style="list-style-type: none"> <li>• Isolated or scattered Development</li> </ul>
Regional Intermodal Connectivity	<ul style="list-style-type: none"> <li>• Regional intermodal connections present</li> </ul>	<ul style="list-style-type: none"> <li>• No regional intermodal service</li> </ul>
Interconnected Multimodal Network	<ul style="list-style-type: none"> <li>• Each modal network meets connectivity index standard using polygon methodology: recommended minimum of 50 polygons per square mile</li> <li>• Connected street pattern, generally gridlike</li> </ul>	<ul style="list-style-type: none"> <li>• Poor Connectivity on modal networks</li> <li>• Unconnected street pattern with cul-de-sacs and dead ends</li> </ul>
Acceptable Levels of Service for Each Mode	<ul style="list-style-type: none"> <li>• Meets recommended Level of Service standards for each mode</li> <li>• Transit oriented development pedestrian, transit, and bicycle LOS of C</li> <li>• Non-motorized oriented development pedestrian and bicycle LOS of C and transit LOS of D</li> </ul>	<ul style="list-style-type: none"> <li>• Poor Level of Service</li> </ul>
Acceptable Areawide Quality of Service for each Mode	Areawide Quality of Service meets recommended standards	Poor Level of Service

## CHAPTER 8

# Application of Analysis of Multimodal Transportation Districts

In order to test the validity of the procedures and process for evaluating multimodal transportation districts outlined in the Handbook, several case studies were performed. The case study that best illustrates the process is found in the relatively small city of DeLand, the county seat of Volusia County. It is located in central Florida, between Daytona Beach and Orlando. The study focused on the evaluation of a potential multimodal transportation district proposed for the downtown area of DeLand.

## DeLand Case Study

### Introduction

DeLand is endowed with a well-defined central core, possesses an efficient grid street network, is the home of Stetson University, and has previously embraced many aspects of successful multimodal planning. Though situated at the crossroads of US 17/92 and State Road 44, DeLand has thus far resisted attempts to widen these heavily traveled routes in defiance of common approaches to highway level of service maintenance. By constraining these facilities, DeLand has protected its classic urban character and form; however, the mechanisms of concurrency management have similarly constrained the growth potential of downtown DeLand. Figure 16, shown below, depicts the proposed district boundaries

Figure 16. District Boundaries



The proposed multimodal district meets the criteria of sufficient population, employment, and size, and also includes a fixed-route transit service through its core. The district is defined by three significant land uses: Stetson University, Educational; City of DeLand and Volusia County administration, Institutional; and Stetson Dormitory and other high/medium density residential. These significant uses are supported by appropriate uses such as stores, offices, entertainment, recreation, and other institutional land uses.

Although employment densities, even with reasonable infill development of vacant commercial acreage, offer only poor to marginal multimodal potential, and residential densities are presently classified as marginal, the district is extremely well organized around a central core, and shows significant corridor organization. Given an excellent grid street system, and a supply of high bicycle and pedestrian level of service, the district shows promise as a multimodal transportation district.

### **Appropriate Scale of Development, Land Use Density, Intensity, Mixture and Organization**

It is important that a prospective district achieves the critical mass necessary to promote, encourage, and sustain pedestrian, bicycle, and transit usage. As such, a multimodal district should:

- **Contain population of at least 5,000**
- **Maintain a ratio of population to jobs of at least 2 to 1**
- **Provide scheduled bus service.**

Using 1997 Volusia County traffic analysis zone (TAZ) data developed on behalf of their Long Range Transportation Plan, and 2000 census block data, recently compiled by the University of Florida Geoplan Center, the gross population and employment ratio criteria were assessed for the DeLand study area. Represented in Table 15 below, this data demonstrates the DeLand district's compliance with the **5000** persons and **2:1 population to jobs** ratio outlined in the Handbook.

**Table 15: Total Population, Employment, & Jobs: Population**

TAZ-Based Estimates					
	1997	2000*	2000**	2010	2020
<b>Total Population</b>	12221	12749	14082	14509	15197
<b>Total Employment</b>	8673	9177	No Data	10855	11113
<b>Ratio Jobs to Population</b>	0.71	0.72	No Data	0.75	0.73
* Extrapolated From 1997 & 2010 Projected Data					
** 2000 Census Data					

In order to implement a multimodal district, the potential area should contain an appropriate mix of land uses to promote the use of multiple modes of transportation. The Urban Land Institute defines mixed-use developments using the following criteria:

- Three or more significant revenue producing land uses one of which is residential that in well-planned projects are mutually supporting
- Significant physical and functional integration of project components, including uninterrupted pedestrian facilities

A diverse mix of complementary land uses is desirable and appropriate within a multimodal transportation district to provide the amenities that attract pedestrians, bicyclists and transit users. *Significant* land uses that are suitable for multimodal transportation districts include office, regional retail, recreation, educations, cultural, institutional, hospital, and high/medium density residential. *Supporting* land uses include commercial uses of hotel, theaters, restaurants, health clubs, day care, convenience retail, and specialty retail or light industrial/manufacturing.

The following three significant uses were identified for the DeLand MMTD:

1. *Stetson University, Significant Educational Use*  
Situated north of the city center bounded on the west by Woodland Blvd (US 17/92), Stetson serves approximately 2500 graduate and undergraduate students. Those TAZs dominated by Stetson suggest 1300 employees are associated with the University and situated within ½ mile of the DeLand city center.
2. *Volusia County Seat, Significant Institutional Use*  
Although the bulk of Volusia County's population resides along the Atlantic Coast and satellite administrative facilities have been provided accordingly, the county courthouse and main administrative and planning facilities are based in downtown DeLand.

3. *Significant High/Medium Density Residential Use*

Aside from the supporting low-density residential population, 80% of Stetson’s 2500 students live on campus. In addition to the high-density residential use provided by Stetson’s dormitory facilities, a handful of multi-family residential units and several large senior housing facilities add peaks to DeLand’s otherwise flat density surface. Thus roughly 2530 of the 5000 minimum population threshold resides in developments dense enough to be considered a significant multimodal district land use.

In addition to the distinction of three significant uses, a preferred ratio of open space, parks, and recreational uses; office, commercial, and light industrial uses; and residential land uses is also included. These ratios have been computed for the DeLand district and the comparison between the ratios achieved by the DeLand district with the preferred ratios is shown in Table 16.

**Table 16. Preferred Ratio of Uses**

	<u>Existing</u>	<u>Preferred</u>
<b>Open/Parks/Recreational</b>	7%	5 - 15%
<b>Office/Commercial/Light Industrial</b>	21%	30 - 70%
<b>Residential</b>	72%	20 - 60%

This summary analysis of the DeLand district’s proportion of appropriate land uses suggests a potential lack of office/commercial and light industrial uses and a glut of residential land use. This apparent deficiency is mitigated by the relatively large 4.5 square mile area of the district, the periphery of which is dominated by single family, low-density land use.

**Organization of Land Uses with Core of Activities and Services**

Multimodal districts should be organized around a central core. To facilitate this analysis in DeLand, buffers of ½ mile and ¼ mile were drawn around the central intersection of the proposed district. These buffers were used to select and identify all parcels within ½ and ¼ mile distance of the city center. The organization of land uses within the core area of the district is shown in Figure 17.

**Figure 17. Land Use Ratios: Downtown vs. Hub & District at Large**

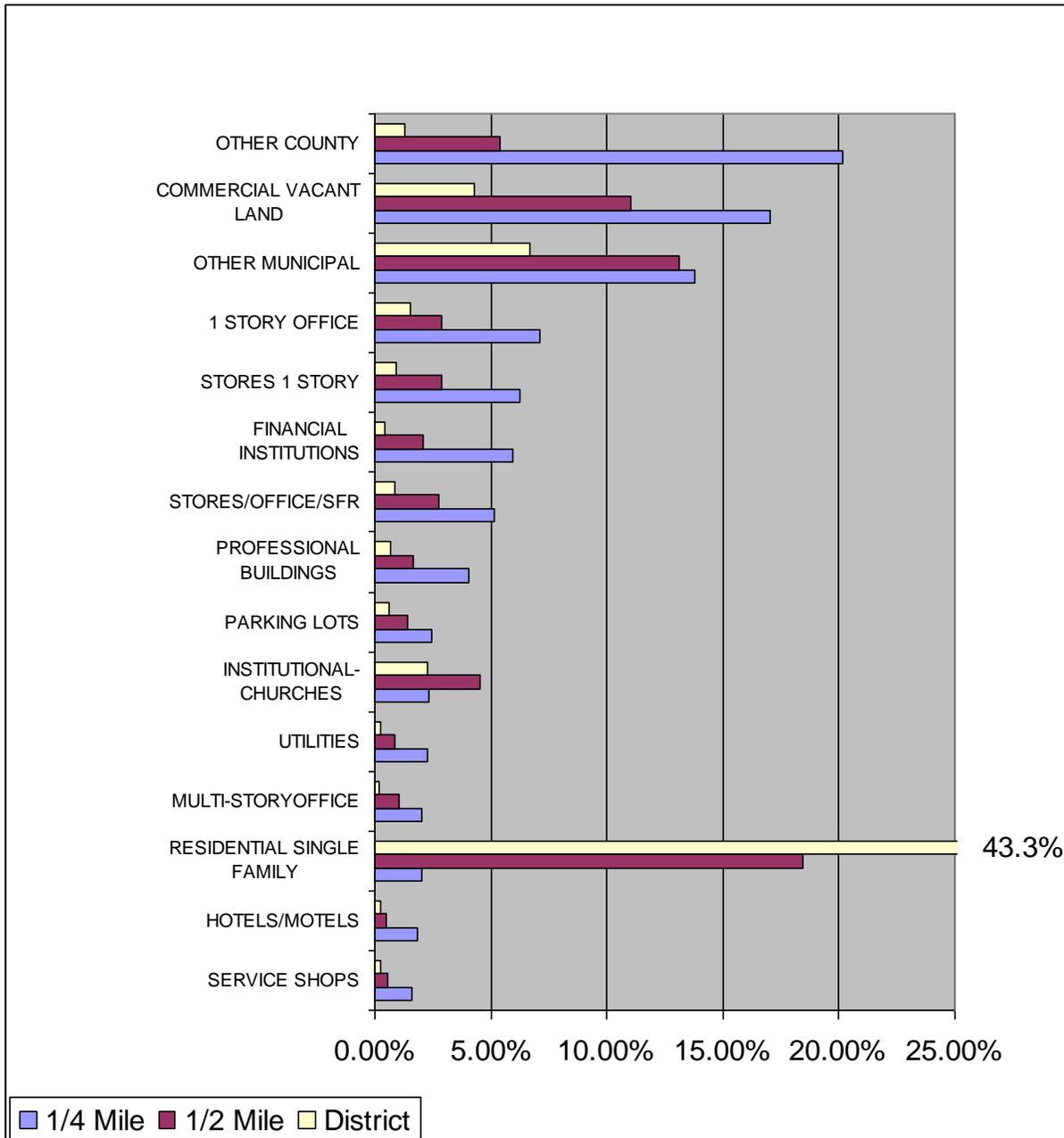


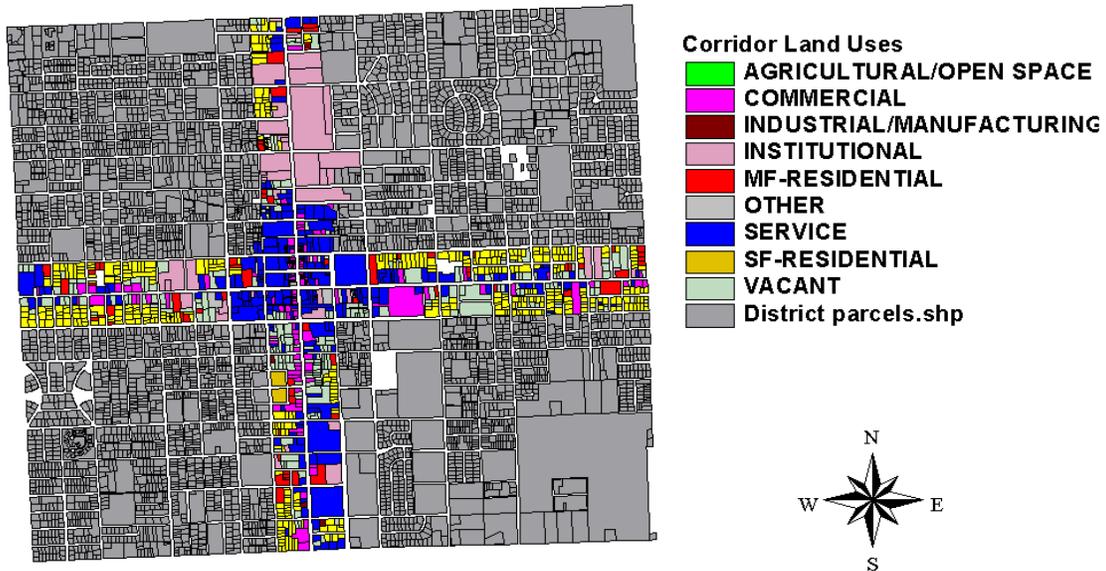
Figure 17 demonstrates the organization of higher intensity uses within the district core. As the chart depicts, government services, offices, stores, financial institutions, and mixed-use facilities contribute considerably more to the downtown and hub landscape than to the district as a whole. Conversely, the relative absence of single-family residential land use in the core area complies nicely with the organizational gradient expected of multimodal districts. Also of note is the opportunity presented by vacant commercial space in the city for high intensity infill development.

### Organization of Land Uses Along Corridors

Although the DeLand study district does not possess multiple activity centers, higher intensity organization along major facilities is apparent. A 200 meter (approx. 1/8 mile) buffer along New York Ave. and Woodland Blvd. was intersected with the district parcel map. The resulting parcels were catalogued by land use and the total area and assessed value for each land use category was extracted.

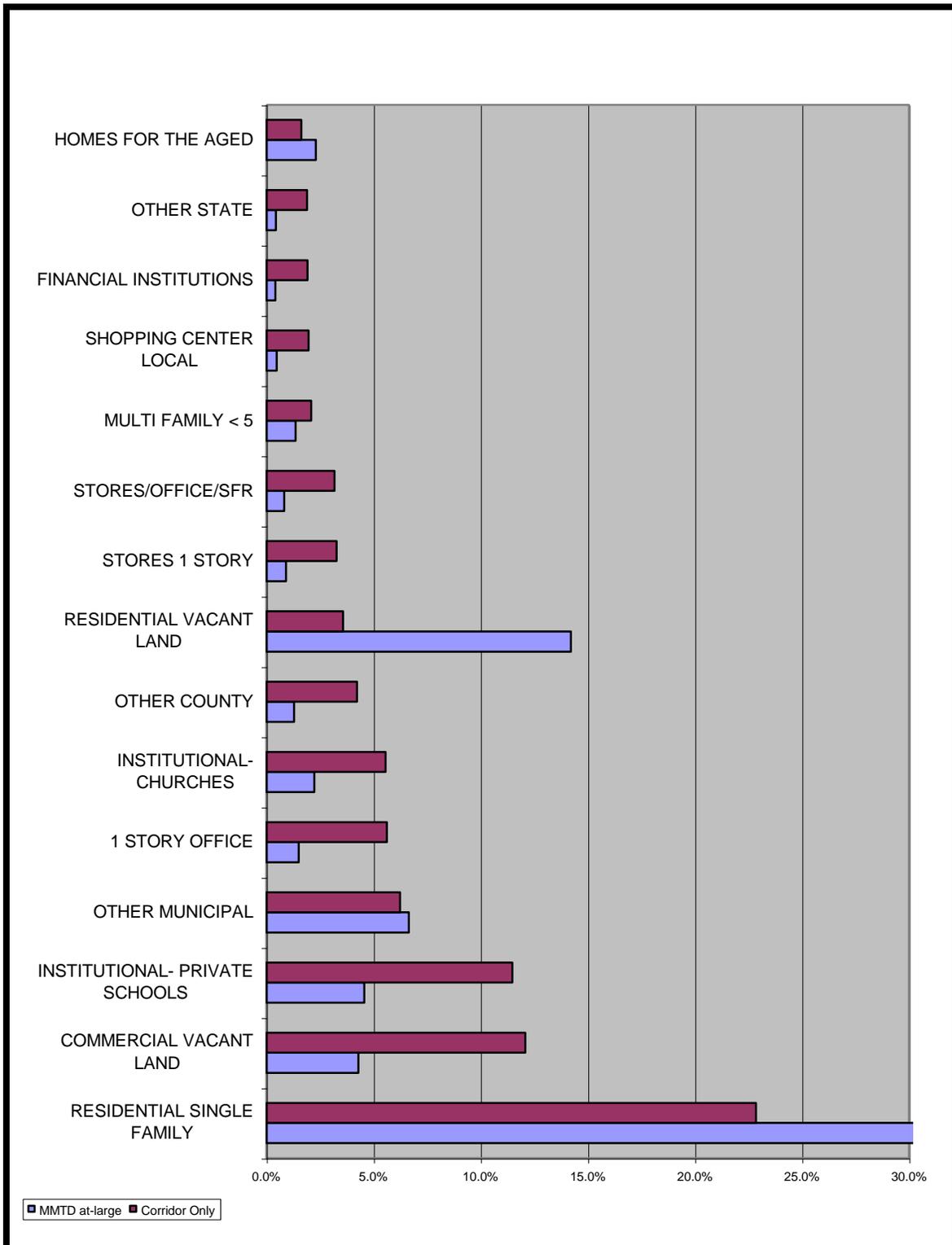
As indicated in Figure 18 below, the major corridors defined by Woodland Blvd (17/92) and New York Ave (SR44) demonstrate high degrees of commercial, institutional (Stetson), and service oriented land uses. Although some single-family residences are situated along outer ends of New York Ave., the frequency of this development pattern is far lower than in the district at large.

**Figure 18: Corridor Organization of Land Uses**



The 15 most spatially significant corridor land uses were compared with the MMTD at-large. This comparison is shown in Figure 19 and suggests the proposed DeLand MMTD fulfills the requirement that higher intensity land uses be organized along major transportation corridors.

Figure 19: Comparison of Corridor Organization of Land Uses



### Appropriate Density and Intensity of Land Use

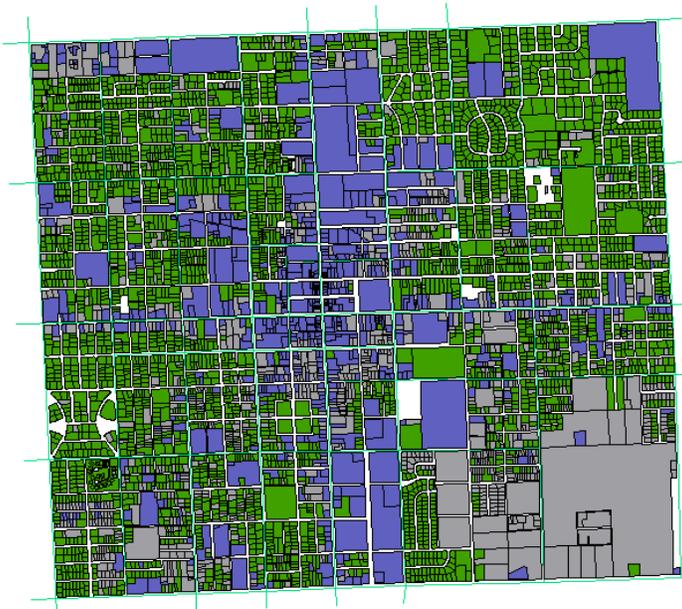
Land use densities and intensities are a critical component in the development of a successful multimodal transportation district. The density should be sufficient to support bus transit along the major corridors and to provide the opportunity for active bicycle and pedestrian use.

At present, the proposed DeLand multimodal district does not possess sufficient density and intensity to be deemed an area of “high” or “good” multimodal potential. However, DeLand does demonstrate remarkable core and corridor organization, and retains sufficient vacant acreage within the district bounds to facilitate considerable infill development. These factors, supplemented by latent redevelopment potential, should compensate for the current marginal to poor potential rating. Table 17 depicts the DeLand MMTD residential density and employment. Figure 20 depicts the residential and non-residential parcels within the district used to compute the gross population and employment density.

**Table 17: Density and Intensity of Land Use: DeLand**

<b>Residential Land Use</b> (units per acre)	<b>Commercial Land Use</b> (units per acre)	<b>Multimodal Potential and Transportation Compatibility</b>
5.14	19.7	Marginal to Poor Potential

**Figure 20: Residential and Non-Residential Property**



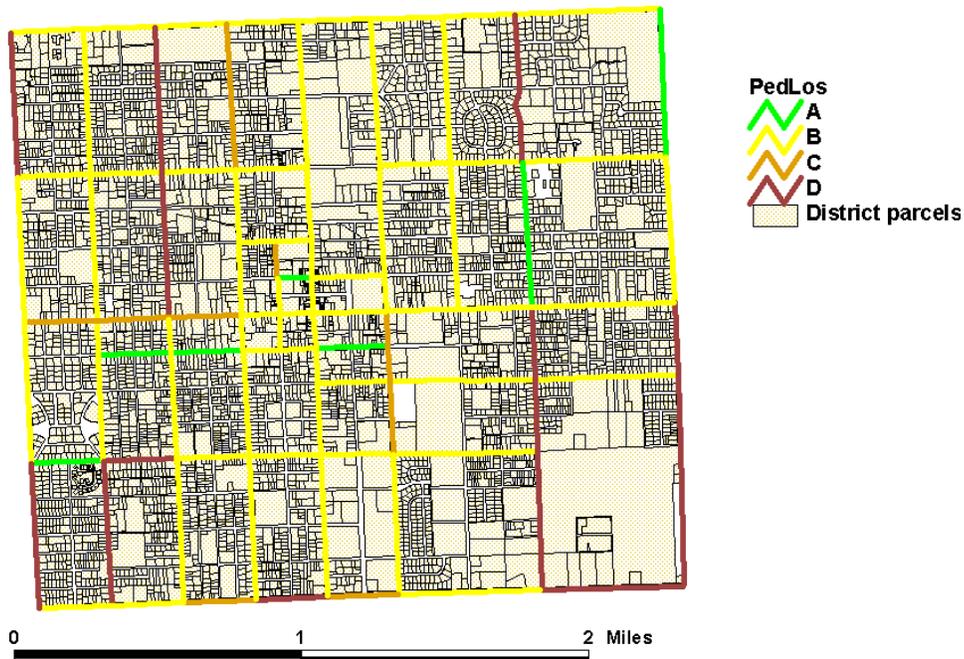
### Network Connectivity and Levels of Service

After assessing the potential of the proposed district with respect to land use mixture, density, intensity, and organization, the next step is the assessment of the transportation elements of the analysis. These include evaluating network connectivity and the areawide level of service, using the steps outlined in the Handbook. These steps include the definition of the modal network; establishment of the user area by mode; determination of the percentage of households and employment within the user area; determination of the LOS; determination of the average modal LOS (QOS); and, if necessary, adjusting the LOS for the percentage of households and employment within the user service area. The step adjusting the LOS is shown in the transit analysis in Figure 22. Using the level of service measurement techniques prescribed for bicycle, pedestrian, and transit, the LOS was calculated for those designated modal facilities. Facility data was collected in DeLand and traffic data an on-going corridor study for one of the major routes was used in the analysis. Where no traffic data was available, inputs were either extrapolated from adjacent segments or given a default value of 1000 AADT.

### Pedestrian Level Of Service

Utilizing the field data, the bicycle and pedestrian levels of service for those facilities designated as collector and above were calculated. The numerical and alphabetic LOS scores for each segment were then copied into the district road GIS and displayed according to Level of Service. Map 1, shown below, depicts existing pedestrian LOS conditions for the DeLand study area. Though presently, the district’s aggregate pedestrian level of service (modal QOS) is 2.4 or alphabetic grade “B”, areas of improvement exist. The LOS could easily be improved with the construction of contiguous sidewalks where they currently do not exist. According to DeLand’s long-range plan, those segments lacking sidewalks have been identified and are targeted for construction. The Pedestrian LOS is shown in Figure 21 below.

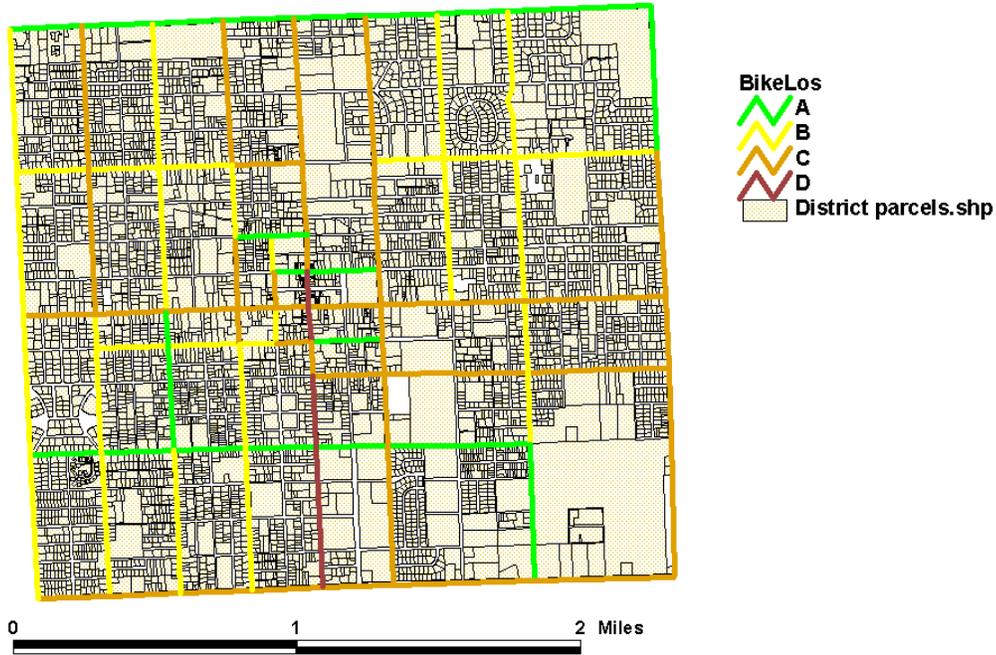
Figure 21. Pedestrian Level of Service



### Bicycle Level of Service

Similar to Figure 21, Figure 22 depicts the existing bicycle level of service for those facilities classified as collectors and above found in the study area. Although no formal bike lanes exist in the district, the combination of generally low volumes and speeds yields, for the most part, acceptable bicycle LOS. The existing bicycle quality of service for the district is 2.34 or LOS “B”.

Figure 22. Bicycle Level Of Service

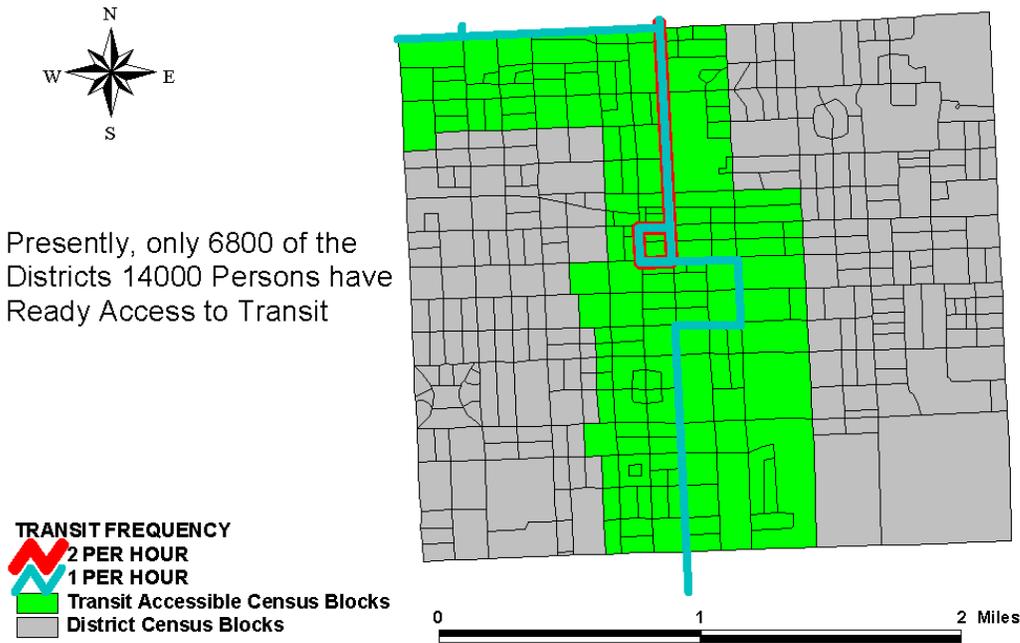


As with the pedestrian facilities, there are opportunities for improving the bicycle LOS. Sufficient right-of-way exists along the immediate downtown segments to reduce vehicle lanes to 11 or 12 feet, and provide designated bike lanes. Additionally, the completion of proposed greenway within the study area would provide parallel capacity and improve the bicycle LOS.

### Transit Level of Service

Votran is the county transit provider. Though Votran’s routes are concentrated in the more densely populated eastern portion of Volusia County, two routes serve the DeLand multimodal transportation district. Although each route offers only 1 bus/hour frequencies, their combination along some facilities within the area increases service to 2 buses/hour, although these frequencies are not evenly spaced. Both routes operate for approximately 12 hours/day from roughly 7am to 7pm. Figure 23, shown below, displays the present alignment of the district’s transit service, service frequency, and those census blocks with ready access to the transit route.

**Figure 23. Existing Transit Service**



While the existing transit level of service is not to standard, a downtown circulator transit route is proposed. The addition of this circulator route would increase the level of service to acceptable standards.

**Street Network**

Although it is evident from the data above, the DeLand MMTD provides generally excellent bicycle and pedestrian levels of service along its multimodal facilities; the geometric arrangement of these facilities is critical to the success of the district. As noted previously, the street system in the DeLand MMTD is a near perfect grid with few irregularities. For the most part, blocks are approximately 600ft on a side, though in many circumstances they are divided further for improved walkability. Though the street system as a whole has few “blind alleys,” thus allowing short walking distances, the planned completion of district sidewalks will improve pedestrian connectivity.

The polygon methodology for obtaining a connectivity index was applied to the modal networks defined in the proposed district. This methodology involves the overlay of polygons on the modal network. The higher the number of polygons per square mile, the higher the connectivity within the network. The recommended threshold indicating a desired level of connectivity is a minimum of 50 polygons per square mile. Included in this analysis for DeLand was the Alabama Street Greenway, a planned pedestrian and bicycle facility. The connectivity indices for the modal networks are shown in Table 18.

**Table 18. DeLand Connectivity Indices**

<b>Modal Network</b>	<b>Polygons per Square Mile</b>	<b>Acceptable Connectivity</b>
Pedestrian Network	62	Yes
Bicycle Network	62	Yes
Transit/Auto Network	53	Yes

**Summary: Areawide Quality of Service**

Due to its abundance of sidewalks and generally low traffic speeds and volumes, the DeLand MMTD scores well in both bicycle and pedestrian levels of service. With the addition of bicycle lanes along available street cross sections, completion of sidewalk projects, and minor reduction of vehicle speed in key areas, few of the MMTD’s facilities will fall below LOS “B”. In the case of the most difficult facility, the completion of the greenway will provide excellent parallel capacity.

Presently, transit service in the area is lacking. Although two Votran routes access the district, transit LOS is hindered by low frequencies, service spans, and coverage. The addition of a circulator system, operating out to ½ mile of the city core at frequencies greater than 2 buses/hour would raise the District’s transit LOS to within acceptable levels.

Generally, the DeLand District is endowed with a well-connected grid street pattern, and although several sidewalk sections are incomplete, the sidewalk-building program contained in the long-range plan will provide the needed relief.

**Final Evaluation of DeLand Multimodal Transportation District**

Based on the Data and Analysis, the DeLand multimodal transportation district under consideration meets or exceeds most of the criteria for a successful district. In addition to satisfying the fundamental population, employment, and area thresholds, the DeLand district possesses an excellent pattern of roadways, generally high bicycle and pedestrian levels of service, and well-developed core and corridor organization. Though employment intensity is less than ideal and transit service is presently inadequate under Handbook guidelines, the possibilities for infill development, and discussion of a possible downtown circulator are promising. Overall, the DeLand district’s benefits far outweigh its detractors thus yielding a high probability for successful development of a working multimodal transportation district.

One of two noticeable hindrances to the DeLand multimodal transportation district is less-than-ideal employment intensity and residential density. As such, it is the recommendation of this study that existing vacant or redevelopable acreage be reserved for projects of sufficient density or intensity to augment existing figures. The city’s future land use plan should reflect this goal, perhaps by regulating minimum densities and floor area ratios in the district core rather than more traditional maximum thresholds.

As discussed in the Multimodal LOS element of this report, significant bicycle and pedestrian improvements are possible through relatively simple and cost-effective means. Redesign of roadway cross section along New York Ave/SR 44 and portions of Woodland Blvd/US 17/93, in conjunction with minor decreases in travel speed will benefit LOS along these facilities. Likewise slight speed reductions, perhaps through the use of traffic calming devices, along Amelia Avenue would improve LOS along this relatively busy pedestrian facility. Further, the completion of sidewalk construction, already planned by the City of DeLand, would drastically improve many of the district's less accommodating pedestrian routes. Finally, construction of the proposed Alabama Ave Greenway would provide parallel capacity for bicyclists along those portions of Woodland Blvd not amenable to improvement due to right of way constriction.

The final conclusion of this study regards the need to enhance transit service in the district. Although the district is presently served by fixed-route transit, and although land uses such as retail, health care, and government are presently available, the low service frequency, relatively short service span, and lack of coverage suggest a need for improvement. One method used by cities such as Orlando is a downtown circulator. In the context of DeLand, a local circulator would not be burdened by the regional concerns evident in the district's two Votran Routes. By restricting its alignment to the proposed district, and a handful of adjacent uses such as the hospital and neighboring shopping centers, a lightweight circulator system operating at 15 to 30 minute intervals would dramatically improve transit LOS while potentially removing automobile trips from the street network.

## APPENDIX A

# Glossary of Terms

**Americans with Disabilities Act (ADA):** Federal civil rights law, enacted in 1990, mandating the provision of access for persons with disabilities. Title 2 of the law applies to transportation facilities and transit vehicles.

**Comprehensive Plan:** A city or county plan for land use, housing, transportation, capital facilities, open space and other issues affecting the physical development of a community.

**Density:** The ratio of a unit of land to a unit of area. Most commonly used with residential land uses, such as residential units per acre, households per acre or population per square mile.

**Fixed-Route Service:** Bus service operated over a set route on a regular schedule.

**Headway:** The amount of time between transit vehicles operating on a particular route.

**Integrated Transit Service:** A concept to expand mobility and provide transportation choices by integrating transportation facilities and services appropriate to the land uses in an area.

**Intensity:** The ratio of a unit of land to a unit of area, most commonly used with commercial land uses.

**Intermodal Transfer:** The ability to move from one mode of transportation to another during a transit journey.

**Land Use:** Buildings and/or activities that occupy a given piece of land, usually classified as residential, commercial, industrial, public, or open space.

**Level of Service (LOS):** A quantitative breakdown of quality of service from the transportation user's perspective. Level of Service is divided into six letter grades, with LOS A denoting the best conditions and LOS F indicating the worst conditions.

**Mass Transit:** The general term used to identify bus, rail, or other types of transportation service moving large numbers of passengers.

**Master Plan:** A comprehensive long-range plan intended to guide the growth and development of a community or region.

**Mixed Use or Mixed Land Use:** Generally refers to different compatible land uses located within a single structure or in close proximity.

**Modal Split:** The proportion of total person trips on various modes.

**Mode:** The types of transportation available for use such as rail, bus, vanpool, single-occupant auto, pedestrian, or bicycle.

**Multimodal:** Transportation facilities designed for joint use with connections between different modes.

**Multiple Land Use:** Different compatible land uses located within a single structure or in close proximity.

**Peak Periods:** The hours when traffic is greatest. Generally, during the work week, there is a morning peak from 6:30-9:00AM and an afternoon peak from 3:30-6:30 PM.

**Pedestrian Friendly:** Designed to accommodate pedestrians with the priorities of safety, minimized walking distance, comfort and interesting surroundings.

**Pedestrian Scaled:** Land uses characterized by narrow streets, small blocks, and an absence of large parking lots and arranged so that walking distances are short.

**Performance Measure/Measures of Effectiveness** - a quantitative or qualitative factor used to evaluate a particular aspect of service

**Primary Facilities:** The major traffic routes identified for additional development to increase capacity.

**Public Transportation:** A system of passenger transportation services.

**Quality of Service:** a user based assessment of how well a service or facility is operating

**Ridership:** The number of people using a transportation system in a given period of time.

**Right-of-Way:** A corridor of land acquired by reservation, dedication, prescription or condemnation, and intended to be utilized as a road, rail line, utility service, buffer, or similar use.

**Service Area:** A geographic area where transit service is provided.

**Station Area:** An area surrounding a transit station containing transit-related activities and designed to accommodate large numbers of people. Station areas are generally defined as the area within a ¼ mile radius of the station.

**Street Classification Systems:**

**Principal Arterial:** Street normally used for the conveyance of high volumes of vehicular traffic.

**Minor Arterial:** Street carrying traffic to the arterial streets and highways.

**Collector:** Street used primarily for access to the adjoining properties.

**Local Street:** Minor street parallel to or adjacent to arterial streets and highways providing access to abutting properties and protection from through traffic.

**Alley:** Minor street used primarily for vehicular service access to the back of the side of properties.

**Streetscape:** The overall character, design quality, and particular physical elements of a public environment. Streetscape elements include the paving materials, curbs, landscaping, lighting, and street furniture.

**Strip Mall:** Any auto-oriented shopping center located along a major arterial road. Strip malls are characterized by large amounts of parking in front of the buildings.

**Transit:** A general term applied to passenger service available for use by the public and generally operated on fixed-routes with fixed-schedules, although flexible routing and scheduling services may be included.

**Transit Center:** A facility providing connections between buses serving different routes, or between different transportation modes.

**Transit-Compatible/Supportive Land Use:** Areas with adequate development density, mix of uses, and design to allow pedestrian travel, transit access and efficient transit service.

**Transit Corridor:** A major right-of-way with high volumes of transit vehicles.

**Transit Planning Area/Station Area:** The area within a reasonable walking distance from a transit facility.

**Travel Time:** The amount of time spent in transit from an origin to a destination.

**Trip:** A single or one-way movement to or from a destination.

**Trip Ends:** The total number of trips entering and leaving a specific land use or site over a designated period of time.

**Trip Generation:** The total number of trip ends produced by a specific land use

**Trip Linking:** The ability to visit several destinations during one journey.

**Urban Centers:** Downtown, town center and higher density neighborhoods designed for walking and high levels of public transportation service.

**Vehicle Miles Traveled (VMT):** The total number of miles traveled per vehicle.

**Zoning Ordinance:** A municipal ordinance dividing a municipality into districts and prescribes land use type, land use relationships, densities, height and setback, bulk distribution, required parking, loading and servicing requirements, and performance standards within a defined municipal boundary.

**APPENDIX B****Annotated Bibliography**

In preparing the Multimodal Areawide LOS Handbook, a review was made of the following documents. A brief summary of the documents and their relevance to the multimodal areawide LOS efforts follows.

**Best Development Practices: Doing the Right Thing and Making Money at the Same Time**

*Florida Department of Community Affairs and Florida Department of Energy, 1996*

This document provides a summary of recommended best practices in the areas of land use, transportation, environmental and housing, which promote the goals of managed growth and energy conservation from the Florida Comprehensive Plan. Key elements related to multimodal transportation districts include: verification of characteristics in land use types found in potential multimodal transportation districts, summary of traditional design features, characteristics of mixed use developments in Florida, descriptions of density gradients for Florida's multimodal transportation districts, descriptions of general land use types for retail, service and other land use types, and extensive references to recommended practices for transportation.

***Bicycle and Pedestrian Facility Planning and Design Guidelines***

*North Central Texas Council of Governments, 1995*

This document provides guidelines for the planning and design of bicycle and pedestrian facilities. Four factors are identified for pedestrian-friendly design: ease of street crossing, sidewalk continuity, street layout and topography. Extensive urban design practices were recommended for bicyclist and pedestrian accommodations. Bicycle discussions are oriented around providing service that matches user needs. A bicycle catchment area for transit is identified based on a 5 minute and 10 minute service time.

**Building Livable Communities: A Policy Makers Guide to Transit Oriented Development**

*The Center for Livable Communities, 1996*

This document outlines the benefits of transit oriented design and provides a summary of the elements of good transit friendly design, which include appropriate land use, site design and pedestrian and transit friendly facilities. The document also discusses implementation tools and options for financing. Case studies are provided, as well as a checklist of design practices developed from New Jersey Transit.

***Building on Success: A Report from Eastward Ho!***

*South Florida Regional Planning Council, 1998*

This document summarizes the experience and success of integrated land use and transportation planning in South Florida.

***Central Florida Mobility Design Manual***

*LYNX, 1995 Edition*

This manual documents the recommended planning practices for Central Florida in promoting transit usage. Key elements related to multimodal transportation districts include: discussion of linkages for pedestrian circulation, bicycle interconnectivity and circulation, definitions of bicycle facilities, table of transit amenities, potential benefits of

various transit stop situations, and mobility design checklist.

***Charter of the New Urbanism: Region; Neighborhood, District, and Corridor; Block, Street, and Building***

*Congress for the New Urbanism, 2000*

This document provides a summary of the concepts used in new urbanism design that emphasizes transit-oriented design and pedestrian oriented design.

***Cities Back from the Edge: New Life for Downtown***

*Roberta Brandes Gratz and Norman Mintz, 1998*

This text discusses approaches to suburban and urban development that incorporate many of the principles of new urbanism, neotraditional design, and transit oriented design.

***Design and Safety of Pedestrian Facilities, A Recommended Practice***

*Institute of Transportation Engineers, 1998*

This document provides recommended practices for the design of pedestrian facilities. Key elements utilized include a table on the recommended practice for the location of sidewalks.

***Fractured Metropolis: Improving the New City, Restoring the Old City, Reshaping the Region***

*Jonathan Barnett, 1995*

This document discusses the history of urban development in America, its transition and the causes of suburbanization. It also includes recommendations for a national policy agenda focusing on a return to traditional urban planning and design. The text presents the design principles of new urbanism, neotraditional and transit oriented design principles.

***Guide to Land Use and Public Transportation, A***

*Snohomish County Transportation Authority and FTA, 1993*

This document provides a foundation of transit-oriented design developed for SNO-TRAN in Washington State. The document provides a vision for multimodal transportation and descriptions of urban centers, which promote multimodal transportation. Key elements related to multimodal transportation districts include: characteristics of a good urban center, layers of a specific area plan, transit-compatible site planning issues, site plan checklist, description of mixed use development, efficiency of interconnected roadway network, and a glossary of terms.

***Handbook for Walkable Communities***

*Dan Burden and Michael Wallwork, PE.*

This handbook discusses the principles of pedestrian and bicycle travel and recommends engineering practices and criteria to support bicycle and pedestrian use. Areawide design issues as related to connectivity of roadways and bicycle/pedestrian networks are also presented.

***HARTLine Transit Friendly Planning and Design Handbook and Technical Manual***

*HARTLine, 1995*

This handbook provides recommended practices for transit-friendly design and a policy statement supporting this design. The following criteria are recommended for use in considering the implementation of transit friendly design.

Density thresholds:

- Low density: 15 dwelling units per acre
- Moderate density: 30 dwelling units per acre
- High density: 50 dwelling units per acre

Developer thresholds for transit-oriented design:

- 100,000 square foot shopping center
- 50,000 square foot single or multi-tenant
- Mixed use developments more than 50,000 square and all residential development containing more than 200 units or greater than 7 units per acre

### **How Transportation and Community Partnerships Are Shaping America**

*Project for Public Spaces, Inc. 2000*

This two part series documents the successful provision of transit friendly/pedestrian friendly design in transit stops and stations, found in the first section, and streets and roads, found in the second section. Case studies are used throughout to illustrate the success of implementing these practices.

### **Integrating Community Design and Transportation**

*Center for Urban Transportation Research, 1993*

This document analyzes and explores the relationship between urban form and transportation through a number of case studies. This document closely examines the history of development types and the evolution of development patterns and the supporting transportation networks.

### **Legal Research Digest: The Zoning and Real Estate Implications of Transit-Oriented Development**

*Transportation Research Board of the National Academies of Science, 1999*

This document discusses zoning and the legal and real estate implications of the transit-oriented developments. The emphasis is on the implementation of transit-oriented design as part of the overall development, zoning and transportation process.

### **Lexicon of the New Urbanism, The**

*Duany Plater-Zyberk & Company, 1999*

This document outlines the principles of the new urbanism movement. The document provides a summary of applicable terms and examples of the design principles.

### **Livable Neighborhoods, Street Layout, Design and Traffic Management Guidelines**

*West Australian Planning Commission, 2000*

This document was formulated as a guideline for urban design, street layout and traffic management for developers in West Australia. The guidelines are currently being tested and will be reevaluated. The guidelines support the following characteristics: walkable neighborhoods clustered to form towns along transportation routes, interconnected street patterns with high quality public spaces as focal points, layout and performance objectives which provide a variety of lot sizes and housing choices, local retail, employment opportunities and regional context.

### **Making Streets that Work**

*City of Seattle, 1996*

This planning guideline discusses the principals of street design for pedestrians. Key elements related to multimodal transportation districts include description of the role of streets in the regional transportation system and pedestrian activity, and a glossary.

### **Next American Metropolis: Ecology, Community and the American Dream**

*Peter Calthorpe, 1993*

This document is considered to be the seminal text of the new urbanism movement. The principles of this text are referenced throughout planning literature.

### **Pedestrian and Transit Friendly Design**

*Public Transportation Office, Florida Department of Transportation, 1996*

This handbook provides recommendations for pedestrian and transit friendly design. A checklist of features associated with pedestrian and transit friendly design is provided, and divided into essential, highly desirable and nice additions.

### **Pedestrian Environment, The**

*1000 Friends of Oregon, 1993*

This document discusses research related to the effectiveness of the pedestrian environment and its contribution to multimodal potential. Four factors were compiled to form a pedestrian environment factor and include ease of crossing, sidewalk continuity, sidewalk connectivity, and topography.

### **Planning for Transit Friendly Land Use: A Handbook for New Jersey Communities**

*NJ Transit, 1994*

This handbook provides the framework for many of the concepts developed for the multimodal transportation districts. The handbook discusses the relationship of the pedestrian, bicycle, roadway and transit modes with land use and urban form. Land use is discussed in terms of the pattern, density, intensity and mix required for supporting transit usage. The transit station area environment is discussed in detail. Model zoning ordinances are provided for New Jersey communities to promote transit friendly design in the station area.

### **Regional Growth Management Strategy**

*San Diego Association of Governments, 1996*

This document provides an example of local land use elements that support transit oriented design.

### **Street Design Guidelines for Healthy Neighborhoods**

*Dan Burden, et.al., 1999. Center for Livable Communities.*

This handbook provides recommendations for the design of roadways in livable communities. The handbook emphasizes roadways, but also recognizes the importance of pedestrians and transit in livable neighborhoods. A classification of streets is proposed which matches the desired functionality and role of the roadways within the livable communities design philosophy. Factors considered in the classification include maximum width, design speed, corner radii, curvature, medians, street length, vehicle volumes, walkways, bike lanes, trees, traffic flow and parking.

**Streets and Sidewalks, People and Cars: The Citizens Guide to Traffic Calming**

*Local Government Commission, Center for Livable Cities, 2000*

This document is a practical guide to traffic calming and is a resource for traffic calming techniques. A table is provided relating various traffic calming treatments to vehicle volume, vehicle speed, noise, vehicle conflicts, traffic diversion, pedestrian safety, bicycle safety, emergency vehicle access, estimated costs, timeline for construction, and appropriate of use for arterial or residential roadways.

**TCHRP Report 22, The Role of Transit in Creating Livable Communities, 1997**

This report evaluates the role of transit in urban form and livable places. Key elements related to multimodal transportation districts include concepts describing principal attributes desired in communities and strategies to ensure these attributes are provided.

**TCHRP Report 33: Transit-Friendly Streets: Design and Traffic Management Strategies to Support Livable Communities,**

*Project for Public Spaces, 1998.*

This research report uses a variety of case studies to illustrate the application of transit friendly design principles to streets. Transit corridors were compared and evaluated qualitatively. Major design configurations and elements were also summarized and compared.

**Transit Oriented Development Design Guideline**

*Sacramento California, 1990*

This design guide provides a reference for local governments in implementing transit oriented design principles.

**Transportation and Land Use Innovations: When You Can't Pave Your Way Out of Congestion**

*Reid Ewing, 1997*

This handbook offers suggestions for reducing congestion, automobile dependence and vehicle miles of travel. Key elements related to multimodal transportation districts include a discussion of street network design, land planning for accessibility, land use compatibility promoting transit use, pedestrian and bicycle-friendly design, and areawide LOS criteria.

**Transportation Land Use and Sustainability**

*Florida Center for Community Design and Research, 1994.*

The emphasis of this work is on sustainable transportation alternatives, the importance of multimodal transportation, and the links to land use. The key element identified in this work that contributes the multimodal areawide LOS technique is the analysis of neighborhood street patterns.

**Victorian Code for Residential Development: Multi-Dwellings**

*Department of Planning and Housing, Melbourne, Victoria, Australia, 1992.*

This design and development code is used for the assessment of applications for development proposals, and was evaluated as a case study supporting model local development ordinances for multimodal transportation districts. The code is organized around the following elements: E1 site layout, E2 streetscape character, E3 density, E4 building envelope, E5 energy efficiency, E6 dwelling entry and interior, E7 open space, E8 car parking and vehicle access, E9 visual and acoustic privacy, E10 landscaping, E11 site facilities, and E12 infrastructure. Each element defines objectives and

performance criteria, and visual examples illustrating the desire outcomes are provided.

***Victorian Code for Residential Development: Subdivision and Single Dwellings***

*Department of Planning and Housing, Melbourne, Victoria, Australia, 1992.*

This design and development code is used for the assessment of applications for development proposals, and was evaluated as a case study supporting the preparation of model local development ordinances for multimodal transportation districts. The code is organized around the following elements: E0 community design, E1 lot size and orientation, E2 building siting and design, E3 private open space, E4 vehicle parking, E5 public open space, E6 movement and network, E7 pedestrians and bicyclists, E8 streetscape, E9 street design, E10 street construction, E11 utilities provision, and E12 drainage network. Each element defines objectives and performance criteria and provides visual examples illustrating the desire outcomes.

## APPENDIX C

# Transit Oriented Design References

The following references offer guidelines and recommendations for transit-oriented design:

- **Pedestrian and Transit Friendly Design**  
Public Transportation Office, Florida Department of Transportation, 1996
- **Central Florida Mobility Design Manual**  
LYNX, 1995 Edition
- **HARTLine Transit Friendly Planning and Design Handbook and Technical Manual**  
HARTLine, 1995
- **Best Development Practices: Doing the Right Thing and Making Money at the Same Time**  
Florida Department of Community Affairs, 1996
- **Building Plans and Urban Design Principles for Towns, Cities and Villages in South Florida**  
Florida Department of Community Affairs and Treasure Coast Regional Planning Council, 1998.
- **Lexicon of the New Urbanism, The**  
Duany Plater-Zyberk & Company, 1999
- **Next American Metropolis: Ecology, Community and the American Dream**  
Peter Calthorpe, 1993
- **Charter of the New Urbanism: Region; Neighborhood, District, and Corridor; Block, Street, and Building**  
Congress for the New Urbanism, 2000
- **Planning for Transit Friendly Land Use: A Handbook for New Jersey Communities**  
NJ Transit, 1991
- **TCHRP Report 33: Transit-Friendly Streets: Design and Traffic Management Strategies to Support Livable Communities**  
Project for Public Spaces, 1998.

**APPENDIX D****Multimodal Transportation Districts –  
Gainesville Case Study****Gainesville Case Study MMTD Implementation Final  
Report****Introduction**

Given the professed desire of Floridians to improve and maintain their urban quality of life and the irrefutable fact that Florida's urban population continues to explode, it is clear that the state's planning agencies require increasingly powerful tools to mitigate the congestion incident to the state's dramatic progress. From its inception, the Florida Growth Management Act has recognized the implicit relationship between transportation and land use planning, but only recently have steps been taken to address this relationship explicitly. As such, the addition of Multimodal Transportation District (MMTD) and Multimodal Areawide Level of Service (MA-LOS) methodologies to Florida's concurrency management toolkit is an innovative step towards understanding the complex relationship between transportation and land use and how best to accommodate growth and development.

The primary objective of this project is the implementation of a hypothetical Gainesville, FL Multimodal Transportation District utilizing the methodologies outlined in the Handbook. Through consultation with local planning agencies, a rough area of interest was outlined. This region, bisected by US 441—a major urban arterial, lies just north of the University of Florida campus. Elements of consideration in the selection process included the city's interest in improving the district; the area's strategic importance with respect to its proximity to UF; the relatively high availability of transit service; the perception of well-mixed land uses; and the lack of existing plans for the area.

In addition to the main case study area, a summary implementation was conducted as part of a UF planning department transit oriented design studio. The subject area for this abbreviated MA-LOS/MMTD application lies immediately south of downtown Gainesville and southeast of the main UF campus. Although this district does not meet the handbook's minimum area and employment thresholds, its abundance of transit and multifamily residential use made it an excellent subject for application of multimodal LOS and connectivity/accessibility measures.

## **Gainesville Case Study MMTD**

Although the MA-LOS Handbook delineates certain thresholds with respect to population, area, and employment, many of its principles are set forth as guidelines rather than rules. Chapters in the Handbook dealing with complementary mix of land uses, density and intensity of land uses, and transit/pedestrian-friendly design examine those factors likely to render a successful MMTD while allowing flexibility in the character of individual districts. To fulfill the data and analysis requirements prescribed by these chapters, as well as the more quantifiable discourse on connectivity and areawide level of service, a wealth of information was assembled. In so doing, several techniques were identified to enhance and augment the existing MA-LOS/MMTD methodology.

Finally, having applied the MA-LOS/MMTD methodology with respect to the letter of the Handbook, this case study attempts to analyze ambiguities and inadequacies in the outlined techniques.

### **Selection of General Study Area:**

Initially, this study presumed Gainesville's downtown area would serve as the target of MMTD implementation. However, input from the local planning staff suggested that the good progress of downtown redevelopment did not warrant additional planning inputs of this magnitude. An area north of the University of Florida campus roughly defined by the 13<sup>th</sup> Street and 6<sup>th</sup> Street corridors was suggested. Though less favorable than downtown, this study district appeared to possess good connectivity, and was thought to be well served by transit. Despite a propensity for single-family dwellings, the area demonstrated a fairly diverse mix of uses, particularly along the aforementioned corridors.

Although the study area is located in one of Gainesville's two massive Transportation Concurrency Exception Areas (TCEA), the city felt that development as an MMTD might invigorate the area by capitalizing on the large bicycle and pedestrian presence immediately to the south. While the area focused on in the study did not represent an ideal application of the MA-LOS/MMTD methodology, it did provide the opportunity to test the regulatory aspects of the document, while evaluating its usefulness as a planning tool.

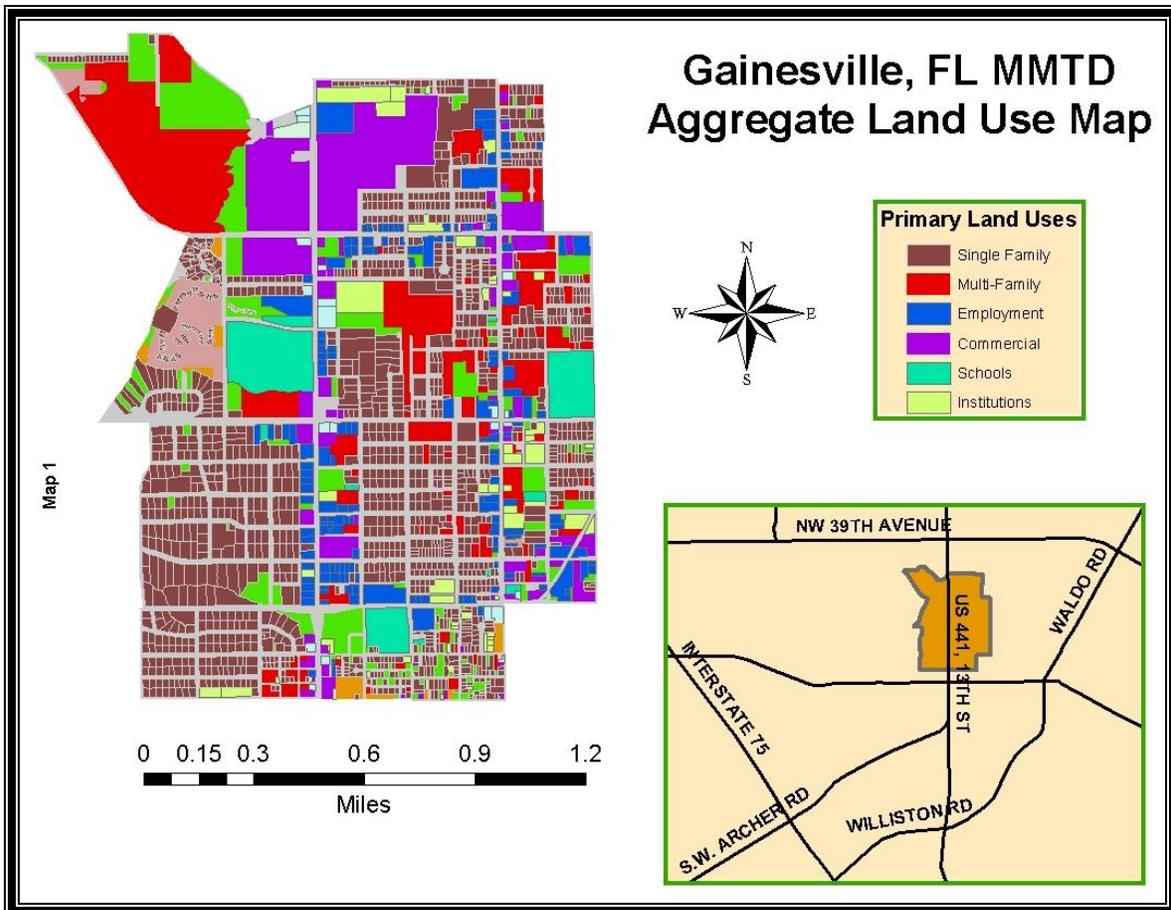
### **MMTD Boundary Delineation:**

After settling on a general study area, further data analysis and consideration of MMTD objectives allowed strictly defined boundaries to be established. Two major considerations governed this process:

1. Adherence to the population, employment, area, and land use organization guidelines established in the MA-LOS/MMTD handbook, and
2. Regard for existing traffic analysis boundaries and logical neighborhood divisions.

The MA-LOS/MMTD handbook establishes specific thresholds for population, employment, and area, as well as textual and tabulated suggestions for organization,

density, and intensity of land uses. To be considered under the provisions of this study, an MMTD should house at least 5000 persons and maintain a 0.5:1 ratio of jobs to population. Additionally, an MMTD must be a minimum of 2 square miles in area. (This threshold was in an earlier draft of the handbook at the time of this analysis.) These “hardwired” criteria were of foremost concern in the development of Gainesville’s MMTD boundaries, but the existence of appropriate mixes of land uses; central core and corridor density/intensity nodes; and relationships between adjacent uses were scrutinized as well. Using these criteria in conjunction with the city’s specified general area, the following MMTD district was defined.

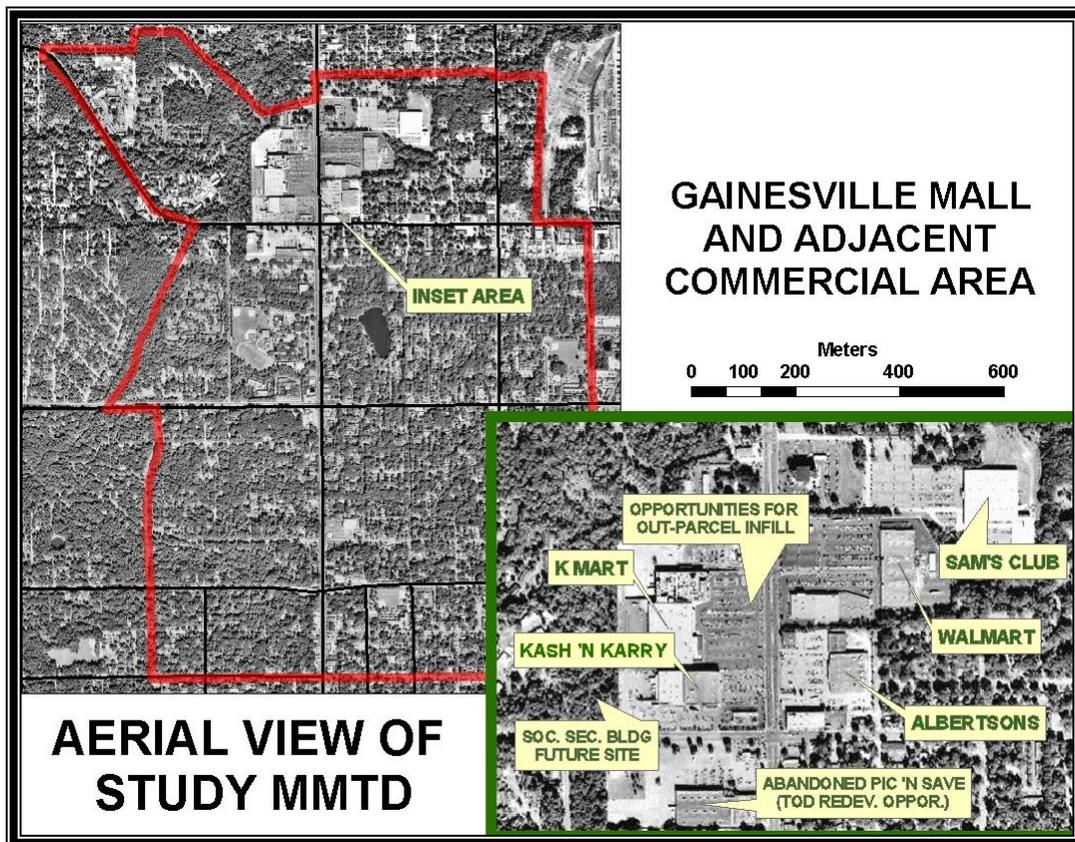


By considering land use and density data prior to finalizing the MMTD boundaries, it became apparent that an adjustment of the northern MMTD boundary from 23<sup>rd</sup> Avenue to 29<sup>th</sup> Avenue was necessary. This northward adjustment captured the Gainesville Mall, an adjacent major commercial center, and several large multi-family developments. As such, considerable relief was added to an area that had thus far been relatively flat in terms of density and intensity. Although this core is by no means central, its inclusion is appropriate given the relation of this study MMTD to the University of Florida campus.

In order to fully understand the City of Gainesville, the impact of Shands Hospital and the University of Florida must be considered. Though excluded from this MMTD, the university dramatically impacts many of the transportation and land use allocations that

occur within the study area. The density/intensity map of the district resembles a one-sided dumbbell rather than the more typical circular gradient. Although the district appears to be unbalanced, this impression is inaccurate due to the impacts of the university and the hospital, even though they are located outside of the district boundaries.

Though less massive than southwest Gainesville’s Butler Plaza, the Gainesville Mall and adjacent shopping area is anchored by two major grocery stores and two major discount department stores. Additionally, several minor anchors and a vast array of smaller shops and restaurants accommodate most consumer needs. The layout of this facility is presently indicative of Cold-War-era, automobile-friendly design, but development of out-parcels in conjunction with a comprehensive and effective multimodal transportation system would likely capitalize on this facility’s proximity to nearby multi-family uses, as well as its relationship with the UF campus. The map below demonstrates the mass of this commercial facility by juxtaposing its broad swath of concrete with the verdant canopy indicative of Gainesville’s older neighborhoods.



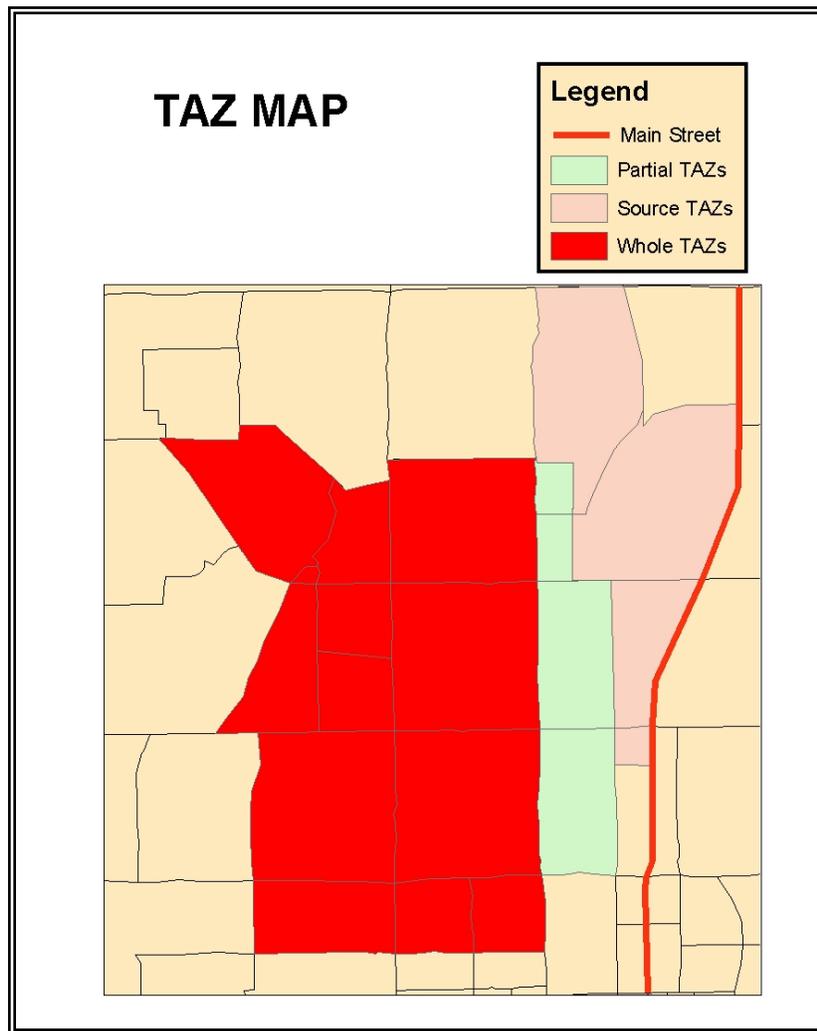
**GIS Data Layers:**

Although the actual computation of the study MMTD’s areawide level of service was determined using the beta-test ArtPlan software package, most of the other MMTD criteria readily lent themselves to GIS analysis. Specifically, the analysis of elements such as network connectivity, land use mix, housing density, and gross population/employment, were conducted using ArcView and ArcInfo. In this regard, a

multitude of data layers were assembled from the Florida Geographic Data Library (FGDL) with the assistance of the University of Florida Geoplan Center. Many of these map layers, such as digital aerial photographs and major road lines were used for strictly descriptive purposes, but other geographic data sets were manipulated to analyze land use mixtures and densities, network connectivity, and transit accessibility.

A parcel level aggregate land use map based on tax appraiser parcel data was very useful in this study. This map grouped similar land uses into eight major categories, such as single-family, multi-family, commercial, employment, etc. The grouping of the 99 land use codes was instrumental in the process of land use analysis and aided in the boundary delineation process. Unfortunately, in spite of its high spatial resolution, it did not effectively provide gross population and employment data. These data are factor into the calculation of the areawide LOS and necessary for the confirmation of the population and employment thresholds established in the Handbook. Although section 4.2 of the Handbook suggests the “dynamic segmentation of the area polygons using census tract level information,” it became apparent that the layout and size of census block-groups lacked the spatial discretion necessary to accurately measure the area’s demographics.

This concern, combined with the specification that techniques of MMTD analysis correspond with FSUTMS data inputs when appropriate, led to the approach of using traffic analysis zones (TAZs) as the primary geographic building block. This method worked extremely well for all areas of the Gainesville MMTD with the exception of the eastern boundary, where the TAZ boundaries were coterminous with Main Street. Because Main Street directly references downtown Gainesville, and because downtown, like the university, is not the principle target of this study, TAZ boundaries were abandoned for the eastern border of the study. For this border, as well as the ambiguous northeast corner of the MMTD, city streets and, in some instances, parcel lines were used to establish a boundary. In the map below, the red represents TAZs taken intact as MMTD boundaries, while the green represents partial TAZs extracted from the peach areas.

**Other Data:**

Aside from GIS data layers, the North Central Florida Regional Planning Council (NCFRPC), provided the critical Zdata files which, when related to the GIS TAZ map, yielded the study MMTD's population and employment data. Additionally, this agency provided current automobile LOS tables for most of the identified major facilities in the study area. Regarding transit service in the study area, Gainesville's Regional Transit System website provided route maps, frequencies, and service spans.

These secondary sources supported the primary research activity of roadway attribute collection. Roadway attributes collected for the study MMTD's major facilities were used to develop a segment-level database of sidewalk width and separation, bike lane status, outside lane width, presence of barriers, and posted speed limits. This data, in conjunction with the aforementioned traffic data was necessary to accurately utilize and critique the ArtPlan MA-LOS software.

**MMTD Prerequisites and Land Use Analysis:**

In its implementation of the MA-LOS/MMTD Handbook's magnitude and land use methodologies, this study progressed through two distinct phases of analysis:

1. Consideration of Basic MMTD requirements
2. Analysis of MMTD land use organization and density/intensity characteristics

**Basic MMTD Requirements:**

As noted previously, the primary data source used in the delineation of the Gainesville study MMTD was a map of traffic analysis zones from FGDL and their corresponding Zdata files provided by the NCFRPC. In addition to the coordination with existing traffic models, TAZ data proved to be the most spatially discrete source of population and employment information available.

For the most part, the use of TAZ data to estimate the MMTD’s population and employment characteristics was a simple process. After joining the Zdata table with the TAZ shapefile, those polygons comprising the MMTD were selected and a table of their attributes was exported for summation. However, the efforts to exclude the Main Street area resulted in several complications. Because TAZs along the eastern perimeter of the MMTD were bisected to avoid collusion with the Main Street commercial area, the Zdata for these partial TAZs had to be extrapolated. The initial approach was to attribute Zdata from the source TAZ to the partial TAZ proportional to its area. However, due to the relatively high intensity of commercial and employment activity along the Main Street edge of the source TAZs the probability of misrepresentation was high. By examining the land use parcel map, it was possible to select TAZs from the interior of the MMTD that closely resembled the land use characteristics of the partial TAZs along the eastern border. Though not statistically validated, the use of this more realistic Zdata allowed for a closer approximation of the partial TAZ’s population and employment.

Summation of the Zdata-1 (population) and Zdata-2 (employment) tables for the MMTD TAZs yields the following results:

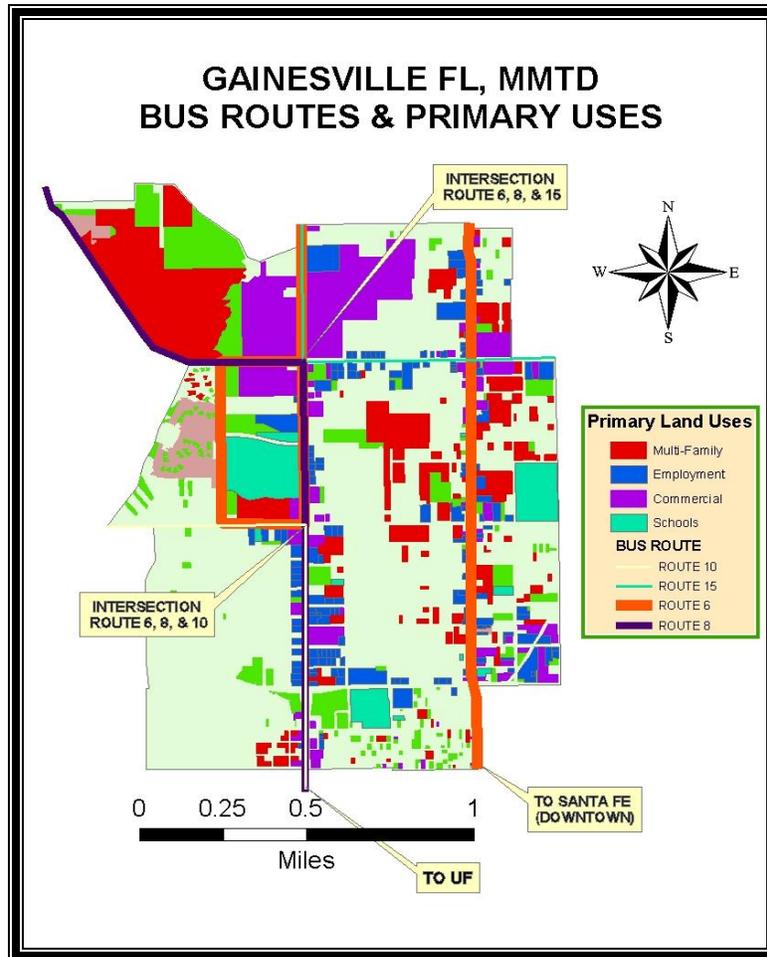
<b>Single Family Pop.</b>	<b>3268</b>
<b>Multi-Family Pop.</b>	<b>4228</b>
<b>Total Population</b>	<b>7396</b>
<b>Total Employment</b>	<b>8349</b>
<b>Jobs to Population</b>	<b>1.13</b>
<b>Area</b>	<b>1.99</b>

As can be seen from this table, the study Gainesville MMTD barely attains the 2 square mile area threshold, but posts favorable population and employment numbers. Of note, the area’s over-square employment to population ratio more than doubles the 0.5:1 benchmark.

In addition to the promising population and employment data, the study MMTD appeared to be well served by Gainesville’s Regional Transit System. Though varying in frequency and service span, four RTS routes (6, 8, 10, & 15) currently serve the study area. Portions of all four routes travel along the area’s primary arterial of NW 13<sup>th</sup> Street (US 441) effectively doubling the bus frequency on the facility. Additionally, the

intersection of routes 6, 10, and 15 at 23<sup>rd</sup> Avenue and 13<sup>th</sup> Street near the Gainesville Mall and nearby multi-family developments, along with the intersection of Routes 6, 8, and 10 at 16<sup>th</sup> Avenue and 13<sup>th</sup> Street near Gainesville High School, provide excellent opportunities for access to the regional transportation system.

The map below depicts these intersections as well as those land uses considered crucial to a successful MMTD. Note how the overlap of bus coverage corresponds to the central core and corridor organization of land uses.



**Land Use Mixture, Organization, and Density/Intensity:**

Having met the most basic requirements in Section 3.1 regarding area, population, employment ratio, and the existence of scheduled bus service, it was necessary to determine whether a diverse mix of complementary land were included in the study MMTD. For this area, the identified three primary uses are regional retail, multi-family dwelling units, and educational facilities. Though the advent of big box power nodes shifted the scope of what may be considered “regional retail,” for the purposes of this study, the Gainesville Mall, located in the northern portion of the MMTD was cited in this capacity. Although single-family units dominate the residential landscape spatially, TAZ data indicates that over half of the area residents dwell in multi-family units. Though many of these units are scattered throughout the MMTD, a considerable number are

located in the northwest portion of the district offering good accessibility to the Gainesville Mall. Occupying the role of third primary use, Gainesville High School is located near the center of the district. With an enrollment of 1,964 students and 157 staff members for the 1999-2000 school year, this institution represents a large potential demand on multimodal facilities.

Supporting uses for the study area include a diverse mix of restaurants, convenience retail, automotive services, low-intensity employment, schools, and government service buildings. The majority of these uses not associated with the designated core of the Gainesville Mall are located along 13<sup>th</sup> Street and 6<sup>th</sup> Street, where they are served in varying capacities by Gainesville’s RTS. Finally, it is relevant to consider the nearby University of Florida as a supporting use. Although the university places monumental demands on Gainesville’s transportation infrastructure, lack of parking and peak hour congestion boost transit ridership far beyond the norm for a similarly sized southern city. Because of its proximity to UF and downtown, the study MMTD includes the benefit of increased frequency and a diversity of transit destinations.

Table 16 of the MA-LOS/MMTD handbook indicates that density of residential uses and intensity of commercial and employment uses are critical to the support of transit and pedestrian modes and the subsequent health of a multimodal district. By dividing the number of dwelling units indicated in the MMTD’s Zdata with the sum of the areas of the relevant land uses from the area’s parcel data, it is possible to effectively estimate the study MMTD’s residential density.

	Single Family	Multi-Family	Combined	Employment
<b>Dwelling Units</b>	1610	2162	3772	8349
<b>Acres</b>	450.2	171.3	621.5	210.9
<b>Density/Intensity</b>	3.6	12.6	6.1	39.6

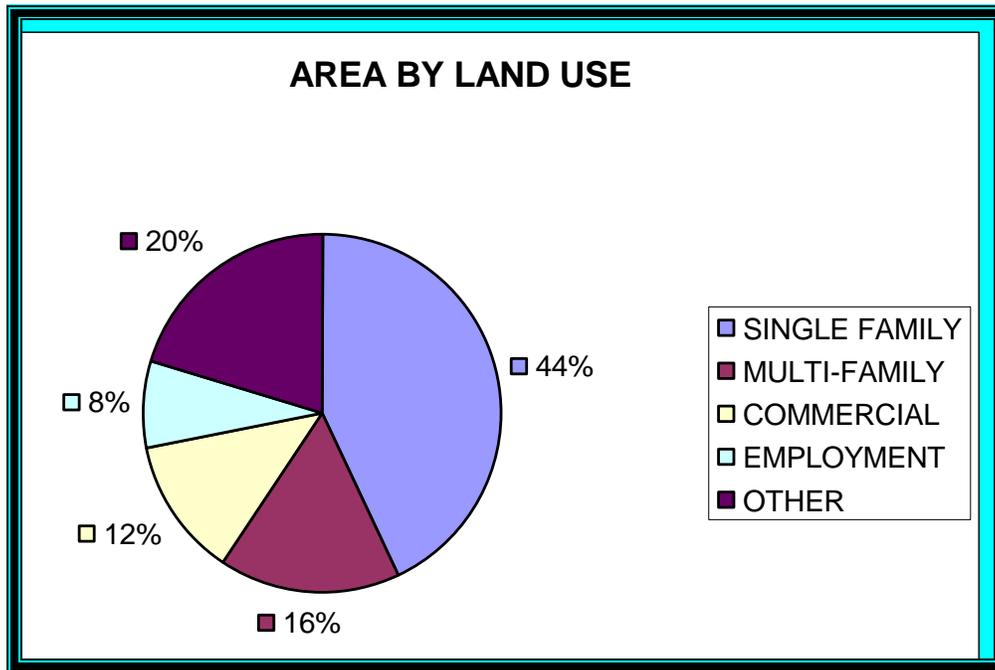
Although the calculated multi-family density of 12.6 suggests “good multimodal potential,” the combined density of 6.1 rates only “marginal” according to Table 16. Likewise, the calculated employment density of 39.6 rests on the border between the table’s “poor” and “marginal” classes.

Section 5.1 of the MA-LOS/MMTD Handbook states:

“Areas with possible multimodal potential as a result of high densities along a major corridor may be considered multimodal districts on an interim basis in the first phase of development plans or implementation of a comprehensive land use plan that achieve the desired level of density, intensity, and organization of land uses within a reasonable planning horizon.”

Given the significant commercial/employment organization along the 13<sup>th</sup> Street/6<sup>th</sup> Street corridor, and the presence of high residential and commercial densities in the study area’s northwest quadrant, it seems the proposed district reasonably fits this “interim” designation. Several infill multi-family developments initiated in the study area and the large paved area designated for parking in front of the Gainesville Mall represent

a potential for greater densities, but it remains undetermined whether the area could actually attain the higher densities required of a fully vested MMTD.



As indicated in the chart above, a major hindrance to the development of acceptable densities and intensities in the study area is the spatial dominance of existing single-family residential units. Presently, less than 50 acres of designated vacant space exist within the study MMTD. If these acres were developed at high residential densities, it is possible the 7 dwelling-unit/acre, “good potential” residential density threshold could be broached. With respect to the more daunting task of raising employment intensities from the present 40 employees/acre to the “good potential” 60 employees/acre, it must again be recognized that the presence of the university to the immediate south “subsidizes” the transit demand of the study district.

With respect to Section 5.2 regarding central cores, the most identifiable point within the study district is the intersection of 23<sup>rd</sup> Avenue and 13<sup>th</sup> Street. The basic ingredients for a central core are embodied here, with the intersection of three transit routes combined with ¼ to ½ mile walking distances to regional retail, Gainesville High School, and several large apartment complexes. Two issues in conflict with this core status are the relative spatial homogeneity of uses within the core radius and the fact that the core is not central with respect to the district at large. This designated core location is more than ½ mile (seven city blocks) from the geographic centroid near 16<sup>th</sup> Avenue and 12<sup>th</sup> Street. Although a considerable mix of uses exists near the geographic center, the primarily single-family nature of this area’s residential development precludes its consideration as a central core.

Given the density of transit service at the 23<sup>rd</sup> Avenue/13<sup>th</sup> Street intersection and along 13<sup>th</sup> Street between the two lobes of the Gainesville Mall, the presence of the huge parking area between the roadway and the commercial structures is not conducive to

transit usage. However, if at some point in the future, at least portions of this area could be converted to a variety of uses, it would enhance the study area's potential central core.

Though the minimal scope of this study MMTD precludes the notion of "major activity centers" along the major corridors as advocated in Exhibit 5 of the Handbook, it is evident from the aggregate land use map that the single-family residential character of the southern portion of the study MMTD is largely suspended along 13<sup>th</sup> Street and 6<sup>th</sup> Street. Although many of these businesses are low intensity uses, and presently do not reference the street in a pedestrian friendly manner, they do represent a potential for a contiguous span of commercial activity from the university to the "central" core.

***Analysis of Connectivity and Multimodal Areawide Level of Service:***

Assessing the Gainesville study MMTD's areawide level of service followed the six-step methodology outlined in Section 4.2 of the MA-LOS/MMTD Handbook.

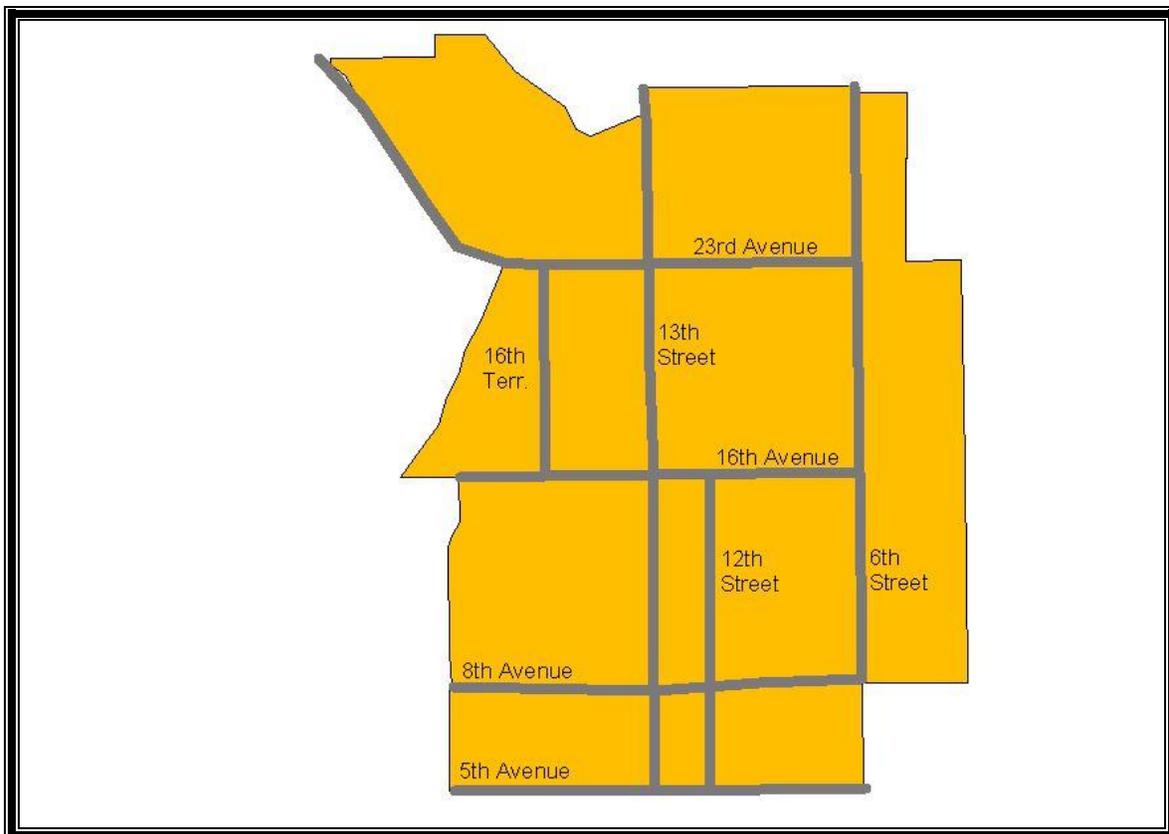
**Step 1: Identify the study area's major multimodal facilities.** For the most part, those roadways included in the FGDL's "Major Roads" data layer were selected for this study. Because automobile LOS calculations had been completed by the NCFRPC for most of these routes' segments, primary data collection demands of this study were reduced considerably.

In addition to these designated major roads, two additional routes were added to the areawide LOS equation. In the northwest area of the district, 16<sup>th</sup> Terrace connects the large multi-family developments along 23<sup>rd</sup> Avenue with Gainesville High School, and provides an alternate path to southern elements of the district and the university beyond. 16<sup>th</sup> Terrace is served by one of the area's transit routes, and so is a logical addition to the district's multimodal infrastructure. For experimental purposes, 12<sup>th</sup> Street, from 5<sup>th</sup> Avenue north to 16<sup>th</sup> Avenue, was added as a substitute bike LOS source for the 13<sup>th</sup> Street facility. Given the greater service area afforded bicycles, their ability to utilize alternate parallel routes while still accessing arterial land uses should be recognized. Similar parallel facilities exist for east-west bicycle mobility along the 8<sup>th</sup> Avenue and 16<sup>th</sup> Avenue corridors, but no traffic volume data was readily available for these routes.

The following table and map summarize the basic characteristics of the major facilities selected for this study.

NAME	DIRECTION	DESIGNATION	AADT	LANES	TRANSIT
13TH ST (US 441)	N-S	CLASS III ARTERIAL	33981	4-D	Y
6TH ST	N-S	MAJOR CITY ROADWAY	7014	4-U	Y
5TH AVE	E-W	OTHER SIGNALIZED ROAD	2762	2-U	N
8TH AVE	E-W	CLASS II ARTERIAL	14773	2-U	N
16TH AVE	E-W	CLASS I ARTERIAL	22949	4-D	Y
23RD AVE/BLVD	E-W	CLASS II ARTERIAL	12152	2-U/4-U	Y
16TH TERRACE	N-S	OTHER SIGNALIZED ROAD	5000*	2-U	Y
12TH STREET	N-S	OTHER SIGNALIZED ROAD	4165	2-U	N

\*ESTIMATED

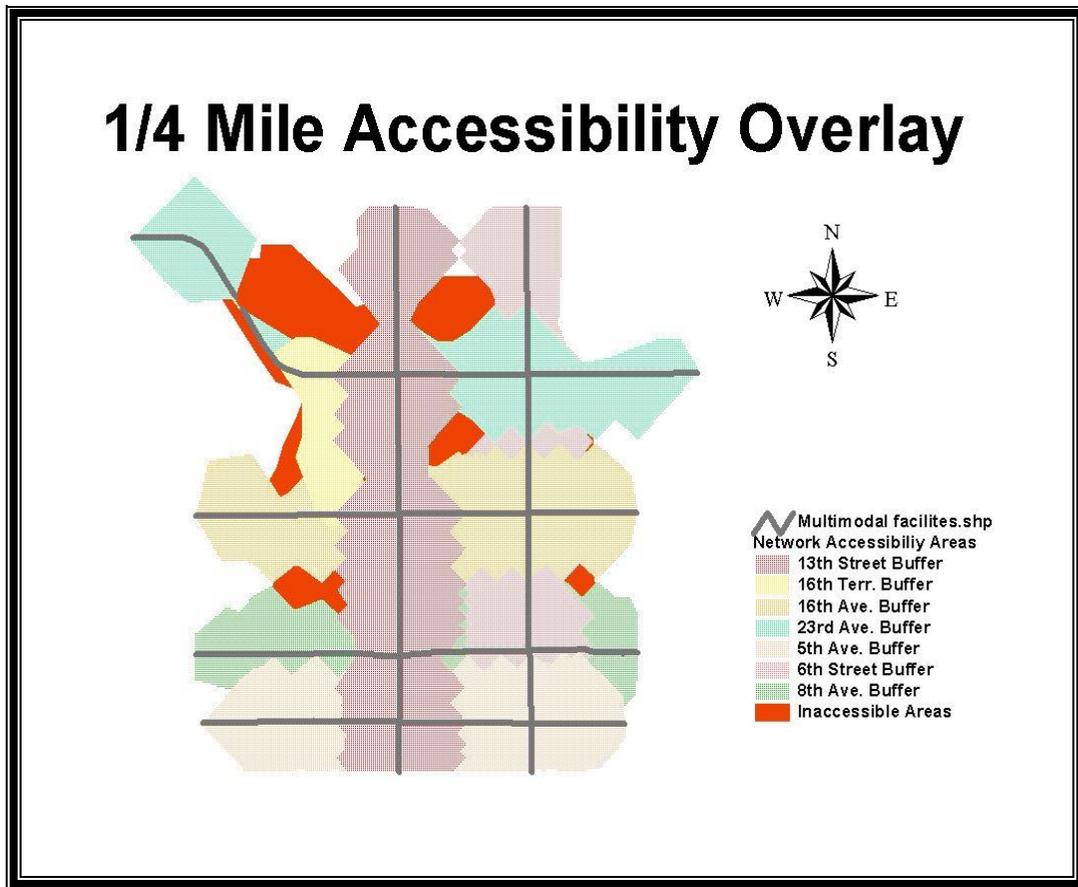


**Step 2: Apply the practical accessibility distances to establish service areas for each facility.** Using the 0.25 mile transit/pedestrian radius and 2.0 mile bicycle accessibility radius, the service areas for each mode were assessed. For this task, all

identified major facilities were considered for the bicycle and pedestrian modes, while only those facilities with transit service were considered for the transit mode. Rather than construct simple 0.25 mile buffers around the major facilities, ArcView Network Analyst was employed to determine more accurate service areas based on the minor road network.

The application of Network Analyst to this problem was a three-step procedure. First, using the Tiger Roads data layer, a point was created for each minor road/major facility intersection. Next, the "Service Area" tool was used to determine the area within a 0.25 mile network range of the intersection. For an ideal grid street system, these areas would resemble perfect diamonds. In the event of dead ends, double-long blocks, and other network imperfections, these diamonds are distorted, effectively reducing pedestrian access to the major multimodal facilities. The final step in the Network Analyst service area calculation utilized ArcInfo to dissolve the boundaries of the individual intersection service areas, thus rendering the service area for an entire facility.

Superior calculation of these service areas would utilize sidewalk layers, dedicated bike paths, internal roads, and pedestrian cut-through points to form a more comprehensive model. In the representation below, the horizontal patterns from top to bottom represent the Tiger Roads network accessibility areas of 23<sup>rd</sup>, 16<sup>th</sup>, 8<sup>th</sup>, and 5<sup>th</sup> Avenues respectively. From left to right, the 16<sup>th</sup> Terrace, 13<sup>th</sup> Street, and 6<sup>th</sup> Street service areas are depicted. The bright red backdrop represents un-serviced areas; however, the absence of service in the northwestern quadrant of the district is primarily the product of missing internal road data, and does not reflect the true connectivity of the region. This failure may be addressed by using an intersection tool in place of the more intuitive union tool, thereby capturing the population of those areas excluded solely due to missing data.



**Step 3 & 4: Determine the LOS for each mode.** In its review capacity, this study employed the ARTPLAN tool to evaluate the multimodal LOS for each major facility. Data from the NCFRPC's automobile LOS tables were used to determine the roadway Class, Average Annual Daily Volume (AADT), and Signals/Mile. Number of Through Lanes, Posted Speed, Median Type, and Left Turn Lanes were physically observed. The remaining traffic and control variable reserved default values. Automobile LOS values were not calculated using ArtPlan, rather they were taken directly from the NCFRPC source data.

After facility level data input was complete for each identified major facility, the segment data input screen was used to refine the LOS input process. In this process, a separate segment was designated for each controlled intersection. Segment length was calculated using the ArcView measurement tool, and facility variables were adjusted as needed. When inputting multimodal segment data, the *Specify Width* option was used for the outside lane value, and Paved Shoulder/Bicycle Lane was not checked unless a clear stripe (or similar division such as pavement type) separated the shoulder/bike lane from the automobile travel lane. This decision, per the advice of Dr. Linda Crider, reduced the bicycle LOS along 13<sup>th</sup> Street where the faded "house" bike symbols provide little bike lane definition. Unless obviously flawed, pavement condition was listed as desirable.

Although debate exists as to whether peak hour transit frequency should be used instead of average frequency, this study considered average frequency when measuring

the study district’s transit LOS. Because some segments are served by multiple transit routes, each with varying frequency and service span, input of bus data was somewhat more complicated than other multimodal variables. This problem was particularly acute in the case of 13<sup>th</sup> Street, where all four of the area’s transit routes interact over different segments of the facility.

Using the RTS bus schedule, the total stops per day were tabulated for each route. This number was then divided by that route’s service span to calculate the average hourly frequency. This step was necessary because many Gainesville bus routes offer half-hour service during peak times, but only hourly service during midday and evening. When two routes with identical operational hours serviced a segment, their average frequencies were simply added. In the event of varying service periods, however, the sum of the frequencies during dual (multi) coverage was prorated against the single bus route frequency.

	Route 6	Route 8	Route 10	Route 15
<b>Stops/Day</b>	24	28	12	24
<b>Span</b>	16	13.5	11	16
<b>Frequency</b>	1.5	2.07	1.09	1.5

Using the example of routes 6 & 8, route 6 begins at 6:30 and ends at 22:30 while route 8 begins at 6:00, but ends at 19:30. Therefore, for 13 hours, between 6:30 and 19:30 both routes operate simultaneously yielding a combined average frequency of 3.57. In the early morning, and in the evening (from 19:30 to 22:30) only route 6 is in operation, with an average frequency of 1.5. In reality, the situation is slightly more complex because route 6 frequency declines in the evening, but mathematically, the above description is sound. To conclude: (13 hours at 3.57 bus/hour + 3.5 hours at 1.5 bus/hour) divided by 16.5 total hours of service yields a combined average frequency of 3.13 bus/hour for a 16.5 hour service span.

**Step 5: Adjust the areawide Q/LOS using accessibility criteria.** Due to the strictly derogatory nature of the accessibility adjustment table, preliminary results suggest that accessibility will have no effect on the district’s multimodal areawide LOS. Because this area of Gainesville possesses a relatively intact grid street network, and because the parallel major multimodal facilities are within ½ mile, nearly total coverage of the combined accessibility areas is achieved. Since measured LOS is mediocre to begin with, it will not be penalized for the few accessibility lapses per the rules of the MA-LOS/MMTD Handbook. An appropriate means of calculating % population/employment served, would consider the accessibility coverage of each analysis unit (TAZ) separately, rather than apply the overall coverage area to the districts gross population and employment figures.

**Step 6: Report the adjusted areawide Q/LOS for each mode.** Utilizing the reported input methodologies, the ARTPLAN beta-test software provided the following segment-level results:

Facility	Segment	Segment Length (ft)	Pedestrian	Bicycle	Bus
<b>13th Street</b>	5th - 7 <sup>th</sup>	692.0	4.00	3.80	2.40
	7th - 10th	1352.0	4.00	3.60	2.40
	10th - 16th	1969.0	4.00	3.60	2.40
	16th - 19th	1309.0	4.00	3.60	2.40
	19th - 23rd	1357.0	4.00	3.60	2.40
	23rd - 29th	898.0	4.00	3.60	2.40
	Mall - 29th	898.0	4.00	3.60	2.40
<b>6th Street</b>	8th - 10th	591	2.49	3.39	1.76
	10th - 16th	2022	2.57	3.47	2.10
	16th - 23rd	2688	2.39	3.47	2.20
	23rd - 31st	2519	2.39	3.47	2.20
<b>16th Terrace</b>	16th - 23rd	2672	2.01	0.89	2.31
<b>5th Avenue</b>	18th - 13th	2570	2.17	2.81	--
	13th - 6th	2620	2.00	2.02	--
<b>8th Avenue</b>	18th - 15th	1760	3.36	4.10	--
	15th - 12th	1452	3.35	4.10	--
	12th - 6th	1969	3.27	3.94	--
<b>16th Avenue</b>	18th - 16th	1075	3.43	3.99	1.05
	16th - 13th	1362	3.41	3.97	2.10
	13th - 6th	2592	3.43	3.91	--
<b>23rd Avenue</b>	21st - 16th	3928	2.23	4.03	1.68
	16th - 13th	1362	2.57	3.58	2.52
	13th - 6th	2619	2.56	3.64	1.68

The version of ARTPLAN employed in this study behaved oddly when aggregating segment LOS results at the facility level, so this process was conducted manually (Excel). Using the MA-LOS/MMTD Handbook formula, **MODE LOS =  $\sum (\text{Segment LOS} * \text{Segment Length}) / \sum \text{Segment Length}$** , the following results were obtained.

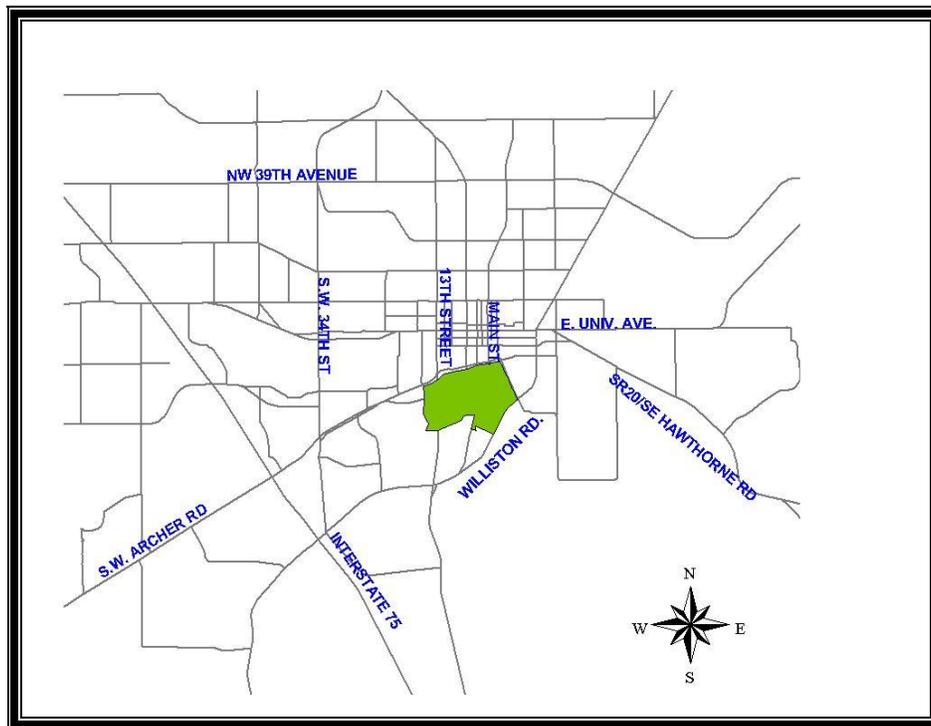
	NUMERICAL LETTER	
<u>MODE</u>	<u>SCORE</u>	<u>GRADE</u>
PEDESTRIAN	2.9	“C”
BICYCLE	3.4	“C”
TRANSIT	2.1	“D”

These results were obtained by considering only those segments offering transit service in the transit LOS calculation. Although parallel bicycle corridors were considered for theoretical purposes, the bicycle and pedestrian networks are identical in this study.

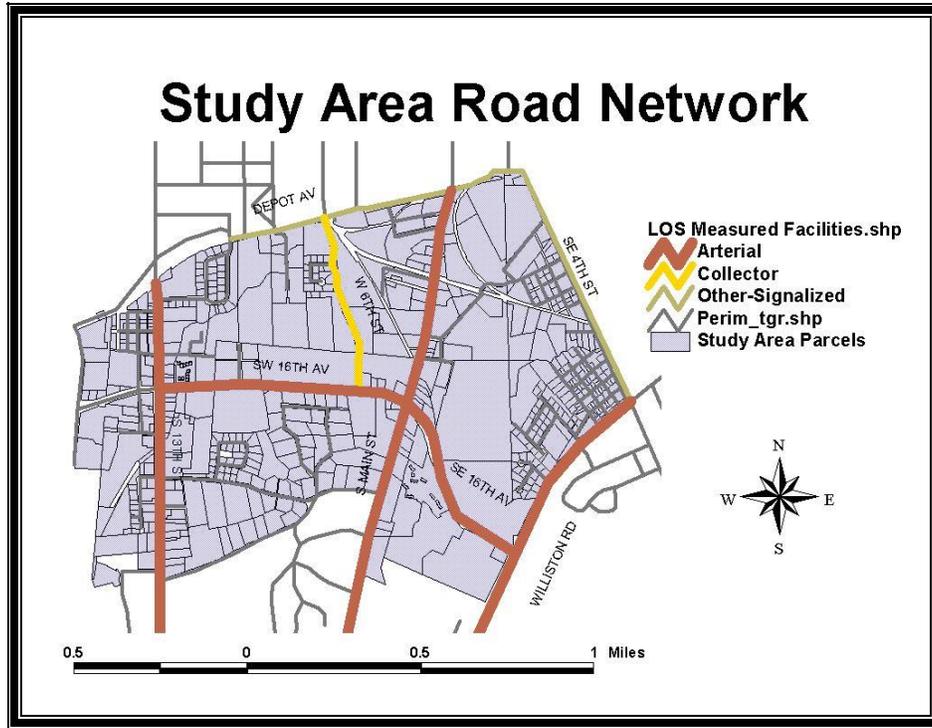
## Summary MMTD Implementation for TOD Studio Study Area

Concurrent with the final stages of the Gainesville Case Study project, the University of Florida Department of Urban and Regional Planning conducted a class studio on transit-oriented development (TOD). The class was required to site a development area in the Gainesville urban area and assess its virtues and shortcomings with respect to transit service availability, access, and land use support. Although the chosen district does not meet the 2 square mile minimum area required of an MMTD, much of the MMTD methodology was applied with great success in an attempt to better understand the district's strengths and weaknesses. Additionally, this TOD project broached new ground in the development of connectivity and accessibility measures which may be incorporated into future MMTD research and implementations.

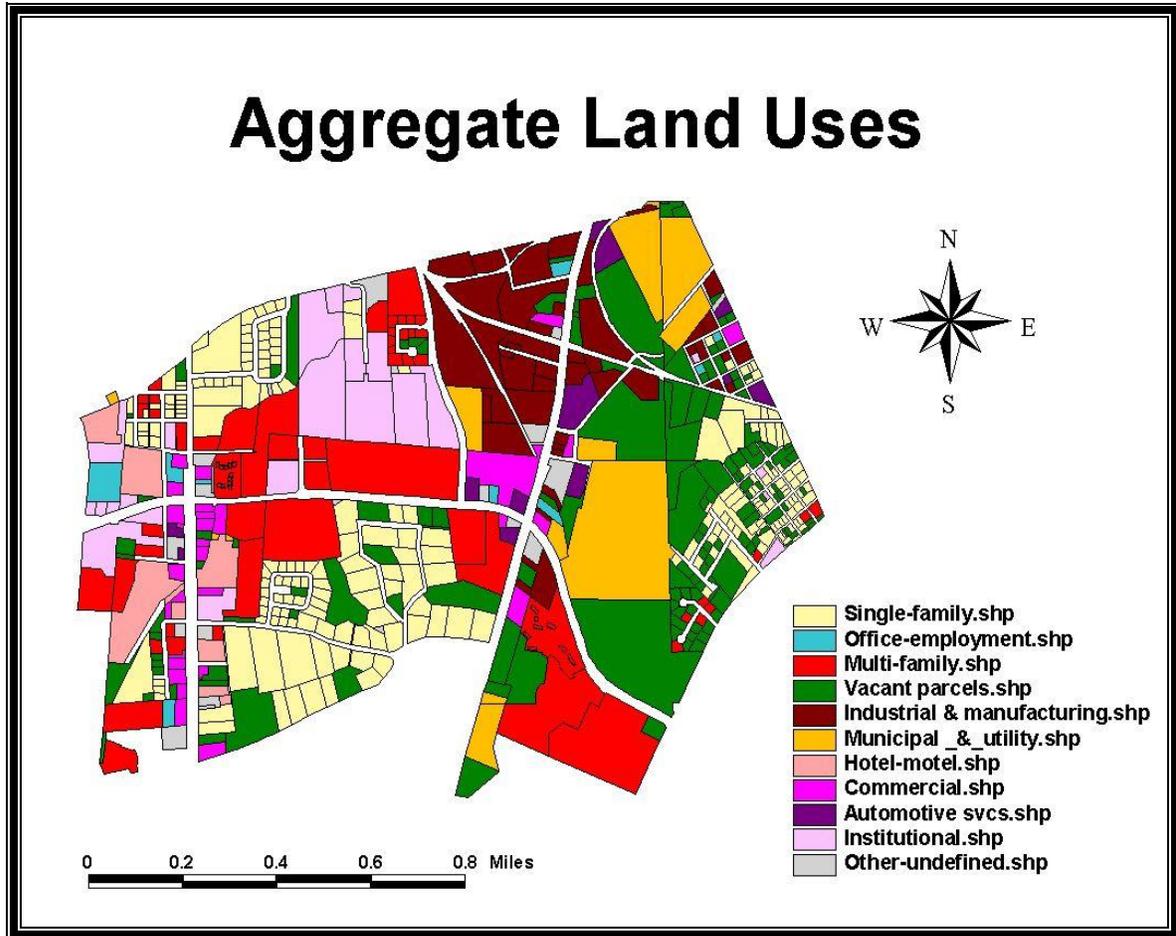
The study area for the TOD project, depicted in the map below, lies to the immediate south of Gainesville's downtown, and is southeast of the University of Florida, Shands Hospital, and Shands at AGH.



Major arterials for the district, shown below, include South 16<sup>th</sup> Avenue, connecting the district to UF/Shands and South Main Street, joining the district to downtown Gainesville. South 13th Street/US 441 bound the district on the west and Williston Road/SR 331 on the east. Other LOS measured facilities include Depot Avenue along the north boundary of the district, West 6<sup>th</sup> Street running between 13<sup>th</sup> and Main, and SE 4<sup>th</sup> Street, forming part of the district's east boundary.



Using an aggregate land use map similar to that constructed for the main case study, the TOD district's land use pattern was depicted. As shown below, the area's dominant contributing land use is multi-family residential. Good corridor intensity exists along 13<sup>th</sup> Street and a neighborhood shopping center anchored by Winn Dixie is sited on the northwest quadrant of the 16<sup>th</sup> Avenue and South Main Street. Although a mix of uses is apparent along Main Street, many of these uses are low intensity industrial or automobile oriented and so not conducive to multimodal planning. Additional impediments include large areas of land near the district's presumed central core tied up in public utility uses, vacant land constrained by water table and wetlands issues, and a large-lot single family neighborhood to the south of the core set apart by a large contiguous chain-link fence.

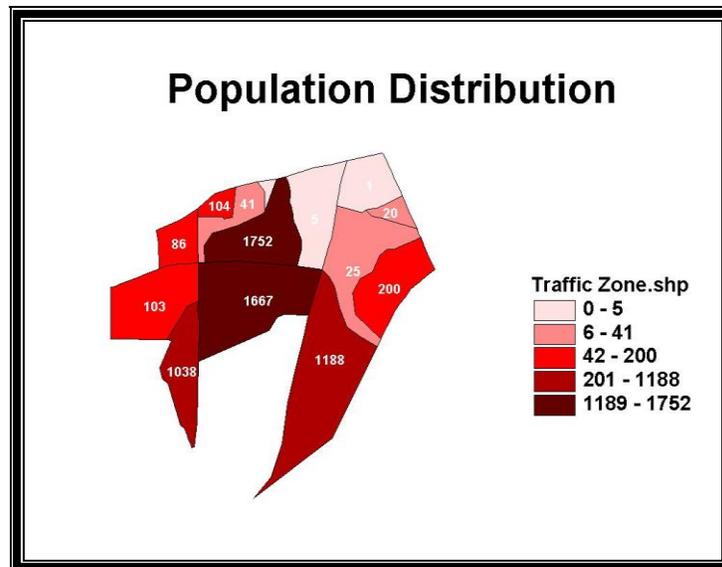


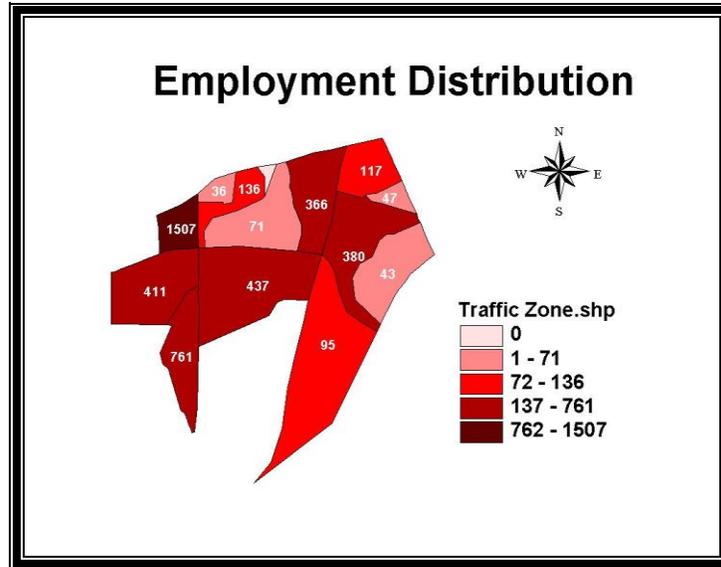
Despite these encumbrances, the TOD study district posts favorable gross population and employment figures. In particular, the wealth of multi-family land uses contributes to a favorable 15 persons/acre population density. Less impressive is the area's 13 jobs/acre, although the jobs:population ratio is in excess of the handbook's 0.5:1 threshold. As in the main Gainesville case study, a large portion of the district's area is consumed by single family uses. It was found in both Gainesville studies that an excess of single family development can hinder the effectiveness of multimodal districts. Although the logical inclusion of TAZs to the south of the district would bring the district area above the 2 square mile threshold, this qualification would be mitigated by adverse impacts on density and intensity.

	<u>Persons</u>	<u>Acres by Land Use</u>	<u>Density</u>
<b>Residential</b>	<b>6035</b>	<b>397</b>	<b>15</b>
<b>Employment</b>	<b>4407</b>	<b>333</b>	<b>13</b>

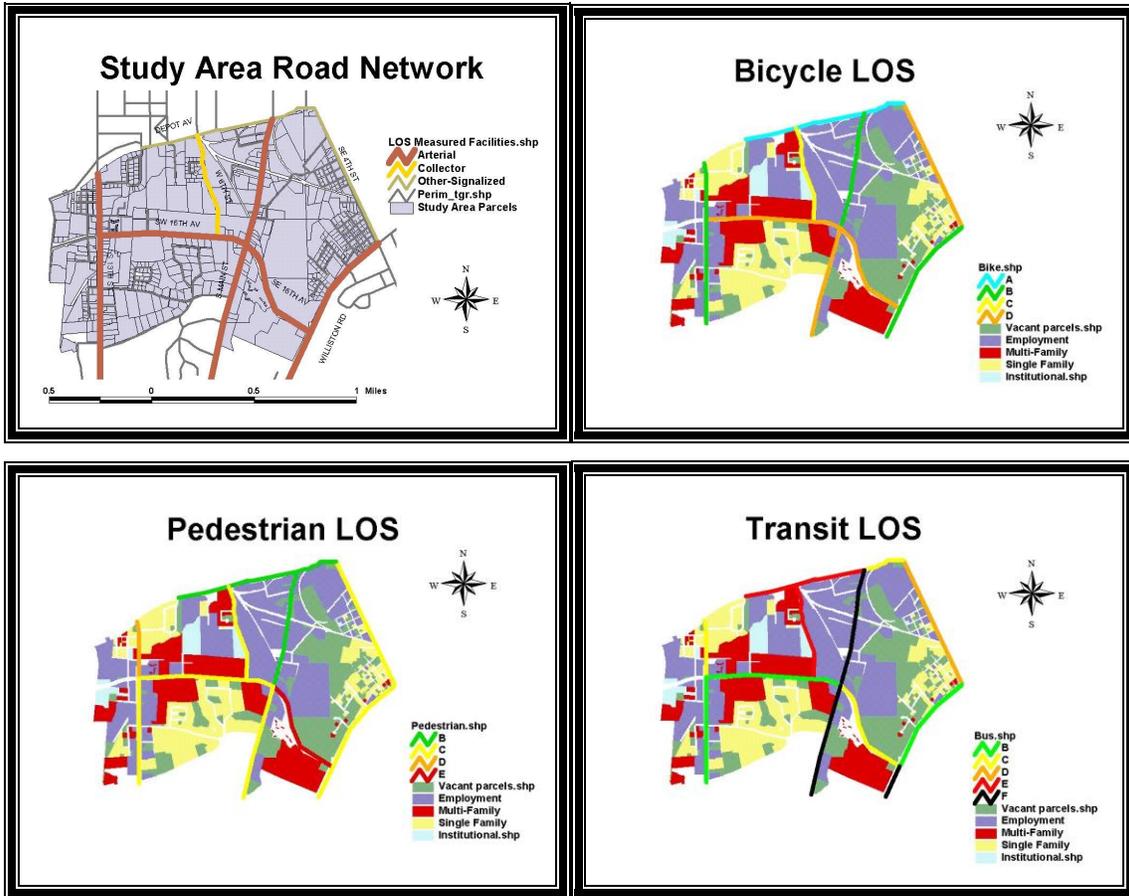
	<u>Persons</u>	<u>Acres</u>	<u>Percent</u>
<b>Single Family</b>	<b>495</b>	<b>1431</b>	<b>39%</b>
<b>Multi Family</b>	<b>5540</b>	<b>1565</b>	<b>42%</b>
<b>Commercial</b>	<b>664</b>	<b>258</b>	<b>7%</b>
<b>Service</b>	<b>3125</b>	<b>369</b>	<b>10%</b>
<b>Industrial</b>	<b>618</b>	<b>73</b>	<b>2%</b>

A review of the area's Zdata 1 and Zdata 2 tables confirms the separation of land uses implied in the parcel map. With certain exceptions, the graphics below indicate that those TAZs endowed with high populations rarely include large amounts of employment opportunities. Therefore, it can be shown that, while the area at large demonstrates a good mix of uses, these uses are spatially segregated within the study boundaries. Further development of connectivity and accessibility tools will aid in the quantification of land use mixture allowing an implementing agency to better evaluate the mode-split potential of a given district.





Having considered the TOD study area in terms of the MA-LOS/MMTD Handbook's density, intensity, land use mix, and land use organization criteria, the studio also applied the multimodal level of service measures to the area's major multimodal network. Comprised of the roadways mentioned above, the network is a mix of four-lane arterials, two-lane major roads, and several collector streets. Many of these facilities are served by transit, although the service frequency varies dramatically. Likewise, the level of bicycle and pedestrian facilities approaches both extremes over different segments of the network. The maps below highlight the measured network, and indicate the ArtPlan derived LOS for bicycle, pedestrian, and transit modes using a red→cyan gradient.



Most noticeable is the disparity between transit LOS and bike/pedestrian LOS along the multi-family-rich South 16<sup>th</sup> Avenue corridor. This is especially apparent along the eastern segment of this facility where the LOS “E” pedestrian score negatively impacts the transit score from LOS “B” to LOS “C”. Also noted is the failing transit LOS along South Main Street that inhibits access of the student population to downtown. Finally, while there are excellent bike/pedestrian facilities on Depot Road along the northern boundary, these facilities provide no connections or access to any other facilities or destinations.

Using the areawide LOS methodology as a planning tool, the TOD studio considered available right-of-way along the sidewalk-free eastern portion of South 16<sup>th</sup> Avenue as an obvious opportunity to improve the region’s multimodal LOS. Additionally, various cross section modifications were tested using ArtPlan in an attempt to improve the bicycle LOS score for the western segment of 16<sup>th</sup> Avenue, but the heavy automobile demands on this arterial prevented a favorable solution. The studio team eventually concluded that a parallel bike/pedestrian restricted facility would be well suited to the area’s needs, and so utilized the MA-LOS/MMTD Handbook’s alternate network option to this end. At intermediate and final build-out stages of the area’s 50-year master plan, areawide LOS was retested to consider the impacts of network modifications. In summation, the MA-LOS/MMTD Handbook proved a capable and useful tool regardless of the concurrency issues faced by this district.