# League City

# Master Mobility Plan

August 2011

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# *ABBREVIATIONS AND ACRONYMS*

***Chapter***

AA – Alternatives Analysis ... 3
AASHTO - American Association of State Highway and Transportation Officials ... 2
ADT – Average Daily Traffic ... 2
AIA – American Institute of Architects ... 9
APA – American Planning Association ... 9
BAHEP – Bay Area Houston Economic Partnership ... 8
BayTran – Bay Area Houston Transportation Partnership ... 3
BRT – Bus Rapid Transit ... 3
CIP – Capital Improvement Plan ... 6
CNU – Congress for the New Urbanism ... 9
CO2 – Carbon Dioxide ... 1
CRT – Commuter Rail Transit ... 3
DOT – U.S. Department of Transportation ... 3
EPA – U.S. Environmental Protection Agency ... 9
ETJ – Extraterritorial Jurisdiction ... C
FTA – Federal Transit Administration ... 3
FAR – Floor Area Ratio ... 5
GCC – The Gulf Coast Center ... 3
GCTD – Galveston County Transit District ... 3
GH&H – Galveston, Houston, & Henderson ... 3
HOV – High-Occupancy Vehicle ... 3
H-GAC – Houston-Galveston Area Council ... 3
HUD – U.S. Department of Housing and Urban Development ... 9
IH – Interstate Highway ... 2
ITE – Institute of Transportation Engineers ... 2
JSC – Johnson Space Center ... 3
LRT – Light Rail Transit ... 3
LOS – Level of Service ... 2
LPA – Locally Preferred Alternative ... 3
LSV – Low-Speed Vehicle ... 3
METRO – Metropolitan Transit Authority of Harris County ... 2

# *EXECUTIVE SUMMARY*

## *PURPOSE*

League City is a rapidly growing community within a growing region. This growth has led to increased traffic congestion and other mobility challenges that degrade the city's overall quality of life. These issues are becoming a liability to the city's continued growth and attractiveness. Consequently, this League City Master Mobility Plan has been developed in an attempt to address the problems directly and proactively.

This is a multi-modal plan that not only examines the roadway network, but also the pedestrian network, bicycle lanes, shared-use paths (i.e., hike & bike trails), commuter rail, regional bus transit (park & ride), local bus transit, and marine transportation.

## *CURRENT SITUATION AND CONTRIBUTING FACTORS*

The traffic situation in League City cannot be attributed to random events. Rather, it is due in large part to conscious choices made by city leadership (elected and staff) over many years. In many cases these choices have been facilitated by the actions of developers and reinforced by the desires of residents.

Specifically, League City has **chosen** to:

- Develop as a **bedroom community** with limited jobs and a small (but growing) retail base.
- Develop with land use patterns and densities that force almost **exclusive dependence on the automobile** for mobility.
- Develop in a manner that relies on a **limited number of arterials** that traverse the community.
- **Sacrifice true connectivity** that could serve to better disperse vehicle traffic.
- Allow roadway design that focuses exclusively on increasing **convenient access to each site and moving cars through the city as quickly as possible.**

The result of these choices is a system of roads that has the following characteristics:

- **Congested and failing** at the most critical (commute) times, and **underutilized and fast** at any other time.
- Extensive on a per capita basis (i.e., miles of road per resident), but consequently **expensive to maintain.**

## *NON-AUTOMOTIVE MOBILITY*

When it comes to getting around League City without a car, options are extremely limited:

- The existing pedestrian network is largely incomplete, disconnected, unsafe, and/or impeded by obstacles.
- League City currently does not have any on-street bicycle lanes.

- Shared-use paths are few and far between.
- There is currently no form of bus or rail fixed-route transit available in League City.

## *FUTURE ROADWAY NETWORK*

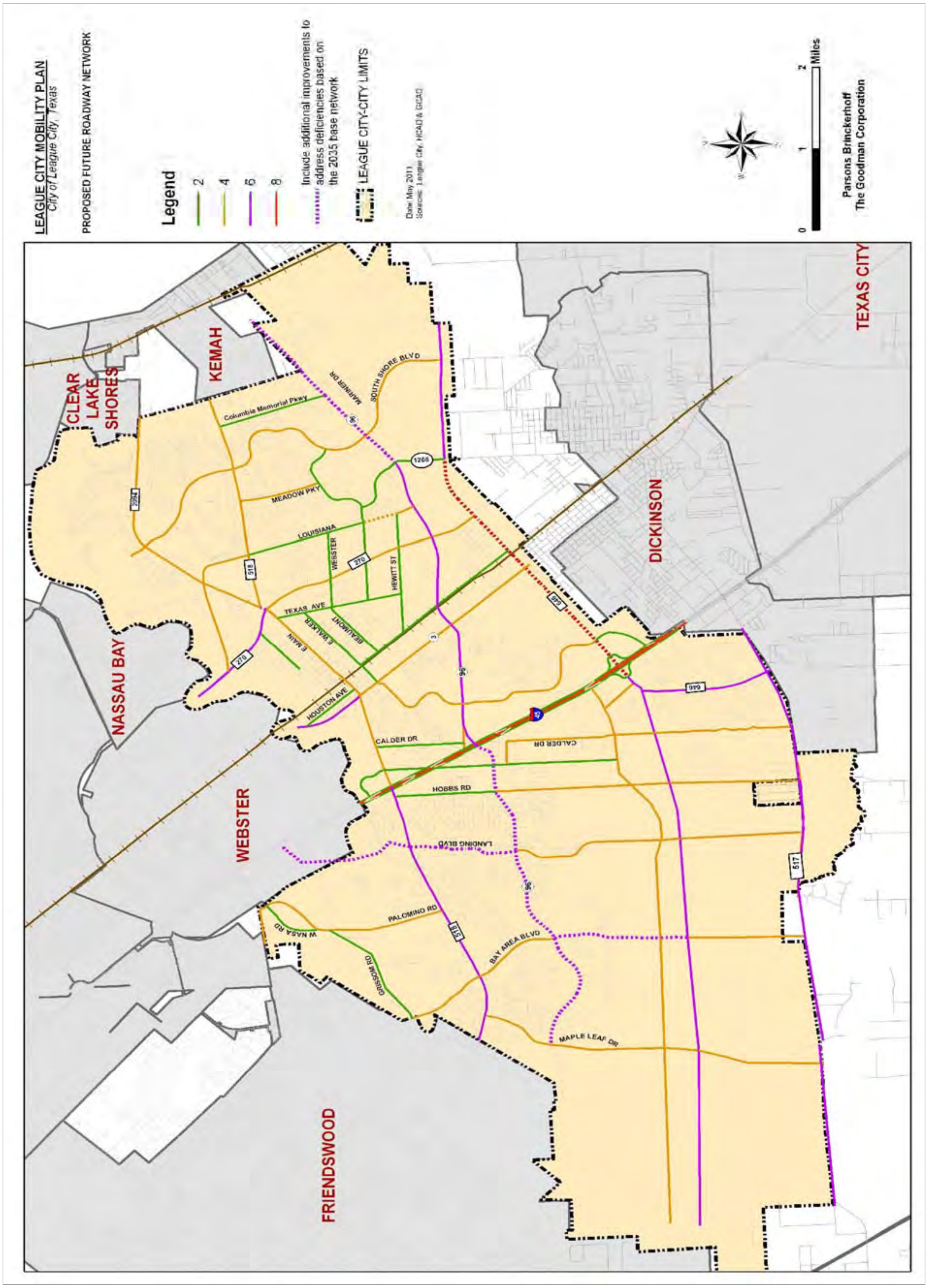
**The robust growth projected for League City over the next 25 years will lead to severe deficiencies in the operation of the roadway network.** League City has adopted Level of Service (LOS) "D" as the minimum standard for acceptable roadway performance.

Extensive analysis of the existing roadway network, its future functioning under projected growth conditions, and improvements needed to meet the LOS D standard have resulted in the 2035 future roadway network as shown in *Figure ES.1*.

## *MOBILITY RECOMMENDATIONS*

*Table ES.1* summarizes the multi-modal recommendations developed in the Master Mobility Plan, including estimated costs.

***Figure ES.1 – Proposed Future Roadway Network***



| ***Table ES.1 – Project Recommendations and Implementation Strategies*** | | | | | |
|---|---|---|---|---|---|
| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
| ***FM 518 Access Management (Raised Medians) From 2004 H-GAC FM 518 Access Mgt Plan; Costs are 2004 dollars*** | | | | | |
| Brookdale/Bay Area Blvd | 2012-13 | $103,200 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Royal-Hobbs/Lafayette to west of IH 45 | 2012-13 | $43,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| East of IH 45 to 40' east of Wesley | 2012-13 | $55,900 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Highland Dr | 2012-13 | $25,800 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Devereaux/Calder to Englewood | 2012-13 | $55,900 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Interurban | 2012-13 | $51,600 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| West City Limit | 2012-13 | $90,300 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Landing Blvd | 2012-13 | $25,800 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| ***FM 518 Access Mgt (Intersection Improvements) From 2004 H-GAC FM 518 Access Mgt Plan; Costs are 2004 dollars*** | | | | | |
| Bay Area Blvd | 2012-13 | $23,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Spring Landing/Palomino | 2012-13 | $18,500 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 2094 | 2012-13 | $5,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 2094 | 2012-13 | $680,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Landing Blvd | 2012-13 | $25,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Hobbs/Lafayette | 2012-13 | $55,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| IH 45 | 2012-13 | $140,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Interurban | 2012-13 | $25,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| SH 3 | 2012-13 | $95,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Texas | 2012-13 | $20,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| ***Traffic Operations Control Center*** | | | | | |
| Citywide | 2015 | $500,000 (Phase I) | Local or CMAQ | M | Not submitted for 2011-2014 TIP |
| ***Long-Term Roadway Improvements*** | | | | | |
| IH 45, btw north and south city limits, widen to 8-lane facility | 2015+ | $19,800,000 | STP-MM (80%) | M | |
| IH 45 frontage road, btw north and south city limits, widen to 2 lanes | 2015+ | $19,800,000 | STP-MM (80%) | H | |
| FM 518, btw west city limit and IH 45, widen to 6-lane major arterial | 2015+ | $8,100,000 | STP-MM (80%) | H | |
| FM 518 Bypass, btw FM 518 and FM 270, build as 4-lane bypass | 2015+ | $8,800,000 | STP-MM (80%) | H | |
| League City Pkwy, btw Maple Leaf Dr and Bay Area Blvd, widen to 4-lane major arterial | 2015+ | $3,600,000 | STP-MM (80%) | M | |
| League City Pkwy, btw IH 45 and FM 1266, widen to 6-lane major arterial | 2015+ | $8,200,000 | STP-MM (80%) | M | |

| Table ES.1 b – Project Recommendations and Implementation Strategies (Continued) | | | | | |
|---|---|---|---|---|---|
| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
| FM 646 W, btw FM 517 and IH 45, widen to 6-lane major arterial | 2015+ | $4,300,000 | STP-MM (80%) | M | |
| FM 646 E, btw IH 45 and east city limit, widen to 6-lane major arterial | 2015+ | $12,100,000 | STP-MM (80%) | H | |
| FM 517, btw west city limit and IH 45, widen to 6-lane major arterial | 2015+ | $32,600,000 | STP-MM (80%) | M | |
| FM 270, btw FM 518 and FM 646, widen to 4-lane major arterial | 2015+ | $5,700,000 | STP-MM (80%) | M | |
| SH 3, btw north city limit and FM 518, widen to 6-lane major arterial | 2015+ | $1,600,000 | STP-MM (80%) | M | |
| Proposed E-W corridor, btw west city limit and IH 45, build as 4-lane minor arterial | 2015+ | $16,600,000 | STP-MM (80%) | H | |
| Proposed E-W corridor (south), btw west city limit and IH 45, build as 6-lane major arterial | 2015+ | $23,900,000 | STP-MM (80%) | H | |
| Maple Leaf Dr, btw FM 518 and FM 517, widen to 4-lane minor arterial and extend to FM 517 | 2015+ | $9,200,000 | STP-MM (80%) | M | |
| Bay Area Blvd, btw SH 96 and FM 517, extend to FM 517 as 4-lane minor arterial | 2015+ | $5,500,000 | STP-MM (80%) | M | |
| Palomino Ln/Bridge, btw W NASA Rd and FM 518, widen to 4-lane minor arterial | 2015+ | $1,700,000 | STP-MM (80%) | H | |
| Landing Blvd, btw League City Pkwy and FM 517, widen and extend to FM 517 as 4-lane minor arterial | 2015+ | $7,800,000 | STP-MM (80%) | H | |
| Landing Bridge, btw FM 518 and IH 45, build as 4-lane bypass | 2015+ | $3,400,000 | STP-MM (80%) | M | |
| Hobbs Rd, btw League City Pkwy and FM 517, widen and upgrade to 4-lane minor arterial | 2015+ | $8,000,000 | STP-MM (80%) | M | |
| Calder Dr, btw IH 45 and FM 517, widen to 4-lane minor arterial | 2015+ | $7,700,000 | STP-MM (80%) | M | |
| Butler Rd, btw IH 45 and proposed E-W corridor, build as 2-lane collector | 2015+ | $1,300,000 | STP-MM (80%) | M | |
| W Walker St, btw SH 3 and League City Pkwy, widen to 4-lane minor arterial | 2015+ | $1,400,000 | STP-MM (80%) | M | |
| W Walker St, btw end of subdivision and IH 45, extend as 2-lane collector | 2015+ | $400,000 | STP-MM (80%) | M | |
| South Shore Blvd, btw end of subdivision and FM 646, widen to 4-lane major arterial | 2015+ | $1,100,000 | STP-MM (80%) | M | |

*Table ES.1 c – Project Recommendations and Implementation Strategies (Continued)*

| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
|---|---|---|---|---|---|
| League City Pkwy, btw Maple Leaf Dr and IH 45, widen to 6-lane major arterial | 2015+ | $9,600,000 | STP-MM (80%) | H | |
| League City Pkwy E, btw FM 1266 and east city limit, widen to 6-lane major arterial | 2015+ | $5,700,000 | STP-MM (80%) | M | |
| SH 96 direct connectors, NB to EB and EB to SB, build two direct connectors, 1 lane each direction | 2015+ | $40,000,000 | STP-MM (80%) | M | |
| FM 646 E, btw IH 45 and FM 1266, widen to 8-lane major arterial | 2015+ | $9,300,000 | STP-MM (80%) | H | |
| Bay Area Blvd, btw League City Pkwy and proposed E-W corridor (south), widen to 6-lane minor arterial | 2015+ | $1,800,000 | STP-MM (80%) | M | |
| Landing Bridge/Blvd, btw IH 45 and League City Pkwy, widen to 6-lane minor arterial | 2015+ | $2,900,000 | STP-MM (80%) | H | |
| Louisiana St, btw Austin St and Hewitt St, widen to 4-lane minor arterial | 2015+ | $500,000 | STP-MM (80%) | M | |
| ***Transit Recommendations*** | | | | | |
| Local Flex Service Vehicle Acquisition | 2012 | $500,000 | 5307 Formula Funds | M | 80% Federal cost eligible through GCTD/GCC |
| Local Flex Service Operations btw South Shore Marina Complex, Historic District, City Hall | 2013 | $312,000 | 1st 3 yrs CMAQ (Pilot Proj); 5307 CCC after Yr3 | M | Yr 1 under CMAQ, City share approximately $53,000; by Yr 4 Transition to 5307 CCC, City share estimated at $140,00 annually |
| SH 3 Intercity Connector (Bus) | 2013-14 | LC Share TBD | 1st 3 yrs CMAQ | M | Project would be interlocal partnership between cities, GCC/Connect Transit, and GCTD |
| Regional Bus Victory Lakes P&R Capital Facility (SB) | 2011 | $4,200,000 | ARRA; 5309 Discretionary | H | Capital Facility construction in 2011 |
| Regional Bus Victory Lakes P&R Service (SB) | 2012 | LC share $60,000 - $100,000 Annually | 1st 3 yrs CMAQ (Pilot Proj), or JARC | H | Service to begin late 2011/early 2012 |
| Regional Bus RiverBend or other P&R site TBD (NB) | 2014 | TBD | 5309 Discretionary; CMAQ | M | RiverBend recommended in site selection analysis by GCC/Connect Transit; however, no agreement on property has been reached |

| Table ES.1 d – Project Recommendations and Implementation Strategies (Continued) | | | | | |
|---|---|---|---|---|---|
| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
| ***Pedestrian Improvements*** | | | | | |
| FM 518 Streetscape Improvements (Five Corners to SH 3) | 2013 | $4,700,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 518 Streetscape Improvements (SH 3 to IH 45) | 2015 | $3,642,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| FM 518 Streetscape Improvements (IH 45 to Landing Blvd) | 2015 | $2,304,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| SH 3 Streetscape (Walker to FM 518) | 2015 | $831,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| SH 3 Streetscape (FM 518 to Walter Hall Park) | 2014 | $1,506,000 | Local | M | Not submitted for 2011-2014 TIP |
| FM 2094 (South Side only, Twin Oaks to S. Compass Rose) | 2013 | $1,275,000 | Local | M | Not submitted for 2011-2014 TIP |
| ***Bicycle*** | | | | | |
| FM 270 to Sportsplex | 2012-13 | $296,240 | CMAQ or Local | H | Project could be advanced to 2011 if City pursues with 100% local funds and City crews |
| ***Marine Transportation/Water Taxi*** | | | | | |
| | 2015 | $250,000 - $500,000 annually | Local | L to M | Initial weekend service pilot project (turnkey contract with local boat operator) |

# Chapter 1 – CONTEXT

## *PURPOSE*

League City is a rapidly growing community within a growing region. This growth has led to increased traffic congestion and other mobility challenges that degrade the city's overall quality of life. These issues are becoming a liability to the city's continued growth and attractiveness. Consequently, this League City Master Mobility Plan has been developed in an attempt to address the problems directly and proactively. Purposes of this plan are as follows:

1. Identify the factors that have contributed to the current situation, and
2. Present an actionable strategy for improving mobility throughout the city.

While the City has undertaken transportation planning in the past, this master mobility plan is unique in that it is the City's first truly multimodal plan. That is, this plan takes a comprehensive look at all viable transportation options (or modes) available to the city. Previous plans have focused almost exclusively on the roadway network and ways to facilitate the movement of automobiles. To be sure, this master mobility plan recognizes that the automobile is the predominant means of travel in League City and will continue to be in the future. As such, this plan carefully assesses the current state of the roadway network and makes recommendations concerning improving traffic flow in the city. However, this plan also presents options for creating a more balanced spectrum of mobility choices. A highly functioning transportation network offers residents alternatives to automobile travel that are easy to access, safe, efficient, and interconnected. Therefore, in addition to the roadway network, this master mobility plan also examines the pedestrian network, bicycle lanes, shared use paths (i.e., hike & bike trails), commuter rail, regional bus transit (park & ride), local bus transit, and marine transportation.

This League City Master Mobility Plan is meant to serve as a step-by-step implementation tool for improving traffic flow, increasing transportation choices, and converting the city's transportation infrastructure from a liability to a functional, enviable asset.

## *CURRENT SITUATION AND CONTRIBUTING FACTORS*

The traffic situation in League City cannot be attributed to random events. Rather, it is due in large part to conscious choices made by city leadership (elected and staff) over many years. In many cases these choices have been facilitated by the actions of developers and reinforced by the desires of residents.

Specifically, League City has **chosen** to:

- Develop as a **"bedroom" community** with limited jobs and a small (but growing) retail base.
  - Few jobs and the city's nearly equidistant location between Houston and Galveston mean a high number of commuters and bi-directional commute patterns.
  - Few opportunities for shopping, entertainment, and other services mean residents must make many trips outside the city to meet their needs.

- Develop with land use patterns and densities that force almost **exclusive dependence on the automobile** for mobility.
- Develop in a manner that relies on a **limited number of arterials** that traverse the community.
- **Sacrifice true connectivity** that could serve to better disperse vehicle traffic.
- Allow roadway design that focuses exclusively on increasing **convenient access to each site and moving cars through the city as quickly as possible.**

The result of these choices is a system of roads that has the following characteristics:

- **Congested and failing** at the most critical (commute) times, and **underutilized and fast** at any other time.
- Extensive on a per capita basis (i.e., miles of road per resident), but consequently **expensive to maintain.**

The first step in successfully reducing congestion will be a paradigm shift in the way city leaders, developers, and residents shape future growth and development patterns in League City. This master mobility plan will address many of the ways in which this might be accomplished, including evolving into a community that is less auto-dependent and offers citizens greater choice. *Table 1.1* highlights some of the differences between auto dependency and multimodalism, across a number of factors.

***Table 1.1 – Characteristics of Automobile Dependency Versus Multimodal Transportation***

| ***Factor*** | ***Automobile Dependency*** | ***Multimodalism*** |
|---|---|---|
| Vehicle ownership | High per capita ownership rate | Medium per capita ownership rate |
| Vehicle travel | High per capita mileage | Medium to low per capita mileage |
| Land use density | Low. Destinations are dispersed | Medium. Destinations are clustered |
| Land use mix | Single-use development patterns | More mixed-use development |
| Land for transportation | Large amounts of land devoted to roads and parking | Medium amounts devoted to roads and parking |
| Road design | Emphasizes automobile traffic | Supports multiple modes and users |
| Street scale | Large scale streets and blocks. | Small to medium streets and blocks |
| Traffic speeds | Maximum traffic speeds | Lower traffic speeds |
| Walking | Mainly in private malls | Mainly on public streets |
| Signage | Large scale, for high-speed traffic | Medium scale, for lower-speed traffic |
| Parking | Generous supply, free | Moderate supply, some pricing |
| Site design | Parking paramount, in front of buildings | Parking sometimes behind buildings |
| Planning practices | Non-drivers are a small minority with little political influence | Planning places high value on modal diversity |
| Social expectations | Non-drivers are stigmatized and their needs given little consideration | Non-drivers are not stigmatized and their needs are considered |

***Source:*** *Introduction to Multi-Modal Transportation Planning,* Victoria Transport Policy Institute, Sep 2009.

## *PUBLIC FRUSTRATION*

A web survey conducted during the development of this master mobility plan received a total of 132 responses. The traffic-induced frustration some residents are experiencing is evident through many of the comments expressed, including the representative sample below:

> "We simply CANNOT GET ANYWHERE in League City unless we go at a very off time. Who can go to the park at 11pm or to the library at 11am? We actually feel very trapped. Because of the horrid League City traffic, we do not do anything in League City; we go elsewhere IF we can get to the freeway. And also because of the traffic, we plan to move away from League City after living here for over 25 years."

> "Traffic has grown exponentially worse since I moved here 17 years ago."

> "…east-west congestion is ridiculous and is causing my family to consider moving from League City."

> "I don't leave my house from 3:00 p.m. until 7:00 p.m. unless [it's an] emergency - can't drive anywhere, too congested!"

Some comments also show a desire for greater transportation choice:

> "To be a quality city, League City needs to address the lack of running/biking/walking trails and their ability to interconnect throughout the city."

> "…the idea of marine transit is very appealing and unique…"

> "Installing sidewalks would make neighborhoods more pedestrian friendly."

> "Bicycling is a good way to get around the area if there were lanes/trails to use."

> "Most interested in commuter rail project."

> "A public bus system that goes to Baybrook Mall for shopping and to the Bay Area park & ride."

This sample of comments makes it clear that mobility is indeed a quality of life issue for residents and, for some, one that is dire enough to make them consider leaving League City altogether. It also is apparent that there is unmet demand for greater choice in getting around League City.

## *PAST AND FUTURE POPULATION GROWTH*

As population has increased in League City and the provision of roadways has not kept pace, traffic congestion has steadily worsened. Over the past 20 years, League City has experienced an annual growth rate of 4% to 6%. This is as compared to an annual growth rate in Houston of approximately 2.77%, and 2.08% for the State of Texas.[1]

The 2000 Census reported a League City population of 45,444 persons. The 2010 Census reports the city's current population to be 83,560 persons. This represents a staggering 84% population increase in one decade, and makes League City the most populous city in Galveston County.

By 2025, League City's population is projected to grow to approximately 138,000 persons.[2]

## *MEANS OF TRANSPORTATION*

The increase in traffic that has come with League City's growth is not at all surprising, given residents' high rates of automobile ownership and propensity to commute alone in a private vehicle. Approximately 98% of League City households own at least one vehicle, with 71% owning two or more vehicles.[3] *Table 1.2* presents the means of transportation to work for League City workers age 16 and over.

***Table 1.2 – Means of Transportation to Work***

| ***Transport Mode*** | ***Percentage*** |
|---|---|
| Drive Alone | 83.4% |
| Car Pool | 10.1% |
| Public Transportation | 0.8% |
| Walk | 1.0% |
| Motorcycle | 0.4% |
| Bicycle | 0.4% |
| Other Means | 1.6% |
| Work from Home | 2.4% |

***Source:*** 2006-2008 American Community Survey (U.S. Census).

## *LAND USE*

**There is an extremely important relationship between transportation and land use that must be considered whenever decisions are being made that affect either realm.** In short, smart land use patterns can promote efficient use of the transportation network and serve to reduce vehicle trips. Poor land use patterns, on the other hand, can stress the transportation network by forcing added and longer vehicle trips. The pivotal question is, what is the difference between "smart" and "poor" land use

[1] City of League City Economic Development Corporation.
[2] 2010 League City Comprehensive Plan.
[3] 2006-2008 American Community Survey (U.S. Census Bureau).

patterns, and how exactly do they influence traffic flow? The answer to this question is multi-faceted, but the bottom line involves the hugely significant concepts of **density and mix.**

**Density is the number of people, homes, or jobs per unit of land area.** Moderate- to high-density areas have a greater number of potential destinations within a given radius than do lower density areas. This concentration of destinations reduces travel distances and the need to travel by automobile. Research confirms that total Vehicle-Miles Traveled (VMT) within a given area decreases as density increases.[4] Moderate to high densities can also provide the efficiencies needed to support public transit service. Conversely, low-density development is characterized by land uses that are spread apart. These land uses tend to be on large lots with excessive amounts of parking. Such development can make walking, biking, or other non-car travel virtually impossible. Because of the amount of land it consumes, low-density development is also difficult and expensive to serve with roads and other infrastructure such as water and sewer.

Two other outcomes that commonly result from higher-density development are slower traffic speeds and a reduced supply of parking. These conditions make driving less attractive because they can actually increase congestion.[5] However, increased congestion is not always a bad thing, if it occurs in an area where alternatives to automobile travel are readily available, easy to use, and safe. In particular, the foot traffic in a high-density area with a strong pedestrian network can foster a vibrant "sense of place" and also contribute significantly to economic sustainability. Thus, even though high density can make driving more difficult, this disincentive to driving may be exactly the desired outcome in specifically chosen areas of the city. In these areas, the net benefits of higher density development can be more important than the simple objective of moving as many cars through as quickly as possible.

**Mix refers to the degree to which differing land uses (e.g., residential, commercial, recreational) are located in close proximity to one another.** The key to a well-functioning mix is that the land uses be interactive and complementary. Mixed uses can occur at various scales, such as mixing within a building (e.g., ground floor retail with offices and/or residential above), along a street, or within a neighborhood. Master planned "mixed-use developments" also are becoming increasingly common nationwide. Such developments typically are compact, walkable centers that are internally connected via streets and a pedestrian network, and that minimize parking requirements by creating shared parking opportunities among the various land uses. Such developments often strive to adhere to the "live/work/play" paradigm (i.e., a location that offers residential, job, and entertainment opportunities with minimal need for an automobile to move among them).

[4] "Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior," Victoria Transport Policy Institute, Aug 2009.
[5] "Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior," Victoria Transport Policy Institute, Aug 2009.

As with increased density, mixed-use development decreases vehicle trips and overall VMT by reducing travel distances and increasing the opportunities for walking and bicycling trips. Indeed, mixed-use development offers many of the same advantages as high-density development, with the added bonus of an even higher potential for "internal trip capture." Internal capture refers to trips that take place within a mixed-use development or mixed use area that would have otherwise required a longer trip outside the area to accomplish the same purpose. *Figure 1.1* illustrates an example of such a development. Because mixed-use development includes differing but complementary land uses that are very near one another, the ability to "park once" and complete multiple tasks without getting back in the car is heightened. According to the Institute of Transportation Engineers, automobile trips within a mixed-use development with a well-integrated pedestrian network can be reduced by 10% to 25%, depending on the array of land uses.

***Figure 1.1 – Internal Trip Capture within Mixed-Use Development***


### *TRANSPORTATION NETWORK*

The degree to which the overall transportation network functions well and meets the needs of users is related to many factors such as safety, cost, efficiency, convenience, and travel time, among others. In the case of League City's network, there are three factors that are particularly relevant and warrant close consideration. These are **mode choice, connectivity, and access management.**

**Mode choice refers to the extent to which users have multiple transportation options available to them for a given trip.** For instance, mode choice is good when a particular trip could be made safely and efficiently by car, foot, bicycle, or transit. If the same trip could only feasibly be made by car, then mode choice is poor.

Central to mode choice is the notion of the "complete street." **A complete street is defined as one that is designed and operated to enable safe access for all users.**[6] While streets are most often thought of as conduits for the movement of cars, communities that embrace complete streets recognize that all travelers – drivers, pedestrians, bicyclists, transit users, etc. – can and should be safely accommodated within the public right-of-way. Complete streets also make provisions for travelers with special needs, such as the elderly, disabled, and children. Examples of features that might be found on a complete street include, but are not limited to, the following:

[6] National Complete Streets Coalition, www.completestreets.org, 2010.

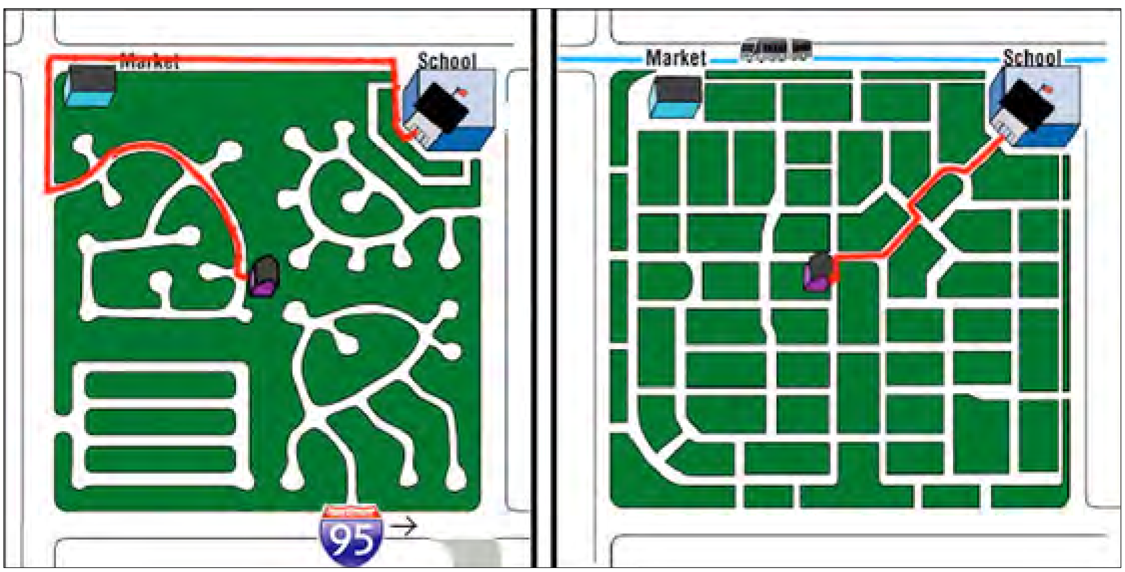
- Sidewalks
- Bike lanes (or wide paved shoulders)
- Exclusive bus lanes
- Crosswalks
- Comfortable and accessible transit stops
- Wheelchair ramps
- Median islands
- Curb extensions

A description of the benefits to be gained through complete streets is presented in *Table 1.3*.

| ***Table 1.3 – Benefits of Complete Streets*** | |
|---|---|
| Congestion Mitigation | Streets that provide good mode choice can give people the option to avoid traffic jams, and increase the overall capacity of the transportation network. |
| Personal Transportation Cost Savings | Complete streets can reduce gas costs by reducing auto trips. Nearly half of all trips in metropolitan areas are three miles or less, and 28% are one mile or less, distances easily covered by foot or bicycle. Yet, 65% of trips under one mile are made by car, in large part because incomplete streets make it dangerous or unpleasant to walk, bicycle, or take public transportation. |
| Infrastructure Cost Savings | Integrating sidewalks, bike lanes, transit amenities, and safe crossings into the initial design of a project spares the expense of retrofits later. |
| Improved Safety | Crashes are reduced through safety improvements. One study found that designing for pedestrian travel by installing raised medians and redesigning intersections and sidewalks reduced pedestrian risk by 28%. |
| Benefits to Transit Service and Users | Complete streets policies help create the safe and comfortable transit stops and smooth predictable transit trips that help make public transportation an attractive option. |
| Economic Development | A balanced transportation system that includes complete streets can bolster economic growth and stability by providing accessible and efficient connections between residences, schools, parks, public transportation, offices, and retail destinations. |
| Air Quality Benefits | Complete streets allow for the reduction of automobile trips, which reduces auto emissions and air pollution. If each resident of an American community of 100,000 replaced one auto trip with one bike trip just once a month, it would cut carbon dioxide ($CO_2$) emissions by 3,764 tons per year in the community. |
| Social and Health Benefits | Complete streets help to provide the elderly, disabled, and children with independence and safe travel options. They also encourage walking and bicycling, which increases the activity level and health of community members. |
| ***Source:*** *National Complete Streets Coalition,* www.completestreets.org, 2010. | |

**Connectivity is the degree to which a road or path system is connected.** Being well connected or poorly connected is integral to the directness of travel between destinations.[7] *Figure 1.2*[8] clearly demonstrates this concept. On the left is a development pattern typical of many suburban communities today, including League City. The hierarchical road network with many cul-de-sacs and dead end streets feeds all traffic onto a few arterials (e.g., FM 518), and makes a trip between home and school, for instance, much longer than it should be. The right half of *Figure 1.2* shows the alternative – a well-connected street grid that offers a much shorter and more direct path between the home and the school. In addition to making trips shorter and faster, well-connected street grids also serve to disperse traffic by giving drivers many options for getting from point A to point B, rather than one or two main routes that are being shared by everyone. Connectivity also applies equally to walking and bicycling paths. Well-connected pedestrian and bicycle routes can offer the added benefit of providing shortcuts that make walking and biking more direct than driving.

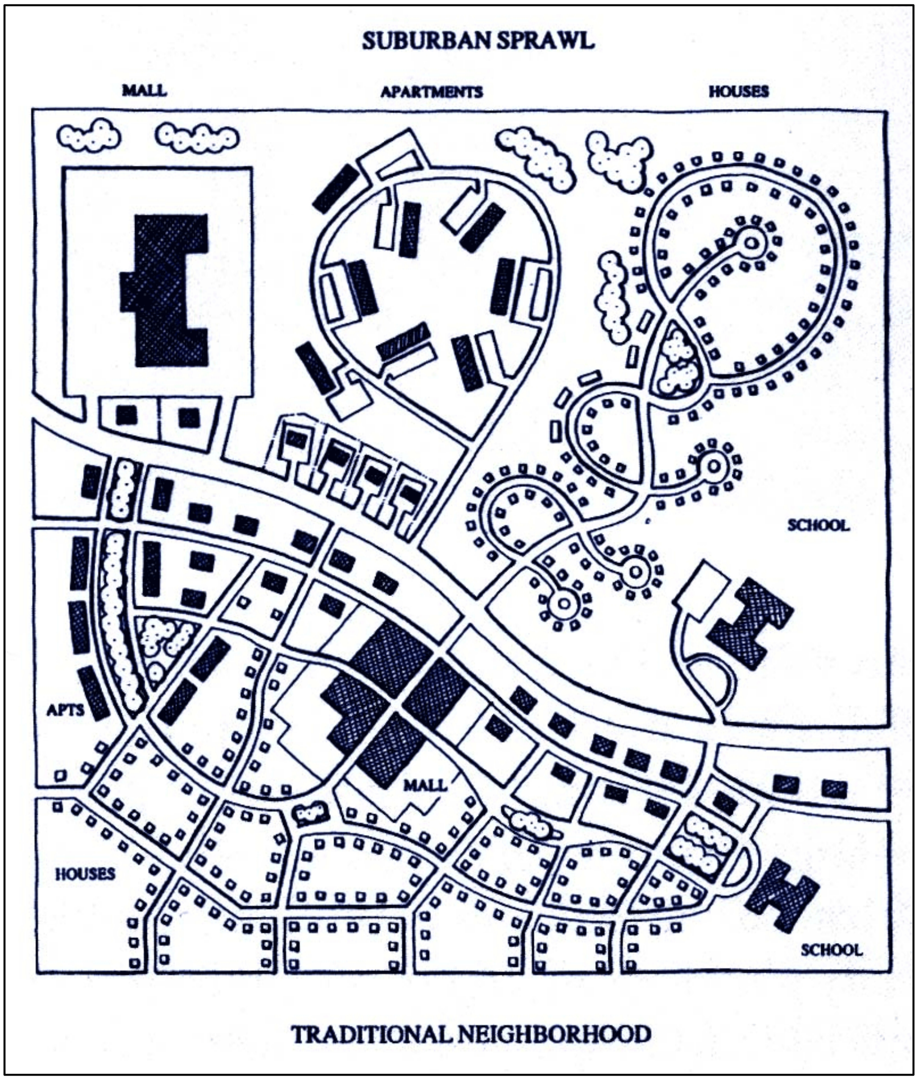
***Figure 1.2 – Poor Connectivity (left) Versus Good Connectivity (right)***




[7] *Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior*, Victoria Transport Policy Institute, Aug 2009.
[8] Matthew Yglesias, http://yglesias.thinkprogress.org, Mar 2009.

*Figure 1.3*[9] presents another representation of the connectivity differences between typical suburban development and the more well-connected development of traditional neighborhoods, specifically with respect to how land uses can be better integrated when supported by a well-connected street grid.

***Figure 1.3 – Connectivity in Suburban Development Versus Traditional Neighborhood***




A lack of connectivity is undoubtedly one of League City's biggest mobility problems. Residential builders have been allowed to develop without regard for the City's adopted *2010 Master Transportation Plan* (MTP) and the Proposed Major Roadway Network from the *2025 Comprehensive Plan*, both of which call for adequate and strategically placed roadways built in conjunction with residential development in order to meet the travel demand created by the new housing. This disregard

9 *Suburban Nation*, Andres Duany, Elizabeth Plater-Zyberk, and Jeff Speck, 2001.

for mobility concerns has resulted in an abundance of cul-de-sac subdivisions with primarily one way in and one way out. Adjacent subdivisions also are not connected to one another, which forces travelers to take circuitous routes in order to move between subdivisions. These conditions serve to further burden the city's already inadequate major arterials.

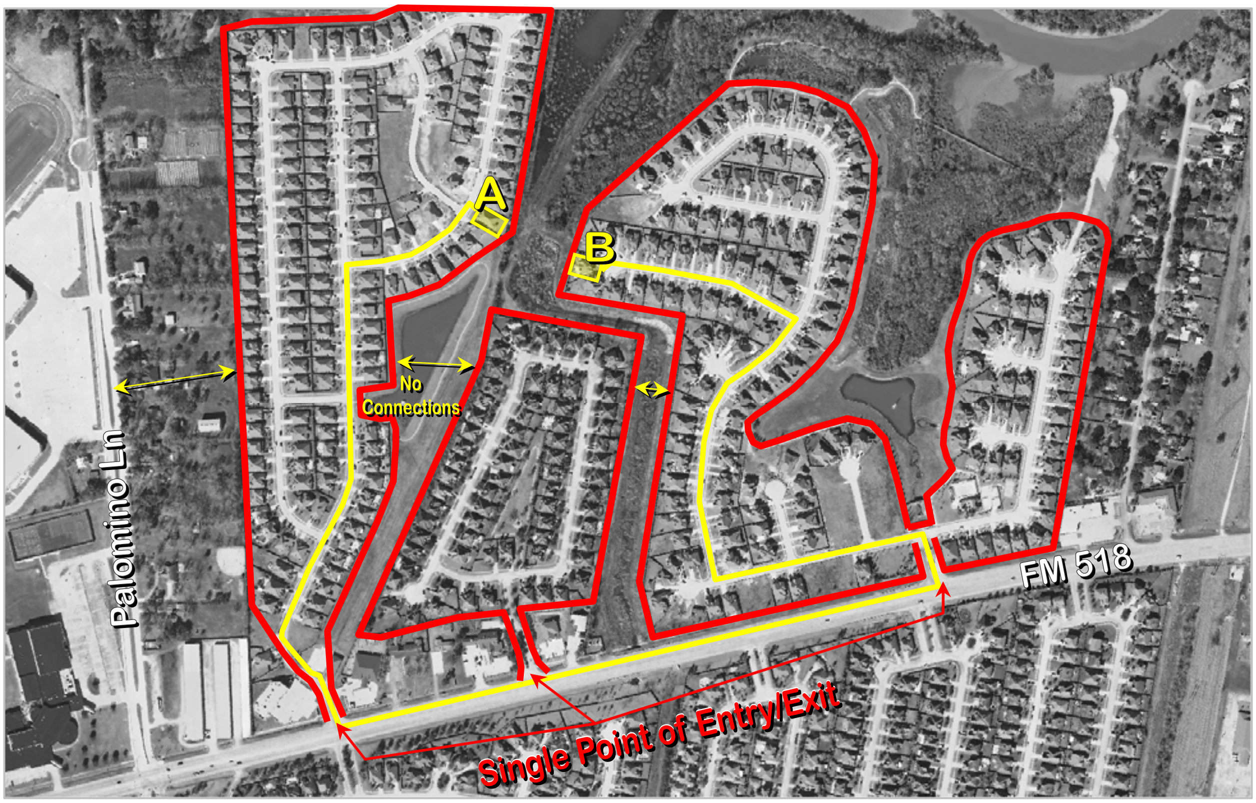
The situation is starkly illustrated by comparing *Figure 1.4* and *Figure 1.5*. *Figure 1.4* shows a portion of the League City Historic District, characterized by a nearly perfect street grid. The network of numerous parallel north-south and east-west streets offers an almost infinite number of paths for traveling from one point in the district to another. **This is excellent connectivity that serves to minimize congestion along any given path.**

***Figure 1.4 – Good Historic Streets***

*Figure 1.5*, conversely, is typical of most of the newer residential development in the city. Shown are three subdivision "pods" located along FM 518, west of IH 45. Each of these pods has a single point of entry/exit, all depositing travelers on to FM 518. Furthermore, the pods themselves have no connection points between them, which means neighbors in adjacent pods have to exit their neighborhood, travel on FM 518, and then enter the adjacent neighborhood. As an example, consider a resident of house "A" who wants to visit a resident of house "B." As the crow flies, these two homes are approximately 420 feet apart, or less than one-tenth of a mile. However, without a direct connection (roadway, pedestrian, or bicycle), this visit requires a trip of approximately a mile and a half, including nearly a half-mile on FM 518. **Thus, lack of connectivity increases the length of this trip nearly twenty-fold.**

It is also worth noting that the campuses of Creekside Intermediate School and Clear Springs High School can be seen along the western edge of this photo, and there are no connections (other than FM 518) between the residential subdivision and these important land uses.

***Figure 1.5 – Single Point of Entry/Exit***



Under these circumstances, it is readily apparent why traffic congestion is so acute along FM 518. **When residents of these poorly-connected subdivisions need to travel anywhere beyond their immediate neighborhood, they have no choice but to use FM 518 because that is where the road network funnels them to, and there are no other options.** TxDOT access management policies on FM 518 west of Hobbs Road also play a role in subdivision access from the artery. Similar examples of these kinds of problems can be found along the city's other major arteries as well.

**Access management is the process of coordinating roadway design and land use for the purpose of improving transportation.**[10] More specifically, it is the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections. It also includes roadway design treatments such as medians and auxiliary lanes, and the appropriate spacing of traffic signals.[11]

*Access* refers to the ability to reach a particular destination, e.g., a business or residence. This is differentiated from the concept of *mobility*, which refers to the movement of automobiles, typically as quickly and efficiently as possible. Roadway access points are those locations such as driveways and median openings that allow drivers to get to their final destination. Generally speaking, roadways with greater access tend to have decreased mobility and vice versa, as shown in *Figure 1.6*.[12] This is because of the deceleration and turning movements associated with accessing destinations, and also because each access point represents a potential conflict between through traffic and traffic using that access.

**One of the most important objectives of access management is to improve safety through the reduction of conflict points.** These are points where collisions are most likely to occur as drivers execute turning and crossing movements. *Figure 1.7*[13] shows the types of movements that result in traffic conflict points.

***Figure 1.6 – Mobility Versus Access***

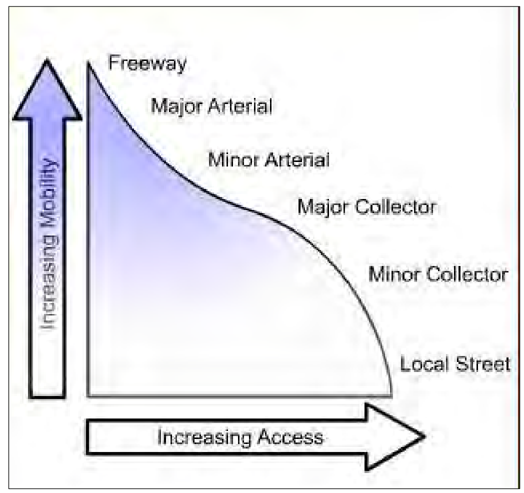
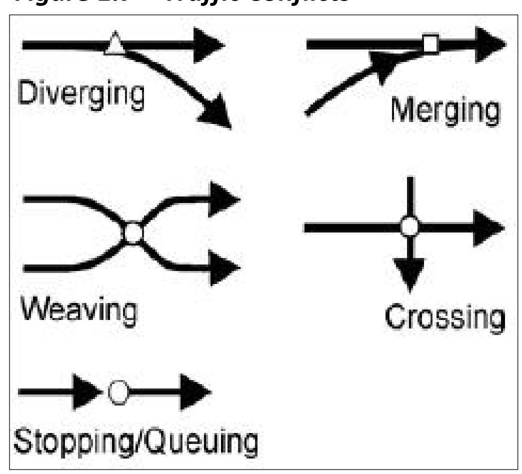



***Figure 1.7 – Traffic Conflicts***




[10] TDM Encyclopedia, Victoria Transport Policy Institute, www.vtpi.org, 2010.
[11] Transportation Research Board (TRB) Committee AHB70 (Access Management), www.accessmanagement.info, 2010.
[12] TRB Committee AHB70 (Access Management), www.accessmanagement.info, 2010.
[13] "Safe Access is Good for Business," Federal Highway Administration, Aug 2006.

A national study looked at nearly 40,000 crashes to determine the crash rate associated with adding access points to major roads. It found that an increase from 10 to 20 access points per mile on major arterial roads increases the crash rate by approximately 30 percent.[14] **The crash rate continues to increase as more access is permitted.**

Inadequate access management is associated with the following adverse social, economic, and environmental impacts:[15]

- An increase in vehicular crashes
- More collisions involving pedestrians and cyclists
- Accelerated reduction in roadway efficiency
- Unsightly commercial strip development
- Degradation of scenic landscapes
- More cut-through traffic in residential areas due to overburdened arterials
- Homes and businesses adversely impacted by a continuous cycle of widening roads
- Increased commute times, fuel consumption, and vehicular emissions as numerous driveways and traffic signals intensify congestion and delays along major roads

The appropriate use of access management techniques on key roadways in League City (e.g., FM 518) will be discussed in detail in Chapter 6, *Roadway Network Recommendations*.

## *JOBS/HOUSING BALANCE*

**Travel impact and congestion levels vary with trip purpose.** Trips for shopping and recreation represent nearly half of all trips and about a third of travel mileage, whereas commuting trips represent only about 15% of local trips and about 18% of local mileage. However, commuting trips contribute to congestion to a much larger degree because they tend to be clustered in the peak hour, while shopping and recreation trips usually occur at off-peak times.[16]

Land use and network improvements that address such things as density, mix, mode choice, and connectivity will serve to reduce automobile trips, as previously discussed. However, the trips most often eliminated by these types of improvements are shopping, recreational, and other non-commute trips. These trip reductions result in decreased energy consumption, pollution emissions, and accident risk, but have less impact on traffic congestion. To address congestion other strategies that specifically target commute trips must be employed. Such strategies can include improved regional accessibility and transit availability. Perhaps the most direct and effective strategy, however, is to eliminate some commutes altogether. This is done by developing a better jobs/housing balance.

[14] "Safe Access is Good for Business," Federal Highway Administration, Aug 2006.
[15] TRB Committee AHB70 (Access Management), www.accessmanagement.info, 2010.
[16] *Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior*, Victoria Transport Policy Institute, Aug 2009.

**The jobs/housing balance refers to the ratio between the number of available jobs in a particular geographic area and the number of households in that same area.** As previously mentioned, League City fits the mold of a "bedroom" community in which more residents work outside the city than within it. This commuting exodus from League City in the morning and influx in the evening results in the tremendous peak-hour congestion League City is currently experiencing. Currently, there are approximately 14,500 jobs in League City.[17] With 25,602 households,[18] League City has a jobs/housing ratio of approximately 0.57 jobs per household. An area is typically considered to be "balanced" when it has a jobs/housing ratio somewhere between 1.3 and 1.7 jobs per household.[19] Therefore, League City is far from balanced. Another 20,000 jobs would go a long way toward significantly reducing commute-induced traffic congestion. A more detailed discussion of strategies for improving the jobs/housing balance in League City can be found in the City's recently completed *2035 Comprehensive Plan*.

## *LEAGUE CITY TRANSPORTATION PLANNING HISTORY*

Several relevant transportation plans have been developed by the City and other entities in the past. Each is discussed below.

**1992** – The City contracted for and adopted the *2010 Master Transportation Plan*. The MTP included an inventory and evaluation of existing roadways, as well as a summary of roadway improvements needed to meet growth forecasts for the area. Transportation policies were largely limited to roadway design. Five amendments were made to the MTP between 1998 and 2005.

**2002** – The Gulf Coast Center (a social services provider for Galveston County) contracted for the *Mobility Plan Update for League City*. The update was not formally approved by City Council; however, it provided a new reference tool for staff that included regional information, updates to traffic analyses, enhanced growth forecasts, and an updated list of short and long range transportation improvements. Equally important, the study expanded beyond discussion of roadways to include discussion of transit and park and ride service, as well as limited discussion of hike & bike trails.

**2004** – The City adopted the *2025 Comprehensive Plan*, which added limited transportation policies related to traffic impact analysis, signal progression, and access management. The comprehensive plan also included an updated map of the Proposed Major Roadway Network.

**2004** – The City adopted the *FM 518 Corridor Access Management Plan*, a TxDOT-sponsored plan.

**2006** – The City adopted the *Parks and Open Space Master Plan*. The plan recommended a "Trail System Concept."

**2008** – City staff initiated the *Main Street Strategic Plan* in an ongoing effort to improve the area surrounding the FM 518 Corridor, including the original village known as the Historic District. Recommendations will include mobility improvements.

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[17] City of League City.
[18] 2006-2008 American Community Survey, U.S. Census Bureau.
[19] *Best Development Practices: A Primer for Smart Growth*, Reid Ewing, 1996.

**2010** – The City adopted the *Trails Master Plan.* The plan recommended a 212-mile network of off-road trails and shared-use paths throughout League City.

As part of the process of this master mobility plan, these and other previous plans were studied and their recommendations factored into the updated recommendations now being made. In addition, plans that were developed concurrently with this master mobility plan (i.e., *Main Street Strategic Plan*, *Trails Master Plan*) have been coordinated with this plan to the maximum extent possible.

### *PLAN FRAMEWORK*

In addition to being multimodal, the development of this master mobility plan represents a departure from prior League City transportation plans in two key ways. The first is the recognition of the pivotal relationship between land use and transportation, as previously discussed. The second is the extensive integration of modeling tools. Specifically, a land use model and a travel demand model were used in concert with one another to demonstrate potential mobility conditions in League City under four different growth scenarios for the year 2035. The growth scenarios each assumed a different land use pattern for future development and redevelopment in League City. The growth scenarios developed by the land use model then were input into the travel demand model. The travel demand model then shows expected levels of congestion on League City's major arterials, if a particular growth scenario were to occur.

With input from the public during the development of the Comprehensive Plan, one of the four scenarios was selected as the "Preferred Growth Scenario." Additional details about the preferred scenario can be found in Chapter 5.

The land use and travel demand modeling results have been factored into the recommendations in this master mobility plan. These data represent insight that has not been available in previous plans. The intent of their inclusion is to develop the best, most relevant recommendations possible. Also, this plan's framework has been designed to help the City make the most informed decisions possible and maximize the chances of success when the recommendations are implemented.

### *PLAN GOALS*

Via public input and stakeholder interviews, several "guiding principles" were established, which serve as the overarching goals for the development of this master mobility plan. These guiding principles are being used to create a transportation network for League City that meets the following objectives:

**Efficiently and safely moves people and goods.** The experience of traveling within or through the community will be judged based upon a number of criteria. Foremost is that all of League City's residents and guests should feel safe while traveling, regardless of whether the trip is by car, bike, foot, kayak, or golf cart. In addition to safety, both residents and guests should expect to be able to travel through the community in a manner that is cost-effective, time sensitive, and convenient to the fullest extent practical.

**Connects destinations.** League City residents and business owners should be fully comfortable stating "you can get **there** from **here**." Consideration of connectivity begins at the front door of the place of departure (such as home) and ends at the front door of the destination (such as the park). It is an issue of safety, convenience, and time. Increased connectivity can have a positive impact on traffic congestion, the timely arrival of emergency services, or simply to allow a child to meet friends at the neighborhood pool.

**Offers travel options.** As Americans, we expect the right to choose between options. Residents and guests of League City deserve the ability to choose from a variety of routes when traveling in or through the community. At the same time, they should also expect the opportunity to choose among "modes." Commuters should be able to choose between traveling by car or transit, including commuter rail. On the other hand, they should also expect to find other options equally attractive, including walking, biking, or another local (and environmentally appropriate) favorite – golf carts.

**Respects and enhances context and character.** Moving people and goods within and through League City is critical but it should not come at a cost to the character of the community. The wrong improvements within the right-of-way can have devastating effects upon the viability of a neighborhood, commercial area, or environmental habitat. On the other hand, a well designed street, sidewalk, or trail with the right mix of amenities can have a powerful impact on the desirability and usefulness of an area.

**Adds to community marketability.** First impressions and some of the most lasting impressions of League City are most often made from the roadway, sidewalk, or parking lot. The experiences of residents and guests to the community do have an impact on decisions about investing in League City. Decisions made regarding improvements to the mobility network should give strong consideration to both economic and fiscal impact (both short and long term).

# Chapter 2 – GENERAL MOBILITY ASSESSMENT: ROADWAY NETWORK

## *LEAGUE CITY MOBILITY OPTIONS: ROADWAYS AND MORE*

The first step in developing a mobility plan for League City is to assess the current state of the city's transportation network across the full spectrum of modes, both existing and planned. This means having a thorough understanding of not only the roadway network, but also the potential for and current state of efforts in local transit, park & ride, commuter rail, hike & bike trails, marine transportation, and the pedestrian network. Unquestionably, the predominant form of transportation in League City is the automobile and will continue to be. Therefore, significant attention must be paid in a plan such as this to improving vehicular mobility to the maximum extent possible and practical, while enhancing network safety. However, there is also a clear potential for establishing a more balanced mobility spectrum in League City (i.e., one that offers effective and efficient alternatives to automobile travel). One objective of this master mobility plan is to outline a clear path to achieving such a balance. Therefore, Chapters 2 and 3 are devoted to examining existing conditions of the roadway network and all other transportation modes, respectively. These existing conditions assessments contribute to the foundation upon which mobility recommendations are made later in this master mobility plan.

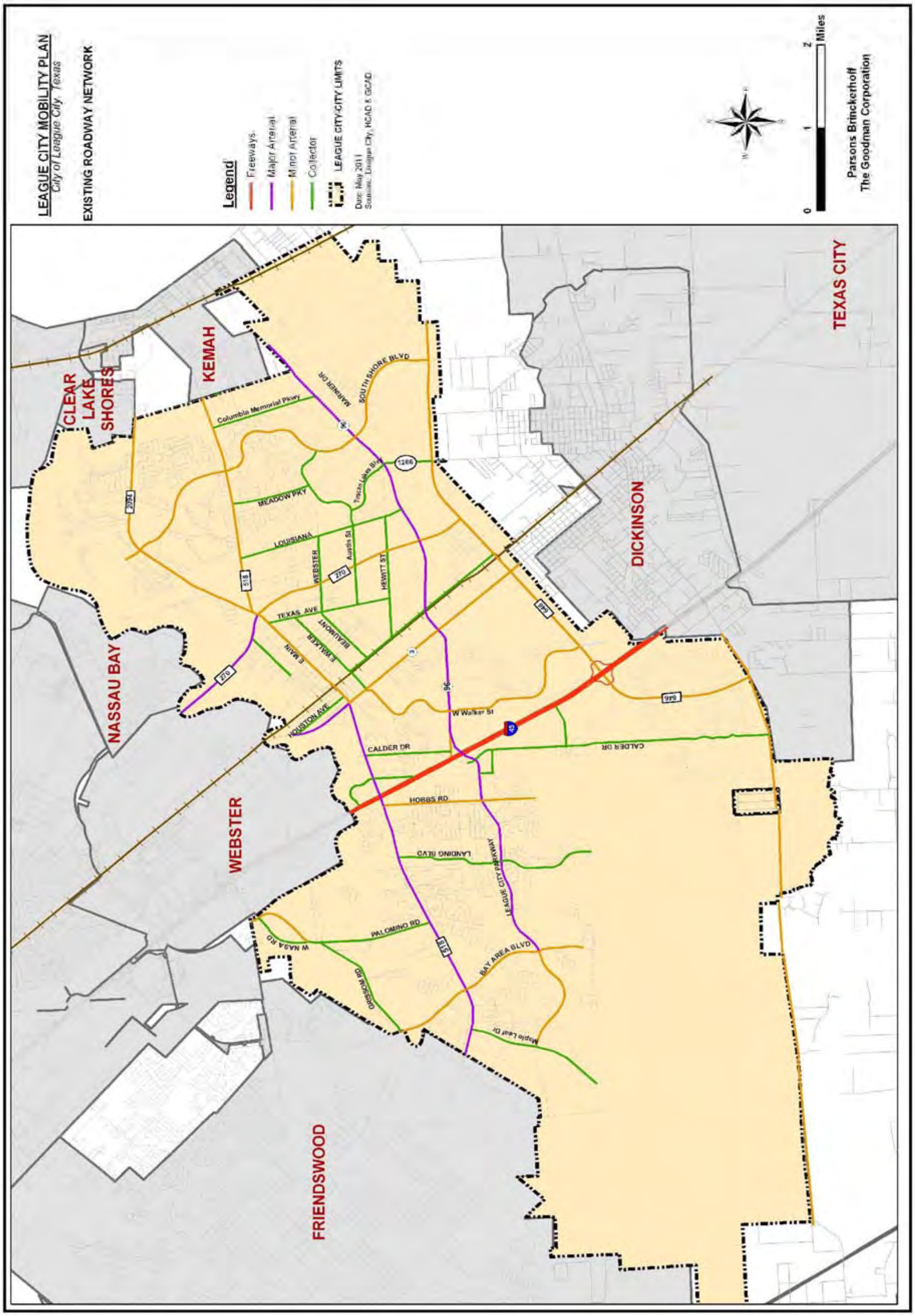
## *ROADWAY NETWORK ASSESSMENT*

The roadway network assessment presented in this chapter includes not only the quantifiable data that describes the physical characteristics of League City's roads and how they function, but also a qualitative discussion of factors such as the roadway classification system, roadway design standards, and roadway connectivity. All of these elements combine to paint a picture of the existing deficiencies in the design and function of the League City roadway network, and serve as the basis for the recommendations for improvement that will be discussed later in the plan.

## *EXISTING HIGHWAY/MAJOR ROADWAY NETWORK*

League City's roadway network consists primarily of five east-west and three north-south state roadway facilities that have been constructed, maintained, and improved by the Texas Department of Transportation (TxDOT). Additionally, there are numerous minor arterials, collectors, and local streets. Although it traverses League City north-south, Interstate Highway 45 (IH 45) was not included in the analysis of the roadway network for the purposes of the Master Mobility Plan; rather the focus is on the mobility needs within League City. However, connections to IH 45 are very important to the efficient flow of traffic throughout League City. The major roadway system is shown in *Figure 2.1*. *Appendix A* includes a detailed description by segment of the major roadways in League City, including speed limit, number of driveways and intersections per segment, median configuration (if any), sidewalk and drainage information, school zones, and segment length.

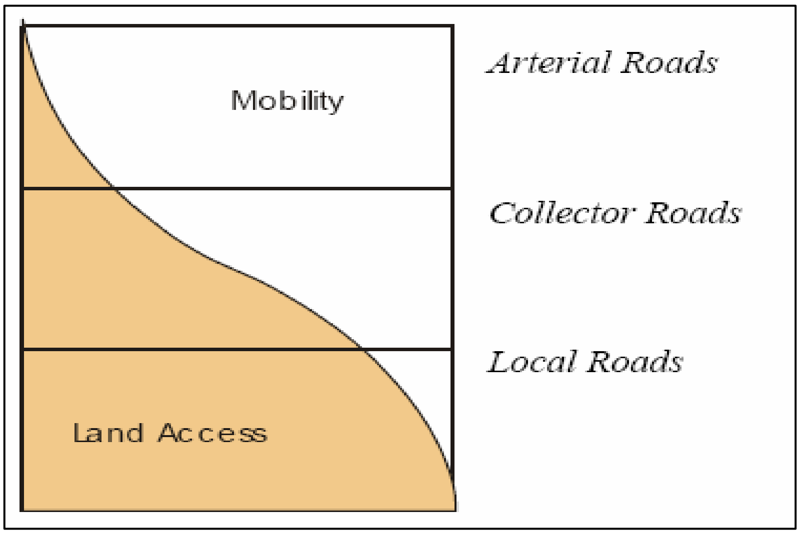
***Figure 2.1 – Existing Major Roadway Network***



### *LEAGUE CITY ROADWAY CLASSIFICATION SYSTEM*

**Historically, roadways have been classified according to the way they meet vehicular needs.** These *functional* classifications essentially described roadways based upon the degree to which the roadway was expected to provide mobility and land access. *Figure 2.2*[1] illustrates this relationship. Arterials emphasize a high level of mobility for through movements, collectors offer approximately balanced service for both functions, and local roads provide direct access to neighborhoods with lower speeds. **League City uses this traditional roadway classification system.** This system also serves as a basis for establishing speed limits, parking restrictions, design standards, and access controls.

***Figure 2.2 – Roadway Classification and Mobility/Land Access Functionality***




The detailed roadway characteristics for each functional class in League City are described next. These functional classes are contained in the League City existing Thoroughfare Plan.

#### *Major Arterial*

Major arterials serve the majority of the through traffic intending to bypass the central city area. The focus of major arterials is to provide mobility rather than land access. A major arterial provides the high-speed mobility that serves moderate to long trip lengths and distributes traffic from the regional freeway system to and from the League City area. State facilities including FM 518 between the western city limit and SH 3; League City Parkway between Bay Area Boulevard and the eastern city limit; SH 3 north of FM 518; and FM 270 north of FM 518 are functionally classified as major arterials in the City's existing roadway network.

#### *Minor Arterial*

Minor arterials provide a lower level of mobility and distribute traffic to smaller geographic areas than major arterials. These provide intra-community continuity without penetrating identifiable neighborhoods. FM 518 between SH 3 and the eastern city limit; FM 2094; FM 646; FM 270 south of FM

[1] *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, ITE, 2010.

518; SH 3 south of FM 518; Bay Area Boulevard; Hobbs Road; Walker Street west of SH 3; and South Shore Boulevard are examples of minor arterials in League City.

***Collector Streets***

Collector streets collect traffic from local streets and channel it into the arterial system. They provide land access and traffic circulation within residential, commercial, and industrial areas. Examples of collector streets in League City include Calder Road and Texas Avenue.

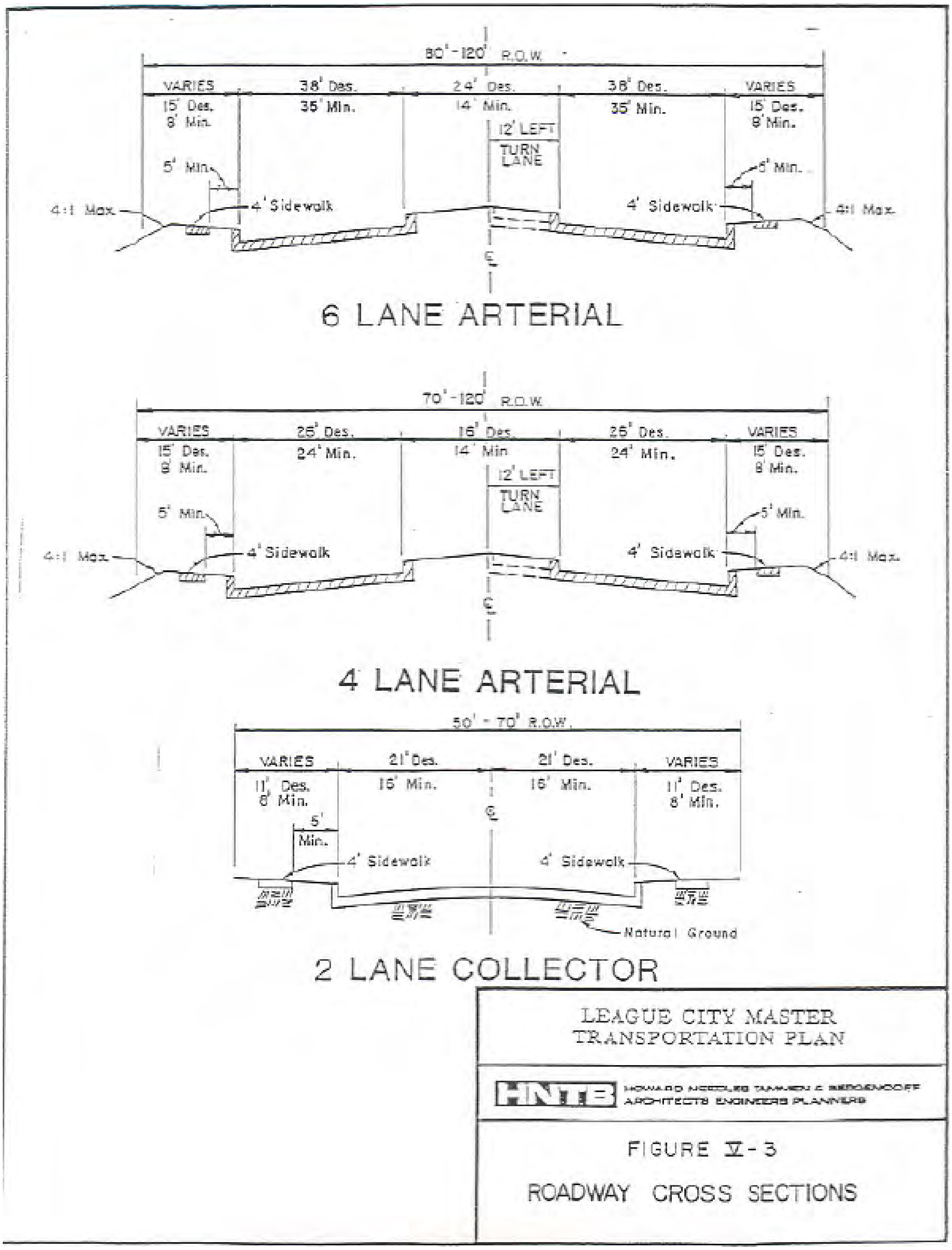
***Local Streets***

Local streets provide access to adjacent properties and neighborhoods. Local streets are generally low speed and designed to discourage through traffic. They often serve short distance travel as compared to collectors or other higher-order roadways.

## *ROADWAY DESIGN STANDARDS*

The roadway cross section design criteria currently used by the City for each functional class are shown in *Figure 2.3*.

***Figure 2.3 – Existing League City Roadway Cross Sections***



**Existing League City design criteria for roadway cross-sections offer flexibility in the configuration of roadways. However, the criteria do not fully address the following:**

- Criteria represent vehicle-oriented thoroughfare configurations only. For example, in all sections, sidewalk widths are called out to be four feet; this is less than the recommended five feet specified by ITE for a vehicle-oriented thoroughfare and well under the nine to twelve feet specified for a walkable thoroughfare.
- Criteria do not provide any guidance that reflects the relationship between the roadway and the adjacent Community Character or development context.
- Criteria lack any consideration for multimodalism.
- Criteria lack any guidance for decision-making where an element of the thoroughfare has a range of widths. It appears that the right-of-way (ROW) width is the sole determinant of space allocation.

## *ROADWAY CONNECTIVITY*

Roadway networks can typically be divided into two major categories which are defined based upon the degree of connectivity provided by the network. A *hierarchical network* is comprised of discontinuous local roadways that link to continuous arterial roadways via connector roads. The majority of suburban roadway development in the Houston-Galveston region is hierarchical *(Figure 2.4)*.

The second category of roadway networks is called a *grid network*. As the name implies, a grid network typically features a series of closely spaced roadways, usually running parallel or perpendicular to each other. The grid system is highly connected, with few or no cul-de-sacs or dead-end streets *(Figure 2.5)*. Grid systems in the Houston-Galveston region predominate in older neighborhoods (e.g., The Heights, Montrose, Galveston). In League City, the Historic District as well as the area to the southwest of the SH 3/FM 646 intersection are the areas that already have a grid street network.

***Figure 2.4 – Hierarchical Street Network***

***Figure 2.5 – Grid Street Network***

**The League City roadway network is primarily hierarchical, with a few small grid areas.** Hierarchical networks drive traffic onto a relatively small number of major streets. These arterial streets are designed to carry high traffic volumes at high speed, while traffic within neighborhoods is low. **Because the lack of connectivity results in few options for continuous travel other than on the arterials, mobility is vulnerable to disruptions on the major streets.**

Lack of connectivity within a hierarchical roadway network leads to less direct travel between points. The discontinuity results in circuitous travel to and from the arterial. As a result, total VMT on a hierarchical network is higher than on a grid network.

**Further, use of alternative travel modes (e.g., walking, bicycling) is discouraged.** For example, the propensity to walk decreases as the total distance of the trip increases. Hierarchical networks are strongly automobile-centric.

**The analysis of existing conditions indicates that League City is beginning to experience the negative outcomes associated with low connectivity levels within its roadway system.** Traffic is concentrated onto a few main arteries. FM 518, for example, connects neighborhoods with the Gulf Freeway and significant retail/commercial development along the corridor. FM 518 today exhibits the following as a result:

- A high density of signalized intersections, some of which operate at Level of Service (LOS) E or F during peak travel times. These include intersections with Hobbs, the IH 45 frontage roads, and SH 3.
- Entire roadway sections that operate over capacity.
- An unacceptably high crash rate that is over double the Texas average for similar routes and exceeds the crash rate in Texas Medical Center.

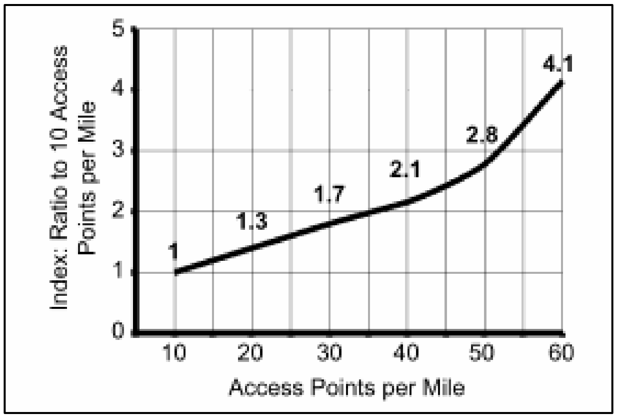
In the short term, these conditions suggest the City should focus on improving street operation to address bottlenecks and safety. Newly constructed Complete Streets can address these issues. On the existing roadway network Transportation Systems Management (TSM) techniques can be employed to specifically address short-term mobility improvements. TSM improvements include adding turn lanes on intersection approaches; modifying traffic signal timing and/or phasing (such as adding a separate left-turn phase); and implementing access management improvements. TSM recommendations will be discussed in further detail in Chapter 6 of this plan.

**Access management is "…the systematic control of the locations, spacing, design, and operation of driveways, median openings, intersections, and street connections to a roadway."[2]** Access management improvements along arterials seek to reduce the number of conflict points along the corridor through improving channelization, consolidating driveway locations, and providing for off-street connections between land uses. **In addition to improving general traffic flow along the corridor, these types of improvements have been proven to reduce accident rates significantly.**

[2] *Access Management Manual*, Transportation Research Board, 2004.

*Figure 2.6*[3] illustrates how accident rates increase with increasing access point density, using 10 access points per mile as the baseline. For example, the section of FM 518 between IH 45 and the Five Corners intersection has approximately 60 access points per mile. *Figure 2.6* indicates that if ten points per mile could be reduced, the accident rate would drop from an index of 4.1 to an index of 2.8 (a 32% reduction).

***Figure 2.6 – Access Point Density and Change in Accident Rate Ratio***




As the region continues to grow, the general lack of connectivity in the League City roadway system will result in an intensification of current trends. Arterial roadways will see increasing traffic volumes with degradation in LOS along those corridors. Additional development along arterials will result in pressure to increase the number of access points, with an attendant increase in the accident rate.

## *LEAGUE CITY ROADWAY CHARACTERISTICS*

The following sections describe some of the current physical characteristics of the major League City roadways, to include number of lanes, signalized intersections, speed limits, and ROW.

A full inventory of additional roadway characteristics is included in *Appendix A*.

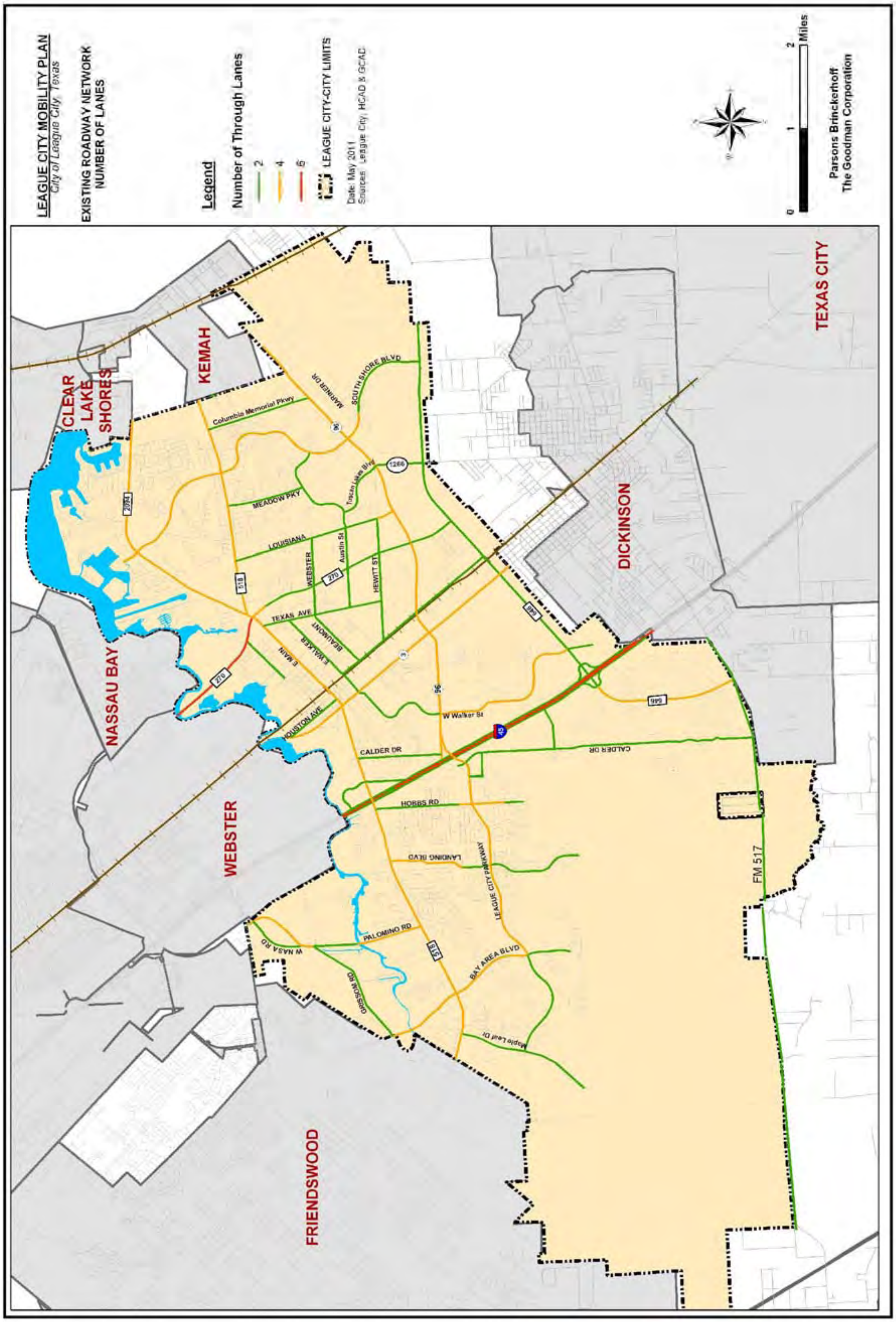
### *Number of Through Lanes*

The number of through lanes for arterials and collectors within League City *(Figure 2.7)* was inventoried for roadway capacity calculation. The majority of League City's arterials consist of four through lanes, while collectors are typically two-lane roads. FM 646 east of IH 45 and FM 270 south of FM 518 have two through lanes within the city limits. Roadways serving the central area of the City, such as FM 518 between IH 45 and FM 270, have two through lanes in each direction with a center two-way left-turn lane (TWLTL).

[3] NCHRP Report 420, *Summary Impacts of Access Management Techniques*, 1999.

A TWLTL is a single continuous center lane from which motorists in either direction may turn left to access adjacent land uses. These lanes create a safety hazard due to the potential for motorists in opposing directions to enter the lane at the same time. Additionally, these lanes reflect the high degree to which access is served despite the roadways' functional classification as arterials.

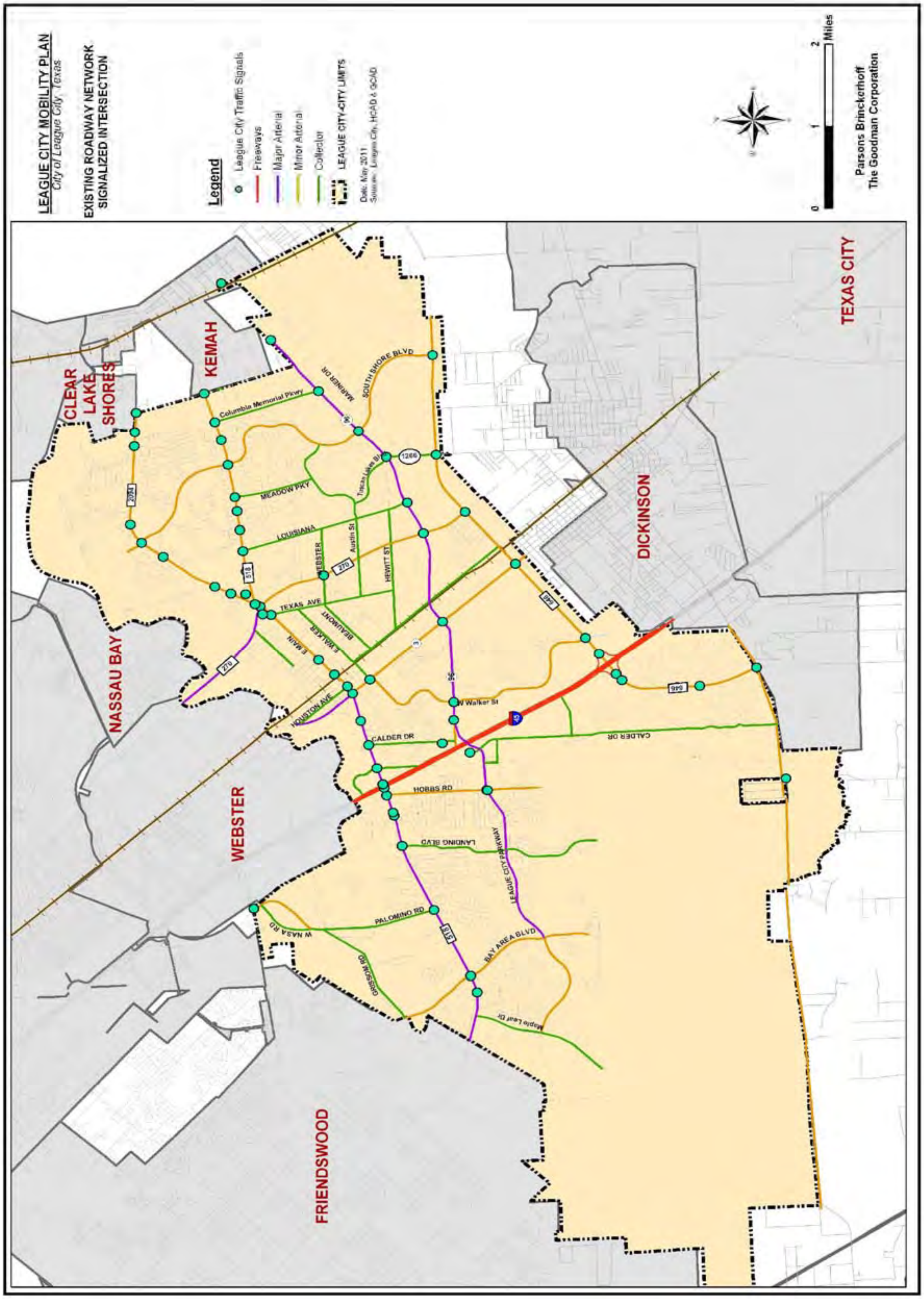
***Figure 2.7 – Existing Roadway Number of Through Lanes***



***Signalized Intersections***

Traffic signals are valuable devices for the control of vehicular and pedestrian traffic. League City currently has a total of 62 signalized intersections *(Figure 2.8)*, all of which are on the City's major corridors (FM 518, FM 646, SH 96, FM 270, FM 2094, SH 3). Prior to June 1, 2011, the only signal owned and maintained by the City of League City was the one at League City Parkway and Hobbs Road; all other signals were operated and maintained by TxDOT. However, when the population of a city reaches 50,000, TxDOT requires that the city take over the operation and maintenance of the signals along non-freeway, state-maintained roadways. League City eclipsed this population threshold with the release of the 2010 Census results, and subsequently took responsibility for all 62 of the City's traffic signals on June 1, 2011.

***Figure 2.8 – Existing Signalized Intersections***



Three signalized intersections in League City currently are equipped with red light cameras (IH 45 at FM 518, SH 3 at FM 518, and FM 2094 at FM 518). Chapter 707 of the Texas Transportation Code, Photographic Traffic Signals, establishes procedures for the use of cameras to monitor vehicles that run red lights, with the objective of improving intersection safety.

A traffic engineering study is required prior to the installation of red light cameras. The purpose of the study is to determine whether, in addition to or as an alternative to the photo enforcement system, a design change to the approach or a change in the signalization of the intersection is likely to reduce the number of red light violations at the intersection. An intersection approach is selected for the installation of a photographic traffic signal enforcement system based on traffic volume, the history of accidents at the approach, the number or frequency of red light violations at the intersection, and similar traffic engineering and safety criteria.

The City contracted with REDFLEX Traffic Systems, Inc. in February 2009 to install and operate red-light cameras at five intersections. TxDOT approved the traffic engineering studies for the three aforementioned intersections and camera installation was completed by October 2009. At the IH 45/FM 518 intersection cameras currently monitor traffic traveling east, south, and west. The SH 3/FM 518 intersection has cameras for eastbound and westbound traffic, and the FM 2094/FM 518 intersection has cameras monitoring the left-turn lanes.

Installation of two additional red light cameras (at FM 270 and League City Parkway, and FM 270 and FM 518) is currently pending approval by City Council.

Significant reductions in most collisions, injuries, and costs caused by drivers running red signals have been reported in several REDFLEX-protected cities as a result of photo enforcement program. The City of League City red-light camera installation is still too recent to permit evaluation of accident histories. However, *Table 2.1* shows that the number of red light violations at the monitored intersections in League City has decreased dramatically since the installation of the cameras.

***Table 2.1 – Red Light Violations at Monitored Intersections***

| ***Month/Year*** | ***Total Violations*** |
|---|---|
| Oct 2009 | 10,752 |
| Nov 2009 | 7,168 |
| Dec 2009 | 4,990 |
| Jan 2010 | 4,160 |
| Feb 2010 | 3,930 |
| Mar 2010 | 3,996 |
| Apr 2010 | 3,446 |
| May 2010 | 3,701 |
| Jun 2010 | 3,914 |
| Jul 2010 | 4,255 |
| Aug 2010 | 4,249 |

*Source:* League City Police Department

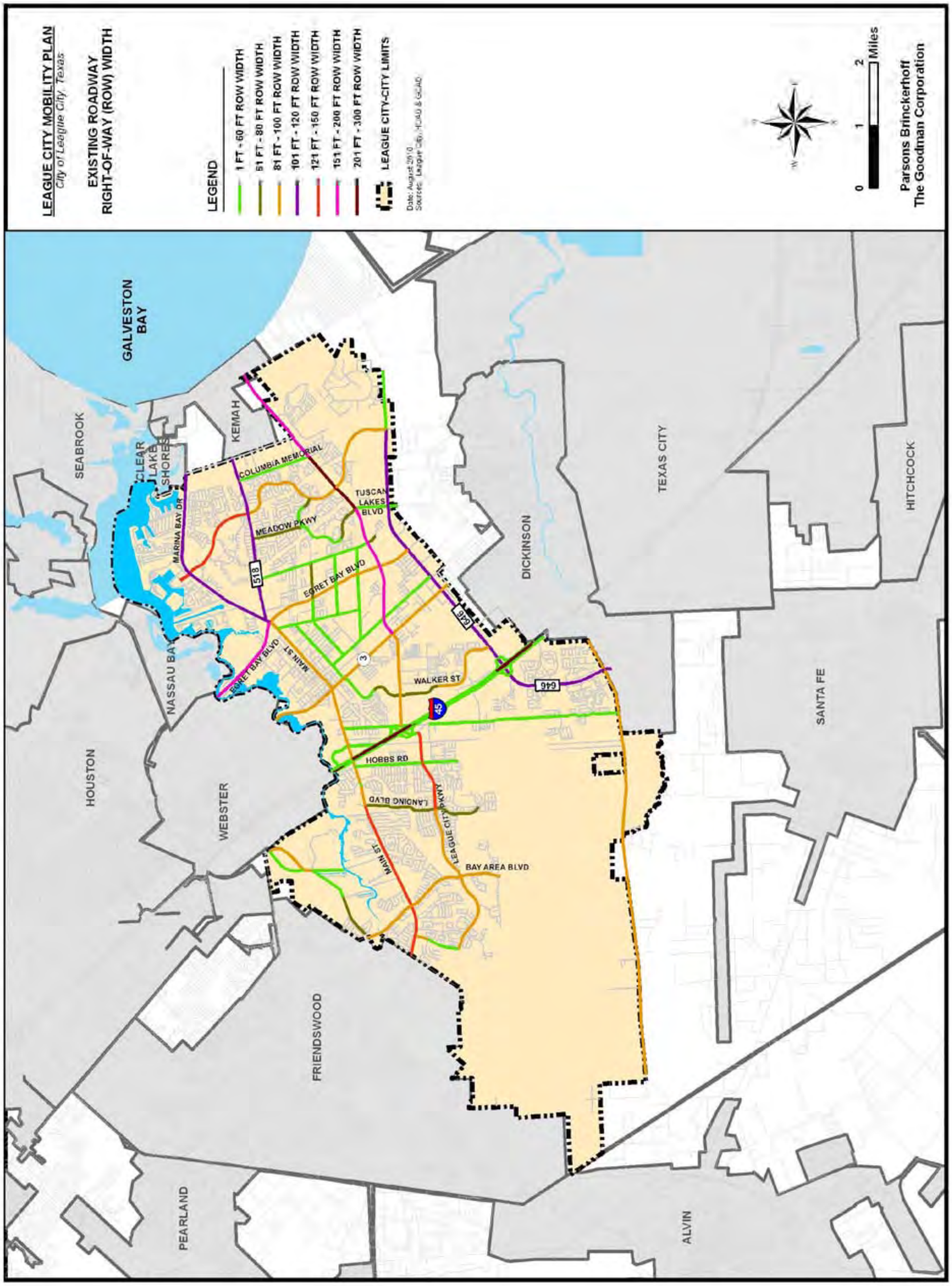
***Speed Limits***

Speed limits on arterials within League City generally range from 30 to 55 miles per hour (mph). Major arterials, such as FM 518, have speed limits of 30 to 40 mph in the city center and 40 to 55 mph elsewhere. The speed limit on collector roadways varies from 25 to 35 mph. School zones have a reduced speed limit at designated times of the day.

***Right-of-Way***

Public roads are located within land which is referred to as road ROW. A typical road ROW can include the driving surface, roadside shoulders and ditch, public utilities, sidewalks, and traffic signs. Any roadway improvement projects within the existing right-of-way are more affordable and easier to implement than those projects that may require extensive ROW acquisition. The current ROW inventory of the League City roadway network is shown in *Figure 2.9*. As shown in this figure, most collectors have ROW of between 60 and 80 feet. Typically, the ROW of 60 feet would allow the maximum expansion of a four-lane undivided facility in place, while ROW of 80 feet can provide extra room for medians, wider shoulders or sidewalks, in addition to the four general travel lanes. The ROW of arterials in League City varies, with the majority of them between 80 feet and 120 feet.

***Figure 2.9 – Right-of-Way***



## *TRAFFIC AND INTERSECTION ANALYSIS*

The following section quantifies the functioning of the League City roadway network in terms of traffic volumes and intersection bottlenecks. These data help to pinpoint those specific locations on the network that are operationally deficient and need to be targeted for improvements.

### *Existing Traffic Volumes and Turning Movements*

Existing traffic volumes are used to analyze the existing roadway system and intersection operating conditions, evaluate deficiencies and needs of the existing transportation system, and serve as the basis for conducting analysis of future conditions.

League City does not currently collect citywide traffic counts on a systematic basis. Recent average daily traffic (ADT) counts were collected on three major east-west corridors (FM 518, SH 96, FM 646). The data indicate an average daily volume of 22,000 vehicles on FM 518; 24,000 vehicles on SH 96 east of IH 45; and 21,000 vehicles on FM 646 between IH 45 and SH 3. In the north-south direction, other than IH 45, SH 3 and FM 270 are the major routes for travelers, followed by South Shore Boulevard and Bay Area Boulevard serving mostly residential areas on both sides of IH 45.

Peak-hour turning movement data were also collected at the ten selected intersections shown in *Table 2.2*. These key intersections were selected for further analysis to identify bottleneck locations in the existing roadway network. The traffic counts were conducted during the morning peak period (7 am to 9 am) and the afternoon peak period (4 pm to 6 pm) during mid-week workdays. The location, lane configuration, and existing peak hour turning movement counts of the study intersections are illustrated in *Figure 2.10* and *Figure 2.11* for the AM peak and PM peak, respectively. It should be noted that the Five Corners intersection (FM 518/FM 270/FM 2094) is not specifically addressed in this master mobility plan because the City has currently undertaken an independent effort to study the intersection and develop a course of action for improving its function.

***Table 2.2 – Key Intersections for In-Depth Analysis***

| ***Intersection #*** | ***Location*** |
|---|---|
| 1 | FM 518 at Hobbs Rd |
| 2 | FM 518 at SB IH 45 frontage road |
| 3 | FM 518 at NB IH 45 frontage road |
| 4 | FM 518 at Wesley Dr |
| 5 | FM 518 at Calder Rd |
| 6 | FM 518 at Interurban Ave |
| 7 | FM 518 at SH 3 |
| 8 | FM 518 at Houston Ave |
| 9 | FM 646 at SB IH 45 frontage road |
| 10 | FM 646 at NB IH 45 frontage road |

There are likely to be additional intersections within League City that will merit similar analyses as traffic volumes grow in League City. Future traffic volumes and related roadway segment LOS as predicted by the travel demand model can assist in identifying intersections that are most likely to experience congestion in the future.

***Figure 2.10 – Lane Configuration and Existing AM Peak Turning Movement Counts***

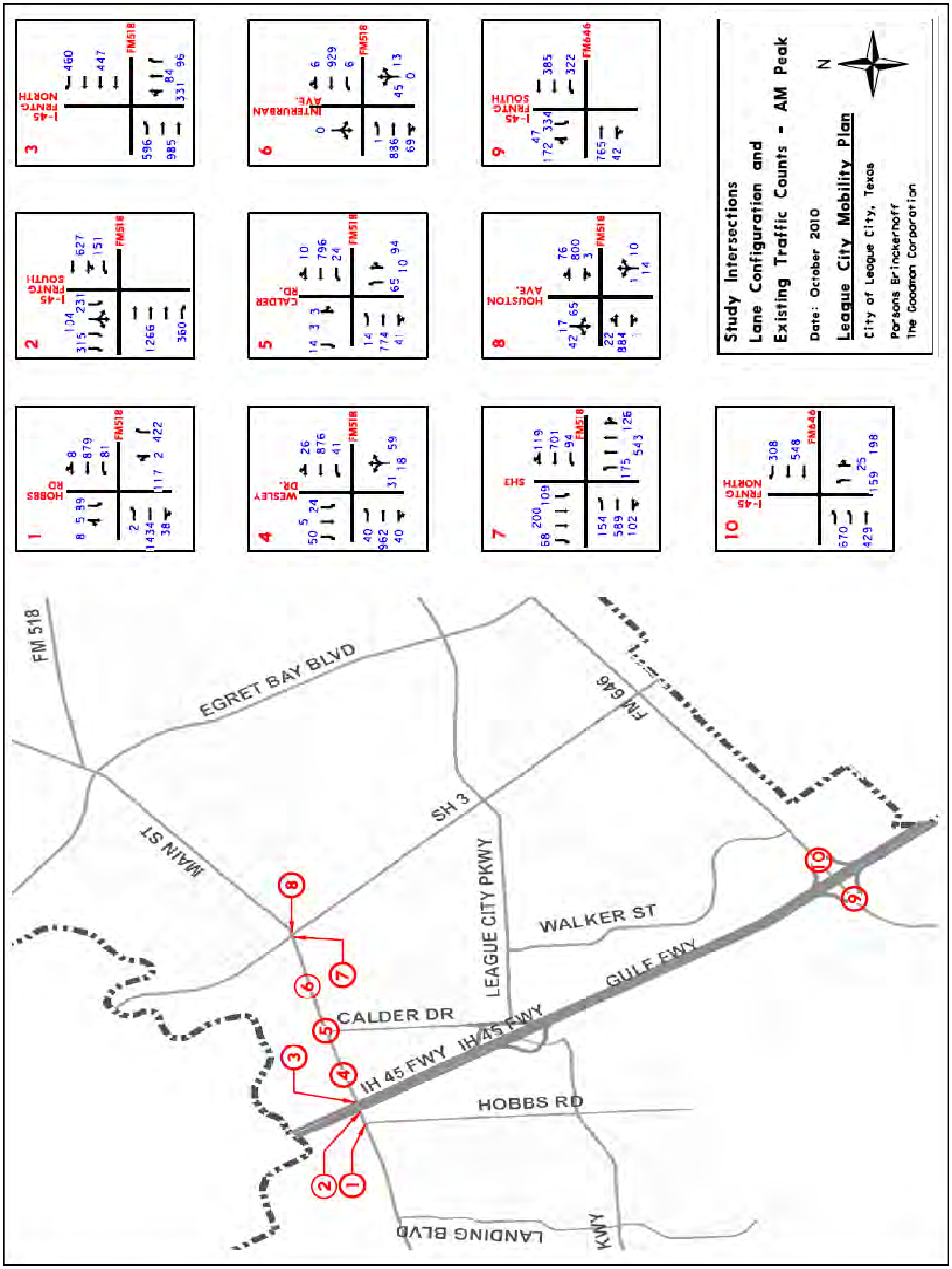
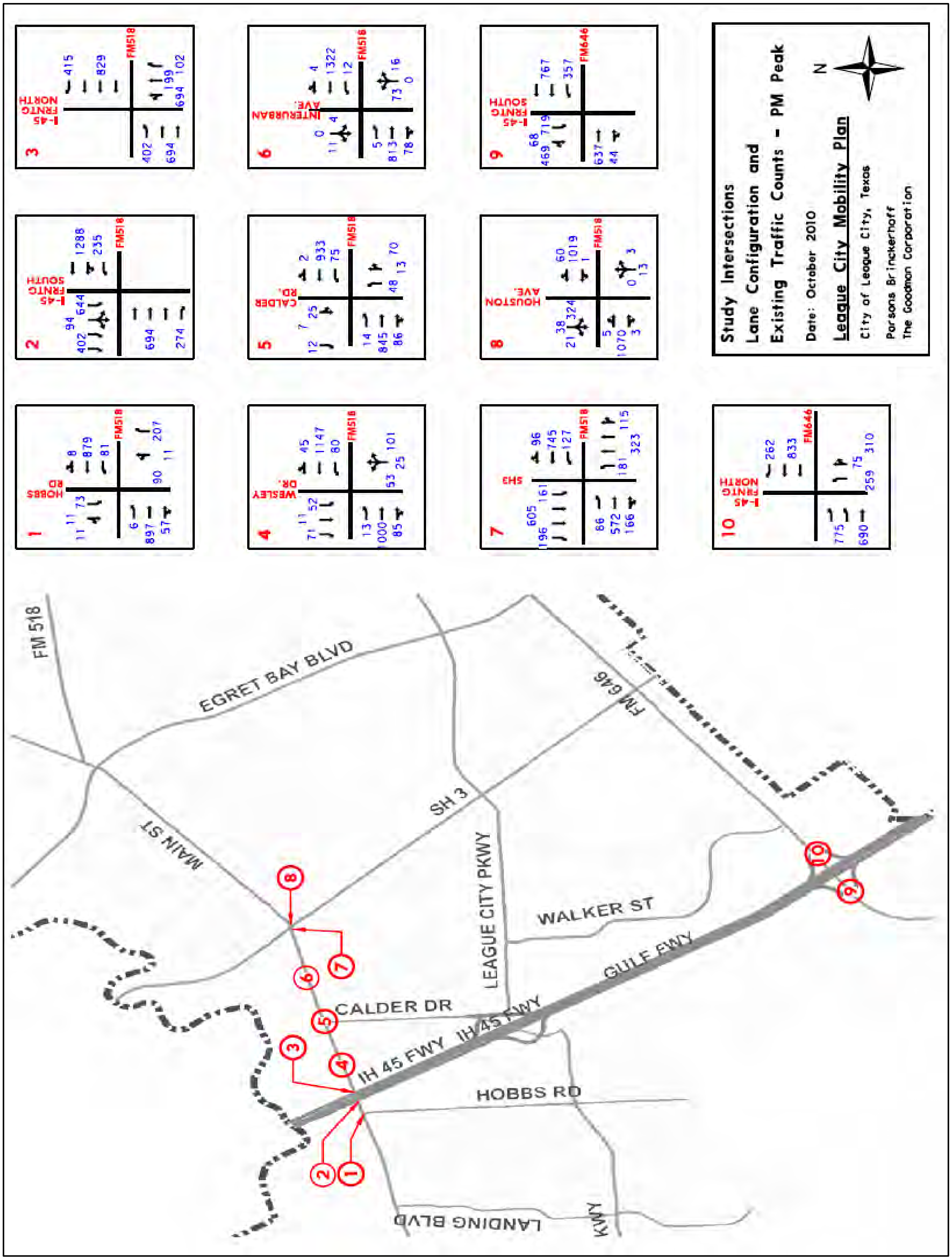


**Figure 2.11 – Lane Configuration and Existing PM Peak Turning Movement Counts**



The peak-hour traffic count and turning movement data indicate that heavy traffic travels on FM 518 during both the AM and PM peak hours. Approximately 20% of traffic on FM 518 utilizes the arterial to access IH 45 south, while approximately 35% uses FM 518 to access IH 45 north. Severe congestion is observed at the intersections of the northbound and southbound IH 45 frontage roads with FM 518. The data also show very high volumes on both the eastbound left and westbound left turns to access IH 45 from FM 646. The intersection of FM 518 and SH 3 also shows congestion, with approximately 10% of through traffic on FM 518 turning northbound on SH 3, and 16% proceeding to the south.

***Level of Service***

Transportation system performance is commonly measured using the LOS grading system which qualitatively characterizes traffic conditions associated with varying levels of traffic. LOS ranges from LOS A, representing free-flow traffic conditions with little or no delay experienced by motorists, to LOS F, describing congested conditions where traffic flows exceed design capacity, resulting in long queues and delays. LOS A, B, and C are generally considered to be satisfactory service levels, while the influence of congestion becomes more noticeable at LOS D. LOS E is undesirable and is considered by most agencies to be the limit of acceptable delay, and LOS F conditions are considered to be unacceptable to most drivers. The LOS methodology has been widely used and provides a consistent tool for evaluating roadway performance. **League City has adopted LOS D as the minimum standard for acceptable roadway performance.**

***Roadway Segment Analysis***

The LOS for an individual roadway segment is measured by comparing the actual traffic volumes to the capacity of the roadway segment. The capacity is determined by the number of lanes, the functional classification of the roadway, the roadway geometrics, and the area type (urban versus rural). The Volume-to-Capacity (V/C) ratio thresholds to determine the LOS level are presented in *Table 2.3*.

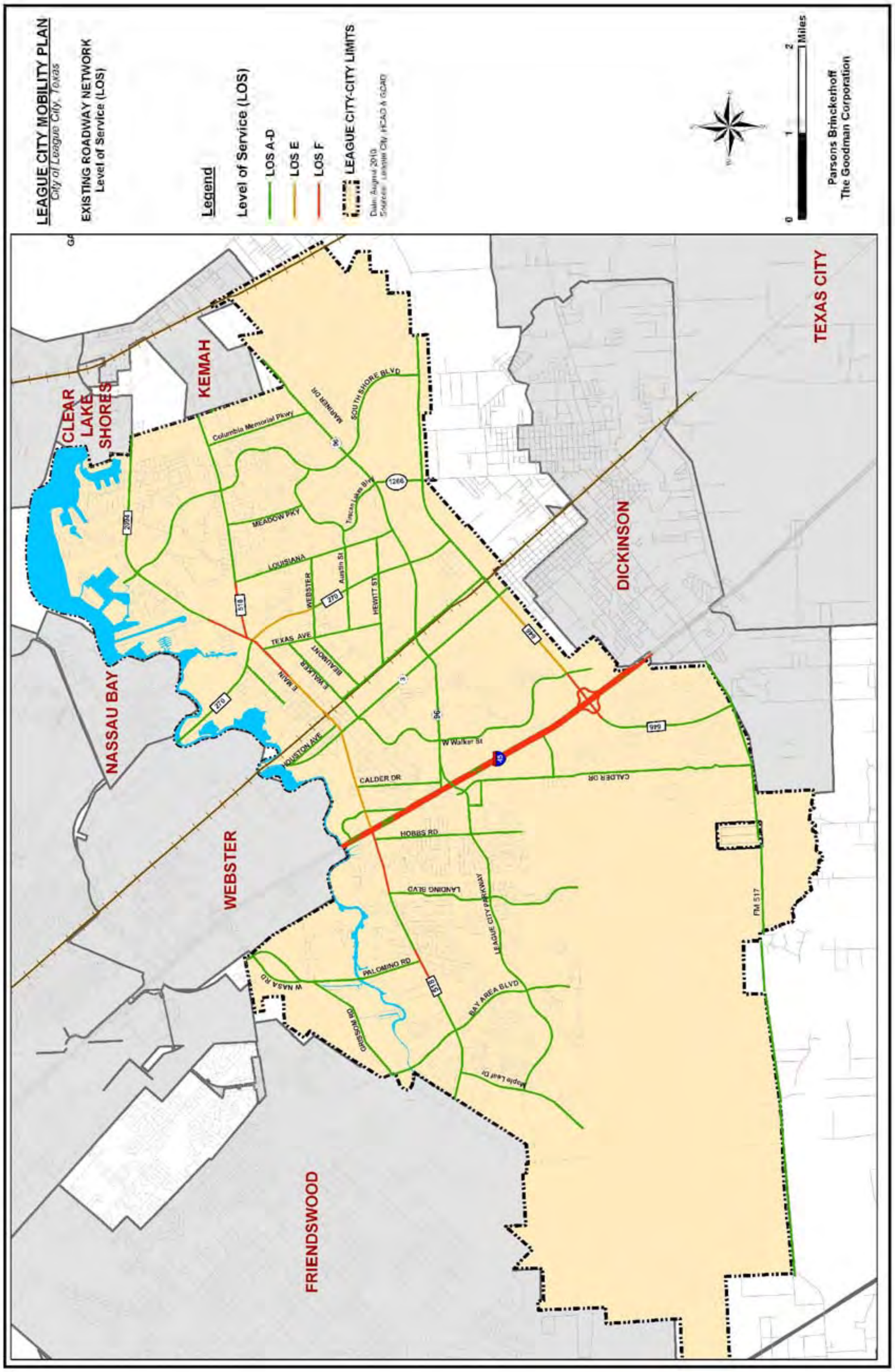
***Table 2.3 – Roadway Segment LOS and V/C Ratio***

| ***Roadway LOS*** | ***V/C Ratio*** |
|---|---|
| LOS A – LOS C (Under Capacity) | < 0.80 |
| LOS D (Near Capacity) | 0.81 – 0.90 |
| LOS E (At Capacity) | 0.91 – 1.00 |
| LOS F (Over Capacity) | > 1.00 |

*Source: Transportation Research Board, Highway Capacity Manual, 2000,*

Based on the existing traffic volumes as predicted by the League City travel demand model and adjusted per direction by the City, the existing roadway peak period LOS results are illustrated in *Figure 2.12*. As presented in the figure, most roadways are operating at LOS D or better under existing traffic conditions. Congestion is focused on FM 518 between Landing Boulevard and FM 270, as well as on FM 646 between IH 45 and SH 3. Other areas that experience congestion include FM 518 near Palomino Lane, and the vicinity of the Five Corners intersection.

***Figure 2.12 – Existing Roadway Peak Period LOS***



***Intersection Analysis***

As mentioned previously, the roadway segment analysis is also supplemented by intersection analyses at critical intersections within the City.

The operating conditions of the study intersections were analyzed using the Transportation Research Board's 2000 Highway Capacity Manual (HCM) methodology. The HCM methodology for signalized intersection analysis calculates the average control delay per vehicle (in seconds per vehicle) for all approaches of the intersection. A letter designation ranging from A through F is then used to assess the intersection operation based on a set of delay ranges. The LOS criteria for signalized intersections are presented in *Table 2.4*.

***Table 2.4 – Signalized Intersection LOS Criteria***

| ***LOS*** | ***Description*** | ***Average Control Delay (second/vehicle)*** |
|---|---|---|
| A | Operations with very low delay occurring with favorable progression and/or short cycle length | 0 – 10 |
| B | Operations with low delay occurring with good progression and/or short cycle lengths | > 10 – 20 |
| C | Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear | > 20 - 35 |
| D | Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable | > 35 – 55 |
| E | Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay | > 55 – 80 |
| F | Operations with delays unacceptable to most drivers occurring due to over-saturation, poor progression, or very long cycle lengths | > 80 |

*Source: Highway Capacity Manual, Transportation Research Board, 2000.*

The traffic engineering software *Synchro* was chosen for intersection analysis in this study. *Synchro* is a macroscopic analysis and optimization program providing an easy-to-use solution for intersection capacity analysis. The existing AM and PM peak hour turning movement counts, geometric conditions, and signal timing plans were entered into the base *Synchro* model. The delay and the current year LOS at the study intersections are shown in *Table 2.5* for both AM and PM peak hours. The complete *Synchro* reports are included in *Appendix B*.

| ***Table 2.5 – Existing LOS at Key Intersections*** | | | | |
|---|---|---|---|---|
| ***Intersection*** | ***Existing AM Peak*** | | ***Existing PM Peak*** | |
| | ***Delay**** | ***LOS***** | ***Delay**** | ***LOS***** |
| FM 518 at Hobbs Road | 88.9 | F | 42.3 | D |
| FM 518 at IH 45 frontage road south | 37.1 | D | 55.7 | E |
| FM 518 at IH 45 frontage road north | 101.3 | F | 211.6 | F |
| FM 518 at Wesley Dr | 22.3 | C | 34.2 | C |
| FM 518 at Calder Road | 10.3 | B | 14.3 | B |
| FM 518 at Interurban Street | 8.6 | A | 18.5 | B |
| FM 518 at SH 3 | 43.2 | D | 61.9 | E |
| FM 518 at Houston Ave | 7.4 | A | 25.1 | C |
| FM 646 at IH 45 SB Ramps | 105 | F | 60.9 | E |
| FM 646 at IH 45 NB Ramps | 25.2 | C | 36.4 | D |

* HCM Average Control Delay
** HCM Level of Service

The most severe traffic flow conditions are currently found at the interchanges with IH 45 or immediately adjacent to the freeway (Hobbs Road). Otherwise, the LOS at roadway intersections in League City today is at or better than the design LOS D.

***Crash and Safety Analysis***

**Safety is as important a consideration for citywide mobility as is the movement of vehicles and people. An in-depth analysis of recent crash data reveals that League City does indeed have areas where safety is a concern and the crash rate is unacceptably high.** *Table 2.6* provides the overall crash data for all roadways (excluding IH 45) in League City for the years 2003 to 2008. **These data indicate that the number of crashes on League City roadways has been trending upward, with a 32% increase between 2003 and 2008.**

| ***Table 2.6 – League City Roadway Network Crash Data by Crash Severity, 2003-2008*** | | | | | | |
|---|---|---|---|---|---|---|
| ***Crash Severity*** | ***2003*** | ***2004*** | ***2005*** | ***2006*** | ***2007*** | ***2008*** |
| Fatality | 4 | 0 | 5 | 3 | 3 | 2 |
| Incapacitating Injury | 28 | 30 | 23 | 30 | 22 | 32 |
| Non-Incapacitating | 117 | 99 | 106 | 92 | 101 | 59 |
| Possible Injury | 108 | 163 | 182 | 157 | 173 | 119 |
| Not Injured | 607 | 663 | 670 | 713 | 839 | 812 |
| Unknown | 69 | 75 | 89 | 69 | 89 | 79 |
| ***Total*** | **676** | **738** | **759** | **782** | **928** | **891** |

***Source:*** *H-GAC, Aug 2009.*

The locations of crashes that caused fatality and incapacitating injury are shown in *Table 2.7*. **FM 518 and FM 646 are the roadways with the highest number of serious accidents, combining for nearly half of all serious accidents on League City roadways.**

***Table 2.7 – Crashes Resulting in Fatality or Incapacitating Injury, 2003-2008***

| *Roadway* | *Total* | *Fatality* | *Incapacitating Injury* |
|---|---|---|---|
| FM 518 | 53 | 1 | 52 |
| FM 646 | 26 | 5 | 21 |
| SH 96 | 17 | 1 | 16 |
| FM 517 | 13 | 2 | 11 |
| FM 270 | 13 | 2 | 11 |
| SH 3 | 13 | 2 | 11 |
| FM 2094 | 9 | 1 | 8 |
| Brittany Bay Boulevard | 9 | | 9 |
| South Shore Boulevard | 6 | 1 | 5 |
| Calder Drive | 2 | 1 | 1 |
| Texas Avenue | 2 | | 2 |
| Tuscan Lakes | 2 | | 2 |
| Admiral Drive | 1 | | 1 |
| Bay Area Boulevard | 1 | | 1 |
| Blue Water | 1 | | 1 |
| Brookport Drive | 1 | | 1 |
| Colony Ridge | 1 | | 1 |
| Columbia Memorial | 1 | | 1 |
| Cottonwood Court | 1 | | 1 |
| Dickinson Avenue | 1 | | 1 |
| E. Walker Street | 1 | | 1 |
| Landing Boulevard | 1 | 1 | |
| Lawrence | 1 | | 1 |
| Mariner Drive | 1 | | 1 |
| NASA Road 1 | 1 | | 1 |
| Ocean Way | 1 | | 1 |
| Palomino Lane | 1 | | 1 |
| W. Main Street | 1 | | 1 |
| Walker | 1 | | 1 |
| ***Total*** | 182 | 17 | 165 |

***Source:*** *H-GAC, Aug 2009*

A common indicator used to reflect roadway safety is the number of crashes per 100 million vehicle miles. This is referred to as the *crash rate*. This indicator compares the number of crashes to the exposure to other vehicles over a given distance. Comparing the crash rate on FM 518 to other areas is illuminating. *Table 2.8* presents the crash rates for FM 518 and other areas in the region and state.

| ***Table 2.8 – Comparative Crash Rates*** | |
|---|---|
| ***Location*** | ***Crash Rate*** |
| Texas (similar roads) Statewide | 150 |
| FM 518 (entire corridor) | 203 |
| Texas Medical Center | 314 |
| FM 518 (IH 45 to FM270/2094) | 324 |
| ***Source:*** *FM 518 Corridor Access Management Plan, H-GAC, 2004* | |

The crash rate along the entire FM 518 corridor (i.e., Pearland, Friendswood, League City, Kemah) is approximately one-third higher than the statewide average for similar roads. **However, the crash rate along FM 518 between IH 45 and the Five Corners intersection in League City is more than double the statewide average and nearly two-thirds higher than the FM 518 corridor average.** In fact, the crash rate along this section of FM 518 is comparable to the rate in Texas Medical Center, which is traversed by the Metropolitan Transit Authority of Harris County's (METRO) at-grade light rail transit system.

Implementation of recommendations discussed in Chapter 6, including elements such as TSM strategies, access management, and intersection reconfiguration, can serve to address the safety concerns on League City roadways.

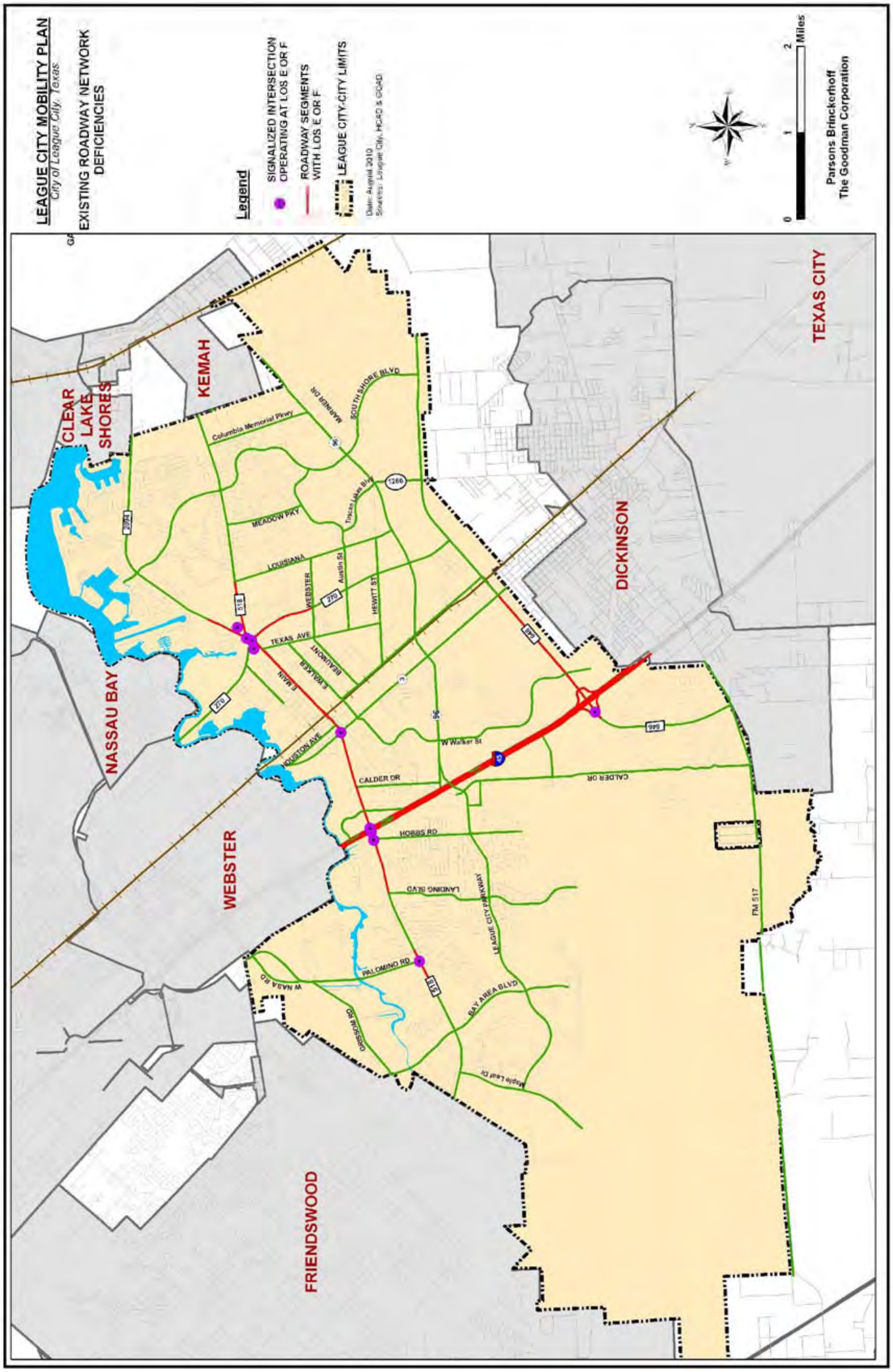
### *EXISTING ROADWAY NETWORK DEFICIENCIES*

Based on League City's stated desire to maintain an LOS D or better on its roadways, those roadways with an existing LOS E or F are classified as deficient. Likewise, signalized intersections operating at worse than LOS D are also deficient. *Figure 2.13* presents the locations of these deficient roadway segments and signalized intersections.

As presented on the deficiencies map, the following segments and intersection bottlenecks are identified as deficiencies in the existing roadway network. The existing congested intersections are concentrated on FM 518.

- FM 518 between Landing Boulevard and FM 270
- FM 646 between IH 45 and SH 3
- FM 270 between FM 518 and Webster Street
- FM 518 at Palomino Lane
- FM 518 at Hobbs Road
- FM 518 at IH 45 frontage roads
- FM 518 at SH 3
- FM 518 at FM 270/FM 2094
- FM 646 at IH 45 frontage road south

***Figure 2.13 – Existing Roadway Network Deficiencies***



## *CONCLUSION*

League City's existing roadway network is characterized by traffic congestion on the major east-west corridors and a significant number of congested intersections, primarily along FM 518. Historically, the city's mobility has been served by the state highways and FM roads, which form the framework of major arterials in the city. As the City has grown, this reliance on the arterial system without the adequate development of a complementary collector street system has become problematic. This deficiency in the roadway network presents connectivity and mobility challenges and places a substantial burden on the city's arterial streets, resulting in congestion and high accident rates. The existing network also does not substantially support any mode other than the automobile, further exacerbating the city's traffic challenges.

As a result of these issues, future transportation improvements in League City will need to focus on capacity enhancements, improved connectivity, and diversification of transportation mode choice.

# Chapter 3 – GENERAL MOBILITY ASSESSMENT: NON-MOTORIZED AND TRANSIT MODES

3

Chapter 2 focused on examining the existing conditions for the most prominent transportation mode in League City, the roadway network. Several other modes have the potential to bring additional transportation options to the city. These include the pedestrian network, bicycle lanes, shared-use paths (hike & bike trails), commuter rail, regional bus transit (park & ride), local bus transit, and marine transportation. Chapter 3 focuses on these transportation choices which provide alternatives to automobile travel. To reiterate, the evaluation includes discussions of recommendations made in previously completed plans and contributes to the foundation upon which mobility recommendations will be made later in this master mobility plan.

## *ADVANTAGES OF A MULTIMODAL TRANSPORTATION NETWORK*

One of the biggest advantages to automobile travel is that it provides nearly ubiquitous access to all locations at any time. Understandably, this high level of personal freedom is often hard for travelers to part with and hard for other transportation modes to compete with. However, **a multimodal transportation network in which the various modes are well-planned, safe, convenient, and efficiently linked to one another can offer numerous benefits to the community and help to lure drivers from their cars.** In addition to increased mobility, a well-functioning multimodal transportation network also offers advantages in the areas of health and wellness, recreation, and livability. *Table 3.1* describes the major benefits that can accrue from having access to a diverse set of transportation choices.

## *PEDESTRIAN/BICYCLE MODES*

**Sidewalks, bicycle lanes, and shared-use paths offer the opportunity for non-motorized travel and constitute an important component of overall mobility.** Providing such facilities can help to reduce auto trips, decrease congestion, and improve air quality. A very well-planned network of pedestrian and bicycle facilities also increases connectivity among destinations in a manner that is much less expensive and disruptive than building, expanding, and maintaining roadways.

The U.S. Department of Transportation (DOT) recently issued a policy statement on the inclusion of pedestrian and bicycle facilities in transportation projects.[1] The policy states very clearly DOT's advocacy of "fully integrated active transportation networks," (i.e., complete streets, Chapter 1). It also encourages other agencies and communities across the country to take the following steps to fully integrate pedestrian and bicycle facilities into their transportation networks.

[1] "US DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations," March 11, 2010, http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm.

- Consider walking and biking as equal to other transportation modes. These should not be an afterthought in roadway design.
- Ensure that there are convenient and safe transportation choices for people of all ages and abilities.
- Go beyond minimum design standards.
- Collect data on walking and biking trips. This enables communities to track trends and prioritize investments to ensure the success of new facilities. These data are also valuable in linking walking and biking with transit.
- Set mode share targets for walking and bicycling, and track them over time.
- Maintain sidewalks and shared-use paths the same way other roadway assets are maintained.
- Improve non-motorized facilities during maintenance projects.

***Table 3.1 – Benefits of Multimodal Transportation Network***

| ***Benefit*** | ***Description*** |
|---|---|
| Efficiency | Transportation diversity creates a more efficient transportation network because it allows each mode to be used for what it does best, resulting in the following:<br>• Reduced traffic congestion;<br>• Air quality improvement;<br>• Increased road safety; and<br>• Facility cost savings. |
| Economic Development | Transportation diversity supports economic development by reducing transportation problems and costs (traffic congestion, road and parking facility costs, accident damages, energy consumption) and by improving employee access to jobs. |
| Livability | Many people value living in or visiting a community where walking and cycling are safe, pleasant, and common. The perception of greater livability can result in increased property values and commercial activity. |
| Consumer Benefits & Savings | Consumers benefit from alternatives that allow them to save money, avoid stress, enjoy additional benefits (such as recreation and exercise), and reduce their need to chauffeur non-drivers. |
| Equity | Inadequate transportation options often limit the personal and economic opportunities available to people who are physically, economically, or socially disadvantaged. Increasing choice helps to provide basic mobility and transportation affordability. |
| Resilience and Security | A more diverse and flexible transportation system can accommodate variable and unexpected changes such as energy supply disruptions and fuel price increases, poverty, and transportation network stresses such as disasters, major sporting and cultural events, and infrastructure construction projects. |
| Option Value | People who do not currently use an alternative mode may value its availability for possible future use when they are unable to drive (option value). Over the course of their lives, most people can expect to rely on alternative modes, due to physical disability, financial constraints, vehicle failures, major disasters, or other limitations. |

***Source:*** *Transportation Cost and Benefit Analysis, 2nd Edition,* Victoria Transport Policy Institute, Jan 2009.

***Sidewalks***

An effective pedestrian network must be both present and well-connected. **League City's existing pedestrian network is largely incomplete, disconnected, unsafe, and/or impeded by obstacles.**

***Typical sidewalk deficiencies in League City – obstacles, missing sidewalks, incomplete sidewalks***
***Left to Right: Hobbs near FM 518; FM 518 near Briarglen; FM 518 near Five Corners***

Areas within and surrounding housing developments typically have sidewalk facilities as required per the City's subdivision ordinances. However, even within subdivisions there are examples of developers having been able to evade their responsibility to install sidewalks or complete the sidewalk network.

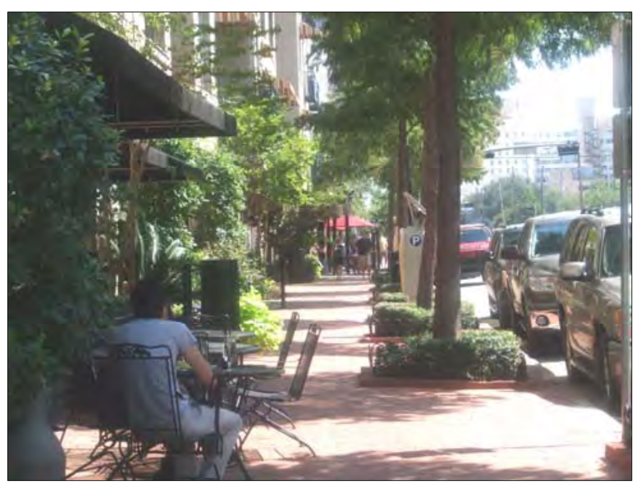
***Incomplete Sidewalks in Residential Developments***
***Left to Right: Corner of Park Falls and Bendwood; Courtland View near Beaumont***

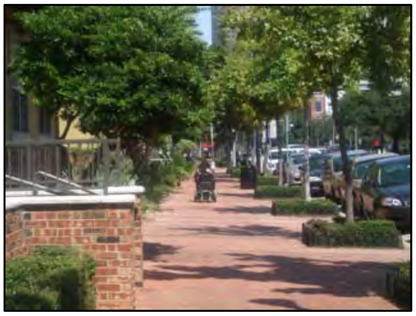
When it comes to public property, the City currently lacks the policies that would levy upon itself the requirement to ensure pedestrian connectivity in those areas that do not fall under the purview of developers. The resulting “gaps” significantly affect the overall effectiveness of League City’s pedestrian network. Inventory data showing the presence or lack of sidewalk facilities along the City’s major corridors is available in *Appendix A*.

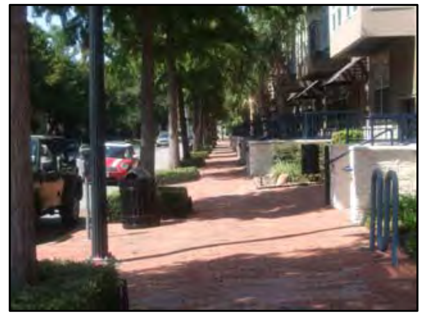
A quality pedestrian network brings numerous benefits to a community. **Walking can be a viable transportation alternative if the pedestrian infrastructure is well-connected, safe, and pleasant.** This is particularly important in a community such as League City where traffic congestion is a big concern and residents have expressed frustration and a feeling of being “trapped” in their homes. **The ability to walk to a destination frees a person from the necessity of using a car for every trip.** In addition to the mobility benefits, walkability also affords opportunities for exercise and recreation.

The pedestrian realm includes not only sidewalks, but also shade trees, benches and other street furniture, pedestrian-oriented lighting, crosswalks, and wheelchair ramps. Other amenities may be present, such as bike racks, waste receptacles, water fountains, or decorative elements such as brick pavers. An ideal pedestrian environment is one in which the pedestrian feels safe and comfortable moving from one point to another on foot. There are many elements that contribute to this feeling of pedestrian security and ease of movement, including the following:

- Sidewalk width
- Sidewalk continuity/connectivity
- Unobstructed sidewalk ROW (utility poles)
- Shade trees
- Presence of trees, landscaping strip, parked cars, or other barriers between the pedestrian and adjacent traffic
- Slow to moderate speed of adjacent traffic
- Presence of ramps for those in wheelchairs, power chairs, or pushing strollers
- Pedestrian-oriented lighting for safety at night
- Crosswalks
- Street width that allows for comfortable, safe crossing within the timing of the “Walk” signal. Medians and refuge islands for wider streets
- Wayfinding signage







***Quality Pedestrian Environment***
***Unobstructed Wide Sidewalks, Shade Trees, Amenities (Benches, Waste Receptacles, Bike Racks), Parking Buffer Between Pedestrians and Adjacent Traffic***

The Deficient Pedestrian Environment photo demonstrates a typical pedestrian environment in League City that lacks many of these elements. The sidewalk is too narrow; there is no buffer between the pedestrians and the adjacent fast-moving traffic; the area lacks shade trees; and obstacles are situated in the middle of the sidewalk that would clearly impede someone in a wheelchair.

***Deficient Pedestrian Environment along FM 518***

Other elements of a quality pedestrian realm are of a more aesthetic nature, but make an important contribution to a pleasant walking environment. These elements include the following:

- Minimum setback, such as buildings situated directly adjacent to the sidewalk, rather than having a large parking lot between the pedestrian and the building. This configuration gives the pedestrian an interesting environment to walk in, with opportunities for "window shopping." It helps to create a "street wall," or sense of enclosure on the street that contributes to the pedestrian's comfort level and can play a role in lowering traffic speeds.
- No "blank walls," i.e. large expanses of buildings with no windows
- Street furniture, such as benches, bike racks, waste receptacles
- Brick pavers and other kinds of decorative sidewalk and/or crosswalk material
- Street art
- Drinking fountains

**_Figure 3.1 – Roadway, Pedestrian, and Land Use Relationship_**

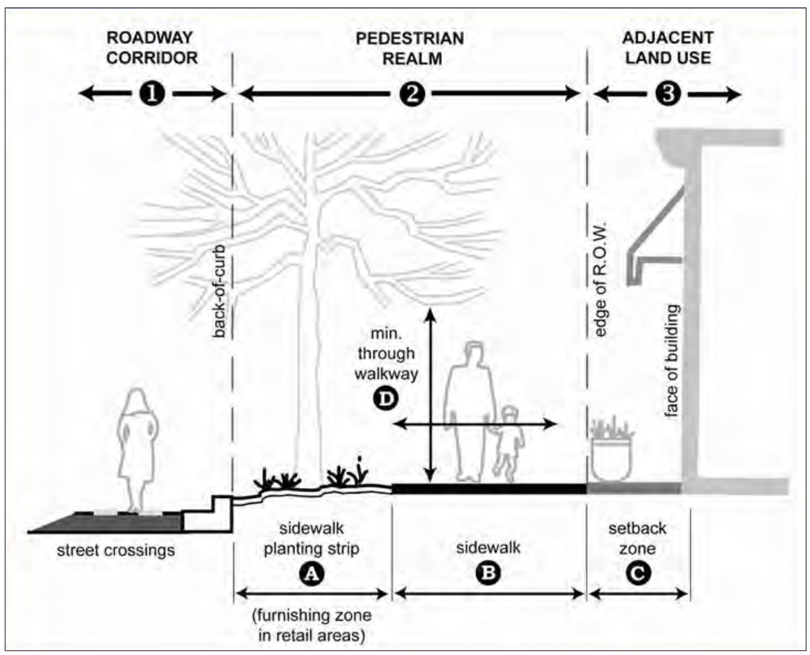



*Figure 3.1* presents the typical elements of and relationship among the roadway corridor, the pedestrian realm, and the adjacent land use, from ITE's *Designing Walkable Urban Thoroughfares*. This is an idealized representation. In reality **the pedestrian environment must be tailored to fit the context of the area in which it resides.** For example, a 10- to 12-foot sidewalk and no setback might be appropriate in a downtown or mixed-use area with retail and sidewalk cafés. However, it would probably make little sense in a purely residential area.

***FM 518 (E. Main Street)***

**While pedestrian improvements are needed in many locations throughout the community, League City officials have identified the stretch of E. Main Street (FM 518) between SH 3 and FM 270 as a priority for initial attention.** This is because this segment includes the Historic District, the city's beloved oak trees, and is in many ways a major "gateway" to League City. Unfortunately, much of this section of E. Main Street is both hostile to pedestrians and visually unappealing in terms of the prevailing landscape and business fronts. Large segments of the corridor have no sidewalks, the sidewalks that are present are often damaged and/or blocked with obstructions such as utility poles, there is very little landscaping or pedestrian-oriented lighting outside of the Historic District, and pedestrians have no safety buffer between them and adjacent fast-moving traffic.

Simultaneous to the development of this master mobility plan, the city has also been developing a Main Street Strategic Plan. Among the objectives of the strategic plan is to foster Main Street's evolution into more of a "destination" corridor, rather than the pass-through corridor that it is currently. **In its current form, Main Street is used primarily to travel in and out of town. As envisioned, it would become a location with a variety of shops, restaurants, and other recreational attractions that would entice residents and visitors to come into the area, park once, and walk among the attractions.** This transformation from an "auto-focused" to a "people-focused" corridor, of course, could have potential traffic throughput ramifications for the rest of the city. It essentially would heighten the need for improvements to the city's other major east-west corridors (FM 646, League City Parkway), as these corridors would need to absorb some of the pass-through traffic from E. Main Street.

In public meetings regarding the Main Street Strategic Plan, League City residents expressed their desire for Main Street to accomplish the following:

- Foster a sense of pride in League City;
- Offer places to live, work, shop, play, and gather;
- Provide an exciting, competitive place to open/maintain a business;
- Incorporate nature to the greatest extent possible; and
- Establish and maintain sustainable services, facilities, and infrastructure.

These are lofty goals that will take efforts across a broad spectrum of areas, both in the public arena (city government) and the private arena (business). **While their influence should not be overstated, pedestrian streetscape improvements are key ingredients that can serve as an important foundation for the redevelopment of an area.**

A detailed inventory of the existing pedestrian streetscape conditions on FM 518 between SH 3 and Five Corners was conducted. The results of this inventory are presented in *Appendix D*, along with detailed methodologies for using these data to quantify the benefits associated with improving the pedestrian realm. Quantifying these benefits is often a key component in the pursuit of funding assistance for streetscape projects. These benefits include elements such as reduced congestion and improved air quality.

***Pedestrian Nexus to Transit***

A quality pedestrian network has value not only as a travel mode in and of itself, but also for the support that it provides to other modes such as transit. As discussed in Chapter 7, every transit rider starts and ends his or her trip as a pedestrian. Thus, quality pedestrian facilities within a minimum one-quarter mile radius of every transit stop are vital to making the transit service accessible to users. No matter how first-rate the transit service itself may be, if potential riders cannot walk safely and comfortably to their boarding locations, and then walk to their ultimate destinations once they exit the transit vehicle, they will be disinclined to use transit as their transportation mode of choice.

***On-Street Bicycle Lanes***

A bicycle lane is defined as a portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists.[2] The width of the bike lane will vary depending on the configuration of the roadway (i.e., presence/lack of on-street parking, curb and gutter); however, bike lanes are typically four to five feet in width.[3]


***Courtesy: www.pedbikeimages.org/Dan Burden***

***On-Street Bicycle Lane***

**League City currently does not have any on-street bicycle lanes**. There is a demand for them, however. During the development of the 2006 *Parks and Open Space Master Plan,*[4] 64% of surveyed residents rated "on-street bike lanes" as either "very important" or "important."

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[2] *Guide for the Development of Bicycle Facilities, 3rd Edition*, American Association of State Highway and Transportation Officials (AASHTO), 1999.

[3] *University Course on Bicycle and Pedestrian Transportation, Lesson 15: Bicycle Lanes,* Federal Highway Administration, Jul 2006.

[4] *Parks and Open Space Master Plan,* Wallace Roberts & Todd, Nov 2006.

***Shared-Use Paths***

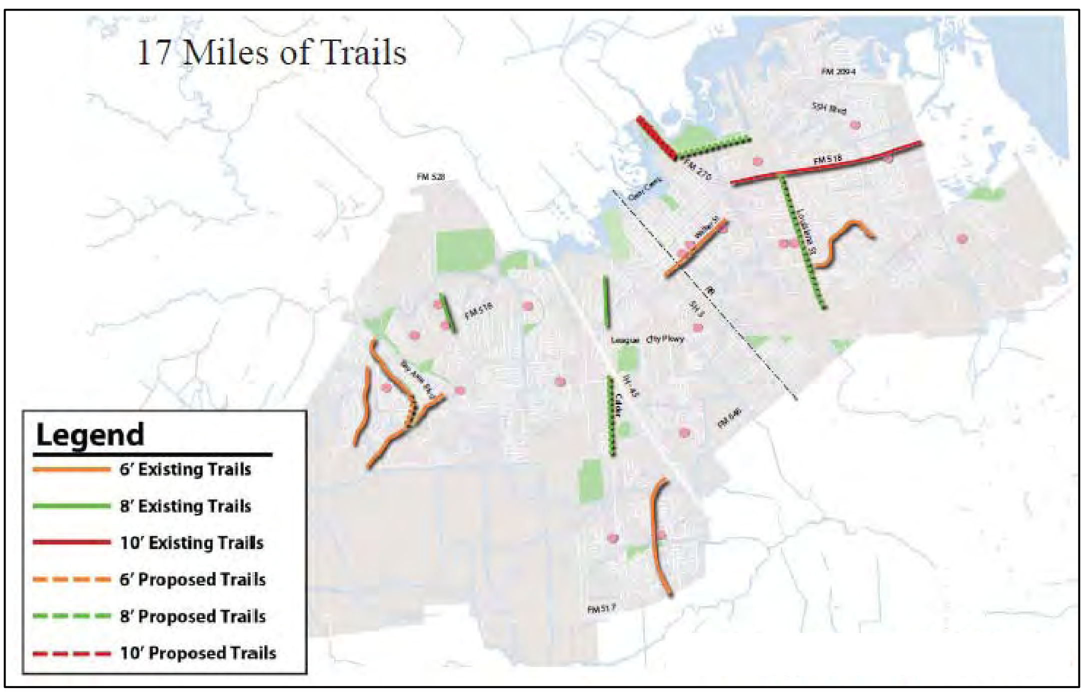
A shared-use path is a transportation/recreation facility that is physically separated from motor vehicle traffic by an open space or barrier.[5] It accommodates various types of users and activities, such as walking, running/jogging, bicycling, and skating. The surface of a shared-use path is typically asphalt, concrete, or firmly packed crushed aggregate.[6]

***Shared-Use Path***

*Courtesy: www.pedbikeimages.org/Reed Huegerich*

**Shared-use paths are few and far between in League City.** As shown in *Figure 3.2*, there are a mere 17 miles of existing and planned paths, which includes 11.5 miles on the ground today and 5.5 miles that are funded for future implementation. However, the city aspires to develop a much more extensive network of shared-use paths for both the mobility and recreational needs of its citizens. Two plans provide the framework for this effort: the 2006 *Parks and Open Space Master Plan* and the 2010 *Trails Master Plan.*[7]

***Figure 3.2 – Existing and Proposed Shared-Use Paths***




***Source: 2010 Trails Master Plan***

[5] *Guide for the Development of Bicycle Facilities, 3rd Edition,* AASHTO, 1999.
[6] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide,* Federal Highway Administration, Sep 2001.
[7] *League City Trails Master Plan,* Clark Condon Associates, May 2010.

***"System of Trails"***

The 2006 *Parks and Open Space Master Plan*, the City's overall parks plan, describes a "system of trails" concept for creating a comprehensive, connected network of shared-use paths in League City. Indeed, the creation of such a citywide network is number two among the City's top five priorities discussed in the 2006 plan. **The plan recommends that a community provide at least one acre of trails per 1,000 residents. The City is deficient in meeting this goal, having only 0.6 acres of trails per 1,000 residents at the time of publication of the 2006 plan.**

A public survey conducted during development of the parks and open space plan confirms League City residents' strong support for a comprehensive network of shared-use paths and their belief that there currently are an insufficient number of paths in League City. When asked about future projects that the City should allocate resources toward, 78% responded that it is either "very important" or "important" to pursue "off-street paths for hiking/jogging/biking." When asked about the City acquiring land for the purpose of preserving open space, 74% believe it is either "very important" or "important" that some of the land be used for "potential trail corridors."

At the end of the survey, respondents were able to offer open-ended comments on any subject. Of the 913 comments received, 155 comments were related to trails and the desire for a better trail network in League City. This represents 17% of all comments, the highest amount received by any single topic.

**Because much of League City has been built-out without provisions made for trail facilities, the 2006 plan notes that one of the best ways to incorporate a trail network may be to take advantage of existing service corridors, such as utility easements, railways, and drainage ditches.** In developed areas, where infrastructure corridors are unavailable, streets could be reconfigured to incorporate multi-use trails or bicycle lanes. The 2006 plan recommends two policies specifically related to the acquisition and development of trails and bicycle facilities:

- *Policy 11 –*

  "In planning and designing the future transportation improvements, major road corridors shall be adequately sized and intentionally designed to permit the inclusion of on- or off-road trail facilities, as appropriate. The City shall investigate opportunities to reconfigure existing arterial and collector road rights-of-way in order to create an accessible citywide greenway and trail network linking different sectors of the city."

- *Policy 10 –*

  "In order to achieve continuity in a linked network of pedestrian and bicycle greenways and trails, the City shall seek, where appropriate, to acquire easements for such purposes from the landowners of existing infrastructure corridors. The City shall work with other local governments, utility agencies, and private landowners to secure such voluntary agreements so as to create a linked trail system between public parks and other major destinations."

New shared-use paths have recently been constructed in League City under the purview of TxDOT. The 2006 plan mentions TxDOT's intention to develop trails along FM 518 and SH 96, spanning the entire width of the city. Subsequently, a 10-foot wide cement trail has been installed along FM 518 from the FM 518/FM 270/FM 2094 (Five Corners) intersection east to SH 146. The timeline for completion of the remainder of this FM 518 trail is unclear at this time. Plans for a trail on SH 96 have been suspended, and the money refunded to TxDOT. However, TxDOT has installed a 10-foot wide cement trail "stub" on the south side of the new SH 96 interchange with IH 45, with the intent that it could be used as a connector to a longer trail in the future. TxDOT also is considering plans for a trail along FM 270, from the Five Corners intersection southward.

***FM 518 Cement Trail***

***2010 Trails Master Plan***

The 2010 *Trails Master Plan* is dedicated specifically to making detailed recommendations for a citywide trail network.

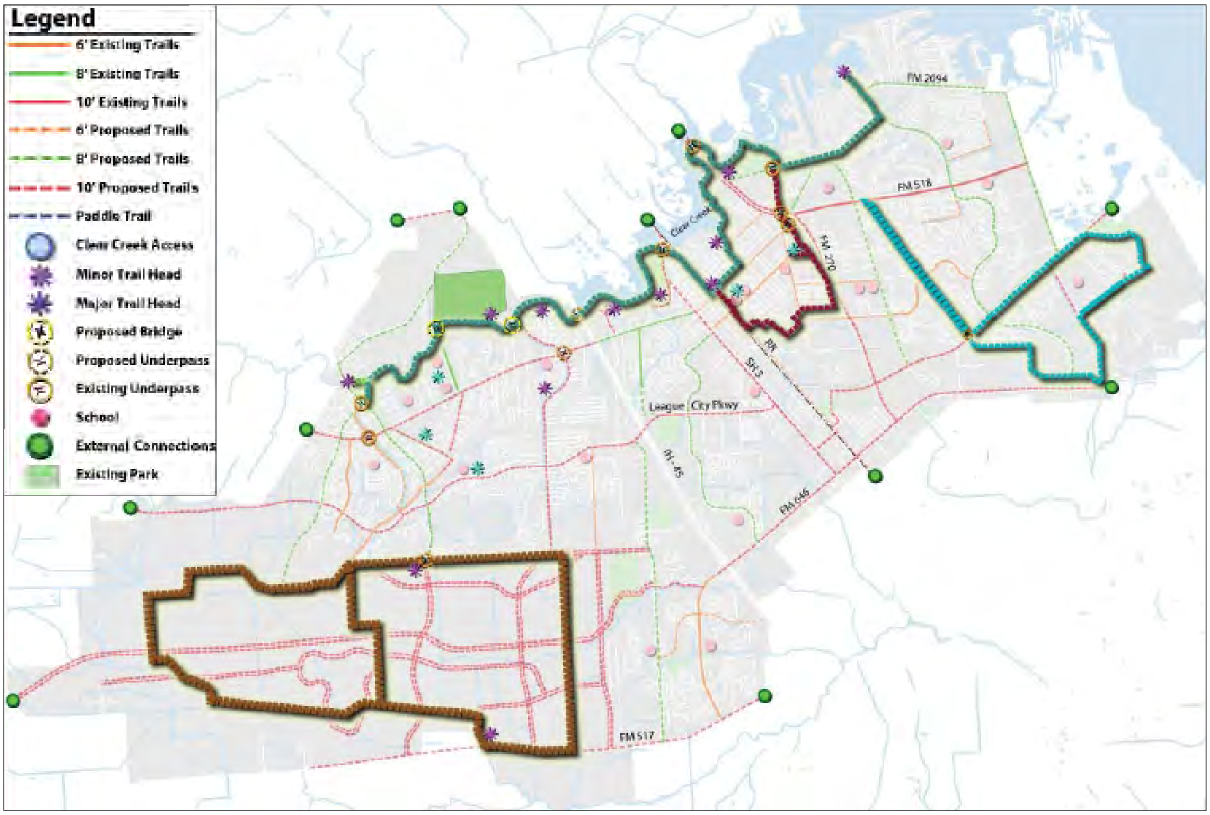
**The *Trails Master Plan* presents an ambitious vision of 212 miles of off-road trails throughout League City.** The proposed trail network is designed to serve four primary purposes, in response to desires expressed by the public, as follows:

- Connections
    - Between schools, parks, neighborhoods, business centers
- Commuting
    - Safe routes to work
- Community Well Being
    - Recreation, exercise
- Athletic Training
    - Running/jogging, biking

According to the 2010 plan, there are currently a mere 11.45 miles of trails in League City, which equates to 0.18 miles per 1,000 people. Full build-out of the trail network laid out in the 2010 plan would bring this number to 1.4 miles of trails per 1,000 people. The network includes 6-, 8-, and 10-foot trails of varying trail materials implemented in four thematic zones across the city. Trails corridors would be developed using public ROW (city, state, or county); drainage or utility easements; open/green space (city, state, or county owned); and/or cooperation with civic uses (schools, churches, municipal facilities, etc). In the mostly undeveloped southwestern quadrant of the city, the 2010 plan recommends getting ahead of development to ensure trails are incorporated initially, rather than trying to retrofit infrastructure after it has already been built. The 2010 plan also makes recommendations for signage and amenities along the trails.

It is envisioned that full build-out of this network would be a 20+ year effort, with a cost of just over $100 million (in 2009 construction costs). This total does not include land acquisition or annual maintenance costs. *Figure 3.3* illustrates the full trail network.

***Figure 3.3 – Trails Master Plan Network***




***SPECIAL ISSUE – GOLF CARTS***

A growing number of League City residents own golf carts and many are looking to expand their use beyond the golf course. In recent years, residents have begun to use golf carts as a convenient alternative to the automobile, particularly for near-home trips to a neighbor's house, to drop off children at school, or take a trip to the park. However, many have wondered if this growing trend could be expanded to allow golf carts to freely travel alongside cars.

In accordance with federal guidelines, the State of Texas differentiates between Low-Speed Vehicle (LSV) and Neighborhood Electric Vehicle (NEV). A traditional golf cart is considered LSV and is limited to a top speed of 25 mph. By Texas State Law, travel by golf cart is fairly limited and must be specifically authorized by the City. Golf carts can be permitted on roadways within master planned communities, on a public/private beach, and on roadways where the posted speed limit is 35 mph or less. Additionally, travel must take place in the daytime and within two miles of the operator's home.

By contrast, NEVs are held to the federal standards associated with motor vehicles. As a result, NEVs are allowed wider latitude. In addition to the places permitted to golf carts, NEVs are allowed along all public roadways with a speed limit that does not exceed 45 mph and are allowed to travel at a maximum speed of 35 mph. League City could choose to place additional restrictions on NEVs if determined to be appropriate.

While League City has discussed the concept of allowing use of golf carts or NEVs along community roadways, a growing number of communities across the country are utilizing these small electric vehicles to promote an alternative to the automobile and to establish an identity as a "green" community. For example, Peachtree City, Georgia, actively promotes the use of golf carts as a means of moving throughout the city, including publication of a map that directs users to paths and streets upon which golf carts may travel. Within the area, Nassau Bay and Clear Lake Shores allow golf carts on local roadways.

### *TRANSIT MODES*

**Public transit, in its many forms, can provide an important alternative to automobile travel and thereby contribute to decreased congestion.** It is also a critical source of mobility for those who either do not have an automobile or cannot drive one due to some limitation such as age or physical disability. Past, present, and potential future transit services in League City include Commuter Rail Technology (CRT) and/or Bus Rapid Transit (BRT), regional bus (park & ride), fixed-route local bus, and demand-response service. The following addresses the prevailing mindset toward transit in League City, the city's demographics as they relate to transit, the current state of service in League City across the various types of transit, and guidelines for the provision of successful transit service.

#### *League City Past and Present Attitudes, Experience with Transit*

The development of this master mobility plan included the opportunity for League City residents to complete a survey in which they could offer their opinions, comments, and concerns about mobility issues. A number of questions on the survey dealt specifically with the subject of transit. The responses to these questions, presented below, indicate the ways League City residents do and do not use transit, and their prevailing views on transit in general. Note that percentages may not always sum to 100% due to some respondents choosing more than one answer.

**Q:** If local public transit (internal to League City) were available, how likely would you be to use it?

- Very Likely: <u>8%</u>
- Likely: <u>24%</u>
- Unlikely: <u>39%</u>
- Very Unlikely: <u>27%</u>

**Q:** If regional public transit (e.g., park & ride or commuter rail to Houston and/or Galveston) were available, how likely would you be to use it?

- Very Likely: <u>17%</u>
- Likely: <u>34%</u>
- Unlikely: <u>29%</u>
- Very Unlikely: <u>19%</u>

**Q:** What is the biggest factor that would determine whether you decided to use transit or not?

- Where it goes: 61%
- Frequency: 18%
- Cost: 7%
- How far I have to walk to get to it: 8%
- Other: 9%
- I wouldn't use transit no matter what: 14%

**Q:** Do you currently use any public transit services offered in the region? *(select all that apply)*

- METRO Park & Ride: 12%
- METRO local buses and/or light rail: 10%
- Mall of the Mainland Park & Ride: 0%
- Other: 3%
- No, I never use public transit: 79%

In another question, residents were asked about what they regard as League City's most pressing mobility problem. Only 9% of respondents felt the city's lack of public transit is the biggest problem. Of course, this result is not surprising given the city's roadway congestion and the public's intense focus on it. Similarly, only 10% said implementing public transit would be the best solution for League City's mobility problems.

**As the survey responses show, public attitudes toward transit could probably be characterized as tepid at best.** The majority of residents (79%) do not use transit at all, and a total of 67% responded they would be either unlikely or very unlikely to use local transit. Acceptance of regional transit (e.g., CRT or park & ride) is somewhat better, with 52% responding they would be either likely or very likely to use it.

It is difficult to know whether the predominant opinions surrounding transit in League City are based on past experience with transit, unfounded pre-conceived notions, or other factors. More in-depth studies in the future may serve to uncover this information. In any case, prior to the design of a specific transit system it is helpful to know the priorities and concerns of the potential customer base.

***Choice Versus Captive Riders***

An important distinction to understand in transit is the notion of choice versus captive riders. **Choice riders are those transit users who own or otherwise have access to a vehicle, but choose to use transit at least some of the time because of some perceived benefit. Captive riders, on the other hand, are those who do not own or have access to a vehicle, or perhaps cannot operate one due to some physical or other limitation.** These riders use transit as their primary means of transportation because they have few other options. For this reason, captive riders are also commonly referred to as the transit dependent. Captive riders are most often those members of the population who are low income, elderly, and/or disabled. Pre-teens and teenagers who have yet to reach driving age are another group of potentially captive riders for whom transit can provide an important source of mobility.

It should be noted that the distinction between choice and captive riders is most applicable to *local bus* transit. Higher forms of transit, such as commuter bus (i.e., park & ride) and rail transit tend to offer more amenities and, as such, have an easier time attracting choice riders.

**The demographics of League City residents point to a population likely to have relatively few captive riders.** First, League City is a relatively affluent community. The median household income in League City is $80,432, as compared to $52,175 for the United States as a whole.[8] League City residents also have high rates of automobile ownership. Approximately 98% of League City households own at least one vehicle, with 71% owning two or more vehicles. Not surprisingly, the vast majority of League City job holders commute to work by driving alone in a private vehicle. *Table 3.2* presents the means of transportation to work for League City workers age 16 and over.

***Table 3.2 – Means of Transportation to Work***

| ***Transport Mode*** | ***Percentage*** |
|---|---|
| Drive Alone | 83.4% |
| Car Pool | 10.1% |
| Public Transportation | 0.8% |
| Walk | 1.0% |
| Motorcycle | 0.4% |
| Bicycle | 0.4% |
| Other Means | 1.6% |
| Work from Home | 2.4% |

***Source:*** 2006-2008 American Community Survey (U.S. Census Bureau)

As previously mentioned, the elderly and disabled also represent important segments of the captive rider population. In League City just over 4% of the population is 65 years of age and over, and approximately 7% of the population is disabled.[9]

Combined, income, automobile ownership rates, and the presence of elderly and disabled comprise what is referred to as *transit need*. **League City's high median income, high auto ownership rates, and relatively few disabled and elderly residents indicate that the transit need (for *captive* riders on local transit) can be characterized as *low*.**

However, transit service can be successful even in a community such as League City, where transit need is low. In such a place, transit can thrive when it does a good job of attracting *choice* riders. A later section in the chapter will discuss the aspects of transit service that can make it appealing to choice riders, as well as other fundamental characteristics that must be in place for transit to be feasible.

Presented next is a discussion of the current state of transit service in League City, across the various types of transit.

[8] 2006-2008 American Community Survey, U.S. Census.
[9] 2008 American Community Survey, U.S. Census.

***Commuter Rail***

***GH&H Rail Line in League City***

There is currently no commuter rail service offered in the Houston-Galveston region. However, an appreciation for the role that commuter rail can play in regional mobility is gaining momentum. Several corridors have been and are being actively studied for their feasibility to accommodate commuter rail. One of these is the Galveston, Houston, & Henderson (GH&H) freight rail line, which is the rail alignment running roughly parallel to SH 3 and connecting central Houston to Galveston Island. This freight rail line traverses 11 cities between Houston and Galveston, including League City. The relatively small amount of freight traffic on this line (8 to 10 trains per day, exclusive of Houston's inner core) makes it an attractive candidate for commuter rail use.

Houston-Galveston Area Council (H-GAC) recently commissioned a regional commuter rail study.[10] Sixteen corridors initially were screened, with the top five being carried through for more in-depth analysis *(Figure 3.4)*. **Of these five, the GH&H was shown to have the highest potential ridership.** This is not surprising, given that the alignment has major job centers at both ends as well as major job and activity centers such as the Johnson Space Center and the Clear Lake Regional Medical Center along the corridor. **Also, because of the tourist attractions in Galveston, demand for passenger rail in this corridor could support weekend service, in addition to peak-period weekday service.**

[10] "Regional Commuter Rail Connectivity Study," Kimley-Horn & Associates, Sep 2008.

***Figure 3.4 – Regional Commuter Rail Candidates***


An in-depth advanced planning report focusing on the commuter rail potential of the GH&H has been completed under the auspices of the City of Galveston.[11] The report examines potential ridership, technology alternatives, capital and operating costs, utility for emergency evacuation, environmental impacts, Transit-Oriented Development (TOD) opportunities, organizational oversight options, and funding and implementation strategies.

As with any project of such a magnitude, there are numerous challenges to implementation on many fronts, as follows:

- Identify a viable way of penetrating the heavily congested freight routes in Houston's inner core;
- Secure necessary funding for both initial construction and ongoing operations;
- Create a new entity or identifying an appropriate existing entity to oversee and run the commuter rail operation; and

[11] "Galveston-Houston ITS Commuter Rail Study," The Goodman Corporation, Dec 2007.

- Garner the political will, support, and cooperation of the multiple municipalities and counties along the corridor.

These are only a few examples of the significant challenges that will have to be successfully overcome before commuter rail in this corridor can become a reality.

In spite of the daunting nature of these challenges, they are not insurmountable. The City of Galveston report confirms the basic feasibility of passenger rail along this alignment and the strong role that commuter rail can play in increased mobility and other benefits for the IH 45 south corridor. Specifically, commuter rail in the Gulf Freeway corridor is projected to produce the following ridership, air quality, and economic benefits:

- Weekday ridership – 11,500 trips per day by 2030
- Reduced VMT – 51.7 million miles per year
- Reduced fuel consumption – 425,000 gallons per year
- Reduced automobile emissions – 509 tons per year
- Development value added - $1.1 billion over 20 years
- Jobs added – 21,000 over 20 years
- Increased municipal tax revenues – $131 million over 20 years
- Evacuation capacity – 2,500 persons per 24-hour period
- Reduced travel time/delay – 1.3 million hours annually

FTA's New Starts program is the mechanism through which aspiring passenger rail programs compete nationally for federal funding. The planning process for commuter rail in the Gulf Freeway corridor has officially entered the first phase of the New Starts process, known as Alternatives Analysis (AA). AA is completed locally by the entity (i.e., municipality or transit agency) desiring to implement the rail project. In the case of the Gulf Freeway corridor, the AA is being executed by a transit consultant on behalf of the City of Galveston and is expected to be completed in 2011.

During AA, commuter rail along with other potential mobility solutions for the corridor are subjected to a rigorous screening and evaluation process across criteria such as ridership, costs, environmental impacts, property impacts, travel time, air quality improvements, and a host of others. The mobility alternatives being evaluated in this corridor include not only CRT, but also BRT and TSM. The end result of the AA process is the selection of a Locally Preferred Alternative (LPA). The LPA will be recommended to the Federal Transit Administration (FTA), who, in turn, will review the AA document, evaluate the merits of the LPA as compared to the other alternatives considered, and make a final determination as to whether to allow the selected alternative to move into the next stage of the New Starts process, known as Preliminary Engineering (PE). Approval to move into PE is tantamount to a commitment that FTA will provide federal funds for the project in the amount of 50% of the total required capital costs, assuming both PE and an in-depth environmental impact assessment are successfully completed. Local entities are responsible for the remaining 50% of capital costs, as well as 100% of operating costs.

Should CRT be selected as the LPA, the AA process will identify the most operationally appropriate locations for CRT stations along the 50-mile alignment. Station locations will be based on a number of factors, including potential ridership from the capture area around the station, proximity to other stations, and train speed. In addition to these operational aspects, there are also municipal issues such as land availability, local funding share, and transit oriented development potential.

Recommendations for League City with respect to participating in the CRT effort and potential station locations are discussed in Chapter 7.

***Bus Rapid Transit***

As mentioned, BRT is being studied as a potential mobility solution for the Gulf Freeway corridor as an alternative to, or even in addition to, commuter rail. BRT is a form of bus transit that can provide service comparable to rail by operating in an exclusive lane or guideway, and by utilizing distinctive vehicles and stations/platforms that have many features in common with those of rail service. In many cases BRT actually has an advantage over rail service due to its ability to leave the exclusive lane or guideway and circulate through a particular area, such as a downtown, in order to distribute passengers closer to their final destination than a rail car would be able to. BRT is being studied for implementation on either IH-45 or SH 3.

League City's considerations with respect to BRT are virtually the same as they are for CRT.

***BRT Examples***

***Regional Bus (Park & Ride)***

**There are existing park & ride commuter bus services available to League City residents, although not within League City's boundaries. Planned services would establish park & ride service in League City.**

***METRO Commuter Bus***

Being nearly equidistant between two major job centers (downtown Houston and Galveston Island) makes League City a unique demand generator for bi-directional regional transit service. However, until recently, the only regional transit service in proximity to League City was METRO's northbound service out of the Bay Area Park & Ride and Park & Pool facilities *(Figure 3.5)*.

Recent increased activity in park & ride facility planning and development in and around League City means that residents could soon have several more options for regional bus service.

***Figure 3.5 – METRO Bay Area Park & Ride and Park & Pool Lots***


METRO's Bay Area Park & Ride is located at the corner of Bay Area Boulevard and Feathercraft Lane, approximately 4.5 miles north of the heart of League City. In addition to this lot, commuter buses serving the Bay Area Park & Ride also stop at a park & pool lot at the corner of Bay Area Boulevard and IH 45, before proceeding northbound via the IH 45 High-Occupancy Vehicle (HOV) lane. The two lots have a combined capacity of approximately 1,400 parking spaces. The park & ride lot typically is 75%-80% full, while the park & pool is consistently over capacity, with numerous cars parked in the grass surrounding the lot and in the parking lots of the surrounding retail centers. METRO currently charges $4.50 for a one-way trip between the Bay Area facilities and downtown Houston.

In a previous study, TxDOT provided the registration zip codes associated with the license plates of vehicles parked at the METRO facilities.[12] The registration ZIP Code presumably represents the home address of the owner of the vehicle. Of 219 vehicles parked at the park & pool on IH 45, 56 were determined to be registered in ZIP Code 77573, which is League City. This represents 26% of the ridership at the park & pool, and is the single largest percentage of any ZIP Code present. Similarly, the 77573 ZIP Code represented 13% of the ridership at the park & ride lot at Feathercraft. Only one ZIP Code (77062) had higher representation. Combined, the ridership at both lots originating from 77573 is 16%, which is the highest representation of any ZIP Code. **This is indicative of the large demand for northbound commuter services from League City.** A recent advanced planning report[13] studied both the northbound and southbound demand and made recommendations for two new park & ride facilities in League City, one each for northbound and southbound service.

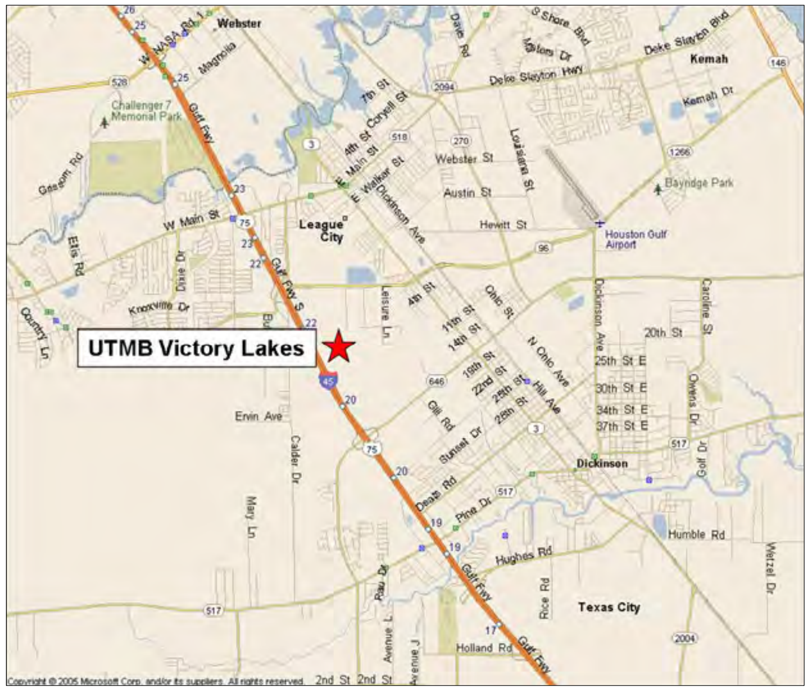
[12] *Mobility Plan Update for League City*, The Goodman Corporation, Sep 2002.
[13] *League City Park & Ride Advanced Planning*, The Goodman Corporation, Mar 2009.

**The recommended location for northbound service is the proposed mixed-use development at RiverBend, located just north of FM 518 and IH 45, along Clear Creek** *(Figure 3.6).* However, efforts to establish park & ride service at this location have stalled due to difficulties in identifying construction funding. The RiverBend development, as a whole, also has experienced development slow-downs as a result of the national recession.

***Figure 3.6 – Proposed RiverBend Mixed-Use Development***

**The recommended location for southbound park & ride service from League City is within the new University of Texas Medical Branch (UTMB) Victory Lakes medical campus.** This park & ride facility is currently under development, having been awarded an infusion of federal "stimulus" funds in August 2009. Completion is estimated in mid- to late 2011. For the first time, the facility will provide League City residents with regional transit service that travels southbound to Galveston.

***Figure 3.7 – UTMB Victory Lakes Medical Campus***




The 65-acre UTMB Victory Lakes campus is located directly adjacent to IH 45 (east side), between SH 96 and FM 646 *(Figure 3.7)*. The entire three million-square foot campus is planned to include a hospital, a specialty care center, medical office buildings, academic facilities, and retail. The park & ride facility will be on approximately four acres in the northwest corner of the campus and will accommodate approximately 450 parking spaces.

The UTMB Victory Lakes campus was chosen as the preferred location for southbound park & ride service for a number of reasons. UTMB Galveston, with 7,500 employees[14] on the island post-Hurricane Ike, is by far Galveston's largest employer. The majority of UTMB Galveston employees living off-island reside in League City. Therefore, UTMB has a vested interest in making the commute of its League City employees easier, particularly because parking on the UTMB Galveston campus is at a premium. Because of this, UTMB agreed to provide the land for the park & ride via a very low-cost ground lease. The park & ride facility will also enhance connectivity between the two UTMB campuses. It should be noted, however, that the park & ride facility will be open to the public, and NOT limited to use by UTMB employees. Approximately 10,000 trips originate daily from the mainland destined for UTMB, including not only UTMB employees but also patients, visitors, and students of the medical school. In addition to UTMB Galveston, the commuter buses also will make stops in Galveston at 25th and Harborside in downtown, 61st and Broadway, and the Moody Gardens/Schlitterbahn entertainment complex. The fare is likely to be approximately $6 to $7, round trip.

**Mall of the Mainland P&R Service.** A park & ride facility with southbound service to Galveston has been operating out of the parking lot at the Mall of the Mainland in Texas City since July 2009. A ridership analysis shows that only a small percentage of users (less than 10%) live in League City. This is likely

[14] *UTMB Back in the Black*, *Galveston County Daily News*, Nov 23, 2010.

because League City patrons have to drive 9 to 10 miles to get to this facility. With only another 15 miles to Galveston, most League City commuters are more likely inclined to make the entire trip by automobile. For those League City commuters who are currently using this service, it is expected that they would begin using the UTMB Victory Lakes facility when it becomes operational.

***Local Bus***

Local bus transit would serve destinations within League City and perhaps the immediate surrounding communities (i.e., Dickinson, Webster). This is differentiated from the regional transit service just discussed, which covers longer distances and is geared primarily toward the needs of commuters.

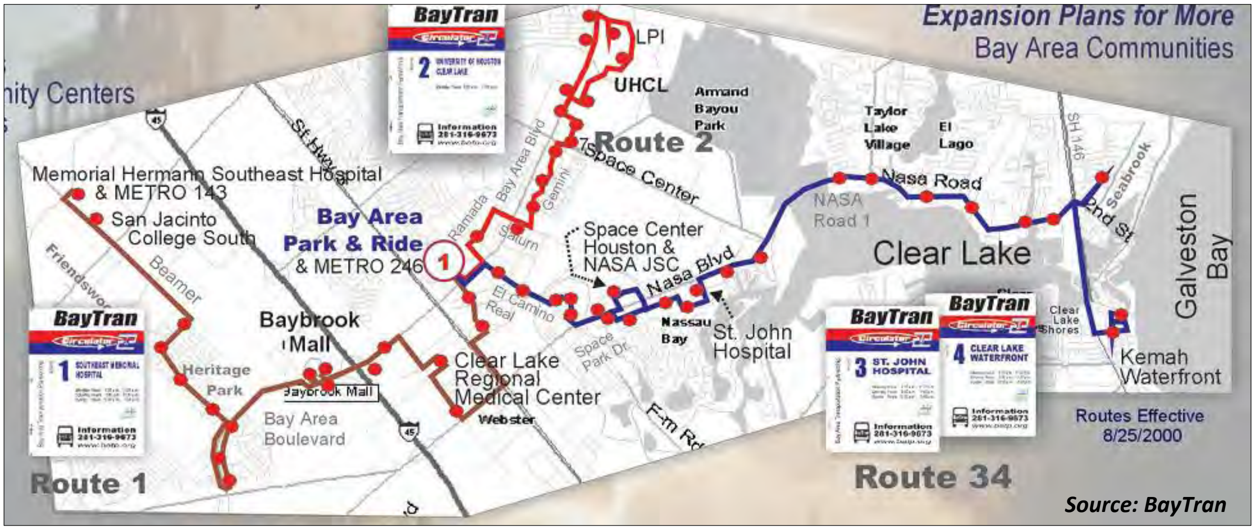
Local bus service can be either fixed route (i.e., following a specific route on a defined schedule) or demand response (i.e., no specific route, and buses come only when requested). Both types of service are discussed next.

***Fixed Route.*** **There is currently no local fixed-route transit service available in League City.** Previous attempts to implement such service in League City and the greater Clear Lake area have been largely unsuccessful.

Bay Area Houston Transportation Partnership (BayTran) operated a network of several fixed routes in the Clear Lake area from mid-2000 until late 2001. Initially, major destinations served included the Bay Area Park & Ride, San Jacinto College South, Memorial Hospital-Southeast, the University of Houston-Clear Lake, Baybrook Mall, Clear Lake Regional Medical Center, NASA/Johnson Space Center (JSC), Saint John's Hospital, and the Clear Lake (Kemah) waterfront, among others. The service operated seven days a week with extensive operating hours (M-F 6:30 a.m. to 11:30 p.m., Saturdays 9 a.m. to 11:30 p.m., Sundays 10:30 a.m. to 8 p.m.) and charged a fare of $1 per person per one-way trip. Three 19-passenger mini-shuttles served the routes. H-GAC provided funding for the service. *Figure 3.8* shows the initial routes included in the BayTran service.

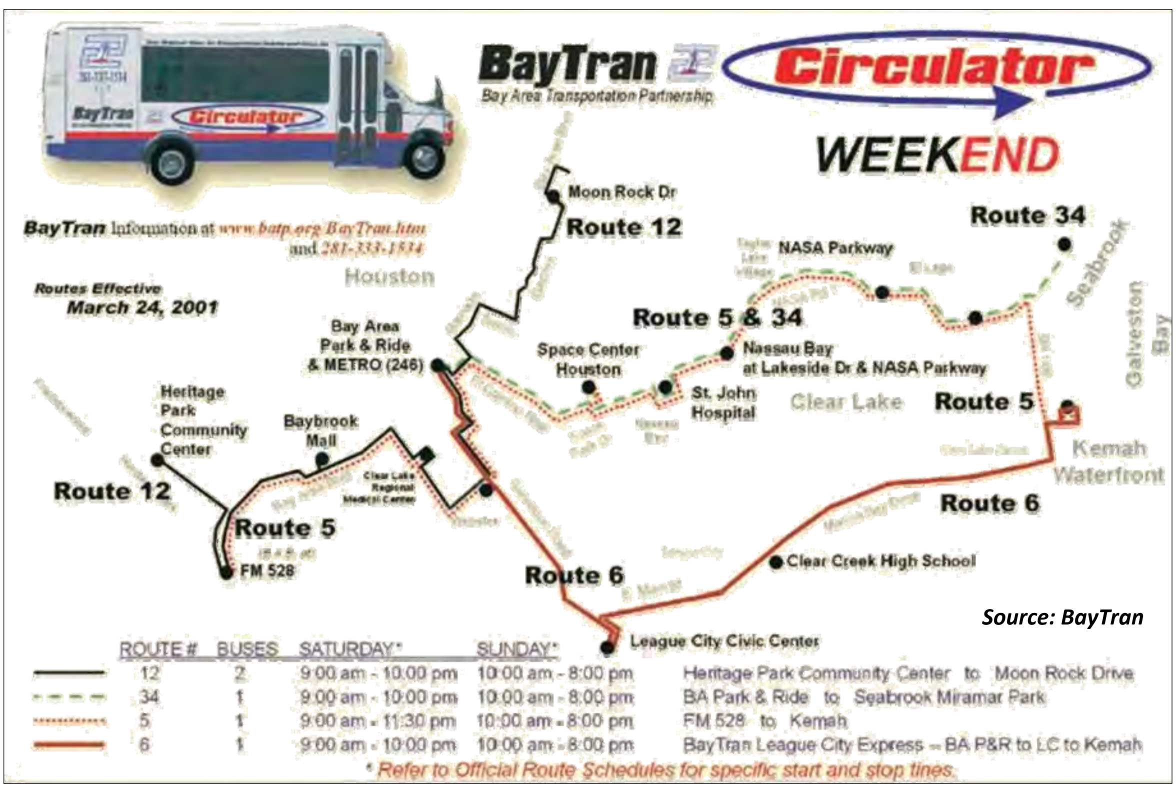

***BayTran Circulator Bus***

***Figure 3.8 – Original BayTran Circulator Routes***




BayTran expanded the service in March 2001, to include two additional routes and two additional buses. One of the additional routes, *League City Express*, operated on weekends only and served major League City destinations with the ability to transfer to other routes. *Figure 3.9* presents the weekend service routes, including Route 6, *League City Express*.

***Figure 3.9 – Expanded BayTran Weekend Service***



Route 6, *League City Express*, ran between the Bay Area Boulevard Park & Ride and the Kemah waterfront. Stops in League City included:

1. SH 3 at Walter Hall Park
2. League City Civic Center
3. E. Main Street at railroad crossing
4. E. Main Street at Wisconsin Avenue
5. E. Main Street at FM 270
6. Clear Creek stadium parking lot
7. FM 2094 at Clear Lake Shores

The BayTran transit service was cancelled after little more than one year of service. **Hindsight reveals that the service was poorly conceived and poorly executed, resulting in low ridership and high costs per passenger.**

With three to five buses covering more than 50 miles of routes, the bus arrival frequency (called *headway*) on most routes was between 1½ to 2 hours. Such frequencies make it virtually impossible for a potential user to plan a reliable transit trip.

The other fatal flaw in the design of the BayTran circulators lies in the notion that simply connecting a string of major destinations is sufficient to guarantee a successful transit service. The BayTran routes did indeed stop at a great many important destinations such as NASA/JSC, Clear Lake Regional Medical Center, Baybrook Mall, and Kemah Waterfront. However, successful transit must consider both Origins and Destinations (O&D), and the nexus between the two. **The BayTran circulator operating design failed to consider the importance of O&D pairs.** While the circulator may have connected a number of important destinations, those destinations did not necessarily have relationships with each other. The missing piece is an understanding of likely origins (i.e., where riders bound for those destinations are originating from) as well as when they are likely to be making that trip and why. This type of analysis could have allowed for better tailoring of the routes and operating hours. **As designed, the BayTran circulator effort was overly ambitious, with too few buses attempting to cover too large an area for too extended a period each day.**

A question on the mobility survey given to League City residents asked whether respondents had used the BayTran circulator and if not, why not. Ninety-seven percent had not used it. While one-third of those people had not used it because they did not yet reside in League City at the time, another third stated that they did not use it because they were unaware of it. This underscores the importance of information availability about the transit service, which will be discussed in further detail later in the chapter. In the case of the BayTran circulator, the lack of awareness went beyond simply not knowing where or how to use the service. Potential patrons were apparently completely unaware that the service even existed. Better marketing could have resulted in higher ridership, at least initially. Of course, unless the other problems just discussed were corrected, ridership would likely have still dropped off because of the low quality of the service.

***Fixed-Route Transit Services in Communities Surrounding League City.*** **While there is no fixed-route transit service within League City's boundaries, there is existing service in many of the surrounding communities and additional routes in the planning stages**. Dickinson, Texas City, La Marque, Seabrook, Kemah, and the Clear Lake/NASA Parkway areas are some of the places where fixed-route transit is or will be operating. Chapter 7, *Transit Recommendations*, will discuss the relationship between potential League City transit and these other services.

***Demand-Response Service***


***Typical Demand-Response Vehicle***

**A form of transit known as demand response is currently available to League City residents.** Demand-response service, also known as paratransit or dial-a-ride, is a transit service in which the rider calls the transit provider to request a ride from a specific origin to a specific destination. The transit provider may require an advance reservation for a ride, such as 24-hour notice. The use of demand-response transit typically is limited to the disabled, the elderly, and their attendants. Demand-response service differs from conventional transit in that the vehicles do not operate on a fixed route or on a fixed schedule, and typically offers curb-to-curb, or even door-to-door, service. Rides may be shared, meaning several passengers may be picked up in the same vehicle from common or different origins and dropped off at common or different destinations.

Demand-response transit in League City is provided by the transportation division of the Gulf Coast Center (GCC), known as Connect Transit. GCC is a mental health and mental retardation social services agency serving Galveston and Brazoria counties. Connect Transit offers its demand-response service to the public, rather than limiting it to disabled and elderly riders. Fares are $1 per person per trip within Galveston and Brazoria Counties, and $3.50 per trip into Harris County. Trips that both start and end within Island Transit's service area on Galveston Island are not provided, nor are trips that both start and end within Harris County.

**Generally, the number of League City residents who take advantage of the demand-response service offered by Connect Transit is very modest.** A representative sample of ridership data was provided by Connect Transit for the year beginning July 1, 2008, and ending June 30, 2009. The data show that Connect provided 56,803 total trips during that one-year timeframe. Of these, 1,063 trips originated from League City and 1,077 trips terminated in League City. The 2,140 total trips (approximately six trips per day) beginning or ending in League City during the sample period represent less than 4% of Connect's total trips. Furthermore, an in-depth analysis of trips by address shows that it is actually just a handful of riders using the service repeatedly, such as to go to dialysis appointments. For example, approximately two-thirds of the trips originating in League City during the sample period (440 trips) come from only five distinct origins. *Table 3.3* shows the top five origin and destination cities for League

City riders and the percentage of total League City trips represented by each city. The remainder of the trips to and from League City was distributed among 13-15 additional cities in Galveston, Brazoria, and Harris Counties.

| ***Table 3.3 – Annual Demand-Response Transit Service To and From League City*** | | | |
|---|---|---|---|
| ***Trips Originating in League City (1,063)*** | | ***Trips Ending in League City (1,077)*** | |
| ***Going To*** | ***% of Total*** | ***Coming From*** | ***% of Total*** |
| Texas City | 34% | Texas City | 35% |
| League City | 14% | League City | 14% |
| Dickinson | 14% | Dickinson | 14% |
| Galveston | 12% | Galveston | 12% |
| La Marque | 11% | La Marque | 12% |
| ***Source:*** Connect Transit | | | |

**As *Table 3.3* shows, among riders who are using demand-response transit to travel to or from League City, the greatest interchange takes place between League City and Texas City, with over one-third of the trips.** It is also worth noting that only 14% of League City-based trips stay internal to League City.

As with the BayTran circulator, use of the Connect Transit service reflects League City's lukewarm embrace of transit. Even though the Connect service is open to the public, it is often the elderly and disabled who benefit from and use demand response transit the most. Therefore, the fact that the elderly and disabled population in League City is relatively small may contribute to the low usage of the Connect service. A simple lack of awareness of the service likely plays a role as well.

***Factors for Successful Transit***

As discussed, League City is characterized by a large number of potential *choice* transit riders, rather than *captive* riders. What follows is a discussion of those factors that most play a role in the success of transit service. This is particularly important for a community like League City where the service will need to be of sufficient quality to lure choice riders. While these factors are applicable to all forms of transit, a distinction will be made between local and commuter transit, since it tends to be easier to attract choice riders to commuter transit than to local transit.

***Density***

Overall transit need has already been discussed in terms of its relevance to the provision of transit service. Perhaps equally important to whether transit can succeed in a particular locale is the density of land uses. Transit exists to serve origins (typically households) and destinations (jobs, retail, etc.). **Being able to serve O&D in an efficient, cost-effective manner requires land use patterns that meet certain minimum densities.** When development is compact, the resources expended to serve a given number of potential riders are decreased. By contrast, attempting to serve low-density development with transit wastes time, wastes fuel, and generally leads to higher labor and operating costs. Ultimately, these all lead to bad service, which results in poor ridership.

**Residential density (i.e., concentration of origins) plays an important role in the viability of transit.** A certain minimum density (generally expressed as dwelling units per acre) is needed to support any transit at all, and higher levels of transit can be supported as density increases. *Table 3.4* presents the generally accepted minimum densities required to support various forms of transit, ranging from minimum bus service to commuter rail. The exception to the correlation between higher densities and higher transit service is commuter rail, which can function with residential densities as low as 1 to 2 dwelling units per acre. This is because commuter rail has a much larger capture area (i.e., the distance riders are willing to travel to get to the train station) than other forms of transit, and because the riders generally arrive at the station via automobile.

***Table 3.4 – Minimum Residential Densities Needed to Support Transit***

| ***Mode of Travel*** | ***Service Level*** | ***Distance Between Routes*** | ***Service Per Day*** | ***Minimum Necessary Dwelling Units per Residential Acre*** | ***Comments*** |
|---|---|---|---|---|---|
| Bus | Minimum | 1 to 2 miles | 20 buses | 4 | |
| Bus | Intermediate | 1 to 2 miles | 40 buses | 7 | Average varies as function of downtown size/ distance from residential area to downtown |
| Bus | Frequent | 1 to 2 miles | 120 buses | 15 | |
| Light Rail | 5 minutes between rush-hour trains | 25 to 100 sq. mile corridors | *(see Service Levels)* | 9 | To downtown of 20 to 50 million sq. ft. of non-residential floor space |
| Rapid Transit | 5 minutes | 100 to 150 sq. mile corridors | *(see Service Levels)* | 12 | To downtown larger than 50 million sq. ft. of non-residential floor space |
| Commuter Rail | 20 trains/day | n/a | 20 trains | 1 to 2 | Only to largest downtowns, if rail line exists |

***Source:*** *Where Transit Works,* Zupon & Pushkarev, Aug 1976.

*Figure 3.10* shows current residential densities in League City. This map shows in very concrete terms what previously has been discussed anecdotally – namely, that residential densities in League City are extremely low. **The highest density areas are approximately two dwelling units per acre, with the majority of the city far below that level.**

***Figure 3.10 – Current League City Residential Densities***

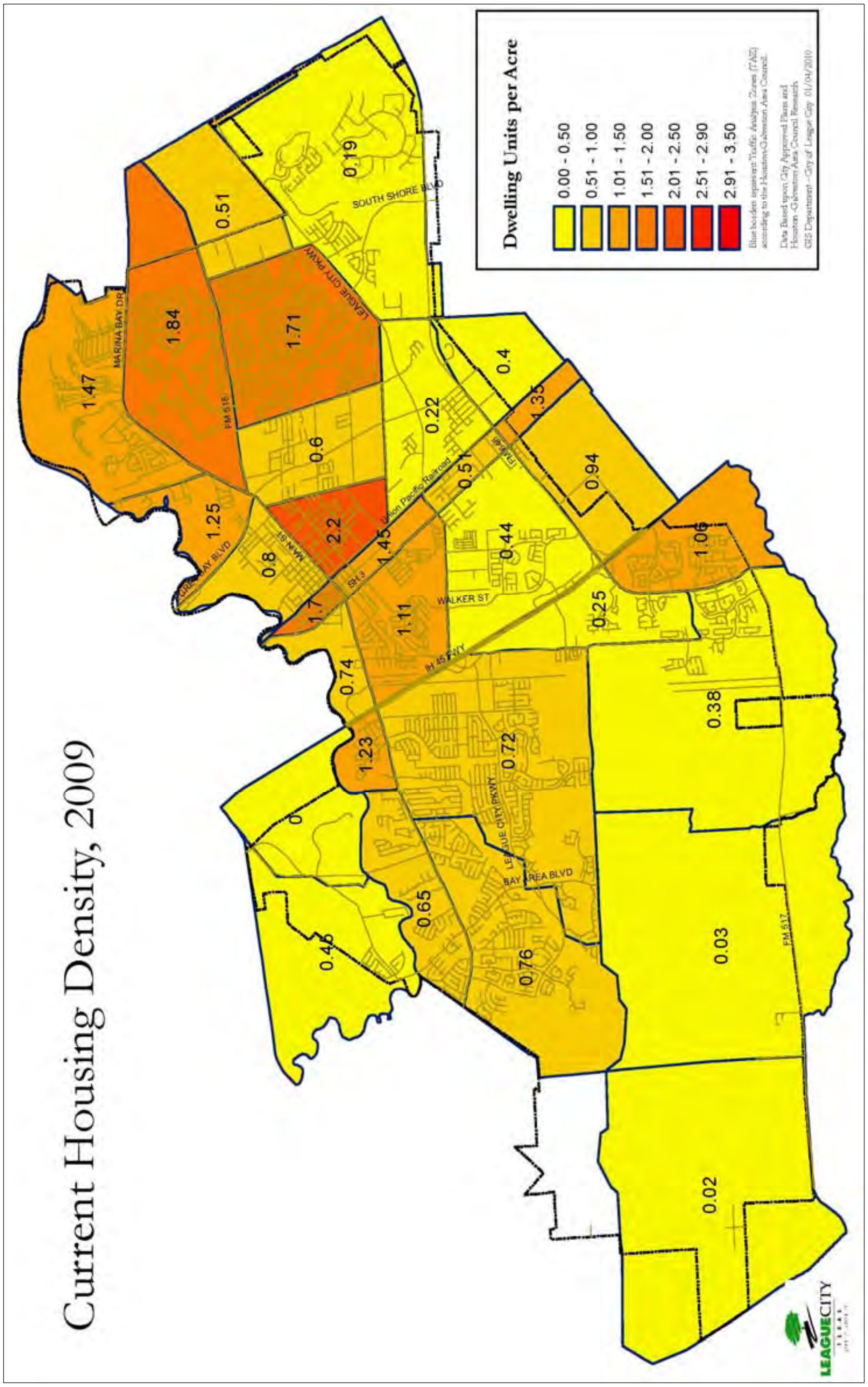
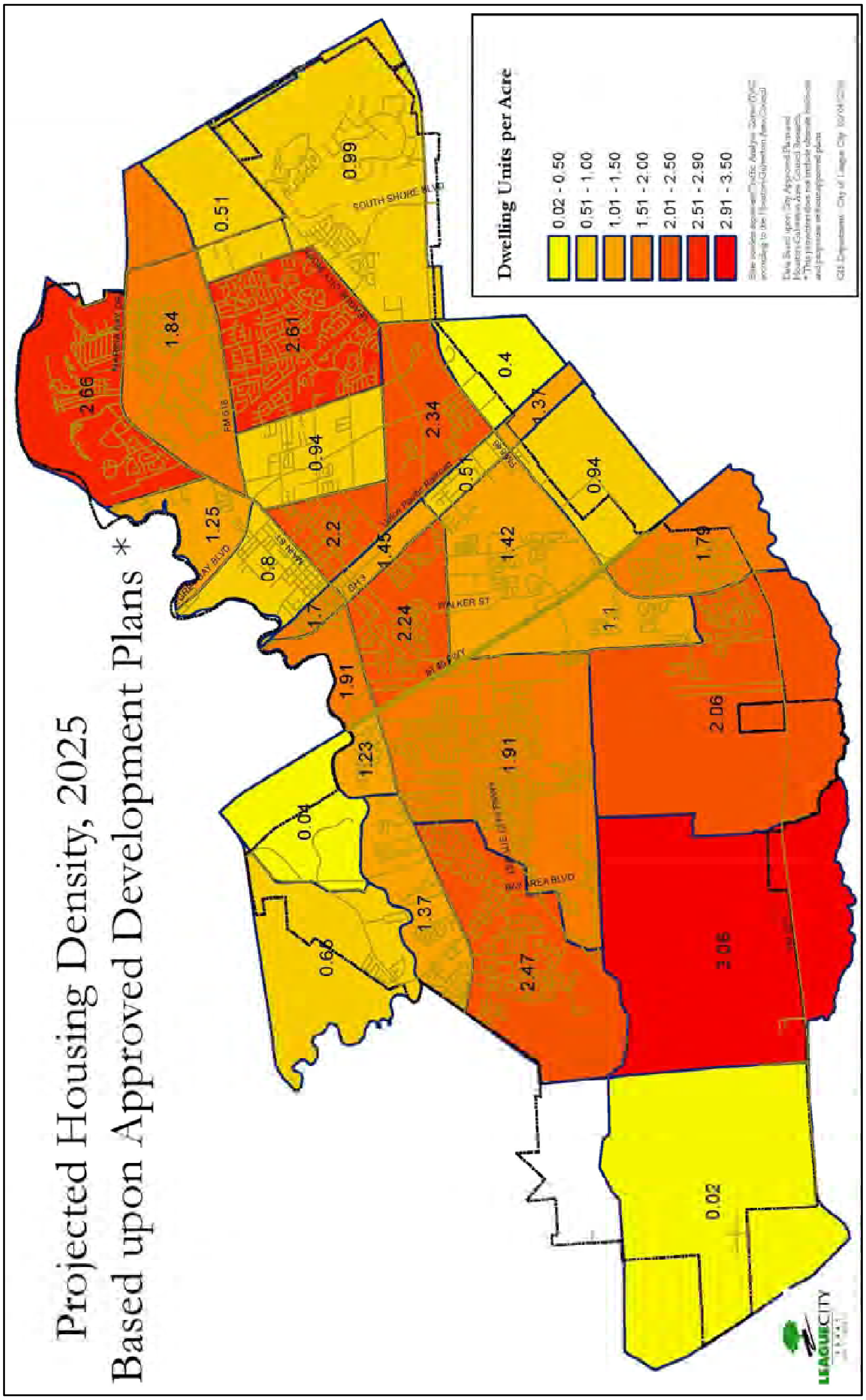


*Figure 3.11* shows projected residential densities in League City in 2025, based on City approved plans and other expected development. Although densities will have increased in just about every area of the city (some areas dramatically), densities are still low in terms of being supportive of transit. **The highest density in the city is projected to be in the southwest area, with just over three dwelling units per acre.**

***Figure 3.11 – Projected League City Residential Densities, 2025***



What are the implications of these low residential densities, now and in the future, for traditional, fixed-route transit service in League City? As shown in *Table 3.4*, residential densities of at least four dwelling units per acre will be needed for even the most minimum of fixed-route bus service. For more frequent service, 7 to 15 dwelling units per acre are required. **Indeed, seven dwelling units per acre appears to be the threshold above which transit use increases sharply; below this level, transit use is minimal.**[15] Clearly, on its current path, League City is far from attaining these levels of density.

**Additionally, non-residential density (i.e., concentration of destinations) is equally as important as residential density. High residential density will not, on its own, lead to good transit service if there is nowhere to go.** These "places to go" need to be dense as well. The existing South Shore Harbour/Marina complex and the proposed RiverBend mixed-use development are examples of locations that have the potential to be dense activity centers in League City. As noted in the preferred growth scenario described in Chapter 5, the City also hopes to promote mixed-use centers of varying densities in other parts of the city. If greater transit use is the goal, it is more important to put housing close to a dense concentration of non-residential activities than it is to simply increase the housing density.[16] **Indeed, an emphasis on creating dense activity centers may be more palatable in a place like League City than a push for a large amount of very dense housing stock.** Undoubtedly, some residents have chosen to live in League City specifically because they can get a big home on a big lot (i.e., low density) for a relatively affordable price.

**Commercial and retail activity in League City tends to take the form of auto-oriented strip malls and other low-density development that is difficult to serve with transit.** This lack of any critical mass of destinations, coupled with the low residential densities, means that League City will need to evolve toward more transit-friendly land use patterns before full-scale, traditional fixed-route transit can be implemented and the benefits it offers can be enjoyed. However, as will be discussed in a later section, there are intermediate forms of transit that can be deployed that will not only provide a valuable service, but also raise awareness of transit and build ridership while League City grows and evolves.

It is worth noting that a study commissioned by the City in 2009 noted the lack of places to go in League City.[17] When asked where they are most likely to spend their leisure time, Clear Lake area residents most often cited Kemah, Galveston, and Webster. Not a single respondent said League City.

Guidance on the creation of destinations and dense activity centers is beyond the scope of this transit analysis; furthermore, the need for such activity has implications (e.g., economic, quality of life) that extend beyond the relationship to transit. Therefore, it is clear that League City stands to benefit in a number of ways from establishing a sustainable density balance in both its housing stock and its activity centers. Such a balance will likely involve the establishment of mixed-use centers as discussed in Chapter 1, a better jobs-housing balance, and the creation of desirable, compact destinations.

**Employment density is one type of non-residential density that is particularly important as a transit-supportive factor.** League City's biggest employers are South Shore Harbour Resort, Clear Creek

[15] "Where Transit Works," Zupon & Pushkarev, Aug 1976.
[16] "Where Transit Works," Zupon & Pushkarev, Aug 1976.
[17] Destination Development International, *League City, Texas: Assessment Findings & Suggestions,* 2009.

Independent School District, the three shopping centers at the intersection of IH 45 and FM 646, and the City of League City itself.[18] However, combined these employers do not provide enough jobs to maintain a desirable jobs-housing balance for the city. As discussed in Chapter 1, an ideal jobs-housing balance would require approximately 20,000 more jobs in League City than currently exist. A better jobs-housing balance (and locating the jobs in dense clusters) would not only reduce congestion by reducing the number of League City residents who have to commute out of the city for work, but it would also support transit service for the same reasons that density of other land uses is supportive of transit.

There is a natural, self-perpetuating relationship between dense land use and transit service. Each one fosters and makes the other better. When attempting to integrate transit into the community, it is important to remember that residents are more likely to use transit:[19]

1. The higher the density and the larger the size of a downtown or another cluster of non-residential activity;
2. The closer their neighborhood is to that non-residential concentration;
3. The higher the residential density of their neighborhood; and
4. The better the transit service.

The following section describes those elements that matter most in providing quality transit service.

***Quality of Service***

Designing the highest quality transit service possible, given available resources, is the goal of any transit planner. When designing service for a community in which most users are likely to be choice riders (such as League City), the emphasis on quality is even more vital. **The reason for this is that choice riders simply will not use the service if they do not perceive it to be of high quality and feel that it meets their needs in very specific ways.** Falling short of this benchmark means that the choice rider will use his car instead of transit, because it is an available option.

There are certain elements that play the greatest role in the perceived quality of transit service.[20] These include the following:

- Headway
- Travel Time
- Availability
- Comfort and Convenience

**Headway** is the frequency of service on a particular transit route. For example, a bus route with ten-minute headways describes a service in which a bus arrives at a particular stop on the route every ten minutes. **Therefore, the more frequent the headway, the more convenient the service is for riders.** Conversely, excessively long headways are inconvenient for transit users and will not be tolerated by

[18] City of League City.
[19] *Where Transit Works,* Zupon & Pushkarev, Aug 1976.
[20] TCRP Report 100, *Transit Capacity and Quality of Service Manual,* Jan 2004.

choice riders. Obviously, the more frequent the headways the greater the number of buses required to provide the service, which leads to higher operating and maintenance costs.

Headways of greater than one hour are regarded as essentially equivalent to offering no service at all.[21] *Table 3.5* shows LOS for fixed-route transit service with headways varying from less than 10 minutes (i.e., more than six buses arriving per hour) to greater than 60 minutes (fewer than one bus per hour). Similar to the concept for roadway LOS, transit LOS is a kind of "report card" that indicates the quality of the transit service. Therefore, an LOS A is very frequent service that allows riders to use the system without the need to even consult a schedule. LOS F is service that comes so infrequently as to be unattractive to all riders. As these data show, **when headways rise above 20 minutes, the service becomes unattractive to choice riders.**

***Table 3.5 – Service Frequency LOS for Fixed-Route Transit Service***

| ***LOS*** | ***Average Headway (minutes)*** | ***Vehicles Per Hour*** | ***Comments*** |
|---|---|---|---|
| A | <10 | >6 | Passengers do not need schedules |
| B | 10-14 | 5-6 | Frequent service, passengers consult schedules |
| C | 15-20 | 3-4 | Maximum desirable time to wait if bus/train missed |
| D | 21-30 | 2 | Service unattractive to choice riders |
| E | 31-60 | 1 | Service available during the hour |
| F | >60 | <1 | Service unattractive to all riders |

***Source:*** TCRP Report 100, *Transit Capacity and Quality of Service Manual,* Jan 2004.

**Travel time** refers to how long it takes to make a trip. **Choice riders generally will not use transit for a trip if it takes longer than it would in an automobile, *unless* there is some other benefit, such as fuel cost savings, parking cost savings, or stress reduction.** The tremendous spike in gas prices in 2008 led to an increase in transit usage among people who would ordinarily use their cars. Many of these new riders were using transit even though the trip took more time, because they were saving on fuel costs. As soon as gas prices relented, however, many of these folks reverted to travel by personal vehicle.

**Availability** encompasses a number of factors having to do with how easily passengers can access and use the transit service. It is perhaps the most important factor in quality of service, because it determines whether or not transit is even a potential mode choice. Unlike the automobile with its nearly ubiquitous access to any location, transit access is limited to specific areas and specific times. Thus, for the transit user, availability is a matter of answering a few basic questions:

- Does it pick me up where I need to be picked up (or very nearby)?
- Does it drop me off where I need to be dropped off (or very nearby)?
- Does it run during the times I need to travel?

[21] TCRP Report 100, *Transit Capacity and Quality of Service Manual,* Jan 2004.

**If the answer to one or more of these questions is no, then it is likely (particularly for the choice rider) that transit will not even be considered as a viable transportation alternative.**

For transit to be available to users, it also must provide sufficient capacity. If a transit vehicle must pass up patrons waiting at a stop because the vehicle is already full, then transit is not available to those potential users.

Passengers must be able to find information on when and where transit service is provided and how to use the service. This includes information such as the location of stops, the schedule, where and how to transfer, the amount of the fare, and payment options. Difficulty in obtaining this information can be a strong deterrent to transit use, particularly among choice riders and/or riders who have never used transit before.

**Comfort and convenience**, like availability, encompasses a number of components. Once the basic requirements of availability are met and transit is established as a feasible transportation alternative, the choice rider turns his attention to more subjective decision-making criteria. These include the following:

- ***Passenger loads*** – This indicates the degree of crowding on the vehicle and whether or not passengers will have to stand for all or part of the trip. This can mean missed opportunities for more productive or relaxing purposes, such as working, reading, or napping.
- The kinds of ***passenger amenities*** provided at transit stops.
- The ***reliability*** of the transit service. Can passengers depend on getting to their destinations at the promised time, or must they allow extra time for service that is frequently late?
- The out-of-pocket ***cost*** of using transit, relative to other modes.
- Passengers' perceptions of ***safety and security*** at transit stops, on board vehicles, and walking to and from transit stops.
- Whether ***transfers*** are required to complete a trip.
- The ***appearance and comfort*** of transit facilities and vehicles.

The elements encompassing quality of service, such as headway, travel time, availability, comfort, and convenience, are important to all transit riders. However, it must be remembered that, **for choice riders, any negative perceptions about these elements can be deal breakers in the selection of transit as a mobility alternative.** Therefore, any transit service designed for League City will be in the best position to succeed if it goes "above and beyond" in its efforts to appeal to choice riders.

***A Note About League City Commute Patterns***

Many League City residents who work outside of the city limits are employed just across Clear Lake. There are unique challenges presented by this particular commuting pattern. If bus stops are conveniently located and residents can easily walk or bike to them, using local transit for a work trip may be an attractive option. However, the predominance of low-density, single-family residential developments in League City means that most potential riders would have to drive to a bus stop. This is problematic for a relatively short commute. If residents have to expend up to one-third or even one-half of their commute time in their cars to get to a bus stop, they will be inclined to just stay in their cars for the entire trip, especially if using transit makes the commute longer than it would be otherwise. Parking availability at the bus stop also may be an issue.

JSC and its many off-site contractors represent a significant employment base on the north side of the lake for League City residents. In addition to the challenges just discussed with bringing League City commuters across Clear Lake, there are also logistical obstacles associated with obtaining through-the-gate access to JSC (a government complex) for a public transit vehicle. Having to walk from the front gate to their offices spread across the large JSC campus would be a potential deterrent to riders. Serving the many off-site JSC contractors is also challenging because the contractors are relatively spread out rather than concentrated in a dense area. This again poses the potential problem of making a transit commute longer than an automobile commute would be. If transit is to successfully serve these locations, a means of overcoming these challenges must be developed.

***Successful Commuter Transit: Commuter Rail and Regional Bus***

All of the factors for successful transit just discussed – headway, travel time, availability, comfort, and convenience – apply just as equally to commuter service as they do to local service. A perceived deficiency in one or more of these areas will result in lower ridership on a commuter train or park & ride bus, just as it would on a local bus. Additionally, the elements that differentiate commuter transit from local transit mean that there are added considerations when planning for successful commuter service.

**For a number of reasons, commuter transit is typically better suited for attracting choice riders than is local transit.** This is because the distances covered by commuter transit are longer than local transit distances; therefore, the vehicles and amenities must be nicer to ensure a comfortable trip. The longer distances can also serve as an incentive for transit use, due to the potential cost savings over driving. Time savings can also play a part, particularly when the commuter service operates in an exclusive guideway, such as a railroad track or HOV lane. Finally, the opportunities to engage in other activities during a long commute trip, such as working, sleeping, or reading, appeals to some commuters.

In the case of commuter rail (or any rail transit) there is also the notion of “rail bias.” This is the premise that, when given comparable bus and rail service, transit users have a distinct preference for rail. When service conditions are equal, CRT will attract from 34% to 43% more riders than will equivalent bus service.[22] This is borne out by the experience of METRO in Houston with the coming of Light Rail Transit (LRT). In ridership surveys, METRO found that approximately 40% of METRORail users had never used METRO’s transit system prior to the opening of the light rail line.[23] It was the rail technology that lured these new transit users. While the METRO light rail is local transit rather than CRT, the situation demonstrates the rail bias often observed.

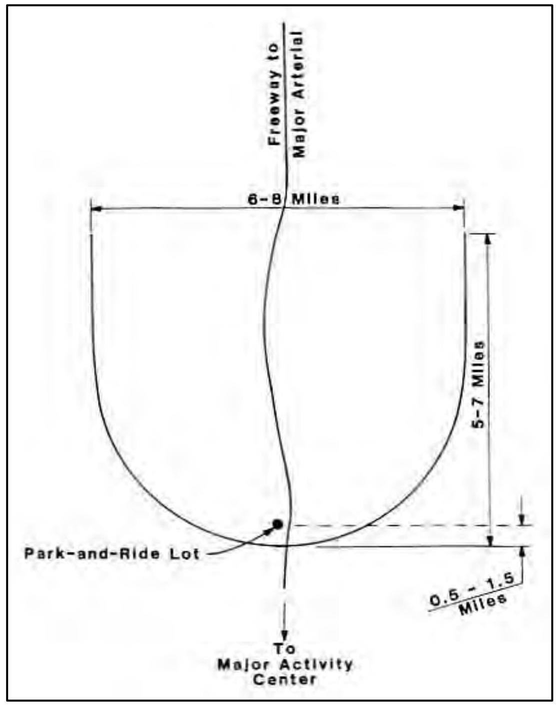
**As shown in *Table 3.4*, commuter rail (or comparable commuter bus service) can be successful with residential densities of as little as 1 to 2 dwelling units per acre.** This is because the “capture area” around a commuter rail station or bus park & ride is much larger than it is for a local transit stop. The

[22] *Impact on Transit Patronage of Cessation or Inauguration of Rail Service,* Transportation Research Record 1221, Edson L. Tennyson, 1989.
[23] *Houstonians Embrace Light Rail,* Vijay Mahal, HDR, Inc. TransitLine, Sep 2008.

capture area refers to the maximum distance transit patrons will travel to get to a station or park & ride. Because commuters most often arrive at the station/park & ride by car, they will typically travel up to 6 to 8 miles to access the commuter service.

There are several design elements that can contribute to the success of a commuter transit operation.

***Figure 3.12 – Park & Ride Capture Area***




***Location.*** A market analysis should be done prior to the selection of a site to ensure that it is properly situated within a capture area that will offer high ridership potential. It should be noted that the shape of the capture area is *not* a circle with the station/park & ride in the middle, which would imply that potential riders will come from equal distances all around the station/park & ride. **Rather, potential riders are most inclined to travel to a commuter rail station or bus park & ride if their trip to the station/park & ride is in the *same direction* as their ultimate commute. They will travel only a very short distance (no more than 1.5 miles) in the wrong direction.** *Figure 3.12* presents the typical capture area for a park & ride facility.[24] [Note that the capture area is more parabolic than circular, and the P&R facility is well off-center. What this indicates is that a League City commuter, for instance, who works in Houston may travel from his home five miles northbound to access commuter transit, but would likely *not* drive those same five miles if they were southbound, because his commute to Houston ultimately goes in the opposite direction.]

***Stops/Stations.*** To make long commuter transit trips time-competitive with automobile travel, it is critical that high average speeds be maintained along the trip. To do this, **the number of times the bus or train stops should be minimized and the stops/stations should not be too close together.** Station spacing is especially critical for commuter trains because of their long acceleration/deceleration times. Commuter rail stations that are too closely spaced prevent the train from being able to achieve a high operating speed.

***Parking.*** Adequate parking to meet the ridership demand at each station or park & ride must be available or potential users will be deterred.

***Headways/Span of Service.*** **Having very frequent headways is not as critical for commuter transit as it is for local transit because commuter services typically operate only in the peak hour and riders often plan for a "just in time" arrival at the station/park & ride.** However, the lack of midday service can cause a problem for some commuters if they need to unexpectedly return home in the middle of the

[24] *Guidelines for Planning, Designing, and Operating Park and Ride Lots in Texas*, TTI, Oct 1983.

day and they do not have their car with them. For this reason, many transit agencies that operate commuter transit offer emergency ride home provisions (such as cab fare) during midday.

There is extensive, successful commuter bus service offered throughout the Houston region, including the METRO Bay Area Boulevard park & ride facilities, which are patronized by a large number of League City residents. The park & ride service from The Woodlands is another example, and one that is particularly comparable to League City because it demonstrates that transit can be highly successful in a relatively affluent community with a large number of choice riders.

***Transit Nexus to Other Modes***

**The success of any transit service can be affected by the quality of the surrounding pedestrian and bicycling network.** Having high-quality pedestrian and bicycle amenities around transit stops is an excellent way to address the so-called “first mile/last mile” problem. This refers to the fact that **one of the most difficult parts of making a transit trip competitive with the automobile is figuring out how to close the gap (first mile) between where the transit rider originates (e.g., his home) and where the transit stop is located, and/or the gap (last mile) between where he is dropped off by the transit vehicle and where his final destination is located.** While some riders are lucky enough to have a transit stop right outside the door of their origin and/or final destination, most will not be so fortunate, and will have to walk or bike to/from a transit stop to complete their trips. If this walking or biking trip is not easy, potential riders may choose to not use transit at all. Conversely, when it is not an impediment this part of the trip may be one that transit users enjoy and consider an advantage of taking transit.

Nearly every transit user begins and/or ends his trip as a pedestrian. Therefore, a lack of sidewalks, steep grades, wide or busy streets, and other obstacles that discourage walking make transit less available to a potential user. The situation is similar for those who use a combination of transit and bicycling. If the transit vehicle does not provide accommodations for bringing bicycles on board, there is nowhere for the cyclist to store his bike at his destination, or the bicycle network around the transit stop is poor, then transit is not likely to be an available option for this particular traveler. For these reasons, **it is critically important that the pedestrian and bicycle networks around transit stops offer an environment that is highly conducive to walking and biking, and that bicycle amenities, such as bike racks on board the bus and at key stops, are provided.** Doing so extends the reach of transit and makes a greater number of destinations accessible to transit users, even if the transit service itself does not directly serve those destinations.

Other means of covering the last mile include shuttle services. Shuttles are particularly common in conjunction with CRT, which is the form of transit least likely to be able to deliver riders very close to their final destination. Thus, shuttle buses can be waiting at the station for the arrival of the train, and then shuttle riders along a fixed route to one or more final destinations.

### *Galveston County Transit District (GCTD)*

GCTD was created recently upon mutual agreement of the municipalities in Galveston County, including League City. Its charter is to ensure the continued equitable provision of transit services throughout the County. The Houston-Galveston region currently has many areas in need of public transportation, but for which there is no organized method for providing service. The creation of GCTD provides a forum for interagency cooperation, coordinated planning, and local funding to help fill transit gaps.

The transit district also provides a forum for all political subdivisions within Galveston County (at its option), and other stakeholders to openly discuss the challenges of providing public transportation and to determine the best and most cost-effective means of supporting needed services. **It is vitally important that League City fully embrace its rights and responsibilities as a member of the District and participate in its activities and decision-making processes.**

A significant portion of Galveston County currently is included within the Houston Urbanized Area (UZA). UZAs are boundaries defined by the U.S. Census Bureau, and the expansion by the Houston UZA into Galveston County is likely to grow with the release of 2010 Census data. This is noteworthy because Congress and the federal government distribute substantial federal funding annually, based on the population within UZA boundaries, to support public transportation development and services. As such, a significant portion of federal funds generated by Galveston County residents would come under the control of the Houston UZA and the designated recipient of this funding, Houston METRO. This does *not* mean, however, that Houston METRO would provide transit service to those areas, such as League City, whose residents are generating a portion of the federal funds Houston METRO receives.

GCTD, therefore, is designed to prevent this diversion of funds and enable Galveston County to secure its fair share of federal and state funding to support public transportation today and for the future. GCTD, once designated as a federal “grantee,” will be able to receive transit funds that would have otherwise gone to Houston METRO and oversee its use to provide transit services throughout Galveston County. GCTD likely can play a helpful role in the implementation of the various forms of transit discussed in this chapter.

## *MARINE TRANSPORTATION*

The Bay Area communities of the Houston-Galveston region, including League City, enjoy many amenities and lifestyle perks associated with their proximity to Clear Lake, Clear Creek, and Galveston Bay. Although these communities typically take full advantage of the recreational aspects of a waterfront location, the potential for using the waterways as transportation remains unrealized. A regional example of a small-scale waterborne transportation system is the water taxi in The Woodlands, which enables riders to access the various residential developments, hotels, restaurants, retail, and other attractions in and around The Woodlands Town Center and The Woodlands Mall.

As a first step toward creating a regional waterborne transportation system for the Bay Area, the Seabrook Economic Development Corporation commissioned a water taxi feasibility study.[25] The stated goals of a Bay Area water taxi service include the following:

- Connect points of interest with fast, efficient, and comfortable ferries or water taxis that would provide riders a unique perspective of Clear Lake;
- Provide residents and visitors increased access to the waters of Clear Lake and Galveston Bay;
- Provide an easy way for visitors staying at hotels around the Bay Area to visit waterfront restaurants and other attractions without the need to drive;
- Provide a unique attraction that attracts additional visitors to the Bay Area without adding to the current traffic congestion;
- Increase business at local restaurants and attractions by making it possible to get to them without using a car;
- Integrate with other transportation improvements to improve access around and across Clear Lake; and
- Enhance regional economic development.

***The Woodlands Water Taxi***

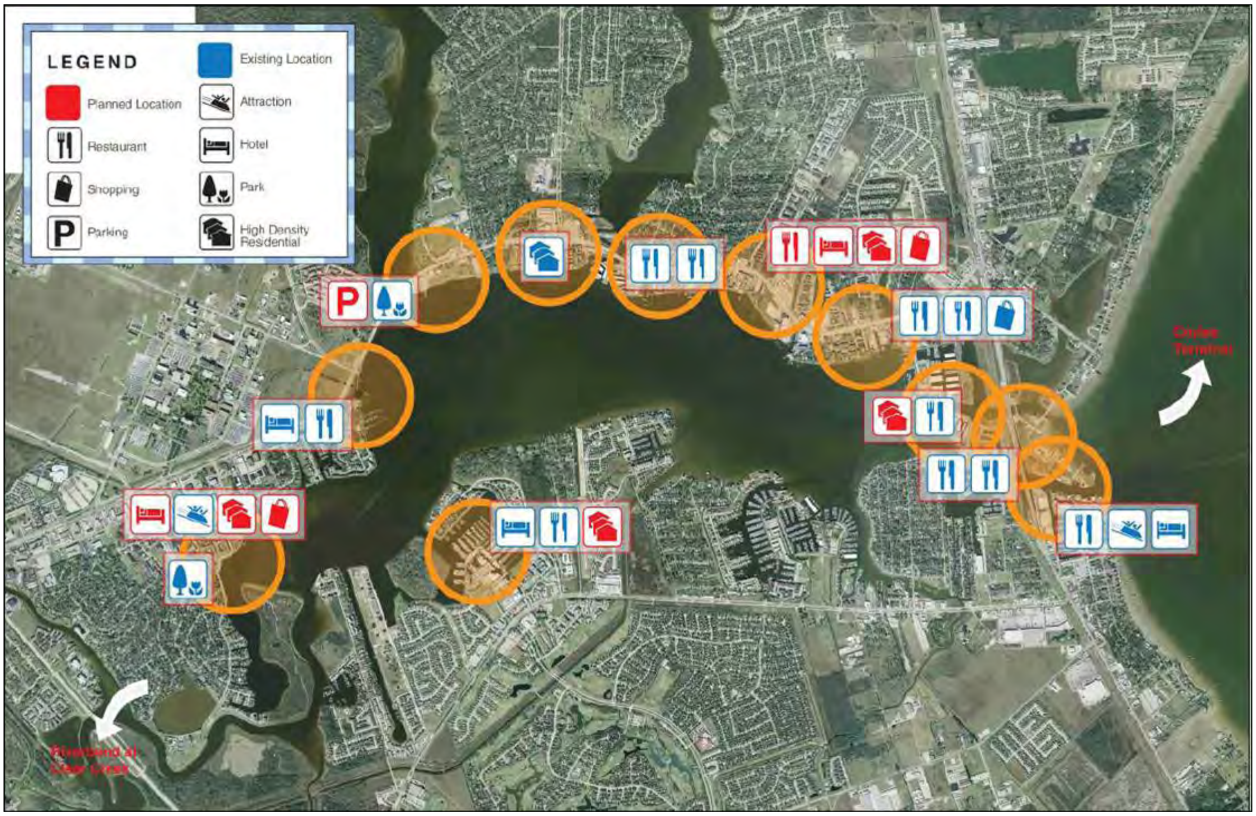
The study includes a brief review of other water taxi systems, an analysis of potential landing sites, development of a conceptual long-range system plan, identification of a candidate route for a demonstration service, and development of a partnership plan for garnering necessary stakeholder support.

**The study ultimately concludes that there is likely sufficient interest and ridership potential to make a water taxi service on Clear Lake feasible.** It is recommended that initially a free demonstration service be run during peak periods (weekends and holidays) for one season to gauge interest and to build awareness and ridership. The conceptual long-range plan consists of an express service connecting the residential and lodging sites at the west end of Clear Lake with a central hub of a water taxi service circulating among the restaurants and attractions at the east end of the lake. Ultimately, service to Galveston Bay also might be added. However, the only Galveston Bay destination currently identified is the Port of Houston cruise terminal at Bayport, which remains idle with no cruise ships presently calling on it. Because of the higher operating costs and larger vessels required to operate in Galveston Bay, the study recommends not implementing this service unless additional development, beyond the cruise terminal, is built.

[25] "Bay Area Waterborne Transportation Study, Phase I: Feasibility Assessment," KPFF Consulting Engineers, Mar 2009.

**The study acknowledges that the primary users of a Bay Area waterborne transportation system will be recreational riders, since very few people both live and work close enough to the water to make the travel time of marine transit competitive with other modes.** Also acknowledged is the impact of Hurricane Ike and the probable need to delay a demonstration project until the waterfront attractions have fully recovered. Of the potential landing sites recommended in the study *(Figure 3.13)*, three are located in League City: the South Shore Harbour Resort and Conference Center, the RiverBend mixed-use development, and Beacon Island. The study presents the advantages and potential constraints of each location.

***Figure 3.13 – Potential Water Taxi Landing Sites***




***Source: Bay Area Waterborne Transportation Study***

There are docks at the South Shore marina that could be readily used as a water taxi landing, although accessing the marina from Clear Lake requires passing through a quarter-mile no-wake zone. For this reason, the study suggests that South Shore could be served best on an on-call basis for groups only.

The planned mixed-use development at RiverBend, with its substantial number of residential units and hotel rooms, is noted as a potential source of a significant number of riders for a water taxi service. However, RiverBend is on Clear Creek, five miles from Clear Lake. Because of both the distance to be covered and the need to travel at slower speeds to avoid wake damage, the travel time to serve RiverBend might be non-competitive with other modes. In addition, vertical bridge clearances between RiverBend and Clear Lake may present difficulties.

Beacon Island, adjacent to the South Shore Harbour Resort, is slated to be a private residential development. As planned, the development would be able to accommodate a water taxi stop. However, access to the island will be controlled and there are no public attractions planned for the development.

## *TRANSPORTATION MODE CHOICE DECISION*

When travelers have more than one transportation option available to them, a decision-making process is undertaken to select a preferred mode for a particular trip. The tradeoffs that are weighed are unique to each individual. However, there are several typical factors that are commonly considered when deciding how to travel from one point to another as shown in *Table 3.6*.

***Table 3.6 – Decision-Making Factors in Transportation Mode Choice***

| ***Factor*** | ***Description*** |
|---|---|
| Trip purpose | Intended destination such as work, school, or shopping can play a role in which mode is selected. The need to transport goods or passengers during the trip is also a factor |
| Cost | May include elements such as fuel, automobile maintenance and insurance, parking, equipment (e.g., bicycle), transit fare |
| Travel Time | How long the trip takes |
| Directness of Trip | Travelers are unlikely to choose a particular mode if trip entails a very circuitous route or requires them to proceed in the wrong direction for part of the trip |
| Safety | Travelers often will forgo a mode of transportation that they perceive as risky to their personal safety. |
| Comfort | Physical comfort such as temperature, shelter from weather, ability to sit, ability to make use of the travel time for other activities (i.e., listening to radio, reading, sleeping, working). Opportunities for stress reduction, recreation, exercise also may be factors. |
| Convenience | Whether transportation mode is available at the needed times and is easy to access. |
| Reliability | Whether particular mode can be relied upon to provide a trip that is consistently available and on time. |
| Proximity | To remain competitive, a transportation mode must be available relatively close to both the traveler's origin and destination (i.e., if a traveler can access a particular mode relatively close to home, but then must walk an exorbitant amount at the other end of the trip to reach his final destination, then that mode likely would not be chosen). |
| Availability | The particular mode must be available as an option for it potentially to be chosen for travel. Availability also includes access of information pertaining to the mode (i.e., bus routes, location of stops for transit users, or location of bike lanes/trails for bicyclists) |
| Connectivity | Many trips entail using more than one mode to complete a trip, such as a combination of transit and biking, transit and walking, or driving and walking. The selection of one or more modes may entail consideration of how they connect to one another. For instance, a potential transit user may be hindered by the fact that the pedestrian network surrounding the transit stops is poor, or by the fact that there are no bike racks available on the bus or at the destination |

As stated in the beginning of this chapter, a multimodal transportation network can offer numerous benefits to a community. For such a network to serve its purpose, the various modes must be regarded positively across most, if not all, of the decision-making factors in *Table 3.6*. The City aspires to develop just such a network.

# Chapter 4 – PUBLIC PARTICIPATION

The process of developing this master mobility plan included an extensive effort to solicit opinions, suggestions, and feedback from League City residents. The public was able to learn about the planning process and complete an online survey via the project website, as well as make their voices heard at a series of public meetings. The valuable feedback collected by the planning team was taken into account to the maximum extent possible in developing the recommendations in this master mobility plan.

## *WEBSITE/SURVEY*

The project website, www.LeagueCityMobility.com, served as a portal for the public to not only learn about the planning process and follow its progression, but also to provide valuable data to the planning team via an online survey. The survey questions, shown in *Table 4.1*, were designed to gather public perceptions and concerns about League City's mobility issues across the wide spectrum of transportation modes.

| ***Table 4.1 – League City Master Mobility Plan Online Survey Questions*** |
|---|
| 1. On which side of the Gulf Freeway do you live?<br>a. East<br>b. West |
| 2. Where do you commute to for work?<br>a. I work in League City (or the greater Clear Lake area)<br>b. I commute to the north (e.g., Houston)<br>c. I commute to the south (e.g., Galveston)<br>d. I do not work |
| 3. What do you feel is the most pressing mobility issue facing League City today?<br>a. Traffic congestion<br>b. Lack of public transit options<br>c. Condition/Lack of hike/bike trails<br>d. Condition/Lack of pedestrian facilities and amenities (e.g., sidewalks, wheelchair ramps, lighting, shade trees)<br>e. Other: |
| 4. What do you feel is the best solution for League City's mobility problems?<br>a. Build more roads/widen existing roads<br>b. Implement public transit<br>c. Make the City more walkable<br>d. Build more hike/bike trails<br>e. Promote mixed-use development that puts homes, jobs, and retail in close proximity to each other<br>f. Other: |

| *Table 4.1 b– League City Master Mobility Plan Online Survey Questions (Continued)* |
|---|
| 5. Traffic congestion is an issue in League City:<br>a. Only during the morning commute<br>b. Only during the evening commute<br>c. During both the morning and evening commutes<br>d. All of the time<br>e. Other times:<br>f. Traffic congestion isn't a major issue in League City |
| 6. Traffic congestion in League City is primarily due to *(choose all that apply)*:<br>a. Not enough ways to access IH 45<br>b. Left turns blocking traffic<br>c. Too many driveways<br>d. Other: |
| 7. What specific location(s) in League City (intersection or roadway segment) do you feel most needs to be addressed from a mobility standpoint?<br>*Open-ended response* |
| 8. How would you rate the quality of League City roads?<br>a. Generally well maintained<br>b. Generally poorly maintained<br>c. Too wide<br>d. Too narrow<br>e. Other: |
| 9. Do you regard speeding as an issue of concern in League City?<br>a. Yes, on major roads<br>b. Yes, on neighborhood roads<br>c. Yes, on both major roads and neighborhood roads<br>d. No, speeding is not an issue |
| 10. If local public transit (internal to League City) were available, how likely would you be to use it?<br>a. Very likely<br>b. Likely<br>c. Unlikely<br>d. Very Unlikely |
| 11. If regional public transit (e.g., park & ride or commuter rail to Houston and/or Galveston) were available, how likely would you be to use it?<br>a. Very likely<br>b. Likely<br>c. Unlikely<br>d. Very Unlikely |
| 12. What is the biggest factor that would determine whether you decided to use transit or not?<br>a. Where it goes<br>b. How frequently it runs<br>c. How much it costs<br>d. How far I have to walk to get to it<br>e. Other:<br>f. I wouldn't use transit no matter what |

| *Table 4.1 c– League City Master Mobility Plan Online Survey Questions (Continued)* |
|---|
| 13. Do you currently use any public transit services offered in the region? *(select all that apply)*<br>a. Yes, I use METRO park & ride<br>b. Yes, I use METRO local buses and/or light rail<br>c. Yes, I use the Island Transit park and ride to Galveston (from Mall of the Mainland)<br>d. Yes, I use the following public transit service:<br>e. No, I never use public transit |
| 14. Did you use the local BayTran transit circulators that were offered in the League City/Clear Lake area in the 2000-2001 timeframe? If not, why not? If you tried it but didn't like it, why not?<br>a. Yes<br>b. No<br>c. Comments: |
| 15. How often do you travel around League City using a mode of transportation OTHER than a car?<br>a. I ALWAYS use a car<br>b. I use a car MOST of the time<br>c. I use a car about as much as I use other modes (e.g., walking, biking)<br>d. I have a car, but I use other modes like walking or biking to get around more often<br>e. I don't have a car<br>f. Other: |
| 16. What mode of transportation do you use most often when NOT using a car?<br>a. Walking<br>b. Biking<br>c. I always use a car<br>d. Other: |
| 17. How would you rate your ability to get around League City without a car?<br>a. Excellent<br>b. Good<br>c. Fair<br>d. Poor |
| 18. How would you rate your ability to get to the next neighborhood without a car?<br>a. Excellent<br>b. Good<br>c. Fair<br>d. Poor |
| 19. How do you regard mobility concerns as compared to other quality of life issues in League City?<br>a. It is my highest priority concern compared to other issues<br>b. It is as equally important as other issues<br>c. It is not very high on my priority list<br>d. Other: |
| 20. Please add any mobility-related comments/concerns you have that have not been addressed above.<br>*Open-ended response* |

A total of 132 completed surveys were received. Full survey responses are available in *Appendix F*. Key points revealed from the survey responses are discussed below.

Survey respondents were divided equally between those who reside on the east side of League City and those who reside on the west side. **A total of 83%, an overwhelming majority of respondents, believe that traffic congestion is the most pressing mobility issue facing League City.** A total of 52% believe the best solution for League City's mobility problems is to build more roads and/or widen existing roads. **Compared to other quality-of-life issues, 38% regard mobility problems as their highest concern.** A total of 70% rate their ability to get around League City without a car as poor.

Responses to transit-related questions revealed a tepid attitude toward public transportation. Only 9% of respondents regard lack of public transit as League City's most pressing mobility issue. Similarly, only 10% said implementing public transit would be the best solution for League City's mobility problems. When it comes to propensity to use local transit, 33% said they would be either "Very Likely" or "Likely" to use it, while 67% would be "Unlikely" or "Very Unlikely." Responses revealed a somewhat higher willingness to use regional transit (e.g., park and ride or commuter rail), with 52% saying they would be "Very Likely" or "Likely" to use it, and 48% being "Unlikely" or "Very Unlikely" to use it. The vast majority of respondents (79%) currently never use any form of public transit offered in the region. When asked about the BayTran transit circulator that operated in the area in 2000-2001, 97% said they did not use it (34% did not live in League City then, and 33% were not aware of it at the time).

Several common themes emerged from the responses to the open-ended questions (questions 7 and 20). These include the following:

- Frustration with congestion at all major intersections, and particularly the Five Corners intersection (FM 518/FM 270/FM 2094)
- Desire to see citywide traffic light synchronization, and particularly on FM 518 west of IH 45, between Landing Boulevard and IH 45
- Insufficient east-west corridors
- Insufficient north/south corridors over Clear Lake/Clear Creek
- There should be no more residential development unless adequate road infrastructure is concurrently developed
- Location of schools and school zones greatly contributes to congestion levels
- Excessive number of traffic signals and stop signs on League City Parkway is preventing it from functioning as a true parkway
- Lack of quality sidewalks overall, and specifically in the vicinity of schools
- Desire for dedicated bike lanes on streets, not just bike trails

## *PUBLIC MEETINGS*

A Master Mobility Plan public meeting was held at the Civic Center to give League City residents the opportunity to directly engage the planning team, offer their input to the planning process, and express their mobility concerns. Approximately 50 League City residents attended this meeting, with slightly more citizens who reside on the east side of League City attending than from the west side of the city. Feedback and comments were collected via map exercises and discussion; attendees were also given the opportunity to fill out the same survey that was posted on the mobility plan website. All feedback gathered during this meeting is included in *Appendix F*.

Concurrent to the development of this master mobility plan, the City was in the process of developing a new Comprehensive Plan, an effort for which public meetings also were held. The comprehensive plan and the master mobility plan are intended to be complementary and share common themes, particularly regarding the land use scenarios that are discussed in Chapter 5. As such, transportation and mobility-related concerns that were raised during the comprehensive plan public meetings were shared with the mobility planning team and were considered when developing the mobility recommendations. The mobility issues identified during the comprehensive plan process are included in *Appendix F*.

# Chapter 5 – LAND USE MODELING AND GROWTH SCENARIOS

The potential mobility challenges that League City will face in the future are closely tied to how the city develops. As discussed in Chapter 1, smart land use patterns make efficient use of the transportation network and can help to minimize traffic congestion. In contrast, poor development patterns exacerbate congestion and choke the mobility network. **With 53% of its land still vacant[1], League City is at a crossroads. Development pressure undoubtedly will lead to buildout of the City's remaining land. What remains to be seen is what form that buildout will take and what effect it will have on traffic flow.** If future growth is allowed to occur in the same haphazard, disjointed manner that has characterized much of League City's recent development, the city should expect its frustrating traffic congestion to only worsen with time. Better development patterns will help to ensure that League City remains a functioning and desirable place to live.

Land use planning is an important exercise for the City to effectively manage the type, pattern, and scale of future development. Decisions made at an early stage of development will have great influence on the community and its mobility. This is because the use of land and the pattern of development helps determine the propensity of pedestrian activity, trip origins and destinations and the corresponding volumes and patterns of traffic, and the demand for and feasibility of high capacity transit, among many other outcomes.

One of the unique aspects of the development of this master mobility plan is the integration of land use and traffic modeling tools. A series of four land use scenarios were developed and modeled for this plan. The impacts from the land use model were then integrated into the transportation model as a means of predicting future conditions under varying circumstances.

## *COMMUNITY CHARACTER VERSUS LAND USE*

The four land use scenarios are based on the preferred character (rather than use) of future development. A traditional land use map illustrates the various land uses in a community using very broad descriptions such as residential (both single-family and multi-family), mixed-use, commercial, industrial, institutional, and public parks and open space. By contrast, the land use descriptions used in this master mobility plan's scenario planning exercise go beyond the typical categorization of the *functional* use of land. Rather, they are based on the ***preferred character*** of future development. In this way, community character land use descriptions account for the physical traits and design attributes that together contribute to the "look and feel" of the area. A character-based land use system focuses on development intensity, which encompasses the density and layout of residential development; the scale and form of non-residential development; and the amount of building and pavement coverage (impervious cover) relative to the extent of open space and natural vegetation or landscaping. This applies both on individual development sites and across entire areas. **It is a combination of the**

[1] City of League City, 2010.

**functional land use and its design characteristics that more accurately determines the compatibility and quality of development, as opposed to the use of land alone.**

Because character-based land use districts are more descriptive of the intended development outcomes, they can help the City to become more deliberate in achieving development outcomes that are preferred and, perhaps more importantly, those that are warranted to meet planning objectives such as mobility and water conservation.

### *EXAMPLES OF COMMUNITY CHARACTER DIFFERENTIATION*

As an example of how a traditional land use map would not clearly show the differentiation between two neighborhoods with vastly different character, consider the Historic District compared to the many master planned subdivisions in League City *(Figure 5.1)*.

***Figure 5.1 – Historic District (left), Master Planned Subdivision (right)***

The Historic District is characterized by grid street patterns, a broad variety of home styles, varying lot sizes and setbacks, and different building orientations and means of (or no) garage access. This represents a traditional form of development that is wholly different than the contemporary, more recently developed neighborhoods. The latter subdivisions are highly patterned in their street and lot layouts and may be characterized by consistent front and side setbacks, uniform building scale, regular placement of driveways, and generally higher building coverage, all of which may be generally described as a monotonous design. Despite these significant differences, both of these types of neighborhoods would be classified simply as "Single-Family Residential" on a traditional land use map that does not take character, in addition to functional use, into account. If the City is to be deliberate as to the character of its future development it is essential that its land use and zoning districts are adequately descriptive.

Fundamental in the definition of character is **how the automobile is accommodated within a development**, in terms of its street design, means of access, the placement and handling of parking, and the resulting arrangement of buildings and open spaces, as illustrated in *Figure 5.2*. In this example the same land use (a drug store) is shown in the context of two areas with very different character, with the provision of automobile access being one of the major differentiators. The drug store on the left is built to the street with easy pedestrian access and cars likely accommodated via on-street parking. The drug store on the right has a large setback from the street to accommodate off-street surface parking, and it is less easily accessible to pedestrians. These contrasting features lead to two areas with vastly different character; however, a traditional land use map would likely not illuminate this difference.

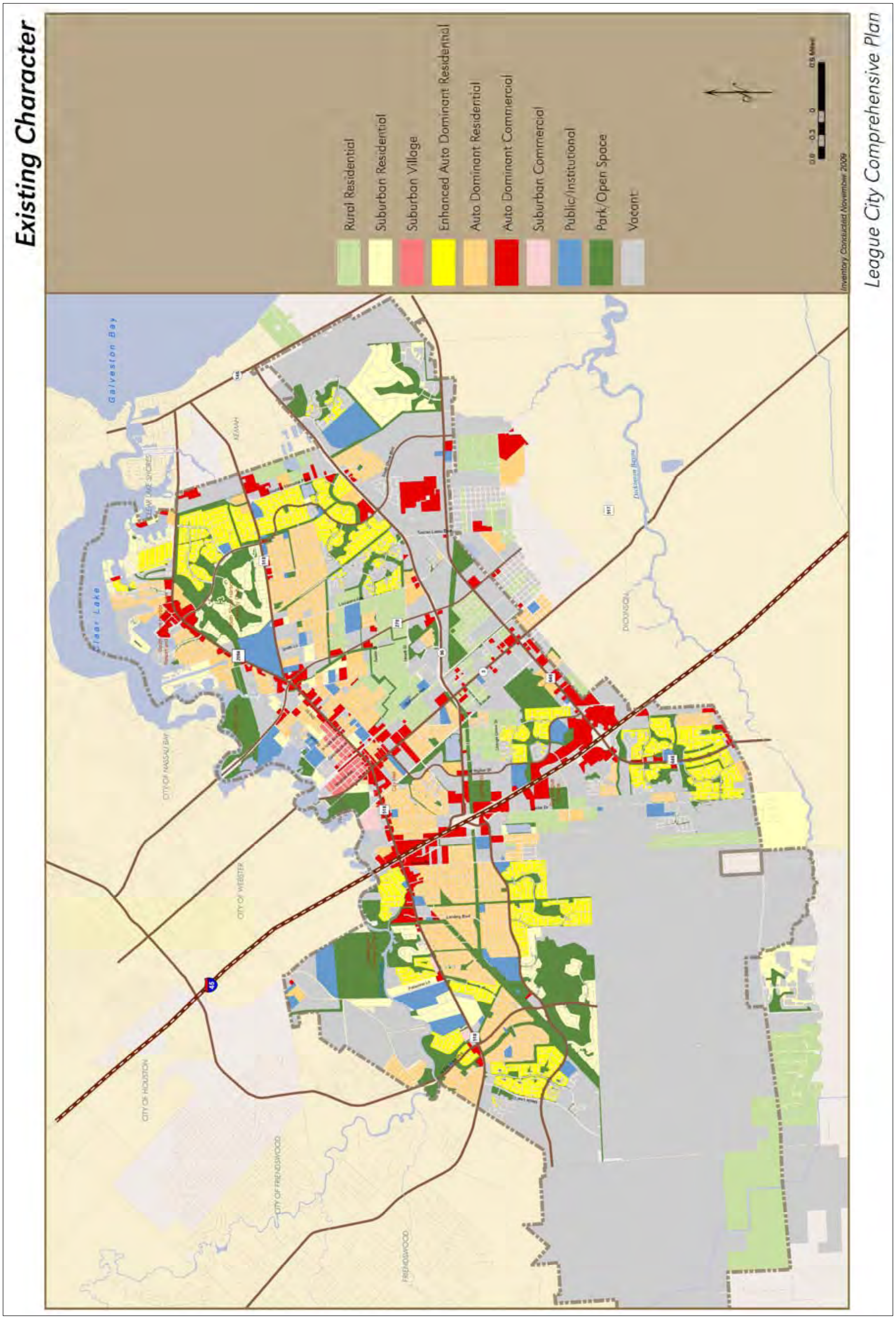
***Figure 5.2 – Same land use in urban environment (left) versus auto-dependent environment (right)***


## *DEFINING CHARACTER CLASSES AND TYPES*

Community character defines the classes of development as **rural, suburban,** and **urban**, which are further delineated into design types. The design types are unique to each community, but generally include countryside, agricultural, and natural within the rural class; suburban and estate within the suburban class; and urban core, urban, and auto-dominant within the urban class. By organizing development according to its character, design strategies may be formed and measures established to assure preferred and acceptable outcomes.

The inventory of existing land use character confirms that League City has character settings along most of the above described spectrum *(Figure 5.3)*. The city's existing development pattern includes large swaths of rural, undeveloped land, particularly in the southwestern parts of the city and its ETJ, but also south of League City Parkway and FM 646. Most of the neighborhoods and commercial areas are characteristic of the auto-dominant and enhanced auto-dominant types, which are both within the urban character class. The remaining neighborhoods, particularly those along Clear Creek and those nestled around liberal open space (such as lakes or a golf course), are in the suburban class and type. League City does not have a traditional urban neighborhood, although the suburban village reflects these design tendencies by way of its regular pattern of lots and street grid. In the middle of the spectrum, especially in the range from urban to suburban, the city has multiple neighborhoods and commercial areas in a gray area between character types because they exhibit aspects of both. This is because these areas were planned and developed in accordance with rather general rules, with the only design parameters being that of a minimum lot size and lists of permitted uses.

***Figure 5.3 – Existing Character***



## *RURAL CHARACTER*

There are three rural types —**countryside**, **agricultural**, and **natural** *(Figure 5.4)*. The latter two are defined by their uses: crop or ranching, plus scattered rural homesteads, for the agricultural; wooded or savannah lands, plus creeks and wetlands for the natural. These rural types are characteristic of the undeveloped portions of the City and ETJ. Natural areas in League City occur mostly along Clear Creek. Countryside is a transitory phenomenon defined by an informal (unplatted) arrangement of larger suburban or estate lots situated along a major road, but surrounded by undeveloped, agricultural lands. In League City, areas of this type exist only along the westernmost extents of FM 517.

***Keys to Rural Character:***

- Wide open landscapes, with no sense of enclosure, and views to the horizon mostly unbroken by buildings;
- Structures are in the background or are entirely invisible by blending into the landscape;
- Very high open space ratios and very low building coverage;
- Great building separation providing privacy and detachment from neighboring dwellings;
- Much greater reliance on natural drainage systems, except where altered significantly by agricultural operations;
- City residents and tourists attracted by opportunities for country drives and longer distance recreational biking; and
- A pleasant environment for walking and biking, especially on off-street trail systems.

***Figure 5.4 – Rural Archetypes***

***"Countryside"*** ***"Agricultural"*** ***"Natural"***

## *SUBURBAN CHARACTER*

There are two suburban types: **suburban** and **estate** *(Figure 5.5)*. Suburban character is much different from the urban types, emerging over the last century as a more garden-like living environment. In this character class the dominant visual feature is "green" and/or open space versus structures. In an estate setting the structure may be entirely hidden from view. Where there is a sense of enclosure along streets, it comes from a tree canopy and/or dense vegetation and landscaping. More extensive green and open space often contributes to recreation opportunities and natural resource protection. Many of League City's neighborhoods draw their suburban character from their open space amenities, such as a golf course, parks, greenways, and/or lakes. A water amenity within a neighborhood, or an office or business park, can shift its character from auto-dominant to suburban since all those in close proximity benefit from the amenity and the pleasant views it affords.

***Keys to Suburban Character:***

- More horizontal development, often even more spread out than Auto-Dominant;
- Space enclosure, if any, provided by trees and vegetation versus buildings;
- Even larger building setbacks from streets than in Auto-Dominant, but usually providing for more green and open space versus surface parking along street frontages;
- More building separation, through larger setbacks and, in some cases, larger lots;
- Much lower lot coverage and a correspondingly higher open space ratio on sites;
- More extensive and intensive landscaping than in Urban and Auto-Dominant settings;
- More opportunity for natural drainage and storm water absorption versus concentrated storm water runoff and conveyance; and
- A more pleasant environment for walking and biking, especially on off-street trail systems.

***Figure 5.5 – Suburban Archetypes***

***Estate*** ***Suburban (large lot)*** ***Suburban***

## *URBAN CHARACTER*

There are three urban character types: **urban core**, **urban**, and **auto-dominant** *(Figure 5.6)*. Urban areas are historically the center of commerce, culture, and entertainment in the community. The features that contribute to an urban character include a rich mixture of vertically integrated uses, a strong building-to-street relationship with little or no building setbacks, on-street and structured parking with very little surface parking, and a strong pedestrian orientation. Urban development is designed with an intensity of use to draw people into close contact, where congestion and personal encounters are both expected and essential for a vibrant community center. Urban spaces are "architectural," meaning that they are enclosed by buildings. In other words, the distance across a space, such as the width of a downtown street in relation to the height of its block faces, is essential for creating an "urban" environment.

***Keys to Urban Character:***

- More vertical development (two- to five-story buildings);
- Zero or minimal front setbacks (building entries and storefronts at the sidewalk);
- Streets and other public spaces framed by buildings;
- Minimal surface parking in favor of on-street and structured parking;
- Most conducive for pedestrian activity and interaction; and
- Housing types range from small single-family to attached residential (such as brownstones and townhouses) and multi-family residential, often with alley access and/or rear garages.

***Figure 5.6 – Auto-Dominant Archetypes***

***Auto-Dominant Commercial*** | ***Auto-Dominant Multi-Family*** | ***Auto-Dominant Residential*** | ***Auto-Dominant Enhanced***

*Urban core* is not found in League City as this type represents a central business district with a very high intensity (typically buildings averaging 20 stories or more). *Urban* also is not found in League City. This type involves storefronts that are in a traditional downtown or main street setting. ***Auto-dominant* is the only and most prevalent urban character type in League City.** It did not exist until the demand for on-site parking became critical for business. Retail, service businesses, and offices all require more land for parking than they have floor area, thus eliminating the sense of enclosure found in urban areas. The commercial development along IH 45 and FM 518 is classic auto-dominant development, especially on larger sites where "big box" retail structures and office buildings are at the rear of the site to accommodate extensive surface parking to the property frontage. The big box retail centers at the intersection of IH 45 and FM 646 are the quintessential auto-dominant commercial developments.

***Keys to Auto-Dominant Character:***

- More horizontal development (mostly one- to two-story buildings);
- Buildings set back from streets, often to accommodate surface parking at the front;
- Very open environment, with streets and other public spaces not framed by buildings or vegetation;
- Significant portions of commercial and industrial development sites devoted to access drives, circulation routes, and surface parking and loading/delivery areas, making pavement the most prominent visual feature;
- Smaller, narrow single-family lots dominated by driveways and front-loading garages, reducing yard and landscaping areas;
- Extent of impervious surface leads to increased storm water runoff;
- Auto-dominant commercial often not conducive for pedestrian circulation; and
- Structured parking generally not feasible or practical.

League City is unique in that it has neighborhoods that are in a grey area between auto-dominant and suburban. While their regular and dense street and lot patterns and consistent building scales and setbacks are analogous to an auto-dominant type, the presence of, and in some cases access to, adjacent open space, together with parks, civic spaces, and an increased vegetative cover, exhibit some suburban attributes. These areas are referred to as Auto-Dominant Enhanced.

## *LAND USE MODEL*

The land use model used in this planning effort takes as its input the community character type, such as suburban residential, auto-dominant commercial, assigned to each parcel in the city. The particular assignment of land uses varies by specific growth scenario, as discussed in the next section. The community character is then converted to growth impacts (population, housing, employment) by multiplying the land acreages by appropriate density, Floor Area Ratio (FAR)[2], family size, or employment intensity ratios for the assigned community character type. The accuracy of the multipliers is verified by calibrating the model to match or closely approximate existing observed conditions. The output of the model is a projection of the number of residents, housing units, and jobs that would exist in League City under each of the land use scenarios.

## *PREFERRED LAND USE SCENARIO*

The land use model was used to run four different potential growth scenarios, each for the year 2035 and based upon different policy and density assumptions. In addition to showing the projected land uses across the city, the scenarios also project the total population, housing units, and employment. Each scenario differs with regard to how the community develops (i.e., types, location, and density of development), the amount of open space preserved, and resulting overall character. The scenarios allow for the visualization of how different policies and development patterns impact overall character and infrastructure needs. For example, a given population can be accomplished by continuing to develop with the City's current land use patterns, resulting in sprawling auto dominant subdivisions, or as an alternative, clustering can be promoted and higher-density development can be targeted in designated areas (Urban High/Urban Low). This second alternative requires less land and therefore allows for open space preservation and a more "rural/estate" character.

The scenarios promote open space preservation, connectivity, walkable mixed use centers, transit supportive development, and a stronger jobs/housing balance. These scenarios were also designed to minimize impacts to infrastructure and flooding and preserve and enhance developed neighborhoods and commercial centers. With input from the public during the development of the Comprehensive Plan, the scenario shown in *Figure 5.7* was selected as the preferred growth scenario. This is the scenario upon which the recommendations in this master mobility plan are based.

Key characteristics of this scenario include the following:

- Residential uses primarily consist of rural/estate and suburban promoting clustered villages
- Mixed-use centers:
  - Urban High – SW part of town, IH 45/FM 646 intersection
  - Urban Low – SW part of town, RiverBend, area surrounding IH 45/FM 646 intersection, north of Challenger 7 Memorial Park, SH 96/SH 146 intersection, FM 270 (south of Nature Park), Shellside

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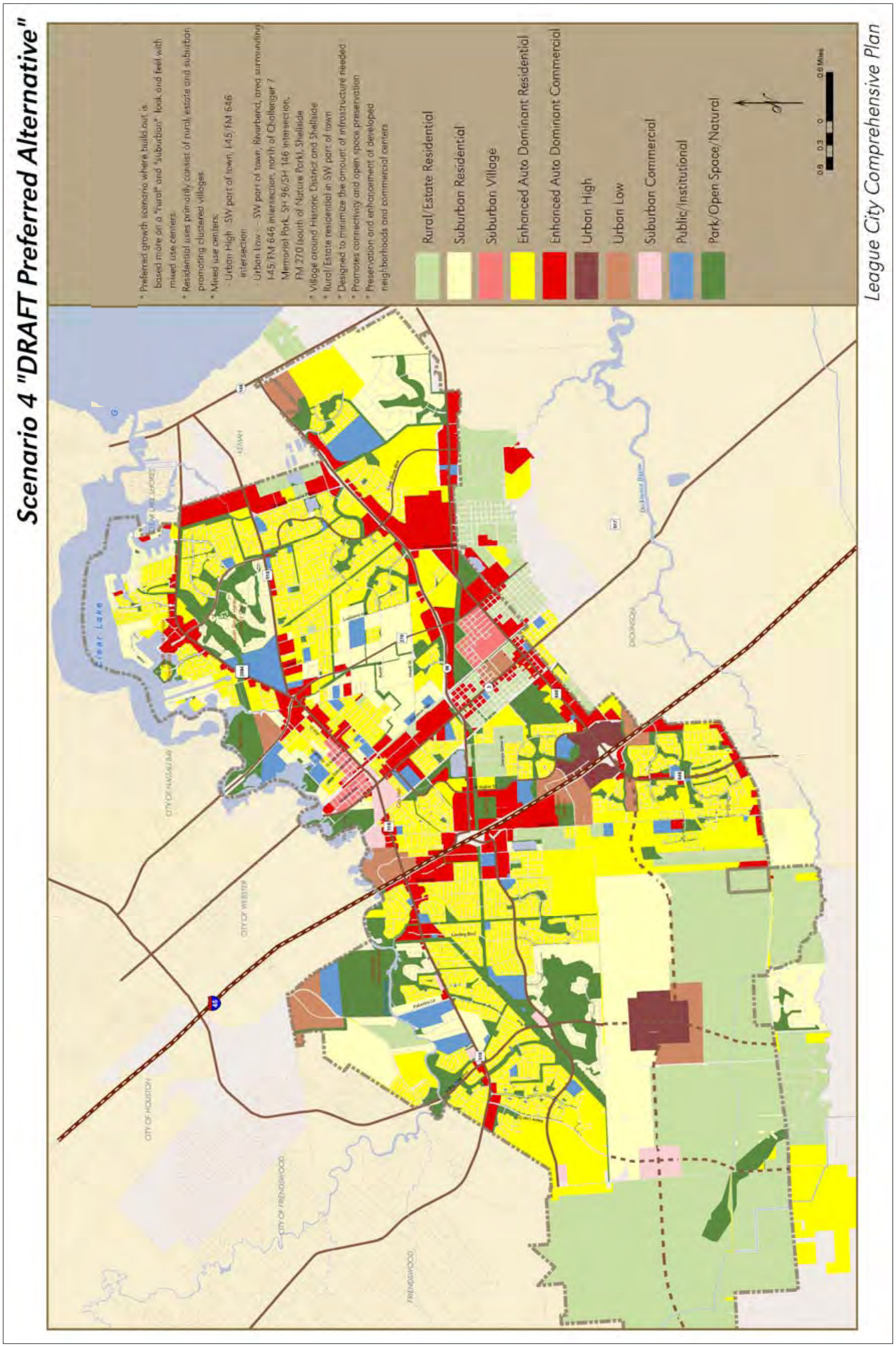
[2] FAR is the relationship between the amount of useable floor area permitted in a building and the area of the lot on which the building stands and is calculated by dividing the gross floor area of a building by the total area of the lot.

- Suburban Village around Historic District and Shellside

The projected population, housing units, and employment for this scenario are as follows:

- Population: 178,875
- Housing units: 77,446
- Employment: 54,931

***Figure 5.7 – Preferred Land Use Scenario***



### *DESCRIPTION OF LAND USE DISTRICTS*

The land use districts reflected by the future and preferred growth scenarios are described below and summarized in *Table 5.1*. A more detailed discussion of community character is included in *Appendix C*.

***Table 5.1 – Summary of Land Use District Characteristics***

| *Residential District* | *Development Type* | *Avg. Lot Size* | *Open Space* | *Density (units/acre)* |
|---|---|---|---|---|
| Rural/Estate Residential | Estate Single-Family | 1.0 acres | 0% | 0.75 |
| | Conventional Single-Family | 20,000 sq. ft. | 15% | 1.20 |
| | Cluster Single-Family | 7,000 sq. ft. | 20% | 2.70 |
| | Village Residential (with mixed housing types) | 3,000 sq. ft. | 44% | 4.16 |
| Suburban Residential | Conventional Single-Family | 10,000 sq. ft. | 18% | 2.00 |
| | Cluster Single-Family | 7,000 sq. ft. | 20% | 2.80 |
| | Planned Residential (with mixed housing types) | 3,000 sq. ft. | 35% | 4.84 |
| | Planned Multi-Family | 1,800 sq. ft. | 35% | 8.00 |
| Suburban Village | Conventional Single-Family | 7,000 sq. ft. | 13% | 3.30 |
| | Single-Family Infill | 5,000 sq. ft. | 18% | 3.66 |
| Auto-Dominant Residential | Conventional Single-Family (Enhanced) | 7,000 sq. ft. | 12% | 3.06 |
| | Cluster Single-Family | 5,500 sq. ft. | 16% | 3.52 |
| | Single-Family Manufactured Home | 5,000 sq. ft. | 18% | 3.75 |
| | Planned Multi-Family | 1,250 sq. ft. | 25% | 12.60 |
| *Non-Residential District* | *Development Type* | *Height* | *Green Space* | *FAR* |
| Suburban Commercial | Office or Retail | 2 stories | 18% | 0.38 |
| Auto-Dominant Commercial | General Commercial (surface parking) | | | 0.43 |
| | General Commercial (structured parking) | up to 4 stories | | 0.75 |
| | Mixed Use (3-story structured parking) | up to 6 stories | 18% | 1.50 |
| Urban Low | Mixed Use (2-story structured parking) | | 20% | 1.67 |
| | Mixed Use (3-story structured parking) | up to 6 stories | 18% | 2.11 |
| Urban High | Mixed Use (2-story structured parking) | up to 6 stories | 15% | 1.77 |
| | Mixed Use (3-story structured parking) | up to 8 stories | 18% | 2.75 |
| | Mixed Use (5-story structured parking) | up to 10 stories | 18% | 3.21 |

***Rural/Estate Residential.*** The intent of this district is to preserve the rural character of League City. To accomplish this objective there are four development options, with variations in densities and percentages of open space. Essential in the design of rural developments is the use of open space and buffering, which is used for adequate separation and buffering within and between different housing or development types. These available options include the following:

- ***Estate single-family*** development that may include lots with an average size of one acre. Due to the size of the lot and the relative openness of an estate development, common open space is not necessary to achieve a rural character. The density of an estate development may reach 0.75 units per acre.

- ***Conventional single-family*** development may have lots that are 20,000 square feet. To maintain a rural character the relative density increases to 1.20 units per acre, with 15% open space.
- ***Cluster single-family*** development would allow lots of 7,000 square feet. An open space ratio of 20% would allow a density of 2.70 units per acre.
- ***Village residential*** development would allow a density up to 4.16 units per acre. To achieve this density within a rural environment a mixture of housing types would be necessary. The average lot size of 3,000 square feet would provide for a variety of residential lot sizes and unit types ranging from single family detached, lot line, and patio dwellings to standard and over/under duplexes, townhomes, and multiplexes. The minimum open space is 44%.

***Suburban Residential.*** The distinguishing factor of the Suburban Residential district is a relative increase in the amount of open space. This open space may be in the form of the yards of larger, private home sites (together with pocket parks, esplanades, etc.); a higher percentage of common open space such as neighborhood parks, retention lakes, or paddocks; or a combination thereof. The available development options within this district are as follows:

- ***Conventional single-family*** development with lots averaging 10,000 square feet and 18% open space, which yields 2.00 units per acre.
- ***Cluster single-family*** development that allows an increase to 2.80 units per acre with 7,000 square foot lots and 20% open space.
- ***Planned residential*** development is comparable to Village Residential in that it allows a variety of housing types with an average lot size of 3,000 square feet. To reflect a suburban character the open space is 35%, allowing a density of 4.84 units per acre.
- ***Planned multi-family*** development allows a broader variety of attached living types, including multiplexes and multi-family dwellings among other attached and detached dwellings. With an average lot size of 1,800 square feet and 35% open space, the density is 8.00 units per acre.

***Suburban Village.*** The purpose of this district is to preserve the character of the community's original town neighborhoods. These areas are unique given their grid street patterns, broad variety of home styles, varying lot sizes and setbacks, and different building orientations and means of (or no) garage access. They are characteristic of the suburban class due to the larger lot sizes and the relative amount of openness, together with a canopy of mature vegetation. Since this district is intended to preserve the character of an existing area its options are as follows:

- ***Conventional single-family*** development which includes 13% open space for a density of 3.30 units per acre.
- ***Single-family infill*** development, which allows a reduced lot size to 5,000 square feet, but requires 18% open space. This option offers an infill bonus of 11% that is intended to encourage reinvestment in the village area.

***Auto-Dominant Residential.*** An auto-dominant character generally describes many of the existing neighborhoods. The attributes of this character type are shallower block depths, smaller lot sizes, reduced dimensions around and between homes, consistent front and side setbacks, mostly front-facing garages with street access, and a limited amount of on-lot or common open space. Due to the relative lot and home sizes there is a high building coverage and increased impervious surface ratio, both on individual sites and collectively across a neighborhood. Developments of this character type are usually highly patterned, meaning that they have uniform setbacks, similar building mass and scale, and a consistent home orientation from lot to lot. The Auto-Dominant Residential district includes four development types, as follows:

- ***Conventional single-family (Enhanced)*** development, which has 7,000 square foot lots and 12% open space, yielding 3.06 units per acre. The term "enhanced" refers to immediate or abutting access to public open space or a natural feature or amenity, plus improved standards including street trees, on-lot landscaping, and increased setbacks. An enhanced development may also have an increased amount of common open space without meriting a suburban class.
- ***Cluster single-family*** development includes a reduced lot size of 5,500 square feet, with an increased open space of 16%. This yields an increased density of 3.52 units per acre.
- ***Single-family manufactured home*** development is to accommodate manufactured home subdivisions. The lot size is 5,000 square feet. A minimum of 18% open space is required, yielding 3.75 units per acre.
- ***Planned multi-family*** development allows a full variety of detached and attached living types, including multi-family dwellings. The lot size of 1,250 square feet per unit allows a density up to 12.60 units per acre, with 25% open space. In order to achieve – and not exceed – the allowed density, two or more housing types would be necessary.

***Suburban Commercial.*** This land use district is for limited office, retail, and other "light" commercial uses. By reason of its intended character this district applies to small sites and buildings that are in near proximity to other suburban or rural districts. To maintain a suburban character there is a minimum 18% on-site green space (referred to as the landscape surface ratio) and a FAR of 0.38. The building height is restricted to two stories. The character is preserved by way of building scale limitations (typically a maximum square footage) and both building and site design standards. In the context of an abutting neighborhood, for instance, a suburban commercial development would be limited in building mass and height, together with other performance and site design standards (e.g., access, circulation, parking and loading, lighting, noise, etc.) to ensure compatibility.

***Auto-Dominant Commercial.*** This district may accommodate a variety of commercial related businesses, including a broad range of office and retail uses. It is mostly used to encompass those areas along primary corridors and at major intersections that are already of this character. Development in this district generally includes single and multi-tenant buildings that are in the form of stand-alone buildings, strip centers, or malls. The design of properties within this district is largely influenced by the required on-site parking whereby the amount of parking surface may well exceed that of the building coverage. There are three development options within this district, with the difference in FARs being attributable to building height and whether there is surface or structured parking. There are incentives inherent in the development options by way of increased floor areas for structured parking and mixed use. The options are as follows:

- ***General commercial (with surface parking)*** development allows building heights up to a maximum of four stories, which is comparable or exceeds that now located in the City. The floor area is limited to 0.43 due to the area occupied by surface parking. The amount of green space is 18%.
- ***General commercial (with two-story structured parking)*** developments with the same building height and open space offer a floor area of 0.75 by way of using structured parking. The increase is due to the reduced amount of site area that is otherwise devoted to surface parking.
- ***Mixed-use (with three-story structured parking)*** development is a preferred development type and for this reason, allows a building height of six stories and a floor area of 1.50. Use of three-story structured parking further improves the efficiency of site development.

***Urban Low.*** To achieve an urban character, this district will have higher FAR and building coverage ratio, building frontages that address the street, on-street and structured parking (with limited surface parking), and a strong pedestrian environment complete with civic spaces and buildings. This district is envisioned as a mixed-use urban center with an average building height of six stories. It is intended for use at development nodes and in areas that can accommodate moderately intensive development, such as along the IH 45 corridor and along the potential future commuter rail alignment. The intensity of this district is such that it warrants structured parking, which is also necessary to achieve an urban character. The district is intended for commercial office, retail, and higher-density residential uses that may include a combination of single or vertically mixed-use buildings. There are two development options, which include the following:

- ***Mixed-use low-2 (with two-story structured parking)*** development may include a multitude of higher-density and commercial office and retail uses in a planned urban context. The buildings may vary in scale with an average height of six stories. The required green space is 20%, which may be used for public plazas and urban greens, as well private space for residential units and buffering from adjacent uses. By stacking the parking in a structure the FAR is 1.67.
- ***Mixed-use low-3 (with three-story structured parking)*** development is similar to mixed-use low-2 only it factors a three-story parking garage. This, together with a decrease in the green space (which is for the purpose of encouraging three-story structured parking), allows a high FAR of 2.11.

***Urban High.*** This district is the most intensive in the community, which may allow buildings up to 10 stories in height. In the growth scenarios this district is planned around the intersection of IH 45 and FM 646, and as an urban center in the southwestern quadrant of League City. Given the intensity of this district structured parking is warranted and necessary to achieve an urban high character. There are three development types, as follows:

- ***Mixed-use high-2 (with two-story structured parking)*** development allows an average building height of six stories, with a two-story parking garage. The percent green space is lower than in the urban low districts to accommodate a higher FAR of 1.77. The green space in an urban high district is commonly for urban plazas. Additional public space may be provided on building roofs, such as a rooftop garden or pool.
- ***Mixed-use high-3 (with 3-story structured parking)*** development raises the parking structure to three stories and allows an average building height of eight stories. With 18% green space, used for public spaces and building setbacks and buffering, the FAR may reach 2.75.
- ***Mixed-use high-5 (with five-story structured parking)*** development is the most intensive type, which would allow buildings to an average height of 10 stories. With a five-story parking structure and 18% green space, the FAR is 3.21.

# Chapter 6 – ROADWAY NETWORK RECOMMENDATIONS

This chapter presents both short- and long-term recommendations for improving the functionality of the League City roadway network, to include achieving the goals of increased mobility, reduced congestion, and enhanced safety. Recommendations range from more cost-effective short-term solutions such as access management and intersection improvements to large capital investments such as new proposed corridors. The existing network deficiencies outlined in Chapter 2 as well as the land use and travel demand modeling efforts discussed in Chapter 5 have formed the basis of the recommendations delineated here.

## *SHORT-TERM RECOMMENDATIONS*

**The aim of the following short-term projects is to produce noticeable mobility improvements over the next five years.** As the project costs are relatively low and their implementation relatively straightforward, League City should make every effort, for the benefit of its citizens, to pursue these high "bang for the buck" projects.

### *Transportation Systems Management and Access Management Strategies*

**The TSM approach to congestion mitigation seeks to identify ways to optimize the capacity of the *existing* system, without resorting to projects requiring high capital outlay and/or extensive ROW acquisition.** TSM strategies include, but are not limited to, traffic signal and intersection improvements, and real-time data collection to monitor and react to traffic conditions. Specifically, traffic signal and intersection improvements can include the following:

- Signal timing optimization and/or synchronization
- Lane reconfiguration, addition of turn lanes
- Vehicle detection systems
- Pavement striping
- Signage and lighting

As discussed in Chapters 1 and 2, access management is the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections for the purpose of enhanced mobility. As such, access management is actually a type of TSM strategy. Taken together, TSM and access management strategies can provide very cost-effective short-term solutions for optimizing the existing transportation system.

The TSM and access management strategies that would be most useful in League City include the following:

- ***Reconfigure and consolidate driveways:*** Closely spaced driveways and their nearness to intersections on arterial streets hinder traffic movement, causing congestion and air pollution. Managing driveways can increase public safety and reduce congestion and air pollution, while maintaining the existing roadway capacity.
- ***Signal spacing and traffic signal improvements:*** Optimized signal timing and synchronization maximizes vehicle progression and reduces delay along the corridor. Particularly, signal coordination helps provide uninterrupted flow of traffic through a series of consecutive signalized intersections and a safer driving environment.
- ***Intersection improvements:*** Intersection improvements include low-cost intersection reconfigurations, such as left-turn bay extensions or restriping to create additional storage space; adding channelized right-turn lanes or auxiliary lanes at intersections with high right-turn volume; and adding pedestrian crossings to improve safety.
- ***Median treatments (raised medians):*** Research shows that as traffic volumes on arterial streets rise beyond 20,000 vehicles per day, TWLTL begins to decrease in functionality, often resulting in safety problems. The installation of raised medians and channelized left turns can reduce the number of conflict points (i.e., opportunities for crashes to occur), creating a safer driving environment. Considerations when implementing a raised median include providing for passenger vehicles making U-turns and for meeting the needs of truck deliveries to adjacent businesses.

**FM 518 is perhaps the corridor in League City with the most pressing need for access management and TSM strategies.** Between Hobbs Road and the Five Corners intersection, the corridor suffers from poor intersection configurations, too many driveways, poor adjacent development planning with respect to traffic flow and safety issues, and a crash rate that is more than double the statewide average from IH 45 eastward. Fortunately the corridor has been extensively studied in the past, most notably in H-GAC's 2004 *FM 518 Corridor Access Management Plan*. The implementation of accepted and proven access management strategies is needed if FM 518 is to become the much improved "destination" corridor the City envisions it to be. **It is highly recommended that League City pursue implementation of the FM 518 access management projects called for in the 2004 H-GAC plan.**

*Tables 6.1* and *6.2* summarize the FM 518 raised median improvements and intersection improvements, respectively, as presented in the 2004 H-GAC plan.

| ***Table 6.1 – FM 518 Corridor Access Management Plan – League City-Recommended Raised Median Improvements*** | | |
|---|---|---|
| ***Location*** | ***Feet of Median*** | ***Cost Estimate*** |
| Brookdale/Bay Area Boulevard | 2,400 | $103,200 |
| Royal - Hobbs/Lafayette to west of IH 45 | 1,000 | $43,000 |
| East of IH 45 to 40 feet east of Wesley | 1,300 | $55,900 |
| Highland Drive | 600 | $25,800 |
| Devereaux/Calder to Englewood | 1,300 | $55,900 |
| Interurban | 1,200 | $51,600 |
| West City Limit | 2,100 | $90,300 |
| Landing Boulevard | 600 | $25,800 |

| ***Table 6.2 – FM 518 Corridor Access Management Plan – League City-Recommended Intersection Improvements*** | | |
|---|---|---|
| ***Intersection*** | ***Add Capacity*** | ***Cost Estimate*** |
| Bay Area Boulevard | WB (right) | $23,000 |
| Spring Landing/Palomino | NB & SB (left) restripe lanes* | $18,500 |
| FM 2094 | WB (extend inside left lane to accommodate queue) | $5,000 |
| Landing Boulevard | WB (dual Left) | $25,000 |
| Hobbs/Lafayette | WB (dual left), NB (dual right), widen Hobbs 2 SB lanes | $55,000 |
| IH 45 west side | EB (dual right), begin new right as additional auxiliary lane | $140,000 |
| IH 45 east side | EB (dual left) | |
| Interurban | NB (left) | $25,000 |
| SH 3 | SB (right) NB, SB, EB, and WB (left) | $95,000 |
| Texas | NB (dual left, shared right) | $20,000 |
| FM 2094 | Develop new NB roadway (create a partial continuous flow intersection) | $680,000 |
| * Timing Change = Add quad left | | |

The total for all FM 518 access management projects in League City as recommended in the 2004 plan is $1,538,000. To account for inflation, this cost is adjusted upwards by 30% for a 2010 estimate of $1,999,400.

Access management criteria need to be considered for other arterials, such as FM 646 and League City Parkway, when roadway widening takes place in the future.

As League City continues to grow, it is increasingly important that an access management policy be put in place. Rural areas with large tracts of vacant land, as exists in the southwestern portion of the City, are particularly vulnerable to incremental development, which often results in linear or strip development and leads to increased conflict points and reduced roadway capacity. In order to effectively implement access management strategies when new development takes place, the adoption of an access management ordinance is recommended as a complement to the existing zoning and subdivision regulations. The ordinance will provide a legal framework for the City to administer and enforce consistent access management standards along key corridors. This ordinance should contain rules and requirements for "core" access management principles, including minimum spacing standards for traffic signals, median openings, and driveways; provisions for corner clearance, joint access, and connectivity; and design requirements for building access connections. The ordinance also should require cross access between adjacent properties, consolidation of excessive driveways, and retrofitting site access to the side or rear portions of the site, if possible.

***Traffic Operations Control Center***

The benefits of access management and TSM strategies can be greatly enhanced by also implementing an active traffic management center. Perhaps the most well-known example of this in the Houston-Galveston region is Houston TranStar, which is a regional traffic management center run jointly by TxDOT, Harris County, METRO, and the City of Houston. Other regional communities and districts, such as Sugar Land, Montgomery County, and Uptown Houston have also established a centralized traffic control/operations center. Such a center in League City, which can be actively manned by law enforcement and EMS personnel, traffic engineers, and/or Public Works personnel, could include the following features/services:

- ***Real-time monitoring of citywide traffic flow*** through the use of remote cameras.
- ***Dynamic Message Signs*** along all major corridors, relaying information to motorists such as road closures, detours, and delays due to traffic congestion, accidents, or construction.
- ***The use of internet and cell phone technologies*** to disseminate critical information to the public. These "remote data" technologies can have multiple uses, including the updating of DMS messages, providing traveler information and communicating information from remote weather stations.
- ***Serve as an Emergency Management Operations Center*** during evacuations and other emergency events. Could be linked to Houston TranStar, Galveston County, and neighboring communities.

The establishment of a traffic control center would be a timely development in conjunction with the City's takeover from TxDOT of maintenance and operations of the traffic signals. As previously discussed, this takeover is mandatory when a city's population eclipses 50,000. League City's population officially surpassed this threshold when the 2010 Census results were released, and the City took over operations and maintenance of the 62 traffic signals on June 1, 2011.

The estimated cost for the first phase of a traffic operations control center is $500,000. As more of the City's traffic signals are synchronized and additional remote cameras are installed, the center can be expanded and additional capability brought online.

## *FUTURE ANALYSIS AND LONG-TERM RECOMMENDATIONS*

The following section evaluates the City's future roadway network performance and congestion level anticipated under the conditions of the preferred growth scenario. From this analysis, future infrastructure improvements needed to accommodate the projected growth can be determined. The forecast of the future traffic volumes is derived from the 2035 travel demand model, which evaluates the effects of the projected 2035 population, employment, and resultant traffic generation on the 2035 base network. The "2035 base network" includes the existing roadway network plus all committed or funded improvements that are included in the City's Capital Improvement Plan (CIP), as well as proposed future roadways as recommended by League City staff. No other improvements are assumed. *Figures 6.1* and *6.2* present the 2035 base roadway network by functional type and number of lanes, respectively. This network serves as the basis for further analysis of deficiencies and needs.

***Figure 6.1 – Base Future Roadway Network by Functional Type***

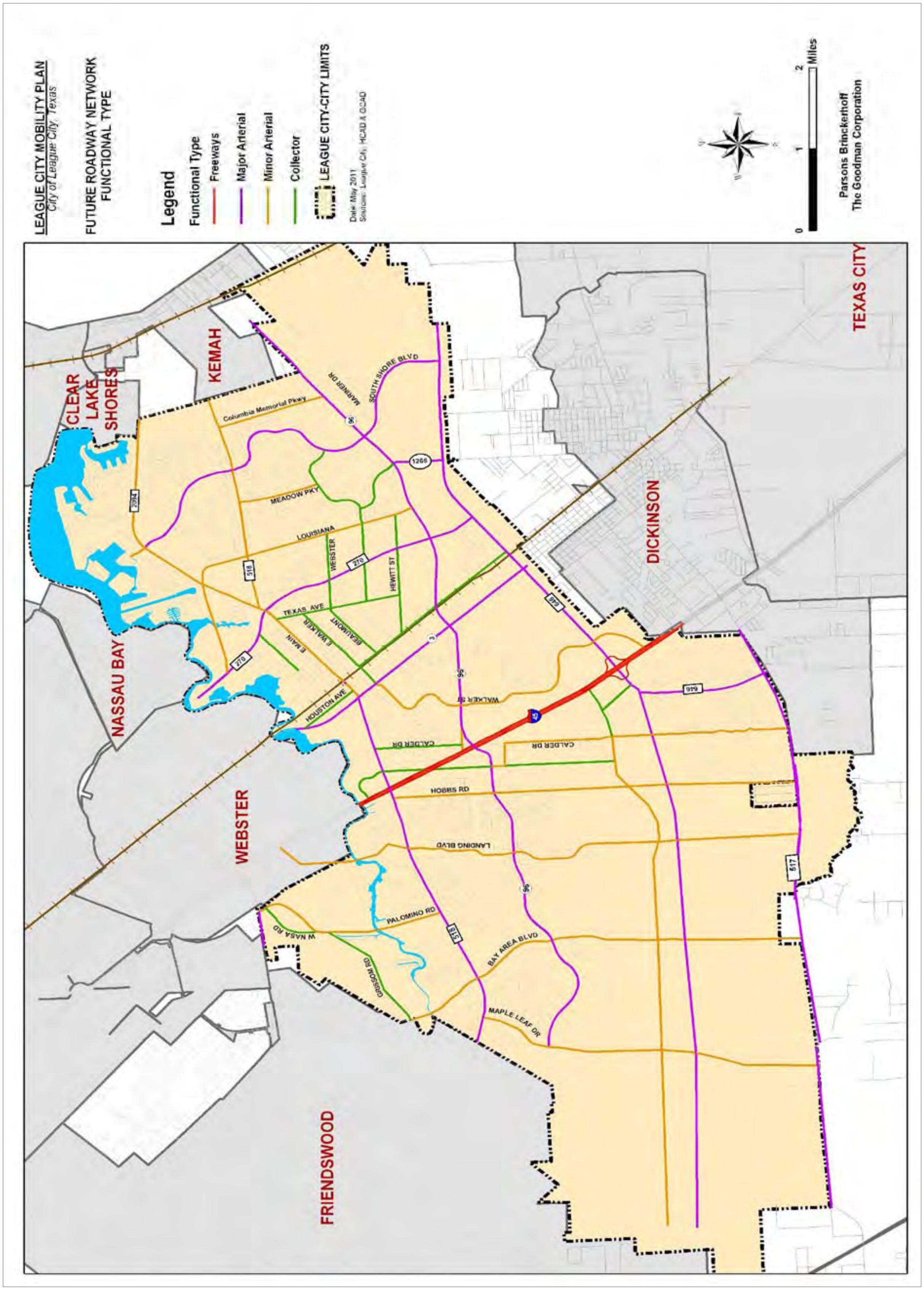
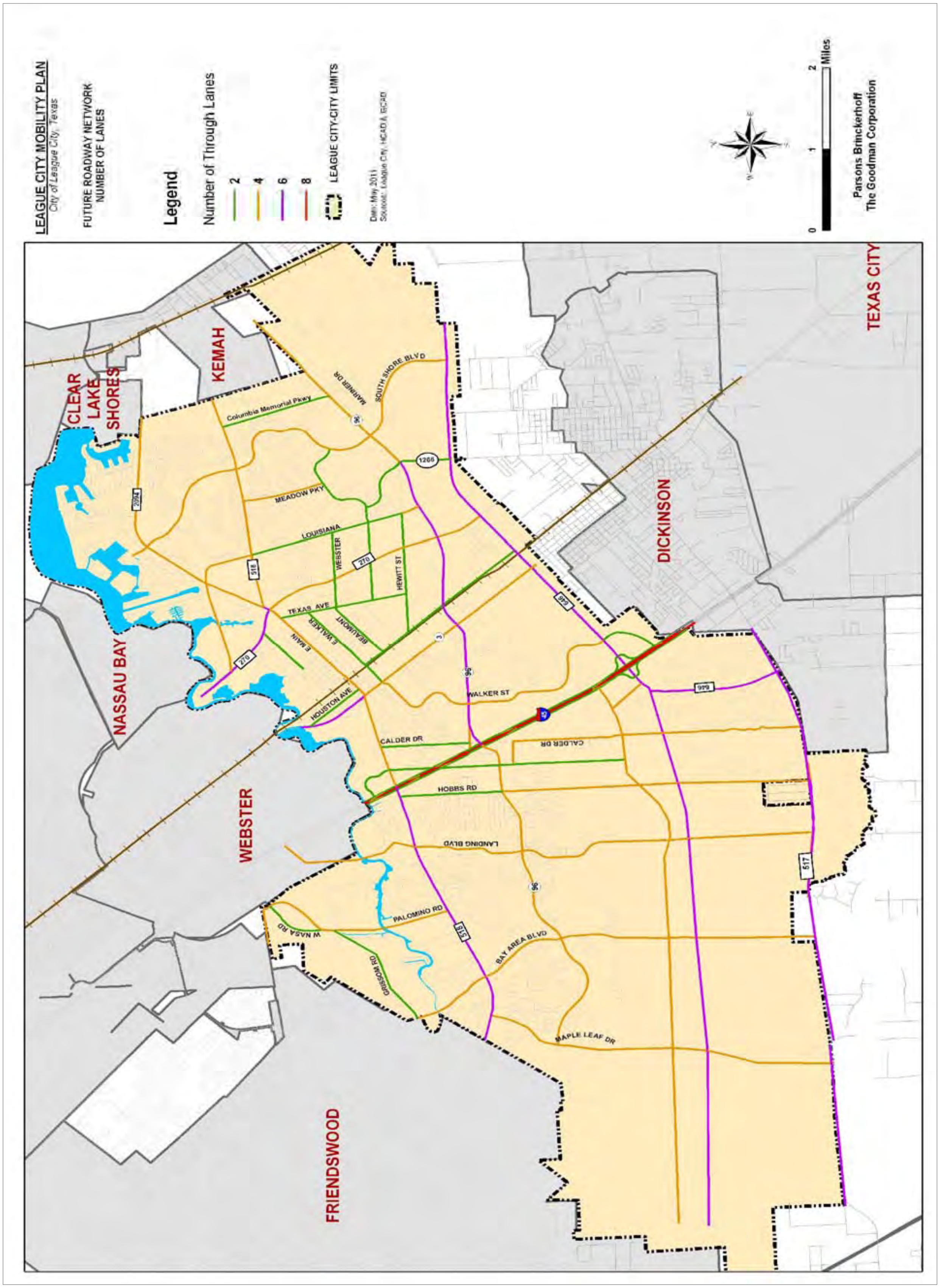


***Figure 6.2 – Base Future Roadway Network by Number of Lanes***



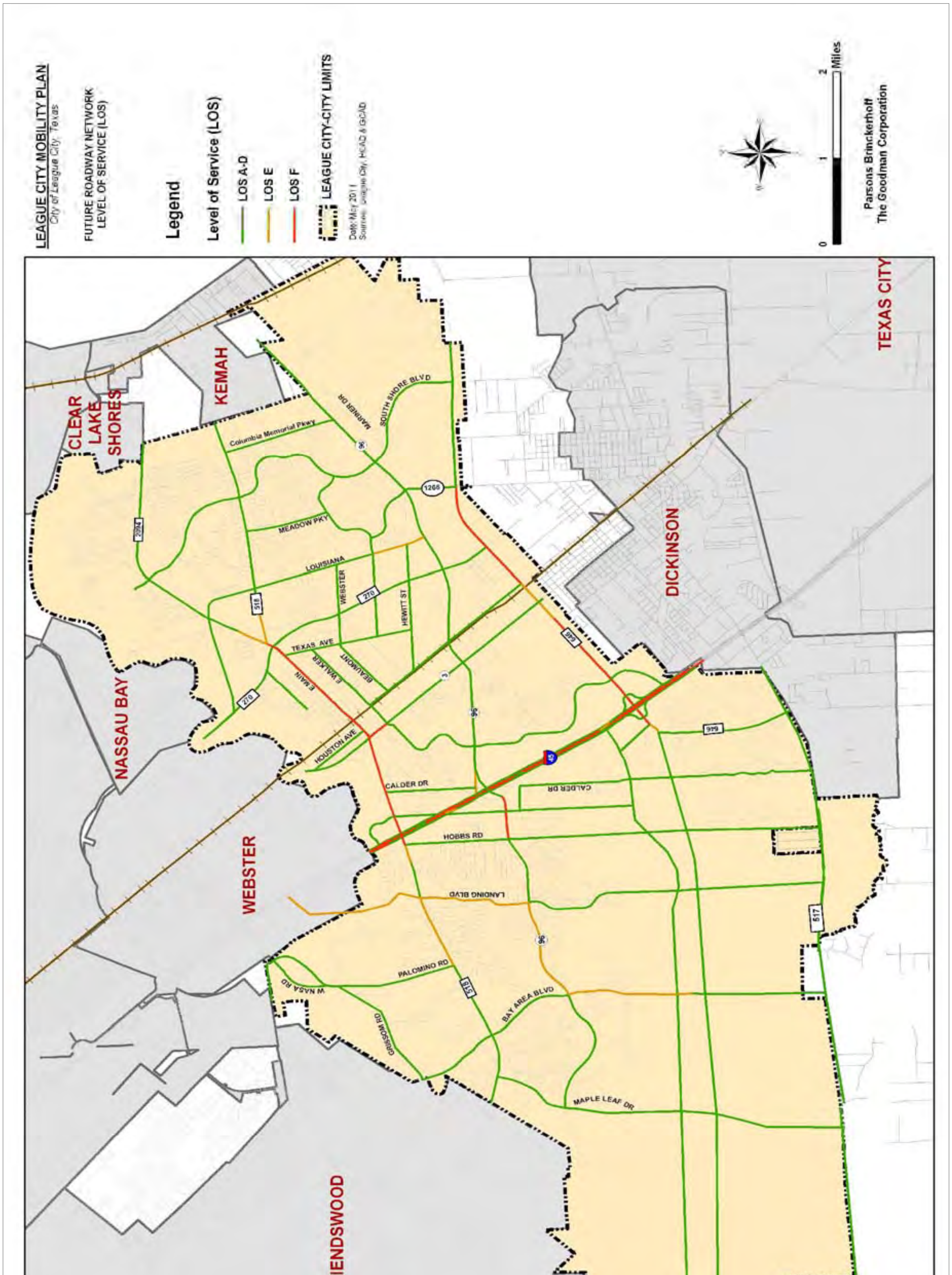
The base future roadway network and the parameters of the preferred growth scenario (population, employment, housing units) were input into the City's travel demand model. The resultant traffic forecast under the preferred growth scenario was then compared to existing conditions to assess the total change between 2009 and 2035, and the average annual growth during the period. Output data from the City's travel demand model, as presented in *Table 6.3*, show that the preferred growth scenario will cause congestion on the roadway system to increase dramatically, with significantly increased congestion observed on the major arterials. Total VMT will more than triple the amount of VMT for major arterials operating at LOS E or worse will grow at an average annual rate exceeding 9% every year.

**Table 6.3 – Changes in VMT* and Roadway Performance 2009 to 2035**

| Measure of Performance (Daily) | 2009 | 2035 | % Change | % Annual Growth |
|---|---|---|---|---|
| VMT - Total All Facilities | 1,309,018 | 4,662,775 | 256% | 5.01% |
| VMT - Major Arterials | 285,206 | 2,165,028 | 659% | 8.11% |
| VMT LOS** E or worse - Total All Facilities | 651,138 | 1,949,975 | 199% | 4.31% |
| VMT LOS E or worse - Major Arterials | 73,992 | 700,048 | 846% | 9.03% |
| *VMT = Total combined distance that all vehicles travel on the system. | | | | |
| **LOS = Based on forecast V/C ratios. | | | | |

The review of future traffic conditions also involved capacity analysis of the roadway segments with projected traffic volumes. To examine the operating conditions of arterial street segments, the projected peak hour traffic volumes were compared to capacity for various roadway types to obtain the peak hour V/C ratio. Capacity values used in the analysis were provided by the City. Using the LOS criteria presented Chapter 2, the morning peak and afternoon peak LOS totals for the base future network were determined. The deficiencies of the future roadway network are illustrated in *Figure 6.3*, based on the LOS threshold of E or worse during either morning or afternoon peak hours. Roadway segments that were predicted to be at or over capacity for the Year 2035 are highlighted on the map. This approach ensures a more conservative accounting of the future system needs as the basis to develop future roadway recommendations.

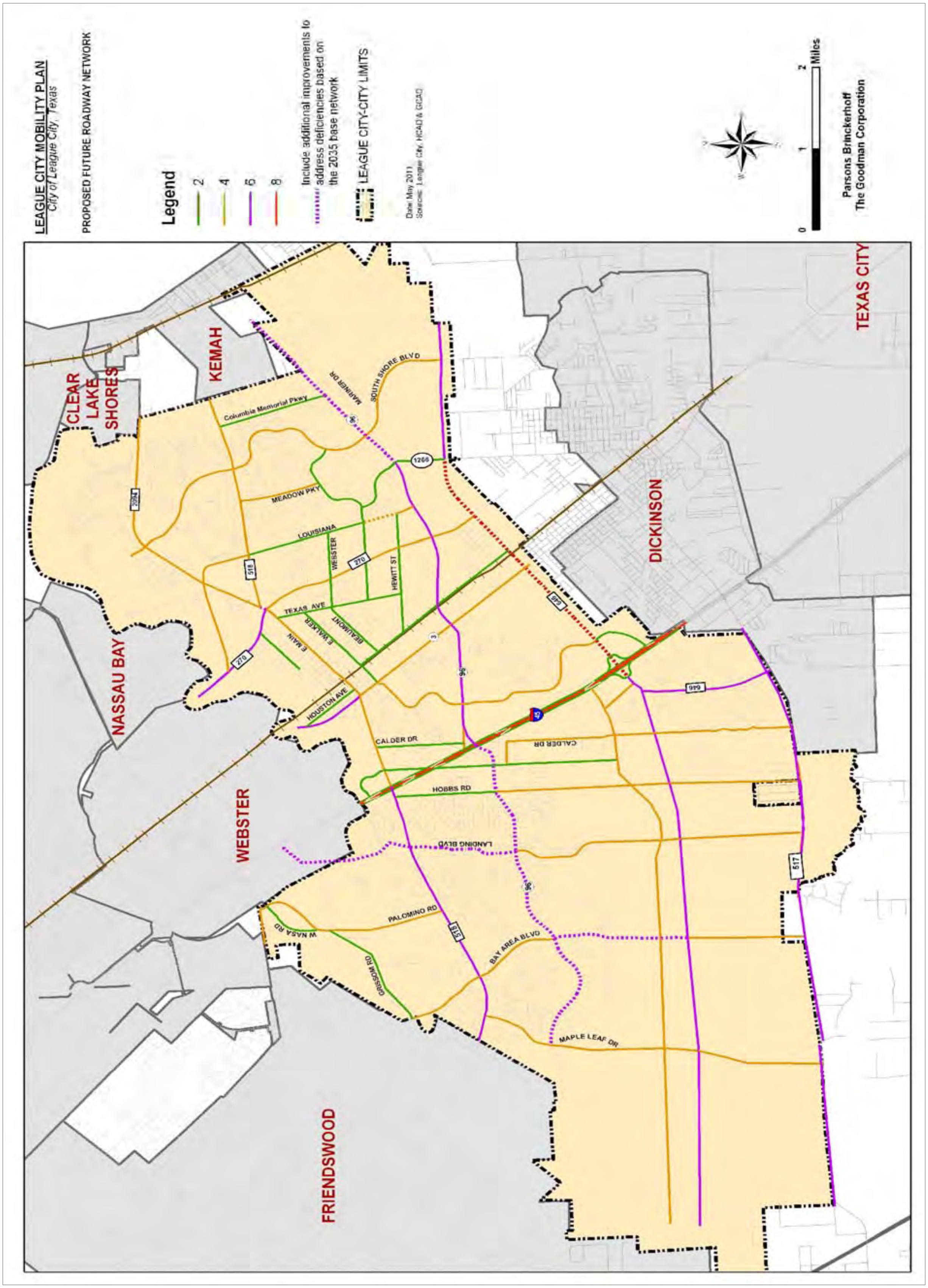
***Figure 6.3 – Preferred Growth Scenario Roadway Network Peak Period LOS***



## *FUTURE ROADWAY NEEDS ASSESSMENT*

Using the City's criteria of achieving LOS D or better as the goal for mobility improvements, significant capacity enhancement will need to be made to League City's future roadway system to accommodate future growth. These improvements will include new or realigned roads, additional lanes on existing roads, new or upgraded freeway interchanges, and gap closure to enhance roadway connectivity. Additional capacity needs for all roadway segments in the City's future base network that will operate at LOS E or worse were identified. These capacity enhancements combined with proposed projects that have been included in the City's future base network are presented as the proposed 2035 roadway network in *Figure 6.4*.

***Figure 6.4 – Proposed Future Roadway Network***



Based on the proposed future base network, as well as the deficiencies and needs that were identified within the future network, the following long-term roadway improvement projects listed in *Tables 6.4* and *6.5* are recommended for implementation. Cost estimates are based on total lane miles to be built and the unit cost assumptions of $1.2 million per lane mile for state facilities and $600,000 per lane mile for city streets. These cost estimates reflect 2010 dollars and do not account for cost escalation to 2035. Cost estimate summaries are presented in *Tables 6.6* and *6.7*. In addition to cost, the feasibility of these recommended projects will be constrained by ROW and environmental impacts.

***Table 6.4 – Recommended Long-Term Roadway Improvements*** [1,2,4]

| *Roadway Name* | *Segment*[3] | *Recommendation* | *Cost ($millions)* |
|---|---|---|---|
| IH 45 | Btw north and south city limit | Widen to 8-lane facility | 19.8[5] |
| IH 45 Frontage Rd | Btw north and south city limit | Widen to 2-lane frontage road | 19.8[5] |
| FM 518 | Btw west city limit and IH 45 | Widen to 6-lane major arterial | 8.1 |
| FM 518 Bypass | Btw FM 518 and FM 270 | Build as 4-lane bypass | 8.8 |
| League City Pkwy (SH 96) | Btw Maple Leaf Dr and Bay Area Blvd | Widen to 4-lane major arterial | 3.6 |
| League City Pkwy (SH 96) | Btw IH 45 and FM 1266 | Widen to 6-lane major arterial | 8.2 |
| FM 646 W | Btw FM 517 and IH 45 | Widen to 6-lane major arterial | 4.3 |
| FM 646 E | Btw IH 45 and east city limit | Widen to 6-lane major arterial[6] | 12.1 |
| FM 517 | Btw west city limit and IH 45 | Widen to 6-lane major arterial | 32.6[9] |
| FM 270 | Btw FM 518 and FM 646 | Widen to 4-lane major arterial | 5.7 |
| SH 3 | Btw north city limit and FM 518 | Widen to 6-lane major arterial | 1.6 |
| Proposed East-West Corridor | Btw west city limit and IH 45 | Build as 4-lane minor arterial | 16.6 |
| Proposed East-West Corridor (south) | Btw west city limit and IH 45 | Build as 6-lane major arterial | 23.9 |
| Maple Leaf Dr | Btw FM 518 and FM 517 | Widen to 4-lane minor arterial and extend to FM 517 | 9.2 |
| Bay Area Blvd | Btw SH 96 and FM 517 | Extend to FM 517 as 4-lane minor arterial | 5.5 |
| Palomino Ln/Bridge | Btw W NASA Rd and FM 518 | Widen to 4-lane minor arterial | 1.7[7] |
| Landing Blvd | Btw League City Pkwy and FM 517 | Widen and extend to FM 517 as 4-lane minor arterial | 7.8 |
| Landing Bridge | Btw FM 518 and IH 45 | Build as 4-lane bypass | 3.4[7] |
| Hobbs Rd | Btw League City Pkwy and FM 517 | Widen and upgrade to 4-lane minor arterial | 8.0 |
| Calder Dr | Btw IH 45 and FM 517 | Widen to 4-lane minor arterial[8] | 7.7 |
| Butler Rd | Btw IH 45 and Proposed E-W corridor | Build as 2-lane collector | 1.3 |
| W Walker St | Btw SH 3 and League City Pkwy | Widen to 4-lane minor arterial | 1.4 |
| W Walker St | Btw end of subdivision and IH 45 | Extend as 2-lane collector | 0.4 |
| South Shore Blvd | Btw end of subdivision and FM 646 | Widen to 4-lane major arterial | 1.1 |
| | | ***Total*** | **212.6** |

*Table 6.4 – Recommended Long-Term Roadway Improvements (Continued)*

*Notes:*

*1.* Estimated construction costs based on assumption of $1.2M per lane mile for state facilities and $600,000 per lane mile for other city roads. Costs do not include ROW, utility adjustment, or relocation costs.
*2.* All estimated construction costs reflect 2011 estimates and do not take into account future cost escalation to 2035.
*3.* Lengths for roadway segments were measured using League City Roadway Network GIS file provided by Occam Consulting Engineers.
*4.* Estimated construction costs based on roadway widening only, not including reconstruction of streets, mainlanes, or frontage roads. Estimates do not include costs for access management, TSM and other transportation improvement strategies on roadways, additional expense for elevated infrastructure (e.g., FM 518 Bypass), and do not reflect certain short segments that exist.
*5.* Estimated construction costs assume only proposed widening of 1 additional lane for each direction for both mainlanes and frontage roads, no reconstruction.
*6.* FM 646 between IH 45 and SH 3 is under construction for 4 lanes. Estimated construction cost includes 2 additional lanes for FM 646 between IH 45 and SH 3, and 4 additional lanes between SH 3 and the east city limit.
*7.* Estimated construction costs include $1M each for Palomino Bridge and Landing Bridge. These costs will be shared between City of League City and City of Webster.
*8.* Estimated construction cost assumes reconstruction of entire 4-lane roadway facility.
*9.* Estimated construction cost reflects full buildout of roadway facility that includes segments outside of League City city limits.

***Table 6.5 – Recommended Roadway Improvements to Address Deficiencies in 2035 Base Network[1,2,4]***

| ***Roadway Name*** | ***Segment[3]*** | ***Recommendation*** | ***Cost (millions)*** |
|---|---|---|---|
| League City Pkwy | Btw Maple Leaf Dr and IH 45 | Widen to 6-lane major arterial | 9.6 |
| League City Pkwy E | Btw FM 1266 and east city limit | Widen to 6-lane major arterial | 5.7 |
| SH 96 Direct Connectors | WB to NB, and EB to SB | Build two direct connectors, one lane each direction | 40.0 |
| FM 646 E | Btw IH 45 and FM 1266 | Widen to 8-lane major arterial | 9.3 |
| Bay Area Blvd | Btw League City Pkwy and proposed East-West corridor (south) | Widen to 6-lane minor arterial | 1.8 |
| Landing Bridge/Blvd | Btw IH 45 and League City Pkwy | Widen to 6-lane minor arterial | 2.9 |
| Louisiana St | Btw Austin St and Hewitt St | Widen to 4-lane minor arterial | 0.5 |
| | | ***Total*** | **69.7** |

*Notes:*

*1.* Estimated construction costs based on assumption of $1.2M per lane mile for state facilities and $600,000 per lane mile for other city roads. These costs do not include ROW, utility adjustment, or relocation costs.
*2.* All estimated construction costs reflect 2011 estimates and do not take into account future cost escalation to 2035.
*3.* Lengths for roadway segments were measured using League City Roadway Network GIS file provided by Occam Consulting Engineers.
*4.* Estimated construction costs based on roadway widening only, not including reconstruction of streets, mainlanes, or frontage roads. Estimates do not include costs for access management, TSM, and other transportation improvement strategies on roadways, additional expense for elevated infrastructure (e.g., FM 518 Bypass), and do not reflect certain short segments that exist.

| ***Table 6.6 – Cost Summary for Proposed Long-Term Roadway Improvements*** [1,2,3] | |
|---|---|
| Lane Miles Needed on State Facilities (include IH 45) | 104 |
| Lane Miles Needed on State Facilities (exclude IH 45) | 71 |
| Lane Miles Needed on other City Streets[4] | 143 |
| Cost Estimate for State Facilities (includes IH 45) | $124,600,000 |
| Cost Estimate for State Facilities (excludes IH 45) | $85,000,000 |
| Cost Estimate for other City Streets | $88,000,000 |
| ***Total Cost Estimate (includes IH 45)*** | **$212,600,000** |
| ***Total Cost Estimate (excludes IH 45)*** | **$173,000,000** |

*Notes:*
*1.* Estimated construction costs based on original future (2035) deficiency and needs analysis. Costs assume $1.2M per lane mile for state facilities and $600,000 per lane mile for other city roads.
*2.* All estimated construction costs reflect 2011 estimates and do not take into account future cost escalation to 2035.
*3.* Estimated construction costs based on roadway widening only, not including reconstruction of streets, mainlanes, or frontage roads. Estimates do not include costs for ROW, utility adjustment or relocation, access management, TSM, and other transportation improvement strategies on roadways, or additional expense for elevated infrastructure (e.g., FM 518 Bypass).
*4.* City streets include other major arterials, minor arterials, and collectors.

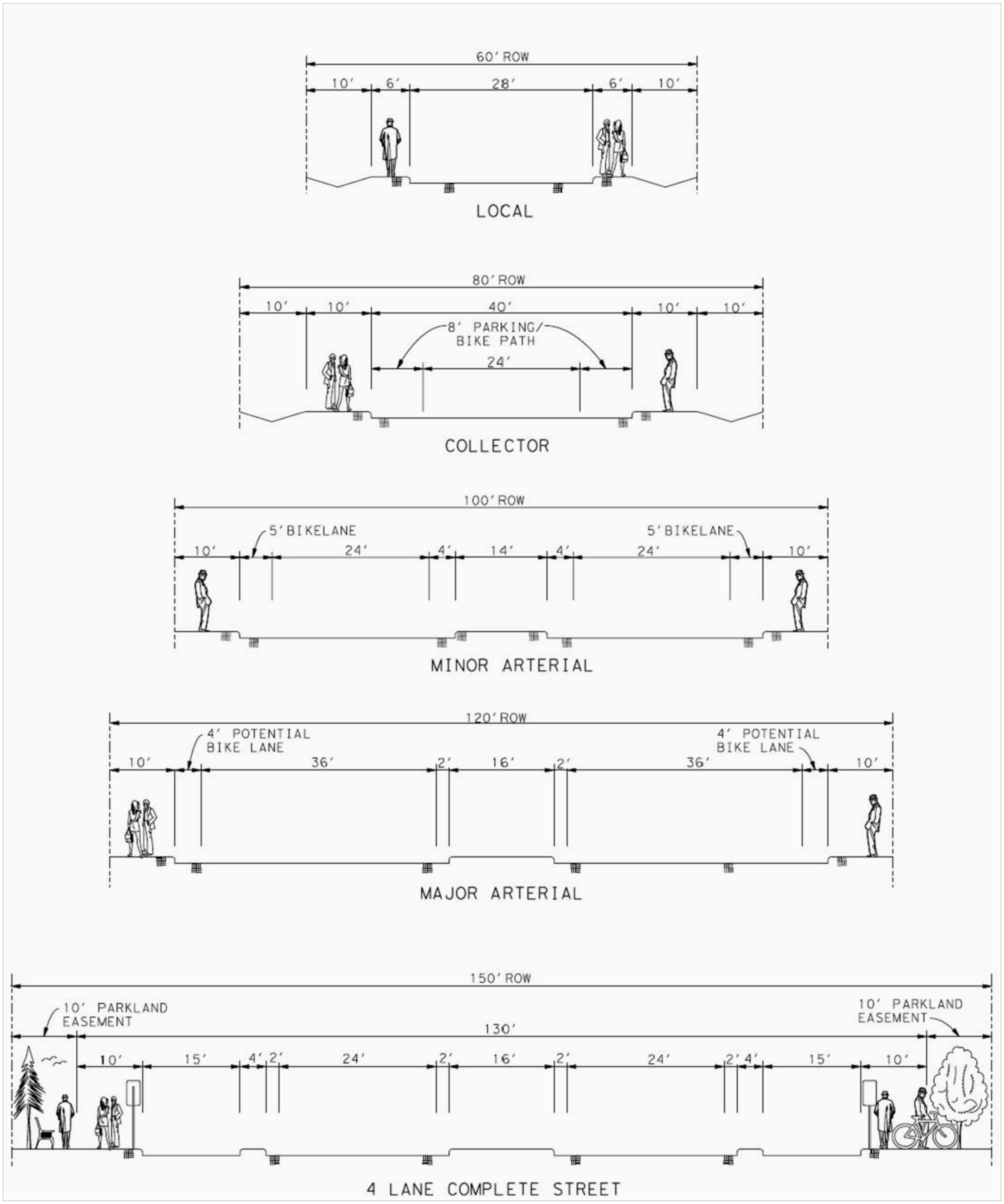
| ***Table 6.7 – Cost Summary for Improvements to Address Deficiencies in 2035 Base Network*** [1,2,3] | |
|---|---|
| Lane Miles Needed on State Facilities | 65 |
| Lane Miles Needed on other City Streets[4] | 5 |
| Cost Estimate for State Facilities | $64,648,000 |
| Cost Estimate for Other City Streets | $5,088,000 |
| ***Total Cost Estimate (includes IH 45)*** | **$69,736,000** |

*Notes:*
*1.* Estimated construction costs based on original future (2035) deficiency and needs analysis. Costs assume $1.2M per lane mile for state facilities and $600,000 per lane mile for other city roads.
*2.* All estimated construction costs reflect 2011 estimates and do not take into account future cost escalation to 2035.
*3.* Estimated construction costs based on roadway widening only, not including reconstruction of streets, mainlanes, or frontage roads. Estimates do not include costs for ROW, utility adjustment or relocation, access management, TSM, and other transportation improvement strategies on roadways, or additional expense for elevated infrastructure (e.g., FM 518 Bypass).
*4.* City streets include other major arterials, minor arterials, and collectors.

## RECOMMENDED ROADWAY CROSS SECTIONS

*Figure 6.5* illustrates the recommended cross sections for existing and planned roadway facilities in League City. These design standards should be adhered when implementing the recommendations included in this chapter.

***Figure 6.5 – Roadway Cross Sections***



## *ROADWAY CONNECTIVITY*

As addressed in Chapter 2, lack of connectivity of League City's existing roadway system has posed another challenge to mobility on the City's roadway network. An inadequate collector system increases trip length for all modes of transportation. Trips that should be made on the collector system must be made on the major thoroughfare network, which in turn reduces the effectiveness of the overall roadway network. Thus, in addition to the proposed enhancements to the City's major arterial network, connectivity improvements on the City's secondary roadway system (minor arterials and collectors) can help relieve the congestion on the major arterials by providing alternative travel routes and reducing congestion at the bottleneck locations such as freeway interchanges. Such improvements also provide better connections between neighborhoods and destinations.

## *CONCLUSION*

**The robust growth projected for League City over the next 25 years will lead to severe deficiencies in the operation of the roadway network.** Without significant improvements to the transportation system, congestion levels will increase dramatically and motorists will experience unacceptable travel conditions with slow travel speed and lengthy delays.

While League City cannot expect to be able to "build its way out" of its mobility problems, increased roadway capacity will be a vital and unavoidable component of the solution. This expansion will need to include adding the maximum amount of capacity possible to many existing roadways, as well as building new roadways in strategic locations.

In addition to capacity expansion there are also lower-cost tools at the City's disposal for improving the functioning of the roadway network. These include various forms of access management and TSM strategies.

To ensure the functioning of the roadway network at an acceptable level far into the future, the City of League City must deploy a comprehensive set of projects that run the gamut from lane restriping to brand new corridors.

# Chapter 7 – TRANSIT RECOMMENDATIONS

7

Transit service can exist in many different forms and levels of service, depending on the needs and characteristics of the community it serves. When implemented in a smart and efficient way, transit service can offer a number of benefits, including being a viable alternative to automobile travel for those who have cars, a vital means of transportation for those who do not, and a contributor to reduced congestion and pollution levels.

League City is a bedroom community with a large number of commuters traveling to the north and to the south every day. Because of this, **the City can easily support commuter transit, such as commuter rail and park & ride buses.** When it comes to traditional, fixed-route (i.e., local bus) transit; however, the situation is somewhat different. As discussed in Chapter 3, **the population demographics and current land use patterns of League City present challenges to the implementation of local transit service.** There are, however, flexible transit variations that may be feasible for local service in League City at the present time. Furthermore, as the City evolves toward more sustainable land use patterns, opportunities for more extensive local transit service will develop and can be pursued. This chapter will present both short-term (through approximately 2015) and long-term (beyond 2015) recommendations for each of the transit options that are feasible in League City.

## *LOCAL TRANSIT*

**The implementation of successful local transit in League City will require an incremental approach given the city's non-supportive land use patterns and lack of density.** This type of approach will serve to build transit awareness and ridership while the City transitions over the long-term toward the type of community envisioned in the preferred growth scenario. Among the benefits presented by the preferred growth scenario is the opportunity to be more "transit friendly."

### *Local Transit: Short/Medium Term*

The ways in which League City local transit service might evolve incrementally over the short and medium term are discussed below.

#### *Flex Route*

A flex route is a form of transit characterized by an intermediate level of service between that of total demand response and total fixed route. As such, it is an attractive option to consider for the start of incremental local service in League City. Two different types of flex routes are described below.

- **Point deviation** service operates on a fixed schedule with specific stops; however, it does not have a fixed route. Vehicles accommodate requests for pickups and drop offs at locations other than specified stops (points), as long as they can be accommodated within the fixed schedule. Therefore, service is provided to certain key origins and destinations, but can use any route to get there including avoiding congestion or servicing other locations. For example, service could be provided between South Shore Harbour and the Sportsplex, but whether FM 518, SH 96, or a zigzag route would be used would depend on conditions and requests.

- **Route deviation** service operates along a fixed route, making scheduled stops along the way. Vehicles deviate from the route to pick up and drop off passengers upon request. The vehicle then returns to the fixed route at the point at which it departed. Therefore, a particular fixed route would always be served (allowing passengers to depend on observing a bus pass by regularly); however, the bus might accommodate requests off that line as well.

**The flexibility and fewer vehicles required for point and route deviation service means that it can be provided at a lower cost than standard fixed-route service.** The resources and infrastructure of Connect Transit also could be tapped to help provide such service in League City.

***Flex Service in Houston Region***

League City can look to Houston for examples of flex routes that are operating today. In particular, there are two privately owned "jitneys" in operation in central Houston that are meeting a specific transit demand unable to be met by METRO.

The term jitney refers to a form of transportation currently making a comeback in communities across the U.S., after first appearing in 1914. A jitney is generally a small capacity vehicle that operates using a type of route deviation – that is, it follows a rough service route but can go slightly out of its way to pick up or drop off passengers. The jitney ordinance put in place by the City of Houston specifies that a jitney must have a seating capacity of no fewer than nine and no more than 15 passengers, including the driver.

The *REV Eco-Shuttle* is a jitney service operating electric, zero emissions vehicles throughout Downtown, Midtown, and the Washington Avenue corridor. The service was initiated in April 2008 and vehicles operate seven days a week. Passengers can call for pickup or book a ride online and are promised to be picked up within seven minutes in Midtown and Downtown, and 15 minutes on the Washington Avenue corridor. No fare is charged; drivers work for tips only. The service is marketed toward Downtown and Midtown workers who need to quickly travel the area, for example, on their lunch break, and visitors to the entertainment districts who want the ability to park once and travel among several venues.

***REV Eco-Shuttle***


***Washington Wave***

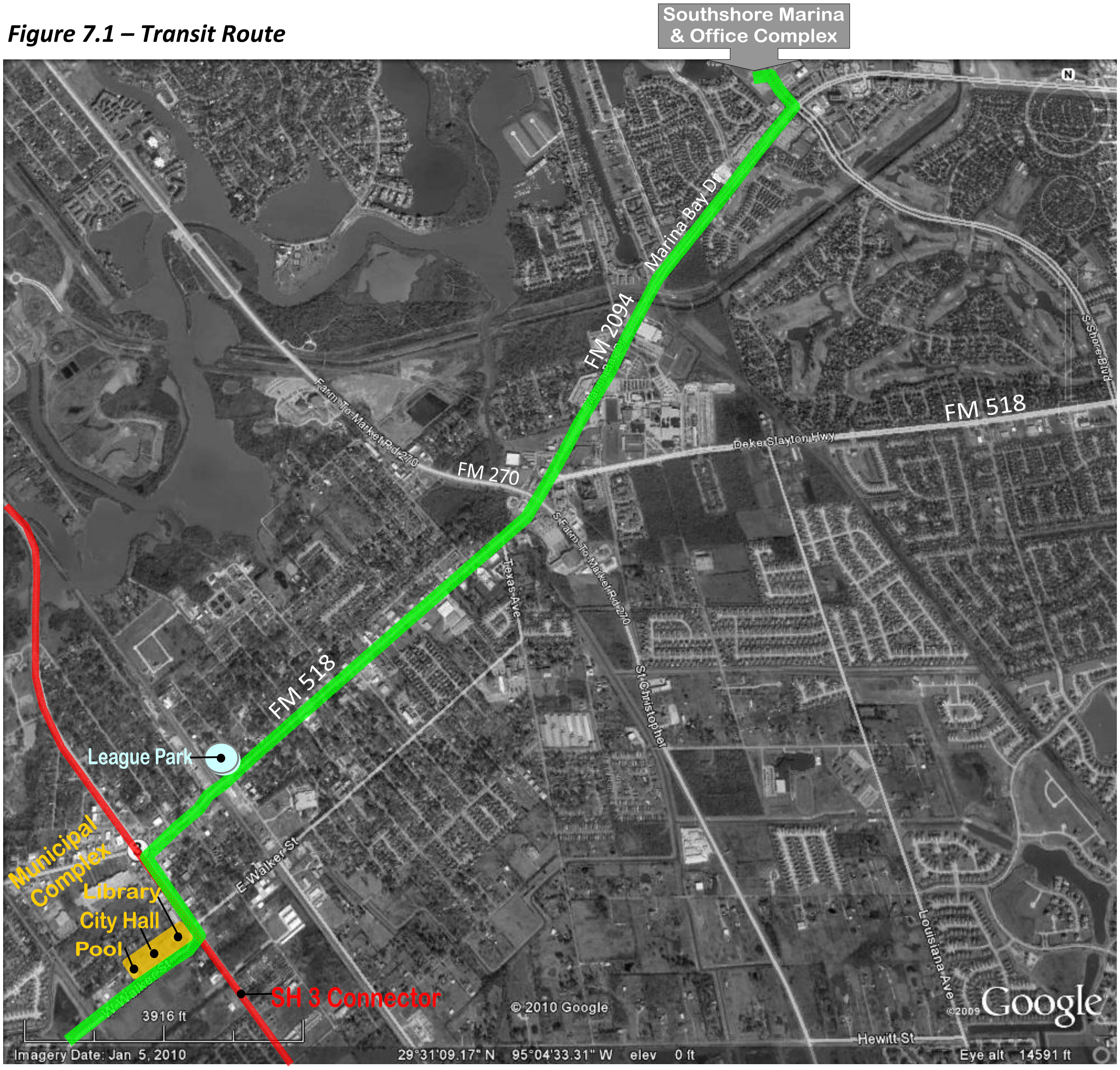
The *Washington Wave* is a jitney service operating vehicles very similar to those used for airport parking or rental car shuttles. The service was started in November 2009 to provide safe transportation among the many bars and clubs along the Washington Avenue corridor. Service was expanded shortly thereafter to include Midtown and the Heights, and there are further expansion plans for the Rice Village, Downtown, Uptown, Upper Kirby/Shepherd, and Montrose. The Wave is focused primarily on providing after-hours transportation throughout Houston's major entertainment venues and activity centers. Service is offered Thursday through Monday for $5 per ride, or $8 for an unlimited all-night pass. Passengers can simply "flag down" a passing Wave vehicle, or call or email for pickup. Free parking is provided in both a City of Houston parking lot on the edge of Downtown and an office building parking lot.

***Potential League City Flex Service***

Transit service very similar to the flex routes in Houston could conceivably work in League City. In particular, *Figure 7.1* shows a route that would make sense as "starter" service. Operating on Walker Street, SH 3, FM 518, and FM 2094, this service would connect a number of key destinations, including the following:

- Municipal Complex (city hall, library, pool)
- League Park
- Historic District
- Clear Creek High School
- CCISD Administrative Offices
- South Shore Harbour Resort and office complex

***Figure 7.1 – Transit Route***




Operating the service with the flexibility of point or route deviation would expand the reach of the service by allowing the vehicle to depart the fixed route to pick up and drop off passengers in, for instance, the residential areas of the Historic District and South Shore. As previously discussed in this chapter, successful transit service requires not only destinations but also a reasonable concentration of origins, which is often residential.

Such a service might utilize a vehicle similar to those used for the flex routes in Houston, or an alternative vehicle. Once choice might be a type of "historic trolley" used in many communities. For example, the City of Galveston currently operates an electric rubber-tire trolley vehicle that resembles an historic trolley (E-bus). This type of vehicle produces zero emissions. It is capable of serving local transit passenger loads along the limited proposed route, and would be appropriate for an area with both historic and waterfront characters.


***Historic Trolley Vehicle***

Initial acquisition costs for two hybrid-electric vehicles would be approximately $500,000. League City's share could be as little as 20% ($100,000) depending on the particular funding program the City chose to pursue for support. Alternatively, State Transportation Development Credits could be pursued to serve as local share in lieu of cash. Annual operating expenses would be approximately $312,000 (2,600 annual operating hours * $60 per hour per vehicle * 2 vehicles). A significant portion of operating funds could be provided for the first three years of operation under the Houston-Galveston Area Council's Pilot Project program, which supplies Congestion Mitigation and Air Quality (CMAQ) funding. League City's share in the first year is estimated to be $53,000, growing to approximately $140,000 annually by year four when the program would no longer be eligible for CMAQ funds.

The proposed route, in crossing SH 3, also would enable connections to any future transit service on SH 3, which will be discussed later in the chapter.

***Regional Connections to Other Existing Service***

While League City does not currently have fixed-route transit service of its own, several of the surrounding communities do have existing service in operation. When designing transit service (both short- and long-term) for League City it will be very important to establish connections to these other services. **Bay Area residents regularly travel among the many neighboring Bay Area cities for goods, services, jobs, shopping, medical treatment, and entertainment; thus, transit service that stays completely internal to League City's boundaries would not fully meet the needs of its citizens.** Surrounding service includes METRO's park & ride service on Bay Area Boulevard; fixed-route service provided by Connect Transit in Texas City, La Marque, and Dickinson; and service in Clear Lake/La Porte/Seabrook provided by Harris County Transit Services.

**METRO** provides commuter bus service from its park & ride facilities at the intersection of Bay Area Boulevard and Feathercraft Lane, and the intersection of Bay Area Boulevard and IH 45. Riders using this service can access downtown Houston and, via transfer, other locations such as Texas Medical Center. Until League City has its own park & ride facility providing northbound commuter service, it will be important for any interim service to connect to the METRO park & rides.

Major destinations served by fixed-route service currently operating in **Texas City, La Marque, and Dickinson** include Mainland Medical Center, College of the Mainland, Mall of the Mainland, the Gulf

Coast Center, and others. Connections to these medical, educational, shopping, and social services would be beneficial to League City residents.

**Harris County Transit Services** currently operates six fixed routes serving Baytown, South Houston, Pasadena, La Porte, Clear Lake, and Seabrook. The #5 Clear Lake/La Porte/Seabrook route, shown in *Figure 7.2*, could be a good candidate for connection opportunities between any League City transit service and the Harris County system. Destinations on this route that could be of most importance to League City residents include St. John's Hospital on NASA Parkway and the University of Houston-Clear Lake on Bay Area Boulevard.

***Figure 7.2 - Harris County Transit Route #5***


***Source: Harris County Transit Services Division***

**Harris County/BayTran NASA Parkway Circulator.** In addition to the #5 route, there is an additional Harris County route in the planning stages (in partnership with BayTran) that would serve the NASA/Clear Lake area. This route would travel the entire length of NASA Parkway between IH 45 and SH 146. This route presumably would connect to Route #5, since they share an overlapping segment on NASA Parkway. Connectivity between League City local transit and both of these routes will provide important access to destinations on the north side of Clear Lake.

**Internal League City Connections.** In addition to connecting to transit service in the surrounding communities, any local transit service should also offer connections to the UTMB Victory Lakes Park & Ride facility, any other park & ride facilities built in League City, and any commuter rail or BRT station that may be built in League City.

***SH 3 Connector Route***

What is clear from the preceding discussion is that transit is operating in municipalities all around League City, with more routes on the way. Having these services connected is beneficial to all citizens of the Bay Area cities. However, **connections among independent services that were not designed in concert with one another can be problematic.** These connections, while necessary, may not be as direct or efficient as they should be in order to provide the highest quality service possible.

**SH 3, as a natural spine connecting Webster, League City, Dickinson, Texas City, and La Marque, provides an excellent opportunity to efficiently connect the transit routes in the Bay Area cities.** The individual city circulators, with minor route modifications as necessary, could each connect to a route running solely along SH 3 from Webster to La Marque. This would help to avoid the excessively long headways and other inefficiencies that might result from other attempts to provide connectivity among the various routes.

**League City should cooperate with its neighboring municipalities to advocate for such a connector route on SH 3, to the benefit of both League City residents and the Bay Area region as a whole.** The Galveston County Transit District may be a conduit through which this can be pushed. As previously discussed, one of the alternatives being studied for regional mobility along the Gulf Freeway corridor is BRT on SH 3. However, BRT is designed to be faster service with fewer stops. Thus, BRT on SH 3 would not preclude the need for a complementary, more local service that enables connections for riders making shorter trips between the SH 3 cities. Transit is becoming a reality in every direction across League City's borders. Without an intercity connection, League City stands to become an obstacle that not only isolates transit users on either side, but also prevents potential users within League City from traveling among the Bay Area municipalities.

***Pedestrian/Bicycle Connectivity***

As previously discussed, the nexus between the transit, pedestrian, and bicycle modes is critical. League City must ensure that any local transit that is implemented is supported by a robust pedestrian and bicycle network. The City should avail itself of funding programs such as the Federal Transit Administration's (FTA) Livable Communities Initiative (LCI) and the Federal Highway Administration's (FHWA) Safe Routes to School (SRTS) program, both of which provide funds for improving the pedestrian environment. These and other funding tools are discussed further detail in *Appendix E*.

***Connect Transit Demand-Response Service***

As previously discussed, the demand-response service provided by Connect Transit is not utilized widely by League City residents. It is likely that at least a portion of the low ridership can be attributed to a simple lack of awareness that the service is available. **Improved marketing efforts throughout League**

**City are recommended to build awareness of the service, with particular emphasis on its tremendous value and its availability to all members of the public, rather than just the disabled and the elderly.**

***Local Transit: Long Term***

**The success of more extensive local transit service in the long-term depends most significantly on altered land use patterns.** As discussed in Chapter 5, the City does intend to try to steer development toward higher density, at least in certain small pockets at strategic locations. However, the overall densities projected by the future land use plan indicate that an extensive, citywide transit system with numerous fixed routes is not likely to be a realistic goal. Rather, local transit can be successful by taking a very targeted approach that focuses service on those pockets of density, both in terms of internal circulation and connecting the activity centers to one another. These areas include those identified as "urban" in the future land use plan, as well as nodes of activity that exist today such as South Shore, the FM 646/IH 45 shopping centers, and the municipal complex. If the transformation of E. Main Street into a "destination corridor" is successfully accomplished, that will be an ideal location for transit service as well. As the time comes, more in-depth study can be done to design specific routes that would best serve these objectives.

Again, any local transit service in the long term should strive to offer connections to other services in the surrounding communities, as well as the UTMB Victory Lakes park & ride facility, any other park & ride facilities built in League City, and any commuter rail or BRT station that may be built in League City. Pedestrian and bicycle connectivity should be ensured as well.

## *COMMUTER TRANSIT*

Commuter transit is poised to be immediately successful in League City because of its demographics and the relatively long, bi-directional commutes of many of its residents. Some combination of CRT, BRT, and/or park & ride will emerge to serve the commuting needs of the Bay Area region, including League City.

***Commuter Rail/Bus Rapid Transit: Short/Medium Term***

As discussed in Chapter 3, a study is currently ongoing to determine the best commuter transit solution for the Gulf Freeway corridor. CRT and BRT are the two capital- and infrastructure-intensive options being considered. Because they are significant undertakings, neither of these options is likely to be operating in the short- to medium-term (before 2015). However, during this development timeframe it is very important for League City to stay engaged in the process because implementation of a transit project of this magnitude requires the active participation of every affected municipality, on every front from funding sources to operating details. League City also should remain actively involved with the newly formed GCTD, as this entity is likely to play an important role in the development and operations of the commuter transit system.

***CRT/BRT: Long Term***

League City has a strong desire to have a commuter rail station located within its city limits if, and when, commuter rail becomes a reality in the SH 3 corridor. The 11 cities located along the rail alignment all recognize the potential economic development and TOD that can be spurred by a commuter rail station and, as a result, nearly all of the cities along the rail alignment share this same strong desire to host a station. However, as previously discussed in this chapter, **operational constraints for successful commuter rail service may preclude having a station in every city that desires one.** In the case of League City, there are characteristics that would make the city an attractive host for a station, but also some inherent obstacles that prevent League City from being an ideal location for a station.

League City is the most populous city in Galveston County and has a large number of commuters traveling to the north and the south. Counterintuitive though it may be, these characteristics actually make placing a station in League City less than ideal. The reason for this is the issue of "backtracking," as discussed earlier in this chapter. When driving to a park & ride lot to catch a commuter bus or train, commuters are typically not inclined to drive more than 1.5 miles in the opposite direction of their ultimate commute. Thus, a commuter rail station in northern League City, for instance, would mean that a large number of League City residents commuting to the south would have to drive some unacceptable distance to the north to get to the station. Similarly, a station in southern League City would force northbound commuters to drive out of their way in the wrong direction. Even a station in the center of the city is problematic because in that case there would be commuters going in *both* directions who would be inconvenienced. Backtracking can be a deterrent to taking transit and thus can lead to decreased ridership.

The solution to this issue is to have a station to the north of League City in Webster, and one to the south in Dickinson. In such a scenario no League City resident does any backtracking, regardless of which direction they are commuting. They simply choose the station that is appropriately upstream or downstream of their home.

Another drawback to locating a station in League City is the lack of jobs. Successful commuter transit serves large employment centers and in the Bay Area, the majority of the jobs are located north of Clear Lake. Therefore, it would be easier to distribute commuters (via shuttle) to their jobs from a station in Webster than it would be from one in League City.

The attributes that make League City a good location for a commuter rail station include being populous (more so than Dickinson) and having a fair amount of vacant land along the rail alignment (Webster has comparatively less vacant land along the GH&H). To be prepared to potentially host a station, the City of League City has conducted a comparative study of potential locations for a station and adjacent TOD. The study considers contiguous vacant parcels, floodplain, land use conflicts, acreage, land acquisition costs, proximity to civic uses, infrastructure capacity, population density, and proximity to major arterials. As previously discussed, the City should also consider the ease of pedestrian and bicycle connections as well as connectivity to any local transit that is in place. Should the operational and municipal factors fall into place such that League City is determined to be an appropriate station location, the fact that the City has done this advance work will be to its advantage.

A scenario under which there might be a commuter rail station in League City even if there are also stations in Webster and Dickinson is if so-called "skip stop" operations are used. Under this scenario, not all trains would stop at every station along the rail alignment, thereby being able to maintain the desired operating speed. Thus, League City (and/or Webster, Dickinson) might have a station that is only served by every other train in peak hours. Alternatively, a "scaled down" station could be built in

League City that is used exclusively for recreational travel on the weekends, when the service has grown enough that weekend service is warranted.

If a BRT system is ultimately constructed rather than commuter rail, there will be greater flexibility in station locations. A BRT vehicle is likely to be at capacity after one or two stops; thus BRT operations are more likely to be "skip stop" with the vehicles running non-stop to the final destination after serving only a station or two. This operating concept will necessitate a greater number of stations to ensure that all cities along the corridor are served.

Even though a large number of riders will arrive at a commuter rail or BRT station by car, it is still important to ensure excellent pedestrian and bicycle connectivity, such that patrons have the option to use the service without the use of an automobile. Site selection criteria for any potential station should include the proximity to and ease with which the station can be integrated with the surrounding sidewalk network and bicycling paths/lanes. If a site is selected that does not have good connectivity, the resources should be allocated to put the needed pedestrian and bicycle infrastructure in place. Bike racks also should be provided at the station.

For the long term, League City must stay engaged and expect to play an instrumental role in making the service successful. This will include participating in the ongoing revenue requirements (in cooperation with the other cities and stakeholders along the corridor) and marketing the service to the public. The City also should strive to ensure the development of high-quality TOD surrounding any station in League City, which will be mutually beneficial to both the transit service and the City.

***Regional Bus (Park & Ride)***

A 2009 park & ride study identified significant ridership demand in League City, particularly in the northbound direction.[1] A new facility currently being developed as well as future facilities could serve to meet this demand.

***Park & Ride: Short/Medium Term***

**A 450-space park & ride facility currently is under development at the University of Texas Medical Branch (UTMB) Victory Lakes campus in League City.** Construction is expected to be completed by Fall 2011, with operations starting shortly thereafter. The facility will offer southbound service to UTMB Galveston, with a few other stops on the island to enable non-UTMB riders to access other employers and destinations.

Capital costs including construction and vehicle acquisition have been fully covered by "stimulus" funding, funds from the Gulf Coast Center, and funds from grants pursued by the Gulf Coast Center and the City of Galveston. No contribution by the City of League City was required. Operating funds are being pursued through the Houston-Galveston Area Council's Pilot Project program and other grants. UTMB and the City of League City will also provide operating funds. League City's contribution for operating expenses is expected to be $60,000 to $100,000 annually.

[1] *League City Park & Ride Advanced Planning,* The Goodman Corporation, Mar 2009.

**The success of this park & ride facility is in the City's interest both from a mobility standpoint and a financial one, since the City will have to contribute local share funds to cover a portion of the operating costs.** Therefore, the City should work closely with UTMB and the transit provider to market the service, particularly because it will be the first time that any park & ride service will be offered within League City. This marketing should target not only UTMB employees, but also the many others who have reason to travel to UTMB, including patients, visitors, and medical students. Additionally, the city should facilitate ways to get the word out among League City residents who work for other employers on the island, or otherwise need to access destinations in Galveston besides UTMB.

**In the medium-term League City should also continue to pursue the development of a park & ride facility that will offer northbound service to Houston.** The aforementioned League City park & ride study identified current demand for over 2,000 parking spaces for northbound commuters, growing to over 3,000 spaces by 2035.[2] The study also applied approximately 15 criteria for selecting a site that would function well as a park & ride, including such things as size, visibility/access, environmental considerations, and traffic impacts. Based on these criteria, the RiverBend mixed-use development was determined to be the most suitable location for a northbound park & ride, of the four sites that were compared in the study. If the RiverBend development gets off the ground in the near future, the city should continue to consider this site for a park & ride facility and work with the developer and other relevant parties, including possibly METRO, to see it through. If RiverBend will not be feasible, the City should identify other potential locations and enter into discussions with H-GAC and others, as necessary to plan for the development of a northbound park & ride facility.

As always, pedestrian and bicycle connectivity should be considered and planned for.

Finally, any interim fixed-route transit that might be implemented should stop at the park & ride facilities to enable riders to transfer from the local to the commuter transit service.

***Park & Ride: Long Term***

Tremendous growth is projected for League City in the future, particularly on the west side. Therefore, in the long-term, **the City should develop one to two additional park & ride facilities, ideally on the west side.** This could be one facility each for northbound and southbound service, just as is proposed for the short-/medium-term, or one larger facility that serves both directions. However, the location of a particular park & ride with respect to the freeway usually makes providing service in one direction easier than the other. The dense, "urban high" mixed-use center planned for the west side under the preferred growth scenario (Chapter 5), may be a favorable location for the inclusion of a park & ride facility, both for its mixed-use nature and its access to Grand Parkway and IH 45. Again, pedestrian and bicycle connectivity and connectivity between the park & ride facilities and local transit routes will be important.

[2] *League City Park & Ride Advanced Planning,* The Goodman Corporation, Mar 2009.

***A Note about Commuter Rail versus Park & Ride***

**If commuter rail becomes a reality in the Houston-Galveston corridor, there may be a need to modify plans for park & ride service to minimize any redundant or competing service between the two modes.** The park & ride service can be adjusted such that it is complementary to the commuter rail, rather than being eliminated altogether. Furthermore, the commuter rail and park & ride services will offer different levels of final destination access which may appeal to various transit riders for different reasons. For instance, commuter rail will not enable access to downtown Houston without a transfer to another mode (e.g., light rail or local bus). Conversely, a park & ride bus conceivably can allow a rider to access a downtown destination via a "one-seat" ride (i.e., no transfer necessary). For this reason, some may prefer to take a park & ride bus rather than the commuter rail.

## *RECOMMENDATION SUMMARY*

### *Short Term/Medium Term*

*Local Transit*

1. Implement "flex routes," (i.e., point deviation or route deviation service).
2. Ensure connections to existing services in surrounding communities (i.e., METRO, Harris County, Texas City/La Marque, Dickinson), as well as to any regional transit in League City (i.e., UTMB Victory Lakes P&R, any future P&R facilities, any future commuter rail or BRT station).
3. Ensure pedestrian and bicycle connectivity to local transit service (including bike racks on buses).
4. Cooperate with other municipalities to advocate for an SH 3 connector route.
5. Increase marketing of currently available Connect Transit demand-response service.
6. Participate in the activities and decision-making processes of the newly formed GCTD.

*Commuter Rail/BRT*

1. Stay engaged in the ongoing Alternatives Analysis process to select a regional mobility solution for the Gulf Freeway corridor.
2. Continue to consider preferable station locations within League City.
3. Engage GCTD.

*Regional Bus (Park & Ride)*

1. Complete construction and initiate operations at UTMB Victory Lakes park & ride facility (southbound service to Galveston).
2. Work with UTMB and transit provider to market UTMB Victory Lakes park & ride service to League City residents.
3. Identify appropriate location for park & ride facility to provide northbound service to Houston and pursue development with appropriate parties.
4. Ensure pedestrian and bicycle connectivity to park & ride facilities.
5. Ensure connectivity between any interim local transit service and the park & ride facilities.

***Long Term***

*Local Transit*

1. Identify targeted opportunities to develop small-scale transit that serves and connects dense activity centers.
2. Ensure connections to existing services in surrounding communities (i.e., METRO, Harris County, Texas City/La Marque, Dickinson), as well as to any regional transit in League City (i.e., UTMB Victory Lakes P&R, any future P&R facilities, any future commuter rail station).
3. Ensure pedestrian and bicycle connectivity to local transit service (including bike racks on buses).
4. Engage GCTD.

*Commuter Rail/BRT*

1. Provide suitable station location(s), should League City be deemed an appropriate location for a station given operational needs.
2. Participate in ongoing revenue requirements (in cooperation with other cities and stakeholders along the corridor).
3. Participate in marketing activities.
4. Engage GCTD.

*Regional Bus (Park & Ride)*

1. Identify one to two locations for additional park & ride facilities, ideally on the city's rapidly growing west side. Pursue development with appropriate parties.
2. Ensure pedestrian and bicycle connectivity to park & ride facilities.
3. Ensure connectivity between any local transit service and the park & ride facilities.

# Chapter 8 – PEDESTRIAN, BICYCLE, AND MARINE RECOMMENDATIONS

The pedestrian, bicycle, and marine recommendations discussed in this chapter will complete the multimodal character of the transportation network League City desires to provide for its citizens.

## *PEDESTRIAN RECOMMENDATIONS*

### *FM 518 (E. Main Street)*

The elements of a desirable pedestrian realm were reviewed in Chapter 3. **As discussed, the City's highest priority corridor for pedestrian improvements is E. Main Street, between SH 3 and FM 270.** As such, it is recommended that the City proceed with developing a conceptual program of improvements for the corridor, followed by detailed design work and preliminary engineering. Concurrently, the City should also identify and pursue relevant sources of funding assistance so that the cost burden for the improvements is not solely borne by League City taxpayers. Funding sources and the types of projects they can be used for are discussed at length in *Appendix E.*

A detailed inventory of the existing pedestrian conditions on this segment was conducted and the results are available in *Appendix D.* The inventory process described in *Appendix D* is the first step in assessing existing conditions, establishing needs and priorities, and laying the groundwork for the pursuit of funding by quantifying anticipated traffic reduction and air quality benefits. As revealed by the E. Main Street inventory, the need for pedestrian improvements is significant.

Developing a conceptual program of improvements is the next step after conducting the inventory and includes those decisions that will factor into the overall "look and feel" of the corridor. These decisions also have ramifications for capital and maintenance costs. As such, they should be made before actual design work is started so as to serve as guidelines for the architects and to prevent costly rework later on. Examples of items that should be considered prior to detailed streetscape design work include:

- Desired sidewalk width
- Desired spacing of pedestrian lighting and trees (or other landscaping)
- Solar versus conventional pedestrian lights
- Placement of amenities (e.g., benches and waste bins on every corner or only at bus stops)

A corridor such as FM 518 presents challenges that must also be taken into account. For instance, the utility poles along the corridor act not only as visual clutter but also as physical obstacles for pedestrians and those in wheelchairs. Therefore, burying the utilities is something that may be considered, unless it is deemed cost prohibitive. Also, there may be areas where there is simply not enough ROW to accommodate the desired improvements without property taking or concessions by the property owner. These are specific issues that are dealt with in the design process, but need to be considered holistically ahead of time.


***Example Before and After FM 518 Streetscape Improvements***

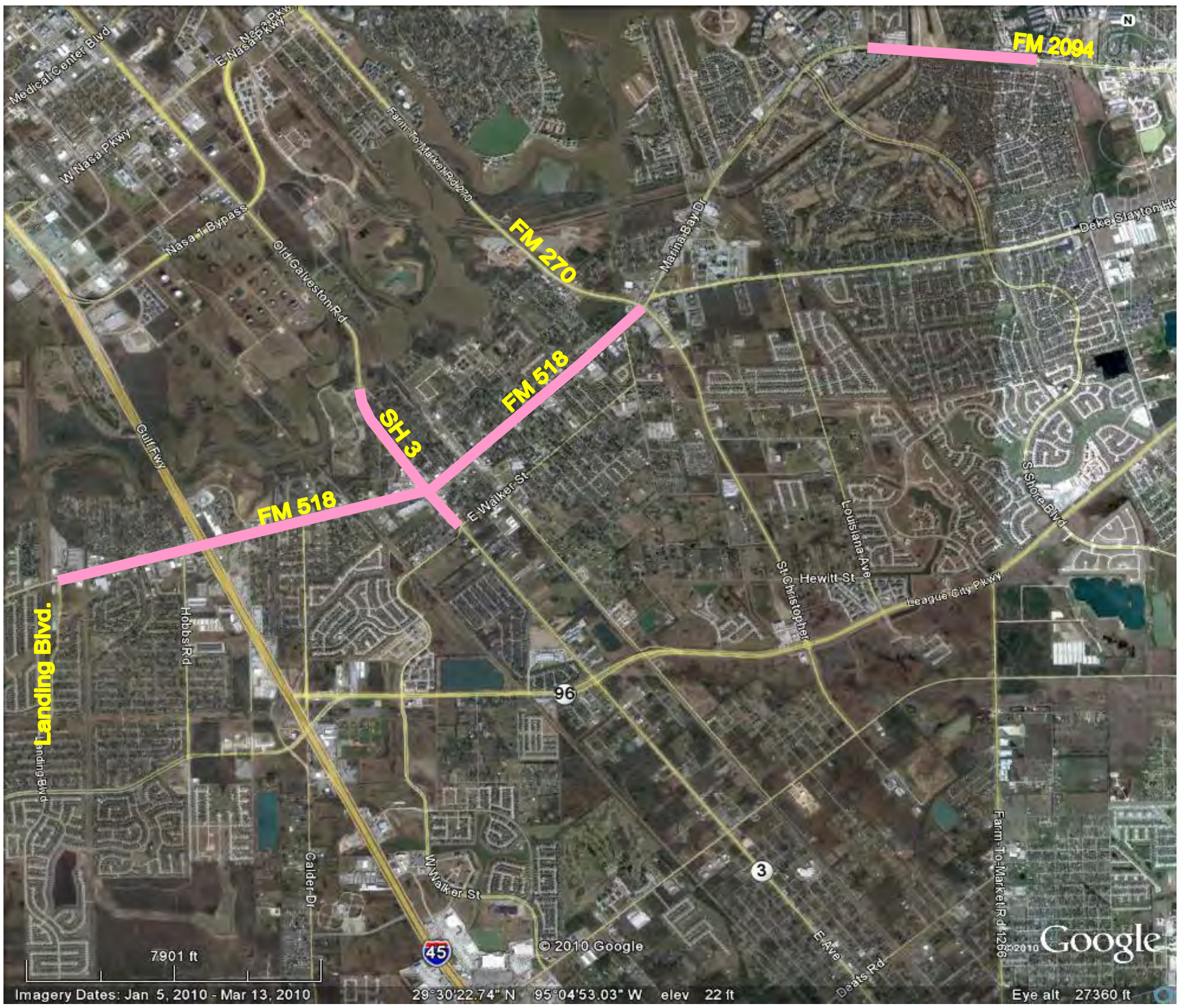
The cost estimate for a given program of streetscape improvements depends heavily on the level of need on the corridor and the decisions made with respect to how extensive or basic the treatments will be. Developing a thorough cost estimate for streetscape improvements on FM 518 will entail a more detailed inventory including measurements of such things as available ROW, linear feet of missing and damaged sidewalks, and planting strip width. However, an estimated cost can be developed using just the length of the corridor. An accepted, all-inclusive estimate for the types of streetscape improvements proposed (sidewalks, landscaping, lighting, etc.) is approximately $300 per linear foot. The E. Main Street corridor between SH 3 and Five Corners is approximately 7,832 feet long. Thus, the total cost to install these streetscape improvements along both sides of the street in this corridor would be approximately **$4,700,000.** Some block faces will require more treatment than could be provided for $300/lf, and some will require less. Thus, the cost estimate is an average designed to take these variances into account and also account for the constraints such as lack of ROW that preclude some improvements in certain areas.

***Other Priority Corridors***

In addition to the recommended streetscape improvements on FM 518 between SH 3 and the Five Corners intersection, *Table 8.1* and *Figure 8.1* call out several priority corridor segments that are also recommended for improved pedestrian infrastructure. Estimated costs are included for each, based on the corridor length and the $300/linear foot cost estimate discussed previously. The methodologies presented in *Appendix D* for inventory, quantification of benefits, and funding pursuit are also applicable.

| ***Table 8.1 – Priority Corridors for Pedestrian Streetscape Improvements*** | | | |
|---|---|---|---|
| ***Corridor*** | ***From*** | ***To*** | ***Approximate Cost*** |
| FM 518 | SH 3 | IH 45 | $3,642,000 |
| FM 518 | IH 45 | Landing Boulevard | $2,304,000 |
| SH 3 | Walker Street | FM 518 | $831,000 |
| SH 3 | FM 518 | Walter Hall Park | $1,506,000 |
| FM 2094 (south side only) | Twin Oaks Boulevard | S. Compass Rose Boulevard | $1,275,000 |

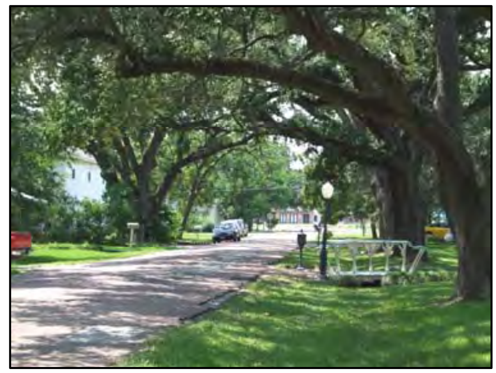
***Figure 8.1 – Priority Streetscape Improvement Corridors***




These corridor segments are chosen specifically for the connectivity they provide to key destinations, the amount of current pedestrian activity observed in these areas, and because they represent large gaps in currently developed areas that lack adequate pedestrian infrastructure.

***Historic District***

The core of the Historic District consists of a near-perfect, highly connected street grid with short block lengths that facilitate mobility for both vehicles and pedestrians alike. As such, the City has identified it as a “pedestrian-oriented” area. However, the Historic District is a largely residential area consisting of narrow streets with open gutters and no sidewalks. The residents of this area feel that the character of these streets is both in keeping with the historic nature of the neighborhood and also contributes to traffic calming. Therefore, it is not recommended that sidewalks be installed in the residential parts of the Historic District.



***Residential Streets in Historic District***

***Pedestrian Connectivity to Schools***

During the development of both this master mobility plan and the Comprehensive Plan, the citizens of League City repeatedly expressed the need for safe and complete sidewalks in the vicinity of schools. This should be a top priority for League City. Federal funding assistance is available for school sidewalk projects via the SRTS program, described in *Appendix E.*

***Long-Term Pedestrian Infrastructure***

The trail network outlined in the *Trails Master Plan 2010* will add considerable pedestrian infrastructure to the City that can be used for both recreational and mobility purposes. However, the pedestrian network in League City over the long-term will also require significant investment in sidewalks along the major corridors and within the residential developments.

As corridors such as SH 96 and FM 646 become more built-out in the future and the southwest part of League City transitions from largely vacant to largely residential, the City needs to remain cognizant of the pedestrian infrastructure needs in these areas. Policies must be enacted that require the installation of adequate pedestrian infrastructure ***concurrent*** to development, and developers must not be allowed to shirk this responsibility. The City also must levy upon itself the requirement to ensure pedestrian connectivity in those areas that do not fall under the purview of developers.

### BICYCLE RECOMMENDATIONS

The *Trails Master Plan 2010* delineates 212 miles of off-road trails to be completed throughout League City over the next 20+ years. These trails can be used for a variety of purposes (recreation, transportation, commuting) and by a variety of users (runners, bicyclists, children, etc). This trail system, when built out, will serve an important mobility function in League City. Therefore, the Master Mobility Plan does not include recommendations that are redundant to the Trails Master Plan, but rather complementary to it. The proposed trail system is entirely off-road and, due to necessary prerequisites to implementation such as ROW acquisition and environmental clearance, more long-term in nature. **In the short-term there are opportunities to implement relatively easy, low-cost solutions, particularly for bicycle facilities, that connect key destinations and require no additional ROW.** It is also important to remember that, as discussed in Chapter 3, League City residents have expressed a strong desire for ***on-street*** bicycle facilities.

***Figure 8.2 – Bicycle Route***

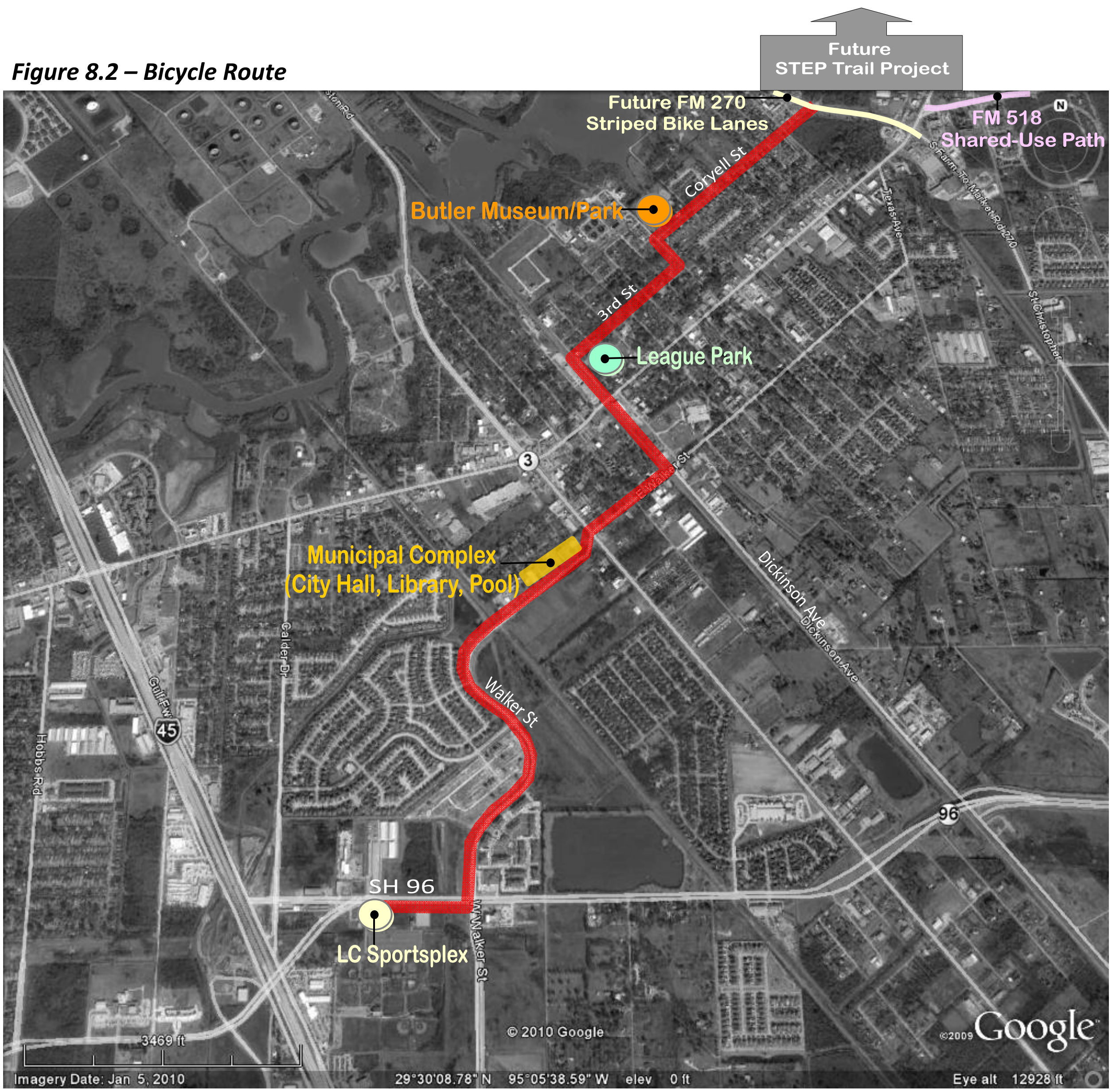


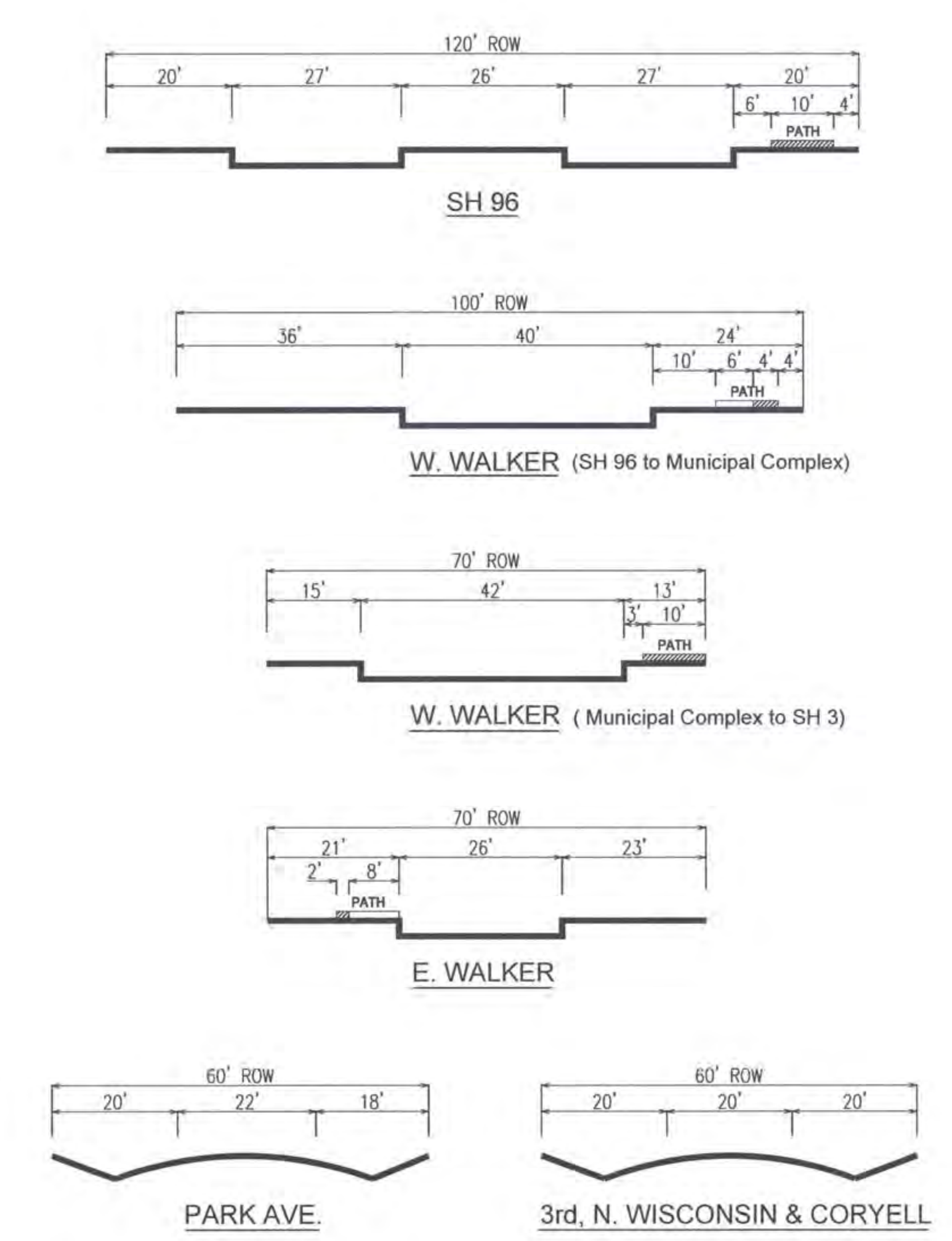
*Figure 8.2* presents a proposed bicycle route which constitutes an excellent near-term opportunity to link important destinations and connect to other existing and proposed (funded) bicycle facilities and paths. Approximately 55% of the route would be created by expanding the existing sidewalk to convert the facility to a wider shared-use path, or by installing a shared use path where none currently exists. The remainder of the route would be “shared roadway” in which signage indicates that the roadway is part of a designated bike route. In these areas adequate ROW is not available to stripe a bicycle lane, but traffic volumes are sufficiently low to ensure the safety of bicyclists as long as motorists are alerted to their presence by the signage. The route, spanning from the League City Sportsplex to FM 270 near the Five Corners intersection, would encompass the following segments and associated improvements:

- Coryell Street – 3$^{rd}$ Street (FM 270 to Park Avenue/Dickinson Avenue), signed route;
- Park Avenue/Dickinson Avenue to Walker Street, signed route;
- E. Walker Street (Park Avenue/Dickinson Avenue to SH 3), expand existing sidewalk and add traffic barrier per AASHTO standards;
- W. Walker Street (SH 3 to western edge of Municipal Complex), new 10-foot shared-use concrete path (to link to existing sidewalk);
- W. Walker Street (western edge of Municipal Complex to SH 96), expand existing sidewalk to create 10-foot shared-use concrete path; and
- SH 96 (W. Walker Street to Sportsplex), shared-use concrete path (new).

Additionally, the striped bicycle lane could be continued south on Walker Street to FM 646, providing access to UTMB, the Victory Lakes subdivision, and the retail complexes at FM 646 and IH 45.

*Figure 8.3* presents cross-sections for each of the segments constituting the bicycle route.

***Figure 8.3 – Bicycle Route Segment Cross-Sections***



As shown in *Figure 8.2,* the proposed bicycle route would provide primary access to the Sportsplex, the Municipal complex (City Hall/Library/Pool), League Park, and Butler Museum. It also would establish connectivity to several other existing and planned bicycle facilities, providing access to even more destinations. These existing and planned facilities include the following:

- FM 518 shared-use path (from FM 2094 to City limits) (existing);
- Proposed FM 270 striped bicycle lane (funded); and
- Proposed "FM 518 Bypass" Transportation Enhancement (TE) Trail Facility (funded).

Completing the bicycle route between Walker Street and the Sportsplex will require the installation of a short segment of concrete shared-use path on the south side of SH 96. This new segment could be connected easily to the trail "stub" that currently exists between the Sportsplex and IH 45. If and when this trail is extended across IH 45, bicycle connectivity to the west side of League City also would be established.

As mentioned, this low-cost bicycle route is designed to be complementary to the trail system recommended in the Trails Master Plan. It provides for easy connection to many of the plan's trails, including direct connections to two of the "Signature Trails" – the Clear Creek Trail and the History Trail.

The anticipated cost of this proposed bicycle route is **$296,240** (including 15% engineering and contingencies). Costs for each of the individual segments are delineated in *Table 8.2.*

***Table 8.2 – Segment Costs for Proposed Bicycle Route***

| ***Road/Street*** | ***From*** | ***To*** | ***Length (ft)*** | ***Proposed Facility*** | ***Estimated Cost*** |
|---|---|---|---|---|---|
| SH 96 | LC Sportsplex | W. Walker | 1,480 | New 10' Bike Path (off-road) | $52,500 |
| W. Walker | SH 96 | LC Municipal Complex | 4,700 | Widen existing sidewalk 6' (off-road) | $94,000 |
| W. Walker | LC Municipal Complex | SH 3 | 1,600 | New 10' Bike Path (off-road) | $49,500 |
| E. Walker | SH 3 | Park Avenue | 1,650 | Widen existing sidewalk 2' & add traffic barrier | $53,800 |
| Park Avenue | E. Walker | 3rd Street | 2,080 | Shared Roadway w/Signs | $2,040 |
| 3rd Street | Park Avenue | N. Wisconsin | 1,980 | Shared Roadway w/Signs | $1,940 |
| N. Wisconsin | 3rd Street | Coryell | 630 | Shared Roadway w/Signs | $620 |
| Coryell | N. Wisconsin | FM 270 | 3,270 | Shared Roadway w/Signs | $3,200 |

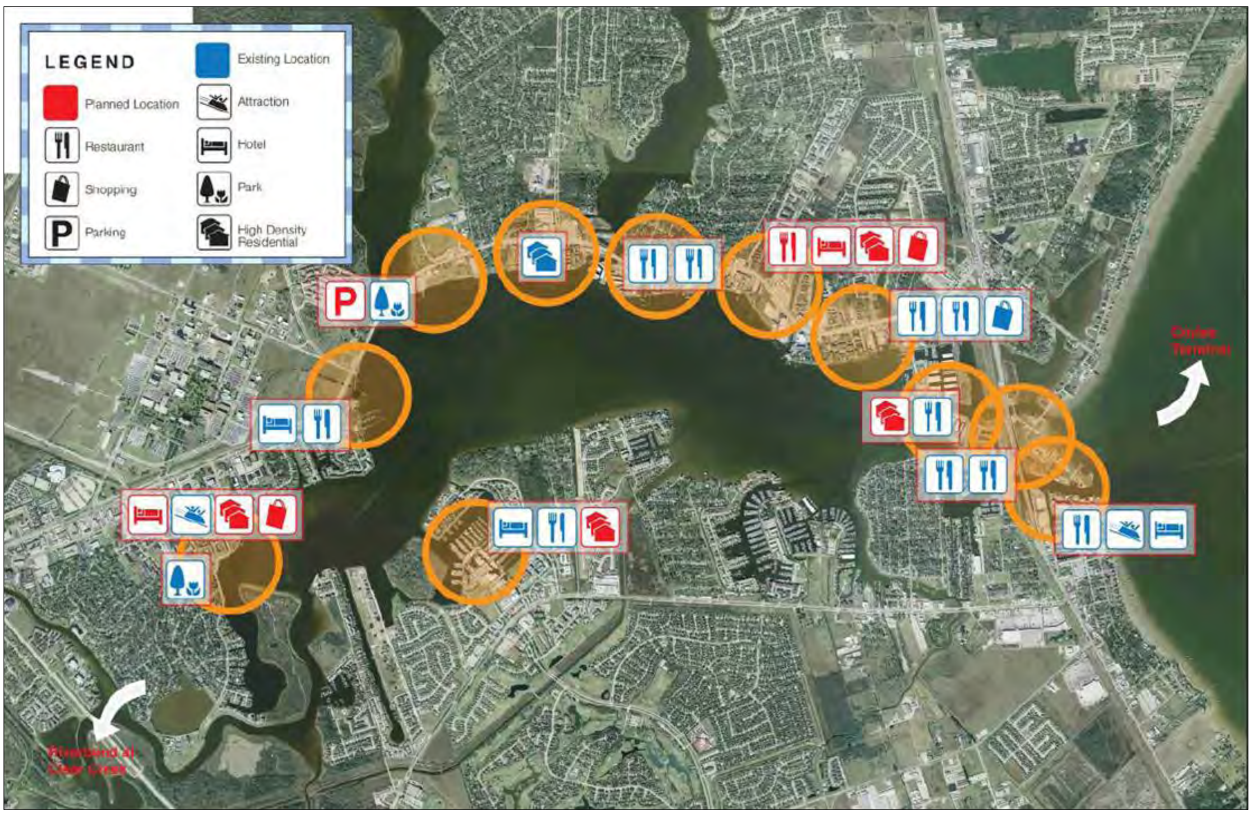
The identification of this bicycle route represents both a near-term opportunity as well as an example of other, similar opportunities the City can identify and pursue in the future. As the future land use plan is realized and the undeveloped areas are built out, the City should consider where similar bike routes can be easily implemented that complement the more ambitious network outlined in the *Trails Master Plan*

*2010*. Doing so will enable League City residents to observe progress sooner rather than later, as well as make the most efficient use of their taxpayer dollars. Implementing new bike routes concurrent with development also will offer the advantage of avoiding more costly retrofits later.

## *MARINE TRANSPORTATION RECOMMENDATIONS*

Chapter 3 described the results of a waterborne transportation study that examined the feasibility of a Bay Area water taxi on Clear Lake and Galveston Bay, including three potential landing sites in League City: the South Shore Harbour Resort and Conference Center, the RiverBend mixed-use development, and Beacon Island *(Figure 8.4)*. The study acknowledges that while there is likely enough interest and ridership to make such a system feasible, the water taxi would be primarily a recreational service, since very few people both live and work close enough to the water to make the travel time of marine transit competitive with other modes.

***Figure 8.4 – Potential Water Taxi Landing Sites***




***Source: Bay Area Waterborne Transportation Study***

Not being used as a transit option or for commuting purposes should not deter League City from advocating for and participating in any efforts to implement a water taxi service. Any automobile trip that is removed from the roadways can contribute to decreased congestion and reduced air pollution, regardless of whether the trip is for commuting or recreational purposes. Additionally, a water taxi may help League City achieve some of its goals related to economic development by serving as a regional attraction that brings additional sales tax revenue to the City.

The implementation of a water taxi, as envisioned in the study, will require the cooperation of many partners, such as the Bay Area cities, BayTran, the Bay Area Houston Economic Partnership (BAHEP), the Bay Area Convention and Visitors' Bureau, Harris County, Galveston County, private developers, and commercial vessel operators. League City should strive to be a cooperative and active partner in this effort.

In the shorter term, League City might choose to pursue a more limited and targeted water taxi service. For instance, when the mixed-use development planned for RiverBend in League City is complete, it could make sense to connect it via water taxi to the planned mixed-use development in Nassau Bay. A connection to South Shore Harbour would likely be feasible as well. Initial operating hours could be limited to the peak recreational hours (i.e., Friday evenings and all day Saturdays and Sundays). As ridership grows, and if demand warrants it, limited commute hours might be added to serve, for example, people who reside in either of the mixed-use developments and work at Johnson Space Center or South Shore (most likely necessitating a connecting circulator at the Nassau Bay and South Shore landings). The League City Improvement District (which includes the RiverBend site) could be a potential funding source for the service. A demonstration service might be started relatively easily through a joint venture with one of the numerous existing Clear Lake dinner cruise providers (i.e., Star Fleet, Majestic Ventures) since they already have the necessary infrastructure in place and might be interested in providing a turnkey service. The annual operating expenses for such a service are estimated to be between $250,000 and $500,000. The transition to a permanent service with independent infrastructure will require the addition of capital assets such as vessels and docking and fueling facilities. The capital costs for these assets will vary depending on the scale of service, but can be estimated to be between $1.2 million and $1.5 million. Building a successful, smaller-scale water taxi service such as this will be a critical first step to growing toward a larger, more robust marine transportation system that will benefit both League City and its neighboring Bay Area cities.

These recommendations are dependent upon, of course, both the recovery of the economy (especially with regard to the completion of the planned mixed-use development projects) and the full post-Hurricane Ike recovery of the various waterfront attractions.

# Chapter 9 – LAND USE AND MOBILITY

9

The relationship between transportation and land use is well known and well documented. In recent years a spate of movements related to the optimal design of communities, including how best to address the relationship between land use and mobility, has arisen. Such movements include Smart Growth, Sustainable Communities, Context-Sensitive Solutions, and Complete Streets, among others. There is also a growing trend toward what is known as "Form-Based Code," which is a type of building code that emphasizes physical form rather than building use, as an alternative to conventional zoning. **By understanding the basic tenets of these movements and planning principles and how they might apply to League City, the City can move toward its land use and mobility goals, and ultimately toward being a healthier and more successful community.**

These ideas and planning approaches have been developed by a wide variety of sources, including ITE, the Urban Land Institute (ULI), the American Planning Association (APA), the Form Based Codes Institute, the American Institute of Architects (AIA), the Congress for the New Urbanism (CNU), the Institute for Sustainable Communities, and others. These ideas have been incorporated into guidelines and recommended practices by the U.S. DOT, Environmental Protection Agency (EPA), Department of Housing and Urban Development (HUD), several states, and many cities. This chapter will focus on these planning and urban design principals and guidelines as they relate to League City's future development and mobility.

## *MODERN GUIDELINES FOR SUCCESSFUL DEVELOPMENT*

Several modern planning movements offer guidance on achieving development patterns that are desirable and sustainable on multiple fronts, from mobility to quality of life to municipal financial responsibility. These movements and their applicability to League City are discussed next.

### *Smart Growth*

**Among other guidance, *Smart Growth* proposes guidelines emphasizing infill development or development where infrastructure (roadways, water, drainage, sewers, schools, etc.) is currently available or easily extended.** One benefit of such growth patterns is to foster a more compact city where property taxes and values can rise in advance of additional infrastructure requirements, making a community more sustainable in a financial sense. From a mobility standpoint, compact development reduces the amount of roadways and other transportation infrastructure required, reducing both initial capital outlay and ongoing maintenance costs. A growing number of communities across the country, such as San Diego, California, and Summit County, Utah, have chosen to implement policies that encourage or mandate near-term development in certain areas, and discourage or forbid development in other areas until some agreed-upon time in the future.

League City has significant swaths of vacant land, representing equally significant infrastructure investment that will be required when these areas are developed. While future development in these areas is largely already spoken for in terms of approved Planned Unit Developments (PUD), League City would still benefit from identifying opportunities to encourage infill (rather than "greenfield") development in areas that already have public infrastructure in place or where it can be easily extended. This focus will result in adding property value, and therefore bonding capacity, ahead of the need to sell bonds to develop needed public infrastructure.

***Sustainable Communities***

**The *Sustainable Communities* movement provides guidance as to the type and distribution of neighborhood-oriented land uses, such as commercial/retail, services, and public facilities**. One of the prevailing notions of this movement is that an "ideal" neighborhood is one which includes diverse land uses within a relatively compact radius, allowing the needs of daily life to be easily met without necessarily using an automobile. Desirable land uses in such a neighborhood might include a drug store, convenience food store, bank, library, day care, medical/dental office, coffee shop, and restaurant. *Figure 9.1*[1] shows an example of a sustainable neighborhood. In addition to the presence of these land uses, a high quality pedestrian and transit network must be provided that links the neighborhood-oriented facilities to the residences. This approach results in less automobile travel, a more convenient pedestrian-oriented lifestyle with less energy consumption and vehicle emissions, and a stronger sense of community.

***Figure 9.1 – Example Sustainable Neighborhood***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[1] *Sustainable Urbanism*, Douglas Farr, 2008.

The provision of sustainable neighborhoods can certainly benefit League City from both a mobility and quality of life standpoint. However, the community character land use descriptions for future growth in League City, as presented in Chapter 5, do not reference the inclusion of neighborhood commercial or services within the residential categories. Mixed uses are referred to only in the "Urban Low" and "Urban High" land use categories. These two categories comprise less than 5% of the development in the preferred growth scenario. **As such, it is recommended that League City take a closer look at opportunities to integrate neighborhood services within the residential areas, for the successful functioning of the mobility network and the benefit of League City residents.**

***Mixed-Use Development***

**The emphasis of *mixed use development*, much like that of the Sustainable Communities movement, is on creating proximity among diverse and complementary land uses.** However, the scale referred to as mixed-use development is typically at the parcel level rather than the neighborhood level. Mixed-use developments around the region include the Sugar Land Town Square, the Woodlands Town Center, and the new City Centre on the site of the former Town and Country Mall. Each of these developments includes residential, office space, and retail/restaurants (i.e., the quintessential "live/work/play" paradigm often associated with mixed-use developments).

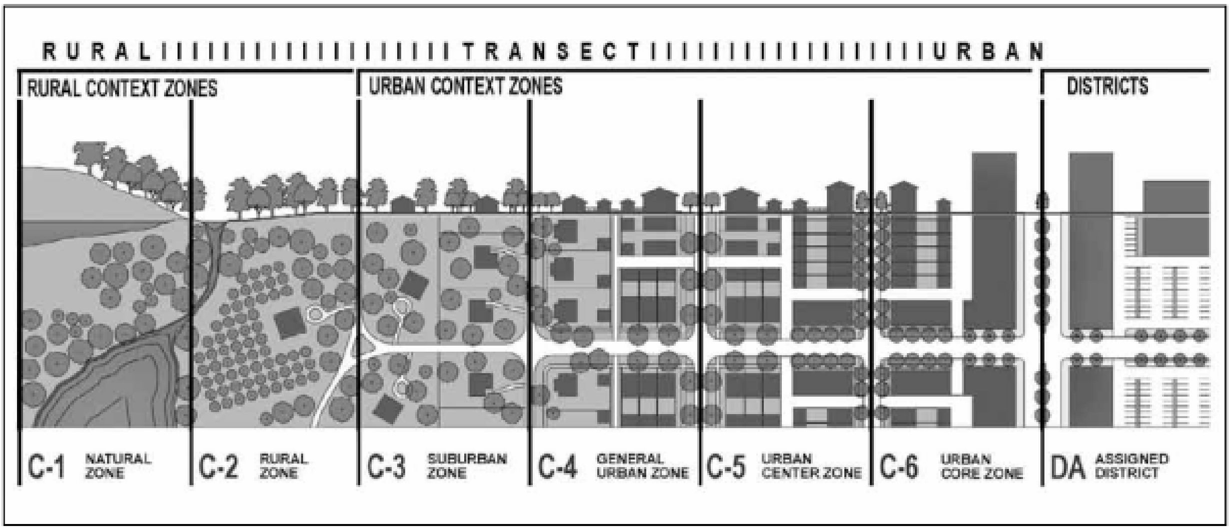
From a mobility standpoint, one of the biggest advantages of mixed-use development is its ability to reduce automobile trips through what is termed "internal capture" – that is, pedestrian trips that are made internal to a mixed use development that would have otherwise required a vehicle trip if the land uses had not been integrated within the development. According to ITE, automobile trips can be reduced by between 10% and 25% by creating a mixed use development with a well integrated pedestrian network. The exact percent reduction depends on the particular array of land uses.

League City, in its preferred growth scenario, has made provision for mixed use development via the "Urban Low" and "Urban High" land use categories. However, these land uses comprise less than five percent of total development.

***Context-Sensitive Solutions***

***Context-Sensitive Solutions* is the movement geared toward building roadways that are context sensitive (i.e., appropriate) to the surrounding development.** *Figure 9.2* presents the context zones (or transects) representing the type and intensity of development in an area. The context zones most applicable to League City are C-3, C-4, and C-5.

***Figure 9.2 – Context Zones***




ITE has published extensive guidelines relating roadway design to the nature of the adjacent land uses.[2] *Table 9.1* presents these guidelines for the C-3, C-4, and C-5 transects that are found in League City. As shown, the guidelines include parameters for such important design considerations as lane width, on- and off-street parking, access management, and intersection configurations, among others.

[2] *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, ITE, 2010.

***Table 9.1 – Roadway, Travelway, Intersection Parameters***

## Urban Context Zones and Roadway Types

| Context | Suburban (C-3) | | | | General Urban (C-4) | | | | Urban Center/Core (C-5/6) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Residential | | Commercial | | Residential | | Commercial | | Residential | | Commercial | |
| | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street |
| Building Orientation (entrance orientation) | front, side | front, side | front, side | front, side | front | front | front | front | front | front | front | front |
| Maximum Setback [1] | 20 ft. | 20 ft. | 5 ft. | 5 ft. | 15 ft. | 15 ft. | 0 ft. | 0 ft. | 10 ft. | 10 ft. | 0 ft. | 0 ft. |
| Off-Street Parking Access/Location | rear, side | rear, side | rear, side | rear, side | rear, side | rear, side | rear, side | rear, side | rear | rear, side | rear, side | rear, side |
| **Roadside** | | | | | | | | | | | | |
| Recommended Roadside Width [2] | 12.5 ft. | 10.5 ft. | 15 ft. | 14 ft. | 12.5 ft. | 10.5 ft. | 16 ft. | 14 ft. | 19.5 ft. | 16 ft. | 19.5 ft. | 16 ft. |
| Pedestrian Buffers (planting strip exclusive of travel way width) [2] | 6-8 ft. planting strip | 5-8 ft. planting strip | 6 ft. tree well | 5-6 ft. tree well | 6-8 ft. planting strip | 5-8 ft. planting strip | 6 ft. tree well | 5-6 ft. tree well | 6 ft. tree well | 6 ft. tree well | 6 ft. tree well | 6 ft. tree well |
| Street Lighting | For all collector thoroughfares in all context zones, intersection safety lighting, basic street lighting, and retail pedestrian-scaled lighting is recommended. See Chapter 8 (Roadside Design Guidelines) and Chapter 10 (Intersection Design Guidelines). | | | | | | | | | | | |
| **Traveled Way** | | | | | | | | | | | | |
| Desired Operating Speed (mph) | 30 | 25 | 30 | 25 | 30 | 25 | 25-30 [3] | 25 | 25-30 | 25 | 25-30 [3] | 25 |
| Design Speed | Design speed should be a maximum of 5 mph over the operating speed. Design speed is used as a control for certain geometric design elements including sight distance, and horizontal and vertical curvature. | | | | | | | | | | | |
| Number of Through Lanes | 2-4 | 2 | 2-4 | 2 | 2-4 | 2 | 2-4 | 2-4 | 4 | 2-4 | 4 | 2-4 |
| Lane Width [4] | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. | 10-11 ft. |
| Parallel On-Street Parking Width | 7 ft. | 7 ft. | 7-8 ft. | 7-8 ft. | 7 ft. | 7 ft. | 7-8 ft. | 7-8 ft. | 7 ft. | 7 ft. | 7-8 ft. | 7-8 ft. |
| Min. Combined Parking/Bike Lane Width | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. | 13 ft. |
| Horizontal Radius (per AASHTO) [5] | 510 ft. | 333 ft. | 510 ft. | 333 ft. | 510 ft. | 333 ft. | 510 ft. | 333 ft. | 510 ft. | 333 ft. | 510 ft. | 333 ft. |
| Vertical Alignment | Use AASHTO minimums as a target, but consider combinations of horizontal and vertical per AASHTO Green Book. | | | | | | | | | | | |
| Medians which will accommodate single left-turn lanes at intersections [6] | Optional 14 ft. | None | Optional 14 ft. | None | Optional 14 ft. | None | Optional 14 ft. | None | Optional 14 ft. | None | Optional 14 ft. | None |
| Bike Lanes | On collector Avenues, bike lanes may be provided (6 ft.-5 ft. wide adjacent to 7-8 ft. parking lanes respectively). | | | | | | | | | | | |
| Access Management [7] | Provide low to moderate levels of access management on collector Avenues and Streets | | | | | | | | | | | |
| Typical Traffic Volume Range (vpd) | 1,500-10,000 | 500-5,000 | 1,500-15,000 | 1,000-10,000 | 1,500-10,000 | 500-5,000 | 1,500-15,000 | 1,000-10,000 | 1,500-10,000 | 500-5,000 | 1,500-15,000 | 1,000-10,000 |
| **Intersections** | | | | | | | | | | | | |
| Roundabout | Consider urban single lane roundabouts at intersections on collector avenues and streets with less than 20,000 entering vehicles per day | | | | | | | | | | | |
| Curb Return Radii | Refer to Chapter 10 on Intersection Design Guidelines for details | | | | | | | | | | | |

**League City should look to adopt the ITE CSS design guidelines, adapted as necessary to local preferences and conditions.** To that end, *Table 9.2* maps the correlation between the ITE guidelines and the "community character" land use descriptions being used by League City for the future growth scenarios. As an example, *Table 9.2* shows that the ITE guidelines for residential roadways in the C-4 transect are applicable to all of the residential land use categories being used by League City.

***Table 9.2 – Land Use Categories – Preferred Scenario***

**Urban Context Zones and Street Types**

| Land Use | Development | Suburban (C-3) | | | | General Urban (C-4) | | | | Urban Center (C-5/6) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Density or | Residential | | Commercial | | Residential | | Commercial | | Residential | | Commercial | |
| | FAR | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street | Avenue | Street |
| **Rural/Estate** | | | | | | | | | | | | | |
| *Estate single family* | 0.75 | X | X | | | X | X | | | | | | |
| *Conventional single family* | 1.2 | X | X | | | X | X | | | | | | |
| *Cluster single family* | 2.7 | X | X | | | X | X | | | | | | |
| *Village residential* | 4.16 | X | | | | X | X | | | | | | |
| **Suburban Residential** | | | | | | | | | | | | | |
| *Conventional single family* | 2 | X | X | | | X | X | | | | | | |
| *Cluster single family* | 2.8 | X | X | | | X | X | | | | | | |
| *Planned residential* | 4.84 | X | X | | | X | X | | | | | | |
| *Planned multi-family* | 8 | | | | | X | X | | | X | X | | |
| **Suburban Village** | | | | | | | | | | | | | |
| *Conventional single family* | 3.3 | | X | | | X | X | | | | | | |
| *Single family infill* | 3.66 | X | X | | | X | X | | | | | | |
| **Auto-Dominant Residential** | | | | | | | | | | | | | |
| *Conventional single family (Enhanced) ,* | 3.06 | X | X | | | X | X | | | | | | |
| *Cluster single family* | 3.52 | X | X | | | X | X | | | | | | |
| *Single family manufactured home* | 3.75 | X | X | | | X | X | | | | | | |
| *Planned multi-family* | 12.6 | | | | | X | X | | | X | X | | |
| **Suburban Commercial** | 0.38 | | | X | X | X | X | X | X | | | | |
| **Auto-Dominant Commercial** | | | | | | | | | | | | | |
| *General commercial (with surface parking)* | 0.43 | | | X | X | | | X | X | | | X | X |
| *General commercial (with two-story parking)* | 0.75 | | | X | X | | | X | X | | | X | |
| *Mixed use (with three-story parking)* | 1.5 | | | | | | | X | | | | X | |
| **Urban Low** | | | | | | | | | | | | | |
| *Mixed use low-2 (with two-story parking)* | 1.67 | | | | | | | X | X | | | X | |
| *Mixed use low-3 (with three-story parking)* | 2.11 | | | | | | | X | | | | X | |
| **Urban High** | | | | | | | | | | | | | |
| *Mixed use high-2 (with two-story parking)* | 1.77 | | | | | | | X | X | | | X | |
| *Mixed use high-3 (with 3-story parking)* | 2.75 | | | | | | | | | | | X | |
| *Mixed use high-5 (with five-story parking)* | 3.21 | | | | | | | | | | | X | |

ITE also has developed design parameters for the pedestrian realm. The area between the curb and the property line is divided into several zones, as shown in *Figure 9.3*.

In similar fashion as the roadway parameters, *Table 9.3* presents recommended design parameters for the various zones of the pedestrian realm, for those context zones (C-3, C-4, and C-5) most applicable to League City. It also takes into account whether the ground floor of the adjacent development is predominantly commercial or residential.

***Figure 9.3 – Pedestrian Realm Zones***

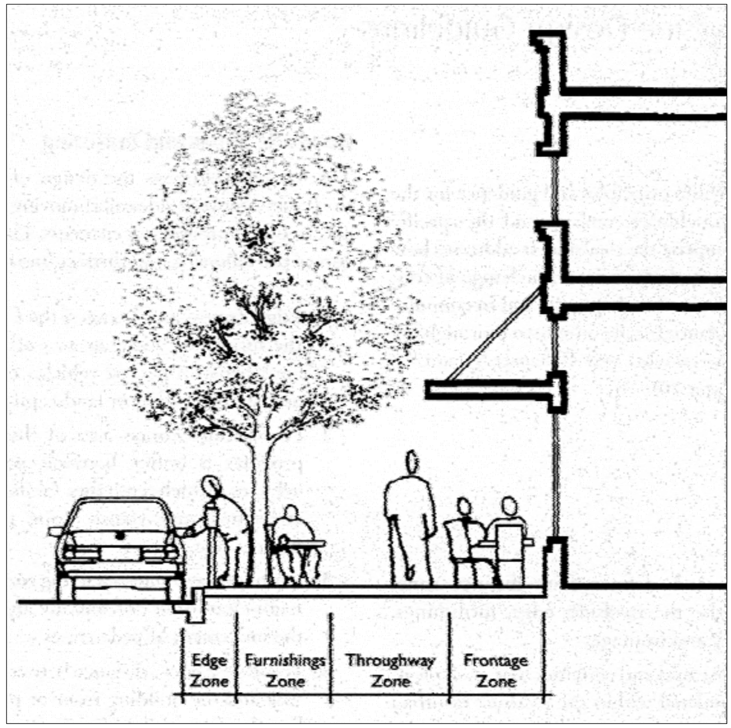


***Table 9.3 – Roadway Type and Sidewalk Zone Parameters***

**Context Zone and Predominant Ground Floor Land Use**

| Roadway Type | Sidewalk Zone [1] | | C-6 and C-5 | | | C-4 w/ Predominantly Commercial Ground Floor Use | | | C-4 w/ Predominantly Residential Frontage | | | C-3 w/ Predominantly Commercial Ground Floor Use | | | C-3 w/ Predominantly Residential Frontage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boulevard | Edge | | 1.5 ft.<br>2.5 ft. at diagonal parking | 21.5 foot (recommended) | 12 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 19 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 16.5 foot (recommended) | 9 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 16 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 14.5 foot (recommended) | 9 foot (constrained) |
| | Furnishings | | 7 ft.<br>(trees in tree wells) | | | 7 ft.<br>(trees in tree wells) | | | 8 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | | 7 ft.<br>(trees in tree wells) | | | 8 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | |
| | Throughway | | 10 ft. | | | 8 ft. | | | 8 ft. | | | 6 ft. | | | 6 ft. | | |
| | Frontage | | 3 ft. | | | 2.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | | 1.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | |
| Boulevard Without Parking | Edge | | THIS THOROUGHFARE TYPE NOT APPLICABLE TO THE PREDOMINANTLY COMMERCIAL GROUND FLOOR LAND USES FOUND IN C-4 THROUGH C-6 CONTEXT ZONES | | | | | | 0.5 ft. | 18.5 foot (Recommended) | 9 foot (constrained) | THIS THOROUGHFARE TYPE NOT APPLICABLE TO THE PREDOMINANTLY COMMERCIAL GROUND FLOOR LAND USES | | | 0.5 ft. | 16.5 foot (recommended) | 9 foot (constrained) |
| | Furnishings | | | | | | | | 10 ft.<br>(landscape strip w/ trees and groundcovers. or low shrubs) | | | | | | 10 ft.<br>(landscape strip w/ trees and groundcovers, or low shrubs) | | |
| | Throughway | | | | | | | | 8 ft. | | | | | | 6 ft. | | |
| | Frontage | | | | | | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | | | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | |
| Avenue | Edge | | 1.5 ft.<br>2.5 ft. at diagonal parking | 19.5 foot (recommended) | 12.0 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 16 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 14.5 foot (recommended) | 9 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 16 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 14.5 foot (recommended) | 9 foot (constrained) |
| | Furnishings | With Parking | 6 ft.<br>trees in tree wells | | | 6 ft.<br>(trees in tree wells) | | | 8 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | | 6 ft.<br>(trees in tree wells) | | | 8 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | |
| | | Without Parking | 8 ft. with buffer landscaping | | | 8 ft. with buffer landscaping | | | 8 ft. with buffer landscaping | | | 8 ft. with buffer landscaping | | | 8 ft. with buffer landscaping | | |
| | Throughway | | 9 ft. | | | 6 ft. | | | 6 ft. | | | 6 ft. | | | 6 ft. | | |
| | Frontage | | 3 ft. | | | 2.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | | 2.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | |
| Street | Edge | | 1.5 ft.<br>2.5 ft. at diagonal parking | 16 foot (recommended) | 12.0 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 16 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 11.5 foot (recommended) | 9 foot (constrained) | 1.5 ft.<br>2.5 ft. at diagonal parking | 15 foot (recommended) | 12 foot (constrained) | 0.5 ft. | 11.5 foot (recommended) | 9 foot (constrained) |
| | Furnishings | | 6 ft.<br>(trees in tree wells) | | | 6 ft.<br>(trees in tree wells) | | | 5 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | | 6 ft.<br>(trees in tree wells) | | | 5 ft.<br>(landscape strip w/ trees and grasses, or groundcovers) | | |
| | Throughway | | 6 ft. | | | 6 ft. | | | 6 ft. | | | 6 ft. | | | 6 ft. | | |
| | Frontage | | 2.5 ft. | | | 2.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | | 1.5 ft. | | | 0 ft. along lawn and groundcover<br>1 foot along low walls, fences and hedges<br>1.5 ft. along facades, tall walls and fences | | |

**As** **with**

**the roadway design parameters, League City should strongly consider adopting the ITE CSS design guidelines for the pedestrian realm, adapted as necessary to local preferences and conditions.** *Table 9.4* maps the correlation between the ITE pedestrian guidelines and the community character land-use descriptions being used by League City for the future growth scenarios.

***Complete Streets***

**According to the *Complete Streets* movement, the sole purpose of streets is *not* simply the conveyance of automobiles.** Rather, streets should be designed such that all modes of transport are accommodated – pedestrians, bicyclists, transit, and automobiles. Thus, a "complete street" may feature bicycle lanes, wide sidewalks, crosswalks, transit lanes, and other features that render it safer, more livable, and welcoming to everyone, including the elderly, disabled, and children. Communities across the country are instituting complete streets policies, furthering the paradigm shift away from thinking of streets as the exclusive domain of those in automobiles.

***Complete Street – Charlotte, NC***

The adoption of a complete streets policy in League City is a natural fit with the development of this multimodal mobility plan. The National Complete Streets Coalition offers guidelines on implementation and best practices based on 30 case studies of states, cities, counties, and MPO that have adopted and are implementing complete streets policies. Federal funding for complete streets programs is available via a number of the sources discussed in *Appendix E*, including STP, Transportation Enhancements (TE), CMAQ Improvement Program, and SRTS.

## Table 9.4 – Context Zone, Ground-Floor Land Use, Street Type

| | | Urban Center (C-5/6) | | | | | | | | General Urban (C-4) | | | | | | | | Suburban (C-3) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | Development | Predominant Ground-floor Use | | | | | | | | Predominant Ground-floor Use | | | | | | | | Predominant Ground-floor Use | | | | | | | |
| | Gross | *Commercial* | | | | *Residential* | | | | *Commercial* | | | | *Residential* | | | | *Commercial* | | | | *Residential* | | | |
| | Density or | *Blvd* | *Blvd* | *Ave* | *St* | *Blvd* | *Blvd* | *Ave* | *St* | *Blvd* | *Blvd* | *Ave* | *St* | *Blvd* | *Blvd* | *Ave* | *St* | *Blvd* | *Blvd* | *Ave* | *St* | *Blvd* | *Blvd* | *Ave* | *St* |
| | FAR | *w/Pkg* | *wo/Pkg* | | | *w/Pkg* | *wo/Pkg* | | | *w/Pkg* | *wo/Pkg* | | | *w/Pkg* | *wo/Pkg* | | | *w/Pkg* | *wo/Pkg* | | | *w/Pkg* | *wo/Pkg* | | |
| **Rural/Estate** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Estate single family | 0.75 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Conventional single family | 1.2 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Cluster single family | 2.7 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Village residential | 4.16 | | | | | | | | | | | | | X | X | X | X | | | | | X | X | X | |
| **Suburban Residential** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conventional single family | 2 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Cluster single family | 2.8 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Planned residential | 4.84 | | | | | | | | | | | | | X | X | X | X | | | | | X | X | X | X |
| Planned multi-family | 8 | | | | | X | X | X | X | | | | | X | X | X | X | | | | | | | | |
| **Suburban Village** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conventional single family | 3.3 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Single family infill | 3.66 | | | | | | | | | | | | | | | X | X | | | | | X | X | X | X |
| **Auto-Dominant Residential** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conventional single family (Enhanced), | 3.06 | | | | | | | | | | | | | | | X | X | | | | | | | X | X |
| Cluster single family | 3.52 | | | | | | | | | | | | | | | X | X | | | | | | X | X | X |
| Single family manufactured home | 3.75 | | | | | | | | | | | | | | | X | X | | | | | | X | X | X |
| Planned multi-family | 12.6 | | | | | X | X | X | X | | | | | X | X | X | X | | | | | | | | |
| **Suburban Commercial** | 0.38 | | | | | | | | | | X | X | X | | | X | X | X | X | X | X | | | X | X |
| **Auto-Dominant Commercial** | | | | | | | | | | | | | | | | | | | | | | | | | |
| General commercial (with surface parking) | 0.43 | X | X | X | X | | | | | X | X | X | X | | | | | X | X | X | X | | | | |
| General commercial (with two-story parking) | 0.75 | X | X | X | | | | | | X | X | X | X | | | | | X | X | X | X | | | | |
| Mixed use (with three-story parking) | 1.5 | X | X | X | | | | | | X | X | X | | | | | | | | | | | | | |
| **Urban Low** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mixed use low-2 (with two-story parking) | 1.67 | X | X | X | | | | | | X | X | X | X | | | | | | | | | | | | |
| Mixed use low-3 (with three-story parking) | 2.11 | X | X | X | | | | | | X | X | X | | | | | | | | | | | | | |
| **Urban High** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mixed use high-2 (with two-story parking) | 1.77 | X | X | X | | | | | | X | X | X | X | | | | | | | | | | | | |
| Mixed use high-3 (with 3-story parking) | 2.75 | X | X | X | | | | | | | | | | | | | | | | | | | | | |
| Mixed use high-5 (with five-story parking) | 3.21 | X | X | X | | | | | | | | | | | | | | | | | | | | | |

### *FORM-BASED CODE*

One way in which the many of the aforementioned principles of Smart Growth, Sustainable Communities, Mixed Use Development, Context Sensitive Solutions, and Complete Streets may be codified in League City is through the use of form-based code. **As an alternative to conventional zoning, form-based codes use *physical form*, rather than separation of uses, as the organizing principle for the code.**[3]

Form-based codes, which are presented in both diagrams and words, address the relationship between building facades and the public realm, the form and mass of buildings in relation to one another, and the scale and types of streets and blocks. In contrast to conventional zoning's focus on the micromanagement and segregation of land uses, form-based code designates the appropriate form and scale (and therefore, *character*) of development. This is a natural fit with the community character land use planning that League City is currently adopting. Not to be confused with design guidelines or general statements of policy, form-based codes are regulatory, not advisory. They are drafted to implement the objectives of a community plan, such as those in this Master Mobility Plan.

Form-based code does not necessarily have to be undertaken citywide. Rather, specific revitalization areas may be targeted as "form districts" for which form-based overlay code is applied. For instance, the community of Farmers Branch, Texas, (outside Dallas) has adopted form-based code to foster the creation of a vibrant town center in the area of an anticipated light rail station.[4] The Form-Based Code Institute makes available many examples of form-based code that have been adopted by communities nationwide.

A particular form-based code template in growing use is the so-called "SmartCode." Originally released in 2003, this model code is an open source program available free of charge to any community with an interest in creating a local form-based code.[5] It takes the work out of creating form-based code "from scratch," and allows communities to simply tailor the pre-written code as desired. The SmartCode is based on the land use "transect" discussed earlier in this chapter, and folds zoning, subdivision regulations, urban design, and basic architectural standards into one compact document. Communities that have calibrated the SmartCode for local use include such varied locales as Leander, Texas; Miami, Florida; Taos, New Mexico; Petaluma, California; and Post Falls, Idaho.

[3] Form Based Codes Institute, www.formbasedcodes.org.
[4] http://www.ci.farmers-branch.tx.us/work/planning/ordinances/station-area-codes.
[5] SmartCode Central, www.smartcodecentral.org.

# Chapter 10 – FUNDING AND IMPLEMENTATION STRATEGIES

### *HISTORY AND CONTEXT*

League City is an approximately 50-year old incorporated municipality that has grown dramatically over the past two decades into a suburban residential community of over 70,000 residents. As such, the City of League City has struggled with many of the challenges associated with managing growth, traffic congestion, and travel time delay. Nearly every major thoroughfare within League City originally was constructed as a state FM facility designed to handle rural traffic volumes. These have been improved in piecemeal fashion by TxDOT as congestion has worsened. Unlike many similar suburban cities within the Houston-Galveston region that also experienced rapid growth over the past 20 years, League City has not been actively engaged in the MPO funding and implementation processes.

The four-year Transportation Improvement Program (TIP) is the primary funding document for H-GAC, the region's MPO. League City periodically has submitted candidate projects in response to TIP project calls, and periodic special calls for projects over the years. However, League City historically has not taken an active role participating in ongoing subcommittee level activities. Until the U.S. Census 2010, League City was not guaranteed a seat at the MPO Transportation Policy Council (TPC) – which requires a population of 50,000 for a city to obtain a permanent seat. The TPC is the highest level of decision-making for MPO-selected categories of federal transportation funding – that is, funding that originates at the federal level and is distributed by formula to each of the States, and ultimately to the MPOs. As the MPO, H-GAC has project selection authority for two primary categories of federal funds: Surface Transportation Program - Metropolitan Mobility (STP-MM) and the CMAQ Improvement Program.

Not only will League City obtain a seat at the TPC through the population increase in the decennial Census, but the City also will obtain a permanent seat at the Technical Advisory Committee (TAC). The TAC and its TIP subcommittee are both essential parts of the programming and project selection process for federally funded projects within our region – and their recommendations are carried forward to the full TPC for review and approval. Although League City could have participated for a number of years in the TPC/TAC process through the nomination of at-large "smaller cities" representatives, in only one year over the past decade did any League City elected representative serve as either a TPC or TAC member as a smaller cities representative. Moving forward, active participation by League City elected officials and appropriate municipal staff in the TPC, TAC, and related subcommittees will be critical to ensure success in the area of federal funding pursuit.

Traditionally, cities that have been most active in the MPO decision-making process have received a larger portion of federal funds on an annual basis. League City has lagged behind peer cities that sponsor transportation projects within the region such as Pearland, Sugar Land, and even Pasadena. Comparing the projects currently in the 2008-2011 TIP for these select cities is most revealing:[1]

[1] Totals include federal, state, and local projects, both completed and yet to be implemented.

Pearland: 7 Projects, $90.9 million[2]

Sugar Land: 14 Projects, $90.5 million

Pasadena: 14 Projects, $69.9 million

**League City: 4 Projects, $15.72 million of which $14.4 million is 100% LOCALLY FUNDED**

The total number of projects included within the 2011-2014 TIP falls short of League City's existing demand for upgraded mobility infrastructure. Moreover, it also reflects a minimal amount of "leverage" of local tax dollars to achieve overall programmatic and project goals. In other words, within the same timeframe as other regional peer cities, League City will complete fewer critical mobility projects – and potentially pay more local dollars in doing so. The failure to leverage local expenditures against available federal funds means that League City taxpayers will pay more and see fewer mobility improvements in their community. With numerous mobility challenges, League City must take advantage of available STP-MM and CMAQ funds, which can pay up to 80% of capital costs with federal funds. This is an area of fiduciary responsibility to the citizens that League City's decision makers can carry forward with this master mobility plan.

## *PURSUIT OF FEDERAL FUNDING FOR MASTER MOBILITY PLAN*

This master mobility plan establishes infrastructure priorities for League City for both immediate and long-range improvements to assist the City in meeting its mobility and quality-of-life objectives. *Appendix E* delineates the myriad of federal and state resources which traditionally have been utilized to support various types of transportation improvements. These resources are distributed at the local level through H-GAC, and additionally at the federal level through discretionary calls for projects or congressionally directed funding (earmarks) through the annual congressional transportation appropriation process and the Transportation Authorizing Bill.

### *MPO Funding Process*

Congress has established specific guidelines for the regional coordination of federally funded transportation infrastructure. These guidelines stipulate that, within larger urbanized areas, the MPO is to ensure that the planning and development of transportation improvements is fully coordinated and part of a comprehensive long-range transportation plan. As the MPO for the eight-County Houston-Galveston Transportation Management Area (TMA), H-GAC coordinates all federal and state transportation funding for the long-range transportation plan, which currently projects needs through 2035. Shorter term projects for which early development has been completed, and for which local share resources have been committed, are programmed as part of the MPO's four-year TIP.

During the development of this master mobility plan, the City submitted a request for funding to be programmed through the MPO for the FY2011–FY2014 timeframe. This request focused primarily on short-term access management improvements. Proposed projects contained within the long-range plan and the TIP also must be included in the State Transportation Improvement Program (STIP).

[2] In 2000-2010 timeframe, Pearland was represented as a "small cities" member of the TPC and TAC, and thus did not have a "permanent" seat.

Funding to support the transportation improvements contained within the long-range plan (also known as the Regional Transportation Plan or RTP) and TIP is derived from federal and state resources allocated to Texas and other political subdivisions within the Houston–Galveston region. Funding to support roadway-related improvements is derived through the formula distribution of federal funding received annually by the State of Texas. Historically, Texas has been a "donor" state, receiving approximately 92% of the federal funding generated by gasoline sales within the state. These funds are further allocated to the various TxDOT District offices within the State.

***Transportation Management Area (TMA)***

Metropolitan regions in the United States that have failed to meet air quality standards as set forth by the U.S. Environmental Protection Agency (EPA) are classified as "nonattainment." TMAs are established in these regions and give the MPO greater authority to "flex" some highway funding categories from highways to transit, if doing so can better meet local air quality objectives. Those counties within the H-GAC planning area currently considered nonattainment and thus part of a TMA are Harris, Galveston, Brazoria, Fort Bend, Liberty, Chambers, Montgomery, and Waller counties. The sources of federal highway funding that fall within the flex category include the CMAQ Improvement Program and STP funding categories.

***Congressional Authorization and Congressionally Directed Funding***

All federal funding for transportation improvement is authorized through major congressional umbrella legislation which establishes ceilings for the various categories of transportation funding. Previous authorizing legislation includes the bills known as the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), the 1998 Transportation Equity Act for the 21$^{st}$ Century (TEA-21), and the 2005 Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Currently, federal transportation funding is contingent on "continuing resolutions" of Congress since the most recent authorizing legislation terminated on September 30, 2009. These continuing resolutions enable the federal government to continue to fund Medicare, Social Security, and the 13 Appropriation categories including transportation.

The authorizing umbrella legislation establishes specific categories of federal spending and, as previously indicated, ceilings above which specific appropriations cannot exceed. The Congressional Authorizing Bill often includes specific projects which, as authorized, do not need further specific appropriation by Congress. The Authorizing Bill for Transportation also includes significant funding for the "Secretary's Discretion" in both highway and transit categories. Over the last 20 years, Congress has determined to direct this discretionary funding to specific projects within each Representative's district. This process, known as "earmarking," has been subject to increasing scrutiny by the public and the political process. As a result recent Congressional guidelines have injected substantial transparency into this process to ensure that proposed projects are worthwhile and not a waste of taxpayer money.

The Congressional leadership of the House Transportation and Infrastructure Committee, which is responsible for authorizing the new Transportation Authorizing Bill, has been advocating for a $500 billion, six-year umbrella legislation which would represent a 60% increase in federal transportation funding over existing levels. To achieve this objective Congress must find the revenue resources to support the increased expenditures. The most obvious method in which to generate these resources is from the user fees that the public pays at the gas pump for its gasoline. The political motivation to raise the existing federal tax on gasoline, which has not been increased since 1991, will test the resolve of the next Congress when it convenes. The nation's transportation infrastructure is deteriorating and our urban areas are growing. The expenditure required for the nation to catch up with its transportation infrastructure needs has been estimated at $1.3 trillion.

### *FEDERAL AND STATE TRANSPORTATION FUNDING: OUTLOOK AND STRATEGY FOR LEAGUE CITY*

The City must develop an implementation strategy which recognizes that, even in an atmosphere of economic downtown, uncertainty regarding the availability of federal and state funding, and diminishing state transportation resources, there is an opportunity to successfully pursue federal and state funding to support mobility improvements for League City. This strategy depends heavily on the City moving significant capital intensive projects into a "shovel ready" status, and completing lower cost projects primarily with the City's available local funding.

The term shovel ready, which has been widely advanced due to its reference through the recent "economic stimulus" legislation, refers to those projects that have advanced through the preliminary engineering and environmental phases of project development. The term refers to those projects for which ROW has been acquired, and for which the local sponsor has sufficient local resources to meet or exceed the traditional local share required to leverage federal and state funding. The City has the capability to meet these criteria.

The strategy for pursuit of federal and state funding to support mobility infrastructure recommendations contained within this master mobility plan, therefore, is based on the following assumptions and actions:

1. ***Get To The Head of The Line*** – Many local political subdivisions have limited financial resources to spend on mobility improvements and thus must rely heavily on federal and state resources to advance projects. This will result in fewer projects which have advanced to shovel ready status. This provides an opportunity for League City to advance its priority projects to take advantage of federal and state funding opportunities through H-GAC's Long-Range Plan and TIP process. **ACTIVE participation on a monthly basis in the TPC, TAC, and TIP Subcommittees is essential**. The City's previous lack of participation in the MPO process likely resulted in the loss of tens of millions in federal funds that could have been secured over the past decade. Now, having exceeded 50,000 in population, the City must take a proactive role in the federal funding process, as a matter of fiduciary responsibility to its taxpayers.

2. ***Pursue Congressionally Directed Funding*** – Even in light of the current atmosphere against the "earmarking" process, there will still be substantial projects funded through Congressional direction. This is due to the reality that if Congress does not direct the funding it will revert to the "Secretary's Discretions," thereby shifting decision making from Congress to the Executive Branch. This is unlikely to be fully institutionalized. Accordingly, the City should be working with its Congressional delegation on pursuit of funding to support major transportation infrastructure

projects that can have significant bang for the buck for the region in terms of reduced vehicle-miles traveled (VMT), reduced pollution, and reduced energy use. Commuter rail, transit, upgrade of traffic management capability, and relief of major freight rail/highway conflicts are a few examples of projects for which federal and state funding should be pursued directly from Congress.

3. ***Presentation to the TxDOT Commission*** – The City must impress upon the TxDOT Commission the importance of future mobility improvements for League City. The City also must express to the Commission its willingness to "go the extra mile" in financial support for critical projects, such as by providing more than the typically required local share to advance the project within the TxDOT project programming process.
4. ***Pursue Regional Partnerships*** – The City is not isolated from regional growth impacts in terms of mobility improvement. The City should continue to pursue partnerships for support of major infrastructure improvements. Federal and state mobility funding processes increasingly are seeking demonstration of linkages between transportation, housing, economic development, and public/private partnerships that can better ensure that federal and state funding to support mobility infrastructure will have the maximum impact. As such, the City should develop partnerships that reinforce the importance of federal and state support and the resulting bang for the buck.

## *MULTIMODAL RECOMMENDATIONS SUMMARY*

*Table 10.1* summarizes the key multimodal recommendations made in this master mobility plan. The funding and implementation strategies discussed in this chapter can be used to begin pursuit of these projects immediately. As of the time this plan was published, final rankings for projects submitted for inclusion in the 2011-2014 TIP had not yet been released by H-GAC.

**Table 10.1 – Project Recommendations and Implementation Strategies**

| **Project** | **Proposed Years** | **Cost** | **Funding Sources** | **Priority (High-Medium-Low)** | **Comments** |
|---|---|---|---|---|---|
| ***FM 518 Access Management (Raised Medians) From 2004 H-GAC FM 518 Access Mgt Plan; Costs are 2004 dollars*** | | | | | |
| Brookdale/Bay Area Blvd | 2012-13 | $103,200 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Royal-Hobbs/Lafayette to west of IH 45 | 2012-13 | $43,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| East of IH 45 to 40' east of Wesley | 2012-13 | $55,900 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Highland Dr | 2012-13 | $25,800 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Devereaux/Calder to Englewood | 2012-13 | $55,900 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Interurban | 2012-13 | $51,600 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| West City Limit | 2012-13 | $90,300 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Landing Blvd | 2012-13 | $25,800 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| ***FM 518 Access Mgt (Intersection Improvements) From 2004 H-GAC FM 518 Access Mgt Plan; Costs are 2004 dollars*** | | | | | |
| Bay Area Blvd | 2012-13 | $23,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Spring Landing/Palomino | 2012-13 | $18,500 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 2094 | 2012-13 | $5,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 2094 | 2012-13 | $680,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Landing Blvd | 2012-13 | $25,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Hobbs/Lafayette | 2012-13 | $55,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| IH 45 | 2012-13 | $140,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Interurban | 2012-13 | $25,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| SH 3 | 2012-13 | $95,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| Texas | 2012-13 | $20,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| ***Traffic Operations Control Center*** | | | | | |
| Citywide | 2015 | $500,000 (Phase I) | Local or CMAQ | M | Not submitted for 2011-2014 TIP |
| ***Long-Term Roadway Improvements*** | | | | | |
| IH 45, btw north and south city limits, widen to 8-lane facility | 2015+ | $19,800,000 | STP-MM (80%) | M | |
| IH 45 frontage road, btw north and south city limits, widen to 2 lanes | 2015+ | $19,800,000 | STP-MM (80%) | H | |
| FM 518, btw west city limit and IH 45, widen to 6-lane major arterial | 2015+ | $8,100,000 | STP-MM (80%) | H | |
| FM 518 Bypass, btw FM 518 and FM 270, build as 4-lane bypass | 2015+ | $8,800,000 | STP-MM (80%) | H | |
| League City Pkwy, btw Maple Leaf Dr and Bay Area Blvd, widen to 4-lane major arterial | 2015+ | $3,600,000 | STP-MM (80%) | M | |
| League City Pkwy, btw IH 45 and FM 1266, widen to 6-lane major arterial | 2015+ | $8,200,000 | STP-MM (80%) | M | |

| Table 10.1 b – Project Recommendations and Implementation Strategies (Continued) | | | | | |
|---|---|---|---|---|---|
| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
| FM 646 W, btw FM 517 and IH 45, widen to 6-lane major arterial | 2015+ | $4,300,000 | STP-MM (80%) | M | |
| FM 646 E, btw IH 45 and east city limit, widen to 6-lane major arterial | 2015+ | $12,100,000 | STP-MM (80%) | H | |
| FM 517, btw west city limit and IH 45, widen to 6-lane major arterial | 2015+ | $32,600,000 | STP-MM (80%) | M | |
| FM 270, btw FM 518 and FM 646, widen to 4-lane major arterial | 2015+ | $5,700,000 | STP-MM (80%) | M | |
| SH 3, btw north city limit and FM 518, widen to 6-lane major arterial | 2015+ | $1,600,000 | STP-MM (80%) | M | |
| Proposed E-W corridor, btw west city limit and IH 45, build as 4-lane minor arterial | 2015+ | $16,600,000 | STP-MM (80%) | H | |
| Proposed E-W corridor (south), btw west city limit and IH 45, build as 6-lane major arterial | 2015+ | $23,900,000 | STP-MM (80%) | H | |
| Maple Leaf Dr, btw FM 518 and FM 517, widen to 4-lane minor arterial and extend to FM 517 | 2015+ | $9,200,000 | STP-MM (80%) | M | |
| Bay Area Blvd, btw SH 96 and FM 517, extend to FM 517 as 4-lane minor arterial | 2015+ | $5,500,000 | STP-MM (80%) | M | |
| Palomino Ln/Bridge, btw W NASA Rd and FM 518, widen to 4-lane minor arterial | 2015+ | $1,700,000 | STP-MM (80%) | H | |
| Landing Blvd, btw League City Pkwy and FM 517, widen and extend to FM 517 as 4-lane minor arterial | 2015+ | $7,800,000 | STP-MM (80%) | H | |
| Landing Bridge, btw FM 518 and IH 45, build as 4-lane bypass | 2015+ | $3,400,000 | STP-MM (80%) | M | |
| Hobbs Rd, btw League City Pkwy and FM 517, widen and upgrade to 4-lane minor arterial | 2015+ | $8,000,000 | STP-MM (80%) | M | |
| Calder Dr, btw IH 45 and FM 517, widen to 4-lane minor arterial | 2015+ | $7,700,000 | STP-MM (80%) | M | |
| Butler Rd, btw IH 45 and proposed E-W corridor, build as 2-lane collector | 2015+ | $1,300,000 | STP-MM (80%) | M | |
| W Walker St, btw SH 3 and League City Pkwy, widen to 4-lane minor arterial | 2015+ | $1,400,000 | STP-MM (80%) | M | |
| W Walker St, btw end of subdivision and IH 45, extend as 2-lane collector | 2015+ | $400,000 | STP-MM (80%) | M | |
| South Shore Blvd, btw end of subdivision and FM 646, widen to 4-lane major arterial | 2015+ | $1,100,000 | STP-MM (80%) | M | |

*Table 10.1 c – Project Recommendations and Implementation Strategies (Continued)*

| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
|---|---|---|---|---|---|
| League City Pkwy, btw Maple Leaf Dr and IH 45, widen to 6-lane major arterial | 2015+ | $9,600,000 | STP-MM (80%) | H | |
| League City Pkwy E, btw FM 1266 and east city limit, widen to 6-lane major arterial | 2015+ | $5,700,000 | STP-MM (80%) | M | |
| SH 96 direct connectors, NB to EB and EB to SB, build two direct connectors, 1 lane each direction | 2015+ | $40,000,000 | STP-MM (80%) | M | |
| FM 646 E, btw IH 45 and FM 1266, widen to 8-lane major arterial | 2015+ | $9,300,000 | STP-MM (80%) | H | |
| Bay Area Blvd, btw League City Pkwy and proposed E-W corridor (south), widen to 6-lane minor arterial | 2015+ | $1,800,000 | STP-MM (80%) | M | |
| Landing Bridge/Blvd, btw IH 45 and League City Pkwy, widen to 6-lane minor arterial | 2015+ | $2,900,000 | STP-MM (80%) | H | |
| Louisiana St, btw Austin St and Hewitt St, widen to 4-lane minor arterial | 2015+ | $500,000 | STP-MM (80%) | M | |
| ***Transit Recommendations*** | | | | | |
| Local Flex Service Vehicle Acquisition | 2012 | $500,000 | 5307 Formula Funds | M | 80% Federal cost eligible through GCTD/GCC |
| Local Flex Service Operations btw South Shore Marina Complex, Historic District, City Hall | 2013 | $312,000 | 1st 3 yrs CMAQ (Pilot Proj); 5307 CCC after Yr3 | M | Yr 1 under CMAQ, City share approximately $53,000; by Yr 4 Transition to 5307 CCC, City share estimated at $140,00 annually |
| SH 3 Intercity Connector (Bus) | 2013-14 | LC Share TBD | 1st 3 yrs CMAQ | M | Project would be interlocal partnership between cities, GCC/Connect Transit, and GCTD |
| Regional Bus Victory Lakes P&R Capital Facility (SB) | 2011 | $4,200,000 | ARRA; 5309 Discretionary | H | Capital Facility construction in 2011 |
| Regional Bus Victory Lakes P&R Service (SB) | 2012 | LC share $60,000 - $100,000 Annually | 1st 3 yrs CMAQ (Pilot Proj), or JARC | H | Service to begin late 2011/early 2012 |
| Regional Bus RiverBend or other P&R site TBD (NB) | 2014 | TBD | 5309 Discretionary; CMAQ | M | RiverBend recommended in site selection analysis by GCC/Connect Transit; however, no agreement on property has been reached |

*Table 10.1 d – Project Recommendations and Implementation Strategies (Continued)*

| ***Project*** | ***Proposed Years*** | ***Cost*** | ***Funding Sources*** | ***Priority (High-Medium-Low)*** | ***Comments*** |
|---|---|---|---|---|---|
| ***Pedestrian Improvements*** | | | | | |
| FM 518 Streetscape Improvements (Five Corners to SH 3) | 2013 | $4,700,000 | CMAQ (80%) | H | Submitted for 2011-2014 TIP |
| FM 518 Streetscape Improvements (SH 3 to IH 45) | 2015 | $3,642,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| FM 518 Streetscape Improvements (IH 45 to Landing Blvd) | 2015 | $2,304,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| SH 3 Streetscape (Walker to FM 518) | 2015 | $831,000 | CMAQ (80%) | M | Not submitted for 2011-2014 TIP |
| SH 3 Streetscape (FM 518 to Walter Hall Park) | 2014 | $1,506,000 | Local | M | Not submitted for 2011-2014 TIP |
| FM 2094 (South Side only, Twin Oaks to S. Compass Rose) | 2013 | $1,275,000 | Local | M | Not submitted for 2011-2014 TIP |
| ***Bicycle*** | | | | | |
| FM 270 to Sportsplex | 2012-13 | $296,240 | CMAQ or Local | H | Project could be advanced to 2011 if City pursues with 100% local funds and City crews |
| ***Marine Transportation/Water Taxi*** | | | | | |
| | 2015 | $250,000 - $500,000 annually | Local | L to M | Initial weekend service pilot project (turnkey contract with local boat operator) |

# *Appendices*

*Appendix* ***A*** – Roadway Characteristics Inventory

*Appendix* ***B*** – Synchro Reports

*Appendix* ***C*** – Community Character Descriptions

*Appendix* ***D*** – FM 518 Streetscape Inventory, Quantification of Benefits, and Funding Pursuit

*Appendix* ***E*** – Federal-State-Local Funding Alternatives

*Appendix* ***F*** – Public Comments

## *Appendix A – ROADWAY CHARACTERISTICS INVENTORY*

A COPY OF THIS APPENDIX IS INCLUDED ON THE CD ON THE BACK COVER OF THIS REPORT.

# Appendix A – Roadway Characteristics

| Roadway | Segment | Volume * | PHV* | Lanes* | Capacity* | V/C* | Speed Limit | | | | # of Curb Cuts/ Segment | | | | # of Street Intersections/ Segment | | | | Median | Sidewalks | | | | Drainage Ditches | | | | School Zones | Length (in Ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | N Side | S Side | E Side | W Side | N Side | S Side | E Side | W Side | N Side | S Side | E Side | W Side | | N Side | S Side | E Side | W Side | N Side | S Side | E Side | W Side | (Number) | | |
| FM 518 | West City Limit to Maple Leaf | 17400 | 1032 | 2 | 950 | 0.54 | 55 | 50-55 | N/A | N/A | 0 | 0 | N/A | N/A | 1 | 0 | N/A | N/A | Center Turn Lane | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 1687.35 | |
| | Maple Leaf St to Bay Area Blvd | 26300 | 1452 | 2 | 950 | 0.76 | 50-55 | 50 | N/A | N/A | 5 | 0 | N/A | N/A | 1 | 2 | N/A | N/A | Center Turn Lane | Partial | None | N/A | N/A | Full | Full | N/A | N/A | 1 | 2634.15 | |
| | Bay Area Blvd to Landing Blvd | 30300 | 1808 | 2 | 950 | 0.95 | 45-55 | 45-50 | N/A | N/A | 25 | 22 | N/A | N/A | 8 | 6 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | Full | Full | N/A | N/A | 2 | 9340.98 | |
| | Landing Blvd to Hobbs Rd | 31100 | 1638 | 2 | 950 | 0.86 | 40-45 | 40-45 | N/A | N/A | 19 | 18 | N/A | N/A | 4 | 2 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | Partial | Partial | N/A | N/A | 2 | 3381.07 | |
| | Hobbs Rd to IH 45 | 31700 | 1666 | 2 | 950 | 0.88 | 40 | 40 | N/A | N/A | 4 | 3 | N/A | N/A | 0 | 0 | N/A | N/A | Partial | Partial | Full | N/A | N/A | None | None | N/A | N/A | None | 620.82 | |
| | IH 45 to Calder Rd | 39200 | 1956 | 2 | 950 | 1.03 | 40 | 40 | N/A | N/A | 14 | 16 | N/A | N/A | 1 | 2 | N/A | N/A | Full/Center Turn Lane | Partial | Full | N/A | N/A | None | None | N/A | N/A | None | 2770.74 | |
| | Calder Rd to SH 3 | 30700 | 1597 | 2 | 950 | 0.84 | 40 | 40 | N/A | N/A | 27 | 19 | N/A | N/A | 0 | 3 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | None | None | N/A | N/A | None | 3459.73 | |
| | SH 3 to Kansas Ave | 32000 | 1364 | 2 | 950 | 0.72 | 30 | 30 | N/A | N/A | 12 | 8 | N/A | N/A | 6 | 5 | N/A | N/A | None | Partial | Partial | N/A | N/A | None | None | N/A | N/A | None | 2596.51 | |
| | Kansas to Alabama | 29200 | 1260 | 2 | 950 | 0.66 | 30-40 | 30-40 | N/A | N/A | 42 | 27 | N/A | N/A | 3 | 4 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | None | None | N/A | N/A | 1 | 3783.33 | |
| | Alabama to Texas Ave | 26900 | 1218 | 2 | 950 | 0.64 | 40 | 40 | N/A | N/A | 6 | 6 | N/A | N/A | 0 | 0 | N/A | N/A | Center Turn Lane | Partial | None | N/A | N/A | None | None | N/A | N/A | None | 647.58 | |
| | Texas Ave to FM 270 | 30000 | 1372 | 2 | 950 | 0.72 | 40 | 40 | N/A | N/A | 2 | 4 | N/A | N/A | 0 | 0 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | None | None | N/A | N/A | None | 848.75 | |
| | FM 270 to FM 2094 | 48900 | 2257 | 3 | 950 | 0.8 | 40 | 40 | N/A | N/A | 1 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | Center Turn Lane | Full | None | N/A | N/A | None | None | N/A | N/A | 1 | 345.82 | |
| | FM 2094 to Louisiana | 17600 | 800 | 2 | 950 | 0.42 | 40 | 45-50 | N/A | N/A | 11 | 8 | N/A | N/A | 0 | 1 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | 1 | 3494.19 | |
| | Louisiana to Meadow Pkwy | 12500 | 302 | 2 | 950 | 0.16 | 45-50 | 50 | N/A | N/A | 4 | 4 | N/A | N/A | 1 | 2 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | None | 3508.35 | Landscaped Median |
| | Meadow Pkwy to S. Shore Blvd | 11700 | 264 | 2 | 950 | 0.14 | 50 | 50 | N/A | N/A | 0 | 10 | N/A | N/A | 0 | 1 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | None | 2126.8 | Landscaped Median |
| | S. Shore Blvd to Columbia Memorial Pkwy (FM 1266 North) | 17300 | 618 | 2 | 950 | 0.33 | 50 | 50 | N/A | N/A | 1 | 5 | N/A | N/A | 2 | 1 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | 1 | 2874.11 | Landscaped Median |
| | Columbia Memorial Pkwy to East City Limit | 21400 | 754 | 2 | 950 | 0.4 | 50 | 50 | N/A | N/A | 4 | 6 | N/A | N/A | 0 | 0 | N/A | N/A | Full | Full | Full | N/A | N/A | None | Partial | N/A | N/A | 1 | 1964.43 | Landscaped Median |
| FM 2094 | FM 518 to Davis Rd | 32500 | 1552 | 2 | 950 | 0.82 | 40 | 40 | N/A | N/A | 8 | 5 | N/A | N/A | 2 | 0 | N/A | N/A | Partial | Full | Full | N/A | N/A | None | None | N/A | N/A | 1 | 2604.29 | Partial Landscaped Median |
| | Davis Rd to S. Shore Blvd | 32200 | 1918 | 2 | 950 | 0.93 | 45 | 45 | N/A | N/A | 10 | 6 | N/A | N/A | 2 | 0 | N/A | N/A | Full | Partial | Full | N/A | N/A | None | None | N/A | N/A | 1 | 5188.91 | Mostly Landscaped Medians |
| | S. Shore Blvd to East City Limit | 19600 | 962 | 2 | 950 | 0.51 | 45 | 45 | N/A | N/A | 29 | 10 | N/A | N/A | 8 | 1 | N/A | N/A | Full | Partial | Partial | N/A | N/A | Partial | Partial | N/A | N/A | None | 8608.45 | Full Landscaped Median |
| FM 270 | North City Limit to FM 518 | 29800 | 1456 | 2 | 950 | 0.77 | N/A | N/A | 45 | 45 | N/A | N/A | 7 | 15 | N/A | N/A | 3 | 3 | Center Turn Lane | N/A | N/A | Partial | Partial | N/A | N/A | Full | Full | None | 7985.8 | Sidewalks on ES in front of Dev.Property only |
| | FM 518 to Webster St | 16800 | 878 | 2 | 950 | 0.46 | N/A | N/A | 45 | 45 | N/A | N/A | 10 | 6 | N/A | N/A | 2 | 1 | Center Turn Lane | N/A | N/A | Partial | Partial | N/A | N/A | Full | Full | 1 | 4314.25 | |
| | Webster St to Austin St | 15300 | 601 | 1 | 950 | 0.63 | N/A | N/A | 55 | 45 | N/A | N/A | 3 | 2 | N/A | N/A | 0 | 0 | Partial | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 2334.96 | Striped Center Median |
| | Austin St to Hewitt St | 10700 | 247 | 1 | 950 | 0.26 | N/A | N/A | 55 | 55 | N/A | N/A | 1 | 1 | N/A | N/A | 0 | 0 | Partial | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 2121.83 | Striped Center Median |
| | Hewitt St to League City Pkwy | 10200 | 178 | 1 | 950 | 0.19 | N/A | N/A | 55 | 55 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | Partial | N/A | N/A | None | Partial | N/A | N/A | Full | Full | None | 2031.78 | Striped Center Median |
| | League City Pkwy to FM 646 | 21800 | 802 | 1 | 950 | 0.84 | N/A | N/A | 55 | 55 | N/A | N/A | 0 | 2 | N/A | N/A | 0 | 1 | Partial | N/A | N/A | None | Partial | N/A | N/A | Full | Full | None | 2868.36 | Par. SW on WS in front CVS only/par.StripeMed. |
| Columbia | FM 518 to League City Pkwy | 4100 | 135 | 1 | 680 | 0.2 | N/A | N/A | 50 | 50 | N/A | N/A | 20 | 1 | N/A | N/A | 2 | 3 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 6431.38 | |
| Tuscan Lakes Blvd | Subdivision to League City Pkwy | 5900 | 476 | 2 | 600 | 0.4 | N/A | N/A | 30 | 30 | N/A | N/A | 0 | 0 | N/A | N/A | 2 | 2 | None | N/A | N/A | Full | None | N/A | N/A | None | None | None | 756.26 | |
| | League City Pkwy to FM 646 | 16700 | 598 | 2 | 680 | 0.44 | N/A | N/A | 45 | 45 | N/A | N/A | 0 | 1 | N/A | N/A | 1 | 0 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 2889.83 | |
| | FM 646 to South City Limit | 11300 | 678 | 2 | 680 | 0.5 | N/A | N/A | 45 | 45 | N/A | N/A | 2 | 0 | N/A | N/A | 0 | 0 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 723.81 | |
| South Shore Boulevard | Austin St. to FM 2094 | 6200 | 306 | 1 | 680 | 0.45 | N/A | N/A | 35 | 35 | N/A | N/A | 2 | 1 | N/A | N/A | 2 | 1 | Full | N/A | N/A | Full | Partial | N/A | N/A | None | None | None | 1028.49 | Landscaped Median |
| | FM 2094 to FM 518 | 10700 | 592 | 2 | 680 | 0.44 | N/A | N/A | 35 | 35 | N/A | N/A | 7 | 5 | N/A | N/A | 4 | 5 | Full | N/A | N/A | Full | Partial | N/A | N/A | None | None | 1 | 7747.63 | Landscaped Median / Draininage in Center |
| | FM 518 to Austin St. | 10700 | 592 | 2 | 680 | 0.44 | N/A | N/A | 30 | 30 | N/A | N/A | 2 | 4 | N/A | N/A | 3 | 5 | Partial | N/A | N/A | Partial | Partial | N/A | N/A | None | None | None | 7701.27 | Landscaped Median |
| | Austin St to League City Pkwy | 9100 | 268 | 2 | 680 | 0.2 | N/A | N/A | 30 | 30 | N/A | N/A | 4 | 1 | N/A | N/A | 1 | 1 | Full | N/A | N/A | Partial | Full | N/A | N/A | None | None | None | 2575.63 | Landscaped Median |
| | League City Pkwy to FM 646 | 8300 | 860 | 2 | 680 | 0.59 | N/A | N/A | 30 | 30 | N/A | N/A | 2 | 2 | N/A | N/A | 1 | 2 | Partial | N/A | N/A | None | None | N/A | N/A | None | None | None | 7777.84 | |
| | FM 646 to South City Limit (Caroline) | 4000 | 201 | 1 | 680 | 0.3 | N/A | N/A | 30 | 30 | N/A | N/A | 2 | 2 | N/A | N/A | 0 | 0 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 642.69 | |
| League City Pkwy | West City Limit to Maple Leaf | 2000 | 66 | 1 | 680 | 0.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3021.77 | |
| | Maple Leaf to Westover Park Ave | 3800 | 94 | 1 | 680 | 0.14 | 35 | 35 | N/A | N/A | 0 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | Full | N/A | N/A | None | None | N/A | N/A | None | 1409.2 | |
| | Westover Park Ave to Bay Area Blvd | 5300 | 189 | 1 | 680 | 0.28 | 35 | 35 | N/A | N/A | 0 | 0 | N/A | N/A | 2 | 1 | N/A | N/A | None | Partial | Partial | N/A | N/A | None | Partial | N/A | N/A | None | 5649.65 | Sidewalk ends where subdivision changes |
| | Bay Area Blvd to Landing Blvd | 11900 | 297 | 2 | 680 | 0.44 | 35 | 35 | N/A | N/A | 5 | 1 | N/A | N/A | 2 | 3 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | 1 | 6368.81 | |
| | Landing Blvd to Hobbs Rd | 11900 | 297 | 2 | 680 | 0.44 | 35-45 | 35 | N/A | N/A | 0 | 1 | N/A | N/A | 3 | 1 | N/A | N/A | Full | Full | Full | N/A | N/A | None | None | N/A | N/A | 1 | 4157.27 | Landscape/Drainage |
| | Hobbs Rd to Calder Rd | 14500 | 719 | 2 | 680 | 0.53 | 45 | 35 | N/A | N/A | 3 | 1 | N/A | N/A | 1 | 1 | N/A | N/A | Full | Partial | Partial | N/A | N/A | None | None | N/A | N/A | 1 | 2667.06 | Sidewalks in front of dev. Property only |
| | Calder Rd to IH 45 | 11500 | 624 | 2 | 680 | 0.46 | 45 | 35 | N/A | N/A | 0 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | Full | None | Full | N/A | N/A | None | None | N/A | N/A | None | 637.82 | Landscaped Median |
| | IH 45 to Calder Rd | 7500 | 342 | 2 | 680 | 0.25 | 45 | 35-45 | N/A | N/A | 1 | 1 | N/A | N/A | 0 | 0 | N/A | N/A | Full | None | Full | N/A | N/A | None | None | N/A | N/A | None | 637.82 | Landscaped Median |
| | Calder Rd to Walker St | 17900 | 921 | 2 | 950 | 0.48 | 45 | 45 | N/A | N/A | 2 | 2 | N/A | N/A | 0 | 0 | N/A | N/A | Full | None | None | N/A | N/A | None | Partial | N/A | N/A | None | 3054.2 | Landscaped Median |
| | Walker St to SH 3 | 15200 | 806 | 2 | 950 | 0.42 | 45 | 45 | N/A | N/A | 5 | 23 | N/A | N/A | 2 | 4 | N/A | N/A | Full | Partial | Partial | N/A | N/A | Partial | Partial | N/A | N/A | None | 5312.02 | |
| | SH 3 to FM 270 | 17800 | 1046 | 2 | 950 | 0.55 | 55 | 55 | N/A | N/A | 1 | 1 | N/A | N/A | 1 | 0 | N/A | N/A | Full | Partial | Partial | N/A | N/A | Full | Full | N/A | N/A | None | 5989.42 | Landscaped Median/Sidewalks at CVS only |
| | FM 270 to Louisiana | 15900 | 942 | 2 | 950 | 0.5 | 55 | 55 | N/A | N/A | 2 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | Full | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 2268.51 | Landscaped Median |
| | Louisiana to Tuscan Lakes Blvd | 18600 | 854 | 2 | 950 | 0.45 | 55 | 55 | N/A | N/A | 2 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | Full | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 3085.53 | Landscaped Median |
| | Tuscan Lakes Blvd to S. Shore Blvd | 22400 | 1194 | 2 | 950 | 0.62 | 55 | 55 | N/A | N/A | 0 | 2 | N/A | N/A | 0 | 0 | N/A | N/A | Full | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 2420.6 | Landscaped Median |
| | S. Shore Blvd to Columbia Memorial Pkwy | 13800 | 578 | 2 | 950 | 0.3 | 55 | 55 | N/A | N/A | 3 | 4 | N/A | N/A | 0 | 1 | N/A | N/A | Full | Partial | Partial | N/A | N/A | Full | Full | N/A | N/A | None | 3511.98 | Landscaped Med./Sidewalks in front of bus.only |
| | Columbia Memorial Pkwy to East City Limit | 7600 | 296 | 2 | 950 | 0.16 | 55 | 55 | N/A | N/A | 0 | 0 | N/A | N/A | 0 | 2 | N/A | N/A | Full | None | None | N/A | N/A | Full | Full | N/A | N/A | 1 | 8983.09 | Landscaped Median |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SH 3** | North City Limit to FM 518 | 23200 | 1158 | 2 | 950 | 0.61 | N/A | N/A | 40-50 | 40-50 | N/A | N/A | 26 | 11 | N/A | N/A | 7 | 2 | Full | N/A | N/A | Partial | Partial | N/A | N/A | Partial | Partial | None | 5713.37 | Asphalt Median/Sidewalk-ES in front of CVS only |
| | FM 518 to Walker St | 19200 | 1022 | 2 | 950 | 0.54 | N/A | N/A | 40 | 40 | N/A | N/A | 8 | 8 | N/A | N/A | 3 | 2 | Center Turn Lane | N/A | N/A | Full | Partial | N/A | N/A | None | None | None | 1362.51 | |
| | Walker St to League City Pkwy | 18100 | 968 | 2 | 950 | 0.51 | N/A | N/A | 50 | 50 | N/A | N/A | 30 | 12 | N/A | N/A | 1 | 3 | Center Turn Lane | N/A | N/A | Partial | None | N/A | N/A | Partial | Partial | 1 | 5704.94 | Sidewalks on ES in front of Dev.Property only |
| | League City Pkwy to FM 646 | 15800 | 750 | 2 | 950 | 0.39 | N/A | N/A | 50 | 50 | N/A | N/A | 19 | 17 | N/A | N/A | 4 | 4 | Center Turn Lane | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 5660.57 | |
| | FM 646 to South City Limit | 17800 | 940 | 2 | 950 | 0.49 | N/A | N/A | 40 | 50 | N/A | N/A | 1 | 3 | N/A | N/A | 0 | 1 | Center Turn Lane | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 707.22 | |
| **FM 646** | South City Limit (FM 646) to IH 45 | 16000 | 776 | 1 | 680 | 0.57 | 45-50 | 45 | N/A | N/A | 6 | 7 | N/A | N/A | 5 | 6 | N/A | N/A | None | Partial | Partial | N/A | N/A | Partial | Partial | N/A | N/A | 1 | 9695.21 | Future Landscaped Median |
| | IH 45 to Walker St | 19600 | 618 | 1 | 680 | 0.45 | 50 | 45 | N/A | N/A | 1 | 2 | N/A | N/A | 0 | 0 | N/A | N/A | Partial / Center Turn Lane | Partial | None | N/A | N/A | Partial | Full | N/A | N/A | None | 2138.53 | |
| | Walker St to SH 3 | 20600 | 851 | 1 | 680 | 0.62 | 50 | 45 | N/A | N/A | 16 | 9 | N/A | N/A | 1 | 4 | N/A | N/A | Center Turn Lane | Partial | Partial | N/A | N/A | Full | Full | N/A | N/A | None | 5309.5 | |
| | SH 3 to Dickinson Ave | 18500 | 632 | 1 | 680 | 0.46 | 50 | 50 | N/A | N/A | 5 | 4 | N/A | N/A | 1 | 1 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 1490.2 | |
| | Dickinson Ave to FM 270 | 16300 | 469 | 1 | 680 | 0.35 | 50 | 50 | N/A | N/A | 1 | 3 | N/A | N/A | 4 | 1 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 4442.08 | |
| | FM 270 to Tuscan Lakes Blvd | 15400 | 472 | 1 | 680 | 0.36 | 50 | 50 | N/A | N/A | 4 | 4 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 5354.16 | |
| | Tuscan Lakes Blvd to S. Shore Blvd | 13900 | 688 | 1 | 680 | 0.51 | 50 | 50 | N/A | N/A | 4 | 5 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 2423.61 | |
| | S. Shore Blvd to East City Limit | 17800 | 627 | 1 | 680 | 0.92 | 50 | 50 | N/A | N/A | 0 | 2 | N/A | N/A | 1 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 12530.23 | |
| **FM 517** | West City Limit to McFarland Rd | 6800 | 386 | 1 | 680 | 0.57 | 60 | N/A | N/A | N/A | 5 | N/A | N/A | N/A | 0 | N/A | N/A | N/A | None | None | N/A | N/A | N/A | Full | N/A | N/A | N/A | None | 7953.51 | |
| | McFarland Rd to Calder Rd | 7100 | 450 | 1 | 680 | 0.66 | 55-60 | 55-60 | N/A | N/A | 21 | 9 | N/A | N/A | 6 | 2 | N/A | N/A | Partial / Center Turn Lane | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 23252.63 | Small strip sidewalk on NS in front dev.prop.only |
| | Calder Rd to FM 646 | 2000 | 166 | 1 | 680 | 0.25 | 55-60 | 55-60 | N/A | N/A | 2 | 11 | N/A | N/A | 1 | 2 | N/A | N/A | Partial / Center Turn Lane | Partial | Partial | N/A | N/A | Full | Full | N/A | N/A | None | 3925.18 | Sidewalk on SS in front of Walgreens only |
| | FM 646 to East City Limit | 1900 | 102 | 1 | 680 | 0.15 | 50 | N/A | N/A | N/A | 6 | N/A | N/A | N/A | 2 | N/A | N/A | N/A | Center Turn Lane | Partial | N/A | N/A | N/A | None | N/A | N/A | N/A | None | 2815.1 | |
| **Maple Leaf** | FM 518 to League City Pkwy | 3800 | 94 | 1 | 550 | 0.17 | N/A | N/A | 35 | 35 | N/A | N/A | 1 | 0 | N/A | N/A | 2 | 1 | Partial | N/A | N/A | Partial | None | N/A | N/A | None | None | None | 4031.32 | Full Landscaped Median to Westwood |
| **Bay Area Boulevard** | North City Limit to Grissom Rd | 10900 | 636 | 2 | 680 | 0.47 | N/A | N/A | 40 | 40 | N/A | N/A | 0 | 0 | N/A | N/A | 0 | 0 | Full | N/A | N/A | Full | None | N/A | N/A | Full | Full | None | 604.23 | Landscaped Median |
| | Grissom Rd to FM 518 | 13400 | 759 | 2 | 680 | 0.56 | N/A | N/A | 35 | 35 | N/A | N/A | 7 | 2 | N/A | N/A | 3 | 3 | Full | N/A | N/A | Full | Full | N/A | N/A | Partial | Partial | None | 4844.66 | Landscaped Median |
| | FM 518 to League City Pkwy | 10500 | 545 | 2 | 550 | 0.49 | N/A | N/A | 30 | 30 | N/A | N/A | 18 | 25 | N/A | N/A | 8 | 6 | Full | N/A | N/A | Partial | Partial | N/A | N/A | None | None | None | 5205.71 | Landscaped Median |
| | League City Pkwy to Southern Extent | 1300 | 66 | 1 | 550 | 0.12 | N/A | N/A | 30 | 30 | N/A | N/A | 1 | 1 | N/A | N/A | 1 | 2 | Partial | N/A | N/A | Partial | Full | N/A | N/A | None | None | None | 3498.48 | Partial Median with Future Full Median |
| **Old NASA Rd** | FM 528 to (North City Limit) to Grissom | 2600 | 181 | 1 | 600 | 0.3 | N/A | N/A | 35 | 35 | N/A | N/A | 5 | 1 | N/A | N/A | 0 | 2 | Partial | N/A | N/A | Partial | None | N/A | N/A | None | None | None | 4383.89 | Mostly Landscaped Medians |
| **Hobbs Road** | FM 518 to League City Pkwy | 5000 | 236 | 1 | 550 | 0.43 | N/A | N/A | 35 | 35 | N/A | N/A | 26 | 7 | N/A | N/A | 6 | 3 | None | N/A | N/A | Partial | Partial | N/A | N/A | None | None | 1 | 5915.35 | Sidewalks to Savanna on WS/Partial to Aberdeen |
| **Walker Street** | Texas Ave to Dickinson Ave | 6200 | 305 | 1 | 550 | 0.56 | 25 | 25 | N/A | N/A | 17 | 30 | N/A | N/A | 5 | 10 | N/A | N/A | None | Full | Full | N/A | N/A | None | None | N/A | N/A | 2 | 4753.34 | |
| | Dickinson Ave to SH 3 | 5100 | 241 | 1 | 550 | 0.44 | 25 | 25 | N/A | N/A | 11 | 8 | N/A | N/A | 1 | 1 | N/A | N/A | None | Full | Full | N/A | N/A | None | None | N/A | N/A | None | 1479.33 | |
| | SH 3 to League City Pkwy | 4300 | 235 | 1 | 550 | 0.43 | N/A | N/A | 25-35 | 25-35 | N/A | N/A | 4 | 7 | N/A | N/A | 1 | 2 | None | N/A | N/A | Partial | None | N/A | N/A | None | None | None | 6193 | Sidewalks on ES up to 500 W. Walker |
| | League City Pkwy to FM 646 | 5800 | 381 | 2 | 550 | 0.35 | N/A | N/A | 35 | 35 | N/A | N/A | 3 | 8 | N/A | N/A | 4 | 1 | Full | N/A | N/A | Partial | Partial | N/A | N/A | None | None | 1 | 10219 | Landscaped Median/Sidewalks dev.prop.only |
| **Louisiana Street** | FM 518 to Webster St | 3500 | 174 | 1 | 550 | 0.32 | N/A | N/A | 30 | 30 | N/A | N/A | 10 | 3 | N/A | N/A | 2 | 6 | None | N/A | N/A | Partial | Partial | N/A | N/A | Partial | Partial | 1 | 4826.3 | |
| | Webster St to Austin St | 2600 | 248 | 1 | 550 | 0.45 | N/A | N/A | 30 | 30 | N/A | N/A | 4 | 5 | N/A | N/A | 0 | 0 | None | N/A | N/A | None | Full | N/A | N/A | Full | Full | 1 | 2170.63 | |
| | Austin St to Hewitt St | 2000 | 122 | 1 | 550 | 0.22 | N/A | N/A | 30 | 30 | N/A | N/A | 0 | 0 | N/A | N/A | 5 | 0 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 2010.48 | |
| | Hewitt St to League City Pkwy | 3400 | 204 | 1 | 550 | 0.37 | N/A | N/A | 30 | 30 | N/A | N/A | 2 | 3 | N/A | N/A | 0 | 0 | None | N/A | N/A | Full | Full | N/A | N/A | None | None | None | 1079.96 | |
| **Meadow Pkwy** | FM 518 to Austin St | 3800 | 317 | 1 | 550 | 0.58 | N/A | N/A | 30 | 30 | N/A | N/A | 2 | 3 | N/A | N/A | 4 | 0 | Partial | N/A | N/A | None | Full | N/A | N/A | None | None | None | 4638.69 | Bike Lane both sides |
| **Landing Blvd** | FM 518 to League City Pkwy | 1800 | 73 | 1 | 550 | 0.13 | N/A | N/A | 25 | 25 | N/A | N/A | 5 | 44 | N/A | N/A | 15 | 7 | Partial | N/A | N/A | Partial | Partial | N/A | N/A | None | None | None | 6274.6 | Full Landsc. Med to Jeb Stuart/Mostly Full ES Sidewalks |
| | League City Pkwy to Southern Extent | 1400 | 66 | 1 | 550 | 0.12 | N/A | N/A | 35 | 35 | N/A | N/A | 0 | 0 | N/A | N/A | 7 | 5 | None | N/A | N/A | Full | Partial | N/A | N/A | None | None | None | 5853.38 | Sidewalks on WS ony at Goldeneye and Kildeer |
| **Calder Rd** | FM 518 to League City Pkwy | 4800 | 353 | 1 | 600 | 0.59 | N/A | N/A | 30 | 30 | N/A | N/A | 14 | 5 | N/A | N/A | 3 | 5 | Center Turn Lane | N/A | N/A | Partial | None | N/A | N/A | Partial | Partial | None | 7368.4 | |
| | League City Pkwy to FM 517 | 8400 | 627 | 1 | 680 | 0.92 | N/A | N/A | 30 | 30 | N/A | N/A | 22 | 43 | N/A | N/A | 8 | 11 | Partial | N/A | N/A | Partial | Partial | N/A | N/A | Partial | Partial | 1 | 17962.55 | Partial Landscaped Median/Partial Sidewalks |
| **Dickinson Avenue** | Walker St to Hewitt St | 2800 | 132 | 1 | 600 | 0.22 | N/A | N/A | 30 | 30 | N/A | N/A | 13 | 0 | N/A | N/A | 2 | 0 | None | N/A | N/A | None | None | N/A | N/A | Partial | Full | None | 3310.46 | |
| | Hewitt St to FM 646 | 1900 | 93 | 1 | 600 | 0.16 | N/A | N/A | 30 | 30 | N/A | N/A | 20 | 0 | N/A | N/A | 3 | 1 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 8073.68 | |
| **Kansas Avenue** | Northern Extent (Clear Creek) to FM | 2200 | 108 | 1 | 550 | 0.2 | N/A | N/A | 25 | 25 | N/A | N/A | 13 | 10 | N/A | N/A | 5 | 7 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 3393.9 | |
| | FM 518 to Walker St | 1100 | 75 | 1 | 550 | 0.14 | N/A | N/A | 25 | 25 | N/A | N/A | 15 | 6 | N/A | N/A | 2 | 2 | None | N/A | N/A | Partial | None | N/A | N/A | None | Full | 1 | 1384.12 | |
| | Walker St to Beaumont St | 3200 | 163 | 1 | 550 | 0.3 | N/A | N/A | 25 | 25 | N/A | N/A | 10 | 7 | N/A | N/A | 1 | 0 | None | N/A | N/A | None | None | N/A | N/A | None | Full | 1 | 1297.73 | |
| **Coryell Street** | Wisconsin Ave to FM 270 | 2200 | 107 | 1 | 550 | 0.2 | 25 | 25 | N/A | N/A | 12 | 21 | N/A | N/A | 5 | 4 | N/A | N/A | None | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 3297.34 | Only on site of JSC Bank |
| **Alabama** | 7th St to FM 518 | 3500 | 203 | 1 | 550 | 0.37 | N/A | N/A | 25 | 25 | N/A | N/A | 10 | 20 | N/A | N/A | 2 | 4 | None | N/A | N/A | Partial | Partial | N/A | N/A | Partial | Full | None | 1345.36 | Sidwalks at Gas station on FM 518 and 2 blocks north of Coryell |
| **Beaumont Street** | Dickinson Ave to Kansas St | 1500 | 75 | 1 | 550 | 0.14 | 25 | 25 | N/A | N/A | 1 | 5 | N/A | N/A | 1 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 1097.6 | |
| | Kansas St to Webster St | 2100 | 112 | 1 | 550 | 0.2 | 25 | 25 | N/A | N/A | 12 | 16 | N/A | N/A | 7 | 5 | N/A | N/A | None | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 2714.08 | Sidewalks in 1900 blk |
| **Webster Street** | Texas Ave to FM 270 | 2900 | 146 | 1 | 550 | 0.27 | 25 | 25 | N/A | N/A | 5 | 9 | N/A | N/A | 0 | 0 | N/A | N/A | None | Partial | None | N/A | N/A | Full | Full | N/A | N/A | None | 1835.55 | |
| | FM 270 to Louisiana | 1500 | 233 | 1 | 550 | 0.42 | 25 | 25 | N/A | N/A | 13 | 5 | N/A | N/A | 1 | 0 | N/A | N/A | Center Turn Lane | None | Partial | N/A | N/A | Full | Full | N/A | N/A | 1 | 3002.92 | |
| **Austin Street** | Texas Ave to FM 270 | 1300 | 77 | 1 | 550 | 0.14 | 25 | 25 | N/A | N/A | 11 | 9 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 2498.28 | |
| | FM 270 to Louisiana | 6100 | 447 | 1 | 550 | 0.81 | 25 | 25 | N/A | N/A | 7 | 9 | N/A | N/A | 2 | 0 | N/A | N/A | None | None | None | N/A | N/A | None | None | N/A | N/A | None | 2541.13 | |
| | Louisiana to Meadow Pkwy | 3300 | 272 | 1 | 550 | 0.5 | 35 | 35 | N/A | N/A | 0 | 0 | N/A | N/A | 2 | 4 | N/A | N/A | None | None | Full | N/A | N/A | None | None | N/A | N/A | None | 4263.66 | |
| | Meadow Pkwy to S. Shore Blvd | 1500 | 69 | 1 | 550 | 0.12 | 35 | 35 | N/A | N/A | 1 | 0 | N/A | N/A | 2 | 1 | N/A | N/A | None | Partial | Full | N/A | N/A | None | None | N/A | N/A | None | 2867.53 | |
| **Hewitt Street** | Dickinson Ave. to Texas Ave. | 1200 | 54 | 1 | 550 | 0.1 | 30 | 30 | N/A | N/A | 7 | 3 | N/A | N/A | 0 | 1 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 2517.43 | |
| | Texas Ave. to FM270 | 780 | 26 | 1 | 550 | 0.05 | 30 | 30 | N/A | N/A | 10 | 0 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | None | N/A | N/A | Full | Full | N/A | N/A | None | 5535.61 | |
| | FM 270 to Louisiana | 1400 | 83 | 1 | 550 | 0.15 | 30 | 30 | N/A | N/A | 0 | 8 | N/A | N/A | 0 | 0 | N/A | N/A | None | None | Full | N/A | N/A | Full | Full | N/A | N/A | None | 2194.39 | Gravel Road |
| **Texas Avenue** | FM 518 to Walker St | 3200 | 158 | 1 | 550 | 0.29 | N/A | N/A | 25 | 25 | N/A | N/A | 12 | 5 | N/A | N/A | 2 | 1 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | 1 | 1614.61 | |
| | Walker St to Webster St | 5200 | 252 | 1 | 550 | 0.46 | N/A | N/A | 25 | 25 | N/A | N/A | 2 | 6 | N/A | N/A | 2 | 3 | None | N/A | N/A | Partial | None | N/A | N/A | Full | Full | 1 | 1651.43 | |
| | Webster St to Austin St | 1630 | 96 | 1 | 550 | 0.17 | N/A | N/A | 25 | 25 | N/A | N/A | 6 | 12 | N/A | N/A | 3 | 1 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 2146.08 | |
| | Austin St to Hewitt St | 1100 | 40 | 1 | 550 | 0.07 | N/A | N/A | 25 | 25 | N/A | N/A | 6 | 7 | N/A | N/A | 0 | 0 | None | N/A | N/A | None | None | N/A | N/A | Full | Full | None | 1971.15 | |
| **Davis Road** | Northern Extent to FM 2094 | 3800 | 189 | 1 | 550 | 0.35 | N/A | N/A | 30 | 30 | N/A | N/A | 20 | 41 | N/A | N/A | 2 | 0 | None | N/A | N/A | Partial | Partial | N/A | N/A | Partial | None | None | 5650.79 | Sidewalks first block north of FM 2094 |
| **Grissom Rd** | Old NASA Rd to Bay Area Blvd | 2600 | 180 | 1 | 600 | 0.3 | 25-30 | 25-30 | N/A | N/A | 0 | 9 | N/A | N/A | 2 | 4 | N/A | N/A | Partial | Partial | Partial | N/A | N/A | Partial | Partial | N/A | N/A | None | 7711.1 | Median only at entrance of Autumn Lakes |

# *Appendix B – SYNCHRO REPORTS*

# HCM Signalized Intersection Capacity Analysis
## 1: FM 518 & Lafayette Ln

10/26/2010

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 2 | 1434 | 38 | 81 | 879 | 8 | 117 | 2 | 422 | 89 | 5 | 8 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | 5.5 | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Frt | 1.00 | 1.00 | | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.95 | 1.00 | | 0.95 | 1.00 |
| Satd. Flow (prot) | 1770 | 3526 | | 1770 | 3534 | | | 1775 | 1583 | | 1778 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.32 | 1.00 | | 0.65 | 1.00 |
| Satd. Flow (perm) | 1770 | 3526 | | 1770 | 3534 | | | 591 | 1583 | | 1203 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 2 | 1559 | 41 | 88 | 955 | 9 | 127 | 2 | 459 | 97 | 5 | 9 |
| RTOR Reduction (vph) | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 155 | 0 | 0 | 8 |
| Lane Group Flow (vph) | 2 | 1598 | 0 | 88 | 964 | 0 | 0 | 129 | 304 | 0 | 102 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | 3 | 4 | | 4 |
| Actuated Green, G (s) | 1.0 | 49.6 | | 6.4 | 55.0 | | | 12.5 | 12.5 | | 8.5 | 8.5 |
| Effective Green, g (s) | 1.0 | 49.6 | | 6.4 | 55.0 | | | 12.5 | 12.5 | | 8.5 | 8.5 |
| Actuated g/C Ratio | 0.01 | 0.50 | | 0.06 | 0.55 | | | 0.12 | 0.12 | | 0.08 | 0.08 |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | 5.5 | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | 2.0 | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 18 | 1749 | | 113 | 1944 | | | 74 | 198 | | 102 | 135 |
| v/s Ratio Prot | 0.00 | c0.45 | | c0.05 | c0.27 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.22 | 0.19 | | c0.08 | 0.00 |
| v/c Ratio | 0.11 | 0.91 | | 0.78 | 0.50 | | | 1.74 | 1.54 | | 1.00 | 0.01 |
| Uniform Delay, d1 | 49.1 | 23.2 | | 46.1 | 13.9 | | | 43.8 | 43.8 | | 45.7 | 41.9 |
| Progression Factor | 1.00 | 1.00 | | 0.76 | 2.24 | | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Incremental Delay, d2 | 1.0 | 8.9 | | 20.9 | 0.7 | | | 384.1 | 264.9 | | 89.1 | 0.0 |
| Delay (s) | 50.1 | 32.1 | | 56.0 | 31.9 | | | 427.9 | 308.7 | | 134.9 | 41.9 |
| Level of Service | D | C | | E | C | | | F | F | | F | D |
| Approach Delay (s) | | 32.1 | | | 33.9 | | | 334.8 | | | 127.3 | |
| Approach LOS | | C | | | C | | | F | | | F | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 88.9 | HCM Level of Service | F |
| HCM Volume to Capacity ratio | 1.13 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 29.0 |
| Intersection Capacity Utilization | 86.3% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 1266 | 360 | 151 | 627 | 0 | 0 | 0 | 0 | 315 | 104 | 231 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | 6.0 | 6.0 | | | | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | | 0.91 | 1.00 | 0.91 | 0.91 | | | | | 0.91 | 0.86 | 0.95 |
| Frt | | 1.00 | 0.85 | 1.00 | 1.00 | | | | | 1.00 | 0.96 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | 0.95 | 1.00 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (prot) | | 5085 | 1583 | 1610 | 3386 | | | | | 3221 | 1518 | 1504 |
| Flt Permitted | | 1.00 | 1.00 | 0.95 | 0.46 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (perm) | | 5085 | 1583 | 1610 | 1543 | | | | | 3221 | 1518 | 1504 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 1376 | 391 | 164 | 682 | 0 | 0 | 0 | 0 | 342 | 113 | 251 |
| RTOR Reduction (vph) | 0 | 0 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 161 |
| Lane Group Flow (vph) | 0 | 1376 | 158 | 148 | 698 | 0 | 0 | 0 | 0 | 308 | 195 | 27 |
| Turn Type | | | Perm | Prot | | | | | | Split | | Prot |
| Protected Phases | | 6 | | 5 | 2 5 | | | | | 8 | 8 | 8 |
| Permitted Phases | | | 6 | | | | | | | | | |
| Actuated Green, G (s) | | 40.5 | 40.5 | 27.0 | 27.0 | | | | | 14.5 | 14.5 | 14.5 |
| Effective Green, g (s) | | 40.5 | 40.5 | 27.0 | 27.0 | | | | | 14.5 | 14.5 | 14.5 |
| Actuated g/C Ratio | | 0.40 | 0.40 | 0.27 | 0.27 | | | | | 0.14 | 0.14 | 0.14 |
| Clearance Time (s) | | 6.0 | 6.0 | 6.0 | | | | | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | | 1.0 | 1.0 | 1.0 | | | | | | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | | 2059 | 641 | 435 | 914 | | | | | 467 | 220 | 218 |
| v/s Ratio Prot | | c0.27 | | 0.09 | c0.21 | | | | | 0.10 | c0.13 | 0.02 |
| v/s Ratio Perm | | | 0.10 | | | | | | | | | |
| v/c Ratio | | 0.67 | 0.25 | 0.34 | 0.76 | | | | | 0.66 | 0.88 | 0.13 |
| Uniform Delay, d1 | | 24.3 | 19.7 | 29.3 | 33.6 | | | | | 40.4 | 41.9 | 37.2 |
| Progression Factor | | 1.29 | 4.25 | 0.29 | 0.41 | | | | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | | 0.4 | 0.2 | 0.0 | 0.3 | | | | | 2.6 | 30.8 | 0.1 |
| Delay (s) | | 31.8 | 83.8 | 8.4 | 13.9 | | | | | 43.0 | 72.8 | 37.3 |
| Level of Service | | C | F | A | B | | | | | D | E | D |
| Approach Delay (s) | | 43.3 | | | 13.0 | | | 0.0 | | | 50.3 | |
| Approach LOS | | D | | | B | | | A | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 37.1 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.74 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 85.1% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↑ | | | ↑↑↑ | ↱ | | ↰↑ | ↱ | | | |
| Volume (vph) | 596 | 985 | 0 | 0 | 447 | 460 | 331 | 84 | 96 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Lane Util. Factor | 1.00 | 0.95 | | | 0.91 | 1.00 | | 0.95 | 1.00 | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (prot) | 1770 | 3539 | | | 5085 | 1583 | | 3403 | 1583 | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (perm) | 1770 | 3539 | | | 5085 | 1583 | | 3403 | 1583 | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 648 | 1071 | 0 | 0 | 486 | 500 | 360 | 91 | 104 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 229 | 0 | 0 | 97 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 648 | 1071 | 0 | 0 | 486 | 271 | 0 | 451 | 7 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Split | | Prot | | | |
| Protected Phases | 1 | 1 6 | | | 2 | | 4 | 4 | 4 | | | |
| Permitted Phases | | | | | | 2 | | | | | | |
| Actuated Green, G (s) | 61.0 | 61.0 | | | 14.0 | 14.0 | | 7.0 | 7.0 | | | |
| Effective Green, g (s) | 61.0 | 61.0 | | | 14.0 | 14.0 | | 7.0 | 7.0 | | | |
| Actuated g/C Ratio | 0.61 | 0.61 | | | 0.14 | 0.14 | | 0.07 | 0.07 | | | |
| Clearance Time (s) | 6.0 | | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Vehicle Extension (s) | 1.0 | | | | 1.0 | 1.0 | | 1.0 | 1.0 | | | |
| Lane Grp Cap (vph) | 1080 | 2159 | | | 712 | 222 | | 238 | 111 | | | |
| v/s Ratio Prot | c0.37 | 0.30 | | | 0.10 | | | c0.13 | 0.00 | | | |
| v/s Ratio Perm | | | | | | c0.17 | | | | | | |
| v/c Ratio | 0.60 | 0.50 | | | 0.68 | 1.22 | | 2.90dl | 0.07 | | | |
| Uniform Delay, d1 | 12.0 | 10.9 | | | 40.9 | 43.0 | | 46.5 | 43.4 | | | |
| Progression Factor | 0.31 | 0.25 | | | 1.00 | 1.00 | | 1.00 | 1.00 | | | |
| Incremental Delay, d2 | 1.8 | 0.6 | | | 2.2 | 133.3 | | 418.2 | 0.1 | | | |
| Delay (s) | 5.6 | 3.3 | | | 43.1 | 176.3 | | 464.7 | 43.5 | | | |
| Level of Service | A | A | | | D | F | | F | D | | | |
| Approach Delay (s) | | 4.2 | | | 110.6 | | | 385.7 | | | 0.0 | |
| Approach LOS | | A | | | F | | | F | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 101.3 | HCM Level of Service | F |
| HCM Volume to Capacity ratio | 0.82 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 85.1% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 40 | 962 | 40 | 41 | 876 | 26 | 31 | 18 | 59 | 24 | 5 | 50 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 0.93 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.99 | | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 3518 | | 1770 | 3524 | | | 1702 | | 1770 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.90 | | 0.48 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 3518 | | 1770 | 3524 | | | 1555 | | 898 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 43 | 1046 | 43 | 45 | 952 | 28 | 34 | 20 | 64 | 26 | 5 | 54 |
| RTOR Reduction (vph) | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 29 | 0 | 0 | 0 | 49 |
| Lane Group Flow (vph) | 43 | 1087 | 0 | 45 | 979 | 0 | 0 | 89 | 0 | 26 | 5 | 5 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 4 | | | 3 | |
| Permitted Phases | | | | | | | 4 | | | 3 | | 3 |
| Actuated Green, G (s) | 4.2 | 36.7 | | 4.3 | 36.8 | | | 10.4 | | 8.3 | 8.3 | 8.3 |
| Effective Green, g (s) | 4.2 | 36.7 | | 4.3 | 36.8 | | | 10.4 | | 8.3 | 8.3 | 8.3 |
| Actuated g/C Ratio | 0.05 | 0.43 | | 0.05 | 0.43 | | | 0.12 | | 0.10 | 0.10 | 0.10 |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | 2.0 | 1.5 | | 2.0 | 1.5 | | | 2.0 | | 2.0 | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 88 | 1524 | | 90 | 1531 | | | 191 | | 88 | 183 | 155 |
| v/s Ratio Prot | 0.02 | c0.31 | | c0.03 | 0.28 | | | | | | 0.00 | |
| v/s Ratio Perm | | | | | | | | c0.06 | | c0.03 | | 0.00 |
| v/c Ratio | 0.49 | 0.71 | | 0.50 | 0.64 | | | 0.47 | | 0.30 | 0.03 | 0.03 |
| Uniform Delay, d1 | 39.2 | 19.7 | | 39.2 | 18.8 | | | 34.6 | | 35.5 | 34.5 | 34.6 |
| Progression Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 1.6 | 1.3 | | 1.6 | 0.7 | | | 0.7 | | 0.7 | 0.0 | 0.0 |
| Delay (s) | 40.8 | 21.0 | | 40.7 | 19.4 | | | 35.2 | | 36.2 | 34.6 | 34.6 |
| Level of Service | D | C | | D | B | | | D | | D | C | C |
| Approach Delay (s) | | 21.8 | | | 20.3 | | | 35.2 | | | 35.1 | |
| Approach LOS | | C | | | C | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 22.3 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.60 | | |
| Actuated Cycle Length (s) | 84.7 | Sum of lost time (s) | 25.0 |
| Intersection Capacity Utilization | 57.4% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 14 | 774 | 41 | 24 | 796 | 10 | 65 | 10 | 94 | 3 | 3 | 14 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | 1.00 | 0.86 | | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.98 | 1.00 |
| Satd. Flow (prot) | 1770 | 3512 | | 1770 | 3533 | | 1770 | 1611 | | | 1817 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.75 | 1.00 | | | 0.84 | 1.00 |
| Satd. Flow (perm) | 1770 | 3512 | | 1770 | 3533 | | 1404 | 1611 | | | 1561 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 15 | 841 | 45 | 26 | 865 | 11 | 71 | 11 | 102 | 3 | 3 | 15 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 92 | 0 | 0 | 0 | 14 |
| Lane Group Flow (vph) | 15 | 883 | 0 | 26 | 875 | 0 | 71 | 21 | 0 | 0 | 6 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 8 | | | 4 | |
| Permitted Phases | | | | | | | 8 | | | 4 | | 4 |
| Actuated Green, G (s) | 2.6 | 71.1 | | 3.0 | 71.5 | | 9.4 | 9.4 | | | 9.4 | 9.4 |
| Effective Green, g (s) | 2.6 | 71.1 | | 3.0 | 71.5 | | 9.4 | 9.4 | | | 9.4 | 9.4 |
| Actuated g/C Ratio | 0.03 | 0.71 | | 0.03 | 0.72 | | 0.09 | 0.09 | | | 0.09 | 0.09 |
| Clearance Time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 46 | 2497 | | 53 | 2526 | | 132 | 151 | | | 147 | 149 |
| v/s Ratio Prot | 0.01 | c0.25 | | c0.01 | 0.25 | | | 0.01 | | | | |
| v/s Ratio Perm | | | | | | | c0.05 | | | | 0.00 | 0.00 |
| v/c Ratio | 0.33 | 0.35 | | 0.49 | 0.35 | | 0.54 | 0.14 | | | 0.04 | 0.01 |
| Uniform Delay, d1 | 47.8 | 5.6 | | 47.7 | 5.4 | | 43.2 | 41.6 | | | 41.2 | 41.1 |
| Progression Factor | 1.00 | 1.00 | | 0.86 | 0.92 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Incremental Delay, d2 | 1.5 | 0.4 | | 2.4 | 0.4 | | 2.1 | 0.2 | | | 0.0 | 0.0 |
| Delay (s) | 49.3 | 6.0 | | 43.5 | 5.3 | | 45.3 | 41.7 | | | 41.2 | 41.1 |
| Level of Service | D | A | | D | A | | D | D | | | D | D |
| Approach Delay (s) | | 6.7 | | | 6.4 | | | 43.1 | | | 41.1 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 10.3 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.38 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 16.5 |
| Intersection Capacity Utilization | 46.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 1 | 886 | 69 | 6 | 929 | 6 | 45 | 0 | 13 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | | | |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 0.97 | | | | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | | | | |
| Satd. Flow (prot) | 1770 | 3501 | | 1770 | 3536 | | | 1739 | | | | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.95 | | | | |
| Satd. Flow (perm) | 1770 | 3501 | | 1770 | 3536 | | | 1717 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 1 | 963 | 75 | 7 | 1010 | 7 | 49 | 0 | 14 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 1 | 1035 | 0 | 7 | 1017 | 0 | 0 | 53 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | | 4 | | |
| Actuated Green, G (s) | 1.0 | 67.6 | | 1.2 | 67.8 | | | 13.7 | | | | |
| Effective Green, g (s) | 1.0 | 67.6 | | 1.2 | 67.8 | | | 13.7 | | | | |
| Actuated g/C Ratio | 0.01 | 0.68 | | 0.01 | 0.68 | | | 0.14 | | | | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | | | | |
| Lane Grp Cap (vph) | 18 | 2367 | | 21 | 2397 | | | 235 | | | | |
| v/s Ratio Prot | 0.00 | c0.30 | | c0.00 | 0.29 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.03 | | | | |
| v/c Ratio | 0.06 | 0.44 | | 0.33 | 0.42 | | | 0.22 | | | | |
| Uniform Delay, d1 | 49.0 | 7.5 | | 49.0 | 7.3 | | | 38.4 | | | | |
| Progression Factor | 0.85 | 0.89 | | 1.00 | 1.00 | | | 1.00 | | | | |
| Incremental Delay, d2 | 0.5 | 0.6 | | 3.4 | 0.6 | | | 0.2 | | | | |
| Delay (s) | 42.3 | 7.2 | | 52.4 | 7.8 | | | 38.6 | | | | |
| Level of Service | D | A | | D | A | | | D | | | | |
| Approach Delay (s) | | 7.2 | | | 8.1 | | | 38.6 | | | 0.0 | |
| Approach LOS | | A | | | A | | | D | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 8.6 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.40 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 17.5 |
| Intersection Capacity Utilization | 40.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 154 | 589 | 102 | 94 | 701 | 119 | 109 | 200 | 68 | 175 | 543 | 126 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.91 | |
| Frt | 1.00 | 0.98 | | 1.00 | 0.98 | | 1.00 | 1.00 | 0.85 | 1.00 | 0.97 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 3461 | | 1770 | 3462 | | 1770 | 3539 | 1583 | 1770 | 4942 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 3461 | | 1770 | 3462 | | 1770 | 3539 | 1583 | 1770 | 4942 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 167 | 640 | 111 | 102 | 762 | 129 | 118 | 217 | 74 | 190 | 590 | 137 |
| RTOR Reduction (vph) | 0 | 11 | 0 | 0 | 10 | 0 | 0 | 0 | 62 | 0 | 35 | 0 |
| Lane Group Flow (vph) | 167 | 740 | 0 | 102 | 881 | 0 | 118 | 217 | 12 | 190 | 692 | 0 |
| Turn Type | Prot | | | Prot | | | Prot | | Perm | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 7 | 4 | | 3 | 8 | |
| Permitted Phases | | | | | | | | | 4 | | | |
| Actuated Green, G (s) | 15.3 | 49.6 | | 11.1 | 45.4 | | 9.0 | 18.5 | 18.5 | 13.8 | 23.3 | |
| Effective Green, g (s) | 15.3 | 49.6 | | 11.1 | 45.4 | | 9.0 | 18.5 | 18.5 | 13.8 | 23.3 | |
| Actuated g/C Ratio | 0.13 | 0.42 | | 0.09 | 0.38 | | 0.08 | 0.16 | 0.16 | 0.12 | 0.20 | |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Vehicle Extension (s) | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 3.5 | 3.5 | 2.0 | 3.5 | |
| Lane Grp Cap (vph) | 230 | 1455 | | 167 | 1332 | | 135 | 555 | 248 | 207 | 976 | |
| v/s Ratio Prot | c0.09 | c0.21 | | 0.06 | c0.25 | | 0.07 | 0.06 | | c0.11 | c0.14 | |
| v/s Ratio Perm | | | | | | | | | 0.01 | | | |
| v/c Ratio | 0.73 | 0.51 | | 0.61 | 0.66 | | 0.87 | 0.39 | 0.05 | 0.92 | 0.71 | |
| Uniform Delay, d1 | 49.3 | 25.2 | | 51.4 | 30.0 | | 53.9 | 44.7 | 42.3 | 51.5 | 44.2 | |
| Progression Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Incremental Delay, d2 | 9.3 | 1.3 | | 4.6 | 2.6 | | 41.1 | 0.5 | 0.1 | 39.4 | 2.5 | |
| Delay (s) | 58.6 | 26.5 | | 56.0 | 32.5 | | 95.0 | 45.2 | 42.4 | 91.0 | 46.6 | |
| Level of Service | E | C | | E | C | | F | D | D | F | D | |
| Approach Delay (s) | | 32.3 | | | 34.9 | | | 59.1 | | | 55.8 | |
| Approach LOS | | C | | | C | | | E | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 43.2 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.81 | | |
| Actuated Cycle Length (s) | 118.0 | Sum of lost time (s) | 31.5 |
| Intersection Capacity Utilization | 71.9% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 22 | 884 | 1 | 3 | 800 | 76 | 65 | 17 | 42 | 1 | 14 | 10 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Lane Util. Factor | | 0.95 | | | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | | 1.00 | | | 0.99 | | | 0.95 | | | 0.94 | |
| Flt Protected | | 1.00 | | | 1.00 | | | 0.97 | | | 1.00 | |
| Satd. Flow (prot) | | 3534 | | | 3493 | | | 1732 | | | 1757 | |
| Flt Permitted | | 0.91 | | | 0.95 | | | 0.82 | | | 0.99 | |
| Satd. Flow (perm) | | 3237 | | | 3329 | | | 1458 | | | 1744 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 24 | 961 | 1 | 3 | 870 | 83 | 71 | 18 | 46 | 1 | 15 | 11 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 20 | 0 | 0 | 10 | 0 |
| Lane Group Flow (vph) | 0 | 986 | 0 | 0 | 951 | 0 | 0 | 115 | 0 | 0 | 17 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 6 | | | 2 | | | 8 | | | 4 | |
| Permitted Phases | 6 | | | 2 | | | 8 | | | 4 | | |
| Actuated Green, G (s) | | 77.0 | | | 77.0 | | | 12.5 | | | 12.5 | |
| Effective Green, g (s) | | 77.0 | | | 77.0 | | | 12.5 | | | 12.5 | |
| Actuated g/C Ratio | | 0.77 | | | 0.77 | | | 0.12 | | | 0.12 | |
| Clearance Time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | | 2492 | | | 2563 | | | 182 | | | 218 | |
| v/s Ratio Prot | | | | | | | | | | | | |
| v/s Ratio Perm | | c0.30 | | | 0.29 | | | c0.08 | | | 0.01 | |
| v/c Ratio | | 0.40 | | | 0.37 | | | 0.63 | | | 0.08 | |
| Uniform Delay, d1 | | 3.8 | | | 3.7 | | | 41.6 | | | 38.7 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.5 | | | 0.4 | | | 5.2 | | | 0.1 | |
| Delay (s) | | 4.3 | | | 4.1 | | | 46.7 | | | 38.7 | |
| Level of Service | | A | | | A | | | D | | | D | |
| Approach Delay (s) | | 4.3 | | | 4.1 | | | 46.7 | | | 38.7 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 7.4 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.43 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 10.5 |
| Intersection Capacity Utilization | 62.7% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 6 | 897 | 57 | 81 | 879 | 8 | 90 | 11 | 207 | 73 | 11 | 11 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | 5.5 | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | 1.00 | | 0.96 | 1.00 |
| Satd. Flow (prot) | 1770 | 3507 | | 1770 | 3534 | | | 1783 | 1583 | | 1785 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.40 | 1.00 | | 0.68 | 1.00 |
| Satd. Flow (perm) | 1770 | 3507 | | 1770 | 3534 | | | 742 | 1583 | | 1264 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 7 | 975 | 62 | 88 | 955 | 9 | 98 | 12 | 225 | 79 | 12 | 12 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 207 | 0 | 0 | 11 |
| Lane Group Flow (vph) | 7 | 1034 | 0 | 88 | 964 | 0 | 0 | 110 | 18 | 0 | 91 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | 3 | 4 | | 4 |
| Actuated Green, G (s) | 1.2 | 67.6 | | 10.4 | 76.8 | | | 9.5 | 9.5 | | 9.5 | 9.5 |
| Effective Green, g (s) | 1.2 | 67.6 | | 10.4 | 76.8 | | | 9.5 | 9.5 | | 9.5 | 9.5 |
| Actuated g/C Ratio | 0.01 | 0.56 | | 0.09 | 0.64 | | | 0.08 | 0.08 | | 0.08 | 0.08 |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | 5.5 | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | 2.0 | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 18 | 1976 | | 153 | 2262 | | | 59 | 125 | | 100 | 125 |
| v/s Ratio Prot | 0.00 | c0.29 | | c0.05 | 0.27 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.15 | 0.01 | | c0.07 | 0.00 |
| v/c Ratio | 0.39 | 0.52 | | 0.58 | 0.43 | | | 1.86 | 0.14 | | 0.91 | 0.01 |
| Uniform Delay, d1 | 59.0 | 16.2 | | 52.7 | 10.7 | | | 55.2 | 51.5 | | 54.8 | 50.9 |
| Progression Factor | 1.00 | 1.00 | | 1.09 | 0.57 | | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Incremental Delay, d2 | 5.0 | 1.0 | | 0.3 | 0.1 | | | 446.3 | 0.2 | | 60.9 | 0.0 |
| Delay (s) | 64.0 | 17.2 | | 57.6 | 6.2 | | | 501.6 | 51.6 | | 115.7 | 50.9 |
| Level of Service | E | B | | E | A | | | F | D | | F | D |
| Approach Delay (s) | | 17.5 | | | 10.5 | | | 199.4 | | | 108.2 | |
| Approach LOS | | B | | | B | | | F | | | F | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 42.3 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.70 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 23.0 |
| Intersection Capacity Utilization | 58.2% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 694 | 274 | 235 | 1288 | 0 | 0 | 0 | 0 | 402 | 94 | 644 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | 6.0 | 6.0 | | | | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | | 0.91 | 1.00 | 0.91 | 0.91 | | | | | 0.91 | 0.86 | 0.95 |
| Frt | | 1.00 | 0.85 | 1.00 | 1.00 | | | | | 1.00 | 0.90 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | 0.95 | 1.00 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (prot) | | 5085 | 1583 | 1610 | 3387 | | | | | 3221 | 1435 | 1504 |
| Flt Permitted | | 1.00 | 1.00 | 0.95 | 0.46 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (perm) | | 5085 | 1583 | 1610 | 1543 | | | | | 3221 | 1435 | 1504 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 754 | 298 | 255 | 1400 | 0 | 0 | 0 | 0 | 437 | 102 | 700 |
| RTOR Reduction (vph) | 0 | 0 | 228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 317 |
| Lane Group Flow (vph) | 0 | 754 | 70 | 229 | 1426 | 0 | 0 | 0 | 0 | 393 | 374 | 96 |
| Turn Type | | | Perm | Prot | | | | | | Split | | Prot |
| Protected Phases | | 6 | | 5 | 2 5 | | | | | 8 | 8 | 8 |
| Permitted Phases | | | 6 | | | | | | | | | |
| Actuated Green, G (s) | | 28.0 | 28.0 | 46.0 | 46.0 | | | | | 28.0 | 28.0 | 28.0 |
| Effective Green, g (s) | | 28.0 | 28.0 | 46.0 | 46.0 | | | | | 28.0 | 28.0 | 28.0 |
| Actuated g/C Ratio | | 0.23 | 0.23 | 0.38 | 0.38 | | | | | 0.23 | 0.23 | 0.23 |
| Clearance Time (s) | | 6.0 | 6.0 | 6.0 | | | | | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | | 1.0 | 1.0 | 1.0 | | | | | | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | | 1187 | 369 | 617 | 1298 | | | | | 752 | 335 | 351 |
| v/s Ratio Prot | | c0.15 | | 0.14 | c0.42 | | | | | 0.12 | c0.26 | 0.06 |
| v/s Ratio Perm | | | 0.04 | | | | | | | | | |
| v/c Ratio | | 0.64 | 0.19 | 0.37 | 1.10 | | | | | 0.52 | 1.12 | 0.27 |
| Uniform Delay, d1 | | 41.4 | 36.9 | 26.6 | 37.0 | | | | | 40.2 | 46.0 | 37.7 |
| Progression Factor | | 0.76 | 2.08 | 0.17 | 0.29 | | | | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | | 2.1 | 0.9 | 0.2 | 45.7 | | | | | 2.6 | 84.3 | 1.9 |
| Delay (s) | | 33.7 | 77.6 | 4.6 | 56.6 | | | | | 42.8 | 130.3 | 39.6 |
| Level of Service | | C | E | A | E | | | | | D | F | D |
| Approach Delay (s) | | 46.1 | | | 49.4 | | | 0.0 | | | 72.3 | |
| Approach LOS | | D | | | D | | | A | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 55.7 | HCM Level of Service | E |
| HCM Volume to Capacity ratio | 0.98 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 105.6% | ICU Level of Service | G |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 402 | 694 | 0 | 0 | 829 | 415 | 694 | 199 | 102 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Lane Util. Factor | 1.00 | 0.95 | | | 0.91 | 1.00 | | 0.95 | 1.00 | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (prot) | 1770 | 3539 | | | 5085 | 1583 | | 3407 | 1583 | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (perm) | 1770 | 3539 | | | 5085 | 1583 | | 3407 | 1583 | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 437 | 754 | 0 | 0 | 901 | 451 | 754 | 216 | 111 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 244 | 0 | 0 | 72 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 437 | 754 | 0 | 0 | 901 | 207 | 0 | 970 | 39 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Split | | Prot | | | |
| Protected Phases | 1 | 1 6 | | | 2 | | 4 | 4 | 4 | | | |
| Permitted Phases | | | | | | 2 | | | | | | |
| Actuated Green, G (s) | 62.0 | 62.0 | | | 26.0 | 26.0 | | 14.0 | 14.0 | | | |
| Effective Green, g (s) | 62.0 | 62.0 | | | 26.0 | 26.0 | | 14.0 | 14.0 | | | |
| Actuated g/C Ratio | 0.52 | 0.52 | | | 0.22 | 0.22 | | 0.12 | 0.12 | | | |
| Clearance Time (s) | 6.0 | | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Vehicle Extension (s) | 1.0 | | | | 1.0 | 1.0 | | 1.0 | 1.0 | | | |
| Lane Grp Cap (vph) | 915 | 1828 | | | 1102 | 343 | | 397 | 185 | | | |
| v/s Ratio Prot | c0.25 | 0.21 | | | c0.18 | | | c0.28 | 0.02 | | | |
| v/s Ratio Perm | | | | | | 0.13 | | | | | | |
| v/c Ratio | 0.48 | 0.41 | | | 0.82 | 0.60 | | 3.64dl | 0.21 | | | |
| Uniform Delay, d1 | 18.6 | 17.8 | | | 44.7 | 42.4 | | 53.0 | 48.0 | | | |
| Progression Factor | 0.14 | 0.09 | | | 1.00 | 1.00 | | 1.00 | 1.00 | | | |
| Incremental Delay, d2 | 1.4 | 0.5 | | | 6.8 | 7.7 | | 657.1 | 2.6 | | | |
| Delay (s) | 4.0 | 2.1 | | | 51.5 | 50.1 | | 710.1 | 50.6 | | | |
| Level of Service | A | A | | | D | D | | F | D | | | |
| Approach Delay (s) | | 2.8 | | | 51.0 | | | 642.4 | | | 0.0 | |
| Approach LOS | | A | | | D | | | F | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 211.6 | HCM Level of Service | F |
| HCM Volume to Capacity ratio | 0.83 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 105.6% | ICU Level of Service | G |
| Analysis Period (min) | 15 | | |

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 13 | 1000 | 85 | 80 | 1147 | 45 | 53 | 25 | 101 | 52 | 11 | 71 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 0.99 | | | 0.92 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.99 | | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 3498 | | 1770 | 3519 | | | 1696 | | 1770 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.90 | | 0.31 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 3498 | | 1770 | 3519 | | | 1541 | | 584 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 14 | 1087 | 92 | 87 | 1247 | 49 | 58 | 27 | 110 | 57 | 12 | 77 |
| RTOR Reduction (vph) | 0 | 4 | 0 | 0 | 2 | 0 | 0 | 31 | 0 | 0 | 0 | 66 |
| Lane Group Flow (vph) | 14 | 1175 | 0 | 87 | 1294 | 0 | 0 | 164 | 0 | 57 | 12 | 11 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 4 | | | 3 | |
| Permitted Phases | | | | | | | 4 | | | 3 | | 3 |
| Actuated Green, G (s) | 2.2 | 49.4 | | 10.8 | 58.0 | | | 17.3 | | 16.9 | 16.9 | 16.9 |
| Effective Green, g (s) | 2.2 | 49.4 | | 10.8 | 58.0 | | | 17.3 | | 16.9 | 16.9 | 16.9 |
| Actuated g/C Ratio | 0.02 | 0.41 | | 0.09 | 0.49 | | | 0.14 | | 0.14 | 0.14 | 0.14 |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | 2.0 | 1.5 | | 2.0 | 1.5 | | | 2.0 | | 2.0 | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 33 | 1447 | | 160 | 1709 | | | 223 | | 83 | 264 | 224 |
| v/s Ratio Prot | 0.01 | c0.34 | | c0.05 | c0.37 | | | | | | 0.01 | |
| v/s Ratio Perm | | | | | | | | c0.11 | | c0.10 | | 0.01 |
| v/c Ratio | 0.42 | 0.81 | | 0.54 | 0.76 | | | 0.74 | | 0.69 | 0.05 | 0.05 |
| Uniform Delay, d1 | 58.0 | 30.9 | | 51.9 | 25.0 | | | 48.9 | | 48.7 | 44.3 | 44.3 |
| Progression Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 3.2 | 3.4 | | 2.0 | 1.7 | | | 10.4 | | 17.1 | 0.0 | 0.0 |
| Delay (s) | 61.1 | 34.3 | | 54.0 | 26.7 | | | 59.2 | | 65.9 | 44.3 | 44.3 |
| Level of Service | E | C | | D | C | | | E | | E | D | D |
| Approach Delay (s) | | 34.6 | | | 28.4 | | | 59.2 | | | 52.7 | |
| Approach LOS | | C | | | C | | | E | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 34.2 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.82 | | |
| Actuated Cycle Length (s) | 119.4 | Sum of lost time (s) | 31.5 |
| Intersection Capacity Utilization | 70.3% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 14 | 845 | 86 | 75 | 933 | 2 | 48 | 13 | 70 | 25 | 7 | 12 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | 1.00 | 0.87 | | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | 1.00 |
| Satd. Flow (prot) | 1770 | 3490 | | 1770 | 3538 | | 1770 | 1627 | | | 1794 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.73 | 1.00 | | | 0.69 | 1.00 |
| Satd. Flow (perm) | 1770 | 3490 | | 1770 | 3538 | | 1368 | 1627 | | | 1285 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 15 | 918 | 93 | 82 | 1014 | 2 | 52 | 14 | 76 | 27 | 8 | 13 |
| RTOR Reduction (vph) | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 70 | 0 | 0 | 0 | 12 |
| Lane Group Flow (vph) | 15 | 1006 | 0 | 82 | 1016 | 0 | 52 | 20 | 0 | 0 | 35 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 8 | | | 4 | |
| Permitted Phases | | | | | | | 8 | | | 4 | | 4 |
| Actuated Green, G (s) | 2.7 | 85.6 | | 8.8 | 91.7 | | 9.1 | 9.1 | | | 9.1 | 9.1 |
| Effective Green, g (s) | 2.7 | 85.6 | | 8.8 | 91.7 | | 9.1 | 9.1 | | | 9.1 | 9.1 |
| Actuated g/C Ratio | 0.02 | 0.71 | | 0.07 | 0.76 | | 0.08 | 0.08 | | | 0.08 | 0.08 |
| Clearance Time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 40 | 2490 | | 130 | 2704 | | 104 | 123 | | | 97 | 120 |
| v/s Ratio Prot | 0.01 | c0.29 | | c0.05 | 0.29 | | | 0.01 | | | | |
| v/s Ratio Perm | | | | | | | c0.04 | | | | 0.03 | 0.00 |
| v/c Ratio | 0.38 | 0.40 | | 0.63 | 0.38 | | 0.50 | 0.16 | | | 0.36 | 0.01 |
| Uniform Delay, d1 | 57.8 | 6.9 | | 54.0 | 4.7 | | 53.3 | 51.9 | | | 52.7 | 51.3 |
| Progression Factor | 1.00 | 1.00 | | 0.86 | 2.09 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Incremental Delay, d2 | 2.1 | 0.5 | | 5.8 | 0.3 | | 1.4 | 0.2 | | | 0.8 | 0.0 |
| Delay (s) | 60.0 | 7.4 | | 52.1 | 10.1 | | 54.6 | 52.1 | | | 53.5 | 51.3 |
| Level of Service | E | A | | D | B | | D | D | | | D | D |
| Approach Delay (s) | | 8.2 | | | 13.3 | | | 53.0 | | | 52.9 | |
| Approach LOS | | A | | | B | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 14.3 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.43 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 16.5 |
| Intersection Capacity Utilization | 53.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 5 | 813 | 78 | 12 | 1322 | 4 | 73 | 0 | 16 | 4 | 0 | 11 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | 5.5 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 0.98 | | | 0.90 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | | | 0.99 | |
| Satd. Flow (prot) | 1770 | 3493 | | 1770 | 3538 | | | 1746 | | | 1653 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.33 | | | 1.00 | |
| Satd. Flow (perm) | 1770 | 3493 | | 1770 | 3538 | | | 594 | | | 1674 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 884 | 85 | 13 | 1437 | 4 | 79 | 0 | 17 | 4 | 0 | 12 |
| RTOR Reduction (vph) | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 12 | 0 |
| Lane Group Flow (vph) | 5 | 965 | 0 | 13 | 1441 | 0 | 0 | 90 | 0 | 0 | 4 | 0 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | | 4 | | |
| Actuated Green, G (s) | 1.2 | 77.4 | | 2.6 | 78.8 | | | 14.5 | | | 2.5 | |
| Effective Green, g (s) | 1.2 | 77.4 | | 2.6 | 78.8 | | | 14.5 | | | 2.5 | |
| Actuated g/C Ratio | 0.01 | 0.65 | | 0.02 | 0.66 | | | 0.12 | | | 0.02 | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | 5.5 | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | 18 | 2253 | | 38 | 2323 | | | 72 | | | 35 | |
| v/s Ratio Prot | 0.00 | 0.28 | | c0.01 | c0.41 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.15 | | | c0.00 | |
| v/c Ratio | 0.28 | 0.43 | | 0.34 | 0.62 | | | 1.25 | | | 0.12 | |
| Uniform Delay, d1 | 59.0 | 10.4 | | 57.9 | 11.9 | | | 52.8 | | | 57.7 | |
| Progression Factor | 1.39 | 0.48 | | 1.26 | 0.56 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | 2.9 | 0.6 | | 1.6 | 1.1 | | | 186.7 | | | 0.6 | |
| Delay (s) | 84.6 | 5.5 | | 74.4 | 7.8 | | | 239.5 | | | 58.2 | |
| Level of Service | F | A | | E | A | | | F | | | E | |
| Approach Delay (s) | | 6.0 | | | 8.4 | | | 239.5 | | | 58.2 | |
| Approach LOS | | A | | | A | | | F | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 16.5 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.66 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 17.0 |
| Intersection Capacity Utilization | 57.9% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 86 | 572 | 166 | 127 | 745 | 96 | 161 | 605 | 196 | 181 | 323 | 115 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.91 | |
| Frt | 1.00 | 0.97 | | 1.00 | 0.98 | | 1.00 | 1.00 | 0.85 | 1.00 | 0.96 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 3420 | | 1770 | 3479 | | 1770 | 3539 | 1583 | 1770 | 4885 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 3420 | | 1770 | 3479 | | 1770 | 3539 | 1583 | 1770 | 4885 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 93 | 622 | 180 | 138 | 810 | 104 | 175 | 658 | 213 | 197 | 351 | 125 |
| RTOR Reduction (vph) | 0 | 22 | 0 | 0 | 8 | 0 | 0 | 0 | 93 | 0 | 54 | 0 |
| Lane Group Flow (vph) | 93 | 780 | 0 | 138 | 906 | 0 | 175 | 658 | 120 | 197 | 422 | 0 |
| Turn Type | Prot | | | Prot | | | Prot | | Perm | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 7 | 4 | | 3 | 8 | |
| Permitted Phases | | | | | | | | | 4 | | | |
| Actuated Green, G (s) | 10.3 | 50.9 | | 11.1 | 51.7 | | 13.5 | 19.0 | 19.0 | 14.0 | 19.5 | |
| Effective Green, g (s) | 10.3 | 50.9 | | 11.1 | 51.7 | | 13.5 | 19.0 | 19.0 | 14.0 | 19.5 | |
| Actuated g/C Ratio | 0.09 | 0.42 | | 0.09 | 0.43 | | 0.11 | 0.16 | 0.16 | 0.12 | 0.16 | |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Vehicle Extension (s) | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 3.5 | 3.5 | 2.0 | 3.5 | |
| Lane Grp Cap (vph) | 152 | 1451 | | 164 | 1499 | | 199 | 560 | 251 | 207 | 794 | |
| v/s Ratio Prot | 0.05 | 0.23 | | c0.08 | c0.26 | | 0.10 | c0.19 | | c0.11 | 0.09 | |
| v/s Ratio Perm | | | | | | | | | 0.08 | | | |
| v/c Ratio | 0.61 | 0.54 | | 0.84 | 0.60 | | 0.88 | 1.18 | 0.48 | 0.95 | 0.53 | |
| Uniform Delay, d1 | 52.9 | 25.8 | | 53.6 | 26.3 | | 52.4 | 50.5 | 46.0 | 52.7 | 46.1 | |
| Progression Factor | 0.87 | 0.84 | | 0.86 | 1.18 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Incremental Delay, d2 | 4.7 | 1.3 | | 25.3 | 1.5 | | 31.8 | 96.4 | 1.7 | 48.4 | 0.8 | |
| Delay (s) | 50.9 | 22.9 | | 71.5 | 32.6 | | 84.3 | 146.9 | 47.7 | 101.0 | 46.8 | |
| Level of Service | D | C | | E | C | | F | F | D | F | D | |
| Approach Delay (s) | | 25.8 | | | 37.7 | | | 116.2 | | | 62.7 | |
| Approach LOS | | C | | | D | | | F | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 61.8 | HCM Level of Service | E |
| HCM Volume to Capacity ratio | 0.75 | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 18.5 |
| Intersection Capacity Utilization | 76.0% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 5 | 1070 | 3 | 1 | 1019 | 60 | 324 | 38 | 21 | 0 | 13 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Lane Util. Factor | | 0.95 | | | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | | 1.00 | | | 0.99 | | | 0.99 | | | 0.98 | |
| Flt Protected | | 1.00 | | | 1.00 | | | 0.96 | | | 1.00 | |
| Satd. Flow (prot) | | 3537 | | | 3510 | | | 1774 | | | 1818 | |
| Flt Permitted | | 0.95 | | | 0.95 | | | 0.75 | | | 1.00 | |
| Satd. Flow (perm) | | 3361 | | | 3350 | | | 1381 | | | 1818 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 1163 | 3 | 1 | 1108 | 65 | 352 | 41 | 23 | 0 | 14 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Lane Group Flow (vph) | 0 | 1171 | 0 | 0 | 1171 | 0 | 0 | 415 | 0 | 0 | 15 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 6 | | | 2 | | | 8 | | | 4 | |
| Permitted Phases | 6 | | | 2 | | | 8 | | | 4 | | |
| Actuated Green, G (s) | | 74.5 | | | 74.5 | | | 35.0 | | | 35.0 | |
| Effective Green, g (s) | | 74.5 | | | 74.5 | | | 35.0 | | | 35.0 | |
| Actuated g/C Ratio | | 0.62 | | | 0.62 | | | 0.29 | | | 0.29 | |
| Clearance Time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | | 2087 | | | 2080 | | | 403 | | | 530 | |
| v/s Ratio Prot | | | | | | | | | | | 0.01 | |
| v/s Ratio Perm | | 0.35 | | | c0.35 | | | c0.30 | | | | |
| v/c Ratio | | 0.56 | | | 0.56 | | | 1.03 | | | 0.03 | |
| Uniform Delay, d1 | | 13.2 | | | 13.3 | | | 42.5 | | | 30.4 | |
| Progression Factor | | 0.75 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 1.0 | | | 1.1 | | | 52.4 | | | 0.0 | |
| Delay (s) | | 10.9 | | | 14.4 | | | 94.9 | | | 30.4 | |
| Level of Service | | B | | | B | | | F | | | C | |
| Approach Delay (s) | | 10.9 | | | 14.4 | | | 94.9 | | | 30.4 | |
| Approach LOS | | B | | | B | | | F | | | C | |

| Intersection Summary | | | | |
|---|---|---|---|---|
| HCM Average Control Delay | 25.1 | HCM Level of Service | C | |
| HCM Volume to Capacity ratio | 0.71 | | | |
| Actuated Cycle Length (s) | 120.0 | Sum of lost time (s) | 10.5 | |
| Intersection Capacity Utilization | 69.8% | ICU Level of Service | C | |
| Analysis Period (min) | 15 | | | |
| c Critical Lane Group | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 765 | 42 | 322 | 385 | 0 | 0 | 0 | 0 | 334 | 47 | 172 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Lane Util. Factor | | 0.95 | | 1.00 | 0.95 | | | | | 1.00 | 1.00 | |
| Frt | | 0.99 | | 1.00 | 1.00 | | | | | 1.00 | 0.88 | |
| Flt Protected | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 3511 | | 1770 | 3539 | | | | | 1770 | 1643 | |
| Flt Permitted | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (perm) | | 3511 | | 1770 | 3539 | | | | | 1770 | 1643 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 832 | 46 | 350 | 418 | 0 | 0 | 0 | 0 | 363 | 51 | 187 |
| RTOR Reduction (vph) | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 | 0 |
| Lane Group Flow (vph) | 0 | 873 | 0 | 350 | 418 | 0 | 0 | 0 | 0 | 363 | 108 | 0 |
| Turn Type | | | | Prot | | | | | | Perm | | |
| Protected Phases | | 6 | | 5 | 2 | | | | | | 4 | |
| Permitted Phases | | | | | | | | | | 4 | | |
| Actuated Green, G (s) | | 36.6 | | 8.5 | 51.6 | | | | | 25.9 | 25.9 | |
| Effective Green, g (s) | | 36.6 | | 8.5 | 51.6 | | | | | 25.9 | 25.9 | |
| Actuated g/C Ratio | | 0.41 | | 0.09 | 0.57 | | | | | 0.29 | 0.29 | |
| Clearance Time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Vehicle Extension (s) | | 2.0 | | 2.0 | 2.0 | | | | | 2.0 | 2.0 | |
| Lane Grp Cap (vph) | | 1428 | | 167 | 2029 | | | | | 509 | 473 | |
| v/s Ratio Prot | | c0.25 | | c0.20 | 0.12 | | | | | | 0.07 | |
| v/s Ratio Perm | | | | | | | | | | c0.21 | | |
| v/c Ratio | | 0.61 | | 2.10 | 0.21 | | | | | 0.71 | 0.23 | |
| Uniform Delay, d1 | | 21.1 | | 40.8 | 9.3 | | | | | 28.7 | 24.4 | |
| Progression Factor | | 1.00 | | 0.70 | 2.19 | | | | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 2.0 | | 511.0 | 0.2 | | | | | 3.9 | 0.1 | |
| Delay (s) | | 23.0 | | 539.7 | 20.5 | | | | | 32.6 | 24.5 | |
| Level of Service | | C | | F | C | | | | | C | C | |
| Approach Delay (s) | | 23.0 | | | 257.1 | | | 0.0 | | | 29.4 | |
| Approach LOS | | C | | | F | | | A | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 104.8 | HCM Level of Service | F |
| HCM Volume to Capacity ratio | 0.83 | | |
| Actuated Cycle Length (s) | 90.0 | Sum of lost time (s) | 19.0 |
| Intersection Capacity Utilization | 74.7% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 670 | 429 | 0 | 0 | 548 | 308 | 159 | 25 | 198 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Lane Util. Factor | 0.97 | 1.00 | | | 0.95 | 1.00 | 1.00 | 1.00 | | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | 1.00 | 0.87 | | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (prot) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1615 | | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (perm) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1615 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 728 | 466 | 0 | 0 | 596 | 335 | 173 | 27 | 215 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 207 | 0 | 185 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 728 | 466 | 0 | 0 | 596 | 128 | 173 | 57 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | | | | |
| Protected Phases | 1 | 6 | | | 2 | | | 8 | | | | |
| Permitted Phases | | | | | | 2 | 8 | | | | | |
| Actuated Green, G (s) | 23.5 | 64.8 | | | 34.3 | 34.3 | 12.7 | 12.7 | | | | |
| Effective Green, g (s) | 23.5 | 64.8 | | | 34.3 | 34.3 | 12.7 | 12.7 | | | | |
| Actuated g/C Ratio | 0.26 | 0.72 | | | 0.38 | 0.38 | 0.14 | 0.14 | | | | |
| Clearance Time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Vehicle Extension (s) | 2.0 | 2.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | | | | |
| Lane Grp Cap (vph) | 896 | 1341 | | | 1349 | 603 | 250 | 228 | | | | |
| v/s Ratio Prot | c0.21 | 0.25 | | | c0.17 | | | 0.04 | | | | |
| v/s Ratio Perm | | | | | | 0.08 | c0.10 | | | | | |
| v/c Ratio | 0.81 | 0.35 | | | 0.44 | 0.21 | 0.69 | 0.25 | | | | |
| Uniform Delay, d1 | 31.2 | 4.7 | | | 20.7 | 18.7 | 36.8 | 34.4 | | | | |
| Progression Factor | 0.93 | 1.81 | | | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| Incremental Delay, d2 | 4.5 | 0.6 | | | 1.1 | 0.8 | 6.5 | 0.2 | | | | |
| Delay (s) | 33.6 | 9.1 | | | 21.8 | 19.5 | 43.3 | 34.6 | | | | |
| Level of Service | C | A | | | C | B | D | C | | | | |
| Approach Delay (s) | | 24.0 | | | 21.0 | | | 38.2 | | | 0.0 | |
| Approach LOS | | C | | | C | | | D | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 25.2 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.61 | | |
| Actuated Cycle Length (s) | 90.0 | Sum of lost time (s) | 19.5 |
| Intersection Capacity Utilization | 74.7% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 637 | 44 | 357 | 767 | 0 | 0 | 0 | 0 | 719 | 68 | 469 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Lane Util. Factor | | 0.95 | | 1.00 | 0.95 | | | | | 1.00 | 1.00 | |
| Frt | | 0.99 | | 1.00 | 1.00 | | | | | 1.00 | 0.87 | |
| Flt Protected | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 3505 | | 1770 | 3539 | | | | | 1770 | 1619 | |
| Flt Permitted | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (perm) | | 3505 | | 1770 | 3539 | | | | | 1770 | 1619 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 692 | 48 | 388 | 834 | 0 | 0 | 0 | 0 | 782 | 74 | 510 |
| RTOR Reduction (vph) | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 64 | 0 |
| Lane Group Flow (vph) | 0 | 735 | 0 | 388 | 834 | 0 | 0 | 0 | 0 | 782 | 520 | 0 |
| Turn Type | | | | Prot | | | | | | Perm | | |
| Protected Phases | | 6 | | 5 | 2 | | | | | | 4 | |
| Permitted Phases | | | | | | | | | | 4 | | |
| Actuated Green, G (s) | | 20.3 | | 20.7 | 47.5 | | | | | 40.0 | 40.0 | |
| Effective Green, g (s) | | 20.3 | | 20.7 | 47.5 | | | | | 40.0 | 40.0 | |
| Actuated g/C Ratio | | 0.20 | | 0.21 | 0.48 | | | | | 0.40 | 0.40 | |
| Clearance Time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Vehicle Extension (s) | | 2.0 | | 2.0 | 2.0 | | | | | 2.0 | 2.0 | |
| Lane Grp Cap (vph) | | 712 | | 366 | 1681 | | | | | 708 | 648 | |
| v/s Ratio Prot | | c0.21 | | c0.22 | 0.24 | | | | | | 0.32 | |
| v/s Ratio Perm | | | | | | | | | | c0.44 | | |
| v/c Ratio | | 1.03 | | 1.06 | 0.50 | | | | | 1.10 | 0.80 | |
| Uniform Delay, d1 | | 39.9 | | 39.6 | 18.0 | | | | | 30.0 | 26.5 | |
| Progression Factor | | 1.00 | | 1.09 | 0.53 | | | | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 42.4 | | 55.8 | 0.7 | | | | | 66.1 | 6.7 | |
| Delay (s) | | 82.2 | | 99.1 | 10.4 | | | | | 96.1 | 33.2 | |
| Level of Service | | F | | F | B | | | | | F | C | |
| Approach Delay (s) | | 82.2 | | | 38.5 | | | 0.0 | | | 69.2 | |
| Approach LOS | | F | | | D | | | A | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 60.9 | HCM Level of Service | E |
| HCM Volume to Capacity ratio | 1.08 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 19.0 |
| Intersection Capacity Utilization | 94.5% | ICU Level of Service | F |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 775 | 690 | 0 | 0 | 833 | 262 | 259 | 75 | 310 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Lane Util. Factor | 0.97 | 1.00 | | | 0.95 | 1.00 | 1.00 | 1.00 | | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | 1.00 | 0.88 | | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (prot) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1638 | | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (perm) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1638 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 842 | 750 | 0 | 0 | 905 | 285 | 282 | 82 | 337 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 144 | 0 | 152 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 842 | 750 | 0 | 0 | 905 | 141 | 282 | 267 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | | | | |
| Protected Phases | 1 | 6 | | | 2 | | | 8 | | | | |
| Permitted Phases | | | | | | 2 | 8 | | | | | |
| Actuated Green, G (s) | 26.7 | 68.4 | | | 34.7 | 34.7 | 19.1 | 19.1 | | | | |
| Effective Green, g (s) | 26.7 | 68.4 | | | 34.7 | 34.7 | 19.1 | 19.1 | | | | |
| Actuated g/C Ratio | 0.27 | 0.68 | | | 0.35 | 0.35 | 0.19 | 0.19 | | | | |
| Clearance Time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Vehicle Extension (s) | 2.0 | 2.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | | | | |
| Lane Grp Cap (vph) | 917 | 1274 | | | 1228 | 549 | 338 | 313 | | | | |
| v/s Ratio Prot | c0.25 | 0.40 | | | c0.26 | | | c0.16 | | | | |
| v/s Ratio Perm | | | | | | 0.09 | 0.16 | | | | | |
| v/c Ratio | 0.92 | 0.59 | | | 0.74 | 0.26 | 0.83 | 0.85 | | | | |
| Uniform Delay, d1 | 35.6 | 8.4 | | | 28.6 | 23.4 | 38.9 | 39.1 | | | | |
| Progression Factor | 1.35 | 1.03 | | | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| Incremental Delay, d2 | 4.0 | 0.5 | | | 4.0 | 1.1 | 15.4 | 18.9 | | | | |
| Delay (s) | 52.0 | 9.1 | | | 32.6 | 24.5 | 54.3 | 58.0 | | | | |
| Level of Service | D | A | | | C | C | D | E | | | | |
| Approach Delay (s) | | 31.8 | | | 30.7 | | | 56.5 | | | 0.0 | |
| Approach LOS | | C | | | C | | | E | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 36.4 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.82 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 19.5 |
| Intersection Capacity Utilization | 94.5% | ICU Level of Service | F |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 2 | 1434 | 38 | 81 | 879 | 8 | 117 | 2 | 422 | 89 | 5 | 8 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | 5.5 | 5.5 | | 5.5 | 5.5 | |
| Lane Util. Factor | 1.00 | 0.91 | | 1.00 | 0.91 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Frt | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 0.85 | | 1.00 | 0.90 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 5066 | | 1770 | 5078 | | 1770 | 1585 | | 1770 | 1683 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 5066 | | 1770 | 5078 | | 1770 | 1585 | | 1770 | 1683 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 2 | 1559 | 41 | 88 | 955 | 9 | 127 | 2 | 459 | 97 | 5 | 9 |
| RTOR Reduction (vph) | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 166 | 0 | 0 | 9 | 0 |
| Lane Group Flow (vph) | 2 | 1598 | 0 | 88 | 963 | 0 | 127 | 295 | 0 | 97 | 5 | 0 |
| Turn Type | Prot | | | Prot | | | Prot | | | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 3 | 8 | | 7 | 4 | |
| Permitted Phases | | | | | | | | | | | | |
| Actuated Green, G (s) | 1.0 | 43.8 | | 8.2 | 51.0 | | 32.6 | 26.3 | | 8.7 | 2.4 | |
| Effective Green, g (s) | 1.0 | 43.8 | | 8.2 | 51.0 | | 32.6 | 26.3 | | 8.7 | 2.4 | |
| Actuated g/C Ratio | 0.01 | 0.40 | | 0.07 | 0.46 | | 0.30 | 0.24 | | 0.08 | 0.02 | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | 5.5 | 5.5 | | 5.5 | 5.5 | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | 2.0 | 2.0 | |
| Lane Grp Cap (vph) | 16 | 2017 | | 132 | 2354 | | 525 | 379 | | 140 | 37 | |
| v/s Ratio Prot | 0.00 | c0.32 | | c0.05 | 0.19 | | 0.07 | c0.19 | | c0.05 | 0.00 | |
| v/s Ratio Perm | | | | | | | | | | | | |
| v/c Ratio | 0.12 | 0.79 | | 0.67 | 0.41 | | 0.24 | 0.78 | | 0.69 | 0.14 | |
| Uniform Delay, d1 | 54.1 | 29.1 | | 49.6 | 19.5 | | 29.3 | 39.1 | | 49.3 | 52.8 | |
| Progression Factor | 1.00 | 1.00 | | 1.21 | 0.36 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | 1.3 | 3.3 | | 8.5 | 0.5 | | 0.1 | 8.9 | | 11.3 | 0.6 | |
| Delay (s) | 55.3 | 32.4 | | 68.5 | 7.4 | | 29.4 | 48.0 | | 60.7 | 53.4 | |
| Level of Service | E | C | | E | A | | C | D | | E | D | |
| Approach Delay (s) | | 32.4 | | | 12.5 | | | 44.0 | | | 59.7 | |
| Approach LOS | | C | | | B | | | D | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 29.1 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.77 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 23.0 |
| Intersection Capacity Utilization | 83.4% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 1266 | 360 | 151 | 627 | 0 | 0 | 0 | 0 | 315 | 104 | 231 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | 6.0 | 6.0 | | | | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | | 0.91 | 1.00 | 0.91 | 0.91 | | | | | 0.91 | 0.86 | 0.95 |
| Frt | | 1.00 | 0.85 | 1.00 | 1.00 | | | | | 1.00 | 0.95 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | 0.95 | 1.00 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (prot) | | 5085 | 1583 | 1610 | 3386 | | | | | 3221 | 1518 | 1504 |
| Flt Permitted | | 1.00 | 1.00 | 0.95 | 0.46 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (perm) | | 5085 | 1583 | 1610 | 1543 | | | | | 3221 | 1518 | 1504 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 1376 | 391 | 164 | 682 | 0 | 0 | 0 | 0 | 342 | 113 | 251 |
| RTOR Reduction (vph) | 0 | 0 | 268 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 162 |
| Lane Group Flow (vph) | 0 | 1376 | 123 | 148 | 698 | 0 | 0 | 0 | 0 | 308 | 196 | 26 |
| Turn Type | | | Perm | Prot | | | | | | Split | | Prot |
| Protected Phases | | 6 | | 5 | 2 5 | | | | | 8 | 8 | 8 |
| Permitted Phases | | | 6 | | | | | | | | | |
| Actuated Green, G (s) | | 34.5 | 34.5 | 42.5 | 42.5 | | | | | 15.0 | 15.0 | 15.0 |
| Effective Green, g (s) | | 34.5 | 34.5 | 42.5 | 42.5 | | | | | 15.0 | 15.0 | 15.0 |
| Actuated g/C Ratio | | 0.31 | 0.31 | 0.39 | 0.39 | | | | | 0.14 | 0.14 | 0.14 |
| Clearance Time (s) | | 6.0 | 6.0 | 6.0 | | | | | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | | 1.0 | 1.0 | 1.0 | | | | | | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | | 1595 | 496 | 622 | 1308 | | | | | 439 | 207 | 205 |
| v/s Ratio Prot | | c0.27 | | 0.09 | c0.21 | | | | | 0.10 | c0.13 | 0.02 |
| v/s Ratio Perm | | | 0.08 | | | | | | | | | |
| v/c Ratio | | 0.86 | 0.25 | 0.24 | 0.53 | | | | | 0.70 | 0.95 | 0.13 |
| Uniform Delay, d1 | | 35.5 | 28.1 | 22.8 | 26.1 | | | | | 45.4 | 47.1 | 41.7 |
| Progression Factor | | 0.56 | 0.51 | 0.13 | 0.12 | | | | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | | 4.3 | 0.8 | 0.1 | 0.2 | | | | | 4.1 | 46.9 | 0.1 |
| Delay (s) | | 24.2 | 15.2 | 3.0 | 3.4 | | | | | 49.5 | 94.1 | 41.8 |
| Level of Service | | C | B | A | A | | | | | D | F | D |
| Approach Delay (s) | | 22.2 | | | 3.3 | | | 0.0 | | | 60.7 | |
| Approach LOS | | C | | | A | | | A | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 25.6 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.72 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 85.1% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 596 | 985 | 0 | 0 | 447 | 460 | 331 | 84 | 96 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Lane Util. Factor | 0.86 | 0.86 | | | 0.91 | 1.00 | | 0.95 | 1.00 | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 | | | |
| Flt Protected | 0.95 | 0.99 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (prot) | 1522 | 4763 | | | 5085 | 1583 | | 3403 | 1583 | | | |
| Flt Permitted | 0.95 | 0.61 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (perm) | 1522 | 2916 | | | 5085 | 1583 | | 3403 | 1583 | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 648 | 1071 | 0 | 0 | 486 | 500 | 360 | 91 | 104 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 207 | 0 | 0 | 90 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 415 | 1304 | 0 | 0 | 486 | 293 | 0 | 451 | 14 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Split | | Prot | | | |
| Protected Phases | 1 | 1 6 | | | 2 | | 4 | 4 | 4 | | | |
| Permitted Phases | | | | | | 2 | | | | | | |
| Actuated Green, G (s) | 55.5 | 55.5 | | | 21.5 | 21.5 | | 15.0 | 15.0 | | | |
| Effective Green, g (s) | 55.5 | 55.5 | | | 21.5 | 21.5 | | 15.0 | 15.0 | | | |
| Actuated g/C Ratio | 0.50 | 0.50 | | | 0.20 | 0.20 | | 0.14 | 0.14 | | | |
| Clearance Time (s) | 6.0 | | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Vehicle Extension (s) | 1.0 | | | | 1.0 | 1.0 | | 1.0 | 1.0 | | | |
| Lane Grp Cap (vph) | 768 | 2403 | | | 994 | 309 | | 464 | 216 | | | |
| v/s Ratio Prot | 0.27 | c0.27 | | | 0.10 | | | c0.13 | 0.01 | | | |
| v/s Ratio Perm | | | | | | c0.19 | | | | | | |
| v/c Ratio | 0.54 | 0.54 | | | 0.49 | 0.95 | | 1.49dl | 0.07 | | | |
| Uniform Delay, d1 | 18.6 | 18.6 | | | 39.4 | 43.7 | | 47.3 | 41.4 | | | |
| Progression Factor | 0.11 | 0.11 | | | 0.71 | 0.64 | | 1.00 | 1.00 | | | |
| Incremental Delay, d2 | 1.4 | 0.5 | | | 0.1 | 35.5 | | 34.3 | 0.0 | | | |
| Delay (s) | 3.5 | 2.4 | | | 27.9 | 63.6 | | 81.5 | 41.4 | | | |
| Level of Service | A | A | | | C | E | | F | D | | | |
| Approach Delay (s) | | 2.7 | | | 46.0 | | | 74.0 | | | 0.0 | |
| Approach LOS | | A | | | D | | | E | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 27.9 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.71 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 85.1% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 40 | 962 | 40 | 41 | 876 | 26 | 31 | 18 | 59 | 24 | 5 | 50 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 1.00 | 0.91 | | 1.00 | 0.95 | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.97 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 5055 | | 1770 | 3524 | | | 1806 | 1583 | 1770 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.97 | 1.00 | 0.72 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 5055 | | 1770 | 3524 | | | 1806 | 1583 | 1345 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 43 | 1046 | 43 | 45 | 952 | 28 | 34 | 20 | 64 | 26 | 5 | 54 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 60 | 0 | 0 | 51 |
| Lane Group Flow (vph) | 43 | 1086 | 0 | 45 | 979 | 0 | 0 | 54 | 4 | 26 | 5 | 3 |
| Turn Type | Prot | | | Prot | | | Split | | Perm | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | 4 | 4 | | | 3 | |
| Permitted Phases | | | | | | | | | 4 | 3 | | 3 |
| Actuated Green, G (s) | 5.1 | 63.2 | | 9.2 | 67.3 | | | 6.8 | 6.8 | 5.8 | 5.8 | 5.8 |
| Effective Green, g (s) | 5.1 | 63.2 | | 9.2 | 67.3 | | | 6.8 | 6.8 | 5.8 | 5.8 | 5.8 |
| Actuated g/C Ratio | 0.05 | 0.57 | | 0.08 | 0.61 | | | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | 2.0 | 1.5 | | 2.0 | 1.5 | | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 82 | 2904 | | 148 | 2156 | | | 112 | 98 | 71 | 98 | 83 |
| v/s Ratio Prot | 0.02 | c0.21 | | 0.03 | c0.28 | | | c0.03 | | | 0.00 | |
| v/s Ratio Perm | | | | | | | | | 0.00 | c0.02 | | 0.00 |
| v/c Ratio | 0.52 | 0.37 | | 0.30 | 0.45 | | | 0.48 | 0.04 | 0.37 | 0.05 | 0.03 |
| Uniform Delay, d1 | 51.3 | 12.7 | | 47.4 | 11.5 | | | 49.9 | 48.5 | 50.3 | 49.5 | 49.4 |
| Progression Factor | 1.32 | 0.15 | | 0.85 | 0.69 | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 2.4 | 0.3 | | 0.4 | 0.7 | | | 1.2 | 0.1 | 1.2 | 0.1 | 0.1 |
| Delay (s) | 69.9 | 2.3 | | 40.6 | 8.6 | | | 51.1 | 48.6 | 51.5 | 49.6 | 49.5 |
| Level of Service | E | A | | D | A | | | D | D | D | D | D |
| Approach Delay (s) | | 4.8 | | | 10.0 | | | 49.7 | | | 50.1 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 11.0 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.46 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 25.0 |
| Intersection Capacity Utilization | 53.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 14 | 774 | 41 | 24 | 796 | 10 | 65 | 10 | 94 | 3 | 3 | 14 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | 1.00 | 0.86 | | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.98 | 1.00 |
| Satd. Flow (prot) | 1770 | 3512 | | 1770 | 3533 | | 1770 | 1611 | | | 1817 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.75 | 1.00 | | | 0.84 | 1.00 |
| Satd. Flow (perm) | 1770 | 3512 | | 1770 | 3533 | | 1404 | 1611 | | | 1569 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 15 | 841 | 45 | 26 | 865 | 11 | 71 | 11 | 102 | 3 | 3 | 15 |
| RTOR Reduction (vph) | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 93 | 0 | 0 | 0 | 14 |
| Lane Group Flow (vph) | 15 | 884 | 0 | 26 | 875 | 0 | 71 | 20 | 0 | 0 | 6 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 8 | | | 4 | |
| Permitted Phases | | | | | | | 8 | | | 4 | | 4 |
| Actuated Green, G (s) | 4.2 | 79.3 | | 4.3 | 79.4 | | 9.9 | 9.9 | | | 9.9 | 9.9 |
| Effective Green, g (s) | 4.2 | 79.3 | | 4.3 | 79.4 | | 9.9 | 9.9 | | | 9.9 | 9.9 |
| Actuated g/C Ratio | 0.04 | 0.72 | | 0.04 | 0.72 | | 0.09 | 0.09 | | | 0.09 | 0.09 |
| Clearance Time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 68 | 2532 | | 69 | 2550 | | 126 | 145 | | | 141 | 142 |
| v/s Ratio Prot | 0.01 | c0.25 | | 0.01 | c0.25 | | | 0.01 | | | | |
| v/s Ratio Perm | | | | | | | c0.05 | | | | 0.00 | 0.00 |
| v/c Ratio | 0.22 | 0.35 | | 0.38 | 0.34 | | 0.56 | 0.14 | | | 0.04 | 0.01 |
| Uniform Delay, d1 | 51.3 | 5.7 | | 51.5 | 5.7 | | 48.0 | 46.1 | | | 45.7 | 45.6 |
| Progression Factor | 0.55 | 0.10 | | 1.00 | 1.00 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.6 | 0.4 | | 1.3 | 0.4 | | 3.4 | 0.2 | | | 0.0 | 0.0 |
| Delay (s) | 28.7 | 0.9 | | 52.8 | 6.0 | | 51.4 | 46.3 | | | 45.8 | 45.6 |
| Level of Service | C | A | | D | A | | D | D | | | D | D |
| Approach Delay (s) | | 1.4 | | | 7.4 | | | 48.3 | | | 45.6 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 8.8 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.38 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 16.5 |
| Intersection Capacity Utilization | 46.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 1 | 886 | 69 | 6 | 929 | 6 | 45 | 0 | 13 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | | | |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 0.97 | | | | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | | | | |
| Satd. Flow (prot) | 1770 | 3501 | | 1770 | 3536 | | | 1739 | | | | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.95 | | | | |
| Satd. Flow (perm) | 1770 | 3501 | | 1770 | 3536 | | | 1717 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 1 | 963 | 75 | 7 | 1010 | 7 | 49 | 0 | 14 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 1 | 1035 | 0 | 7 | 1017 | 0 | 0 | 53 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | | 4 | | |
| Actuated Green, G (s) | 1.0 | 67.6 | | 1.2 | 67.8 | | | 13.7 | | | | |
| Effective Green, g (s) | 1.0 | 67.6 | | 1.2 | 67.8 | | | 13.7 | | | | |
| Actuated g/C Ratio | 0.01 | 0.68 | | 0.01 | 0.68 | | | 0.14 | | | | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | | | | |
| Lane Grp Cap (vph) | 18 | 2367 | | 21 | 2397 | | | 235 | | | | |
| v/s Ratio Prot | 0.00 | c0.30 | | c0.00 | 0.29 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.03 | | | | |
| v/c Ratio | 0.06 | 0.44 | | 0.33 | 0.42 | | | 0.22 | | | | |
| Uniform Delay, d1 | 49.0 | 7.5 | | 49.0 | 7.3 | | | 38.4 | | | | |
| Progression Factor | 1.00 | 1.00 | | 0.98 | 0.30 | | | 1.00 | | | | |
| Incremental Delay, d2 | 0.5 | 0.6 | | 2.6 | 0.4 | | | 0.2 | | | | |
| Delay (s) | 49.5 | 8.0 | | 50.7 | 2.6 | | | 38.6 | | | | |
| Level of Service | D | A | | D | A | | | D | | | | |
| Approach Delay (s) | | 8.1 | | | 3.0 | | | 38.6 | | | 0.0 | |
| Approach LOS | | A | | | A | | | D | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 6.5 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.40 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 17.5 |
| Intersection Capacity Utilization | 40.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 154 | 589 | 102 | 94 | 701 | 119 | 109 | 200 | 68 | 175 | 543 | 126 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.91 | |
| Frt | 1.00 | 0.98 | | 1.00 | 0.98 | | 1.00 | 1.00 | 0.85 | 1.00 | 0.97 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 3461 | | 1770 | 3462 | | 1770 | 3539 | 1583 | 1770 | 4942 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 3461 | | 1770 | 3462 | | 1770 | 3539 | 1583 | 1770 | 4942 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 167 | 640 | 111 | 102 | 762 | 129 | 118 | 217 | 74 | 190 | 590 | 137 |
| RTOR Reduction (vph) | 0 | 14 | 0 | 0 | 14 | 0 | 0 | 0 | 68 | 0 | 38 | 0 |
| Lane Group Flow (vph) | 167 | 737 | 0 | 102 | 877 | 0 | 118 | 217 | 6 | 190 | 689 | 0 |
| Turn Type | Prot | | | Prot | | | Prot | | Perm | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 7 | 4 | | 3 | 8 | |
| Permitted Phases | | | | | | | | | 4 | | | |
| Actuated Green, G (s) | 11.7 | 43.5 | | 9.5 | 41.3 | | 7.0 | 8.0 | 8.0 | 14.0 | 15.0 | |
| Effective Green, g (s) | 11.7 | 43.5 | | 9.5 | 41.3 | | 7.0 | 8.0 | 8.0 | 14.0 | 15.0 | |
| Actuated g/C Ratio | 0.12 | 0.44 | | 0.10 | 0.41 | | 0.07 | 0.08 | 0.08 | 0.14 | 0.15 | |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Vehicle Extension (s) | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 3.5 | 3.5 | 2.0 | 3.5 | |
| Lane Grp Cap (vph) | 207 | 1506 | | 168 | 1430 | | 124 | 283 | 127 | 248 | 741 | |
| v/s Ratio Prot | c0.09 | 0.21 | | 0.06 | c0.25 | | 0.07 | 0.06 | | c0.11 | c0.14 | |
| v/s Ratio Perm | | | | | | | | | 0.00 | | | |
| v/c Ratio | 0.81 | 0.49 | | 0.61 | 0.61 | | 0.95 | 0.77 | 0.05 | 0.77 | 0.93 | |
| Uniform Delay, d1 | 43.0 | 20.3 | | 43.5 | 23.1 | | 46.3 | 45.1 | 42.5 | 41.4 | 42.0 | |
| Progression Factor | 0.86 | 0.79 | | 0.92 | 0.88 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Incremental Delay, d2 | 17.9 | 1.1 | | 4.0 | 1.9 | | 65.1 | 12.1 | 0.2 | 12.0 | 18.1 | |
| Delay (s) | 54.8 | 17.0 | | 44.0 | 22.1 | | 111.4 | 57.2 | 42.7 | 53.4 | 60.1 | |
| Level of Service | D | B | | D | C | | F | E | D | D | E | |
| Approach Delay (s) | | 23.9 | | | 24.3 | | | 70.2 | | | 58.7 | |
| Approach LOS | | C | | | C | | | E | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 39.7 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.75 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 25.0 |
| Intersection Capacity Utilization | 71.9% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 22 | 884 | 1 | 3 | 800 | 76 | 65 | 17 | 42 | 1 | 14 | 10 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Lane Util. Factor | | 0.95 | | | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | | 1.00 | | | 0.99 | | | 0.95 | | | 0.94 | |
| Flt Protected | | 1.00 | | | 1.00 | | | 0.97 | | | 1.00 | |
| Satd. Flow (prot) | | 3534 | | | 3493 | | | 1732 | | | 1757 | |
| Flt Permitted | | 0.91 | | | 0.95 | | | 0.82 | | | 0.99 | |
| Satd. Flow (perm) | | 3237 | | | 3329 | | | 1458 | | | 1744 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 24 | 961 | 1 | 3 | 870 | 83 | 71 | 18 | 46 | 1 | 15 | 11 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 20 | 0 | 0 | 10 | 0 |
| Lane Group Flow (vph) | 0 | 986 | 0 | 0 | 951 | 0 | 0 | 115 | 0 | 0 | 17 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 6 | | | 2 | | | 8 | | | 4 | |
| Permitted Phases | 6 | | | 2 | | | 8 | | | 4 | | |
| Actuated Green, G (s) | | 77.0 | | | 77.0 | | | 12.5 | | | 12.5 | |
| Effective Green, g (s) | | 77.0 | | | 77.0 | | | 12.5 | | | 12.5 | |
| Actuated g/C Ratio | | 0.77 | | | 0.77 | | | 0.12 | | | 0.12 | |
| Clearance Time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | | 2492 | | | 2563 | | | 182 | | | 218 | |
| v/s Ratio Prot | | | | | | | | | | | | |
| v/s Ratio Perm | | c0.30 | | | 0.29 | | | c0.08 | | | 0.01 | |
| v/c Ratio | | 0.40 | | | 0.37 | | | 0.63 | | | 0.08 | |
| Uniform Delay, d1 | | 3.8 | | | 3.7 | | | 41.6 | | | 38.7 | |
| Progression Factor | | 0.27 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.4 | | | 0.4 | | | 5.2 | | | 0.1 | |
| Delay (s) | | 1.4 | | | 4.1 | | | 46.7 | | | 38.7 | |
| Level of Service | | A | | | A | | | D | | | D | |
| Approach Delay (s) | | 1.4 | | | 4.1 | | | 46.7 | | | 38.7 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 6.0 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.43 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 10.5 |
| Intersection Capacity Utilization | 62.7% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 6 | 897 | 57 | 81 | 879 | 8 | 90 | 11 | 207 | 73 | 11 | 11 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | 5.5 | 5.5 | | 4.0 | 5.5 | |
| Lane Util. Factor | 1.00 | 0.91 | | 1.00 | 0.91 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | 1.00 | 0.86 | | 1.00 | 0.93 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 5040 | | 1770 | 5078 | | 1770 | 1597 | | 1770 | 1723 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 5040 | | 1770 | 5078 | | 1770 | 1597 | | 1770 | 1723 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 7 | 975 | 62 | 88 | 955 | 9 | 98 | 12 | 225 | 79 | 12 | 12 |
| RTOR Reduction (vph) | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 209 | 0 | 0 | 11 | 0 |
| Lane Group Flow (vph) | 7 | 1032 | 0 | 88 | 963 | 0 | 98 | 28 | 0 | 79 | 13 | 0 |
| Parking (#/hr) | | | | | | | | | 0 | | | |
| Turn Type | Prot | | | Prot | | | Prot | | | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 3 | 8 | | 7 | 4 | |
| Permitted Phases | | | | | | | | | | | | |
| Actuated Green, G (s) | 1.0 | 59.8 | | 8.7 | 67.5 | | 12.1 | 8.0 | | 12.0 | 6.4 | |
| Effective Green, g (s) | 1.0 | 59.8 | | 8.7 | 67.5 | | 12.1 | 8.0 | | 12.0 | 6.4 | |
| Actuated g/C Ratio | 0.01 | 0.54 | | 0.08 | 0.61 | | 0.11 | 0.07 | | 0.11 | 0.06 | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | 5.5 | 5.5 | | 4.0 | 5.5 | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | 3.0 | 2.0 | |
| Lane Grp Cap (vph) | 16 | 2740 | | 140 | 3116 | | 195 | 116 | | 193 | 100 | |
| v/s Ratio Prot | 0.00 | c0.20 | | c0.05 | 0.19 | | c0.06 | 0.02 | | c0.04 | 0.01 | |
| v/s Ratio Perm | | | | | | | | | | | | |
| v/c Ratio | 0.44 | 0.38 | | 0.63 | 0.31 | | 0.50 | 0.24 | | 0.41 | 0.13 | |
| Uniform Delay, d1 | 54.2 | 14.4 | | 49.1 | 10.1 | | 46.1 | 48.1 | | 45.7 | 49.1 | |
| Progression Factor | 1.00 | 1.00 | | 1.13 | 0.42 | | 1.00 | 1.00 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | 6.8 | 0.4 | | 4.3 | 0.2 | | 0.7 | 0.4 | | 1.4 | 0.2 | |
| Delay (s) | 61.0 | 14.8 | | 60.0 | 4.4 | | 46.9 | 48.5 | | 47.1 | 49.4 | |
| Level of Service | E | B | | E | A | | D | D | | D | D | |
| Approach Delay (s) | | 15.1 | | | 9.1 | | | 48.1 | | | 47.6 | |
| Approach LOS | | B | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 18.3 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.43 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 21.5 |
| Intersection Capacity Utilization | 58.4% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 694 | 274 | 235 | 1288 | 0 | 0 | 0 | 0 | 402 | 94 | 644 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | 6.0 | 6.0 | | | | | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | | 0.91 | 1.00 | 0.86 | 0.86 | | | | | 0.91 | 0.86 | 0.95 |
| Frt | | 1.00 | 0.85 | 1.00 | 1.00 | | | | | 1.00 | 0.90 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | 0.95 | 1.00 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (prot) | | 5085 | 1583 | 1522 | 4802 | | | | | 3221 | 1435 | 1504 |
| Flt Permitted | | 1.00 | 1.00 | 0.95 | 0.61 | | | | | 0.95 | 0.99 | 1.00 |
| Satd. Flow (perm) | | 5085 | 1583 | 1522 | 2916 | | | | | 3221 | 1435 | 1504 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 754 | 298 | 255 | 1400 | 0 | 0 | 0 | 0 | 437 | 102 | 700 |
| RTOR Reduction (vph) | 0 | 0 | 257 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 64 | 219 |
| Lane Group Flow (vph) | 0 | 754 | 41 | 229 | 1426 | 0 | 0 | 0 | 0 | 393 | 369 | 194 |
| Turn Type | | | Perm | Prot | | | | | | Split | | Prot |
| Protected Phases | | 6 | | 5 | 2 5 | | | | | 8 | 8 | 8 |
| Permitted Phases | | | 6 | | | | | | | | | |
| Actuated Green, G (s) | | 15.0 | 15.0 | 53.0 | 53.0 | | | | | 24.0 | 24.0 | 24.0 |
| Effective Green, g (s) | | 15.0 | 15.0 | 53.0 | 53.0 | | | | | 24.0 | 24.0 | 24.0 |
| Actuated g/C Ratio | | 0.14 | 0.14 | 0.48 | 0.48 | | | | | 0.22 | 0.22 | 0.22 |
| Clearance Time (s) | | 6.0 | 6.0 | 6.0 | | | | | | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | | 1.0 | 1.0 | 1.0 | | | | | | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | | 693 | 216 | 733 | 2314 | | | | | 703 | 313 | 328 |
| v/s Ratio Prot | | c0.15 | | 0.15 | c0.30 | | | | | 0.12 | c0.26 | 0.13 |
| v/s Ratio Perm | | | 0.03 | | | | | | | | | |
| v/c Ratio | | 1.09 | 0.19 | 0.31 | 0.62 | | | | | 0.56 | 1.18 | 0.59 |
| Uniform Delay, d1 | | 47.5 | 42.1 | 17.4 | 21.0 | | | | | 38.3 | 43.0 | 38.6 |
| Progression Factor | | 0.80 | 1.60 | 0.25 | 0.21 | | | | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | | 59.7 | 1.8 | 0.1 | 0.1 | | | | | 3.2 | 108.5 | 7.6 |
| Delay (s) | | 97.6 | 69.0 | 4.4 | 4.5 | | | | | 41.5 | 151.5 | 46.2 |
| Level of Service | | F | E | A | A | | | | | D | F | D |
| Approach Delay (s) | | 89.5 | | | 4.5 | | | 0.0 | | | 81.5 | |
| Approach LOS | | F | | | A | | | A | | | F | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 51.3 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.84 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 105.6% | ICU Level of Service | G |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 402 | 694 | 0 | 0 | 829 | 415 | 694 | 199 | 102 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Lane Util. Factor | 0.91 | 0.91 | | | 0.91 | 1.00 | | 0.95 | 1.00 | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | | 1.00 | 0.85 | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (prot) | 1610 | 3379 | | | 5085 | 1583 | | 3407 | 1583 | | | |
| Flt Permitted | 0.95 | 0.46 | | | 1.00 | 1.00 | | 0.96 | 1.00 | | | |
| Satd. Flow (perm) | 1610 | 1543 | | | 5085 | 1583 | | 3407 | 1583 | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 437 | 754 | 0 | 0 | 901 | 451 | 754 | 216 | 111 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 265 | 0 | 0 | 78 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 385 | 806 | 0 | 0 | 901 | 186 | 0 | 970 | 33 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Split | | Prot | | | |
| Protected Phases | 1 | 1 6 | | | 2 | | 4 | 4 | 4 | | | |
| Permitted Phases | | | | | | 2 | | | | | | |
| Actuated Green, G (s) | 45.0 | 45.0 | | | 18.0 | 18.0 | | 29.0 | 29.0 | | | |
| Effective Green, g (s) | 45.0 | 45.0 | | | 18.0 | 18.0 | | 29.0 | 29.0 | | | |
| Actuated g/C Ratio | 0.41 | 0.41 | | | 0.16 | 0.16 | | 0.26 | 0.26 | | | |
| Clearance Time (s) | 6.0 | | | | 6.0 | 6.0 | | 6.0 | 6.0 | | | |
| Vehicle Extension (s) | 1.0 | | | | 1.0 | 1.0 | | 1.0 | 1.0 | | | |
| Lane Grp Cap (vph) | 659 | 1382 | | | 832 | 259 | | 898 | 417 | | | |
| v/s Ratio Prot | c0.24 | 0.24 | | | c0.18 | | | c0.28 | 0.02 | | | |
| v/s Ratio Perm | | | | | | 0.12 | | | | | | |
| v/c Ratio | 0.58 | 0.58 | | | 1.08 | 0.72 | | 1.61dl | 0.08 | | | |
| Uniform Delay, d1 | 25.2 | 25.2 | | | 46.0 | 43.6 | | 40.5 | 30.5 | | | |
| Progression Factor | 0.11 | 0.10 | | | 0.73 | 0.81 | | 1.00 | 1.00 | | | |
| Incremental Delay, d2 | 1.5 | 0.7 | | | 52.7 | 12.4 | | 54.1 | 0.4 | | | |
| Delay (s) | 4.1 | 3.1 | | | 86.5 | 47.6 | | 94.6 | 30.8 | | | |
| Level of Service | A | A | | | F | D | | F | C | | | |
| Approach Delay (s) | | 3.4 | | | 73.5 | | | 88.0 | | | 0.0 | |
| Approach LOS | | A | | | E | | | F | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 54.8 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.84 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.0 |
| Intersection Capacity Utilization | 105.6% | ICU Level of Service | G |
| Analysis Period (min) | 15 | | |

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 13 | 1000 | 85 | 80 | 1147 | 45 | 53 | 25 | 101 | 52 | 11 | 71 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lane Util. Factor | 1.00 | 0.91 | | 1.00 | 0.95 | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 0.99 | | | 1.00 | 0.85 | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.97 | 1.00 | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 5026 | | 1770 | 3519 | | | 1801 | 1583 | 1770 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.79 | 1.00 | 0.24 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 5026 | | 1770 | 3519 | | | 1469 | 1583 | 454 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 14 | 1087 | 92 | 87 | 1247 | 49 | 58 | 27 | 110 | 57 | 12 | 77 |
| RTOR Reduction (vph) | 0 | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 99 | 0 | 0 | 66 |
| Lane Group Flow (vph) | 14 | 1172 | 0 | 87 | 1294 | 0 | 0 | 85 | 11 | 57 | 12 | 11 |
| Turn Type | Prot | | | Prot | | | Perm | | Perm | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 4 | | | 3 | |
| Permitted Phases | | | | | | | 4 | | 4 | 3 | | 3 |
| Actuated Green, G (s) | 2.0 | 49.2 | | 8.7 | 55.9 | | | 10.7 | 10.7 | 16.4 | 16.4 | 16.4 |
| Effective Green, g (s) | 2.0 | 49.2 | | 8.7 | 55.9 | | | 10.7 | 10.7 | 16.4 | 16.4 | 16.4 |
| Actuated g/C Ratio | 0.02 | 0.45 | | 0.08 | 0.51 | | | 0.10 | 0.10 | 0.15 | 0.15 | 0.15 |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Vehicle Extension (s) | 2.0 | 1.5 | | 2.0 | 1.5 | | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 32 | 2248 | | 140 | 1788 | | | 143 | 154 | 68 | 278 | 236 |
| v/s Ratio Prot | 0.01 | c0.23 | | 0.05 | c0.37 | | | | | | 0.01 | |
| v/s Ratio Perm | | | | | | | | c0.06 | 0.01 | c0.13 | | 0.01 |
| v/c Ratio | 0.44 | 0.52 | | 0.62 | 0.72 | | | 0.59 | 0.07 | 0.84 | 0.04 | 0.05 |
| Uniform Delay, d1 | 53.4 | 21.9 | | 49.1 | 21.0 | | | 47.6 | 45.1 | 45.5 | 40.1 | 40.1 |
| Progression Factor | 0.66 | 0.41 | | 1.24 | 0.56 | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 3.2 | 0.8 | | 5.9 | 2.5 | | | 4.4 | 0.1 | 54.5 | 0.0 | 0.0 |
| Delay (s) | 38.4 | 9.8 | | 66.9 | 14.3 | | | 51.9 | 45.2 | 100.0 | 40.1 | 40.1 |
| Level of Service | D | A | | E | B | | | D | D | F | D | D |
| Approach Delay (s) | | 10.2 | | | 17.6 | | | 48.1 | | | 63.5 | |
| Approach LOS | | B | | | B | | | D | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 18.9 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.69 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.5 |
| Intersection Capacity Utilization | 64.1% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 14 | 845 | 86 | 75 | 933 | 2 | 48 | 13 | 70 | 25 | 7 | 12 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | 1.00 | 0.87 | | | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | 1.00 |
| Satd. Flow (prot) | 1770 | 3490 | | 1770 | 3538 | | 1770 | 1627 | | | 1794 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.73 | 1.00 | | | 0.72 | 1.00 |
| Satd. Flow (perm) | 1770 | 3490 | | 1770 | 3538 | | 1368 | 1627 | | | 1334 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 15 | 918 | 93 | 82 | 1014 | 2 | 52 | 14 | 76 | 27 | 8 | 13 |
| RTOR Reduction (vph) | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 71 | 0 | 0 | 0 | 12 |
| Lane Group Flow (vph) | 15 | 1007 | 0 | 82 | 1016 | 0 | 52 | 19 | 0 | 0 | 35 | 1 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | Perm |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 8 | | | 4 | |
| Permitted Phases | | | | | | | 8 | | | 4 | | 4 |
| Actuated Green, G (s) | 2.6 | 75.2 | | 10.6 | 83.2 | | 7.7 | 7.7 | | | 7.7 | 7.7 |
| Effective Green, g (s) | 2.6 | 75.2 | | 10.6 | 83.2 | | 7.7 | 7.7 | | | 7.7 | 7.7 |
| Actuated g/C Ratio | 0.02 | 0.68 | | 0.10 | 0.76 | | 0.07 | 0.07 | | | 0.07 | 0.07 |
| Clearance Time (s) | 5.5 | 5.5 | | 5.5 | 5.5 | | 5.5 | 5.5 | | | 5.5 | 5.5 |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | 2.0 | 2.0 | | | 2.0 | 2.0 |
| Lane Grp Cap (vph) | 42 | 2386 | | 171 | 2676 | | 96 | 114 | | | 93 | 111 |
| v/s Ratio Prot | 0.01 | c0.29 | | c0.05 | 0.29 | | | 0.01 | | | | |
| v/s Ratio Perm | | | | | | | c0.04 | | | | 0.03 | 0.00 |
| v/c Ratio | 0.36 | 0.42 | | 0.48 | 0.38 | | 0.54 | 0.17 | | | 0.38 | 0.01 |
| Uniform Delay, d1 | 52.9 | 7.7 | | 47.1 | 4.6 | | 49.4 | 48.1 | | | 48.9 | 47.6 |
| Progression Factor | 1.52 | 0.19 | | 0.59 | 0.22 | | 1.00 | 1.00 | | | 1.00 | 1.00 |
| Incremental Delay, d2 | 1.7 | 0.5 | | 0.6 | 0.3 | | 3.3 | 0.3 | | | 0.9 | 0.0 |
| Delay (s) | 82.2 | 1.9 | | 28.5 | 1.3 | | 52.8 | 48.4 | | | 49.8 | 47.6 |
| Level of Service | F | A | | C | A | | D | D | | | D | D |
| Approach Delay (s) | | 3.1 | | | 3.4 | | | 50.0 | | | 49.2 | |
| Approach LOS | | A | | | A | | | D | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 7.1 | HCM Level of Service | A |
| HCM Volume to Capacity ratio | 0.44 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 16.5 |
| Intersection Capacity Utilization | 53.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 5 | 813 | 78 | 12 | 1322 | 4 | 73 | 0 | 16 | 4 | 0 | 11 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | 5.5 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | 1.00 | 0.99 | | 1.00 | 1.00 | | | 0.98 | | | 0.90 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.96 | | | 0.99 | |
| Satd. Flow (prot) | 1770 | 3493 | | 1770 | 3538 | | | 1746 | | | 1653 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | | 0.34 | | | 1.00 | |
| Satd. Flow (perm) | 1770 | 3493 | | 1770 | 3538 | | | 622 | | | 1674 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 884 | 85 | 13 | 1437 | 4 | 79 | 0 | 17 | 4 | 0 | 12 |
| RTOR Reduction (vph) | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 12 | 0 |
| Lane Group Flow (vph) | 5 | 965 | 0 | 13 | 1441 | 0 | 0 | 89 | 0 | 0 | 4 | 0 |
| Turn Type | Prot | | | Prot | | | Perm | | | Perm | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | | 3 | | | 4 | |
| Permitted Phases | | | | | | | 3 | | | 4 | | |
| Actuated Green, G (s) | 1.0 | 69.6 | | 2.5 | 71.1 | | | 12.5 | | | 2.4 | |
| Effective Green, g (s) | 1.0 | 69.6 | | 2.5 | 71.1 | | | 12.5 | | | 2.4 | |
| Actuated g/C Ratio | 0.01 | 0.63 | | 0.02 | 0.65 | | | 0.11 | | | 0.02 | |
| Clearance Time (s) | 6.0 | 6.0 | | 6.0 | 6.0 | | | 5.5 | | | 5.5 | |
| Vehicle Extension (s) | 2.0 | 3.0 | | 2.0 | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | 16 | 2210 | | 40 | 2287 | | | 71 | | | 37 | |
| v/s Ratio Prot | 0.00 | c0.28 | | 0.01 | c0.41 | | | | | | | |
| v/s Ratio Perm | | | | | | | | c0.14 | | | c0.00 | |
| v/c Ratio | 0.31 | 0.44 | | 0.33 | 0.63 | | | 1.25 | | | 0.12 | |
| Uniform Delay, d1 | 54.2 | 10.2 | | 52.9 | 11.6 | | | 48.8 | | | 52.8 | |
| Progression Factor | 0.57 | 0.38 | | 1.26 | 0.59 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | 3.8 | 0.6 | | 1.4 | 1.1 | | | 189.1 | | | 0.5 | |
| Delay (s) | 34.8 | 4.5 | | 67.9 | 7.9 | | | 237.8 | | | 53.3 | |
| Level of Service | C | A | | E | A | | | F | | | D | |
| Approach Delay (s) | | 4.6 | | | 8.5 | | | 237.8 | | | 53.3 | |
| Approach LOS | | A | | | A | | | F | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 16.0 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.67 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 17.0 |
| Intersection Capacity Utilization | 57.9% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 86 | 572 | 166 | 127 | 745 | 96 | 161 | 605 | 196 | 181 | 323 | 115 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Lane Util. Factor | 1.00 | 0.95 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 | 1.00 | 0.91 | |
| Frt | 1.00 | 0.97 | | 1.00 | 0.98 | | 1.00 | 1.00 | 0.85 | 1.00 | 0.96 | |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (prot) | 1770 | 3420 | | 1770 | 3479 | | 1770 | 3539 | 1583 | 1770 | 4885 | |
| Flt Permitted | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 | 0.95 | 1.00 | |
| Satd. Flow (perm) | 1770 | 3420 | | 1770 | 3479 | | 1770 | 3539 | 1583 | 1770 | 4885 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 93 | 622 | 180 | 138 | 810 | 104 | 175 | 658 | 213 | 197 | 351 | 125 |
| RTOR Reduction (vph) | 0 | 24 | 0 | 0 | 9 | 0 | 0 | 0 | 101 | 0 | 60 | 0 |
| Lane Group Flow (vph) | 93 | 778 | 0 | 138 | 905 | 0 | 175 | 658 | 112 | 197 | 416 | 0 |
| Turn Type | Prot | | | Prot | | | Prot | | Perm | Prot | | |
| Protected Phases | 1 | 6 | | 5 | 2 | | 7 | 4 | | 3 | 8 | |
| Permitted Phases | | | | | | | | | 4 | | | |
| Actuated Green, G (s) | 8.5 | 39.0 | | 10.2 | 40.7 | | 21.0 | 22.1 | 22.1 | 13.7 | 14.8 | |
| Effective Green, g (s) | 8.5 | 39.0 | | 10.2 | 40.7 | | 21.0 | 22.1 | 22.1 | 13.7 | 14.8 | |
| Actuated g/C Ratio | 0.08 | 0.35 | | 0.09 | 0.37 | | 0.19 | 0.20 | 0.20 | 0.12 | 0.13 | |
| Clearance Time (s) | 6.5 | 6.5 | | 6.5 | 6.5 | | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | |
| Vehicle Extension (s) | 2.0 | 2.0 | | 2.0 | 2.0 | | 2.0 | 3.5 | 3.5 | 2.0 | 3.5 | |
| Lane Grp Cap (vph) | 137 | 1213 | | 164 | 1287 | | 338 | 711 | 318 | 220 | 657 | |
| v/s Ratio Prot | 0.05 | 0.23 | | c0.08 | c0.26 | | 0.10 | c0.19 | | c0.11 | 0.09 | |
| v/s Ratio Perm | | | | | | | | | 0.07 | | | |
| v/c Ratio | 0.68 | 0.64 | | 0.84 | 0.70 | | 0.52 | 0.93 | 0.35 | 0.90 | 0.63 | |
| Uniform Delay, d1 | 49.4 | 29.7 | | 49.1 | 29.5 | | 40.0 | 43.1 | 37.8 | 47.4 | 45.0 | |
| Progression Factor | 0.85 | 0.31 | | 0.70 | 0.44 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Incremental Delay, d2 | 9.3 | 2.4 | | 24.1 | 2.5 | | 0.6 | 18.1 | 0.8 | 33.0 | 2.1 | |
| Delay (s) | 51.5 | 11.5 | | 58.4 | 15.5 | | 40.5 | 61.3 | 38.6 | 80.5 | 47.1 | |
| Level of Service | D | B | | E | B | | D | E | D | F | D | |
| Approach Delay (s) | | 15.7 | | | 21.1 | | | 53.2 | | | 56.9 | |
| Approach LOS | | B | | | C | | | D | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 35.5 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.76 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 18.5 |
| Intersection Capacity Utilization | 76.0% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | SEL | SET | SER | NWL | NWT | NWR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 5 | 1070 | 3 | 1 | 1019 | 60 | 324 | 38 | 21 | 0 | 13 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Lane Util. Factor | | 0.95 | | | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | | 1.00 | | | 0.99 | | | 0.99 | | | 0.98 | |
| Flt Protected | | 1.00 | | | 1.00 | | | 0.96 | | | 1.00 | |
| Satd. Flow (prot) | | 3537 | | | 3510 | | | 1774 | | | 1818 | |
| Flt Permitted | | 0.95 | | | 0.95 | | | 0.75 | | | 1.00 | |
| Satd. Flow (perm) | | 3361 | | | 3350 | | | 1381 | | | 1818 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 1163 | 3 | 1 | 1108 | 65 | 352 | 41 | 23 | 0 | 14 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 | 2 | 0 |
| Lane Group Flow (vph) | 0 | 1171 | 0 | 0 | 1171 | 0 | 0 | 414 | 0 | 0 | 15 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 6 | | | 2 | | | 8 | | | 4 | |
| Permitted Phases | 6 | | | 2 | | | 8 | | | 4 | | |
| Actuated Green, G (s) | | 61.7 | | | 61.7 | | | 37.8 | | | 37.8 | |
| Effective Green, g (s) | | 61.7 | | | 61.7 | | | 37.8 | | | 37.8 | |
| Actuated g/C Ratio | | 0.56 | | | 0.56 | | | 0.34 | | | 0.34 | |
| Clearance Time (s) | | 5.5 | | | 5.5 | | | 5.0 | | | 5.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 2.0 | | | 2.0 | |
| Lane Grp Cap (vph) | | 1885 | | | 1879 | | | 475 | | | 625 | |
| v/s Ratio Prot | | | | | | | | | | | 0.01 | |
| v/s Ratio Perm | | 0.35 | | | c0.35 | | | c0.30 | | | | |
| v/c Ratio | | 0.62 | | | 0.62 | | | 0.87 | | | 0.02 | |
| Uniform Delay, d1 | | 16.3 | | | 16.3 | | | 33.8 | | | 23.9 | |
| Progression Factor | | 0.48 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 1.4 | | | 1.6 | | | 15.5 | | | 0.0 | |
| Delay (s) | | 9.2 | | | 17.9 | | | 49.4 | | | 23.9 | |
| Level of Service | | A | | | B | | | D | | | C | |
| Approach Delay (s) | | 9.2 | | | 17.9 | | | 49.4 | | | 23.9 | |
| Approach LOS | | A | | | B | | | D | | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 19.0 | HCM Level of Service | B |
| HCM Volume to Capacity ratio | 0.72 | | |
| Actuated Cycle Length (s) | 110.0 | Sum of lost time (s) | 10.5 |
| Intersection Capacity Utilization | 69.8% | ICU Level of Service | C |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 637 | 44 | 357 | 767 | 0 | 0 | 0 | 0 | 719 | 68 | 469 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Lane Util. Factor | | 0.95 | | 1.00 | 0.95 | | | | | 1.00 | 1.00 | |
| Frt | | 0.99 | | 1.00 | 1.00 | | | | | 1.00 | 0.87 | |
| Flt Protected | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 3505 | | 1770 | 3539 | | | | | 1770 | 1619 | |
| Flt Permitted | | 1.00 | | 0.14 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (perm) | | 3505 | | 261 | 3539 | | | | | 1770 | 1619 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 692 | 48 | 388 | 834 | 0 | 0 | 0 | 0 | 782 | 74 | 510 |
| RTOR Reduction (vph) | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 0 |
| Lane Group Flow (vph) | 0 | 735 | 0 | 388 | 834 | 0 | 0 | 0 | 0 | 782 | 529 | 0 |
| Turn Type | | | | pm+pt | | | | | | Perm | | |
| Protected Phases | | 6 | | 5 | 2 | | | | | | 4 | |
| Permitted Phases | | | | 2 | | | | | | 4 | | |
| Actuated Green, G (s) | | 22.1 | | 45.3 | 45.3 | | | | | 42.2 | 42.2 | |
| Effective Green, g (s) | | 22.1 | | 45.3 | 45.3 | | | | | 42.2 | 42.2 | |
| Actuated g/C Ratio | | 0.22 | | 0.45 | 0.45 | | | | | 0.42 | 0.42 | |
| Clearance Time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Vehicle Extension (s) | | 2.0 | | 2.0 | 2.0 | | | | | 2.0 | 2.0 | |
| Lane Grp Cap (vph) | | 775 | | 370 | 1603 | | | | | 747 | 683 | |
| v/s Ratio Prot | | 0.21 | | c0.18 | 0.24 | | | | | | 0.33 | |
| v/s Ratio Perm | | | | c0.30 | | | | | | c0.44 | | |
| v/c Ratio | | 0.95 | | 1.05 | 0.52 | | | | | 1.05 | 0.77 | |
| Uniform Delay, d1 | | 38.4 | | 28.2 | 19.6 | | | | | 28.9 | 24.8 | |
| Progression Factor | | 1.00 | | 1.22 | 0.54 | | | | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 21.8 | | 52.1 | 0.8 | | | | | 45.8 | 5.0 | |
| Delay (s) | | 60.2 | | 86.6 | 11.3 | | | | | 74.7 | 29.8 | |
| Level of Service | | E | | F | B | | | | | E | C | |
| Approach Delay (s) | | 60.2 | | | 35.2 | | | 0.0 | | | 55.5 | |
| Approach LOS | | E | | | D | | | A | | | E | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 49.1 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 1.01 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 12.5 |
| Intersection Capacity Utilization | 94.5% | ICU Level of Service | F |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 775 | 690 | 0 | 0 | 833 | 262 | 259 | 75 | 310 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Lane Util. Factor | 0.97 | 1.00 | | | 0.95 | 1.00 | 1.00 | 1.00 | | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | 1.00 | 0.88 | | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (prot) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1638 | | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (perm) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1638 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 842 | 750 | 0 | 0 | 905 | 285 | 282 | 82 | 337 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 144 | 0 | 152 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 842 | 750 | 0 | 0 | 905 | 141 | 282 | 267 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | | | | |
| Protected Phases | 1 | 6 | | | 2 | | | 8 | | | | |
| Permitted Phases | | | | | | 2 | 8 | | | | | |
| Actuated Green, G (s) | 26.7 | 68.4 | | | 34.7 | 34.7 | 19.1 | 19.1 | | | | |
| Effective Green, g (s) | 26.7 | 68.4 | | | 34.7 | 34.7 | 19.1 | 19.1 | | | | |
| Actuated g/C Ratio | 0.27 | 0.68 | | | 0.35 | 0.35 | 0.19 | 0.19 | | | | |
| Clearance Time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Vehicle Extension (s) | 2.0 | 2.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | | | | |
| Lane Grp Cap (vph) | 917 | 1274 | | | 1228 | 549 | 338 | 313 | | | | |
| v/s Ratio Prot | c0.25 | 0.40 | | | c0.26 | | | c0.16 | | | | |
| v/s Ratio Perm | | | | | | 0.09 | 0.16 | | | | | |
| v/c Ratio | 0.92 | 0.59 | | | 0.74 | 0.26 | 0.83 | 0.85 | | | | |
| Uniform Delay, d1 | 35.6 | 8.4 | | | 28.6 | 23.4 | 38.9 | 39.1 | | | | |
| Progression Factor | 1.32 | 1.07 | | | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| Incremental Delay, d2 | 5.9 | 0.8 | | | 4.0 | 1.1 | 15.4 | 18.9 | | | | |
| Delay (s) | 52.8 | 9.7 | | | 32.6 | 24.5 | 54.3 | 58.0 | | | | |
| Level of Service | D | A | | | C | C | D | E | | | | |
| Approach Delay (s) | | 32.5 | | | 30.7 | | | 56.5 | | | 0.0 | |
| Approach LOS | | C | | | C | | | E | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 36.7 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.82 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 19.5 |
| Intersection Capacity Utilization | 94.5% | ICU Level of Service | F |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 765 | 42 | 322 | 385 | 0 | 0 | 0 | 0 | 334 | 47 | 172 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Lane Util. Factor | | 0.95 | | 1.00 | 0.95 | | | | | 1.00 | 1.00 | |
| Frt | | 0.99 | | 1.00 | 1.00 | | | | | 1.00 | 0.88 | |
| Flt Protected | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | 3511 | | 1770 | 3539 | | | | | 1770 | 1643 | |
| Flt Permitted | | 1.00 | | 0.95 | 1.00 | | | | | 0.95 | 1.00 | |
| Satd. Flow (perm) | | 3511 | | 1770 | 3539 | | | | | 1770 | 1643 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 832 | 46 | 350 | 418 | 0 | 0 | 0 | 0 | 363 | 51 | 187 |
| RTOR Reduction (vph) | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 144 | 0 |
| Lane Group Flow (vph) | 0 | 874 | 0 | 350 | 418 | 0 | 0 | 0 | 0 | 363 | 94 | 0 |
| Turn Type | | | | Prot | | | | | | Perm | | |
| Protected Phases | | 6 | | 5 | 2 | | | | | | 4 | |
| Permitted Phases | | | | | | | | | | 4 | | |
| Actuated Green, G (s) | | 30.0 | | 20.4 | 56.9 | | | | | 20.6 | 20.6 | |
| Effective Green, g (s) | | 30.0 | | 20.4 | 56.9 | | | | | 20.6 | 20.6 | |
| Actuated g/C Ratio | | 0.33 | | 0.23 | 0.63 | | | | | 0.23 | 0.23 | |
| Clearance Time (s) | | 6.5 | | 6.5 | 6.5 | | | | | 6.0 | 6.0 | |
| Vehicle Extension (s) | | 2.0 | | 2.0 | 2.0 | | | | | 2.0 | 2.0 | |
| Lane Grp Cap (vph) | | 1170 | | 401 | 2237 | | | | | 405 | 376 | |
| v/s Ratio Prot | | c0.25 | | c0.20 | 0.12 | | | | | | 0.06 | |
| v/s Ratio Perm | | | | | | | | | | c0.21 | | |
| v/c Ratio | | 0.75 | | 0.87 | 0.19 | | | | | 0.90 | 0.25 | |
| Uniform Delay, d1 | | 26.6 | | 33.5 | 6.9 | | | | | 33.7 | 28.4 | |
| Progression Factor | | 1.00 | | 0.81 | 1.85 | | | | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | 4.4 | | 16.5 | 0.2 | | | | | 21.2 | 0.1 | |
| Delay (s) | | 31.0 | | 43.6 | 12.9 | | | | | 54.9 | 28.5 | |
| Level of Service | | C | | D | B | | | | | D | C | |
| Approach Delay (s) | | 31.0 | | | 26.9 | | | 0.0 | | | 44.4 | |
| Approach LOS | | C | | | C | | | A | | | D | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 33.2 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.83 | | |
| Actuated Cycle Length (s) | 90.0 | Sum of lost time (s) | 19.0 |
| Intersection Capacity Utilization | 74.7% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 670 | 429 | 0 | 0 | 548 | 308 | 159 | 25 | 198 | 0 | 0 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Lane Util. Factor | 0.97 | 1.00 | | | 0.95 | 1.00 | 1.00 | 1.00 | | | | |
| Frt | 1.00 | 1.00 | | | 1.00 | 0.85 | 1.00 | 0.87 | | | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (prot) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1615 | | | | |
| Flt Permitted | 0.95 | 1.00 | | | 1.00 | 1.00 | 0.95 | 1.00 | | | | |
| Satd. Flow (perm) | 3433 | 1863 | | | 3539 | 1583 | 1770 | 1615 | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 728 | 466 | 0 | 0 | 596 | 335 | 173 | 27 | 215 | 0 | 0 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 0 | 207 | 0 | 185 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 728 | 466 | 0 | 0 | 596 | 128 | 173 | 57 | 0 | 0 | 0 | 0 |
| Turn Type | Prot | | | | | Perm | Perm | | | | | |
| Protected Phases | 1 | 6 | | | 2 | | | 8 | | | | |
| Permitted Phases | | | | | | 2 | 8 | | | | | |
| Actuated Green, G (s) | 23.5 | 64.8 | | | 34.3 | 34.3 | 12.7 | 12.7 | | | | |
| Effective Green, g (s) | 23.5 | 64.8 | | | 34.3 | 34.3 | 12.7 | 12.7 | | | | |
| Actuated g/C Ratio | 0.26 | 0.72 | | | 0.38 | 0.38 | 0.14 | 0.14 | | | | |
| Clearance Time (s) | 6.5 | 6.0 | | | 6.5 | 6.5 | 6.5 | 6.5 | | | | |
| Vehicle Extension (s) | 2.0 | 2.0 | | | 2.0 | 2.0 | 2.0 | 2.0 | | | | |
| Lane Grp Cap (vph) | 896 | 1341 | | | 1349 | 603 | 250 | 228 | | | | |
| v/s Ratio Prot | c0.21 | 0.25 | | | c0.17 | | | 0.04 | | | | |
| v/s Ratio Perm | | | | | | 0.08 | c0.10 | | | | | |
| v/c Ratio | 0.81 | 0.35 | | | 0.44 | 0.21 | 0.69 | 0.25 | | | | |
| Uniform Delay, d1 | 31.2 | 4.7 | | | 20.7 | 18.7 | 36.8 | 34.4 | | | | |
| Progression Factor | 0.75 | 1.24 | | | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| Incremental Delay, d2 | 3.4 | 0.4 | | | 1.1 | 0.8 | 6.5 | 0.2 | | | | |
| Delay (s) | 26.7 | 6.3 | | | 21.8 | 19.5 | 43.3 | 34.6 | | | | |
| Level of Service | C | A | | | C | B | D | C | | | | |
| Approach Delay (s) | | 18.7 | | | 21.0 | | | 38.2 | | | 0.0 | |
| Approach LOS | | B | | | C | | | D | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 22.7 | HCM Level of Service | C |
| HCM Volume to Capacity ratio | 0.61 | | |
| Actuated Cycle Length (s) | 90.0 | Sum of lost time (s) | 19.5 |
| Intersection Capacity Utilization | 74.7% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

# *Appendix C – COMMUNITY CHARACTER DESCRIPTIONS*

The City of League City is in the process of developing this master mobility plan to guide its future multimodal transportation infrastructure investments. An integral part of the mobility planning process is the development and evaluation of alternative buildout scenarios. This is because the character of development (including type, pattern, and density) is an essential determinant of trip volumes and the patterns of travel within the community and the region.

League City has experienced significant growth in recent years. Its approximate population has grown from 16,578 persons in 1980 to 71,222 persons[1] in 2008. This amounts to an average annual growth rate ranging between 10% and 12%. In terms of its total land area, including the city limits and extraterritorial jurisdiction, the city is approximately 41.5% developed, with a little more than 17,500 acres remaining. It is expected that the city will reach buildout during the horizon of this master mobility plan, approaching a population of approximately 190,000 persons. Therefore, the scenario planning process is particularly relevant to proactively plan the character of future development in the context of mobility, together with other essential long-range planning considerations such as the capacities of its public facilities and services.

This section defines and describes the land use districts that are reflected by the alternative growth scenarios and, most importantly, the outcome of this process: the preferred future development of League City and its extraterritorial jurisdiction (ETJ). The individual land use districts are mostly the same from scenario to scenario. However, the requisite impacts on the local mobility system change with changes in the types and amounts of different land uses and the corresponding patterns of development. For example, the differences in the patterns and character of development represented by Scenarios 2 and 3 are significant due to the relative acreages and densities of *rural* and *suburban* development. Rural development has a maximum density of 4.16 dwelling units per acre while suburban development may allow a density up to eight dwelling units per acre, provided it is clustered and in a planned environment. Furthermore, the extent of *urban high* development is much greater in Scenario 2, which translates to a higher intensity of nonresidential and mixed use development. This warrants different considerations in the community's long-range transportation planning. For these and other reasons, evaluating different development scenarios and density assumptions is an essential part of the future land use and mobility planning processes.

## *WHY IS LAND USE PLANNING IMPORTANT AND HOW DOES IT RELATE TO MASTER MOBILITY PLAN?*

Land use planning is an important exercise for the City to effectively manage the type, pattern, and scale of future development. Decisions made at an early stage of development will have great influence on

[1] 2008 U.S. Bureau of Census

the community and its mobility – and infrastructure – system(s). This is so because, in the context of mobility, the use of land and the pattern of development helps determine the propensity of pedestrian activity, trip origins and destinations and the corresponding volumes and patterns of traffic, and the demand for and feasibility of high capacity transit, among many others. Therefore, not only will the plan contribute to improved planning for mobility, but it will also guide decisions relating to zone change and subdivision requests, capital infrastructure improvements, and ultimately, community character. In the context of utility planning, the land use plan may also be used to reconcile the extent of future development with the capacities of the infrastructure systems (e.g., potable water supply).

The land use designations used in the scenario planning process are different from those used in the past. The 2004 Comprehensive Plan[2] uses very broad descriptions including residential (including single-family and multi-family and condominium), mixed-use (including mixed-use employment centers and neighborhood commercial centers), commercial, industrial, institutional, and public parks and open space. The descriptions used in the scenario planning exercise are based on the preferred character (rather than use) of future development. In this way, the districts are more descriptive of the intended development outcomes, which directly relate to density, the amount of open space and impervious area, and the scale and form of the built environment. This begins a transition for the City to become more deliberate in achieving the development outcomes that are preferred and, perhaps more importantly, those that are warranted to meet other planning objectives, e.g. water usage and conservation.

It is important to acknowledge that changes to the structure of the zoning districts and their requisite standards are warranted to bring them in line with the land use districts. Ultimately, the zoning districts should directly correspond with the land use districts. In this way, the intended character of development that is expressed by the land use plan and preferred growth scenario will be implemented by the zoning ordinance. This will assure quality, sustainable development that is consistent with the aims and objectives of the community.

[2] Section 4.0, Achieving the Vision, *League City Comprehensive Plan*, Mar 2004.

### *How Does Community Character Differ from Land Use?*

First and foremost, community character is a system for evaluating the features of individual developments that collectively contribute to the micro-character of an individual neighborhood, center, or district, and the macro-character of the community. The components that distinguish the quality of development include more than its land use, such as the amount of preserved open space and vegetation, the amount of imperviousness, the orientation of buildings and parking areas, and the relationship of buildings (scale and bulk) to the site. Together with aesthetic enhancements, such as the design of buildings, landscaping and screening, sign control, and site amenities, the community character may be significantly improved.

> **Local character** is the distinctive identity of a particular place that results from the interaction of many factors - built form, landscape, history, people, and their activities. Development that respects and supports local character can:
>
> - attract highly-skilled workers and high-tech businesses;
> - help in the promotion and branding of cities and regions;
> - potentially add a premium to the value of housing;
> - reinforce a sense of identity among residents, and encourage them to help actively manage their neighborhood;
> - offer people meaningful choices between very distinctive places, whose differences they value; and
> - encourage the conservation and responsible use of non-renewable resources.
>
> *Source: Ministry for the Environment*

As a land use system, community character goes beyond typical categorization of the functional use of land—such as single and multiple family residential, office and retail commercial, and light and heavy industrial—to account, as well, for the physical traits and design attributes that together, contribute to its “look and feel.” A character-based land use system focuses on development intensity, which encompasses the density and layout of residential development; the scale and form of non-residential development; and the amount of building and pavement coverage (impervious cover) relative to the extent of open space and natural vegetation or landscaping. This applies both on individual development sites and across entire areas.

It is a combination of the functional land use and its design characteristics that more accurately determines the compatibility and quality of development, as opposed to the use of land alone. Aesthetic enhancements, such as the architecture of buildings, the extent of landscaping and hardscaping[3], the type and amount of buffering, uniformity and control of signage, and other site amenities enhance the development aesthetic, but do not influence development character per se, as used in this context of land use planning and design.

To explain in the context of League City, what is designated as *Suburban Village* on the land use plan represents the original town areas. The neighborhoods have grid street patterns, a broad variety of home styles, varying lot sizes and setbacks, and different building orientations and means of (or no) garage access. This represents a traditional form of development that is wholly different than the contemporary, more recently developed neighborhoods. The latter subdivisions are highly patterned in their street and lot layouts and may be characterized by consistent front and side setbacks, uniform

[3] Hardscaping refers to the installation of non-plant features in the landscape, (pavement, walls, fountains, etc.)

building scale, regular placement driveways, and generally higher building coverage and Floor Area Ratios (FAR), all of which may be generally described as a monotonous design *(Figure C.1)*.

A focus on development character highlights a range of settings in which land uses can occur within a community. These settings stretch along a continuum of character ranging from rural to urban (least to most intense), with suburban and other intermediate character types in between. Fundamental in the definition of character is how the automobile is accommodated within a development, in terms of its street design, means of access, the placement and handling of parking, and the resulting arrangement of buildings and open spaces *(Figure C.2)*.

***Figure C.1 – Differentiation of Character***

The aerial image on the left represents the *Suburban Village*. It is *suburban* in character by way of its larger lots, greater separation between dwelling units, and the amount of "green" by way of its vegetation and on-lot, private open space. On the right is a contemporary subdivision. It, too, is *suburban* yet its character is different by way of its street layout, regular lot pattern, uniformity in building scale, and consolidated, common open space. Therefore, while the single family residential use is the same in both examples, the character is different. If the City is to be deliberate as to the character of its future development it is essential that its land use – and zoning – districts are adequately descriptive.

### *DEFINING THE CHARACTER CLASSES AND TYPES*

Community character defines classes of development as urban, suburban, and rural. These classes are further delineated into design types. The design types are unique to each community, but generally include countryside, agricultural, and natural within the rural class; suburban and estate within the suburban class; and urban core, urban, and auto-urban (or auto-dominant) within the urban class. By organizing development according to its character, design strategies may be formed and measures established to assure preferred and acceptable outcomes.

***Figure C.2 – Uses in Differing Character Environments***


The same drug store use may be designed in the context of its character environs, in this case, in an *urban* downtown (left) or an *auto-dependent*, stand-alone site (right).

The inventory of existing land use character confirms that League City has character settings along most of the above described spectrum. The city's existing development pattern includes large swaths of rural, undeveloped land, particularly in the southwestern parts of the city and ETJ, and also south of League City Parkway and FM 646. Most of the neighborhoods and commercial areas are characteristic of the auto-urban and enhanced auto-urban types, which are both within the urban character class. The remaining neighborhoods, particularly those along Clear Creek and those nestled around liberal open space (such as lakes or a golf course), fall into the suburban class and type. League City does not have a traditional urban neighborhood although the suburban village reflects these design tendencies by way of its regular pattern of lots and street grid. In the middle of the spectrum, especially in the range from urban to suburban, League City has multiple neighborhoods and commercial areas that fall into a gray area between character types because they exhibit aspects of both. This is because these areas were planned and developed in accordance with rather general rules, with the only design parameters being that of a minimum lot size and lists of permitted uses.

The following are descriptions of the individual character classes and types:

***RURAL CHARACTER***

There are three rural types: countryside, agricultural, and natural. The latter two are defined by their uses: crop or ranching, plus scattered rural homesteads, for the agricultural; wooded or savannah lands, plus creeks and wetlands for the natural. These rural types are characteristic of the undeveloped portions of the city and the ETJ. Countryside is a transitory phenomenon defined by an informal (unplatted) arrangement of larger suburban or estate lots situated along a major road, but surrounded by undeveloped, agricultural lands.

**Keys to Rural Character:**

- Wide open landscapes, with no sense of enclosure, and views to the horizon mostly unbroken by buildings.
- Structures are in the background—or invisible entirely as they blend into the landscape.
- Very high open space ratios and very low building coverage.
- Great building separation providing privacy and detachment from neighboring dwellings.
- Much greater reliance on natural drainage systems, except where altered significantly by agricultural operations.
- City residents and tourists attracted by opportunities for country drives and longer distance recreational biking.
- A pleasant environment for walking and biking, especially on off-street trail systems.

The rural design types are further described as follows:

- *Countryside* is an exurban residential living environment. Typically, countryside areas occur in the rural areas around the fringes of a suburbanizing community. In this way they reflect the early signs of suburbanization. In League City, areas of this type exist only along the westernmost extents of FM 517.
- *Agricultural* character is defined by its related uses (e.g., row crops and pasture). Homes are clearly accessory and secondary to the agricultural operations. The landscape is accented by farmsteads, barns, fences lining farm fields and livestock areas, and a virtually unbroken horizon, all of which contribute to its rural character. This is characteristic of the outlying, undeveloped areas of League City where development has not yet occurred and the use is dominated for agricultural purposes.
- *Natural* areas are constrained for development due to features such as streams and floodplains or densely vegetated areas. There are several natural areas in League City, mostly along Clear Creek. In the undeveloped area and throughout the community there are stream corridors and natural drainage ways that reflect this character. Natural areas are ideal for public parkland acquisition or establishment of a nature preserve for public access, such as those along Clear Creek *(Figure C.3)*.

***SUBURBAN CHARACTER***

There are two suburban types: suburban and estate. Suburban character is much different from the urban types, emerging over the last century as a more garden-like living environment. In this character class the dominant visual feature is "green" and/or open space versus structures. In an estate setting the structure may be entirely hidden from view. Where there is a sense of enclosure along streets, it comes from a tree canopy and/or dense vegetation and landscaping. More extensive green and open space often contributes to recreation opportunities and natural resource protection. Many of League City's neighborhoods draw their suburban character from their open space amenities, such as a golf course, parks, greenways, and/or lakes. A water amenity within a neighborhood, or in an office or business park, can shift its character from auto-urban to suburban since all those in close proximity benefit from the amenity and the pleasant views it affords.

**Keys to Suburban Character:**

- More horizontal development, often even more spread out than Auto-Dominant.
- Space enclosure, if any, provided by trees and vegetation versus buildings.
- Even larger building setbacks from streets than in Auto-Dominant, but usually providing for more green and open space versus surface parking along street frontages.
- More building separation, through larger setbacks and, in some cases, larger lots.
- Much lower lot coverage and a correspondingly higher open space ratio on sites.
- More extensive and intensive landscaping than in Urban and Auto-Dominant settings.
- More opportunity for natural drainage and storm water absorption versus concentrated storm water runoff and conveyance.
- A more pleasant environment for walking and biking, especially on off-street trail systems.

***Figure C.3 – Rural Archetypes***

Countryside

Agricultural

Natural

The suburban design types are further described as follows:

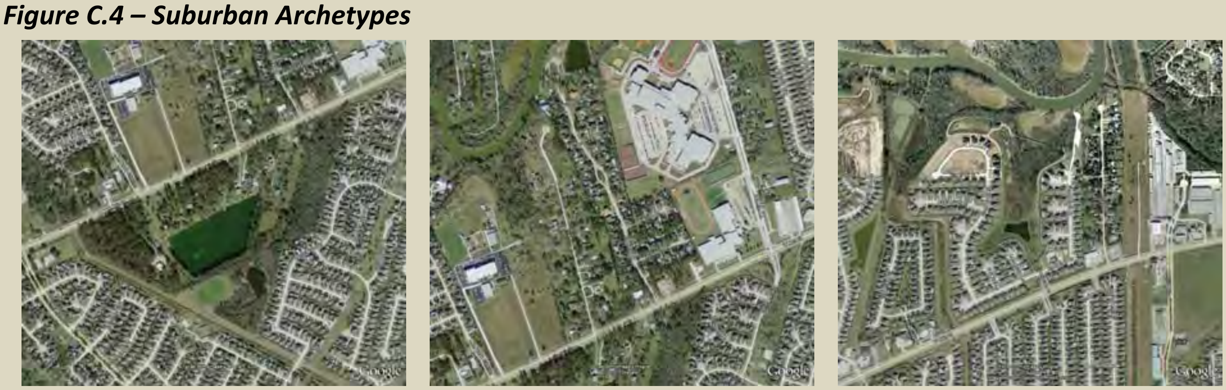
- *Suburban* development is characteristic of its vast open spaces and dense vegetation and landscaping. Larger front and side setbacks and greater space between dwellings or buildings contribute to a sense of spaciousness - and the opportunity for more extensive landscaping. The planting of street trees and front yard landscaping makes a significant difference because the total mass of vegetation is greater than that of the buildings and also serves a natural screening function. Unlike estate, suburban character areas are served with full public utilities, including water lines capable of delivering adequate flows and pressure for fire fighting.

The suburban character type is predominantly residential, but both office and retail uses can be designed to have a suburban character, or even an estate character. There are a couple good examples of suburban commercial developments along FM 517 west of IH 45. These sites have a balance between buildings and parking areas and natural vegetation and open space. When non-residential uses are designed to a suburban standard, the result is a lower intensity development with open space or a large landscaped area. A significant portion (often approach as much as one-half) of a suburban commercial site is often left undisturbed and/or supplemented with landscaping, which results in a very different character from what is normally considered a commercial or office use. As a result, there can be economic constraints to this non-residential development style. However, such developments are much less likely to cause concern to their residential neighbors, especially if the structures also are designed with residential characteristics (e.g., pitched roof).

- *Estate* is a larger lot version of suburban, where the lots are large enough not to need public sewer (although public utilities sometimes are available in incorporated areas). The lots in wooded areas can be as small as one acre; in more open land, three- to five-acre lots are needed to achieve an estate character. With the recent national trend to much larger homes, a street tree planting program that creates a hedgerow effect along the road is needed in open land to screen the homes. In wooded areas, the street frontage should be left natural to establish and maintain an estate character *(Figure C.4)*.

***URBAN CHARACTER***

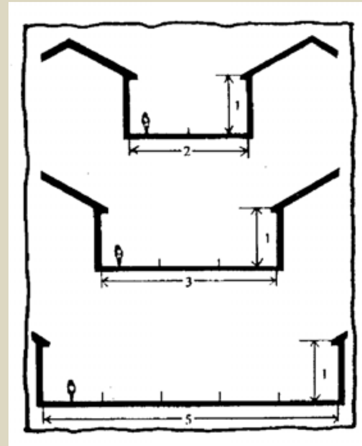
***Figure C.4 – Suburban Archetypes***



Estate | Suburban (large lot) | Suburban

There are three urban character types: urban core, urban, and auto-urban. Urban areas are historically the center of commerce, culture, and entertainment in the community. The features that contribute to an urban character include a rich mixture of vertically integrated uses, a strong building-to-street relationship with little or no building setbacks, on-street and structured parking with very little surface parking, and a strong pedestrian orientation. Urban development is designed with an intensity of use to draw people into close contact, where congestion and personal encounters are both expected and essential for a vibrant community center. Urban spaces are "architectural," meaning that they are enclosed by buildings. In other words, the distance across a space, e.g. the width of a downtown street in relation to the height of its block faces, is essential for creating an "urban" environment *(Figure C.5)*.

***Figure C.5 – Enclosure***



Enclosure is defined by the width-to-height factor. As illustrated above, a 1:2 ratio provides enclosure that is indicative of urban space.

The three urban character types are described as follows:

- *Urban* core is not found in League City as this type represents a central business district with a very high intensity (typically buildings averaging 20 stories or more). This is not uncommon in a suburban municipality situated on the edge of a major metropolitan area. Examples of this character type include Downtown Houston, Texas Medical Center, Greenway Plaza, and portions of the Uptown-Gallery District.
- *Urban* character also is not found in League City. This type involves storefronts that are in a traditional downtown or main street setting. The fact that this type is not present reflects how the community began as the suburban village and then was influenced contemporary land use patterns stretching along IH 45 and each of the arterial spines, such as FM 518 / Main Street / Marina Bay Drive; FM 1266 / League City Parkway; and lesser so along FM 646.

**Keys to Urban Character:**

- More vertical development (2 to 5-story buildings).
- Zero or minimal front setbacks (building entries and storefronts at the sidewalk).
- Streets and other public spaces framed by buildings.
- Minimal surface parking in favor of on-street and structured parking.
- Most conducive for pedestrian activity and interaction.
- Housing types range from small single-family to attached residential (e.g., brownstones, townhouses) and multi-family residential, often with alley access and/or rear garages.

- *Auto-urban* is the only and most prevalent urban character type in League City. It did not exist until the demand for on-site parking of automobiles became critical for business. Retail, service businesses, and offices all require more land for parking than they have floor area, thus eliminating the sense of enclosure found in urban areas. The commercial development along IH 45 and FM 518 is a classic auto-urban commercial strip, especially on larger sites where "big box" retail structures and office buildings are at the rear of the site to accommodate extensive surface parking to the property frontage. The big box retail centers at the intersection of IH 45 and FM 646 are the quintessential auto-urban commercial developments.

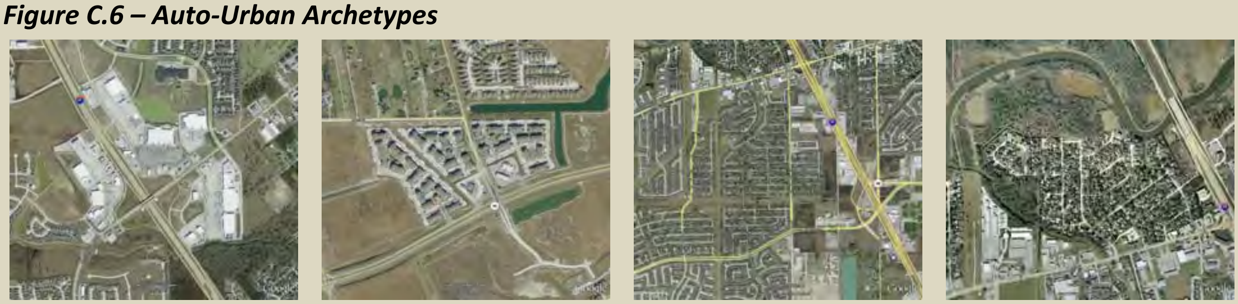
In the context of residential development, the parking lots serving high-density attached and multi-family housing lead to an auto-urban atmosphere. Such scenes are found at most apartment complexes in League City, such as at the intersection of Louisiana Avenue and League City Parkway. For smaller single-family housing on relatively small and narrow lots, houses with front-loaded garages that extend beyond the front door (often referred to as a "snout house") is the classic example of auto-urban because the driveway and front-facing garage dominate the lot frontage and house façade. Furthermore, by reason of their small and narrow lots and limited setbacks, these homes have little separation between them and create a relatively dense single family living environment.

League City is somewhat unique in that it has neighborhoods that are in a gray area between auto-urban and suburban. While their regular and dense street and lot patterns and consistent building scales and setbacks are analogous to an auto-urban type, the presence of and, in some cases, access to adjacent open space, together with parks, civic spaces, and an increased vegetative cover, exhibit some suburban attributes. These areas are referred to as Auto-Urban Enhanced *(Figure C.6)*.

**Keys to Auto-Urban Character:**

- More horizontal development (mostly 1 to 2-story buildings).
- Buildings set back from streets, often to accommodate surface parking at the front.
- A very open environment, with streets and other public spaces not framed by buildings or vegetation.
- Significant portions of commercial and industrial development sites devoted to access drives, circulation routes, and surface parking and loading/delivery areas, making pavement the most prominent visual feature.
- Smaller, narrow single-family lots dominated by driveways and front-loading garages, reducing yard and landscaping areas.
- Extent of impervious surface leads to increased storm water runoff.
- Auto urban commercial often not conducive for pedestrian circulation.
- Structured parking generally not feasible or practical.

***Figure C.6 – Auto-Urban Archetypes***



Auto-Urban Commercial | Auto-Urban Multi-Family | Auto-Urban Residential | Auto-Urban Enhanced

### *LAND USE SCENARIOS*

The land use scenarios relate to the use of land (e.g., residential, commercial, industrial), and also reflect the intended *character* of development. This approach observes the use of land with an added focus on the relative relationship among the land areas that are used for buildings, landscaping, and vehicular use areas. Rather than emphasizing the separation of uses into different districts, a character-based system relies upon a mix of open space and intensity controls to ensure that development within each district has a predictable character. In this way, by using these measurable controls, a site may accommodate different types of housing or forms of development while preserving the intended character. This will help League City realize expected outcomes in the quality of its development. Also, and more importantly from the perspective of mobility and infrastructure planning, the use of character-based land use better defines the actual densities and hence, dwelling units and population that is necessary to accurately determine needed capacities and improvements.

The land use scenarios delineate the future use and character of development within the city limits and Extraterritorial Jurisdiction (ETJ) that is planned to accommodate the city's buildout development. The amount of population growth and hence, demand on the city's mobility – and utility – infrastructure relies on two factors; the rate of growth and the character of development. As explored by the alternative land use scenarios, the build-out population of League City is directly related to the amount of development and its character. For instance, holding the population steady (based on known capacities), a deliberate choice to develop more densely in certain locations (such as those reflected as urban low or urban high) requires less land. This would leave more of the rural landscape and enable more open space to be preserved. It would also be more efficient in the provision of community infrastructure and services. Conversely, a low-density pattern of development will require a greater land area (likely reaching full buildout) leaving fewer and smaller open spaces and eliminating the rural character. The latter approach would require more infrastructure and at a greater cost.

The land use designations are shown in *Table C.1, Land Use Districts*. The table reflects the districts and the allowable development types within each district, where applicable, together with the lot sizes, percentages of open space, and densities for the residential districts, and heights, percentage of green space, and FARs for the nonresidential districts. The individual districts and the rationales are described below. For comparison purposes, also shown are the existing zoning districts and their actual densities. In each district, there is one or more development types available that allow greater density than that currently achieved, provided the application of a different development approach.

**Table C.1 – Land Use Districts**

| District | Development Type | Average Lot Size | Open Space | Density |
|---|---|---|---|---|
| Rural/Estate Residential | *RFS-20* | *20,000 sq. ft.* | *12%* | *1.25* |
| | Estate Single Family | 1.0 ac. | 0% | 0.75 |
| | Conventional Single Family | 20,000 sq. ft. | 15% | 1.20 |
| | Cluster Single Family | 7,000 sq. ft. | 20% | 2.70 |
| | Village Residential (with mixed housing types) | 3,000 sq. ft. | 44% | 4.16 |
| Suburban Residential | *RFS-10* | *10,000 sq. ft.* | *12%* | *2.26* |
| | Conventional Single Family | 10,000 sq. ft. | 18% | 2.00 |
| | Cluster Single Family | 7,000 sq. ft. | 20% | 2.80 |
| | Planned Residential (with mixed housing types) | 3,000 sq. ft. | 35% | 4.84 |
| | Planned Multi-Family | 1,800 sq. ft. | 35% | 8.00 |
| Suburban Village | Convention Single Family | 7,000 sq. ft. | 13% | 3.30 |
| | Single-Family Infill | 5,000 sq. ft. | 18% | 3.66 |
| Auto-Dominant Residential | *RFS-7* | *7,000 sq. ft.* | *12%* | *3.40* |
| | *RFS-5* | *5,000 sq. ft.* | *12%* | *4.00* |
| | *RFS-2* | *2,000 sq. ft.* | *12%* | *9.00* |
| | Conventional Single Family (Enhanced) | 7,000 sq. ft. | 12% | 3.06 |
| | Cluster Single Family | 5,500 sq. ft. | 16% | 3.52 |
| | Single-Family Manufactured Home | 5,000 sq. ft. | 18% | 3.75 |
| | Planned Multi-Family | 1,250 sq. ft. | 25% | 12.60 |
| **District** | **Development Type** | **Height** | **Green Space** | **Floor Area (FAR)** |
| Suburban Commercial | *CN* | *2 story* | *10%* | *0.41* |
| | *CO* | *2 story* | *15%* | *0.40* |
| | Office or Retail | 2 story | 18% | 0.38 |
| Auto-Dominant Commercial | *CG* | *Up to 4 stories* | *15%* | *0.45* |
| | General Commercial (surface parking) | Up to 4 stories | 18% | 0.43 |
| | General Commercial (structured parking) | Up to 4 stories | 18% | 0.75 |
| | Mixed Use (3-story structured parking) | Up to 6 stories | 18% | 1.50 |
| Urban Low | *CM* | *Up to 8 stories* | *15%* | *1.43* |
| | Mixed Use (2-story structured parking) | Up to 6 stories | 20% | 1.67 |
| | Mixed Use (3-story structured parking) | Up to 6 stories | 18% | 2.11 |
| Urban High | *CM* | *Up to 8 stories* | *15%* | *1.43* |
| | Mixed Use (2-story structured parking) | Up to 6 stories | 15% | 1.77 |
| | Mixed Use (3-story structured parking) | Up to 8 stories | 18% | 2.75 |
| | Mixed Use (5-story structured parking) | Up to 10 stories | 18% | 3.21 |

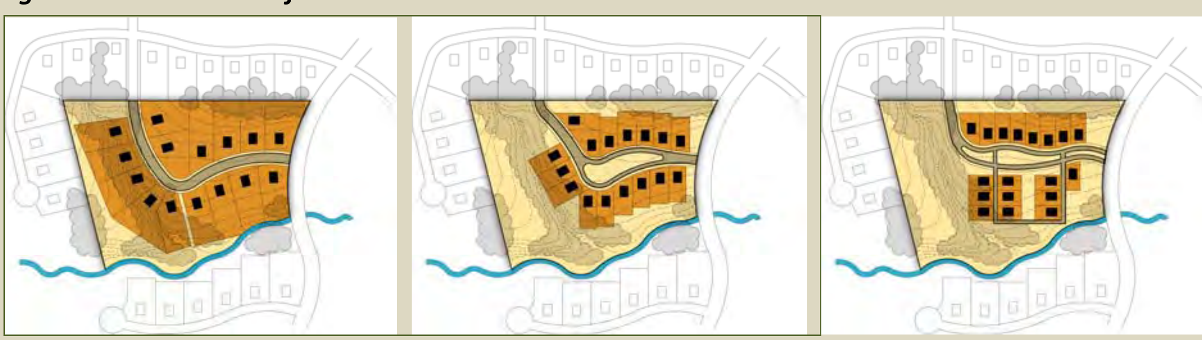
### *RATIONALE*

The underlying rationale of the land use districts recognizes that development *may* assume different uses, housing types, lot and street patterns, and building forms while observing the intended character. In this way, there may be more than one development type within the same land use district, provided there are certain and adequate standards and controls to realize the intended outcomes. This approach encourages better – and more innovative - design by allowing development to occur in the context of its environment; whether it is preservation of a natural feature, conservation of environmental resources, or an abutting, incompatible development *(Figure C.7)*.

This approach offers many benefits, including the following:

- Ability to determine and realize the intended character of future development;
- Increased assurance as to development outcomes;
- Improved compatibility within and between districts;
- Increased flexibility to protect natural resources and open space;
- Fewer zoning map amendments and streamlined approval;
- Increased certainty in the development process;
- Ability to better plan for infrastructure needs;
- Mixed-use projects on a by-right basis; and
- Buffering commensurate with the level of impact.

***Figure C.7 – Rationale of Character-Based Land Use Districts***



A character-based system differs from the City's current use-based system in that each of the above developments may be permitted in the same land use (or zoning) district. A use-based land use and zoning system would require each of these to be in separate districts even though their relative densities and thus, impacts (e.g., traffic, utility demands) are the same. In this way, while the form of development or type of house may be different the character remains the same. This is so as a character-based system uses density and open space measures to control – and ensure – the intended character. The density and open space controls may hold the density constant (density neutral) or may allow a bonus as means to provide incentive to preserve open space and resources or to achieve other community objectives.

## *DESCRIPTIONS OF LAND USE DISTRICTS*

The land use districts reflected by the future and preferred development scenarios are as follows:

***Rural/Estate Residential*** – The intent of this district is to preserve the rural character of League City. To accomplish this objective there are four development options, with variations in densities and percentages of open space. Essential in the design of rural developments is the use of open space and buffering, which is used for adequate separation and buffering within and between different housing or development types. These available options include the following:

- ***Estate single-family development*** may include lots with an average size of one acre. Due to the size of the lot and the relative openness of an estate development common open space is not necessary to achieve a rural character. The density of an estate development may reach 0.75 units per acre.
- ***Conventional single-family development*** may have lots that are 20,000 square feet (similar to the RSF-20 zoning district). To maintain a rural character the relative density increases to 1.20 units per acre, with 15% open space.
- ***Cluster single-family development*** would allow lots of 7,000 square feet (comparable to the RSF-7 zoning district). An open space ratio of 20% would allow a density of 2.70 units per acre.
- ***Village residential development*** would allow a density up to 4.16 units per acre. To achieve this density within a rural environment a mixture of housing types would be necessary. The average lot size of 3,000 square feet would provide for a variety of residential lot sizes and unit types ranging from single-family detached, lot line, and patio dwellings to standard and over-under duplexes, townhomes, and multiplexes. The minimum open space is 44%.

***Suburban Residential*** – The distinguishing factor of the Suburban Residential district is a relative increase in the amount of open space. This open space may be in the form of the yards of larger, private home sites (together with pocket parks, esplanades, etc.); a higher percentage of common open space such as neighborhood parks, retention lakes, or paddocks; or a combination thereof. The available development options within this district include:

- ***Conventional single-family development*** with lots averaging 10,000 square feet and 18% open space, which yields 2.00 units per acre.
- ***Cluster single-family development*** allows an increase to 2.80 units per acre with 7,000 square foot lots and 20% open space.
- ***Planned residential development*** is comparable to Village Residential in that is allows a variety of housing types with an average lot size of 3,000 square feet. To reflect a suburban character the open space in 35% allowing a density of 4.84 units per acre.

- ***Planned multi-family development*** allows a broader variety of attached living types, including multiplexes and multi-family dwellings among other attached and detached dwellings. With an average lot size of 1,800 square feet and 35% open space the density is 8.00 units per acre.

***Suburban Village*** – The purpose of this district is to preserve the character of the community's original town neighborhoods. These areas are unique given their grid street patterns, broad variety of home styles, varying lot sizes and setbacks, and different building orientations and means of (or no) garage access. They are characteristic of the suburban class due to the larger lot sizes and the relative amount of openness, together with a canopy of mature vegetation. Since this district is intended to preserve the character of an existing area its options are as follows:

- ***Conventional single-family development*** comparable to the existing RSF-7 zoning, which includes 13% open space for a density of 3.30 units per acre.
- ***Single-family infill development*** allows a reduced lot size to 5,000 square feet (comparable to the RSF-5 zoning district), but requires 18% open space. This option offers an infill bonus of 11% that is intended to encourage reinvestment in the village area.

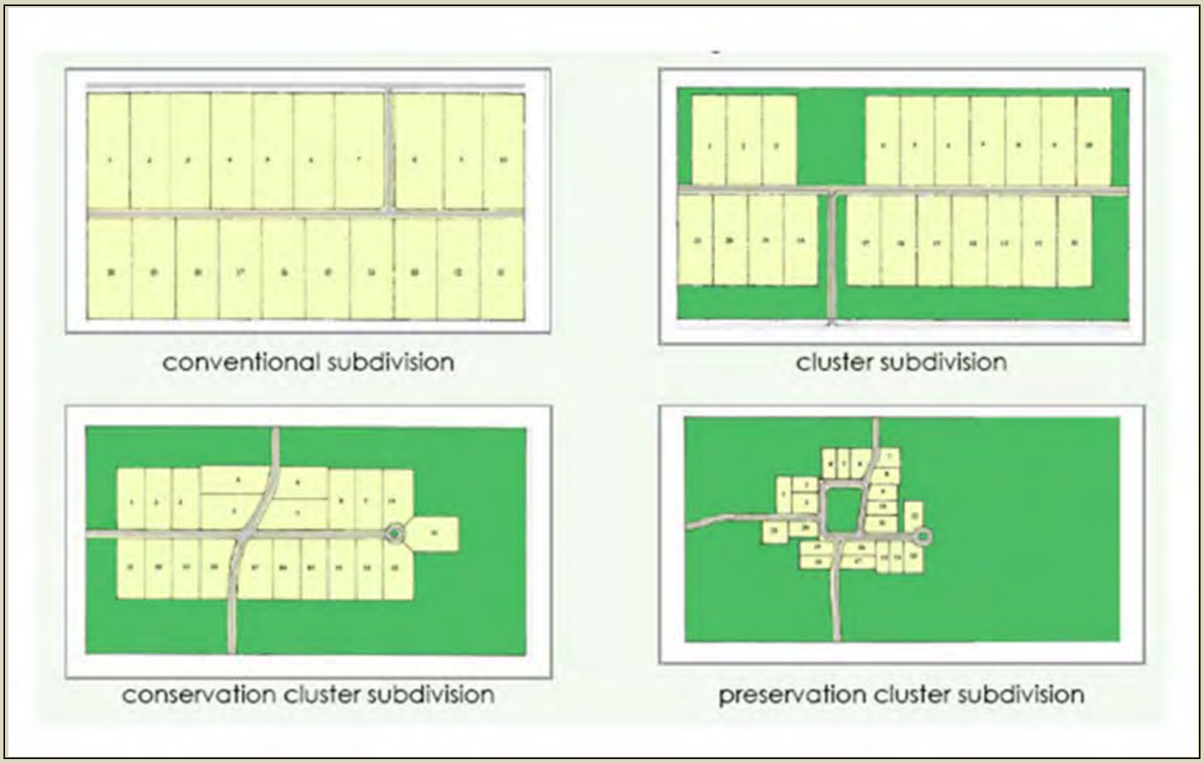
This district also serves the purpose of neighborhood conservation so as to preserve the uniqueness of this area. Doing so will require the establishment of unique standards that match the circumstances at the time of development and at the present time. Essentially, standards must be established that are commensurate with the built environment, including certain allowances or by-right waivers to allow certain and well-defined building additions and/or lot improvements. The district may also help prevent nonconforming situations brought about by the institution of new or different standards.

***Auto-Dominant Residential*** – An auto-dominant character generally describes many of the existing neighborhoods. The attributes of this character type are shallower block depths, smaller lot sizes, reduced dimensions around and between homes, consistent front and side setbacks, mostly front-facing garages with street access, and a limited amount of on-lot or common open space. Due to the relative lot and home sizes there is a high building coverage and increased impervious surface ratio, both on individual sites and collectively across a neighborhood. Developments of this character type are usually highly patterned, meaning that they have uniform setbacks, similar building mass and scale, and a consistent home orientation from lot-to-lot. The Auto-Dominant Residential district includes four development types as follows:

- ***Conventional single-family (Enhanced) development*** has 7,000 sq. ft. lots (comparable to the RSF-7 zoning district) and 12% open space yielding 3.06 units per acre. The term "enhanced" refers to immediate or abutting access to public open space or a natural feature or amenity, plus improved standards including street trees, on-lot landscaping, and increased setbacks. An enhanced development may also have an increased amount of common open space without meriting a suburban class.

- ***Cluster single-family development*** includes a reduced lot size of 5,500 square feet, with an increased open space of 16%. This yields an increased density of 3.52 units per acre.
- ***Single-family manufactured home development*** accommodates manufactured home subdivisions. The lot size is 5,000 square feet, comparable to that now required in the RSF-5 zoning district. A minimum of 18% open space is required, yielding 3.75 units per acre.[4]
- ***Planned multi-family development*** allows a full variety of detached and attached living types, including multi-family dwellings. The lot size of 1,250 square feet per unit allows a density up; to 12.60 units per acre, with 25% open space. In order to achieve, and not exceed, the allowed density, two or more housing types would be necessary. The open space may be used to fulfill site drainage requirements, together with perimeter buffering and common green space *(Figure C.8)*.

***Figure C.8 – Methods of Clustering***




Clustering may assume different forms with proportional relationships between lot sizes and percentages of open space. The housing types may be the same or different.

***Suburban Commercial*** – This land use district is for limited office, retail, and other light commercial uses. By reason of its intended character, this district applies to small sites and buildings that are in near

[4] The RSF-5 Residential Single-Family zoning district does not currently require any provision of open space.

proximity to other suburban or rural districts. To maintain a suburban character there is a minimum 18% on-site green space (referred to as the landscape surface ratio) and a FAR of 0.38. The building height is restricted to two stories. The character is preserved by way of building scale limitations (typically a maximum square footage) and both building and site design standards. In the context of an abutting neighborhood, for instance, a suburban commercial development would be limited in building mass and height, together with other performance and site design standards (e.g., access, circulation, parking and loading, lighting, noise) to ensure compatibility.

***Auto-Dominant Commercial*** – This district may accommodate a variety of commercial related businesses, including a broad range of office and retail uses. It is mostly used to encompass those areas along primary corridors and at major intersections that are already of this character. Development in this district generally includes single and multi-tenant buildings that are in the form of a stand-alone buildings, strip centers, or malls. The design of properties within this district is largely influenced by the required on-site parking whereby the amount of parking surface may well exceed that of the building coverage. There are three development options within this district, with the difference in FAR being attributable to building height and whether there is surface or structured parking. There are incentives inherent in the development options by way of increased floor areas for structured parking and mixed use. The options are as follows:

**Floor Area Ratio (FAR)** means a measure of the allowable size of floor area on a lot compared to the size of the lot. FAR gives developers flexibility in deciding whether to construct a low building covering most of the lot or a tall building covering only a part of the lot, as long as the total allowable floor area coverage is not exceeded.

- ***General commercial (with surface parking) development*** allows building heights up to a maximum of four stories, which is comparable or exceeds that now located in the City. This is comparable to the Commercial Office (CO) zoning district, but less than that of 125 feet currently allowed by the Commercial General (CG) and Commercial Mixed Use (CM) zoning districts. The FAR is limited to 0.43 due to the area occupied by surface parking. This accounts for the City's off-street parking requirements for office and retail of one space per 250 square feet.[5] The amount of green space is 18%.
- ***General commercial (with two-story structured parking) development*** with the same building height and open space offer a FAR of 0.75 by way of used structured parking. The increase is due to the reduced amount of site area that is otherwise devoted to surface parking.
- ***Mixed-use (with three-story structured parking) development*** is a preferred development type and, for this reason, allows a building height of six stories and a FAR of 1.50. Use of three-story structured parking further improves the efficiency of site development.

**Mixed use** is where different activities take place in the same building, street, or neighborhood. Design that supports mixed use can:

- allow transportation infrastructure to be used more efficiently;
- lower the household expenditures on transportation;
- increase the viability of local shops and facilities;
- encourage walking and cycling - bringing health benefits, reducing the need to own a car and thus reducing emissions;
- enhance social equity;
- increase personal safety;
- offer people convenience, choices and opportunity which lead to a sense of personal well being.

*Source: Ministry for the Environment*

***Urban Low*** – To achieve an urban character, this district will have higher FAR and building coverage ratios, building frontages that address the street, on-street and structured parking (with limited surface parking), and a strong pedestrian environment complete with civic spaces and buildings. This district is envisioned as a mixed-use urban center with an average building height of six stories. It is intended for use at development nodes and in areas that can accommodate moderately intensive development, such as along the IH 45 corridor and along the potential future commuter rail alignment. The intensity of this district is such that it warrants structured parking, which is also necessary to achieve an urban character. The district is intended for commercial office and retail uses, higher-density residential uses that may include a combination of single or vertically mixed use buildings. There are two development options, as follows:

[5] Required parking of one space per 250 square feet for office uses is twice that typically required. For the purposes of this analysis there is no difference in the allowable floor areas for retail and office uses by reason of exiting parking requirements.

- ***Mixed-use low-2 (with two-story structured parking) development*** may include a multitude of higher density and commercial office and retail uses in a planned urban context. The buildings may vary in scale with an average height of six stories. The required green space is 20%, which may be used for public plazas and urban greens, as well private space for residential units and buffering from adjacent uses. By stacking the parking in a structure the FAR is 1.67.
- ***Mixed-use low-3 (with three-story structured parking) development*** is similar to mixed-use low-2, only it factors a three-story parking garage. This, together with a decrease in the green space (which is for the purpose of encouraging three-story structured parking), allows a high FAR of 2.11.

***Urban High*** – This district is the most intensive in the community, which may allow buildings up to 10 stories in height. In both Scenarios 2 and 3, this district is planned around the intersection of IH 45 and FM 676, and as an urban center for the rural or suburban district that surrounds it in the undeveloped southwestern quadrant of the City. Given the intensity of this district structured parking is warranted and necessary to achieve an urban high character. There are three development types including:

- ***Mixed-use high-2 (with two-story structured parking) development*** allows an average building height of six stories, with a two-story parking garage. The percent green space is lower than in the urban low districts to accommodate a higher FAR of 1.77. Also, the green space in an urban high district is commonly for urban plazas. Additional public space may be provided on building roofs, such as a rooftop garden or pool.
- ***Mixed-use high-3 (with three-story structured parking) development*** raises the parking structure to three stories and allows an average building height of eight stories. With 18% green space, used for public spaces and building setbacks and buffering, the FAR may reach 2.75.
- ***Mixed-use high-5 (with five-story structured parking) development*** is the most intensive type, which would allow buildings to an average height of 10 stories. With a five-story parking structure and 18% green space, the FAR is 3.21.

# *Appendix D – FM 518 STREETSCAPE INVENTORY, QUANTIFICATION OF BENEFITS, AND FUNDING PURSUIT*

The City's highest priority corridor for pedestrian improvements is FM 518 (E. Main Street) between SH 3 and FM 270. This appendix presents the detailed existing conditions inventory that was conducted on that segment, as the first step in determining the level of deficiency on the corridor and developing a baseline from which to design improvements. The appendix also explains the methodologies that can be used to quantify the benefits, such as reduced congestion and improved air quality, which can accrue from the implementation of pedestrian improvements. This is important because the most common sources of federal, state, and local funding assistance often require the quantification of such benefits as a condition of awarding funds.

## *EXISTING CONDITIONS INVENTORY AND METHODOLOGY*

A block-by-block inventory of the existing pedestrian conditions is the first step in identifying deficiencies, designing a conceptual program of improvements, and developing cost estimates for those improvements. The pedestrian infrastructure elements inventoried include the following:

- ***Sidewalks and curbs.*** Sidewalk condition is critical to the level of pedestrian accessibility. Damaged or missing sidewalks and curbs discourage or even completely impede walking. A useful indicator of where sidewalks are needed is the presence of "desire lines." These are the trails worn in the grass by pedestrians who have walked the same route repeatedly despite the lack of a sidewalk. Therefore, people are indicating their desire for a sidewalk in that location.
- ***Ramps.*** A continuous network of ramps ensures accessibility for those utilizing wheelchairs and motorized scooters, as well as strollers.
- ***Landscaping, including planting strips.*** Landscaping serves multiple purposes. It provides shade for pedestrians; contributes to a feeling of safety by providing a buffer between the street and the sidewalk; and provides for a more pleasant and aesthetically pleasing pedestrian environment. All of these factors encourage more pedestrian activity.
- ***Driveways.*** Where a sidewalk crosses a driveway, the driveway is actually a part of the sidewalk. As such, damaged driveways need to be repaired to ensure full pedestrian accessibility.
- ***Pedestrian-oriented lighting.*** Street lighting alone is inadequate for ensuring a safe, comfortable environment for pedestrians who utilize the sidewalk at night. Pedestrian-oriented lighting in the appropriate locations is necessary to maintain a safe and inviting pedestrian environment. Often pedestrian lights can be installed directly on street light poles (commonly referred to as "cobra heads"), which prevents having to install an additional pole on the street.

- ***Public amenities.*** Streetscape amenities such as benches, bike racks, and waste receptacles contribute to the overall quality of the pedestrian environment and encourage pedestrian activity.

To determine the relative condition of each block face along the corridor, a score was given to each of the seven key elements being evaluated (sidewalks, driveways, curbs, ramps, lighting, landscaping, and amenities). *Table D.1* presents the ranking system, with the highest score corresponding to the worst conditions.

| ***Table D.1 – Ranking System*** | | |
|---|---|---|
| ***Score*** | | ***Treatment Needed*** |
| 0 | = | Minimum |
| 1 | = | Moderate |
| 2 | = | Maximum |

The individual element scores then were summarized by block face, adding the scores for all elements, resulting in a total score for each block face. The total score provides an initial indicator of the overall block face condition and, therefore, facilitates prioritization of those most in need of improvement. Based on composite block face scores, the following ranges provide a rough approximation of relative condition:

- **Scores 0-6 (Minimum Treatment Needed)**: Indicates that this particular block face generally has sidewalks and curbs in good condition or need only minimum repair; Americans with Disabilities Act (ADA) standards for cross slope, width, and ramps at driveways and intersections are met; trees or other landscaping provide buffers to pedestrians from motor vehicles; and there are pedestrian-oriented lighting and street amenities.

- **Scores 7-10 (Moderate Treatment Needed)**: Indicates that sidewalks exist, although some areas may need to be improved; right-of-way is available; sidewalks and curbs may need some repair; ramps may need to be installed where there are none or existing ramps are inadequate or broken; some landscaping is needed; some planting strips are needed; and there is insufficient pedestrian-oriented lighting or amenities.

- **Scores 11+ (Maximum Treatment Needed)**: Indicates that sidewalks and curbs are in bad condition or in some areas none exist; there are few or no ramps; little to no landscaping or planting strips exist; little to no pedestrian-oriented lighting or amenities exist.

*Table D.2* shows an example of block face scoring.

***Table D.2 – Example Block Face Scoring***

| ***Criteria*** | ***Ranking*** | ***Explanation*** |
|---|---|---|
| Sidewalk | 2 | Narrow with obstacles, poor condition |
| Curbs | 1 | Damaged |
| Driveways | 1 | Poor condition |
| Ramps | 2 | Not compliant |
| Landscaping | 2 | None |
| Lighting | 2 | No pedestrian-oriented lighting |
| Amenities | 2 | None |
| ***Total*** | **12** | |

A summary of the scores for each block face is presented in *Table D.3*. With seven pedestrian elements scored, the worst score a block face can receive is 14.

| ***Table D.3 – FM 518 Block Face Composite Score Summary*** | | |
|---|---|---|
| | ***North*** | ***South*** |
| SH 3 to Houston Avenue | 13 | 13 |
| Houston Avenue to Simms Street | 13 | 13 |
| Simms Street to RR tracks | 13 | 13 |
| RR tracks to Colorado Avenue | 12 | 12 |
| Colorado Avenue to Iowa Avenue | 12 | 12 |
| Iowa Avenue to Wisconsin Avenue | 13 | 13 |
| Wisconsin Avenue to Briarglen Drive | 13 | 13 |
| Briarglen Drive to Alabama Avenue | 12 | 12 |
| Alabama Avenue to FM 270 | 12 | 12 |

***Table D.3* shows that the entire FM 518 corridor between SH 3 and FM 270 is in need of maximum treatment (i.e., block face score of 11+).** The north side of the corridor is particularly bad, with virtually no sidewalks outside of the Historic District. Some pedestrian lighting and benches are present but, again, these are only found in the Historic District (between the railroad tracks and Iowa Street). In the Historic District these amenities are found in greater numbers on the north side of the corridor than on the south side.

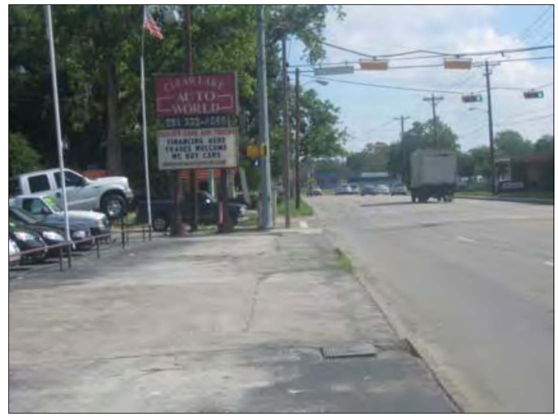
*Table D.4* presents the individual scores for each of the seven streetscape elements ranked on the nine block faces, on both the north and south sides of the street.

| ***Table D.4 – Ranking Scores*** | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***SH 3 to Houston*** | | ***Houston to Simms*** | | ***Simms to RR Tracks*** | | ***RR Tracks to Colorado*** | | ***Colorado to Iowa*** | | ***Iowa to Wisconsin*** | | ***Wisconsin to Briarglen*** | | ***Briarglen to Alabama*** | | ***Alabama to FM 270*** | |
| | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** | ***N*** | ***S*** |
| **Sidewalk** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Curbs** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Driveways** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **Ramps** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Landscaping** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Lighting** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Amenities** | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 |
| ***Total*** | **13** | **13** | **13** | **13** | **13** | **13** | **12** | **12** | **12** | **12** | **13** | **13** | **13** | **13** | **12** | **12** | **12** | **12** |

A narrative summary of the conditions found on each block face is presented next.

***SH 3 to Houston Avenue***

***North Side.*** The land use on this block is predominately commercial. Most of the block is asphalt pavement. This block face lacks major pedestrian infrastructure, sidewalks, curbs, ramps, planting strip, and pedestrian-oriented lighting.



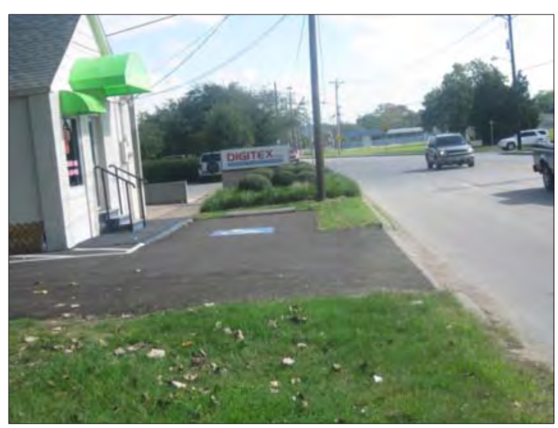

***SH 3 to Houston, North Side***

***South Side.*** The land use on this block is predominately commercial. Most of the block is asphalt pavement, with the exception of a small segment of sidewalk near the McDonald's. For the majority of the block, all of the major pedestrian infrastructure would need to be installed, such as sidewalks, curbs, ramps, and planting strip. This block lacks amenities and pedestrian-oriented lighting.

***SH 3 to Houston, South Side***

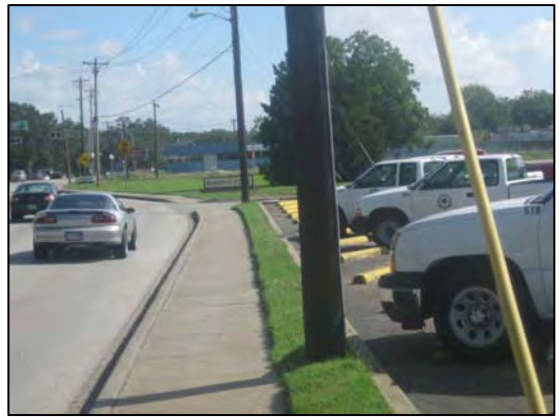
***Houston Avenue to Simms Street***

***North Side.*** The land use on this block is commercial. Only half of the block has a sidewalk present. There is some landscaping; however, there would be limited space for a planting strip. Cobra head lights are present on which pedestrian-oriented lighting could be installed.




***Houston to Simms, North Side***

***South Side.*** This block hosts commercial land uses. The sidewalk and curb are in good condition; however, there is no barrier (planting strip or otherwise) between the sidewalk and the roadway. This makes for an unsafe condition, both perceived and real, for pedestrians. To reconfigure the infrastructure to allow for a planting strip and landscaping would require moving utility poles, which may be cost prohibitive. This block face lacks pedestrian-oriented lighting.



***Houston to Simms, South Side***

***Simms Street to GH&H Railroad Tracks***

***North Side.*** The land use on this block is commercial. A brick sidewalk is present along half of the block; the other half has a sidewalk on private property. This block face lacks pedestrian-oriented lighting.

***Simms to RR Tracks, North Side***

***South Side.*** The land use on this block is commercial. The sidewalk and curb are in good condition; however, there is no barrier (planting strip or otherwise) between the sidewalk and the roadway. This makes for an unsafe condition, both perceived and real, for pedestrians. There are several pole obstructions in the sidewalk. To reconfigure the infrastructure to allow for a planting strip and landscaping would require moving utility poles, which may be cost prohibitive. Cobra head lights are present on which pedestrian-oriented lighting could be installed.


***Simms to RR Tracks, South Side***

***GH&H Railroad Tracks to Colorado Avenue***

***North Side.*** League Park, a church, and commercial uses are located on this block. A brick sidewalk in fair to poor condition is present. A planting strip containing pole obstructions is present with limited space for landscaping. A pedestrain lamp and a bench are present.

***RR Tracks to Colorado, North Side***

***South Side.*** This block is predominately commercial land use with a brick sidewalk. Half of the block is heavily shaded by the large oak trees of the Historic District. There is no planting strip and one would not be able to be installed due to the presence of the trees. The sidewalk is adequate, but there is curb damage that will require repair/replacement. Two pedestrian lights and one bench are present on this block.

***RR Tracks to Colorado, South Side***

***Colorado Avenue to Iowa Avenue***

***North Side.*** The land uses on this block are commercial. The brick sidewalk, curbs, and ramps are in good to fair condition, with some damage to some of the brick pavers. A generous planting strip with several of the city's historic oak tress is present. Pedestrian lights and several benches are present on this block.

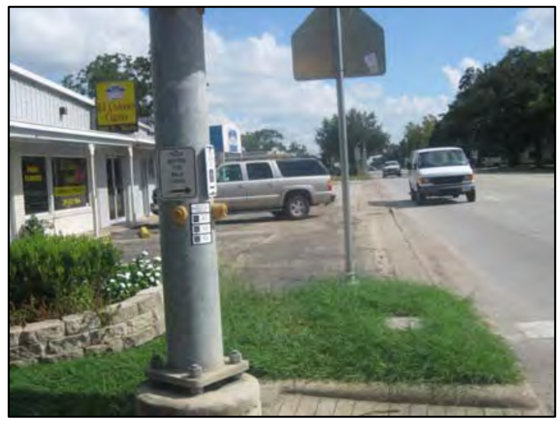
***Colorado to Iowa, North Side***

***South Side.*** Helen's Garden park and some commercial land uses are located on this block. Most of the block has no sidewalk, but there is a very worn foot path ("desire line") present. Because of where the historic oak trees are located, installation of a sidewalk between the roadway and the trees (where the foot path is now) would leave pedestrians unprotected. However, there is a wide area between the trees and the property line of the park where a sidewalk may be able to be installed. There is a brick sidewalk between Kansas and Iowa Streets. One pedestrian light is present at Kansas Street.

***Colorado to Iowa, South Side***

***Iowa Avenue to Wisconsin Avenue***

***North Side.*** This block consists of commercial land uses. The majority of the block consists of asphalt pavement and driveways, and there is no sidewalk or planting strip present. Other amenities such as landscaping and pedestrian lighting are also absent. The majority of the curb is damaged.



***Iowa to Wisconsin, North Side***

***South Side.*** This block contains commercial land uses. There is no sidewalk or planting strip present, except in small, disconnected segments. Space limitations and obstructions due to signs and poles would make it difficult to include a planting strip on this block. Much of the curb is damaged. No cobra head lights are present on this block.

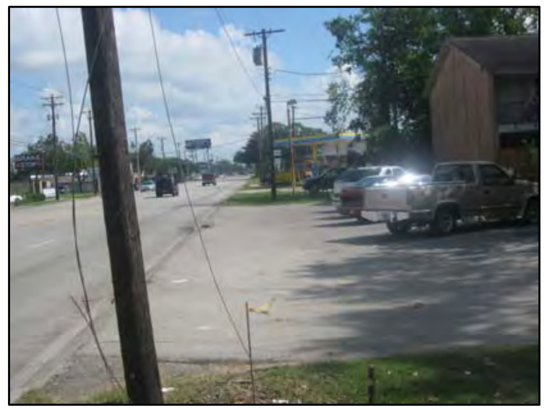
***Iowa to Wisconsin, South Side***

***Wisconsin Avenue to Briarglen Drive***

***North Side.*** This block is comprised of commercial land uses and vacant lots. There is no sidewalk, except in small, disconnected segments. The foot path worn into the grass indicates need for a sidewalk. Curb damage is present. Space is available for a planting strip and landscaping. Cobra head lights are present on which pedestrian lighting could be installed.

***Wisconsin to Briarglen, North Side***

***South Side.*** This block contains predominately commercial land uses and apartment complexes. There is no sidewalk, except in small, disconnected segments. The foot path worn into the grass indicates need for a sidewalk. The majority of the curbs are damaged. Cobra head lights are present on which pedestrian lighting could be installed.



***Wisconsin to Briarglen, South Side***

***Briarglen Drive to Alabama Avenue***

***North Side.*** This block consists of commercial land uses. Some sections of the block have a sidewalk; other sections have only asphalt pavement. This block lacks a planting strip, trees, landscaping, and pedestrian-oriented lighting. The majority of the curb is damaged.

***Briarglen to Alabama, North Side***

***South Side.*** This block consists primarily of large, overgrown vacant lots and some commercial land uses. There is no sidewalk, although a very well-worn foot path in the grass indicates need for one. The majority of the curb is damaged. This block lacks a planting strip, although there is ample room for one.

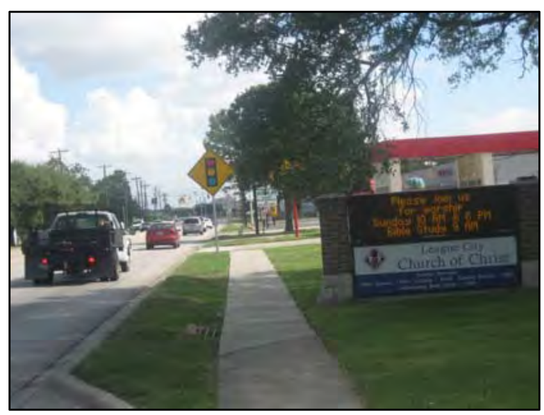
***Briarglen to Alabama, South Side***

***Alabama Avenue to FM 270***

***North Side.*** This block consists of commercial land uses and overgrown vacant lots. A small sidewalk segment is available near the Five Corners intersection; however, the majority of the block has no sidewalk. There is a foot path worn into the grass, indicating that a sidewalk is needed. Parts of the block have virtually no room to walk due to the lack of sidewalk and the overgrowth (e.g., near Texas Avenue), making for a very dangerous situation for pedestrians. No pedestrian amenities are present (lighting, landscaping, planting strip, etc.), but there is enough space for these elements to be installed.

***Alabama to FM 270, North Side***

***South Side.*** This block is home to a church and commercial land uses. Most of the block is missing a sidewalk, including the approach to the Five Corners intersection. Some planting strip is in place, although there are no trees or other landscaping planted in it. Cobra heads are present on which pedestrian-oriented lighting could be installed.



***Alabama to FM 270, South Side***

## *FUNDING PURSUIT AND QUANTIFICATION OF BENEFITS*

Pedestrian infrastructure improvements will require the City to commit local funds for the project(s). However, the City does not need to always provide 100% of the funding required, as there are numerous avenues (many of which are detailed in *Appendix E*) through which federal and other sources of funding can be tapped. These sources often provide up to 80% of the project cost, leaving League City with just 20% of the project cost to fund with local dollars. **One of the keys to accessing this funding leverage is the ability to quantify the expected benefits that will result from the streetscape improvements.**

The discussion of E. Main Street that follows exemplifies the process that League City can undertake anywhere in the city to demonstrate expected benefits such as reduced traffic congestion, reduced fuel consumption, and improved air quality. The Houston-Galveston Area Council (H-GAC), the Texas Department of Transportation (TxDOT), and other entities that control funding sources often rank proposed projects based on these metrics. Therefore, being able to demonstrate quantifiable benefits is vitally important if League City desires to off-load some of the financial burden of implementation from the City's taxpayers.

## *QUANTIFIABLE MOBILITY BENEFITS OF STREETSCAPE IMPROVEMENTS*

The many ways in which pedestrian streetscape improvements can benefit a community were discussed in Chapter 3. This section will discuss two quantifiable benefits in particular that are directly related to mobility and can be measured via the inventory methods outlined in this appendix. These benefits are increased pedestrian activity and increased transit usage, both of which result in reduced VMT. **As previously discussed, quantifying the expected benefits is an extremely important step in being awarded implementation funds from regional, state, and federal sources.** The starting point for measuring these benefits is to determine the existing and desired Pedestrian Level of Service (PLOS).

### *PEDESTRIAN LEVEL OF SERVICE*

Similar to LOS measurements for other modes of transportation (e.g., roadways, transit), PLOS is an indication of the ease, safety, and comfort experienced by a walker in a particular pedestrian environment.

*Table D.5* converts the total existing conditions score for a particular block face to a corresponding PLOS score. This scoring conversion system was developed by adapting the generic model presented in a Florida Department of Transportation study.[1]

[1] "Modeling the Roadside Walking Environment – Pedestrian Level of Service," Transportation Research Record 1773, Paper No. 01-0511, 2001

| Table D.5 – Existing Conditions Score and PLOS | |
|---|---|
| ***Existing Conditions Score*** | ***PLOS*** |
| 1, 2, 3 | A |
| 4, 5, 6 | B |
| 7, 8 | C |
| 9, 10 | D |
| 11, 12 | E |
| 13, 14 | F |

After each block face was assigned a total score and PLOS based on the block face's existing conditions, an "after" score and corresponding PLOS were also assigned which reflect the *anticipated* condition of the block face after streetscape improvements are implemented. Unless there are mitigating circumstances that would prevent it, the objective is to bring all block faces to a PLOS of A. An example of this process is presented in *Table D.6*. All of the inventoried block faces would be done similarly.

| Table D.6 – Example Block Face Condition Scores and PLOS, Before and After Improvements | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***NORTH SIDE OF STREET*** | | | | ***SOUTH SIDE OF STREET*** | | | |
| | ***Existing Score*** | ***Existing PLOS*** | ***New Score*** | ***New PLOS*** | ***Existing Score*** | ***Existing PLOS*** | ***New Score*** | ***New PLOS*** |
| **FM 518 – Alabama to FM 270** | | | | | | | | |
| Sidewalk | 2 | -- | 0 | -- | 2 | -- | 0 | -- |
| Curbs | 2 | -- | 0 | -- | 2 | -- | 0 | -- |
| Driveways | 1 | -- | 0 | -- | 1 | -- | 0 | -- |
| Ramps | 2 | -- | 0 | -- | 2 | -- | 0 | -- |
| Landscaping | 1 | -- | 0 | -- | 1 | -- | 0 | -- |
| Lighting | 2 | -- | 0 | -- | 2 | -- | 0 | -- |
| Amenities | 2 | -- | 0 | -- | 2 | -- | 0 | -- |
| ***Total*** | **12** | **E** | **0** | **A** | **12** | **E** | **0** | **A** |

### *Increased Pedestrian Activity*

Improving the pedestrian realm makes walking more feasible and appealing than it would be without the improvements. **Proactive measures to facilitate pedestrian activity can result in a one-for-one replacement of auto trips of one-quarter mile or less with a pedestrian trip.[2]** Some longer auto trips may also be replaced if good pedestrian infrastructure brings desirable destinations within reach,

[2] "The Texas Guide to Accepted Mobile Source Emission Reduction Strategies," Texas Transportation Institute, August 2003

eliminating the need to drive to a location much farther away. This replacement of auto trips with walking trips results in reduced VMT, which decreases both traffic congestion and air pollution.

An increase in PLOS along a particular segment will result in a reduction in traffic along that segment as some auto trips are converted to pedestrian trips. Depending on the magnitude of the PLOS increase, this traffic reduction is assumed to be either 2%, 4%, or 6%. For instance, a PLOS increase that raises a block face score from a "B" to an "A" is assumed to reduce the traffic along that segment by 2%. At the other extreme, going from an "F" to an "A" would reduce traffic by 6%.

According to TxDOT, traffic levels along the stretch of FM 518 examined here are approximately 35,000 vehicles per day. Because the streetscape conditions in this area are very poor (PLOS E or F), pedestrian infrastructure improvements would be expected to reduce traffic levels by 6%, or approximately 2,100 vehicles daily. Since PLOS improvements can spur the replacement of auto trips of one-quarter mile or less with a pedestrian trip, a reduction of 2,100 vehicles each making a quarter-mile trip represents a daily VMT reduction of 525 miles (2,100 x 0.25).

In addition to the decreased congestion resulting from this VMT reduction, there is also an associated improvement in air quality. Environmental benefits through increased pedestrian activity are estimated through the application of a methodology described in *The Texas Guide to Accepted Mobile Source Emission Reduction Strategies* (August 2003), published by the Texas Transportation Institute for TxDOT. The three primary pollutants of concern in the Houston-Galveston region are Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), and Carbon Monoxide (CO).

Pollution reduction results from both the removal of vehicle trips and from the elimination of the corresponding "cold starts." A cold start is the moment when a vehicle is first started, and it represents a significant source of vehicle emissions. Thus, removing 2,100 vehicle trips as described above represents both 525 vehicle miles reduced and the elimination of 2,100 cold starts.

Using emission factors developed by the Environmental Protection Agency (EPA) for the Houston-Galveston region, it is possible to calculate the daily emissions that will be eliminated as a result of the reduced cold starts and reduced VMT. With the elimination of 2,100 cold starts and 525 VMT, a total of approximately 280 pounds of emissions (NOx, VOC, and CO) will be eliminated daily.

### *INCREASED TRANSIT RIDERSHIP*

The second quantifiable mobility benefit of pedestrian improvements has to do with their ability to increase transit usage. While League City does not yet have fixed-route transit, when transit service does emerge it will be more effective with quality pedestrian infrastructure in place to support it. Streetscape improvements make accessing transit easier, resulting in higher transit ridership as some drivers choose to use transit instead of driving.

It is also important to note that for areas where transit service exists, **federal funding is available for streetscape improvements via the Federal Transit Administration's Livable Communities Initiative (LCI).** LCI effectively allows cities and municipal management districts to be awarded funds from a wide variety of regional, state, and federal sources for pedestrian infrastructure within 500 feet of any fixed-route bus stop or 1,500 feet of a transit terminal. Eligible improvements include not only sidewalks, but also pedestrian-oriented lighting, crosswalks, landscaping, wheelchair ramps, street furniture, and public art. Numerous cities and municipal management districts within the Houston-Galveston region have effectively used LCI to create more walkable environments. Examples include the Midtown, Upper Kirby, and Uptown districts of Houston; the Woodlands Town Center; and downtown Galveston.

The close relationship between an improved pedestrian environment and its contribution to better transit service and increased ridership has been documented in several studies nationwide. The most recent research addressing the relationship between the pedestrian environment, which is measured in PLOS, and bus service performance, which is measured in Bus LOS (BLOS), is contained in the 2002 *Quality and Level of Service Handbook*, prepared by the Florida Department of Transportation (FDOT). The handbook presents compelling evidence of a relationship between the quality of the pedestrian environment as PLOS, and the quality of the bus service as BLOS.

The relationship between PLOS and BLOS is presented in *Table D.7*.

***Table D.7 – Pedestrian LOS Adjustment Factors on Bus LOS***

| ***PLOS*** | ***Adjustment Factor on BLOS*** |
|---|---|
| A | 1.15 |
| B | 1.10 |
| C | 1.05 |
| D | 1.00 |
| E | 0.80 |
| F | 0.55 |

***Source:*** *Florida Department of Transportation*

The difference between a PLOS A (1.15) and a PLOS B (1.10), as shown in *Table D.7*, is a BLOS adjustment of 5%. This 5% increase in BLOS translates directly to a 5% increase in transit ridership. Likewise, as PLOS increases from D to A, the result would be a 15% increase in transit ridership. The expected ridership increases for each possible PLOS change are calculated similarly.

As an example, consider a hypothetical transit route operating on E. Main St. There may be a bus stop at the corner of E. Main St and Park Ave, and the PLOS along the block face that includes this stop may have been determined to be PLOS E (i.e., fairly bad pedestrian conditions). Prior to any pedestrian improvements, there are found to be 40 daily bus boardings at this stop. Pedestrian improvements are then implemented which bring the area up to a PLOS A. As shown in *Table D.8*, an improvement from PLOS E to PLOS A results in a ridership increase of 35% (1.15 – 0.80 = 0.35). Thus, daily ridership at this stop could be expected to increase from 40 boardings to 54 boardings (40 x 0.35 = 14 additional boardings). If each of these additional boardings represents an automobile trip that has been replaced with a transit trip, the cumulative effect of improving the pedestrian realm along an entire transit route can result in significant traffic reduction and decreased air pollution.

According to H-GAC, the average automobile trip length in the region is 8.6 miles and the average vehicle occupancy rate is 1.25 persons per vehicle (ppv). These factors can be used to calculate reduced VMT and emissions as a result of increased transit ridership. For example, 100 added transit trips would equate to 80 reduced vehicle trips (100/1.25 ppv). These 80 vehicle trips represent 688 reduced VMT (80*8.6 miles/trip). The reductions in Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), and Carbon Monoxide (CO) would then be calculated using the same method shown previously.

When local transit service is implemented in League City, this methodology can be implemented to quantify the ridership benefits that can accrue when the transit system is supported by a quality pedestrian network.

# *Appendix E – FEDERAL-STATE-LOCAL FUNDING ALTERNATIVES*

## *CAPITAL AND SERVICE IMPROVEMENT FUNDING STRATEGIES*

There are several categories of federal, state, and other funds that League City can pursue for roadway, transit, and other modal capital improvements and related services, or operations and maintenance (O&M) costs. The available alternatives include the following programs:

### *Coastal Management Program (CMP)*

*Purpose*: The federal Coastal Zone Management Act of 1972 (CZMA) brings approximately $2.2 million in federal coastal management program funds annually to Texas state and local entities to implement projects and program activities. The Texas Coastal Coordination Council has funded projects in all parts of the coastal zone for a wide variety of purposes.

*Eligible Activities*: The Council established the following priorities for use of these funds by coastal communities:

- Coastal Natural Hazards Response
- Critical Areas Enhancement
- Shoreline Access
- Waterfront Revitalization and Ecotourism Development
- Permit Streamlining/Assistance and Governmental Coordination
- Information and Data Availability
- Public Education and Outreach

*Responsible Governmental Agency:* The State of Texas, Coastal Coordination Council

*Web Address*: http://www.glo.state.tx.us/coastal/cmp.html

*Applicability to League City:* League City, with waterfront along the Clear Creek watershed, and Clear Lake (part of the upper Galveston Bay system), could consider utilization of CMP funds for projects including waterfront access, paddling trails, water taxi/excursion/ecotourism, shoreline enhancement, and mitigation of negative impacts along the City's waterfront.

### *Community Development Block Grants (CDBG)*

*Purpose*: Since 1974 CDBG has been the backbone of improvement efforts in many communities, providing a flexible source of annual grant funds for local governments nationwide. With the participation of their citizens, communities can devote these funds to a wide range of activities that best serve their own particular development priorities, provided that these projects (1) benefit low- and moderate-income families; (2) prevent or eliminate slums or blight; or (3) meet other urgent community development needs.

*Eligible Activities*: As one of the Nation's largest Federal grant programs, the impact of CDBG-funded projects can be seen in the housing stock, the business environment, the streets, and public facilities of almost every community. The largest single use of State CDBG funds traditionally has been the provision of public facilities. However, in the last few years, the program has played an increasingly key role in stimulating economic development activities that expand job and business opportunities for lower income families and neighborhoods.

States establish their own programs and rules to govern the distribution of their CDBG funds. While states may implement policies that give priority to particular activities, such as economic development projects or wastewater treatment systems, their choices are limited by the activities that are eligible under the national program, which include the following:

- Acquiring real property (primarily land, buildings, and other permanent improvements to the property) for program purposes. CDBG also helps communities demolish property and clear sites to prepare the land for other uses.
- Reconstructing or rehabilitating housing and other property. From homeless shelters to single-family homes to shopping centers, CDBG enables communities to improve properties that have become less usable, whether due to age, neglect, natural disaster, or changing needs. New construction of housing is allowed only in certain circumstances.
- Building public facilities and improvements, such as streets, sidewalks, sewers, and water systems, parks and community centers, fire stations.
- Helping people prepare for and obtain employment through education and job training, welfare-to-work activities, and other services.
- Assisting for-profit businesses with special economic development activities. Such projects might include microenterprise loans to low-income entrepreneurs, assembling land to attract new industry, or business loans to help retain or expand existing businesses that employ low-income workers.
- Providing public services for youths, seniors, or the disabled.
- Carrying out crime reduction initiatives such as establishing neighborhood watch programs, providing extra police patrols, rehabilitating or constructing police substations, and clearing abandoned buildings used for illegal activities.
- Assisting homebuyers directly through, for example, down payment assistance or a revolving loan fund for first-time buyers.
- Enforcing local building codes to reverse housing deterioration and other signs of blight.

- Meeting planning and administrative expenses, such as costs related to developing a Consolidated Plan and managing CDBG funds.

*Responsible Governmental Agency:* HUD/Municipalities

*Web Address*: http://www.hud.gov/offices/cpd/communitydevelopment/programs/

*Applicability to League City:* As one of the only federal funding categories which can be utilized as matching funds against other federal funds, CDBG could be utilized in conjunction with other federal funds to improve public infrastructure (roads, utilities, sidewalks, transit capital) in portions of the City which would qualify, including "Shellside," portions of the Historic District, and the sub-area of the City between Five Corners and the Historic District.

### *Congestion Mitigation and Air Quality (CMAQ) Improvement Program*

The purpose of the CMAQ program is to fund transportation projects or programs that contribute to attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for ozone and carbon monoxide (CO). The construction of transit facilities such as park and rides and terminals are eligible for up to three years of federal assistance under the CMAQ program. The construction of bicycle and pedestrian facilities is also eligible under the CMAQ program. CMAQ-funded projects are selected on a competitive basis by the MPO (H-GAC) on a semi-annual basis, in conjunction with the development of the three-year Transportation Improvement Program (TIP). The MPO reviews and ranks CMAQ project requests and recommends selection based on a variety of factors, including the air quality benefits (cost per pound of pollutant reduced), system connectivity, environmental justice, and regional significance. Project readiness, which includes prior inclusion in the Regional Transportation Plan (RTP), local share commitment, completion of preliminary engineering, environmental analysis, and right-of-way acquisition, is also a prerequisite for full consideration. The CMAQ program is traditionally funded on an 80% federal/20% local basis. However, sponsors are able to improve project scores by increasing the percentage of local share participation.

*Applicability to League City:* Eligible projects include recommendations for access management, Intelligent Transportation Systems (ITS), pedestrian streetscape infrastructure, bicycle facilities/striping, procurement of transit vehicles, and new transit service "Pilot Projects," among other eligible activities. Note: H-GAC issued a call for CMAQ and STP-MM projects for the 2011-2014 TIP, which closed October 2010. The City of League City did submit several near term priority projects for TIP consideration.

### *FTA Section 5307 Urbanized Program*

Transit capital and planning activities are eligible under the FTA 5307 Formula Program on an 80% federal, 20% local basis. An example of capital expenditure would be the purchase of new transit vehicles, shelters, or other capital items that support transit services. It may also be used for eligible "Capital Cost of Contracting" activities, which could support up to 40% reimbursement for turnkey *private sector* bus operations.

*Applicability to League City:* Houston METRO is the designated recipient for Houston Urbanized Area (UZA) formula transit funds. However, League City is located within the Houston UZA, and a portion of the UZA funds (50% of the formula is population based) is generated by citizens residing in League City. At some point in the near future, it would be appropriate for League City's "Fair Share" of formula funding to support transit capital and eligible Capital Cost of Contracting activities for transit service in League City. The current Fair Share dollar estimate for League City within the Houston UZA, based on adjusted 2010 Census data, is approximately $415,000 in federal funds annually.

The Gulf Coast Center-Connect Transit is currently utilizing small-urban transit formula funds from other portions of Galveston County to provide demand-response services within League City. TxDOT, however, is requesting that the Gulf Coast Center-Connect Transit begin to utilize Houston UZA 5307 formula funds within northern Galveston County communities such as League City. In 2010, during the course of the League City Master Mobility Plan effort, the Galveston County Transit District was formed, with participation by League City on the Board of Directors. It is likely that any future agreement to program FTA Section 5307 funds for use in League City would be negotiated by the Galveston County Transit District.

### *FTA Section 5309 Discretionary Program*

FTA's Section 5309 Discretionary Program provides funding on an 80% federal/20% local share basis to fund eligible transit capital needs, including transit access and streetscape improvements developed in accordance with FTA's Livable Communities Initiative (LCI). Congress selects the FTA Discretionary funds during its annual Transportation Appropriations process and also every six years under the Transportation Reauthorization process. Applicants must be eligible FTA grantees, such as a county, a municipality, a municipal management district, or a transit authority.

*Applicability to League City:* The upcoming Transportation Reauthorization Bill, and the Annual Transportation Appropriations Bills will provide opportunities for League City to submit discretionary funding requests through its U.S. Congressional and Senate Delegations.

### *Job Access/Reverse Commute (JARC)*

*Purpose*: The JARC grant program assists states and localities in developing new or expanded transportation services that connect welfare recipients and other low-income persons to jobs and other employment related services.

The Job Access and Reverse Commute grant program is intended to establish a coordinated regional approach to job access challenges. All projects funded under this program must be the result of a collaborative planning process that includes states and Metropolitan Planning Organizations (MPO), transportation providers, agencies administering Temporary Assistance for Needy Families (TANF) and Welfare to Work (WtW) funds, human services agencies, public housing, child care organizations, employers, states and affected communities, and other stakeholders. The program is expected to leverage other funds that are eligible to be expended for transportation and encourage a coordinated approach to transportation services.

*Eligible Activities*: Job Access projects are targeted at developing new or expanded transportation services such as shuttles, vanpools, new bus routes, connector services to mass transit, and guaranteed ride home programs for welfare recipients and low income persons. Reverse Commute projects provide transportation services to suburban employment centers from urban, rural and other suburban locations for all populations. Criteria for evaluating grant applications for Job Access and Reverse Commute grants include the following:

- Coordinated human services/transportation planning process involving state or local agencies that administer the TANF and WtW programs, the community to be served, and other area stakeholders;
- Unmet need for additional services and extent to which the service will meet that need; and
- Project financing, including sustainability of funding and financial commitments from human service providers and existing transportation providers.

Other factors that may be taken into account include the use of innovative approaches, schedule for project implementation, and geographic distribution.

*Responsible Governmental Agency:* In urbanized areas with 200,000 population or more, MPOs select the applicant(s). In small, urbanized areas under 200,000 population and in non-urbanized, rural areas, states select the applicant(s). Tribal governments must go through the state process but, once selected, can choose to be sub-recipients of the state or apply directly to FTA.

*Web Address*: http://www.fta.dot.gov/funding/grants/grants_financing_3550.html

*Applicability to League City:* League City lies within the service areas of the Gulf Coast Center, the new Galveston County Transit District, and the U.S. Census designated Houston Urbanized Area (UZA). If an applicable project such as a reverse commute project from League City to Galveston was proposed, the project partners could submit a joint application to H-GAC during its annual project call.

### *Federal Highway Administration (FHWA) Transportation and Community and System Preservation (TCSP) Program*

The TCSP program provides funding for grants and research to investigate and address the relationship between transportation and community and system preservation. Local governments are eligible for discretionary grants to plan and implement strategies that improve the efficiency of the transportation system; reduce environmental impacts of transportation; reduce the need for costly future public infrastructure investments; ensure efficient access to jobs, services, and centers of trade; examine development patterns; and identify strategies to encourage private sector development patterns that achieve these goals. Projects eligible for federal highway and transit funding or other activities determined by the Secretary of Transportation to be appropriate also are eligible for TCSP funding.

*Applicability to League City:* Calls for Projects, including annual Transportation Appropriations cycles.

### *Transportation Enhancement (TE) Program*

The goal of the program is to encourage diverse modes of travel, increase the community benefits of transportation investment, strengthen partnerships between state and local governments, and promote citizen involvement in transportation decisions. To be eligible for consideration, all projects must demonstrate a relationship to the surface transportation system through either function or impact, go above and beyond standard transportation activities, and incorporate one of the following 12 categories:

- Provision of facilities for pedestrians and bicycles
- Provision of safety and education activities for pedestrians and bicyclists
- Acquisition of scenic easements and scenic and historic properties
- Scenic or historic highway programs (including providing tourist and welcome center facilities)
- Landscaping and other scenic beautification
- Historic preservation
- Rehabilitation and operation of historic transportation buildings, structures, or facilities (including historic railroad facilities and canals)
- Preservation of abandoned railway corridors (including the conversion and use for pedestrian and bicycle facilities)
- Control and removal of outdoor advertising
- Archaeological planning and research
- Environmental mitigation to address water pollution due to highway runoff, or reduction of vehicle-caused wildlife mortality while maintaining habitat connectivity
- Establishment of transportation museums

TE is a statewide competitive program and is administered in accordance with applicable federal and state rules and regulations. Projects are submitted to TxDOT and the MPO for review, and selected for funding by the Texas Transportation Commission. The funds provided by this program are on a cost reimbursement basis and are not grant funds. Projects undertaken with enhancement funds are eligible for reimbursement of up to 80% of allowable costs. The governmental entity nominating a project is responsible for the remaining cost share, including all cost overruns.

*Applicability to League City*: League City was awarded a TE 518 Bypass Trail Project by the TxDOT Commission earlier in 2010.

### *Surface Transportation Program (STP)*

*Purpose:* The STP provides flexible funding that may be used by states and localities for projects on any Federal-aid highway (including National Highway System (NHS) bridge projects on any public road), transit capital projects, and intracity and intercity bus terminals and facilities. A portion of funds reserved for rural areas may be spent on rural minor collectors. STP is the largest FHWA flexible funds program. Funding is at 80% Federal share and may be used for all projects eligible for funds under current FHWA and FTA programs.

*Eligible Activities:* A state may obligate funds apportioned to it for the Surface Transportation Program only for the following:

- Construction, reconstruction, rehabilitation, resurfacing, restoration, and operational improvements for highways (including Interstate highways) and bridges (including bridges on public roads of all functional classifications), including construction or reconstruction necessary to accommodate other transportation modes, and including the seismic retrofit and painting of and application of calcium magnesium acetate, sodium acetate/formate, or other environmentally acceptable, minimally corrosive anti-icing and de-icing compositions on bridges and approaches thereto and other elevated structures; or mitigation of damage to wildlife, habitat, and ecosystems caused by a transportation project funded under this program.
- Capital costs for transit projects eligible for assistance, including vehicles and facilities, whether publicly or privately owned, that are used to provide intercity passenger service by bus.
- Carpool projects, fringe and corridor parking facilities and programs, bicycle transportation and pedestrian walkways, and the modification of public sidewalks to comply with the Americans with Disabilities Act of 1990.
- Highway and transit safety infrastructure improvements and programs, hazard eliminations, projects to mitigate hazards caused by wildlife, and railway-highway grade crossings.
- Highway and transit research and development and technology transfer programs.
- Capital and operating costs for traffic monitoring, management, and control facilities and programs.
- Surface transportation planning programs.
- Transportation enhancement activities.
- Transportation control measures listed under the Clean Air Act.
- Development and establishment of management systems.
- Participation in natural habitat and wetlands mitigation efforts related to projects funded by this program, which may include participation in natural habitat and wetlands mitigation banks; contributions to statewide and regional efforts to conserve, restore, enhance, and create natural habitats and wetlands; and development of statewide and regional natural habitat and wetlands conservation and mitigation plans, including any banks, efforts, and plans authorized pursuant to the Water Resources Development Act of 1990.
- Infrastructure-based intelligent transportation systems capital improvements.
- Environmental restoration and pollution abatement projects (including the retrofit or construction of storm water treatment systems) to address water pollution or environmental

degradation caused or contributed to by transportation facilities. Projects shall be carried out when the transportation facilities are undergoing reconstruction, rehabilitation, resurfacing, or restoration.

*Responsible Governmental Agency:* FHWA/MPO

*Web Address*: http://www4.law.cornell.edu/uscode/23/133.html

*Applicability to League City:* Added capacity roadway and highway improvements, such as expansion of FM 646, construction of the Grand Parkway, and major bridge construction or reconstruction would all be eligible project activities.

### *Safe Routes to School (SRTS)*

*Purpose:* The program is an effort by parents, schools, community leaders, and local, state, and federal governments to improve the health and well-being of children by enabling them and encouraging them to walk and bicycle to school. SRTS programs examine conditions around schools and conduct projects and activities that work to improve safety and accessibility, and reduce traffic and air pollution in the vicinity of schools. As a result, these programs help make bicycling and walking to school safer and more appealing transportation choices thus encouraging a healthy and active lifestyle from an early age.

*Eligible Activities:* Education initiatives; encouragement strategies that generate excitement about walking and bicycling to school; enforcement activities that help change unsafe behaviors of drivers, bicyclists, and pedestrians; and engineering efforts that change the built environment, including sidewalks, bicycle lanes, crosswalks, etc.

*Responsible Governmental Agency:* FHWA

*Web Address:* http://www.saferoutesinfo.org/legislation_funding

*Applicability to League City:* Many League City residents have expressed concern about the pedestrian conditions in the immediate areas surrounding the City's schools. SRTS offers a source of funding to address this issue.

### *Rail Line Relocation Grants (DOT-FHWA)*

*Purpose:* The program is for any construction project for the improvement of the route or structure of a rail line that either (1) is carried out for the purpose of mitigating the adverse effects of rail traffic on safety, motor vehicle traffic flow, community quality of life, or economic development; or (2) involves a lateral or vertical relocation of any portion of the rail line.

*Eligible Activities*: This grant program provides funding support for the following activities:

The supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a relocation project, including bond costs and other costs relating to the issuance of bonds or other debt financing instruments and costs in performing project related audits, and includes:

- Locating, surveying, and mapping;
- Track installation, restoration, and rehabilitation;

- Acquisition of rights-of-way;
- Relocation assistance, acquisition of replacement housing sites, and acquisition and rehabilitation, relocation, and construction of replacement housing;
- Elimination of obstacles and relocation of utilities; and
- Other activities defined by the Secretary of Transportation.

A grantee shall pay at least 10% of the shared costs of a project that is funded in part by a grant awarded under this program. Local share may be paid in cash or in-kind. The in-kind contributions that are permitted include the following:

- A contribution of real property or tangible personal property (whether provided by the State or a person for the State).
- A contribution of the services of employees of the grantee or other non-Federal entity, calculated on the basis of costs incurred by the grantee or other non-Federal entity for the pay and benefits of the employees, but excluding overhead and general administrative costs.
- A payment of any costs that were incurred for the project before the filing of an application for a grant for the project under this section, and any in-kind contributions that were made for the project before the filing of the application, if and to the extent that the costs were incurred or in-kind contributions were made, as the case may be, to comply with a provision of a statute required to be satisfied in order to carry out the project.

*Responsible Governmental Agency:* FHWA

*Applicability to League City:* Although not likely to result in relocation of the UP/GH&H line, in the future, if conflicts with utilities, including drainage and other related infrastructure were to occur, this funding program could provide an alternative resource.

### *Local Share Match Funding Alternatives*

There are several alternatives that exist to assist League City in meeting its local share funding requirements, as follows.

- *General Funds or Capital Improvement Program (CIP) Bond Funds* – The City may choose to include local share match within its local CIP or capital bond program. For example, if a $5 million capital program is desired, $1 million could be included within a future bond sale to meet local share (20%) match requirements. Additionally, if the City is already planning to expend local funds on sidewalks or trails, such expenditures can also be “captured” and credited towards a federally eligible project, as long as an approved FTA Letter of No Prejudice (LONP) has previously been obtained and the project is bid subject to federal requirements.
- *Land Value* **–** For capital projects such as transit terminals, the value of land donated to the project can satisfy local share requirements. Land donations to a project could come from a developer, or other governmental entities such as the County.

- *Tax Increment Reinvestment Zones (TIRZ*) *(Chapter 311 Texas Tax Code)* – TIRZ can provide a significant dedicated resource to major infrastructure investments over a multi-year period. Not only can TIRZ be an attractive economic development tool for "greenfield" development, as an incentive to developers, but TIRZ also can be effective tools for downtown and infill development projects, as they can provide additional dedicated capital and synergies once there is a positive uptick in property values and tax "increment" (above the year 1 base). TIRZ can also be used in conjunction with other special districts, such as Municipal Management Districts, to ensure that built improvements are maintained over the long term. TIRZ also can be utilized to build very specific capital improvements – for instance, the Austin-San Antonio Rail Authority has enabling legislation to utilize TIRZ around future commuter rail stations, as a method of capturing a portion of tax increment to support capital bonds for the rail project and its related facilities.
- *Municipal Management Districts (Chapter 375 Texas Local Government Code)* – The recently created municipal management district could be an effective partner in traditional urban renewal-infill development projects. This could include pedestrian streetscape projects, landscaping, pedestrian lighting, and other back-of-curb improvements that have a positive impact on economic development. The advantage of a municipal management district is the ability to sustain improvements through fee assessments. Ongoing commitment to operations and maintenance (O&M) costs during the life of a capital project is essential to a successful capital improvement program.
- *State Transportation Development Credits (TDC)* – A state may use toll revenues that are generated and used by public, quasi-public, and private agencies to build, improve, or maintain highways, bridges, or tunnels that serve the public purpose of interstate commerce as credit toward the non-federal share requirement for any funds made available to carry out eligible Department of Transportation-related capital projects. A transit authority or municipality may apply to TxDOT-Public Transportation Division for Transportation Development Credits in lieu of local share cash for eligible transit capital facilities projects. The Texas Transportation Commission is responsible for awarding State TDCs.

### *Capturing and Protecting Local Value: FTA Letter of No Prejudice (LONP)*

A tool of great value to a Federal Transit Administration grantee is the LONP federal pre-award authority mechanism. Under an approved LONP, an eligible capital project can be "protected" for federal reimbursement for up to five years. This tool allows local governments and transit authorities to advance project activities with local funds, building "local share" credit toward the overall project, and allowing for subsequent federal reimbursement should discretionary, CMAQ, TEP, or other funds be made available. Examples of successful projects within the Houston-Galveston region that utilized the LONP mechanism include The Woodlands Town Center Pedestrian/Transit Corridor; Midtown Pedestrian/Transit Masterplan; Uptown Houston Pedestrian/Transit Master Plan; Galveston Island Rail Trolley; and Galveston Downtown-Strand LCI. In order to receive an LONP and protect its local investments, a project sponsor must meet FTA environmental clearance and advanced/preliminary engineering planning requirements, obtain approval of the LONP by the FTA Regional Office, and procure all bids for design, engineering, and construction in accordance with federal requirements.

*Applicability to League City:* Eligible transit capital projects, such as proposed streetscape improvements along FM 518/Main Street (if served by future transit services), construction of park and rides, rail stations, and other related facilities would all be eligible for advanced implementation, if an LONP is utilized.

### *FTA Livable Communities Initiative: A Framework for Urban Design*

FTA LCI guidelines provide a framework for the design of streetscape improvements that enhance transit and pedestrian user access to transit facilities and services. Under LCI, pedestrian/transit access improvements are eligible within a 500-ft. radius of a transit stop and within a 1,500-ft. radius around a transit terminal. Improvements such as sidewalks, Americans with Disabilities Act (ADA) ramps, street trees, street furniture (benches and waste receptacles), transit shelters, and pedestrian-oriented lighting are considered eligible by FTA for inclusion within a capital grant, if they demonstrate improved transit-pedestrian access. Although LCI does not have any specific funding source "attached" to it, the development of project components and qualification of costs in accordance with the program greatly enhances the fundability of a transit access-based urban revitalization effort.

*Purpose*: The objectives of the initiative are to improve mobility and the quality of services available to residents of neighborhoods by:

- Strengthening the link between transit planning and community planning, including land use policies and urban design supporting the use of transit and ultimately providing physical assets that better meet community needs;
- Stimulating increased participation by community organizations and residents, minority and low-income residents, small and minority businesses, persons with disabilities and the elderly in the planning and design process;
- Increasing access to employment, education facilities and other community destinations through high quality, community-oriented, technologically innovative transit services and facilities; and
- Leveraging resources available through other Federal, State and local programs.

*Eligible Activities*: Eligible project planning activities include the following:

- Preparation of implementation plans and designs incorporating LCI elements;
- Assessment of environmental, social, economic, land use, and urban design impacts of projects;
- Feasibility studies;
- Technical assistance;

- Participation by community organizations, and the business community, including small and minority owned businesses, and persons with disabilities;
- Evaluation of best practices; and
- Development of innovative urban design, land use, and zoning practices.

Eligible capital activities or capital project enhancements of demonstration projects include the following:

- Property acquisition, restoration or demolition of existing structures, site preparation, utilities, building foundations, walkways, and open space that are physically and functionally related to mass transportation facilities;
- Purchase of buses, enhancements to transit stations, park & ride lots and transfer facilities incorporating community services such as daycare, health care, and public safety;
- Safety elements such as lighting, surveillance, and community police and security services;
- Site design improvements including sidewalks, aerial walkways, bus access, and "kiss & ride" facilities; and
- Operational enhancements such as transit marketing and pass programs, customer information services, and advanced vehicle locating, dispatch, and information systems.

[NOTE: Congress has established independent financial appropriation to support LCI. Funding can be drawn from eligible Transportation Reauthorization and Annual Appropriations resources to meet LCI objectives.]

*Responsible Governmental Agency:* FTA

*Web Address*: http://fta.dot.gov/publications/publications_11003.html

*Applicability to League City*: Pedestrian-streetscape improvements along Main Street, City Hall, the South Shore Marina complex, and adjacent to other potential transit service areas would apply.

### *DOT/HUD Livability Initiative*

Similar to FTA's LCI, the DOT-HUD Livability Initiative emphasizes that land use, transportation, connectivity, and employment should be linked in both planning and implementation. The DOT Livability Initiative website includes a quote from FHWA Administrator Victor Mendez, who states:

> *"Livability is about tying the quality and location of transportation facilities to broader opportunities such as access to good jobs, affordable housing, quality schools, and safe streets. This includes addressing safety and capacity issues on all roads through better planning and design, maximizing and expanding new technologies such as ITS and the use of quiet pavements, using Travel Demand Management approaches to system planning and operations, etc."* http://www.fhwa.dot.gov/livability/

The first award of joint DOT-HUD funding under the program was announced in December 2009, and included a variety of urban mobility projects, including streetcars, and urban circulators. Rather than a distinct funding resource (in its first funding awards), this program has built upon the existing FTA New Starts/Small Starts and the Bus and Bus Facilities Programs.

The renewed emphasis on urban renewal and the nexus between transit services, circulation, and employment is anticipated to be a continued priority for the DOT in coming years.

*Web Address*: http://www.dot.gov/affairs/2009/dot18509.htm

*Applicability to League City:* Infill development, historic preservation, transit circulation, and multi-modal access to employment will be an opportunity within built portions of League City, including the historic district. Enhanced accessibility to employment access could include circulators in the AM and PM peaks to commuter bus park & rides, commuter rail stations, and to local employment bases, such as the South Shore Marina/Office complex.

## *Appendix F – PUBLIC COMMENTS*

THIS APPENDIX IS ON THE CD ON THE BACK COVER OF THIS REPORT.

The Goodman Corporation is a nationally recognized transportation and urban planning consulting firm possessing a wide range of planning skills complemented with a unique understanding of the governmental processes for funding and implementing complex publicly sponsored transportation and land use initiatives. Since 1980 TGC has specialized in assisting public and private clients in planning, funding, and implementing land use and mobility projects using innovative planning; leading multi-disciplinary teams in preparing planning products to support successful development and redevelopment initiatives; engaging elected leadership, staff, and the community-at-large to actively participate in the planning process; and using strong community support as a catalyst for securing available public funding resources.

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