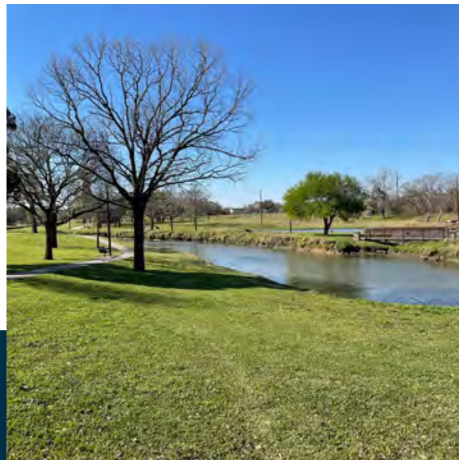

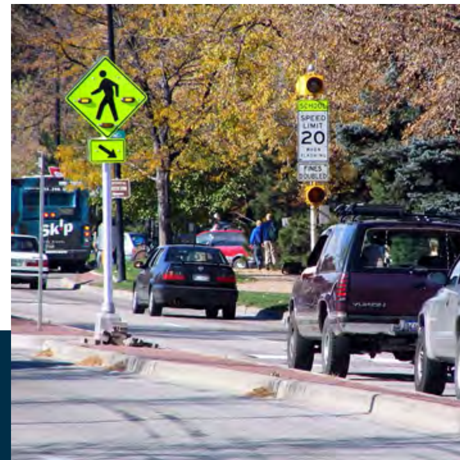

JUNE 2022

Houston-Galveston Area Council

SOUTHEAST HARRIS COUNTY Subregional Plan

PREPARED BY

Kimley»Horn
Expect More. Experience Better.

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APPENDIX C Methodology

APPENDIX D Area-Wide Improvements

APPENDIX E Intersection Conditions and Recommendations

APPENDIX F Corridor Conditions and Recommendations

APPENDIX G Evaluation of Improvements

Acknowledgements

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STAKEHOLDERS

Representatives from four (4) stakeholder groups were engaged during both phases of this study's development (please refer to meeting notes in Appendix A for additional information):

- Schools and Residential Stakeholders
- Public Safety Stakeholders
- Industrial and Business Stakeholders
- Municipal and Civic Stakeholders

CITIZENS OF SE HARRIS COUNTY

This plan was made for the community, with the help of the community. The continuous dedication of time and effort by members of the community, not only in the planning process, but in their daily interests, is what made this effort possible.

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Houston-Galveston Area Council

Executive Summary

The Houston-Galveston Area Council (H-GAC), in partnership with Harris County, began the Southeast Harris County Subregional Study to address the concerns of the local municipalities regarding existing transportation within the study area. With the recent and future growth of the subregion, planning is required to address existing traffic and safety issues so that they are not exacerbated by future growth.

A primary focus in development of the subregional study was to engage the public and develop a plan for citizen input. The planning process coordinated with and included existing plans of the incorporated cities, as well as Harris County. In developing the Southeast Harris County Subregional Study, a public engagement process, an overarching vision and corresponding goals guided its creation.

0.1 VISION AND GOALS

The vision of the Southeast Harris County Subregional Study is to "recommend improvements to address multimodal transportation, development, and economic policy needs in the subregion that align with H-GAC's goals of mobility, safety, economic competitiveness, transportation asset condition, and natural and cultural resources."

The corresponding goals and objectives are used to ensure that the recommendations from this study help the subregion achieve the vision over time.

GOAL	OBJECTIVES
Mobility	Expand and accommodate all roadway users by incorporating Complete Streets principles, as appropriate
	Increase operational efficiency and reliability of major intersections and roadways
Safety	Improve safety on the Vision Zero high-injury network with a goal of zero fatalities
Economic	Provide mobility options for residents and visitors
	Increase truck travel time reliability on the regional freight network
Maintenance	Achieve a state of good repair for transportation assets
	Improve transportation asset resiliency and stormwater capacity
Natural/Cultural Resources	Reduce transportation emissions
	Minimize impacts requiring mitigation

0.2 PLAN DEVELOPMENT

PUBLIC INVOLVEMENT

Input from daily users of the transportation system was an important part of the planning process. To ensure that the correct issues were being addressed, input was solicited from the community through public meetings, a project website with a survey and an online interactive commenting map, and comprehensive outreach using various outlets. A Steering Committee and stakeholder group were also formed to ensure that the planning process and final recommendations aligned with the subregion's goals and addressed the pertinent issues.

EXISTING CONDITIONS

Data was collected for the study area that included population, employment, transportation networks, and environmental characteristics.

POPULATION GROWTH

From 2018 to 2040, the subregion's population is projected to grow by 9,000 people. With a study area encompassing 95 square miles, this equates to about 95 people per square mile.

CRASHES

The overall number of crashes in the study area steadily decreased between 2015 and 2019, by approximately 8% overall. However, in 2019, there were still approximately 6,000 crashes total, with 1.2% of those crashes involving bicycles or pedestrians.

CONGESTION

The existing traffic level-of-service (a measure of congestion) for the study area shows that the majority of the transportation network is nearing capacity. This indicates a need for improvements within the network to address future capacity.

PREVIOUS STUDIES

The areawide, corridor, and intersection improvements recommended in this study incorporate those recommended in some of the studies previously conducted by H-GAC, Harris County, and individual cities and entities. Plans that were incorporated into the creation of the Southeast Harris County Subregional Study include:

- Pasadena Livable Centers Study
- Pasadena Healthy Parks Plan
- Pasadena Capital Improvement Program
- Deer Park Parks & Recreation Open Spaces Master Plan
- Houston Bike Plan
- Harris County Precinct 2 Parks and Trails Plan
- H-GAC Regional Transportation Plan
- H-GAC Transportation Improvement Program
- TxDOT SH 3 Access Management Study

NETWORK AND CORRIDOR SCREENING

The study area was evaluated to determine the most important intersections and corridors to study. The selection process was developed and vetted by the Steering Committee; it was ultimately determined to select locations based on mobility and safety. 100 high-congestion intersections, 50 high-crash intersections, 25 high-congestion corridors, and more than 25 miles of high-crash corridor segments were identified for more detailed study.

INTERSECTION AND CORRIDOR ANALYSIS

Using a traffic analysis software, the intersections were evaluated to determine how well they operate with the current amount of traffic they serve. Given the outputs of this analysis, recommendations were made to address the existing issues. To analyze future operations, anticipated future growth in the area was added to the traffic model, simulating conditions in 2045. Recommendations were then made to address the issues simulated in this future model.

0.3 PROPOSED IMPROVEMENTS

Areawide improvements include **recommendations for freight, transit, active transportation, and policy.**

Some highlights include:

- *Widening designated freight corridors to accommodate more heavy traffic*
- *A future transit-specific study to investigate specific areas of need*
- ***1,665 miles** of new, repaired, or improved sidewalk*
- ***230 miles** of new shared use paths*

Location-specific recommendations for study corridors and intersections vary according to needs and include the ***Improvements Toolbox on page 8***.

Recommendations to increase economic potential along the study corridors were also included in the study.

Some enhancements that were considered included:

- *Navigation/ wayfinding signage*
- *Landscaping*
- *Hardscape features at intersections*
- *Traffic calming measures*

Individual summary sheets, which include existing condition data and recommend improvements, are provided for each intersection and corridor segment. Individual pages are also provided for each corridor segment with recommended economic enhancements.

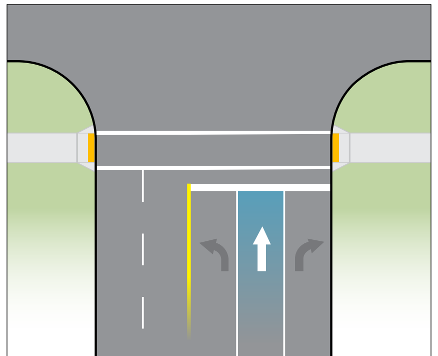
0.4 EVALUATION OF IMPROVEMENTS

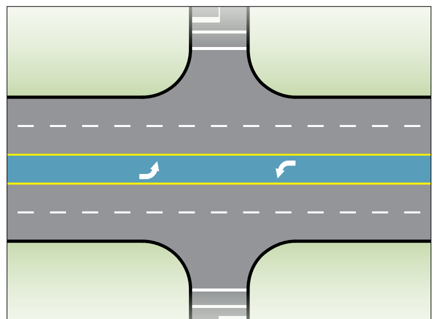
Improvements were then evaluated to determine how effective they might be in advancing the goals and overall vision of the study. These improvements should be measured regularly in the future to determine their continued effectiveness. Some measurements include:

- *Crash reduction*
- *Emission reduction*
- *Travel time delay reduction*

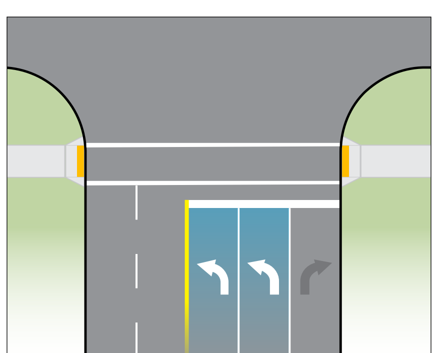
0.5 IMPLEMENTATION PLAN

A plan for implementing improvements recommended in this study was developed for each jurisdiction in the subregion. Study locations were prioritized, and improvements were identified as short-term or long-term to provide a general timeline for jurisdictions to consider as they develop their Capital Improvement Plans. Additionally, local, state, and federal funding sources were identified to illuminate opportunities for jurisdictions.


Install through lane


Install continuous two-way left-turn lane

Install Dallas flashing yellow arrow turn signal


Install dual left-turn lanes

CAPACITY AND SAFETY IMPROVEMENTS

Recommendation	Intersection	Corridor	Timeline
Driveway Closure	✓	✓	Long-Term
Realign intersection	✓		Long-Term

CAPACITY IMPROVEMENTS

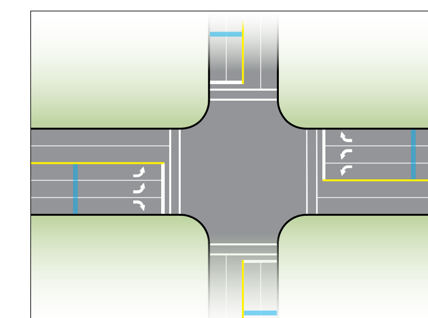
Recommendation	Intersection	Corridor	Timeline
Signal Timing/ Phasing Modification	✓	✓	Both
Install through lane	✓	✓	Long-Term
Install TWLTL		✓	Long-Term
Install Flashing Yellow Arrow signal	✓		Both
Install through-right turn lane	✓		Long-Term
Install exclusive left-turn lane (dual left)	✓		Long-Term
Install exclusive left-turn lane	✓		Long-Term
Install exclusive right-turn lane	✓		Long-Term

SAFETY IMPROVEMENTS

Recommendation	Intersection	Corridor	Timeline
Road Diet		✓	Long-Term
Install Shared Use Path		✓	Long-Term
Install bike lane		✓	Long-Term
Install/ upgrade segment lighting		✓	Short-Term
Install/ upgrade intersection lighting	✓	✓	Short-Term
Install advance warning signage	✓	✓	Both
Install reflectorized signal back plates	✓		Short-Term
Install/ upgrade curve signage		✓	Short-Term
Parking Study		✓	Long-Term
Install raised median		✓	Long-Term
Upgrade pavement	✓	✓	Both
Upgrade pavement markings	✓	✓	Short-Term
Upgrade pavement markings	✓	✓	Short-Term
Install transverse rumble strips	✓		Short-Term
Install centerline/ edgeline rumble strips		✓	Short-Term
Install/ upgrade pedestrian elements	✓	✓	Short-Term
Install/ upgrade pedestrian curb ramps		✓	Short-Term
Install/ upgrade sidewalk		✓	Short-Term


Install/ upgrade LED lighting


Install raised median


Install rumble strips approaching the intersection


Upgrade pedestrian system to include countdown signals and audible pushbuttons

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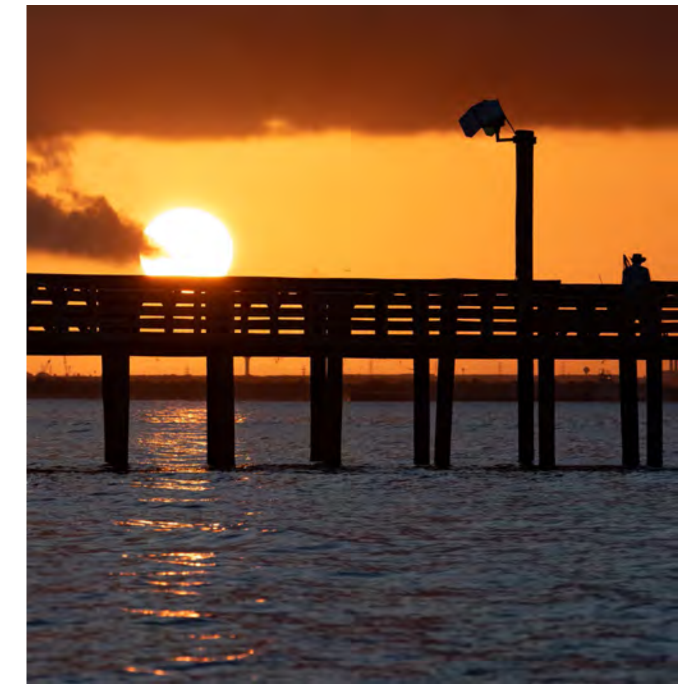
1

Introduction

- 1.1 Project History
- 1.2 Vision and Goals
- 1.3 Report Organization



Introduction

The Southeast Harris County Subregional Study, also known as the SE Harris Study, is a multimodal mobility plan intended to consolidate the subregion's various plans. The study area includes portions of Houston, South Houston, Pasadena, Deer Park, La Porte, and unincorporated Harris County. Mobility planning is a process that defines future improvements that will move people and goods around and through the study area safely and efficiently. Effective multimodal mobility planning enhances and improves the quality of life for residents and visitors by creating options for accessing destinations with or without a personal automobile. This SE Harris Study identifies current and future multimodal mobility needs within the subregion and provides a blueprint for meeting those needs.

1.1 PROJECT HISTORY

The Houston-Galveston Area Council (H-GAC) is a federally mandated administrative agency responsible for coordination of the highway, transit, and land use planning processes that are required to receive federal funds for highway and transit improvements. The purpose of H-GAC is to provide local citizens and elected officials the opportunity to be involved in the transportation planning process at a regional scale.

H-GAC was originally chosen by the Texas Department of Transportation (TxDOT) to manage a Planning and Environmental Linkage (PEL) Study for the SH 225 corridor; however, TxDOT decided to manage the study themselves. During this transition, H-GAC continued to be informed by area constituents of larger issues on and off the TxDOT network. Specifically, the issues that were brought to the attention of H-GAC regarded truck traffic to and from the Port Houston container terminals. Issues such as lack of truck parking and truck cut-through traffic causing damage to off-system local roads due to unaccommodating turning radii were noted. Stakeholders and members of the public also identified lack of sidewalk connectivity, poor pavement conditions, and crash hotpots along major roadways as areas of concern for the subregion.

The original study area stretched from the Ship Channel to Galveston Bay to Harris County line, to IH-45/IH-610 E, however, this study area was too large for the level of detail desired, so it was pared down to the core study area illustrated in Exhibit 1.1a. This core study area captures the major truck cut-through traffic and would tie into, without overlapping, the SH 225 PEL, IH-45 PEL, and previously completed SH 146 Subregional Study.

Exhibit 1.1a - Project Study Area

The final study area was defined on July 11, 2019 in a Request for Proposals for the Transportation Regional Network as follows:

> *"The study area is in the eastern portion of Harris County; the western border of the study area is IH 610/IH 45 South, the eastern border SH 146, the northern border Buffalo Bayou, and the southern border is Genoa Red Bluff. The study area includes the cities of Houston, South Houston, Pasadena, Deer Park, and La Porte. SH 225 serves as a primary access route to Port Houston's Barbours Cut Container Terminal and has a high level of truck traffic. Development in the study area ranges from petrochemical plants and tank farms to residential and commercial areas."*

Additionally, H-GAC was solicited by members of the Harris County community to conduct a mobility study in the southeastern part of the county. Stakeholders identified mobility and safety issues at key corridors and intersections in the subregion that would warrant such a study. More information on engagement with the Steering and Stakeholder committees as well as with the general public are provided in **Chapter 2 – Public Involvement.**

1.2 VISION AND GOALS

After defining the study area, a statement that provides an image of the future the plan intends to create, known as a Vision, was established. The Vision for the SE Harris Study was created by the Steering Committee in November 2020.

VISION

> *"Recommend improvements to address multimodal transportation, development, and economic policy needs in the subregion that align with H-GAC's goals of mobility, safety, economic competitiveness, transportation asset condition, and natural and cultural resources."*

Once the Vision was established, it was further refined into five goals that align with H-GAC's own goals, as shown in ***Figure 1.2a***.

Figure 1.2a - Project Goals

Each goal is supported by more specific objectives, and the fulfillment of each goal is evaluated using a set of performance measures. The combination of the goals, objectives, and performance measures were used throughout the planning process to support the overarching vision. All recommendations made in the report work toward accomplishing at least one of the goals and its corresponding objectives and performance measures. A full overview of the plan's goals, objectives and performance measures can be found in ***Chapter 8 – Evaluation of Improvements*** and are summarized in ***Figure 1.2b***.

Table A - Project Goals, Objectives, and Performance Measures

GOAL	OBJECTIVES
Mobility	Expand and accommodate all roadway users by incorporating Complete Streets principles, as context-appropriate
	Increase operational efficiency and reliability of major intersections and roadways
Safety	Improve safety on the Vision Zero high-injury network with a goal of zero fatalities
Economic	Provide mobility options for residents and visitors
	Increase truck travel time reliability on the regional freight network
Maintenance	Achieve a state of good repair for transportation assets
	Improve transportation asset resiliency and stormwater capacity
Natural/Cultural Resources	Reduce transportation emissions
	Minimize impacts requiring mitigation

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1.3 REPORT ORGANIZATION

The Table of Contents on ***page i*** is available as an overview of where specific items are located within the report. Generally, the report is organized into the following chapters:

CHAPTER 1 **Introduction** explains the planning process of the SE Harris Planning Study as well as its vision, goals, and objectives.

CHAPTER 2 **Public Involvement** describes how the priorities and concerns of the public are integrated into the plan.

CHAPTER 3 **The Subregion Today** reviews the existing conditions of the subregion, including transportation, demographic, and environmental elements.

CHAPTER 4 **Methodology** describes the methods used to collect data, prioritize corridors and intersections, and analyze existing and future conditions.

CHAPTER 5 **Area-Wide Conditions and Recommendations** identifies current and future multimodal mobility needs within the subregion and strategies for meeting those needs.

CHAPTER 6 **Intersection Conditions and Recommendations** identifies current and future mobility and safety needs at priority intersections and strategies for meeting those needs.

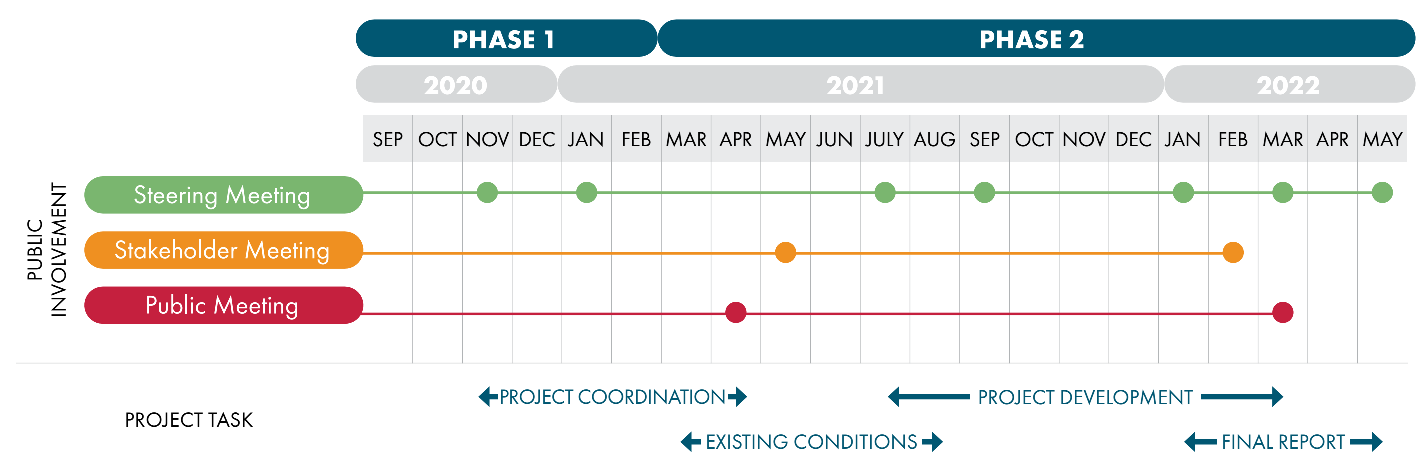
CHAPTER 7 **Corridor Conditions and Recommendations** identifies current and future multimodal mobility and safety needs along priority corridors and strategies for meeting those needs.

CHAPTER 8 **Evaluation of Recommendations** summarizes and evaluates the recommendations made in the previous chapters based on performance measures established by the Vision.

CHAPTER 9 **Implementation Strategy** summarizes recommendations made in previous chapters into one Implementation Matrix and identifies timeline and responsible parties for each action.

Details on committee meetings and public engagement events are provided in ***Chapter 2 – Public Involvement.*** An overview of major project milestones is illustrated in ***Exhibit 1.3a*** below:

Exhibit 1.3a – Project Schedule



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2

Public Engagement

- 2.1 Steering Committee
- 2.2 Stakeholders
- 2.3 Public

Public Engagement

The development of the study was guided by input received from several different groups representing local agencies, stakeholders, and the public. Feedback that was given from each of the groups helped shape the people involved, the focus of the study, and ultimately the recommendations.

The first phase of public engagement solicited comments on existing issues concerning mobility, safety, and other transportation conditions in and around the study area and was initiated by hosting an on-line public engagement webpage – https://engage.h-gac.com/southeast-harris-county-subregional-study – on March 18, 2021. The website offered a variety of engagement tools and opportunities to submit input, including a public survey, an interactive commenting map, data dashboard of existing conditions, and ability to submit questions directly to H-GAC staff about the study. The initial public commenting period was advertised from April 15, 2021 to May 14, 2021. Comments were also solicited from specific stakeholder groups during the public commenting period on May 4 and May 6, 2021. These initial comments received were made available for public review through the end of the study.

The second phase of public engagement gathered feedback on proposals to improve issues identified from comments received in the first outreach phase and from analysis of traffic volumes and crash data collected. Proposals were displayed in an interactive map through the project's engage.h-gac.com webpage. This map tool displayed study area's primary intersections and corridors with hyperlinks to summary sheets that described both the existing conditions and proposed improvements. The map tool also displayed other recommendations for active transportation facilities and activity centers for a future study of public transportation service options.

Initial review of the proposals began with the Steering Committee during meetings on January 25, 2022 and January 26, 2022. Following the incorporation of Steering Committee comments, the Study Team scheduled a series of Stakeholder meetings between February 7, 2022 and February 18, 2022. These Stakeholder meetings gathered input from representatives of local municipalities, schools, public safety, and area businesses.

Once comments were collected from the Steering Committee and Stakeholder groups and incorporated into the proposals, the Study Team advertised a second public commenting period from March 28, 2022 to April 11, 2022. A virtual public meeting was held on March 28, 2022 at 6:00PM via ZOOM to present the reviewed proposals and solicit input through the end of the public commenting period. Due to the large number of limited English proficiency in the study area, H-GAC staff provided Spanish subtitles for the presentation and offered Spanish interpreters during this meeting.

Promotional efforts by H-GAC included notices to area stakeholders, social media postings on various platforms, mentions in the H-GAC regional newsletter, and distribution of a press release to local media outlets. Comments received during this period were incorporated into a draft report for and shared with the Steering Committee for review from April 28, 2022 to May 9, 2022. Following the Steering Committee's final review, the Study Team incorporated edits into the final report.

Summaries of each group's involvement are provided below. Complete details of each meeting and feedback from the online tools are included in **Appendix A.**

2020 SEP · OCT · NOV · DEC — 2021 JAN · FEB · MAR · APR · MAY · JUN · JUL · AUG · SEP · OCT · NOV · DEC — 2022 JAN · FEB · MAR · APR · MAY

PHASE 1 COMMENTS ON EXISTING CONDITIONS

- **October 21, 2020** RTP Sub-Committee Meeting presentation
- **November 4, 2020** Steering Committee Meeting #1
- **December 3, 2020** Greater Houston Freight Committee Meeting
- **January 26, 2021** Steering Committee Meeting #2
- **March 2, 2021** SH 225 Coordination Meeting
- **March 25, 2021** Public Meeting #1
- **April 15, 2021** Public Meeting #1
- **May 4, 2021** Stakeholder Meeting #1 – Municipal and Civic
Stakeholder Meeting #1 – Public Safety
- **May 6, 2021** Stakeholder Meeting #1 – Education and Residential
Stakeholder Meeting #1 – Industrial and Business

PHASE 2 COMMENTS ON RECOMMENDATIONS

- **July 12, 2021** Steering Committee Meeting #3
- **September 21, 2021** Steering Committee Meeting #4
- **January 25, 2022** Steering Committee Meeting #5
- **February 9, 2022** Stakeholder Meeting #2 – Education and Residential
- **February 9, 2022** Stakeholder Meeting #2 – Harris County Precinct 2
- **February 9, 2022** Stakeholder Meeting #2 – Industrial and Business
- **February 9, 2022** Stakeholder Meeting #2 – Municipal and Civic
- **February 9, 2022** Stakeholder Meeting #2 – Public Safety
- **February 15, 2022** Stakeholder Meeting #2 – Harris County Precinct 2 Engineering Department
- **February 16, 2022** Stakeholder Meeting #2 – City of Houston
- **March 28, 2022** Public Meeting #2
- **April 28, 2022** Steering Committee Meeting #6

2.1 STEERING COMMITTEE

The Steering Committee met with the project team at key milestones throughout the study to provide input, serve as a sounding board, and help the decision-making process. Six total meetings were held with the Steering Committee, to introduce the study, identify priorities and success statements of the Steering Committee, review public input, discuss specific technical assumptions, review recommendations, and provide final thoughts. Members of the Steering Committee included representatives from TxDOT, Harris County, the City of Houston, the City of South Houston, the City of Pasadena, the City of La Porte, the City of Deer Park, the Economic Alliance Houston Port Region, the Gulf Coast Rail District, and Harris County Transit.

MAJOR OUTCOMES

- Stakeholder membership identified
- Agency priorities identified
- Vision and goals were confirmed
- Key challenge and opportunity areas were discussed
- Traffic modeling assumptions were revised
- Draft recommendations were edited based on feedback
- Concurrent studies were incorporated into the analysis and recommendations
- Draft report was revised based on comments provided

2.2 STAKEHOLDERS

The project team, with input from the Steering Committee, identified a list of stakeholders to provide local and technical guidance for the study. Stakeholders included representatives of public safety, schools, municipal and civic organizations, and industrial and business groups.

There were two groups of meetings with the stakeholder groups, for 11 total meetings. The purpose of the first group of meetings was to introduce the project team and the study overview, including the study area, schedule, vision and goals, public outreach, existing conditions, network screening and selection, and next steps. The second group of meetings was scheduled into individual meetings with each group of stakeholders. The purpose of the second meeting was to present the study progress since the last public meeting and solicit feedback. An interactive online map was used to present the draft recommendations and collect comments.

MAJOR OUTCOMES

- More qualitative and quantitative data was provided to inform the analyses
- Transit recommendations were pared down to recommend future more detailed study
- Recommendation presentation was revised to be more reader-friendly
- Additional background information was presented to the public
- Specific recommendations were revised based on technical feedback

2.3 PUBLIC

A virtual Public Meeting was held on April 15, 2021 at 6:00PM via ZOOM to present the study objective, existing transportation facilities and conditions in the area, and the array of commenting tools, including the on-line comment map. Promotional efforts by H-GAC included three notices sent via ConstantContact to area stakeholders and notice subscribers, social media postings on various platforms, mentions in the H-GAC regional newsletters, interviews with news media outlets, and distribution of a press release to local media outlets. More information on this outreach can be found in ***Appendix A.***

The purpose of the second public meeting was to present the study progress since the last public meeting, as well as the draft recommendations. An interactive online map was used to present the draft recommendations and collect public comment.

MAJOR OUTCOMES

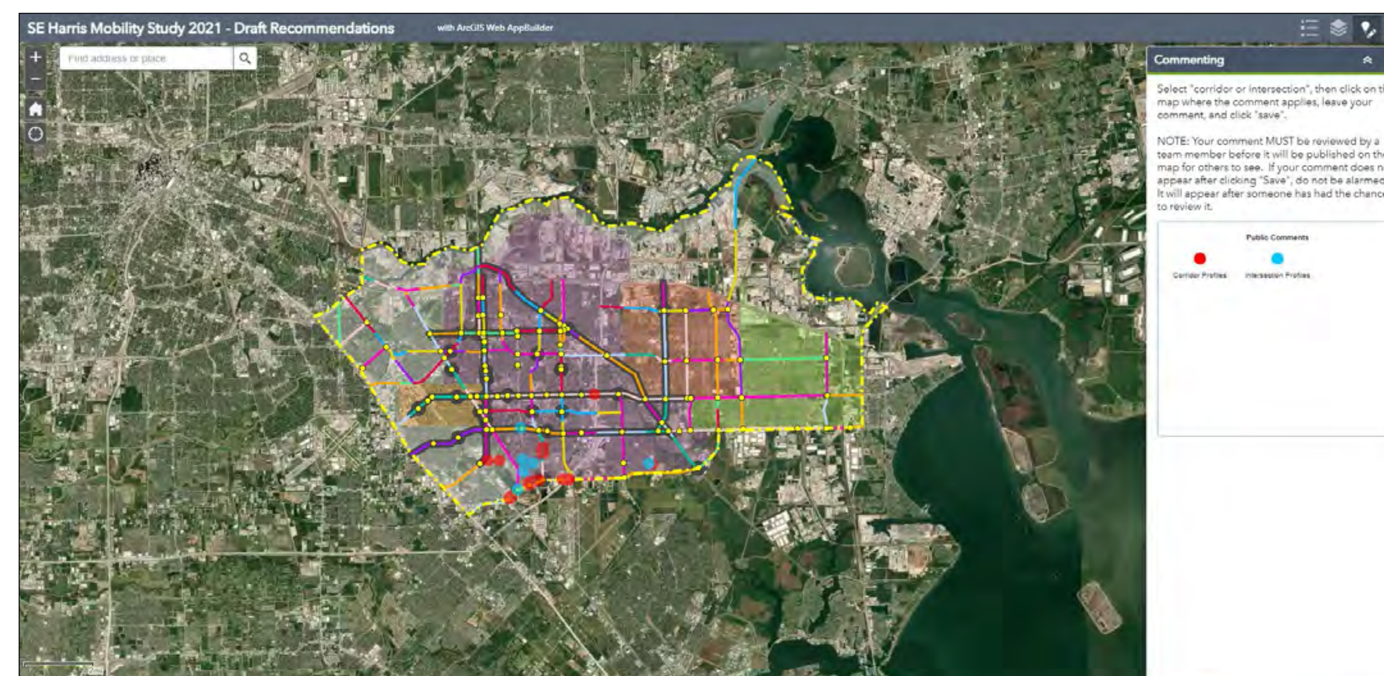
- Safety and congestion were identified as the highest priority issues
- Reduced delay at intersections and improved quality of roadway pavement, drainage, and markings were identified as the most desired improvements
- Conflicts with truck traffic identified as the number one safety issue
- Specific areas requiring improvements were identified

2.3.1 PROJECT WEBSITE

The project website had a rotation of public tools available to solicit feedback from the public.

From March 18, 2021, to June 30, 2021, two tools were available for the public to interact with on the project website. This included a survey with questions about how people travel through and around the study area and a map where people could provide comments regarding several different transportation topics. During this time, there were 677 total visits to the website from 537 unique users.

From March 28, 2022, to April 11, 2022, there was an online map that presented the draft recommendations and allowed for people to leave comments. This map received 24 comments, which are summarized in ***Appendix A.***



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3

The Subregion Today

- 3.1 Socioeconomic
- 3.2 Environmental
- 3.3 Transportation

The Subregion Today

This chapter includes a summary of the existing conditions of the Southeast Harris County subregion regarding demographics, environment, and transportation. These conditions will provide a better understanding of what makes this subregion unique, and therefore, how to best plan for its future.

The study area covers approximately 95 square miles of Southeast Harris County and includes the cities of Houston, South Houston, Pasadena, Deer Park, La Porte, and a portion of unincorporated Harris County.

3.1 SOCIOECONOMIC

3.1.1 POPULATION

The total population for the Southeast Harris County study area in 2018 was 300,000 people with a total of 93,500 households. The projected population for 2040 is 309,000 people (approximate data provided by H-GAC demographics dashboard).

309,000 *projected population for 2040*

58% *of households are owner-occupied*

42% *of households are renter-occupied*

16% *of the population were living below the poverty level of $29,420 for a family of five*

POPULATION BY AGE

AGES UNDER 18 **28.9%**

AGES 18-34 **25.6%**

AGES 35-64 **36.1%**

AGES 65+ **9.5%**

POPULATION BY RACE

HISPANIC **67.7%**

WHITE **25.5%**

BLACK **1.8%**

ASIAN **1.3%**

VEHICLES PER HOUSEHOLD

NO CARS **6.0%**

1 CAR **31.0%**

2 CARS **38.0%**

3+ CARS **25.0%**

ENGLISH PROFICIENCY

NO ENGLISH **4.8%**

NOT WELL **9.7%**

WELL **8.6%**

VERY WELL **26.2%**

ENGLISH ONLY **50.6%**

Growth rates in the study area were estimated using a travel demand model (TDM) created by H-GAC. Outputs from the TDM are average daily traffic (ADT) volumes along segments of each corridor in the study area for years 2020 and 2045. Spencer Highway and Fairmont Parkway are two east-west running corridors that span almost the entire study area and exhibit traffic growth patterns "typical" of the study area. ADT along segments of each corridor were averaged to get an "average" corridor ADT shown in ***Table B,*** then the "average" corridor ADTs for each analysis year were compared to obtain a compounded annual growth rate.

Table B
Study Area Growth Rate

Growth Rate Estimation		2020 ADT	2045 ADT	Annual Growth Rate
Spencer Highway	*Overall*	715,779	745,252	0.16%
	Average	23,859	24,842	0.20%
Fairmont Parkway	*Overall*	619,485	642,753	0.15%
	Average	24,779	25,710	0.17%

The average annual growth rate was determined to be 0.2% along Spencer Highway and 0.15% along Fairmont Parkway. However, after discussions with H-GAC and local municipalities, a more conservative estimate of future traffic volumes was agreed upon and the annual growth rate is assumed to be 1% compounded annually.

3.1.2 ECONOMIC ACTIVITY AND EMPLOYMENT

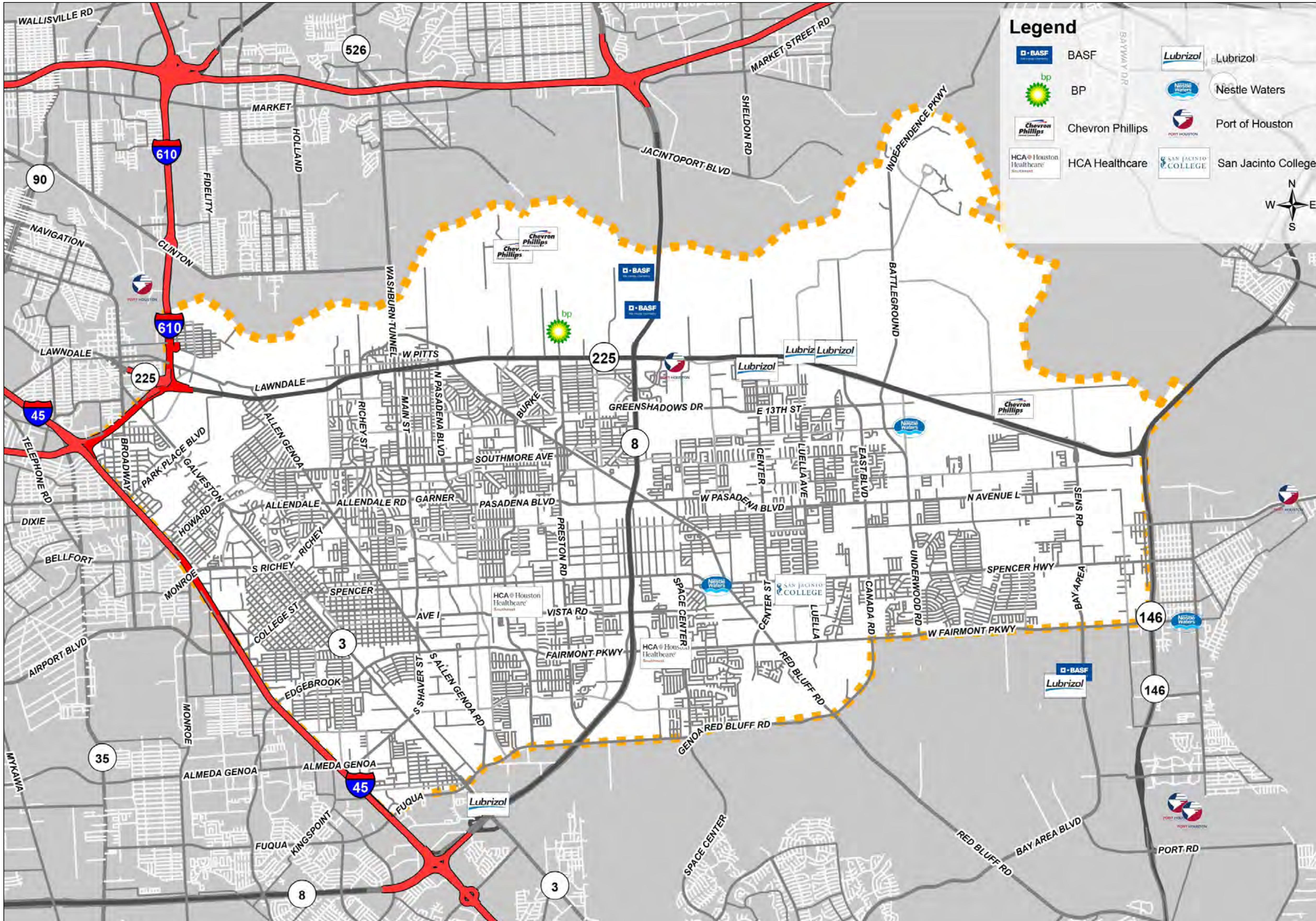
The cities within the Southeast Harris County study area were founded between 1890 and 1910, during which time the greater Houston-Galveston area experienced significant economic growth. The soil was well-suited for some agricultural production, like Pasadena's famous strawberries, and the bayside location was prime for land and sea trade. The Houston Ship Channel was dredged and opened for ships, and oil became the predominant business in Texas, forever transforming the character of this area.

Today, major employers in the area include:

- BASF Corporation
- British Petroleum
- Chevron Phillips
- Nestle Water
- Port Houston
- Lubrizol Specialty Chemicals
- San Jacinto College - Central
- HCA Houston Healthcare - Southeast

The location of these companies is illustrated in ***Exhibit 3.1.2a.***

Exhibit 3.1.2a
Major Employers Map



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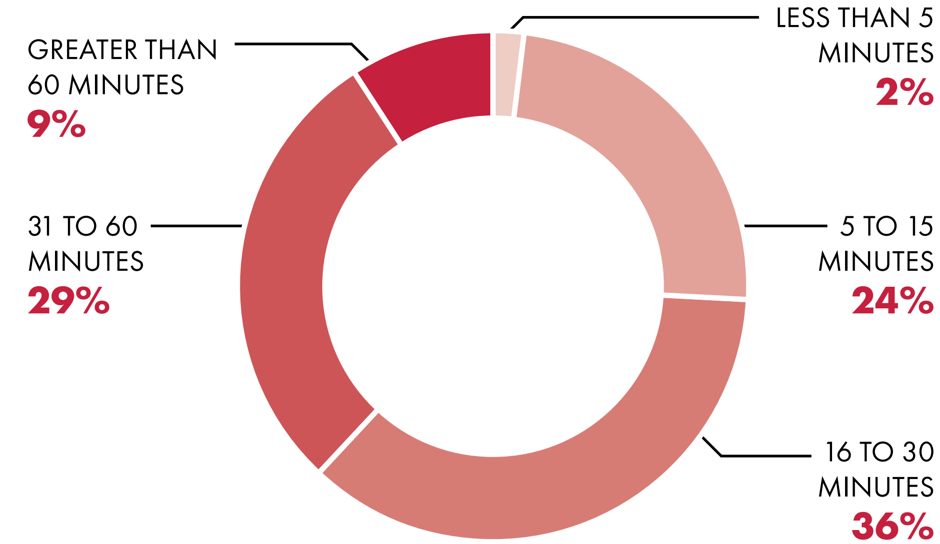
Employees commute daily from throughout Harris County and the greater Houston area to work at these companies.

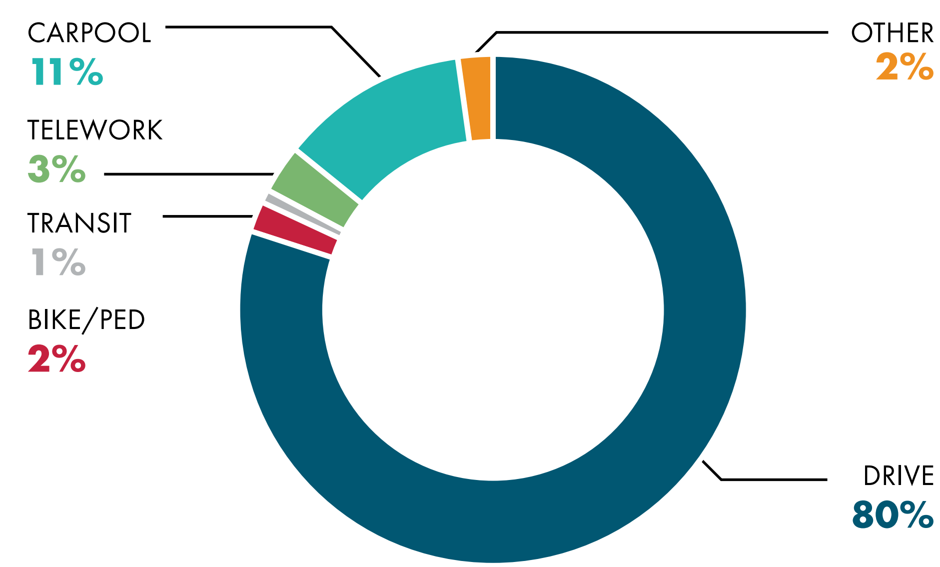
TRAVEL TIME TO WORK (2018)



74% of the working population within the study area spent more than 15 minutes traveling to work

38% of people spent more than 30 minutes traveling to work

MODE OF TRAVEL TO WORK (2018)



The predominant mode of commute transportation was **driving** (80%).

Additionally, the amount of industrial economic activity due to proximity to the port generates a higher than typical amount of heavy vehicle (truck) traffic. Existing traffic conditions will be explored further in ***Section 3.3*** as well as ***Chapters 5, 6, and 7***.

3.2
ENVIRONMENTAL

3.2.1 LAND USE

While the land north of State Highway (SH) 225 is mostly industrial, serving the Port of Houston and major employers in the area, the land south of SH 225 is a mix of residential, commercial, and port-related uses along major corridors.

Distribution of land use types is illustrated in ***Exhibit 3.2.1a.***

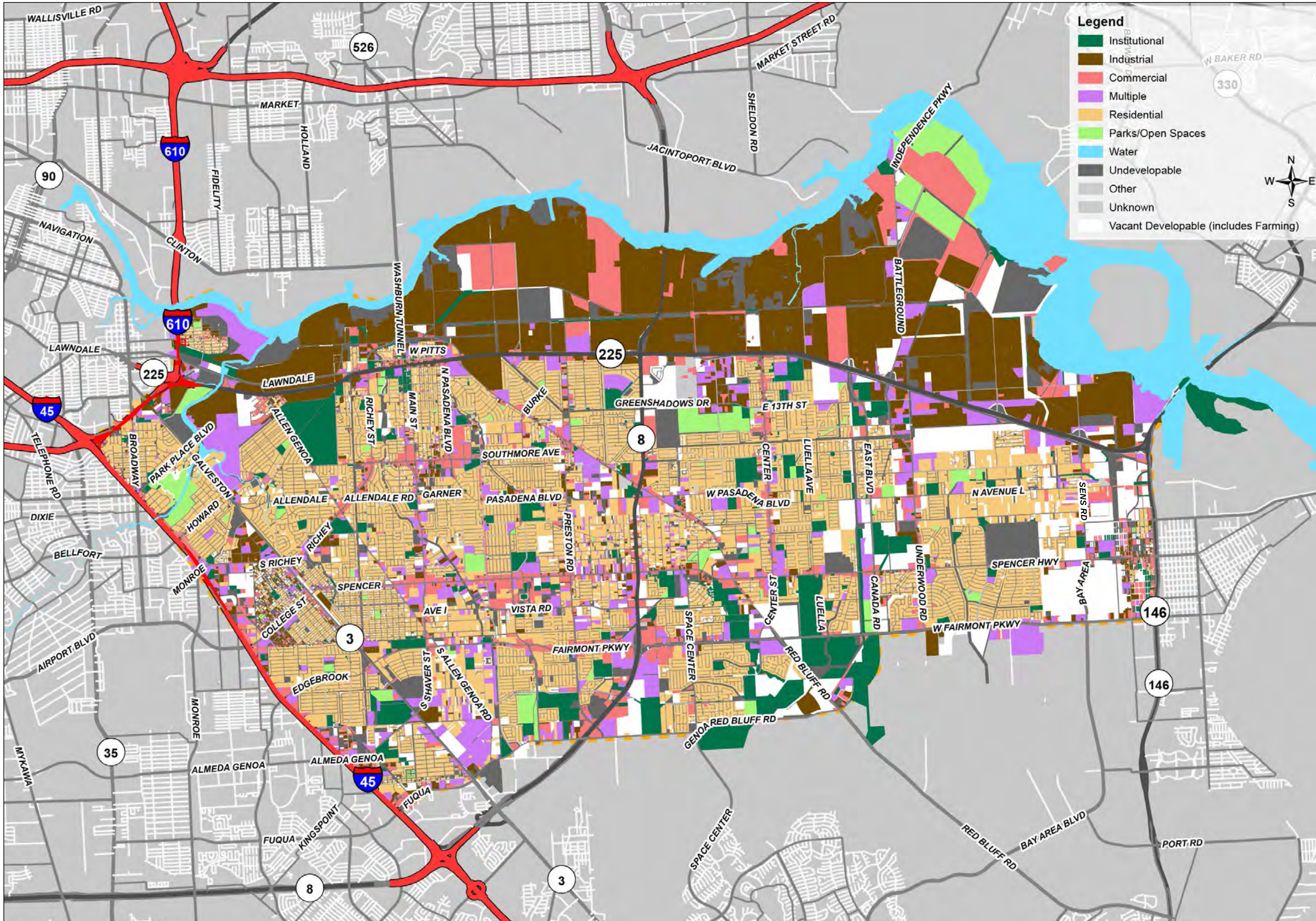


Exhibit 3.2.1a
Land Use Map

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3.2.2 ENVIRONMENTAL FEATURES

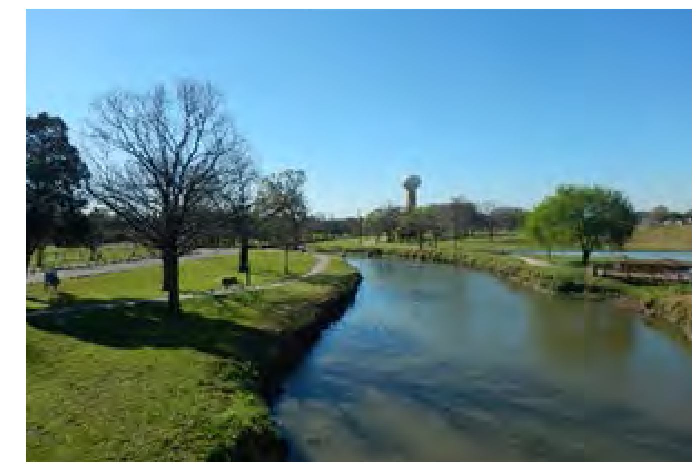
The study area is located just south of Buffalo Bayou and west of Trinity Bay. Three offshoots of Buffalo Bayou – Vince Bayou, Little Vince Bayou and Sims Bayou – penetrate the study area from the north, while an offshoot of Clear Lake – Armand Bayou – penetrates the area from the south.

135 square miles of the study area is considered in the floodway or floodplain according to the Harris County Flood District. While the waterways in the study area can pose a flood threat, they can also serve as recreational space and natural paths for hike and bike trails. There are 88 miles of trails and 84 parks within the study area, totaling 2,140 acres.

88 MILES OF TRAILS

84 PARKS

2,140 ACRES



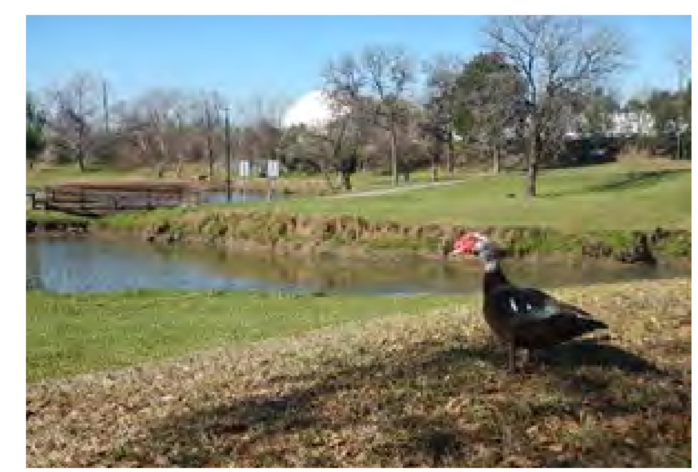
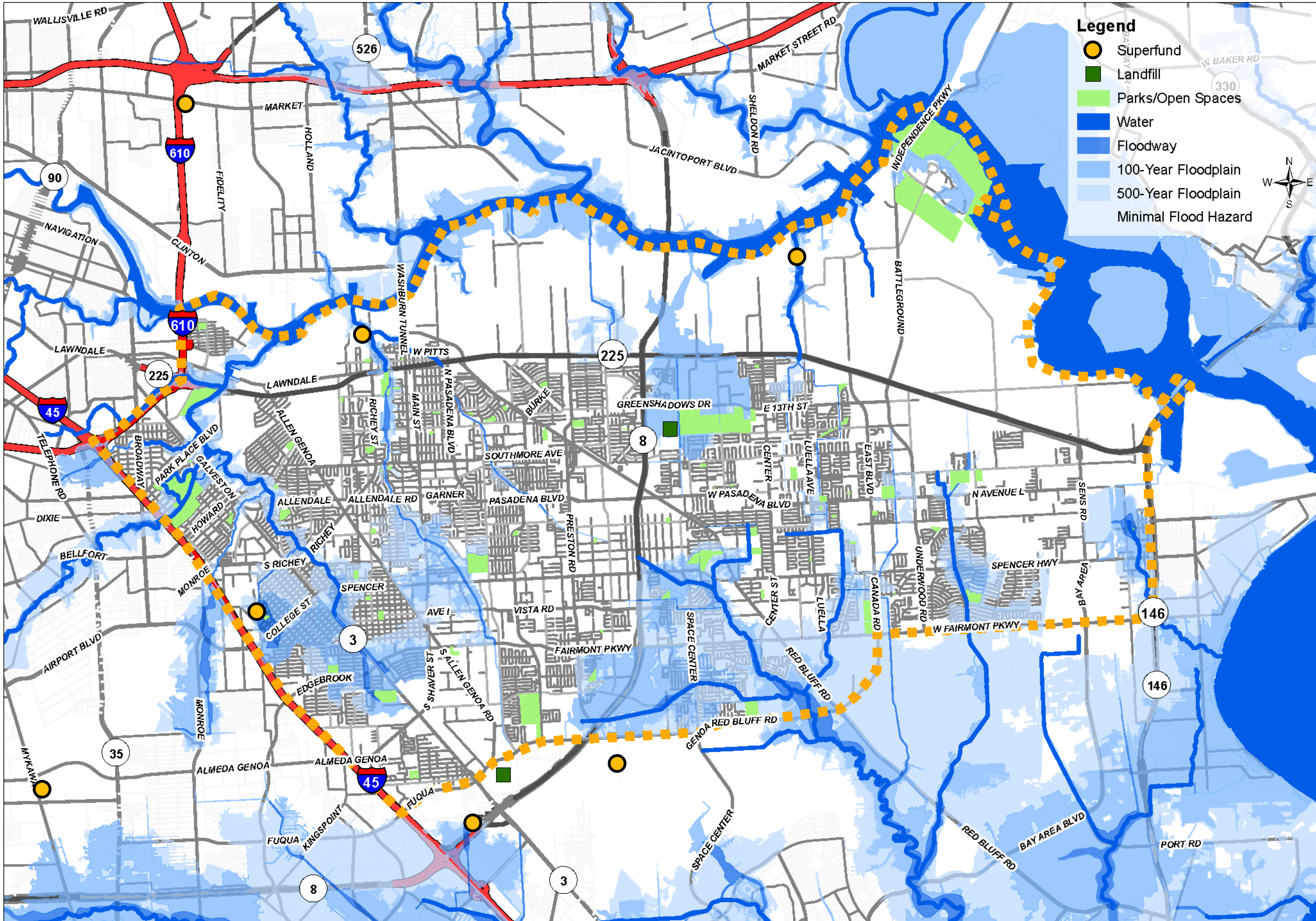


Exhibit 3.2.2a
Environmental Features Map



3.2.3 CULTURAL FEATURES

As this area is so closely tied to the early history of Houston, there are many cultural landmarks, specifically, Battleship Texas and the Battle of San Jacinto Monument.

The Houston Ship Channel, already a world-renowned economic engine, is also located in the study area.

Sylvan Beach was once the beating heart of La Porte and is still an important gathering place for musicians, craftsmen, locals, and tourists.

Image credit: Patrick Feller

Image credit: Patrick Feller

The Pasadena Strawberry Festival, held every May in the city's Municipal Fairgrounds, unites the community over fun games, provides scholarships to high school volunteers, and celebrates the city's agricultural roots.

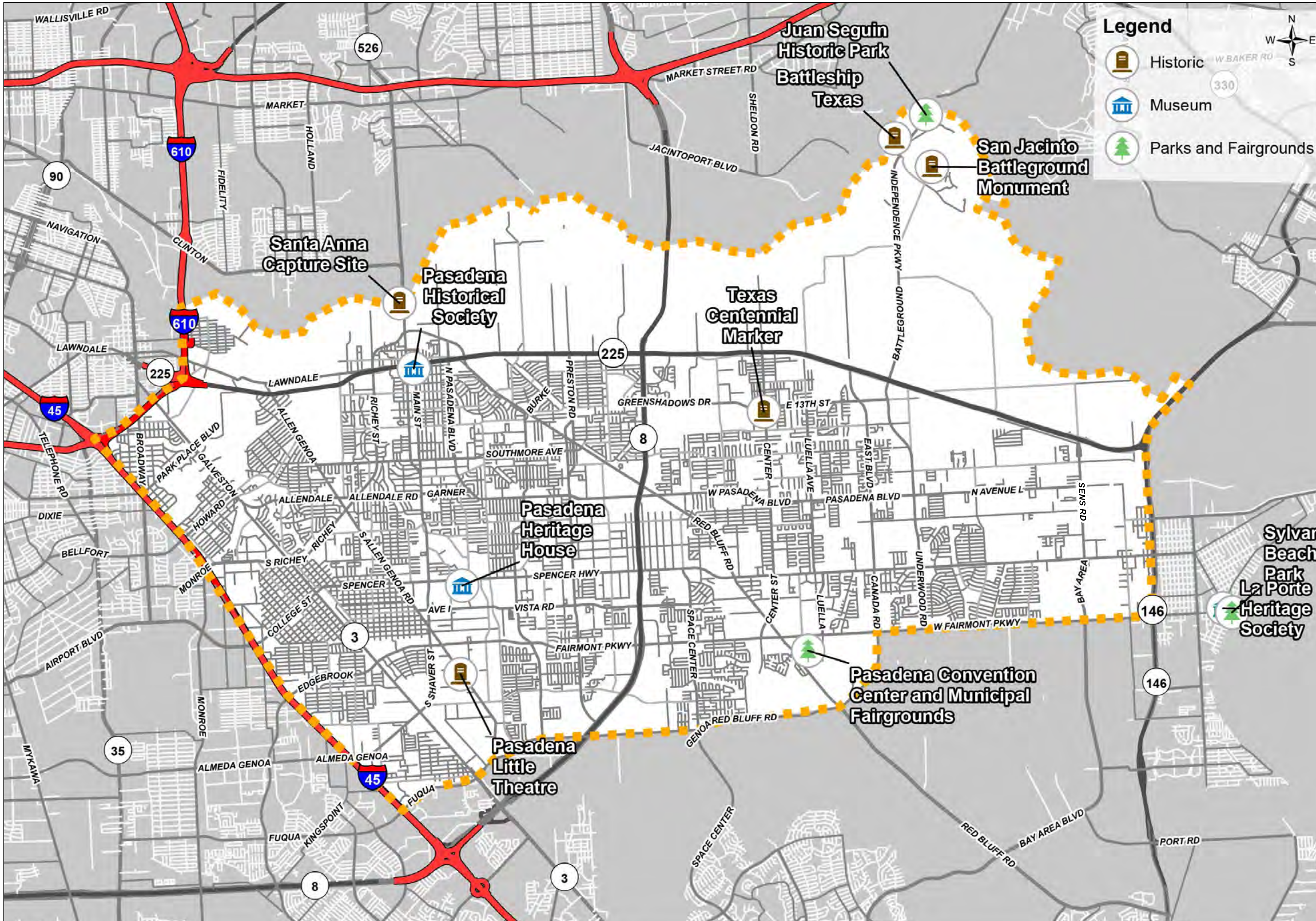
Image credit: Cortney Martin

Image credit: Cortney Martin

The Houston Botanic Gardens provide space for community members – families, businesses, artists, etc. – to gather and appreciate nature. The Gardens host concerts, culinary classes, children's workshops, and other community events.

There are murals throughout the SE Harris Subregion, representing the talents and diverse identities within the community.

Exhibit 3.2.3a
Cultural Features Map



3.3 TRANSPORTATION

The transportation network in the Southeast Harris County subregion consists of roadways, freight, transit, active transportation.

3.3.1 SAFETY

Crash data was collected from TxDOT's CRIS system for 2015-2019. Exhibit 3.3.1a depicts the density of all crashes within the study area.

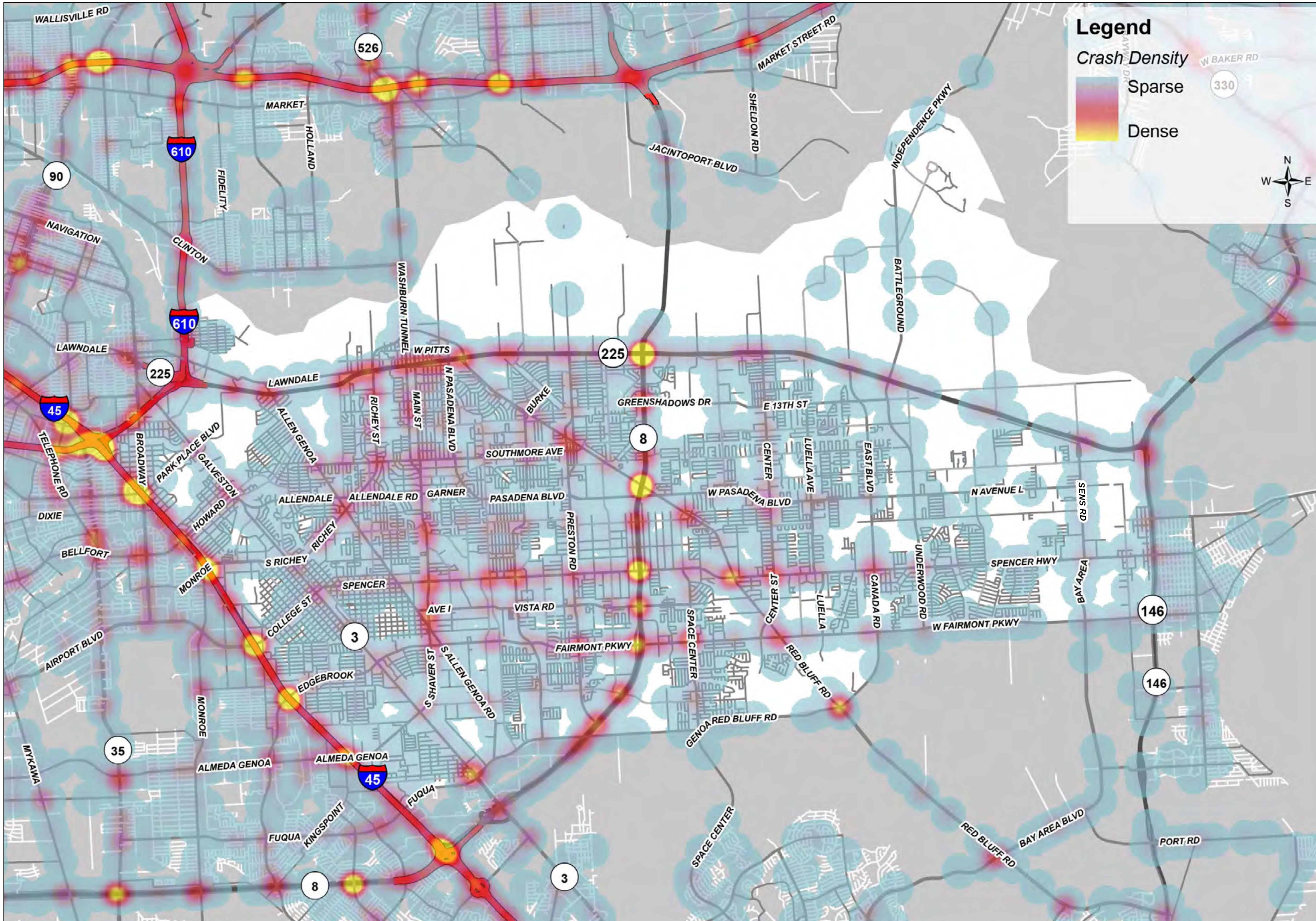


Exhibit 3.3.1a
Crash Density

While crashes occur on all roadways, higher crash density occurs along higher capacity/speed roadways and at intersections of higher capacity/speed roadways. While Interstates make up only 2% of the miles of roadways in the study area, 18% of all crashes take place on them, including 16% of fatalities. Alternatively, local roadways make up 64% of all roadways in the study area, but only 16% of crashes take place on them, including 8% of fatalities.

Table C shows the classifications of each roadway, what percentage (by length of roadway) of the roadway network they account for, what percentage of overall crashes take place on that classification of roadway, and percent of total fatalities occur on that classification of roadway.

With the County's vision for zero traffic fatalities and traffic-related serious injuries, there is room for improvement on the subregion's roadways.

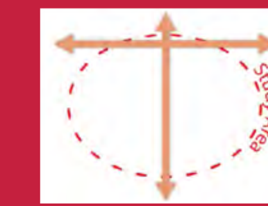
Table C – Crash Percentage by Roadway

Roadway Type	Interstate	Freeway/ Expressway	Principal Arterial	Minor Arterial	Major Collector	Local
Length of Roadway (Miles)	**18 miles** (2%)	**72 miles** (7%)	**60 miles** (6%)	**89 miles** (9%)	**134 miles** (13%)	**657 miles** (64%)
Number of Crashes	**7,637** (18%)	**4,881** (11%)	**11,174** (26%)	**7,148** (17%)	**5,521** (13%)	**6,785** (16%)
Number of Fatalities	**17** (16%)	**16** (15%)	**32** (30%)	**19** (18%)	**14** (13%)	**8** (8%)

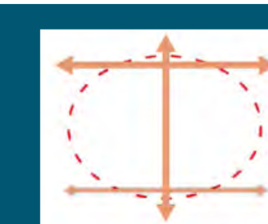
3.3.2 ROADWAY NETWORK

The roadway network for the subregion is comprised of several roadway types defined by TxDOT. Roadways are assigned a hierarchy classification to better regulate uses and make travel safer and more efficient.

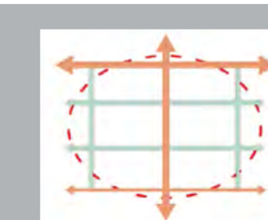
INTERSTATE: Limited access divided highways, as designated by the Federal Highway Administration (FHWA). These are the highest capacity roadways and span the longest distances, serving to allow people to travel great distances in the least amount of time.



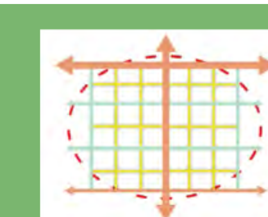
FREEWAY/EXPRESSWAY: Similar to interstates but serving shorter distances. As they are limited access, they do not directly serve the adjacent land uses.



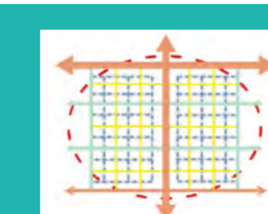
PRINCIPAL ARTERIAL: High capacity, high speed roadways that have at-grade crossings and directly serve some adjacent land uses, although access is still more limited than lesser classifications. Principal Arterials typically connect cities and major communities to one another.



MINOR ARTERIAL: Major roadways that provide connectivity within communities. Minor Arterials connect Major Collectors to Principal Arterials.



MAJOR COLLECTOR: Moderate capacity roadways providing connections from local roadways to Minor Arterials.



LOCAL: Low-capacity roadways that provide access between homes and local businesses and to larger capacity roadways.

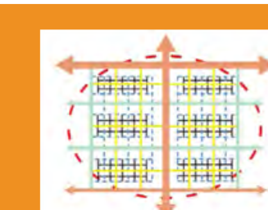


Exhibit 3.3.2a shows the existing roadway inventory from TxDOT for the study area in 2020.

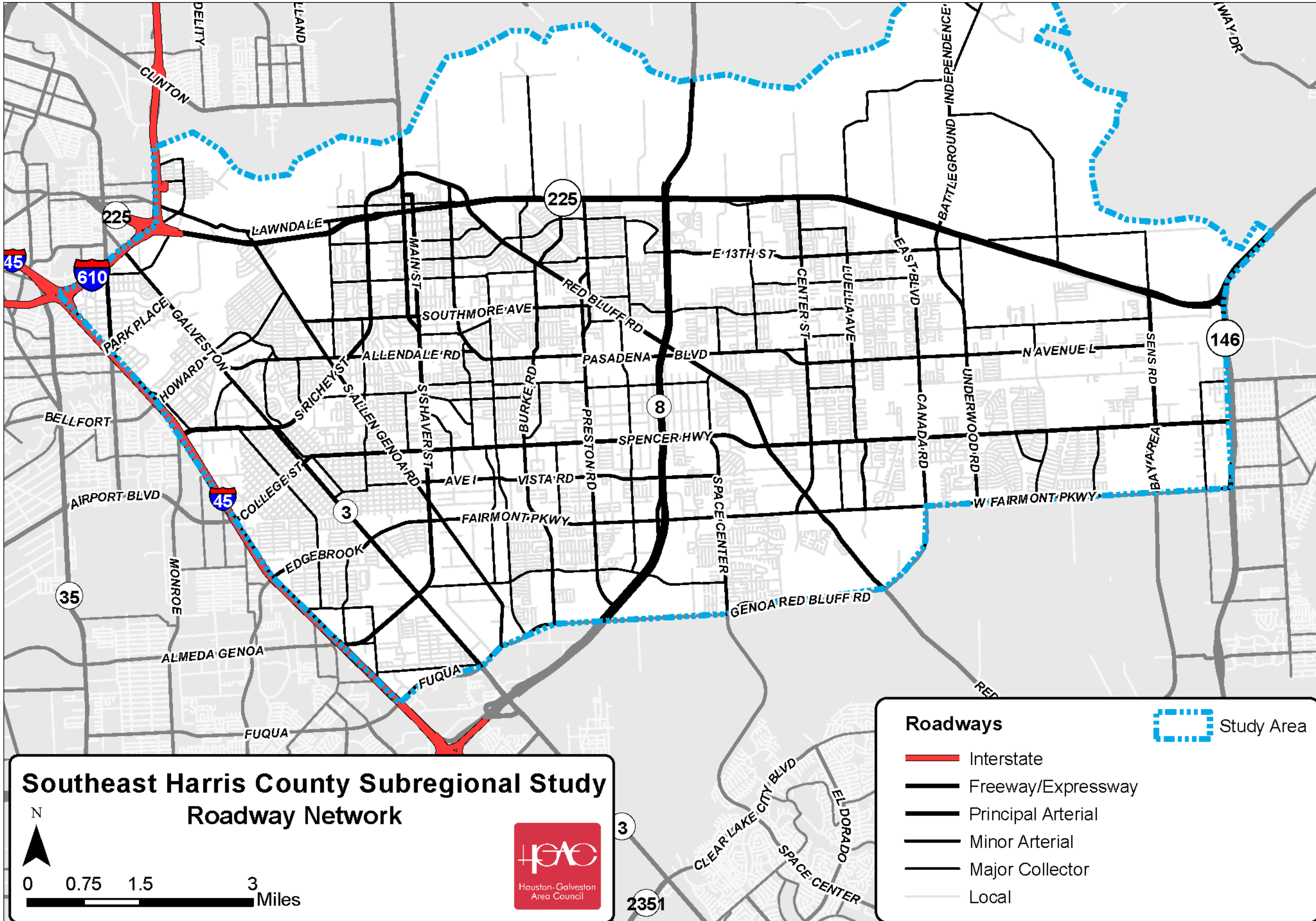


Exhibit 3.3.2a
Roadway Classifications

3.3.3 FREIGHT NETWORK (TRUCK, RAIL, AND PORT)

The existing freight network in the study area consists of rail lines and the National Highway Freight Network, connecting the study area to major port areas in the east including Galveston and Baytown.

Exhibit 3.3.3a depicts the location of these freight facilities within the subregion.

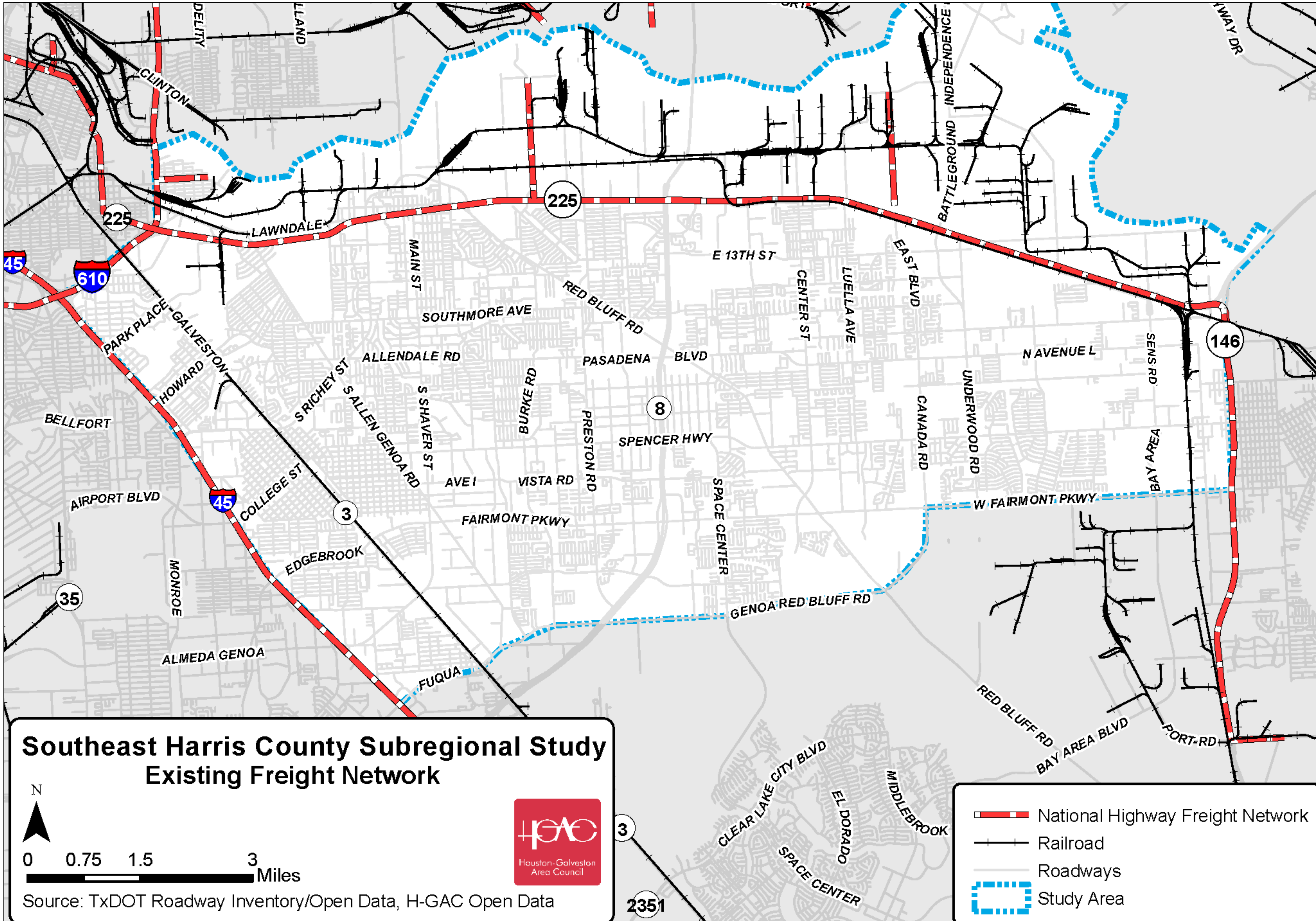


Exhibit 3.3.3a
Freight Network

3.3.4 TRANSIT NETWORK

Houston METRO provides four local bus routes:

- Route 005 – *Southmore*
- Route 038 – *Manchester-Lawndale*
- Route 050 – *Broadway*
- Route 076 – *Evergreen*

Harris County Transit provides the Baytown/La Porte Shuttle and the Gulfgate Connection Shuttle in the study area.

The Monroe Park and Ride is located within the study area and services two routes:

- Route 247 – *Fuqua/Bay Area*
- Route 297 – *Gulf Freeway/TMC*

The South Point Park and Ride is located just south of the study area near I-45 and Beltway 8 and services Route 297.

METROLift operates on the east side of the study area, providing accessible shared-ride public transit, in accordance with the Americans with Disabilities Act (ADA).

There are no major Transit Centers within the study area, but one is located west of the study area within Hobby Airport.

Exhibit 3.3.4a shows the location of all transit facilities (excluding METROLift) within the study area.

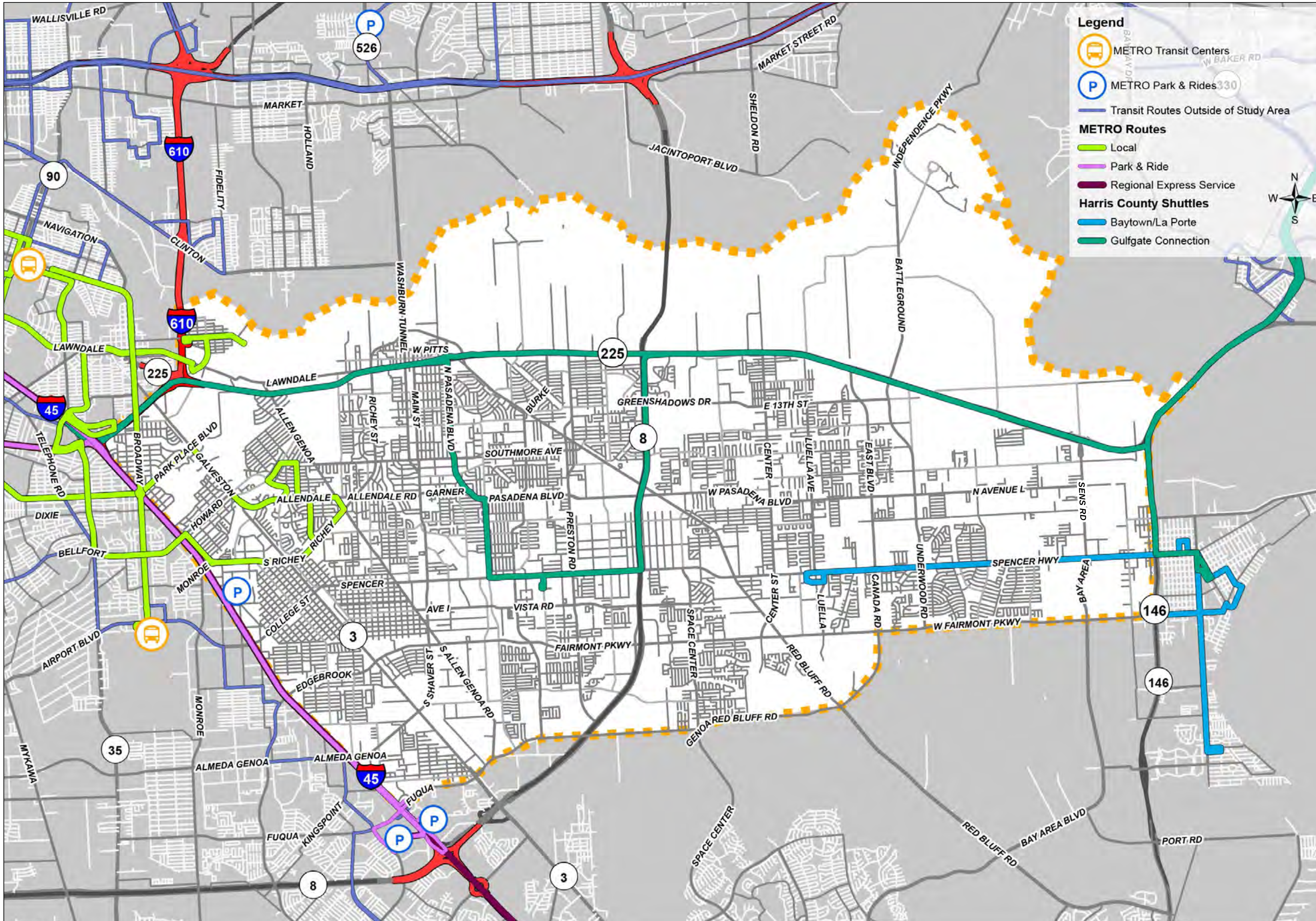


Exhibit 3.3.4a Transit Network

3.3.5 ACTIVE TRANSPORTATION NETWORK

The existing active transportation network includes bicycle and pedestrian facilities. Data collected from H-GAC's Open Data portal indicates that there are approximately 926 miles of existing sidewalks in the study area. Most sidewalks exist along local streets and throughout residential areas. Additionally, there are approximately 25 miles of existing bikeways and 92 miles of proposed bikeways within the study area, the majority of which are shared use paths or trails. The condition of these facilities was not evaluated within this dataset.

Exhibit 3.3.5a depicts the existing bicycle and pedestrian network within the study area.

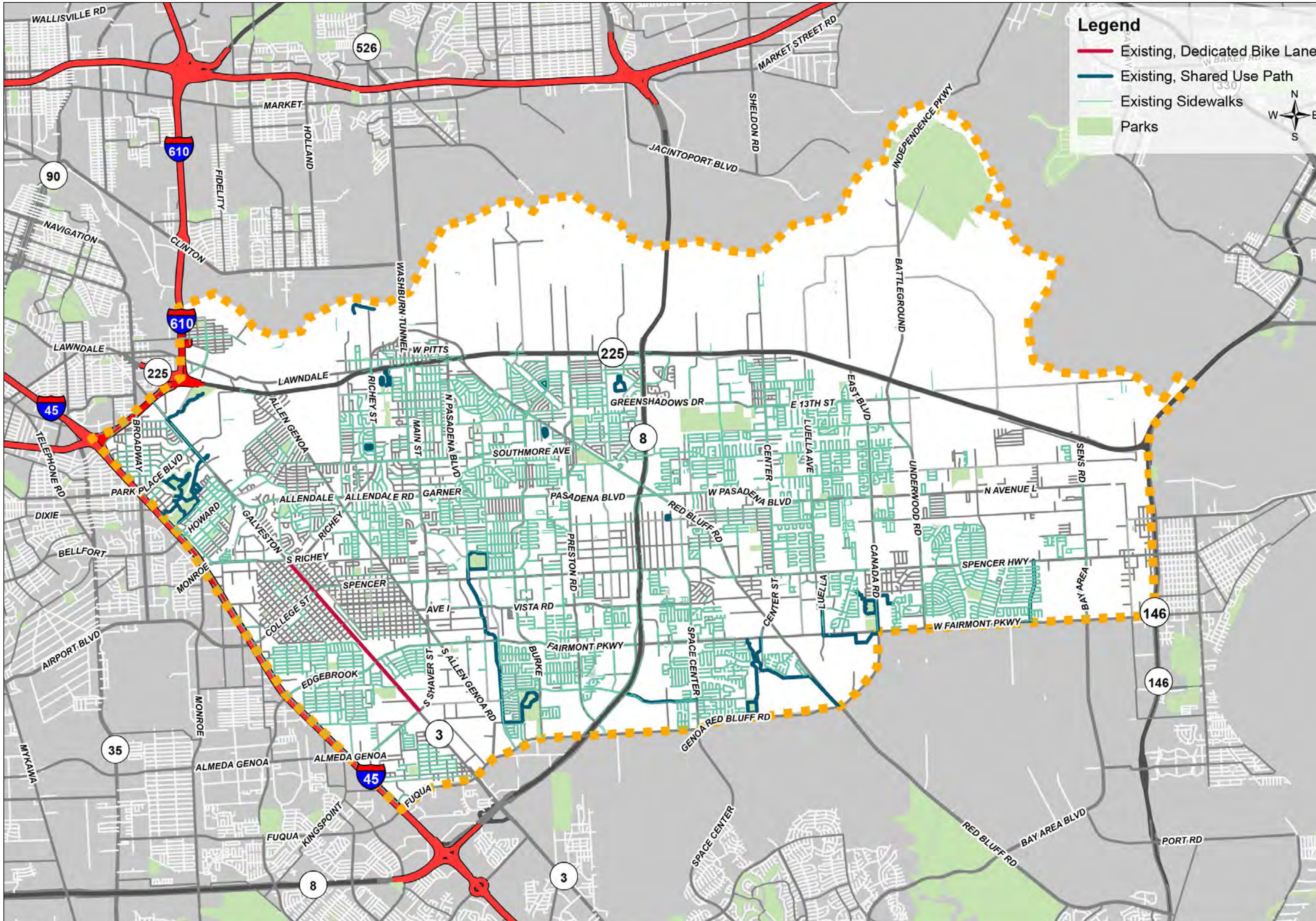


Exhibit 3.3.5a
Active Transportation Network

3.3.6 EVACUATION ROUTES

Evacuation routes are designated by TxDOT and are shown on ***Exhibit 3.3.6a***. The primary evacuation routes within the study area include I-45, SH 8, SH 225, and SH 146. These roadways are all Interstates, Freeways, or Expressways, allowing for the greatest amount of traffic to move at a faster speed in the case of an emergency evacuation. These routes also avoid neighborhood-level roadways.

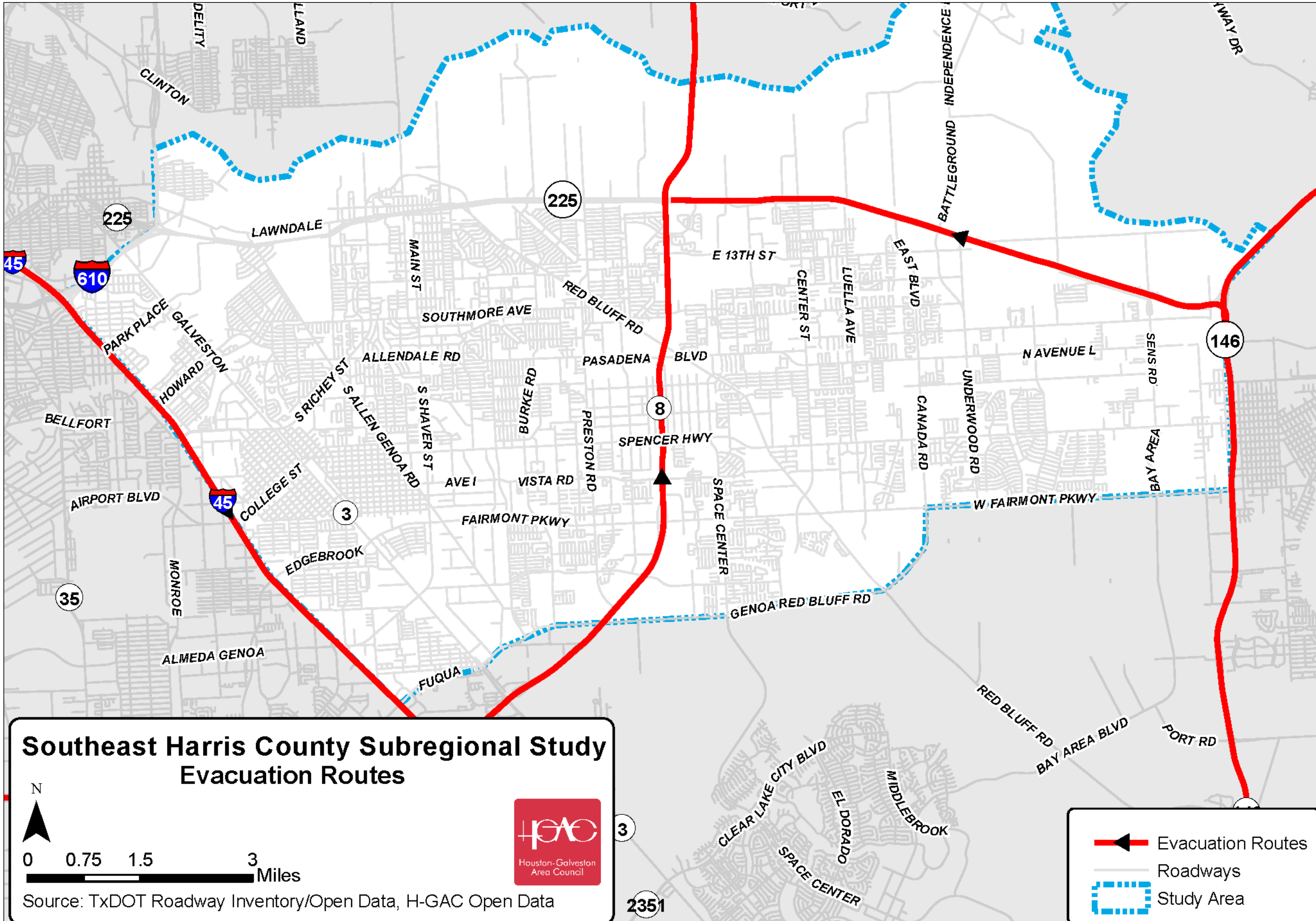


Exhibit 3.3.6a Evacuation Routes

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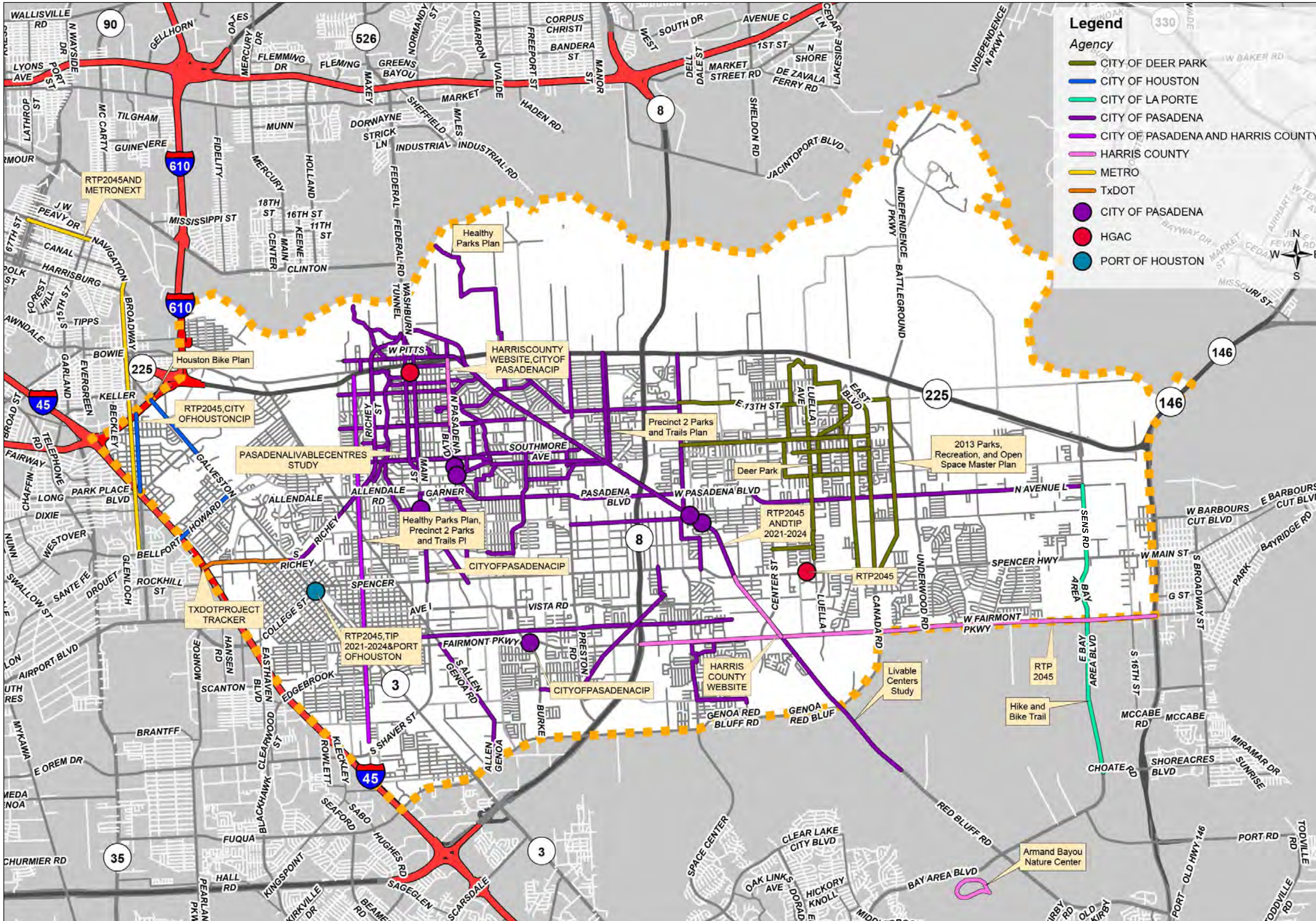
3.3.7 PREVIOUS STUDIES

The areawide, corridor, and intersection improvements recommended in this study incorporate those recommended in some of the studies previously conducted by H-GAC, Harris County, and individual cities and entities. Relevant studies are described below:

- **Pasadena Livable Centers Study** consolidates existing plans under one vision and implementation strategy with the intent to improve active modes facilities, parks and open spaces, housing, and economic development in the north Pasadena area.
- **Pasadena Healthy Parks Plan** utilizes community engagement and data analysis to identify the best opportunities for park locations, improvements, funding, and maintenance such that the community can realize economic development, environmental resilience, and improvements in human health and connection.
- **Pasadena Capital Improvement Program** addresses the infrastructure needs of the City of Pasadena annually as new projects are added, existing projects are adjusted, and community needs and priorities shift.
- **Deer Park Parks & Recreation Open Spaces Master Plan** guides the development of new and restoration of existing recreational facilities to promote a high quality of life in the community.
- **La Porte Hike and Bike Trail** provides more than thirteen miles of trails throughout the city.
- **Houston Bike Plan** lays the groundwork for a safer, more accessible, more connected, and better maintained network of bicycle infrastructure throughout the City of Houston.
- **Harris County Precinct 2 Parks and Trails Plan** prepares the Precinct 2 parks and trails system to best serve the diverse communities in the area by prioritizing investment strategies and outlining best practices for programming and design.
- **H-GAC Regional Transportation Plan** identifies transportation needs, goals, and policies that will support regional growth over the next 25 years. The RTP sets the framework for a balanced and forward-thinking system with the identification of major investment strategies supporting roadway improvements, mass transit, and active modes facilities.
- **H-GAC Transportation Improvement Program** is a financial plan of transportation projects approved to receive federal funding over the next four years. Projects selected are priorities for the region in all surface transportation areas including transit, roadway and highways, active modes, preventative maintenance, rehabilitation and operations.
- **TxDOT SH 3 Access Management Study** identifies short-, medium-, and long-term improvements to reduce crashes, improve mobility, and support development along the corridor.

Exhibit 3.3.7a illustrates where each study has a recommended improvement in the study area.

Exhibit 3.3.7a
Previously Recommended Projects Map



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4

Methodology

- 4.1 Data Collection
- 4.2 Network Screening
- 4.3 Analysis Methodology

Methodology

To determine recommendations for the SE Harris subregion that align with this study's Vision and Goals, data was collected and analyzed. This chapter describes the methods used to collect data, prioritize corridors and intersections, and analyze existing and future conditions.

4.1 DATA COLLECTION

4.1.1 TRAFFIC VOLUME DATA

Study intersections and corridors were identified through collaboration with the Steering and Stakeholder Committees.

Turning Movement Counts (TMCs) were collected at all study intersections on May 13, 2021 between 7:00am – 8:30am and 4:00pm – 6:00pm. 24-hour bidirectional ADT counts were collected at 96 locations along study corridors to understand daily traffic patterns along each corridor. Truck traffic was identified as a concern, so volumes were collected by vehicle class to determine the percent of heavy vehicles at each intersection and along each corridor. Raw traffic counts are available in **Appendix C**.

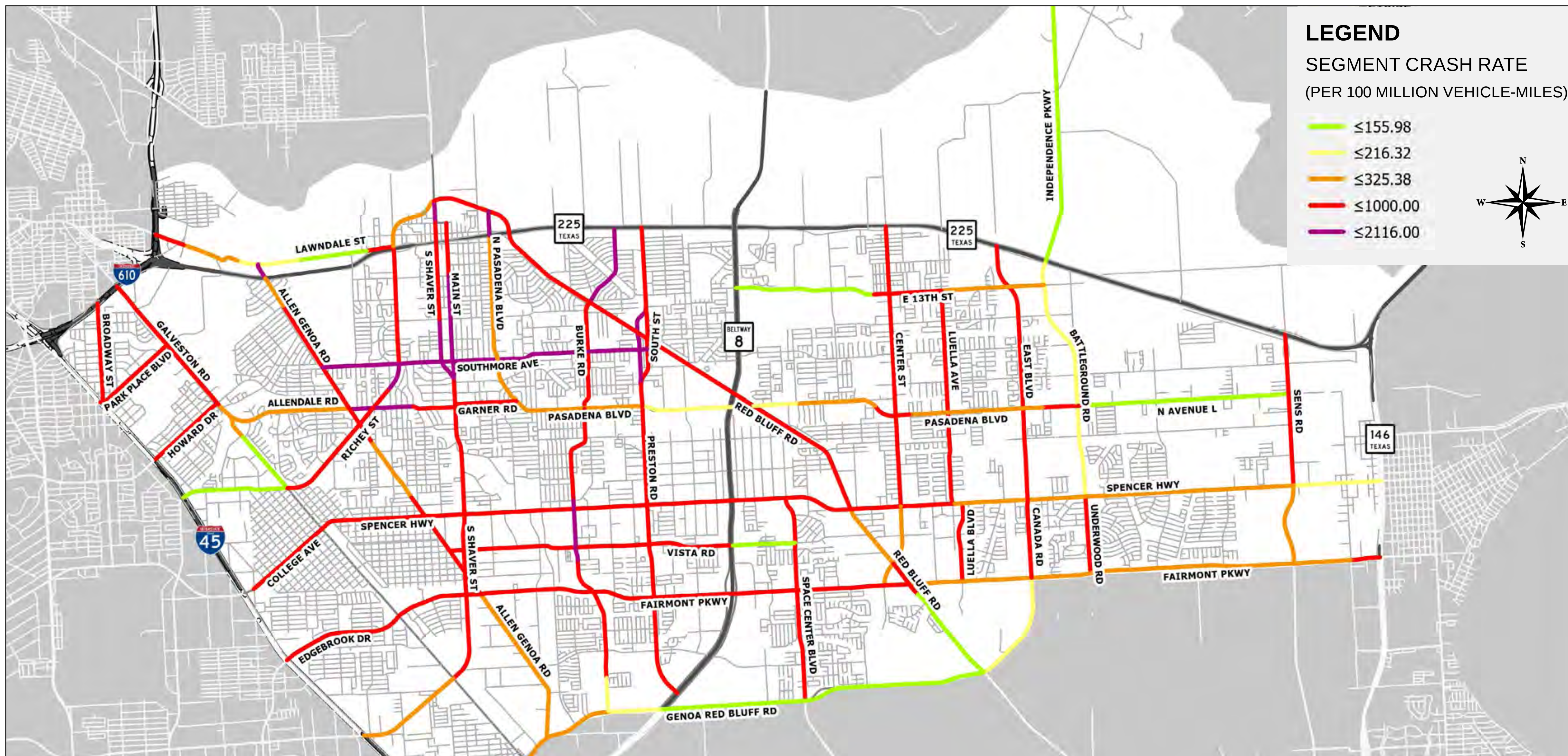
4.1.2 CRASH DATA

Crash data was collected from TxDOT's CRIS system for 2015-2019. Raw crash data is available in **Appendix C**.

Of all accidents
<1%
were fatalities

30%
of the fatalities involved bikes/pedestrians

4.1.2a - Crash Rates



4.2 NETWORK SCREENING

To effectively analyze the network, a screening process was executed to determine the most important intersections and corridors to study. A network screening methodology was developed and vetted by the Steering Committee to focus on two key themes – mobility and safety.

4.2.1 INTERSECTION SCREENING

Through the screening process, one hundred (100) high-congestion intersections were identified for further study. Priority intersections are shown in ***Exhibit 4.2.1a*** with a grey highlight. Circles without a grey highlight are signalized intersections which were considered but "screened-out" after this initial evaluation. Priority intersections were selected primarily based on the intersections total entering volume and volume-to-capacity ratio. Input from steering committee, stakeholders, and the public was also considered before the list was finalized. Total entering volume is symbolized in ***Exhibit 4.2.1a*** by circle size (larger circle indicates larger volume). Volume to capacity, expressed as vehicles per hour per lane (VPHPL), is symbolized by color for varying thresholds (red indicates intersections which are near capacity). Priority intersections include intersections with large total entering volume and high volume-to-capacity ratio. For example, priority intersections to be studied include Spencer Highway at Strawberry Road, Spencer Highway at Center Street, and Fairmont Parkway at Red Bluff Road.

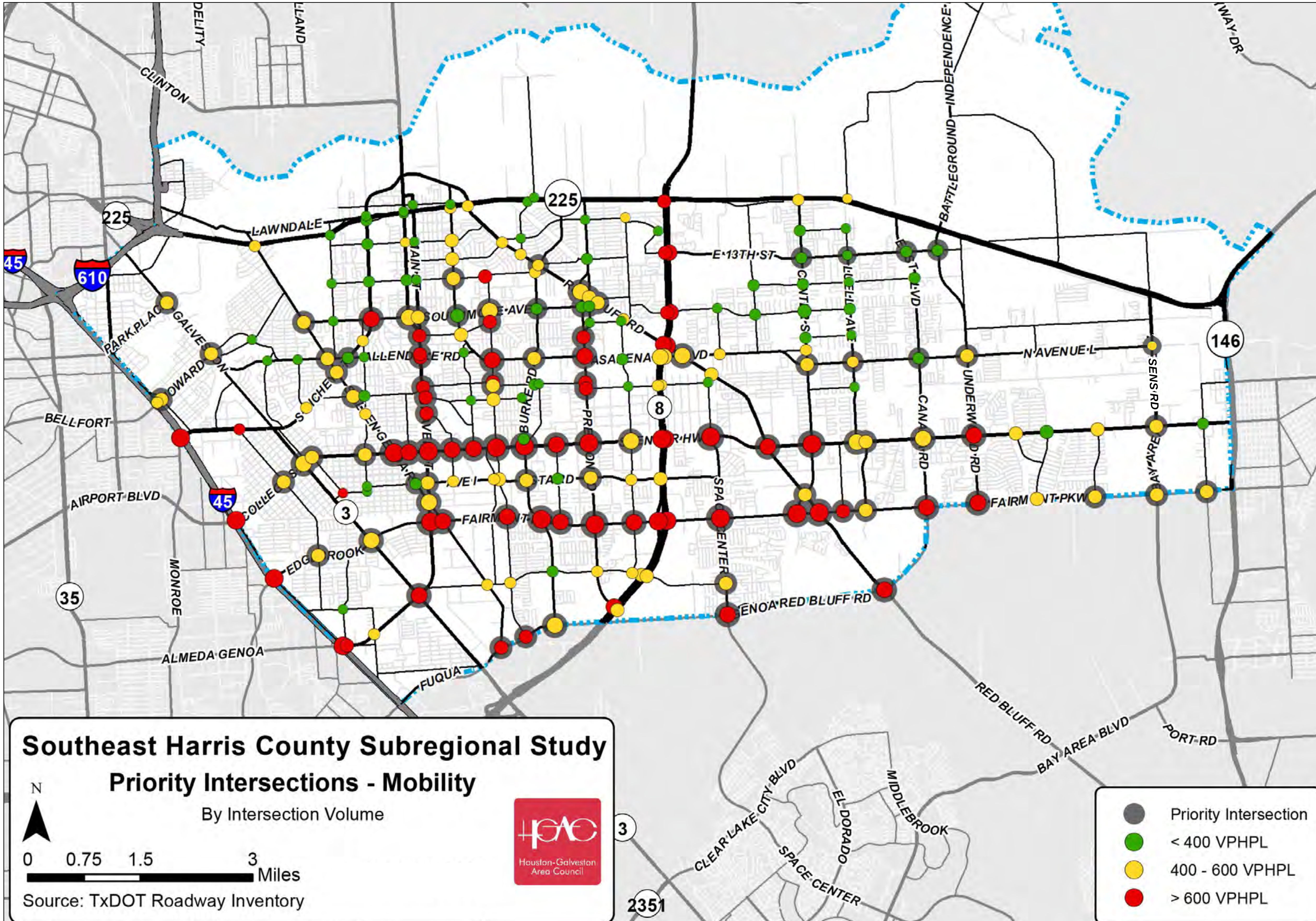
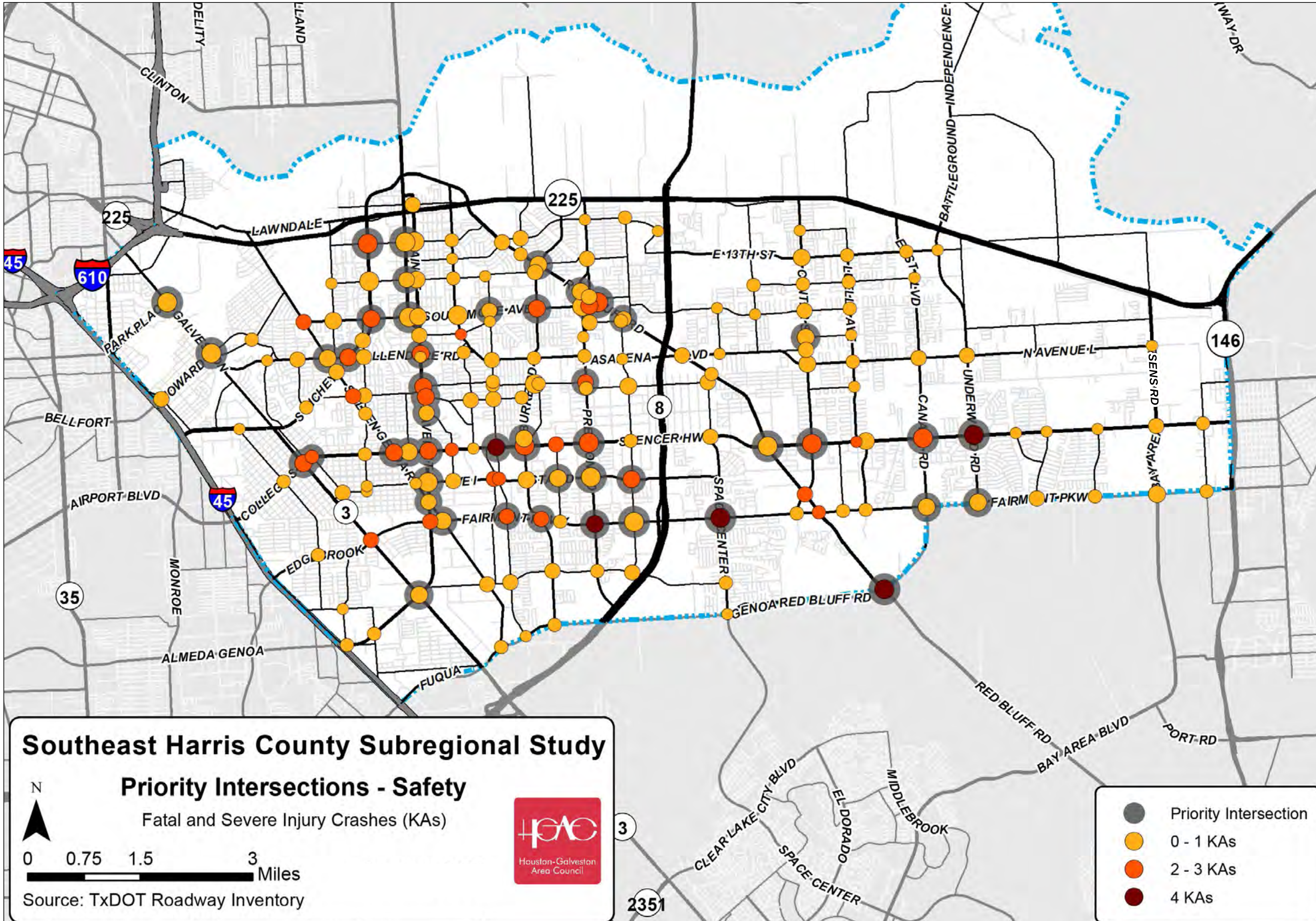


Exhibit 4.2.1a Mobility-Priority Intersections

Fifty (50) high-crash intersections were identified for further study. Priority intersections are shown in ***Exhibit 4.2.1b*** with a grey highlight. Circles without a grey highlight are signalized intersections which were considered but "screened-out" after this initial evaluation. Priority intersections were selected primarily based on the intersections number and rate of fatal crashes, severe injury crashes, total crashes, and non-vehicular crashes. Input from steering committee, stakeholders, and the public was again considered. Crash rate, expressed as crashes per million entering vehicles (MEV), is symbolized in ***Exhibit 4.2.1b*** by circle size (larger circle indicates larger crash rate). Fatal and severe injury crashes is symbolized by color for varying thresholds (brown indicates intersections with four or more fatal or sever injury crashes). Priority intersections include intersections with high crash severity, frequency, and rate. As examples, high-crash priority intersections to be studied include Spencer Highway at Red Bluff Road, Spencer Highway at Preston Road, and Spencer Highway at East Boulevard.



▶ ***Exhibit 4.2.1b***
Safety-Priority Intersections

4.2.2 CORRIDOR SCREENING

Twenty-five (25) high-congestion corridors were identified for further study. Priority corridors are shown in ***Exhibit 4.2.2a*** with a grey highlight. These corridors were selected primarily based on functional classification, as indicated by TxDOT's most recent Roadway Inventory. Input from steering committee, stakeholders, and the public was also considered. Functional classification is symbolized in ***Exhibit 4.2.2a*** to distinguish roadways as either interstate/freeway, principal arterial, minor arterial, and major collector. Principal and minor arterials were selected for further study because these are off-system (non-TxDOT) roadways and high-volume roadways. For example, priority corridors to be studied include Spencer Highway, Fairmont Parkway, and Red Bluff Road.

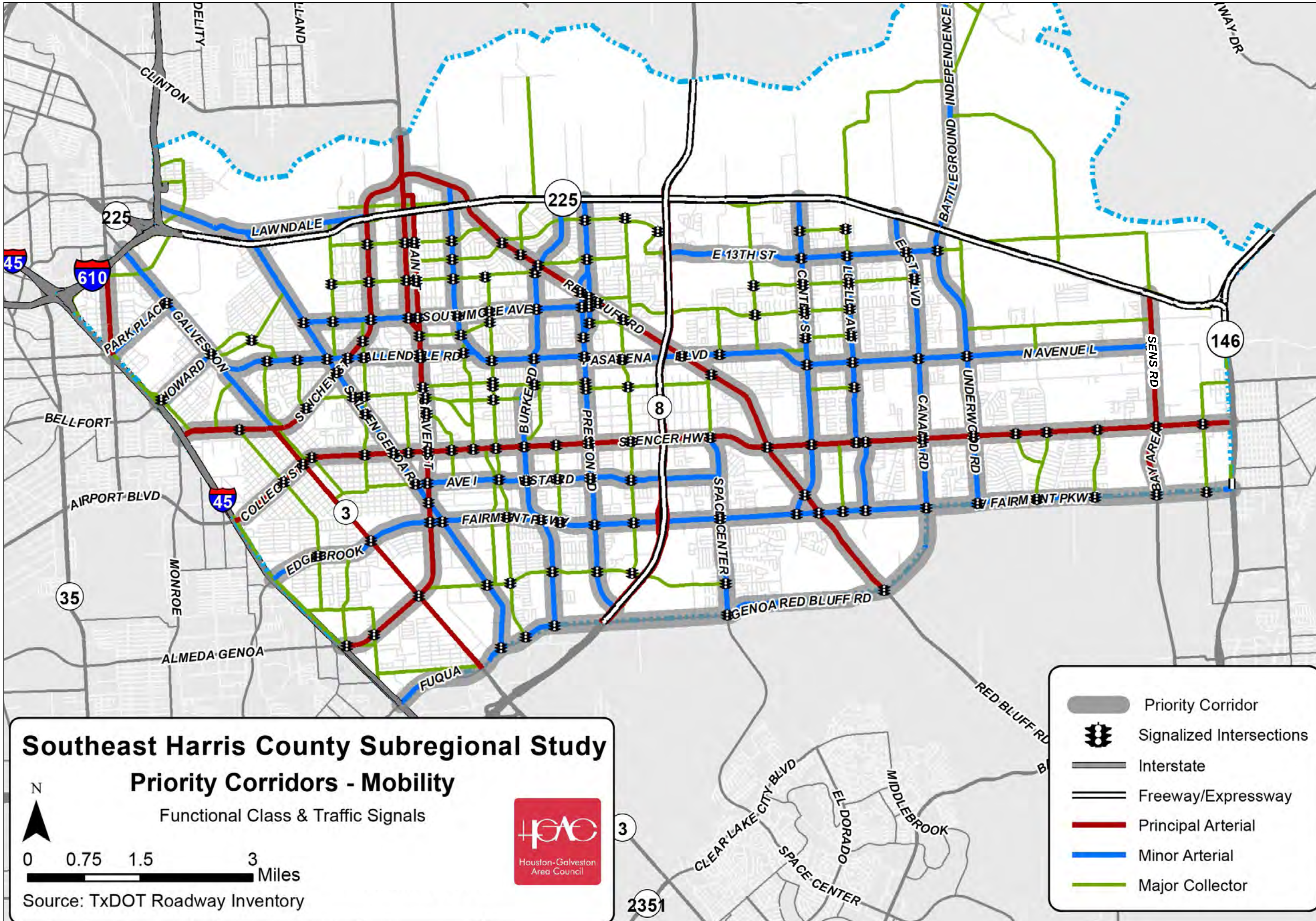


Exhibit 4.2.2a Mobility-Priority Corridors

More than twenty-five (25) miles of high-crash segments were identified for further study. Priority segments are shown as red in ***Exhibit 4.2.2b***. A heat map of crash density is symbolized here such that darker colors indicate higher crash density. Priority segments were selected primarily based on the number and rate of fatal crashes, severe injury crashes, total crashes, and non-vehicular crashes. Input from steering committee, stakeholders, and the public was also considered. Considerable weight was also given to Harris County's High-Injury Network, per the recent Vision Zero action plan. For efficiency during analysis, the priority segments are long continuous segments. For example, priority segments to be studied include along Spencer Hwy from SH 3 to Center Street which is a 6.8-mile segment with 45 fatal or severe injury crashes and along Fairmont Parkway from SH 3 to Red Bluff Road which is a 6-mile segment with 34 fatal or severe injury crashes.

See ***Exhibit 4.1.2a*** for crash rates per roadway segment.

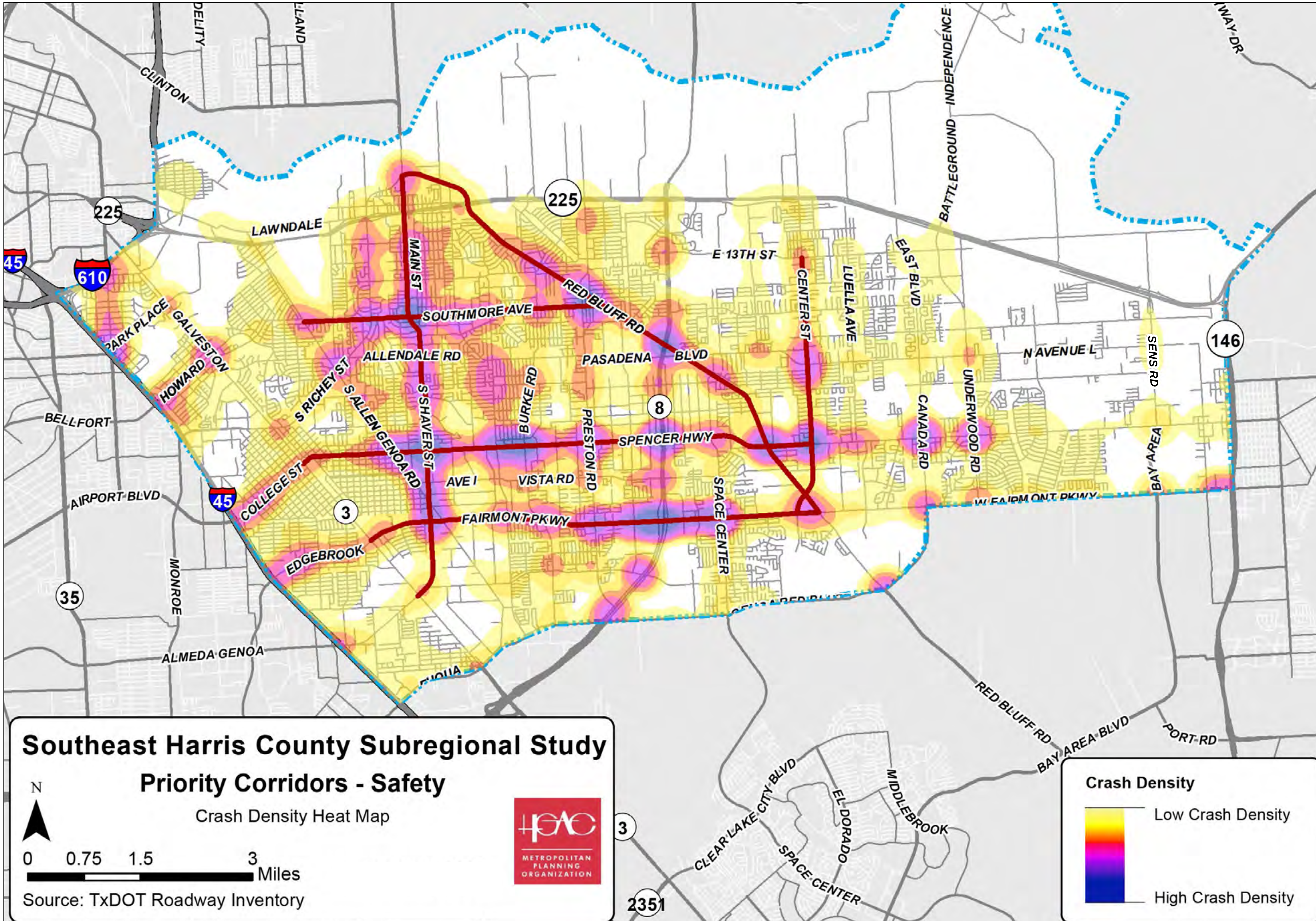


Exhibit 4.2.2b
Safety-Priority Corridors

4.2.3 STUDY LOCATIONS

All study locations, whether identified for safety or mobility needs, are illustrated in ***Exhibit 4.2.3a*** below.

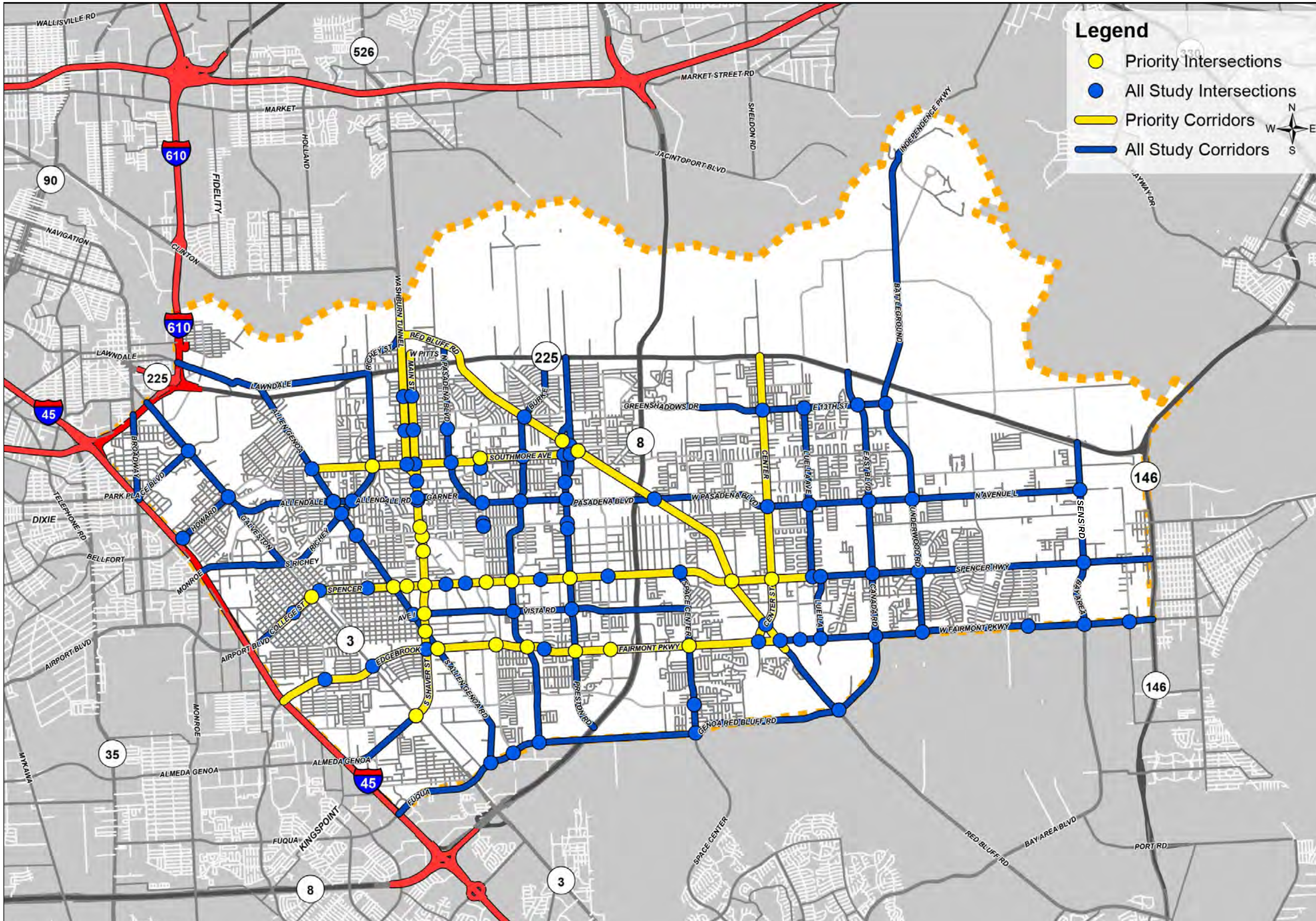


Exhibit 4.2.3a
All Study Locations

4.3 ANALYSIS METHODOLOGY

4.3.1 INTERSECTION CAPACITY ANALYSIS

A capacity analysis was performed to identify study intersections with deficiencies and poor level of service (LOS) and recommend mobility improvements if necessary. Analyses were performed during the morning and afternoon peak traffic hours for four scenarios, as summarized in ***Table D***.

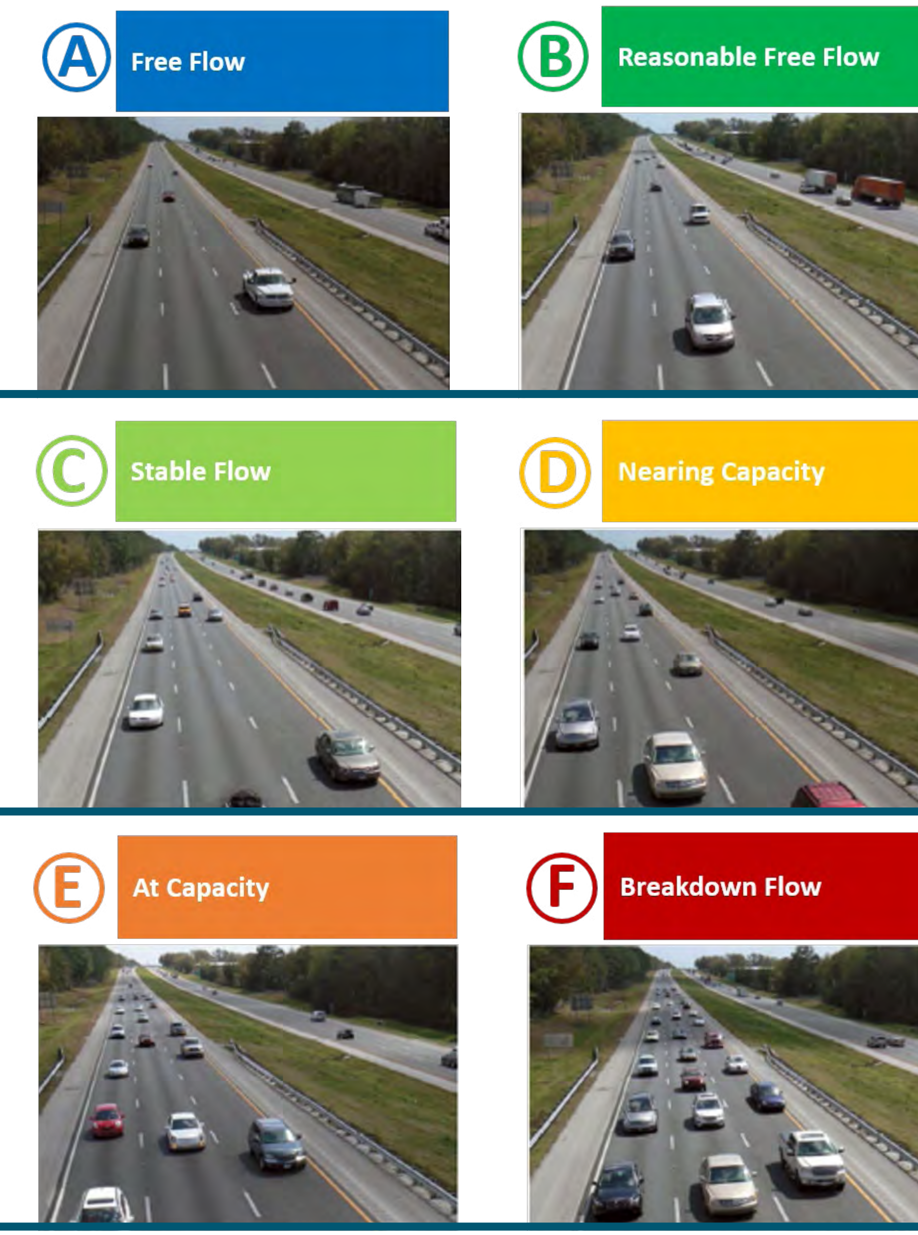
Table D - Analysis Scenarios

Analysis Scenario	Network	Traffic Volumes
2021 Existing	Existing	Adjusted 2021 Volumes
2021 Improved	Existing + **Short-Term Improvements**	Adjusted 2021 Volumes
2045 Existing	Existing	Adjusted 2021 Volumes + **24 Years Annual Growth**
2045 Improved	Existing + Short-Term Improvements + **Long-Term Improvements**	Adjusted 2021 Volumes + **24 Years Annual Growth**

Analysis results are in terms of LOS, which is a qualitative term describing conditions a driver will experience while traveling on a roadway, and it ranges from A (very little delay) to F (long delays and congestion). ***Exhibit 4.3.1a*** below illustrates roadway conditions at each LOS.

Exhibit 4.3.1a - Roadway Conditions at each Level-Of-Service

LEVEL OF SERVICE (LOS)



Free flowing traffic, high speeds, few delays
(SUNDAY MORNING)

Very low speeds, frequent stopping, volume is nearing/ greater than capacity
(RUSH HOUR)

Stable flow, fluctuating speeds, moderate to long delays
(WEEKDAY LUNCHTIME)

Table E shows the definition of LOS for signalized intersections.

The analysis was conducted using the Synchro 11™ software package, and Highway Capacity Manual calculations were used to determine LOS for each study intersection.

Table E
Level-Of-Service Thresholds

LOS	Average Total Delay *(seconds per vehicle)*
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

EXISTING TRAFFIC VOLUMES

Bi-directional average daily traffic (ADT) volumes were collected in the study area by CJ Hensch in May 2021. At the time, it was assumed the traffic reductions due to the COVID-19 pandemic were still in effect. If this collected data had been used in the capacity analysis, deficiencies in the network would have been underestimated and improvements recommended at the end of this study would have not prepared SE Harris County for future non-pandemic traffic conditions. Therefore, the "actual" collected data, needed adjustment to reflect non-reduced, non-pandemic traffic conditions.

To adjust the "actual" data to reflect non-pandemic conditions, first, historic average daily traffic (ADT) volumes were obtained from TxDOT's Statewide Traffic Analysis and Reporting System (STARS) database. These historic ADTs were obtained at the same locations (or as close as possible) where "actual" ADTs were collected in 2021, as shown in ***Exhibit 4.3.1b.***

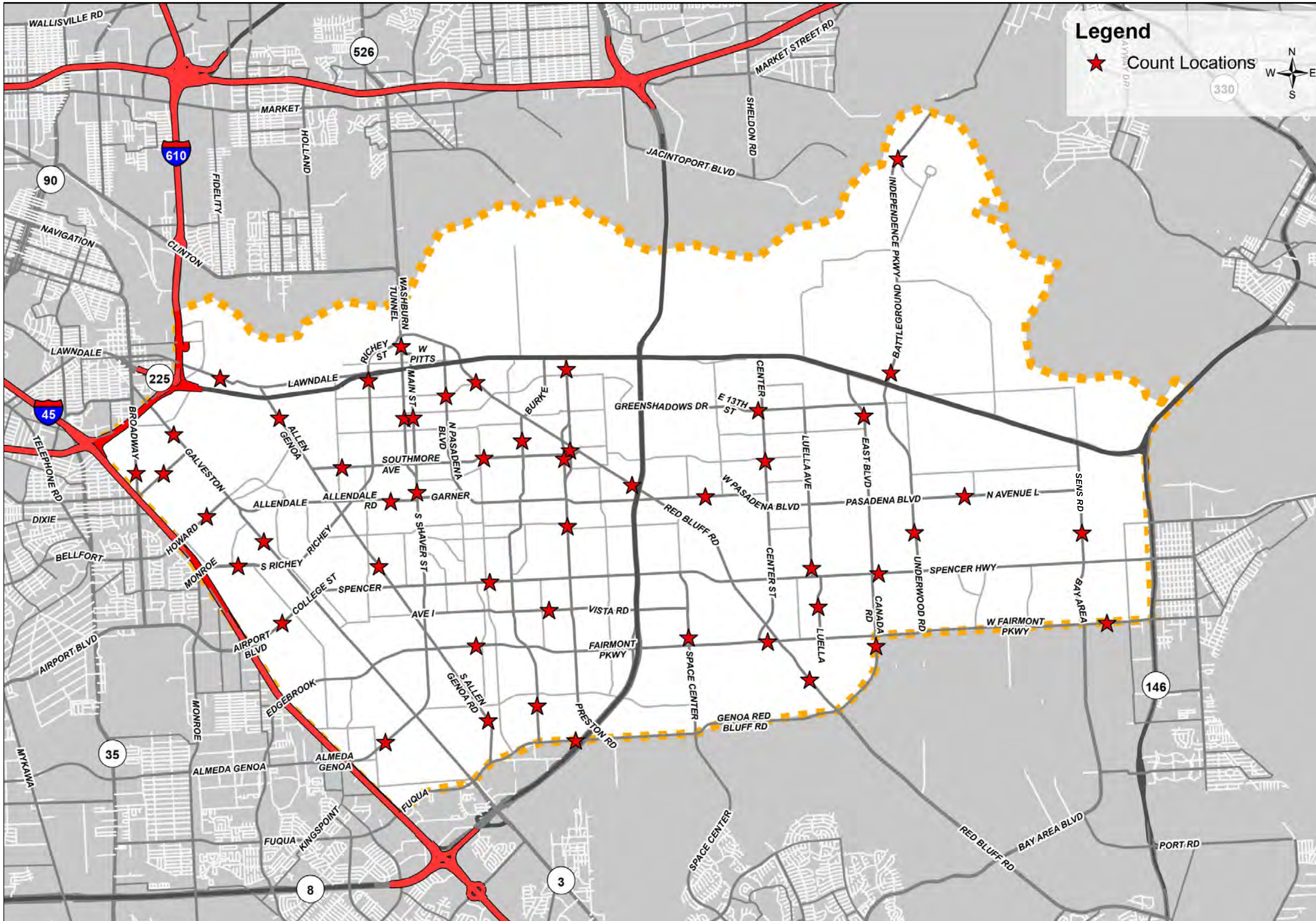


Exhibit 4.3.1b
Map of ADT locations

The average annual growth rate at each location was calculated using the three most recent historic ADT datapoints, and it is considered a "historic growth rate." This calculation is illustrated below in ***Table F***.

Table F
Historic Growth Rate Calculation

SH 3 N of Timbercreek Dr		
Year	**ADT**	**Compound Annual Growth**
2017	10,980	
2018	9,830	-2.09%
2019	12,202	4.83%
2021	13,035	1.37% (average)

The historic growth rate was applied to the most recent historic ADT to project an "expected" 2021 ADT that could be compared to the "actual" 2021 ADT. The "expected" ADT divided by the "actual" ADT is known as the Daily Adjustment Factor.

Equation 1
Example Calculation of Daily Adjustment Factor

$$\frac{\text{"Expected" 2021 ADT} \quad 13{,}035}{\text{"Actual" 2021 ADT} \quad 9{,}910} = 1.32 \text{ Daily Adjustment Factor}$$

The Daily Adjustment Factor describes how "expected" traffic compares to "actual" traffic in 2021:

- **Daily Adjustment Factor < 1.0 – "actual" ADT is greater than "expected" ADT**, implying that traffic volumes under pandemic conditions are greater than what was projected using the historic growth rate, which is unlikely because activity in public spaces was reduced overall during the pandemic.
- **Daily Adjustment Factor = 1.0 – "actual" ADT equals "expected" ADT**, implying that traffic volumes under pandemic conditions are equal to what was projected using the historic growth rate, which is more likely along some roadways where activity was still occurring during the pandemic.
- **Daily Adjustment Factor > 1.0 – "actual" ADT is less than "expected" ADT**, implying that traffic volumes under pandemic conditions are less than what was projected using the historic growth rate, which matches the assumption that overall traffic was reduced due to the pandemic.

Because it is unlikely for "actual" traffic to be greater than "expected" traffic, the Daily Adjustment Factor was assumed to be 1.0 where it was calculated to be less than 1.0.

Along with ADTs, turning movement counts (TMCs) were collected at study intersections in May 2021. Again, because traffic reductions were still in effect when this data was collected, using these "actual" TMCs in the analysis would have resulted in underestimated capacity deficiencies. Therefore, the TMCs also needed to be adjusted to reflect non-pandemic conditions before analysis could proceed.

First, each study intersection was associated with the nearest ADT count location, as illustrated in ***Exhibit 4.3.1c***. Each ADT location can have several TMC locations associated with it, therefore it acts as a "parent" to them.

TMCs are collected during the morning (AM) and afternoon (PM) peak hours of each intersection. To obtain the "adjusted" 2021 peak hour volume, the "actual" peak hour volumes are multiplied by the "parent" Adjustment Factor.

FUTURE TRAFFIC VOLUMES

HGAC provided the study team with TDM outputs that projected traffic volumes throughout the study area for years 2020 and 2045. These volumes are bi-directional average daily traffic (ADT) volumes, similar to what was collected in May 2021, representing traffic along every link of roadway larger than a local road (as classified by TxDOT).

Historic growth was used to determine an expected future growth rate in the sub region. The average historic growth rate across all ADT locations is 1%. This compound growth rate was applied to the 2021 adjusted turning movement counts (TMCs) to obtain TMCs for the 2045 analysis scenarios.

4.3.2 CORRIDOR CAPACITY ANALYSIS

Volume-to-capacity ratio (V/C), or how much traffic a roadway actually experiences vs. how much it was designed to accommodate, was the key metric used to evaluate mobility along study corridors and determine if installation of additional through lanes should be recommended. Corridors with V/C greater than 0.6 (approaching capacity) are most likely to have through lanes recommended. Additionally, if through lanes were recommended at study intersections along the corridor after the intersection capacity analysis, then it is highly likely that through lanes would be recommended throughout the corridor to maintain a consistent cross-section.

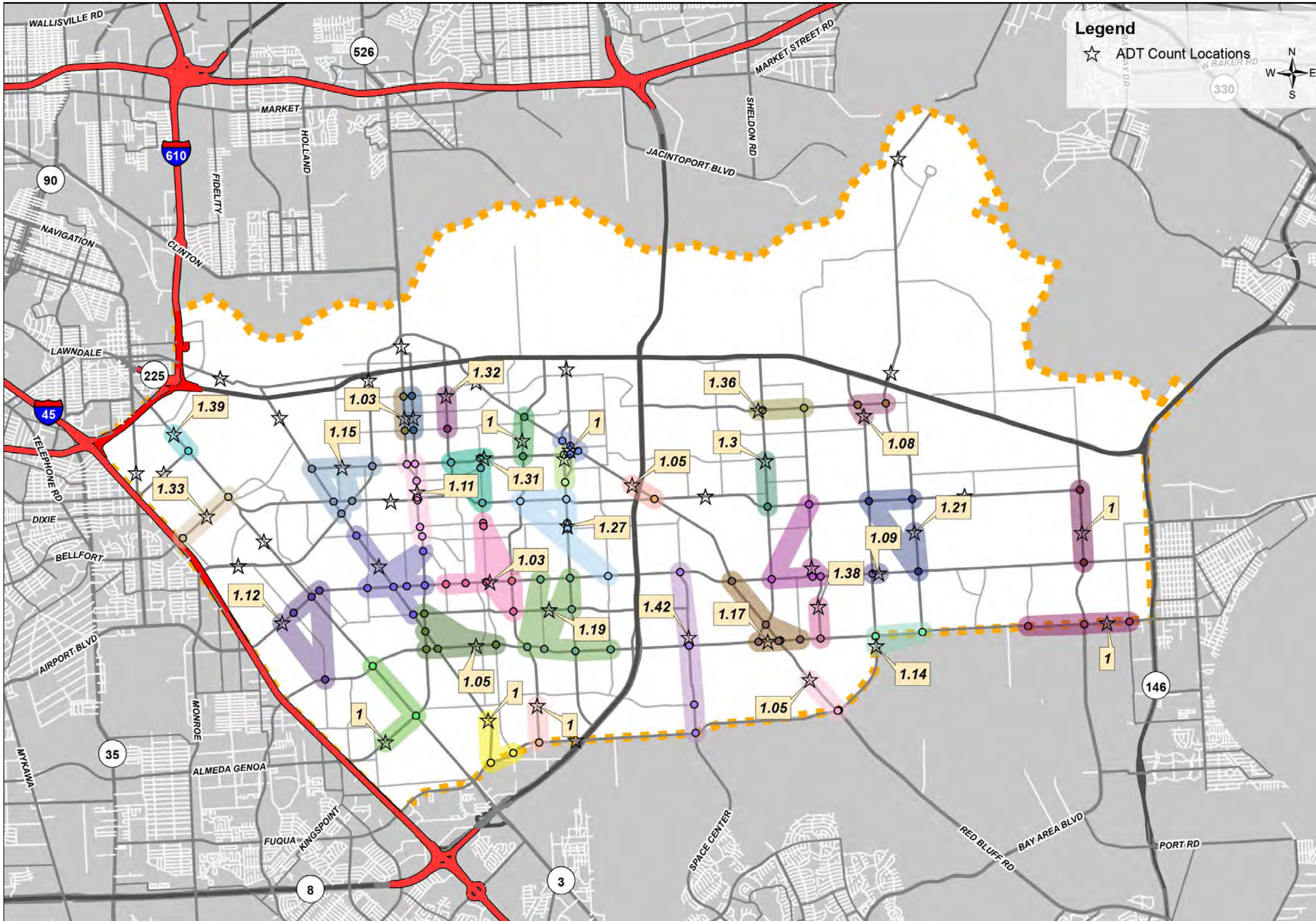
Corridor capacity was estimated using roadway classification and cross-section. The relationship between these parameters is outline in the ***Table G*** below.

Table G
Capacity Parameters

Classification	Number of Lanes	Capacity (vehicles/day)	Capacity (vehicles/hour/lane)
Principal Arterial	8	73,690	921
Principal Arterial or Minor Arterial	6	55,300	922
Minor Arterial or Collector	4	36,800	920
Collector	2	18,300	915

To estimate the volume side of the V/C ratio, bi-directional average daily traffic (ADT) volumes were collected in the study area by CJ Hensch in May 2021. At the time, it was assumed the traffic reductions due to the COVID-19 pandemic were still in effect. If this collected data had been used in the capacity analysis, deficiencies in the network would have been underestimated and improvements recommended at the end of this study would have not prepared SE Harris County for future non-pandemic traffic conditions. Therefore, the "actual" collected data, needed adjustment to reflect non-reduced, non-pandemic traffic conditions. Refer to ***Section 4.3.1*** for details on how the collected ADTs were adjusted.

Exhibit 4.3.1c
Map of TMC locations and Adjustment Factor Clusters



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5

Area-Wide Improvements

- 5.1 Freight
- 5.2 Transit
- 5.3 Active Transportation
- 5.4 Policy

Area-Wide Improvements

This chapter provides an overview of recommended improvements throughout the SE Harris County subregion that are not specific to the study intersections and corridors. Details on recommendations at study intersection and corridors can be found in Chapters 6 and 7, respectively.

This chapter includes recommendations on:

- Freight, including railways and truck routes,
- Transit, including an investigation into METRO area service,
- Active transportation, including sidewalks, bikeways, and shared use paths, and
- Policy, including potential revisions to existing municipality ordinances

5.1 FREIGHT

A freight assessment of the study area was completed that examined freight moving within and through the study area. Much of the freight leaving Port of Houston terminals travels via truck along SH 146 to connect with SH 225 and IH 10 or via freight rail; however, the assessment revealed other corridors with higher than the regional average of truck traffic. It was observed that most of the study corridors had 10% to 20% trucks in their daily traffic. Additionally, the corridors listed below have over 20% of trucks in their daily traffic:

- Lawndale Street
- Richey Street
- Spencer Highway (between Underwood Road and SH 146)
- Fairmont Parkway (between Beltway 8 and SH 146)
- Independence Parkway/Battleground Road/Underwood Road

20%+ of trucks in their daily traffic

Exhibit 5.1a illustrates the portion of truck traffic along study corridors as well as freight facilities in and around the study area that may act as attractors of truck traffic. It should be noted that several corridors currently not designated as truck routes (i.e., Spencer Highway) do carry a noticeable volume of trucks.

Additional analysis was performed to identify study corridors with a higher percentage of truck traffic attributed to freight operations. Trucks with more than four axles were attributed to freight operations. It was observed most of the study corridors had less than 5% of traffic attributed to freight. The corridors listed below have over 5% of trucks in daily traffic that can be attributed to freight operations:

- Lawndale Street
- Richey Street
- Red Bluff Road
- Spencer Highway (between Underwood Road and SH 146)
- Fairmont Parkway (between Beltway 8 and SH 146)
- Independence Parkway/Battleground Road/Underwood Road

5%+ of trucks can be attributed to freight operations

Exhibit 5.1b illustrates the portion of freight truck traffic along study corridors as well as freight facilities in and around the study area that may act as attractors of freight truck traffic. Similar to overall truck percentages, several corridors in the study area currently not designated as truck routes do experience freight traffic via heavy truck.

In addition to reviewing vehicle classification counts, the assessment also examined crash hotspots for freight-related crashes and fatalities involving freight. It was observed that most crashes occurred along highways and at intersections along the frontage roads of highways, including IH 45, IH 610, SH 225, SH 146, and BW 8.

Exhibit 5.1c illustrates the freight-related crashes throughout the study area.

Further analysis was performed to identify routes utilized by the trucks in the study area, specifically, study corridors that the trucks use as pass-through routes. The following study corridors were identified as routes with noticeable truck traffic:

- Richey Street between IH 45 and Galveston Road
- Spencer Highway between Sens Road and SH 146
- Fairmont Parkway between Beltway 8 and S Broadway Street

Streetlight data was utilized to identify routes used by the trucks originating from the Barbour's Cut Terminal in La Porte and from the Bayport Industrial District, specifically to identify the percentage of trucks traveling along study corridors. Trips to and from Barbour's Cut Terminal originate both within and outside the greater Houston area with destinations including the industries, warehouses, and distribution centers located along SH 225 and SH 146. This industrial development is primarily located in the cities of Pasadena, La Porte and Deer Park. Additionally, analysis indicates that more trucks travel to and from La Porte and the Bayport Industrial District, located just south of the study area, than to and from the industries located in Pasadena and Deer Park.

Based on a high-level review, high truck activity – and therefore congestion and safety issues – is expected along the following corridors:

EAST-WEST CORRIDORS:

- Lawndale Street
- E 13th Street
- Spencer Highway
- Fairmont Parkway

NORTH-SOUTH CORRIDORS:

- Richey Street
- Red Bluff Road
- Independence Parkway/Battleground Road/Underwood Road
- Sens Road

The land uses along these corridors is primarily commercial and industrial, including minor industries, warehouses, logistics and distribution centers. Streetlight data helped establish that Independence Parkway/Battleground Road/Underwood Road is used as a pass-through route by trucks traveling north-south between Bayport Industrial District and SH 225 and that Richey Street is used as a pass-through route between IH 45 and SH 225. Both pass-through routes allow freight drivers to avoid congested IH 610 interchanges.

With the expected increase in Port Houston's tonnage and a rise of resin packaging facilities within and around the study area, the freight activity is expected to rise along these study corridors. Corridors currently on the City of La Porte designated truck route system shall be widened and upgraded to accommodate the current and expected growth in truck traffic. The improvements to these corridors will improve 80% of the intersections with crashes involving commercial vehicles. Furthermore, additional signage and pavement markings should be installed to direct trucks to only use designated truck routes when traveling through the study area. Additional monitoring and enforcement of truck traffic would lead to less freight traffic on non-truck designated routes. This should reduce truck volumes on undesignated facilities such as Spencer Highway and Sens Road.

The improvements to these corridors will improve **80%** of the intersections with crashes involving commercial vehicles.

A full version of the Freight Assessment is included in ***Appendix D***.

RECOMMENDATION

- Additional signage should be installed, and additional enforcement conducted, on segments of routes demonstrating truck/freight traffic that are not designated as truck routes.

Exhibit 5.1a
Total Truck Percentage Throughout Study Area

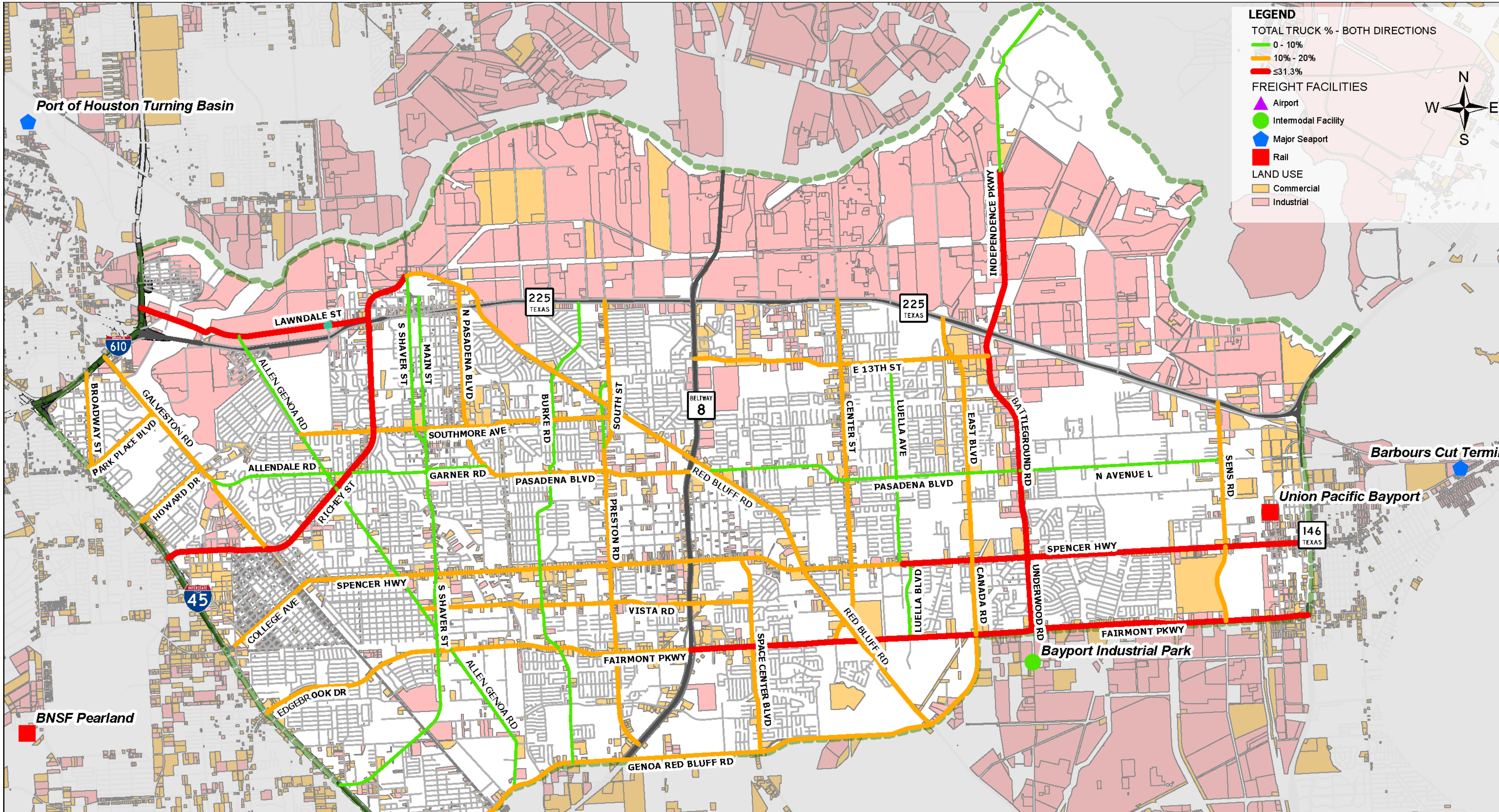


Exhibit 5.1b
Total Freight Truck Percentage Throughout Study Area

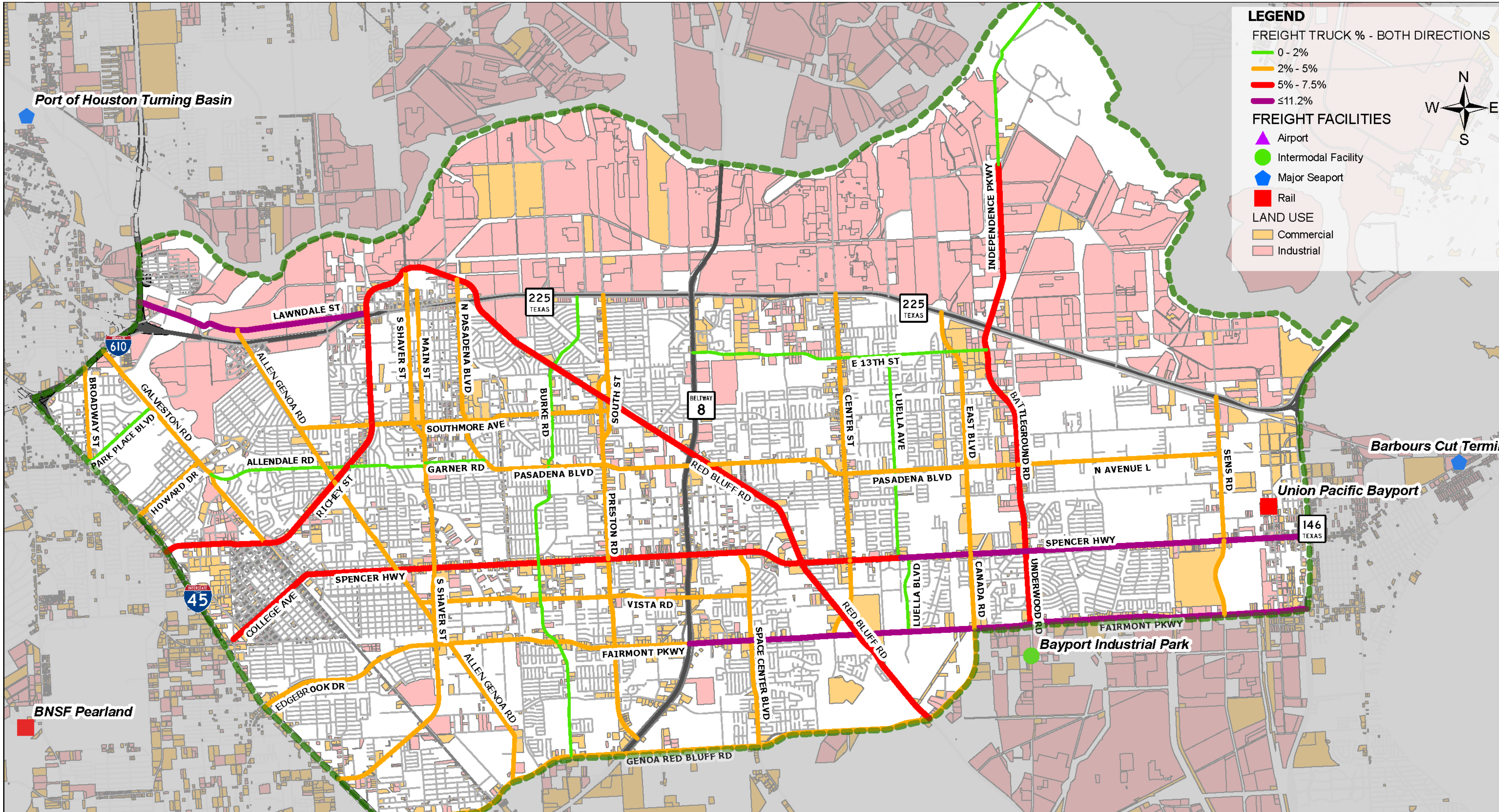
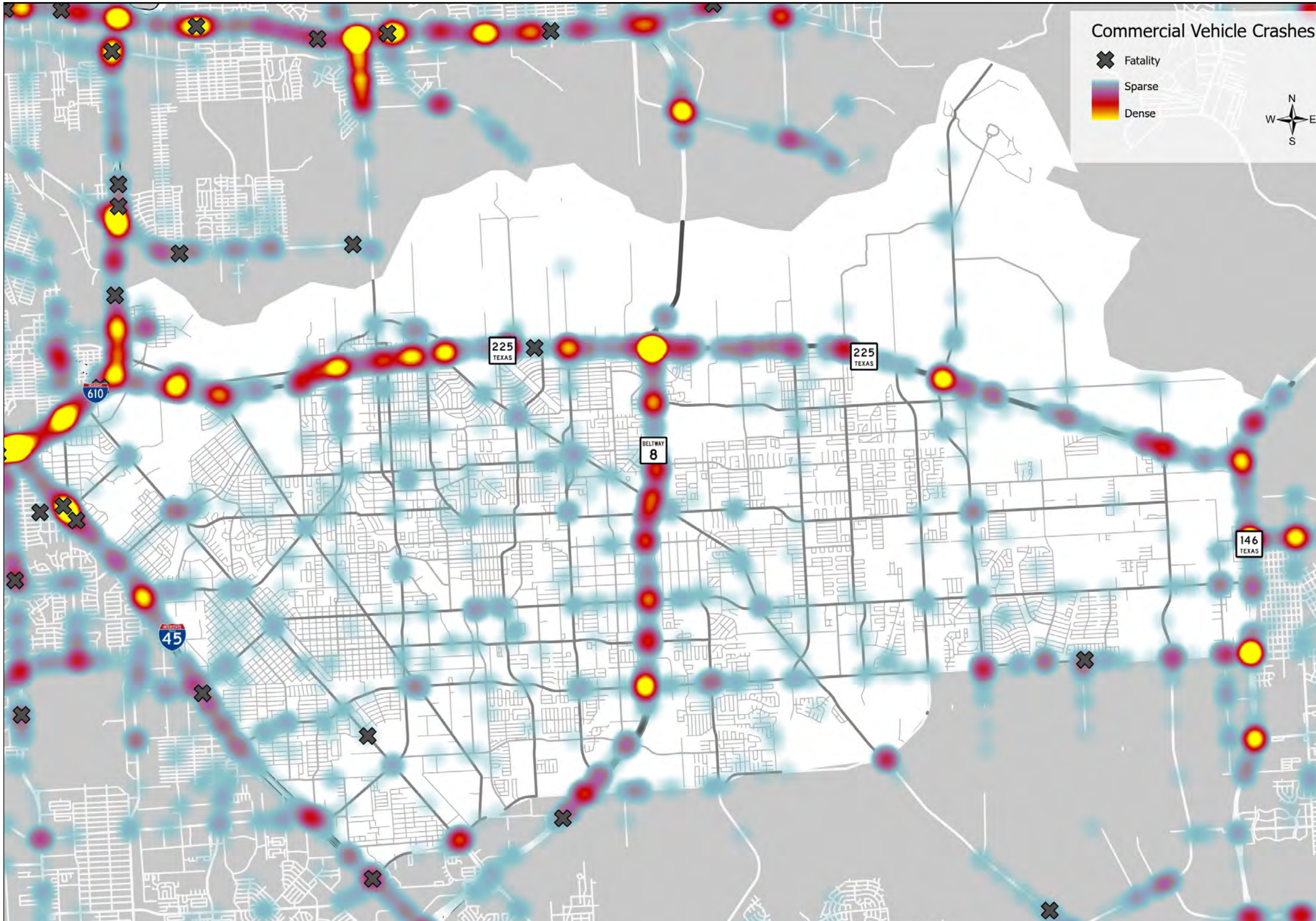


Exhibit 5.1c
Freight-Related Crashes Throughout Study Area



5.2 TRANSIT

In the SE Harris County subregion, there is an existing transit network that includes:

4
Houston METRO local bus routes

2
Harris County Transit shuttle bus routes

2
Park-n-Ride regional commuter bus routes

80
Existing bus stops in the study area, 84% of which do not have a bus shelter.

Exhibit 5.2a illustrates the routes and types of existing transit facilities in the study area.

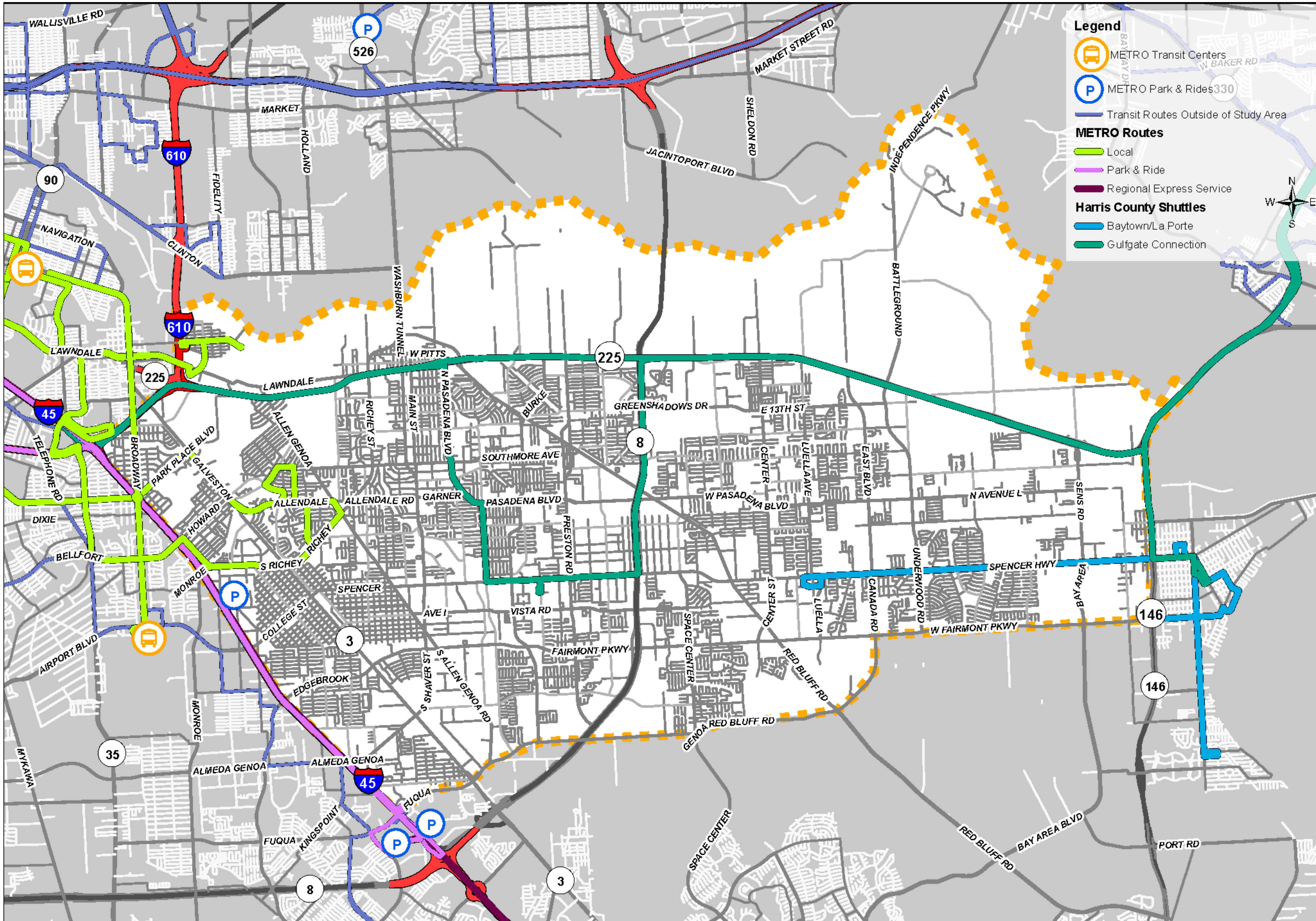


Exhibit 5.2a
Existing Public Transit Facilities

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As part of the public outreach process, several comments were made by area residents expressing a desire for more frequent bus service and a re-examination of the existing routes. Specifically, there is a desire to connect the existing routes to each other and to routes outside the area.

After discussions with the City of Pasadena, Harris County Transit, and H-GAC it was determined that the best course of action would be to commission a transit-specific study for Pasadena to examine transit options in a more detailed manner. As a result, no specific recommendations were made as part of this study other than for H-GAC to lead a Pasadena-specific study in the near future.

Harris County Transit regularly identifies recommendations for future bus routes. Their recommendations are shown in dashed orange lines on ***Exhibit 5.2b*** as "Potential Bus Routes." As an outcome of this SE Harris Study, one additional route was added from Spencer Highway/College Avenue and S Allen Genoa Road west to the existing Monroe Park and Ride along I-45 between Winkler Drive and College Avenue.

H-GAC identified activity centers in the area, based on an index of population and employment density, where there are more than 7,200 residents and jobs per square mile. The resulting activity centers are illustrated with orange shading in ***Exhibit 5.2b***. These activity centers indicate where there is high potential for transit, given the density of person activity in the area. When combined on a map with the previous Harris County Transit recommendations, there are many overlapping locations.

The following descriptions are highlights from the potential transit corridors, as labeled with numbered orange circles in ***Exhibit 5.2b***.

1. Connections can be made between the existing routes and Park & Ride hubs.
2. Connections can be made between the Gulfgate Connection Shuttle and METRO local routes along Lawndale Street and other roadways north of SH 225; this would serve commuters and residents.
3. A connection can be made between the Baytown/La Porte Shuttle and the Gulfgate Connection Shuttle near San Jacinto College.
4. A north-south connection can be made along Burke Road, Pasadena Boulevard, and Strawberry Road to provide access to the HCA Southeast campus.
5. A connection can be made between Gulfgate Connection Shuttle and the METRO local routes along Southmore Avenue and Richey Street.

The potential routes listed above are preliminary and were not done in combination with specific route or stop studies, apart from the recommendations from Harris County Transit.

Additional areawide recommendations are shown in ***Exhibits 5.2c*** and ***5.2d***, which include bus stop shelter locations and locations where bus stop lighting should be improved.

RECOMMENDATION

- Perform a future Transit Feasibility Study for the study area. That study should involve H-GAC, Harris County Transit, local municipalities, the public, and local stakeholders, at a minimum. The study should evaluate specific route and stop feasibility, potential demand/ridership, and a cost-benefit methodology.

1. Connections can be made between the existing routes and Park & Ride hubs.
2. Connections can be made between the Gulfgate Connection Shuttle and METRO local routes along Lawndale Street and other roadways north of SH 225; this would serve commuters and residents.
3. A connection can be made between the Baytown/La Porte Shuttle and the Gulfgate Connection Shuttle near San Jacinto College.
4. A north-south connection can be made along Burke Road, Pasadena Boulevard, and Strawberry Road to provide access to the HCA Southeast campus.
5. A connection can be made between Gulfgate Connection Shuttle and the METRO local routes along Southmore Avenue and Richey Street.

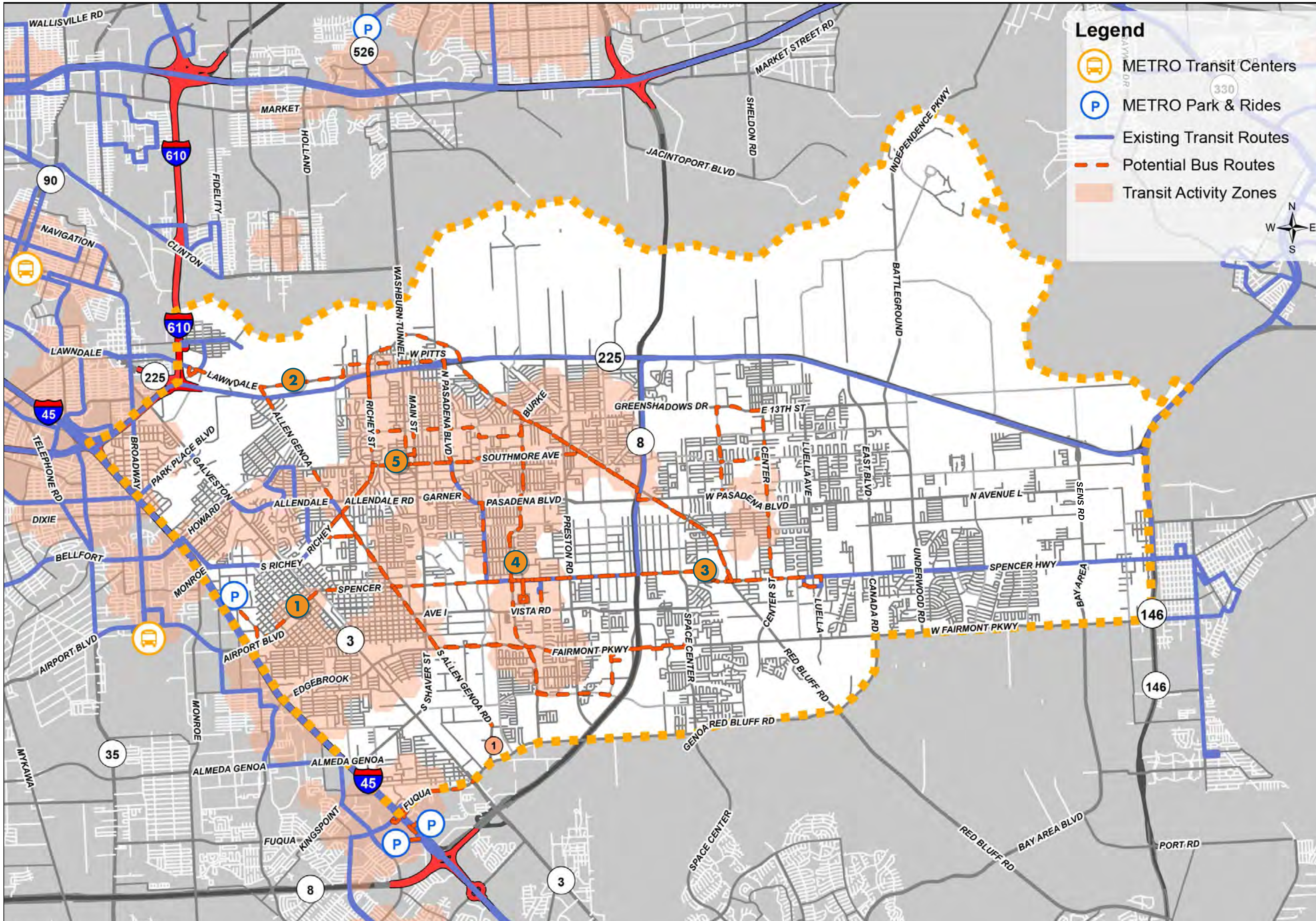

Exhibit 5.2b
Potential Public Transit Facilities

Exhibit 5.2c
Existing Bus Stops and Shelters

Exhibit 5.2d
Bus Facility Lighting

5.3 ACTIVE TRANSPORTATION

The existing active transportation network is extensive in the SE Harris County subregion, including:

925 **miles** *of sidewalks*

25 **miles** *of bike routes and bike lanes*

88 **miles** *of trails and shared use paths*

Exhibit 5.3a illustrates the existing active modes facilities in the study area.

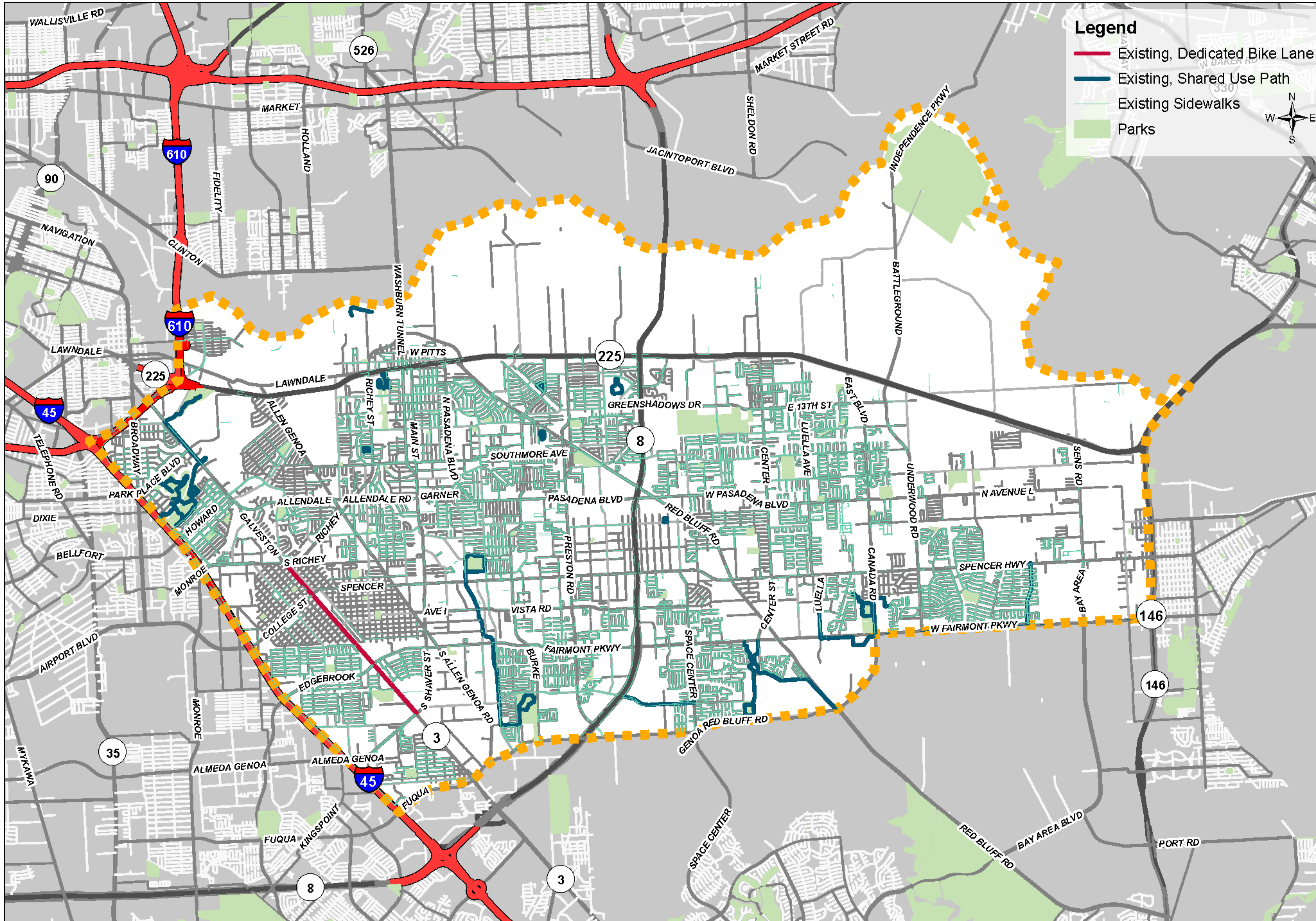

Exhibit 5.3a
Existing Active Transportation Network

Some gaps in the existing active modes network were identified that could be filled. Recommendations for sidewalks, bicycle lanes, and shared use paths that run parallel to study corridors are described in detail in ***Chapter 7 – Corridor Conditions*** and Recommendations. Recommendations for shared use paths that do not follow study corridors are described in this chapter. Additional areawide recommendations for curb ramp improvements are shown in ***Exhibit 5.3b***.

Exhibit 5.3b Areawide Improvements to Curb Ramps

The combined existing and proposed active modes network is illustrated in ***Exhibit 5.3c***. These recommendations only include general location of the facilities. Each municipality should prioritize the connections and, prior to construction, perform design-level analysis of the appropriate location for each. This design-level analysis should also consider potential lighting, intersection transitions, ADA accommodations, signage/wayfinding, and amenities (benches, water fountains, bicycle repair stations, dog waste bag stands, etc.). Each municipality will have their own specific design standards; cost and design of each facility will vary. The next section outlines best practices for facility design to encourage use by more people. These principles provide for higher comfort and increased safety and should be used as minimum guidelines where possible.

5.3.1 DESIGN GUIDELINES

General best practices for designing active transportation facilities are outlined below. These design principles meet the high-comfort standards for all users and abilities, encouraging more widespread use. To accommodate the maximum number of participants on the active transportation network, this study predominantly recommends shared use paths, especially those along high-speed, high-volume roadways.

Where right-of-way constraints exist, shared use paths may not always be a viable option. When a facility must be provided on-street, a buffered bike lane should be the primary facility alternative, and reduction of speed of traffic, through traffic calming or other strategies, should also be considered. Where existing facilities exist that do not meet the minimums outlined below, municipalities should consider upgrading the facilities.

SHARED USE PATH

- The minimum paved width for a shared use path is 10 feet.
- The minimum recommended distance between a shared use path and adjacent roadway edge is 4 feet on a high-speed roadway. A barrier should be provided where the separation is less than 4 feet.

BUFFERED BIKE LANE

- A 6-foot bike lane is recommended when possible, however, a minimum width of 5 feet is acceptable.
- A physical separation buffer is recommended; buffer treatments can include vertical delineators, concrete barriers, raised pavement markers, and planter boxes. They can also serve as a tool for beautification, integrating art and place-making elements into a streetscape.
- If a striped buffer is provided with no physical separation, 2 feet is the recommended minimum for the buffer; there must be two solid white lines parallel to the bike lane, with interior diagonal cross hatching or chevron markings if the buffer is 3 feet in width or wider.
- When buffering a bike lane from a parking lane, a minimum 1.5-foot width (in addition to the travel lane side buffer) is recommended to encourage cyclists to ride outside of the door zone of parked cars.

BIKE ROUTE

- Bike routes are identified with both pavement markings and signage. The marking used for this facility, also known as a "sharrow," is a bicycle with a double arrow above it to mark the direction of travel. Signage is useful when placed at the beginning of a shared lane to alert motorists.
- Sharrows should be placed immediately after an intersection and spaced at 250-foot intervals.

SIDEWALKS

- A 6-foot sidewalk is recommended when possible, however, a minimum sidewalk width of 5 feet is acceptable.
- It is recommended that a buffer zone of 4-6 feet be incorporated to further separate pedestrians from the roadway. This buffer zone is often created by a landscaped or hardscaped strip next to the curb, but it can also be created by the presence of bike lanes or on-street parking.
- In cases where the sidewalk is immediately adjacent to the curb, the sidewalk should be widened an additional 2-3 feet.

Numerous previous studies have recommended facilities in the past. All jurisdictions should coordinate when implementing any corridor to ensure effective continuity and efficient construction, to allow for a better user experience across jurisdictional boundaries.

1. The area between SH 225 and the Washburn Tunnel roundabout is generally mixed-use, allowing residents to live, work, and play in the area. Additionally, both Vince Bayou and Little Vince Bayou run through the area, making it prime location for trails and parks. Sidewalks and other active mode facilities would serve industry employees and residents north of SH 225, providing additional options for mobility in the area.
2. The existing trail along Vince Bayou south of Spencer Highway may be extended north along the entirety of the bayou to provide a north-south corridor, shielding pedestrians and bicyclists from vehicular traffic for the length of the study area.
3. The existing shared use path along Fairmont Parkway east of Canada Street may be extended west to the edge of the study area to provide a major east-west corridor. Coordination with the City of Houston is recommended to extend the path further west.
4. Although South Houston is very dense, the city's sidewalk network has many gaps. Shared use paths along Main Street and College Street should be constructed to provide "arterials" that provide connectivity within the city, but also more regionally. More sidewalks could be constructed throughout the city to provide greater access to these "arterials" and other activity centers – schools, parks, churches, markets, etc.

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5. Trails along Berry Bayou, the electrical easement parallel to 7th Street, and the drainage easement along the eastern edge of the South Houston would provide off-road mobility options for pedestrians and cyclists.
6. A shared use path along Battleground Road should be constructed from the San Jacinto monument to Fairmont Parkway, providing an extensive north-south corridor. If intersected by the 8 additional proposed shared use paths, this would enable pedestrians and bicyclists from around the subregion to access many of its parks and a major historical landmark.
7. Sidewalk and trail connectivity should be improved near Burke Crenshaw Park. The existing sidewalk along the east side of Strawberry Road should be extended south to the intersection at Genoa Red Bluff Road, then connect to the existing sidewalks along the north side of Genoa Red Bluff and along the west side of Burke Road. This would improve the neighborhoods access to both Burke Crenshaw Park and the Universal Park. Additionally, trail connections within Birke Crenshaw Park should be improved such that pedestrians can avoid traversing along roadways or grass as much as possible.

Proposal recommendations result in:

1,665 miles
of new, repaired, or improved sidewalk (207% growth)

26 miles
of new dedicated bike routes or bike lanes (1,525% growth)

230 miles
of new shared use paths (461% growth)

Exhibit 5.3c illustrates the proposed active modes network.

Improving active transportation connectivity would enable pedestrians and bicyclists to move around the subregion safely and more easily and could help the subregion market itself to residents and visitors desiring more active mobility options.

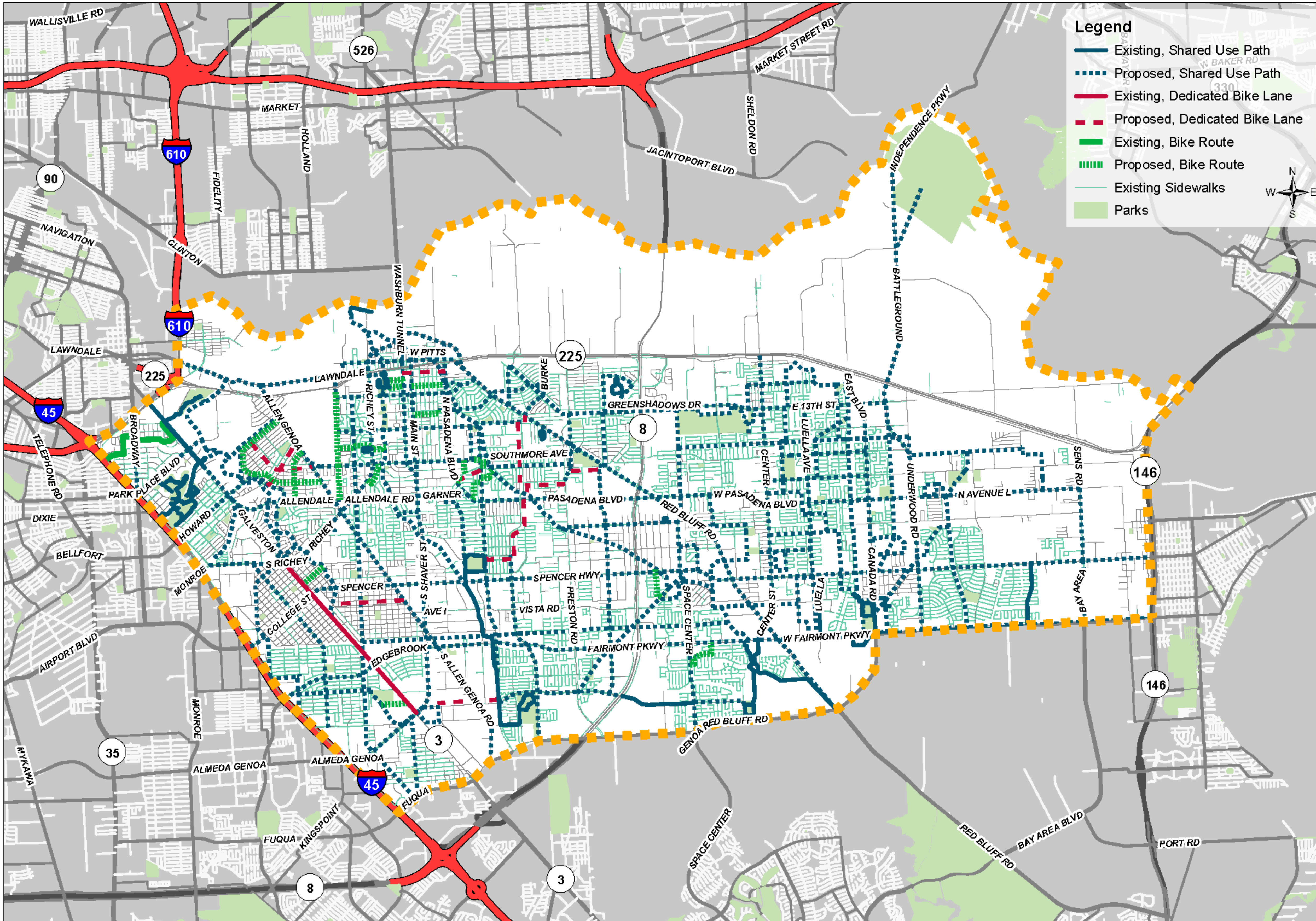


Exhibit 5.3c
Existing and Proposed Active Modes Network

5.4 POLICY

Specific policy recommendations will vary by agency, given individual planning and design standards. Any specific design guidelines below come from best practices in the industry and should be used as a guide; municipalities should conduct specific studies, in combination with feedback from decision-makers when writing new or revising existing policy. In general, policy should allow for all recommendations to be implemented. Where recommendations conflict with existing policy or city ordinances, policy changes should be made to accommodate them. In addition to the specific recommendations, policy should be revised where appropriate to address the following subjects. Updating policy will provide regulations for new or re-development. For existing locations where these issues need to be addressed, coordination between agencies and property owners will be required.

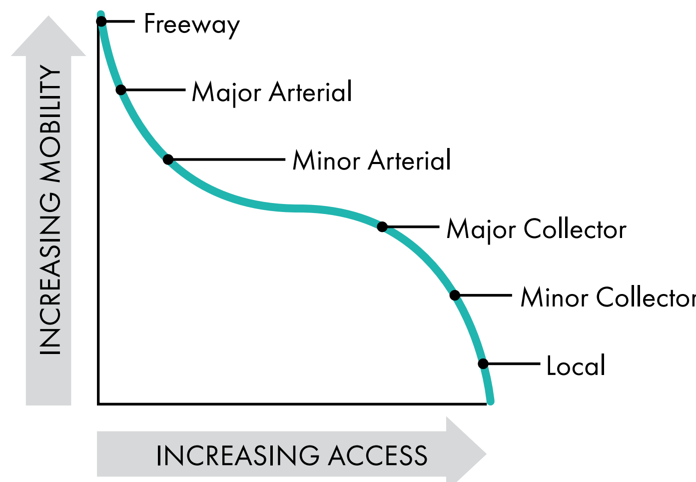
5.4.1 ACCESS MANAGEMENT

As development continues, agencies should evaluate their current policies for access management. This includes spacing between streets and driveways, turn lanes, and medians. Current conditions in the study area allow for safety issues as well as inefficiencies in traffic flow and travel time.

STREET AND DRIVEWAY SPACING

Roadways are assigned a hierarchy classification to better regulate uses and make travel safer and more efficient. Roadway hierarchy generally dictates that freeways should provide the least amount of access and local streets should have the most access, with all other facilities varying by type, as shown in ***Exhibit 5.4.1a***. By decreasing access, mobility efficiency and safety improve.

Exhibit 5.4.1a – Mobility-Access Relationship



The American Association of State Highway and Transportation Officials (AASHTO) provides some guidance on spacing of roadways. In their publication, the AASHTO Green Book, they distinguish between urban and rural areas. In general, for more developed areas, freeway spacing may vary between 1 to 5 miles apart from one another, arterials are typically no more than 1 mile apart, and collectors and local streets will vary greatly and should be consistent with the community context. Each lower classification of roadway provides access to the classification above it, creating a true network of roadways.

It is typical in the study area, as well as the greater Houston area, to find that many Minor and Major Arterials have excessive driveway openings. Changes in policy should include, either in the form of ordinance requirements or incentives:

- Maximum allowance of driveways specific to each functional classification, per property by type, or by frontage distance
- Provisions for shared driveway access/connectivity between neighboring properties or strip centers
- Alley access, either allowing alleys to be constructed for parking/ access, or requirement of properties abutting alleys to use them for access

An example of a policy that might address these points: "Along a Major Arterial, a maximum of one driveway is allowed for every 200 feet of frontage per commercial business. If the property abuts another property of similar use, the properties should consolidate to use one shared driveway between properties. Strip centers will be allowed one driveway for every 500 feet of frontage, or two per center, whichever is least restrictive. For properties abutting alleyways, the alleys must be used for frontage to the public street."

This is a general example and will be different for every municipality. Considerations should be made for who will be burdened with cost, how to retrofit existing access points, and at what point in the development process they should be addressed.

5.4.2 BICYCLE AND PEDESTRIAN FACILITIES

Policies should also be considered to provide bicycle and pedestrian facilities and to improve the user experience along these facilities. Policies could include:

- Design guidelines for facility types (sidewalks, bike lanes, shared use paths, etc.), to include minimum widths, barriers, striping, signing, lighting, etc.
- Requirements for safe crossings where facilities meet one another or the public right-of-way
- Requirements for connections to existing bicycle and pedestrian facilities with all new or redevelopments
- Provision of amenities along new or existing sidewalks or bicycle facilities; amenities could include bicycle parking, shade trees, benches, trash cans, dog waste bags, bicycle repair stations, etc.
- Provision of safety equipment along new or existing pedestrian or bicycle facilities, including adequate lighting and alert stations

5.4.3 TRANSIT

While the recommendation of this SE Harris Study is to perform a Transit Feasibility Study for the area, there are policy changes that should be implemented either preemptively or in combination with the future study. These policies will promote the use of transit and improve the user experience.

- Provide pedestrian and bicycle facilities at each stop and station, with connections to major retail and residential nodes
- At stops and stations, provide bike parking/ storage and shared mobility options (micro-transit, scootershare, bikeshare, and transportation network companies – TNCs)
- Make all stops and stations ADA-compliant with separation from the roadway
- Partner with area employers to encourage transit ridership
- Promote transit-oriented development

5.4.4 PERFORMANCE METRIC SCHEDULE

Municipalities should implement a schedule that requires for a regular measurement of performance metrics to monitor how the improvements are improving traffic flow and safety in the area. Over time, if the metrics show that the improvements are no longer sufficient for maintaining an acceptable level of service or safety standard, new improvements should be considered. This measurement schedule will vary by municipality, but should be at a maximum of 5 years, or whenever new measurement methods are introduced.

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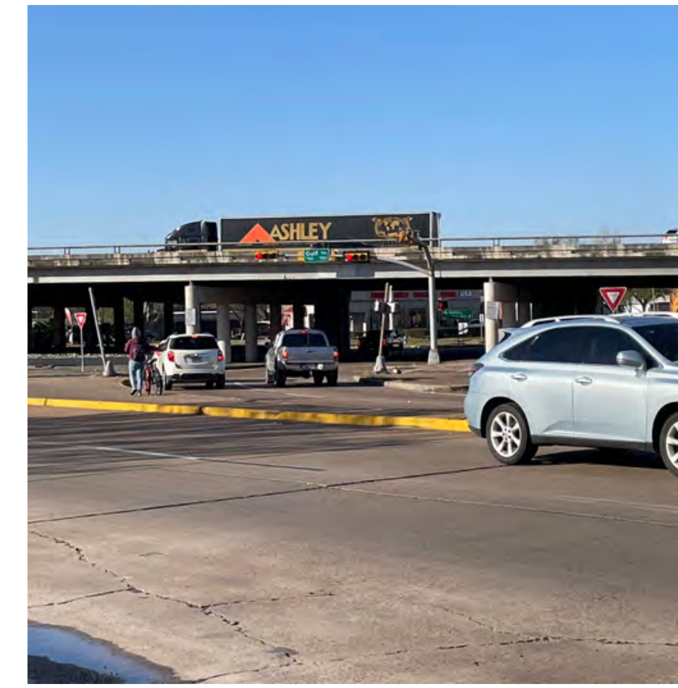
6

Intersection Conditions and Recommendations

- 6.1 Existing Conditions Summary
- 6.2 Proposed Conditions Summary
- 6.3 Recommendations Summary



Intersection Conditions and Recommendations

This chapter provides an overview of the existing conditions and recommended improvements at study intersections throughout the Southeast Harris County subregion. Details on the methodology for choosing study intersections, methodology for considering the effects of the COVID-19 pandemic, and capacity analysis methodology are described in ***Chapter 4 – Methodology.***

Short-term and long-term recommendations were developed to address concerns observed under existing conditions, specifically to improve safety and mobility as established in the goals of the study. Short-term recommendations were designated as such because they are generally lower-cost or more readily implemented. Long-term recommendations are those that may require right-of-way, require more planning or coordination, or are high-cost solutions. Individual jurisdictions should prioritize the projects as they can within their Capital Improvement Plan (CIP) each year.

6.1 SAFETY

A portion of the recommended improvements are intended to make the study intersections safer for all users – drivers, passengers, bicyclists, and pedestrians. While 50 intersections were prioritized for safety improvements, almost all the 104 study intersections had some safety improvements recommended. The number and rate of fatal and severe injury crashes influenced the types of safety improvements recommended at each intersection. Additionally, observations of intersection geometry led to the recommendation of more intersection-specific safety improvements. Further exploration of existing road safety and crash history is discussed in ***Section 3.3***.

Some examples of recommended safety improvements include:

- ***Refresh pavement markings***
- ***Install ADA-compliant curb ramps***
- ***Install or upgrade intersection lighting***

The full list of safety recommendations is included in ***Exhibit 6.3a***.

6.2 MOBILITY

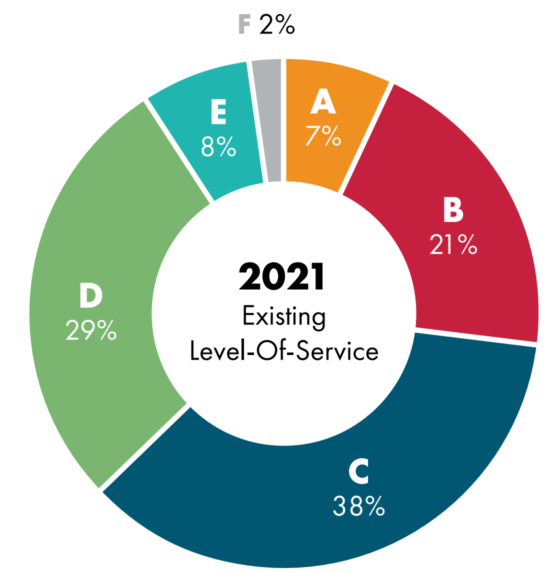
A portion of the recommended improvements are intended to improve intersection efficiency, thereby improving overall mobility throughout the subregion. Mobility improvements were only recommended for study intersections with poor Level-of-Service (LOS) in either the 2021 or 2045 analysis scenario.

6.2.1 SHORT-TERM (2021) ANALYSIS

Each study intersection was analyzed to better understand current operations before recommendations could be developed. Synchro™, a traffic analysis software, was used to create a model to analyze the operation of study intersections as they currently operate, in the "2021 Existing" scenario during the weekday hours of highest use, or the PM peak hour (5:00-7:00 PM). The complete analysis results can be found in ***Appendix E***.

In the 2021 Existing scenario, the study intersections have a LOS similar to other urban-suburban areas within the greater Houston region. Most intersections, 63%, have a LOS of A, B or C, so they need no capacity improvements but may need safety improvements. The remaining study intersections, about 37%, have a LOS of D, E or F, meaning they will need capacity improvements in addition to some potential safety improvements. This level-of-service distribution throughout the network is illustrated in ***Exhibit 6.2.1a***, and in map form in ***Exhibit 6.2.1c.***

Exhibit 6.2.1a
2021 Existing Level-Of-Service Distribution

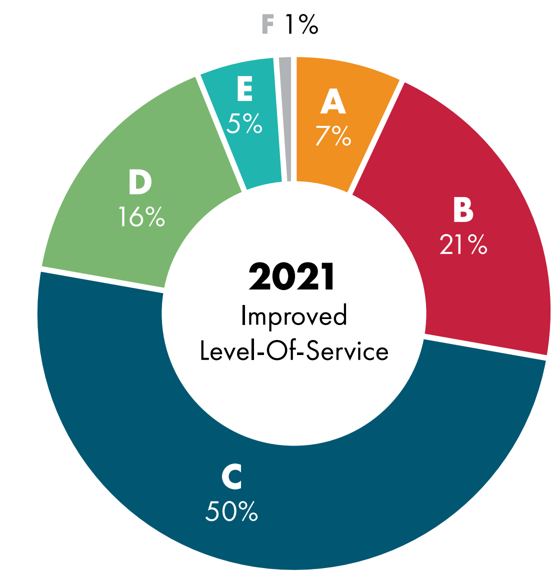


The results of the 2021 Existing analysis scenario helped determine potential improvements to the network that could be applied in the short-term. Short-term improvements are assumed to be constructed or implemented within five years of this study.

An additional Synchro™ model was created to analyze the operation of study intersections with the addition of short-term improvements to the existing roadway network, also known as the 2021 Improved scenario. Adjusted 2021 volumes were used. The complete analysis results can be found in ***Appendix E***.

Due to the implementation of short-term improvements, the Synchro analysis determined that there would be a 13% decrease in total network delay between the 2021 Existing and Improved scenarios. The portion of "failing" intersections also decreased from 37% to 21%. The level-of-service distribution for the 2021 Improved scenario is illustrated in ***Exhibit 6.2.1b***, and in map form in ***Exhibit 6.2.1d***.

Exhibit 6.2.1b
2021 Improved Level-Of-Service Distribution



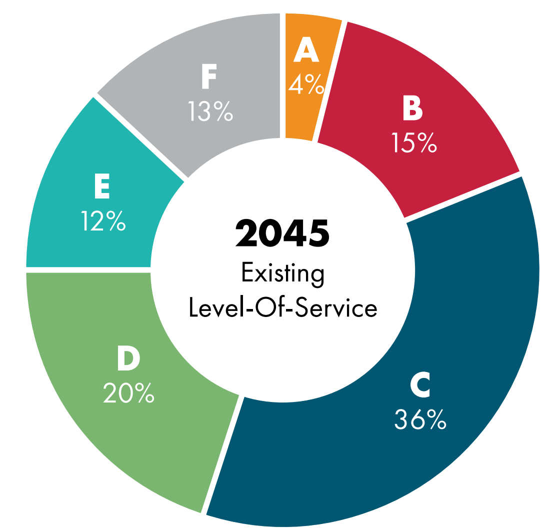
All the improvements recommended at study intersections are discussed in ***Section 6.3***.

6.2.2 LONG-TERM (2045) ANALYSIS

A model was created to analyze the operation of study intersections in the 2045 Existing analysis scenario, as described in Table D. The complete analysis results of the 2045 Existing scenario can be found in full in ***Appendix E***.

As in the 2021 Existing scenario, the study intersections in the 2045 Existing scenario have a LOS similar to other urban-suburban areas within the greater Houston region. Most intersections, 55%, have a LOS of A, B or C, so they need no capacity improvements but may need safety improvements. The remaining study intersections, about 45%, have a LOS of D, E or F, meaning they will need capacity improvements in addition to some potential safety improvements. An increase in "failing" intersections is expected in 2045 due to background growth. This level-of-service distribution is illustrated in ***Exhibit 6.2.2a***, and in map form in ***Exhibit 6.2.2c***.

Exhibit 6.2.2a
2045 Existing Level-Of-Service Distribution

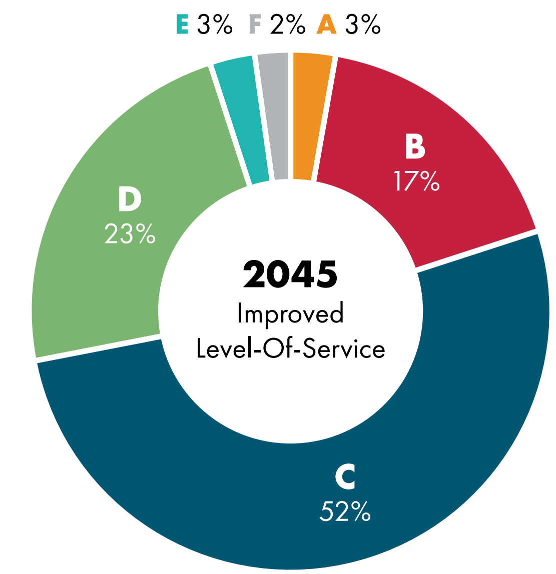


The results of the 2045 Existing analysis scenario helped determine potential improvements to the network that could be applied in the long-term. Long-term improvements are assumed to be constructed or implemented between five and twenty-five years after this study's completion, between years 2026 and 2046.

Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term and long-term improvements to the existing roadway network, also known as the 2045 Improved scenario. Projected 2045 volumes were used. The complete analysis results can be found in ***Appendix E***.

Due to the implementation of long-term improvements, the Synchro analysis determined that there would be a 31% decrease in total network delay between the 2045 Existing and Improved scenarios. The portion of "failing" intersections also decreased from 44% to 28%. A greater decrease in these metrics was expected because long-term improvements are more substantial, requiring reconstruction of an entire intersection, pavement, or traffic signal equipment. The level-of-service distribution for the 2045 Improved scenario is illustrated in ***Exhibit 6.2.2b***, and in map form in ***Exhibit 6.2.2d***.

Exhibit 6.2.2b
2045 Improved Level-Of-Service Distribution



All the improvements recommended at study intersections are discussed in ***Section 6.3***.

Exhibit 6.2.1c
2021 Existing
Level-Of-Service Map

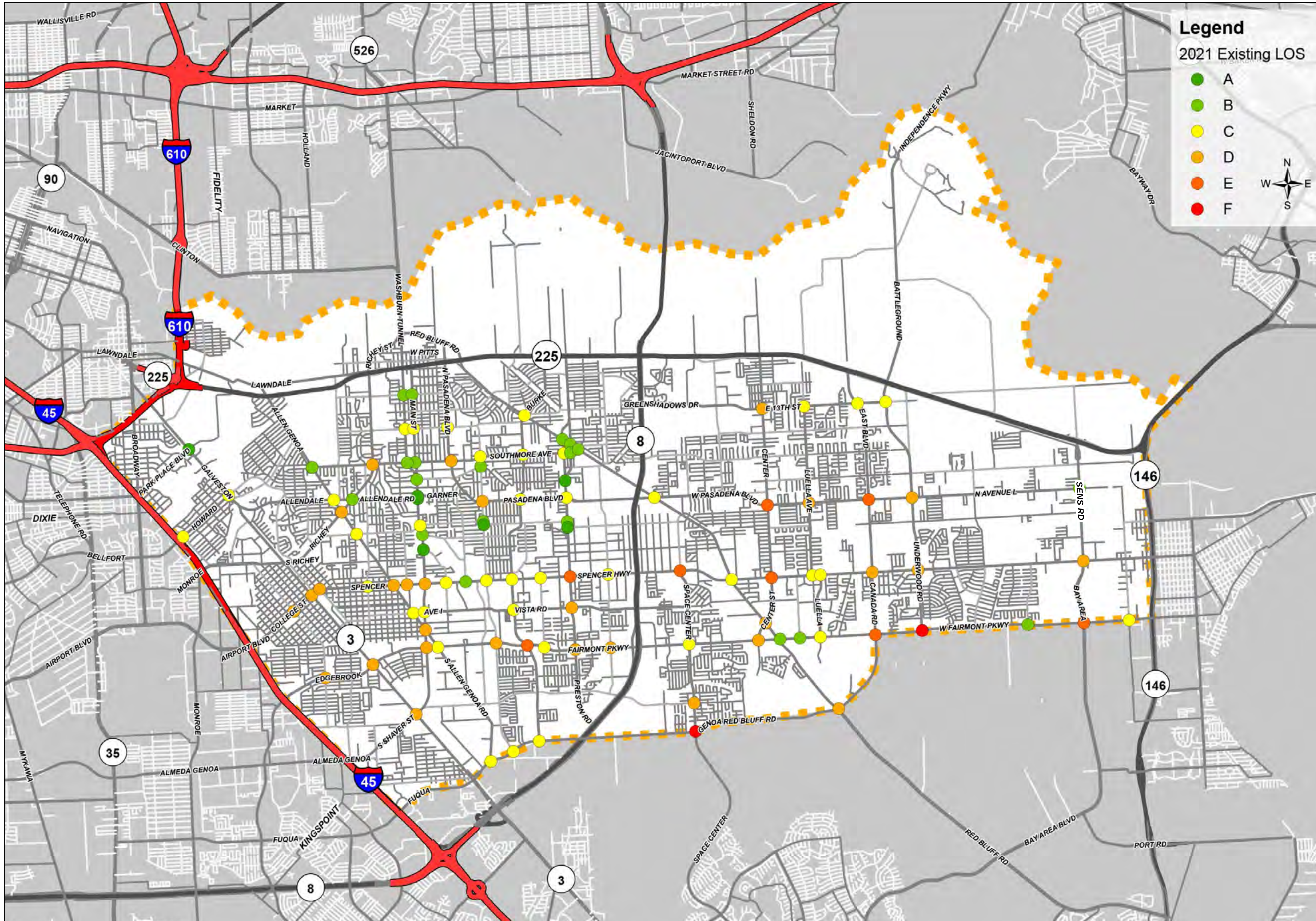


Exhibit 6.2.1d
2021 Improved Level-Of-Service Map

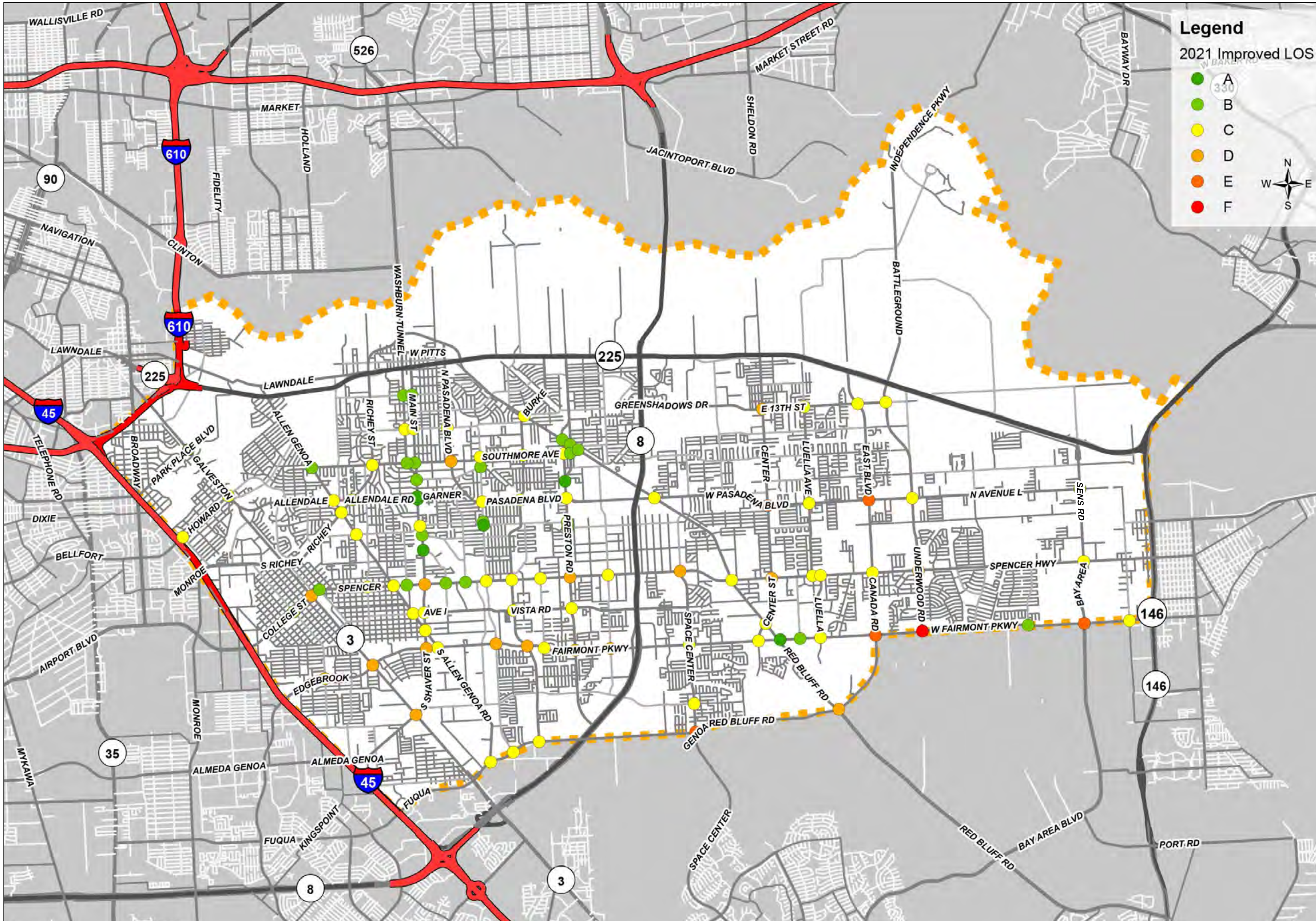


Exhibit 6.2.2c
2045 Existing
Level-Of-Service Map

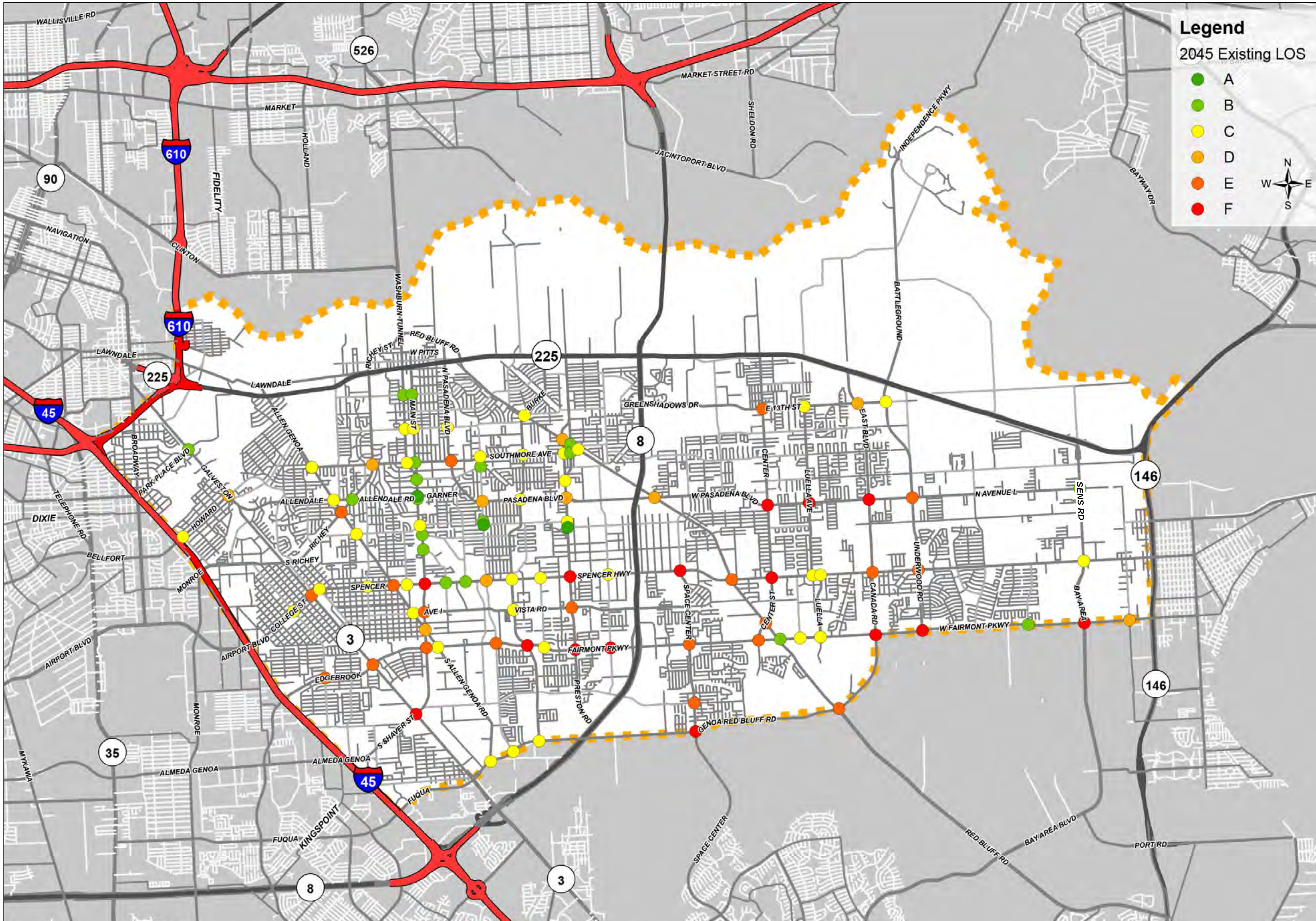
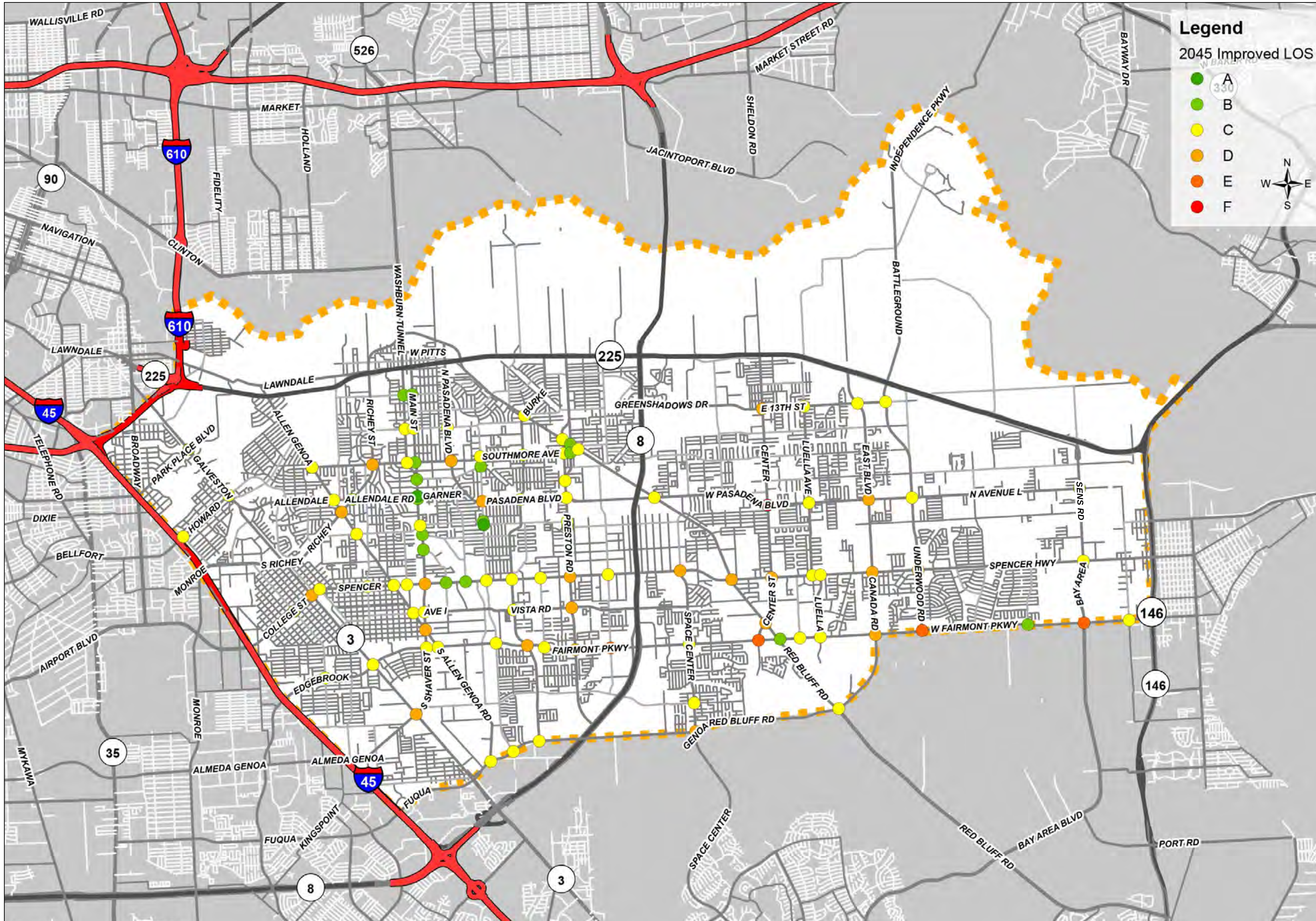
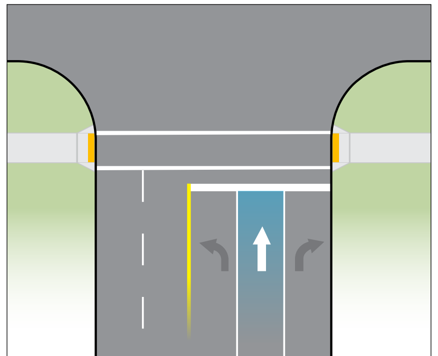
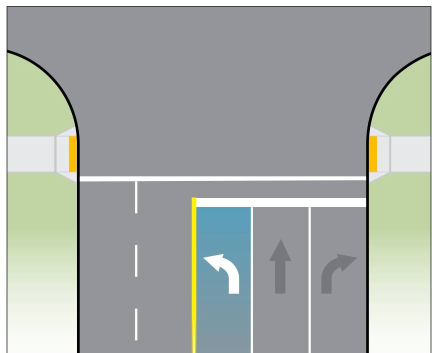
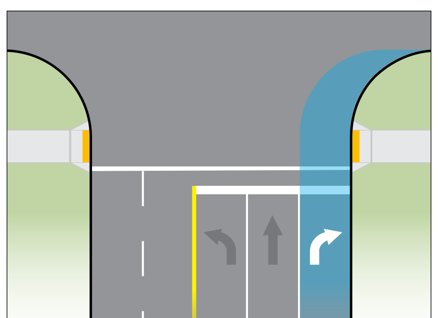


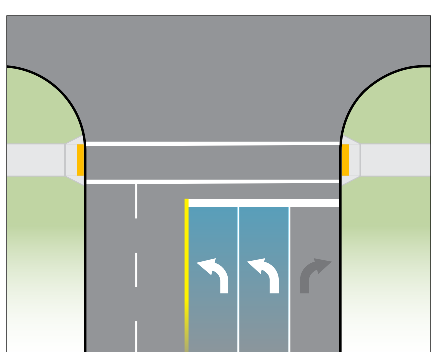
Exhibit 6.2.2d
2045 Improved Level-Of-Service Map




Install through lane


Install exclusive left-turn lane


Install exclusive right-turn lane


Install dual left-turn lanes

6.3 RECOMMENDATIONS SUMMARY

Recommended improvements across all study intersections have been summarized in a Toolbox for easy review. Information about each improvement type includes improvement name, construction cost, improvement objective (safety or mobility) and implementation timeline (short-term or long-term). See the Toolbox in ***Exhibit 6.3a*** below.

Exhibit 6.3a – Intersection Recommendations Toolbox

CAPACITY AND SAFETY IMPROVEMENTS

Recommendation	Intersection	Timeline
Driveway Closure	✓	Long-Term
Realign intersection	✓	Long-Term

CAPACITY IMPROVEMENTS

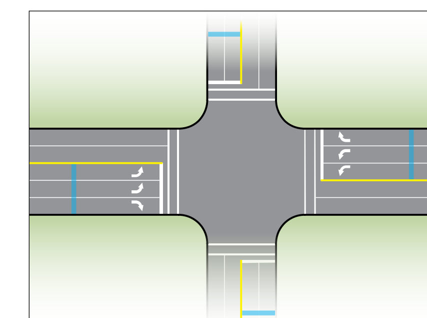
Recommendation	Intersection	Timeline
Signal Timing/Phasing Modification	✓	Both
Install through lane	✓	Long-Term
Install Flashing Yellow Arrow signal	✓	Both
Install through-right turn lane	✓	Long-Term
Install exclusive left-turn lane (dual left)	✓	Long-Term
Install exclusive left-turn lane	✓	Long-Term
Install exclusive right-turn lane	✓	Long-Term

SAFETY IMPROVEMENTS

Recommendation	Intersection	Timeline
Install/upgrade intersection lighting	✓	Short-Term
Install advance warning signage	✓	Short-Term
Install reflectorized signal back plates	✓	Short-Term
Upgrade pavement	✓	Both
Upgrade pavement markings	✓	Short-Term
Upgrade pavement markings	✓	Short-Term
Install transverse rumble strips	✓	Short-Term
Install/upgrade pedestrian elements	✓	Short-Term


Install/upgrade LED intersection lighting


Install reflectorized signal backplates


Install rumble strips approaching the intersection


Upgrade pedestrian system to include countdown signals and audible pushbuttons

All information which led to the development of recommended improvements for each study intersection, including location within the study area, crash data, and capacity analysis results is organized in "summary sheets" for each study intersection. This provides a more visual snapshot of the intersection as it is now and as it could be with the implementation of the recommendations. The structure of an example summary sheet is illustrated below in ***Exhibit 6.3b*** and all intersection summary sheets are included in ***Appendix E***.

SE Harris Sub-Regional Study, Intersection Summary Sheets

STREET 1 & STREET 2

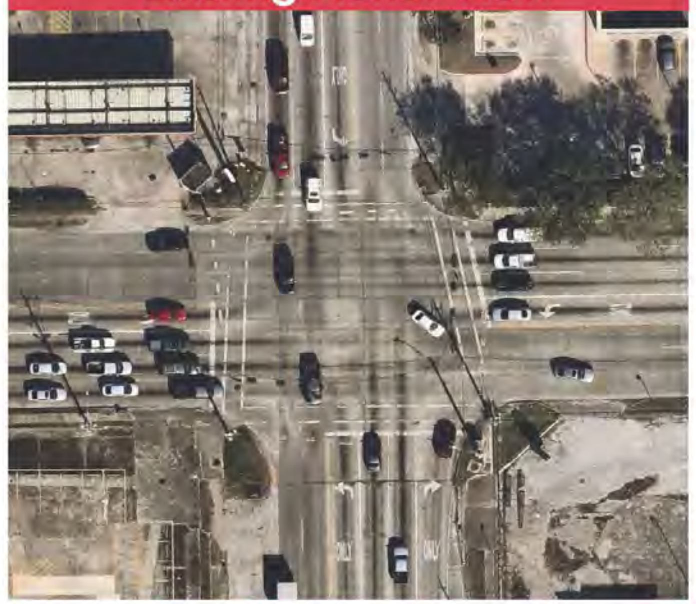
Intersection ID: X.X.X

Location of study intersection within study area

Identified as mobility-priority or safety-priority

Priority Intersection

Existing Aerial View

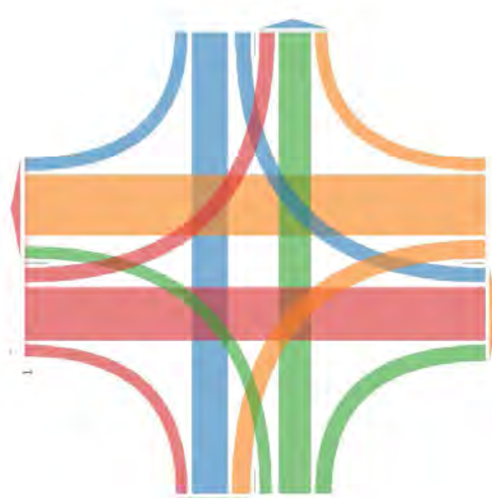


Recommended Improvements

Short-Term Recommendations	*Long-Term Recommendations*
SAFETY	
- Description	- Description
CAPACITY	
- Description	- Description

Location Key Map

2021 Turning Movement Counts



Traffic Model Results

Study Year	2021		2045	
Scenario	*Existing*	*With Recommendations*	*Existing*	*With Recommendations*
Level-Of-Service	X	X	X	X
Delay (s/veh)	XX.XX	XX.XX	XX.XX	XX.XX
% Change in Delay	-	-XX.X%	-	-XX.X%

Crash Data (2016-2020)

Total Crashes	XXX
Severe Crashes (Fatal, Severe Injury)	(X,X)
Crashes with Another Vehicle	XXX
Crashes with a Bicyclist	XX
Crashes with a Pedestrian	XX
Crashes with a Fixed Object	XX
Most Common Object Struck	DESCRIPTION
Most Common Manner of Collision	DESCRIPTION
Most Common Factor of Collision	DESCRIPTION

Exhibit 6.3b
Example Intersection Summary Sheet

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7

Corridor Conditions and Recommendations

- 7.1 Existing Traffic Conditions Summary
- 7.2 Proposed Traffic Conditions Summary
- 7.3 Traffic Recommendations Summary
- 7.4 Enhancements to Increase Economic Potential

Corridor Conditions and Recommendations

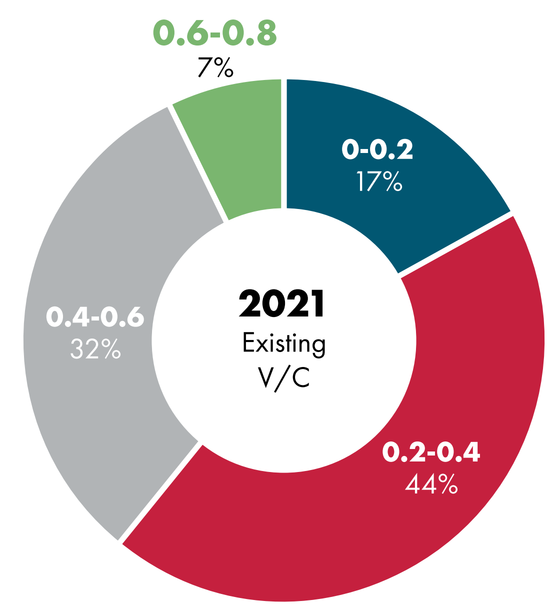
This chapter provides an overview of the existing conditions and recommended improvements at study corridors throughout the Southeast Harris County subregion. Details on the methodology for choosing study corridors, methodology for considering the effects of the COVID-19 pandemic, and capacity analysis methodology are described in ***Chapter 4 – Methodology.***

7.1 EXISTING TRAFFIC CONDITIONS SUMMARY

Each study corridor was analyzed to better understand current operations before recommendations could be developed. Existing road safety and crash history were previously discussed in section 3.3; only existing mobility conditions will be covered in this section.

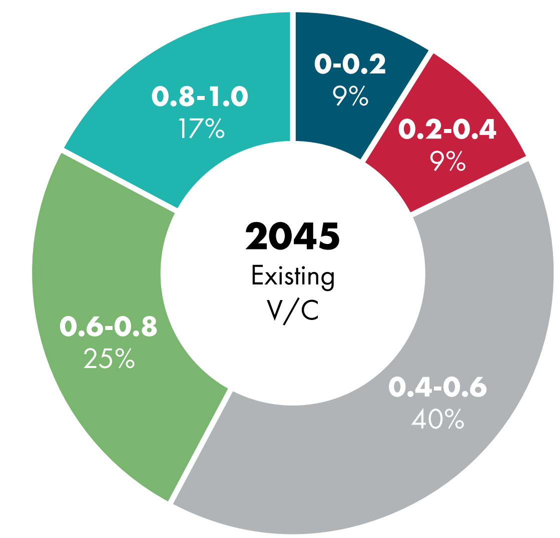
In the 2021 Existing scenario, the study corridors have volume-to-capacity ratios (V/C) typical for an urban-suburban area within the greater Houston region. Most corridors, 93%, have a V/C under 0.6, meaning that it is just over half "full", so it is unlikely that they will need capacity improvements like adding through lanes. The remaining study corridors, about 7%, have a V/C that is approaching capacity, so they will need some capacity improvements in the short-term. This V/C distribution is illustrated in ***Exhibit 7.1a below***.

Exhibit 7.1a – 2021 Existing Volume-to-Capacity Ratio Distribution



In the 2045 Existing scenario, the study corridors still have typical V/C, however the balance has shifted towards meeting and nearly exceeding capacity. Without the implementation of short-term improvements, it is expected that about 42% of study corridors will have a V/C that is approaching capacity, so they will need some capacity improvements in the long-term. This volume-to-capacity ratio distribution is illustrated in ***Exhibit 7.1b below***.

Exhibit 7.1b – 2045 Existing Volume-to-Capacity Ratio Distribution



Analyzing existing conditions along study corridors helped determine potential improvements that could be applied in both the short-term and long-term. Short-term improvements are assumed to be constructed or implemented within five years of this study. Long-term improvements are assumed to be constructed or implemented between five and twenty-five years after this study's completion. All the improvements recommended at study corridors are discussed in section 7.3.

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7.2 PROPOSED TRAFFIC CONDITIONS SUMMARY

7.2.1 RECOMMENDED SAFETY IMPROVEMENTS

A portion of the recommended improvements are intended to make the study corridors safer for all users – drivers, passengers, bicyclists, pedestrians, etc. While six corridors were prioritized for safety improvements, almost all the 26 study corridors had some safety improvements recommended. The number and rate of fatal and severe injury crashes influenced the types of safety improvements recommended along each segment.

Some examples of recommended safety improvements include:

- Manage driveway access
- Conduct a Road Diet
- Install or upgrade curve signage

These recommendations must make the corridors safe for pedestrians and bicyclists as well as vehicle drivers, therefore, complimentary active modes improvements were recommendations alongside the improvements only applied to the roadway.

Some examples of recommended active modes improvements include:

- Install shared use paths or sidewalks
- Install or upgrade ADA-compliant curb ramps
- Install mid-block pedestrian crossing

The full list of safety recommendations is included in ***Exhibit 7.3a***.

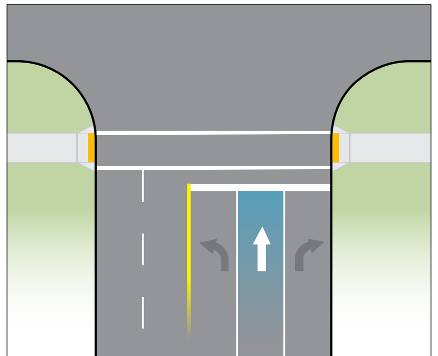
7.2.2 RECOMMENDED MOBILITY IMPROVEMENTS

A portion of the recommended improvements are intended to make travel along study corridors faster, thereby improving vehicle mobility throughout the subregion. Additionally, the active mode recommendations described in section 7.3.1 improve pedestrian and bicyclist mobility as well as safety by providing new connections to existing facilities in the area. The active mode recommendations create a more complete network for pedestrians and bicyclists to use for commuting or leisure. Refer to section 4.3 for an areawide view of the active modes network.

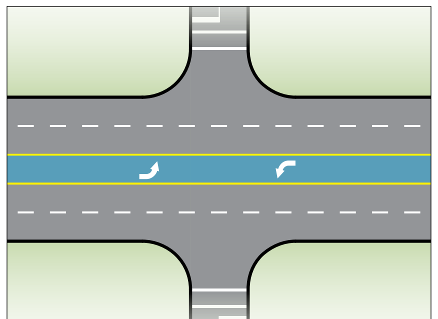
A full list of mobility improvements is included in ***Exhibit 7.3a***.

7.3 TRAFFIC RECOMMENDATIONS SUMMARY

Recommended improvements across all study corridors have been summarized in a Toolbox for easy review. Information about each improvement type includes improvement name, construction cost, improvement objective (safety or mobility) and implementation timeline (short-term or long-term). See the Toolbox in ***Exhibit 7.3a***.



Install through lane



Install continuous two-way left-turn lane

Exhibit 7.3a – Corridor Recommendations Toolbox

CAPACITY AND SAFETY IMPROVEMENTS

Recommendation	Corridor	Timeline
Driveway Closure	✓	Both

CAPACITY IMPROVEMENTS

Recommendation	Corridor	Timeline
Signal Timing/ Phasing Modification	✓	Both
Install through lane	✓	Long-Term
Install TWLTL	✓	Long-Term

SAFETY IMPROVEMENTS

Recommendation	Corridor	Timeline
Road Diet	✓	Long-Term
Install Shared Use Path	✓	Long-Term
Install bike lane	✓	Long-Term
Install/ upgrade segment lighting	✓	Short-Term
Install/ upgrade intersection lighting	✓	Short-Term
Install advance warning signage	✓	Short-Term
Install/ upgrade curve signage	✓	Short-Term
Parking Study	✓	Long-Term
Install raised median	✓	Long-Term
Upgrade pavement	✓	Both
Upgrade pavement markings	✓	Short-Term
Upgrade pavement markings	✓	Short-Term
Install centerline/ edgeline rumble strips	✓	Short-Term
Install/ upgrade pedestrian elements	✓	Short-Term
Install/ upgrade pedestrian curb ramps	✓	Short-Term
Install/ upgrade sidewalk	✓	Short-Term

Install/ upgrade LED lighting

Install raised median

Install/ upgrade LED intersection lighting

Upgrade pedestrian system to include countdown signals and audible pushbuttons

All information that led to the development of recommended improvements for each study corridor, including location within the study area, crash data, and capacity analysis results is organized in "summary sheets" for each segment. This provides a more visual snapshot of the segment as it is now and as it could be with the implementation of the recommendations. The structure of an example summary sheet is illustrated below in ***Exhibit 7.3b*** and the summary sheets are in ***Appendix F***.

SE Harris Sub-Regional Study, Corridor Summary Sheets

CORRIDOR NAME FROM START TO END

Corridor Segment ID: X.X

Location of study intersection within study area

Identified as mobility-priority or safety-priority

Priority Corridor

Cross Sections

Recommended Improvements

Median - Recommendation Description

Pavement - Recommendation Description

Lighting - Recommendation Description

Signs and Signals - Recommendation Description

Active Modes - Recommendation Description

Access - Recommendation Description

Other - Recommendation Description

Previously Proposed Projects

Project Name - Project Description

Segment Key Map

Crash Data (2016-2020)

Total Crashes	XX
Severe Crashes (Fatal, Severe Injury)	X, Y
Crashes with Another Vehicle	XX
Crashes with a Bicyclist	XX
Crashes with a Pedestrian	XX
Crashes with a Fixed Object	XX
Most Common Object Struck	DESCRIPTION
Most Common Manner of Collision	DESCRIPTION
Most Common Factor of Collision	DESCRIPTION

Capacity Data

2021 Average Daily Traffic (ADT)	XXXXX
2021 Volume-to-Capacity Ratio (V/C)	X.X
2045 Average Daily Traffic (ADT)	XXXXX
2045 Volume-to-Capacity Ratio (V/C)	X.XX

Segment Characteristics

Segment Length (mi)	X.X mi	Center Width (ft)	X ft
Posted Speed (mph)	XX mph	Sidewalk Location	Description
ROW Width (ft)	XX ft	Sidewalk Width (ft)	X
Roadway Width (ft)	XX ft	Sidewalk coverage (%)	XX.XX%
Number of Lanes	X	Buffer Width (ft)	XX ft
Center Type	Description		

Exhibit 7.3b Example Corridor Summary Sheet

7.4 ENHANCEMENTS TO INCREASE ECONOMIC POTENTIAL

7.4.1 INTRODUCTION

Southeast Harris County is the primary location of much of the Greater Houston area industrial base, as well as the various commercial areas, neighborhoods, parks, and other areas that blend to make up the communities of Deer Park, southeastern areas of Houston, LaPorte, and South Houston. Each of these communities has a unique vision for their future identity and economic potential. Some have established concepts for the future performance of activities along roadway segments that are a part of this study. That information is captured and interpreted in this section. In those instances where neither the communities nor the county have established expectations for specific street segments, the consultant team has made recommendations intended to improve conditions needed to spur private investors into action in a manner that is logical for the corridor.

7.4.2 THE CASE FOR ECONOMIC ENHANCEMENTS

Mobility considerations, by nature, address the larger scale economic interests of the Southeast Harris County region – more specifically the ability to move goods and people successfully throughout the area, including conditions that involve interaction between passenger vehicles and commercial trucks and equipment. Often less considered is the ability of improvements within the right-of-way to also directly impact the local economy occurring along a corridor or in a community. Whether new development on previously vacant property or activity to upgrade or evolve existing development, every new investment (or reinvestment) along a roadway has the potential to increase the economic performance of the corridor that may result in new business opportunities, capture of a new or expanded audience, new local jobs, increased customers or production volume, or another means of expansion. For local communities that investment can result in increased ad valorem tax, sales tax, or other revenue streams. Those investments allow for an area to become or remain competitive in comparison to other places and communities and, in turn, create wealth along the corridor and in the community.

"Economic enhancements" are adjustments within the right-of-way that spur desired investment and changes in character. In most cases, the intent of economic enhancements is not to foster immediate, large-scale changes along a corridor unless previously planned by a community or if spurred on by unique circumstances or obvious changes in development trends. Rather, the intent is to incorporate improvements designed to "nudge" or support private investment over time toward a more desired or economically productive, yet realistic development pattern.

7.4.3 METHOD OF ANALYSIS

Economic potential and the enhancements recommended to spur the private investment needed to meet that potential was determined using a combination of:

- **Professional Observation.** The team conducted visual observation of the various corridors coupled with review of aerial imagery that allowed for first-hand examination of development patterns, corridor activities and their association with the design and functionality of the right-of-way. It also provided an opportunity to view the evolution of the physical environment along each corridor and gain understanding of the likelihood of each segment to be impacted by local development trends.
- **Plans and Projects.** The team reviewed plans for areas along various corridors through corridor studies, regional plans, communitywide plans, and various other planning documents. Consideration was also given to plans and specific projects that could spur development or indicate a desire for specific types of activities along a corridor, including trails and parks plans or capital improvement projects.
- **Staff Discussion.** When possible, staff from various communities and Harris County were interviewed to add another level of understanding of anticipated performance of specific corridors or larger scale economic visions for the community that could be supported by corridor reinvestment.

7.4.4 CLASSIFICATION OF CORRIDOR CHARACTER

For purposes of this study, economic performance is associated with corridor character. "Character" represents a variety of variables including:

- **Location.** Proximity of specific corridor segments to growing development pressure, major amenities such as destination parks and green spaces, a highly performing intersection or roadway such as SH 225, or a major activity center such as the Port of Houston plays a direct role in the current and anticipated character of an area.
- **Land use.** Easily the most commonly considered variable when analyzing places, land use is comprised of common categories such as residential, commercial, industrial or parks. Use is valuable from understanding information such as the possibility of sales tax or hotel tax production, but on its own does not provide sufficient detail and is therefore often further broken down into categories such as single-family homes, apartments, retail, and office.
- **Development pattern.** Development patterns put land use into physical context. Patterns offer a better understanding of the how people will interact with and think of a specific use. As an example, a commercial retail strip focuses on convenience and daily service capture. In comparison, a major commercial center is larger with greater variety. Similarly, an industrial park provides a different aesthetic and the benefit of shared resources that may not be available to freestanding industrial sites.
- **Density.** The overall density of activity plays directly into the economic performance of a corridor in a variety of ways. Density typically results in higher values and an increase in overall activity that also translates into increased sales revenues for commercial activities. Areas with sufficient density can also become local or regional destinations, particularly when coupled with an easily accessible mix of uses and amenities.
- **Modal Focus.** Almost every character type in the Greater Houston area is dependent upon the automobile as the primary mode of travel. However, there is a direct correlation between the level of walkability of an area and character. Areas with higher walkability will typically offer more distinctive commercial areas and/or amenities worth that warrant a longer stay. Walkability also requires proximity between places that reduces the amount of time required to walk. Walkable areas will also typically place greater focus on aesthetics, including more interesting architecture, green space, street trees and other interesting amenities.

For purposes of this study, categories of character utilized for analysis of corridors includes:

- **Open Space.** This character type ranges from parks and recreation areas to vacant, undeveloped green spaces. Open spaces can add value to a corridor or can constitute an opportunity for new development.
- **Suburban/Auto-Dominant.** By definition, areas of corridors that meet this classification are overwhelmingly dependent upon and designed to cater to the automobile. Focus is on placement of parking lots, garages, and other methods of making automobile travel and use convenient and easy. "Enhanced" auto-dominant areas still place strong emphasis on automobile convenience, but they also incorporate increased emphasis on walkability and improving aesthetics from both the roadway and from pedestrian areas.
- **Near-Urban.** A recent adaptation in character is the rise of "near urban" activities. From small scale to large, near-urban areas have become an increasingly successful means of injecting urban qualities into Auto-dominant areas. Near-urban character places strong focus on walkability and "experience" rather than convenience. Near-urban spaces are typically mixed use and include specialty shops, restaurants and entertainment that are as interesting in the evening hours as during the day.
- **Urban.** Urban character places much more extensive focus on walkability and maximization of use of land. Development is most often multi-story and commonly features an array of uses. Transit service is a higher priority for travel, particularly in large scale urban areas. There are no urban areas along the corridors under examination in the study area.

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7.4.5 CORRIDOR ENHANCEMENTS CONSIDERED

Economic enhancements are intended to build upon mobility focused recommendations using the following features:

1. **Pedestrian paths** such as expanded sidewalks, shared paths and urban trails
2. **Navigation/wayfinding signage** associated with the area, community/place branding, an urban trail or other
3. **Landscaping** in the right-of-way such as the areas between the curb and sidewalk or property line and sidewalk, including green space, intentional landscaping and/or street trees
4. **Intersection improvements** consisting of hardscape features such as pavers, asphalt imprinting, bulbouts, bollards, or other
5. **Pedestrian crosswalks/enhancements** such as midpoint crosswalks, protective signals, lighting, landscaping, neckdowns, or other treatments as appropriate
6. **Traffic calming measures** intended to adjust driver behavior and awareness that could include psycho-perceptive devices such as street trees, reduced lane widths, and "rumble strips" but may also include vertical and/or horizontal deflection if warranted
7. **Access management** that expands upon mobility recommendations, most often associated with managing ingress/egress from adjacent activities
8. **Medians** ranging from raised concrete to well branded hardscaping and landscaping; however, medians can also include larger, open green spaces with more informal landscape treatments
9. **Other** includes special features such as light rail/bus stops, public art installations, gateway monumentation, branded lighting, or other amenities unique to the corridor

7.4.6 PRIORITY CORRIDOR SHEETS

Pages describing the corridors and listing their potential enhancements are provided in ***Appendix F***.

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8

Evaluation of Improvements

- 8.1 Vision and Goals
- 8.2 Improvement Costs
- 8.3 Improvement Benefits
- 8.4 Overall Evaluation

Evaluation of Improvements

The improvements recommended in this study were based on the Study Vision. In this chapter, performance measures derived from the Vision will be used to evaluate the effectiveness of the improvements. These improvements should be measured regularly in the future.

8.1 VISION AND GOALS

As stated in Chapter 1, the Vision for the Southeast Harris Subregional Planning Study is as follows:

VISION

"Recommend improvements to address multimodal transportation, development, and economic policy needs in the subregion that align with H-GAC's goals of mobility, safety, economic competitiveness, transportation asset condition, and natural and cultural resources."

The Vision was further refined into five goals that align with H-GAC's own goals, and each goal is supported by more specific objectives. Performance measures – measurable metrics such as travel time, connectivity, and volume-to-capacity ratio – provide a means to evaluate if and how the objectives are fulfilled. See the goals, objectives, and performance measures illustrated in ***Table H***.

Some performance measures apply to different scales in the study area; for instance, volume-to-capacity ratio applies to a corridor, whereas Level-of-Service applies to an intersection, to evaluate how the goal of Mobility was fulfilled. At the same time, other performance measures, such as predicted crash and emissions reductions, apply to multiple scales and must account for their differences. Crash reduction along a corridor is not directly comparable to crash reduction at an intersection, they must be reported separately. Also, areawide performance measures are not used to compare areas to each other but rather compare the one study area under existing conditions to itself under improved conditions. ***Table I*** lists the performance measures by goal and scale.

Table H
Project Goals, Objectives, and Performance Measures

GOAL	OBJECTIVES
Mobility	Expand and accommodate all roadway users by incorporating Complete Streets principles, as context-appropriate
	Increase operational efficiency and reliability of major intersections and roadways
Safety	Improve safety on the Vision Zero high-injury network with a goal of zero fatalities
Economic	Provide mobility options for residents and visitors
	Increase truck travel time reliability on the regional freight network
Maintenance	Achieve a state of good repair for transportation assets
	Improve transportation asset resiliency and stormwater capacity
Natural/Cultural Resources	Reduce transportation emissions
	Minimize impacts requiring mitigation

Table I
Performance Measures by Goal and Scale

GOAL	SCALE		
	AREAWIDE	CORRIDOR	INTERSECTION
Mobility	Travel Time Cost Savings	V/C	Delay Reduction
Safety	Predicted Crash Reduction	Predicted Crash Reducation	Predicted Crash Reduction
Economic	Cost; ROW Acquisition	Cost; Cross-Section; ROW Aquisition	Cost; ROW Acquisition
Maintenance	Pavement Condition	Pavement Condition	Pavement Condition
Preservation	Emission Reduction	Emission Reduction	Emission Reduction

8.2 IMPROVEMENT COSTS

Each recommendation has an associated unit cost. The unit used to quantify the recommendation may be Intersection (Int), Approach (App), Linear Feet (LF), Square Yards (SQYD), or Each (EA). These costs were estimated using current industry practice and the most recent TxDOT bid documents. Table J below summarizes the cost estimates and other assumptions used in this analysis.

Where the implementation of recommendations requires right-of-way acquisition, an additional cost is added on a case-by-case basis using the market value of properties from which ROW would be acquired. Where the implementation of recommendations has some unintentional adverse effects to the environment and to traffic flow, an additional Emissions Cost and Delay Cost is added on a case-by-case basis.

Table J
Cost Estimation

Improvements	Unit Cost	Unit	Notes and Assumptions
New Signal	$ 425,000	EA	
Signal Mod (Major)	$ 200,000	EA	Major modifications include changing all signal heads, replacing poles, rewiring conduit, etc.
Signal Mod (Minor)	$ 75,000	EA	Minor modifications include changing signal heads on one approach, changing left-turn phasing, etc.
Signal Mod (Hardware: lenses, back-plates with retroreflective borders, etc.)	$ 25,000	Int	Cost in terms of intersection, not individual backplate/lens
Reflectorized Signal Backplates	$ 3,000	Int	To replace all in an intersection
Flashing Yellow Arrow (2 approaches)	$ 4,000	App	$8,000 for 2 approaches
Flashing Yellow Arrow (4 approaches)	$ 3,000	App	$12,000 for 4 approaches
Signal Timing	$ 6,500	Int	
Vehicle Detection	$ 70,000	Int	Assume loop detection
Pedestrian countdown heads	$ 3,500	EA	Price per head, includes wiring
New PHB	$ 275,000	EA	
New RRFB	$ 40,000	EA	
Pedestrian Crossing Signs & Markings	$ 15,000	EA	Assume a standard midblock cross walk with signs (no RRFB)
Pedestrian Ramp	$ 5,000	EA	
Sidewalk	$ 35	LF	Assume 6' width
Shared Use Path	$ 65	LF	Assume 10' width
New Pavement Markings (whole intersection)	$ 5,000	App	Assume more than 2 approaches, up to 100-150' at every approach
Refresh Pavement Markings	$ 15	LF	Cost is based on LF of separate markings such as 4"W or 6"Y, etc.
Bike Lane	$ 15	LF	Striping only
Rumble Strips (Edge or Centerline)	$ 15	LF	Minimum threshold of $5000
Rumble Strips (Transverse)	$ 500	Lane	
Surface Treatment	$ 120	SQYD	
Left-turn Lane	$ 175,000	EA	(assume 300-foot turn lane)
Right-Turn Lane	$ 200,000	EA	(assume 300-foot turn lane)
TWLTL (on existing pavement)	$ 60	LF	
TWLTL (on new pavement)	$ 600	LF	Assume 14' existing medians
Road Diet (Reduce travel lanes + TWLTL)	$ 100	LF	Assume existing cross-section is 4-lane undivided and proposed section is 3-lane with bike lanes, no buffer
Raised Median	$ 500	LF	Cost is based off total LF of corridor and not the LF of actual median (median openings etc. would reduce cost); assume 14' median
Hooded Left-Turn in Median	$ 50,000	EA	
Positive Left-Turn Offset	$ 100,000	EA	
Driveway Closure	$ 20,000	EA	
Segment Lighting	$ 60	LF	Assume $9k/pole with 1 pole every 150 ft; lighting needed on both sides of the roadway if there is a median (double length)
Intersection Lighting	$ 30,000	Int	Based on 4 poles per intersection, cost is slightly less than segment
Remove/Trim Vegetation/Prep ROW	$ 5,000	EA	TxDOT avg price $1500 per STA, assumes 3.5 STA per site.
Updated Transit Stop (ADA Compliance)	$ 2,500	EA	
Small Signs	$ 1,000	EA	

8.3 IMPROVEMENT BENEFITS

To estimate benefits, reductions in crashes, travel time, and emissions were considered.

8.3.1 SAFETY BENEFITS

Each recommended improvement has an associated "Crash Modification Factor" or CMF, which helps us quantify the expected reduction in crashes associated with implementation. The CMF may be any value between 0 and 1.0; the smaller the value, the more effective the improvement is at reducing crashes. For example, if the CMF is 0.12, the improvement is expected to reduce crashes by 88% over its service life.

Some improvements may only apply to specific types of crashes, such as crashes that occur at night or crashes that involve a pedestrian or bicyclist. For example, installing a shared use path will not necessarily affect all crashes, but it will likely affect crashes involving pedestrians and bicyclists. Because bike-ped crashes make up a subset of the total crashes at a study location, we will only apply the CMF for a shared use path to that subset. For example, if there are 100 total crashes at a study location, 40 of them involve a pedestrian or bicyclist, and the CMF for a shared use path is 0.12, then we would expect 35 crashes involving a pedestrian or bicyclist to be "prevented" over the service life of the shared use path.

If there are multiple recommendations at a study location that apply to a specific crash type, then their collective crash reduction power must be obtained to avoid overestimating "prevented" crashes. Consider that a shared use path (CMF 0.12), curb ramps (CMF 0.12), and a mid-block crossing (CMF 0.65) are all recommended along the same corridor segment. These recommendations all apply to bike-ped crashes, so the combined CMF is simply the product of the three individual CMFs, which would be 0.00936. If there are 100 total crashes and 40 bike-ped crashes, the implementation of those three recommendations would "prevent" 39 crashes over their service life. If had not been combined, the three CMFs, it would have appeared that 84 crashes had been prevented, which is not possible because there were only 40 bike-ped crashes to begin with.

This method – the individual CMFs, combined CMF method, and application of CMFs to particular crash types – comes from the Caltrans Local Roadway Safety Manual, which guides California practitioners on proactive safety analysis to ensure they have the best opportunity to secure HSIP safety funding during Caltrans calls-for-projects. Guidance was taken from Caltrans, as opposed to TxDOT, as data was more readily available for each of the recommended improvements. This guidance is compatible with HSIP funding and is regarded as a national standard.

Crash data was collected from TxDOT's Crash Records Information System (CRIS) over the five years before the beginning of this study, between January 2015 and January 2020. It is assumed that these crash rates will remain constant over the next twenty years, so the total number of crashes over the next twenty years is four times the number of crashes that have occurred over the past five years. For example, if there were 100 crashes at a location between 2015 and 2020, it is assumed there will be 400 crashes there between 2020 and 2040. By the same logic, if there were 2 fatal bike-ped crashes at a location in the past, there will be 8 fatal bike-ped crashes there in the future. Additionally, the service life of each recommended improvement is assumed to be twenty years.

Once the number of "prevented" crashes has been determined, the benefits of the recommended improvements must be translated to a dollar amount to compare directly against costs. The monetized value of a crash, according to USDOT, corresponds to its severity, as shown in the ***Table K***.

Table K
Value of Reduced Fatalities and Injuries

CRASH SEVERITY	MONETIZED VALUE
K – Fatal	$11,600,000
A – Incapacitating Injury	$554,800
B – Non-Incapacitating Injury	$151,100

The cost of recommended improvements are construction costs in present day dollars, whereas the prevented crash cost savings – the benefits – are accrued over 20 years (the assumed service life of all improvements). To analyze costs and benefits in truly comparable terms, the benefits must be discounted into present-day dollars at a rate of 7% (per USDOT) for twenty years. If an improvement will prevent 1 fatal crash every year for the next twenty years, the cost savings in present day dollars would not be $232,000,000 ($11,600,000 twenty times), it would be $122,890,565, per Equation 1 below. Not discounting the annual cost savings would not account for the time value of money and would greatly overestimate the benefits in this analysis.

Equation 1
Discounted Cash Flows

Total time, **N** = 20 years
Interval time periods, **n** = 1-20 years
Discount rate, **r** = 7% or 0.07

$$\text{Discounted Crash Cost Savings} = \sum_{n=1}^{N} \frac{\text{Crash Cost Savings}_n}{(1+r)^n}$$

Crash reduction savings were computed for all scales of study: areawide, corridor, and intersection. Areawide crash reduction savings is valued at about $1.31 billion.

Both monetary crash reduction savings and percentage of total reduced crashes were considered to determine a qualitative score for each study location. ***Tables L*** and ***M*** outlines the breakdown of the Safety Score based on these factors for intersections and corridors, respectively.

Table L
Intersection Safety Score Criteria

CRASH REDUCTION	CRASH SAVINGS	SAFETY SCORE
68% - 100%	75% - 100%	A
35% - 68%	50% - 75%	B
3% - 35%	0% - 50%	C
< 3%	< 0%	F

Table M
Corridor Safety Score Criteria

CRASH REDUCTION	CRASH SAVINGS	SAFETY SCORE
76% - 100%	67% - 100%	A
38% - 76%	33% - 67%	B
0% - 38%	0% - 33%	C
< 0%	< 0%	F

Exhibits 8.3.1a and ***8.3.1b*** illustrate the distribution of overall safety scores for study intersections and corridors, respectively.

Exhibit 8.3.1a
Intersection Safety Score Distribution

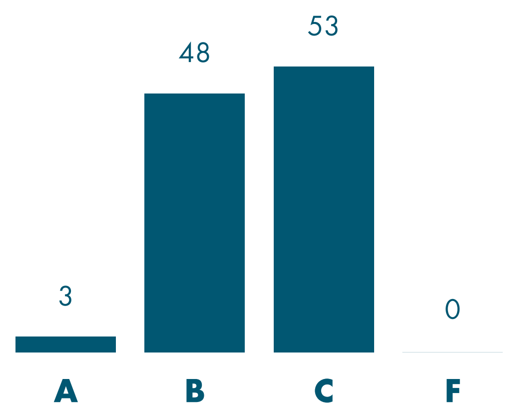
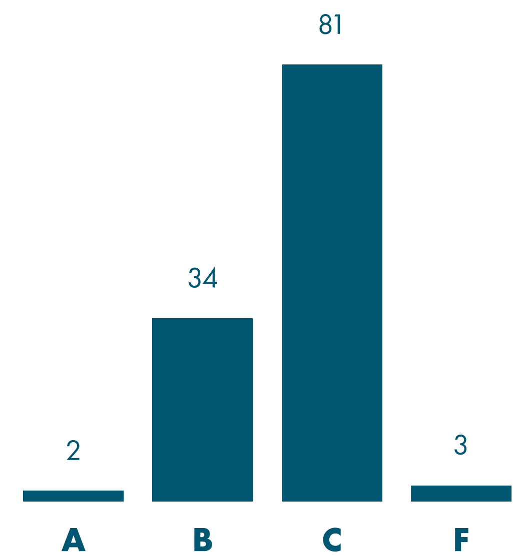


Exhibit 8.3.1b
Corridor Safety Score Distribution



8.3.2 MOBILITY BENEFITS

Mobility benefits were evaluated on all three different scales – areawide, corridor, and intersection – using the following performance measures:

1. Network Travel Time Savings
2. Corridor Volume-to-Capacity Ratios
3. Vehicle Delay at Intersections

NETWORK TRAVEL TIME SAVINGS

Travel time across the entire network is computed by Synchro™ in hours experienced by all vehicles entering the study area during a peak hour. To compare travel time savings to other benefits and costs in the study, travel time savings must be quantified as a dollar amount.

Based on USDOT Benefit-Cost Analysis Guidance, passenger car drivers value their travel time at about $17.80 per person-hour, whereas commercial vehicle operators value their travel time at about $32.00 per person-hour. An assumption was made that 2% of vehicles entering the study area are commercial vehicles and 98% are passenger cars.

Because Synchro reports delay for a single peak-hour period, a k-factor was applied to estimate travel time for an entire weekday. 10% of total trips were assumed to occur during a single peak hour, therefore, a k-factor of 10 was selected.

Equation 2 below explains how travel time is quantified as a dollar amount.

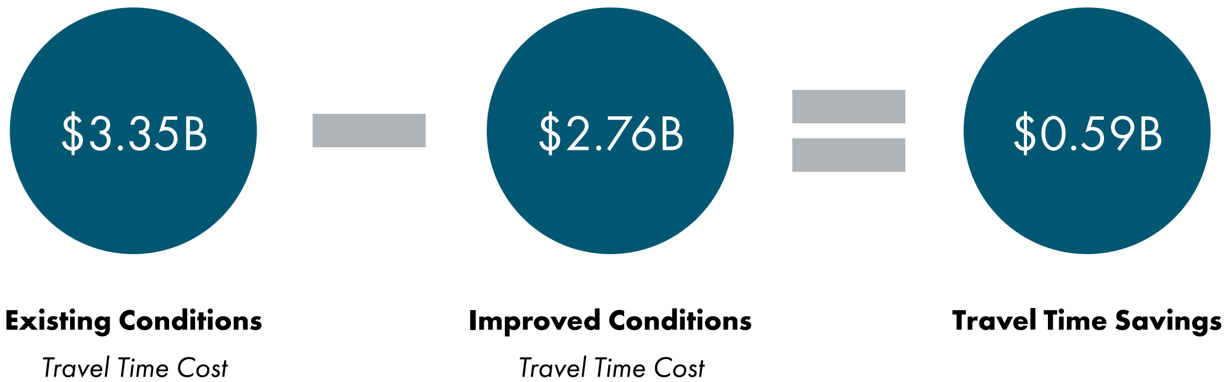
Equation 2 – Cost of Travel Time

$$\text{Travel Time Cost}\left(\frac{\$}{\text{year}}\ \text{per hour of delay}\right) = D * k * T * \left((P_{PC} * O_{PC} * V_{PC}) + (P_{CV} * O_{CV} * V_{CV})\right)$$

Peak Hour Delay, **D** (hours)
Passenger Car Portion in Study Area, $\mathbf{P_{PC}}$ = X%
Average Passenger Car Occupancy, $\mathbf{O_{PC}}$ = 1.48
Value of Travel Time for Passenger Car Occupant, $\mathbf{V_{PC}}$ = $17.80
Commercial Vehicle Portion in Study Area, $\mathbf{P_{CV}}$ = Y%
Average Commercial Vehicle Occupancy, $\mathbf{O_{CV}}$ = 1.0
Value of Travel Time for Commercial Vehicle Occupant, $\mathbf{V_{PC}}$ = $32.00
K-Factor, **k** = 10
Time, **T** = 260 weekdays per year

Network delay for individual analysis scenarios – years 2021 and 2045 – was used to interpolate delay for inervening years. Travel time cost per year, per hour of delay, is then multiplied by the delay for each year. The procedure described in the Safety Benefits section is used to discount all twenty years of travel time costs.

Finally, the total present-day value of travel time savings for the existing scenario is compared to that for the improved scenario. The difference between the two values is the mobility benefit incurred by the recommended improvements.



CORRIDOR VOLUME-TO-CAPACITY RATIO

As described in ***Chapter 4 – Methodology***, volume-to-capacity ratios (V/C) were estimated for study corridors using roadway classification and cross-section. With the addition of recommended through-lanes, V/C along study corridors are expected to reduce. A greater reduction of V/C proves that the recommendations are more effective, earning them a better evaluation.

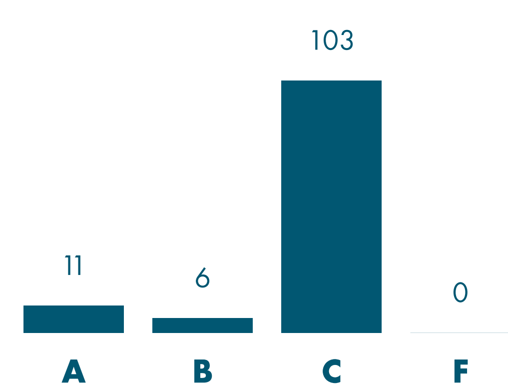
The percent reduction between the V/C under existing conditions and that under recommended conditions was given a score as enumerated in ***Table N*** below.

Table N – Corridor Mobility Score Criteria

V/C REDUCTION	MOBILITY SCORE
> 32%	A
20% - 32%	B
0% - 19%	C
< 0%	F

The distribution of Corridor Mobility Scores across the network is illustrated in ***Exhibit 8.3.2a***.

Exhibit 8.3.2a
Corridor Mobility Score Distribution



INTERSECTION VEHICLE DELAY

As described in ***Chapter 4 – Methodology***, average delay experienced by vehicles was used to evaluate the performance of each study intersection. Recommendations such as additional lanes and changes to signal timing and phasing caused delays at study intersections to reduce. A greater reduction of delay proves that the recommendations are more effective, earning them a better evaluation.

Additionally, the travel time savings at intersections were also taken into consideration. The calculations from the previous section on Network Travel Time were applied to each intersection to determine the value of time saved due to the recommended improvements.

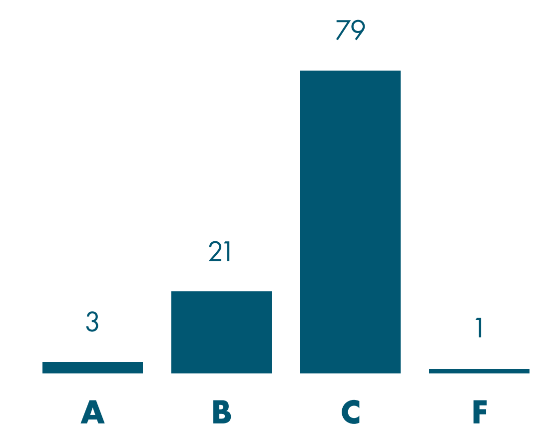
The percent reduction in delay combined with the dollar value of time saved was given a score as enumerated in ***Table O*** below.

Table O
Intersection Mobility Score Criteria

DELAY REDUCTION	TRAVEL TIME SAVINGS	MOBILITY SCORE
> 49%	> $45M	A
24% - 49%	$22M - $45M	B
0% - 49%	$0 - $45M	C
< 0%	< $0	F

The distribution of Intersection Mobility Scores across the network is illustrated in Exhibit ***8.3.2a***.

Exhibit 8.3.2a
Intersection Mobility Score Distribution



8.3.3 ENVIRONMENTAL BENEFITS

As vehicles travel throughout the study area, they emit compounds that are detrimental to the environment. The amount of compounds emitted by each vehicle is related to the amount of time the vehicle is driving in the study area. If the vehicle travels slowly from its origin to its destination, with many stops and delays, it will emit more compounds than a vehicle that travels moderately fast. Therefore, in theory, reducing delay across the study area should reduce the amount of harmful compounds emitted by vehicles.

Synchro™ uses the delay per vehicle to calculate Nitrous Oxide (NOx) emissions. Synchro also reports gallons of fuel consumed, which can be used along with EPA guidance to calculate Carbon Dioxide (CO2) emissions.

By comparing the emissions in the existing network to those in the improved network, we can estimate the environmental benefits of the recommended improvements. Environmental benefits, like safety and mobility benefits, are quantified as a dollar amount, which is computed by multiplying the quantity of reduced emissions of each pollutant by the dollar value of avoiding each ton of emissions of that pollutant in that year. Similar to the discounting procedure used for the crash prevention and delay reduction benefits, annual emissions reduction benefits must be discounted into present day dollars at a rate of 7%. FHWA estimates the yearly damage costs of emissions in its Benefit Cost Analysis guidance as illustrated in ***Table P*** below.

Table P
Damage Costs for Emissions per Metric Ton

EMISSION TYPE	NOX	CO2
2021	$15,600	$52
2022	$15,800	$53
2023	$16,000	$54
2024	$16,200	$55
2025	$16,500	$56
2026	$16,800	$57
2027	$17,100	$58
2028	$17,400	$60
2029	$17,700	$61
2030	$18,100	$62
2031	$18,100	$63
2032	$18,100	$64
2033	$18,100	$65
2034	$18,100	$66
2035	$18,100	$67
2036	$18,100	$69
2037	$18,100	$70
2038	$18,100	$71
2039	$18,100	$72
2040	$18,100	$73
2041	$18,100	$74
2042	$18,100	$75
2043	$18,100	$77
2044	$18,100	$78
2045	$18,100	$79
2046	$18,100	$80
2047	$18,100	$81
2048	$18,100	$82
2049	$18,100	$83
2050	$18,100	$85

The total savings due to emissions reductions were calculated for both intersections and corridors in a similar way to travel time savings. The dollar value of emission reductions was given a score as enumerated in ***Table Q***.

Table Q
Intersection Emissions Score Criteria

INTERSECTION EMISSIONS SAVINGS	CORRIDOR EMISSIONS SAVINGS	SCORE
> $255M	> $865k	A
$127M - $255M	$433k - $865k	B
$0 - $127M	$0 - $433k	C
< $0	< $0	F

Exhibits 8.3.3a and ***8.3.3b*** illustrate the distribution of emissions scores for study intersections and corridors, respectively.

Exhibit 8.3.3a
Intersection Emissions Score Distribution

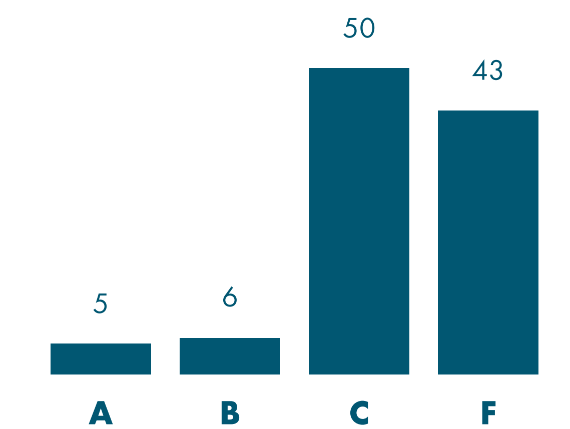
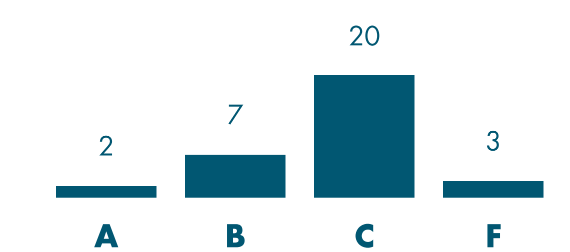


Exhibit 8.3.3b
Corridor Emissions Score Distribution



8.3.4 ECONOMIC BENEFITS

Economic gain is expected for the subregion due to the construction of recommended corridor cross-sections. Improved pedestrian and bicyclist facilities promotes tourism, attracts new businesses, and increases property values. Road Diets will slow traffic down, allowing businesses lining the roadways to catch the eyes of vehicle passengers.

At specific study locations, economic gain is quantified using an overall benefit-to-cost ratio (BC), which is the sum of all benefits divided by the sum of all costs. When BC is less than 1.0, the costs of implementing recommended improvements outweigh the benefits. When BC is greater than 100.0, the benefits far outweigh the costs. In both cases, it is recommended that improvements at those locations are investigated further.

Exhibits 8.3.4a and ***8.3.4b*** illustrate the distribution of overall economic scores for study intersections and corridors, respectively.

Exhibit 8.3.4a
Intersection Economic Score Distribution

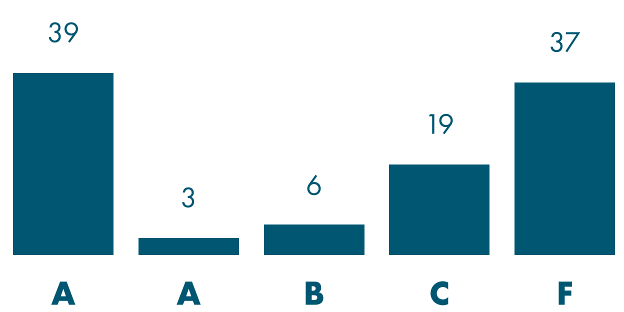
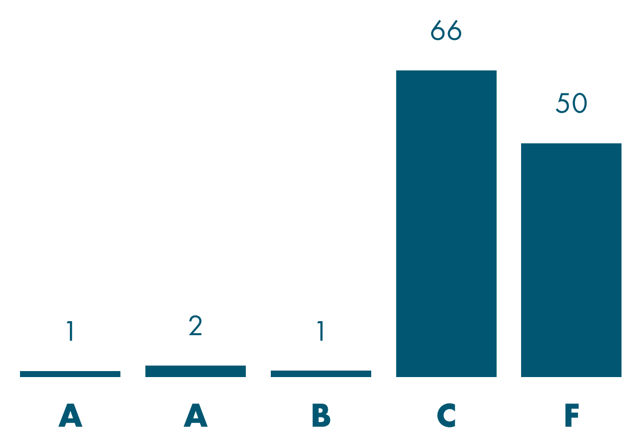


Exhibit 8.3.4b
Corridor Economic Score Distribution



8.4 OVERALL EVALUATION

Each corridor and intersection were evaluated using the performance measures described in ***Section 8.1*** and were given a score on how the recommendations there fulfilled each goal. The individual goal scores contributed to an overall score of the study location, which led to the implementation plan in ***Chapter 9 – Implementation***.

See ***Tables S*** and ***T*** for scores and benefit-cost ratios for all corridors and intersections, respectively. Scores for each project goal are illustrated in ***Tables S*** and ***T*** as Harvey balls instead of the scores described in this chapter to provide a more qualitative evaluation. ***Table R*** outlines how letter scores are translated into Harvey Balls.

An expanded version of ***Tables S*** and ***T*** can be found in ***Appendix G***.

Table R - Score-to-Harvey Ball Translation

SCORE	HARVEY BALL
A	●
B	◕
C	◑
F	◔
"-" or "*"	○

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9

Implementation

- 9.1 Timeline
- 9.2 Process
- 9.3 Potential Funding
- 9.4 Implementation by Jurisdiction

Implementation

This chapter describes the process by which improvements recommended in this study may be implemented in the future, including potential timelines and funding sources. Specific details on recommended improvements are provided for each jurisdiction in the study area.

9.1 TIMELINE

As explained in ***Chapter 6 – Intersection Conditions and Recommendations***, short-term and long-term recommendations were developed to address concerns observed at study intersections under existing conditions. Short-term recommendations were designated as such because they are generally lower-cost or more readily implemented. Long-term recommendations are those that may require right-of-way acquisition, require more planning or coordination, are major geometry changes, or are higher-cost solutions.

Recommended improvements along study corridors are not designated as short-term or long-term. Each individual jurisdiction should program these and all potential projects per their own priorities and should add them into their Capital Improvement Plan appropriately.

9.2 PROCESS

Once a rough timeline has been identified for implementing recommendations in each jurisdiction, City officials should update ordinances and policies where recommendations conflict with existing policies. Next, thoroughfare plans should be prepared or revised to take full advantage of funding opportunities.

Then, City officials should coordinate with existing and ongoing transportation planning efforts within the County, such as the following:

- 2040 Harris County Transportation Plan
- Harris County Multimodal Thoroughfare Plan
- Harris County Equity in Transportation Plan

Finally, City officials should apply for funding. See section 9.3 for potential funding sources that jurisdictions within SE Harris County may take advantage of.

9.3 POTENTIAL FUNDING

The cost of constructing and maintaining mobility improvements can be significant, particularly for communities that are also responsible for a myriad of other roadways and services. Following are different methods for financing construction and maintenance of improvements under local control.

9.3.1 LOCAL FUNDING SOURCES

No revenue stream is more local and locally controlled than those directly available to the community or county as a result of local taxes and fees. Three methods most commonly used for funding local mobility improvements include:

- General fund includes revenues available through the annual collection of taxes and fees, including ad valorem taxes,
- Bonds or Certificates of Obligation allow communities to issue debt for purposes of public works, including recommendations made by this study. Bonds typically require voter approval whereas Certificates of Obligation may be issued without a vote of the general public.
- Cities may issue a special sales tax for purposes of economic development, including right-of-way improvements. The tax is typically monitored by an Economic Development Corporation and traditionally does not exceed ½ cent. The types of eligible projects can differ by community based upon ballot language.

Traditionally, local funds are only used on roads and rights-of-way where the local government is charged with maintenance, unless the city's interests are furthered by providing a matching portion of funding. For that reason, it would be more likely that the responsibility for acquiring the majority of funding for improvements along a roadway maintained by Harris County would be borne by Harris County.

Other examples of local funding sources are as follows:

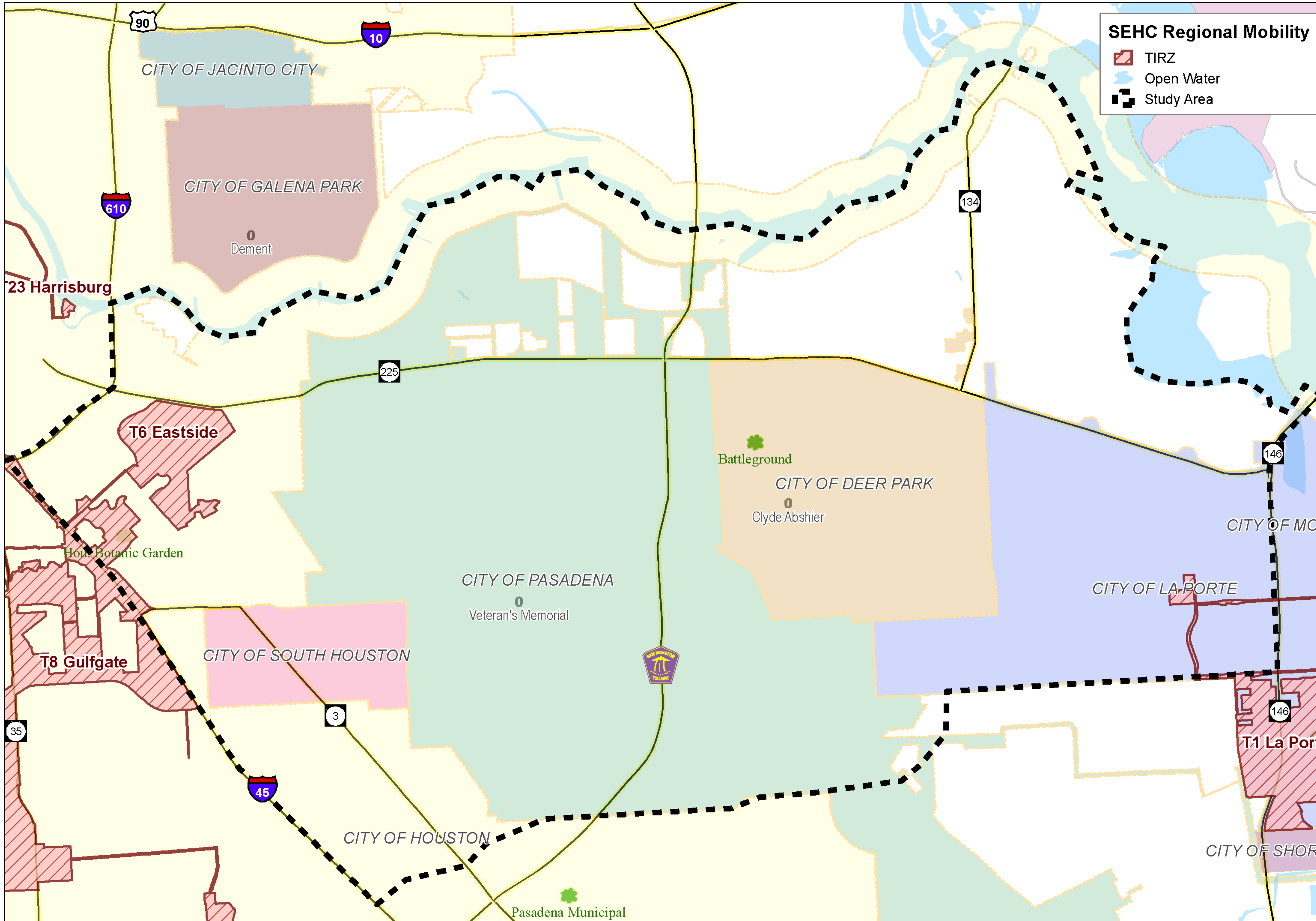
Developer-funded Improvement Projects (381 Agreements) – Chapter 381 of the Local Government Code allows counties to provide incentives encouraging developers to build in their jurisdictions. A county may administer and develop a program to make loans and grants of public money to promote state or local economic development and to stimulate, encourage and develop business location and commercial activity in the county. The county also may develop and administer a program for entering into a tax abatement agreement. This tool allows counties to negotiate directly with developers and businesses.

County Assistance Districts – any county may adopt this sales tax, in all or part of the county, if the new combined local sales tax rate would not exceed 2 percent at any location within the district. The commissioners court serves as the board of directors. County assistance district funds can be used for safety and roadway projects.

Special Finance Districts. Special finance districts are permitted through the Texas State Legislature for purposes of making or maintaining improvements that spur private development or maintain the quality of an area.

- ***Tax Increment Reinvestment Zone.*** A tax increment reinvestment zone, more commonly known as TIRZ, is a creation of a municipality or county and may be created either by the government entity or by petition. A TIRZ begins by establishing a "base value". The taxes gained by an increase in value above the base value is the "increment" that is available annually to a reinvestment zone for purposes of making capital improvements. Capital improvements can include mobility improvements such as those recommended in this study. A TIRZ can use both annual allotment and bonds as methods for financing improvements. A TIRZ expires by a set date at which time both the base value and increment are collected by the municipality. Other government entities such as counties and emergency districts can participate in a TIRZ. Each entity can determine percentage of "participation" in which case only a percentage of increment is available for use by the TIRZ. Exhibit 9.3.1a depicts the various TIRZs that exist within the study area including two in Houston (TIRZ Nos. 6 & 8) and one in LaPorte (TIRZ No. 1).
- ***Municipal Management District.*** A municipal management district is a government entity created by the State of Texas either through specific legislation or through the Texas Commission for Environmental Quality. A management district is funded through an annual assessment (in the same manner as a homeowners association), a property tax or a sales tax. While created by the state, a management district is only funded through petition of property owners (in the case of an assessment) or by vote (in the case of a sales or property tax). A management district can pay for the cost of construction of improvements in the right-of-way; however, the amount of available revenue typically limits the scale of construction allowed. On the other hand, a management district is an excellent tool for ongoing maintenance of improvements beyond major road reconstruction. There are currently no municipal management districts within the study area. The East End District and Hobby Area District are adjacent and located in the City of Houston.

Exhibit 9.3.1a
Tax Increment Reinvestment Zones within Study Area



9.3.2 STATE FUNDING SOURCES

TxDOT TA and SRTS Program – TxDOT administers Transportation Alternatives Set-Aside (TA) and Safe Routes to School (SRTS) Program funds for locally sponsored bicycle and pedestrian infrastructure projects in communities less than 200,000

TxDOT HSIP – formulaic funds for safety related projects based on crash history. Formulaic funds safety projects that are consistent with the State's strategic highway safety plan (SHSP) and that correct or improve a hazardous road location or feature or address a highway safety problem

Texas Enterprise Zone – a state sales and use tax refund program to encourage private investment and job creation in economically distressed areas of the state. Nominated companies that meet minimum capital investment thresholds can receive up to $3.75 million.

9.3.3 FEDERAL FUNDING SOURCES

H-GAC Transportation Improvement Program (TIP) – finances transportation improvement projects using US Department of Transportation funds over a period of four years. This study is intended to inform the TIP. Communities and the county can submit projects for funding through the TIP as part of the competitive process. Projects require matching funds and are selected based upon a variety of criteria. Communities and the county can also utilize local funds, including those available through special finance districts, as leverage to pursue federal funding for projects, both within the TIP and through other grants that may become available from time to time.

Community Development Block Grant (CDBG) – funds are available through the US Department of Housing and Urban Development for purposes of meeting three national objectives including benefit to low- and moderate-income persons, preventing or eliminating slums or blight, and meeting urgent needs. While it is unlikely that projects associated with this study meet the latter two criteria, several would be eligible for funding in an effort to benefit low- and moderate-income persons. Exhibit 9.3.3a indicates portions of the study area in which 51% or more of persons are considered low and moderate income.

Within the study area, the cities of Houston and Pasadena are classified as "entitlement communities" that are assigned an annual allotment of CDBG funds to use on a variety of projects. Harris County also receives funding as an entitlement county. The cities of Deer Park, LaPorte and South Houston are a part of the Harris County CDBG program through a cooperative agreement with each city.

CDBG annual allotments issued in FY21 included almost $25,029,000 for Houston, $1,681,000 in Pasadena, and $14,463,000 for Harris County. Given substantial community need, demand for funding from each entity traditionally strongly exceeds available resources.

Other resources are often available through the CDBG program to address major events, including CDBG-DR funds (disaster recovery) for Hurricane Harvey. However, those funds serve a very specific purpose and are managed through the State of Texas.

Infrastructure Investment and Jobs Act – funds improvements to surface, air, and marine transportation systems; energy systems; water and wastewater systems; environmental programs; and broadband networks. Approximately $284 billion has been allocated for transportation systems alone, which includes road safety, public transit, and ports.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant (previously known as BUILD and TIGER grants) – funds projects that: (1) support transportation projects that focus on creating good-paying jobs, improving safety, applying transformative technology, and explicitly addressing climate change and advancing racial equity; (2) build, repair, rebuild, and revitalize freight and passenger transportation networks; and/or (3) improve access to reliable, safe, and affordable transportation

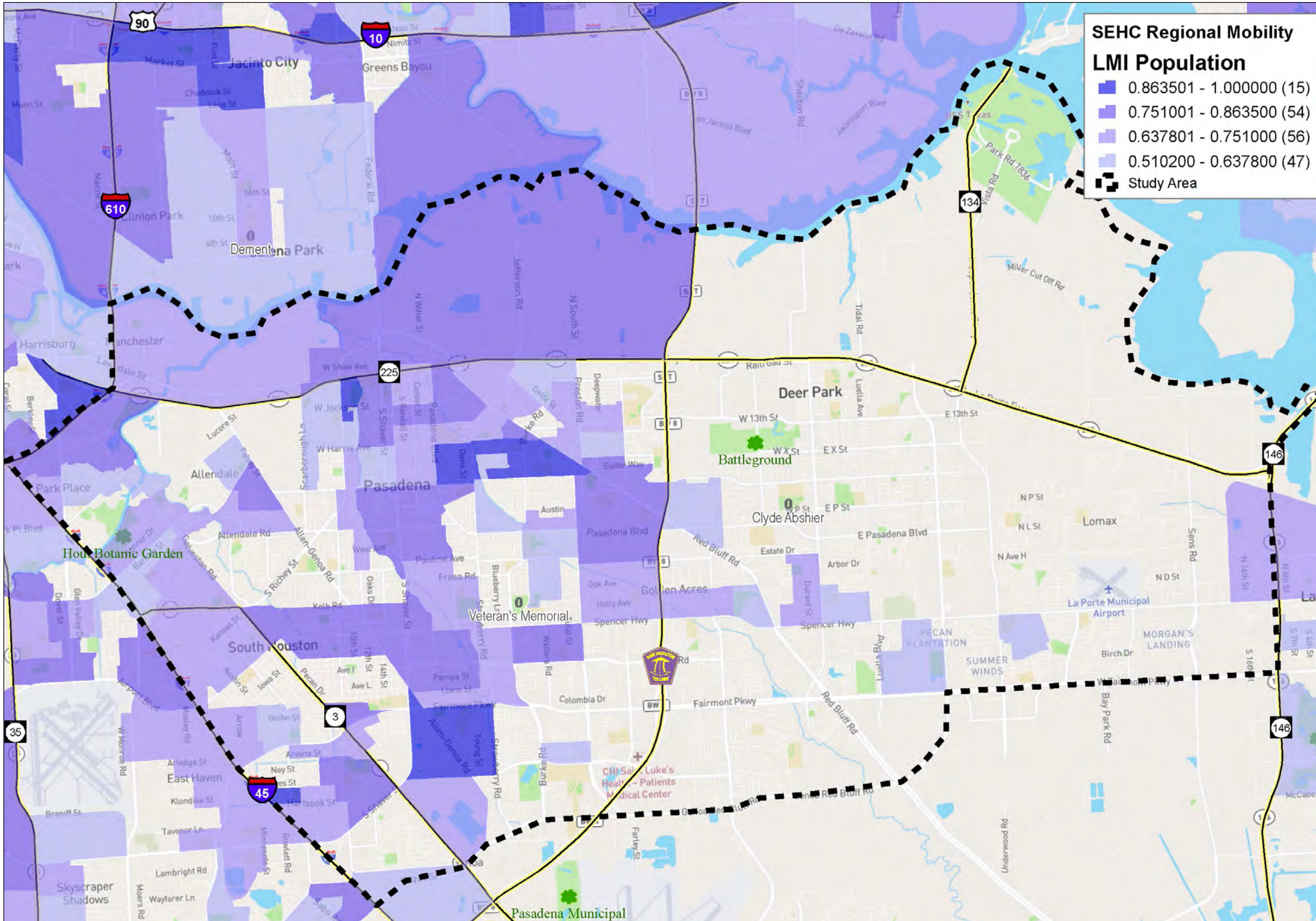
Infrastructure for Rebuilding America (INFRA) Grant – funds projects that improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas (emphasis on freight-related projects).

Consolidated Rail Infrastructure and Safety Improvement (CRISI) Program – funds the deployment of railroad safety technology, capital projects that address congestion challenges, facilitate ridership growth, and increase multimodal connections, railway and roadway safety improvements such as signals and barriers, safety programs, corridor service development plans, and workforce development activities.

Safe Streets and Roads for All Program – developing "Vision Zero" action plans and other improvements to reduce crashes and fatalities, especially for cyclists and pedestrians.

NHTSA Highway Safety Programs – formulaic funds for programs for improving driver behavior and safety. These include programs to reduce injuries and death from crashes, improve driver education, provide proficiency testing and physical and driving examination, and improve pedestrian performance and bicycle safety

Exhibit 9.3.3a
Low- to Moderate-Income Communities in Study Area



9.4 IMPLEMENTATION BY JURISDICTION

HARRIS COUNTY

Forty-eight (48) study corridor segments and twenty (20) study intersections are within the jurisdiction of Harris County, as illustrated in ***Exhibit 9.4.1a***.

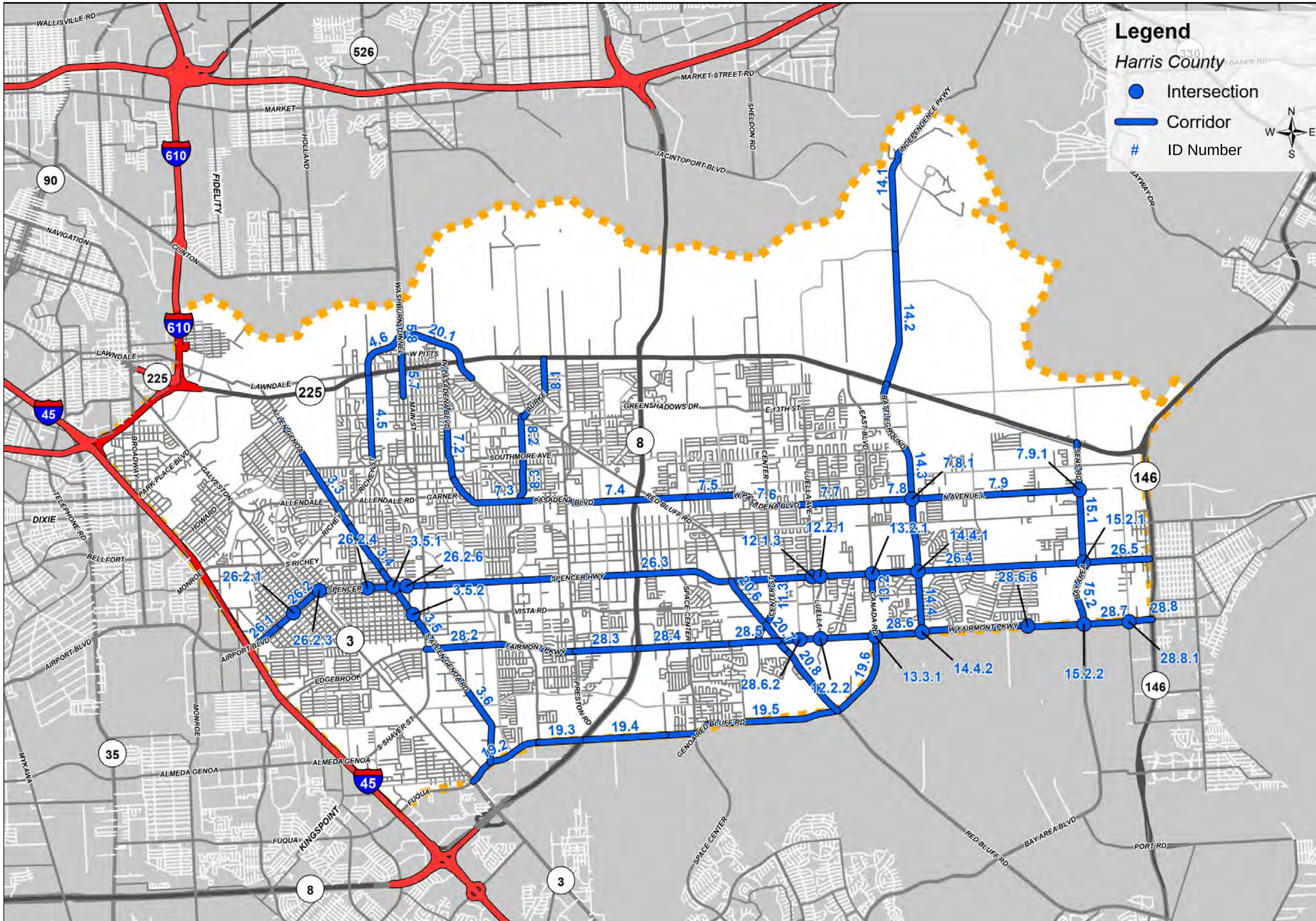


Exhibit 9.4.1a Study Locations under Harris County Jurisdiction

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HARRIS COUNTY

Harris County must partner with at least one other agency at each location, most commonly with the City of La Porte, with which the County must partner on thirteen intersections, and with the City of Pasadena, with which the County must partner with on twenty-nine corridor segments. These partnerships may result in shared cost of total improvements.

Improvements recommended in Harris County are as follows:

IMPROVEMENT	OCCURRENCES IN HARRIS COUNTY
Road Diet	16
Install raised median	6
Upgrade pavement	27
Install/upgrade pedestrian elements	24
Install Shared Use Path	36
Install bike lane	2
Install/upgrade segment lighting	22
Install/upgrade curve signage	5
Signal Timing/Phasing Modification	48
Install through lane	1
Driveway Closure	6
Upgrade pavement markings	1
Install transverse rumble strips	1
Install/upgrade pedestrian elements	4
Install/upgrade intersection lighting	1
Install advance warning signage	1
Signal Timing/Phasing Modification	13
Install through lane	4
Install Flashing Yellow Arrow signal	1
Install exclusive left-turn lane (dual left)	5
Install exclusive left-turn lane	2
Install exclusive right-turn lane	5
Realign intersection	1

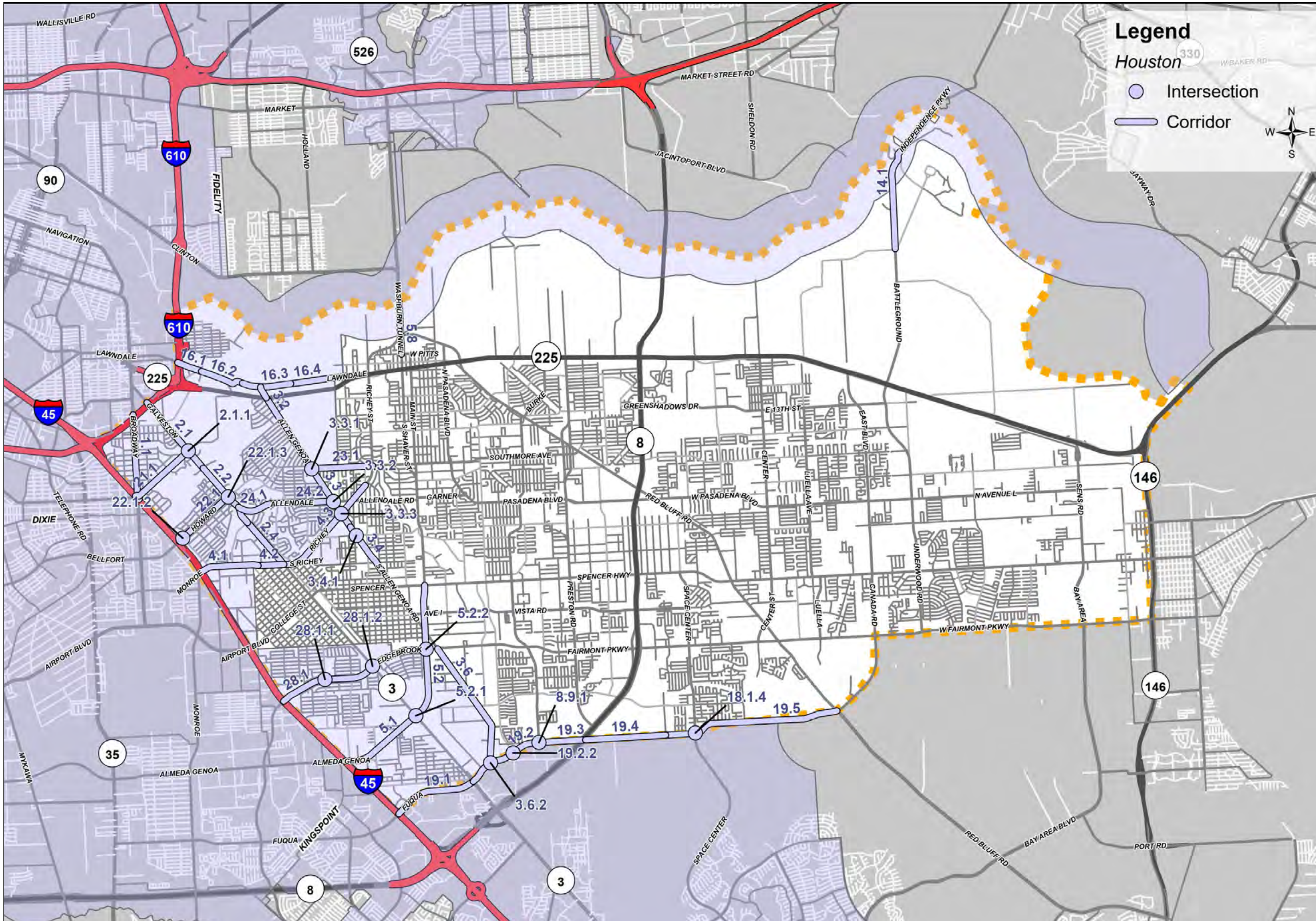
HARRIS COUNTY TOTALS

- The total cost of recommended improvements at locations under Harris County jurisdiction is **$930 million**.
- The total benefit of recommended improvements is **$2.5 billion**
- **2.71** benefit-cost ratio

Additional details on specific improvement projects being recommended in Harris County can be found in ***Appendix G***.

CITY OF HOUSTON

Thirty-two (32) study corridor segments and sixteen (16) study intersections are within the jurisdiction of the City of Houston, as illustrated in ***Exhibit 9.4.2a***.



9.4.2a
Study Locations under City of Houston Jurisdiction

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CITY OF HOUSTON

The City of Houston has full jurisdiction over thirteen corridor segments and eight intersections within the study area. However, the City must also partner with other agencies at some locations, most commonly with the City of South Houston, with which Houston must partner on eleven intersections, and with the City of Pasadena, with which Houston must partner with on fourteen corridor segments. These partnerships may result in shared cost of total improvements.

Improvements recommended in the City of Houston are as follows:

IMPROVEMENT	OCCURRENCES IN HOUSTON
Road Diet	3
Install raised median	1
Upgrade pavement	21
Install/upgrade pedestrian elements	11
Install Shared Use Path	25
Install/upgrade segment lighting	11
Install/upgrade curve signage	2
Parking Study	1
Signal Timing/Phasing Modification	32
Install TWLTL	2
Driveway Closure	3
Upgrade pavement	2
Install/upgrade pedestrian elements	10
Install/upgrade intersection lighting	1
Install reflectorized signal back plates	16
Signal Timing/Phasing Modification	11
Install through lane	3
Install Flashing Yellow Arrow signal	3
Install exclusive left-turn lane (dual left)	4
Install exclusive left-turn lane	1
Install exclusive right-turn lane	4
Driveway Closure	1
Realign intersection	1

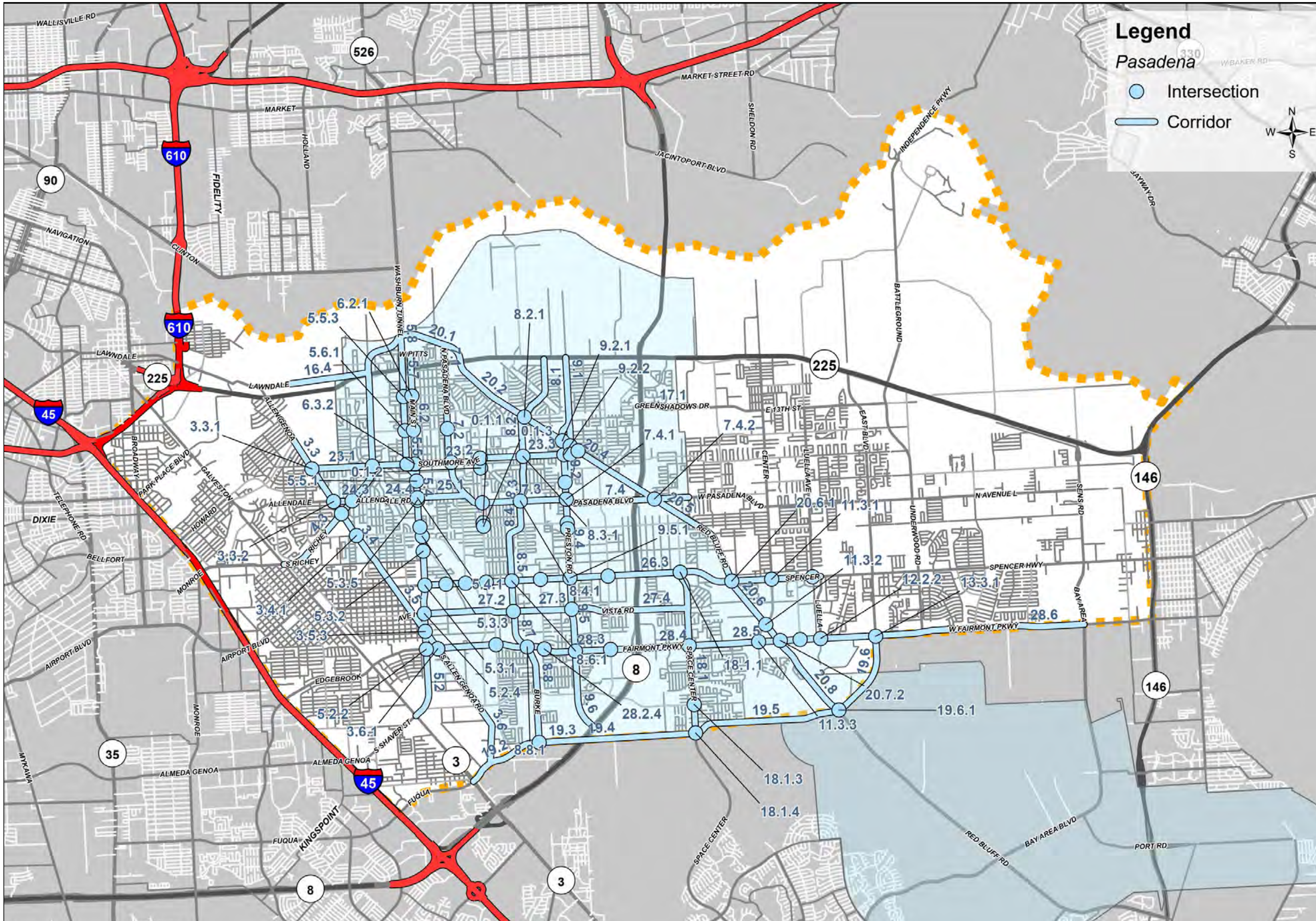
CITY OF HOUSTON TOTALS

- The total cost of recommended improvements at locations under City jurisdiction is **$187 million**.
- The total benefit of recommended improvements is **$1.25 billion**.
- **6.7** benefit-cost ratio

Additional details on specific improvement projects being recommended in City of Houston can be found in ***Appendix G***.

CITY OF PASADENA

Seventy-one (71) study corridor segments and seventy-two (72) study intersections are within the jurisdiction of the City of Pasadena, as illustrated in ***Exhibit 9.4.3a***.



9.4.3a
Study Locations under City of Pasadena Jurisdiction

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CITY OF PASADENA

The City of Pasadena has full jurisdiction over thirty-six corridor segments and fifty-seven intersections within the study area. However, the City must also partner with other agencies at some locations, most commonly with the City of Houston, with which Pasadena must partner on ten intersections, and with Harris County, with which Pasadena must partner with on twenty-nine corridor segments. These partnerships may result in shared cost of total improvements.

Improvements recommended in the City of Pasadena are as follows:

IMPROVEMENT	OCCURRENCES IN PASADENA
Road Diet	15
Install raised median	10
Upgrade pavement	48
Install/upgrade pedestrian elements	44
Install Shared Use Path	48
Install bike lane	3
Install/upgrade segment lighting	31
Install advance warning signage	1
Install/upgrade curve signage	11
Parking Study	2
Signal Timing/Phasing Modification	71
Install TWLTL	3
Driveway Closure	17
Upgrade pavement	9
Upgrade pavement markings	5
Install transverse rumble strips	2
Install/upgrade pedestrian elements	35
Install/upgrade intersection lighting	3
Install reflectorized signal back plates	68
Install advance warning signage	13
Signal Timing/Phasing Modification	38
Install through lane	9
Install Flashing Yellow Arrow signal	3
Install through-right turn lane	1
Install exclusive left-turn lane (dual left)	12
Install exclusive left-turn lane	5
Install exclusive right-turn lane	19
Driveway Closure	6
Realign intersection	2

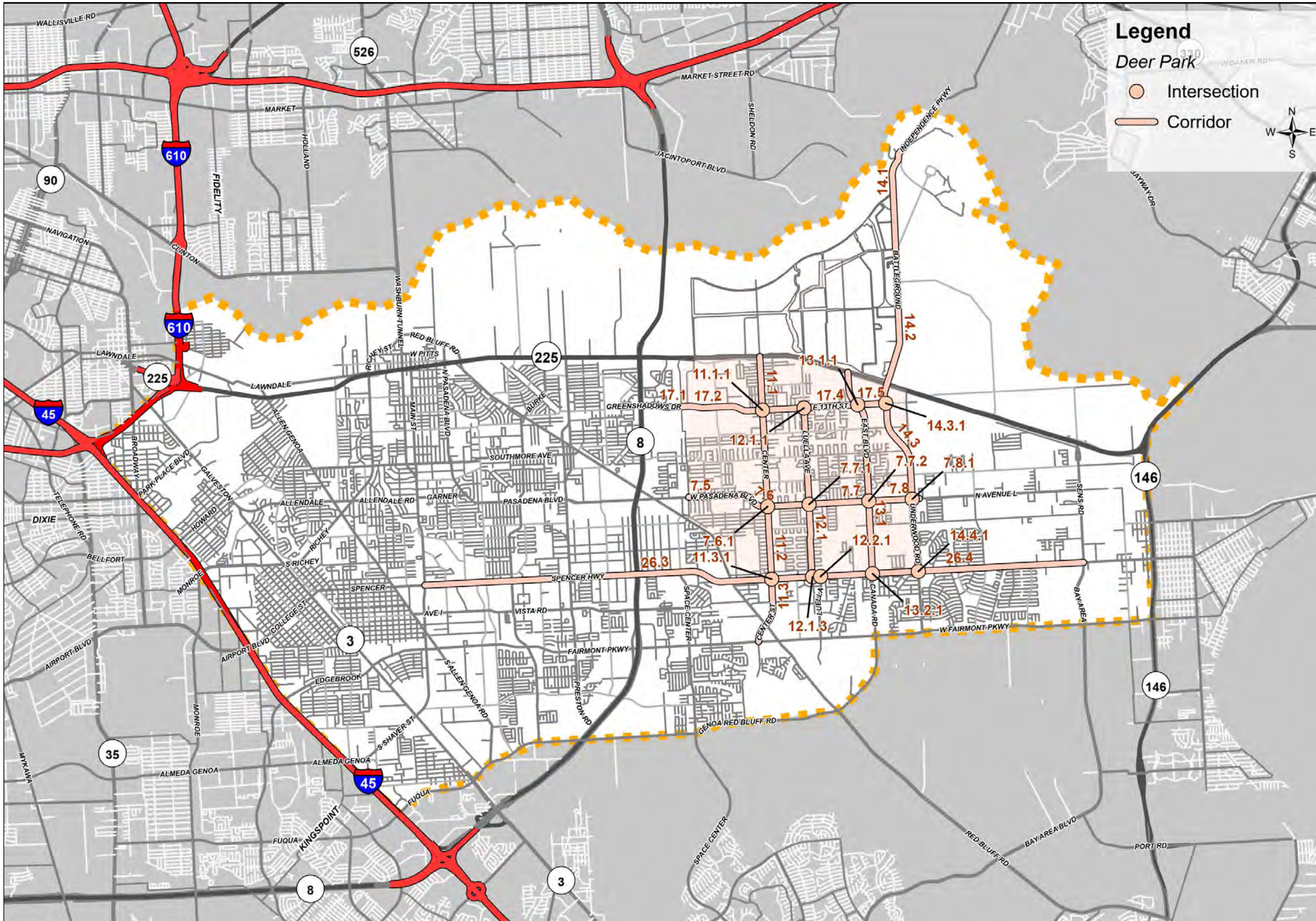
CITY OF PASADENA TOTALS

- The total cost of recommended improvements at locations under City jurisdiction is **$1.05 billion**.
- The total benefit of recommended improvements is **$4.25 billion**.
- **4.05** benefit-cost ratio

Additional details on specific improvement projects being recommended in City of Pasadena can be found in ***Appendix G***.

CITY OF DEER PARK

Nineteen (19) study corridor segments and thirteen (13) study intersections are within the jurisdiction of the City of Deer Park, as illustrated in ***Exhibit 9.4.4a***.



9.4.4a
Study Locations under City of Deer Park Jurisdiction

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CITY OF DEER PARK

The City of Deer Park has full jurisdiction over eight corridor segments and seven intersections within the study area. However, the City must also partner with other agencies at some locations, most commonly with Harris County, with which Deer Park must partner with on ten corridor segments and five intersections. These partnerships may result in shared cost of total improvements.

Improvements recommended in the City of Deer Park are as follows:

IMPROVEMENT	OCCURRENCES IN DEER PARK
Road Diet	6
Install raised median	4
Upgrade pavement	15
Install/upgrade pedestrian elements	12
Install Shared Use Path	18
Install/upgrade segment lighting	7
Signal Timing/Phasing Modification	19
Driveway Closure	2
Install/upgrade pedestrian elements	1
Install reflectorized signal back plates	8
Install advance warning signage	1
Signal Timing/Phasing Modification	9
Install through lane	1
Install Flashing Yellow Arrow signal	4
Install exclusive left-turn lane (dual left)	3
Install exclusive left-turn lane	1
Install exclusive right-turn lane	7

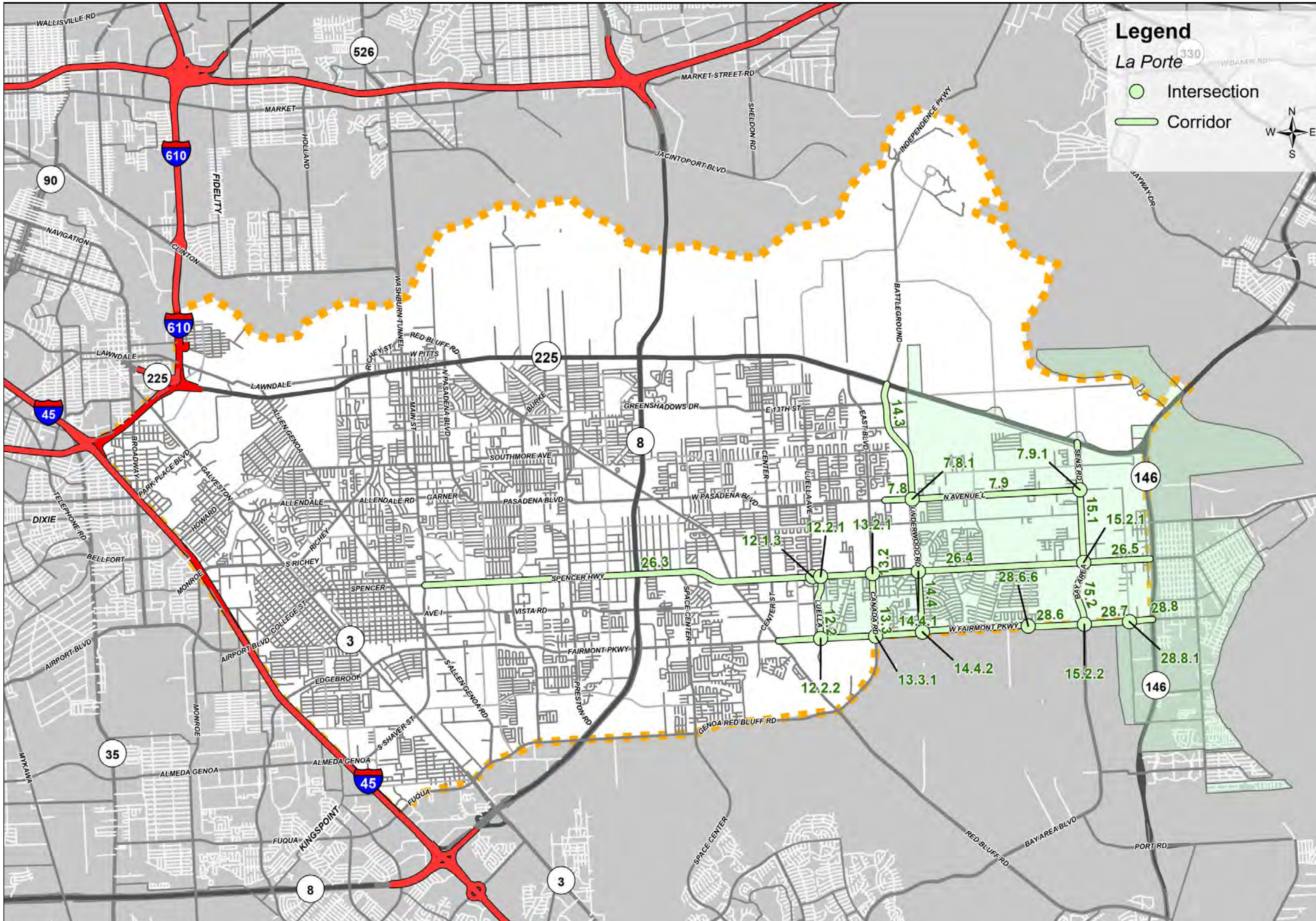
CITY OF DEER PARK TOTALS

- The total cost of recommended improvements at locations under City jurisdiction is **$485 million**.
- The total benefit of recommended improvements is **$1.97 billion**.
- **4.06** benefit-cost ratio

Additional details on specific improvement projects being recommended in City of Deer Park can be found in ***Appendix G***.

CITY OF LA PORTE

Fifteen (15) study corridor segments and thirteen (13) study intersections are within the jurisdiction of the City of La Porte, as illustrated in **Exhibit 9.4.5a**.



9.4.5a
Study Locations under City of La Porte Jurisdiction

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CITY OF LA PORTE

The City of La Porte has full jurisdiction over only two corridor segments and no intersections within the study area, therefore the City must partner with other agencies at most locations, most commonly with Harris County, with which La Porte must partner with on thirteen corridor segments and all thirteen intersections. These partnerships may result in shared cost of total improvements.

Improvements recommended in the City of La Porte are as follows:

IMPROVEMENT	OCCURRENCES IN LA PORTE
Road Diet	3
Install raised median	2
Upgrade pavement	7
Install/upgrade pedestrian elements	7
Install Shared Use Path	11
Install bike lane	1
Install/upgrade segment lighting	7
Signal Timing/Phasing Modification	15
Install through lane	1
Driveway Closure	1
Install/upgrade pedestrian elements	2
Signal Timing/Phasing Modification	9
Install through lane	4
Install Flashing Yellow Arrow signal	1
Install exclusive left-turn lane (dual left)	4
Install exclusive left-turn lane	2
Install exclusive right-turn lane	4

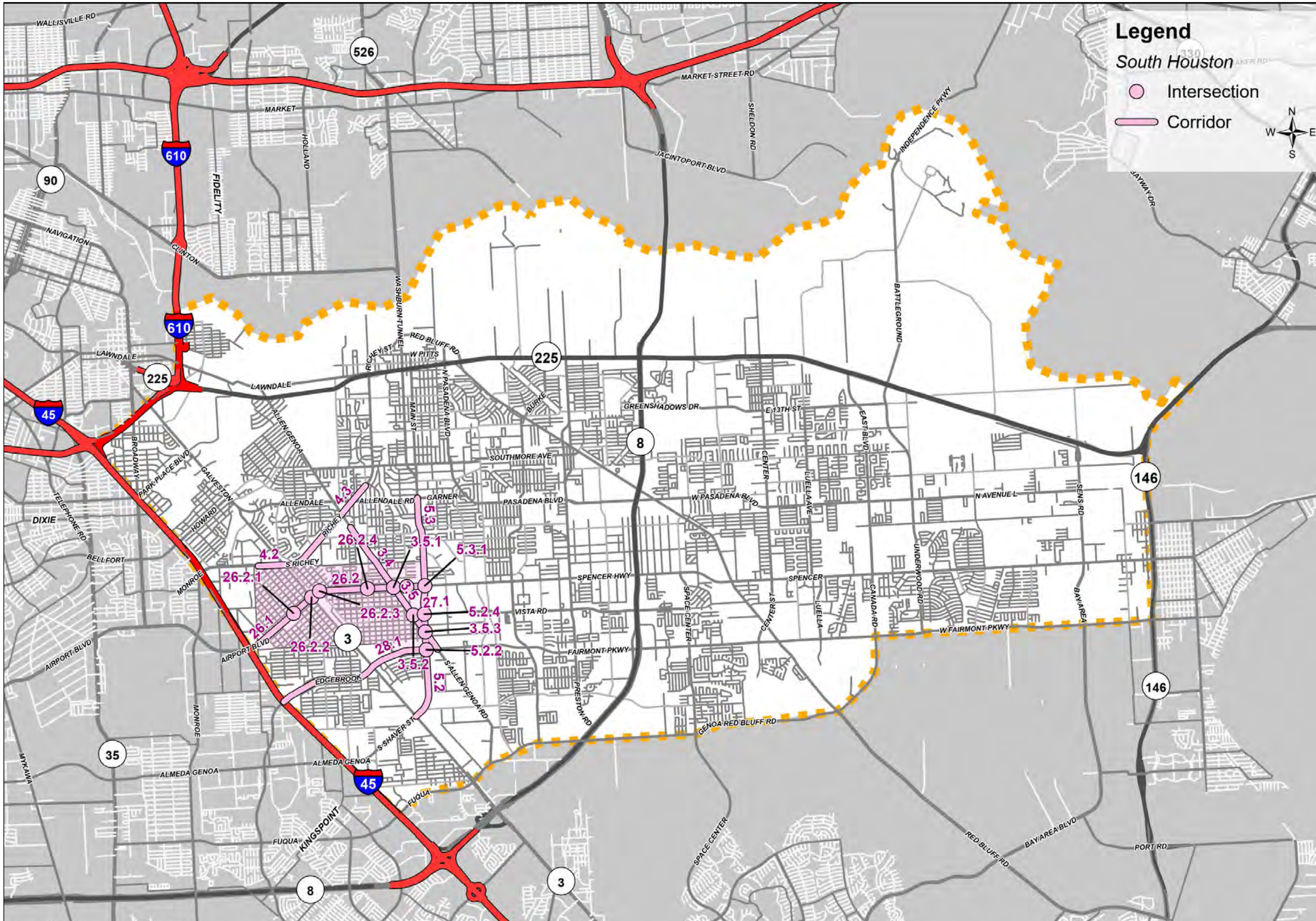
CITY OF DEER PARK TOTALS

- The total cost of recommended improvements at locations under City jurisdiction is **$487 million**.
- The total benefit of recommended improvements is **$1.79 billion**.
- **3.68** benefit-cost ratio

Additional details on specific improvement projects being recommended in City of La Porte can be found in ***Appendix G***.

CITY OF SOUTH HOUSTON

Ten (10) study corridor segments and eleven (11) study intersections are within the jurisdiction of the City of South Houston, as illustrated in ***Exhibit 9.4.6a***.



9.4.6a Study Locations under City of South Houston Jurisdiction

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CITY OF SOUTH HOUSTON

The City of South Houston has full jurisdiction over only one corridor segment and one intersection within the study area, therefore the City must partner with other agencies at most locations, most commonly with the Cities of Pasadena and Houston, with which South Houston must partner with on five corridor segments each, and Harris County, with which South Houston must partner on six intersections. These partnerships may result in shared cost of total improvements.

Improvements recommended in the City of South Houston are as follows:

IMPROVEMENT	OCCURRENCES IN SOUTH HOUSTON
Road Diet	1
Install raised median	3
Upgrade pavement	6
Install/upgrade pedestrian elements	6
Install Shared Use Path	9
Install/upgrade segment lighting	5
Install/upgrade curve signage	1
Parking Study	2
Signal Timing/Phasing Modification	10
Install TWLTL	3
Driveway Closure	3
Upgrade pavement	2
Upgrade pavement markings	3
Install transverse rumble strips	3
Install/upgrade pedestrian elements	6
Install/upgrade intersection lighting	3
Install reflectorized signal back plates	5
Install advance warning signage	3
Signal Timing/Phasing Modification	9
Install through lane	1
Install Flashing Yellow Arrow signal	1
Install through-right turn lane	1
Install exclusive left-turn lane (dual left)	4
Install exclusive right-turn lane	2
Driveway Closure	2
Realign intersection	1

CITY OF DEER PARK TOTALS

- The total cost of recommended improvements at locations under City jurisdiction is **$400 million**.
- The total benefit of recommended improvements is **$811 million**.
- **2.03** benefit-cost ratio

Additional details on specific improvement projects being recommended in City of La Porte can be found in ***Appendix G***.