SH 6 ACCESS MANAGEMENT STUDY NORTH

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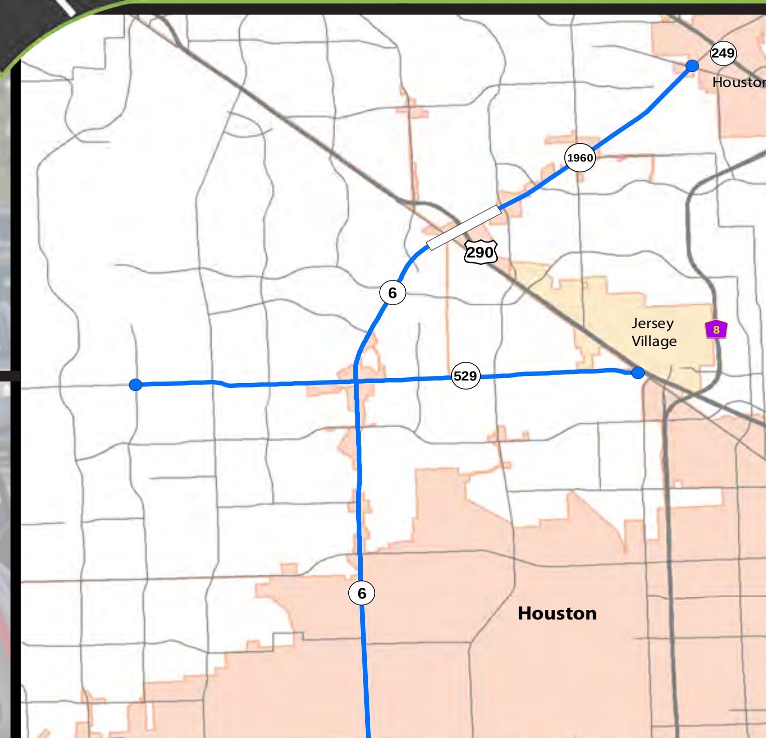

Houston-Galveston Area Council

Study conducted by:

ALLIANCE TRANSPORTATION GROUP

With: Avenue Consultants
Brown & Gay Engineers, Inc.
Hutson Land Planners & Development Consultants, LLC.
Community Awareness Services

Transportation Policy Council Accepted, January 2011

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Acknowledgements

Lead Agency Houston-Galveston Area Council

Managers Christy Willhite AICP/ Noel C. Bowman

Steering Committee

Houston-Galveston Area Council

Christy Willhite, AICP, *Contract Manager*
Noel C. Bowman, *Project Manager*
Ilyas Choudry
Meredith Dang
Stephan Gage
Mike Fuller
Gina Mitteco
Anthony Khalil

City of Houston

Jeff Weatherford, P.E.

Harris County

Charles Dean, P.E.
Loyd Smith, P.E.

Texas Department of Transportation (TxDOT)

Catherine McCreight
Greg Ranft, P.E.
Patrick Gant, P.E.
Sanjay G. Upadhyay, P.E.

Consultant Team

Alliance Transportation Group, Inc.

J. Michael Heath, P.E., *Project Manager*
Steven J. Miller, P.E.
Scott A. Feldman, P.E., PTOE
James H. Harvey, Jr., AICP
Lisa Weston, Ph.D., AICP
Debra Harvey
Scott Grantham
Kevin Burns, EIT

In partnership with:

Avenue Consultants, Inc.

David Thompson

Brown & Gay Engineers, Inc.

Isaac Joskowicz, P.E.
Matthew Brannen, P.E.
Jeff Durson, P.E.

Hutson Land Planners & Developers

Duane Hutson, AICP
Ronan O'Connor, AICP

Community Awareness Services

Jerri Anderson
Justin LaFerriere

Stakeholder Advisory Group

Ransom Daly	ACMP, Inc.
R.M. Eaton	Barkers Landing Home Owners Association
Peter Wang	Bike Houston
Robin Holzer	Citizens Transportation Coalition
Mike Castro	City of Jersey Village
Jan Perino	Copperfield Coalition
Rick Scialdone	Copperfield Coalition
Carl Chambers	Copperfield Place Village Council
Mary Evans	Cy-Fair Houston Chamber of Commerce
W.R. "Bill" Rowden	Cy-Fair Houston Chamber of Commerce
Tina Howard	Easton Commons Community Association
Clark Martinson	Energy Corridor District
Robert Rayburn	Energy Corridor District
Theresa Rodriguez	Greater Houston Partnership
Richard A. Zientek	Harris County
Jack C. Searcy, Jr.	Houston Northwest Chamber of Commerce
Barbara Thomason	Houston Northwest Chamber of Commerce
Gayle Minto	Hunters Park Community Association
Ann Hodge	Katy Area Chamber of Commerce
Lance LaCour	Katy Economic Development Council
Kurt Luhrsen	Metropolitan Transit Authority
Martin Elder	Metropolitan Transit Authority
Elizabeth Pettit	Middlegate Village Homeowners Association
Ann Cates	North Houston Association
Paula Lenz	North Houston Association
Sarah Singleton	Senator Dan Patrick's Office
Jim Gillett	Southdown Village Community Association
Mike Moliere	Stone Creek Homeowners Association
Vicki Butler	Tallow Wood Homeowners Association
Roger Hord	West Houston Association

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CHAPTER 1: INTRODUCTION

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PURPOSE OF STUDY

In 2001, the Houston-Galveston Area Council (H-GAC) initiated a series of access management studies throughout the greater Houston region. The SH 6 Access Management Study North is a part of this regional initiative and was sponsored by H-GAC, the Texas Department of Transportation (TxDOT), the City of Houston, and Harris County. This study analyzes the SH 6 / FM 1960 and FM 529 corridors, and makes recommendations to improve mobility and safety, while maintaining economic viability.

Access Management

The Transportation Research Board defines access management as "the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway." Access management seeks to provide vehicular access to land uses, while maintaining safety and efficiency of the transportation system as a whole. For this reason, access management is often a balancing act, considering both access to individual locations and the movement of the system as a whole.

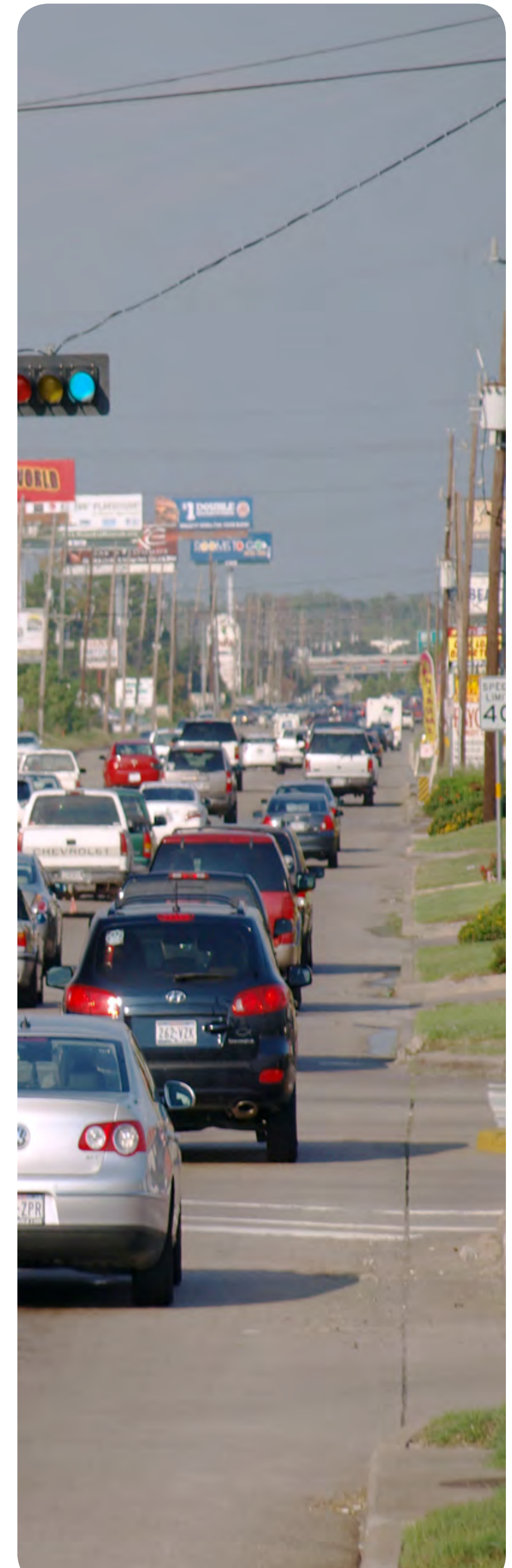
Source: Access Management Manual, TRB 2004

There are several characteristics of SH 6 / FM 1960 and FM 529 which make these corridors candidates for access management solutions. Peak period congestion along the corridors is significant, as indicated by level of service (LOS) data. Crash statistics for the corridors are also significant. Between 2003 and 2007, the crash rates for several segments of the corridors were greater than the statewide average. Meanwhile, commercial and residential development continues in the area, transitioning from rural to suburban patterns, and population in the region continues to grow. In sum, these corridors are candidates for access management solutions for a combination of reasons: (1) high peak period congestion, (2) high crash statistics, (3) transitional development patterns, and (4) continued regional growth.

Access management strategies have demonstrated results in increasing efficiency of transportation systems. These strategies deal with the number and spacing of driveways, intersections, and signals along roadways. With these issues in mind, three goals were formulated in conjunction with public and stakeholder input for the SH 6 Access Management Study North: improve mobility, improve safety, and maintain the economic viability of the area.

Goals of the Study

- **Improve Mobility**
- **Improve Safety**
- **Maintain Economic Viability**



Applying access management along developed roadways presents a number of challenges. First, access management improvements fundamentally alter the way people use the existing transportation system. Public and stakeholder education, acceptance, and buy-in are needed to successfully implement recommended improvements. Therefore, a robust public involvement process was essential to the study. A complete record of this process is contained in Appendix H.

Second, operational improvements such as raised medians and signal relocations will redistribute traffic and impact intersection operations throughout the corridors. For this reason, recommended improvements were evaluated for consistency with feedback provided through the public involvement process and were analyzed to ensure that residents, businesses, and community organizations would continue to benefit from improvements as conditions change in the future.

This study took a comprehensive approach to evaluate and recommend complementary solutions throughout the study corridors. The study considered:

- Land uses (residential, commercial, office, civic, industrial, recreational, public, agricultural);
- Transportation choices (walk, bike, ride, and drive);
- The transportation system as a whole (right of way, traffic volumes, lane assignments, signal timing, connecting roadways, park and rides, planned improvements, composition of traffic, and types of transportation users); and
- Project constraints (political boundaries, floodways, utility districts, pipelines, easements).

Recommendations include:

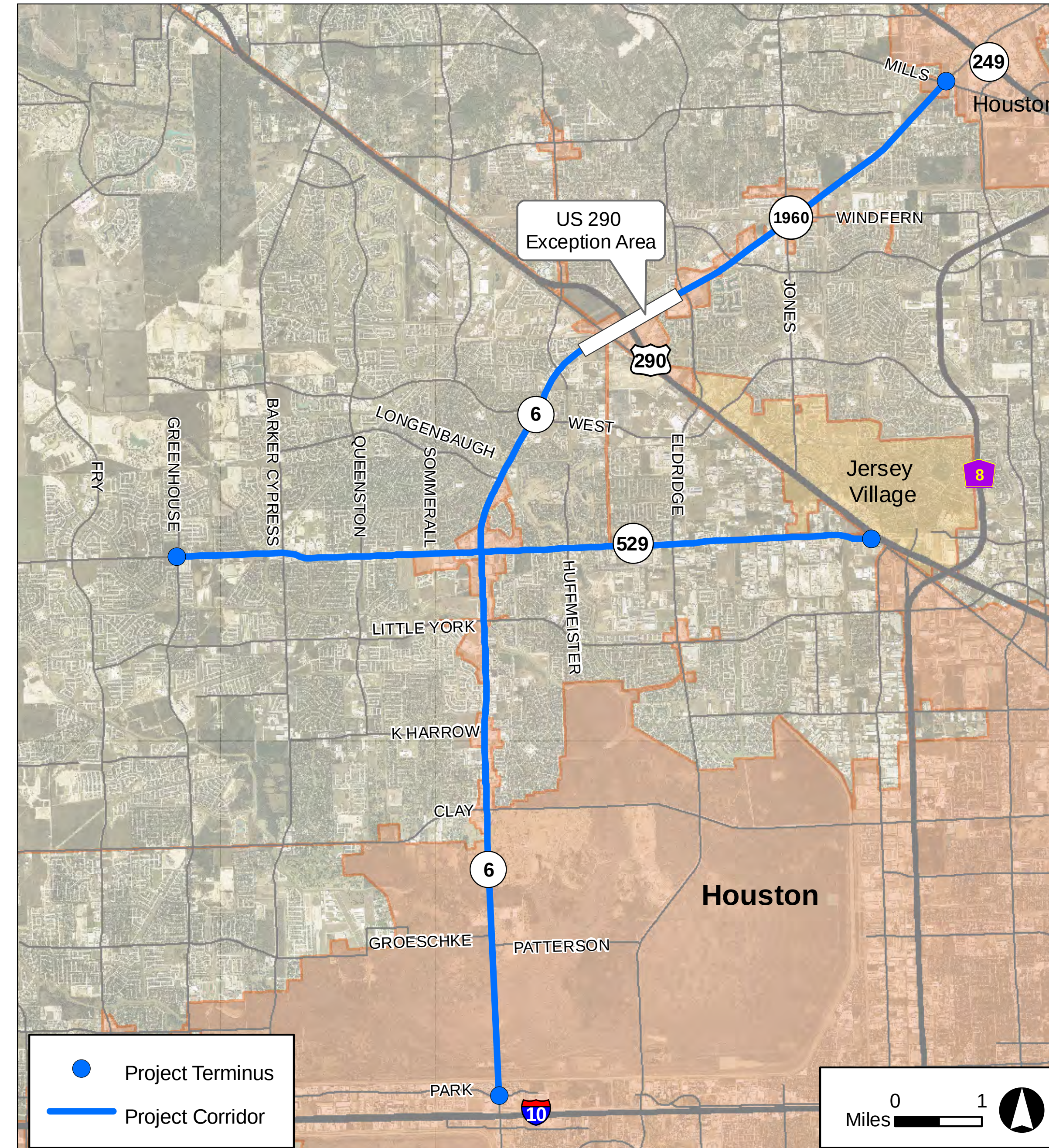
1. Roadway and operational improvements;
2. Bicycle and pedestrian improvements;
3. Livable communities that encourage mixed use development;
4. Transit implementation; and
5. Policy and funding options.

STUDY AREA

The study area is located in northwest Houston, part of the nation's sixth largest metropolitan region (See Figure 1.1). The SH 6 / FM 1960 corridor has regional importance as an outer ring arterial of Houston, connecting to Sugar Land in the southern metro region. Both SH 6 / FM 1960 and FM 529 tie into US 290, another regionally important corridor which moves vehicles into and out of downtown Houston. The southern portion of the study area lies inside Houston, where strip annexation along major roadways has brought much of the land directly abutting the SH 6 / FM 1960 corridor inside the city limits. The FM 529 corridor abuts Jersey Village to the east. Much of the remaining study area lies in unincorporated parts of Harris County.

As shown in Figure 1.1, the project includes two intersecting roadways: SH 6 / FM 1960 and FM 529. Both roads are state facilities and are maintained by TxDOT. SH 6 / FM 1960 is a continuous roadway that runs generally north and south. North of FM 529, it veers to the northeast. It is classified as SH 6 south of US 290 and FM 1960 north of US 290. FM 529 runs east and west, intersecting SH 6 in the center of the study area. The SH 6 / FM 1960 - US 290 interchange is currently being evaluated as a part of a separate study for TxDOT and is not included in this study. The interchange is referred to in this document as the Exception Area.

Figure 1.1: Study Area



CHAPTER 2: METHODOLOGY

DEVELOPMENT OF METHODOLOGY AND PUBLIC INVOLVEMENT PLAN
IDENTIFICATION OF TOOLS
REVIEW OF PREVIOUS STUDIES AND EXISTING DATA
ANALYSIS OF EXISTING CONDITIONS
PUBLIC MEETING #1 AND CONSULTATION
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The methodology for SH 6 Access Management Study North was designed to address access management issues and to develop context sensitive, community supported solutions. The methodology was developed in coordination with H-GAC and was approved by the Steering Committee prior to implementation.

This study followed these steps:

1. Development of methodology and Public Involvement Plan
2. Identification of available tools
3. Review of previous studies and existing data
4. Analysis of existing conditions
5. Public Meeting #1 and consultation
6. Identification of specific issues
7. Selection of tools
8. Development of proposed solutions
9. Critical analysis of solutions
10. Public Meeting #2
11. Refinement of recommendations
12. Business Open House
13. Finalization of recommendations
14. Public Meeting #3
15. Presentation of Final Report

DEVELOPMENT OF METHODOLOGY AND PUBLIC INVOLVEMENT PLAN

A Public Involvement Plan for the entire planning process was designed in coordination with the H-GAC Steering Committee. The activities included in this plan included:

- Gather input from the public, stakeholders, and the business community on issues and concerns related to access management within the study area;
- With public input, develop a set of criteria (measures of effectiveness) to evaluate proposed alternative solutions; and
- Allow the public to review proposed solutions and recommendations for changes to address access management issues and concerns.

The Public Involvement Plan promoted an active and effective public dialogue. Feedback on the process was quite positive and received numerous accolades from participants in the public and outreach meetings. A copy of the Public Involvement Plan, as well as a complete record of the public outreach and public participation activities conducted following the plan, are provided in Appendix H.

IDENTIFICATION OF TOOLS

Available access management tools were identified for the study area. This list provided a starting point for the types of solutions that could be developed. Options included both traditional and innovative tools. Detailed descriptions of tools are provided in Chapter 4.

Traditional tools included:

- Establishing comprehensive access code;
- Requiring internal circulation / property interconnectivity;
- Coordinate traffic signals, enforce minimum signal spacing;
- Requiring / enforcing driveway setbacks from intersections;
- Requiring / enforcing minimum driveway spacing requirements;
- Consolidating existing driveways;
- Constructing alternate access roads;
- Adding travel lanes;
- Adding channelized deceleration and turn lanes at intersections;
- Replacing congested intersections with grade separations;
- Constructing raised median and channelized turn locations;
- Reducing visual clutter;
- Improving informational signage;
- Building parallel facilities;
- Creating transit access; and
- Providing bicycle and pedestrian access.

Innovative tools included:

- Roundabouts;
- Quadrant Roads (See Figure 2.1);
- Median U-Turn Intersections (See Figure 2.2);
- Continuous Flow Intersections (See Figure 2.3);
- Land use plans to reduce demand on the roadway system, respecting surrounding development (livable centers, transit-oriented development, walkable mixed use development); and
- Implementation of improvements through public/private partnerships.

Access management tools may be classified by the amount of time required for implementation- short, medium, and long term. Short, medium, and long term tools were all considered as part of this study to address access management issues.

Figure 2.1: Quadrant Road

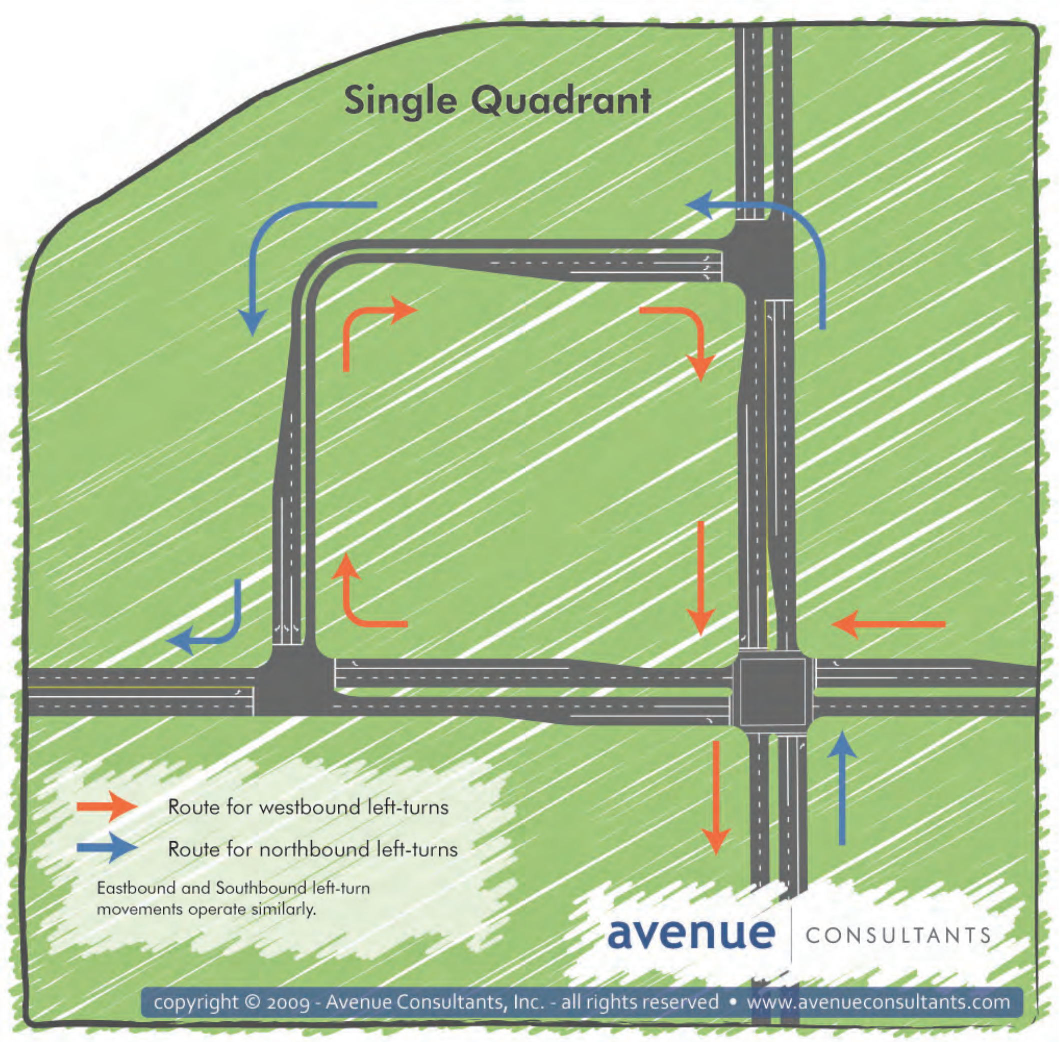
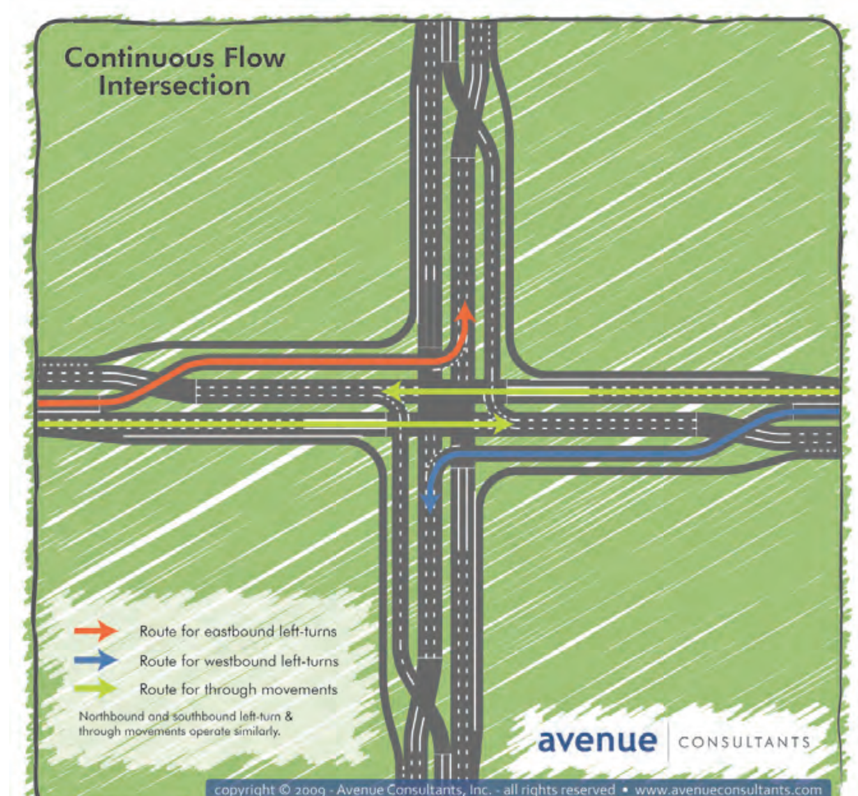


Figure 2.2: Median U-Turn Intersection

Figure 2.3: Continuous Flow Intersection



REVIEW OF PREVIOUS STUDIES AND EXISTING DATA

Previous plans, studies, and data were gathered and reviewed. Data covered all transportation modes and land uses adjacent to the corridors. In addition, regulations applicable to the corridors were researched. Information was compiled to create a picture of current conditions for presentation to the public and as a baseline for further analysis. Data sources are provided in Appendix F.

Morning and evening traffic conditions were observed in the study area. These data were used to evaluate existing conditions and identify specific deficiencies. Additional research included an inventory of driveways and intersections, land use and buildings, signal locations and timing, crash locations, internal site circulation, traffic counts, lane geometry, general signage, pedestrian and bicycle facilities. This information is presented in the following chapters and in the appendices.

ANALYSIS OF EXISTING CONDITIONS

Analysis of existing conditions included:

- Identifying applicable regulations from TxDOT, Harris County, the City of Houston, and the City of Jersey Village, for access management and improvements;
- Identifying constraints based on cost of acquiring right of way in built out areas;
- Determining level of service for each intersection and arterial segment within the corridors;
- Analyzing the impact of traffic signal timing and location;
- Analyzing crash data;
- Evaluating land use and transportation interaction within the study area; and
- Analyzing connectivity among the various transportation modes (passenger/commercial auto, freight trucks, bicycles, pedestrians, buses, commuter and passenger rail).

Existing conditions established the baseline for further analysis. A detailed description of the analysis of existing conditions is presented in Chapter 3.

PUBLIC MEETING #1 AND CONSULTATION

Public Meeting #1 was held on October 15, 2009 from 6:00 to 8:00 PM at the Copperfield Church. The meeting began with a thirty minute open house in which participants talked with the study team and viewed maps of the study area with information on existing facilities, intersection levels of service, and crash frequencies. After the open house participants assembled in small groups, each with a facilitator, to carry out a set of activities to identify travel patterns, issues with the corridor, and other metrics vital to the study. In these activities, attendees:

- Indicated their travel patterns on the corridor;
- Helped develop a list of evaluation criteria (measures of effectiveness) which would be used in rating solutions;
- Voted on and ranked the evaluation criteria in terms of importance;
- Rated segments of the corridor based on safety issues, travel delay, and other criteria;
- Developed a list of issues and concerns related to specific locations on the corridor;
- Wrote about strategies that would achieve their long term vision; and
- Rated the relative importance of issues related to the study.

The final activity was in survey form and the same survey was publicized and made available online for a period of 30 days following the meeting. Surveys were used to give participants a confidential opportunity to share their opinions. Input from Public Meeting #1 and the online survey was used to establish priorities and evaluation criteria for proposed solutions. For results from the Public Meeting #1, see Figures 2.4 -2.7 and Appendix H.

Figure 2.4: Public Meeting 1 - Survey Respondent Characteristics

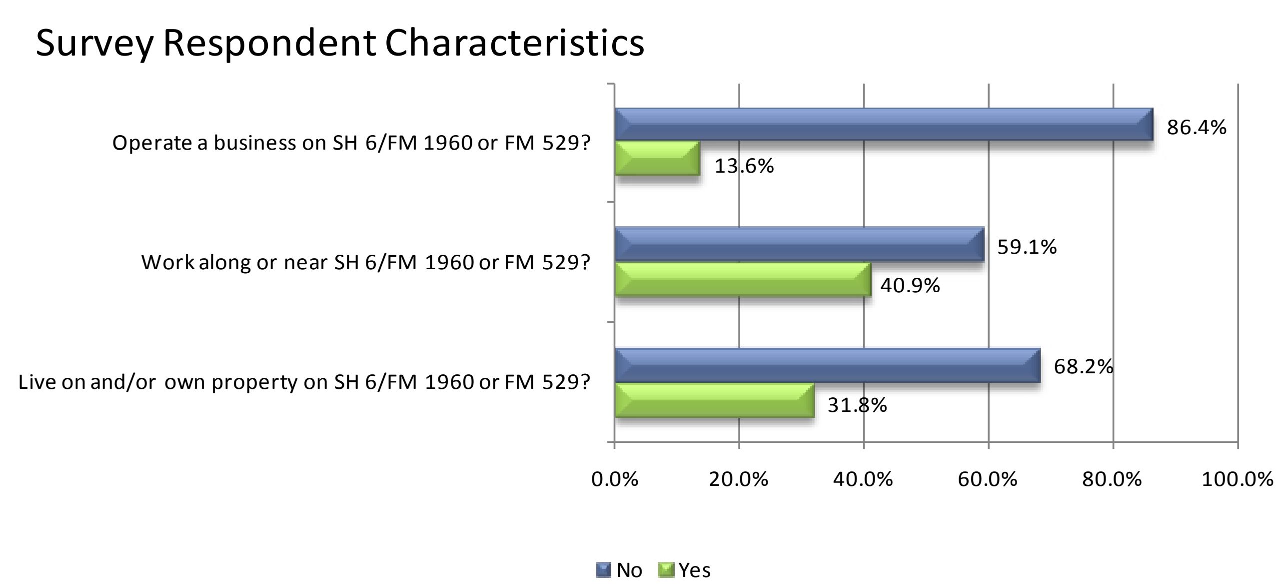


Figure 2.6: Public Meeting 1 - Acceptance of Improvements

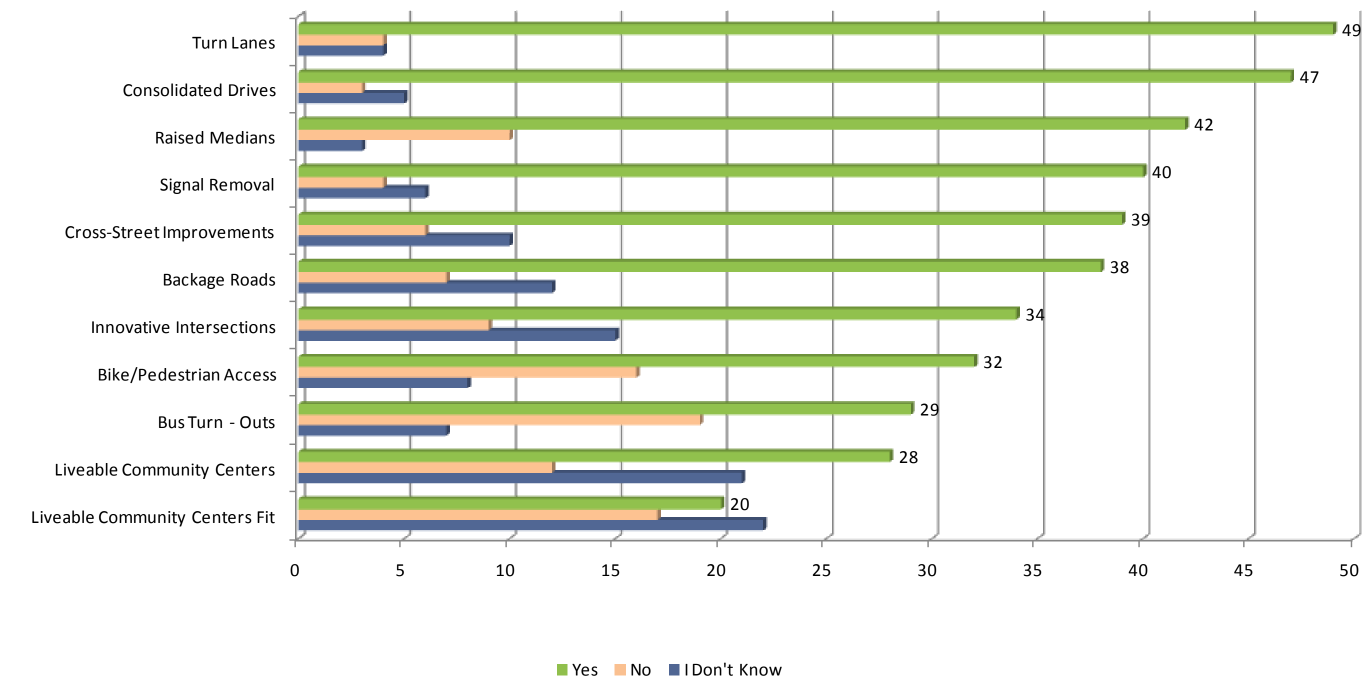


Figure 2.5: Public Meeting 1 - How do you use SH 6 and FM 529?

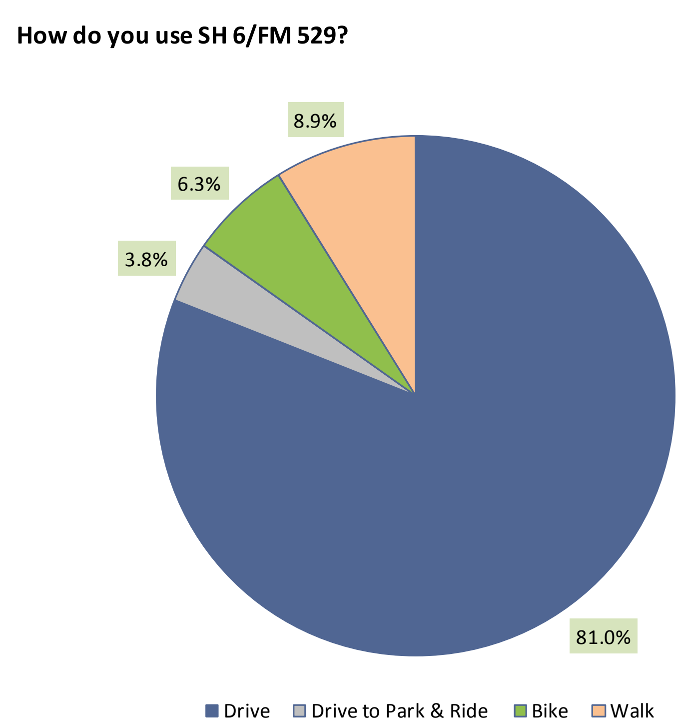
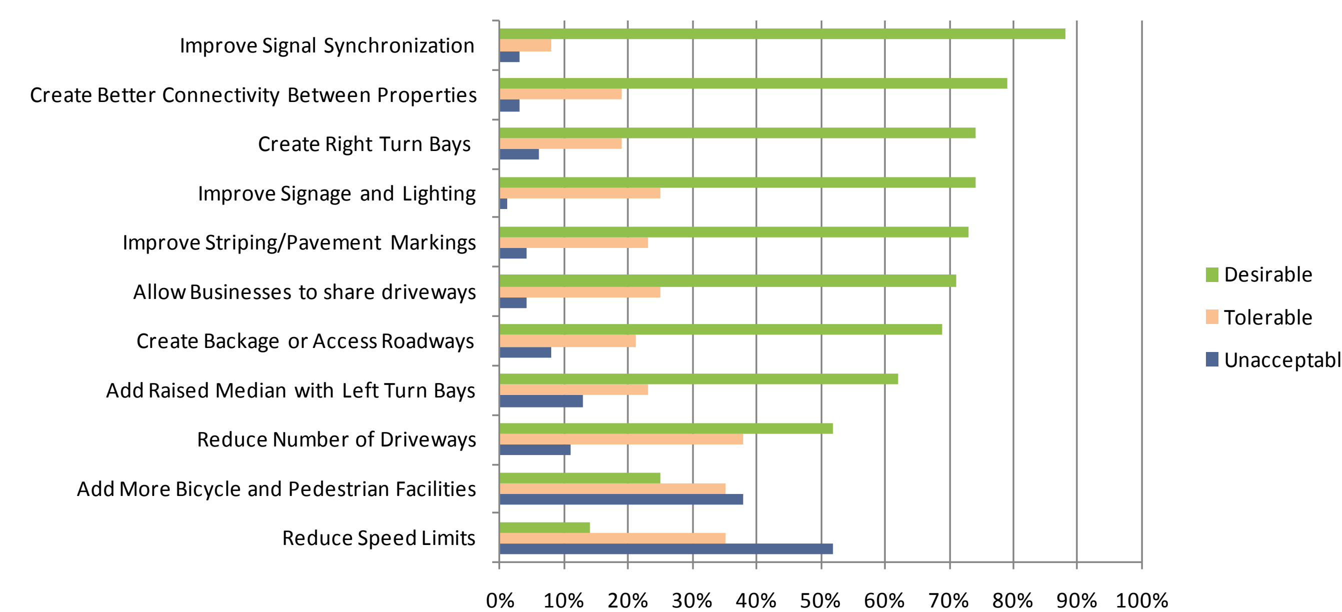


Figure 2.7: Public Meeting 1 - Desirable Methods of Adressing Mobility Issues



Meetings were held with a number of groups in the community as part of the consultation process. Consultation increased community knowledge of the proposed changes, built community understanding and support for implementation of the project, increased input and review, and ensured context sensitive solutions and multi-modal transportation system development. The study team met with the following groups throughout the public involvement process:

- Copperfield Coalition
- North Houston Association
- West Houston Association
- Cy-Fair Chamber of Commerce
- Katy Economic Development Council
- Katy Independent School District
- Cy-Fair Independent School District
- Cy-Fair Volunteer Fire Department
- Houston Fire Department

IDENTIFICATION OF SPECIFIC ISSUES

Input from the public was used in conjunction with analysis of existing conditions to define specific access management issues to be addressed. These issues included:

- Poor driveway spacing and design;
- High number of crashes;
- High number of conflict points;
- Reduced mobility (congestion and travel delay);
- Access to businesses;
- Large amounts of cut through traffic;
- Lack of interconnectivity of land parcels;
- Poor signal spacing;
- Periodic flooding;
- Corridor mobility during hurricane evacuation;
- Visual clutter (e.g. signage, utility poles, vegetation, etc.);
- Reduced air quality;
- Deficiency of transit options;
- Deficiency of bicycle facilities;
- Deficiency of pedestrian facilities (sidewalks);
- Lack of interconnectivity between modes;
- Difficulty in accessing future commuter rail line along US 290;
- Challenge of additional travel demand on the existing system;
- School accessibility;
- Difficulty for emergency responders;
- Economic vitality of the corridor; and
- Poor parcel interconnectivity.

SELECTION OF TOOLS

Tools were selected to fulfill project goals and objectives. Tools were evaluated for effectiveness, difficulty of implementation, time for implementation, cost, requirement of right of way, and effects on safety and mobility. Tools were also evaluated based on criteria established through the public involvement process.

Participant Comments from Public Meeting #1:

I would like to see raised medians along the entire corridor. Landscaping with local communities and home owner's associations for smart growth that is appealing. Also limit the number of access points for businesses.

Time traffic lights to improve traffic during peak times....Innovative intersection designs @ Jones to 1960 & Hwy + 290 & 1960

DEVELOPMENT OF PROPOSED SOLUTIONS

A set of recommendations was developed along with specific improvements to address identified access management challenges. Proposed solutions included bicycle, pedestrian, transit improvements, and development of livable centers in the study area. These proposed solutions were presented at Public Meeting #2 to obtain feedback.

CRITICAL ANALYSIS OF SOLUTIONS

Analyses were conducted to determine how proposed solutions would affect the study area in the interim year of 2019, and the ultimate year of 2035, paying special attention to the ranked evaluation criteria. Future traffic volumes were provided by H-GAC to assist in the development of 2019 and 2035 traffic forecasts for SH 6 / FM 1960 and FM 529. These years were used for analysis. The schedule for improvements is dependent on available funding.

Evaluation criteria were based on input from the public involvement process to ensure that success would be based on the expressed views of the community, and solutions would be context sensitive. A holistic set of solutions was prepared to meet the public's identified needs and criteria for successful solutions.

PUBLIC MEETING #2 AND CONSULTATION

Public Meeting #2 was held on April 6, 2010, from 6:00 to 8:00 pm at the Copperfield Church. The meeting began with an open house, in which participants talked with the study team and viewed maps and exhibits depicting preliminary designs and recommendations. Recommendations were based on analysis of corridor conditions, input from the public, and professional knowledge. In addition to roadway, bicycle, and pedestrian improvements, recommendations included designs for livable centers. Participants looked carefully at the exhibits, engaged with the study team, asked questions, gave feedback and highlighted areas of concern.

After the open house, participants were seated and listened to a presentation about the status of the project including background, results from Public Meeting #1, the online survey, and preliminary designs and recommendations. The study team covered proposed solutions and rationales for implementing them. The presentation was followed by an extended question and answer session. Participants then gave additional input through a survey, which was also made available online.

Recommendations were also vetted with regional stakeholders and the H-GAC Steering Committee. TxDOT noted the need to clarify and provide detailed median opening information. In response, the study team developed a comprehensive recommendation and accompanying exhibit that delineated specific median location recommendations and received comments. Additional stakeholder outreach was conducted to solicit further input on the proposed recommendations from local school districts, emergency response agencies, and business and community organizations.

REFINEMENT OF DRAFT SOLUTIONS

Based on specific comments from the public, modifications were made to median locations and operational improvements. Public involvement was a key component in the development of context sensitive solutions. Criteria developed and prioritized by the public were used in the analysis of alternatives for addressing the access management issues and concerns.

BUSINESS OPEN HOUSE

After the first two public meetings, H-GAC's project manager and the study team determined that the business community needed additional opportunity to view the preliminary results of the study. A Business Open House was held on September 14, 2010, from 7:30 am to 2:00 pm at the Copperfield Community Center. The meeting was publicized through local chambers of commerce and all local business people were invited to attend.

Throughout the day people dropped in, met with the study team, asked questions, viewed exhibits and recommendations, and raised potential concerns. This meeting gave the study team insight about the project from a business perspective.

FINALIZATION OF RECOMMENDATIONS

Recommendations were finalized, taking into account public input from the first two public meetings, stakeholder consultation, and the Business Open House. The final set of recommendations included estimated time frames, improvement costs, and potential methods of funding and implementation. The final recommendations are provided in Chapter 5 and Appendix C.

PUBLIC MEETING #3

Public Meeting #3 was held on November 18, 2010 from 6:30 to 8:00 pm at Copperfield Church. The meeting was held as an open house for the public to see all plans and recommendations, to interact with the study team, discuss and comment on the report before it was adopted by H-GAC and set for implementation. Results are provided in Appendix H.

PRESENTATION OF FINAL REPORT

All necessary adjustments were made and the results of the study were published in this final report, which was presented to H-GAC.

CHAPTER 3: EXISTING CONDITIONS

To fully understand existing conditions, physical characteristics and operational data were reviewed, and SH 6 / FM 1960 and FM 529 were observed under morning and evening conditions. These data were used to establish a baseline for proposed access management solutions. Data sources are listed in Appendix F.

Physical characteristics included:

- Roadway geometry such as number of lanes, lane widths, horizontal and vertical alignment, medians, shoulders and bicycle lanes;
- Intersection configuration;
- Driveway location and spacing;
- Signage, both for the roadway and visual impact of signing outside the right of way;
- Right-of-way width;
- Presence of intermodal facilities;
- Planned facilities along the corridor;
- Land use and other regional data for the current year; and
- Published plans for improvements.

Operational characteristics of the corridors included:

- Crash data;
- Annual average daily traffic volumes;
- Intersection turning movement counts;
- Signal timing and interconnect information; and
- Issues identified by stakeholders.

Finally, legal requirements were reviewed implementing improvements and for access management criteria for all relevant jurisdictions.

REGIONAL CONNECTIVITY

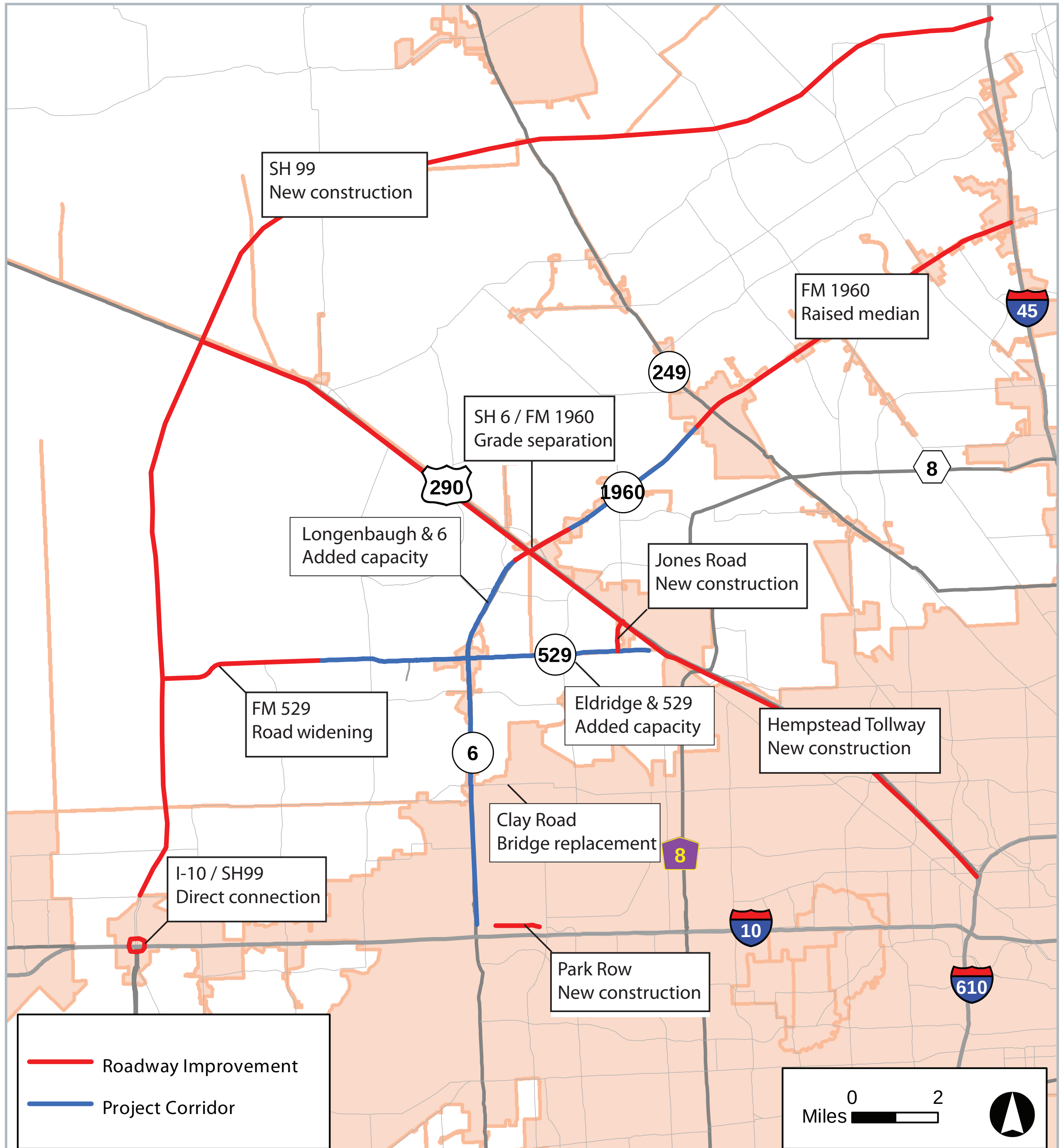
Regional connectivity is concerned with how roadways are connected to the greater region. Because traffic patterns include regional as well as local traffic, looking at connectivity leads to an understanding of the larger picture.

SH 6 provides direct access to IH-10 and US 290 within the study area. Major intersecting thoroughfares include Clay Road, Little York Road, FM 529 and West Road. These roadways provide connections to Barker Cypress Road to the west and Eldridge Parkway to the east, which are parallel connectors between IH-10 and US 290. Each parallel connector is offset from SH 6 by approximately 2.2 miles.

FM 1960 provides a direct link between US 290 and SH 249. The major intersecting thoroughfares within this segment are Jones Road and Eldridge Parkway. Both of these intersecting roadways provide a connection between FM 1960 and US 290. There are no other parallel surface roadways in the immediate vicinity which connect to US 290 and SH 249. SH 6 / FM 1960 is also designated as a Hurricane Evacuation Route.

FM 529 provides access to US 290 and Grand Parkway, a facility parallel to IH-10. Major intersecting roadways include Barker Cypress Road, SH 6, and Eldridge Parkway.

Figure 3.1: Planned Projects



PLANNED PROJECTS IN THE AREA

Considering regional planned projects is essential so that planning efforts may fit together and individual plans take into account changes happening in other locations.

There are several planned projects within the general area of the corridor study, illustrated in Figure 3.1. These projects include roadway widening, grade separation, and new alignment construction. These projects are identified in the 2008-2011 Transportation Improvement Plan (TIP) for the region and the website related to the proposed Hempstead Tollway. A proposed grade separation at SH 6 and FM 529, shown in the 2008-2011 TIP, has been removed from the TIP and is not considered for action.

The grade separation project at the interchange of SH 6 / FM 1960 and US 290 directly impacts this study. The project will be similar to the recently completed project at SH 6 and IH-10. Express lanes which currently pass over the railroad and Hempstead Highway will be extended beyond Wortham Boulevard and return to grade southwest of Eldridge Parkway.

Another planned project is the widening of FM 529 to a four-lane divided cross section from Greenhouse Road to the future SH 99 (Grand Parkway). In addition, projects are planned to provide significant capacity upgrades along the following roadways:

- US 290 (IH-610 to west of Bauer);
- Grand Parkway (IH-10 to US 290 plus direct connector ramps at IH-10); and
- Jones Road (US 290 to West Little York).

According to Houston METRO staff, there are long range plans to add bus service along SH 6. Houston METRO also has long range plans to provide commuter rail service along US 290, with a stop planned northwest of the corridor at the existing Cypress Park and Ride location.

LAND USE

Land use and transportation are closely related. Land uses place a level of traffic demand on the transportation system and rely on the system to remain viable. Therefore, it is important to consider the interface between existing land use and the transportation system to see the type of demand generated and how the system responds to that demand.

A general picture of land use in the study area is shown in Figure 3.2. Land use patterns consist of commercial development along portions of SH 6 / FM 1960 and to a lesser extent along FM 529. Single family and multi-family uses are located along the main corridors and some distance away from the corridor. There are some heavy industrial uses along the eastern portion of FM 529. Overall, land uses are separated with limited connections between different uses and limited mixed use development. The land use pattern is relatively low density. Land uses for subareas are detailed below.

Development along SH 6 from Clay Road to FM 529 has followed traditional suburban patterns with strip commercial development along the primary roadways and residential communities spread out beyond. This pattern is broken up by Bear Creek, which is part of the Addicks Reservoir Watershed.

Development along SH 6 from FM 529 to US 290 is the result of a master planned community. While retail fronts SH 6 in this area, signage requirements, driveway spacing and landscape easements set the Copperfield neighborhood apart. Stricter driveway spacing and signage requirements are reflected in a lower number of crashes in this area. Langham and Horsepen Creeks and major utility easements have deterred the continuation of these development patterns along this segment of roadway.

Development along FM 1960 from US 290 to Mills Road has followed traditional suburban patterns with strip commercial development along the primary roadways and contained residential communities spread out beyond. This pattern is broken up by White Oak and Green Bayous. These bayous are the primary tributaries of the White Oak Bayou and Green Bayou Watersheds, respectively.

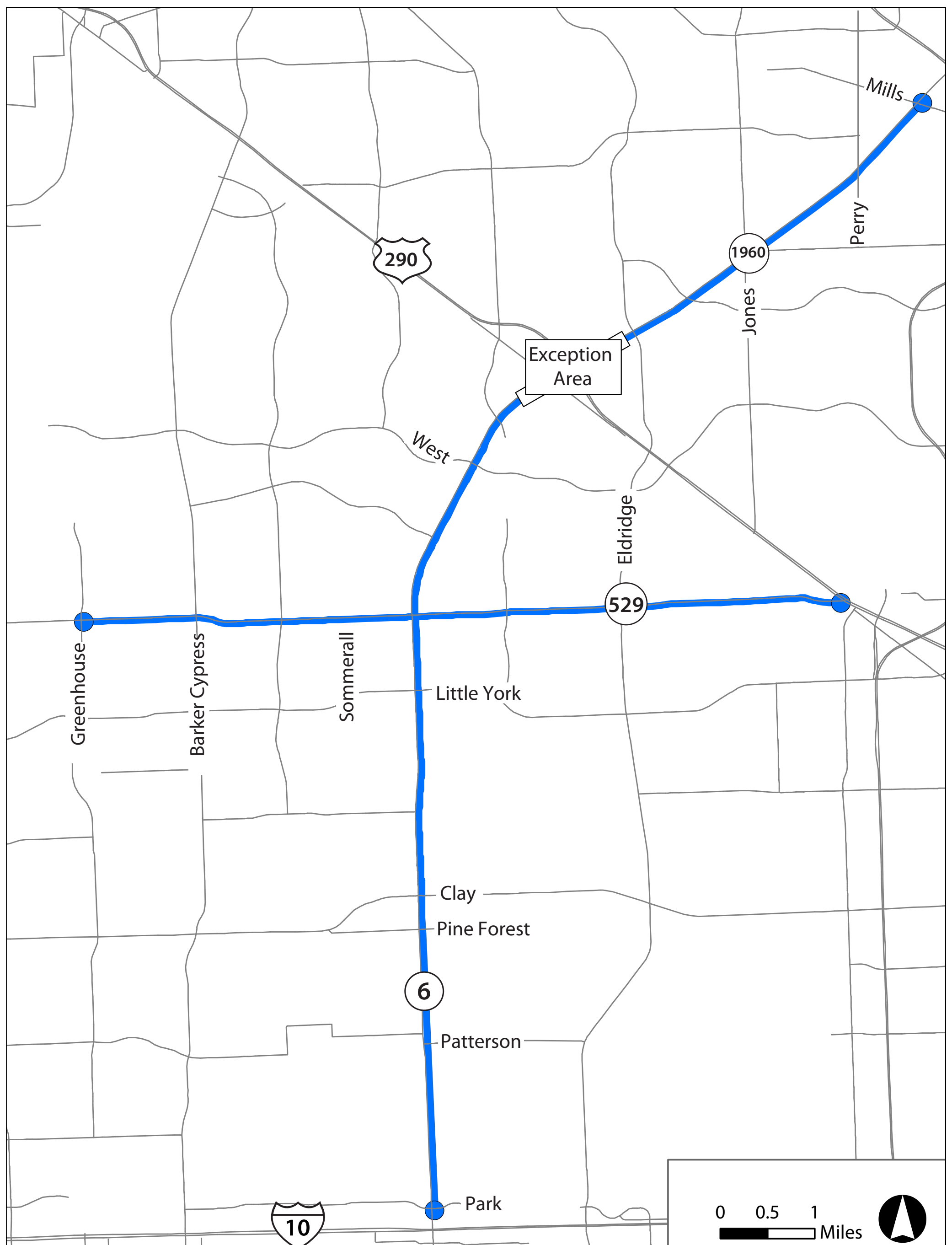
Development along FM 529 from Greenhouse Road to US 290 includes both traditional suburban patterns with commercial and residential uses as well as some heavy industrial uses located on the east side of the corridor. This development pattern is broken up by Bear and Langham Creeks that are part of the Addicks Reservoir Watershed.

Figure 3.2: Land Use Concept Map

ROADWAY CHARACTERISTICS

In this context, roadway characteristics refers to the physical dimensions of roadway elements such as lane widths. These characteristics are objective descriptions of existing roadways and related facilities.

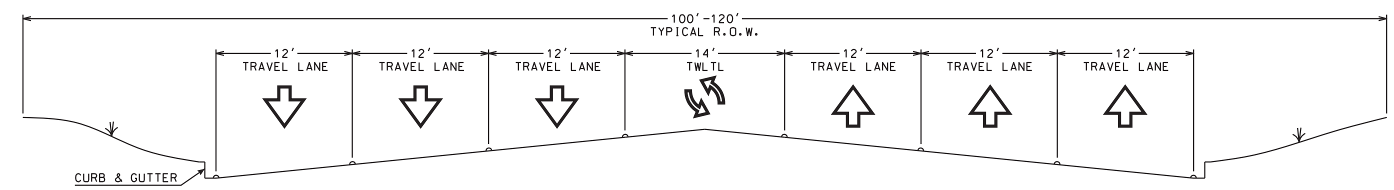
Figure 3.3: Reference Map



FM 1960

From Mills Road to US 290, FM 1960 is 4. 6 miles in length, contains nine signalized and six unsignalized street intersections, and has no signalized driveways. FM 1960 is a six-lane arterial with a two-way left-turn lane (TWLTL) and curb and gutter. The speed limit is 40 mph. This segment of the corridor has an existing 100-foot right of way. Pedestrian facilities are limited to intersection improvements and narrow sidewalks at bridges. There are no bicycle improvements, and no existing transit service on the corridor.

Figure 3.4: FM 1960 from Mills to north of US 290



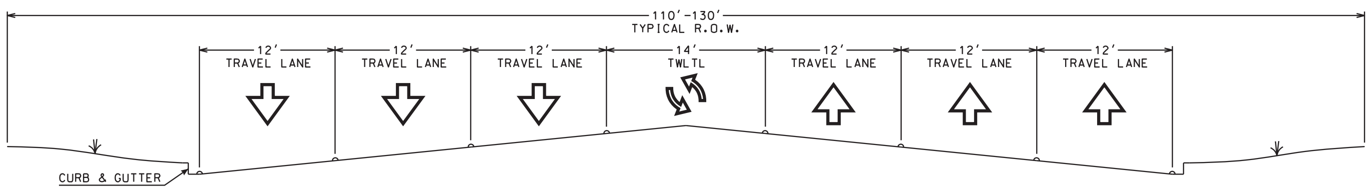
From US 290 to IH-10, SH 6 is 9.6 miles in length and contains 18 signalized street intersections, one signalized driveway intersection, and eight unsignalized street intersections. Pedestrian facilities are limited to intersection improvements and isolated sidewalk sections. There are no bicycle improvements, and no existing transit service on the corridor.

FM 529 spans 8.1 miles in the study area from Greenhouse Road to US 290. FM 529 has nine signalized and nine unsignalized intersections west of SH 6, and eight signalized and 12 unsignalized intersections east of SH 6 for a total of 17 signalized and 21 unsignalized street intersections. Within the study area, FM 529 has a 120-foot existing right of way. Langham Creek High School is located on this segment. The majority of FM 529 in the study area contains bicycle lanes. Close to major intersections such as SH 6, there is no striping, but the bicycle lanes continue on the other side of the intersection.

SH 6

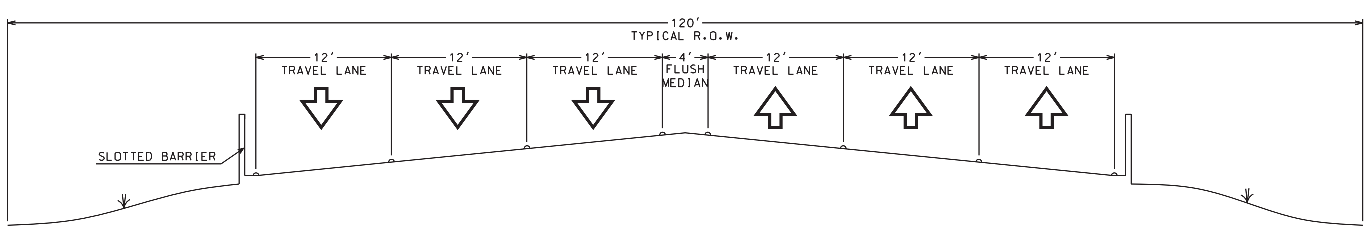
South of US 290, SH 6 is a six-lane curb and gutter section with a center two-way left-turn lane (TWLTL). Posted speed limit is 40 mph between US 290 and Pine Forest, and transitions to 55 mph south of Pine Forest. This segment of the corridor has an existing 120-foot right of way.

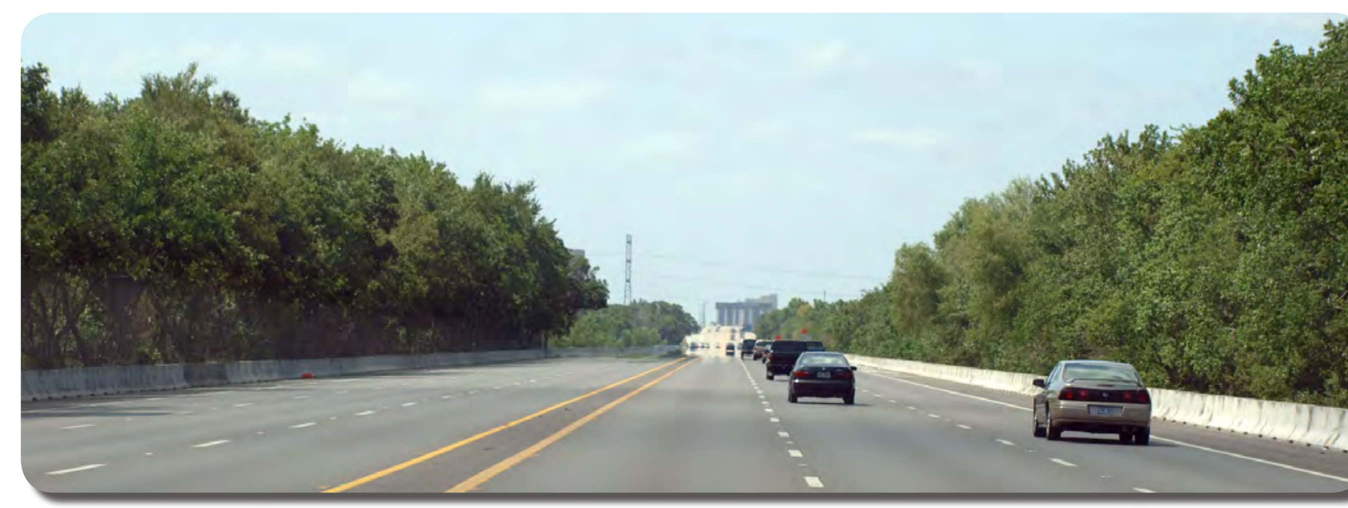
Figure 3.5: SH 6 from US 290 to Patterson



From south of Patterson Road to the Park Row overpass, SH 6 is a six-lane roadway with a painted median, shoulders, and slotted barriers at the edge of the shoulder. The posted speed limit is 55 mph.

Figure 3.6: SH 6 from Patterson to Park Row

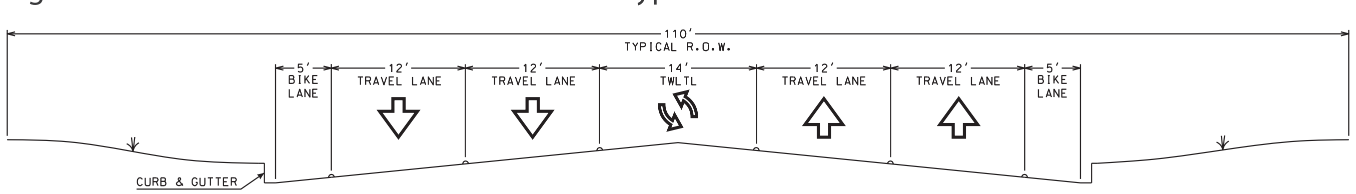




FM 529

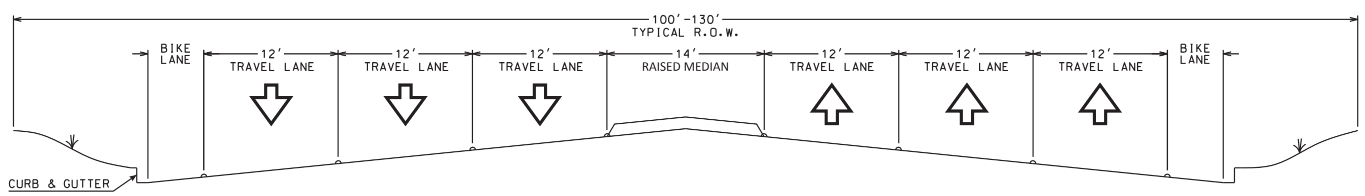
From Greenhouse Road to Barker Cypress, FM 529 is a four-lane arterial, with a two-way left-turn lane, curb and gutter. The posted speed limit of 45 mph.

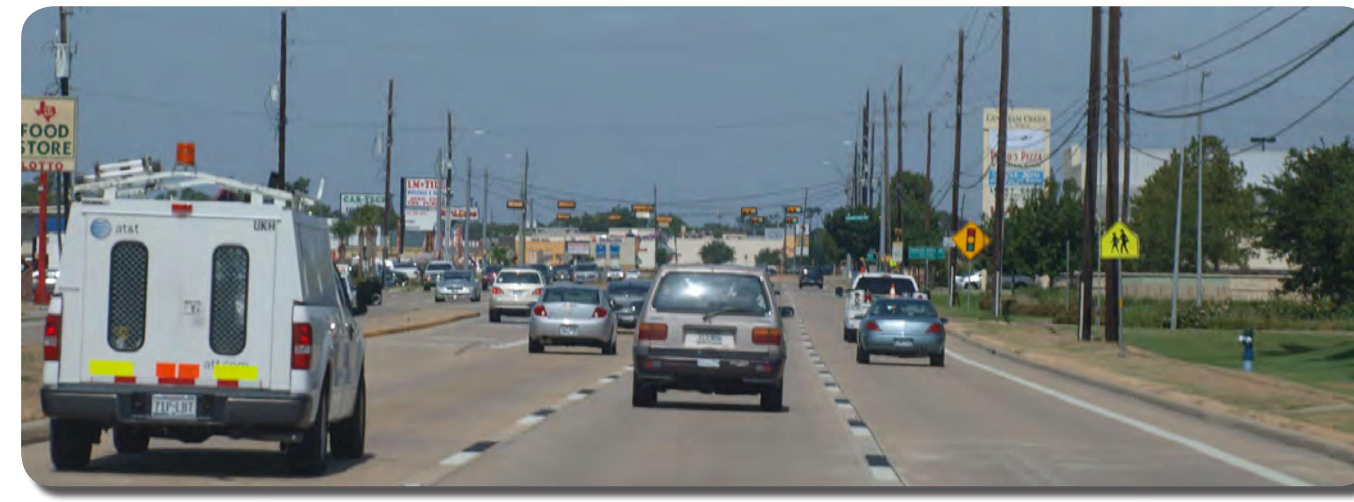
Figure 3.7: FM 529 from Greenhouse to Barker Cypress



From Barker Cypress to Sommerall, FM 529 is a six-lane arterial, with curb and gutter. This section has raised medians. The posted speed limit is 45 mph.

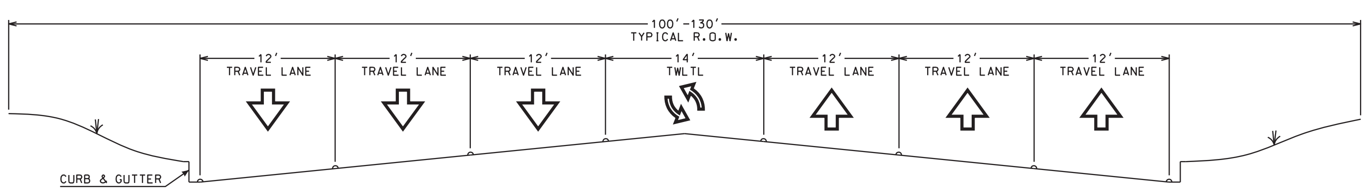
Figure 3.8: FM 529 from Barker Cypress to Sommerall

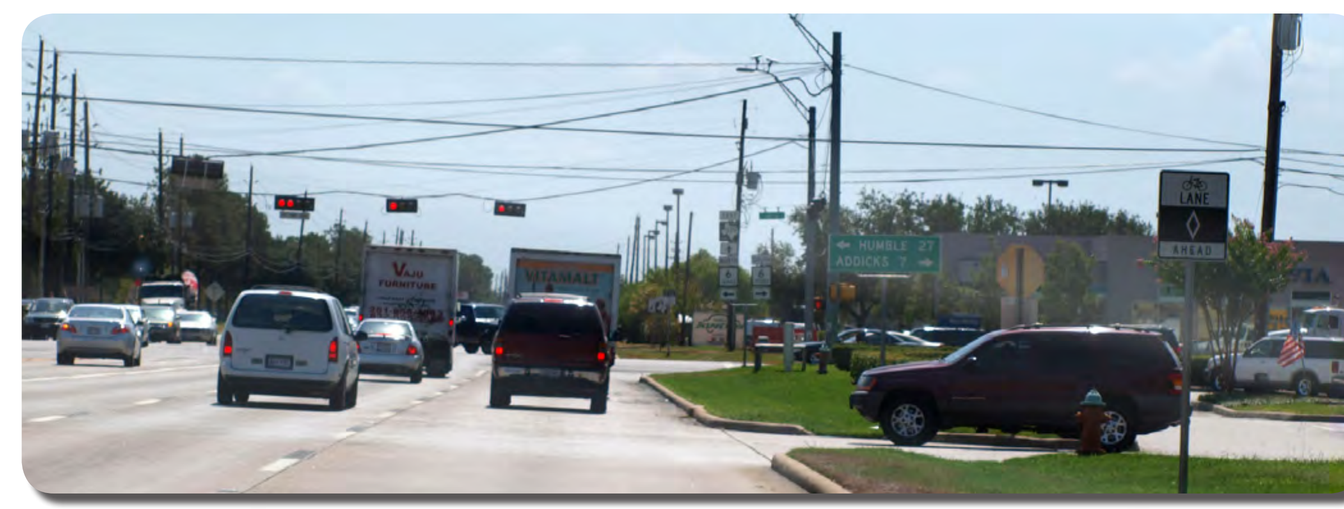




From Sommerall to SH 6, FM 529 is a six-lane arterial, with curb and gutter. This section has a two-way left-turn lane (TWLTL). The posted speed limit is 45 mph.

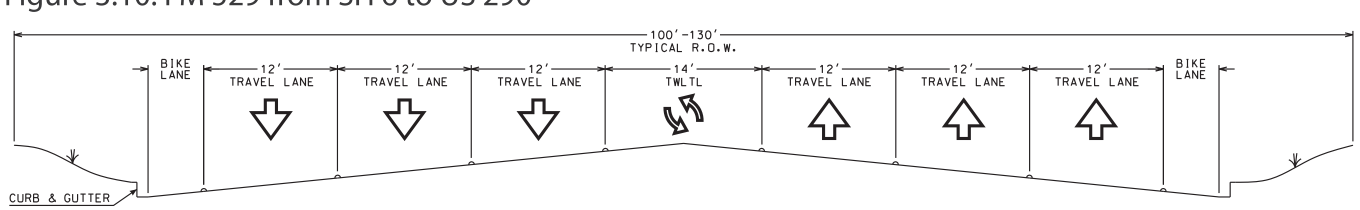
Figure 3.9: FM 529 from Sommerall to SH 6





From SH 6 to US 290, FM 529 is a six-lane arterial, with a two-way left-turn lane and curb and gutter. The posted speed limit is 45 mph. The two-way left-turn lane transitions to a raised, then painted, median at a railroad grade crossing west of Golden Gate Boulevard. Pedestrian facilities consist of intermittent sidewalks and ramps at intersections.

Figure 3.10: FM 529 from SH 6 to US 290



RAILROADS

The interface of railroad infrastructure with a roadway is important for safety reasons. There is one at-grade railroad crossing in the study area located on FM 529, west of Golden Gate Drive. This crossing is a spur off the Union Pacific Railroad (UPRR) Eureka Subdivision mainline, which provides deliveries to the Hanson Pipe and Precast facility located at 11201 FM 529. The UPRR Eureka Subdivision mainline carries five to ten trains per day. In addition, a grade-separated crossing occurs on SH 6 immediately south of US 290. This crossing is within the US 290 corridor improvements project study area, and will have minimal effect on access operational conditions along SH 6.

INTERSECTIONS

Intersections are critical points along a roadway where two or more roads meet. The status of a road's intersections is tremendously important to the road's overall operation. Lane configuration and signalization are aspects which affect intersection performance.

All signalized intersections in the study area have dedicated left-turn lanes. Only one intersection—FM 1960 and Jones Road—has dual left-turn lanes serving the major street. The only channelized right-turn lanes in the corridor are on FM 1960 at Jones Road and Perry Road. These turn lanes provide minimal storage. Access is blocked when the queue extends 60 feet from the intersection. Recent improvements at the intersection of SH 6 and Longenbaugh include the addition of a second eastbound left-turn lane.

Existing signals are located at the intersections listed in Table 3.1. In the study area four signals are maintained by the City of Houston and the rest are maintained by the Texas Department of Transportation. Traffic signal timing and phasing data were obtained from the appropriate agencies and these data are provided in Appendix A.

Table 3.1: Signalized Intersections

Signalized Intersections	
SH 6 & Patterson Road	FM 1960 & Mills Road
SH 6 & Golf Course Drive/Pine Forest Drive	FM 1960 & Eldridge Parkway
SH 6 & Clay Road	FM 1960 & Palmetto Shore Drive
SH 6 & Cairnway Drive	FM 1960 & Fallbrook Drive
SH 6 & Loch Katrine Lane	FM 1960 & Steepletop Drive
SH 6 & Kieth Harrow Blvd	FM 1960 & Jones Road
SH 6 & Addicks Satsuma Road	FM 1960 & Bobcat Road
SH 6 & Timber Creek Pl Lane	FM 1960 & Perry Road
SH 6 & Timber Creek Pl Dr/Yorktown Crossing	FM 529 & Northwinds Dr/Fairview Street
SH 6 & Little York Road	FM 529 & Greenhouse Road
SH 6 & Kingfield Drive	FM 529 & Paddock Bend Drive
SH 6 & Smithstone Drive	FM 529 & Barker Cypress Road
SH 6 & Home Depot	FM 529 & Glen Polar Drive
SH 6 & FM 529	FM 529 & Hudson Oaks Drive
SH 6 & Sugar Ridge Drive	FM 529 & Queenston Blvd
SH 6 & Ridge Park Drive	FM 529 & Spring Creek Street
SH 6 & Huffmeister Road	FM 529 & Huffmeister Road
SH 6 & Easton Commons Drive/Pebble Lake Drive	FM 529 & Eldridge Parkway
SH 6 & Forest Trails Drive	FM 529 & Golden Gate Drive
SH 6 & Willow River Drive	FM 529 & SH 6
SH 6 & West Road	FM 529 & Glen Chase Drive
SH 6 & Cherry Park Dr/Longenbaugh Drive	FM 529 & Lakeview Haven Drive
FM 529 & Jackrabbit Road	FM 529 & Hanson Parkway
FM 529 & Spring Creek Street	FM 529 & Addicks Satsuma Road

TRAFFIC DATA

TRAFFIC VOLUMES

Volume is the measure of how many vehicles are on the roadway in a given time period. Volume defines the usage level of the road.

Historical traffic volume data (2002 to 2008) for the study area were obtained from TxDOT and are shown in Figures 3.11 and 3.12. Daily traffic volumes along SH 6 / FM 1960 are consistently in the range of 45,000 to 55,000 vehicles per day. Traffic volumes generally peaked in 2006 and have fallen off slightly in the following years. Although the definitive reason for this drop is not known, it is likely that the construction at IH-10 and SH 6 caused some traffic to reroute. After construction is completed, traffic will most likely increase to previous levels.

Figure 3.11: Historical Traffic Counts along SH 6 / FM 1960

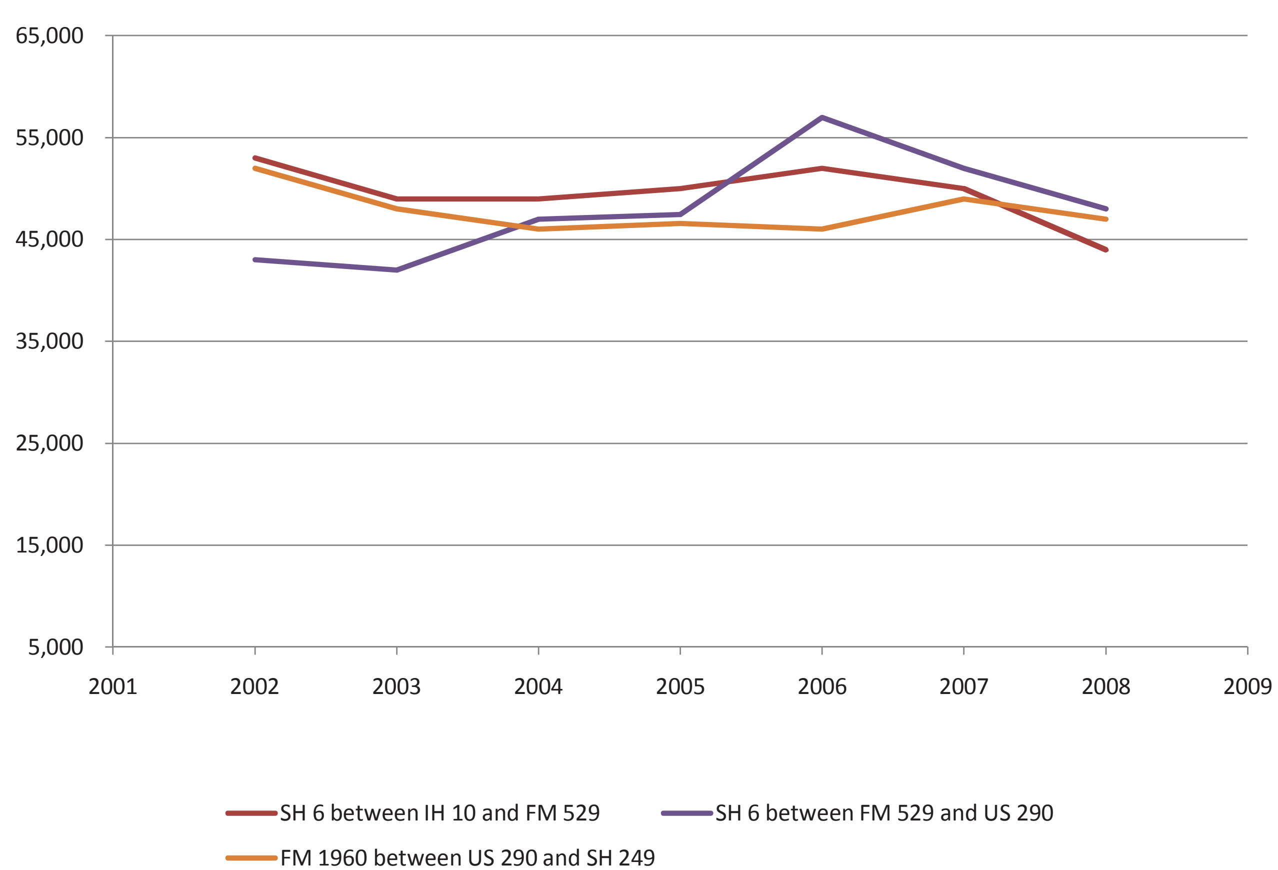
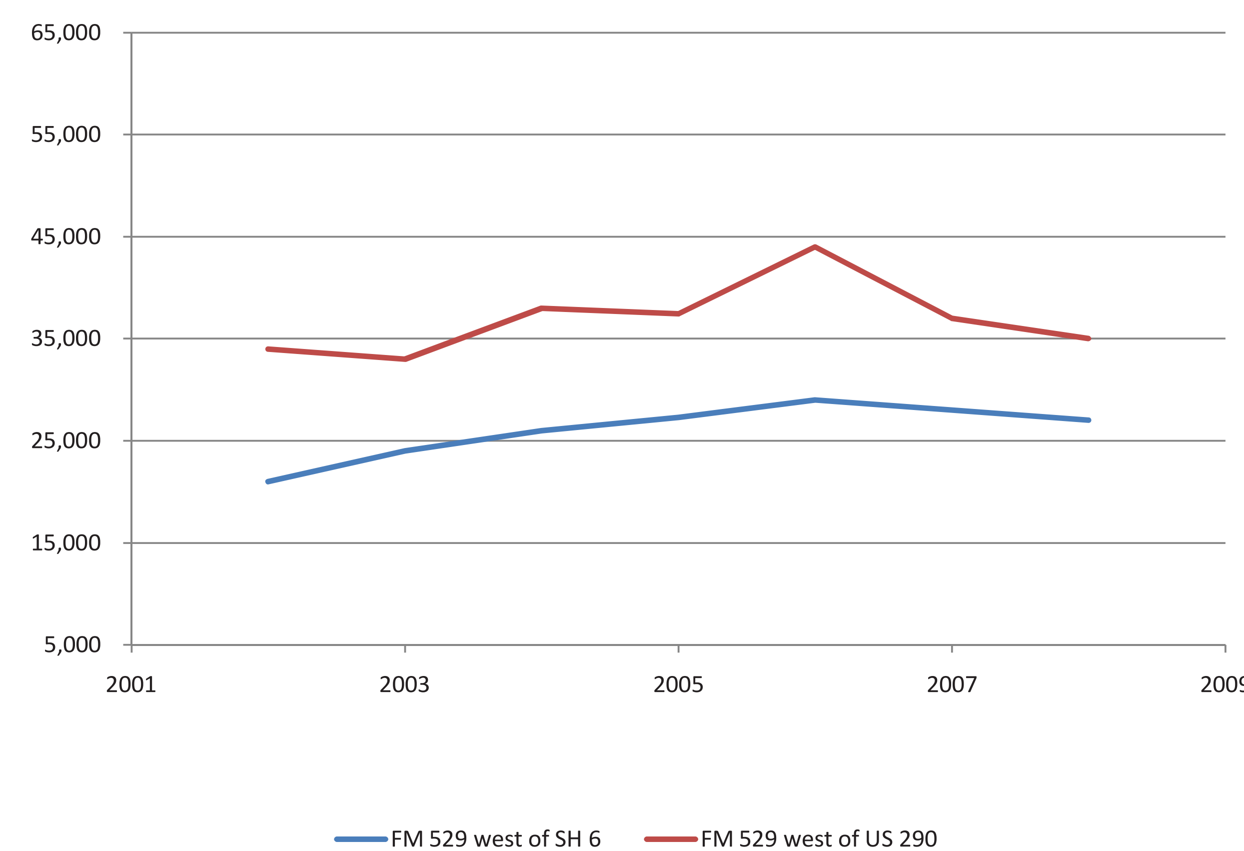
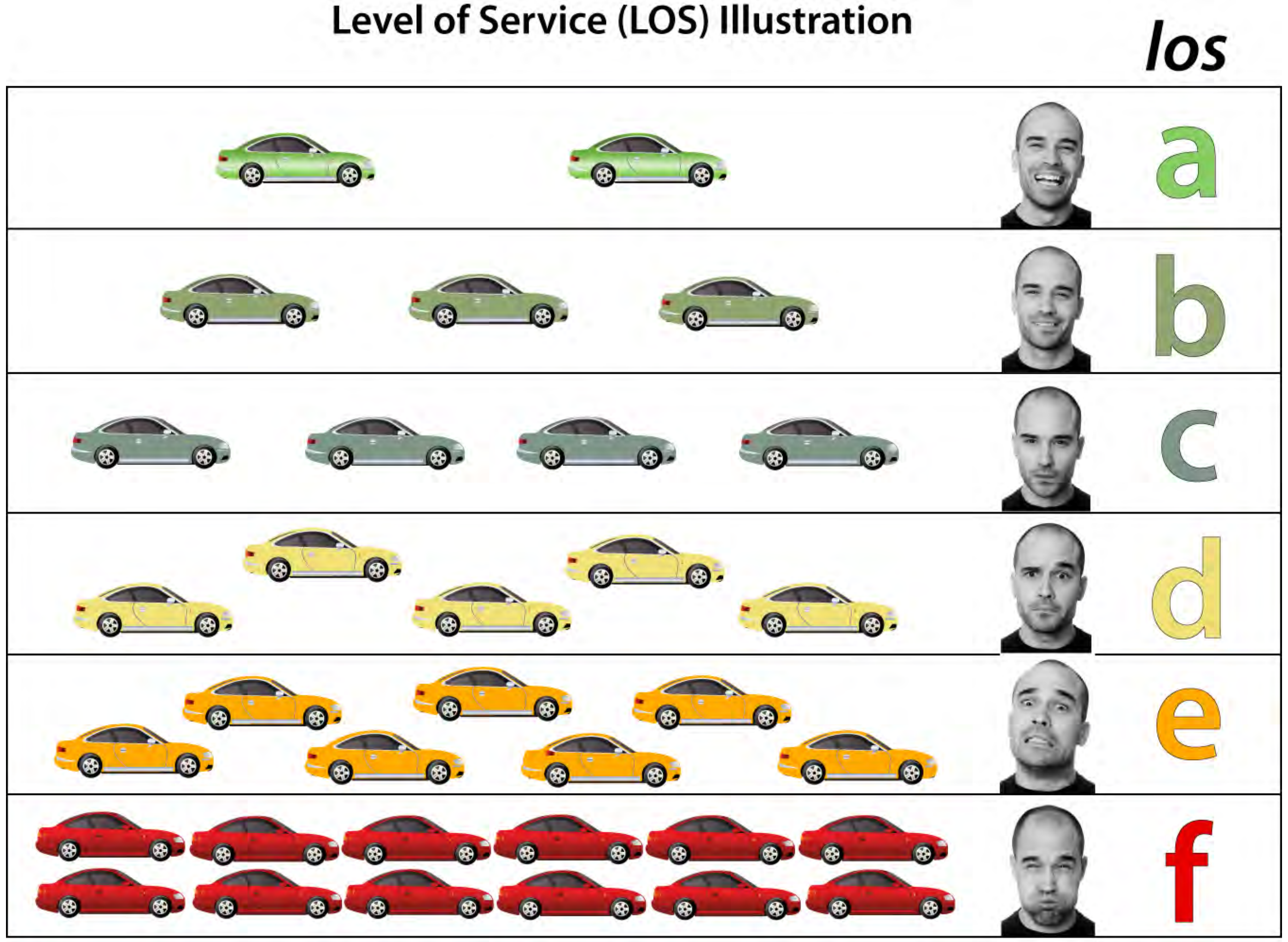


Figure 3.12: Historical Traffic Counts along FM 529



Level of Service (LOS) Illustration



LEVEL OF SERVICE (LOS)

Level of service (LOS) is a measure of traffic operations on a roadway. Level of service provides a performance index of traffic flow in terms of travel time, maneuverability, interruptions, congestion, convenience, and safety. Essentially, level of service measures delay.

Level of service is rated with one of six letter designations from A through F, with LOS A representing the best operating conditions (light traffic with minimal delay) and LOS F representing the worst (very heavy traffic with long delays). LOS D is generally considered the limit of acceptable traffic operating conditions in urban areas. The Highway Capacity Manual, published by the Transportaion Reseach Board, contains tables of average delay and average speed which are used to determine level of service. A complete list of data sources is provided in Appendix F.

For this study, level of service was measured for intersections and for arterials during peak AM and PM periods. The key difference between the two measurements is that intersection level of service considers delay for all movements at the intersection – including the main roadway and the side street –whereas arterial level of service only considers delay on through movements of the main roadway.

If an intersection has a signal cycle that makes side street traffic stop longer than the main roadway, the intersection may have a lower level of service than its arterial segment, because the side street delay is part of the equation. Likewise, high turning volumes at intersections, which reduce the amount of time allotted to through movements, can decrease levels of service.

Table 3.2 Level of Service for Intersections and Arterials

Level of Service	Intersections: Average Delay (seconds / vehicle)	Arterials: Average Speed (miles / hour)
A	≤ 10	> 35
B	> 10 and ≤ 20	< 28 and ≤ 35
C	> 20 and ≤ 35	< 22 and ≤ 28
D	> 35 and ≤ 55	< 17 and ≤ 22
E	> 55 and ≤ 80	< 13 and ≤ 17
F	> 80	≤ 13

Intersection Level of Service

To determine intersection level of service, AM and PM data were collected for the years between 2006 and 2009. Data included all vehicle movements through intersections (e.g. straight, left turn, right turn). All data were projected to 2009 using historical growth factors. Complete count data are provided in Appendix A.

The results of the 2009 intersection level of service analysis were consistent with observed traffic patterns. Major intersections—SH 6 & FM 529, FM 1960 & Eldridge, FM 529 & Eldridge—performed at level of service F for both AM and PM. Some major intersections performed slightly better in PM than in AM, because there was less turning volume at these intersections. Generally, minor intersections performed at level of service D or better. One standout result was that Jackrabbit performed at level of service F for PM. This is because Jackrabbit is being used as a cut through between West and FM 529.

Figure 3.13: Intersection Level of Service - 2009 AM

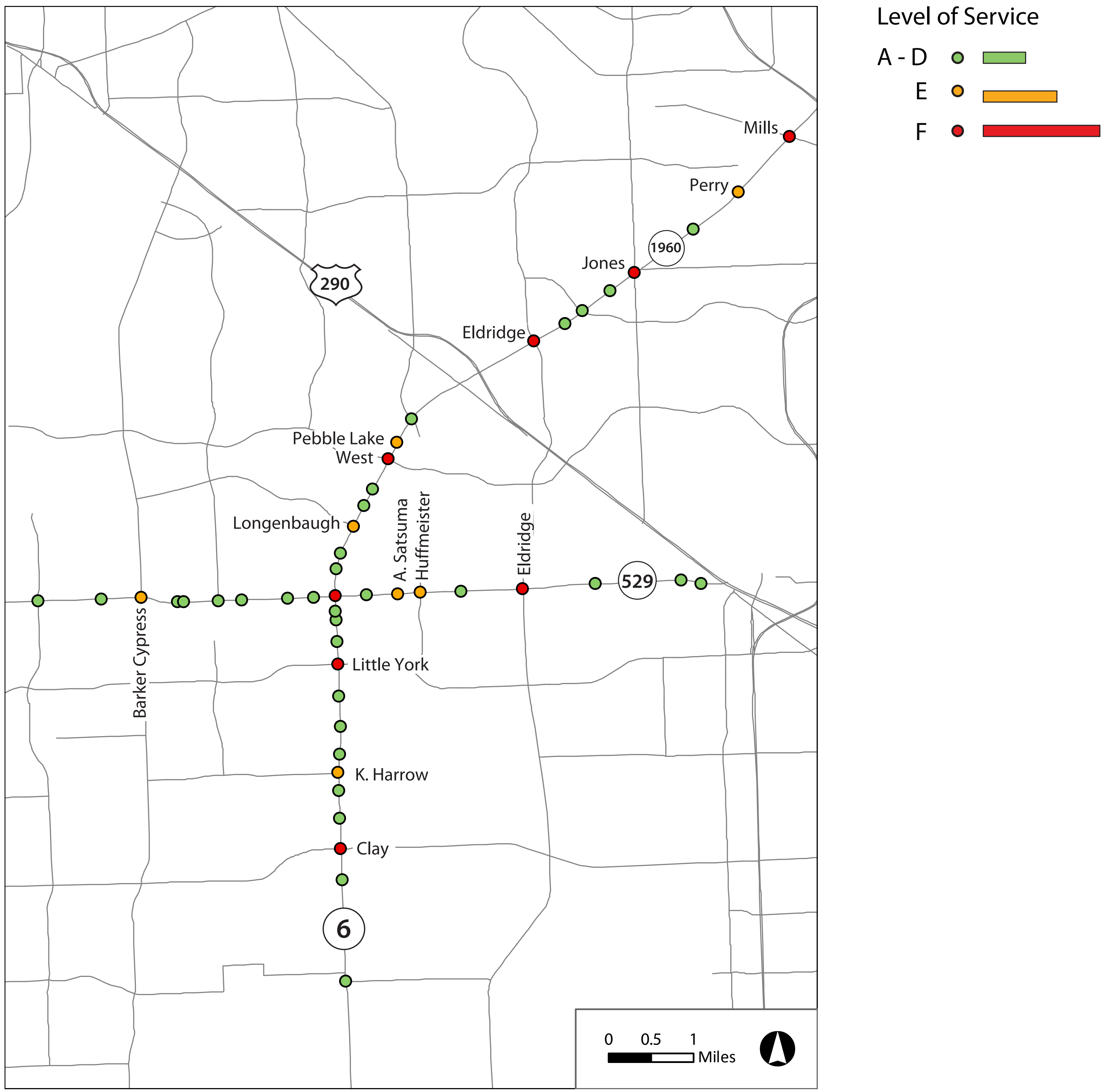


Figure 3.14: Intersection Delay (seconds) - 2009 AM

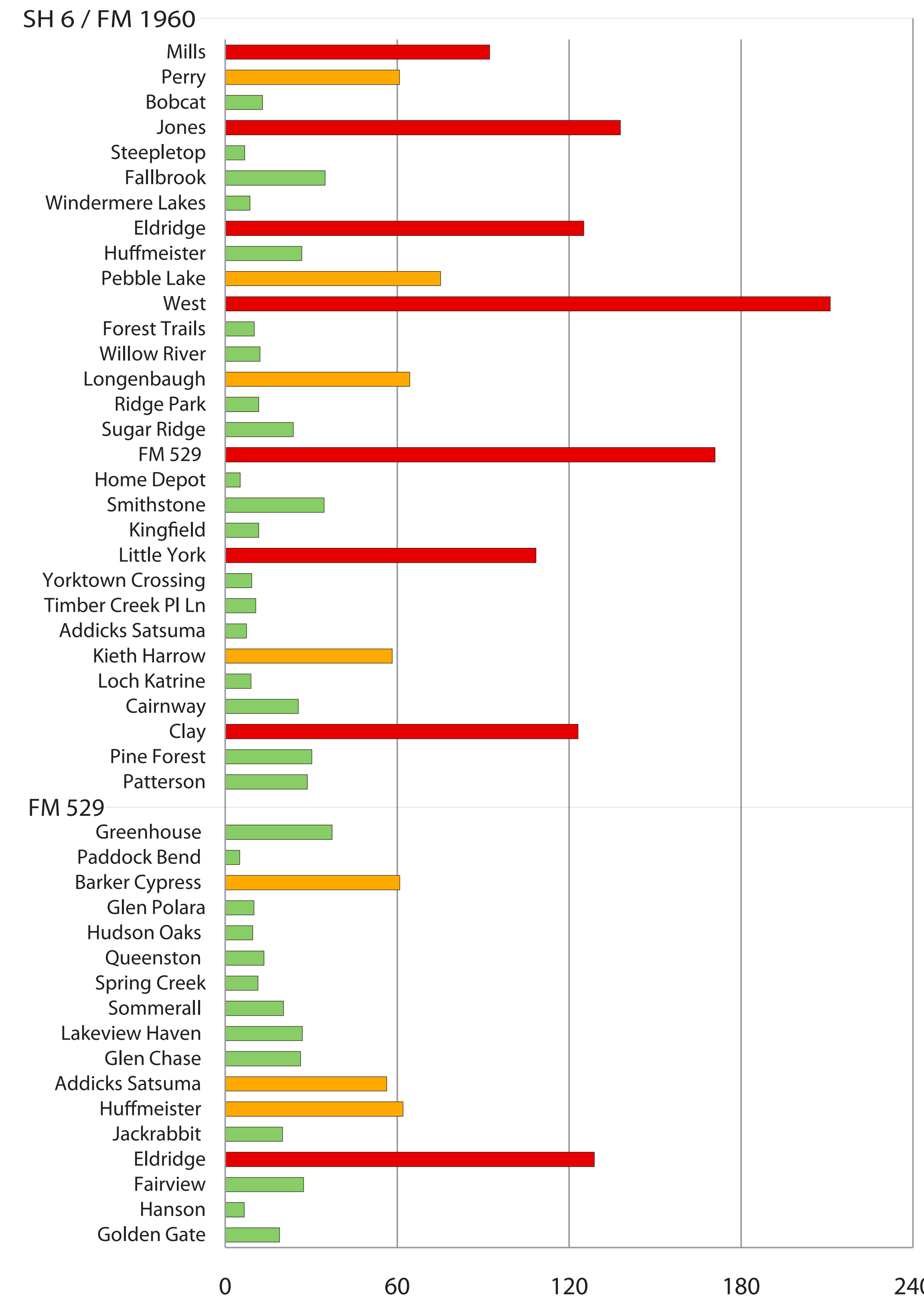


Figure 3.15: Intersection Level of Service - 2009 PM

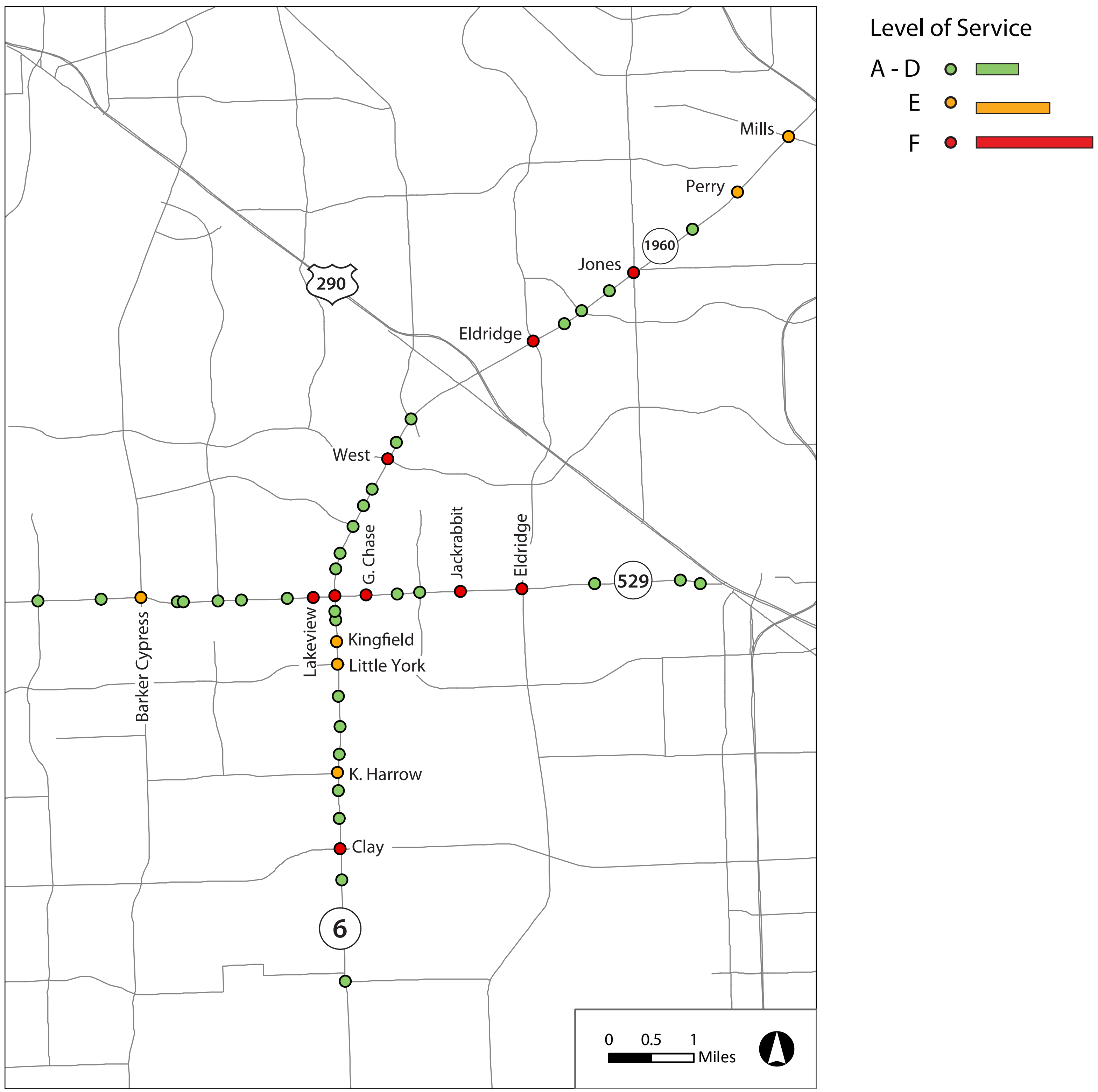
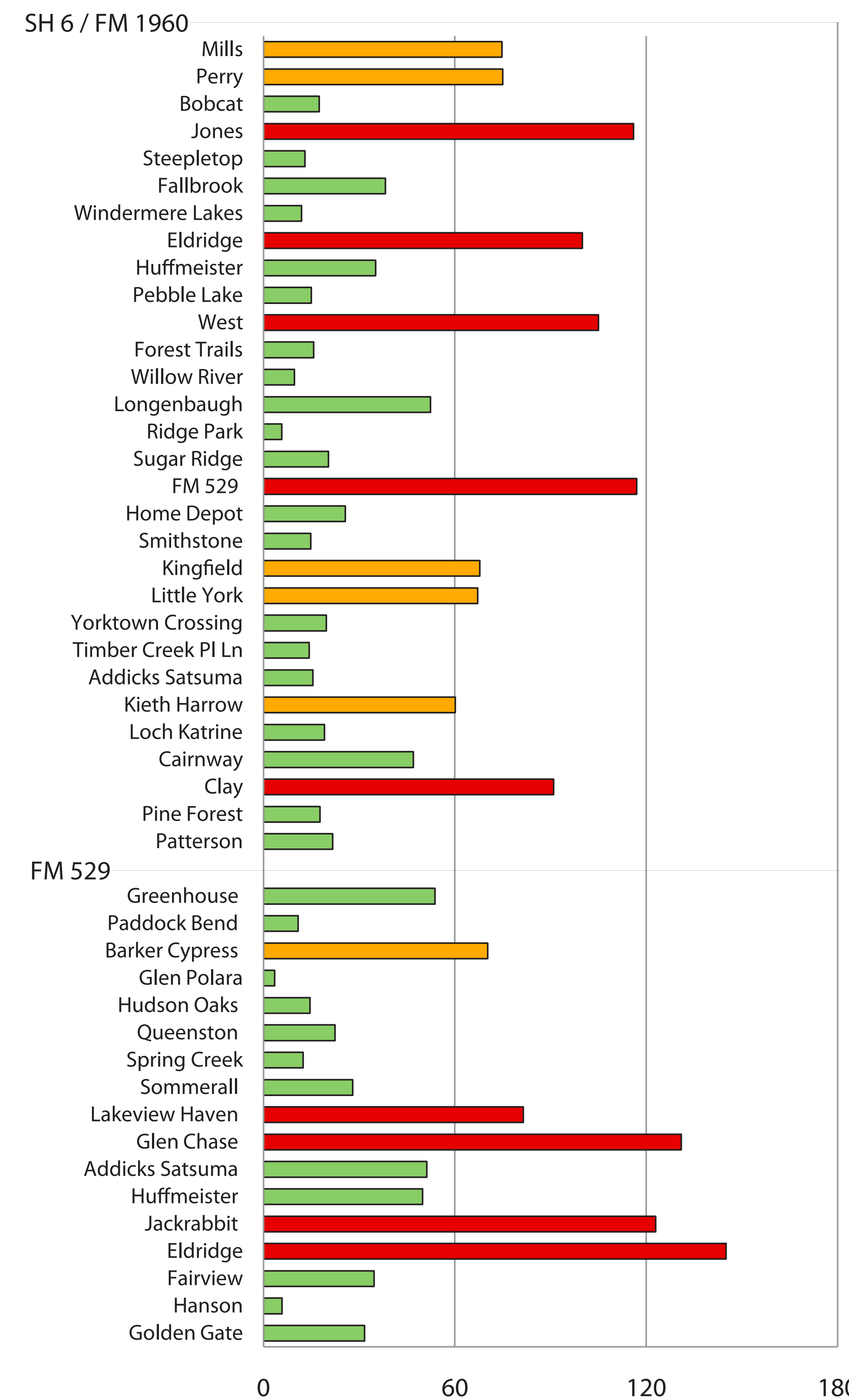


Figure 3.16: Intersection Delay (seconds) - 2009 PM



Arterial Level of Service

Arterial level of service is determined by finding the time required to travel a given segment without interference of traffic signals, adding in delay time due to traffic signals, and dividing by segment length. This calculation results in an average speed over the course of the segment. Speed can then be referenced in the Highway Capacity Manual to determine level of service.

For arterial level of service it is important to note that speed is averaged over the entire segment. If traffic moves very slowly on the first part of the segment and very fast on the second, speed is still measured as an average and it may appear that traffic moved at a moderate speed for the entire section. One caveat is that intersection delay at US 290 & SH 6 / FM 1960 was not included in arterial level of service analysis, resulting in artificially better performance for segments on either side of the US 290 divide.

The 2009 arterial level of service was consistent with observed traffic patterns. In the AM, there were major delays northbound and southbound on SH 6 / FM 1960 and eastbound on FM 529. In the PM, there were major delays along portions of SH 6 / FM 1960 northbound and southbound, and major delays on FM 529 westbound. One standout was PM southbound from Jones to US 290, which performed better than expected. As described above, intersection delay for US 290 & SH 6 / FM 1960 was not factored in, so segments adjacent to this intersection were most likely at a lower level of service than calculated.

Figure 3.17: Arterial Level of Service - 2009 AM

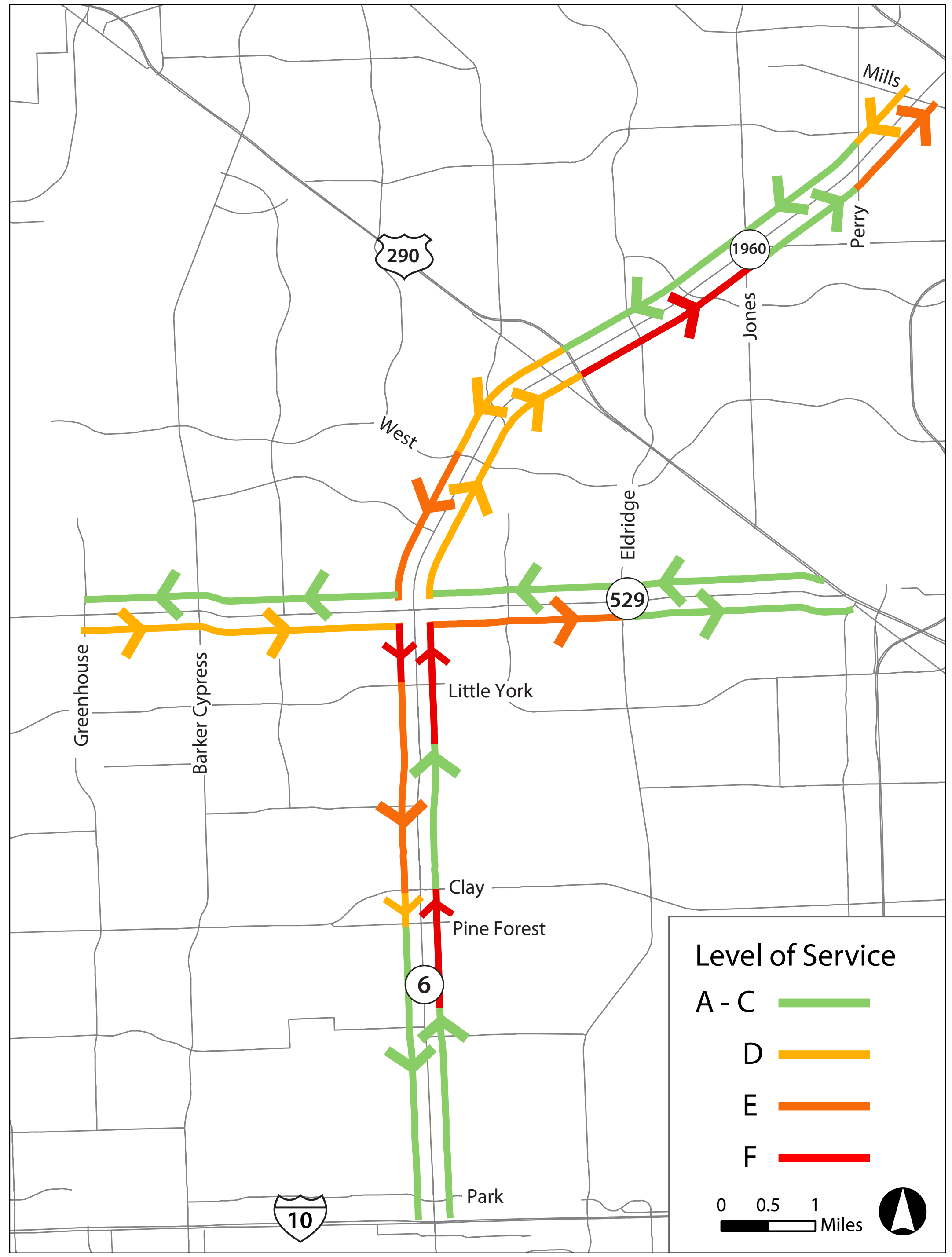
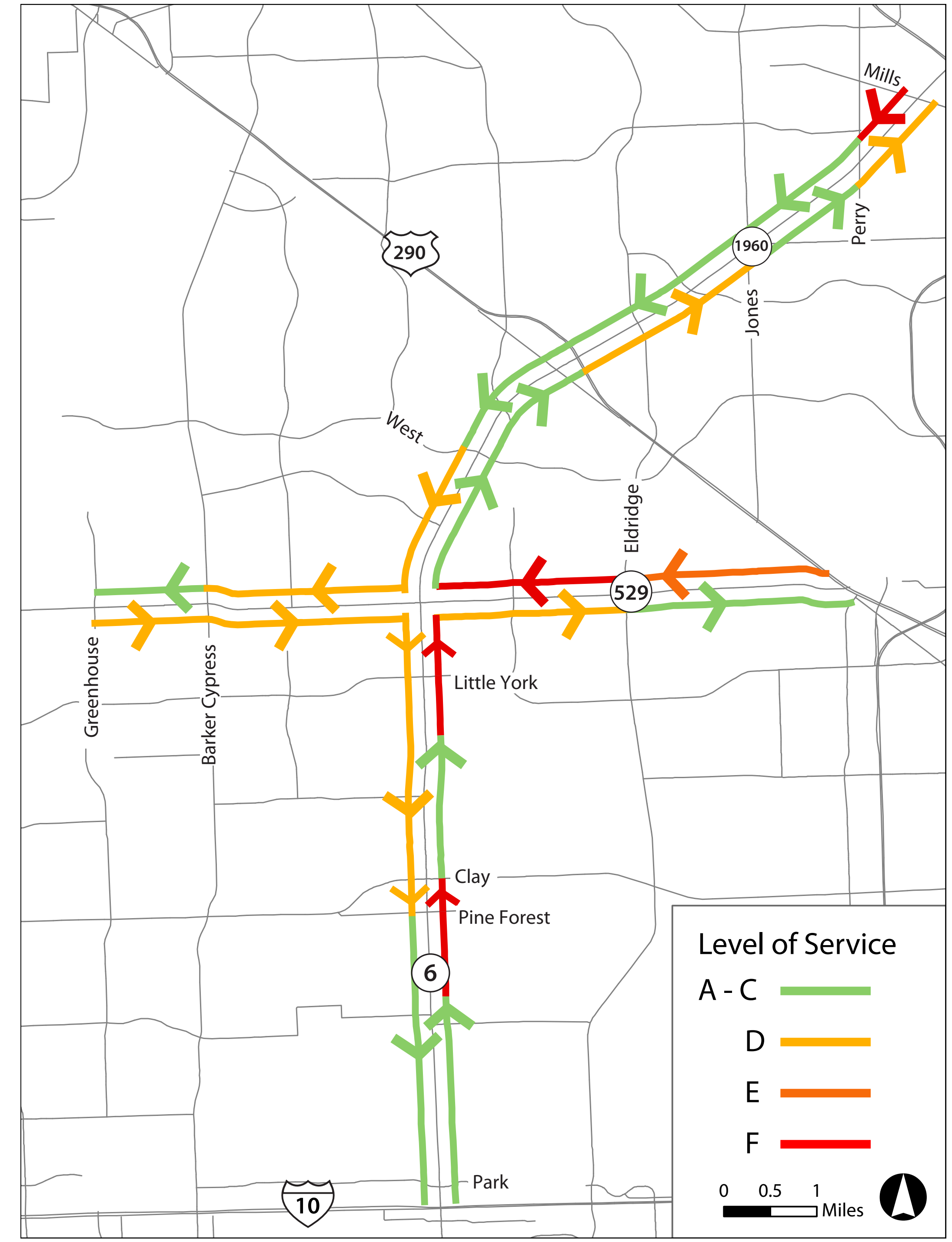


Figure 3.18: Arterial Level of Service - 2009 PM



ACCESS MANAGEMENT PRACTICES

Jurisdictions have different approaches to access management rules and enforcement. These approaches affect the location of driveways and cross streets. Locations can change over time as parcels develop, redevelop, and change street access.

Various parts of the corridor are covered by driveway and access standards from TxDOT, the City of Houston, Harris County, and the City of Jersey Village. While TxDOT criteria became more stringent in 2004, these requirements were not retroactive. Current published access criteria are as follows:

- TxDOT has minimum spacing criteria for state highway system routes within metropolitan planning organization boundaries. Spacings are based on posted speed as follows: for 40 mph, a spacing of 305 feet; for 45 mph, a spacing of 360 feet; and, for 50 mph or higher, a spacing of 425 feet. Adopted criteria also allow for variances to these spacings under certain circumstances.

- The City of Houston requires minimum offsets from intersections for non-residential driveways. Along a primary street, the offset is 100 feet; along a minor street the offset distance is 60 feet. Criteria limit the number of driveways per parcel based on frontage. A parcel with up to 170 feet of frontage is allowed 1 driveway, a parcel with 170 to 250 feet of frontage is allowed two driveways, a parcel with 250 to 450 feet of frontage is allowed three driveways, and one additional driveway is allowed for each 250 feet of frontage in excess of 450 feet.

- The City of Jersey Village has criteria for high volume driveways per lot. Along arterials, lots are allowed one driveway for under 100 feet of frontage, two driveways for 100 to 300 feet, and one additional driveway for each additional 300 feet of width. Driveways along arterials must be at least 65 feet from the intersection, at least 20 feet from adjacent driveways, and at least 10 feet from a property line.

- Harris County requires driveways on the same parcel to have separation of 20 feet or more and prohibits driveways within intersection radius returns.

DRIVEWAYS AND ACCESS

Driveways are access points to a roadway, places where vehicles enter and exit. Driveway density—the number of driveways per mile of road—has a significant influence on the functionality of the road.

A field investigation was conducted and aerial maps were reviewed to identify driveway locations along SH 6 / FM 1960 and FM 529. From this research, the team determined that there are 876 access points within the study area. Average access density is 38 access points per mile on SH 6 / FM 1960, and 42 access points per mile on FM 529. Figure 3.18 shows the driveway density per mile. A breakdown of the access densities by segment is shown in Table 3.2.

Figure 3.19: Driveway Density

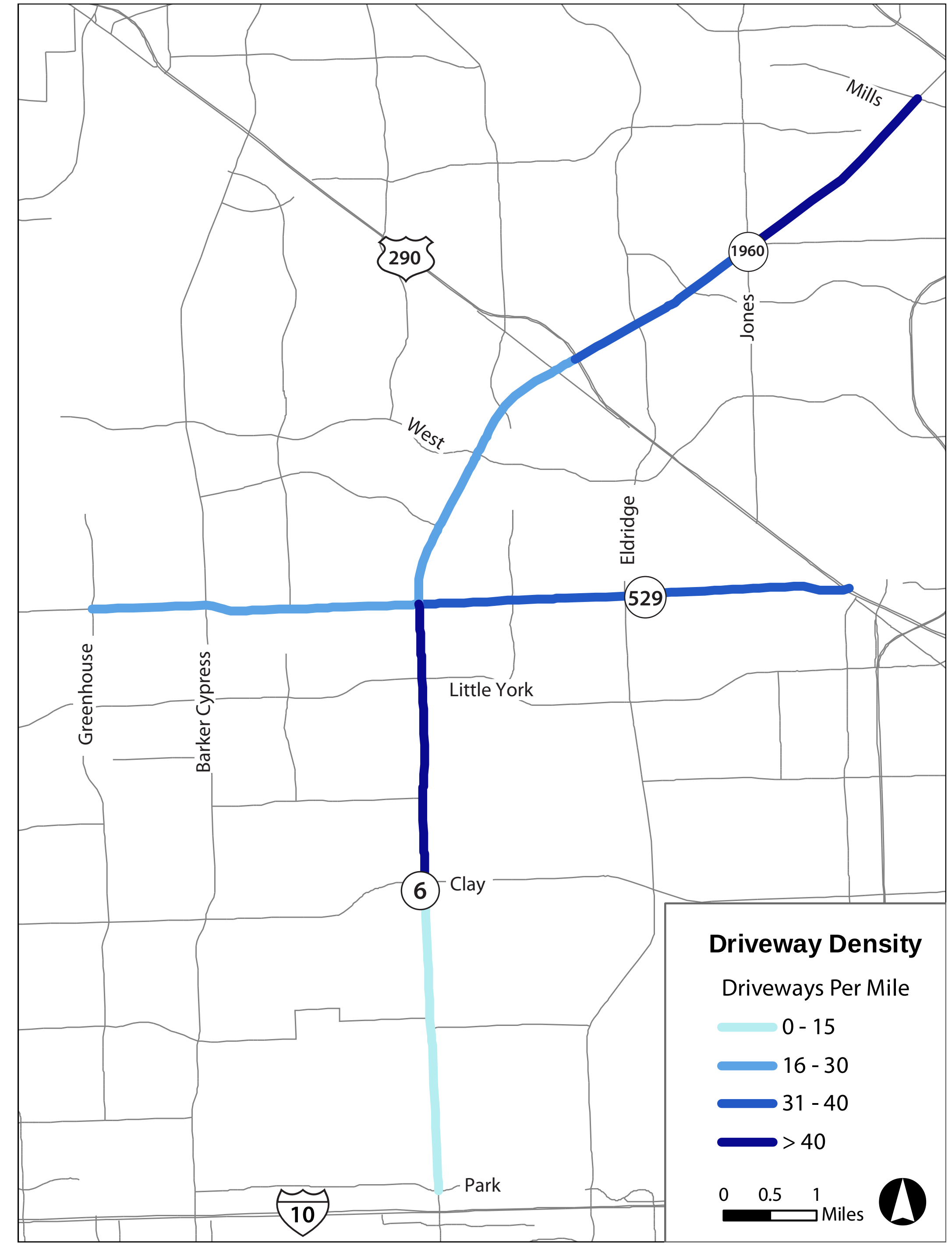


Table 3.3: Access Densities by Segment

Roadway	Limits		Access / Density			Desirable Driveway Density (driveways/ mile)*
	From	To	Driveways	Segment Length (Miles)	Driveways/ Mile	
SH 6	Park Row	Clay Road	30	3.3	9.1	8.4
SH 6	Clay Road	Little York	124	2.2	56.4	8.4
SH 6	Little York	FM 529	34	0.8	42.5	8.4
SH 6	FM 529	US 290	83	3.3	25.2	8.4
FM 1960	US 290	Jones Rd	77	2.2	35.0	6.1
FM 1960	Jones Rd	Mills Rd	114	2.4	47.5	6.1
FM 529	Greenhouse	SH 6	103	3.5	29.4	6.1
FM 529	SH 6	US 290	171	4.6	37.2	6.1

* Source: Access Management Manual, Transportation Research Board, Table 9-9, 2003; Desirable densities are based on minimum access spacing for a given posted speed.

CRASH DATA

Crash data are key indicators of roadway safety. Applied spatially, crash data can be used to assess the relative safety of specific roadway segments. A concentration of crashes in a particular location can indicate a safety problem.

Data were obtained from the Crash Records Bureau of the Department of Public Safety, for the period of January 2003 through December 2007. Current reporting requirements are for all fatal crashes, all injury crashes, and property damage only crashes in which apparent property damage is $1,000 or greater. They do not include low severity crashes in which no one is injured and property damage is minimal. Therefore, data represent only serious crashes. Data were supplied in GIS format, with crashes plotted based on reported location. Spatial accuracy was within 50-100 yards.

Crash data for intersections and their functional areas were excluded from this analysis. An intersection's functional area is approximately the storage length of its turning lanes. Crashes related to access management issues, such driveways, were considered to be of interest, rather than crashes related to intersection movements.

Figure 3.20: SH 6 / FM 1960 Crash Rate (per million hundred million vehicle miles)

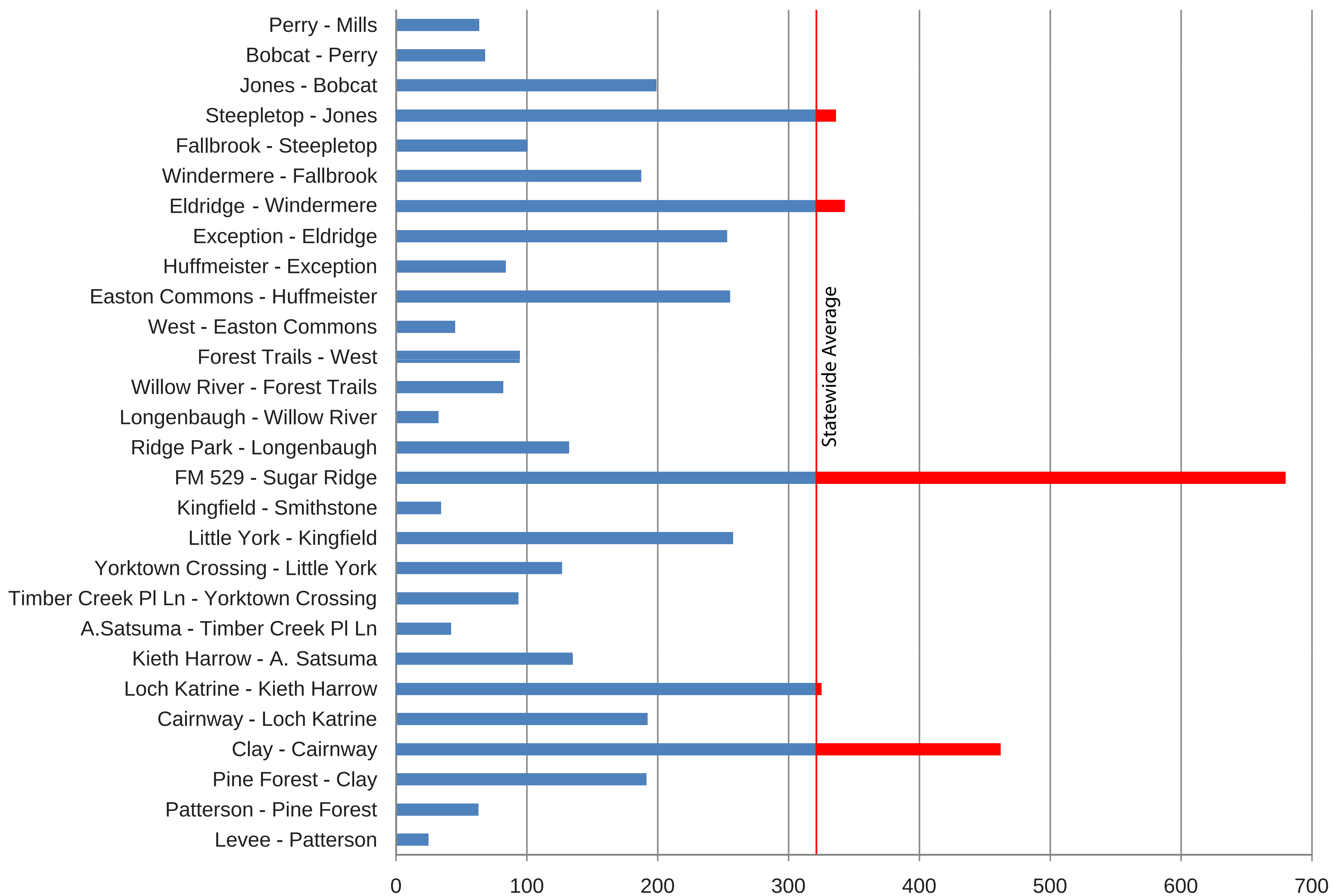
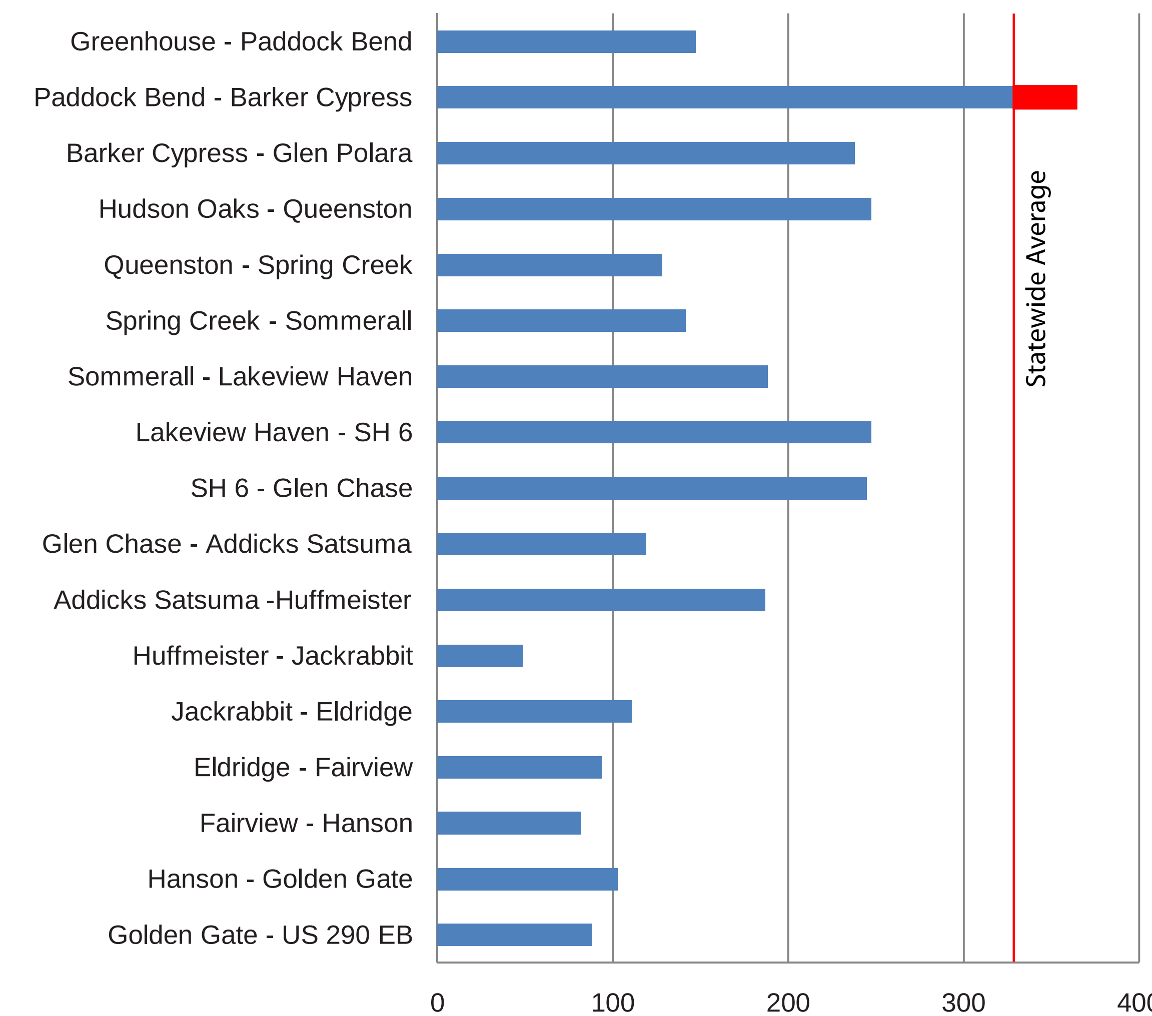


Figure 3.21 : FM 529 Crash Rates (per hundred million vehicle miles)



The following conclusions were drawn from crash data:

1. Between 2003 and 2007, there were 6,295 crashes along the study corridors. This represents an average of about 1,259 crashes per year over the five-year period or about 3.4 crashes per day.
2. There were 16 crashes that involved fatalities, with 16 people killed, which is equivalent to one fatality every 114 days. There were 2,088 crashes that involved injuries, with a total of 3,484 injuries over the five-year period, which is equivalent to 1.9 injuries per day.
3. Of the 6,295 crashes that occurred on the study corridors, 6,070 crashes (96.4%) involved two or more vehicles. 24 crashes (0.4%) involved pedestrians, with a total of 25 pedestrians affected. 13 crashes (0.2%) involved bicyclists, with 13 bicyclists affected.
4. Along the study corridors, the highest concentration of intersection crashes occurred at SH 6 & Clay, SH 6 & Jones., FM 529 & Barker-Cypress, SH 6 & Kieth Harrow, and SH 6 & FM 529. The highest concentration of crashes occurred on SH 6 between FM 529 and Sugar Ridge, and on SH 6 between Clay and Cairnway.

Figures 3.19 and 3.20 show crash rates by segment for the study corridors. The statewide average crash rate for an undivided roadway with 4 or more lanes is 319 crashes per 100 million vehicle miles traveled. As indicated in the graphs, six segments exceed the statewide average crash rate. It is significant that these segments also have high numbers of conflict points and high driveway density.

- FM 1960 from Steepletop to Jones;
- FM 1960 from Eldridge to Windermere;
- SH 6 from FM 529 to Sugar Ridge;
- SH 6 from Loch Katrine to Kieth Harrow;
- SH 6 from Clay to Cairnway; and
- FM 529 from Greenhouse to Barker Cypress.

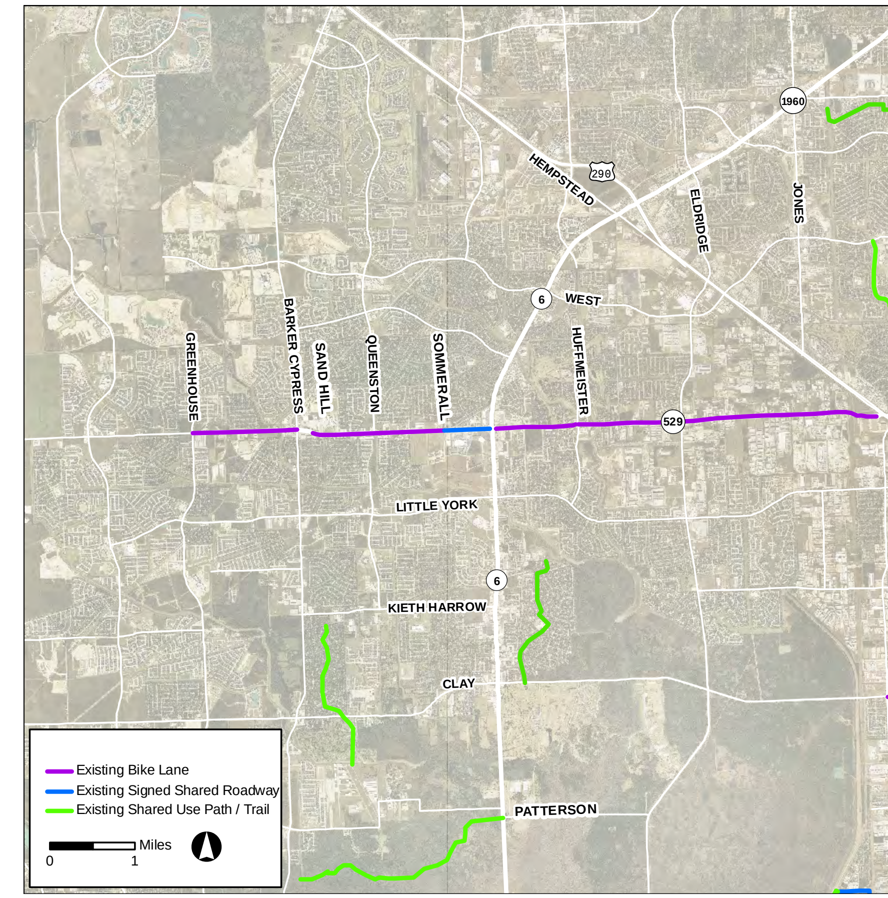
TRANSIT

With the power to provide transportation for non-drivers and reduce the numbers of vehicles on the roads, bus and rail transit are another part of the multimodal equation. There is no transit service in the corridor at the present time. Houston METRO operates park and ride facilities near the corridor: the Addicks Park and Ride at IH-10 and Park Row; the West Little York Park and Ride at US 290 and West Little York; and the Cypress Park and Ride at US 290 and Spinner Road. Trailblazing signage on FM 529 directs commuters to the West Little York Park and Ride.

PEDESTRIAN AND BICYCLE FACILITIES

The location, type, and usability of pedestrian and bicycle facilities indicate how multimodal an area is and the degree to which walking and cycling are viable and safe alternatives to vehicular transportation.

Figure 3.22: Existing Bicycle Facilities



There are a number of existing bicycle and pedestrian facilities in the study area. FM 529 is designated as a bicycle route in the 2035 H-GAC Regional Bikeway Plan. As noted above, there is a marked bicycle lane that runs intermittently along the route. However, the bicycle lane is not continuous. The bicycle lane terminates before the intersection of SH 6 and FM 529 and then continues beyond the intersection.

Pedestrian infrastructure in the corridor is generally limited to push buttons and ramps or landings at signalized intersections which do not connect to sidewalks. There are a few locations where sidewalks are provided, including several sections along 529. The longest existing section is on the south side of FM 529 from east of Barker Cypress to west of Queenston. SH 6 / FM 1960 has very few sidewalks in the study area, with the notable exception of sidewalks on bridges.
The following is a list of existing bicycle facilities along the study corridors:

SH 6 / FM 1960
- Bicycle trail on Patterson Road (west of SH 6)
- Bicycle trail on Clay Road (east of SH 6)

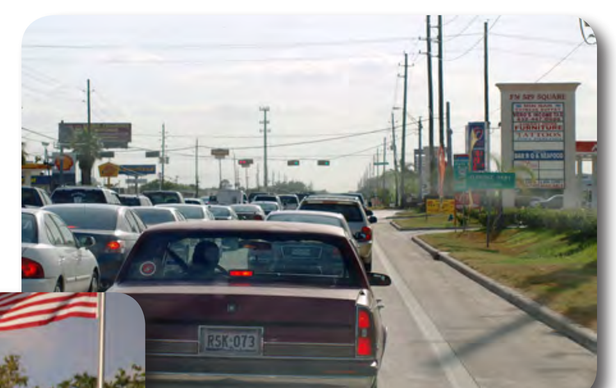
FM 529
- Bicycle lane from Greenhouse to Barker Cypress
- Bicycle lane from Sand Hill Glen to Sommerall
- Signed shared roadway from Sommerall to SH 6
- Bicycle lane from SH 6 to US 290

SIGNAGE

Signage can play several roles—to help drivers navigate, to indicate place, and to advertise. It is important to assess whether needed navigational signage is in place and to determine whether there is conflicting signage or visual distractions, as these issues can affect roadway operations.

Existing roadway informational signage consists of street signs at intersections, and advance information signage (e.g. "Queenston Next Signal") for some intersections. Notably, these signs do not include block information. In addition, there are route marker signs for state routes, bicycle route signs on FM 529, and trailblazer signs which provide directions to transportation and other facilities. Commercial signage has a significant presence along extended lengths of the corridor. In many cases, commercial signs limit drivers' ability to see signs related to traffic safety.

Along SH 6, from FM 529 to Huffmeister, there are restrictions for maximum height allowed for non-traffic signage. This portion of the study area is much less cluttered than other areas. Examples of the varying sign densities are shown in the following photos.



UTILITIES

Utility lines are typically part of the right of way and may be buried underneath roadways. It is important to consider these lines when planning major roadway modifications. Each roadway cross section within the study area includes significant utilities within the right of way. These include electric distribution transmission pipelines, water lines, gas lines, telephone lines, and wastewater lines. Designs for roadway modifications must consider these utilities and accommodate them in the right of way.

CHAPTER 4: ACCESS MANAGEMENT TOOLS

CHANNELIZED (RAISED) MEDIANS
ADDITION OF TURN LANES
SIGNAL MODIFICATION
DRIVEWAY CONSOLIDATION
ALTERNATE ACCESS ROADS
BICYCLE AND PEDESTRIAN IMPROVEMENTS
SIGNAGE
ADDITION OF THROUGH CAPACITY
INNOVATIVE INTERSECTIONS
LIVABLE CENTERS

The study team identified available tools to address access management issues in the study area, then narrowed the list to solutions which would fit the criteria established in the public involvement process and be most applicable to access management issues in the study area. This chapter defines the final list of tools and provides examples of how they are applied in the final recommendations. For a complete list of tools that were considered, see Chapter 2.

The final list of tools fell into these categories:

- Channelized (raised) medians;
- Addition of turn lanes
- Signal modification;
- Driveway consolidation;
- Alternate access roads;
- Bicycle and pedestrian improvements;
- Signage;
- Added through capacity;
- Innovative intersections; and
- Livable centers.

CHANNELIZED (RAISED) MEDIANS

A raised median is a barrier between lanes, elevated to prevent vehicles from crossing over. Raised medians restrict driveway and cross street access. As a trade-off, they allow better mobility for vehicles on the main roadway and fewer conflict points. As a center lane treatment, a raised median is an alternative to the two way left turn lane (TWLTL), which is the existing center lane along the majority of the study corridors.

Median openings should be provided periodically, approximately every quarter mile, and typically at intersections or prominent driveways. Openings do not always allow full purpose movements. For example, some openings may only allow left turns in (See Figures 4.1-4.3). Reducing the number of allowed movements at median openings also reduces the number of conflict points.

Research has shown that raised median treatments provide better safety and mobility than TWLTLs. (Iowa State University Institute for Transportation, Access Management Toolkit, 2009). Given the existing and projected traffic volumes within the corridors, and the known safety benefits of raised medians on high-volume arterial roadways, the study team recommended the installation of raised medians along the entire length of SH 6 / FM 1960 and FM 529. See Figures 4.1, 4.2, and 4.3 for examples of different types of median breaks applied in the final recommendations.

Figure 4.1: No left turns or through movements from side street

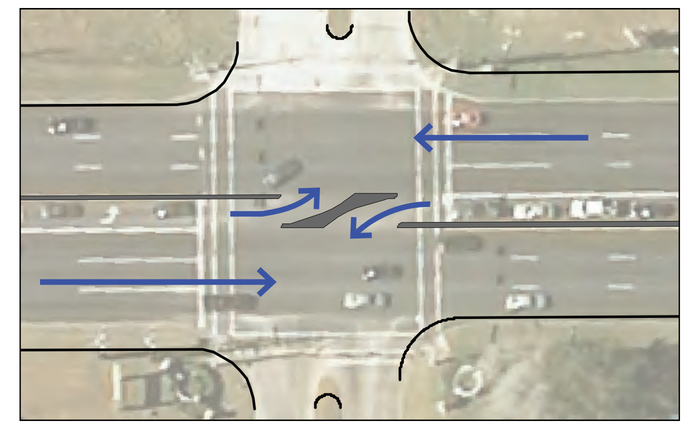


Figure 4.2: High-T Intersection: through traffic does not stop; left turning movements allowed

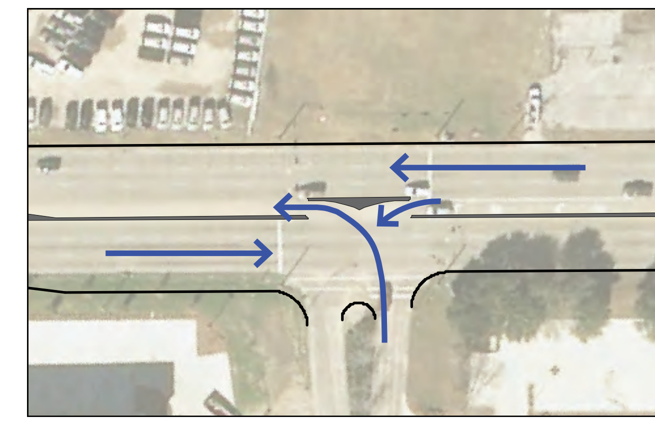
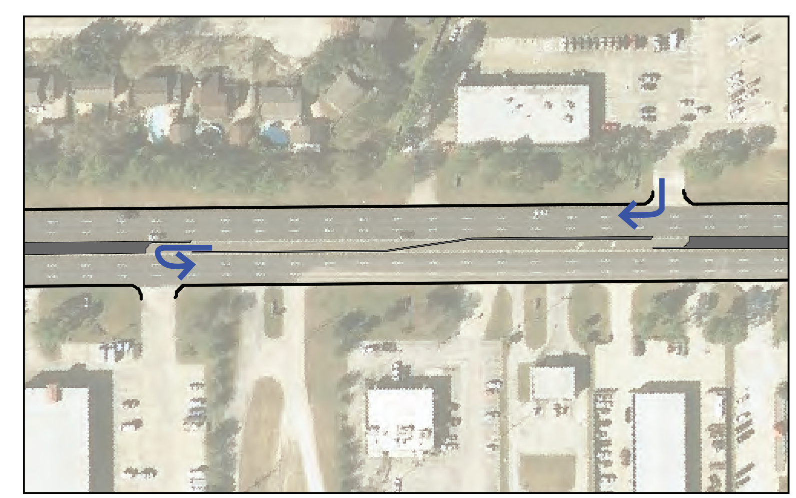


Figure 4.3: Drivers who want to turn left where no median opening exists should take a right, then make a u-turn



ADDITION OF TURN LANES

One way to improve mobility for intersections experiencing significant delay is by adding turn lanes. If a left turn lane already exists, a second one may be added to facilitate more through movement and distribute vehicle stacking between two lanes. Turn lanes can be added by reconfiguring existing lanes, or by adding new lanes.

The addition of turn lanes generally requires the acquisition of right-of-way corner clips at an intersection and may include additional right of way for the extension of a sidewalk through the amended intersection.

Two examples of the proposed added turn lanes are:

- A second left turn lane southbound onto Easton Commons;
- A southbound right turn lane onto Willow River.

Figure 4.4: Proposed added left turn lane, southbound onto Easton Commons

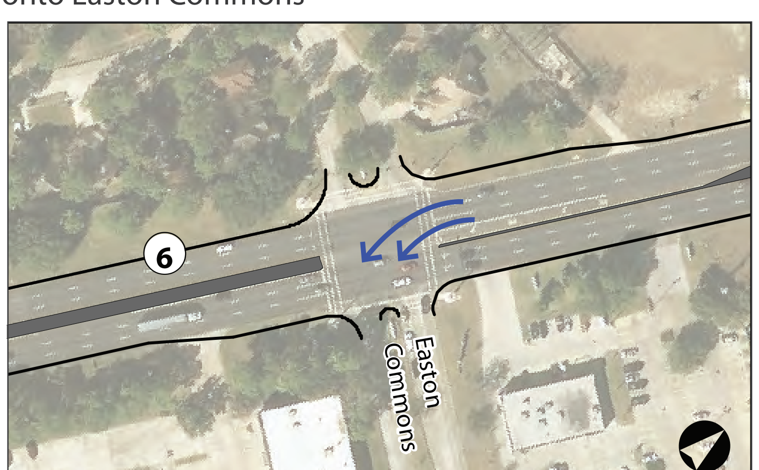
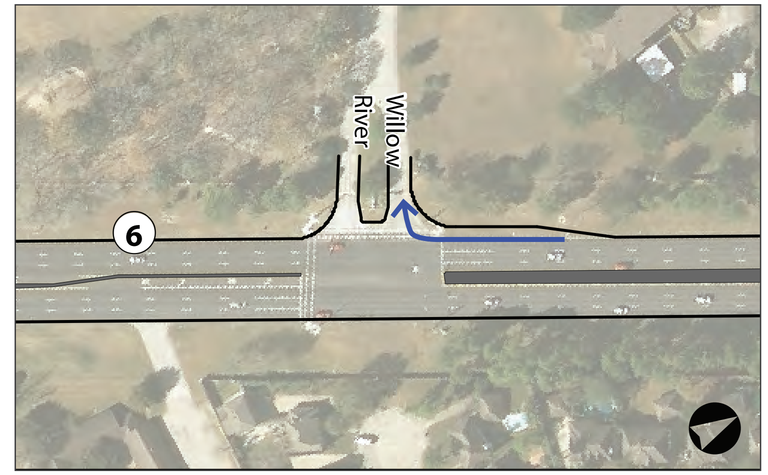


Figure 4.5: Proposed southbound right turn lane onto Willow River



SIGNAL MODIFICATION

The Institute of Transportation Engineers (ITE), describes traffic signal retiming as perhaps the most cost-effective way to improve traffic movement and increase safety. According to ITE studies, comprehensive signal retiming projects have resulted in 7-13 percent reduction in overall travel time, 15-37 percent reduction in delay and a 6-9 percent fuel savings. Therefore, comprehensive signal retiming is one of the final recommendations of this study. Signals should be monitored over time and adjustments made as necessary.

The more signals in an area are coordinated, the better. In the simplest coordination scheme, one entity maintains operation of all signals, allowing for interconnection and better progression between the signals. This arrangement is recommended for the study area. Signals along SH 6 / FM 1960 are all interconnected with the exception of Patterson Road. Along FM 529, some signals are operated by the City of Houston, and the remainder are operated by TxDOT.

Consolidation or removal of traffic signals can work in tandem with other strategies to increase the overall mobility of an area. The main advantage of a signal consolidation is that traffic on the main roadway will no longer have to stop at the intersection.

When a signal is removed, most traffic movements are still accommodated. The key change is that vehicles will not be able to turn left from a side road onto the main road. Instead, they will be rerouted to a nearby roadway. For example, vehicles wanting to turn left from Copperfield onto SH 6 will need to take a right onto SH 6, then make a U-turn at Huffmeister.

All signal locations were reviewed and several locations were identified for possible signal consolidation. Consolidation was considered in cases where signals were located in close proximity to one another and where consolidation would aid overall corridor through movements without significantly inconveniencing side road traffic. Based on these criteria, ten signals are proposed for removal:

- SH 6 at Addicks Satsuma Road;
- SH 6 at Yorktown Crossing Parkway;
- SH 6 at Kingfield Drive;
- SH 6 at Home Depot;
- SH 6 at Sugar Ridge Drive;
- SH 6 at Forest Trails Drive;
- FM 1960 at Steepletop Drive;
- FM 529 at Glen Polara Drive;
- FM 529 at Lakeview Haven Drive; and
- FM 529 at Glen Chase Drive.

DRIVEWAY CONSOLIDATION

Driveway density—the number of driveways along a length of road—is a major factor in the road's functionality. Studies have shown that when driveway access is granted to too many properties without considering future traffic volumes and roadway classifications, additional driveways increase the rate of accidents and decrease the efficiency of the roadway. The National Cooperative Highway Research Program (NCHRP) Report 3-52 shows that accident rates increase dramatically as the number of driveways per mile increases along arterial roadways.

One clear way to address this issue is through driveway consolidation. There are two main reasons for consolidation or removal of a specific driveway:

- A driveway is located close to the functional area of the intersection; or
- A driveway provides redundant parcel access and does not meet TxDOT Access Management spacing criteria, i.e. it is too close to other driveways.

Driveway consolidation requires several concurrent efforts. Existing driveways cannot be closed without property owners' consent. Most closures require agreements among adjacent parcel owners for shared maintenance and cross parcel access. Examples of agreements are provided in Appendix G. In addition, the provision of alternate access via alternate access roads may assist in discussions about consolidation and access. Finally, jurisdictions may enforce more stringent access management criteria over time as parcels redevelop, and effect closures in that manner.

In the Access Management Manual, the Transportation Research Board has published tables of recommended driveway densities based on the speed limit of the roadway. For the study corridors, the number of existing access points exceeds recommended density (see Table 4.1).

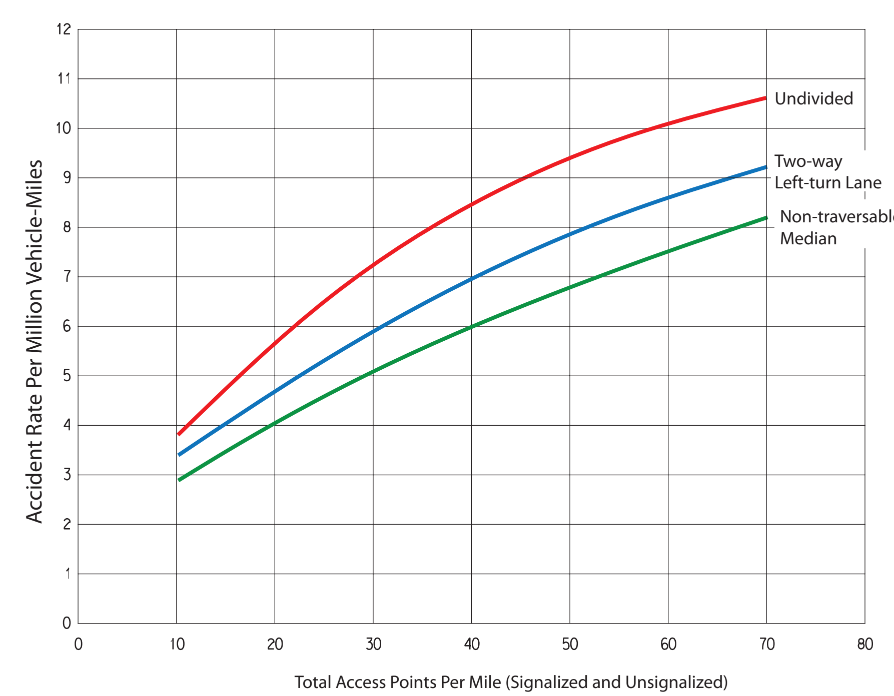
All driveways along SH 6 / FM 1960 and FM 529 were examined and analysis was performed to determine whether existing parcel access points could be consolidated. Based on this analysis, recommendations were made and reviewed to ensure that closures would not have significant detrimental impact on business operations. Table 4.1 indicates proposed consolidations by corridor section and the resultant driveway density if all proposed consolidations occur.

Table 4.1: Driveway Densities Before and After Proposed Consolidations

Limits				Access / Density						
Roadway	From	To	Segment Length (Miles)	Total Driveways	Consolidate (Functional)	Consolidate (Density)	Retain	Driveways / Mile Before Consolidations	Driveways / Mile After Consolidations	Desirable Density (Driveways/mile)*
SH 6	Park Row	Clay	3.3	30	7	2	21	9.1	6.4	8.4
SH 6	Clay	Little York	2.2	124	21	25	78	56.4	35.5	8.4
SH 6	Little York	FM 529	0.8	34	14	3	17	42.5	21.3	8.4
SH 6	FM 529	US 290	3.3	83	12	9	62	25.2	18.8	8.4
FM 1960	US 290	Jones	2.2	77	5	10	62	35	28.2	6.1
FM 1960	Jones	Mills	2.4	114	10	25	79	47.5	32.9	6.1
FM 529	Greenhouse	SH 6	3.5	103	22	7	74	29.4	21.1	6.1
FM 529	SH 6	US 290	4.6	171	28	42	101	37.2	22.0	6.1

** Source: Access Management Manual, Transportation Research Board, Table 9-9, 2003. Desirable densities are based on minimum access spacing for a posted speed.*

Figure 4.6: Relationship of Crashes to Driveway Density
Source: TRB NCHRP Report 420, Impacts of Access Management Techniques



ALTERNATE ACCESS ROADS

Alternate access roads provide alternative connections parallel to arterial roadways and allow for access to properties off the main arterial. Alternate access roads reduce conflict points between through traffic and turning traffic associated with direct property access. Alternate access roads will require that Harris County or the City of Houston, depending on the roadway, commit to placing such roads in planning documents and work with landowners to create the desired access. These changes will require phasing over time.

There are few existing alternate access roads or parcel connection roadways in the corridors. The study team reviewed the corridors, and proposed locations where such roadways could be added. Locations were selected to allow drivers to move between adjacent businesses without reentering the main roadways, or allow drivers to bypass a major intersection. In addition, roadway realignment in several select locations would improve overall corridor mobility and safety. These alternative access roads are shown in Figures 4.8 - 4.12.

A. Extension of Cypress
B. Completion of Huffmeister
C. Realignment of Glen Chase and Cherry Park
D. Alternate access roads - southeast quadrant of SH 6 and FM 529
E. Realignment of Groeschke with Patterson

Figure 4.7: Locations of Recommended Alternate Access Roads

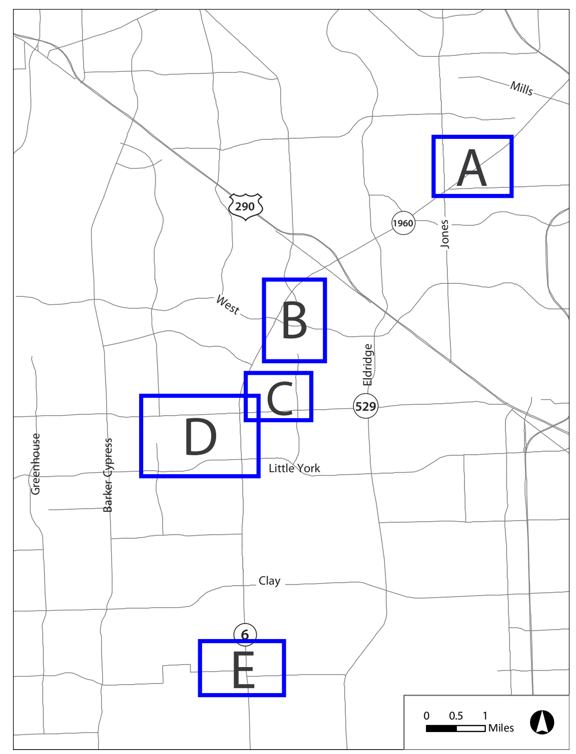


Figure 4.8: Extension of Cypress

Figure 4.9: Completion of Huffmeister

The extension of Cypress and completion of Huffmeister provide alternative connections for local trips, relieving pressure on SH 6.

Figure 4.10: Realignment of Glen Chase and Cherry Park

Many drivers use Glen Chase and Cherry Park as a quadrant road to bypass the SH 6 / FM 529 intersection. Recognizing the potential of this route to remove traffic from the SH 6 and FM 529, the study team recommends the realignment of the intersection of Glen Chase and Cherry Park and the removal of all-way-stops on Cherry Park.

Figure 4.11: Alternate access roads - southeast quadrant of SH 6 and FM 529

A series of alternate access roads are recommended on the southeast quadrant of the SH 6 / FM 529 intersection, to increase accessibility of parcels and reduce reliance on the arterial roadways.

- Extension of Smithstone west to intersect Bouldgreen Street, and north to intersect FM 529 at Ridgeberry.
- Extension of Yorktown Crossing north from West Little York to intersect Lakeview Haven south of Smithstone;
- Extension of Kingfield west from SH 6 then north to intersect with Smithstone at Sommerall; and
- Back parcel access on the east side of SH 6 between Kingfield and Home Depot.

Figure 4.12: Realignment of Groeschke with Patterson

It is recommended that Groeschke be realigned with the intersection of Patterson and SH 6. Currently, the two intersections are offset by approximately 500 feet. Eliminating the offset would remove a safety hazard and allow Groeschke turning traffic to be signalized. This realignment will require coordination with the US Army Corps of Engineers.

BICYCLE AND PEDESTRIAN IMPROVEMENTS

Bicycle and pedestrian infrastructure can be classified as on-facility sidewalks or off-facility paths. On-facility sidewalks are directly adjacent to the main roadway. Off-facility paths are located off the main roadway and provide alternative ways of getting from point A to point B.

Taking into account the high volume, multi-lane character of the study corridors, and the fact that users of these facilities will be of diverse age and skill levels, the study team recommends construction of both on-facility sidewalks and off-facility paths.

Figure 4.13: On- and Off-Facility Paths

SIGNAGE

Advance signage alerts drivers with information about the road ahead, such as which intersection is coming up and lane directions. Advance cross street signage should be added to the corridors where it not currently present. Signage will help with advance lane changes and alleviate merge-weave movements near major intersections. Signage should be enhanced to include block information as well as street names. Median U-turn Intersections (MUTs), will require advance signage to direct motorists who are unfamiliar with the operation of MUTs and help them safely maneuver the intersections. To increase visibility of directional signage and reduce visual clutter, commercial signage throughout the corridor should be standardized and restricted.

ADDITION OF THROUGH CAPACITY

One option to increase the capacity of a roadway is to add through lanes. Challenges related to this strategy are the need for additional right of way and relocation of utilities, both with high associated costs.

The study team recommends the addition of through lanes in only one location: on FM 529 between Greenhouse and Barker Cypress. However, some recommended side road improvements will have a net impact on through capacity. For example, adding a dedicated turn lane on an intersecting roadway will increase through capacity on the intersecting roadway at the intersection by reducing the green time given to the cross street.

INNOVATIVE INTERSECTIONS

A series of innovative intersection designs were evaluated to address challenges associated with heavily congested intersections. Innovative intersections reduce the number of phases at the main intersection, which results in increased efficiency and capacity. This is accomplished by rerouting left turns at a point ahead of the main intersection, or by having the driver first go through, then make a U-turn, and finally a right turn.

Innovative intersections include:

- Continuous Flow Intersection (CFI) - Left turns cross over the opposing traffic prior to the intersection (see Figure 4.14);
- Median U-turn Intersection (MUT) - Eliminates left turns from the main intersection, redirecting them with a combination of through, right, and U-turn movements (See Figure 4.15);
- Super street - Similar to MUT, but eliminates through movements and left turns from cross street;
- Jughandle - Left turns redirected through the intersection, take a right, and loop around (See Figure 4.16); and
- Quadrant road - Left turns redirected to an adjacent roadway, cutting a corner (See Figure 4.16).

At most intersections along the study corridors, traditional improvements, such as adding turn lanes and modifying signal timing, were sufficient to accommodate projected 2035 traffic volumes. Four high-volume locations were identified for innovative treatments: 1) SH 6 at Clay Road; 2) SH 6 at FM 529; FM 1960 at Jones Road; and 4) FM 529 at Eldridge Parkway.

Analysis was conducted for each identified intersection. Table 4.2 and Figures 4.14, 4.15, and 4.16 show the analysis conducted for the intersection of SH 6 and FM 529. Complete innovative intersection analyses are provided in Appendix E. After vetting these solutions with the H-GAC steering committee, stakeholders and the public, modeling was performed for the best one or two options for each location and a final recommendation for each location was selected, as follows:

- SH 6 & Clay Road: two-leg median U-turn intersection;
- At SH 6 & FM 529: four-leg median U-turn intersection;
- At FM 1960 & Jones Road: four-leg median U-turn intersection; and
- At Eldridge Parkway: four-leg median U-turn intersection.

Table 4.2: Intersection Analysis, SH 6 & FM 529

Objective Criteria							
		40%	30%	20%	10%	100%	
Scenario	Relative Costs	Operational Performance	Safety	Compatibility	Impacts	Composite Score	Rank*
Median U-Turn	2	2	1	1	1	1.4	1
CFI	3	1	2	2	3	1.7	2
Quadrant	2	3	2	1	1	2.1	3
Jughandle	3	3	1	2	3	2.2	4
Grade Separated	4	1	2	4	4	2.2	4
No Build	1	4	4	1	1	3.1	6

*Rank 1 is the highest rating and rank 6 is the lowest.

Figure 4.14: Continuous Flow Intersection

Advantages
- Improves safety and reduces conflict points
- Increased intersection capacity
- Reduced delay, travel time, and queuing
- Less expensive and has less impact than overpass

Disadvantages
- Potential for driver confusion
- Some right of way usually required
- Can create access restrictions

Figure 4.15: Median U-Turn Intersection

Advantages
- Increases intersection capacity
- Reduces delay, travel time, and queuing
- Low implementation cost

Disadvantages
- Out of direction travel for left turns
- Right of way may be required at u-turn
- No u-turns at main intersection
- Potential for driver confusion

Figure 4.16: Quadrant (1) and Jughandle (2) Intersections

Advantages
- Increases intersection capacity
- Reduces delay, travel time, and queuing
- Low implementation cost potential
- Enhances development opportunity

Disadvantages
- Out of direction travel for left turns
- Right of way may be required for quadrant roadway
- No u-turns at main intersection
- Potential for driver confusion
- Adds intersection to corridor

LIVABLE CENTERS

H-GAC's 2035 Regional Transportation Plan identifies the livable center concept as a strategy to address projected growth and transportation demand in the region. Livable centers are safe, convenient, and attractive areas where people can live, work, and play with less reliance on their vehicles. Livable centers have three key features:

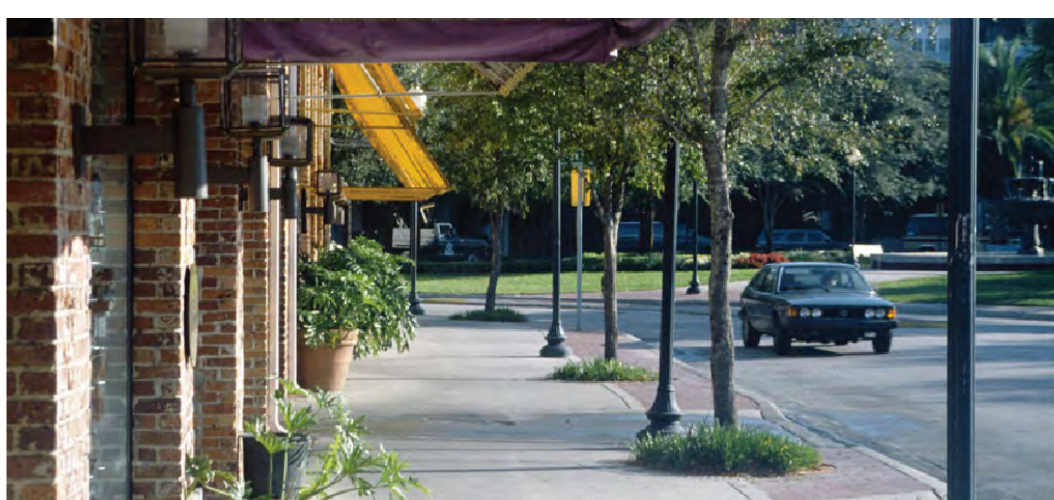
- Compact and Mixed Use
- Designed to be Walkable
- Connected and Accessible

COMPACT AND MIXED USE

Livable centers concentrate housing, employment, shopping, and entertainment in areas with good pedestrian networks that are easily served by transit. Clustering many different land uses in a compact area gives people the opportunity to accomplish various activities without using a car. Livable centers also function as one-stop destinations for drivers. Careful design and planning of parking structures or lots can minimize their impact on the visual and pedestrian environments while maximizing their convenience and accessibility.

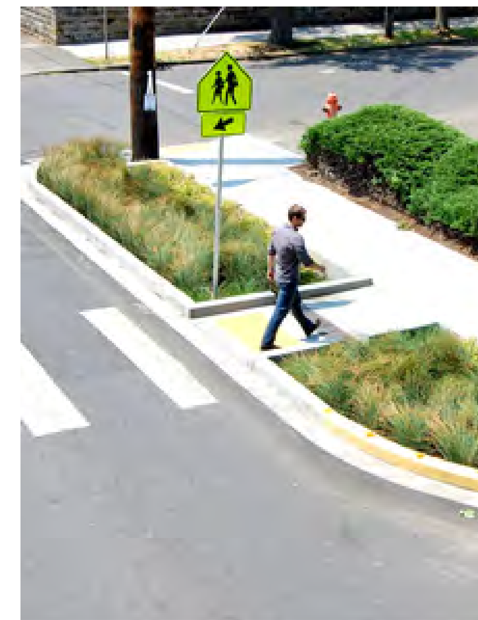
DESIGNED TO BE WALKABLE

Livable centers provide safe, convenient, and engaging experiences for pedestrians. A quality pedestrian environment has appropriately oriented and scaled buildings, good separation of persons on foot from vehicle circulation and parking, design elements that create a sense of identity, and places to interact with others such as plazas and parks.



CONNECTED AND ACCESSIBLE

Livable centers make it easy to reach multiple destinations within the Center and in surrounding developments by foot, bicycle, car, or transit. A well-designed street and sidewalk network provides good connectivity and increases safety for all users.



IMPLEMENTATION

Understanding the essential components and benefits of Livable centers is the first step in making these special places a reality. Additional measures will help ensure their successful implementation:

- Review existing plans and ordinances (e.g. zoning and development standards, street and parking criteria, subdivision regulations) to ensure that the design elements of livable centers are not discouraged or prohibited by current requirements;
- Establish design guidelines or ordinances appropriate for livable centers, including financial and development incentives; and
- Coordinate infrastructure, streetscape, and transit service improvements by bringing all stakeholders together such as engineers, emergency personnel, transportation and transit officials, developers, and local officials and residents.

H-GAC's website (www.h-gac.com/livablecenters) provides additional information about elements of livable centers and H-GAC's Livable Centers Program. Existing livable centers near the study area are located in Jersey Village and Barker Cypress & US 290.

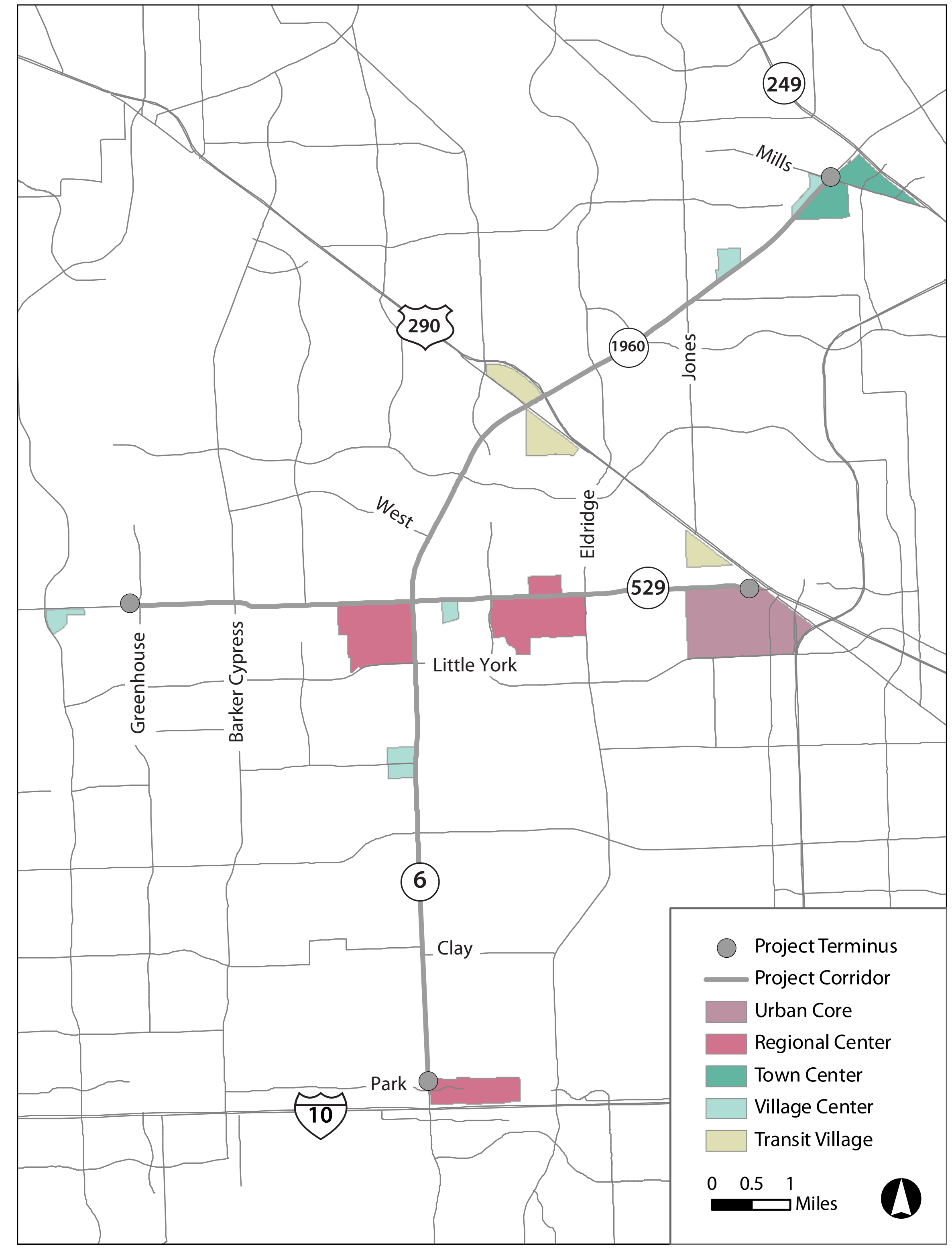
SITE SELECTION

For this study, data for many sites along the corridor were collected and analyzed using Geographic Information Systems (GIS). Seventeen sites were identified from the study area where it may be feasible to develop a livable center. Livable centers may be classified by type to indicate their size and character. Identified sites were of various sizes (33 to 767 acres) to highlight possibilities of establishing centers of different types. The seventeen candidate sites were given the following classifications.

- Urban Core
- Regional Center
- Town Center
- Village Center
- Transit Village

Each site was physically checked and reviewed with the following criteria: acreage, road frontage, rail access, bikeways, bus stops and routes, floodplain, watershed, school district, jurisdictions, and land uses within and adjacent to the tract. These criteria were placed in a decision matrix which allowed for an objective analysis of the various sites. A complete record of the livable centers site selection is provided in Appendix D.

Figure 4.17: Livable Center Site Selection



CHAPTER 5: RECOMMENDED IMPROVEMENTS

This chapter presents recommendations to improve safety and mobility along the study corridors while maintaining economic viability. Recommendations are a result of a robust public involvement effort, agency and stakeholder coordination, and comprehensive technical analyses. Recommendations encompass bicycle and pedestrian facilities, transit, land use and policy recommendations, and roadway improvements.

Recommendations are classified as short-, medium-, and long-term projects. Specific time frames are not defined due to uncertainties about future funding. Improvements are further classified by jurisdiction to indicate funding responsibilities. TxDOT, Harris County, and the City of Houston have responsibilities for specific improvements. The complete list of improvements with cost estimates and responsible jurisdictions is provided in Appendix C.

BICYCLE AND PEDESTRIAN IMPROVEMENTS

Accommodation strategies for pedestrians and bicyclists in the corridors were evaluated based on input from the public and stakeholders. The objective was to provide safe access to desirable destinations, while taking into account the varied skill and age levels of potential users of these modes.

A two-pronged approach is recommended to accommodate bicyclists and pedestrians. Bicyclists and pedestrians have varying degrees of skills and confidence in high traffic areas. A direct route on the main facilities of FM 529 is recommended for experienced bicyclists and pedestrians. For those who are less confident and prefer to minimize the amount of time spent on these busy roadways, hike and bike facilities that roughly parallel to SH 6 are proposed. These hike and bike facilities will also provide connectivity to dense commercial areas along these busy corridors.

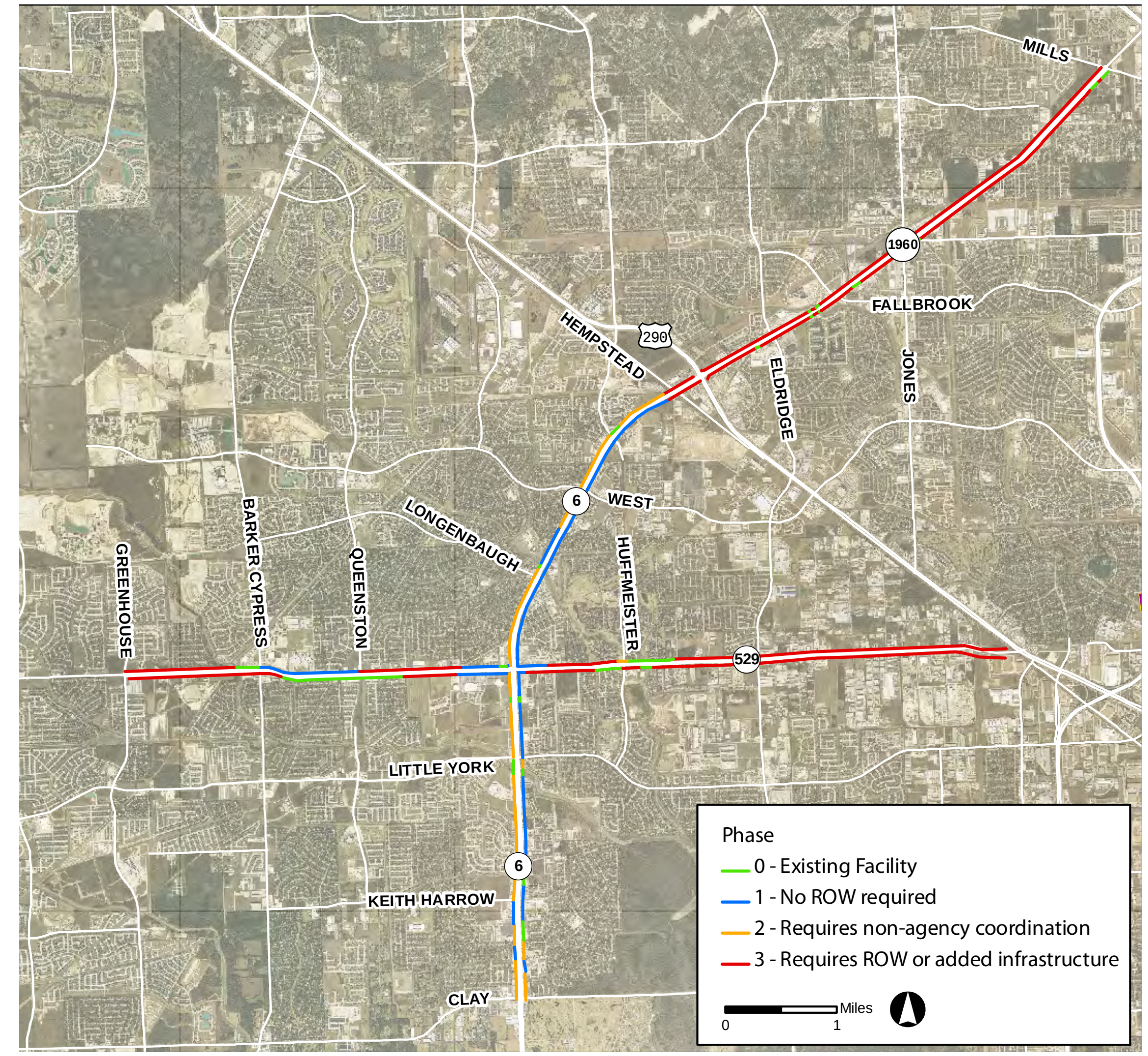
ON-FACILITY SIDEWALK

On-facility sidewalks are relatively narrow concrete paved pedestrian travelways located within the right of way of a roadway. It is recommended that on-facility sidewalks be built as the new access management strategies are implemented. Where feasible, the sidewalk should be eight to ten feet wide to accommodate joint use by bicyclists and pedestrians. Additionally, the sidewalk should include detectable, ADA-compliant ramps at crossings. All crossings at signalized intersections should include countdown pedestrian lights.

OFF-FACILITY PATH

Off-facility paths are wide paved non-motorized vehicular travelways that are located at a safe distance from a vehicular facility, or roadway. Recommended off-facility paths connect the network of existing hike and bike plans developed by Harris County, the Energy Corridor, and H-GAC. Implementation of the path relies on the Houston County Flood Control District (HCFCD) and local Municipal Utility Districts (MUDs), and the U.S. Army Corps of Engineers willingness to partner with other entities to install paths in their respective right of way. Local MUDs have already begun constructing hike and bike facilities in the area.

Figure 5.1 On-Facility Sidewalk

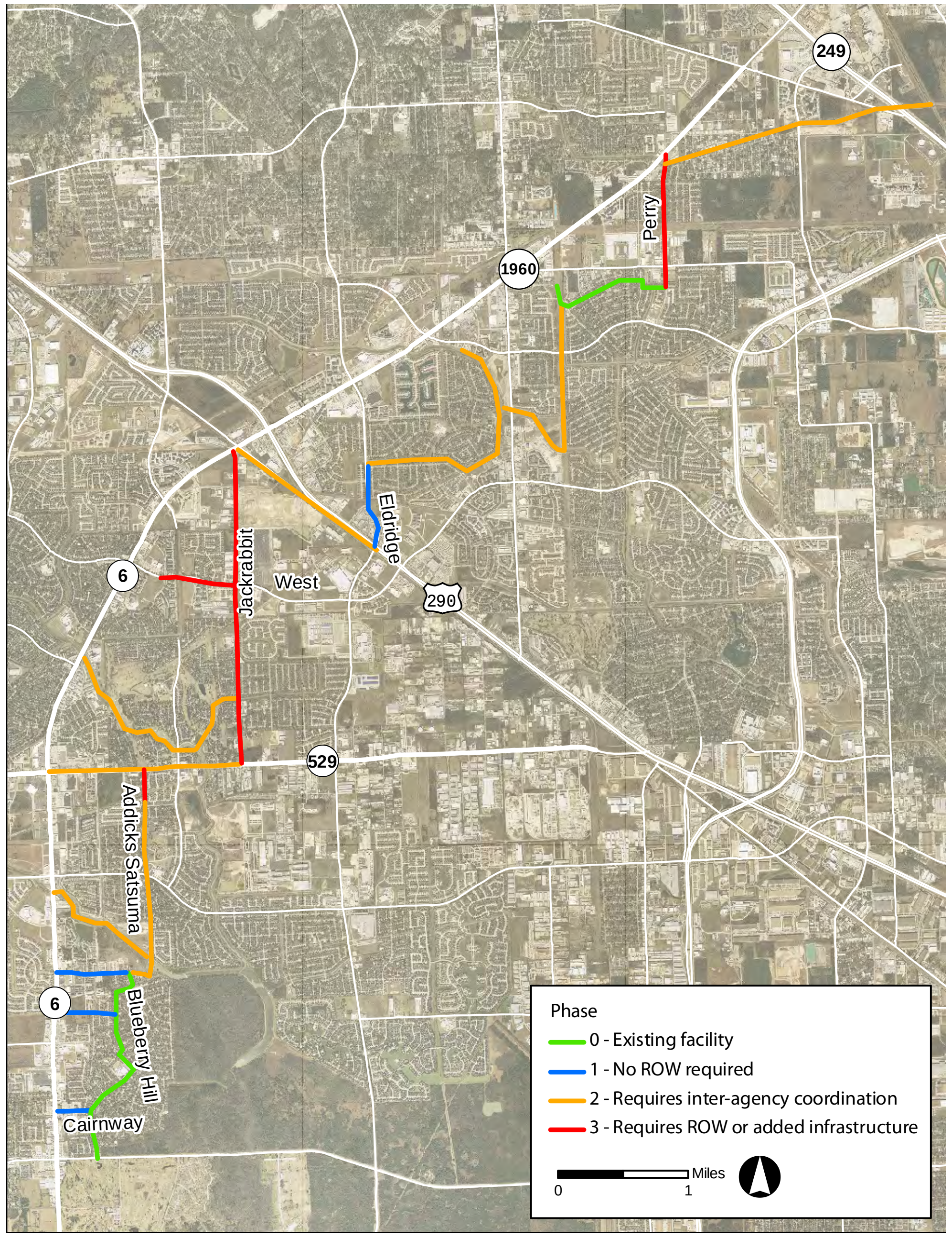


PHASING

Several factors were considered to determine phasing for the bicycle and pedestrian facilities. These factors included acquisition of right of way, movement of utilities, and inclusion of non-agency partners in the development of the facility.

Facilities proposed for Phase I (short term) development do not require right of way acquisition, relocation of utilities, or inclusion of non-agency partners. Those proposed for Phase II (medium-term) require the inclusion and cooperation of non-agency partners. Long-term projects may require the acquisition of right of way, relocation of utilities, or major improvements to address drainage issues. Non-agency partners that may assist in the implementation of facilities include: Municipal Utility Districts (MUDs), the U.S. Army Corps of Engineers, and the Harris County Flood Control District (HCFCD). Other entities may construct trails in HCFCD right of way if they follow this procedure:

Figure 5.2 Off-Facility Path



- Submit written project description;
- Complete abstracting prior to agreement;
- Ascertain if HCFCD owns property, or easement only and resolve any issues;
- Have a meeting on site with all interested parties;
- Submit construction plans for approval;
- Obtain approved agreement; and
- Build.

TRANSIT

To make transit viable in the study area, new pedestrian connections need to be made and gaps in infrastructure filled so pedestrians can easily travel from their homes to bus stops. Provision of these connections will be the responsibility of commercial business owners and home owners associations, in many instances working together.

Transit-supportive connections and infrastructure are long-term recommendations, to be constructed in tandem with TxDOT roadway reconstruction and in cooperation with property owners as new subdivision or zoning changes occur. The following transit recommendations were developed:

- Bring bus service to the corridor (short term)
- Connect service with existing park and ride facilities (short term)
- Extend commuter rail service in the direction of the study area or provide tie-in with the commuter rail (medium term)

LAND USE

The current land use pattern along the corridor is strip commercial, multi-family, and large residential subdivisions. Large commercial parcels have limited access to large scale residential development behind the commercial strip. In general, the residential developments in the study area have limited or circuitous connections to adjacent residential developments. This makes it difficult for adjacent parallel movement along long stretches of the corridor.

To address these issues, the following long-term solutions are recommended. It is essential that steady progress towards these solutions be made by the appropriate groups and agencies:

- Build alternate access roads;
- Consolidate driveways; and
- Establish a livable center.

Alternative access roads and driveway consolidation are discussed below. More information on livable centers is provided in Appendix D.

ALTERNATIVE ACCESS ROADS

The first step for implementation of alternate access roads is for the City of Houston to specify road locations in the City's Long Range Plan. Once these roads are identified in the Plan, a developer who has such a road through an undeveloped parcel will be required to build the road as part of site development. Alternate access roads which pass through developed parcels and are considered essential to the access management in the area may be considered for eminent domain takings. However, this option should only be considered as a last resort and voluntary partnering measures are preferred.

DRIVEWAY CONSOLIDATION

As described in Chapter 3, driveway density along the study corridors is extremely high. To implement driveway consolidation, jurisdictions will need to institute procedural changes. First, the county will need to adopt more stringent access management criteria regarding access spacing. For example, the county could adopt criteria similar to TxDOT's Access Management Manual. In cases of re-subdivision, existing driveways would be reviewed to ensure all driveways conform to TxDOT's access management criteria. If one or more driveways are not in compliance, the property owner would be given a set amount of time to come into compliance. As properties redevelop over time, TxDOT will be able to enforce their driveway spacing policies as adopted in 2004.

In addition, there is a voluntary option for consolidation of driveways. In cases where a property owner chooses to consolidate a driveway, TxDOT's previous programs would close the driveway, landscape a large portion of the old driveway, reconnect the sidewalk, and reconfigure the old driveway to provide additional parking spaces. TxDOT should consider continuing this program indefinitely in high driveway density locations such as the study area.

ROADWAY IMPROVEMENTS

This section contains an analysis of future year scenarios in which recommended improvements are not made (no build) and in which improvements are made (build); and a set of maps highlighting roadway improvements. A complete list of roadway improvements is provided in Appendix C, along with cost estimates and responsible jurisdictions.

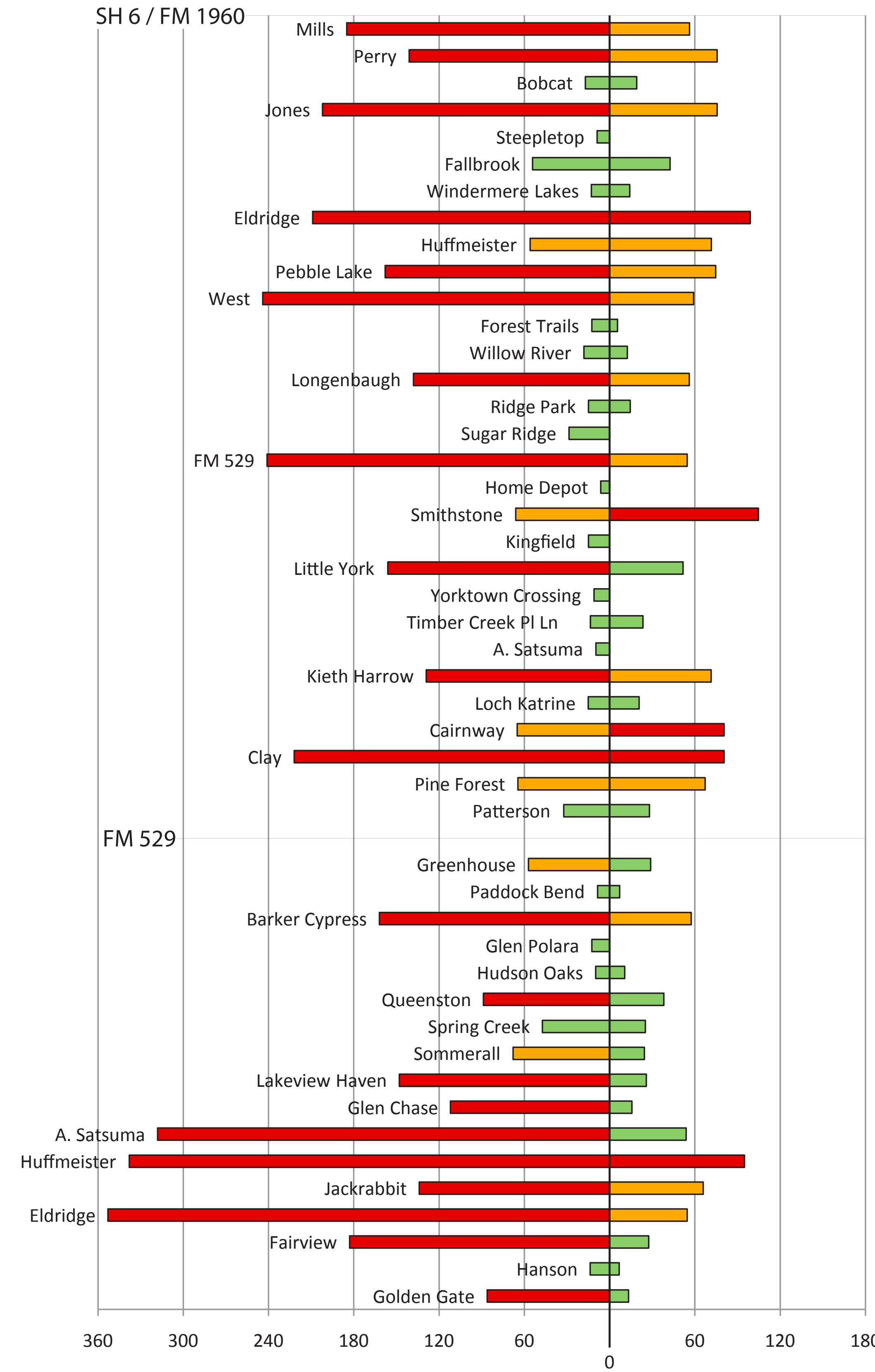
BUILD AND NO BUILD SCENARIOS

After the list of recommended improvements was completed, the improvements were analyzed using simulation models to determine the future effects of the improvements on the transportation system. Analysis was conducted for the future year of 2035 under peak AM and peak PM conditions. Two scenarios were created in the travel demand model:

- No Build - recommended improvements are not made; and
- Build - recommended improvements are made.

The following analysis highlights differences between the build and no build scenarios for both intersection and arterial level of service. As described in Chapter 3, the main difference between these metrics is that intersection level of service counts delay for all movements through the intersection whereas arterial level of service only counts delay on through movements of the main roadway.

Figure 5.3: Intesection delay (seconds) - 2035 AM - No Build | Build



Level of Service

- A - D
- E
- F

Figure 5.4: Intersection Level of Sevice - 2035 AM - No Build

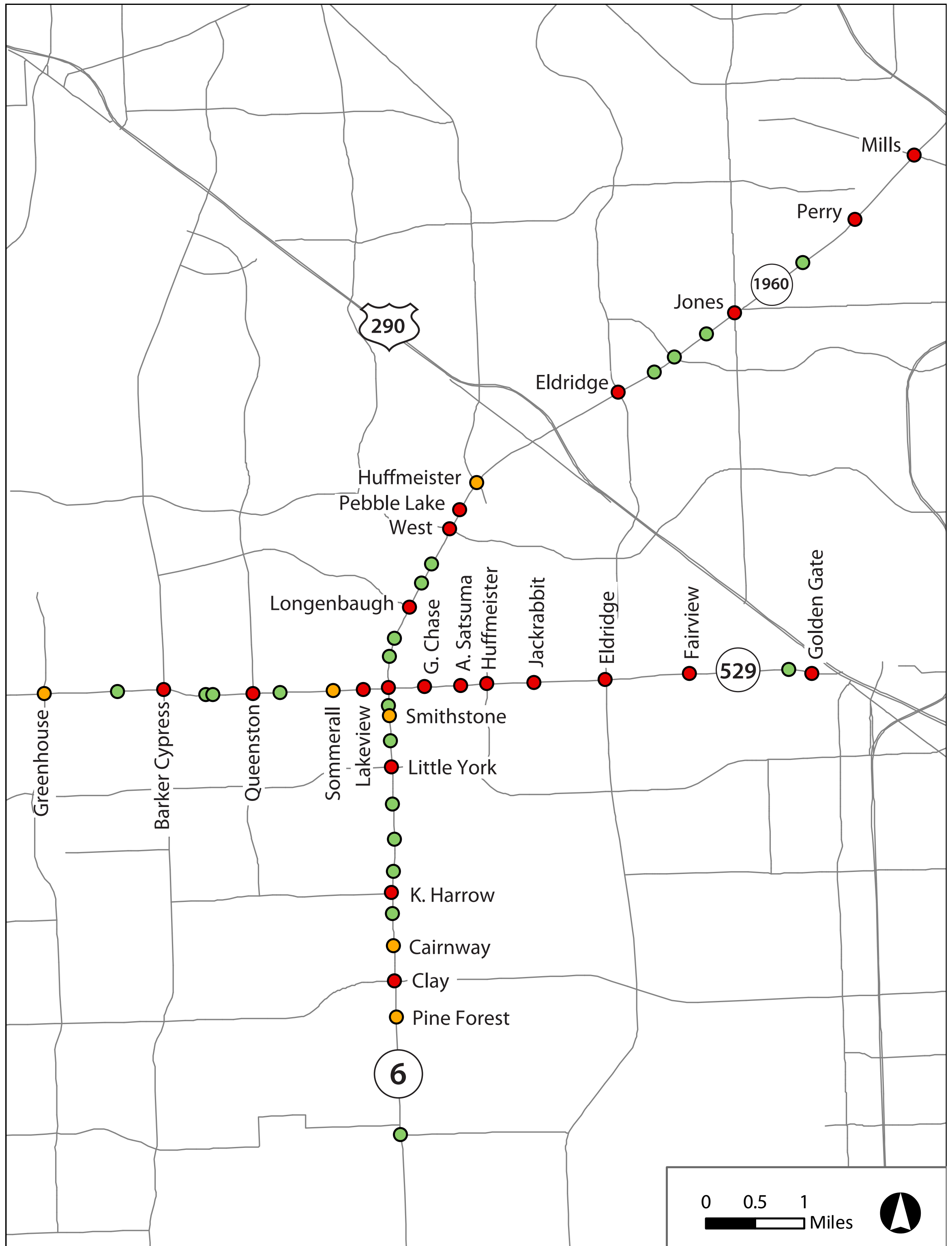
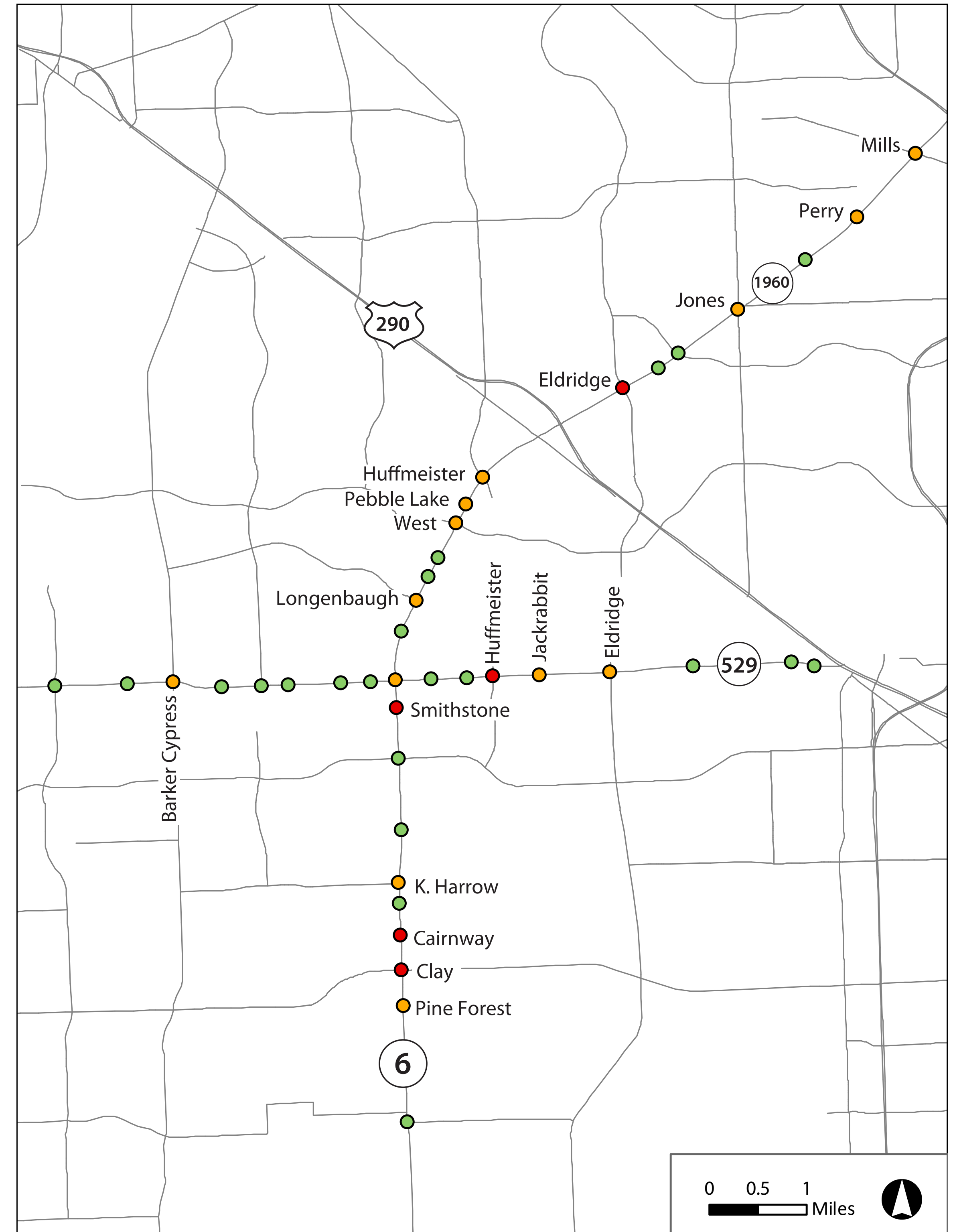


Figure 5.5: Intersection Level of Sevice - 2035 AM - Build



Intersection Level of Service

Letter designations for levels of service are useful for assessment at a glance. However, quantitative delay time provides the best performance measure because it is more specific. For example, several intersections improved greatly from no build to build but kept the same letter designations. 2035 level of service analysis takes into account the construction of innovative intersections in four locations: SH 6 & Clay, SH 6 & FM 529, FM 1960 & Jones, and FM 529 & Eldridge.

From the no build scenario to the build scenario, there were major reductions in delay nearly across the board. In AM, there was reduction from 21 LOS F intersections in the no build scenario to 5 in the build scenario. In PM, there was a reduction from 19 LOS F intersections in the no build scenario to 8 in the build scenario. In AM, FM 529 saw major intersection improvements between no build and build, reducing LOS F intersections from nine down to one. In PM, SH 6 south of US 290 saw significant improvements improving all but three intersections to LOS D or better.

A handful of intersections actually decreased in level of service between no build and build. Generally, these exceptions are caused by redistribution of traffic on the corridors and by cases where a slight increase in delay pushed an intersection over the line into a lower level of service. For instance, from the AM no build to the AM build scenario, delay at Smithstone & SH 6 increased from 65 seconds to 100 seconds. This is explained by a specific improvement in the build scenario -the removal of the signal at the Home Depot. This signal removal will redistribute existing traffic from the Home Depot to Smithstone.

Figure 5.6: Intesection delay (seconds) - 2035 PM - No Build | Build

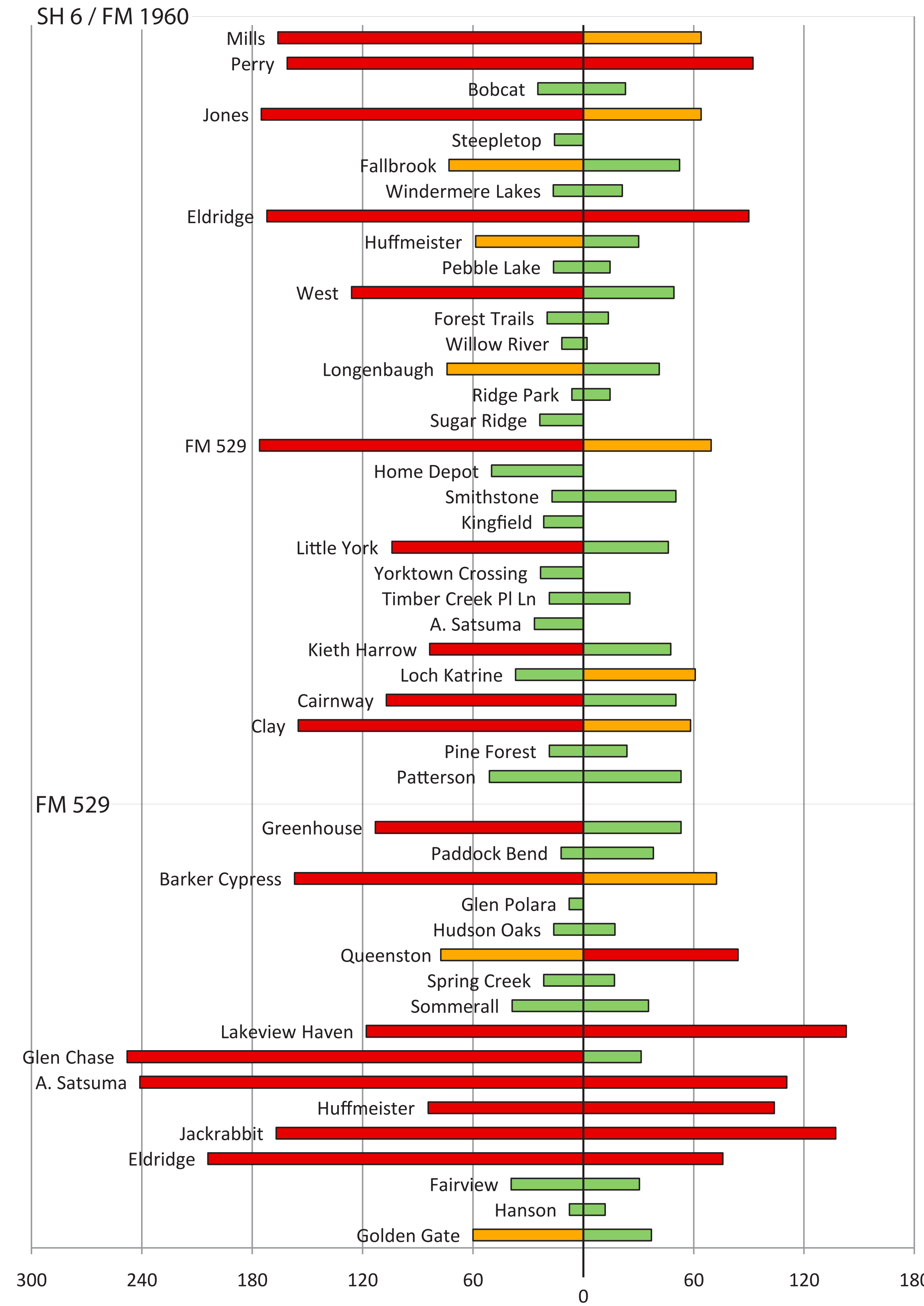


Figure 5.7: Intersection Level of Sevice - 2035 PM - No Build

Level of Service

A - D

E

F

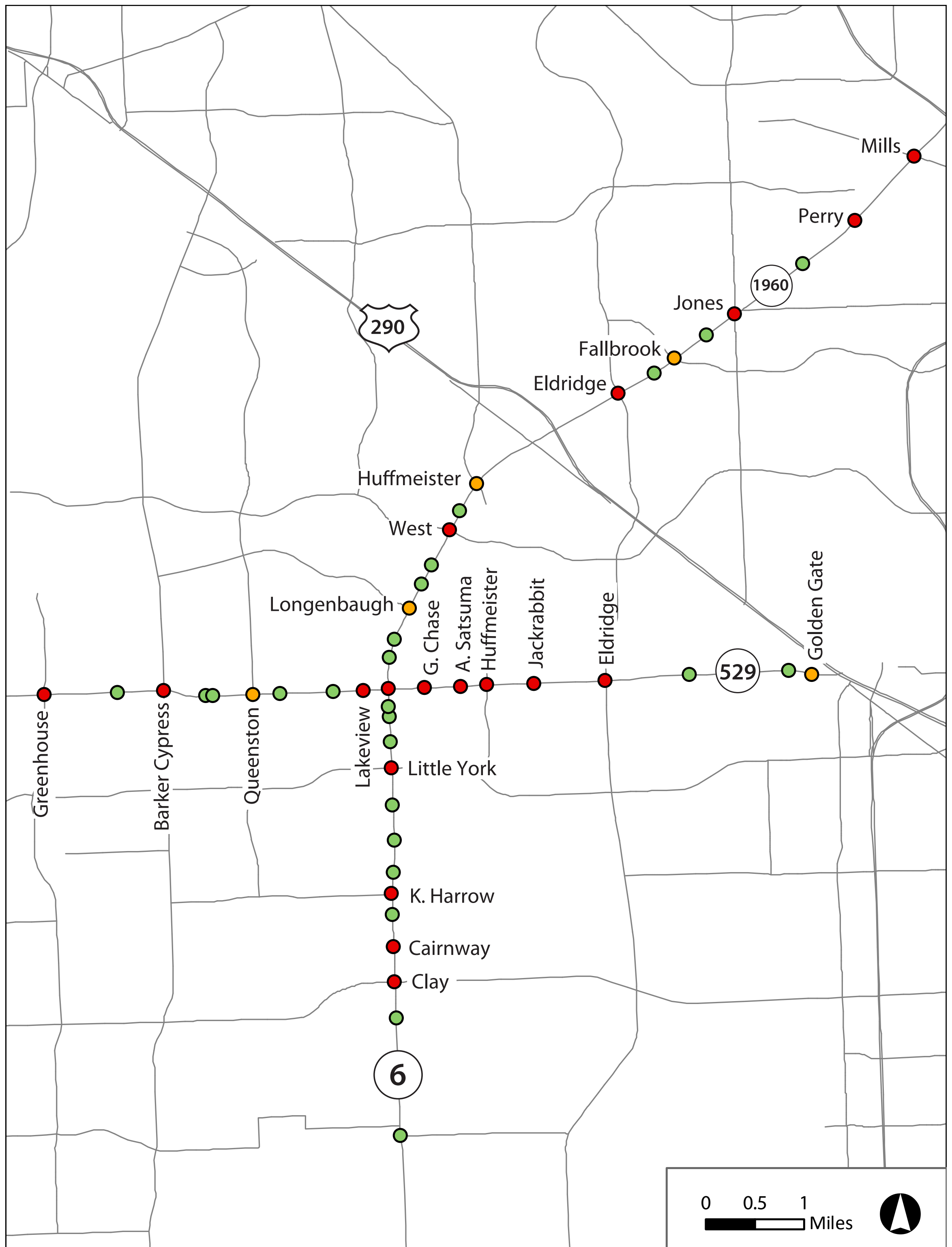
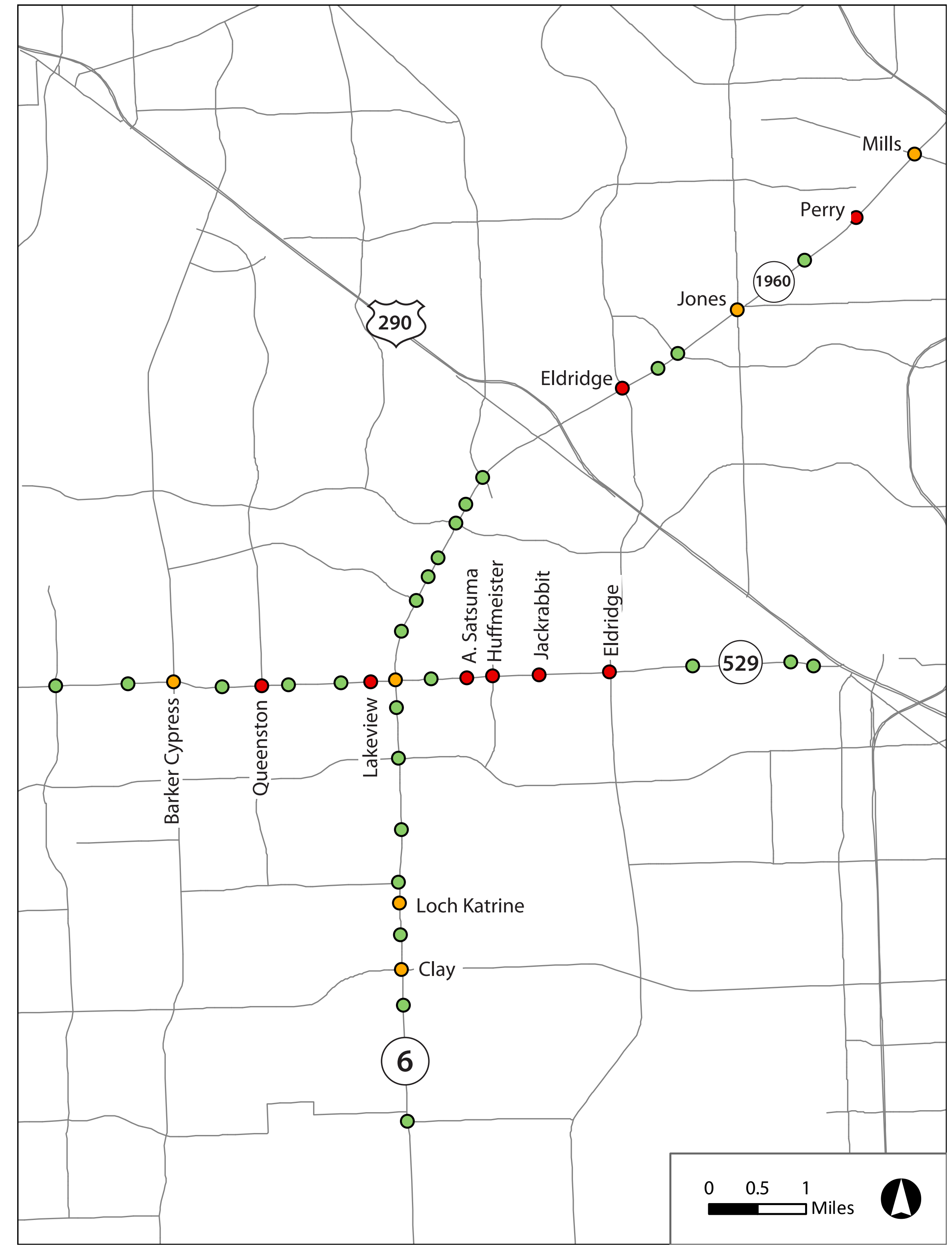


Figure 5.8: Intersection Level of Sevice - 2035 PM - Build



Arterial Level of Service

For AM arterial level of service, the build scenario produced performance improvements northbound and southbound on SH 6 / FM 1960 and eastbound on FM 529. Two areas of significant improvement were SH 6 between US 290 and FM 529 and FM 529 west of SH 6. Some segments improved in performance, but kept the same letter designations.

For PM arterial level of service, the build scenario produced projected performance improvements northbound and southbound on SH 6 / FM 1960 and eastbound and westbound on FM 529. Significant improvements were projected for southbound on SH 6 between US 290 and FM 529, southbound on SH 6 south of FM 529, and westbound on FM 529.

Several segments remained at the same level of service, in spite of reduction in delay, because they fell short of the cutoff point for a better level. For a small number of segments, level of service actually decreased between build and no build. This is explained by redistribution of traffic. Small losses on these segments are offset by large gains on the overall system.

Figure 5.9: Arterial Level of Sevice - 2035 AM - No Build

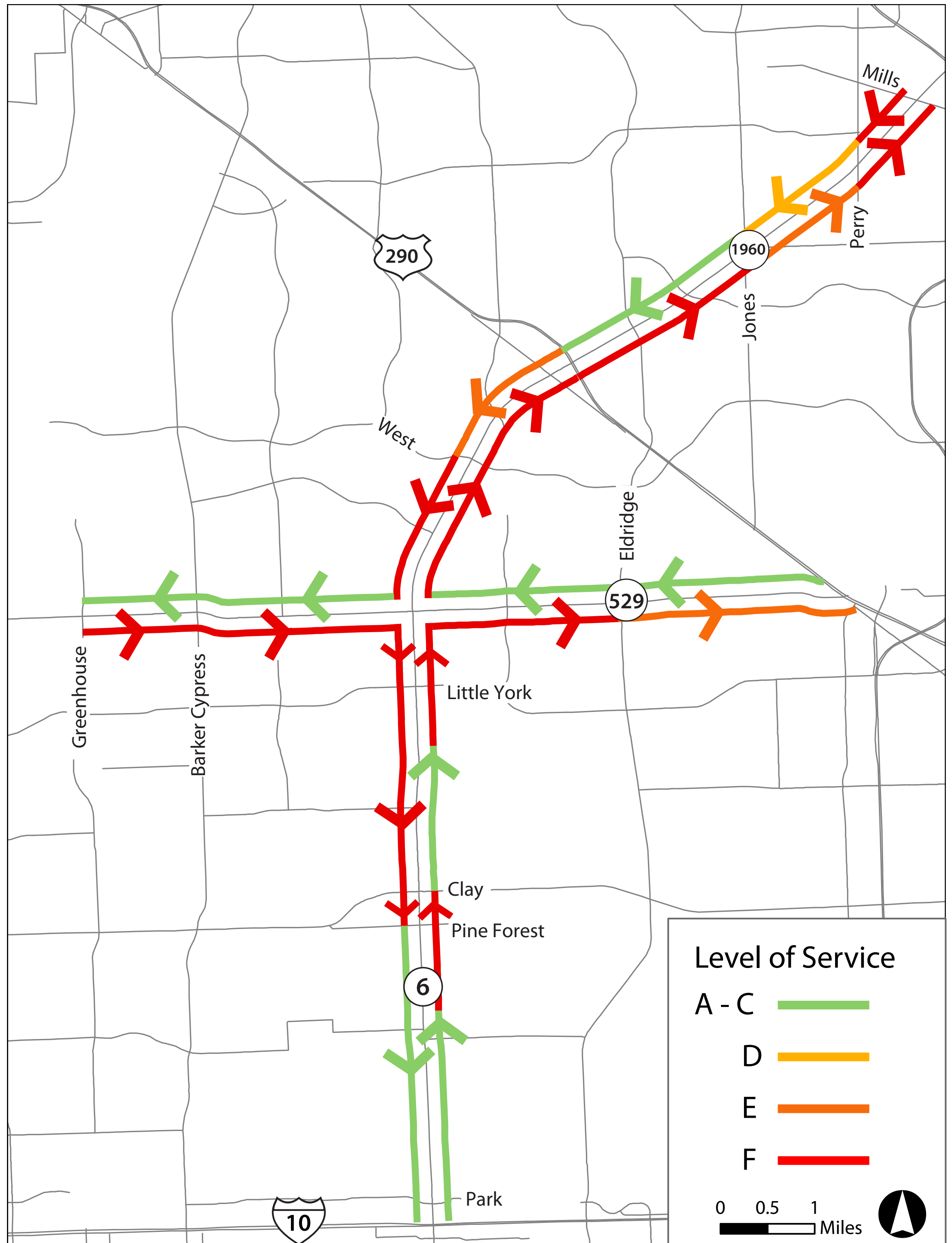


Figure 5.10: Arterial Level of Sevice - 2035 AM - Build

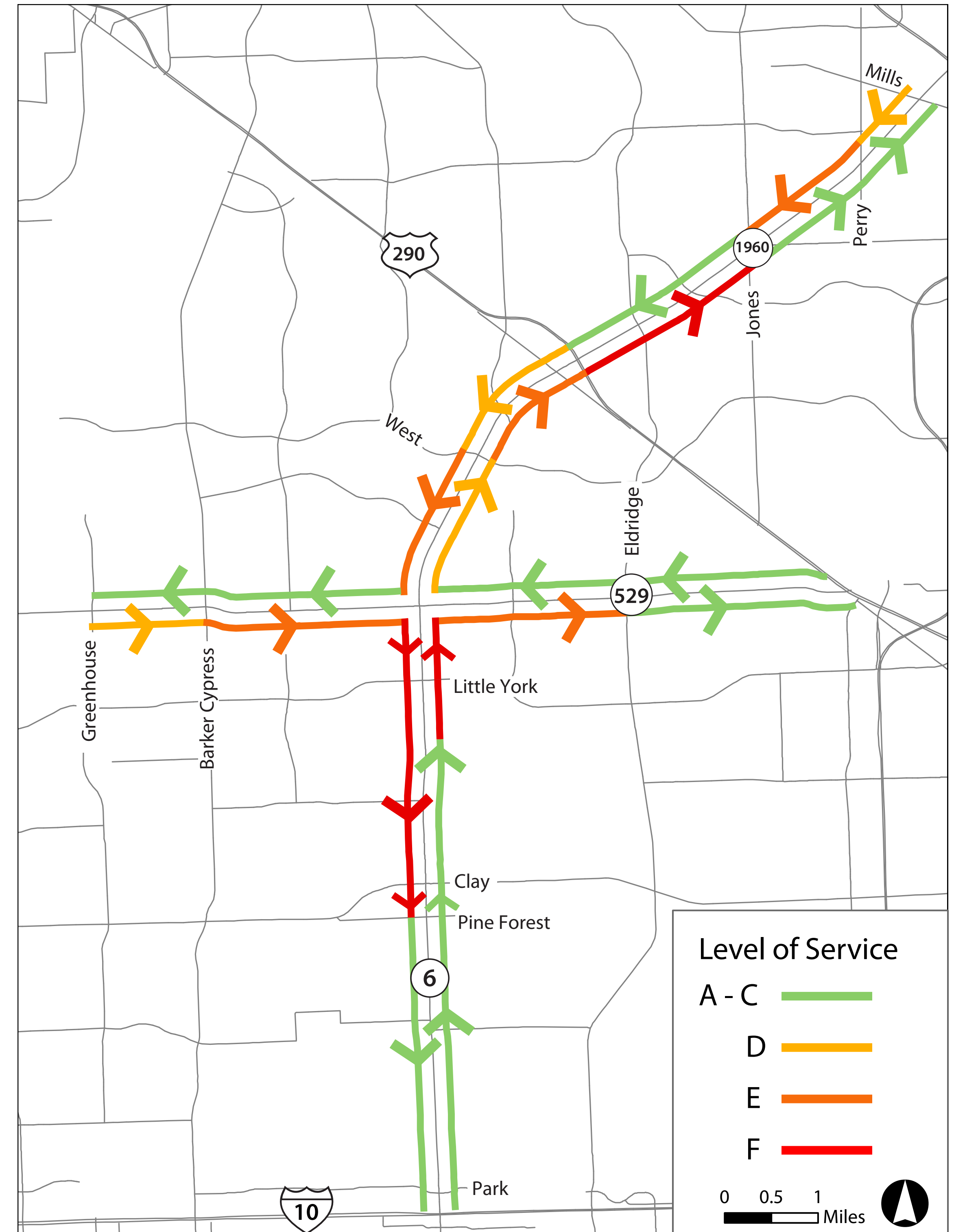


Figure 5.11: Arterial Level of Sevice - 2035 PM - No Build

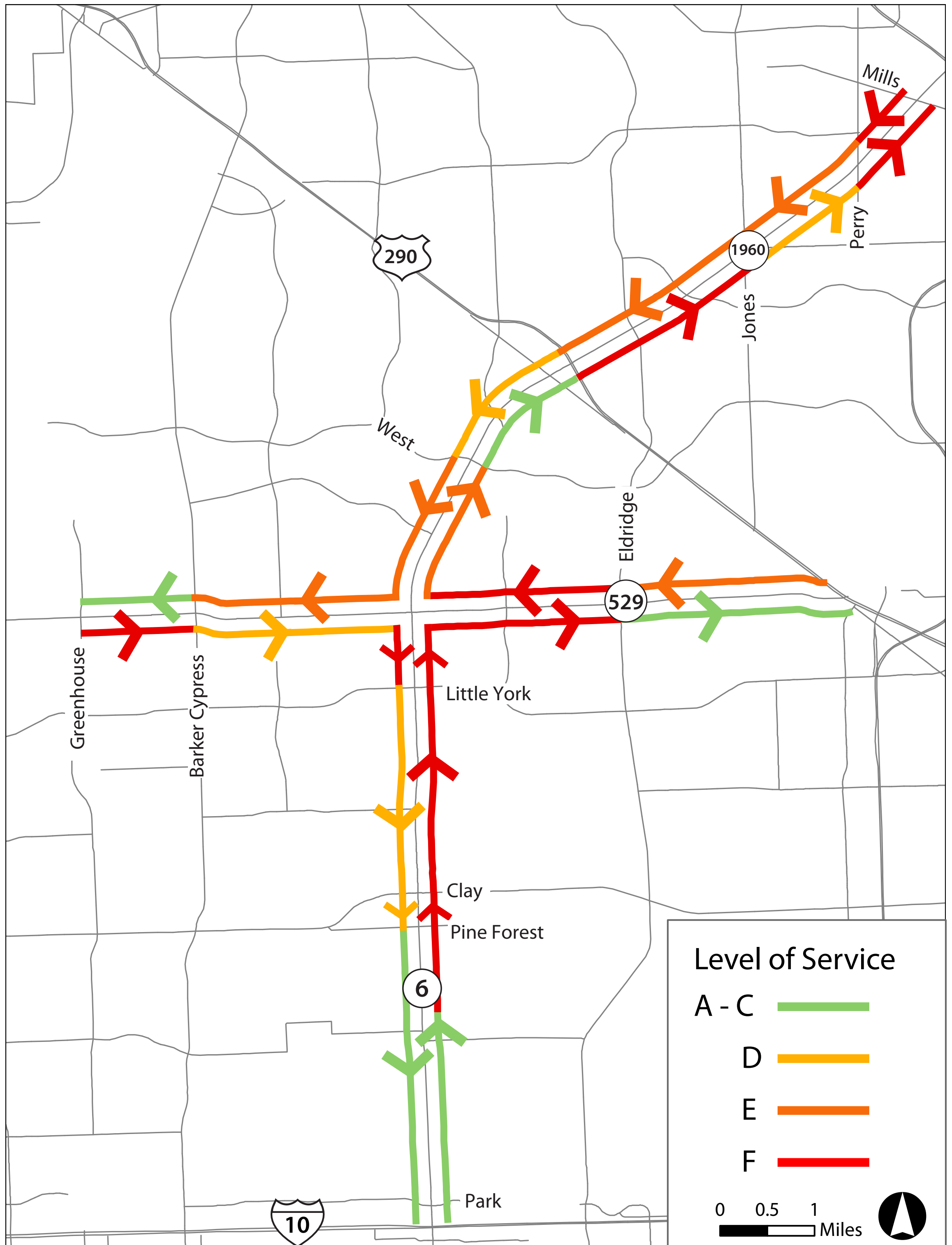
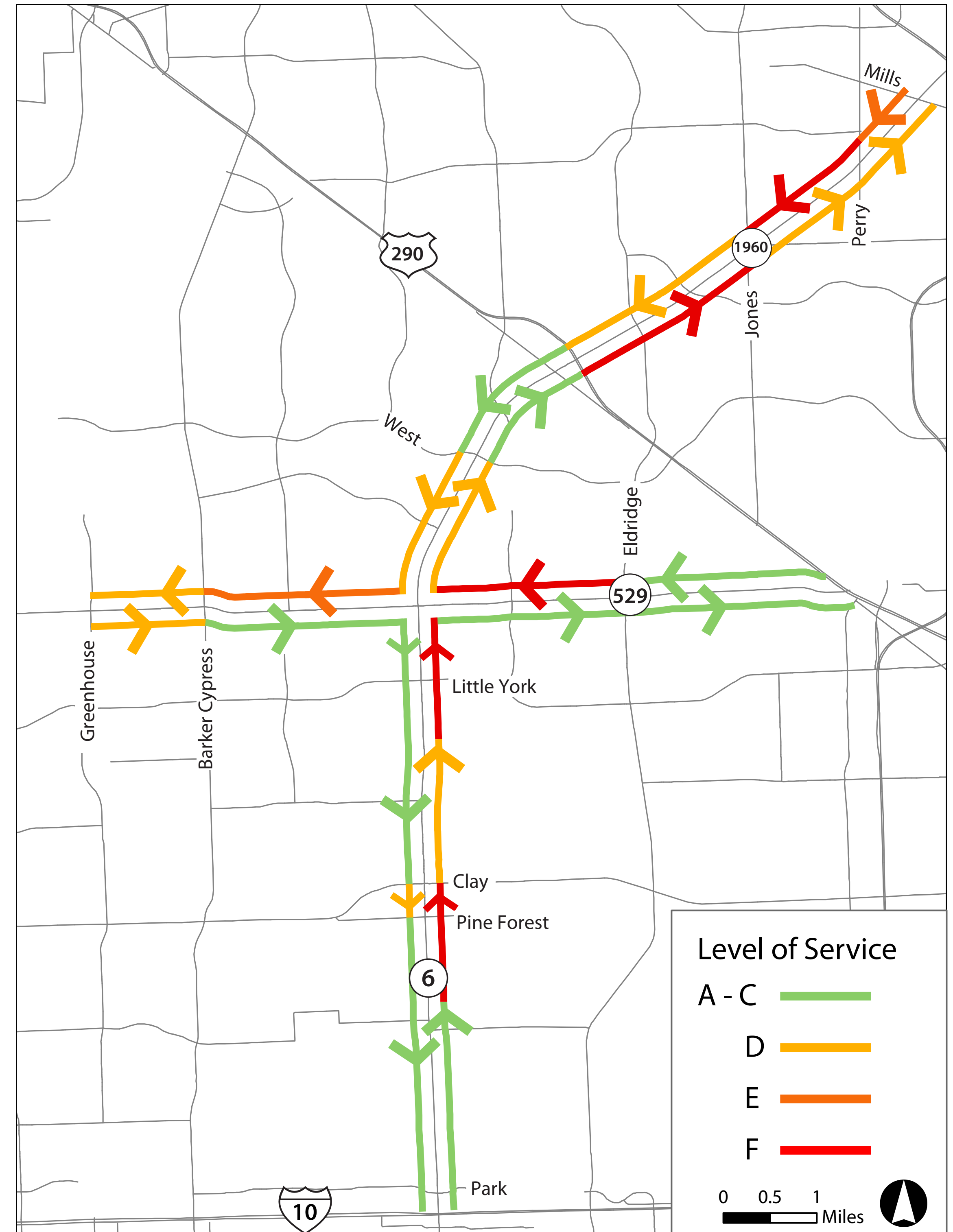
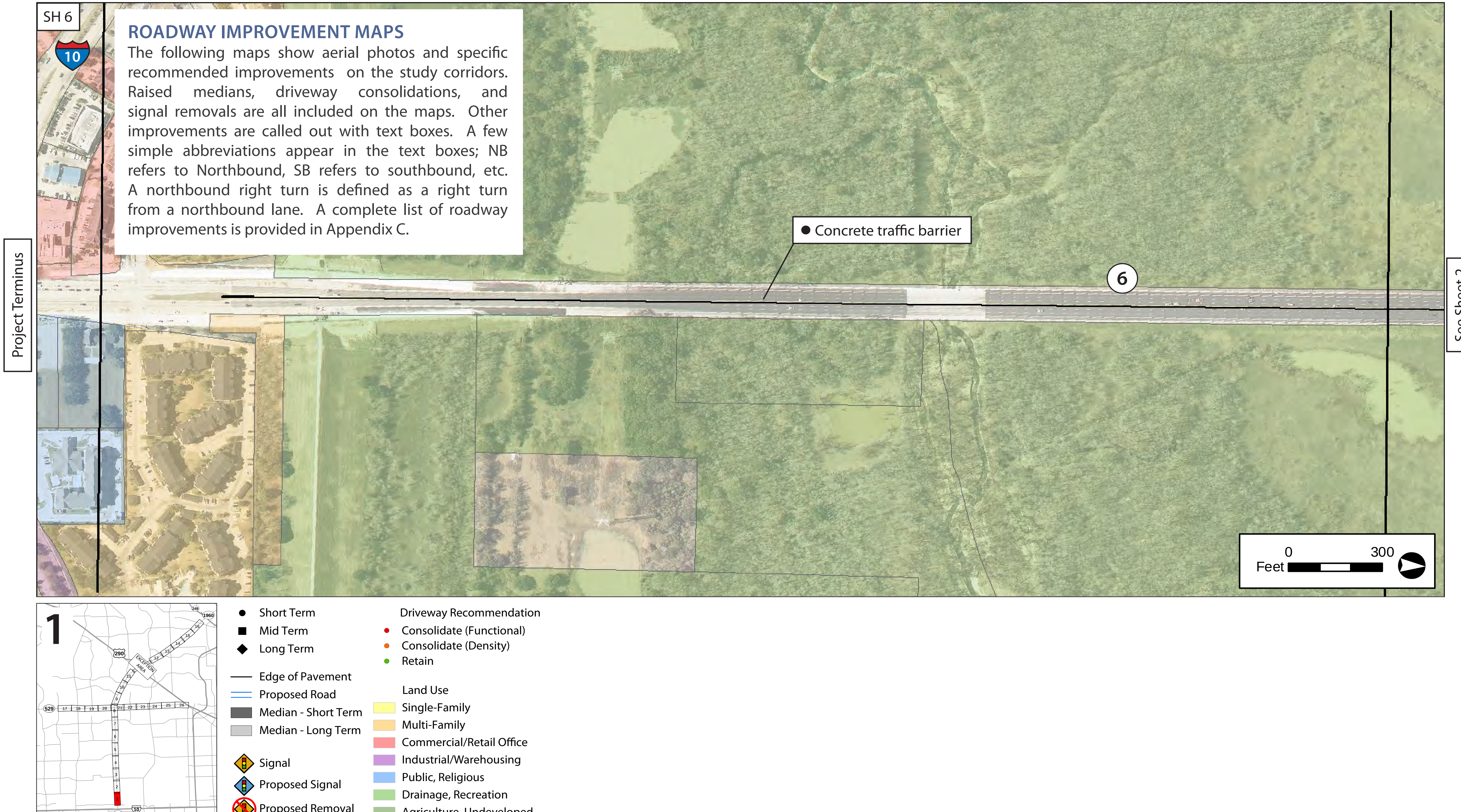


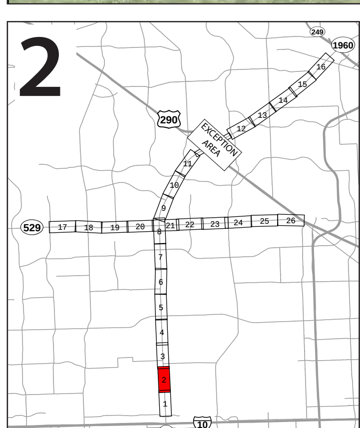
Figure 5.12: Arterial Level of Sevice - 2035 PM - Build



ROADWAY IMPROVEMENT MAPS

The following maps show aerial photos and specific recommended improvements on the study corridors. Raised medians, driveway consolidations, and signal removals are all included on the maps. Other improvements are called out with text boxes. A few simple abbreviations appear in the text boxes; NB refers to Northbound, SB refers to southbound, etc. A northbound right turn is defined as a right turn from a northbound lane. A complete list of roadway improvements is provided in Appendix C.





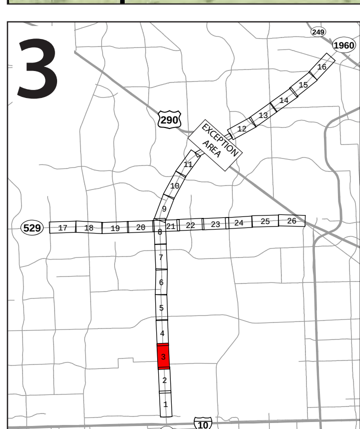
- Short Term
- Mid Term
- Long Term

- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term

- Signal
- Proposed Signal
- Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped



- Short Term
- Mid Term
- Long Term

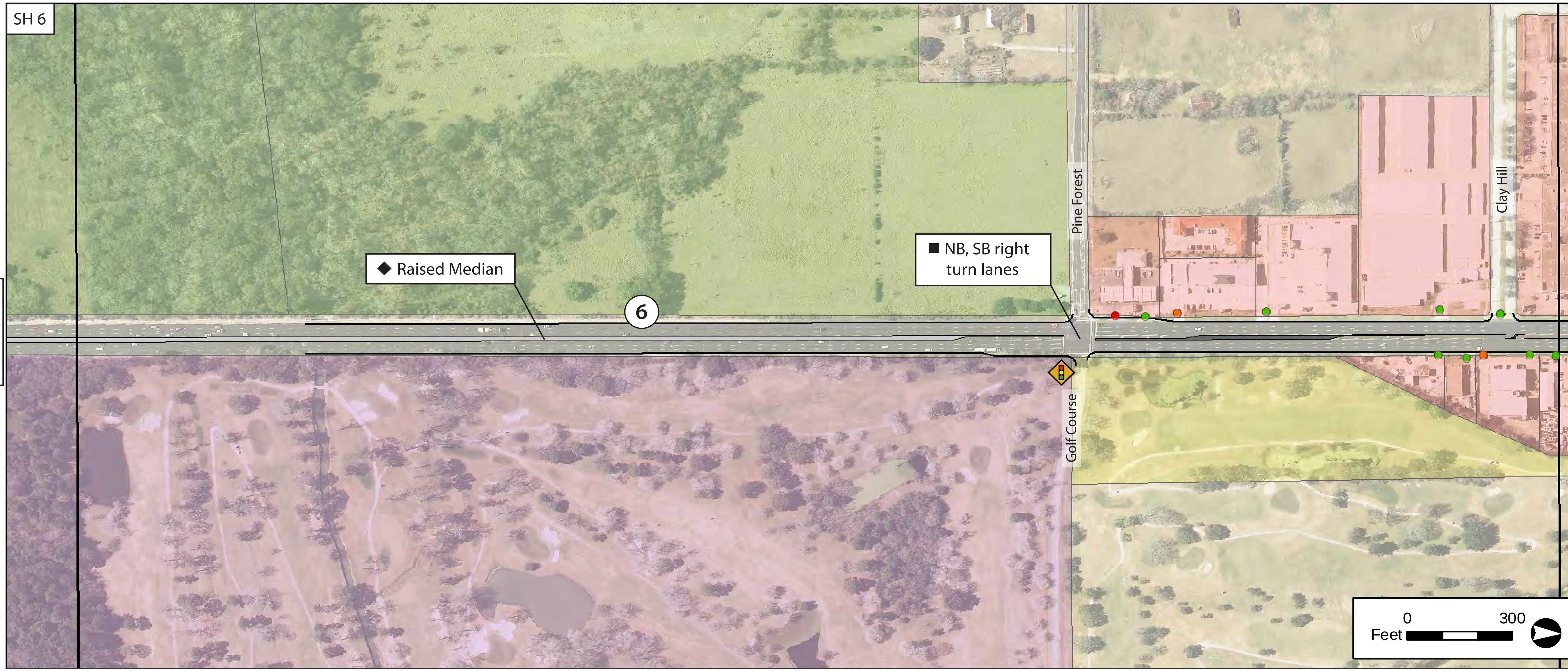
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

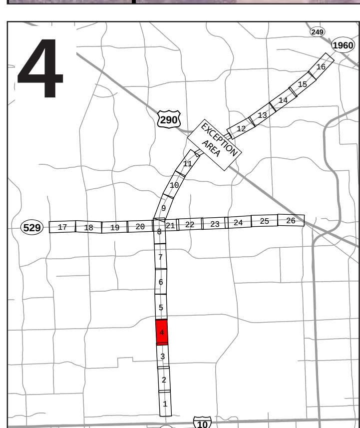
Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped

See Sheet 3



See Sheet 5



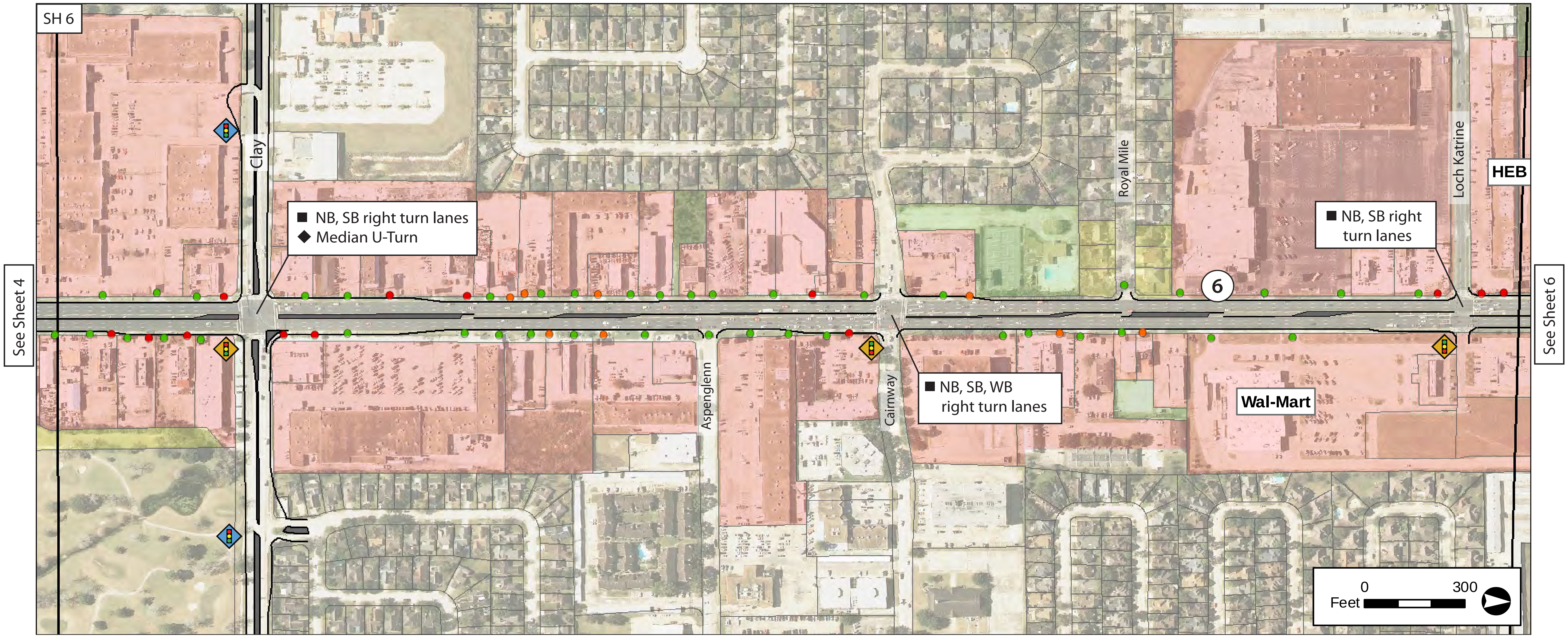
- ● Short Term
- ■ Mid Term
- ◆ Long Term

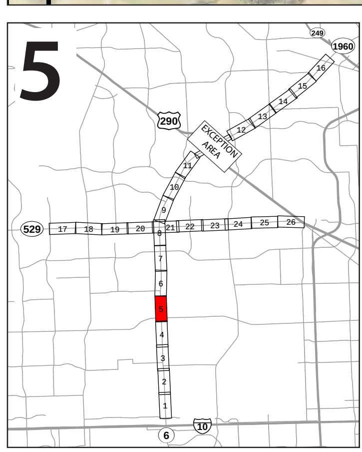
- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term

- Signal
- Proposed Signal
- Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped





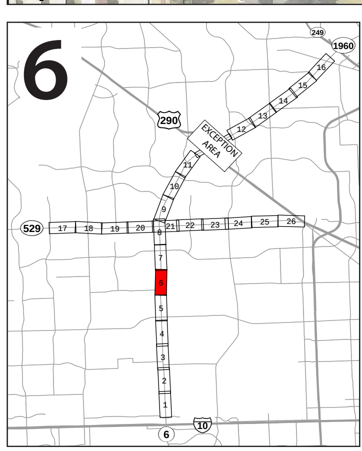
- ● Short Term
- ■ Mid Term
- ◆ Long Term

- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term

- Signal
- Proposed Signal
- Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped



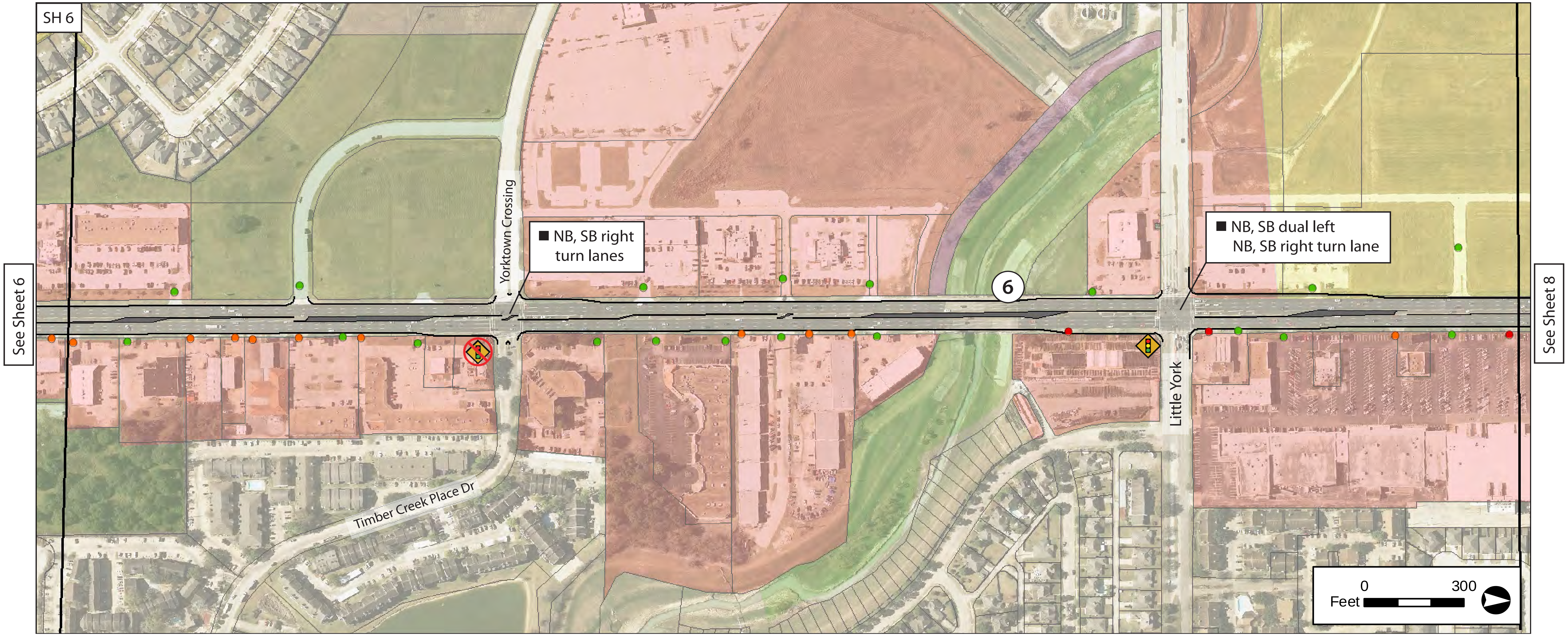
Short Term
Mid Term
Long Term

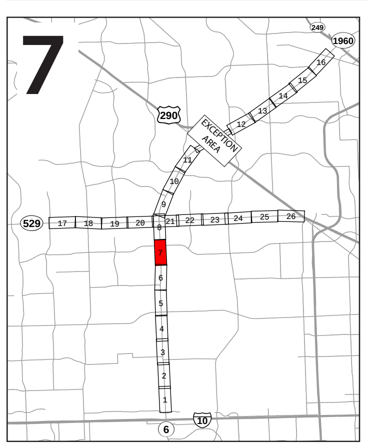
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain

Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped





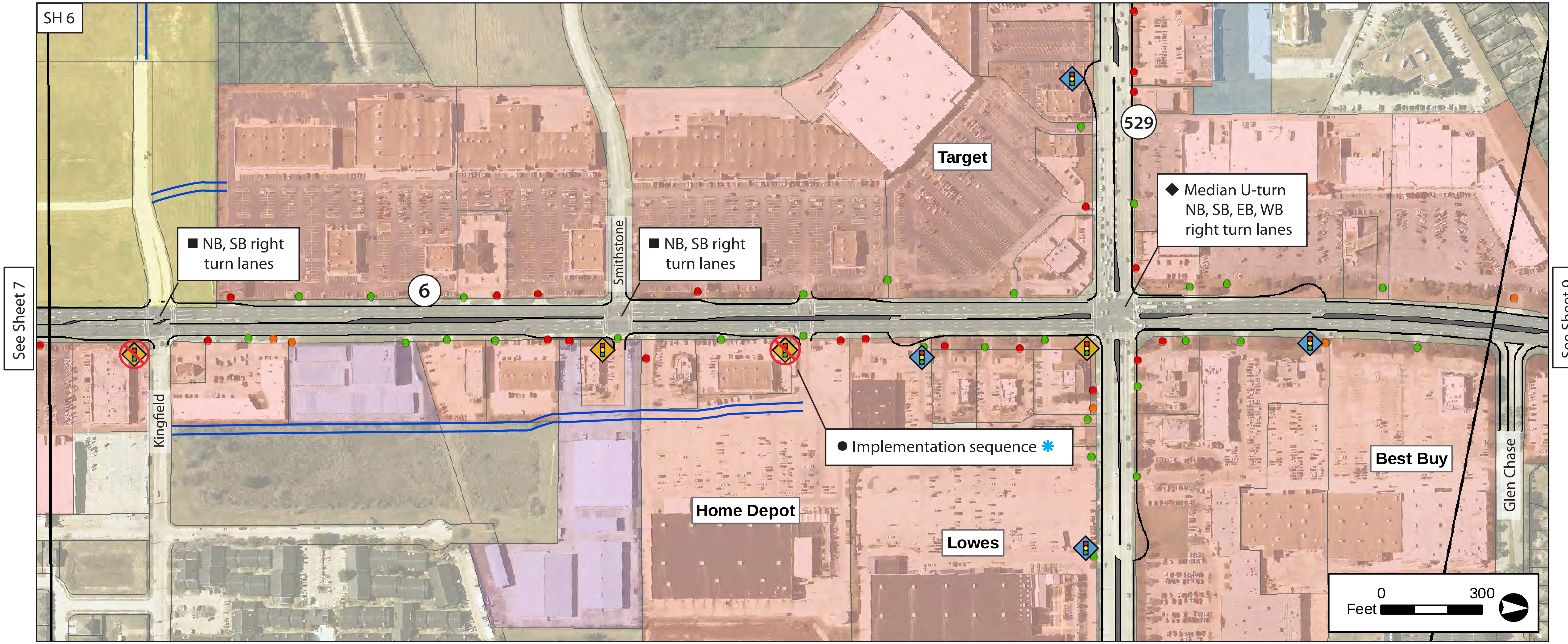
- Short Term
- Mid Term
- Long Term

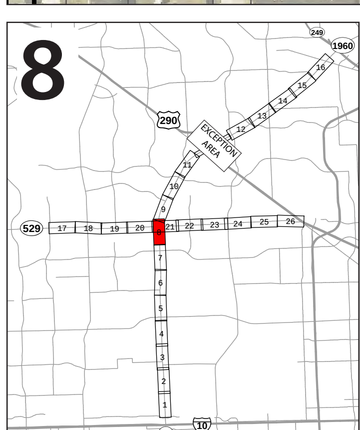
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped





● Short Term
■ Mid Term
◆ Long Term

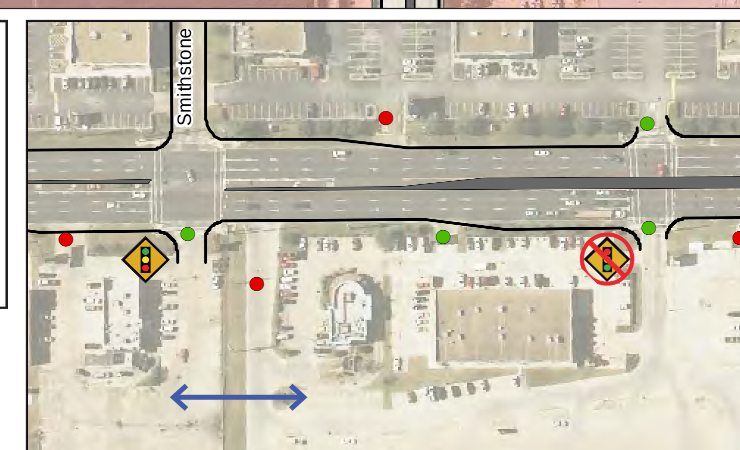
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

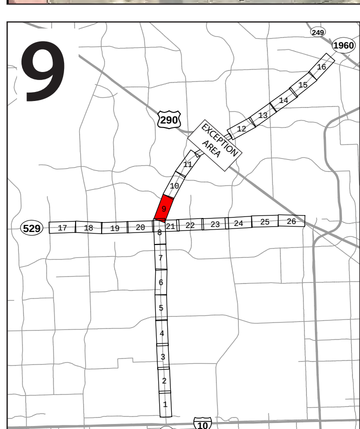
Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain

Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped

● Implementation sequence:
1. Provide cross parcel access with alternate access road
2. Change driveways (Home Depot and across from Smithstone) to right in right out
3. Remove signal





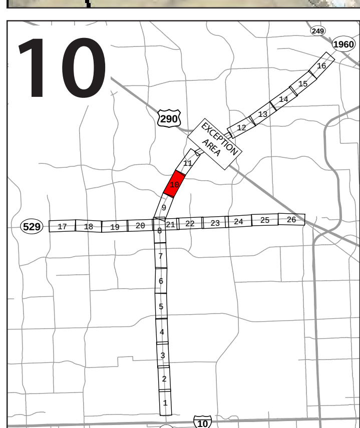
- ● Short Term
- ■ Mid Term
- ◆ Long Term

- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term

- Signal
- Proposed Signal
- Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

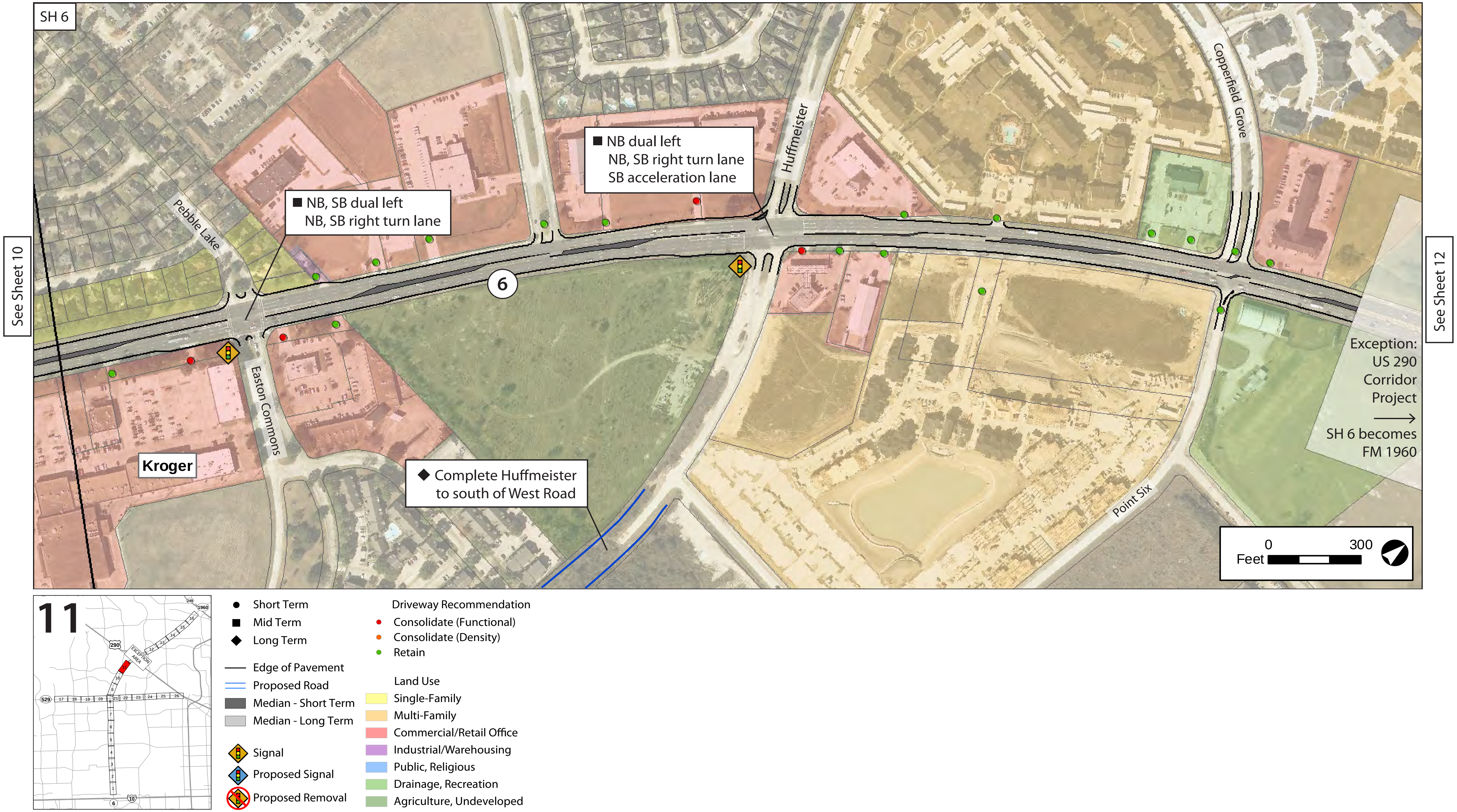
Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped

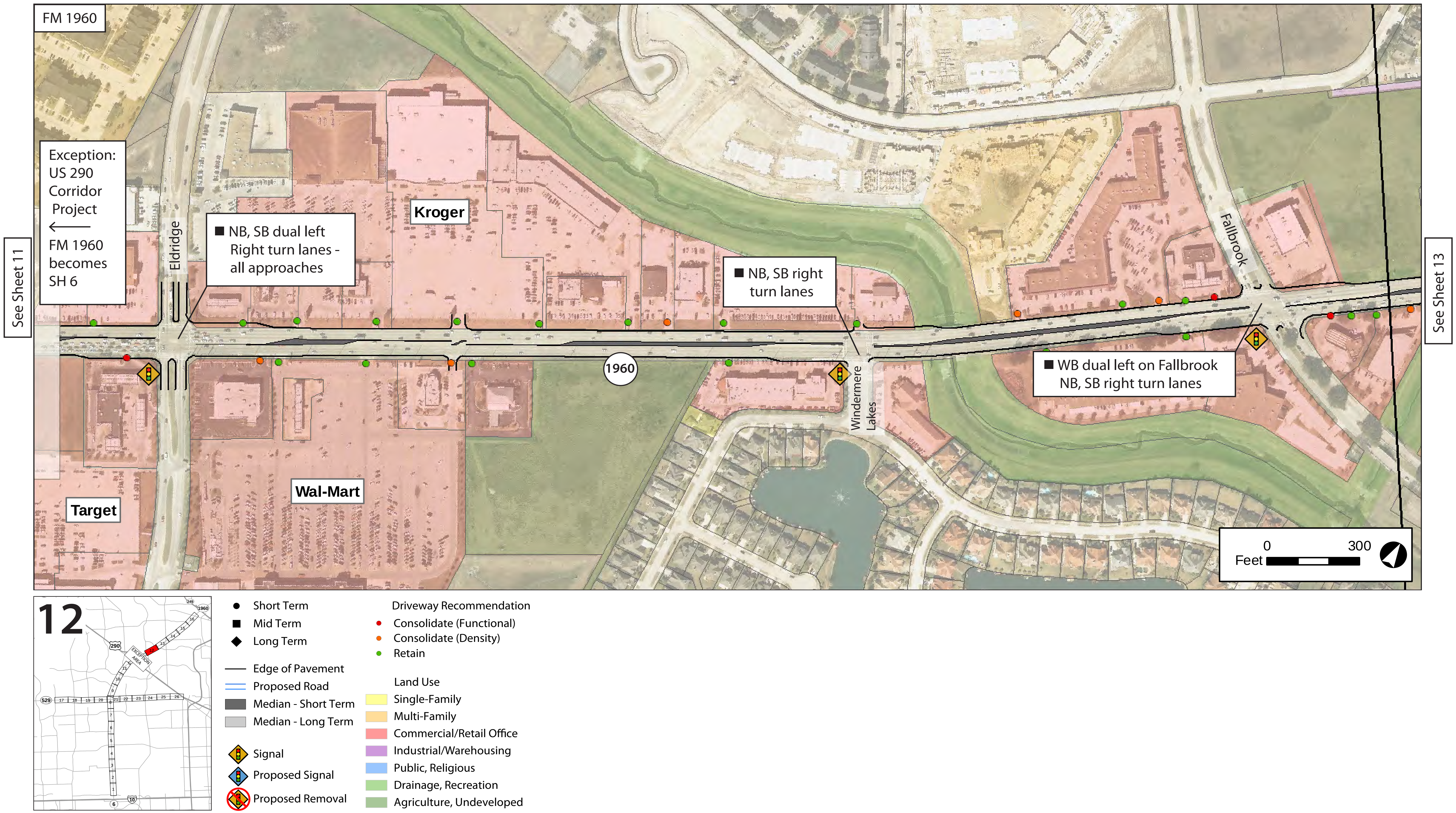


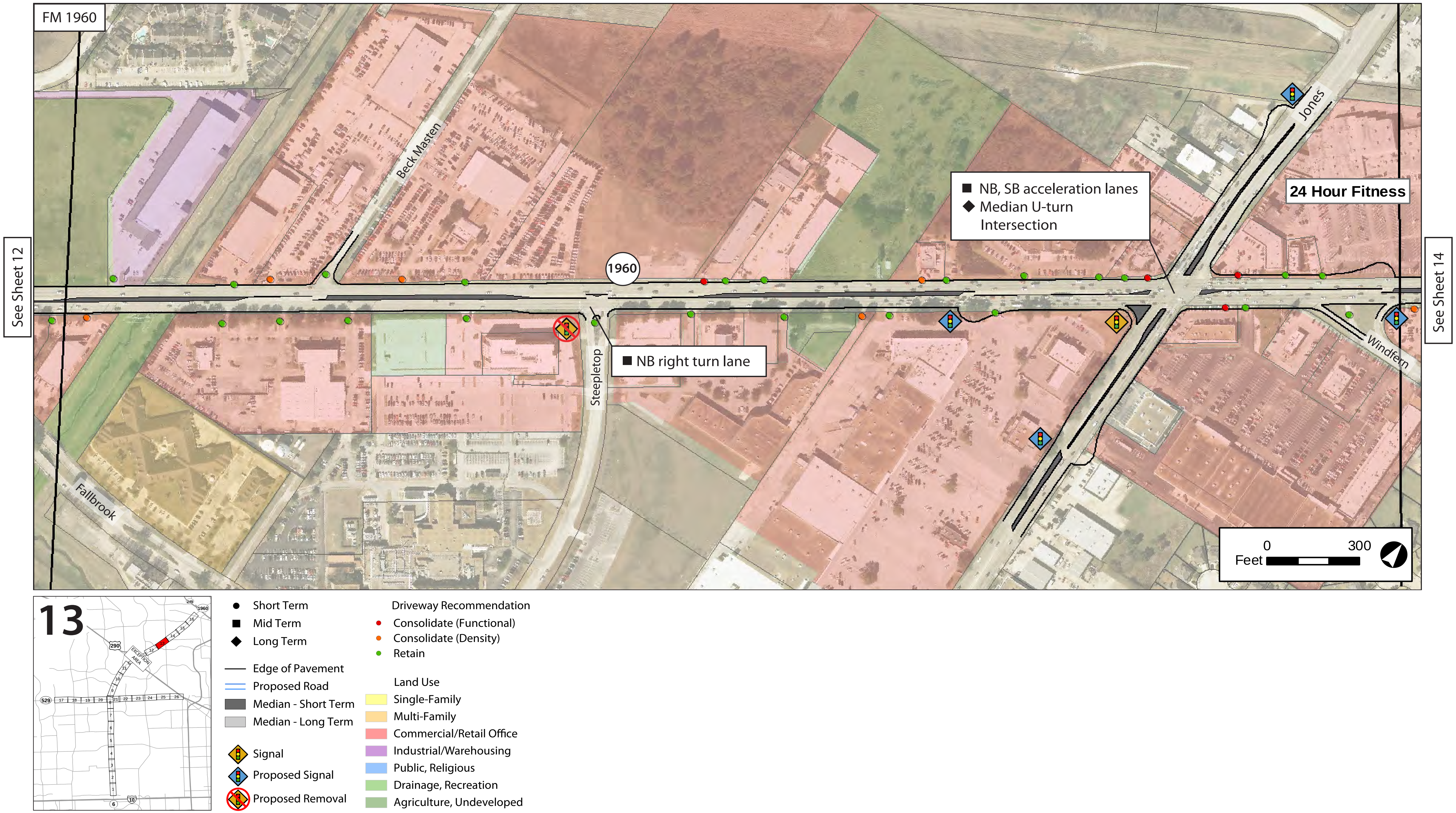
- ● Short Term
- ■ Mid Term
- ◆ Long Term
- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term
- Signal
- Proposed Signal
- Proposed Removal

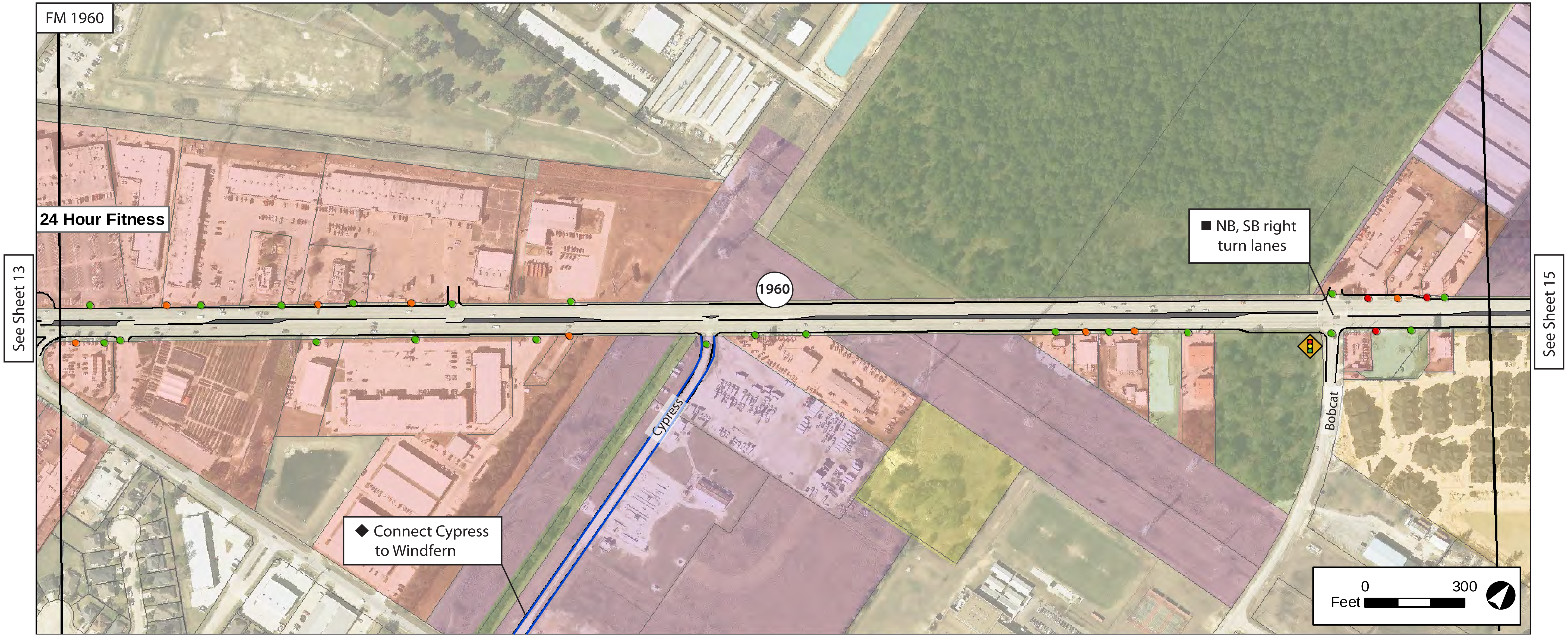
Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

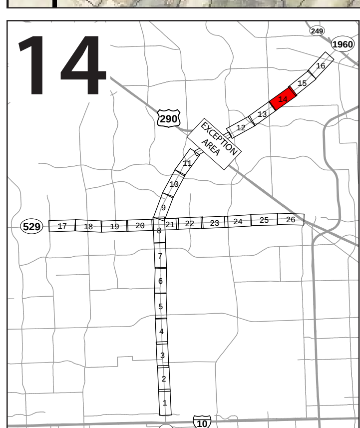
Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped


SH 6
See Sheet 10
See Sheet 12
Pebble Lake
Easton Commons
Huffmeister
Copperfield Grove
Point Six
Kroger
6
■ NB, SB dual left
NB, SB right turn lane
■ NB dual left
NB, SB right turn lane
SB acceleration lane
◆ Complete Huffmeister
to south of West Road
Exception:
US 290
Corridor
Project
SH 6 becomes
FM 1960
0
300
Feet
11
Short Term
Mid Term
Long Term
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term
Signal
Proposed Signal
Proposed Removal
Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain
Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped


FM 1960
Exception:
US 290
Corridor
Project
FM 1960
becomes
SH 6
See Sheet 11
See Sheet 13
Eldridge
Kroger
Wal-Mart
Target
1960
Windermere Lakes
Fallbrook
NB, SB dual left
Right turn lanes -
all approaches
NB, SB right
turn lanes
WB dual left on Fallbrook
NB, SB right turn lanes
0
300
Feet
12
Short Term
Mid Term
Long Term
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term
Signal
Proposed Signal
Proposed Removal
Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain
Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped


FM 1960
See Sheet 12
See Sheet 14
Beck Masten
1960
Jones
24 Hour Fitness
NB, SB acceleration lanes
Median U-turn Intersection
NB right turn lane
Steepletop
Windfern
Fallbrook
0
300
Feet
13
Short Term
Mid Term
Long Term
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term
Signal
Proposed Signal
Proposed Removal
Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain
Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped





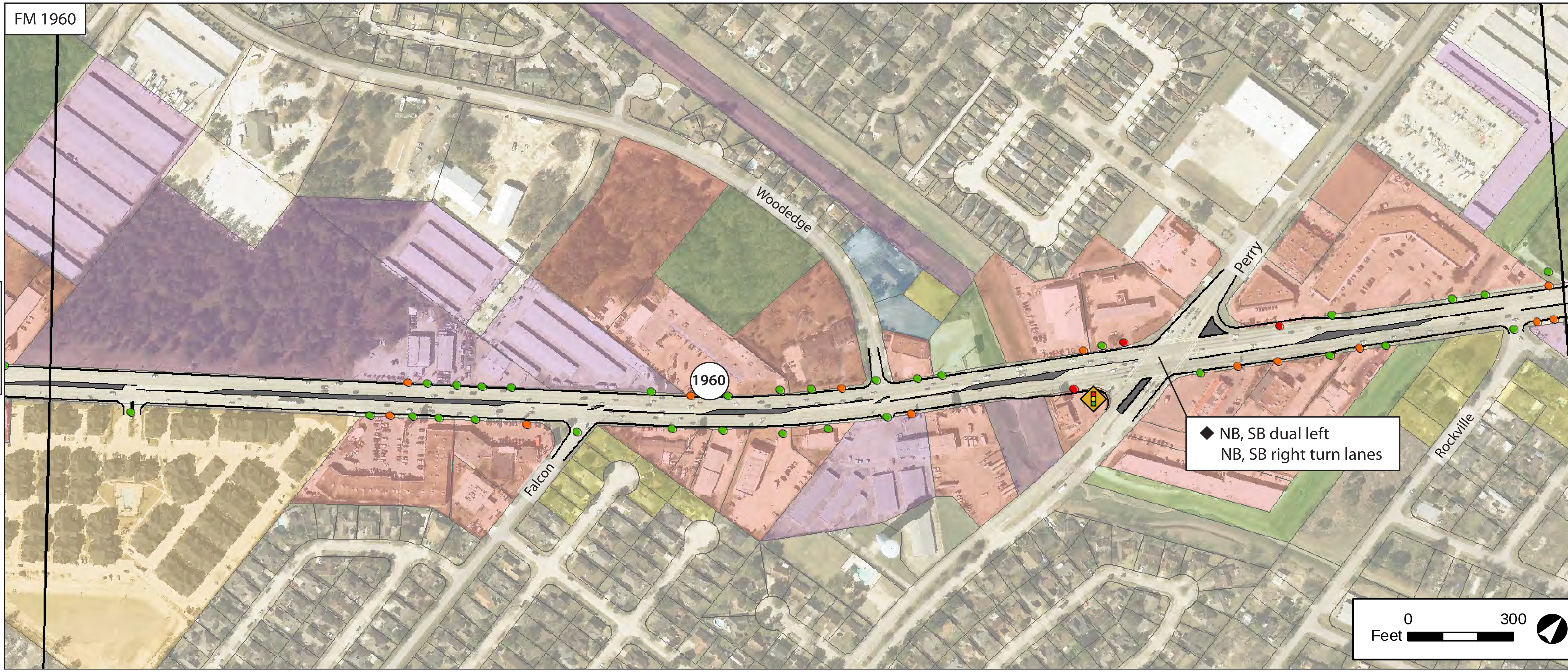
Short Term
Mid Term
Long Term

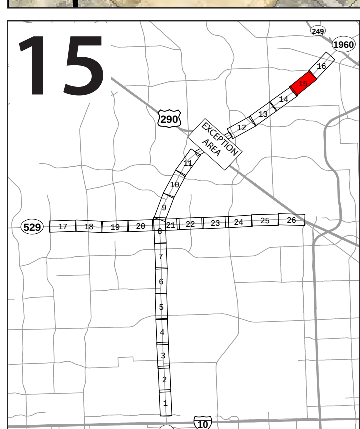
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain

Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped





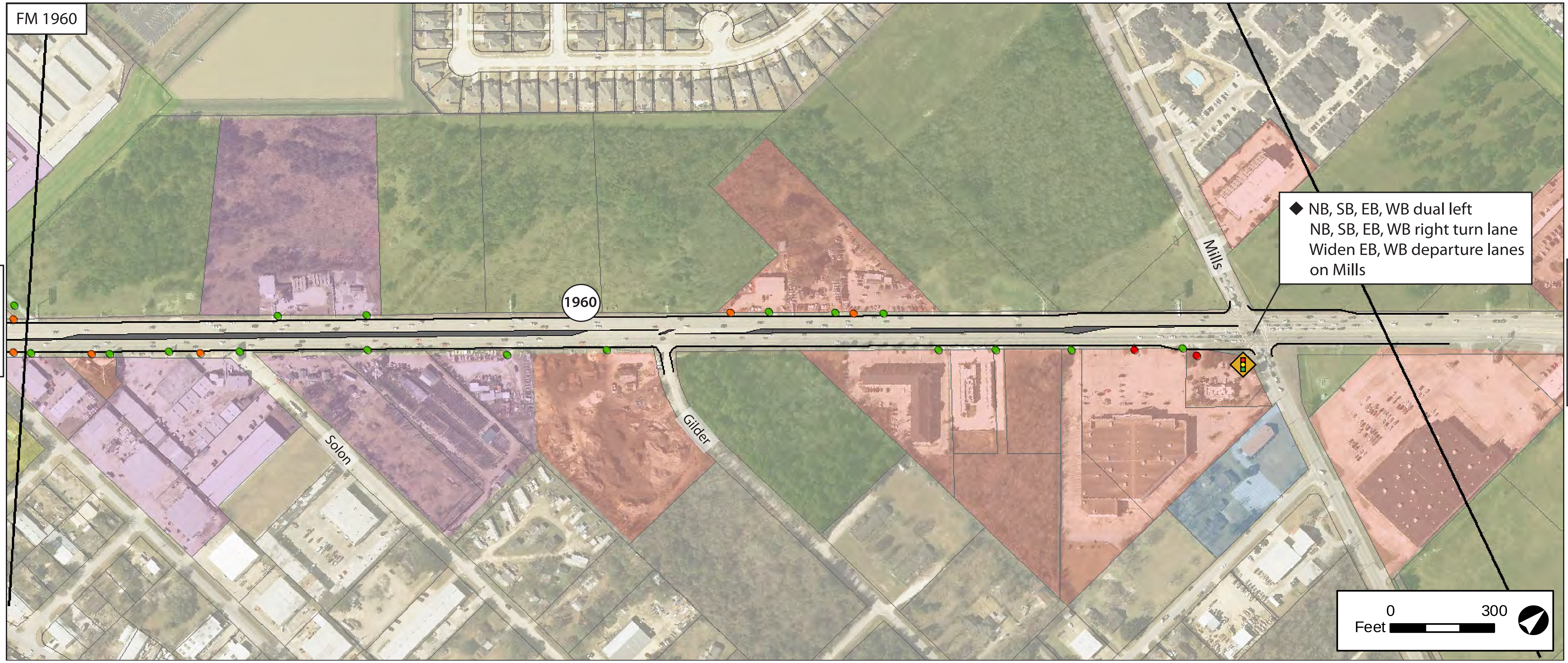
● Short Term
■ Mid Term
◆ Long Term

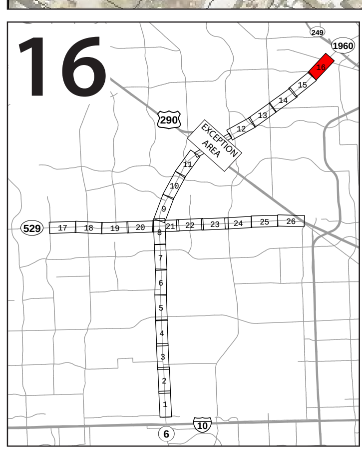
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain

Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped





● Short Term
■ Mid Term
◆ Long Term

Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain

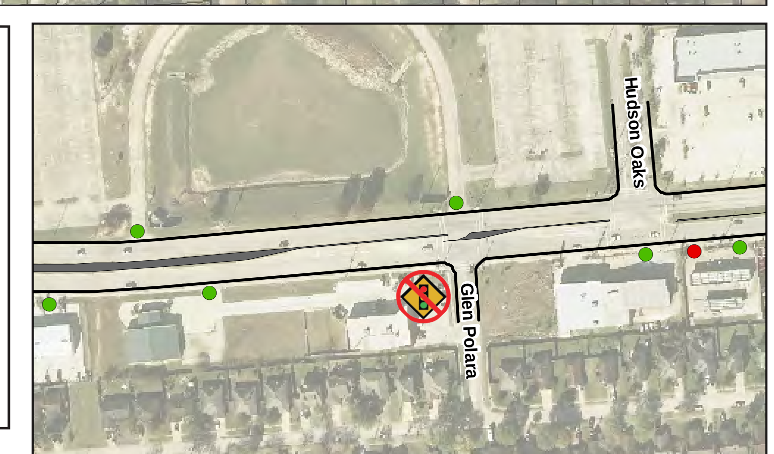
Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped

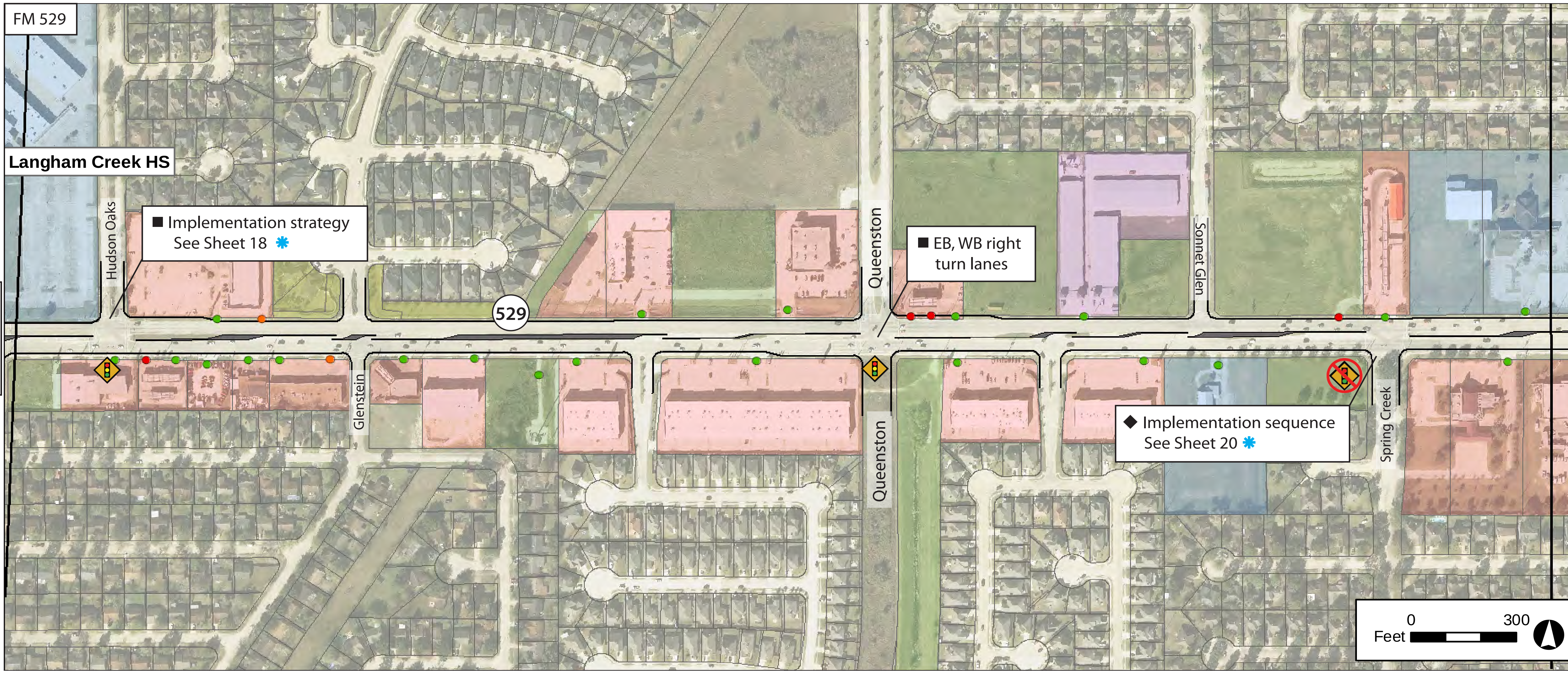

FM 529
Project Terminus
Greenhouse
Remington Grove
Livery
Paddock Bend
529
New WB lane - dedicated right turn lane lane
Add lanes EB, WB
Raised Median
See Sheet 18
0
300
Feet
17
Short Term
Mid Term
Long Term
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term
Signal
Proposed Signal
Proposed Removal
Driveway Recommendation
Consolidate (Functional)
Consolidate (Density)
Retain
Land Use
Single-Family
Multi-Family
Commercial/Retail Office
Industrial/Warehousing
Public, Religious
Drainage, Recreation
Agriculture, Undeveloped

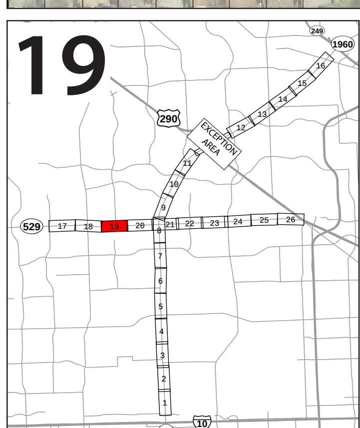
Coordinate with Cy-Fair ISD on school access

● At Glen Polara:
Extend median through intersection
Change to right in right out
Remove signal
Add WB right turn lane into driveway

■ At Hudson Oaks:
Add WB right turn lane
Shave median (east of intersection) to allow U-turns







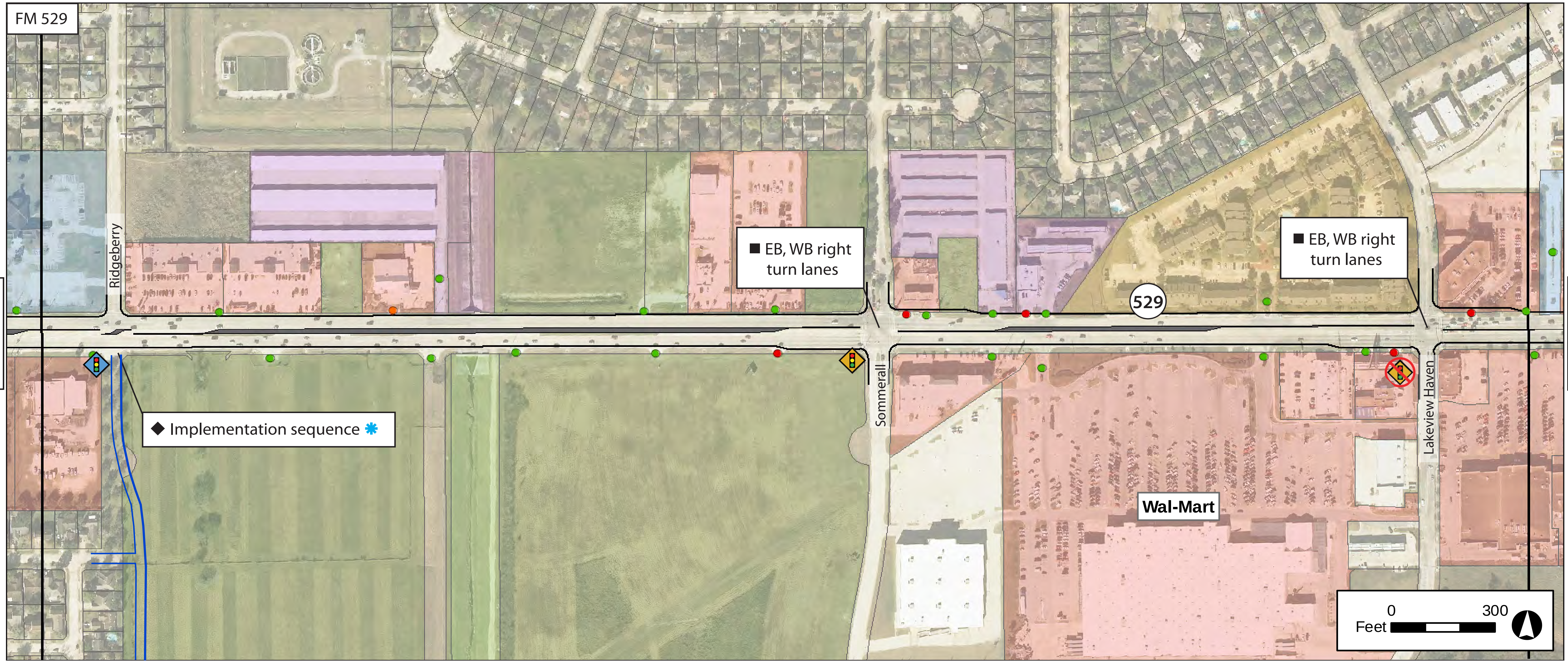
- ● Short Term
- ■ Mid Term
- ◆ Long Term
- Edge of Pavement
- Proposed Road
- Median - Short Term
- Median - Long Term
- Signal
- Proposed Signal
- Proposed Removal

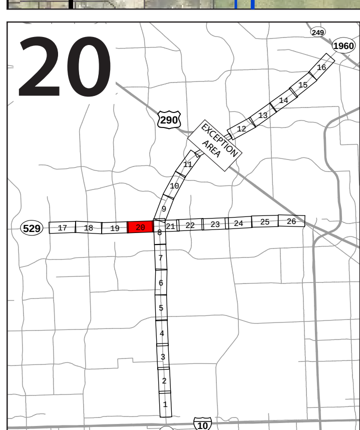
Driveway Recommendation

- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use

- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped





- ● Short Term
- ■ Mid Term
- ◆ Long Term

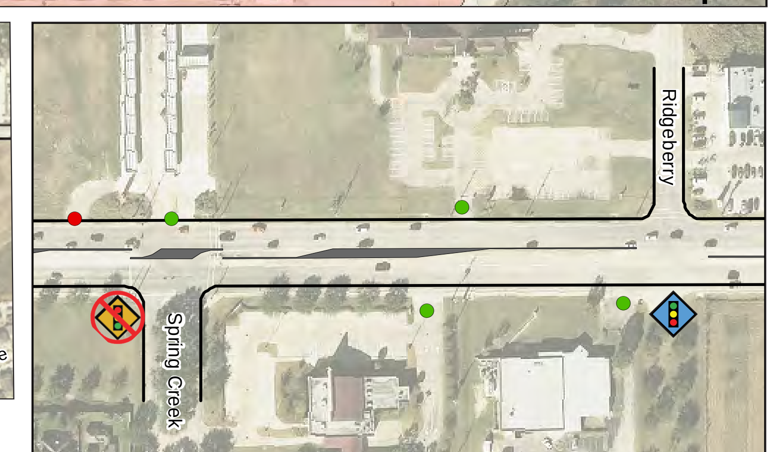
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

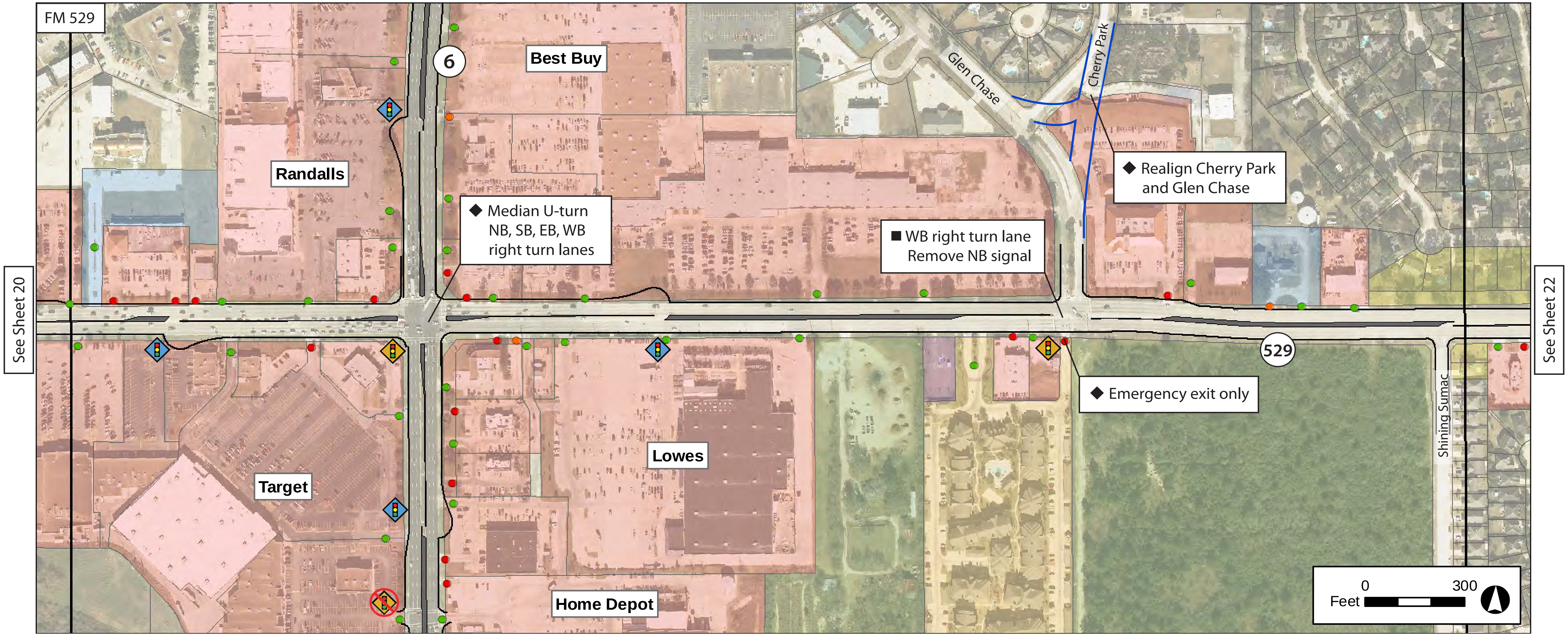
Signal
Proposed Signal
Proposed Removal

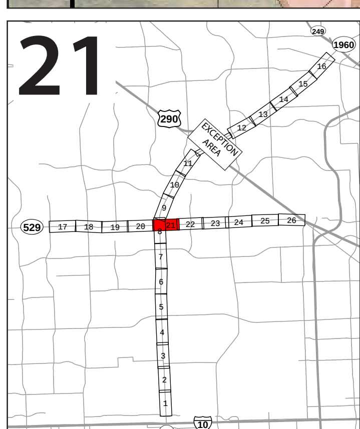
Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped

◆ Implementation sequence:
1. Connect Smithstone to Bouldgreen, Rockbend, and Ridgeberry intersection
2. Add signal at Ridgeberry
3. Remove signal at Spring Creek







- ● Short Term
- ■ Mid Term
- ◆ Long Term

Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term

Signal
Proposed Signal
Proposed Removal

Driveway Recommendation
- Consolidate (Functional)
- Consolidate (Density)
- Retain

Land Use
- Single-Family
- Multi-Family
- Commercial/Retail Office
- Industrial/Warehousing
- Public, Religious
- Drainage, Recreation
- Agriculture, Undeveloped


FM 529
See Sheet 21
See Sheet 23
Halfpenny
Winding Walk
Blenheim Palace
Shining Sumac
Addicks Satsuma
Huffmeister
529
EB, WB right turn lane
EB right turn lane, NB lane on Addicks Satsuma
0
300
Feet
22
Short Term
Mid Term
Long Term
Edge of Pavement
Proposed Road
Median - Short Term
Median - Long Term
Signal
Proposed Signal
Proposed Removal
Driveway Recommendation
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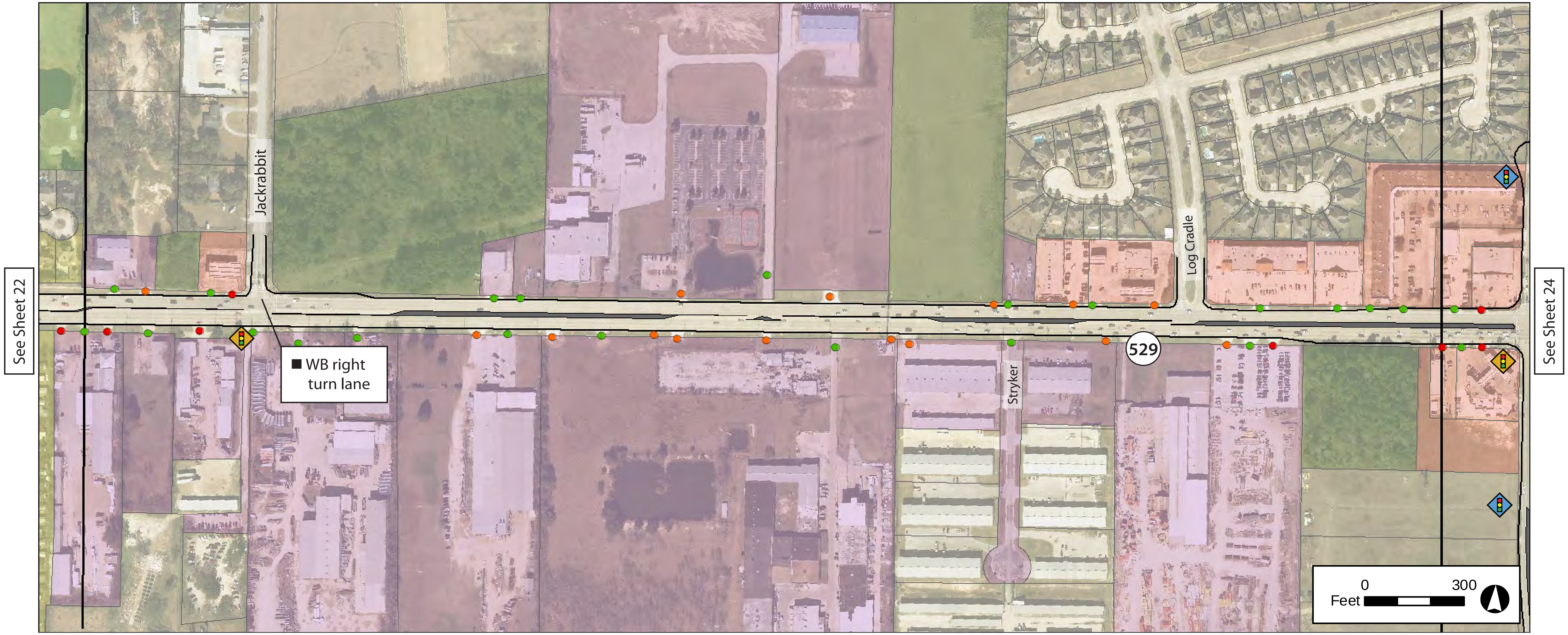

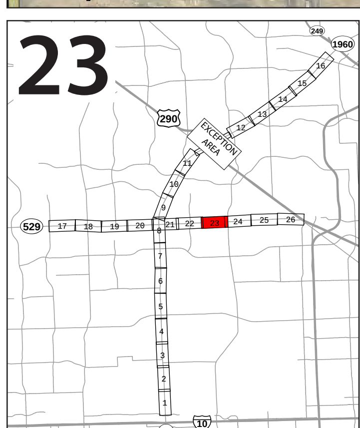

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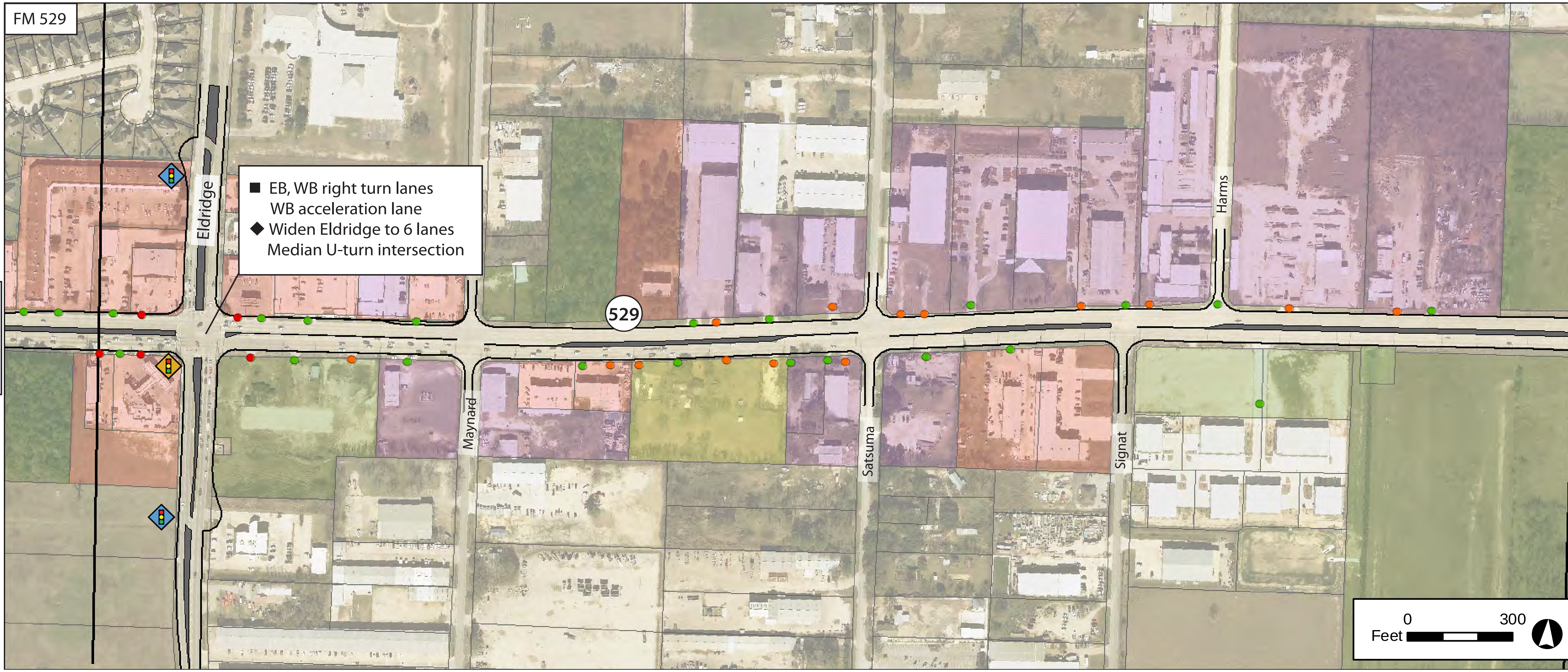

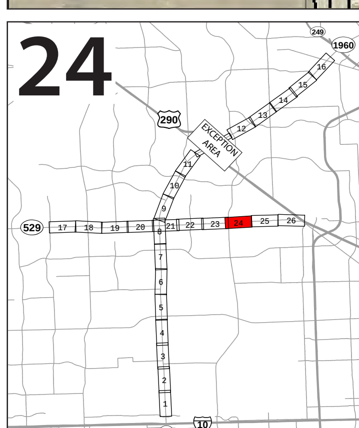

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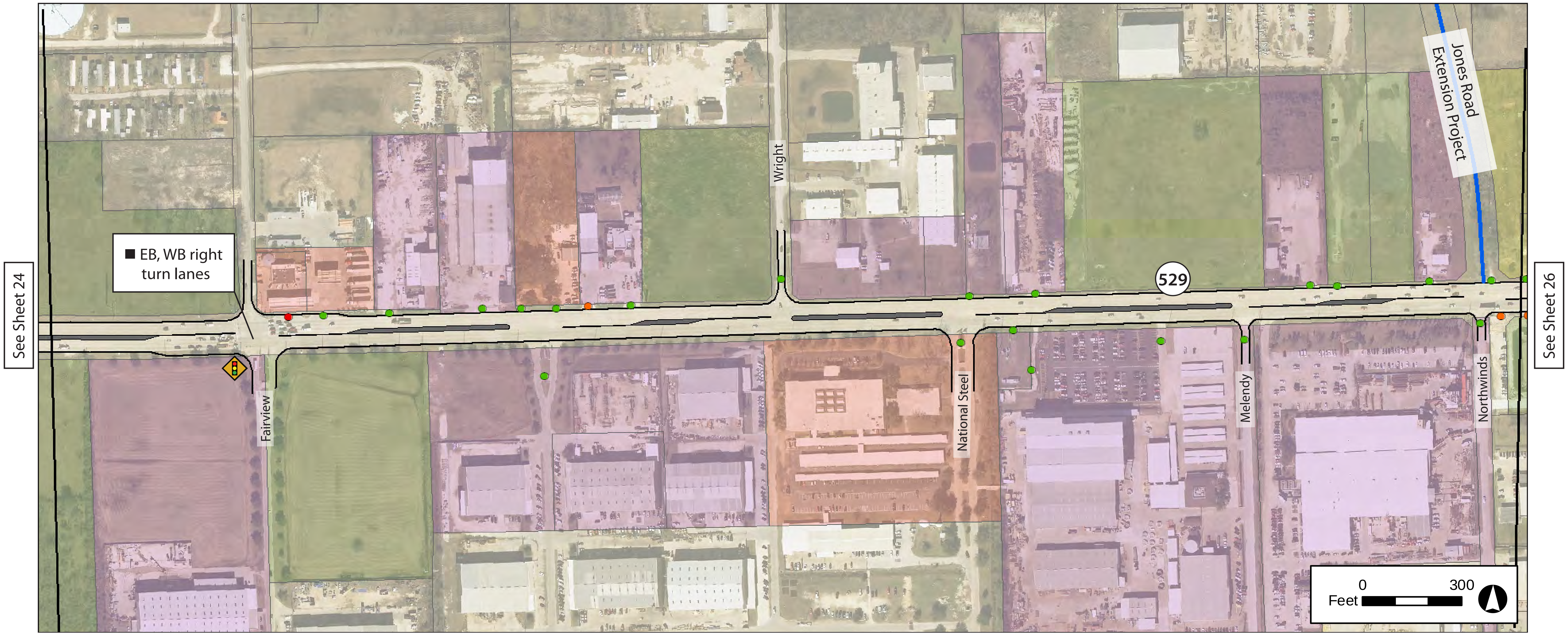

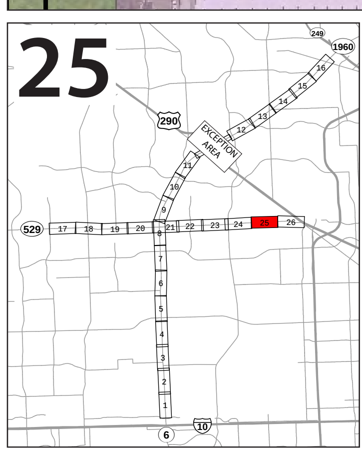

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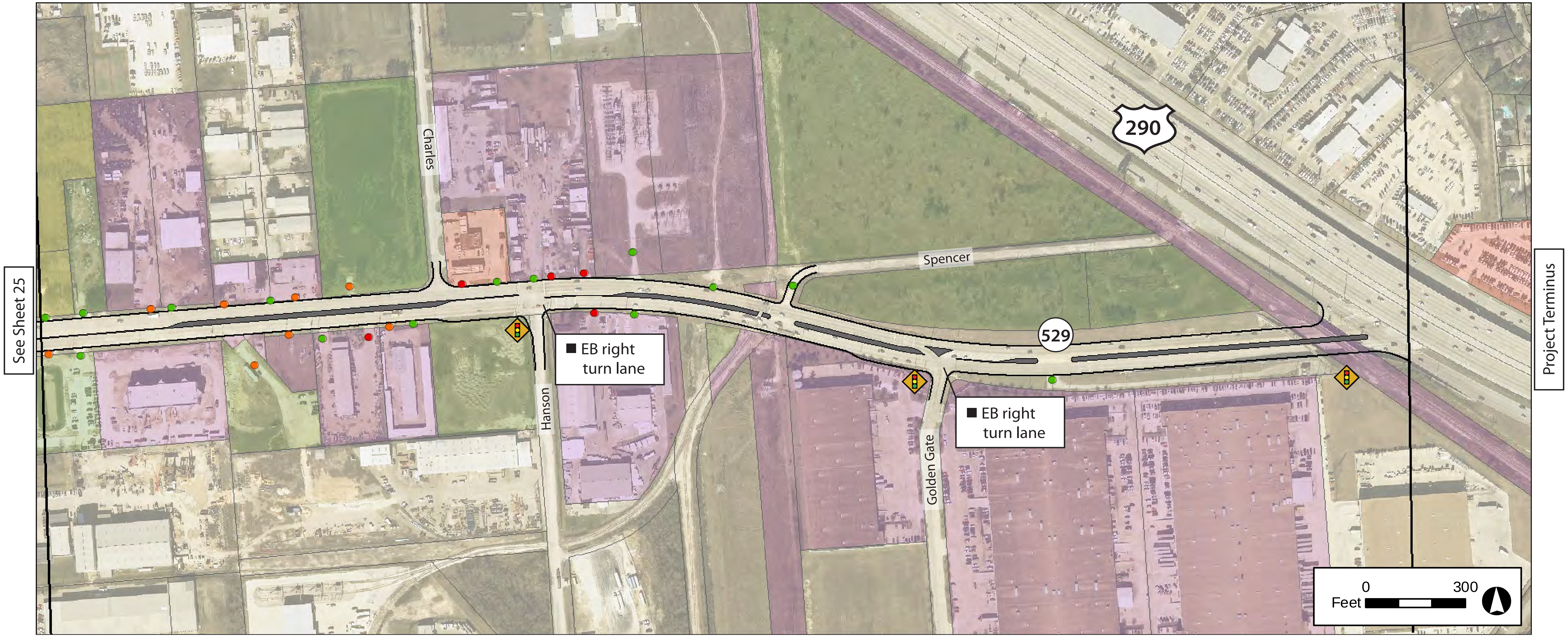

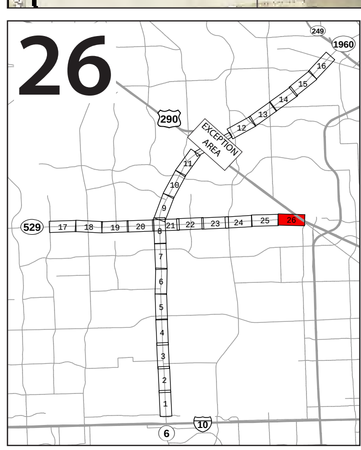

● Short Term
■ Mid Term
◆ Long Term

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Median - Long Term

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SUMMARY OF IMPROVEMENT COSTS

Cost estimates are based on engineering and construction industry historical costs and conceptual plan documents. Cost estimates are not warranted to match actual bids. Estimates are based on 2010 dollars. A detailed list of improvements with costs is provided in Appendix C.

Most of improvement descriptions below are self explanatory. Speed change lanes are acceleration or deceleration lanes including right-turn lanes.

Table 5.1: Short Term Improvement Costs

Roadway	Improvement	Improvement Cost	ROW Cost	Total Cost
SH 6	Install Concrete Traffic Barrier	$944,908	$0	$944,908
	Install Median	$6,370,807	$0	$6,370,807
	Pedestrian Improvements	$1,224,124	$0	$1,224,124
	Remove Traffic Signal	$84,000	$0	$84,000
	Traffic Signal Improvements	$232,500	$0	$232,500
FM 1960	Install Median	$3,584,430	$0	$3,584,430
	Remove Traffic Signal	$14,000	$0	$14,000
	Traffic Signal Improvements	$108,500	$0	$108,500
FM 529	Install Median	$6,867,599	$0	$6,867,599
	Pedestrian Improvements	$407,372	$0	$407,372
	Remove Traffic Signal	$14,000	$0	$14,000
	Traffic Signal Improvements	$170,500	$0	$170,500
	Roadway	**Improvement Cost**	**ROW Cost**	**Total Cost**
Totals	SH 6	$8,856,339	$0	$8,856,339
	FM 1960	$3,706,930	$0	$3,706,930
	FM 529	$7,459,471	$0	$7,459,471
	Construct New Roadways	$933,630	$1,470,000	$2,403,630
	Total Costs	**$20,956,370**	**$1,470,000**	**$22,426,370**

Table 5.2: Medium Term Improvement Costs

Roadway	Improvement	Improvement Cost	ROW Cost	Total Cost
SH 6	Pedestrian Improvements	$1,149,291	$0	$1,149,291
	Speed Change Lanes	$7,221,256	$776,860	$7,998,116
FM 1960	Speed Change Lanes	$2,784,790	$373,040	$3,157,830
FM 529	Pedestrian Improvements	$10,868	$0	$10,868
	Speed Change Lanes	$3,869,154	$424,710	$4,293,864
	Roadway	**Improvement Cost**	**ROW Cost**	**Total Cost**
Totals	SH 6	$8,370,548	$776,860	$9,147,408
	FM 1960	$2,784,790	$373,040	$3,157,830
	FM 529	$3,880,022	$424,710	$4,304,732
	Construct New Roadways	$613,889	$935,000	$1,548,889
	Total Costs	$15,649,249	$2,509,610	$18,158,859

Table 5.3: Long Term Improvement Costs

Roadway	Improvement	Improvement Cost	ROW Cost	Total Cost
SH 6	Install Median	$276,189	$0	$276,189
	Median U-Turn Bulbs	$3,095,802	$569,150	$3,664,952
	Pedestrian Improvements	$108,127	$0	$108,127
FM 1960	Median U-Turn Bulbs	$1,455,778	$619,790	$2,075,568
	Pedestrian Improvements	$1,687,858	$0	$1,687,858
	Speed Change Lanes	$2,658,401	$132,700	$2,791,101
FM 529	Median U-Turn Bulbs	$673,345	$219,600	$892,945
	Pedestrian Improvements	$2,256,697	$0	$2,256,697
	Widen Roadway	$3,159,999	$0	$3,159,999

	Roadway	Improvement Cost	ROW Cost	Total Cost
Totals	SH 6	$3,480,118	$569,150	$4,049,268
	FM 1960	$5,802,037	$752,490	$6,554,527
	FM 529	$6,090,041	$219,600	$6,309,641
	Construct New Roadways	$5,050,670	$2,410,970	$7,461,640
	Total Costs	$20,422,865	$3,952,210	$24,375,075

IMPLEMENTATION AND FUNDING

Improvements and alterations identified in this study require funding by public entities for implementation. Because the study corridors are part of the TxDOT system, funding would historically be provided through the H-GAC project nomination process, and then fed into the Statewide Transportation Improvement Plan (STIP) for TxDOT funding. There is also potential to use local matching funds for side road tie-ins to local roadway networks.

All improvements in this study must be approved for implementation by TxDOT and any other entity with jurisdiction over the applicable roadways (the City of Houston, the City of Jersey Village and Harris County) as appropriate. Upon appropriate approvals, the recommendations of this study may be programmed per the implementation recommendations as funding is available.

Since the TxDOT funding stream is not currently sufficient to cover statewide transportation improvement needs, alternate funding mechanisms must be considered for project improvements. These mechanisms may come governmental entities, or through district overlays, associations, and agreements.

GOVERNMENTAL ENTITIES

While TxDOT funding is constrained, TxDOT still has the ability to fund projects through the H-GAC nomination process, which places projects on the STIP. Projects within this corridor are eligible for consideration as part of this process.

Local entities in Texas have recently undertaken projects of local need or importance on the state system with local monies. Locally funded projects skip the waiting process of funding through the STIP and are under traffic earlier. Such funding can include regular Capital Improvements Plan (CIP) programming, inclusion in bond elections, and/or use of pass-through or State Infrastructure Bank financing. Any such funding requires sponsorship of a local political entity with jurisdiction over the roadway.

DISTRICT OVERLAYS, ASSOCIATIONS, AND AGREEMENTS

There are several mechanisms that allow public agencies and associations of property owners to provide improvements in a corridor. These mechanisms require legislative authorization for implementation. Desired outcomes may include improved safety, increased consumer flow, and beautification.

Participation in a property owners association may be voluntary or required due to the location of the property in a special overlay district. Involuntary participation in association goals may include taxation or the taking of property. Four particular types of associations appear to be most appropriate for this corridor: Transportation Reinvestment Zones (TRIZ), Tax Increment Finance (TIF) Zone, Transportation Corporations, and driveway sharing agreements.

Transportation Reinvestment Zones (TRIZ)

Municipal Transportation Reinvestment Zones (TRIZ) were created in the Texas Transportation Code Chapter 222, Section 106. As the name states, they must be proposed by municipalities, which means that Harris County is not eligible to create a TRIZ. Section 107 of Chapter 222, does allow the creation of County Transportation Reinvestment Zones. TRIZs may be created for any of four purposes:

1. Promote public safety;
2. Facilitate the development or redevelopment of property;
3. Facilitate the movement of traffic; and
4. Enhance a local entity's ability to sponsor a project authorized under Section 222.104 of the Texas Transportation Code.

However, if either the municipality or the county creates a TRIZ it must be for the purpose of entering into a pass-through toll agreement with TxDOT. Counties that create a TRIZ must hold a public meeting, offer opportunities for public comment, describe the boundaries of the TRIZ, and describe the tax abatement and the benefits to the county.

Tax Increment Finance (TIF) Zone

The Texas Tax Code, Chapter 311, Section 5, Subsection 1b allows the creation of reinvestment zones if an area has a "predominance of defective and inadequate sidewalks or street layout." Section 311.0123 allows a sales tax increment to be used to pay back bonds or notes, if the increased sales are attributable to the improvements made in the zone.

Transportation Corporations

The concept of the Transportation Corporation is established in Chapter 431 of the Texas Transportation Code. Its purpose is to:

1. Promote and develop public transportation facilities and systems by new and alternative means;
2. Expand and improve of transportation facilities and systems;
3. Create corporations to secure and obtain rights-of-way for urgently needed transportation systems and to assist in the planning and design of those systems;
4. Reduce the burdens and demands on the limited funds available to the commission and an increase in the effectiveness and efficiency of the commission; and
5. Promote and develop transportation facilities and systems that are public, not private, in nature, although these facilities and systems may benefit private interests as well as the public.

Transportation Corporations must be incorporated and have boards assigned. The Texas Transportation Commission must recognize the Transportation Corporation or give the corporation permission to form with a Minute Order. Transportation Corporations can issue bonds, accept cash donations, and provide services for a fee. Transportation Corporations do not appear to have any taxing authority, however it may be possible for a corporation to be financed using a TIF.

Driveway Sharing Agreements

One way for a governing body to continuously evaluate access and the impact of land use on nearby facilities is to require a driveway evaluation during the property selling process. For properties on facilities that have changed dramatically over the years, this can be an effective tool. Should the outcome of such an evaluation require the subsequent sharing of driveways, an agreement may be required, such as the example in Appendix G.

These are the results of a cursory examination of the existing laws. Any final determination of the appropriateness and the accuracy of the above statements should be done by a Texas public attorney.

CONCLUSION

The story of SH 6 Access Management Study, North is one of bringing people and resources together to create proposed solutions supported by the local community that will improve access management on SH 6 / FM 1960 and FM 529 for years to come.

The project was initiated because of current access management challenges along the corridor. At public meetings, participants helped determine the goals of the project: to improve mobility and safety while maintaining economic viability for the corridor. The public set the course for the project, selecting criteria to evaluate proposed solutions, and identifying areas of concern along SH 6 / FM 1960 and FM 529. In addition to public meetings, the study team sought out business, public agency, and neighborhood stakeholder groups and coordinated closely with them to incorporate their input into the development of proposed solutions.

People from many different fields collaborated on this study from engineers, to planners, to policy makers, to hundreds of other diverse fields represented by stakeholders and the general public. By drawing upon many fields of expertise, the study team ensured that solutions were well designed , context sensitive, and feasible to implement.

The study team used a multi-faceted process to generate proposed solutions. This process involved engagement with the public and with stakeholders; collection and analysis of data; and development of several types of solutions based on that analysis. Solutions effectively dealt with safety and mobility issues of motorists on the existing roadway; improvements to the greater system in the form of alternate access roads; more sustainable land use patterns through a livable center; and multimodal access issues related to transit, and bicycle and pedestrian facilities. The comprehensive nature of this study; the public involvement process; and the breadth of developed solutions have been unprecedented for a study of this kind. To all who worked on and participated in this study, a warm thank you.