US 90A ACCESS MANAGEMENT STUDY

H-GAC HNTB

January 2014


ALT
90

ACKNOWLEDGMENTS

Lead Agency **Houston-Galveston Area Council**
Project Manager Stephan Gage

Steering Committee

Houston-Galveston Area Council
Marco Bracamontes
Stephan Gage

Texas Department of Transportation
Paul Bartholomew
Ben Mebarkia, P.E.
Sanjay Upadhyay, P.E.
Jeff Volk, P.E.

Fort Bend County
DeWayne Davis, P.E.
Paulette Shelton
Richard Stolleis, P.E.

City of Richmond
Gary Gillen
Lenert Kurtz
Joseph T. Rogers
Terri Vela
Bill Whitworth

City of Rosenberg
Albert Cantu
Darrel Himley
Joseph T. Rogers
Travis Tanner

Rosenberg Economic Development Corporation
Matt Fielder

West Fort Bend Management District
Rachel Steele

Central Fort Bend Chamber Alliance
Shanta Kuhl

Fort Bend Economic Development Council
Perri D’Armond

Lamar Consolidated ISD
Ronald Oberhoff

Consultant Team

HNTB Corporation
Inas Aweidah, P.E., Project Manager
Martin Gonzalez, P.E.
Brittney Davis

In partnership with
EPIC Transportation Group, LP
Asakura Robinson Company

Transportation Policy Council Members

Honorable Ed Emmett, Chairman, County Judge, Harris County
Honorable Stephen C. Costello, 1st Vice Chair, Council Member, At-Large 1, City of Houston
Honorable Matt Sebesta, Jr., 2nd Vice Chair, County Commissioner, Pct 2, Brazoria County
Honorable Tom Reid, Secretary, Mayor, City of Pearland
Honorable James Patterson, Past Chair, County Commissioner, Pct. 4, Fort Bend County
Michael W. Alford, P.E., District Engineer, TxDOT Houston District
Honorable Norman Brown, County Commissioner, Pct. 4, Liberty County
Larry Calhoun, Executive Director, City of Conroe
Honorable Kenneth Clark, County Commissioner, Pct. 4, Galveston County
Bert Keller, Chairman, Gulf Coast Rail District
Scott Elmer, P.E., Assistant City Manager, City of Missouri City
Tucker Ferguson, P.E., District Engineer, TxDOT Beaumont District
Honorable Robert A. Fry, Jr., Mayor, West University Place
Robert L. Hall, Jr., County Engineer, Chambers County
Honorable Harish Jajoo, Council Member, City of Sugar Land
Dwight Jefferson, Member, Board of Directors, METRO
Honorable Doug Kneupper, P.E., City Engineer, City of Texas City
Daniel Kruger, Director of Public Works & Engineering, City of Houston
Honorable Darrell Morrison, P.E., Council Member, District H, City of Pasadena
Honorable James Noack, County Commissioner, Pct. 3, Montgomery County
Honorable Melissa Noriega, Council Member, At Large 3, City of Houston
Honorable Dennis O’Keeffe, Council Member, City of League City
Janiece Longoria, Commissioner & Chairman, Port of Houston Authority
Honorable Marie Robb, Council Member, City of Galveston
Orval Rhoads, P.E., County Engineer, Waller County
Honorable Terry Sain, Council Member, District 4, City of Baytown
Jack Steele, Executive Director, H-GAC, H-GAC At-Large
Arthur L. Storey, Jr., P.E., Executive Director, Harris County Public Infrastructure
Brenda Mainwaring, Ex-Officio Member, Vice President, Public Affairs, Union Pacific Railroad
Honorable Allen B. Fletcher, Ex-Officio Member, 8-County Region Representative, Texas State Legislator

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Executive Summary 1

1 INTRODUCTION

Study Purpose and Goals 7

Study Process 7

Study Area 10

Project Facts 10

Study Area Growth 10

2 ANALYSIS OF EXISTING CONDITIONS

Physical Characteristics 12
- Land Use & Zoning 12
- Roadway & Intersections 12
- Existing Typical Sections 14
- Driveway & Access 17
- Signing & Pavement Markings 19
- Pavement Condition 19
- Railroads 19
- Pedestrian & Bicycle Infrastructure 20
- Transit 21
- Planned Projects in the Area 21

Operational Characteristics 21
- Crash Data Analysis 21
- Crash Rate Comparison 21
- Daily Traffic Volumes 23
- Intersection Turning Movement Counts 23
- Driveways Unsignalized Intersection Turning Movement Counts 23
- Traffic Flow 23
- Intersection Geometry 24
- Traffic Signals 24
- Existing Traffic Analysis 24

Existing Policies 25
- TxDOT Access Management 25
- Existing Access Management Practices 25

3 PUBLIC INVOLVEMENT

Goals of Public Involvement 27

Public Involvement Plan 27
- Steering Committee 27
- Stakeholder Meetings 27
- Public Meetings 28

First Public Meeting 28
- Excerpts from First Public Meeting 28

Second Public Meeting 30
- Excerpts from Second Public Meeting 30

4 RECOMMENDED IMPROVEMENTS & IMPLEMENTATION STRATEGIES

Recommendations 31
- Signalized Intersections Improvements 32
- Roadway Improvements 32
- Public Transit Improvements 32
- Downtown Area Improvements 32
- Bicycle Route Improvements 35
- Pedestrian Improvements 36

Traffic Analysis 37
- Signalized Intersection LOS 37
- Roadway LOS 37
- Traffic Signal Warrant Analyses 38

Benefits of Recommended Improvements 38
- Travel Time Savings 38
- Crash Cost Savings 38
- Air Quality 39

Implementation 39
- Considerations for Short- to Medium-Term Improvements 39
- Considerations for Long-Term Improvements 40
- Phasing and Cost Strategy 40
- Recommended Improvement Layouts 44

5 FUTURE CORRIDOR NEEDS

Issues Regarding Access Management 79
- Property Owner and Developer Needs versus Public Needs 79
- Agency obligation to provide access 79
- Intergovernmental Coordination 79
- Driveway Permitting and Design Requirements. 79
- Access Management Implementation Strategies 80

Strategies for Future Development 80
- Livable Centers 80
- Envisioning Groups 82
- Downtown Redevelopment 82
- Redesigning Morton Street 82
- Redevelopment along the Study Area Corridors 83

6 APPENDIX

A **Access Management Principles**

B **H-GAC Regional Analysis Zone Data**

C **Driveway Density Summary**

D **Planned Projects in Study Area**

E **Intersection Lane Use and Turning Movement Counts**

F **Traffic Analysis**

G **Benefits Calculations**

H **Detailed Cost Estimates**

SUPPLEMENTAL DATA CD

1 **Crash Data**

2 **TxDOT ADT Maps**

3 **Signalized Intersection Turning Movement Counts**

4 **Driveway and Unsignalized Intersection TMCs**

5 **Existing Traffic Signal Inventory**

6 **Existing Signal Timing Plans**

7 **Existing 2013 AM Peak Intersection LOS Results**

8 **Existing 2013 PM Peak Intersection LOS Results**

9 **Scenario 1 - 2015 AM Peak Intersection LOS Results**

10 **Scenario 1 - 2015 PM Peak Intersection LOS Results**

11 **Scenario 2 - 2015 AM Peak Intersection LOS Results**

12 **Scenario 2 - 2015 PM Peak Intersection LOS Results**

13 **Synchro Traffic Model Files**

EXECUTIVE SUMMARY

The Houston-Galveston Area Council partnered with the Texas Department of Transportation (TxDOT) and the West Fort Bend Management District (WFBMD) to conduct an access management study on US 90A from Bamore Road to Harlem Road, FM 1640 from Bamore Road to FM 762, and FM 762 from FM 1640 to US 90A, in Fort Bend County, Texas, as shown in Figure ES.1.

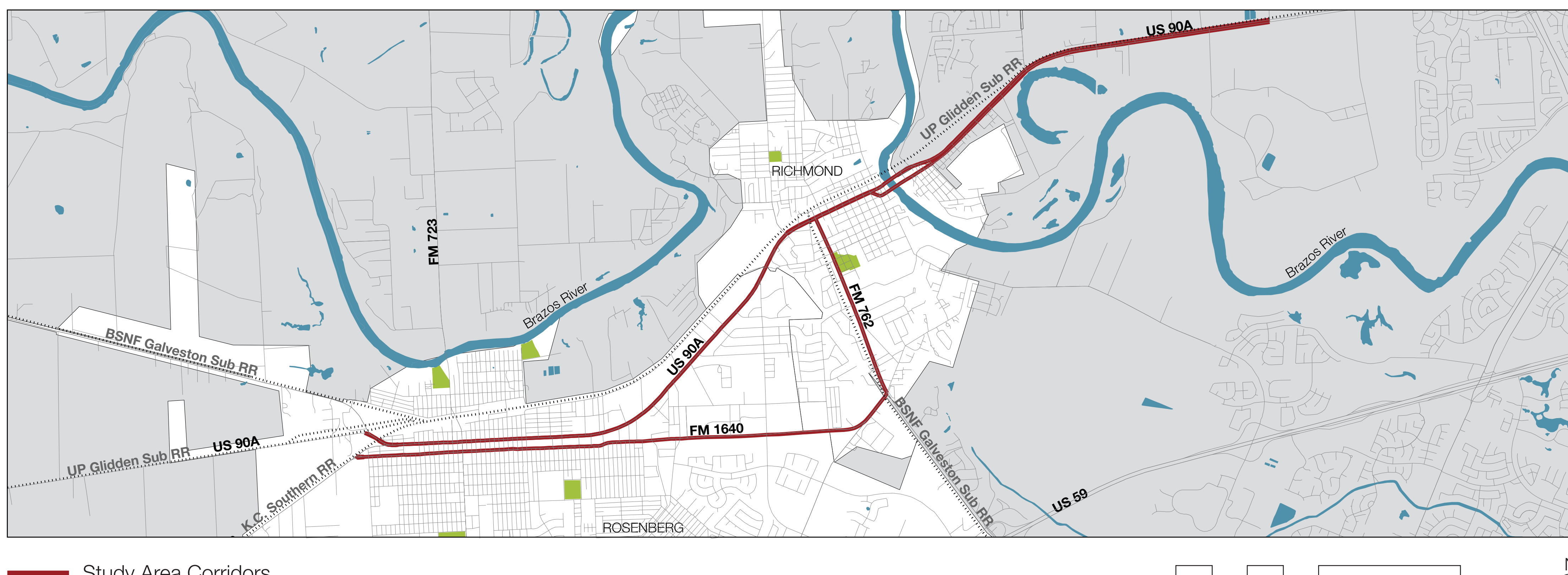
Growing vehicular congestion on US 90A within the cities of Richmond and Rosenberg motivated H-GAC and its partners to evaluate a variety of operational strategies designed to reduce traffic delay and improve safety. Study partners included TxDOT, WFBMD, Fort Bend County, and the cities of Richmond and Rosenberg.

This Executive Summary documents the study goals, existing conditions, public involvement, recommended short-, medium-, and long-term improvements, and project benefits.

STUDY GOALS

- Improve traffic flow along US 90A, FM 1640, and FM 762
- Improve safety and decrease the number of crashes
- Create corridor access management guidelines
- Provide phasing plan for implementation of solutions
- Provide for an open process throughout the project development

Figure ES.1: Study Area



EXISTING CONDITIONS

Varied Typical Sections/ROW

Typical sections and right-of-way (ROW) width vary along all of the corridors. Some sections have curb and gutter, some have shoulders and ditches, some have shoulders that extend into continuous parking lots, as shown in Figure ES.2. This inconsistency can cause driver confusion and creates issues for pedestrians and cyclists.

Driveways

All study area corridors have high driveway densities.

The Institute of Transportation Engineers recommends no more than 4 driveways per 500 feet or roughly 42 driveways per mile. Sections of US 90A, FM 1640, and FM 762 have more than 1.5 times the maximum number of driveways (see Table ES.1). The high driveway density in these locations corresponds very closely with the locations of high crash rates observed in Figure ES.3.

Crash Rates

A majority of crashes within the study area occur at intersections and can be attributed to high driveway density, inappropriate on street parking, a lack of protected left turn lanes, and inadequate length on existing turn lanes.

Crash rates for the study corridors are 2.1 to 4.2 times higher than the Texas average crash rate, as shown in Figure E.S, indicating a significant safety concern.

Figure ES.2

Table ES.1: Driveway Density along Study Area Corridors

Corridor	Segment	Distance (miles)	Total Driveway	Driveway Density
US 90A	Barmore Rd to Lane Dr	3.3	232	70.5 driveways per mile
US 90A	Lane Dr to Harlem Rd	4.2	105	25.1
FM 1640	Barmore Rd to Radio Ln	2.2	152	69.6
FM 1640	Radio Ln to FM 762	1.6	39	24.8
FM 762	US 90A to FM 1640	1.3	83	63.1

Figure ES.3: Crash Rate by Roadway Section

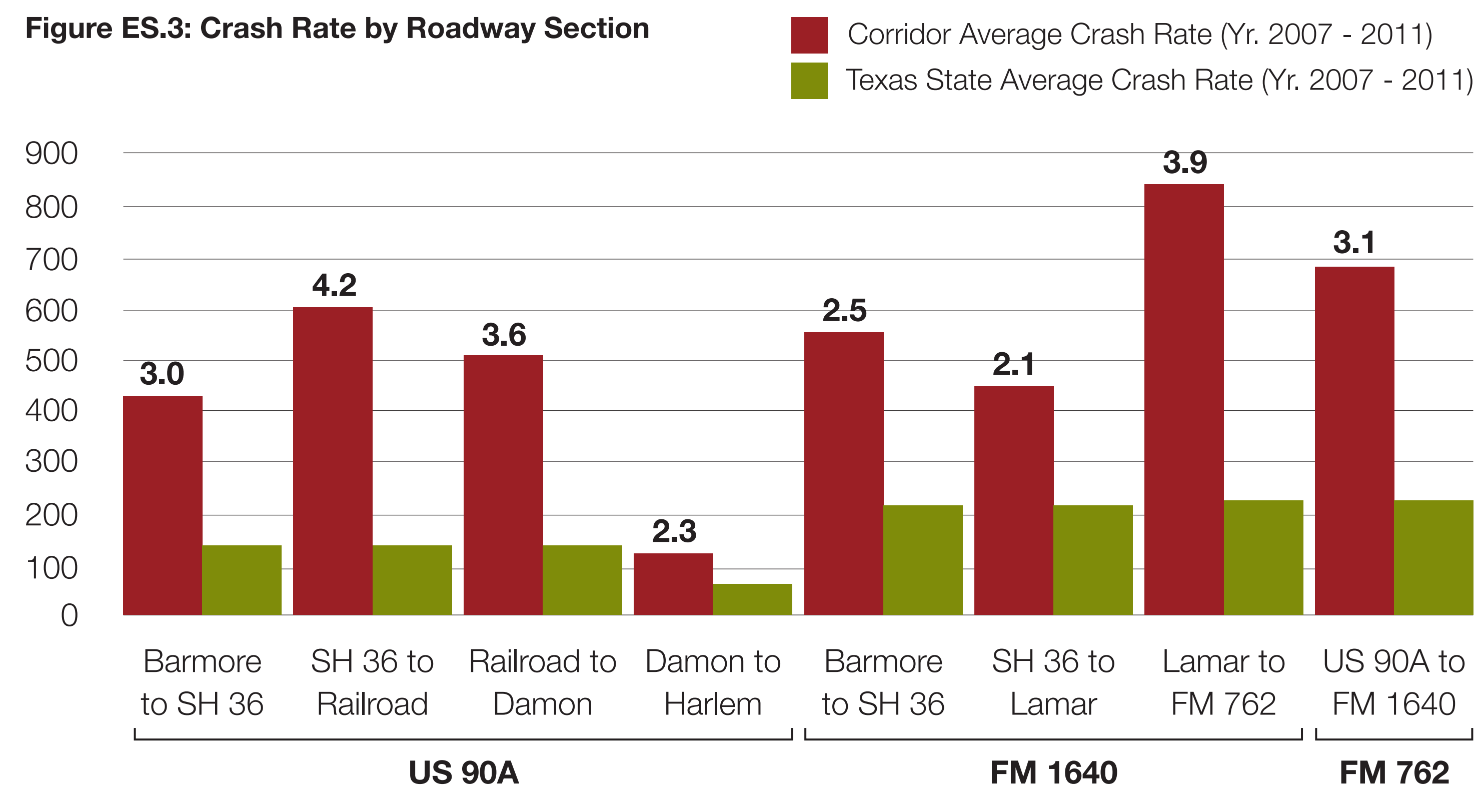


Figure ES.4: Westbound Bridge over Brazos River

Figure ES.5: UPRR Crossing at US 90A and Pitts Rd

Traffic

The traffic analysis found that the number of lanes is adequate for current volumes, but the signalized intersections are not functioning at an appropriate level of service (LOS) due to a lack of dedicated turn lanes, inadequate length on existing turn lanes, close proximity of driveways to intersections, and inappropriate signal phasing and timing. Exisitng LOS along each corridor is shown in Table ES.2, while a definition of the traffic conditions for each LOS rating is shown in Table ES.3.

Table ES.2: Existing LOS of Study Area Corridors

Corridor	LOS
US 90A	C
FM 1640	D / C
FM 762	D

Table ES.3: Level of Service (LOS)

A	B	C	D	E	F
Free Flow	Reasonably Free Flow	Stable Flow	Approaching Unstable Flow	Unstable Flow	Breakdown Flow

Physical Constraints

The study area is unique due is geographic location.

- The Brazos River presents mobility challenges due to the cost of bridge crossings and the lack thereof.
- The existing bridges over the Brazos River create a bottleneck for traffic entering and leaving Richmond (Figure ES.4).
- The location of the railroad tracks restricts certain improvements along the tracks, such as roadway widening or accommodation of bicycle and pedestrian facilities (Figure ES.5).

Figure ES.6: Public Meeting #1

Figure ES.7: Public Meeting #2

Public Involvement

Public involvement efforts for this project were maximized to ensure the greatest amount of participation, including steering committee meetings and several stakeholder and public meetings (Figures ES.6 and ES.7). A project website was also created to keep interested parties informed of project progress.

PLANNED PROJECTS

Several planned projects within the study area were considered during development of the recommended improvements. The study team endorses the need for these projects for improvements to capacity and connectivity within the existing roadway network.

Short to medium term (0 to 10 years) projects include:

- Rehabilitation of US 90A, FM 1640, and Golfview Drive;
- Widening of Harlem Road;
- Railroad grade separation of FM 359 at US 90A; and
- Conversion of US 90A and FM 1640 to a one-way pair system between FM 359 and Millie Street.

Long term (over 10 years) planned projects include:

- Extension of FM 762 north along 10th Street across the Brazos River with connection to McCrary Road;
- A new overpass for US 90A at the railroad crossing east of Lane Drive;
- A new grade separation for the US 90A connection to SH 36 at the railroad crossing;
- Rehabilitation and/or widening of the Brazos River bridges; and
- Widening of US 90A, FM 762, FM 723, Spur 529, FM 359, and Harlem Road.

RECOMMENDED IMPROVEMENTS

A summary of recommended improvements by implementation phase and the agency responsible is provided in Table ES.4. Due to the narrow ROW on US 90A between Bamore and Louise, the study recommends implementation of the planned one-way pair as the best option to improve safety without affecting businesses through ROW acquisition. Implementation of the one-way pair project also presents an excellent opportunity to efficiently implement the recommended short term improvements.

Table ES.4

Time Frame	Improvement	Agency
Short-Term (0 - 5 yrs)	Addition of raised medians along US 90A	TxDOT
	Addition or extension of left turn lanes on US 90A, FM 1640 and FM 762	TxDOT
	Signing, pavement markings, sidewalk and ADA ramp improvements	TxDOT
	Upgrade traffic signal equipment and optimization of signal timing	TxDOT
	Traffic signal synchronization along corridor	TxDOT
	Realign Lane Dr with Old Richmond Road	Rosenberg
Medium-Term (5 - 10 yrs)	Installation of Traffic Signal at Damon St east of Brazos River	TxDOT
	Widening and addition of left turn lanes between 5th St and 7th St	TxDOT
	Extend Avenue A from Damon St to Edgewood St	Richmond
	Realign cross streets with US 90A at Jeanetta, Cole, Radio, and Herndon	Rosenberg
	Realign Miles at FM 1640	Rosenberg
Long-Term (10+ yrs)	Extend Harlem Rd south of US 90A to New Territory	Fort Bend County
	Construct new east-west road north of US 90A from FM 359 to SH 99	Fort Bend County
	Additional Brazos River Bridge Crossings (Austin St and/or Golfview St)	Richmond and/or Fort Bend County
	Widen FM 3155 from US 90A to George Park	Rosenberg
	Widen Old Richmond Road for shared use bike lanes	Rosenberg
	Implementation of Livable Center study recommendations in Richmond and Rosenberg	Richmond and Rosenberg
	Implementation of pedestrian, bicycle and transit improvements	Richmond and Rosenberg

Benefits

Implementation of the recommended access management improvements is projected to:

- Reduce turning movement conflicts and Improve safety
- Enhance Traffic Operations
- Improve roadway network connectivity providing congestion relief on US 90A
- Reduce Travel Time
  - › Reduce delay by **13.6%** during the weekday AM peak period (2 hours) and **18.2%** during the weekday PM peak period (2 hours).
  - Improve Safety Resulting in Crash Cost Savings
    - › Estimated average annual crash savings of **$4 million**
  - Improve Air Quality
    - › Reduction of **3.4%** of Volatile Organic Compounds (VOC), carbon monoxide (CO), and nitrogen oxides (NOx) levels.

Refer to Appendix G for the benefits calculations.

The Transportation Research Board has collected numerous studies that measure the actual crash reductions after implementation of various access management treatments. Applying these estimated crash reductions to the specific short and medium-term access management recommendations yielded the results in Table ES.5.

Table ES.5: Crash Reduction by Segment

Facility	Segment	Est % Crash Reduction
US 90A	Barmore to Louise	35%
	Louise to Railroad	36%
	Railroad to Damon	14%
	Damon to Harlem	17%
FM 1640	Barmore to Louise	35%
	Louise to Lamar	36%
FM 762	FM 1640 to US 90A	46%

IMPLEMENTATION COSTS

Short Term Costs

Short-term projects typically do not require additional ROW. The total estimated cost of construction for the short term recommendations is approximately $10 million, most of which will be the responsibility of TxDOT. These costs do not include engineering, ROW, utility relocations or other unknown items that may be identified through the course of detailed design.

Medium and Long Term Costs

Certain medium term improvements shown in the report under TxDOT's responsibility related to traffic signals, sidewalks and pedestrian ramps were estimated at $350,000. The costs for other medium and long term projects involving new facilities on new locations could not be determined due to the need for more detailed alignment studies, and consideration for engineering factors, environmental constraints, ROW needs, geotechnical conditions, bridge type, and other unknown factors affecting costs.

CHAPTER 1

ACCESS MANAGEMENT is the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. The purpose is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. For additional information, including benefits and tools to accomplish access management, refer to Appendix A (Source: Access Management Manual, TRB 2003).

INTRODUCTION

STUDY PURPOSE AND GOALS

The Houston-Galveston Area Council (H-GAC) commissioned a study to identify access management improvement techniques for the US 90A corridor from Bamore Road to Harlem Road, FM 1640 from Bamore Road to FM 762, and FM 762 from FM 1640 to US 90A.

The study includes collection of sufficient information to measure, evaluate, and identify a range of viable short, medium, and long-term improvement concepts that will improve safety and mobility; reduce motorist delay; reduce crash rates; enhance land use; and preserve long-term property values along the corridor. The medium and long term strategies also focus on providing opportunities along some sections of the corridor for connectivity, circulation, adding pedestrian and bicycle facilities, as well as enhancing aesthetics, all of which will help stimulate economic vitality. The short-term strategies focus on improvements that will enhance safety and mobility along the corridors.

Summary of Study Goals

- Improve traffic flow along US 90A, FM 762 and FM 1640;
- Improve safety and decrease the number of crashes;
- Create corridor access management guidelines;
- Provide phasing plan for implementation of solutions; and
- Provide for an open process throughout the project development.

STUDY PROCESS

Significant portions of the Access Management Study involve collecting and analyzing existing relevant data along the corridors such as traffic volumes, crash data, and physical characteristics of the study area corridors. Gathering public opinion is important in an access management study. To ensure that the specific needs of the community were incorporated into the study recommendations, a steering committee comprised of the funding agencies, local jurisdictions, and local organizations was formed to guide the technical and administrative aspects of the study. To obtain the community's input on critical issues and needs along US 90A, FM 1640, and FM 762, and to obtain feedback on the initial set of improvement alternatives, two public meetings were conducted. Comments from the public meetings and steering committee were incorporated into the final recommended improvements.

Figure 1.1 depicts the study process along a time line. The process included data collection, analysis of existing conditions, proposing recommendations with the infusion of public input through public meetings, stakeholder meetings, and steering committee oversight throughout the process.

Figure 1.1: Access Management Study Schedule

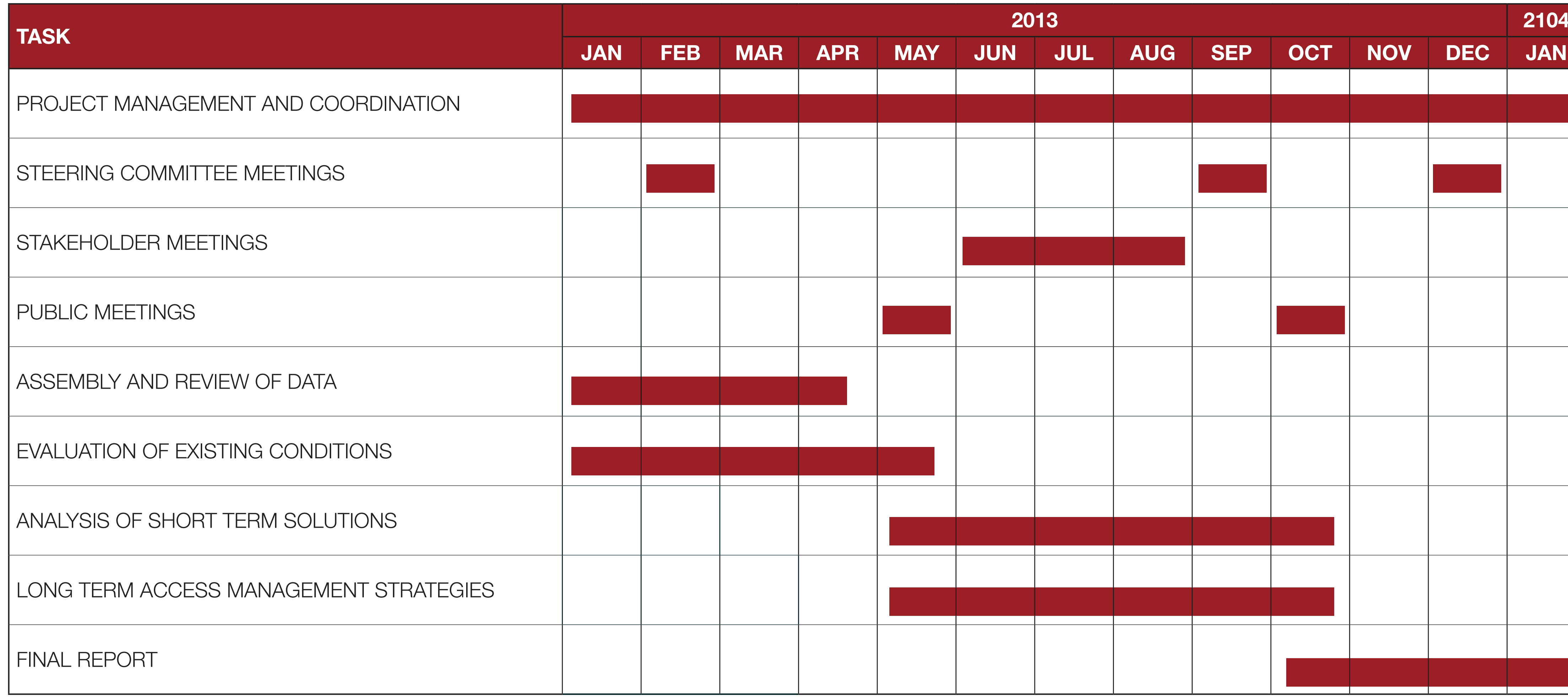
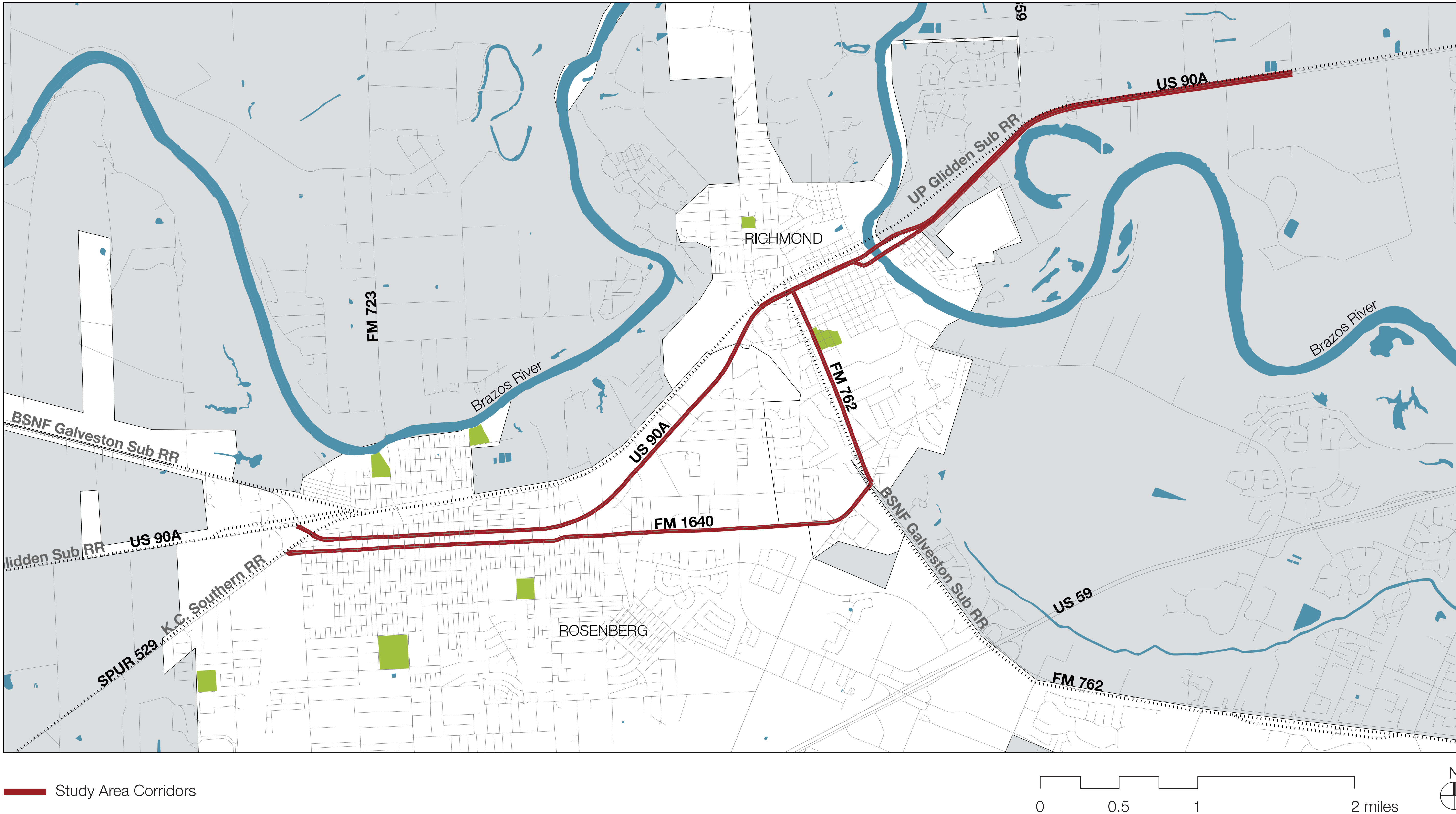


Figure 1.2: Study Area



STUDY AREA

The US 90A Access Management Study limits covers three distinct facilities, including US 90A from Spur 529 to Harlem Road, FM 1640 from Bamore Road to FM 762, and FM 762 from FM 1640 to US 90A (see Figure 1.2). All of the three corridors are located in Fort Bend County. US 90A is a major east-west arterial traversing the cities of Richmond and Rosenberg and continues east past Houston, Texas. The right-of-way (ROW) along US 90A varies from 70 feet to 186 feet. The ROW along FM 1640 varies from 80 feet to 140 feet. The ROW along FM 762 is approximately 100 feet south of Austin Street and approximately 70 feet north of Austin Street.

PROJECT FACTS

US 90A

- Facility Type: Principal Arterial
- Study Limits: Spur 529 to Harlem Road
- Corridor Length: 7.5 miles
- Facility Owner: Texas Department of Transportation
- Facility Maintenance: Texas Department of Transportation
- Number of Lanes: 4-5 Lanes
- Right of Way: Varies from 70 feet to 186 feet

FM 1640

- Facility Type: Farm-to-Market Road – Major Collector
- Study Limits: Bamore Road to FM 762
- Corridor Length: 3.8 miles
- Facility Owner: Texas Department of Transportation
- Facility Maintenance: Texas Department of Transportation
- Number of Lanes: 4-5 Lanes
- Right of Way: Varies from 80 feet to 140 feet

FM 762

- Facility Type: Farm-to-Market Road – Minor Arterial
- Study Limits: FM 1640 to US 90A
- Corridor Length: 1.3 miles
- Facility Owner: Texas Department of Transportation
- Facility Maintenance: Texas Department of Transportation
- Number of Lanes: 4 Lanes
- Right of Way: Varies from 70 feet to 100 feet

STUDY AREA GROWTH

According to H-GAC regional growth models, jobs within the study area are anticipated to increase 61% by 2035. The household population within the study area is projected to increase 59% by 2035. The number of jobs and household population for the adjacent areas are also anticipated to increase at a similar rate. The projected job growth will attract more people to the cities of Richmond and Rosenberg, increasing the need for access management. Details on the H-GAC Regional Analysis Zones (RAZ) that make up the study area can be found in Appendix B.

CHAPTER 2

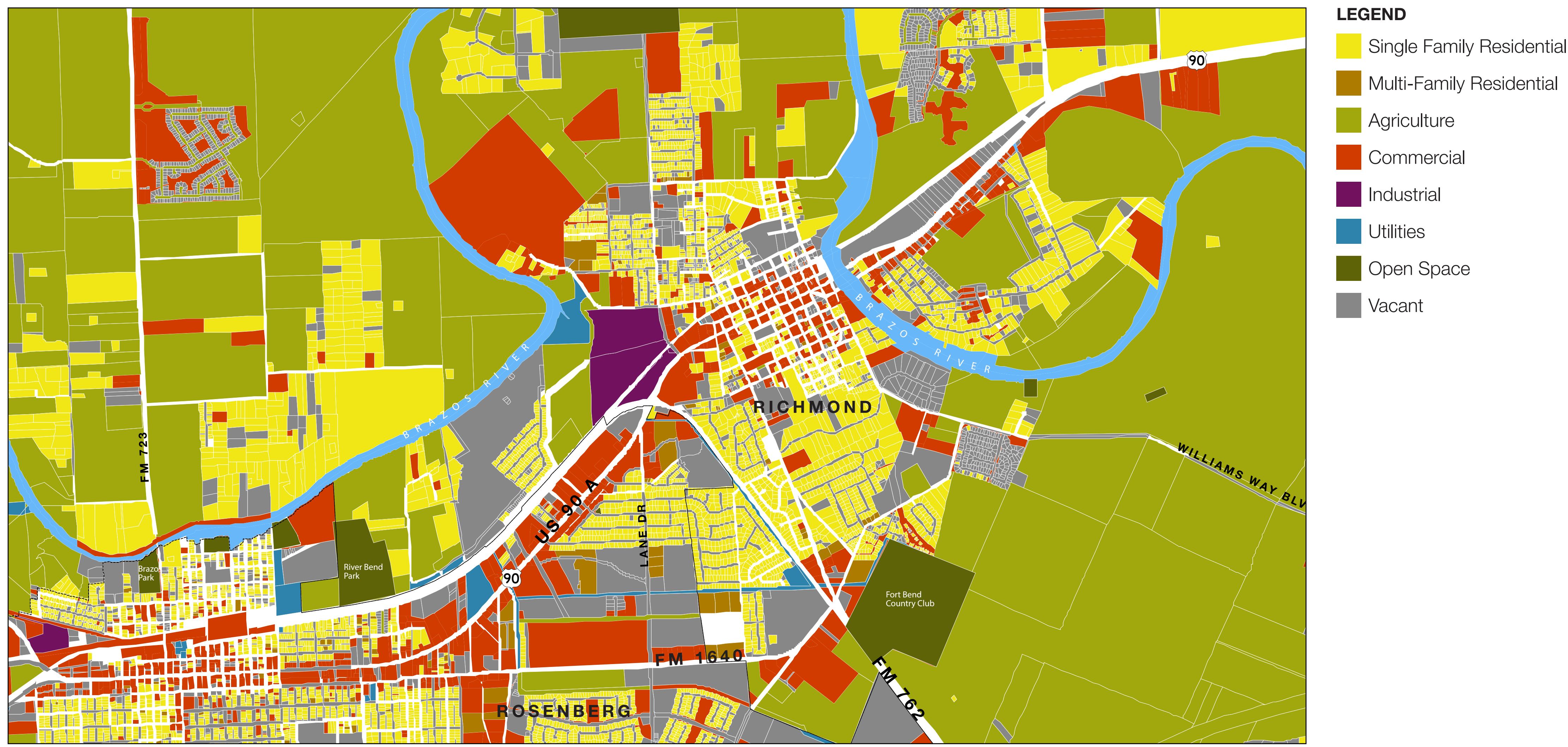
ANALYSIS OF EXISTING CONDITIONS

In order to properly assess the improvements needed along the corridor to optimize safety and mobility, it is critical to take a closer look into the physical and the operational characteristics of the corridor.

The physical characteristics include land use, roadway features, intersections, typical sections, driveways, modal facilities, signage, pavement markings, and planned facilities along the corridor.

The operational characteristics encompass an evaluation on how the facility is functioning under existing conditions, identifying sections with high crash rates and applying the appropriate access management tools to improve the safety along those sections, and identifying sections and intersections experiencing congestion and unreasonable delays. A traffic simulation model is used to quantify and document the existing congestion and delays; the same model is used to help quantify the benefits of the improvements.

Figure 2.1: Land Use Map



PHYSICAL CHARACTERISTICS

Land Use and Zoning

The US 90A and FM 1640 corridors are two of the primary commercial corridors in western Fort Bend County. Moving one to two blocks away from the corridors, land use becomes more residential, suggesting a large potential pool of pedestrians. Despite the overall commercial character, the building typology and block sizes shift throughout the corridors. Blocks are roughly 350 feet in length and the character is that of a historic downtown, including smaller buildings and shops in the historic areas. Away from the historic areas, block lengths increase, exceeding 1500 feet in some places, and the building character shifts to large-scale retail. FM 762 is predominantly residential in use, with parcels becoming larger toward the southern end of the study area, with more large-scale commercial uses.

Roadway and Intersections

US 90A (also known as Avenue H in Rosenberg and Jackson Street in Richmond) is a principal, east-west arterial. The posted speed limit is 35 miles per hour (mph) in Rosenberg, and increases to 40 mph traveling east past Miles Street up to 2nd Street in Richmond. The speed limit is 55 mph from east of the Brazos River to past Harlem Road.

It is mainly a four-lane undivided roadway, with a curb and gutter section in downtown Rosenberg and downtown Richmond. It has shoulder sections of varying width on one or both sides in the rest of the corridor. A continuous left turn lane (CLTL) exists between Millie/Jenetta and Lane Drive. Raised median with turn lanes exists east of Collins up to 9th Street. US 90A becomes a divided facility at 3rd Street in Richmond. To the east of 3rd Street, the eastbound and westbound lanes are on separate bridges across the Brazos River, beyond which they remain separated by a wide grassy median all the way past Harlem. Left-turn and right-turn lanes exist at several locations. A total of 23 signalized intersections exist along this corridor, of which two are overhead flashers (Houston Street and 4th Street). Houston Street was a regular signalized intersection in the past. Now, it is downgraded to a two-way Stop control supplemented by the overhead flasher. The 4th Street flasher exists in support of the Rosenberg fire station located off 4th Street, between US 90A and FM 1640.

Major north-south thoroughfares that intersect US 90A include SH 36 (1st Street) in Rosenberg; FM 762, FM 359, and Harlem Road in Richmond. Aligned with SH 36 on the north side of US 90A is FM 723, which extends northward to terminate at Westpark Tollway. On the south side of US 90A, SH 36 intersects US 59 as it continues south to Needville and beyond. Both FM 359 and Harlem Road terminate at US 90 A and both have recently undergone roadway widening improvements. FM 359 (also known as South Mason Road) continues north and then northwesterly to intersect Westpark Tollway. Harlem Road continues north to intersect Grand Parkway before terminating at Westpark Tollway.

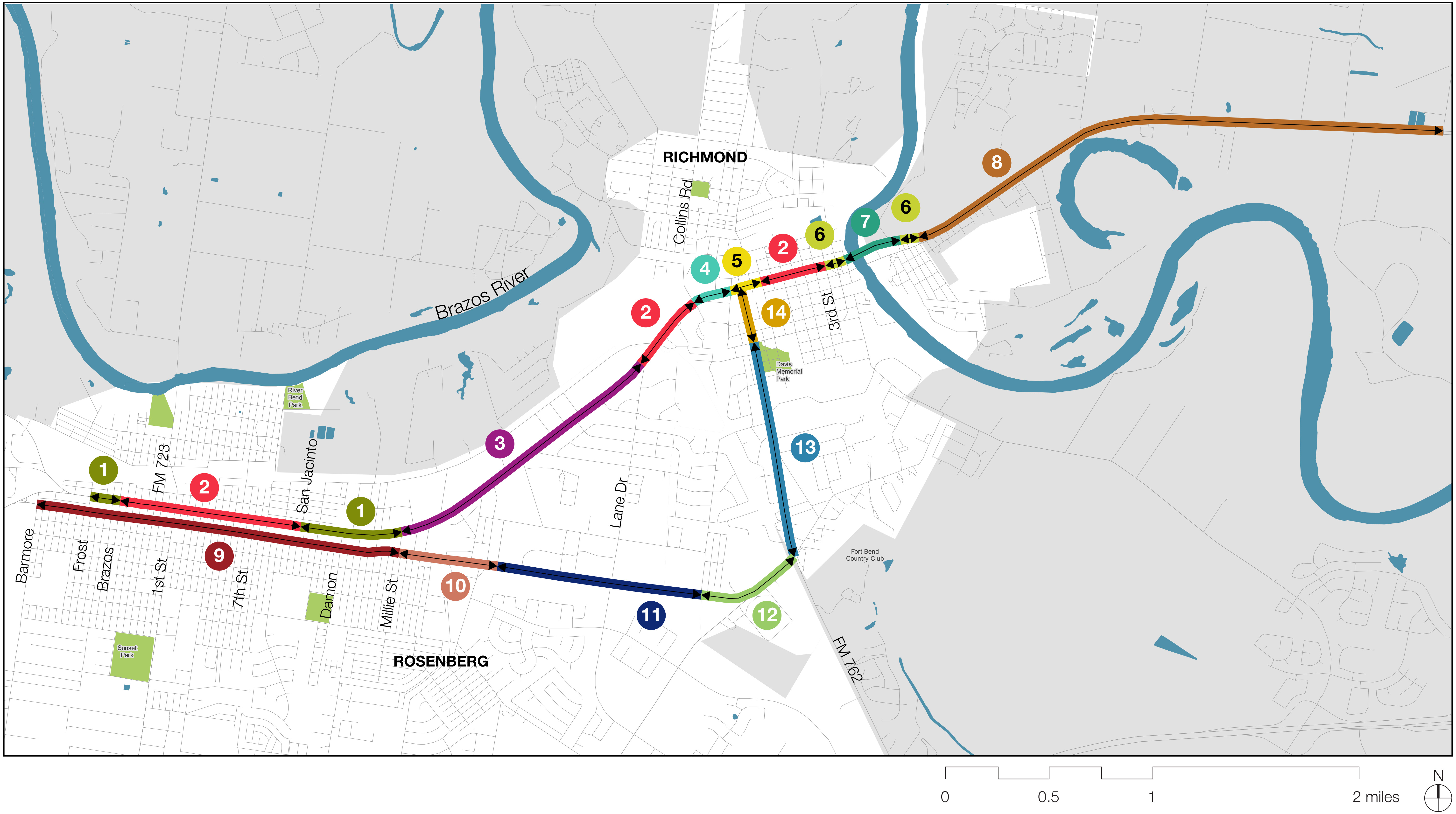
FM 1640 (also known as Avenue I in Rosenberg), is a minor, east-west arterial. It is mainly a four-lane undivided roadway with curb and gutter section within downtown Rosenberg, and shoulders of varying width on one or both sides going east. A CLTL exists beginning east of Millie Street to just past Lamar Drive. FM 1640 was recently widened into a divided facility just east of Lamar up to its terminus at FM 762. The divided portion of FM 1640 is a six-lane facility with curb and gutter section. Left-turn and right-turn lanes exist at several locations. A total of 12 signalized intersections exist along this corridor. Posted speed is 35 mph up to Radio Lane and increases to 45 mph going east towards FM 762. Major intersections include SH 36, Reading Road/Lane Drive, FM 2218 and FM 762.

Reading Road extends south and intersects US 59. FM 2218 intersects US 59 as it extends south to terminate at SH 36.

School zones associated with the Navarro Middle School (located east of Radio Lane), and Lamar Junior High School (located off Stadium Drive) exist along FM 1640.

FM 762 (known as South 11th Street and Thompson Road in Richmond) is a four-lane, undivided, minor, north-south arterial. Posted speed limit is 30 mph near US 90A and increases to 35 mph and 45 mph going south towards FM 1640. Left-turn lanes exist at a few locations. In addition to the signals at US 90A and FM 1640, two other signals exist at Lamar Drive and at Loop 762/Austin/South 2nd Street. FM 762 intersects US 59 as it extends south.

Figure 2.2: Locations of Typical Sections Within Study Area



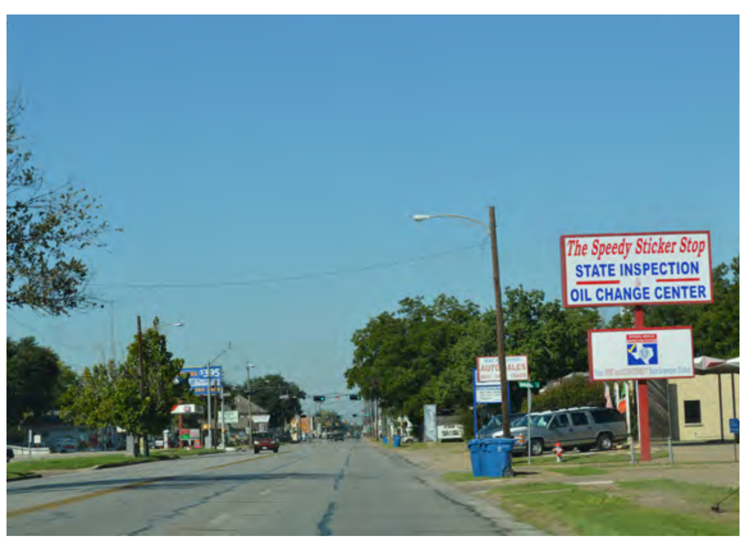
Existing Typical Sections

Typical sections and Right-of-Way (ROW) vary along all of the corridors. See Figure 2.2 for the locations of the various typical sections within the study area. The typical sections for US 90A, FM 1640 and FM 762 are described in Figure 2.3, 2.4, and 2.5, respectively.

FIGURE 2.3: US 90A TYPICAL SECTIONS

1 From Frost Street to Brazos Street; From San Jacinto Street to Millie Street

- Four 12-foot driving lanes with variable width shoulders
- 100' ROW width
- Paved shoulders, no ditches



2 From Brazos Street to San Jacinto Street; From Lane Drive to Collins Road; From 9th Street to 3rd Street

- Four 12-foot driving lanes
- 80' ROW width
  (70' from 9th St to 3rd St)
- Curb and gutter

3 From Millie Street to Lane Drive

- Four 12-foot driving lanes with one 12-foot center turn lane
- 100' to 120' ROW width
- Shoulders vary between paved and open ditch

4 From Collins Road to Union Street

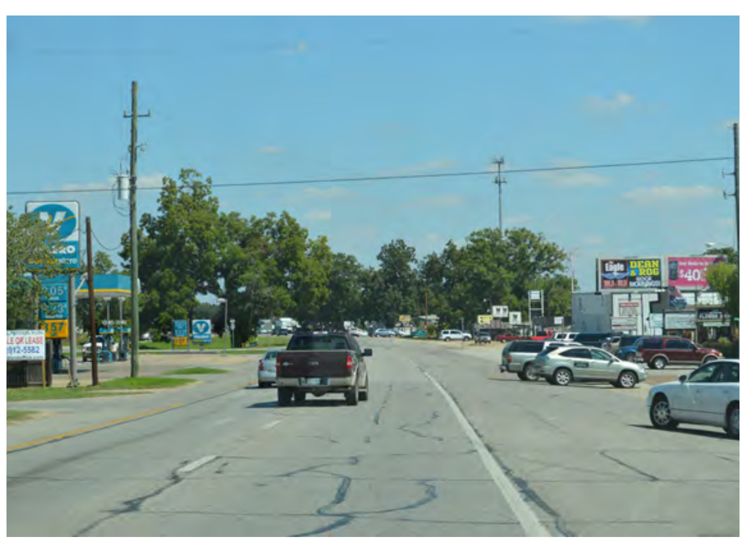
- Four 12-foot driving lanes with a raised median and channelized left turn lanes
- 100' ROW width
- Variable width paved shoulders

5 From Union Street to 9th Street

- Four 12-foot driving lanes with a raised median and channelized left turn lanes
- 70' ROW width
- Curb and gutter

6 Jackson Street (WB) from 3rd Street to Brazos River; From Brazos River to Damon Street

- Two-12-foot driving lanes with a left turn lane
- 70' ROW width
- Some areas curb and gutter, some paved shoulder



6 Liberty Street (EB) from 3rd Street to Brazos River; From Brazos River to Damon Street

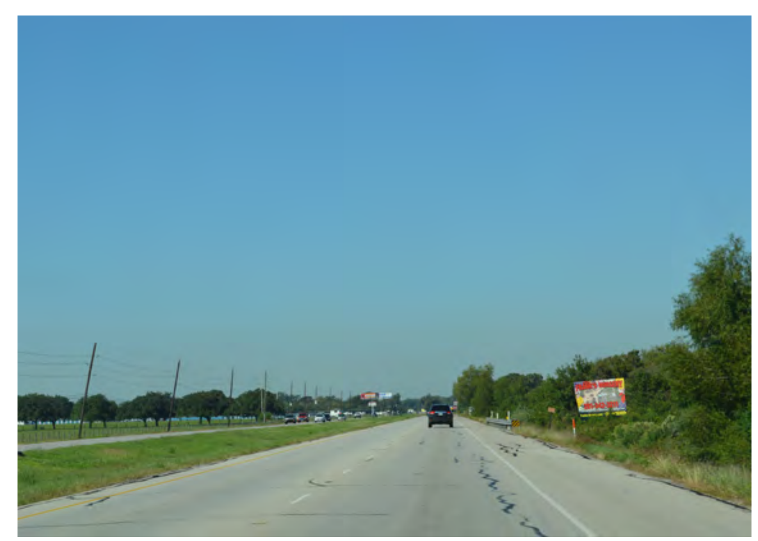
- Two 12-foot driving lanes with a left turn lane and paved shoulder
- ROW width approximately 70', usual

7 Jackson Street (WB) on Bridge over Brazos River

- Two 12-foot driving lanes with two 2-foot shoulders
- ROW width unknown

7 Liberty Street (EB) on Bridge over Brazos River

- Two 12-foot driving lanes with 6-foot sidewalk and 10–foot shoulder
- ROW width unknown



8 From Damon Street to Harlem Road

- Two 12-foot driving lanes with a left turn lane and paved shoulder
- ROW width approximately 70', usual

FIGURE 2.4: FM 1640 TYPICAL SECTIONS

9 From Bamore Road to Millie Street

- Four 12-foot driving lanes with no shoulders
- 80’ ROW width
- Curb and gutter

11 From Horace Mann Avenue to Lamar Drive

- Four 12-foot driving lanes with a 12-foot center left turn lane, no shoulders
- ROW width varies from 130’ to 140’
- Open ditches

10 From Millie Street to Horace Mann Avenue

- Four 12-foot lanes with 12-foot center left turn lane, no shoulders
- 80’ ROW width
- Curb and gutter

12 From Lamar Drive to FM 762

- Six 12-foot driving lanes with a raised median and channelized left turn lanes
- 140’ ROW width typical, but varies near FM 2218 from 140’ to 238’
- Curb and Gutter

FIGURE 2.5: FM 762 TYPICAL SECTIONS

13 From FM 1640 to Austin Street

- Four 12-foot driving lanes with no shoulders
- Approximately 100' ROW width
- Open ditches

14 From Austin Street to US 90A

- Four 12-foot driving lanes with no shoulders
- Approximately 70' ROW width
- Curb and gutter

Driveways and Access

A comprehensive field investigation was conducted and aerial maps were reviewed along the entire length of the corridors to identify locations of existing driveways along US 90A, FM 1640, and FM 762. The investigation concluded that there are approximately 611 driveways along the 12.54 mile study area, for all three corridors. Figure 2.7 shows the driveway density along the three study area corridors, US 90A, FM 1640, and FM 762. A driveway summary table is located in Appendix C. A crash data analysis is discussed later in this chapter; however, Figure 2.8 is included next to the driveway density figure to show the correlation between number of driveways and crash hot spots.

Figure 2.6: Example of Driveway/Access along Study Area Corridors

Figure 2.7: Driveway Density

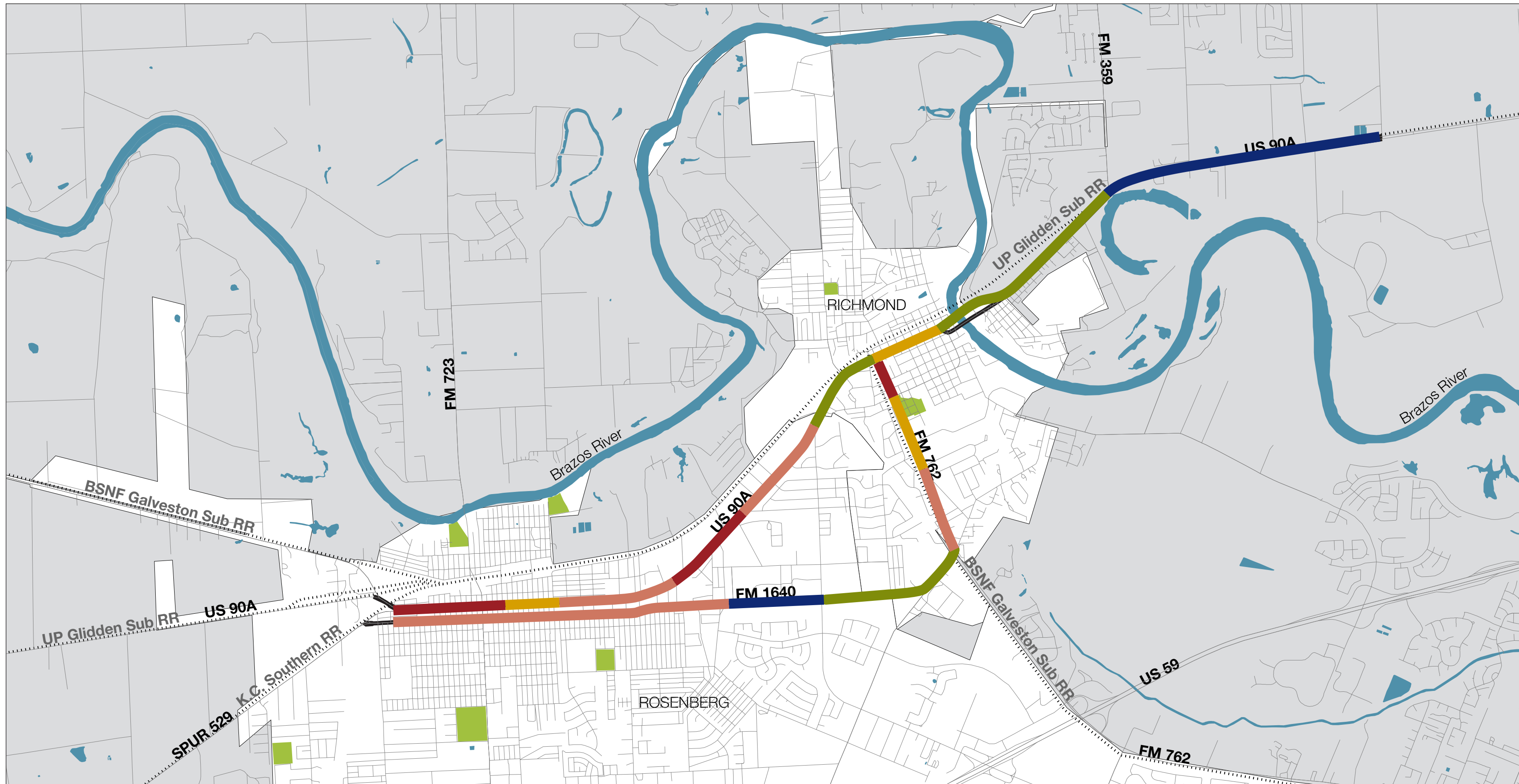
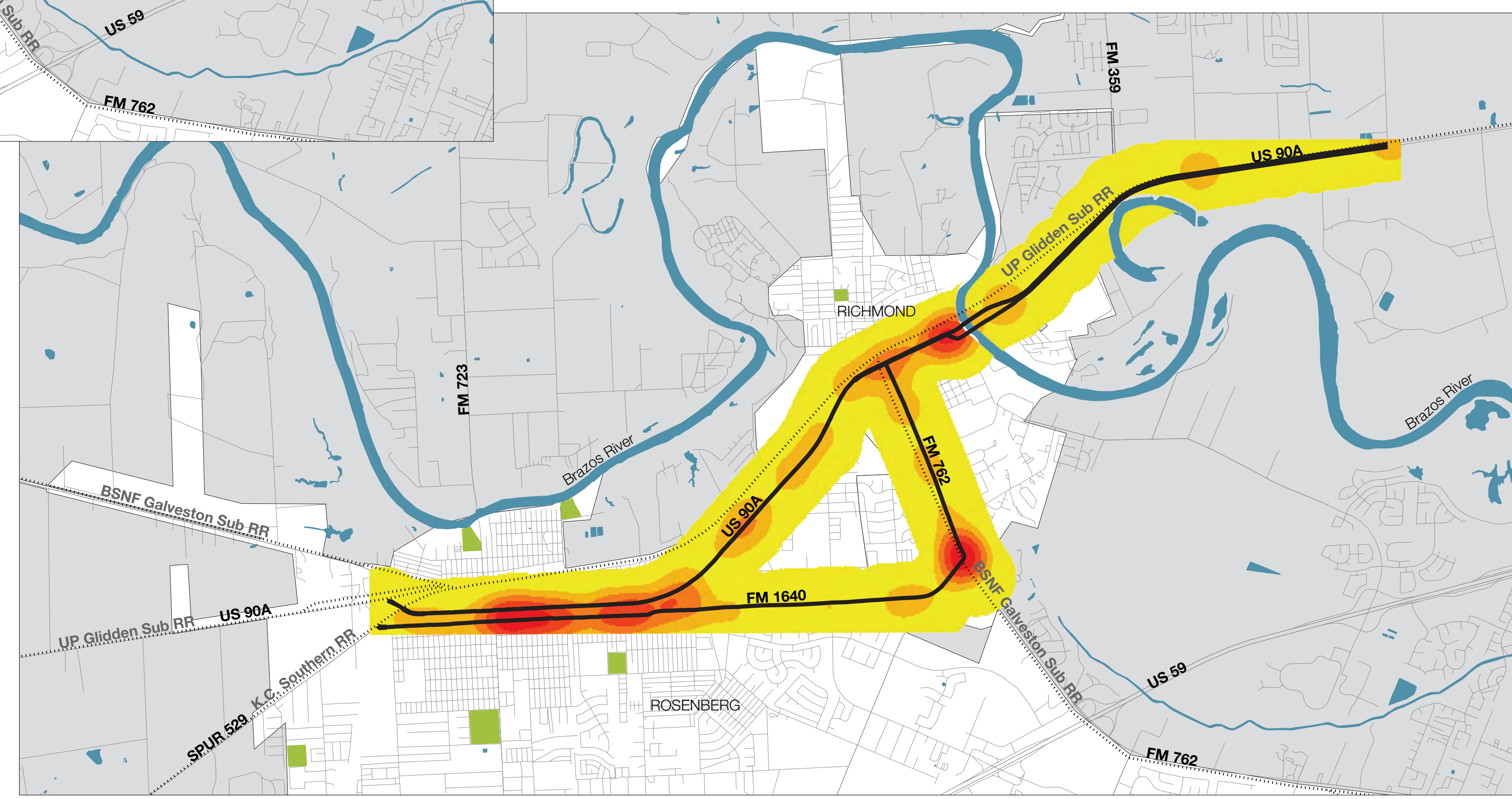


Figure 2.8: Crash Hot Spots



Driveway Density
(Number per mile)

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- > 81

Crash Hot Spots 2007 - 2011
(Number of crashes per quarter mile)

- 0 - 49
- 40 - 99
- 100 - 149
- 150 - 199
- 200 - 250

N

0 0.5 1 2 miles

Signing and Pavement Markings

Advanced warning signs are present along US 90A, FM 1640, and FM 762 for major intersections (i.e. US 90A at SH 36; FM 1640 at SH 36; and FM 1640 at FM 762). However, block numbers are not available on road signs within the project area. It was also noted that some street signs are faded and need to be replaced (i.e. FM 1640 at Reading Road). There is also signage along the three corridors for surrounding cities and public and civic facilities including the George Memorial Library, fire department, police station and sheriff's office. Pavement markings on most of the facilities need to be upgraded with new striping and raised reflective pavement markers for better visibility at night and in rainy conditions.

Pavement Condition

The condition of the asphalt pavement along US 90A through the entire study limits is consistent with numerous longitudinal and transverse cracking. The asphalt pavement condition along FM 762 is slightly better with fewer transverse cracks and several locations where the longitudinal cracks are limited to the lane edges along the stripe lines. FM 1640 has the most pavement condition diversity. From Bamore Road to Radio Lane, the asphalt pavement condition is very similar to US 90A, with numerous longitudinal and transverse cracks. Between Radio Lane and Lamar, the conditions improve, similar to FM 762, with fewer transverse cracks. Between Lamar and FM 762, the pavement switches to concrete and was constructed in 2013.

Railroads

There are two railroad crossings within the study area. The first crossing is the grade separated BNSF Galveston Subdivision at US 90A near the Oak Bend Medical Center, as shown in Figure 2.9.

The second crossing is the BNSF Galveston Subdivision at the intersection of FM 1640 and FM 762 (at-grade crossing near the George Memorial Library), as shown in Figure 2.10. This intersection was recently upgraded. Due to the proximity to the FM 762 intersection, there are no plans to grade separate the road and railroad tracks.

The BNSF Galveston Subdivision parallels US 90A until it turns south on the west side of the Oak Bend Medical Center and then parallels FM 762. Currently, there are approximately 20 to 30 trains per day crossing daily.

The UPRR Glidden Subdivision railroad tracks parallel the entire length of the project area along US 90A. There are no rail crossings along any of the study area corridors; however, the profile at some of the side street at-grade crossings, such as Pitts Road (see Figure 2.11), is high. Currently, there are approximately 30 to 40 trains daily along this track. Additionally, Amtrak's Sunset Limited operates 6 trains per week along this route.

Figure 2.9: BNSF Railroad Crossing at US 90A

Figure 2.10: BNSF Railroad Crossing at FM 1640

Figure 2.11: UPRR Crossing at Pitts Road near US 90A

Pedestrian and Bicycle Infrastructure

Pedestrian facilities in the cities of Richmond and Rosenberg are limited. There are sidewalks along portions of the major commercial corridors; however, continuous sidewalks are located mainly in the historic downtown areas.

US 90A was originally designed as a rural facility with open ditches. Over time, expansion of US 90A has resulted in a narrowing of the buffer area between the roadway and existing businesses. Many of the ditches have been filled in and paved over, such that the roadway extends to the narrow parking strips in front of the businesses, leaving no place for a sidewalk, as seen in Figure 2.12.

Most of the sidewalks along the study area corridors do not meet ADA requirements. Moreover, many sidewalks within the study area are in poor condition. Discontinuous sidewalks are also common along the other corridors, especially where land uses are sparsely situated (see Figure 2.13). Pedestrians are limited to using grass strips or driveways along the corridors as walking paths, or as depicted in Figure 2.14, the center left turn lane.

Figure 2.15 depicts a cow path used by pedestrians to cross over the BNSF railroad track just west of the Oak Bend Medical Center. This is a safety concern due to the grade at which this crossing occurs; however, there are no other alternatives to cross at this location.

The cities of Richmond and Rosenberg, as well as Fort Bend County, do not have dedicated bicycle facilities. Data from the Houston-Galveston Area Council identify a few bikeways as “proposed” and one as “constructed”; however, no infrastructure or signage was observed during field investigations.

Figure 2.12: Example of Inadequate Pedestrian Facilities

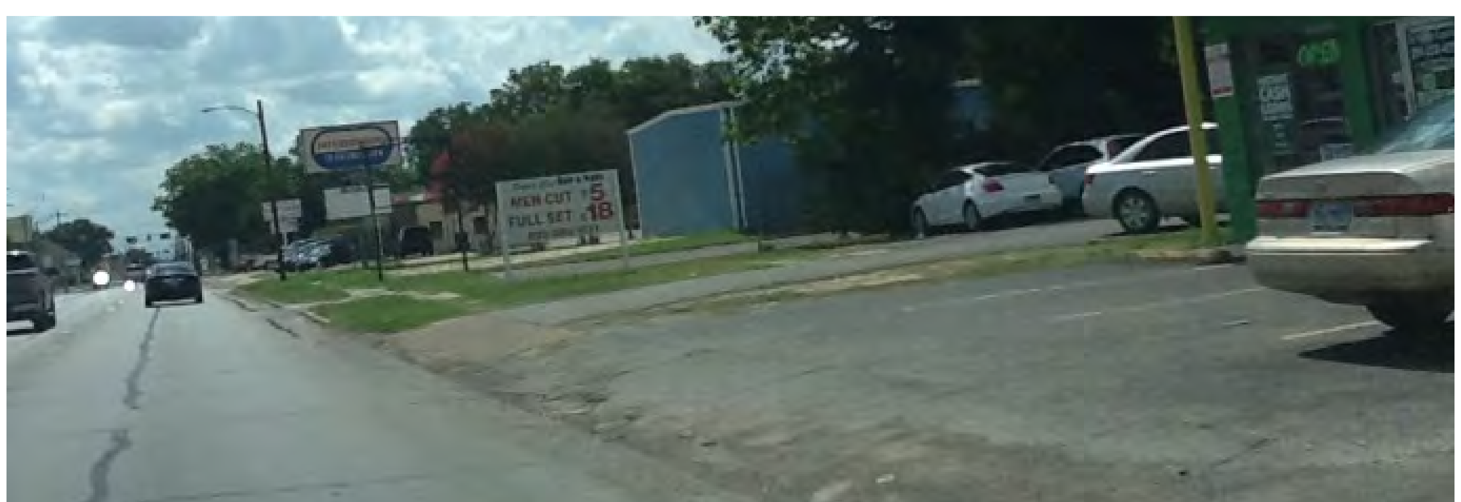


Figure 2.13: Example of Inadequate Pedestrian Facilities

Figure 2.14: Pedestrians using CLTL

Figure 2.15: Cowpath over the BNSF and US 90A Crossing

Transit

The Public Transit Department of Fort Bend County provides both rural and urban transit service on a weekday demand-response and commuter route service basis. Neither service has a direct impact on the study corridors. Additionally, the Public Transit Department provides park-and-ride service in the area. Currently, the Public Transit Department serves over 60,000 riders annually (SPI, 2013). However, existing travel patterns and projected growth indicate that transit will need to be expanded in the future (SPI, 2013).

Demand-response service is offered within the study area; however, this service must be requested at least 24-hours in advance (Fort Bend County, 2013). The transit department also offers a service called "New Freedom Transportation" for people with disabilities in the rural areas of Fort Bend County. Three fixed route commuter services into Harris County to Uptown, Greenway Plaza, and the Texas Medical Center, with transfers available at the West Bellfort Park-and-Ride for service to downtown Houston and other destinations (Fort Bend County, 2013 and SPI, 2013). This form of transit serves "the highest population/commuter ridership potential areas and provides transit options to commuters from regional park-and-ride facilities" (SPI, 2013, p. 34).

Planned Funded Projects in the Study Area

The planned funded projects for the US 90A Access Management Study project area are shown in Figure 2.16. The projects shown are categorized by type and schedule (as short- or long-range). The projects are listed in H-GAC's 2035 RTP Update, H-GAC's 2013-2016 TIP, TxDOT's project listing, the Fort Bend County Thoroughfare Plan, and the City of Rosenberg Thoroughfare Plan. Refer to Appendix D for a list of planned funded and unfunded projects in the study area.

OPERATIONAL CHARACTERISTICS

Crash Data Analysis

Crash data was obtained from H-GAC for the years 2007 through 2011. The data is from the Crash Records Information System (CRIS) database maintained by TxDOT. Summaries of the crash data are provided on the Supplementary Data CD.

Of the 37 signalized intersections, including two flashers, 17 locations had 25 or more crashes. The 25 crash number was selected as the threshold since it translates to an average of five or more crashes per year, which is considered significant from a traffic control perspective.

Crash Rate Comparison

Figure 2.17 shows the crash rate for each section of the roadway and how it compares with the Texas rate. For all segments considered, the corridor average crash rates are 2.1 times to 4.2 times higher than the Texas average crash rate, as shown by the number above the corridor average crash rate column. Typically, a roadway segment is considered to have a significant safety problem when the crash rate is at least two times the statewide average.

Figure 2.17: Crash Rate by Roadway Section

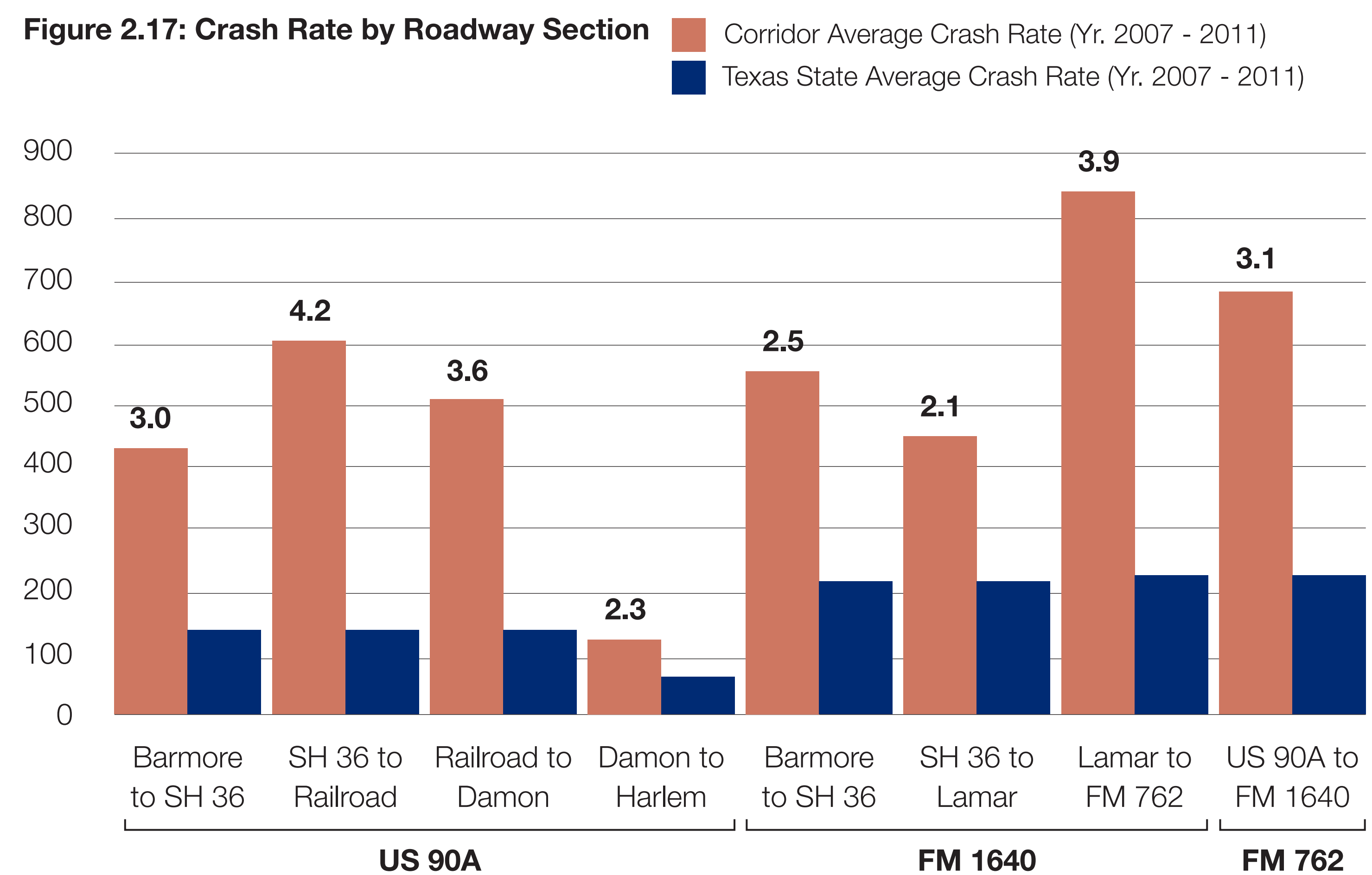
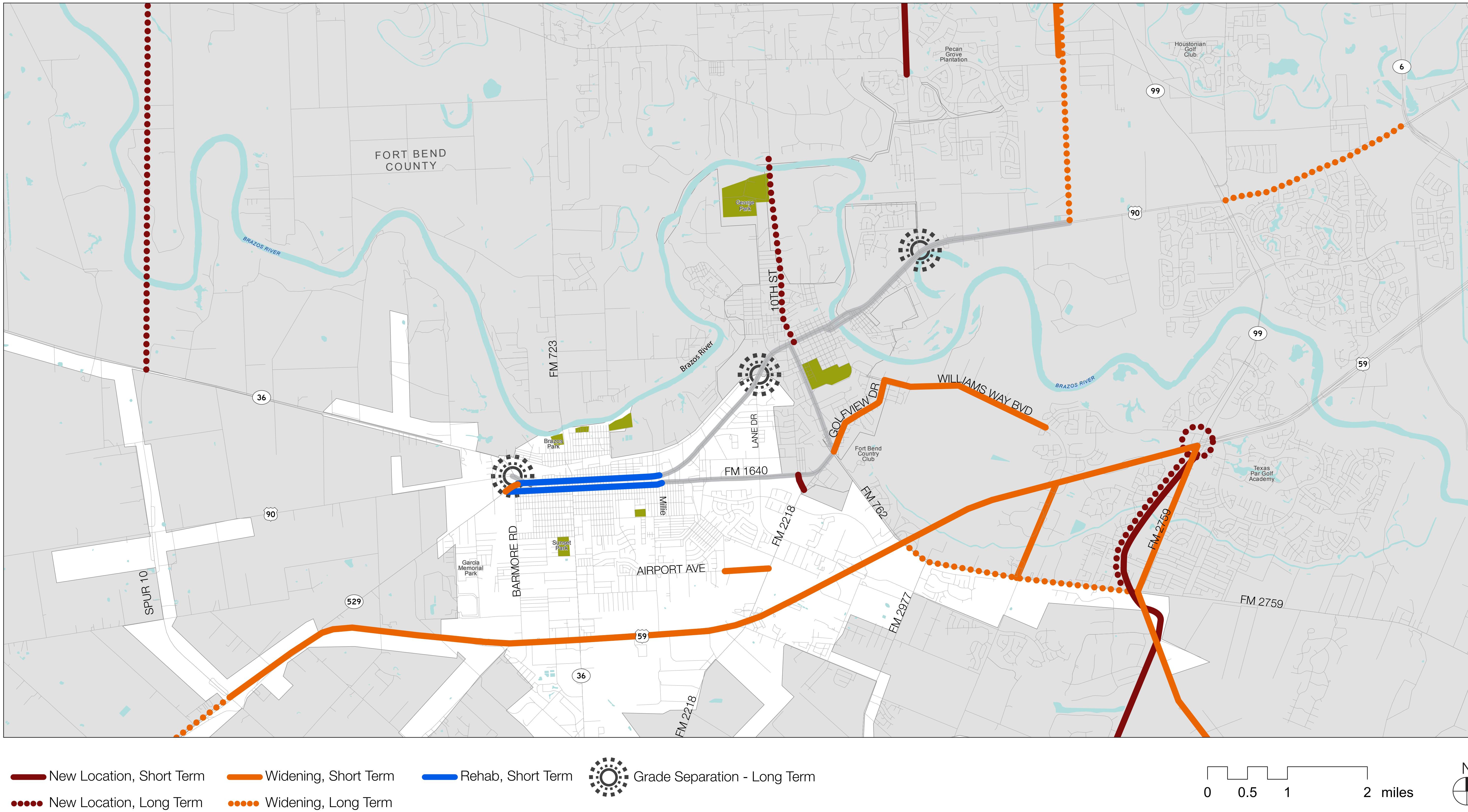


Figure 2.16: Planned Projects in the Study Area



Between 2007 and 2011, 1,861 crashes occurred on the study corridors. A table breaking down each of these crashes by the type of crash is included on the Supplementary Data CD. The crash data also included factors contributing to crash occurrence for all but 891 of the crashes. Excluding these 891 crashes where no factor was provided, the top seven contributing factors accounted for 90% of the remaining 970 crashes. The top ten contributing factors are included in Table 2.1.

Table 2.1: Top 10 Contributing Factors for Crashes on Study Area Corridors

Rank	Contributing Factor for Crash	Number of Crashes (2007-2011)
1	Slowing/Stopping - For Officer, Flagman, or Traffic Control	272
2	One Vehicle Leaving Driveway	178
3	Slowing/Stopping - For Traffic	163
4	Vehicle Changing Lanes	94
5	Slowing/Stopping - To Make Left Turn	82
6	One Vehicle Entering Driveway	60
7	One Vehicle Backward From Parking	28
8	Construction - Within Posted Road Construction Zone (Not Related to Crash)	17
9	Slowing/Stopping - To Make Right Turn	13
10	School Bus Related Crash	11

The aforementioned contributing factors can be attributed to:

- High driveway density and inappropriate off street parking (Rankings 2, 6 and 7 are due to driveways and access to/from driveways); and
- Lack of a protected left turn lane or proper turning storage for vehicles (Rankings 1, 3 and 5 are due to cars stopping in a travel lane either to turn left to a business or cross street or due to signal operation).

Daily Traffic Volumes

Average daily traffic (ADT) volumes were obtained from TxDOT for years 2007 to 2011. On US 90A, the 2011 two-way ADT volumes vary from a high of 29,000 vehicles to a low of 13,700 vehicles. It is higher at the east end and progressively decreases going west towards Rosenberg.

The range of two-way ADT volumes on FM 1640 is from 21,500 to 17,900. It decreases going west from FM 762 towards Rosenberg.

On FM 762, between US 90A and FM 1640, the two-way ADT is 18,400 vehicles.
The Texas Department of Transportation ADT maps for 2007 through 2011 are included on the Supplementary Data CD.

Intersection Turning Movement Counts

Weekday intersection and pedestrian movement counts were recorded at all 37 signalized and flasher locations in the first quarter of 2013. The counts were recorded on a weekday for a minimum of two hours in the morning and two hours in the evening during the commuter rush hours. Illustrations depicting the intersection lane uses and turning movement counts for the AM and PM peak periods are included in Appendix E. The detailed traffic count data are included on the Supplementary Data CD.

Driveway and Unsignalized Intersection Turning Movement Counts

Turning Movement Counts for vehicles and pedestrians at 34 driveways and other unsignalized intersections were recorded in September 2013 for one hour in the AM peak period and one hour in the PM peak period. The locations were chosen based on proximity to signalized intersections, proximity to proposed median improvements, high traffic generating businesses, and public land uses. This data was used to assist in making decisions on recommended improvements and proposed turn-lane storage lengths. The locations and counts are included on the Supplementary Data CD.

Traffic Flow

The flow of traffic is certainly higher in the evening period than the morning period on all three corridors. Among the three corridors, the top ten intersections in terms of PM peak hour volumes are shown in Table 2.2.

Table 2.2 PM Peak Hour Volumes of Top Ten Intersections

Rank	Intersection	PM Peak Hour Volume
1	US 90A at FM 359	3,460
2	FM 1640 at FM 762	2,993
3	US 90A at Harlem	2,799
4	US 90A at Collins	2,764
5	US 90A at Pitts	2,678
6	US 90A at FM 762	2,511
7	US 90A at Lane	2,457
8	US 90A at SH 36	2,387
9	FM 1640 at Reading / Lane	2,301
10	FM 1640 at SH 36	2,210

Intersection Geometry

Most signalized locations are regular four-legged intersections. Only seven are T-intersections as follows:

- US 90A at Sally Anne
- US 90A at 2nd Street
- US 90A at South 2nd Street
- US 90A at FM 359
- US 90A at Harlem
- FM 1640 at Stadium
- FM 1640 at Lamar

Parking is allowed on several of the cross streets within Rosenberg and Richmond very close to the subject intersections.

Traffic Signals

To determine the improvements needed to the traffic signals and intersection geometry, a complete field inventory of all signalized intersections and signal hardware was conducted. It appears none of the intersections have hardwired or wireless interconnectivity. Existing signal timing plans were obtained from TxDOT for use in the intersection level of service (LOS) analysis. The existing traffic signal inventory and signal timing plans are included on the Supplementary Data CD.

Existing Traffic Analysis

The primary measure of effectiveness (MOE) used in determining traffic impact at an intersection is LOS. LOS is a qualitative measure of operating conditions at an intersection based on control delay and is given a letter designation from A to F, where LOS A represents free-flow conditions and LOS F represents heavy congestion. Desirable LOS in metropolitan areas is "D" or better, which may not necessarily be achieved due to congestion.

Signalized Intersection LOS

The LOS criteria used for signalized intersections is summarized in Figure 2.18.

Synchro software was used to model and analyze existing 2013 AM and PM intersection LOS based on existing peak hour volumes, signal timing plans, intersection lane use, turn lane storage lengths, speed limits, etc. Based on the analysis, the existing AM peak LOS is generally "C" or better (mostly As and Bs). Five locations are at LOS "D" and one is LOS "E". In the PM peak, LOS is "C" or better except for three locations at LOS "D" and two at LOS "F". Refer to Appendix F for AM and PM Peak LOS at each of the signalized intersections. A graphical form of the existing intersection LOS for the AM and PM peak hours and the detailed Synchro output is included on the Supplementary Data CD.

Figure 2.18: LOS Criteria

LOS:	Signalized Intersection Control Delay
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

(Sec/Vehicle)

Roadway LOS

Urban roadway LOS is heavily influenced by the operation of signalized intersections, and according to the 2010 Highway Capacity Manual (HCM) it is based on travel speed and critical volume/capacity ratios as shown in Figure 2.19.

Synchro software models urban roadway LOS based on the 2010 HCM criteria listed above. It identifies any segment of the urban roadway with speeds between 36 and 45 mph as class II arterial. This is the case for a major portion of our corridors, based on which, the existing 2013 average arterial LOS are shown in Table 2.3:

Figure 2.19: LOS by Volume / Capacity

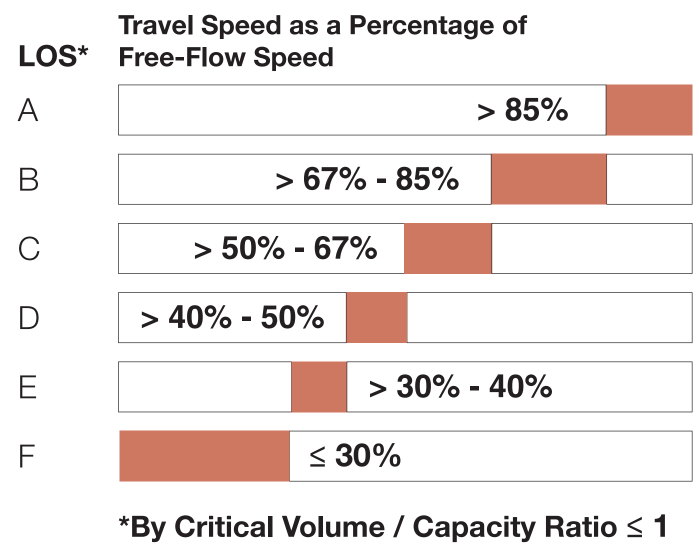


Table 2.3: Corridor LOS

	AM PEAK		PM PEAK	
Corridor	EB LOS	WB LOS	EB LOS	WB LOS
US 90A	C	C	C	C
FM 1640	D	C	D	C
	NB LOS	SB LOS	NB LOS	SB LOS
FM 762	D	D	D	E

EXISTING POLICIES

TxDOT addresses the roadway elements including; number of lanes, lane width, intersection treatment, sidewalks, bike lanes along their facilities, driveway access, and median and shoulder treatment. Design guidelines are used to determine whether improvements and new developments fit within the existing character of the area while maintaining its integrity. The existing ordinances from the cities of Richmond and Rosenberg, Richmond Historic District, and the West Fort Bend Management District address types of development and redevelopment in the area, parking requirements, and pedestrian facilities, construction/maintenance, non-motorized facilities. Although each entity does not comprehensively cover all of these access management related principles, they do overlap and provide some guidance for future improvements.

TxDOT Access Management

The principles and guidelines outlined in the TxDOT Access Management Manual (2011) should be the primary design go-by standards as US 90A, FM 1640, and FM 762 are all TxDOT facilities. The standards in the manual allow municipalities to either use the manual for access permitting or for the municipality to establish their own access management procedures. According to the TxDOT Access Management Manual, municipalities have authority to apply access management techniques such as, shared access, cross access, lot width requirements, driveway throat lengths, internal street circulation, and general thoroughfare planning. The techniques applied by the municipality should be coordinated with TxDOT to realize the safety and operational benefits of access management (TxDOT Access Management Manual, 2011)

The local TxDOT district office should be contacted to obtain a permit to construct a driveway or to improve an existing driveway. Applicants must submit a completed TxDOT Form 1058: Permit to Construct Access Driveway Facilities on Highway Right of Way. Variances are permitted to keep from land-locking a property where the land-locking would occur as a direct result of a TxDOT project where TxDOT does not control access or development during highway reconstruction and rehabilitation projects.

Existing Access Management Practices

Although the cities of Richmond and Rosenberg do not have formal access management practices in place, there are existing ordinances and guidelines for designing and building infrastructure within the project area. Additionally, the West Fort Bend Management District and the Richmond Historic District each have design guidelines to help unify new development and revitalization of the area.

City of Richmond

The City of Richmond has platting, subdivision, and infrastructure design ordinances available on the Richmond Fire Department Website. The City of Richmond requires that all plats and re-plats be reviewed by the City Commission, which gives the City some element of control over the building and infrastructure changes that take place. The recommendation for the layout of streets to form a 90 degree angle promotes consistency with the grid network already established in the City. Sidewalks are required on all streets. The subdivision ordinance states pedestrian walkways should be at least 10' in width for access to high pedestrian activity areas such as schools, playgrounds, shopping centers, and transportation and community facilities. Aside from typical parking requirements determined by use, the City of Richmond doesn't have ordinances stipulating the design of lots.

Richmond Historic District
The Richmond Historic District has design standards or guidelines for commercial and residential buildings in the historic district as well as a comprehensive preservation plan for the historic district. The intent of the guidelines is to preserve maintain the historic resources within the City of Richmond while ensuring the character of new development is complimentary to the existing infrastructure. The Historical Commission requires that for new construction buildings, parking lots should be situated to the rear. This applies to the Historic District, but is instrumental in maintaining the character of the area.

City of Rosenberg
The City of Rosenberg has specific standards pertaining to roadway design and access, such as street design standards, driveways, parking, traffic standards, and pedestrian facilities. However, much of the street standards are in the Rosenberg Design Standards, which are not codified in the city's Code of Ordinances. The City's design ordinances are in line with TxDOT requirements found in the TxDOT Access Management Manual and the TxDOT Roadway Design Manual. However, they do not stringently dictate what is happening beyond the highway ROW, especially on commercial properties. Other key items found in Rosenberg's Code of Ordinances are requirements for pedestrian facilities and treatments for its historic downtown area. The Design Guidelines and Code of Ordinances need to be reconciled to fix the discrepancies.

West Fort Bend Management District
The West Fort Bend Management District does not have access management standards in place. However, the District has established minimum architectural and landscaping standards and guidelines for new construction, development, or redevelopment of US 59, portions of SH 36, US 90A, FM 359, portions of FM 762, FM 2218, and Spur 10. Both the cities of Richmond and Rosenberg have agreed to the standards outlined by the West Fort Bend Management District. These standards were created in an effort to unify the aesthetic look of development among the aforementioned corridors, including: building and parking lot setbacks; building materials, screening, and fencing; landscaping and tree preservation; and signage and lighting standards.

PUBLIC INVOLVEMENT

GOALS OF PUBLIC INVOLVEMENT

To ensure a comprehensive public involvement program that addresses the unique aspects of the US 90A project, the study team adhered to four guiding principles:

1. Identify and involve all stakeholders in the study process
2. Be proactive
3. Bring diverse interests to the table
4. Build consensus

Using these four principles, the HNTB team established public involvement goals to guide the public involvement process and to ensure the activities had purpose. The public involvement goals for the US 90A Access Management Study are as follows:

1. Increase level of awareness regarding traffic issues and problems within the study area
2. Provide interested business, residents, and other constituents with opportunities to offer input into the study process
3. Provide a method for incorporating input into the technical recommendations
4. Provide a mechanism for relaying study findings and recommendations to the public
5. Develop a platform and constituency for future discussions and consensus buildings

PUBLIC INVOLVEMENT PLAN

Public involvement is a fundamental part of any access management study. For the US 90A project, efforts were made to maximize participation. A steering committee was formed, two public meeting were held, and several stakeholder meetings were conducted. In addition, a website was developed under the address http://www.h-gac.com/am/go to keep interested parties abreast of current project progress.

Steering Committee

The Steering Committee was comprised of the Houston-Galveston Area Council, Texas Department of Transportation, Fort Bend County, City of Richmond, City of Rosenberg, Rosenberg Economic Development Corporation, West Fort Bend Management District, Central Fort Bend Chamber Alliance, Fort Bend Economic Development Council, and Lamar Consolidated ISD. The purpose of the Steering Committee was to guide and direct the technical aspects of the study throughout the various stages of development.

Stakeholder Meetings

Stakeholder meetings were held to help educate concerned people who may not fully understand the study effort or may need additional information to understand how the study impacts their business or property. Numerous Stakeholder meetings were held during the course of the study.

Public Meetings
Two public meetings were held as part of the US 90A Access Management Study. The first meeting presented the goals and objectives of the study, the existing conditions, educational material on access management, and data collected along the corridor. Input from the public was solicited through a questionnaire to help guide the development of solutions and to better understand public perception regarding trouble spots along the corridor.

The second and final public meeting was conducted to solicit public input on the proposed recommendations. Input from the public was solicited through a comment form to obtain feedback on the recommendations and assess the public's level of satisfaction with the study recommendations.

FIRST PUBLIC MEETING

The first public meeting was held at the George Memorial Library in Richmond, Texas on May 15, 2013. There were 98 members of the general public and 2 elected officials in attendance. 82 comments were received.

Excerpts from First Public Meeting
The public's top five priorities for access management are:

1. Improving signal synchronization.
2. Intersection improvements.
3. Creation of right turn bays.
4. Better signing and lighting.
5. Addition of raised median with left turn bays.

Figure 3.1: Public Meeting #1

Figure 3.2: Public Meeting #1

Figure 3.3: Public Meeting #1

Figure 3.4: Access Management Tools

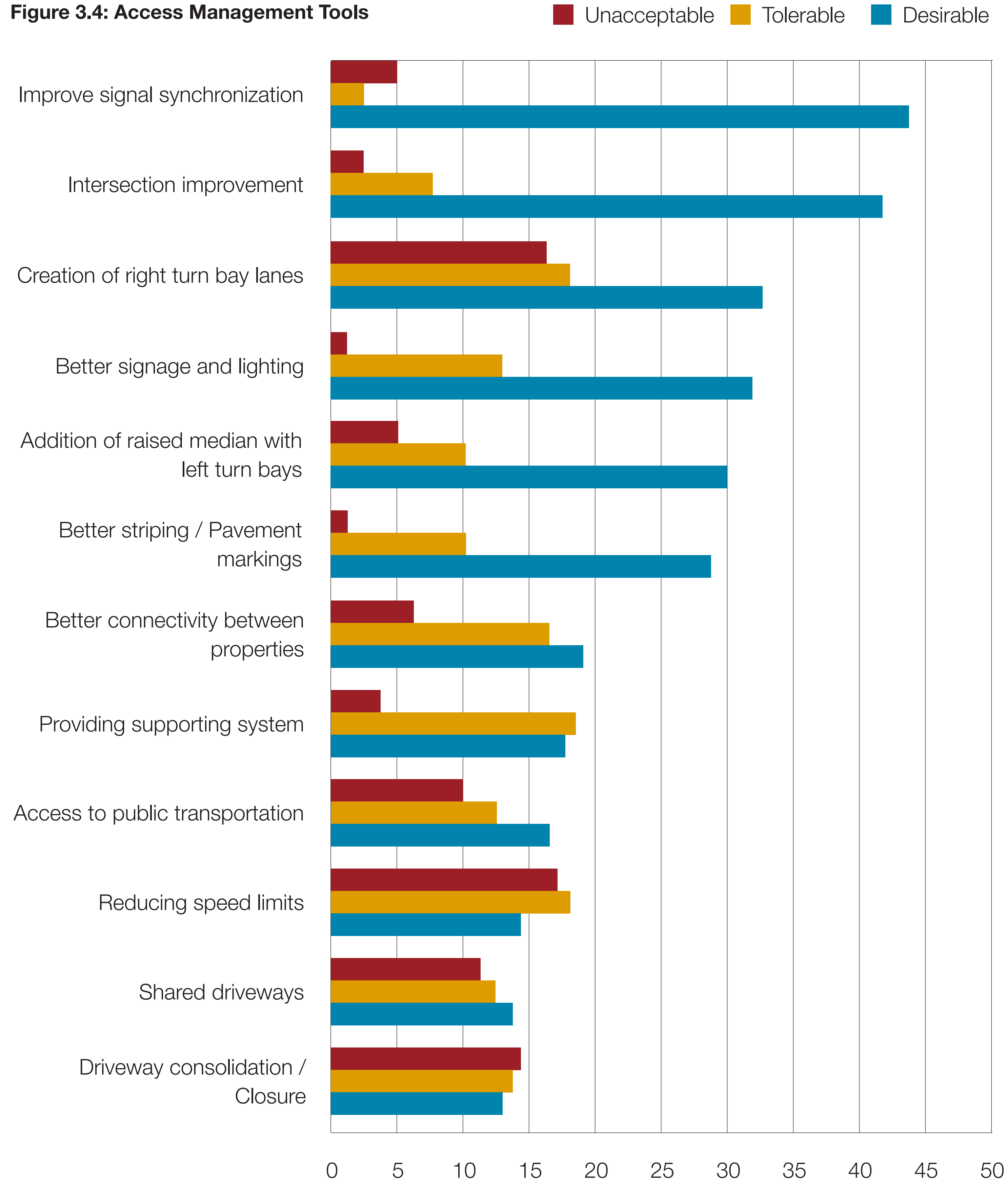


Figure 3.5: Public Priorities for Improvements along US 90A

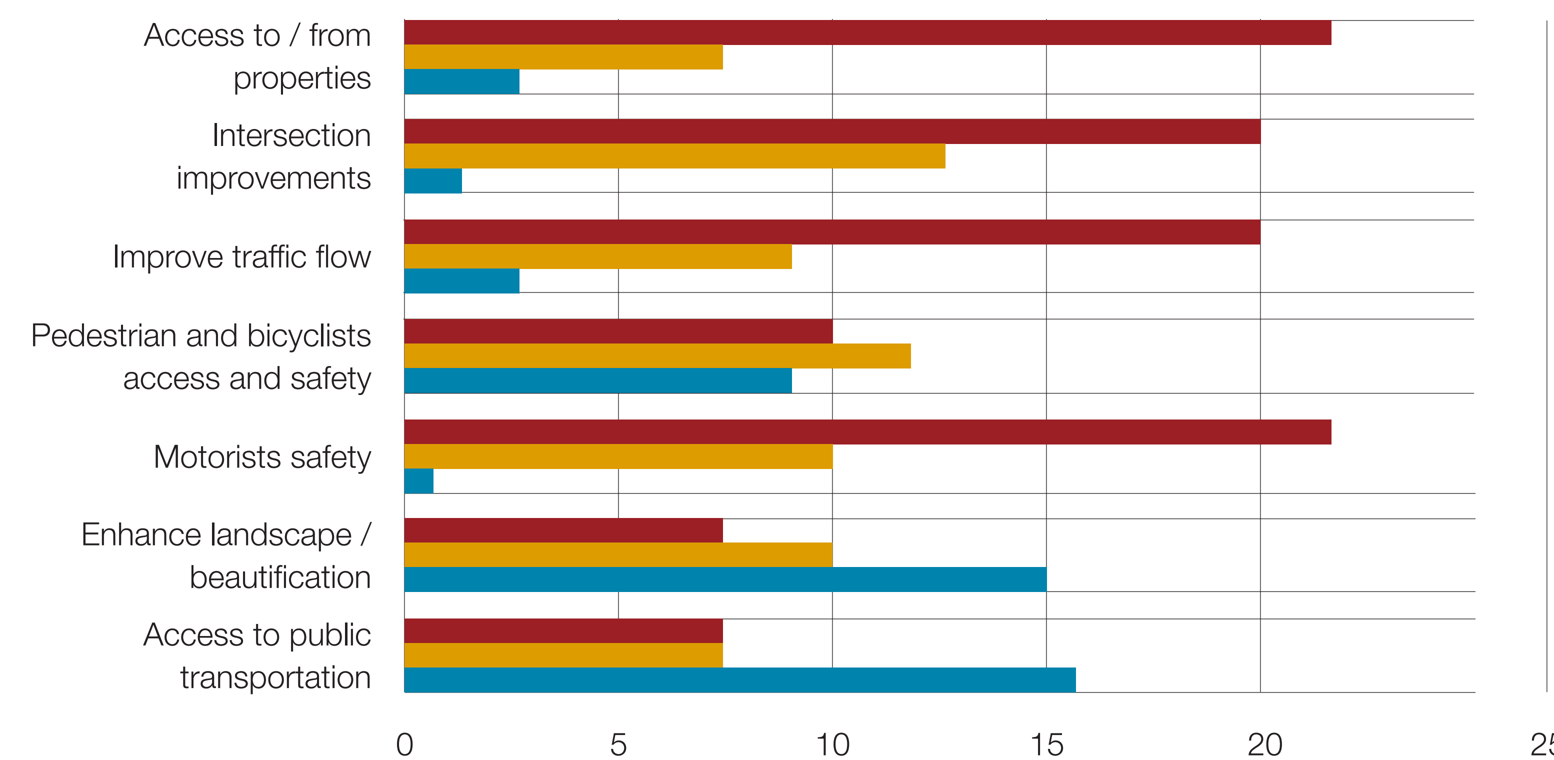


Figure 3.6: Public Priorities for Improvements along FM 1640

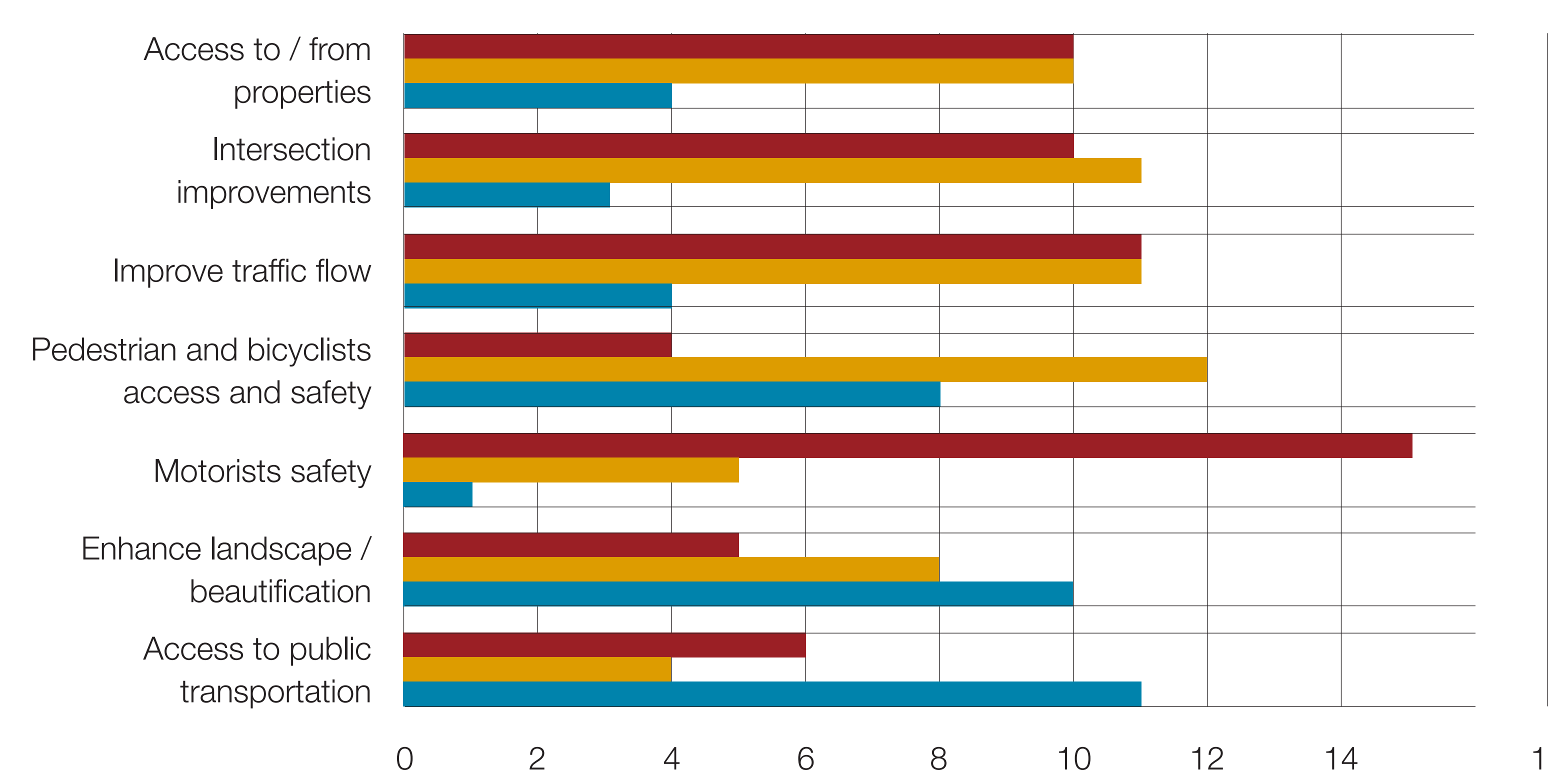
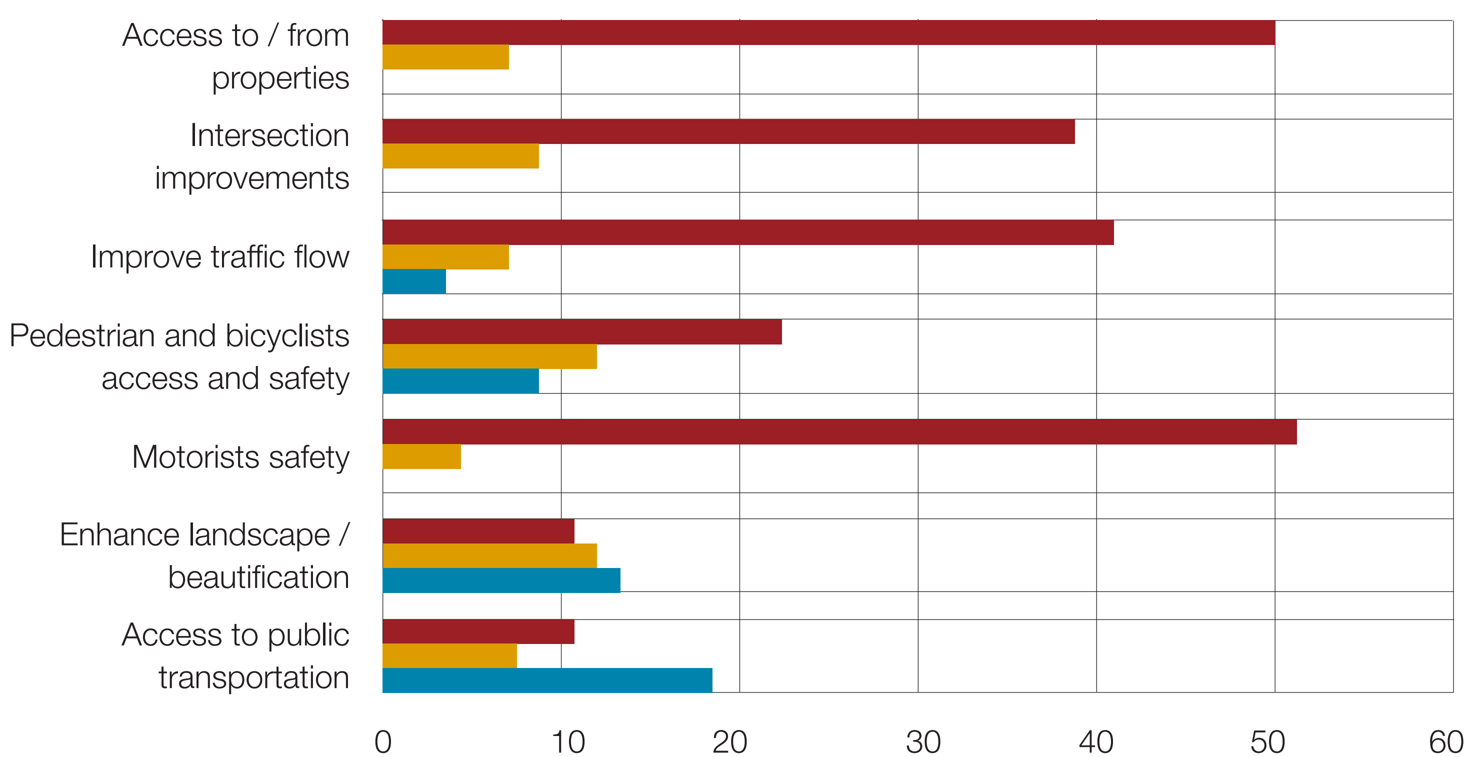


Figure 3.7: Public Priorities for Improvements along FM 762



SECOND PUBLIC MEETING

The second public meeting was held at the Fort Bend Country Club in Richmond, Texas on October 23, 2013. 38 members of the public and 3 elected officials attended. A total of 6 comments were received at the meeting, one comment was emailed, one was faxed, and one was mailed.

Excerpts from Second Public Meeting

Overall, the comments received were satisfactory, particularly in regards to driveway consolidation and installation of a signalized intersection at US 90A and Damon Street east of the Brazos River. There were concerns regarding the effects of raised medians on businesses located along US 90A in Rosenberg. As a result, modifications were made to some of the raised medians.

Figure 3.8: Public Opinion of Recommended Improvements

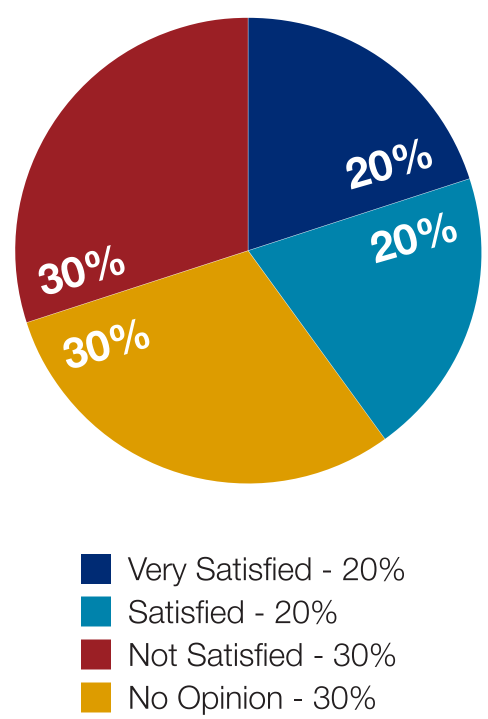


Figure 3.9: Public Meeting #2

Figure 3.10: Public Meeting #2

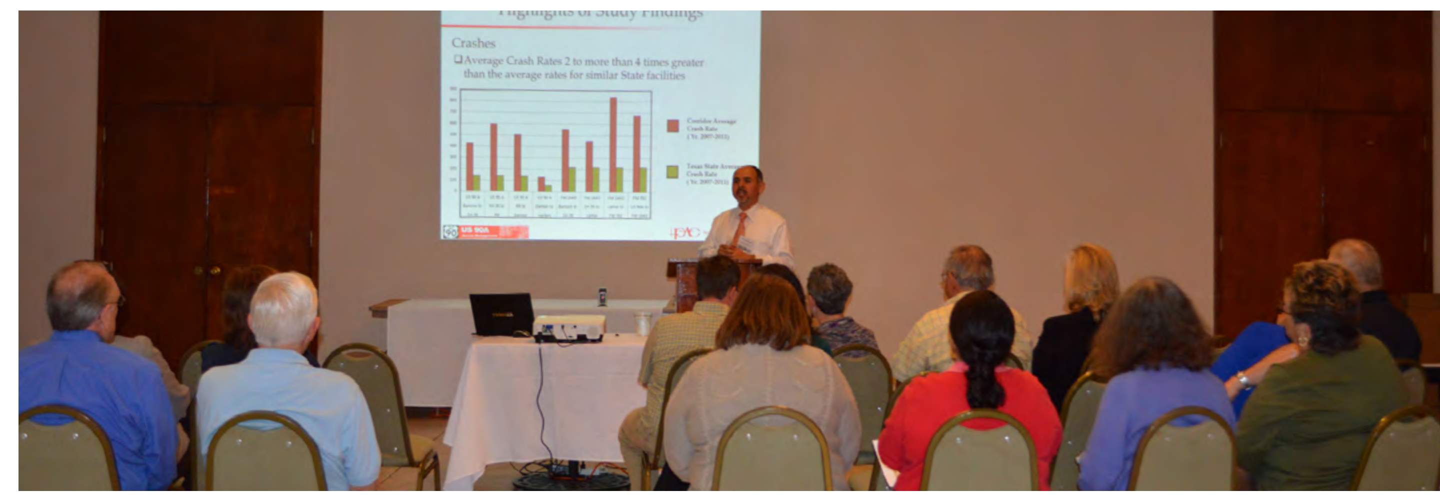


Figure 3.11: Public Meeting #2

CHAPTER 4

RECOMMENDED IMPROVEMENTS & IMPLEMENTATION STRATEGIES

RECOMMENDATIONS

The process for identifying recommended improvements that improve mobility and safety begins with evaluation of existing conditions, public input, traffic modeling of before and after conditions, and refinement based on traffic model results and additional public input.

Public input on trouble spots, improvement priorities and acceptable access management tools were collected at the first public meeting and used to develop an initial set of improvement recommendations. Based on public input, including recommendations from the steering committee, local agencies and other small group meetings, the initial improvements were modified and input into a traffic model to evaluate their benefits. Refinements were made and the final recommended improvements are included in this chapter. The improvements were classified into one of three phases for implementation: Short, medium, and long-term.

Figure 4.1: Recommended Improvements Phases

Recommended Improvements	
Short-Term	Improvements that are low cost, within existing right-of-way, easy to plan and implement
Medium and Long-Term	Improvements that require greater financial resources, more coordination, moderate to high right-of-way, utility coordination, and longer time for planning, engineering and implementation

Since cost is a factor in programming improvements by each agency, it may not be possible to implement all of the short-term improvements at one time and additional prioritization may be necessary.

The recommended improvements were grouped into six categories as shown below. Recommended improvements at specific locations are shown on the aerial layout sheets, while other, more general recommendations for implementation along the entire corridor are discussed below. A summary table of the short-, medium-, and long-term improvements by type and agency responsibility is also included.

Figure 4.2: Types of Recommended Improvements

Recommended Improvements Categories
• Signalized Intersections • Roadways • Public Transit • Downtown Areas • Bicycle Routes • Pedestrians

Signalized Intersection Improvements

Following analysis of the existing conditions and traffic signal inventory, several recommended improvements were identified as noted below. The specific traffic signal improvements recommended at each intersection are shown in Figure 4.3 on the following page.

- Update traffic signal controllers with capabilities for appropriate vehicle detectors to improve efficiency of signal timing
- Manually synchronize signal timing along each corridor to provide for vehicle progression through multiple signals without stopping
- Add back plates at signals without them
- Add dedicated left turn signal heads for new left turn lanes
- Convert any older small signal heads to 12-inch signal heads
- Add advanced warning signs at high crash intersections
- Upgrade pedestrian ramps for compliance with current ADA requirements and add pedestrian crossing signals where appropriate
- Add safety lighting at signals that are currently without lighting
- Add new traffic signal at Damon St and US 90A, east of the Brazos River
- Remove traffic signals on US 90A at Houston St (flasher) and South 3rd St in Richmond; and on FM 1640 at Damon St in Rosenberg

Roadway Improvements

After evaluating the existing traffic conditions, crash data and hot spots, driveway density, specific driveway locations, roadway geometrics, and input from the public, stakeholders and steering committee, several improvement recommendations were identified to help improve safety and mobility. A general list of recommendations is provided below. Specific improvements are shown on the Recommended Improvement Layouts at the end of this chapter.

- Add raised medians to reduce turning movement conflicts
- Add or widen outside shoulder at median openings to facilitate u-turns
- Add left or right turn bays or increase length of existing turn bays
- Add raised islands along outside shoulder edge to delineate driveway openings where parking lots are continuously connected to shoulder
- Realign cross streets to eliminate offset intersections
- Add or replace pavement markings for left turn lanes, bike routes, school zones and railroad crossings
- Add block numbering on street signs at intersections
- Add advance signing for upcoming cross street intersections
- Add a continuous two way left turn lane on FM 762
- Provide recommendations for future new roads to facilitate circulation and relieve US 90A
- Provide recommendations for new river bridge crossing locations for future consideration
- Conduct speed study to determine if posted speed is adequate

Public Transit Improvements

Extension, implementation, and improvement of pedestrian facilities may help facilitate the introduction of public transit within the study area. Currently, public transit within the study area operates on a demand-response basis; however, the Fort Bend County Public Transit Department is developing a long-range transit plan to meet population growth and travel demand. The study team recommends transit routes that are complementary to the recommended pedestrian facilities, as well as transit routes proposed in the City of Rosenberg Transit and Pedestrian Plan and Fort Bend County Subregional Planning Initiative, to support the success of public transit within the cities of Richmond and Rosenberg.

Downtown Area Improvements

Both Richmond and Rosenberg have historically significant downtown areas. While the areas themselves are attractive, pedestrian friendly, and offer on-street parking, there is no signage encouraging residents or tourists to pass through the downtown areas. Downtown area improvement recommendations include:

- Conduct Livable Centers Study for Downtown Richmond
- Conduct Livable Centers Study for Downtown Rosenberg
- Add wayfinding signage along the corridors to downtown areas
- Infill development
- Widen and improve sidewalks and ramps (Upgrades for ADA compliance may be necessary)
- Remove some on-street parking and provide off-street parking lots on adjacent streets with adequate signage to encourage a more pedestrian and family friendly environment.
- Add landscaping and hardscape elements – benches, trash bins, planters, kiosks, special lighting and treatment to sidewalks, etc…
- Add pedestrian crossing signals with pushbuttons in heavy pedestrian traffic areas

Figure 4.3: Intersection Recommended Improvements (Supporting tables can be found on the following page)

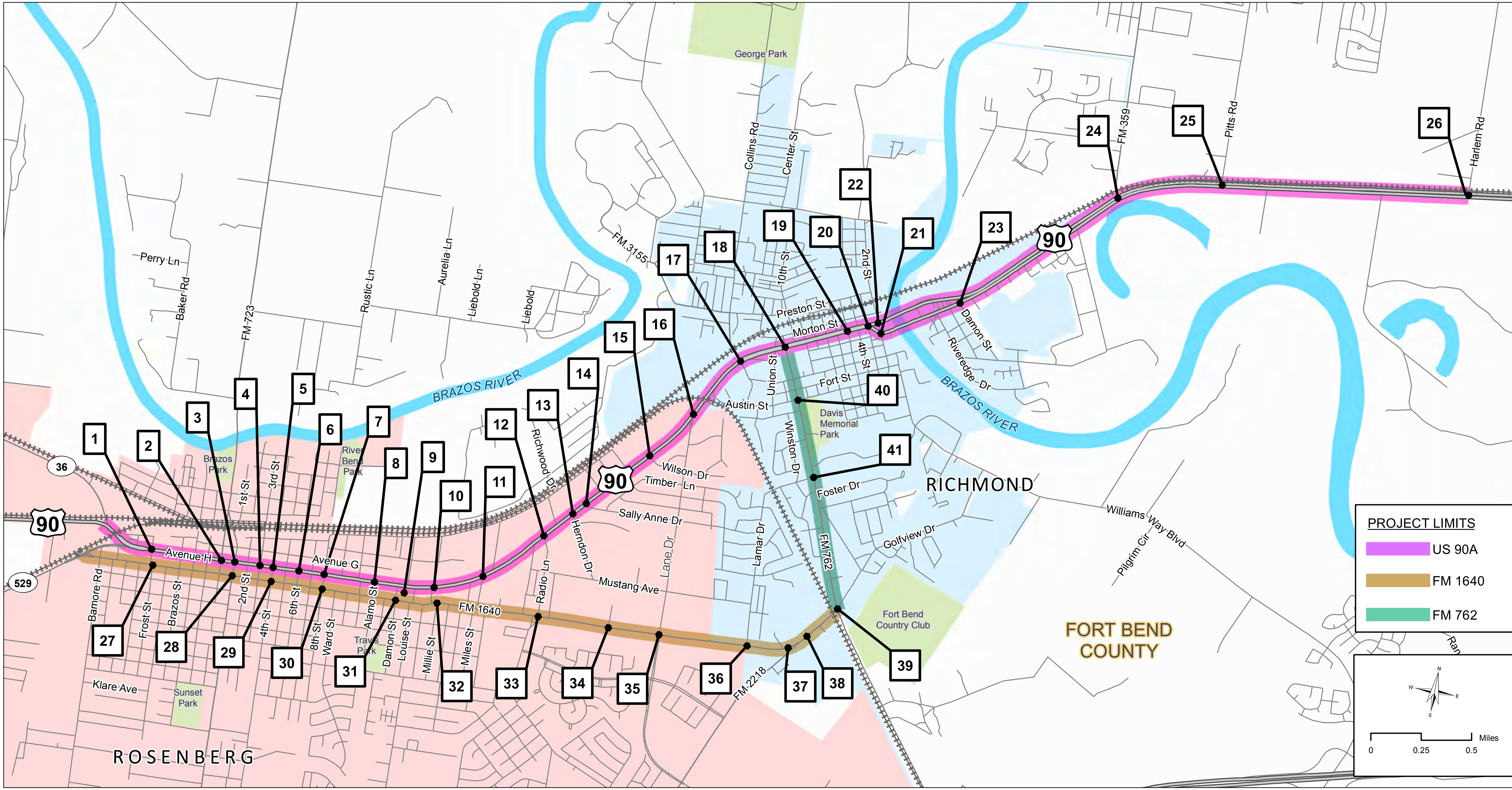


Figure 4.3: Continued

#	List of Signalized Intersections	Short & Medium-Term Improvements: Remove Signal	Reconstruct Signal	Install New Signal	Install Back Plates	Install Safety Lighting	Install or Reconstruct Wheel Chair Ramps
	US 90A						
1	Frost Street (currently unsignalized)						Short-term
2	Houston Street (Flasher)	Short-term					
3	1st Street (SH 36)		Short-term				Short-term
4	3rd Street		Short-term				Short-term
5	4th Street (Emergency Flasher)		Short-term			Short-term	Short-term
6	6th Street		Short-term				Short-term
7	8th Street		Short-term				Short-term
8	Alamo Street		Short-term				Short-term
9	EB FM 1640 (to EB US 90A) at WB FM 1640 (to WB US 90) (new signal location)			Short-term			Short-term
10	Jennetta / Millie Street		Medium-term				Short-term
11	Miles Street		Short-term				Short-term
12	Radio Lane / S. Richwood Drive						Short-term
13	Herndon Drive	Medium-term		Medium-term			Medium-term
14	Sally Anne Drive		Short-term				Short-term
15	Wilson Drive						Short-term
16	Lane Drive	Short-term		Short-term			Short-term
17	Collins Road (FM 3155)		Short-term			Short-term	Short-term
18	S 11th St (Thompson Road / FM 762)						
19	South 5th Street		Short-term				Short-term
20	South 3rd Street	Short-term				Short-term	Short-term
21	South 2nd Street		Short-term				Short-term
22	US 90 (EB) at Souther 2nd Street		Short-term				Short-term
23	Damon (new signal location)			Short-term			Short-term
24	FM 359						
25	Pitts Road						
26	Harlem Road						
	FM 1640						
27	Frost Street (currently unsignalized)						Short-term
28	SH 36		Short-term			Short-term	Short-term
29	4th Street		Short-term		Short-term	Short-term	Short-term
30	8th Street		Short-term		Short-term		Short-term
31	Damon Street	Short-term					
32	Millie Street						Short-term
33	Radio Lane						
34	Stadium Drive						Short-term
35	Lane Drive / Reading Road						Short-term
36	Lamar Drive						
37	FM 2218 (B. F. Terry Boulevard)						
38	Walmart Driveway						
39	FM 762						
	FM 762						
40	Austin Street						
41	Lamar Drive						

Short-term Improvement

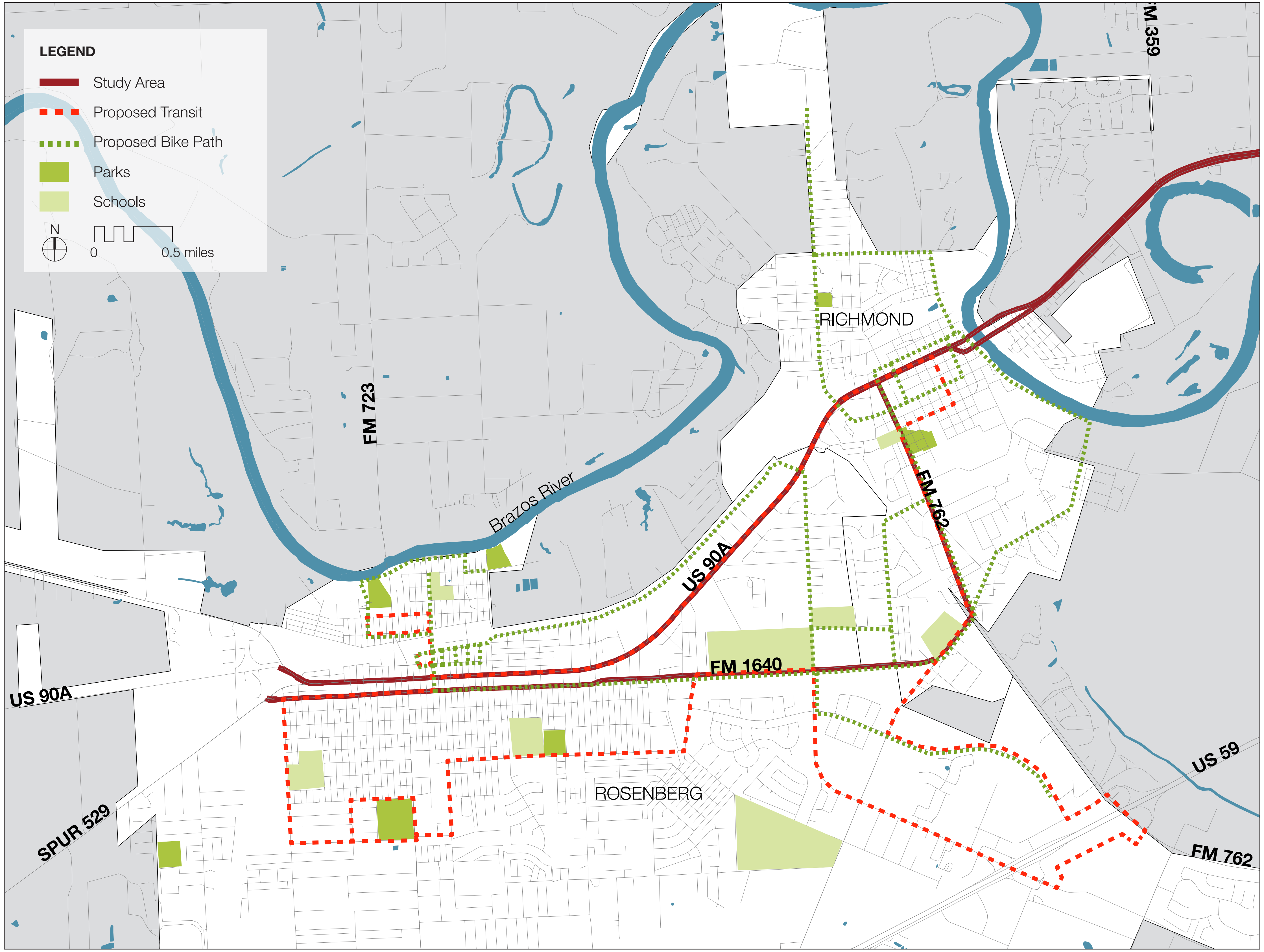
Medium-term Improvement

Bicycle Route Improvements

The cities of Richmond and Rosenberg should conduct an evaluation to determine the feasibility of adding bicycle facilities within the study area. In addition to assessing demand for bicycle facilities, the evaluation should assess the adequacy of existing city streets for designation as bicycle routes as well as the adequacy of existing ROW to accommodate street widening for a bicycle lane. Bicycle routes could prove to be successful near local schools and community facilities, providing better connectivity between Richmond and Rosenberg, as well as within neighborhoods, parks, and proposed transit routes.

The study team recommends implementation of bicycle routes along the length of FM 1640 from 3rd Street to FM 762 with a connection to Radio Lane down to the Brazos Town Center. Additionally, the recommended bicycle route on FM 1640 should be extended along Golfview to the Brazos River, where it could turn north along the river bank leading cyclists into downtown Richmond. Consideration should also be given to providing a bicycle route along Old Richmond road to improve circulation within historic downtown Rosenberg and provide a connection to River Bend and Brazos parks. The goal is to provide continuous facilities along the corridors to connect the cities, proposed transit routes, parks, schools, and community facilities. Figure 4.4 shows the proposed bicycle routes and public transit routes.

Figure 4.4: Proposed Bicycle Facilities



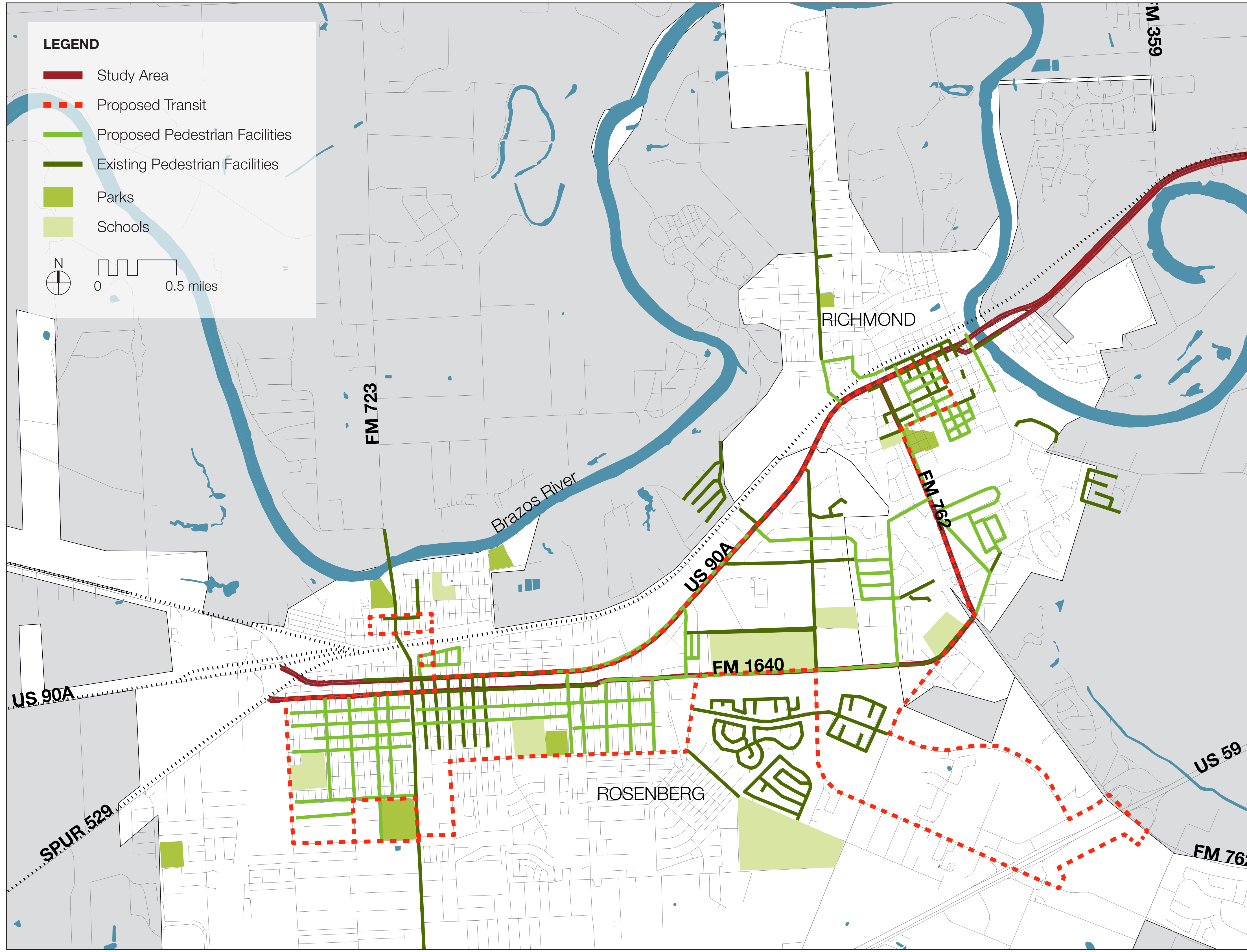
Pedestrian Improvements

The study team recommends improving pedestrian facilities within the study area to provide better connectivity between the cities of Richmond and Rosenberg. Figure 4.5 illustrates the existing and proposed pedestrian facilities. Additionally, the Figure shows the transit route proposed for the area in the City of Rosenberg Transit and Pedestrian Study. The proposed pedestrian facilities provide better connectivity from neighborhoods to local schools, parks, and the transit route.

Accessible design is essential for pedestrian facilities in order for them to be useable by all people. Because most of the work involves retrofitting existing places, improving the pedestrian environment may be done on a street-by-street, neighborhood-by-neighborhood basis (Source: ntl.bts.gov). Existing pedestrian facilities along US 90A, FM 1640 and FM 762 should be improved to meet ADA compliance. Along US 90A, pedestrian improvements may not be possible until long-term reconstruction occurs and the typical section changes from one with shoulders to a curb and gutter facility with an underground drainage pipe system.

Along FM 1640, pedestrian facilities should be extended to connect the neighborhoods to Wharton Jr. College and the George Memorial Library. Improvements along FM 762 should occur near the school, church, and YMCA; however, similar to US 90A, pedestrian improvements may not be possible along the entire length of FM 762, specifically between Lamar and FM 1640, due to the open ditch drainage system. Further studies should be conducted to determine how the neighborhoods along FM 762 could be connected to the George Memorial Library.

Figure 4.5: Proposed Pedestrian Facilities



TRAFFIC ANALYSIS

While the medium-term improvements may require more time for implementation, both the short and medium-term improvements were included in the proposed traffic model.

Signalized Intersection LOS

Synchro signal timing software was utilized to model proposed traffic conditions. An opening year of 2015 was assumed. Based on historic traffic data, an annual traffic growth rate of one percent was applied to 2013 traffic to estimate 2015 traffic.

2015 projected traffic conditions were modeled for the Base Condition (Scenario 1) and One-way pair condition (Scenario 2). The 2015 Base Condition includes signal optimization, but no change in current lane use or intersection configuration and none of the short or medium-term recommendations.

For the One-way Pair Condition, US 90A is assumed one-way westbound and FM 1640 is assumed one-way eastbound within downtown Rosenberg between Frost Street on the west side and Louise Street on the east side. In addition, the number of lanes on US 90A was reduced to three from four between 1st Street (SH 36) and 8th Street to create space for pedestrian-friendly activities, since the model showed that roadway LOS can be sustained at LOS D or better.

Results of the 2015 proposed traffic conditions analysis indicate that the majority of signalized intersections for the Base Scenario (existing condition with signal optimization) are projected to operate at LOS D or better with a few at LOS E and F. In the 2015 One-way Pair Scenario (with short and medium-term recommendations), all intersections are projected to operate at LOS D or better. A summary table with the LOS results for each signalized intersection in the existing 2013 and proposed 2015 Scenario 1 and 2, is included in Appendix F. Recommended improvements at each signalized intersection are shown in Figure 4.3. Synchro model output for each signalized intersection for the 2015 AM and PM for Scenarios 1 and 2 are included on the Supplemental Data CD. The Synchro traffic modeling files are also included on the Supplemental Data CD.

Roadway LOS

Beyond year 2015, H-GAC's traffic models for years 2018, 2025 and 2035 with ADT projections were used to determine future traffic growth. In the near future, traffic growth in the Richmond/Rosenberg area is expected to increase, which is supported by the number of roadway improvements proposed in the TIP and the 2035 RTP. On average, H-GAC's future traffic projections yielded an annual traffic growth rate of 2.5% beyond year 2015.

Projected roadway capacity/LOS is summarized in Table 4.1 for 2015, 2018, 2025 and 2035 conditions. All three corridors currently have 4 lanes each, and the proposed configuration in 2015 is either one-way,

Table 4.1 Roadway LOS

Facility	Length (miles)	# of Lanes	Proposed Median	ADT Thresholds After Adjusting for Median Type		2011		2015		2018		2025		2035		Widening to 6-lane roadway may be necessary
				LOS C	LOS D	Base Yr ADT	Roadway LOS*	Projected ADT	Roadway LOS*	Projected ADT	Roadway LOS*	Projected ADT	Roadway LOS*	Projected ADT	Roadway LOS*	
US 90A: Barmore to SH 36 (Rosenberg)	0.7	4	One-way**	36,005	37,810	12,700	C or Better	25,061	C or Better	13,949	C or Better	16,639	C or Better	19,494	C or Better	
US 90A: SH 36 to Louise (Rosenberg)	0.9	4	One-way**	36,005	37,810	18,000	C or Better	26,467	C or Better	19,500	C or Better	21,248	C or Better	24,811	C or Better	
US 90A: Louise to RR (Rosenberg)	1.8	4	Divided	37,900	39,800	18,000	C or Better	29,911	C or Better	32,969	C or Better	35,871	C or Better	41,195	Worse than D	After 2025
US 90A: RR to 9th St (Richmond)	0.6	4	Divided	37,900	39,800	23,000	C or Better	33,303	C or Better	34,747	C or Better	37,223	C or Better	40,581	Worse than D	After 2025
US 90A: 9th St to 3rd St (Richmond)	0.3	4	Undivided**	28,425	29,850	15,400	C or Better	33,303	Worse than D	34,747	Worse than D	37,223	Worse than D	40,581	Worse than D	4-ln Divided After 2020
US 90A: 3rd St to Damon (Richmond)	0.5	4	Divided	37,900	39,800	26,000	C or Better	33,303	C or Better	34,747	C or Better	37,223	C or Better	40,581	Worse than D	After 2025
US 90A: Damon to Harlem (Richmond)	2.7	4	Divided	37,900	39,800	25,000	C or Better	35,712	C or Better	35,980	C or Better	38,532	LOS D	43,994	Worse than D	After 2025
FM 1640: Barmore to SH 36 (Rosenberg)	0.7	4	One-way**	36,005	37,810	9,100	C or Better	13,422	C or Better	18,987	C or Better	21,031	C or Better	23,350	LOS D	
FM 1640: SH 36 to Louise (Rosenberg)	0.9	4	One-way**	36,005	37,810	16,500	C or Better	13,422	C or Better	18,987	C or Better	21,031	C or Better	23,350	LOS D	
FM 1640: Louise to Lamar (Rosenberg)	1.7	4	TWLTL or Lefts**	36,005	37,810	16,500	C or Better	23,400	C or Better	24,879	C or Better	27,535	C or Better	31,375	C or Better	
FM 1640: Lamar to FM 762 (Richmond)	0.5	6	Divided	58,400	59,900	19,300		16,118	C or Better	20,843	C or Better	22,446	C or Better	25,931	C or Better	
FM 762: US 90A to FM 1640 (Richmond)	1.3	4	Undivided w/ Lefts**	36,005	37,810	22,000		19,431	C or Better	16,392	C or Better	18,270	C or Better	22,468	C or Better	

*FDOT 2012 Generalized Service Volume Tables, Interrupted Flow Facilities, State Signalized Arterials, Class I (40 MPH or Higher Posted Speed Limit)
**Multilane, Undivided, No Lefts, No Rights - Adjustment Factor = -25%
**Multilane, Undivided, TWLTL or Exclusive Lefts, No Rights - Adjustment Factor = -5%

two-way divided, or two-way undivided. Anytime the roadway LOS dips below “D”, we recommend additional lane capacity improvements such as a 6-lane divided configuration or at the minimum a 4-lane divided configuration.

Traffic Signal Warrant Analyses

Signal warrant analyses were performed for two new traffic signals recommended by the study. At the eastern end of the US 90A/FM 1640 one way pair between Damon St and Louise St, where EB FM 1640 traffic bound for EB US 90A crosses with the WB FM 1640 traffic bound for WB US 90A, a traffic signal is warranted in 2015 per the results of the analysis.

At US 90A and Damon St east of the Brazos River, the study recommends a traffic signal to improve safety at this location with numerous small businesses, pedestrian crossings and a sight distance issue due to the crest of the EB US 90A Brazos River bridge. This location was very close to meeting a warrant for a signal in 2015. Due to the public comments regarding safety in this location and the planned future development north of US 90A, a signal is recommended and was included in the traffic model. The Signal Warrant Analyses for both intersections are included in Appendix F.

BENEFITS OF RECOMMENDED IMPROVEMENTS

Travel Time Savings

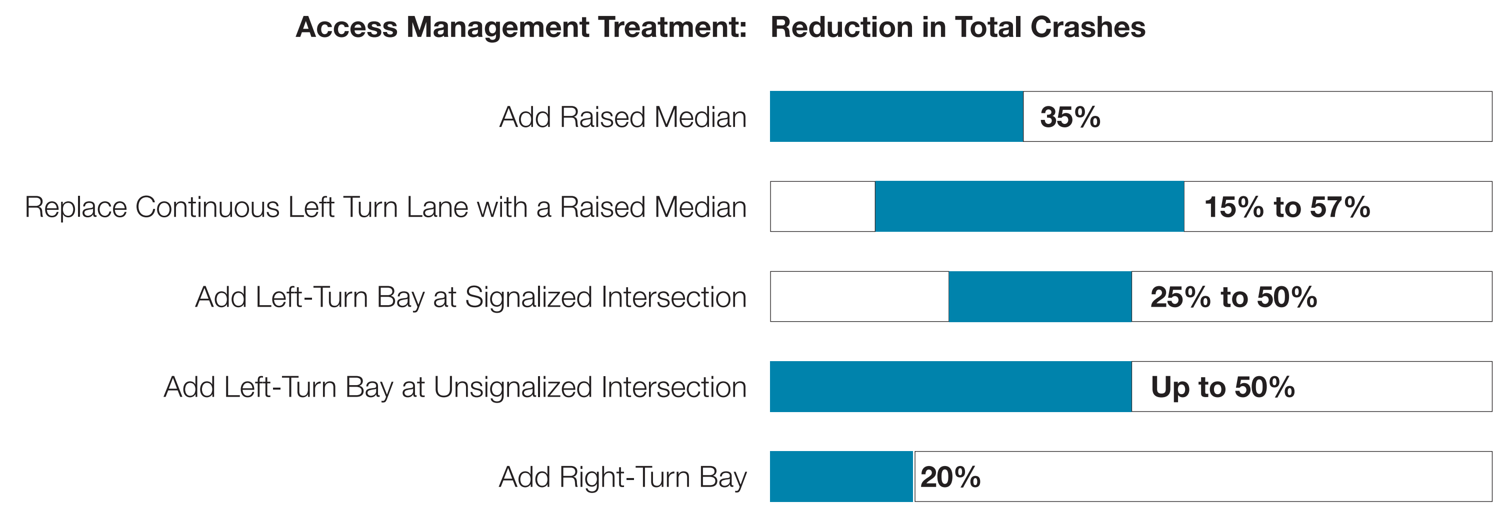
Travel time is an integral component of transportation cost, and therefore an assessment of potential savings in travel time is useful in the evaluation of transportation improvements. Based on traffic simulation models developed for the three study area corridors, addition of the recommended improvements to the existing condition results in a reduction of total vehicle delay by approximately 94 hours during the weekday AM peak period and 162 hours during the weekday PM peak period. Assuming 260 weekdays a year, the annual peak hour travel time savings due to the recommended improvements are estimated at approximately $1.65 million for the combined AM and PM peak periods. Refer to Appendix G for additional information about the reduction in delay and time savings calculations.

Crash Cost Savings

The Transportation Research Board Access Management Manual has summarized research on the effects of various access management treatments and has published percent reductions in crashes for various treatments. Refer to Figure 4.6 for estimated crash reductions for several different treatment types recommended in this study.

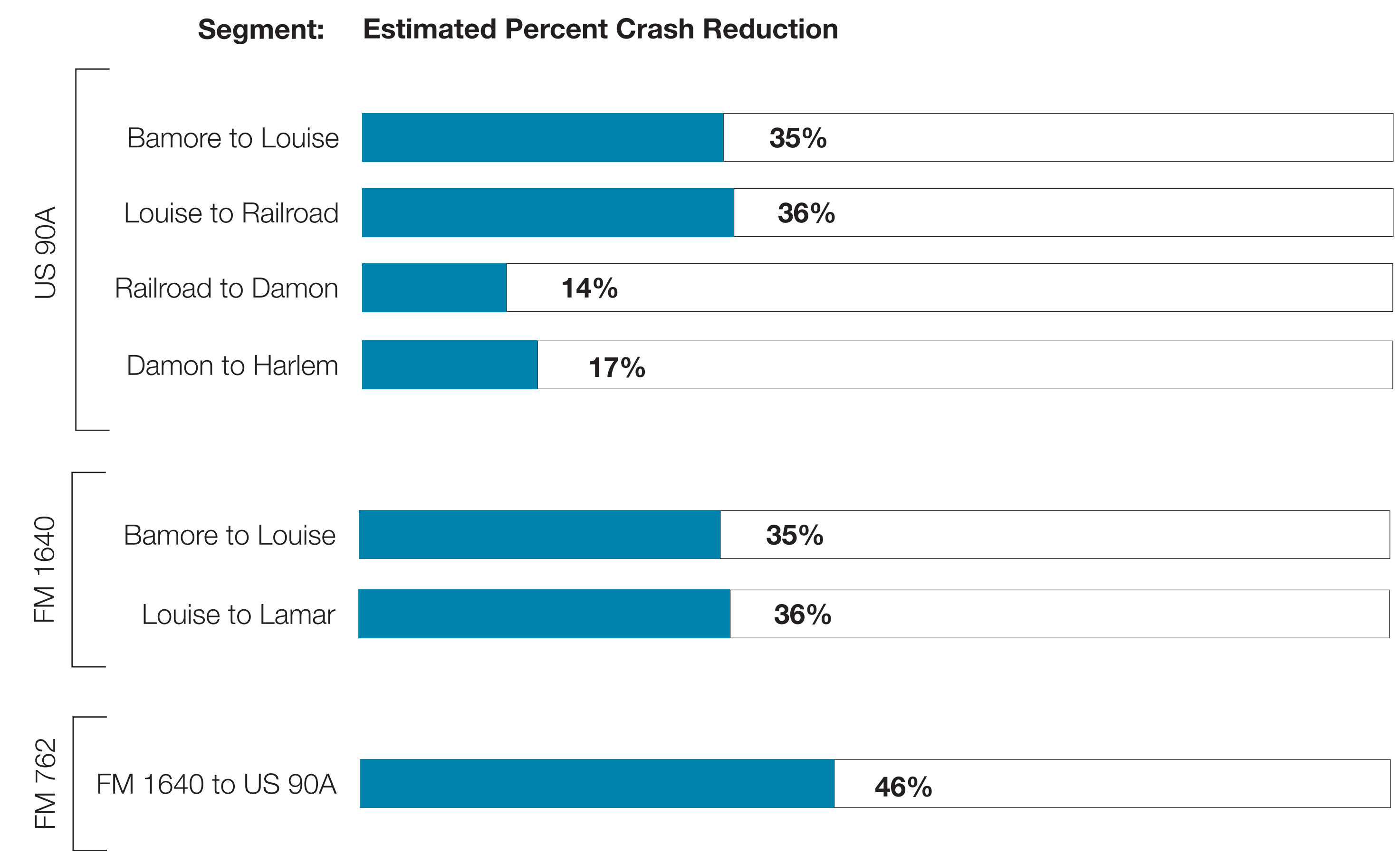
The estimated percent reduction in crashes was applied to the various segments of the three study corridors based on the specific short and medium-term access management treatments recommended. The results are summarized in Figure 4.7. Refer to Appendix G for additional detail regarding estimation of the crash reduction percentages.

Figure 4.6: Reduction in Total Crashes by Access Management Treatment



Source: TRB Access Management Manual, 2003

Figure 4.7: Estimated Crash Reduction by Segment



Crash data for the five year period from 2007 – 2011 was analyzed for each segment of the study corridors and the average annual number of crashes by severity was determined. To illustrate the impact of reducing crashes, the monetary costs per crash type were used, as reported by the National Safety Council, shown in Table 4.2.

Table 4.2: Cost of Crashes by Injury Type

Crash Type	Cost
Fatal	$4,459,000
Incapacitating Injury	$225,100
Non-incapacitating Evident Injury	$57,400
Possible Injury	$27,200
No Injury	$2,400

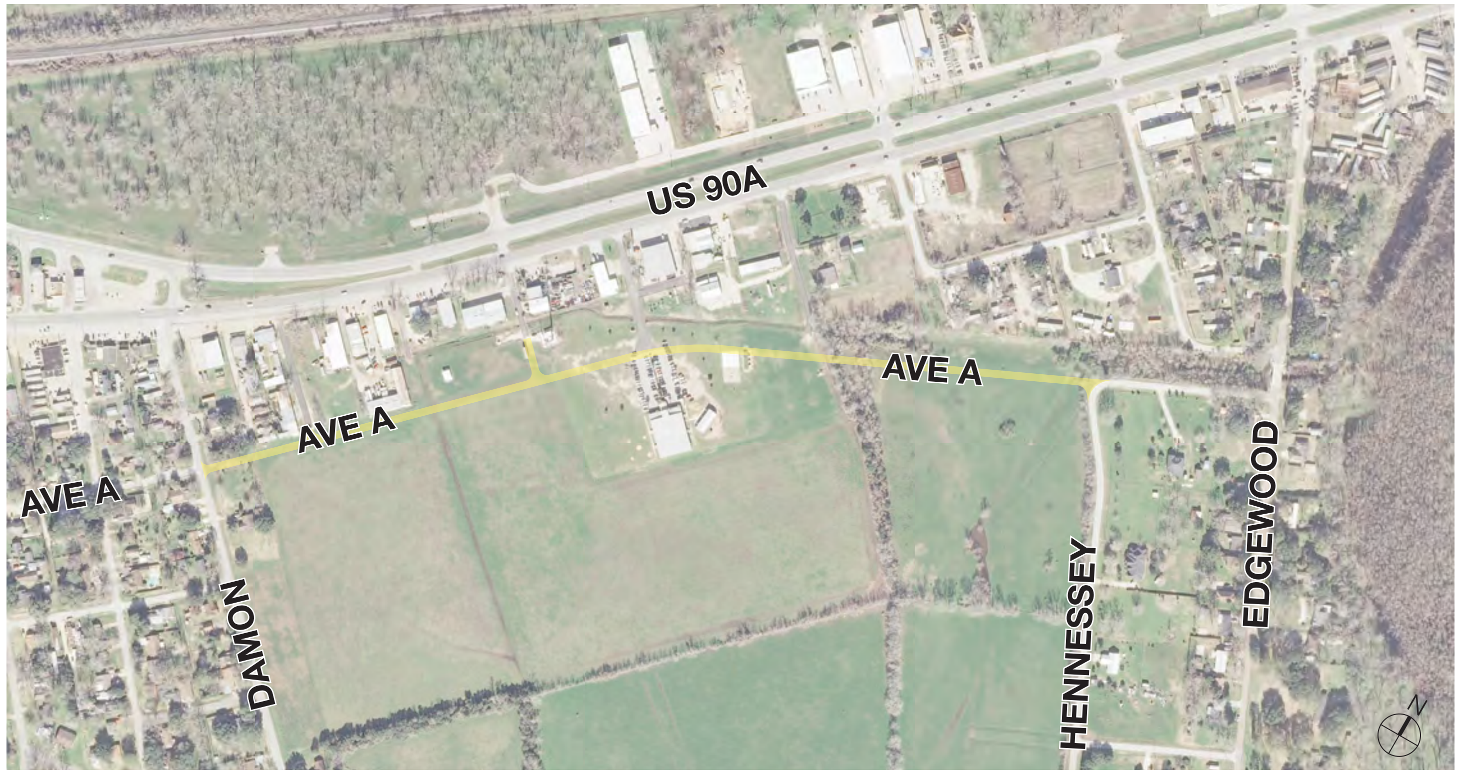
Source: Estimating the Costs of Unintentional Injuries, National Safety Council, 2011

Applying the monetary values per crash type above to the calculated reduction in average annual crashes yielded an estimated average annual crash savings of $4 million, following implementation of the proposed improvements. Refer to Appendix G for calculation details on the estimated crash savings.

Air Quality

Air Pollution Costs refers to motor vehicle air pollutant (called mobile emissions) damages, including human health, ecological, and aesthetic degradation. The term "emissions" generally refers to gases and particles introduced into the air. The United States Environmental Protection Agency (EPA) describes air pollution as the contamination of air by the discharge of harmful substances, which include Volatile Organic Compounds (VOC), carbon monoxide (CO), and nitrogen oxides (NOx). The concentration of these air pollutants is related to traffic congestion. Lower speeds associated with traffic congestion tend to result in higher levels of pollutants. The recommended improvements for US 90A, FM 1640, and FM 762 are designed to improve safety and reduce delay along the corridor. The reduction in congestion as a result of implementing these recommendations is projected to result in a 3.4% reduction in VOC, CO, and NOx levels. Refer to Appendix G for calculations.

Figure 4.8: Extension of Avenue A



IMPLEMENTATION

Considerations for Short- to Medium-Term Improvements

There are several planned projects within the study area in the short to medium-term that were taken into account during development of the study recommendations. Some of these projects include rehabilitation of US 90A and FM 1640 for the entire study limits, rehabilitation of Golfview Drive, widening of Harlem Road from Plantation Drive to SH 99, and a grade separation at FM 359.

On the west side of the US 90A corridor, TxDOT is currently developing plans for a one-way pair with US 90A and FM 1640. Due to the narrow right-of-way on this section of US 90A, this study recommends implementation of the one-way pair as the best option to improve safety without right-of-way acquisition. For the remainder of the US 90A corridor to the Brazos River, the study recommends adding raised medians to reduce turning movement conflicts and improve safety. It is also recommended that advance signing for upcoming cross streets, traffic signal controller upgrades, pedestrian crossing signals, ADA compliant wheelchair ramps and the other recommended signal improvements be implemented with the one-way pair project and other rehabilitation projects along US 90A and FM 1640. Implementation of these short-term improvements will help to enhance safety and mobility along the corridors.

East of the Brazos River, a new traffic signal is recommended at Damon Street and US 90A. Not only will this improve safety and traffic operations in the vicinity, it will slow traffic across the Brazos River bridges, which was a key concern by the public, due to the higher pedestrian activity at this location.
The extension of Avenue A from Damon Street east to Edgewood will require additional right-of-way and is recommended as a medium-term improvement, as shown in Figure 4.8. This improvement should be implemented before the FM 359 overpass at US 90A as the ramps for the overpass will cut off access from Edgewood to westbound US 90A. A parallel back street with access to a signalized intersection at US 90A will serve all of the residential area south of US 90A.

Along FM 762, the short-term recommendations include addition of left turn bays for protection at certain high volume intersections. Due to the lower turning volumes compared with those along US 90A and fewer businesses along this corridor, a continuous left turn lane along the center of the road is a safer alternative than the current undivided roadway and is recommended as a medium to long-term improvement. This can be accommodated without right-of-way in some areas. This will require modification to the open ditch drainage system along FM 762.

Most of the other medium-term recommendations are cross street re-alignments to eliminate offset intersections and improve traffic operations and safety. These are generally city streets and will require additional right-of-way. At these locations, a more detailed evaluation is needed to look at crashes, traffic congestion, utilities and right-of-way to determine the benefits and costs so that the cities can prioritize these projects and work into their capital improvement plans over a period of time. The re-alignments shown are conceptual and efforts should be made to find a solution with the least impact to adjacent property owners.

The planned rehabilitation projects along US 90A and FM 1640 present an excellent opportunity to efficiently implement the recommended short term improvements.

Considerations for Long-Term Improvements

Similar to the short-term projects, there are several planned long-term projects in the area, which are included on H-GAC's Regional Transportation Plan. After evaluation of the study area, the study team endorses the need for these projects for improvement to capacity and connectivity. Some of these projects include extension of FM 762 along 10th Street to the Brazos River with a bridge and connection to McCrary Rd; a new overpass for US 90A at the RR crossing east of Lane Drive; a new grade separation for the US 90A connection to SH 36 at the RR crossing; rehabilitation and/or widening of the Brazos River bridges; and widening of US 90A, FM 762, FM 723, Spur 529, FM 359, and Harlem Road.

Other long-term improvement recommendations from this study are listed below and are shown in Figure 4.9.

1. Widen the lanes along Old Richmond Road to serve as shared use vehicle/bicycle lanes. If widening cannot be performed within existing right of way, a benefit to cost analysis should be performed to take into consideration the residential and commercial displacements of any right of way acquisition.

2. Widen FM 3155 from US 90A to George Park. The same note regarding right of way acquisition from project 1 above applies to this project.

3. Extend Austin Street east across the Brazos River. To further accommodate growth in the future, additional Brazos River crossings were explored. One option consists of extension of Austin Street from 2nd Street across the river, connecting to Avenue A at Damon Street. This crossing will tie to the recommended medium-term new street from Damon to to Edgewood, providing an alternative for all of the residential traffic south of US 90A to access Rosenberg without using US 90A. The option should also include improvement of the intersection of Austin Street with 2nd Street/Williams Way.

4. Extend Golfview east across the Brazos River. A second option for a new river crossing includes extension of Golfview from Williams Way across the river, then turning north and connecting to FM 359 at US 90A. This route is further south of US 90A and would provide much needed congestion relief to US 90A through the Downtown Richmond area and the US 90A bridges, as well as the northern portion of FM 762. Golview also provides direct access to FM 1640 and FM 2218, improving the overall roadway network and mobility for both Richmond and Rosenberg. This route would also serve future development in Richmond, east of the river.

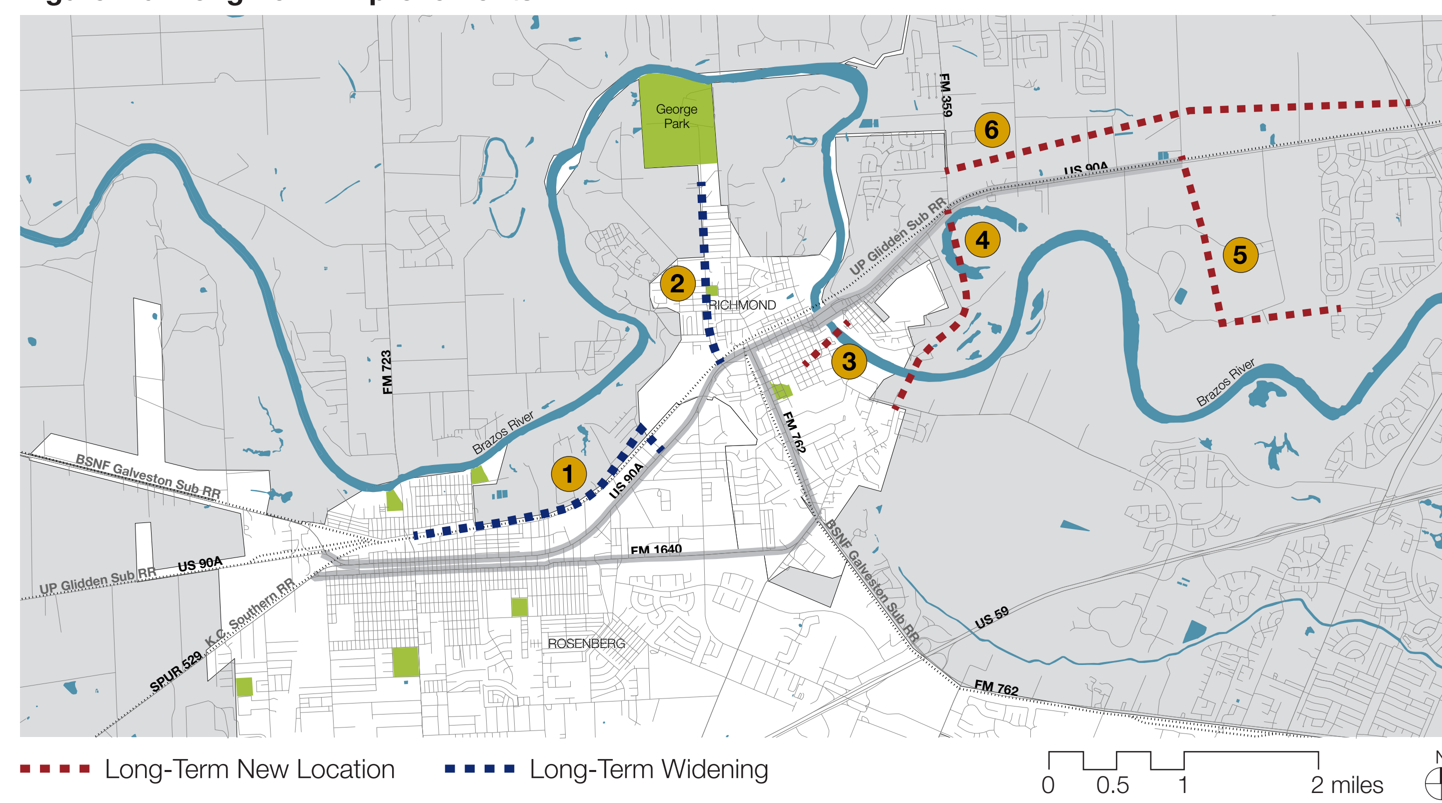
5. Extend Harlem Road south from US 90A to New Territory.

6. Construct new east-west road north of US 90A from FM 359 to SH 99. Projects 5 and 6 will provide connectivity and facilitate circulation as the area develops in the future.

More detailed alignment studies should be undertaken to develop projects 3 through 6, taking into account engineering factors, environmental constraints, major utilities, residential and commercial impacts, locations for potential future development, the overall city and regional traffic network, and benefits vs. costs.

The other long-term recommendations described previously in this chapter, such as pedestrian, bicycle, transit and improvements identified in the Richmond and Rosenberg Downtown Livable Centers Studies, may need to be implemented over a period of time so that funding can be programmed in small increments to achieve the long-term goal.

Figure 4.9: Long-Term Improvements



Phasing and Cost Strategy

A summary of the number, type and jurisdiction agency responsible for the recommended improvements, grouped by implementation phase, are presented in Tables 4.3, 4.4 and 4.5. The costs for the recommended improvements by implementation phase and agency are presented in Table 4.6. A more detailed cost estimate for each improvement type is included in Appendix H. Following the cost estimates are the aerial layout sheets showing the locations of the specific improvements.

Table 4.3: Short-Term Improvements

		SHORT TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762																									
					by TxDOT																						
	Segment	New Traffic Signal	Upgrade Signal Equipment	Optimize Traffic Signal Timing	Extension of Left Turn Lane (A1)	Extension of Right Turn Lane (A2)	Add Raised Island to Delineate Roadway (A3)	Realign Roadway (A4)	Turn Lane Closure (A6)	Add New Left/Right Turn Lane (A8)	Construct Signalized Intersection with Channelization (C1)	Construct New Intersection (C2)	General Intersection Improvements (C3)	Median Closure (D1)	Raised Median With Left Turn Lane (D2)	Repave Median (D3)	Raised Median (D4)	Continuous Center Left Turn Lane (D5)	Pavement Striping (D6)	Reconstruct Driveway (E1)	Add Raised Island to Delineate Driveways (E2)	Driveway Closure (E3)	Minor Driveway Modifications (E4)	Widen Roadway (F1)	Widen Shoulder (F2)	Pavement Widening for U-Turns (F3)	Street Closure (G)
		EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA	EA
1	US 90A From Bamore to Millie St	1	6	6			1					1			2		5				3			1			
2	US 90A From Millie St to Collins	1	3	7	1	1	4	1			1		1		28		3			4	12	6		2		8	
3	US 90A From Collins to Riveredge	0	3	5			2			1			1				4				16	1					
4	US 90A From Riveredge to Harlem Rd	1	0	3	14	4	5		3	8	1			4	3	5	2			1	12	1	1	2	1	15	
5	FM 1640 From Bamore to FM 762	0	3	12											8			3	6			3					
6	FM 762 From FM 1640 to US 90A	0	0	2						9			6		1			2	10	10				11			1
Total	**US 90A, FM 1640 and FM 762**	**3**	**15**	**35**	**15**	**5**	**12**	**1**	**3**	**18**	**2**	**1**	**8**	**4**	**42**	**5**	**14**	**5**	**16**	**15**	**43**	**11**	**1**	**16**	**1**	**23**	**1**

Table 4.3: Short-Term Improvements Continued

		SHORT TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762				
		by Richmond		by Rosenberg	by County	by Others
	Segment	Widen Roadway (F1)	Roadway Extension (A5)	Minor Driveway Modification (E4)	Street Closure (G)	Roadway Extension (A5)
		EA	EA	EA	EA	EA
1	US 90A From Bamore to Millie St					
2	US 90A From Millie St to Collins					
3	US 90A From Collins to Riveredge	1			2	
4	US 90A From Riveredge to Harlem Rd	1				1
5	FM 1640 From Bamore to FM 762			1		
6	FM 762 From FM 1640 to US 90A					
Total	**US 90A, FM 1640 and FM 762**	**2**	**0**	**1**	**2**	**1**

Table 4.4: Medium-Term Improvements

		MEDIUM TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762						
		by TxDOT		by Richmond	by Rosenberg			by Others
Segment		Raised Median with Left Turn Lane (D2)	Widen Roadway (F1)	Roadway Extension (A5)	Realign Roadway (A4)	Roadway Extension (A5)	Widen Roadway (F1)	Roadway Extension (A5)
		EA	EA	EA	EA	EA	EA	EA
1	US 90A From Bamore to Millie St							
2	US 90A From Millie St to Collins				3	1	1	
3	US 90A From Collins to Riveredge	1	1					
4	US 90A From Riveredge to Harlem Road			1				1
5	FM 1640 From Bamore to FM 762	2			1		1	
6	FM 762 From FM 1640 to US 90A							
Total	**US 90A, FM 1640 and FM 762**	**3**	**1**	**1**	**4**	**1**	**2**	**1**

Table 4.5 Long-Term Improvements

		LONG TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762					
		by TxDOT	by Richmond		by Rosenberg	by County	
Segment		Widen FM 3155 From US 90A to George Park	Extend Golfview East Across the Brazos River to US 90A at FM 359	Extend Austin St. Across the Brazos River and Connect to Ave A	Widen Old Richmond Road	Construct New East-West Road North of US 90A From FM 359 to SH 99	Extend Harlem Rd. South of US 90A to New Territory
		EA	EA	EA	EA	EA	EA
1	US 90A from Barmore to Millie St	0	0	0	0	0	0
2	US 90A from Millie St to Collins	0	0	0	1	0	0
3	US 90A from Collins to Riveredge	1	0	1	0	0	0
4	US 90A from Riveredge to Harlem Rd	0	1	0	0	1	1
5	FM 1640 from Barmore to FM 762	0	0	0	0	0	0
6	FM 762 from FM 1640 to US 90A	0	0	0	0	0	0
Total	**US 90A, FM 1960 and FM 762**	**1**	**1**	**1**	**1**	**1**	**1**

Table 4.6: Preliminary Cost Estimate

US 90A ACCESS MANAGEMENT PRELIMINARY COST ESTIMATES – Includes portions of US 90A, FM 1640, and FM 762 (Total Approximate Length = 12.5 Miles)																		
	Primary Funding Source	**TxDOT**				**City of Richmond**				**City of Rosenberg**				**County**				**Others**				**Total (in Millions)**
	Improvement	**Number**	**Unit**	**Unit Cost**	**Cost**	**Number**	**Unit**	**Unit Cost**	**Cost**	**Number**	**Unit**	**Unit Cost**	**Cost**	**Number**	**Unit**	**Unit Cost**	**Cost**	**Number**	**Unit**	**Unit Cost**	**Cost**	
SHORT TERM (Less than 5 years)	***NEW PROJECTS***																					**$9.58**
	New Traffic Signal	3	EA	$175,000.00	$525,000																	
	Upgrade Signal Equipment	15	EA	$75,000.00	$1,125,000																	
	Optimize Traffic Signal Timing	35	EA	$5,000.00	$175,000																	
	Synchronize Traffic Signals	1	LS	$50,000.00	$50,000																	
	Add Right Turn Lane	69,701	SF	$14.51	$1,011,287																	
	Add Left Turn Lane	262,224	SF	$14.51	$3,804,589																	
	Pavement Addition	62,873	SF	$13.00	$817,349													6,866	SF	$13.00	$89,258	
	Add Raised Median / Channelization (Concrete)	92,120	SF	$14.00	$1,289,680																	
	Pavement Removal	64,947	SF	$2.06	$133,746					1,586	SF	$2.06	$3,266									
	Add Pedestrian Crosswalks	24	EA	$3,393.00	$81,432																	
	Concrete Sidewalks	8,550	SF	$56.00	$478,800																	
	TOTAL (SHORT TERM)				**$9,491,883**				**$ --**				**$3,266**				**$ --**				**$89,258**	
MEDIUM TERM (5-10 years)	New Traffic Signal	1	EA	$175,000.00	$175,000																	**TBD**
	Upgrade Signal Equipment	1	EA	$75,000.00	$75,000																	
	Pavement Addition	640	SF	$13.00	$8,320													29,005	SF	$13.00	$377,065	
	Concrete Sidewalks With Ramps	1,700	SF	$56.00	$95,200																	
	Realign Jeannetta St.									1	EA	TBD	TBD									
	Realign Cole									1	EA	TBD	TBD									
	Widen Radio Lane									1	EA	TBD	TBD									
	Realign and Extend Herndon									1	EA	TBD	TBD									
	Widening of US 90A between 5th and 7th St	1	EA	TBD	TBD																	
	Extend Avenue A from Damon St to Edgewood St					1	EA	TBD	TBD													
	Realignment and Widening of Miles									1	EA	TBD	TBD									
	TOTAL (MEDIUM TERM)				**TBD**				**TBD**				**TBD**				**TBD**				**$377,065**	
LONG TERM (10 years +)	Extend Austin Street east across the Brazos River, connect to Avenue A					1	EA	TBD	TBD													**TBD**
	Extend Harlem Road south of US 90A to New Territory													1	EA	TBD	TBD					
	Widen Old Richmond Road									1	EA	TBD	TBD									
	Widen FM 3155: US 90A to George Park	1	EA	TBD	TBD																	
	Extend Golfview east across the Brazos River to US 90A at FM 359					1	EA	TBD	TBD													
	Construct new east-west road north of US 90A from FM 359 to SH99													1	EA	TBD	TBD					
	TOTAL (LONG TERM)				**TBD**				**TBD**				**TBD**				**TBD**				**TBD**	**TBD**
	GRAND TOTAL				**TBD**				**TBD**				**TBD**				**TBD**				**TBD**	**TBD**

* All costs are based on TxDOT 12-month average bid tabs for Houston (Oct 2012 to Sept 2013)
Units: EA = Each, INT = Intersection, MI = Miles, SF = Square Feet, LS = Lump Sum

Recommended Improvement Layouts

IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

INTERSECTION IMPROVEMENTS

C2 Construct New Intersection

MEDIAN IMPROVEMENTS

D4 Raised Median

0 50 100 200 300 feet


HOUSTON
1ST
2ND
3RD
4TH
5TH
6TH
7TH
8TH
BUENA VISTA MEXICAN RESTAURANT
RUDY'S RELIABLE SIGNS
PENKERT TIRE SUPPLY
BOB'S TACO STATION
DOSTAL'S DESIGNS
RUSTIC KUTS FURNITURE & WESTERN DECOR
TRANSCO TRANSMISSIONS
CITGO
HUNTER'S WINDOW TINT INC.
AVE H
US 90A
SONIC DRIVE-IN
ROSENBERG CARPET CORNER
EXXON
JOE'S AUTO SERVICES
VALENTINE HAIR & NAIL SALON
FURNITURE MATTRESS
FRIENDLY MOTOR SALES
TWO M'S MALT N BURGER MART
HALF PRICE FURNITURE
REED REALTY
NEW FIRST NATIONAL BANK
PHILLIP'S 66
ROSENBERG FIRE DEPT
FM 1640
AVE I
HARTZ CHICKEN BUFFET
FIRST BAPTIST CHURCH
BUFFALO BAYOU WOODWORKS
0 50 100 200 300 feet

IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A3 Add Raised Island to Delineate Roadway

A4 Realign Roadway

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

D4 Raised Median

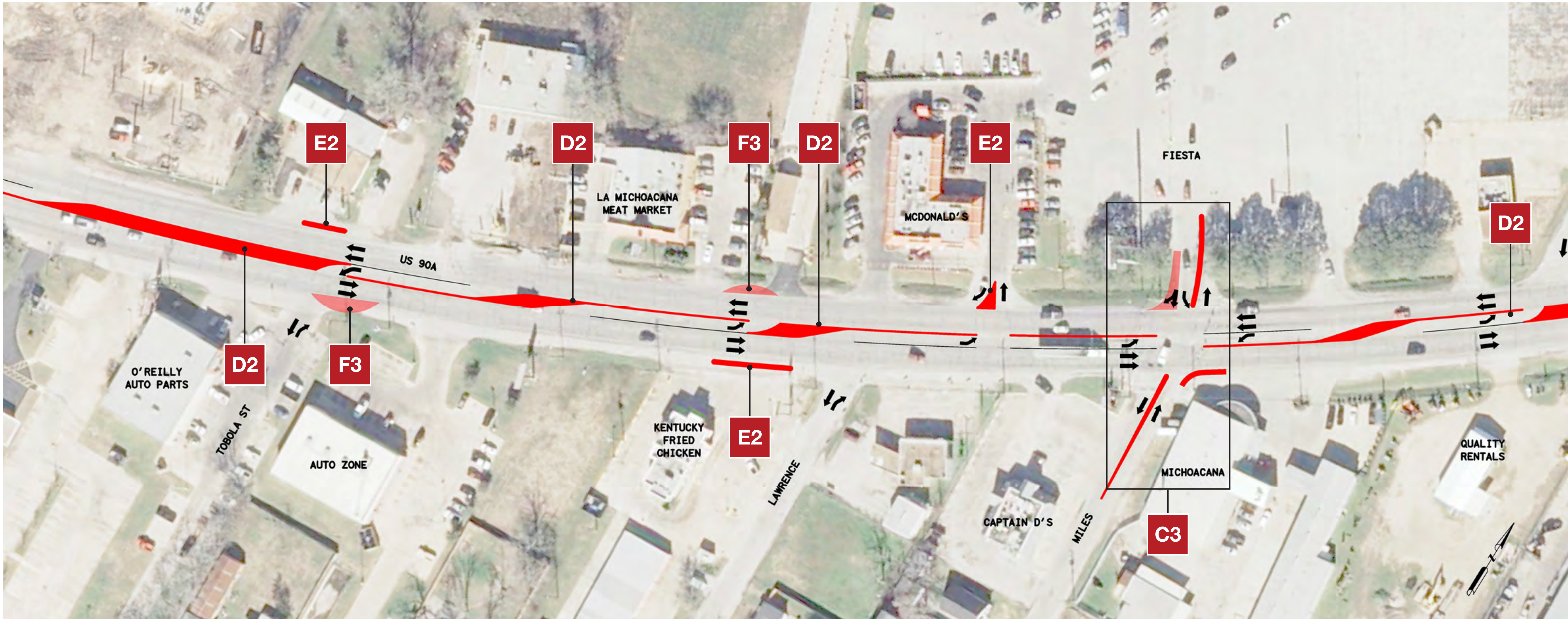
DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

WIDENING

F1 Widen Roadway

0 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

INTERSECTION IMPROVEMENTS

C3 General Intersection Improvements

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

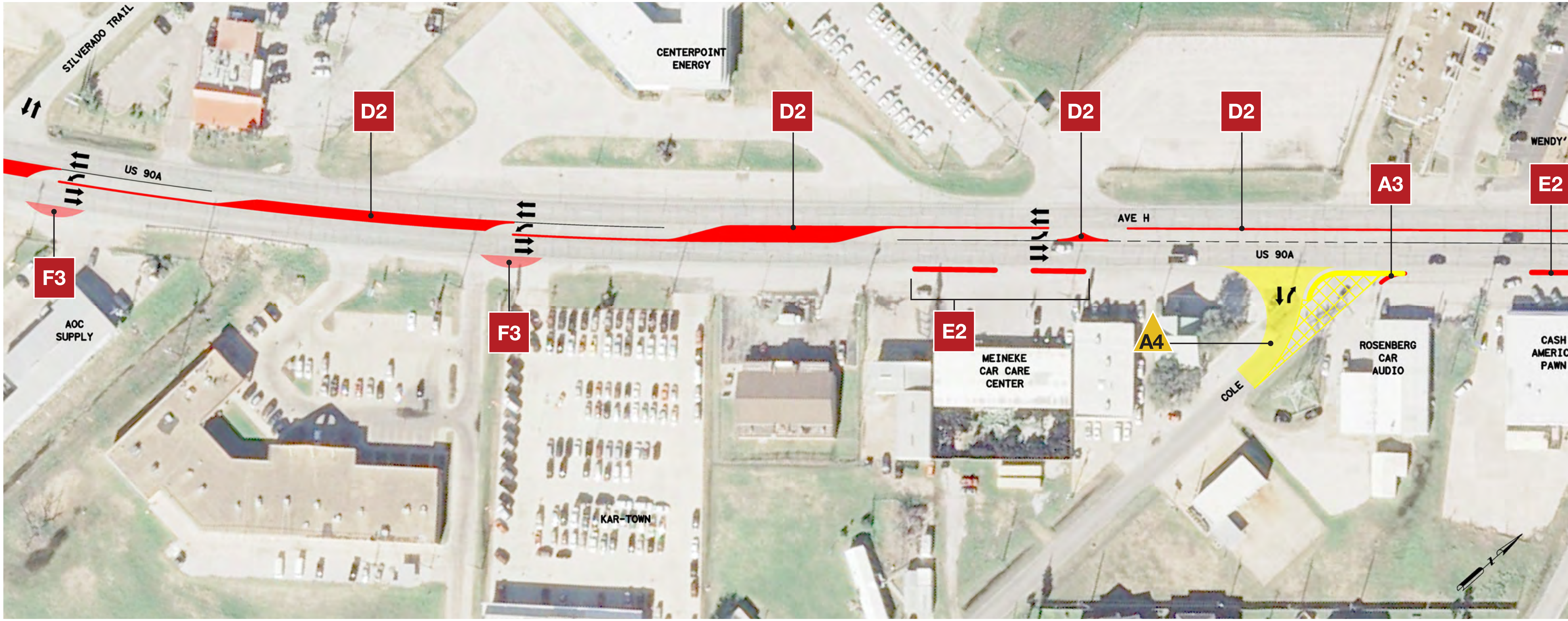
DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A3 Add Raised Island to Delineate Roadway

A4 Realign Roadway

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

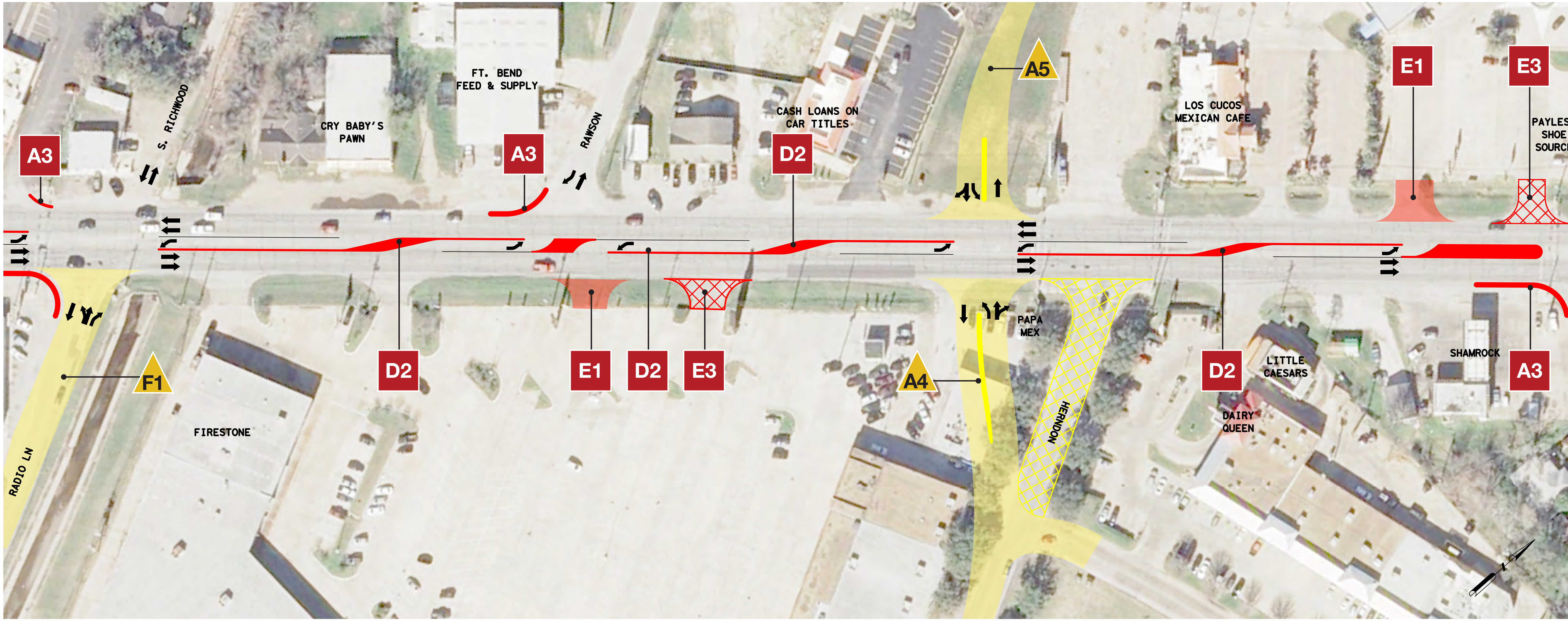
DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A3 Add Raised Island to Delineate Roadway
- A4 Realign Roadway
- A5 Roadway Extension

MEDIAN IMPROVEMENTS

- D2 Raised Median with Left Turn Lane

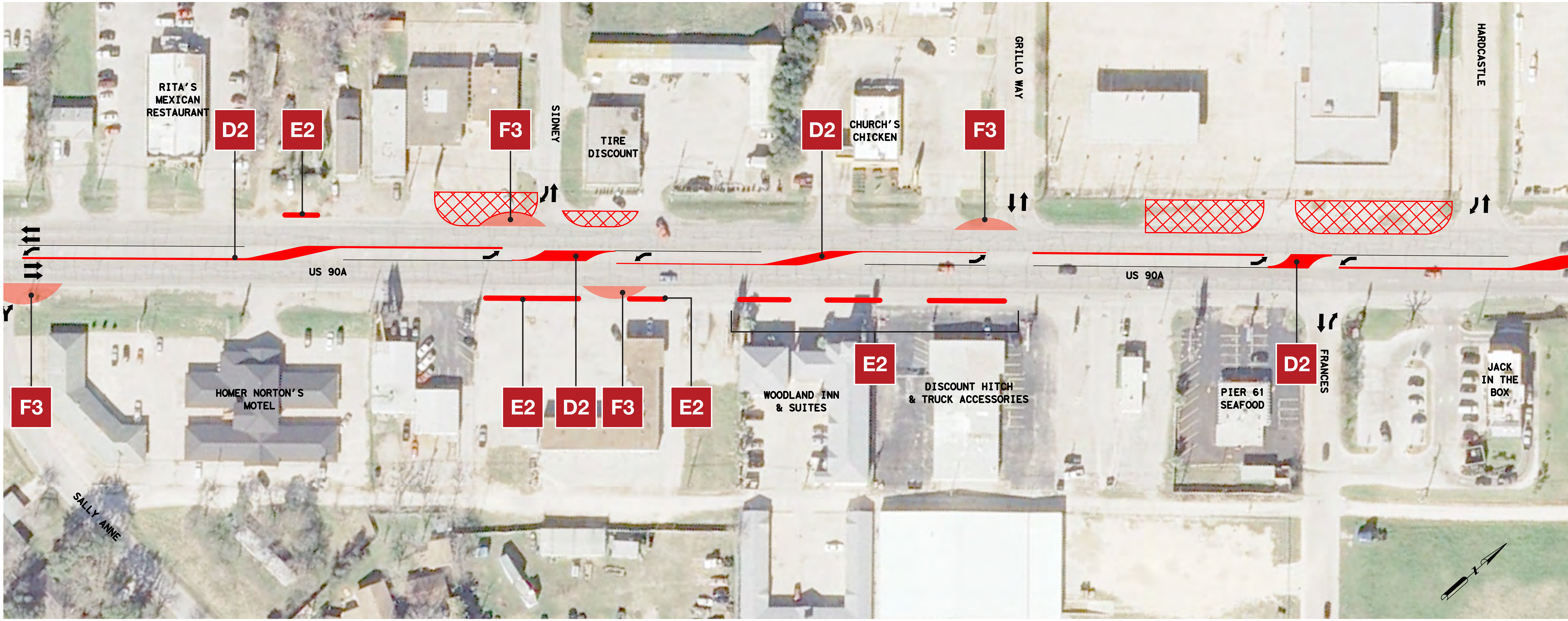
DRIVEWAY IMPROVEMENTS

- E1 Reconstruct Driveway
- E3 Driveway Closure

WIDENING

- F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

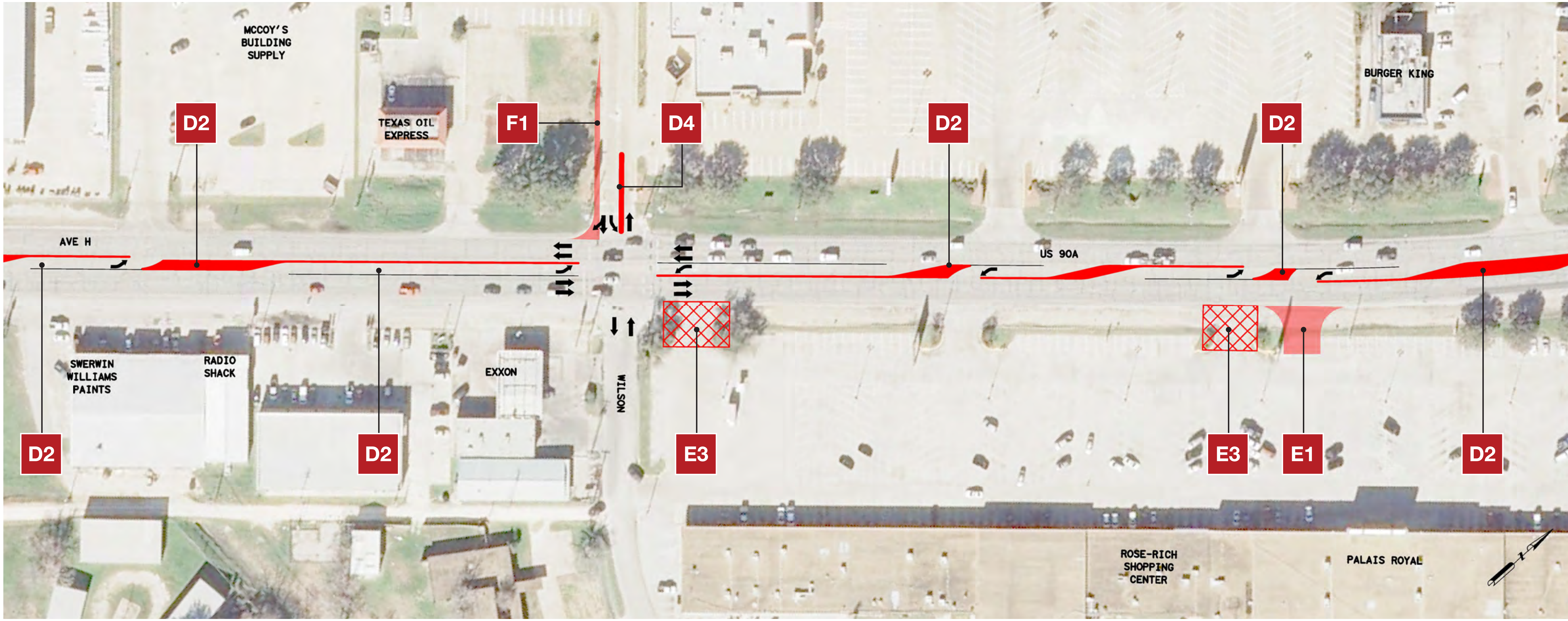
DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

- **D2** Raised Median with Left Turn Lane
- **D4** Raised Median

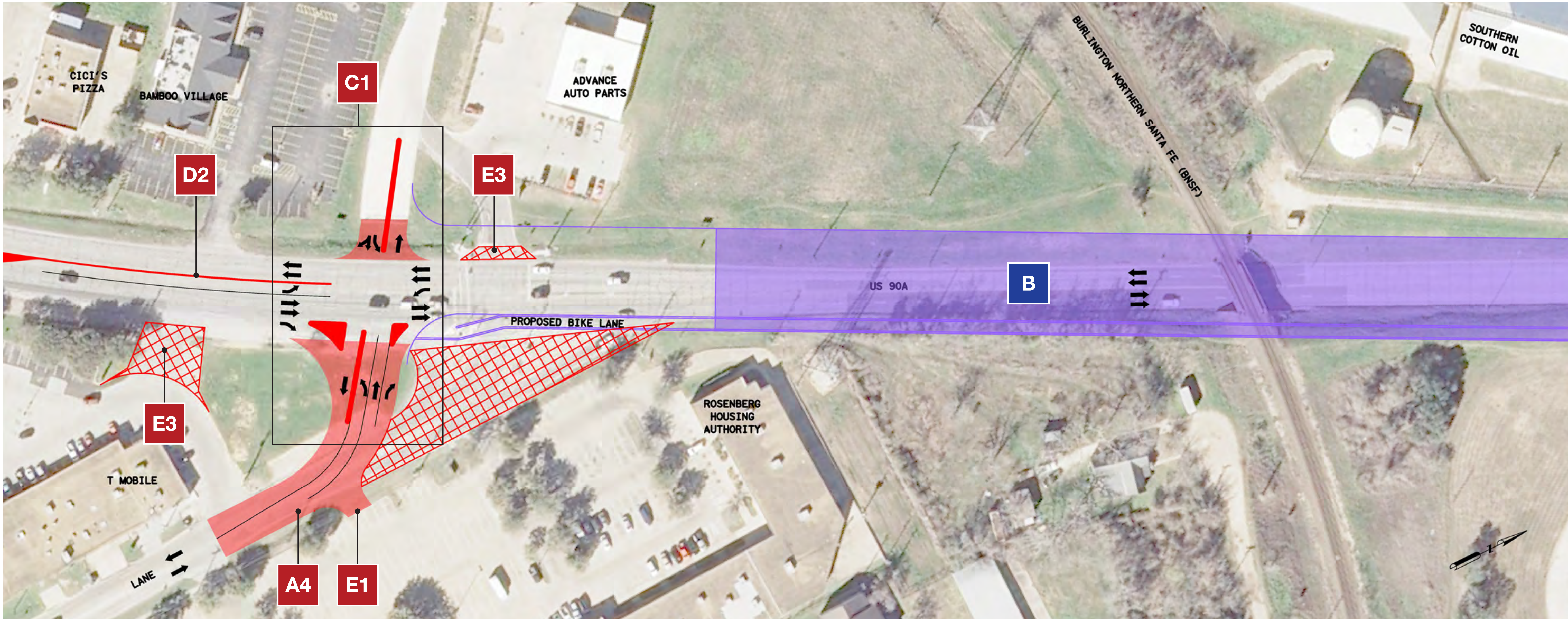
DRIVEWAY IMPROVEMENTS

- **E1** Reconstruct Driveway
- **E3** Driveway Closure

WIDENING

- **F1** Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A4 Realign Roadway

GRADE SEPARATION

B Construct Overpass

INTERSECTION IMPROVEMENTS

C1 Construct Signalized Intersection with Channelization

MEDIAN IMPROVEMENTS

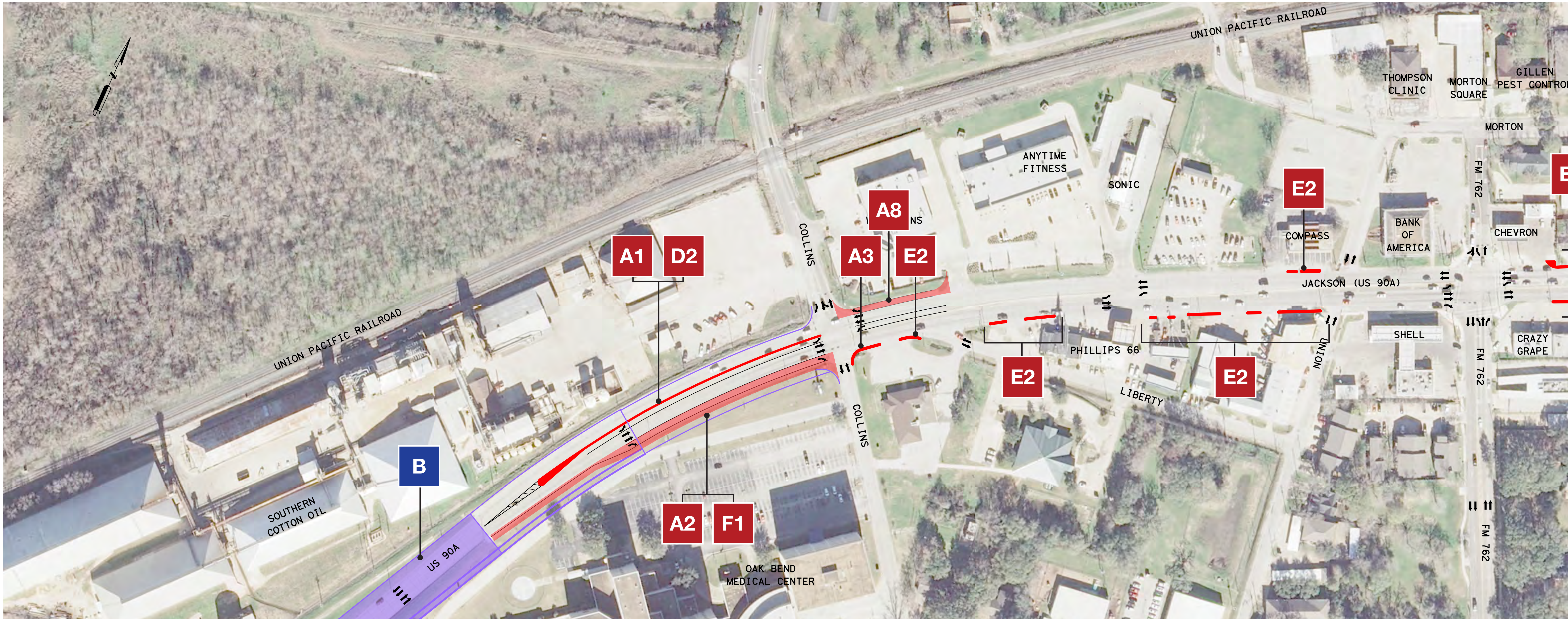
D2 Raised Median with Left Turn Lane

DRIVEWAY IMPROVEMENTS

E1 Driveway Reconstruction

E3 Driveway Closure

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A1 Extension of Left Turn Lane
- A2 Extension of Right Turn Lane
- A3 Add Raised Islands to Delineate Roadway
- A8 Add New Right Hand Turn Lane

GRADE SEPARATION

- B Construct Overpass

MEDIAN IMPROVEMENTS

- D2 Raised Median with Left Turn Lane

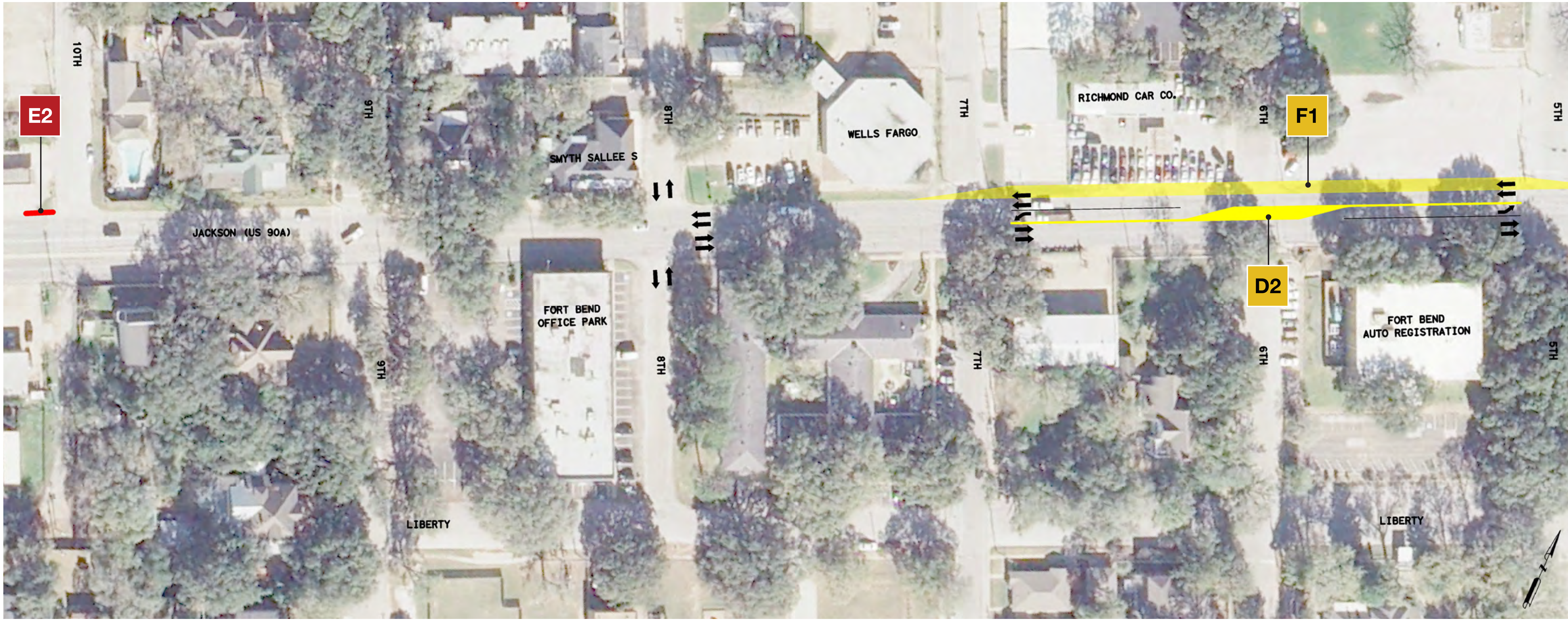
DRIVEWAY IMPROVEMENTS

- E2 Add Raised Islands to Delineate Driveways

WIDENING

- F1 Widen Roadway

0 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

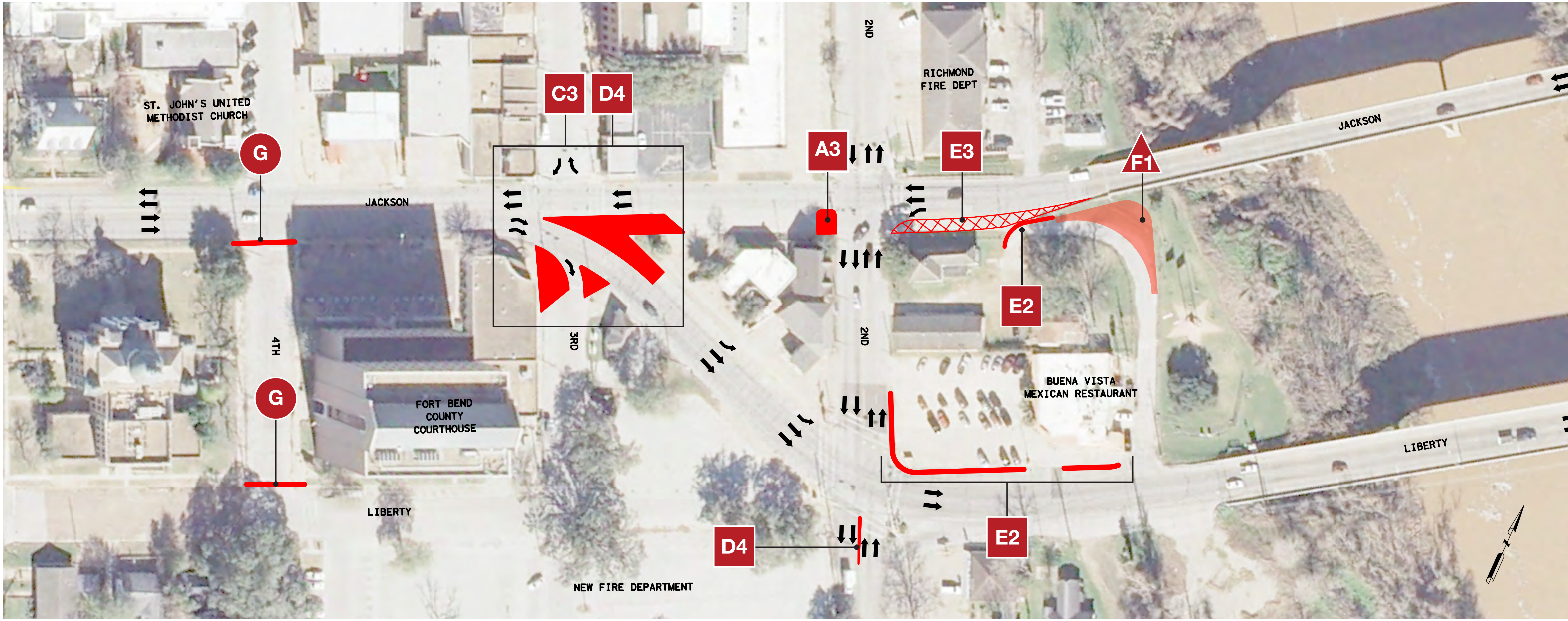
DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

WIDENING

F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A3 Add Raised Islands to Delineate Roadway

INTERSECTION IMPROVEMENTS

C3 General Intersection Improvements

MEDIAN IMPROVEMENTS

D4 Raised Median

DRIVEWAY IMPROVEMENTS

E2 Add Raised Islands to Delineate Driveways

E3 Driveway Closure

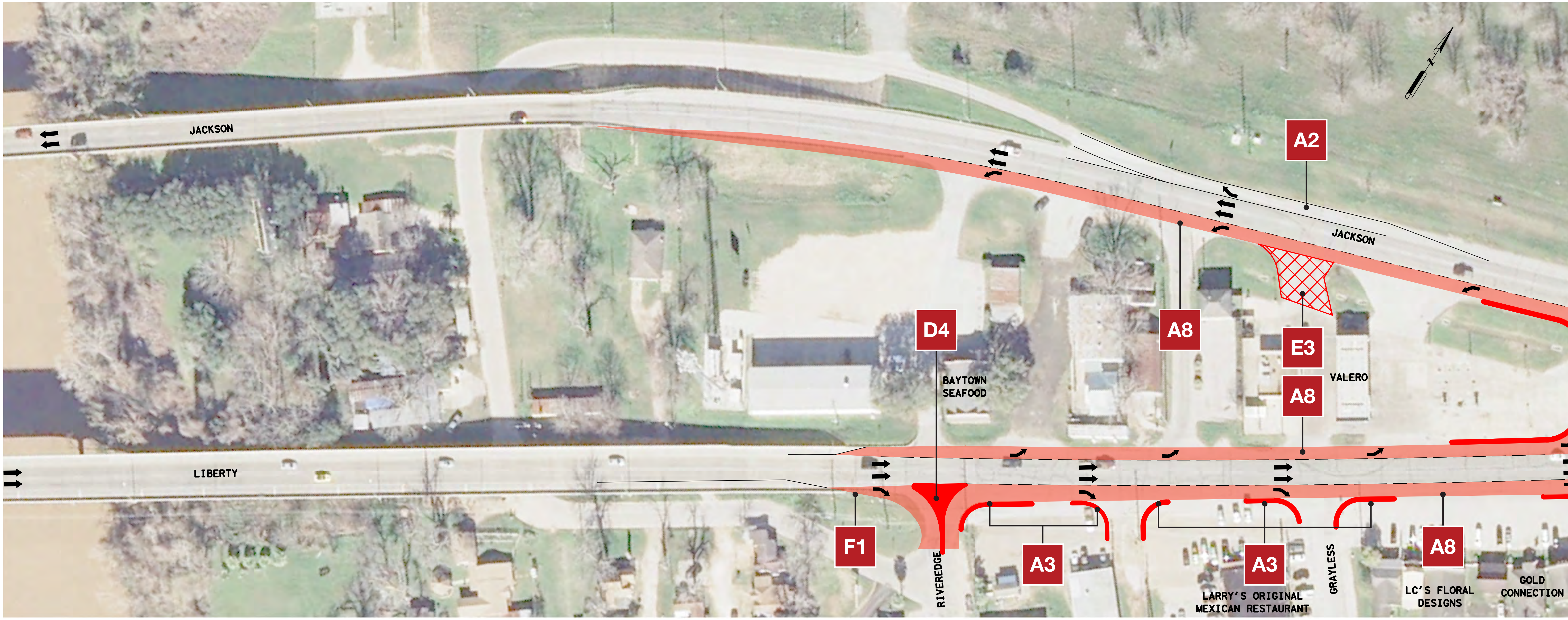
WIDENING

F1 Widen Roadway

STREET CLOSURE

G

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A2 Extension of Right Turn Lane
- A3 Add Raised Islands to Delineate Roadway
- A8 Add New Left/Right Turn Lane

MEDIAN IMPROVEMENTS

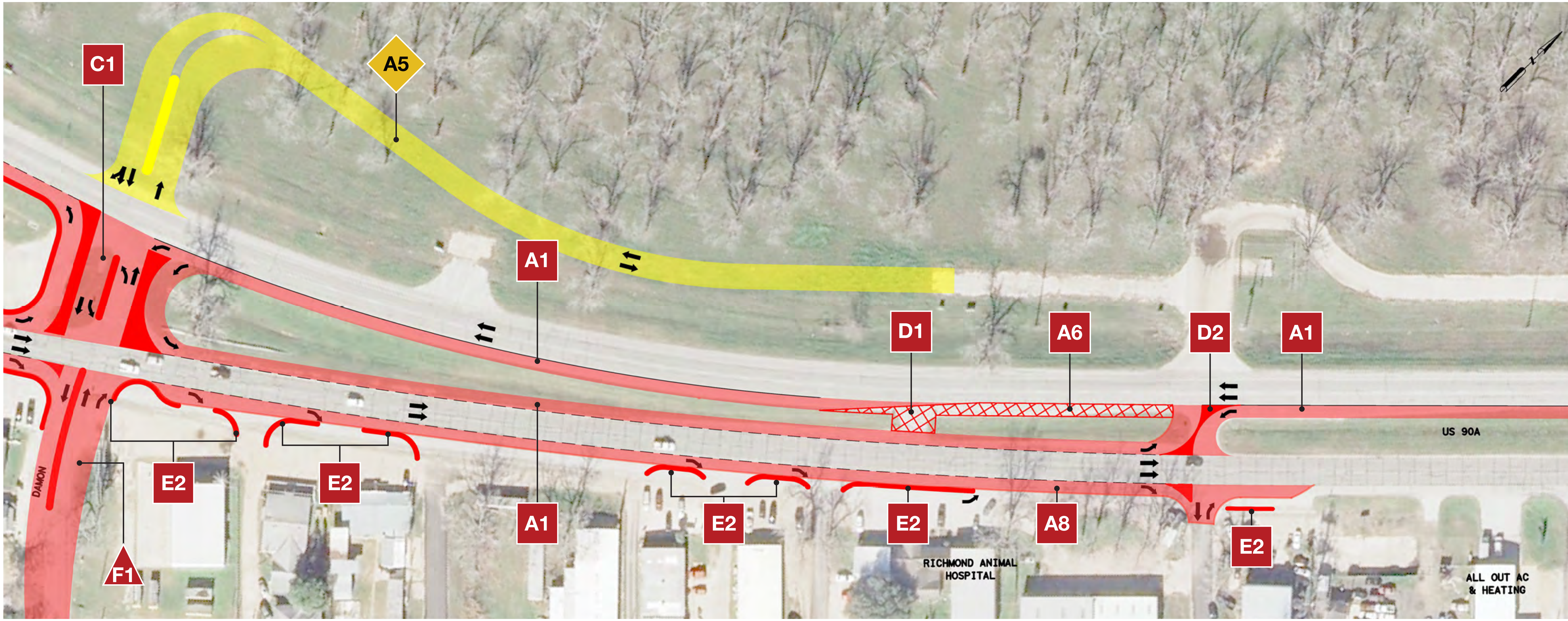
- D4 Raised Median

DRIVEWAY IMPROVEMENTS

- E3 Driveway Closure

WIDENING

- F1 Roadway Widening



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A1 Extension of Left Turn Lane
- A5 Roadway Extension
- A6 Turn Lane Closure
- A8 Add New Right Turn Lane

INTERSECTION IMPROVEMENTS

- C1 Construct Signalized Intersection with Channelization

MEDIAN IMPROVEMENTS

- D1 Median Closure
- D2 Raised Median with Left Turn Lane

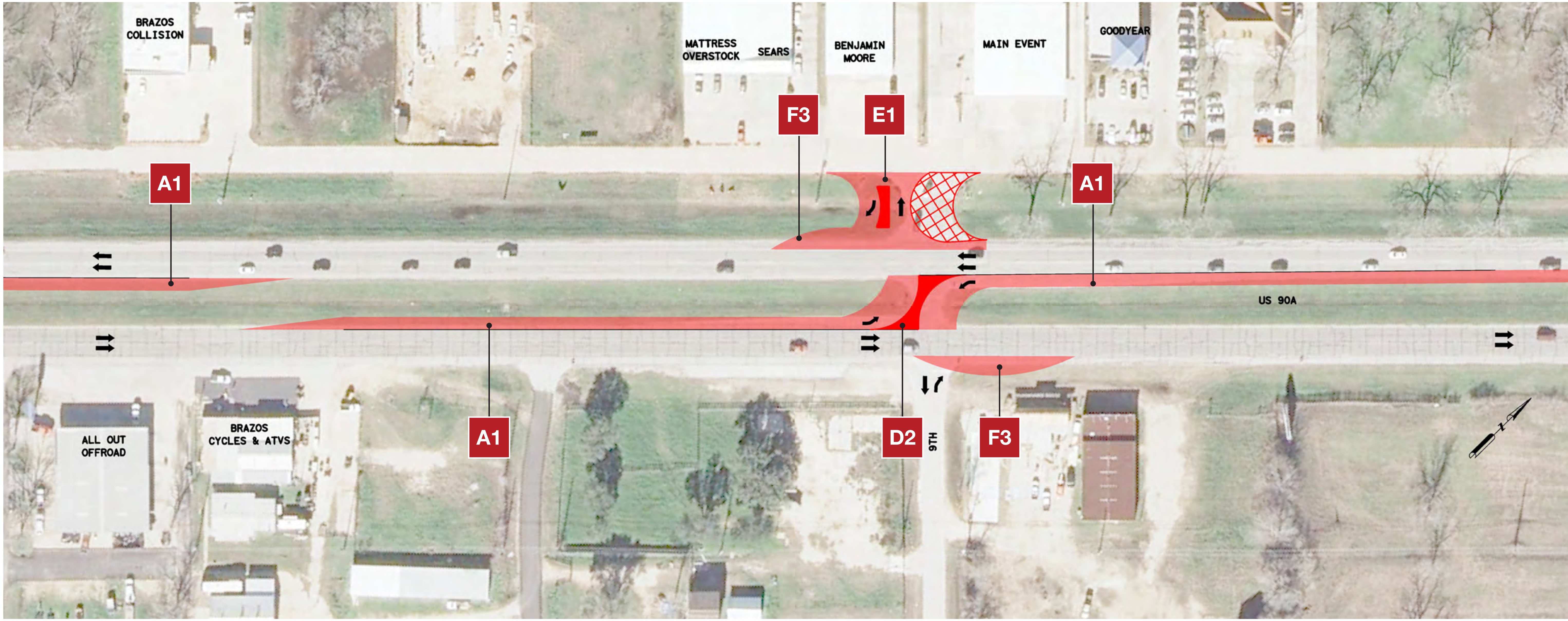
DRIVEWAY IMPROVEMENTS

- E2 Add Raised Islands to Delineate Driveways

WIDENING

- F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A1 Extension of Left Turn Lane

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

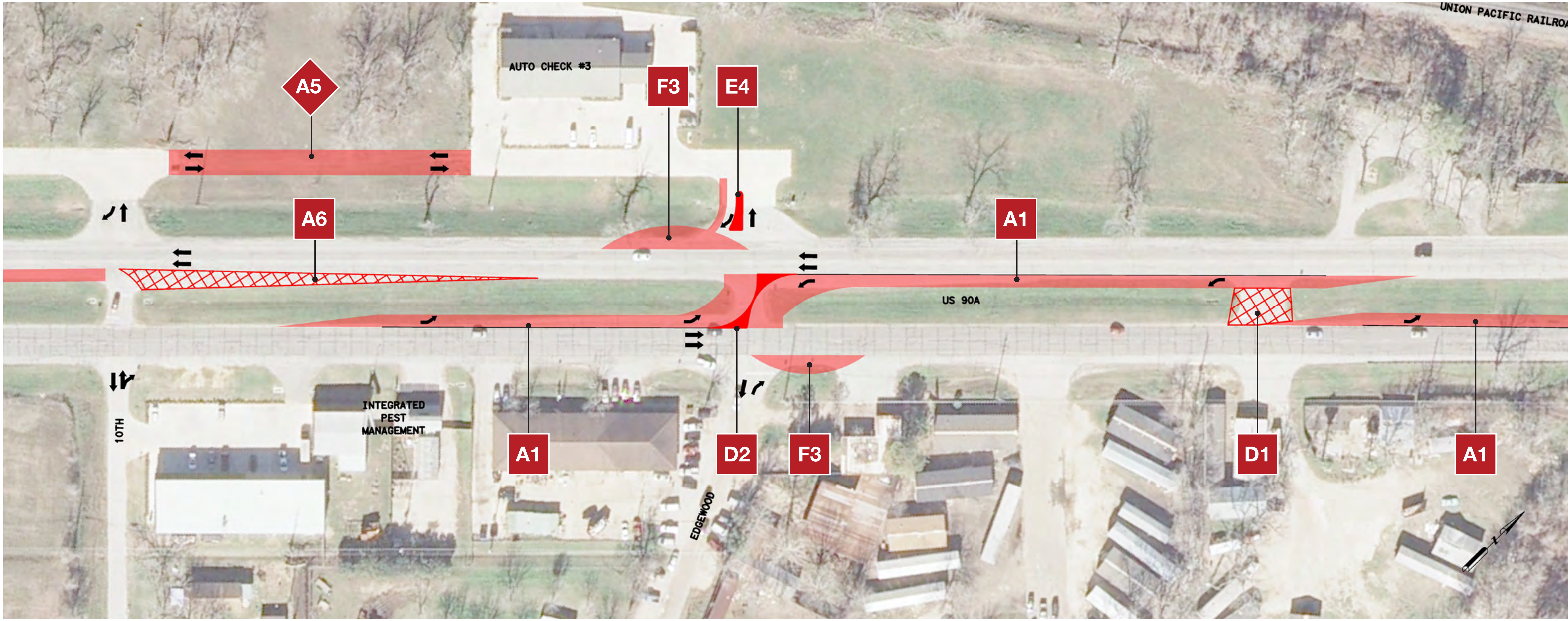
DRIVEWAY IMPROVEMENTS

E1 Reconstruct Driveway

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A1 Extension of Left Turn Lane
- A5 Roadway Extension
- A6 Turn Lane Closure

MEDIAN IMPROVEMENTS

- D1 Median Closure
- D2 Raised Median with Left Turn Lane

DRIVEWAY IMPROVEMENTS

- E4 Minor Driveway Modification

WIDENING

- F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet

IMPROVEMENT LEGEND

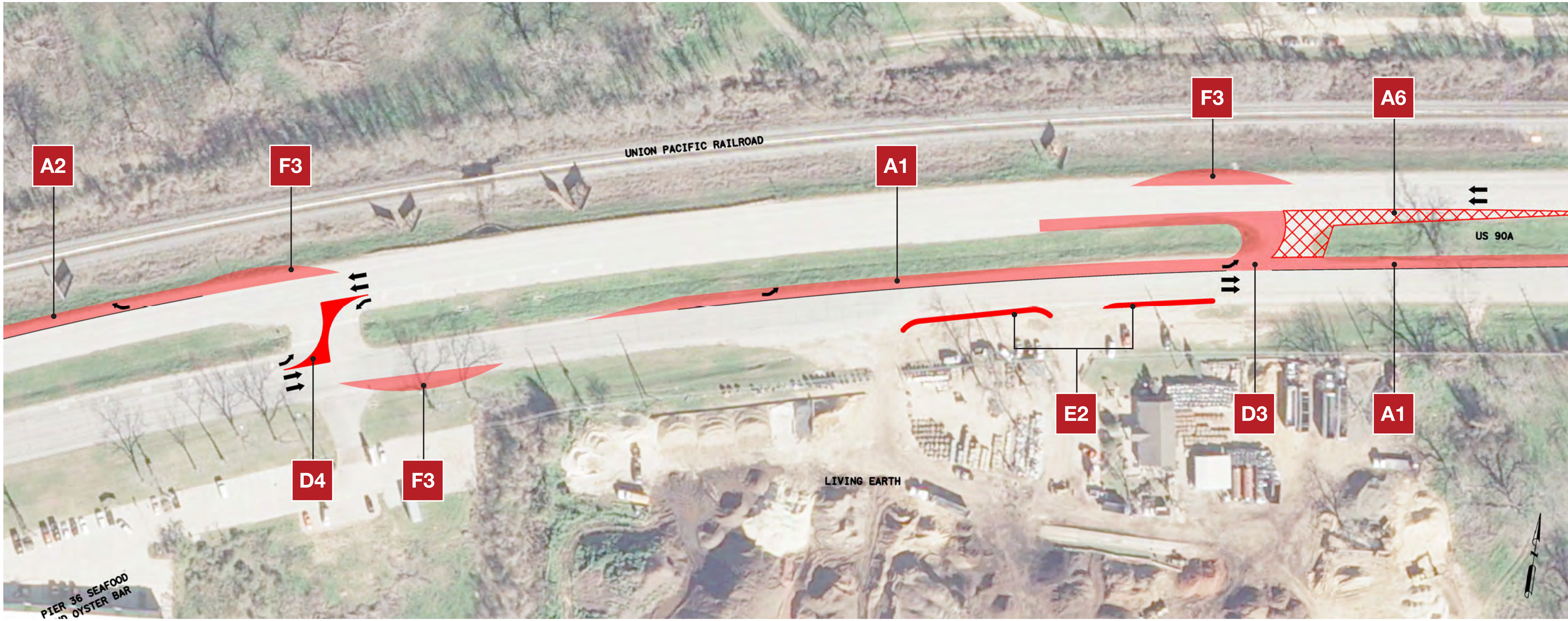
- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A1	Extension of Left Turn Lane
A2	Extension of Right Turn Lane

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- **A1** Extension of Left Turn Lane
- **A2** Extension of Right Turn Lane
- **A6** Turn Lane Closure

MEDIAN IMPROVEMENTS

- **D3** Repave Median
- **D4** Raised Median

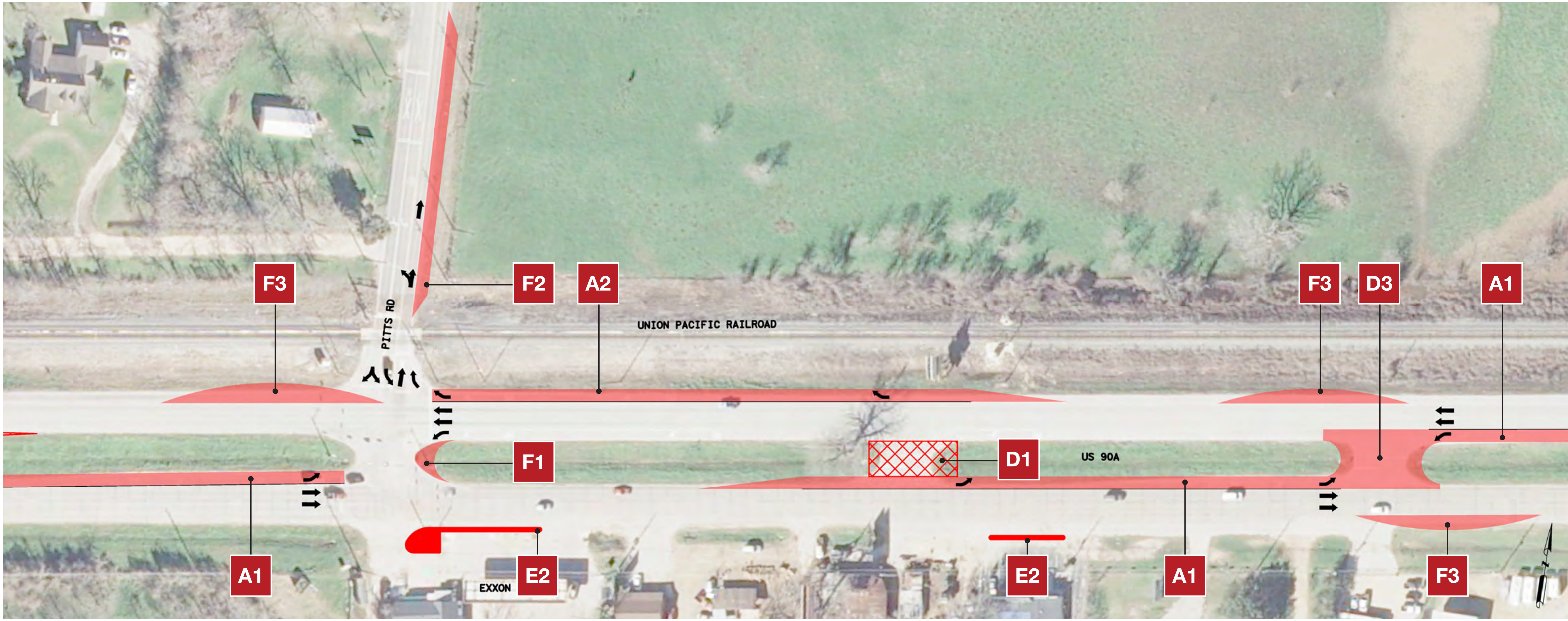
DRIVEWAY IMPROVEMENTS

- **E2** Add Raised Islands to Delineate Driveways

WIDENING

- **F3** Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A1 Extension of Left Turn Lane
- A2 Extension of Right Turn Lane

MEDIAN IMPROVEMENTS

- D1 Median Closure
- D3 Repave Median

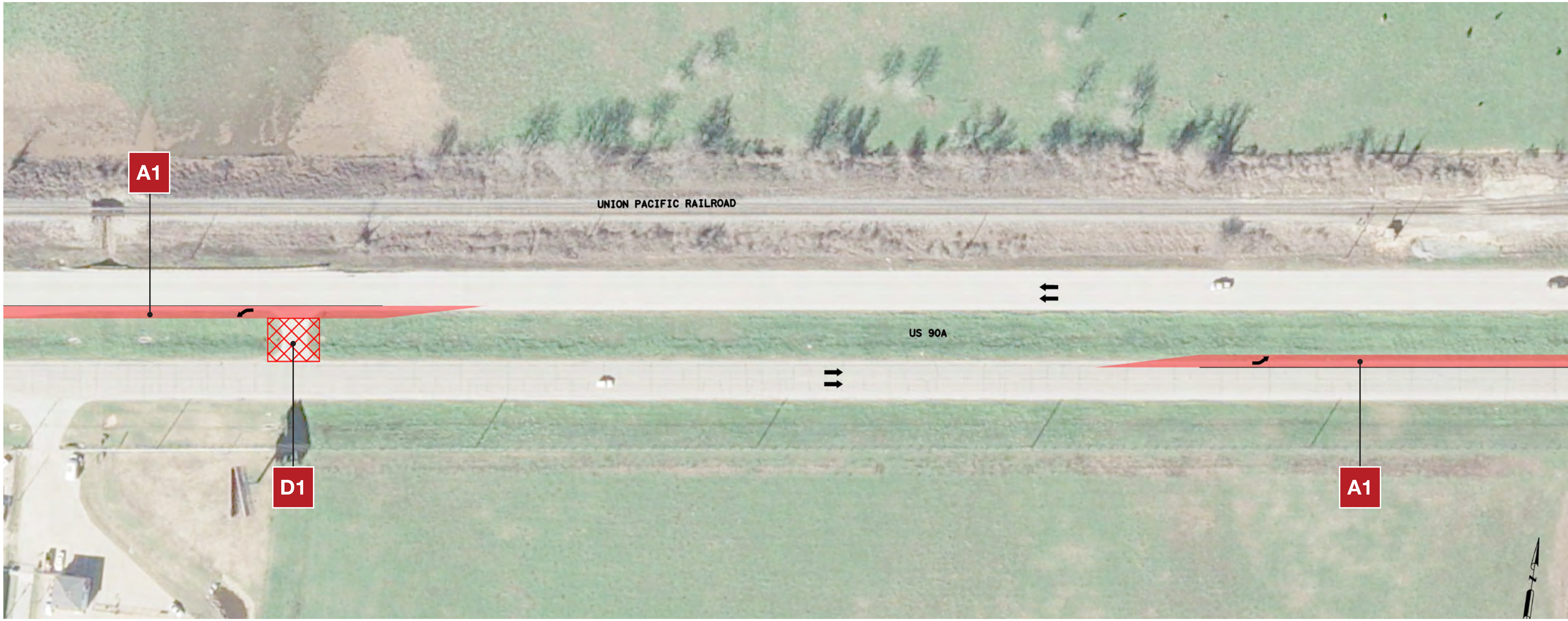
DRIVEWAY IMPROVEMENTS

- E2 Add Raised Islands to Delineate Driveways

WIDENING

- F1 Widen Roadway
- F2 Widen Shoulder
- F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

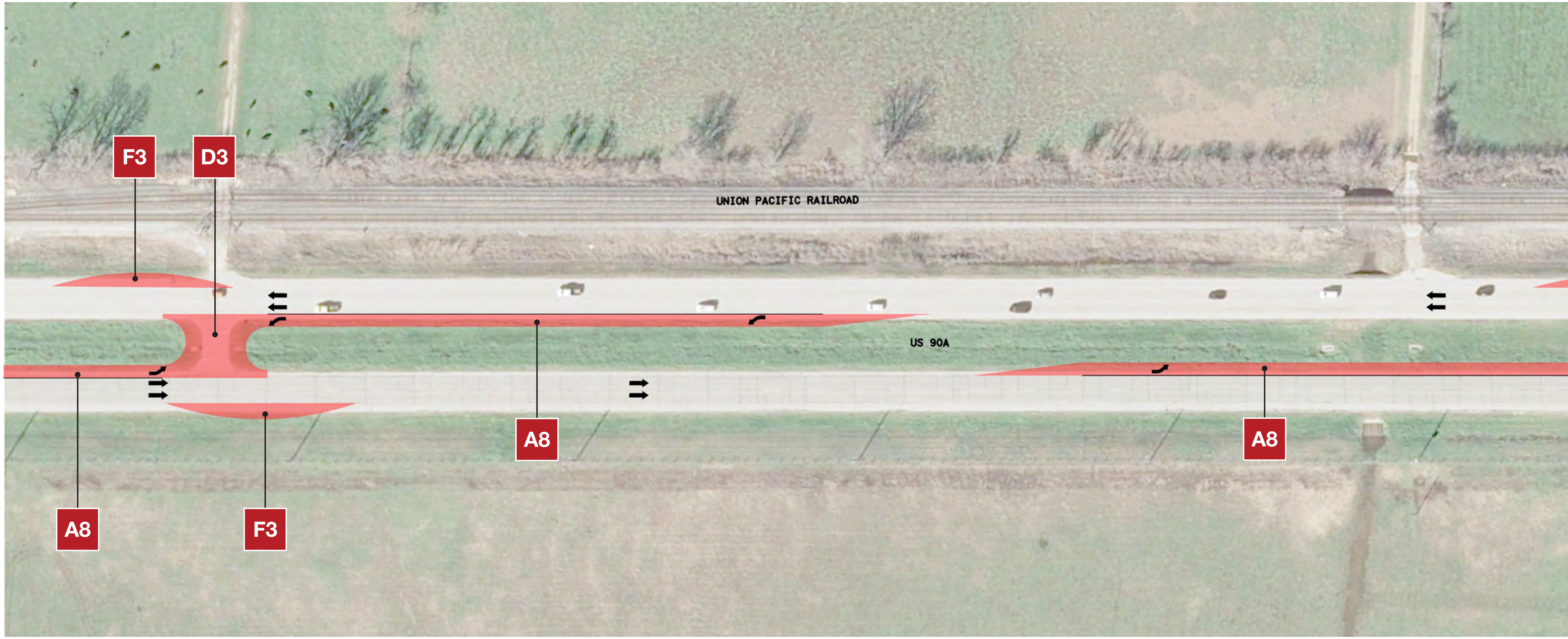
ROADWAY IMPROVEMENTS

A1 Extension of Left Turn Lane

MEDIAN IMPROVEMENTS

D1 Median Closure

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A8 Add New Left Turn Lane

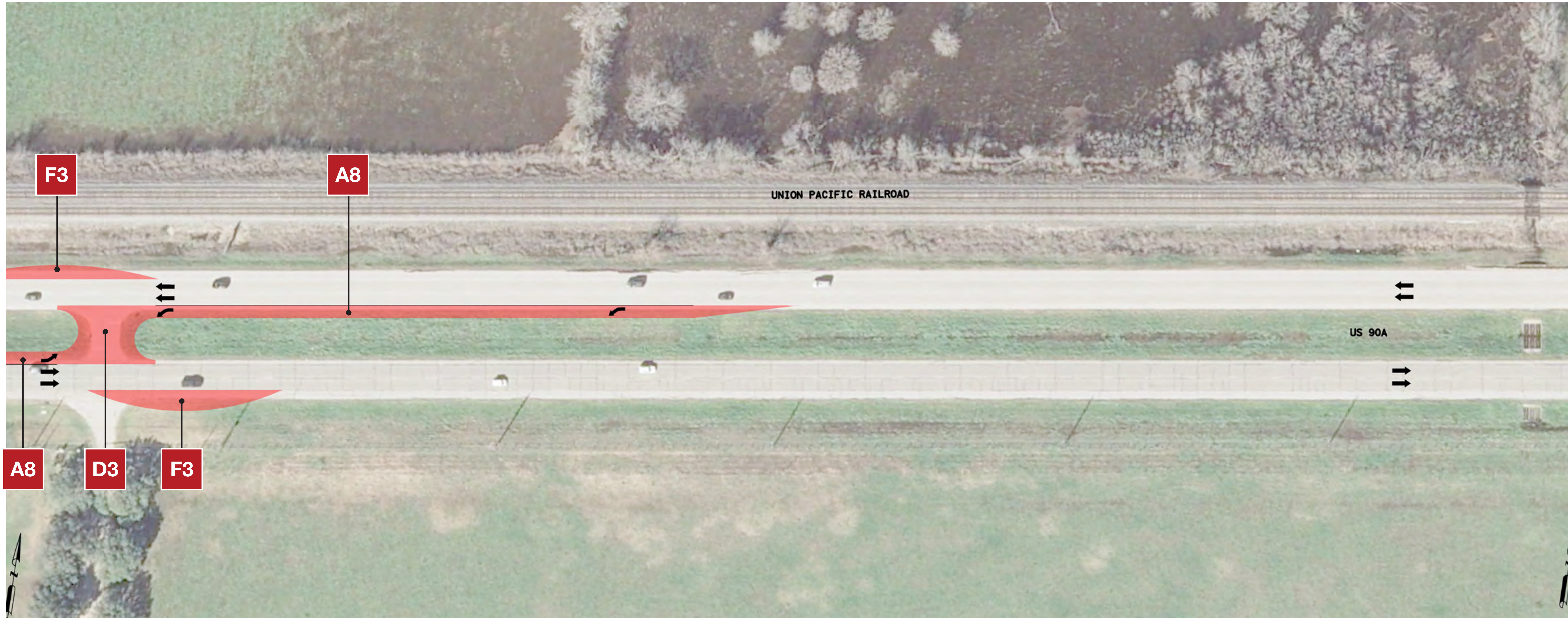
MEDIAN IMPROVEMENTS

D3 Repave Median

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others
- Pavement Striping

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A8 Add New Left Turn Lane

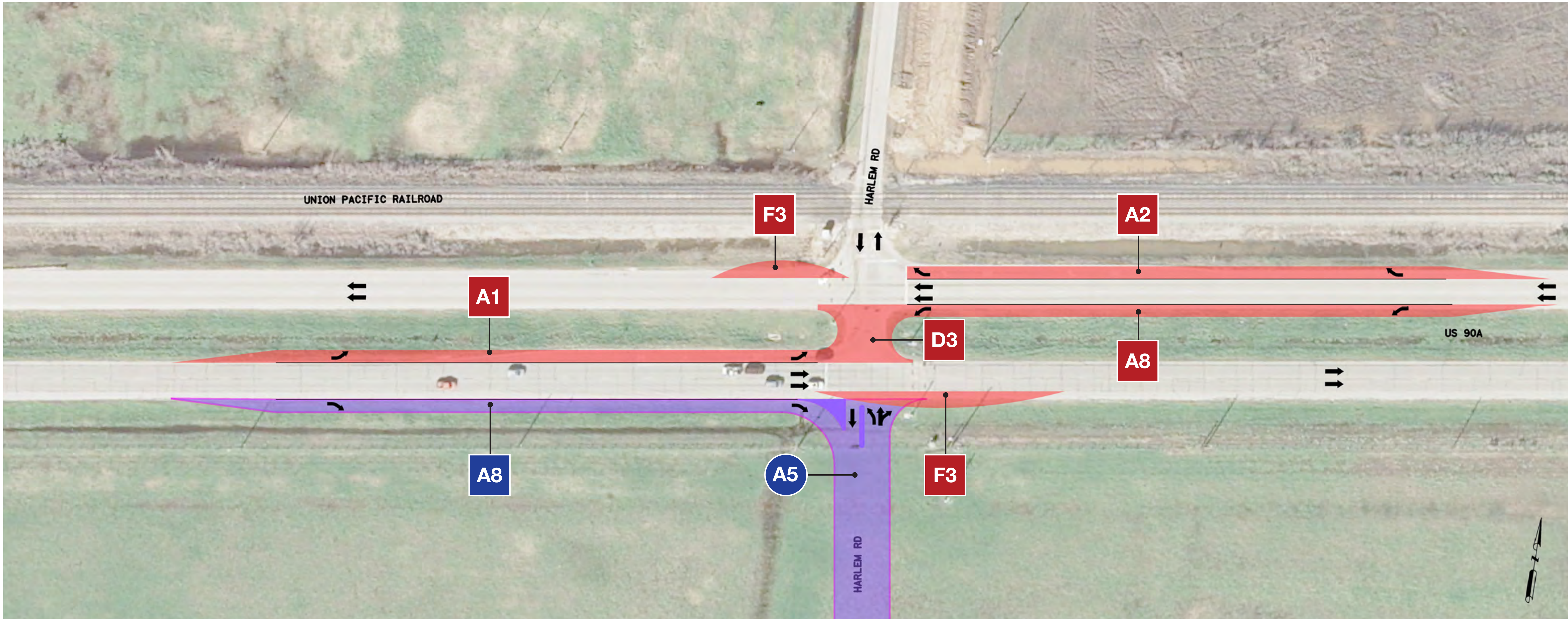
MEDIAN IMPROVEMENTS

D3 Repave Median

WIDENING

F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A1 Extension of Left Turn Lane
- A2 Extension of Right Turn Lane
- A5 Roadway Extension
- A8 Add New Right Turn Lane
- A8 Add New Right Turn Lane

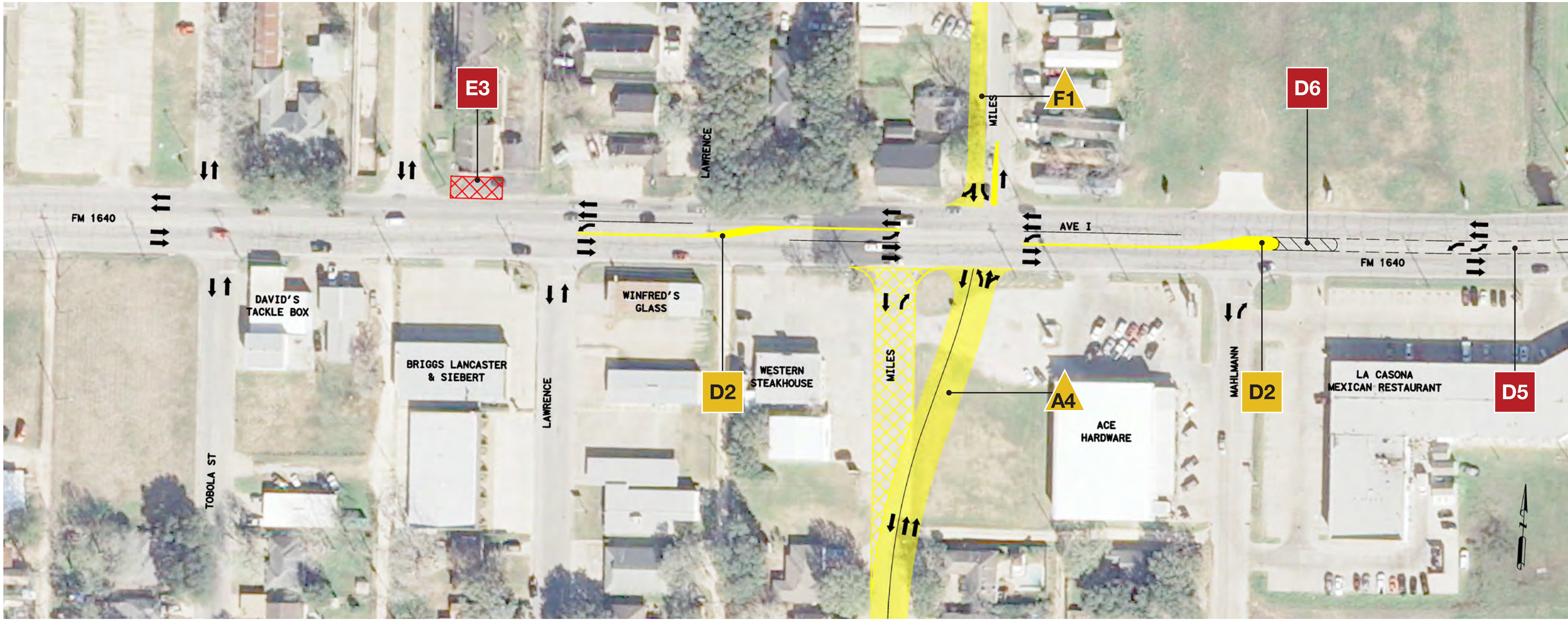
MEDIAN IMPROVEMENTS

- D3 Repave Median

WIDENING

- F3 Pavement Widening for U-Turns

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A4 Realign Roadway

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

D5 Continuous Center Left Turn Lane

D6 Pavement Striping

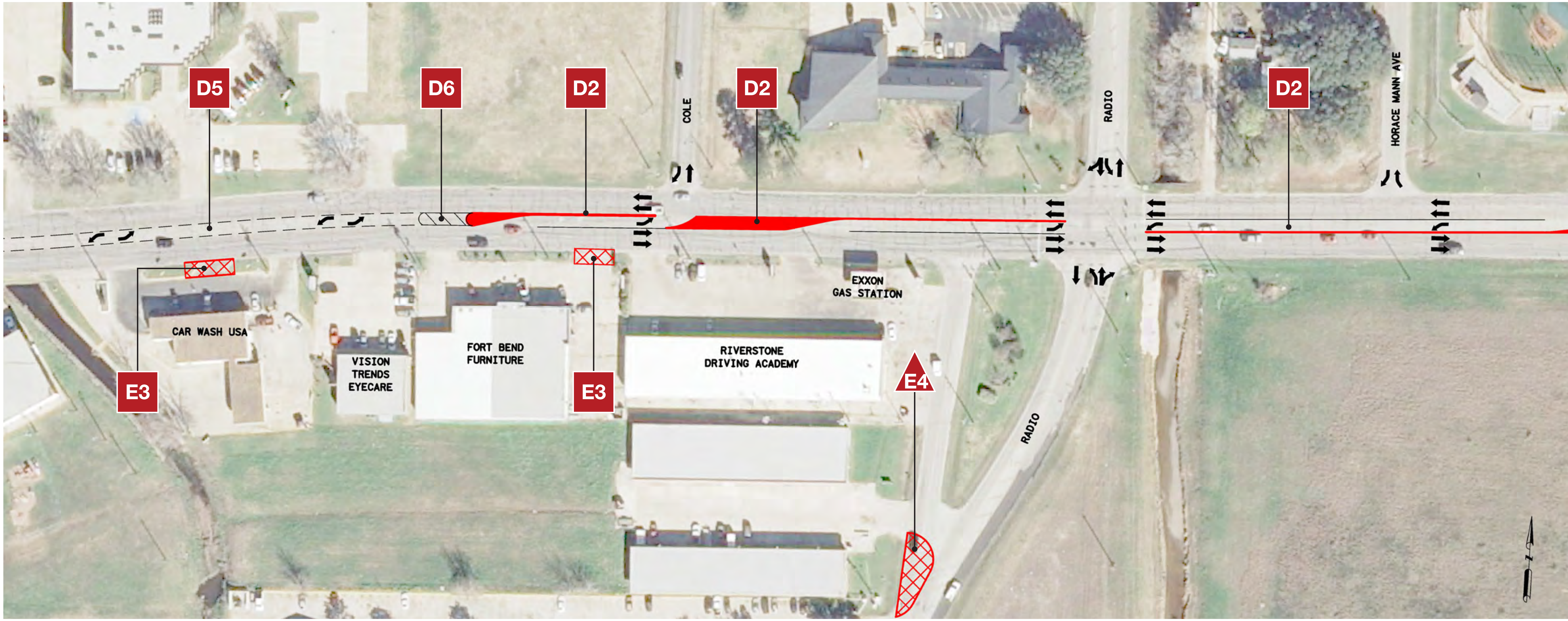
DRIVEWAY IMPROVEMENTS

E3 Driveway Closure

WIDENING

F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

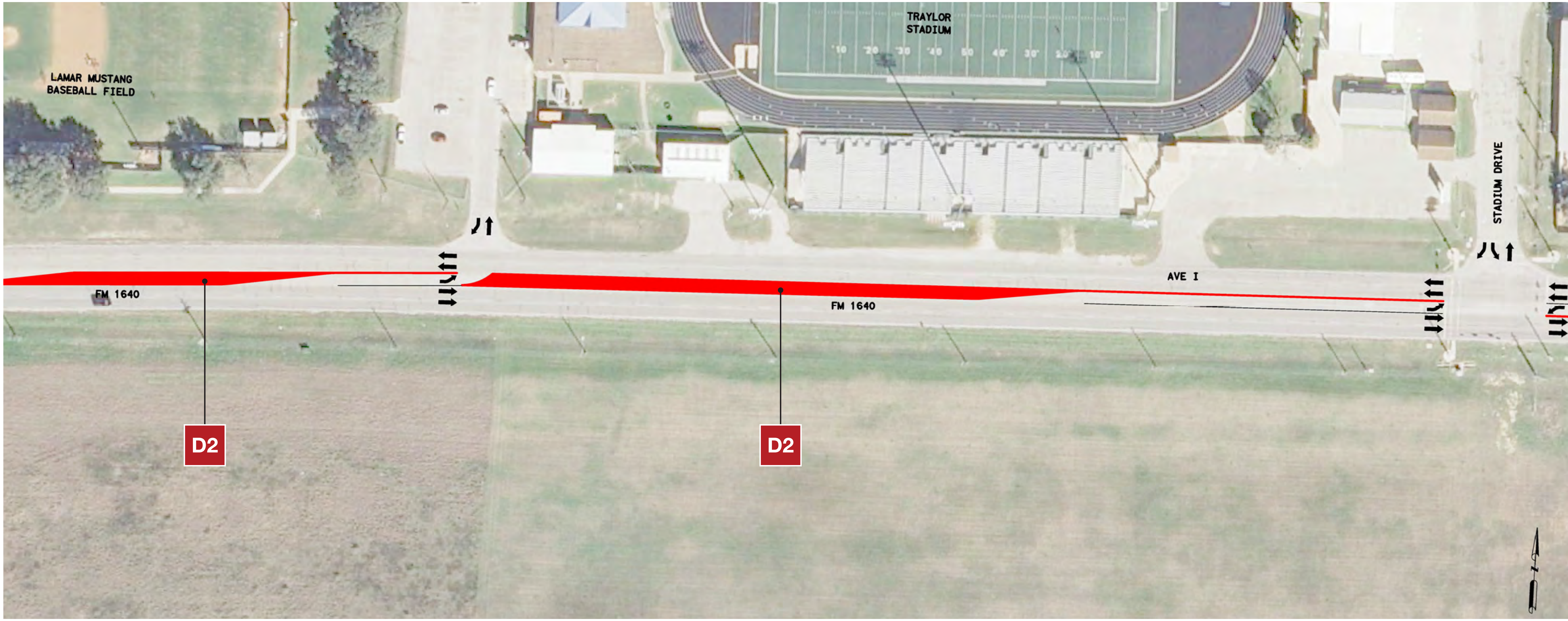
MEDIAN IMPROVEMENTS

- D2 Raised Median with Left Turn Lane
- D5 Continuous Center Left Turn Lane
- D6 Pavement Striping

DRIVEWAY IMPROVEMENTS

- E3 Driveway Closure
- E4 Minor Driveway Modification

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

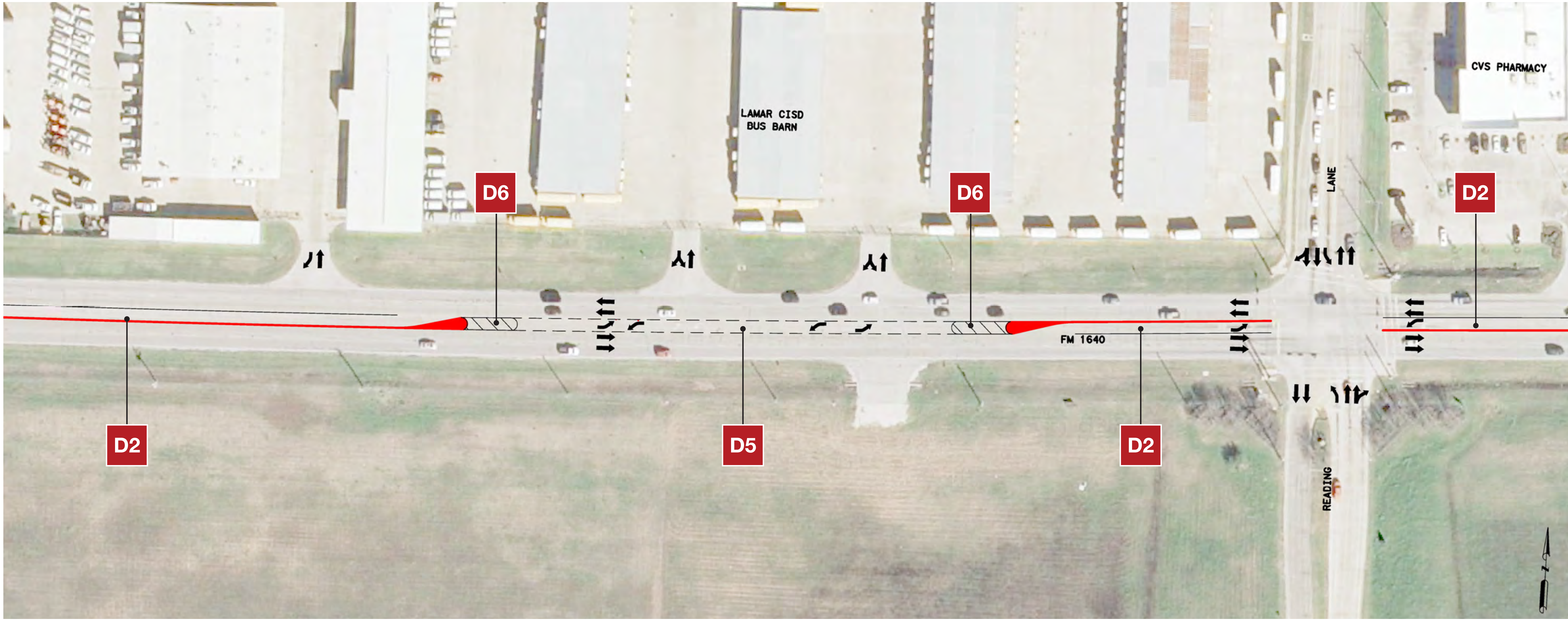
- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

- **D2** Raised Median with Left Turn Lane
- **D5** Continuous Center Left Turn Lane
- **D6** Pavement Striping

0 25 50 100 200 300 feet

IMPROVEMENT LEGEND

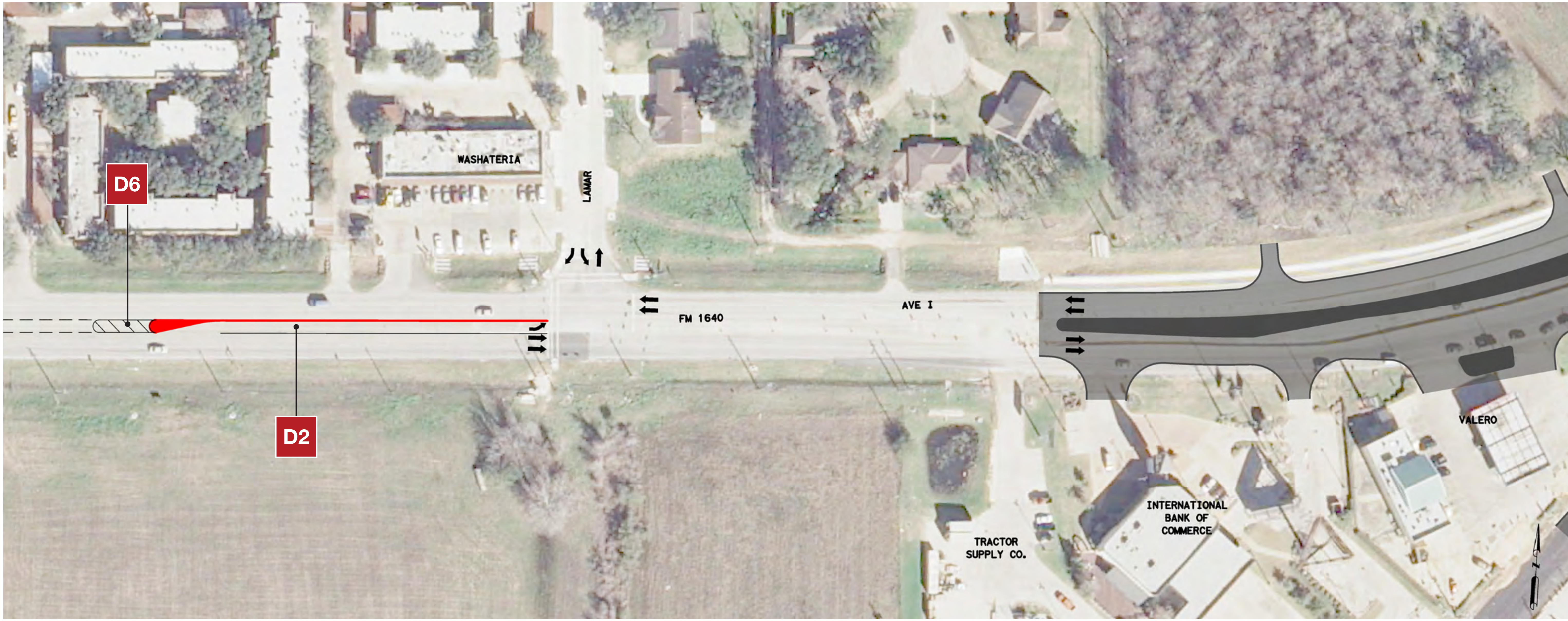
- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

- **D2** Raised Median with Left Turn Lane
- **D5** Continuous Center Left Turn Lane
- **D6** Pavement Striping

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

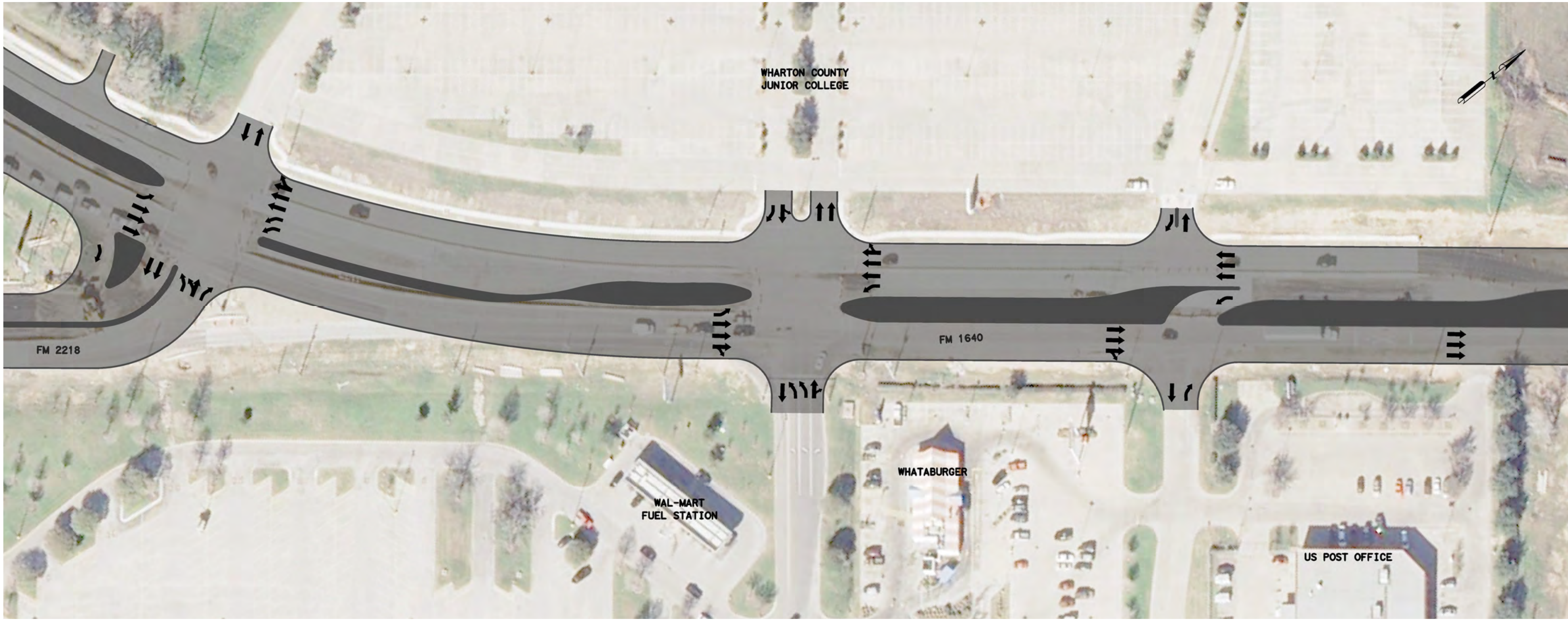
- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

MEDIAN IMPROVEMENTS

- D2 Raised Median with Left Turn Lane
- D6 Pavement Striping

0 25 50 100 200 300 feet

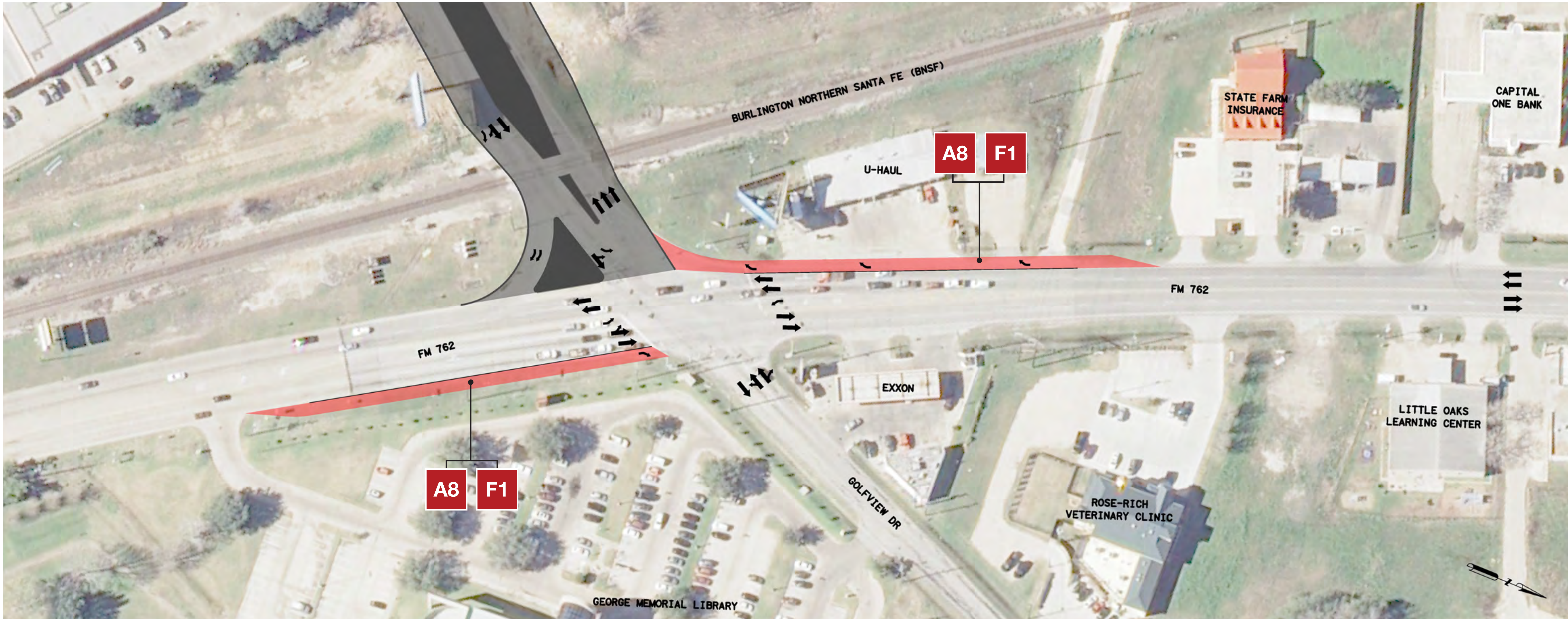


IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

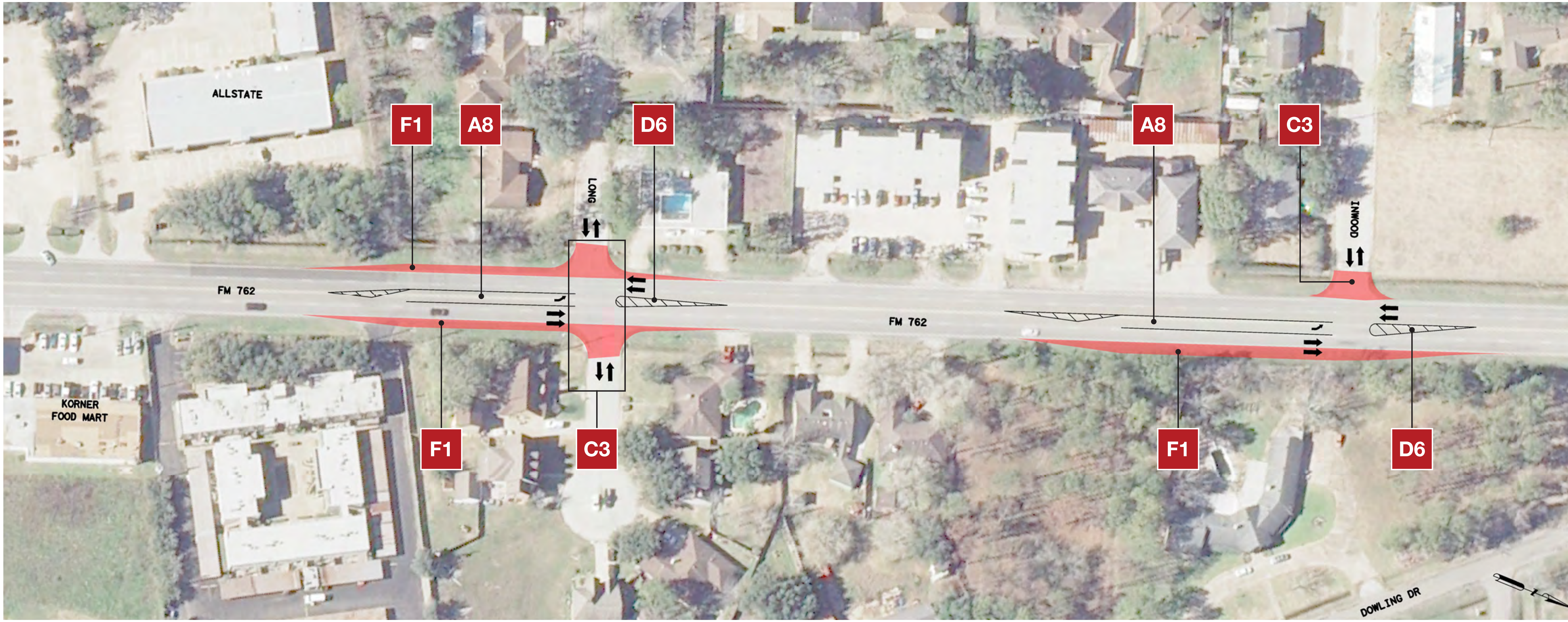
ROADWAY IMPROVEMENTS

A8 Add New Right Turn Lane

WIDENING

F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A8 Add New Left Turn Lane

INTERSECTION IMPROVEMENTS

C3 General Intersection Improvements

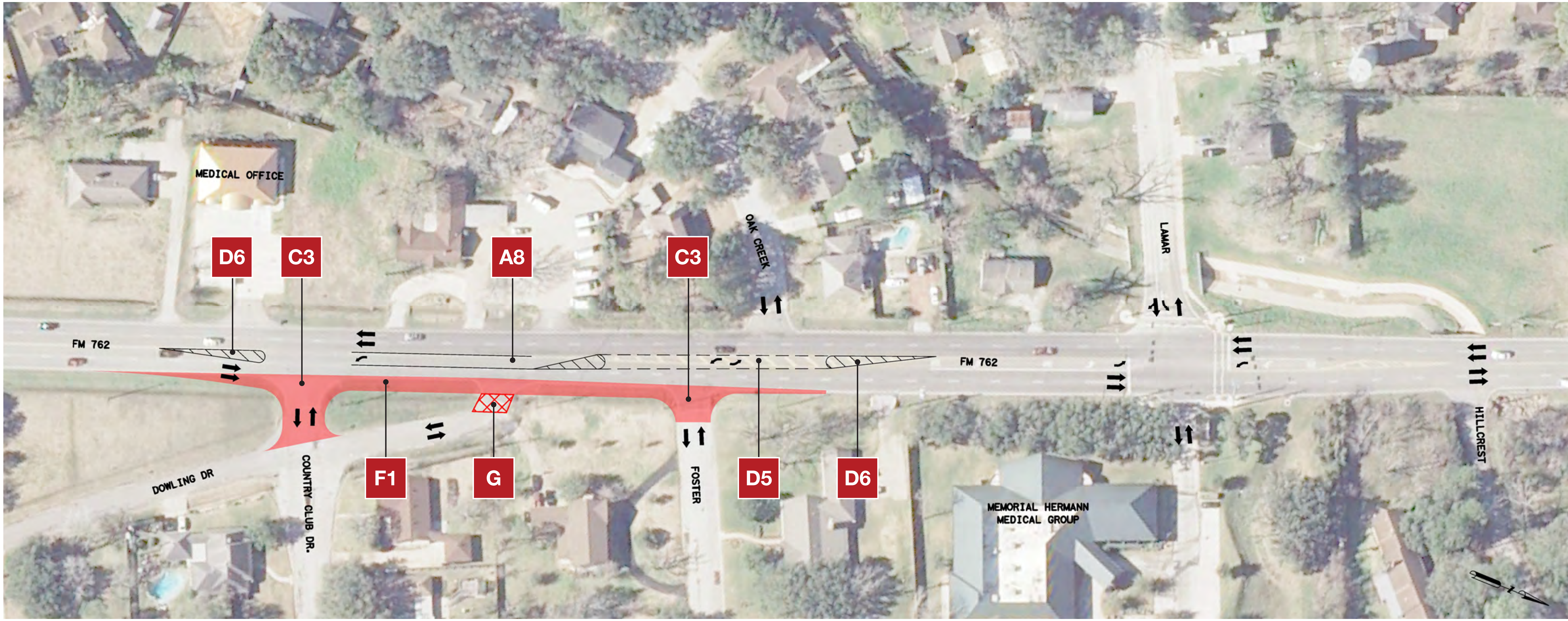
MEDIAN IMPROVEMENTS

D6 Pavement Striping

WIDENING

F1 Widen Roadway

0 25 50 100 200 300 feet



IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A8 Add New Left Turn Lane

INTERSECTION IMPROVEMENTS

C3 General Intersection Improvements

MEDIAN IMPROVEMENTS

D5 Continuous Center Left Turn Lane

D6 Pavement Striping

WIDENING

F1 Widen Roadway

STREET CLOSURE

G

0 25 50 100 200 300 feet

IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

- A8 Add New Left Turn Lane
- A8 Add New Right Turn Lane

INTERSECTION IMPROVEMENTS

- C3 General Intersection Improvements

MEDIAN IMPROVEMENTS

- D5 Continuous Center Left Turn Lane
- D6 Pavement Striping

DRIVEWAY IMPROVEMENTS

- E1 Reconstruct Driveway

WIDENING

- F1 Widen Roadway

0 25 50 100 200 300 feet

IMPROVEMENT LEGEND

- Remove Pavement
- New Pavement
- Pavement Striping
- Raised Island
- Improvement by County
- Improvement by TxDOT
- Improvement by City
- Improvement by Others

- Short Term
- Medium Term
- Long Term

ROADWAY IMPROVEMENTS

A8 Add New Right Turn Lane

INTERSECTION IMPROVEMENTS

C3 General Intersection Improvements

MEDIAN IMPROVEMENTS

D2 Raised Median with Left Turn Lane

WIDENING

F1 Widen Roadway

0 25 50 100 200 300 feet

CHAPTER 5

FUTURE CORRIDOR NEEDS

ISSUES REGARDING ACCESS MANAGEMENT

Although progress has occurred since the first access management study of the H-GAC region in April 2002, additional systematic strategies could be applied to the study area corridors to coordinate the access needs of adjacent land uses with the function of the transportation system. Some issues related to access management in the Richmond Rosenberg area are further discussed below.

Property owner and developer needs versus public needs

The need to provide a safe roadway often conflicts with the developer's desire to have unlimited and convenient access. Based on field observations within the study area, developers in the study area have not been held accountable to ensure their development does not adversely impact traffic in the area, and that their needs do not adversely impact the public. Figure 5.1 shows the access granted to developers and property owners. While convenient for them, this type of open access is detrimental to drivers and pedestrians because of the safety hazards it presents.

Figure 5.1: Example of Access Management Issues along Study Area Corridors

Agency obligation to provide access

Agencies are required to provide access to any platted parcel of land. Usually the land use and platting power to control the configuration and the intensity of development are vetted with either the city or county. The State needs strong support and cooperation from the city and county to ensure that access management is an integral part of the process.

Intergovernmental Coordination

Interagency support and improved communication are critical in carrying out a successful access management program. TxDOT, Fort Bend County, City of Richmond, and City of Rosenberg must work together and establish unified criteria to preserve the integrity of development. This can be done in collaboration with the West Fort Bend Management District which has already developed a set of design guidelines. Internally, the agencies should resolve how to review and approve developer and property owner requests for development. A brief brochure or handout outlining procedures for plat reviews that includes a contact person could become an effective tool for distributing the access management requirements and related information.

Driveway permitting and design requirements

The permitting processes of the various agencies should be examined and modified to address the requirements for a wider range of site uses or redevelopment. Monitoring these permits could ensure that the original permit conditions and previous agreements with developers and property owners are applicable. Driveway design and specifications should be reviewed periodically to proactively avoid additional access issues.

Access Management Implementation and Strategies

The strategies proposed in this plan go beyond traditional roadway improvements to address land development and access management considerations along US 90A, FM 1640, and FM 762. There is a strong connection between land use and transportation that should be taken into consideration along the study area corridors. This document is a versatile planning tool that can serve as a guide to prevent future access problems and provide solutions for existing problems, which may encourage development and redevelopment of the study area. The recommendations should be implemented through a combination of regulations, interagency or public-private agreements, and roadway improvement projects.

TxDOT, Fort Bend County, City of Richmond, and City of Rosenberg should work together to identify barriers to implementing access management strategies in the region. These agencies should establish uniform guidelines for future development and redevelopment based on the TxDOT approved Access Management Manual and Transportation Research Board Access Management Manual. Some recommended guidelines are provided in Figure 5.2. The guidelines should be consistently applied by the various agencies when reviewing permit application for platting, access, development, and redevelopment. Collaboration on these guidelines can also help guide the aesthetics along the corridor.

The access management policies developed in the region should be straight forward, coordinated, and consistently applied. Furthermore, they should address the following:

1. Functional Area of an Intersection
2. Driveway Spacing and Geometry
3. Traffic Impact Study

Strategies to be Considered

- Adoption and implementation of the design guidelines outlined by the West Fort Bend Management District (WFBMD). The WFBMD can work closely with property owners and developers to coordinate access management and corridor issues with various agencies, helping prevent further degradation of safety and capacity along the corridor. Furthermore, the WFBMD can serve as the link between the community and various agencies. The WFBMD can also help to identify public-private partnership initiatives, apply for grants, and create opportunities to support the economic development/redevelopment along these corridors.

- Promote mixed-use development and redevelopment along the corridor to create livable centers where people can work, play, and live within a walking distance and create an environment that is less dependent on vehicular use. This creates an opportunity for the various agencies to provide public transportation.

- Promote multimodal facilities to support alternatives to vehicular use such as public transportation, and pedestrian and bicycle facilities. As previously noted, there is a strong connection between land use and transportation. Providing multimodal transportation facilities in the Richmond-Rosenberg area will encourage walking and biking.

STRATEGIES FOR FUTURE DEVELOPMENT

Current land development patterns along the corridors include low-density areas with singular land use with inadequate parking with poor pedestrian linkages and visual blight. Based on feedback from the Steering Committee, poor pedestrian linkages tends to be a significant safety issue in the study area, particularly at US 90A and the BNSF railroad overpass near the Oak Bend Medical Center. This not only presents safety concerns for pedestrians, but it also contributes to poor mobility within the study area.

The short and medium term recommendations were developed to address safety and mobility within the study area. The long-term recommendations were developed to encourage economic development and revitalization in the cities of Richmond and Rosenberg. Business owners along US 90A expressed concern that tourists and consumers are attracted to the new Brazos Town Center located along US 59 and FM 762. The strategies presented below were created to encourage people to drive through Richmond and Rosenberg and not bypass along US 59. If implemented methodically, the following strategies can help to revitalize Richmond and Rosenberg.

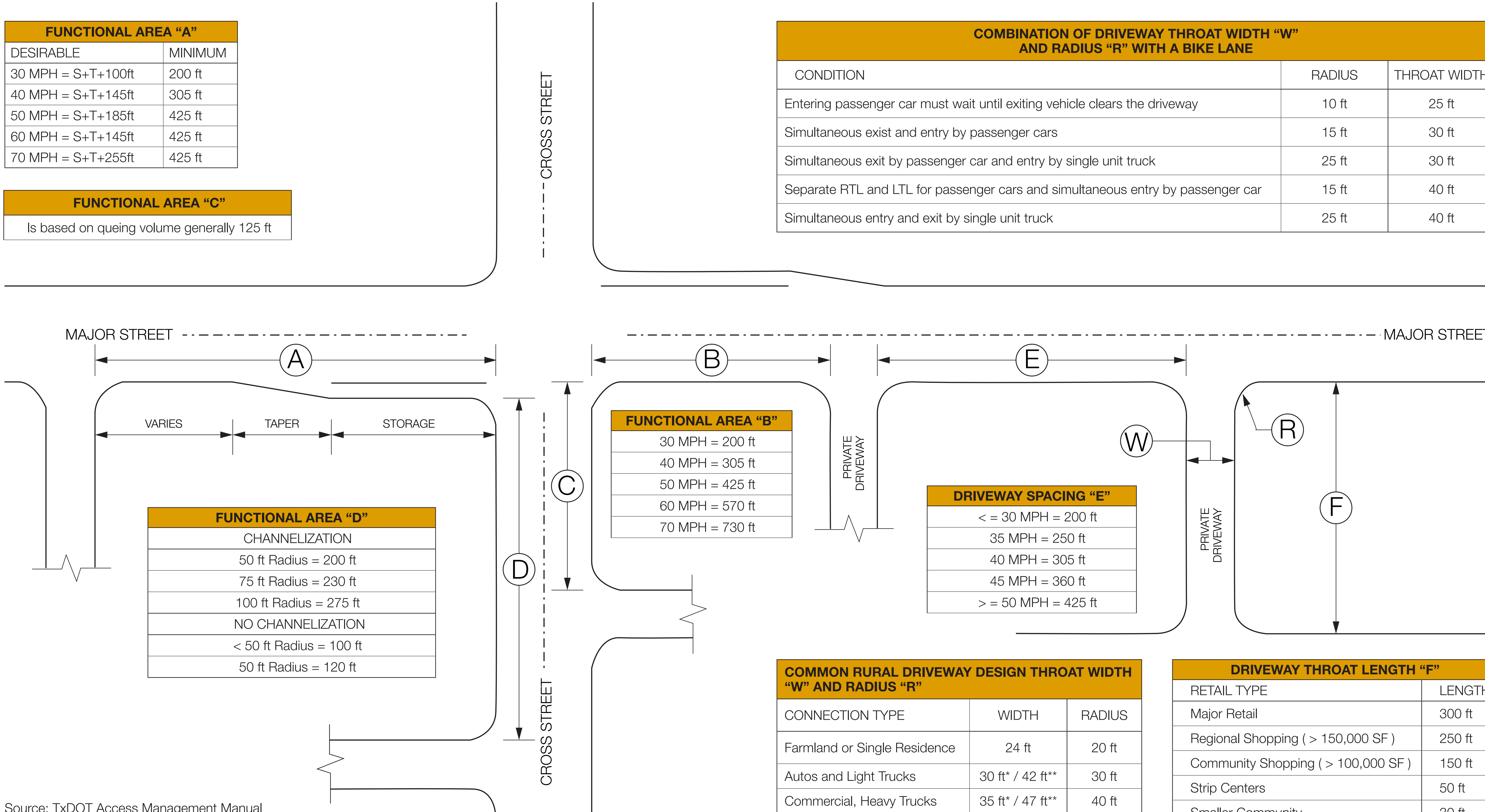
Livable Centers

The Houston-Galveston Area Council (H-GAC) has created a livable centers program to facilitate the creation of walkable, mixed-use places that provide multi-modal transportation options, improve environmental quality, and promote economic development (Figure 5.3). A majority of the development along the study area corridors consists of low-density development such as big box retail, abandoned strip malls, and single-family homes. This type of development encourages automobile dependency and visual blight.

There is a high dependency on vehicles because there are no adequate transportation methods such as walking, biking or public transit. The cities of Richmond and Rosenberg can become less dependent on single occupant vehicles by creating redevelopment scenarios around quality existing development including the downtown areas and historic buildings around the study area. Additionally, the cities can promote creation of a downtown where people can live, work, and play in the same area, which would attract people into the heart of the cities instead of allowing them to pass by unaware along US 59. Within these areas, biking and walking should be encouraged to bring the development to the pedestrian level.

Livable centers studies should be conducted in both Richmond and Rosenberg to help create a more pedestrian-friendly environment.

Figure 5.2: Access Management Recommended Guidelines



FUNCTIONAL AREA "A"	
DESIRABLE	MINIMUM
30 MPH = S+T+100ft	200 ft
40 MPH = S+T+145ft	305 ft
50 MPH = S+T+185ft	425 ft
60 MPH = S+T+145ft	425 ft
70 MPH = S+T+255ft	425 ft

FUNCTIONAL AREA "C"
Is based on queing volume generally 125 ft

COMBINATION OF DRIVEWAY THROAT WIDTH "W" AND RADIUS "R" WITH A BIKE LANE		
CONDITION	RADIUS	THROAT WIDTH
Entering passenger car must wait until exiting vehicle clears the driveway	10 ft	25 ft
Simultaneous exist and entry by passenger cars	15 ft	30 ft
Simultaneous exit by passenger car and entry by single unit truck	25 ft	30 ft
Separate RTL and LTL for passenger cars and simultaneous entry by passenger car	15 ft	40 ft
Simultaneous entry and exit by single unit truck	25 ft	40 ft

FUNCTIONAL AREA "B"
30 MPH = 200 ft
40 MPH = 305 ft
50 MPH = 425 ft
60 MPH = 570 ft
70 MPH = 730 ft

DRIVEWAY SPACING "E"
< = 30 MPH = 200 ft
35 MPH = 250 ft
40 MPH = 305 ft
45 MPH = 360 ft
> = 50 MPH = 425 ft

FUNCTIONAL AREA "D"
CHANNELIZATION
50 ft Radius = 200 ft
75 ft Radius = 230 ft
100 ft Radius = 275 ft
NO CHANNELIZATION
< 50 ft Radius = 100 ft
50 ft Radius = 120 ft

COMMON RURAL DRIVEWAY DESIGN THROAT WIDTH "W" AND RADIUS "R"		
CONNECTION TYPE	WIDTH	RADIUS
Farmland or Single Residence	24 ft	20 ft
Autos and Light Trucks	30 ft* / 42 ft**	30 ft
Commercial, Heavy Trucks	35 ft* / 47 ft**	40 ft

* Single lane exit
** Two lane exit

DRIVEWAY THROAT LENGTH "F"	
RETAIL TYPE	LENGTH
Major Retail	300 ft
Regional Shopping (> 150,000 SF)	250 ft
Community Shopping (> 100,000 SF)	150 ft
Strip Centers	50 ft
Smaller Community	30 ft

Source: TxDOT Access Management Manual
TRB Access Management Manual

Figure 5.3: Downtown Rosenberg

Figure 5.4: Downtown Richmond

Envisioning Groups

The cities of Richmond and Rosenberg should work closely with the West Fort Bend Management District, their respective economic development councils, and key developers, to establish a group that focus on future development of the cities. The group should consist of key stakeholders and others who are heavily involved in the cities to ensure that the most beneficial development strategies are proposed.

Downtown Redevelopment

For the most part, the downtown areas of Richmond and Rosenberg are aesthetically pleasing and pedestrian friendly. Both cities pride themselves on their historic downtowns and their amenities. Both have an “old town” charm with unique qualities that could be better promoted to passersby. To attract more people to these areas, the cities should implement a wayfinding signage program. The activities within the downtowns (historic Morton Street in Richmond and the cultural arts district and Railroad Museum in Rosenberg) should be advertised to encourage tourists.

Additionally, businesses in the historic downtown areas should reorient their signs and window displays so as to attract people’s attention as they walk or drive by. This is particularly important for vehicular traffic because attractive window displays will encourage them to get out of their vehicle and walk around the downtown area and explore the local shops.

Figure 5.5: Morton Street in Downtown Richmond

Figure 5.6: Example of How Morton Street could be Redeveloped

Redesigning Morton Street

During a meeting with the City of Richmond staff, it was noted that Morton Street is the heart of the downtown area and should therefore be preserved. To encourage more visitors to Morton Street and the historic downtown area, Morton Street could be redesigned to encourage more pedestrian traffic through the area. This could be achieved by installing brick pavers along the street, wayfinding signage, and adding art to welcoming people to Historic Downtown Richmond. Furthermore, the sidewalks immediately adjacent to the store fronts could be widened to accommodate activities such as a farmer’s market on the weekends or other activities the city deems could thrive here. Not only will this enhance the aesthetic quality of the area, but it will also encourage economic vitality in this area.

Alternative parking solutions should be developed within the downtown areas, such as shared parking facilities located in the vacant lots throughout the downtown areas. This type of parking solution could be particularly beneficial with the implementation of mixed-use development. During the day, the parking lots would be used for business purposes, while at night the residents would use the parking lots.

Other alternatives should include transit opportunities in the downtown areas, reductions of curb cuts along US 90A and FM 1640, primary vehicular access at collector and cross streets, wayfinding signage along the corridors particularly for the historic downtown areas, and improved pedestrian and bicycle linkages.

Redevelopment along the Study Area Corridors

Redevelopment along the corridors should be focused around the historic downtown areas and historic buildings along US 90A in Richmond. Furthermore, redevelopment should have a consistent design style to improve aesthetics, include lighting, street furniture, and pedestrian facilities. Fort Bend County conducted a Subregional planning study earlier this year to develop strategies for future development and to strengthen corridors within the area. Redevelopment strategies presented in the study include the following:

- Mixed-Use Development
  - › Re-purpose existing buildings and excess parking that brings buildings to the street with parking facilities behind it.
- Integrate Higher Density Residential Development
  - › Construct multifamily housing, such as townhomes and apartments, such as downtown lofts or apartments above retail spaces.
- Improve Walkability
- Encourage and improve walkability by adding pedestrian facilities along U S90A.
- Increase Multimodal Access
  - › Emphasize transit, walking, and bicycling as viable forms of transportation within the study area corridors.
- Optimize Parking Strategies
  - › Develop shared parking strategies, particularly along areas of 90A with strip development and big box retail.
- Enhance Arts and Entertainment
  - › Improve links to downtown Richmond and Rosenberg through wayfinding signage, and promoting events to attract tourists.

Figure 5.7: Example of On-Street Parking

Source: lansingrivertrail.org

This type of development could be achieved through a phased development approach from current development patterns to more planned and controlled approach. The phasing approach should be prototypical so they can be applied anywhere along the corridors and could be executed as follows:

Figure 5.8: Approach to Redevelopment

PHASE

1. Master Plan and Beautification
2. Strengthen Corners and Increase Transit / Modal Opportunities
3. Redevelop / Infill Development
4. Increase Density and Maximize Pedestrian / Bicycle Linkages

APPENDIX A - ACCESS MANAGEMENT PRINCIPLES

An effective access management program will find a balance between safety, mobility, and access. The following examples of best practices in access management should be the focus of the US 90A Access Management Study.

Based on FHWA guidelines, access management is achieved through the application of these planning, regulatory, and design strategies.

- Policies, directives, and guidelines issued by state and local agencies having permit authority on development and roadway infrastructure improvements.

  State and local agencies may adopt specific policies, directives, or guidelines that are directly or indirectly related to access management. A local government typically sets forth public policies in its comprehensive plan. State agencies may establish formal agency policies, procedures, and directives under their general administrative functions. Access management issues are sometimes addressed through guidelines, which do not require specific legislative authority but which lack the mandatory status and enforceability of regulations.

- Regulations, codes, and guidelines that are enforceable.

  Access management regulations may address various aspects of access management, such as the location and spacing of connections, design of access connections, spacing of median openings, spacing of traffic signals, joint and cross access requirements, interchange areas, and access permitting. These regulations may take the form of comprehensive statewide access codes or local access management ordinances, and they can be more effectively enforced than guidelines.

- Acquisition of access rights by states and local jurisdictions that serve to protect transportation interests and enable sufficient infrastructure is built.

  State transportation agencies and local governments have the authority to acquire access rights. This is how freeways and arterial roadways are protected. The acquisition of access rights, while often costly and time consuming, is a long-lasting solution.

- Land development regulations by state and local jurisdictions that address property access and related issues.

  In addition to access management and driveway design requirements, local agencies establish a variety of land development regulations that affect access outcomes. Zoning regulations address lot dimensions (e.g., setback and lot frontage), lot coverage, parking, landscaping, site circulation, development intensity or density, and the permitted use of land. Subdivision regulations govern the division of land into lots, blocks, and public ways and can ensure proper street layout in relation to existing or planned roadways, adequate space for emergency access and utilities, and internal access to subdivision lots. State agencies rarely have these powers.

- Development review and impact assessments by state and local jurisdictions.

  Some aspects of access management are addressed at the site review stage, in response to a request for a development or connection permit. This may be accomplished through the subdivision or site plan review process of local agencies or during the access permitting process of state agencies. Larger developments are often required to submit a traffic impact assessment to assist the agency in its review. Requirements are usually based on policies already adopted.

- Good geometric design of transportation facilities

  Geometric design features, such as intersections, frontage roads, median types, median openings, auxiliary lanes, driveway design, and intersection channelization are used to manage access and vehicular turning movements. Geometric design criteria are normally included in design manuals and are advanced through the roadway improvement process.

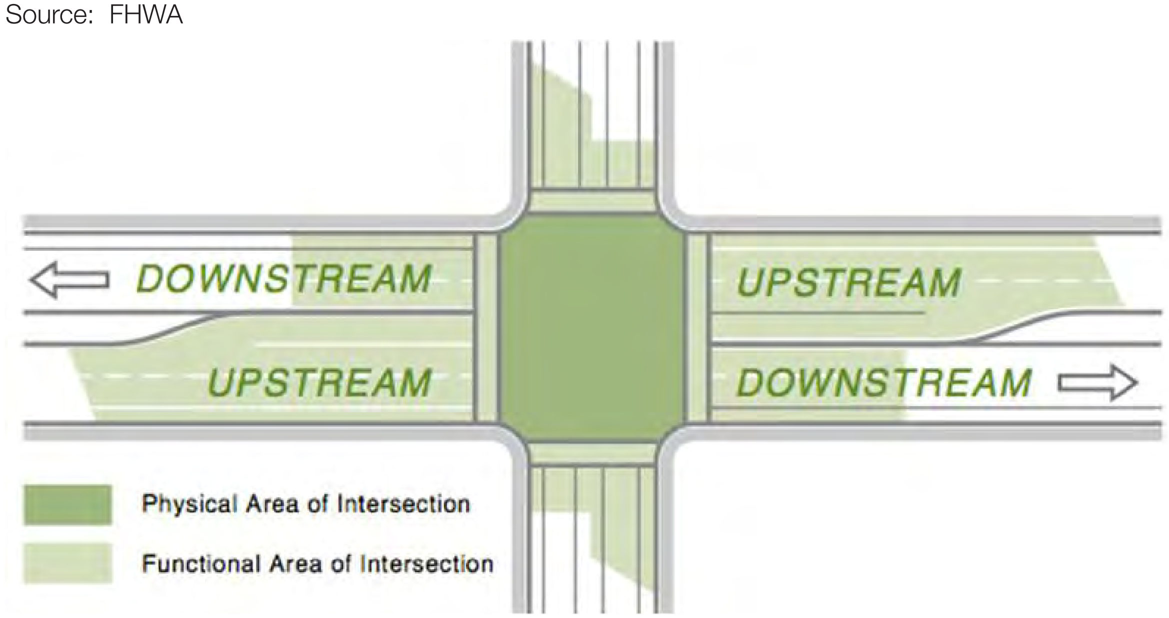
- Understanding of access implications by businesses and property owners.

  Some property owners and some local planners or permit agencies do not always consider the full effects of introducing driveways or minor streets. Further, local entities often perceive economic damage when some access management techniques are proposed, i.e., closing median breaks, relocating driveways, or limiting the number of access points. Education, case studies and before and after examples are needed to show that carefully planned development can coexist with good access management. Public and business community involvement is essential to the success of the implementation of the project.

The following are the major elements to be addressed for any Access Management study in an effort to improve access, mobility and safety:

Intersections
According to the Transportation Research Circular Number 456 (1996), a majority of the delays along corridors occur as a result of stops at signalized intersections. Additionally, the number of signalized intersections per mile has a significant influence on travel speeds. Pennsylvania DOT agrees that signalized intersections should be spaced far enough from the next to prevent back up of vehicles from one intersection to the other. Uniform spacing is preferable and provides for a better flow of traffic. The Virginia Department of Transportation notes that intersections should be designed to limit the number of conflict points and accommodate non-motorized modes of transportation. Furthermore, VDOT found that spacing signalized intersections approximately ½ mile apart will support a wide range of speeds. FHWA has defined the physical area of an intersection as the fixed area that represents the space confined within the corners of the intersection (see **Figure 31**). The functional area of an intersection is located immediately adjacent and includes the areas upstream and downstream of the physical area of the intersection. The functional area of an intersection can vary in distance (FHWA).

Figure 31: Physical and Functional Areas of an Intersection
Source: FHWA



AASHTO states the upstream functional area of an intersection is influenced by distance traveled during perception-reaction time; deceleration distance while the motorists comes to a stop; and length of queue at an intersection. This part of the intersection is dependent upon whether or not traffic in the through lanes is required to come to a complete stop.

Turn Lanes
According to Pennsylvania Department of Transportation, left turn lanes are used exclusively for left turn movements, and should be provided in areas with high-turn volumes. A left turn lane allows turn movements to be removed from through traffic, reducing the delay of through traffic. This separates traffic movement and increases the capacity of an intersection or roadway, and also reduces the opportunities for rear-end crashes.

A deceleration lane or right-turn lane provides space for a motorist to decrease their speed before making a turn movement into a driveway or a side street. These lanes separate vehicles slowing to make a right turn from through traffic and allow right turns to be completed without impeding the travel speed of through traffic. These lane can also reduce rear-end crashes (Pennsylvania Department of Transportation).

Median Treatments
Median treatments have a significant impact on safety. Raised medians should be used to limit left turns to and from driveways is with proper use of medians. AASHTO recommends raised medians or continuous left turn lanes. Raised medians separate opposing directions of travel, significantly reducing the potential for crashes (FHWA). Determination for raised versus flush median is typically based on traffic volume and speed along a particular corridor. For example, along a four-lane corridor with high capacity and turn volumes, a raised median is safer. Along a two-lane facility, a flush median would be sufficient as there is likely less congestion along that corridor. Flush medians can be converted into raised medians at signalized intersections to improve safety. TxDOT encourages raised medians along high speed, high traffic corridors. As urban arterial traffic is expected to rise above 24,000 VPD in a design year, a CLTL will begin to function poorly no matter how well driveways are managed. A raised median will function much better in place of a TWLTL. Dedicated left-turn bays and right-turn slip lanes separate turning traffic from through traffic, greatly increasing the flow and capacity of the route.

When such medians are used, signal spacing also becomes critical to traffic flow. Stop lights spaced less than ¼ mile apart will result in slow-speed routes. Ideally, traffic signals (and major intersections) should be spaced at least ½ mile apart to maintain desirable speeds.

Figure 32 and **Figure 33** below demonstrate how conflict points can be removed from a roadway with the installation of a raised median.

Figure 32: Reduction in Conflict Points with Median Breaks

Source: Iowa Access Management Handbook

Before: 11 Traffic Conflicts

After: 6 Traffic Conflicts
Left-turning vehicles separated from through traffic

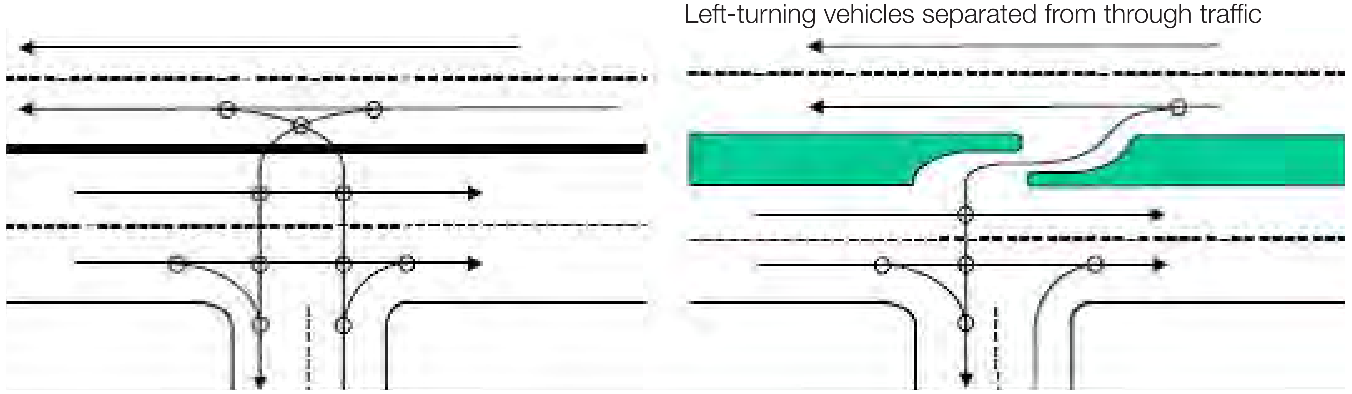
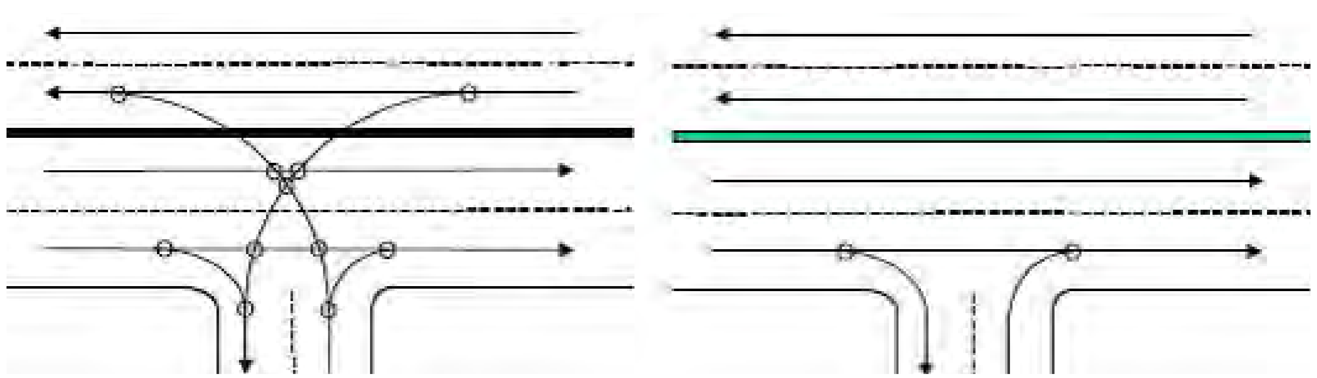


Figure 33: Reduction in Conflict Points with Raised Median

Source: Iowa Access Management Handbook

Before: 11 Traffic Conflict Points

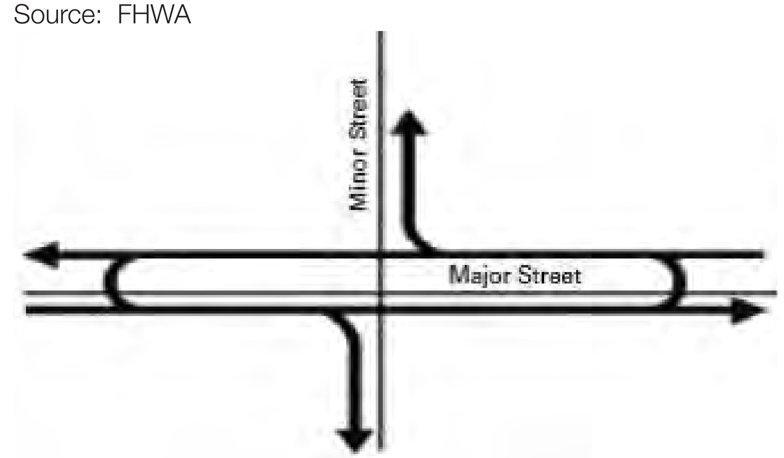
After: 2 Traffic Conflict Points



Median U-turns can be implemented along a corridor with medium to high speed four-lane divided highways. Desirable minimum median widths between 40 and 60 ft are typically needed to accommodate large trucks so that they do not encroach on curbs or shoulders. Intersections with narrower medians need bulb-outs or loons at U-turn crossovers. According to the FHWA, a median U-turn opening has sixteen conflict points, while a standard intersection has thirty-two conflict points. This type of median treatment can reduce crashes by 20 to 50%. **Figure 34** below provides a diagram of a median U-turn along a major corridor.

Figure 34: Median U-Turn Movements along Major Corridor

Source: FHWA



Driveways

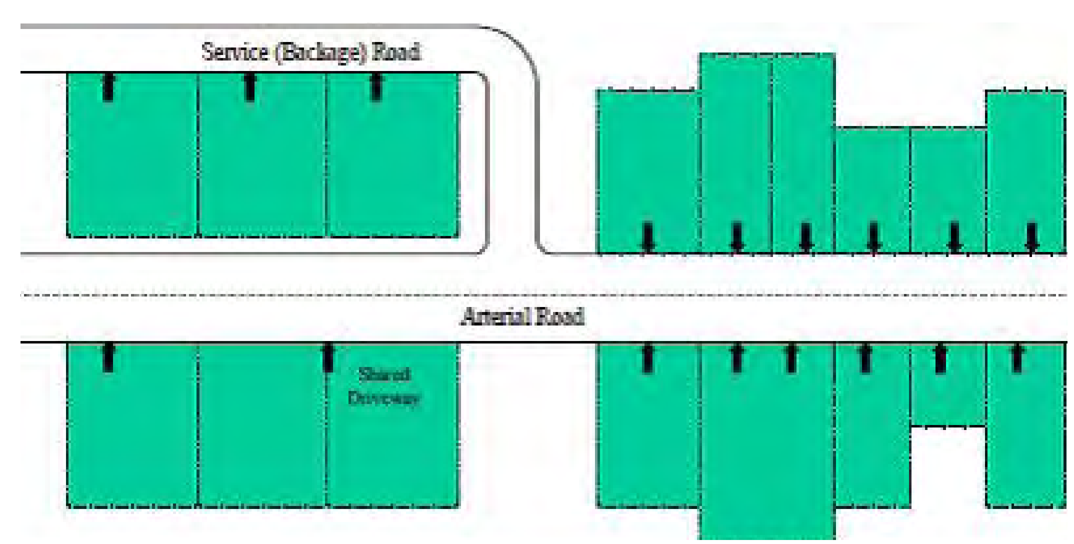
Driveway width and spacing are important elements of access management. Driveways should be designed to adequately ensure safety and efficient movement of vehicles to and from the roadway. Elements to be considered include upstream and downstream sight distance, angle, and turn radius, number of lanes, and vertical grade and length of the driveway throat (FHWA). **Figure 35** below demonstrates the different between adequate and an inadequate driveway spacing.

Figure 35: Difference in Adequate and Inadequate Driveway Spacing

Source: FHWA

Good Spacing

Inadequate Spacing



According to FHWA, wide driveway openings with no discernible curbs or boundaries along rural and arterial roadways are common. Furthermore, increased speed differential increases the probability of crashes along the roadway with multiple driveways. The optimal width for a one-way in commercial driveway is 14 to 16 feet, and 11 feet for each lane of a two-way driveway. A two-lane driveway should have a median divider to enhance safety for motorists and pedestrians. Dual left-turn lanes into driveways and dual right-turn lanes onto public streets should be used only with traffic control.
One of the most important access management principles to implement is relocating driveways away from street corners. A driveway opening located too close to an intersection may cause traffic to be blocked by motorists turning into the driveway; turn lanes to be blocked, increase possibility for rear-end or broadside collision or driver confusion (FHWA).

Driveways that enter the public roadway at traffic signals should have at least two outbound lanes—one for right turns and one for left turns (with a minimum width of 22 feet) and one inbound lane of 14 feet minimum width. Dual left-turn lanes into driveways and dual right-turn lanes onto public streets should be used only with traffic control. All noncommercial (residential) driveways should normally have a width between 14 feet and 24 feet. Where larger vehicles (farm equipment or trucks) will use a driveway, at least a 20- foot width should be provided. Narrow driveways are not ideal under any circumstances; however they can best be tolerated on local streets and roads that carry little of no through traffic. Narrow driveways are more tolerable for residential properties than for retail businesses, since businesses generate many more vehicles entering and exiting driveways per hour. Increasing driveway width thus becomes a very important consideration along the study area roadways that.

Each access point introduces conflicts and friction into the traffic stream and with more conflict points there is a higher potential for crashes, longer travel times, and greater delays. **Table 6** below shows that relative Crash Rates for un-signalized access points increase with the number of access points. For example, there is a 3-fold increase in crash rates when the number of access points is increased from 10 to 60.

Table 6: Crash Rates for Un-signalized Access Points

UN-SIGNALIZED ACCESS POINTS PER MILE*	AVERAGE SPACING (FT)**	RELATIVE CRASH RATES
10	1056	1
20	528	1.4
30	352	1.8
40	264	2.1
50	211	2.4
60	176	3.0
70	151	3.5

*On both sides of the road
**On the same side of the road, assuming equal split between both sides
Source: Access Management Manual, TRB 2003

Driveway consolidation greatly improves the functionality of a major roadway. By limiting the ingress and egress points, the roadway will be able to operate more efficiently, channeling the turns into more predictable locations will help reduce the potential for collisions. Additionally, having fewer driveways minimizes the number of trips that a motorist needs to take using the arterial. This may be achieved through the utilization or creation of minor roadways and/or service roads (i.e., frontage/backage roads).

Something to consider during the process of driveway consolidation is the alignment with entry points on opposite sides of the road. Where driveways are closely offset or have no offset at all, drivers may attempt to cross the busy road directly from one to another. Positioning entryways with no offset essentially creates minor intersections. While this does provide for more predictable movements, it still can generate traffic backups if high-intensity land uses are located across from one another. A benefit of this design is that it allows for future signalization if the demand should call for it. Drives with inadequate or improper offset, offer increased opportunity for unsafe crossing movements and should be avoided.

Bicycle and Pedestrian Facilities
Access management is generally promoted as a way to improve driving conditions for motorists. However, FHWA has found that access management also provides safety benefits for pedestrians and cyclists. FHWA has identified the following access management design features that will help improve pedestrian safety:

- **Driveway spacing:** Each pedestrian path that crosses a road or driveway represents several potential points of conflict between a pedestrian and a vehicle. Therefore, reducing the number of driveways will proportionally reduce the quantity of conflict points.
- **Right-turn lanes with minimum turn radius:** On high-volume driveways, providing a dedicated right-turn lane will allow vehicles to decelerate and turn using a minimum turn radius. This reduces turning speeds into driveways and allows narrower driveway crossings for pedestrians.
- **Sidewalk setbacks and clear zones:** Locating sidewalks away from the curb offers many operational and safety benefits. In addition, a landscaped or other clearly marked buffer helps to visually define sidewalk and driveway locations. A corner clear zone—free of visual obstructions such as signs, large trees and bushes, or parked vehicles—allows pedestrians to be seen by any oncoming vehicles.
- **Mid-block crosswalks:** Where the distance between pedestrian crosswalks is large, a mid-block pedestrian crossing can improve safety by presenting a dedicated place for people to cross. This adds predictability to the route and can reduce crashes while making the area more convenient for pedestrians.
- **Medians:** Medians offer areas of safe refuge to pedestrians. Pedestrian crash rates are lower on roads with raised medians than on undivided highways or those with center left turn lane (CLTL).

Other tools that need to be considered in any access management study include improvements to signing, pavement marking, way finding, illumination, signal synchronization and signal timing, improving circulation and support street system and an efficient incident management system to minimize down time and roadway closure.

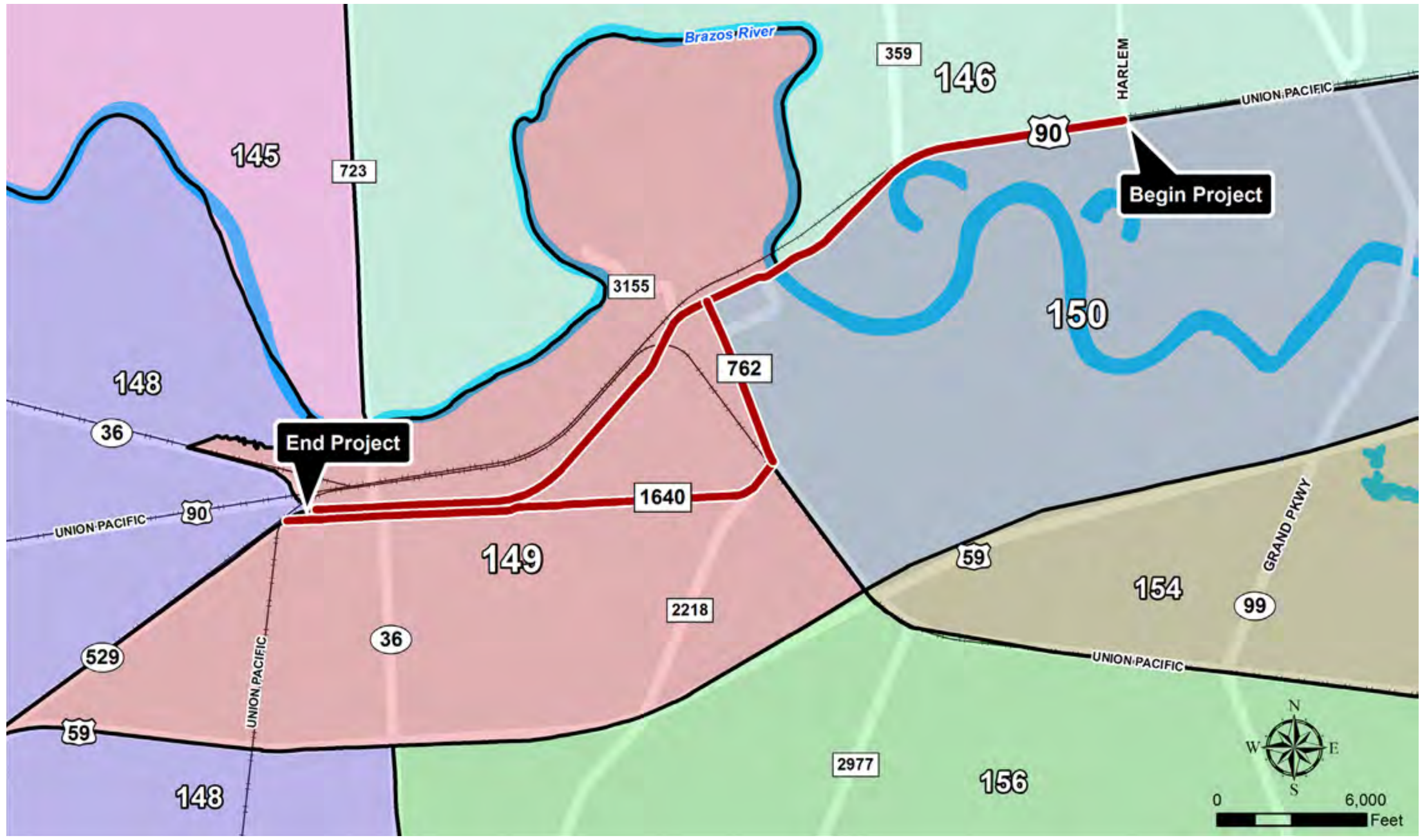
APPENDIX B - H-GAC REGIONAL ANALYSIS ZONE DATA

The study area is located within three Regional Analysis Zones (RAZ), 146, 149, and 150 (see Figure 1.3). A majority of the study area is located within RAZ 149. As indicated in Table 1.1, the number of jobs within RAZ 149 is projected to increase by 61% from approximately 28,000 in 2012 to 45,000 in 2035 and by 72% from 2012 to 48,000 in 2040. The household population within RAZ 149 is projected to increase by 59% from 42,100 in 2012 to 67,000 in 2035 and by 66% from 2012 to 70,100 in 2040. The number of jobs and household population in RAZ 146 and RAZ 150 are also anticipated to increase at a similar rate. Therefore, the projected job growth will attract more people to the cities of Richmond and Rosenberg, increasing the population and the need for access management.

Table 1.1: Project Population and Employment Growth with Study Area
Source: H-GAC RAZ Data, 2012

RAZ	JOBS					HOUSEHOLD POPULATION				
	2012 Jobs	2035 Jobs	Percent Increase (from 2012)	2040 Jobs	Percent Increase (from 2012)	2012 Household Population	2035 Household Population	Percent Increase (from 2012)	2040 Household Population	Percent Increase (from 2012)
146	8,601	23,350	171.48%	28,248	228.43%	87,070	138,619	59.20%	148,532	70.59%
149	28,091	45,230	61.01%	48,418	72.36%	42,136	67,033	59.09%	70,145	66.47%
150	7,791	12,431	59.56%	15,595	100.17%	27,495	49,952	81.68%	54,612	98.63%

Figure 1.3: Regional Analysis Zones Map
Source: H-GAC RAZ Data, 2012



APPENDIX C - DRIVEWAY DENSITY SUMMARY

US 90A from Barmore Road to Harlem Road					
Segment	**Distance (Miles)**	**Driveways Eastbound**	**Driveways Westbound**	**Driveways Total**	**Driveway Density**
Barmore Rd. to Brazos St.	0.49	13	12	25	51.02
Brazos St. to 3rd St.	0.39	23	16	39	100
3rd St. to 8th St.	0.32	9	11	20	62.5
8th St. to Miles St.	0.79	17	34	51	64.56
Miles St. to Sally Anne Dr.	0.64	28	27	55	85.94
Sally Anne Dr. to Lane Dr.	0.66	23	19	42	63.64
Lane Dr. to FM 762	0.62	8	7	15	24.19
FM 762 to S. 2nd St.	0.48	10	12	22	45.83
N. 2nd St. to FM 359	1.36	31	16	47	34.56
FM 359 to Pitts Rd.	0.51	8	0	8	15.69
Pitts Rd. to Harlem Rd.	1.22	11	2	13	10.66
Barmore Road to Harlem Road	**7.47**	**181**	**156**	**337**	**45.11**

FM 1640 from Bamore Road to FM 762					
Segment	**Distance (Miles)**	**Driveways Eastbound**	**Driveways Westbound**	**Driveways Total**	**Driveway Density**
Bamore Rd. to SH 36	0.66	25	20	45	68.24
SH 36 to 4th St.	0.19	6	8	14	72.33
4th St. to 8th St.	0.25	10	10	20	78.51
8th St. to Millie St.	0.57	23	19	42	73.14
Millie St. to Radio Ln.	0.50	17	14	31	61.84
Radio Ln. to Lane Dr.	0.61	1	9	10	16.40
Lane Dr. to FM 762	0.96	9	20	29	30.21
Bamore Road to FM 762	**0.66**	**25**	**20**	**45**	**68.24**

FM 762 from FM 1640 to US 90A					
Segment	**Distance (Miles)**	**Driveways Southbound**	**Driveways Northbound**	**Driveways Total**	**Driveway Density**
FM 1640 to Foster Drive	0.57	23	15	38	66.88
Foster Drive to Austin Street	0.48	15	7	22	45.93
Austin Street to US 90A	0.27	11	12	23	85.70
FM 1640 to US 90A	**1.32**	**49**	**34**	**83**	**63.09**

TOTAL	**9.45**	**255**	**210**	**465**	**49.23**

APPENDIX D - PLANNED PROJECTS IN STUDY AREA

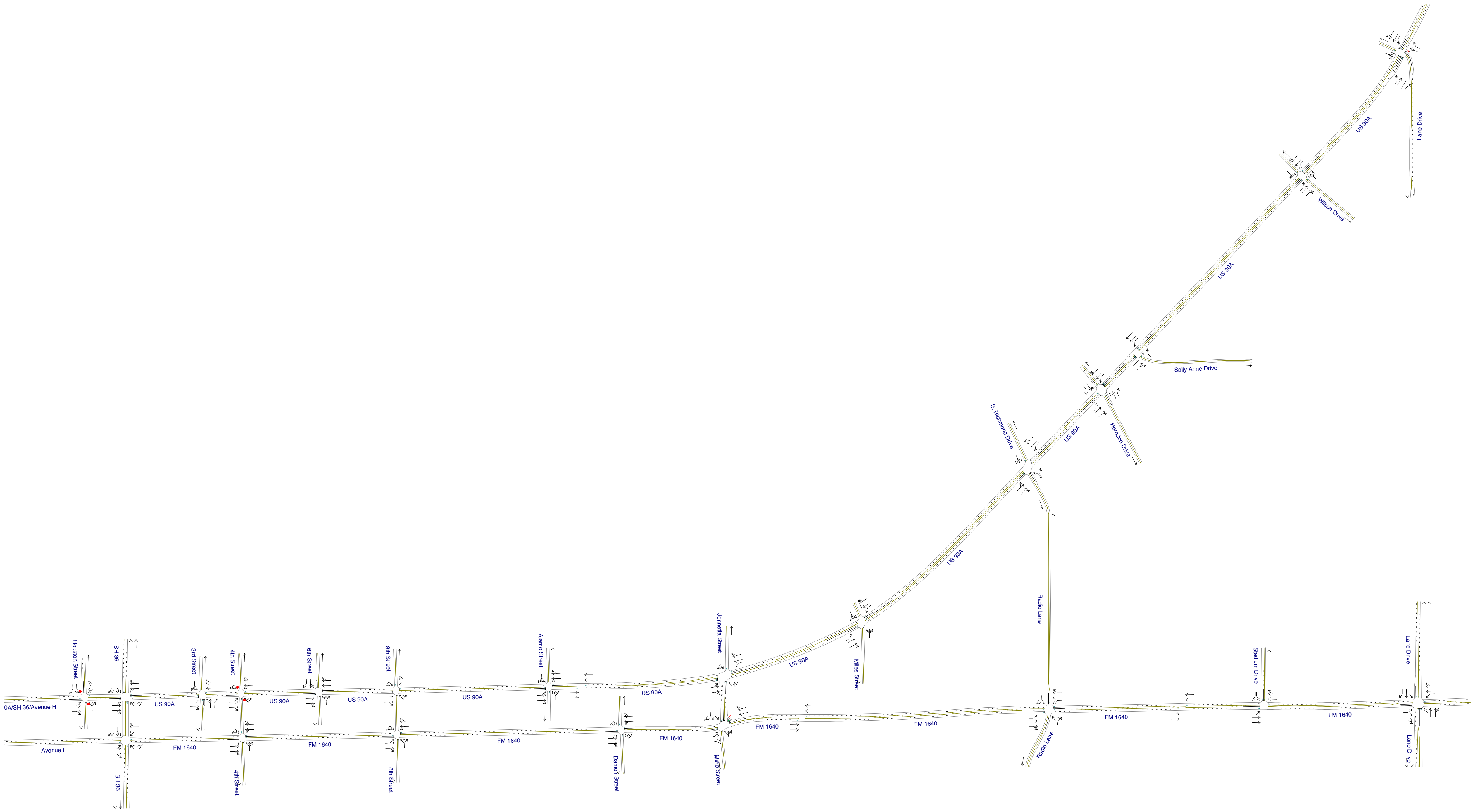
Short-Term, Funded Projects										
Category	**CSJ**	**MPOID**	**Street**	**From**	**To**	**Project Status**	**Description**	**Sponsor**	**Est. Let Date**	**Total Cost**
Widening		12785	Airport Ave	Graeber St	FM 2218	TIP	Reconstruct existing 2-lane roadway to 2-lane with CLTL curb & gutter with storm sewer	City of Rosenberg	2013	$2,450,000
Widening	1415-03-010	14711	FM 2759	US 59 S	FM 762/FM 2759 on Crabb River Rd	TIP	Widen to 4-lanes divided	Fort Bend County	2015	$10,950,748
Widening	0543-03-067	14710	FM 762	FM 762/FM 2759	S of LCISD School on Crabb River Rd	TIP	Widen to 4-lanes divided	Fort Bend County	2015	$10,950,748
Widening		10335	Golfview Rd	FM 762	Williams Way Blvd	TIP	Reconstruct existing 2-lane roadway to 2-lane with two-way left turn lane, curb & gutter and storm sewer	Fort Bend County	2013	$3,193,667
Widening		14753	Harlem Rd	SH 99	Plantation Dr	TIP	Reconstruct existing 2-lane to 4-lane curb & gutter with open ditch drainage.	Fort Bend County	2013	$5,948,800
New Location		7809	Lamar Dr	FM 1640	FM 2218	TIP	Construct 4-lane roadway on new location	City of Richmond	2016	$366,376
New Location		15560	Mason Rd	SH 99	Skinner Ln	TIP	Construct 4-lane concrete curb&gutter roadway partially in new location	Fort Bend County	2014	$6,500,000
New Location		15223	SH 99	US 59 S	Brazoria C/L	TIP	Seg C-2: PS&E for 4-lane tollway with non-continuous two 2-lane frontage roads and interchanges	FBCTRA	2017	$497,000,000
Widening	0089-09-901	15572	SP 529	FM 1640	US 90A	TIP	Realign and widen to 4 lanes	TxDOT	2017	$1,919,000
Widening	0027-12-097	6048	US 59 S	0.31 mi W of FM 2759	0.42 mi W of FM 762	TIP	Widen to 8 mainlanes with hov lanes, frontage roads, ITS & TMS	TxDOT	2014	$94,960,980
Widening	0027-12-105	6049	US 59 S	SP 10	0.42 mi W of FM 762	TIP	Widen to 6-lane rural freeway, frontage roads, ITS & TMS with grade separation	TxDOT	2014	$137,000,000
Widening	0027-12-114	9912	US 59 S	0.38 mi W of FM 762	0.31 mi W of FM 2759	TIP	Construct 2-way hov lanes	TxDOT	2014	$12,265,000
Widening	0027-12-106	6050	US 59 S	W of SP 10	W of SH 36	TIP	Widen to 6-lane rural freeway, frontage roads, ITS & TMS	TxDOT	2014	$153,000,000
Widening		7740	Williams Way Blvd	Hillcrest Dr	Ransom Rd	TIP	Widen from 2-lane to 4-lane divided urban section	Fort Bend County	2013	$8,334,000
Widening		7806	Williams Way Blvd	US 59 S	FM 762	TIP	Widen to 4-lane divided roadway and extend 4-lane divided roadway in new location	Fort Bend County	2016	$10,956,369
Rehab	1683-01-037	15559	FM 1640	Spur 529	Millie St	TIP	EB one-way pair, criss-cross, intersections and 1.5" overlay	TxDOT	2015	$2,086,000
Rehab	0027-06-056	15558	US 90A	Spur 529	Millie St	TIP	WB one-way pair, criss-cross, intersections and 1.5" overlay	TxDOT	2015	$2,086,000

Long-Term, Funded Projects										
Category	**CSJ**	**MPOID**	**Street**	**From**	**To**	**Project Status**	**Description**	**Sponsor**	**Est. Let Date**	**Total Cost**
Widening	0543-03-900	803	FM 762	US 59 S	Crabb River Rd	RTP-Long	Widen 2-lane to 4-lane divided suburban arterial	TxDOT	2034	$57,491,183
New Location	3510-03-004	14247	SH 99	At US 59 S		RTP-Long	Construct 4 direct connectors (toll)	FBCTRA	2030	$104,000,000
Widening	0089-09-058	6051	US 59 S	W of SP 10	W of Hamlink Rd	RTP-Long	Widen to 6-main lanes, grade separations, 2-lane frontage roads, its & tms	TxDOT	2031	$101,000,000
New Location		7741	10th St	Brazos River North Bank	US 90A	RTP-Short	Construct 2-lane concrete divided w/ curb & gutter (in sections)	City of Richmond	2020	$10,939,400
Widening		12622	Harlem Rd	SH 99	US 90A	RTP-Short	Widen from 4 to 6 lanes w/bridges	Fort Bend County	2020	$33,892,128
New Location	3510-03-002	10128	SH 99	US 59 S	FM 762	RTP-Short	Seg C: construct 4-lane tollway with interchanges and two non-continuous 2-lane frontage roads	Fort Bend County	2017	$218,000,000
New Location		464	SP 10	Waller County Line	SH 36	RTP-Short	Extension of 2-lane roadway	Fort Bend County	2018	$14,317,318
Grade Separation	0027-06-046	9430	SH 36/US 90A	UPRR in Rosenberg		RTP-Short	Replace Railroad Underpass	TxDOT	2017	$18,510,000
Grade Separation	0543-02-055	12855	FM 359	At US 90A and UPRR		RTP-Long	Railroad Grade Separation (Elevated T)	TxDOT	2025	$25,799,147
Grade Separation	0027-07-032	9637	US 90A	At W City Limits of Richmond and BNSF Railroad		RTP-Long	Replace Railroad Underpass	TxDOT	2021	$41,483,000
Widening	0027-08-137	275	US 90A	SH 99	SH 6	RTP-Short	Widen from 4 to 6 lanes	TxDOT		$6,557,000

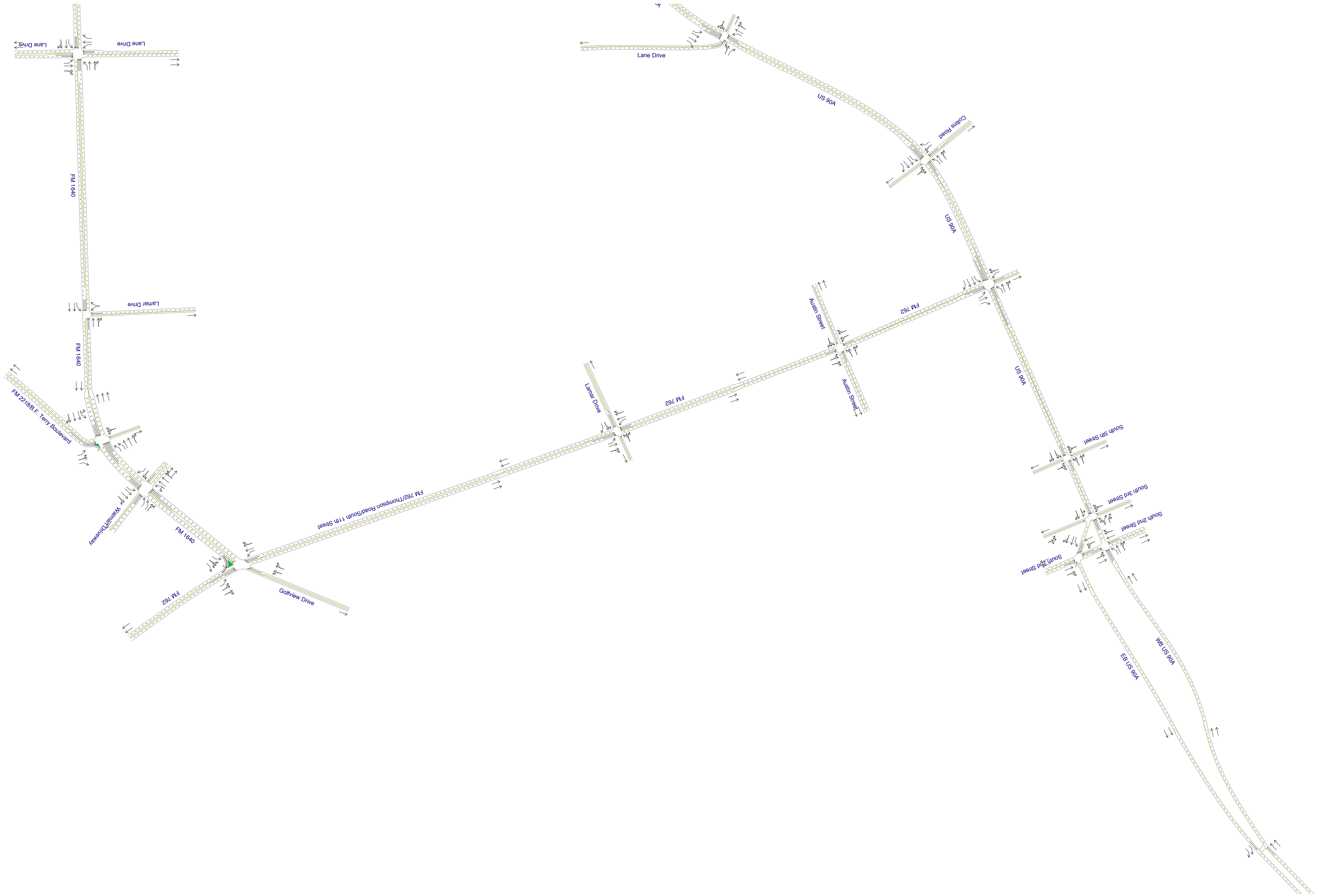
Long-Term, Unfunded Projects										
Category	**CSJ**	**MPOID**	**Street**	**From**	**To**	**Project Status**	**Description**	**Sponsor**	**Est. Let Date**	**Total Cost**
Widening		12621	FM 359	FM 359	US 90A	RTP	Widen from 2 to 6-Lanes	TxDOT		$49,404,721
Widening		11681	FM 529	US 59	FM 1640	RTP	Widen to 4-Lanes in Sections	TxDOT		$29,114,566
Widening	0188-09-040	981	FM 723	FM 1093	N of the Brazos River	RTP	Widen to 4-lane divided rural	TxDOT		$45,633,578
Widening		12620	FM 723	FM 359	US 90A	RTP	Widen from 2 to 6 lanes with bridge	TxDOT		$118,400,728
Widening		982	FM 762	US 90A	FM 1640	RTP	Widen to 6-Lane Divided	TxDOT		$11,546,025
Widening		12812	FM 762	FM 1640	FM 2759	RTP	Widen from 2 to 6-Lanes (in Sections)	TxDOT		$87,062,162
Widening	0187-05-048	9695	SP 10	SH 36	US 59	RTP	Widen to 4-lane divided rural facility	TxDOT		$26,792,422
Widening	0027-07-026	272	US 90A	Millie St.	FM 762	RTP	Reconstruct from 4 Lanes to 6-Lane Divided Curb & Gutter Section	TxDOT		$48,500,898
Widening	0027-08-146	10114	US 90A	Loop 762	FM 359	RTP	Widen to 6-Lane Divided (Phase 3 of 3)	TxDOT		$34,484,612
Widening	0027-08-147	10115	US 90A	FM 359	SH 99	RTP	Widen to 6-Lane Divided (Phase 2 of 3)	TxDOT		$72,751,298
Rehab	0027-08-161	11269	US 90A	US 90A WB at Brazos River		RTP	Rehabilitate Bridge and Approaches	TxDOT		$7,622,424
Rehab	0027-06-900		US 90A	SP 10	SP 529	TxDOT	Base Repair and 1.5" ACP Overlay	TxDOT		$960,000
Rehab	0024-07-041		US 90A	Millie St	Brazos River	TxDOT	Base Repair and 1.5" ACP Overlay	TxDOT		$1,001,000
Rehab	0027-08-170		US 90A	Brazos River	FM 359	TxDOT	Base Repair and 1.5" ACP Overlay	TxDOT		$504,000
Rehab	0027-08-172		US 90A	FM 359	SH 6	TxDOT	Base Repair and 1.5" ACP Overlay	TxDOT		$2,420,000
Widening	0187-05-049		SH 36	SP 529 in Rosenberg	Austin County Line	TxDOT	Widen existing pavement to 4-lane divided rural	TxDOT		$97,300,000

APPENDIX E - INTERSECTION LANE USE AND TURNING MOVEMENT COUNTS

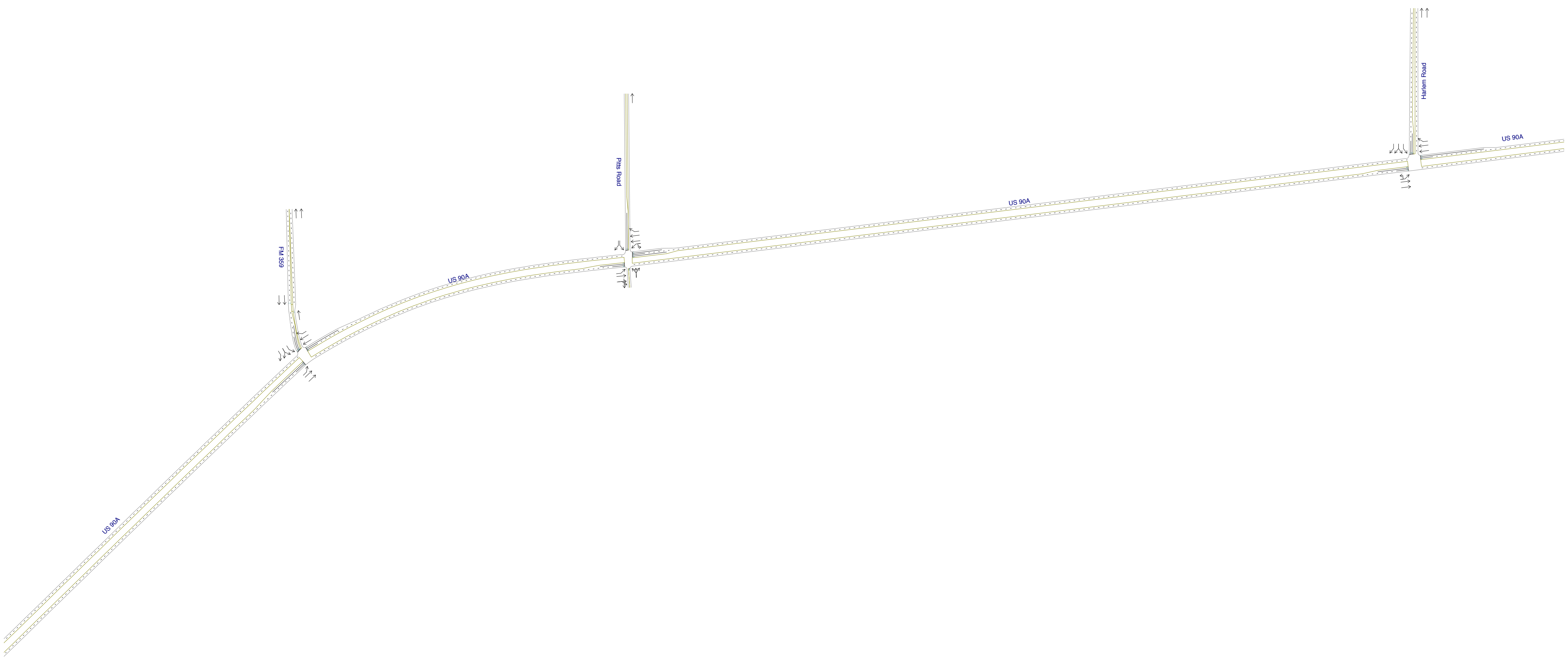
Intersection Lane Use



Intersection Lane Use



Intersection Lane Use



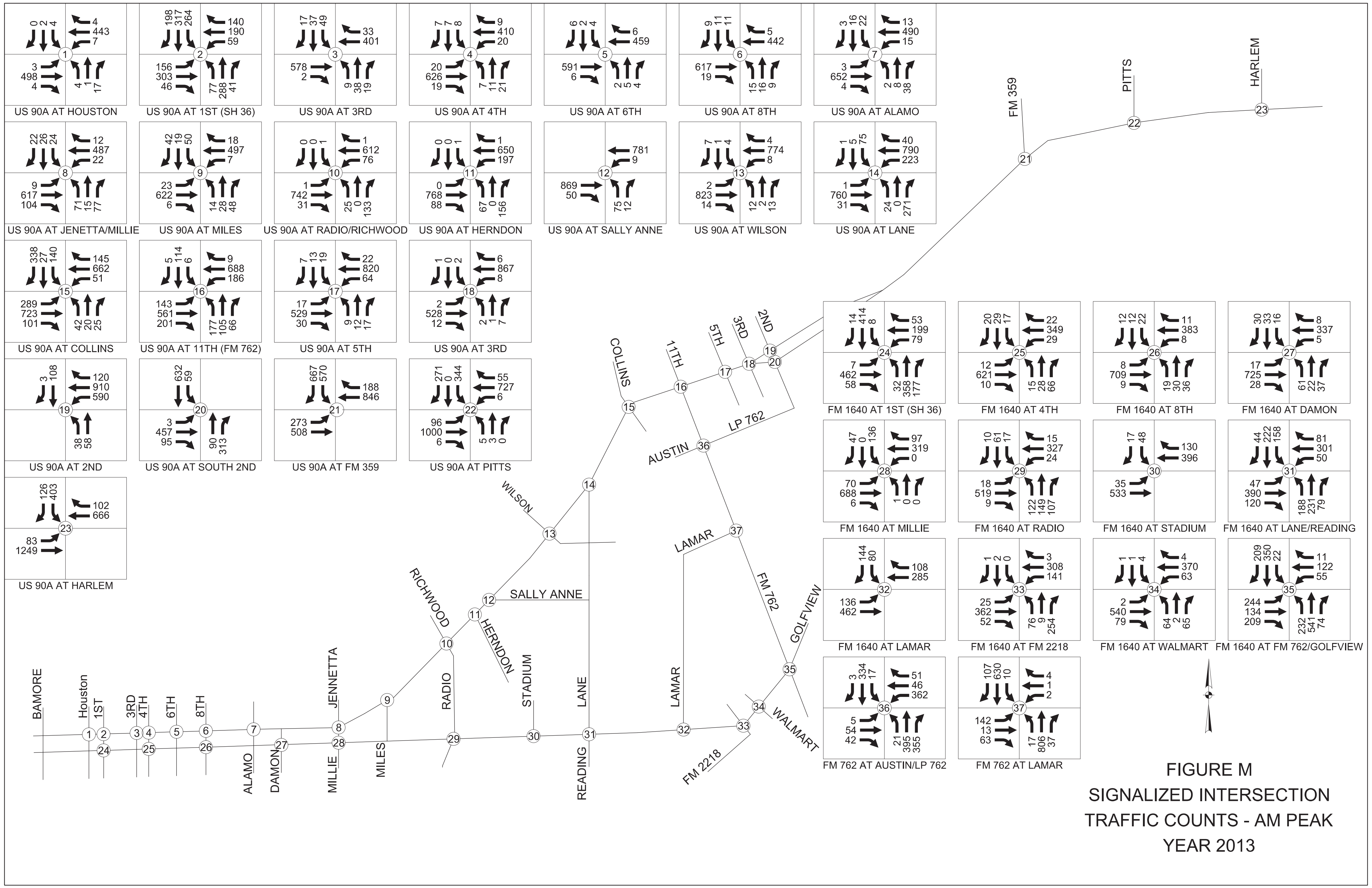


FIGURE M
SIGNALIZED INTERSECTION
TRAFFIC COUNTS - AM PEAK
YEAR 2013

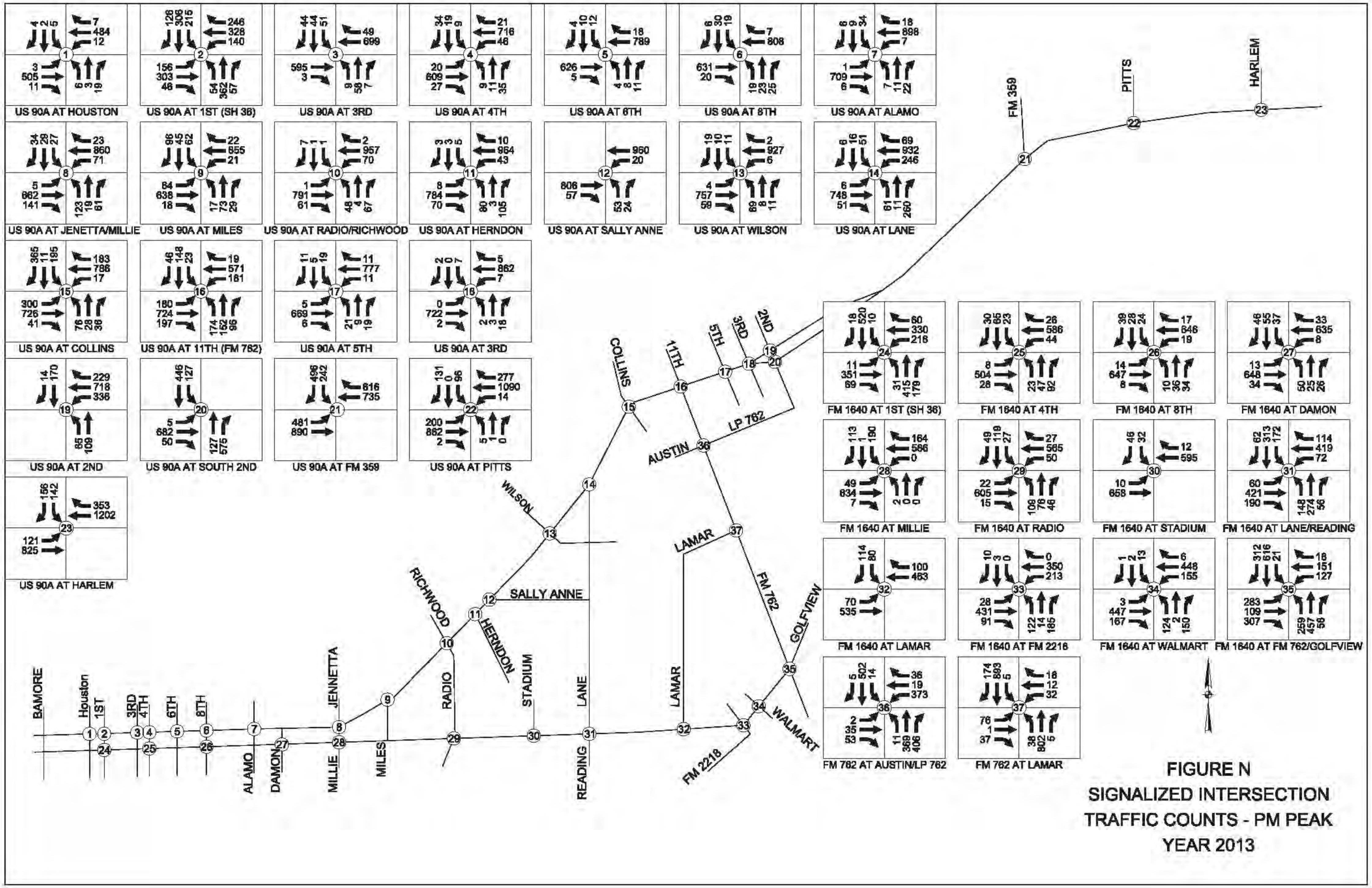


FIGURE N
SIGNALIZED INTERSECTION TRAFFIC COUNTS - PM PEAK
YEAR 2013

APPENDIX F - TRAFFIC ANALYSIS

The following assumptions and conditions were included in the Traffic Model:

- On the west end of the one-way pair, the intersection of US 90A at Frost (where eastbound US 90A traffic has to turn right and go southbound) and FM 1640 at Frost (where such turning traffic has to turn left to go eastbound on FM 1640) were modeled as unsignalized intersections since TxDOT is still evaluating them to determine whether signals are warranted.

- On the east end of the one-way pair where eastbound FM 1640 traffic (heading to eastbound US 90A) and westbound FM 1640 traffic (heading to westbound US 90A) cross, a new intersection is proposed. This intersection is midway between US 90A and FM 1640 and between Damon and Louise. The volumes at this location meet the warrants for a signal, and a signal is assumed for future conditions.

- On the east end, due to the one-way pair operation, the signalized intersection of FM 1640 at Damon in Rosenberg is recommended for removal. In addition the overhead flasher at US 90A and Houston just west of SH 36 is also recommended for removal.

- In Richmond, a newly reconfigured intersection has been proposed where US 90A and Damon intersect just east of the twin bridges across the Brazos River. This new intersection is designed to improve safety for residential traffic and pedestrians crossing US 90A, streamlining the access to/from several existing and future businesses located on either side of US 90A near Damon. With the proposed configuration, and based on current peak hour traffic in 2013, this location comes very close to warranting a signal now and even more so in the near future, therefore, it is assumed as signalized for future conditions.

- The signal at 3rd Street on US 90A was eliminated to streamline the operations through downtown Richmond and improve safety.

NOTE: Synchro traffic model files are included on the Supplementary Data CD.

Detailed LOS results for each signalized intersection are included in the following table.

List of Signalized Intersections		Year 2013 (Existing) Condition		Scenario 1 Year 2015 Base Condition		Scenario 2 Year 2015 One-way Pair with Timing Optimization	
		AM LOS	PM LOS	AM LOS	PM LOS	AM LOS	PM LOS
1	US 90 (SH 36/Avenue H) at Frost Street	N/A	N/A	Not Analyzed - Under Review by TxDOT		Not Analyzed - Under Review by TxDOT	
2	US 90 (SH 36/Avenue H) at Houston Street (Flasher)	A	A	A	A	A	A
3	US 90 at 1st Street (SH 36)	E	F	E	F	C	C
4	US 90 at 3rd Street	A	A	A	A	A	A
5	US 90 at 4th Street (Emergency Flasher)	A	A	A	A	A	A
6	US 90 at 6th Street	A	A	A	A	A	A
7	US 90 at 8th Street	A	A	A	A	A	A
8	US 90 at Alamo Street	A	A	A	A	A	A
9	EB FM 1640 (to EB US 90A) at WB FM 1640 (to WB US 90A) (new signal)	N/A	N/A	N/A	N/A	B	B
10	US 90 at Jennetta/Millie Street	B	C	B	C	B	B
11	US 90 at Miles Street	B	C	B	C	B	B
12	US 90 at Radio Lane/S. Richwood Drive	A	A	B	A	A	A
13	US 90 at Herndon Drive	C	B	C	B	C	B
14	US 90 at Sally Anne Drive	A	A	A	A	A	A
15	US 90 at Wilson Drive	A	B	A	B	A	A
16	US 90 at Lane Drive	B	B	B	B	B	B
17	US 90 (Jackson Street) at Collins Road	C	D	C	D	C	D
18	US 90 at South 11th Street (Thompson Road/FM 762)	D	D	D	D	D	D
19	US 90 at South 5th Street	A	A	A	A	A	A
20	US 90 at South 3rd Street	A	A	A	A	A	A
21	US 90 at South 2nd Street	B	B	B	B	B	B
22	US 90 (EB) at South 2nd Street	C	C	C	D	B	C
23a	US 90 (EB) at Damon (new signal)	A	A	A	A	B	B
23b	US 90 (WB) at Damon (new signal)	A	A	A	A	B	A
24	US 90 at FM 359	D	C	E	C	D	C
25	US 90 at Pitts Road	D	C	D	C	C	C
26	US 90 at Harlem Road	B	B	C	B	C	B
27	FM 1640 at Frost Street	N/A	N/A	Not Analyzed - Under Review by TxDOT		Not Analyzed - Under Review by TxDOT	
28	FM 1640 (Avenue I) at SH 36	B	B	B	B	C	C
29	FM 1640 at 4th Street	A	B	A	B	A	A
30	FM 1640 at 8th Street	A	A	A	A	A	A
31	FM 1640 at Damon Street	B	B	B	B	A	A
32	FM 1640 at Millie street	A	A	A	A	A	B
33	FM 1640 at Radio Lane	C	C	C	C	C	C
34	FM 1640 at Stadium Drive	A	A	A	A	A	A
35	FM 1640 at Lane Drive / Reading Road	D	D	D	D	C	C
36	FM 1640 at Lamar Drive	B	B	B	B	B	A
37	FM 1640 at FM 2218 (B. F. Terry Boulevard)	B	C	B	C	B	B
38	FM 1640/FM 2218 at Walmart Driveway	B	B	B	B	B	B
39	FM 1640/FM 2218 at FM 762	D	F	D	F	D	D
40	FM 762 (S 11th Street) at Austin Street	B	B	B	B	B	B
41	FM 762 (S 11th Street) at Lamar Drive	B	B	B	B	B	B

APPENDIX G - BENEFITS CALCULATIONS

TIME TRAVEL SAVINGS

Travel time is an integral component of transportation cost, and therefore an assessment of potential savings in travel time is useful in the evaluation of transportation improvements. The value of travel time includes costs to consumers or personal (unpaid) time spent on travel, and costs to businesses of paid employee time spent in travel. In order to estimate potential travel time savings for transportation improvements, a monetary value is placed on the amount of time saved.

The **Table 1** below summarizes illustrates several of the traffic related improvements resulting from implementation of the recommended improvements. The improvements are projected to reduce delay by 13.6% during the weekday AM peak period (2 hours) and 18.2% during the weekday PM peak period (2 hours).

Table 1

US 90A, FM 1640 and FM 762 Combined								
Period	**Scenario**	**Total Delay, hours**	**Percent Improvement**	**Avg Speed, mph**	**Percent Improvement**	**Fuel Consumed, gal**	**Percent Improvement**
AM	Existing	692	13.6%	24	8.3%	2568	1.9%
	Proposed	598		26		2518	
PM	Existing	890	18.2%	23	13%	3038	4.6%
	Proposed	728		26		2898	

According to the Texas A&M Transportation Institute's 2012 Annual Urban Mobility Report, the value of time based on congestion is $16.79 per person-hour for autos and $86.81 per person-hour for trucks.

Using the Consumer Price Index (CPI) to adjust for inflation and assuming an average vehicle occupancy of 1.2 persons, the value to time per auto is equivalent to $20.55 per hour (2013$). The equivalent value for trucks is $106.26 (2013$). Based on an estimate of 5% trucks on the study area corridors, the average cost per vehicle hour is $24.84 per hour (5% x $106.26 + 95% x $20.55).

Total Travel Time cost savings are calculated based on a reduction in total vehicle delays for AM and PM weekday peak periods, consisting of the highest 2 hour period in AM and highest 2 hour period in PM, as shown in Table 1 above. 94 hrs/day + 162 hrs/day) x 260 weekdays/Yr x $24.84/hr = $1.65 million.

CRASH COST SAVINGS

Crash savings are calculated based on estimated crash reductions resulting from implementation of access management treatments, multiplied by the cost for different crash severity types. The Transportation Research Board Access Management Manual has summarized research on the effects of various access management treatments and has published percent reductions in crashes for various treatments. Since the recommended access management treatments vary along each corridor, the corridor was broken into segments based on the treatment types and the appropriate percent reduction in crashes was determined for each segment.

The average annual crashes (average of 5 year period from 2007 to 2011) were also broken into the same segment limits as the treatment types discussed above, and further divided by type of injury: fatality, incapacitating, non-incapacitating, possible injury or no injury. The average annual crashes by injury type were then multiplied by the estimated percent reduction in crashes to obtain the actual number of crashes anticipated to be reduced due to the improvements. These crash numbers, by injury type, were then multiplied by the cost for each injury type to determine the estimated annual crash cost savings. See **Table 2** for the estimated percent reduction in crashes calculated for each segment and **Table 3** for the calculation of the reduction in crashes multiplied by the cost for each injury type to determine savings.

Table 2: Estimated Percent Reduction in Crashes

US 90A		
Segment	**Access Management Treatment**	**Est. % Crash Reduction**
Bamore to Louise	Conversion from 4 lane undivided to one way pair (divided facility)	35%
Louise to RR	Replace two-way left turn lane with raised median	15% to 57% = 36% avg.
RR to Damon	W. of Collins: Add raised median	35%
	7th to 5th: Add raised median	35%
	4th and 3rd: Add raised median	35%
	Riveredge to Damon: Add Lt Turn & Rt Turn Bay	35% + 20% = 55%
	Avg	40%
		0.5 mile x 40%
		0.9 mile x 0%
		14% Weighted Avg
Damon to Harlem	5%: Add Rt Turn Bay E of Damon	20%
	50%: Add raised median Damon to Pitts	10%
	45%: Add 2 sets Lt Turn Bays Pitts to Harlem	25%
		17% Weighted Avg

FM 1640		
Segment	**Access Management Treatment**	**Est. % Crash Reduction**
Bamore to Louise	Conversion from 4 lane undivided to one way pair (divided facility)	35%
Louise to Lamar	Replace two-way left turn lane with raised median at Millie	15% to 57% = 36% avg.
	Replace two-way left turn lane with raised median between Lawrence and Mahlmann	15% to 57% = 36% avg.
	Replace two-way left turn lane with raised median W of Cole to E of Stadium	15% to 57% = 36% avg.
	Replace two-way left turn lane with raised median at Lane	15% to 57% = 36% avg.
	Replace two-way left turn lane with raised median W of Lamar	15% to 57% = 36% avg.
		1.1 miles x 36%
		0.6 miles x 0%
		23% Weighted Average

FM 762		
Segment	**Access Management Treatment**	**Est. % Crash Reduction**
FM 1640 to US 90A	Add Rt Turn Bay at FM 1640	20%
	Add Lt Turn Bay at Inwood (Unsignalized)	75%
	Add Lt Turn Bay at Country Club Dr (Unsignalized)	75%
	Add Two-way Lt Turn Lane at Foster (Unsignalized)	35%
	Add Lt Turn Bay at Pecan (Unsignalized)	75%
	Add Lt & Rt Turn Bay at Austin (Signalized)	(25% to 50%) + 20% = 58%
	No change at Lamar	0%
	No change at Main	0%
		413% / 9 = 46% Avg

Table 3

		2007 to 2011								
	Facility	Segment Length (miles)	Avg Number of Crashes	Fatality Count	Incapacitating Injury Count	Non-incapacitating Injury Count	Possible Injury Count	Unknown I njury Count	Non-injury Count	Total Injury Count
US 90A	Bamore to SH 36 (Rosenberg)	0.7	14	0	0	1.2	4.2	1.6	36.8	5.4
US 90A	SH 36 to Louise (Rosenberg)	0.9	42	0.2	0	4.2	15.6	8.6	100.4	19.8
US 90A	Louise to RR (Rosenberg)	1.8	63	0	0.4	5	20.6	10.2	174.8	26
US 90A	RR to Damon (Richmond)	1.4	59	0.2	2	6.8	19.2	7.4	154.4	28
US 90A	Damon to Harlem (Richmond)	2.7	33	0	0.4	3.4	6	2	68.2	9.8
FM 1640	Bamore to SH 36 (Rosenberg)	0.7	12	0	0	0.8	4	2.4	31.4	4.8
FM 1640	SH 36 to Louise (Rosenberg)	0.9	30	0.2	0	3.4	12.2	3.4	77	15.6
FM 1640	Louise to Lamar (Rosenberg)	1.7	33	0.4	0	2.2	9.4	4.6	91.2	11.6
FM 1640	Lamar to FM 762 (Richmond)	0.5	29	0	1	3.2	7.2	4.2	73.8	11.4
FM 762	US 90A to FM 1640 (Richmond)	1.3	57	0	1	7.8	18.6	4.2	148	27.4

US 90A: Bamore to SH 36 (Rosenberg)				
US 90A: SH 36 to Louise (Rosenberg)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 35% of Annual Average**	**Savings**
Death	$4,459,000	0.2	0.07	$312,130
Incapacitating Injury	$225,100	0	0.00	$-
Non-Incapacitating Injury	$57,400	5.4	1.89	$108,486
Possible Injury	$27,200	30	10.50	$285,600
No Injury	$2,400	137.2	48.02	$115,248
TOTAL				$821,464

US 90A: Louise to RR (Rosenberg)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 36% of Annual Avg**	**Savings**
Death	$4,459,000	0	0.00	$-
Incapacitating Injury	$225,100	0.4	0.14	$32,414
Non-Incapacitating Injury	$57,400	5	1.80	$103,320
Possible Injury	$27,200	30.8	11.09	$301,594
No Injury	$2,400	174.8	62.93	$151,027
TOTAL				$588,355

US 90A: RR to Damon (Richmond)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 14% of Annual Avg**	**Savings**
Death	$4,459,000	0.2	0.03	$124,852
Incapacitating Injury	$225,100	2	0.28	$63,028
Non-Incapacitating Injury	$57,400	6.8	0.95	$54,645
Possible Injury	$27,200	26.6	3.72	$101,293
No Injury	$2,400	154.4	21.62	$51,878
TOTAL				$395,696

US 90A: Damon to Harlem (Richmond)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 14% of Annual Avg**	**Savings**
Death	$4,459,000	0	0.00	$-
Incapacitating Injury	$225,100	0.4	0.07	$15,307
Non-Incapacitating Injury	$57,400	3.4	0.58	$33,177
Possible Injury	$27,200	8	1.36	$36,992
No Injury	$2,400	68.2	11.59	$27,826
TOTAL				$113,302

FM 1640: Bamore to SH 36 (Rosenberg)				
FM 1640: SH 36 to Louise (Rosenberg)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 35% of Annual Avg**	**Savings**
Death	$4,459,000	0.2	0.07	$312,130
Incapacitating Injury	$225,100	0	0.00	$-
Non-Incapacitating Injury	$57,400	4.2	1.47	$84,378
Possible Injury	$27,200	22	7.70	$209,440
No Injury	$2,400	108.4	37.94	$91,056
TOTAL				**$697,004**

FM 1640: Louise to Lamar (Rosenberg)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 23% of Annual Avg**	**Savings**
Death	$4,459,000	0.4	0.09	$410,228
Incapacitating Injury	$225,100	0	0.00	$-
Non-Incapacitating Injury	$57,400	2.2	0.51	$29,044
Possible Injury	$27,200	14	3.22	$87,584
No Injury	$2,400	91.2	20.98	$50,342
TOTAL				**$577,199**

FM 762: US 90A to FM 1640 (Richmond)				
Crash Type	**Cost**	**Annual Average**	**Reduction, 46% of Annual Avg**	**Savings**
Death	$4,459,000	0	0.00	$-
Incapacitating Injury	$225,100	1	0.5	$103,546
Non-Incapacitating Injury	$57,400	7.8	3.6	$205,951
Possible Injury	$27,200	22.8	10.5	$285,274
No Injury	$2,400	148	68.1	$163,392
TOTAL				**$758,163**

GRAND TOTAL CRASH SAVINGS: $4,000,000

EMISSIONS			
	CO (kg)	NOx (kg)	VOC (kg)
AM Existing	89.73	17.46	20.8
AM Proposed	87.98	17.12	20.39
Improvement	-1.75	-0.34	-0.41
PM Existing	106.18	20.66	24.61
PM Proposed	101.29	19.71	23.47
Improvement	-4.89	-0.95	-1.14
Total Improvement			
AM + PM	-6.64	-1.29	-1.55
x 2 (over 2 hr Peak)	-13.28	-2.58	-3.1
x 260 days/year	-3452.8	-670.8	-806
		Yearly Reduction	
Total Existing	101873	19822	23613
AM + PM kg per year			
Total Improvement / Year	**-3.4%**	**-3.4%**	**-3.4%**

APPENDIX H - DETAILED COST ESTIMATES

SHORT TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762

Segment		by TxDOT										by Richmond					by Rosenberg					by County		by Others
		New Traffic Signal	Upgrade Signal Equipment	Optimize Traffic Signal Timing	Synchronize Traffic Signals	Add Right Turn Lane	Add Left Turn Lane	Pavement Addition	Add Raised Median / Channelization (Concrete)	Pavement Removal	Concrete Sidewalks	Add Right Turn Lane	Add Left Turn Lane	Pavement Addition	Add Raised Median / Channelization (Concrete)	Pavement Removal	Add Right Turn Lane	Add Left Turn Lane	Pavement Addition	Add Raised Median / Channelization (Concrete)	Pavement Removal	Street Closure	Pavement Addition	Pavement Addition
		EA	EA	EA	LS	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	EA	SF	SF
1	US 90A From Bamore to Millie St	1	6	6	0	0	3,845	0	15,478	0	2,800	0	0	0	0	0	0	0	0	0	0	0	0	0
2	US 90A From Millie St to Collins	1	3	7	0	15,826	0	25,142	32,935	36,667	1,350	0	0	0	0	0	0	0	0	0	0	0	0	0
3	US 90A From Collins to Riveredge	0	3	5	0	2,918	0	0	9,418	1,653	1,500	0	0	2,436	0	0	0	0	0	0	0	2	0	0
4	US 90A From Riveredge to Harlem Road	1	0	3	0	40,828	190,186	36,464	16,209	23,873	0	0	0	24,569	0	0	0	0	0	0	0	0	0	6,866
5	FM 1640 From Bamore to FM 762	0	3	12	0	0	0	0	17,218	2,222	2,500	0	0	0	0	0	0	0	0	0	1,586	0	0	0
6	FM 762 From FM 1640 to US 90A	0	0	2	0	10,129	68,193	1,267	862	532	400	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**US 90A, FM 1640 and FM 762**	**3**	**15**	**35**	**1**	**69,701**	**262,224**	**62,873**	**92,120**	**64,947**	**8,550**	**0**	**0**	**27,005**	**0**	**0**	**0**	**0**	**0**	**0**	**1,586**	**2**	**0**	**6,866**

MEDIUM TERM IMPROVEMENTS ALONG US 90A, FM 1640, AND FM 762

Segment		by TxDOT					by Richmond	by Rosenberg					by Others
		New Traffic Signal	Upgrade Signal Equipment	Widening of US 90A between 5th and 7th St	Pavement Addition	Concrete Sidewalks With Ramps	Extend Avenue A	Realign Cole	Widen Radio Lane	Realign Jeannetta St.	Realign and Extend Herndon	Realignment and Widening of Miles	Pavement Addition
		EA	EA	EA	SF	SF	EA	EA	EA	EA	EA	EA	SF
1	US 90A From Bamore to Millie St	0	0	0	640	0	0	0	0	0	0	0	0
2	US 90A From Millie St to Collins	1	1	0	0	1,050	0	1	1	1	1	0	0
3	US 90A From Collins to Riveredge	0	0	1	0	250	0	0	0	0	0	0	0
4	US 90A From Riveredge to Harlem Road	0	0	0	0	0	1	0	0	0	0	0	29,005
5	FM 1640 From Bamore to FM 762	0	0	0	0	400	0	0	0	0	0	1	0
6	FM 762 From FM 1640 to US 90A	0	0	0	0	0	0	0	0	0	0	0	0
Total	**US 90A, FM 1640 and FM 762**	**1**	**1**	**1**	**640**	**1,700**	**1**	**1**	**1**	**1**	**1**	**1**	**29,005**

SHORT AND MEDIUM TERM IMPROVEMENTS						New Traffic Signal Per Each		Upgrade Signal Equipment Per Each		Optimize Traffic Signal Timing		Add Right Turn Lane Per Square Foot		Add Left Turn Lane Per Square Foot		Pavement Addition Per Square Foot	
Item	Code	Description	Unit	TxDOT Prices from Estimate	Price	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST
100	2002	PREPARING ROW	STA	$2,262.40	$2,500.00		$-		$-		$-	6.1	$15,250.00	6.1	$15,250.00		$-
104	2001	REMOVING CONC (PAV)	SY	$3.88	$6.00		$-		$-		$-		$-		$-		$-
104	2009	REMOVING CONC (RIPRAP)	SY	$3.44	$5.00		$-		$-		$-		$-		$-		$-
104	2021	REMOVING CONC (CURB)	LF	$4.33	$4.50		$-		$-		$-		$-		$-		$-
104	2036	REMOVING CONC (SIDEWALK OR RAMP)	SY	$4.61	$11.00		$-		$-		$-		$-		$-		$-
105	2014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY	$2.95	$6.00		$-		$-		$-	678	$4,068.00	678	$4,068.00	84	$504.00
110	2001	EXCAVATION (ROADWAY)	CY	$5.61	$8.00		$-		$-		$-	0	$-	0	$-		$-
112	2002	SUBGRADE WIDENING (DENS CONT)	STA	$917.31	$1,000.00		$-		$-		$-	6.1	$6,100.00	6.1	$6,100.00	1.5	$1,500.00
132	2005	EMBANKMENT (FINAL)(ORD COMP)(TY C)	CY	$6.09	$20.00		$-		$-		$-		$-	0	$-		$-
150	2001	BLADING	STA	$293.38	$295.00		$-		$-		$-	6.1	$1,799.50	6.1	$1,799.50	1.5	$442.50
160	2003	FURNISHING AND PLACING TOPSOIL (4")	SY	$3.25	$3.25		$-		$-		$-	0	$-	0	$-		$-
162	2002	BLOCK SODDING	SY	$2.52	$4.00		$-		$-		$-		$-		$-		$-
164	2045	STRAW OR HAY MULCHING	SY	$0.14	$0.20		$-		$-		$-	1356	$271.20	1356	$271.20	333	$66.67
168	2001	VEGETATIVE WATERING	MG	$13.91	$14.00		$-		$-		$-	1	$14.00	1	$14.00	1	$14.00
170	2001	IRRIGATION SYSTEM	LS		$25,000.00		$-		$-		$-		$-		$-		$-
247	2041	FL BS (CMP IN PLC)(TY A GR 1)(FNAL POS	CY	$83.49	$85.00		$-		$-		$-	166	$14,110.00	166	$14,110.00	37	$3,154.44
260	2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$148.18	$175.00		$-		$-		$-	8.4	$1,470.00	8.4	$1,470.00	1.9	$328.13
260	2014	LIME TRT (SUBGR)(DC)(6")	SY	$4.00	$4.00		$-		$-		$-	750	$3,000.00	750	$3,000.00	167	$668.00
316	2006	ASPH (AC-20-5TR)	GAL	$5.14	$5.00		$-		$-		$-	299	$1,493.33	299	$1,493.33	67	$333.33
316	2222	AGGR(TY-PB GR-4S SAC-B)	CY	$88.99	$150.00		$-		$-		$-	6.8	$1,018.18	6.8	$1,018.18	1.5	$227.27
341	2122	D-GR HMA(QCQA) TY-D PG70-22	TON	$83.62	$85.00		$-		$-		$-	82	$6,981.33	82	$6,981.33	18	$1,558.33
354	2023	PLANE ASPH CONC PAV(0" TO 4")	SY	$0.59	$3.50		$-		$-		$-	0	$-	0	$-		$-
360	2018	CURB (TYPE II)	LF	$4.09	$4.00		$-		$-		$-	610	$2,440.00	610	$2,440.00	150	$600.00
360	2023	CONC PAV (JOINT REINF) (6")	SY	$40.06	$40.00		$-		$-		$-	0	$-	0	$-		$-
360	2026	CONC PAV (JOINT REINF) (10")	SY	$39.18	$40.00		$-		$-		$-		$-		$-		$-
432	2066	RIPRAP (CONC)(CL B)	CY	$258.00	$300.00		$-		$-		$-	0	$-	0	$-		$-
502	2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$3,936.84	$3,000.00		$-		$-		$-	1	$3,000.00	1	$3,000.00	0.5	$1,500.00
506	2034	TEMPORARY SEDIMENT CONTROL FENCE	LF	$1.00	$3.00		$-		$-		$-	610	$1,830.00	610	$1,830.00	150	$450.00
506	2040	TEMP SEDIMENT CONTROL FENCE (REMOVE)	LF		$1.00		$-		$-		$-	610	$610.00	610	$610.00	150	$150.00
531	2005	CURB RAMPS (TY 1)	EA	$1,473.79	$1,600.00		$-		$-		$-	0	$-	0	$-		$-
531	2024	CONC SIDEWALK (5")	SY	$45.28	$45.50		$-		$-		$-	0	$-	0	$-		$-
533	2006	SHOULDER TEXTURING (MILLED)(ASPHALT)	LF	$0.18	$0.20		$-		$-		$-	0	$-	0	$-		$-
636	2001	ALUMINUM SIGNS (TY A)	SF	$19.55	$26.00		$-		$-		$-	0	$-	0	$-		$-
644	2001	INS SM RD SN SUP&AM TY 10BWG(1) SA(P)	EA	$330.07	$400.00		$-		$-		$-	1	$400.00	1	$400.00	1	$400.00
662	2004	WK ZN PAV MRK NON-REMOV (W) 4" (SLD)	LF	$0.12	$0.30		$-		$-		$-		$-		$-	150	$45.00
662	2032	WK ZN PAV MRK NON-REMOV (Y) 4" (SLD)	LF	$0.13	$0.30		$-		$-		$-		$-		$-	150	$45.00
662	2050	WK ZN PAV MRK REMOV (REFL) TY I-A	EA	$2.90	$3.00		$-		$-		$-		$-		$-	10	$30.00
666	2003	REFL PAV MRK TY I (W) 4" (BRK)(100MIL)	LF	$0.40	$0.50		$-		$-		$-		$-		$-	150	$75.00
666	2006	REFL PAV MRK TY I (W) 4" (DOT)(100MIL)	LF	$1.10	$1.50		$-		$-		$-		$-		$-		$-
666	2012	REFL PAV MRK TY I (W) 4" (SLD)(100MIL)	LF	$0.33	$0.50		$-		$-		$-	610	$305.00	610	$305.00	150	$75.00
666	2036	REFL PAV MRK TY I (W) 8" (SLD)(100MIL)	LF	$0.82	$1.00		$-		$-		$-	120	$120.00	120	$120.00		$-
666	2042	REFL PAV MRK TY I (W) 12"(SLD)(100MIL)	LF	$2.20	$3.00		$-		$-		$-	40	$120.00	40	$120.00		$-
666	2048	REFL PAV MRK TY I (W) 24"(SLD)(100MIL)	LF	$4.90	$6.00		$-		$-		$-	40	$240.00	40	$240.00		$-

SHORT AND MEDIUM TERM IMPROVEMENTS CONTINUED						New Traffic Signal		Upgrade Signal Equipment		Optimize Traffic Signal Timing		Add Right Turn Lane		Add Left Turn Lane		Pavement Addition	
						Per Each		Per Each				Per Square Foot		Per Square Foot		Per Square Foot	
Item	Code	Description	Unit	TxDOT Prices from Estimate	Price	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST
666	2054	REFL PAV MRK TY I (W) (ARROW) (100MIL)	EA	$100.81	$140.00		$-		$-		$-	1	$140.00	1	$140.00	1	$140.00
666	2096	REFL PAV MRK TY I (W) (WORD) (100MIL)	EA	$117.35	$145.00		$-		$-		$-	1	$145.00	1	$145.00	1	$145.00
666	2105	REFL PAV MRK TY I (Y) 4" (BRK)(100MIL)	LF	$0.37	$0.50		$-		$-		$-	0	$-	0	$-		$-
666	2111	REFL PAV MRK TY I (Y) 4" (SLD)(100MIL)	LF	$0.37	$0.50		$-		$-		$-		$-		$-		$-
666	2132	REFL PAV MRK TY I (Y) 24"(SLD)(100MIL)	LF	$3.82	$6.00		$-		$-		$-		$-		$-		$-
672	2012	REFL PAV MRKR TY I-C	EA	$3.40	$3.50		$-		$-		$-	10	$35.00	10	$35.00	10	$35.00
672	2015	REFL PAV MRKR TY II-A-A	EA	$3.21	$3.50		$-		$-		$-		$-		$-		$-
677	2001	ELIM EXT PAV MRK & MRKS (4")	LF	$0.22	$0.45		$-		$-		$-		$-		$-		$-
677	2003	ELIM EXT PAV MRK & MRKS (8")	LF	$0.52	$0.60		$-		$-		$-		$-		$-		$-
677	2008	ELIM EXT PAV MRK & MRKS (ARROW)	EA	$25.03	$60.00		$-		$-		$-		$-		$-		$-
677	2018	ELIM EXT PAV MRK & MRKS (WORD)	EA	$39.68	$60.00		$-		$-		$-		$-		$-		$-
678	2001	PAV SURF PREP FOR MRK (4")	LF	$0.03	$0.05		$-		$-		$-		$-		$-		$-
678	2003	PAV SURF PREP FOR MRK (8")	LF	$0.07	$0.10		$-		$-		$-		$-		$-		$-
678	2007	PAV SURF PREP FOR MRK (ARROW)	EA	$5.71	$10.00		$-		$-		$-		$-		$-		$-
678	2018	PAV SURF PREP FOR MRK (WORD)	EA	$5.83	$10.00		$-		$-		$-		$-		$-		$-
6055	2001	IN - LANE OR TRANSVERSE RUMBLE STRIP	LF	$20.00	$20.00		$-		$-		$-		$-		$-		$-
XXX	XXX	DRAINAGE IMPROVEMENTS	MI		$500,000.00		$-		$-		$-		$-	0	$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (RECONSTRUCTION)	EA		$150,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (TS2 CABINET)	EA		$25,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (DETECTION)	EA		$24,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (PEDESTRIAN)	EA		$1,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (SIGNAL HEADS)	EA		$1,100.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (BACK PLATES)	EA		$100.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (POLES)	EA		$8,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (REMOVE SIGNAL)	EA		$10,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	SIGNAL SYNCHRONIZATION	LS		$50,000.00		$-		$-		$-		$-		$-		$-
XXX	XXX	CONSTRUCT BRIDGE	SF		$60.00		$-		$-		$-		$-		$-		$-
		SUB TOTAL 1					$-		$-		$-		$64,960.55		$64,960.55		$12,486.68
						MISC 20%	$-										
XXX	XXX	BONDS	LS		5%		$-		$-		$-		$3,248.03		$3,248.03		$624.33
500	2001	MOBILIZATION	LS		20%	10%	$-		$-		$-		$12,992.11		$12,992.11		$2,497.34
		SUB TOTAL 2					$-		$-		$-		$81,200.69		$81,200.69		$15,608.34
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS		20%		$-		$-		$-		$16,240.14		$16,240.14		$3,121.67
		GRAND TOTAL					$-		$-		$-		$97,440.82		$97,440.82		$18,730.01
		CALLED					$-		$-		$-		$97,500.00		$97,500.00		$18,800.00
												PRICE PER SQUARE FOOT	$14.51	PRICE PER SQUARE FOOT	$14.51	PRICE PER SQUARE FOOT	$13.00
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)				PRICE PER EACH	$175,000.00	PRICE PER EACH	$75,000.00	PRICE PER EACH	$5,000.00	PRICE PER EACH	$97,500.00	PRICE PER EACH	$97,500.00	PRICE PER MILE	$6,527.00

SHORT AND MEDIUM TERM IMPROVEMENTS CONTINUED						Add Raised Median / Channelization (Concrete)		Add Pedestrian Crosswalks		Pavement Removal		Concrete Sidewalks	
						Per Square Foot		Per Each		Per Square Foot		Per Square Foot	
Item	Code	Description	Unit	TxDOT Prices from Estimate	Price	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST
100	2002	PREPARING ROW	STA	$2,262.40	$2,500.00		$-		$-		$-		$-
104	2001	REMOVING CONC (PAV)	SY	$3.88	$6.00		$-		$-		$-		$-
104	2009	REMOVING CONC (RIPRAP)	SY	$3.44	$5.00		$-		$-		$-		$-
104	2021	REMOVING CONC (CURB)	LF	$4.33	$4.50		$-		$-		$-		$-
104	2036	REMOVING CONC (SIDEWALK OR RAMP)	SY	$4.61	$11.00		$-		$-		$-		$-
105	2014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY	$2.95	$6.00		$-		$-	1544	$9,264.00		$-
110	2001	EXCAVATION (ROADWAY)	CY	$5.61	$8.00		$-		$-	255	$2,040.00		$-
112	2002	SUBGRADE WIDENING (DENS CONT)	STA	$917.31	$1,000.00		$-		$-		$-		$-
132	2005	EMBANKMENT (FINAL)(ORD COMP)(TY C)	CY	$6.09	$20.00		$-		$-	100	$2,000.00		$-
150	2001	BLADING	STA	$293.38	$295.00		$-		$-		$-		$-
160	2003	FURNISHING AND PLACING TOPSOIL (4")	SY	$3.25	$3.25		$-		$-	1544	$5,018.00		$-
162	2002	BLOCK SODDING	SY	$2.52	$4.00		$-		$-		$-		$-
164	2045	STRAW OR HAY MULCHING	SY	$0.14	$0.20		$-		$-		$-		$-
168	2001	VEGETATIVE WATERING	MG	$13.91	$14.00		$-		$-		$-		$-
170	2001	IRRIGATION SYSTEM	LS		$25,000.00		$-		$-		$-		$-
247	2041	FL BS (CMP IN PLC)(TY A GR 1)(FNAL POS	CY	$83.49	$85.00		$-		$-		$-		$-
260	2012	LIME(HYD,COM OR QK)(SLRY)OR QK(DRY)	TON	$148.18	$175.00		$-		$-		$-		$-
260	2014	LIME TRT (SUBGR)(DC)(6")	SY	$4.00	$4.00		$-		$-		$-		$-
316	2006	ASPH (AC-20-5TR)	GAL	$5.14	$5.00		$-		$-		$-		$-
316	2222	AGGR(TY-PB GR-4S SAC-B)	CY	$88.99	$150.00		$-		$-		$-		$-
341	2122	D-GR HMA(QCQA) TY-D PG70-22	TON	$83.62	$85.00		$-		$-		$-		$-
354	2023	PLANE ASPH CONC PAV(0" TO 4")	SY	$0.59	$3.50		$-		$-		$-		$-
360	2018	CURB (TYPE II)	LF	$4.09	$4.00	1114	$4,456.00		$-		$-		$-
360	2023	CONC PAV (JOINT REINF) (6")	SY	$40.06	$40.00		$-		$-		$-		$-
360	2026	CONC PAV (JOINT REINF) (10")	SY	$39.18	$40.00		$-		$-		$-		$-
432	2066	RIPRAP (CONC)(CL B)	CY	$258.00	$300.00	41	$12,155.56		$-		$-		$-
502	2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$3,936.84	$3,000.00	0.5	$1,500.00	0.25	$750.00	0.25	$750.00		$-
506	2034	TEMPORARY SEDIMENT CONTROL FENCE	LF	$1.00	$3.00		$-		$-		$-		$-
506	2040	TEMP SEDIMENT CONTROL FENCE (REMOVE)	LF		$1.00		$-		$-		$-		$-
531	2005	CURB RAMPS (TY 1)	EA	$1,473.79	$1,600.00		$-		$-		$-	1	$1,600.00
531	2024	CONC SIDEWALK (5")	SY	$45.28	$45.50		$-		$-		$-	6	$252.78
533	2006	SHOULDER TEXTURING (MILLED)(ASPHALT)	LF	$0.18	$0.20		$-		$-		$-		$-
636	2001	ALUMINUM SIGNS (TY A)	SF	$19.55	$26.00		$-		$-		$-		$-
644	2001	INS SM RD SN SUP&AM TY 10BWG(1) SA(P)	EA	$330.07	$400.00		$-		$-		$-		$-
662	2004	WK ZN PAV MRK NON-REMOV (W) 4" (SLD)	LF	$0.12	$0.30		$-		$-		$-		$-
662	2032	WK ZN PAV MRK NON-REMOV (Y) 4" (SLD)	LF	$0.13	$0.30		$-		$-		$-		$-
662	2050	WK ZN PAV MRK REMOV (REFL) TY I-A	EA	$2.90	$3.00		$-		$-		$-		$-
666	2003	REFL PAV MRK TY I (W) 4" (BRK)(100MIL)	LF	$0.40	$0.50		$-		$-		$-		$-
666	2006	REFL PAV MRK TY I (W) 4" (DOT)(100MIL)	LF	$1.10	$1.50		$-		$-		$-		$-
666	2012	REFL PAV MRK TY I (W) 4" (SLD)(100MIL)	LF	$0.33	$0.50		$-		$-		$-		$-
666	2036	REFL PAV MRK TY I (W) 8" (SLD)(100MIL)	LF	$0.82	$1.00	1114	$1,114.00		$-		$-		$-
666	2042	REFL PAV MRK TY I (W) 12"(SLD)(100MIL)	LF	$2.20	$3.00		$-	360	$1,080.00		$-		$-
666	2048	REFL PAV MRK TY I (W) 24"(SLD)(100MIL)	LF	$4.90	$6.00		$-	72	$432.00		$-		$-

SHORT AND MEDIUM TERM IMPROVEMENTS CONTINUED						Add Raised Median / Channelization (Concrete)		Add Pedestrian Crosswalks		Pavement Removal		Concrete Sidewalks	
						Per Square Foot		Per Each		Per Square Foot		Per Square Foot	
Item	Code	Description	Unit	TxDOT Prices from Estimate	Price	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST
666	2054	REFL PAV MRK TY I (W) (ARROW) (100MIL)	EA	$100.81	$140.00		$-		$-		$-		$-
666	2096	REFL PAV MRK TY I (W) (WORD) (100MIL)	EA	$117.35	$145.00		$-		$-		$-		$-
666	2105	REFL PAV MRK TY I (Y) 4" (BRK)(100MIL)	LF	$0.37	$0.50		$-		$-		$-		$-
666	2111	REFL PAV MRK TY I (Y) 4" (SLD)(100MIL)	LF	$0.37	$0.50		$-		$-		$-		$-
666	2132	REFL PAV MRK TY I (Y) 24"(SLD)(100MIL)	LF	$3.82	$6.00		$-		$-		$-		$-
672	2012	REFL PAV MRKR TY I-C	EA	$3.40	$3.50	111	$388.50		$-		$-		$-
672	2015	REFL PAV MRKR TY II-A-A	EA	$3.21	$3.50		$-		$-		$-		$-
677	2001	ELIM EXT PAV MRK & MRKS (4")	LF	$0.22	$0.45		$-		$-		$-		$-
677	2003	ELIM EXT PAV MRK & MRKS (8")	LF	$0.52	$0.60		$-		$-		$-		$-
677	2008	ELIM EXT PAV MRK & MRKS (ARROW)	EA	$25.03	$60.00		$-		$-		$-		$-
677	2018	ELIM EXT PAV MRK & MRKS (WORD)	EA	$39.68	$60.00		$-		$-		$-		$-
678	2001	PAV SURF PREP FOR MRK (4")	LF	$0.03	$0.05		$-		$-		$-		$-
678	2003	PAV SURF PREP FOR MRK (8")	LF	$0.07	$0.10		$-		$-		$-		$-
678	2007	PAV SURF PREP FOR MRK (ARROW)	EA	$5.71	$10.00		$-		$-		$-		$-
678	2018	PAV SURF PREP FOR MRK (WORD)	EA	$5.83	$10.00		$-		$-		$-		$-
6055	2001	IN - LANE OR TRANSVERSE RUMBLE STRIP	LF	$20.00	$20.00		$-		$-		$-		$-
XXX	XXX	DRAINAGE IMPROVEMENTS	MI		$500,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (RECONSTRUCTION)	EA		$150,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (TS2 CABINET)	EA		$25,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (DETECTION)	EA		$24,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (PEDESTRIAN)	EA		$1,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (SIGNAL HEADS)	EA		$1,100.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (BACK PLATES)	EA		$100.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (POLES)	EA		$8,000.00		$-		$-		$-		$-
XXX	XXX	TRAFFIC SIGNAL IMPROVEMENTS (REMOVE SIGNAL)	EA		$10,000.00		$-		$-		$-		$-
XXX	XXX	SIGNAL SYNCHRONIZATION	LS		$50,000.00		$-		$-		$-		$-
XXX	XXX	CONSTRUCT BRIDGE	SF		$60.00		$-		$-		$-		$-
		SUB TOTAL 1											
XXX	XXX	BONDS	LS		5%		$19,614.06		$2,262.00		$19,072.00		$1,852.78
500	2001	MOBILIZATION	LS		20%								
		SUB TOTAL 2					$980.70		$113.10		$953.60		$92.64
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS		20%		$3,922.81		$452.40		$3,814.40		$370.56
		GRAND TOTAL											
		CALLED					$24,517.57		$2,827.50		$23,840.00		$2,315.97
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)					$4,903.51		$565.50		$4,768.00		$463.19
							$29,421.08		$3,393.00		$28,608.00		$2,779.17
							$29,430.00		$3,393.00		$28,700.00		$2,800.00
										PRICE / SF	$2.06		
						PRICE / SF	$14.00	PRICE / EACH	$3,393.00	PRICE / EACH	$1,689.00	PRICE / SF	$56.00

ALT 90

HGAC

HNTB