APPENDIX D
2035 TRAFFIC ANALYSIS

INTRODUCTION

South Lamar Boulevard, between Riverside Drive and Ben White Boulevard, is a highly traveled roadway and a primary route to and from downtown Austin. It is an important commercial corridor and home to a diverse group of residents living in proximity to the roadway. The landscape of the corridor is rapidly changing, attracting more people to the corridor looking to experience and be part of the local culture. The rapid growth along the corridor is causing safety and mobility concerns. This report documents the project methodology and evaluation of existing and forecasted traffic operations on South Lamar Boulevard.

PROJECT PURPOSE

The purpose of this traffic project was to identify short and long-term transportation improvements to:

1. Improve safety
2. Increase multimodal mobility and accessibility
3. Improve quality of life for the corridor

A microscopic traffic simulation software tool, *VISSIM,* was used to simulate existing, No-Build, and Build alternative operational scenarios for the South Lamar corridor.

PROJECT AREA

The project area consists of the entire (three miles) South Lamar corridor, between Riverside Drive and Ben White Boulevard. The project area includes 12 signalized intersections:

- Riverside Drive
- Barton Springs Road
- Treadwell Street
- Lamar Square Drive
- Hether Street/Mary Street
- Oltorf Street
- Bluebonnet Lane
- Manchaca Road
- Barton Skyway
- Panther Trail
- Brodie Oaks/Lamar Oaks driveways
- US 290/Ben White Boulevard (box diamond intersection)

VISSIM MODEL CODING METHODOLOGY

COMPUTER SIMULATION

The South Lamar corridor was simulated using the microscopic simulation model *VISSIM* (version 5.40). VISSIM (a German acronym which translated means "traffic in towns – simulation") has main two components: a traffic simulator and a signal state generator. The traffic simulator is a microscopic traffic flow simulation model which includes car following and a lane change logic model. The signal state generator is signal control software that uses detector information from the traffic simulator and updates the status of the traffic signals on a discrete time step basis (as small as one tenth of a second). *VISSIM* is classified as a microscopic simulation model because it models vehicles and other components as individual units and updates them every second. After defining the street geometry, traffic control and vehicular volumes, *VISSIM* outputs many measures of effectiveness (MOEs) such as average delay, queue length, speed etc. that can then be used as a basis for comparison of alternatives. *VISSIM* also has the capability of modeling various modes of transit such as buses, trains, and rail. *VISSIM* has a user friendly 3D animation tool which can be used to show the existing and future transportation network in 3D animation form.

ANALYSIS METHODOLOGY

The South Lamar corridor was simulated using *VISSIM* to evaluate AM and PM peak hour traffic operations on weekdays. The future (Year 2035) volumes were developed based on a background annual traffic growth rate and forecasted trips generated by identified future land developments (e.g., Lamar Union). The future volume forecasts were then imported into the *VISSIM* software for simulation.

VISSIM SIMULATION

One of the most important analytical tools of traffic engineering is microscopic simulation software. A transportation system simulation by means of a simulation model allows the prediction of the effects of modified lane configurations, traffic control and any changes made in the transportation system on the system's operational performance. Operational performance is measured in terms of MOEs, which include average vehicle speed, vehicle stops, delays, vehicle hours of travel, vehicle miles of travel, fuel consumption, and several other measures. The MOEs provide useful input in the selection of future alternative improvements to handle issues related to traffic such as traffic congestion, delay, queues, etc.

VISSIM is capable of simulating individual vehicle behavior in a roadway network and is capable of simulating the operation of signalized intersections. VISSIM applies interval-based simulation to describe traffic operations. Each vehicle is a distinct object whose characteristics are updated every second. Each variable control device (such as traffic signals) and each event are registered and updated every second. In addition, each vehicle is identified by category (auto, carpool, truck, or bus) and by type. Additionally, specific driver behavioral characteristics are assigned to specific vehicles. The major features of the VISSIM model are identified as follows:

- Link types and connectors;
- Fleet components (bus, truck, car);
- Load factor (number of passengers/vehicle);
- Automobile routing and turning movement;
- Bus operations (headways, dwell times, stations, and routes);
- Priority rules (right of way designations);
- Stop and yield signs; and
- Pretimed/actuated and transit signal priority signal control.

MODEL PARAMETERS

The traffic flow model used by *VISSIM* is a discreet, stochastic, time step based microscopic model, with driver-vehicle-units as single entities. The model contains a psycho-physical car following model for longitudinal vehicle movement and a rule-based algorithm for lateral movements (lane changing). The model is based on the continuous work of Wiedemann (1974, 1991).

Vehicles follow each other in an oscillating process. As a faster vehicle approaches a slower vehicle on a single lane, it has to decelerate. The action point of conscious reaction depends on the speed difference, distance, and driver-dependent behavior. On multi-lane links, moved-up vehicles check whether they can improve their position by changing lanes. If so, they check the possibility of finding acceptable gaps on neighboring lanes. Car following and lane-changing together form the traffic flow model, comprising the basis of *VISSIM*. The model parameters can be adjusted to reflect the field condition in the model.

More detailed information regarding *VISSIM* modeling parameters can be found in the *VISSIM* user's manual.

MODEL DEVELOPMENT

The HDR team developed the network for the South Lamar corridor. Field observations and aerial photographs were used to obtain accurate geometrics. Existing traffic volume counts collected in the field in September 2014 were used for developing the existing conditions models.

The major component inputs for the South Lamar corridor VISSIM model included the following:

<u>Roadway Geometrics</u> **–** The first step in defining a network is describing the network geometry. VISSIM uses the concept of links and connectors to define the roadway network. Links are one-directional segments of streets or freeways, and connectors are usually the intersection of two or more links. In the case of a two-way street, each roadway block would consist of two one-directional links as shown in Figure 1.

<u>Volume Data</u> – Year 2014 traffic volume counts collected in the field were used to calibrate the existing conditions models.

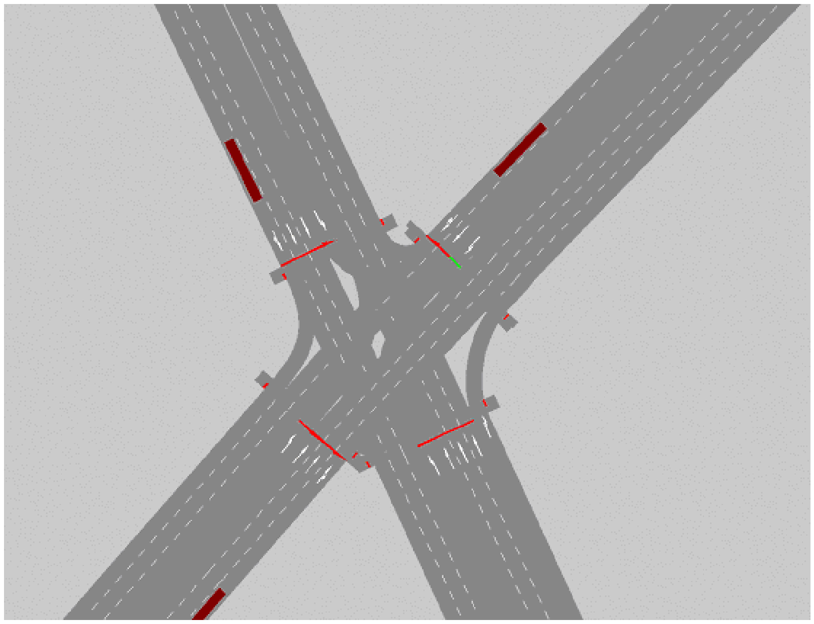
Entry and exit volumes at the periphery of the network were obtained from tube counts and intersection turning movement counts (TMCs), since entry volumes are coded as input when building the model, and exit volumes are used to calibrate the model to ensure appropriate distribution of traffic through the simulated network.

When coding the model, turning movement input describes how traffic is distributed to departure links. TMCs were used to determine existing routing decisions for each approach at an intersection. When a simulation is run, traffic volumes enter the network through entry links and are distributed through the network according to routing decisions assigned to each intersection approach.

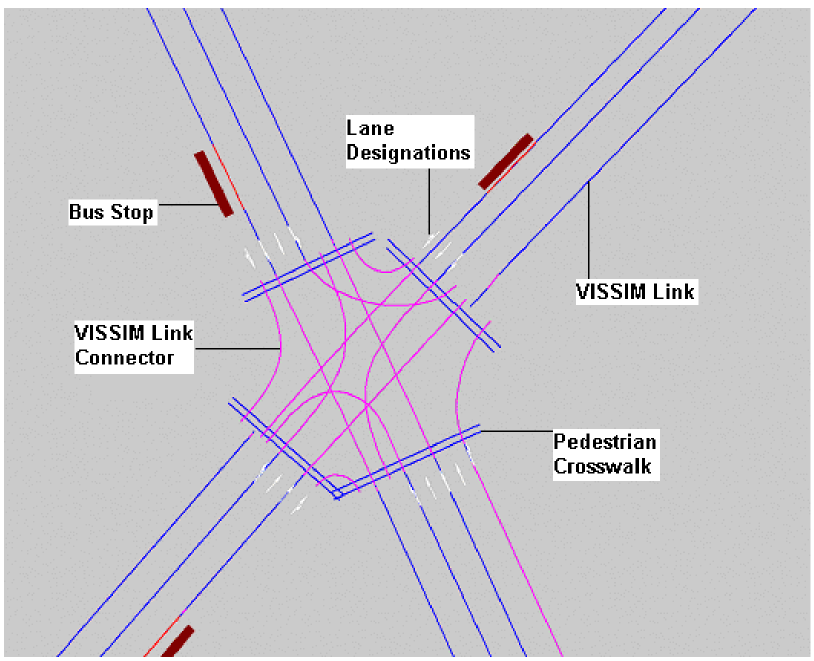
<u>Traffic Control</u> – Existing conditions analysis involved coding of traffic signal phasing, timing, and coordination in *Synchro*. This traffic signal information was then imported into the *VISSIM* models to simulate the operation of existing signalized intersections.

<u>Transit Operations</u> – Information on local bus routes, schedules, and bus stops was collected from the Capital Metropolitan Transportation Authority's website. The collected information on transit routes and stops was included in the development of the *VISSIM* network.

FIGURE 1
INTERSECTION LINK TO CONNECTOR DIAGRAM



(A) Typical VISSIM Intersection



(B) Typical Intersection Converted to VISSIM Link-Connector Diagram

MODEL CALIBRATION

The models were calibrated using field-counted traffic volume data. Turning movement counts at intersections within the corridor were used to verify that volumes shown on the corresponding links in the model were distributing in a manner consistent with real-world conditions. In case the volumes were not consistent, adjustments were made accordingly. In addition, field observations were conducted and the models were calibrated based on field observations of queue lengths, traffic signal operations, transit operations, and pedestrian operations. Finally, field gathered travel time data for South Lamar Boulevard was compared to the travel time output from the simulation model.

In order to account for inherent variability in traffic flow and operations, 25 and 20 replications were performed for the AM peak and PM peak hour model scenario, respectively, and the average results were reported for each.

MEASURES OF EFFECTIVENESS

Operational performance is expressed in terms of measures of effectiveness (MOEs), which include average vehicle speed, delay, vehicle miles of travel, travel time, fuel consumption, emissions and several other measures. While the *VISSIM* model provides a wide variety of MOEs, which are available to the City for other purposes, only a few MOEs that focus on the scope of this project were used to establish a baseline evaluation of existing traffic operations.

<u>Vehicle Delay</u> – Delay is a measure of lost travel time and is influenced by a number of factors, including cycle length, signal coordination, and degree of saturation/volume-to-capacity ratio. Vehicle delay can be measured at a network level (in vehicle-hours) and at a vehicle-level (delay time per vehicle) and was measured for autos and buses.

<u>Intersection Level-of-Service</u> - Level-of-Service (LOS) is a qualitative measure of operating conditions at a location and is directly related to vehicle delay at intersections, as shown in Table 1. LOS is given a letter designation ranging from A to F (free flow to heavily congested), with LOS C generally considered as the limit of satisfactory operation. For example, LOS can be related to the grading scale of a report card: A = excellent, B = good, C = average, D = below average, E = needs improvement, and F = failing.

Utilizing procedures in *Highway Capacity Manual 2010* and the MOEs reported by *VISSIM*, LOS was determined for intersections within the project area network.

TABLE 1
LEVEL-OF-SERVICE DEFINITIONS FOR INTERSECTIONS

Level-of-Service (LOS)	Control Delay (sec/veh)		Description
	Signalized Intersections	Unsignalized Intersections	
A	≤ 10.0	≤ 10.0	Very low vehicle delays, free traffic flow, signal progression extremely favorable, most vehicles arrive during given signal phase.
B	10.1 to 20.0	10.1 to 15.0	Good signal progression, more vehicles stop and experience higher delays than for LOS A.
C	20.1 to 35.0	15.1 to 25.0	Stable traffic flow, fair signal progression, significant number of vehicles stop at signals.
D	35.1 to 55.0	25.1 to 35.0	Noticeable traffic congestion, longer delays and unfavorable signal progression, many vehicles stop at signals.
E	55.1 to 80.0	35.1 to 50.0	Limit of acceptable vehicle delay, unstable traffic flow, poor signal progression, traffic near roadway capacity, frequent cycle failures.
F	> 80.0	> 50.0	Unacceptable delay, extremely unstable flow, heavy congestion, traffic exceeds roadway capacity, stop-and-go conditions.

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

EXISTING CONDITIONS

The analysis of existing conditions forms the basis for *VISSIM* traffic simulation development and for evaluation of alternative scenarios. The major elements of the existing conditions scenario are year 2014 vehicular volumes collected as part of the project, as well as geometrics of the existing roadway network. Field studies were conducted to collect supplemental data such as travel time runs, queue length, average speed, vehicle stops, etc., needed for the evaluation of traffic operations. Traffic data collected in the field included AM and PM peak period intersection turning movement counts, pedestrian counts, and bicycle counts. In addition, 24-hour bi-directional traffic counts were obtained at three locations within the project area, and travel time runs were performed along South Lamar Boulevard. The City of Austin provided signal timing plans for signalized intersections. This section describes how this information was used to develop the *VISSIM* model for the subsequent analyses.

INTERSECTION SIGNAL TIMING

There are currently 12 signalized intersections along the South Lamar corridor, including one box diamond intersection at South Lamar Boulevard and Ben White Boulevard. The traffic signals are maintained and operated by the City of Austin. The HDR team coordinated with the City to obtain existing intersection signal timing and phasing data. The existing signal timing and phasing were coded into *VISSIM* to ensure the model results reflect actual operations in the field.

EXISTING TRAFFIC DATA

Extensive data collection was performed to obtain information on existing conditions along the South Lamar corridor.

The following data were collected in the field as part of this project:

- 24-hour bi-directional tube counts
- AM (7:00 – 9:00) and PM (4:00 – 6:00) peak hour turning movements, including pedestrians and bicycles
- AM and PM peak hour travel time runs

The 24-hour bi-directional tube counts were collected at three locations along the corridor to identify the volume of traffic flowing through the corridor at various locations. AM and PM turning movement counts (TMCs) were collected at all signalized intersections along the corridor. The peak hour TMCs also included pedestrian and bicycle volumes. A summary of the peak hour traffic volumes along the South Lamar corridor are identified in Table 2, and the complete TMCs are attached to this report.

TABLE 2
EXISTING PEAK HOUR TRAFFIC VOLUMES

Locations	AM Peak (vph)	PM Peak (vph)
South of Riverside Dr.	2,940	3,400
Between Oltorf St. and Bluebonnet Ln.	2,870	3,220
North of Brodie Oaks	2,030	2,600

PEDESTRIAN AND BICYCLE VOLUMES

Pedestrian and bicycle volumes were collected at all signalized intersections within the project area to identify current activity along the South Lamar corridor. Intersections with the highest concentrations of pedestrian and bicycle activity during the peak periods are summarized in Table 3.

TABLE 3
EXISTING PEAK HOUR PEDESTRIAN AND BICYCLE VOLUMES

Intersection	AM Peak (ped/hr)	PM Peak (ped/hr)	AM Peak (bike/hr)	PM Peak (bike/hr)
Riverside Dr.	36	66	58	97
Barton Springs Rd.	5	13	45	75
Treadwell St.	4	9	6	21
Hether/Mary St.	4	8	2	14

TRANSIT FACILITIES

Capital Metro operates several bus lines along South Lamar Boulevard. There are currently four MetroBus routes in operation and one MetroRapid route. MetroRapid offers enhanced vehicles, bus stops, and amenities along with greater frequency compared to the MetroBus routes.

PEDESTRIAN/BICYCLE FACILITIES

While sidewalks are primarily continuous and of adequate width along South Lamar Boulevard, there are several sections where sidewalks are broken or missing. Between Bluff Street and Treadwell Street on the west side of South Lamar Boulevard, the sidewalk alternates between a rough dirt track and a thin concrete strip approximately three feet wide.

Current bicycle facilities on South Lamar Boulevard consist of mostly continuous, but narrow, five-foot bicycle lanes adjacent to the main traffic lanes. Where the bike lanes are not present, cyclists share the road with fast-moving traffic. The facility is generally considered to be unsuitable for regular use by a majority of commuter and recreational users. There are also multiple bus stops along the corridor, and frequent bus service directly conflicts with the bike lane.

CRASH ANALYSIS

The main purpose of a crash analysis is to identify crash patterns and develop mitigation measures to prevent similar crashes. The crash analysis for South Lamar Boulevard was based on crash data provided by Texas Department of Transportation (TxDOT) from January 2009 through August 2014. The crash data were reported per the following crash severity categories:

- Fatal
- Incapacitating injury
- Non-incapacitating injury
- Non-injury
- Possible injury
- Unknown

Top accident locations on South Lamar Boulevard are shown in **Table 4**.

TABLE 4
EXISTING PEAK HOUR PEDESTRIAN AND BICYCLE VOLUMES

Location	Number of Crashes
Butler Road	91
Collier Street/Evergreen Avenue	63
Oltorf Street	58
Barton Springs Road	57
Barton Skyway	57

The total crashes by severity for the corridor are shown in **Table 5**. South Lamar Boulevard experienced the highest total number of crashes in 2009.

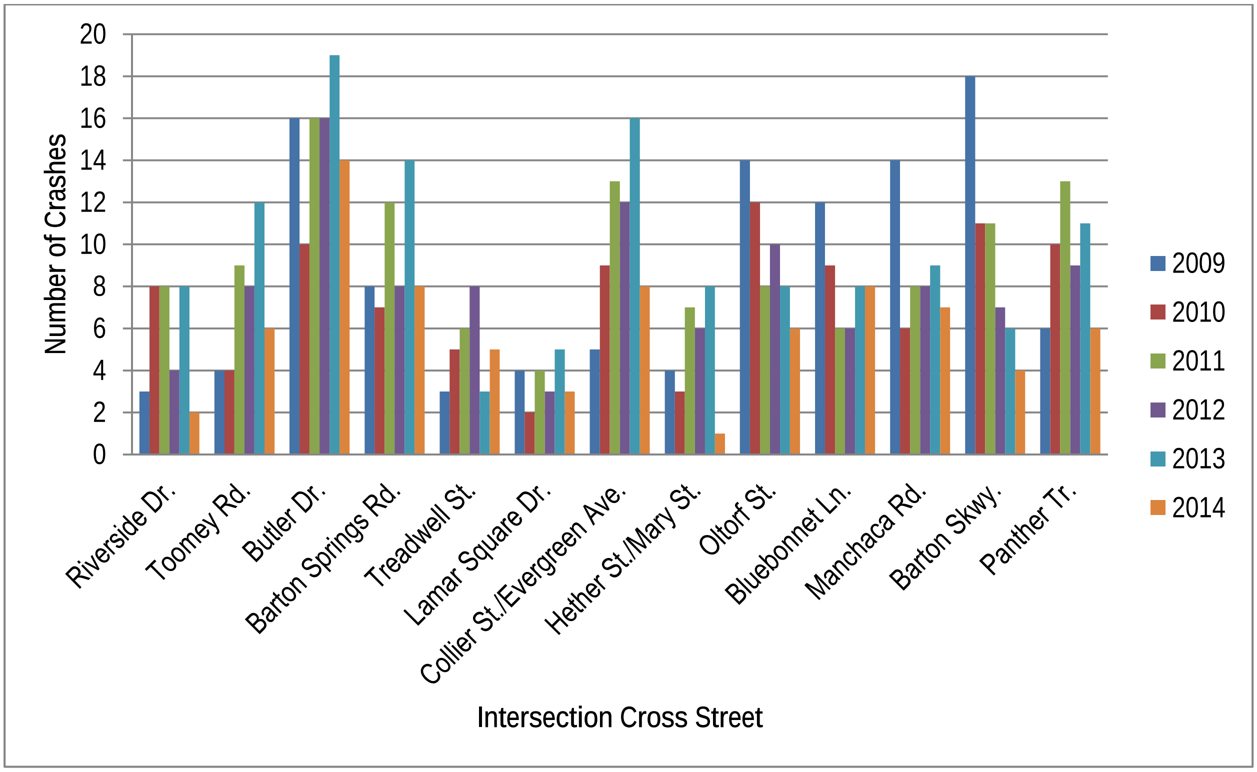
TABLE 5
EXISTING PEAK HOUR PEDESTRIAN AND BICYCLE VOLUMES

Year	Fatal	Incapacitating Injury	Non-Incapacitating Injury	Non-Injury	Possible Injury	Unknown	Total
2009	2	5	34	92	42	4	179
2010	0	7	35	71	28	0	141
2011	1	7	39	84	38	4	173
2012	0	2	57	67	34	0	160
2013	0	4	40	90	41	0	175
2014 (Jan. – Aug.)	1	5	29	50	24	1	110
Total	4	30	234	454	207	9	938

CRASHES BY INTERSECTION

The crash data were sorted by intersection where the crash was reported to occur. **Figure 3** shows the numbers of crashes, by year, at intersections along the South Lamar corridor.

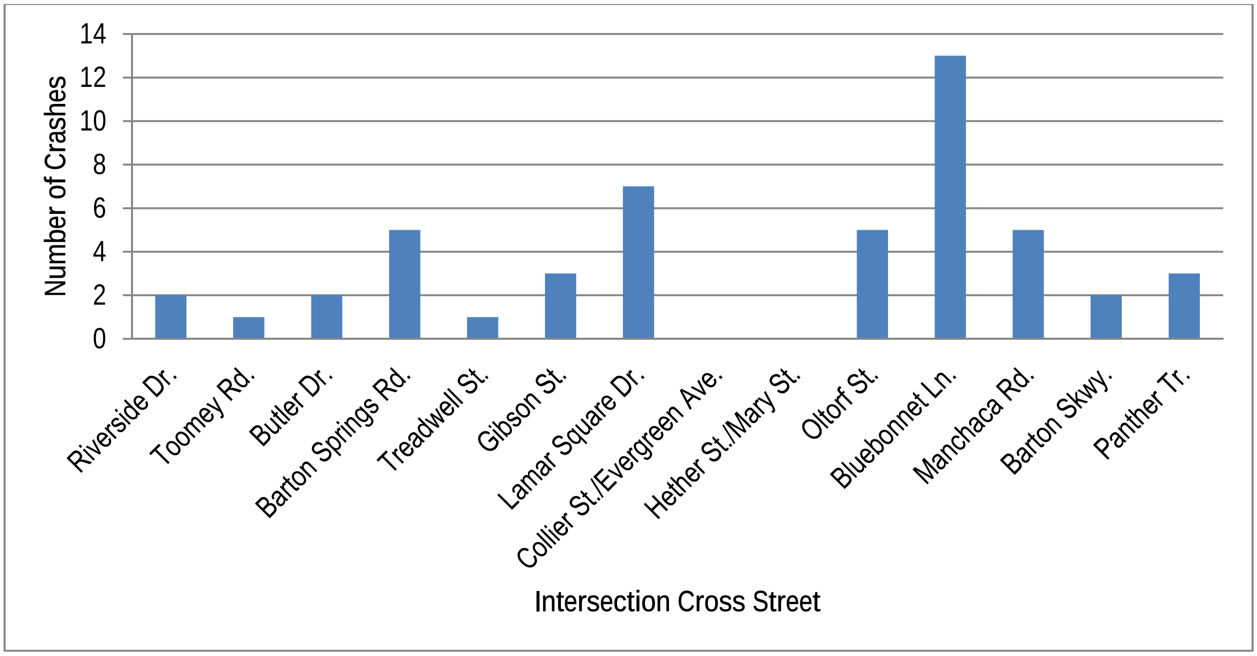
FIGURE 3
SOUTH LAMAR BOULEVARD CRASHES BY INTERSECTION AND YEAR, 2009 – 2014



PEDESTRIAN/BICYCLE CRASHES

Crashes involving pedestrian or bicycles were isolated and summarized by intersection along the South Lamar Corridor. **Table 3-10** shows the results for all crashes over the past five years.

FIGURE 4
SOUTH LAMAR BOULEVARD CRASHES INVOLVING PEDESTRIANS OR BICYCLES, 2009 – 2014



TRAFFIC OPERATIONS ANALYSIS

Operational performance is expressed in terms of MOEs, which can include average vehicle speed, delay, vehicle miles of travel, travel time, fuel consumption, emissions, and several other measures. While the *VISSIM* model provides a wide variety of MOEs, only a few MOEs that focus on the scope of this project were used to establish existing traffic operations.

Network-wide statistics are critical to the evaluation of the overall efficiency of the transportation network. *VISSIM* simulated statistics for total network delay and average delay per vehicle in the AM and PM peak hours are summarized in Table 6.

TABLE 6
VISSIM NETWORK-WIDE AVERAGE STATISTICS

Peak-Hour	Total Network Delay (vehicle hour)	Delay per Vehicle (sec)
2014 Existing Conditions – Weekday		
AM Peak Hour	445.3	178.1
PM Peak Hour	503.9	158.4

Intersection level of service (LOS) is an important MOE for evaluating the existing conditions at the intersections along the South Lamar corridor. As shown in Table 7, the majority of the intersections along the corridor operate at an acceptable LOS of A, B, C, or D during the AM and PM peak hours. The two intersections at the north end of the corridor operate at unacceptable LOS (E or F) during both of the peak hours. The intersections at Bluebonnet Lane and Brodie Oaks operate at unacceptable LOS during the PM peak hour as well.

An evaluation of existing conditions (Year 2014) served as the basis for evaluating future year conditions. Based on the existing traffic model MOEs, the AM peak period has the worst congestion along South Lamar corridor. Levels of service for all signalized intersections are summarized in Table 7.

TABLE 7
SIGNALIZED INTERSECTIONS LEVELS OF SERVICE – EXISTING (2014)

Intersection	AM Peak Hour		PM Peak Hour	
	Delay per Vehicle (sec)	LOS	Delay per Vehicle (sec)	LOS
Riverside Dr.	61.4	E	68.9	E
Barton Springs Rd.	112.1	F	64.6	E
Treadwell St.	48.3	D	14.8	B
Lamar Square Dr.	91.6	F	5.4	A
Hether St./Mary St.	26.5	C	29.7	C
Oltorf St.	44.5	D	30.2	C
Bluebonnet Ln.	24.6	C	62.4	E
Manchaca Rd.	46.7	D	12.8	B
Barton Skwy.	17.6	B	15.4	B
Panther Tr.	10.4	B	13.5	B
Brodie Oaks	42.8	D	76.0	E
US 290 (NW)	8.6	A	12.6	B
US 290 (NE)	26.6	C	37.6	D
US 290 (SW)	15.4	B	22.5	C
US 290 (SE)	33.7	C	19.6	B

MULTIMODAL LEVEL OF SERVICE

Like the intersection LOS analysis in the previous section, a multimodal LOS analysis was performed to measure the overall functionality of South Lamar Boulevard's pedestrian, bicycle, and transit uses. The methodology, outlined in *Highway Capacity Manual 2010* (*HCM 2010*), uses a wide variety of inputs (sidewalk width, bicycle facility type, transit service frequency) to calculate segment-level and corridor-level numerical scores for each mode (transit, bicycle pedestrian). The scores are then converted to LOS. Multimodal LOS was analyzed using *HCS Streets* software, which implements the *HCM 2010* methodology. Table 8 presents the overall facility multimodal LOS scores for each mode under existing conditions for the South Lamar corridor.

TABLE 8
EXISTING (2014) MULTIMODAL LEVEL OF SERVICE

Peak Hour	Pedestrian		Bicycle		Transit	
	NB	SB	NB	SB	NB	SB
AM	D	D	F	F	B	A
PM	D	D	F	F	A	B

The existing pedestrian LOS is D in both the AM and PM peak periods. The lack of a significant buffer between the automobile travel lane and the sidewalk, as well as the significant delay encountered in crossing South Lamar Boulevard, degrade the pedestrian LOS.

The existing bicycle LOS is the worst among the three modes mainly due to bicycle lane presence/width and the lack of a buffer between the bicycle lane and relatively high-speed automobile traffic. The poor bicycle LOS is also associated with the presence of numerous driveway conflicts along the corridor.

The existing transit LOS on South Lamar Boulevard is adequate due to the number of routes serving the South Lamar Corridor, the relative frequency of service, and the lack of delay at bus stops.

2035 TRAFFIC FORECASTS & ANALYSIS

METHODOLOGY

Year 2035 AM peak and PM peak hour turning movement counts were developed to forecast future year traffic conditions along the South Lamar Boulevard Corridor. Growth projections analysis was established on the year 2014 as the base year for AM peak and PM peak hour traffic counts.

Traffic volume forecasting drew upon available data about both past traffic conditions and future land development and traffic volumes along the corridor. Background future growth for corridor traffic was calculated based on average annual daily traffic counts conducted by TxDOT and future year daily traffic volume projections by TxDOT and Capital Area Metropolitan Planning Organization. Additionally, land development planning information from the City of Austin's Development Services Department provided the basis for trip generation estimates based on projected land use type and development size.

The projected growth in traffic on South Lamar Boulevard was thus based on a combination of an annual growth rate applied to all existing AM peak and PM peak hour turning movement volumes and trips generated by major future developments along the corridor. Additional details are provided in Appendix C.

2035 FORECASTED VOLUMES

The forecasted growth was applied to all existing AM peak and PM peak hour turning movement counts at each project area intersection. Table 9 shows the forecasted volumes for the year 2035 AM peak and PM peak hours. All AM peak and PM peak hour turning movements are shown in Appendix C.

TABLE 9
2035 FORECASTED TRAFFIC VOLUMES

Locations	AM Peak (vph)	PM Peak (vph)
South of Riverside Dr.	3,910	4,500
Between Oltorf St. and Bluebonnet Ln.	3,800	4,280
North of Brodie Oaks	3,700	3,480

ROADWAY IMPROVEMENTS

To accommodate the increase in traffic volumes from 2014 existing conditions to 2035 and to provide complete multimodal facilities for all users, improvements will be necessary. The following sections summarize the recommended short-term improvements and long-term improvements for the 2035 scenarios.

SHORT-TERM IMPROVEMENTS

Short-term improvements were identified for the South Lamar corridor based on the existing condition traffic analysis. These improvements are recommended for implementation within the next five years. Table 10 lists the short-term improvements by intersection.

TABLE 10
SHORT-TERM IMPROVEMENTS

Limits (Lamar @)	Project	Mode				Description
		🚗	🚶	🚲	🚌	
5th/6th Streets	Operational	X				Prohibit left-turn movements along Lamar Blvd. during peak periods.
Riverside Dr.	Operational			X		Construct "Dutch junction" at intersection.
Riverside Dr. & Toomey Rd.	Operational	X	X			Install new traffic signal.
Between Riverside Dr. & Treadwell St.	Raised Median	X				Construct raised landscaped median with select openings at driveways.
Between Riverside Dr. and Barton Springs Rd.	Bicycle Lanes			X		Construct 2-way cycle tracks on both sides of S. Lamar Blvd.
Barton Springs Rd.	Operational			X		Construct "Dutch junction" at intersection.
	Bus Queue Jump				X	Install NB and SB bus queue jumps (using right-turn lanes).
	Operational	X				Construct dual SB left-turn bays.
	Operational	X			X	Convert NB approach to two through lanes with third receiving lane for bus stop pullout.
Treadwell St.	Network			X		Construct bicycle connection under UPRR tracks to West Bouldin Creek Greenbelt.
Between Riverside Dr. & Treadwell St.	Operational	X	X	X	X	Construct full "idealized" cross section.
South Lamar and Collier St./ Evergreen Ave.	Operational/ Safety	X	X			• Install new traffic signal. • Prohibit left-turn movement at Mary St. approach. • Build roundabout at Mary St. and Evergreen Ave. • Close NB "ramp" from South Lamar Blvd. to Mary St.
Oltorf St.	Bus Queue Jump				X	Install NB bus queue jump (using right-turn lane).
	Operational	X	X			Move pedestrian crossing across S. Lamar Blvd. from south side to north side of intersection.
	Safety	X	X			Remove channelization from NB right-turn lane.
South Lamar & Del Curto Rd.	Operational	X	X			• Install new traffic signal. • Prohibit left-turn movement at WB Bluebonnet Ln. approach. • Construct roundabout at Del Curto Rd. and Bluebonnet Ln.
Bluebonnet Ln.	Bus Queue Jump				X	Install NB bus queue jump (using right-turn lane).
	Bicycle Lanes			X		Install continuous 2-way cycle track across South Lamar Blvd.
Manchaca Rd.	Bus Queue Jump				X	Install NB bus queue jump (using proposed bus lane).
Between Manchaca Rd. and Barton Skwy.	Bus Lane				X	Construct NB bus lane.
Barton Skwy.	Operational/Bus Queue Jump	X			X	Construct NB right-turn bay and install bus queue jump (using right-turn lane).
South Lamar Blvd. and West Oak Dr.	Safety		X			Install pedestrian hybrid beacon.
South Lamar Blvd. and Brodie Oaks	Operational	X				Prohibit NB left-turn movement from US 290/SH 71 underpass.
Between Riverside Drive and Panther Trail	Operational/ Safety	X				Reduce speed limit to 35 mph
Corridor-wide	Policy				X	Pass ordinance to assign right-of-way to buses at pullouts.
	Informational/ Recreational	X	X	X		Install wayfinding signs, especially to/from area green spaces.
	Safety		X			Time leading pedestrian intervals at signalized crosswalks where significant conflict between turning vehicles and pedestrians exists.
	Bicycle Supply			X		Install B-cycle stations where supported by local demand.
	Operational	X				Install adaptive signal system.
	Informational	X				Install dynamic message signs with travel times, alternative, routes, parking info, etc.
	Operational/ Safety	X				Institute an incident management program.
	Bus Stops				X	Provide covered, enclosed bus stops.
	Bus Stops				X	Install far side bus stops instead of nearside stops.

LONG-TERM IMPROVEMENTS

Long-term projects are recommended for implementation within the next 20 years and may require more funding to implement than short-term projects. To obtain the necessary right-of-way needed to build the full recommended cross section for Lamar Boulevard, properties along the corridor will have to wait until redevelopment occurs. Long-term recommendations will need time to enact. Table 11 details long-term projects.

TABLE 11
LONG-TERM IMPROVEMENTS

Limits (Lamar @)	Project	Mode				Description
		🚗	🚶	🚲	🚌	
North Lamar Blvd. and 5th/6th Sts.	Operational	X				Construct grade separation.
Between Riverside Dr. and Panther Tr.	Operational/ Safety	X				Consider implementation of variable speed limit.
Between Barton Springs Rd. and Treadwell St.	Safety		X			Install pedestrian crossing (pedestrian hybrid beacon or elevated) near Bluff St., when warranted.
South Lamar Blvd. and Hether St./Mary St.	Operational/ Safety	X				Acquire right-of-way to realign Mary St. approach to remove skew with Hether St.
South Lamar Blvd. and Bluebonnet Ln.	Operational/ Safety	X				Acquire right-of-way to realign Bluebonnet Ln. approach(es) to remove skew at South Lamar Blvd.
Between Treadwell St. and Brodie Oaks	Operational	X	X	X	X	Construct full "idealized" cross section.
Corridor-wide	Network		X	X		Install bicycle and pedestrian connections to side streets and adjacent communities.
Corridor-wide	Parking	X				Implement parking district with centralized parking facilities.
Corridor-wide	Bus Lane				X	Implement transit-only lane(s) during peak periods, when supported by ridership.

ANALYSIS OF 2035 ALTERNATIVES

The 2035 alternatives demonstrate the future conditions and operations associated with increased traffic volumes and the improvements along South Lamar Boulevard in the future. The approved and other short-term recommended improvements based on the existing conditions models were incorporated in the 2035 alternatives. Each 2035 alternative is described in the following sections in detail.

2035 No Build Scenario

The 2035 No-Build scenario incorporates the forecasted 2035 traffic volumes with minimal changes to corridor infrastructure. This scenario incorporates the new signalized intersection at The 704 Apartments and the pedestrian hybrid beacon near Oxford Avenue, both opened after data collection was conducted in September 2014. The 2035 No Build results are compared with the 2035 Urban Rail scenario results in Table 12.

2035 Build Scenario

The 2035 Build scenario incorporates the forecasted 2035 traffic volumes with improvements recommended for this project, as listed in the previous section. . In addition to the base Build scenario, two additional scenarios were modeled that account for reductions in automobile trip demand of 10 percent and 20 percent, respectively. This reduction is due to multimodal infrastructure proposed for the corridor and in support of the City's plans. The recommended improvements to multimodal facilities (e.g., a complete sidewalk network, cycle tracks) would result in trip diversions from automobile to other modes due to more desirable conditions and amenities. Table 12 shows the automobile LOS results for the 2035 No-Build and Build (20 percent automobile demand reduction) scenarios. Table 13 and Table 14 show the travel time along South Lamar Boulevard and network-level MOEs, respectively.

TABLE 12
SIGNALIZED INTERSECTION LEVELS OF SERVICE – YEAR 2035

Intersection	AM Peak Hour				PM Peak Hour			
	No-Build		Build		No-Build		Build	
	Delay per Vehicle (sec)	LOS	Delay per Vehicle (sec)	LOS	Delay per Vehicle (sec)	LOS	Delay per Vehicle (sec)	LOS
Riverside Dr.	171.6	F	57.2	E	151.5	F	86.9	F
Barton Springs Rd.	202.3	F	111.2	F	163.8	F	72.6	E
Treadwell St.	90.6	F	56.0	E	47.7	D	17.9	B
Lamar Square Dr.	167.9	F	110.2	F	48.5	D	8.5	A
Hether St./Mary St.	69.1	E	36.4	D	60.0	E	25.0	C
Oltorf St.	166.8	F	77.1	E	50.2	D	27.4	C
Bluebonnet Ln.	116.6	F	44.3	D	84.6	F	72.1	E
Manchaca Rd.	183.2	F	76.2	E	19.3	B	15.2	B
Barton Skwy.	159.2	F	32.6	C	28.4	C	16.7	B
The 704	74.1	E	5.2	A	24.6	C	6.3	A
Panther Tr.	111.0	F	9.2	A	30.3	C	10.3	B
Brodie Oaks	137.3	F	42.8	D	94.2	F	52.3	D
US 290 (NW)	11.6	B	8.8	A	12.5	B	13.5	B
US 290 (NE)	191.8	F	25.4	C	120.4	F	34.2	C
US 290 (SW)	17.0	B	15.6	B	72.6	E	23.5	C
US 290 (SE)	64.2	E	33.7	C	29.4	C	23.7	C

TABLE 13
SOUTH LAMAR BOULEVARD TRAVEL TIME – YEAR 2035

Direction	2035	
	No Build (min)	Build (min)
AM Peak		
NB	27.7	17.2
SB	8.9	8.0
PM Peak		
NB	14.9	11.0
SB	13.5	10.9

TABLE 14
SOUTH LAMAR BOULEVARD NETWORK DELAY – YEAR 2035

Peak-Hour	Total Network Delay (vehicle hour)	Delay per Vehicle (sec)
2035 No Build Conditions		
AM Peak Hour	1004.5	401.9
PM Peak Hour	1031.9	301.3
2035 Build Conditions		
AM Peak Hour	511.0	204.4
PM Peak Hour	547.5	170.5

The total network delay was converted into annual delay based on the above differences in AM peak and PM peak hour network delay being realized over 3 hours each per day (typical workday) and 250 days per year (typical number of workdays per year). Using a value of time of $17.67 (based on that used by Texas Transportation Institute), the improvements have a monetary benefit of almost $13 million in Year 2035 alone.