TRAFFIC ENGINEERING STUDY
Red Light Running Camera Evaluation Analysis
EB & WB US 290 Service Roads at Senate Avenue
Jersey Village, Texas

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9/7/2018

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I. INTRODUCTION

PURPOSE

This traffic study is intended for the evaluation of potential safety deficiencies and installation of red light running counter-measures for the intersections of the eastbound and westbound US 290 Service Roads at Senate Avenue, in the City of Jersey Village, Texas. The traffic engineering analysis consists of traffic data collection, qualitative assessment of the conditions, crash analysis, evaluation of signal operations and visibility, and evaluation of signal clearance intervals. Based on the analysis performed in this study, a series of effective counter-measures will be evaluated and recommended.

REQUIREMENTS

Texas Transportation Code Title 7 (Vehicles and Traffic) Subtitle I (Enforcement of Traffic Laws) Chapter 707 (Photographic Traffic Signal Enforcement System Section 707.003 (Installation and Operation of Photographic Traffic Signal Enforcement System), requires that the local authority shall conduct a traffic engineering study of the approach to determine whether, in addition to or as an alternative to the system, a design change to the approach or a change in the signalization of the intersection is likely to reduce the number of red light violations at the intersection.

Section 707.003, further requires that the intersection approach must be selected for the installation of a photographic traffic signal enforcement system based on traffic volume, the history of accidents at the approach, the number or frequency of red light violations at the intersection, and similar traffic engineering and safety criteria, without regard to the ethnic or socioeconomic characteristics of the area in which the approach is located.

In addition to the requirements of Section 707.003, the traffic study evaluated and documented the criteria outlined in the Texas Department of Transportation (TxDOT) Form 2296-RLC "Evaluation of the Need for Red Light Running Camera Engineering Analysis".

The United States Department of Transportation Federal Highway Administration (FHWA) developed an *Engineering Countermeasures to Reduce Red-Light Running Intersection Safety Brief (FHWA-SA-10-005)* that defines red-light running and provides potential engineering countermeasures to reducing red-light running. Some of the engineering countermeasures listed in the brief include:

- Improving Signal Visibility and Conspicuity,
- Increasing the Likelihood for stopping,
- Removing reasons for intentional violations and
- Eliminating the need to stop.

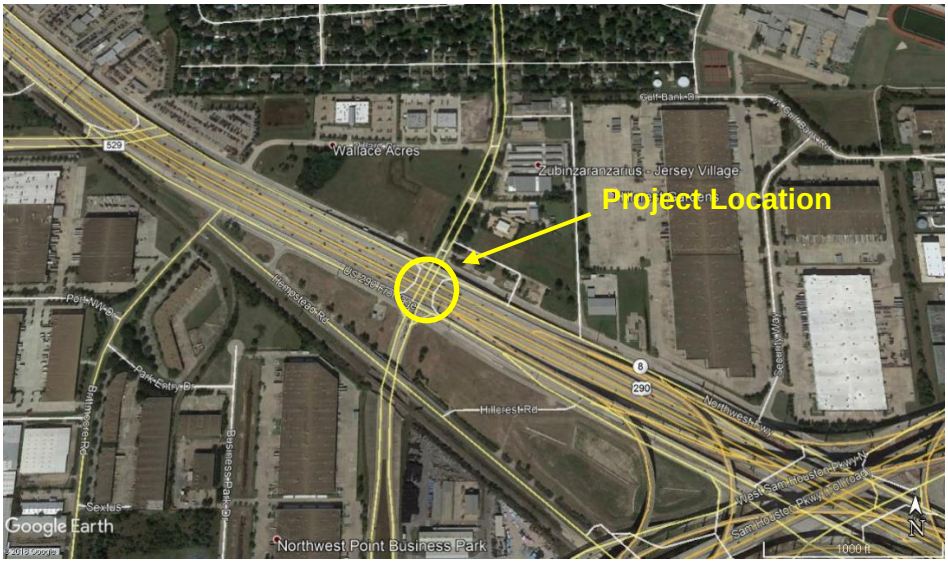


Figure 1. Intersection Location Map

II. INTERSECTION CONDITION ASSESSMENT

This section includes an assessment of the intersection operation and current field conditions as reviewed by a qualified registered professional traffic engineer.

As shown on Figure 1, Senate Avenue passes under US 290 (also known as Northwest Freeway) mainline; and intersects the EB & WB US 290 Service Roads at grade on north & south side of the freeway main line. Both EB & WB US 290 Service Road signals are operated with a single controller as shown on the signal schematic shown on Figure 2, provided by Texas DOT.

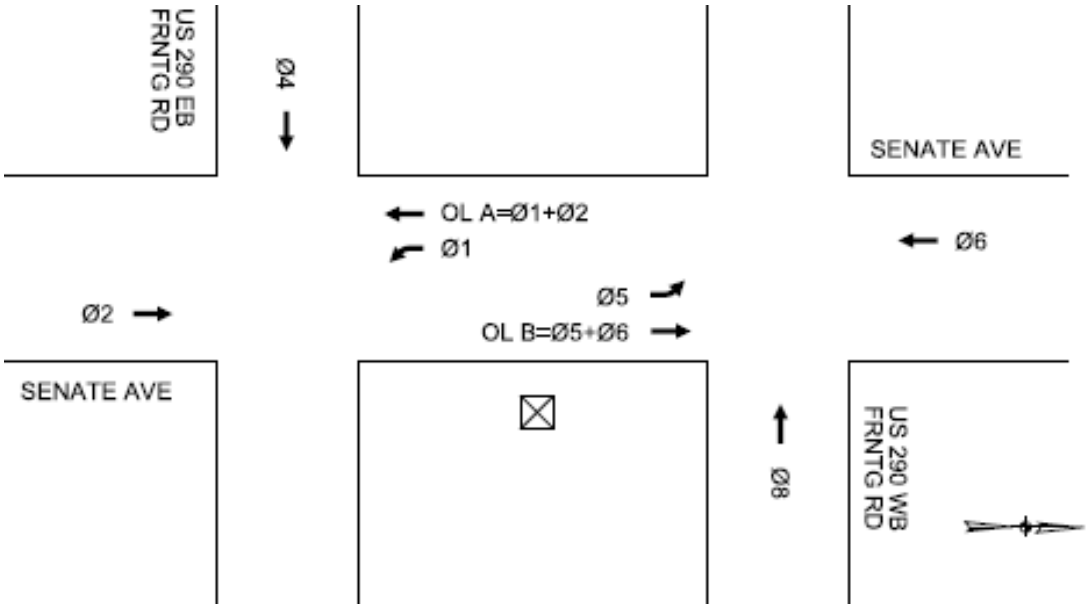


Figure 2. Traffic Signal Phasing

Section below is a summary of the intersection assessment including signal visibility, pavement condition, vehicle detection system, and signal operations.

WB US 290 Service Road Approach

The WB approach is located downstream of the US 290 westbound off ramp and consists of 4 lanes (2 through, 1 right turn, 1 U-turn) with curb and sidewalk as shown in Figure 2.

Figure 3. WB US 290 Service Road Approach

Signal Visibility – Signal heads are visible from 1200'+ which is more than the MUTCD requirement of 390', as shown on Table 4D-2 below for posted speed of 40 mph. A "signal ahead" sign is installed at approximately 600' back from the stop bar. The traffic signal heads are horizontal-mounted and include "tunnel visors" and "backplates" for maximum visibility.

Table 4D-2. Minimum Sight Distance for Signal Visibility

85th-Percentile Speed	Minimum Sight Distance
20 mph	175 feet
25 mph	215 feet
30 mph	270 feet
35 mph	325 feet
40 mph	390 feet
45 mph	460 feet
50 mph	540 feet
55 mph	625 feet
60 mph	715 feet

Note: Distances in this table are derived from stopping sight distance plus an assumed queue length for shorter cycle lengths (60 to 75 seconds).

Table 1. 2009 MUTCD Table 4D-2

Pavement Conditions - A visual inspection of the pavement condition at the intersection showed no signs of significant wearing or cracking that could inhibit a driver's ability to stop while approaching the intersection. All required pavement marking (i.e. stop bar, lane lines, arrows, crosswalks) are present. However, the low contrast between the lighter color pavement surface and white paint is a concern but the markings are visible. Signing is adequate and in conformance with MUTCD.

Vehicle Detectors – three (3) sets Loop sensors are installed in the pavement on this approach. 6' x 20' presence sensors are installed at the stop bar in all lanes, 6' x 6' advance pulse sensors are installed at approximately 110' from the stop bar in all lanes, and 2, of 6' x 6' (in array) advance pulse sensors are installed at approximately 240' from stop bar. Pedestrian signal heads are installed for all permitted and marked crossings.

Signal Operation – Arrival at the signal is random due to separation distance of approximately 0.5 mile from previous signal at Beltway 8 and WB US 290 Service Road. However, the signal phasing and operation is not a contributing factor to red light running. Observed traveling speeds on WB US 290 Service Road appear to be higher than the posted limits. Higher than posted traveling speeds are caused by (1) the "open" condition of the road, (2) the separation distance from previous signal, and (3) motorists existing the freeway are traveling well in excess of the limits. Addition of a speed limit sign at the ramp merge area may help in settling the traffic on WB US 290 Service Road.

SB Senate Avenue Approach

The southbound Senate Avenue approach is a curbed 4-lane divided with no sidewalks and posted speed of 35 mph. The southbound approach is characterized by presence of mature trees planted on both shoulder side and the median, as depicted on Figure 4.

Figure 4. SB Senate Avenue Approach

Signal Visibility – Trees obscure full visibility to the signal heads at 500' back from the stop bar. A "signal ahead" warning sign is present at 370' from the stop bar to warn motorists of the impending signal. Technically, at least one signal head is visible at 400' +/- which exceeds the required 325' distance at 35 mph approach speed. However, the visual distraction can impact the driver's behavior. The driver's view to the signal heads can be improved with selective tree trimming and frequent maintenance to ensure continued compliance with the visibility distance requirements.

Pavement Conditions - A visual inspection of the pavement condition at the intersection showed no signs of significant wearing or cracking that could inhibit a driver's ability to stop while approaching the intersection. All required pavement marking (i.e. stop bar, lane lines, arrows, crosswalks) are present. The low contrast between the lighter color pavement surface and white paint is a concern but the markings are visible. Signing is adequate and in conformance with MUTCD.

Vehicle Detectors – 6' x 20' vehicle loop sensors in presence mode are installed in all lanes and are functioning.

Signal Operation – Arrival at the signal is random. The signal phasing and operation is not a contributing factor to red light running.

EB US 290 Service Road Approach

The EB approach is consists of 4 lanes (1 shared through & left, 2 through, 1 right turn) with curb and sidewalk as shown in Figure 5.

Figure 5. EB US 290 Service Road Approach

Signal Visibility – Signal heads are visible from 1000'+ which is more than the MUTCD requirement of 390', as shown on Table 4D-2 below for posted speed of 40 mph. The traffic signal heads are horizontal-mounted and include "tunnel visors" and "backplates" for maximum visibility.

Pavement Conditions - A visual inspection of the pavement condition at the intersection showed no signs of significant wearing or cracking that could inhibit a driver's ability to stop while approaching the intersection. All required pavement marking (i.e. stop bar, lane lines, arrows, crosswalks) are present. The low color contrast between the lighter color pavement surface and white paint is a concern but markings are visible. Signing is adequate and in conformance with MUTCD.

Vehicle Detectors – Three (3) sets Loop sensors are installed in the pavement on this approach. 6' x 20' presence sensors are installed at the stop bar in all lanes, and 2 sets of 6' x 6' advance pulse sensors are installed at approximately 110' and at approximately 240' from stop bar. Pedestrian signal heads are installed for all permitted crossings.

Signal Operation – Arrival is generally in "loose" platoon when released from the previous signal at FM 529, approximately 0.43 miles away. Since the signal is located after the US 290 on ramp, a portion of the traffic on the service road enters the main line freeway. The signal phasing and operation is not a contributing factor to red light running. Observed traveling speeds appear to be higher than the posted limits, thus, addition of a speed limit sign after the ramp area may help in settling the traffic on WB US 290 Service Road.

NB Senate Avenue Approach

The Northbound Senate Avenue approach has 4 lanes (3 through lanes & 1 right turn) divided with no sidewalks and posted speed of 35 mph, as depicted on Figure 6. There are 3 overhead bridge structures on this approach which limit sight to the signal, from outer lane.

Figure 6. NB Senate Avenue Approach

Signal Visibility – This approach is on horizontal curve approaching the signal, in combination with 3 bridge overpasses, as shown in Figure 7. The signal heads are visible from approximately 600', which is higher than the 325' requirements for 35 mph speed limit. However, the traveling speeds are significantly higher than the posted speeds which may contribute to visibility concerns; specially from the outer lane. Recommend installation of a "signal ahead" warning sign in advance of the bridge to warn motorists of the impending signal.

Figure 7. NB Senate Avenue Approach Before Overpass

Pavement Conditions - A visual inspection of the pavement condition at the intersection showed no signs of significant wearing or cracking that could inhibit a driver's ability to stop while approaching the intersection. All required pavement marking (i.e. stop bar, lane lines, arrows, crosswalks) are present but faded. The low contrast between the lighter color pavement surface and white paint pavement is a concern but markings are visible. Signing adequate and in conformance with the requirements of MUTCD.

Vehicle Detectors – 6' x 20' vehicle loop sensors, in presence mode, are installed in all lanes and are functioning.

Signal Operation – Arrival at the signal is random. The signal phasing and operation is not a contributing factor to red light running.

III. TRAFFIC VOLUMES

24-hour directional traffic volume data were collected on Wednesday, August 29,2018; for all 4 approaches of the intersections. Figures 8-10 depict the daily flow variation and hourly volumes of the intersection approaches. Copies of the actual volume data are provided in the Appendix C of this report. As depicted, data indicates a distinct high morning peak in the EB US 290 Service Road and SB Senate Avenue, between the hours of 7:00 to 8:00 AM. The afternoon high peak occurs between 4:00 to 5:00 PM on WB US 290 Service Road and NB Senate Avenue. The afternoon peak hour is the heaviest hourly volume.

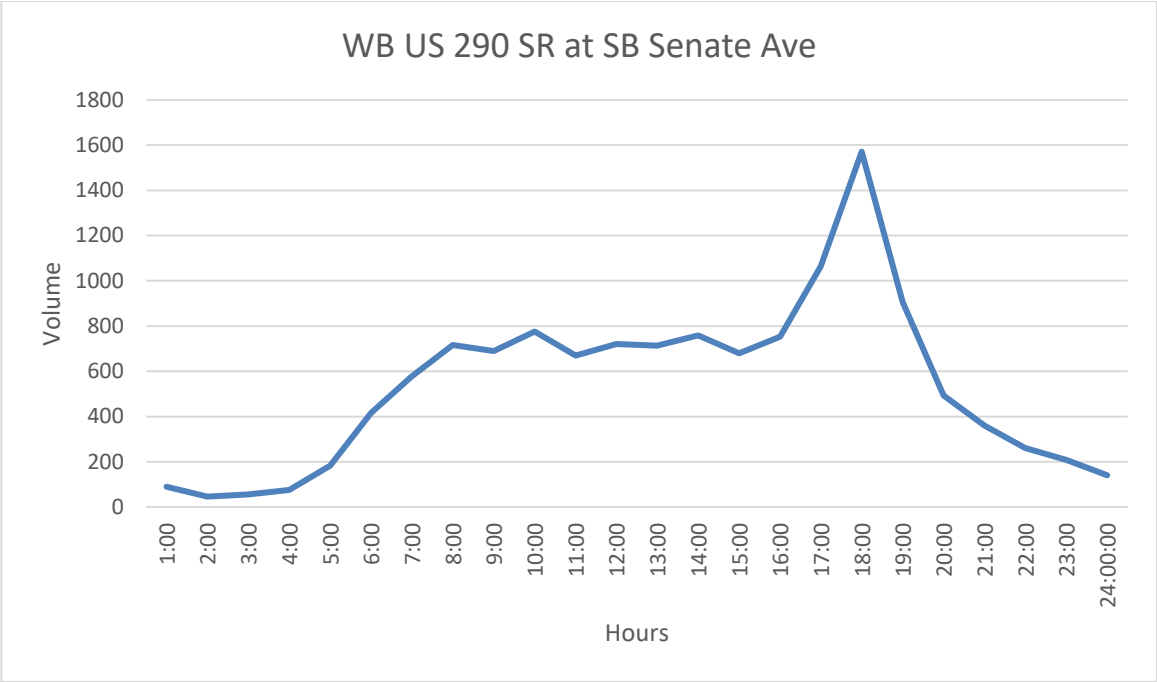


Figure 8. WB US 290 Service Road Daily Traffic Flow

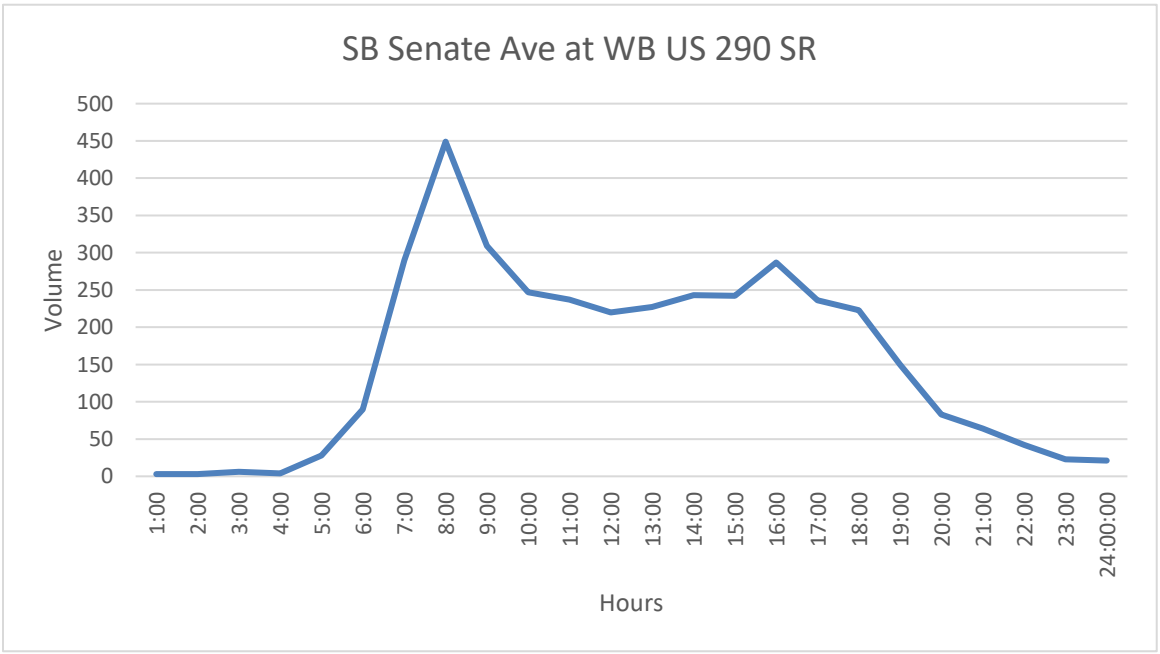


Figure 9. SB Senate Avenue Daily Traffic Flow

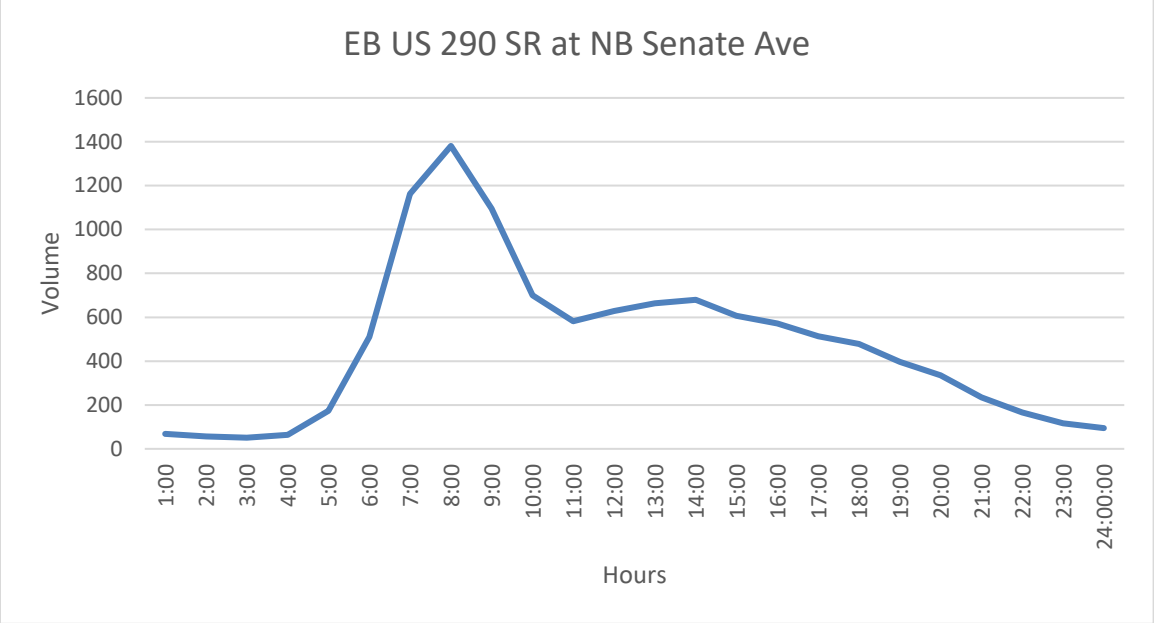


Figure 10. EB US 290 Service Road Daily Traffic Flow

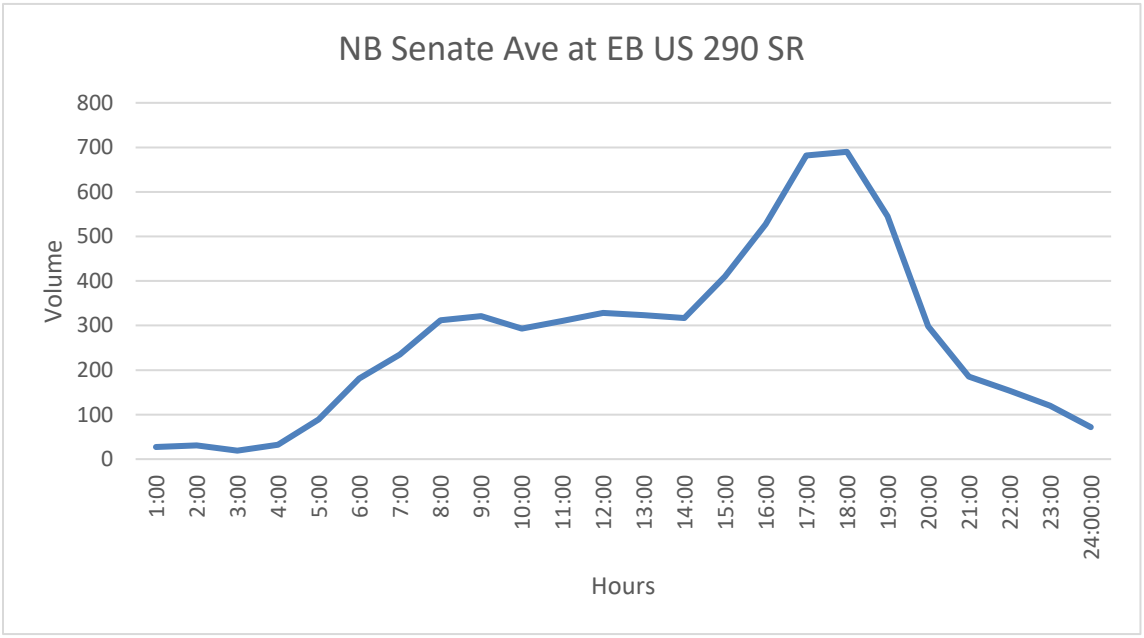


Figure 11. NB Senate Avenue Daily Traffic Flow

IV. CRASH ANALYSIS

City of Jersey Village Police Department (JVPD) complied and provided an 18-month crash history for the intersection approaches by type and severity, for the period 1/2017 through 8/2018. Table 2 below contains a summary of the crash data. Detail summaries provided by JVPD are provided in the Appendix B of this report.

Approach	Total	Right Angle	Rear End	Side Swipe	Other	Injury Crash	RLC Related
SB Senate Ave	1	1	0	0	0	0	0
NB Senate Ave	14	12	2	0	0	3	4
EB US 290 SR	9	7	2	0	0	2	0
WB US 290 SR	10	7	3	0	0	1	2
Total All Crashes	34	27	7	0	0	6	6

Table 2. 18-Month Crash Summary (1/2017-8/2018, JVPD)

The analysis of the data suggests a pattern of “right-angle” type crashes at the intersection with relatively high incidents of running red light (RLC) type crashes. Northbound Senate Avenue and westbound US 290 Service Road approaches have the highest number of crashes. As “right-angle” crash type is typically susceptible to correction by installation of red light running counter-measures, all 4 approaches are expected to be good candidates for consideration.

V. ENFORCEMENT DATA

City of Jersey Village provided records of enforcement activities for the most recent 18-month period (January 1, 2017 through August 20, 2018). Records indicate that a total of 5,671 citations were issued for the 3-mile section of EB & WB US 290 Service Road, from Hilcrest Road to N Eldridge Parkway.

For the intersection of EB & WB US 290 Service Road at Senate Avenue, a total of 866 citations were issues, almost evenly divided at 432 in eastbound direction and 434 in the westbound direction. A total includes 8 “red light running” citations were issued, 4 in the eastbound direction and 4 in the westbound direction. Some of the reasons for citations included the following:

- Speeding
- Unsafe lane change
- Turn from improper lane

VI. SIGNAL CLEARANCE INTERVALS

Traffic existing signal timing data was provided by TXDOT and is shown in Table 3. Appendix D contains the full timing data document for the intersection.

PHASES	1	2	3	4	5	6	7	8
Minimum Green	5	5	0	5	5	5	0	5
Passage	1.0	1.0	0.0	1.0	1.0	1.0	0.0	1.0
Maximum 1	25	25	0	25	25	25	0	25
Maximum 2	65	40	0	55	50	30	0	75
Yellow Change	3.6	4.7	3.0	4.3	4.7	3.6	3.0	4.3
Red Clearance	1.6	1.1	0.0	2.0	1.2	1.6	0.0	2.0

PHASES	9	10	11	12	13	14	15	16
Minimum Green	1	0	0	1	1	0	0	1
Passage	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Maximum 1	1	0	0	0	1	0	0	0
Maximum 2	1	0	0	0	1	0	0	0
Yellow Change	4.5	3.0	3.0	4.3	4.5	3.0	3.0	4.3
Red Clearance	2.0	0.0	0.0	2.0	2.0	0.0	0.0	2.0

Table 3. Existing Signal Timing (Provided by TXDOT)

The calculated yellow and all-red clearance intervals were determined using formulas provided by the *ITE Traffic Engineering Handbook (5th Edition)*. The Yellow Change Interval time + Red Clearance Interval time includes a reaction time, a deceleration element, and an intersection clearing time, using the following equations:

$$Y = t + \frac{1.47v}{2(a + Gg)} \qquad R = \frac{W + L}{1.47v}$$

Where:
Y= yellow change interval (sec)
R= all-red interval (sec)
t= perception-reaction time (1 sec)
v= approach speed (ft/sec)
a= deceleration rate (10 ft/sec^2)
g=acceleration rate in response to the onset of a yellow indication. (ft/sec^2)
G= approach grade, with uphill positive and downhill negative (percent grade / 100)
W= width of intersection from near curb line to far curb line (ft)
L=length of vehicle (20 ft)

The calculated yellow and all-red intervals are provided in Table 4. It should be noted that for positive approach grades, 0% slope was assumed for the calculations.

Approach	Approach Grade %	Approach Speed MPH	W (Distance), Ft	Calculated Yellow Interval (Sec)	All-Red Interval (Sec)
NB Senate Ave (Ø2)	4.700%	35	66	3.6	1.7
SB Senate Ave (Ø6)	0.000%	35	66	3.6	1.7
EB US 290 Service Rd (Ø4)	-0.67%	40	100	4.0	2.1
WB US 290 Service Rd (Ø8)	0.000%	40	115	4.0	2.3

Table 4. Calculated Yellow & All-Red Intervals

Approach	Yellow Interval (Sec)		All-Red Interval (Sec)	
	Existing	Calculated	Existing	Calculated
NB Senate Ave (Ø2)	4.7	3.6	1.1	1.7
SB Senate Ave (Ø6)	3.6	3.6	1.6	1.7
EB US 290 Service Rd (Ø4)	4.3	4.0	2.0	2.1
WB US 290 Service Rd (Ø8)	4.3	4.0	2.0	2.3

Table 5. Yellow & All-Red Interval Comparison

Overall, the existing yellow intervals are higher and more conservative than the calculated values and shall remain in effect. The existing all-red intervals are consistent with the calculated values for the most part. However, it is recommended that the all-red interval for the NB Senate Ave approach (Ø2) be increased from existing 1.1 seconds to 1.7 seconds.

VII. TXDOT ENGINEERING ANALYSIS EVALUATION FORM

The Texas Department of Transportation (TxDOT) has developed an engineering analysis form titled “Evaluation of the Need for Red Light Running Camera Engineering Analysis” which is also referred to as Form 2296-RLC. The evaluation analysis worksheets, included in Appendix A, include sections for information on intersection and signal data, signal timing and traffic data, crash and enforcement data, and other supporting information.

VIII. POTENTIAL ENGINEERING COUNTERMEASURES

As discussed previously, the Texas Transportation Code Title 7 (Vehicles and Traffic) Subtitle I (Enforcement of Traffic Laws) Chapter 707 (Photographic Traffic Signal Enforcement System Section 707.003 (Installation and Operation of Photographic Traffic Signal Enforcement System), requires that the local authority shall conduct a traffic engineering study of the approach to determine whether, in addition to or as an alternative to the system, a design change to the approach or a change in the signalization of the intersection id likely to reduce the number of red light violations at the intersection.

Based on the criteria provided in the Institute of Transportation Engineers (ITE) and the Federal Highway Administration (FHWA) publication titled *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running: An Informational Report.* Some of the engineering countermeasures, Table 6 below summarizes the countermeasures that can be considered under each of the countermeasure groupings identified above. These engineering countermeasures are based on a driver characteristic called the “unintentional violator.” This type of driver may be incapable of stopping or may be inattentive while approaching the intersection due to poor judgement by the driver or in the design or operation of the intersection. A second type of driver characteristic is the “intentional violator” who, based on his/her judgement, knows they may violate the signal yet proceeds through the intersection anyway. This type of driver is most affected by enforcement countermeasures, while unintentional red-light runners are most affected by engineering countermeasures.

Improvement category	Intersection Approaches			
	SB Senate Ave	WB US 290 SR	NB Senate Ave	EB US 290 SR
Improve Signal Visibility/Conspicuity				
Signal for Each Approach Through Lane	Existing	Existing	Existing	Existing
Install Backplates	Existing	Existing	Existing	Existing
Modify Placement of Signal Heads	Trim trees	Existing OK	Existing OK	Existing OK
Increase Size of Signal Displays	Existing OK	Existing OK	Existing OK	Existing OK
Install Programmable Signal/ Visors or Louvers	Existing/Visors	Existing/Visors	Existing/Visors	Existing/Visors
Install LED Signal Lenses	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Increase the Likelihood for Stopping				
Install Signal Ahead Signs	Existing	Existing	Install	Not Recommended
Install Transverse Rumble Strips	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Install Activated Advance Warning Flashers	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Improve Pavement Surface Condition	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Remove Reasons for Intentional Violations				
Adjust Yellow Change Interval	Existing OK	Existing OK	Existing OK	Existing OK
Provide or Adjust All-Red Clearance Interval	Existing OK	Existing OK	Increase interval	Existing OK
Adjust Signal Cycle Length	Existing OK	Existing OK	Existing OK	Existing OK
Provide Dilemma Zone Protection	Not Recommended	Existing	Not Recommended	Existing
Eliminate the Need to Stop				
Coordinate Signal Operation	Existing OK	Existing OK	Existing OK	Existing OK
Remove Unwarranted Signals	N/A	N/A	N/A	N/A
Construct a Roundabout	Not Recommended	Not Recommended	Not Recommended	Not Recommended

Source: USDOT Federal Highway Administration

Table 6. Summary of Countermeasures for Reducing Red-Light Running

IX. CONCLUSIONS & RECOMMENDATIONS

The analysis determined a high concentration of “right-angle” type crashes for US 290 Service Road approaches with Senate Avenue, on both sides of the Northwest Freeway. The “right-angle” crash type at signalized intersections are generally attributed to failure to obey the traffic control device, either intentionally or un-intentionally. The enforcement data provided by JVPD illustrates that although there has been a high level of enforcement, a persistent violation pattern remains. Implementation of a red-light-running cameras has been shown to significantly reduce the “right-angle” crash frequency at major intersections, specifically through the enforcement of “intentional violators”. Other red-light running counter-measures, designed to improve the conspicuity of the traffic signal, can also be considered to reduce the unintentional violations.

In conclusion, installation of red light running enforcement cameras on all 4 approaches, will reduce the violation incidents and therefore improving the overall safety of the intersection. Other potentially effective red light running countermeasure listed on Table 6, will also further enhance the safety by curtailing violations. A summary of recommended improvements is provided below:

SB Senate Avenue

- Trim trees and increase the maintenance frequency to ensure visibility of the signals.
- Install a red light running enforcement camera.

NB Senate Avenue

- Install a “signal ahead” sign prior to the structures on this approach.
- Increase the All-Red interval from 1.1 to 1.7 seconds for this phase (Ø2).
- Install a red light running enforcement camera.

EB US 290 Service Road

- Install a red light running enforcement camera.
- Install a speed limit sign.

WB US 290 Service Road

- Install a red light running enforcement camera.
- Install a speed limit sign.

APPENDIX INDEX

APPENDIX A
TxDOT ENGINEERING ANALYSIS WORKSHEET
(Form 2296RLC)

Evaluation of the Need for Red Light Running Cameras Engineering Analysis

City: Jersey Village County: Harris

Intersection: EB & WB US 290 Service Roads at Senate Avenue

A. Intersection and Signal Data

1. Signal Visibility
   a. Minimum Sight Distance to Signal

Approach	Grade	Speed Limit (MPH)	Measured (ft.)	Required (ft.)*
SB Senate Ave	0%	35	400	325
WB US 290 SR	0%	40	1200+	390
NB Senate Ave	+4.7%	35	600	325
EB US 290 SR	-0.67%	40	1000+	390

- See TMUTCD Table 4D-2 for minimum sight distance requirements

   b. Are "SIGNAL AHEAD" warning signs present? ☒ Yes ☐ No
   Yes- on WB US 290SR & SB Senate Ave
   No – EB US 290SR & NB Senate Ave
   c. Are "SIGNAL AHEAD" warning signs needed? ☒ Yes ☐ No
   Needed only on NB & SB Senate Avenue
   d. Are other warning signs present in the vicinity of the intersection?
   ☐ Yes ☒ No

   Explain: _____.

   e. Information on Signal Heads

Approach	Lens Size	Lens Type (LED or Bulb)	Back Plates (Y or N)	Retroreflective Border (Y or N)
SB Senate Ave	12"	Bulb	Y	N
WB US 290 SR	12"	Bulb	Y	N
NB Senate Ave	12"	Bulb	Y	N
EB US 290 SR	12"	Bulb	Y	N

2. Pavement and Marking Data
   a. Are stop bars in "good" condition? ☒ Yes ☐ No
   Explain: The stop bars on all 4 approaches are visible but the color contrast Between the light color concrete pavement and white paint provides lesser target value.
   b. Are lanes "clearly" visible? ☒ Yes ☐ No
   Explain:
   c. Are crosswalks "clearly" marked? ☒ Yes ☐ No
   Explain: crosswalks are visible but the color contrast between light color concrete pavement and paint, provides lesser target value

   d. What is the pavement condition (ruts, potholes, cracking, etc.)?
   ☒ Good Explain: Grooved concrete pavement
   ☐ Fair Explain:
   ☐ Poor Explain:

e. Do pavement surface treatments exist (rumble strips, texturing, pavers, etc.)?
☐ Yes Explain:
☒ No

3. Provide diagram of intersection including: pavement markings, width of lanes and medians,

NORTH

See Signal Plans in Appendix E

location of signal heads and signs, locations of loops/detectors, and grades.

See signal plans provided by TxDOT in Appendix E

B. Signal Timing and Traffic Data

1. Clearance Intervals

Approach	Posted Speed Limit	Grade	Width of Intersection	Yellow Interval		All Red Interval	
				Existing	Calculated*	Existing	Calculated*
SB Senate Ave	35	0%	66’	3.6	3.6	1.6	1.7
WB US 290 SR	40	0%	115’	4.3	4.0	2.0	2.3
NB Senate Ave	35	-0.67%	66’	4.7	3.6	1.1	1.7
EB US 290 SR	40	+4.7%	100’	4.3	4.0	2.0	2.1

- Reference ITE for calculation of clearance intervals

2. Include existing controller settings for each phase and each time-of-day. Information should include applicable settings such as minimum green, max 1 & 2, passage, minimum gap/ext., protected-permissive, lead-lag, yellow and all red, walk and ped clearance time, recall settings, offsets, cycle length, etc. Include analysis of peak hour conditions and a determination of whether signal timings are contributing to red-light running problems. See controller timings provided by TxDOT in Appendix D

   a. Does signal timing or phasing factor in as a possible contributor to red light running at this intersection?
   ☐ Yes Explain:
   ☒ No

   b. List comments or recommendations on potential signal timing or phasing changes:
   No phasing changes are recommended. Increase All-Red interval from 1.1 seconds to 1.7 seconds for NB Senate Ave (Ø2).

3. Vehicle Detection Data

Approach	Detection Type (loop, video, etc.)	Detector Location (measured from stop bar)
SB Senate Ave	Loop	2 sets of 6’ x 20’ at stop bar
WB US 290 SR	Loop	6’ x 20’ at stop bar, 6’x6’ loops at 110’, 2 sets of 6’x6’ at 240’
NB Senate Ave	Loop	2 sets of 6’ x 20’ at stop bar
EB US 290 SR	Loop	6’ x 20’ at stop bar, 6’x6’ loops at 110’ & 240’

4. Traffic Volume Data

Approach	Daily Volumes		Peak Hour Volumes	
	Total	Heavy Vehicles	Total	Heavy Vehicles
SB Senate Ave	3727	-	449	-
WB US 290 SR	12922	-	1571	-
NB Senate Ave	6501	-	690	-
EB US 290 SR	11327	-	11327	-

C. Crash and Enforcement Data

1. 18 Months of "Before" Crash Data

Approach	Collision Type	Total	Number of Injury Crashes	Number of Fatal Crashes	Crashes Associated with Red Light Running
SB Senate Ave	Rear End	0	0	0	0
	Angle	1	0	0	0
	Head-on	0	0	0	0
	Pedestrian	0	0	0	0
	Pedal cyclist	0	0	0	0
	Other	0	0	0	0
	Total	1	0	0	0
WB US 290 SR	Rear End	3	0	0	0
	Angle	7	1	0	2
	Head-on	0	0	0	0
	Pedestrian	0	0	0	0
	Pedal cyclist	0	0	0	0
	Other	0	0	0	0
	Total	10	1	0	2
NB Senate Ave	Rear End	2	0	0	0
	Angle	12	3	0	4
	Head-on	0	0	0	0
	Pedestrian	0	0	0	0
	Pedal cyclist	0	0	0	0
	Other	0	0	0	0
	Total	14	3	0	4
EB US 290 SR	Rear End	2	0	0	0
	Angle	7	2	0	0
	Head-on	0	0	0	0
	Pedestrian	0	0	0	0
	Pedal cyclist	0	0	0	0
	Other	0	0	0	0
	Total	9	2	0	0

2. Violation Rate

a. Number of red light running citations per year issued by law enforcement Number: 866 Citations on US 290 SR (432 EB & 434 WB) including 8 citations for running red light(4 EB & 4 WB)
Year: Jan. 1, 2017 – Aug. 20, 2018

b. Observed Violations: None Observed Date:
Time Period:

Approach	Traffic Volume	Number of Violations

3. Enforcement and Operational Issues

a. Describe the difficulty experienced by law enforcement officers in patrol cars or on foot in apprehending violators. Law enforcement resources are limited. This is a high congestion during morning and afternoon peak periods. Speed are also higher than posted. Enforcement level has been high with 866 citations issued in 18-month period, but, red light running remains a concern with high level of "right-angle" crash types.

b. Describe the ability of law enforcement officers to apprehend violators safely within a reasonable distance from the violation. Law enforcement resources are limited for consistent enforcement. This is a congested area during AM & PM peak periods. Long enforcement activities affects the congestion level and impacts freeway ramp operation.

c. Are pedestrians at risk due to violations? ☐ Yes ☒ No
Explain:

Number of pedestrians per hour: None Observed
Pedestrian crosswalk provided? ☒ Yes ☐ No

d. Have there been any changes to the operations of the intersection (signal timing, restriping, increased enforcement, etc.) with the past three years. Yes. TxDOT recently completed intersection improvements at the intersections on both side of the freeway.

D. Other Supporting Information:

See traffic study for more details.

APPENDIX B

CRASH DATA

2018 RLC YEAR TOTAL'S	Total Int. CRASHES	RLC RELATED CRASHES	RLC INJ CRASHES	RL RELATED INJ	NON RLR CRASHES	NON RLC REL.INJ CRA.	NON RLC REL. INJ.	RLR FATAL CRASHES	RLC FATAL CRASHES	NON RLR FATALITIES	NON RLR FATALITES
JV01 SB SENATE @ WBSR	0	0	0	0	0	0	0	0	0	0	0
JV02 NBSenate @ EBSR	5	1	1	2	4	0	0	0	0	0	0
JV03 EBSR @ SENATE	3	0	0	0	3	1	1	0	0	0	0
JV04 WBSR @ SENATE	5	1	1	2	4	0	0	0	0	0	0
JV05 SB JONES @ WBSR	8	0	0	0	8	1	1	0	0	0	0
JV06 WBSR @ JONES	7	0	0	0	7	0	0	0	0	0	0
JV07 EBSR @ JONES	7	2	2	3	5	0	0	0	0	0	0
JV08 EBSR @ FM 529	4	1	1	1	3	1	2	0	0	0	0
JV09 WBSR @ FM 529	4	0	0	0	4	0	0	0	0	0	0
JV13 WBSR @ WEST RD	8	5	2	5	3	1	1	0	0	0	0
JV18 NB FM 529 @ EBSR	2	0	0	0	1	0	0	0	0	0	0
	53	10	7	13	42	4	5	0	0	0	0

Source: JVPD

2017 RLC YEAR TOTAL'S	Total Int. CRASHES	RLC RELATED CRASHES	RLC INJ CRASHES	RL RELATED INJ	NON RLR CRASHES	NON RLC REL.INJ CRASHES	NON RLC REL. INJ.	RLR FATAL CRASHES	RLC REL. FATALITIES	NON RLR FATAL CRA	NON RLR FATALITES
JV01 SB SENATE @ WBSR	1	0	0	0	1	0	0	0	0	0	0
JV02 NB Senate @ EBSR	9	3	1	1	6	1	1	0	0	0	0
JV03 EBSR @ SENATE	6	0	1	2	6	0	0	0	0	0	0
JV04 WBSR @ SENATE	5	1	0	0	4	0	0	0	0	0	0
JV05 SB JONES @ WBSR	6	0	0	0	6	1	1	0	0	0	0
JV06 WBSR @ JONES	8	1	0	0	7	0	0	0	0	0	0
JV07 EBSR @ JONES	10	1	0	0	9	1	1	0	0	0	0
JV08 EBSR @ FM 529	3	3	1	1	0	0	0	0	0	0	0
JV09 WBSR @ FM 529	5	0	1	1	5	0	0	0	0	0	0
JV13 WBSR @ WEST RD	14	7	2	3	7	0	0	0	0	0	0
JV18 NB FM 529 @ EBSR	9	1	0	0	8	1	1	0	0	0	0
	76	17	6	8	59	4	4	0	0	0	0

Source: JVPD

APPENDIX C

TRAFFIC VOLUMES

GRAM Traffic Counting, Inc
1506 Festival Houston, Texas 77062
832-752-3303 or 888-315-6141

Site Code: 9
Station ID: 1601
Senate Ave SB at wb US 290 Service Rd
Jersey Village, Texas
Latitude: 0' 0.0000 Undefined

Start Time	29-Aug-18 Wed	SB Morning	SB Afternoon	Hour Totals Morning	Hour Totals Afternoon
12:00		1	52		
12:15		0	54		
12:30		2	59		
12:45		0	62	3	227
01:00		2	60		
01:15		0	56		
01:30		0	59		
01:45		1	68	3	243
02:00		1	52		
02:15		2	47		
02:30		1	58		
02:45		2	85	6	242
03:00		0	91		
03:15		2	67		
03:30		2	73		
03:45		0	56	4	287
04:00		2	80		
04:15		3	54		
04:30		8	58		
04:45		15	44	28	236
05:00		14	61		
05:15		15	63		
05:30		34	46		
05:45		27	53	90	223
06:00		53	46		
06:15		57	37		
06:30		81	39		
06:45		99	28	290	150
07:00		123	33		
07:15		143	18		
07:30		98	15		
07:45		85	17	449	83
08:00		91	19		
08:15		73	23		
08:30		79	12		
08:45		66	10	309	64
09:00		72	18		
09:15		60	10		
09:30		62	9		
09:45		53	5	247	42
10:00		55	6		
10:15		56	9		
10:30		71	6		
10:45		55	2	237	23
11:00		57	5		
11:15		48	4		
11:30		50	12		
11:45		65	0	220	21
Total		1886	1841		
Percent		50.6%	49.4%		
Grand Total		1886	1841		
Percent		50.6%	49.4%		
ADT		ADT 3,727		AADT 3,727	

GRAM Traffic Counting, Inc
1506 Festival Houston, Texas 77062
832-752-3303 or 888-315-6141

Site Code: 7
Station ID: 1607
Senate Ave south of EB US 290 Service Rd
Jersey Village, Texas
Latitude: 0' 0.0000 Undefined

Start Time	29-Aug-18 Wed	NB Morning	NB Afternoon	Hour Totals Morning	Hour Totals Afternoon
12:00		8	86		
12:15		5	71		
12:30		11	96		
12:45		3	70	27	323
01:00		7	72		
01:15		7	101		
01:30		13	66		
01:45		4	78	31	317
02:00		7	83		
02:15		1	87		
02:30		2	130		
02:45		9	110	19	410
03:00		5	116		
03:15		10	112		
03:30		9	151		
03:45		8	148	32	527
04:00		16	174		
04:15		18	148		
04:30		30	192		
04:45		25	168	89	682
05:00		25	178		
05:15		32	171		
05:30		81	186		
05:45		43	155	181	690
06:00		32	179		
06:15		60	142		
06:30		65	140		
06:45		78	84	235	545
07:00		73	76		
07:15		56	101		
07:30		86	68		
07:45		97	53	312	298
08:00		75	60		
08:15		78	48		
08:30		108	36		
08:45		60	41	321	185
09:00		79	39		
09:15		60	44		
09:30		79	43		
09:45		75	28	293	154
10:00		75	45		
10:15		83	27		
10:30		72	28		
10:45		80	20	310	120
11:00		86	22		
11:15		74	18		
11:30		89	22		
11:45		79	10	328	72
Total		2178	4323		
Percent		33.5%	66.5%		
Grand Total		2178	4323		
Percent		33.5%	66.5%		
ADT		ADT 6,501		AADT 6,501	

GRAM Traffic Counting, Inc
1506 Festival Houston, Texas 77062
832-752-3303 or 888-315-6141

Site Code: 8
Station ID: 1615
WB US 290 Service Rd east of Senate Av
Jersey Village, Texas
Latitude: 0' 0.0000 Undefined

Start Time	29-Aug-18 Wed	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon
12:00		24	181		
12:15		31	189		
12:30		24	158		
12:45		11	185	90	713
01:00		9	183		
01:15		20	201		
01:30		9	193		
01:45		8	182	46	759
02:00		18	155		
02:15		10	175		
02:30		9	196		
02:45		19	154	56	680
03:00		21	169		
03:15		12	194		
03:30		22	173		
03:45		20	217	75	753
04:00		27	224		
04:15		47	232		
04:30		58	299		
04:45		51	309	183	1064
05:00		61	354		
05:15		83	444		
05:30		131	410		
05:45		141	363	416	1571
06:00		110	310		
06:15		136	237		
06:30		131	190		
06:45		201	169	578	906
07:00		173	155		
07:15		185	122		
07:30		175	125		
07:45		183	91	716	493
08:00		148	106		
08:15		171	97		
08:30		208	84		
08:45		162	73	689	360
09:00		138	80		
09:15		248	70		
09:30		195	54		
09:45		195	57	776	261
10:00		165	69		
10:15		162	59		
10:30		164	42		
10:45		178	38	669	208
11:00		184	50		
11:15		171	37		
11:30		189	26		
11:45		176	27	720	140
Total		5014	7908		
Percent		38.8%	61.2%		
Grand Total		5014	7908		
Percent		38.8%	61.2%		
ADT		ADT 12,922		AADT 12,922	

GRAM Traffic Counting, Inc
1506 Festival Houston, Texas 77062
832-752-3303 or 888-315-6141

Site Code: 5
Station ID: 1613
EB US 290 Service Rd west of FM 529
Jersey Village, Texas
Latitude: 0' 0.0000 Undefined

Start Time	29-Aug-18 Wed	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon
12:00		26	160		
12:15		15	179		
12:30		16	160		
12:45		11	164	68	663
01:00		13	163		
01:15		17	195		
01:30		16	181		
01:45		10	140	56	679
02:00		15	161		
02:15		12	147		
02:30		15	146		
02:45		9	152	51	606
03:00		12	146		
03:15		10	129		
03:30		24	158		
03:45		18	139	64	572
04:00		10	137		
04:15		35	153		
04:30		61	93		
04:45		68	131	174	514
05:00		64	97		
05:15		88	152		
05:30		168	113		
05:45		190	116	510	478
06:00		221	101		
06:15		277	91		
06:30		281	106		
06:45		383	98	1162	396
07:00		305	102		
07:15		324	64		
07:30		396	89		
07:45		356	81	1381	336
08:00		328	66		
08:15		289	66		
08:30		239	60		
08:45		239	43	1095	235
09:00		191	54		
09:15		197	35		
09:30		154	41		
09:45		158	36	700	166
10:00		117	34		
10:15		137	33		
10:30		168	29		
10:45		160	20	582	116
11:00		152	31		
11:15		157	25		
11:30		141	16		
11:45		178	23	628	95
Total		6471	4856		
Percent		57.1%	42.9%		
Grand Total		6471	4856		
Percent		57.1%	42.9%		
ADT		ADT 11,327		AADT 11,327	

APPENDIX D

SIGNAL TIMING DATA

INSTALLED ON
09-08-2016

Access Data

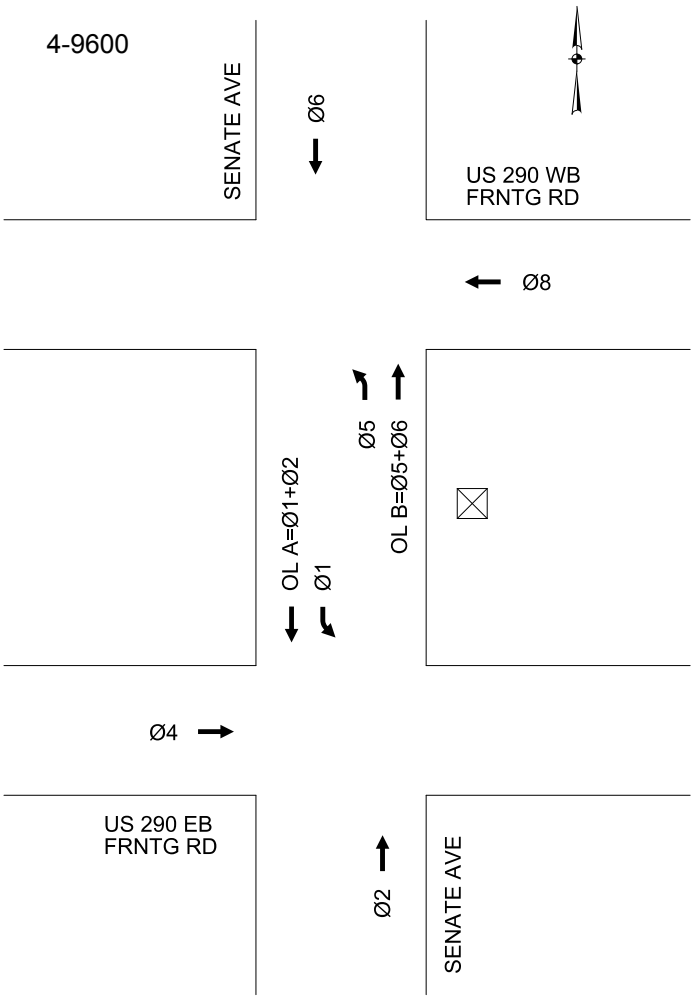
Date:
4/21/2015

Time:
15:40

Intersection Name:	US 290 at Senate (Const.)
Source:	Database

	Level 1	Level 2
Security Code:	9999	

	Baud Rate	Data Bits	Parity
Printer Port 2	0-1200	0-Eight	0
Com Port 2	5-19200		
Com Port 3	4-9600		



Phase Vehicle Timing Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

PHASES	1	2	3	4	5	6	7	8
Minimum Green	5	5	0	5	5	5	0	5
Passage	1.0	1.0	0.0	1.0	1.0	1.0	0.0	1.0
Maximum 1	25	25	0	25	25	25	0	25
Maximum 2	65	40	0	55	50	30	0	75
Yellow Change	3.6	4.7	3.0	4.3	4.7	3.6	3.0	4.3
Red Clearance	1.6	1.1	0.0	2.0	1.2	1.6	0.0	2.0

PHASES	9	10	11	12	13	14	15	16
Minimum Green	1	0	0	1	1	0	0	1
Passage	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Maximum 1	1	0	0	0	1	0	0	0
Maximum 2	1	0	0	0	1	0	0	0
Yellow Change	4.5	3.0	3.0	4.3	4.5	3.0	3.0	4.3
Red Clearance	2.0	0.0	0.0	2.0	2.0	0.0	0.0	2.0

Phase Pedestrian Timing Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

PHASES	1	2	3	4	5	6	7	8
Walk	0	4	0	4	0	4	0	4
Pedestrian Clear	0	15	0	15	0	15	0	15
Flashing Walk	0	0	0	0	0	0	0	0
Eextended Ped Cear	0	0	0	0	0	0	0	2
Act Rest in Walk	0	0	0	0	0	0	0	0

PHASES	9	10	11	12	13	14	15	16
Walk	0	5	5	0	0	5	5	0
Pedestrian Clear	0	10	10	0	0	10	10	0
Flashing Walk	0	0	0	0	0	0	0	0
Eextended Ped Cear	0	0	0	0	0	0	0	0
Act Rest in Walk	0	0	0	0	0	0	0	0

Phase General Control Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

PHASES	1	2	3	4	5	6
Initial	1-Inactive	4-Green	5-Dark	1-Inactive	4-Green	1-Inactive
Non-Actuated Respons	0-none	0-none	0-none	0-none	0-none	0-none
Vehicle Recall	0-None	3-Max	0-None	3-Max	0-None	3-Max
Ped Recall	0-None	0-None	0-None	0-None	0-None	0-None
Recall DDelay	0	0	0	0	0	0

PHASES	7	8	9	10	11	12
Initial	5-Dark	1-Inactive	1-Inactive	1-Inactive	1-Inactive	1-Inactive
Non-Actuated Respons	0-none	0-none	0-none	0-none	0-none	0-none
Vehicle Recall	0-None	3-Max	0-None	3-Max	3-Max	0-None
Ped Recall	0-None	0-None	0-None	0-None	0-None	0-None
Recall DDelay	0	0	0	0	0	0

PHASES	13	14	15	16
Initial	1-Inactive	1-Inactive	1-Inactive	1-Inactive
Non-Actuated Respons	0-none	0-none	0-none	0-none
Vehicle Recall	0-None	3-Max	3-Max	0-None
Ped Recall	0-None	0-None	0-None	0-None
Recall DDelay	0	0	0	0

Phase Miscellanenous Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

PHASES	1	2	3	4	5	6	7	8
Non-Locking Memory	1	1	1	1	1	1	1	1
Dual Entry	1	0	0	0	1	0	0	0
Last Car Passage	0	0	0	0	0	0	0	0
Conditional Service	0	0	0	0	0	0	0	0
No Simultaneous Gap Out	0	0	0	0	0	0	0	0

PHASES	9	10	11	12	13	14	15	16
Non-Locking Memory	1	1	1	1	1	1	1	1
Dual Entry	1	1	1	1	1	1	1	1
Last Car Passage	0	0	0	0	0	0	0	0
Conditional Service	0	0	0	0	0	0	0	0
No Simultaneous Gap Out	0	0	0	0	0	0	0	0

Phase Spec Sequence Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

PHASES	1	2	3	4	5	6	7	8
OMIT	0	0	0	0	0	0	0	0
Minus Yellow	0	0	0	0	0	0	0	0
Omit Calls	0	0	0	0	0	0	0	0

PHASES	9	10	11	12	13	14	15	16
OMIT	0	0	0	0	0	0	0	0
Minus Yellow	0	0	0	0	0	0	0	0
Omit Calls	0	0	0	0	0	0	0	0

Phase Vehicle Detector Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

DETECTOR	1	2	3	4	5	6	7	8
Assigned Phase	1	2	3	4	5	6	7	8
Operation Mode	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh
Switch PHase	0	0	0	0	0	0	0	0
Extend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay	0	0	0	0	0	0	0	0

DETECTOR	9	10	11	12	13	14	15	16
Assigned Phase	0	0	0	0	0	0	0	0
Operation Mode	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh
Switch PHase	0	0	0	0	0	0	0	0
Extend	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0
Delay	0	0	0	0	0	0	0	0

Phase Pestrian Detector Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

DETECTOR	1	2	3	4	5	6	7	8
Assigned Phase	1	2	3	4	5	6	7	8
Operation Mode	1-Ped	1-Ped	1-Ped	1-Ped	1-Ped	1-Ped	1-Ped	1-Ped
Switch PHase	0	0	0	0	0	0	0	0
Extend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay	0	0	0	0	0	0	0	0

Phase Spec Detector Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

DETECTOR	1	2	3	4	5	6	7	8
Assigned Phase	0	0	0	0	0	0	0	0
Operation Mode	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh	0-Veh
Switch PHase	0	0	0	0	0	0	0	0
Extend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay	0	0	0	0	0	0	0	0

Unit General Control Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

Startup Time	5
Startup State	0-Flash
Red Revert	2.0
Auto Pedestrian Clear	0
Stop Time Reset	0
Alternate Sequence	16

RING	1	2	3	4
Input Response	Ring 1	Ring 2	None	None
Output Selection	Ring 1	Ring 2	None	None

I/O Modes	Input	Output
"ABC" Connector	0	0
"D" Connector	0	0

Unit Remote Flash Data

Intersection Name: US 290 at Senate (Const.) Date: 4/21/2015

Source: Database Time: 3:40:04PM

Channel

	1	2	3	4	5	6	7	8	9	10	11	12
FLASH	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red	1-Red
ALT FLASH	0	0	0	0	0	0	0	0	0	0	0	0

Channel

	13	14	15	16	17	18	19	20	21	22	23	24
FLASH	0-No	0-No	0-No	0-No	0-No	0-No	0-No	0-No	0-No	0-No	0-No	0-No
ALT FLASH	0	0	0	0	0	0	0	0	0	0	0	0

TEST A = Flash 0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Flash Entry	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Flash Exit	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Unit Overlap Data

Intersection Name: US 290 at Senate (Const.) Date: 4/21/2015

Source: Database Time: 3:40:04PM

PHASE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Overlap A	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Overlap B	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0
Overlap I	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Overlap J	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Overlap K	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Overlap L	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0
Overlap M	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Overlap N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1

Codes: 0=NO 1=YES Phase is included in overla

OVERLAP	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
TRL GRN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YEL/10	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
RED/10	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
-GRN/YEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+GRN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Unit Alt Sequence Data

Intersection Name: US 290 at Senate (Const.) Date: 4/21/2015

Source: Database Time: 3:40:04PM

Alternate Sequence	Pair 1		Pair 2		Pair 3		Pair 4	
	1/1	1/2	2/1	2/2	3/1	3/2	4/1	4/2
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

Coordination Mode Data

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)
Source	Database
Operation Mode	1-Auto
Mode (Normal)	0-Perm
Maximum	2-Max II
Correction	2-Short Way
Offset Mode	0-Beg Green
Force Mode	0-Plan
Max Dwell Time	0
Yield Period	0
Manual Controls: Dial	2
Split	1
Offset	1

Coordination Timing Plan Data - Dial 1 Split 1

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)			
Source	Database			
Cycle Length	80			
Ring Sum Times	92	81	0	0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	30	18	0	20	15	14	0	28
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord Ph
Ph Min Veh Serv	11	11	9	12	11	11	9	12
Ph Min Ped Serv								

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	12	0	0	12	12	0	0	12
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	0	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate	0	0	0
Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time			

Coordination Timing Plan Data - Dial 1 Split 2

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)			
Source	Database			
Cycle Length	90			
Ring Sum Times	77	69	0	0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	20	25	0	24	20	16	0	25
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord Ph
Ph Min Veh Serv	11	11	9	12	11	11	9	12
Ph Min Ped Serv								

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	0	0	0	8	0	0	0	8
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	7	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate	0	0	0
Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time			

Coordination Timing Plan Data - Dial 2 Split 1

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)			
Source	Database			
Cycle Length	140			
Ring Sum Times	151	99	0	0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	53	20	0	58	17	22	0	40
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord Ph
Ph Min Veh Serv	11	11	9	12	11	11	9	12
Ph Min Ped Serv								

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	12	0	0	8	12	0	0	8
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	0	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate	0	0	0
Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time			

Coordination Timing Plan Data - Dial 3 Split 1

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)			
Source	Database			
Cycle Length	135			
Ring Sum Times	129	111	0	0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	40	40	0	29	25	19	0	47
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord
Ph Min Veh Serv	11	11	9	12	11	11	9	Ph
Ph Min Ped Serv								12

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	12	0	0	8	12	0	0	8
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	130	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time	0	0	0

Coordination Timing Plan Data - Dial 4 Split 1

Date 9/8/2016 Time 15:25

Intersection Name	US 290 at Senate (Const.)			
Source	Database			
Cycle Length	80			
Ring Sum Times	92	80	0	0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	29	18	0	21	15	14	0	27
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord Ph
Ph Min Veh Serv	11	11	9	12	11	11	9	12
Ph Min Ped Serv								

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	12	0	0	12	12	0	0	12
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	0	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time	0	0	0

Coordination Timing Plan Data - Dial 4 Split 2

Date 9/8/2016 Time 15:25

Intersection Name US 290 at Senate (Const.)

Source Database

Cycle Length 90

Ring Sum Times 102 88 0 0

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Time	37	18	0	23	15	15	0	34
Mode	1-Coord Ph	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	1-Coord Ph
Ph Min Veh Serv	11	11	9	12	11	11	9	12
Ph Min Ped Serv								

Phase	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 14	Phase 15	Phase 16
Time	12	0	0	12	12	0	0	12
Mode	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated	0-Actuated
Ph Min Veh Serv	12	9	9	12	12	9	9	12
Ph Min Ped Serv								

Offset	Offset 1	Offset 2	Offset 3
Time	0	0	0
Mode	0-Normal	0-Normal	0-Normal
Alternate Sequence	0	0	0
Ring 2 Lag Time	0	0	0
Ring 3 Lag Time	0	0	0
Ring 4 Lag Time	0	0	0

Local TBC DST and Equate Data

Date: 4/21/2015 Time: 3:40:04PM

Intersection Name: US 290 at Senate (Const.)

Source: Database

	Month	Week
DST Begin	3	2
DST End	11	1
	Hour	**Minute**
Cycle Zero Reference time	24	0

	Equates						
Source	1	2	3	4	5	6	7
1	7	0	0	0	0	0	0
2	3	4	5	6	0	0	0

Local TBC Traffic Data

Intersection Name: US 290 at Senate (Const.) Date: 4/21/2015

Source: Database Time: 3:40:04PM

	PRGM	Time	PATTERN		PHASE FUNCTION															
IT	Day	HH:MM	D/S/O	FLASH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	00:01	1/1/1																	
2	1	09:00	4/2/1																	
3	1	19:30	4/1/1																	
4	1	22:00	1/1/1																	
5	2	00:01	1/1/1																	
6	2	06:00	2/1/1																	
7	2	09:00	1/2/1																	
8	2	15:30	3/1/1																	
9	2	19:00	4/1/1																	
10	2	22:00	1/1/1																	

APPENDIX E

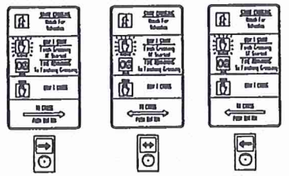
SIGNAL PLANS

TRAFFIC SIGNAL POLE DESCRIPTIONS			
POLE #	POLE TYPE	MAST ARM LENGTHS	ATTACHMENTS
POLE 1	30'	32'	SMA, LUM, S2
POLE 2	10'		PB1, W1
POLE 3	10'		PB2, PB3, W2, W3
POLE 4	30'	36' & 36'	DMA, LUM, PB5/4, W4, W5, S1, S3
POLE 5	10'		PB6, PB7, W6, W7
POLE 6	10'		PB8, W8

NOTES:

1. LOCATION OF UNDERGROUND AND ABOVE GROUND INSTALLATIONS IS APPROXIMATE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL UTILITY LOCATIONS PRIOR TO ANY CONSTRUCTION. SEE "TRAFFIC SIGNAL UTILITY LAYOUT" SHEET FOR MORE DETAILS.
2. ABANDON ALL CONDUIT, CABLE AND GROUND BOXES THAT WILL NOT BE REUSED AS PART OF THE PROPOSED SIGNAL INSTALLATION AT THIS LOCATION.
3. SEE "LEGEND FOR PLAN LAYOUT" SHEET FOR ALL PROPOSED OVERHEAD SIGN DESIGNS, ELECTRICAL SCHEDULE AND LOOP DETECTOR DESIGNATION TABLE.
4. PEDESTRIAN SIGNALS AND PUSH BUTTONS ARE TO BE WIRED IN SERIES.

PROPOSED SIGN SCHEDULE



R10-3eR 9X15 — PB1, PB3 PB4, PB6

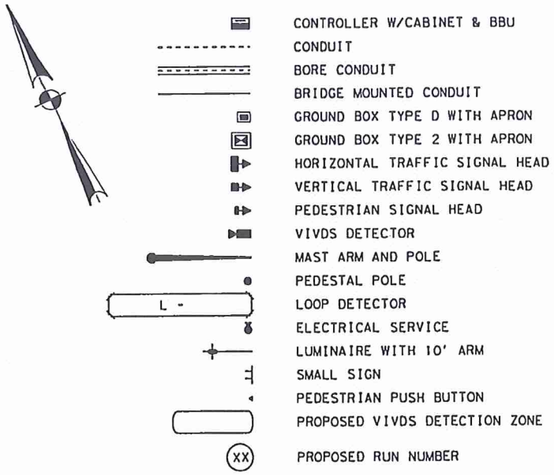
R10-3eRL 9X15 — PB5/4

R10-3eL 9X15 — PB7, PB8

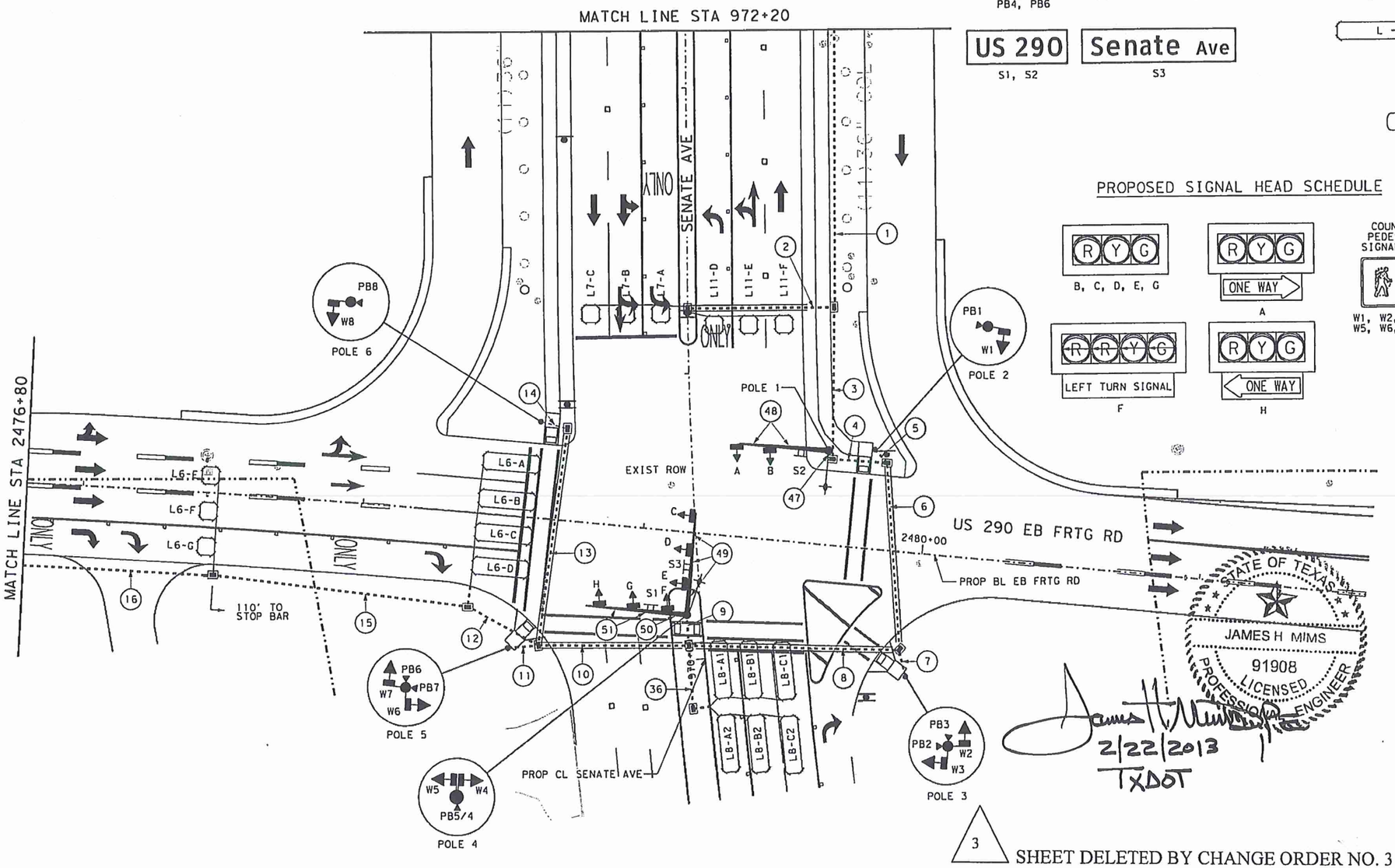
US 290 — S1, S2

Senate Ave — S3

LEGEND



- CONTROLLER W/CABINET & BBU
- CONDUIT
- BORE CONDUIT
- BRIDGE MOUNTED CONDUIT
- GROUND BOX TYPE D WITH APRON
- GROUND BOX TYPE 2 WITH APRON
- HORIZONTAL TRAFFIC SIGNAL HEAD
- VERTICAL TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- VIVDS DETECTOR
- MAST ARM AND POLE
- PEDESTAL POLE
- LOOP DETECTOR
- ELECTRICAL SERVICE
- LUMINAIRE WITH 10' ARM
- SMALL SIGN
- PEDESTRIAN PUSH BUTTON
- PROPOSED VIVDS DETECTION ZONE
- (XX) PROPOSED RUN NUMBER



PROPOSED SIGNAL HEAD SCHEDULE

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY DALE H. HILLIARD, P.E. 70892 ON 5/21/2012

Dale H Hilliard

0 10 20 40

James H Mims 2/22/2013 TXDOT

3 SHEET DELETED BY CHANGE ORDER NO. 3

DESIGN SPEED LIMIT ON US 290 FRONTAGE RD 40 MPH
DESIGN SPEED LIMIT ON SENATE AVE 35 MPH

REV. NO.	DATE	DESCRIPTION	BY

EXCELSIS, INC.
CONSULTING ENGINEERS
2825 WILCREST DR, SUITE 100
HOUSTON, TEXAS 77042
TBPE NO. F-731

Texas Department of Transportation © 2012

US 290

PROPOSED TRAFFIC SIGNAL LAYOUT
SENATE AVE

SHEET 1 OF 3

DSN:	FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
CK:	6	TEXAS				US 290
DRN:	STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
CK:	HOU	HARRIS	0050	09	071, ETC	2051

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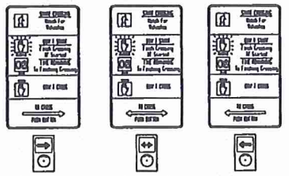
sgroave

TRAFFIC SIGNAL POLE DESCRIPTIONS			
POLE #	POLE TYPE	MAST ARM LENGTHS	ATTACHMENTS
POLE 1	30'	32'	SMA, LUM, S2
POLE 2	10'		PB1, W1
POLE 3	10'		PB2, PB3, W2, W3
POLE 4	30'	36' & 36'	DMA, LUM, PB5/4, W4, W5, S1, S3
POLE 5	10'		PB6, PB7, W6, W7
POLE 6	10'		PB8, W8

NOTES:

1. LOCATION OF UNDERGROUND AND ABOVE GROUND INSTALLATIONS IS APPROXIMATE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL UTILITY LOCATIONS PRIOR TO ANY CONSTRUCTION. SEE "TRAFFIC SIGNAL UTILITY LAYOUT" SHEET FOR MORE DETAILS.
2. ABANDON ALL CONDUIT, CABLE AND GROUND BOXES THAT WILL NOT BE REUSED AS PART OF THE PROPOSED SIGNAL INSTALLATION AT THIS LOCATION.
3. SEE "LEGEND FOR PLAN LAYOUT" SHEET FOR ALL PROPOSED OVERHEAD SIGN DESIGNS, ELECTRICAL SCHEDULE AND LOOP DETECTOR DESIGNATION TABLE.
4. PEDESTRIAN SIGNALS AND PUSH BUTTONS ARE TO BE WIRED IN SERIES.

PROPOSED SIGN SCHEDULE



R10-3eR 9X15 — PB1, PB3 PB4, PB6

R10-3eRL 9X15 — PB5/4

R10-3eL 9X15 — PB7, PB8

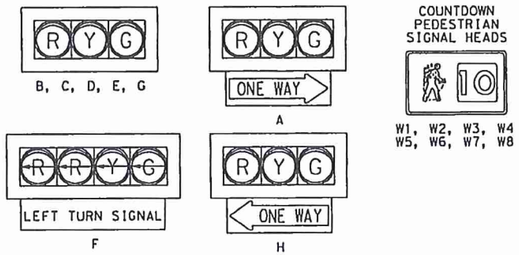
US 290 — S1, S2

Senate Ave — S3

LEGEND

- CONTROLLER W/CABINET & BBU
- CONDUIT
- BORE CONDUIT
- BRIDGE MOUNTED CONDUIT
- GROUND BOX TYPE D WITH APRON
- GROUND BOX TYPE 2 WITH APRON
- HORIZONTAL TRAFFIC SIGNAL HEAD
- VERTICAL TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- VIVDS DETECTOR
- MAST ARM AND POLE
- PEDESTAL POLE
- LOOP DETECTOR
- ELECTRICAL SERVICE
- LUMINAIRE WITH 10' ARM
- SMALL SIGN
- PEDESTRIAN PUSH BUTTON
- PROPOSED VIVDS DETECTION ZONE
- (XX) PROPOSED RUN NUMBER

PROPOSED SIGNAL HEAD SCHEDULE



DESIGN SPEED LIMIT ON US 290 FRONTAGE RD 40 MPH
DESIGN SPEED LIMIT ON SENATE AVE 35 MPH

SHEET ADDED BY CHANGE ORDER NO. 3

STATE OF TEXAS — DALE H. HILLIARD — 70892 — LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY DALE H. HILLIARD, P.E. 70892 ON 9/17/2012

Dale H. Hilliard

0 10 20 40

REV. NO.	DATE	DESCRIPTION	BY

EXCELSIS, INC.
CONSULTING ENGINEERS
2825 WILCREST DR, SUITE 100
HOUSTON, TEXAS 77042
TBPE NO. F-731

Texas Department of Transportation © 2012

US 290
PROPOSED TRAFFIC SIGNAL LAYOUT
SENATE AVE
2051A

SHEET 1 OF 3

DSN:	FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
CK:	6	TEXAS				US 290
DRN:	STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
CK:	HOU	HARRIS	0050	09	071, ETC	2051A

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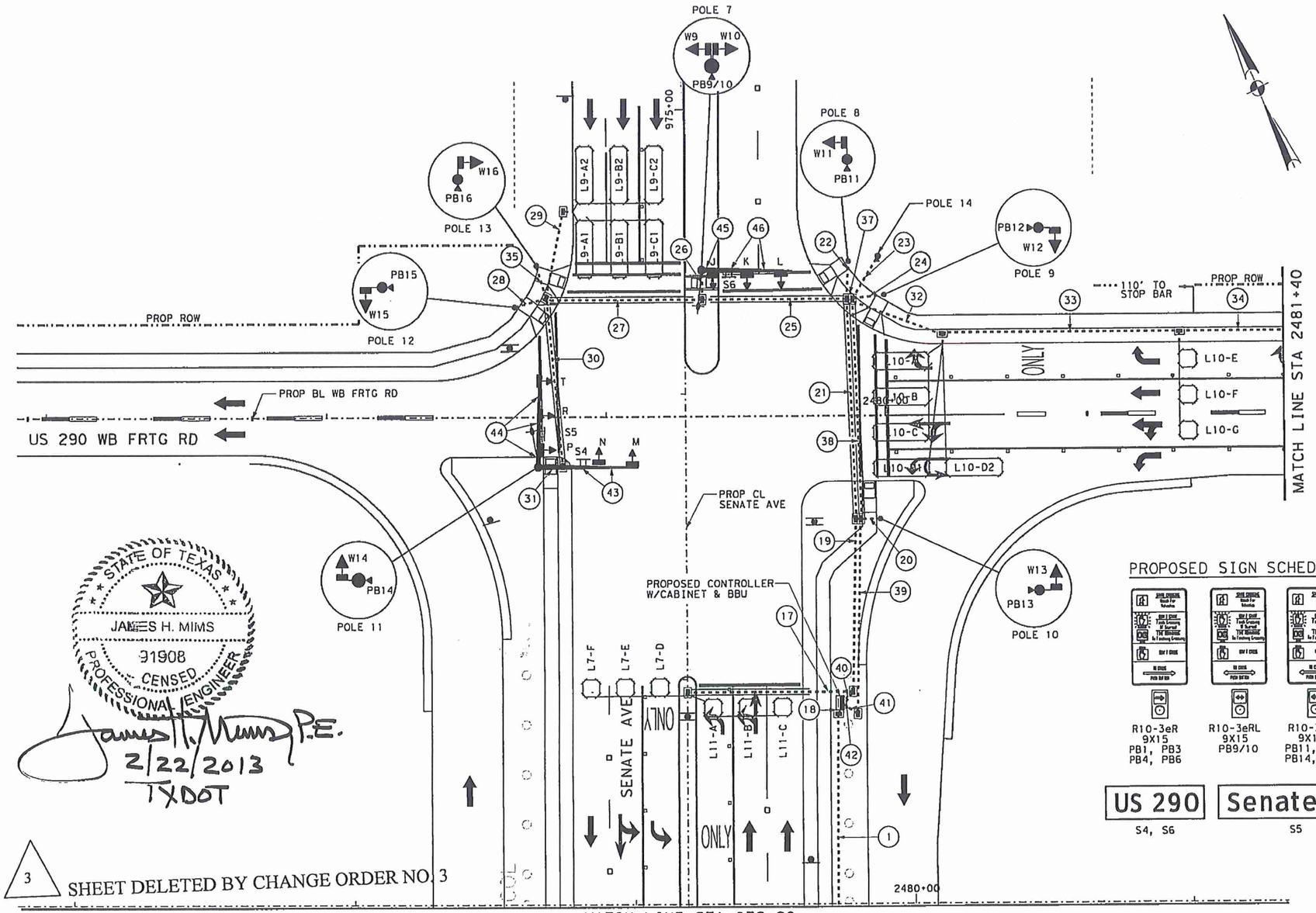


LEGEND

- CONTROLLER W/CABINET & BBU
- CONDUIT
- BORE CONDUIT
- BRIDGE MOUNTED CONDUIT
- GROUND BOX TYPE D WITH APRON
- GROUND BOX TYPE 2 WITH APRON
- HORIZONTAL TRAFFIC SIGNAL HEAD
- VERTICAL TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- VIVDS DETECTOR
- MAST ARM AND POLE
- PEDESTAL POLE
- L - LOOP DETECTOR
- ELECTRICAL SERVICE
- LUMINAIRE WITH 10' ARM
- SMALL SIGN
- PEDESTRIAN PUSH BUTTON
- PROPOSED VIVDS DETECTION ZONE
- (XX) PROPOSED RUN NUMBER

PROPOSED SIGN SCHEDULE

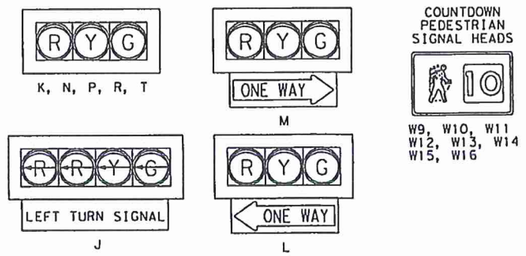
R10-3eR 9X15	R10-3eRL 9X15	R10-3eL 9X15
PB1, PB3 PB4, PB6	PB9/10	PB11, PB13 PB14, PB15

US 290 — S4, S6

Senate Ave — S5

TRAFFIC SIGNAL POLE DESCRIPTIONS			
POLE #	POLE TYPE	MAST ARM LENGTHS	ATTACHMENTS
POLE 7	30'	32'	SMA, LUM, PB9/10, W9, W10, S6
POLE 8	10'		PB11, W11
POLE 9	10'		PB12, W12
POLE 10	10'		PB13, W13
POLE 11	30'	32' & 36'	DMA, LUM, PB14, W14, S4, S5
POLE 12	10'		PB15, W15
POLE 13			PB16, W16
POLE 14			METER W/DISCONNECT

PROPOSED SIGNAL HEAD SCHEDULE



NOTES:

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2. ABANDON ALL CONDUIT, CABLE AND GROUND BOXES THAT WILL NOT BE REUSED AS PART OF THE PROPOSED SIGNAL INSTALLATION AT THIS LOCATION.
3. SEE "LEGEND FOR PLAN LAYOUT" SHEET FOR ALL PROPOSED OVERHEAD SIGN DESIGNS, ELECTRICAL SCHEDULE AND LOOP DETECTOR DESIGNATION TABLE.
4. PEDESTRIAN SIGNALS AND PUSH BUTTONS ARE TO BE WIRED IN SERIES.

DESIGN SPEED LIMIT ON US 290 FRONTAGE RD 40 MPH
DESIGN SPEED LIMIT ON SENATE AVE 35 MPH

STATE OF TEXAS
JAMES H. MIMS
91908
LICENSED
PROFESSIONAL ENGINEER

James H. Mims P.E.
2/22/2013
TXDOT

3 SHEET DELETED BY CHANGE ORDER NO. 3

STATE OF TEXAS
DALE H. HILLIARD
70892
LICENSED
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY DALE H. HILLIARD, P.E. 70892 ON 5/21/2012

Dale H. Hilliard

0 10 20 40

REV. NO.	DATE	DESCRIPTION	BY

EXCELSIS, INC.
CONSULTING ENGINEERS
2825 WILCREST DR, SUITE 100
HOUSTON, TEXAS 77042
TBPE NO. F-731

US 290

PROPOSED TRAFFIC SIGNAL LAYOUT
SENATE AVE

SHEET 2 OF 3

DSN:	FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
CK:	6	TEXAS				US 290
DRN:	STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
CK:	HOU	HARRIS	0050	09	071, ETC	2052

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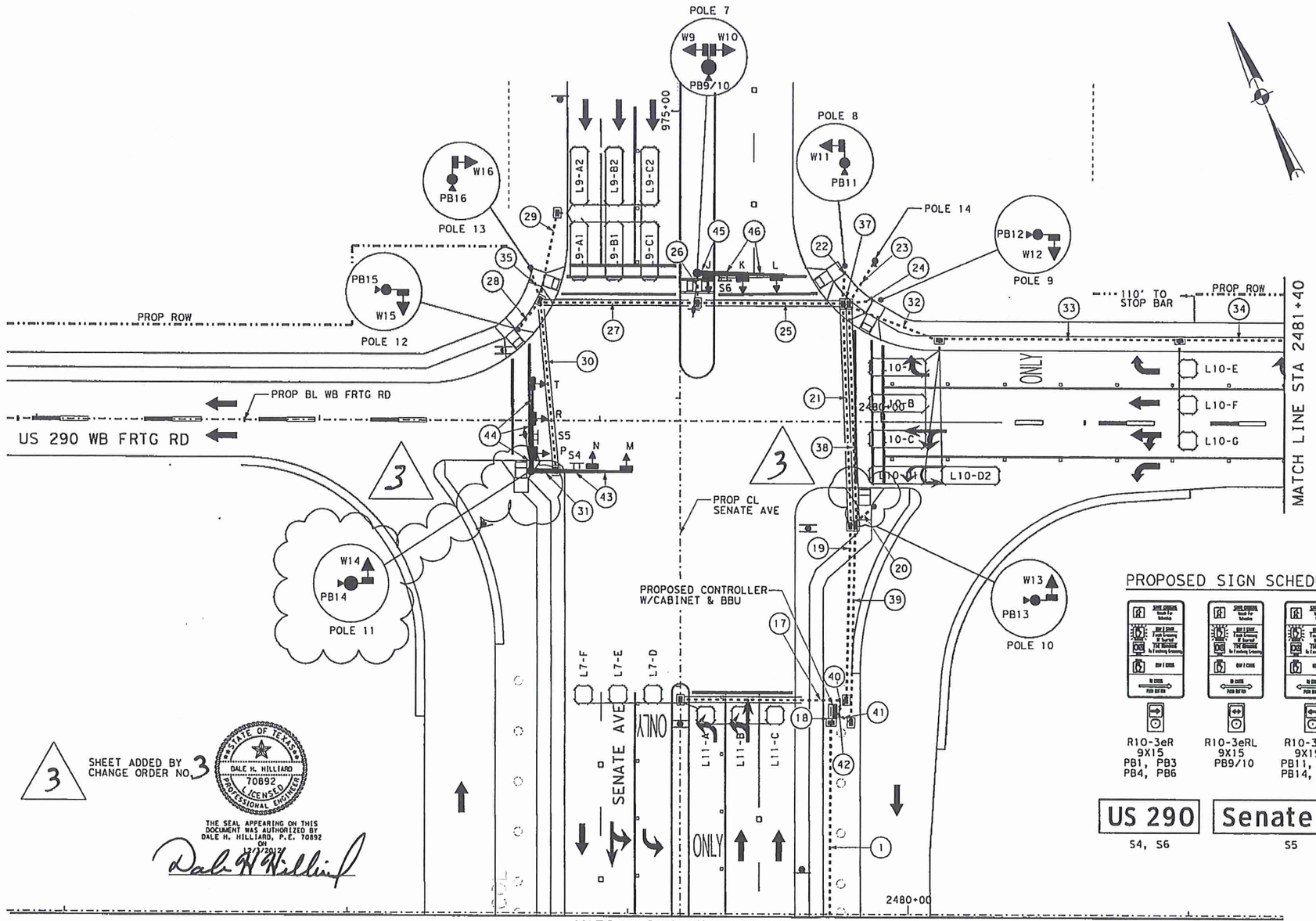
071SGP05.dgn



LEGEND

- CONTROLLER W/CABINET & BBU
- CONDUIT
- BORE CONDUIT
- BRIDGE MOUNTED CONDUIT
- GROUND BOX TYPE D WITH APRON
- GROUND BOX TYPE 2 WITH APRON
- HORIZONTAL TRAFFIC SIGNAL HEAD
- VERTICAL TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- VIVDS DETECTOR
- MAST ARM AND POLE
- PEDESTAL POLE
- LOOP DETECTOR
- ELECTRICAL SERVICE
- LUMINAIRE WITH 10' ARM
- SMALL SIGN
- PEDESTRIAN PUSH BUTTON
- PROPOSED VIVDS DETECTION ZONE
- (XX) PROPOSED RUN NUMBER

PROPOSED SIGN SCHEDULE

R10-3eR 9X15	R10-3eRL 9X15	R10-3eL 9X15
PB1, PB3 PB4, PB6	PB9/10	PB11, PB13 PB14, PB15

US 290 S4, S6 — Senate Ave S5

3 SHEET ADDED BY CHANGE ORDER NO. 3

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY DALE H. HILLIARD, P.E. 70892 ON 12/3/2012

STATE OF TEXAS · DALE H. HILLIARD · 70892 · LICENSED PROFESSIONAL ENGINEER

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TRAFFIC SIGNAL POLE DESCRIPTIONS			
POLE #	POLE TYPE	MAST ARM LENGTHS	ATTACHMENTS
POLE 7	30'	32'	SMA, LUM, PB9/10, W9, W10, S6
POLE 8	10'		PB11, W11
POLE 9	10'		PB12, W12
POLE 10	10'		PB13, W13
POLE 11	30'	32' & 36'	DMA, LUM, PB14, W14, S4, S5
POLE 12	10'		PB15, W15
POLE 13			PB16, W16
POLE 14			METER W/DISCONNECT

PROPOSED SIGNAL HEAD SCHEDULE

K, N, P, R, T — (R Y G)

M — (R Y G) ONE WAY

J — (R R Y G) LEFT TURN SIGNAL

L — (R Y G) ONE WAY

COUNTDOWN PEDESTRIAN SIGNAL HEADS — W9, W10, W11, W12, W13, W14, W15, W16

NOTES:

1. LOCATION OF UNDERGROUND AND ABOVE GROUND INSTALLATIONS IS APPROXIMATE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL UTILITY LOCATIONS PRIOR TO ANY CONSTRUCTION. SEE "TRAFFIC SIGNAL UTILITY LAYOUT" SHEET FOR MORE DETAILS.
2. ABANDON ALL CONDUIT, CABLE AND GROUND BOXES THAT WILL NOT BE REUSED AS PART OF THE PROPOSED SIGNAL INSTALLATION AT THIS LOCATION.
3. SEE "LEGEND FOR PLAN LAYOUT" SHEET FOR ALL PROPOSED OVERHEAD SIGN DESIGNS, ELECTRICAL SCHEDULE AND LOOP DETECTOR DESIGNATION TABLE.
4. PEDESTRIAN SIGNALS AND PUSH BUTTONS ARE TO BE WIRED IN SERIES.

DESIGN SPEED LIMIT ON US 290 FRONTAGE RD 40 MPH
DESIGN SPEED LIMIT ON SENATE AVE 35 MPH

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STATE OF TEXAS · DALE H. HILLIARD · 70892 · LICENSED PROFESSIONAL ENGINEER

REV. NO.	DATE	DESCRIPTION	BY

EXCELSIS, INC.
CONSULTING ENGINEERS
2825 WILCREST DR, SUITE 100
HOUSTON, TEXAS 77042
TBPE NO. F-731

US 290
PROPOSED TRAFFIC SIGNAL LAYOUT
SENATE AVE 2052A
SHEET 2 OF 3

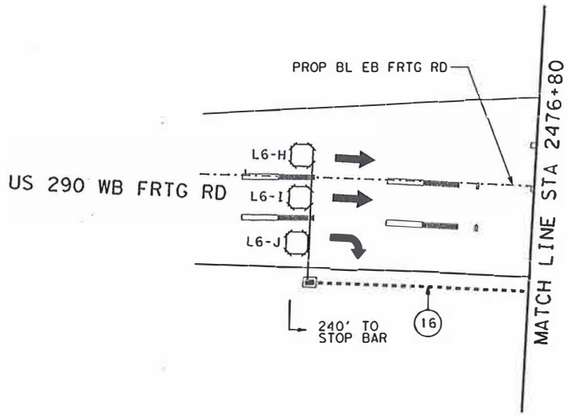
DSN:	FED. RD. DIV. NO.	STATE	PROJECT NO.				HIGHWAY NO.
CK:	6	TEXAS					US 290
DRN:	STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.		SHEET NO.
	HOU	HARRIS	0050	09	071,ETC		2052A

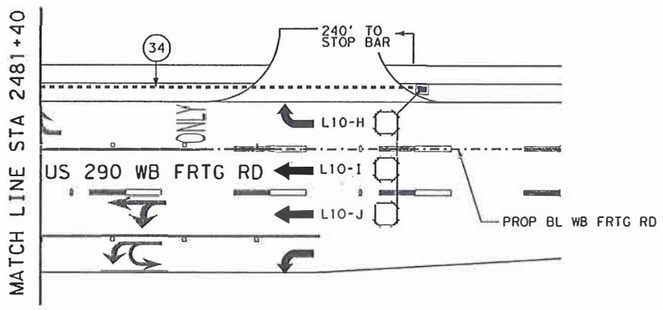
NOTES:

1. LOCATION OF UNDERGROUND AND ABOVE GROUND INSTALLATIONS IS APPROXIMATE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL UTILITY LOCATIONS PRIOR TO ANY CONSTRUCTION. SEE "TRAFFIC SIGNAL UTILITY LAYOUT" SHEET FOR MORE DETAILS.
2. ABANDON ALL CONDUIT, CABLE AND GROUND BOXES THAT WILL NOT BE REUSED AS PART OF THE PROPOSED SIGNAL INSTALLATION AT THIS LOCATION.
3. SEE "LEGEND FOR PLAN LAYOUT" SHEET FOR LOOP DETECTOR DESIGNATION TABLE.

LEGEND

- CONTROLLER W/CABINET & BBU
- CONDUIT
- BORE CONDUIT
- BRIDGE MOUNTED CONDUIT
- GROUND BOX TYPE D WITH APRON
- GROUND BOX TYPE 2 WITH APRON
- HORIZONTAL TRAFFIC SIGNAL HEAD
- VERTICAL TRAFFIC SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- VIVDS DETECTOR
- MAST ARM AND POLE
- PEDESTAL POLE
- L - LOOP DETECTOR
- ELECTRICAL SERVICE
- LUMINAIRE WITH 10' ARM
- SMALL SIGN
- PEDESTRIAN PUSH BUTTON
- PROPOSED VIVDS DETECTION ZONE
- (XX) PROPOSED RUN NUMBER





DESIGN SPEED LIMIT ON US 290 FRONTAGE RD 40 MPH

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY DALE H. HILLIARD, P.E. 70892 ON 5/21/2012

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REV. NO.	DATE	DESCRIPTION	BY

EXCELSIS, INC.
CONSULTING ENGINEERS
2825 WILCREST DR, SUITE 100
HOUSTON, TEXAS 77042
TBPE NO. F-731

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US 290
PROPOSED TRAFFIC SIGNAL LAYOUT
SENATE AVE

SHEET 3 OF 3

DSN:	FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
CK:	6	TEXAS				US 290
DRN:	STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
CK:	HOU	HARRIS	0050	09	071, ETC	2053

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9/10/2008