An aerial photograph of a road interchange, likely a diamond interchange, with multiple lanes and ramps. The surrounding area is a mix of open land, some vegetation, and what appears to be a construction site or undeveloped area. The image is in grayscale and serves as the background for the report cover.

SUNSET ROAD: I-10 TO RIVER ROAD

FINAL TRAFFIC ENGINEERING REPORT

PCDOT Project No. 4SRRIV
CONSOR Project No. 2019-023
Kittelson Project No. 243120.000

August 2020

Final Traffic Engineering Report

Sunset Road Interstate 10 to River Rd

Prepared for:



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PCDOT Project No. 4SRRIV
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August 2020



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1.0 EXECUTIVE SUMMARY

The Pima County Department of Transportation (PCDOT), in coordination with the Arizona Department of Transportation (ADOT) and the City of Tucson Department of Transportation, is investigating alternatives to extend Sunset Road from Interstate 10 (I-10) to River Road. The plan to connect Sunset Road from Silverbell Road to River Road was split into two phases.

The first phase connected Silverbell Road to the existing I-10 Eastbound Frontage Road (EBFR). Phase 1 was completed in 2017 and consists of a three-lane roadway, which includes a two-way left-turn lane and a 720-foot long bridge over the Santa Cruz River. The bridge has a shared-use path along the southern side and a pedestrian sidewalk on the northern side. The shared-use path extends along Sunset Road to the EBFR where it connects with the Chuck Huckelberry Loop (the Loop) regional multi-use path.

Phase 2 will extend Sunset Road from the I-10 Westbound Frontage Road (WBFR) to River Road and is planned to be split into two projects. One project will include the reconstruction of the I-10/Sunset Road TI over I-10 by ADOT, as recommended in the I-10 Mainline, Ina Road TI to Ruthrauff Road TI Design Concept Report (DCR) prepared in 2012. The reconstruction of the I-10/Sunset Road TI is currently included in the ADOT's Five-year construction program. The second project is conducted by PCDOT/RTA and will include constructing new bridges over the Union Pacific Railroad (UPRR) and the Rillito Creek, and will involve building a new intersection at Sunset Road and River Road.

This report documents the traffic analysis conducted to determine the roadway and intersection capacity and lane configuration requirements for Phase 2. The report also documents capacity and traffic control requirements on the section of Sunset Road recently constructed (Phase 1) to serve a large planned development (Sunset Innovation Campus) adjacent to the I-10/Sunset Road TI.

1.1 Existing Conditions

Sunset Road, between Silverbell Road and the EBFR, is a three-lane urban collector roadway that is approximately 3,000 feet long. The daily traffic volume on the segment in 2019 (existing conditions) was 5,700 vehicles per day (vpd). Sunset Road has a posted speed limit of 35 miles per hour (mph) and the existing intersections at the I-10/Sunset Road TI operate at acceptable levels of service (LOS D or better) during the weekday AM and PM peak hours. A review of five-year crash data from September 2014 through September 2019 did not reveal any patterns or trends in the area indicating a safety issue requiring mitigation.

Extending Sunset Road from I-10 to River Road will require reconstruction of the traffic interchange, with Sunset Road crossing over I-10, allowing the roadway to cross over the adjacent Union Pacific Railroad (UPRR) mainline. The extension will also impact the Loop and River Road on the north/east side. River Road is a four-lane urban principal arterial with a posted speed of 45 mph.

1.2 Future Conditions

The extension of Sunset Road from Silverbell Road to River Road is included in the Regional Transportation Authority (RTA) plan with the intent to provide needed access across I-10, improve regional mobility, and support development in the area. ADOT has plans to reconstruct the I-

I-10/Sunset Road TI as part of the upcoming I-10 widening from Ina Road to Ruthrauff Road. The planned interchange configuration will be a tight diamond with a bridge over the future widened I-10 mainline. The Sunset Road extension will cross over the UPRR mainline and connect with River Road. The I-10 bridge and Sunset Road extension will include bicycle lanes/paved shoulder and pedestrian walkways connecting to the Loop.

According to the Pima Association of Governments (PAG) regional travel demand model, the 2045 estimated traffic on Sunset Road will increase to 22,000 vpd west of I-10 and will grow to 12,200 vpd at the I-10/Sunset Road TI. With the addition of the Sunset Road extension, from I-10 to River Road, the daily traffic is projected to increase from 12,200 vpd to 18,000 vpd at the traffic interchange and along the new connection. The majority of the increase in traffic demand is expected to come from new development in the area, the Sunset Innovation Campus, being developed by Pima County on the vacant property located south of Sunset Road between the Santa Cruz River and the I-10 Eastbound Frontage Road.

1.3 Recommendations

Based on the analysis of existing and future traffic conditions, the following recommendations should be considered:

- Construct Sunset Road from I-10 to River Road
 - The extension of Sunset Road from I-10 to River Road will require a four-lane roadway section. The recommended cross-section includes 12-foot wide travel lanes, a raised median, six-foot wide paved shoulders/bicycle lanes, and six-foot wide concrete sidewalk facilities on both sides. The raised median should be a minimum of 10-foot wide, widening to a minimum of 18-feet to accommodate left-turn lanes at intersections.
 - Install a traffic signal and intersection street lighting at the new Sunset Road/River Road intersection.
 - Provide ADA compliant connections on Sunset Road to the multi-use path located on the southern embankment of the Rillito Creek.
 - Provide a posted speed limit of 35 mph on Sunset Road.
 - Maintain a design speed of 50 mph and a posted speed limit of 45 mph on River Road.
 - Provide access to Pima County Natural Resources, Parks and Recreation maintenance yard.
- Reconstruct Sunset Road West (South), from I-10 to the Santa Cruz River
 - Widen the existing three-lane section to a four-lane divided section with raised median and six-foot wide paved shoulders for approximately 900 feet west of the I-10 frontage road to accommodate the new traffic interchange and the intersections at the planned driveways to the Sunset Innovation Campus development.
 - Install conduit and pull boxes for a future traffic signal at the main campus driveway.
- Provide the lane configurations for each study intersection, as illustrated in Figure 13, and turn-lane storage lengths, as provided in Table 10, to accommodate the traffic demand for the I-10/Sunset Road TI and the Sunset Road extension from I-10 to River Road. Capacity analysis results indicate that the proposed improvements will provide sufficient capacity to serve the 2045 traffic projections.
- Right-turn lanes at the planned Sunset Innovation Campus driveways on Sunset Road and the I-10 EBFR would be installed in conjunction with the development.

2.0 INTRODUCTION

In 2006, the Regional Transportation Authority (RTA) 20-year multimodal plan and sales tax were approved by the voters of Pima County. One of the 35 roadway projects included constructing Sunset Road from Silverbell Road to Interstate 10 (I-10) and from I-10 to River Road. Sunset Road once extended from Silverbell Road to I-10, but the Sunset Road Bridge over the Santa Cruz River collapsed during the flood of 1983, losing an important regional connection. See Figure 1 for location and vicinity maps.

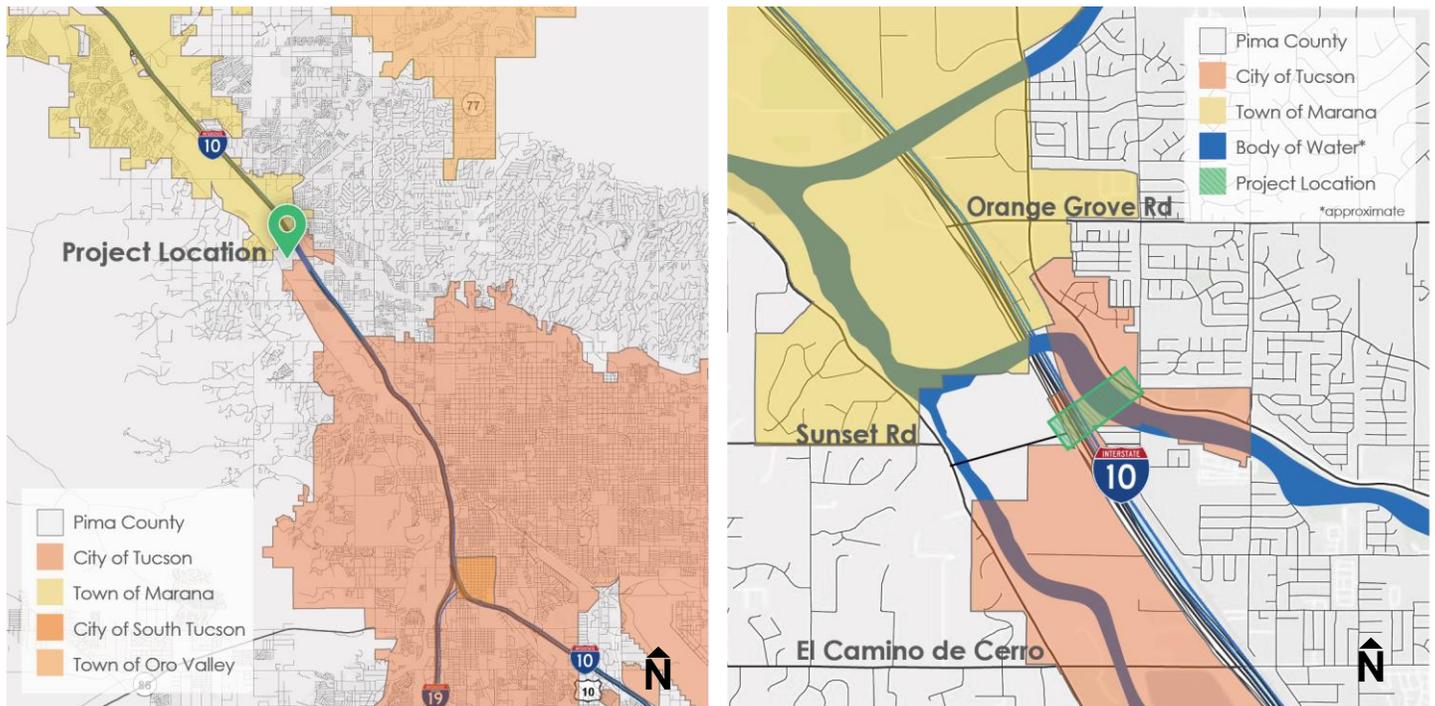
Due to the expected population and employment growth in the northwest Tucson region, the connection of Silverbell Road to I-10 (Phase 1) and the extension to River Road (Phase 2) were included in the RTA plan to provide needed access, improve regional mobility, and support development in the area.

Phase 1, connecting Silverbell Road to the existing I-10 Eastbound Frontage Road (EBFR), was completed in 2017 and consists of a three-lane roadway, which includes a two-way left-turn lane and a 720-foot long bridge over the Santa Cruz River. The bridge has a ten-foot shared-use path along the southern side and a six-foot pedestrian sidewalk on the northern side. The shared-use path extends along Sunset Road to the EBFR where it connects with the Chuck Huckelberry Loop (the Loop) regional multi-use path. Paved shoulders are provided on both sides of Sunset Road and the posted speed limit is 35 miles per hour (mph).

Phase 2 will extend Sunset Road from the I-10 Westbound Frontage Road (WBFR) to River Road and is planned to be split into two projects. One project will include the reconstruction of the I-10/Sunset Road TI over I-10 by ADOT, as recommended in the I-10 Mainline, Ina Road TI to Ruthrauff Road TI Design Concept Report (DCR) prepared in 2012. The reconstruction of the I-10/Sunset Road TI is currently included in the ADOT's Five-year construction program. The second project will be conducted by Pima County/RTA and will include constructing new bridges over the Union Pacific Railroad (UPRR) and the Rillito Creek, and will involve building a new intersection at Sunset Road and River Road.

This report documents the traffic analysis conducted to determine the roadway and intersection capacity and lane configuration requirements for Phase 2. The future conditions analysis evaluated two alternatives – one with the proposed roadway improvements included in the 2045 Regional Mobility and Accessibility Plan, herein after referred to as "No-Build" traffic conditions, and another with the Sunset Road extension from I-10 to River Road, herein after indicated as "Build" traffic conditions. It is worth noting that No-build conditions included the build out of the I-10/Sunset Road TI which is planned by ADOT as part of the I-10 widening with construction anticipated to start in Fiscal Year (FY) 2022. The analysis also considered capacity and traffic control requirements on the section of Sunset Road recently constructed (Phase 1) to serve the Sunset Innovation Campus development that is planned for property adjacent to the Sunset Road TI.

Figure 1. Project Location and Vicinity Map



2.1 Traffic Report Overview

Existing (2019) and future (2045) No-Build and Build traffic conditions were examined on Sunset Road between Silverbell Road and River Road to determine roadway and intersection capacity, lane configurations, traffic control requirements and multi-modal needs. As part of the analysis, the following intersections were evaluated:

- Sunset Road/Silverbell Road
- Sunset Road/Sunset Innovation Campus South Driveway
- Sunset Road/Sunset Innovation Campus Main Driveway
- Sunset Road/I-10 EBFR
- Sunset Road/I-10 WBFR
- Sunset Road/River Road
- I-10 EBFR/Sunset Innovation Campus West Driveway
- I-10 EBFR/Sunset Innovation Campus East Driveway

The traffic analysis followed the guidelines provided in the *Pima County Roadway Design Manual* and the 2016 *Pima County Subdivision and Development Street Standards, ADOT Traffic Guidelines and Processes and City of Tucson Transportation Access Management Guidelines*. Existing and future (2045) No-Build and Build traffic conditions during the AM and PM peak hours were evaluated using the procedures set forth in the Highway Capacity Manual. Future traffic projections included the estimated traffic demand generated by the planned Sunset Innovation Campus.

3.0 EXISTING CONDITIONS

Sunset Road, from Silverbell Road to I-10, consists of a three-lane roadway classified as an urban collector. The following sections describe the existing land-use and roadway conditions within the study area.

3.1 Land Use

The property between I-10 and River Road along the proposed Sunset Road extension alignment has little development and little space for new development, given the constraints created by the Rillito Creek and UPRR mainline. Existing land use includes a Pima County Natural Resources, Parks, and Recreation maintenance yard and residential/industrial businesses to the south and east along Tres Nogales Road and West Sunset Road. These roadways connect to Camino de la Tierra to provide access. The proposed Sunset Road extension cuts through the Pima County property and would not impact the other properties or their access.

Zoning of the properties adjacent to the corridor includes residential and business/commercial land uses. The zoning within and around the vicinity of the project is provided in Figure 2.

South (west) of the I-10/Sunset Road TI, the land is zoned as GR-1 under Pima County zoning ordinances and I-1 in the City of Tucson limits. GR-1 is the rural residential zone, which is intended to discourage commercial development and serve the needs of the rural area. I-1 provides for industrial uses that do not have offensive characteristics to land uses permitted in more restrictive nonresidential zones.

North of the I-10/Sunset Road TI and up to River Road, the land where the future Sunset Road alignment lies is mostly under the City of Tucson zoning ordinances, including land zoned as C-2, MU, and SH. The descriptions of the City of Tucson zoning ordinances are as follows:

- C-2 is a commercial zone. It provides for general commercial uses serving the community and region. Residential uses are also permitted here.
- SH is the suburban homestead zone. It provides for low-density, large-lot residential development.
- MU is the multiple-use zone, which allows for residential, agricultural, civic, commercial, and recreational land uses.

Figure 2. Zoning Map



Data from PimaMaps November 2019



3.2 Physical Conditions

3.2.1 Roadway

In this report, Sunset Road is assumed to be a north-south roadway as I-10 is considered an east-west facility. Sunset Road from Silverbell Road to I-10 provides one travel lane in each direction, a center turn lane, and six-foot wide paved shoulders. On the east(south) side of the roadway, 12 feet of additional pavement is present from the Santa Cruz River Bridge to approximately 800 feet south (west) of the EBFR. A temporary curb between the paved shoulder and this additional pavement is in place. This additional pavement area was constructed to accommodate a future right turn lane for the property located on the east (south) side of the road. A 10-foot wide multiuse path runs on the east (south) side of Sunset Road, and a six-foot asphalt paved pedestrian walkway runs on the west (north) side.

At the I-10/Sunset Road TI, Sunset Road runs under I-10 with a single lane per direction, providing access onto the eastbound and westbound frontage roads and I-10 ramps. Sunset Road is uncurbed at this location, with paved shoulders on both sides of the road. There are curb and gutter and sidewalk ramps at the intersections, which currently operate under stop control. The I-10 bridge clearance is 14' 1" providing adequate clearance for most heavy vehicles.

The existing Sunset Road corridor lies within Pima County right-of-way near Silverbell Road, City of Tucson right-of-way, and ADOT right-of-way near the existing I-10/Sunset Road TI. The Sunset Road extension will be primarily within City of Tucson right-of-way.

River Road is a four-lane divided roadway with a 20-foot raised median, eight-foot paved shoulders, and six-foot sidewalks on both sides.

3.2.2 Speed Limits

The posted speed on Sunset Road between Silverbell Road and I-10 is 35 mph. The posted speed on the I-10 frontage roads and River Road is 45 mph.

3.2.3 Intersections and Driveways

Existing intersection lane configurations and traffic control are provided in Figure 4. The I-10/Sunset Road TI has both intersections operating with stop control. The EBFR/Sunset Road intersection has all the approaches controlled by stop signs. The WBFR/Sunset Road intersection has the traffic on Sunset Road having to stop while traffic on the frontage roads is free-flow.

On Sunset Road just south (west) of the EBFR, there is an enhanced crossing of The Loop multi-use path that runs parallel to the frontage road in this area. This crossing operates as a two-stage crossing where bicyclists and pedestrians on the multi-use path yield for vehicles on Sunset Road.

Figure 3. Sunset Road Crossing for The Loop

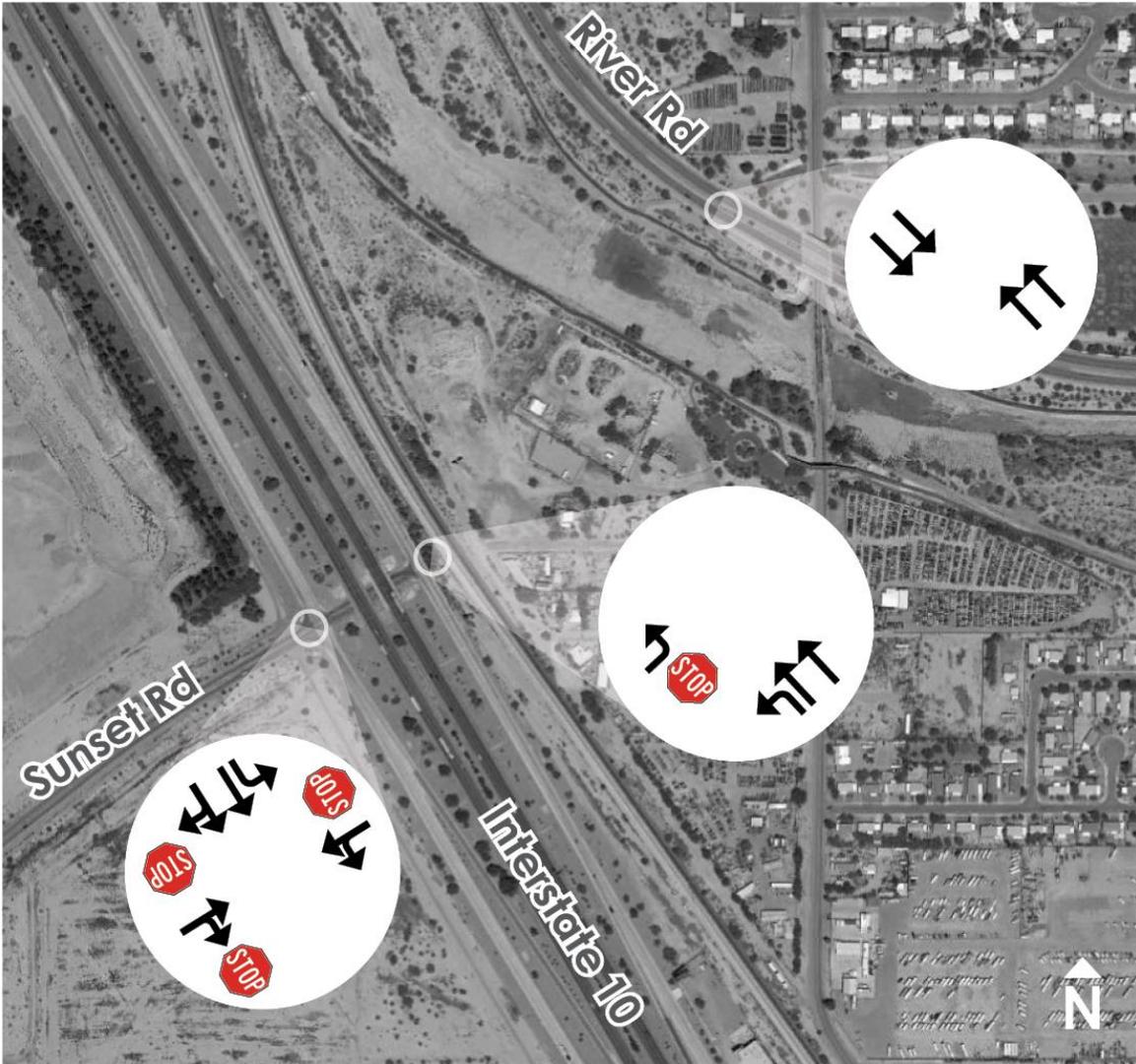


Source: Google Maps

There are no driveways in the immediate vicinity of the I-10/Sunset Road TI or at the proposed Sunset Road/River Road intersection. A driveway providing access to the Pima County Parks & Recreation facility on River Road is approximately ¼ mile west of the future intersection with Sunset Road. Shannon Road intersects River Road about ½ mile to the east. Camino de la Tierra does not connect to River Road. The Loop crosses the Sunset Road extension alignment along both banks of the Rillito Creek. New connections to this multi-use path will need to be provided.

It is worth noting that the current physical conditions have temporarily changed due to traffic control adjustments for the reconstruction of the I-10/Ruthrauff Road TI located approximately 1.25 miles south/east of the I-10/Sunset Road TI. Some of the traffic control changes include a temporary signal at the Sunset Road/EBFR intersection and lane configuration modifications at the Sunset Road/EBFR and Sunset Road/WBFR intersections.

Figure 4. Existing Lane Configurations and Traffic Control



3.3 Traffic Volumes and Existing Levels of Service

In 2019, turning-movement counts were collected by the Pima County Department of Transportation on November 6, 2019, for the two intersections located at the I-10/Sunset Road TI. The counts were conducted on a mid-weekday during the morning (from 7:00 to 9:00 a.m.) and evening (from 4:00 to 6:00 p.m.) peak periods. The AM and PM peak hours occurred from 7:15 to 8:15 a.m. and from 4:45 to 5:45 p.m., respectively.

Figure 5 provides a summary of the existing intersection turning movement counts. Appendix A contains the traffic count data.

Figure 5. Existing Volumes – AM and PM Peak Hours



Intersection Level of Service (LOS) is measured by the average control delay in seconds per vehicle and is a performance measure used to evaluate intersection operations. According to the *Highway Capacity Manual (HCM)*, there are six levels of service that have been defined to measure unsignalized and signalized operations, and they range from LOS A to LOS F. Intersections with a LOS A experience a greater degree of mobility, while intersections with a LOS F operate with congestion and experience extended queueing. Table 1 defines each level of service for stop-controlled and signalized intersections.

Table 1 Level of Service Thresholds for Stop-Controlled and Signalized Intersections

Level of Service	Stop-Controlled Intersection Control Delay (sec/veh)	Signalized Intersection Control Delay (sec/veh)	Definitions
A	0-10	≤ 10	The intersection operates with free-flow conditions and experiences minimal control delay.
B	> 10-15	> 10-20	The intersection experiences insignificant control delay.
C	> 15-25	> 20-35	The intersection has stable operations, though individual cycle failures occur.
D	> 25-35	> 35-55	Small increases in flow affect the travel speed and increase the delay. Many vehicles stop. This is the limit of acceptable delay in an urban area.
E	> 35-50	> 55-80	There is significant control delay with poor progression, high volume-to-capacity ratios, etc.
F	> 50	> 80	The control delay at the intersection is unacceptable, as it is over capacity. The volume-to-capacity ratio is greater than 1.0.

Source: HCM, Sixth Edition

Level of service and delay analyses were performed utilizing Synchro 10, as it is a software that can provide a macroscopic evaluation of transportation systems. Methods from the *Highway Capacity Manual, Sixth Edition* were used to obtain the intersection level of service and delay.

Pima County and the City of Tucson have specific design requirements for all intersections and roadway segments. Outlined in the 2016 *Pima County Subdivision and Development Street Standards* (10), all intersections and through movements shall operate at a LOS D or better, and no turning lane movement shall fall below a LOS E.

Table 2 presents the results of the existing AM and PM peak hour traffic conditions for the unsignalized, stop-controlled intersections at the traffic interchange. Appendix B contains the capacity analysis worksheets.

Table 2. Existing Levels of Service

Time Period	EB		WB		NB		SB		Overall Intersection	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
I-10 Eastbound Frontage Road at Sunset Road										
AM	E	38.7	-	-	22.7	C	13.4	B	31.0	D
PM	A	9.7	-	-	10.7	B	10.6	B	10.3	B
I-10 Westbound Frontage Road at Sunset Road										
AM	-	-	14.4	B	-	-	-	-	7.6	B*
PM	-	-	21.6	C	-	-	-	-	4.3	C*

*Two-way LOS based on Critical Movement

**Sunset Road is designated as northbound/southbound.

The Sunset Road/EBFR intersection operates at LOS D in the AM peak hour and LOS B in the PM peak hour. The LOS results indicate that during the morning and afternoon peak hours, the I-10/Sunset Road TI operates at an acceptable level of service (D or better); however, the EBFR approach is operating close to capacity (LOS E) in the AM peak hour.

PAG collected 24-hour traffic count data on River Road in 2016 between Orange Grove Road and Shannon Road. From the gathered data, the K-factor (the proportion of average daily traffic occurring in one hour) and the D factor (the directional distribution of traffic traveling in the peak direction) were calculated.

Table 3 provides the existing average daily volume and traffic factors on River Road. During the AM peak hour, the majority of commuter vehicles are traveling eastbound on River Road, towards La Cholla Boulevard. During the PM peak hour, the majority of commuter vehicles are traveling westbound on River Road towards Orange Grove Road.

Table 3. River Road Traffic Factors

Street-Segment	ADT	K _{AM}	K _{PM}	D _{AM}	D _{PM}
East Bound					
River Road - Orange Grove Road to Shannon Road	9,289	0.12	0.13	67%	38%
West Bound					
River Road - Orange Grove Road to Shannon Road	9,293	0.12	0.13	33%	62%

3.4 Crash Analysis

The crash history on Sunset Road and River Road was reviewed to identify potential safety issues. ADOT provided crash data for the most recent five-year period, from September 2014 to September 2019 for Sunset Road and April 2014 to April 2019 for River Road. The crash data evaluated for River Road correspond to the segment of River Road from Joiner Road (about ¼ mile west of the proposed Sunset Road/River Road intersection) to Camino de la Tierra (about 600 feet east of the future intersection).

During these periods, no fatal crashes were reported. Table 4 summarizes the reported crashes by severity according to the following: fatal, incapacitating injury, non-incapacitating injury, and property damage only (PDO) crashes. Table 5 organizes the data by collision type. Appendix C includes the crash datasheets.

Table 4. Crashes by Injury Severity

Injury Severity	Sunset Road at EBFR	Sunset Road at WBFR	River Road Segment between Joiner Road and Camino de la Tierra
Fatal	-	-	-
Class 4 (incapacitating) Injury	1	-	3
Bodily (non-incapacitating) Injury	4	2	3
PDO*	1	4	11
Total Crashes	6	6	17
Severity Index**	2.5	1.3	2.0

*PDO – property damage only

**Severity index was calculated based on crash severity parameters developed by the National Safety Council.

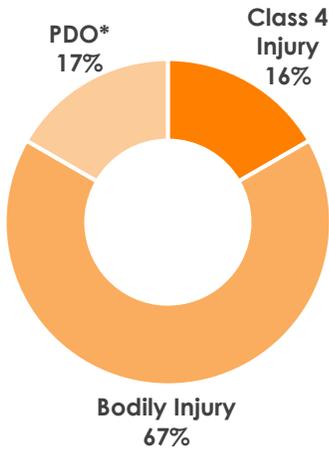
The Severity Index was calculated using the formula provided by Pima County. Index = $[5.8(\text{Fatality} \ \& \ \text{Class 4 Injury}) + 2(\text{Class 2 \ \& \ 3 Bodily Injury}) + \text{Property Damage}] / (\text{Total No. of Crashes})$

The severity index values provided in Table 4 are higher than the Pima County average severity indexes documented in the 2016 Safety Management System Annual Report. In 2016, the Pima County Severity Index for unsignalized intersections with six or more crashes was 1.52 with a standard deviation of 0.98, and 1.47 for roadway segments with a standard deviation 0.42.

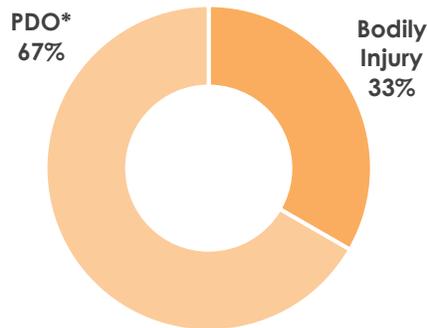
The reconstruction of the I-10/Sunset Road TI which will include traffic signal control is anticipated to improve safety at the Sunset Road/EBFR intersection. Extending Sunset Road to River Road may increase crash potential since a new intersection and conflict point will be introduced onto River Road. Installing a signal may reduce the potential of more severe crashes.

Figure 6. Crashes by Injury Severity Summary

Sunset Road at EBFR



Sunset Road at WBFR



River Road

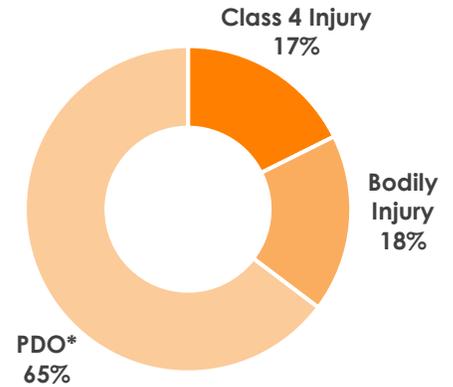


Table 5. Crashes by Collision Type

Collision Type	Sunset Road at EBFR Intersection		Sunset Road at WBFR Intersection		River Road from Joiner Road to Shannon Road	
	Number	% of Total	Number	% of Total	Number	% of Total
Single Vehicle	-	-	1	17%	9	53%
Rear End	-	-	1	17%	1	6%
Turning	-	-	1	17%	2	12%
Angle	5	83%	2	33%	4	23%
Sideswipe	-	-	1	17%	-	-
Miscellaneous	-	-	-	-	-	-
Fixed Object	-	-	-	-	-	-
Backing	-	-	-	-	-	-
Head On	-	-	-	-	-	-
Other	1	17%	-	-	1	6%
Animal	-	-	-	-	-	-
Total Crashes	6		6		17	

3.5 Alternative Transportation Modes

Alternative transportation modes include existing public transportation services by Sun Tran, as well as pedestrian, bicycle, and equestrian amenities within the project area.

Currently, no transit service is provided on Silverbell Road, Sunset Road, or River Road within the study area. The PAG Long Range Regional Transit Plan Update does not include transit service on these roadways.

River Road is a designated bike route that has 8-foot wide striped paved shoulders on both sides of the four-lane divided roadway.

The Loop, a Pima County paved non-motorized multi-use path (6), generally runs along the banks of the Santa Cruz River, the Rillito Creek, and the Cañada del Oro Wash. In the area of the I-10/Sunset Road TI, the Loop runs along the south (west) side of the EBFR and crosses Sunset Road west of the traffic interchange.

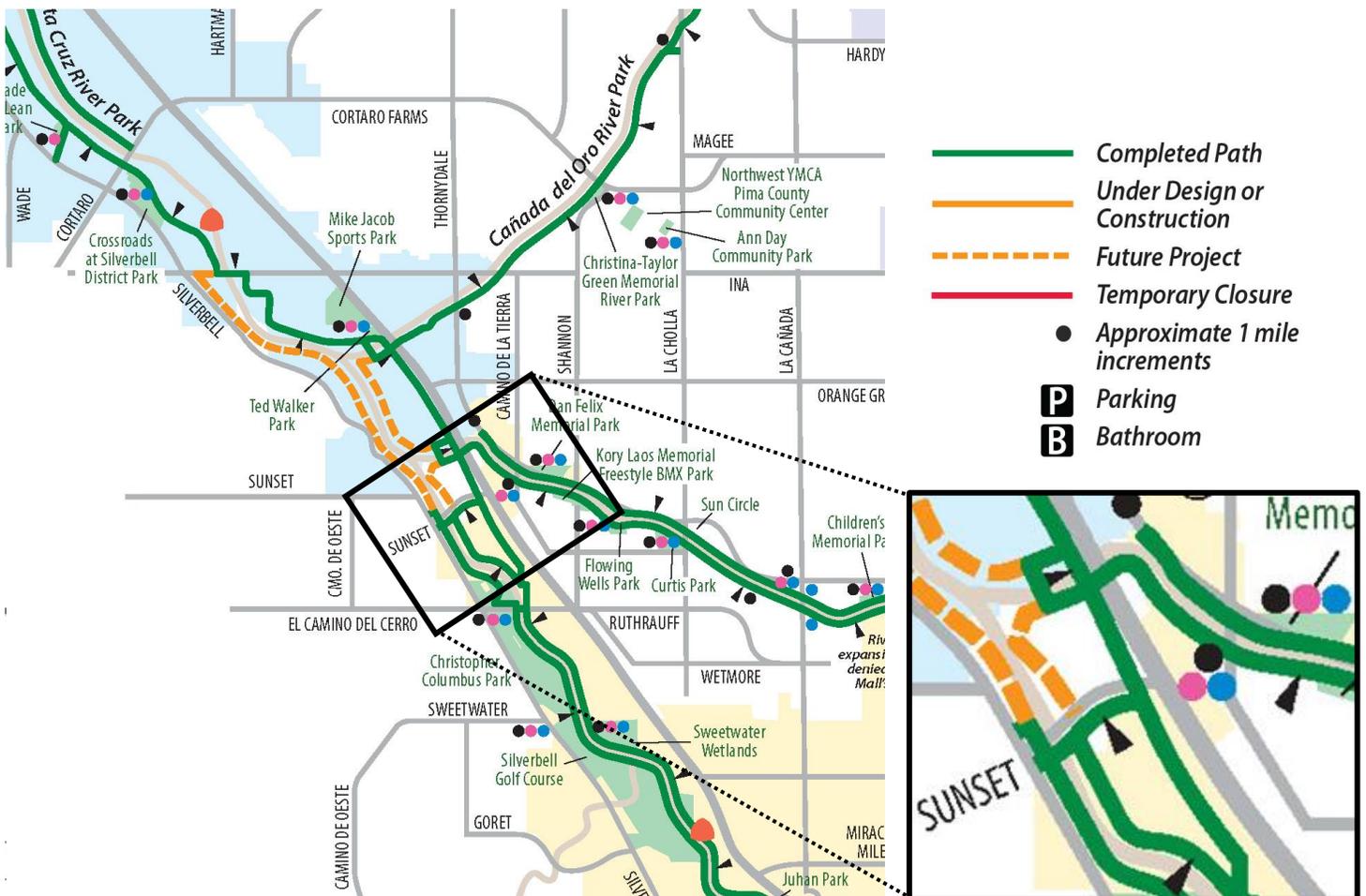
In the area of River Road, The Loop runs along both the north and south banks of the Rillito Creek. There is an existing connection from The Loop to River Road. The Loop runs along the east (south) side of Sunset Road between the I-10 EBFR and Silverbell Road.

Figure 7 illustrates the existing and planned multi-use path facilities in the vicinity of the I-10/Sunset Road TI.

A 6-foot wide asphalt path runs on the west (north) side of Sunset Road from I-10 to Silverbell Road. River Road has sidewalks running along both the north and south sides of the road.

There are no trails in the area designated explicitly for equestrian usage.

Figure 7. The Loop Pathway System Map – Pima County



4.0 FUTURE CONDITIONS

The future conditions analysis identifies how the study area's transportation system will operate with the extension of Sunset Road from I-10 to River Road, with traffic generated by the proposed Sunset Innovation Campus, other planned developments within the area and general growth in the region.

4.1 Planned Developments

Pima County acquired over 100 acres of property near Sunset Road in 2012 and has plans to develop the land as an employment center. The Sunset Innovation Campus will be a new campus-style employment site with nearly one million square feet of office and technical research space. Access to the campus would be located off of Sunset Road and the EBFR. The campus location, in relation to the Sunset Road improvements, is shown in Figure 8.

A preliminary conceptual site plan for the campus is provided in Figure 9. In addition to the office space, an amphitheater, connection to the Loop, a park, and several parking structures are also proposed as part of the development.

Current access plans for the site (unlike that shown in Figure 9) includes two driveways on Sunset Road – a South Driveway and a Main Driveway and two driveways on the I-10 EBFR. Construction of this development is expected to begin in 2022 with buildout completed by 2045.

Currently, there are no plans to develop the property between I-10 and River Road. Pima County has long-term development plans for the property adjacent to the Sunset Innovation Campus.

Figure 8. Sunset Innovation Campus Location



Figure 9. Sunset Innovation Campus – Preliminary Site Plan

CONCEPTUAL SITE PLAN



LEGEND

- PROJECT BOUNDARY
- - - EASEMENT
- - - 100 YEAR FEMA FLOODPLAIN
- - - ARCHEOLOGY LIMITS

KEY

- 1 OFFICE 1A: 50,000 SF
- 2 OFFICE 1B: 90,000 SF
- 3 PARKING STRUCTURE 1A
- 4 OFFICE 2A: 40,000 SF
- 5 OFFICE 2B: 40,000 SF
- 6 OFFICE 2C / PARKING 2A: 17,500 SF
- 7 OFFICE 2D / PARKING 2B: 17,500 SF
- 8 OFFICE 3A / PARKING 3A: 35,000 SF
- 9 OFFICE 3B / PARKING 3B: 35,000 SF
- 10 OFFICE 3C: 60,000 SF
- 11 PARKING STRUCTURE 3C
- 12 PARKING STRUCTURE 3D
- 13 OFFICE 4A: 180,000 SF
- 14 PARKING STRUCTURE 4A
- 15 OFFICE 4B: 180,000 SF
- 16 OFFICE 4C: 120,000 SF
- 17 PARKING STRUCTURE 4B
- 18 OFFICE 5A: 40,000 SF
- 19 OFFICE 5B: 20,000 SF
- 20 OFFICE 5C: 20,000 SF
- 21 OFFICE 5D: 40,000 SF
- 22 THE LOOP (MULT-USE PATH)
- 23 SUNSET GARDENS
- 24 CAMPUS COMMONS
- 25 CAMPUS SQUARE
- 26 SUNSET AMPHITHEATER
- 27 CAMPUS TRAILHEAD
- 28 SANTA CRUZ RIVER PATH
- 29 SUNSET PARK
- 30 CAMPUS PARKLET

SUNSET PROFESSIONAL CAMPUS

THE DESIGN WAS CREATED USING THE MOST RECENT AVAILABLE AERIAL PHOTOGRAPHS AND DESIGN DATA PROVIDED BY THE DESIGNER. COORDINATE, ELEVATION AND DISTANCE DATA ARE FOR INFORMATIONAL PURPOSES ONLY. THIS PLAN IS NOT TO BE USED FOR CONSTRUCTION OR ANY OTHER PURPOSE WITHOUT THE DESIGNER'S WRITTEN PERMISSION.

PROJECT: PCD-14 CONCEPTUAL SITE PLAN
 FILE NAME: PCD-14 CONCEPTUAL SITE PLAN.DWG

PIMA COUNTY
 THE PLANNING CENTER

Trip Generation

Weekday AM and PM peak-hour vehicle trip estimates for the Sunset Innovation Campus were estimated using the Institute of Transportation Engineer's (ITE) *Trip Generation Manual*, 9th Edition (13). Table 6 summarizes the anticipated number of trips that will be generated by the proposed development.

Table 6. Estimated Trip Generation

Land Use	ITE Code	Size	Daily Trips	Weekday AM Peak Hour Trips			Weekday PM Peak Hour Trips		
				Total	In	Out	Total	In	Out
General Office Building	710	50,000 SF	552	78	69	9	75	13	62
General Office Building	710	90,000 SF	993	140	124	16	134	23	111
General Office Building	710	40,000 SF	441	62	55	7	60	10	50
General Office Building	710	40,000 SF	441	62	55	7	60	10	50
General Office Building	710	17,500 SF	193	27	24	3	26	4	22
General Office Building	710	17,500 SF	193	27	24	3	26	4	22
General Office Building	710	35,000 SF	386	55	48	7	52	9	43
General Office Building	710	35,000 SF	386	55	48	7	52	9	43
General Office Building	710	60,000 SF	662	94	82	12	89	15	74
General Office Building	710	180,000 SF	1,985	281	247	34	268	46	222
General Office Building	710	180,000 SF	1,985	281	247	34	268	46	222
General Office Building	710	120,000 SF	1,324	187	165	22	179	30	149
General Office Building	710	40,000 SF	441	62	55	7	60	10	50
General Office Building	710	20,000 SF	221	31	27	4	30	5	25
General Office Building	710	20,000 SF	221	31	27	4	30	5	25
General Office Building	710	40,000 SF	441	62	55	7	60	10	50
Net New Trips			10,865	1,535	1,352	183	1,469	249	1,220

Based on the ITE trip generation method, the Sunset Innovation Campus is projected to generate 10,865 net new trips each day; 1,535 net new trips during the weekday AM peak hour and 1,469 net new trips during the weekday PM peak hour.

4.2 Planned Transportation Improvements

Recently constructed and planned transportation improvements in the project vicinity include:

- **Ina Road, Silverbell Road to I-10** – The Town of Marana widened Ina Road from a two-lane facility to a four-lane facility. The widening included the construction of two new bridges over the Santa Cruz River and tied into the ADOT I-10/Ina Road TI improvements. Construction was completed in May 2019.
- **Silverbell Road, Grant Road to Ina Road** – This RTA project will widen the existing two-lane roadway to a divided four-lane roadway with pedestrian facilities and bike lanes. The project is being designed and constructed in multiple phases. The first phase, Grant Road to Goret Road, finished construction in January 2017. Phase two, Goret Road to El Camino del Cerro, is currently under design and is expected to start construction in 2022. Phase three, El Camino del Cerro to Ina Road, is scheduled to begin design in 2021, with the construction of the entire corridor anticipated to be completed by 2026.
- **I-10/Ruthrauff Road Traffic Interchange** – Construction is underway for a redesigned traffic interchange at I-10 and Ruthrauff Road/El Camino del Cerro. Ruthrauff Road/El Camino del Cerro will be widened to two lanes in each direction and will be raised to cross over I-10, the UPRR, and Davis Avenue/Highway Drive. I-10 will be widened to four lanes in each direction and will be lowered to go beneath Ruthrauff Road/El Camino del Cerro. Construction is anticipated to be completed by late 2021.

4.3 No-Build Traffic Conditions

The analysis of the future (2045) No-Build scenario identifies the intersection operations associated with the reconstruction of the I-10/Sunset Road TI and build-out of the Sunset Innovation Campus, and does not include the extension of Sunset Road from I-10 to River Road.

4.3.1 Peak Hour Traffic Volume Projections

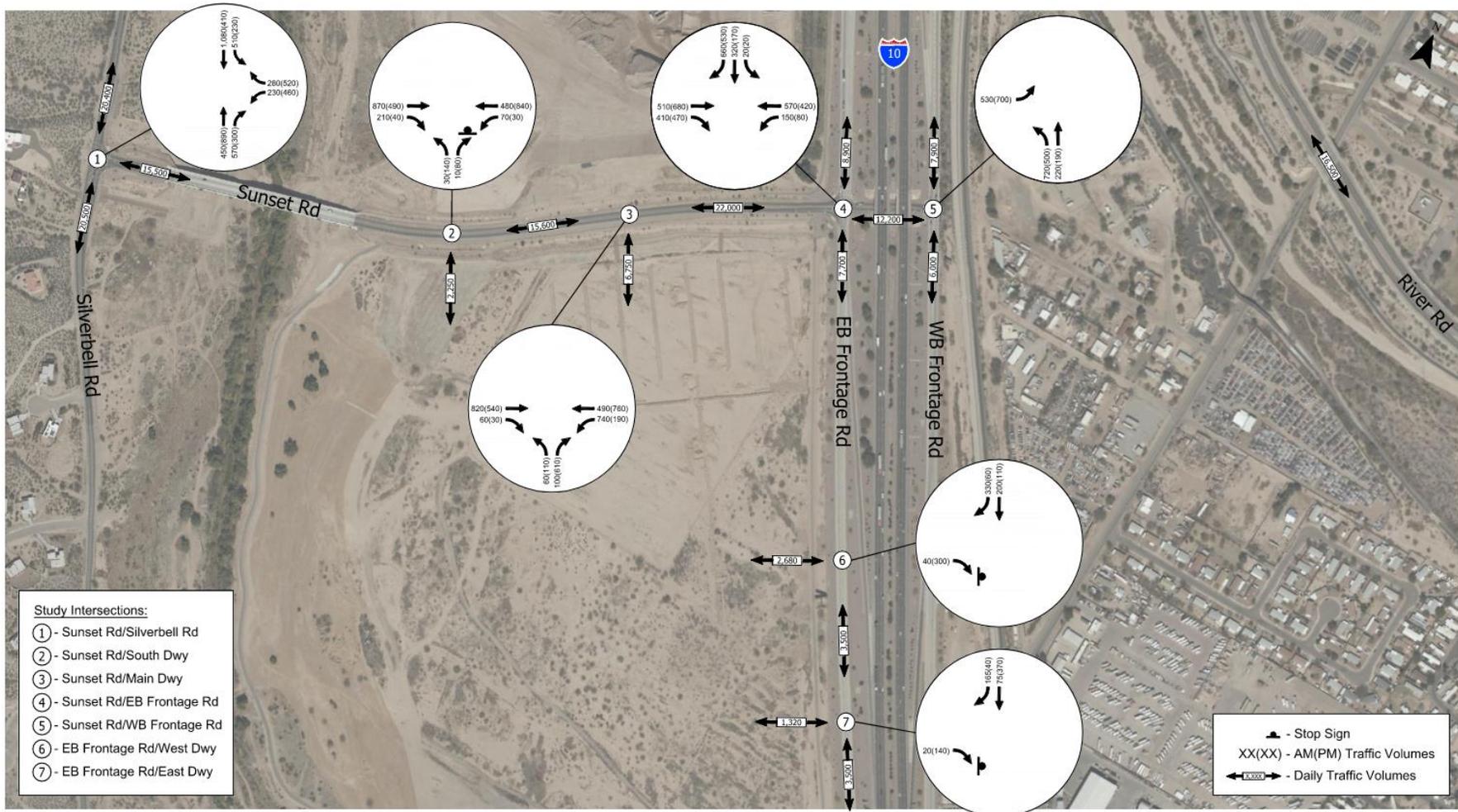
Future traffic volume projections were developed utilizing PAG's 2045 regional travel demand model. PAG recently revised the socioeconomic data used in the model to reflect a reduction in expected regional population growth. Regional population estimates for 2045 were reduced from approximately 1.5 million to 1.2 million residents in the greater Tucson area. The current population in the region is approximately 1.0 million.

Key aspects of the 2045 No-Build roadway network and land use included in PAG's travel demand model are:

- Roadway improvement projects defined in the 2045 Regional Mobility and Accessibility Plan
- Sunset Road from Silverbell Road to I-10 has a three-lane cross-section
- I-10 has an eight-lane section in the vicinity of the Sunset Road TI
- Silverbell Road has a four-lane cross-section
- High density office-related land use is defined for the property where the future Sunset Innovation Campus is planned.

According to PAG's traffic projections, the campus development is anticipated to generate approximately 14,000 daily trips, which is approximately 3,000 more trips than what is outlined in Table 6 based on the ITE Trip Generation methodology. Future peak-hour intersection traffic volumes were developed for the No-Build scenario using PAG's 2045 No-Build daily projections. Figure 10 presents the 2045 No-Build average daily traffic and weekday AM and PM peak hour intersection volumes.

Figure 10. 2045 No-Build Traffic Volume Projections

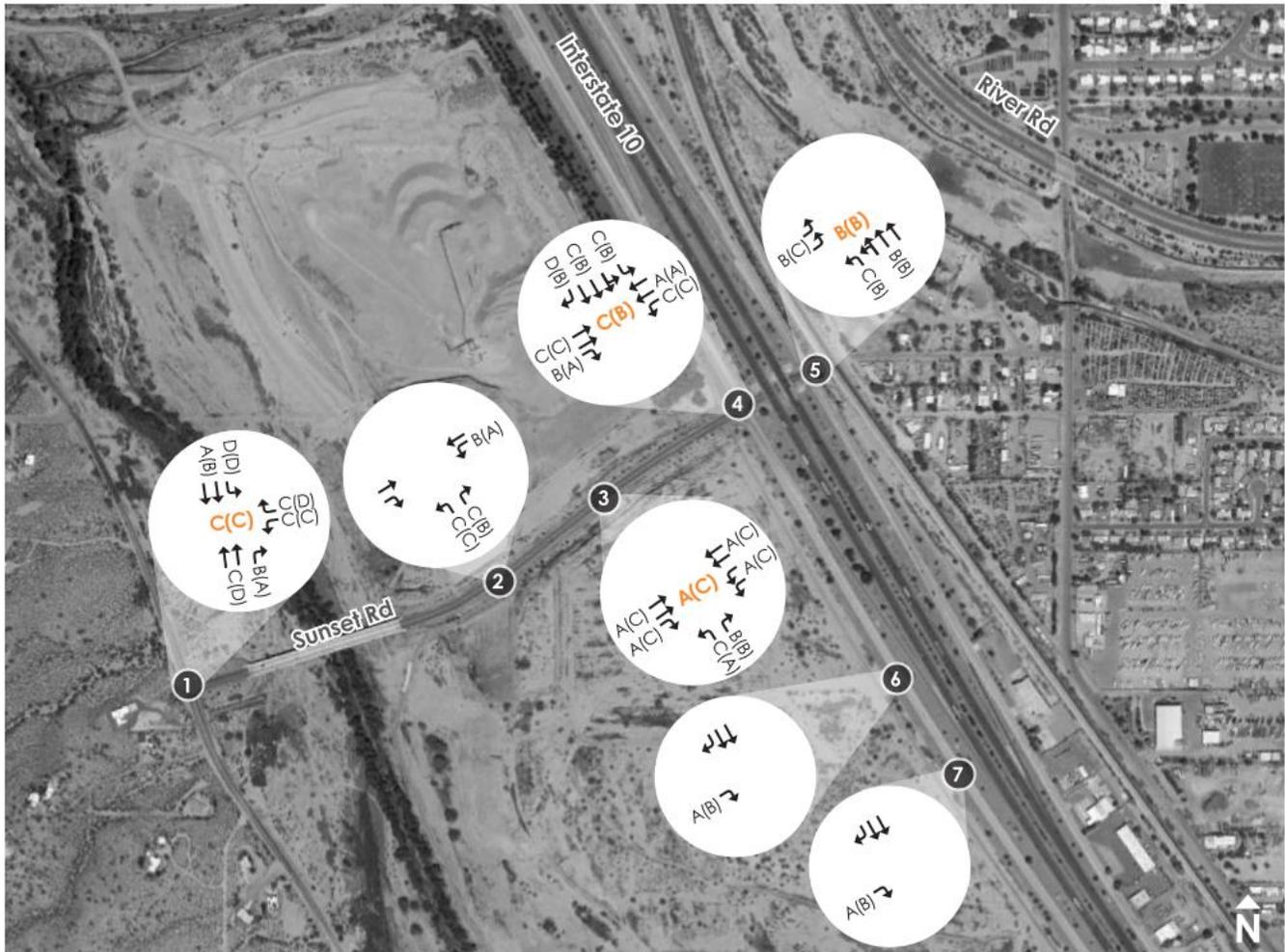


4.3.2 Capacity and Level of Service Analysis

The weekday AM and PM peak hour turning movement volumes shown in Figure 10 were used to conduct an operational analysis at each study intersection, compute the level of service, and determine the lane configurations for the 2045 No-Build scenario. Intersection capacity is the maximum rate at which vehicles can pass through an intersection in one hour and is dependent on various factors such as the number of lanes, signal control, lane utilization, and grades, etc. The capacity requirements for the future traffic volumes were assessed using Synchro 10 following the methodologies outlined in the *Highway Capacity Manual, Sixth Edition (7)*. Figure 11 provides the estimated levels of service and proposed intersection lane configuration for the 2045 No-Build scenario. Appendix D includes the analysis worksheets for the 2045 No-Build scenario.

Note that intersections 2, 6, and 7, are T-intersections and are stop-controlled on the side streets accessing the Sunset Innovation Campus. According to methodologies outlined in the HCM, the major street of a two-way stop-controlled intersection is presumed to operate without delay due to control on the minor streets, and therefore, only the minor streets have an associated delay and level of service estimate.

Figure 11. 2045 No-Build Level of Service Projections



As indicated in Figure 11, all intersections and individual intersection turning movements are expected to operate under capacity in 2045, with a LOS D or better, during the weekday AM and PM peak hours. Lane configurations for the I-10/Sunset Road TI were assumed based on the future I-10 widening project. The Sunset Innovation Campus access driveways are anticipated to be constructed with the proposed development.

4.4 Build Traffic Conditions

The analysis of the future (2045) Build scenario identifies the intersection capacity and lane configuration requirements associated with the reconstruction of the I-10/Sunset Road TI, extension of Sunset Road from I-10 to River Road, and build-out of the Sunset Innovation Campus

4.4.1 Peak Hour Traffic Volume Projections

2045 Build traffic projections were developed utilizing PAG's 2045 regional travel demand model. In addition to the key model aspects listed for the No-Build model, the model included Sunset Road as a three-lane cross section from I-10 to River Road. Figure 12 provides the 2045 daily traffic volumes, as well as the intersection turning movement volumes for the weekday AM and PM peak hours for the Build scenario.

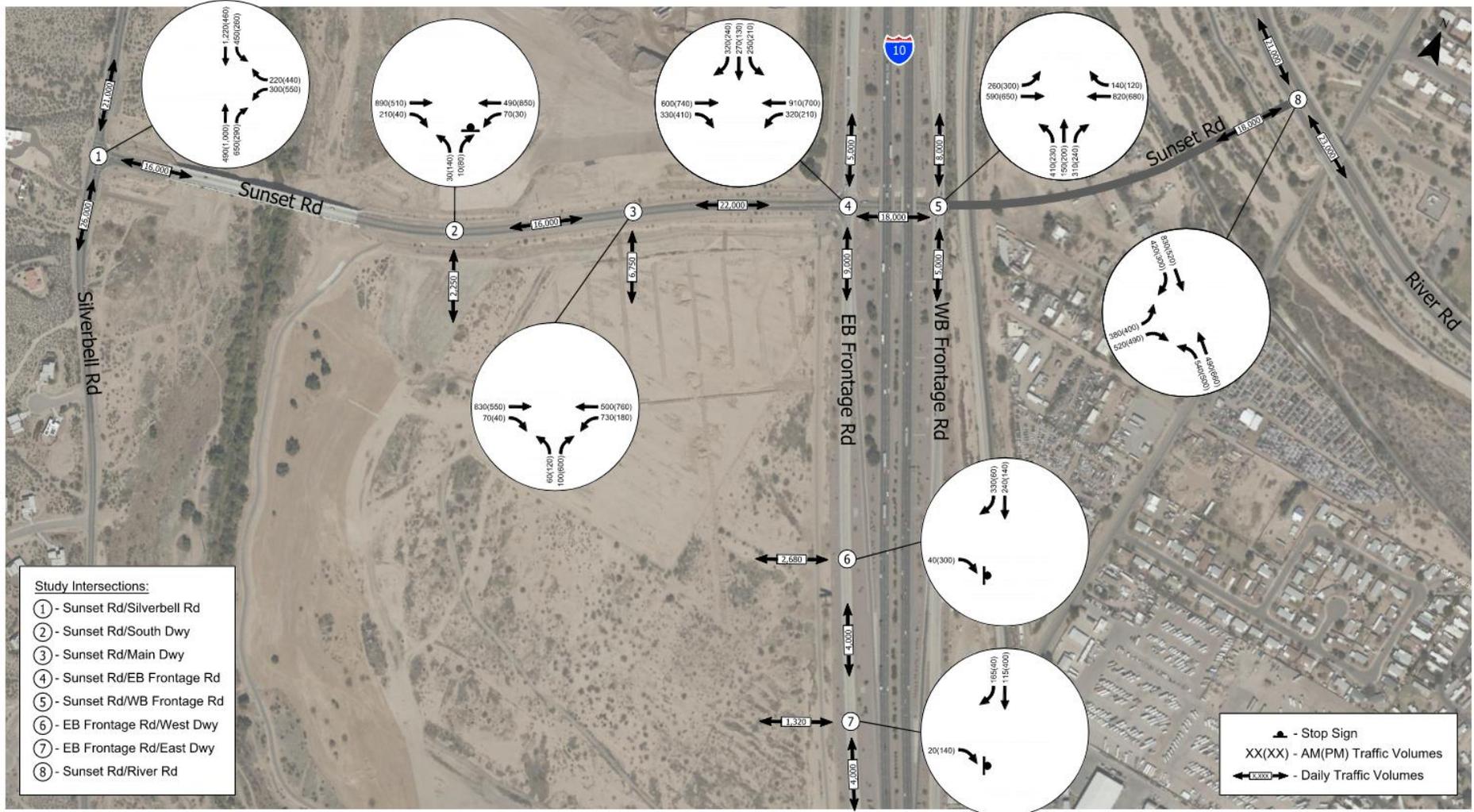
For comparison, traffic demand on the adjacent/parallel roadways to Sunset Road providing access to I-10 was analyzed with and without the Sunset Road extension. Under the No-Build scenario, there would be no traffic projected for Sunset Road north of I-10 and north-south trips that would have been accommodated on the extension of Sunset Road from I-10 to River Road would be shifted to El Camino del Cerro/Ruthrauff Road and Orange Grove Road, resulting in additional traffic demand on these roadways. Table 7 summarizes the 2045 traffic demand projections on Ruthrauff Road and Orange Road under the No-Build and Build scenarios.

Table 7. 2045 Traffic Demand on Parallel Roadways

Parallel Roadway	No-Build Volume (vpd)	Build Volume (vpd)	Demand difference with Sunset Road Extension (vpd)
Ruthrauff Road	50,200	46,000	-4,200 (-8.3%)
Orange Grove Road	55,000	45,000	-10,000 (-18.2%)

2045 truck data was also provided by the PAG travel demand model. The model is projecting 4% of trucks on the extension of Sunset Road from I-10 to River Road. The recommended truck distribution is 3% medium trucks and 1% heavy trucks.

Figure 12. 2045 Build Traffic Volume Projections



4.4.2 Capacity and Level of Service Analysis

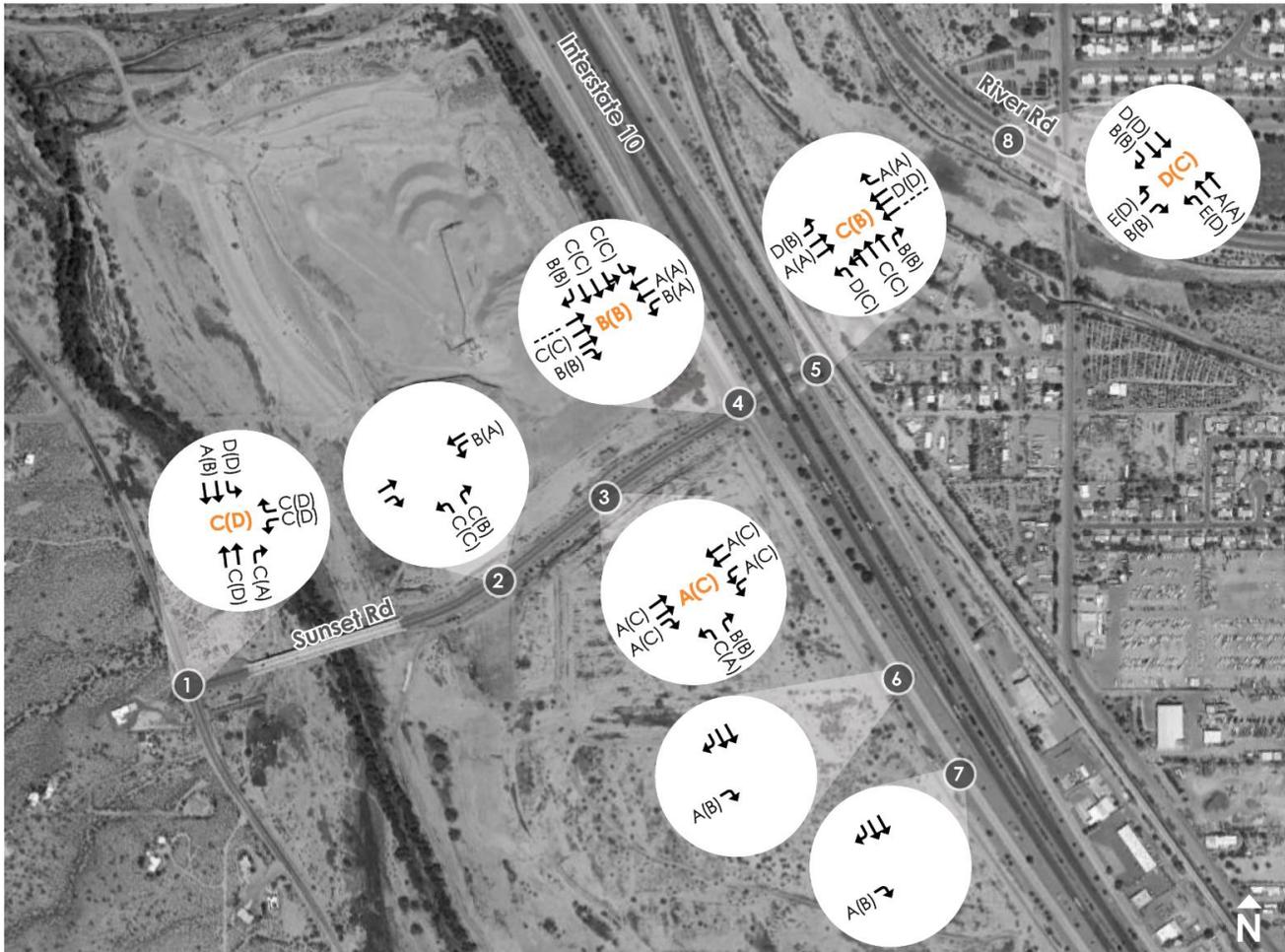
The weekday AM and PM peak hour turning movement volumes shown in Figure 12 were used to determine lane configurations at each existing and proposed intersection in the project area and determine the 2045 traffic levels of service for the Build scenario.

The capacity of a roadway segment depends on the capacity of the intersections along the segment, as well as street environment factors including driveway density and activity, speed limit, median type, intersection density, and pedestrian crossings. Planning-level roadway capacity estimates have been developed by the Florida Department of Transportation (FDOT). Using the FDOT capacity tables, a two-lane arterial roadway with exclusive left-turn lanes (i.e. two-way left-turn lanes) can generally accommodate 17,700 vpd at LOS D. The 2045 traffic volume projections on Sunset Road between Silverbell Road and River Road range between 16,000 and 22,000 vpd. Based on these criteria, the following number of travel lanes will be required on Sunset Road to serve the projected traffic demand: Silverbell Road to Sunset Innovation Campus – 2 lanes; Sunset Innovation Campus to River Road – 4 lanes.

Intersection capacity requirements for the future Build scenario provided were evaluated using Synchro 10 following the methodologies set forth in the *Highway Capacity Manual, Sixth Edition (7)*. Figure 13 provides the estimated levels of service for Build traffic conditions and proposed lane configurations at each study intersection. Note that at unsignalized intersections with only stop control on the minor side street or driveway, the HCM methodology only provides level of service estimates for movements from the side street/driveway or left-turn movements into the side street/driveway. Other movements on the major street are presumed to operate without delay due to the side street/driveway traffic. Appendix E contains the 2045 Build traffic analysis worksheets.

Detailed analyses of the intersections are discussed below. The cycle lengths for the AM and PM peak hours were determined by optimizing the operations of signalized intersection in Synchro. Signal warrants and turn lane warrants are discussed separately in Sections 4.5 and 4.6. Recommended turn-lane storage lengths for each intersection can be found in Section 5.3.

Figure 13. 2045 Build Level of Service Projections



Sunset Road/Silverbell Road Intersection

Sunset Road/Silverbell Road was modeled with the following signal operations for 2045 projected traffic volumes:

- 60-second cycle length during the AM peak hour
- 90-second cycle length during the PM peak hour
- Actuated-uncoordinated control
- Overlap phase for westbound right-turn lane (Silverbell Road to Sunset Road) and southbound left-turn lane

The overall intersection and individual turning movements are estimated to operate under capacity, with a LOS D or better, during the weekday AM and PM peak hours. For the lane configuration at the intersection, Silverbell Road was analyzed with a four-lane divided cross-section, as currently planned by the RTA with a designated westbound right-turn lane (which is existing) and one eastbound left-turn lane. Sunset Road was analyzed using the existing lane configuration.

Sunset Road/Sunset Innovation Campus South Driveway Intersection

Sunset Road/Sunset Innovation Campus South Driveway was modeled as an unsignalized T-intersection with the following characteristics:

- The Sunset Innovation Campus South Driveway is stop-controlled.

The overall intersection delay is anticipated to operate under capacity during the AM and PM peak hour at a LOS C. The critical movement at this intersection is the westbound left-turn lane from the campus onto Sunset Road during the afternoon peak. Should vehicles turning left from the campus driveway experience long delays, it is anticipated that they will divert to the main driveway, which is signalized.

Sunset Road/Sunset Innovation Campus Main Driveway Intersection

Sunset Road/Main Driveway was analyzed as a signalized T-intersection with the following signal operations:

- 60-second cycle length during the AM peak hour
- 90 second cycle length during the PM peak hours
- Actuated-coordinated control
- Overlap phase for westbound right-turn lane and southbound left-turn lane

As shown in Figure 12, a large number (730) southbound left-turns are anticipated to access the Sunset Innovation Campus during the AM peak hour. As such, dual southbound left-turn lanes were analyzed as part of the intersection assessment. The intersection is projected to operate at a LOS C or better during the AM and PM peak hours with the lane configurations illustrated in Figure 13.

I-10/Sunset Road Traffic Interchange

Per the recommendations of the I-10, Ina Road TI to Ruthrauff Road TI DCR, the two frontage road intersections will be signalized with the reconstruction of the Sunset Road TI. The following signal operations were assumed in the analysis:

- 120-second cycle length during the AM peak hour
- 90-second cycle length during the PM peak hour
- Actuated-coordinated control

For 2045 traffic projections, the Sunset Road/EBFR and Sunset Road/WBFR intersections are forecast to operate at levels of service C and B during the AM and PM peak hours. The EBFR and WBFR were analyzed with one left and right-turn lane, one shared left-through lane and two through lanes. Sunset Road, across the TI, was analyzed with a five-lane cross-section including one left and right-turn lane and two through lanes. No individual movements are expected to operate at worse than LOS D with volume-to-capacity ratios lower than 0.70.

Sunset Road/River Road Intersection

Sunset Road will tie into River Road approximately 375 feet west of the center of the Camino De La Tierra bridge. For 2045 Build traffic conditions, the intersection was analyzed as a signalized T-intersection with the following parameters:

- 120-second cycle length during the AM peak hour
- 90-second cycle length during the PM peak hour
- Actuated-uncoordinated control
- Overlap phase for northbound right-turn lane and westbound left-turn lane

The intersection is projected to operate at acceptable levels of service, LOS D and LOC C, during the AM and PM peak hours, respectively, with the lane configuration provided in Figure 13. Two turning movements, the westbound and northbound left-turns, are anticipated to operate near capacity at LOS E during the AM peak hour. As discussed in Section 5.3, storage lengths were calculated to accommodate the 2045 Build scenario traffic demand with the left/right turn lane.

Eastbound Frontage Road and Sunset Innovation Campus Driveways

Two driveways, intersecting the EBFR, are planned as part of the Sunset Innovation Campus development. The East and West Driveways were modeled as unsignalized T-intersections with the following characteristics:

- Stop control on the driveways only.
- Eastbound movements are free

The critical movement for this intersection is the exiting (northbound) right-turn lane. During both the AM and PM peak hours, the right-turn lane is projected to operate under capacity at a LOS A and LOS B, respectively.

4.5 Signal Warrant Analysis

A preliminary signal warrant analysis was conducted for 2045 Build traffic conditions at the following intersections:

- Sunset Road/Sunset Innovation Campus Main Driveway
- Sunset Road/River Road

The warrant analysis was performed using Warrant 1, Eight-Hour Vehicular volume, and Warrant 2, Four-Hour Vehicular Volume, of the 2009 *Manual on Uniform Traffic Control Devices* (8).

To determine eight-hour and four-hour volumes ADOT *Traffic, Guidelines and Procedures (TGP) 611* (9) was used to obtain the hourly adjustment factors. The intersections of Sunset Road/Sunset Innovation Campus Main Driveway and Sunset Road/River Road both meet Warrants 1 and 2 for 2045 Build traffic conditions. Table 8 and Table 9 summarize the eight-hour warrants for each intersection, as

both were analyzed under Conditions A and B. Figure 14 displays the four-hour warrant graph, as taken from the *Manual on Uniform Traffic Control Devices (MUTCD)*.

Table 8. Signal Warrant 1 – Sunset Road/Sunset Innovation Campus Main Driveway

Number of Lanes		Vehicles Per Hour		Condition A		Condition B	
Major Street	Minor Street	Major Street*	Minor Street**	100%	70%	100%	70%
2	1	1,600	110	No	Yes	No	Yes

* Major street vehicles per hour (vph) represents the total 8-hour average of both approaches

**Minor street vph represents the 8-hour average of one approach

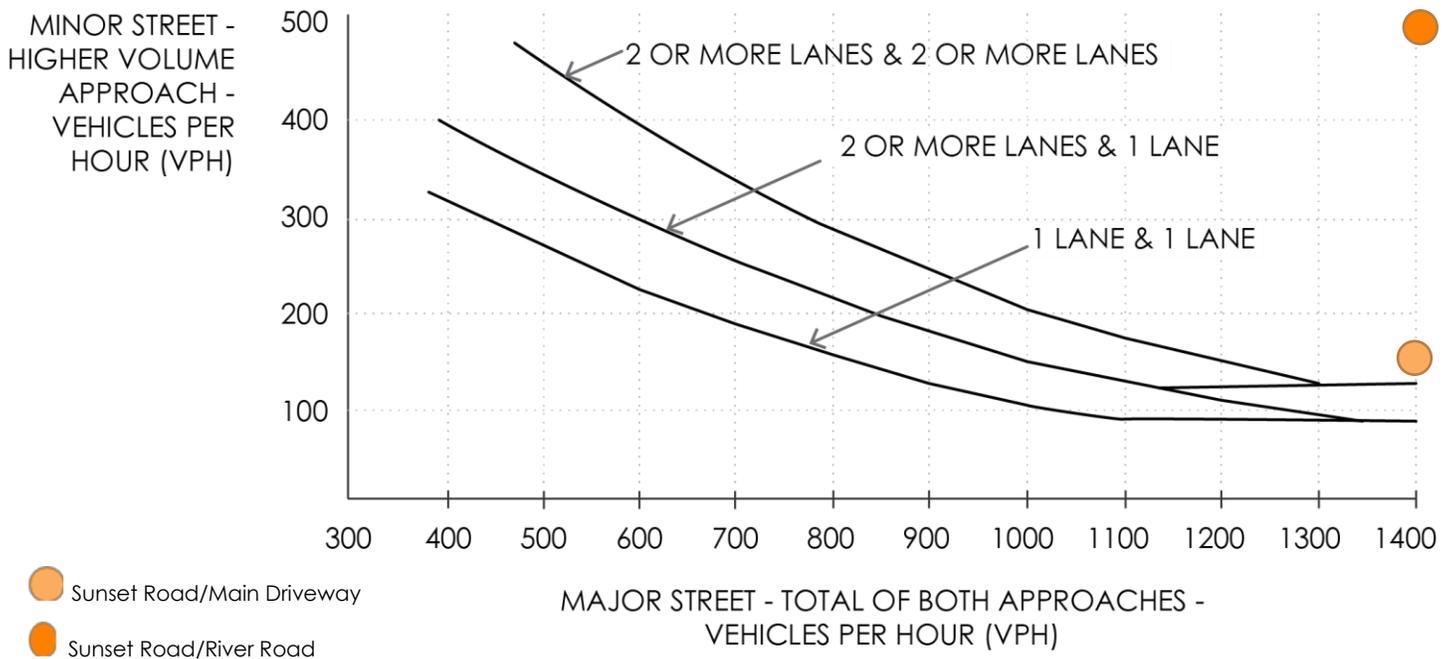
Table 9. Signal Warrant 1 – Sunset Road/River Road

Number of Lanes		Vehicles Per Hour		Condition A		Condition B	
Major Street	Minor Street	Major Street*	Minor Street**	100%	70%	100%	70%
2	2	2,052	676	Yes	Yes	Yes	Yes

* Major street vehicles per hour (vph) represents the total 8-hour average of both approaches

**Minor street vph represents the 8-hour average of one approach

Figure 14. Signal Warrant 2 – Four-Hour Vehicular Volume



Based on the signal warrant analysis for Warrant 1 and Warrant 2, the Sunset Road/Sunset Innovation Campus Main Driveway and Sunset Road/River Road intersections will meet the need for traffic signal control for 2045 traffic conditions. It is recommended that a signal be installed at the Sunset Road/River Road intersection with the construction of the Sunset Road extension. While it is expected that a traffic signal will be required at the Sunset Innovation Campus Main Driveway, it is recommended that the traffic signal be installed with the construction of the Sunset campus. As part of the Sunset Road improvements, conduit and pull boxes are recommended to be installed to accommodate a future signal. Appendix F contains the traffic signal warrant worksheets.

Though the extension of Sunset Road is being led by Pima County, the City of Tucson would operate and maintain the traffic signals on the extension of Sunset Road including the signals at the I-10/Sunset Road TI. PCDOT would operate the proposed traffic signal for the Sunset Innovation Campus main entrance.

4.6 Turn Lane Warrant Analysis

Right-turn lane warrants for 2045 Build traffic conditions were applied at the following study intersections:

- Sunset Road/Sunset Innovation Campus South Driveway
- Sunset Road/Sunset Innovation Campus Main Driveway
- Sunset Road/EBFR
- Sunset Road/WBFR
- EBFR/Sunset Innovation Campus West Driveway
- EBFR/Sunset Innovation Campus East Driveway

The two-lane right-turn lane warrant outlined in the *Pima County Subdivision and Development Street Standards* was utilized for the South Driveway and Main Driveway access points. The ADOT TGP 245 criteria was used to evaluate the right-turn lane requirements at the I-10/Sunset Road TI and the access points for the Sunset Innovation Campus along the EBFR. The results from the right-turn lane warrant analysis are summarized below:

- Sunset Road/Sunset Innovation Campus South Driveway – Turn lane warrant is met for the northbound right-turn movements
- Sunset Road/Sunset Innovation Campus Main Driveway – Turn lane warrant is met for the northbound right-turn movements
- Sunset Road/EBFR – Turn lane warrant is met for the eastbound right-turn movements
- Sunset Road/WBFR – Turn lane warrant is met for the westbound right-turn movements
- EBFR/Sunset Innovation Campus West Driveway – Turn lane warrant is met for the eastbound right-turn movements
- EBFR/Sunset Innovation Campus East Driveway – Turn lane warrant is met for the eastbound right-turn movements

For the Sunset Innovation Campus access driveways intersecting the EBFR, it is recommended that the eastbound turn-lanes be installed with the development. For additional information regarding right-turn lane warrants, see Appendix G.

Left-turn lane warrants for 2045 Build future traffic conditions were also applied at the following study intersections:

- Sunset Road/Sunset Innovation Campus South Driveway
- Sunset Road/Sunset Innovation Campus Main Driveway
- Sunset Road/EBFR
- Sunset Road/WBFR

The left-turn lane warrant outlined in the *Pima County Subdivision and Development Street Standards* were utilized for the South Driveway and Main Driveway access points. The ADOT TGP 245 criteria was used to evaluate the left-turn lane requirements at the I-10/Sunset Road TI intersections. The results from the left-turn lane warrant analysis are described below:

- Sunset Road/Sunset Innovation Campus South Driveway – Turn lane warrant is met for the southbound left-turn movements
- Sunset Road/Sunset Innovation Campus Main Driveway – Turn lane warrant is met for the southbound left-turn movements

- Sunset Road/EBFR – Turn lane warrant is met for the eastbound and southbound left-turn movements
- Sunset Road/WBFR – Turn lane warrant is met for the westbound and northbound left-turn movements

According to the ADOT TGP 245, dual left-turn lanes should be considered when the turning volume exceeds 300 vehicles per hour. At the intersections of Sunset Road/EBFR and Sunset Road/WBFR, the left-turn volumes are projected to be equal to or greater than 300 vehicles per hour during one of the peak periods for 2045 projected volumes. Dual left-turn lanes were considered, though a single left-turn lane is anticipated to provide sufficient capacity and operate with volume to capacity ratios less than 0.70 at a LOS D or better during both the AM and PM peak hours, as illustrated in Figure 13.

5.0 PROPOSED IMPROVEMENTS

Proposed recommendations for Sunset Road are a result of capacity and level of service outcomes for 2045 Build traffic conditions, traffic signal warrant findings, and turn lane analyses.

5.1 Design Parameters

Sunset Road should be designed according to the requirements and standards identified in the Pima County Roadway Design Manual (12), ADOT Roadway Design Guidelines, and AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2018 edition (The Green Book) (14).

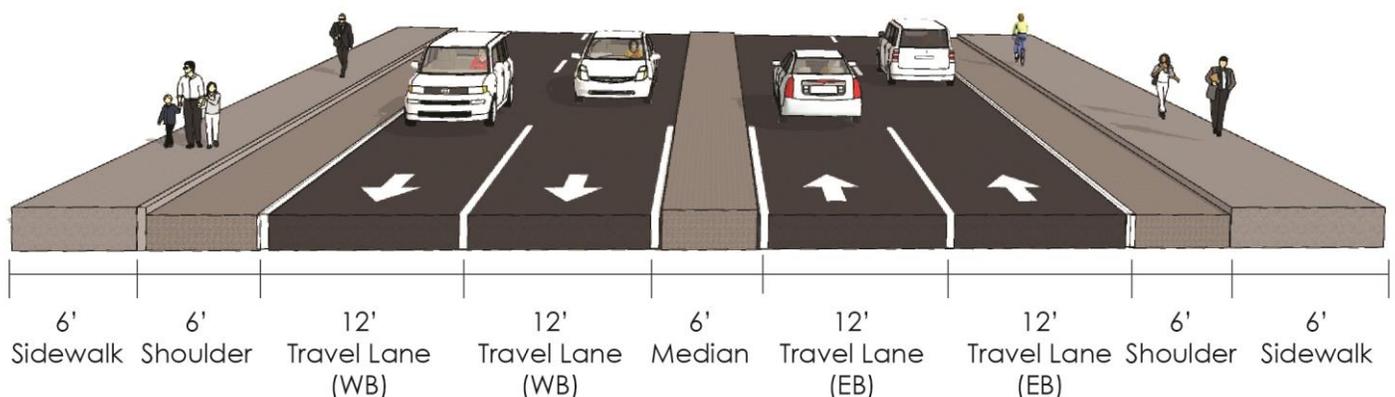
The following design criteria are recommended for this project:

- **Design Speed:** Sunset Road, from I-10 to River Road, will serve as a collector road. As Sunset Road, from Silverbell Road to the EBFR, has an existing posted speed limit of 35 mph, it is suggested that this speed be maintained for the extension from I-10 to River Road.
- **Stopping Sight Distance:** The stopping sight distance should be a minimum of 305 feet for a design speed of 40 mph, according to the criteria established in Table 7-1 of the AASHTO Green Book, 2018 (14).
- **Clear Zone:** According to the AASHTO Roadside Design Guide (15), the clear zone for a design speed less than or equal to 40 mph with an ADT over 6,000 vpd should range between 16 - 18 feet for foreslopes and backslopes.
- **Design Vehicle:** Sunset Road should be designed to accommodate a WB-67 design vehicle.

5.2 Roadway Segments

An urban four-lane roadway is proposed for the extension of Sunset Road from I-10 to River Road. The proposed cross-section includes 12-foot travel lanes, a raised median, six-foot-wide paved shoulders, vertical curb, and six-foot-wide concrete sidewalk facilities located on both sides of Sunset Road.

Figure 15. Sunset Road, I-10 to River Road Typical Section



5.3 Turn Bay Storage Lengths

Storage length requirements are based on the 95th percentile queue lengths estimated for 2045 Build traffic volumes. The queue lengths were calculated using three different approaches– Synchro, HCM Sixth Edition methodologies, and microsimulation (SimTraffic). Guidance from the PCDOT/TDOT *Pavement Marking Design Manual* (16) and the *ADOT TGP 490* (9) were used for minimum storage length requirements. According to PCDOT/TDOT guidelines, the minimum right-turn and left-turn lane storage lengths for a road with a posted speed of 40 mph or less is 110 feet. Per ADOT guidelines, the storage length for a right-turn and left-turn lane is the sum of the braking distance and the queue length. Table 10 summarizes the recommended turn bay storage lengths at each study intersection based on the calculated queue lengths using the three methodologies or the minimum storage lengths.

Table 10. Recommended Storage Lengths (feet)

Intersection	Eastbound		Westbound		Northbound		Southbound	
	EB LT	EB RT	WB LT	WB RT	NB LT	NB RT	SB LT	SB RT
Sunset Road/ Silverbell Road	250	-	-	200	-	-	475	-
Sunset Road/ South Driveway	-	-	110	110	-	110	200	-
Sunset Road/ Main Driveway	-	-	110	250	-	110	200	-
Sunset Road/ EBFR	-	400	-	-	200	365	-	-
Sunset Road/ WBFR	-	-	-	335	-	-	150	415
Sunset Road/ River Road	-	270	520	-	450	-	-	-
Driveway 1/ EBFR	-	150	-	-	-	110	-	-
Driveway 2/ EBFR	-	150	-	-	-	110	-	-

*Sunset Road is designated as northbound/southbound.

If the queue length outputs, provided by Synchro or SimTraffic, yielded longer queues than the minimum storage length requirements, an average of the macroscopic and microsimulation results was calculated for the recommended distances shown in Table 9. If the queue length outputs, provided by Synchro and SimTraffic, generated shorter queues than the minimum storage length requirements, the minimum storage lengths are recommended to be utilized.

The lane configurations shown in Figure 13 are consistent with the recommendations provided in the ADOT I-10 Mainline DCR for the I-10/Sunset Road TI, except for the southbound left-turn and northbound right-turn movements at the Sunset Road/EBFR intersection. At this location, the I-10 mainline DCR recommends dual lefts and dual right turn lanes. The recommendations of this report include a single left-turn lane and a single right-turn lane at the Sunset Road/EBFR intersection. The

recommendations are based on the analysis conducted using the updated 2045 socio-economic data for Pima County.

5.4 Access

It is not expected that side street or driveway connections will be required to provide access to properties adjacent to the Sunset Road extension except for Pima County Natural Resources, Parks and Recreation maintenance yard.

5.5 Alternative Transportation Modes

The Sunset Road extension will impact the existing multiuse path located on both sides of the Rillito Creek. A connection with the path on the northern bank path and the new roadway is recommended to provide connectivity between the north and south sides of I-10 for multi-modal users.

5.6 Lighting

Intersection lighting will be provided at the Sunset Road TI and the new signalized intersections at Sunset Road/River Road and Sunset Road/Sunset Innovation Campus Main Driveway. As part of the Sunset Innovation Campus development, roadway lighting should also be extended from the Sunset Road TI along the frontage of the campus on Sunset Road and the EBFR. Though the extension of Sunset Road is being led by Pima County, the City of Tucson will operate and maintain the lighting on Sunset Extension. PCDOT would operate the street lighting system on Sunset Road south (west) of I-10.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Existing traffic volumes, historical crash data, and 2045 No-Build and Build traffic volume projections were evaluated to determine the roadway and intersection capacity, lane configurations, and traffic control requirements for the I-10/Sunset Road TI and Sunset Road from I-10 to River Road. The findings of this analysis and the proposed recommendations for the extension of Sunset Road and the Sunset Innovation Campus access driveways are discussed below.

Findings

- The existing intersections at the I-10/Sunset Road TI operate at acceptable intersection levels of service (LOS D or better), during the weekday AM and PM peak hours.
- A review of historical crash data did not reveal any patterns or trends in the area that require mitigation.
- The PAG regional travel demand model, for the 2045 Build scenario, estimates that traffic demand on Sunset Road between Silverbell Road and I-10 will range between 16,000 and 22,000 vpd and will be 18,000 vpd on the new Sunset extension from I-10 and River Road. The Sunset Innovation Campus development is expected to generate 14,000 new daily trips in 2045.
- A four-lane cross-section from the Sunset Innovation Campus to River Road will provide sufficient capacity to provide acceptable levels of service.
- Traffic signals are warranted at the Sunset Road/ River Road and Sunset Road/Sunset Innovation Campus Main Driveway based on 2045 Build traffic projections.
- For the 2045 No-Build scenario, capacity analysis results indicate that the lane configurations provided in Figure 11 are anticipated to provide acceptable levels of service at each study intersections. However, under the No-Build scenario, trips that would have been accommodated on the extension of Sunset Road from I-10 to River Road would be shifted to El Camino del Cerro/Ruthrauff Road and Orange Grove Road. This would result in additional traffic demand on El Camino del Cerro/Ruthrauff Road and Orange Grove Road as indicated in Table 7. The extension of Sunset Road would be needed to provide access to Sunset Innovation Campus without causing traffic impacts to adjacent arterials (El Camino del Cerro/Ruthrauff Road and Orange Road).
- For 2045 Build traffic conditions, capacity analysis results indicate that the lane configurations provided in Figure 13 will provide acceptable levels of service at each study intersection. Specifically, intersection levels of service are estimated to operate at a LOS D or better, and individual movements will operate at a LOS E or better during weekday AM and PM peak hours.
- The lane configurations included in Figure 13 are consistent with the recommendations provided in the ADOT I-10 Mainline DCR for the I-10/Sunset Road TI, except for the southbound left-turn and northbound right turn movements at the Sunset Road/EBFR intersection. At this location, the I-10 mainline DCR recommends dual left and dual right turn lanes. The results of

the analysis conducted for this study indicated a single left-turn lane and a single right-turn lane at the Sunset Road/EBFR intersection will operate at acceptable levels of service.

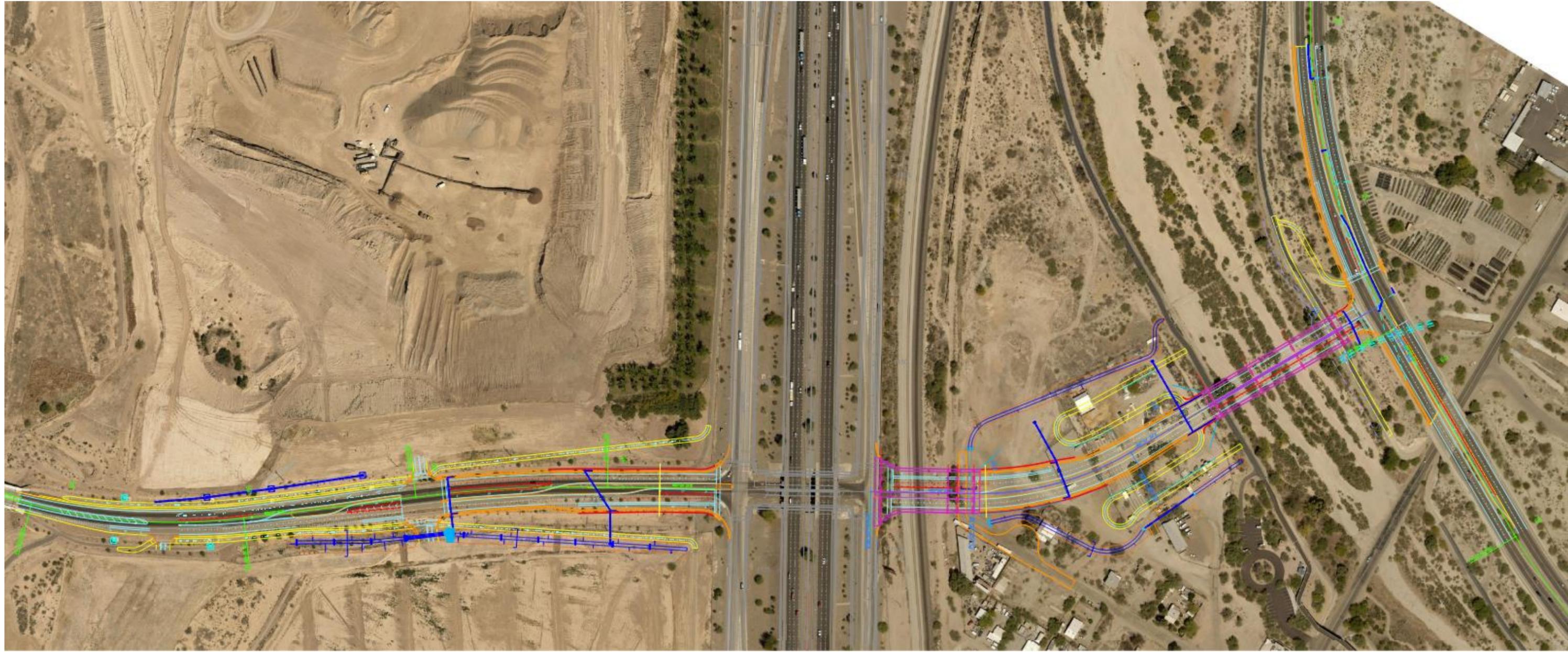
- The City of Tucson would operate the traffic signal and lighting system on the extension of Sunset Road including the traffic signals proposed for the I-10/Sunset Road TI.
- It is anticipated that PCDOT would operate the traffic signal and lighting system on the existing segment of Sunset Road to the south (west) of I-10.
- The PAG regional travel demand model, for the 2045 Build scenario, is projecting 4% of trucks on the extension of Sunset Road from I-10 to River Road.
- The Sunset Innovation Campus access driveways including the traffic signal for the main driveway are anticipated to be constructed with the proposed development.

Recommendations

Based on the analysis of existing and future traffic conditions, the following recommendations should be considered:

- Construct Sunset Road from I-10 to River Road
 - The extension of Sunset Road from I-10 to River Road will require a four-lane roadway section. The recommended cross-section includes 12-foot wide travel lanes, a raised median, six-foot wide paved shoulders/bicycle lanes, and six-foot wide concrete sidewalk facilities on both sides. The raised median should be a minimum of 10-foot wide, widening to a minimum of 18-feet to accommodate left-turn lanes at intersections.
 - Install a traffic signal and intersection street lighting at the Sunset Road/River Road intersection
 - Provide ADA compliant connections on Sunset Road to the multi-use path located on the embankment of the Rillito Creek
 - Provide a posted speed limit of 35 mph on Sunset Road
 - Maintain a design speed of 50 mph and a posted speed limit of 45 mph on River Road
 - Provide access to Pima County Natural Resources, Parks and Recreation maintenance yard
- Reconstruct Sunset Road south (west) of I-10
 - Widen the existing three-lane section to a four-lane divided section with raised median and 6-foot wide paved shoulders/bicycle lanes for approximately 900 feet west of the I-10 frontage road and construct intersections at the planned driveways to the planned Sunset Innovation Campus development
 - Install conduit and pull boxes for a future traffic signal at the main campus driveway
- Provide the lane configurations for each study intersection, as illustrated in Figure 13, and turn-lane storage lengths as provided in Table 10. Capacity analysis results indicate that the proposed improvements will provide sufficient capacity to serve the projected 2045 transportation demand. Refer to Figure 16 for an initial layout of the proposed Sunset Road improvements.
- Right-turn lanes at the planned Sunset Innovation Campus driveways on Sunset Road and the I-10 EBFR would be installed in conjunction with development.

Figure 16. Proposed Sunset Road Layout



7.0 REFERENCES

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5. PCDOT Roadway Segment High Volume Crash Data.
https://webcms.pima.gov/UserFiles/Servers/Server_6/File/Government/Transportation/Traffic%20Engineering/Traffic%20Crash%20Statistics/High%20Volume%20Road%20Segments.pdf
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https://webcms.pima.gov/UserFiles/Servers/Server_6/File/Government/Transportation/Traffic%20Engineering/Traffic%20Crash%20Statistics/Safety%20Management%20System%20Report.pdf

Appendix A Traffic Volumes

Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

I10 Frontage Rd @ Sunset Rd (East Intersection)

File Name : I10FrontageRd@SunsetRd (East Intersection) 2019.11.06

Site Code : 00000000

Start Date : 11/6/2019

Page No : 1

Groups Printed- Unshifted

Start Time	I10 FRONTAGE RD SB					SUNSET RD WB					I10 FRONTAGE RD NB					SUNSET RD EB					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	0	0	0	0	0	0	0	0	0	0	16	53	0	0	69	55	0	0	0	55	124
07:15 AM	0	0	1	0	1	0	0	0	0	0	15	49	0	0	64	73	0	0	0	73	138
07:30 AM	0	0	0	0	0	0	0	0	0	0	17	45	0	0	62	75	0	0	0	75	137
07:45 AM	0	0	0	0	0	0	0	0	0	0	12	62	0	0	74	96	0	0	0	96	170
Total	0	0	1	0	1	0	0	0	0	0	60	209	0	0	269	299	0	0	0	299	569
08:00 AM	0	0	0	0	0	0	0	0	0	0	7	51	0	0	58	67	0	0	0	67	125
08:15 AM	0	0	0	0	0	0	0	0	0	0	3	41	0	0	44	63	0	0	0	63	107
08:30 AM	0	0	0	0	0	0	0	0	0	0	14	50	0	0	64	49	0	0	0	49	113
08:45 AM	0	0	0	0	0	0	0	0	0	0	11	28	0	0	39	39	0	0	0	39	78
Total	0	0	0	0	0	0	0	0	0	0	35	170	0	0	205	218	0	0	0	218	423
*** BREAK ***																					
04:00 PM	0	0	0	0	0	0	0	0	0	0	26	104	0	0	130	37	0	0	0	37	167
04:15 PM	0	0	0	0	0	0	0	0	0	0	32	123	0	0	155	58	0	0	0	58	213
04:30 PM	0	0	0	0	0	0	0	0	0	0	41	133	0	0	174	46	0	0	0	46	220
04:45 PM	0	0	0	0	0	0	0	0	0	0	40	130	0	0	170	56	0	0	0	56	226
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05:15 PM	0	0	0	0	0	0	0	0	0	0	25	165	0	0	190	52	0	0	0	52	242
05:30 PM	0	0	0	0	0	0	0	0	0	0	37	177	0	0	214	36	0	0	0	36	250
05:45 PM	0	0	0	0	0	0	0	0	0	0	36	152	0	0	188	55	0	0	0	55	243
Total	0	0	0	0	0	0	0	0	0	0	139	651	0	0	790	199	0	0	0	199	989
Grand Total	0	0	1	0	1	0	0	0	0	0	373	1520	0	0	1893	913	0	0	0	913	2807
Apprch %	0	0	100	0		0	0	0	0		19.7	80.3	0	0		100	0	0	0		
Total %	0	0	0	0		0	0	0	0		13.3	54.2	0	0	67.4	32.5	0	0	0	32.5	

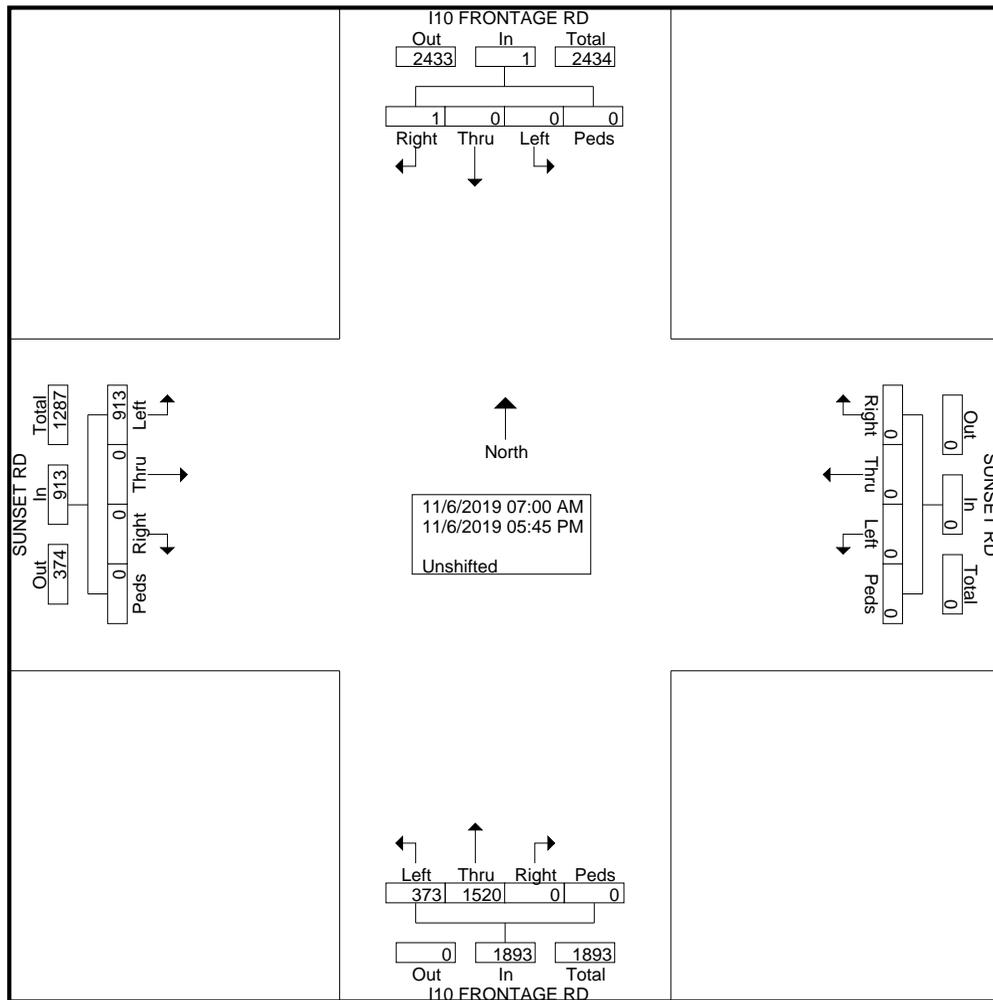
Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

I10 Frontage Rd @ Sunset Rd (East Intersection)

File Name : I10FrontageRd@SunsetRd (East Intersection) 2019.11.06
 Site Code : 00000000
 Start Date : 11/6/2019
 Page No : 2



Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

I10 Frontage Rd @ Sunset Rd (East Intersection)

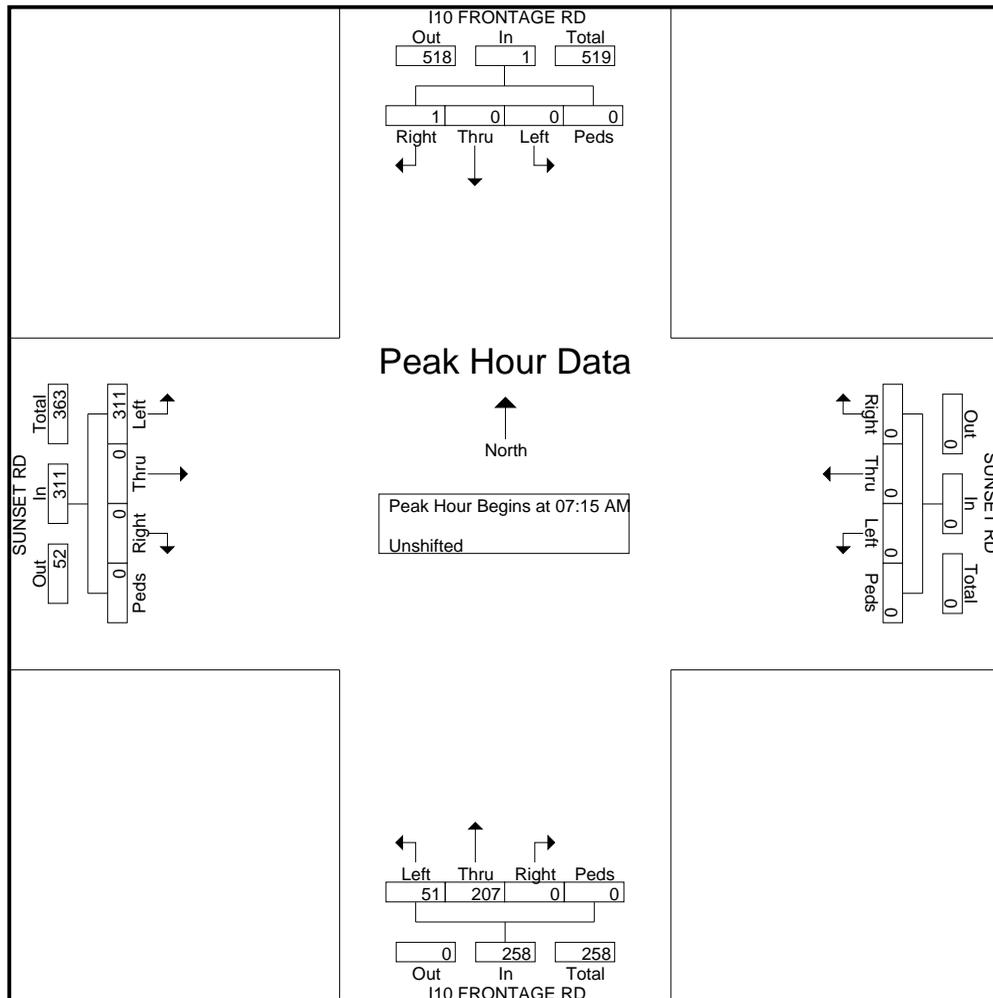
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Site Code : 00000000

Start Date : 11/6/2019

Page No : 3

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Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	0	1	0	1	0	0	0	0	0	15	49	0	0	64	73	0	0	0	73	138
07:30 AM	0	0	0	0	0	0	0	0	0	0	17	45	0	0	62	75	0	0	0	75	137
07:45 AM	0	0	0	0	0	0	0	0	0	0	12	62	0	0	74	96	0	0	0	96	170
08:00 AM	0	0	0	0	0	0	0	0	0	0	7	51	0	0	58	67	0	0	0	67	125
Total Volume	0	0	1	0	1	0	0	0	0	0	51	207	0	0	258	311	0	0	0	311	570
% App. Total	0	0	100	0		0	0	0	0		19.8	80.2	0	0		100	0	0	0		
PHF	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.750	.835	.000	.000	.872	.810	.000	.000	.000	.810	.838



Pima County DOT

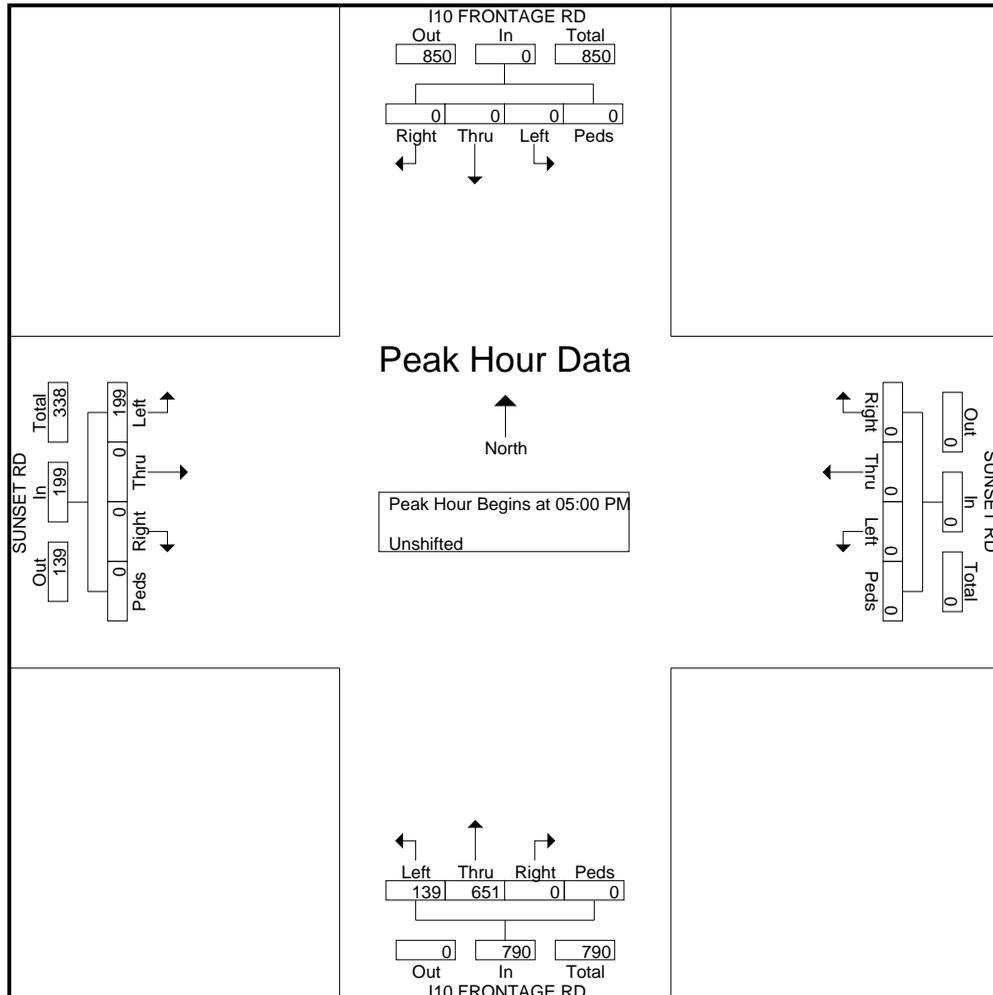
Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

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 Page No : 4

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Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	0	0	0	0	0	0	0	0	0	0	41	157	0	0	198	56	0	0	0	56	254
05:15 PM	0	0	0	0	0	0	0	0	0	0	25	165	0	0	190	52	0	0	0	52	242
05:30 PM	0	0	0	0	0	0	0	0	0	0	37	177	0	0	214	36	0	0	0	36	250
05:45 PM	0	0	0	0	0	0	0	0	0	0	36	152	0	0	188	55	0	0	0	55	243
Total Volume	0	0	0	0	0	0	0	0	0	0	139	651	0	0	790	199	0	0	0	199	989
% App. Total	0	0	0	0	0	0	0	0	0	0	17.6	82.4	0	0		100	0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.848	.919	.000	.000	.923	.888	.000	.000	.000	.888	.973



Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

I10 Frontage Rd @ Sunset Rd (West Intersection)

File Name : I10FrontageRd@SunsetRd (West Intersection) 2019.11.06

Site Code : 00000000

Start Date : 11/6/2019

Page No : 1

Groups Printed- Unshifted

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07:30 AM	2	216	20	0	238	7	5	0	0	12	0	0	0	0	0	0	68	92	0	160	410
07:45 AM	1	189	43	0	233	6	5	0	0	11	0	0	0	0	0	0	82	107	0	189	433
Total	5	651	110	0	766	30	21	0	0	51	0	0	0	0	0	0	266	335	0	601	1418
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08:15 AM	7	109	39	0	155	2	3	0	0	5	0	0	0	0	0	0	44	41	0	85	245
08:30 AM	1	109	32	1	143	4	7	0	0	11	0	0	0	0	0	0	42	29	0	71	225
08:45 AM	0	22	20	0	42	7	7	0	0	14	0	0	0	0	0	0	28	16	0	44	100
Total	12	398	129	1	540	16	20	0	0	36	0	0	0	0	0	0	175	140	0	315	891
*** BREAK ***																					
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04:15 PM	2	9	31	0	42	6	25	0	0	31	0	0	0	0	0	0	43	5	0	48	121
04:30 PM	1	14	55	0	70	8	31	0	0	39	0	0	0	0	0	0	42	6	0	48	157
04:45 PM	0	15	47	0	62	3	32	1	0	36	0	0	0	0	0	0	42	4	0	46	144
Total	5	42	178	0	225	25	108	1	0	134	0	0	0	0	0	0	157	22	0	179	538
05:00 PM	3	12	43	1	59	6	28	0	0	34	0	0	0	0	0	0	45	7	0	52	145
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05:30 PM	0	10	40	0	50	4	30	0	0	34	0	0	0	0	0	0	31	12	0	43	127
05:45 PM	1	5	44	0	50	3	26	0	0	29	0	0	0	0	0	0	36	11	0	47	126
Total	5	36	175	1	217	18	102	0	0	120	0	0	0	0	0	0	153	40	0	193	530
Grand Total	27	1127	592	2	1748	89	251	1	0	341	0	0	0	0	0	0	751	537	0	1288	3377
Apprch %	1.5	64.5	33.9	0.1		26.1	73.6	0.3	0		0	0	0	0	0	0	58.3	41.7	0		
Total %	0.8	33.4	17.5	0.1	51.8	2.6	7.4	0	0	10.1	0	0	0	0	0	0	22.2	15.9	0	38.1	

Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

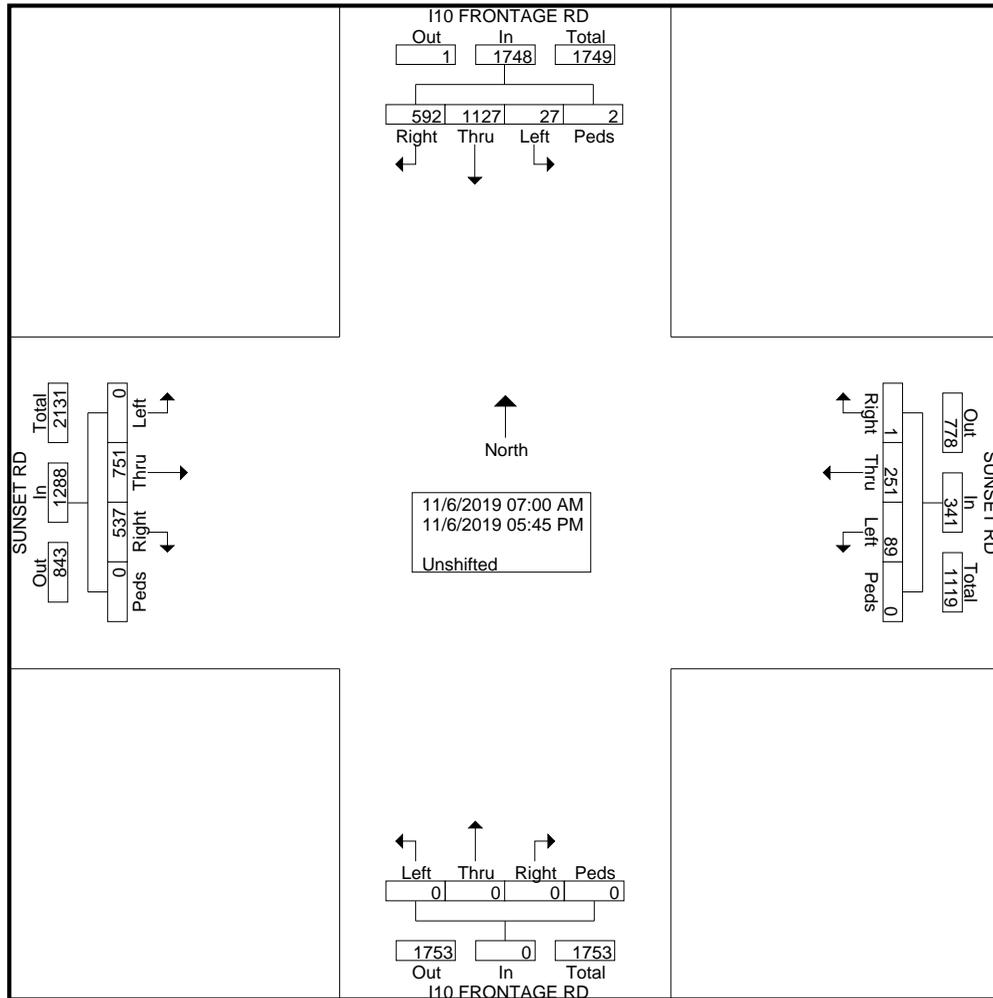
I10 Frontage Rd @ Sunset Rd (West Intersection)

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Site Code : 00000000

Start Date : 11/6/2019

Page No : 2



Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

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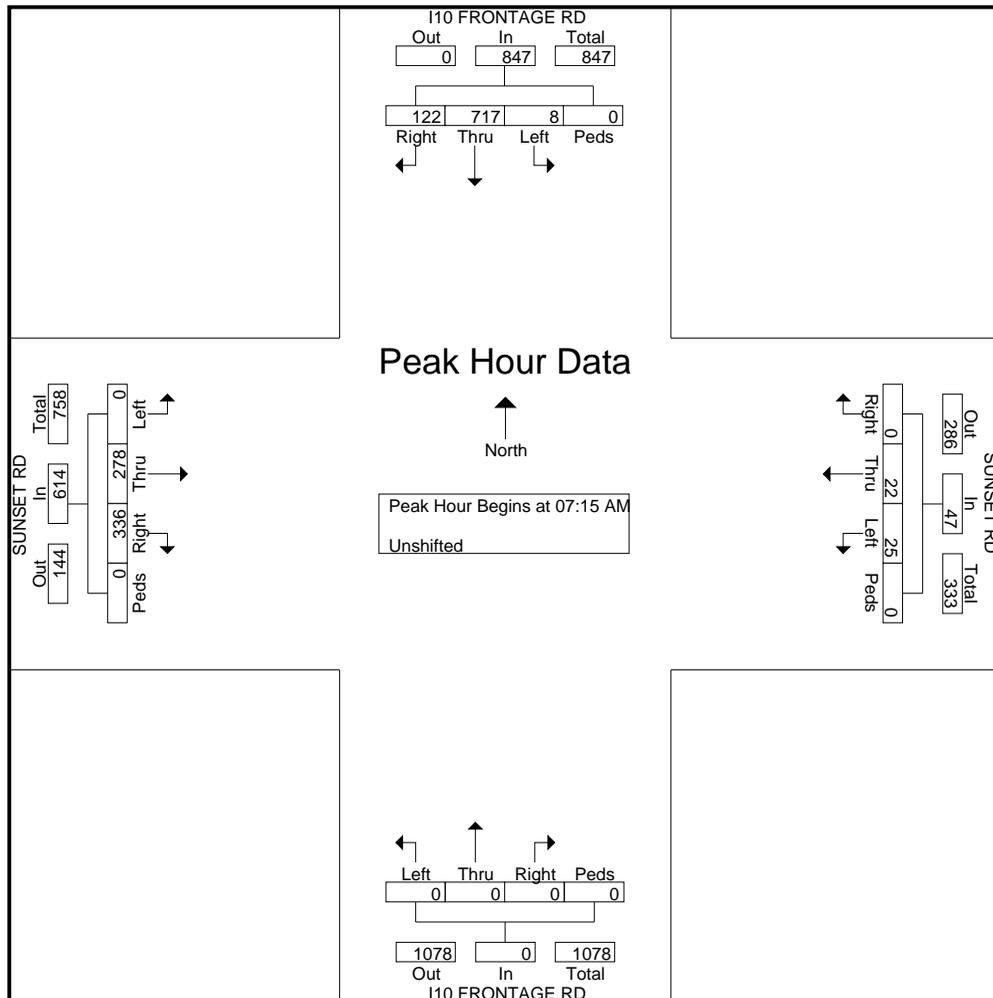
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Page No : 3

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Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	1	154	21	0	176	9	9	0	0	18	0	0	0	0	0	0	67	83	0	150	344
07:30 AM	2	216	20	0	238	7	5	0	0	12	0	0	0	0	0	0	68	92	0	160	410
07:45 AM	1	189	43	0	233	6	5	0	0	11	0	0	0	0	0	0	82	107	0	189	433
08:00 AM	4	158	38	0	200	3	3	0	0	6	0	0	0	0	0	0	61	54	0	115	321
Total Volume	8	717	122	0	847	25	22	0	0	47	0	0	0	0	0	0	278	336	0	614	1508
% App. Total	0.9	84.7	14.4	0		53.2	46.8	0	0		0	0	0	0		0	45.3	54.7	0		
PHF	.500	.830	.709	.000	.890	.694	.611	.000	.000	.653	.000	.000	.000	.000	.000	.000	.848	.785	.000	.812	.871



Pima County DOT

Traffic Engineering Division
TRAFFIC MOVEMENT COUNT

November 06, 2019

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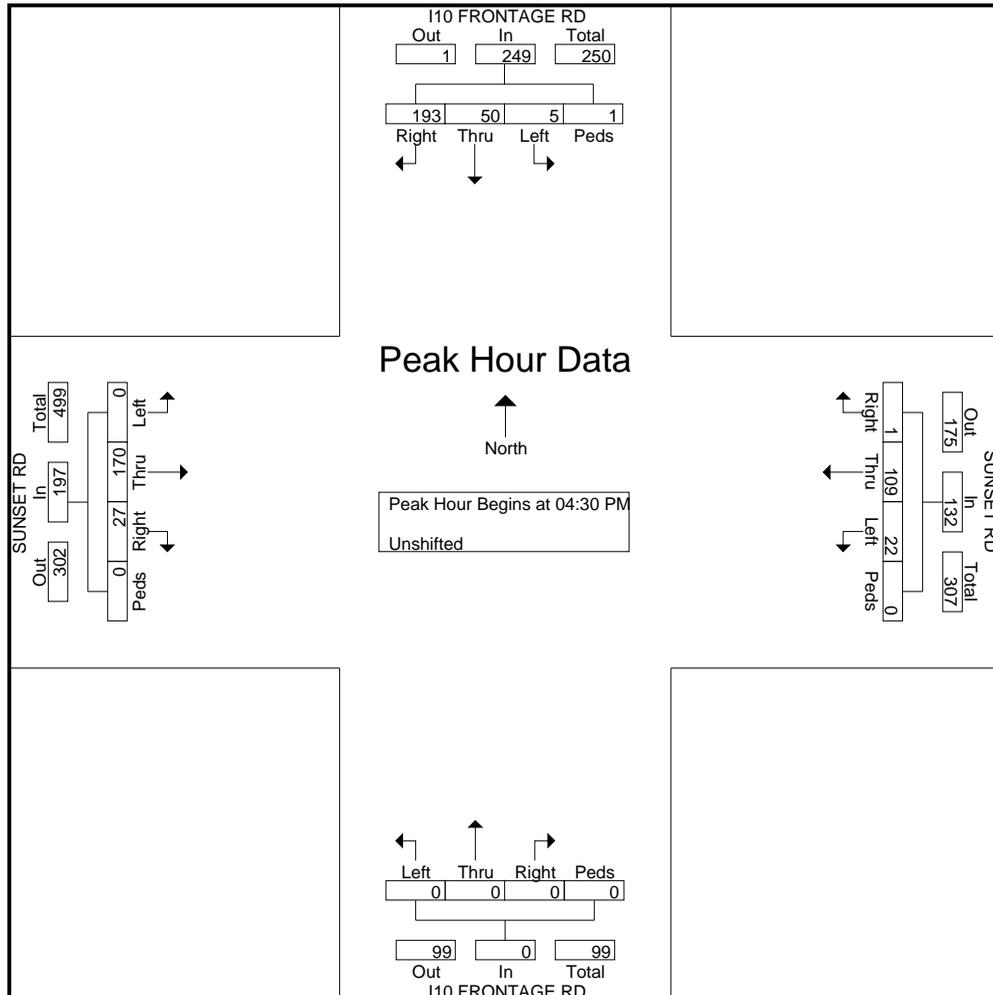
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Start Date : 11/6/2019

Page No : 4

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Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	1	14	55	0	70	8	31	0	0	39	0	0	0	0	0	0	42	6	0	48	157
04:45 PM	0	15	47	0	62	3	32	1	0	36	0	0	0	0	0	0	42	4	0	46	144
05:00 PM	3	12	43	1	59	6	28	0	0	34	0	0	0	0	0	0	45	7	0	52	145
05:15 PM	1	9	48	0	58	5	18	0	0	23	0	0	0	0	0	0	41	10	0	51	132
Total Volume	5	50	193	1	249	22	109	1	0	132	0	0	0	0	0	0	170	27	0	197	578
% App. Total	2	20.1	77.5	0.4		16.7	82.6	0.8	0		0	0	0	0	0	0	86.3	13.7	0		
PHF	.417	.833	.877	.250	.889	.688	.852	.250	.000	.846	.000	.000	.000	.000	.000	.000	.944	.675	.000	.947	.920



Appendix B
Existing Level of Services
Worksheets

Intersection	
Intersection Delay, s/veh	31
Intersection LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↑		↑					↑	↑↑	
Traffic Vol, veh/h	0	278	336	25	26	0	0	0	0	8	717	122
Future Vol, veh/h	0	278	336	25	26	0	0	0	0	8	717	122
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.95	0.87
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	320	386	29	30	0	0	0	0	9	755	140
Number of Lanes	0	1	1	0	1	0	0	0	0	1	2	0

Approach	EB	WB	SB
Opposing Approach	WB	EB	
Opposing Lanes	1	2	0
Conflicting Approach Left	SB		WB
Conflicting Lanes Left	3	0	1
Conflicting Approach Right		SB	EB
Conflicting Lanes Right	0	3	2
HCM Control Delay	22.7	13.4	38.7
HCM LOS	C	B	E

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	0%	49%	100%	0%	0%
Vol Thru, %	100%	0%	51%	0%	100%	66%
Vol Right, %	0%	100%	0%	0%	0%	34%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	278	336	51	8	478	361
LT Vol	0	0	25	8	0	0
Through Vol	278	0	26	0	478	239
RT Vol	0	336	0	0	0	122
Lane Flow Rate	320	386	59	9	503	392
Geometry Grp	8	8	8	7	7	7
Degree of Util (X)	0.642	0.7	0.148	0.018	0.94	0.706
Departure Headway (Hd)	7.232	6.524	9.112	7.229	6.723	6.483
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	498	552	396	494	538	556
Service Time	5.003	4.295	6.812	4.99	4.484	4.244
HCM Lane V/C Ratio	0.643	0.699	0.149	0.018	0.935	0.705
HCM Control Delay	22.2	23.2	13.4	10.1	51.2	23.4
HCM Lane LOS	C	C	B	B	F	C
HCM 95th-tile Q	4.5	5.5	0.5	0.1	11.8	5.6

Intersection						
Int Delay, s/veh	7.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	286	0	51	207	0	0
Future Vol, veh/h	286	0	51	207	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	16965	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	340	0	61	246	0	0

Major/Minor	Minor2	Major1	
Conflicting Flow All	245	-	0
Stage 1	0	-	-
Stage 2	245	-	-
Critical Hdwy	6.84	-	4.14
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	5.84	-	-
Follow-up Hdwy	3.52	-	2.22
Pot Cap-1 Maneuver	722	0	-
Stage 1	-	0	-
Stage 2	773	0	-
Platoon blocked, %			-
Mov Cap-1 Maneuver	722	-	-
Mov Cap-2 Maneuver	722	-	-
Stage 1	-	-	-
Stage 2	773	-	-

Approach	EB	NB
HCM Control Delay, s	14.4	
HCM LOS	B	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1
Capacity (veh/h)	-	-	722
HCM Lane V/C Ratio	-	-	0.472
HCM Control Delay (s)	-	-	14.4
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	2.5

HCM 6th Signalized Intersection Summary
8: Silverbell Rd & Sunset Rd

Exist AM Peak Hour
01/20/2020

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	108	40	90	200	414	200
Future Volume (veh/h)	108	40	90	200	414	200
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	117	43	98	217	450	217
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	191	170	1076	912	874	1076
Arrive On Green	0.11	0.11	0.58	0.58	0.58	0.58
Sat Flow, veh/h	1781	1585	1870	1585	1065	1870
Grp Volume(v), veh/h	117	43	98	217	450	217
Grp Sat Flow(s),veh/h/ln	1781	1585	1870	1585	1065	1870
Q Serve(g_s), s	1.6	0.6	0.6	1.7	8.3	1.4
Cycle Q Clear(g_c), s	1.6	0.6	0.6	1.7	8.9	1.4
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	191	170	1076	912	874	1076
V/C Ratio(X)	0.61	0.25	0.09	0.24	0.52	0.20
Avail Cap(c_a), veh/h	1132	1007	2674	2266	1783	2674
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	10.7	10.3	2.4	2.6	4.4	2.6
Incr Delay (d2), s/veh	3.2	0.8	0.0	0.1	0.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.2	0.0	0.1	0.3	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	13.9	11.1	2.4	2.8	4.9	2.7
LnGrp LOS	B	B	A	A	A	A
Approach Vol, veh/h			315			667
Approach Delay, s/veh			2.7			4.1
Approach LOS			A			A
Timer - Assigned Phs		2			6	8
Phs Duration (G+Y+Rc), s		18.5			18.5	6.7
Change Period (Y+Rc), s		4.0			4.0	4.0
Max Green Setting (Gmax), s		36.0			36.0	16.0
Max Q Clear Time (g_c+I1), s		3.7			10.9	3.6
Green Ext Time (p_c), s		1.3			3.6	0.3
Intersection Summary						
HCM 6th Ctrl Delay			5.0			
HCM 6th LOS			A			

Intersection	
Intersection Delay, s/veh	10.3
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↑		↑					↑	↑↑	
Traffic Vol, veh/h	0	194	27	22	117	0	0	0	0	5	50	193
Future Vol, veh/h	0	194	27	22	117	0	0	0	0	5	50	193
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	211	29	24	127	0	0	0	0	5	54	210
Number of Lanes	0	1	1	0	1	0	0	0	0	1	2	0

Approach	EB	WB	SB
Opposing Approach	WB	EB	
Opposing Lanes	1	2	0
Conflicting Approach Left	SB		WB
Conflicting Lanes Left	3	0	1
Conflicting Approach Right		SB	EB
Conflicting Lanes Right	0	3	2
HCM Control Delay	10.7	10.6	9.7
HCM LOS	B	B	A

Lane	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	0%	16%	100%	0%	0%
Vol Thru, %	100%	0%	84%	0%	100%	8%
Vol Right, %	0%	100%	0%	0%	0%	92%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	194	27	139	5	33	210
LT Vol	0	0	22	5	0	0
Through Vol	194	0	117	0	33	17
RT Vol	0	27	0	0	0	193
Lane Flow Rate	211	29	151	5	36	228
Geometry Grp	8	8	8	7	7	7
Degree of Util (X)	0.328	0.04	0.245	0.009	0.056	0.312
Departure Headway (Hd)	5.598	4.894	5.849	6.082	5.579	4.93
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	637	724	607	585	638	722
Service Time	3.382	2.678	3.643	3.852	3.349	2.699
HCM Lane V/C Ratio	0.331	0.04	0.249	0.009	0.056	0.316
HCM Control Delay	11.1	7.9	10.6	8.9	8.7	9.9
HCM Lane LOS	B	A	B	A	A	A
HCM 95th-tile Q	1.4	0.1	1	0	0.2	1.3

Intersection						
Int Delay, s/veh	4.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↘		↖↗			
Traffic Vol, veh/h	199	0	139	651	0	0
Future Vol, veh/h	199	0	139	651	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	16965	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	205	0	143	671	0	0

Major/Minor	Minor2	Major1	
Conflicting Flow All	622	-	0
Stage 1	0	-	-
Stage 2	622	-	-
Critical Hdwy	6.84	-	4.14
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	5.84	-	-
Follow-up Hdwy	3.52	-	2.22
Pot Cap-1 Maneuver	419	0	-
Stage 1	-	0	-
Stage 2	498	0	-
Platoon blocked, %			-
Mov Cap-1 Maneuver	419	-	-
Mov Cap-2 Maneuver	419	-	-
Stage 1	-	-	-
Stage 2	498	-	-

Approach	EB	NB
HCM Control Delay, s	21.6	
HCM LOS	C	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1
Capacity (veh/h)	-	-	419
HCM Lane V/C Ratio	-	-	0.49
HCM Control Delay (s)	-	-	21.6
HCM Lane LOS	-	-	C
HCM 95th %tile Q(veh)	-	-	2.6

HCM 6th Signalized Intersection Summary
8: Silverbell Rd & New Sunset Rd

Exist PM Peak Hour
01/20/2020

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	100	210	260	101	120	160
Future Volume (veh/h)	100	210	260	101	120	160
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	109	228	283	110	130	174
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	417	371	724	613	616	724
Arrive On Green	0.23	0.23	0.39	0.39	0.39	0.39
Sat Flow, veh/h	1781	1585	1870	1585	991	1870
Grp Volume(v), veh/h	109	228	283	110	130	174
Grp Sat Flow(s),veh/h/ln	1781	1585	1870	1585	991	1870
Q Serve(g_s), s	1.1	2.7	2.3	1.0	2.3	1.3
Cycle Q Clear(g_c), s	1.1	2.7	2.3	1.0	4.6	1.3
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	417	371	724	613	616	724
V/C Ratio(X)	0.26	0.61	0.39	0.18	0.21	0.24
Avail Cap(c_a), veh/h	2025	1802	2480	2102	1547	2480
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	6.6	7.2	4.7	4.3	6.3	4.4
Incr Delay (d2), s/veh	0.3	1.7	0.3	0.1	0.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.6	0.3	0.1	0.2	0.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	6.9	8.9	5.0	4.4	6.5	4.5
LnGrp LOS	A	A	A	A	A	A
Approach Vol, veh/h	337		393			304
Approach Delay, s/veh	8.3		4.8			5.4
Approach LOS	A		A			A
Timer - Assigned Phs		2			6	8
Phs Duration (G+Y+Rc), s		12.2			12.2	8.9
Change Period (Y+Rc), s		4.0			4.0	4.0
Max Green Setting (Gmax), s		28.0			28.0	24.0
Max Q Clear Time (g_c+I1), s		4.3			6.6	4.7
Green Ext Time (p_c), s		2.0			1.6	1.0
Intersection Summary						
HCM 6th Ctrl Delay			6.1			
HCM 6th LOS			A			

Appendix C Crash Data

IncidentID	Microfilm	ADOTRece Status	DataConv2	IncidentDa	IncidentDa	IncidentYe	IncidentM	IncidentDa	IncidentHo	OfficerNcic	OfficerId	FileNumbe	ExtendedN	DamageOv	PhotosTaki	Photografi	Photografi	Photografi	Investigate	DateTime	CollisionM	LightCondi	FirstHarmf	FirstHarmf	TotalUnits	TotalMoto	TotalNonV	TotalInjur	TotalFatali	TotalMoto	TotalNonV	TotalMoto	TotalNonV	InjurySevei	MedicalTre
2881088	#####	200	#####	#####	2014	10	7	15	799			2.01E+09	1003								1	1	1		1	1	0	1	0	1	0	0	0	4	
2894789	#####	200	#####	#####	2014	11	6	10	799			2.01E+09	1000								1	1	38		1	1	0	1	0	1	0	0	0	2	
2919869	#####	200	#####	#####	2015	2	2	0	799			2.02E+09	1003								1	5	36		1	1	0	1	0	1	0	0	0	4	
2949310	#####	200	#####	#####	2015	4	6	15	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
2958528	#####	200	#####	#####	2015	5	5	5	799			2.02E+09	1000								6	2	16		2	2	0	0	0	0	0	0	1		
2986263	#####	200	#####	#####	2015	8	6	19	799			2.02E+09	1003								1	3	31		1	1	0	0	0	0	0	0	1		
2988958	#####	200	#####	#####	2015	8	3	13	1000			1.51E+08	1000								4	1	16		2	2	0	2	0	2	0	0	2		
2990213	#####	200	#####	#####	2015	9	4	15	799			2.02E+09	1000								6	1	16		2	2	0	0	0	0	0	0	1		
2993884	#####	200	#####	#####	2015	9	4	8	799			2.02E+09	1003								4	1	16		5	6	0	2	0	2	0	0	3		
2993885	#####	200	#####	#####	2015	9	2	7	799			2.02E+09	1003								4	1	16		3	3	0	1	0	1	0	0	3		
2996912	#####	200	#####	#####	2015	9	5	16	799			2.02E+09	1003								1	1	36		1	1	0	0	0	0	0	0	1		
3007908	#####	200	#####	#####	2015	9	4	17	799			2.02E+09	1000								1	1	1		1	1	0	1	0	1	0	0	3		
3019760	#####	200	#####	#####	2015	11	2	17	799			2.02E+09	1003								6	3	16		2	2	0	1	0	1	0	0	3		
3032939	#####	200	#####	#####	2016	1	1	6	799			2.02E+09	1003								6	5	16		2	8	0	0	0	0	0	0	1		
3048086	#####	200	#####	#####	2016	2	6	19	799			2.02E+09	1003								1	4	49		1	1	0	0	0	0	0	0	1		
3055676	#####	200	#####	#####	2016	2	3	7	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3084850	#####	200	#####	#####	2016	5	3	17	799			2.02E+09	1000								4	1	16		2	2	0	0	0	0	0	0	1		
3091910	#####	200	#####	#####	2016	5	3	8	799			2.02E+09	1000								4	1	16		2	2	0	0	0	0	0	0	1		
3099871	#####	200	#####	#####	2016	6	6	14	799			2.02E+09	1003								1	1	39		1	2	0	0	0	0	0	0	1		
3100522	#####	200	#####	#####	2016	6	4	13	799			2.02E+09	1000								1	1	45		1	1	0	0	0	0	0	0	1		
3116295	#####	200	#####	#####	2016	7	5	16	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3129309	#####	200	#####	#####	2016	8	4	7	799			2.02E+09	1003								4	1	16		2	4	0	1	0	1	0	0	3		
3136164	#####	200	#####	#####	2016	9	5	17	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3138861	#####	200	#####	#####	2016	9	5	7	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3145034	#####	200	#####	#####	2016	10	5	7	799			2.02E+09	1000								4	1	16		2	3	0	0	0	0	0	0	1		
3152051	#####	200	#####	#####	2016	10	3	7	799			2.02E+09	1000								4	1	16		3	4	0	1	0	1	0	0	2		
3165145	#####	200	#####	#####	2016	12	2	7	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3172658	#####	200	#####	#####	2016	12	6	19	799			2.02E+09	1000								6	4	16		2	4	0	0	0	0	0	0	1		
3187524	#####	200	#####	#####	2017	2	5	7	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3214550	#####	200	#####	#####	2017	3	5	14	799			2.02E+09	1003								4	1	16		2	4	0	0	0	0	0	0	1		
3229542	#####	200	#####	#####	2017	5	6	6	799			2.02E+09	1003								4	1	16		3	3	0	0	0	0	0	0	1		
3236044	#####	200	#####	#####	2017	6	1	17	799			2.02E+09	1003								2	1	16		2	2	0	1	0	1	0	0	3		
3237569	#####	200	#####	#####	2017	6	4	17	799			2.02E+09	1000								4	1	16		3	4	0	0	0	0	0	0	1		
3243388	#####	200	#####	#####	2017	6	3	16	799			2.02E+09	1000								6	1	16		2	2	0	0	0	0	0	0	1		
3245662	#####	200	#####	#####	2017	6	5	15	1003			1.71E+09	1003								2	1	16		2	2	0	1	0	1	0	0	3		
3263066	#####	200	#####	#####	2017	8	4	15	799			2.02E+09	1003								2	1	16		2	2	0	0	0	0	0	0	1		
3271526	#####	200	#####	#####	2017	8	7	21	1000			1.71E+08	1000								1	5	34		1	2	0	2	0	2	0	0	3		
3272489	#####	200	#####	#####	2017	9	3	7	799			2.02E+09	1003								4	1	16		2	2	0	0	0	0	0	0	1		
3291561	#####	200	#####	#####	2017	11	6	12	799			2.02E+09	1003								1	1	39		1	1	0	0	0	0	0	0	1		
3302607	#####	200	#####	#####	2017	12	6	7	799			2.02E+09	1003								1	1	41		1	1	0	0	0	0	0	0	1		
3304978	#####	200	#####	#####	2017	12	6	18	1003			1.71E+09	1003								4	5	16		2	2	0	2	0	2	0	0	2		
3317367	#####	200	#####	#####	2018	1	6	21	799			2.02E+09	1000								6	5	16		2	6	0	0	0	0	0	0	1		
3321857	#####	200	#####	#####	2018	1	5	6	799			2.02E+09	1003								1	2	28		1	1	0	0	0	0	0	0	1		
3323358	#####	210	#####	#####	2018	1	6	9	1000			1.8E+08	1000								97	1	18		2	1	1	1	0	0	1	0	4		
3328826	#####	200	#####	#####	2017	12	2	8	1003			1.71E+09	1003								1	1	30		1	1	0	0	0	0	0	0	1		
3330364	#####	200	#####	#####	2018	2	4	5	799			2.02E+09	1003								6	5	16		2	2	0	0	0	0	0	0	1		
3331413	#####	200	#####	#####	2018	2	4	17	799			2.02E+09	1000								4	1	16		2	2	0	0	0	0	0	0	1		
3348888	#####	200	#####	#####	2018	3	4	6	799			2.02E+09	1003								1	1	39		1	1	0	0	0	0	0	0	1		
3357348	#####	200	#####	#####	2018	4	2	9	799			2.02E+09	1003								6	1	16		2	2	0	0	0	0	0	0	1		
3366902	#####	200	#####	#####	2018	5	3	7	799			2.02E+09	1003								4	1	16		3	3	0	0	0	0	0	0	1		
3369910	#####	200	#####	#####	2018	5	5	15	799			2.02E+09	1003								4	1	16		2	8	0	0	0	0	0	0	1		
3379506	#####	200	#####	#####	2018	6	2	7	799			2.02E+09	1003								4	1	16		2	2	0	1	0	1	0	0	2		
3392083	#####	200	#####	#####	2018	7	7	17	799			2.02E+09	1000								1	1	41		1	1	0	0	0	0	0	0	1		
3396607	#####	200	#####	#####	2018	8	6	7	799			2.02E+09	1003								6	1	16		2	2	0	2	0	2	0	0	2		
3402698	#####	200	#####	#####	2018	8	5	4	799			2.02E+09	1000								4	5	16		2	4	0	0	0	0	0	0	1		
3417530	#####	200	#####	#####	2018	9	4	7	799			2.02E+09	1003								6	1	16		2	2	0	0	0	0	0	0	1		
3426678	#####	200	#####																																

FatalAccide	TowAwayF	NscReport	SchoolBusF	WorkZoneI	WorkersPr	AlcoholInv	DrugInvolv	Hazardous	HitAndRun	RouteNam	CrossingFe	Offset	OffsetMea	OffsetUnit	MPNum	MPOffset	CityId	CountyId	StateId	StateCode	CountryCo	Latitude	Longitude	ValidLocati	LocationTo	HESInterse	Intersectio	Intersectio	Intersectio	TrafficWay	Intersectio	JunctionRe	Weather	PropertyDi	PropertyDi	OffsetDire	Secondary	GeocodeO	GeocodeCr	GeocodeO X	Y
0	1	0	0	0	0	0	0	0	0	01010	M251	0.33	0	1	251	0.333	310	19	3 AZ	32.30718	-111.041	1	1	0	0	0	5	0	0	1	0	-1	10	M251	0.333	970610.9	476584.7				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.56	0	1	251	0.557	310	19	3 AZ	32.30452	-111.039	1	1	0	0	0	1	0	0	2	0	-1	10	Non-C M251	0.557	971296.2	475622.3				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.29	0	1	251	0.288	310	19	3 AZ	32.30789	-111.041	1	1	0	0	0	5	0	0	1	4	-1	10	Non-C M251	0.288	970570.5	476842				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.18	0	1	251	0.179	310	19	3 AZ	32.30926	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	Non-C M251	0.179	970277.7	477338.1				
0	0	0	0	0	0	0	0	0	0	01010	M251	0.57	0	1	251	0.569	999	19	3 AZ	32.30422	-111.039	1	1	0	0	0	5	0	0	2	0	0	10	M251	0.569	971252	475511.8				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.17	0	1	251	0.171	310	19	3 AZ	32.30936	-111.042	1	1	0	0	0	4	0	0	1	0	0	10	Non-C M251	0.171	970256.5	477374				
0	0	0	0	0	0	0	0	0	0	010 CAMIN	Sunset Rd	30	0	0	0	0	999	19	3 AZ	32.30883	-111.037	1	1	0	0	0	2	99	0	1	1	0	Camino De Sunset Rd	0.005682	971650.2	477194.8					
0	0	0	0	0	0	0	0	0	0	11010	M251	0.55	0	1	251	0.546	999	19	3 AZ	32.30465	-111.039	1	1	0	0	0	5	0	0	2	0	0	10	Non-C M251	0.546	971267.3	475670.2				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.43	0	1	251	0.431	310	19	3 AZ	32.30594	-111.04	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.431	970875.4	476136.4				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.22	0	1	251	0.217	310	19	3 AZ	32.30863	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.217	970300	477111.6				
0	0	0	0	0	0	0	0	0	0	01010	M251	0.2	0	1	251	0.201	310	19	3 AZ	32.30899	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	Non-C M251	0.201	970335.8	477239.6				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.5	0	1	251	0.499	999	19	3 AZ	32.30509	-111.039	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.499	971059.9	475827.5				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.23	0	1	251	0.229	310	19	3 AZ	32.30848	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.229	970332.6	477056.5				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.24	0	1	251	0.24	310	19	3 AZ	32.30849	-111.041	1	1	0	0	0	1	0	0	1	1	255	0	0	10	Non-C M251	0.24	970441.5	477060.6		
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.2	0	1	251	0.2	310	19	3 AZ	32.30885	-111.042	1	1	0	0	0	4	0	0	1	2	0	10	M251	0.2	970254.7	477188.4				
-1	0	0	0	0	0	0	0	0	0	11010	M251	0.21	0	1	251	0.209	310	19	3 AZ	32.30873	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.209	970280.2	477145.2				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.48	0	1	251	0.477	999	19	3 AZ	32.30552	-111.039	1	1	0	0	0	5	0	0	1	0	0	10	Non-C M251	0.477	971076.2	475985.9				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.59	0	1	251	0.589	999	19	3 AZ	32.30397	-111.039	1	1	0	0	0	1	0	0	1	0	0	10	M251	0.589	971308.5	475422.9				
0	0	0	0	0	0	0	0	0	0	01010	M251	0.25	0	1	251	0.249	310	19	3 AZ	32.30823	-111.041	1	1	0	0	0	1	0	0	2	0	0	10	M251	0.249	970386.6	476964.9				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.58	0	1	251	0.581	999	19	3 AZ	32.30422	-111.038	1	1	0	0	0	4	0	0	1	0	0	10	Non-C M251	0.581	971362.7	475515.5				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.15	0	1	251	0.146	310	19	3 AZ	32.30952	-111.042	1	1	0	0	0	5	0	0	4	2	0	10	M251	0.146	970110	477433.7				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.38	0	1	251	0.383	310	19	3 AZ	32.30654	-111.04	1	1	0	0	0	1	0	0	1	0	0	10	M251	0.383	970746.6	476354.7				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.2	0	1	251	0.197	310	19	3 AZ	32.30904	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	Non-C M251	0.197	970324.5	477258.8				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.19	0	1	251	0.194	310	19	3 AZ	32.30892	-111.042	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.194	970239.6	477214				
0	0	0	0	0	0	0	0	0	0	01010	M251	0.55	0	1	251	0.549	999	19	3 AZ	32.30447	-111.039	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.549	971194.8	475604.5				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.51	0	1	251	0.508	999	19	3 AZ	32.30499	-111.039	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.508	971082.1	475790.8				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.44	0	1	251	0.438	310	19	3 AZ	32.30586	-111.04	1	1	0	0	0	5	0	0	1	2	0	10	M251	0.438	970892.9	476106.7				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.57	0	1	251	0.57	999	19	3 AZ	32.30436	-111.038	1	1	0	0	0	5	0	0	2	0	0	10	Non-C M251	0.57	971332.1	475564.2				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.26	0	1	251	0.258	310	19	3 AZ	32.30812	-111.041	1	1	0	0	0	5	0	0	2	2	0	10	M251	0.258	970409.8	476925.5				
0	0	0	0	1	0	0	0	0	0	01010	Sunset Rd	0	0	0	251	0.192	310	19	3 AZ	32.30933	-111.041	1	1	1	1	2	11	1	1	0	0	10	Non-C M251	0.258	970409.8	476925.5					
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.3	0	1	251	0.301	310	19	3 AZ	32.30758	-111.041	1	1	0	0	0	5	0	0	1	0	0	10	M251	0.301	970525.5	476729.4				
0	1	0	0	0	0	1	0	0	0	01010	Sunset Rd	-46	0	0	251	0.201	310	19	3 AZ	32.30922	-111.041	1	1	0	0	0	1	0	0	1	3	0	10	Non-C M251	-0.00871	970423.9	477327.3				
0	1	0	0	0	0	0	0	0	0	01010	M251	0.5	0	1	251	0.5	999	19	3 AZ	32.30523	-111.039	1	1	0	0	0	5	0	0	2	0	0	10	Non-C M251	0.5	971140.2	475880.2				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.59	0	1	251	0.589	999	19	3 AZ	32.30412	-111.038	1	1	0	0	0	5	0	0	1	0	0	10	Non-C M251	0.589	971385.6	475479				
0	1	0	0	0	0	0	0	0	0	010 SUNSET	I-10 Cardin	0	0	0	0	0	310	19	3 AZ	32.30882	-111.042	1	1	1	1	11	2	1	11	1	0	0	Sunset Rd I-10 Cardin	0	970092.5	477177.3					
0	1	0	0	0	0	0	0	0	0	110 SUNSET	I-10 Cardin	0	0	0	0	0	310	19	3 AZ	32.30882	-111.042	1	1	1	1	11	2	1	11	1	0	0	Sunset Rd I-10 Cardin	0	970092.5	477177.3					
0	0	0	0	0	1	0	0	0	0	010 CAMIN	Jusnic Cir	-50	0	0	0	0	999	19	3 AZ	32.3071	-111.037	1	1	0	0	0	4	0	0	1	3	0	Camino De Jusnic Cir	-0.00947	971661.2	475655.7					
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.4	0	1	251	0.399	310	19	3 AZ	32.30635	-111.04	1	1	0	0	0	5	0	0	1	2	0	10	M251	0.399	970787.6	476285.1				
-1	1	0	0	0	0	0	0	0	0	01010	M251	0.3	0	1	251	0.299	310	19	3 AZ	32.30775	-111.041	1	1	0	0	0	5	0	0	1	4	31	0	10	Non-C M251	0.299	970600.2	476791.6			
0	1	0	0	0	0	0	0	0	0	01010	M251	0.24	0	1	251	0.239	310	19	3 AZ	32.30835	-111.042	1	1	0	0	0	5	0	0	2	0	0	10	M251	0.239	970360.4	477009.2				
0	1	0	0	0	0	0	0	0	0	01010	Sunset Rd	-0.2	0	1	251	0.392	310	19	3 AZ	32.30683	-111.04	1	1	0	0	0	1	1	14	1	3	0	10	Non-C M251	-0.2	970940.6	476460.4				
-1	0	0	0	0	0	0	0	0	0	01010	M251	0.6	0	1	251	0.599	999	19	3 AZ	32.30399	-111.038	1	1	0	0	0	5	0	0	2	0	0	10	Non-C M251	0.599	971415.1	47543				

Appendix D
2045 No Build Traffic Level of
Service Worksheets

HCM 6th Signalized Intersection Summary
 1: Silverbell Rd & Sunset Rd

2045 No Build AM Peak Hour
 07/21/2020

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	230	280	450	570	510	1080
Future Volume (veh/h)	230	280	450	570	510	1080
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	250	304	474	600	537	1137
Peak Hour Factor	0.92	0.92	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	412	367	807	727	553	2017
Arrive On Green	0.23	0.23	0.23	0.23	0.22	0.57
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	250	304	474	600	537	1137
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	7.2	10.4	6.8	13.0	11.8	11.6
Cycle Q Clear(g_c), s	7.2	10.4	6.8	13.0	11.8	11.6
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	412	367	807	727	553	2017
V/C Ratio(X)	0.61	0.83	0.59	0.83	0.97	0.56
Avail Cap(c_a), veh/h	513	457	807	727	553	2017
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.7	20.9	19.7	11.9	20.1	7.9
Incr Delay (d2), s/veh	1.4	10.0	1.1	7.8	30.8	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	5.2	8.0	4.9	14.4	16.4	6.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	21.1	30.9	20.8	19.7	51.0	8.2
LnGrp LOS	C	C	C	B	D	A
Approach Vol, veh/h	554		1074			1674
Approach Delay, s/veh	26.5		20.2			21.9
Approach LOS	C		C			C
Timer - Assigned Phs	1	2			6	8
Phs Duration (G+Y+Rc), s	18.5	20.0			38.5	18.7
Change Period (Y+Rc), s	6.0	* 7			6.0	5.5
Max Green Setting (Gmax), s	12.5	* 13			32.0	16.5
Max Q Clear Time (g_c+I1), s	13.8	15.0			13.6	12.4
Green Ext Time (p_c), s	0.0	0.0			8.1	0.8

Intersection Summary

HCM 6th Ctrl Delay	22.1
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↘	↑↑	↘	↗
Traffic Vol, veh/h	870	210	70	480	30	10
Future Vol, veh/h	870	210	70	480	30	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	250	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	946	228	76	522	33	11

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1174	0	1359 946
Stage 1	-	-	-	-	946 -
Stage 2	-	-	-	-	413 -
Critical Hdwy	-	-	4.13	-	6.63 6.23
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.83 -
Follow-up Hdwy	-	-	2.219	-	3.519 3.319
Pot Cap-1 Maneuver	-	-	593	-	151 316
Stage 1	-	-	-	-	376 -
Stage 2	-	-	-	-	637 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	593	-	132 316
Mov Cap-2 Maneuver	-	-	-	-	262 -
Stage 1	-	-	-	-	376 -
Stage 2	-	-	-	-	555 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	19.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	262	316	-	-	593	-
HCM Lane V/C Ratio	0.124	0.034	-	-	0.128	-
HCM Control Delay (s)	20.7	16.8	-	-	12	-
HCM Lane LOS	C	C	-	-	B	-
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0.4	-

HCM 6th Signalized Intersection Summary
3: Main Dwy & Sunset Rd

2045 No Build AM Peak Hour
07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↗	↖↗	↑↑	↖	↗
Traffic Volume (veh/h)	820	60	740	490	60	100
Future Volume (veh/h)	820	60	740	490	60	100
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	891	65	804	533	67	109
Peak Hour Factor	0.92	0.92	0.92	0.92	0.90	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	2035	908	1200	2756	162	360
Arrive On Green	0.57	0.57	0.09	0.52	0.09	0.09
Sat Flow, veh/h	3647	1585	3456	3647	1781	1585
Grp Volume(v), veh/h	891	65	804	533	67	109
Grp Sat Flow(s),veh/h/ln	1777	1585	1728	1777	1781	1585
Q Serve(g_s), s	8.6	1.1	4.5	4.8	2.1	3.4
Cycle Q Clear(g_c), s	8.6	1.1	4.5	4.8	2.1	3.4
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	2035	908	1200	2756	162	360
V/C Ratio(X)	0.44	0.07	0.67	0.19	0.41	0.30
Avail Cap(c_a), veh/h	2035	908	1421	2756	475	639
HCM Platoon Ratio	1.00	1.00	0.67	0.67	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.70	0.70	1.00	1.00
Uniform Delay (d), s/veh	7.3	5.7	6.4	4.4	25.7	19.2
Incr Delay (d2), s/veh	0.7	0.2	0.7	0.1	1.7	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.9	0.6	1.6	1.4	1.7	2.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	8.0	5.9	7.1	4.5	27.4	19.7
LnGrp LOS	A	A	A	A	C	B
Approach Vol, veh/h	956			1337	176	
Approach Delay, s/veh	7.9			6.1	22.6	
Approach LOS	A			A	C	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		9.5	12.2	38.4		50.5
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s		16.0	12.0	20.0		36.0
Max Q Clear Time (g_c+I1), s		5.4	6.5	10.6		6.8
Green Ext Time (p_c), s		0.4	1.7	4.3		3.9
Intersection Summary						
HCM 6th Ctrl Delay			7.9			
HCM 6th LOS			A			

Notes

User approved pedestrian interval to be less than phase max green.

Volume
4: EB Frontage Rd & Sunset Rd

2045 No Build AM Peak Hour
07/21/2020



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗	↖	↑↑					↘	↑↑↑	↗
Traffic Volume (vph)	0	510	410	150	570	0	0	0	0	20	320	660
Future Volume (vph)	0	510	410	150	570	0	0	0	0	20	320	660
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	1522	4806	1583
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	1522	4806	1583
Satd. Flow (RTOR)			377									216
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)										10%		
Lane Group Flow (vph)	0	554	446	163	620	0	0	0	0	20	350	717
Turn Type		NA	Perm	Prot	NA					Perm	NA	Perm
Protected Phases		2		1	2 1						4 12	
Permitted Phases			2							4 12		4 12
Total Split (s)		36.0	36.0	30.0								
Total Lost Time (s)		6.0	6.0	4.0								
Act Effct Green (s)		33.9	33.9	20.9	58.8					49.7	49.7	49.7
Actuated g/C Ratio		0.28	0.28	0.17	0.49					0.41	0.41	0.41
v/c Ratio		0.55	0.62	0.53	0.36					0.03	0.18	0.92
Control Delay		34.8	14.4	28.8	8.7					21.9	22.8	41.5
Queue Delay		0.1	0.0	0.4	0.7					0.0	0.0	0.0
Total Delay		34.9	14.4	29.1	9.4					21.9	22.8	41.5
LOS		C	B	C	A					C	C	D
Approach Delay		25.8			13.5						35.2	
Approach LOS		C			B						D	
Queue Length 50th (ft)		148	101	103	191					10	66	400
Queue Length 95th (ft)		228	175	149	213					29	91	#665
Internal Link Dist (ft)		766			244			320			664	
Turn Bay Length (ft)			150									350
Base Capacity (vph)		1000	717	383	1710					631	1992	782
Starvation Cap Reductn		0	0	38	703					0	0	0
Spillback Cap Reductn		51	0	0	0					0	0	0
Storage Cap Reductn		0	0	0	0					0	0	0
Reduced v/c Ratio		0.58	0.62	0.47	0.62					0.03	0.18	0.92

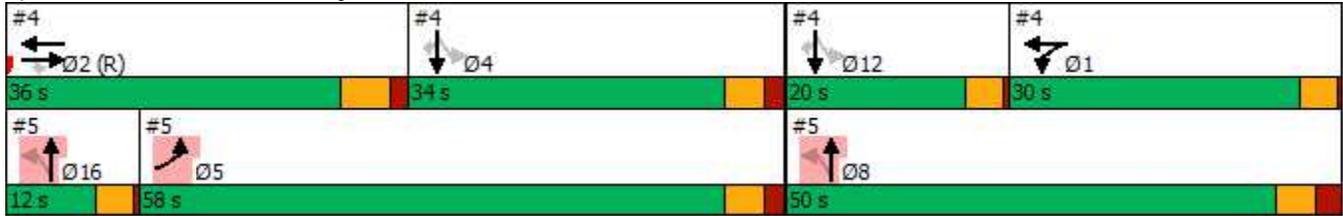
Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 26.0	Intersection LOS: C
Intersection Capacity Utilization 82.7%	ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: EB Frontage Rd & Sunset Rd



Volume
5: WB Frontage Rd & Sunset Rd

2045 No Build AM Peak Hour
07/21/2020



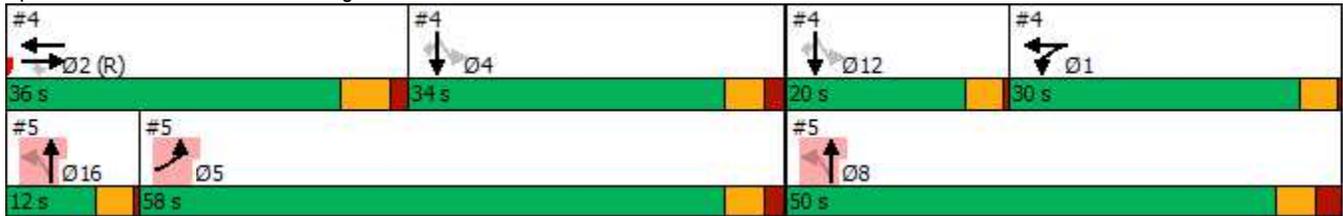
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1	Ø2	Ø4	Ø8	Ø12	Ø16
Lane Configurations	↖↗		↖	↖↖↖								
Traffic Volume (vph)	530	0	720	220	0	0						
Future Volume (vph)	530	0	720	220	0	0						
Satd. Flow (prot)	3433	0	1522	4662	0	0						
Flt Permitted	0.950		0.950	0.970								
Satd. Flow (perm)	3433	0	1522	4662	0	0						
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92						
Growth Factor	100%	100%	100%	100%	100%	100%						
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%						
Bus Blockages (#/hr)	0	0	0	0	0	0						
Parking (#/hr)												
Mid-Block Traffic (%)	0%			0%	0%							
Shared Lane Traffic (%)			50%									
Lane Group Flow (vph)	576	0	391	631	0	0						
Turn Type	Prot		Perm	NA								
Protected Phases	5			8 16			1	2	4	8	12	16
Permitted Phases			8 16									
Total Split (s)	58.0						30.0	36.0	34.0	50.0	20.0	12.0
Total Lost Time (s)	5.5											
Act Effct Green (s)	51.9		56.6	56.6								
Actuated g/C Ratio	0.43		0.47	0.47								
v/c Ratio	0.39		0.55	0.29								
Control Delay	8.1		26.3	19.9								
Queue Delay	2.6		0.1	0.0								
Total Delay	10.6		26.4	19.9								
LOS	B		C	B								
Approach Delay	10.6			22.4								
Approach LOS	B			C								
Queue Length 50th (ft)	146		246	113								
Queue Length 95th (ft)	0		361	144								
Internal Link Dist (ft)	244			1117	318							
Turn Bay Length (ft)												
Base Capacity (vph)	1501		707	2165								
Starvation Cap Reductn	776		0	0								
Spillback Cap Reductn	0		14	22								
Storage Cap Reductn	0		0	0								
Reduced v/c Ratio	0.79		0.56	0.29								

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 18.2	Intersection LOS: B
Intersection Capacity Utilization 95.0%	ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 5: WB Frontage Rd & Sunset Rd



Intersection						
Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	40	0	0	200	330
Future Vol, veh/h	0	40	0	0	200	330
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	43	0	0	217	359

Major/Minor	Minor2	Major2
Conflicting Flow All	- 109	- 0
Stage 1	- -	- -
Stage 2	- -	- -
Critical Hdwy	- 6.94	- -
Critical Hdwy Stg 1	- -	- -
Critical Hdwy Stg 2	- -	- -
Follow-up Hdwy	- 3.32	- -
Pot Cap-1 Maneuver	0 924	- -
Stage 1	0 -	- -
Stage 2	0 -	- -
Platoon blocked, %		- -
Mov Cap-1 Maneuver	- 924	- -
Mov Cap-2 Maneuver	- -	- -
Stage 1	- -	- -
Stage 2	- -	- -

Approach	EB	SB
HCM Control Delay, s	9.1	0
HCM LOS	A	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	924	-	-
HCM Lane V/C Ratio	0.047	-	-
HCM Control Delay (s)	9.1	-	-
HCM Lane LOS	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-

Intersection						
Int Delay, s/veh	0.7					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	20	0	0	75	165
Future Vol, veh/h	0	20	0	0	75	165
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	22	0	0	82	179

Major/Minor	Minor2		Major2	
Conflicting Flow All	-	41	-	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	6.94	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	3.32	-	-
Pot Cap-1 Maneuver	0	1021	-	-
Stage 1	0	-	-	-
Stage 2	0	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	-	1021	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	SB
HCM Control Delay, s	8.6	0
HCM LOS	A	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	1021	-	-
HCM Lane V/C Ratio	0.021	-	-
HCM Control Delay (s)	8.6	-	-
HCM Lane LOS	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-

HCM 6th Signalized Intersection Summary
 1: Silverbell Rd & Sunset Rd

2045 No Build PM Peak Hour
 07/21/2020

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	460	520	890	300	230	410
Future Volume (veh/h)	460	520	890	300	230	410
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	500	565	967	326	250	446
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	667	593	1059	1065	290	1748
Arrive On Green	0.37	0.37	0.30	0.30	0.11	0.49
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	500	565	967	326	250	446
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	21.0	29.8	22.6	7.3	7.5	6.3
Cycle Q Clear(g_c), s	21.0	29.8	22.6	7.3	7.5	6.3
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	667	593	1059	1065	290	1748
V/C Ratio(X)	0.75	0.95	0.91	0.31	0.86	0.26
Avail Cap(c_a), veh/h	674	600	1075	1073	358	1903
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.4	26.1	29.1	5.8	35.8	12.7
Incr Delay (d2), s/veh	4.6	25.4	11.6	0.2	16.3	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	14.2	21.1	16.3	9.7	10.4	4.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	28.0	51.5	40.7	6.0	52.1	12.8
LnGrp LOS	C	D	D	A	D	B
Approach Vol, veh/h	1065		1293			696
Approach Delay, s/veh	40.5		32.0			26.9
Approach LOS	D		C			C
Timer - Assigned Phs	1	2			6	8
Phs Duration (G+Y+Rc), s	15.7	32.6			48.3	37.6
Change Period (Y+Rc), s	6.0	7.0			6.0	5.5
Max Green Setting (Gmax), s	13.0	26.0			46.0	32.5
Max Q Clear Time (g_c+I1), s	9.5	24.6			8.3	31.8
Green Ext Time (p_c), s	0.2	1.0			3.3	0.4
Intersection Summary						
HCM 6th Ctrl Delay			33.8			
HCM 6th LOS			C			

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑↑	↖	↗
Traffic Vol, veh/h	490	40	30	840	140	80
Future Vol, veh/h	490	40	30	840	140	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	250	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	533	43	33	913	152	87

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	576	0	1056
Stage 1	-	-	-	-	533
Stage 2	-	-	-	-	523
Critical Hdwy	-	-	4.13	-	6.63
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.83
Follow-up Hdwy	-	-	2.219	-	3.519
Pot Cap-1 Maneuver	-	-	995	-	235
Stage 1	-	-	-	-	587
Stage 2	-	-	-	-	560
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	995	-	227
Mov Cap-2 Maneuver	-	-	-	-	361
Stage 1	-	-	-	-	587
Stage 2	-	-	-	-	542

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	18.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	361	546	-	-	995	-
HCM Lane V/C Ratio	0.422	0.159	-	-	0.033	-
HCM Control Delay (s)	22	12.8	-	-	8.7	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	2	0.6	-	-	0.1	-

HCM 6th Signalized Intersection Summary
3: Main Dwy & Sunset Rd

2045 No Build PM Peak Hour
07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑↑	↑↑	↑	↑
Traffic Volume (veh/h)	540	30	190	760	110	610
Future Volume (veh/h)	540	30	190	760	110	610
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	587	33	207	826	120	663
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	788	351	497	1184	1029	1022
Arrive On Green	0.22	0.22	0.09	0.44	0.58	0.58
Sat Flow, veh/h	3647	1585	3456	3647	1781	1585
Grp Volume(v), veh/h	587	33	207	826	120	663
Grp Sat Flow(s),veh/h/ln	1777	1585	1728	1777	1781	1585
Q Serve(g_s), s	13.9	1.5	3.9	16.9	2.7	23.0
Cycle Q Clear(g_c), s	13.9	1.5	3.9	16.9	2.7	23.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	788	351	497	1184	1029	1022
V/C Ratio(X)	0.75	0.09	0.42	0.70	0.12	0.65
Avail Cap(c_a), veh/h	1737	775	573	2211	1029	1022
HCM Platoon Ratio	1.00	1.00	1.33	1.33	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.82	0.82	1.00	1.00
Uniform Delay (d), s/veh	32.7	27.8	23.7	21.4	8.6	9.7
Incr Delay (d2), s/veh	1.4	0.1	0.5	0.6	0.2	3.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	10.0	1.0	2.8	9.8	1.9	12.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	34.1	28.0	24.2	22.0	8.8	12.9
LnGrp LOS	C	C	C	C	A	B
Approach Vol, veh/h	620			1033	783	
Approach Delay, s/veh	33.8			22.5	12.3	
Approach LOS	C			C	B	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		56.0	10.0	24.0		34.0
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s		26.0	8.0	44.0		56.0
Max Q Clear Time (g_c+I1), s		25.0	5.9	15.9		18.9
Green Ext Time (p_c), s		0.4	0.1	4.1		6.9
Intersection Summary						
HCM 6th Ctrl Delay			22.1			
HCM 6th LOS			C			

Volume
4: EB Frontage Rd & Sunset Rd

2045 No Build PM Peak Hour
07/21/2020



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗	↖	↑↑					↘	↑↑↑	↗
Traffic Volume (vph)	0	680	470	80	420	0	0	0	0	20	170	530
Future Volume (vph)	0	680	470	80	420	0	0	0	0	20	170	530
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	1522	4801	1583
Flt Permitted				0.950						0.950	0.999	
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	1522	4801	1583
Satd. Flow (RTOR)			511									256
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										10%		
Lane Group Flow (vph)	0	739	511	87	457	0	0	0	0	20	187	576
Turn Type		NA	Perm	Prot	NA					Perm	NA	Perm
Protected Phases		2		1	2 1						4 12	
Permitted Phases			2							4 12		4 12
Total Split (s)		33.0	33.0	10.0								
Total Lost Time (s)		6.0	6.0	4.0								
Act Effct Green (s)		31.5	31.5	9.5	45.0					33.5	33.5	33.5
Actuated g/C Ratio		0.35	0.35	0.11	0.50					0.37	0.37	0.37
v/c Ratio		0.60	0.58	0.47	0.26					0.04	0.10	0.77
Control Delay		25.7	9.2	32.6	5.7					15.1	17.1	19.9
Queue Delay		0.3	0.0	0.0	0.0					0.0	0.0	0.0
Total Delay		26.0	9.2	32.6	5.7					15.1	17.1	19.9
LOS		C	A	C	A					B	B	B
Approach Delay		19.2			10.0							19.1
Approach LOS		B			B							B
Queue Length 50th (ft)		220	106	14	0					8	25	157
Queue Length 95th (ft)		261	143	#123	158					20	36	252
Internal Link Dist (ft)		766			244			320			664	
Turn Bay Length (ft)			150									350
Base Capacity (vph)		1239	886	186	1769					651	2055	823
Starvation Cap Reductn		0	0	0	0					0	0	0
Spillback Cap Reductn		127	0	0	0					0	0	0
Storage Cap Reductn		0	0	0	0					0	0	0
Reduced v/c Ratio		0.66	0.58	0.47	0.26					0.03	0.09	0.70

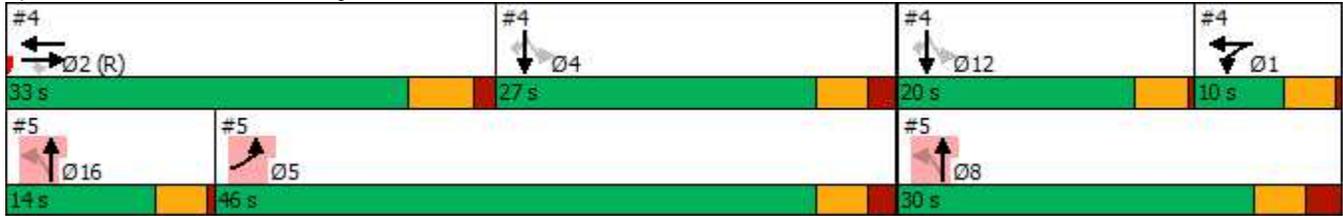
Intersection Summary

Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 17.2	Intersection LOS: B
Intersection Capacity Utilization 74.5%	ICU Level of Service D

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: EB Frontage Rd & Sunset Rd



Volume
5: WB Frontage Rd & Sunset Rd

2045 No Build PM Peak Hour
07/21/2020



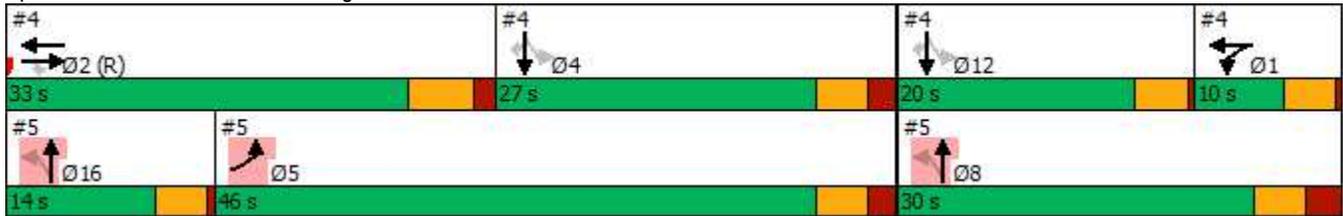
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1	Ø2	Ø4	Ø8	Ø12	Ø16
Lane Configurations	↖↗		↖	↖↖↖								
Traffic Volume (vph)	700	0	500	190	0	0						
Future Volume (vph)	700	0	500	190	0	0						
Satd. Flow (prot)	3433	0	1522	4671	0	0						
Flt Permitted	0.950		0.950	0.972								
Satd. Flow (perm)	3433	0	1522	4671	0	0						
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92						
Growth Factor	100%	100%	100%	100%	100%	100%						
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%						
Bus Blockages (#/hr)	0	0	0	0	0	0						
Parking (#/hr)												
Mid-Block Traffic (%)	0%			0%	0%							
Shared Lane Traffic (%)			50%									
Lane Group Flow (vph)	761	0	271	479	0	0						
Turn Type	Prot		Perm	NA								
Protected Phases	5			8 16			1	2	4	8	12	16
Permitted Phases			8 16									
Total Split (s)	46.0						10.0	33.0	27.0	30.0	20.0	14.0
Total Lost Time (s)	5.5											
Act Effct Green (s)	37.7		40.8	40.8								
Actuated g/C Ratio	0.42		0.45	0.45								
v/c Ratio	0.53		0.39	0.23								
Control Delay	11.0		19.9	16.3								
Queue Delay	10.2		0.0	0.0								
Total Delay	21.2		19.9	16.3								
LOS	C		B	B								
Approach Delay	21.2			17.6								
Approach LOS	C			B								
Queue Length 50th (ft)	0		126	68								
Queue Length 95th (ft)	187		200	91								
Internal Link Dist (ft)	244			1117	318							
Turn Bay Length (ft)												
Base Capacity (vph)	1558		688	2114								
Starvation Cap Reductn	766		0	0								
Spillback Cap Reductn	0		0	0								
Storage Cap Reductn	0		0	0								
Reduced v/c Ratio	0.96		0.39	0.23								

Intersection Summary

Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 19.4	Intersection LOS: B
Intersection Capacity Utilization 86.9%	ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 5: WB Frontage Rd & Sunset Rd



Intersection						
Int Delay, s/veh	6.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	300	0	0	110	60
Future Vol, veh/h	0	300	0	0	110	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	326	0	0	120	65

Major/Minor	Minor2		Major2	
Conflicting Flow All	-	60	-	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	6.94	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	3.32	-	-
Pot Cap-1 Maneuver	0	993	-	-
Stage 1	0	-	-	-
Stage 2	0	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	-	993	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	SB
HCM Control Delay, s	10.4	0
HCM LOS	B	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	993	-	-
HCM Lane V/C Ratio	0.328	-	-
HCM Control Delay (s)	10.4	-	-
HCM Lane LOS	B	-	-
HCM 95th %tile Q(veh)	1.4	-	-

Intersection						
Int Delay, s/veh	2.7					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	140	0	0	370	40
Future Vol, veh/h	0	140	0	0	370	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	152	0	0	402	43

Major/Minor	Minor2	Major2
Conflicting Flow All	- 201	- 0
Stage 1	- -	- -
Stage 2	- -	- -
Critical Hdwy	- 6.94	- -
Critical Hdwy Stg 1	- -	- -
Critical Hdwy Stg 2	- -	- -
Follow-up Hdwy	- 3.32	- -
Pot Cap-1 Maneuver	0 806	- -
Stage 1	0 -	- -
Stage 2	0 -	- -
Platoon blocked, %		- -
Mov Cap-1 Maneuver	- 806	- -
Mov Cap-2 Maneuver	- -	- -
Stage 1	- -	- -
Stage 2	- -	- -

Approach	EB	SB
HCM Control Delay, s	10.5	0
HCM LOS	B	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	806	-	-
HCM Lane V/C Ratio	0.189	-	-
HCM Control Delay (s)	10.5	-	-
HCM Lane LOS	B	-	-
HCM 95th %tile Q(veh)	0.7	-	-

Appendix E
2045 Build Traffic Level of
Service Worksheets

HCM 6th Signalized Intersection Summary
 1: Silverbell Rd & Sunset Rd

2045 Build AM Peak Hour
 07/21/2020



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	300	220	490	650	450	1220
Future Volume (veh/h)	300	220	490	650	450	1220
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	326	239	516	684	474	1284
Peak Hour Factor	0.92	0.92	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	403	359	834	731	527	2012
Arrive On Green	0.23	0.23	0.23	0.23	0.21	0.57
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	326	239	516	684	474	1284
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	9.6	7.6	7.2	13.0	9.1	13.6
Cycle Q Clear(g_c), s	9.6	7.6	7.2	13.0	9.1	13.6
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	403	359	834	731	527	2012
V/C Ratio(X)	0.81	0.67	0.62	0.94	0.90	0.64
Avail Cap(c_a), veh/h	531	472	834	731	564	2053
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.3	19.5	19.0	11.6	19.4	8.2
Incr Delay (d2), s/veh	6.9	2.2	1.4	19.4	16.7	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	7.8	5.0	5.1	18.3	12.1	7.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	27.2	21.8	20.4	31.0	36.1	8.8
LnGrp LOS	C	C	C	C	D	A
Approach Vol, veh/h	565		1200			1758
Approach Delay, s/veh	24.9		26.4			16.2
Approach LOS	C		C			B
Timer - Assigned Phs	1	2			6	8
Phs Duration (G+Y+Rc), s	17.4	20.0			37.4	18.0
Change Period (Y+Rc), s	6.0	* 7			6.0	5.5
Max Green Setting (Gmax), s	12.5	* 13			32.0	16.5
Max Q Clear Time (g_c+I1), s	11.1	15.0			15.6	11.6
Green Ext Time (p_c), s	0.3	0.0			8.7	0.9

Intersection Summary

HCM 6th Ctrl Delay	21.1
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↘	↑↑	↘	↗
Traffic Vol, veh/h	890	210	70	490	30	10
Future Vol, veh/h	890	210	70	490	30	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	250	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	967	228	76	533	33	11

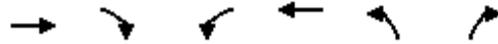
Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1195	0	1386 967
Stage 1	-	-	-	-	967 -
Stage 2	-	-	-	-	419 -
Critical Hdwy	-	-	4.13	-	6.63 6.23
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.83 -
Follow-up Hdwy	-	-	2.219	-	3.519 3.319
Pot Cap-1 Maneuver	-	-	582	-	145 307
Stage 1	-	-	-	-	368 -
Stage 2	-	-	-	-	633 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	582	-	126 307
Mov Cap-2 Maneuver	-	-	-	-	256 -
Stage 1	-	-	-	-	368 -
Stage 2	-	-	-	-	550 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	20.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	256	307	-	-	582	-
HCM Lane V/C Ratio	0.127	0.035	-	-	0.131	-
HCM Control Delay (s)	21.1	17.2	-	-	12.1	-
HCM Lane LOS	C	C	-	-	B	-
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0.4	-

HCM 6th Signalized Intersection Summary
3: Main Dwy & Sunset Rd

2045 Build AM Peak Hour
07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↗	↖↗	↑↑	↖	↗
Traffic Volume (veh/h)	830	70	730	500	60	100
Future Volume (veh/h)	830	70	730	500	60	100
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	902	76	793	543	67	109
Peak Hour Factor	0.92	0.92	0.92	0.92	0.90	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	2031	906	1190	2756	162	362
Arrive On Green	0.57	0.57	0.14	0.78	0.09	0.09
Sat Flow, veh/h	3647	1585	3456	3647	1781	1585
Grp Volume(v), veh/h	902	76	793	543	67	109
Grp Sat Flow(s),veh/h/ln	1777	1585	1728	1777	1781	1585
Q Serve(g_s), s	8.7	1.3	4.6	2.4	2.1	3.4
Cycle Q Clear(g_c), s	8.7	1.3	4.6	2.4	2.1	3.4
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	2031	906	1190	2756	162	362
V/C Ratio(X)	0.44	0.08	0.67	0.20	0.41	0.30
Avail Cap(c_a), veh/h	2031	906	1406	2756	475	640
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.86	0.86	1.00	1.00
Uniform Delay (d), s/veh	7.4	5.8	5.9	1.8	25.8	19.2
Incr Delay (d2), s/veh	0.7	0.2	0.8	0.1	1.7	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	5.0	0.7	1.5	0.6	1.7	2.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	8.1	6.0	6.7	1.9	27.4	19.6
LnGrp LOS	A	A	A	A	C	B
Approach Vol, veh/h	978			1336	176	
Approach Delay, s/veh	7.9			4.8	22.6	
Approach LOS	A			A	C	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		9.5	12.2	38.3		50.5
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s		16.0	12.0	20.0		36.0
Max Q Clear Time (g_c+I1), s		5.4	6.6	10.7		4.4
Green Ext Time (p_c), s		0.4	1.6	4.4		4.0

Intersection Summary

HCM 6th Ctrl Delay	7.3
HCM 6th LOS	A

Notes

User approved pedestrian interval to be less than phase max green.

Volume
4: EB Frontage Rd & Sunset Rd

2045 Build AM Peak Hour
07/21/2020



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗	↘	↑↑					↘	↑↑↑	↗
Traffic Volume (vph)	0	600	330	320	910	0	0	0	0	250	270	320
Future Volume (vph)	0	600	330	320	910	0	0	0	0	250	270	320
Satd. Flow (prot)	0	5085	1583	1770	3539	0	0	0	0	1522	4734	1583
Flt Permitted				0.950						0.950	0.985	
Satd. Flow (perm)	0	5085	1583	1770	3539	0	0	0	0	1522	4734	1583
Satd. Flow (RTOR)			318									118
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	0	652	359	348	989	0	0	0	0	139	426	348
Turn Type		NA	Perm	Prot	NA					Perm	NA	Perm
Protected Phases		2		1	2 1						4 12	
Permitted Phases			2							4 12		4 12
Total Split (s)		30.0	30.0	45.0								
Total Lost Time (s)		6.0	6.0	4.0								
Act Effct Green (s)		24.5	24.5	45.0	73.5					35.0	35.0	35.0
Actuated g/C Ratio		0.20	0.20	0.38	0.61					0.29	0.29	0.29
v/c Ratio		0.63	0.62	0.52	0.46					0.31	0.31	0.64
Control Delay		46.8	19.0	13.9	6.8					34.8	33.4	29.4
Queue Delay		0.2	0.0	3.7	0.8					0.0	0.0	0.0
Total Delay		47.1	19.0	17.6	7.6					34.8	33.4	29.4
LOS		D	B	B	A					C	C	C
Approach Delay		37.1			10.2						32.1	
Approach LOS		D			B						C	
Queue Length 50th (ft)		134	78	118	257					98	100	158
Queue Length 95th (ft)		215	179	296	330					155	125	246
Internal Link Dist (ft)		766			244			320			664	
Turn Bay Length (ft)			150									350
Base Capacity (vph)		1036	576	664	2167					484	1508	585
Starvation Cap Reductn		0	0	227	784					0	0	0
Spillback Cap Reductn		64	0	0	0					1	2	0
Storage Cap Reductn		0	0	0	0					0	0	0
Reduced v/c Ratio		0.67	0.62	0.80	0.72					0.29	0.28	0.59

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 55 (46%), Referenced to phase 6:EBWB, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.64

Intersection Signal Delay: 24.7

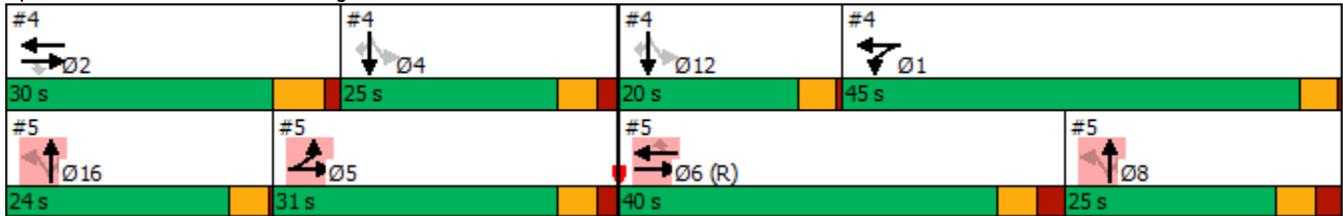
Intersection LOS: C

Intersection Capacity Utilization 58.8%

ICU Level of Service B

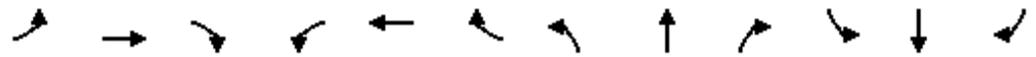
Analysis Period (min) 15

Splits and Phases: 4: EB Frontage Rd & Sunset Rd



Volume
5: WB Frontage Rd & Sunset Rd

2045 Build AM Peak Hour
07/21/2020



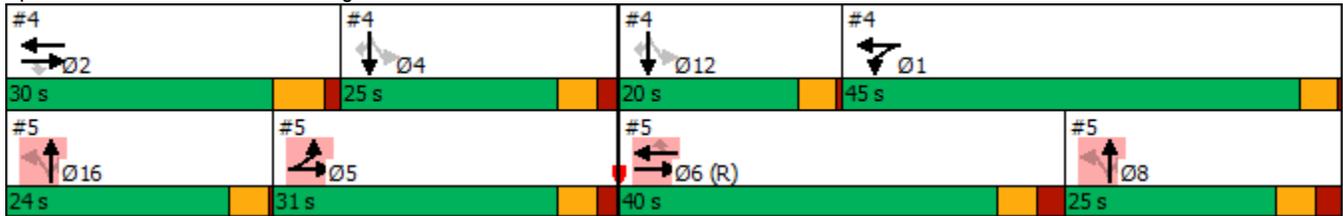
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↗↗			↗↗↗	↘	↘	↗↗↗	↘			
Traffic Volume (vph)	260	590	0	0	820	140	410	150	310	0	0	0
Future Volume (vph)	260	590	0	0	820	140	410	150	310	0	0	0
Satd. Flow (prot)	1770	3539	0	0	5085	1583	1522	4671	1583	0	0	0
Flt Permitted	0.950						0.950	0.972				
Satd. Flow (perm)	1770	3539	0	0	5085	1583	1522	4671	1583	0	0	0
Satd. Flow (RTOR)						137			233			
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)							50%					
Lane Group Flow (vph)	283	641	0	0	891	152	223	386	337	0	0	0
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	5	6 5			6			8 16				
Permitted Phases						6	8 16		8 16			
Total Split (s)	31.0				40.0	40.0						
Total Lost Time (s)	5.5				6.0	6.0						
Act Effct Green (s)	32.9	74.2			35.8	35.8	33.8	33.8	33.8			
Actuated g/C Ratio	0.27	0.62			0.30	0.30	0.28	0.28	0.28			
v/c Ratio	0.58	0.29			0.59	0.27	0.52	0.29	0.55			
Control Delay	14.8	4.3			38.2	8.3	40.0	33.6	14.0			
Queue Delay	30.6	0.5			0.6	0.0	0.0	0.0	0.0			
Total Delay	45.4	4.8			38.8	8.3	40.0	33.6	14.0			
LOS	D	A			D	A	D	C	B			
Approach Delay		17.3			34.4			28.1				
Approach LOS		B			C			C				
Queue Length 50th (ft)	175	67			219	8	169	91	62			
Queue Length 95th (ft)	325	198			267	59	238	110	140			
Internal Link Dist (ft)		244			1409			1117			318	
Turn Bay Length (ft)						150			350			
Base Capacity (vph)	485	2189			1515	567	530	1626	703			
Starvation Cap Reductn	205	1069			0	0	0	0	0			
Spillback Cap Reductn	0	0			282	0	0	0	0			
Storage Cap Reductn	0	0			0	0	0	0	0			
Reduced v/c Ratio	1.01	0.57			0.72	0.27	0.42	0.24	0.48			

Intersection Summary

Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 55 (46%), Referenced to phase 6:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.64	
Intersection Signal Delay: 26.9	Intersection LOS: C
Intersection Capacity Utilization 58.8%	ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 5: WB Frontage Rd & Sunset Rd



Intersection						
Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	40	0	0	240	330
Future Vol, veh/h	0	40	0	0	240	330
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	43	0	0	261	359

Major/Minor	Minor2	Major2
Conflicting Flow All	- 131	- 0
Stage 1	- -	- -
Stage 2	- -	- -
Critical Hdwy	- 6.94	- -
Critical Hdwy Stg 1	- -	- -
Critical Hdwy Stg 2	- -	- -
Follow-up Hdwy	- 3.32	- -
Pot Cap-1 Maneuver	0 894	- -
Stage 1	0 -	- -
Stage 2	0 -	- -
Platoon blocked, %		- -
Mov Cap-1 Maneuver	- 894	- -
Mov Cap-2 Maneuver	- -	- -
Stage 1	- -	- -
Stage 2	- -	- -

Approach	EB	SB
HCM Control Delay, s	9.2	0
HCM LOS	A	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	894	-	-
HCM Lane V/C Ratio	0.049	-	-
HCM Control Delay (s)	9.2	-	-
HCM Lane LOS	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-

Intersection						
Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	20	0	0	115	165
Future Vol, veh/h	0	20	0	0	115	165
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	22	0	0	125	179

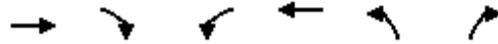
Major/Minor	Minor2	Major2
Conflicting Flow All	- 63	- 0
Stage 1	- -	- -
Stage 2	- -	- -
Critical Hdwy	- 6.94	- -
Critical Hdwy Stg 1	- -	- -
Critical Hdwy Stg 2	- -	- -
Follow-up Hdwy	- 3.32	- -
Pot Cap-1 Maneuver	0 988	- -
Stage 1	0 -	- -
Stage 2	0 -	- -
Platoon blocked, %		- -
Mov Cap-1 Maneuver	- 988	- -
Mov Cap-2 Maneuver	- -	- -
Stage 1	- -	- -
Stage 2	- -	- -

Approach	EB	SB
HCM Control Delay, s	8.7	0
HCM LOS	A	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	988	-	-
HCM Lane V/C Ratio	0.022	-	-
HCM Control Delay (s)	8.7	-	-
HCM Lane LOS	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-

HCM 6th Signalized Intersection Summary
8: Sunset Rd & River Rd

2045 Build AM Peak Hour
07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Volume (veh/h)	830	420	540	490	380	520
Future Volume (veh/h)	830	420	540	490	380	520
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	865	438	562	510	396	542
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	966	823	586	2336	440	913
Arrive On Green	0.27	0.27	0.33	0.66	0.25	0.25
Sat Flow, veh/h	3647	1585	1781	3647	1781	1585
Grp Volume(v), veh/h	865	438	562	510	396	542
Grp Sat Flow(s),veh/h/ln	1777	1585	1781	1777	1781	1585
Q Serve(g_s), s	26.9	21.1	35.6	6.6	24.8	0.0
Cycle Q Clear(g_c), s	26.9	21.1	35.6	6.6	24.8	0.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	966	823	586	2336	440	913
V/C Ratio(X)	0.90	0.53	0.96	0.22	0.90	0.59
Avail Cap(c_a), veh/h	1004	840	596	2394	488	955
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.3	18.4	37.9	7.9	41.9	15.7
Incr Delay (d2), s/veh	10.2	0.6	26.9	0.0	18.3	0.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	18.9	18.3	26.9	4.3	19.0	13.9
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	50.5	19.0	64.7	7.9	60.3	16.6
LnGrp LOS	D	B	E	A	E	B
Approach Vol, veh/h	1303			1072	938	
Approach Delay, s/veh	39.9			37.7	35.1	
Approach LOS	D			D	D	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		33.9	43.3	37.8		81.1
Change Period (Y+Rc), s		5.5	5.5	6.5		5.5
Max Green Setting (Gmax), s		31.5	38.5	32.5		77.5
Max Q Clear Time (g_c+I1), s		26.8	37.6	28.9		8.6
Green Ext Time (p_c), s		1.7	0.2	2.3		4.0
Intersection Summary						
HCM 6th Ctrl Delay			37.8			
HCM 6th LOS			D			

HCM 6th Signalized Intersection Summary
 1: Silverbell Rd & Sunset Rd

2045 Build PM Peak Hour
 07/21/2020

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	550	440	1000	290	260	460
Future Volume (veh/h)	550	440	1000	290	260	460
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	573	458	1042	302	271	479
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	611	544	1134	1050	309	1862
Arrive On Green	0.34	0.34	0.32	0.32	0.12	0.52
Sat Flow, veh/h	1781	1585	3647	1585	1781	3647
Grp Volume(v), veh/h	573	458	1042	302	271	479
Grp Sat Flow(s),veh/h/ln	1781	1585	1777	1585	1781	1777
Q Serve(g_s), s	26.9	23.1	24.4	6.9	8.5	6.4
Cycle Q Clear(g_c), s	26.9	23.1	24.4	6.9	8.5	6.4
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	611	544	1134	1050	309	1862
V/C Ratio(X)	0.94	0.84	0.92	0.29	0.88	0.26
Avail Cap(c_a), veh/h	628	559	1151	1057	357	1973
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.5	26.2	28.4	6.1	35.5	11.3
Incr Delay (d2), s/veh	21.6	11.0	11.6	0.1	19.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	20.8	15.1	17.4	8.8	11.4	4.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	49.1	37.2	40.0	6.2	54.6	11.4
LnGrp LOS	D	D	D	A	D	B
Approach Vol, veh/h	1031		1344			750
Approach Delay, s/veh	43.8		32.4			27.0
Approach LOS	D		C			C
Timer - Assigned Phs	1	2			6	8
Phs Duration (G+Y+Rc), s	16.7	34.6			51.3	35.2
Change Period (Y+Rc), s	6.0	7.0			6.0	5.5
Max Green Setting (Gmax), s	13.0	28.0			48.0	30.5
Max Q Clear Time (g_c+I1), s	10.5	26.4			8.4	28.9
Green Ext Time (p_c), s	0.2	1.2			3.6	0.7
Intersection Summary						
HCM 6th Ctrl Delay			34.9			
HCM 6th LOS			C			

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↘	↑↑	↘	↗
Traffic Vol, veh/h	510	40	30	850	140	80
Future Vol, veh/h	510	40	30	850	140	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	100	250	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	554	43	33	924	152	87

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	597	0	1082
Stage 1	-	-	-	-	554
Stage 2	-	-	-	-	528
Critical Hdwy	-	-	4.13	-	6.63
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.83
Follow-up Hdwy	-	-	2.219	-	3.519
Pot Cap-1 Maneuver	-	-	978	-	226
Stage 1	-	-	-	-	574
Stage 2	-	-	-	-	557
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	978	-	218
Mov Cap-2 Maneuver	-	-	-	-	353
Stage 1	-	-	-	-	574
Stage 2	-	-	-	-	538

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	19.2
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	353	531	-	-	978	-
HCM Lane V/C Ratio	0.431	0.164	-	-	0.033	-
HCM Control Delay (s)	22.7	13.1	-	-	8.8	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	2.1	0.6	-	-	0.1	-

HCM 6th Signalized Intersection Summary
 3: Main Dwy & Sunset Rd

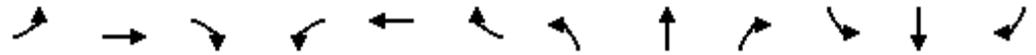
2045 Build PM Peak Hour
 07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑↑	↑↑	↑	↑
Traffic Volume (veh/h)	550	40	180	760	120	600
Future Volume (veh/h)	550	40	180	760	120	600
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	598	43	196	826	130	652
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	799	356	487	1186	1028	1017
Arrive On Green	0.22	0.22	0.06	0.33	0.58	0.58
Sat Flow, veh/h	3647	1585	3456	3647	1781	1585
Grp Volume(v), veh/h	598	43	196	826	130	652
Grp Sat Flow(s),veh/h/ln	1777	1585	1728	1777	1781	1585
Q Serve(g_s), s	14.1	1.9	3.7	18.2	3.0	22.5
Cycle Q Clear(g_c), s	14.1	1.9	3.7	18.2	3.0	22.5
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	799	356	487	1186	1028	1017
V/C Ratio(X)	0.75	0.12	0.40	0.70	0.13	0.64
Avail Cap(c_a), veh/h	1737	775	571	2211	1028	1017
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.93	0.93	1.00	1.00
Uniform Delay (d), s/veh	32.5	27.8	24.3	26.0	8.7	9.8
Incr Delay (d2), s/veh	1.4	0.1	0.5	0.7	0.3	3.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	10.1	1.3	2.7	11.9	2.1	12.1
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	34.0	27.9	24.8	26.7	8.9	12.9
LnGrp LOS	C	C	C	C	A	B
Approach Vol, veh/h				1022	782	
Approach Delay, s/veh				26.3	12.2	
Approach LOS				C	B	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		56.0	9.8	24.2		34.0
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s		26.0	8.0	44.0		56.0
Max Q Clear Time (g_c+I1), s		24.5	5.7	16.1		20.2
Green Ext Time (p_c), s		0.6	0.1	4.1		6.9
Intersection Summary						
HCM 6th Ctrl Delay			23.7			
HCM 6th LOS			C			

Volume
4: EB Frontage Rd & Sunset Rd

2045 Build PM Peak Hour
07/21/2020



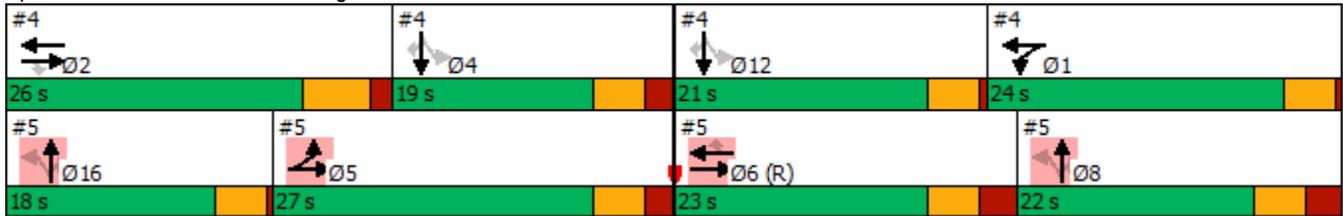
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗	↘	↑↑					↘	↑↑↑	↗
Traffic Volume (vph)	0	740	410	210	700	0	0	0	0	210	130	240
Future Volume (vph)	0	740	410	210	700	0	0	0	0	210	130	240
Satd. Flow (prot)	0	5085	1583	1770	3539	0	0	0	0	1522	4700	1583
Flt Permitted				0.950						0.950	0.978	
Satd. Flow (perm)	0	5085	1583	1770	3539	0	0	0	0	1522	4700	1583
Satd. Flow (RTOR)			446									158
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Lane Group Flow (vph)	0	804	446	228	761	0	0	0	0	114	255	261
Turn Type		NA	Perm	Prot	NA					Perm	NA	Perm
Protected Phases		2		1	2 1						4 12	
Permitted Phases			2							4 12		4 12
Total Split (s)		26.0	26.0	24.0								
Total Lost Time (s)		6.0	6.0	4.0								
Act Effct Green (s)		22.6	22.6	26.5	53.1					25.4	25.4	25.4
Actuated g/C Ratio		0.25	0.25	0.29	0.59					0.28	0.28	0.28
v/c Ratio		0.63	0.61	0.44	0.36					0.27	0.19	0.47
Control Delay		29.0	10.5	8.7	5.8					26.9	24.8	13.5
Queue Delay		0.1	0.0	1.3	1.1					0.0	0.0	0.0
Total Delay		29.0	10.5	10.0	6.8					26.9	24.8	13.5
LOS		C	B	A	A					C	C	B
Approach Delay		22.4			7.6							20.5
Approach LOS		C			A							C
Queue Length 50th (ft)		154	91	7	174					59	43	46
Queue Length 95th (ft)		201	127	95	232					106	62	109
Internal Link Dist (ft)		766			244			320			664	
Turn Bay Length (ft)			150									350
Base Capacity (vph)		1274	730	521	2086					523	1617	648
Starvation Cap Reductn		0	0	140	1012					0	0	0
Spillback Cap Reductn		37	0	0	0					0	0	0
Storage Cap Reductn		0	0	0	0					0	0	0
Reduced v/c Ratio		0.65	0.61	0.60	0.71					0.22	0.16	0.40

Intersection Summary

Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 45 (50%), Referenced to phase 6:EBWB, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.64	
Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 55.0%	ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 4: EB Frontage Rd & Sunset Rd



Volume
5: WB Frontage Rd & Sunset Rd

2045 Build PM Peak Hour
07/21/2020



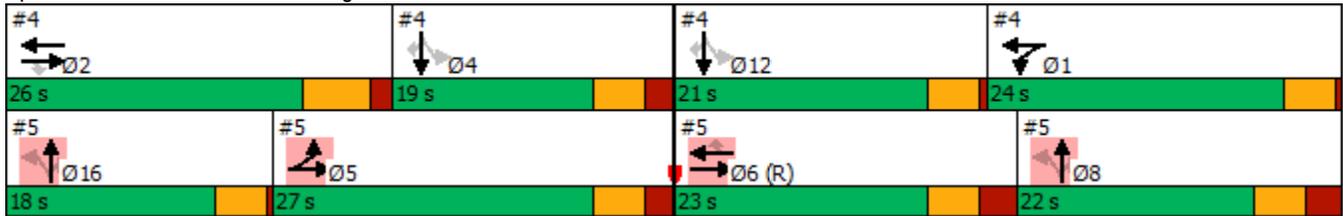
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑			↑↑↑	↗	↘	↔↔↔	↗			
Traffic Volume (vph)	300	650	0	0	680	120	230	200	240	0	0	0
Future Volume (vph)	300	650	0	0	680	120	230	200	240	0	0	0
Satd. Flow (prot)	1770	3539	0	0	5085	1583	1522	4719	1583	0	0	0
Flt Permitted	0.950						0.950	0.982				
Satd. Flow (perm)	1770	3539	0	0	5085	1583	1522	4719	1583	0	0	0
Satd. Flow (RTOR)						224			163			
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)							50%					
Lane Group Flow (vph)	326	707	0	0	739	130	125	342	261	0	0	0
Turn Type	Prot	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	5	6 5			6			8 16				
Permitted Phases						6	8 16		8 16			
Total Split (s)	27.0				23.0	23.0						
Total Lost Time (s)	5.5				6.0	6.0						
Act Effct Green (s)	27.4	53.3			20.4	20.4	24.7	24.7	24.7			
Actuated g/C Ratio	0.30	0.59			0.23	0.23	0.27	0.27	0.27			
v/c Ratio	0.60	0.34			0.64	0.24	0.30	0.26	0.47			
Control Delay	10.4	3.1			35.3	1.1	26.3	25.1	12.4			
Queue Delay	8.1	0.4			0.0	0.0	0.0	0.0	0.0			
Total Delay	18.5	3.5			35.4	1.1	26.4	25.1	12.4			
LOS	B	A			D	A	C	C	B			
Approach Delay		8.2			30.2			20.8				
Approach LOS		A			C			C				
Queue Length 50th (ft)	193	0			142	0	65	58	43			
Queue Length 95th (ft)	290	124			191	0	108	75	99			
Internal Link Dist (ft)		244			1409			1117			318	
Turn Bay Length (ft)						150			350			
Base Capacity (vph)	539	2096			1151	531	487	1513	618			
Starvation Cap Reductn	171	856			0	0	0	0	0			
Spillback Cap Reductn	0	0			6	0	7	12	0			
Storage Cap Reductn	0	0			0	0	0	0	0			
Reduced v/c Ratio	0.89	0.57			0.65	0.24	0.26	0.23	0.42			

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 45 (50%), Referenced to phase 6:EBWB, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 19.0
 Intersection Capacity Utilization 55.0%
 Intersection LOS: B
 ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 5: WB Frontage Rd & Sunset Rd



Intersection						
Int Delay, s/veh	6.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	300	0	0	140	60
Future Vol, veh/h	0	300	0	0	140	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	326	0	0	152	65

Major/Minor	Minor2		Major2	
Conflicting Flow All	-	76	-	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	6.94	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	3.32	-	-
Pot Cap-1 Maneuver	0	970	-	-
Stage 1	0	-	-	-
Stage 2	0	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	-	970	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	SB
HCM Control Delay, s	10.6	0
HCM LOS	B	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	970	-	-
HCM Lane V/C Ratio	0.336	-	-
HCM Control Delay (s)	10.6	-	-
HCM Lane LOS	B	-	-
HCM 95th %tile Q(veh)	1.5	-	-

Intersection						
Int Delay, s/veh	2.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗			↕↕	↗
Traffic Vol, veh/h	0	140	0	0	400	40
Future Vol, veh/h	0	140	0	0	400	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	16974	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	152	0	0	435	43

Major/Minor	Minor2	Major2
Conflicting Flow All	- 218	- 0
Stage 1	- -	- -
Stage 2	- -	- -
Critical Hdwy	- 6.94	- -
Critical Hdwy Stg 1	- -	- -
Critical Hdwy Stg 2	- -	- -
Follow-up Hdwy	- 3.32	- -
Pot Cap-1 Maneuver	0 786	- -
Stage 1	0 -	- -
Stage 2	0 -	- -
Platoon blocked, %		- -
Mov Cap-1 Maneuver	- 786	- -
Mov Cap-2 Maneuver	- -	- -
Stage 1	- -	- -
Stage 2	- -	- -

Approach	EB	SB
HCM Control Delay, s	10.7	0
HCM LOS	B	

Minor Lane/Major Mvmt	EBLn1	SBT	SBR
Capacity (veh/h)	786	-	-
HCM Lane V/C Ratio	0.194	-	-
HCM Control Delay (s)	10.7	-	-
HCM Lane LOS	B	-	-
HCM 95th %tile Q(veh)	0.7	-	-

HCM 6th Signalized Intersection Summary
8: Sunset Rd & River Rd

2045 Build PM Peak Hour
07/21/2020



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↵	↑↑	↵	↑
Traffic Volume (veh/h)	520	300	500	660	400	490
Future Volume (veh/h)	520	300	500	660	400	490
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	565	326	543	717	435	533
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	667	734	584	2107	491	957
Arrive On Green	0.19	0.19	0.33	0.59	0.28	0.28
Sat Flow, veh/h	3647	1585	1781	3647	1781	1585
Grp Volume(v), veh/h	565	326	543	717	435	533
Grp Sat Flow(s),veh/h/ln	1777	1585	1781	1777	1781	1585
Q Serve(g_s), s	12.9	11.6	24.7	8.6	19.6	0.0
Cycle Q Clear(g_c), s	12.9	11.6	24.7	8.6	19.6	0.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	667	734	584	2107	491	957
V/C Ratio(X)	0.85	0.44	0.93	0.34	0.89	0.56
Avail Cap(c_a), veh/h	700	749	649	2270	542	1002
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.9	15.2	27.2	8.7	29.1	9.9
Incr Delay (d2), s/veh	9.2	0.4	19.0	0.1	15.1	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	10.3	10.9	19.0	5.4	15.3	9.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	42.1	15.6	46.3	8.8	44.2	10.5
LnGrp LOS	D	B	D	A	D	B
Approach Vol, veh/h	891			1260	968	
Approach Delay, s/veh	32.4			24.9	25.7	
Approach LOS	C			C	C	
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		28.6	32.9	22.2		55.2
Change Period (Y+Rc), s		5.5	5.5	6.5		5.5
Max Green Setting (Gmax), s		25.5	30.5	16.5		53.5
Max Q Clear Time (g_c+I1), s		21.6	26.7	14.9		10.6
Green Ext Time (p_c), s		1.5	0.8	0.8		5.9
Intersection Summary						
HCM 6th Ctrl Delay			27.3			
HCM 6th LOS			C			

Appendix F
2045 Signal
Warrant Analysis

Signal Warrant Assessment

Based on 2009 Edition of the MUTCD

Project #: 24312
 Project Name: Sunset Rd DCR
 Analyst: LMW
 Date: 1/29/2020
 Intersection: Sunset Rd/Main Dwy
 Scenario: 2045 Traffic Projections

Volume Adjustment Factor = 1.0
 North-South Approach = Major
 East-West Approach = Minor
 Major Street Thru Lanes = 2
 Minor Street Thru Lanes = 1
 Speed > 40 mph? No
 Population < 10,000? No
 Warrant Factor 100%
 Peak Hour or Daily Count? Peak Hour

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Highest	Yes	Yes
#2	Four-Hour	Yes	Yes
#3	Peak Hour	Yes	Yes

**This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.*

Select Type Of Major Street Approach From Dropdown Menu

Rural Major Collector

Select Type Of Minor Street Approach From Dropdown Menu

Rural Minor Collector

Note: traffic volume profile for weekday (if weekend is desired, tab "vol profile" needs to be adjusted)

Hour		Major Street		Minor Street		Major St.	Minor St.
Begin	End	NB	SB	EB	WB	Adj. Factor	Adj. Factor
7:15 PM	8:15 PM	900	1230	0	160	1.00	1.00
2nd Highest Hour		803	1098	0	127	0.89	0.79
3rd Highest Hour		697	952	0	120	0.77	0.75
4th Highest Hour		687	939	0	106	0.76	0.66
5th Highest Hour		610	833	0	99	0.68	0.62
6th Highest Hour		600	820	0	91	0.67	0.57
7th Highest Hour		581	794	0	90	0.65	0.56
8th Highest Hour		532	727	0	84	0.59	0.52
9th Highest Hour		503	688	0	84	0.56	0.52
10th Highest Hour		484	661	0	82	0.54	0.51
11th Highest Hour		474	648	0	73	0.53	0.46
12th Highest Hour		474	648	0	70	0.53	0.44
13th Highest Hour		465	635	0	57	0.52	0.36
14th Highest Hour		387	529	0	55	0.43	0.35
15th Highest Hour		377	516	0	52	0.42	0.33
16th Highest Hour		271	370	0	51	0.30	0.32
17th Highest Hour		271	370	0	30	0.30	0.19
18th Highest Hour		184	251	0	30	0.20	0.19
19th Highest Hour		116	159	0	12	0.13	0.07
20th Highest Hour		97	132	0	9	0.11	0.06
21st Highest Hour		48	66	0	6	0.05	0.04
22nd Highest Hour		39	53	0	1	0.04	0.01
23rd Highest Hour		39	53	0	1	0.04	0.01
24th Highest Hour		29	40	0	1	0.03	0.01

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
7:15 PM	8:15 PM	900	1230	0	160
2nd Highest Hour		803	1098	0	127
3rd Highest Hour		697	952	0	120
4th Highest Hour		687	939	0	106
5th Highest Hour		610	833	0	99
6th Highest Hour		600	820	0	91
7th Highest Hour		581	794	0	90
8th Highest Hour		532	727	0	84
9th Highest Hour		503	688	0	84
10th Highest Hour		484	661	0	82
11th Highest Hour		474	648	0	73
12th Highest Hour		474	648	0	70
13th Highest Hour		465	635	0	57
14th Highest Hour		387	529	0	55
15th Highest Hour		377	516	0	52
16th Highest Hour		271	370	0	51
17th Highest Hour		271	370	0	30
18th Highest Hour		184	251	0	30
19th Highest Hour		116	159	0	12
20th Highest Hour		97	132	0	9
21st Highest Hour		48	66	0	6
22nd Highest Hour		39	53	0	1
23rd Highest Hour		39	53	0	1
24th Highest Hour		29	40	0	1

100% Warrant Met
70% Warrant Met

Number of lanes for moving traffic on each approach (Major Street) 2
 Number of lanes for moving traffic on each approach (Minor Street) 1
 Warrant Factor 100%
 Row Index for VLOOKUP 2

Lookup Table

Condition A - Minimum Vehicular Volume										
Index	Lanes		Combined Major Street				Higher Minor Street			
	Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	1	500	400	350	280	150	120	105	84
2	2 or more	1	600	480	420	336	150	120	105	84
3	2 or more	2 or more	600	480	420	336	200	160	140	112
4	1	2 or more	500	400	350	280	200	160	140	112

Condition B - Interruption of Continuous Traffic										
Index	Lanes		Combined Major Street				Higher Minor Street			
	Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	1	750	600	525	420	75	60	53	42
2	2 or more	1	900	720	630	504	75	60	53	42
3	2 or more	2 or more	900	720	630	504	100	80	70	56
4	1	2 or more	750	600	525	420	100	80	70	56

Vehicles per hour on major street (100% Volume) 600
 Vehicles per hour on major street (80% Volume) 480
 Vehicles per hour on major street (70% Volume) 420
 Vehicles per hour on major street (56% Volume) 336
 Vehicles per hour on higher-volume minor-street approach (100% Volume) 150
 Vehicles per hour on higher-volume minor-street approach (80% Volume) 120
 Vehicles per hour on higher-volume minor-street approach (70% Volume) 105
 Vehicles per hour on higher-volume minor-street approach (56% Volume) 84
 Vehicles per hour on major street (100% Volume) 900
 Vehicles per hour on major street (80% Volume) 720
 Vehicles per hour on major street (70% Volume) 630
 Vehicles per hour on major street (56% Volume) 504
 Vehicles per hour on higher-volume minor-street approach (100% Volume) 75
 Vehicles per hour on higher-volume minor-street approach (80% Volume) 60
 Vehicles per hour on higher-volume minor-street approach (70% Volume) 53
 Vehicles per hour on higher-volume minor-street approach (56% Volume) 42

Calculations												
Combined Major Street	Higher Minor Street	Major Plus Minor	Hourly Rank	Condition A				Condition B				
				100%	80%	70%	56%	100%	80%	70%	56%	
2130	160	2290	1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1901	127	2028	2	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1649	120	1769	3	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1626	106	1732	4	N	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1443	99	1542	5	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes
1420	91	1511	6	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes
1374	90	1464	7	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes
1260	84	1343	8	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes
1191	84	1275	9	N	N	N	Yes	Yes	Yes	Yes	Yes	Yes
1145	82	1227	10	N	N	N	N	Yes	Yes	Yes	Yes	Yes
1122	73	1196	11	N	N	N	N	N	Yes	Yes	Yes	Yes
1122	70	1193	12	N	N	N	N	N	Yes	Yes	Yes	Yes
1099	57	1156	13	N	N	N	N	N	N	Yes	Yes	Yes
916	55	971	14	N	N	N	N	N	N	N	Yes	Yes
893	52	946	15	N	N	N	N	N	N	N	Yes	Yes
641	51	692	16	N	N	N	N	N	N	N	N	Yes
641	30	671	17	N	N	N	N	N	N	N	N	N
435	30	465	18	N	N	N	N	N	N	N	N	N
275	12	287	19	N	N	N	N	N	N	N	N	N
229	9	238	20	N	N	N	N	N	N	N	N	N
115	6	120	21	N	N	N	N	N	N	N	N	N
92	1	93	22	N	N	N	N	N	N	N	N	N
92	1	93	22	N	N	N	N	N	N	N	N	N
69	1	70	24	N	N	N	N	N	N	N	N	N
				1	3	4	9	10	12	15	16	

Warrant Summary

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition is Met	Threshold	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	600	150	1	8	No	Yes
	B	900	75	10	8	Yes	
80%	A	480	120	3	8	No	No
	B	720	60	12	8	Yes	
70%	A	420	105	4	8	No	Yes
	B	630	53	15	8	Yes	
56%	A	336	84	9	8	Yes	Yes
	B	504	42	16	8	Yes	

Is Warrant #1 met based on the applicable warrant factor?

Yes

Traffic Volumes						Calculations			
Hour		Major Street		Minor Street		Combined Major Street	Higher Minor Street	Threshold	Is Threshold Met?
Begin	End	NB	SB	EB	WB				
7:15 PM	8:15 PM	900	1230	0	160	2130	160	80	Yes
2nd Highest Hour		803	1098	0	127	1901	127	80	Yes
3rd Highest Hour		697	952	0	120	1649	120	80	Yes
4th Highest Hour		687	939	0	106	1626	106	80	Yes
5th Highest Hour		610	833	0	99	1443	99	80	Yes
6th Highest Hour		600	820	0	91	1420	91	80	Yes
7th Highest Hour		581	794	0	90	1374	90	81	Yes
8th Highest Hour		532	727	0	84	1260	84	94	No
9th Highest Hour		503	688	0	84	1191	84	104	No
10th Highest Hour		484	661	0	82	1145	82	112	No
11th Highest Hour		474	648	0	73	1122	73	117	No
12th Highest Hour		474	648	0	70	1122	70	117	No
13th Highest Hour		465	635	0	57	1099	57	121	No
14th Highest Hour		387	529	0	55	916	55	169	No
15th Highest Hour		377	516	0	52	893	52	176	No
16th Highest Hour		271	370	0	51	641	51	271	No
17th Highest Hour		271	370	0	30	641	30	271	No
18th Highest Hour		184	251	0	30	435	30	372	No
19th Highest Hour		116	159	0	12	275	12	465	No
20th Highest Hour		97	132	0	9	229	9	494	No
21st Highest Hour		48	66	0	6	115	6	571	No
22nd Highest Hour		39	53	0	1	92	1	587	No
23rd Highest Hour		39	53	0	1	92	1	587	No
24th Highest Hour		29	40	0	1	69	1	604	No

7

Number of lanes for moving traffic on each approach (Major Street) 2
 Number of lanes for moving traffic on each approach (Minor Street) 1
 Warrant Factor 100%
 Row Index for VLOOKUP 2

Lookup Table

Index	Major Street	Minor Street	Break Point	x ²	x	c	alt
1	1	1	1100	0.00025	0.70119	549.643	80
2	2 or more	1	1380	0.00025	0.75657	654.704	80
3	2 or more	2 or more	1290	0.00032	0.99411	875.600	115
4	1	2 or more	1190	0.00028	0.80531	669.814	115
5	1	1	780	0.00042	0.75589	394.893	60
6	2 or more	1	980	0.00040	0.81250	473.690	60
7	2 or more	2 or more	890	0.00046	1.01643	620.143	80
8	1	2 or more	790	0.00041	0.82464	476.500	80

70% Factor 100% Factor

Is Warrant #2 met based on the applicable warrant factor?

Yes

Signal Warrant Assessment

Based on 2009 Edition of the MUTCD

Project #: 24312
 Project Name: Sunset Rd DCR
 Analyst: LMW
 Date: 1/29/2020
 Intersection: Sunset Road/River Road
 Scenario: 2045 Traffic Projections

Volume Adjustment Factor = 1.0
 North-South Approach = Minor
 East-West Approach = Major
 Major Street Thru Lanes = 2
 Minor Street Thru Lanes = 2
 Speed > 40 mph? No
 Population < 10,000? No
 Warrant Factor 100%
 Peak Hour or Daily Count? Peak Hour

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Highest	Yes	Yes
#2	Four-Hour	Yes	Yes
#3	Peak Hour	Yes	Yes

**This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.*

Select Type Of Major Street Approach From Dropdown Menu

Urban Minor Arterial

Select Type Of Minor Street Approach From Dropdown Menu

Rural Major Collector

Note: traffic volume profile for weekday (if weekend is desired, tab "vol profile" needs to be adjusted)

Hour		Major Street		Minor Street		Major St.	Minor St.
Begin	End	EB	WB	NB	SB	Adj. Factor	Adj. Factor
7:15 PM	8:15 PM	1250	1030	900	0	1.00	1.00
2nd Highest Hour		1183	975	803	0	0.95	0.89
3rd Highest Hour		1167	961	697	0	0.93	0.77
4th Highest Hour		1117	920	687	0	0.89	0.76
5th Highest Hour		1100	906	610	0	0.88	0.68
6th Highest Hour		1100	906	600	0	0.88	0.67
7th Highest Hour		1050	865	581	0	0.84	0.65
8th Highest Hour		1033	851	532	0	0.83	0.59
9th Highest Hour		1000	824	503	0	0.80	0.56
10th Highest Hour		933	769	484	0	0.75	0.54
11th Highest Hour		900	742	474	0	0.72	0.53
12th Highest Hour		883	728	474	0	0.71	0.53
13th Highest Hour		850	700	465	0	0.68	0.52
14th Highest Hour		733	604	387	0	0.59	0.43
15th Highest Hour		583	481	377	0	0.47	0.42
16th Highest Hour		550	453	271	0	0.44	0.30
17th Highest Hour		383	316	271	0	0.31	0.30
18th Highest Hour		317	261	184	0	0.25	0.20
19th Highest Hour		167	137	116	0	0.13	0.13
20th Highest Hour		117	96	97	0	0.09	0.11
21st Highest Hour		100	82	48	0	0.08	0.05
22nd Highest Hour		67	55	39	0	0.05	0.04
23rd Highest Hour		33	27	39	0	0.03	0.04
24th Highest Hour		33	27	29	0	0.03	0.03

Traffic Volumes					
Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
7:15 PM	8:15 PM	1250	1030	900	0
2nd Highest Hour		1183	975	803	0
3rd Highest Hour		1167	961	697	0
4th Highest Hour		1117	920	687	0
5th Highest Hour		1100	906	610	0
6th Highest Hour		1100	906	600	0
7th Highest Hour		1050	865	581	0
8th Highest Hour		1033	851	532	0
9th Highest Hour		1000	824	503	0
10th Highest Hour		933	769	484	0
11th Highest Hour		900	742	474	0
12th Highest Hour		883	728	474	0
13th Highest Hour		850	700	465	0
14th Highest Hour		733	604	387	0
15th Highest Hour		583	481	377	0
16th Highest Hour		550	453	271	0
17th Highest Hour		383	316	271	0
18th Highest Hour		317	261	184	0
19th Highest Hour		167	137	116	0
20th Highest Hour		117	96	97	0
21st Highest Hour		100	82	48	0
22nd Highest Hour		67	55	39	0
23rd Highest Hour		33	27	39	0
24th Highest Hour		33	27	29	0

100% Warrant Met
70% Warrant Met

Number of lanes for moving traffic on each approach (Major Street) 2
 Number of lanes for moving traffic on each approach (Minor Street) 2
 Warrant Factor 100%
 Row Index for VLOOKUP 3

Calculations												
Combined Major Street	Higher Minor Street	Major Plus Minor	Hourly Rank	Condition A				Condition B				
				100%	80%	70%	56%	100%	80%	70%	56%	
2280	900	3180	1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2158	803	2962	2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2128	697	2825	3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2037	687	2724	4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2006	610	2616	5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2006	600	2606	6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1915	581	2496	7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1885	532	2417	8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1824	503	2327	9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1702	484	2186	10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1642	474	2116	11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1611	474	2085	12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1550	465	2015	13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1338	387	1725	14	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1064	377	1441	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1003	271	1274	16	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
699	271	970	17	Yes	Yes	Yes	Yes	N	N	N	Yes	Yes
578	184	761	18	N	Yes	Yes	Yes	N	N	N	N	Yes
304	116	420	19	N	N	N	N	N	N	N	N	N
213	97	310	20	N	N	N	N	N	N	N	N	N
182	82	231	21	N	N	N	N	N	N	N	N	N
122	39	160	22	N	N	N	N	N	N	N	N	N
61	39	100	23	N	N	N	N	N	N	N	N	N
61	29	90	24	N	N	N	N	N	N	N	N	N
				17	18	18	18	16	16	17	18	

Warrant Summary

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition is Met	Threshold	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	600	200	17	8	Yes	Yes
	B	900	100	16	8	Yes	Yes
80%	A	480	160	18	8	Yes	Yes
	B	720	80	16	8	Yes	Yes
70%	A	420	140	18	8	Yes	Yes
	B	630	70	17	8	Yes	Yes
56%	A	336	112	18	8	Yes	Yes
	B	504	56	18	8	Yes	Yes

Is Warrant #1 met based on the applicable warrant factor?

Yes

Vehicles per hour on major street (100% Volume) 600
 Vehicles per hour on major street (80% Volume) 480
 Vehicles per hour on major street (70% Volume) 420
 Vehicles per hour on major street (56% Volume) 336
 Vehicles per hour on higher-volume minor-street approach (100% Volume) 200
 Vehicles per hour on higher-volume minor-street approach (80% Volume) 160
 Vehicles per hour on higher-volume minor-street approach (70% Volume) 140
 Vehicles per hour on higher-volume minor-street approach (56% Volume) 112
 Vehicles per hour on major street (100% Volume) 900
 Vehicles per hour on major street (80% Volume) 720
 Vehicles per hour on major street (70% Volume) 630
 Vehicles per hour on major street (56% Volume) 504
 Vehicles per hour on higher-volume minor-street approach (100% Volume) 100
 Vehicles per hour on higher-volume minor-street approach (80% Volume) 80
 Vehicles per hour on higher-volume minor-street approach (70% Volume) 70
 Vehicles per hour on higher-volume minor-street approach (56% Volume) 56

Traffic Volumes						Calculations			
Hour		Major Street		Minor Street		Combined Major Street	Higher Minor Street	Threshold	Is Threshold Met?
Begin	End	EB	WB	NB	SB				
7:15 PM	8:15 PM	1250	1030	900	0	2280	900	115	Yes
2nd Highest Hour		1183	975	803	0	2158	803	115	Yes
3rd Highest Hour		1167	961	697	0	2128	697	115	Yes
4th Highest Hour		1117	920	687	0	2037	687	115	Yes
5th Highest Hour		1100	906	610	0	2006	610	115	Yes
6th Highest Hour		1100	906	600	0	2006	600	115	Yes
7th Highest Hour		1050	865	581	0	1915	581	115	Yes
8th Highest Hour		1033	851	532	0	1885	532	115	Yes
9th Highest Hour		1000	824	503	0	1824	503	115	Yes
10th Highest Hour		933	769	484	0	1702	484	115	Yes
11th Highest Hour		900	742	474	0	1642	474	115	Yes
12th Highest Hour		883	728	474	0	1611	474	115	Yes
13th Highest Hour		850	700	465	0	1550	465	115	Yes
14th Highest Hour		733	604	387	0	1338	387	115	Yes
15th Highest Hour		583	481	377	0	1064	377	177	Yes
16th Highest Hour		550	453	271	0	1003	271	197	Yes
17th Highest Hour		383	316	271	0	699	271	335	No
18th Highest Hour		317	261	184	0	578	184	407	No
19th Highest Hour		167	137	116	0	304	116	603	No
20th Highest Hour		117	96	97	0	213	97	678	No
21st Highest Hour		100	82	48	0	182	48	705	No
22nd Highest Hour		67	55	39	0	122	39	759	No
23rd Highest Hour		33	27	39	0	61	39	816	No
24th Highest Hour		33	27	29	0	61	29	816	No

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Number of lanes for moving traffic on each approach (Major Street) 2
 Number of lanes for moving traffic on each approach (Minor Street) 2
 Warrant Factor 100%
 Row Index for VLOOKUP 3

Lookup Table

Index	Major Street	Minor Street	Break Point	x ²	x	c	alt
1	1	1	1100	0.00025	0.70119	549.643	80
2	2 or more	1	1380	0.00025	0.75657	654.704	80
3	2 or more	2 or more	1290	0.00032	0.99411	875.600	115
4	1	2 or more	1190	0.00028	0.80531	669.814	115
5	1	1	780	0.00042	0.75589	394.893	60
6	2 or more	1	980	0.00040	0.81250	473.690	60
7	2 or more	2 or more	890	0.00046	1.01643	620.143	80
8	1	2 or more	790	0.00041	0.82464	476.500	80

70% Factor 100% Factor

Is Warrant #2 met based on the applicable warrant factor?

Yes

Appendix G
2045 Turn Lane
Warrant Analysis

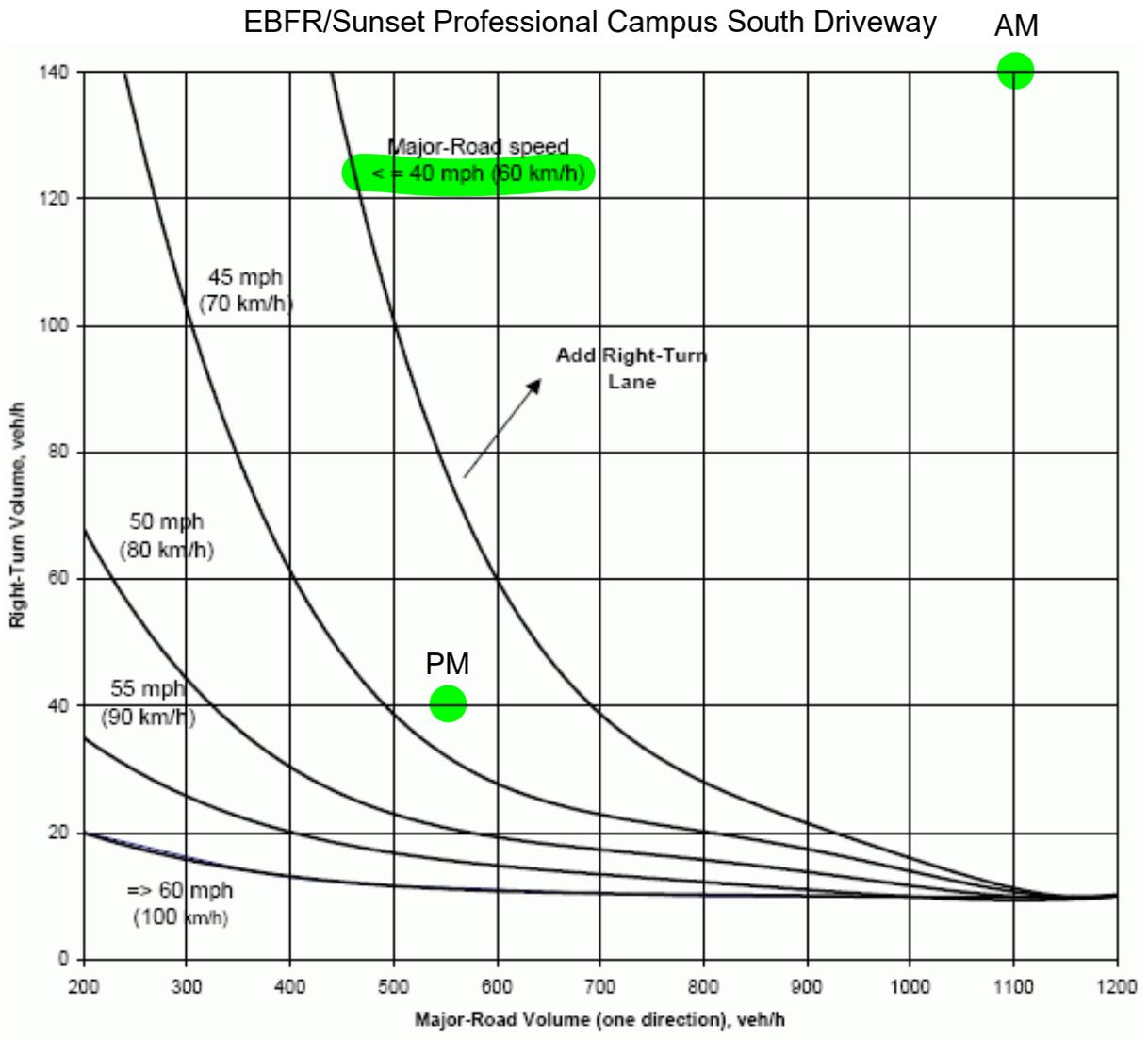
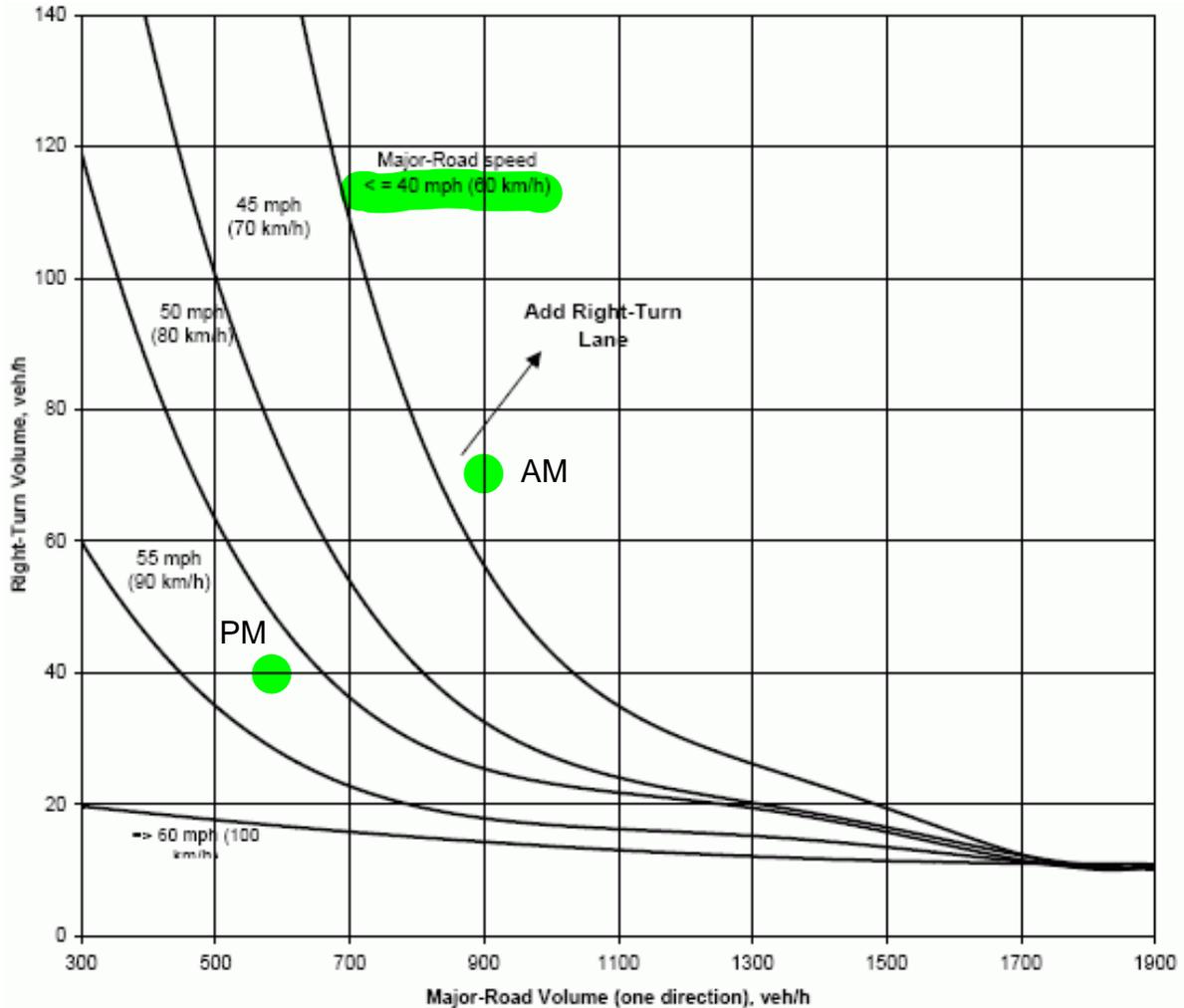


Figure 5-2 – Right Turn Lane Guidelines for Two-Lane Roadway¹⁴

¹⁴ Source: MoDOT. Engineering Policy Guide. Sheet 940.9.8 “Right Turn Lane Guidelines for Two-Lane Roadways,” 2007.

Sunset Road/Sunset Professional Campus Main Driveway



Note: Existing roadway constraints may restrict the ability or need to install turning lanes. Traffic Engineering may require a traffic engineering analysis to support alternative recommendations for the installation of turning lanes.

Figure 5-3 – Right Turn Guidelines for Four-Lane Roadways¹⁵

5.3.1 Total Turn Lane Length

A separate turning lane consists of a taper plus a full width auxiliary lane. The design of turn lanes is primarily based on the speed at which drivers turn into the lane, the speed to which drivers must reduce in order to turn into the driveway, and the required vehicular storage length. Other special considerations include the volume of trucks that will use the turning lane and the steepness of an ascending or descending grade.

The Pima County Department of Transportation (PCDOT) and the City of Tucson Department of Transportation (TDOT) provide design guidelines for minimum

¹⁵ Source: MoDOT. Engineering Policy Guide. Sheet 940.9.9 “Right Turn Lane Guidelines for Four-Lane Roadways.” 2007.

245 TURN LANE WARRANTS

The intent of this document is to offer guidance to warrant the installation of dedicated left or right turn lanes on state routes, whether during new construction, major reconstruction, or in the course of the encroachment permitting process. **The primary determining factors to warrant an exclusive turn lane shall be: (a) the combination of through traffic volume and turning traffic volume, (b) the posted roadway speed, and (c) the number of through lanes on the roadway.** Note: Dual right- or left-turn lanes should be considered when the turning volume exceeds 300 vehicles per hour. In addition to the criteria presented in the tables below, other factors should be taken into consideration when performing a warrant study such as: shoulder width, percentage of trucks, sight distance, highway grade, horizontal and vertical curvature and crash history.

Right-Turn Lane Warrants

Sunset Road/EBFR

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Right-turn Traffic Volume				
	# of thru lanes per direction				
	1		2		3
	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	All Speeds
≤ 200					
201 – 300	-	30	-	-	-
301 – 400	-	19	-	55	-
401 – 500	85	14	-	30	-
501 – 600	58	12	140	25	-
601 – 700	27	9	80	18	-
701 – 800	20	8	53	15	-
801 – 900	12	7	40	12	-
901 – 1000	9	6	30	11	-
1001 – 1100	8	5	23	9	18
1101 – 1200	7	5	18	8	16
1201 – 1300	6	4	14	8	15
1301 – 1400	6	4	11	6	12
1400+	5	3	8	6	10

245 TURN LANE WARRANTS

The intent of this document is to offer guidance to warrant the installation of dedicated left or right turn lanes on state routes, whether during new construction, major reconstruction, or in the course of the encroachment permitting process. **The primary determining factors to warrant an exclusive turn lane shall be: (a) the combination of through traffic volume and turning traffic volume, (b) the posted roadway speed, and (c) the number of through lanes on the roadway.** Note: Dual right- or left-turn lanes should be considered when the turning volume exceeds 300 vehicles per hour. In addition to the criteria presented in the tables below, other factors should be taken into consideration when performing a warrant study such as: shoulder width, percentage of trucks, sight distance, highway grade, horizontal and vertical curvature and crash history.

Right-Turn Lane Warrants

Sunset Road/WBFR

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Right-turn Traffic Volume				
	# of thru lanes per direction				
	1		2		3
	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	All Speeds
≤ 200					
201 – 300	-	30	-	-	-
301 – 400	-	19	-	55	-
401 – 500	85	14	-	30	-
501 – 600	58	12	140	25	-
601 – 700	27	9	80	18	-
701 – 800	20	8	53	15	-
801 – 900	12	7	40	12	-
901 – 1000	9	6	30	11	-
1001 – 1100	8	5	23	9	18
1101 – 1200	7	5	18	8	16
1201 – 1300	6	4	14	8	15
1301 – 1400	6	4	11	6	12
1400+	5	3	8	6	10

AM/PM

245 TURN LANE WARRANTS

The intent of this document is to offer guidance to warrant the installation of dedicated left or right turn lanes on state routes, whether during new construction, major reconstruction, or in the course of the encroachment permitting process. **The primary determining factors to warrant an exclusive turn lane shall be: (a) the combination of through traffic volume and turning traffic volume, (b) the posted roadway speed, and (c) the number of through lanes on the roadway.** Note: Dual right- or left-turn lanes should be considered when the turning volume exceeds 300 vehicles per hour. In addition to the criteria presented in the tables below, other factors should be taken into consideration when performing a warrant study such as: shoulder width, percentage of trucks, sight distance, highway grade, horizontal and vertical curvature and crash history.

Right-Turn Lane Warrants

EBFR/Sunset Professional Campus West Driveway

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Right-turn Traffic Volume					
	# of thru lanes per direction					
	1		2		3	
	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	All Speeds	
PM	< 200			0		
	201 – 300	-	30	-	-	
	301 – 400	-	19	55	-	
	401 – 500	85	14	30	-	
AM	501 – 600	58	12	140	25	
	601 – 700	27	9	80	18	
	701 – 800	20	8	53	15	
	801 – 900	12	7	40	12	
	901 – 1000	9	6	30	11	
	1001 – 1100	8	5	23	9	18
	1101 – 1200	7	5	18	8	16
	1201 – 1300	6	4	14	8	15
	1301 – 1400	6	4	11	6	12
	1400+	5	3	8	6	10

245 TURN LANE WARRANTS

The intent of this document is to offer guidance to warrant the installation of dedicated left or right turn lanes on state routes, whether during new construction, major reconstruction, or in the course of the encroachment permitting process. **The primary determining factors to warrant an exclusive turn lane shall be: (a) the combination of through traffic volume and turning traffic volume, (b) the posted roadway speed, and (c) the number of through lanes on the roadway.** Note: Dual right- or left-turn lanes should be considered when the turning volume exceeds 300 vehicles per hour. In addition to the criteria presented in the tables below, other factors should be taken into consideration when performing a warrant study such as: shoulder width, percentage of trucks, sight distance, highway grade, horizontal and vertical curvature and crash history.

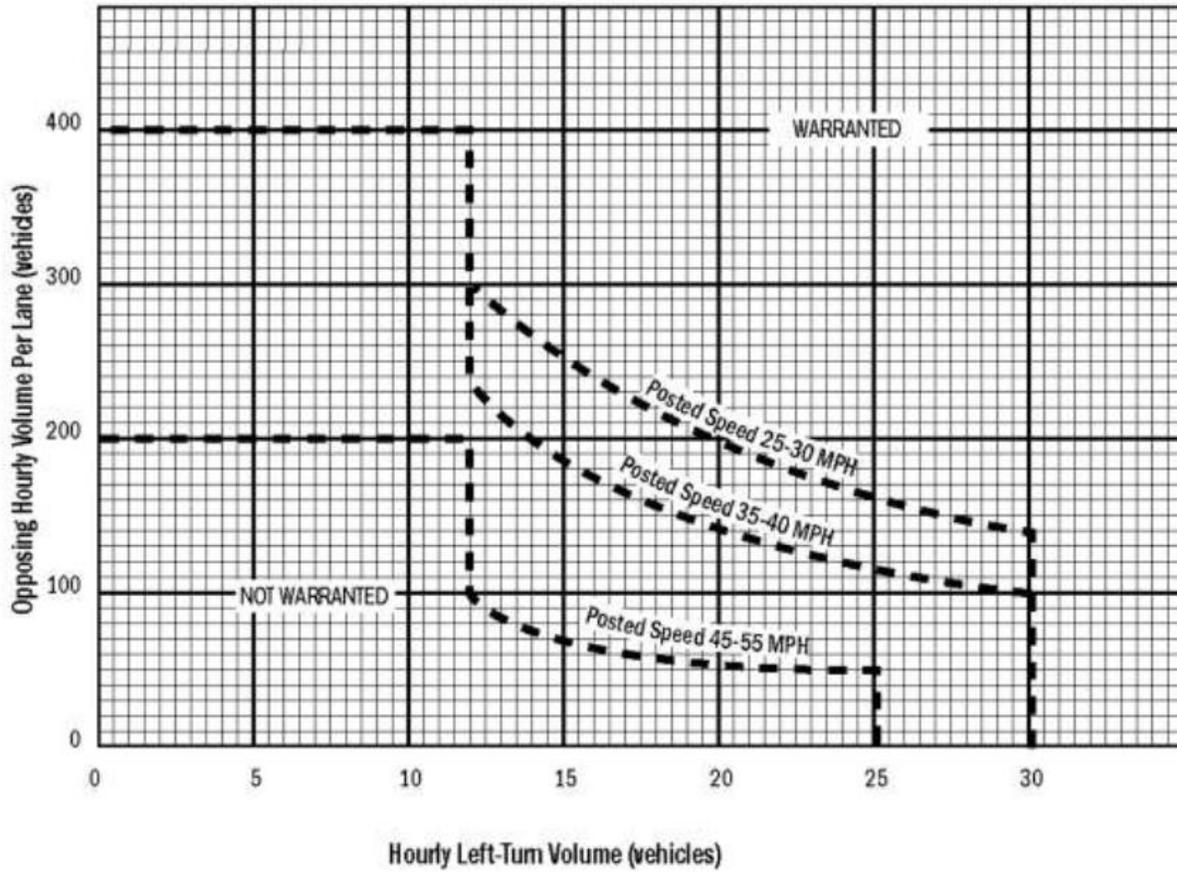
Right-Turn Lane Warrants

EBFR/Sunset Professional Campus East Driveway

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Right-turn Traffic Volume				
	# of thru lanes per direction				
	1		2		3
	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	All Speeds
≤ 200					
AM 201 – 300	-	30	-	-	-
301 – 400	-	19	-	55	-
PM 401 – 500	85	14	-	30	-
501 – 600	58	12	140	25	-
601 – 700	27	9	80	18	-
701 – 800	20	8	53	15	-
801 – 900	12	7	40	12	-
901 – 1000	9	6	30	11	-
1001 – 1100	8	5	23	9	18
1101 – 1200	7	5	18	8	16
1201 – 1300	6	4	14	8	15
1301 – 1400	6	4	11	6	12
1400+	5	3	8	6	10

8. APPENDIX

A-1 LEFT TURN LANE GUIDELINES⁹



Left-Turn Lane Warrants

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Left-turn Traffic Volume			
	# of thru lanes per direction			
	1		2	
	(Undivided)*			
	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed	< 45 MPH Posted Speed	≥ 45 MPH Posted Speed
≤ 200	30	15	-	-
201 – 300	12	12	40	30
301 – 400	12	12	30	25
401 – 500	12	12	25	18
501 – 600	12	12	15	12
601 – 1000	12	12	10	8
1000+	12	8	10	8

*On non-freeway divided highways, left-turn or U-turn lanes should be provided at median breaks.

Volumes and traffic factors utilized should be based on data from ADOT’s Multimodal Planning Division, or should be based on current traffic counts as approved by the Regional Traffic Engineer. For encroachment permits, analysis of the relevant through and turning traffic volumes should be completed in the design year as identified in ADOT Traffic Guidelines and Processes (TGP) 240. For new construction and major reconstruction, analysis should be performed based on data for the appropriate design year. Turn lane warrant studies should be reviewed and approved by the Regional Traffic Engineer. In cases where the State Highway section in question intersects a route under other jurisdiction, it is recommended that a turning movement analysis be performed on the intersecting route as well.

When it is determined that a turn lane is warranted, shoulder width should be provided as part of the turn lane design in accordance with the ADOT Roadway Design Guidelines, which should be used to determine the minimum continuous usable width of paved shoulder along the turn lanes. Turn lane design should also conform to the guidance in ADOT TGP430.

