SECTION 4
TRAFFIC ANALYSIS

Traffic analyses were conducted to determine the existing operational characteristics of the SR 89A study corridor. Analyses were also conducted for the design year 2025 to determine the traffic conditions expected under the "no-build" scenario. This "no-build" analysis will determine the anticipated future operational conditions if no improvements are made to SR 89A and the Soldiers Pass Road Study Area and will determine the necessity of improvements to the corridor. The existing and projected traffic data is presented in the following sections along with the operational analysis results. Additional information regarding the operational characteristics of the Preferred Alternatives is contained in Section 8.

4.1 EXISTING TRAFFIC VOLUMES

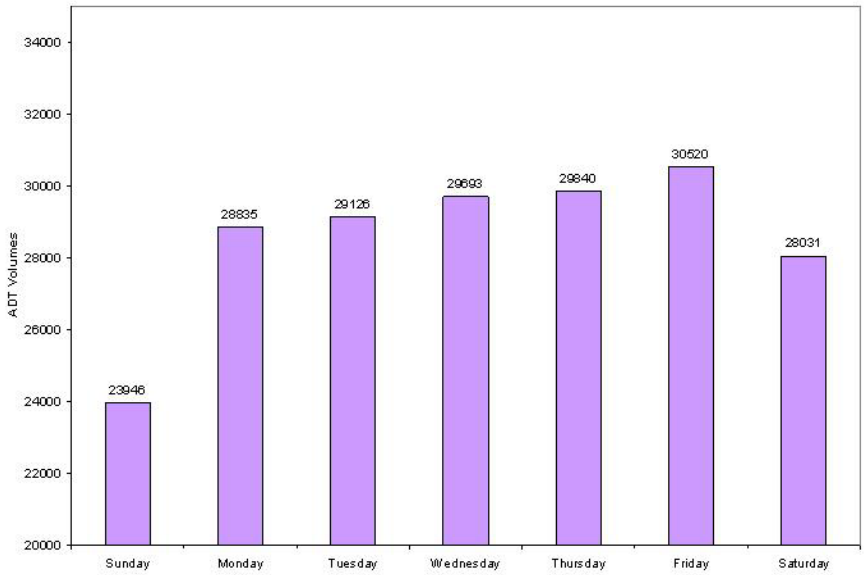
Table 4.1 shows the available historical traffic data for the SR89A Soldiers Pass Road area, which includes volumes on SR 89A and the major cross-streets. Traffic volumes on the other cross-streets were not available. The historical traffic data shown in Table 4.1 was obtained from the City of Sedona and the ADOT website.

Table 4.1 – Historical Traffic Data

Location	2002	2003	2004
SR 89A, between Coffee Pot Dr. and SR 179	29,000	24,600	30,200
Oak Creek Blvd., south of SR 89A	-	570	-
Posse Ground Rd., north of SR 89A	1,250	-	-
Airport Rd., south of SR 89A	2,231	-	-

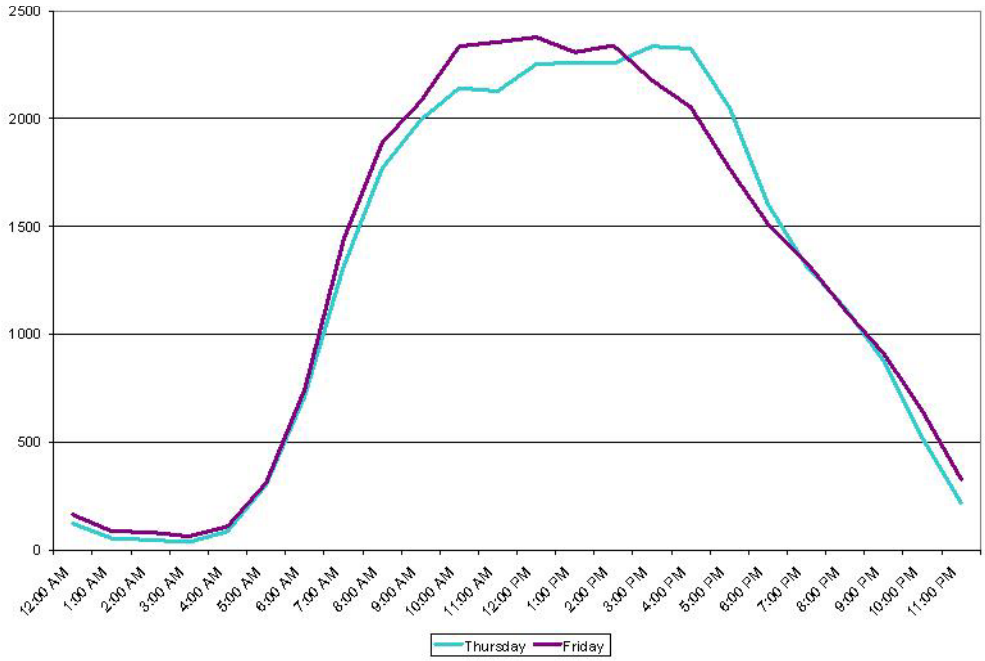
The initial traffic data collection for SR 89A was conducted from June 26, 2005 through July 5, 2005 (Figure 4.1). Automated 24-hour traffic counters were set at five locations within the project boundaries for seven consecutive days. The five locations counted included SR 89A west of Posse Ground Rd, SR 89A east of Brewer Rd, Saddlerock Circle north of June Bug Circle, Soldiers Pass Rd north of N. Airport Rd, and Airport Rd north of Valley View Rd. The traffic count data was organized and analyzed to determine the peak two day period of the week. The count data indicated that Thursday and Friday are the two highest volume days of the week for the project area.

Figure 4.1 – SR 89A Average Daily Traffic Volumes - June 2005



In order to adequately analyze the existing project corridor for peak times, it was necessary to determine the peak traffic time periods throughout the day on SR 89A. The SR 89A counts for Thursday and Friday were averaged together, which demonstrated that there were no distinct morning or evening peak travel time periods. However, they did show an overall peak period that ranged from 10:00 AM until 5:00 PM. Therefore, turning movement counts were collected for the Soldiers Pass Road area for the hours of 2:00 PM to 4:00 PM on Thursday, July 28, 2005 and Friday, July 29, 2005 (Figure 4.2).

Figure 4.2 – SR89A Hourly Traffic Volumes, June 2005



The following is a list of intersections that were counted as a part of the traffic data collection:

- Oak Creek Blvd/SR 89A
- Posse Ground Rd/SR 89A
- Saddlerock Cir/SR 89A
- Soldiers Pass Rd/SR 89A
- Airport Rd/SR 89A
- Les Springs Dr/SR 89A

It is important to note that the 24 hour count taken on Airport Road indicated that the peak days and hours do not coincide with the rest of the project area. At the time the traffic counts were conducted they indicated that the peak day and hour on Airport Road was Saturday at 8:00 PM. This inconsistency with the peaks from other roads within the project area occurs due to a tourist attraction of sunset viewing from Airport Mesa, located south on Airport Road. Due to the nature of this attraction, the peak hour on Airport Road changes throughout the year coinciding with the hours of the sunset. However, the peak hours on SR 89A, which is a higher volume roadway, occur earlier in the day then the sunset event.

Turning movement volumes were collected at the peak time periods during June of 2005; however, these volumes did not include high tourist traffic and were not conducted during a time period when the West Sedona Elementary School was in session. The City of Sedona is a community with a high tourist draw in the fall months; the *SR 179 Technical Memorandum No. 6, Seasonal Variation Traffic Counts* included a comparison of counts collected along SR 89A from August to October and showed an approximate percent increase of 8% on Thursday and Friday. A seasonal adjustment factor of +8% was applied to all existing counts collected for the project area. In addition to the seasonal adjustment, the elementary school traffic needed to be added to the corridor. There were no current school traffic volumes available, therefore it was necessary to determine the number of trips generated by the elementary in order to evaluate the corridor's true peak periods.

A generally accepted method of estimating the number of trips to be generated by developments is to use the regression equations developed by the Institute of Transportation Engineers (ITE), and to use the average trip rates when these regression equations are not available. These trip generation equations and rates were developed through a compilation of extensive field studies and traffic counts at existing developments throughout the United States. *Trip Generation, Seventh Edition*, published by the Institute of Transportation Engineers (ITE), 2003 is the result of these studies and provides trip generation rates for various developments. The ITE trip generation rates for elementary schools are shown in Table 4.2, where "T" equals the total number of trips generated.

Table 4.2 – ITE Trip Generation Rates

Elementary School (ITE 7th Edition, Land Use 520)	Distribution	
AM Peak Hour T = 0.42 x (Students)	55 % In	45 % Out
PM Peak Hour T = 0.28 x (Students)	45 % In	55 % Out
Daily T = 1.29 x (Students)	50 % In	50 % Out

The Sedona Oak Creek School District reported that the West Sedona Elementary School had approximately 580 students in August of 2005. Analysis of historical counts indicated that the approximate direction of approaches to and from the elementary school is 70% to/from the west on SR 89A and 30% to/from the east on SR 89A. Therefore, using these distributions and the ITE trip generation rates, West Sedona Elementary School generates approximately 840 total trips a day with 270 generated in the morning peak hour and 180 in the afternoon peak hour. These trips were

distributed throughout the Soldiers Pass area for the total peak and daily traffic volumes. Figure 4.3 shows the final adjusted existing 2005 volumes calculated along with the pedestrian and bicycle counts.

4.2 PROJECTED TRAFFIC VOLUMES

Projected traffic volumes were not available through the City of Sedona; therefore, projected volumes provided by Lima and Associates from the *DRAFT Verde Valley Multi-Modal Transportation Study Update* were used for this study. Understanding future socioeconomic, roadway and traffic conditions helps guide the development of roadway improvement alternatives and access management strategies. As part of the *Verde Valley Multi-modal Transportation Study Update*, the regional travel demand model was updated to reflect the latest adopted jurisdictional general land use plans. Resulting socioeconomic conditions for both existing year 2003 and the year 2025 planning horizon show anticipated growth in the area. Utilizing these growth projections, the future roadway network was modeled, including SR 89A and surrounding roadways. The travel demand model projected traffic volumes that were used to analyze future roadway conditions and needs.

4.2.1 Future Socioeconomic Conditions

An important element in understanding future traffic and roadway pressures is estimating the future socioeconomic conditions. Table 4.3 shows estimated growth in the Verde Valley region between 2003 and 2025. These projections were developed based initially on 2000 U.S. Census data and updated to year 2003 conditions in consultation with the local jurisdictions. The updated Census data were then projected to 2025 by applying future land use from local general plans, and through additional input and review by the jurisdictions.

Table 4.3 – Socioeconomic Data

	Population		**Occupied DU**		**Total Employment**	
	2003	**2025**	**2003**	**2025**	**2003**	**2025**
Unincorporated Yavapai County (including Village of Oak Creek)	20,436	36,469	8,418	15,057	2,590	4,045
Village of Oak Creek	6,123	8,780	2,987	4,292	608	876
Camp Verde	10,001	15,702	3,894	6,076	2,698	5,570
Clarkdale *	3,837	8,910	1,657	3,848	557	1,338
Cottonwood	10,240	19,884	4,463	8,896	3,987	8,125
Jerome	329	520	182	288	295	295
Sedona	10,700	15,360	5,209	7,445	6,372	7,763
Total	**61,666**	**105,625**	**26,810**	**45,902**	**17,107**	**28,012**

* Preliminary projections
Source: Lima & Associates, *DRAFT Verde Valley Multi-Modal Transportation Study Update*

Table 4.3 shows estimated growth in the Verde Valley region over the next 20-25 years. Population is expected to grow by nearly 72% for the entire region. Cottonwood, Clarkdale and unincorporated Yavapai County are expected to experience the most growth. Cottonwood's population will nearly double, and population in the unincorporated areas is shown to grow by nearly 80%. Slower growth rates are expected for the other jurisdictions within the study area. The population of Sedona and the Village of Oak Creek is anticipated to grow by approximately 43%, reflecting the limits on developable land and regulation restrictions.

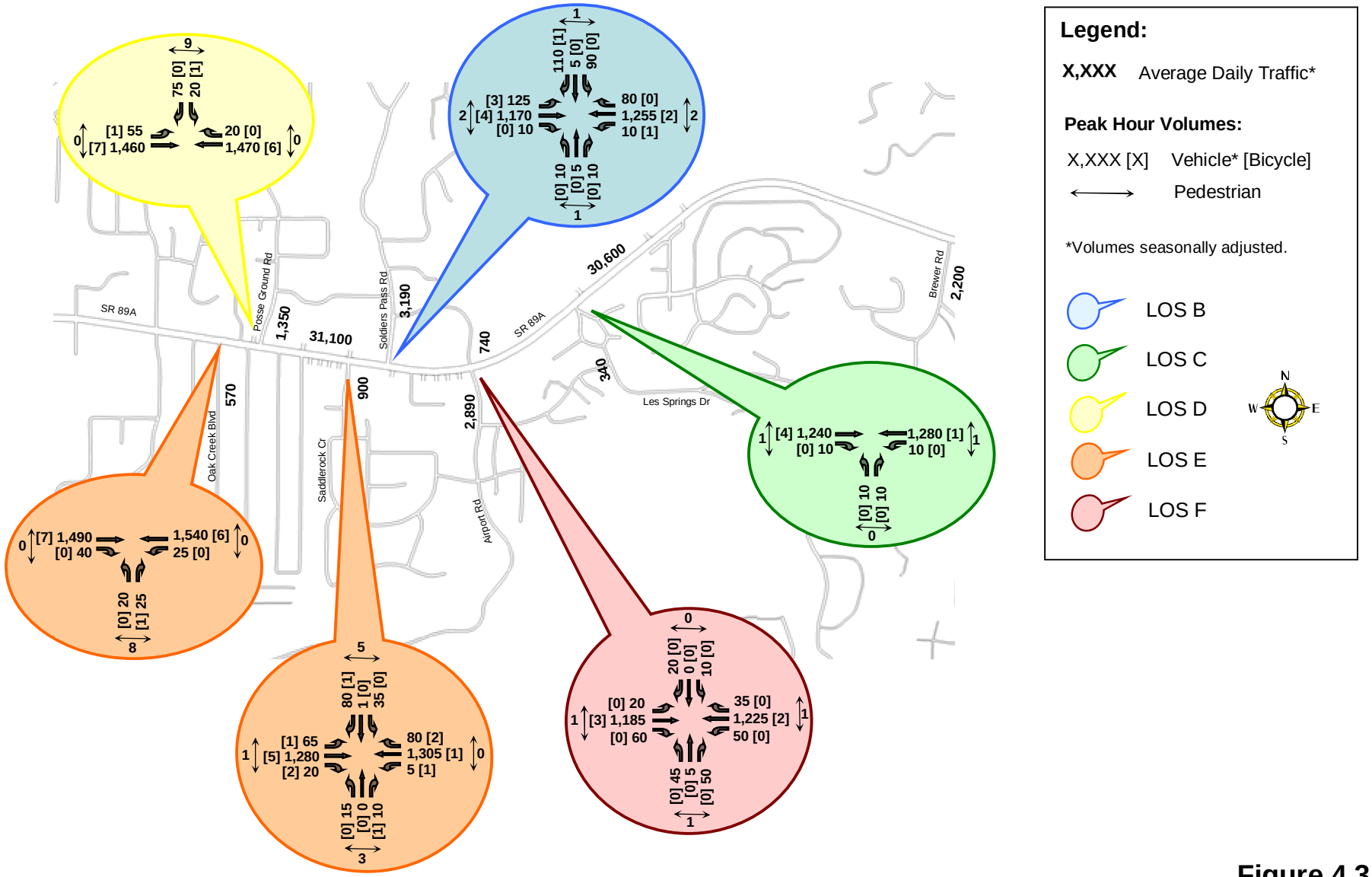


Figure 4.3

Existing Year 2005 Traffic Volumes and Level of Service (LOS)
Soldiers Pass Road Area Traffic Study

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4.2.2 Travel Demand Model

The projected socioeconomic data provides a base to estimate future traffic volumes utilizing a traffic forecasting travel demand model. Travel demand models estimate traffic volumes for specified roadway networks based on population, employment and roadway characteristics. The model used was developed using the GIS based TransCAD traffic forecasting software. It was calibrated against current known conditions including 2003 population data and 2003 traffic counts using the current road network. Model output based on 2003 networks and socioeconomic input is compared to observed traffic patterns and counts. This validates that the model is providing accurate output prior to developing forecasts.

4.2.3 No Build Project Volumes

The regional travel demand model, as described above, provided the framework to produce future traffic volumes on SR 89A and the Soldiers Pass Road Study Area. Existing turning movement percentages and travel patterns within the study area were applied to the model projections. The Year 2025 “no- build” peak hour turning movement volumes and daily traffic volumes are displayed on Figure 4.4.

4.3 TRAFFIC OPERATIONAL ANALYSIS

The concept of Level of Service (LOS) uses qualitative measures that characterize operational conditions within traffic streams and their perception by motorists and passengers. The descriptions of individual levels of service characterize these conditions in terms of factors such as speed and travel time, delay, freedom to maneuver, traffic interruptions, comfort and convenience. Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level represents a range of operating conditions. All capacity analyses conducted for this project were based on methodologies and procedures presented in the 2000 *Highway Capacity Manual* (HCM).

At a STOP-controlled intersection, the LOS is determined for the side street traffic (plus non-free-flow movements from the major street, such as opposed left turns) only. Drivers on the side street must select gaps in the traffic flow of the main street through which they can execute a turning movement or cross the street. In the presence of a queue, or back-up of vehicles, each driver must also time to move forward in the queue when the previous vehicle has executed its movement. Therefore, the LOS for the side street, or minor street approach, depends on the distribution of gaps in the main street traffic, driver judgment in selecting gaps, and the follow-up time to move to the front of the queue.

At a signalized intersection, the LOS depends on the time when a driver approaches the intersection, the driver’s position in the queue, the traffic signal cycle length, and green times. These in turn depend on the volume demands, and the delay for all drivers to accelerate when the light turns green. The control delay for a signalized intersection is calculated for each lane group by approach (e.g. left turn lane group, through lane group, and right turn lane group on the northbound approach), and then aggregated for each approach and for the intersection as a whole.

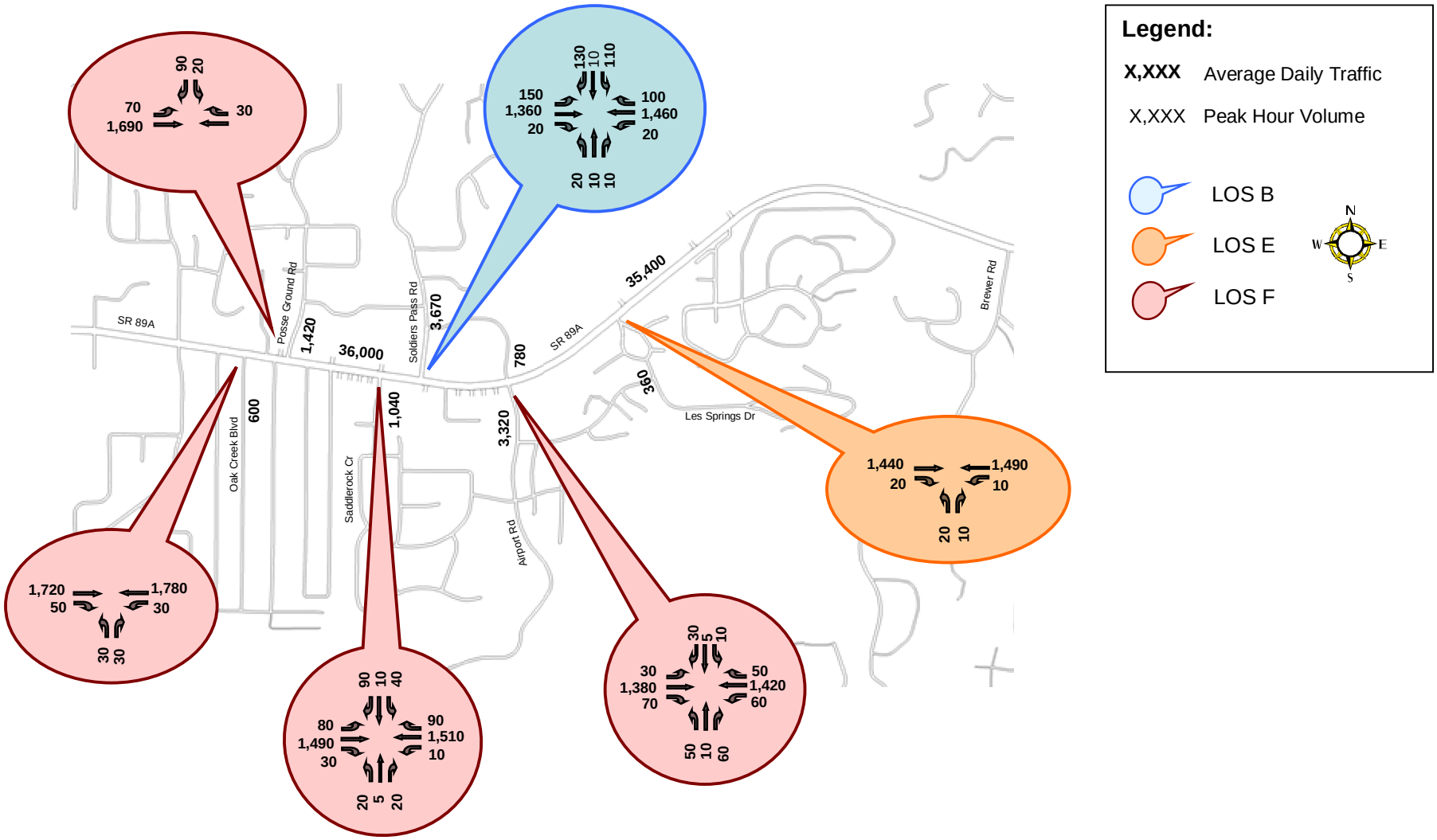

Figure 4.4

No Build Year 2025 Traffic Volumes and LOS
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4.3.1 Existing Conditions

Level of service analyses were conducted for all project intersections where peak hour turning movement volumes were collected; the analysis utilized the existing lane configuration shown on Figure 2.3 with the peak hour turning movement data shown on Figure 4.3. Although turning movement counts were not taken on Rolling Hills Drive, the volumes at Les Springs Drive were assumed at the intersection for analysis purposes. Intersection analyses for the existing conditions were conducted using the Synchro 6.0 computer software program. Synchro uses the methodologies set forth by the Highway Capacity Manual (HCM) to calculate level of service. The existing signal timings for Soldiers Pass Road were obtained from ADOT for use in the analysis.

The existing intersection level of service analyses results for the 2005 traffic data are displayed in Table 4.4 and on Figure 4.3.

Table 4.4 – 2005 Existing Intersection Levels of Service

Control	Location	2005 Peak Hour	
2-way Stop	Oak Creek Blvd/SR 89A	NB	E
2-way Stop	Posse Ground Rd/SR 89A	SB	D
2-way Stop	Saddlerock Circle/SR 89A	NB SB	E E
Signal	Soldiers Pass Rd/SR 89A	All	B
2-way Stop	Airport Rd/SR 89A	NB SB	F F
2-way Stop	Les Springs Dr/SR 89A	NB	C
2-way Stop	Rolling Hills Dr/SR 89A	NB	C

Note: Stop control LOS is for intersection approach.

4.3.2 No-Build Design Year 2025 Conditions

Design year 2025 level of service analyses were conducted for each project intersection using the existing lane configuration shown on Figure 2.3 with the peak hour turning movement data shown on Figure 4.4. Although turning movement volumes are not shown on Rolling Hills Drive, the volumes at Les Springs Drive were assumed at the intersection for analysis purposes. The traffic analysis for the No Build condition assumes the roundabout intersections at Brewer and SR 179 are implemented. The intersection analyses for the projected conditions were conducted using the Synchro 6.0 software with an optimization of the signal timings for Soldiers Pass Road, to account for the roundabout intersections at Brewer Road and SR 179 a random arrival type was used.

Year 2025 no-build intersection level of service results are shown in Table 4.5 and on Figure 4.4.

Table 4.5 – Year 2025 No-Build Intersection Levels of Service

Control	Location	2005 Peak Hour	
2-way Stop	Oak Creek Blvd/SR 89A	NB	F
2-way Stop	Posse Ground Rd/SR 89A	SB	F
2-way Stop	Saddlerock Circle/SR 89A	NB SB	F F
Signal	Soldiers Pass Rd/SR 89A	All	B
2-way Stop	Airport Rd/SR 89A	NB SB	F F
2-way Stop	Les Springs Dr/SR 89A	NB	E
2-way Stop	Rolling Hills Dr/SR 89A	NB	F

Note: Stop control LOS is for intersection approach.

4.3.3 Conclusions

Year 2025 no-build intersection levels of service results indicate that the existing stop controlled intersections on SR 89A will not be sufficient for projected future traffic demands for this area. The existing intersections will need to be improved prior to this analysis year in order to achieve sufficient levels of service along the corridor. Additional information regarding the operational characteristics of the Preferred Alternatives is contained in Section 8.

4.4 CRASH ANALYSIS

4.4.1 Three Year Crash Summary

The main source of information for a safety evaluation is a crash analysis. Within the study corridor, locations exhibiting high crash rates and specific crash patterns can be identified. This information is used to assist in identifying potential safety problems along the corridor. For this study, a Traffic Crash History was obtained from the Traffic Records Department of the Arizona Department of Transportation. Data was obtained for the time period from March 2002 to March 2005. The following, Table 4.6, is a summary of this data.

Table 4.6 – Crash Summary for Time Period March 2002 to March 2005

Description	Number	Percent
Total Crashes	125	100%
Single Vehicle	12	10%
Right-Angle Crash	19	15%
Left-Turn Crash	17	14%
Rear-End Crash	53	42%
Side Swipe	22	18%
Other	2	1%
Injury	31	25%
Fatality	0	0%
Daytime Crashes	98	78%
Nighttime Crashes	18	15%
Dawn or Dusk Crashes	9	7%

The following facts are highlighted from Table 4.3:

- A majority of the crashes (78%) occur during the daytime;
- No reported crashes involved fatalities;
- A high number of the crashes (42%) were rear-end crashes.
- Right-Angle and Left-Turn crashes (29%) account for another majority of the crashes

4.4.2 Mid-Block Crash Segments

The crash records that were provided for this study did not indicate specific numbers of accidents at intersection locations along the study area. Therefore, all accidents were included in the crash analysis among the mid-block segments.

The formula to calculate segment crash rates is:

$$\text{Crash Rate} = \frac{\text{No. of crashes over three years x 1,000,000 Vehicle-miles}}{\text{Number of years x ADT x Length of segment (in miles) x 365 days/year}}$$

The Soldiers Pass Traffic Study Area was broken into three separate segments for crash analysis purposes. These segments included Oak Creek Blvd to Soldiers Pass Road, Soldiers Pass Road to Les Springs Drive, and Les Springs Drive to Brewer Road.

The segments were analyzed for crash rates and for types of accidents. Figure 4.5 displays the crash analysis results for the study area. Table 4.7 also gives a summary of the crash rates calculated for each segment of the study corridor.

Table 4.7 – Segment Crash Rates

Segment	Average ADT Volume	No. of Crash by Severity			Avg. Crash Rate**
		Fatal	Injury	Total	
Oak Creek Blvd to Soldiers Pass Rd	27,933	0	10	51	6.46
Soldiers Pass Rd to Les Springs Dr	27,933	0	13	29	2.48
Les Springs Dr to Brewer Rd	27,933	0	8	45	1.87
Accident Totals		0	31	125	

**Yearly crash rate per 1,000,000 vehicle miles.

National Cooperative Highway Research Program (NCHRP) Report 420, Impacts of Access Management Techniques, documented the study of roughly 240 roadway segments in eight different states. This report indicates that a rate of 2.6 crashes per million vehicle miles traveled is representative of this type of facility. The only segment with a rate greater than 2.6 is between Oak Creek Blvd to Soldiers Pass Rd.

Oak Creek Blvd to Soldiers Pass Rd

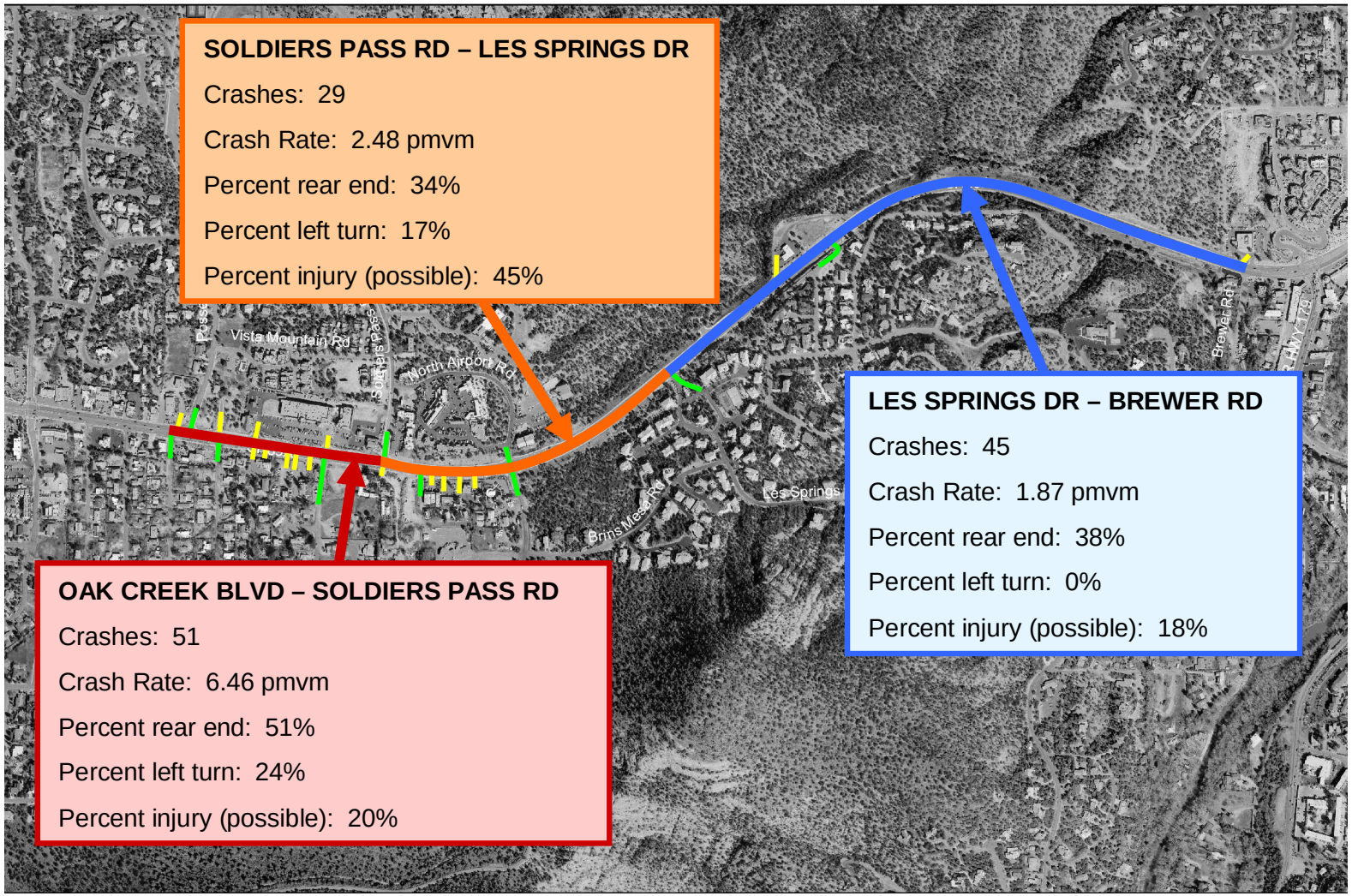
Fifty-one crashes occurred in a three year period on this 1,363 foot long roadway segment with twenty-six of the crashes being rear-end accidents. Ten of the crashes resulted in some type of injury; however, there were no fatalities. This segment may have a higher accident rate (6.46) due to the high number of access points along this segment. Figure 4.5 indicates the driveway locations throughout the corridor, and shows that this shorter segment has a high number of driveways. The high number of rear-ends and left turn crashes supports this assumption.

Soldiers Pass Rd to Les Springs Dr

Twenty-nine crashes occurred in a three year period on this roadway segment with ten of the crashes being rear-end accidents. Thirteen of the crashes resulted in some type of injury. Figure 4.5 indicates that this segment also has a high number of access locations; however, this segment also contains a signalized intersection and two breaks in the two-way left turn section of the roadway.

Les Springs Dr to Brewer Rd

Forty-five crashes occurred in a three year period on this roadway segment with seventeen of the crashes being rear-end accidents. This segment runs approximately 4,150 feet, and therefore, although there were forty-five crashes reported, the crash rate is lower for this segment of roadway. Eight of the crashes resulted in some type of injury. This segment contained a majority of single and side-swipe collisions within the corridor.



Legend:

Cross streets

Driveway locations

X.XX pmvm Crash rate per million vehicle miles

N W E S

Figure 4.5

Crash Data [March 2002 – March 2005]
Soldiers Pass Road Area Traffic Study

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