



Shephard ▲ Wesnitzer, Inc.

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*Engineering an environment of excellence.*

# SKY RANCH LODGE

## Traffic Impact Analysis

PREPARED FOR:

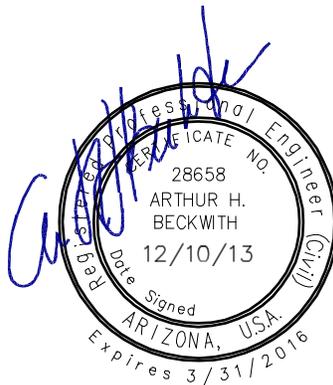
Sky Ranch Lodge  
1105 Airport Road  
Sedona, AZ 86336

December 10, 2013

SWI File No. 12100

PREPARED BY:

Shephard-Wesnitzer Inc.  
110 W. Dale Avenue  
Flagstaff AZ 86001



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## **INTRODUCTION**

Sky Ranch Lodge is an existing hotel in “West” Sedona located on the Airport Mesa west of the Sedona Airport on Airport Road. The project location is shown on Figure 1 -- Vicinity Map. The expansion will include 40 rooms and a meeting room capable of supporting 200 patrons. The meeting room facility is approximately 7,500 square feet including associated support space. The site plan is shown on Figure 2 – Site Plan. Per the City of Sedona, a Traffic Impact Analysis is warranted when a development generates more than 100 vehicles during a peak hour. It should be noted that the proposed additional 40 rooms are projected to generate 22 vehicles per hour during the AM peak hour, 24 vehicles per hour during the PM peak hour. The 200 person meeting room, which is anticipated to be attended mostly by patrons of the hotel, has been projected to conservatively generate 50% of its trips off-site and therefore will add 25 trips in the AM peak and 25 trips during the PM peak. The City of Sedona (COS) is requiring a Traffic Impact Analysis (TIA) be performed for the proposed “Sky Ranch Lodge” to ensure efficiency and safety in traffic operations are maintained within the surrounding transportation network.

Per ADOT's Traffic Impact Analysis for Proposed Development guideline, a Category I analysis is characterized as a development that generates less than 500 peak hour trips during the morning or afternoon peak hour and therefore will be used as the guide from which this TIA will be performed.

## **PURPOSE OF THE REPORT AND STUDY OBJECTIVE**

The purpose of this document is to identify possible traffic impacts and to recommend any potential improvements to maintain efficient and safe traffic operations. The objectives of this study are to:

1. Determine the trip generation rates, directional distribution and travel patterns of site generated traffic at build out.
2. Determine the extent to which traffic generated by the proposed development will impact current traffic conditions in the surrounding area.
3. Determine what traffic control and/or geometric improvements might be necessary to maintain acceptable levels of service upon build out of the proposed development.

This study will specifically look at the intersection of Highway 89A/Airport Drive, as well as the overall operation of Airport Road. Although a queuing analysis is only required for Category II analyses, a queuing analysis will be included in this study.

### **EXECUTIVE SUMMARY**

The Sky Ranch Lodge expansion is located on a 7.63 acre site on Airport Mesa in Sedona, AZ. The Project will consist of an expansion to include 40 new rooms and a new 7,500 square foot / 200 person meeting room. The property is located on Airport mesa which is approximately 1 mile up Airport Road. The site is surrounded by Airport facilities and Forest Service property. The hotel is not located near any other commercial facilities and approximately 4,600 feet from the nearest residential intersection therefore pedestrian and bicycle traffic is close to non-existent. Pedestrian activity is active at two locations along Airport Road; the Vortex and at the “Sunset Vista” at the top of the mesa. Both locations were observed at length on numerous days and both had all of the pedestrians arrive via vehicle.

The *Institute of Transportation Engineers (ITE) Trip Generation* land use code for hotels with meeting room facilities predicts 327 daily trips. To address the City’s concern that the ITE standards might not adequately reflect Sedona conditions, 50 additional daily trips were added.

The intersection of Airport Road/Highway 89A and Airport Road will continue to operate at an acceptable Level of Service (LOS) with the additional traffic generated by the expansion. The Highway Capacity Manual (HCM) rates intersections and road capacities using a Level of Service scale of A through F, the intersection at Highway 89A and Airport Road currently operates at a Level of Service (LOS) B for both morning and evening peak hours, and will continue to do so after the Sky Ranch Lodge expansion is complete.

### **STUDY AREA CONDITIONS**

Sky Ranch Lodge is accessible via Airport Road approximately 1 mile up on top of Airport mesa via three existing driveways to the resort. Airport Road in the vicinity of the site is currently a two-lane, two-way roadway with unpaved shoulders north of the Chimney Spire Road and minimal or no shoulders south of the Chimney Spire Road. It consists of approximately 24 foot wide paved surface

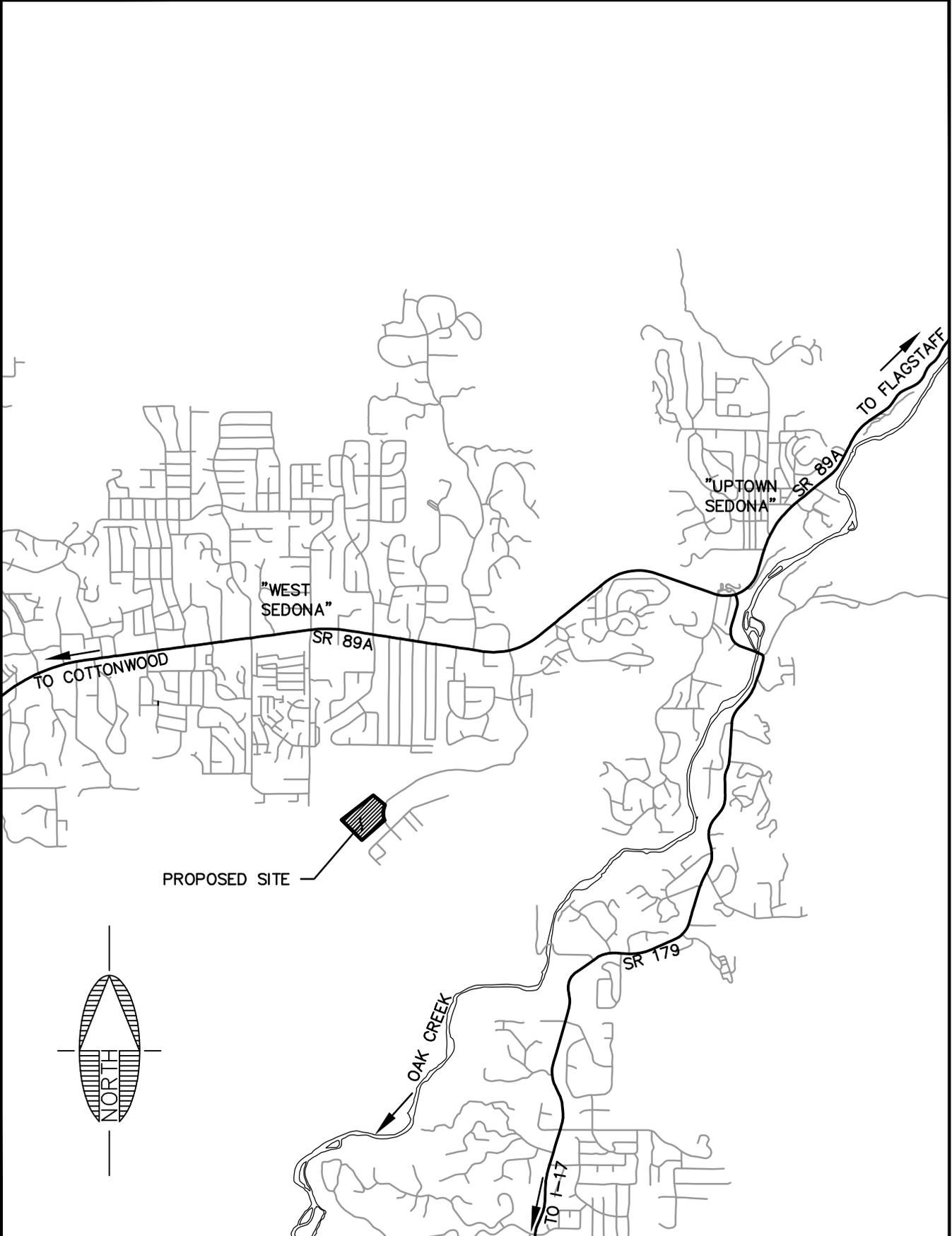
north of Chimney Spire Road and approximately 20 to 22 foot wide south of Chimney Spire Road and includes one travel lane in each direction. South of Chimney Spire Road, Airport Road starts to ascend on the side of the mesa creating a cut on one side of the road and a fill on the other. On the cut side of the road, a concrete curb channel was installed for drainage purposes and on the fill side of the road, a guardrail exist to protect vehicles from leaving the roadway. The posted speed limit on Airport Road is 25 mph. Airport Road is currently striped to allow no passing in both directions.

There is an existing pedestrian crossing that accesses the parking lot across Airport Road from Sky Ranch Lodge. There is no striped crosswalk, but there is a pedestrian sign warning vehicles travelling on Airport Road. Internal circulation will be addressed as the site plan moves further along in its planning process; the intent is to have a walkable site. Only minor outside pedestrian traffic is anticipated to access the Vista or nearby trails for recreational hiking. Due to the remoteness of the lodge, off-site tourist activities are expected to be done via vehicle.

As mentioned previously the site is currently developed with three existing driveways of off Airport Road. Airport Road is a collector roadway with one lane in each direction that serves as the primary access to Sedona Airport from Highway 89A. The roadway appears to be in need of some surface maintenance. Striping throughout the roadway is faded and needs to be re-striped.

The intersection of Airport Road/Highway 89A is signalized. Both westbound and eastbound legs of Highway 89A have a dedicated left turn lane, two through lanes, and a dedicated right turn lane entering the intersection. Both northbound and southbound legs of Airport Road have a dedicated left turn lane and one combination through/right turn lane entering the intersection. The through movement is minimal due to the land use on the north side of the intersection including an office complex, church and hotel. See Figure 3 for lane configuration details.

Airport Road from Highway 89A to the top of the Mesa is approximately 1 mile long. From Highway 89A intersection to approximately 1,100 feet south (Chimney Spire Road) land uses adjacent to Airport Road include commercial property and access to the Saddlerock and Les Springs subdivisions. Beyond the 1,100 feet south to the top of the mesa at approximately 5,700 feet, Airport Road is rural in nature with no access points except to the small parking lot for the Vortex.



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SKY RANCH LODGE CITY OF SEDONA  
ARIZONA

**VICINITY MAP**

SHEET  
**F1**  
OF

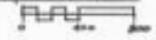
COTTAGES	
10 SINGLE STORY	20 UNITS
5 @ 1295 SF EA.	
5 @ 1050 SF EA.	
LODGE	
1 TWO STORY	20 UNITS
13,280 SF TOTAL	
CONFERENCE CENTER	
1 SINGLE STORY	3 MTG. RMS.
6000 SF TOTAL	LOBBY, REST
	RMS, PREP
	KITCH, STOR.
PARCEL SIZE*	519,220 sf
	(11.9 AC)
PARKING & ROADS	66,300 sf
	17% coverage
BUILDING FOOTPRINT	79,340 sf
	16% coverage
HARDSCAPE/POOLS	13,856 sf
	3% coverage
TOTAL BUILT ENVIRONMENT COVERAGE	32%
NATURAL & REVEGETATED OPEN SPACE	78%
*Coverage statistics based on existing and proposed areas	



**SKY RANCH LODGE SITE PLAN**



**AIRPORT MESA PLAN**





## Sky Ranch Lodge Expansion

Sedona Community Plan Amendment Request

May 11, 2012

Prepared By -

**Design Group architects**

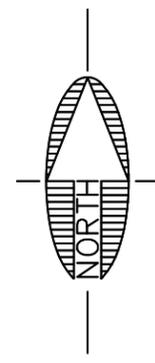
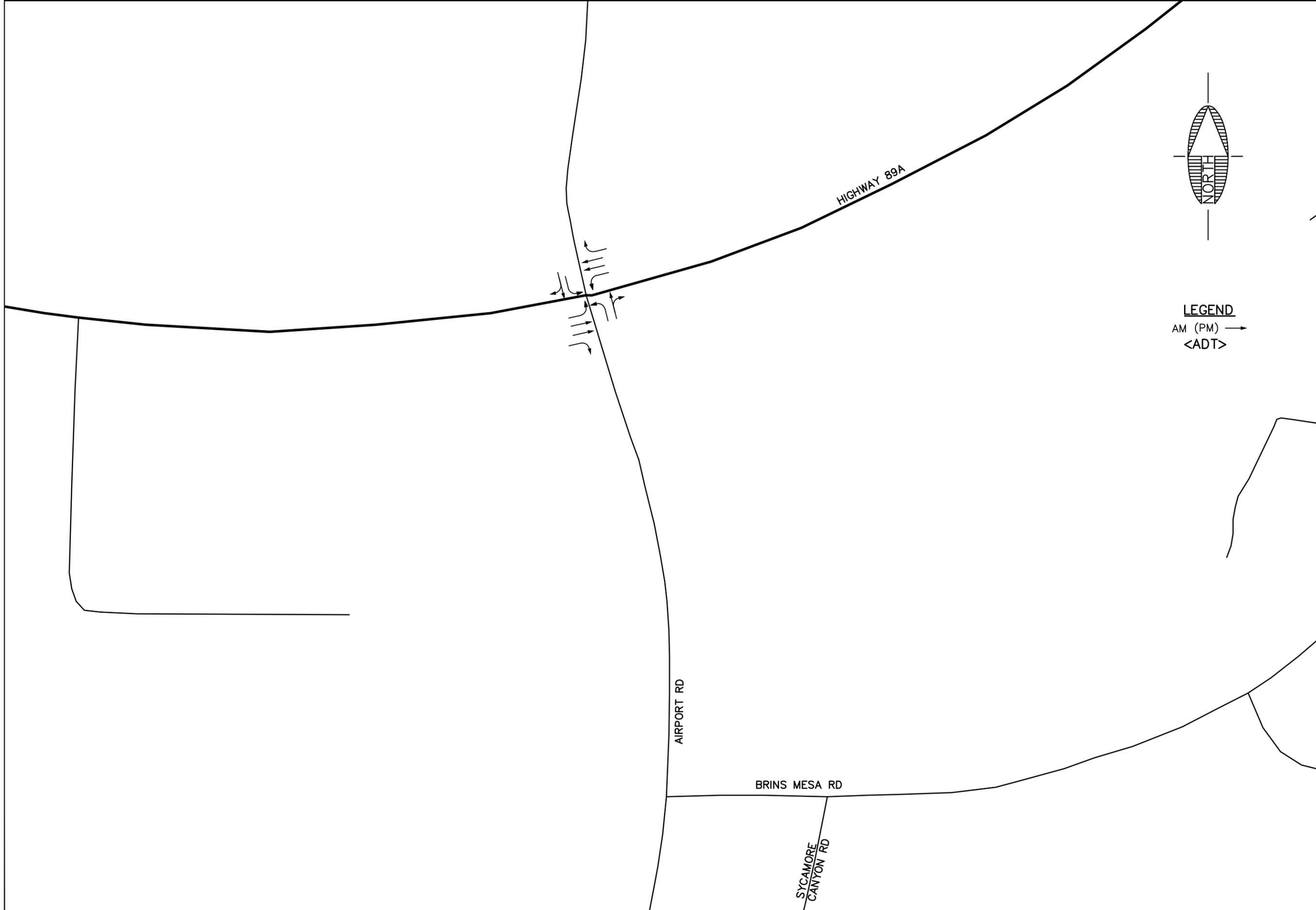
275 Jordan Road  
Sedona, Arizona 86301  
928-282-4702 (local)  
928-282-2775 (toll-free)




The Vortex parking area does seem to be too small for its popularity and therefore feels congested as vehicles slow to look for parking. Both the Vortex and Overlook areas generate pedestrian traffic after their vehicles are parked. The Vortex parking is on the same side as the Vortex landmark, where the Overlook parking requires pedestrians to cross Airport Road. The crossing is not marked but road signage and speed bumps exist to warn drivers. On occasion the when the Vortex parking area is full a visitor may park at the Overlook and walk down Airport Road to the Vortex landmark. In order to reduce the number of visitors walking on Airport Road a new hiking trail has been constructed from the parking area at the Overlook to the parking area at the Vortex.

Signage is scheduled to be installed to direct pedestrians to use the trail.

Other than the occasional recreational bicyclist or pedestrian, bicycle and pedestrian activity is close to non-existent mostly due to the fact that there is not real connectivity to draw this type of activity.



**LEGEND**  
 AM (PM) →  
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SKY RANCH LODGE				SEDONA AZ		<b>2013</b> <b>EXISTING INTERSECTION LANE CONFIGURATION</b>																	

## **EXISTING TRAFFIC CHARACTERISTICS**

### *INTERSECTION*

Accident data from January 1, 2009 to December 31, 2011 has been analyzed for Airport Road. Airport Road has experienced a total of four accidents in the last three years, all without injury and none of them involving pedestrian or bicycle traffic. They involved a rear end accident at the SR 89A intersection, a vehicle backing, and two vehicles individually hitting the guardrail. This information was obtained from the City of Sedona Police Department; the full accident list is included in the Appendix for reference.

Results of the Final Soldiers Pass Road Area Traffic Study (SPRAT), dated April 2007, indicate that there is no distinct morning or evening peak hour travel time periods. The data indicates a peak travel period between 10AM and 5PM. Existing intersection turning movements at the intersection of Airport Road/Highway 89A were collected by Shephard-Wesnitzer, Inc. from 11 AM to 1PM and 4PM to 6PM on November 7, 2013. There is a peak hour from 12PM to 1PM and another peak hour from 5PM to 6PM. The existing traffic shows an approximate 50 percent split in eastbound traffic vs. westbound traffic. See Figure 4 for existing traffic volumes. The complete intersection counts are included in the Appendix.

It should be noted that October and early November typically have the highest counts of the year in Sedona and that between the 5:00 and 6:00 PM hour a lot of the “sunset” traffic enters and exits the intersection as tourist drive to the Vista area on the mesa.

Level of Service (LOS) results define traffic flow conditions. A scale of “A” to “F” is used to rate congestion as determined by delay (seconds/vehicle). A LOS “A” represents optimum conditions and LOS “F” defines undesirable congested conditions. Urban environments are considered effective down to LOS “D”. Capacity analyses were conducted using the methodologies defined in the 2000 Highway Capacity Manual (HCM). HCS 2010 was used to analyze the intersection to determine existing conditions LOS. Table 1 illustrates the existing LOS for the intersection study. The completed LOS analysis worksheets are provided in the Appendix.

Queue lengths represent the number of vehicles stopped in any one lane at one time, either waiting for a gap in traffic or waiting for the light to change. The area of this study requires specific attention be paid to queue lengths and their possible conflicts, therefore each movement's queuing lengths will also be presented in Table 1. The queuing length listed for the signalized intersection represents the 50th percentile length during each cycle.

**TABLE 1 – 2013 EXISTING CONDITIONS  
FOR AIRPORT ROAD/HIGHWAY 89A**

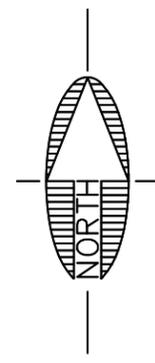
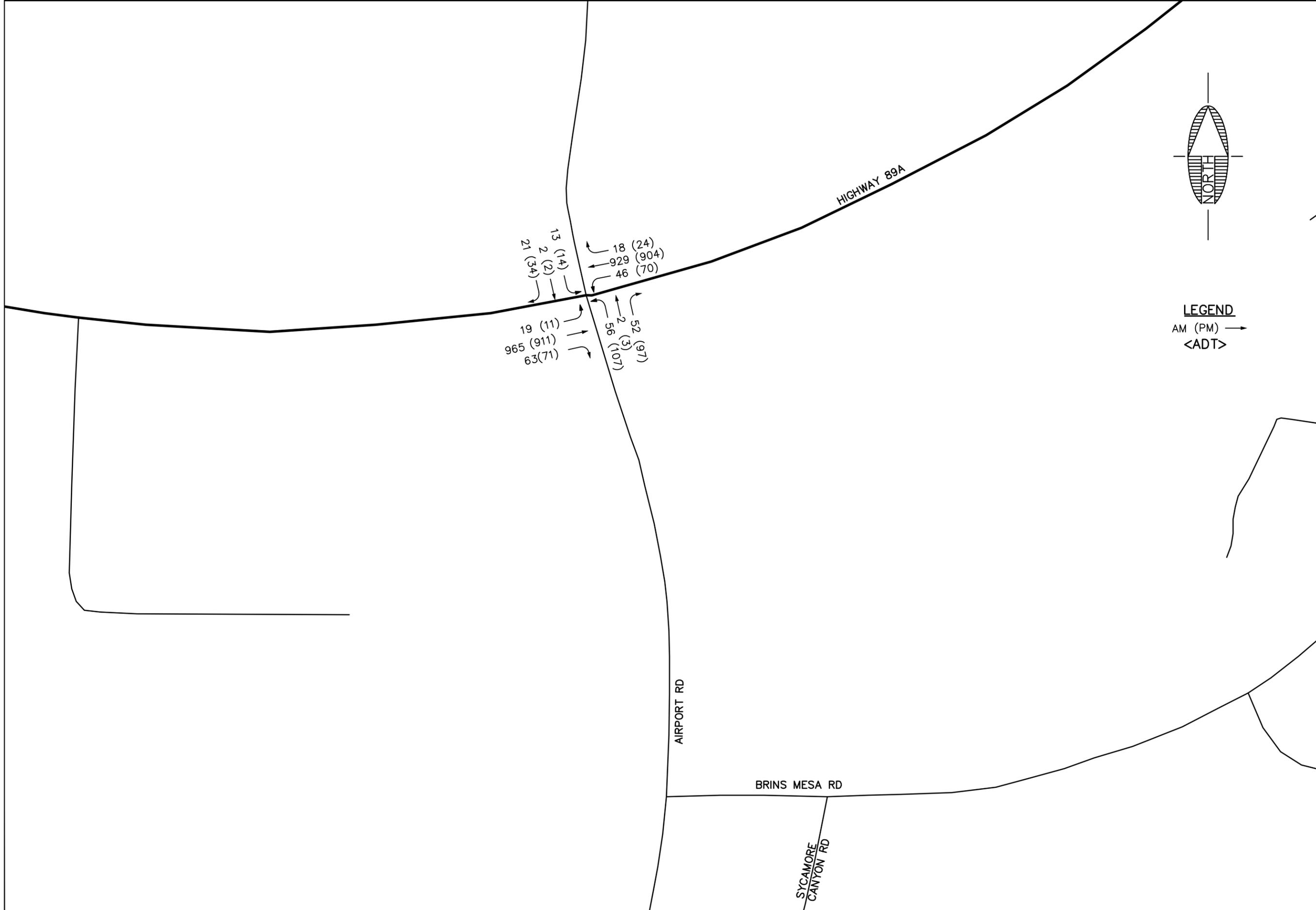
Highway 89A - Airport Rd Signal Controlled	Existing Level of Service					
	AM			PM		
	LOS	Q	Delay(sec)	LOS	Q	Delay(sec)
<b>Intersection</b>	<b>B</b>		<b>14.2</b>	<b>B</b>		<b>14.8</b>
Eastbound Approach	B			B		12.9
--Eastbound Left	A	0.1	8.4	A	0.1	8.2
--Eastbound Through	B	6.4	13.7	B	5.9	13.2
--Eastbound Right	A	0.6	9.5	A	0.7	9.5
Westbound Approach	B		13.1	B		12.8
--Westbound Left	A	0.3	8.8	A	0.5	8.8
--Westbound Through	B	6.0	13.4	B	5.8	13.2
--Westbound Right	A	0.2	9.0	A	0.2	9.1
Northbound Approach	C		28.9	C		30.5
--Northbound Left	C	1.1	29.5	C	2.3	31.5
--Northbound Through/Right	C	1.1	28.4	C	2.0	29.4
Southbound Approach	C		28.4	C		29.0
--Southbound Left	C	0.3	29.7	C	0.3	31.8
--Southbound Through/Right	C	0.4	27.7	C	0.7	28.0

### ROADWAY

According to the Highway Capacity Manual (HCM) and the variables present at Airport Road, it can accommodate approximately 800 vehicles per hour (vph) for a LOS C. At a LOS D, which is typically what roads are designed for, the capacity increases to 1,100 vph. ADT traffic counts for

two locations of Airport Road were collected; one just south of Highway 89A and another one uphill from the vortex parking area. Two locations were chosen in order to determine how many vehicles are using Airport Road near the Highway 89A intersection and how many are using Airport Road to travel all the way to the top of the mesa. As shown in the table below, both the AM and PM peak hour volumes are well below the actual capacity of Airport Road. The ADT traffic counts are included in the appendix.

Location	AM Peak Volume (vph)	PM Peak Volume (vph)	ADT (vpd)
South of Vortex Parking (1)	119	196	1,620
South of 89A (2)	167	271	2,253



**LEGEND**  
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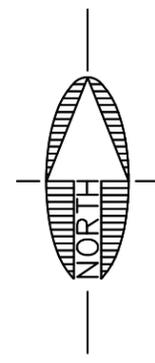
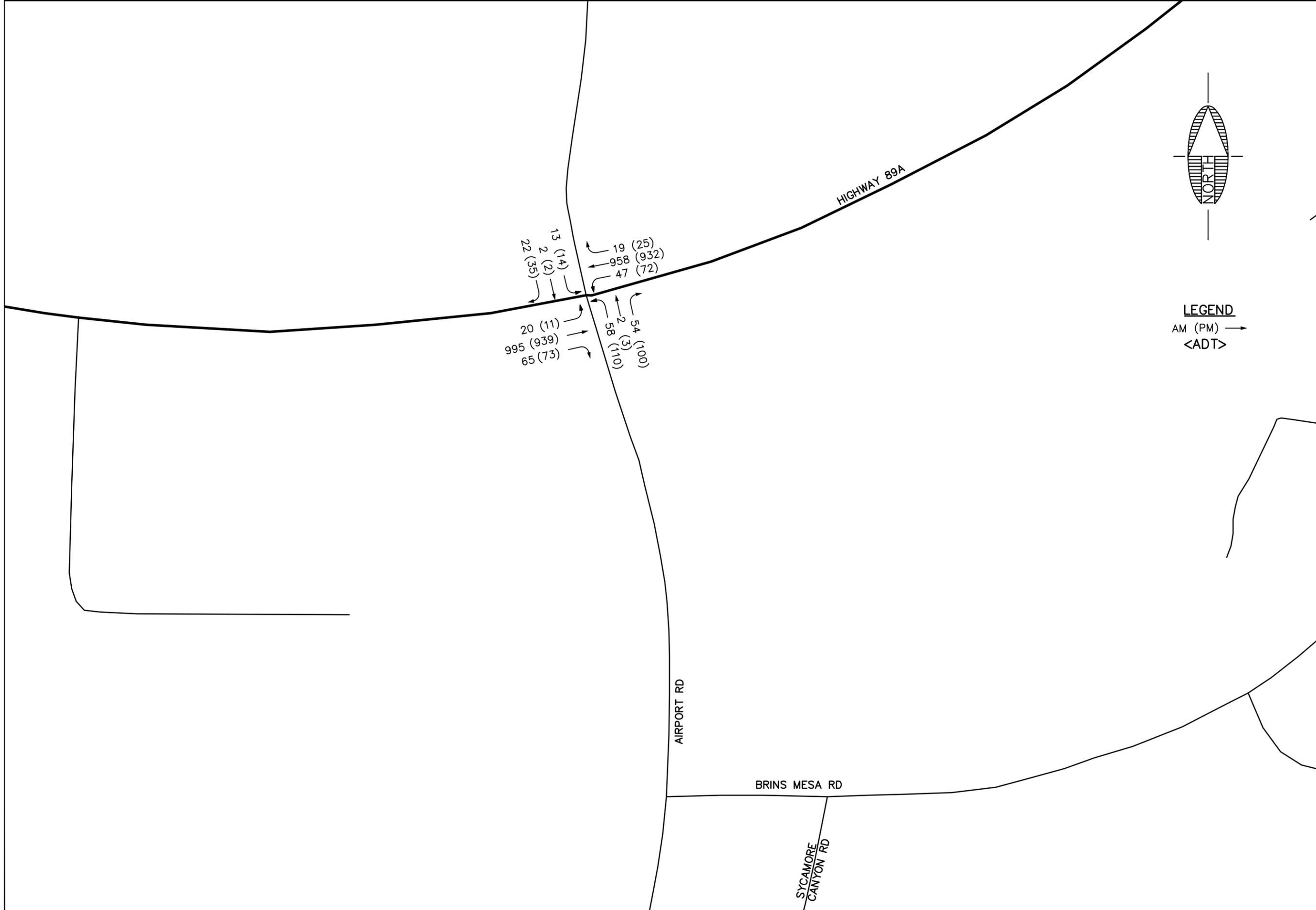
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## **PROJECTED TRAFFIC**

The Sky Ranch Lodge expansion is expected to be completed by the end of 2014. Therefore, one year of background traffic has been applied to the “2013 Existing” traffic counts before “site generated traffic” was added. Background traffic is the traffic existing around the site at a given year that is not due to the development being added but instead due to general population growth in the area. The ADOT Average Annual Growth Rate (AAGR) for the area is listed as 1.031; therefore a growth rate of 3.1 percent has been applied to the existing counts. One year of growth to the 2013 existing traffic counts is illustrated in Figure 5 – 2014 Background Traffic.

The average daily traffic volumes, including AM and PM peak hour trips generated by the proposed development have been estimated using trip rates provided by the *Institution of Transportation Engineers (ITE) Trip Generation, Eighth Edition*. ITE land use code 310: Hotel predicts 327 daily trips including 22 AM and 24 PM peak hour trips for the proposed site. The number of proposed rooms was used as the independent variable; for a “Hotel”, meeting space is accounted for within the expected “room” trip generation.

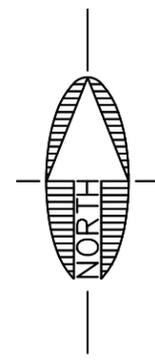
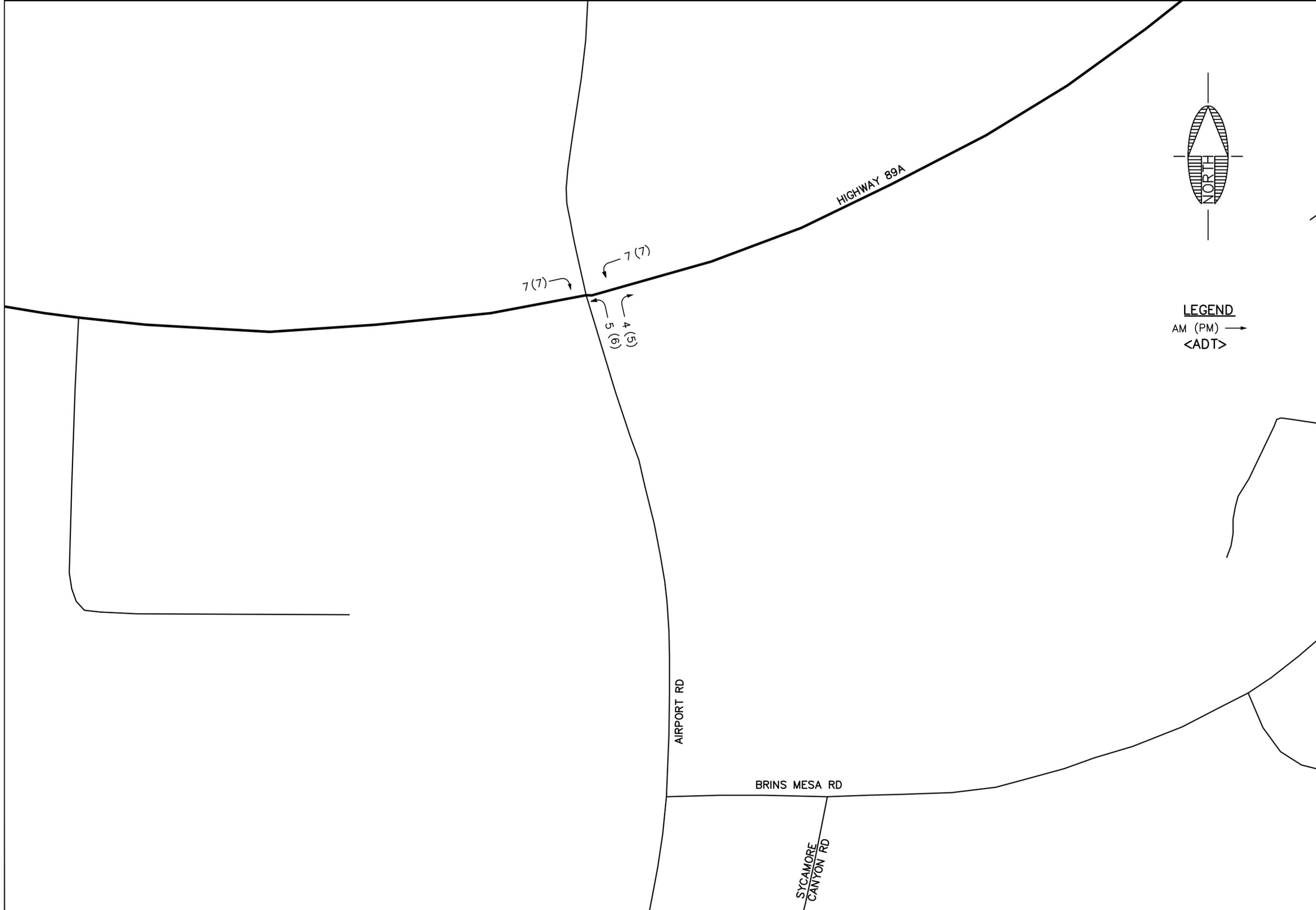
Although convention facilities are included in ITE land use code 310, the COS is concerned that this method underestimates the trips generated by the meeting room. ITE was contacted to see if any additional information on hotels with conference centers was available, but unfortunately that information does not exist. Research on trips generated by convention facilities shows an average of 1.5 to 3 people per vehicle for events. SWI assumes there will be 2 people per vehicle, resulting in an additional 100 daily trips generated by the conference center. SWI also assumes approximately 50% of the people will also stay at the lodge, reducing the amount of trips generated to 50 daily trips. Several municipalities throughout the southwest use methods similar to ITE land use code 310 to estimate trips generated by hotels with conference centers. Additionally, the ADOT Traffic Engineering Policies, Guidelines, and Procedures for traffic studies also recommends using ITE to estimate the amount of trips generated by a proposed development. For the purposes of this study, SWI will run an analysis with traffic volumes estimated by the ITE method as well as a worst case scenario that includes an additional 50 vehicles per day. See Table 2 for a full list of generated traffic, and Figure 6 for the site generated traffic distribution at the intersection of Airport Rd/Highway 89A.



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 <b>Shepherd Westtzen Inc.</b>		110 West Dale Ave Flagstaff, AZ 86001 928/773-0384 928/774-6884 fax www.swiaz.com	JOB NO: 12100 DATE: DEC 2013 SCALE: 1"=100' DRAWN: SCI DESIGNED: SCI CHECKED: GEC	SKY RANCH LODGE 2014 <b>BACKGROUND TRAFFIC</b> SEDONA AZ
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LAND USE	ITE CODE	VARIABLE	TIME PERIOD	EQUATION	% ENTERING	WKDAY TOTAL	AM		PM			
							TOTAL	in	out	TOTAL	in	out
<b>Sky Ranch Lodge</b>	<b>310</b>											
Variable = Rooms		40	<i>Weekday</i>	$T=8.17(X)$	50%	327						
Hotel			<i>AM Peak</i>	$T=0.56(X)$	61%		22	14	9			
			<i>PM peak</i>	$T=0.59(X)$	53%					24	13	11
				Subtotal Trips		327	22	14	9	24	13	11
				Site Interaction	0.0%	0	0	0	0	0	0	0
				<b>Subtotal Trips With Site Interaction (Site Entrance/Exit Total)</b>		<b>327</b>	<b>22</b>	<b>14</b>	<b>9</b>	<b>24</b>	<b>13</b>	<b>11</b>
				Passer-by Traffic	0.0%	0	0	0	0	0	0	0
				<b>Total Trips With Site Interaction and Passer-by Traffic (Surrounding Area Traffic Increase)</b>		<b>327</b>	<b>22</b>	<b>14</b>	<b>9</b>	<b>24</b>	<b>13</b>	<b>11</b>



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		SKY RANCH LODGE																					
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## **TRAFFIC ANALYSIS**

### *LEVEL OF SERVICE/QUEUING*

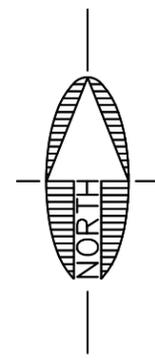
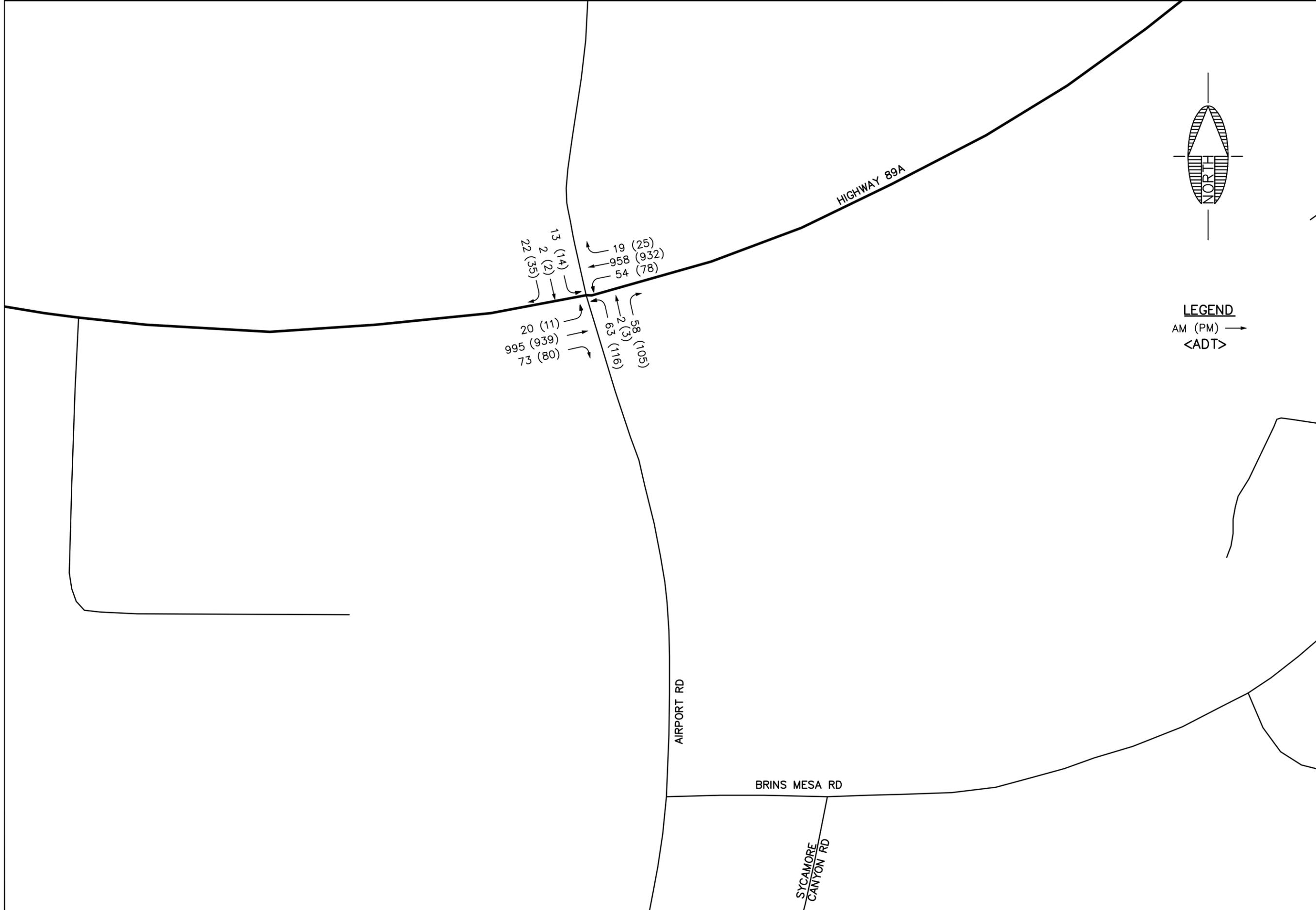
The site generated traffic estimated using the ITE method was added to the 2014 background traffic to determine the proposed total traffic volumes, see Figure 7. SWI also calculated a worst case scenario by including an additional 50 trips to the PM peak hour rates, see Figure 8. The overall peak hour volume was higher for the 5PM to 6PM peak hour than that of the 12PM to 1 PM peak hour. The peak hour traffic volume on Airport Road was higher during the 5PM to 6PM peak hour, while the traffic volume on Highway 89A was higher during the 12PM to 1PM peak hour. Both peak hours were used for this analysis. Capacity analyses were conducted using the methodologies defined in the HCM. HCS 2010 was used to analyze the intersections to determine proposed conditions. Table 3 illustrates the proposed conditions for the study area at the expected time of completion (2014) for the intersection of Airport Road and Highway 89A. Since this is a Category I study, only the opening year (2014) was studied. The completed HCS worksheets are provided in the Appendix.

### *AIRPORT ROAD ANALYSIS*

As defined in the Existing Traffic Characteristics of the report, Airport Road in its existing configuration can accommodate approximately up to 800 vehicles per hour (vph) for a LOS C and 1,100 vph at a LOS D. As shown in the table below, both the AM and PM peak hour volumes are well below the actual capacity of Airport Road. The ADT traffic counts are included in the appendix.

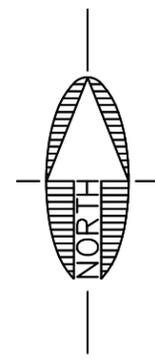
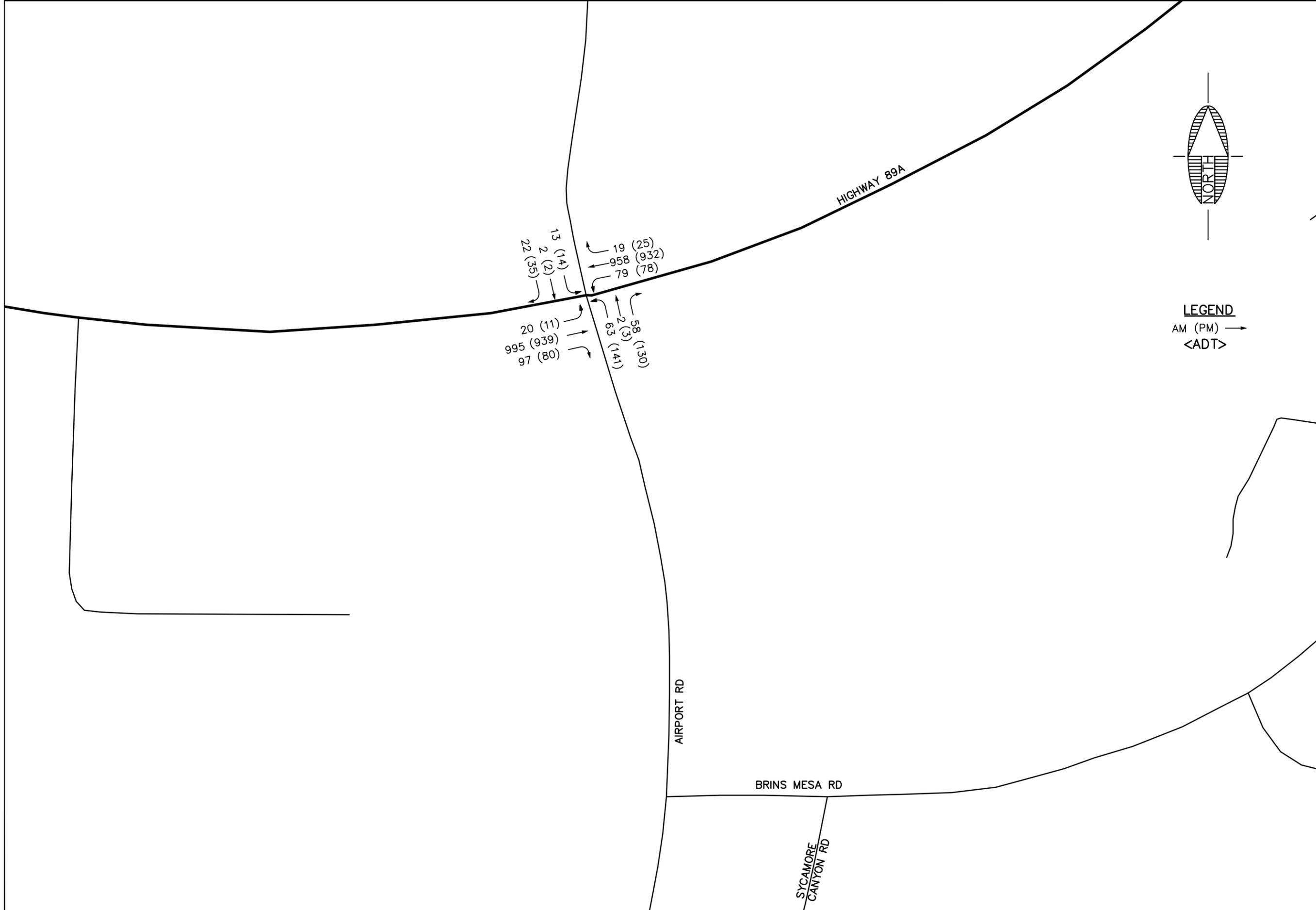
Location	Existing AM Peak Volume (vph)	Existing PM Peak Volume (vph)	Existing ADT (vpd)	Proposed AM Peak Volume (vph)	Proposed PM Peak Volume (vph)	Proposed ADT (vpd)
South of Vortex Parking (1)	119	196	1,620	166	245	1,997
South of 89A (2)	167	271	2,253	214	320	2,640

After build out of the proposed Sky Ranch Lodge, Airport Road is expected to have 320 vph during the PM peak hour, an overall increase of 49 vehicles. After the proposed expansion of the Sky Ranch Lodge, Airport Road will be running at 29 percent of a LOS D the typical road design capacity just south of the SR 89A signal. Since the proposed AM and PM peak volumes are both well below the capacity of operating under a LOS C, the LOS capacity analysis was not performed.



**LEGEND**  
 AM (PM) →  
 <ADT>

		110 West Dale Ave Flagstaff, AZ 86001 928/773-0384 928/774-6884 fax <a href="http://www.swiaz.com">www.swiaz.com</a>	JOB NO: 12100 DATE: DEC 2013 SCALE: 1"=100' DRAWN: SCI DESIGNED: SCI CHECKED: GEC	SKY RANCH LODGE SEDONA AZ <b>2014</b> <b>TOTAL TRAFFIC</b>																
CALL TWO WORKING DAYS BEFORE YOU DIG <b>1-800-STAKE-IT</b>		REVISIONS <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>NO.</th> <th>DESCRIPTION</th> <th>DATE</th> <th>BY</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>			NO.	DESCRIPTION	DATE	BY												
NO.	DESCRIPTION	DATE	BY																	
DRAWING NO. <b>F7</b>		SHT NO.      OF																		



**LEGEND**  
 AM (PM) →  
 <ADT>

 <b>Shepherd Westtzen Inc.</b>		110 West Dale Ave Flagstaff, AZ 86001 928/773-0304 928/774-6804 fax www.swiaz.com	JOB NO: 12100 DATE: DEC 2013 SCALE: 1"=100' DRAWN: SCI DESIGNED: SCI CHECKED: GEC	SKY RANCH LODGE SEDONA AZ <b>2014</b> <b>WORST CASE TOTAL TRAFFIC</b>																
REVISIONS <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>NO.</th> <th>DESCRIPTION</th> <th>DATE</th> <th>BY</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		NO.	DESCRIPTION	DATE	BY													CALL TWO WORKING DAYS BEFORE YOU DIG <b>1-800-STAKE-IT</b>		
NO.	DESCRIPTION	DATE	BY																	
DRAWING NO. <b>F08</b>		SHT NO.      OF																		

**TABLE 3 – 2014 PROPOSED CONDITIONS COMPARISON  
FOR HIGHWAY 89A/AIRPORT ROAD**

Highway 89A - Airport Rd Signal Controlled	2014 Background Conditions						2014 Total Conditions (Using ITE 310)						2014 Total Conditions (Worst Case)					
	AM			PM			AM			PM			AM			PM		
	LOS	Q	Delay	LOS	Q	Delay	LOS	Q	Delay	LOS	Q	Delay	LOS	Q	Delay	LOS	Q	Delay
<b>Intersection</b>	<b>B</b>		<b>15.3</b>	<b>B</b>		<b>15.0</b>	<b>B</b>		<b>14.5</b>	<b>B</b>		<b>15.1</b>	<b>B</b>		<b>14.4</b>	<b>B</b>		<b>15.5</b>
Eastbound Approach	B		13.5	B		13.1	B		13.5	B		13.1	B		13.4	B		13.1
--Eastbound Left	A	0.1	8.5	A	0.1	8.3	A	0.1	8.5	A	0.1	8.3	A	0.1	8.5	A	0.1	8.3
--Eastbound Through	B	6.7	13.9	B	6.1	13.5	B	6.7	13.9	B	6.2	13.5	B	6.7	13.9	B	6.1	13.5
--Eastbound Right	A	0.6	9.5	A	0.7	9.6	A	0.7	9.6	A	0.8	9.6	A	1.0	9.8	A	0.8	9.6
Westbound Approach	B		13.3	B		13.0	B		13.3	B		13.0	B		13.2	B		13.0
--Westbound Left	A	0.4	9.0	A	0.6	8.9	A	0.4	9.1	A	0.6	9.0	A	0.6	9.3	A	0.6	9.0
--Westbound Through	B	6.3	13.6	B	6.1	13.4	B	6.3	13.6	B	6.1	13.4	B	6.3	13.6	B	6.1	13.4
--Westbound Right	A	0.2	9.1	A	0.2	9.1	A	0.2	9.1	A	0.2	9.1	A	0.2	9.1	A	0.2	9.1
Northbound Approach	C		30.6	C		30.6	C		29.1	C		30.7	C		29.1	C		31.5
--Northbound Left	C	2.3	29.5	C	2.3	31.6	C	1.3	29.7	C	2.5	31.8	C	1.3	29.7	C	3.1	32.6
--Northbound Through/Right	C	2.1	29.5	C	2.1	29.5	C	1.2	28.5	C	2.2	29.6	C	1.2	28.5	C	2.8	30.2
Southbound Approach	C		29.1	C		29.1	C		28.5	C		29.1	C		28.5	C		29.5
--Southbound Left	C	0.3	31.9	C	0.3	31.9	C	0.3	29.9	C	0.3	32.2	C	0.3	29.9	C	0.3	33.4
--Southbound Through/Right	C	0.7	28.0	C	0.7	28.0	C	0.5	27.7	C	0.7	28.0	C	0.5	27.7	C	0.7	28.0

## **CONCLUSIONS AND RECOMMENDATIONS**

The Sky Ranch Lodge expansion proposal located at the top of Airport Mesa addition of 40 rooms predicts 327 daily trips including 22 AM and 24 PM peak hour trips for the proposed site. The 200 person meeting room is assumed to generate 50 off-site trips per day including 25 Am and 25 PM peak hour trips.

The intersection of Airport Road/Highway 89A currently operates at a LOS B for both morning and evening peak hours, and will continue to do so after the Sky Ranch Lodge expansion is complete. The additional traffic on Airport Road will not negatively impact the LOS of the roadway. The current traffic volumes on Airport Road are below the actual capacity of the roadway. SWI does not recommend any additional studies or modifications to Airport Road.

As mentioned previously, the Vortex parking area appears insufficient based on its popularity causing it to feel congested as vehicles slow to look for parking. The construction of the new Forest Service trail connecting the Vortex and Airport parking areas will reduce the probability of both bicyclists and pedestrians from traveling along Airport Road from the Overlook to the Vortex. Trail signage will help visitors to use the trail.

**APPENDIX**

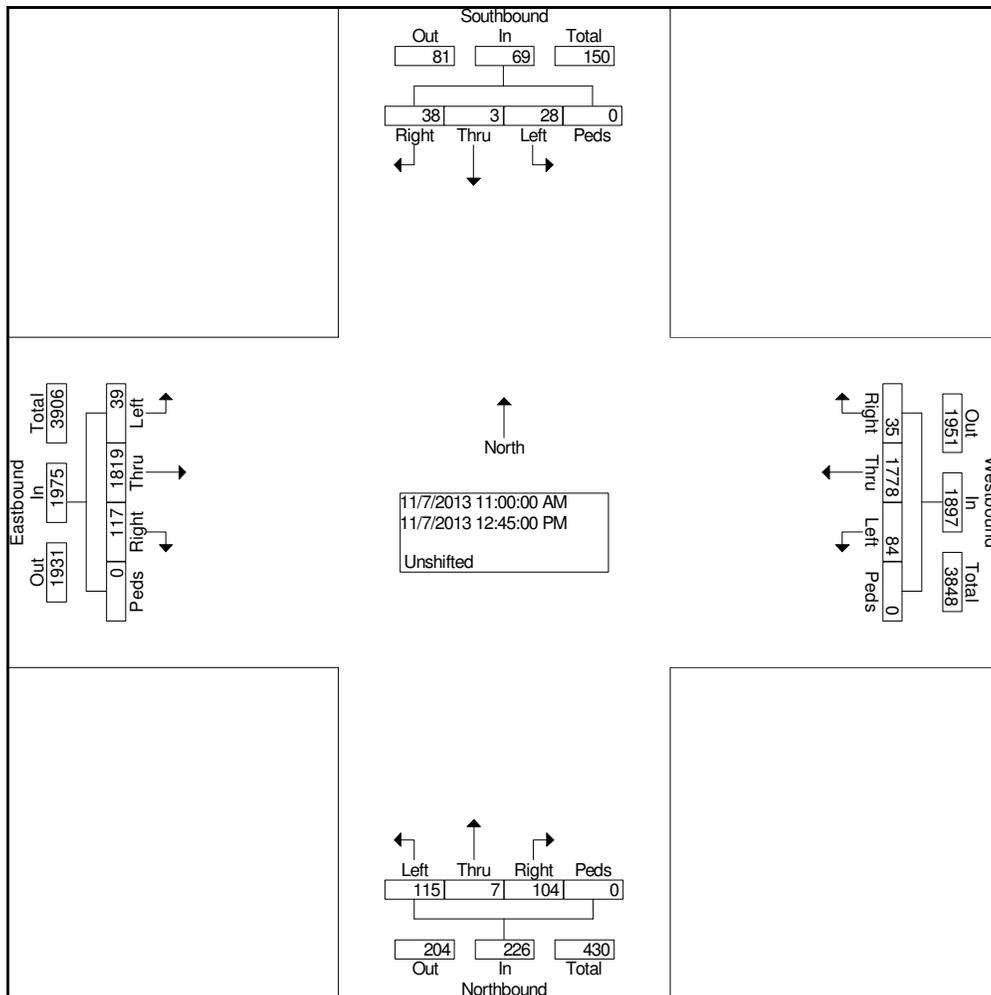
Shephard-Westnitzer, Inc.  
 Sedona Flagstaff Cottonwood Prescott Kin  
 (928) 773-0354

Start Time: 11:00 am  
 End Time: 1:00 pm  
 AM Peak Hour: Airport Rd/89A

File Name : 11am Count  
 Site Code : 00000000  
 Start Date : 11/7/2013  
 Page No : 1

Groups Printed- Unshifted

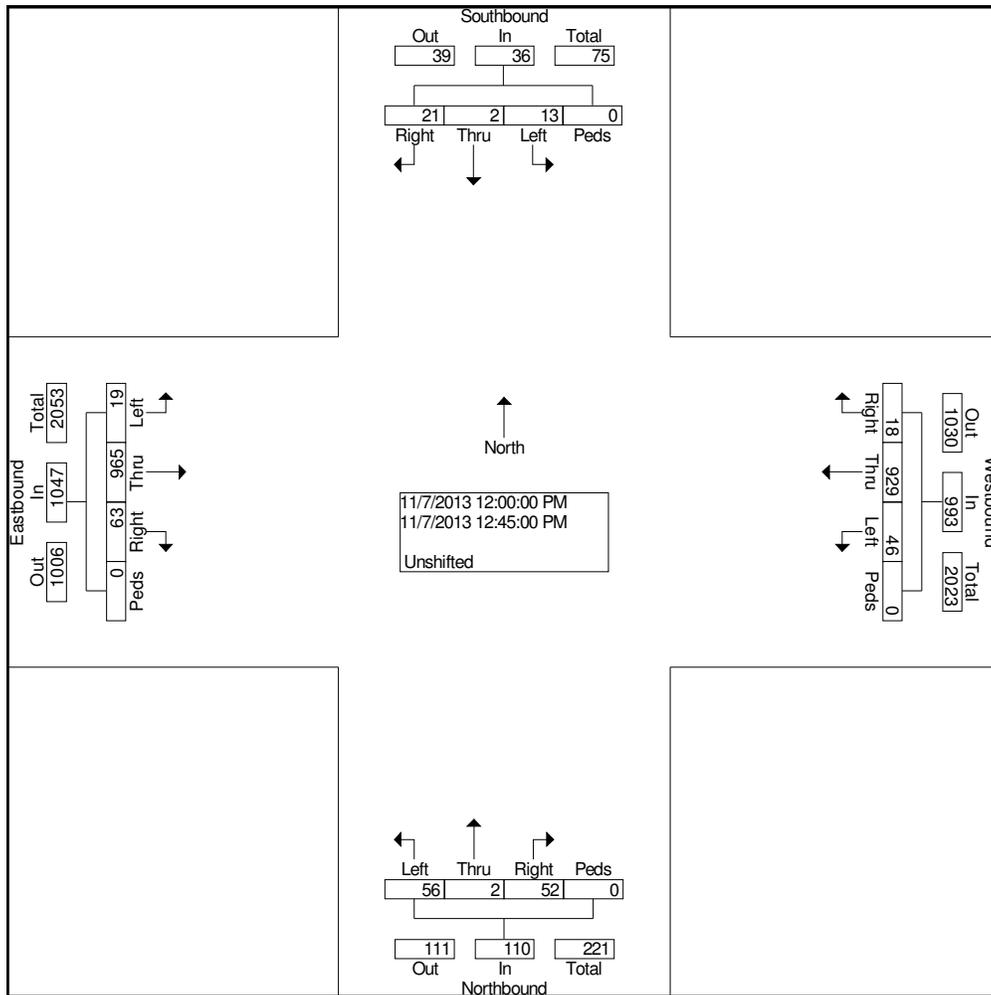
Start Time	Southbound Southbound				Westbound Westbound				Northbound Northbound				Eastbound Eastbound				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
11:00 AM	2	0	5	0	4	215	12	0	11	1	10	0	10	202	5	0	477
11:15 AM	7	1	2	0	7	209	11	0	19	2	13	0	16	229	7	0	523
11:30 AM	5	0	5	0	4	213	6	0	14	2	17	0	13	210	3	0	492
11:45 AM	3	0	3	0	2	212	9	0	8	0	19	0	15	213	5	0	489
Total	17	1	15	0	17	849	38	0	52	5	59	0	54	854	20	0	1981
12:00 PM	3	1	7	0	5	227	7	0	10	1	11	0	14	250	1	0	537
12:15 PM	8	0	2	0	3	230	8	0	19	0	16	0	11	242	5	0	544
12:30 PM	2	1	1	0	1	214	16	0	10	0	14	0	19	260	4	0	542
12:45 PM	8	0	3	0	9	258	15	0	13	1	15	0	19	213	9	0	563
Total	21	2	13	0	18	929	46	0	52	2	56	0	63	965	19	0	2186
Grand Total	38	3	28	0	35	1778	84	0	104	7	115	0	117	1819	39	0	4167
Apprch %	55.1	4.3	40.6	0.0	1.8	93.7	4.4	0.0	46.0	3.1	50.9	0.0	5.9	92.1	2.0	0.0	
Total %	0.9	0.1	0.7	0.0	0.8	42.7	2.0	0.0	2.5	0.2	2.8	0.0	2.8	43.7	0.9	0.0	



Shephard-Westnitzer, Inc.  
 Sedona Flagstaff Cottonwood Prescott Kin  
 (928) 773-0354

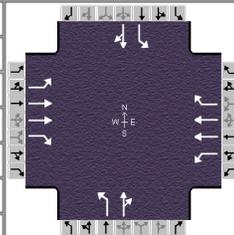
File Name : 11am Count  
 Site Code : 00000000  
 Start Date : 11/7/2013  
 Page No : 2

Start Time	Southbound Southbound					Westbound Westbound					Northbound Northbound					Eastbound Eastbound					Int. Total
	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	Rig ht	Thru	Left	Ped s	App. Total	
Intersection	12:00 PM																				
Volume	21	2	13	0	36	18	929	46	0	993	52	2	56	0	110	63	965	19	0	1047	2186
Percent	58.3	5.6	36.1	0.0		1.8	93.6	4.6	0.0		47.3	1.8	50.9	0.0		6.0	92.2	1.8	0.0		
12:45 Volume	8	0	3	0	11	9	258	15	0	282	13	1	15	0	29	19	213	9	0	241	563
Peak Factor																					0.971
High Int. Volume	12:00 PM																				
Peak Factor	0.818					12:45 PM					12:15 PM					12:30 PM					
	3	1	7	0	11	9	258	15	0	282	19	0	16	0	35	19	260	4	0	283	
																					0.925



# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2013		Analysis Period	1 > 7:00
File Name	89A-Airport 2013 AM Peak.xus					
Project Description	2013 Existing AM Peak					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	19	965	63	46	929	18	56	2	52	13	2	21

Signal Information													
Cycle, s	90.0	Reference Phase	6										
Offset, s	0	Reference Point	End										
Uncoordinated	No	Simult. Gap E/W	On										
Force Mode	Fixed	Simult. Gap N/S	On										
		Green		5.0	50.0	20.0	0.0	0.0	0.0				
		Yellow		4.0	4.0	4.0	0.0	0.0	0.0				
		Red		1.0	1.0	1.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.4		3.0			6.4		5.5
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.3		0.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	21	1072	70	51	1032	20	62	60		14	26	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1407	1619		1364	1632	
Queue Service Time (g <sub>s</sub> ), s	0.4	16.8	1.8	1.0	16.0	0.5	3.3	2.7		0.8	1.1	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.4	16.8	1.8	1.0	16.0	0.5	4.4	2.7		3.5	1.1	
Capacity (c), veh/h	390	2010	895	377	2010	895	375	360		342	363	
Volume-to-Capacity Ratio (X)	0.054	0.534	0.078	0.135	0.514	0.022	0.166	0.167		0.042	0.070	
Available Capacity (c <sub>a</sub> ), veh/h	390	2010	895	377	2010	895	375	360		342	363	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.4	0.6	0.3	6.0	0.2	1.1	1.1		0.3	0.4	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.4	12.6	9.3	8.7	12.4	9.0	29.4	28.3		29.7	27.7	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.0	0.2	0.1	0.9	0.0	0.1	0.1		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.4	13.7	9.5	8.8	13.4	9.0	29.5	28.4		29.7	27.7	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.3		B	13.1		B	28.9		C	28.4		C
Intersection Delay, s/veh / LOS	14.2						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	0.7		A	0.6		A

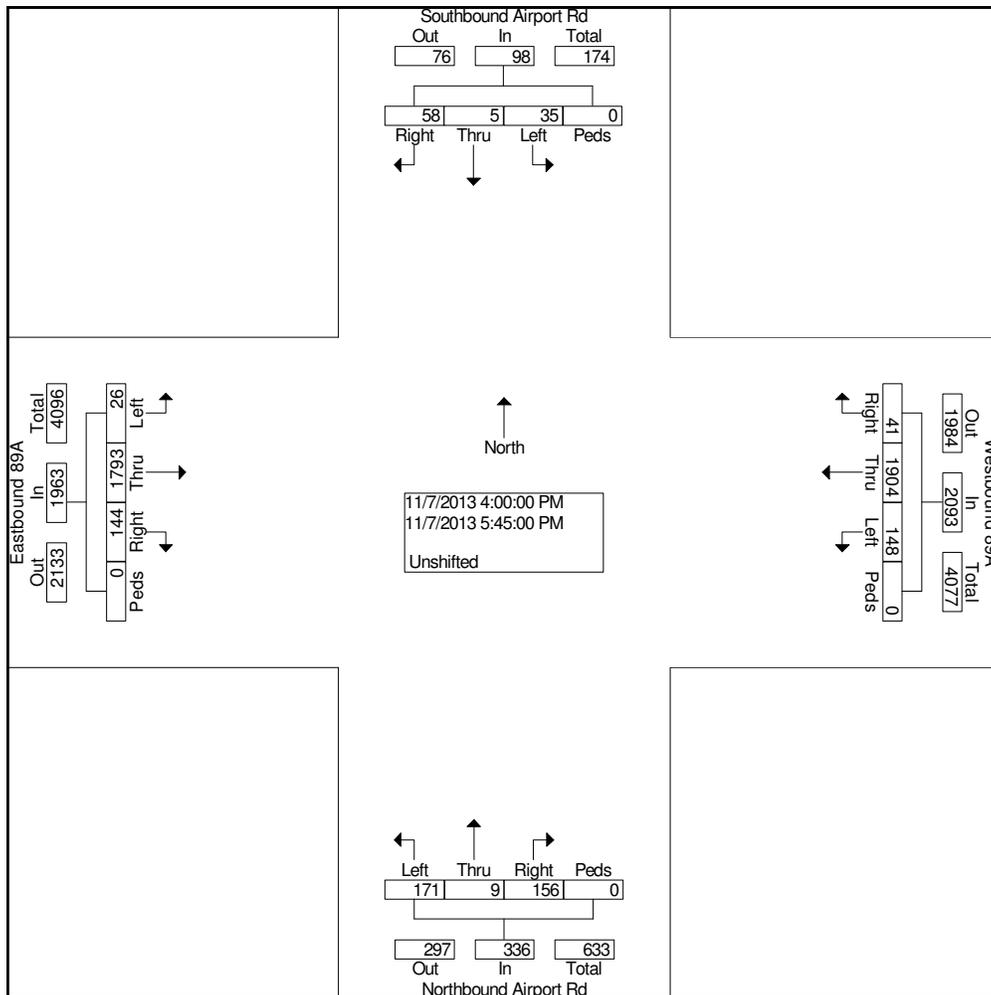
Shephard-Westnitzer, Inc.  
 Sedona Flagstaff Cottonwood Prescott Kin  
 (928) 773-0354

Start Time: 4:00 pm  
 End Time: 5:00 pm  
 PM Peak Hour: Airport Rd/89A

File Name : 4pm Count  
 Site Code : 00000000  
 Start Date : 11/7/2013  
 Page No : 1

Groups Printed- Unshifted

Start Time	Southbound Airport Rd Southbound				Westbound 89A Westbound				Northbound Airport Rd Northbound				Eastbound 89A Eastbound				Int. Total	
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds		
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	8	2	4	0	3	280	22	0	13	0	8	0	13	256	7	0		616
04:15 PM	5	0	4	0	6	257	17	0	19	1	9	0	14	224	1	0		557
04:30 PM	3	1	6	0	6	247	13	0	19	3	33	0	28	218	3	0		580
04:45 PM	8	0	7	0	2	216	26	0	8	2	14	0	18	184	4	0		489
Total	24	3	21	0	17	1000	78	0	59	6	64	0	73	882	15	0		2242
05:00 PM	5	1	5	0	5	234	28	0	14	1	13	0	30	250	1	0		587
05:15 PM	14	0	3	0	7	236	21	0	25	0	18	0	25	231	3	0		583
05:30 PM	9	1	4	0	4	216	9	0	29	1	50	0	9	220	4	0		556
05:45 PM	6	0	2	0	8	218	12	0	29	1	26	0	7	210	3	0		522
Total	34	2	14	0	24	904	70	0	97	3	107	0	71	911	11	0		2248
Grand Total	58	5	35	0	41	1904	148	0	156	9	171	0	144	1793	26	0		4490
Apprch %	59.2	5.1	35.7	0.0	2.0	91.0	7.1	0.0	46.4	2.7	50.9	0.0	7.3	91.3	1.3	0.0		
Total %	1.3	0.1	0.8	0.0	0.9	42.4	3.3	0.0	3.5	0.2	3.8	0.0	3.2	39.9	0.6	0.0		



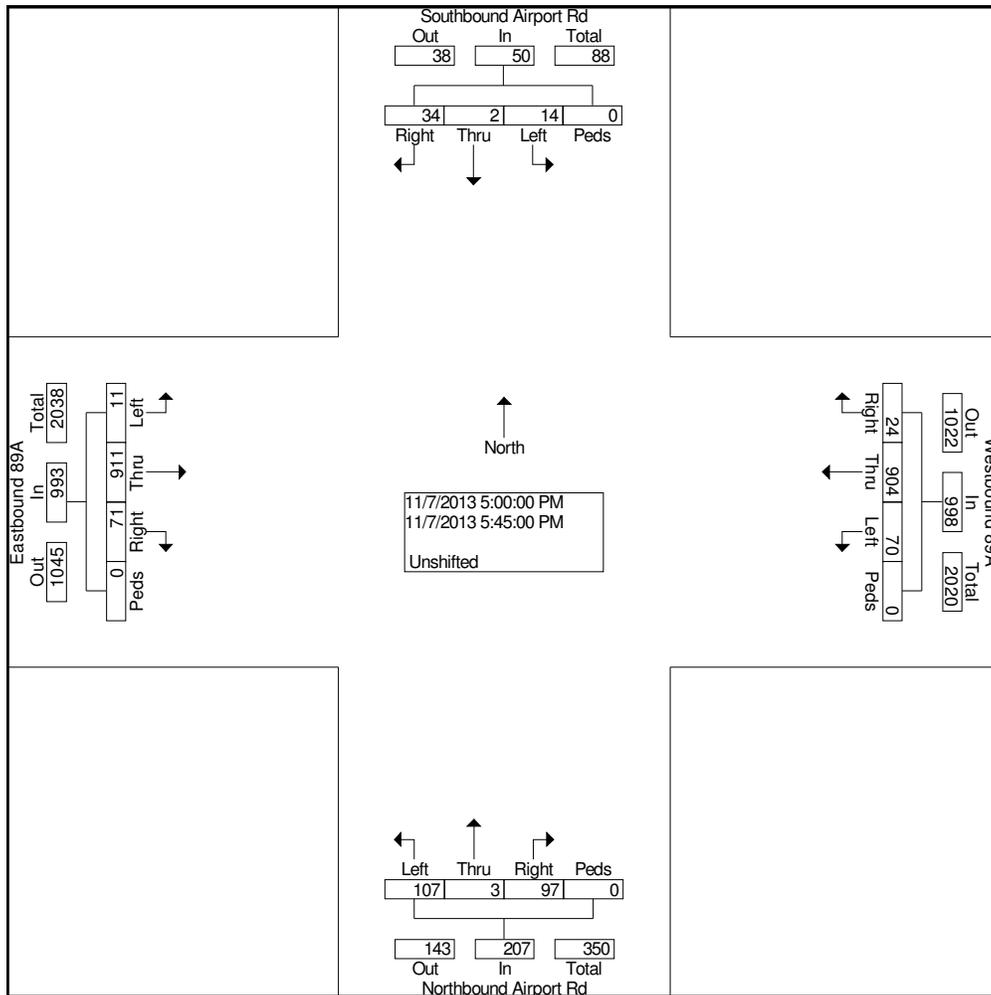
Shephard-Westnitzer, Inc.  
 Sedona Flagstaff Cottonwood Prescott Kin  
 (928) 773-0354

File Name : 4pm Count  
 Site Code : 00000000  
 Start Date : 11/7/2013  
 Page No : 2

Start Time	Southbound Airport Rd Southbound					Westbound 89A Westbound					Northbound Airport Rd Northbound					Eastbound 89A Eastbound					Int. Total
	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	Rig ht	Thr u	Left	Ped s	App. Total	
05:00 PM	34	2	14	0	50	24	904	70	0	998	97	3	107	0	207	71	911	11	0	993	2248
Volume	68.0	4.0	28.0	0.0		2.4	90.6	7.0	0.0		46.9	1.4	51.7	0.0		7.2	91.7	1.1	0.0		
Percent																					
05:00 Volume	5	1	5	0	11	5	234	28	0	267	14	1	13	0	28	30	250	1	0	281	587
Peak Factor																					0.957
High Int. Volume	14	0	3	0	17	5	234	28	0	267	29	1	50	0	80	30	250	1	0	281	
Peak Factor					0.735					0.934					0.647						0.883

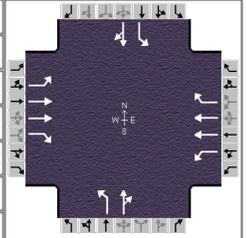
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1

Intersection



# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2013	Analysis Period	1 > 7:00	
File Name	89A-Airport 2013 PM Peak.xus					
Project Description	2013 Existing PM Peak					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	11	911	71	70	904	24	107	3	97	14	2	34

Signal Information				Signal Phases								
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

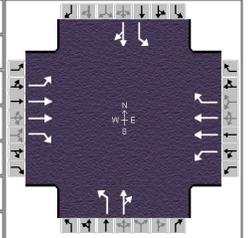
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.2		3.6			10.5		8.1
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.4		0.5
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	12	1012	79	78	1004	27	119	111		16	40	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1389	1618		1302	1624	
Queue Service Time (g <sub>s</sub> ), s	0.2	15.5	2.1	1.6	15.4	0.7	6.7	5.2		0.9	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.2	15.5	2.1	1.6	15.4	0.7	8.5	5.2		6.1	1.8	
Capacity (c), veh/h	400	2010	895	397	2010	895	361	359		295	361	
Volume-to-Capacity Ratio (X)	0.031	0.504	0.088	0.196	0.500	0.030	0.329	0.309		0.053	0.111	
Available Capacity (c <sub>a</sub> ), veh/h	400	2010	895	397	2010	895	361	359		295	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	5.9	0.7	0.5	5.8	0.2	2.3	2.0		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.2	12.3	9.3	8.7	12.3	9.0	31.3	29.2		31.8	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	0.9	0.2	0.1	0.9	0.1	0.2	0.2		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.2	13.2	9.5	8.8	13.2	9.1	31.5	29.4		31.8	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	12.9		B	12.8		B	30.5		C	29.0		C
Intersection Delay, s/veh / LOS	14.8						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	0.9		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2014	Analysis Period	1 > 7:00	
File Name	89A-Airport 2014 Worst Case AM Peak.xus					
Project Description	2014 Worst Case AM Peak					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	20	995	97	79	958	19	63	2	58	13	2	22

Signal Information				Signal Timing Diagram								
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

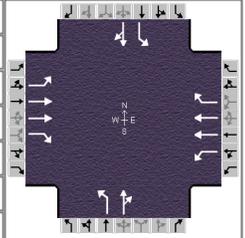
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.4		3.8			6.9		5.8
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.3		0.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	22	1106	108	88	1064	21	70	67		14	27	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1406	1618		1356	1631	
Queue Service Time (g <sub>s</sub> ), s	0.4	17.6	2.9	1.8	16.7	0.5	3.7	3.0		0.8	1.2	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.4	17.6	2.9	1.8	16.7	0.5	4.9	3.0		3.8	1.2	
Capacity (c), veh/h	380	2010	895	367	2010	895	374	360		336	362	
Volume-to-Capacity Ratio (X)	0.058	0.550	0.120	0.239	0.530	0.024	0.187	0.185		0.043	0.074	
Available Capacity (c <sub>a</sub> ), veh/h	380	2010	895	367	2010	895	374	360		336	362	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.7	1.0	0.6	6.3	0.2	1.3	1.2		0.3	0.5	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.5	12.8	9.5	9.2	12.6	9.0	29.6	28.4		29.9	27.7	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.1	0.3	0.1	1.0	0.0	0.1	0.1		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.5	13.9	9.8	9.3	13.6	9.1	29.7	28.5		29.9	27.7	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.4		B	13.2		B	29.1		C	28.5		C
Intersection Delay, s/veh / LOS	14.4						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.5		A	1.5		A	0.7		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2014		Analysis Period	1 > 7:00
File Name	89A-Airport 2014 Total PM Peak.xus					
Project Description	2014 Total PM Peak					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	11	939	80	78	932	25	116	3	105	14	2	35

Signal Information				Signal Phases								
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

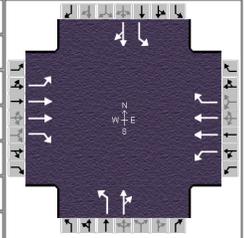
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.2		3.8			11.2		8.5
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.5		0.5
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.02		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	12	1043	89	87	1036	28	129	120		16	41	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1387	1617		1292	1624	
Queue Service Time (g <sub>s</sub> ), s	0.2	16.2	2.3	1.8	16.0	0.7	7.4	5.6		0.9	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.2	16.2	2.3	1.8	16.0	0.7	9.2	5.6		6.5	1.8	
Capacity (c), veh/h	389	2010	895	387	2010	895	360	359		287	361	
Volume-to-Capacity Ratio (X)	0.031	0.519	0.099	0.224	0.515	0.031	0.358	0.334		0.054	0.114	
Available Capacity (c <sub>a</sub> ), veh/h	389	2010	895	387	2010	895	360	359		287	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.1	0.8	0.6	6.1	0.2	2.5	2.2		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.3	12.5	9.4	8.9	12.5	9.0	31.6	29.4		32.1	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.0	0.2	0.1	0.9	0.1	0.2	0.2		0.0	0.1	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.3	13.5	9.6	9.0	13.4	9.1	31.8	29.6		32.2	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.1		B	13.0		B	30.7		C	29.1		C
Intersection Delay, s/veh / LOS	15.1						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	0.9		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information			
Agency		Duration, h	0.25				
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other	
Jurisdiction		Time Period				PHF	0.90
Intersection	89A/Airport Rd	Analysis Year	2014		Analysis Period	1 > 7:00	
File Name	89A-Airport 2014 Total AM Peak.xus						
Project Description	2014 Total AM Peak						



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	20	995	72	54	958	19	63	2	58	13	2	22

Signal Information												
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

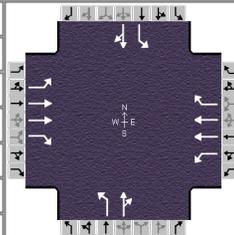
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.4		3.2			6.9		5.8
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.3		0.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	22	1106	80	60	1064	21	70	67		14	27	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1406	1618		1356	1631	
Queue Service Time (g <sub>s</sub> ), s	0.4	17.6	2.1	1.2	16.7	0.5	3.7	3.0		0.8	1.2	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.4	17.6	2.1	1.2	16.7	0.5	4.9	3.0		3.8	1.2	
Capacity (c), veh/h	380	2010	895	367	2010	895	374	360		336	362	
Volume-to-Capacity Ratio (X)	0.058	0.550	0.089	0.164	0.530	0.024	0.187	0.185		0.043	0.074	
Available Capacity (c <sub>a</sub> ), veh/h	380	2010	895	367	2010	895	374	360		336	362	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.7	0.7	0.4	6.3	0.2	1.3	1.2		0.3	0.5	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.5	12.8	9.4	9.0	12.6	9.0	29.6	28.4		29.9	27.7	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.1	0.2	0.1	1.0	0.0	0.1	0.1		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.5	13.9	9.6	9.1	13.6	9.1	29.7	28.5		29.9	27.7	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.5		B	13.3		B	29.1		C	28.5		C
Intersection Delay, s/veh / LOS	14.5						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.5		A	1.4		A	0.7		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2014		Analysis Period	1 > 7:00
File Name	89A-Airport 2014 Background PM Peak.xus					
Project Description	2014 Background PM Peak					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	11	939	73	72	932	25	110	3	100	14	2	35

Signal Information												
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

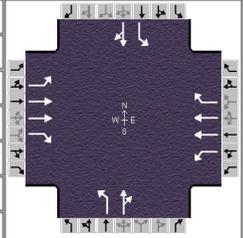
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.2		3.6			10.8		8.2
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.5		0.5
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	12	1043	81	80	1036	28	122	114		16	41	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1387	1617		1298	1624	
Queue Service Time (g <sub>s</sub> ), s	0.2	16.2	2.1	1.6	16.0	0.7	6.9	5.3		0.9	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.2	16.2	2.1	1.6	16.0	0.7	8.8	5.3		6.2	1.8	
Capacity (c), veh/h	389	2010	895	387	2010	895	360	359		292	361	
Volume-to-Capacity Ratio (X)	0.031	0.519	0.091	0.207	0.515	0.031	0.339	0.318		0.053	0.114	
Available Capacity (c <sub>a</sub> ), veh/h	389	2010	895	387	2010	895	360	359		292	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.1	0.7	0.6	6.1	0.2	2.3	2.1		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.3	12.5	9.4	8.8	12.5	9.0	31.4	29.3		31.9	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.0	0.2	0.1	0.9	0.1	0.2	0.2		0.0	0.1	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.3	13.5	9.6	8.9	13.4	9.1	31.6	29.5		31.9	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.1		B	13.0		B	30.6		C	29.1		C
Intersection Delay, s/veh / LOS	15.0						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	0.9		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2014	Analysis Period	1 > 7:00	
File Name	89A-Airport 2014 Background AM Peak.xus					
Project Description	2014 Background Traffic					



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	20	995	65	47	958	19	110	3	100	14	2	35

Signal Information												
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

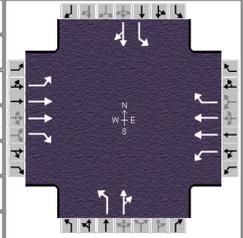
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.4		3.0			10.8		8.2
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.5		0.5
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	22	1106	72	52	1064	21	122	114		16	41	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1387	1617		1298	1624	
Queue Service Time (g <sub>s</sub> ), s	0.4	17.6	1.9	1.0	16.7	0.5	6.9	5.3		0.9	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.4	17.6	1.9	1.0	16.7	0.5	8.8	5.3		6.2	1.8	
Capacity (c), veh/h	380	2010	895	367	2010	895	360	359		292	361	
Volume-to-Capacity Ratio (X)	0.058	0.550	0.081	0.142	0.530	0.024	0.339	0.318		0.053	0.114	
Available Capacity (c <sub>a</sub> ), veh/h	380	2010	895	367	2010	895	360	359		292	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.7	0.6	0.4	6.3	0.2	2.3	2.1		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.5	12.8	9.3	8.9	12.6	9.0	31.4	29.3		31.9	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.1	0.2	0.1	1.0	0.0	0.2	0.2		0.0	0.1	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.5	13.9	9.5	9.0	13.6	9.1	31.6	29.5		31.9	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.5		B	13.3		B	30.6		C	29.1		C
Intersection Delay, s/veh / LOS	15.3						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.5		A	1.4		A	0.9		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2013	Analysis Period	1 > 7:00	
File Name	89A-Airport 2013 PM Peak.xus					
Project Description	2013 Existing PM Peak					



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	11	911	71	70	904	24	107	3	97	14	2	34

Signal Information												
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

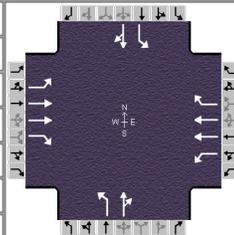
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.2		3.6			10.5		8.1
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.4		0.5
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.01		0.00

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	12	1012	79	78	1004	27	119	111		16	40	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1389	1618		1302	1624	
Queue Service Time (g <sub>s</sub> ), s	0.2	15.5	2.1	1.6	15.4	0.7	6.7	5.2		0.9	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.2	15.5	2.1	1.6	15.4	0.7	8.5	5.2		6.1	1.8	
Capacity (c), veh/h	400	2010	895	397	2010	895	361	359		295	361	
Volume-to-Capacity Ratio (X)	0.031	0.504	0.088	0.196	0.500	0.030	0.329	0.309		0.053	0.111	
Available Capacity (c <sub>a</sub> ), veh/h	400	2010	895	397	2010	895	361	359		295	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	5.9	0.7	0.5	5.8	0.2	2.3	2.0		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.2	12.3	9.3	8.7	12.3	9.0	31.3	29.2		31.8	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	0.9	0.2	0.1	0.9	0.1	0.2	0.2		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.2	13.2	9.5	8.8	13.2	9.1	31.5	29.4		31.8	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	12.9		B	12.8		B	30.5		C	29.0		C
Intersection Delay, s/veh / LOS	14.8						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	0.9		A	0.6		A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2013		Analysis Period	1 > 7:00
File Name	89A-Airport 2013 AM Peak.xus					
Project Description	2013 Existing AM Peak					



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	19	965	63	46	929	18	56	2	52	13	2	21

Signal Information				Signal Phases								
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

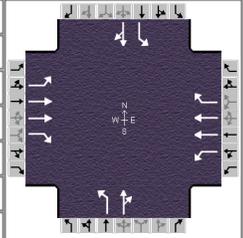
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.4		3.0			6.4		5.5
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.3		0.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	21	1072	70	51	1032	20	62	60		14	26	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1407	1619		1364	1632	
Queue Service Time (g <sub>s</sub> ), s	0.4	16.8	1.8	1.0	16.0	0.5	3.3	2.7		0.8	1.1	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.4	16.8	1.8	1.0	16.0	0.5	4.4	2.7		3.5	1.1	
Capacity (c), veh/h	390	2010	895	377	2010	895	375	360		342	363	
Volume-to-Capacity Ratio (X)	0.054	0.534	0.078	0.135	0.514	0.022	0.166	0.167		0.042	0.070	
Available Capacity (c <sub>a</sub> ), veh/h	390	2010	895	377	2010	895	375	360		342	363	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.4	0.6	0.3	6.0	0.2	1.1	1.1		0.3	0.4	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.4	12.6	9.3	8.7	12.4	9.0	29.4	28.3		29.7	27.7	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.0	0.2	0.1	0.9	0.0	0.1	0.1		0.0	0.0	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.4	13.7	9.5	8.8	13.4	9.0	29.5	28.4		29.7	27.7	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.3		B	13.1		B	28.9		C	28.4		C
Intersection Delay, s/veh / LOS	14.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.4	A	0.7	A	0.6	A

# HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency		Duration, h	0.25			
Analyst		Analysis Date	Nov 8, 2013		Area Type	Other
Jurisdiction		Time Period		PHF	0.90	
Intersection	89A/Airport Rd	Analysis Year	2014		Analysis Period	1 > 7:00
File Name	89A-Airport 2014 Worst Case PM Peak.xus					
Project Description	2014 Worst Case PM Peak					



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	11	939	80	78	932	25	141	3	130	14	2	35

Signal Information				Signal Phases								
Cycle, s	90.0	Reference Phase	6									
Offset, s	0	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
Green	5.0	50.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	1	6	5	2		4		8
Case Number	1.1	3.0	1.1	3.0		6.0		6.0
Phase Duration, s	10.0	55.0	10.0	55.0		25.0		25.0
Change Period, (Y+R <sub>c</sub> ), s	5.0	5.0	5.0	5.0		5.0		5.0
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g <sub>s</sub> ), s	2.2		3.8			13.0		10.0
Green Extension Time (g <sub>e</sub> ), s	0.0	0.0	0.0	0.0		0.5		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.09		0.01

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Assigned Movement	1	6	16	5	2	12	7	4	14	3	8	18
Adjusted Flow Rate (v), veh/h	12	1043	89	87	1036	28	157	148		16	41	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1809	1610	1810	1809	1610	1387	1616		1260	1624	
Queue Service Time (g <sub>s</sub> ), s	0.2	16.2	2.3	1.8	16.0	0.7	9.1	7.0		1.0	1.8	
Cycle Queue Clearance Time (g <sub>c</sub> ), s	0.2	16.2	2.3	1.8	16.0	0.7	11.0	7.0		8.0	1.8	
Capacity (c), veh/h	389	2010	895	387	2010	895	360	359		261	361	
Volume-to-Capacity Ratio (X)	0.031	0.519	0.099	0.224	0.515	0.031	0.435	0.412		0.060	0.114	
Available Capacity (c <sub>a</sub> ), veh/h	389	2010	895	387	2010	895	360	359		261	361	
Back of Queue (Q), veh/ln (50th percentile)	0.1	6.1	0.8	0.6	6.1	0.2	3.1	2.8		0.3	0.7	
Overflow Queue (Q <sub>3</sub> ), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d <sub>1</sub> ), s/veh	8.3	12.5	9.4	8.9	12.5	9.0	32.3	30.0		33.4	27.9	
Incremental Delay (d <sub>2</sub> ), s/veh	0.0	1.0	0.2	0.1	0.9	0.1	0.3	0.3		0.0	0.1	
Initial Queue Delay (d <sub>3</sub> ), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	8.3	13.5	9.6	9.0	13.4	9.1	32.6	30.2		33.4	28.0	
Level of Service (LOS)	A	B	A	A	B	A	C	C		C	C	
Approach Delay, s/veh / LOS	13.1		B	13.0		B	31.5		C	29.5		C
Intersection Delay, s/veh / LOS	15.5						B					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.2		B	2.2		B	3.0		C	3.0		C
Bicycle LOS Score / LOS	1.4		A	1.4		A	1.0		A	0.6		A

# Traffic Data Service

2224 E. Cedar Ave. #7  
 Flagstaff AZ 86004  
 800-837-2562

Site Code: 2  
 Station ID:  
 Airport Road South of Parking area

Latitude: 0' 0.000 Undefined

Start Time	09-Nov-13 Sat		North		South		Combined		10-Nov-Sun		North		South		Combined	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00	3	28	3	25	6	53	0	22	1	35	1	57				
12:15	0	24	0	29	0	53	0	28	0	27	0	55				
12:30	0	37	1	27	1	64	1	41	0	23	1	64				
12:45	0	31	0	36	0	67	0	35	0	24	0	59				
01:00	0	21	0	24	0	45	1	22	1	23	2	45				
01:15	0	17	0	31	0	48	0	21	0	26	0	47				
01:30	0	18	0	22	0	40	0	21	0	20	0	41				
01:45	1	34	2	22	3	56	0	20	1	13	1	33				
02:00	0	27	0	26	0	53	0	32	0	26	0	58				
02:15	0	33	0	33	0	66	0	23	0	21	0	44				
02:30	0	23	0	35	0	58	0	32	0	28	0	60				
02:45	0	33	0	25	0	58	0	26	0	33	0	59				
03:00	0	29	0	41	0	70	0	33	0	27	0	60				
03:15	0	28	0	33	0	61	0	17	0	23	0	40				
03:30	0	25	0	28	0	53	0	30	0	24	0	54				
03:45	0	30	0	42	0	72	0	32	0	19	0	51				
04:00	0	26	0	22	0	48	1	29	1	34	2	63				
04:15	0	35	0	23	0	58	0	36	0	24	0	60				
04:30	1	47	0	32	1	79	0	56	0	25	0	81				
04:45	0	52	2	28	2	80	1	60	1	38	2	98				
05:00	0	82	0	33	0	115	1	52	0	39	1	91				
05:15	2	43	0	58	2	101	2	23	1	73	3	96				
05:30	1	17	0	79	1	96	1	18	1	52	2	70				
05:45	1	16	2	45	3	61	1	13	0	70	1	83				
06:00	6	11	2	16	8	27	4	6	0	16	4	22				
06:15	9	14	1	11	10	25	7	8	3	10	10	18				
06:30	10	10	3	16	13	26	12	9	1	15	13	24				
06:45	10	11	3	10	13	21	14	11	9	6	23	17				
07:00	5	7	3	9	8	16	7	12	5	13	12	25				
07:15	10	5	7	7	17	12	3	9	10	7	13	16				
07:30	10	9	14	12	24	21	6	8	15	8	21	16				
07:45	7	4	10	10	17	14	12	7	10	4	22	11				
08:00	11	2	7	7	18	9	10	7	13	5	23	12				
08:15	8	7	12	4	20	11	10	5	14	6	24	11				
08:30	8	2	12	13	20	15	12	8	8	7	20	15				
08:45	15	4	11	6	26	10	9	3	5	5	14	8				
09:00	17	2	15	6	32	8	19	6	8	2	27	8				
09:15	22	7	24	7	46	14	15	8	13	4	28	12				
09:30	14	8	23	14	37	22	22	5	13	3	35	8				
09:45	15	4	19	5	34	9	34	6	21	2	55	8				
10:00	17	2	20	4	37	6	22	0	36	4	58	4				
10:15	18	8	9	13	27	21	16	1	25	2	41	3				
10:30	18	2	30	6	48	8	11	1	25	2	36	3				
10:45	10	6	27	3	37	9	26	2	26	1	52	3				
11:00	31	5	14	2	45	7	28	1	36	3	64	4				
11:15	41	3	21	0	62	3	28	1	26	1	54	2				
11:30	18	0	21	6	39	6	22	2	34	2	56	4				
11:45	16	1	22	3	38	4	28	0	40	3	68	3				
Total	355	890	340	989	695	1879	386	848	403	878	789	1726				
Day Total	1245		1329		2574		1234		1281		2515					
% Total	13.8%	34.6%	13.2%	38.4%			15.3%	33.7%	16.0%	34.9%						
Peak	11:00	04:30	10:30	05:00	10:30	04:45	11:00	04:15	11:00	05:00	11:00	04:30				
Vol.	106	224	92	215	192	392	106	204	136	234	242	366				
P.H.F.	0.646	0.683	0.767	0.680	0.774	0.852	0.946	0.850	0.850	0.801	0.890	0.934				

# Traffic Data Service

2224 E. Cedar Ave. #7  
 Flagstaff AZ 86004  
 800-837-2562

Site Code: 2  
 Station ID:  
 Airport Road South of Parking area

Latitude: 0' 0.000 Undefined

Start Time	11-Nov-13		North		South		Combined		12-Nov-		North		South		Combined	
	Mon		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00			1	25	1	22	2	47		2	25	2	21	4	46	
12:15			0	21	0	29	0	50		1	31	1	19	2	50	
12:30			1	32	0	23	1	55		1	30	2	22	3	52	
12:45			0	18	1	19	1	37		1	24	0	27	1	51	
01:00			0	21	1	20	1	41		0	22	1	14	1	36	
01:15			0	23	1	18	1	41		0	21	2	19	2	40	
01:30			0	37	0	23	0	60		0	18	0	26	0	44	
01:45			0	24	0	32	0	56		0	18	0	27	0	45	
02:00			0	23	0	23	0	46		0	20	0	27	0	47	
02:15			0	22	0	29	0	51		0	18	0	17	0	35	
02:30			0	31	0	26	0	57		0	25	0	30	0	55	
02:45			0	21	0	24	0	45		0	28	0	30	0	58	
03:00			0	26	0	26	0	52		0	21	0	35	0	56	
03:15			0	33	0	25	0	58		0	24	0	22	0	46	
03:30			0	25	0	35	0	60		0	19	0	29	0	48	
03:45			0	26	0	27	0	53		0	21	0	25	0	46	
04:00			0	24	0	34	0	58		0	16	0	30	0	46	
04:15			0	44	0	30	0	74		0	30	0	19	0	49	
04:30			0	31	0	41	0	72		0	38	0	31	0	69	
04:45			1	62	2	27	3	89		0	50	0	18	0	68	
05:00			1	49	1	23	2	72		0	42	0	30	0	72	
05:15			1	32	0	68	1	100		1	18	1	59	2	77	
05:30			3	14	1	75	4	89		0	7	0	38	0	45	
05:45			1	12	2	29	3	41		2	7	1	34	3	41	
06:00			2	5	1	27	3	32		4	14	3	12	7	26	
06:15			7	7	1	11	8	18		4	6	0	12	4	18	
06:30			6	3	2	11	8	14		4	7	5	13	9	20	
06:45			7	13	4	9	11	22		8	3	3	6	11	9	
07:00			7	5	5	12	12	17		4	8	1	16	5	24	
07:15			7	6	8	10	15	16		8	4	8	3	16	7	
07:30			10	5	5	5	15	10		9	1	5	2	14	3	
07:45			14	5	13	6	27	11		17	2	12	2	29	4	
08:00			8	7	9	2	17	9		13	3	5	5	18	8	
08:15			14	5	12	1	26	6		13	4	8	3	21	7	
08:30			12	2	18	1	30	3		12	5	18	1	30	6	
08:45			23	4	18	2	41	6		15	9	13	3	28	12	
09:00			10	2	21	0	31	2		10	4	13	3	23	7	
09:15			18	6	18	6	36	12		7	8	17	11	24	19	
09:30			16	2	29	4	45	6		17	4	21	2	38	6	
09:45			18	5	22	2	40	7		19	5	20	5	39	10	
10:00			18	2	31	4	49	6		22	2	13	6	35	8	
10:15			17	3	20	4	37	7		15	1	25	0	40	1	
10:30			20	0	24	0	44	0		15	2	18	0	33	2	
10:45			21	0	23	1	44	1		11	0	22	0	33	0	
11:00			21	0	33	0	54	0		18	1	24	1	42	2	
11:15			24	0	24	1	48	1		19	2	16	1	35	3	
11:30			15	0	20	0	35	0		14	0	20	2	34	2	
11:45			21	1	29	0	50	1		13	0	19	0	32	0	
Total			345	764	400	847	745	1611		299	668	319	758	618	1426	
Day Total			1109		1247		2356			967		1077		2044		
% Total			14.6%	32.4%	17.0%	36.0%				14.6%	32.7%	15.6%	37.1%			
Peak			10:30	04:15	11:00	05:15	10:30	04:45		09:30	04:15	10:15	05:00	09:30	04:30	
Vol.			86	186	106	199	190	350		73	160	89	161	152	286	
P.H.F.			0.896	0.750	0.803	0.663	0.880	0.875		0.830	0.800	0.890	0.682	0.950	0.929	

# Traffic Data Service

2224 E. Cedar Ave. #7  
Flagstaff AZ 86004  
800-837-2562

Site Code: 2  
Station ID:  
Airport Road South of Parking area

Latitude: 0' 0.000 Undefined

Start Time	13-Nov-13		North		South		Combined		14-Nov-		North		South		Combined		
	Wed		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Thu	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00			1	21	1	25	2	46		0	23	0	20	0	43		
12:15			0	20	0	23	0	43		0	17	0	17	0	34		
12:30			0	38	0	28	0	66		0	27	0	18	0	45		
12:45			0	22	0	28	0	50		0	16	0	22	0	38		
01:00			0	19	0	20	0	39		0	21	0	16	0	37		
01:15			0	15	0	16	0	31		0	18	0	19	0	37		
01:30			1	15	1	15	2	30		0	25	0	22	0	47		
01:45			0	19	0	18	0	37		0	21	1	17	1	38		
02:00			0	15	0	24	0	39		0	25	0	13	0	38		
02:15			0	26	0	26	0	52		0	19	0	19	0	38		
02:30			0	19	0	22	0	41		1	15	0	20	1	35		
02:45			0	19	0	20	0	39		1	13	1	28	2	41		
03:00			0	13	0	14	0	27		0	22	0	30	0	52		
03:15			0	20	0	29	0	49		0	27	0	20	0	47		
03:30			0	26	0	24	0	50		0	18	0	25	0	43		
03:45			0	17	0	26	0	43		0	22	0	22	0	44		
04:00			0	25	0	21	0	46		0	28	0	26	0	54		
04:15			0	22	0	27	0	49		0	32	0	25	0	57		
04:30			0	<b>30</b>	0	32	0	62		0	<b>28</b>	0	23	0	51		
04:45			0	<b>49</b>	0	14	0	<b>63</b>		0	<b>43</b>	0	31	0	<b>74</b>		
05:00			0	<b>45</b>	0	20	0	<b>65</b>		1	<b>38</b>	0	<b>25</b>	1	<b>63</b>		
05:15			1	<b>28</b>	1	<b>76</b>	2	<b>104</b>		1	<b>36</b>	1	<b>40</b>	2	<b>76</b>		
05:30			2	15	0	<b>53</b>	2	<b>68</b>		0	16	0	<b>64</b>	0	<b>80</b>		
05:45			2	17	4	<b>29</b>	6	46		0	8	2	<b>52</b>	2	60		
06:00			1	4	1	<b>21</b>	2	25		5	3	2	11	7	14		
06:15			6	10	3	19	9	29		6	14	2	5	8	19		
06:30			6	8	1	8	7	16		6	20	4	4	10	24		
06:45			9	6	4	7	13	13		11	25	2	13	13	38		
07:00			7	2	7	6	14	8		6	10	6	7	12	17		
07:15			13	8	9	3	22	11		6	7	8	3	14	10		
07:30			12	5	7	4	19	9		6	3	9	5	15	8		
07:45			14	6	10	4	24	10		<b>21</b>	7	6	6	27	13		
08:00			11	2	9	1	20	3		<b>17</b>	3	11	1	28	4		
08:15			7	4	13	2	20	6		<b>31</b>	6	9	6	40	12		
08:30			6	2	11	2	17	4		<b>20</b>	5	11	5	31	10		
08:45			11	6	7	4	18	10		13	3	14	20	27	23		
09:00			16	4	16	6	32	10		7	6	14	21	21	27		
09:15			13	4	9	12	22	16		11	4	40	8	51	12		
09:30			18	2	13	9	31	11		18	2	19	6	37	8		
09:45			17	4	29	4	46	8		16	3	20	2	36	5		
10:00			22	1	17	2	39	3		14	0	17	6	31	6		
10:15			12	2	20	3	32	5		22	3	27	2	49	5		
10:30			18	1	16	0	34	1		14	2	15	0	29	2		
10:45			<b>18</b>	0	21	1	<b>39</b>	1		14	0	22	2	36	2		
11:00			<b>23</b>	0	<b>31</b>	2	<b>54</b>	2		22	0	<b>16</b>	1	<b>38</b>	1		
11:15			<b>30</b>	4	<b>23</b>	0	<b>53</b>	4		21	0	<b>19</b>	0	<b>40</b>	0		
11:30			<b>20</b>	0	<b>23</b>	0	<b>43</b>	0		14	1	<b>34</b>	0	<b>48</b>	1		
11:45			14	0	<b>23</b>	0	37	0		18	0	<b>28</b>	1	<b>46</b>	1		
Total			331	640	330	750	661	1390		343	685	360	749	703	1434		
Day Total			971		1080		2051			1028		1109		2137			
% Total			16.1%	31.2%	16.1%	36.6%				16.1%	32.1%	16.8%	35.0%				
Peak			10:45	04:30	11:00	05:15	10:45	04:45		07:45	04:30	11:00	05:00	11:00	04:45		
Vol.			91	152	100	179	189	300		89	145	97	181	172	293		
P.H.F.			0.758	0.776	0.806	0.589	0.875	0.721		0.718	0.843	0.713	0.707	0.896	0.916		



# Traffic Data Service

2224 E. Cedar Ave. #7  
 Flagstaff AZ 86004  
 800-837-2562

Site Code: 1  
 Station ID:  
 Airport Road South of US 89

Latitude: 0' 0.000 Undefined

Start Time	09-Nov-13		North		South		Combined		10-Nov-Sun		North		South		Combined	
	Sat		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Sun		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00			2	21	1	16	3	37			0	14	0	20	0	34
12:15			0	18	0	25	0	43			0	18	0	19	0	37
12:30			0	19	1	15	1	34			0	28	0	18	0	46
12:45			0	23	0	19	0	42			1	24	0	19	1	43
01:00			0	19	0	16	0	35			1	14	1	18	2	32
01:15			0	17	0	25	0	42			0	17	0	14	0	31
01:30			0	17	0	19	0	36			0	10	0	18	0	28
01:45			0	30	1	13	1	43			0	24	1	15	1	39
02:00			0	20	0	24	0	44			0	20	0	19	0	39
02:15			0	31	0	27	0	58			0	22	0	21	0	43
02:30			0	18	0	26	0	44			0	25	0	13	0	38
02:45			0	21	0	11	0	32			0	20	0	24	0	44
03:00			0	20	0	39	0	59			0	23	0	20	0	43
03:15			0	27	0	24	0	51			0	16	0	17	0	33
03:30			0	26	0	29	0	55			0	28	0	24	0	52
03:45			0	23	0	31	0	54			0	23	0	16	0	39
04:00			0	17	0	16	0	33			1	24	1	26	2	50
04:15			0	34	0	18	0	52			0	28	0	15	0	43
04:30			0	40	0	16	0	56			0	38	0	20	0	58
04:45			0	42	0	19	0	61			0	46	0	15	0	61
05:00			0	63	0	21	0	84			1	55	0	25	1	80
05:15			2	29	0	64	2	93			2	27	1	54	3	81
05:30			0	13	1	64	1	77			1	18	1	50	2	68
05:45			2	9	0	27	2	36			0	10	0	52	0	62
06:00			4	7	2	13	6	20			3	5	1	11	4	16
06:15			7	8	2	11	9	19			4	7	1	8	5	15
06:30			5	9	4	12	9	21			6	9	2	12	8	21
06:45			7	7	4	8	11	15			11	8	5	5	16	13
07:00			5	7	1	7	6	14			5	9	6	13	11	22
07:15			7	5	4	5	11	10			4	9	9	6	13	15
07:30			9	8	10	10	19	18			6	6	6	7	12	13
07:45			8	5	5	9	13	14			11	4	10	3	21	7
08:00			6	1	4	8	10	9			11	7	8	3	19	10
08:15			11	5	7	2	18	7			10	3	11	6	21	9
08:30			6	4	10	6	16	10			8	7	6	5	14	12
08:45			10	4	8	4	18	8			5	3	4	4	9	7
09:00			13	2	11	2	24	4			16	5	7	2	23	7
09:15			9	5	18	6	27	11			10	8	12	4	22	12
09:30			15	9	13	8	28	17			15	3	14	3	29	6
09:45			13	4	12	1	25	5			20	4	16	2	36	6
10:00			13	2	15	5	28	7			17	0	29	3	46	3
10:15			12	7	10	7	22	14			12	0	23	1	35	1
10:30			16	2	16	6	32	8			9	0	17	2	26	2
10:45			7	4	25	0	32	4			26	2	21	1	47	3
11:00			19	2	11	2	30	4			19	1	23	3	42	4
11:15			37	4	14	2	51	6			27	1	23	2	50	3
11:30			20	0	15	6	35	6			15	1	25	0	40	1
11:45			14	1	19	3	33	4			20	0	29	3	49	3
Total			279	709	244	747	523	1456			297	674	313	661	610	1335
Day Total			988		991		1979				971		974		1945	
% Total			14.1%	35.8%	12.3%	37.7%					15.3%	34.7%	16.1%	34.0%		
Peak			11:00	04:15	10:00	05:00	11:00	04:45			10:45	04:15	11:00	05:00	11:00	05:00
Vol.			90	179	66	176	149	315			87	167	100	181	181	291
P.H.F.			0.608	0.710	0.660	0.688	0.730	0.847			0.806	0.759	0.862	0.838	0.905	0.898

# Traffic Data Service

2224 E. Cedar Ave. #7  
Flagstaff AZ 86004  
800-837-2562

Site Code: 1  
Station ID:  
Airport Road South of US 89

Latitude: 0' 0.000 Undefined

Start Time	11-Nov-13		North		South		Combined		12-Nov-		North		South		Combined		
	Mon		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00			1	16	0	12	1	28		0	19	2	10	2	29		
12:15			0	16	0	20	0	36		1	21	0	14	1	35		
12:30			0	19	0	16	0	35		1	13	2	14	3	27		
12:45			0	7	0	17	0	24		1	11	0	16	1	27		
01:00			0	15	0	11	0	26		0	14	1	11	1	25		
01:15			0	19	1	12	1	31		0	15	2	14	2	29		
01:30			0	25	0	15	0	40		0	19	0	12	0	31		
01:45			0	17	0	18	0	35		0	13	0	21	0	34		
02:00			0	15	0	15	0	30		0	17	0	19	0	36		
02:15			0	13	0	17	0	30		0	13	0	15	0	28		
02:30			0	22	0	19	0	41		0	19	0	15	0	34		
02:45			0	16	0	14	0	30		0	23	0	11	0	34		
03:00			0	17	0	27	0	44		0	16	0	30	0	46		
03:15			0	23	0	16	0	39		0	16	0	18	0	34		
03:30			0	24	0	23	0	47		0	12	0	17	0	29		
03:45			0	19	0	19	0	38		0	17	0	17	0	34		
04:00			0	17	0	22	0	39		0	12	0	21	0	33		
04:15			0	42	0	16	0	58		0	23	0	11	0	34		
04:30			0	23	0	30	0	53		0	36	0	19	0	55		
04:45			1	46	2	21	3	67		0	38	0	12	0	50		
05:00			1	50	2	22	1	72		0	47	0	26	0	73		
05:15			0	33	1	62	1	95		1	16	0	56	1	72		
05:30			2	13	0	51	2	64		0	7	0	31	0	38		
05:45			2	7	2	17	4	24		1	3	1	23	2	26		
06:00			2	3	1	19	3	22		4	7	2	5	6	12		
06:15			6	6	0	10	6	16		3	4	1	7	4	11		
06:30			4	3	5	9	9	12		4	5	3	11	7	16		
06:45			4	9	2	8	6	17		7	1	1	4	8	5		
07:00			7	4	4	8	11	12		3	5	2	12	5	17		
07:15			7	4	6	8	13	12		2	2	5	2	7	4		
07:30			4	4	6	5	10	9		5	3	3	2	8	5		
07:45			16	4	3	3	19	7		12	2	4	2	16	4		
08:00			11	5	5	1	16	6		12	4	1	5	13	9		
08:15			9	2	13	1	22	3		10	2	6	2	16	4		
08:30			11	2	10	1	21	3		7	5	7	1	14	6		
08:45			15	2	11	2	26	4		9	1	9	2	18	3		
09:00			8	1	10	0	18	1		9	3	9	1	18	4		
09:15			15	4	15	5	30	9		7	5	9	4	16	9		
09:30			12	1	28	3	40	4		15	3	15	4	30	7		
09:45			14	4	13	3	27	7		11	3	15	2	26	5		
10:00			10	0	19	3	29	3		17	1	4	6	21	7		
10:15			16	2	8	2	24	4		10	1	18	0	28	1		
10:30			16	0	20	0	36	0		9	1	16	0	25	1		
10:45			23	0	16	1	39	1		8	0	10	0	18	0		
11:00			14	0	28	0	42	0		12	1	17	1	29	2		
11:15			20	0	19	1	39	1		15	0	9	1	24	1		
11:30			11	0	16	0	27	0		11	0	14	1	25	1		
11:45			14	1	19	0	33	1		9	0	11	0	20	0		
Total			276	575	283	605	559	1180		216	499	199	528	415	1027		
Day Total			851		888		1739			715		727		1442			
% Total			15.9%	33.1%	16.3%	34.8%				15.0%	34.6%	13.8%	36.6%				
Peak			10:30	04:15	10:30	04:45	10:30	04:45		09:30	04:15	10:15	05:00	09:30	04:30		
Vol.			73	161	83	156	156	298		53	144	61	136	105	250		
P.H.F.			0.793	0.805	0.741	0.629	0.929	0.784		0.779	0.766	0.847	0.607	0.875	0.856		

# Traffic Data Service

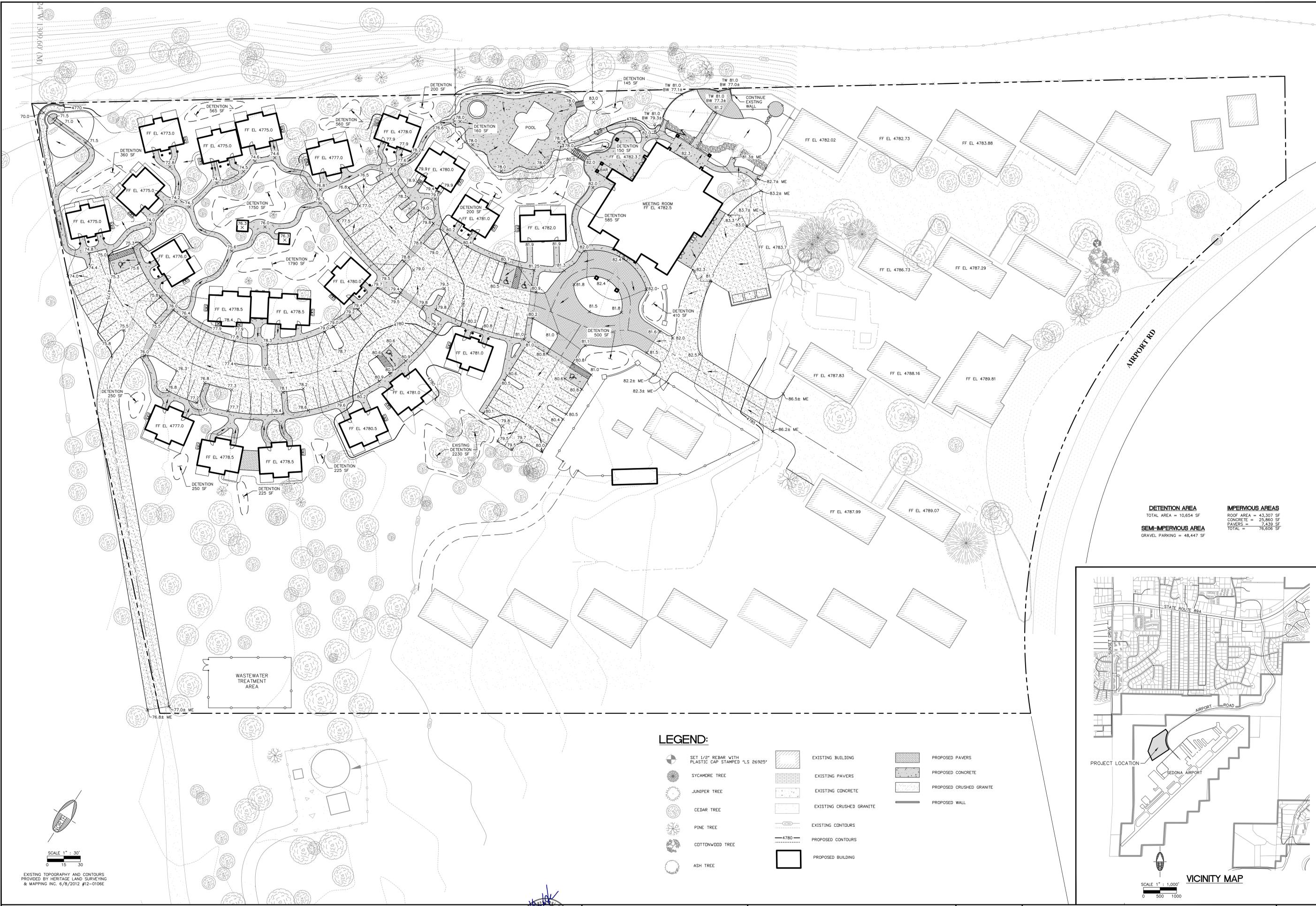
2224 E. Cedar Ave. #7  
 Flagstaff AZ 86004  
 800-837-2562

Site Code: 1  
 Station ID:  
 Airport Road South of US 89

Latitude: 0' 0.000 Undefined

Start Time	13-Nov-13		North		South		Combined		14-Nov-		North		South		Combined	
	Wed		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Thu	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00			0	14	0	14	0	28		0	12	0	10	0	22	
12:15			0	15	0	12	0	27		0	8	0	12	0	20	
12:30			0	25	0	20	0	45		0	18	0	9	0	27	
12:45			0	14	0	20	0	34		0	9	0	17	0	26	
01:00			0	18	0	14	0	32		0	12	0	6	0	18	
01:15			0	18	0	13	0	31		0	17	0	11	0	28	
01:30			0	11	0	13	0	24		0	11	0	16	0	27	
01:45			0	11	0	14	0	25		0	14	1	9	1	23	
02:00			0	8	0	12	0	20		0	17	0	12	0	29	
02:15			0	14	0	19	0	33		0	17	0	11	0	28	
02:30			0	12	0	14	0	26		1	13	0	16	1	29	
02:45			0	14	0	7	0	21		0	11	1	20	1	31	
03:00			0	11	0	13	0	24		0	16	0	15	0	31	
03:15			0	11	0	10	0	21		0	19	0	13	0	32	
03:30			0	15	0	13	0	28		0	9	0	17	0	26	
03:45			0	14	0	22	0	36		0	16	0	16	0	32	
04:00			0	18	0	14	0	32		0	16	0	21	0	37	
04:15			0	17	0	17	0	34		0	25	0	14	0	39	
04:30			0	27	0	16	0	43		0	29	0	14	0	43	
04:45			0	44	0	7	0	51		0	40	0	8	0	48	
05:00			0	31	0	12	0	43		0	39	0	18	0	57	
05:15			1	25	1	60	2	85		2	28	0	37	2	65	
05:30			2	13	0	40	2	53		1	14	0	67	1	81	
05:45			1	12	4	23	5	35		0	7	1	29	1	36	
06:00			2	5	1	13	3	18		3	2	3	9	6	11	
06:15			4	5	2	11	6	16		4	6	2	6	6	12	
06:30			4	5	0	5	4	10		4	4	1	4	5	8	
06:45			9	3	4	5	13	8		8	7	1	11	9	18	
07:00			3	1	4	2	7	3		7	5	4	4	11	9	
07:15			11	5	3	2	14	7		5	6	6	3	11	9	
07:30			8	4	5	3	13	7		3	2	4	5	7	7	
07:45			10	5	1	2	11	7		10	3	1	1	11	4	
08:00			10	2	5	2	15	4		12	4	5	1	17	5	
08:15			6	3	7	1	13	4		9	2	6	5	15	7	
08:30			3	1	8	3	11	4		9	4	5	4	14	8	
08:45			10	4	3	1	13	5		8	3	6	1	14	4	
09:00			10	1	8	5	18	6		4	4	8	1	12	5	
09:15			11	3	7	12	18	15		7	4	7	5	14	9	
09:30			14	2	5	9	19	11		10	1	8	4	18	5	
09:45			8	1	20	3	28	4		10	2	9	2	19	4	
10:00			15	1	6	2	21	3		9	0	13	5	22	5	
10:15			10	1	13	0	23	1		10	3	17	3	27	6	
10:30			12	1	16	0	28	1		8	1	8	0	16	1	
10:45			15	0	14	1	29	1		10	0	16	1	26	1	
11:00			16	0	14	2	30	2		19	0	11	1	27	1	
11:15			16	2	17	1	33	3		16	0	11	0	27	0	
11:30			13	1	16	0	29	1		14	1	25	0	39	1	
11:45			9	0	13	0	22	0		13	0	15	1	28	1	
Total			233	468	197	504	430	972		216	481	195	495	411	976	
Day Total			701		701		1402		697		690		1387			
% Total			16.6%	33.4%	14.1%	35.9%			15.6%	34.7%	14.1%	35.7%				
Peak			10:45	04:30	10:30	05:15	10:45	04:45		11:00	04:30	10:45	05:00	11:00	04:45	
Vol.			60	127	61	136	121	232		62	136	63	151	124	251	
P.H.F.			0.938	0.722	0.897	0.567	0.917	0.682		0.816	0.850	0.630	0.563	0.795	0.775	





<b>DETENTION AREA</b>	<b>IMPERVIOUS AREAS</b>
TOTAL AREA = 10,654 SF	ROOF AREA = 43,307 SF
	CONCRETE = 25,860 SF
	PAVERS = 2,430 SF
	TOTAL = 76,606 SF
<b>SEMI-IMPERVIOUS AREA</b>	
GRAVEL PARKING = 48,447 SF	

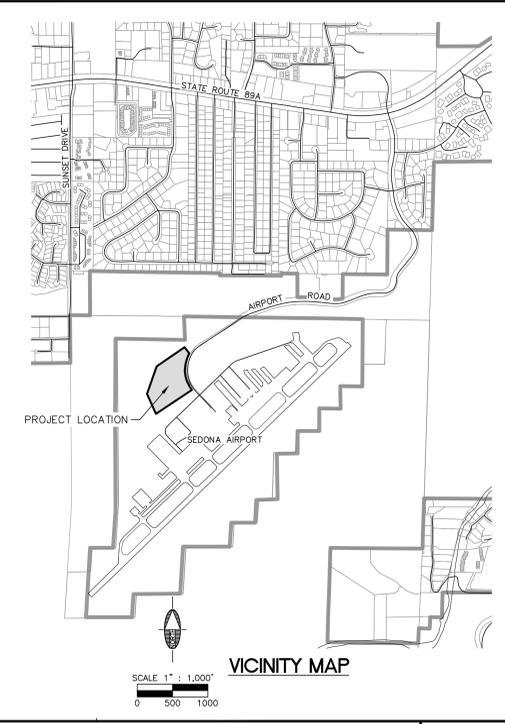
**LEGEND:**

- SET 1/2" REBAR WITH PLASTIC CAP STAMPED "LS 26925"
- SYCAMORE TREE
- JUNIPER TREE
- CEDAR TREE
- PINE TREE
- COTTONWOOD TREE
- ASH TREE
- EXISTING BUILDING
- EXISTING PAVERS
- EXISTING CONCRETE
- EXISTING CRUSHED GRANITE
- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPOSED BUILDING
- PROPOSED PAVERS
- PROPOSED CONCRETE
- PROPOSED CRUSHED GRANITE
- PROPOSED WALL



SCALE 1" = 30'

EXISTING TOPOGRAPHY AND CONTOURS PROVIDED BY HERITAGE LAND SURVEYING & MAPPING INC. 6/8/2012 #12-0106E



CALL TWO WORKING DAYS BEFORE YOU DIG  
1-800-STAKE-IT

*[Signature]*  
DATE: 12/06/13  
AUTHOR: R. BECKWITH  
12/06/13  
DRAWN: [Signature]  
CHECKED: [Signature]

REVISIONS			
NO.	DESCRIPTION	DATE	BY

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928.282.2058 Fax

JOB NO: 12100  
DATE: DEC 13  
SCALE: 1"=30'  
DRAWN: MWJ  
DESIGN: AHB  
CHECKED: AHB

SKY RANCH LODGE  
SEDONA, ARIZONA  
**PRELIMINARY GRADING PLAN**

SHEET  
**1**  
OF 1



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928.282.2058 fax

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*Engineering an environment of excellence.*

# PRELIMINARY DRAINAGE REPORT for Sky Ranch Lodge

APN: 408-27-001  
Sedona, Arizona

Prepared for:  
Sky Ranch Lodge  
1105 Airport Road  
Sedona, AZ 86336

Prepared by:  
Shephard-Wesnitzer, Inc.  
Consulting Engineers  
75 Kallof Place  
Sedona, Arizona 86336

December 6, 2013  
Job #13013

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**Introduction** ..... 1  
**Objective**..... 1  
**Procedure**..... 2  
**Results** ..... 2  
**Conclusion and Recommendations**..... 3  
**References**..... 4  
**Software**..... 4

**APPENDIX**

- Vicinity Map
- Fema Firm Panel
- Runoff Coefficients
- Pond Pack Detention Calculations
- Preliminary Grading Plan

## **Introduction**

The project site is located at the top of airport mesa in Sedona, Arizona. The project site is in Section 13, Township 17 North and Range 5 East, of the Gila and Salt River Base Meridian, Yavapai County. A vicinity map is provided in the Appendix.

The existing Sky Ranch Lodge consists of 94 lodging units and associated accessory structures. There are multiple lodging buildings with 1 to 8 lodging units in each building. Limited events such as weddings are hosted at the site but there are no support services such as catering available.

The Sky Ranch Lodge is located on a leased area of about 7.63 acres from Yavapai County. APN: 408-27-001 is approximately 241.31 acres in total. Most of the property development consists of the airport including runway and accessory structures that directly support airport use. There is a restaurant associated with the airport improvements.

The project site is bounded by Coconino National Forest land to the north and west. The site slopes to the northwest at approximately 2%. Storm water runoff flows to the northwest and exits the property along the northern and western property boundaries.

The proposed Sky Ranch Lodge expansion consists of a 7500 sf. meeting room and 40 lodging units. Each of the lodging unit buildings will be approximately 1000 sf and house 2 units. In addition to the meeting room and lodging units, the expansion will include concrete sidewalks and gravel parking areas. All new roofs will be guttered with rain water leaders directed toward the detention areas throughout the expansion area. The pool deck drainage will consist of several area drains and be piped to detention areas. The proposed facilities will be located on a leased area that will be increased to 12.16 acres. The existing improvements will remain on the property.

## **Objective**

The objective of this preliminary report is to determine the impact the proposed development of each unit will have on the runoff characteristics of the site. Mitigation measures will be determined for the adverse impacts of each unit to runoff conditions. The design of future proposed drainage control structures will be in accordance with City of Sedona requirements.

## **Procedure**

The stormwater runoff from a standard unit was determined so that multiple detention basins could be constructed on the site with minimal impacts to existing vegetation could occur. Rainfall data was taken from the NOAA ATLAS 14 rainfall Intensity-Duration-Frequency table found on the NOAA National Weather Service website.

Drainage patterns in the post-developed condition will follow the existing drainage patterns. Storm runoff will be directed to detention basins constructed throughout the property. The proposed site improvements and preliminary basin locations are shown on the Preliminary Grading Plan included in the Appendix.

Haestad Method's *Pond Pack* computer program was used to calculate the peak flows for existing and post-developed conditions, and to determine the volume of the proposed detention required. The Pond Pack calculations utilized the Modified Rational Method.

## **Results**

The standard unit or area used for the analysis was 2,000 square feet. This area includes the roof area for each unit plus concrete sidewalk around the unit. A storm time of duration of 10 minutes was used in the existing and post-developed scenarios. The Rational C coefficient for the existing condition was determined to be 0.55. The following table summarizes the peak flows in the existing condition for one unit.

**Table 1. Existing Condition Peak Flows (cfs)**

<b>2 Year</b>	<b>10 Year</b>	<b>25 Year</b>	<b>100 Year</b>
0.06	0.10	0.13	0.18

The composite Rational C coefficient for the post-developed condition was set at 0.95. The following table summarizes the post-developed condition peak flows for one unit.

**Table 2. Post-Development Condition Peak Flows (cfs)**

<b>2 Year</b>	<b>10 Year</b>	<b>25 Year</b>	<b>100 Year</b>
0.11	0.17	0.22	0.30

The maximum required storage for each unit was estimated to be 82 cubic feet during the 100 year storm. The PondPack summary calculations are included for each storm in the Appendix.

The proposed impervious area for the expansion is 75,312 sf. Based on our estimate of 82 cf. per 2000 sf. of impervious area; the required detention volume is approximately 3100 cu. ft. The detention area provided is 8620 sf. These areas will be graded with shallow slopes to a depth range of 0.5' to 1.0' to contain the required detention volume. Each detention area will have an outlet structure to release the runoff to a pre-development rate unless the percolation rate allows for emptying in 24 hours.

### **Conclusion and Recommendations**

Peak discharges for the 2, 10, 25 and 100-year storm events were determined for the proposed project lodging units for both the existing and post-developed conditions. Runoff from proposed buildings and site will be directed to the detention areas. The detention areas have been located to collect and offset increases in the peak flow rates for the 2, 10, 25 and 100-year storm events. Refer to the Preliminary Grading and Drainage Plan for grades, finished floor elevations, locations, and notes.

The stormwater pollution prevention best management practices proposed are the surface detention areas. These areas will either be grassed or rocked and landscaped. The only hard surface for vehicular traffic is the area in front of the porte cochere and it is proposed to be pavers and drain to a grassy detention area.

The design concepts in this report will ensure that the drainage integrity of the site is sustained with proper maintenance activity. Activities include frequent clearing of debris and sediment from the detention pond, disturbed slope treatment and erosion control. Frequent monitoring will ensure expedient remedies to common problems such as erosion, sedimentation, and flow obstructions.

## **References**

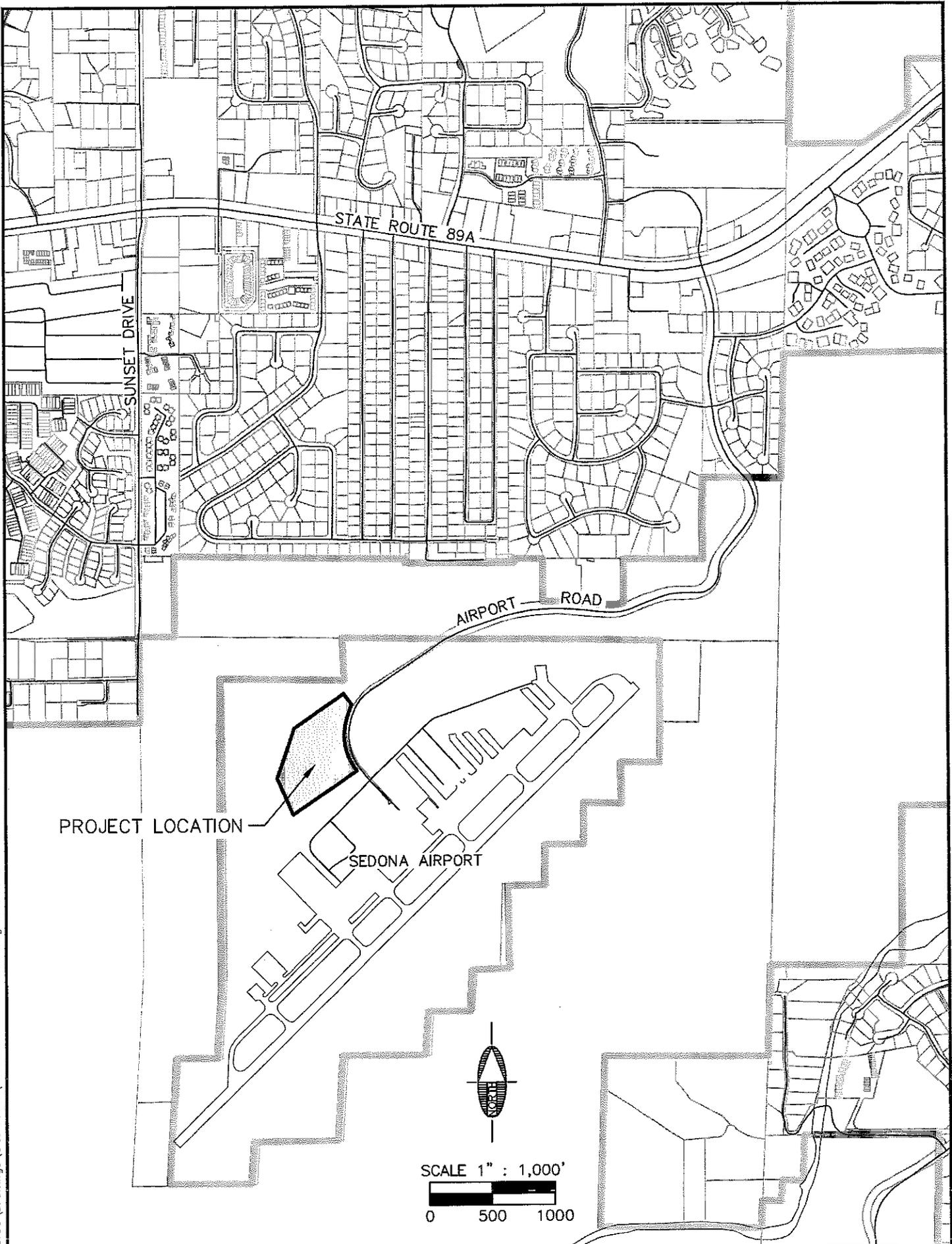
Drainage Criteria, City of Sedona, November 2009

Yavapai County Drainage Criteria Manual, Yavapai County Flood Control District, November 1998

Highway Drainage Design Manual of Hydrology, ADOT, 1993

## **Software**

*PondPack V8i*, Bentley Systems Inc.



**SWI**  
 Shephard & Wesnitzer, Inc

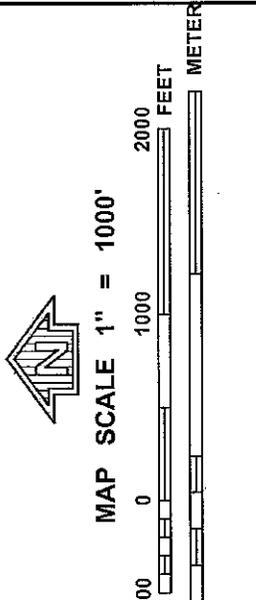
75 Kallef Place  
 Sedona, AZ 86336  
 928.282.1061  
 928.282.2058 fax  
 www.swiaz.com

JOB NO.	12100
DATE	NOV 13
SCALE	AS SHOWN
DRAWN	MWJ
DESIGN	
CHECKED	

SKY RANCH LODGE  
 VICINITY MAP

SEDONA  
 ARIZONA

SHEET  
**1**  
 OF 1



**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**

**FLOOD INSURANCE RATE MAP**

**PANEL 1435G**

**YAVAPAI COUNTY, ARIZONA AND INCORPORATED AREAS**

**PANEL 1435 OF 3900**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
SEDONA CITY OF YAVAPAI COUNTY	040130	1435	G
	040093	1435	G

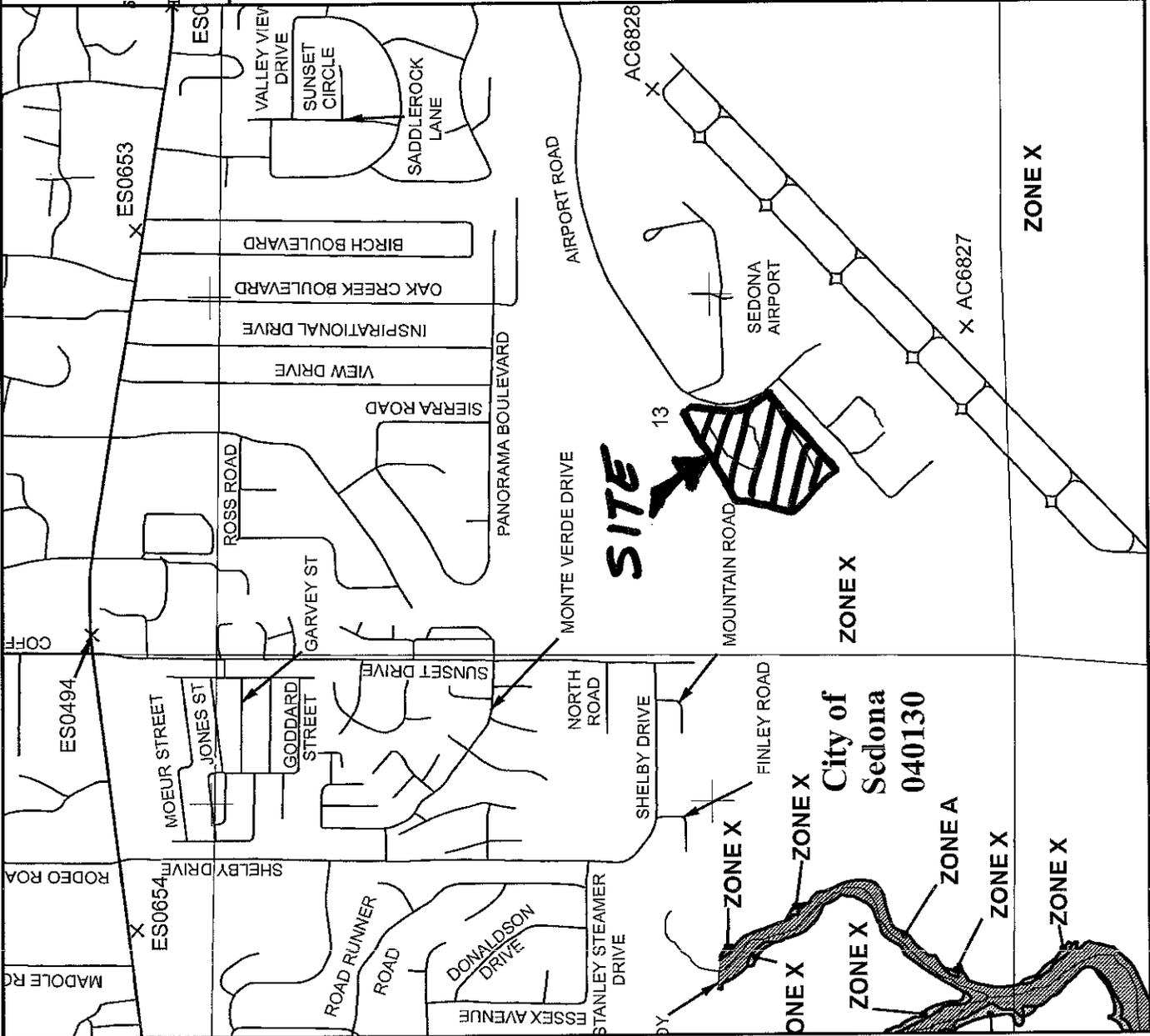
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER 04025C1435G**

**MAP REVISED SEPTEMBER 3, 2010**

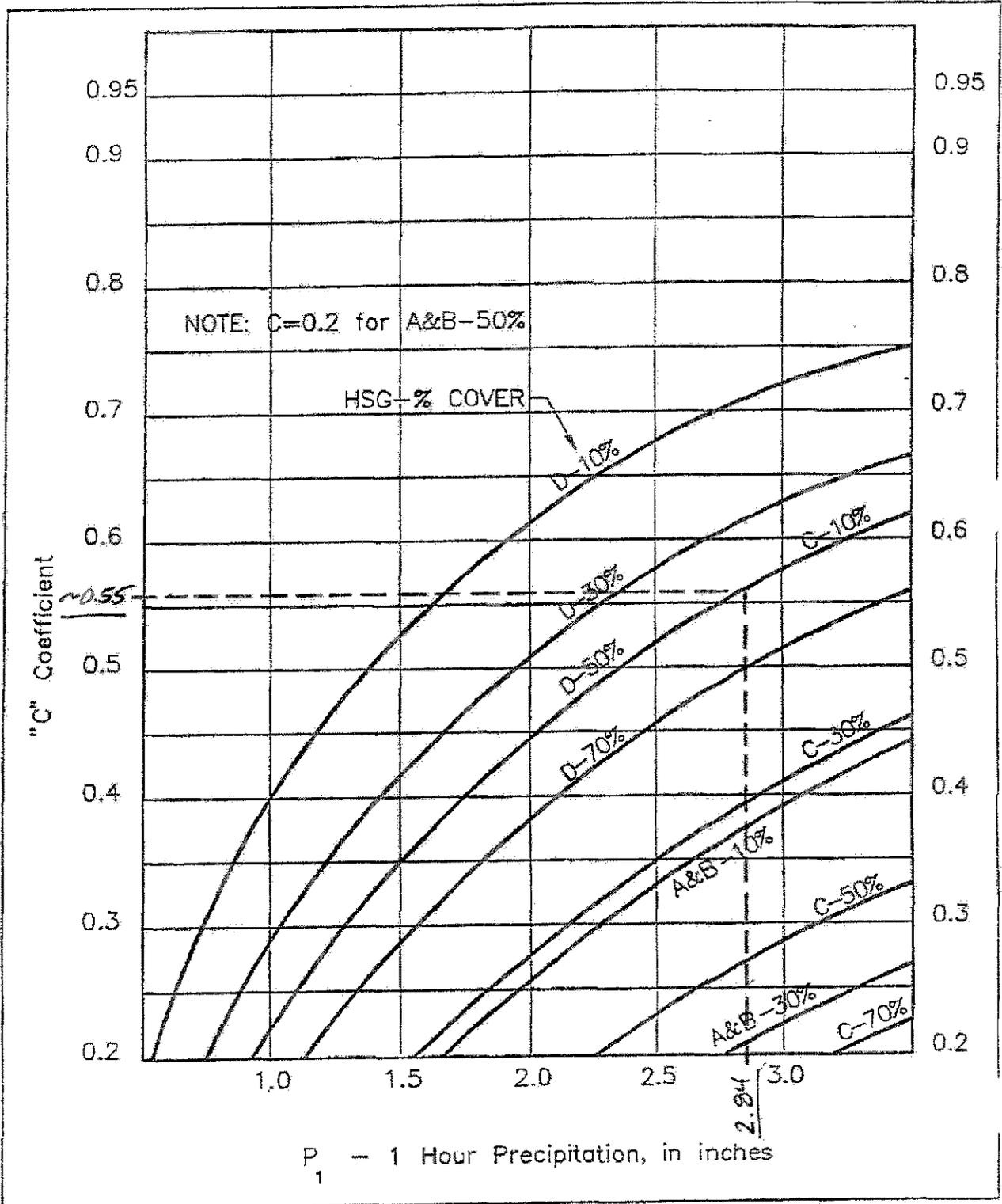
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



**FIGURE 2-7  
RATIONAL "C" COEFFICIENT  
MOUNTAIN  
(JUNIPER & GRASS)**

AS A FUNCTION OF RAINFALL DEPTH, HYDROLOGIC SOIL GROUP (HSG),  
AND % OF VEGETATION COVER



## Scenario Calculation Summary

Scenario Summary			
ID	38		
Label	Post-Development 2 Year		
Notes			
Active Topology	Post-Development Active Topology		
Hydrology	Post-Development Hydrology		
Rainfall Runoff	2 Year		
Physical	Post-Development Physical		
Initial Condition	Post-Development Initial Condition		
Boundary Condition	Post-Development Boundary Condition		
Infiltration and Inflow	Post-Development Infiltration and Inflow		
Output	Post-Development Output		
User Data Extensions	Post-Development User Data Extensions		
PondPack Engine Calculation Options	Base Calculation Options		
Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours
Rainfall Summary			
Return Event Tag	2	Rainfall Type	I-D-F Storm
Total Depth	(N/A) in	Storm Event	Sedona IDF Table - 2 Year

### Modified Rational Method Grand Summary

Frequency (years)	Area (ft <sup>2</sup> )	Adjusted C Coefficient	Duration (hours)	Intensity (in/h)	Flow (Peak) (ft <sup>3</sup> /s)	Flow (Allowable) (ft <sup>3</sup> /s)	Volume (inflow) (ft <sup>3</sup> )	Volume (Storage) (ft <sup>3</sup> )
2	2,000.0	0.950	0.183	2.395	0.11	0.06	69.5	29.2

### Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft <sup>3</sup> )	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft <sup>3</sup> )
CM-1	Post-Development 2 Year	2	None	68.0	0.084	0.11	(N/A)	(N/A)
O-1	Post-Development 2 Year	2	None	70.0	0.100	0.11	(N/A)	(N/A)

### Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft <sup>3</sup> )	Peak Time (hours)	Peak Flow (ft <sup>3</sup> /s)	End Point	Node Flow Direction
-------	------	----------	--	----------------------	-----------------------------------	-----------	------------------------

## Scenario Calculation Summary

Scenario Summary	
ID	36
Label	Post-Development 10 Year
Notes	
Active Topology	Post-Development Active Topology
Hydrology	Post-Development Hydrology
Rainfall Runoff	10 Year
Physical	Post-Development Physical
Initial Condition	Post-Development Initial Condition
Boundary Condition	Post-Development Boundary Condition
Infiltration and Inflow	Post-Development Infiltration and Inflow
Output	Post-Development Output
User Data Extensions	Post-Development User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary			
Return Event Tag	10	Rainfall Type	I-D-F Storm
Total Depth	(N/A) in	Storm Event	Sedona IDF Table - 10 Year

### Modified Rational Method Grand Summary

Frequency (years)	Area (ft <sup>2</sup> )	Adjusted C Coefficient	Duration (hours)	Intensity (in/h)	Flow (Peak) (ft <sup>3</sup> /s)	Flow (Allowable) (ft <sup>3</sup> /s)	Volume (inflow) (ft <sup>3</sup> )	Volume (Storage) (ft <sup>3</sup> )
10	2,000.0	0.950	0.200	3.818	0.17	0.10	120.9	48.3

### Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft <sup>3</sup> )	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft <sup>3</sup> )
CM-1	Post-Development 10 Year	10	None	115.0	0.084	0.17	(N/A)	(N/A)
O-1	Post-Development 10 Year	10	None	117.0	0.100	0.17	(N/A)	(N/A)

### Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft <sup>3</sup> )	Peak Time (hours)	Peak Flow (ft <sup>3</sup> /s)	End Point	Node Flow Direction
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## Scenario Calculation Summary

Scenario Summary	
ID	35
Label	Post-Development 25 Year
Notes	
Active Topology	Post-Development Active Topology
Hydrology	Post-Development Hydrology
Rainfall Runoff	25 Year
Physical	Post-Development Physical
Initial Condition	Post-Development Initial Condition
Boundary Condition	Post-Development Boundary Condition
Infiltration and Inflow	Post-Development Infiltration and Inflow
Output	Post-Development Output
User Data Extensions	Post-Development User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary			
Return Event Tag	25	Rainfall Type	I-D-F Storm
Total Depth	(N/A) in	Storm Event	Sedona IDF Table - 25 Year

### Modified Rational Method Grand Summary

Frequency (years)	Area (ft <sup>2</sup> )	Adjusted C Coefficient	Duration (hours)	Intensity (in/h)	Flow (Peak) (ft <sup>3</sup> /s)	Flow (Allowable) (ft <sup>3</sup> /s)	Volume (inflow) (ft <sup>3</sup> )	Volume (Storage) (ft <sup>3</sup> )
25	2,000.0	0.950	0.183	4.983	0.22	0.13	144.6	60.8

### Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft <sup>3</sup> )	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft <sup>3</sup> )
CM-1	Post-Development 25 Year	25	None	142.0	0.084	0.22	(N/A)	(N/A)
O-1	Post-Development 25 Year	25	None	145.0	0.100	0.22	(N/A)	(N/A)

### Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft <sup>3</sup> )	Peak Time (hours)	Peak Flow (ft <sup>3</sup> /s)	End Point	Node Flow Direction
-------	------	----------	--	----------------------	-----------------------------------	-----------	------------------------

## Scenario Calculation Summary

Scenario Summary	
ID	33
Label	Post-Development 100 Year
Notes	
Active Topology	Post-Development Active Topology
Hydrology	Post-Development Hydrology
Rainfall Runoff	100 Year
Physical	Post-Development Physical
Initial Condition	Post-Development Initial Condition
Boundary Condition	Post-Development Boundary Condition
Infiltration and Inflow	Post-Development Infiltration and Inflow
Output	Post-Development Output
User Data Extensions	Post-Development User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary			
Return Event Tag	100	Rainfall Type	I-D-F Storm
Total Depth	(N/A) in	Storm Event	Sedona IDF Table - 100 Year

### Modified Rational Method Grand Summary

Frequency (years)	Area (ft <sup>2</sup> )	Adjusted C Coefficient	Duration (hours)	Intensity (in/h)	Flow (Peak) (ft <sup>3</sup> /s)	Flow (Allowable) (ft <sup>3</sup> /s)	Volume (inflow) (ft <sup>3</sup> )	Volume (Storage) (ft <sup>3</sup> )
100	2,000.0	0.950	0.183	6.760	0.30	0.18	196.2	82.4

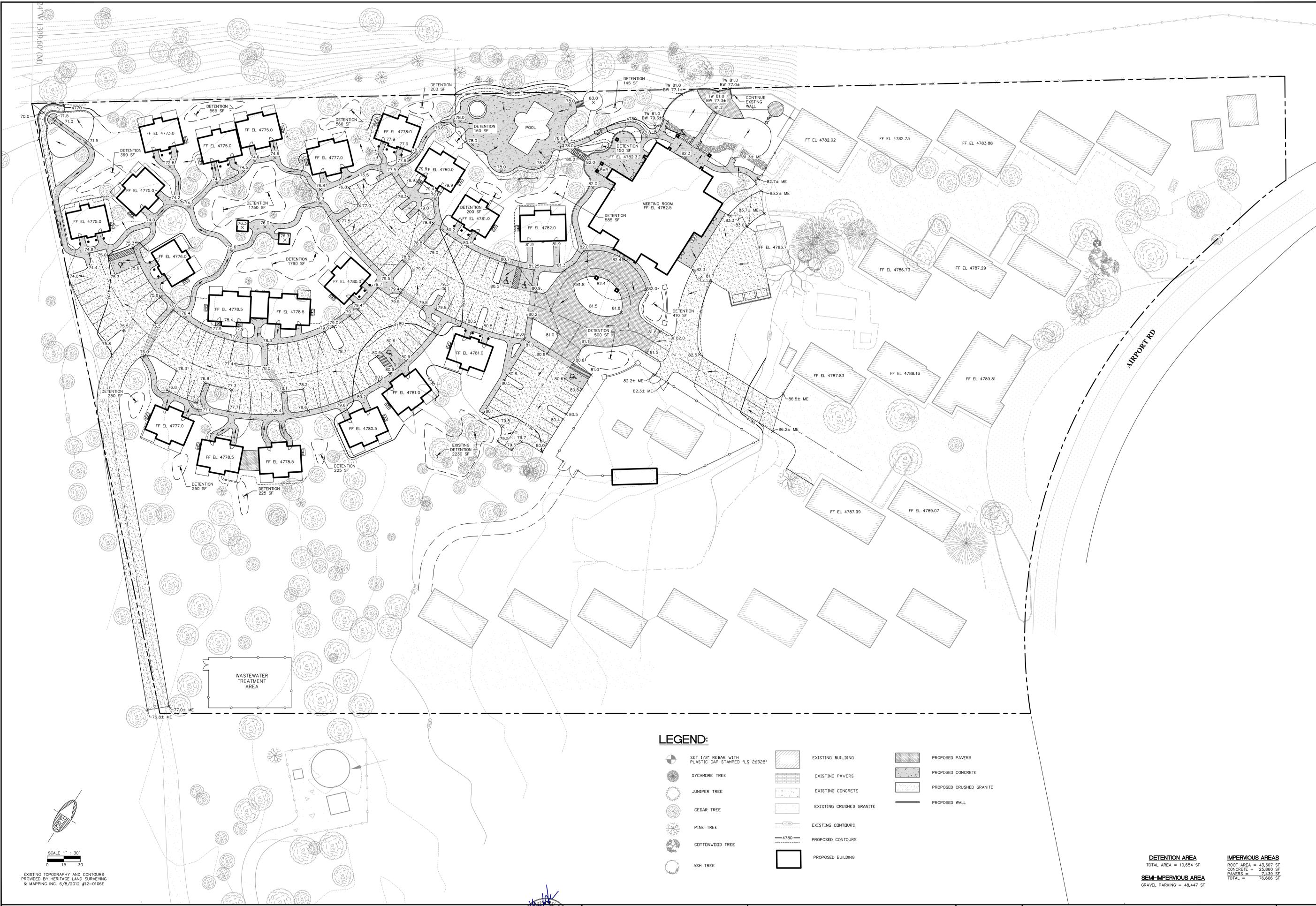


### Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft <sup>3</sup> )	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft <sup>3</sup> )
CM-1	Post-Development 100 Year	100	None	192.0	0.084	0.30	(N/A)	(N/A)
O-1	Post-Development 100 Year	100	None	196.0	0.100	0.30	(N/A)	(N/A)

### Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft <sup>3</sup> )	Peak Time (hours)	Peak Flow (ft <sup>3</sup> /s)	End Point	Node Flow Direction
-------	------	----------	--------------------------------------	-------------------	--------------------------------	-----------	---------------------



EXISTING TOPOGRAPHY AND CONTOURS PROVIDED BY HERITAGE LAND SURVEYING & MAPPING INC. 6/8/2012 #12-0106E

SCALE 1" = 30'

**LEGEND:**

- SET 1/2" REBAR WITH PLASTIC CAP STAMPED "LS 26925"
- SYCAMORE TREE
- JUNIPER TREE
- CEDAR TREE
- PINE TREE
- COTTONWOOD TREE
- ASH TREE
- EXISTING BUILDING
- EXISTING PAVERS
- EXISTING CONCRETE
- EXISTING CRUSHED GRANITE
- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPOSED BUILDING
- PROPOSED PAVERS
- PROPOSED CONCRETE
- PROPOSED CRUSHED GRANITE
- PROPOSED WALL

**DETENTION AREA**  
TOTAL AREA = 10,654 SF

**SEMI-IMPERVIOUS AREA**  
GRAVEL PARKING = 48,447 SF

**IMPERVIOUS AREAS**  
ROOF AREA = 43,307 SF  
CONCRETE = 25,860 SF  
PAVERS = 7,439 SF  
TOTAL = 76,606 SF

CALL TWO WORKING DAYS BEFORE YOU DIG  
1-800-STAKE-IT

*[Professional Engineer Seal]*  
DATE: 12/06/13  
12/06/13  
ENGINEER 373172016

REVISIONS			
NO.	DESCRIPTION	DATE	BY

**SWI**  
Shephard & Wesnitzer, Inc.  
www.swiaz.com

75 Kallaf Place  
Sedona, AZ 86336  
928.282.1061  
928.282.2058 fax

JOB NO: 12100  
DATE: DEC 13  
SCALE: 1"=30'  
DRAWN: MWJ  
DESIGN: AHB  
CHECKED: AHB

SKY RANCH LODGE  
PRELIMINARY GRADING PLAN  
SEDONA, ARIZONA  
SHEET 1 OF 1



Shephard  Wesnitzer, Inc.

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*Engineering an environment of excellence.*

## Sky Ranch Lodge Expansion

### Wastewater Concept Report

April 19, 2013

SWI # 12100.004

Prepared For:  
Mr. Rick Hamilton, General Manager  
Sky Ranch Lodge  
1105 Airport Road  
Sedona, AZ 86336  
(928) 282-6400

Prepared By:  
David M. Monihan Jr., PE, RLS  
Shephard - Wesnitzer, Inc.



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## **1. PROJECT DESCRIPTION**

This report was prepared to address the wastewater system improvements required for proposed expansion of the Sky Ranch Lodge development. Mr. Max Licher and Mr. Mike Bower, Design Group, are currently supporting the owner in securing Planning and Zoning approval for the project. Some initial calculations were completed and supplied to Design Group as part of the initial submittals to the City of Sedona. This report is to provide further detail in a more formal format in support of that work.

### **1.1. EXISTING FACILITIES**

The existing Sky Ranch Lodge consists of 94 lodging units and associated accessory structures. There are multiple lodging buildings with 1 to 8 lodging units in the building. Limited events such as weddings are hosted at the site but there are no support services such as catering available.

It is located on a leased area of about 7.63 acres. That is located in Yavapai County on APN 408-27-001 which is approximately 241.31 acres. Most of the property development consists of the airport including runway and accessory structures that directly support airport use. There is a restaurant associated with the airport improvements.

### **1.2. PROPOSED FACILITIES**

The proposed Sky Ranch Lodge expansion consists of a conference center and 40 additional lodging units. That will include a lodge with 20 units and 10 buildings with 2 lodging units each.

The proposed facilities will be located on a leased area that will be increased to 12.16 acres.

The Site Investigation Report in Appendix 5.1 includes some maps.

## **2. SITE INVESTIGATION**

Some initial calculations were completed based upon general assumptions. It appeared that a disposal area of approximately 26,000 square feet would be required assuming advanced treatment for wastewater from existing and proposed facilities. A reserve area of that same size would also be required. An area of 30,000 square feet was established in planning documents but there is also the intent to reuse the effluent for irrigation purposes if possible.

### **2.1. SURFACE CHARACTERIZATION**

On March 14, 2013 Mr. David M. Monihan Jr., PE, RLS, Shephard Wesnitzer, Inc completed a surface characterization of the project in accordance with Arizona Department of Environmental Quality (ADEQ) and Yavapai County Environmental Services (YCES) requirements. Mr. Rich Hamilton, General Manager, Sky Ranch Lodge and Mr. Max Licher, Design Group were present for most of the time and participated in selecting sites for excavations to be included in the subsurface characterization.

The entire property was examined. The topographic survey maps were confirmed. No surface features were noted that would preclude either a standard or alternative wastewater system. It appears that compliance with applicable setbacks is achievable. No waivers are anticipated at this time.

No evidence of past or current failure (surfacing effluent) was noted for the existing leach field. The exact location of the existing field is not known, however the proposed conference system will encroach significantly so it will be abandoned with the proposed development.

### **2.2. SUBSURFACE CHARACTERIZATION**

On March 20, 2013 Mr. David M. Monihan Jr., PE, RLS, Shephard Wesnitzer, Inc completed a subsurface characterization of the project in accordance with Arizona Department of Environmental Quality (ADEQ) and Yavapai County Environmental Services (YCES) requirements. Mr. Rich Hamilton, General Manager, Sky Ranch Lodge was present for the initial work. Excavations were re-filled as the work was completed.

The only test hole adequately deep for a standard system was located near the existing system. This will effectively eliminate the consideration of a standard septic tank system for the proposed project. (Alternative wastewater systems can still be considered.) The existing system may conform to current requirements and might have been suitable for continued use except that it is in conflict with the proposed development.

### **2.3. SITE INVESTIGATION REPORT**

The results are documented in Uniform Site Investigation Report Form in Appendix 5.1.

It appears that advanced treatment, such as a textile filter, and a shallow disposal system, such as a drip irrigation system can be designed for the project.

The unadjusted soil application rate (SAR) appropriate to use in a concept report in gallons per day per square foot:

SAR, unadjusted = 0.40 gpdpsf

### **3. CONCEPT**

Mr. Joshua Myers, RS, Yavapai County Development Services, Environmental Unit prepared a letter dated October 2, 2012 regarding the proposed development. A copy is included in Appendix 5.2. He specifically mentions the large system general permit 4.23 in the second paragraph. He specifically mentions the nitrogen density requirements in the third paragraph. SWI had considered both basic design issues in our earlier communications. In this concept report we can put some numbers and provide further clarity to those issues.

#### **3.1. DESIGN FLOW**

A design flow was calculated for the existing and proposed facilities using standard values from ADEQ regulations. Assumptions were made regarding usage and will need to be confirmed and refined in the actual design process. It would also be good to review a year of water usage data as part of the final design flow determination.

The following components were included in the calculation of the design flow for the existing facilities:

- lodging units without kitchenette
- lodging units with kitchenette
- Laundry
- Employees
- Special event guests

The result was a design flow of

Design Flow, Existing = 11,500 gpd

The following components were included in the calculation of the design flow for the proposed facilities:

- additional lodging units without kitchenette
- additional lodging units with kitchenette
- additional laundry
- Employees
- Conference Center

A full commercial kitchen or restaurant is not included in the calculation. The conference facility is assumed to have a maximum occupancy of 190.

The result was a design flow of

Design Flow, Proposed = 6,000 gpd

The total design flow for the wastewater system is

Design Flow, Total = 11,500 + 6,000 = 17,500 gpd

## 3.2. TREATMENT

The large system General Aquifer Protection permit, 4.23, covers a design flow from 3,000 to 24,000 gpd. The proposed system can be covered by a General Aquifer Protection permit. ADEQ has developed the rules for these systems but they have delegated the administration of the program to YCES.

All of the systems covered by the general permits for 0 to 3,000 gpd can be used except for the 4.15 general permit for aerobic systems. (For this size of system they require routine attention from a certified operator but the facility can not economically support that level of skilled operational staff.) Therefore aerobic systems are not considered for this project.

A standard septic tank has been providing adequate treatment for the existing facility however the expansion area available for disposal does not have adequate soil depth for septic tank effluent. The septic tank provides a minimal level of treatment depending on the soil for further treatment before the effluent re-enters the general environmental and natural water cycle. A septic tank also provides no reduction of nitrogen and is subject to nitrogen density calculations which are included in a subsequent section of this report. Therefore septic tank treatment was not considered for this project.

SWI recommends a textile filter which is covered by the general aquifer protection permit 4.12. Specifically we propose the AdvanTex system manufactured by Orenco Systems Inc. (OSI). The system has an A309 Listing by ADEQ including the larger units which would be used for a project of this size. SWI has completed the design number of these systems from a single family residence to a subdivision with a design flow of 30,000 gpd. Some of the advantages include:

- A clear and odorless effluent.
- Increased soil application rate for advanced treatment reduces the disposal area.
- Responsive to changes in influent loading without effluent quality degradation.
- Underground installation is less of an aesthetic issue.
- Use of submersible pumps rather than blowers reduces the noise impact.
- Using pumps instead of blowers reduces the odor impact of the system.
- Passive biological nitrogen removal to comply with nitrogen density requirements.
- System will report alarm conditions via telephone line.
- Operator can adjust the system remotely using a web based interface.

The textile system is expected to produce an effluent quality of 15 mg/l BOD (Biochemical Oxygen Demand), 15 mg/l SS (Suspended Solids), and 15 mg/l Total Nitrogen. This is substantially better than a septic tank which produces 150, 75, and 53 respectively. It is worth noting that despite the increase in development and associated wastewater flows the actual pollutant load to the environment will decrease due to the increase in treatment levels.

The project may be developed in phases. The wastewater treatment system will consist of some components that can easily be phased also. There will be a recirculation tank that should be sized for the full development which will include risers for pumps. There will be multiple textile filter pods for the full development. The pods and the associated pumps in the recirculation tank can be added with each phase of development. However since the existing development

represents about 2/3's of the total flow it may not be economically advantageous. That will be evaluated in the design of the system when the actual design flows have been well established.

### 3.3. DISPOSAL

The soil is shallow and the underlying layer is restrictive in many of the test holes as shown in the site investigation report. A shallow drip irrigation system is the preferred method to address these conditions as it effectively spreads the effluent evenly over the entire disposal area. The pumping system can be designed to provide small even doses throughout the day which enhances soil adsorption which significantly increases soil treatment. It also enhances evaporation and transpiration while limiting the potential for surfacing of effluent.

Drip irrigation has been successfully applied to wastewater effluent since 1991. It consists of 1/2" polyethylene pipe with drip emitters in the pipe every two feet. They are placed at a spacing of two feet although they can be adjusted to preserve trees. A bactericide prevents biological growth that prevents clogging of the drip emitters. An herbicide is used to prevent roots from entering the emitter but does not damage the vegetation. It may be placed in thin trenches or plowed into the soil with special equipment at a depth of 6 to 12 inches. It can also be placed on plowed soil and covered with fill.

A spread sheet was used to tabulate and analyze the effluent disposal for this project. A copy is included in Appendix 5.3. The advanced treatment allows a higher adjusted SAR:

$$\text{SAR, adjusted} = 0.655 \text{ gpdpsf}$$

The shallowness of the soil layer and the restrictive layer below it will require some analysis of the mounding potential in the disposal area. This is the potential for the saturated condition below the drip lines to rise above the ground surface and become exposed. There are a number of ways to address this in the design including consideration of evaporation and transpiration but that is beyond the normal scope of a concept report.

The disposal area required for the existing and proposed development can be calculated using the design flow and adjusted SAR:

$$\begin{aligned} \text{Disposal Area, Required} &= 17,500 / 0.655 = 26,718 \text{ sf} \\ &= 0.61 \text{ acres} \end{aligned}$$

This may be a dedicate area which will essentially return to the original natural state of vegetation. The effluent is spread over too large of an area to significantly improve the vegetation in summer. It can be incorporated into the landscaping which will offset some of the watering need especially in the spring, fall and winter. A waiver of the 10 foot building setback would be required to encroach upon that setback but is possible with suitable design considerations.

The disposal area will be divided to allow for operational flexibility. Those divisions could be constructed in phases consistent with the phasing of development.

A reserve area of the same size is required or some other equivalent method of providing for a replacement in case of initial area failure. No construction is required until it is needed.

### 3.4. NITROGEN DENSITY

In 2005 the Arizona Department of Environment Quality (ADEQ) rules in regard to onsite wastewater systems were revised. Existing systems were not impacted by the revision as long as no changes were made to the system or the property development. A general permit 4.23 was already established for large systems or multiple systems on a single property with a capacity of 3,000 gpd to 24,000 gpd in the previous rule revisions in 1999. One significant change was made in the new rule which was a nitrogen density requirement.

Those rules specify that the design nitrogen loading is 0.0333 lbs/day/person to the treatment system. They require that the nitrogen density for the effluent application to the property is less than 0.088 lbs/acre.

Assuming each person produces 80 gpd, the full time population equivalent for the development can be calculated as

$$\text{Full Time Population Equivalent} = 17,500 / 80 = 219$$

Assuming the treatment specified above of 15 mg/l and the initial nitrogen loading of 59 mg/l, the nitrogen density on the leased area can be calculated as

$$\text{Nitrogen Density} = 0.0333 * 219 * (15/59) / 12.16 = 0.152 \text{ lb/acre} > 0.088$$

Therefore the nitrogen density on the leased area exceeds the ADEQ requirement of 0.088 lb/acre.

However the ADEQ requirement for nitrogen density is applicable to the entire parcel. If the leased area had met the standard no further analysis or justification would be required. Since it does not, further analysis may be performed.

The required area to meet the nitrogen density requirement can be calculated as

$$\text{Area} = 12.16 * 0.152 / 0.088 = 21.00 \text{ acres}$$

$$\text{Additional Area} = 21.0 - 12.16 = 8.84 \text{ acres}$$

The size of this parcel is 241.31 acres. The nitrogen density requirement in ADEQ rule applies to the entire parcel including the runway and aviation buffer areas. The percentage of the parcel needed to meet nitrogen density requirements can be calculated:

$$\text{Percentage for Sky Ranch Lodge} = 21 * 100 / 241.31 = 8.7\%$$

It appears from general usage information available to the writer at this time that the existing and proposed development represents the majority (>50%) of wastewater applied to the site. There is a restaurant which does represent a significant flow but the other uses seem to have little potential to generate wastewater. A complete analysis for the property using water records and assuming septic tank treatment could be performed if requested by the regulatory agency as part of the approval process.

It is worth repeating that the pollutant load on the environment from the proposed development, specifically the nitrogen loading, will be reduced by this project.

#### **4. CONCLUSION**

The wastewater system to provide for the full proposed development consists of

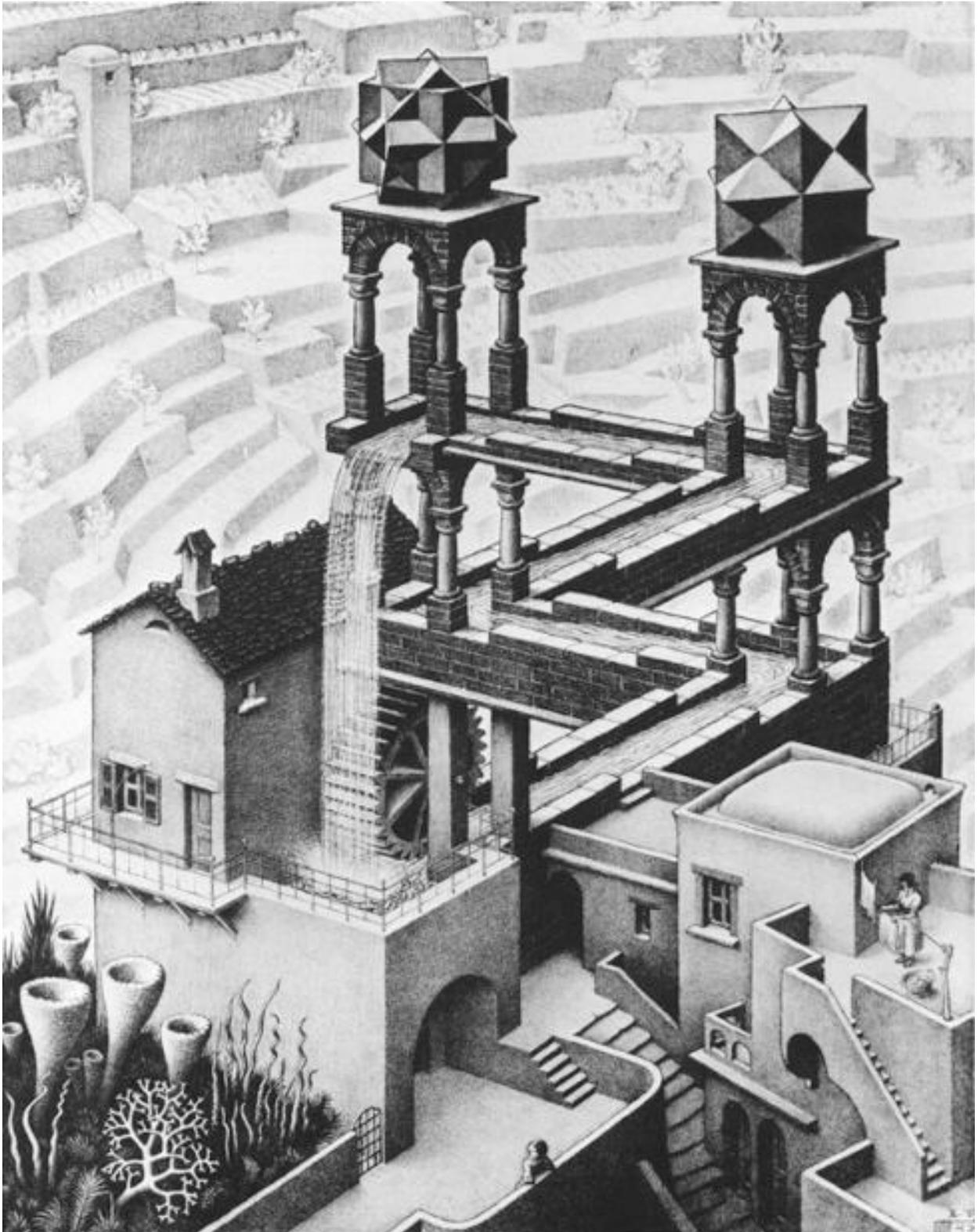
- A textile filter system with a capacity of 17,500 gpd.
- A drip irrigation system of 26,800 sf.

The project may be developed in phases. The wastewater treatment and disposal system components consist of multiple units that can be phased.

This will provide a highly treated effluent that can be properly disposed of onsite. It will meet the regulatory requirements applicable to the project. It will reduce the pollutant load on the environment below current levels.

The construction cost of the wastewater system is expected to be \$190,000 to \$275,000.

5. APPENDIX



## **5.1. SITE INVESTIGATION REPORT FORM**

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Insert Site Investigation, 8 pages.

## **5.2. YAVAPAI COUNTY DEVELOPMENT SERVICES**

Insert YCDS Letter, 1 page.

### **5.3. APPLICATION RATE / SOIL EVALUATION**

This page intentionally left blank.

Insert Application Rate / Soil Evaluation, 2 pages.

## **5.1. SITE INVESTIGATION REPORT FORM**

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**1 Authorization For Site Investigation**

I certify that I am (check one)  the Owner,  the Authorized Representative or  an Other Person and have authority to grant the investigator access to the property for this site investigation and authorize the work certified in this site assessment.

Name & Address

(Printed) \_\_\_\_\_ Refer to SWI Contract with client

Signature \_\_\_\_\_

**2 Project Identification**

Property Owner or Project Name Sky Ranch Lodge (Rick Hamilton, Mgr. & Max Licher, Design Group, Architect)

**3 Site Information [A.A.C. R18-9-A309(B)(2)(a)]**

Address 1105 Airport Road City Sedona  
 Parcel Number 408-27-001 Lot Number NA  
 Township 17N Range 5E Section 13 SW 1/4  
 Latitude 34 ° 51 ' 7.6 " N Longitude 111 ° 47 ' 29.3 " W

**4 Investigator Information [A.A.C. R18-9-A310(H)]**

Name David M. Monihan Jr., PE, RLS Phone (928) 773-0354 / FAX (928) 774-8934  
 Title Project Manager / Engineer Firm Name Shephard Wesnitzer, Inc.  
 Mailing Address 110 West Dale Avenue City Flagstaff State AZ  
 Zip 86001 E-Mail DMonihan@swiaz.com

**5 Surface Characterization [A.A.C. R18-9-A310(C)]**

Identify the presence or absence of all of the following possible limiting conditions in the intended location of the treatment works and the primary and reserve areas of the on-site wastewater treatment facility:

- A) The surface slope is greater than 15 % at the intended location of the on-site wastewater facility  YES  No
- B) Setback distances do NOT meet all the minimum values specified in R18-9-A312(C)  YES  No

**NOTE: Check YES if the location or size of the dwelling or other improvements, or the bedroom count or the fixture unit count is UNKNOWN to the site investigator.**

- C) Surface drainage characteristics could adversely affect the ability of the facility to function properly  YES  No **NOTE: If YES, please describe in Attachment 4.**
- D) A 100-year flood hazard zone, as indicated on the applicable flood insurance rate map, is located within the property on which the on-site wastewater treatment facility will be installed  YES  No **NOTE: If YES, please specify the FEMA Flood Insurance Map Number or Other Source 04025C 1435G**
- E) An outcropping of rock that cannot be excavated is present and could impair the function of soil receiving the discharge  YES  No
- F) Fill material deposits are present  YES  No

**If the answer is YES to any of the above potential surface limiting conditions, please show location and note the condition type on Site Investigation Map (Item 7).**

**6 Subsurface Characterization Method [A.A.C. R18-9-A310(D)]**

Check method used to perform subsurface characterization per A.A.C. R18-9-A310(D)(1) and (3)

- A) ASTM D5921 used?  Yes  No (if Yes, please enclose Attachment 1)
- B) Percolation test method used?  Yes  No (if Yes, please enclose Attachment 2)
- C) Seepage performance test method used?  Yes  No (if Yes, please enclose Attachment 3)
- D) Other ADEQ approved method?  Yes  No (if Yes, please provide in Attachment 4 the method and data)



**8 Subsurface Limiting Conditions [A.A.C. R18-9-A310(D)(2)]**

Identify the presence or absence of all of the following possible limiting conditions in the intended location of the primary and reserve disposal areas of the on-site wastewater treatment facility to a depth of at least 12 feet below land surface or to an impervious soil or rock layer if encountered at a shallower depth:

- A) The soil absorption rate determined under A.A.C. R18-9-A312(D)(2) is:
  - 1. More than 1.20 gallons per day per square foot?  Yes  No
  - 2. Less than 0.20 gallons per day per square foot?  Yes  No
  - 3. A **site-specific soil absorption rate (SAR)** is required per A.A.C. R18-9-A312 (D)(2)(b)?  Yes  No
- B) The vertical separation distance from the bottom of the lowest point of the disposal works to the seasonal high water table is less than the minimum vertical separation specified in A.A.C. R18-9-A312(E)(1)?  Yes  No
- C) Does seasonal saturation occur within surface soils that could affect the performance of the on-site wastewater treatment facility?  Yes  No If Yes, describe evidence: \_\_\_\_\_
- D) Do any of the following subsurface limiting conditions that may cause or contribute to surfacing of wastewater occur within 12 feet of the land surface:
  - 1. An impervious soil or rock layer?  Yes  No
  - 2. A zone of saturation that substantially limits downward percolation from the disposal works?  Yes  No
  - 3. Soil with more than 50 percent rock fragments?  Yes  No
- E) Do any of the following subsurface limiting conditions that may promote accelerated downward movement of insufficiently treated wastewater occur within 12 feet of the land surface:
  - 1. Fractures or joints in rock that are open, continuous, or interconnected?  Yes  No
  - 2. Karst voids or channels?  Yes  No
  - 3. Highly permeable materials such as deposits of cobbles or boulders?  Yes  No
- F) Does subsurface conditions exist that may convey wastewater to a Water of the State and cause or contribute to an exceedance of a water quality standard established in 18 A.A.C. 11, Articles 1 and 4?  Yes  No
- G) Depth to groundwater below land surface 800 feet as determined by  Trench or boring,  Subdivision report,  Published groundwater data or  Relevant well data.

**If the answer is Yes to any of the above subsurface limiting conditions, please show location and note the associated limiting condition type on Site Investigation Map (Item 7).**

**9 Site Investigation Attachments**

#	Attachment Description	Attached?
1	ASTM D5921 Subsurface Soil Characterization	<input checked="" type="checkbox"/> Yes, total of <u>2</u> pages.
4	Other Information	<input checked="" type="checkbox"/> Yes, total of <u>3</u> pages.
		<input type="checkbox"/> Yes, total of _____ pages.

**10 Investigator Certification**

- A)  Arizona-registered Professional engineer Certification Number: 13494 Expiration Date: 9/30/15
- B)  Arizona-registered Professional geologist Certification Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_
- C)  Arizona-registered Sanitarian Registration Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_
- D)  A certificate of training from a course recognized by ADEQ

Course Name: \_\_\_\_\_ Completion Date: \_\_\_\_\_

- E)  Qualifies under another category designated in writing by ADEQ. **Please use Attachment 4 to provide approved Qualification Category & Date Approved.**

By signing this section, I certify that I am qualified to conduct this investigation as specified in R18-9-A310(H) and have inspected the property identified in Item 3 for purposes of performing a site investigation. I have performed this site investigation in accordance with R18-9-A310 and have completed this investigation to the best of my knowledge.

Printed Investigator Name/

**Date of Investigation:** David M. Monihan Jr, PE, RLS, SWI / 3/14&20/13

**Investigator Signature/** David M Monihan Jr. / 4/8/2013  
**Date Signed**

**Professional Seal**

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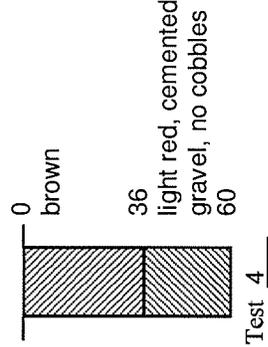
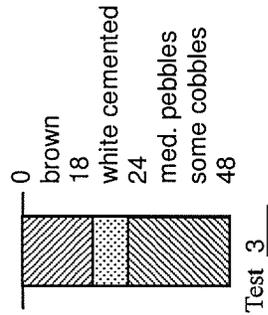
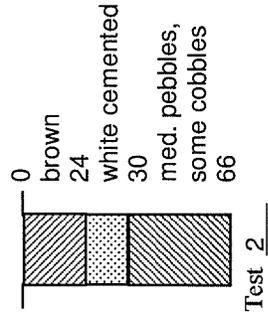
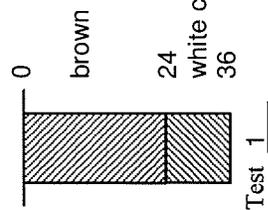
**ATTACHMENT 1 — ASTM 5921 METHOD FOR SUBSURFACE SOIL CHARACTERIZATION**

Facility Address: 1105 Airport Road, Sedona, AZ  
 Tested by: David M. Monihan Jr., PE, RLS  
 Date Test Completed: 3/20/13

Parcel Number: 408-27-001  
 Depth to Groundwater: **PLEASE REPORT IN ITEM 8.G**

Test Hole #	Depth Interval Below Land Surface (Inches)	Texture	Structure	Rock Fragments %	Mottles %	Boundary	Dry Consistency	Moist Consistency	SAR
1	0 - 24	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	24 - 36	---	0 - M	95	0	---	R	---	SS
2	0 - 24	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	24 - 30	---	0 - M	95	0	C	R	---	SS
	30 - 66	SL	1 VF GR	60	0	---	VH	---	SS
3	0 - 18	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	18 - 24	---	0 - PL	95	0	C	R	---	SS
	24 - 48	SL	1 VR GR	60	0	---	VH	---	SS
4	0 - 36	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	36 - 60	SL	1 VR GR	60	0	---	VH	---	SS

Comments: Depths were variable within a test hole. The hard rocky white cemented layer does appear to be permeable since there is no mottling or apparent runoff.



**Professional Seal**

Incorporated into a Sealed Design Report

**ATTACHMENT 1, CONTINUED - ASTM 5921 METHOD FOR SUBSURFACE SOIL CHARACTERIZATION**

Facility Address: 1105 Airport Road, Sedona, AZ

Parcel Number: 408-27-001

Tested by: David M. Monihan Jr., PE, RLS

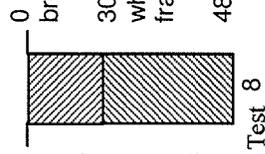
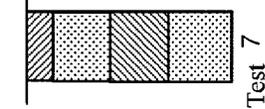
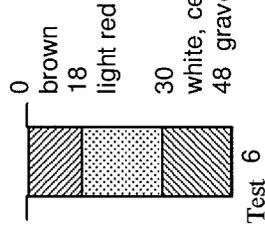
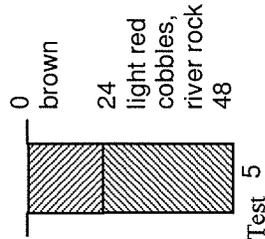
Depth to Groundwater: PLEASE REPORT IN ITEM 8.G ON PAGE 3 OF FORM

Date Test Completed: 3/20/13

Test Hole #	Depth Interval Below Land Surface (Inches)	Texture	Structure	Rock Fragments %	Mottles %	Boundary	Dry Consistency	Moist Consistency	SAR
5	0 - 24	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	24 - 48	LS	1 VF ABK	70	0	---	VH	---	SS
6	0 - 18	SiCL	2 M ABK	10	0	C	---	VFR	0.4
	18 - 30	LS	1 VF ABK	60	0	C	MH	---	0.4
	30 - 48	LS	1 VF ABK	85	0	---	MH	---	0.4
7	0 - 12	SiCL	2 M ABK	10	0	B	---	VFR	0.4
	12 - 60	LS	1 VF GR	70	0	B	MH	---	0.4
	60 - 72	LS	1 VF GR	85	0	B	VH	---	SS
	72 - 132	LS	1 VF GR	70	0	---	MH	---	0.4
8	0 - 30	SiCL	2 M ABK	10	0	B	---	VFR	0.4
	30 - 48	---	---	95	0	---	VR	---	

Comments: Depths were variable within a test hole. Designer should adjust SAR for rock.

The hard rocky white cemented layer does appear to be permeable since there is no mottling or apparent runoff.



Professional Seal

Incorporated into a Sealed Design Report

**ATTACHMENT 4 – OTHER INFORMATION**

Facility Address: 1105 Airport Road, Sedona, AZ

Parcel Number: 408-27-001

Date Test Completed: 3/20/13

**Other Information pertinent to this Site Investigation Report:** Please specify the Report Item related to all Attachments or Other Information provided.

3/14/13 Surface Characterization:

- The site was reviewed with Max Licher, Architect, Design Group and Rich Hamilton, Mgr., Sky Ranch Lodge.
- A total of 8 test hole sites were identified and the property toured extensively.
- Rick Hamilton will coordinate excavation and contact SWI.
- There is only one existing leach field. (Originally it was thought that there were two.) It will be abandoned since the proposed building and entry way parking will be located there. The leach field showed no evidence of current or past failure.
- The exterior perimeter of the site was walked and photographs taken.
- The topographic map accurately represents the site observations.
- Vegetation consists of Pinon, Juniper, Mesquite, brush and prickly pear.
- No significant drainageways were observed. All can be diverted. None drain 20 acres to constitute a wash.

3/20/13 Subsurface Characterization:

- The upper soil layer was consistent in texture and structure throughout the site although depths varied.
- The layer below varied in texture, structure, % rock and consistency although the presence of white cementation was consistent throughout.
- The test holes are reported in numerical order. The order of observation was 7, 8, 3, 2, 1, 4, 5 & 6.
- Photographs were taken of all test holes.
- Rick Hamilton and various staff were present at various times throughout the evaluation process.
- Test holes were excavated before I arrived and were re-filled as I completed work.

Continued on pages 2 through 3

Prepared by (Please Print): David M. Monihan Jr., PE, RLS; Shephard Wesnitzer, Inc.

Date Report Completed: 4/12/2013

**ATTACHMENT 4, CONTINUED – OTHER INFORMATION**

Facility Address: 1105 Airport Road, Sedona, AZ

Parcel Number: 408-27-001

Date Test Completed: 3/20/13

**Other Information continued.**

Exhibit Drawing / Topographic Map prepared by Heritage Land Surveying dated 6/8/12. Annotated by SWI.



(X) TEST HOLE

**ATTACHMENT 4, CONTINUED – OTHER INFORMATION**

Facility Address: 1105 Airport Road, Sedona, AZ

Parcel Number: 408-27-001

Date Test Completed: 3/20/13

**Other Information continued.**

Concept Plan prepared by Design Group dated 5/11/12. Annotated by SWI.



⊗ TEST HOLE

## **5.2. YAVAPAI COUNTY DEVELOPMENT SERVICES**

# Yavapai County Development Services

**Prescott Office**  
500 S. Marina Street, Prescott, AZ 86303  
(928) 771-3214 Fax: (928) 771-3432



**Cottonwood Office**  
10 S. 6<sup>th</sup> Street, Cottonwood, AZ 86326  
(928) 639-8151 Fax: (928) 639-8153

Addressing – Building Safety – Customer Service & Permitting – Environmental – Land Use – Planning

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To: Max Licher  
Design Group Architects

From: Joshua Myers, RS  
Environmental Unit  
(928) 649-6219

Date: 2 October 2012

Re: Sky Ranch Lodge Conceptual Wastewater System

Mr. Licher,

Yavapai County Development Services – Environmental Unit (YCDS-EU) permits on-site wastewater treatment systems under delegation from the Arizona Department of Environmental Quality (ADEQ) to ensure compliance with Arizona Administrative Code Title 18-9 and all other State and Local rules and regulations. This Title of Arizona Administrative Code was enacted to ensure that all on-site wastewater systems permitted under this rule set were both environmentally sound and safe to public health. This level of safety is achieved by using tested best management practices as well as overall sound design practices.

A system such as the one proposed for the Sky Ranch Lodge will have considerably more stringent permitting requirements than a system serving the typical residential setting simply due to the greatly increased design flow of the system. YCDS-EU is delegated to permit on-site wastewater systems having a total design flow of up to 24,000 gallons per day (GPD). A typical residential septic system has a design flow of 450-600 GPD. Systems having a design flow of 3,000 to 24,000 GPD must comply with the Type 4.23 General Permitting requirements in order to be approved.

Advanced treatment may or may not be a requirement depending on the Nitrate discharge of the system. A discharge limit for total Nitrates is established in the 4.23 requirements and advanced treatment to reduce the nitrate discharge of the system may be necessary in order to remain below the allowable limit.

Provided that the site conditions are suitable (sufficient available area and suitable soil conditions) and that the permitting requirements can be met, there is no reason that a system such as the one proposed for the Sky Ranch Lodge could not be approved. Please feel free to direct any questions or concerns to this department.

Thank you.

### **5.3. APPLICATION RATE / SOIL EVALUATION**

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APPLICATION RATE / SOIL EVALUATION

Project: Sky Ranch Lodge, Concept Plan  
 Job No: 12100.004.WWRPT  
 Design: DMM  
 Date: 19-Apr-13

Disposal Field (Trench / Bed): Trench

Soil Texture: Silty Clay Loam  
 Soil Structure: Moderate  
 Soil Consistence: Very Friable

Soil Application Rate (Table) = 0.40 gpdpsf

Effluent Quality, BOD: 15 mg/l  
 Effluent Quality, SS: 15 mg/l  
 Adjusted Soil Application Rate (Calc.) = 0.655 gpdpsf  
 Adustment Percentage = 164%

Perc (min/in)	App. (gpdpsf)	ADEQ1 15/15	ADEQ2 30/30	ADEQ3 150/75
1	1.20	3.85	2.73	1.20
2	1.20	3.85	2.73	1.20
3	1.10	3.30	2.37	1.10
4	1.00	2.80	2.04	1.00
5	0.90	2.33	1.73	0.90
7	0.75	1.72	1.31	0.75
10	0.63	1.30	1.02	0.63
15	0.50	0.91	0.74	0.50
20	0.44	0.75	0.62	0.44
25	0.40	0.66	0.55	0.40
30	0.36	0.56	0.48	0.36
35	0.33	0.50	0.43	0.33
40	0.31	0.46	0.40	0.31
45	0.29	0.42	0.36	0.29
50	0.28	0.40	0.35	0.28
55	0.27	0.38	0.33	0.27
60	0.25	0.34	0.30	0.25
120	0.20	0.26	0.23	0.20

Effluent Quality, Log 10 (Total Coliform): 5  
 Vertical Separation (Seasonal High Water) = 3.00 feet  
 Vertical Separation (Limiting Condition, Surfacing) = 2.50 feet

Notes:

1. ADEQ Regulation R18-9-A312.D and E (2/20/06)
2. Application Rate (A312.D.2.) from Table, without interpolation.
3. Interpolation allowed except between 50 and 60 or 60 and 120.
4. Per A312.D.3.:  $SARa = ([11.39 * (TSS + BOD)^{-1/3}] - 1.87) * SAR^{1.13} + 1 * SAR$
5. Vertical Separation, Groundwater (A312.E.2) from Table, without Interpretation
6. Vertical Separation, Limiting Layer, Surfacing (A312.E.3) from Table, without Interpretation

APPLICATION RATE / SOIL EVALUATION

Project: Sky Ranch Lodge, Concept Plan  
 Job No: 12100.004.WWRPT  
 Design: DMM  
 Date: 19-Apr-13

Disposal Field: Trench

Soil Texture: Silty Clay Loam  
 Soil Structure: Moderate  
 Soil Consistence: Very Friable

	Sequence of Soil Characteristics Question (ADEQ R18-9-A312D)	Trench	Bed
A.	Is the horizon gravelly coarse sand or coarser?	Special	Special
B.	Is the structure of the horizon moderate or strongly platy?	Special	Special
C.	Is the texture of the horizon sandy clay loam, clay loam, silty clay loam, or finer and the soil structure weak platy?	Special	Special
D.	Is the moist consistency stronger than firm or any cemented class?	Special	Special
E.	Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	Special	Special
F.	Is the texture sandy clay loam, clay loam, silty clay loam, or silty loam and the structure massive?	Special	Special
G.	Is the texture of the horizon loam or sandy loam and the structure massive?	0.2	0.13
H.	Is the texture sandy clay, clay or silty clay of low clay content and the structure moderate or strong?	0.2	0.13
I.	Is the texture sandy clay loam, clay loam, or silty clay loam and the structure weak?	0.2	0.13
J.	Is the texture sandy clay loam, clay loam, or silty clay loam and the structure moderate or strong?	0.4	0.27
K.	Is the texture sandy loam, loam, or silty loam and the structure weak?	0.4	0.27
L.	Is the texture sandy loam, silt loam and the structure moderate or strong?	0.6	0.4
M.	Is the texture fine sand, very fine sand, loamy fine sand, or loamy very fine sand?	0.4	0.27
N.	Is the texture loamy sand or sand?	0.8	0.53
O.	Is the texture coarse sand?	1.2	Special