SUMMARY OF THE TRAFFIC ANALYSIS

BROADWAY CORRIDOR,
EUCLID AVENUE TO COUNTRY CLUB ROAD

AUGUST 30, 2012

Overview

In the lead up to the task of determining a general corridor development approach for Broadway, a considerable amount of technical data has been gathered and developed to help inform the process. This includes information regarding existing land use and urban form, surveys of historic and architectural resources, topographic mapping, and traffic information. This information will be presented to the CTF and the public over the next several months. This document summarizes the traffic information presented at the August 30th CTF meeting. Please note that the work reported here is an ongoing effort and will be refined and extended during the DCR process as the need arises.

The traffic study prepared for this project provides initial information regarding how various roadway configurations can be expected to function over the design life of this project. The study is presented in the document "Final Traffic Engineering Study, Broadway Corridor Study Euclid Avenue to Country Club Road" by Kittelson & Associates, December 2011. That study addresses the full range of transportation modes applicable to Broadway -- pedestrian, bicycle, and transit as well as general arterial traffic.

Kittelson's study focused on two typical roadway cross sections. The first is referred to here as the *eight-lane section* which entails six general purpose lanes (three each direction) and two multiuse lanes dedicated to transit and right turning vehicles. The second section, referred to as the *six-lane section*, has only the six general purpose lanes. With the six-lane section, separate right turn lanes and bus pull through or pullouts would be needed at major intersections. Separate bikes lanes would be provided with both sections though with the eight-lane section bikes may share the multiuse lanes as currently the case from Columbus eastward.

Current regional planning calls for the eight-lane section. That section is also specified in the voter-approved RTA plan. Questions have been raised as to the need for eight lanes however, and Kittelson has included an evaluation of the operational effects of eliminating the multiuse lanes. That evaluation required "micro simulation" modeling, a more sophisticated analysis than normally applied to arterial roadway development.

Generally, Kittelson found that both the six-lane and eight-lane sections will operate satisfactorily through the year 2040. They also found that the effect of eliminating the multiuse lanes on general arterial traffic is nearly negligible in terms of average delay per vehicle, average number of stops per vehicle, and average speed. The greatest impact was a 6% increase in eastbound travel time during the afternoon peak hour. A greater impact would be felt by transit however for which the level of service would be reduced by 6% to 15% depending on the metric being used.

Kittelson points out that beyond simply traffic operation, several other issues also need to be considered. One is safety, particularly the increased frequency of rear-end crashes associated with right turning vehicles slowing in the outer travel lane. Another is the safe and convenient access to businesses needed for a thriving commercial corridor. And with the multiuse lanes, the conflict between bicycles and right-turning vehicles crossing the bike lane is reduced.

The broader question of to what extent the corridor development should be designed to accommodate short and long-term transit is also a consideration, perhaps an overriding one. Broadway has been identified as one of two regional high capacity transit corridors. It is well suited for transit given the major activity centers is serves -- downtown Tucson, the University of Arizona, El Con Mall, Williams Center, and Park Mall. Sun Tran Route 8, which extends along Broadway from downtown as far eastward as Harrison Road, has in excess of 10,000 riders per weekday, by far the greatest in the region. PAG is currently developing for bus rapid transit (BRT) plan for Broadway.

Kittelson more recently performed a follow-up analysis of a *four-lane section*. That analysis, as with those noted above, was based on PAG's projected year 2040 volumes which are being used for this project (the "project volumes"). The four lane scenario falls well short of achieving an acceptable level of service. A second analysis, using volumes based on lower projected growth, also failed but not to the same degree.

The remainder of this document discusses these and other topics in more detail. Its purpose is to help clarify and explain the content of the traffic report, and to make its information accessible to participants in the upcoming discussion of how the corridor should look and function for the future.

Updated Traffic Study

Kittelson's report cited above is an update of the original report they prepared in 2009. The updated report incorporated these changes:

(1) 2040 PAG traffic projections were used instead of the 2030 values originally used. The 2040 values weren't available at the time of the initial study;

(2) More recent traffic counts were used to reflect existing conditions. For Broadway, that means 2010 actual counts were used instead of the 2008 counts used before;

(3) The micro-simulation analysis of the operational implications of eliminating the multiuse lanes was added.

Figure 1 compares the PAG existing and projected traffic volumes used by the two reports. As noted in the following section, the values used for traffic analysis here are adjusted to better reflect conditions in the immediate area. The operational analysis of the six and eight-lane sections is described in a separate section later.

Figure 1-- Comparison of current and projected PAG ADT's between the 2009 to 2012 traffic reports

	From Original 2009 Report			From Updated 2011 Report			Change in "Existing ADT"		Change in ADT from 2030 to 2040	
	Existing ADT	Base Year	2030 ADT	Existing ADT	Base Year	2040 ADT	Change	Annual Rate	Change	Annual Rate
Broadway Blvd										
West of Euclid	30,000	2008	35,000	35,000	2010	33,000	5,000	8.3%	-2,000	-6.7%
Euclid to Highland	30,000	2008	35,000	34,000	2010	41,000	4,000	6.7%	6,000	20.0%
Highland to Campbell	30,000	2008	44,400	34,000	2010	46,000	4,000	6.7%	1,600	5.3%
Campbell to Tucson Blvd	37,300	2008	43,000	40,000	2010	56,000	2,700	3.6%	13,000	34.9%
Tucson Blvd to Country Club	37,300	2008	48,700	40,000	2010	46,000	2,700	3.6%	-2,700	-7.2%
East of Country Club	41,000	2008	51,800	41,000	2008	53,000	--	--	1,200	2.9%
Euclid Avenue										
North of Broadway	30,000	2006	40,800	24,000	2010	46,000	-6,000	-5.0%	5,200	17.3%
South of Broadway	22,000	2007	41,100	18,000	2010	44,000	-4,000	-6.1%	2,900	13.2%
Highland Ave										
North of Broadway	5,000	2004	14,400	5,000	2004	17,000	--	--	2,600	52.0%
South of Broadway	n/a	n/a	n/a	7,000	2009	n/a	--	--	--	--
Campbell Ave										
North of Broadway	40,500	2006	49,700	45,000	2010	55,000	4,500	2.8%	5,300	13.1%
South of Broadway	41,000	2004	51,900	34,000	2010	70,000	-7,000	-2.8%	18,100	44.1%
Tucson Blvd										
North of Broadway	12,000	2005	12,700	12,000	2010	12,000	--	--	-700	-5.8%
South of Broadway	11,000	2005	12,400	11,000	2010	12,000	--	--	-400	-3.6%
Country Club Road										
North of Broadway	22,300	2004	31,400	20,000	2010	26,000	-2,300	-1.7%	-5,400	-24.2%
South of Broadway	16,800	2004	25,200	17,000	2010	22,000	200	0.2%	-3,200	-19.0%

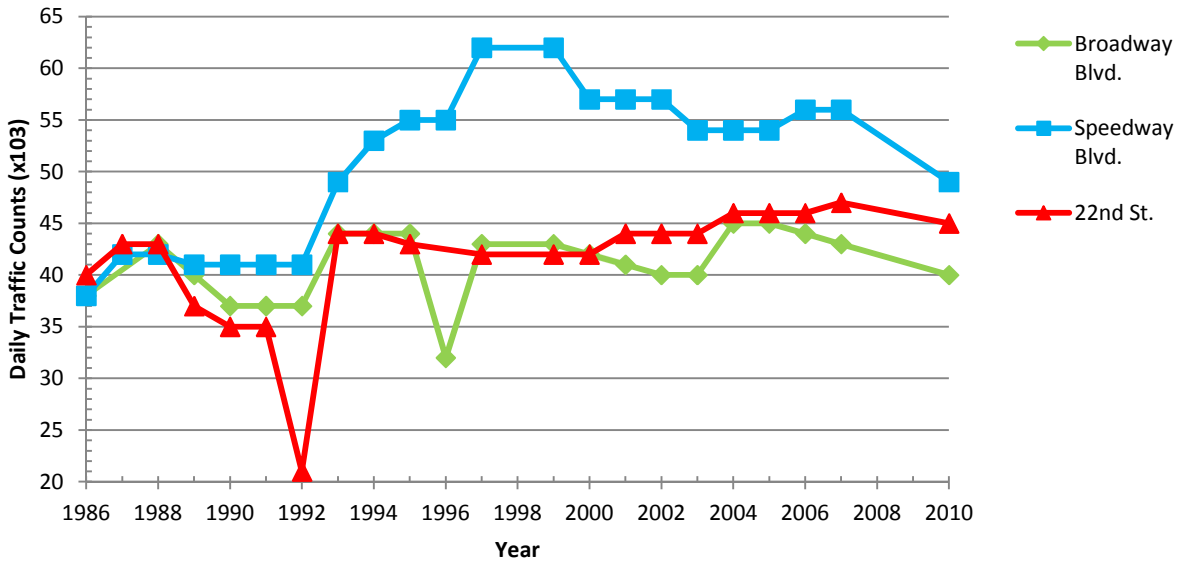
Notes:

1. ADT -- Average Daily Traffic is traffic volume in vehicles per day. Values shown are from PAG regional modeling.
2. Existing ADT is based on traffic counts taken in the "Base Year" indicated.

Historic Cross Town Traffic Volumes

PAG maintains annual records of average daily traffic counts on the roadway network. Figure 2 indicates historic volumes on three major east-west arterials. The data indicate that volumes on Broadway have dropped somewhat from the historic highs of around 45,000 vehicles per day, coinciding with the current recession. It is reasonable to assume that volumes will again increase as economic conditions improve.

Figure 2 -- Historic Volumes on East-West Arterials



Projected Traffic Volumes

Projected traffic volumes for existing conditions and 2040 are shown in Figure 3. Existing ADT (average daily trips) and the PAG 2040 projections are as noted in Figure 1. For the "Project Volumes" used here, the PAG volumes have been adjusted based on a more detailed assessment of probable development, volumes on adjacent segments, and the volumes the various cross streets are able to deliver to the intersection. This information is summarized in Figure 3.

The "Low Growth Rate" volumes used for the four-lane evaluation mentioned above are also shown. They assume the growth in traffic volume to be only two-thirds of that predicted by PAG. Figure 3 indicates a rate of growth in project volumes for Broadway ranging from 0.4% to 1.3%, and the lower growth rate volumes from 0.2% to 1.7%. It is noted that the rate of increase between 2008 and 2010 based on actual counts increased from 3.6% to 8.3%.

Figure 3 -- Summary of Peak Hour Volumes and Growth Rates

		PAG Projections			Project Volumes			Low Growth Rate		
	Existing ADT	2040 ADT	Projected Growth Change	Rate	2040 ADT	Projected Growth Change	Rate	2040 ADT	Projected Growth Change	Rate
Broadway Blvd										
West of Euclid	35,000	33,000	-2,000	-0.2%	39,000	4,000	0.4%	37,000	2,000	0.2%
Euclid to Highland	34,000	41,000	7,000	0.7%	41,000	7,000	0.7%	37,500	3,500	0.3%
Highland to Campbell	34,000	46,000	12,000	1.2%	46,000	12,000	1.2%	40,000	6,000	0.6%
Campbell to Tucson Blvd	40,000	56,000	16,000	1.3%	56,000	16,000	1.3%	48,000	8,000	0.7%
Tucson Blvd to Country Club	40,000	46,000	6,000	0.5%	47,000	7,000	0.6%	43,500	3,500	0.3%
East of Country Club	41,000	53,000	12,000	1.0%	53,000	12,000	1.0%	47,000	6,000	0.5%
Euclid Avenue										
North of Broadway	24,000	46,000	22,000	3.1%	36,000	12,000	1.7%	30,000	6,000	0.8%
South of Broadway	18,000	44,000	26,000	4.8%	29,000	11,000	2.0%	23,500	5,500	1.0%
Highland Ave										
North of Broadway	5,000	17,000	12,000	8.0%	9,000	4,000	2.7%	7,000	2,000	1.3%
South of Broadway	7,000	n/a	n/a	n/a	10,000	3,000	1.4%	8,500	1,500	0.7%
Campbell Ave										
North of Broadway	45,000	55,000	10,000	0.7%	54,000	9,000	0.7%	49,500	4,500	0.3%
South of Broadway	34,000	70,000	36,000	3.5%	56,000	22,000	2.2%	45,000	11,000	1.1%
Tucson Blvd										
North of Broadway	12,000	12,000	--	0.0%	15,000	3,000	0.8%	13,500	1,500	0.4%
South of Broadway	11,000	12,000	1,000	0.3%	14,000	3,000	0.9%	12,500	1,500	0.5%
Country Club Road										
North of Broadway	20,000	26,000	6,000	1.0%	31,000	11,000	1.8%	25,500	5,500	0.9%
South of Broadway	17,000	22,000	5,000	1.0%	25,000	8,000	1.6%	21,000	4,000	0.8%

Notes:

"Growth Rate" based on equal annual increments over a 30-year period except for the change in current ADT where the difference in base years is taken to be the period.

Level of Service

Traffic engineers use "Level of Service" or "LOS" to measure the operational effectiveness of various transportation modes. LOS is rated by the letters "A" through "F" with "A" being the best and "F" the worst. Figure 4 describing level of service for classic vehicular travel provides a sense of how this concept works.

Figure 4 -- Description of Level of Service for General Traffic Flow

LOS	General Character of Operation	Typical Vehicle Spacing	AASHTO Description
A	Traffic flows freely with vehicles moving at or above the posted speed limit. Drivers are easily able to change lanes.	27 car lengths	Free flow
B	Traffic flows reasonably freely at or above the speed limit but the ability to change lanes is slightly restricted.	16 car lengths	Reasonably free flow
C	Traffic operates at or near free-flow conditions though the ability to change lanes is noticeably restricted and requires greater attention. Drivers are generally comfortable, and the posted speed is maintained. The roadway operates near but safely below capacity. This is the targeted LOS for some urban and most rural highways.	11 car lengths	Stable flow
D	Traffic operates at decreasing free-flow levels. Speeds decrease as the traffic volume slightly increases. The ability to maneuver in traffic stream is much more limited and driver comfort levels decrease. This LOS is a common design standard for urban streets during peak hours, and the typical standard applied by the City of Tucson.	8 car lengths	Approaching unstable flow
E	Traffic volume exceeds the capacity of the roadway and flow becomes irregular. Speeds rarely reach the posted limit and vary rapidly as there are virtually no usable gaps to maneuver within the traffic stream. Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. LOS E is a common standard in larger urban areas where some roadway congestion is inevitable.	6 car lengths	Unstable flow
F	Traffic flow breaks down. Frequent slowing and stopping occurs. This is essentially a traffic jam with vehicles able to move only in lockstep with those in front of them.	n/a	Forced or breakdown flow

Different transportation elements have different ways of defining level of service. For signalized intersections, LOS is defined in terms of average delay as indicated in Figure 5. For urban arterials such as Broadway, signalized intersections generally control the flow of traffic and the roadway operation. For this project, Kittelson determined LOS for each approach and movement as well as the overall operation of each intersection.

Other criteria apply for unsignalized intersections though those are also based on average delay. Level of service for general arterial traffic is measured by the average speed including the effects of delay at signalized intersections, pedestrian crossings, side streets, and driveways. That definition is also provided in Figure 5.

Levels of service are also defined for pedestrians, bicyclists, and transit users are determined utilizing a scoring methodology that considers such parameters as user comfort, access to the facility, and perception of the facility. For instance, bicycle LOS considers bike lane width, number of driveways and side streets, speed of traffic, presence of parked cars, and other factors.

For traffic flow, LOS D is the target of performance commonly used by transportation agencies including the City of Tucson. LOS E is also accepted by some transportation agencies in more mixed use urbanized parts of their communities and in transit corridors. The City will accept LOS E if LOS D cannot be reasonably attained. Ion any case, LOS E can be considered the threshold of acceptable performance.

Figure 5 -- LOS Definitions for Vehicular Traffic

Signalized Intersections		Arterial Traffic	
LOS	Average Delay (Sec)	LOS	Average Speed (mph)
A	<= 10	A	> 30
B	> 10 - 20	B	> 23 - 30
C	> 20 - 35	C	> 18 - 23
D	> 35 - 55	D	> 14 - 18
E	> 55 - 80	E	>10 - 14
F	> 80	F	< =10

Existing Traffic Operation

Kittelson evaluated the levels of service for the signalized intersections based on detailed traffic counts taken in 2010 during the morning (AM) and evening (PM) peak travel periods. The LOS was determined based on the delay definitions just described. The resulting levels of service as well as the delays in seconds (shown in parenthesis) are providing in Figure 6. These levels of service apply to the "overall intersection" as they are based on the average delay of all heciles entering during the hour in question. All signalized intersections currently operate at LOS D or better. The LOS of particular movements, eastbound left turns for example, can be much greater as discussed below.

Figure 6 -- Existing Intersection Operation

	AM Peak LOS (Delay)	PM Peak LOS (Delay)
Euclid Avenue	D (45)	C (32)
Highland Avenue	B (11)	A (8)
Campbell Avenue	D (48)	D (45)
Tucson Boulevard	C (21)	C (24)
Country Club Road	C (34)	D (42)

The overall operation of Broadway was also determined. Average travel speed between Euclid Avenue and Country Club Road in the peak direction of travel was measured at approximately 25 mph during both the morning and evening periods. While this travel speed reflects LOS B operations, it does not account for the additional delay created by the four signalized pedestrian crossings which are randomly activated. Not only do these signalized crossings create significant delay and queuing, particularly during peak traffic periods, but they also disrupt traffic progression through the signalized intersections which are coordinated to optimize traffic flow.

Existing Pedestrian Activity

Pedestrian counts were taken at the four existing signalized pedestrian crossing at Park, Cheerry, Norris, and Plumer, and at the currently unsignalized crossting at Treat. The signalized crossings are pedestrian-activated installations known as HAWKS. Figure 7 shows both the number of pedestrians crossing and the number of signal activations.

Peak pedestrian hours do not correspond to peak hours for traffic. Hourly volumes for both are shown in Figure 7 along with the peak hour of pedestrian crossings.

The current HAWK crossings are "single phase" where both directions of Broadway traffic are crossed under a single activation. That halts traffic in both directions for an extended period to allow pedestrians to cross the entire roadway. Kittelson recommends that the new crossings be two-phase, that is the crossing of each direction will be done independently under separate activations. Two-phased crossing can be incorporated into the general signal phasing scheme, improving the overall level of service.

Figure 7 -- Current Pedestrian Volumes

	2011 Pedestrian Volumes (Signal Activations)		
	During Peak Traffic Hours on Broadway		Peak Pedestrian
Location	AM	PM	Crossing Activity
Park Ave (HAWK)	22 (18)	11 (9)	41 (15); 9:15-10:15 AM
Cherry Ave (HAWK)	19 (11)	14 (12)	21 (9); 7:45-8:45
Norris Ave (HAWK)	3 (3)	6 (5)	15 (9); 3:15-4:15 PM
Plumer Ave (HAWK)	17 (12)	14 (13)	27 (12); 3:15-4:15 PM
Treat (marked crosswalk)	1 (NA)	1 (NA)	6 (NA); 9:45-10:45

Existing Bicycle Activity

Fewer than 10 bicycles on Broadway Boulevard were counted during the PM peak period (4:00-6:00 pm) at Norris Avenue. That is a reflection of the poor bicycle environment that currently exists.

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Existing Transit

Transit service along Broadway on the other hand is a major component of travel within the existing corridor. Sun Tran Route 8, which serves Broadway, carried 3.1 million passengers in the twelve months ending June 30, 2012. That is the busiest route in Tucson and 67% greater than the second busiest, Route 16 serving 12th Avenue and Oracle Road. It far exceeds ridership of other east-west corridors, being twice that of Speedway Boulevard and four times that of Grant Road. Had all of the Sun Tran passengers on Broadway instead driven individually to their destinations, over 49 million more vehicle-miles would have been driven on Broadway or roadways. Transit is clearly an important part of the Broadway transportation picture.

Existing Multimodal Level of Service

Figure 8 shows the existing levels of service determined for transit, bikes and pedestrians. The poor score for bicycle is attributable to the volume of traffic in the adjacent travel lanes and the frequency of driveways and side streets. There are approximately 100 driveways and side streets each side of Broadway over the two-mile project length.

Figure 8 -- Existing Multimodal LOS

	Transit	Bicycle	Pedestrian
Score	1.3	4.56	3.35
LOS	A	E	C

Crash History

Crash data for the 3-year period from January 1, 2008 to December 31, 2010 is summarized in Figure 9. During this 3-year period a total 434 crashes occurred along this section of Broadway Boulevard. No fatalities occurred during this period. The roadway segment between Campbell Avenue and Tucson Boulevard experienced the highest number of crashes. Rear-end crashes tend to be the most common on roadways with a high number of driveways and side streets, and at intersections that are congested.

Figure 9 -- Summary of Crash Data

Signalized Intersections

	Euclid Avenue		Highland Avenue		Campbell Avenue		Tucson Boulevard		Country Club Road	
Total	67		12		101		51		70	
Angle	5	7%	1	8%	12	12%	2	4%	5	7%
Rear-End	16	24%	3	25%	41	41%	17	33%	24	34%
Turning	13	19%	3	25%	20	20%	10	20%	11	16%
Other	33	49%	5	42%	28	28%	22	43%	30	43%

Roadway Segments

	Euclid to Highland (0.5 mi)		Highland to Campbell (0.4 mi)		Campbell to Tucson Blvd (0.5 mi)		Tucson Blvd to Country Club (0.5 mi)	
Total	27		26		59		21	
Angle	1	4%	1	4%	3	5%	0	0%
Rear-End	8	30%	9	35%	33	56%	15	71%
Turning	4	15%	9	35%	11	19%	0	0%
Other	14	52%	7	27%	12	20%	6	29%

Projected Lane Requirements

Using the Project Volumes of Figure 3, Kittelson determined recommended lane configurations at each intersection. A target level of service D was used in accordance with City standards and well-established industry practice. The recommended number of lanes for through, left turn, and right turn movements are provided in Figure 10. Also shown is the existing number of each movement for comparison. Values shown in red indicate an increase over existing conditions.

Key findings are as follows:

-- The most obvious change is the addition of third travel lanes in both directions of Broadway.

-- Double lefts are called for in all directions at the major intersections -- Euclid, Campbell, and Country Club.

-- Exclusive right turn lanes are needed in the westbound direction at Campbell, the eastbound and westbound directions at Tucson Boulevard, and in all directions at Country Club.

Exclusive right turn lanes on Broadway would be automatically addressed with the eight-lane section but would be provided as separate lanes if not. Except for the alternate Country Club intersection, the recommended lane configuration achieves overall intersection levels of service of D or better.

Two configurations have been evaluated for the Country Club intersection. The "recommended" configuration includes double left and exclusive right turn lanes in each direction described above. It is anticipated that the proximity of sensitive structures (notably Broadway Village and Chase Bank) will make providing this recommendation difficult. An "alternate" configuration, consisting of single left turn lanes each direction and an exclusive right lane in only the westbound direction, has also been analyzed to provide some sense of the operational effects of providing a lesser configuration.

It can be seen in Figure 10 that the alternate configuration would drop the overall intersection LOS from C for both AM and PM peak hours to D and E respectively. While LOS E is not desirable, it may be considered acceptable in light of the implications of the wider section.

These lane configurations are shown schematically in Attachment A. Both the six-lane and eight lane sections are indicated with the multiuse lanes being dashed. Other information depicted in Attachment A is described later.

Figure 10. Existing and Recommended Lane Configurations

	Existing				2040			
Intersection	LT	TH or TH/RT	RT	AM/PM LOS	LT	TH or TH/RT	RT	AM/PM LOS
Euclid Ave								
EB,WB	1	3	1	D / C	**2**	3	1	C / C
SB,NB	1	2	1		**2**	2	1	
Park Ave								
EB,WB	1	2	1,0	B / A	1	**3**	0	A / A
SB,NB	0	1	0		0	1	0	
Highland Ave								
EB,WB	1	2	0	B / A	1	**3**	0	B / A
SB,NB	1	1	0		1	1	0	
Cherry Ave								
EB,WB	1	2	0	B / B	1	**3**	0	A / A
SB,NB	1	1	1		1	1	1	
Campbell Ave								
EB,WB	1	2	1,0	D / D	**2**	**3**	**1**	D / D
SB,NB	2	3	1		2	3	1	
Norris Ave								
EB,WB	1	2	0	A / C	1	**3**	0	A / A
SB,NB	0	1	0		0	1	0	
Plumer Ave								
EB,WB	1	2	0	B / B	1	**3**	0	A / A
SB,NB	1	1	0		1	1	0	
Tucson Blvd								
EB,WB	1	2	0	C / C	1	**3**	**1**	B / C
SB,NB	1	1	1		1	1	1	
Treat Ave								
EB,WB	1	2	0	B / C	1	**3**	0	A / B
SB,NB	0	1	0		0	1	0	
Country Club								
EB,WB	1	3,2	0,1	C / D	**2**	**3**	**1**	C / C
SB,NB	1	2	0,1		**2**	2	**1**	
Country Club Alt								
EB,WB	1	3,2	0,1	--	1	**3**	0,1	D / E
SB,NB	1	2	0,1		1	2	1	

Signalized Intersection Analysis

The five intersections to be signalized are at Euclid Avenue, Highland Avenue, Campbell Avenue, Tucson Boulevard, and Country Club Road. A narrower "alternate" Country Club intersection was also included in this analysis in anticipation of difficulty in fitting the wider roadway section between Chase Bank and Broadway Village without seriously impacting one or the other. That information will be useful in evaluating alternative configurations for the Country Club intersection in a later study.

The delay for various movements at each intersection was determined using procedures documented in the Transportation Research Board's *Highway Capacity Manual 2010 (HCM2010)*. Since delay is a function of the number and types of lanes, a trial-and-error approach is needed to determine a lane configuration that achieves the target level of service. The target level of service D has been used to determine lane requirements with the understanding that LOS E may be permissible in certain conditions.

Kittelson used the software package *Synchro* to perform the calculations. Evaluations for six and four-lane configurations were performed using the standard project volumes. As discussed above, the four-lane configuration was also evaluated using the low growth projections. Morning (AM) and afternoon (PM) peak hour volumes were both evaluated.

The delays determined along with corresponding levels of service (seconds per vehicle) for each movement are tabulated in Attachment B. Also shown are the average delay of the "overall intersection" (that is the average delay of all vehicles entering the intersection) and of the "worst movement"--that is the greatest delay among the individual movements. Overall intersection delay is the normal design standard. Worst movements are shown here to indicate the degree to which the delay for particular movements will exceed that of the overall intersection. That information is used to determine the storage lengths needed for exclusive right and left turn lanes.

These results are tabulated in Figure 11 for morning (AM) and afternoon (PM) peak hours. Values with LOS E and F are shown in blue and red respectively. It can be seen that the six-lane section generally will perform as intended, operating at LOS D or better for overall intersection performance. The only exception is the alternative Country Club intersection which will drop to LOS E during the peak afternoon hour. The southbound left turn movements at Campbell will equal or exceed the LOS F criterion during both the morning and afternoon peak hours.

Figure 11. Summary of AM and PM Peak Hour "Overall Intersection" and" Worst Movement" Levels of Service

Six Lane Section, Project Traffic Volumes

	Intersection Overall		Worst Movement	
	AM	PM	AM	PM
Euclid Ave	C(34)	C(32)	D(46) SB LT	D(46) WB LT
Highland Ave	B(13)	A(9)	D(48) SB LT	D(38) SB LT
Campbell Ave	D(46)	D(54)	F(115) SB LT	F(104) SB LT
Tucson Blvd	B(18)	C(22)	D(47) NB TH	D(52) NB LT
County Club	C(23)	C(30)	D(38) SB LT	E(70) SB LT
County Club Alt	D(42)	E(74)	D(53) WB TH	F(221) WB LT

Four Lane Section, Project Traffic Volumes

	Intersection Overall		Worst Movement	
	AM	PM	AM	PM
Euclid Ave	E(64)	D(42)	F(126) WB TH	E(63) EB TH
Highland Ave	B(17)	B(12)	E(61) SB LT	D(44) SB LT
Campbell Ave	F(93)	F(104)	F(254) WB TH	F(253) EB TH
Tucson Blvd	D(41)	E(56)	E(59) WB TH	F(95) EB TH
County Club	C(35)	E(69)	E(61) WB TH	F(138) EB TH
County Club Alt	D(41)	F(106)	F(150) EB LT	F(389) EB LT

Four Lane Section, Reduced Traffic Volumes

	Intersection Overall		Worst Movement	
	AM	PM	AM	PM
Euclid Ave	D(45)	D(37)	F(83) WB TH	D(54) WB LT
Highland Ave	B(14)	B(11)	D(48) NB LT	D(45) SB LT
Campbell Ave	E(70)	F(93)	F(200) WB TH	F(244) EB TH
Tucson Blvd	C(26)	D(46)	D(50) NB TH	E(76) EB TH
County Club	C(28)	E(64)	D(40) WB TH	F(132) EB TH
County Club Alt	C(32)	F(92)	F(122) EB LT	F(374) EB LT

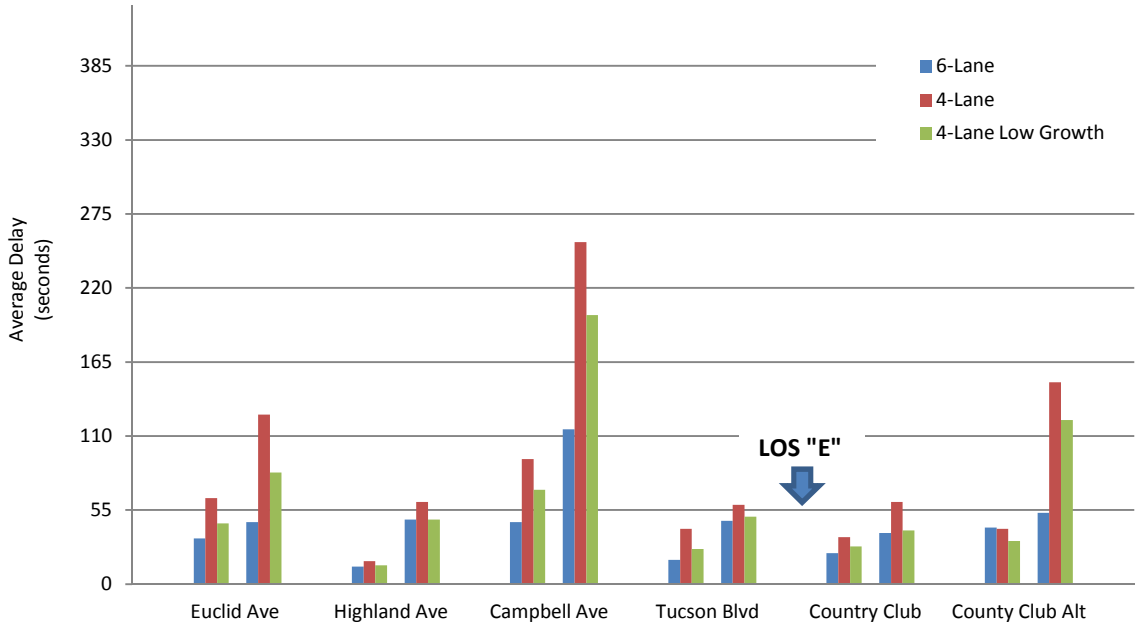
The four-lane section using project volumes does not fair as well. All of the intersections except Highland would exceed the LOS E threshold during either the morning or afternoon peak hours. The Campbell Avenue intersection would experience LOS F during both peak hours. The average delay for eastbound traffic at Campbell would exceed four minutes.

Applying the lower growth projected volumes to the four-lane section improves the situation though significant delays would still be experienced. It would be difficult to technically justify the use of the lower volumes even if they did result in the roadway operating acceptably.

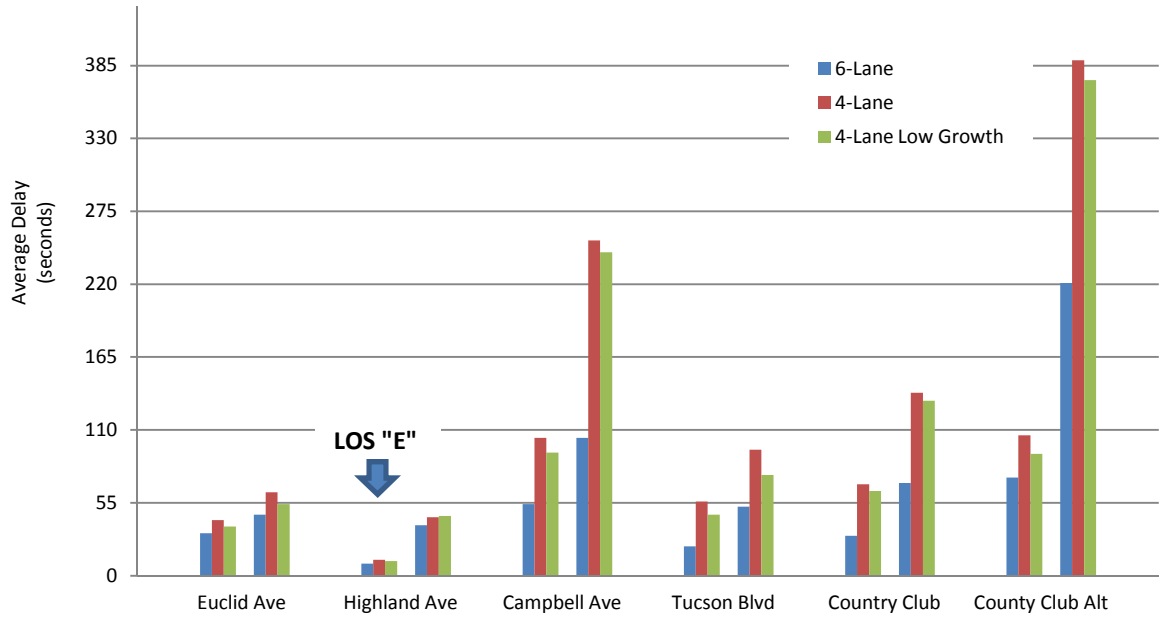
The results are also plotted as bar graphs in Attachment B to better visualize the results. The lowest horizontal gridline corresponds to LOS E (55 second delay) threshold, the lowest acceptable level of service for arterial roadways discussed previously. Each successive gridline is a multiple of that threshold. Two clusters for each intersection bundle the six-lane section, the four-lane section, and the four-lane section with lower growth traffic volumes for easy visual comparison. The clusters to the left represent overall intersection operation while that to the right reflects the worst movement. Those plots are also summarized here in Figure 12 for convenience.

Figure 12. Summary of Intersection Operation over the Project Length

AM Peak



PM Peak



Notes:

1. Lowest grid line (average delay of 55 seconds) reflects Level of Service (LOS) "E", the lowest acceptable threshold of intersection operation. Each subsequent grid line is a multiple of LOS E.
2. For each intersection, the grouping of bars on the left side reflects the overall intersection performance which is the normal standard for design. That to the right represents the "worst movement" indicating the delay that could be experienced with

Other Measures of Operational Effectiveness

The ability of the roadway to handle a particular volume of traffic can also be measured in other ways such as the time required to traverse a particular reach of roadway or particularly average speed, a measure that drivers can better relate to. The Synchro analysis also provides that information which is tabulated in Figure 13. Bar graphs are provided to help illustrate the results.

The LOS shown here is that for overall travel through the corridor. It does not correspond directly to intersection LOS described earlier but does take into account the delay experienced at intersections along the way. It should be noted that these values overstate the actual performance as Synchro does not take into account the effects of buses stopped in travel lanes to board and discharge passenger, the slowing of vehicles turning into commercial property, or the effect of HAWKs.

Figure 13 -- Other Traffic Operational Comparisons

Broadway Blvd		Travel Time		Speed		Arterial LOS	
		AM	PM	AM	PM	AM	PM
Existing	EB	6.0	6.5	28.8	25.6	B	B
	WB	7.4	6.7	25.6	23.5	B	B
6-Lane	EB	6.0	6.7	20.8	18.9	C	C
	WB	7.1	6.4	20.5	23.0	C	C
4-Lane	EB	8.3	13.8	15.1	9.1	D	F
	WB	13.4	8.6	10.9	17.0	E	D
4-Lane Low Growth	EB	6.8	12.4	18.5	10.2	C	E
	WB	10.8	7.4	13.5	19.8	E	C

Notes:

1. Travel time is average time in minutes to drive between Euclid and Country Club.
2. Speed is average speed of trip between Euclid and Country Club Road in mph.

Figure 13a -- Eastbound Comparison

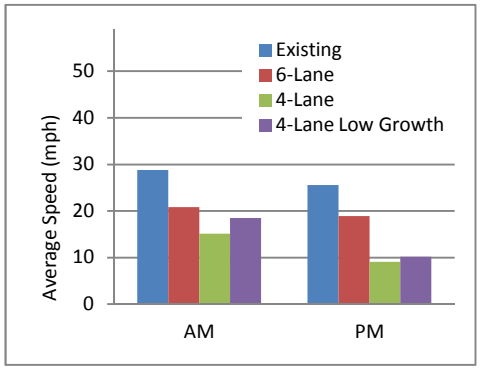
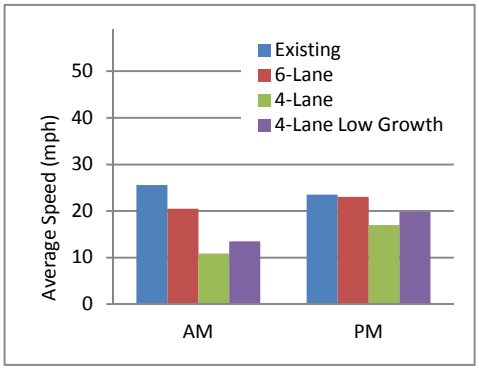


Figure 13b -- Westbound Comparison



It can be seen that the arterial LOS results are similar to those determined for the signalized intersections. Acceptable operation is found for the 6-lane configuration in all cases. For the four-lane configuration, peak hour levels of service are LOS E or F in the dominant direction of traffic with corresponding average speeds on the order of ten miles per hour.

Turn Lane Storage Requirements

Sufficient turn lane storage is needed to allow turning vehicles to pull out of the travel lanes for the signalized intersections to function as intended. The traffic report has determined the necessary lengths of right and left turn lanes which are summarized here in Figure 14 for reference. It can be seen that the single left turn lanes at Country Club Road for the alternate configuration would be much longer than if double lefts are provided.

Figure 14 -- Recommended Turn Lane Storage Requirements at Signalized Intersections

	Eastbound Turn Lanes		Westbound Turn Lanes		Northbound Turn Lanes		Southbound Turn Lanes	
Intersection	Left	Right	Left	Right	Left	Right	Left	Right
Euclid Avenue	170' x 2	110'	150' x 2	290'	110' x 2	210'	140'	350'
Highland Avenue	110'	110'	110'	110'	140'	--	120'	--
Campbell Avenue	160' x 2	110'	130' x 2	200'	130' x 2	200'	220' x 2	200'
Tucson Boulevard	110'	110'	110'	110'	170'	110'	170'	130'
Country Club Road	140' x 2	110'	130' x 2	220'	110' x 2	150'	160' x 2	130'
Country Club Road Alt	300'	--	300'	150'	200'	110'	400'	110'

Bus Stops

Bus stops will be handled differently depending on the choice between six and eight lanes. With the eight-lane section, the buses would simply stop in the multiuse lanes to board and discharge passengers. With the six-lane section, bus pullouts would be provided where possible to allow buses to leave the travel lane to board and discharge. Pullouts would not typically be provided at non-signalized intersections due to the difficulty for buses to merge back into arterial traffic without the shelter of a red light.

Attachment A shows where bus stops currently exist and how they would likely be handled with and without the multiuse lanes. The pullouts shown for the six-lane section indicate where additional right-of-way would be needed.

Access Management

The City of Tucson's Transportation Access Management Guidelines specified 660' as the minimum spacing between full access median openings for an arterial roadway. This guideline along with a review of existing cross street traffic demand, network connectivity, and potential future development has been used to develop the scheme of median openings shown. The recommended opening locations are also shown in the drawings of Attachment A. The opening at Warren Avenue would allow left turns off Broadway but would force only right turns off Warren.

Operational Comparison of Six and Eight-Lane Sections

The traffic study update also determined the impact on traffic and transit operations of using a standard six-lane section rather than the eight-lane section originally contemplated. The eight-lane section includes the same travel lanes as the six-lane section but includes also a multiuse lane in each direction for buses, right-turning vehicles, and potentially bikes. Synchro does not have the ability to account for dedicated bus lanes or the other factors that the presence of lack of multiuse lanes would impact.

To evaluate the operational effects of the multiuse lanes, a sophisticated micro simulation modeling approach has been employed that explicitly incorporates the effects of pedestrian movement, driveway activity, HAWK pedestrian crossings, and bus service. VISSIM software was used for this purpose. Key elements of the VISSIM analysis include:

-- Separate models were created to reflect the six and eight-lanes sections.

-- The model limits extend from a point west of Cherry Avenue to a point east of Tucson Boulevard. That section is particularly active and considered best able to reflect operational differences since it includes two HAWK

crossings, heavy commercial activity including the Safeway shopping center, and the Campbell Avenue, Cherry Avenue, and Tucson Boulevard intersections.

-- Peak 2040 PM hour projected volumes (4:00 PM to 5:00 PM) are used. Peak AM volumes have not been analyzed but would likely provide similar results in opposite directions.

-- The models include one driveway per block in each direction to reflect the general ingress/egress activity associated with adjacent businesses. Twenty vehicles are assumed to enter and exit these driveways during the peak hour.

-- Additional driveways were provided to represent the higher volumes at Sonic and Safeway. The driveway for Sonic has been assumed to have 40 vehicles per hour (both in and out). The separate driveway for Safeway was assumed to serve 160 vehicles in and 70 vehicles out. These values are based on traffic counts made for this study.

-- The signal at Campbell was assumed to have a 90 second cycle, to be coordinated with adjacent installations, and given transit priority.

-- HAWK pedestrian crossings were included at Cherry and Plumer Avenues. They are assumed to be two-stage crossings synchronized with the roadway signal system, with vehicles stopping on flashing red lights. Pedestrian volumes are based on actual counts taken for this study increased by 25% to reflect 2040 volumes.

-- Multiuse lanes for the eight-lane section would be available only to transit vehicles, bikes, and right turning vehicles. The extent to which placing bikes in the multiuse lanes might diminish transit operation cannot be modeled in VISSIM and has not been explicitly determined.

-- For the six-lane section, buses use a standard travel lane though bus pullouts are provided at signalized intersections for boarding and discharging passengers. At non-signalized intersections buses stop in the travel lane. For the eight-lane section they would stop in the multiuse lane.

-- Regular bus service is assumed at 10-minute headways stopping at all stops. Express bus service or bus rapid transit is assumed to have 15 minute headways and stop only at Campbell. Dwell times of 30 seconds are assumed at Campbell and 15 seconds at other stops.

Several measures of operational comparison are shown in Figure 15. It can be seen that not providing multiuse lanes would increase the average delay for transit about 10% while that of general arterial traffic would not be significantly affected. The total travel time would be increased in the 10% to 15% range in both cases.

Figure 15 -- Comparison of Eight and Six Lane Traffic Operations

Arterial Traffic	8 Lanes	6 Lanes	Change	Percent
Average Delay time (Seconds per Vehicle)	78.8	79.3	0.5	0.6%
Average Number of Stops per Vehicle	2.12	2.16	0.04	1.9%
Average Speed (Miles per Hour)	17.3	17.1	-0.2	-1.2%
Average Eastbound Travel Time (seconds)	160	170	10	6.3%
Average Westbound Travel Time (seconds)	142	161	19	13.4%

Buses	8 Lanes	6 Lanes	Change	Percent
Average Delay time (Seconds per Vehicle)	92.6	103.3	10.7	11.6%
Average Number of Stops per Vehicle	1.37	1.58	0.21	15.3%
Average Speed (Miles per Hour)	16.3	15.3	-1	-6.1%
Average Eastbound Travel Time (seconds)	262	263	0	0.0%
Average Westbound Travel Time (seconds)	230	255	25	10.9%

Other traffic operational analyses are likely to be needed during the DCR process to evaluate alternative configurations for the Euclid, Campbell, and Country Club intersections.

Multi-Modal Operations Analysis

As mentioned earlier, HCM2010 includes methodology for determining levels of service for transit, bicycles and pedestrian travel. Levels of service for these modes are primarily based on user experience and perception of the facility. Figure 16 lists factors taken into account in determining multi-modal levels of service (MMLOS).

Several six-lane configurations were preliminarily evaluated in the traffic study to provide an initial sense of how various lane configurations would fair in this regard. Those results are presented in Figure 17.

More alternatives will be considered in the DCR process. For example, the cross section ultimately emerging from the Grant Road Corridor study has a 12' landscaped buffer between the roadway and sidewalk.

It can be seen there that the level of service for bicyclists needs improvement in any scenario. As noted earlier, consolidating access points to adjacent development would be one way to improve that.

Figure 16-- Factors Considered in Determining Multimodal Level of Service

Transit
- -- Frequency of Service
- -- Perceived wait time and travel time
- -- Actual speed
- -- Provisions for waiting passengers

Bicycle
- -- Vehicle volume in outside lane
- -- Percentage of heavy vehicles
- -- Vehicle speeds
- -- Widths of travel and bicycle lanes
- -- Pavement quality
- -- Cross street width at signalized intersections
- -- The number of unsignalized intersections and driveways
- -- Time to cross intersections

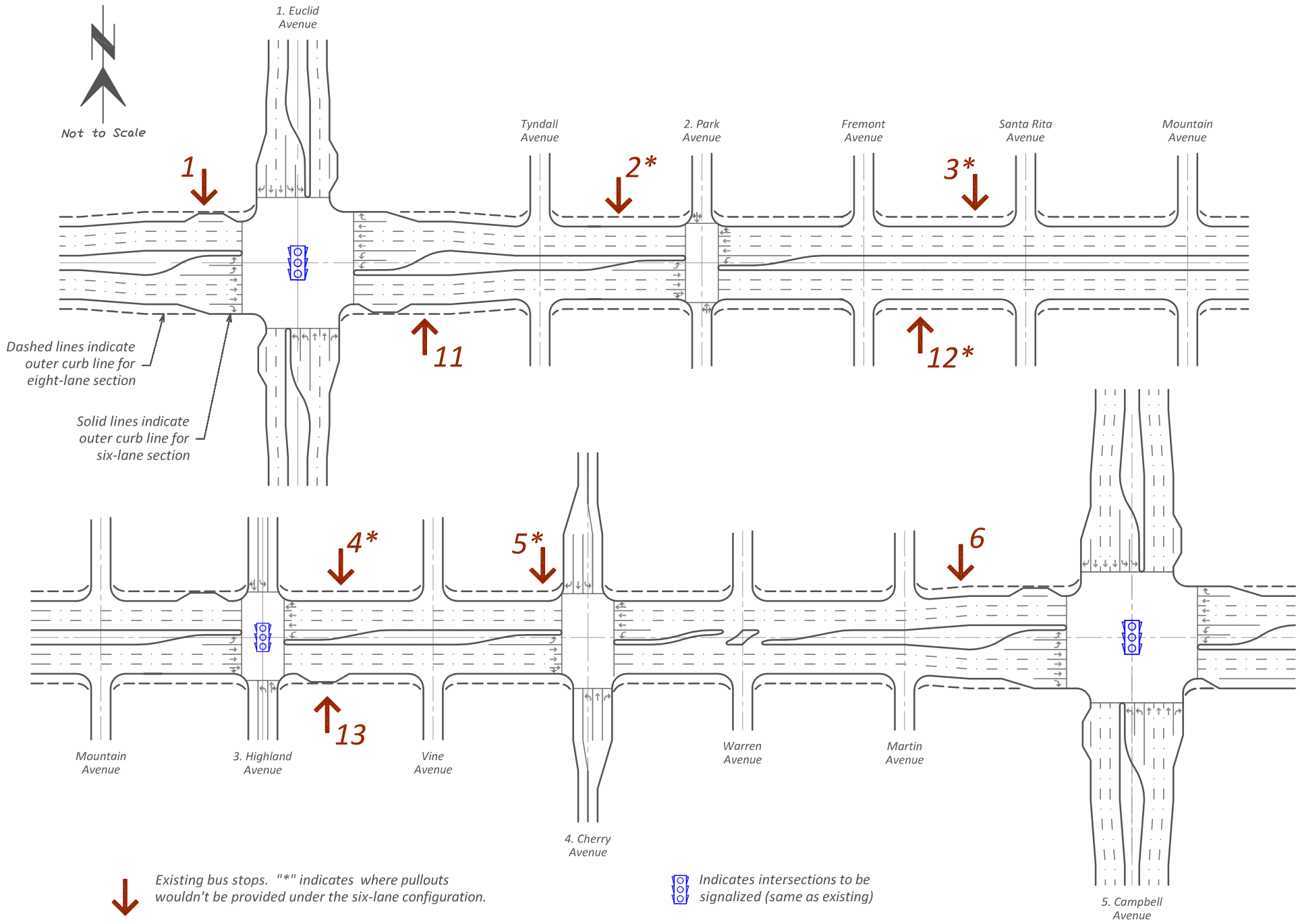
Pedestrian
- -- Vehicle volume in outside lane
- -- Vehicle speeds
- -- Presence and width of sidewalk and buffer
- -- Lateral separation between vehicles and pedestrians
- -- Right-turns on red and permitted left-turns during "Walk" phase
- -- Crossing delay (signalized and uncontrolled)
- -- Time to cross intersections

Figure 17-- Multi-Modal Level of Service Results

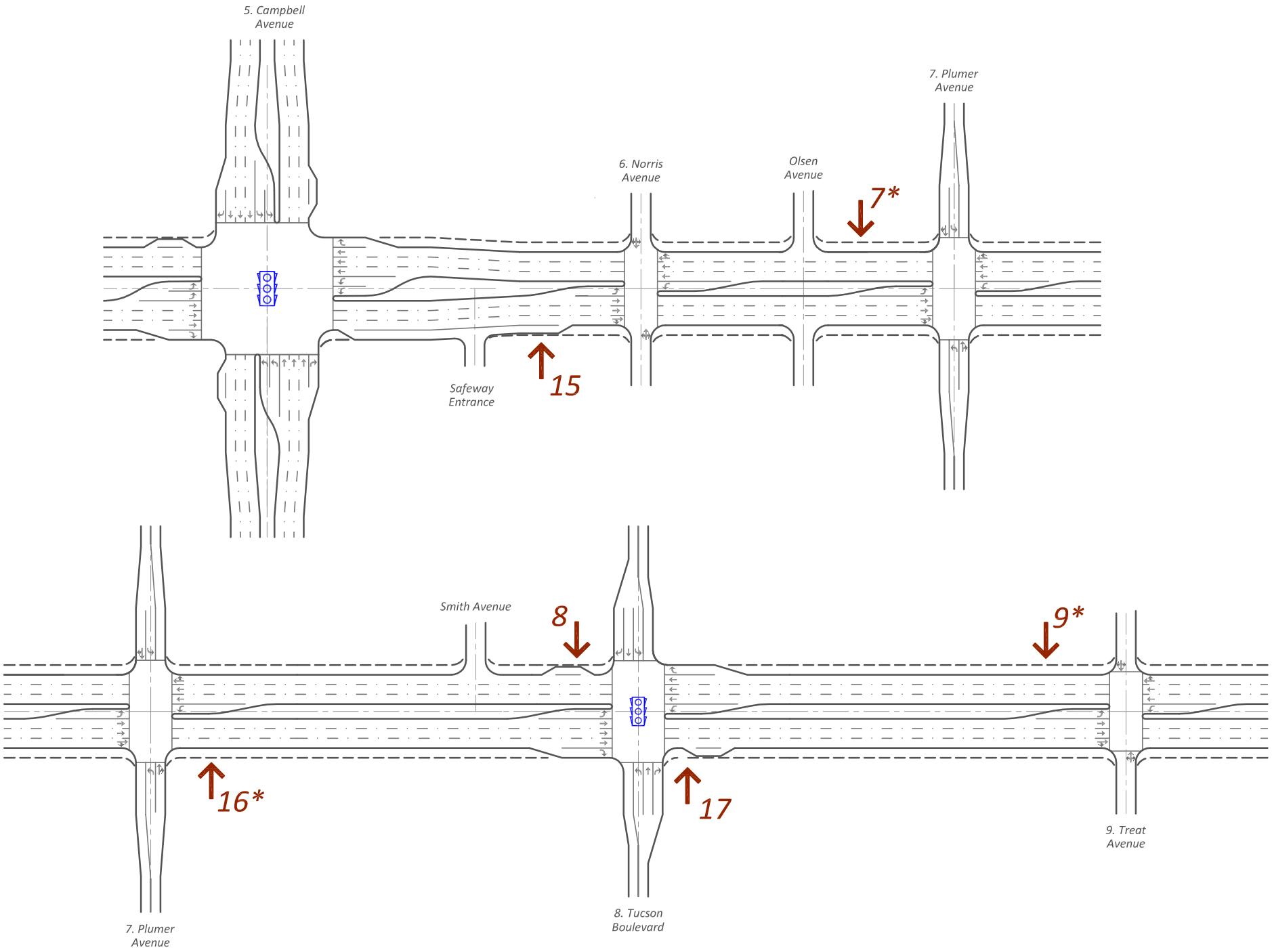
Configuration		Transit	Bicycle	Pedestrian
Six-Lane divided roadway,	Facility Width:	--	6'	5'
No transit lane, 6' bike	MMLOS Score:	1.27	4.37	3.19
lane, 5' sidewalk	Corresponding LOS:	A	E	C
Six-Lane divided roadway,	Facility Width:	--	6'	5'
No transit lane, 6' bike	MMLOS Score:	1.27	4.27	3.18
lane, 6' sidewalk	Corresponding LOS:	A	E	C
Six-Lane divided roadway,	Facility Width:	--	6'	5'
12' transit lane, 6' bike	MMLOS Score:	0.25	3.59	3.11
lane, 6' sidewalk	Corresponding LOS:	A	D	C

All alternatives based on a six-lane divided roadway

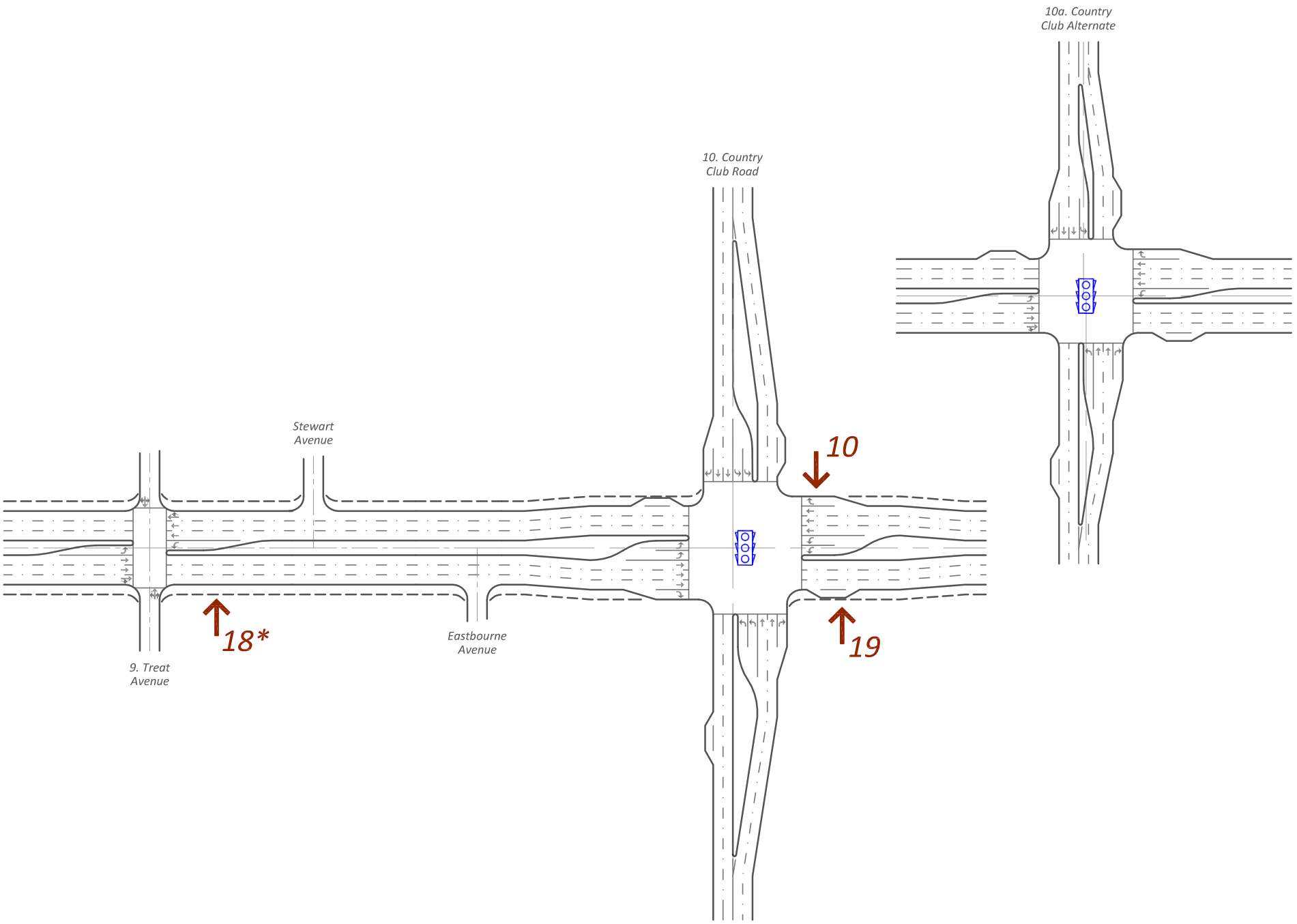
Attachment A
Intersection Configurations



Attachment A (1 of 3) -- Traffic Study Results



Attachment A (2 of 3) -- Traffic Study Results



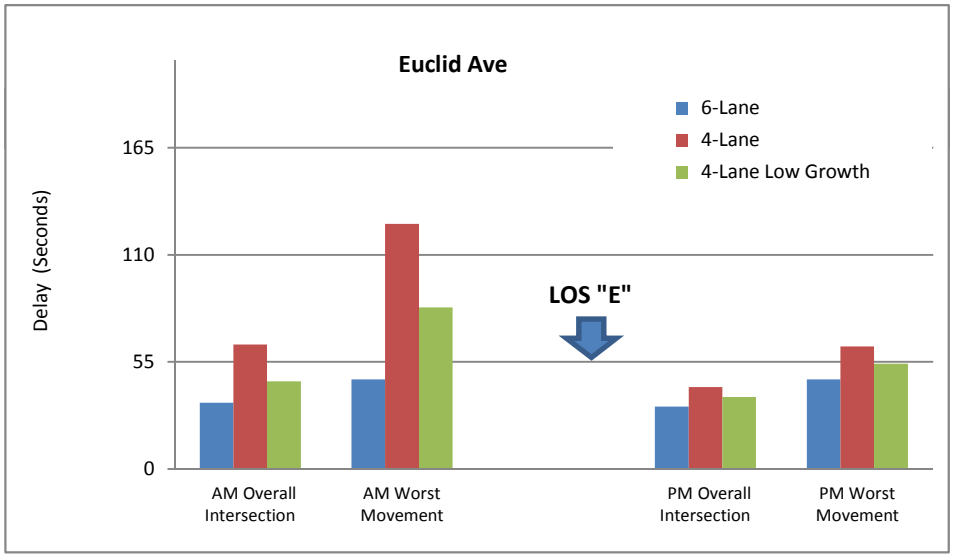
Attachment A (3 of 3) -- Traffic Study Results

Attachment B
Signalized Intersection Analysis results

Attchment B. (1 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

Euclid Ave

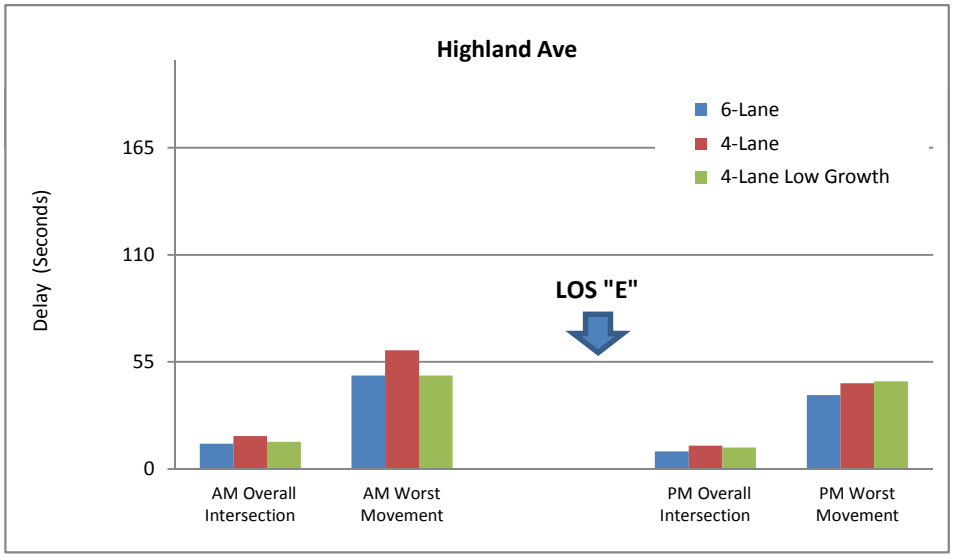
	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	38	D	42	D	44	D	40	D	55	D	49	D
2		TH	34	C	113	F	58	E	28	C	63	E	47	D
3		RT	23	C	10	A	8	A	20	B	8	A	7	A
4		Approach	34	C	90	F	51	D	30	C	59	E	45	D
5	WB	LT	30	C	31	C	15	B	46	D	59	E	54	D
6		TH	35	C	126	F	83	F	27	C	43	D	37	D
7		RT	37	D	29	C	25	C	27	C	19	B	17	B
8		Approach	34	C	90	F	67	E	31	C	41	D	37	D
9	NB	LT	32	C	23	C	20	B	33	C	30	C	28	C
10		TH	41	D	44	D	38	D	36	D	39	D	38	D
11		RT	24	C	10	A	8	A	23	C	12	B	11	B
12		Approach	36	D	34	C	29	C	34	C	33	C	32	C
13	SB	LT	46	D	48	D	43	D	43	D	45	D	42	D
14		TH	32	C	35	C	32	C	31	C	33	C	32	C
15		RT	22	C	6	A	6	A	35	C	30	C	28	C
16		Approach	33	C	31	C	28	C	34	C	34	C	33	C
	Overall Intersection		34	C	64	E	45	D	32	C	42	D	37	D
	Worst Movement		46	D	126	F	83	F	46	D	63	E	54	D
			SB LT		WB TH		WB TH		WB LT		EB TH		WB LT	



Attchment B. (2 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

Highland Ave

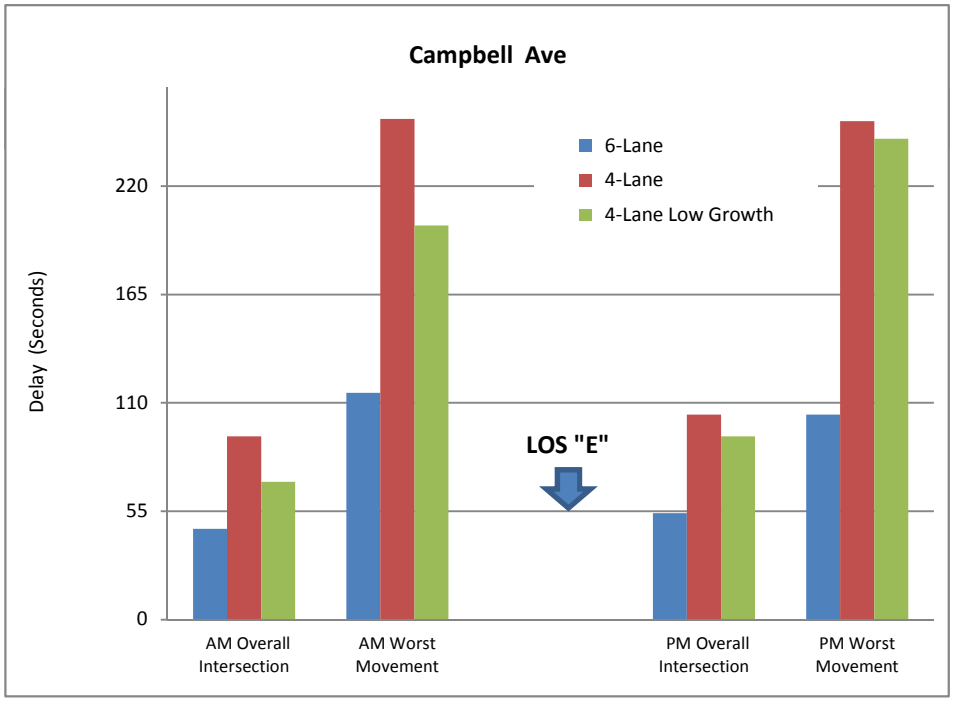
	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	30	C	55	D	23	C	11	B	16	B	11	B
2		TH			10	A	9	A	--	--	11	B	9	A
3		RT			2	A	2	A	--	--	2	A	2	A
4		TH+RT	7	A					6	A				
5		Approach	8	A	12	B	9	A	6	A	11	B	9	A
6	WB	LT	9	A	12	B	10	A	11	B	21	C	10	A
7		TH	--	--	14	B	12	B	--	--	9	A	12	B
8		RT	--	--	2	A	2	A	--	--	2	A	2	A
9		TH+RT	8	A					6	A				
10		Approach	9	A	13	B	11	B	6	A	9	A	11	B
11	NB	LT	43	D	49	D	48	D	34	C	37	D	40	D
12		TH+RT	34	C	33	C	27	C	31	C	22	C	23	C
13		Approach	37	D	40	D	37	D	33	C	31	C	33	C
14	SB	LT	48	D	61	E	39	D	38	D	44	D	45	D
15		TH+RT	28	C	25	C	22	C	32	C	23	C	23	C
16		Approach	37	D	41	D	30	C	36	D	35	C	36	D
	Overall Intersection		13	B	17	B	14	B	9	A	12	B	11	B
	Worst Movement		48	D	61	E	48	D	38	D	44	D	45	D
			SB LT		SB LT		NB LT		SB LT		SB LT		SB LT	



Attchment B. (3 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

Campbell Ave

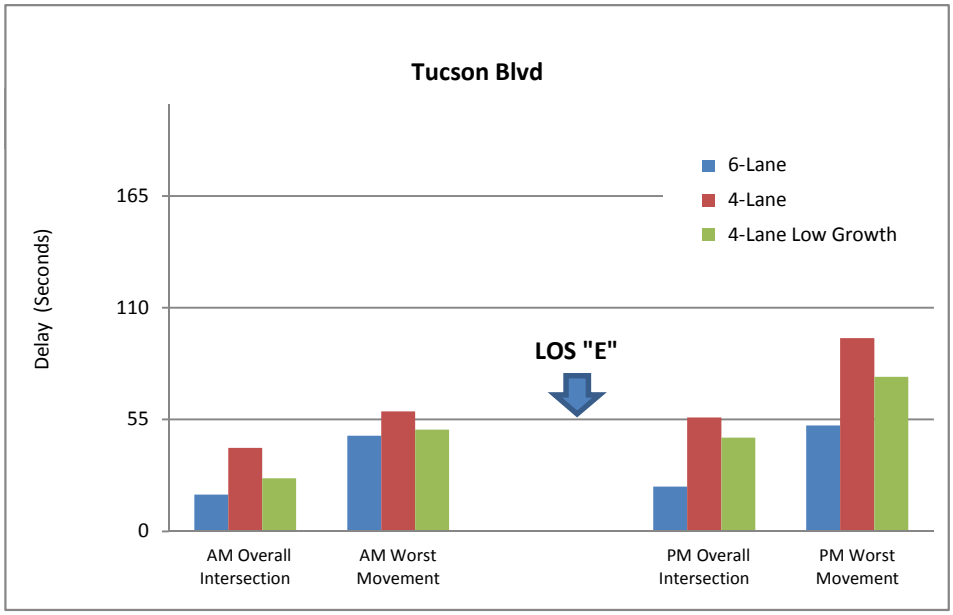
	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	44	D	41	D	36	D	97	F	101	F	110	F
2		TH	28	C	69	E	41	D	59	E	253	F	244	F
3		RT	20	B	7	A	5	A	19	B	10	A	11	B
4		Approach	30	C	60	E	36	D	62	E	215	F	209	F
5	WB	LT	60	E	66	E	52	D	62	E	62	E	104	F
6		TH	61	E	254	F	200	F	27	C	78	E	64	E
7		RT	25	C	16	B	11	B	22	C	12	B	17	B
8		Approach	56	E	202	F	163	F	32	C	65	E	63	E
9	NB	LT	37	D	37	D	34	C	36	D	33	C	33	C
10		TH	55	D	56	E	40	D	78	E	78	E	36	D
11		RT	20	B	14	B	12	B	27	C	22	C	18	B
12		Approach	50	D	50	D	37	D	66	E	66	E	34	C
13	SB	LT	115	F	113	F	50	D	104	F	105	F	161	F
14		TH	29	C	30	C	29	C	44	D	45	D	28	C
15		RT	23	C	21	C	19	B	26	C	18	B	10	A
16		Approach	44	D	44	D	31	C	55	D	56	E	57	E
	Overall Intersection		46	D	93	F	70	E	54	D	104	F	93	F
	Worst Movement		115 SB LT	F	254 WB TH	F	200 WB TH	F	104 SB LT	F	253 EB TH	F	244 EB TH	F



Attchment B. (4 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

Tucson Blvd

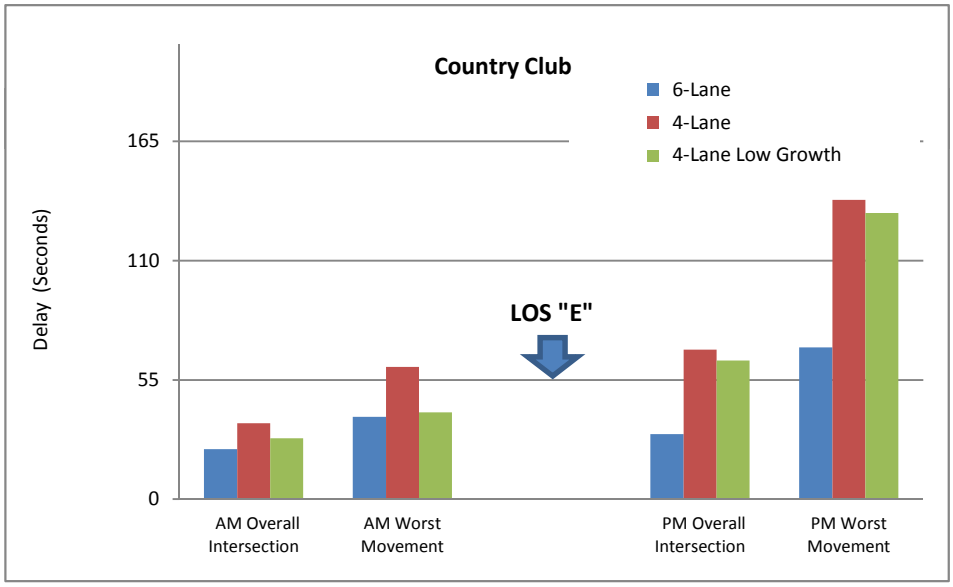
	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	33	C	33	C	31	C	34	C	36	D	38	D
2		TH	17	B	26	C	21	C	23	C	95	F	76	E
3		RT	13	B	5	A	4	A	15	B	8	A	6	A
4		Approach	17	B	24	C	20	B	23	C	87	F	71	E
5	WB	LT	14	B	16	B	18	B	12	B	9	A	13	B
6		TH	8	A	59	E	24	C	8	A	37	D	18	B
7		RT	1	A	1	A	1	A	1	A	3	A	1	A
8		Approach	8	A	55	D	23	C	7	A	33	C	16	B
9	NB	LT	41	D	47	D	47	D	52	D	60	E	38	D
10		TH	47	D	52	D	50	D	38	D	41	D	51	D
11		RT	27	C	10	A	11	B	26	C	13	B	19	B
12		Approach	42	D	43	D	41	D	39	D	41	D	41	D
13	SB	LT	36	D	37	D	39	D	42	D	47	D	76	E
14		TH	37	D	42	D	45	D	48	D	52	D	63	E
15		RT	30	C	21	C	16	B	27	C	18	B	12	B
16		Approach	34	C	34	C	37	D	42	D	43	D	58	E
	Overall Intersection		18	B	41	D	26	C	22	C	56	E	46	D
	Worst Movement		47	D	59	E	50	D	52	D	95	F	76	E
			NB TH		WB TH		NB TH		NB LT		EB TH		EB TH	



Attchment B. (5 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

County Club

	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	17	B	17	B	16	B	37	D	32	C	27	C
2		TH	9	A	17	B	14	B	15	B	138	F	132	F
3		RT	1	A	3	A	3	A	4	A	3	A	4	A
4		Approach	10	A	16	B	14	B	18	B	116	F	120	F
5	WB	LT	22	C	23	C	18	B	42	D	42	D	37	D
6		TH	23	C	61	E	40	D	24	C	58	E	39	D
7		RT	18	B	10	A	9	A	22	C	15	B	13	B
8		Approach	22	C	50	D	33	C	26	C	48	D	34	C
9	NB	LT	32	C	28	C	24	C	36	D	29	C	28	C
10		TH	36	D	38	D	37	D	42	D	45	D	40	D
11		RT	26	C	9	A	9	A	26	C	16	B	17	B
12		Approach	34	C	33	C	31	C	39	D	38	D	34	C
13	SB	LT	38	D	41	D	38	D	70	E	75	E	55	D
14		TH	32	C	34	C	33	C	43	D	46	D	41	D
15		RT	27	C	17	B	14	B	26	C	12	B	10	A
16		Approach	33	C	33	C	31	C	49	D	50	D	41	D
	Overall Intersection		23	C	35	C	28	C	30	C	69	E	64	E
	Worst Movement		38	D	61	E	40	D	70	E	138	F	132	F
			SB LT		WB TH		WB TH		SB LT		EB TH		EB TH	



Attchment B. (6 of 6)
Levels Of Congestion Under Various Lane Configurations And Growth Scenarios

County Club Alt

	Approach/ Movement		AM Peak 6-Lane Delay	AM Peak 6-Lane LOS	AM Peak 4-Lane Delay	AM Peak 4-Lane LOS	AM Peak 4-Lane Low Growth Delay	AM Peak 4-Lane Low Growth LOS	PM Peak 6-Lane Delay	PM Peak 6-Lane LOS	PM Peak 4-Lane Delay	PM Peak 4-Lane LOS	PM Peak 4-Lane Low Growth Delay	PM Peak 4-Lane Low Growth LOS
1	EB	LT	46	D	150	F	122	F	52	D	389	F	374	F
2		TH+RT	43	D	19	B	15	B	71	E	179	F	181	F
3		Approach	43	D	36	D	29	C	69	E	209	F	206	F
4	WB	LT	29	C	77	E	21	C	221	F	265	F	37	D
5		TH	53	D	61	E	40	D	78	E	58	E	39	D
6		RT	24	C	10	A	9	A	31	C	15	B	13	B
7		Approach	46	D	54	D	34	C	86	F	74	E	34	C
8	NB	LT	33	C	28	C	24	C	38	D	29	C	28	C
9		TH	42	D	38	D	37	D	60	E	45	D	40	D
10		RT	27	C	9	A	9	A	28	C	16	B	17	B
11		Approach	39	D	33	C	31	C	52	D	38	D	34	C
12	SB	LT	40	D	41	D	38	D	198	F	75	E	55	D
13		TH	34	C	34	C	33	C	39	D	46	D	41	D
14		RT	27	C	17	B	14	B	25	C	12	B	10	A
15		Approach	34	C	33	C	31	C	81	F	50	D	41	D
	Overall Intersection		42	D	41	D	32	C	74	E	106	F	92	F
	Worst Movement		53	D	150	F	122	F	221	F	389	F	374	F
			WB TH		EB LT		EB LT		WB LT		EB LT		EB LT