Traffic Engineering Consultants, Inc.

TRAFFIC IMPACT STUDY

REVISED PRELIMINARY PLAT
Summit Valley Addition
S.H. 9 and 36th Avenue SE
Norman, Oklahoma

Prepared for:
Clour Engineering of Oklahoma, Inc.

November 2009

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1.0 BACKGROUND

Traffic Engineering Consultants, Inc. (TEC) was retained to conduct a traffic impact study on a proposed new single family residential development known as Summit Valley Addition in September 2003. That study included a review of the available access to and from the development, the geometric layout of the internal street system and the use and placement of traffic calming devices within the development.

The original development, as described in the previous study, included a total of 1030 single family residential lots and one commercial lot proposed to be used as a gasoline service station with convenience market. Traffic volume data was collected in the vicinity of all proposed points of access where the new addition streets were to connect to existing city streets and the adjacent state highway. The existing traffic data was used to determine the future 2013 background traffic data. The new addition traffic was then determined and distributed among the proposed points of access and adjacent intersections. The new addition traffic was added to the projected future 2013 background traffic and capacity analyses were conducted to determine if street geometry or traffic control changes would be required at the intersections to accommodate the new traffic.

The results of the analyses conducted in the original study indicated the points of access to the north along Lindsay Street, and to the west along 24th Avenue SE are expected to operate at levels-of-service in the "A" and "B" range. This indicates sufficient capacity is expected to be available under the 2013 future traffic conditions at these intersections and also that excess capacity exists to accommodate additional traffic in the future.

The intersections along S.H. 9, along the south side of the addition were also analyzed under these traffic conditions. However, the analyses considered S.H. 9 to be reconstructed to include two through lanes and separate left turn and right turn lanes in each direction at each intersection. The new wider roadway section of S.H. 9 has been approved, is currently under design and is to be constructed utilizing Federal funds. Under these conditions, the two pints of access to the new addition along S.H. 9 were determined to operate at acceptable levels-of-service.

A revised plat for the Summit Valley Addition is proposed to include a reduction in the number of single family residential lots and an increase in the number of commercial land use lots. **Figure 1** indicates the area where these changes are proposed to occur in the original plat. **Figure 2** indicates the changes that

include a total reduction of single family residential lots from 1030 to 840 and an increase in the number of commercial zoned lots from one to a total of seven. As shown, all of the new commercial lots are proposed to be located along the south side of the addition, along S.H. 9. No changes in access to the development are proposed as part of these revisions to the original plat. This study was requested to review the traffic effects due to the land use changes within the revised plat. The areas where the traffic changes are expected to occur are at the points of access along S.H. 9.

2.0 TRAFFIC

2.1 Existing Traffic

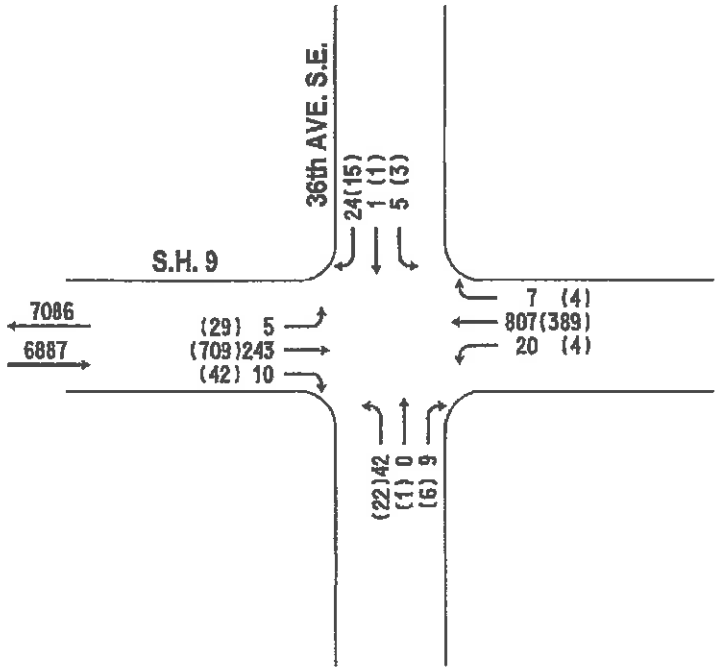
The majority of the changes in traffic generated by the development are expected to occur along the south side of the development. Therefore, new traffic data was only collected along S.H. 9, in the vicinity of the only current point of access to the development, at the intersection with 36th Avenue SE. The a.m. and p.m. peak our turning movement data collected at the intersection and the twenty-four hour directional traffic data collected along S.H. 9 are summarized in **Figure 3** and included in the appendix. The current peak hour traffic volume data was then balanced as indicated in **Figure 4**. For analysis purposes, the traffic entering and exiting the development on the north leg of the intersection was excluded, so as to include only the true background traffic in the future projections.

2.2 Future Background Traffic

The balanced 2009 data was used to determine the future background design year traffic volumes. The design year, the year in which the addition is projected to be fully built-out, was determined to be 2019. This is an extension of the design year studied in the original study. An average annual growth rate of 2.5% was applied to the balanced 2009 background traffic to determine the future 2019 background traffic. This future background traffic for the vicinity of the intersection of S.H. 9 and 36th Avenue SE is summarized in **Figure 5**.

2.3 Development Traffic

Although the total development traffic is expected to change due to the revisions made to the land uses and land use sizes, this study is primarily focused on the traffic changes expected to occur at the points of access along S.H. 9. The projected distribution of site generated traffic contained in the original study is indicated in **Figure 6**. To determine the changes in traffic, the new commercial land use areas were reviewed and typical commercial land uses were determined to occupy each of the new commercial lots.

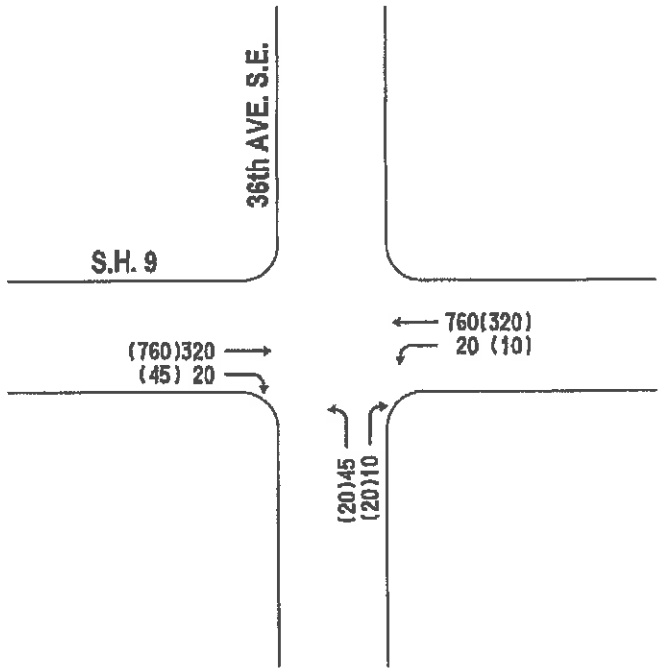


LEGEND
XXX = A.M. PEAK HOUR
(XXX) = P.M. PEAK HOUR
XXXX = 24 HOUR VOL

DATA COLLECTED NOV. 4-5, 2009

FIGURE 3. CURRENT 2009 TRAFFIC DATA

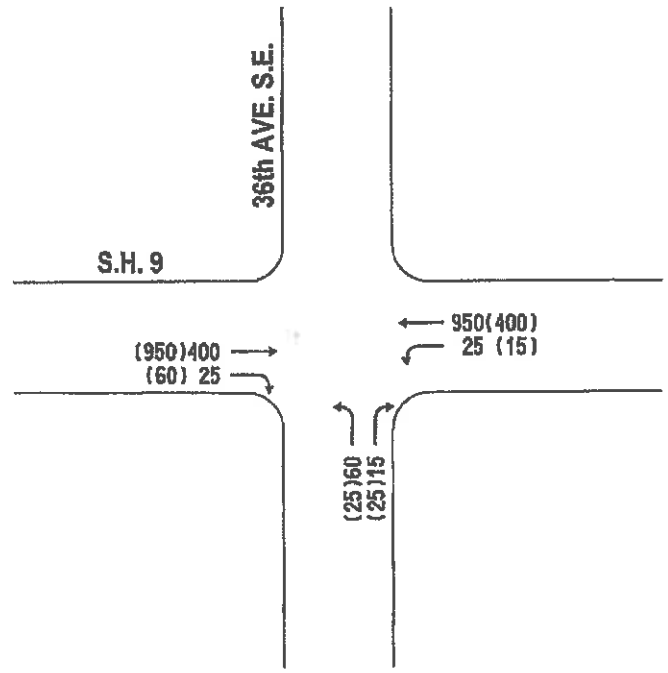
TRAFFIC ENGINEERING CONSULTANTS



LEGEND
XXX = A.M. PEAK HOUR
(XXX) = P.M. PEAK HOUR

FIGURE 4. PROPOSED BALANCED 2009 TRAFFIC

TRAFFIC ENGINEERING CONSULTANTS



LEGEND
XXX = A.M. PEAK HOUR
(XXX) = P.M. PEAK HOUR

APPLIED 2.5% AGR TO 2009
BALANCED TRAFFIC DATA

FIGURE 5. PROJECTED 2019 BACKGROUND TRAFFIC DATA

TRAFFIC ENGINEERING CONSULTANTS

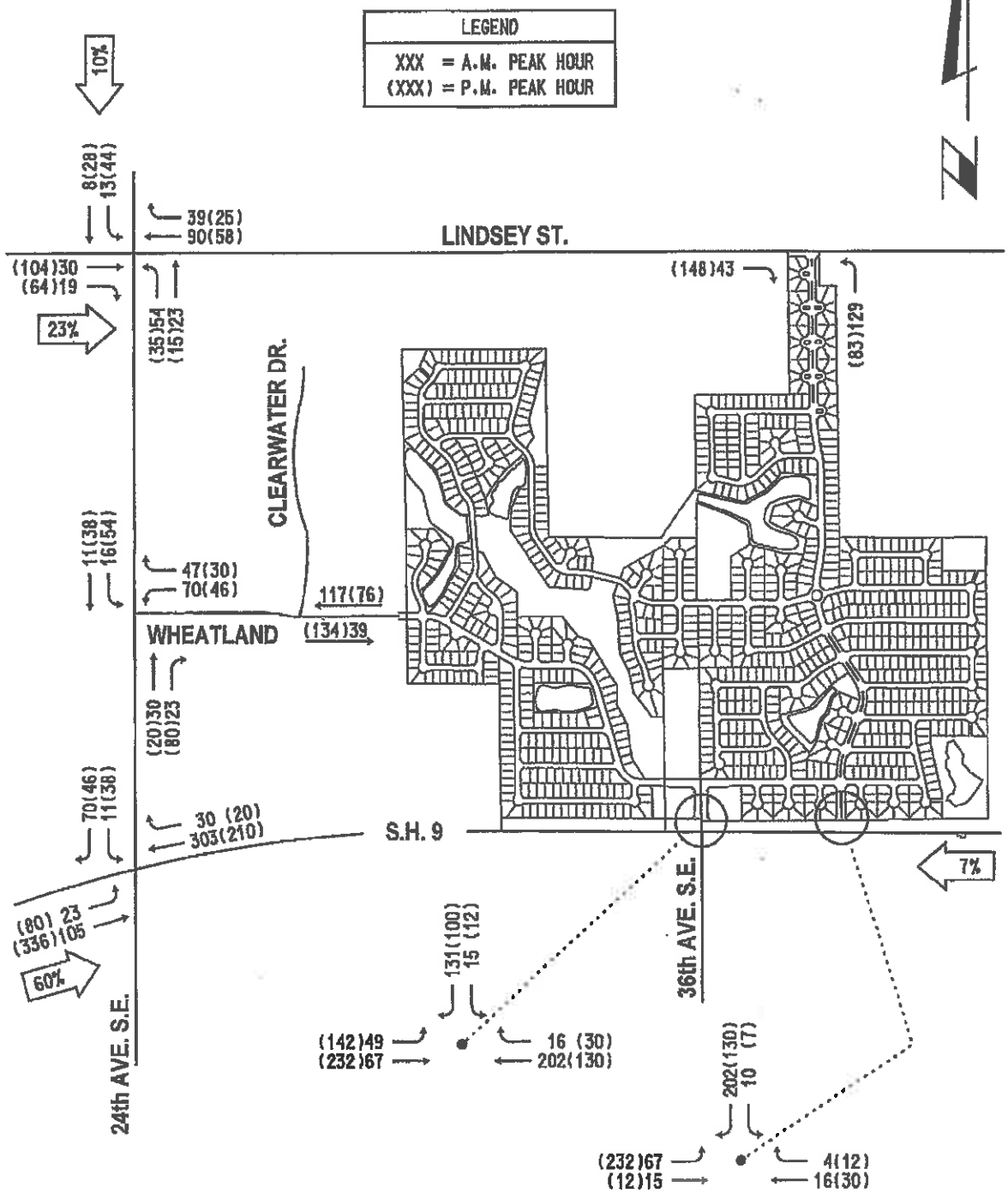


FIGURE 6. PROJECTED DISTRIBUTION OF SITE GENERATED TRAFFIC

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The top portion of **Table 1** indicates the assumed land use types and sizes utilized to determine the amount of traffic these commercial lots are expected to generate. As in the original traffic study, TEC referred to the latest edition of the Trip Generation report as provided by the Institute of Transportation Engineers (ITE) to project this new traffic. A rate reduction factor of 25% was applied to the commercial land use traffic. The internal capture reduction accounts for the traffic that patronizes the commercial lots, but originates within the residential development and thus is not added to the adjacent street traffic.

The bottom section of **Table 1** indicates the amount of single family residential traffic that will be reduced from the overall development. When the reduction of the residential traffic is applied to the new commercial traffic, the resultant net increase in development traffic is determined. This net increase is then added to the overall traffic the new development is expected to generate. The distribution percentages utilized in the original traffic study were not applied to the new development traffic total to determine the amount of peak hour traffic expected to utilize the two points of access to the development along S.H. 9. Due to the type of land uses, it was assumed that a larger portion of the commercial traffic would originate east of the development. The projected distribution of the traffic increase due to the commercial lots is indicated in **Figure 7**. The new development traffic projected to utilize these intersections along S.H. 9 for access that includes the original development and the new commercial lots is summarized in **Figure 8**. This development traffic was then added to the projected future 2019 background traffic. The total future 2019 traffic used to conduct the capacity analyses is summarized in **Figure 9**.

3.0 CAPACITY ANALYSIS

TEC conducted several analyses utilizing the projected traffic volumes. The analyses were conducted using *Synchro Professional, Version 7.0*, which is a software package for modeling and optimizing traffic signal timings at signalized intersections, and analyzing unsignalized intersections in accordance with the methodology of the latest edition of the *Highway Capacity Manual*. The *Highway Capacity Manual* is provided by the Transportation Research Board of the National Research Council, Washington, D.C. The information has been widely accepted throughout the U.S. as a guide for defining and solving transportation challenges. The information is approved and distributed by the U.S. Department of Transportation, Federal Highway Administration.

TABLE 1.

PROJECTED SITE GENERATED TRAFFIC VOLUMES

Summit Valley Addition - Revised Preliminary Plat

Lot	Building Type (Land Use)	Approx. Gross Floor Area or Other	Avg. Weekday Veh. Trip Ends: PER DAY (vpd)	Per Peak Hour of Adjacent Street Traffic: One Hour Between 7am & 9am (vph)	Per Peak Hour of Adjacent Street Traffic: One Hour Between 4pm & 6pm (vph)	Average AM Peak Hour Directional Distribution: IN	Average AM Peak Hour Directional Distribution: OUT	Average AM Peak Hour Directional Volume: IN	Average AM Peak Hour Directional Volume: OUT	Average PM Peak Hour Directional Distribution: IN	Average PM Peak Hour Directional Distribution: OUT	Average PM Peak Hour Directional Volume: IN	Average PM Peak Hour Directional Volume: OUT
1	TRIP RATE* Specialty Retail Center	(s.f.) 2000	44.32 89	2.71 14 5	6.84 5 14	0.48 0.44	0.52 0.56	7 2	7 3	0.44 0.48	0.56 0.52	2 7	3 7
2	TRIP RATE* Specialty Retail Center	(s.f.) 2500	44.32 111	2.71 17 7	6.84 7 17	0.48 0.44	0.52 0.56	8 3	9 4	0.44 0.48	0.56 0.52	3 8	4 9
3	TRIP RATE* Drive-In Bank	(s.f.) 3000	148.15 444	12.35 37	25.82 77	0.56	0.44	21	16	0.50	0.50	39	39
4	TRIP RATE* Gas/Serv Station w/Conv Mrkt	(fuel pos.) 12	162.78 1953	10.16 122	13.38 161	0.50	0.50	61	61	0.50	0.50	80	80
5	TRIP RATE* Fast Food Rest. w / Drive-Through	(s.f.) 3000	496.12 1488	49.35 148	33.84 102	0.51	0.49	76	73	0.52	0.48	53	49
6	TRIP RATE* Single Tenant Office Building	(s.f.) 3000	11.57 35	1.80 5	1.73 5	0.89	0.11	5	1	0.15	0.85	1	4
Total Commercial Development			4120	323 325	357 376			178 167	107 157			178 187	179 188

TRIP RATE REDUCTIONS						
REDUCTION TYPE	REDUCTION AMOUNT (%)	AM PEAK HOUR REDUCTION IN	AM PEAK HOUR REDUCTION OUT	PM PEAK HOUR REDUCTION IN	PM PEAK HOUR REDUCTION OUT
INTERNAL CAPTURE	25	42 44	39 42	47 44	47 45
		134	125	134	134
Total Development Volume		126	118	141	141

Single Family Units Displaced by Proposed New Commercial Development and Plat Revisions													
	TRIP RATE* Single Family Detached Housing	(unit) 166	9.57 1589	0.75 125	1.01 168	0.25	0.75	.31	93	0.63	0.37	106	62

* Trip Rates from "TRIP GENERATION", 8th Ed., Vols.2 and 3, Institute of Transportation Engineers.

Total Net Increase in Traffic Due to Commercial Development and Plat Revisions									
	Avg. Weekday Veh. Trip Ends: PER DAY (vpd)	Per Peak Hour of Adjacent Street Traffic: One Hour Between 7am & 9am (vph)	Per Peak Hour of Adjacent Street Traffic: One Hour Between 4pm & 6pm (vph)		Average AM Peak Hour Directional Volume: IN	Average AM Peak Hour Directional Volume: OUT		Average PM Peak Hour Directional Volume: IN	Average PM Peak Hour Directional Volume: OUT
	2532	200	208		94	25		35	79

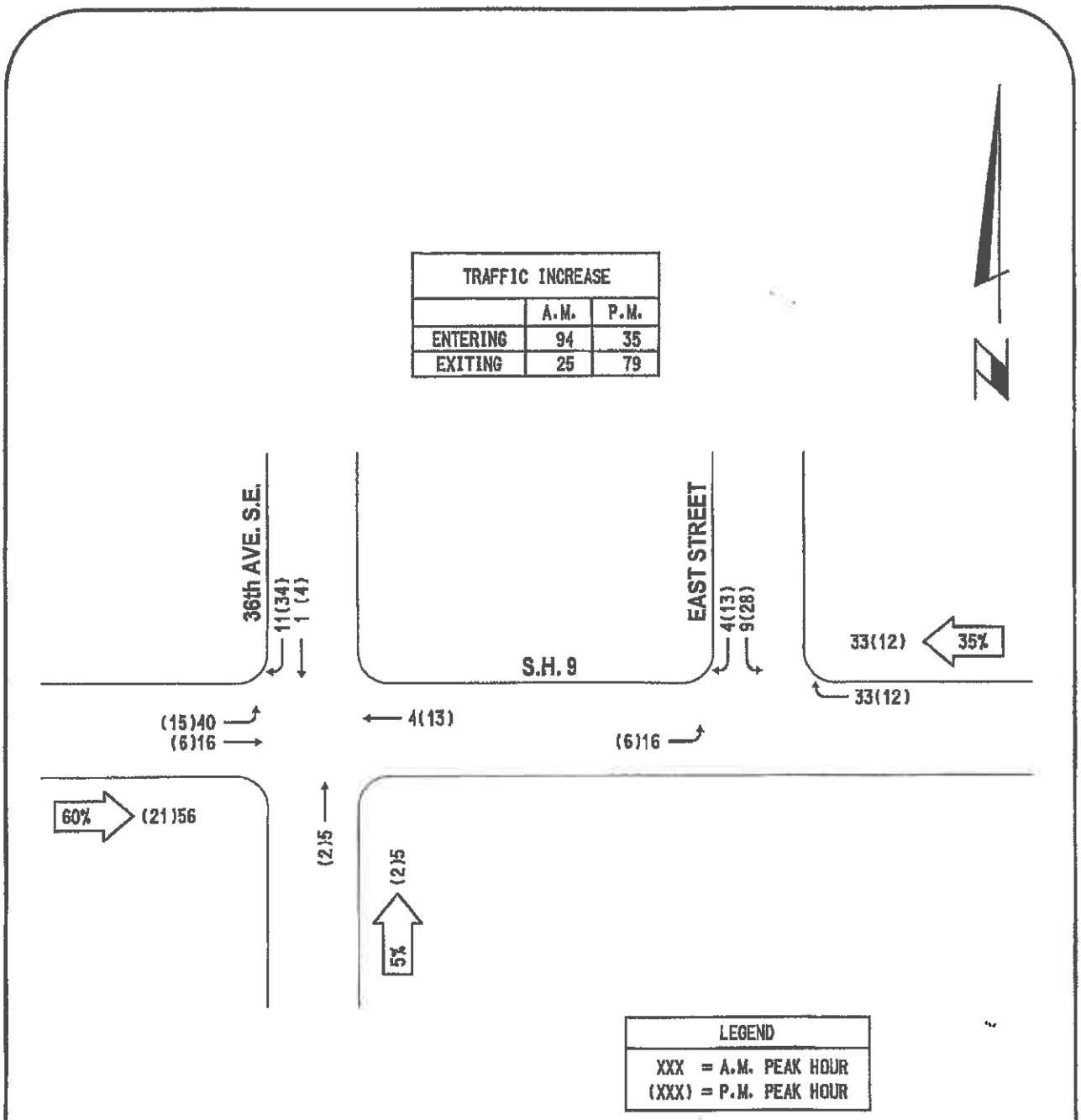

FIGURE 7. PROJECTED DISTRIBUTION OF TRAFFIC INCREASE DUE TO COMMERCIAL LOTS

TRAFFIC ENGINEERING CONSULTANTS

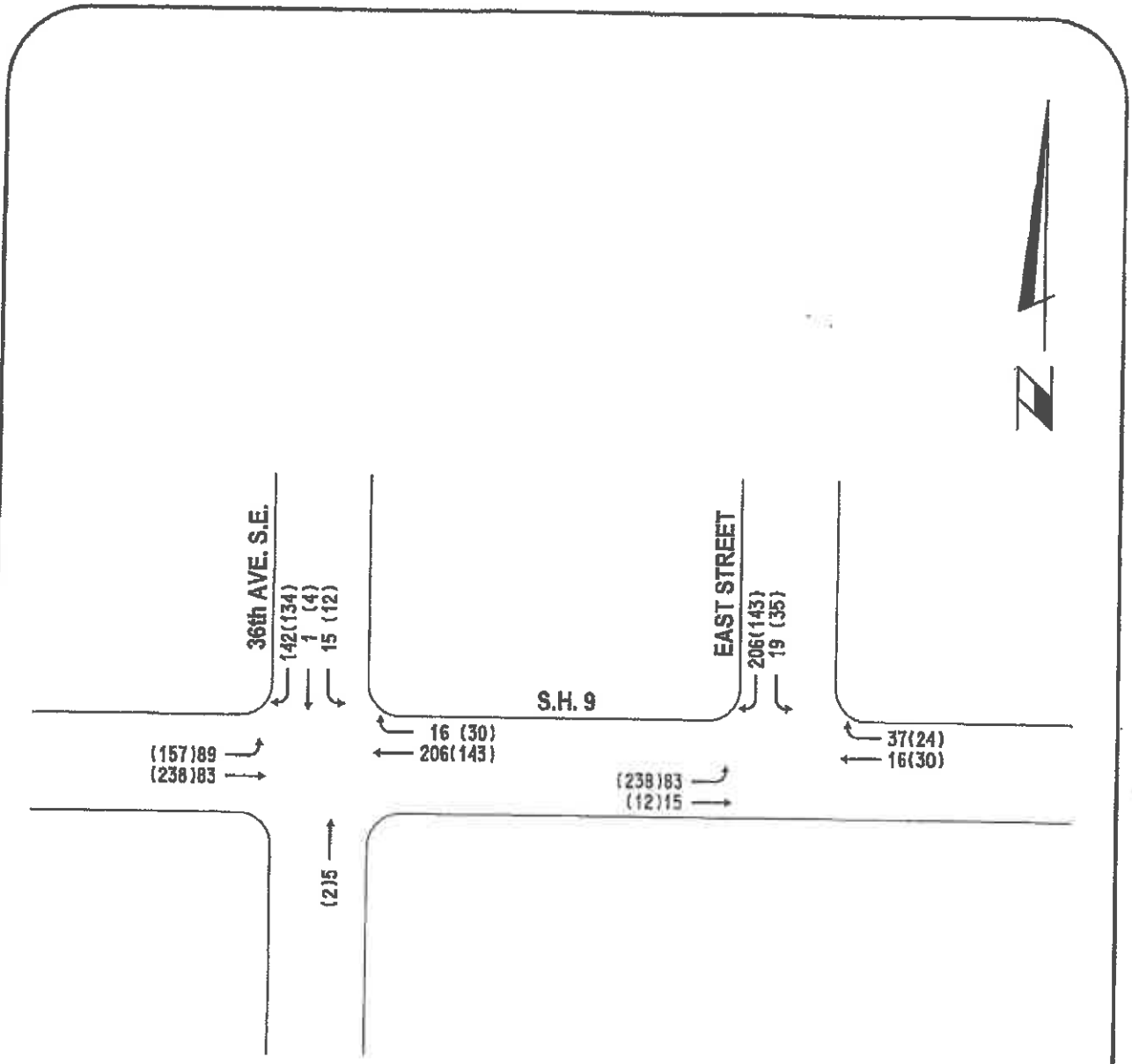

FIGURE 8. TOTAL PROJECTED SITE GENERATED TRAFFIC

TRAFFIC ENGINEERING CONSULTANTS

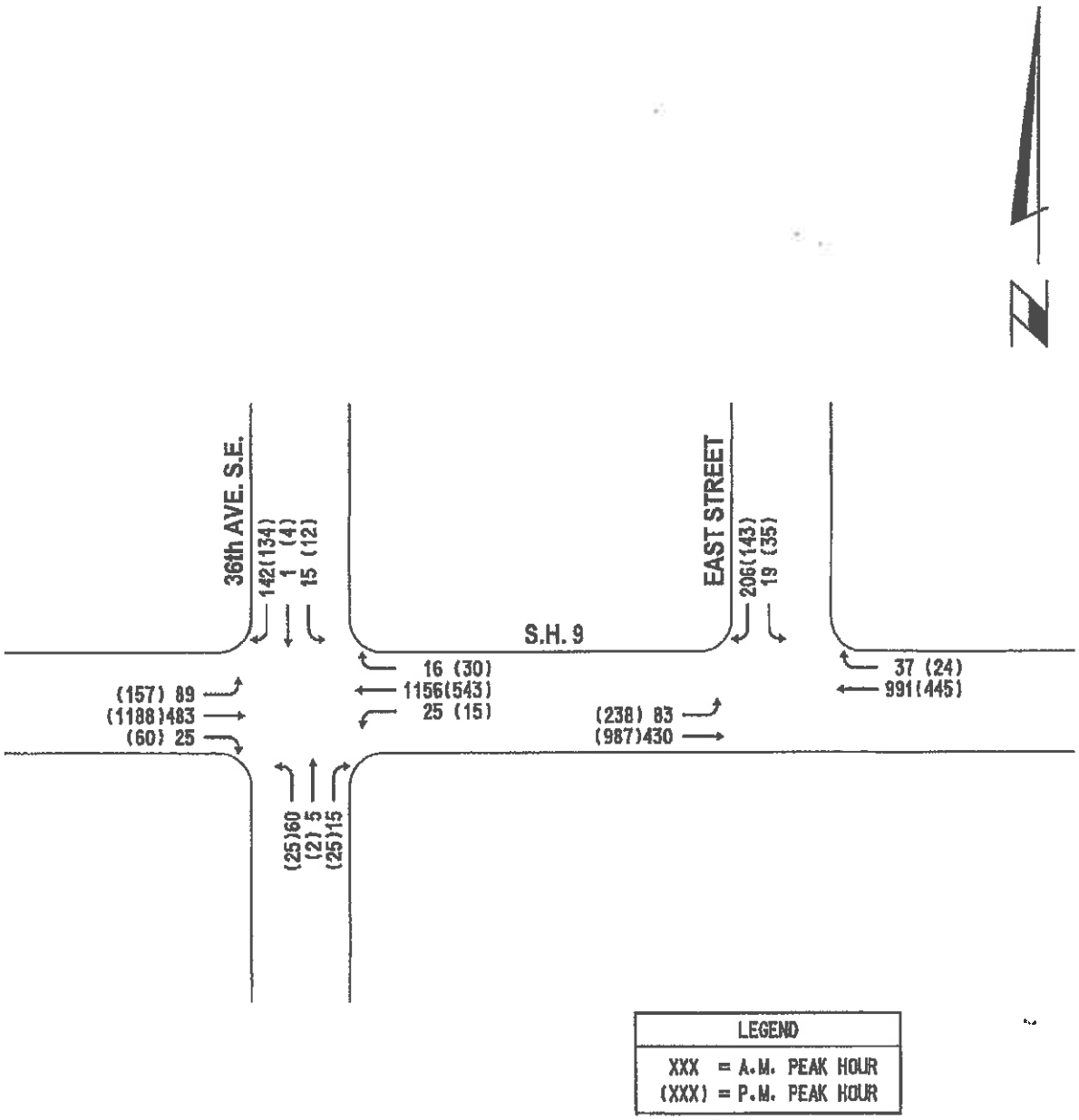

FIGURE 9. TOTAL PROJECTED 2019 TRAFFIC

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The capacity analysis provides a measure of the amount of traffic that a given facility can accommodate. Traffic facilities generally operate poorly at or near capacity. The analysis is intended to estimate the maximum amount of traffic that can be accommodated by a facility while maintaining prescribed operational qualities. The definition of operational criteria is accomplished using level-of-service (LOS). The concept of LOS is defined as a qualitative measure and describes operational conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience and safety. Six levels-of-service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from "A" to "F", with LOS "A" representing the best operating conditions and LOS "F" the worst.

The average control delay, for signalized intersections, is estimated for each lane group and aggregated for each approach for the intersection as a whole. The LOS, for this type of traffic control, is directly related to the control delay value. The LOS criteria for signalized intersections are indicated below.

SIGNALIZED INTERSECTIONS

Level-of-Service	Control Delay per Vehicle (s/veh)
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

The criteria for stop controlled or unsignalized intersections have different threshold values than do those for signalized intersections. A higher level of control delay has been determined to be acceptable at a signalized intersection for the same LOS. The LOS criteria for unsignalized intersections are indicated below.

UNSIGNALIZED INTERSECTIONS

Level-of-Service	Control Delay per Vehicle (s/veh)
A	0-10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Capacity analyses were conducted on the intersections along S.H. 9 proposed to provide access to the development. As previously stated, the remaining points of access to the development are not expected to operate differently than determined in the original report. The two intersections along S.H. 9 at 36th Avenue SE and the new East Street are expected to be affected most by the change in land use in the revised plat being proposed. As in the previous report, these intersections were analyzed assuming S.H. 9 to be improved to a four lane roadway section with separate left turn and right turn lanes at each of these intersections. Each of the intersections were assumed to be operating as unsignalized intersections with the eastbound and westbound movements operating in the free flow condition.

The results of the capacity analyses conducted are summarized in **Table 2** below and included in the appendix. The results indicate the overall levels-of-service are expected to be in the acceptable range. However, the northbound movement at the intersection of S.H. 9 and 36th Avenue SE is projected to operate with very long delays during both the a.m. and p.m. peak hour periods.

TABLE 2.
CAPACITY ANALYSIS RESULTS
Projected Future 2019 Traffic Conditions and Future SH 9 Roadway Conditions

Intersection	Type of Traffic Control	AM Peak Hour				PM Peak Hour			
		Critical Approach		Intersection		Critical Approach		Intersection	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
SH 9 and 36th AVE SE	Unsignalized	* / NB	F	24.5	C	* / NB	F	16.7	B
SH 9 and East Street	Unsignalized	21.3 / SB	C	3.3	A	25.5 / SB	D	3.6	A
Signalized Condition									
SH 9 and 36th AVE SE	Signalized	16.6 / NB	B	10.2	B	19.0 / NB	B	12.7	B

* Indicates the delay exceeds 100 seconds per vehicle

As included in the original study, the intersection of S.H. 9 and 36th Avenue SE was also reviewed to determine if signalization is warranted. TEC conducted a review of the traffic signal warrants as contained in the latest edition of the *Manual on Uniform Traffic Control Devices (MUTCD)*. This warrant review was conducted under the projected future 2019 peak hour traffic conditions and the future roadway geometry conditions. Based on this review, the intersection of S.H. 9 and 36th Avenue SE is projected to satisfy Warrant 3B-*Peak Hour Volumes*. The results of this analysis are included in the appendix.

The intersection of S.H. 9 and 36th Avenue SE was then reviewed assuming the type of traffic control at this intersection was changed to signalize control. The results of these analyses are summarized in the lower portion of **Table 2** and included in the appendix. Based on the results of these analyses, this intersection is projected to operate at level-of-service "B" under the signalized condition, during both the a.m. and p.m. peak hour periods. As indicated in the original study, the signalization of this intersection would be expected to be warranted when approximately one-half of the development is built-out, assuming all proposed points of access are constructed and in operation.

APPENDIX

EXISTING TRAFFIC DATA

Traffic Engineering Consultants, Inc.
6000 S. Western Ave., Suite 300
Oklahoma City, Ok. 73139

File Name : 36TH AVE SE & SH 9
Site Code : 00000000
Start Date : 11/04/09
Page No : 1

Groups Printed- Unshifted

	36th AVE. S.E. Southbound					S.H. 9 Westbound					36th AVE. S.E. Northbound					S.H. 9 Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	1	1	7	0	9	4	172	0	0	176	12	0	0	0	12	2	53	2	0	57	254
07:15 AM	1	0	9	0	10	7	185	1	0	193	7	0	3	0	10	1	61	3	0	65	278
07:30 AM	3	0	4	0	7	6	242	3	0	251	15	0	4	0	19	2	72	5	0	79	356
07:45 AM	0	0	4	0	4	3	208	3	0	214	8	0	2	0	10	0	57	0	0	57	285
Total	5	1	24	0	30	20	807	7	0	834	42	0	9	0	51	5	243	10	0	258	1173
08:00 AM	1	0	5	0	6	0	159	0	0	159	6	0	3	0	9	1	70	0	0	71	245
08:15 AM	0	0	5	0	5	2	143	0	0	145	6	0	0	0	6	0	72	5	0	77	233
08:30 AM	0	0	6	0	6	1	139	0	0	140	5	0	1	0	6	3	59	2	0	64	216
08:45 AM	1	0	7	0	8	1	113	0	0	114	7	0	0	0	7	0	62	3	0	65	194
Total	2	0	23	0	25	4	554	0	0	558	24	0	4	0	28	4	263	10	0	277	888
*** BREAK ***																					
04:00 PM	0	1	2	0	3	1	84	0	0	85	4	0	1	0	5	6	148	11	1	166	259
04:15 PM	1	0	3	0	4	7	67	0	0	74	3	1	2	0	6	5	153	11	0	169	253
04:30 PM	2	0	2	0	4	1	90	0	0	91	5	1	7	0	13	11	163	12	0	186	294
04:45 PM	3	0	0	0	3	2	96	2	0	100	2	0	0	0	2	5	161	6	0	172	277
Total	6	1	7	0	14	11	337	2	0	350	14	2	10	0	26	27	625	40	1	693	1083
05:00 PM	0	0	3	0	3	2	92	1	0	95	6	0	1	0	7	8	175	12	0	195	300
05:15 PM	0	0	8	0	8	0	105	0	0	105	7	0	1	0	8	7	198	10	0	215	336
05:30 PM	0	1	4	0	5	0	96	1	0	97	7	1	4	0	12	9	175	14	0	198	312
05:45 PM	0	0	4	0	4	0	117	0	0	117	3	0	1	0	4	4	142	4	0	150	275
Total	0	1	19	0	20	2	410	2	0	414	23	1	7	0	31	28	690	40	0	758	1223
Grand Total	13	3	73	0	89	37	2108	11	0	2156	103	3	30	0	136	64	1821	100	1	1986	4367
Apprch %	14.6	3.4	82	0		1.7	97.8	0.5	0		75.7	2.2	22.1	0		3.2	91.7	5	0.1		
Total %	0.3	0.1	1.7	0	2	0.8	48.3	0.3	0	49.4	2.4	0.1	0.7	0	3.1	1.5	41.7	2.3	0	45.5	

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File Name : 36TH AVE SE & SH 9
Site Code : 00000000
Start Date : 11/04/09
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	36th AVE. S.E. Southbound					S.H. 9 Westbound					36th AVE. S.E. Northbound					S.H. 9 Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1		7	0	9	4	172	0	0	176	12	0	0	0	12		53	2	0	57	254
07:15 AM	1	0		0		7	185	1	0	193	7	0	3	0	10	1	61	3	0	65	278
07:30 AM	3	0	4	0	7	6	242	3	0	251	15	0	4	0	19	2	72	5	0	79	356
07:45 AM	0	0	4	0	4	3	208	3	0	214	8	0	2	0	10	0	57	0	0	57	285
Total Volume	5	1	24	0	30	20	807	7	0	834	42	0	9	0	51	5	243	10	0	258	1173
% App. Total	16.7	3.3	80	0		2.4	96.8	0.8	0		82.4	0	17.6	0		1.9	94.2	3.9	0		
PHF	.417	.250	.667	.000	.750	.714	.834	.583	.000	.831	.700	.000	.563	.000	.671	.625	.844	.500	.000	.816	.824

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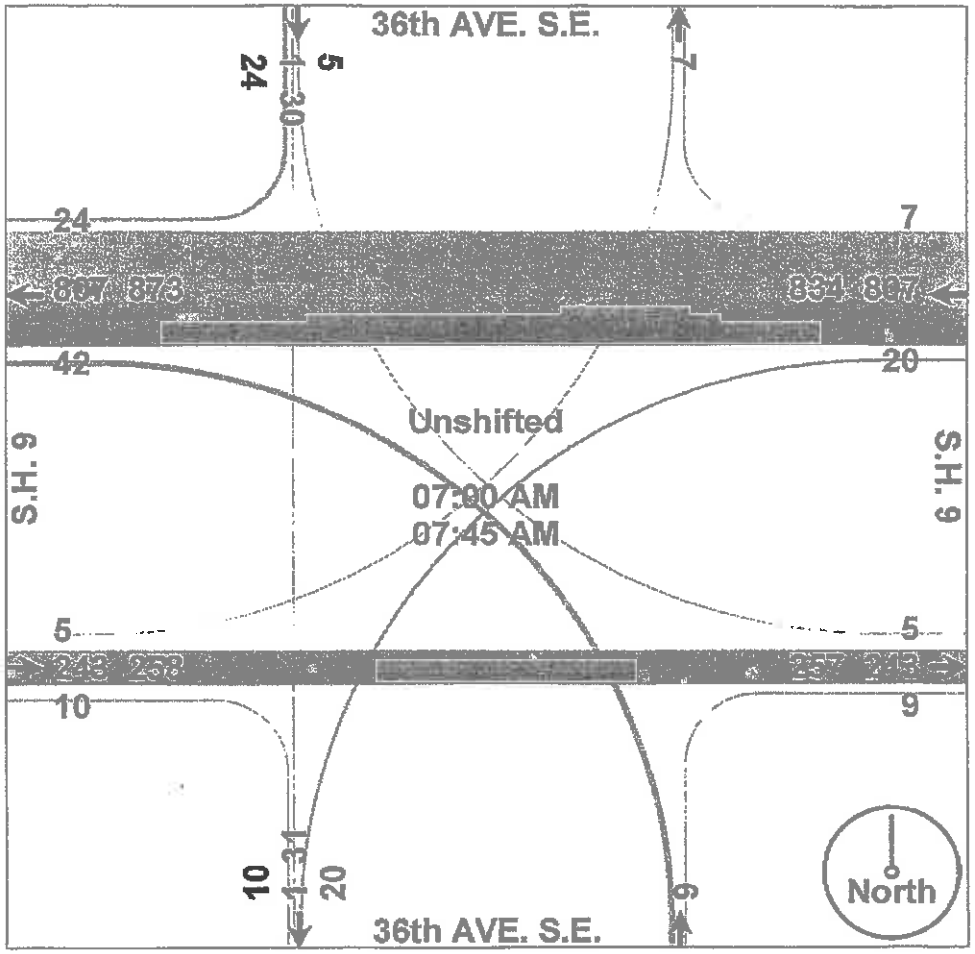

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File Name : 36TH AVE SE & SH 9
Site Code : 00000000
Start Date : 11/04/09
Page No : 4

	36th AVE. S.E. Southbound					S.H. 9 Westbound					36th AVE. S.E. Northbound					S.H. 9 Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	3					2		2													
05:00 PM	0	0	3	0	3	2	92	1	0	95	6	0	1	0	7	8	175	12	0	195	300
05:15 PM	0	0	8	0	8	0	105	0	0	105	7	0	1	0	8	7	198	10	0	215	336
05:30 PM	0	1	4	0	5	0	96	1	0	97	7	1	4	0	12	9	175	14	0	198	312
Total Volume	3	1	15	0	19	4	389	4	0	397	22	1	6	0	29	29	709	42	0	780	1225
% App. Total	15.8	5.3	78.9	0		1	98	1	0		75.9	3.4	20.7	0		3.7	90.9	5.4	0		
PHF	.250	.250	.469	.000	.594	.500	.926	.500	.000	.945	.786	.250	.375	.000	.604	.806	.895	.750	.000	.907	.911

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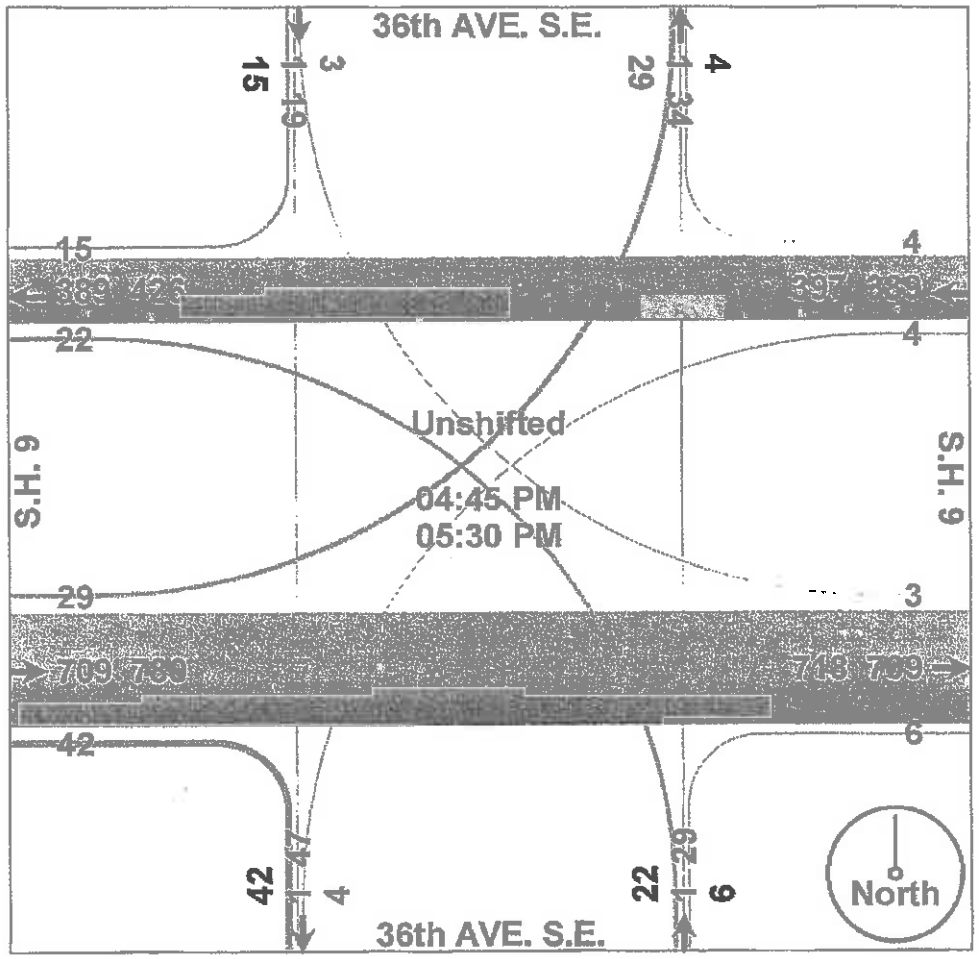
Site Code : 00000000
Start Date : 11/04/09
Page No : 5



Traffic Engineering Consutants, Inc.
6000 S. Western Ave., Suite 300
Oklahoma City, Ok. 73139

Site Code: 1
Station ID:
S.H. 9
WEST OF 36th AVE. S.E.
Latitude: 0' 0.000 Undefined

Start	02-Nov-09		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
Time	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
12:00 AM	*	*	*	*	*	*	31	68	*	*	*	*	*	*	31	68
01:00	*	*	*	*	*	*	29	34	*	*	*	*	*	*	29	34
02:00	*	*	*	*	*	*	23	27	*	*	*	*	*	*	23	27
03:00	*	*	*	*	*	*	26	24	*	*	*	*	*	*	26	24
04:00	*	*	*	*	*	*	71	21	*	*	*	*	*	*	71	21
05:00	*	*	*	*	*	*	193	37	*	*	*	*	*	*	193	37
06:00	*	*	*	*	*	*	591	149	*	*	*	*	*	*	591	149
07:00	*	*	*	*	*	*	895	276	*	*	*	*	*	*	895	276
08:00	*	*	*	*	*	*	622	301	*	*	*	*	*	*	622	301
09:00	*	*	*	*	*	*	428	277	*	*	*	*	*	*	428	277
10:00	*	*	*	*	*	*	387	258	*	*	*	*	*	*	387	258
11:00	*	*	*	*	*	*	386	316	*	*	*	*	*	*	386	316
12:00 PM	*	*	*	*	375	373	371	337	*	*	*	*	*	*	373	355
01:00	*	*	*	*	364	413	*	*	*	*	*	*	*	*	364	413
02:00	*	*	*	*	370	462	*	*	*	*	*	*	*	*	370	462
03:00	*	*	*	*	412	550	*	*	*	*	*	*	*	*	412	550
04:00	*	*	*	*	382	714	*	*	*	*	*	*	*	*	382	714
05:00	*	*	*	*	465	760	*	*	*	*	*	*	*	*	465	760
06:00	*	*	*	*	387	561	*	*	*	*	*	*	*	*	387	561
07:00	*	*	*	*	207	388	*	*	*	*	*	*	*	*	207	388
08:00	*	*	*	*	172	358	*	*	*	*	*	*	*	*	172	358
09:00	*	*	*	*	127	255	*	*	*	*	*	*	*	*	127	255
10:00	*	*	*	*	93	144	*	*	*	*	*	*	*	*	93	144
11:00	*	*	*	*	50	121	*	*	*	*	*	*	*	*	50	121
Lane	0	0	0	0	3404	5099	4053	2125	0	0	0	0	0	0	7084	6869
Day	0		0		8503		6178		0		0		0		13953	
AM Peak							07:00	11:00							07:00	11:00
Vol.							895	316							895	316
PM Peak					17:00	17:00	12:00	12:00							17:00	17:00
Vol.					465	760	371	337							465	760

Comb. Total	0		0		8503		6178		0		0		0	13953

ADT Not Calculated

CAPACITY ANALYSIS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	89	483	25	25	1156	16	60	5	15	15	1	142
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	97	525	27	27	1257	17	65	5	16	16	1	154
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					1275							
pX, platoon unblocked												
vC, conflicting volume	1274			552			1556	2047	262	1786	2057	628
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1274			552			1556	2047	262	1786	2057	628
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	82			97			0	88	98	58	98	64
cM capacity (veh/h)	541			1014			40	44	736	39	44	426

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1	SB 2
Volume Total	97	262	262	27	27	628	628	17	87	16	155
Volume Left	97	0	0	0	27	0	0	0	65	16	0
Volume Right	0	0	0	27	0	0	0	17	16	0	154
cSH	541	1700	1700	1700	1014	1700	1700	1700	49	39	401
Volume to Capacity	0.18	0.15	0.15	0.02	0.03	0.37	0.37	0.01	1.76	0.42	0.39
Queue Length 95th (ft)	16	0	0	0	2	0	0	0	213	36	45
Control Delay (s)	13.1	0.0	0.0	0.0	8.6	0.0	0.0	0.0	542.1	154.4	19.6
Lane LOS	B				A				F	F	C
Approach Delay (s)	2.0				0.2				542.1	32.3	
Approach LOS									F	D	

Intersection Summary			
Average Delay	24.5		
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	83	430	991	37	19	206
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	90	467	1077	40	21	224
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1117				1491	539
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1117				1491	539
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	85				79	54
cM capacity (veh/h)	621				98	487

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1	SB 2
Volume Total	90	234	234	539	539	40	21	224
Volume Left	90	0	0	0	0	0	21	0
Volume Right	0	0	0	0	0	40	0	224
cSH	621	1700	1700	1700	1700	1700	98	487
Volume to Capacity	0.15	0.14	0.14	0.32	0.32	0.02	0.21	0.46
Queue Length 95th (ft)	13	0	0	0	0	0	19	59
Control Delay (s)	11.8	0.0	0.0	0.0	0.0	0.0	51.5	18.5
Lane LOS	B						F	C
Approach Delay (s)	1.9			0.0			21.3	
Approach LOS							C	

Intersection Summary				
Average Delay	3.3			
Intersection Capacity Utilization	46.8%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	483	25	25	1156	16	60	5	15	15	1	142
Ideal Flow (vphpi)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.97		1.00	0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583		1750		1770	1585	
Flt Permitted	0.21	1.00	1.00	0.95	1.00	1.00		0.68		0.73	1.00	
Satd. Flow (perm)	386	3539	1583	1770	3539	1583		1243		1365	1585	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	97	525	27	27	1257	17	65	5	16	16	1	154
RTOR Reduction (vph)	0	0	16	0	0	8	0	13	0	0	20	0
Lane Group Flow (vph)	97	525	11	27	1257	9	0	73	0	16	135	0
Turn Type	Perm		Prot	Prot		Perm	Perm			pm+pt		
Protected Phases		4	4	3	8			2		1	6	
Permitted Phases	4					8	2			6		
Actuated Green, G (s)	19.3	19.3	19.3	1.1	24.4	24.4		8.8		13.4	13.4	
Effective Green, g (s)	19.3	19.3	19.3	1.1	24.4	24.4		8.8		13.4	13.4	
Actuated g/C Ratio	0.42	0.42	0.42	0.02	0.53	0.53		0.19		0.29	0.29	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	163	1491	667	43	1885	843		239		405	464	
v/s Ratio Prot		0.15	0.01	0.02	c0.36					0.00	c0.09	
v/s Ratio Perm	0.25					0.01		0.06		0.01		
v/c Ratio	0.60	0.35	0.02	0.63	0.67	0.01		0.31		0.04	0.29	
Uniform Delay, d1	10.2	9.0	7.7	22.1	7.8	5.0		15.9		11.8	12.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	5.7	0.1	0.0	25.3	0.9	0.0		0.7		0.0	0.4	
Delay (s)	16.0	9.1	7.7	47.4	8.7	5.0		16.6		11.8	12.9	
Level of Service	B	A	A	D	A	A		B		B	B	
Approach Delay (s)		10.1			9.4			16.6			12.8	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	157	1188	60	15	543	30	25	2	25	12	4	134
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	171	1291	65	16	590	33	27	2	27	13	4	146
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					1275							
pX, platoon unblocked												
vC, conflicting volume	623			1357			2108	2288	646	1638	2321	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	623			1357			2108	2288	646	1638	2321	295
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	82			97			0	93	93	74	85	79
cM capacity (veh/h)	954			503			17	31	414	50	29	701

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1	SB 2
Volume Total	171	646	646	65	16	295	295	33	57	13	150
Volume Left	171	0	0	0	16	0	0	0	27	13	0
Volume Right	0	0	0	65	0	0	0	33	27	0	146
cSH	954	1700	1700	1700	503	1700	1700	1700	33	50	422
Volume to Capacity	0.18	0.38	0.38	0.04	0.03	0.17	0.17	0.02	1.70	0.26	0.36
Queue Length 95th (ft)	16	0	0	0	3	0	0	0	157	22	40
Control Delay (s)	9.6	0.0	0.0	0.0	12.4	0.0	0.0	0.0	600.2	101.9	18.2
Lane LOS	A				B				F	F	C
Approach Delay (s)	1.1				0.3				600.2	24.9	
Approach LOS									F	C	

Intersection Summary			
Average Delay	16.7		
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	238	987	445	24	35	143
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	259	1073	484	26	38	155
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	510				1538	242
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	510				1538	242
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	75				53	80
cM capacity (veh/h)	1052				80	759

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1	SB 2
Volume Total	259	536	536	242	242	26	38	155
Volume Left	259	0	0	0	0	0	38	0
Volume Right	0	0	0	0	0	26	0	155
cSH	1052	1700	1700	1700	1700	1700	80	759
Volume to Capacity	0.25	0.32	0.32	0.14	0.14	0.02	0.47	0.20
Queue Length 95th (ft)	24	0	0	0	0	0	49	19
Control Delay (s)	9.5	0.0	0.0	0.0	0.0	0.0	85.0	11.0
Lane LOS	A						F	B
Approach Delay (s)	1.9			0.0			25.5	
Approach LOS							D	

Intersection Summary				
Average Delay	3.6			
Intersection Capacity Utilization	38.8%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	1188	60	15	543	30	25	2	25	12	4	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.93		1.00	0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.98		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583		1701		1770	1591	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.78		0.70	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583		1365		1300	1591	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	171	1291	65	16	590	33	27	2	27	13	4	146
RTOR Reduction (vph)	0	0	32	0	0	21	0	23	0	0	112	0
Lane Group Flow (vph)	171	1291	33	16	590	12	0	33	0	13	38	0
Turn Type	Prot		Perm	Prot		Perm	Perm			pm+pt		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases			4			8	2			6		
Actuated Green, G (s)	7.7	24.6	24.6	1.0	17.9	17.9		6.9		11.5	11.5	
Effective Green, g (s)	7.7	24.6	24.6	1.0	17.9	17.9		6.9		11.5	11.5	
Actuated g/C Ratio	0.16	0.50	0.50	0.02	0.36	0.36		0.14		0.23	0.23	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	278	1773	793	36	1290	577		192		310	373	
v/s Ratio Prot	c0.10	c0.36		0.01	0.17					0.00	c0.02	
v/s Ratio Perm			0.02			0.01		c0.02		0.01		
v/c Ratio	0.62	0.73	0.04	0.44	0.46	0.02		0.17		0.04	0.10	
Uniform Delay, d1	19.3	9.6	6.2	23.8	11.9	10.0		18.6		14.7	14.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	4.0	1.5	0.0	8.5	0.3	0.0		0.4		0.1	0.1	
Delay (s)	23.3	11.1	6.3	32.3	12.2	10.0		19.0		14.7	14.9	
Level of Service	C	B	A	C	B	B		B		B	B	
Approach Delay (s)		12.3			12.5			19.0			14.9	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	12.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	49.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

TRAFFIC SIGNAL WARRANT ANALYSIS

Traffic Engineering Consultants, Inc.

SH 9 and 36th AVE SE - Norman, OK

Projected 2019 Traffic Conditions

Study Name : T-1969 Summit Valley Revised Plat
Study Date : 11/10/09
Page No. : 1

Signal Warrants - Summary

Major Street Approaches

Eastbound: **SH 9**
Number of Lanes: **2**
Approach Speed: **55**
Total Approach Volume: **2,002**

Westbound: **SH 9**
Number of Lanes: **2**
Approach Speed: **55**
Total Approach Volume: **1,785**

Minor Street Approaches

Northbound: **36th AVE SE**
Number of Lanes: **1**
Total Approach Volume: **132**

Southbound: **36th AVE SE**
Number of Lanes: **2**
Total Approach Volume: **308**

Warrant Summary (Rural values apply.)

Warrant 1 - Eight Hour Vehicular Volumes ..... Not Satisfied

Warrant 1A - Minimum Vehicular Volume ..... Not Satisfied
Required volumes reached for 2 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic ..... Not Satisfied
Required volumes reached for 2 hours, 8 are needed

Warrant 1 A&B - Combination of Warrants ..... Not Satisfied
Required volumes reached for 2 hours, 8 are needed

Warrant 2 - Four Hour Volumes ..... Not Satisfied
Number of hours (2) volumes exceed minimum < minimum required (4).

Warrant 3 - Peak Hour ..... Satisfied

Warrant 3A - Peak Hour Delay ..... Not Satisfied
Total approach volumes and delays on minor street do not exceed minimums for any hour.

Warrant 3B - Peak Hour Volumes ..... Satisfied
Volumes exceed minimums for at least one hour.

Warrant 4 - Pedestrian Volumes ..... Not Satisfied
Required 4 Hr pedestrian volume reached for 0 hour(s) and the single hour volume for 0 hour(s)

Warrant 5 - School Crossing ..... Not Satisfied
Number of gaps > .0 seconds (0) exceeds the number of minutes in the crossing period (0).

Warrant 6 - Coordinated Signal System ..... Not Satisfied
No adjacent coordinated signals are present

Warrant 7 - Crash Experience ..... Not Satisfied
Number of accidents (-1) is less than minimum (5). Volume minimums are not met.

Warrant 8 - Roadway Network ..... Not Satisfied
Major Route conditions not met. One or more volume requirement met.

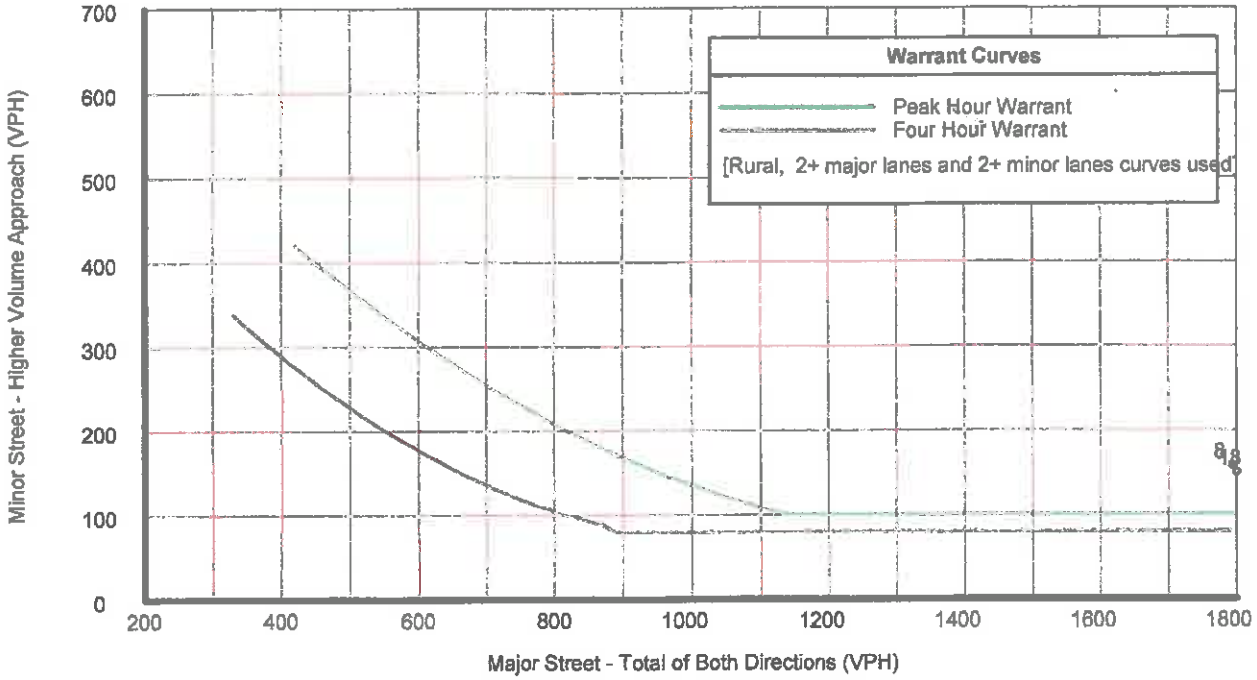
Traffic Engineering Consultants, Inc.

SH 9 and 36th AVE SE - Norman, OK

Projected 2019 Traffic Conditions

Study Name : T-1969 Summit Valley Revised Plat
Study Date : 11/10/09
Page No. : 2

Signal Warrants - Summary



Analysis of 8-Hour Volume Warrants:

Hour	Major	Higher Minor		War-1A			War-1B			War-1A&B		
Begin	Total	Vol	Dir	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
01:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
02:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
03:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
04:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
05:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
06:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
07:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
08:00	1,794	158	SB	420-Yes	140-Yes	Both	630-Yes	70-Yes	Both	504-Yes	112-Yes	Both
09:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
10:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
11:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
12:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
13:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
14:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
15:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
16:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
17:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
18:00	1,993	150	SB	420-Yes	140-Yes	Both	630-Yes	70-Yes	Both	504-Yes	112-Yes	Both
19:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
20:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
21:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
22:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---
23:00	0	0	NB	420-No	140-No	---	630-No	70-No	---	504-No	112-No	---