



## TECHNICAL MEMORANDUM

To: F. John Barzizza  
The Hills Fitness Center  
4615 Bee Cave Road  
Austin, Texas 78746

From: Scott A. Feldman, P.E., P.T.O.E.  
Alliance Transportation Group  
100 East Anderson Lane, Suite 300  
Austin, Texas 78752

Date: March 20, 2006

Re: Traffic Study for The Hills Fitness Center



### Introduction

Alliance Transportation Group, Inc. has been retained to evaluate the traffic impacts of the proposed re-development of the Hills Fitness Center located along Bee Cave Road, within the City of West Lake Hills, Texas. This study evaluates the traffic impacts of the proposed site, particularly driveway access to Bee Cave Road. The location of the site is illustrated in **Figure 1**.

This study includes an evaluation of a Future Build-out condition (Year 2010). Based on analysis results, recommendations were identified to ensure that intersections in the study area operate at an adequate level of service, level of service "D" or better.

**Table 1** shows the proposed land uses for the site. An artists rendering of the proposed re-development is provided in **Figure 2**. It is anticipated that the site will be fully developed by 2010.

**Table 1: Proposed Land Use Summary**

Land Use Summary			
ITE Use	ITE Description	Qty	Units
492	Health Club/Fitness Club	40.5	KSF
710	General Office	16.35	KSF
720	Medical-Dental Office	30.415	KSF
720	Medical-Dental Office	24.0	KSF

Existing and projected traffic volumes and geometric data are based on information taken from April 2004 traffic counts and the existing roadway network.

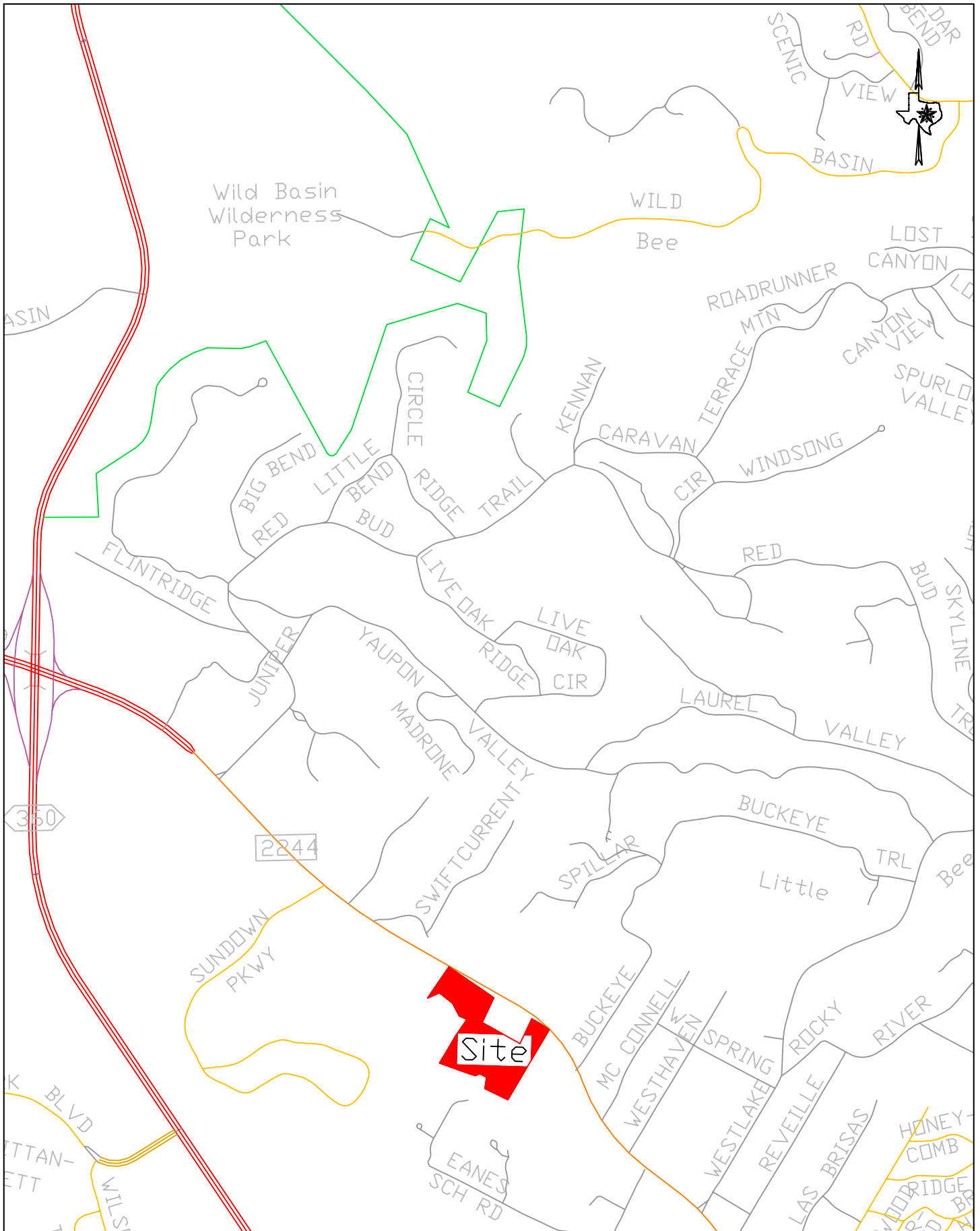


Figure 1. Study Area



## ***Traffic Analysis***

Alliance Transportation Group has conducted an evaluation of the potential traffic impacts associated with the re-development of the Hills Fitness Center site. The study utilized existing traffic data, and the evaluation of traffic impacts as they pertain to the location of the site.

### **Study Methodology**

The following information provides a summary of the technical analysis used for this study. The methodology is based upon a thorough analysis of existing and projected site-generated traffic on area roadways. The study methodology is as follows:

1. Obtain 2004 24-hour bi-directional count for Bee Cave Road.
2. Determine the annual growth rate for the background traffic based on the Texas Department of Transportation's Traffic Count Maps and apply the annual growth rate to existing traffic. Based on the relatively small growth rate, a conservative average growth rate of 2.0% was used.
3. Using the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 7<sup>th</sup> Edition, estimate site trip generation for the AM and PM Peak traffic periods.
4. Develop trip distribution percentage factors for 2010 for the site based on existing count data and proposed site access points.
5. Distribute traffic generated by the site during the AM and PM Peak hours onto area roadways using the above noted trip distribution factors.
6. Analyze the intersection of the site driveways and Bee Caves Road using the methodology found in the *2000 Highway Capacity Manual*.
7. Formulate improvement recommendations, if required, for access to the site. Where possible, improvement recommendations are based on attaining an intersection level of service "D".

## **Existing Conditions**

### ***Area Roadway Facilities***

#### **Bee Cave Road**

Bee Cave Road is currently a four-lane un-divided arterial (MAU4) throughout the study area. The CAMPO 2030 Mobility Plan indicates that there are plans to upgrade Bee Cave Road to a four-lane divided arterial (MAD4) by the year 2030. This project may occur prior to the full buildout of the site as a two-way left-turn lane.

## 2004 Existing Conditions

A 24-hour bi-directional traffic count was collected on Bee Cave Road in the vicinity of the proposed development in April of 2004. The results of the count are summarized in **Table 2**.

**Table 2: Existing Volumes**

Travel Lane	AM Peak Volume	PM Peak Volume
Eastbound Bee Cave	1282	1063
Westbound Bee Cave	791	1280

## 2010 Development Year

### *Background Traffic*

Existing and projected traffic volumes using the roadway system without the proposed project are commonly called background traffic volumes. For the Hills Fitness Center site, existing background traffic is based upon traffic volume counts collected in March 2004. A growth rate of 2.0% was applied to all traffic. The anticipated build out date for the site is 2010. All background traffic was grown over a six-year period. Existing traffic counts are found in **Appendix A**.

### *Trip Generation*

Entering and exiting volumes were calculated using information from *ITE's Trip Generation Manual, 7th edition*<sup>(2)</sup> and are shown in **Table 3**. The reported volumes are for the peak generation hours for the Hills Fitness Center site.

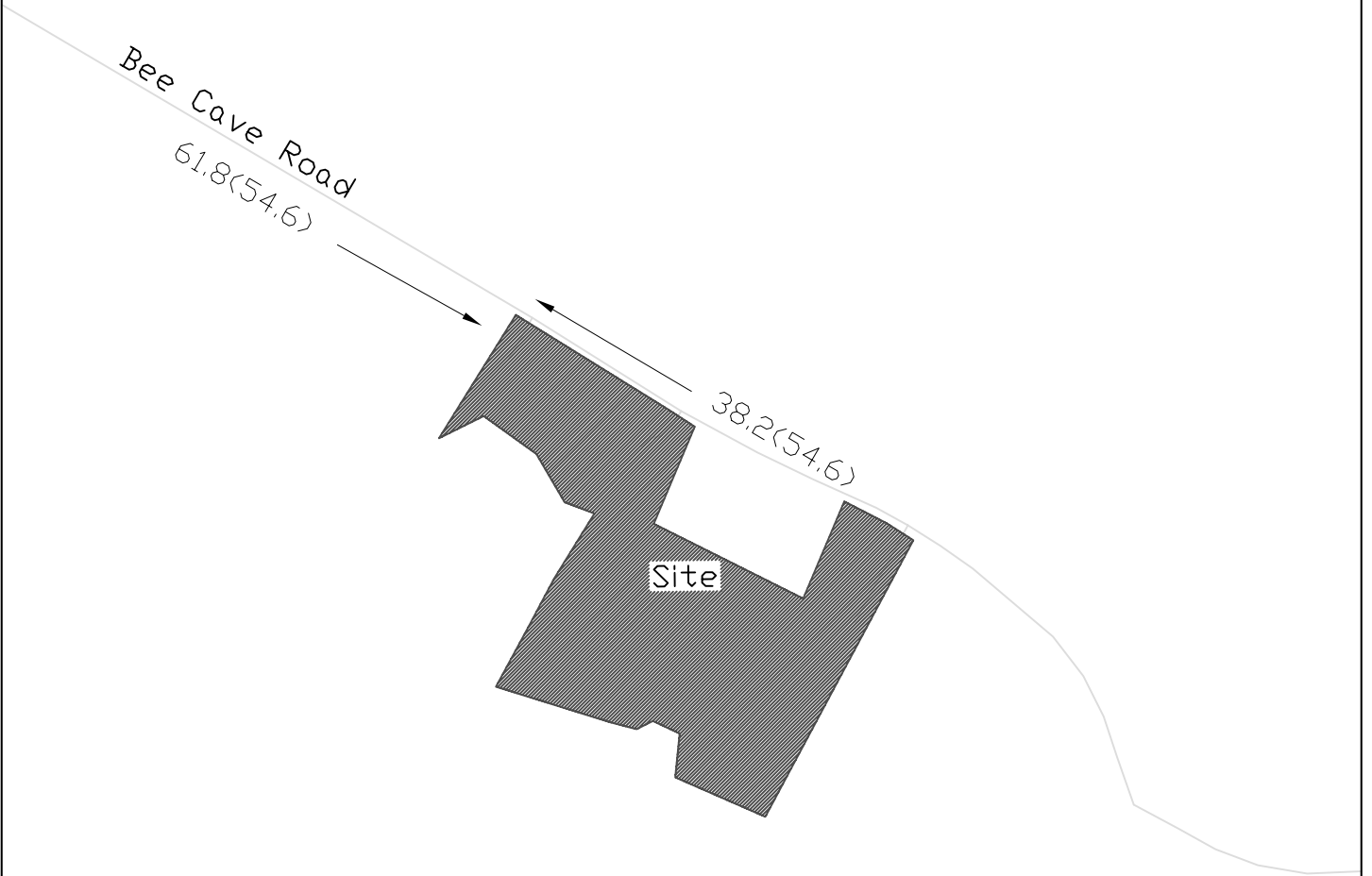
**Table 3: Unadjusted ITE Trip Generation**

ITE Description	24 Hour	AM Peak Volumes			PM Peak Volumes		
		Total	Enter	Exit	Total	Enter	Exit
Medical-Dental Office	766	60	47	12	84	23	61
Medical-Dental Office	1029	75	60	15	104	28	76
Health Club/Fitness Club	1334	49	21	28	164	84	80
General Office	331	44	39	5	24	4	20

Pass-by and internal trips can account for a significant portion of a site's generated traffic. Pass-by trips are attracted to the site from traffic passing on an adjacent street. Internal trips are trips that use only internal roadways within the site traveling from one land use to another. Due to the land use in this development, no reduction for pass-by or internal capture was applied.

### *Trip Distribution*

Trip distribution takes into account where the vehicles generated by the site are going to or coming from based on the roadway network. Distribution percentages were developed using existing 24-hour traffic counts. All future site traffic was then distributed using those percentages. The percentages shown on the anticipated future roadway network in **Figure 3** were applied to the site generated traffic for the year 2010.



LEGEND  
XX(XX) –AM(PM) SITE TRIP PERCENTAGES

Figure 3. Site Trip Distribution

## Intersection Analysis

The intersection analysis performed for this study was based on the methodology outlined in *The Highway Capacity Manual, (HCM)* <sup>(1)</sup>, chapter 17. The primary measurement of effectiveness in the HCM is Level of Service (LOS). For intersections, LOS describes operational conditions in six levels based upon delay at intersections. These six levels are given the letters “A” through “F” and are given different descriptions and defining criteria. **Table 4** shows the criteria for each level of service for un-signalized intersections.

**Table 4: LOS Criteria for Stop Controlled Intersections**

Level -of- Service	Average Total Delay (sec/veh)
A	≤ 10
B	>10 and ≤ 15
C	>15 and ≤ 25
D	>25 and ≤ 35
E	>35 and ≤ 50
F	>50

Synchro *version 6.0*<sup>(5)</sup> was used to evaluate future conditions. Results of this analysis are presented in **Table 5**. **Figures 4 through 6** show the intersections with projected year 2010 volumes. The worksheets from this analysis are included in **Appendix B**.

**Table 5: Year 2010 Levels of Service**

Intersection	Type Of Control	Time Period	2009 With Site LOS
Bee Cave Road & Site Driveway 1	Un-signalized	AM PM	A A
Bee Cave Road & Site Driveway 2	Un-signalized	AM PM	A C
Bee Cave Road & Site Driveway 3	Un-signalized	AM PM	A A

As indicated in Table 5, there are no capacity improvements required along Bee Cave Road for the site intersections to operate at an acceptable level of service. It is noted that the analysis assumes that the center driveway will accommodate a separate outbound left and right turn lane.

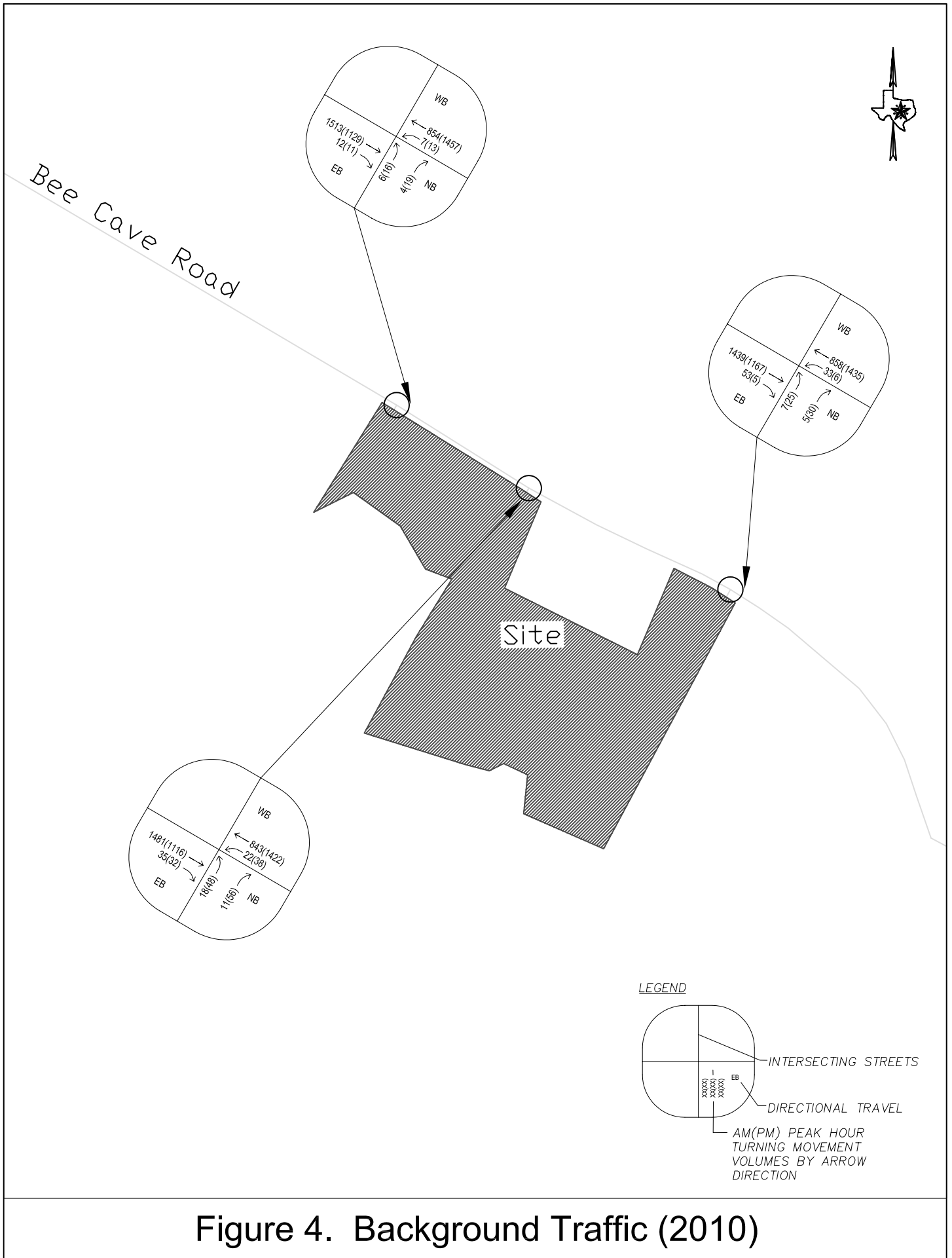


Figure 4. Background Traffic (2010)

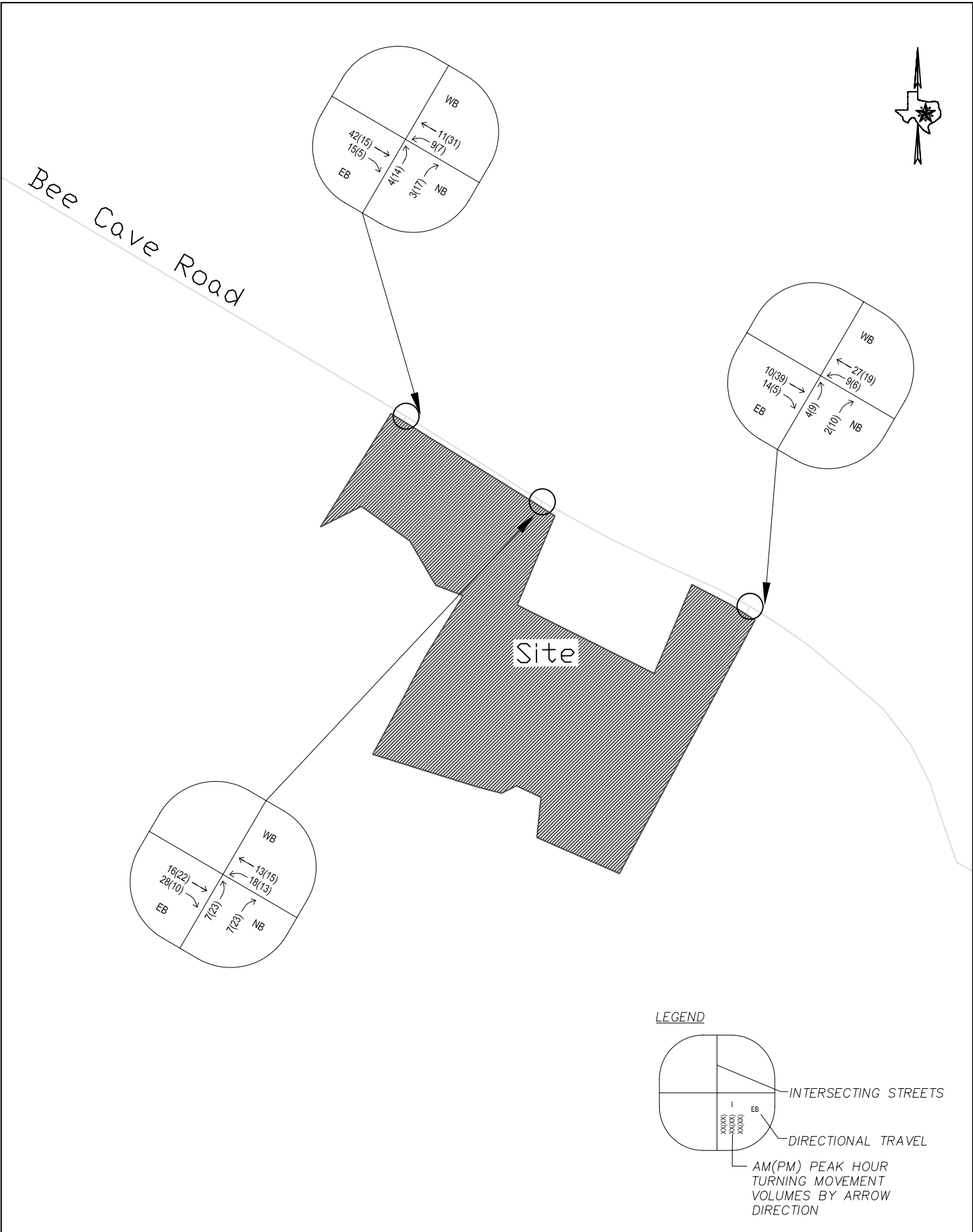
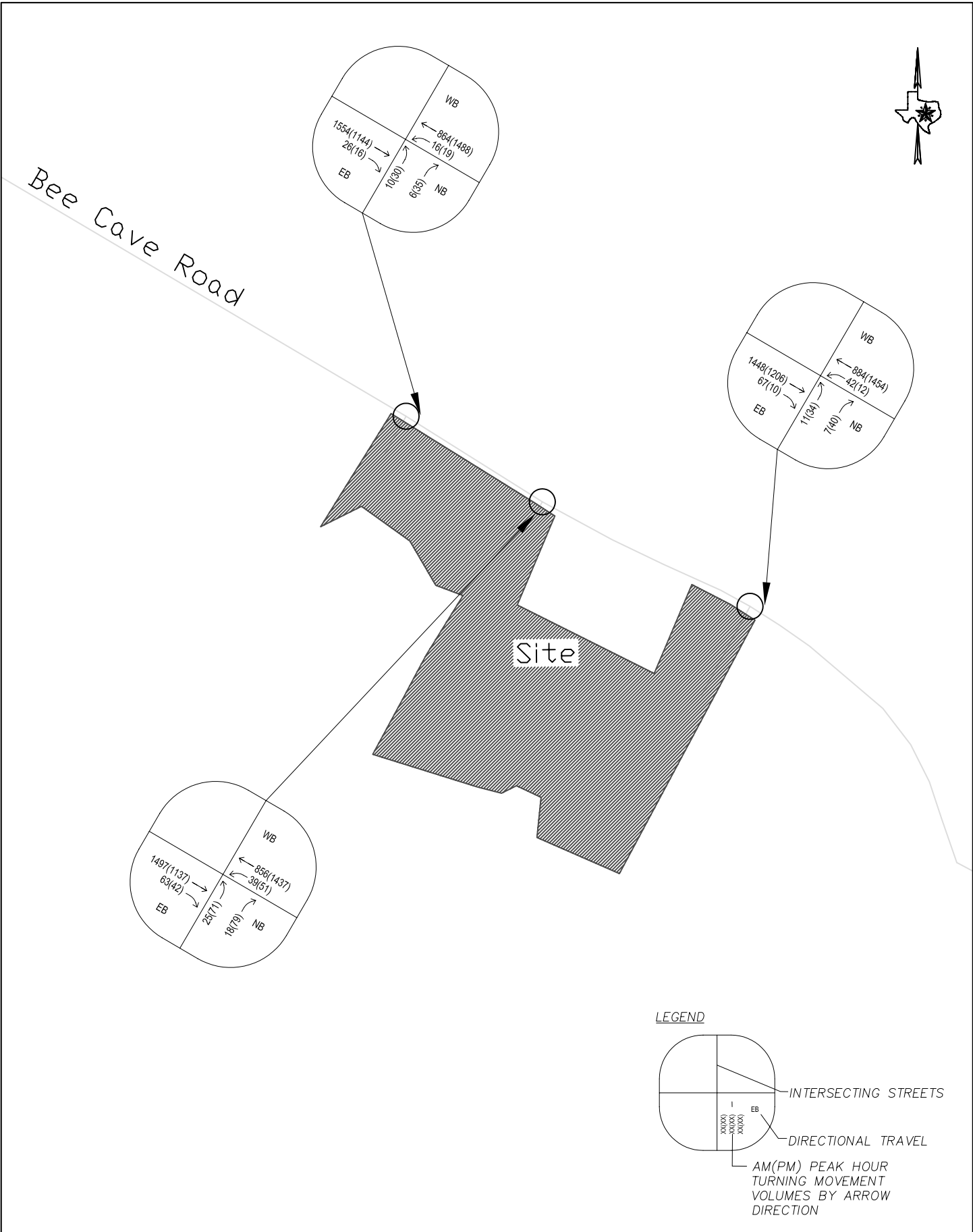
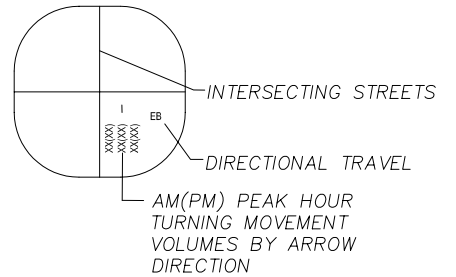


Figure 5. Site Traffic (2010)



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**Figure 6. Background + Site Traffic (2010)**

## **Conclusions**

This study has analyzed the future (Year 2010) traffic operations of the three driveway intersections along Bee Cave Road serving the Hills Fitness Center, based on the planned re-development of the site. The analyses performed indicate that no geometric modifications will be required to accommodate this expanded development on the site. A planned center left-turn lane along Bee Cave Road in the vicinity of the site will provide for improved operations over that analyzed in this study.

Based on the results of this study, it is our recommendation that the re-development of the Hills Fitness Center be approved as planned.

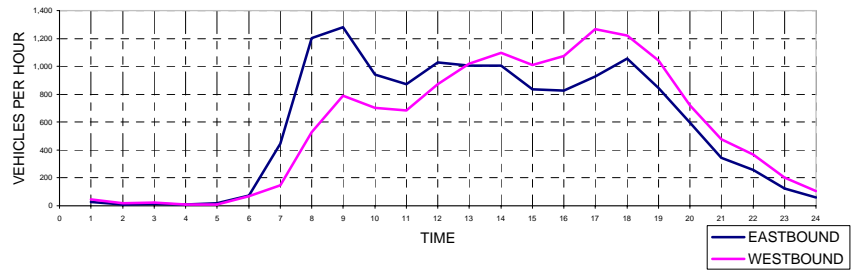
## References

1. Highway Capacity Manual, Transportation Research Board, Washington D.C., 2000.
2. Trip Generation 7th Edition, Institute of Transportation Engineers, Washington D.C., 2003.
3. “Synchro”, Trafficware LTD, Sugarland, Texas 2005.

**Appendix A: 2004 24-hour Counts**



**EASTBOUND & WESTBOUND BEE CAVES ROAD**



**Average Daily Traffic Data**

Project : The Hills Fitness Club  
 Date: 4/1/2004  
 Day of Week: Thursday  
 Site: Bee Caves Road  
 Location: West of Buckeye  
 City/State: West Lake Hills, Texas

End Time	EASTBOUND Bee Caves Road		WESTBOUND Bee Caves Road	
15	10		16	
30	7		12	
45	7		13	
100	3	27	7	48
115	1		6	
130	4		3	
145	2		1	
200	3	10	7	17
215	1		6	
230	4		5	
245	5		4	
300	2	12	6	21
315	1		3	
330	2		4	
345	0		1	
400	5	8	2	10
415	5		0	
430	2		1	
445	6		5	
500	4	17	5	11
515	11		9	
530	10		11	
545	15		19	
600	38	74	28	67
615	50		21	
630	100		25	
645	119		42	
700	174	443	60	148
715	244		85	
730	329		90	
745	315		133	
800	316	1,204	218	526
815	300		204	
830	326		191	
845	328		180	
900	328	1,282	216	791
915	256		197	
930	219		174	
945	238		157	
1000	226	939	174	702
1015	234		146	
1030	193		188	
1045	194		168	
1100	252	873	184	686
1115	250		205	
1130	242		213	
1145	271		229	
1200	266	1,029	226	873

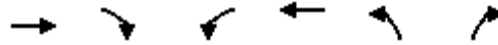
End Time	EASTBOUND Bee Caves Road		WESTBOUND Bee Caves Road	
1215	249		250	
1230	260		254	
1245	256		263	
1300	238	1,003	254	1,021
1315	289		261	
1330	254		281	
1345	237		283	
1400	225	1,005	270	1,095
1415	195		246	
1430	201		250	
1445	223		252	
1500	215	834	261	1,009
1515	181		280	
1530	202		225	
1545	221		285	
1600	220	824	282	1,072
1615	257		290	
1630	203		321	
1645	219		321	
1700	246	925	333	1,265
1715	287		318	
1730	294		297	
1745	236		332	
1800	241	1,058	272	1,219
1815	224		273	
1830	219		269	
1845	203		263	
1900	198	844	236	1,041
1915	161		221	
1930	180		185	
1945	149		173	
2000	108	598	142	721
2015	92		125	
2030	96		120	
2045	79		112	
2100	76	343	120	477
2115	79		101	
2130	60		120	
2145	62		74	
2200	56	257	73	368
2215	32		72	
2230	39		49	
2245	34		53	
2300	19	124	30	204
2315	21		43	
2330	14		27	
2345	12		19	
2400	12	59	16	105

Daily Traffic Data      EASTBOUND      WESTBOUND  
 Total ADT      13,792      13,497  
 27,289

## **Appendix B: LOS Analysis of 2010 Conditions**

HCM Unsignalized Intersection Capacity Analysis  
 1: Bee Cave Road & Driveway 1

2010 AM Peak Background + Site



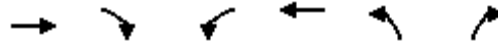
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↑	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1448	67	42	884	11	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1574	73	46	961	12	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1647		2182	823
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1647		2182	823
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			88		65	98
cM capacity (veh/h)			389		35	316

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1049	597	366	641	20
Volume Left	0	0	46	0	12
Volume Right	0	73	0	0	8
cSH	1700	1700	389	1700	53
Volume to Capacity	0.62	0.35	0.12	0.38	0.37
Queue Length 95th (ft)	0	0	10	0	33
Control Delay (s)	0.0	0.0	3.9	0.0	108.5
Lane LOS			A		F
Approach Delay (s)	0.0		1.4		108.5
Approach LOS					F

Intersection Summary					
Average Delay			1.3		
Intersection Capacity Utilization		65.4%		ICU Level of Service	C
Analysis Period (min)			15		

HCM Unsignalized Intersection Capacity Analysis  
 1: Bee Cave Road & Driveway 1

2010 PM Peak Background + Site



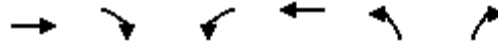
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑↑
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1206	10	12	1454	34	40
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1311	11	13	1580	37	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1322		2133	661
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1322		2133	661
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		10	89
cM capacity (veh/h)			519		41	405

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	874	448	540	1054	80
Volume Left	0	0	13	0	37
Volume Right	0	11	0	0	43
cSH	1700	1700	519	1700	80
Volume to Capacity	0.51	0.26	0.03	0.62	1.00
Queue Length 95th (ft)	0	0	2	0	138
Control Delay (s)	0.0	0.0	0.7	0.0	192.7
Lane LOS	A			F	
Approach Delay (s)	0.0		0.2		192.7
Approach LOS				F	

Intersection Summary					
Average Delay			5.3		
Intersection Capacity Utilization			59.6%	ICU Level of Service	B
Analysis Period (min)			15		

HCM Unsignalized Intersection Capacity Analysis  
 2: Bee Cave Road & Driveway 2

2010 AM Peak Background + Site



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↗	↖
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1497	63	39	856	25	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1627	68	42	930	27	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1696		2211	848
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1696		2211	848
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		18	94
cM capacity (veh/h)			372		33	305
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	1085	611	353	620	27	20
Volume Left	0	0	42	0	27	0
Volume Right	0	68	0	0	0	20
cSH	1700	1700	372	1700	33	305
Volume to Capacity	0.64	0.36	0.11	0.36	0.82	0.06
Queue Length 95th (ft)	0	0	10	0	71	5
Control Delay (s)	0.0	0.0	3.9	0.0	277.3	17.6
Lane LOS			A		F	C
Approach Delay (s)	0.0		1.4		168.6	
Approach LOS					F	
Intersection Summary						
Average Delay			3.4			
Intersection Capacity Utilization			62.4%	ICU Level of Service	B	
Analysis Period (min)			15			

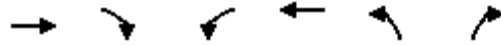
HCM Unsignalized Intersection Capacity Analysis  
 2: Bee Cave Road & Driveway 2

2010 PM Peak Background + Site

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↘	↗
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1137	42	51	1437	71	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1236	46	55	1562	77	86
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1282		2151	641
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1282		2151	641
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		0	79
cM capacity (veh/h)			537		37	418
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	824	458	576	1041	77	86
Volume Left	0	0	55	0	77	0
Volume Right	0	46	0	0	0	86
cSH	1700	1700	537	1700	37	418
Volume to Capacity	0.48	0.27	0.10	0.61	2.09	0.21
Queue Length 95th (ft)	0	0	9	0	211	19
Control Delay (s)	0.0	0.0	2.9	0.0	737.5	15.8
Lane LOS			A		F	C
Approach Delay (s)	0.0		1.0		357.4	
Approach LOS					F	
Intersection Summary						
Average Delay			19.6			
Intersection Capacity Utilization			87.4%	ICU Level of Service	E	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 3: Bee Cave Road & Driveway 3

2010 AM Peak Background + Site



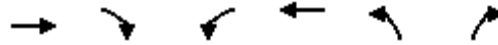
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑↑
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1554	26	16	864	10	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1689	28	17	939	11	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1717		2208	859
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1717		2208	859
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		70	98
cM capacity (veh/h)			365		36	300

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1126	591	330	626	17
Volume Left	0	0	17	0	11
Volume Right	0	28	0	0	7
cSH	1700	1700	365	1700	54
Volume to Capacity	0.66	0.35	0.05	0.37	0.33
Queue Length 95th (ft)	0	0	4	0	29
Control Delay (s)	0.0	0.0	1.7	0.0	101.8
Lane LOS	A			F	
Approach Delay (s)	0.0		0.6		101.8
Approach LOS	F				

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis  
 3: Bee Cave Road & Driveway 3

2010 PM Peak Background + Site



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑↑
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1144	16	19	1488	30	35
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1243	17	21	1617	33	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1261		2102	630
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1261		2102	630
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		24	91
cM capacity (veh/h)			547		43	424

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	829	432	560	1078	71
Volume Left	0	0	21	0	33
Volume Right	0	17	0	0	38
cSH	1700	1700	547	1700	83
Volume to Capacity	0.49	0.25	0.04	0.63	0.85
Queue Length 95th (ft)	0	0	3	0	111
Control Delay (s)	0.0	0.0	1.1	0.0	148.6
Lane LOS	A			F	
Approach Delay (s)	0.0		0.4		148.6
Approach LOS				F	

Intersection Summary					
Average Delay			3.7		
Intersection Capacity Utilization			65.0%	ICU Level of Service	C
Analysis Period (min)			15		