

Alberta Transportation
2nd Floor, Twin Atria Building
4999 - 98 Avenue
Edmonton, AB T6B 2X3

July 30, 2004
Our File: 5170.14

**Attention: Mr. Jarret Berezanski, P.Eng.
Project Planning Specialist**

Dear Jarret,

RE: SPY HILL LANDS DEVELOPMENT PROJECT – TRAFFIC IMPACT STUDY ADDENDUM

Based on our conversation of May 11, 2004 we were advised that Malcolm Brown of the City of Calgary's Transportation Development Services, having reviewed our Traffic Impact Study¹ (TIS), requested that Alberta Transportation review the following:

- A sensitivity analysis of the growth patterns assumed for 85 Street (from the 3% used in the TIS to 10%) in order to confirm the required intersection treatment at the site driveway access to 85 Street.
- Provide additional detail around the directional-distribution patterns on Country Hills Boulevard and Stoney Trail. Mr. Brown expressed interest relating to the amount of traffic that would continue east on Country Hills Boulevard and the resulting impact on traffic noise.
- A capacity analysis at the Country Hills Boulevard/85 Street intersection at the Year 2007 horizon assuming 1,000,000 tonnes of aggregate for the Stoney Trail construction.

Intersection Treatment at Site Access

In our TIS, we assumed and applied an annual compound growth rate of 3% per year to estimate the design year (Year 2007) background traffic volumes at the proposed site access intersection. This growth rate was applied to the existing (Year 2003) 85 Street through traffic volumes only. We did not anticipate any traffic growth for the Young Offenders Centre. Based

¹ Finn Transportation Consultants, Spy Hill Lands Development Project – Traffic Impact Study, August 7, 2003.

on the Year 2007 post-development traffic volumes and Alberta Transportation's left- and right-turn lane warrants, we determined that an upgrade to provide for a Type III intersection treatment would be warranted for northbound 85 Street.

Mr. Brown requested that a sensitivity analysis be completed using a 10% annual linear growth rate for the background traffic. We reassessed the intersection by applying the higher growth rate on the 85 Street through traffic (the resulting background and post-development traffic volumes are shown in **Figure 1** – this and all other figures are attached). The increase in background volumes resulted in a Type IV intersection treatment being warranted for northbound 85 Street. The Type IV treatment at the intersection of the site driveway and 85 Street is shown conceptually on **Figure 2**.

Distribution of Site Traffic

Mr. Brown expressed interest relating to the future amount of truck traffic projected for Country Hills Boulevard, and it's possible an impact on noise attenuation requirements for the adjacent communities. We reviewed our directional-distribution assumptions from the TIS. Further clarification of the expected truck traffic patterns south of the gravel extraction site is illustrated in **Figure 3**.

As shown, we anticipated that the majority of truck traffic originating from, or destined to, south of the site would make use of 112 Avenue east to Sarcee Trail rather than 85 Street south to Country Hills Boulevard in order to access Stoney Trail. This was primarily because the majority of the aggregate is destined to areas east of Sarcee Trail (e.g., ring road construction, highway rehabilitation, ...). The Sarcee Trail route will also act as a 'relief valve' if congestion occurs at the Country Hills Boulevard/85 Street intersection.

In terms of number of vehicles, 36 vehicles were projected to travel on Country Hills Boulevard during the a.m. peak hour, and 13 vehicles during the p.m. peak hour. This is based on the traffic generation outlined in the previous report². We expected approximately a 50/50 split between inbound and outbound traffic. 36 vehicles-per-hour represents about 1.7% of the post-development traffic volumes projected for Country Hills Boulevard east of 85 Street.

Country Hills Boulevard/85 Street Intersection Capacity Analysis

Mr. Brown also requested that a capacity analysis be completed at the Country Hills Boulevard/85 Street intersection at the Year 2007 horizon. We carried out a turning movement count at the intersection on Tuesday, July 27, 2004 from 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. We found that the a.m. street peak hour for the intersection to be from 7:15 and 8:15 a.m. Similarly

² Finn Transportation Consultants, Spy Hill Lands Development Project – Traffic Impact Study, August 7, 2003, p. 16.

the p.m. street peak hour is between 4:15 and 5:15 p.m. The street peak hour turning movement traffic volumes are summarized in **Figure 4**.

We estimated the future Year 2007 background traffic volumes at the subject intersection by applying a growth factor of 25% per year to all traffic volumes surveyed. The 25% growth rate was determined by reviewing historical traffic counts at the Country Hills Boulevard/Stoney Trail intersection, which showed annual increases of between -18% to +130% over since 1999. We felt that the growth of the area further to the west would be rapid and significant in the next few years, and as such we selected a relatively high percentage of growth rate for the traffic at the intersection. The site-generated traffic at the design year was superimposed on the future Year 2007 background traffic to illustrate the traffic level at the post-development situation. These are also included in Figure 4.

We assessed the operating conditions of the intersection using the Synchro/SimTraffic software package (based on the methodology outlined in the *Highway Capacity Manual*³). The future 2007 background and post-development scenarios were assessed, for both morning and afternoon peak hours. The intersection was analyzed as a signalized intersection using the existing lane configuration. The analysis results are summarized in **Tables 1** and **2** (attached). We expect that all traffic movements at the intersection will operate satisfactorily with levels-of-service (LOS) for the individual movements ranging from 'A' to 'C'. The overall intersection is expected to operate at LOS is 'B' for both the background and post-development scenarios.

* * * * *

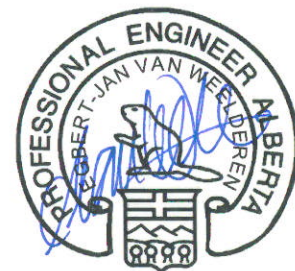
We trust that this letter clearly summarizes our analysis and findings related to the impact of the Spy Hill Lands Development Project. Please call me if you need to clarify any aspect of this letter.

Sincerely,

D.A. Watt Consulting

E. (Eppo) van Weelderren, CD, P.Eng.
Project Engineer
Transportation

Attachments: Figures 1, 2, 3 and 4
Tables 1 and 2
AT Warrant Analyses
Synchro outputs



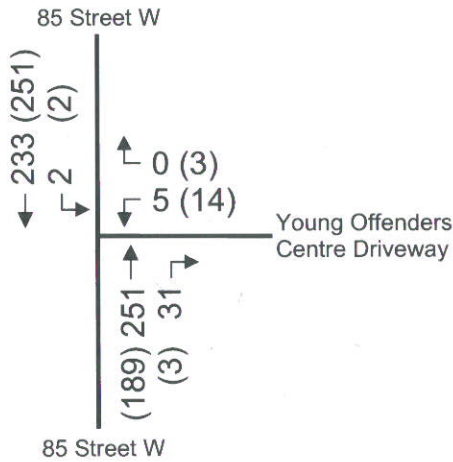
July 30, 2004

PERMIT TO PRACTICE D. A. WATT CONSULTING GROUP LTD. Signature <u></u> Date <u>July 30, 2004</u> PERMIT NUMBER: P 3818 The Association of Professional Engineers, Geologists and Geophysicists of Alberta

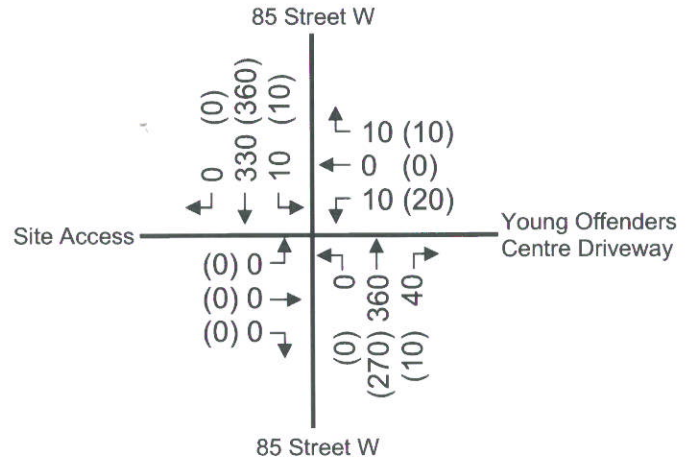
³ National Research Council, Highway Capacity Manual 2000, Washington, D.C., 2000.



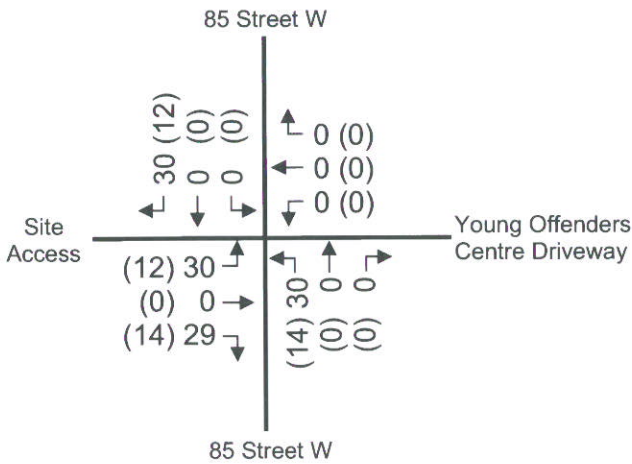
EXISTING TRAFFIC VOLUMES (2003)



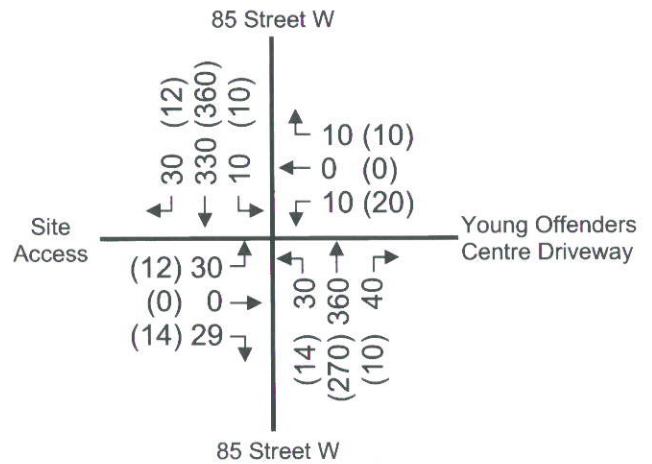
FUTURE BACKGROUND TRAFFIC VOLUMES (2007)



SITE-GENERATED TRAFFIC VOLUMES (2007)



POST-DEVELOPMENT TRAFFIC VOLUMES (2007)



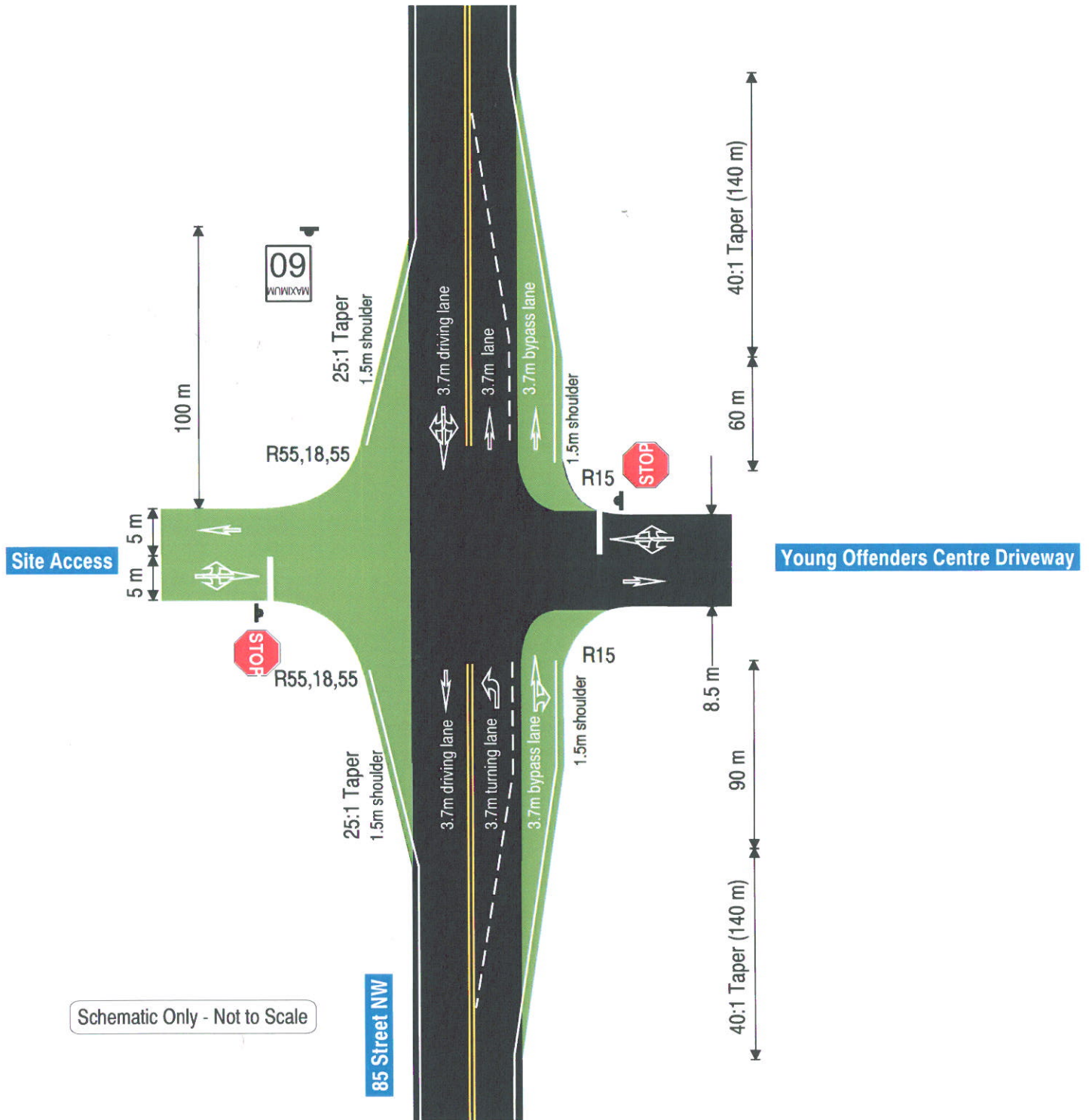
Legend:

(YY) XX →

- AM Peak Hour Vehicle Turning Movements (vehicles per hour)
- PM Peak Hour Vehicle Turning Movements (vehicles per hour)

TRAFFIC VOLUMES AT SITE ACCESS

Figure



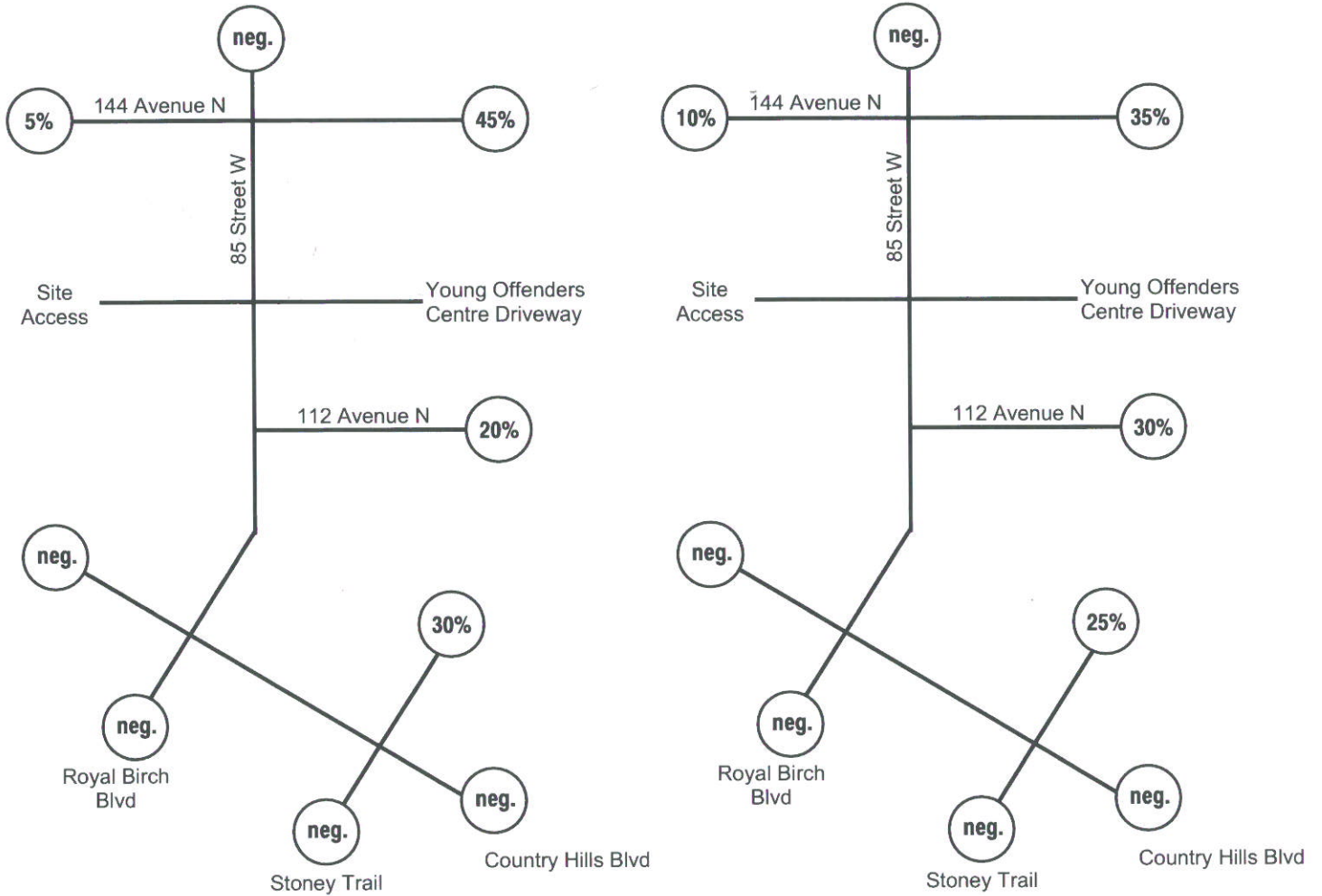
Schematic Only - Not to Scale

RECOMMENDED 85 STREET/SITE ACCESS INTERSECTION TREATMENT



2007 AM PEAK HOUR TRIP DISTRIBUTION

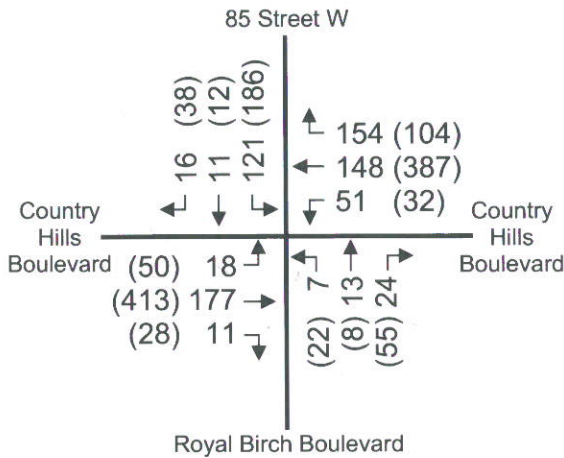
2007 PM PEAK HOUR TRIP DISTRIBUTION



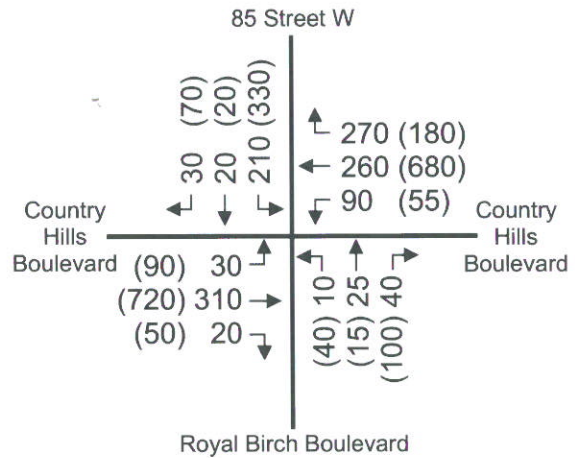
Schematic - Not To Scale



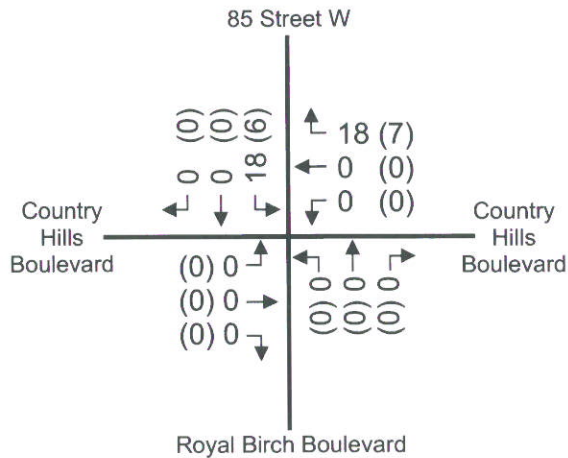
EXISTING TRAFFIC VOLUMES (2004)



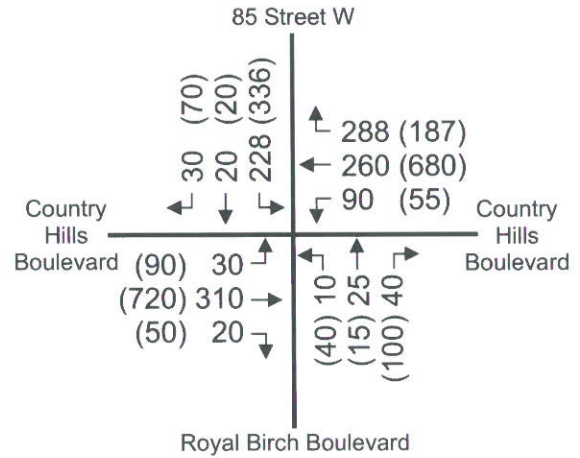
FUTURE BACKGROUND TRAFFIC VOLUMES (2007)



SITE-GENERATED TRAFFIC VOLUMES (2007)



POST-DEVELOPMENT TRAFFIC VOLUMES (2007)



Legend:

(YY) XX →

- AM Peak Hour Vehicle Turning Movements (vehicles per hour)
- PM Peak Hour Vehicle Turning Movements (vehicles per hour)

TRAFFIC VOLUMES AT 85 STREET / COUNTRY HILLS BOULEVARD INTERSECTION

Table 1: 2007 Background Operating Conditions

Country Hills Boulevard / 85 Street		LOS	Delay (sec)	V/C Ratio	
2007 Background A.M. Peak Hour	EB	Left	B	14.7	0.11
		Shared Through/Right	B	13.6	0.19
	WB	Left	B	16.7	0.27
		Through	B	14.8	0.22
		Right	A	4.0	0.42
	NB	Left	A	8.0	0.02
		Through	A	7.8	0.02
		Right	A	3.3	0.05
	SB	Shared Left/Through	A	9.3	0.22
		Right	A	3.7	0.05
	Intersection Summary		B	10.7	0.42 (max)
2007 Background P.M. Peak Hour	EB	Left	C	21.3	0.45
		Shared Through/Right	B	15.0	0.43
	WB	Left	B	17.3	0.28
		Through	B	16.9	0.54
		Right	A	3.5	0.30
	NB	Left	A	9.9	0.08
		Through	A	9.3	0.01
		Right	A	3.0	0.13
	SB	Shared Left/Through	B	11.2	0.33
		Right	A	3.3	0.09
	Intersection Summary		B	13.4	0.54 (max)

Table 2: 2007 Post-Development Operating Conditions

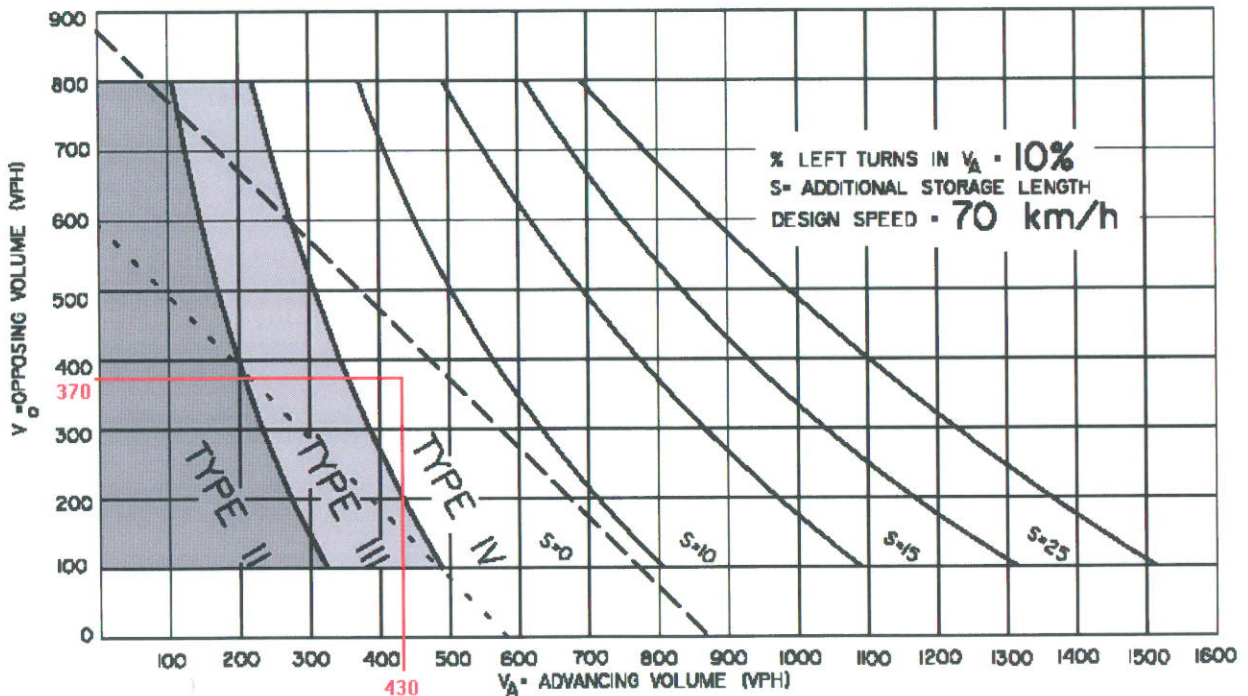
Country Hills Boulevard / 85 Street			LOS	Delay (sec)	V/C Ratio
2007 Post- Development A.M. Peak Hour	EB	Left	B	14.7	0.11
		Shared Through/Right	B	13.6	0.19
	WB	Left	B	16.7	0.27
		Through	B	14.8	0.22
		Right	A	4.0	0.44
	NB	Left	A	8.0	0.02
		Through	A	7.8	0.02
		Right	A	3.3	0.05
	SB	Shared Left/Through	A	9.4	0.24
		Right	A	3.7	0.05
	Intersection Summary			B	10.6
2007 Post- Development P.M. Peak Hour	EB	Left	C	21.3	0.45
		Shared Through/Right	B	15.0	0.43
	WB	Left	B	17.3	0.28
		Through	B	16.9	0.54
		Right	A	3.5	0.31
	NB	Left	A	9.9	0.08
		Through	A	9.3	0.01
		Right	A	3.0	0.13
	SB	Shared Left/Through	B	11.2	0.33
		Right	A	3.3	0.09
	Intersection Summary			B	13.4

**85 Street Northbound, AM Peak Hour
Intersection Improvement Warrant Analysis
2007 Post Development Traffic Volumes**

Warrant for Left Turn Lane. When making a left turn into the driveway, the turning vehicle may be delayed by a vehicle or vehicles in the opposing stream. Through vehicles in the advancing stream following the left-turning vehicle may be delayed by, or exposed to collision with turning vehicle. The interference caused by standing left turning vehicles in the through advancing traffic can reduce capacity and create a safety hazard. The amount of interference is dependent on opposing volumes, advancing volumes and the number of left turning vehicles.

- a. Number of left-turning vehicles per hour $V\lambda = 30$ vph
- b. Advancing volume $V_a = 30 + 360 + 40 = 430$ vph
- c. Proportion of left turns in V_a $L = V\lambda / V_a = 30 / 430 = 7.0\%$
- d. Opposing Volume $V_o = 370$ vph

∴ We find from Figure D-7.6-3a that a left turn lane is warranted for this direction during the AM Peak Hour. A Type IV treatment is required.

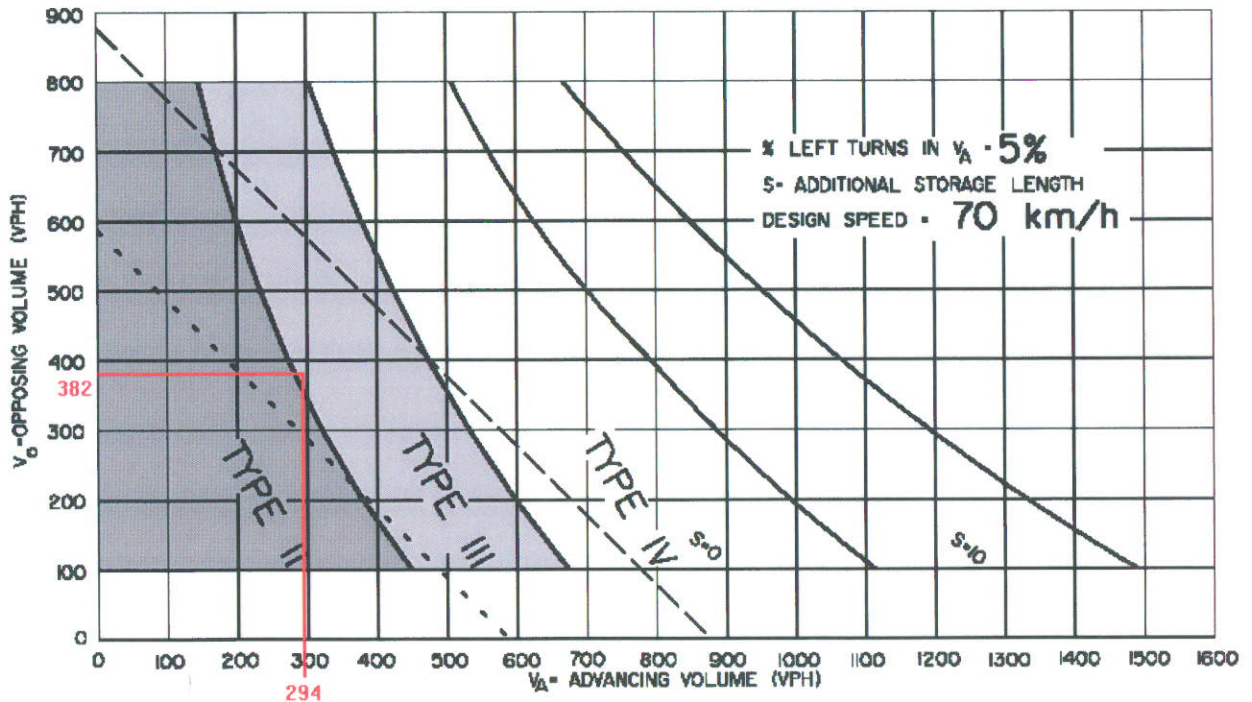


**85 Street Northbound, PM Peak Hour
Intersection Improvement Warrant Analysis
2007 Post Development Traffic Volumes**

Warrant for Left Turn Lane. When making a left turn into the driveway, the turning vehicle may be delayed by a vehicle or vehicles in the opposing stream. Through vehicles in the advancing stream following the left-turning vehicle may be delayed by, or exposed to collision with turning vehicle. The interference caused by standing left turning vehicles in the through advancing traffic can reduce capacity and create a safety hazard. The amount of interference is dependent on opposing volumes, advancing volumes and the number of left turning vehicles.

- a. Number of left-turning vehicles per hour $V\lambda = 14$ vph
- b. Advancing volume $V_a = 14 + 270 + 10 = 294$ vph
- c. Proportion of left turns in V_a $L = V\lambda / V_a = 14 / 294 = 4.8\%$
- d. Opposing Volume $V_o = 382$ vph

∴ We find from Figure D-7.6-3a that a left turn lane is warranted for this direction during the PM Peak Hour. A Type III treatment is required.



**85 Street Southbound
Intersection Improvement Warrant Analysis
2007 Post Development Traffic Volumes**























Warrant for Right Turn Lane. To warrant an exclusive right turn lane at a two-lane highway intersection in Alberta, the following three conditions must all be met:

- a. Main road (85 Street) AADT \geq 1800 vpd 5700 vpd \checkmark
- b. Intersecting road (Site Access) AADT \geq 900 vpd 1100 vpd \checkmark
- c. Right turn daily traffic volume \geq 360 vpd 250 vpd χ

\therefore A right turn lane is not warranted.

Lanes, Volumes, Timings
3: Country Hills Blvd & 85 Street NW

2007 Background AM Peak
7/28/2004

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	45.0		160.0	100.0		30.0	0.0		30.0	0.0		30.0
Storage Lanes	1		1	1		1	1		1	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.2	15.2		15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Ped Bike Factor	1.00			1.00			1.00				1.00	
Fr t		0.991				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950				0.956	
Satd. Flow (prot)	1269	4820	0	1615	3322	1325	1742	2734	1559	0	2596	1136
Flt Permitted	0.591			0.545			0.608				0.728	
Satd. Flow (perm)	787	4820	0	924	3322	1325	1112	2734	1559	0	1971	1136
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17				270			40			30
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		60			60			50			60	
Link Distance (m)		276.0			302.0			285.0			264.0	
Travel Time (s)		16.6			18.1			20.5			15.8	
Volume (vph)	30	310	20	90	260	270	10	25	40	210	20	30
Confl. Peds. (#/hr)	5			5			5			5		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	40%	5%	5%	10%	7%	20%	2%	30%	2%	30%	40%	40%
Adj. Flow (vph)	30	310	20	90	260	270	10	25	40	210	20	30
Lane Group Flow (vph)	30	330	0	90	260	270	10	25	40	0	230	30
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	4	4		8	8	8	2	2	2	6	6	6
Minimum Initial (s)	20.0	20.0		20.0	20.0	20.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	29.0	29.0		29.0	29.0	29.0	34.5	34.5	34.5	34.5	34.5	34.5
Total Split (s)	33.0	33.0	0.0	33.0	33.0	33.0	37.0	37.0	37.0	37.0	37.0	37.0
Total Split (%)	47.1%	47.1%	0.0%	47.1%	47.1%	47.1%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%
Maximum Green (s)	27.0	27.0		27.0	27.0	27.0	30.5	30.5	30.5	30.5	30.5	30.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	Max	Max	Max	Max	Max
Walk Time (s)	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Flash Dont Walk (s)	15.0	15.0		15.0	15.0	15.0	20.0	20.0	20.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5		5	5	5	5	5	5	5	5	5
Act Effct Green (s)	22.6	22.6		22.6	22.6	22.6	33.0	33.0	33.0		33.0	33.0
Actuated g/C Ratio	0.36	0.36		0.36	0.36	0.36	0.52	0.52	0.52		0.52	0.52
v/c Ratio	0.11	0.19		0.27	0.22	0.42	0.02	0.02	0.05		0.22	0.05
Control Delay	14.7	13.6		16.7	14.8	4.0	8.0	7.8	3.3		9.3	3.7

Lanes, Volumes, Timings
 3: Country Hills Blvd & 85 Street NW

2007 Background AM Peak
 7/28/2004

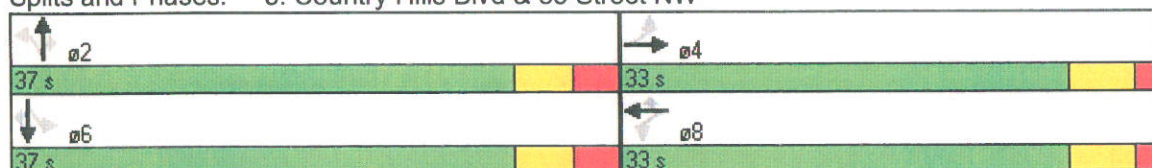
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	14.7	13.6		16.7	14.8	4.0	8.0	7.8	3.3		9.3	3.7
LOS	B	B		B	B	A	A	A	A		A	A
Approach Delay		13.7			10.4			5.4			8.6	
Approach LOS		B			B			A			A	
Queue Length 50th (m)	2.3	9.0		7.4	10.9	0.0	0.5	0.6	0.0		6.9	0.0
Queue Length 95th (m)	7.2	14.3		17.1	18.2	12.8	2.6	2.3	3.9		13.8	3.4
Internal Link Dist (m)		252.0			278.0			261.0			240.0	
Turn Bay Length (m)	45.0			100.0		30.0			30.0			30.0
Base Capacity (vph)	326	2007		383	1376	707	577	1419	829		1023	604
Starvation Cap Reductn	0	0		0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.09	0.16		0.23	0.19	0.38	0.02	0.02	0.05		0.22	0.05

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 63.6
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.42
 Intersection Signal Delay: 10.7
 Intersection Capacity Utilization 61.9%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service B

Splits and Phases: 3: Country Hills Blvd & 85 Street NW



Lanes, Volumes, Timings
3: Country Hills Blvd & 85 Street NW

2007 Background PM Peak
7/28/2004

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	45.0		160.0	100.0		30.0	0.0		30.0	0.0		30.0
Storage Lanes	1		1	1		1	1		1	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.2	15.2		15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Ped Bike Factor	1.00			1.00			1.00				0.99	
Frt		0.990				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950				0.955	
Satd. Flow (prot)	1615	4815	0	1615	3385	1325	1692	2369	1486	0	2802	1445
Flt Permitted	0.315			0.308			0.536				0.730	
Satd. Flow (perm)	534	4815	0	522	3385	1325	950	2369	1486	0	2127	1445
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		19				180			100			70
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		60			60			50			60	
Link Distance (m)		276.0			302.0			285.0			264.0	
Travel Time (s)		16.6			18.1			20.5			15.8	
Volume (vph)	90	720	50	55	680	180	40	15	100	330	20	70
Confl. Peds. (#/hr)	10			10			10			10		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	5%	5%	10%	5%	20%	5%	50%	7%	20%	40%	10%
Adj. Flow (vph)	90	720	50	55	680	180	40	15	100	330	20	70
Lane Group Flow (vph)	90	770	0	55	680	180	40	15	100	0	350	70
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	4	4		8	8	8	2	2	2	6	6	6
Minimum Initial (s)	20.0	20.0		20.0	20.0	20.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	29.0	29.0		29.0	29.0	29.0	34.5	34.5	34.5	34.5	34.5	34.5
Total Split (s)	34.0	34.0	0.0	34.0	34.0	34.0	36.0	36.0	36.0	36.0	36.0	36.0
Total Split (%)	48.6%	48.6%	0.0%	48.6%	48.6%	48.6%	51.4%	51.4%	51.4%	51.4%	51.4%	51.4%
Maximum Green (s)	28.0	28.0		28.0	28.0	28.0	29.5	29.5	29.5	29.5	29.5	29.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	Max	Max	Max	Max	Max
Walk Time (s)	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Flash Dont Walk (s)	15.0	15.0		15.0	15.0	15.0	20.0	20.0	20.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5		5	5	5	5	5	5	5	5	5
Act Effct Green (s)	23.9	23.9		23.9	23.9	23.9	32.1	32.1	32.1		32.1	32.1
Actuated g/C Ratio	0.37	0.37		0.37	0.37	0.37	0.50	0.50	0.50		0.50	0.50
v/c Ratio	0.45	0.43		0.28	0.54	0.30	0.08	0.01	0.13		0.33	0.09
Control Delay	21.3	15.0		17.3	16.9	3.5	9.9	9.3	3.0		11.2	3.3

Lanes, Volumes, Timings
 3: Country Hills Blvd & 85 Street NW

2007 Background PM Peak
 7/28/2004

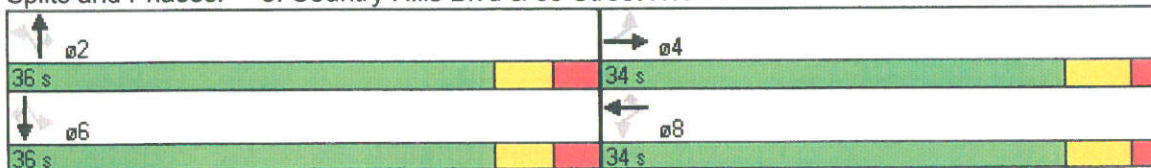
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	21.3	15.0		17.3	16.9	3.5	9.9	9.3	3.0		11.2	3.3
LOS	C	B		B	B	A	A	A	A		B	A
Approach Delay		15.7			14.3			5.4			9.9	
Approach LOS		B			B			A			A	
Queue Length 50th (m)	7.8	23.4		4.4	32.1	0.0	2.1	0.4	0.0		11.1	0.0
Queue Length 95th (m)	19.9	31.9		12.2	45.5	9.8	7.9	2.0	7.0		24.1	5.9
Internal Link Dist (m)		252.0			278.0			261.0			240.0	
Turn Bay Length (m)	45.0			100.0		30.0			30.0			30.0
Base Capacity (vph)	229	2074		224	1451	671	476	1188	795		1067	760
Starvation Cap Reductn	0	0		0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.39	0.37		0.25	0.47	0.27	0.08	0.01	0.13		0.33	0.09

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 64
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.54
 Intersection Signal Delay: 13.4
 Intersection Capacity Utilization 71.4%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 3: Country Hills Blvd & 85 Street NW



Lanes, Volumes, Timings
3: Country Hills Blvd & 85 Street NW

2007 Post-Development AM Peak
7/28/2004

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	45.0		160.0	100.0		30.0	0.0		30.0	0.0		30.0
Storage Lanes	1		1	1		1	1		1	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.2	15.2		15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Ped Bike Factor	1.00			1.00			1.00				1.00	
Frnt		0.991				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950				0.956	
Satd. Flow (prot)	1269	4820	0	1615	3322	1325	1742	2734	1559	0	2597	1136
Flt Permitted	0.591			0.545			0.598				0.727	
Satd. Flow (perm)	787	4820	0	924	3322	1325	1094	2734	1559	0	1969	1136
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17				288			40			30
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		60			60			50			60	
Link Distance (m)		276.0			302.0			285.0			264.0	
Travel Time (s)		16.6			18.1			20.5			15.8	
Volume (vph)	30	310	20	90	260	288	10	25	40	228	20	30
Confl. Peds. (#/hr)	5			5			5			5		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	40%	5%	5%	10%	7%	20%	2%	30%	2%	30%	40%	40%
Adj. Flow (vph)	30	310	20	90	260	288	10	25	40	228	20	30
Lane Group Flow (vph)	30	330	0	90	260	288	10	25	40	0	248	30
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	4	4		8	8	8	2	2	2	6	6	6
Minimum Initial (s)	20.0	20.0		20.0	20.0	20.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	29.0	29.0		29.0	29.0	29.0	34.5	34.5	34.5	34.5	34.5	34.5
Total Split (s)	33.0	33.0	0.0	33.0	33.0	33.0	37.0	37.0	37.0	37.0	37.0	37.0
Total Split (%)	47.1%	47.1%	0.0%	47.1%	47.1%	47.1%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%
Maximum Green (s)	27.0	27.0		27.0	27.0	27.0	30.5	30.5	30.5	30.5	30.5	30.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	Max	Max	Max	Max	Max
Walk Time (s)	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Flash Dont Walk (s)	15.0	15.0		15.0	15.0	15.0	20.0	20.0	20.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5		5	5	5	5	5	5	5	5	5
Act Effct Green (s)	22.6	22.6		22.6	22.6	22.6	33.0	33.0	33.0		33.0	33.0
Actuated g/C Ratio	0.36	0.36		0.36	0.36	0.36	0.52	0.52	0.52		0.52	0.52
v/c Ratio	0.11	0.19		0.27	0.22	0.44	0.02	0.02	0.05		0.24	0.05
Control Delay	14.7	13.6		16.7	14.8	4.0	8.0	7.8	3.3		9.4	3.7

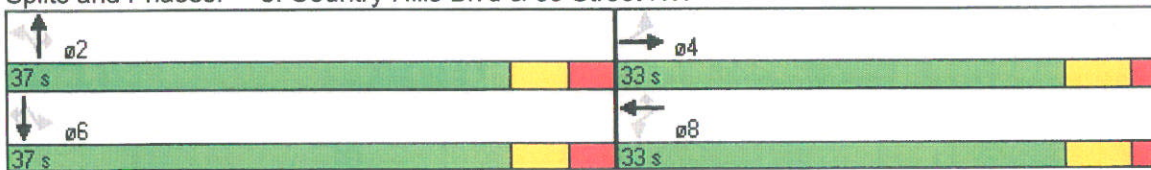
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	14.7	13.6		16.7	14.8	4.0	8.0	7.8	3.3		9.4	3.7
LOS	B	B		B	B	A	A	A	A		A	A
Approach Delay		13.7			10.2			5.4			8.8	
Approach LOS		B			B			A			A	
Queue Length 50th (m)	2.3	9.0		7.4	10.9	0.0	0.5	0.6	0.0		7.5	0.0
Queue Length 95th (m)	7.2	14.3		17.1	18.2	13.2	2.6	2.3	3.9		14.7	3.4
Internal Link Dist (m)		252.0			278.0			261.0			240.0	
Turn Bay Length (m)	45.0			100.0		30.0			30.0			30.0
Base Capacity (vph)	326	2007		383	1376	718	568	1419	829		1022	604
Starvation Cap Reductn	0	0		0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.09	0.16		0.23	0.19	0.40	0.02	0.02	0.05		0.24	0.05

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 63.6
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.44
 Intersection Signal Delay: 10.6
 Intersection Capacity Utilization 63.0%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service B

Splits and Phases: 3: Country Hills Blvd & 85 Street NW



Lanes, Volumes, Timings
3: Country Hills Blvd & 85 Street NW

2007 Post-Development PM Peak
7/28/2004

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	45.0		160.0	100.0		30.0	0.0		30.0	0.0		30.0
Storage Lanes	1		1	1		1	1		1	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (m)	15.2	15.2		15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Ped Bike Factor	1.00			1.00			1.00				0.99	
Frnt		0.990				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950				0.955	
Satd. Flow (prot)	1615	4815	0	1615	3385	1325	1692	2369	1486	0	2802	1445
Flt Permitted	0.315			0.308			0.532				0.730	
Satd. Flow (perm)	534	4815	0	522	3385	1325	943	2369	1486	0	2127	1445
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		19				187			100			70
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Link Speed (k/h)		60			60			50			60	
Link Distance (m)		276.0			302.0			285.0			264.0	
Travel Time (s)		16.6			18.1			20.5			15.8	
Volume (vph)	90	720	50	55	680	187	40	15	100	336	20	70
Confl. Peds. (#/hr)	10			10			10			10		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	5%	5%	10%	5%	20%	5%	50%	7%	20%	40%	10%
Adj. Flow (vph)	90	720	50	55	680	187	40	15	100	336	20	70
Lane Group Flow (vph)	90	770	0	55	680	187	40	15	100	0	356	70
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	4	4		8	8	8	2	2	2	6	6	6
Minimum Initial (s)	20.0	20.0		20.0	20.0	20.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	29.0	29.0		29.0	29.0	29.0	34.5	34.5	34.5	34.5	34.5	34.5
Total Split (s)	34.0	34.0	0.0	34.0	34.0	34.0	36.0	36.0	36.0	36.0	36.0	36.0
Total Split (%)	48.6%	48.6%	0.0%	48.6%	48.6%	48.6%	51.4%	51.4%	51.4%	51.4%	51.4%	51.4%
Maximum Green (s)	28.0	28.0		28.0	28.0	28.0	29.5	29.5	29.5	29.5	29.5	29.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	Max	Max	Max	Max	Max
Walk Time (s)	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Flash Dont Walk (s)	15.0	15.0		15.0	15.0	15.0	20.0	20.0	20.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5		5	5	5	5	5	5	5	5	5
Act Effct Green (s)	23.9	23.9		23.9	23.9	23.9	32.1	32.1	32.1		32.1	32.1
Actuated g/C Ratio	0.37	0.37		0.37	0.37	0.37	0.50	0.50	0.50		0.50	0.50
v/c Ratio	0.45	0.43		0.28	0.54	0.31	0.08	0.01	0.13		0.33	0.09
Control Delay	21.3	15.0		17.3	16.9	3.5	9.9	9.3	3.0		11.2	3.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	21.3	15.0		17.3	16.9	3.5	9.9	9.3	3.0		11.2	3.3
LOS	C	B		B	B	A	A	A	A		B	A
Approach Delay		15.7			14.2			5.4			9.9	
Approach LOS		B			B			A			A	
Queue Length 50th (m)	7.8	23.4		4.4	32.1	0.0	2.1	0.4	0.0		11.4	0.0
Queue Length 95th (m)	19.9	31.9		12.2	45.5	10.0	7.9	2.0	7.0		24.5	5.9
Internal Link Dist (m)		252.0			278.0			261.0			240.0	
Turn Bay Length (m)	45.0			100.0		30.0			30.0			30.0
Base Capacity (vph)	229	2074		224	1451	675	473	1188	795		1067	760
Starvation Cap Reductn	0	0		0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.39	0.37		0.25	0.47	0.28	0.08	0.01	0.13		0.33	0.09

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 64
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.54
 Intersection Signal Delay: 13.4
 Intersection Capacity Utilization 71.8%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 3: Country Hills Blvd & 85 Street NW

