Patton Harris Rust & Associates
Engineers. Surveyors. Planners. Landscape Architects.

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Memorandum

To:	**Kimberley Fogle**
Organization/Company:	Fauquier County
From:	John F. Callow
Date:	October 5, 2007
Project Name/Subject:	New Baltimore Costco
PHR+A Project file Number:	15116-1-0
cc:	

Per your request, Patton Harris Rust & Associates (PHR+A) has prepared this document to present the trip generation based upon the 7th edition of Institute of Transportation Engineers' (ITE) *Trip Generation Report* for Costco and By-right uses as shown in **Table 1** and **Table 2**, respectively. **Table 3** shows the comparison between Costco and By-right trip generation.

PHR+A has also provided the Synchro analysis report during 2009 build-out PM peak hour conditions for the signalized intersections of Route 29/Route 600 (Broad Run Church Road) and Route 29/Proposed Cross Creek Site-Driveway for the Costco and By-right uses, respectively.

Table 1
Proposed Development with Costco
Trip Generation Summary

Code	Land Use	Amount	Weekday AM Peak Hour In	Out	Total	Weekday PM Peak Hour In	Out	Total	Weekday ADT	Saturday Peak Hour In	Out	Total	Saturday ADT
East Side of Cross Creek Drive													
820	Ga. Shopping Center	25,200 SF	42	27	68	121	131	252	2,772	184	170	353	3,877
861	Discount Club	148,000 SF	59	24	83	314	314	628	6,186	497	517	1,014	7,955
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
944	Gas Station (Costco)	12 pumps	69	69	138	83	83	166	2,023	83	83	166	2,023
West Side of Cross Creek Drive													
820	Ga. Shopping Center	32,000 SF	48	31	79	142	153	295	3,238	215	198	413	4,507
881	Pharmacy w/ DT	14,000 SF	21	16	37	59	62	121	1,234	55	55	110	1,234
912	Drive-in Bank	6,400 SF	44	35	79	146	146	293	1,424	121	116	237	491
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
948	Automated Car Wash	5,000 SF	36	35	71	36	35	71	706	36	35	71	1,412
	Total Amount	250,000 SF											
		Total Trips	407	317	724	999	987	1,986	19,453	1,375	1,283	2,658	23,827
	(15% maximum per use) Total Internal		18	18	35	64	64	127	1,313	94	94	189	1,596
	(15% maximun) Total Pass-by		54	54	109	149	149	298	2,918	199	199	399	3,574
	Total "New Trips"		**335**	**245**	**580**	**787**	**774**	**1,561**	**15,221**	**1,082**	**989**	**2,070**	**18,657**

Table 2
Proposed Development with By-right
Trip Generation Summary

Code	Land Use	Amount	Weekday AM Peak Hour In	Out	Total	Weekday PM Peak Hour In	Out	Total	Weekday ADT	Saturday Peak Hour In	Out	Total	Saturday ADT
East Side of Cross Creek Drive													
820	Ga. Shopping Center	138,000 SF	116	74	190	372	403	774	8,373	555	512	1,067	11,318
850	Supermarket	49,000 SF	110	70	181	271	260	531	4,672	292	281	572	8,702
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
West Side of Cross Creek Drive													
820	Ga. Shopping Center	27,200 SF	44	28	72	127	138	265	2,913	193	178	371	4,068
912	Drive-in Bank	6,400 SF	44	35	79	146	146	293	1,424	121	116	237	491
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
932	H-T Restaurant	4,900 SF	29	27	56	33	21	54	623	62	36	98	776
	Total Amount	250,000 SF											
		Total Trips	490	370	860	1,112	1,072	2,184	21,120	1,531	1,305	2,836	29,236
	(15% maximum per use) Total Internal		14	14	29	42	42	85	748	46	46	92	1,392
	(15% maximun) Total Pass-by		62	62	125	161	161	321	3,116	209	209	417	4,334
	Total "New Trips"		**413**	**293**	**706**	**909**	**869**	**1,778**	**17,256**	**1,277**	**1,050**	**2,327**	**23,509**

Table 3
Trip Generation Comparison
Costco versus By-right

Code	Land Use	Amount	Weekday AM Peak Hour In	Out	Total	Weekday PM Peak Hour In	Out	Total	Weekday ADT	Saturday Peak Hour In	Out	Total	Saturday ADT
Development with Costco		Total	335	245	580	787	774	1,561	15,221	1,082	989	2,070	18,657
Development with By-right		Total	413	293	706	909	869	1,778	17,256	1,277	1,050	2,327	23,509
Development "with Costco" versus "with By-right"			***-78***	***-48***	***-126***	***-122***	***-95***	***-217***	***-2,035***	***-195***	***-62***	***-257***	***-4,853***

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	1348	243	91	2168	19	218	22	40	8	47	198
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	225		300	450		320	630		0	0		200
Storage Lanes	1		1	1		1	1		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.957				0.850
Flt Protected	0.950			0.950			0.950	0.973			0.993	
Satd. Flow (prot)	1703	3406	1524	1703	3406	1524	1681	1648	0	0	1850	1583
Flt Permitted	0.950			0.950			0.950	0.973			0.993	
Satd. Flow (perm)	1703	3406	1524	1703	3406	1524	1681	1648	0	0	1850	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			270			21		15				8
Link Speed (mph)		55			55			45			45	
Link Distance (ft)		1654			2354			1732			3068	
Travel Time (s)		20.5			29.2			26.2			46.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	6%	6%	6%	6%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	39	1498	270	101	2409	21	242	24	44	9	52	220
Shared Lane Traffic (%)							35%					
Lane Group Flow (vph)	39	1498	270	101	2409	21	157	153	0	0	61	220
Turn Type	Prot		pm+ov	Prot		pm+ov	Split			Split		pm+ov
Protected Phases	5	2	8	1	6	4	8	8		4	4	5
Permitted Phases			2			6						4
Total Split (s)	12.0	69.0	14.0	15.0	72.0	12.0	14.0	14.0	0.0	12.0	12.0	12.0
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
Act Effct Green (s)	8.0	65.0	79.0	11.0	68.0	80.0	10.0	10.0			8.0	16.0
Actuated g/C Ratio	0.07	0.59	0.72	0.10	0.62	0.73	0.09	0.09			0.07	0.15
v/c Ratio	0.31	0.74	0.23	0.59	1.14	0.02	1.03	0.94			0.45	0.93
Control Delay	55.6	19.4	1.1	53.5	88.3	1.6	129.9	101.9			60.1	79.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Delay	55.6	19.4	1.1	53.5	88.3	1.6	129.9	101.9			60.1	79.6
LOS	E	B	A	D	F	A	F	F			E	E
Approach Delay		17.4			86.2			116.1			75.4	
Approach LOS		B			F			F			E	
Queue Length 50th (ft)	27	381	0	66	~1044	0	~125	104			42	120
Queue Length 95th (ft)	62	470	21	m87	#1187	m1	#266	#240			86	#212
Internal Link Dist (ft)		1574			2274			1652			2988	
Turn Bay Length (ft)	225		300	450		320	630					200

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	124	2013	1171	170	2106	1114	153	163			135	237
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	0.31	0.74	0.23	0.59	1.14	0.02	1.03	0.94			0.45	0.93

Intersection Summary

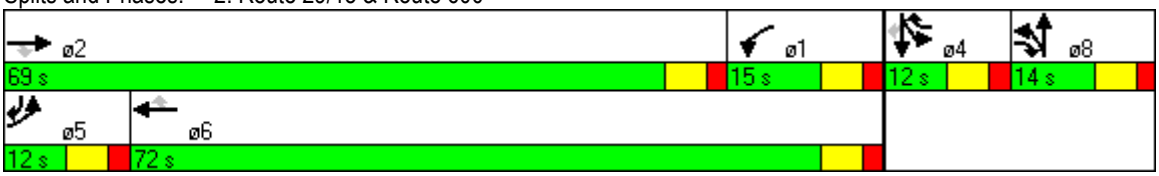
Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 78 (71%), Referenced to phase 2:EBT, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.14
Intersection Signal Delay: 62.3 Intersection LOS: E
Intersection Capacity Utilization 90.0% ICU Level of Service E
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Route 29/15 & Route 600



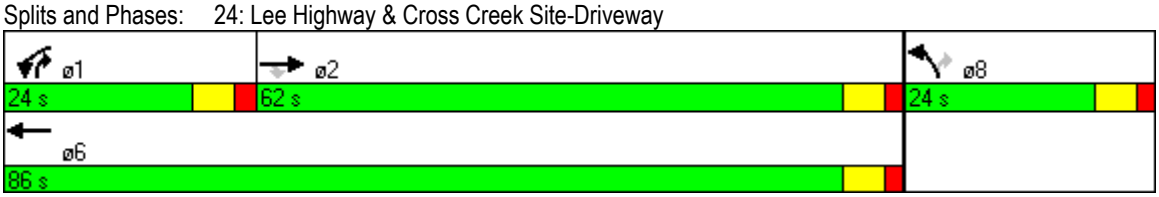
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1002	389	350	1889	384	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Grade (%)	0%			0%	0%	
Storage Length (ft)		200	400		400	0
Storage Lanes		1	2		1	1
Taper Length (ft)		25	25		25	25
Lane Util. Factor	0.95	1.00	0.97	0.95	0.97	1.00
Ped Bike Factor						
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3406	1583	3433	3406	3433	1583
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	3406	1583	3433	3406	3433	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		432				65
Link Speed (mph)	55			55	30	
Link Distance (ft)	2354			433	1721	
Travel Time (s)	29.2			5.4	39.1	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	2%	2%	6%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	1113	432	389	2099	427	383
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1113	432	389	2099	427	383
Turn Type		Perm	Prot			pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases		2				8
Total Split (s)	62.0	62.0	24.0	86.0	24.0	24.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	60.3	60.3	18.8	83.0	19.0	41.7
Actuated g/C Ratio	0.55	0.55	0.17	0.75	0.17	0.38
v/c Ratio	0.60	0.41	0.66	0.82	0.72	0.60
Control Delay	3.9	0.8	48.5	12.3	50.6	26.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	3.9	0.8	48.5	12.3	50.6	26.7
LOS	A	A	D	B	D	C
Approach Delay	3.0			18.0	39.3	
Approach LOS	A			B	D	
Queue Length 50th (ft)	29	0	131	440	146	172
Queue Length 95th (ft)	m34	m0	183	553	201	270
Internal Link Dist (ft)	2274			353	1641	
Turn Bay Length (ft)		200	400		400	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Base Capacity (vph)	1866	1063	624	2571	624	658
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.41	0.62	0.82	0.68	0.58

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.82	
Intersection Signal Delay: 16.8	Intersection LOS: B
Intersection Capacity Utilization 69.8%	ICU Level of Service C
Analysis Period (min) 15	

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 24: Lee Highway & Cross Creek Site-Driveway



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	1397	243	91	2206	19	218	22	40	8	47	198
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	225		300	300		320	0		630	0		200
Storage Lanes	1		1	1		1	0		1	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950				0.956			0.993	
Satd. Flow (prot)	1703	3406	1524	1703	3406	1524	0	1781	1583	0	1850	1583
Flt Permitted	0.950			0.950				0.956			0.993	
Satd. Flow (perm)	1703	3406	1524	1703	3406	1524	0	1781	1583	0	1850	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			270			21			44			14
Link Speed (mph)		55			55			45			45	
Link Distance (ft)		1654			2354			1732			3068	
Travel Time (s)		20.5			29.2			26.2			46.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	6%	6%	6%	6%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	39	1552	270	101	2451	21	242	24	44	9	52	220
Shared Lane Traffic (%)												
Lane Group Flow (vph)	39	1552	270	101	2451	21	0	266	44	0	61	220
Turn Type	Prot		pm+ov	Prot		pm+ov	Split		Perm	Split		pm+ov
Protected Phases	5	2	8	1	6	4	8	8		4	4	5
Permitted Phases			2			6			8			4
Total Split (s)	12.0	68.0	17.0	13.0	69.0	12.0	17.0	17.0	17.0	12.0	12.0	12.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0
Act Effct Green (s)	8.0	64.0	77.0	9.0	65.0	73.0		13.0	11.0		8.0	20.0
Actuated g/C Ratio	0.07	0.58	0.70	0.08	0.59	0.66		0.12	0.10		0.07	0.18
v/c Ratio	0.31	0.78	0.24	0.73	1.22	0.02		1.27	0.22		0.45	0.74
Control Delay	55.6	21.3	0.8	64.4	125.3	1.5		192.6	16.6		60.1	55.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	55.6	21.3	0.8	64.4	125.3	1.5		192.6	16.6		60.1	55.6
LOS	E	C	A	E	F	A		F	B		E	E
Approach Delay		19.0			121.9			167.6			56.6	
Approach LOS		B			F			F			E	
Queue Length 50th (ft)	27	417	0	69	~1114	1		~237	0		42	139
Queue Length 95th (ft)	62	514	9	m89	#1263	m1		#400	34		86	#249
Internal Link Dist (ft)		1574			2274			1652			2988	
Turn Bay Length (ft)	225		300	300		320			630			200

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	124	1982	1148	139	2013	1018		210	198		135	299
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	0.31	0.78	0.24	0.73	1.22	0.02		1.27	0.22		0.45	0.74

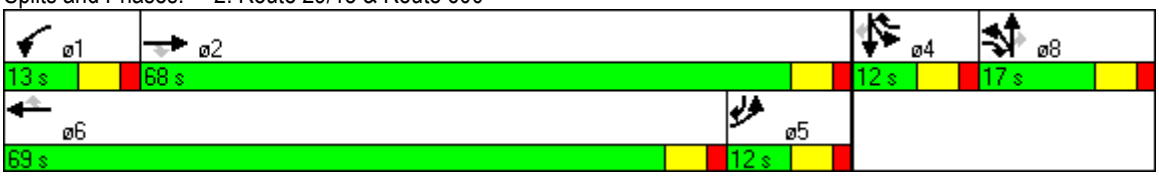
Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 70 (64%), Referenced to phase 2:EBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.27	
Intersection Signal Delay: 83.0	Intersection LOS: F
Intersection Capacity Utilization 96.5%	ICU Level of Service F
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

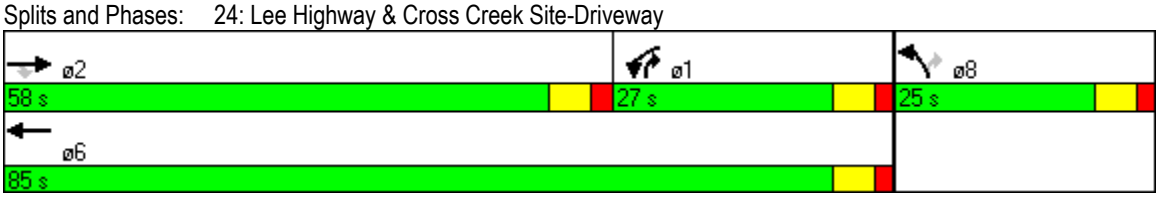
Splits and Phases: 2: Route 29/15 & Route 600



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	996	444	398	1883	428	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Grade (%)	0%			0%	0%	
Storage Length (ft)		200	400		400	0
Storage Lanes		1	2		1	1
Taper Length (ft)		25	25		25	25
Lane Util. Factor	0.95	1.00	0.97	0.95	0.97	1.00
Ped Bike Factor						
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3406	1583	3433	3406	3433	1583
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	3406	1583	3433	3406	3433	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		489				53
Link Speed (mph)	55			55	30	
Link Distance (ft)	2354			433	1721	
Travel Time (s)	29.2			5.4	39.1	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	2%	2%	6%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	1107	493	442	2092	476	428
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1107	493	442	2092	476	428
Turn Type		Perm	Prot			pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases		2				8
Total Split (s)	58.0	58.0	27.0	85.0	25.0	27.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	55.6	55.6	22.3	81.9	20.1	46.4
Actuated g/C Ratio	0.51	0.51	0.20	0.74	0.18	0.42
v/c Ratio	0.64	0.47	0.63	0.83	0.76	0.61
Control Delay	5.5	1.2	44.6	13.2	51.2	25.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.5	1.2	44.6	13.2	51.2	25.6
LOS	A	A	D	B	D	C
Approach Delay	4.2			18.7	39.1	
Approach LOS	A			B	D	
Queue Length 50th (ft)	57	0	146	456	164	198
Queue Length 95th (ft)	80	m0	200	573	221	305
Internal Link Dist (ft)	2274			353	1641	
Turn Bay Length (ft)		200	400		400	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Base Capacity (vph)	1720	1042	718	2535	655	698
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.47	0.62	0.83	0.73	0.61

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 104 (95%), Referenced to phase 2:EBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.83	
Intersection Signal Delay: 17.8	Intersection LOS: B
Intersection Capacity Utilization 70.9%	ICU Level of Service C
Analysis Period (min) 15	

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 24: Lee Highway & Cross Creek Site-Driveway