TRAFFIC IMPACT ASSESSMENT

for a

Hannaford Supermarket

Lot 15 - Commerce Park
Hinesburg, Vermont

APPENDICES

July 20, 2011

LAMOUREUX & DICKINSON
14 Morse Drive
Essex Junction, Vermont 05452
(802) 878-4450
Consulting Engineers, Inc.

Appendix A
DHV Calculations

LAMOUREUX & DICKINSON
Consulting Engineers, Inc.
14 Morse Drive
Essex Junction, VT 05452
Tel: (802) 878-4450 / Fax: (802) 878-3135
Email: LDengineering.com

Project: HINESBURG HANNAFORD
Project No. 10024 Sheet No. 1 of
Calculated by RD Date 2-01-11
Checked by Date
Scale

VTRANS 2010 RED BOOK (2009 DATA)
RURAL PRIMARY & SECONDARY GROWTH RATES
2010 → 2012 = 1.01
2010 → 2017 = 1.03

SEGMENT	AADT 2010	AADT 2012	AADT 2017
CVU - COMMERCE	9,400	9,500	9,700
COMMERCE - MECHANICSVILLE	9,400	9,500	9,700
MECHANICSVILLE - CHARLOTTE	11,800	11,900	12,200
CHARLOTTE - SILVER	10,300	10,400	10,600
CVU → NORTH	9,200	9,300	9,500

CALCULATE DHV'S

VTRANS 2010 RED BOOK
RURAL NON-INTERSTATE - USE LOWER OF:
EQUATION DHV = 0.1084 × AADT + 30
OR
K-FACTOR 0.1127

SEGMENT	2012 DHV	2017 DHV
CVU - COMMERCE	1,060	1,080
COMMERCE - MECH.	1,060	1,080
MECH. - CHARLOTTE	1,320	1,350
CHARLOTTE - SILVER	1,160	1,180
CVU → NORTH	1,040	1,060

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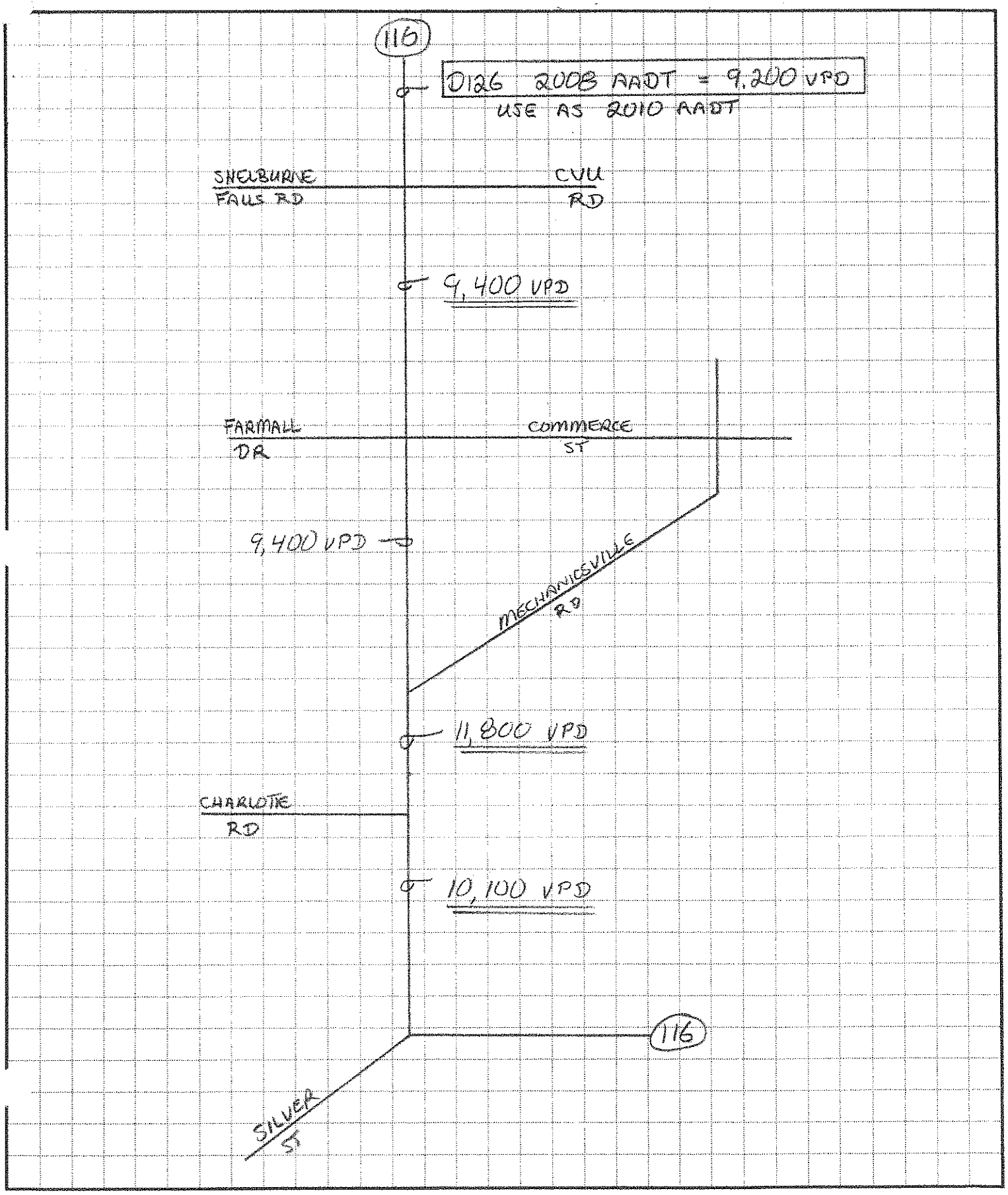

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AADT CALCULATIONS

CVU / SHELBURNE FALLS RD.

	AADT	Σ 12 HR
NORTH APPROACH	9,200	8,549
SOUTH APPROACH	?	8,696

SOURCE: D126 2008 AJR - $\boxed{\text{USE AS 2010 AADT}}$
VTRANS 4/29 & 30/09 TMC

SOUTH APPROACH AADT = 9,200 × (8,696/8,549)
= 9,400 VPD

COMMERCE ST. / FARMALL DR

	AADT	Σ 12 HR
NORTH APPROACH	9,400	9,144
SOUTH APPROACH	?	9,123

SOURCE: CCMPO 6/02/10 TMC

SOUTH APPROACH AADT = 9,400 × (9,123/9,144)
= 9,400 VPD

MECHANICSVILLE RD

	AADT	Σ 12 HR
NORTH APPROACH	9,400	8,859
SOUTH APPROACH	?	11,084

SOURCE: CCMPO 6/03/10 TMC

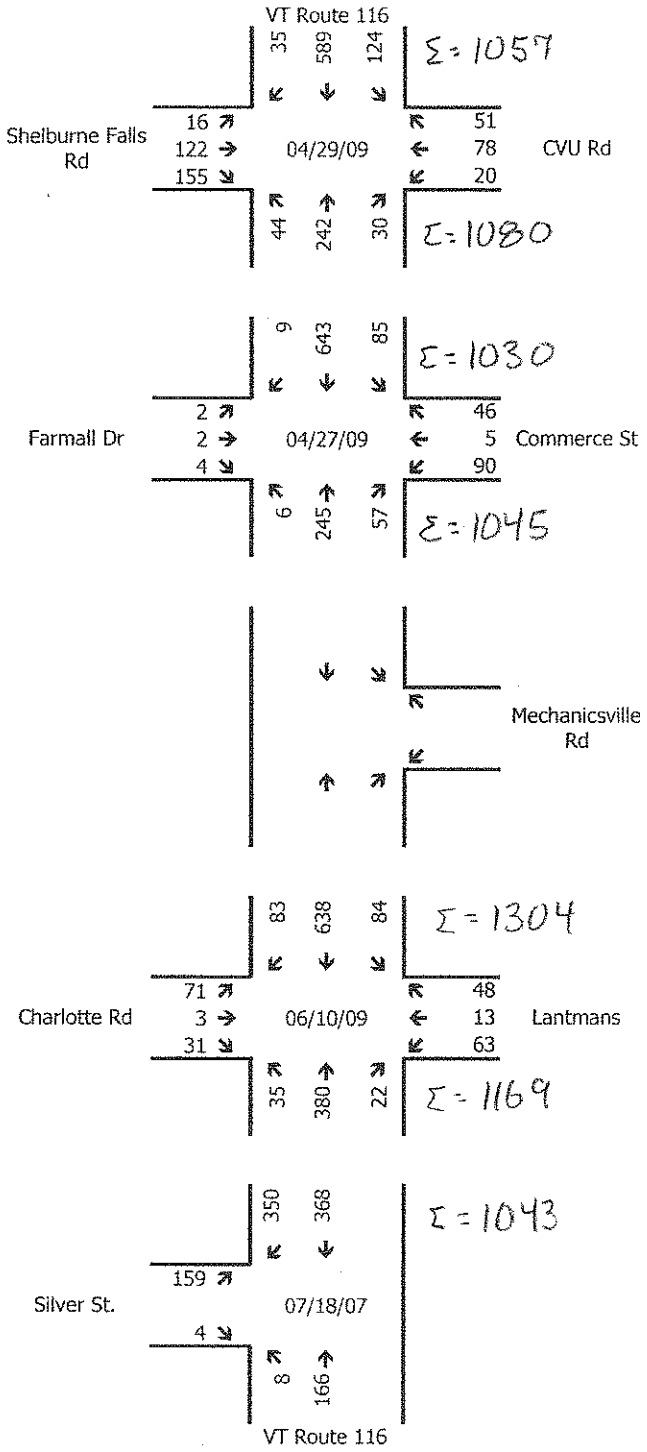
SOUTH APPROACH AADT = 9,400 × (11,084/8,859)
= 11,800 VPD

CHARLOTTE RD

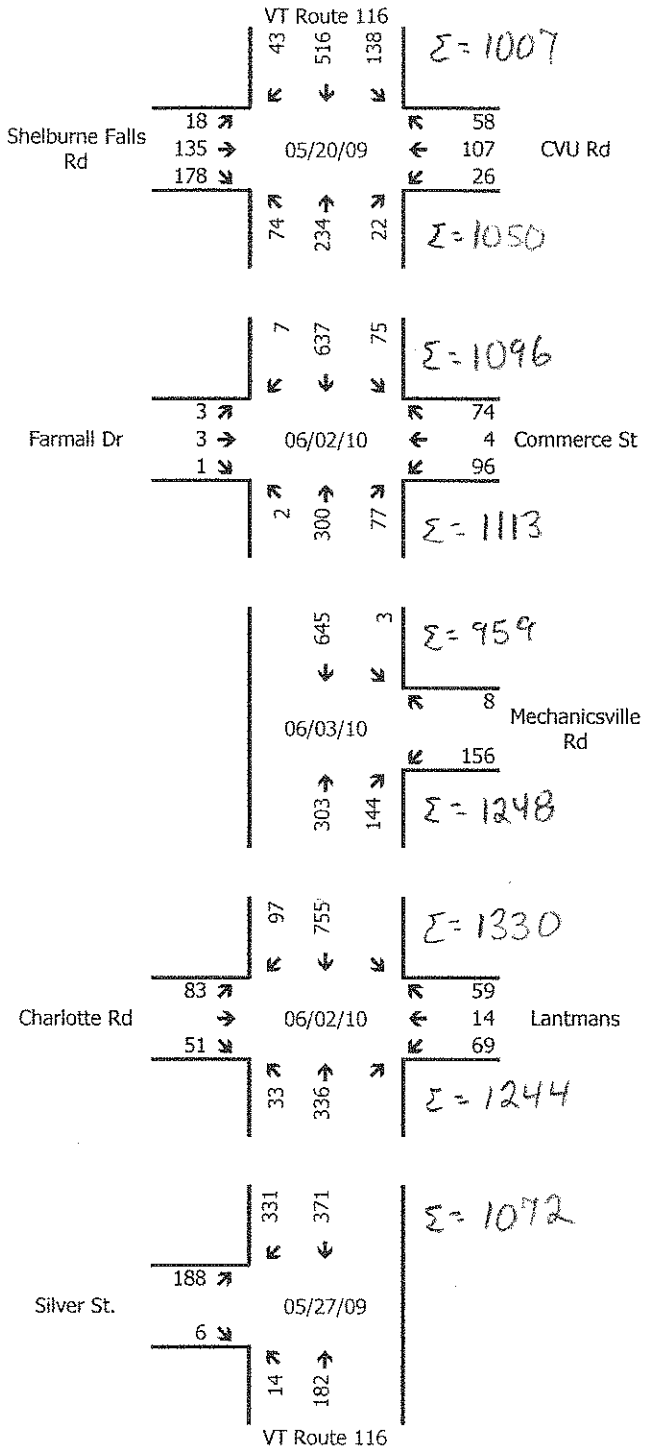
	AADT	Σ 12 HR
NORTH APPROACH	11,800	11,399
SOUTH APPROACH	?	10,199 - 465 + 205 = 9,939

SOURCE: CCMPO 6/02/10 TMC
VTRANS 6/10/09 TMC

SOUTH APPROACH AADT = 11,800 × (9,939/11,399)
= 10,300 VPD



VTrans Counts



CCMPO Counts

PM PEAK HOUR

LAMOUREUX & DICKINSON
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Project
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DHV ADJUSTMENT FACTORS

SHELBURNE FALLS / CVU RD

CCMPO 5/20/09 TMC

	2012	2017
NORTH APPR.	1,040/1007	1060/1007
	1.033	1.053

FARMALL / COMMERCE ST

CCMPO 6/02/10 TMC

	2012	2017
NORTH APPR.	1060/1096	1080/1096
	0.967	0.985

MECHANICSVILLE RD

CCMPO 6/03/10 TMC

	2012	2017
SOUTH APPR.	1320/1248	1350/1248
	1.058	1.082

CHARLOTTE RD

CCMPO 6/02/10 TMC

	2012	2017
NORTH APPR.	1320/1330	1350/1330
	0.993	1.015

SILVER ST

CCMPO 5/27/09 TMC

	2012	2017
NORTH APPR.	1,160/1072	1180/1072
	1.082	1.101

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Shelburne Falls Rd / CVU Rd

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 05/20/09
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		= 1.000
BASE YEAR	2012	= 1.033
FUT. YEAR	2017	= 1.053

(43)	(516)	(138)
[44]	[533]	[143]
{ 45 }	{ 543 }	{ 145 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

(18)	[19]	{ 19 }
(135)	[139]	{ 142 }
(178)	[184]	{ 187 }

(58)	[60]	{ 61 }
(107)	[111]	{ 113 }
(26)	[27]	{ 27 }

NORTH

(74)	(234)	(22)
[76]	[242]	[23]
{ 78 }	{ 246 }	{ 23 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(555)	(486)	(1007)	(1050)
2012	[573]	[503]	[1041]	[1085]
2017	{ 584 }	{ 511 }	{ 1059 }	{ 1104 }

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Farmall Dr / Commerce St

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 06/02/10
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		=	1.000
BASE YEAR	2012	=	0.967
FUT. YEAR	2017	=	0.985

(7)	(637)	(75)
[7]	[616]	[73]
{ 7 }	{ 627 }	{ 74 }

KEY

( ) OBSERVED PEAK HOUR VOLUME
[ ] 2012 DHV
{ } 2017 DHV

(3)	[3]	{ 3 }
(3)	[3]	{ 3 }
(1)	[1]	{ 1 }

(74)	[72]	{ 73 }
(4)	[4]	{ 4 }
(96)	[93]	{ 95 }

NORTH

(2)	(300)	(77)
[2]	[290]	[74]
{ 2 }	{ 296 }	{ 76 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(20)	(329)	(1096)	(1113)
2012	[20]	[319]	[1061]	[1076]
2017	{ 20 }	{ 325 }	{ 1080 }	{ 1097 }

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Mechanicsville Rd

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 06/03/10
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		= 1.000
BASE YEAR	2012	= 1.058
FUT. YEAR	2017	= 1.082

( )	(645)	(3)
[0]	[682]	[3]
{ 0 }	{ 698 }	{ 3 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

( )	[0]	{ 0 }
( )	[0]	{ 0 }
( )	[0]	{ 0 }

(8)	[8]	{ 9 }
( )	[0]	{ 0 }
(156)	[165]	{ 169 }

NORTH

( )	(303)	(144)
[0]	[321]	[152]
{ 0 }	{ 328 }	{ 156 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(0)	(311)	(959)	(1248)
2012	[0]	[328]	[1014]	[1320]
2017	{ 0 }	{ 337 }	{ 1038 }	{ 1351 }

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Charlotte Rd

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 06/02/10
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		= 1.000
BASE YEAR	2012	= 0.993
FUT. YEAR	2017	= 1.015

(97)	(671)	(84)
[96]	[666]	[83]
{ 98 }	{ 681 }	{ 85 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

(83)	[82]	{ 84 }
( )	[0]	{ 0 }
(51)	[51]	{ 52 }

(59)	[59]	{ 60 }
(14)	[14]	{ 14 }
(69)	[69]	{ 70 }

NORTH

(33)	(336)	(22)
[33]	[334]	[22]
{ 33 }	{ 341 }	{ 22 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(278)	(248)	(1330)	(1182)
2012	[276]	[247]	[1320]	[1175]
2017	{ 281 }	{ 251 }	{ 1349 }	{ 1199 }

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Silver St

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 05/27/09
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		=	1.000
BASE YEAR	2012	=	1.082
FUT. YEAR	2017	=	1.101

(331)	(371)	( )
[358]	[401]	[0]
{ 364 }	{ 408 }	{ 0 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

(188)	[203]	{ 207 }
( )	[0]	{ 0 }
(6)	[6]	{ 7 }

( )	[0]	{ 0 }
( )	[0]	{ 0 }
( )	[0]	{ 0 }

(14)	(182)	( )
[15]	[197]	[0]
{ 15 }	{ 200 }	{ 0 }

NORTH

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(539)	(0)	(1072)	(573)
2012	[582]	[0]	[1159]	[619]
2017	{ 593 }	{ 0 }	{ 1179 }	{ 630 }

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Project: [illegible]
Project No. 10024 Sheet No. 11 of
Calculated by RD Date 2-01-11
Checked by Date
Scale

MECHANICSVILLE RD / COMMERCE ST

2008 AADT = 2,600 VPD (BTWN VT 116 & COMMERCE ST)
SOURCE: CCMPO HBRG 11

2012 AADT = 2,600 × 1.01 = 2630 VPD
DHV = 2630 × 0.1127 = 296 VPH
(2630 × 0.1084) + 30 = 315 VPH

2017 AADT = 2,600 × 1.03 = 2,680 VPD
DHV = 2680 × 0.1127 = 302 VPH
(2680 × 0.1084) + 30 = 320 VPH

USE RAW COUNT AS 2010 DHV &
APPLY GROWTH FACTORS:
2010 → 2012 = 1.01
2010 → 2017 = 1.03

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: Mechanicsville Rd/Commerce St

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 06/03/10
AM/PM?: PM

ENTER DHV ADJ. FACTORS:

DHV		=	1.000
BASE YEAR	2012	=	1.010
FUT. YEAR	2017	=	1.030

(57)	(147)	(0)
[58]	[148]	[0]
{ 59 }	{ 151 }	{ 0 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

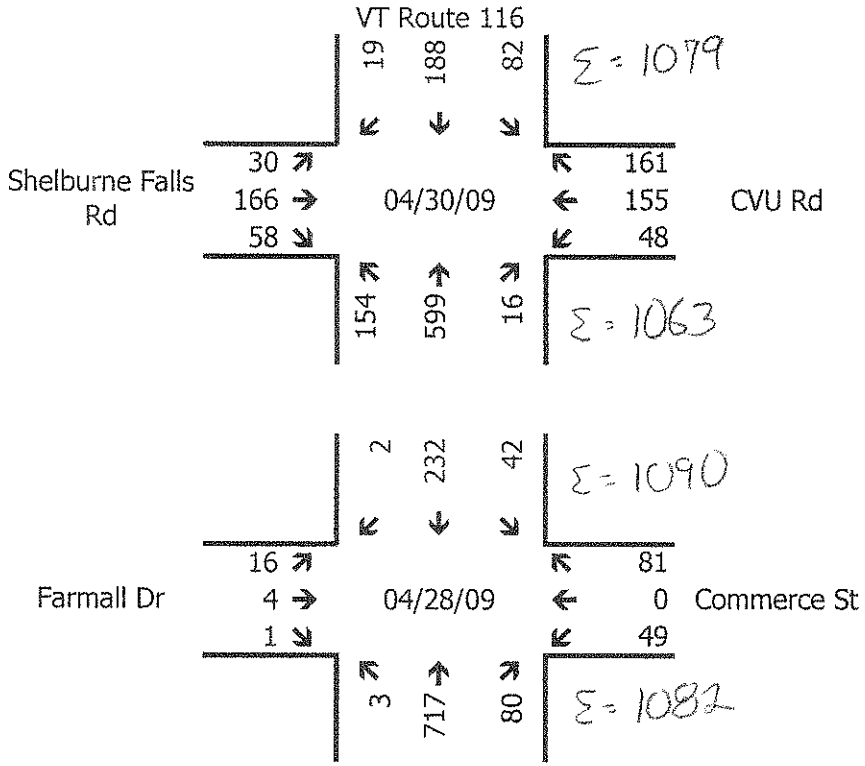
(94)	[95]	{ 97 }	(4)	[4]	{ 4 }
(7)	[7]	{ 7 }	(13)	[13]	{ 13 }
(18)	[18]	{ 19 }	(12)	[12]	{ 12 }

NORTH

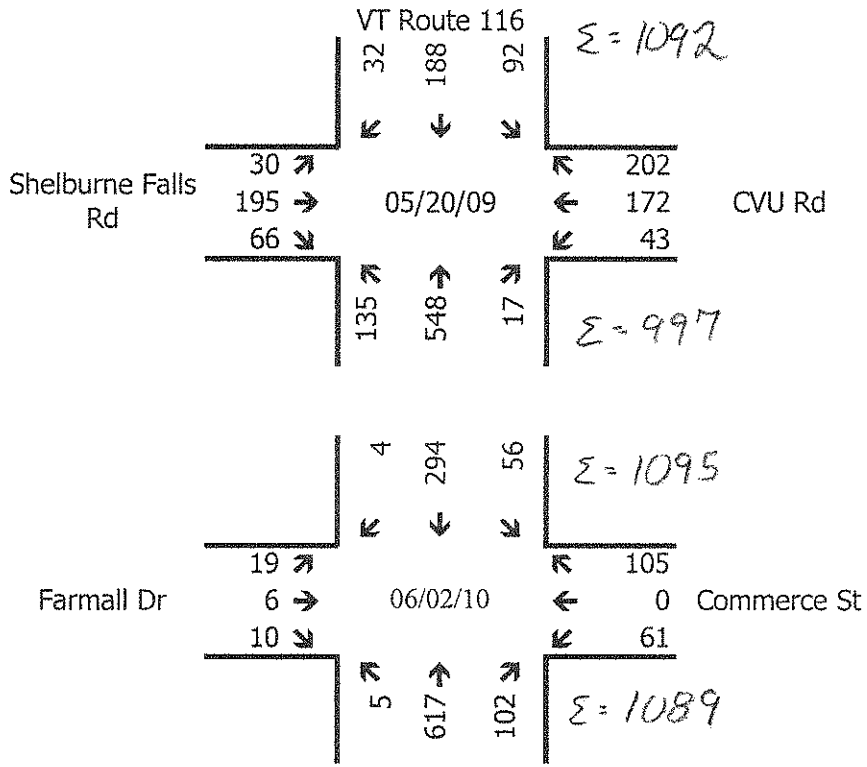
(15)	(138)	(4)
[15]	[139]	[4]
{ 15 }	{ 142 }	{ 4 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(204)	(40)	(440)	(334)
2012	[206]	[40]	[444]	[336]
2017	{ 210 }	{ 40 }	{ 453 }	{ 343 }



VTrans Counts



CCMPO Counts

AM PEAK HOUR

CVU Rd

2012 DHV

1040/1092 = 0.952

2017 DHV

1060/1092 = 0.971

Commerce St.

2012 DHV

1060/1095 = 0.968

2017 DHV

1080/1095 = 0.986

P:\2010\10024\turnfig.qpw,02/01/11

RD
2-03-11

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Shelburne Falls Rd / CVU Rd

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 05/20/09
AM/PM?: AM

ENTER DHV ADJ. FACTORS:

DHV		=	1.000
BASE YEAR	2012	=	0.952
FUT. YEAR	2017	=	0.971

(32)	(188)	(92)
[30]	[179]	[88]
{ 31 }	{ 183 }	{ 89 }

KEY

( ) OBSERVED PEAK HOUR VOLUME
[ ] 2012 DHV
{ } 2017 DHV

(30)	[29]	{ 29 }	↗	↖	(202)	[192] { 196 }
(195)	[186]	{ 189 }	→	←	(172)	[164] { 167 }
(66)	[63]	{ 64 }	↘	↙	(43)	[41] { 42 }

NORTH

↖	↑	↗
(135)	(548)	(17)
[129]	[522]	[16]
{ 131 }	{ 532 }	{ 17 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(630)	(721)	(1092)	(997)
2012	[601]	[687]	[1040]	[950]
2017	{ 611 }	{ 700 }	{ 1060 }	{ 969 }

LAMOUREUX & DICKINSON CONSULTING ENGINEERS, INC.
INTERSECTION TURNING MOVEMENT DHV CALCULATIONS

PROJECT / TOWN: Hannaford / Hinesburg
PROJECT #: 10024
INTERSECTION: VT 116 / Farmall Dr / Commerce St

BY: R. Dickinson
CHECKED:

COUNT DAY/DATE: CCMPO 06/02/10
AM/PM?: AM

ENTER DHV ADJ. FACTORS:

DHV		= 1.000
BASE YEAR	2012	= 0.968
FUT. YEAR	2017	= 0.986

(4)	(294)	(56)
[4]	[285]	[54]
{ 4 }	{ 290 }	{ 55 }

KEY

( )	OBSERVED PEAK HOUR VOLUME
[ ]	2012 DHV
{ }	2017 DHV

(19)	[18]	{ 19 }
(6)	[6]	{ 6 }
(10)	[10]	{ 10 }

(105)	[102]	{ 104 }
(0)	[0]	{ 0 }
(61)	[59]	{ 60 }

NORTH

(5)	(617)	(102)
[5]	[597]	[99]
{ 5 }	{ 608 }	{ 101 }

TOTAL APPROACH VOLUMES:

YEAR	WEST	EAST	NORTH	SOUTH
COUNT	(44)	(330)	(1095)	(1089)
2012	[43]	[320]	[1060]	[1055]
2017	{ 44 }	{ 326 }	{ 1080 }	{ 1074 }

Appendix B
Project Trip Generation & Distribution Calculations

Consulting Engineers, Inc.
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Email: LDengineering.com

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TRIP GENERATION & DISTRIBUTION CALCULATIONS
SOURCE: ITE TRIP GENERATION, 8th ED. LUC #850

PM PEAK HOUR
(SEE PG 2)

ENTER 197
EXIT 189
386 VTE/HR

AVG. RATE IS USED INSTEAD OF EQUATION DUE TO EQUATION $R^2 < 0.75$
(ITE TRIP GENERATION HANDBOOK, 2nd ED.)

PRIMARY TRIPS
64% FROM TABLE 5.10 ITE TRIP GENERATION HANDBOOK, LUC #850

ENTER 197 × 0.64 = 126
EXIT 189 × 0.64 = 121
247 VTE/HR

TO/FROM	PERCENT	# TRIPS ENTER	# TRIPS EXIT
VT 116N	6%	8	7
VT 116S	24%	30	29
SILVER ST.	12%	15	14
MECHANICSVILLE RD	18%	23	22
CHARLOTTE RD	22%	28	27
SHELBURNE FALLS RD	12%	15	15
HINESBURG VILLAGE	6%	7	7
		126	121

PASS-BY TRIPS
36% FROM TABLE 5.10

ENTER 197 × 0.36 = 71
EXIT 189 × 0.36 = 68
139 VTE/HR

(2)

Supermarket
(850)

Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

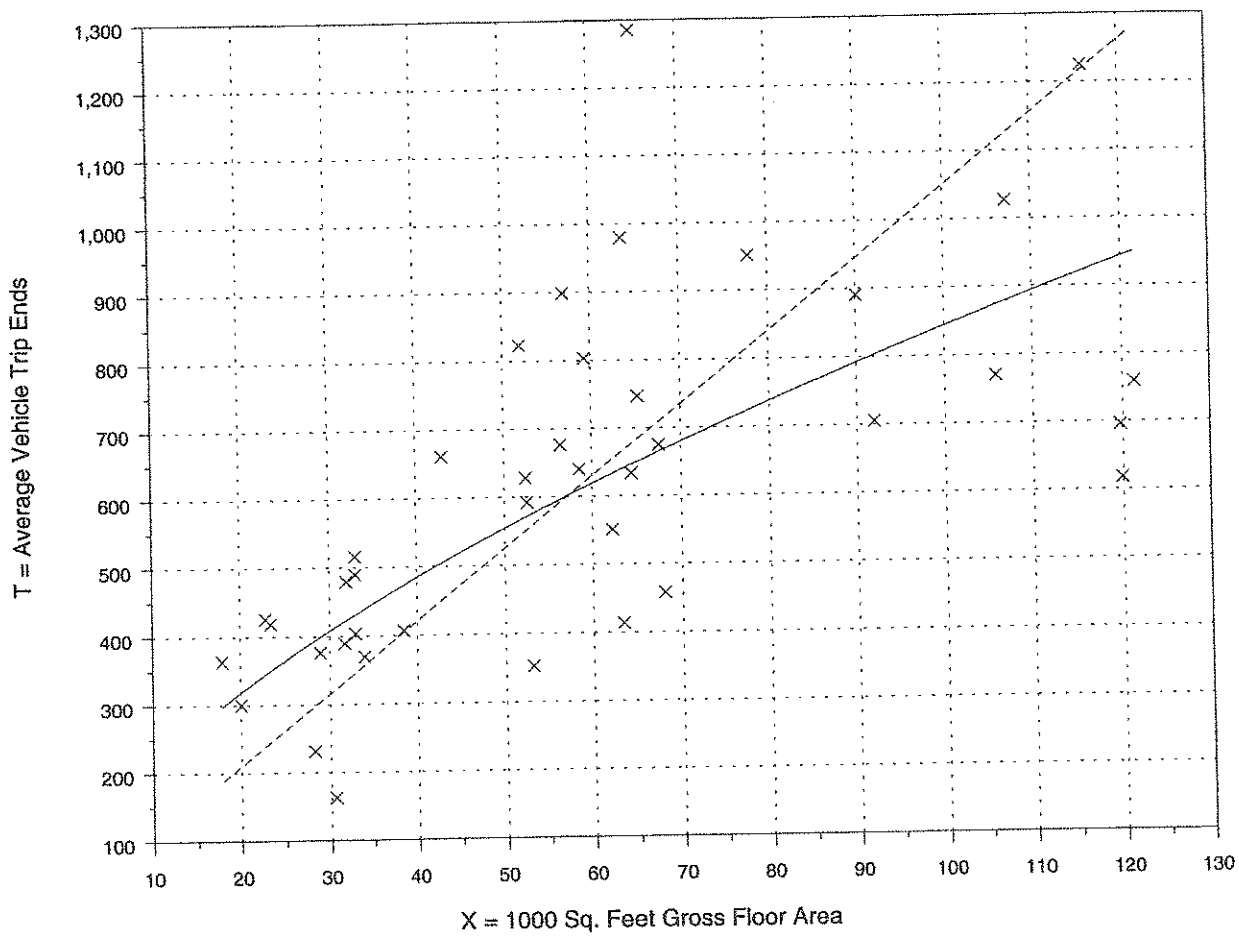
Number of Studies: 40
Average 1000 Sq. Feet GFA: 59
Directional Distribution: 51% entering, 49% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
10.50	5.15 - 20.29	4.97

10.50 x 36.783 = 386 VTE/HR (197 IN, 189 OUT)

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.61 Ln(X) + 3.95

X = 36.783
T = 468 VTE/HR

R^2 = 0.52 <0.75

USE AVG. RATE

2-17-11
RD

Consulting Engineers, Inc.
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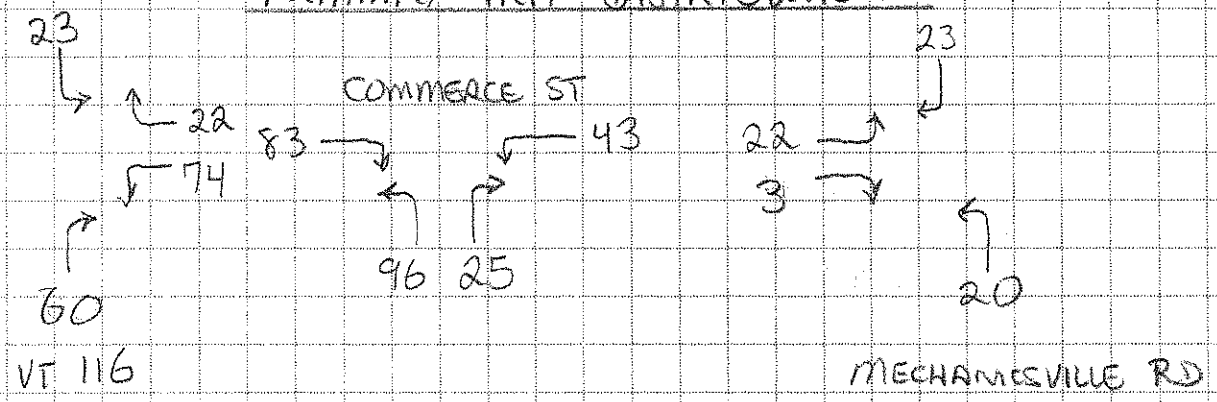
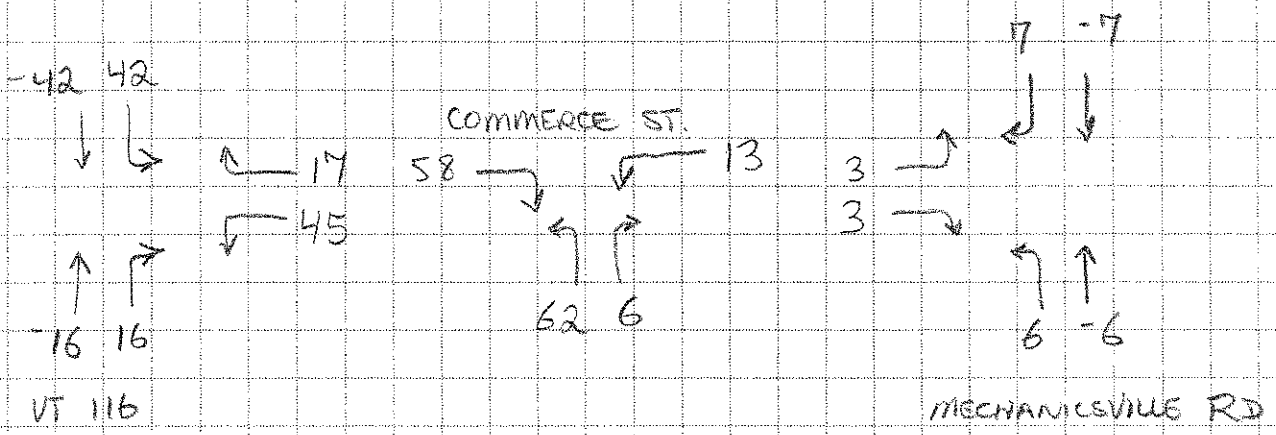
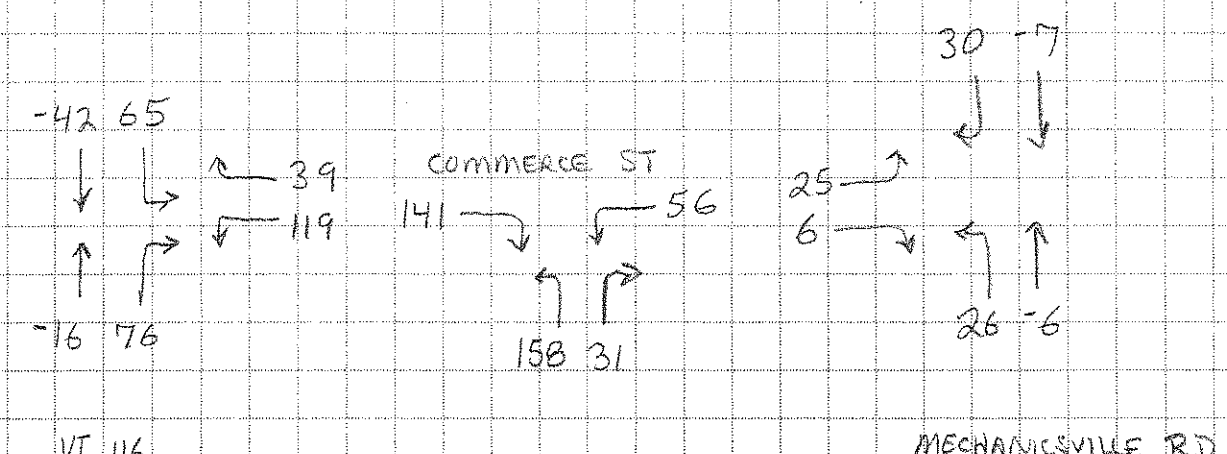
PRIMARY TRIP DISTRIBUTION



PASS-BY TRIP DISTRIBUTION



TOTALS



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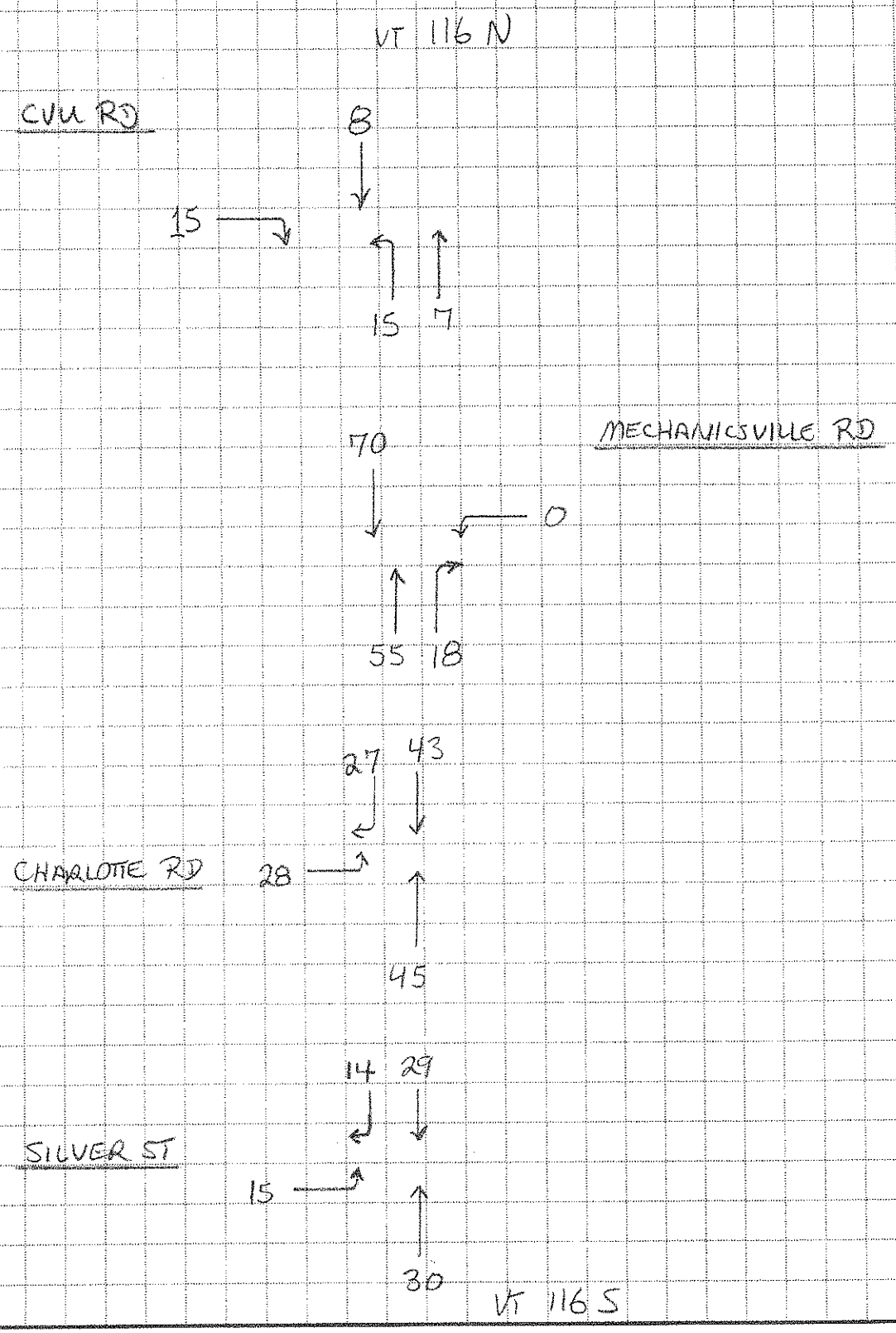
PRIMARY TRIP DISTRIBUTION (CONT.)



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Scale

AM PEAK HOUR TRIP GENERATION & DISTRIBUTION CALCULATIONS

AM PEAK HOUR (SEE PG 6)

ENTER	81
EXIT	51
	132 VTE/HR

PRIMARY TRIPS

USE 64% FROM PM PEAK HOUR

TO/FROM	PERCENT	# TRIPS ENTER	# TRIPS EXIT
VT 116N	18%	9	6
VT 116S	64%	33	21
MECH'VILLE RD	18%	9	6
		51	33

Σ = 84 VTE/HR

PASS-BY TRIPS

USE 36% FROM PM PEAK HOUR
(CONSERVATIVE - ACTUAL AM PEAK HOUR EXPECTED TO BE GREATER)

ENTER	30
EXIT	18
	48 VTE/HR

Supermarket
(850)

Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 5
Average 1000 Sq. Feet GFA: 30
Directional Distribution: 61% entering, 39% exiting

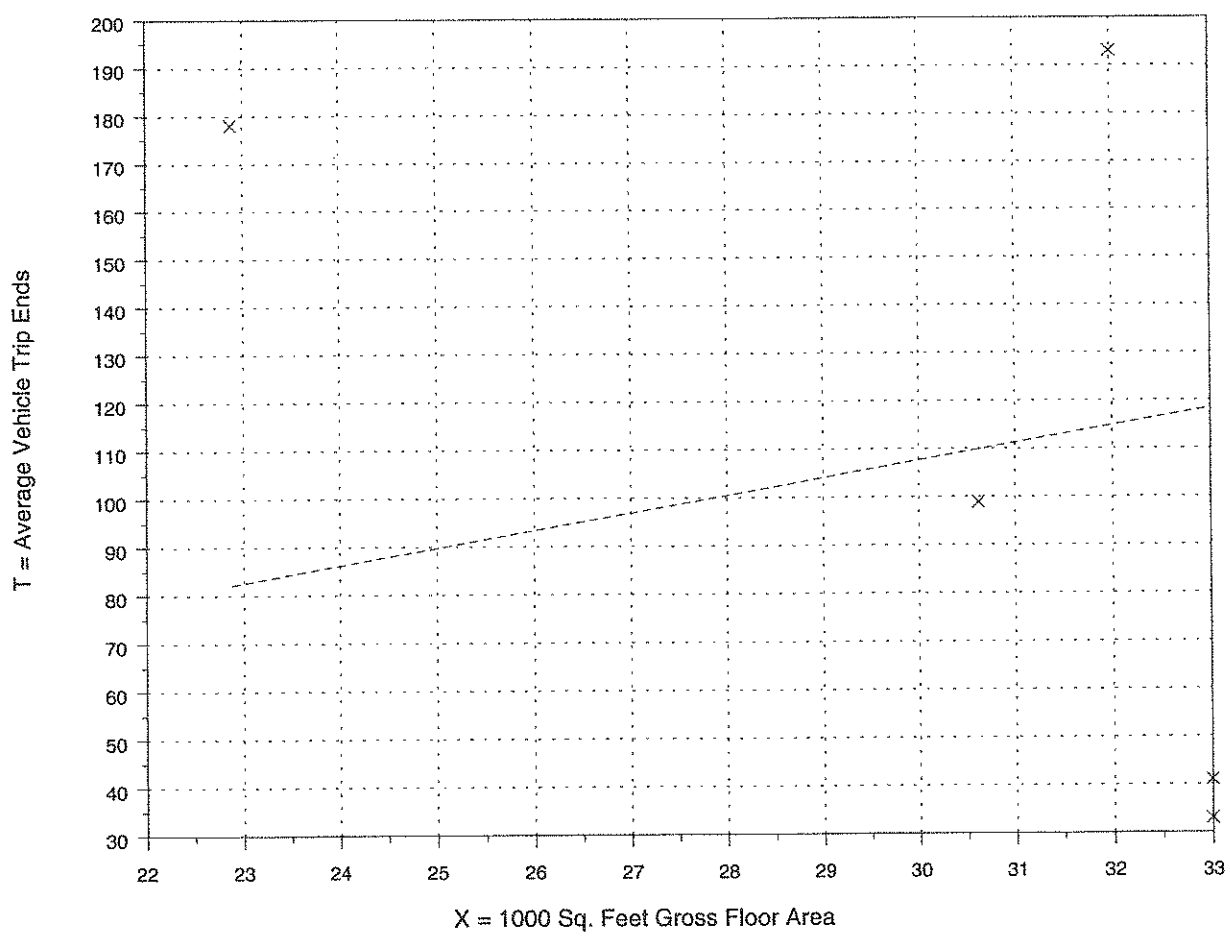
Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
3.59	1.00 - 7.78	3.18

3.59 × 36.783 KSF = 132 VTE/HR (81 IN, 51 OUT)

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× **Actual Data Points**

------ **Average Rate**

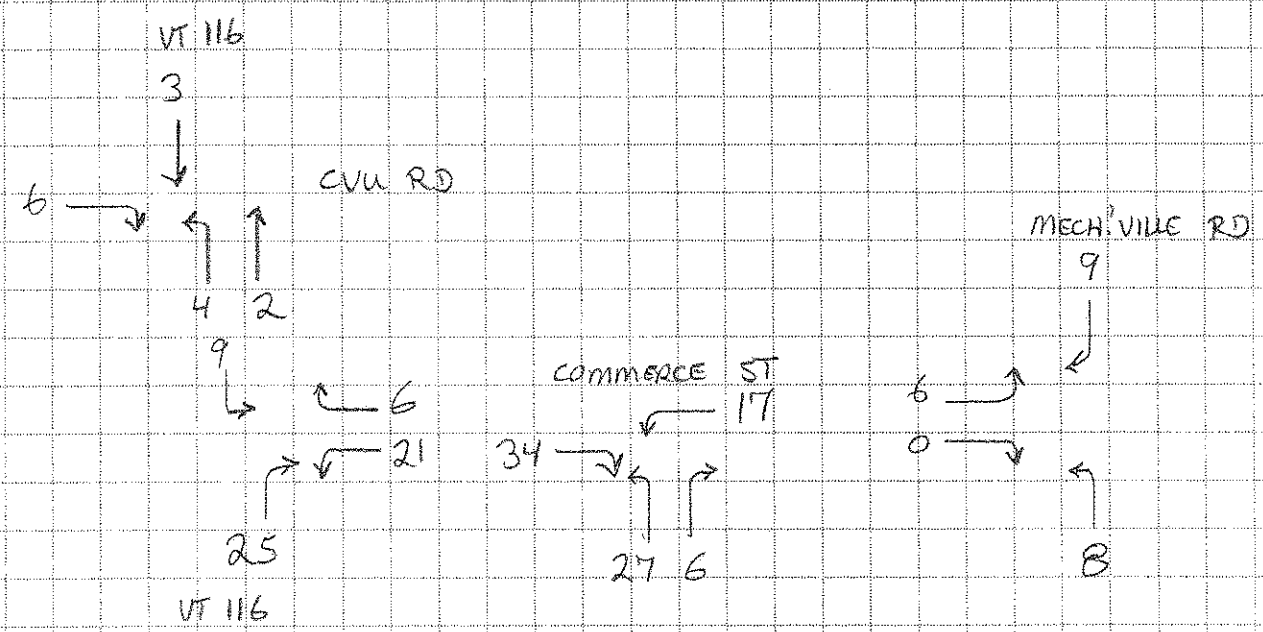
Fitted Curve Equation: Not given

R^2 = ****

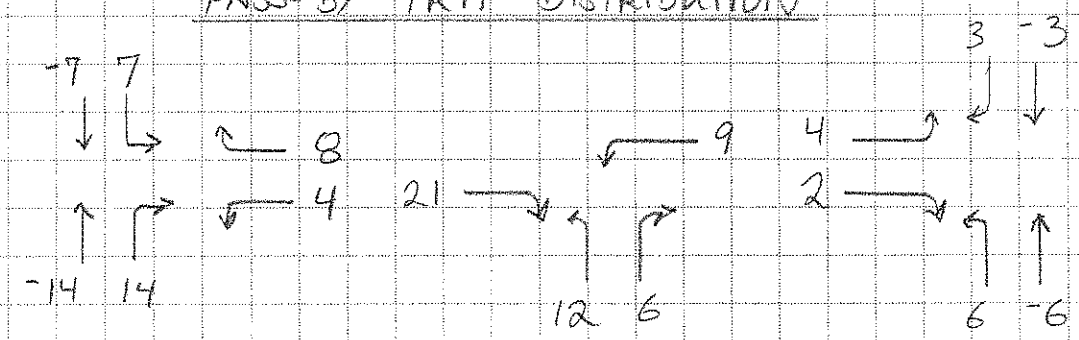
Consulting Engineers, Inc.
14 Morse Drive
Essex Junction, VT 05452
Tel: (802) 878-4450 / Fax: (802) 878-3135
Email: LDengineering.com

Project No. 10024 Sheet No. 1 of
Calculated by R. DICKINSON Date 2-25-11
Checked by Date
Scale

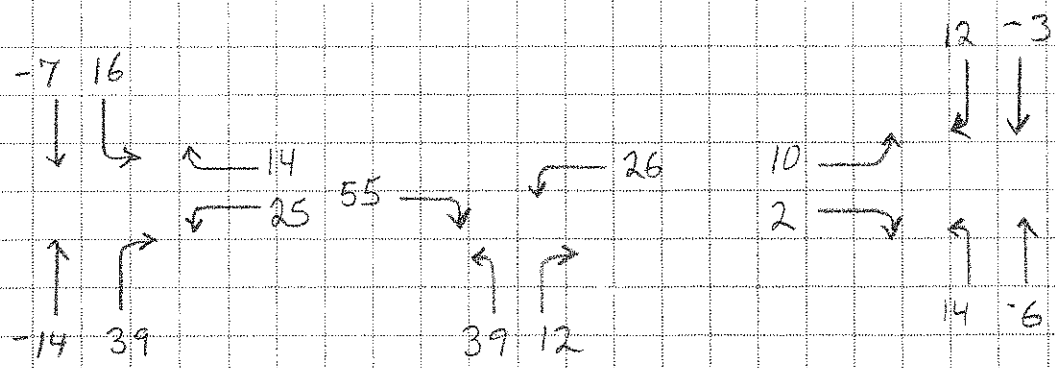
AM PEAK HOUR
PRIMARY TRIP DISTRIBUTION



PASS-BY TRIP DISTRIBUTION



TOTAL



Appendix C
VT Route 116 & CVU Rd
Capacity Analyses

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		2%			-2%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.92			0.96			0.99			0.99	
Flt Protected		1.00			0.99			0.99			0.99	
Satd. Flow (prot)		1696			1794			1787			1781	
Flt Permitted		0.96			0.85			0.71			0.85	
Satd. Flow (perm)		1634			1535			1294			1527	
Volume (vph)	39	146	239	27	117	61	112	246	23	145	523	83
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	39	146	239	27	117	61	112	246	23	145	523	83
RTOR Reduction (vph)	0	80	0	0	26	0	0	4	0	0	7	0
Lane Group Flow (vph)	0	344	0	0	179	0	0	377	0	0	744	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		13.7			13.7			34.3			34.3	
Effective Green, g (s)		15.7			15.7			36.3			36.3	
Actuated g/C Ratio		0.26			0.26			0.60			0.60	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		2.0			2.0			2.0			2.0	
Lane Grp Cap (vph)		428			402			783			924	
v/s Ratio Prot												
v/s Ratio Perm		c0.21			0.12			0.29			c0.49	
v/c Ratio		0.80			0.45			0.48			0.81	
Uniform Delay, d1		20.7			18.5			6.6			9.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		10.7			0.3			2.1			7.9	
Delay (s)		31.5			18.8			8.7			17.0	
Level of Service		C			B			A			B	
Approach Delay (s)		31.5			18.8			8.7			17.0	
Approach LOS		C			B			A			B	

Intersection Summary

HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	84.4%	ICU Level of Service	E
Analysis Period (min)	60		

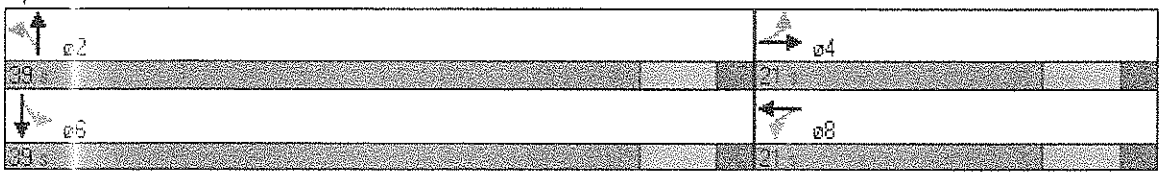
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	39	146	27	117	112	246	145	523
Lane Group Flow (vph)	0	424	0	205	0	381	0	751
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phases	4	4	8	8	2	2	6	6
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	21.0	21.0	21.0	21.0	39.0	39.0	39.0	39.0
Total Split (%)	35.0%	35.0%	35.0%	35.0%	65.0%	65.0%	65.0%	65.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio		0.84		0.46		0.49		0.80
Control Delay		34.1		18.7		9.6		19.0
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		34.1		18.7		9.6		19.0
Queue Length 50th (ft)		104		49		69		188
Queue Length 95th (ft)		#296		118		160		#507
Internal Link Dist (ft)		677		742		2508		498
Turn Bay Length (ft)								
Base Capacity (vph)		540		475		783		936
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.79		0.43		0.49		0.80

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Shelburne Falls Rd & VT 116



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		2%			-2%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.92			0.96			0.99			0.98	
Flt Protected		1.00			0.99			0.98			0.99	
Satd. Flow (prot)		1694			1794			1786			1781	
Flt Permitted		0.96			0.85			0.69			0.85	
Satd. Flow (perm)		1633			1540			1252			1524	
Volume (vph)	39	146	249	26	117	61	123	239	22	145	518	83
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	39	146	249	26	117	61	123	239	22	145	518	83
RTOR Reduction (vph)	0	83	0	0	27	0	0	4	0	0	7	0
Lane Group Flow (vph)	0	351	0	0	177	0	0	380	0	0	739	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		13.8			13.8			34.2			34.2	
Effective Green, g (s)		15.8			15.8			36.2			36.2	
Actuated g/C Ratio		0.26			0.26			0.60			0.60	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		2.0			2.0			2.0			2.0	
Lane Grp Cap (vph)		430			406			755			919	
v/s Ratio Prot												
v/s Ratio Perm		c0.21			0.12			0.30			c0.48	
v/c Ratio		0.82			0.44			0.50			0.80	
Uniform Delay, d1		20.7			18.4			6.8			9.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		11.8			0.3			2.4			7.9	
Delay (s)		32.5			18.7			9.2			17.0	
Level of Service		C			B			A			B	
Approach Delay (s)		32.5			18.7			9.2			17.0	
Approach LOS		C			B			A			B	

Intersection Summary

HCM Average Control Delay	19.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	60		

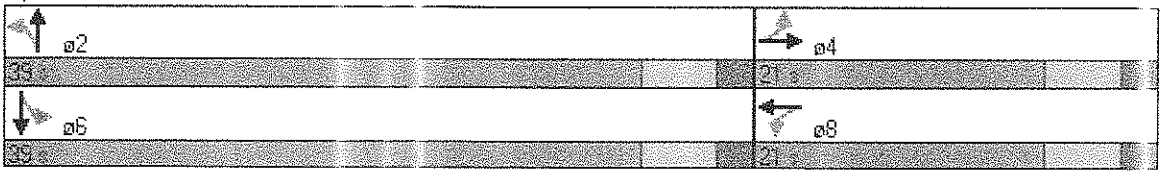
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	39	146	26	117	123	239	145	518
Lane Group Flow (vph)	0	434	0	204	0	384	0	746
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phases	4	4	8	8	2	2	6	6
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	21.0	21.0	21.0	21.0	39.0	39.0	39.0	39.0
Total Split (%)	35.0%	35.0%	35.0%	35.0%	65.0%	65.0%	65.0%	65.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio		0.85		0.46		0.51		0.80
Control Delay		35.0		18.4		10.1		18.8
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		35.0		18.4		10.1		18.8
Queue Length 50th (ft)		106		48		71		186
Queue Length 95th (ft)		#503		117		168		#503
Internal Link Dist (ft)		677		742		2508		498
Turn Bay Length (ft)								
Base Capacity (vph)		544		477		754		933
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.80		0.43		0.51		0.80

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Shelburne Falls Rd & VT 116



3: Shelburne Falls Rd & VT 116

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		2%			-2%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.94			1.00			0.98	
Flt Protected		0.99			1.00			0.99			0.99	
Satd. Flow (prot)		1742			1736			1797			1776	
Flt Permitted		0.90			0.94			0.81			0.70	
Satd. Flow (perm)		1574			1632			1477			1261	
Volume (vph)	34	216	78	42	202	196	165	554	17	89	193	38
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	34	216	78	42	202	196	165	554	17	89	193	38
RTOR Reduction (vph)	0	16	0	0	41	0	0	1	0	0	7	0
Lane Group Flow (vph)	0	312	0	0	399	0	0	735	0	0	313	0
Heavy Vehicles (%)	2%	5%	2%	2%	5%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm			Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		16.3			16.3			32.3			21.5	
Effective Green, g (s)		18.3			18.3			34.3			23.5	
Actuated g/C Ratio		0.30			0.30			0.57			0.39	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		2.0			2.0			2.0			2.0	
Lane Grp Cap (vph)		475			493			872			489	
v/s Ratio Prot								c0.09				
v/s Ratio Perm		0.20			c0.24			c0.38			0.25	
v/c Ratio		0.66			0.81			0.84			0.64	
Uniform Delay, d1		18.4			19.5			10.9			15.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.5			9.6			7.7			2.2	
Delay (s)		20.9			29.2			18.6			17.3	
Level of Service		C			C			B			B	
Approach Delay (s)		20.9			29.2			18.6			17.3	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	21.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	87.8%	ICU Level of Service	E
Analysis Period (min)	60		

c Critical Lane Group

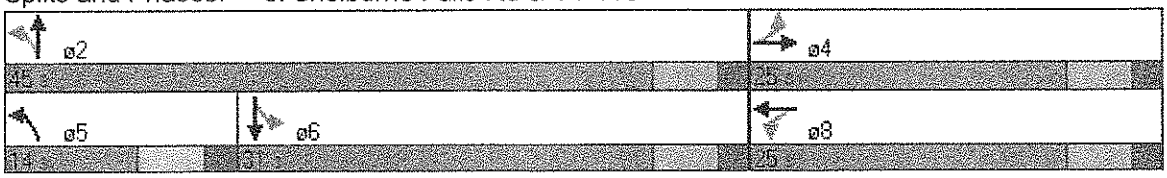
3: Shelburne Falls Rd & VT 116

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	34	216	42	202	165	554	89	193
Lane Group Flow (vph)	0	328	0	440	0	736	0	320
Turn Type	Perm		Perm		pm+pt		Perm	
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phases	4	4	8	8	5	2	6	6
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	14.0	21.0	21.0	21.0
Total Split (s)	25.0	25.0	25.0	25.0	14.0	45.0	31.0	31.0
Total Split (%)	35.7%	35.7%	35.7%	35.7%	20.0%	64.3%	44.3%	44.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.68		0.83		0.85		0.66
Control Delay		27.6		36.6		24.2		22.4
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		27.6		36.6		24.2		22.4
Queue Length 50th (ft)		114		153		199		96
Queue Length 95th (ft)		#269		#372		#564		209
Internal Link Dist (ft)		677		742		2508		498
Turn Bay Length (ft)								
Base Capacity (vph)		540		585		928		562
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.61		0.75		0.79		0.57

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 61.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Shelburne Falls Rd & VT 116



3: Shelburne Falls Rd & VT 116

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		2%			-2%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.94			1.00			0.98	
Flt Protected		0.99			1.00			0.99			0.99	
Satd. Flow (prot)		1739			1736			1796			1777	
Flt Permitted		0.90			0.93			0.81			0.70	
Satd. Flow (perm)		1578			1631			1463			1260	
Volume (vph)	34	216	84	42	202	196	169	556	17	89	196	38
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	34	216	84	42	202	196	169	556	17	89	196	38
RTOR Reduction (vph)	0	17	0	0	42	0	0	1	0	0	7	0
Lane Group Flow (vph)	0	317	0	0	398	0	0	741	0	0	316	0
Heavy Vehicles (%)	2%	5%	2%	2%	5%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm			Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		16.5			16.5			32.2			21.4	
Effective Green, g (s)		18.5			18.5			34.2			23.4	
Actuated g/C Ratio		0.30			0.30			0.56			0.39	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		2.0			2.0			2.0			2.0	
Lane Grp Cap (vph)		481			497			862			486	
v/s Ratio Prot								c0.10				
v/s Ratio Perm		0.20			c0.24			c0.39			0.25	
v/c Ratio		0.66			0.80			0.86			0.65	
Uniform Delay, d1		18.4			19.4			11.2			15.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.5			9.1			9.0			2.4	
Delay (s)		20.9			28.5			20.2			17.7	
Level of Service		C			C			C			B	
Approach Delay (s)		20.9			28.5			20.2			17.7	
Approach LOS		C			C			C			B	

Intersection Summary

HCM Average Control Delay	21.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	88.7%	ICU Level of Service	E
Analysis Period (min)	60		

c Critical Lane Group

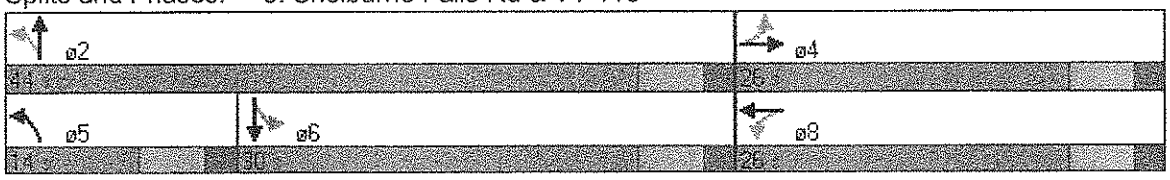
3: Shelburne Falls Rd & VT 116

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	34	216	42	202	169	556	89	196
Lane Group Flow (vph)	0	334	0	440	0	742	0	323
Turn Type	Perm		Perm		pm+pt		Perm	
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phases	4	4	8	8	5	2	6	6
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	14.0	21.0	21.0	21.0
Total Split (s)	26.0	26.0	26.0	26.0	14.0	44.0	30.0	30.0
Total Split (%)	37.1%	37.1%	37.1%	37.1%	20.0%	62.9%	42.9%	42.9%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio		0.67		0.82		0.88		0.67
Control Delay		26.4		34.3		27.5		23.5
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		26.4		34.3		27.5		23.5
Queue Length 50th (ft)		113		149		210		100
Queue Length 95th (ft)		#261		#360		#586		#219
Internal Link Dist (ft)		677		742		2508		498
Turn Bay Length (ft)								
Base Capacity (vph)		565		605		905		546
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.59		0.73		0.82		0.59

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 61.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Shelburne Falls Rd & VT 116



Appendix D
VT Route 116 & Commerce St
Capacity Analyses

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	12	11	11	12	12
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	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.96	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1781	1583	1711	1810	1531	1711	1795	
Flt Permitted		0.74	1.00		0.72	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1384	1583		1343	1583	1711	1810	1531	1711	1795	
Volume (vph)	24	8	51	95	9	83	36	299	76	82	615	43
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	24	8	51	95	9	83	36	299	76	82	615	43
RTOR Reduction (vph)	0	0	45	0	0	73	0	0	24	0	1	0
Lane Group Flow (vph)	0	32	6	0	104	10	36	299	52	82	657	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			
Actuated Green, G (s)		11.7	11.7		11.7	11.7	4.7	66.1	66.1	8.2	69.6	
Effective Green, g (s)		13.7	13.7		13.7	13.7	6.7	68.1	68.1	10.2	71.6	
Actuated g/C Ratio		0.12	0.12		0.12	0.12	0.06	0.62	0.62	0.09	0.65	
Clearance Time (s)		6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)		172	197		167	197	104	1121	948	159	1168	
v/s Ratio Prot							0.02	0.17		c0.05	c0.37	
v/s Ratio Perm		0.02	0.00		c0.08	0.01			0.03			
v/c Ratio		0.19	0.03		0.62	0.05	0.35	0.27	0.06	0.52	0.56	
Uniform Delay, d1		43.2	42.3		45.7	42.4	49.5	9.6	8.3	47.5	10.6	
Progression Factor		1.00	1.00		1.00	1.00	0.98	1.02	1.17	1.00	1.00	
Incremental Delay, d2		0.2	0.0		5.2	0.0	0.5	0.4	0.1	1.2	2.0	
Delay (s)		43.3	42.3		50.9	42.5	49.1	10.1	9.7	48.7	12.5	
Level of Service		D	D		D	D	D	B	A	D	B	
Approach Delay (s)		42.7			47.2			13.4			16.6	
Approach LOS		D			D			B			B	

Intersection Summary

HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	ø10
Lane Configurations												
Volume (vph)	24	8	51	95	9	83	36	299	76	82	615	
Lane Group Flow (vph)	0	32	51	0	104	83	36	299	76	82	658	
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	10
Permitted Phases	4		4	8		8			2			
Detector Phases	4	4	4	8	8	8	5	2	2	1	6	
Minimum Initial (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
Minimum Split (s)	16.0	16.0	16.0	16.0	16.0	16.0	14.0	16.0	16.0	14.0	16.0	19.0
Total Split (s)	19.0	19.0	19.0	19.0	19.0	19.0	14.0	55.0	55.0	17.0	58.0	19.0
Total Split (%)	17.3%	17.3%	17.3%	17.3%	17.3%	17.3%	12.7%	50.0%	50.0%	15.5%	52.7%	17%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	None
v/c Ratio		0.18	0.21		0.62	0.31	0.27	0.25	0.07	0.47	0.53	
Control Delay		44.5	13.8		63.0	12.5	48.8	11.6	5.4	55.2	13.6	
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay		44.5	13.8		63.0	12.5	48.8	11.6	5.4	55.2	13.6	
Queue Length 50th (ft)		20	0		70	0	24	97	7	55	211	
Queue Length 95th (ft)		56	43		#160	56	m29	m206	m22	116	#647	
Internal Link Dist (ft)		686			1356			1990			2508	
Turn Bay Length (ft)						125	75		75	175		
Base Capacity (vph)		200	267		189	295	159	1181	1021	206	1248	
Starvation Cap Reductn		0	0		0	0	0	0	0	0	0	
Spillback Cap Reductn		0	0		0	0	0	0	0	0	0	
Storage Cap Reductn		0	0		0	0	0	0	0	0	0	
Reduced v/c Ratio		0.16	0.19		0.55	0.28	0.23	0.25	0.07	0.40	0.53	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
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: Farmall Dr & VT 116

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	12	11	11	12	12
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	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	0.86		1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.96	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583	1770	1603		1711	1810	1531	1711	1794	
Flt Permitted		0.77	1.00	0.74	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1441	1583	1372	1603		1711	1810	1531	1711	1794	
Volume (vph)	24	8	51	211	9	122	36	264	147	147	554	43
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	24	8	51	211	9	122	36	264	147	147	554	43
RTOR Reduction (vph)	0	0	41	0	99	0	0	0	55	0	2	0
Lane Group Flow (vph)	0	32	10	211	32	0	36	264	92	147	595	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm		Perm	Perm			Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		18.9	18.9	18.9	18.9		4.7	53.9	53.9	13.2	62.4	
Effective Green, g (s)		20.9	20.9	20.9	20.9		6.7	55.9	55.9	15.2	64.4	
Actuated g/C Ratio		0.19	0.19	0.19	0.19		0.06	0.51	0.51	0.14	0.59	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)		274	301	261	305		104	920	778	236	1050	
v/s Ratio Prot					0.02		0.02	0.15		c0.09	c0.33	
v/s Ratio Perm		0.02	0.01	c0.15					0.06			
v/c Ratio		0.12	0.03	0.81	0.11		0.35	0.29	0.12	0.62	0.57	
Uniform Delay, d1		36.9	36.3	42.6	36.8		49.5	15.6	14.2	44.7	14.1	
Progression Factor		1.00	1.00	1.00	1.00		1.03	0.75	0.89	1.00	1.00	
Incremental Delay, d2		0.1	0.0	17.7	0.1		0.2	0.2	0.1	3.7	2.2	
Delay (s)		37.0	36.3	60.4	36.9		51.4	11.9	12.7	48.4	16.4	
Level of Service		D	D	E	D		D	B	B	D	B	
Approach Delay (s)		36.6			51.4			15.3			22.7	
Approach LOS		D			D			B			C	

Intersection Summary

HCM Average Control Delay	27.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	63.5%	ICU Level of Service	B
Analysis Period (min)	60		

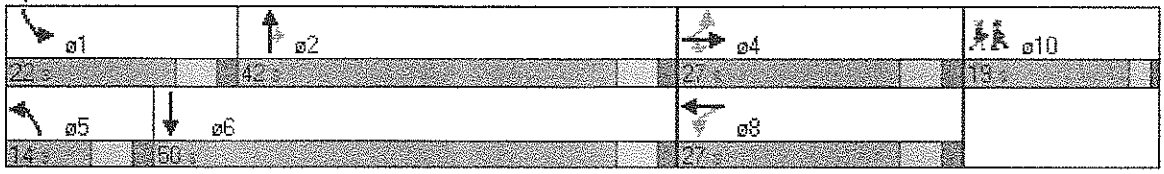
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø10
Lane Configurations											
Volume (vph)	24	8	51	211	9	36	264	147	147	554	
Lane Group Flow (vph)	0	32	51	211	131	36	264	147	147	597	
Turn Type	Perm		Perm	Perm		Prot		Perm	Prot		
Protected Phases		4			8	5	2		1	6	10
Permitted Phases	4		4	8				2			
Detector Phases	4	4	4	8	8	5	2	2	1	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	16.0	16.0	16.0	16.0	16.0	14.0	16.0	16.0	14.0	16.0	19.0
Total Split (s)	27.0	27.0	27.0	27.0	27.0	14.0	42.0	42.0	22.0	50.0	19.0
Total Split (%)	24.5%	24.5%	24.5%	24.5%	24.5%	12.7%	38.2%	38.2%	20.0%	45.5%	17%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	None
v/c Ratio		0.12	0.15	0.81	0.33	0.26	0.28	0.17	0.62	0.53	
Control Delay		36.7	11.0	69.8	10.2	49.1	13.2	5.7	56.6	17.5	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay		36.7	11.0	69.8	10.2	49.1	13.2	5.7	56.6	17.5	
Queue Length 50th (ft)		18	0	139	5	24	86	12	99	237	
Queue Length 95th (ft)		51	39	#302	71	m24	m148	m35	182	#665	
Internal Link Dist (ft)		686			1356		1990			2508	
Turn Bay Length (ft)						75		75	175		
Base Capacity (vph)		306	373	289	433	159	960	864	283	1129	
Starvation Cap Reductn		0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0	0	0	
Storage Cap Reductn		0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio		0.10	0.14	0.73	0.30	0.23	0.28	0.17	0.52	0.53	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
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: Farmall Dr & VT 116



1: Farmall Dr & VT 116

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	12	11	11	12	12
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	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1789	1583		1775	1583	1711	1810	1531	1711	1800	
Flt Permitted		0.72	1.00		0.70	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1344	1583		1304	1583	1711	1810	1531	1711	1800	
Volume (vph)	33	7	16	60	1	118	14	636	101	61	299	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	7	16	60	1	118	14	636	101	61	299	13
RTOR Reduction (vph)	0	0	14	0	0	105	0	0	20	0	1	0
Lane Group Flow (vph)	0	40	2	0	61	13	14	636	81	61	311	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			
Actuated Green, G (s)		6.8	6.8		6.8	6.8	1.3	42.3	42.3	4.7	45.7	
Effective Green, g (s)		8.8	8.8		8.8	8.8	3.3	44.3	44.3	6.7	47.7	
Actuated g/C Ratio		0.11	0.11		0.11	0.11	0.04	0.55	0.55	0.08	0.60	
Clearance Time (s)		6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)		148	174		143	174	71	1002	848	143	1073	
v/s Ratio Prot							0.01	c0.35		c0.04	c0.17	
v/s Ratio Perm		0.03	0.00		c0.05	0.01			0.05			
v/c Ratio		0.27	0.01		0.43	0.07	0.20	0.63	0.10	0.43	0.29	
Uniform Delay, d1		32.7	31.7		33.2	31.9	37.1	12.3	8.4	34.8	7.9	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.4	0.0		0.7	0.1	0.5	3.1	0.2	0.7	0.7	
Delay (s)		33.0	31.7		34.0	32.0	37.6	15.4	8.6	35.6	8.6	
Level of Service		C	C		C	C	D	B	A	D	A	
Approach Delay (s)		32.6			32.7			14.9			13.0	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.2
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

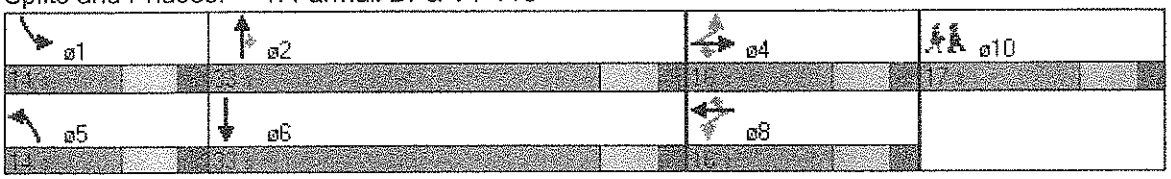
1: Farmall Dr & VT 116

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	ø10
Lane Configurations												
Volume (vph)	33	7	16	60	1	118	14	636	101	61	299	
Lane Group Flow (vph)	0	40	16	0	61	118	14	636	101	61	312	
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	10
Permitted Phases	4		4	8		8			2			
Detector Phases	4	4	4	8	8	8	5	2	2	1	6	
Minimum Initial (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
Minimum Split (s)	16.0	16.0	16.0	16.0	16.0	16.0	14.0	16.0	16.0	14.0	16.0	17.0
Total Split (s)	16.0	16.0	16.0	16.0	16.0	16.0	14.0	33.0	33.0	14.0	33.0	17.0
Total Split (%)	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	17.5%	41.3%	41.3%	17.5%	41.3%	21%
Yellow 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
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	None
v/c Ratio		0.24	0.08		0.39	0.40	0.09	0.53	0.10	0.33	0.23	
Control Delay		34.4	15.2		39.0	10.8	34.4	15.7	7.4	37.4	8.0	
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay		34.4	15.2		39.0	10.8	34.4	15.7	7.4	37.4	8.0	
Queue Length 50th (ft)		18	0		28	0	7	172	10	29	31	
Queue Length 95th (ft)		52	19		71	56	26	#619	59	72	212	
Internal Link Dist (ft)		686			1356			1990			2508	
Turn Bay Length (ft)						125	75		75	175		
Base Capacity (vph)		208	251		196	338	214	1209	1038	216	1335	
Starvation Cap Reductn		0	0		0	0	0	0	0	0	0	
Spillback Cap Reductn		0	0		0	0	0	0	0	0	0	
Storage Cap Reductn		0	0		0	0	0	0	0	0	0	
Reduced v/c Ratio		0.19	0.06		0.31	0.35	0.07	0.53	0.10	0.28	0.23	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 80
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Farmall Dr & VT 116



ITE

1: Farmall Dr & VT 116

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	12	11	11	12	12
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	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	0.85		1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.96	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1789	1583	1770	1585		1711	1810	1531	1711	1800	
Flt Permitted		0.58	1.00	0.73	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1083	1583	1362	1585		1711	1810	1531	1711	1800	
Volume (vph)	33	7	16	85	1	132	14	622	140	77	292	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	7	16	85	1	132	14	622	140	77	292	13
RTOR Reduction (vph)	0	0	14	0	115	0	0	0	31	0	1	0
Lane Group Flow (vph)	0	40	2	85	18	0	14	622	109	77	304	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	5%	2%	2%	5%	2%
Turn Type	Perm		Perm	Perm			Prot		Perm	Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		8.3	8.3	8.3	8.3		1.3	39.1	39.1	6.4	44.2	
Effective Green, g (s)		10.3	10.3	10.3	10.3		3.3	41.1	41.1	8.4	46.2	
Actuated g/C Ratio		0.13	0.13	0.13	0.13		0.04	0.51	0.51	0.11	0.58	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)		139	204	175	204		71	930	787	180	1040	
v/s Ratio Prot					0.01		0.01	c0.34		c0.05	0.17	
v/s Ratio Perm		0.04	0.00	c0.06					0.07			
v/c Ratio		0.29	0.01	0.49	0.09		0.20	0.67	0.14	0.43	0.29	
Uniform Delay, d1		31.5	30.4	32.4	30.7		37.1	14.4	10.2	33.5	8.6	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.4	0.0	0.8	0.1		0.5	3.9	0.4	0.6	0.7	
Delay (s)		31.9	30.4	33.2	30.8		37.6	18.3	10.5	34.1	9.3	
Level of Service		C	C	C	C		D	B	B	C	A	
Approach Delay (s)		31.5			31.7			17.2			14.3	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.2
Intersection Capacity Utilization	61.9%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

ITE

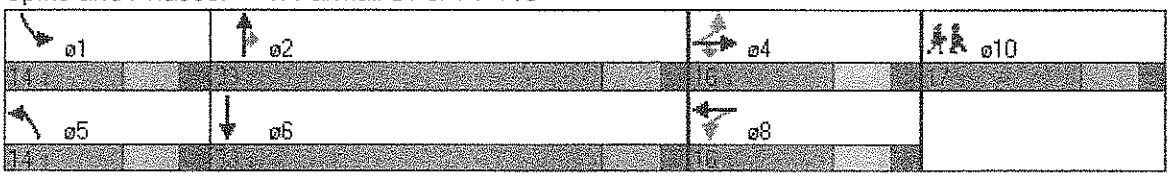
1: Farmall Dr & VT 116

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø10
Lane Configurations											
Volume (vph)	33	7	16	85	1	14	622	140	77	292	
Lane Group Flow (vph)	0	40	16	85	133	14	622	140	77	305	
Turn Type	Perm		Perm	Perm		Prot		Perm	Prot		
Protected Phases		4			8	5	2		1	6	10
Permitted Phases	4		4	8				2			
Detector Phases	4	4	4	8	8	5	2	2	1	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	16.0	16.0	16.0	16.0	16.0	14.0	16.0	16.0	14.0	16.0	17.0
Total Split (s)	16.0	16.0	16.0	16.0	16.0	14.0	33.0	33.0	14.0	33.0	17.0
Total Split (%)	20.0%	20.0%	20.0%	20.0%	20.0%	17.5%	41.3%	41.3%	17.5%	41.3%	21%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	None
v/c Ratio		0.25	0.07	0.49	0.42	0.09	0.58	0.15	0.39	0.24	
Control Delay		34.6	15.1	41.8	10.6	34.4	17.9	7.6	38.2	8.3	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay		34.6	15.1	41.8	10.6	34.4	17.9	7.6	38.2	8.3	
Queue Length 50th (ft)		18	0	40	0	7	180	15	36	33	
Queue Length 95th (ft)		52	19	93	60	26	#601	75	86	207	
Internal Link Dist (ft)		686			1356		1990			2508	
Turn Bay Length (ft)						75		75	175		
Base Capacity (vph)		188	251	204	350	214	1066	928	220	1257	
Starvation Cap Reductn		0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0	0	0	
Storage Cap Reductn		0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio		0.21	0.06	0.42	0.38	0.07	0.58	0.15	0.35	0.24	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 80
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Farmall Dr & VT 116



Appendix E
VT Route 116 & Mechanicsville Rd
Capacity Analyses

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 No-Build
Project ID: 10024
East/West Street: Mechanicsville Rd
North/South Street: VT 116
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		365	157	3	736	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		365	157	3	736	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	171		9			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	171		9			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		-2			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		3		180				
C(m) (vph)		1044		245				
v/c		0.00		0.73				
95% queue length		0.01		6.86				
Control Delay		8.5		57.4				
LOS		A		F				
Approach Delay				57.4				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 Build
Project ID: 10024
East/West Street: Mechanicsville Rd
North/South Street: VT 116
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		396	164	3	784	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		396	164	3	784	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	165		9			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	165		9			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		-2			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	0				
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		3		174				
C(m) (vph)		1011		220				
v/c		0.00		0.79				
95% queue length		0.01		8.33				
Control Delay		8.6		75.5				
LOS		A		F				
Approach Delay				75.5				
Approach LOS				F				

Appendix F
VT Route 116 & Charlotte Rd
Capacity Analyses

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1700	1900
Lane Width	11	11	11	12	11	12	12	12	12	12	12	12
Grade (%)		6%			-4%			-2%			4%	
Total Lost time (s)	4.0		4.0		4.0			4.0			4.0	
Lane Util. Factor	1.00		1.00		1.00			1.00			1.00	
Frt	1.00		0.85		0.94			0.99			0.98	
Flt Protected	0.95		1.00		0.98			1.00			1.00	
Satd. Flow (prot)	1659		1485		1725			1815			1567	
Flt Permitted	0.95		1.00		0.98			0.80			1.00	
Satd. Flow (perm)	1659		1485		1725			1452			1567	
Volume (vph)	89	0	55	70	14	62	33	372	22	0	801	103
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	89	0	55	70	14	62	33	372	22	0	801	103
RTOR Reduction (vph)	0	0	50	0	24	0	0	1	0	0	3	0
Lane Group Flow (vph)	89	0	5	0	122	0	0	426	0	0	901	0
Heavy Vehicles (%)	2%	0%	2%	0%	0%	0%	2%	5%	2%	2%	5%	2%
Turn Type	Prot		custom	Split			Perm			Perm		
Protected Phases	4			8	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	7.7		7.7		8.2			70.1			70.1	
Effective Green, g (s)	9.7		9.7		10.2			72.1			72.1	
Actuated g/C Ratio	0.09		0.09		0.09			0.66			0.66	
Clearance Time (s)	6.0		6.0		6.0			6.0			6.0	
Vehicle Extension (s)	2.0		2.0		2.0			2.0			2.0	
Lane Grp Cap (vph)	146		131		160			952			1027	
v/s Ratio Prot	c0.05				c0.07						c0.57	
v/s Ratio Perm			0.00					0.29				
v/c Ratio	0.61		0.04		0.76			0.45			0.88	
Uniform Delay, d1	48.3		45.9		48.7			9.2			15.4	
Progression Factor	1.00		1.00		1.00			1.00			0.89	
Incremental Delay, d2	5.0		0.0		18.4			1.5			10.9	
Delay (s)	53.3		45.9		67.1			10.8			24.6	
Level of Service	D		D		E			B			C	
Approach Delay (s)		50.5			67.1			10.8			24.6	
Approach LOS		D			E			B			C	

Intersection Summary

HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	60		

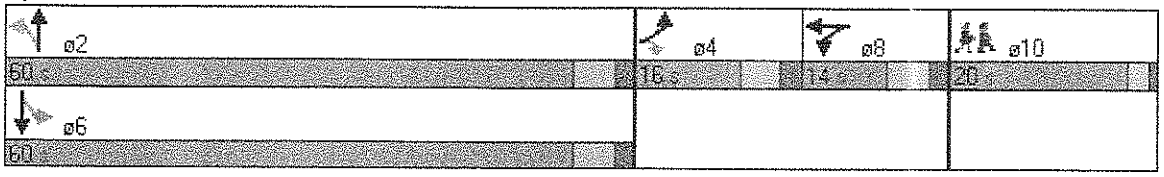
c Critical Lane Group

Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	ø10
Lane Configurations							
Volume (vph)	89	55	14	33	372	801	
Lane Group Flow (vph)	89	55	146	0	427	904	
Turn Type	Prot	custom		Perm			
Protected Phases	4		8		2	6	10
Permitted Phases		4		2			
Detector Phases	4	4	8	2	2	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	16.0	16.0	14.0	16.0	16.0	16.0	20.0
Total Split (s)	16.0	16.0	14.0	60.0	60.0	60.0	20.0
Total Split (%)	14.5%	14.5%	12.7%	54.5%	54.5%	54.5%	18%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	C-Min	C-Min	C-Min	None
v/c Ratio	0.55	0.28	0.79		0.81	0.84	
Control Delay	60.6	16.1	74.6		31.8	22.7	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	60.6	16.1	74.6		31.8	22.7	
Queue Length 50th (ft)	60	0	84		187	471	
Queue Length 95th (ft)	127	47	#233		#622	#1126	
Internal Link Dist (ft)			318		1559	1990	
Turn Bay Length (ft)		50					
Base Capacity (vph)	181	211	186		525	1082	
Starvation Cap Reductn	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	
Reduced v/c Ratio	0.49	0.26	0.78		0.81	0.84	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 19 (17%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Charlotte Rd & VT 116



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1700	1900
Lane Width	11	11	11	12	11	12	12	12	12	12	12	12
Grade (%)		6%			-4%			-2%			4%	
Total Lost time (s)	4.0		4.0		4.0			4.0			4.0	
Lane Util. Factor	1.00		1.00		1.00			1.00			1.00	
Frt	1.00		0.85		0.95			1.00			0.98	
Flt Protected	0.95		1.00		0.97			1.00			1.00	
Satd. Flow (prot)	1659		1485		1727			1821			1563	
Flt Permitted	0.95		1.00		0.97			0.77			1.00	
Satd. Flow (perm)	1659		1485		1727			1416			1563	
Volume (vph)	117	0	52	29	4	22	33	422	9	0	816	130
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	117	0	52	29	4	22	33	422	9	0	816	130
RTOR Reduction (vph)	0	0	44	0	21	0	0	0	0	0	4	0
Lane Group Flow (vph)	117	0	8	0	35	0	0	464	0	0	942	0
Heavy Vehicles (%)	2%	0%	2%	0%	0%	0%	2%	5%	2%	2%	5%	2%
Turn Type	Prot		custom	Split			Perm			Perm		
Protected Phases	4			8	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	9.4		9.4		5.5			71.1			71.1	
Effective Green, g (s)	11.4		11.4		7.5			73.1			73.1	
Actuated g/C Ratio	0.10		0.10		0.07			0.66			0.66	
Clearance Time (s)	6.0		6.0		6.0			6.0			6.0	
Vehicle Extension (s)	2.0		2.0		2.0			2.0			2.0	
Lane Grp Cap (vph)	172		154		118			941			1039	
v/s Ratio Prot	c0.07				c0.02						c0.60	
v/s Ratio Perm			0.01					0.33				
v/c Ratio	0.68		0.05		0.29			0.49			0.91	
Uniform Delay, d1	47.5		44.4		48.7			9.2			15.6	
Progression Factor	1.00		1.00		1.00			1.00			1.07	
Incremental Delay, d2	8.9		0.1		0.5			1.9			13.7	
Delay (s)	56.4		44.5		49.2			11.1			30.4	
Level of Service	E		D		D			B			C	
Approach Delay (s)		52.7			49.2			11.1			30.4	
Approach LOS		D			D			B			C	

Intersection Summary

HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

Lane Group	EBL	EBR	WBT	NBL	NBT	SBT	ø10
Lane Configurations							
Volume (vph)	117	52	4	33	422	316	
Lane Group Flow (vph)	117	52	55	0	464	946	
Turn Type	Prot	custom		Perm			
Protected Phases	4		8		2	6	10
Permitted Phases		4		2			
Detector Phases	4	4	8	2	2	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	16.0	16.0	14.0	16.0	16.0	16.0	20.0
Total Split (s)	16.0	16.0	14.0	60.0	60.0	60.0	20.0
Total Split (%)	14.5%	14.5%	12.7%	54.5%	54.5%	54.5%	18%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	C-Min	C-Min	C-Min	None
v/c Ratio	0.68	0.26	0.36		1.08	0.87	
Control Delay	69.4	17.7	38.9		206.1	26.5	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	69.4	17.7	38.9		206.1	26.5	
Queue Length 50th (ft)	80	2	22		~364	555	
Queue Length 95th (ft)	#189	48	72		#520m	#1176	
Internal Link Dist (ft)			318		1559	1990	
Turn Bay Length (ft)		50					
Base Capacity (vph)	181	206	177		430	1093	
Starvation Cap Reductn	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	
Reduced v/c Ratio	0.65	0.25	0.31		1.08	0.87	

Intersection Summary

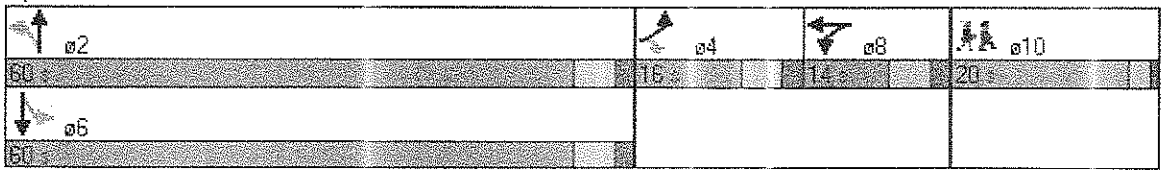
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 18 (16%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 130
Control Type: Actuated-Coordinated

~ 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: 3: Charlotte Rd & VT 116



Appendix G
VT Route 116 & Silver St
Capacity Analyses

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 No-Build
Project ID: 10024
East/West Street: Silver St.
North/South Street: VT 116
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	216			425	380
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	216			425	380
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	0	1			1	1
Configuration		LT			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				222		7
Peak Hour Factor, PHF				1.00		1.00
Hourly Flow Rate, HFR				222		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			4	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	0	
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	15						229	
C(m) (vph)	828						360	
v/c	0.02						0.64	
95% queue length	0.06						4.88	
Control Delay	9.4						32.0	
LOS	A						D	
Approach Delay							32.0	
Approach LOS							D	

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 Build
Project ID: 10024
East/West Street: Silver St.
North/South Street: VT 116
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	242			440	382
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	242			440	382
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	0	1			1	1
Configuration	LT				T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				233		7
Peak Hour Factor, PHF				1.00		1.00
Hourly Flow Rate, HFR				233		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			4	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	0	
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	15						240	
C(m) (vph)	816						339	
v/c	0.02						0.71	
95% queue length	0.06						6.44	
Control Delay	9.5						40.2	
LOS	A						E	
Approach Delay							40.2	
Approach LOS							E	

Appendix H
Mechanicsville Rd & Commerce St
Capacity Analyses

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 No-Build
Project ID:
East/West Street: Commerce St/Thorn Bush Rd
North/South Street: Mechanicsville Rd
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	142	5	1	151	64
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	15	142	5	1	151	64
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	14	29	6	102	14	19
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	14	29	6	102	14	19
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		-2			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	15	1		49			135	
C(m) (vph)	1355	1435		594			579	
v/c	0.01	0.00		0.08			0.23	
95% queue length	0.03	0.00		0.27			0.91	
Control Delay	7.7	7.5		11.6			13.1	
LOS	A	A		B			B	
Approach Delay				11.6			13.1	
Approach LOS				B			B	

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 Build
Project ID:
East/West Street: Commerce St/Thorn Bush Rd
North/South Street: Mechanicsville Rd
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	41	125	5	1	138	94
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	41	125	5	1	138	94
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	14	29	6	127	14	25
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	14	29	6	127	14	25
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		-2			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	41	1		49			166	
C(m) (vph)	1336	1455		550			543	
v/c	0.03	0.00		0.09			0.31	
95% queue length	0.09	0.00		0.29			1.31	
Control Delay	7.8	7.5		12.2			14.5	
LOS	A	A		B			B	
Approach Delay				12.2			14.5	
Approach LOS				B			B	

Appendix I
Commerce St & NBM/Hannaford Capacity Analyses

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed: 6/23/11
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 No-Build
Project ID: 10024
East/West Street: Commerce St
North/South Street: NBM/Hannaford
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		122	26	8	95	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		122	26	8	95	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	24		13			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	24		13			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		8		37				
C(m) (vph)		1434		792				
v/c		0.01		0.05				
95% queue length		0.02		0.15				
Control Delay		7.5		9.8				
LOS		A		A				
Approach Delay				9.8				
Approach LOS				A				

HCS+: Unsignalized Intersections Release 5.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: R. Dickinson
Agency/Co.:
Date Performed:
Analysis Time Period: PM DHV
Intersection:
Jurisdiction: Hinesburg
Units: U. S. Customary
Analysis Year: 2017 Build
Project ID: 10024
East/West Street: Commerce St
North/South Street: NBM/Hannaford
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		122	167	64	95	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		122	167	64	95	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	182		44			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	182		44			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		64		226				
C(m) (vph)		1273		593				
v/c		0.05		0.38				
95% queue length		0.16		1.83				
Control Delay		8.0		14.8				
LOS		A		B				
Approach Delay				14.8				
Approach LOS				B				