LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LTR	0.68	0.643	8.0	1.000	1896	0.25	1.0	0.0	9.0	A	9.0	A
Westbound												
LT	0.87	0.643	10.1	1.000	613	0.40	13.0	0.0	23.1	C	22.8	C
R	0.01	0.643	4.5	1.000	1038	0.11	0.0	0.0	4.5	A		
Northbound												
L	0.35	0.243	21.9	1.000	268	0.11	0.8	0.0	22.7	C		
TR	0.35	0.243	21.9	1.000	405	0.11	0.5	0.0	22.4	C	22.5	C
Southbound												
LT	0.30	0.243	21.6	1.000	376	0.11	0.4	0.0	22.1	C	21.9	C
R	0.02	0.243	20.2	1.000	392	0.11	0.0	0.0	20.2	C		

Intersection Delay = 14.6 (sec/veh) Intersection LOS = B

Board of Zoning Adjustment
District of Columbia
CASE NO.16566
EXHIBIT NO.45A2

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 70.0 sec				
Actual Green Time for Lane Group, G			17.0	
Effective Green Time for Lane Group, g			17.0	
Opposing Effective Green Time, go			17.0	
Number of Lanes in Lane Group, N			1	
Number of Opposing Lanes, No			1	
Adjusted Left-Turn Flow Rate, Vlt			94	
Proportion of Left Turns in Opposing Flow, Plto			0.49	
Adjusted Opposing Flow Rate, Vo			111	
Lost Time for Lane Group, tl			4.00	
Left Turns per Cycle: LTC=VltC/3600			1.83	
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo			2.16	
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)			1.00	
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing Queue Ratio: qro=1-Rpo(go/C)			0.76	
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g			2.61	
gu =g-gq if gq>=gf, =g-gf if gq<gf			14.39	
n=(gq-gf)/2, n>=0			1.31	
Ptho=1-Plto			0.51	
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]			1.00	
El1 (Figure 9-7)			1.46	
El2=(1-Ptho**n)/Plto, El2>=1.0			1.20	
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g			0.24	
gdiff=max(gq-gf,0)			2.61	
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)			0.58	
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt			0.580	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 70.0 sec				
Actual Green Time for Lane Group, G	45.0	45.0		17.0
Effective Green Time for Lane Group, g	45.0	45.0		17.0
Opposing Effective Green Time, go	45.0	45.0		17.0
Number of Lanes in Lane Group, N	2	1		1
Number of Opposing Lanes, No	1	2		1
Adjusted Left-Turn Flow Rate, Vlt	40	128		54
Proportion of Left Turns in Lane Group, Plt	0.03	0.24		0.49
Proportion of Left Turns in Opposing Flow, Plto	0.24	0.03		0.00
Adjusted Opposing Flow Rate, Vo	534	1298		140
Lost Time for Lane Group, tl	4.00	4.00		4.00
Left Turns per Cycle: LTC=VltC/3600	0.78	2.49		1.05
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	10.38	13.28		2.72
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00	1.00		1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	0.0	4.3		3.0
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.36	0.36		0.76
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	5.86	7.90		0.47
gu =g-gq if gq>=gf, =g-gf if gq<gf	39.14	37.10		14.00
n=(gq-gf)/2, n>=0	2.93	1.82		0.00
Ptho=1-Plto	0.76	0.97		1.00
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.10	0.24		0.49
El1 (Figure 9-7)	2.38	5.28		1.60
El2=(1-Ptho**n)/Plto, El2>=1.0	2.30	1.80		1.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.05	0.06		0.17
gdiff=max(gq-gf,0)	5.86	3.64		0.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.77	0.50		0.82
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.838	0.501		0.815

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 70.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.6 sec/veh Intersection LOS B

ERROR MESSAGES

No errors to report.

HCS: Signalized Intersections Release 3.1c

Inter: Reservoir Road & 38th Street
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road

City/St: Washington, DC
Proj #: 1701-001 BG2
Period: PM Existing
N/S St: 38th Street / Entrance 1 GU

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	2	0	1	1	0	0	1	1
LGConfig		LT	R		LTR		L	TR			LT	R
Volume	37	458	36	56	593	7	157	35	148	47	13	5
Lane Width		12.0	12.0		12.0		12.0	12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
WB Left	A				SB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	45.0					17.0			
Yellow	4.0					4.0			
All Red	0.0					0.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1124	1749	0.49	0.643	6.9	A	6.7	A
R	1038	1615	0.04	0.643	4.6	A		
Westbound								
LTR	1757	2733	0.41	0.643	6.2	A	6.2	A
Northbound								
L	330	1357	0.53	0.243	24.6	C		
TR	406	1670	0.50	0.243	23.8	C	24.2	C
Southbound								
LT	269	1109	0.25	0.243	21.8	C	21.7	C
R	392	1615	0.02	0.243	20.2	C		

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Reservoir Road & 38th Street
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	PM Existing
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	38th Street / Entrance 1 GU

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	37	458	36	56	593	7	157	35	148	47	13	5
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	10	127	10	16	165	2	44	10	41	13	4	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900			1900	1900
ParkExist												
NumPark												
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
No. Lanes	0	1	1	0	2	0	1	1	0	0	1	1
LGConfig		LT	R		LTR		L	TR			LT	R
Lane Width		12.0	12.0		12.0		12.0	12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow		550	40		729		174	203			66	6
%InSharedLn												
Prop Turns	0.07			0.09		0.01			0.81	0.79		
NumPeds			0			0			0			0
NumBus		0	0		0		0	0			0	0

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0		0.0	0.0			0.0	0.0
Arriv. Type		3	3		3		3	3			3	3
Unit Ext.		3.0	3.0		3.0		3.0	3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0		2.0	2.0			2.0	2.0
Ext of g		2.0	2.0		2.0		2.0	2.0			2.0	2.0
Ped Min g		3.0			3.0			3.0			3.0	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
WB Left	A				SB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	45.0					17.0			
Yellow	4.0					4.0			
All Red	0.0					0.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	37	0.90	41	0					
Thru	458	0.90	509	1	LT		550	0.07	
Right	36	0.90	40	1	R	0	40		
Westbound									
Left	56	0.90	62	0					
Thru	593	0.90	659	2	LTR		729	0.09	0.01
Right	7	0.90	8	0		0			
Northbound									
Left	157	0.90	174	1	L		174		
Thru	35	0.90	39	1	TR		203		0.81
Right	148	0.90	164	0		0			
Southbound									
Left	47	0.90	52	0					
Thru	13	0.90	14	1	LT		66	0.79	
Right	5	0.90	6	1	R	0	6		

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.921	1749
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Westbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.998	0.758	2733

Northbound							Sec LT Adj/LT Sat:				
L	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	----	0.714	1357
TR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.879	1.000	1670

Southbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.584	1109
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615

0

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Pri.							
Sec.							
Left							
Thru	LT	550	1749	# 0.31	0.643	1124	0.49
Right	R	40	1615	0.02	0.643	1038	0.04
Westbound							
Pri.							
Sec.							
Left							
Thru	LTR	729	2733	0.27	0.643	1757	0.41
Right							
Northbound							
Pri.							
Sec.							
Left	L	174	1357	# 0.13	0.243	330	0.53
Thru	TR	203	1670	0.12	0.243	406	0.50
Right							
Southbound							
Pri.							
Sec.							
Left							
Thru	LT	66	1109	0.06	0.243	269	0.25
Right	R	6	1615	0.00	0.243	392	0.02

Sum (v/s) critical = 0.44

Lost Time/Cycle, L = 8.00 sec Critical v/c(X) = 0.50

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.49	0.643	6.5	1.000	1124	0.11	0.3	0.0	6.9	A	6.7	A
R	0.04	0.643	4.6	1.000	1038	0.11	0.0	0.0	4.6	A		
Westbound												
LTR	0.41	0.643	6.1	1.000	1757	0.11	0.2	0.0	6.2	A	6.2	A
Northbound												
L	0.53	0.243	23.0	1.000	330	0.13	1.6	0.0	24.6	C		
TR	0.50	0.243	22.8	1.000	406	0.11	1.0	0.0	23.8	C	24.2	C
Southbound												
LT	0.25	0.243	21.3	1.000	269	0.11	0.5	0.0	21.8	C	21.7	C
R	0.02	0.243	20.1	1.000	392	0.11	0.0	0.0	20.2	C		

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 70.0 sec				
Actual Green Time for Lane Group, G			17.0	
Effective Green Time for Lane Group, g			17.0	
Opposing Effective Green Time, go			17.0	
Number of Lanes in Lane Group, N			1	
Number of Opposing Lanes, No			1	
Adjusted Left-Turn Flow Rate, Vlt			174	
Proportion of Left Turns in Opposing Flow, Plto			0.79	
Adjusted Opposing Flow Rate, Vo			66	
Lost Time for Lane Group, tl			4.00	
Left Turns per Cycle: LTC=VltC/3600			3.38	
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo			1.28	
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)			1.00	
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing Queue Ratio: qro=1-Rpo(go/C)			0.76	
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g			0.00	
gu =g-gq if gq>=gf, =g-gf if gq<gf			17.00	
n=(gq-gf)/2, n>=0			0.00	
Ptho=1-Plto			0.21	
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]			1.00	
El1 (Figure 9-7)			1.40	
El2=(1-Ptho**n)/Plto, El2>=1.0			1.00	
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g			0.24	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)			0.71	
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt			0.714	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 70.0 sec				
Actual Green Time for Lane Group, G	45.0	45.0		17.0
Effective Green Time for Lane Group, g	45.0	45.0		17.0
Opposing Effective Green Time, go	45.0	45.0		17.0
Number of Lanes in Lane Group, N	1	2		1
Number of Opposing Lanes, No	2	1		1
Adjusted Left-Turn Flow Rate, Vlt	41	62		52
Proportion of Left Turns in Lane Group, Plt	0.07	0.09		0.79
Proportion of Left Turns in Opposing Flow, Plto	0.09	0.07		0.00
Adjusted Opposing Flow Rate, Vo	729	550		203
Lost Time for Lane Group, tl	4.00	4.00		4.00
Left Turns per Cycle: LTC=VltC/3600	0.80	1.21		1.01
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	7.46	10.69		3.95
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00	1.00		1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	17.3	0.0		3.2
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.36	0.36		0.76
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	2.77	7.00		6.48
gu =g-gq if gq>=gf, =g-gf if gq<gf	27.74	38.00		10.52
n=(gq-gf)/2, n>=0	0.00	3.50		1.66
Ptho=1-Plto	0.91	0.93		1.00
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.07	0.28		0.79
El1 (Figure 9-7)	2.99	2.42		1.70
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00	3.19		1.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.05	0.06		0.21
gdiff=max(gq-gf,0)	0.00	7.00		0.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.92	0.61		0.58
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.921	0.758		0.584

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 70.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.8 sec/veh Intersection LOS B

ERROR MESSAGES

No errors to report.

HCS: Signalized Intersections Release 3.1c

Inter: Reservoir Road & 37th Street
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road

City/St: Washington, DC
Proj #: 1701-001 BG2
Period: AM Existing
N/S St: 37th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	1	0	1	0	0	1	1
LGConfig		LT	R		LT	R		LTR			LT	R
Volume	88	1001	1	1	386	35	3	11	5	181	4	102
Lane Width		12.0	12.0		12.0	12.0		12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
WB Left	A				SB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	58.0					12.0			
Yellow	4.0					4.0			
All Red	1.0					1.0			

Cycle Length: 80.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1280	1765	0.95	0.725	23.7	C	23.7	C
R	1171	1615	0.00	0.725	3.0	A		
Westbound								
LT	1375	1897	0.31	0.725	4.0	A	4.0	A
R	1171	1615	0.03	0.725	3.1	A		
Northbound								
LTR	238	1588	0.09	0.150	29.4	C	29.4	C
Southbound								
LT	204	1359	1.00	0.150	98.3	F	74.9	E
R	242	1615	0.47	0.150	32.5	C		

Intersection Delay = 27.3 (sec/veh) Intersection LOS = C

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Reservoir Road & 37th Street
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	AM Existing
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	37th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	88	1001	1-	1	386	35	3	11	5	181	4	102
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	24	278	1	1	107	10	1	3	2	50	1	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900	1900		1900			1900	1900
ParkExist												
NumPark												
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
No. Lanes	0	1	1	0	1	1	0	1	0	0	1	1
LGConfig		LT	R		LT	R		LTR			LT	R
Lane Width		12.0	12.0		12.0	12.0		12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow		1210	1		430	39		21			205	113
%InSharedLn												
Prop Turns	0.08			0.00			0.14		0.29	0.98		
NumPeds			0			0			0			0
NumBus		0	0		0	0		0			0	0

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0		0.0			0.0	0.0
Arriv. Type		3	3		3	3		3			3	3
Unit Ext.		3.0	3.0		3.0	3.0		3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0		2.0			2.0	2.0
Ext of g		2.0	2.0		2.0	2.0		2.0			2.0	2.0
Ped Min g		3.0			3.0			3.0			3.0	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
WB Left	A				SB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	58.0					12.0			
Yellow	4.0					4.0			
All Red	1.0					1.0			

Cycle Length: 80.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	88	0.90	98	0					
Thru	1001	0.90	1112	1	LT		1210	0.08	
Right	1	0.90	1	1	R	0	1		
Westbound									
Left	1	0.90	1	0					
Thru	386	0.90	429	1	LT		430	0.00	
Right	35	0.90	39	1	R	0	39		
Northbound									
Left	3	0.90	3	0					
Thru	11	0.90	12	1	LTR		21	0.14	0.29
Right	5	0.90	6	0		0			
Southbound									
Left	181	0.90	201	0					
Thru	4	0.90	4	1	LT		205	0.98	
Right	102	0.90	113	1	R	0	113		

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.929	1765
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Westbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.999	1897
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Northbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.861	0.970	1588

Southbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.715	1359
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound			-					
Pri.								
Sec.								
Left								
Thru	LT	1210	1765	#	0.69	0.725	1280	0.95
Right	R	1	1615		0.00	0.725	1171	0.00
Westbound								
Pri.								
Sec.								
Left								
Thru	LT	430	1897		0.23	0.725	1375	0.31
Right	R	39	1615		0.02	0.725	1171	0.03
Northbound								
Pri.								
Sec.								
Left								
Thru	LTR	21	1588		0.01	0.150	238	0.09
Right								
Southbound								
Pri.								
Sec.								
Left								
Thru	LT	205	1359	#	0.15	0.150	204	1.00
Right	R	113	1615		0.07	0.150	242	0.47

Sum (v/s) critical = 0.84

Lost Time/Cycle, L = 10.00 sec Critical v/c(X) = 0.96

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.95	0.725	9.6	1.000	1280	0.46	14.1	0.0	23.7	C	23.7	C
R	0.00	0.725	3.0	1.000	1171	0.11	0.0	0.0	3.0	A		
Westbound												
LT	0.31	0.725	3.9	1.000	1375	0.11	0.1	0.0	4.0	A	4.0	A
R	0.03	0.725	3.1	1.000	1171	0.11	0.0	0.0	3.1	A		
Northbound												
LTR	0.09	0.150	29.3	1.000	238	0.11	0.2	0.0	29.4	C	29.4	C
Southbound												
LT	1.00	0.150	34.0	1.000	204	0.50	64.3	0.0	98.3	F	74.9	E
R	0.47	0.150	31.1	1.000	242	0.11	1.4	0.0	32.5	C		

Intersection Delay = 27.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G				
Effective Green Time for Lane Group, g				
Opposing Effective Green Time, go				
Number of Lanes in Lane Group, N				
Number of Opposing Lanes, No				
Adjusted Left-Turn Flow Rate, Vlt				
Proportion of Left Turns in Opposing Flow, Plto				
Adjusted Opposing Flow Rate, Vo				
Lost Time for Lane Group, tl				
Left Turns per Cycle: LTC=VltC/3600				
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo				
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)				
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g				
Opposing Queue Ratio: qro=1-Rpo(go/C)				
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g				
gu =g-gq if gq>=gf, =g-gf if gq<gf				
n=(gq-gf)/2, n>=0				
Ptho=1-Plto				
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]				
El1 (Figure 9-7)				
El2=(1-Ptho**n)/Plto, El2>=1.0				
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)				
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N** flt				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G	58.0	58.0	12.0	12.0
Effective Green Time for Lane Group, g	58.0	58.0	12.0	12.0
Opposing Effective Green Time, go	58.0	58.0	12.0	12.0
Number of Lanes in Lane Group, N	1	1	1	1
Number of Opposing Lanes, No	1	1	1	1
Adjusted Left-Turn Flow Rate, Vlt	98	1	3	201
Proportion of Left Turns in Lane Group, Plt	0.08	0.00	0.14	0.98
Proportion of Left Turns in Opposing Flow, Plto	0.00	0.08	0.98	0.14
Adjusted Opposing Flow Rate, Vo	430	1210	205	21
Lost Time for Lane Group, tl	5.00	5.00	5.00	5.00
Left Turns per Cycle: LTC=VltC/3600	2.18	0.02	0.07	4.47
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	9.56	26.89	4.56	0.47
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00	1.00	1.00	1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	9.3	48.6	5.3	0.0
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.28	0.28	0.85	0.85
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	2.02	10.43	8.21	0.00
gu =g-gq if gq>=gf, =g-gf if gq<gf	48.74	9.38	3.79	12.00
n=(gq-gf)/2, n>=0	0.00	0.00	1.47	0.00
Ptho=1-Plto	1.00	0.92	0.02	0.86
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.08	0.00	0.14	0.98
El1 (Figure 9-7)	2.14	4.56	1.71	1.41
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00	1.00	1.02	1.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.04	0.03	0.19	0.33
gdiff=max(gq-gf,0)	0.00	0.00	2.95	0.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.93	1.00	0.97	0.72
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.929	0.999	0.970	0.715

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 80.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.3 sec/veh Intersection LOS C

ERROR MESSAGES

No errors to report.

HCS: Signalized Intersections Release 3.1c

Inter: Reservoir Road & 37th Street
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road

City/St: Washington, DC
Proj #: 1701-001 BG2
Period: PM Existing
N/S St: 37th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	1	0	1	0	0	1	1
LGConfig		LT	R		LT	R		LTR			LT	R
Volume	110	543	1	1	550	48	3	11	7	128	5	106
Lane Width		12.0	12.0		12.0	12.0		12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left A			
Thru	A				Thru A			
Right	A				Right A			
Peds					Peds			
WB Left	A				SB Left A			
Thru	A				Thru A			
Right	A				Right A			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	58.0				12.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 80.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1123	1549	0.65	0.725	7.0	A	7.0	A
R	1171	1615	0.00	0.725	3.0	A		
Westbound								
LT	1377	1899	0.44	0.725	4.7	A	4.6	A
R	1171	1615	0.05	0.725	3.1	A		
Northbound								
LTR	233	1554	0.10	0.150	29.5	C	29.5	C
Southbound								
LT	205	1364	0.72	0.150	44.2	D	39.1	D
R	242	1615	0.49	0.150	32.7	C		

Intersection Delay = 11.4 (sec/veh) Intersection LOS = B

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Reservoir Road & 37th Street
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	PM Existing
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	37th Street

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
Y	N	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	443
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	2

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	1	10	12
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	1	10	12
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		412
Potential Capacity		595
Pedestrian Impedance Factor		1.00
Movement Capacity		595
Probability of Queue free St.		0.92

Step 2: LT from Major St.	4	1
Conflicting Flows		824
Potential Capacity		815
Pedestrian Impedance Factor		1.00
Movement Capacity		815
Probability of Queue free St.		0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows		1369

Potential Capacity	140
Pedestrian Impedance Factor	1.00
Maj. L, Min T Impedance factor	0.99
Maj. L, Min T Adj. Imp Factor.	0.99
Cap. Adj. factor due to Impeding mvmnt	0.99
Movement Capacity	139

Worksheet 8 Shared Lane Calculations

Shared Lane Calculations

Movement	7	8	9	10	11	12
v(vph)			21		47	
Movement Capacity				139		595
Shared Lane Capacity				296		

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
v(vph)	9				68			
C m(vph)	815				296			
v/c	0.01				0.23			
95% queue length								
Control Delay	9.5				20.8			
LOS	A				C			
Approach Delay						20.8		
Approach LOS						C		

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 3
Count Date: CAB
Time Period: AM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	1339	37	30	457	4	10
HFR:	1339	37	30	457	4	10
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
N	Y	N	N	Y	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	Y	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	N	N	N	N	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
N	N	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	457
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	2	1

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	4	7	9
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	4	7	9
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	688	
Potential Capacity	393	
Pedestrian Impedance Factor	1.00	
Movement Capacity	393	
Probability of Queue free St.	0.97	

Step 2: LT from Major St.	4	1
Conflicting Flows	1376	
Potential Capacity	505	
Pedestrian Impedance Factor	1.00	
Movement Capacity	505	
Probability of Queue free St.	0.94	
Maj. L Shared In. Prob. Queue Free St.	0.92	

Step 4: LT from Minor St.	7	10

Conflicting Flows	1875
Potential Capacity	65
Pedestrian Impedance Factor	1.00
Maj. L, Min T Impedance factor	0.92
Maj. L, Min T Adj. Imp Factor.	0.94
Cap. Adj. factor due to Impeding mvmnt	0.94
Movement Capacity	61

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
v(vph)		30	4			10		
C m(vph)		505	61			393		
v/c	0.06	0.07				0.03		
95% queue length								
Control Delay		12.6	68.3			14.4		
LOS		B	F			B		
Approach Delay				29.8				
Approach LOS				D				

Worksheet 11 Shared Major LT Impedance and Delay

Rank 1 Delay Calculations

Movement	2	5
P oj	1.00	0.94
V i1	0	457
V i2	0	0
S i1	1700	1700
S i2	1700	1700
P* 0j	1.00	0.92
D maj left	0.0	12.6
N number major st lanes	2	1
Delay, rank 1 mvmts	-1.$	1.0

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 3
Count Date: CAB
Time Period: PM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	554	15	15	799	34	23
HFR:	554	15	15	799	34	23
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

Lane 1			Lane 2			Lane 3		
L	T	R	L	T	R	L	T	R
N	Y	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

Lane 1			Lane 2			Lane 3		
L	T	R	L	T	R	L	T	R
Y	Y	N	N	Y	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

Lane 1			Lane 2			Lane 3		
L	T	R	L	T	R	L	T	R
Y	N	N	N	N	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
N	N	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	399
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	2

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	4	7	9
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	4	7	9
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	562	
Potential Capacity	476	
Pedestrian Impedance Factor	1.00	
Movement Capacity	476	
Probability of Queue free St.	0.95	

Step 2: LT from Major St.	4	1
Conflicting Flows	569	
Potential Capacity	1013	
Pedestrian Impedance Factor	1.00	
Movement Capacity	1013	
Probability of Queue free St.	0.99	
Maj. L Shared In. Prob. Queue Free St.	0.98	

Step 4: LT from Minor St.	7	10

Conflicting Flows	99[redacted]
Potential Capacity	2[redacted]
Pedestrian Impedance Factor	1.00
Maj. L, Min T Impedance factor	0.98
Maj. L, Min T Adj. Imp Factor.	0.99
Cap. Adj. factor due to Impeding mvmnt	0.99
Movement Capacity	243

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
	|------			||		|	
	|		------	||		|	
	|			||		|	
v(vph)	15	34		23				
C m(vph)	1013	243		476				
v/c	0.01	0.14		0.05				
95% queue length								
Control Delay	8.6	22.2		13.0				
LOS	A	C		B				
Approach Delay				18.5				
Approach LOS				C				

Worksheet 11 Shared Major LT Impedance and Delay

Rank 1 Delay Calculations

Movement	2	5
P oj	1.00	0.99
V i1	0	399
V i2	0	0
S i1	1700	1700
S i2	1700	1700
P* 0j	1.00	0.98
D maj left	0.0	8.6
N number major st lanes	1	2
Delay, rank 1 mvmts	0.0	0.1

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 2
Count Date: CAB
Time Period: AM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	1259	86	59	476	10	17
HFR:	1259	86	59	476	10	17
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
N	Y	N	N	Y	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	Y	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	N	N	N	N	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
N	N	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	476
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	2	1

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	4	7	9
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	4	7	9
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	673	
Potential Capacity	403	
Pedestrian Impedance Factor	1.00	
Movement Capacity	403	
Probability of Queue free St.	0.96	

Step 2: LT from Major St.	4	1
Conflicting Flows	1345	
Potential Capacity	519	
Pedestrian Impedance Factor	1.00	
Movement Capacity	519	
Probability of Queue free St.	0.89	
Maj. L Shared In. Prob. Queue Free St.	0.84	

Step 4: LT from Minor St.	7	10

Conflicting Flows	1896
Potential Capacity	63
Pedestrian Impedance Factor	1.00
Maj. L, Min T Impedance factor	0.84
Maj. L, Min T Adj. Imp Factor.	0.88
Cap. Adj. factor due to Impeding mvmnt	0.88
Movement Capacity	55

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
	|----			||		|	
	|		----||			|	
	|			||		|	
v(vph)	59	10		17				
C m(vph)	519	55		403				
v/c	0.11	0.18		0.04				
95% queue length								
Control Delay	12.8	84.3		14.3				
LOS	B	F		B				
Approach Delay				40.2				
Approach LOS				E				

Worksheet 11 Shared Major LT Impedance and Delay

Rank 1 Delay Calculations

Movement	2	5
P oj	1.00	0.89
V i1	0	476
V i2	0	0
S i1	1700	1700
S i2	1700	1700
P* 0j	1.00	0.84
D maj left	0.0	12.8
N number major st lanes	2	1
Delay, rank 1 mvmts	-1.$	2.0

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 2
Count Date: CAB
Time Period: PM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	553	24	43	789	24	19
HFR:	553	24	43	789	24	19
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
N	Y	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	Y	N	N	Y	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	N	N	N	N	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
N	N	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	394
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	2

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	4	7	9
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	4	7	9
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	565	
Potential Capacity	473	
Pedestrian Impedance Factor	1.00	
Movement Capacity	473	
Probability of Queue free St.	0.96	

Step 2: LT from Major St.	4	1
Conflicting Flows	577	
Potential Capacity	1006	
Pedestrian Impedance Factor	1.00	
Movement Capacity	1006	
Probability of Queue free St.	0.96	
Maj. L Shared In. Prob. Queue Free St.	0.94	

Step 4: LT from Minor St.	7	10

Conflicting Flows	104[redacted]	
Potential Capacity	22[redacted]	
Pedestrian Impedance Factor		1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt		0.96
Movement Capacity		218

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
v(vph)	43	24			19			
C m(vph)	1006	218			473			
v/c	0.04	0.11			0.04			
95% queue length								
Control Delay	8.7	23.6			12.9			
LOS	A	C			B			
Approach Delay				18.9				
Approach LOS				C				

Worksheet 11 Shared Major LT Impedance and Delay

Rank 1 Delay Calculations

Movement	2	5
P oj	1.00	0.96
V i1	0	394
V i2	0	0
S i1	1700	1700
S i2	1700	1700
P* 0j	1.00	0.94
D maj left	0.0	8.7
N number major st lanes		1 2
Delay, rank 1 mvmts		0.0 0.2

HCS: Signalized Intersections Release 3.1c

Inter: Reservoir Road & 39th Street
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road

City/St: Washington, DC
Proj #: 1701-001 BG2
Period: AM Total Future 2010
N/S St: 39th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	1	1	0	0	0	0	0	0
LGConfig		LT			T	R					LR	
Volume	152	1124			481	16				57		54
Lane Width		12.0			12.0	12.0					12.0	
RTOR Vol						0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	A				Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru	A				Thru			
Right	A				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0					17.0		
Yellow	4.0					4.0		
All Red	1.0							

Cycle Length: 71.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1707	2694	0.83	0.634	13.7	B	13.7	B
Westbound								
T	1204	1900	0.44	0.634	6.9	A	6.8	A
R	1024	1615	0.02	0.634	4.8	A		
Northbound								
Southbound								
LR	370	1545	0.33	0.239	22.8	C	22.8	C

Intersection Delay = 12.4 (sec/veh) Intersection LOS = B

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Reservoir Road & 39th Street
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	AM Total Future 2010
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	39th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	152	1124			481	16				57		54
PHF	0.90	0.90			0.90	0.90				0.90		0.90
PK 15 Vol	42	312			134	4				16		15
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900			1900	1900					1900	
ParkExist												
NumPark												
% Heavy Veh	0	0			0	0				0		0
No. Lanes	0	2	0	0	1	1	0	0	0	0	0	0
LGConfig		LT			T	R					LR	
Lane Width		12.0			12.0	12.0					12.0	
RTOR Vol						0						0
Adj Flow		1418			534	18					123	
%InSharedLn												
Prop Turns	0.12									0.51		0.49
NumPeds						0			0			0
NumBus		0			0	0					0	

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0					0.0	
Arriv. Type		3			3	3					3	
Unit Ext.		3.0			3.0	3.0					3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0			2.0	2.0					2.0	
Ext of g		2.0			2.0	2.0					2.0	
Ped Min g		3.0			3.0						3.0	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	A				Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru	A				Thru			
Right	A				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0					17.0		
Yellow	4.0					4.0		
All Red	1.0							

Cycle Length: 71.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	152	0.90	169	0					
Thru	1124	0.90	1249	2	LT		1418	0.12	
Right				0					
Westbound									
Left				0					
Thru	481	0.90	534	1	T		534		
Right	16	0.90	18	1	R	0	18		
Northbound									
Left				0					
Thru				0					
Right				0					
Southbound									
Left	57	0.90	63	0					
Thru				0	LR		123	0.51	0.49
Right	54	0.90	60	0		0			

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound									Sec LT Adj/LT Sat: ----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	1.000	0.746 ----	2694
Westbound									Sec LT Adj/LT Sat: ----		
T	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	1.000	1900
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Northbound									Sec LT Adj/LT Sat: ----		
					---					----	
Southbound									Sec LT Adj/LT Sat: ----		
LR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.834	0.975 ----	1545

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Pri.							
Sec.							
Left							
Thru	LT	1418	2694	0.53	0.634	1707	0.83
Right							
Westbound							
Pri.							
Sec.							
Left							
Thru	T	534	1900	0.28	0.634	1204	0.44
Right	R	18	1615	0.01	0.634	1024	0.02
Northbound							
Pri.							
Sec.							
Left							
Thru							
Right							
Southbound							
Pri.							
Sec.							
Left							
Thru	LR	123	1545	0.08	0.239	370	0.33
Right							

Sum (v/s) critical = 0.00

Lost Time/Cycle, L = 0.00 sec Critical v/c(X) = 0.00

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.83	0.634	10.1	1.000	1707	0.37	3.6	0.0	13.7	B	13.7	B
Westbound												
T	0.44	0.634	6.6	1.000	1204	0.11	0.3	0.0	6.9	A	6.8	A
R	0.02	0.634	4.8	1.000	1024	0.11	0.0	0.0	4.8	A		
Northbound												
Southbound												
LR	0.33	0.239	22.3	1.000	370	0.11	0.5	0.0	22.8	C	22.8	C

Intersection Delay = 12.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 71.0 sec				
Actual Green Time for Lane Group, G				
Effective Green Time for Lane Group, g				
Opposing Effective Green Time, go				
Number of Lanes in Lane Group, N				
Number of Opposing Lanes, No				
Adjusted Left-Turn Flow Rate, Vlt				
Proportion of Left Turns in Opposing Flow, Plto				
Adjusted Opposing Flow Rate, Vo				
Lost Time for Lane Group, tl				
Left Turns per Cycle: LTC=VltC/3600				
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo				
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)				
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g				
Opposing Queue Ratio: qro=1-Rpo(go/C)				
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g				
gu =g-gq if gq>=gf, =g-gf if gq<gf				
n=(gq-gf)/2, n>=0				
Ptho=1-Plto				
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]				
El1 (Figure 9-7)				
El2=(1-Ptho**n)/Plto, El2>=1.0				
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)				
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 71.0 sec				
Actual Green Time for Lane Group, G	45.0			
Effective Green Time for Lane Group, g	45.0			
Opposing Effective Green Time, go	45.0			
Number of Lanes in Lane Group, N	2			
Number of Opposing Lanes, No	1			
Adjusted Left-Turn Flow Rate, Vlt	169			
Proportion of Left Turns in Lane Group, Plt	0.12			
Proportion of Left Turns in Opposing Flow, Plto	0.00			
Adjusted Opposing Flow Rate, Vo	534			
Lost Time for Lane Group, tl	5.00			
Left Turns per Cycle: LTC=VltC/3600	3.33			
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	10.53			
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00			
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	0.0			
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.37			
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	5.24			
gu =g-gq if gq>=gf, =g-gf if gq<gf	39.76			
n=(gq-gf)/2, n>=0	2.62			
Ptho=1-Plto	1.00			
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24))}	0.38			
El1 (Figure 9-7)	2.38			
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00			
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.06			
gdiff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.58			
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.746			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 71.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 12.4 sec/veh Intersection LOS B

HCS: Signalized Intersections Release 3.1c

Inter: Reservoir Road & 39th Street
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road

City/St: Washington, DC
Proj #: 1701-001 BG2
Period: PM Total Future 2010
N/S St: 39th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	2	0	0	0	0	0	0	0
LGConfig		LT			TR						LR	
Volume	78	494			766	35				26		66
Lane Width		12.0			12.0						12.0	
RTOR Vol						0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left				
Thru	A				Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	A			
Thru	A				Thru				
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	45.0					17.0			
Yellow	4.0					4.0			
All Red	0.0					0.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	967	1505	0.66	0.643	9.4	A	9.4	A
Westbound								
TR	2305	3586	0.39	0.643	6.0	A	6.0	A
Northbound								
Southbound								
LR	366	1505	0.28	0.243	21.9	C	21.9	C

Intersection Delay = 8.3 (sec/veh) Intersection LOS = A

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Reservoir Road & 39th Street
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	PM Total Future 2010
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	39th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	78	494			766	35				26		66
PHF	0.90	0.90			0.90	0.90				0.90		0.90
PK 15 Vol	22	137			213	10				7		18
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900			1900						1900	
ParkExist												
NumPark												
% Heavy Veh	0	0			0	0				0		0
No. Lanes	0	1	0	0	2	0	0	0	0	0	0	0
LGConfig		LT			TR						LR	
Lane Width		12.0			12.0						12.0	
RTOR Vol						0						0
Adj Flow		636			890						102	
%InSharedLn												
Prop Turns	0.14					0.04				0.28		0.72
NumPeds						0			0			0
NumBus		0			0						0	

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0						0.0	
Arriv. Type		3			3						3	
Unit Ext.		3.0			3.0						3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0			2.0						2.0	
Ext of g		2.0			2.0						2.0	
Ped Min g		3.0			3.0						3.0	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left				
Thru	A				Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	A			
Thru	A				Thru				
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	45.0					17.0			
Yellow	4.0					4.0			
All Red	0.0					0.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	78	0.90	87	0					
Thru	494	0.90	549	1	LT		636	0.14	
Right				0					
Westbound									
Left				0					
Thru	766	0.90	851	2	TR		890		0.04
Right	35	0.90	39	0		0			
Northbound									
Left				0					
Thru				0					
Right				0					
Southbound									
Left	26	0.90	29	0					
Thru				0	LR		102	0.28	0.72
Right	66	0.90	73	0		0			

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.792	1505

Westbound							Sec LT Adj/LT Sat:		----		
TR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.993	1.000	3586

Northbound							Sec LT Adj/LT Sat:		----		

Southbound							Sec LT Adj/LT Sat:		----		
LR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.803	0.986	1505

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Pri.							
Sec.							
Left							
Thru	LT	636	1505	0.42	0.643	967	0.66
Right							
Westbound							
Pri.							
Sec.							
Left							
Thru	TR	890	3586	0.25	0.643	2305	0.39
Right							
Northbound							
Pri.							
Sec.							
Left							
Thru							
Right							
Southbound							
Pri.							
Sec.							
Left							
Thru	LR	102	1505	0.07	0.243	366	0.28
Right							

Sum (v/s) critical = 0.00

Lost Time/Cycle, L = 0.00 sec Critical v/c(X) = 0.00

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.66	0.643	7.7	1.000	967	0.23	1.6	0.0	9.4	A	9.4	A
Westbound												
TR	0.39	0.643	5.9	1.000	2305	0.11	0.1	0.0	6.0	A	6.0	A
Northbound												
Southbound												
LR	0.28	0.243	21.5	1.000	366	0.11	0.4	0.0	21.9	C	21.9	C

Intersection Delay = 8.3 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 70.0 sec				
Actual Green Time for Lane Group, G	45.0			
Effective Green Time for Lane Group, g	45.0			
Opposing Effective Green Time, go	45.0			
Number of Lanes in Lane Group, N	1			
Number of Opposing Lanes, No	2			
Adjusted Left-Turn Flow Rate, Vlt	87			
Proportion of Left Turns in Lane Group, Plt	0.14			
Proportion of Left Turns in Opposing Flow, Plto	0.00			
Adjusted Opposing Flow Rate, Vo	890			
Lost Time for Lane Group, tl	4.00			
Left Turns per Cycle: LTC=VltC/3600	1.69			
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	9.11			
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00			
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	8.4			
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.36			
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	4.93			
gu =g-gq if gq>=gf, =g-gf if gq<gf	36.56			
n=(gq-gf)/2, n>=0	0.00			
Ptho=1-Plto	1.00			
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.14			
El1 (Figure 9-7)	3.51			
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00			
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.05			
gdiff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.79			
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.792			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	110	543	1	1	550	48	3	11	7	128	5	106
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	31	151	1	1	153	13	1	3	2	36	2	29
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900	1900		1900			1900	1900
ParkExist												
NumPark												
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
No. Lanes	0	1	1	0	1	1	0	1	0	0	1	1
LGConfig		LT	R		LT	R		LTR			LT	R
Lane Width		12.0	12.0		12.0	12.0		12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow		725	1		612	53		23			148	118
%InSharedLn												
Prop Turns	0.17			0.00			0.13		0.35	0.96		
NumPeds			0			0			0			0
NumBus		0	0		0	0		0			0	0

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0		0.0	-		0.0	0.0
Arriv. Type		3	3		3	3		3			3	3
Unit Ext.		3.0	3.0		3.0	3.0		3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0		2.0			2.0	2.0
Ext of g		2.0	2.0		2.0	2.0		2.0			2.0	2.0
Ped Min g		3.0			3.0			3.0			3.0	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
WB Left	A				SB Left	A			
Thru	A				Thru	A			
Right	A				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	58.0					12.0			
Yellow	4.0					4.0			
All Red	1.0					1.0			

Cycle Length: 80.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	110	0.90	122	0					
Thru	543	0.90	603	1	LT		725	0.17	
Right	1	0.90	1	1	R	0	1		
Westbound									
Left	1	0.90	1	0					
Thru	550	0.90	611	1	LT		612	0.00	
Right	48	0.90	53	1	R	0	53		
Northbound									
Left	3	0.90	3	0					
Thru	11	0.90	12	1	LTR		23	0.13	0.35
Right	7	0.90	8	0		0			
Southbound									
Left	128	0.90	142	0					
Thru	5	0.90	6	1	LT		148	0.96	
Right	106	0.90	118	1	R	0	118		

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.815	1549
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Westbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	1.000	1899
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Northbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.853	0.959	1554

Southbound							Sec LT Adj/LT Sat:		----		
LT	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	0.718	1364
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Pri.							
Sec.							
Left							
Thru	LT	725	1549	# 0.47	0.725	1123	0.65
Right	R	1	1615	0.00	0.725	1171	0.00
Westbound							
Pri.							
Sec.							
Left							
Thru	LT	612	1899	0.32	0.725	1377	0.44
Right	R	53	1615	0.03	0.725	1171	0.05
Northbound							
Pri.							
Sec.							
Left							
Thru	LTR	23	1554	0.01	0.150	233	0.10
Right							
Southbound							
Pri.							
Sec.							
Left							
Thru	LT	148	1364	# 0.11	0.150	205	0.72
Right	R	118	1615	0.07	0.150	242	0.49

Sum (v/s) critical = 0.58

Lost Time/Cycle, L = 10.00 sec Critical v/c(X) = 0.66

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.65	0.725	5.7	1.000	1123	0.22	1.3	0.0	7.0	A	7.0	A
R	0.00	0.725	3.0	1.000	1171	0.11	0.0	0.0	3.0	A		
Westbound												
LT	0.44	0.725	4.5	1.000	1377	0.11	0.2	0.0	4.7	A	4.6	A
R	0.05	0.725	3.1	1.000	1171	0.11	0.0	0.0	3.1	A		
Northbound												
LTR	0.10	0.150	29.3	1.000	233	0.11	0.2	0.0	29.5	C	29.5	C
Southbound												
LT	0.72	0.150	32.4	1.000	205	0.28	11.8	0.0	44.2	D	39.1	D
R	0.49	0.150	31.2	1.000	242	0.11	1.5	0.0	32.7	C		

Intersection Delay = 11.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G				
Effective Green Time for Lane Group, g				
Opposing Effective Green Time, go				
Number of Lanes in Lane Group, N				
Number of Opposing Lanes, No				
Adjusted Left-Turn Flow Rate, Vlt				
Proportion of Left Turns in Opposing Flow, Plto				
Adjusted Opposing Flow Rate, Vo				
Lost Time for Lane Group, tl				
Left Turns per Cycle: LTC=VltC/3600				
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo				
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)				
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g				
Opposing Queue Ratio: qro=1-Rpo(go/C)				
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g				
gu =g-gq if gq>=gf, =g-gf if gq<gf				
n=(gq-gf)/2, n>=0				
Ptho=1-Plto				
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]				
El1 (Figure 9-7)				
El2=(1-Ptho**n)/Plto, El2>=1.0				
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)				
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N** flt				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G	58.0	58.0	12.0	12.0
Effective Green Time for Lane Group, g	58.0	58.0	12.0	12.0
Opposing Effective Green Time, go	58.0	58.0	12.0	12.0
Number of Lanes in Lane Group, N	1	1	1	1
Number of Opposing Lanes, No	1	1	1	1
Adjusted Left-Turn Flow Rate, Vlt	122	1	3	142
Proportion of Left Turns in Lane Group, Plt	0.17	0.00	0.13	0.96
Proportion of Left Turns in Opposing Flow, Plto	0.00	0.17	0.96	0.13
Adjusted Opposing Flow Rate, Vo	612	725	148	23
Lost Time for Lane Group, tl	5.00	5.00	5.00	5.00
Left Turns per Cycle: LTC=VltC/3600	2.71	0.02	0.07	3.16
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	13.60	16.11	3.29	0.51
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00	1.00	1.00	1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	6.6	48.6	5.3	0.0
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.28	0.28	0.85	0.85
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	4.18	5.45	5.31	0.00
gu =g-gq if gq>=gf, =g-gf if gq<gf	51.41	9.38	6.69	12.00
n=(gq-gf)/2, n>=0	0.00	0.00	0.02	0.00
Ptho=1-Plto	1.00	0.83	0.04	0.87
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.17	0.00	0.13	0.96
El1 (Figure 9-7)	2.57	2.87	1.61	1.41
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00	1.00	1.00	1.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.04	0.03	0.19	0.33
gdiff=max(gq-gf,0)	0.00	0.00	0.05	0.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.82	1.00	0.96	0.72
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}]				
+[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.815	1.000	0.959	0.718

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 80.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.4 sec/veh Intersection LOS B

ERROR MESSAGES

No errors to report.

TOTAL FUTURE DEVELOPMENT CONDITIONS

HCS: Signalized Intersections Release 3.1c

Inter: Foxhall Road & Reservoir Road
Analyst: CAB
Date: 03/23/2000
E/W St: Reservoir Road
City/St: Washington, DC
Proj #: 1701-001 BG2
Period: AM Total Future 2010
N/S St: Foxhall Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	1	0	2	0	1	1	0
LGConfig		LTR		L	T	R		LTR		L	TR	
Volume	10	758	76	91	201	54	31	690	343	442	377	21
Lane Width		12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left		A		
Thru	A					Thru		A		
Right	A					Right		A		
Peds						Peds				
WB Left	A				SB	Left	A	A		
Thru	A					Thru	A	A		
Right	A					Right	A	A		
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	18.0						20.0	24.0		
Yellow	5.0						5.0	5.0		
All Red	1.0						1.0	1.0		

Cycle Length: 80.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	609	2706	1.54	0.225	281.5	F	281.5	F
Westbound								
L	95	422	1.06	0.225	141.5	F		
T	427	1900	0.52	0.225	28.4	C	57.6	E
R	363	1615	0.17	0.225	25.2	C		
Northbound								
LTR	943	3144	1.25	0.300	150.8	F	150.8	F
Southbound								
L	569		0.86	0.625	42.8	D		
TR	1178	1885	0.38	0.625	7.5	A	26.1	C

Intersection Delay = 142.2 (sec/veh) Intersection LOS = F

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Foxhall Road & Reservoir Road
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	AM Total Future 2010
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	Foxhall Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	758	76 -	91	201	54	31	690	343	442	377	21
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	3	211	21	25	56	15	9	192	95	123	105	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900		1900	1900	
ParkExist												
NumPark												
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
No. Lanes	0	2	0	1	1	1	0	2	0	1	1	0
LGConfig		LTR		L	T	R		LTR		L	TR	
Lane Width		12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow		937		101	223	60		1182		491	442	
%InSharedLn												
Prop Turns	0.01		0.09				0.03		0.32			0.05
NumPeds			0			0			0			0
NumBus		0		0	0	0		0		0	0	

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3		3	3	3		3		3	3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0		2.0	2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0		2.0	2.0	
Ped Min g		3.0			3.0			3.0			3.0	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru	A				Thru	A		
Right	A				Right	A		
Peds					Peds			
WB Left	A				SB Left	A	A	
Thru	A				Thru	A	A	
Right	A				Right	A	A	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	18.0					20.0	24.0	
Yellow	5.0					5.0	5.0	
All Red	1.0					1.0	1.0	

Cycle Length: 80.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	10	0.90	11	0					
Thru	758	0.90	842	2	LTR		937	0.01	0.09
Right	76	0.90	84	0		0			
Westbound									
Left	91	0.90	101	1	L		101		
Thru	201	0.90	223	1	T		223		
Right	54	0.90	60	1	R	0	60		
Northbound									
Left	31	0.90	34	0					
Thru	690	0.90	767	2	LTR		1182	0.03	0.32
Right	343	0.90	381	0		0			
Southbound									
Left	442	0.90	491	1	L		491		
Thru	377	0.90	419	1	TR		442		0.05
Right	21	0.90	23	0		0			

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.987	0.760	2706

Westbound							Sec LT Adj/LT Sat:				
L	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	----	0.222	422
T	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	1.000	1900
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Northbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.952	0.915	3144

Southbound							Sec LT Adj/LT Sat:			0.138	262
L	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	----	0.950	1805
TR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.992	1.000	1885

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Pri.								
Sec.								
Left								
Thru	LTR	937	2706	#	0.35	0.225	609	1.54
Right								
Westbound								
Pri.								
Sec.								
Left	L	101	422		0.24	0.225	95	1.06
Thru	T	223	1900		0.12	0.225	427	0.52
Right	R	60	1615		0.04	0.225	363	0.17
Northbound								
Pri.								
Sec.								
Left								
Thru	LTR	1182	3144	#	0.38	0.300	943	1.25
Right								
Southbound								
Pri.		474	1805	#	0.26	0.262	474	1.00
Sec.		17	262		0.06	0.363	95	0.18
Left	L	491				0.625	569	0.86
Thru	TR	442	1885		0.23	0.625	1178	0.38
Right								

Sum (v/s) critical = 0.98

Lost Time/Cycle, L = 18.00 sec Critical v/c(X) = 1.27

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LTR	1.54	0.225	31.0	1.000	609	0.50	250.5	0.0	281.5	F	281.5	F
Westbound												
L	1.06	0.225	31.0	1.000	95	0.50	110.5	0.0	141.5	F		
T	0.52	0.225	27.2	1.000	427	0.13	1.2	0.0	28.4	C	57.6	E
R	0.17	0.225	25.0	1.000	363	0.11	0.2	0.0	25.2	C		
Northbound												
LTR	1.25	0.300	28.0	1.000	943	0.50	122.8	0.0	150.8	F	150.8	F
Southbound												
L	0.86	0.625	29.9	1.000	569	0.39	12.9	0.0	42.8	D		
TR	0.38	0.625	7.3	1.000	1178	0.11	0.2	0.0	7.5	A	26.1	C

Intersection Delay = 142.2 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G		18.0		50.0
Effective Green Time for Lane Group, g		18.0		29.0
Opposing Effective Green Time, go		18.0		24.0
Number of Lanes in Lane Group, N		1		1
Number of Opposing Lanes, No		2		2
Adjusted Left-Turn Flow Rate, Vlt		101		491
Proportion of Left Turns in Opposing Flow, Plto		0.01		0.03
Adjusted Opposing Flow Rate, Vo		937		1182
Lost Time for Lane Group, tl		6.00		6.00
Left Turns per Cycle: LTC=VltC/3600		2.24		10.91
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo		10.96		13.82
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)		1.00		1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g		0.0		0.0
Opposing Queue Ratio: qro=1-Rpo(go/C)		0.77		0.70
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g		17.38		29.00
gu =g-gq if gq>=gf, =g-gf if gq<gf		0.62		0.00
n=(gq-gf)/2, n>=0		8.69		14.50
Ptho=1-Plto		0.99		0.97
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]		1.00		1.00
El1 (Figure 9-7)		3.28		4.18
El2=(1-Ptho**n)/Plto, El2>=1.0		8.31		12.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g		0.22		0.14
gdiff=max(gq-gf,0)		17.38		29.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)		0.22		0.14
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt		0.222		0.138

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G	18.0		24.0	
Effective Green Time for Lane Group, g	18.0		24.0	
Opposing Effective Green Time, go	18.0		50.0	
Number of Lanes in Lane Group, N	2		2	
Number of Opposing Lanes, No	1		1	
Adjusted Left-Turn Flow Rate, Vlt	11		34	
Proportion of Left Turns in Lane Group, Plt	0.01		0.03	
Proportion of Left Turns in Opposing Flow, Plto	0.00		0.00	
Adjusted Opposing Flow Rate, Vo	223		442	
Lost Time for Lane Group, tl	6.00		6.00	
Left Turns per Cycle: LTC=VltC/3600	0.24		0.76	
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	4.96		9.82	
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00		1.00	
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	0.0		0.0	
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.77		0.38	
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	6.77		0.00	
gu =g-gq if gq>=gf, =g-gf if gq<gf	11.23		24.00	
n=(gq-gf)/2, n>=0	3.39		0.00	
Ptho=1-Plto	1.00		1.00	
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.03		0.07	
El1 (Figure 9-7)	1.74		2.17	
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00		1.00	
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.11		0.09	
gdiff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.61		0.92	
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.760		0.915	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				491
v/c ratio from Capacity Worksheet, X				0.86
Primary phase effective green, g				21.0
Secondary phase effective green, gq				29.00
(From Supplemental Permitted LT Worksheet), gu				0.00
Cycle length, C 80.0 Red =(C-g-gq-gu), r				30.0
Arrivals: v/(3600(max(X,1.0))), qa				0.14
Primary ph. departures: s/3600, sp				0.501
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				29.00
XPerm				9.99
XProt				0.66
XCase				3
Queue at beginning of green arrow, Qa				8.05
Queue at beginning of unsaturated green, Qu				3.96
Residual queue, Qr				3.96
Uniform Delay, d1				29.9

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 142.2 sec/veh Intersection LOS F

ERROR MESSAGES

No errors to report.

HCS: Signalized Intersections Release 3.1c

Inter: Foxhall Road & Reservoir Road City/St: Washington, DC
Analyst: CAB Proj #: 1701-001 BG2
Date: 03/23/2000 Period: PM Total Future 2010
E/W St: Reservoir Road N/S St: Foxhall Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	1	0	2	0	1	1	0
LGConfig		LTR		L	T	R		LTR		L	TR	
Volume	10	245	41	222	505	203	36	426	148	160	501	30
Lane Width		12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	A	A		
Thru	A					Thru	A	A		
Right	A					Right	A	P		
Peds						Peds				
WB Left	A				SB	Left		A		
Thru	A					Thru		A		
Right	A					Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	18.0						20.0	24.0		
Yellow	5.0						5.0	5.0		
All Red	1.0						1.0	1.0		

Cycle Length: 80.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	414	1839	0.79	0.225	39.5	D	39.5	D
Westbound								
L	177	786	1.40	0.225	239.6	F		
T	427	1900	1.31	0.225	188.1	F	166.1	F
R	363	1615	0.62	0.225	31.2	C		
Northbound								
LTR	2099	3358	0.32	0.625	7.1	A	7.1	A
Southbound								
L	225	749	0.79	0.300	43.0	D		
TR	565	1884	1.04	0.300	77.9	E	69.8	E

Intersection Delay = 86.6 (sec/veh) Intersection LOS = F

HCS: Signalized Intersections Release 3.1c

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OPERATIONAL ANALYSIS

Intersection:	Foxhall Road & Reservoir Road
City/State:	Washington, DC
Analyst:	CAB
Project No:	1701-001 BG2
Time Period Analyzed:	PM Total Future 2010
Date:	03/23/2000
East/West Street Name:	Reservoir Road
North/South Street Name:	Foxhall Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	245	41	222	505	203	36	426	148	160	501	30
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	3	68	11	62	140	56	10	118	41	44	139	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900		1900	1900	
ParkExist												
NumPark												
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
No. Lanes	0	2	0	1	1	1	0	2	0	1	1	0
LGConfig		LTR		L	T	R		LTR		L	TR	
Lane Width		12.0		12.0	12.0	12.0		12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow		329		247	561	226		677		178	590	
%InSharedLn												
Prop Turns	0.03		0.14				0.06		0.24			0.06
NumPeds			0			0			0			0
NumBus		0		0	0	0		0		0	0	

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3		3	3	3		3		3	3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0		2.0	2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0		2.0	2.0	
Ped Min g		3.0			3.0			3.0			3.0	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A	A		
Thru	A				Thru	A	A		
Right	A				Right	A	P		
Peds					Peds				
WB Left	A				SB Left		A		
Thru	A				Thru		A		
Right	A				Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	18.0					20.0	24.0		
Yellow	5.0					5.0	5.0		
All Red	1.0					1.0	1.0		

Cycle Length: 80.0 secs

VOLUME ADJUSTMENT WORKSHEET

Appr./ Movement	Mvt Volume	PHF	Flow Rate	No. Lanes	Lane Group	RTOR	Adjusted Flow Rate In Lane Grp	Prop. Left Turns	Prop. Right Turns
Eastbound									
Left	10	0.90	11	0					
Thru	245	0.90	272	2	LTR		329	0.03	0.14
Right	41	0.90	46	0		0			
Westbound									
Left	222	0.90	247	1	L		247		
Thru	505	0.90	561	1	T		561		
Right	203	0.90	226	1	R	0	226		
Northbound									
Left	36	0.90	40	0					
Thru	426	0.90	473	2	LTR		677	0.06	0.24
Right	148	0.90	164	0		0			
Southbound									
Left	160	0.90	178	1	L		178		
Thru	501	0.90	557	1	TR		590		0.06
Right	30	0.90	33	0		0			

* Value entered by user.

SATURATION FLOW ADJUSTMENT WORKSHEET

Appr/ Lane Group	Ideal Sat Flow	f W	f HV	f G	f P	f BB	f A	f LU	f RT	f LT	Adj Sat Flow
Eastbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.979	0.520	1839

Westbound							Sec LT Adj/LT Sat:				
L	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	----	0.414	786
T	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	1.000	1.000	1900
R	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.850	----	1615
Northbound							Sec LT Adj/LT Sat:		----		
LTR	1900	1.000	1.000	1.000	1.000	1.000	1.00	0.95	0.964	0.965	3358

Southbound							Sec LT Adj/LT Sat:				
L	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	----	0.394	749
TR	1900	1.000	1.000	1.000	1.000	1.000	1.00	1.00	0.992	1.000	1884

CAPACITY ANALYSIS WORKSHEET

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Pri.								
Sec.								
Left								
Thru	LTR	329	1839		0.18	0.225	414	0.79
Right								
Westbound								
Pri.								
Sec.								
Left	L	247	786	#	0.31	0.225	177	1.40
Thru	T	561	1900		0.30	0.225	427	1.31
Right	R	226	1615		0.14	0.225	363	0.62
Northbound								
Pri.								
Sec.						0.363		
Left								
Thru	LTR	677	3358	#	0.20	0.625	2099	0.32
Right								
Southbound								
Pri.								
Sec.								
Left	L	178	749		0.24	0.300	225	0.79
Thru	TR	590	1884		0.31	0.300	565	1.04
Right								

Sum (v/s) critical = 0.52

Lost Time/Cycle, L = 12.00 sec Critical v/c(X) = 0.61

LEVEL OF SERVICE WORKSHEET

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LTR	0.79	0.225	29.3	1.000	414	0.34	10.3	0.0	39.5	D	39.5	D
Westbound												
L	1.40	0.225	31.0	1.000	177	0.50	208.6	0.0	239.6	F		
T	1.31	0.225	31.0	1.000	427	0.50	157.1	0.0	188.1	F	166.1	F
R	0.62	0.225	27.9	1.000	363	0.21	3.3	0.0	31.2	C		
Northbound												
LTR	0.32	0.625	7.0	1.000	2099	0.11	0.1	0.0	7.1	A	7.1	A
Southbound												
L	0.79	0.300	25.7	1.000	225	0.34	17.3	0.0	43.0	D		
TR	1.04	0.300	28.0	1.000	565	0.50	49.9	0.0	77.9	E	69.8	E

Intersection Delay = 86.6 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G		18.0		24.0
Effective Green Time for Lane Group, g		18.0		24.0
Opposing Effective Green Time, go		18.0		50.0
Number of Lanes in Lane Group, N		1		1
Number of Opposing Lanes, No		2		2
Adjusted Left-Turn Flow Rate, Vlt		247		178
Proportion of Left Turns in Opposing Flow, Plto		0.03		0.06
Adjusted Opposing Flow Rate, Vo		329		677
Lost Time for Lane Group, tl		6.00		6.00
Left Turns per Cycle: LTC=VltC/3600		5.49		3.96
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo		3.85		7.92
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)		1.00		1.00
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g		0.0		0.0
Opposing Queue Ratio: qro=1-Rpo(go/C)		0.77		0.38
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g		4.53		0.00
gu =g-gq if gq>=gf, =g-gf if gq<gf		13.47		24.00
n=(gq-gf)/2, n>=0		2.27		0.00
Ptho=1-Plto		0.97		0.94
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)}]		1.00		1.00
El1 (Figure 9-7)		1.81		2.54
El2=(1-Ptho**n)/Plto, El2>=1.0		2.22		1.00
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g		0.22		0.17
gdiff=max(gq-gf,0)		4.53		0.00
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)		0.41		0.39
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt		0.414		0.394

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

APPROACH	EB	WB	NB	SB
Cycle Length, C 80.0 sec				
Actual Green Time for Lane Group, G	18.0			
Effective Green Time for Lane Group, g	18.0			
Opposing Effective Green Time, go	18.0			
Number of Lanes in Lane Group, N	2			
Number of Opposing Lanes, No	1			
Adjusted Left-Turn Flow Rate, Vlt	11			
Proportion of Left Turns in Lane Group, Plt	0.03			
Proportion of Left Turns in Opposing Flow, Plto	0.00			
Adjusted Opposing Flow Rate, Vo	561			
Lost Time for Lane Group, tl	6.00			
Left Turns per Cycle: LTC=VltC/3600	0.24			
Opposing Flow per Lane, Per Cycle: Volc=VoC/3600fluo	12.47			
Opposing Platoon Ratio, Rpo (Table 9-2 or Eqn 9-7)	1.00			
gf=[Gexp(- a * (LTC ** b))]-tl, gf<=g	0.0			
Opposing Queue Ratio: qro=1-Rpo(go/C)	0.77			
gq=(4.943Volc**0.762)(qro**1.061)-tl, gq<=g	18.00			
gu =g-gq if gq>=gf, =g-gf if gq<gf	0.00			
n=(gq-gf)/2, n>=0	9.00			
Ptho=1-Plto	1.00			
Pl*=Plt[1+{(N-1)g/(gf+gu/El1+4.24)))	0.18			
El1 (Figure 9-7)	2.44			
El2=(1-Ptho**n)/Plto, El2>=1.0	1.00			
fmin=2(1+Plt)/g or fmin=2(1+Pl)/g	0.13			
gdiff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g][1/{1+Pl(El1-1)}], (min=fmin;max=1.00)	0.13			
flt=fm=[gf/g]+gdiff[1/{1+Plt(El2-1)}] +[gu/g][1/(1+Plt(El1-1)],(min=fmin;max=1.0) or flt=[fm+0.91(N-1)]/N**				
flt Primary	0.520			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Adj. LT Vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Primary phase effective green, g				
Secondary phase effective green, gq				
(From Supplemental Permitted LT Worksheet), gu				
Cycle length, C 80.0 Red =(C-g-gq-gu), r				
Arrivals: v/(3600(max(X,1.0))), qa				
Primary ph. departures: s/3600, sp				
Secondary ph. departures: s(gq+gu)/(gu*3600), ss				
XPerm				
XProt				
XCase				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 86.6 sec/veh Intersection LOS F

ERROR MESSAGES

No errors to report.

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 4
Count Date: CAB
Time Period: AM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	1450	170	50	389	3	6
HFR:	1450	170	50	389	3	6
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
N	Y	N	N	Y	Y	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	Y	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	N	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R		T	R	L	T	
N	N	N	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Data for Computing Effect of Delay to Major Street Vehicles:

	Eastbound	Westbound
Shared ln volume, major th vehicles:	0	389
Shared ln volume, major rt vehicles:	0	0
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	2	1

Length of study period, hrs: 0.25

Worksheet 4 Critical Gap and Follow-up time calculation.

Critical Gap Calculations:

Movement	4	7	9
t c,base	4.1	7.5	6.9
t c,hv	2.0	2.0	2.0
P hv	0.00	0.00	0.00
t c,g		0.2	0.1
G	0.00	0.00	0.00
t 3,lt	0.0	0.7	0.0
t c,T:			
1 stage	0.00	0.00	0.00
t c			
1 stage	4.1	6.8	6.9

Follow Up Time Calculations:

Movement	4	7	9
t f,base	2.2	3.5	3.3
t f,HV	1.0	1.0	1.0
P hv	0.00	0.00	0.00
t f	2.2	3.5	3.3

Worksheet 6 Impedance and capacity equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	810	
Potential Capacity	327	
Pedestrian Impedance Factor	1.00	
Movement Capacity	327	
Probability of Queue free St.	0.98	

Step 2: LT from Major St.	4	1
Conflicting Flows	1620	
Potential Capacity	407	
Pedestrian Impedance Factor	1.00	
Movement Capacity	407	
Probability of Queue free St.	0.88	
Maj. L Shared In. Prob. Queue Free St.	0.84	

Step 4: LT from Minor St.	7	10

Conflicting Flows	2024
Potential Capacity	5
Pedestrian Impedance Factor	1.00
Maj. L, Min T Impedance factor	0.84
Maj. L, Min T Adj. Imp Factor.	0.88
Cap. Adj. factor due to Impeding mvmnt	0.88
Movement Capacity	45

Worksheet 8 Shared Lane Calculations

Shared Lane Calculations

Movement	7	8	9	10	11	12
v(vph)	3	6				
Movement Capacity	45	327				
Shared Lane Capacity	106					

Worksheet 10 delay,queue length, and LOS

Movement	1	4	7	8	9	10	11	12
v(vph)	50	9						
C m(vph)	407	106						
v/c	0.12	0.08						
95% queue length								
Control Delay	15.1	42.0						
LOS	C	E						
Approach Delay			42.0					
Approach LOS			E					

Worksheet 11 Shared Major LT Impedance and Delay

Rank 1 Delay Calculations

Movement	2	5
P oj	1.00	0.88
V i1	0	389
V i2	0	0
S i1	1700	1700
S i2	1700	1700
P* 0j	1.00	0.84
D maj left	0.0	15.1
N number major st lanes	2	1
Delay, rank 1 mvmts	-1.$	2.4

HCS: Unsignalized Intersections Release 3.1c

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: CAB
Intersection: Reservoir Road & Entrance 4
Count Date: CAB
Time Period: PM Total Future

Intersection Orientation: East-West Major St.

Vehicle Volume Data:

Movements:	2	3	4	5	7	9
Volume:	523	17	13	836	109	34
HFR:	523	17	13	836	109	34
PHF:	1.00	1.00	1.00	1.00	1.00	1.00
PHV:	0.00	0.00	0.00	0.00	0.00	0.00

Pedestrian Volume Data:

Movements:

Flow:
Lane width:
Walk speed:
% Blockage:

Median Type: None
# of vehicles: 0

Flared approach Movements:

# of vehicles: Northbound 0
# of vehicles: Southbound 0

Lane usage for movements 1,2&3 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
N	Y	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 4,5&6 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	Y	N	N	Y	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 7,8&9 approach:

	Lane 1			Lane 2			Lane 3	
L	T	R	L	T	R	L	T	R
Y	N	Y	N	N	N	N	N	N

Channelized: N
Grade: 0.00

Lane usage for movements 10,11&12 approach: