



SUMMARY MEMORANDUM

TO: Mr. Steve Sargent, P.E.
Oak Point Associates
231 Maine Street
Biddeford, ME 04005

DATE: April 8, 2011

RE: Traffic Impact Review for Proposed Waterville High School Improvements

The purpose of this memorandum is to summarize a traffic impact review that was performed regarding the proposed on-site improvements at Waterville High School in Waterville, Maine. The site location is shown on the map in Figure 1. The improvements are proposed in the area in front of the school, along Brooklyn Avenue and Messalonskee Avenue. Currently, all vehicles enter the student parking lot and bus area via a single one-way drive on Messalonskee Avenue. Traffic exits this area of the school via a single exit drive to Brooklyn Avenue. The proposed improvements include separation of the bus loop with a parking area from the student parking lot. The new student parking lot will contain two-way entrance/exits to Messalonskee Avenue and to Brooklyn Avenue. It is understood that concern was expressed from the neighborhood regarding exiting school trips. As a result, this analysis focuses upon the PM peak hour of the school, including a review of existing and proposed conditions.

Traffic Volumes

Turning movement counts were conducted by Maine Traffic Resources at the following intersections during the afternoon release period on Thursday, March 31st from 1:30 to 3:30 PM:

Intersection Description

Messalonskee Avenue and One-way High School Entrance
Messalonskee Avenue and Brooklyn Avenue
Brooklyn Avenue and One-way High School Exit Drive

The peak hour of the school traffic was found to occur from 2:00 to 3:00 PM. The non-school trips were factored to represent peak school year volumes, which occur in the first week in September, using MaineDOT group mean factors. The resulting peak hour volumes for existing 2011 conditions are shown in Figure 2. Similarly, the volumes for the entire two-hour count period, with the non-school trips factored to reflect peak September volumes, are shown in Figure 3 for informational purposes.

The existing trips were reassigned for the proposed changes in access and circulation. All bus trips were assigned to the bus loop drive off Brooklyn Avenue along with 20 % of the passenger vehicle trips. The remaining 80 % of the passenger trips were assigned to the student parking lot drives based upon the recorded traffic patterns. The projected volumes with the proposed improvements implemented are shown in Figure 4.

Capacity Analyses

Traffic operations are evaluated in terms of level of service (LOS). Level of service is a qualitative measure that describes operations by letter designation. The levels range from A - very little delay to F - extreme delays. Level of service "D" is generally considered acceptable in urban locations while LOS "E" is generally considered the capacity of a facility and the minimum tolerable level. The level of service for unsignalized intersections is based upon the average control per vehicle for each minor, opposed movement, as defined in the following table excerpted from the 2000 "Highway Capacity Manual":

Unsignalized Intersection Level of Service

<u>LOS</u>	<u>Delay Range</u>
A	<= 10.0 seconds
B	> 10.0 and <= 15.0
C	> 15.0 and <= 25.0
D	> 25.0 and <= 35.0
E	> 35.0 and <= 50.0
F	> 50.0

Unsignalized Intersections

The level of service was calculated for the unsignalized site drive and area intersections for existing 2011 conditions and the projected conditions expected with implementation of the proposed on-site school improvements. The analysis was performed using HCS+ software. The results are summarized with the LOS followed by the delay in seconds in parentheses in the following tables:

Intersection of Existing High School Exit, Morrison and Brooklyn Avenues

	PM Peak Hour Level of Service	
	2011	2011
	<u>Existing Configuration</u>	<u>New Configuration</u>
Southbound School Drive	B (12.8)	B (12.5)
Brooklyn Avenue Lefts into School	N/A	A (7.4)
Brooklyn Ave Lefts onto Morrison	A (7.4)	A (7.4)
Morrison Avenue	A (8.4)	A (8.4)

As can be seen in the preceding table, all movements at the intersection of the Brooklyn Avenue, Morrison Avenue, and the school drive operate at LOS B or better. Under the proposed plan, the levels remain the same with a negligible improvement in delay for the school drive since the number of exiting vehicles is reduced.

Intersection of Brooklyn Avenue and Messalonskee Avenue

	Peak Hour Level of Service	
	2011	2011
	<u>Existing Configuration</u>	<u>New Configuration</u>
Northbound Messalonskee Ave Lefts	A (7.4)	A (7.7)
Eastbound Brooklyn Lefts	B (10.3)	B (10.4)

As can be seen above, all movements at the intersection of Brooklyn and Messalonskee Avenue currently operate at LOS B or better. These same levels of service are expected with the implementation of the proposed improvements with insignificant changes in delay.

Intersection of Existing High School Drive and Messalonskee Avenue

	Peak Hour Level of Service	
	2011	2011
	<u>Existing Configuration</u>	<u>New Configuration</u>
Eastbound School Drive	N/A	B (10.4)
Messalonskee Ave Lefts into Drive	A (7.7)	A (7.6)

This drive intersection will also operate at good levels of service, B or better, after the on-site improvements are implemented.

Intersection of New High School Access and Brooklyn Avenue

	Peak Hour Level of Service	
	2011	2011
	<u>Existing Configuration</u>	<u>New Configuration</u>
Southbound School Drive	N/A	A (9.6)
Brooklyn Avenue Lefts into New Drive	N/A	A (7.6)

This proposed new high school drive to Brooklyn Avenue will operate at a high LOS A.

Overall, all intersection movements will operate at LOS B or better under the proposed access plan. The plan will not impact the existing level of service at any of the study area intersections. No capacity concerns were identified by the analysis since all movements operate with minimal delay.

Pedestrian Access

It was noted during the review that there are no sidewalks on Brooklyn Avenue or Morrison Avenue within the vicinity of the school. Students were observed to be walking along the north side of Brooklyn Avenue from the school towards Mae Terrace and Vose Street. Students also walked along the westerly side of Morrison Avenue from the school towards Western Avenue. It is recommended that long range planning for the school give consideration to the addition of sidewalks along these pedestrian access routes.

Intersection Alignments

It was also noted during the counts/observation that the existing high school exit drive on Brooklyn does not align with Morrison Avenue. The through movement from the high school to Morrison requires vehicles to take a left turn and then a sharp right. In the process, most vehicles cross the Morrison Avenue centerline. While few vehicles were recorded traveling from Morrison towards Brooklyn, this is considered a possible safety issue. The movement is further restricted by the location of a utility pole on the southwest corner of Brooklyn and Morrison Avenue. Future long-range planning should consider realigning the exit drive with Morrison if at all feasible. It is important to note, however, that the currently proposed plan will improve the situation by reducing the exiting peak hour through vehicle movements from the existing 54 vehicles to only 14 vehicles, which should be a significant safety improvement.

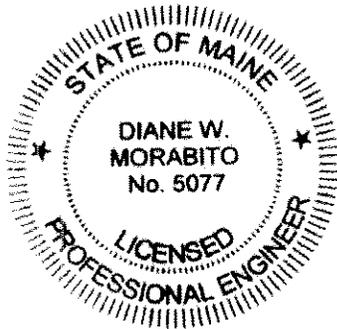
It was noted in the plan review that the proposed new drive to Brooklyn Avenue does not align with driveways on the opposite side of Brooklyn Avenue. Since each curb cut is a potential conflict point, the school drive should be aligned with an existing drive for access management purposes to avoid adding another potential conflict point to Brooklyn Avenue.

Summary and Conclusions

All access drive and nearby intersection movements currently operate at a high level of service B or better. Under the proposed on-site improvement plan, all intersection movements will remain at the same levels of service with insignificant changes in delay showing that the proposed project will not impact off-site traffic operations.

In terms of other long-term considerations, Maine Traffic Resources recommends that sidewalks be provided along Brooklyn Avenue and Morrison Avenue increasing pedestrian safety. Consideration should also be given to aligning the existing Brooklyn Avenue drive with Morrison Avenue for safety reasons. It is important to note, however, that the proposed plan improves safety at this intersection by significantly reducing the number of exiting through vehicles during the peak hour. Lastly, it is recommended that the proposed new drive to Brooklyn Avenue be aligned with a drive on the opposite side for access management purposes.

As always, if you any questions or concerns regarding my review or recommendations, please do not hesitate to contact me.



Sincerely,

Diane W. Morabito

Diane W. Morabito, P.E. PTOE
President



Figure 1

Waterville High School

Site Location

Waterville, Maine

**Maine
Traffic
Resources**

25 Vine Street
Gardiner, ME
04345
Tel: (207) 582-5252
Fax: (207) 582-1677



Legend:
 00 (00) 00 — Background Traffic
 — High School Buses
 — School Passenger Vehicles

Figure 2

**Existing 2011 P.M. Peak Hour of School
 Traffic Volumes
 Waterville, Maine**

**Maine
 Traffic
 Resources**
 25 Vine Street
 Gardiner, ME
 04345
 tel: (207) 582-5352
 fax: (207) 582-1677

Legend:

00 (00) 00

- Background Traffic
- High School Buses
- School Passenger Vehicles



Figure 3

Existing 2011 P.M. Peak Period
 (1:30-3:30) Traffic Volumes
 Waterville, Maine

Maine
 Traffic
 Resources

25 Vine Street
 Gardiner, ME
 04345
 tel: (207) 582-5252
 fax: (207) 582-1677

Legend:
 00 (00) 00 — Background Traffic
 — High School Buses
 — School Passenger Vehicles

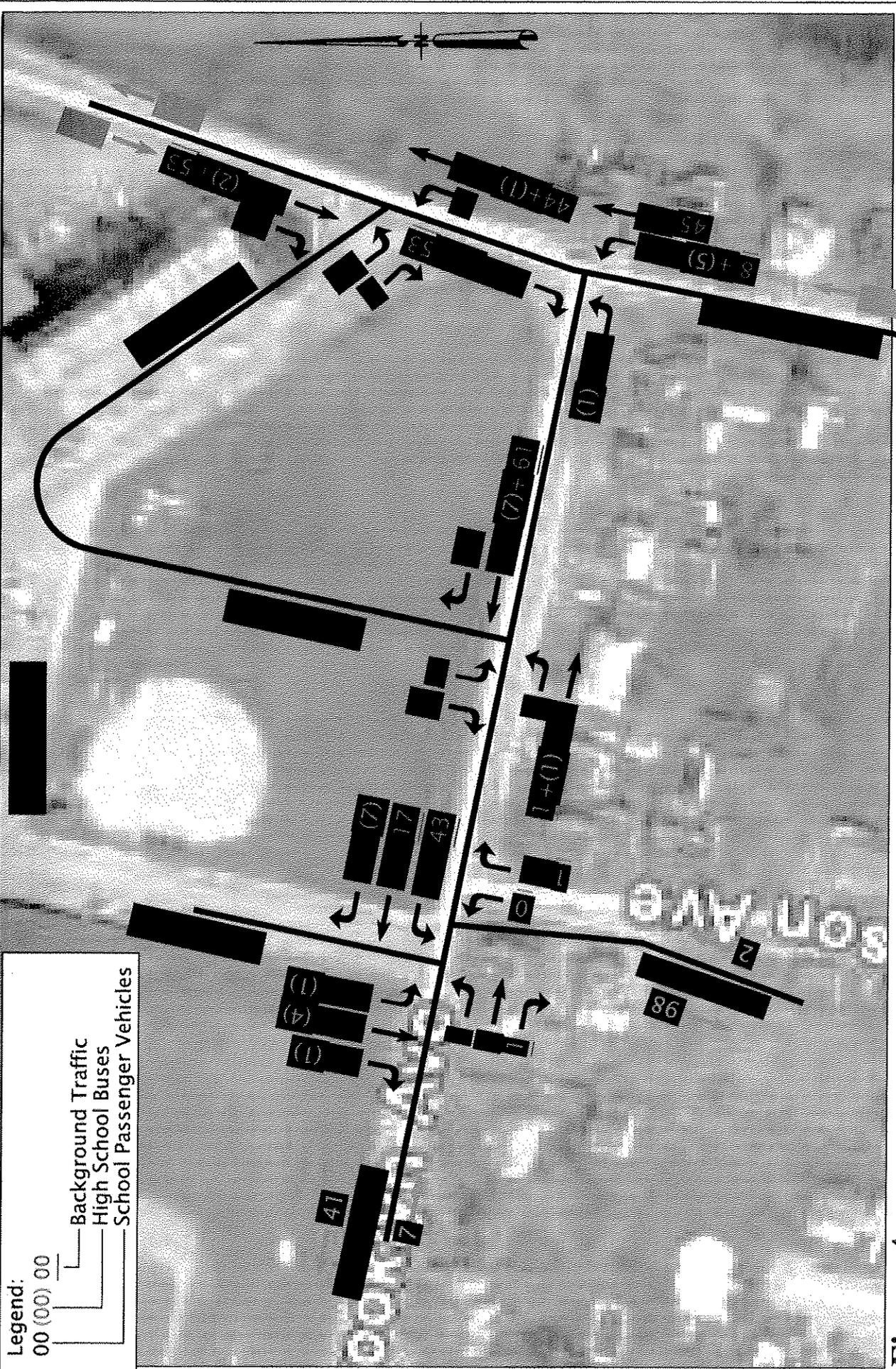


Figure 4

**P.M. Peak Hour of the School
 Traffic Volumes - New Configuration
 Waterville, Maine**

**Maine
 Traffic
 Resources**
 25 Vine Street
 Gardiner, ME
 04345
 Tel: (207) 582-5352
 Fax: (207) 582-1677

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	SK			Intersection	Brooklyn Ave & Morrison/School			
Agency/Co.	MTR			Jurisdiction	Waterville			
Date Performed	03/31/2011			Analysis Year	2011			
Analysis Time Period	2:00 pm							
Project Description Existing 2011 PM Peak Hour								
East/West Street: Brooklyn Ave				North/South Street: Morrison/School				
Intersection Orientation: East-West				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		6	1	43	17			
Peak-Hour Factor, PHF	0.92	0.50	0.50	0.60	0.60	0.60		
Hourly Flow Rate, HFR (veh/h)	0	12	2	71	28	0		
Percent Heavy Vehicles	0	--	--	3	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR	LT				
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	0	0	2	66	54	24		
Peak-Hour Factor, PHF	0.50	0.50	0.50	0.50	0.50	0.50		
Hourly Flow Rate, HFR (veh/h)	0	0	4	132	108	48		
Percent Heavy Vehicles	0	0	0	4	4	4		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration		LTR			LTR			
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LTR			LTR	
v (veh/h)		71		4			288	
C (m) (veh/h)		1598		1073			750	
v/c		0.04		0.00			0.38	
95% queue length		0.14		0.01			1.81	
Control Delay (s/veh)		7.4		8.4			12.8	
LOS		A		A			B	
Approach Delay (s/veh)	--	--		8.4			12.8	
Approach LOS	--	--		A			B	

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	SK			Intersection	Brooklyn Ave & Morrison/School			
Agency/Co.	MTR			Jurisdiction	Waterville			
Date Performed	03/31/2011			Analysis Year	2011			
Analysis Time Period	2:00 pm							
Project Description 2011 PM Peak Hour New Configuration								
East/West Street: Brooklyn Ave				North/South Street: Morrison/School				
Intersection Orientation: East-West				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)	1	5	1	83	35	27		
Peak-Hour Factor, PHF	0.92	0.50	0.50	0.60	0.60	0.60		
Hourly Flow Rate, HFR (veh/h)	1	10	2	138	58	44		
Percent Heavy Vehicles	0	--	--	1	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration	LTR			LTR				
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	0	0	2	14	14	6		
Peak-Hour Factor, PHF	0.50	0.50	0.50	0.50	0.50	0.50		
Hourly Flow Rate, HFR (veh/h)	0	0	4	28	28	12		
Percent Heavy Vehicles	0	0	0	18	18	18		
Percent Grade (%)	0			0				
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration		LTR			LTR			
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR	LTR			LTR		
v (veh/h)	1	138	4			68		
C (m) (veh/h)	1503	1613	1076			545		
v/c	0.00	0.09	0.00			0.12		
95% queue length	0.00	0.28	0.01			0.42		
Control Delay (s/veh)	7.4	7.4	8.4			12.5		
LOS	A	A	A			B		
Approach Delay (s/veh)	--	--	8.4			12.5		
Approach LOS	--	--	A			B		

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	SK			Intersection	Brooklyn & Messalonskee			
Agency/Co.	MTR			Jurisdiction	Waterville			
Date Performed	03/31/2011			Analysis Year	2011			
Analysis Time Period	2:00 pm							
Project Description								
East/West Street: Brooklyn Ave				North/South Street: Messalonskee Ave				
Intersection Orientation: North-South				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)	8	98				53		
Peak-Hour Factor, PHF	0.70	0.70	1.00	1.00	0.55	0.55		
Hourly Flow Rate, HFR (veh/h)	11	140	0	0	0	96		
Percent Heavy Vehicles	1	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	0	1		
Configuration	LT					R		
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	73							
Peak-Hour Factor, PHF	0.50	1.00	0.50	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	146	0	0	0	0	0		
Percent Heavy Vehicles	0	0	0	0	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	1	0	0	0	0	0		
Configuration	L							
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		
v (veh/h)	11					146		
C (m) (veh/h)	1504					828		
v/c	0.01					0.18		
95% queue length	0.02					0.64		
Control Delay (s/veh)	7.4					10.3		
LOS	A					B		
Approach Delay (s/veh)	--	--				10.3		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	SK			Intersection	Brooklyn & Messalonskee		
Agency/Co.	MTR			Jurisdiction	Waterville		
Date Performed	03/31/2011			Analysis Year	2011		
Analysis Time Period	2:00 pm						
Project Description 2011 New Config							
East/West Street: Brooklyn Ave				North/South Street: Messalonskee Ave			
Intersection Orientation: North-South				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Northbound			Southbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)	57	49				74	
Peak-Hour Factor, PHF	0.70	0.70	1.00	1.00	0.55	0.55	
Hourly Flow Rate, HFR (veh/h)	81	70	0	0	0	134	
Percent Heavy Vehicles	5	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0				0
Lanes	0	1	0	0	0		1
Configuration	LT						R
Upstream Signal		0			0		
Minor Street	Eastbound			Westbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	17						
Peak-Hour Factor, PHF	0.50	1.00	0.50	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	34	0	0	0	0	0	
Percent Heavy Vehicles	6	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0				0
Lanes	1	0	0	0	0	0	
Configuration	L						
Delay, Queue Length, and Level of Service							
Approach	Northbound	Southbound	Westbound			Eastbound	
Movement	1	4	7	8	9	10	11
Lane Configuration	LT					L	
v (veh/h)	81					34	
C (m) (veh/h)	1432					705	
v/c	0.06					0.05	
95% queue length	0.18					0.15	
Control Delay (s/veh)	7.7					10.4	
LOS	A					B	
Approach Delay (s/veh)	--	--				10.4	
Approach LOS	--	--				B	

TWO-WAY STOP CONTROL SUMMARY								
General Information					Site Information			
Analyst	SK				Intersection	Messalonskee & High School		
Agency/Co.	MTR				Jurisdiction	Waterville		
Date Performed	03/31/2011				Analysis Year	2011		
Analysis Time Period	2:00 pm							
Project Description Existing 2011								
East/West Street: High School Entrance					North/South Street: Messalonskee Ave			
Intersection Orientation: North-South					Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)	60	110			53	52		
Peak-Hour Factor, PHF	0.65	0.65	1.00	1.00	0.75	0.75		
Hourly Flow Rate, HFR (veh/h)	92	169	0	0	70	69		
Percent Heavy Vehicles	8	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration	LT					TR		
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)								
Peak-Hour Factor, PHF	0.92	1.00	0.92	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	0		
Percent Heavy Vehicles	2	0	2	0	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	0	0	0		
Configuration								
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT							
v (veh/h)	92							
C (m) (veh/h)	1408							
v/c	0.07							
95% queue length	0.21							
Control Delay (s/veh)	7.7							
LOS	A							
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	SK			Intersection	Messalonskee & Access #3		
Agency/Co.	MTR			Jurisdiction	Waterville		
Date Performed	03/31/2011			Analysis Year	2011		
Analysis Time Period	2:00 pm						
Project Description: 2011 New Config							
East/West Street: Access #3				North/South Street: Messalonskee Ave			
Intersection Orientation: North-South				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Northbound			Southbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)	4	61			71	34	
Peak-Hour Factor, PHF	0.65	0.65	1.00	1.00	0.75	0.75	
Hourly Flow Rate, HFR (veh/h)	6	93	0	0	94	45	
Percent Heavy Vehicles	8	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration	LT						TR
Upstream Signal		0			0		
Minor Street	Eastbound			Westbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	49		3				
Peak-Hour Factor, PHF	0.50	1.00	0.50	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	98	0	6	0	0	0	
Percent Heavy Vehicles	2	0	2	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration	LR						
Delay, Queue Length, and Level of Service							
Approach	Northbound	Southbound	Westbound			Eastbound	
Movement	1	4	7	8	9	10	11
Lane Configuration	LT					LR	
v (veh/h)	6					104	
C (m) (veh/h)	1408					772	
v/c	0.00					0.13	
95% queue length	0.01					0.46	
Control Delay (s/veh)	7.6					10.4	
LOS	A					B	
Approach Delay (s/veh)	--	--				10.4	
Approach LOS	--	--				B	

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	SK			Intersection	Brooklyn Ave & Access #2			
Agency/Co.	MTR			Jurisdiction	Waterville			
Date Performed	03/31/2011			Analysis Year	2011			
Analysis Time Period	2:00 pm							
Project Description 2011 new Config								
East/West Street: Brooklyn Ave				North/South Street: Access #2				
Intersection Orientation: East-West				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
	1	2	3	4	5	6		
Movement	L	T	R	L	T	R		
Volume (veh/h)	6	15			91	40		
Peak-Hour Factor, PHF	0.75	0.75	1.00	1.00	0.75	0.75		
Hourly Flow Rate, HFR (veh/h)	8	20	0	0	121	53		
Percent Heavy Vehicles	5	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration	LT						TR	
Upstream Signal	0			0				
Minor Street	Northbound			Southbound				
	7	8	9	10	11	12		
Movement	L	T	R	L	T	R		
Volume (veh/h)				3		55		
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.50	1.00	0.50		
Hourly Flow Rate, HFR (veh/h)	0	0	0	6	0	110		
Percent Heavy Vehicles	0	0	0	0	0	0		
Percent Grade (%)	0			0				
Flared Approach	N			N				
Storage	0			0				
RT Channelized				0			0	
Lanes	0	0	0	0	0	0		
Configuration				LR				
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					LR		
v (veh/h)	8					116		
C (m) (veh/h)	1385					898		
v/c	0.01					0.13		
95% queue length	0.02					0.44		
Control Delay (s/veh)	7.6					9.6		
LOS	A					A		
Approach Delay (s/veh)	--	--				9.6		
Approach LOS	--	--				A		