Intersection Analysis: Island Pond Road & Westside Drive

For the Town of Atkinson, New Hampshire

April 23, 2015

ROCKINGHAM PLANNING COMMISSION
156 Water Street
Exeter, NH 03833
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Island Pond Road and Westside Drive Intersection Analysis

Town of Atkinson, NH

Background

The RPC was asked by the Road Agent for the Town of Atkinson to examine the potential for removing stop signs at the current all-way stop intersection of Island Pond Road and Westside Drive. The Manual of Uniform Traffic Control Devices (MUTCD) establishes recommended approaches for addressing control changes at intersections. However, there are no mandated or universally accepted procedures for assessing the impacts of removing stop controls. The basic approach recommended by the MUTCD is to determine if the intersection meets minimum traffic and safety requirements (known as warrants) for a particular type of control (stop or signal) through studies and use engineering judgment to determine the appropriateness of the control scheme. This analysis utilizes many of the same techniques as an engineering study, it was not conducted by professional traffic. The intent of this study was make an initial assessment as to whether the stop signs on Island Pond Road could be safely removed, as well as provide the Town insight regarding the utility of pursuing a full engineering study for the intersection.

The ***Manual of Uniform Traffic Control Devices*** (MUTCD) is published by the Federal Highway Administration (FHWA) and establishes standards and practices for traffic signs, markings, and intersection controls. This resource is freely available on via the FHWA website at http://mutcd.fhwa.dot.gov/

Recommendation

The analysis conducted by RPC takes a planning level approach, and based on an assessment using MUTCD criteria, indicates that the if the intersection of Island Pond Road and Westside Drive currently had no controls, installing an all-way stop control would not be justified from a traffic volume or traffic safety perspective. The intersection does not meet the minimum standards established by the MUTCD for an all-way stop control, and transitioning to having only the Westside Drive approach under stop control should function efficiently and safely. It is further recommended that prior to changing the control scheme at the intersection the town should consult a traffic engineer for concurrence in that assessment. If the decision is made to go forward with switching the traffic controls, it is recommended that a procedure be followed for stop sign removal that is at least as rigorous as the one outlined later in this document, and that it be completed under the supervision and guidance of a licensed traffic engineer.

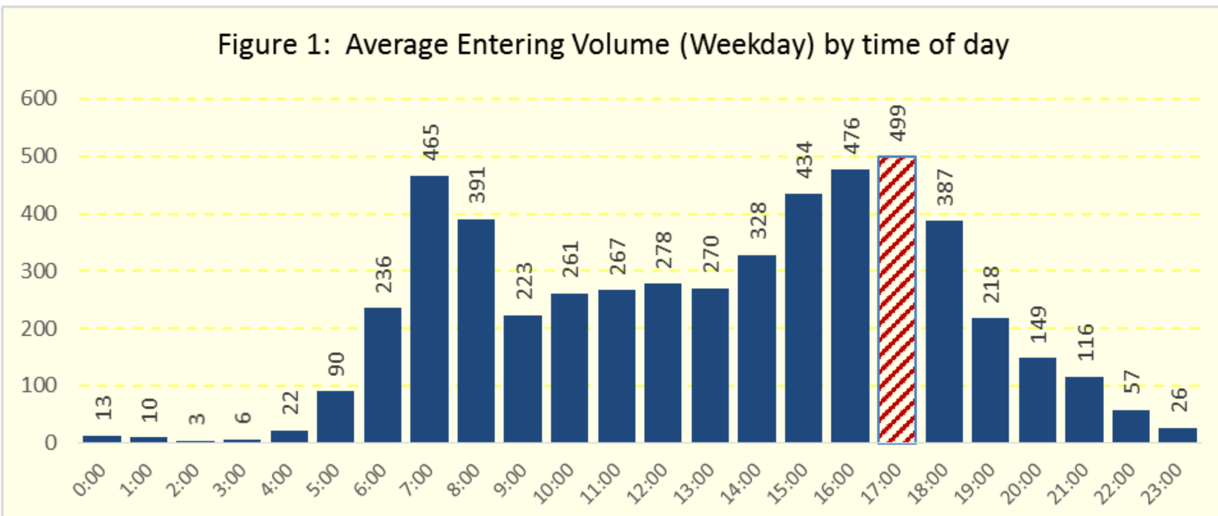
Data Collection and Analysis

Island Pond Road is located in the north-central part of Atkinson and provides an east-west connection between state routes NH 111 and NH 121. Westside Drive provides a north-south connection from Island Pond Road to Main Street in Salem bypassing much of the congestion further west on NH 111 and on NH 28 in Salem. For that reason, this intersection carries a greater amount of commuter traffic than would be generally anticipated on a roadway of this type. Data collection was initiated with the placement of automated traffic recording devices on all three approaches to the intersection on Sunday, October 19th, 2014 and picked up on Saturday, October 26th,

Table 1: Observed Traffic Volumes at Island Pond Road and Westside Drive

	Island Pond Rd. East of Westside Dr.			Island Pond Rd. West of Westside Dr.			Westside Dr. South of Island Pond Rd.			Entering Volumes
	EB	WB	Total	EB	WB	Total	NB	SB	Total	Total
Monday	2360	**2326**	4686	**1251**	1065	2316	**1862**	1758	3620	**5439**
Tuesday	2367	**2285**	4652	**1188**	1050	2238	**1969**	1810	3779	**5442**
Wednesday	2321	**2202**	4523	**1167**	985	2152	**1876**	1714	3590	**5245**
Thursday	2637	**2260**	4897	**1153**	951	2104	**1812**	1741	3553	**5225**
Friday	2486	**2533**	5019	**1276**	1098	2374	**2079**	1893	3972	**5888**
Average Weekday	2434	**2321**	4755	**1207**	1030	2237	**1920**	1783	3703	**5448**

EB=Eastbound, WB=Westbound, NB=Northbound, SB=Southbound
Total Entering Volume is equal to the sum of the vehicles entering the intersection from each leg and is shown in bold



2014. For the purpose of this analysis both weekday total volumes on the roadways and intersection entering volume will be discussed. Only weekday data will be utilized as the Saturday and Sunday counts have only partial data. ***Table 1*** shows the weekday traffic volumes for each approach to the intersection as well as the total entering volume which is the sum of the volumes arriving at the intersection and ignores exiting traffic. This analysis uses the raw traffic count data and has not been factored to create an annualized value (The estimated average for the entire year) which would likely be slightly (4-8%) lower than the observed values given the time of year and seasonal fluctuations in traffic.

The Island Pond Road eastern leg of this intersection carries the largest overall two-way volume, and averaged 4,755 vehicles per day over the course of the observation period. The Westside Drive leg of the intersection has the second highest average weekday two-way volume of just over 3,700 vehicles per day, and the western leg of Island Pond Road carries the lowest average two-way volume at 2,237 vehicles per day. The collected volume information indicates that, on average, 5,448 vehicles enter the intersection on a week day. ***Figure 1*** shows the distribution of this traffic throughout the day and from that it can be seen that the highest entering volume occurs between 5:00 and 6:00 PM and consists of approximately 500 vehicles. The 7:00-8:00 AM, 3:00-4:00 PM, and 4:00-5:00 PM hours are the only other hours of the day that are close to the peak at 465, 434, and 476 vehicles respectively. Every other hour of the day averages less than 400 vehicles entering the intersection.

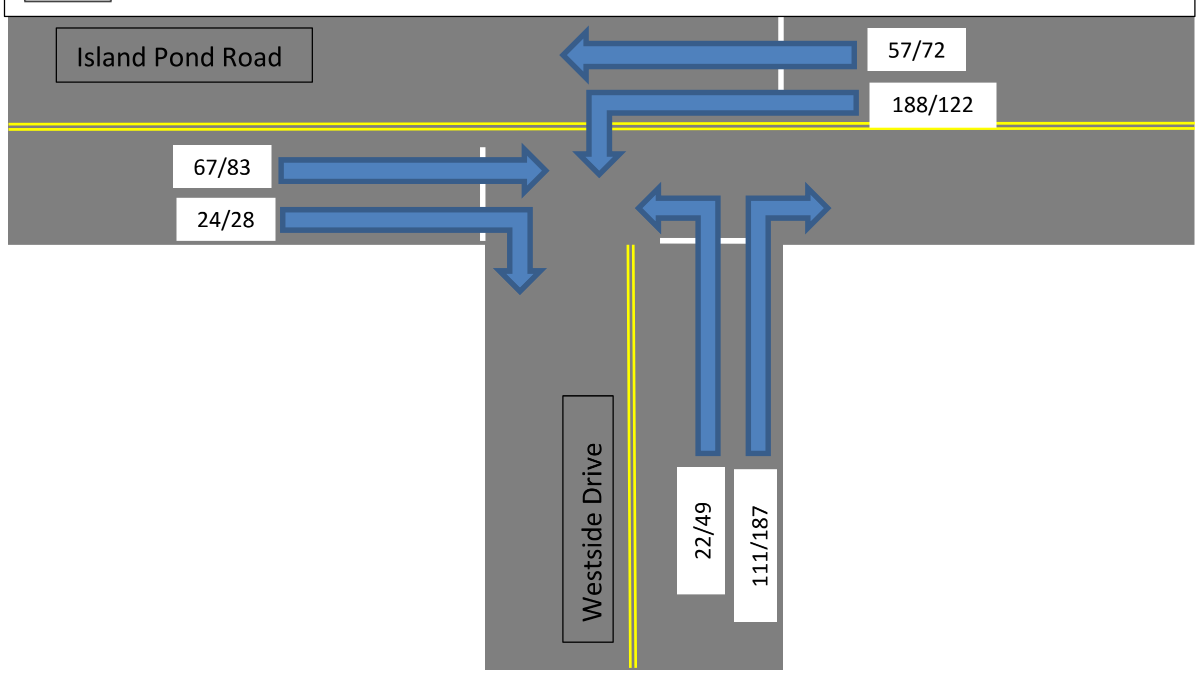
At the same time as the automated traffic recorders were collecting data a manual turning movement count was conducted at the intersection. On October 21st, 2014 observers tallied the turning movements from 7:00-9:00 AM and from 5:00-7:00 PM. The results of that effort are summarized in ***Table 2*** and ***Figure 2*** and indicate that the hour from 7:30-8:30 AM constitutes the AM Peak and that the hour from 5:00-6:00 PM constitutes the PM Peak. The westbound turn from Island Pond Road to Westside Drive is the dominant movement during the AM Peak period and the second most common movement during the PM peak period. The right turn from Westside Drive to Island Pond Road eastbound is the dominant movement during the PM peak period and the second most common movement during the AM Peak period.

Table 2: Turning Movement Count Observed Values

		Westside Drive Northbound				Island Pond Road Eastbound				Island Pond Road Westbound			
		Left		Right		Through		Right		Left		Through	
	Time	V	H	V	H	V	H	V	H	V	H	V	H
	07:00	6	0	25	1	22	0	8	2	30	0	19	0
	07:15	2	0	12	0	12	0	5	0	49	1	18	2
AM Peak	07:30	5	0	18	0	16	0	6	0	63	1	13	1
AM Peak	07:45	6	1	38	1	14	0	9	0	40	0	13	1
AM Peak	08:00	6	0	**29**	2	16	1	4	1	43	1	11	0
AM Peak	08:15	4	0	22	1	20	0	4	0	39	1	17	1
	08:30	7	0	27	1	18	1	6	2	30	1	9	0
	08:45	4	1	23	1	20	1	3	0	29	1	8	0
PM Peak	17:00	13	0	37	0	17	0	8	0	30	0	23	0
PM Peak	17:15	9	2	54	0	25	0	7	0	33	2	11	0
PM Peak	17:30	12	0	52	0	17	1	5	1	29	0	29	0
PM Peak	17:45	13	0	44	0	23	0	7	0	28	0	9	0
	18:00	12	0	42	0	21	0	8	0	26	0	15	0
	18:15	7	1	35	0	14	0	9	0	33	1	12	0
	18:30	8	1	26	0	15	0	5	0	22	1	18	0
	18:45	4	0	26	0	11	0	3	0	14	0	10	0

V= Vehicle
H= Heavy Vehicle

Figure 2: Turning Movement Count Diagram for Island Pond Road and Westside Drive showing the AM/PM Peak hour turning volumes for each movement



Capacity Analysis

A capacity analysis of the intersection was conducted for both the AM and PM peak periods utilizing the existing all-way stop configuration as well as with stop controls only applied to Westside Drive. A summary of the results can be seen in Table 3, and the full reports from the Highway Capacity Analysis software (HCS+) are included as an appendix. Based on this analysis, changing the traffic control scheme to only stop vehicles approaching the intersection along Westside Drive would result in very little change to the function of the intersection. Under the current all-way stop control there is some delay to each vehicle that moves through the intersection as each must stop on every approach. This delay is minimal for the most part resulting in an overall Level of Service of A during the AM Peak and B during the PM peak. This indicates that, even at the most congested times, the intersection flows smoothly with minimal delay to motorists. This is not surprising given that the intersection is only utilizing about 40% of the capacity available for moving vehicles. Under the two-way stop control, the eastbound approach to the intersection drops out of the analysis because the movements of those vehicles (through and right turns) are unconstrained by delay. Westbound vehicles experience less delay under a two-way stop control as they only need to wait for eastbound vehicles (the lowest segment volume) to process through the intersection. This results in a lower length of average delay and increases the level of service of that approach to an "A". Northbound traffic on Westside Drive will experience additional delay under this type of control as those vehicles must stop for all other traffic. This increase is less than 2 seconds per vehicle and is enough to drop the AM peak LOS from an "A" to a "B" although it does not change the LOS for the PM peak.

Level Of Service (LOS) is a qualitative assessment of a road's operating conditions in terms of delay and reflects the relative ease of traffic flow on a scale of A to F, with free-flow being rated LOS A and congested conditions rated as LOS F.

LOS A < 10 seconds delay

LOS B >10 and < 15 seconds delay

LOS C >15 and < 25 seconds delay

LOS D >25 and < 35 seconds delay

LOS E >35 and < 50 seconds delay

LOS F >50 seconds delay

Table 3: Intersection Capacity Analysis

All-Way Stop Control Capacity Analysis

	Eastbound		Westbound		Northbound	
	AM	PM	AM	PM	AM	PM
Degree of Utilization	0.12	0.16	0.40	0.34	0.23	0.40
Flow Rate	95	116	309	245	184	327
Capacity	345	366	559	495	434	577
Delay	8.23	8.84	10.73	10.6	8.81	10.43
Level of Service (LOS)	A	A	B	B	A	B

Two-Way Stop Control Capacity Analysis

Eastbound travel is not constrained and so is not included in the analysis

	Westbound		Northbound	
	AM	PM	AM	PM
Delay	8.0	7.7	10.5	11.9
Volume	257	140	183	266
Capacity	1475	1454	1120	789
v/c	0.17	0.10	0.16	0.34
95% Queue Length	0.63	0.32	0.59	1.52
Level of Service (LOS)	A	A	B	B

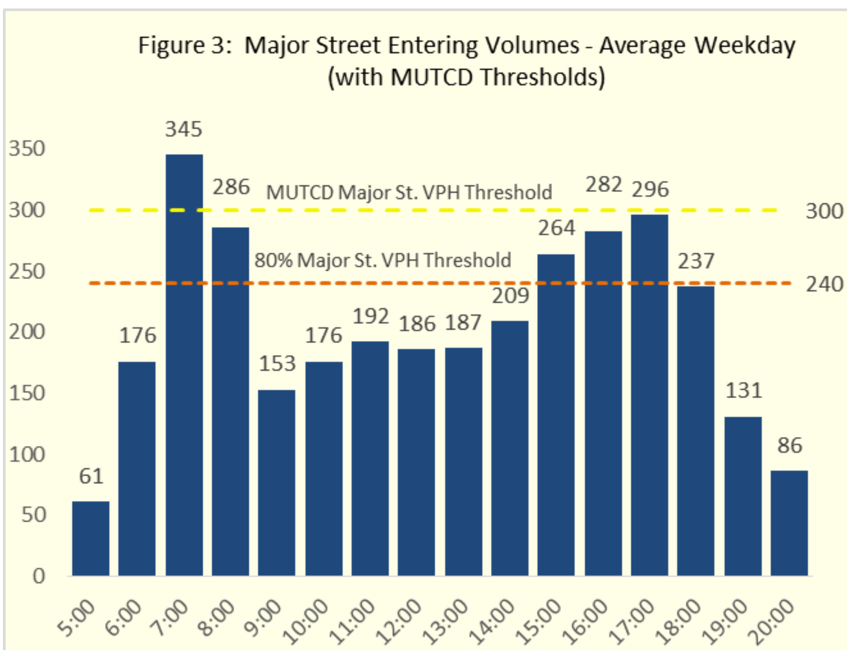
Conversion to two-way stop control

The Manual of Uniform Traffic Control Devices (MUTCD) establishes the standards and practices relating to traffic control devices. The complete standards are included at the end of this document but generally state that stop signs should only be utilized under certain conditions and never for speed control purposes. Stop signs should only be used at intersections where normal right-of-way rules might not be expected to be followed, there is a road connecting to a designated through road, or it is an unsignalized intersection adjacent to signalized intersections. These standards include analysis methods to determine what type of control is best for any particular intersection and the process to be followed for increasing controls (none → two-way stop → all-way stop → traffic signals). However, the standards do not discuss removing control from an intersection such as the desire in this case to convert an all-way stop controlled intersection to two-way stop control. Because of that, an approach was utilized that assessed the need for controls at the intersection as if there were currently none. The MUTCD process for assessing the need for, and type of, stop control at an intersection (Sections 2B.04 through 2B.07) can be utilized to provide a method to determine if all way stop control is warranted by meeting minimum volume, speed, and crash requirements.

MUTCD Method

In situations where the all-way stop control is not intended as a temporary measure (2B.07 A covers temporary installations), there are four primary criteria that generally must be met for the stop signs to be required. These criteria are listed below along with the RPC assessment of the application of each to this particular location.

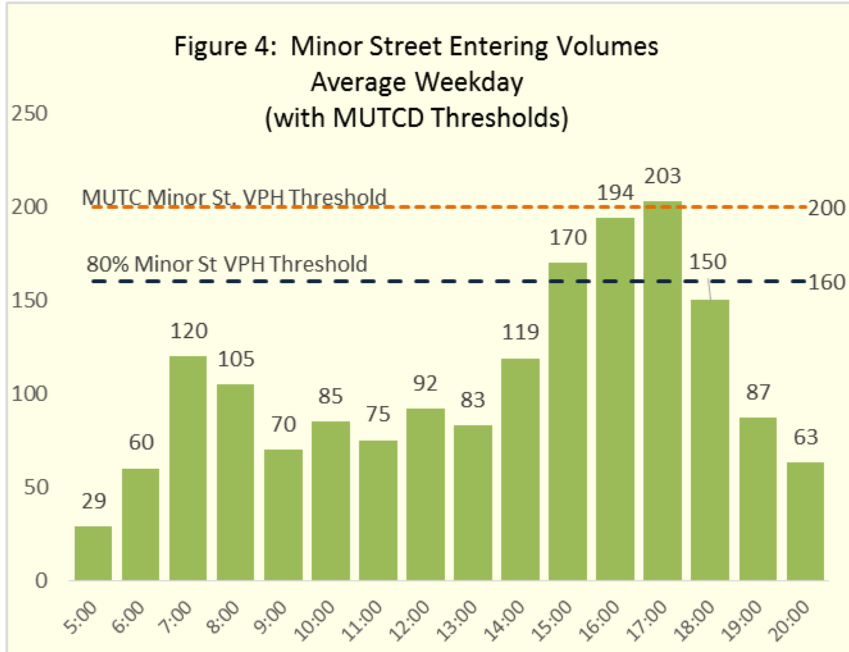
- **2B.07B - Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation.**
  - *The State Crash Records database indicates that there have been two crashes at the intersection between 2004 and 2013 which resulted in minimal, if any, injuries and this is backed by Atkinson Police records as well. One of the crashes was a single-vehicle event that involved skidding off the road during a storm while the other was a two-car crash that is somewhat unclear in nature due to incomplete data in the database. The small number of crashes is well below the five crashes per year that can be addressed by a multi-way stop minimum threshold.*
- **2B.07C 1 - The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and**
  - *As shown in **Figure 3**, the maximum entering volume observed on an average week day was 345 vehicles between 7:00 and 8:00 AM. No other hours averaged over 300 entering vehicles from the Island Pond Road approaches. The intersection does not meet this standard for all-way stop control.*



- **2B.07C 2 - The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8**

hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour;

- *As shown in **Figure 4**, the Westside Drive approach to the intersection had a maximum average hourly volume of 208 vehicles between 5:00 and 6:00 PM and all other hours averaged under 200 vehicles per hour.*



- **2B.07C 3 - If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.**

- *The approach speed is difficult to properly assess because there are stop signs currently at all approaches to the intersection. Vehicles may be moving slower as drivers anticipate needing to stop at the intersection and so the speed pattern may be different without stop signs on Island Pond Road. The current speed limit of 30 MPH on Island Pond Road and the dominant traffic movement of turning from that road onto Westside Drive indicates that most vehicles would slow when approaching the intersection as they would likely be turning.*

- **2B.07D - Where no single criterion is satisfied, but where approach volumes are all satisfied to 80 percent of the minimum values the approach speed criterion is excluded from this condition.**

- ***Figures 3 and 4** show the 80% thresholds for major and minor streets respectively (darker shaded dashed line). In each case, using the 80% thresholds increases the number of hours where the roadway meets the minimum volumes. In each case however, the change is not enough to meet the eight or more hour requirements of this criteria. Island Pond Road approaches are over the minimum requirement (now 240 vehicles per hour) for five hours while the Westside Drive approach exceeds the threshold (now 160 vehicles per hour) for three hours per day. A 25% increase in the volume of traffic on Island Pond Road and a 75% increase in traffic on Westside Drive would be required to meet the 80% thresholds*

Additionally, there are other optional factors that the MUTCD indicates may need to be considered by the traffic engineer.

A. **The need to control left-turn conflicts;**

- *Left-turn conflicts will be increased somewhat under a two-way stop control as vehicles approaching along Westside Drive will need to stop and wait for any vehicles approaching via Island Pond Road. That being said, there are relatively few vehicles turning left from Westside Drive to Island Pond Road as well as relatively few moving eastbound on Island Pond Road* *passing through the intersection. This means that these left-turn conflicts are minimal and should not have a significant impact on the function of the intersection.*

B. **The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;**

- *The pedestrian volumes at this intersection are minimal and are not a factor in the analysis.*

C. **Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and**

- *Sightlines and sight distances along Island Pond Road from the stop line on Westside Drive appear to be adequate to provide safe egress from Westside Drive.*

D. **An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.**

- *Westside Drive is not a through street in that this is not a four-way stop and so this criteria is not relevant to the analysis.*

All-way to two-way conversion process

Researching the conversion of all-way stop control intersections to two-way stop control via the internet found a small number of policies and practices related to this type of change. Predominately, this information dealt with the procedures of making the change in traffic control once the determination was made that converting from all-way stop to two-way was appropriate. The focus is on informing the users of the intersection that a change is going to take place well in advance, and keeping them informed of all the stages of change. A memorandum from the South Carolina Department of Transportation[1] provides an excellent example of these methods and has been modified to fit the Island Pond Road and Westside Drive intersection:

All-way to two-way conversion

1. On the approaches from which stop control is to be removed (Island Pond Road), erect signs having the message "TEMPORARY" beneath the STOP signs, approximately two weeks prior to the date the change is to be implemented.
2. Use a changeable message board to indicate that the traffic pattern at the intersection will be changing as of a certain date.
3. An explanation of the change should be provided by public notice to the local news media approximately one week in advance of the date the change is to be implemented.
4. On the date of the change, the following steps should be done:
    a. Erect signs having the message "CROSS TRAFFIC DOES NOT STOP" or OPPOSING TRAFFIC DOES NOT STOP below or adjacent to the STOP sign on Westside Drive.

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[1] South Carolina DOT Changes to Stop Control Memorandum
http://info.scdot.org/Construction_D/Engineering%20Directive%20Memorandums/EDM6.pdf

b. Remove stop bars on Island Pond Road approaches

c. Bag the STOP signs in Island Pond Road in a brightly colored bag for 30 days.

5. Signs with the message “CROSS TRAFFIC DOES NOT STOP” or “OPPOSING TRAFFIC DOES NOT STOP” should remain in place a minimum of two months after the date of the change, if not indefinitely.

Conclusions

This analysis of the Island Pond Road and Westside Drive intersection indicates that switching to a two-way stop control allowing for Island Pond Road traffic to progress through the intersection without stopping is a feasible undertaking that should not impact the function or safety of the location in any significant manner. It is recommended that should the Town of Atkinson be interested in pursuing this change in control that it do so after a review by a licensed traffic engineer and under their supervision.

Appendix A

- Manual of Uniform Traffic Control Devices Excerpt

2009 Manual of Uniform Traffic Control Devices (MUTCD) with Revisions 1 & 2 incorporated

Section 2B.04 Right-of-Way at Intersections indicates that YIELD or STOP signs should not be used for speed control and generally should be used at an intersection if one or more of the following conditions exist:

A. An intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;

B. A street entering a designated through highway or street; and/or

C. An unsignalized intersection in a signalized area.

The MUTCD further states that once the decision has been made to control the intersection

> "…the decision regarding the appropriate roadway to control should be based on engineering judgment. In most cases, the roadway carrying the lowest volume of traffic should be controlled"

Next, ***Section 2B.06*** provides guidance on the use of YIELD signs versus STOP signs at intersections:

> *At intersections where a full stop is not necessary at all times, consideration should first be given to using less restrictive measures such as YIELD signs (see Sections 2B.08 and 2B.09).*
>
> *The use of STOP signs on the minor-street approaches should be considered if engineering judgment indicates that a stop is always required because of one or more of the following conditions:*
>
> *A. The vehicular traffic volumes on the through street or highway exceed 6,000 vehicles per day;*
>
> *B. A restricted view exists that requires road users to stop in order to adequately observe conflicting traffic on the through street or highway; and/or*
>
> *C. Crash records indicate that three or more crashes that are susceptible to correction by the installation of a STOP sign have been reported within a 12-month period, or that five or more such crashes have been reported within a 2-year period. Such crashes include right-angle collisions involving road users on the minor-street approach failing to yield the right-of-way to traffic on the through street or highway.*

Finally, ***Section 2B.07*** provides support and guidance on the application of Multi-Way Stop controls.

Support: *Multi-way stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.*

The restrictions on the use of STOP signs described in Section 2B.04 also apply to multi-way stop applications.

Guidance: *The decision to install multi-way stop control should be based on an engineering study.*

The following criteria should be considered in the engineering study for a multi-way STOP sign installation:

A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.

C. Minimum volumes:

1. *The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*

2. *The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but*

3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*

D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

Option: *Other criteria that may be considered in an engineering study include:*

A. The need to control left-turn conflicts;

B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;

C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

Appendix B: Intersection Analyses

- All-way Stop Control AM Peak
- All-way Stop Control PM Peak
- Two-way Stop Control AM Peak
- Two-way Stop Control PM Peak

HCS+: Unsignalized Intersections Release 5.6

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: David Walker
Agency/Co.: Rockingham Planning Commission
Date Performed: 11/17/2014
Analysis Time Period: **Weekday AM**
Intersection: Westside Dr/Island Pond Rd
Jurisdiction: Atkinson
Units: U. S. Customary
Analysis Year: 2014
Project ID:
East/West Street: Island Pond Road
North/South Street: Westside Drive

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	67	24	188	57	0	22	0	111	0	0	0
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LR			
PHF	0.95		0.79		0.72			
Flow Rate	95		309		184			
% Heavy Veh	2		2		5			
No. Lanes	1		1		1			
Opposing-Lanes	1		1		0			
Conflicting-lanes	1		1		1			
Geometry group	1		1		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	95		309		184			
Left-Turn	0		237		30			
Right-Turn	25		0		154			
Prop. Left-Turns	0.0		0.8		0.2			
Prop. Right-Turns	0.3		0.0		0.8			
Prop. Heavy Vehicle	0.0		0.0		0.0			
Geometry Group	1		1		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2			
hRT-adj	-0.6		-0.6		-0.6			

hHV-adj	1.7	1.7	1.7
hadj, computed	-0.1	0.2	-0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	95		309		184			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.08		0.27		0.16			
hd, final value	4.59		4.65		4.48			
x, final value	0.12		0.40		0.23			
Move-up time, m	2.0		2.0		2.0			
Service Time	2.6		2.7		2.5			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	95		309		184			
Service Time	2.6		2.7		2.5			
Utilization, x	0.12		0.40		0.23			
Dep. headway, hd	4.59		4.65		4.48			
Capacity	345		559		434			
Delay	8.23		10.70		8.81			
LOS	A		B		A			
Approach:								
Delay	8.23		10.70		8.81			
LOS	A		B		A			

Intersection Delay 9.71 Intersection LOS A

HCS+: Unsignalized Intersections Release 5.6

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: David Walker
Agency/Co.: Rockingham Planning Commission
Date Performed: 11/17/2014
Analysis Time Period: **Weekday PM**
Intersection: Westside Dri/Island Pond Rd
Jurisdiction: Atkinson
Units: U. S. Customary
Analysis Year: 2014
Project ID:
East/West Street: Island Pond Road
North/South Street: Westside Drive

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	83	28	122	72	0	49	0	187	0	0	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LTR		LTR		LR			
PHF	0.95		0.79		0.72			
Flow Rate	116		245		327			
% Heavy Veh	2		2		3			
No. Lanes	1		1		1			
Opposing-Lanes	1		1		0			
Conflicting-lanes	1		1		1			
Geometry group	1		1		1			

Duration, T 1.00 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	116		245		327			
Left-Turn	0		154		68			
Right-Turn	29		0		259			
Prop. Left-Turns	0.0		0.6		0.2			
Prop. Right-Turns	0.3		0.0		0.8			
Prop. Heavy Vehicle	0.0		0.0		0.0			
Geometry Group	1		1		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2			

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2
hRT-adj	-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7	
hadj, computed	-0.1		0.2		-0.4	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	116		245		327			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.10		0.22		0.29			
hd, final value	4.92		5.01		4.44			
x, final value	0.16		0.34		0.40			
Move-up time, m	2.0		2.0		2.0			
Service Time	2.9		3.0		2.4			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	116		245		327			
Service Time	2.9		3.0		2.4			
Utilization, x	0.16		0.34		0.40			
Dep. headway, hd	4.92		5.01		4.44			
Capacity	366		495		577			
Delay	8.84		10.60		10.43			
LOS	A		B		B			
Approach:								
Delay	8.84		10.60		10.43			
LOS	A		B		B			

Intersection Delay 10.23 Intersection LOS B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: David Walker
Agency/Co.: RPC
Date Performed: 2/9/2015
Analysis Time Period: **Weekday AM Peak**
Intersection: Island Pond Road/Westside Driv
Jurisdiction: Atkinson
Units: U. S. Customary
Analysis Year: 2014
Project ID:
East/West Street: Island Pond Road
North/South Street: Westside Drive
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		67	24	188	57	
Peak-Hour Factor, PHF		0.84	0.67	0.73	0.79	
Hourly Flow Rate, HFR		79	35	257	72	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	22		111			
Peak Hour Factor, PHF	0.79		0.71			
Hourly Flow Rate, HFR	27		156			
Percent Heavy Vehicles	5		4			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes	/2		/
Lanes	0	0				
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		257		183				
C(m) (vph)		1475		1120				
v/c		0.17		0.16				

```
95% queue length          0.63          0.59
Control Delay             8.0           10.5
LOS                        A             B
Approach Delay                          10.5
Approach LOS                             B
_______________________________________________________________________________
```

HCS+: Unsignalized Intersections Release 5.6

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______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:               David Walker
Agency/Co.:            RPC
Date Performed:        2/9/2015
Analysis Time Period: Weekday AM Peak
Intersection:          Island Pond Road/Westside Driv
Jurisdiction:          Atkinson
Units: U. S. Customary
Analysis Year:         2014
Project ID:
East/West Street:      Island Pond Road
North/South Street:    Westside Drive
Intersection Orientation: EW                 Study period (hrs):  1.00

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1       2      3      4      5      6
                            L       T      R      L      T      R
_______________________________________________________________________________
Volume                             67     24     188    57
Peak-Hour Factor, PHF              0.84   0.67   0.73   0.79
Peak-15 Minute Volume              20     9      64     18
Hourly Flow Rate, HFR              79     35     257    72
Percent Heavy Vehicles             --     --     2      --     --
Median Type/Storage         Undivided              /
RT Channelized?
Lanes                              1    0           0   1
Configuration                          TR             LT
Upstream Signal?                   No                   No
_______________________________________________________________________________
Minor Street Movements      7       8      9      10     11     12
                            L       T      R      L      T      R
_______________________________________________________________________________
Volume                     22             111
Peak Hour Factor, PHF      0.79           0.71
Peak-15 Minute Volume      7              39
Hourly Flow Rate, HFR      27             156
Percent Heavy Vehicles     5              4
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage         Yes     /2                    /
RT Channelized?
Lanes                         0        0
```

Configuration LR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		72
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			2	5		4			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R

t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	5		4			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			

p(8)
p(9)
p(10)
p(11)
p(12)

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		114	682		96			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	96	
Potential Capacity	955	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	955	
Probability of Queue free St.	0.84	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	114	
Potential Capacity	1475	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1475	
Probability of Queue free St.	0.83	1.00
Maj L-Shared Prob Q free St.	0.82	

Step 3: TH from Minor St.	8	11
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	682	
Potential Capacity	411	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.82
Maj. L, Min T Adj. Imp Factor.		0.86
Cap. Adj. factor due to Impeding mvmnt	0.83	0.72
Movement Capacity	339	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		

Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	682	
Potential Capacity	411	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.82
Maj. L, Min T Adj. Imp Factor.		0.86
Cap. Adj. factor due to Impeding mvmnt	0.83	0.72
Movement Capacity	339	

Results for Two-stage process:	
a	
y	
C t	339

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	27		156			
Movement Capacity (vph)	339		955			
Shared Lane Capacity (vph)		753				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	339		955			
Volume	27		156			
Delay	16.5		9.5			
Q sep	0.12		0.41			
Q sep +1	1.12		1.41			
round (Qsep +1)	1		1			
n max		1				
C sh		753				
SUM C sep		1120				
n		2				
C act		1120				

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		257		183				
C(m) (vph)		1475		1120				
v/c		0.17		0.16				
95% queue length		0.63		0.59				
Control Delay		8.0		10.5				
LOS		A		B				
Approach Delay				10.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.83
v(il), Volume for stream 2 or 5		72
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.82
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.4

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: David Walker
Agency/Co.: Rockingham Planning Commission
Date Performed: 2/6/2015
Analysis Time Period: **Week Day PM Peak**
Intersection: Island Pond Road/Westside Driv
Jurisdiction: Atkinson
Units: U. S. Customary
Analysis Year: 2015
Project ID:
East/West Street: Island Pond Road
North/South Street: Westside Drive
Intersection Orientation: EW   Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		83	28	122	72	
Peak-Hour Factor, PHF		0.83	0.88	0.87	0.62	
Hourly Flow Rate, HFR		100	31	140	116	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	49		187			
Peak Hour Factor, PHF	0.94		0.87			
Hourly Flow Rate, HFR	52		214			
Percent Heavy Vehicles	4		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	0				
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		140		266				
C(m) (vph)		1454		789				
v/c		0.10		0.34				

95% queue length	0.32	1.52
Control Delay	7.7	11.9
LOS	A	B
Approach Delay		11.9
Approach LOS		B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: David Walker
Agency/Co.: Rockingham Planning Commission
Date Performed: 2/6/2015
Analysis Time Period: **Week Day PM Peak**
Intersection: Island Pond Road/Westside Driv
Jurisdiction: Atkinson
Units: U. S. Customary
Analysis Year: 2015
Project ID:
East/West Street: Island Pond Road
North/South Street: Westside Drive
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		83	28	122	72	
Peak-Hour Factor, PHF		0.83	0.88	0.87	0.62	
Peak-15 Minute Volume		25	8	35	29	
Hourly Flow Rate, HFR		100	31	140	116	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	49		187			
Peak Hour Factor, PHF	0.94		0.87			
Peak-15 Minute Volume	13		54			
Hourly Flow Rate, HFR	52		214			
Percent Heavy Vehicles	4		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						

Lanes	0		0
Configuration		LR	

Pedestrian Volumes and Adjustments				
Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		116
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			2	4		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12

	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	4		0			
t(f)		2.2	3.5*		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			

p(7)
p(8)
p(9)
p(10)
p(11)
p(12)

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		131	512		116			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	116	
Potential Capacity	942	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	942	
Probability of Queue free St.	0.77	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	131	
Potential Capacity	1454	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1454	
Probability of Queue free St.	0.90	1.00
Maj L-Shared Prob Q free St.	0.90	

Step 3: TH from Minor St.	8	11

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	512	
Potential Capacity	522	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.90
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.90	0.71
Movement Capacity	472	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	512	
Potential Capacity	522	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.90
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.90	0.71
Movement Capacity	472	

Results for Two-stage process:		
a		
y		
C t	472	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	52		214			
Movement Capacity (vph)	472		942			
Shared Lane Capacity (vph)		789				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	472		942			
Volume	52		214			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		789				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		140		266				
C(m) (vph)		1454		789				
v/c		0.10		0.34				
95% queue length		0.32		1.52				
Control Delay		7.7		11.9				
LOS		A		B				
Approach Delay				11.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.90
v(il), Volume for stream 2 or 5		116
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.90
d(M,LT), Delay for stream 1 or 4		7.7
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.8