Bay Road & Cronin Road Intersection Assessment

Town of Queensbury, Warren County, NY

April, 2012

Prepared For:

WARREN COUNTY, NEW YORK
Department of Public Works

Adirondack/ Glens Falls Transportation Council

Prepared For:

Creighton Manning

Table of Contents

List of Figures

List of Tables

List of Appendices

Chapter 1. Introduction

This report summarizes the results of an accident records review and the evaluation and comparison of several intersection improvements for the Bay Road / Cronin Road intersection in the Town of Queensbury, Warren County, New York. The project location is shown in the Google aerial image below:

A. Site Conditions

The Bay Road / Cronin Road intersection is located in the southern portion of the Town of Queensbury approximately 1/3 mile north of the Quaker Road/NY Route 254 commercial corridor. Bay Road (County Route 7) travels north/south through the Town connecting Queensbury with the City of Glens Falls. Cronin Road is a Town road travelling east/west through the Town from Bay Road to Ridge Road (NY Route 9L). There are several commercial land uses at the intersection that impact operations including the Stewart's Shop (with gas pumps), the Harvest Restaurant, and the O'Leary Chiropractic Center. The intersection also serves as the primary access route to Adirondack Community College.

Pedestrians are accommodated through a sidewalk on the west side of Bay Road extending from Quaker Road to about 700 feet north of Cronin Road. On the east side of Bay Road, there is a sidewalk extending from Cronin Road to Quaker Road. There are no sidewalks along Cronin Road. Bicyclists are accommodated through a striped shoulder/bicycle lane on the east and west sides of Bay Road north of Cronin Road.

Chapter 2. Existing Conditions

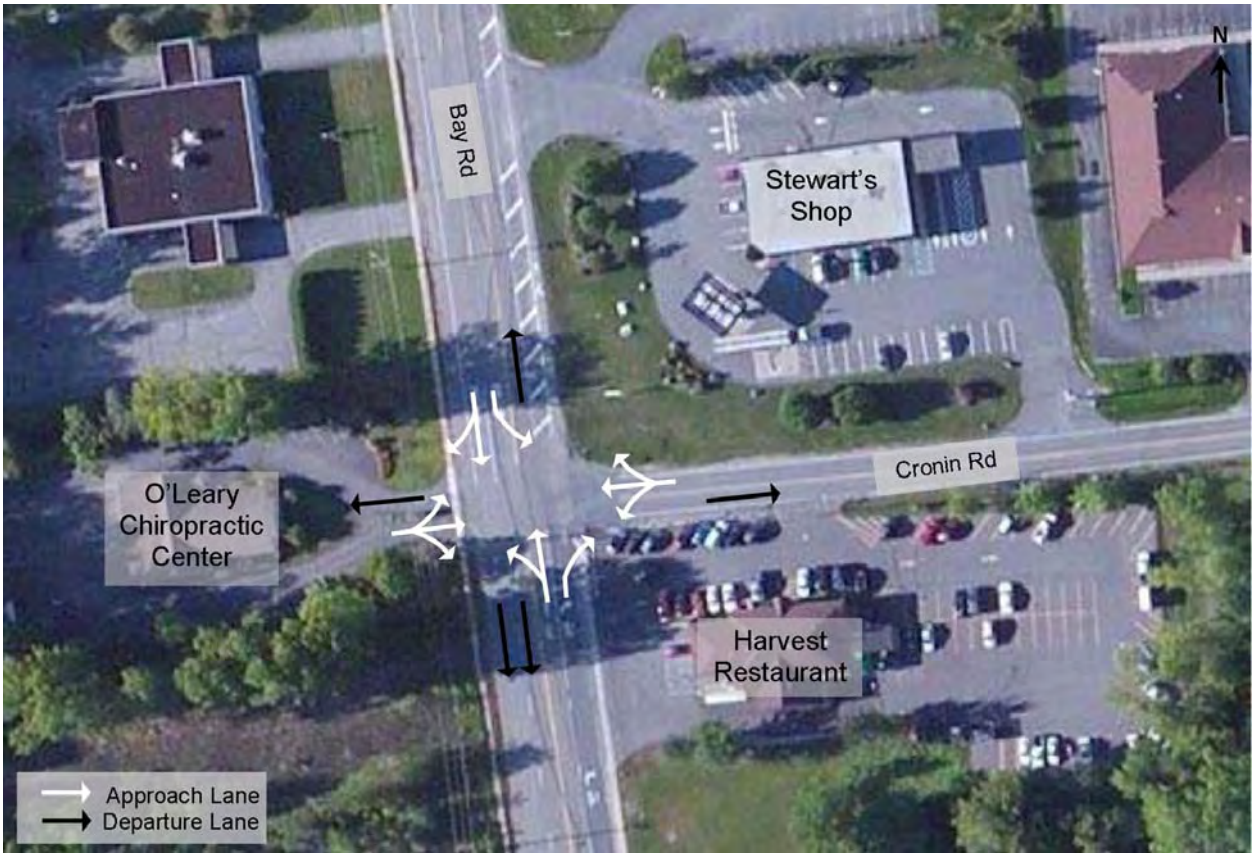
A. Intersection Geometry

The Bay Road / Cronin Road intersection is a four-way intersection operating under stop sign control on the eastbound and westbound approaches. The northbound Bay Road approach to Cronin Road provides a shared left-turn/through lane and a separate right-turn lane. The lack of shoulder on the northbound approach makes the right-turn from Bay Road onto Cronin Road a difficult maneuver that requires vehicle slowing and off-tracking, especially for large vehicles. In addition, there is little separation between the travel lane and the flush sidewalk. This makes walking in this quadrant of the intersection feel "unfriendly", meaning that pedestrians may be less comfortable at this location than in areas with a greater buffer between the sidewalk and travel lane.

Truck slowing and driving over the sidewalk to maneuver the Bay Road northbound right-turn movement onto Cronin Road

Pedestrian walking northbound on Bay Road on the innermost portion of the sidewalk away from vehicles

The southbound approach to the intersection provides a left-turn lane and a shared through/right-turn lane with two receiving lanes exiting the intersection. The presence of two southbound receiving lanes at the intersection creates confusion on all intersection approaches by providing too many travel movement choices, increasing the potential for accidents. The eastbound O'Leary Chiropractic Center driveway and westbound Cronin Road approaches provide a single lane for shared through and turning movements. Departing the intersection, there is a single northbound lane, two southbound lanes, a single lane eastbound on Cronin Road and a single lane entering the chiropractor's office. The intersection geometry is shown in the following Bing aerial image.



B. Accident History

An accident analysis was performed for the Bay Road / Cronin Road intersection using accident data provided by the Warren County Department of Public Works and New York State Department of Transportation. The analysis includes crashes that occurred from November 1, 2006 through December 31, 2011. Table 2.1 summarizes the accident history at the study area intersection. In addition, a detailed accident summary sheet, collision diagram, and detailed accident history are included in Appendix A.

Table 2.1 – Intersection Accident Summary

Accident Type	Accident Severity				
	Fatal	Injury	Property Damage	Non-Reportable[1]	Total
Right Angle	0	10	19	2	31
Rear End	0	0	8	0	8
Left Turn	0	3	1	1	5
Overtaking/Sideswipe	0	0	1	0	1
Total	**0**	**13**	**29**	**3**	**45**

[1] A non-reportable accident indicates no personal injuries occurred and property damages totaled less than $1,000.

Table 2.1 shows that there have been 45 accidents at the Bay Road / Cronin Road intersection over the last six years. Based on the data, 30 of these accidents occurred within the last three years. The data also shows the following:

- All the accidents occurred between 6:00 a.m. and 7:00 p.m. which suggests that night-time visibility is not the primary contributing factor of the crash history.
- Almost 70% of the accidents involved right angle crashes between vehicles on the Bay Road northbound and Cronin Road westbound intersection approaches.
- Almost 15% of the accidents involved two or more southbound vehicles, indicating that there is some confusion on the southbound approach to the intersection. Rear-end collisions are the primary accident type on the southbound approach.

The intersection improvement alternatives developed and evaluated as part of this study will consider options to improve the two accident trends identified above: the northbound/westbound right angle vehicle crashes and the southbound rear-end crashes.

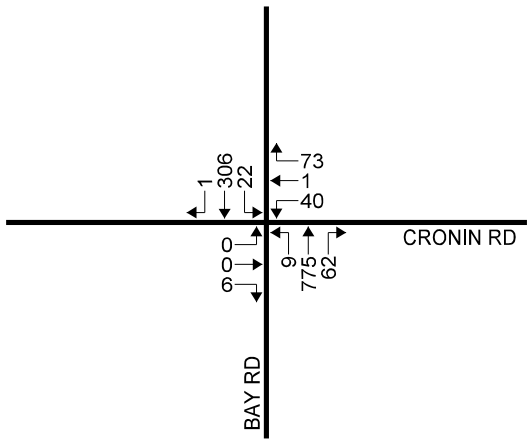
The intersection accident rate was calculated and compared to the statewide average for intersections on state roads with similar geometry and traffic control. The accident rate for the subject intersection is 1.37 accidents per million entering vehicles (acc/MEV) as compared to the statewide average of 0.15 acc/MEV. It is noted that the statewide average is calculated for state roadways only and that since the Bay Road and Cronin Road are county and local roads, respectively, the characteristics may be slightly different.

C. Traffic Volumes

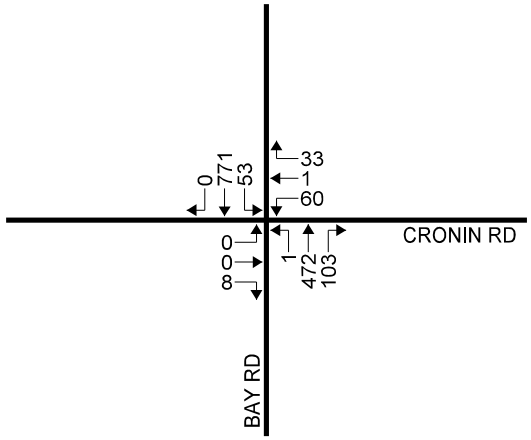
Intersection turning movement traffic counts were conducted at the Bay Road/Cronin Road intersection on January 25, 2012 during the weekday AM peak period from 7:00 to 9:00 a.m., noon peak period from 11:00 a.m. to 1:00 p.m., and the PM peak period from 3:00 to 6:00 p.m. The raw traffic volumes are included in Appendix B. Automatic Traffic Recorders (ATRs) were placed on all approaches to the intersection from February 2, 2012 to February 3, 2012 to collect daily volume and travel speed data. The peak hour traffic counts provide existing traffic conditions at the study intersection as summarized on Figure 2.1 and form the basis for all traffic forecasts. The following observations are evident based on the existing traffic volume data:

- The weekday AM peak hour occurred from 8:00 to 9:00 a.m. Heavy vehicles and school buses account for 1% of intersection volumes during the AM peak hour.
- The noon peak hour occurred from 12:00 to 1:00 p.m. Heavy vehicles and school buses account for 1% of intersection volumes during the noon peak hour.
- The PM peak hour occurred from 3:15 to 4:15 p.m. Heavy vehicles and school buses account for 1% of intersection volumes during the PM peak hour.

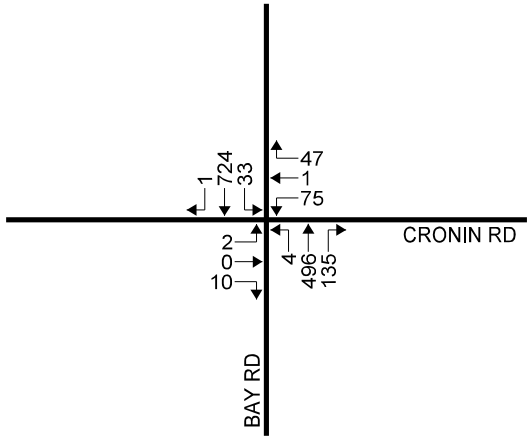
AM PEAK HOUR



NOON PEAK HOUR



PM PEAK HOUR



2012 (ETC) PEAK HOUR
TRAFFIC VOLUMES

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

Creighton Manning

PROJECT: 111-253	DATE: 04/2012	FIGURE: 2.1

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Chapter 3. Alternatives

Based on a review of the existing traffic conditions and accident analysis, four alternatives have been developed for evaluation. The proposed alternative and accident reduction benefit for each is described below.

A. Alternative 1

Alternative 1 involves re-striping the northbound and southbound intersection approaches to provide a dedicated left-turn lane and a shared through/right-turn lane on those approaches. The two exclusive left-turn lanes would be striped opposite each other as is typical for an intersection with a clearly delineated single departure lane. This improvement can be extended to re-stripe Bay Road with a center two-way left-turn lane between Cronin Road and Glenwood Avenue as shown on Figure 3.1. However, the expanded striping improvement is not needed for accident reduction benefits at the Bay Road / Cronin Road intersection. The eastbound and westbound intersection approaches would continue to operate under stop sign control with single lane approaches.

By shifting the northbound travel lanes toward the Bay Road centerline and removing the right-turn lane to create a shoulder, sight distances for vehicles on the Cronin Road approach would be improved and off-tracking on the right-turn movement from Bay Road to Cronin Road would be minimized. In addition, the increased buffer to the sidewalk will provide a higher level of comfort for pedestrians walking in this area. Creating a single receiving lane on Bay Road southbound reduces the confusion and potential for rear-end collisions on this intersection approach. Based upon information published by the New York State Department of Transportation in the Post Implementation Evaluation System (NYSDOT PIES), channelization, with the addition of left-turn lanes with painted separation as proposed in this alternative, has the potential to reduce left-turn crashes by 44%, rear end crashes by 43%, and right-angle crashes by 46%.

B. Alternative 2

Alternative 2 includes installing the striping modifications identified in Alternative 1 in addition to restricting left-turns and through movements from Cronin Road. This should be accomplished through construction of a raised median on Cronin Road at the intersection as illustrated on Figure 3.2. The physical restriction has the potential to eliminate almost 70% of the accidents at the intersection. With the turn restriction from Cronin Road, vehicles have the option to access Quaker Road via the traffic signal at Meadowbrook Road, which is immediately east of Cronin Road. It is noted that with removal of the Cronin Road left-turn and through vehicles from the intersection, the traffic volumes at the intersection do not meet the volume criteria for traffic signal installation. Traffic signal criteria are discussed further under Alternative 3.

C. Alternative 3

Alternative 3 includes installing the re-striping improvements as identified in Alternative 1 in conjunction with a traffic signal. Criteria for consideration of traffic signal installation are contained in the *2009 Manual of Uniform Traffic Control Devices* (National MUTCD), published by the Federal Highway Administration (FHW). This publication specifies the minimum criteria which must be met in order for a new traffic signal to be justified. The satisfaction of a signal warrant in itself is not necessarily justification for installation for a traffic signal. Other engineering and operational factors need to be considered.

The existing traffic conditions, pedestrian characteristics, and physical characteristics of the intersection were compared to the five of the nine signal warrants contained in the National MUTCD that are applicable to this intersection. The analysis, as contained in Appendix C, shows that the existing traffic conditions at the Bay Road / Cronin Road intersection meet the traffic signal warrant criteria for the traffic volume warrants (warrants 1, 2, and 3). The criteria are not met for the pedestrian volume warrant (warrant 4) or the crash experience warrant (warrant 8). The crash experience warrant requires that "adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency". Since previous crash reduction alternatives have not been attempted at this intersection, the warrant is not satisfied. However, due to the satisfaction of the traffic volume warrants, a traffic signal is considered for installation at this intersection as illustrated on Figure 3.3.

Installation of a traffic signal would actively assign right of way to vehicles approaching the intersection and reduce the need for drivers to judge the gap length for entering the traffic stream on Bay Road, which could significantly reduce the northbound/westbound crashes. Therefore, according to NYSDOT PIES data, in addition to the crash reduction factors as identified with Alternative 1, installation of a traffic signal has the potential to reduced left-turn crashes by 27%, rear end crashes by 12%, and right-angle by 42%.

D. Alternative 4

Alternative 4 includes the construction of a single-lane roundabout at the study intersection. This improvement reduces the number and severity of crashes by reducing the potential for conflict. Information published by the Insurance Institute for Highway Safety show that installation of a roundabout reduces the overall number of crashes by 40% and reduces the severity, specifically injury accidents, by 80%. The roundabout provides the benefit of allowing full movement at the intersection while reducing the potential for conflict. One primary difficulty associated with a roundabout is the amount of space required for construction and the impacts to private parcels. Figure 3.4 illustrates one potential alignment for the roundabout that minimizes the number of private parcel and utility impacts.

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ALTERNATIVE 1
RE-STRIPE NB & SB APPROACHES

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

Creighton Manning

PROJECT: 111-253	DATE: 4/2012	FIGURE: 3.1

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ALTERNATIVE 2
RESTRICT LEFT TURNS FROM CRONIN RD
W/ STRIPING MODIFICATIONS

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

Creighton Manning

PROJECT: 111-253	DATE: 4/2012	FIGURE: 3.2

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ALTERNATIVE 3
TRAFFIC SIGNAL
W/ STRIPING MODIFICATIONS

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

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PROJECT: 111-253	DATE: 4/2012	FIGURE: 3.3

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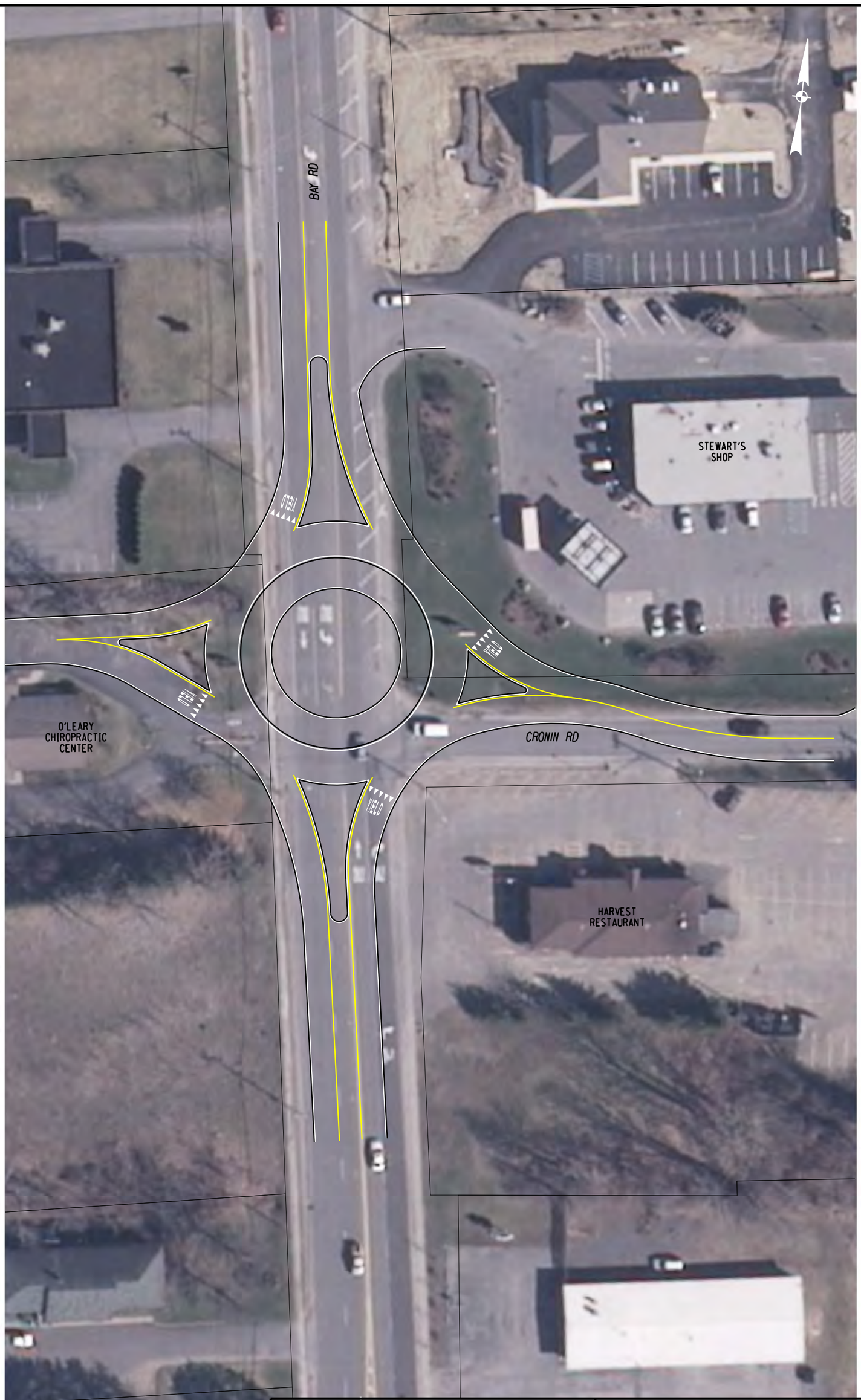

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1" = 50'

ALTERNATIVE 4
CONSTRUCT A SINGLE-LANE ROUNDABOUT

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

Creighton Manning

PROJECT: 111-253 | DATE: 4/2012 | FIGURE: 3.4

Chapter 4. Evaluation

Four alternatives are being progressed for evaluation. The proposed alternative and accident reduction benefit for each is described below.

A. Traffic Analysis

1. Traffic Volume Forecasts:

The design year or Estimated Time of Completion (ETC) for this project is expected during the 2012 construction season. To evaluate the four alternatives, traffic projections were prepared for the ETC+10 (2022) conditions. The projected volumes include background traffic growth and trips from other planned developments in the area. Based on a review of traffic volumes collected by Creighton Manning in 2007, traffic volumes along Bay Road have increased by approximately 2% per year over the last 5 years. Therefore, the existing 2012 traffic volumes were increased by a 2% annual growth rate for 10 years to arrive at the 2022 background growth volumes. Traffic from three additional projects was accounted for in the No-Build traffic volumes. The projects include the following:

- Fairfield Professional Office, which consists of approximately 96,000 square feet (SF) of office space to be constructed along Baybridge Drive
- Baybrook Professional Park, which consists of 40,000 SF of office space and 36 apartments to be constructed along Willowbrook Drive
- Cottage Hill, which consists of 188 condominiums to be constructed along Baybridge Drive

The trips associated with these developments were added to the background growth volumes to arrive at the 2022 No-Build traffic volumes as shown in Table 4.1 and Figure 4.1.

Table 4.1 – Traffic Volume Forecasts

Year	ADT	DDHV
Bay Road – northbound		
ETC 2012	7,915	845[1]
ETC+10 (2022)	11,240	1,225[1]
Bay Road – southbound		
ETC 2012	7,140	825[2]
ETC+10 (2022)	10,585	1,200[2]
Driveway – eastbound		
ETC 2012	230	12[3]
ETC+10 (2022)	275	14[3]
Cronin Road – westbound		
ETC 2012	1,500	125[3]
ETC+10 (2022)	1,820	150[3]

[1] AM Peak Hour
[2] Noon Peak Hour
[3] PM Peak Hour
ETC = Estimated Time of Completion
ADT = Average Daily Traffic (one-way)
DDHV = Directional Design Hourly Volume (one-way)

2. Level of Service and Capacity Analysis:

Intersection Level of Service (LOS) and capacity analysis relate traffic volumes to the physical characteristics of an intersection. Intersection evaluations were made using Synchro8 which automates the procedures contained in the *2000 Highway Capacity Manual*. Evaluations were also completed using SIDRA software to analyze a roundabout at the study intersection. Levels of service range from A to F with level of service A conditions considered excellent with very little vehicle delay while level of service F generally represents conditions with long vehicle delays. Table 4.2 identifies the levels of service and associated delay ranges for each type of traffic control. Appendix D contains detailed descriptions of LOS criteria for signalized, unsignalized, and roundabout controlled intersections, the detailed level of service reports, and detailed level of service summary tables.

Table 4.2 – Levels of Service

Level of Service	Control Delay (sec/veh)	
	Unsignalized Intersection	Signalized or Roundabout Intersection
A	≤ 10.0	≤ 10.0
B	>10.0 and ≤ 15.0	>10.0 and ≤ 20.0
C	>15.0 and ≤ 25.0	>20.0 and ≤ 35.0
D	>25.0 and ≤ 35.0	>35.0 and ≤ 55.0
E	>35.0 and ≤ 50.0	>55.0 and ≤ 80.0
F	>50.0	>80.0

The relative impact of the four alternatives proposed can be determined by comparing the level of service during the design year for the No-Build and Build traffic conditions. Tables 3.3 through 3.5 summarize the results of the Level of Service calculations for the AM, noon, and PM peak hours, respectively.

Standard traffic analysis procedures call for the collection of data during the peak periods. The peak 1-hour traffic volumes are then determined, followed by the peak 15-minute period. It is noted that during the AM peak hours, the 15-minute interval was highly influenced by students arriving and departing the college. Therefore, the AM peak hour results are reflective of the concentrated college traffic.

Table 4.3 – Peak Hour Level of Service Summary

Bay Rd/Cronin Rd Approach and geometry	Intersection Configuration				
	Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
	AM Peak Hour: 2012 (ETC)				
Chiropractor EB	B (11.0)	B (11.0)	B (11.0)	C (22.4)	A (5.8)
Cronin Rd WB	**F (**)**	**F (**)**	E (40.1)	C (25.9)	D (39.0)
Bay Rd NB	A (0.4)	A (8.3)	A (8.3)	C (20.1)	A (6.5)
Bay Rd SB	B (13.0)	B (13.1)	B (13.1)	A (4.0)	A (6.4)
Overall	---	---	---	B (16.5)	A (9.3)
	AM Peak Hour: 2022 (ETC+10)				
Chiropractor EB	B (13.3)	B (13.3)	B (13.3)	C (24.3)	A (8.4)
Cronin Rd WB	**F (**)**	**F (**)**	**F (**)**	F (131)	**F (262)**
Bay Rd NB	A (9.0)	A (9.0)	A (9.0)	F (141)	**F (118)**
Bay Rd SB	C (23.8)	C (24.4)	C (24.4)	A (4.4)	A (6.4)
Overall	---	---	---	F (103)	**F (98.2)**
	Noon Peak Hour: 2012 (ETC)				
Chiropractor EB	B (14.5)	B (14.5)	B (14.5)	B (15.6)	B (10.2)
Cronin Rd WB	**F (75.3)**	**F (101)**	B (11.7)	B (18.1)	B (12.4)
Bay Rd NB	A (0.0)	A (9.3)	A (9.3)	A (6.1)	A (6.1)
Bay Rd SB	A (9.0)	A (9.0)	A (9.0)	B (10.2)	A (6.5)
Overall	---	---	---	A (9.2)	A (6.7)
	Noon Peak Hour: 2022 (ETC+10)				
Chiropractor EB	C (21.1)	C (21.1)	C (21.1)	C (24.8)	C (25.2)
Cronin Rd WB	**F (**)**	**F (**)**	B (14.9)	C (28.7)	B (15.0)
Bay Rd NB	A (0.0)	B (11.0)	B (11.0)	A (6.2)	A (6.4)
Bay Rd SB	B (10.4)	B (10.5)	B (10.5)	B (15.3)	A (9.0)
Overall	---	---	---	B (12.6)	A (8.4)
	PM Peak Hour: 2012 (ETC)				
Chiropractor EB	C (19.0)	C (19.4)	C (19.4)	C (22.9)	A (9.6)
Cronin Rd WB	**F (80.9)**	**F (124)**	B (12.2)	C (27.0)	B (12.8)
Bay Rd NB	A (0.1)	A (9.2)	A (9.2)	A (4.6)	A (5.9)
Bay Rd SB	A (9.1)	A (9.1)	A (9.1)	A (5.3)	A (6.6)
Overall	---	---	---	A (6.9)	A (6.8)
	PM Peak Hour: 2022 (ETC+10)				
Chiropractor EB	E (45.5)	**F (51.3)**	**F (50.3)**	C (22.5)	C (20.7)
Cronin Rd WB	**F (**)**	**F (**)**	C (16.3)	C (32.2)	B (15.8)
Bay Rd NB	A (0.2)	B (10.7)	B (10.7)	A (7.6)	A (6.2)
Bay Rd SB	B (10.6)	B (10.8)	B (10.8)	B (13.3)	A (8.6)
Overall	---	---	---	B (12.4)	A (8.2)

EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound
X (Y.Y) = Level of Service (average delay in seconds per vehicle) reported for the critical movement for unsignalized intersections and the overall approach for signalized intersections
--- = Not Applicable
** = average delay greater than 200 seconds

The level of service analysis shows that under stop control, the westbound Cronin Road approach to the intersection generally operates at longer level of service F conditions when left-turns are allowed. This is especially true during the AM peak hour when the college arrival period significantly affects operations at the intersection for a 15-minute period. The analysis also shows that as funding is available, capacity improvements or turn restrictions (as identified in Alternatives 2, 3, and 4) should be implemented at the intersection.

B. Cost Estimates

The estimated costs for the four alternatives at the Bay Road/Cronin Road intersection include both construction costs and soft costs such as design engineering, detailed cost estimates, preparation of construction documents, public bidding process, right-of-way acquisition, and construction inspection. The estimates are considered planning level and do not include potential relocation of existing utilities. Based on recent bid results and prior experience with projects on New York State highways, planning level cost estimates for each of the four alternatives are provided below. Additional cost estimate information is included in Appendix E.

- Alternative 1 – Re-striping = $50,000
- Alternative 2 – Re-striping & Westbound Turn Restriction = $75,000
- Alternative 3 – Re-striping & Signal Installation = $200,000
- Alternative 4 – Roundabout Construction = $1,725,000

All alternative cost estimates would be increased by $125,000 if the striping improvements are extended to Glenwood Avenue as described in the Alternative 1 narrative in Section 3.A. The striping improvements are completed through removing and replacing the top layer of asphalt to provide a clean surface for re-striping.

C. Impacts

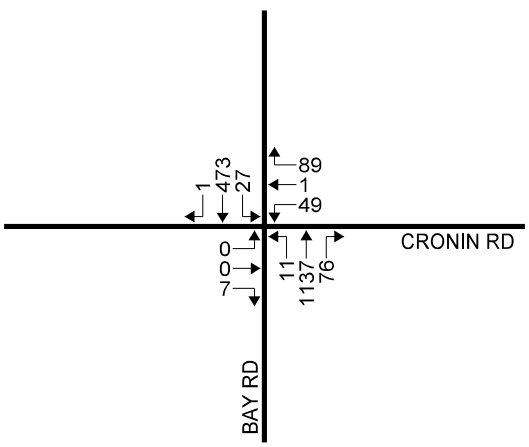
Table 4.6 provides a comparison of the four intersection alternatives. The table qualifies each alternative as having high, medium, or low impacts associated with multiple criteria and good, adequate, or poor operational characteristics.

Table 4.4 – Alternatives Comparison

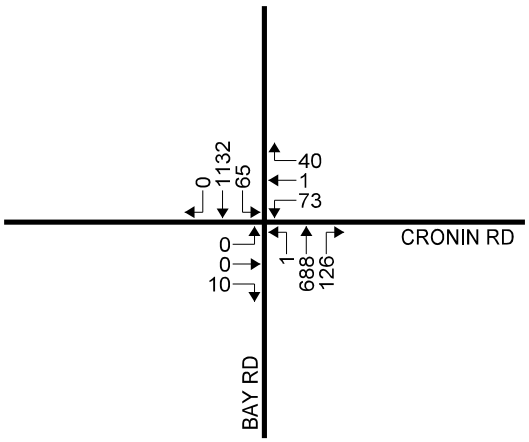
Criteria	Alternative			
	1 Re-striping	2 Re-striping & WB restriction	3 Re-striping & Signal	4 Roundabout
Accident reduction benefit	Medium	High	Medium	High
Intersection operations as compared to existing	Similar	Improved	Improved	Improved
Access impacts to adjacent properties and drivers	Low	High	Medium	High
Right-of-way impacts	None	None	Low	High
Utility impacts	None	None	Potentially High	High
Maintenance concerns	None	Medium	None	Medium
Traffic diversion	None	High	Low	Low
Cost	$50,000	$75,000	$200,000	$1,725,000

It is noted that similar to existing conditions, intersection operations, especially during the AM peak hour, will be poor on the Cronin Road approach to the intersection. The traffic diversion potential for Alternatives 3 and 4 refers to the access changes that would likely occur at the adjacent land uses and is not associated with a slightly more regional diversion.

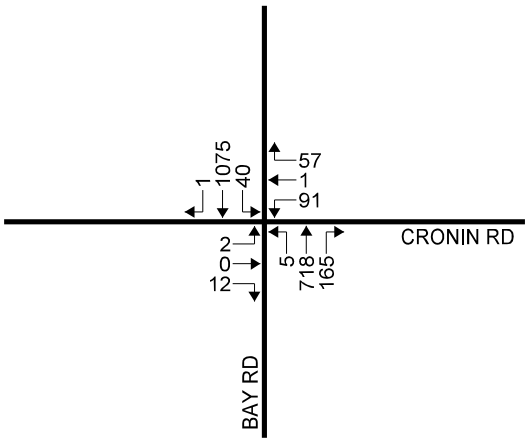
AM PEAK HOUR



NOON PEAK HOUR



PM PEAK HOUR



2022 (ETC + 10) PEAK HOUR
TRAFFIC VOLUMES

BAY RD & CRONIN RD
TOWN OF QUEENSBURY
WARREN COUNTY, NY

Creighton Manning

PROJECT: 111-253	DATE: 04/2012	FIGURE: 4.1

F:\Projects\2011\111-253 Bay & Cronin\cadd\dgn\figures\111-253_fig_traf.dgn

Chapter 5. Conclusions and Recommendations

This report summarizes the results of an accident analysis for the Bay Road / Cronin Road intersection and the evaluation of several intersection improvements with the potential to mitigate the intersection crash history. The evaluation compares the benefits and impacts associated with the four alternatives developed, including operational analyses for the ETC (2012) and ETC+10 (2022) conditions to identify future needs at the intersection.

Based on the accident analysis, the intersection crash rate is more than nine times higher than the statewide average for similar intersections. The analysis shows there are two primary accident patterns at the intersection. Almost 70% off all accidents in the study period involve crashes between northbound and westbound vehicles and nearly 15% of the accidents involve two or more southbound vehicles. Mitigating these two crash patterns is the primary concern when determining the preferred intersection improvement strategy.

The four alternatives under consideration include:

- Alternative 1: Re-stripe the northbound and southbound approaches to provide separate left-turn and shared through/right-turn lanes
- Alternative 2: Re-stripe the northbound and southbound approaches to provide left-turn and shared through/right-turn lanes and restrict westbound left-turn and through movements by constructing a raised median.
- Alternative 3: Re-stripe the northbound and southbound approaches to provide left-turn and shared through/right-turn lanes and install a traffic signal
- Alternative 4: Construct a single-lane roundabout

When comparing the four alternatives, Alternative 1 provides the greatest potential accident reduction benefit for the lowest cost and impacts. It is noted that consistent with existing conditions, the westbound Cronin Road approach to the intersection will operate at level of service F during the three peak hours. However, the trade-off between the intersection operations, the minimal impacts, and low cost may outweigh the intersection operations considerations. Therefore, implementation of Alternative 1 is recommended during the 2012 spring construction season. Subsequent to implementation, intersection accident records should be reviewed annually to confirm the effectiveness of the improvements. If the improvements are not proving effective in reducing the number and severity of accidents at the intersection, further measures should be implemented.

Restriction of left-turn movements from Cronin Road (Alternative 2) or installation of a traffic signal (Alternative 3) would both further reduce the number of accidents at the Bay Road / Cronin Road intersection. While construction of a roundabout (Alternative 4) would also reduce the number and severity of accidents, due to the cost, this alternative is considered not feasible at this time.

Construction of a raised median on the Cronin Road approach to Bay Road to restrict left-turns and through movements from Cronin Road onto Bay Road would be an unpopular decision for the general traveling public from the east. In addition, the construction of a raised median can make snow maintenance efforts cumbersome. However, restricting the left-turn movements has the potential to eliminate future crashes. The crash data shows that these movements account for almost 70% of the 45 crashes experienced at the intersection over the last five years. Drivers have alternate routes on the existing transportation network that have sufficient capacity to accommodate the re-routed traffic.

Several warrants for traffic signal installation are met and capacity analyses indicate that the intersection would operate with improved levels of service under traffic signal control while generally maintaining existing traffic patterns. However, installation of a traffic signal is problematic due to the existing overhead utilities at the intersection. The adjacent photograph shows some of the overhead utility conflicts at the intersection. Existing utility poles would likely require relocation in order to meet utility spacing requirements. Review of available mapping indicates that the existing utility poles appear to be outside of the existing right-of-way meaning that funding for utility pole relocation is the responsibility of the project sponsor.

Existing overhead utility conflicts at the Bay Road / Cronin Road intersection

It is recommended that Alternative 1 be implemented at the Bay Road / Cronin Road intersection during the spring/summer 2012 construction season to mitigate the existing accident patterns at the intersection. After one year, the accident records should be reviewed to identify the effectiveness of the re-striping effort. Growth in the corridor should also be monitored, as the level of service analysis shows that capacity improvements should be provided as growth in the corridor increases.

If the accident and traffic volume data indicate that additional mitigation measures are needed, Alternative 2 or Alternative 3 could be implemented. At this time, implementation of Alternative 2 represents a logical, low-cost, minimal impact option to further address existing safety concerns if Alternative 1 proves insufficient. However, installation of a traffic signal is also a viable intersection improvement. Therefore, if additional improvements are needed, the County and other involved parties will need to evaluate the potential physical impacts and costs versus the accident reduction and capacity benefits. The evaluation should include:

- Further definition of right-of-way impacts
- Capacity analyses to confirm expected corridor growth
- Cost estimate comparison with specific utility impacts
- Funding sources and budgetary constraints

Appendix A

Accident Evaluation

Transportation Assessment
Bay Road/Cronin Road
Town of Queensbury, Warren County, New York

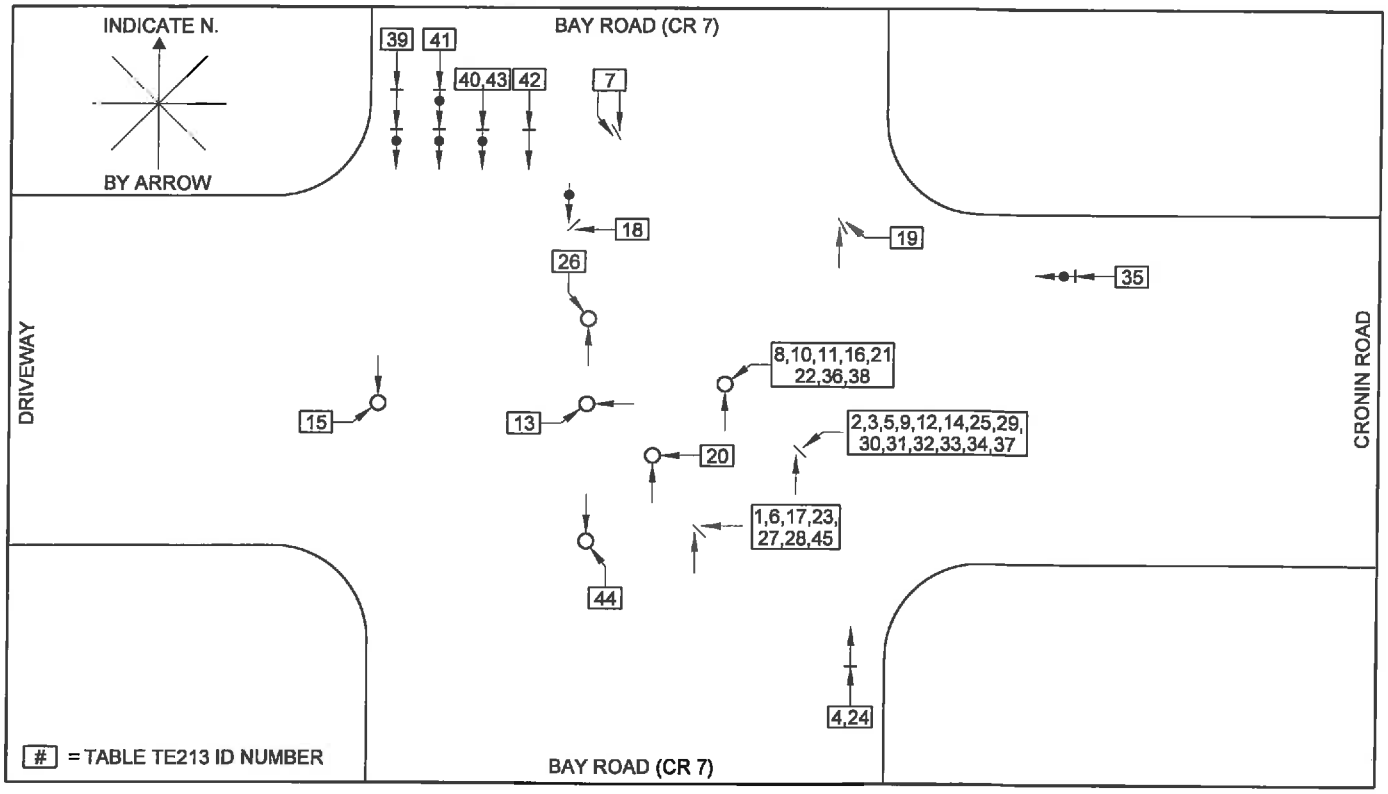
Creighton Manning

COLLISION DIAGRAM

TOWN QUEENSBURY JOB NO. 111-253 NUMBER OF ACCIDENTS 45

INTERSECTION OF BAY ROAD (CR 7) AND CRONIN ROAD BY DDD

PERIOD 6 YRS. 0 MO. FROM 1/1/06 TO 12/31/11 DATE 1/26/12



LEGEND

- PATH OF MOVING MOTOR VEH.
- PATH OF STOPPED MOTOR VEH.
- P PEDESTRIAN PATH
- B BICYCLIST PATH
- A ANIMAL PATH
- FATAL
- NON-FATAL
- REAR END COLLISION
- PARKED VEHICLE
- FIXED OBJECT
- OVERTURNED
- OUT OF CONTROL
- OVERTAKING
- SKIDDING
- HEAD ON
- LEFT TURN
- RIGHT TURN
- RIGHT ANGLE
- SIDESWIPE

ACCIDENT SUMMARY	DAYLIGHT					NIGHT					TOTALS				
CLASSIFICATION BY TYPES	FATAL	NON-FATAL	PROP. DAM.	NON-REP.	TOTAL	FATAL	NON-FATAL	PROP. DAM.	NON-REP.	TOTAL	FATAL	NON-FATAL	PROP. DAM.	NON-REP.	TOTAL
RIGHT ANGLE		9	18	2	29		1	1		2		10	19	2	31
REAR-END			8		8								8		8
HEAD-ON															
LEFT TURN		3	1	1	5							3	1	1	5
OVERTAKING/SIDESWIPE			1		1								1		1
RUN OFF ROAD															
FIXED OBJECT															
PARKED CAR															
PEDESTRIAN/BICYCLIST															
OTHER															
TOTALS		12	28	3	43		1	1		2		13	29	3	45

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Accident Summary Sheet – Bay Road (CR 7)

LOCATION: Bay Road @ Cronin Road TOWN Queensbury, NY

PERIOD COVERED: 11/1/06 thru 12/31/11 COUNTY Warren, NY

DATE: 2/8/12

Time of Day	No. of Accidents
12 AM- 6 AM	0 (0%)
6 AM-10 AM	7 (16%)
10 AM- 4 PM	28 (62%)
4 PM- 7 PM	10 (22%)
7 PM-12 AM	0 (0%)
Unknown	0 (0%)
Total	45 (100%)

Direction of Approach	No. of Vehicles
North	37 (40%)
South	18 (20%)
East	2 (2%)
West	35 (38%)
Unknown	0 (0%)
Total	92 (100%)

Weather	No. of Accidents
Clear	21 (47%)
Cloudy	17 (38%)
Rain	6 (13%)
Snow	0 (0%)
Sleet/Hail/Frz Rain	0 (0%)
Fog/Smog/Smoke	0 (0%)
Unknown	1 (2%)
Total	45 (100%)

Accident Type	No. of Accidents
Sideswipe	0 (0%)
Rear End	8 (18%)
Right Angle	31 (69%)
Left Turn	5 (11%)
Fixed Object	0 (0%)
Overtaking	1 (2%)
Animal	0 (0%)
Other/Unknown	0 (0%)
Total	45 (100%)

Pavement	No. of Accidents
Dry	32 (71%)
Wet	12 (27%)
Muddy	0 (0%)
Snow/Ice	0 (0%)
Slush	0 (0%)
Flooded	0 (0%)
Other	0 (0%)
Unknown	1 (2%)
Total	45 (100%)

Accident Severity	No. of Accidents
Fatal Injury	0 (0%)
Non-Fatal Injury	13 (29%)
Prop. Damage Only	29 (64%)
Non-Reportable	3 (7%)
Unknown	0 (0%)
Total	45 (100%)

Time of Year	No. of Accidents
Winter (Dec.-Feb.)	13 (29%)
Spring (Mar.-May)	7 (16%)
Summer (June-Aug.)	5 (11%)
Fall (Sept.-Nov.)	20 (44%)
Total	45 (100%)

Type of Vehicle	No. of Vehicles
Passenger Cars	92 (100%)
Commercial Vehicles	0 (0%)
Total	92 (100%)

Light Condition	No. of Accidents
Daylight	43 (96%)
Dawn	0 (0%)
Dusk	0 (0%)
Dark-Road Lighted	1 (2%)
Dark-Road Unlighted	1 (2%)
Unknown	0 (0%)
Total	45 (100%)

Appendix B

Traffic Volume Data

Transportation Assessment
Bay Road/Cronin Road
Town of Queensbury, Warren County, New York

Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253a1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 1

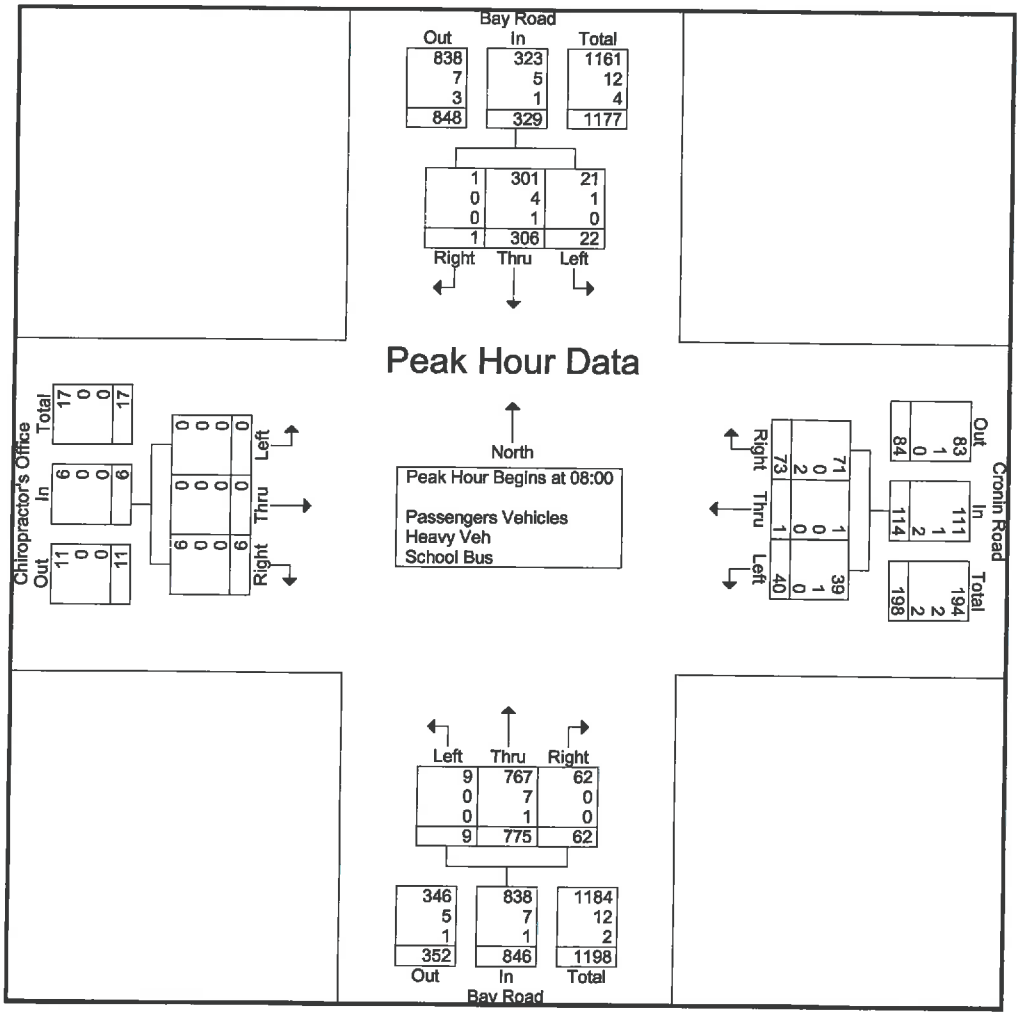
Groups Printed- Passengers Vehicles - Heavy Veh - School Bus

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
07:00	0	0	1	1	11	1	7	19	0	37	10	47	1	53	0	54	121
07:15	0	0	0	0	10	1	9	20	2	90	14	106	3	51	3	57	183
07:30	0	0	2	2	16	0	13	29	2	163	17	182	6	67	0	73	286
07:45	0	0	0	0	10	0	17	27	2	231	21	254	7	88	0	95	376
Total	0	0	3	3	47	2	46	95	6	521	62	589	17	259	3	279	966
08:00	0	0	2	2	11	0	12	23	1	97	15	113	0	67	0	67	205
08:15	0	0	0	0	8	0	11	19	5	136	14	155	7	48	0	55	229
08:30	0	0	3	3	12	0	18	30	1	243	17	261	7	86	0	93	387
08:45	0	0	1	1	9	1	32	42	2	299	16	317	8	105	1	114	474
Total	0	0	6	6	40	1	73	114	9	775	62	846	22	306	1	329	1295
Grand Total	0	0	9	9	87	3	119	209	15	1296	124	1435	39	565	4	608	2261
Apprch %	0	0	100		41.6	1.4	56.9		1	90.3	8.6		6.4	92.9	0.7		
Total %	0	0	0.4	0.4	3.8	0.1	5.3	9.2	0.7	57.3	5.5	63.5	1.7	25	0.2	26.9	
Passengers Vehicles	0	0	9	9	84	3	117	204	15	1280	122	1417	38	549	4	591	2221
% Passengers Vehicles	0	0	100	100	96.6	100	98.3	97.6	100	98.8	98.4	98.7	97.4	97.2	100	97.2	98.2
Heavy Veh	0	0	0	0	3	0	0	3	0	14	2	16	1	10	0	11	30
% Heavy Veh	0	0	0	0	3.4	0	0	1.4	0	1.1	1.6	1.1	2.6	1.8	0	1.8	1.3
School Bus	0	0	0	0	0	0	2	2	0	2	0	2	0	6	0	6	10
% School Bus	0	0	0	0	0	0	1.7	1	0	0.2	0	0.1	0	1.1	0	1	0.4

Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253a1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 2

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 7:00:00 AM to 8:45:00 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 8:00:00 AM																	
8:00:00 AM	0	0	2	2	11	0	12	23	1	97	15	113	0	67	0	67	205
8:15:00 AM	0	0	0	0	8	0	11	19	5	136	14	155	7	48	0	55	229
8:30:00 AM	0	0	3	3	12	0	18	30	1	243	17	261	7	86	0	93	387
8:45:00 AM	0	0	1	1	9	1	32	42	2	299	16	317	8	105	1	114	474
Total Volume	0	0	6	6	40	1	73	114	9	775	62	846	22	306	1	329	1295
% App. Total	0	0	100		35.1	0.9	64		1.1	91.6	7.3		6.7	93	0.3		
PHF	.000	.000	.500	.500	.833	.250	.570	.679	.450	.648	.912	.667	.688	.729	.250	.721	.683
Passengers Vehicles	0	0	6	6	39	1	71	111	9	767	62	838	21	301	1	323	1278
% Passengers Vehicles	0	0	100	100	97.5	100	97.3	97.4	100	99.0	100	99.1	95.5	98.4	100	98.2	98.7
Heavy Veh	0	0	0	0	1	0	0	1	0	7	0	7	1	4	0	5	13
% Heavy Veh	0	0	0	0	2.5	0	0	0.9	0	0.9	0	0.8	4.5	1.3	0	1.5	1.0
School Bus	0	0	0	0	0	0	2	2	0	1	0	1	0	1	0	1	4
% School Bus	0	0	0	0	0	0	2.7	1.8	0	0.1	0	0.1	0	0.3	0	0.3	0.3



Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253md1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 1

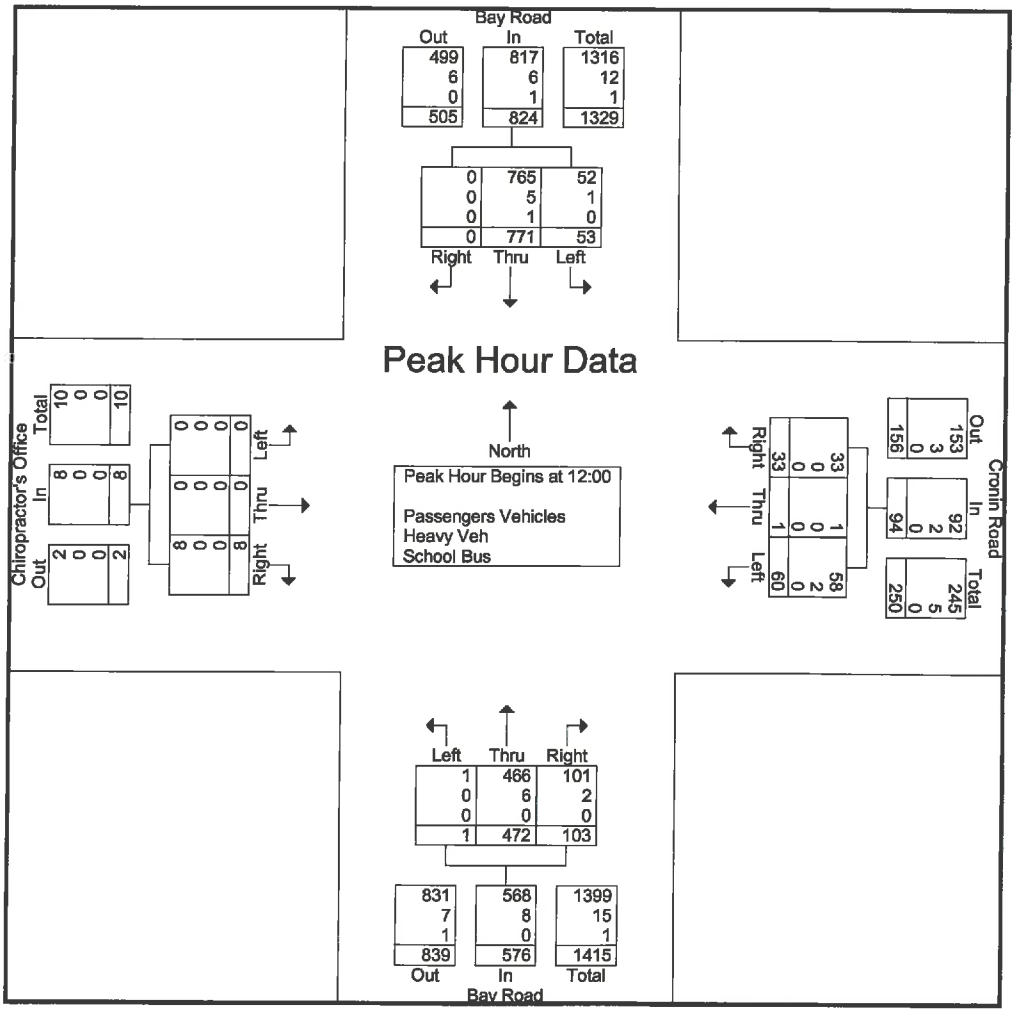
Groups Printed- Passengers Vehicles - Heavy Veh - School Bus

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
11:00	0	0	2	2	9	0	8	17	7	130	19	156	14	162	1	177	352
11:15	2	0	2	4	13	0	10	23	0	106	33	139	10	152	0	162	328
11:30	0	0	1	1	13	0	3	16	1	90	30	121	8	126	0	134	272
11:45	0	0	5	5	25	0	4	29	1	94	31	126	5	103	0	108	268
Total	2	0	10	12	60	0	25	85	9	420	113	542	37	543	1	581	1220
12:00	0	0	3	3	14	1	4	19	0	114	25	139	16	162	0	178	339
12:15	0	0	2	2	19	0	10	29	1	133	28	162	11	176	0	187	380
12:30	0	0	0	0	16	0	9	25	0	102	25	127	16	222	0	238	390
12:45	0	0	3	3	11	0	10	21	0	123	25	148	10	211	0	221	393
Total	0	0	8	8	60	1	33	94	1	472	103	576	53	771	0	824	1502
Grand Total	2	0	18	20	120	1	58	179	10	892	216	1118	90	1314	1	1405	2722
Apprch %	10	0	90		67	0.6	32.4		0.9	79.8	19.3		6.4	93.5	0.1		
Total %	0.1	0	0.7	0.7	4.4	0	2.1	6.6	0.4	32.8	7.9	41.1	3.3	48.3	0	51.6	
Passengers Vehicles	2	0	18	20	118	1	57	176	10	878	212	1100	88	1299	1	1388	2684
% Passengers Vehicles	100	0	100	100	98.3	100	98.3	98.3	100	98.4	98.1	98.4	97.8	98.9	100	98.8	98.6
Heavy Veh	0	0	0	0	2	0	1	3	0	14	4	18	2	14	0	16	37
% Heavy Veh	0	0	0	0	1.7	0	1.7	1.7	0	1.6	1.9	1.6	2.2	1.1	0	1.1	1.4
School Bus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
% School Bus	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0

Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253md1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 2

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00:00 AM to 12:45:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 12:00:00 PM																	
12:00:00 PM	0	0	**3**	**3**	14	**1**	4	19	0	114	25	139	**16**	162	0	178	339
12:15:00 PM	0	0	2	2	**19**	0	**10**	**29**	**1**	**133**	**28**	**162**	11	176	0	187	380
12:30:00 PM	0	0	0	0	16	0	9	25	0	102	25	127	16	**222**	0	**238**	390
12:45:00 PM	0	0	3	3	11	0	10	21	0	123	25	148	10	211	0	221	**393**
Total Volume	0	0	8	8	60	1	33	94	1	472	103	576	53	771	0	824	1502
% App. Total	0	0	100		63.8	1.1	35.1		0.2	81.9	17.9		6.4	93.6	0		
PHF	.000	.000	.667	.667	.789	.250	.825	.810	.250	.887	.920	.889	.828	.868	.000	.866	.955
Passengers Vehicles	0	0	8	8	58	1	33	92	1	466	101	568	52	765	0	817	1485
% Passengers Vehicles	0	0	100	100	96.7	100	100	97.9	100	98.7	98.1	98.6	98.1	99.2	0	99.2	98.9
Heavy Veh	0	0	0	0	2	0	0	2	0	6	2	8	1	5	0	6	16
% Heavy Veh	0	0	0	0	3.3	0	0	2.1	0	1.3	1.9	1.4	1.9	0.6	0	0.7	1.1
School Bus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
% School Bus	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0.1



Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253p1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 1

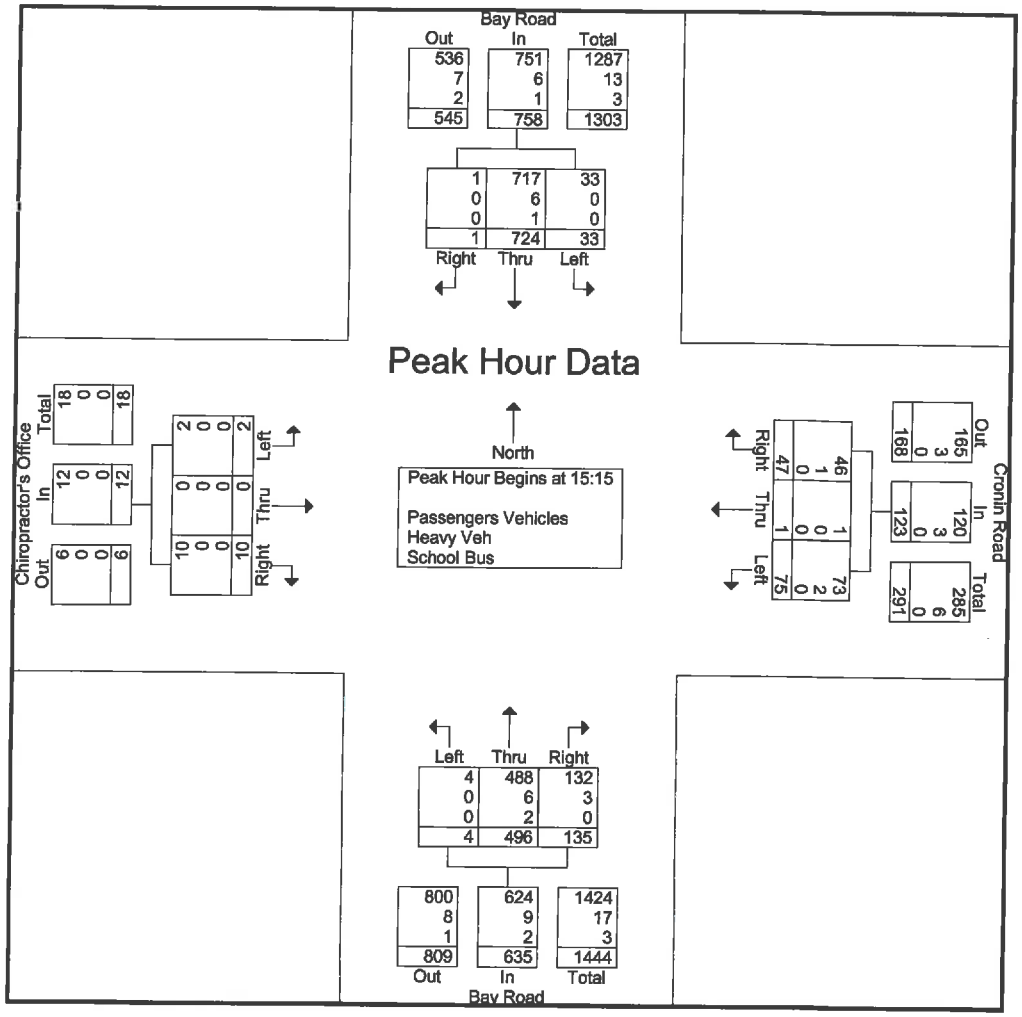
Groups Printed- Passengers Vehicles - Heavy Veh - School Bus

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
15:00	0	0	0	0	12	0	13	25	2	121	34	157	13	122	0	135	317
15:15	0	0	4	4	19	0	10	29	3	111	32	146	8	191	0	199	378
15:30	0	0	2	2	22	1	14	37	0	128	36	164	6	186	1	193	396
15:45	1	0	2	3	11	0	16	27	1	136	32	169	10	164	0	174	373
Total	1	0	8	9	64	1	53	118	6	496	134	636	37	663	1	701	1464
16:00	1	0	2	3	23	0	7	30	0	121	35	156	9	183	0	192	381
16:15	0	0	1	1	12	0	10	22	1	107	24	132	10	154	1	165	320
16:30	0	1	1	2	2	0	13	15	0	86	36	122	20	128	0	148	287
16:45	0	2	1	3	10	0	7	17	0	92	32	124	12	134	0	146	290
Total	1	3	5	9	47	0	37	84	1	406	127	534	51	599	1	651	1278
17:00	0	0	1	1	9	0	3	12	0	95	38	133	11	154	1	166	312
17:15	0	0	0	0	9	0	9	18	0	118	38	156	10	114	0	124	298
17:30	0	0	0	0	18	0	5	23	0	91	17	108	10	93	0	103	234
17:45	0	0	0	0	12	0	5	17	0	56	30	86	6	73	0	79	182
Total	0	0	1	1	48	0	22	70	0	360	123	483	37	434	1	472	1026
Grand Total	2	3	14	19	159	1	112	272	7	1262	384	1653	125	1696	3	1824	3768
Apprch %	10.5	15.8	73.7		58.5	0.4	41.2		0.4	76.3	23.2		6.9	93	0.2		
Total %	0.1	0.1	0.4	0.5	4.2	0	3	7.2	0.2	33.5	10.2	43.9	3.3	45	0.1	48.4	
Passengers Vehicles	2	3	14	19	156	1	109	266	7	1243	378	1628	123	1683	3	1809	3722
% Passengers Vehicles	100	100	100	100	98.1	100	97.3	97.8	100	98.5	98.4	98.5	98.4	99.2	100	99.2	98.8
Heavy Veh	0	0	0	0	3	0	3	6	0	14	6	20	1	11	0	12	38
% Heavy Veh	0	0	0	0	1.9	0	2.7	2.2	0	1.1	1.6	1.2	0.8	0.6	0	0.7	1
School Bus	0	0	0	0	0	0	0	0	0	5	0	5	1	2	0	3	8
% School Bus	0	0	0	0	0	0	0	0	0	0.4	0	0.3	0.8	0.1	0	0.2	0.2

Project: 111-253
Counted By: CDF
Location: Queensbury, NY
Other:

File Name : tm11253p1
Site Code : 11-253-1
Start Date : 1/25/2012
Page No : 2

	Chiropractor's Office Eastbound				Cronin Road Westbound				Bay Road Northbound				Bay Road Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 3:00:00 PM to 5:45:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 3:15:00 PM																	
3:15:00 PM	0	0	4	4	19	0	10	29	3	111	32	146	8	191	0	199	378
3:30:00 PM	0	0	2	2	22	1	14	37	0	128	36	164	6	186	1	193	396
3:45:00 PM	1	0	2	3	11	0	16	27	1	136	32	169	10	164	0	174	373
4:00:00 PM	1	0	2	3	23	0	7	30	0	121	35	156	9	183	0	192	381
Total Volume	2	0	10	12	75	1	47	123	4	496	135	635	33	724	1	758	1528
% App. Total	16.7	0	83.3		61	0.8	38.2		0.6	78.1	21.3		4.4	95.5	0.1		
PHF	.500	.000	.625	.750	.815	.250	.734	.831	.333	.912	.938	.939	.825	.948	.250	.952	.965
Passengers Vehicles	2	0	10	12	73	1	46	120	4	488	132	624	33	717	1	751	1507
% Passengers Vehicles	100	0	100	100	97.3	100	97.9	97.6	100	98.4	97.8	98.3	100	99.0	100	99.1	98.6
Heavy Veh	0	0	0	0	2	0	1	3	0	6	3	9	0	6	0	6	18
% Heavy Veh	0	0	0	0	2.7	0	2.1	2.4	0	1.2	2.2	1.4	0	0.8	0	0.8	1.2
School Bus	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	1	3
% School Bus	0	0	0	0	0	0	0	0	0	0.4	0	0.3	0	0.1	0	0.1	0.2



Appendix C

Signal Warrant Evaluation

Transportation Assessment
Bay Road/Cronin Road
Town of Queensbury, Warren County, New York

Introduction

The purpose of this evaluation is to summarize the results of a traffic signal warrant analysis at the intersection of Bay Road and Cronin Road. The existing and future traffic conditions, pedestrian characteristics, and physical characteristics of the intersection were compared to five of the nine signal warrants contained in the National Manual on Uniform Traffic Control Devices (MUTCD). The intersection currently operates under stop sign control on the eastbound and westbound approaches. The northbound approach provides an exclusive right-turn lane and a shared through/left-turn lane while the southbound approach provides an exclusive left-turn lane and a shared through/right-turn lane. The eastbound and westbound approaches provide a single lane for shared travel movements.

Description of Warrants

Warrant 1, Eight-Hour Vehicular Volume – This warrant is satisfied if for any eight hours of an average day the traffic volumes for Condition A or Condition B specified in Table 4C-1 of the MUTCD are met for the major-street and the higher volume minor-street approach to the intersection.

Warrant 2, Four-Hour Vehicular Volume – This warrant is met when for any four hours of an average day, points plotted on the graph presented on Figure 4C-1 of the MUTCD fall above the appropriate curve.

Warrant 3, Peak Hour – This warrant is met when for any one hour of an average day, points plotted on the graph presented on Figure 4C-3 of the MUTCD fall above the appropriate curve.

Warrant 4, Pedestrian Volume – This warrant is satisfied when for any four hours of an average day, points plotted on the graph presented on Figure 4C-5 of the MUTCD fall above the appropriate curve. This warrant is also satisfied if for any one hour of an average day, points plotted on the graph presented on Figure 4C-7 fall above the appropriate curve.

Warrant 7, Crash Experience – This warrant is used when the severity and frequency of crashes are the primary reason for installation of a traffic signal. This warrant is satisfied when adequate trial of alternatives has failed to reduce the crash frequency, five or more crashes of a type susceptible to correction by a traffic signal have occurred within the last 12 months, and when traffic volumes at the intersection exceed the 80% thresholds identified in warrant 1 for eight hours of an average day.

Warrants 1, 2, 3, 4, and 7 are analyzed in detail in the next section.

Detailed Signal Warrants Analysis

Warrants 1, 2, and 3 – Average hourly traffic volumes recorded by Creighton Manning and turning movement counts serve as the basis for the signal warrant analysis. Table 1 summarizes the analysis of Warrants 1, 2, and 3. A checkmark under the “Signal Warrants Met?” column indicates that the criteria are satisfied for that hour.

Table 1 – Summary of Signal Warrant Analysis

Time Begin (1-hour period)	Existing 2012 Volumes		Signal Warrants Met?			
	Bay Rd	Cronin Rd	#1		#2	#3
			Cond. A	Cond. B		
7:00 AM	786	89		✓		
8:00 AM	1,094	105		✓	✓	
9:00 AM	1,009	102		✓	✓	
10:00 AM	1,144	97		✓	✓	
11:00 AM	1,168	97		✓	✓	
12:00 PM	1,347	128		✓	✓	✓
1:00 PM	1,242	125		✓	✓	
2:00 PM	1,040	122		✓	✓	
3:00 PM	1,438	146		✓	✓	✓
4:00 PM	1,272	112		✓	✓	
5:00 PM	1,151	115		✓	✓	
6:00 PM	594	64				
7:00 PM	481	39				
8:00 PM	449	29				
9:00 PM	264	29				
Required Volumes	**One Lane Major Street**		**500**	**750**	**See Figure 4C-1**	**See Figure 4C-4**
	One Lane Minor Street		**150**	**75**		
	Overall Warrant Met?		**No**	**Yes**	**Yes**	**Yes**

Table 1 shows that the traffic volumes at the intersection meet the signal warrant thresholds for installation of a traffic signal for the eight-hour, four-hour and peak hour scenarios.

Warrant 4, Pedestrian Volume – Review of the signal warrant criteria indicates that a minimum of 107 pedestrians crossing the major street per hour is needed to satisfy criteria A and that a minimum of 133 pedestrians crossing the major street per hour is needed to satisfy criteria B. The corresponding vehicular volumes are 1,100 and 1,450 vehicles on the major street, respectively. Review of the traffic volume data shows that only one pedestrian was observed crossing the street during the AM peak hour while 7 pedestrians were observed crossing the street during the PM peak hour. Based upon the available data, the pedestrian and vehicle volumes at this intersection do not meet thresholds and the warrant is not satisfied.

Warrant 7, Crash Experience – Review of the crash data at the Bay Rd/Cronin Rd intersections shows that there were 45 accidents reported over the last six years, eleven of which occurred within the last 12 months. The 45 reported accidents included 31 right-angle, 8 rear end, 5 left-turn, and one overtaking accident. The right-angle, rear-end and left-turn accidents are susceptible to correction by a traffic signal. However, installation of a traffic signal based upon the crash experience warrant requires “adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency”.

Recommendation

The above analysis shows that the existing traffic conditions at the Bay Road/Cronin Road intersection meet the traffic signal warrant criteria for Warrants 1, 2, and 3. Therefore, a traffic signal should be considered for installation at this intersection.

Figure 4C-1
Four-Hour Vehicular Volume Warrant
Source: Federal MUTCD

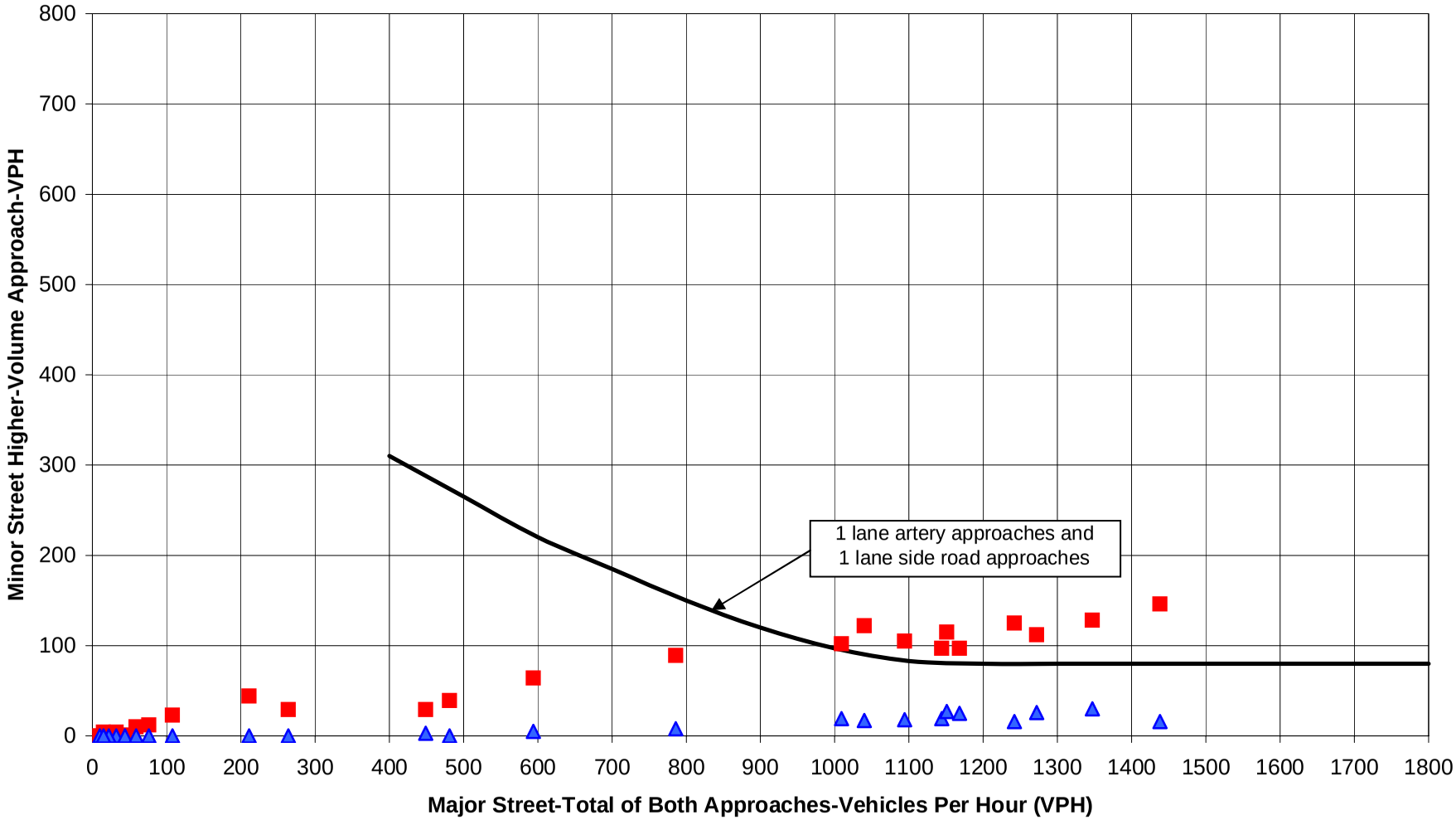
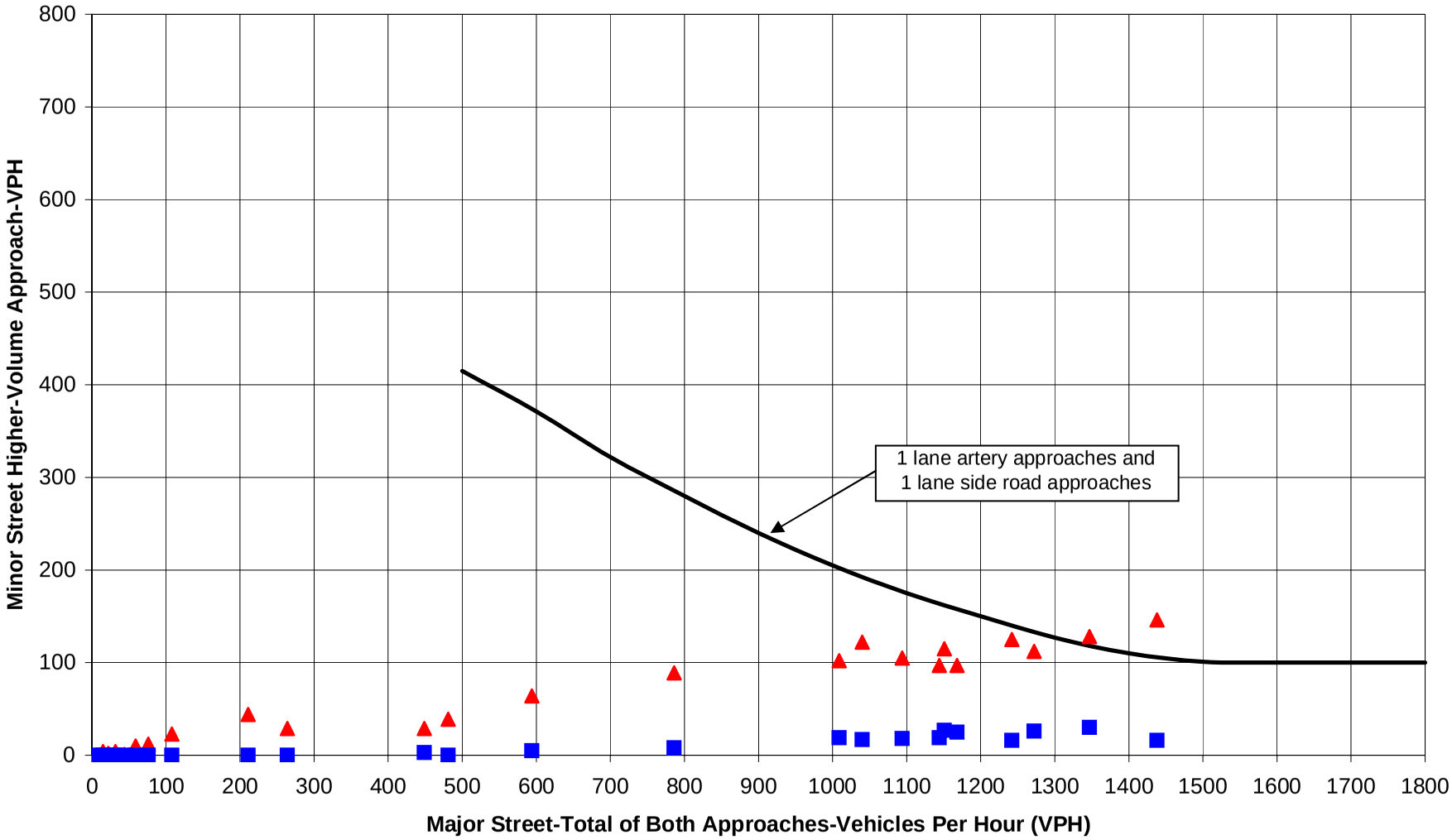


Figure 4C-3
Peak Hour Volume Warrant
Source: Federal MUTCD



Appendix D

Level of Service Analysis

Transportation Assessment
Bay Road/Cronin Road
Town of Queensbury, Warren County, New York

LOS Definitions

The following is an excerpt from the 2000 Highway Capacity Manual (HCM).

Level of Service for Signalized Intersections

Level of service for a signalized intersection is defined in terms of control delay, which is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, geometrics, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions: in the absence of traffic control, geometric delay, any incidents, and any other vehicles. Specifically, LOS criteria for traffic signals are stated in terms of the average control delay per vehicle, typically for a 15-minute analysis period. Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group. Levels of service are defined to represent reasonable ranges in control delay.

LOS A describes operations with low control delay, up to 10 s/veh. This LOS occurs when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay.

LOS B describes operations with control delay greater than 10 and up to 20 s/veh. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay.

LOS C describes operations with control delay greater than 20 and up to 35 s/veh. These higher delays may result from only fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. Cycle failure occurs when a given green phase does not serve queued vehicles, and overflows occur. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

LOS D describes operations with control delay greater than 35 and up to 55 s/veh. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

LOS E describes operations with control delay greater than 55 and up to 80 s/veh. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent.

LOS F describes operations with control delay in excess of 80 s/veh. This level, considered unacceptable to most drivers, often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of lane groups. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also be contribute significantly to high delay levels.

Average control delay and queue length at roundabout controlled intersections are calculated using SIDRA Intersection. The physical geometry such as entry lane width and approach flare, and traffic volume at the roundabout are factors that influence the intersection's performance. The average delay reported using SIRA Intersection is based on the HCM Method of Delay for Level-of-Service.

Level of Service Criteria for Unsignalized Intersections

Four measures are used to describe the performance of two-way stop controlled intersections: control delay, delay to major street through vehicles, queue length, and v/c ratio. The primary measure that is used to provide an estimate of LOS is control delay. This measure can be estimated for any movement on the minor (i.e., stop-controlled) street. By summing delay estimates for individual movements, a delay estimate for each minor street movement and minor street approach can be achieved. The level of service criteria is given in Exhibit 17-2/22.

For all-way stop controlled (AWSC) intersections, the average control delay (in seconds per vehicle) is used as the primary measure of performance. Control delay is the increased time of travel for a vehicle approaching and passing through an AWSC intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection.

Exhibit 17-2/22: Level-of-Service Criteria for Stop Controlled Intersections

Level of Service	Control Delay (sec/veh)
A	$\leq$ 10.0
B	>10.0 and $\leq$ 15.0
C	>15.0 and $\leq$ 25.0
D	>25.0 and $\leq$ 35.0
E	>35.0 and $\leq$ 50.0
F	>50.0

2012 AM Peak Hour

Intersection		2012				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	B (11.0)				
Cronin Rd WB	LTR	F (**)				
Bay Rd NB	LT	A (0.4)				
	R	A (0.0)				
Cronin Rd SB	L	B (13.0)				
	TR	A (0.0)				
Chiropractor EB	LTR		B (11.0)	B (11.0)		
Cronin Rd WB	L(TR)		F (**)	E (42.7)		
Bay Rd NB	L		A (8.3)	A (8.3)		
Cronin Rd SB	L		B (13.1)	B (13.1)		
Chiropractor EB	LTR				C (22.4)	
Cronin Rd WB	LTR				C (25.9)	
Bay Rd NB	L				A (2.3)	
	TR				C (20.3)	
Cronin Rd SB	L				A (7.3)	
	TR				A (3.7)	
Overalll					B (16.5)	
Chiropractor EB	LTR					A (5.8)
Cronin Rd WB	LTR					D (39.0)
Bay Rd NB	LTR					A (6.5)
Cronin Rd SB	LTR					A (6.4)
Overall						A (9.3)
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	E (56.6)		E (56.6)		
Lowe's Dwy WB	L,	E (56.8)		D (56.8)		
	LT	E (56.0)		D (56.0)		
	R	D (50.6)		D (50.6)		
Bay Rd NB	L	C (20.5)		C (20.4)		
	T,TR	C (28.4)		C (28.4)		
Bay Rd SB	L	C (21.8)		C (21.8)		
	T,TR	C (26.7)		C (26.3)		
Overall		D (37.6)		D (37.8)		
Bay Rd/Quaker Rd						
Quaker Rd EB	L	B (14.3)		B (14.3)		
	T,TR	C (21.8)		C (21.4)		
Quaker Rd WB	L	B (15.8)		B (15.6)		
	T,T	C (24.6)		C (24.7)		
	R	B (12.2)		B (12.3)		
Bay Rd NB	L	C (24.0)		C (24.1)		
	T,TR	C (33.1)		C (33.1)		
Bay Rd SB	L	C (22.0)		C (22.4)		
	T,TR	C (30.4)		C (30.5)		
Overall		C (23.7)		C (23.6)		
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	B (18.7)		B (19.0)		
	T,TR	B (18.2)		B (18.4)		
Quaker Rd WB	L	C (20.8)		C (20.5)		
	T,TR	C (21.8)		C (21.8)		
Glenwood Ave NB	L	C (25.8)		C (26.1)		
	TR	C (28.8)		C (29.1)		
Glenwood Ave SB	L	C (26.3)		C (26.6)		
	TR	C (27.3)		C (27.5)		
Overalll		C (21.1)		C (21.1)		

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

2022 AM Peak Hour

Intersection		2022				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	B (13.3)				
Cronin Rd WB	LTR	F (**)				
Bay Rd NB	LT	A (9.0)				
	R	A (0.0)				
Cronin Rd SB	L	C (23.8)				
	TR	A (0.0)				
Chiropractor EB	LTR		B (13.3)	B (13.3)		
Cronin Rd WB	L(TR)		F (**)	F (**)		
Bay Rd NB	L		A (9.0)	A (9.0)		
Cronin Rd SB	L		C (24.4)	C (24.4)		
Chiropractor EB	LTR				C (24.3)	
Cronin Rd WB	LTR				F (131)	
Bay Rd NB	L				A (1.8)	
	TR				F (142)	
Cronin Rd SB	L				A (8.3)	
	TR				A (4.4)	
Overalll					F (103)	
Chiropractor EB	LTR					A (8.4)
Cronin Rd WB	LTR					F (262)
Bay Rd NB	LTR					F (118)
Cronin Rd SB	LTR					A (6.4)
Overall						F (98.2)
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	F (275)		F (**)		
Lowe's Dwy WB	L,	E (57.2)		E (57.2)		
	LT	E (56.3)		E (56.3)		
	R	D (50.5)		D (50.5)		
Bay Rd NB	L	B (16.6)		B (16.4)		
	T,TR	C (25.8)		C (25.8)		
Bay Rd SB	L	B (18.9)		B (18.9)		
	T,TR	C (24.1)		C (23.7)		
Overall		F (103)		F (105)		
Bay Rd/Quaker Rd						
Quaker Rd EB	L	C (27.8)		C (28.0)		
	T,TR	C (27.5)		C (26.9)		
Quaker Rd WB	L	B (19.9)		B (19.6)		
	T,T	C (30.8)		C (31.2)		
	R	B (15.0)		B (15.2)		
Bay Rd NB	L	C (30.5)		C (30.9)		
	T,TR	D (44.7)		D (45.5)		
Bay Rd SB	L	C (28.9)		C (29.1)		
	T,TR	D (37.2)		D (37.4)		
Overall		C (30.6)		C (30.6)		
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	D (37.0)		D (38.3)		
	T,TR	B (19.9)		C (20.1)		
Quaker Rd WB	L	C (25.8)		C (25.5)		
	T,TR	C (23.7)		C (23.7)		
Glenwood Ave NB	L	C (30.3)		C (30.6)		
	TR	D (41.9)		D (42.8)		
Glenwood Ave SB	L	C (30.4)		C (30.7)		
	TR	C (32.0)		C (32.2)		
Overalll		C (26.0)		C (26.2)		

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

2012 Noon Peak Hour

Intersection		2012				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	B (14.5)				
Cronin Rd WB	LTR	F (75.3)				
Bay Rd NB	LT	A (0.0)				
	R	A (0.0)				
Cronin Rd SB	L	A (9.0)				
	TR	A (0.0)				
Chiropractor EB	LTR		B (14.5)	B (14.5)		
Cronin Rd WB	L(TR)		F (101)	B (12.7)		
Bay Rd NB	L		A (9.3)	A (9.3)		
Cronin Rd SB	L		A (9.0)	A (9.0)		
Chiropractor EB	LTR				B (15.6)	
Cronin Rd WB	LTR				B (18.1)	
Bay Rd NB	L				A (3.6)	
	TR				A (6.1)	
Cronin Rd SB	L				A (4.0)	
	TR				B (10.7)	
Overalll					A (9.2)	
Chiropractor EB	LTR					B (10.2)
Cronin Rd WB	LTR					B (12.4)
Bay Rd NB	LTR					A (6.1)
Cronin Rd SB	LTR					A (6.5)
Overall						A (6.7)
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	C (27.0)		C (25.5)		
Lowe's Dwy WB	L,	C (32.7)		C (31.6)		
	LT	C (32.6)		C (31.5)		
	R	C (27.8)		C (26.9)		
Bay Rd NB	L	B (17.5)		B (17.3)		
	T,TR	B (19.0)		B (19.3)		
Bay Rd SB	L	B (15.5)		B (15.9)		
	T,TR	C (23.6)		C (23.3)		
Overall		C (23.5)		C (23.0)		
Bay Rd/Quaker Rd						
Quaker Rd EB	L	C (29.8)		C (31.6)		
	T,TR	C (27.1)		C (26.1)		
Quaker Rd WB	L	B (19.8)		B (19.4)		
	T,T	C (30.8)		C (30.9)		
	R	B (13.5)		B (13.5)		
Bay Rd NB	L	C (30.5)		C (31.2)		
	T,TR	D (40.0)		D (40.9)		
Bay Rd SB	L	C (27.6)		C (28.2)		
	T,TR	D (35.4)		D (36.0)		
Overall		C (30.0)		C (30.1)		
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	C (28.6)		C (28.6)		
	T,TR	C (22.2)		C (21.9)		
Quaker Rd WB	L	C (28.6)		C (27.9)		
	T,TR	C (26.3)		C (26.4)		
Glenwood Ave NB	L	D (35.1)		D (35.4)		
	TR	F (94.9)		F (98.2)		
Glenwood Ave SB	L	C (31.1)		C (31.6)		
	TR	D (40.1)		D (39.0)		
Overalll		C (32.3)		C (32.3)		

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

2022 Noon Peak Hour

Intersection		2022				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	C (21.1)				
Cronin Rd WB	LTR	F (**)				
Bay Rd NB	LT	A (0.0)				
	R	A (0.0)				
Cronin Rd SB	L	B (10.4)				
	TR	A (0.0)				
Chiropractor EB	LTR		C (21.1)		C (21.1)	
Cronin Rd WB	L(TR)		F (**)		C (18.6)	
Bay Rd NB	L		B (11.0)		B (11.0)	
Cronin Rd SB	L		B (10.5)		B (10.5)	
Chiropractor EB	LTR			C (24.8)		
Cronin Rd WB	LTR			C (28.7)		
Bay Rd NB	L			A (2.1)		
	TR			A (6.2)		
Cronin Rd SB	L			A (3.2)		
	TR			B (16.0)		
Overalll				B (12.6)		
Chiropractor EB	LTR					C (25.2)
Cronin Rd WB	LTR					B (15.0)
Bay Rd NB	LTR					A (6.4)
Cronin Rd SB	LTR					A (9.0)
Overall						A (8.4)
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	D (38.5)			D (38.5)	
Lowe's Dwy WB	L,	D (38.6)			D (38.6)	
	LT	D (38.6)			D (38.6)	
	R	C (32.7)			C (32.7)	
Bay Rd NB	L	C (24.0)			C (24.0)	
	T,TR	C (23.3)			C (23.3)	
Bay Rd SB	L	B (18.3)			B (18.3)	
	T,TR	E (56.8)			D (42.4)	
Overall		D (42.8)			D (35.8)	
Bay Rd/Quaker Rd						
Quaker Rd EB	L	F (88.7)			F (95.0)	
	T,TR	C (29.2)			C (28.5)	
Quaker Rd WB	L	C (32.1)			C (31.0)	
	T,T	D (36.1)			D (36.5)	
	R	B (15.6)			B (15.4)	
Bay Rd NB	L	E (66.5)			E (70.6)	
	T,TR	E (62.1)			E (64.9)	
Bay Rd SB	L	F (96.4)			F (87.1)	
	T,TR	E (55.8)			D (53.9)	
Overall		D (47.8)			D (47.4)	
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	E (62.6)			E (63.9)	
	T,TR	C (31.8)			C (31.9)	
Quaker Rd WB	L	C (33.4)			C (33.3)	
	T,TR	C (34.5)			D (36.7)	
Glenwood Ave NB	L	D (40.1)			D (40.4)	
	TR	F (**)			F (**)	
Glenwood Ave SB	L	C (32.8)			C (33.0)	
	TR	F (92.3)			E (75.6)	
Overalll		E (58.2)			E (57.2)	

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

2012 PM Peak Hour

Intersection		2012				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	C (19.0)				
Cronin Rd WB	LTR	F (80.9)				
Bay Rd NB	LT	A (0.1)				
	R	A (0.0)				
Cronin Rd SB	L	A (9.1)				
	TR	A (0.0)				
Chiropractor EB	LTR		C (19.4)	C (19.4)		
Cronin Rd WB	L(TR)		F (124)	B (12.9)		
Bay Rd NB	L		A (9.2)	A (9.2)		
Cronin Rd SB	L		A (9.1)	A (9.1)		
Chiropractor EB	LTR				C (22.9)	
Cronin Rd WB	LTR				C (27.0)	
Bay Rd NB	L				A (2.1)	
	TR				A (4.6)	
Cronin Rd SB	L				A (2.4)	
	TR				A (5.3)	
Overalll					A (6.9)	
Chiropractor EB	LTR					C (20.7)
Cronin Rd WB	LTR					B (15.8)
Bay Rd NB	LTR					A (6.2)
Cronin Rd SB	LTR					A (8.6)
Overall						A (8.2)
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	C (26.4)		C (24.8)		
Lowe's Dwy WB	L,	C (31.9)		C (30.8)		
	LT	C (31.7)		C (30.6)		
	R	C (27.2)		C (26.2)		
Bay Rd NB	L	B (17.4)		B (17.1)		
	T,TR	B (19.3)		B (19.6)		
Bay Rd SB	L	B (15.5)		B (15.8)		
	T,TR	C (22.9)		C (22.4)		
Overall		C (22.8)		C (22.3)		
Bay Rd/Quaker Rd						
Quaker Rd EB	L	D (42.7)		D (44.4)		
	T,TR	C (26.0)		C (25.0)		
Quaker Rd WB	L	B (19.7)		B (19.2)		
	T,T	C (32.7)		C (32.8)		
	R	B (14.6)		B (14.5)		
Bay Rd NB	L	D (36.2)		D (37.2)		
	T,TR	D (45.0)		D (46.7)		
Bay Rd SB	L	C (31.9)		C (32.4)		
	T,TR	D (38.9)		D (39.5)		
Overall		C (32.9)		C (33.1)		
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	D (38.3)		D (38.7)		
	T,TR	C (27.5)		C (27.4)		
Quaker Rd WB	L	C (30.0)		C (29.6)		
	T,TR	C (30.5)		C (31.9)		
Glenwood Ave NB	L	D (38.4)		D (38.2)		
	TR	E (63.0)		E (62.4)		
Glenwood Ave SB	L	C (32.0)		C (32.2)		
	TR	E (56.9)		D (50.4)		
Overalll		C (34.7)		C (34.4)		

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

2022 PM Peak Hour

Intersection		2022				
		Existing	Alt 1 Re-striping	Alt 2 Re-striping & WB restriction	Alt 3 Re-striping & Signal	Alt 4 Roundabout
Bay Rd/Cronin Rd						
Chiropractor EB	LTR	E (45.5)				
Cronin Rd WB	LTR	F (**)				
Bay Rd NB	LT	A (0.2)				
	R	A (0.0)				
Cronin Rd SB	L	B (10.6)				
	TR	A (0.0)				
Chiropractor EB	LTR		F (51.3)		F (51.3)	
Cronin Rd WB	L(TR)		F (**)		C (19.1)	
Bay Rd NB	L		B (10.7)		B (10.7)	
Cronin Rd SB	L		B (10.8)		B (10.8)	
Chiropractor EB	LTR			C (22.5)		
Cronin Rd WB	LTR			C (32.2)		
Bay Rd NB	L			A (2.5)		
	TR			A 97.7)		
Cronin Rd SB	L			A (3.1)		
	TR			B (13.7)		
Overalll				B (12.4)		
Chiropractor EB	LTR					
Cronin Rd WB	LTR					
Bay Rd NB	LTR					
Cronin Rd SB	LTR					
Overall						
Bay Rd/Glenwood Ave/Lowe's Dwy						
Glenwood Ave EB	LTR	D (36.1)			D (36.1)	
Lowe's Dwy WB	L,	D (38.5)			D (38.5)	
	LT	D (38.1)			D (38.1)	
	R	C (32.5)			C 932.5)	
Bay Rd NB	L	C (26.7)			C (26.7)	
	T,TR	C (24.3)			C (24.3)	
Bay Rd SB	L	B (18.7)			B (18.7)	
	T,TR	D (49.3)			D (36.5)	
Overall		D (38.5)			C (32.6)	
Bay Rd/Quaker Rd						
Quaker Rd EB	L	F (134.)			F (143)	
	T,TR	C (28.4)			C (27.7)	
Quaker Rd WB	L	C (24.8)			C (24.1)	
	T,T	D (37.2)			D (38.0)	
	R	B (15.4)			B (15.1)	
Bay Rd NB	L	F (114)			F (120)	
	T,TR	F (103)			F (109)	
Bay Rd SB	L	F (85.2)			E (75.2)	
	T,TR	E (63.2)			E (58.7)	
Overall		E (58.7)			E (58.9)	
Glenwood Ave/Quaker Rd						
Quaker Rd EB	L	E (65.2)			E (65.2)	
	T,TR	D (38.4)			D (38.4)	
Quaker Rd WB	L	D (41.4)			D (41.4)	
	T,TR	E (73.9)			F (84.5)	
Glenwood Ave NB	L	D (40.8)			D (40.8)	
	TR	F (138)			F (138)	
Glenwood Ave SB	L	C (33.1)			C (33.1)	
	TR	F (**)			F (165)	
Overalll		E (78.0)			E (76.9)	

S = Signalized, R = Roundabout, TW = Two-Way Stop intersection.EB, WB, NB, SB = Eastbound, Westbound, Northbound, Southbound

L, T, R = Left-turn, Through, Right-turn movements

X (Y.Y) = Level of Service (average delay per vehicle in seconds)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	6	40	1	73	9	775	62	22	306	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	9	59	1	107	13	1140	91	32	450	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.83	0.83		0.83	0.83	0.83				0.83		
vC, conflicting volume	1790	1773	451	1690	1682	1140	451			1231		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1850	1830	451	1729	1721	1064	451			1175		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	0	98	52	99			93		
cM capacity (veh/h)	23	59	613	53	69	223	1120			483		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	9	168	1153	91	32	451
Volume Left	0	59	13	0	32	0
Volume Right	9	107	0	91	0	1
cSH	613	104	1120	1700	483	1700
Volume to Capacity	0.01	1.62	0.01	0.05	0.07	0.27
Queue Length 95th (ft)	1	322	1	0	5	0
Control Delay (s)	11.0	389.3	0.4	0.0	13.0	0.0
Lane LOS	B	F	A		B	
Approach Delay (s)	11.0	389.3	0.4		0.9	
Approach LOS	B	F				

Intersection Summary			
Average Delay	34.8		
Intersection Capacity Utilization	68.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	6	40	1	73	9	775	62	22	306	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	9	59	1	107	13	1140	91	32	450	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.82	0.82		0.82	0.82	0.82				0.82		
vC, conflicting volume	1790	1773	451	1735	1728	1185	451			1231		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1854	1834	451	1788	1779	1115	451			1171		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	0	98	48	99			93		
cM capacity (veh/h)	21	58	613	47	63	206	1120			479		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	9	168	13	1231	32	451
Volume Left	0	59	13	0	32	0
Volume Right	9	107	0	91	0	1
cSH	613	94	1120	1700	479	1700
Volume to Capacity	0.01	1.78	0.01	0.72	0.07	0.27
Queue Length 95th (ft)	1	344	1	0	5	0
Control Delay (s)	11.0	468.3	8.3	0.0	13.1	0.0
Lane LOS	B	F	A		B	
Approach Delay (s)	11.0	468.3	0.1		0.9	
Approach LOS	B	F				

Intersection Summary			
Average Delay	41.6		
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	6	40	1	73	9	775	62	22	306	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.86			0.91		1.00	0.99		1.00	1.00	
Flt Protected		1.00			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1698			1546		1805	1800		1834	1738	
Flt Permitted		1.00			0.88		0.49	1.00		0.09	1.00	
Satd. Flow (perm)		1698			1383		924	1800		176	1738	
Peak-hour factor, PHF	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Adj. Flow (vph)	0	0	9	59	1	107	13	1140	91	32	450	1
RTOR Reduction (vph)	0	8	0	0	75	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	92	0	13	1228	0	32	451	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	3%	0%	1%	0%	5%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		8.2			8.2		43.8	43.8		43.8	43.8	
Effective Green, g (s)		8.2			8.2		43.8	43.8		43.8	43.8	
Actuated g/C Ratio		0.14			0.14		0.73	0.73		0.73	0.73	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		232			189		675	1314		128	1269	
v/s Ratio Prot		0.00						c0.68			0.26	
v/s Ratio Perm					c0.07		0.01			0.18		
v/c Ratio		0.01			0.49		0.02	0.93		0.25	0.36	
Uniform Delay, d1		22.4			24.0		2.2	6.9		2.7	3.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			2.0		0.1	13.4		4.6	0.8	
Delay (s)		22.4			25.9		2.3	20.3		7.3	3.7	
Level of Service		C			C		A	C		A	A	
Approach Delay (s)		22.4			25.9			20.1			4.0	
Approach LOS		C			C			C			A	

Intersection Summary

HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	6	0	1	73	9	775	62	22	306	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	9	0	1	107	13	1140	91	32	450	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.82	0.82		0.82	0.82	0.82				0.82		
vC, conflicting volume	1790	1773	451	1735	1728	1185	451			1231		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1854	1834	451	1788	1779	1115	451			1171		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	100	98	48	99			93		
cM capacity (veh/h)	21	58	613	47	63	206	1120			479		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	9	109	13	1231	32	451
Volume Left	0	0	13	0	32	0
Volume Right	9	107	0	91	0	1
cSH	613	200	1120	1700	479	1700
Volume to Capacity	0.01	0.55	0.01	0.72	0.07	0.27
Queue Length 95th (ft)	1	72	1	0	5	0
Control Delay (s)	11.0	42.7	8.3	0.0	13.1	0.0
Lane LOS	B	E	A		B	
Approach Delay (s)	11.0	42.7	0.1		0.9	
Approach LOS	B	E				

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

LANE SUMMARY

Bay Rd/Cronin Rd
Existing 2012
AM Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob Block. %
South: Bay Rd NB																
Lane 1	13	1140	91	1244	0.9	1453	0.856	100	6.5	LOS A	8.3	209.4	970	–	0.0	0.0
Approach	13	1140	91	1244	0.9		0.856		6.5	LOS A	8.3	209.4				
East: Cronin Rd WB																
Lane 1	59	1	107	168	3.0	273	0.615	100	39.0	LOS D	2.2	56.3	2700	–	0.0	0.0
Approach	59	1	107	168	3.0		0.615		39.0	LOS D	2.2	56.3				
North: Bay Rd SB																
Lane 1	32	450	1	484	2.2	1212	0.399	100	6.4	LOS A	1.3	34.2	5000	–	0.0	0.0
Approach	32	450	1	484	2.2		0.399		6.4	LOS A	1.3	34.2				
West: Chiropractor Drwy EB																
Lane 1	1	1	9	12	0.0	686	0.017	100	5.8	LOS A	0.0	0.9	50	–	0.0	0.0
Approach	1	1	9	12	0.0		0.017		5.8	LOS A	0.0	0.9				
Intersection				1907	1.4		0.856		9.3	LOS A	8.3	209.4				

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS D. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Bay Rd/Cronin Rd - AM Peak - Existing 2012

Bay Rd/Cronin Rd
Existing 2012
AM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	13	0.0	0.882	10.2	LOS B	8.3	209.4	0.60	0.61	26.7
8T	T	1140	1.0	0.856	6.5	LOS A	8.3	209.4	0.60	0.40	30.0
8R	R	91	0.0	0.860	6.3	LOS A	8.3	209.4	0.60	0.44	28.6
Approach		1244	0.9	0.856	6.5	LOS B	8.3	209.4	0.60	0.41	29.9
East: Cronin Rd WB											
1L	L	59	3.0	0.613	42.1	LOS D	2.2	56.3	1.00	1.20	20.7
6T	T	1	0.0	0.735	35.6	LOS D	2.2	56.3	1.00	1.20	20.8
6R	R	107	3.0	0.613	37.4	LOS D	2.2	56.3	1.00	1.20	21.8
Approach		168	3.0	0.615	39.0	LOS D	2.2	56.3	1.00	1.20	21.4
North: Bay Rd SB											
7L	L	32	5.0	0.399	12.7	LOS B	1.3	34.2	0.36	0.86	39.4
4T	T	450	2.0	0.399	5.9	LOS A	1.3	34.2	0.36	0.44	41.4
4R	R	1	0.0	0.368	9.2	LOS A	1.3	34.2	0.36	0.55	41.7
Approach		484	2.2	0.399	6.4	LOS B	1.3	34.2	0.36	0.47	41.3
West: Chiropractor Drwy EB											
5L	L	1	0.0	0.017	11.8	LOS B	0.0	0.9	0.63	0.73	19.3
2T	T	1	0.0	0.017	4.3	LOS A	0.0	0.9	0.63	0.45	16.3
2R	R	9	0.0	0.017	5.0	LOS A	0.0	0.9	0.63	0.49	17.9
Approach		12	0.0	0.017	5.8	LOS B	0.0	0.9	0.63	0.52	18.0
All Vehicles		1907	1.4	0.856	9.3	LOS A	8.3	209.4	0.58	0.49	33.2

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	7	49	1	89	11	1137	76	27	473	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	10	72	1	131	16	1672	112	40	696	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.74	0.74		0.74	0.74	0.74				0.74		
vC, conflicting volume	2612	2592	696	2490	2481	1672	697			1784		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2998	2971	696	2833	2821	1732	697			1882		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	98	0	87	0	98			83		
cM capacity (veh/h)	0	9	445	7	11	80	909			231		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	204	1688	112	40	697
Volume Left	0	72	16	0	40	0
Volume Right	10	131	0	112	0	1
cSH	445	17	909	1700	231	1700
Volume to Capacity	0.02	12.26	0.02	0.07	0.17	0.41
Queue Length 95th (ft)	2	Err	1	0	15	0
Control Delay (s)	13.3	Err	9.0	0.0	23.8	0.0
Lane LOS	B	F	A		C	
Approach Delay (s)	13.3	Err	8.5		1.3	
Approach LOS	B	F				

Intersection Summary			
Average Delay	748.8		
Intersection Capacity Utilization	90.2%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	7	49	1	89	11	1137	76	27	473	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	10	72	1	131	16	1672	112	40	696	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.73	0.73		0.73	0.73	0.73				0.73		
vC, conflicting volume	2612	2592	696	2546	2537	1728	697			1784		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3026	2998	696	2935	2923	1813	697			1889		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	98	0	84	0	98			82		
cM capacity (veh/h)	0	8	445	6	9	71	909			225		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	204	16	1784	40	697
Volume Left	0	72	16	0	40	0
Volume Right	10	131	0	112	0	1
cSH	445	14	909	1700	225	1700
Volume to Capacity	0.02	14.77	0.02	1.05	0.18	0.41
Queue Length 95th (ft)	2	Err	1	0	16	0
Control Delay (s)	13.3	Err	9.0	0.0	24.4	0.0
Lane LOS	B	F	A		C	
Approach Delay (s)	13.3	Err	0.1		1.3	
Approach LOS	B	F				

Intersection Summary			
Average Delay	743.3		
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	7	49	1	89	11	1137	76	27	473	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.86			0.91		1.00	0.99		1.00	1.00	
Flt Protected		1.00			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1698			1545		1805	1802		1834	1738	
Flt Permitted		1.00			0.88		0.36	1.00		0.09	1.00	
Satd. Flow (perm)		1698			1382		680	1802		168	1738	
Peak-hour factor, PHF	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Adj. Flow (vph)	0	0	10	72	1	131	16	1672	112	40	696	1
RTOR Reduction (vph)	0	9	0	0	53	0	0	4	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	151	0	16	1780	0	40	697	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	3%	0%	1%	0%	5%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		6.0			6.0		46.0	46.0		46.0	46.0	
Effective Green, g (s)		6.0			6.0		46.0	46.0		46.0	46.0	
Actuated g/C Ratio		0.10			0.10		0.77	0.77		0.77	0.77	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		170			138		521	1382		129	1332	
v/s Ratio Prot		0.00						c0.99			0.40	
v/s Ratio Perm					c0.11		0.02			0.24		
v/c Ratio		0.01			1.09		0.03	1.29		0.31	0.52	
Uniform Delay, d1		24.3			27.0		1.7	7.0		2.1	2.7	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			103.9		0.1	135.2		6.1	1.5	
Delay (s)		24.3			130.9		1.8	142.2		8.3	4.2	
Level of Service		C			F		A	F		A	A	
Approach Delay (s)		24.3			130.9			140.9			4.4	
Approach LOS		C			F			F			A	

Intersection Summary			
HCM Average Control Delay	103.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	7	0	1	89	11	1137	76	27	473	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hourly flow rate (vph)	0	0	10	0	1	131	16	1672	112	40	696	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.73	0.73		0.73	0.73	0.73				0.73		
vC, conflicting volume	2612	2592	696	2546	2537	1728	697			1784		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3026	2998	696	2935	2923	1813	697			1889		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	98	100	84	0	98			82		
cM capacity (veh/h)	0	8	445	6	9	71	909			225		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	132	16	1784	40	697
Volume Left	0	0	16	0	40	0
Volume Right	10	131	0	112	0	1
cSH	445	66	909	1700	225	1700
Volume to Capacity	0.02	2.02	0.02	1.05	0.18	0.41
Queue Length 95th (ft)	2	309	1	0	16	0
Control Delay (s)	13.3	607.7	9.0	0.0	24.4	0.0
Lane LOS	B	F	A		C	
Approach Delay (s)	13.3	607.7	0.1		1.3	
Approach LOS	B	F				

Intersection Summary			
Average Delay	30.5		
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		

LANE SUMMARY

Bay Rd/Cronin Rd
ETC+10 2022
AM Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Bay Rd NB																
Lane 1	16	1672	112	1800	0.9	1454	1.238	100	117.8	LOS F	89.1	2243.8	970	–	0.0	100.0
Approach	16	1672	112	1800	0.9		1.238		117.8	LOS F	89.1	2243.8				
East: Cronin Rd WB																
Lane 1	72	1	131	204	3.0	150[2]	1.363	100	262.5	LOS F	12.9	329.6	2700	–	0.0	0.0
Approach	72	1	131	204	3.0		1.363		262.5	LOS F	12.9	329.6				
North: Bay Rd SB																
Lane 1	40	696	1	737	2.2	1271	0.580	100	6.4	LOS A	2.6	65.2	5000	–	0.0	0.0
Approach	40	696	1	737	2.2		0.580		6.4	LOS A	2.6	65.2				
West: Chiropractor Drwy EB																
Lane 1	1	1	10	13	0.0	515	0.026	100	8.4	LOS A	0.1	1.5	50	–	0.0	0.0
Approach	1	1	10	13	0.0		0.026		8.4	LOS A	0.1	1.5				
Intersection				2754	1.4		1.363		98.2	LOS F	89.1	2243.8				

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS F. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

2 Minimum Capacity

MOVEMENT SUMMARY

Bay Rd/Cronin Rd
ETC+10 2022
AM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	16	0.0	1.244	121.5	LOS F	89.1	2243.8	1.00	1.09	6.0
8T	T	1672	1.0	1.238	117.8	LOS F	89.1	2243.8	1.00	1.10	7.1
8R	R	112	0.0	1.242	117.6	LOS F	89.1	2243.8	1.00	1.09	6.1
Approach		1800	0.9	1.238	117.8	LOS F	89.1	2243.8	1.00	1.09	7.1
East: Cronin Rd WB											
1L	L	72	3.0	1.360	265.5	LOS F	12.9	329.6	1.00	1.89	6.6
6T	T	1	0.0	1.471	259.0	LOS F	12.9	329.6	1.00	1.90	6.1
6R	R	131	3.0	1.363	260.8	LOS F	12.9	329.6	1.00	1.89	6.7
Approach		204	3.0	1.363	262.5	LOS F	12.9	329.6	1.00	1.89	6.7
North: Bay Rd SB											
7L	L	40	5.0	0.584	12.8	LOS B	2.6	65.2	0.44	0.81	39.5
4T	T	696	2.0	0.580	6.0	LOS A	2.6	65.2	0.44	0.45	41.2
4R	R	1	0.0	0.490	9.4	LOS A	2.6	65.2	0.44	0.54	41.5
Approach		737	2.2	0.580	6.4	LOS B	2.6	65.2	0.44	0.47	41.1
West: Chiropractor Drwy EB											
5L	L	1	0.0	0.026	14.5	LOS B	0.1	1.5	0.76	0.78	17.6
2T	T	1	0.0	0.026	7.0	LOS A	0.1	1.5	0.76	0.59	13.9
2R	R	10	0.0	0.026	7.7	LOS A	0.1	1.5	0.76	0.62	15.3
Approach		13	0.0	0.026	8.4	LOS B	0.1	1.5	0.76	0.64	15.5
All Vehicles		2754	1.4	1.363	98.2	LOS F	89.1	2243.8	0.85	0.98	12.7

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	8	60	1	33	1	472	103	53	771	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	8	62	1	34	1	492	107	55	803	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.91	0.91		0.91	0.91	0.91				0.91		
vC, conflicting volume	1442	1515	803	1416	1407	492	803			599		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1437	1516	803	1408	1399	396	803			514		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	98	37	99	94	100			94		
cM capacity (veh/h)	92	104	387	99	122	601	830			961		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	8	98	493	107	55	803
Volume Left	0	62	1	0	55	0
Volume Right	8	34	0	107	0	0
cSH	387	140	830	1700	961	1700
Volume to Capacity	0.02	0.70	0.00	0.06	0.06	0.47
Queue Length 95th (ft)	2	99	0	0	5	0
Control Delay (s)	14.5	75.3	0.0	0.0	9.0	0.0
Lane LOS	B	F	A		A	
Approach Delay (s)	14.5	75.3	0.0		0.6	
Approach LOS	B	F				

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	8	60	1	33	1	472	103	53	771	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	8	62	1	34	1	492	107	55	803	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.87	0.87		0.87	0.87	0.87				0.87		
vC, conflicting volume	1442	1515	803	1469	1461	545	803			599		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1434	1517	803	1465	1455	403	803			464		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	98	27	99	94	100			94		
cM capacity (veh/h)	87	99	387	86	107	567	830			954		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	8	98	1	599	55	803
Volume Left	0	62	1	0	55	0
Volume Right	8	34	0	107	0	0
cSH	387	123	830	1700	954	1700
Volume to Capacity	0.02	0.80	0.00	0.35	0.06	0.47
Queue Length 95th (ft)	2	118	0	0	5	0
Control Delay (s)	14.5	101.1	9.3	0.0	9.0	0.0
Lane LOS	B	F	A		A	
Approach Delay (s)	14.5	101.1	0.0		0.6	
Approach LOS	B	F				

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	8	60	1	33	1	472	103	53	771	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.86			0.95		1.00	0.97		1.00	1.00	
Flt Protected		1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1698			1606		1805	1767		1888	1756	
Flt Permitted		1.00			0.80		0.24	1.00		0.39	1.00	
Satd. Flow (perm)		1698			1329		463	1767		779	1756	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	8	62	1	34	1	492	107	55	803	0
RTOR Reduction (vph)	0	7	0	0	30	0	0	13	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	67	0	1	586	0	55	803	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	1%	2%	2%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		5.0			5.0		23.5	23.5		23.5	23.5	
Effective Green, g (s)		5.0			5.0		23.5	23.5		23.5	23.5	
Actuated g/C Ratio		0.12			0.12		0.58	0.58		0.58	0.58	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		210			164		269	1025		452	1019	
v/s Ratio Prot		0.00						0.33			c0.46	
v/s Ratio Perm					c0.05		0.00			0.07		
v/c Ratio		0.00			0.41		0.00	0.57		0.12	0.79	
Uniform Delay, d1		15.6			16.4		3.6	5.3		3.8	6.6	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			1.7		0.0	0.8		0.1	4.1	
Delay (s)		15.6			18.1		3.6	6.1		4.0	10.7	
Level of Service		B			B		A	A		A	B	
Approach Delay (s)		15.6			18.1			6.1			10.2	
Approach LOS		B			B			A			B	

Intersection Summary

HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	40.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	8	0	1	33	1	472	103	53	771	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	8	0	1	34	1	492	107	55	803	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.87	0.87		0.87	0.87	0.87				0.87		
vC, conflicting volume	1442	1515	803	1469	1461	545	803			599		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1434	1517	803	1465	1455	403	803			465		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	98	100	99	94	100			94		
cM capacity (veh/h)	87	99	387	86	107	567	830			954		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	8	35	1	599	55	803
Volume Left	0	0	1	0	55	0
Volume Right	8	34	0	107	0	0
cSH	387	504	830	1700	954	1700
Volume to Capacity	0.02	0.07	0.00	0.35	0.06	0.47
Queue Length 95th (ft)	2	6	0	0	5	0
Control Delay (s)	14.5	12.7	9.3	0.0	9.0	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	14.5	12.7	0.0		0.6	
Approach LOS	B	B				

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		

LANE SUMMARY

Bay Rd/Cronin Rd
Existing 2012
Mid Day Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Bay Rd NB																
Lane 1	1	492	107	600	1.2	1302	0.461	100	6.1	LOS A	1.6	40.5	970	–	0.0	0.0
Approach	1	492	107	600	1.2		0.461		6.1	LOS A	1.6	40.5				
East: Cronin Rd WB																
Lane 1	63	1	34	98	1.9	705	0.139	100	12.4	LOS B	0.3	7.9	2700	–	0.0	0.0
Approach	63	1	34	98	1.9		0.139		12.4	LOS B	0.3	7.9				
North: Bay Rd SB																
Lane 1	55	803	1	859	1.1	1310	0.656	100	6.5	LOS A	3.3	82.1	5000	–	0.0	0.0
Approach	55	803	1	859	1.1		0.656		6.5	LOS A	3.3	82.1				
West: Chiropractor Drwy EB																
Lane 1	1	1	8	10	0.0	436	0.024	100	10.2	LOS B	0.1	1.4	50	–	0.0	0.0
Approach	1	1	8	10	0.0		0.024		10.2	LOS B	0.1	1.4				
Intersection				1568	1.2		0.656		6.7	LOS A	3.3	82.1				

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS B. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Bay Rd/Cronin Rd
Existing 2012
Mid Day Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	1	0.0	0.521	9.9	LOS A	1.6	40.5	0.32	0.79	26.7
8T	T	492	1.0	0.461	6.1	LOS A	1.6	40.5	0.32	0.44	31.8
8R	R	107	2.0	0.460	5.9	LOS A	1.6	40.5	0.32	0.50	29.9
Approach		600	1.2	0.461	6.1	LOS A	1.6	40.5	0.32	0.45	31.5
East: Cronin Rd WB											
1L	L	63	3.0	0.139	14.1	LOS B	0.3	7.9	0.64	0.79	28.1
6T	T	1	0.0	0.149	7.7	LOS A	0.3	7.9	0.64	0.65	29.6
6R	R	34	0.0	0.139	9.4	LOS A	0.3	7.9	0.64	0.68	30.2
Approach		98	1.9	0.139	12.4	LOS B	0.3	7.9	0.64	0.75	28.8
North: Bay Rd SB											
7L	L	55	2.0	0.657	12.8	LOS B	3.3	82.1	0.48	0.79	39.5
4T	T	803	1.0	0.656	6.1	LOS A	3.3	82.1	0.48	0.45	41.1
4R	R	1	0.0	0.521	9.4	LOS A	3.3	82.1	0.48	0.54	41.4
Approach		859	1.1	0.656	6.5	LOS B	3.3	82.1	0.48	0.47	40.9
West: Chiropractor Drwy EB											
5L	L	1	0.0	0.024	16.3	LOS B	0.1	1.4	0.82	0.78	16.6
2T	T	1	0.0	0.024	8.8	LOS A	0.1	1.4	0.82	0.65	12.6
2R	R	8	0.0	0.024	9.6	LOS A	0.1	1.4	0.82	0.67	13.9
Approach		10	0.0	0.024	10.2	LOS B	0.1	1.4	0.82	0.68	14.1
All Vehicles		1568	1.2	0.656	6.7	LOS A	3.3	82.1	0.43	0.48	38.3

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	10	73	1	40	1	688	126	65	1132	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	10	76	1	42	1	717	131	68	1179	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.82	0.82		0.82	0.82	0.82				0.82		
vC, conflicting volume	2076	2165	1179	2044	2033	717	1179			848		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2199	2307	1179	2160	2148	549	1179			708		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	96	0	97	91	100			91		
cM capacity (veh/h)	22	29	234	25	37	444	599			733		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	119	718	131	68	1179
Volume Left	0	76	1	0	68	0
Volume Right	10	42	0	131	0	0
cSH	234	37	599	1700	733	1700
Volume to Capacity	0.04	3.18	0.00	0.08	0.09	0.69
Queue Length 95th (ft)	3	Err	0	0	8	0
Control Delay (s)	21.1	Err	0.0	0.0	10.4	0.0
Lane LOS	C	F	A		B	
Approach Delay (s)	21.1	Err	0.0		0.6	
Approach LOS	C	F				

Intersection Summary			
Average Delay	534.1		
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	10	73	1	40	1	688	126	65	1132	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	10	76	1	42	1	717	131	68	1179	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.79	0.79		0.79	0.79	0.79				0.79		
vC, conflicting volume	2076	2165	1179	2109	2099	782	1179			848		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2232	2345	1179	2275	2262	587	1179			671		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	96	0	96	90	100			91		
cM capacity (veh/h)	20	26	234	20	29	403	599			723		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	119	1	848	68	1179
Volume Left	0	76	1	0	68	0
Volume Right	10	42	0	131	0	0
cSH	234	30	599	1700	723	1700
Volume to Capacity	0.04	4.02	0.00	0.50	0.09	0.69
Queue Length 95th (ft)	3	Err	0	0	8	0
Control Delay (s)	21.1	Err	11.0	0.0	10.5	0.0
Lane LOS	C	F	B		B	
Approach Delay (s)	21.1	Err	0.0		0.6	
Approach LOS	C	F				

Intersection Summary			
Average Delay	534.1		
Intersection Capacity Utilization	79.5%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	10	73	1	40	1	688	126	65	1132	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.86			0.95		1.00	0.98		1.00	1.00	
Flt Protected		1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1698			1606		1805	1774		1888	1756	
Flt Permitted		1.00			0.80		0.11	1.00		0.27	1.00	
Satd. Flow (perm)		1698			1327		216	1774		541	1756	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	10	76	1	42	1	717	131	68	1179	0
RTOR Reduction (vph)	0	9	0	0	35	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	84	0	1	841	0	68	1179	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	1%	2%	2%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		8.3			8.3		48.7	48.7		48.7	48.7	
Effective Green, g (s)		8.3			8.3		48.7	48.7		48.7	48.7	
Actuated g/C Ratio		0.13			0.13		0.75	0.75		0.75	0.75	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		217			169		162	1329		405	1316	
v/s Ratio Prot		0.00						0.47			c0.67	
v/s Ratio Perm					c0.06		0.00			0.13		
v/c Ratio		0.01			0.50		0.01	0.63		0.17	0.90	
Uniform Delay, d1		24.7			26.4		2.1	3.9		2.3	6.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			2.3		0.1	2.3		0.9	9.7	
Delay (s)		24.8			28.7		2.1	6.2		3.2	16.0	
Level of Service		C			C		A	A		A	B	
Approach Delay (s)		24.8			28.7			6.2			15.3	
Approach LOS		C			C			A			B	

Intersection Summary

HCM Average Control Delay	12.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	10	0	1	40	1	688	126	65	1132	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	10	0	1	42	1	717	131	68	1179	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.78	0.78		0.78	0.78	0.78				0.78		
vC, conflicting volume	2076	2165	1179	2109	2099	782	1179			848		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2242	2357	1179	2286	2273	574	1179			659		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	96	100	96	90	100			91		
cM capacity (veh/h)	19	25	234	19	29	405	599			720		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	43	1	848	68	1179
Volume Left	0	0	1	0	68	0
Volume Right	10	42	0	131	0	0
cSH	234	306	599	1700	720	1700
Volume to Capacity	0.04	0.14	0.00	0.50	0.09	0.69
Queue Length 95th (ft)	3	12	0	0	8	0
Control Delay (s)	21.1	18.6	11.0	0.0	10.5	0.0
Lane LOS	C	C	B		B	
Approach Delay (s)	21.1	18.6	0.0		0.6	
Approach LOS	C	C				

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	69.6%	ICU Level of Service	C	
Analysis Period (min)	15			

LANE SUMMARY

Bay Rd/Cronin Rd
ETC+10 2022
Mid Day Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Bay Rd NB																
Lane 1	1	717	131	849	1.2	1286	0.660	100	6.4	LOS A	3.5	87.8	970	–	0.0	0.0
Approach	1	717	131	849	1.2		0.660		6.4	LOS A	3.5	87.8				
East: Cronin Rd WB																
Lane 1	76	1	42	119	1.9	531	0.224	100	15.0	LOS B	0.6	14.0	2700	–	0.0	0.0
Approach	76	1	42	119	1.9		0.224		15.0	LOS B	0.6	14.0				
North: Bay Rd SB																
Lane 1	68	1179	1	1248	1.1	1303	0.958	100	9.0	LOS A	13.7	346.1	5000	–	0.0	0.0
Approach	68	1179	1	1248	1.1		0.958		9.0	LOS A	13.7	346.1				
West: Chiropractor Drwy EB																
Lane 1	1	1	10	13	0.0	158	0.079	100	25.2	LOS C	0.2	5.5	50	–	0.0	0.0
Approach	1	1	10	13	0.0		0.079		25.2	LOS C	0.2	5.5				
Intersection				2228	1.1		0.958		8.4	LOS A	13.7	346.1				

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS C. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Bay Rd/Cronin Rd - Mid Day Peak - ETC+10 2022

Bay Rd/Cronin Rd
ETC+10 2022
Mid Day Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	1	0.0	0.521	10.2	LOS B	3.5	87.8	0.53	0.71	26.7
8T	T	717	1.0	0.661	6.5	LOS A	3.5	87.8	0.53	0.46	30.4
8R	R	131	2.0	0.660	6.3	LOS A	3.5	87.8	0.53	0.51	28.9
Approach		849	1.2	0.660	6.4	LOS B	3.5	87.8	0.53	0.47	30.2
East: Cronin Rd WB											
1L	L	76	3.0	0.224	16.8	LOS B	0.6	14.0	0.80	0.90	27.2
6T	T	1	0.0	0.208	10.3	LOS B	0.6	14.0	0.80	0.81	28.3
6R	R	42	0.0	0.224	12.0	LOS B	0.6	14.0	0.80	0.83	29.1
Approach		119	1.9	0.224	15.0	LOS B	0.6	14.0	0.80	0.87	27.8
North: Bay Rd SB											
7L	L	68	2.0	0.954	15.3	LOS B	13.7	346.1	1.00	0.53	39.1
4T	T	1179	1.0	0.958	8.6	LOS A	13.7	346.1	1.00	0.53	39.4
4R	R	1	0.0	1.042	12.0	LOS B	13.7	346.1	1.00	0.53	39.9
Approach		1248	1.1	0.958	9.0	LOS B	13.7	346.1	1.00	0.53	39.4
West: Chiropractor Drwy EB											
5L	L	1	0.0	0.080	31.5	LOS C	0.2	5.5	1.00	0.92	11.2
2T	T	1	0.0	0.080	23.9	LOS C	0.2	5.5	1.00	0.92	7.0
2R	R	10	0.0	0.080	24.7	LOS C	0.2	5.5	1.00	0.92	7.9
Approach		13	0.0	0.079	25.2	LOS C	0.2	5.5	1.00	0.92	8.2
All Vehicles		2228	1.1	0.958	8.4	LOS A	13.7	346.1	0.81	0.53	36.9

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	10	75	1	47	4	496	135	33	724	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	10	77	1	48	4	511	139	34	746	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.89	0.89		0.89	0.89	0.89				0.89		
vC, conflicting volume	1384	1474	747	1344	1335	511	747			651		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1368	1470	747	1324	1314	383	747			541		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	98	30	99	92	100			96		
cM capacity (veh/h)	98	109	416	111	135	588	870			919		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	12	127	515	139	34	747
Volume Left	2	77	4	0	34	0
Volume Right	10	48	0	139	0	1
cSH	270	161	870	1700	919	1700
Volume to Capacity	0.05	0.79	0.00	0.08	0.04	0.44
Queue Length 95th (ft)	4	127	0	0	3	0
Control Delay (s)	19.0	80.9	0.1	0.0	9.1	0.0
Lane LOS	C	F	A		A	
Approach Delay (s)	19.0	80.9	0.1		0.4	
Approach LOS	C	F				

Intersection Summary			
Average Delay	6.9		
Intersection Capacity Utilization	59.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	10	75	1	47	4	496	135	33	724	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	10	77	1	48	4	511	139	34	746	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.83	0.83		0.83	0.83	0.83				0.83		
vC, conflicting volume	1384	1474	747	1414	1405	581	747			651		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1360	1468	747	1396	1385	393	747			476		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	98	16	99	91	100			96		
cM capacity (veh/h)	92	102	416	92	115	545	870			910		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	12	127	4	651	34	747
Volume Left	2	77	4	0	34	0
Volume Right	10	48	0	139	0	1
cSH	263	136	870	1700	910	1700
Volume to Capacity	0.05	0.93	0.00	0.38	0.04	0.44
Queue Length 95th (ft)	4	159	0	0	3	0
Control Delay (s)	19.4	123.6	9.2	0.0	9.1	0.0
Lane LOS	C	F	A		A	
Approach Delay (s)	19.4	123.6	0.1		0.4	
Approach LOS	C	F				

Intersection Summary			
Average Delay	10.3		
Intersection Capacity Utilization	58.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	10	75	1	47	4	496	135	33	724	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.89			0.95		1.00	0.97		1.00	1.00	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1591		1805	1743		1925	1755	
Flt Permitted		0.96			0.81		0.32	1.00		0.37	1.00	
Satd. Flow (perm)		1675			1322		609	1743		754	1755	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	2	0	10	77	1	48	4	511	139	34	746	1
RTOR Reduction (vph)	0	9	0	0	39	0	0	14	0	0	0	0
Lane Group Flow (vph)	0	3	0	0	87	0	4	636	0	34	747	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	2%	0%	2%	2%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7		44.3	44.3		44.3	44.3	
Effective Green, g (s)		7.7			7.7		44.3	44.3		44.3	44.3	
Actuated g/C Ratio		0.13			0.13		0.74	0.74		0.74	0.74	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		215			170		450	1287		557	1296	
v/s Ratio Prot								0.37			c0.43	
v/s Ratio Perm		0.00			c0.07		0.01			0.05		
v/c Ratio		0.02			0.51		0.01	0.49		0.06	0.58	
Uniform Delay, d1		22.8			24.4		2.1	3.2		2.2	3.6	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			2.6		0.0	1.4		0.2	1.9	
Delay (s)		22.9			27.0		2.1	4.6		2.4	5.4	
Level of Service		C			C		A	A		A	A	
Approach Delay (s)		22.9			27.0			4.6			5.3	
Approach LOS		C			C			A			A	

Intersection Summary

HCM Average Control Delay	6.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	10	0	1	47	4	496	135	33	724	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	10	0	1	48	4	511	139	34	746	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.83	0.83		0.83	0.83	0.83				0.83		
vC, conflicting volume	1384	1474	747	1414	1405	581	747			651		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1359	1468	747	1396	1385	387	747			472		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	98	100	99	91	100			96		
cM capacity (veh/h)	92	102	416	92	115	546	870			909		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	12	49	4	651	34	747
Volume Left	2	0	4	0	34	0
Volume Right	10	48	0	139	0	1
cSH	262	506	870	1700	909	1700
Volume to Capacity	0.05	0.10	0.00	0.38	0.04	0.44
Queue Length 95th (ft)	4	8	0	0	3	0
Control Delay (s)	19.4	12.9	9.2	0.0	9.1	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	19.4	12.9	0.1		0.4	
Approach LOS	C	B				

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		

LANE SUMMARY

Bay Rd/Cronin Rd
Existing 2012
AM Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Bay Rd NB																
Lane 1	4	511	139	655	2.0	1376	0.476	100	5.9	LOS A	1.7	44.0	970	–	0.0	0.0
Approach	4	511	139	655	2.0		0.476		5.9	LOS A	1.7	44.0				
East: Cronin Rd WB																
Lane 1	77	1	48	127	2.6	685	0.185	100	12.8	LOS B	0.4	10.7	2700	–	0.0	0.0
Approach	77	1	48	127	2.6		0.185		12.8	LOS B	0.4	10.7				
North: Bay Rd SB																
Lane 1	34	746	1	781	1.0	1252	0.624	100	6.6	LOS A	2.8	71.1	5000	–	0.0	0.0
Approach	34	746	1	781	1.0		0.624		6.6	LOS A	2.8	71.1				
West: Chiropractor Drwy EB																
Lane 1	2	1	10	13	0.0	470	0.029	100	9.6	LOS A	0.1	1.7	50	–	0.0	0.0
Approach	2	1	10	13	0.0		0.029		9.6	LOS A	0.1	1.7				
Intersection				1576	1.5		0.624		6.8	LOS A	2.8	71.1				

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS B. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Bay Rd/Cronin Rd
Existing 2012
AM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	4	0.0	0.458	9.7	LOS A	1.7	44.0	0.25	0.80	26.8
8T	T	511	2.0	0.476	5.9	LOS A	1.7	44.0	0.25	0.42	32.3
8R	R	139	2.0	0.475	5.7	LOS A	1.7	44.0	0.25	0.49	30.2
Approach		655	2.0	0.476	5.9	LOS A	1.7	44.0	0.25	0.43	31.8
East: Cronin Rd WB											
1L	L	77	3.0	0.185	14.6	LOS B	0.4	10.7	0.66	0.82	27.9
6T	T	1	0.0	0.172	8.1	LOS A	0.4	10.7	0.66	0.68	29.3
6R	R	48	2.0	0.185	9.9	LOS A	0.4	10.7	0.66	0.72	30.0
Approach		127	2.6	0.185	12.8	LOS B	0.4	10.7	0.66	0.78	28.7
North: Bay Rd SB											
7L	L	34	0.0	0.619	12.9	LOS B	2.8	71.1	0.51	0.80	39.5
4T	T	746	1.0	0.624	6.3	LOS A	2.8	71.1	0.51	0.47	41.0
4R	R	1	0.0	0.515	9.6	LOS A	2.8	71.1	0.51	0.56	41.3
Approach		781	1.0	0.624	6.6	LOS B	2.8	71.1	0.51	0.49	40.9
West: Chiropractor Drwy EB											
5L	L	2	0.0	0.029	15.4	LOS B	0.1	1.7	0.80	0.79	17.1
2T	T	1	0.0	0.029	7.8	LOS A	0.1	1.7	0.80	0.63	13.2
2R	R	10	0.0	0.028	8.6	LOS A	0.1	1.7	0.80	0.66	14.5
Approach		13	0.0	0.029	9.6	LOS B	0.1	1.7	0.80	0.67	15.0
All Vehicles		1576	1.5	0.624	6.8	LOS A	2.8	71.1	0.42	0.49	37.8

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	12	91	1	57	5	718	165	40	1075	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	12	94	1	59	5	740	170	41	1108	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.78	0.78		0.78	0.78	0.78				0.78		
vC, conflicting volume	2001	2112	1109	1954	1942	740	1109			910		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2142	2284	1109	2081	2067	526	1109			744		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	91	100	95	0	97	86	99			94		
cM capacity (veh/h)	22	29	257	27	40	430	637			681		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	14	154	745	170	41	1109
Volume Left	2	94	5	0	41	0
Volume Right	12	59	0	170	0	1
cSH	103	43	637	1700	681	1700
Volume to Capacity	0.14	3.60	0.01	0.10	0.06	0.65
Queue Length 95th (ft)	12	Err	1	0	5	0
Control Delay (s)	45.5	Err	0.2	0.0	10.6	0.0
Lane LOS	E	F	A		B	
Approach Delay (s)	45.5	Err	0.2		0.4	
Approach LOS	E	F				

Intersection Summary			
Average Delay	688.1		
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	12	91	1	57	5	718	165	40	1075	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	12	94	1	59	5	740	170	41	1108	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.73	0.73		0.73	0.73	0.73				0.73		
vC, conflicting volume	2001	2112	1109	2039	2027	825	1109			910		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2186	2338	1109	2238	2222	576	1109			692		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	89	100	95	0	97	84	99			94		
cM capacity (veh/h)	19	25	257	20	30	377	637			666		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	14	154	5	910	41	1109
Volume Left	2	94	5	0	41	0
Volume Right	12	59	0	170	0	1
cSH	92	31	637	1700	666	1700
Volume to Capacity	0.16	4.95	0.01	0.54	0.06	0.65
Queue Length 95th (ft)	13	Err	1	0	5	0
Control Delay (s)	51.3	Err	10.7	0.0	10.8	0.0
Lane LOS	F	F	B		B	
Approach Delay (s)	51.3	Err	0.1		0.4	
Approach LOS	F	F				

Intersection Summary				
Average Delay	688.1			
Intersection Capacity Utilization	78.6%	ICU Level of Service	D	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	12	91	1	57	5	718	165	40	1075	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	13	12	12	10	12	12	11	13	14	10	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.88			0.95		1.00	0.97		1.00	1.00	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1724			1591		1805	1750		1925	1756	
Flt Permitted		0.97			0.81		0.14	1.00		0.23	1.00	
Satd. Flow (perm)		1686			1320		259	1750		476	1756	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	2	0	12	94	1	59	5	740	170	41	1108	1
RTOR Reduction (vph)	0	10	0	0	40	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	114	0	5	898	0	41	1109	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	2%	0%	2%	2%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		8.1			8.1		43.9	43.9		43.9	43.9	
Effective Green, g (s)		8.1			8.1		43.9	43.9		43.9	43.9	
Actuated g/C Ratio		0.13			0.13		0.73	0.73		0.73	0.73	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		228			178		190	1280		348	1285	
v/s Ratio Prot								0.51			c0.63	
v/s Ratio Perm		0.00			c0.09		0.02			0.09		
v/c Ratio		0.02			0.64		0.03	0.70		0.12	0.86	
Uniform Delay, d1		22.5			24.6		2.2	4.4		2.4	5.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			7.7		0.3	3.2		0.7	7.8	
Delay (s)		22.5			32.2		2.5	7.7		3.1	13.7	
Level of Service		C			C		A	A		A	B	
Approach Delay (s)		22.5			32.2			7.6			13.3	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	12	0	1	57	5	718	165	40	1075	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	2	0	12	0	1	59	5	740	170	41	1108	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1034				
pX, platoon unblocked	0.73	0.73		0.73	0.73	0.73				0.73		
vC, conflicting volume	2001	2112	1109	2039	2027	825	1109			910		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2186	2338	1109	2238	2222	576	1109			692		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	89	100	95	100	97	84	99			94		
cM capacity (veh/h)	19	25	257	20	30	377	637			666		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	14	60	5	910	41	1109
Volume Left	2	0	5	0	41	0
Volume Right	12	59	0	170	0	1
cSH	92	314	637	1700	666	1700
Volume to Capacity	0.16	0.19	0.01	0.54	0.06	0.65
Queue Length 95th (ft)	13	17	1	0	5	0
Control Delay (s)	51.3	19.1	10.7	0.0	10.8	0.0
Lane LOS	F	C	B		B	
Approach Delay (s)	51.3	19.1	0.1		0.4	
Approach LOS	F	C				

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		

LANE SUMMARY

Bay Rd/Cronin Rd
ETC+10 2022
PM Peak Hour
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block %
South: Bay Rd NB																
Lane 1	5	740	170	915	2.0	1372	0.667	100	6.2	LOS A	3.8	95.5	970	–	0.0	0.0
Approach	5	740	170	915	2.0		0.667		6.2	LOS A	3.8	95.5				
East: Cronin Rd WB																
Lane 1	94	1	59	154	2.6	519	0.296	100	15.8	LOS B	0.7	18.9	2700	–	0.0	0.0
Approach	94	1	59	154	2.6		0.296		15.8	LOS B	0.7	18.9				
North: Bay Rd SB																
Lane 1	41	1108	1	1151	1.0	1240	0.927	100	8.6	LOS A	9.5	238.6	5000	–	0.0	0.0
Approach	41	1108	1	1151	1.0		0.927		8.6	LOS A	9.5	238.6				
West: Chiropractor Drwy EB																
Lane 1	2	1	12	15	0.0	191	0.081	100	20.7	LOS C	0.2	5.6	50	–	0.0	0.0
Approach	2	1	12	15	0.0		0.081		20.7	LOS C	0.2	5.6				
Intersection				2235	1.5		0.927		8.2	LOS A	9.5	238.6				

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all lanes. LOS Method: Delay (HCM).
Level of Service (Worst Lane): LOS C. LOS Method for individual lanes: Delay (HCM).
Approach LOS values are based on the worst delay for any lane.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Bay Rd/Cronin Rd - PM Peak - ETC+10 2022

Bay Rd/Cronin Rd
ETC+10 2022
PM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	50% Back of Queue Vehicles veh	50% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Bay Rd NB											
3L	L	5	0.0	0.644	9.9	LOS A	3.8	95.5	0.42	0.72	26.7
8T	T	740	2.0	0.667	6.2	LOS A	3.8	95.5	0.42	0.42	31.1
8R	R	170	2.0	0.667	6.0	LOS A	3.8	95.5	0.42	0.48	29.3
Approach		915	2.0	0.667	6.2	LOS A	3.8	95.5	0.42	0.43	30.7
East: Cronin Rd WB											
1L	L	94	3.0	0.296	17.6	LOS B	0.7	18.9	0.82	0.93	26.9
6T	T	1	0.0	0.344	11.1	LOS B	0.7	18.9	0.82	0.85	28.0
6R	R	59	2.0	0.297	12.9	LOS B	0.7	18.9	0.82	0.88	28.8
Approach		154	2.6	0.296	15.8	LOS B	0.7	18.9	0.82	0.91	27.6
North: Bay Rd SB											
7L	L	41	0.0	0.937	15.0	LOS B	9.5	238.6	1.00	0.58	39.3
4T	T	1108	1.0	0.927	8.3	LOS A	9.5	238.6	1.00	0.58	39.4
4R	R	1	0.0	1.031	11.7	LOS B	9.5	238.6	1.00	0.58	39.9
Approach		1151	1.0	0.927	8.6	LOS B	9.5	238.6	1.00	0.58	39.4
West: Chiropractor Drwy EB											
5L	L	2	0.0	0.079	26.6	LOS C	0.2	5.6	1.00	0.91	12.5
2T	T	1	0.0	0.079	19.1	LOS B	0.2	5.6	1.00	0.91	8.1
2R	R	12	0.0	0.081	19.9	LOS B	0.2	5.6	1.00	0.91	9.1
Approach		15	0.0	0.081	20.7	LOS C	0.2	5.6	1.00	0.91	9.6
All Vehicles		2235	1.5	0.927	8.2	LOS A	9.5	238.6	0.75	0.54	36.7

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout LOS Method: Same as Signalised Intersections.
Roundabout Capacity Model: SIDRA Standard.

Appendix E

Planning Level Cost Estimates

Transportation Assessment
Bay Road/Cronin Road
Town of Queensbury, Warren County, New York

CALCULATED BY: CDF DATE: 3/9/2012
CHECKED BY: DR DATE: 3/10/12

/Cronin Intersection Improvements
9-Mar-12

Description of Major Improvements:
-Clean existing stripes on Bay Road and restripe with Two Way Left turn Lane
- Northbound Left turn lane on Bay Road

Approximate ROW required: **SF** **0.0000** **Acres**

ITEM DESCRIPTION	UNITS	PRICE	QUANTITY	TOTAL
CLEANING EXISTING PAVMENT STRIPES/SYMBOLS/LETTERS	LS	$3,000.00	1	$ 3,000.00
SIGNING AND STRIPING	LS	$27,500.00	1	$ 27,500.00

SUB-TOTALS		$30,500.00
CONSTRUCTION SUBTOTAL:	$	31,000
CONTINGENCY (15%)	$	4,700
MAINT.AND PROT. OF TRAFFIC (4%)	$	1,300
SURVEY AND STAKEOUT (2%)	$	700
CONSTRUCTION INSPECTION (10%)	$	3,100
CONSTRUCTION TOTAL:	$	40,800
4% MOBILIZATION		1,700
PROJECT SUBTOTAL:	$	**42,500**
DESIGN ENGINEERING (10%)	$	3,800
PERMITS (1.5%)	$	500
LEGAL/ADMIN (2%)	$	700
ROW	$	-
PROJECT TOTAL:	$	**48,000**

CALCULATED BY: CDF DATE: 3/9/2012
CHECKED BY: DH DATE: 3/10/12

/Cronin Intersection Improvements
Mar-12

Description of Major Improvements:
-Mill and Fill Bay Road to restripe with Two Way Left turn Lane
- Northbound Left turn lane on Bay Road

Approximate ROW required: **SF** **0.0000** **Acres**

ITEM DESCRIPTION	UNITS	PRICE	QUANTITY	TOTAL
MILL AND FILL	SF	$1.25	68,000	$ 85,000.00
SIGNING AND STRIPING	LS	$27,500.00	1	$ 27,500.00

SUB-TOTALS		$112,500.00
CONSTRUCTION SUBTOTAL:	$	113,000
CONTINGENCY (15%)	$	17,000
MAINT.AND PROT. OF TRAFFIC (4%)	$	4,600
SURVEY AND STAKEOUT (2%)	$	2,300
CONSTRUCTION INSPECTION (10%)	$	11,300
CONSTRUCTION TOTAL:	$	148,200
4% MOBILIZATION		6,000
PROJECT SUBTOTAL:	$	**154,200**
DESIGN ENGINEERING (10%)	$	13,700
PERMITS (1.5%)	$	1,700
LEGAL/ADMIN (2%)	$	2,300
ROW	$	-
PROJECT TOTAL:	$	**172,000**

CALCULATED BY: CDF DATE: 3/9/2012
CHECKED BY: DATE: 3/10/12

/Cronin Intersection Improvements
-Mar-12

Description of Major Improvements:
-Mill and Fill Bay Road to restripe with Two Way Left turn Lane
- Northbound Left turn lane on Bay Road
- Install Signal at intersection of Bay Road and Cronin Road

Approximate ROW required: **SF** **0.0000** **Acres**

ITEM DESCRIPTION	UNITS	PRICE	QUANTITY	TOTAL
MILL AND FILL	SF	$1.25	68,000	$ 85,000.00
INSTALL SIGNAL	LS	$100,000.00	1	$ 100,000.00
SIGNING AND STRIPING	LS	$30,000.00	1	$ 30,000.00

SUB-TOTALS		$215,000.00
CONSTRUCTION SUBTOTAL:	$	215,000
CONTINGENCY (15%)	$	32,300
MAINT.AND PROT. OF TRAFFIC (4%)	$	8,600
SURVEY AND STAKEOUT (2%)	$	4,300
CONSTRUCTION INSPECTION (10%)	$	21,500
CONSTRUCTION TOTAL:	$	281,700
4% MOBILIZATION		11,300
PROJECT SUBTOTAL:	**$**	**293,000**
DESIGN ENGINEERING (10%)	$	26,000
PERMITS (1.5%)	$	3,300
LEGAL/ADMIN (2%)	$	4,300
ROW	$	-
PROJECT TOTAL:	**$**	**327,000**

CALCULATED BY: CDF DATE: 3/9/2012
CHECKED BY: DATE: 3/10/12

/Cronin Intersection Improvements
>-Mar-12

Description of Major Improvements:
-Mill and Fill Bay Road to restripe with Two Way Left turn Lane
- Northbound Left turn lane on Bay Road
- Install curbed island to prevent left turns from Cronin Road

Approximate ROW required: **SF** **0.0000** **Acres**

ITEM DESCRIPTION	UNITS	PRICE	QUANTITY	TOTAL
UNCLASSIFIED EXCAVATION AND DISPOSAL	CY	$20.00	75	$ 1,500.00
EMBANKMENT IN PLACE	CY	$16.00	25	$ 400.00
FULL DEPTH PAVEMENT AND SUBBASE	SF	$6.50	700	$ 4,550.00
CONCRETE CURB	LF	$35.00	80	$ 2,800.00
MILL AND FILL	SF	$1.25	68,000	$ 85,000.00
SIGNING AND STRIPING	LS	$28,500.00	1	$ 28,500.00

SUB-TOTALS		$122,750.00
CONSTRUCTION SUBTOTAL:	**$**	123,000
CONTINGENCY (15%)	$	18,500
MAINT.AND PROT. OF TRAFFIC (4%)	$	5,000
SURVEY AND STAKEOUT (2%)	$	2,500
CONSTRUCTION INSPECTION (10%)	$	12,300
CONSTRUCTION TOTAL:	**$**	161,300
4% MOBILIZATION		6,500
PROJECT SUBTOTAL:	**$**	**167,800**
DESIGN ENGINEERING (10%)	$	14,900
PERMITS (1.5%)	$	1,900
LEGAL/ADMIN (2%)	$	2,500
ROW	$	-
PROJECT TOTAL:	**$**	**188,000**

CALCULATED BY: CDF DATE: 3/9/2012
CHECKED BY: DATE: 3/10/12

/Cronin Intersection Improvements
-Mar-12

Description of Major Improvements:
-Construct Single-lane Roundabout at intersection of Bay Road and Cronin Road

Approximate ROW required: **7500** **SF** **0.1722** **Acres**

ITEM DESCRIPTION	UNITS	PRICE	QUANTITY	TOTAL
SINGLE LANE ROUNDABOUT	LS	$1,000,000.00	1	$ 1,000,000.00

SUB-TOTALS		$1,000,000.00
CONSTRUCTION SUBTOTAL:	$	1,000,000
CONTINGENCY (30%)	$	300,000
MAINT.AND PROT. OF TRAFFIC (4%)	$	40,000
SURVEY AND STAKEOUT (2%)	$	20,000
CONSTRUCTION INSPECTION (10%)	$	100,000
CONSTRUCTION TOTAL:	$	1,460,000
4% MOBILIZATION		58,400
PROJECT SUBTOTAL:	$	**1,518,400**
DESIGN ENGINEERING (10%)	$	135,500
PERMITS (1.5%)	$	15,000
LEGAL/ADMIN (2%)	$	20,000
ROW	$	34,500
PROJECT TOTAL:	$	**1,724,000**

*** Additional ROW required if installing sidealks around Roundabout***